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E-MAIL: *lefebvrt@tea-emh1.army.mil*

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Hampton Roads	Oakland	
Jacksonville	San Diego	
Morehead City	San Diego APOE	
NY/NJ	Seattle	
Savannah	Tacoma	
Wilmington		

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April 2000

Port Enhancement Analysis

Phase I:

Port Workload Requirements for the East Coast Ports

Carol M. Caldwell

Military Traffic Management Command
Transportation Engineering Agency

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INTRODUCTION

This is Phase I of a two-phase study.

- Phase I identifies the quantity of cargo DOD plans to send through the seaport, and
- Phase II considers the ports' ability to handle their assigned workload.

The Military Traffic Management Command's Transportation Engineering Agency (TEA) has analyzed ports for years. With our Ports for National Defense Program, we survey the ports that are important to national defense, defining their capabilities. We then compare these capabilities to the demand imposed by a notional unit deploying through the port. From this, we assess the port's ability to meet its requirements. This methodology has suited us well in the past. However, as the deployment windows continue to shrink, we are forced to get our CONUS-based deploying forces through the ports faster than ever before. Compound this with the continued economic expansion in many of these areas, and it is becoming a challenge for the ports to dedicate real estate and facilities to respond to our requirements. This is particularly true in the early days of a contingency.

As a result, TEA realized the need for a more precise assessment of each port's ability to meet its requirements. We realized the need to base each port's requirements on the most demanding operation plan (OPLAN) for that port. Using our modeling capability, we can work with the tremendous quantity of information in an OPLAN time-phased force deployment data (TPFDD), massage the data, and extract the detail needed to get an accurate picture of the deployment through each port.

Port of Charleston

.

Virginia Port Authority

OBJECTIVES

The objectives of this initiative are:

Phase I:

(1) Define the OPLAN-based time-phased flow of cargo through the port during a demanding deployment. This flow is defined in terms of quantity and square feet.

(2) Allow planners to assign Transportation Terminal Brigades/Battalions (TTBs) to ports based on workload.

(3) Allow TTBs to adequately prepare for deployment operations.

(4) Validate the need for deploying units to support Sea Ports of Embarkation (SPOEs).

Phase II:

(1) Assist the port commander in quantifying real estate and facility support needed from the port.

(2) In instances where the port cannot meet their requirements, provide the quantitative basis to help both DOD and commercial planners assess potential “fixes.” These fixes could include:

- Re-routing cargo to another port in the region,
- Re-timing the flow, or even
- Working through the local and metropolitan planning organizations to solicit federal funds.

METHODOLOGY

When practical, ports are analyzed on a regional basis. This allows planners to examine an entire region at one time, evaluating peaks and valleys at groups of neighboring ports. In this case, the Ports of Charleston, Hampton Roads, Jacksonville, Morehead City, New York/New Jersey, Savannah and Wilmington are all represented in the TPFDD. Therefore, they are all considered in this analysis.

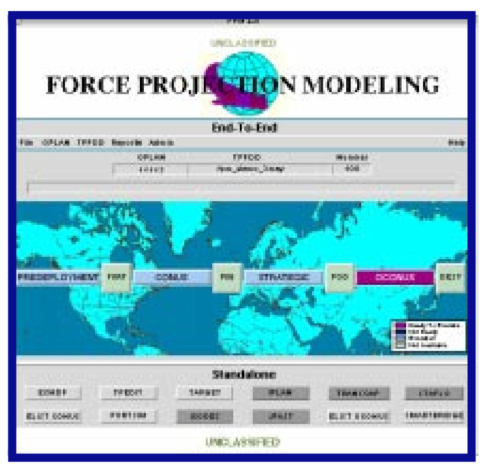
The following tools are utilized to analyze port workload:

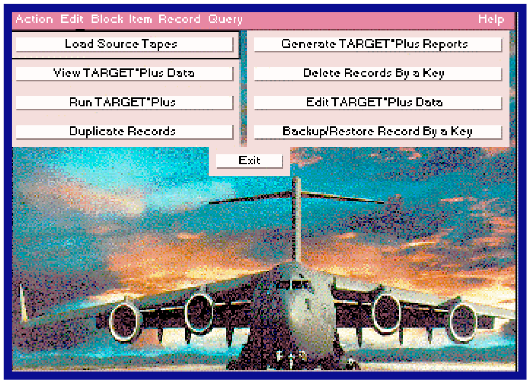
TPEDIT (TPFDD Editor) – An integrated set of automated processing tools that provides TPFDD editing and analysis capability. TPEDIT allows the analyst to:

- View the TPFDD graphically.
- Extract information for the seaport of embarkation (SPOE) of interest.
- Edit the TPFDD. Remove "on-call" and "shortfalled" records. Clean up data issues.
- Review data to determine the amount of cargo (number or ULNs/CINs, quantity, square feet, short tons, measurement tons) flowing through the port.

EXPANDED TPFDD - A database shared by the simulation models and used for tracking movement requirements at the individual item level of detail. Using the Expanded TPFDD the analyst can:

- Load the TPFDD into the Oracle database management system.
- "Expand" the TPFDD cargo detail within Oracle to Level 6 for the SPOE of interest.





TARGET (Transportability Analysis Reports Generator) – A system of models and programs that provide the capability to generate movement requirements at the individual item level of detail (Level 6). The system merges force structure data from the Table of Organization and Equipment (TOE) or the Modified TOE (MTOE) with equipment characteristics from the Department of the Army Standard Equipment Characteristic File (ECF) to create unit equipment tables. With TARGET, the analyst:

- Assigns transport modes by ULN/CIN (convoy/rail).
- Selects transport assets.
  Containers (20' and 40')
  Railcars (89' flatcars, 60' flatcars, 68' DODX railcars).
- Determines convoy, rail, and container requirements.

FPM REPORTS – A set of customized reports extracts detailed cargo information from TARGET output files. These reports, when imported into Microsoft Excel, are the foundation of the port workload effort. The graphs are included in the results section of this report.

ASSUMPTIONS

- The requirements in this report represent:
  - The entire duration of the flow through the ports of Charleston, Hamtpon Roads, Jacksonville, Morehead City, New York/New Jersey, Savannah and Wilmington as defined by the operation plan (OPLAN).
  - All records in the plan scheduled to move by sea under Military Sealift Command's (MSC) control.
  - The most demanding plan for each port. The plan may not necessarily be representative of the flow during an actual deployment.
- TPFDD Records not included in this analysis:
  - "On-call" records. These records are in the plan but are not scheduled to move – they appear with an available to load date (ALD) of 999.
  - "Shortfalled" records. These records are in the plan but are not sourced – they have not been matched with a specific unit.
  - Bulk petroleum, oils, and lubricants (POL) records (packaged POL is included).
- TARGET uses the following transport assets:
  Containers (20-foot, 40-foot)
  Convoy Vehicles (self-propelled, towed) and
  Railcars (89-foot flatcars, 60-foot flatcars, 68-foot DODX railcars)
  NOTE: Commercial Motor was not utilized
- Containers are stuffed at their origin.
- TARGET stuffs containers and loads railcars with unit integrity. In addition, TARGET will not mix unit equipment and containers on the same railcar. This may, in some instances, give a high estimate of containers and railcars for each unit.
- If the origin is less than 400 miles from the seaport of embarkation (SPOE), roadable vehicles convoy from origin to SPOE. If the origin is greater than 400 miles from the SPOE, roadable vehicles are loaded onto railcars for transport to the SPOE. All nonroadable vehicles are loaded onto railcars for transport to the SPOE.
- The breakbulk category includes cargo coded in the TPFDD as containerizable with dimensions exceeding the allowable dimensions of a 20-foot container and nonvehicular cargo coded as noncontainerizable.

RESULTS

The results of this analysis for the Ports of Charleston, Hampton Roads, Jacksonville, Morehead City, New York/New Jersey, Savannah and Wilmington (Figure 1) are in Appendix A through G, respectively. The graphs in each appendix represent the cargo arriving at that port, as outlined in the TPFDD. They show the quantity and square footage of containers, vehicles, aircraft, floating craft, and breakbulk cargo items. Since "vehicles" is such a broad category it is divided into categories as outlined in Table 1.

Table 1
Categories of Vehicles

	Wheeled Vehicles	Tracked Vehicles
Light	Less than 5 ST	Less than 20 ST
Medium	5-30 ST	20-35 ST
Heavy	Greater than 30 ST	Greater than 35 ST

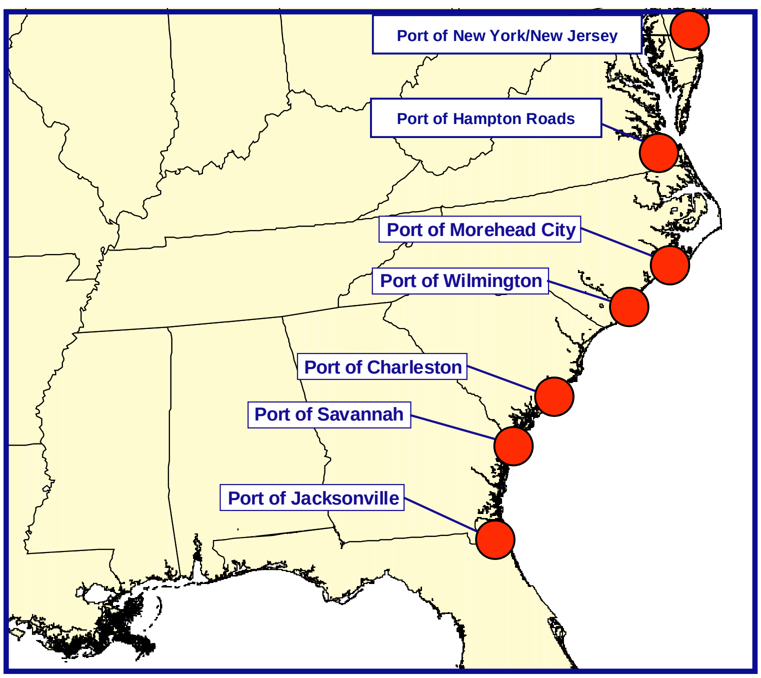


Figure 1. Seaports of Interest

APPENDIX A

PORT OF CHARLESTON

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According to the TPFDD, there are approximately 80 origins sending cargo to the Port of Charleston. The major origins are shown in Figure A-1. Origins sending less than 100 items or less than 20,000 square feet of cargo are listed in Table A-1. Charleston receives a mix of Army, Navy, Air Force, and Marine Corps cargo. Origins in excess of 400 miles send all of their cargo to the Port of Charleston by rail. Origins within 400 miles convoy their roadable vehicles to the port and send everything else by rail. All aircraft self-deploy to the port. Figures A-2 through A-6 show the quantity of transports (containers, railcars, self-deploying aircraft, and convoying vehicles) required to move to the Port of Charleston.

Figures A-7 through A-13 illustrate the quantity of items arriving at the port. Figure A-7 is the total quantity of items. Figures A-8 through A-13 break this down into more detail. Figures A-8 and A-9 are the quantity of vehicles arriving at the port. Figure A-8 outlines the wheeled vehicles and Figure A-9 lays out the tracked vehicles. Figure A-10 shows the quantity of aircraft arriving at the port. These are mostly helicopters, and all move to the port under their own power. Figure A-11 is the number of floating craft arriving at the Port of Charleston. Figures A-12 and A-13 outline the number of containers and breakbulk cargo items, respectively, arriving at the port.

Similar to Figures A-7 through A-13, which lay out the quantity of items arriving, Figure A-14 through A-20 outline the square footage of these categories of cargo.

Figures A-21 through A-28 show how cargo is arriving at the Port of Charleston. Figure A-21 through A-24 shows the number of cargo items arriving by convoy, rail, or self-deploying. Figures A-25 through A-28 show the square footage of cargo arriving by each mode.

As shown earlier, cargo arrives at the Port of Charleston from many origins. Figure A-29 shows visually the amount of cargo coming from the major origins.

Figures A-30 and A-32 show the quantity and square footage, respectively, of cargo arriving at the Port of Charleston by origin. Figure A-31 is the quantity of containers arriving at the Port of Charleston from each origin.

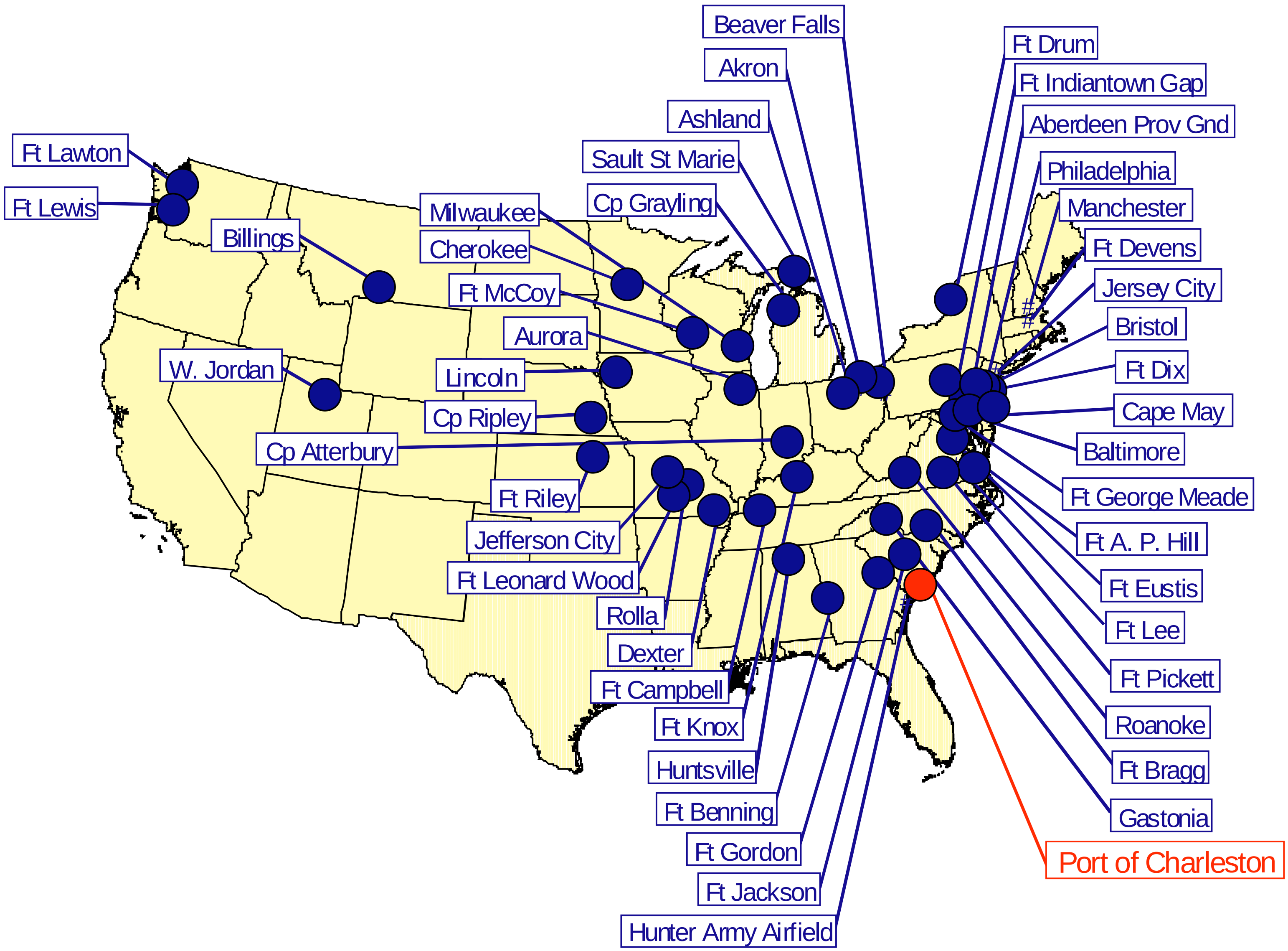


Figure A-1. Cargo Arrives at the Port of Charleston from Many Origins

Table A-1
Origins Sending Cargo to the Port of Charleston
(Origins not in Figure A-1)

Casper, WY
Ogden, UT
Shaw AFB, SC
Brockton, MA
Hempstead, NY
Middletown, RI
Warren, RI
Warwick, RI
Hartford, CT
Blackstone, VA
KingsMill Ord Pl, OH
Lafayette, IN
Athens, AL
Fort Hayes, OH
Fort Totten, NY
Roseau, MN
Crane AAP, IN
Fort Story, VA
Cando, ND
Clinton, MA
Nashville, TN
Arden Hills, MN
Volk Field, WI
Letterkenny Depot, PA
Allendale, SC
Fulton, MO
Selfridge ANGB, MO
Trenton, NJ
Tacoma, WA
Baldin, NC
Yorktown NWS, VA
Earle NWS, NJ
Pope AFB, NC
Williamsburg, VA
Charleston NWS, SC

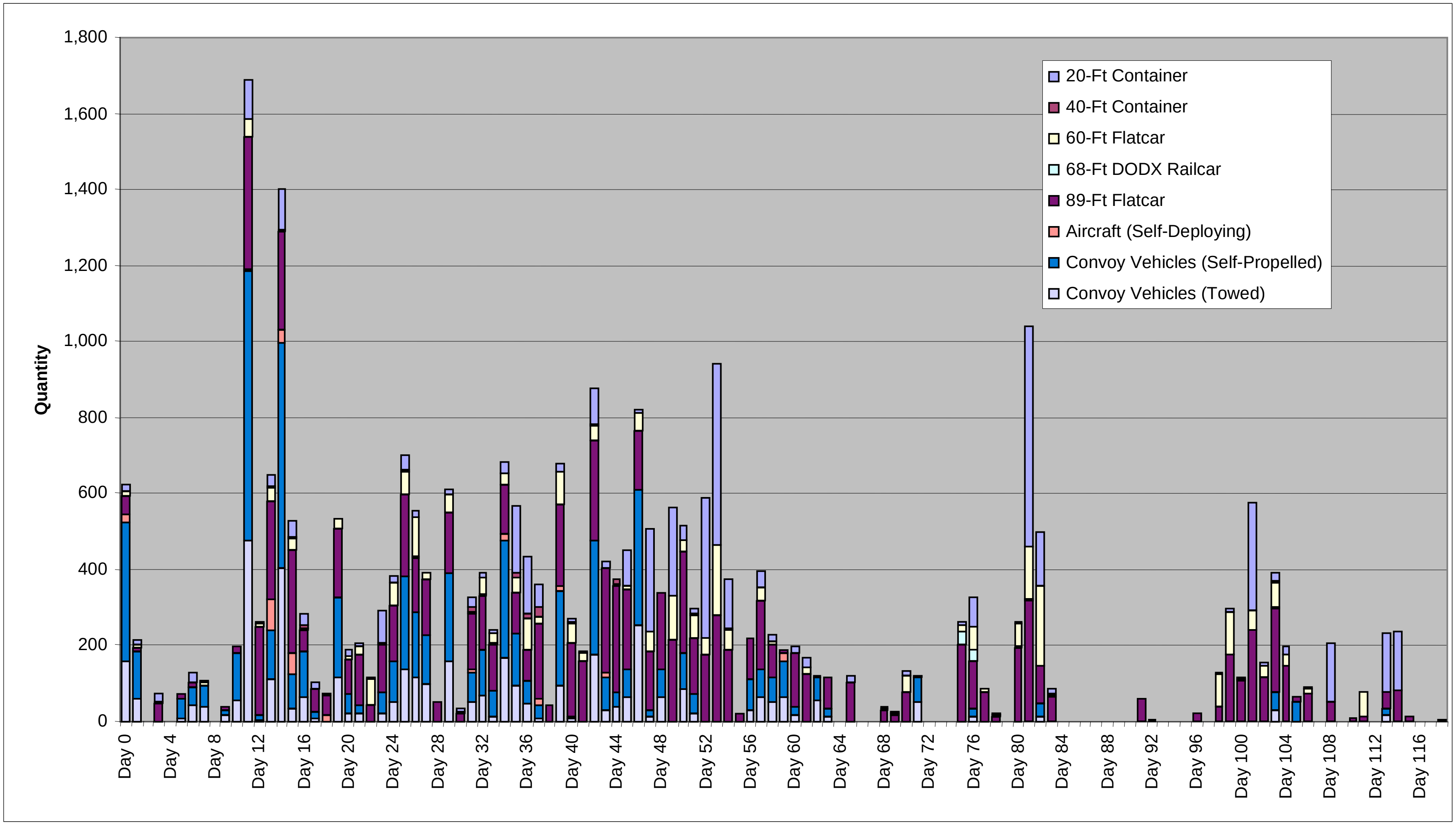


Figure A-2. Total Quantity of Transports Arriving at the Port of Charleston

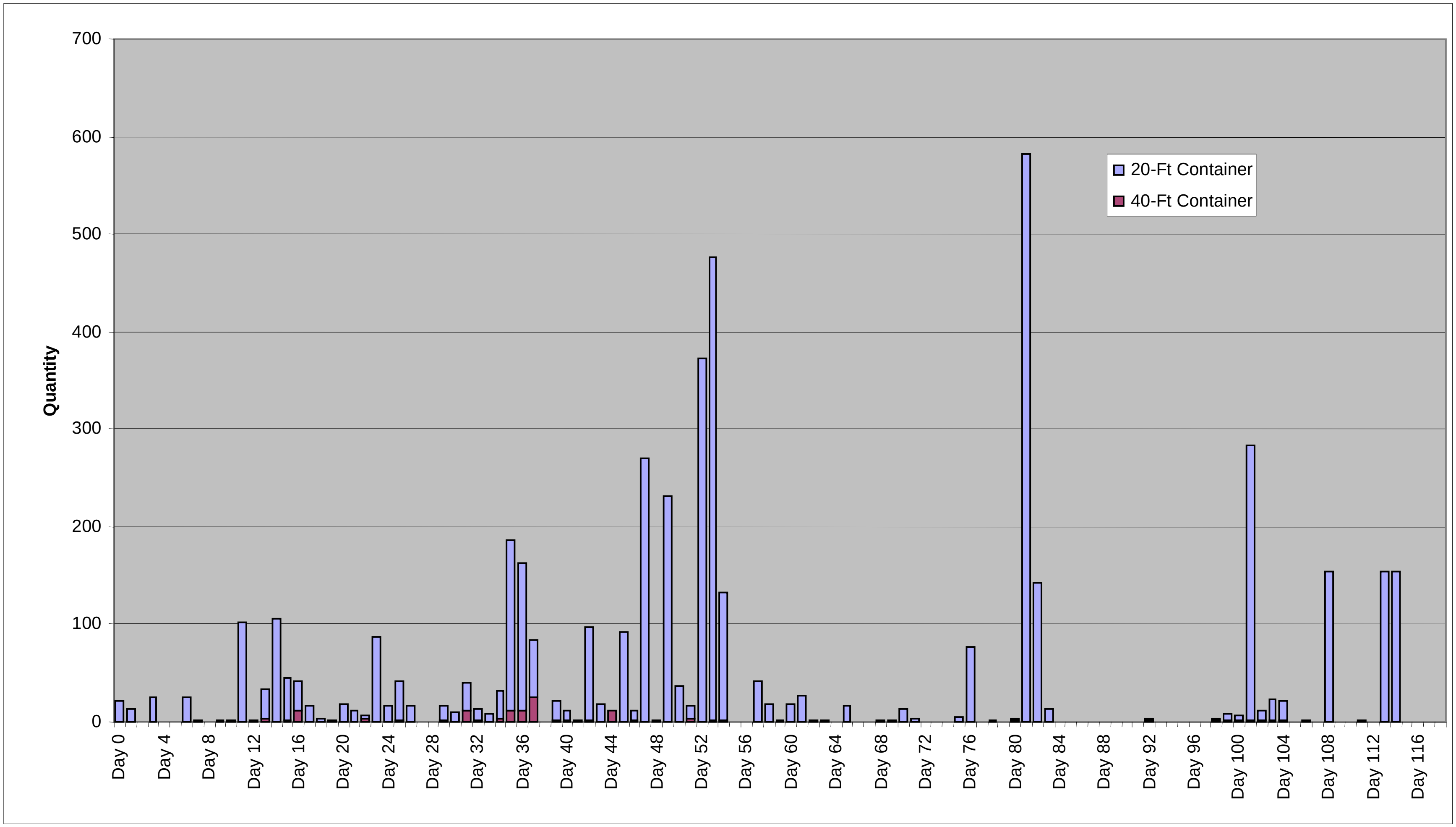


Figure A-3. Quantity of Containers Arriving at the Port of Charleston

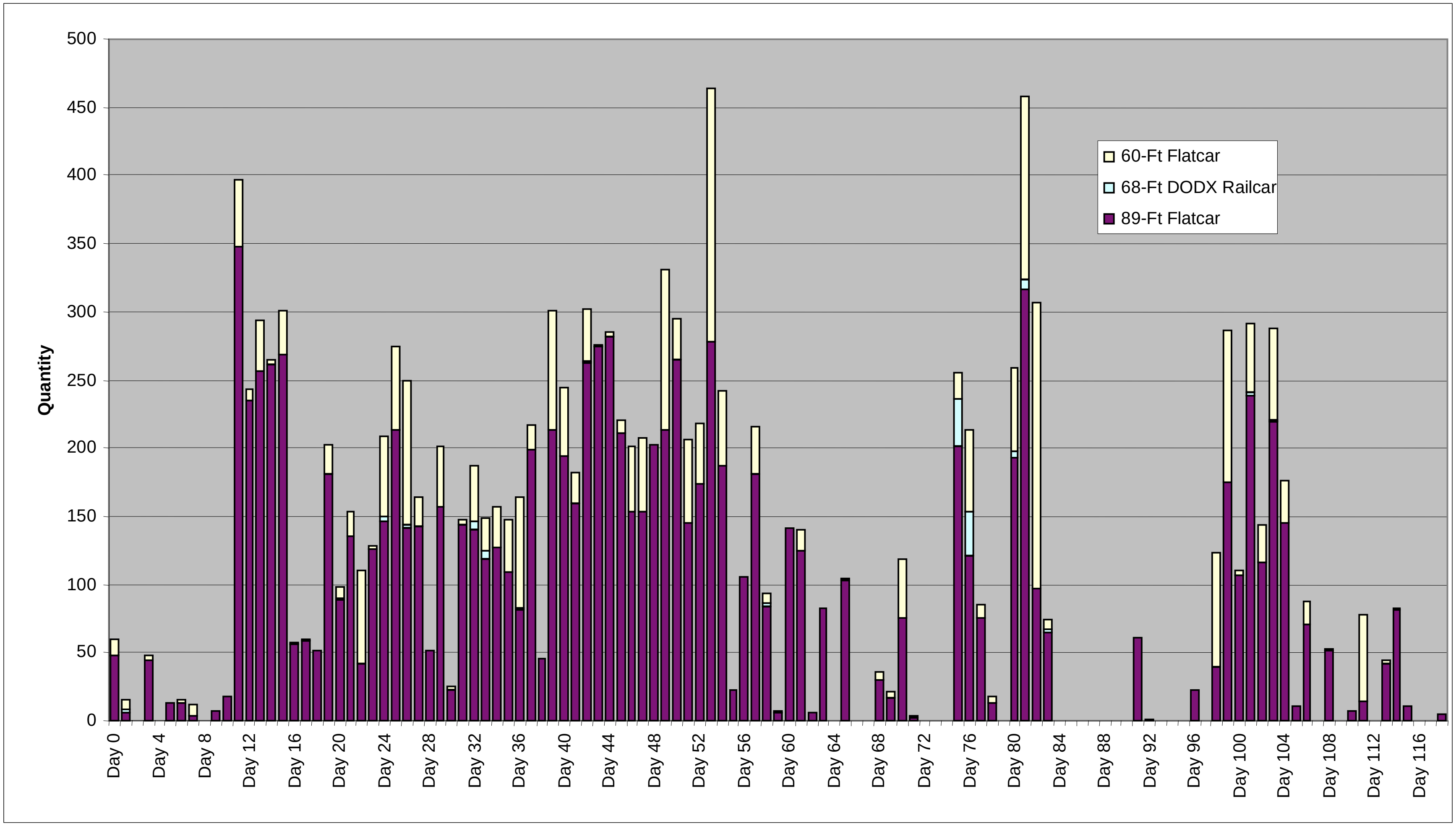


Figure A-4. Quantity of Railcars Arriving at the Port of Charleston

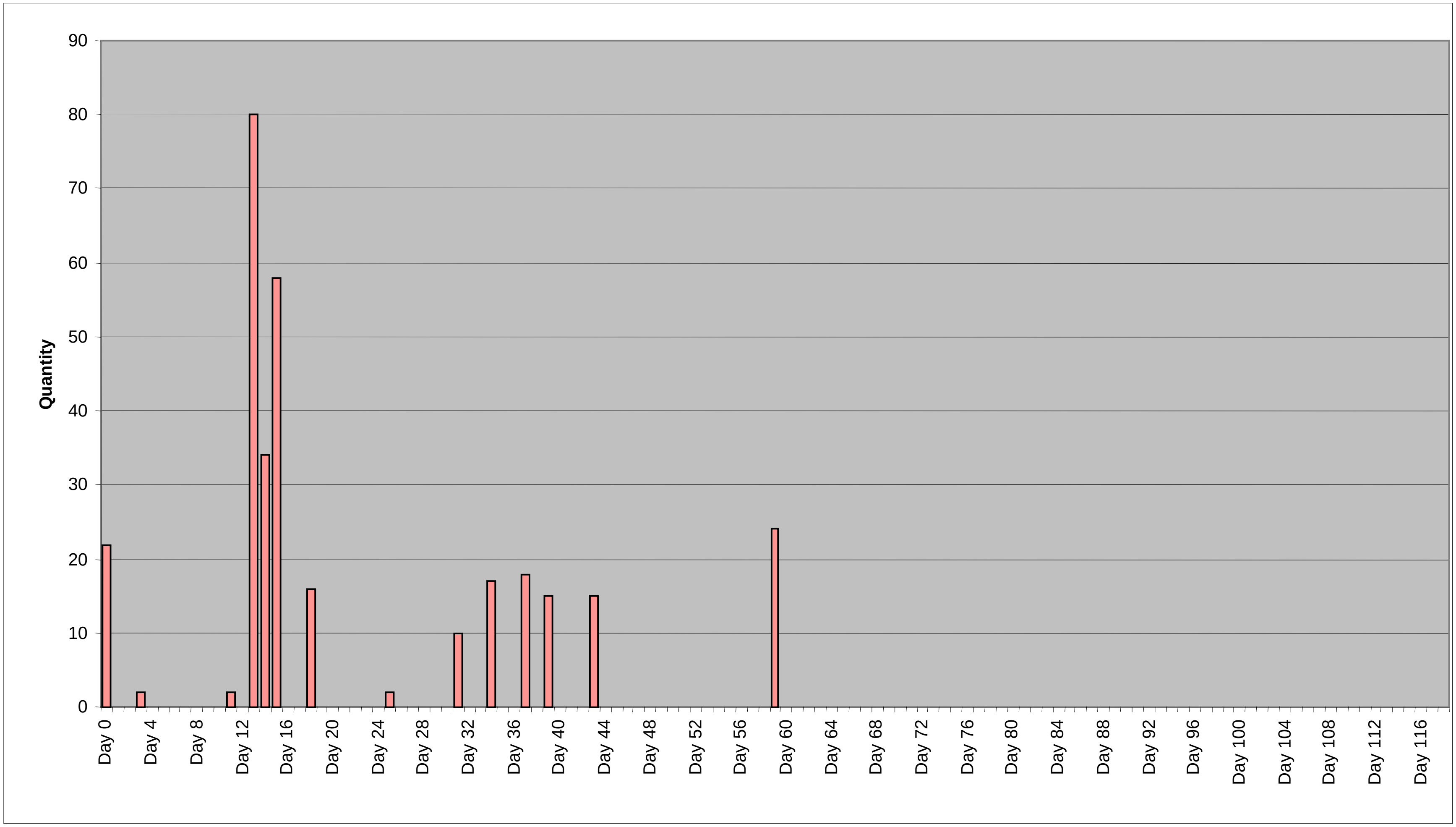


Figure A-5. Quantity of Aircraft Arriving at the Port of Charleston

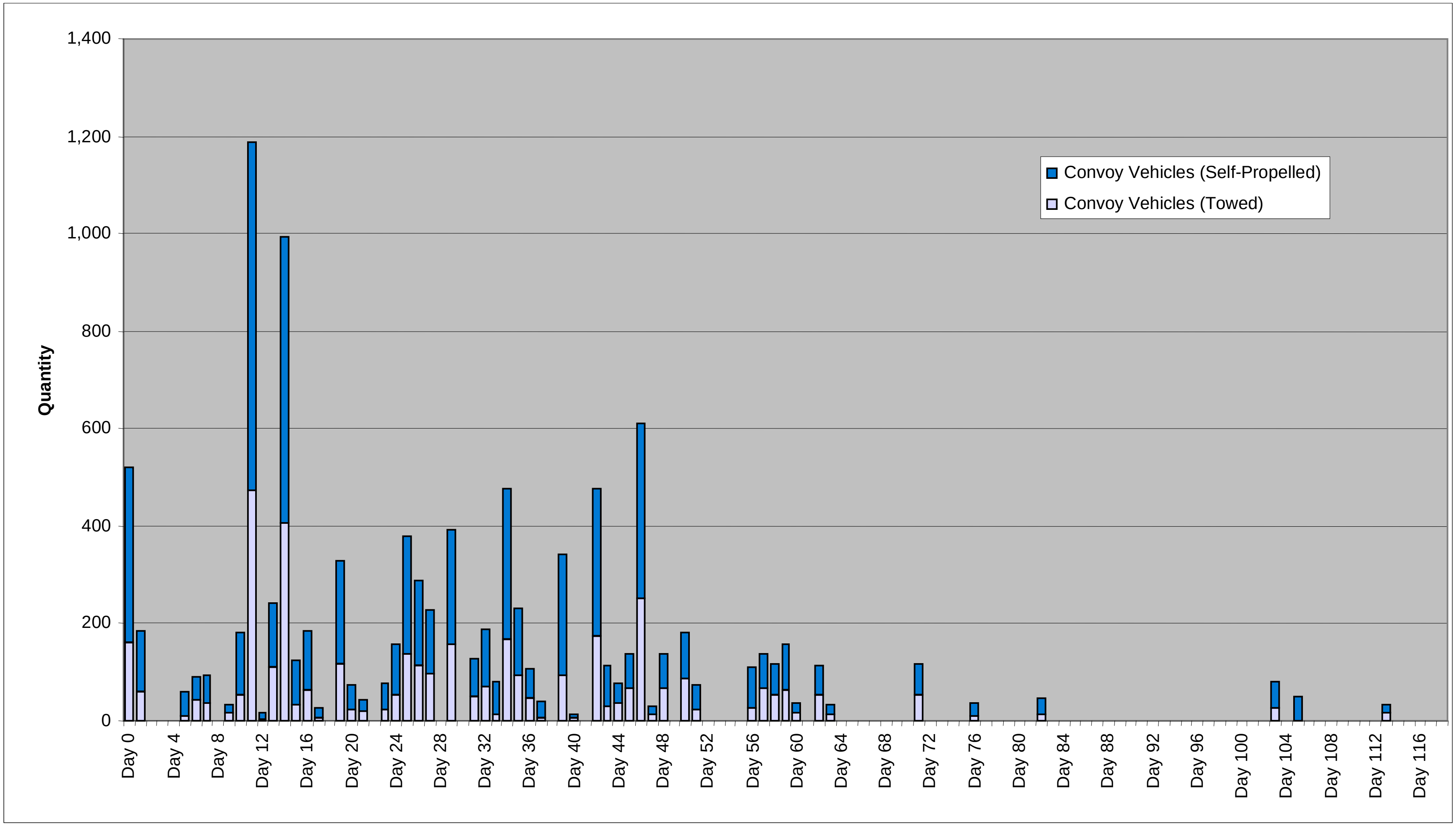


Figure A-6. Quantity of Convoy Vehicles Arriving at the Port of Charleston

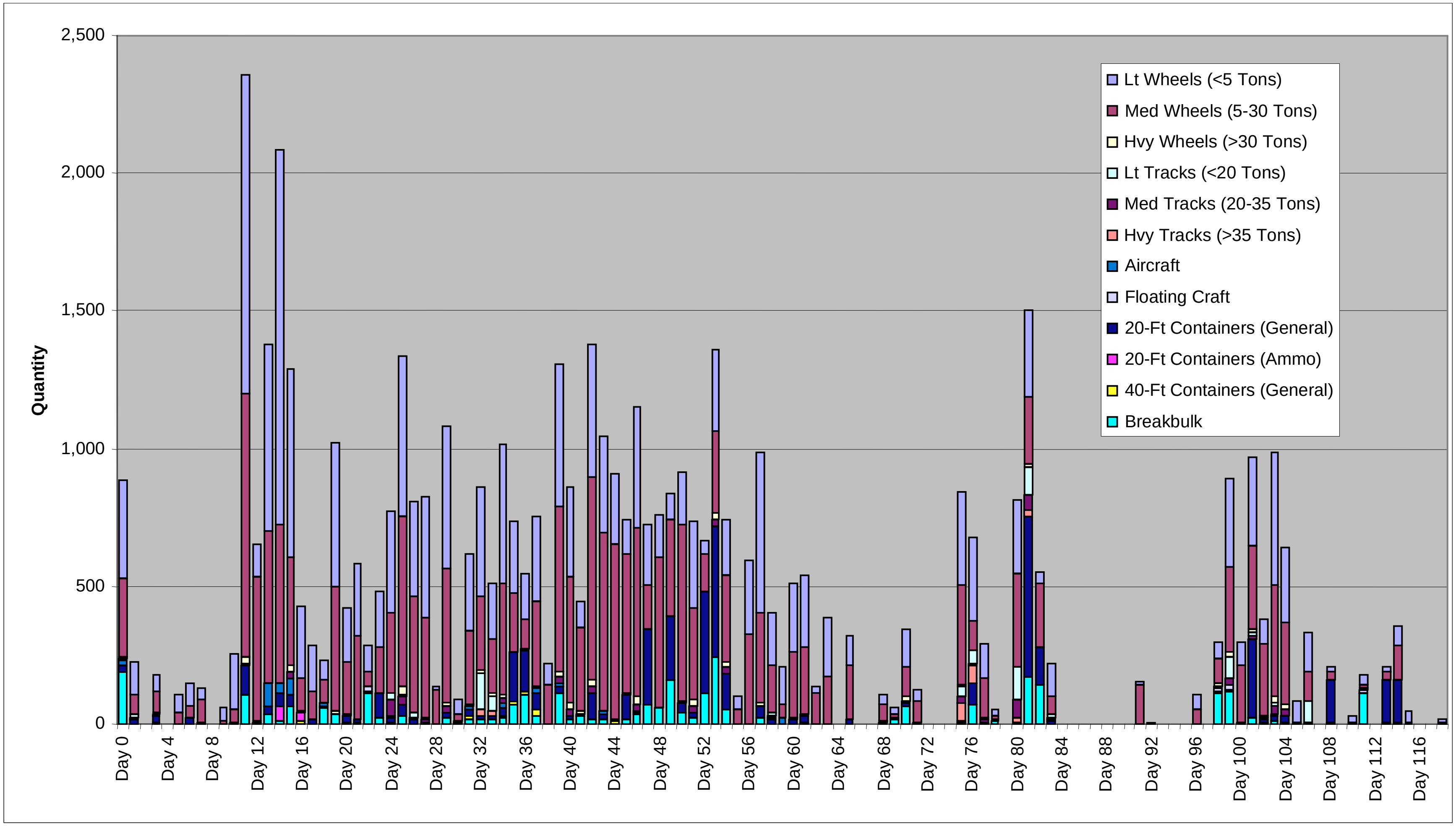


Figure A-7. Total Quantity of Items Arriving at the Port of Charleston

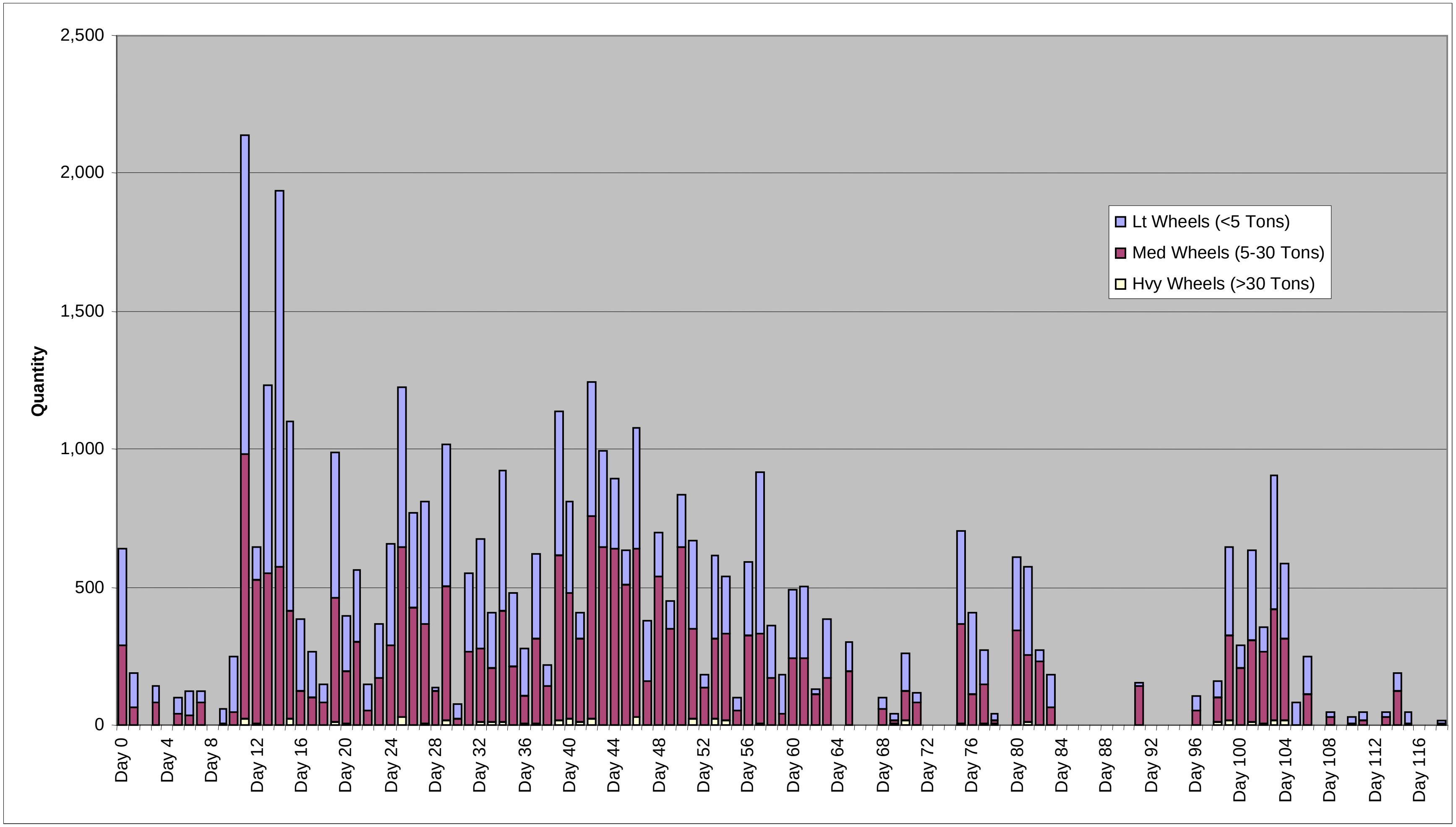


Figure A-8. Quantity of Wheeled Vehicles Arriving at the Port of Charleston

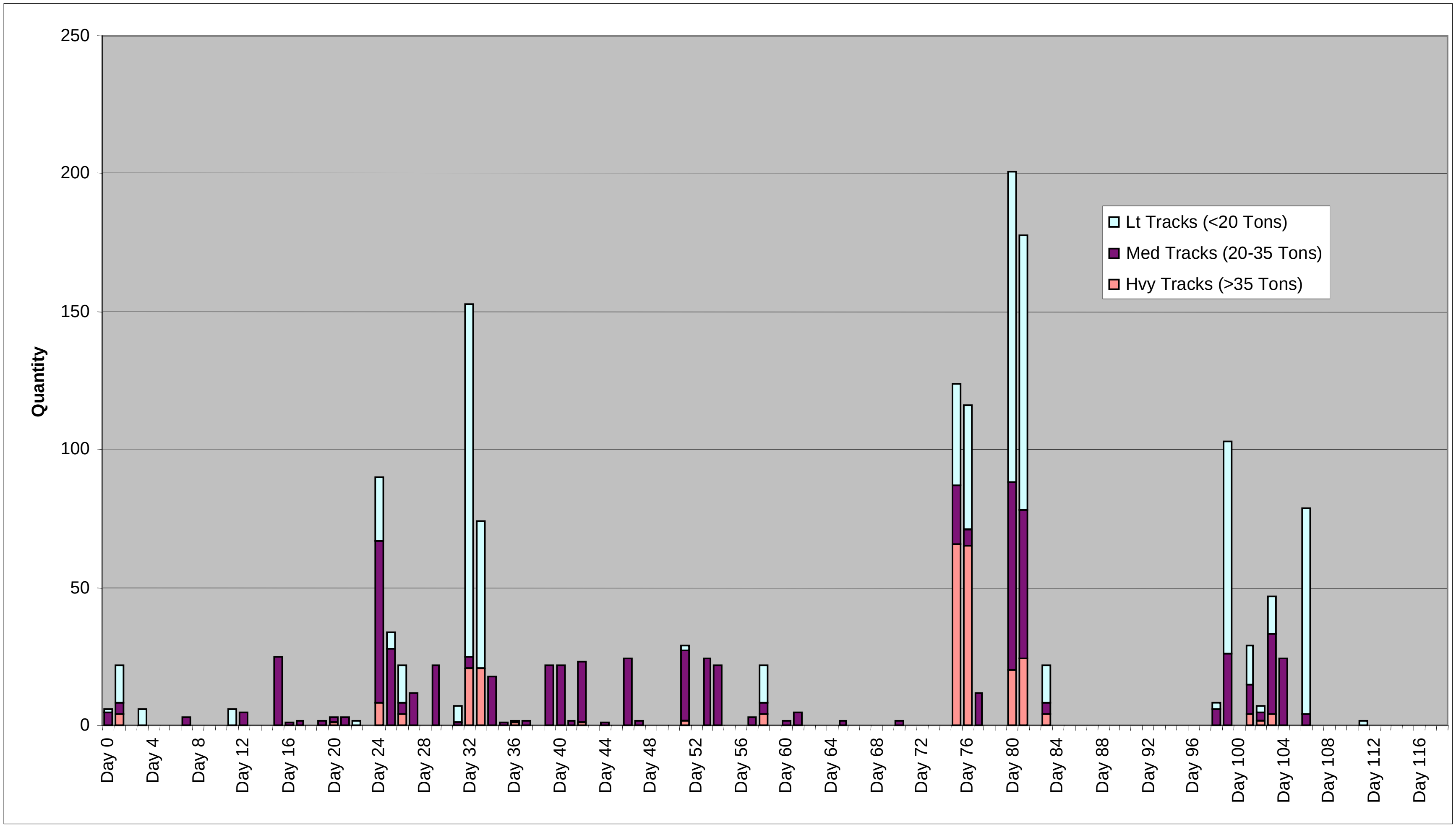


Figure A-9. Quantity of Tracked Vehicles Arriving at the Port of Charleston

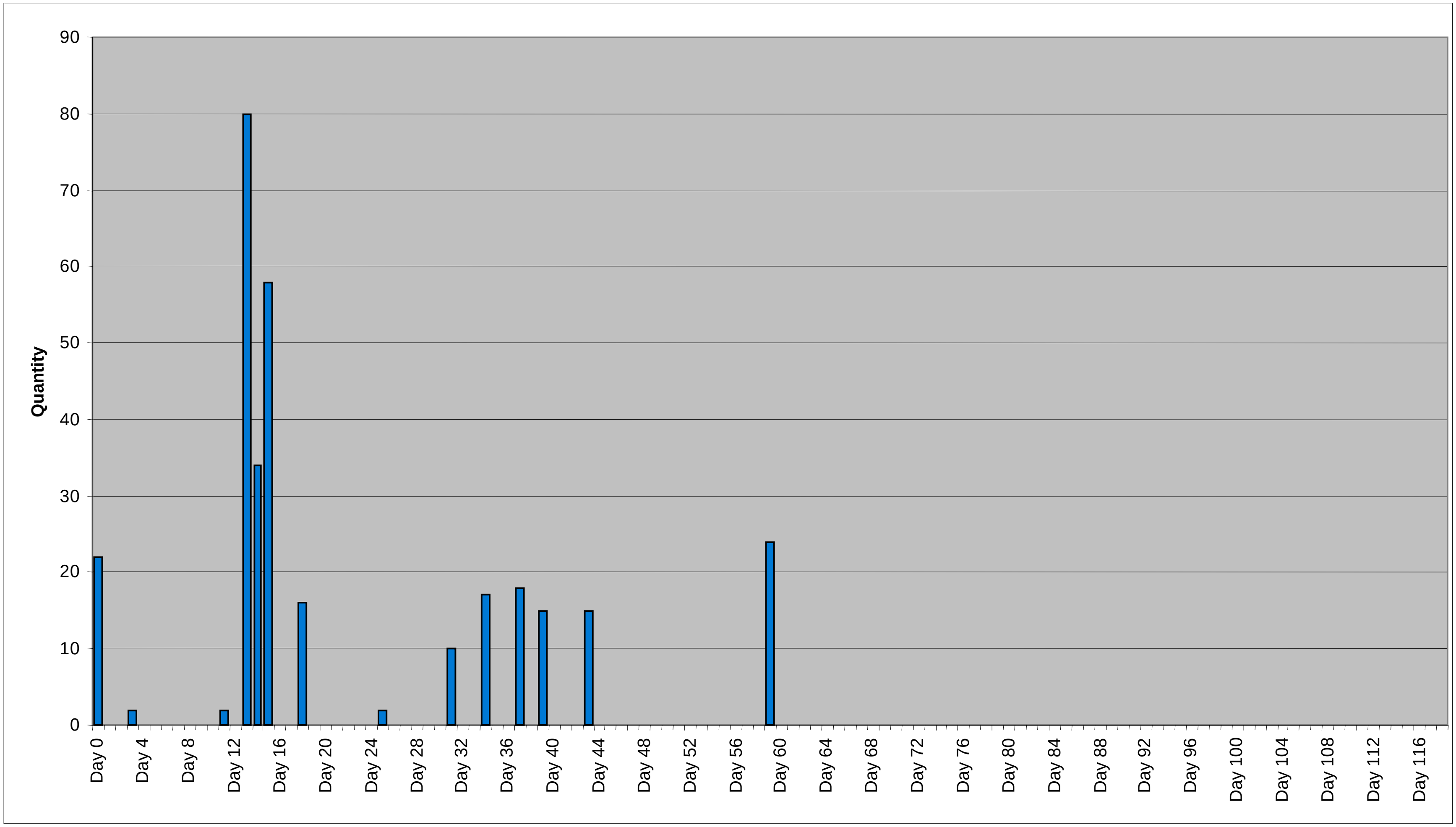


Figure A-10. Quantity of Aircraft Arriving at the Port of Charleston

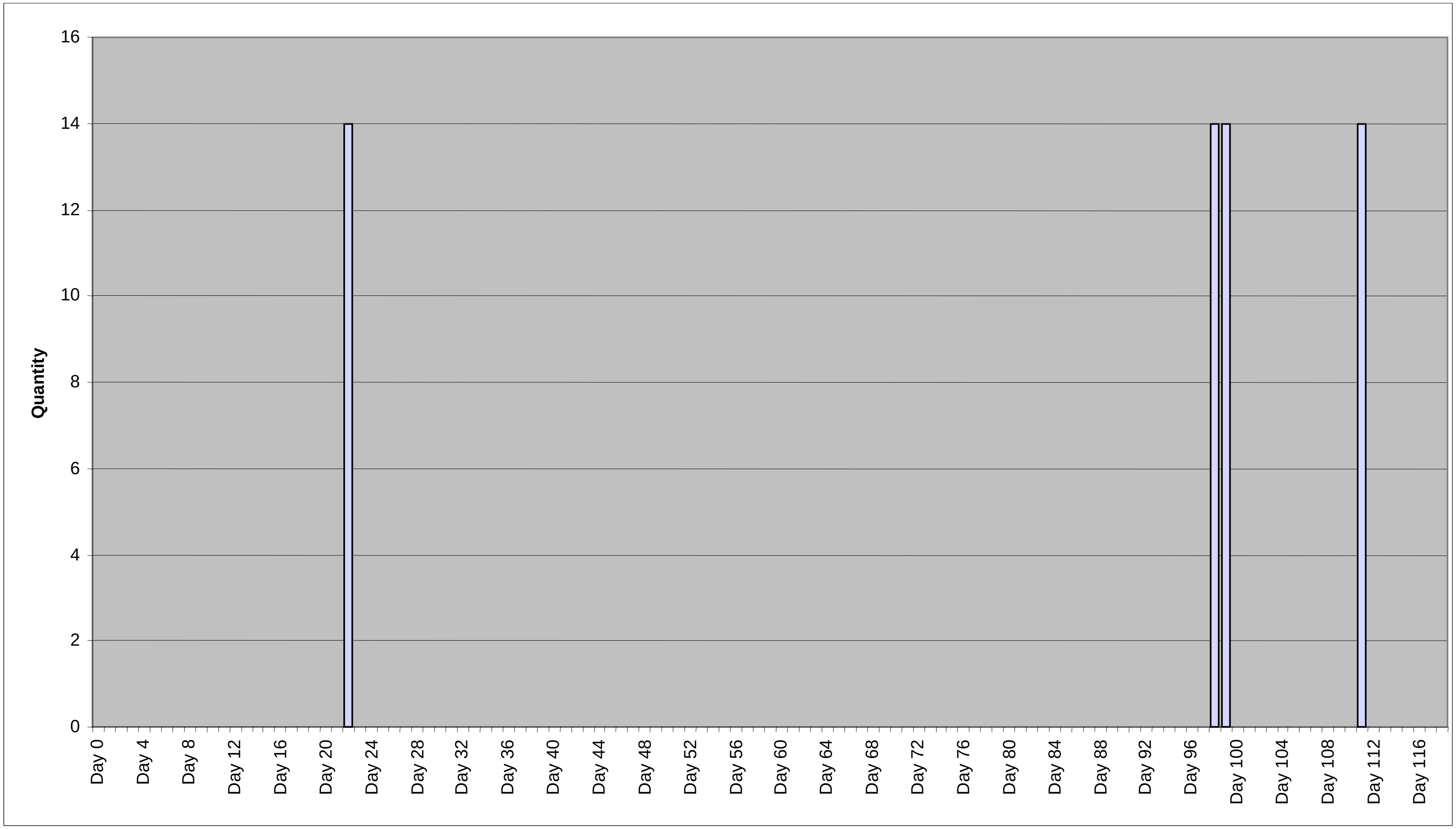


Figure A-11. Quantity of Floating Craft Arriving at the Port of Charleston

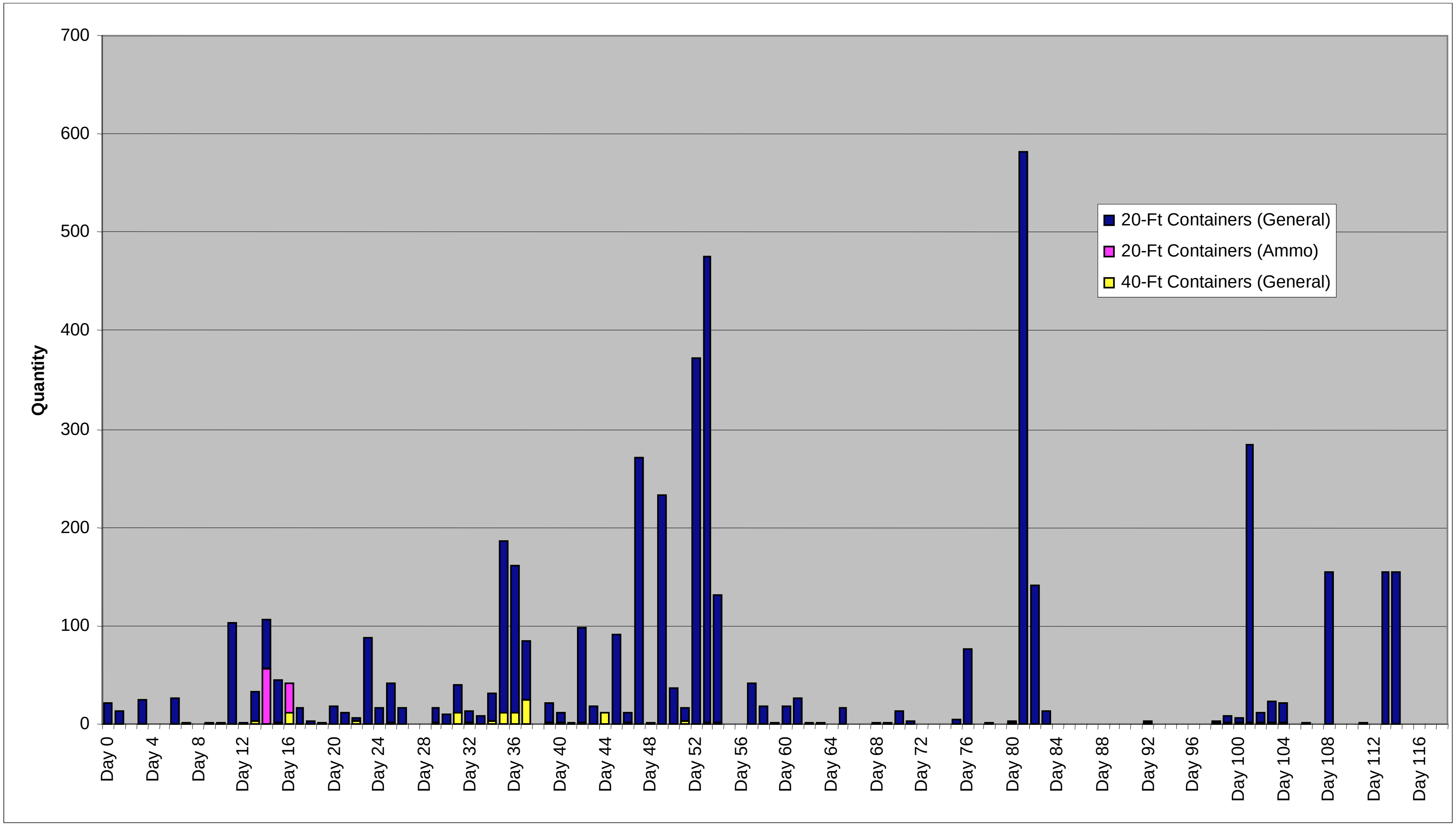


Figure A-12. Quantity of Containers Arriving at the Port of Charleston

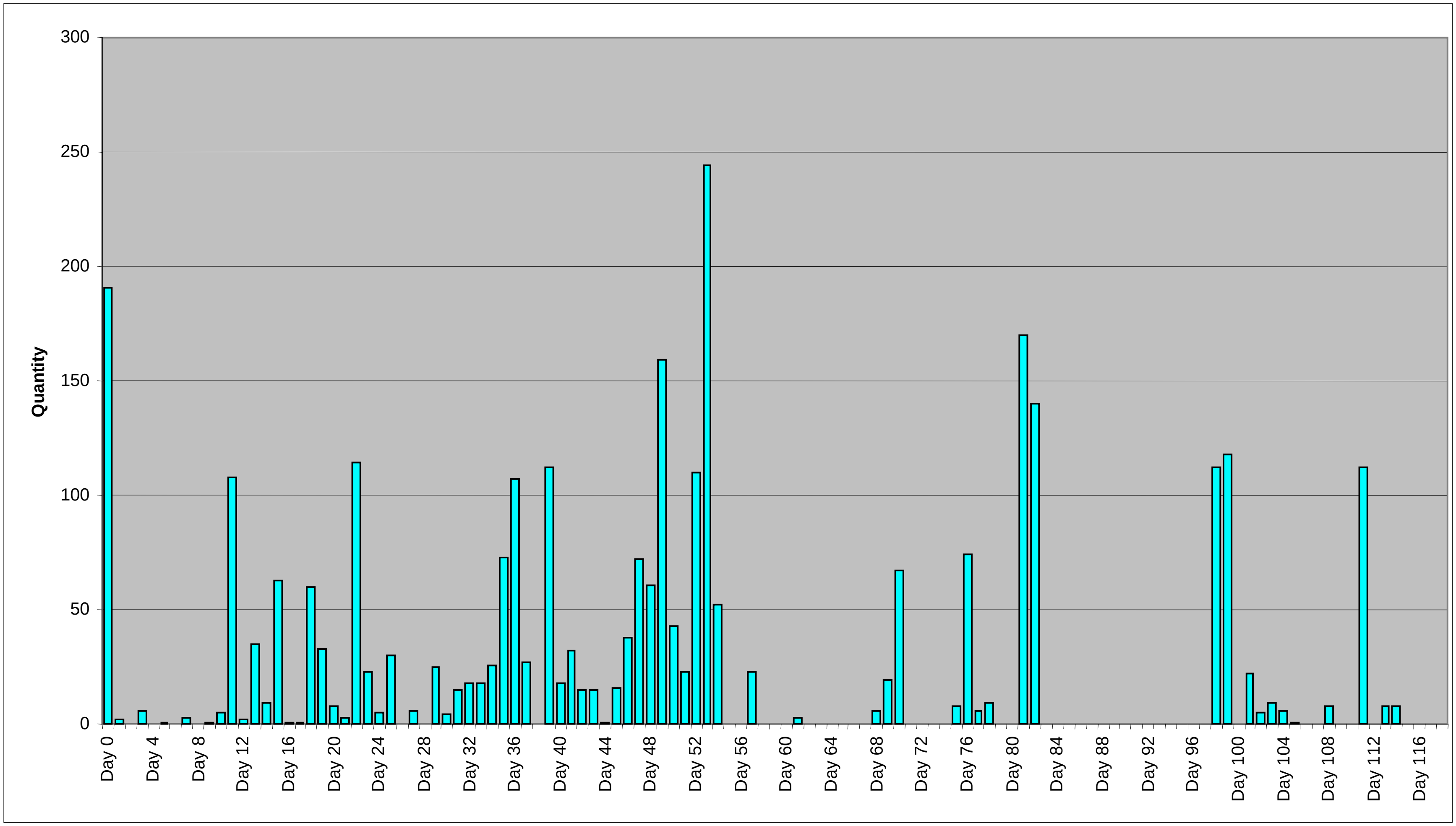


Figure A-13. Quantity of Breakbulk Cargo Items Arriving at the Port of Charleston

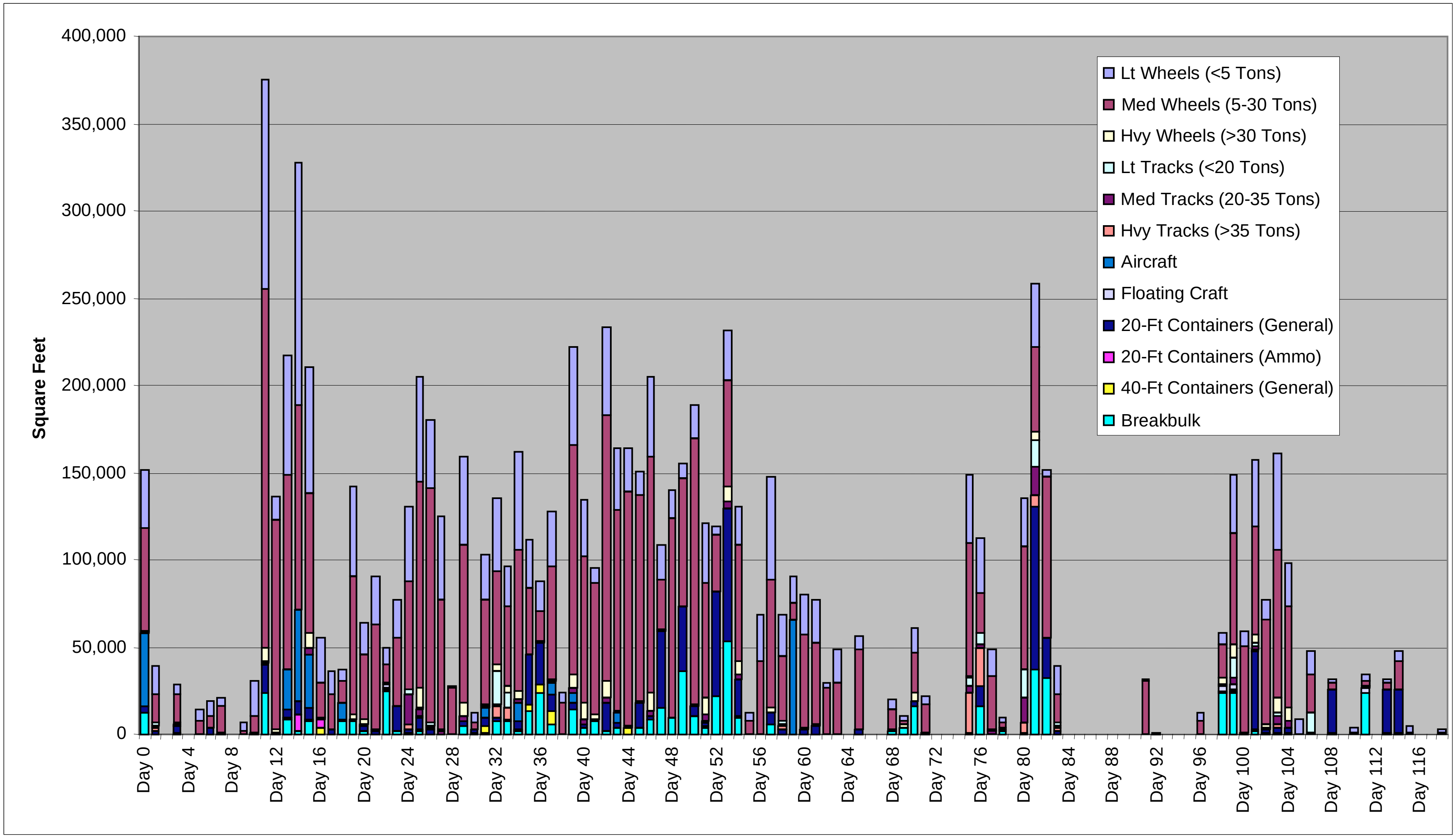


Figure A-14. Total Square Feet of Cargo Arriving at the Port of Charleston

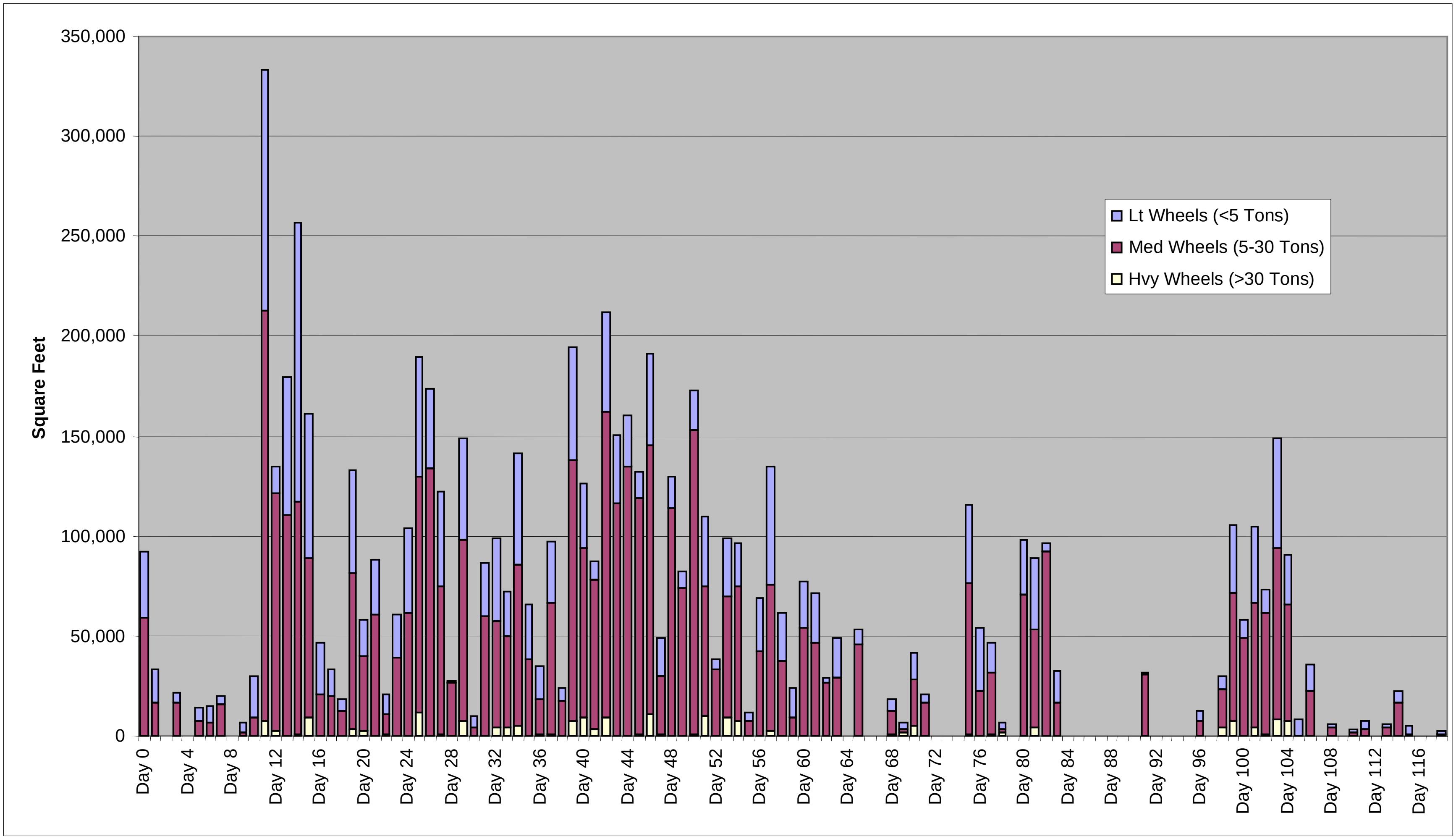


Figure A-15. Square Feet of Wheeled Vehicles Arriving at the Port of Charleston

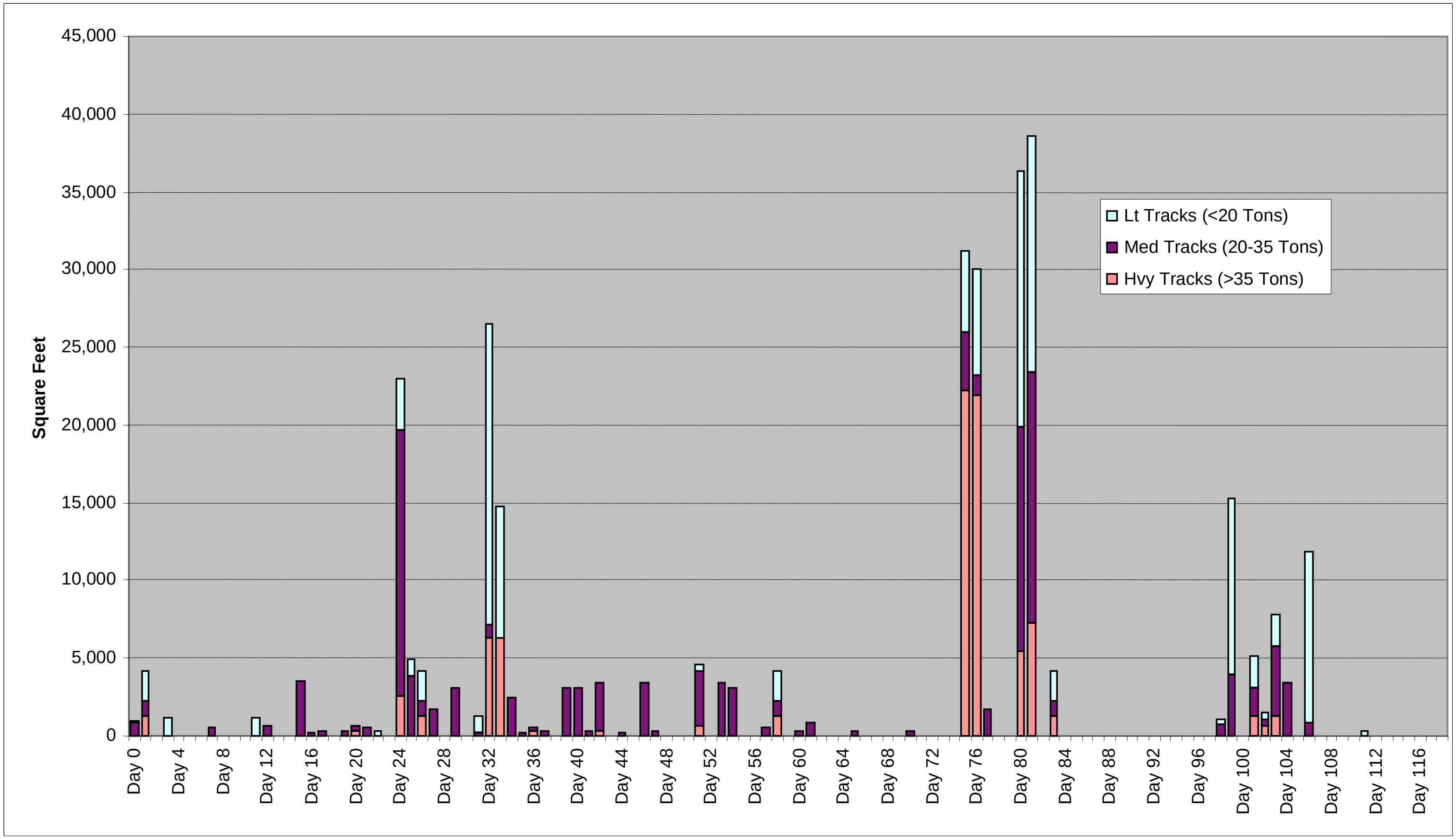


Figure A-16. Square Feet of Tracked Vehicles Arriving at the Port of Charleston

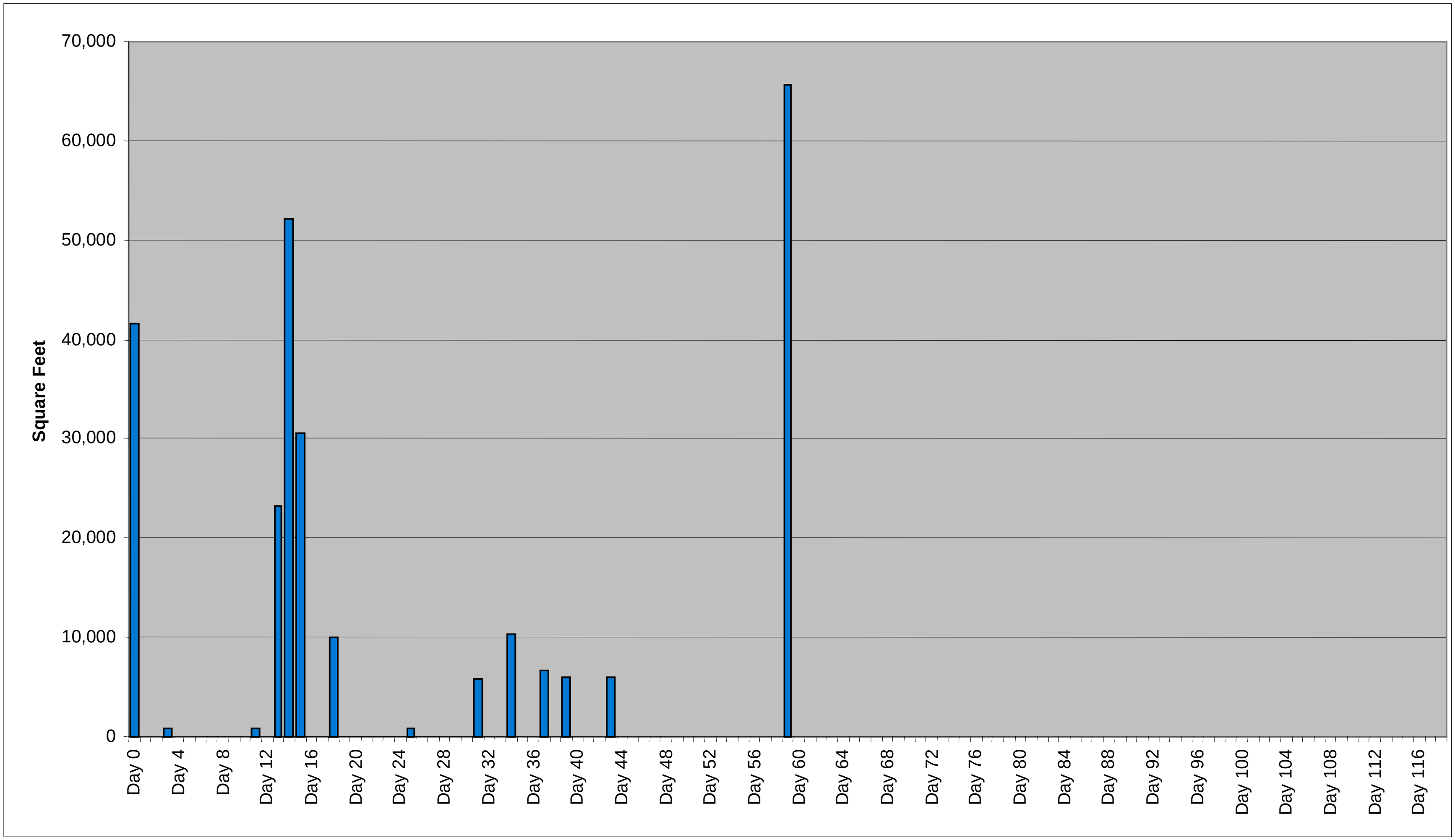


Figure A-17. Square Feet of Aircraft Arriving at the Port of Charleston

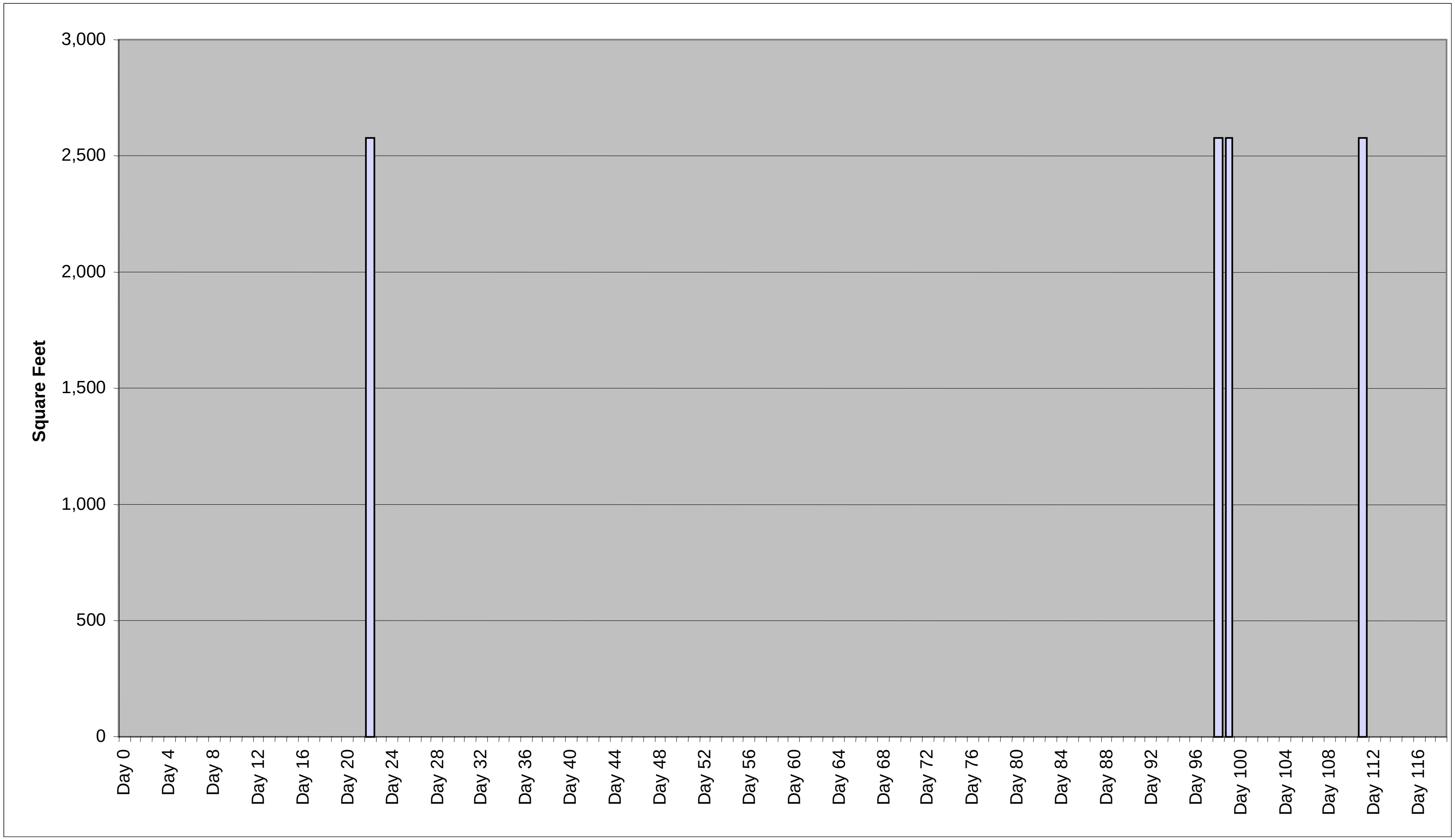


Figure A-18. Square Feet of Floating Craft Arriving at the Port of Charleston

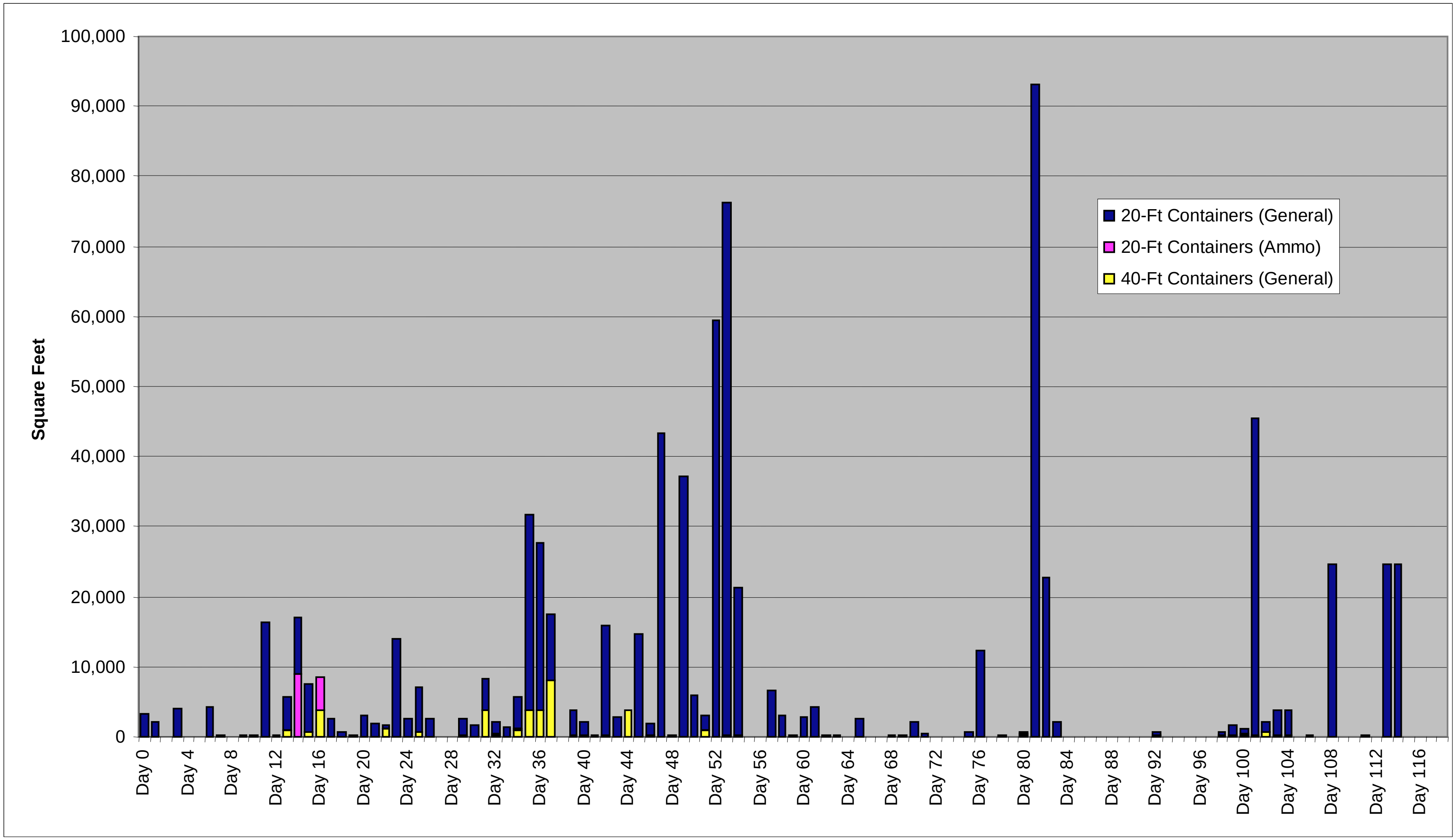


Figure A-19. Square Feet of Containers Arriving at the Port of Charleston

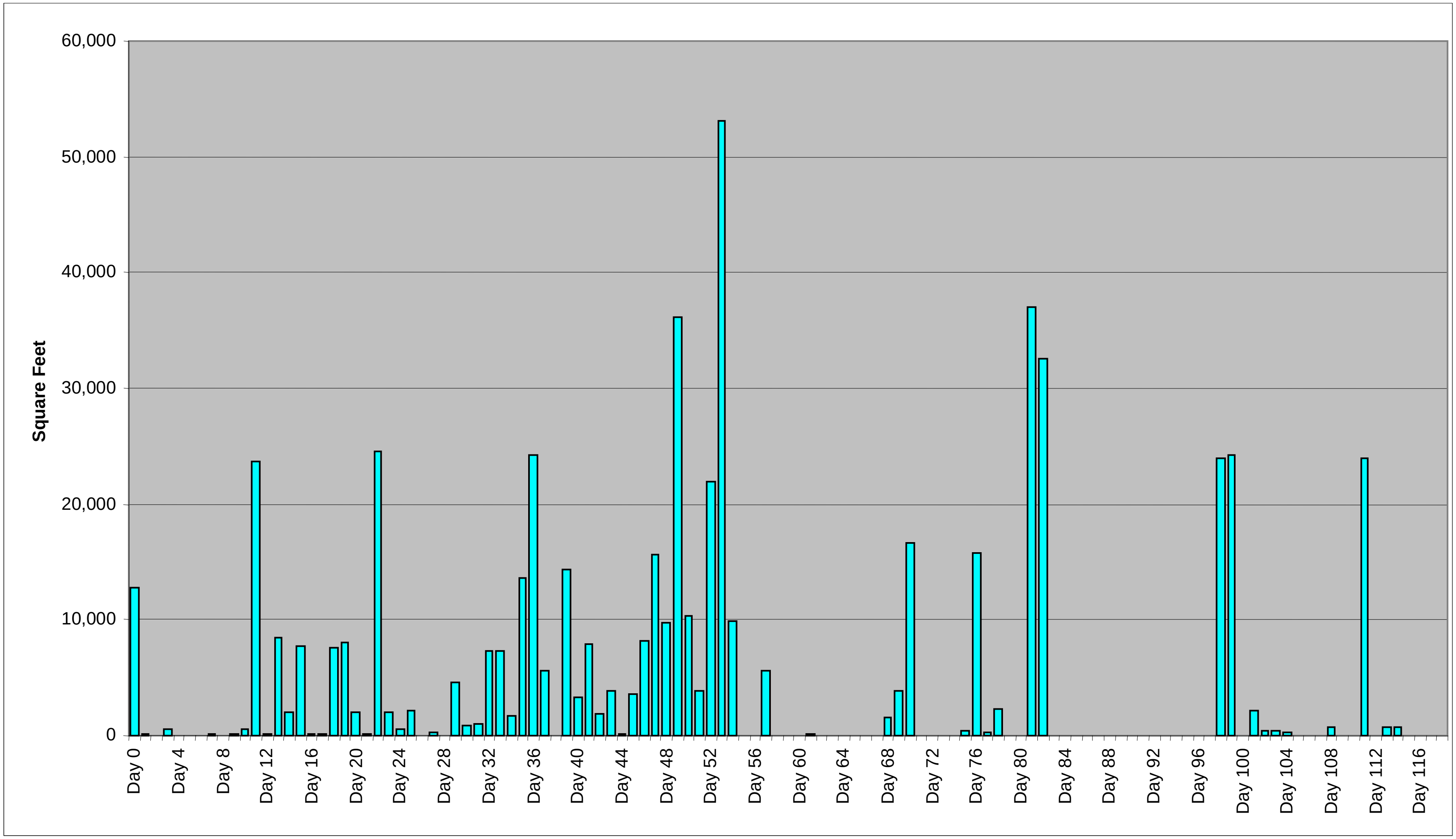


Figure A-20. Square Feet of Breakbulk Cargo Items Arriving at the Port of Charleston

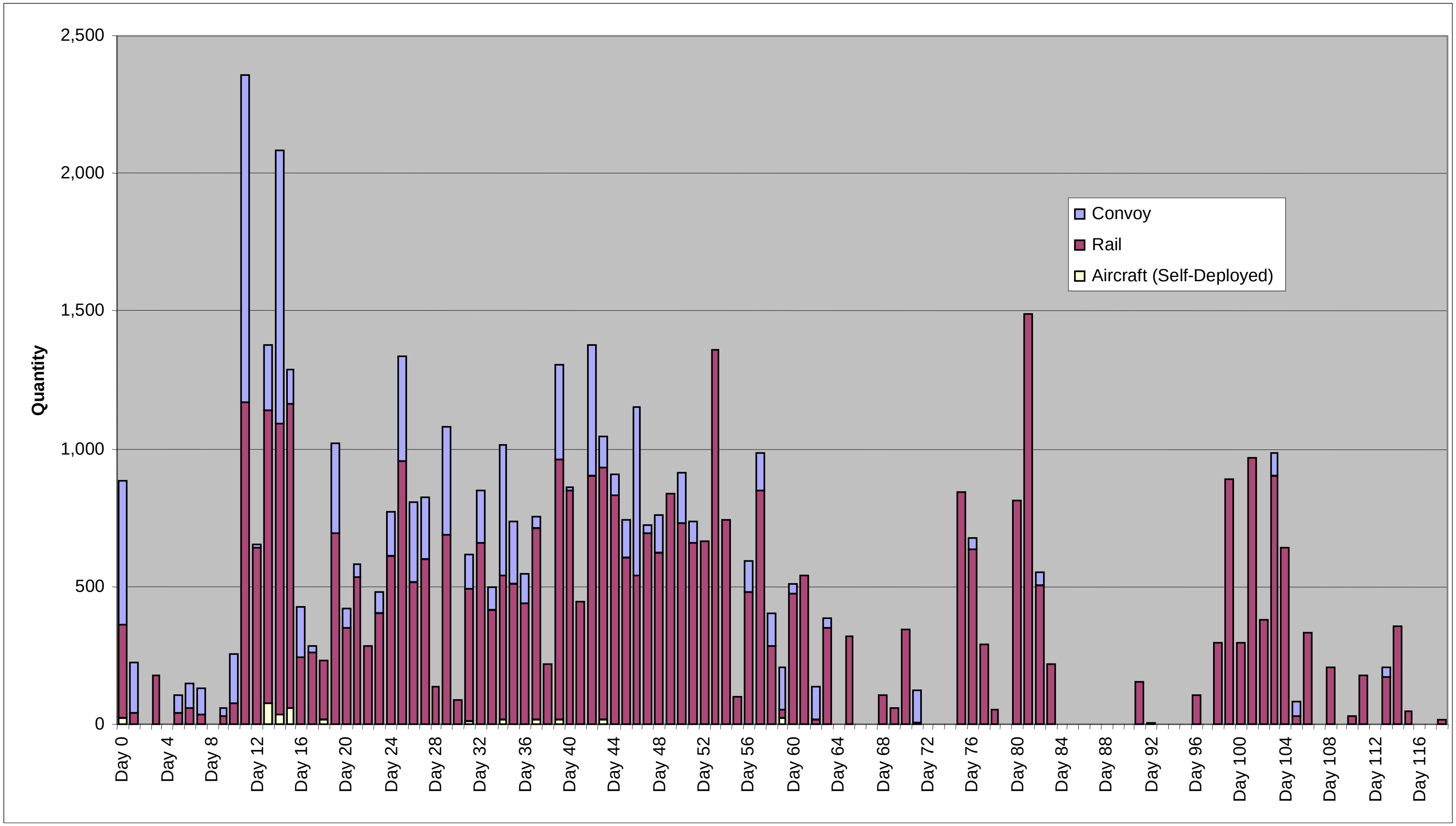


Figure A-21. Quantity of Cargo Items Arriving by Mode to the Port of Charleston

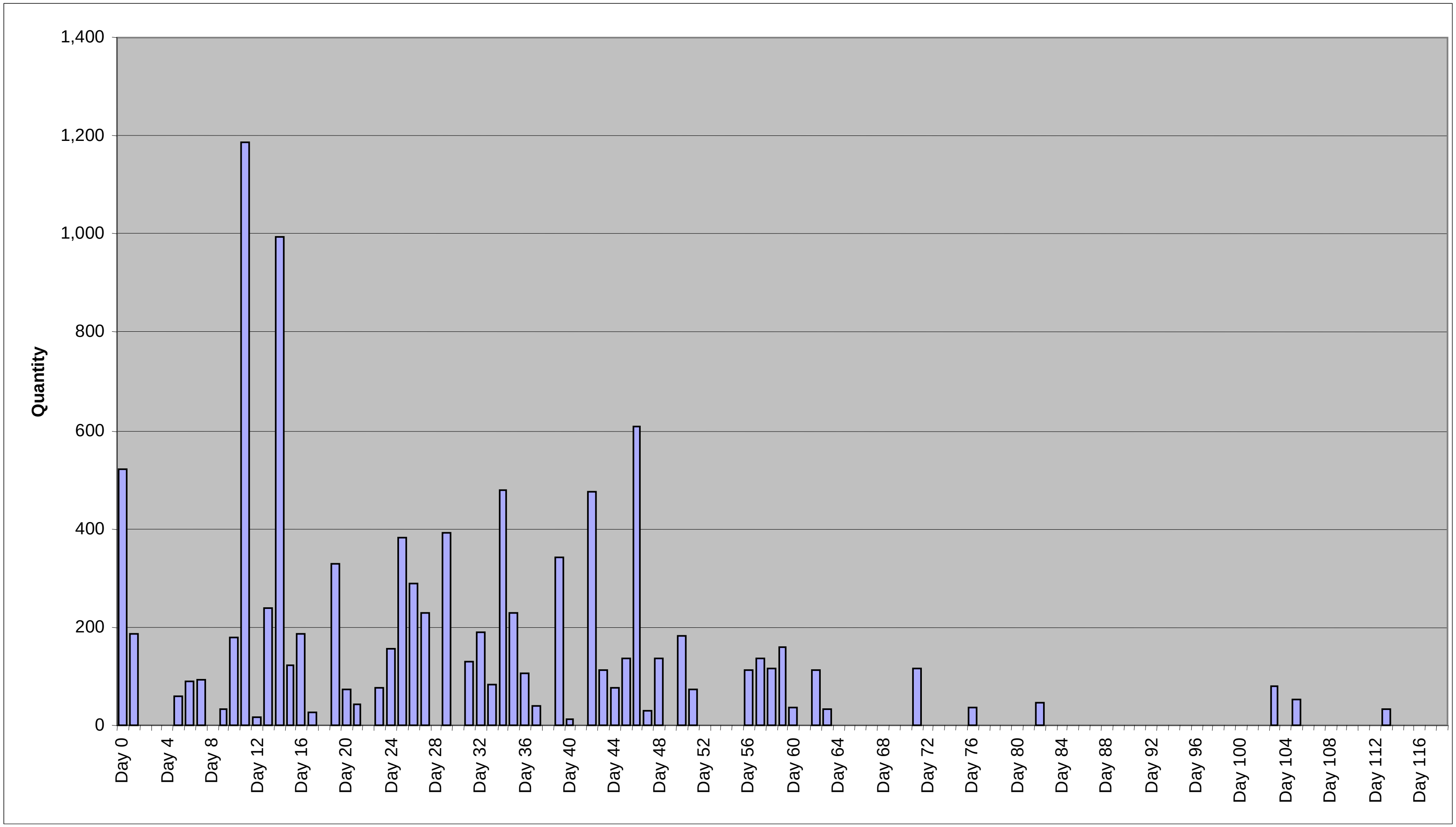


Figure A-22. Quantity of Wheeled Vehicles Convoying to the Port of Charleston

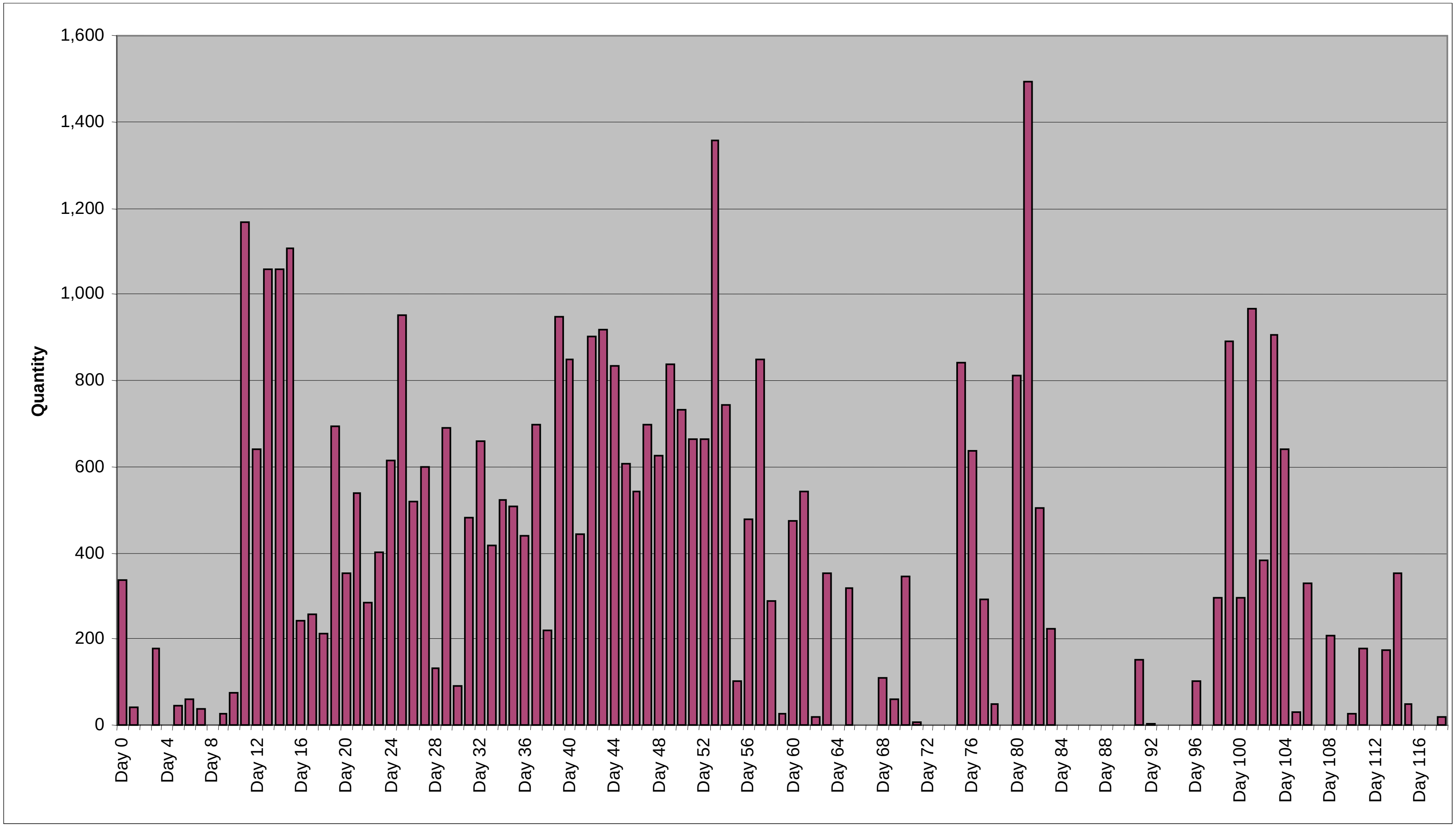


Figure A-23. Quantity of Items Arriving by Rail to the Port of Charleston

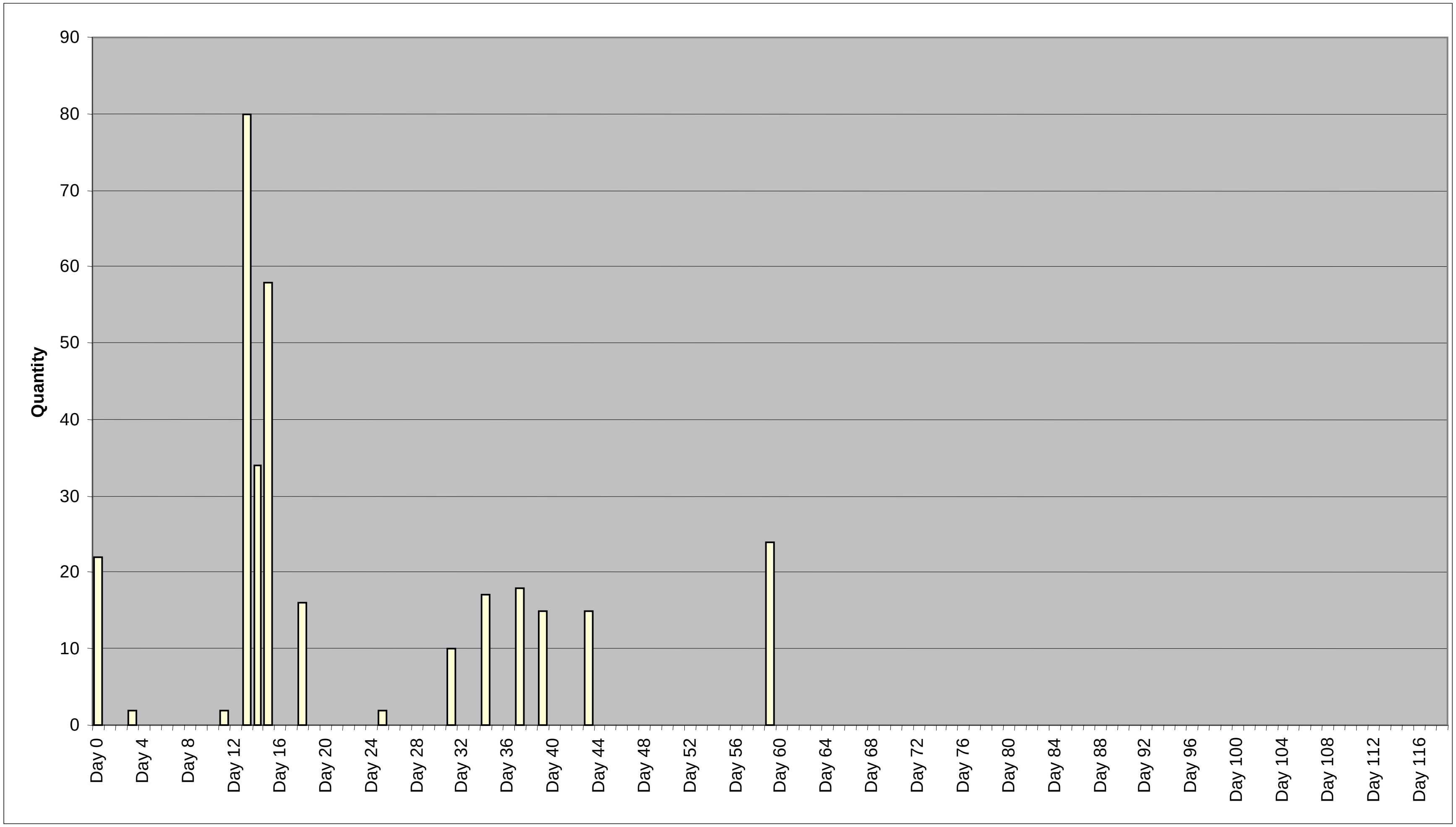


Figure A-24. Quantity of Aircraft Self-Deploying to the Port of Charleston

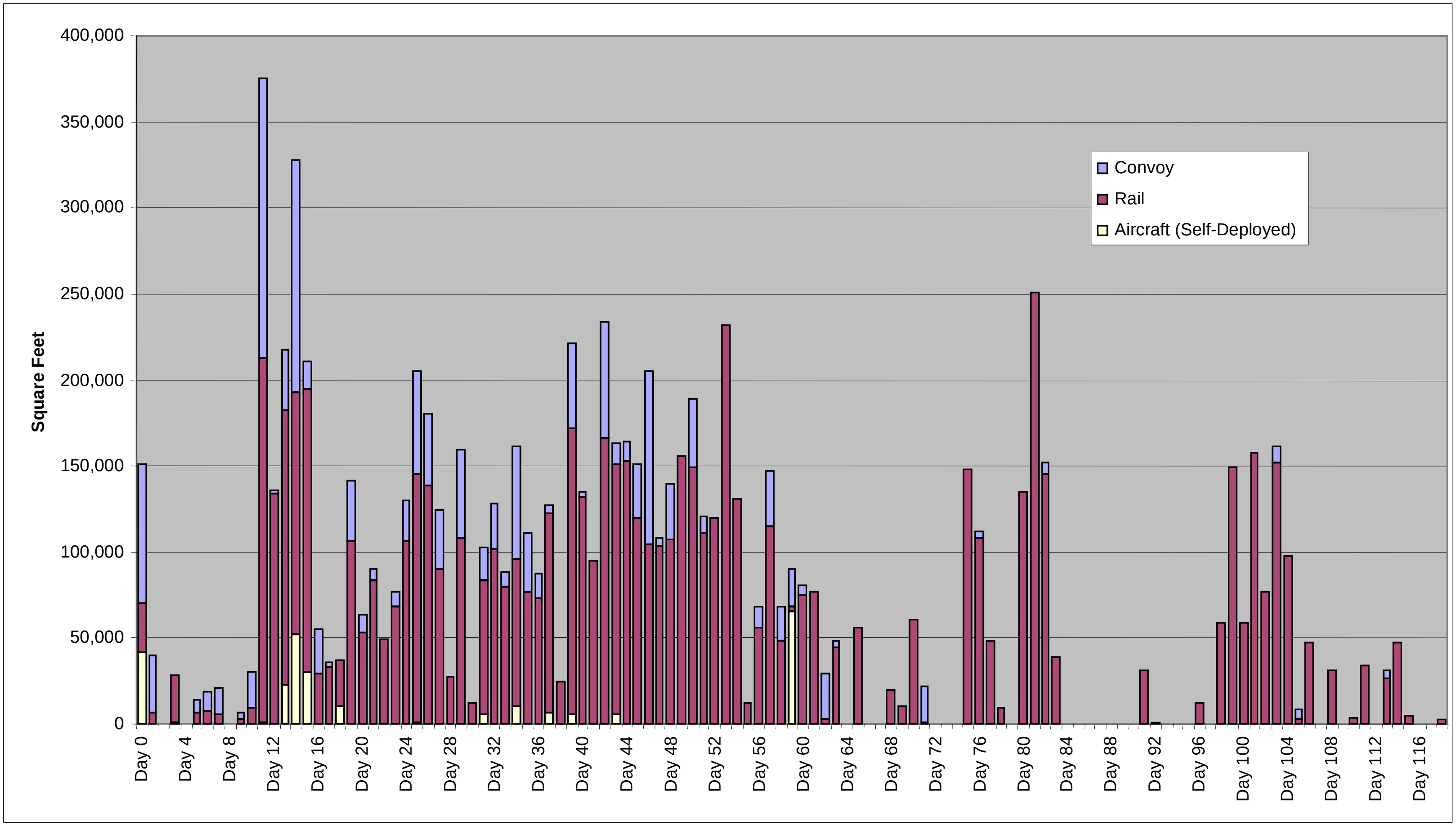


Figure A-25. Square Feet of Cargo Items Arriving by Mode to the Port of Charleston

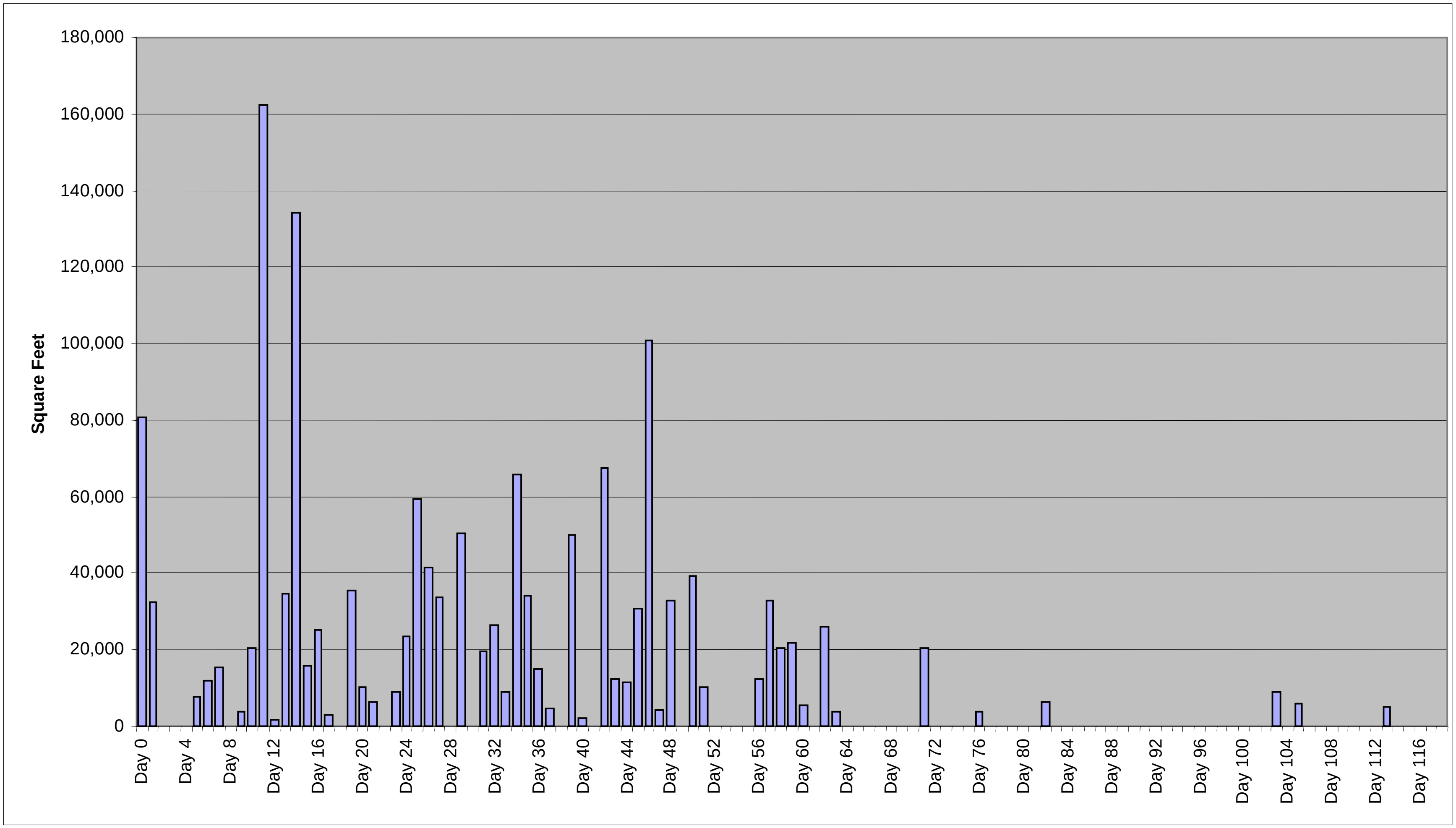


Figure A-26. Square Feet of Wheeled Vehicles Convoying to the Port of Charleston

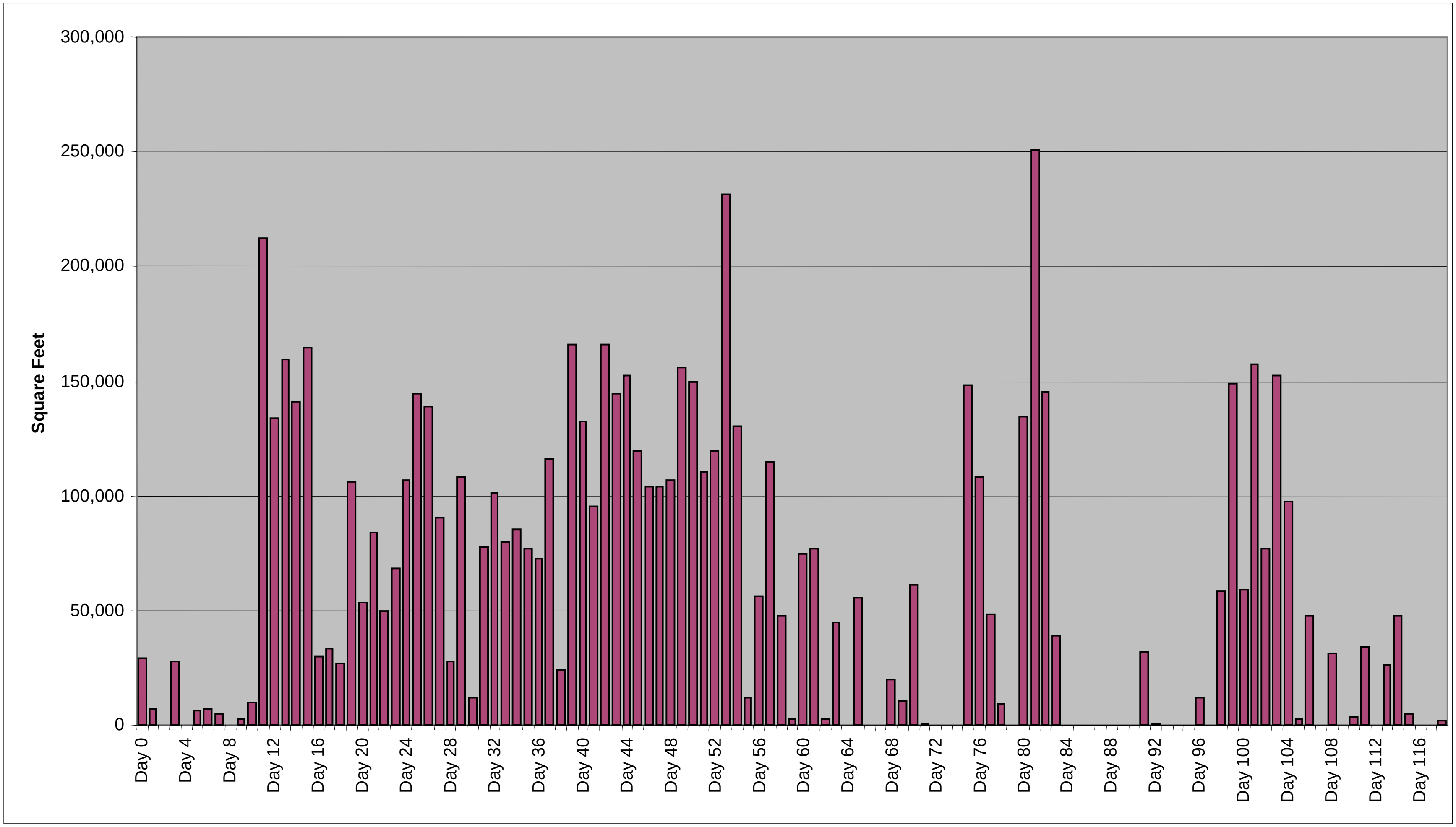


Figure A-27. Square Feet of Cargo Items Arriving by Rail to the Port of Charleston

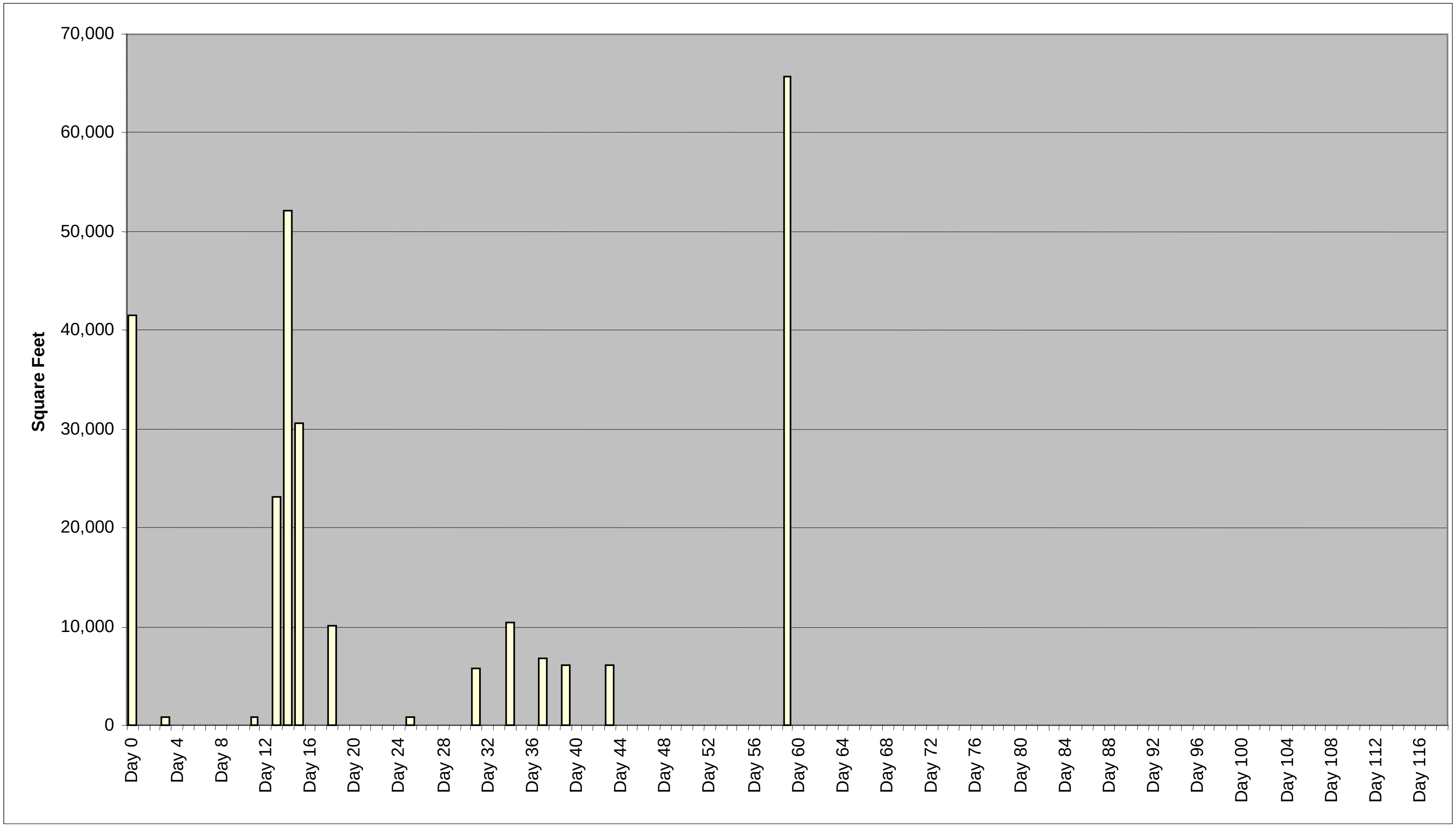


Figure A-28. Square Feet of Aircraft Self-Deploying to the Port of Charleston

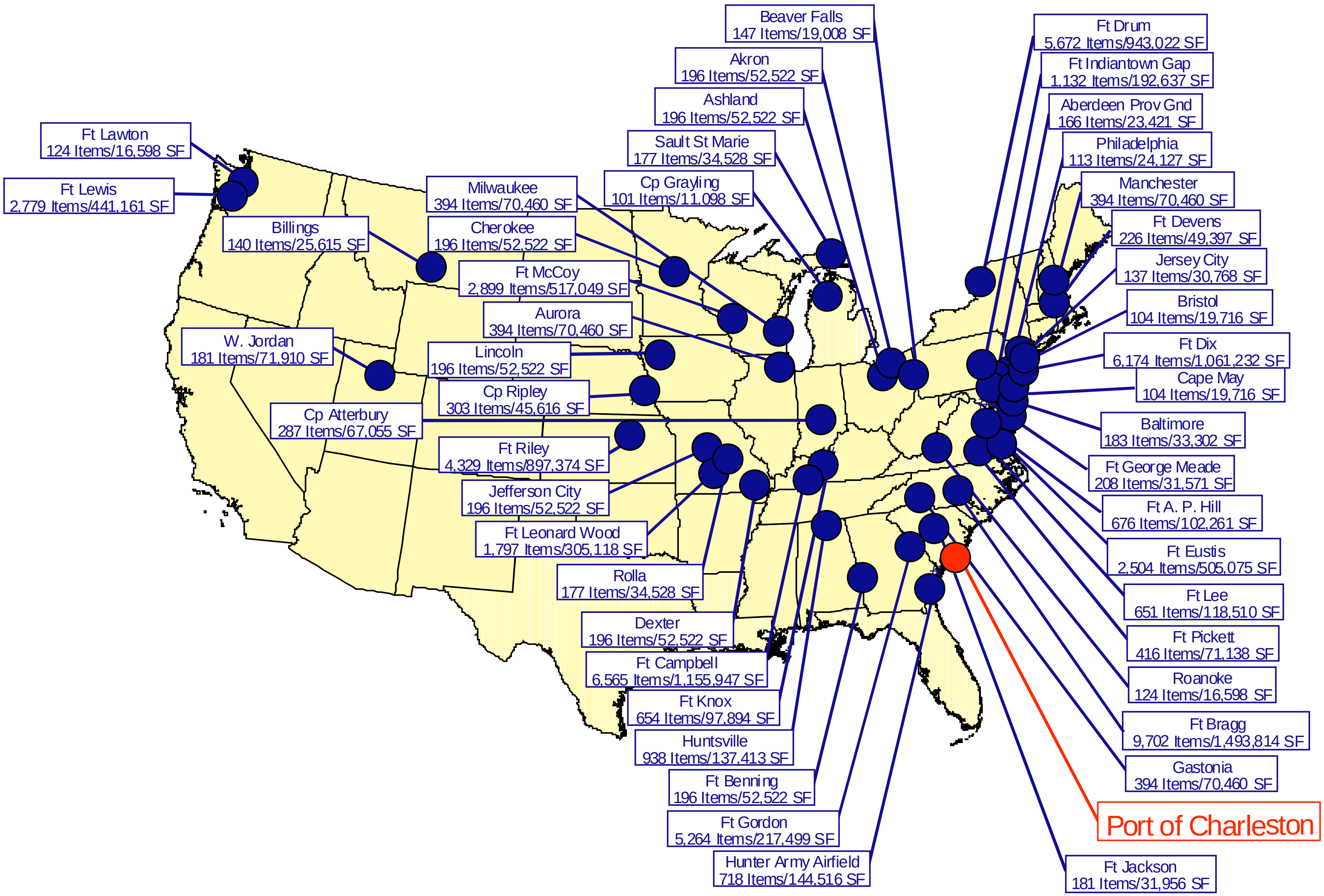


Figure A-29. Amount of Cargo Arriving at the Port of Charleston by Origin

Table A-2
Amount of Cargo Arriving at the Port of Charleston
(Origins not in Figure A-29)

ORIGIN	QUANTITY	SQUARE FEET
Casper, WY	98	16,318
Ogden, UT	76	10,322
Shaw AFB, SC	74	9,475
Brockton, MA	73	8,080
Hempstead, NY	73	8,080
Middletown, RI	73	8,080
Warren, RI	73	8,080
Warwick, RI	73	8,080
Hartford, CT	71	7,920
Blackstone, VA	68	13,126
KingsMill Ord Pl, OH	68	13,126
Lafayette, IN	66	12,217
Athens, AL	63	10,561
Fort Hayes, OH	54	5,856
Fort Totten, NY	54	7,449
Roseau, MN	52	9,524
Crane AAP, IN	44	7,040
Fort Story, VA	42	6,254
Cando, ND	41	7,606
Clinton, MA	41	7,606
Nashville, TN	39	3,786
Arden Hills, MN	38	8,041
Volk Field, WI	37	6,153
Letterkenny Depot, PA	30	4,800
Allendale, SC	29	4,399
Fulton, MO	27	3,568
Selfridge ANGB, MO	23	2,530
Trenton, NJ	15	1,670
Tacoma, WA	12	1,952
Baldin, NC	6	616
Yorktown NWS, VA	6	960
Earle NWS, NJ	4	640
Pope AFB, NC	4	394
Williamsburg, VA	3	772
Charleston NWS, SC	2	320

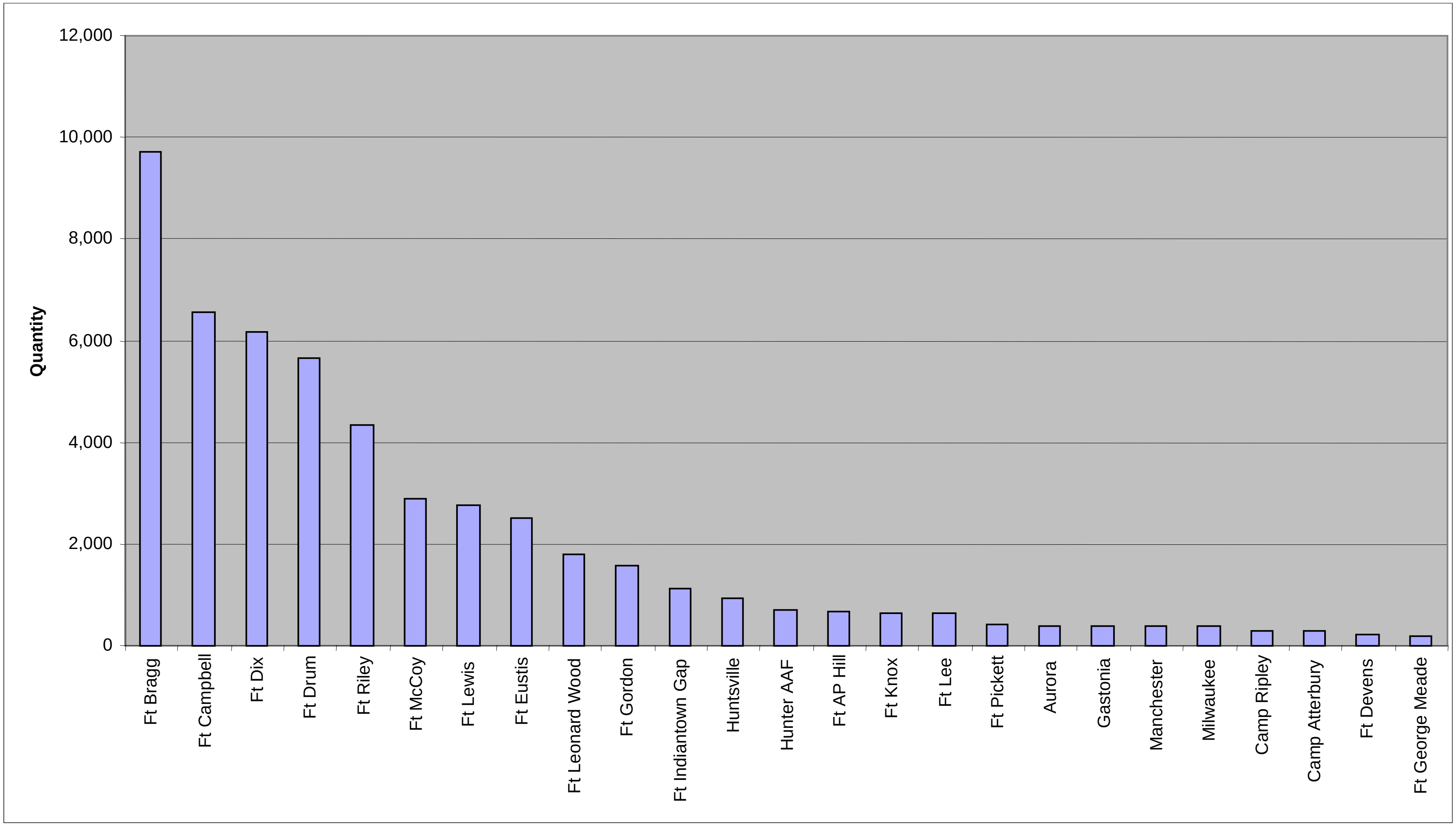


Figure A-30. Quantity of Items Arriving at the Port of Charleston by Origin

Table A-3
Quantity of Items Arriving at the Port of Charleston by Origin
(Origins not in Figure A-30)

ORIGIN	QTY	ORIGIN	QTY
Akron, Oh	196	Warren, RI	73
Ashland, OH	196	Warwick, RI	73
Cherokee, IO	196	Hartford, CT	71
Dexter, MO	196	Blackstone, VA	68
Fort Benning, GA	196	Kings Mill Ord Pl, OH	68
Jefferson City, MO	196	Lafayette, IN	66
Lincoln, NE	196	Athens, Al	63
Philadelphia, PA	187	Fort Hayes, OH	54
Baltimore, MD	183	Fort Totten, NY	54
Fort Jackson, SC	181	Roseau, MN	52
W Jordan, UT	181	Crane AAP, IN	44
Rolla, MO	177	Fort Story, VA	42
Sault St Marie, MI	177	Cando, ND	41
Aberdeen Proving Gr, MD	166	Clinton, MA	41
Beaver Falls, PA	147	Nashville, TN	39
Billings, MT	140	Arden Hills, MN	38
Jersey City, NJ	137	Volk Field, WI	37
Fort Lawton, WA	124	Letterkenny Depot, PA	30
Roanoke, VA	124	Allendale, SC	29
Philadelphia, PA	113	Fulton, MO	27
Bristol, PA	104	Selfridge ANGB, MO	23
Cape May, NJ	104	Trenton, NJ	15
Camp Grayling, MI	101	Tacoma, WA	12
Casper, WY	98	Badin, NC	6
Ogden, UT	76	Yorktown NWS, VA	6
Shaw AFB, SC	74	Earle NWS, NJ	4
Brockton, MA	73	Pope AFB, NC	4
Hempstead, NY	73	Williamsburg, VA	3
Middletown, RI	73	Charleston NWS, SC	2

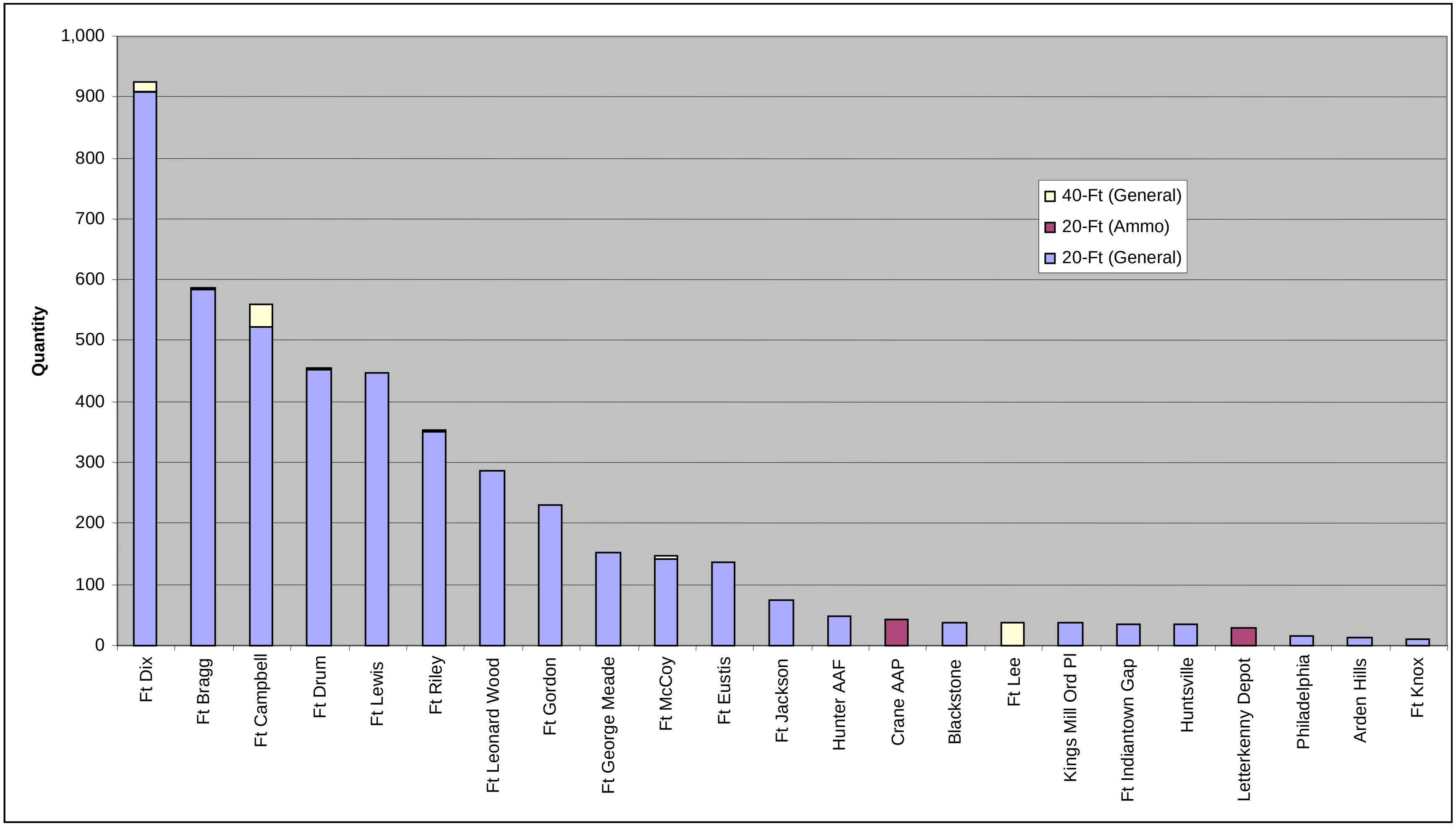


Figure A-31. Quantity of Containers Arriving at the Port of Charleston by Origin

Table A-4
Quantity of Containers Arriving at the Port of Charleston by Origin
(Origins not in Figure A-31)

ORIGIN	20-FT (General)	20-FT (Ammo)	40-FT (General)	TOTAL
Ogden, UT	9			9
W Jordan, UT	8			8
Aurora, IL	5	1		6
Fort A P Hill, VA	5		1	6
Gastonia, NC	5		1	6
Manchester, NH	5		1	6
Milwaukee, WI	5		1	6
Yorktown NWS, VA		6		6
Camp Atterbury, IN	4			4
Earle NWS, NJ		4		4
Camp Ripley , MN	1		2	3
Fort Pickett, VA	3			3
Aberdeen Proving Ground, MD	2			2
Athens, AL	2			2
Billings, MT	2			2
Charleston NWS, SC		2		2
Lafayette, IN	2			2
Roseau, MN	2			2
Baltimore, MD	1			1
Casper, WY	1			1
Fort Totten, NY	1			1
Nashville, TN	1			1
Rolla, MO	1			1
Sault St Marie, MI	1			1

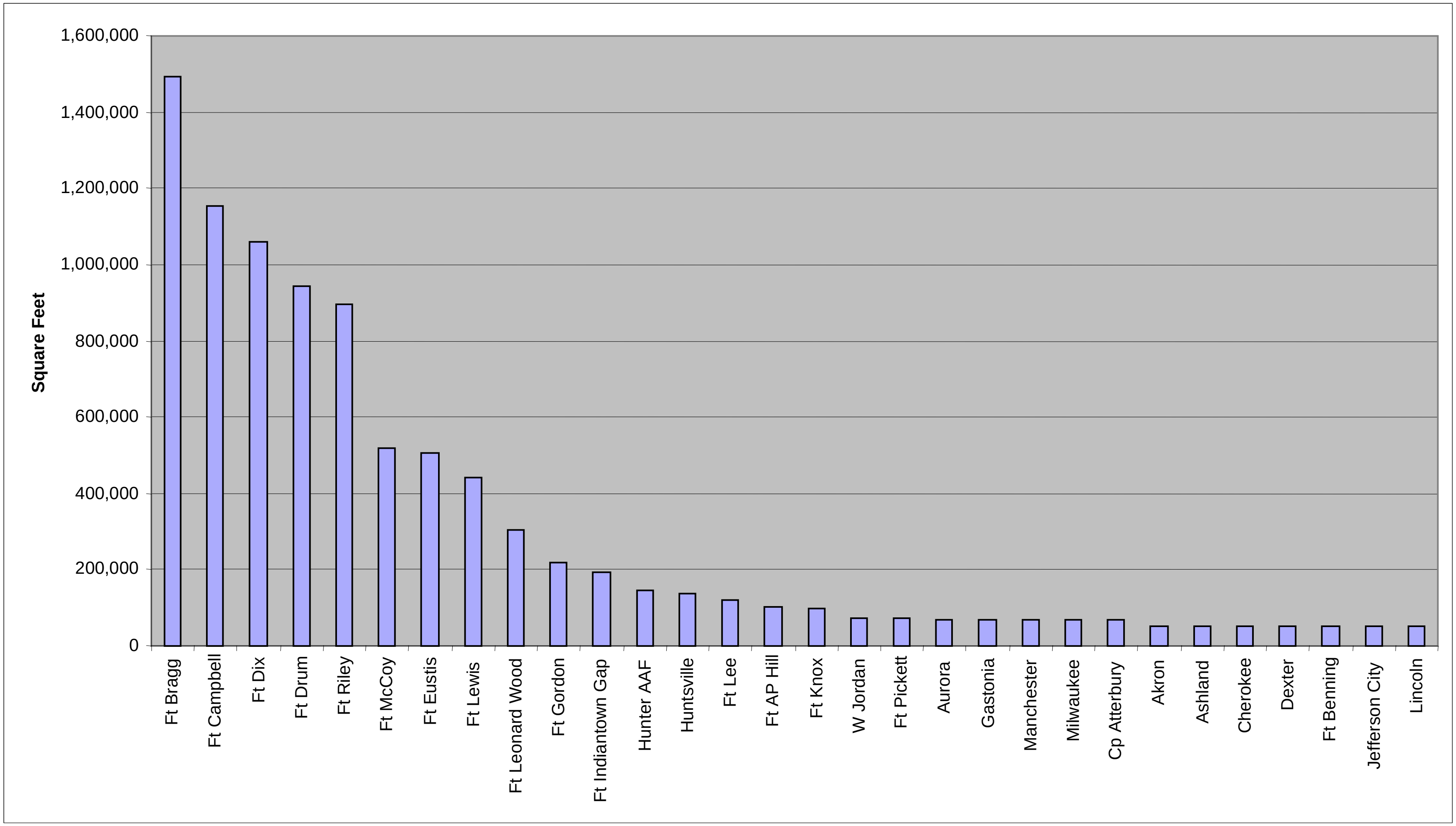


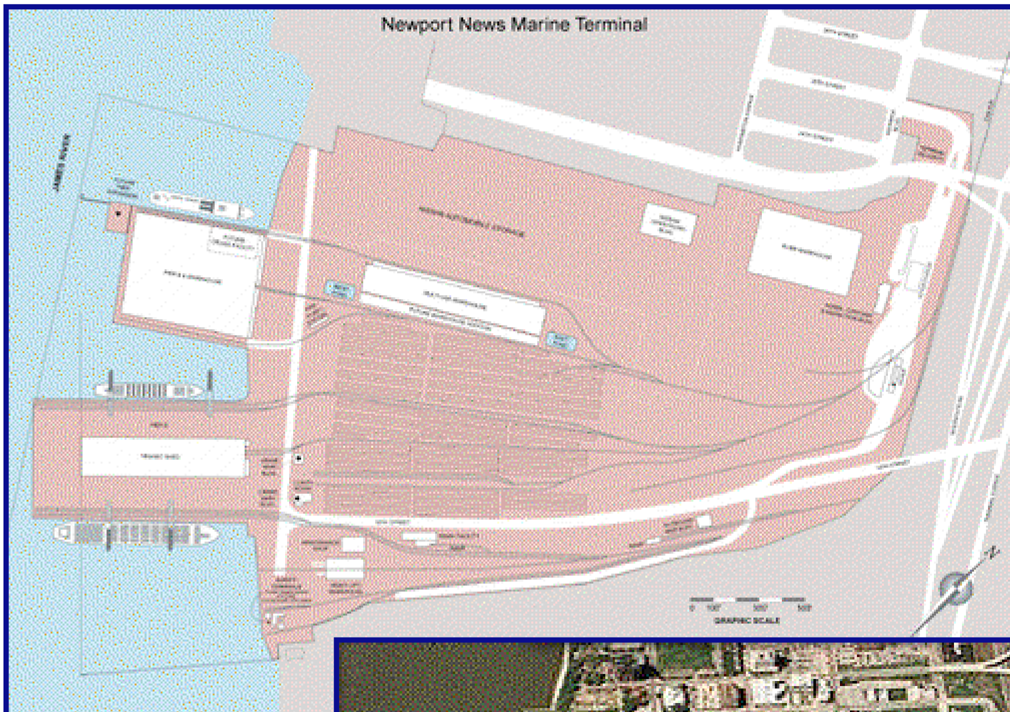
Figure A-32. Square Feet of Cargo Arriving at the Port of Charleston by Origin

Table A-5
Square Feet of Cargo Arriving at the Port of Charleston by Origin
(Origins not in Figure A-32)

ORIGIN	SQUARE FEET	ORIGIN	SQUARE FEET
Fort Devens, MA	49,396.5	Arden Hills, MN	8,040.7
Camp Ripley, MN	45,616.3	Hartford, CT	7,920.4
Rolla, MO	34,528.2	Cando, ND	7,605.6
Sault St Marie, MI	34,528.2	Clinton, MA	7,605.6
Baltimore, MD	33,302.2	Fort Totten, NY	7,448.9
Fort Jackson, SC	31,596.0	Crane AAP, IN	7.040.0
Fort George Meade, MD	31,571.2	Fort Story, VA	6,253.6
Jersey City, NJ	30,768.3	Volk Field, WI	6,153.0
Billings, MT	25,615.4	Fort Hayes, OH	5,856.0
Philadelphia, PA	24,127.3	Letterkenny Depot, PA	4,800.0
Aberdeen Proving Ground, MD	23,421.2	Allendale, SC	4,398.9
Bristol, PA	19,715.9	Nashville, TN	3,785.7
Cape May, NJ	19,715.9	Fulton, MO	3,467.6
Beaver Falls, PA	19,008.0	Selfridge ANGB, MO	2,529.8
Philadelphia, PA	18,080.0	Tacoma, WA	1,952.3
Fort Lawton, WA	16,598.3	Trenton, NJ	1,669.7
Roanoke, VA	16,598.3	Yorktown NWS, VA	960.0
Casper, WY	16,317.5	Williamsburg, VA	771.8
Blackstone, VA	13,126.0	Earle NWS, NJ	640.0
Kings Mill Ord Pl, OH	13,126.0	Badin, NC	616.3
Lafayette, IN	12,217.2	Pope AFB, NC	394.3
Camp Grayling, MI	11,098.1	Charleston NWS, SC	320.0
Athens, AL	10,560.9		
Ogden, UT	10,322.1		
Roseau, MN	9,523.7		
Shaw AFB, SC	9,475.2		
Brockton, MA	8,080.2		
Hempstead, NY	8,080.2		
Middletown, RI	8,080.2		
Warren, RI	8,080.2		
Warwick, RI	8,080.2		

APPENDIX B

PORT OF HAMPTON ROADS



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According to the TPFDD, there are four origins sending cargo to the Port of Hampton Roads. These origins are shown in Figure B-1. The Port of Hampton Roads receives a mix of Army, Navy, Air Force, Marine Corps and Coast Guard, with the bulk of the workload being Marine Corp cargo. Origins in excess of 400 miles send all of their cargo to the Port of Hampton Roads by rail. Origins within 400 miles convoy their roadable vehicles to the port and send everything else by rail. Figures B-2 through B-5 show the quantity of transports (containers, railcars, and convoying vehicles) required to move to the Port of Hampton Roads.

Figures B-6 through B-10 illustrate the quantity of items arriving at the port. Figure B-6 is the total quantity of items. Figures B-7 through B-10 break this down into more detail. Figure B-7 outlines the wheeled vehicles. Figure B-8 is the number of floating craft arriving at the Port of Hampton Roads. Figures B-9 and B-10 outline the number of containers and breakbulk cargo items, respectively, arriving at the port.

Similar to Figures B-6 through B-10, which lay out the quantity of items arriving, Figure B-11 through B-15 outline the square footage of these categories of cargo.

Figures B-16 through B-21 show how cargo is arriving at the Port of Hampton Roads. Figure B-16 through B-18 shows the number of cargo items arriving by convoy or rail. Figures B-19 through B-21 show the square footage of cargo arriving by each mode.

As shown earlier, cargo arrives at the Port of Hampton Roads from many origins. Figure B-22 shows visually the amount of cargo coming from each origin.

Figures B-23 and B-25 show the quantity and square footage, respectively, of cargo arriving at the Port of Hampton Roads by origin. Figure B-24 is the quantity of containers arriving at the Port of Hampton Roads from each origin.

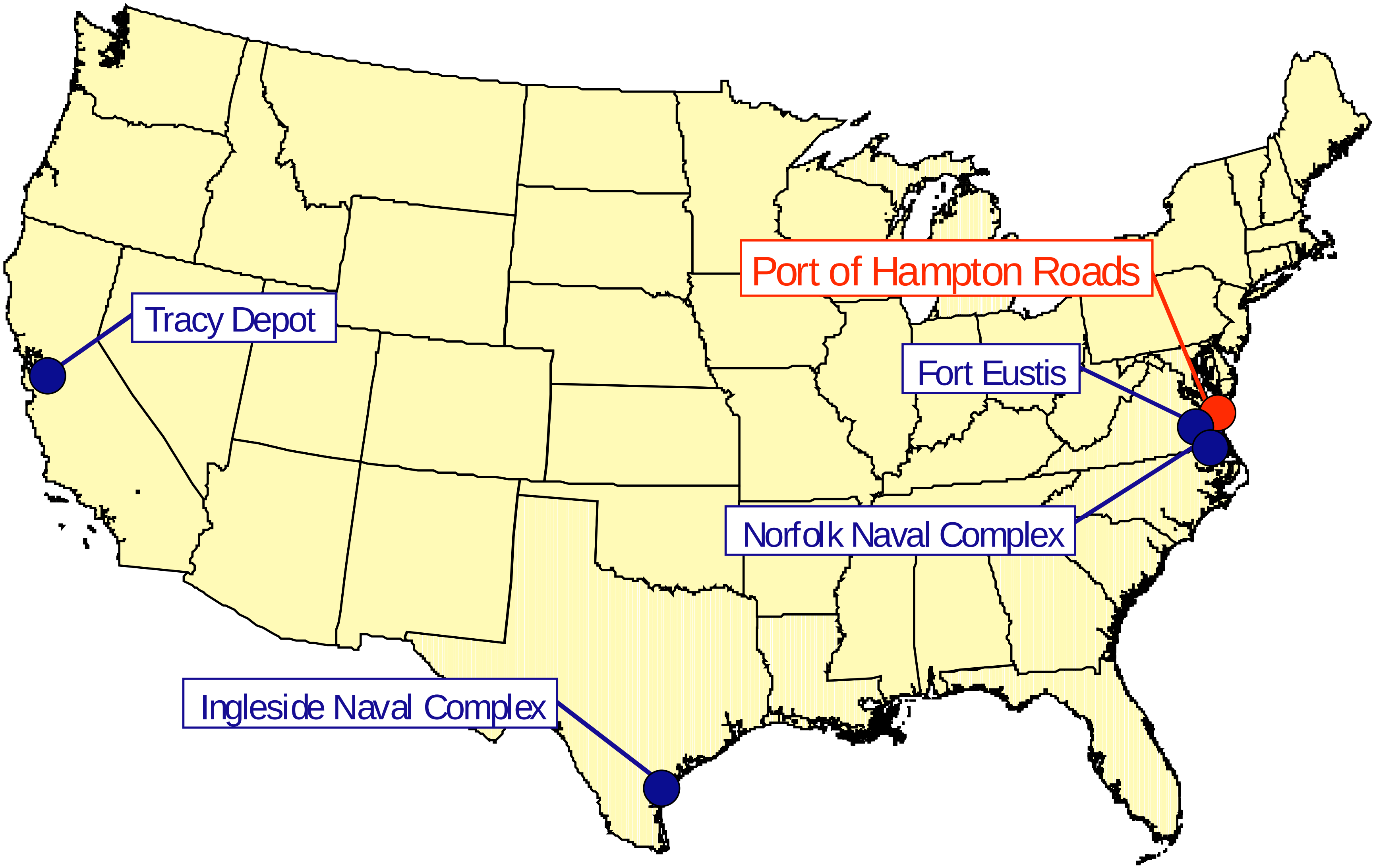


Figure B-1. Cargo Arrives at the Port of Hampton Roads from Many Origins

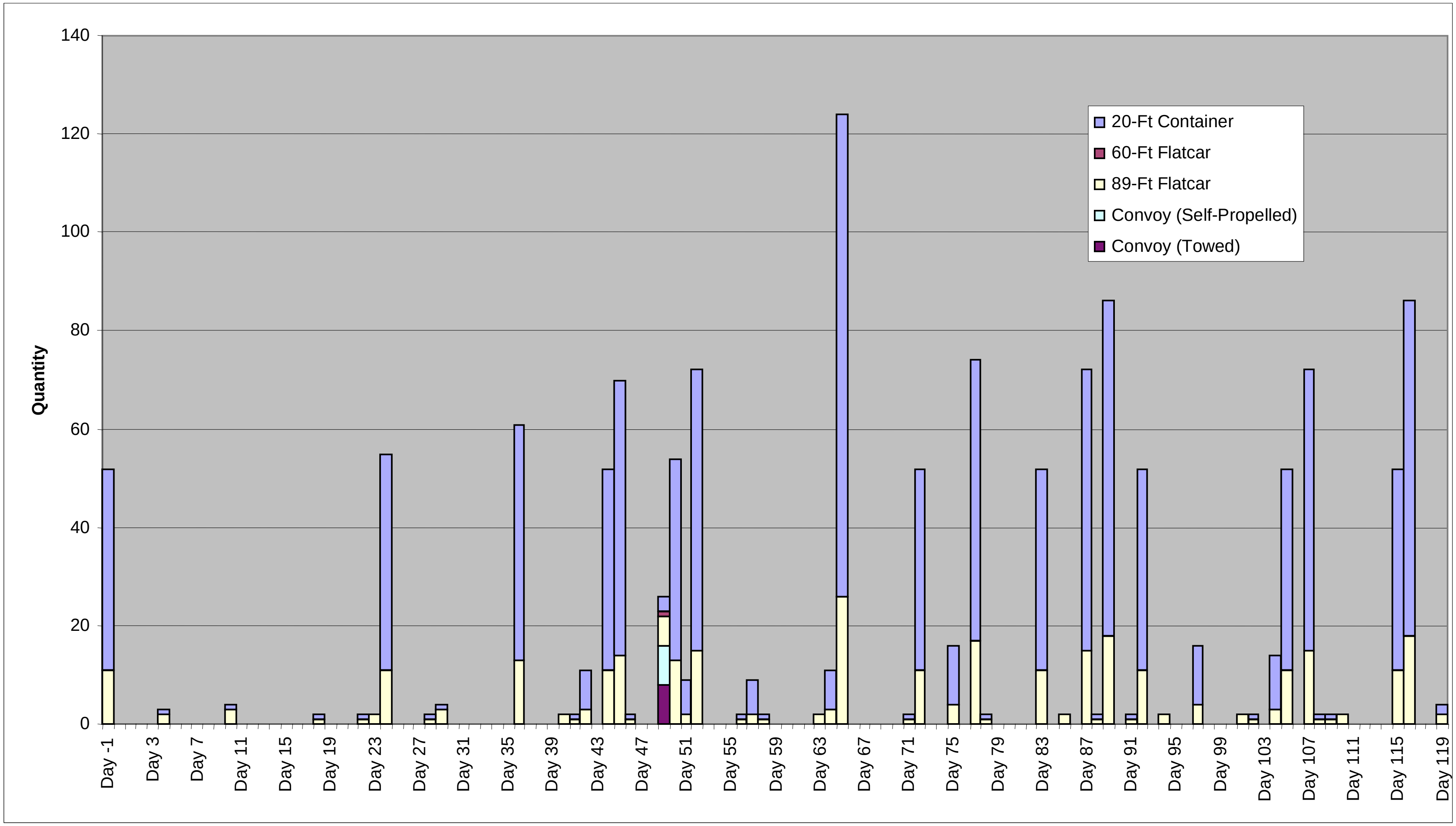


Figure B-2. Total Quantity of Transports Arriving at the Port of Hampton Roads

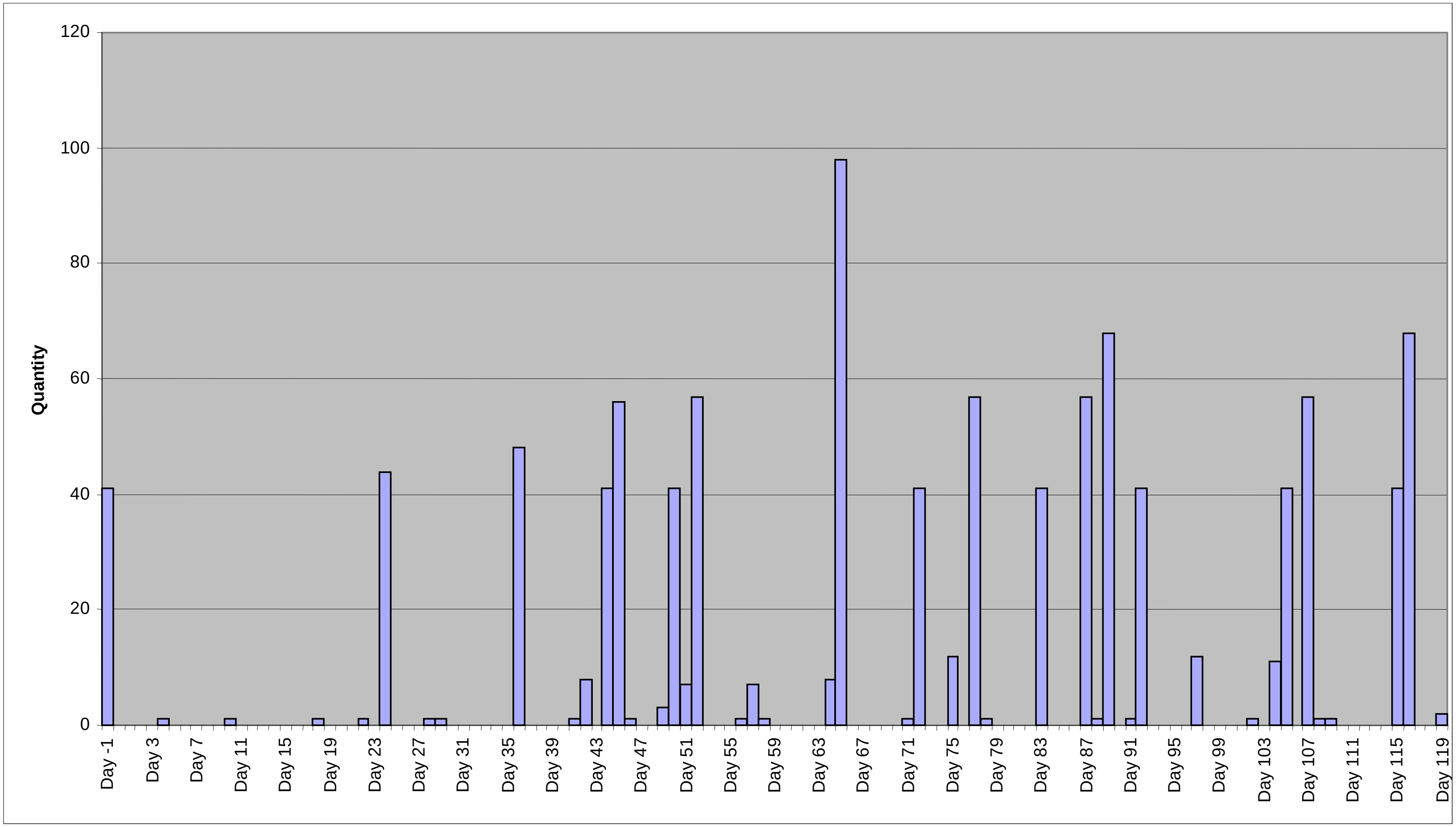


Figure B-3. Quantity of Containers Arriving at the Port of Hampton Roads

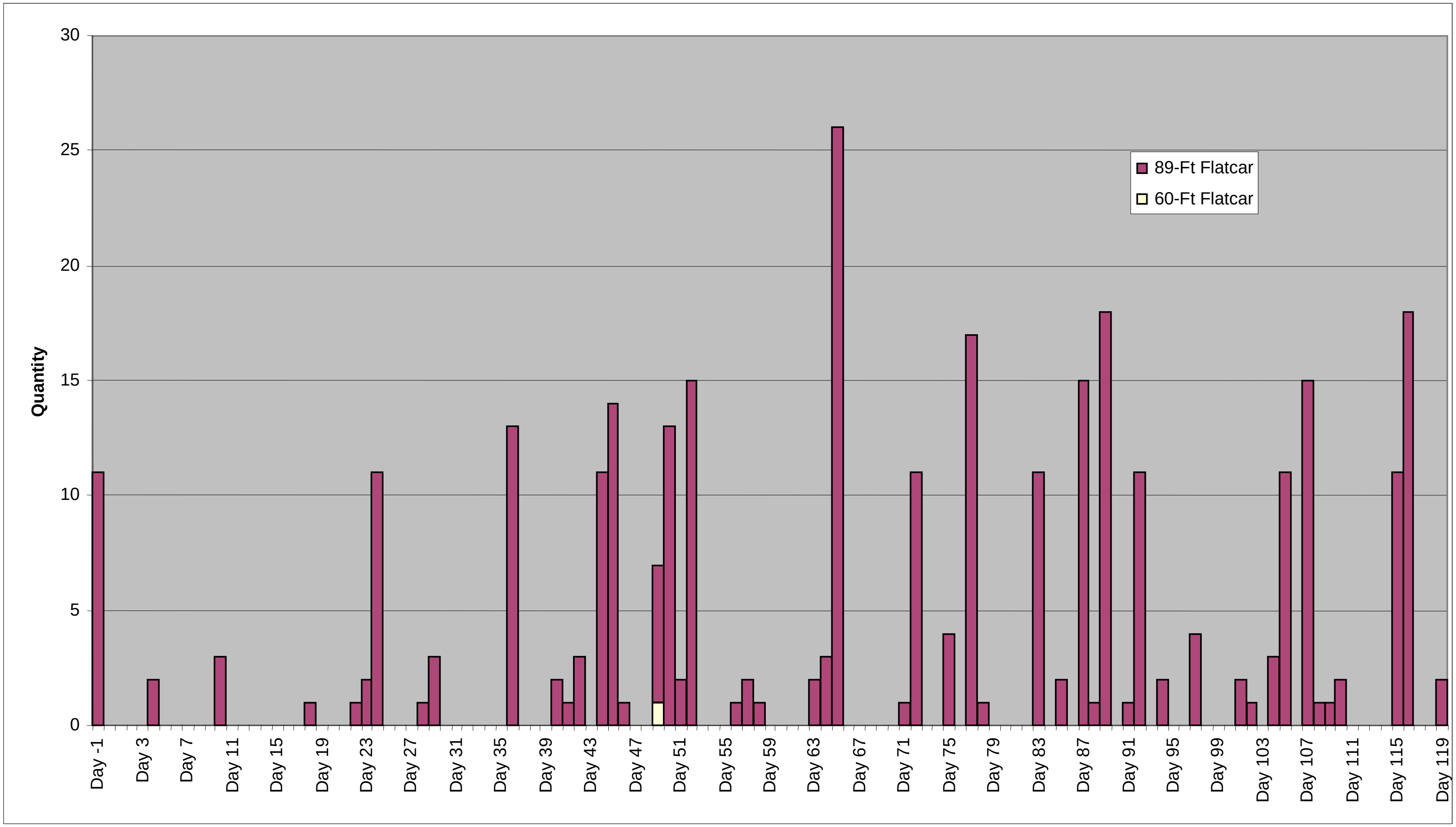


Figure B-4. Quantity of Railcars Arriving at the Port of Hampton Roads

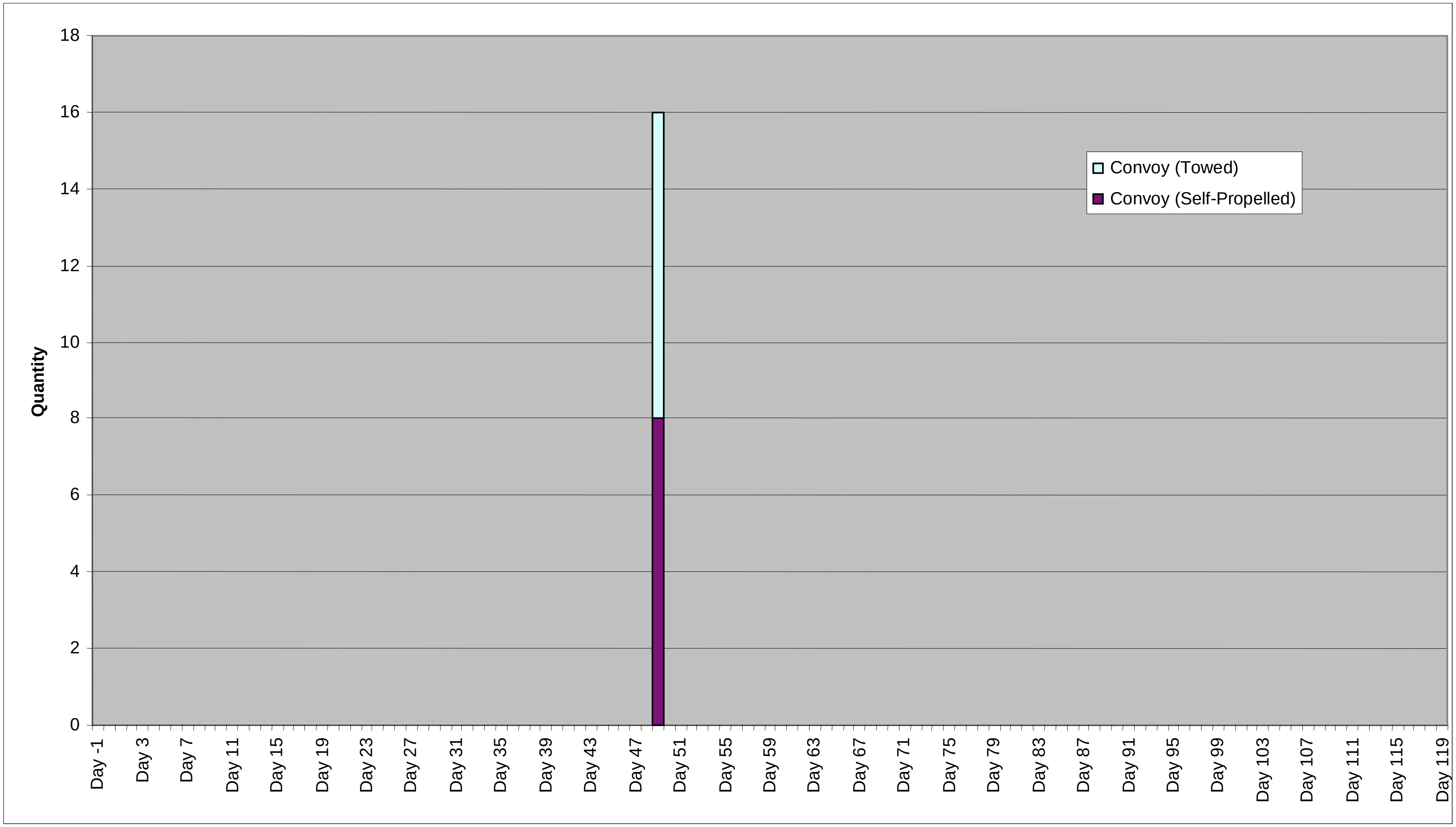


Figure B-5. Quantity of Convoy Vehicles Arriving at the Port of Hampton Roads

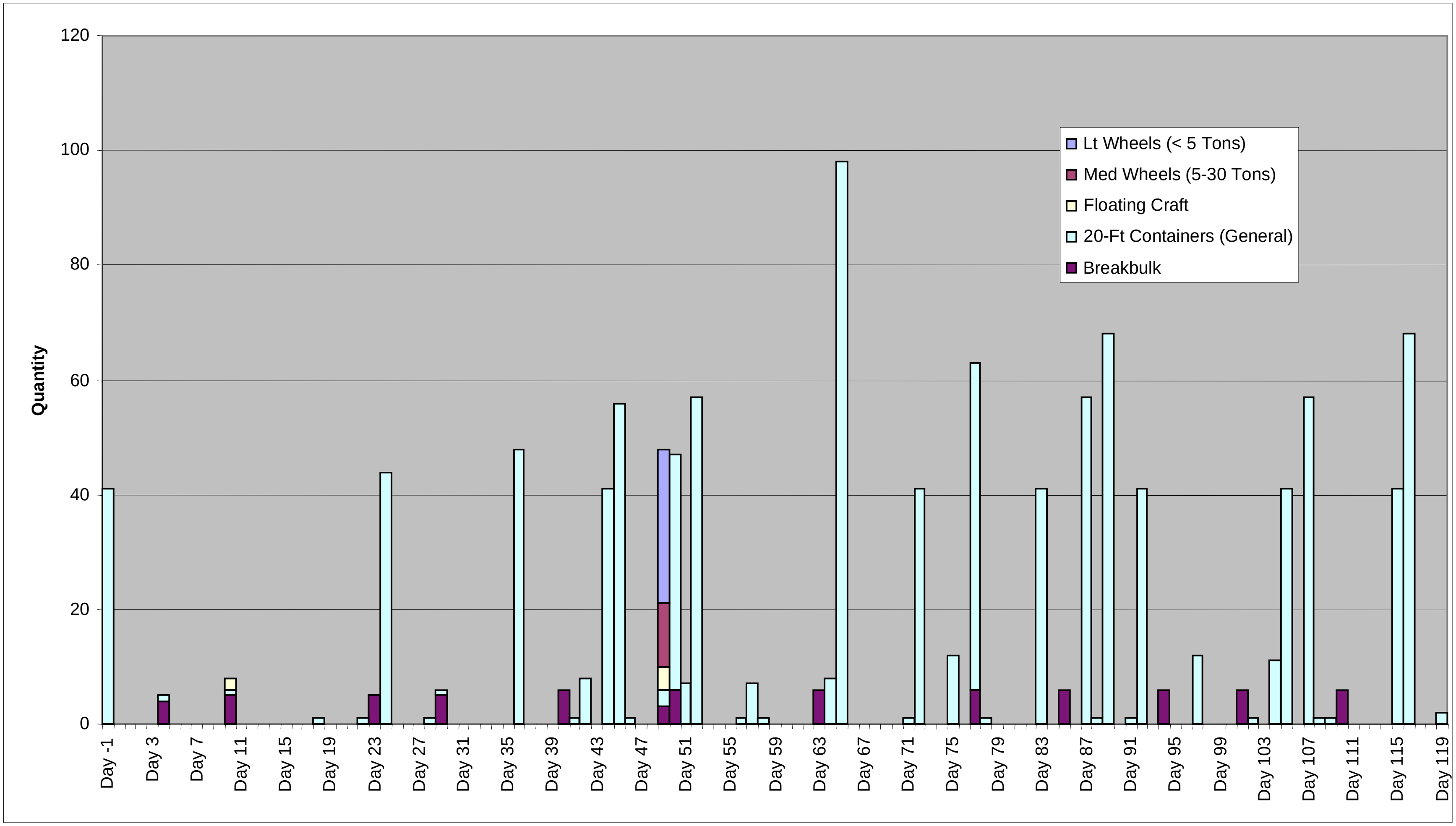


Figure B-6. Total Quantity of Items Arriving at the Port of Hampton Roads

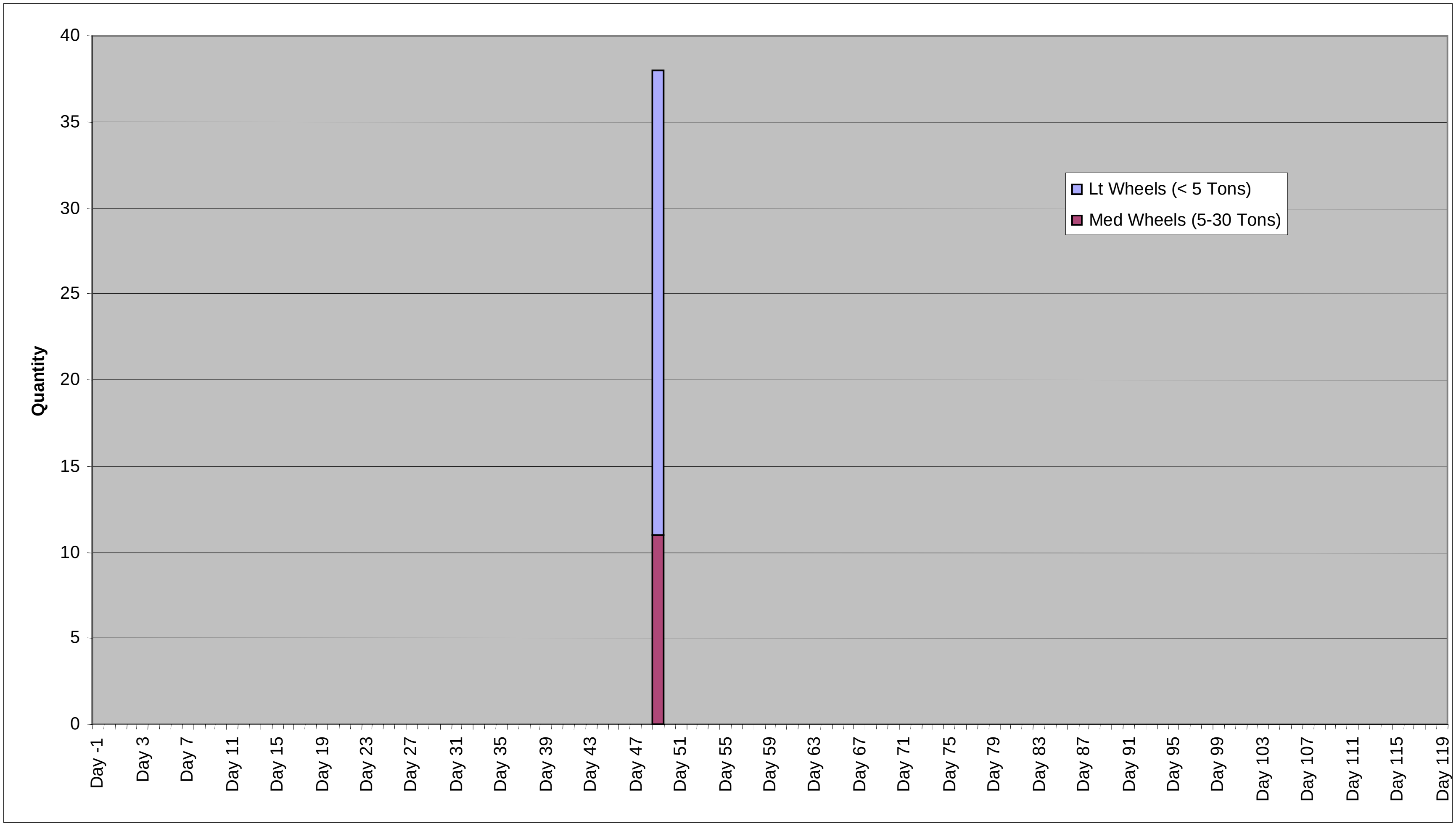


Figure B-7. Total Quantity of Wheeled Vehicles Arriving at the Port of Hampton Roads

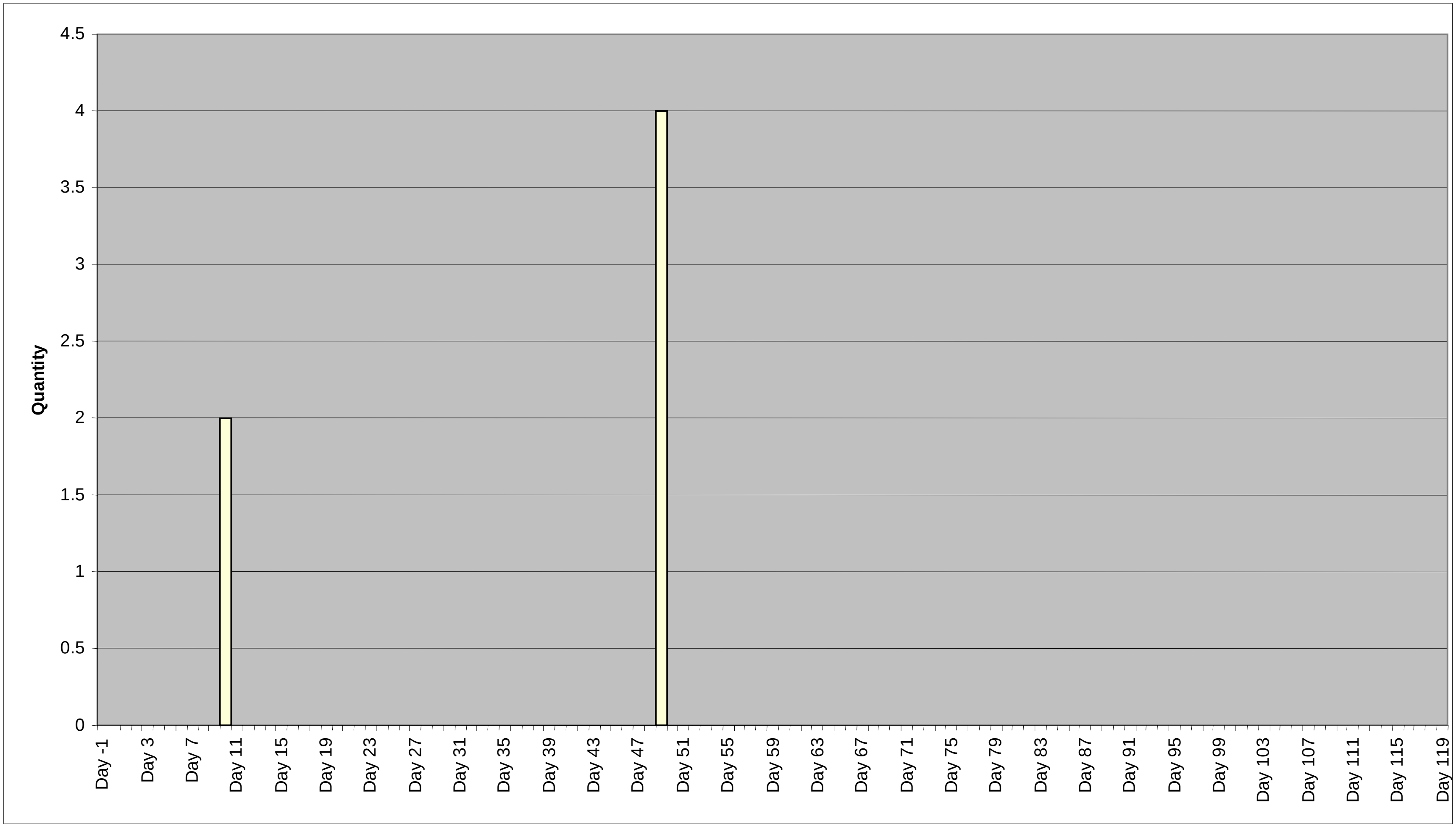


Figure B-8. Quantity of Floating Craft Arriving at the Port of Hampton Roads

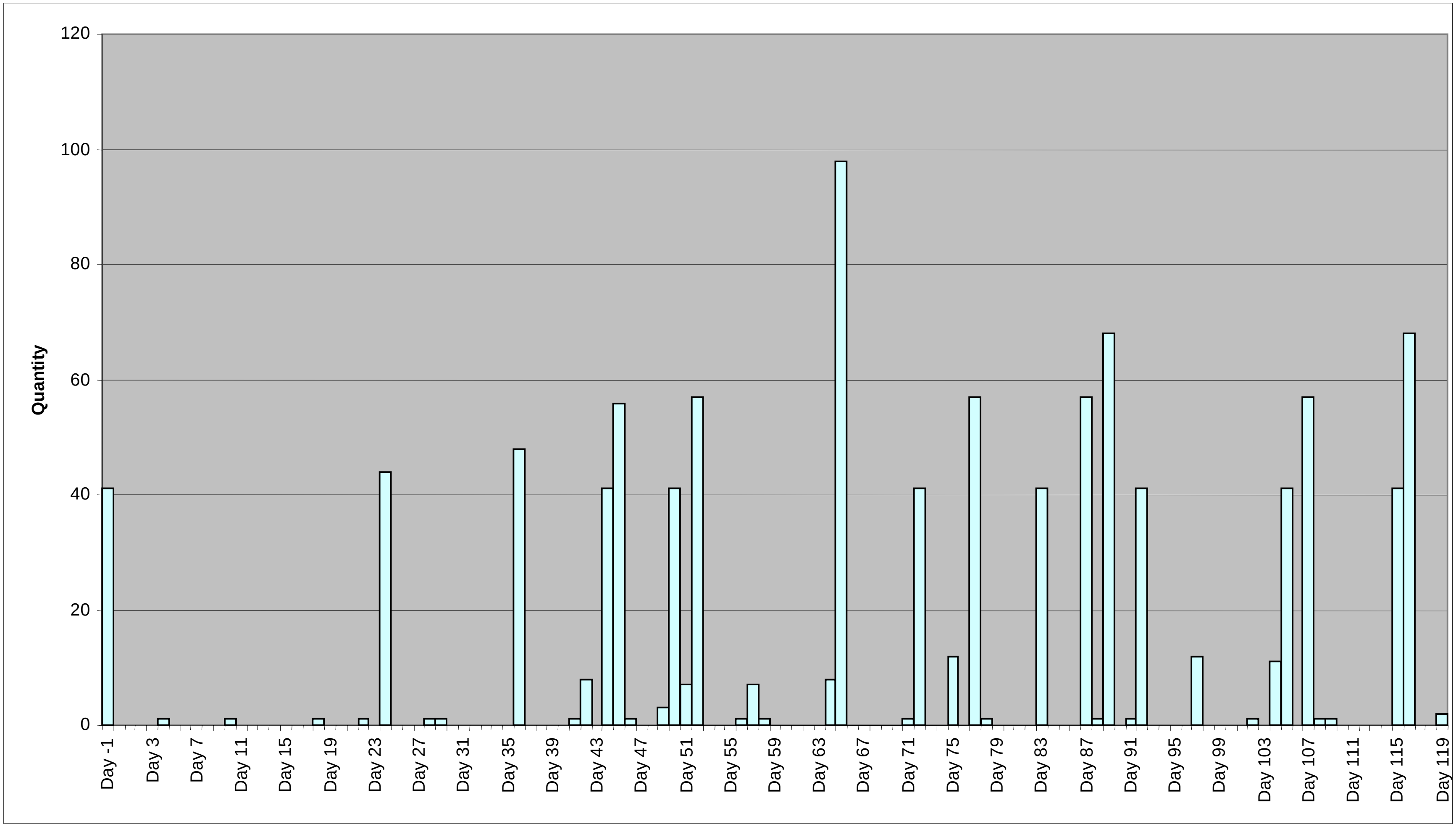


Figure B-9. Quantity of Containers Arriving at the Port of Hampton Roads

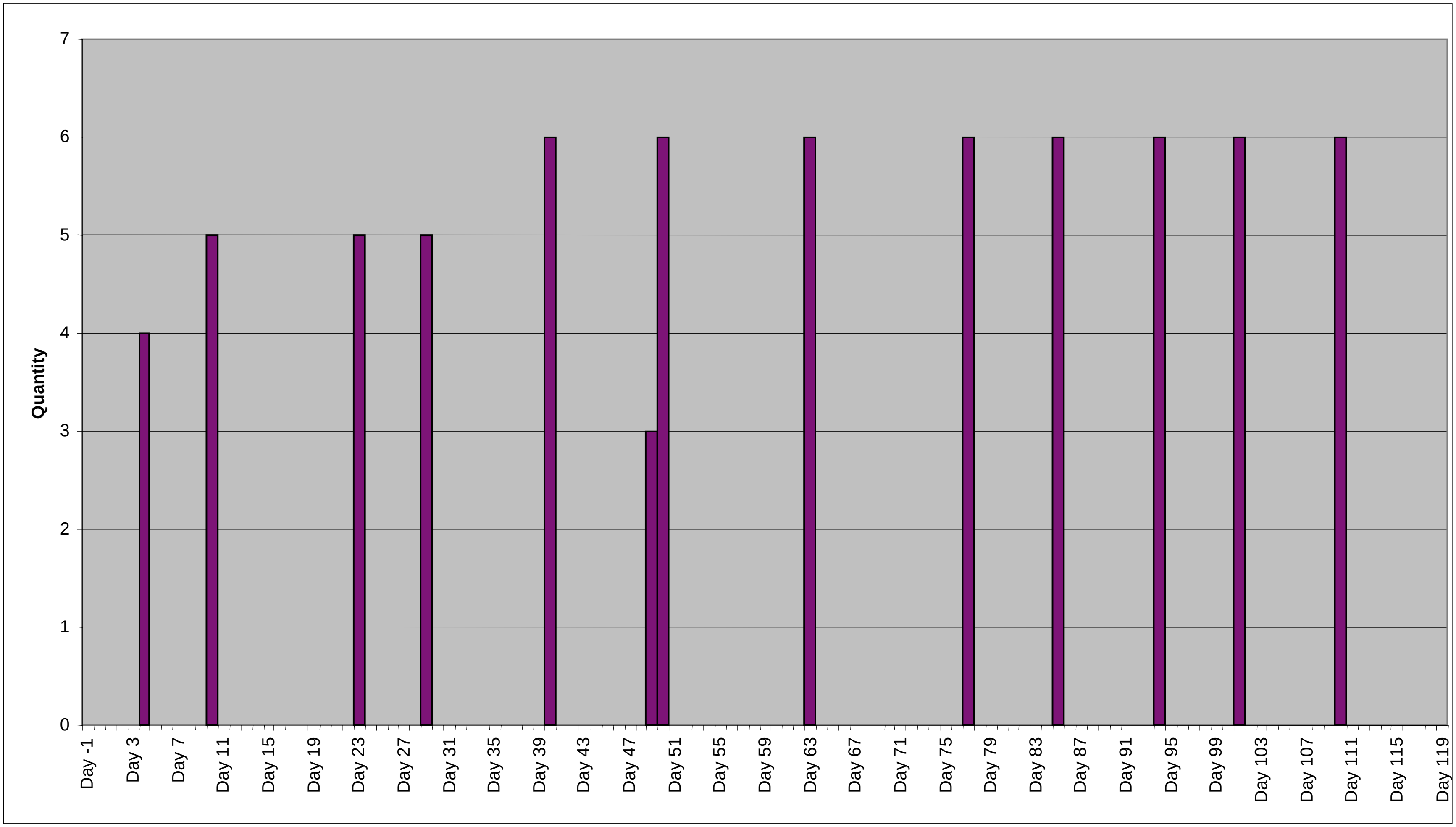


Figure B-10. Quantity of Breakbulk Cargo Items Arriving at the Port of Hampton Roads

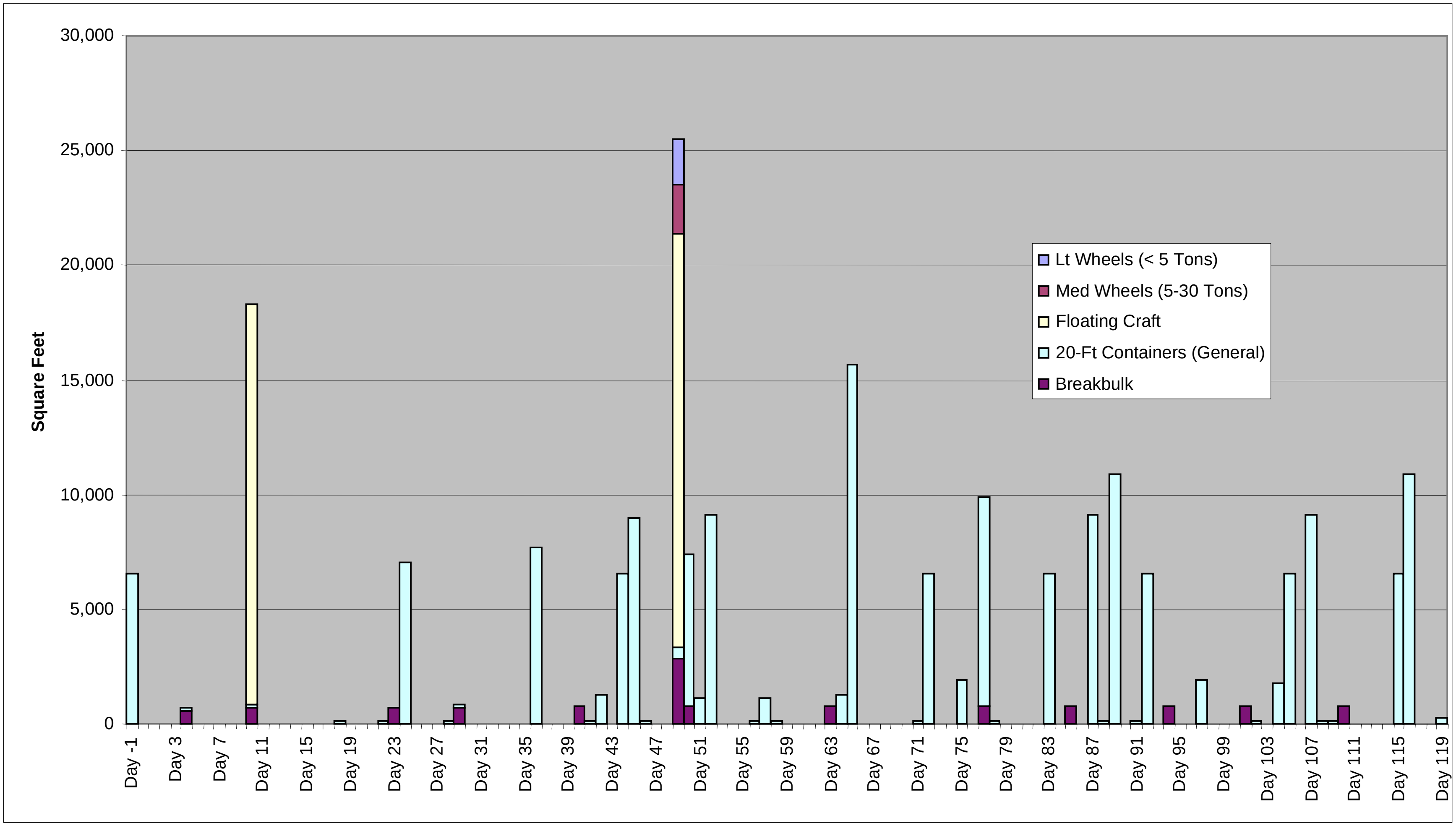


Figure B-11. Total Square Feet of Cargo Arriving at the Port of Hampton Roads

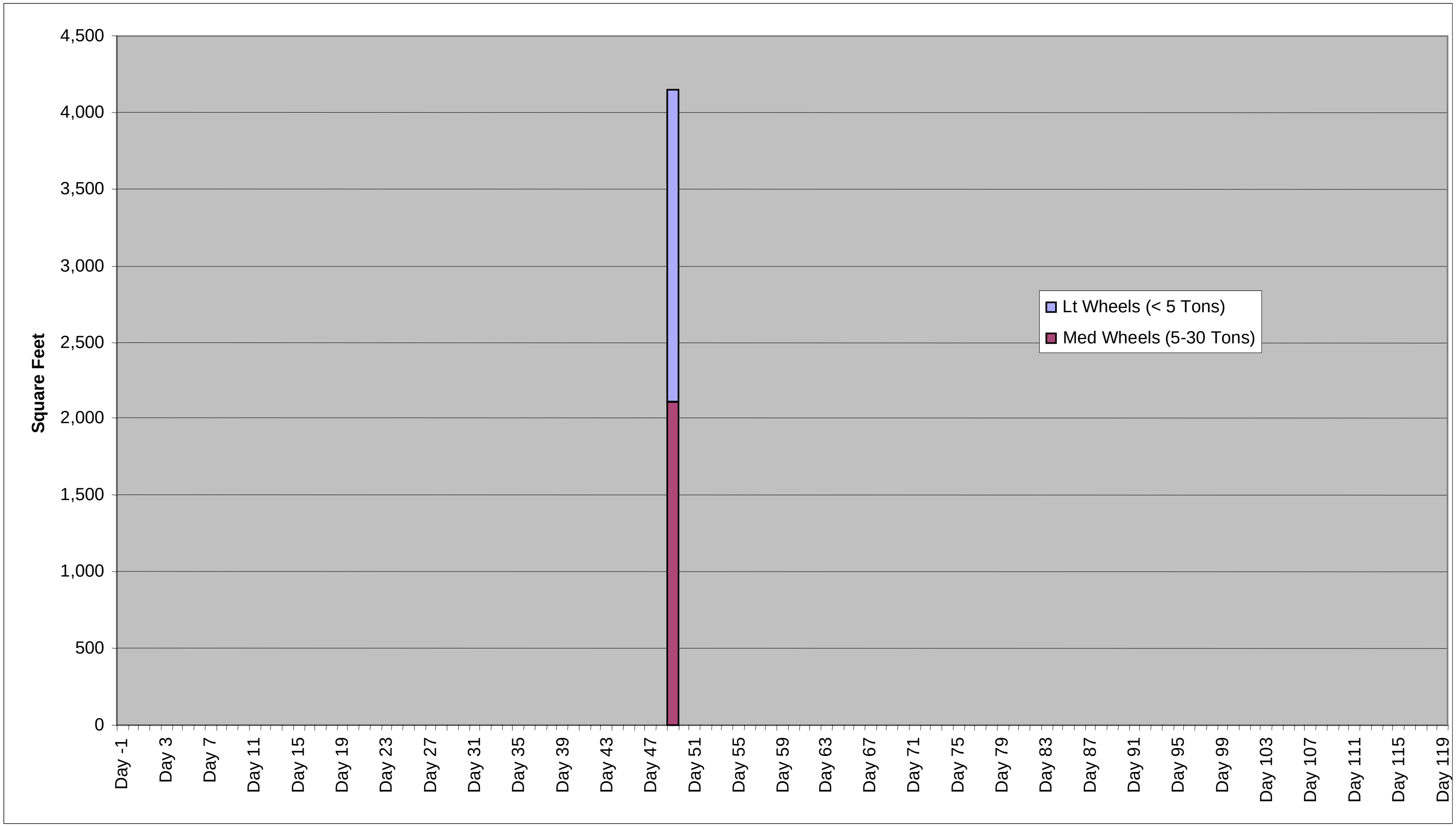


Figure B-12. Square Feet of Wheeled Vehicles Arriving at the Port of Hampton Roads

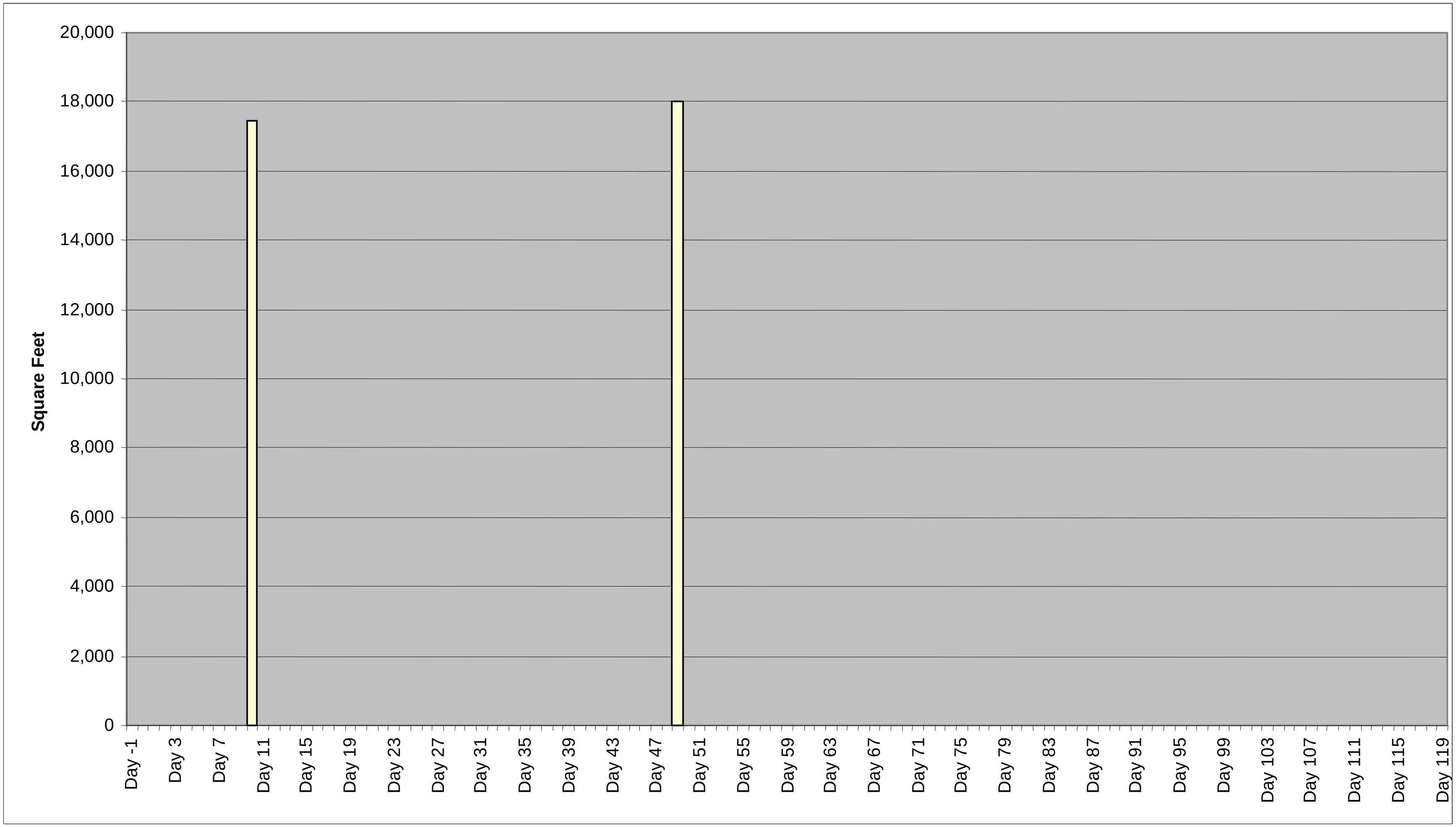


Figure B-13. Square Feet of Floating Craft Arriving at the Port of Hampton Roads

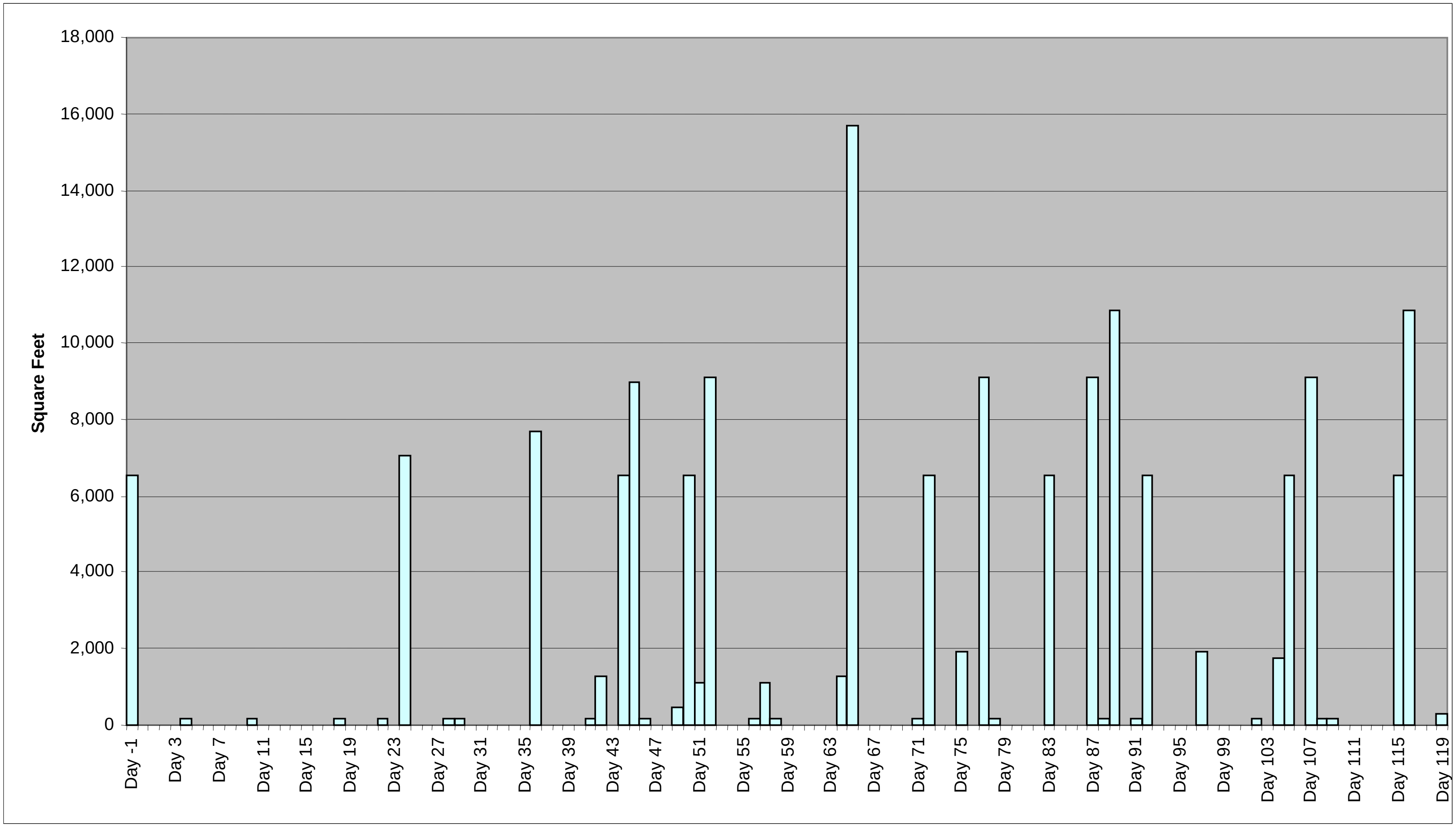


Figure B-14. Square Feet of Containers Arriving at the Port of Hampton Roads

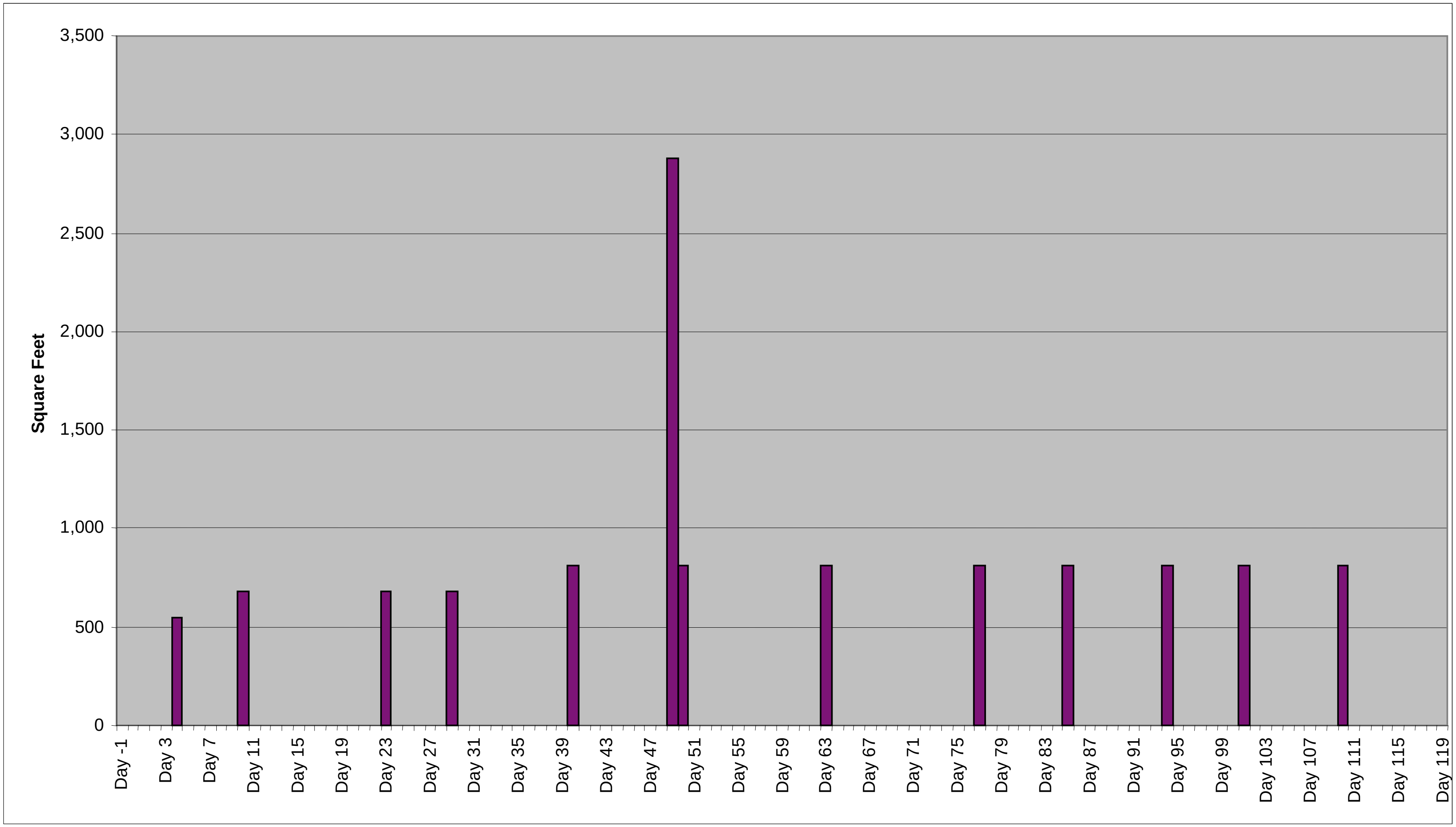


Figure B-15. Square Feet of Breakbulk Cargo Items Arriving at the Port of Hampton Roads

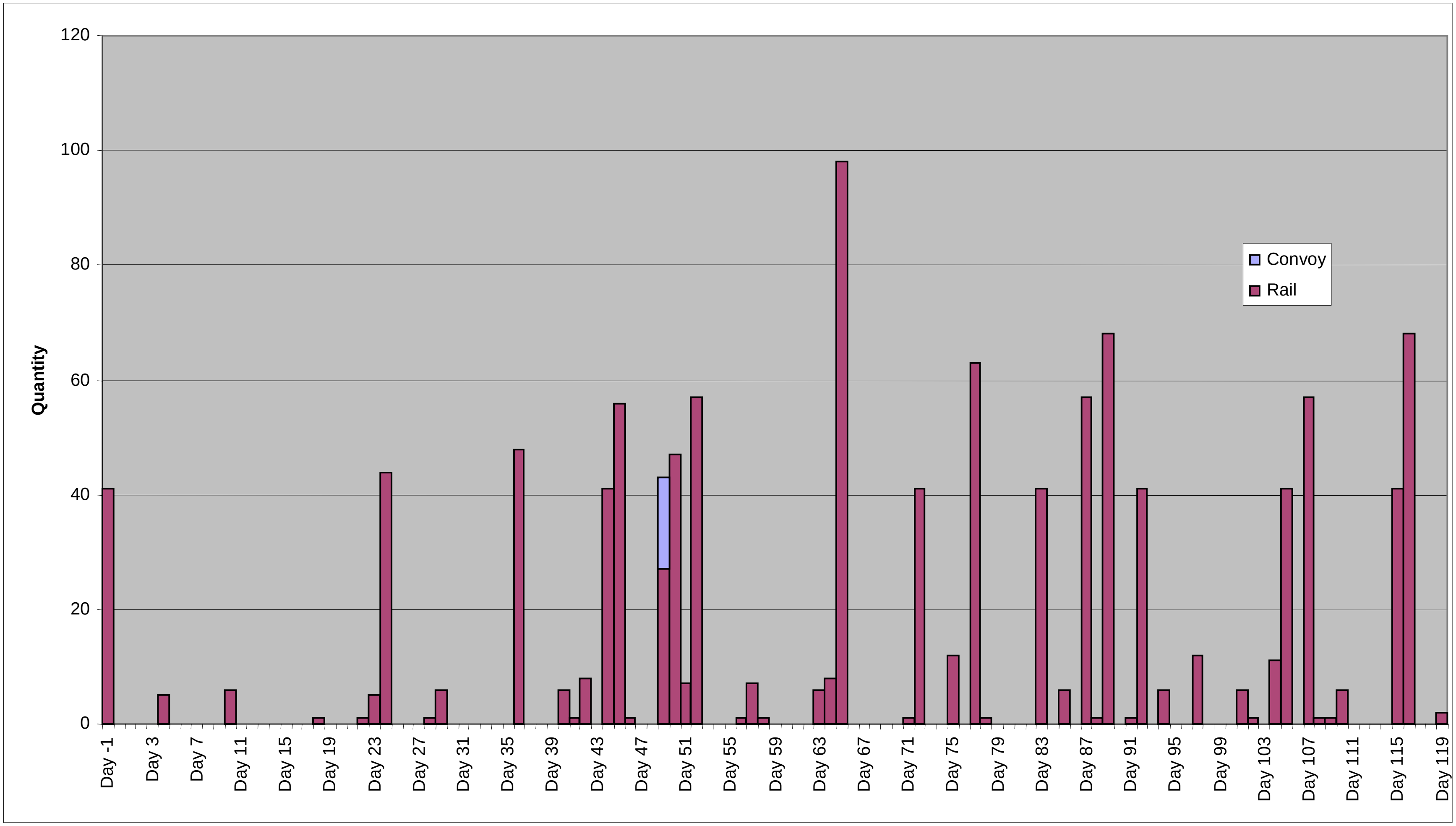


Figure B-16. Quantity of Cargo Items Arriving by Mode to the Port of Hampton Roads

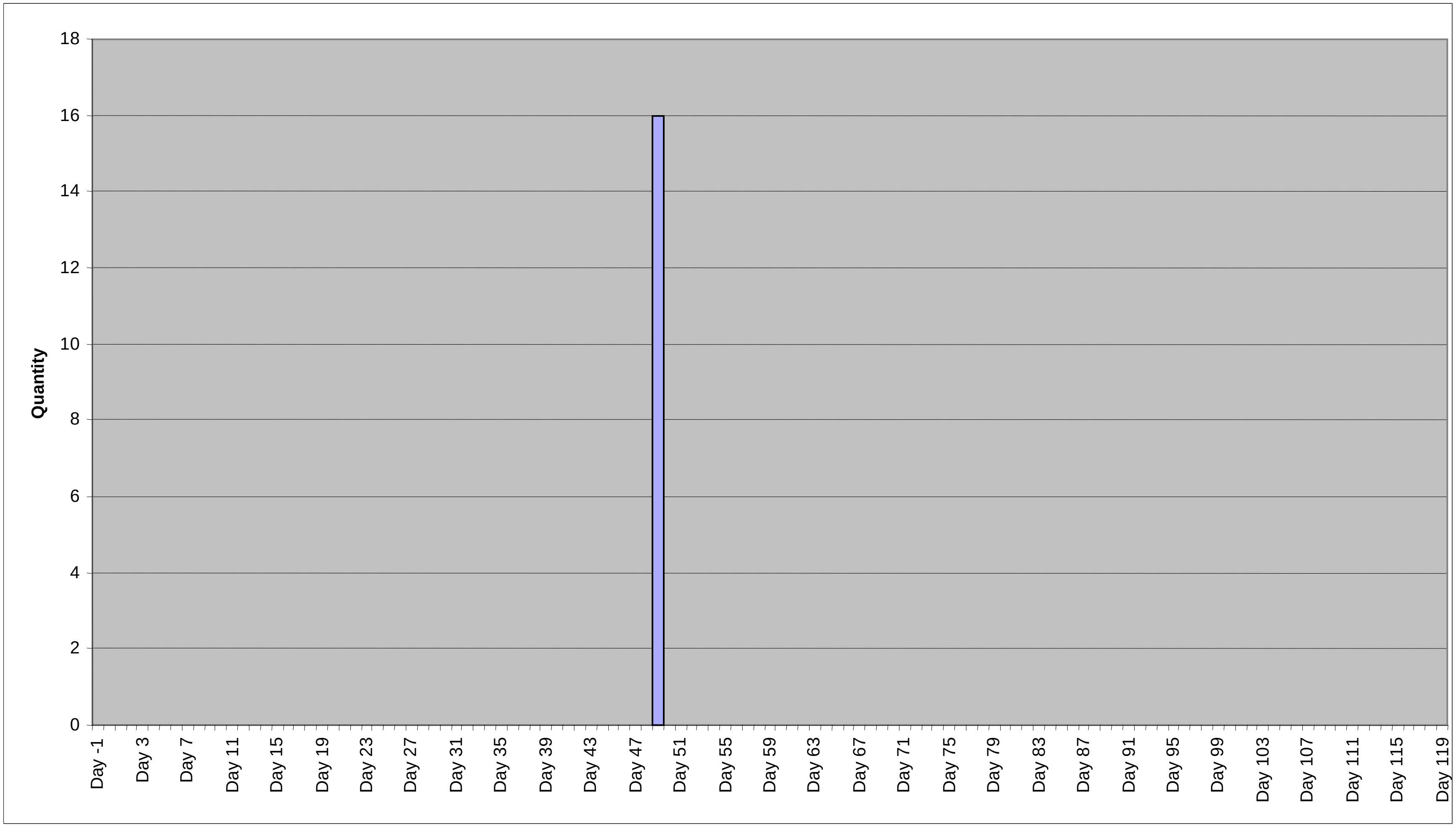


Figure B-17. Quantity of Wheeled Vehicles Convoying to the Port of Hampton Roads

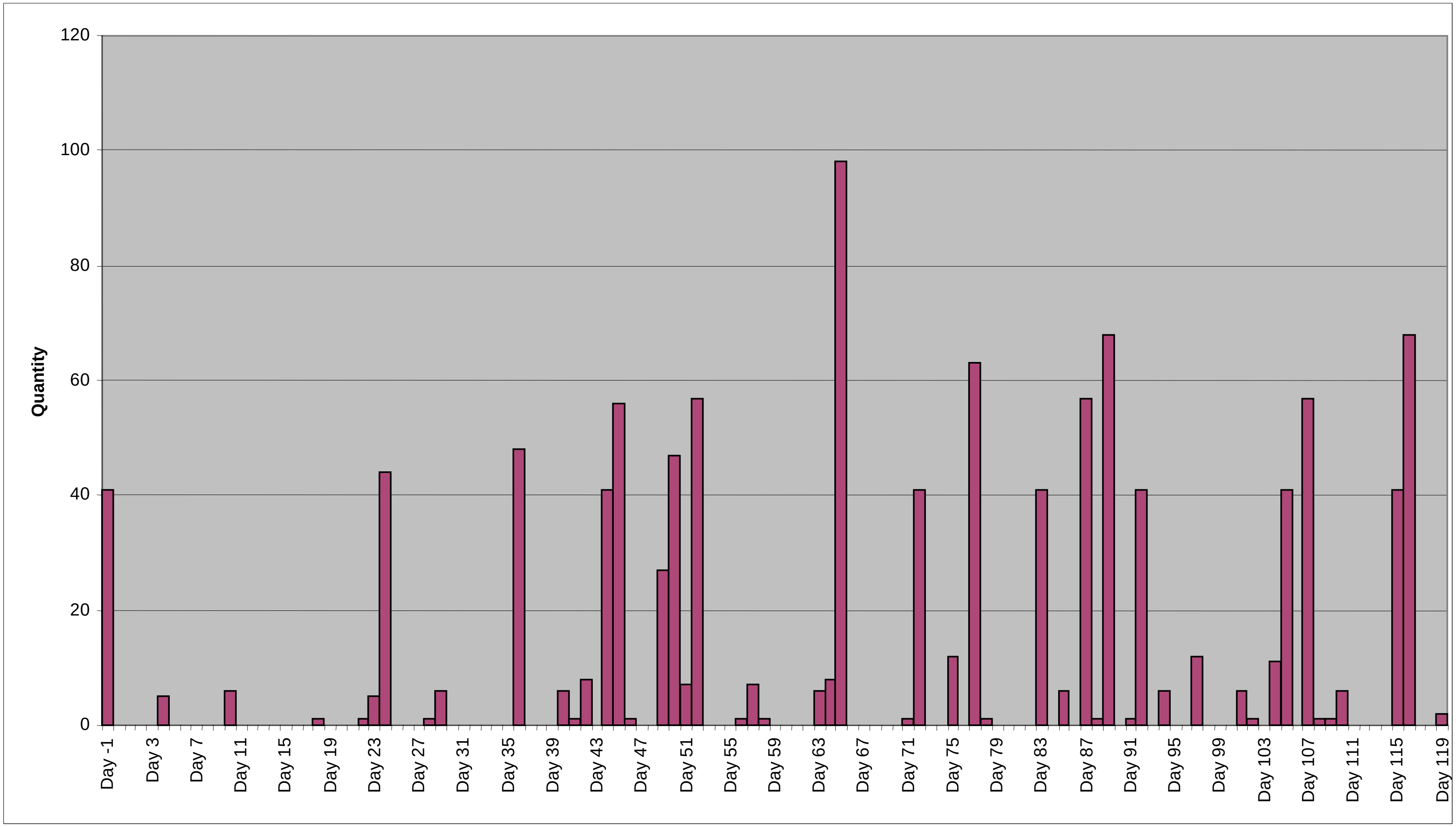


Figure B-18. Quantity of Items Arriving by Rail to the Port of Hampton Roads

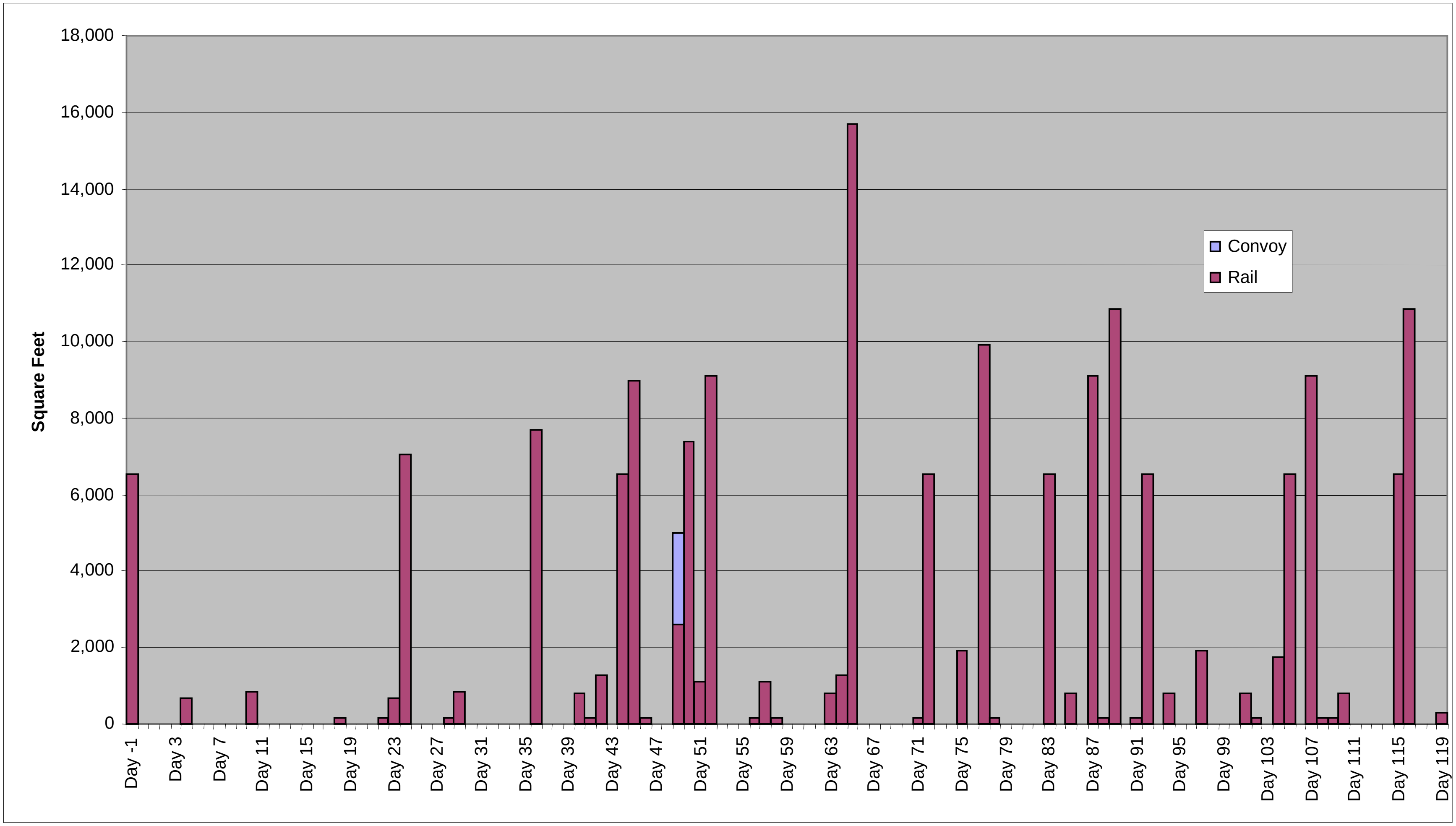


Figure B-19. Square Feet of Cargo Items Arriving by Mode to the Port of Hampton Roads

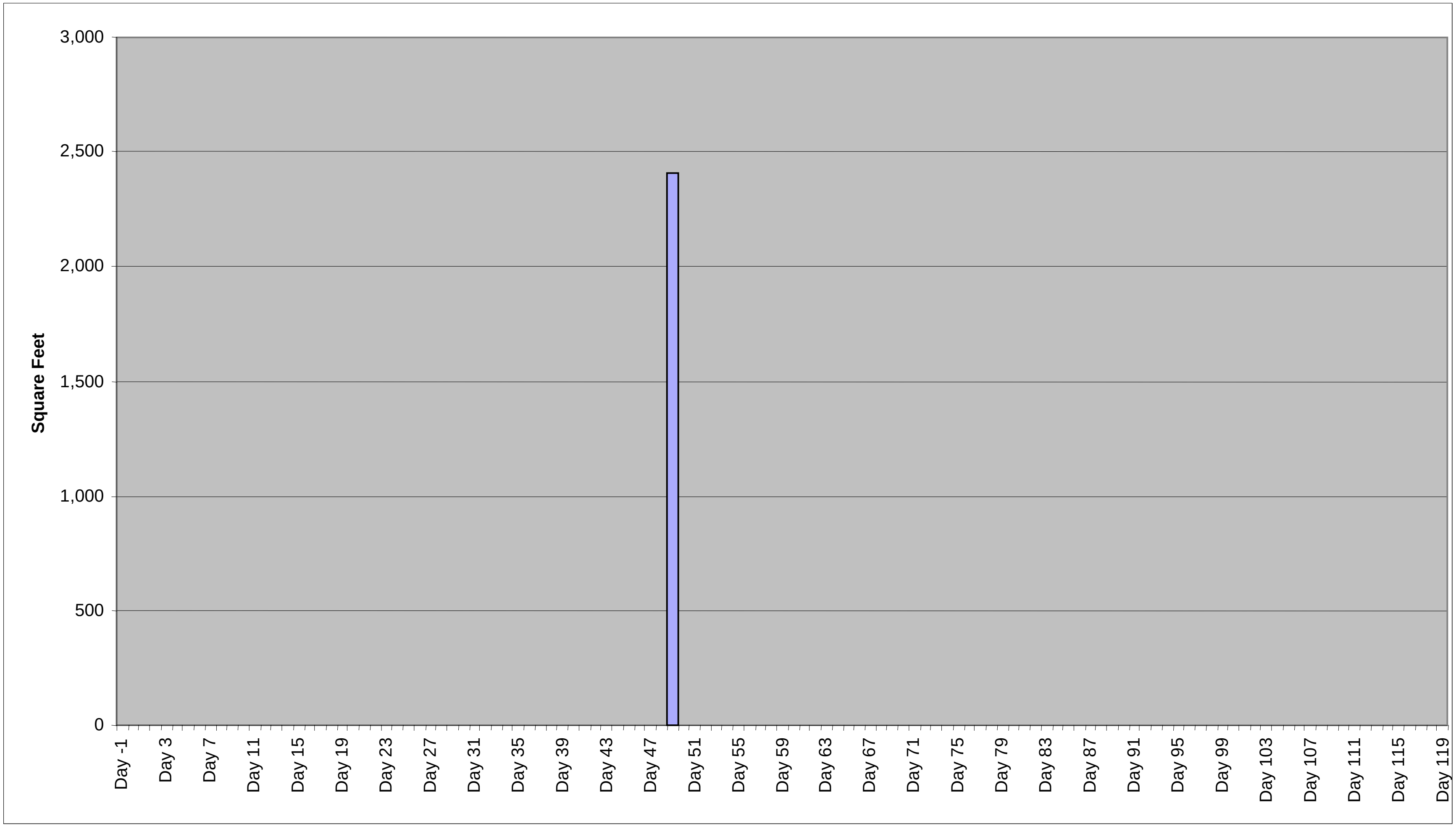


Figure B-20. Square Feet of Wheeled Vehicles Convoying to the Port of Hampton Roads

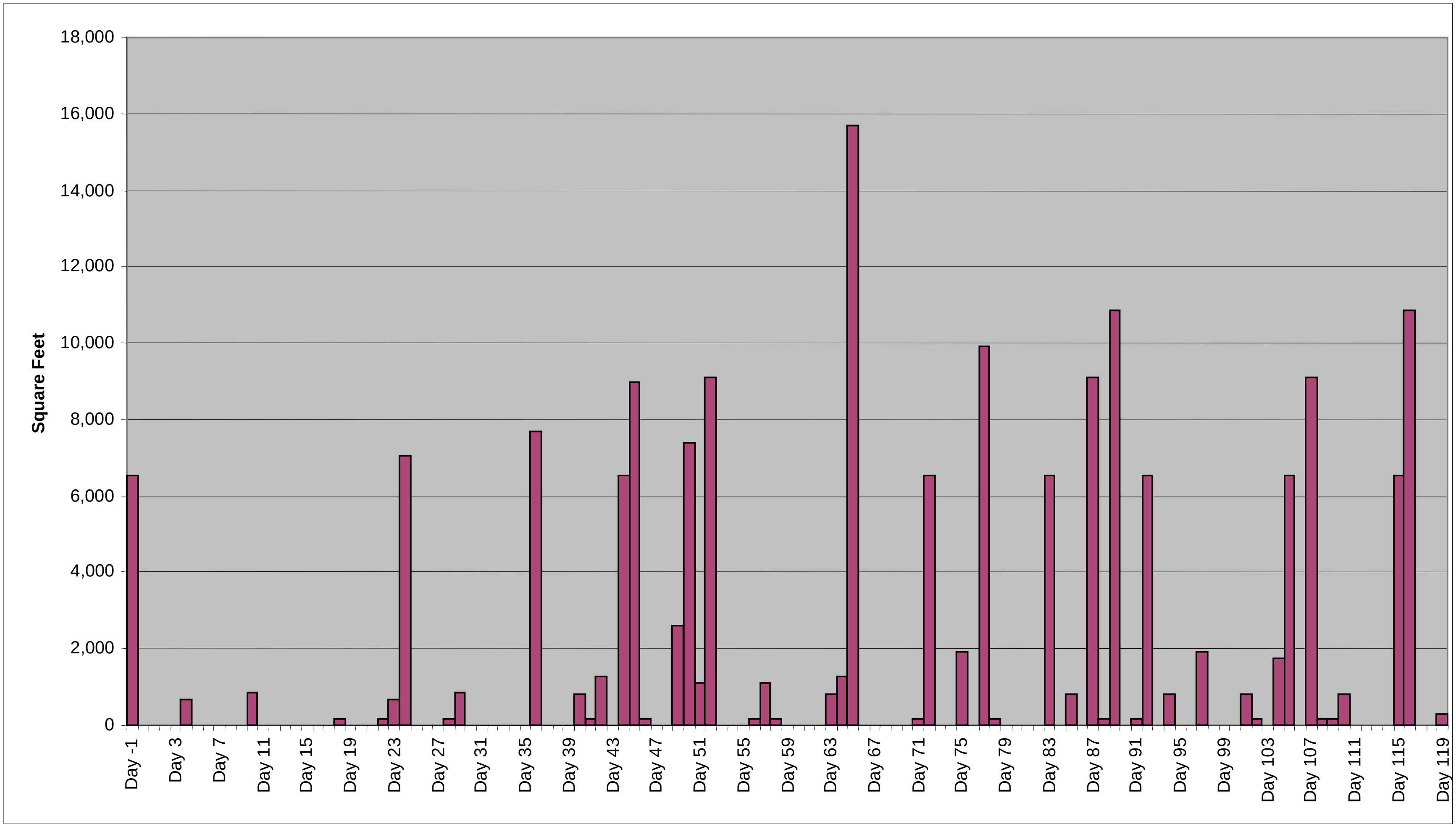


Figure B-21. Square Feet of Cargo Items Arriving by Rail to the Port of Hampton Roads

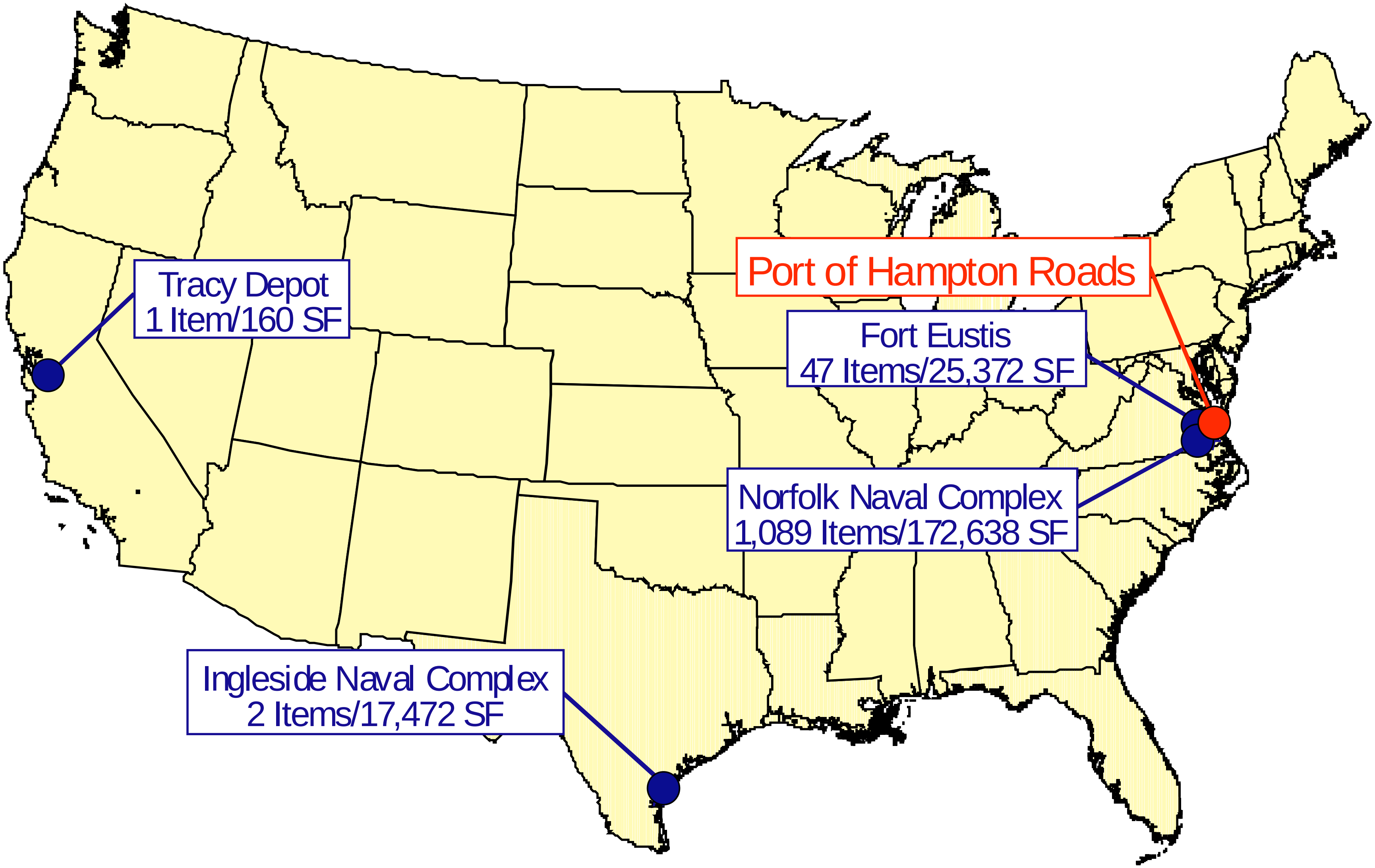


Figure B-22. Amount of Cargo Arriving at the Port of Hampton Roads by Origin

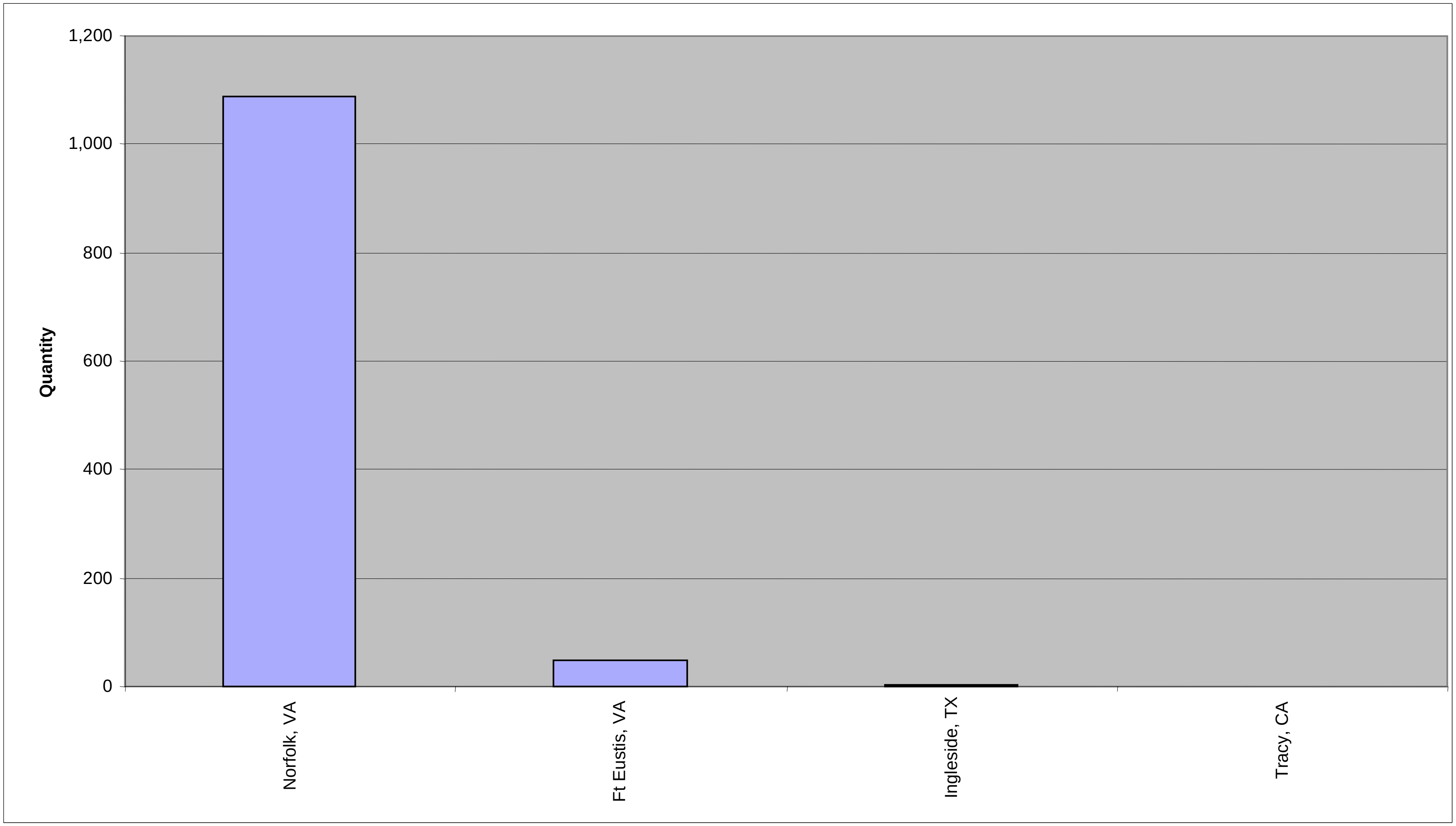


Figure B-23. Quantity of Items Arriving at the Port of Hampton Roads by Origin

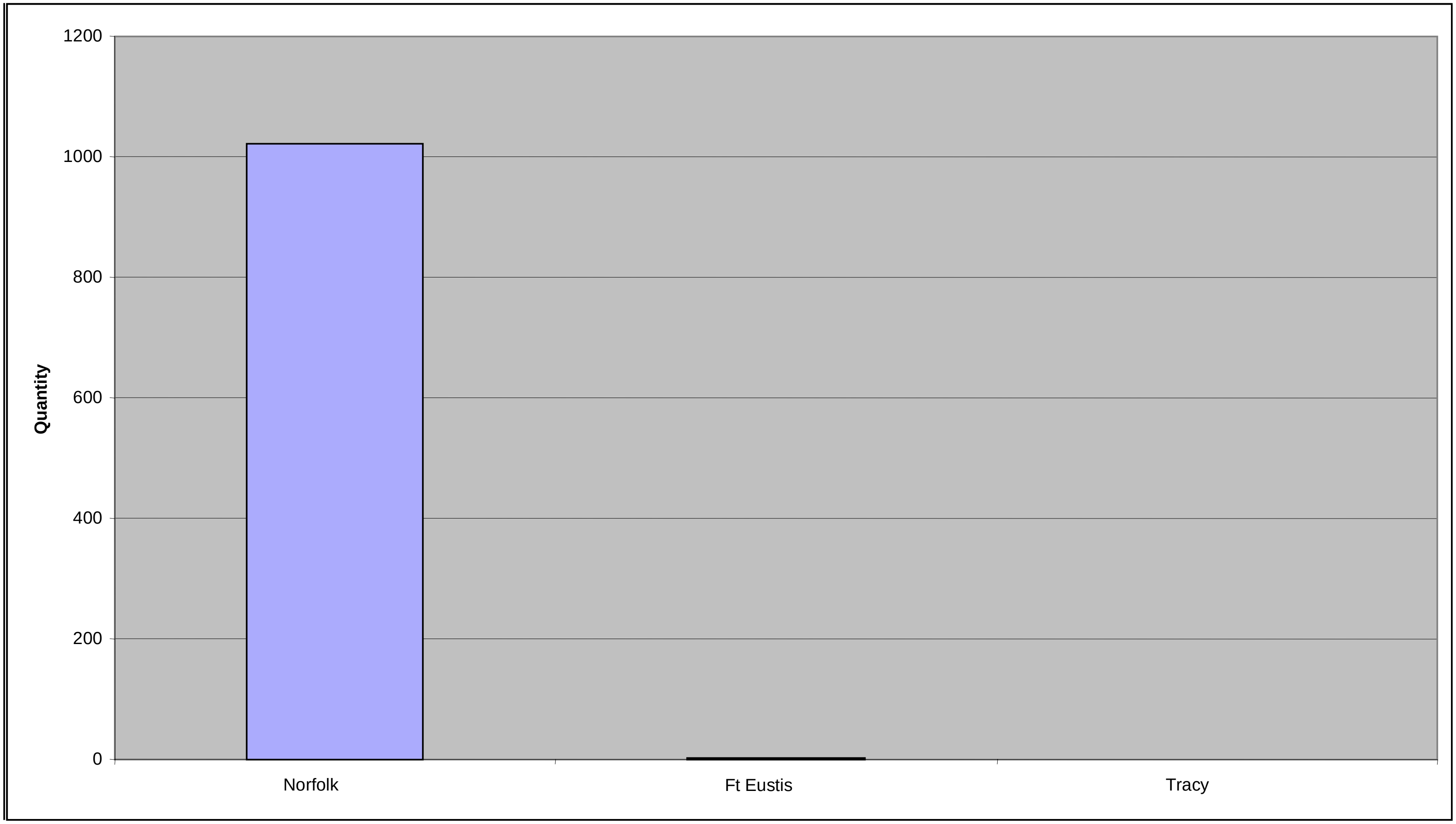


Figure B-24. Quantity of Containers Arriving at the Port of Hampton Roads by Origin

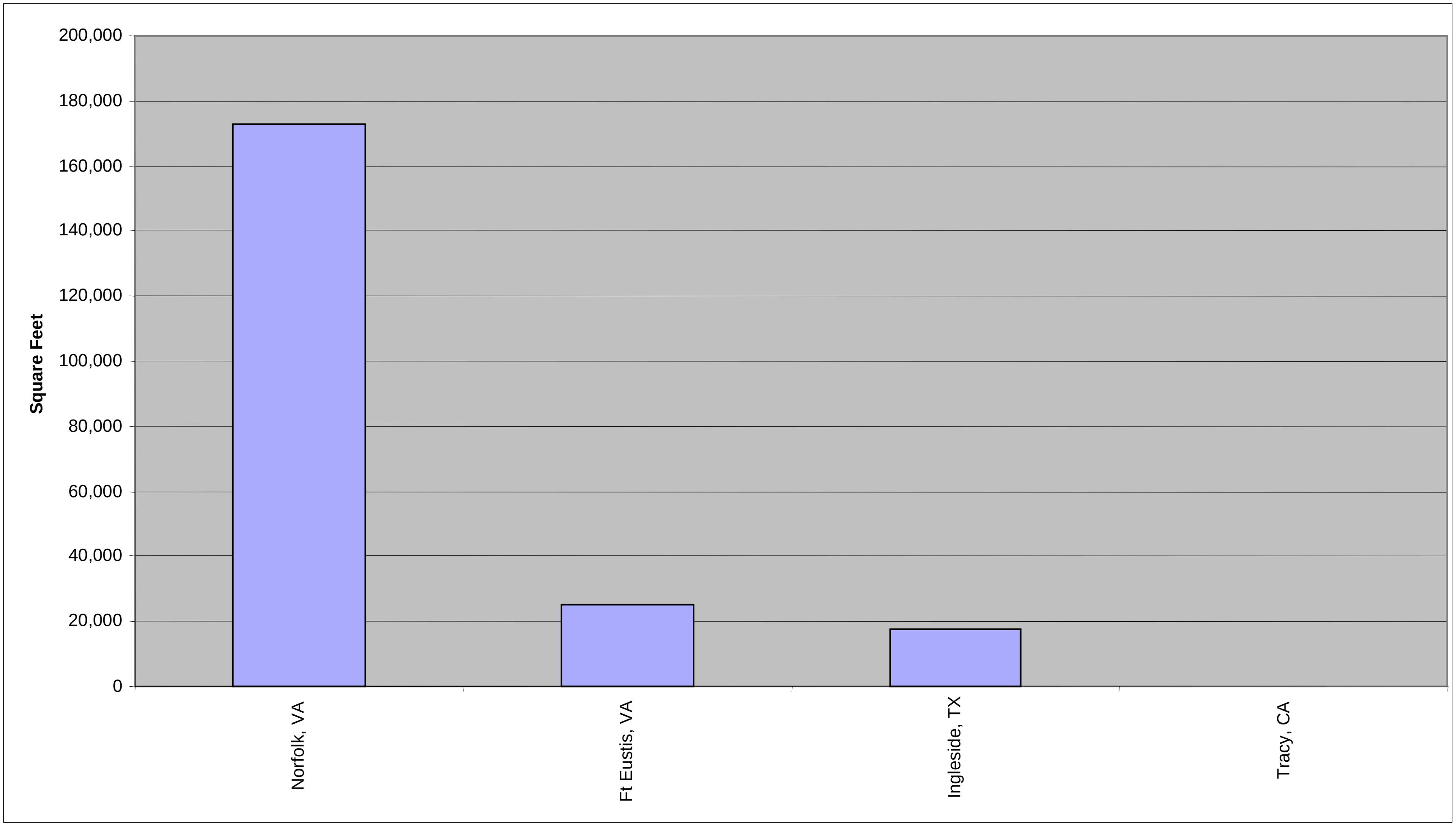
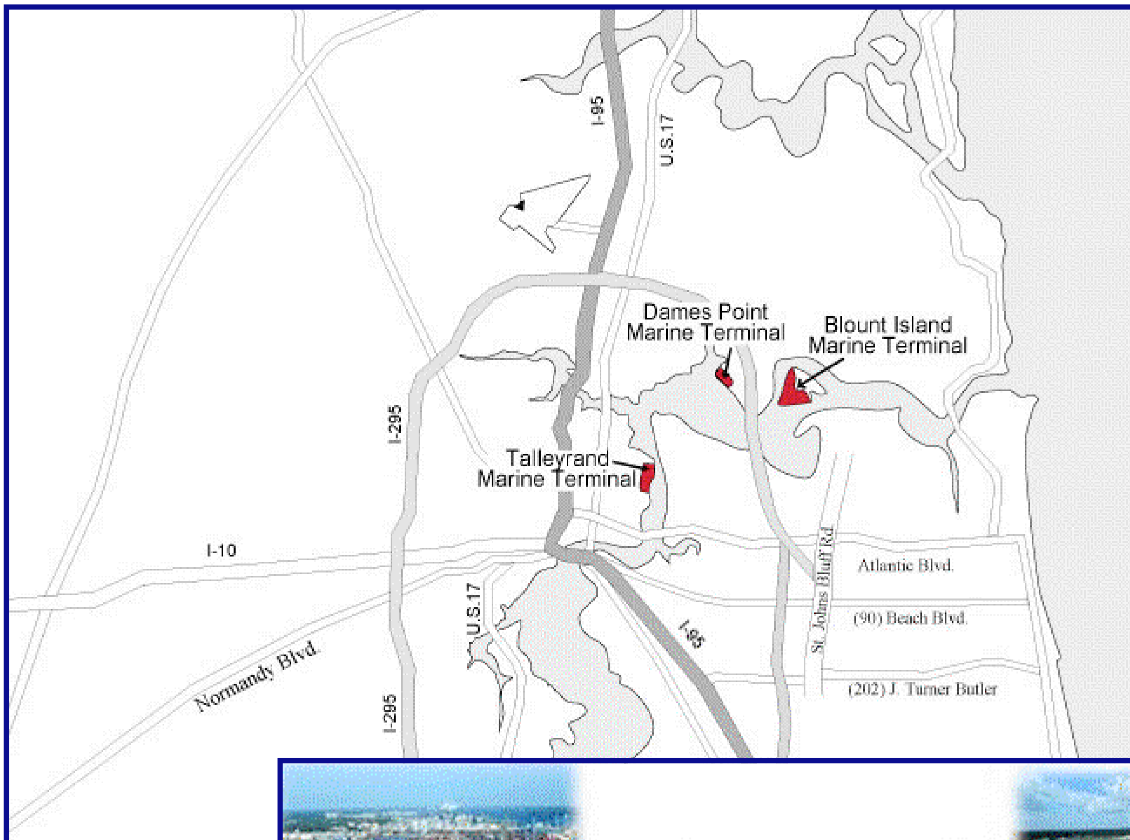


Figure B-25. Square Feet of Cargo Arriving at the Port of Hampton Roads by Origin

APPENDIX C

PORT OF JACKSONVILLE



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According to the TPFDD, there are three origins sending cargo to the Port of Jacksonville. These origins are shown in Figure C-1. Jacksonville receives a mix of Army, Navy, Air Force, and Marine Corps cargo. Origins in excess of 400 miles send all of their cargo to the Port of Jacksonville by rail. Origins within 400 miles convoy their roadable vehicles to the port and send everything else by rail. All aircraft self-deploy to the port. Figures C-2 through C-5 show the quantity of transports (containers, railcars, and self-deploying aircraft) required to move to the Port of Jacksonville.

Figures C-6 through C-11 illustrate the quantity of items arriving at the port. Figure C-6 is the total quantity of items. Figures C-7 through C-11 break this down into more detail. Figures C-7 and C-8 are the quantity of vehicles arriving at the port. Figure C-7 outlines the wheeled vehicles and Figure C-8 lays out the tracked vehicles. Figure C-9 shows the quantity of aircraft arriving at the port. These are mostly helicopters, and all self move to the port under their own power. Figures C-10 and C-11 outline the number of containers and breakbulk cargo items, respectively, arriving at the port.

Similar to Figures C-6 through C-11, which lay out the quantity of items arriving, Figure C-12 through C-17 outline the square footage of these categories of cargo.

Figures C-18 through C-23 show how cargo is arriving at the Port of Jacksonville. Figures C-18 through C-20 show the number of cargo items arriving by rail, or self-deploying. Figures C-21 through C-23 show the square footage of cargo arriving by each mode.

As shown earlier, cargo arrives at the Port of Jacksonville from many origins. Figure C-24 shows visually the amount of cargo coming from each origin.

Figures C-25 and C-27 show the quantity and square footage, respectively, of cargo arriving at the Port of Jacksonville by origin. Figure C-26 is the quantity of containers arriving at the Port of Jacksonville from each origin.

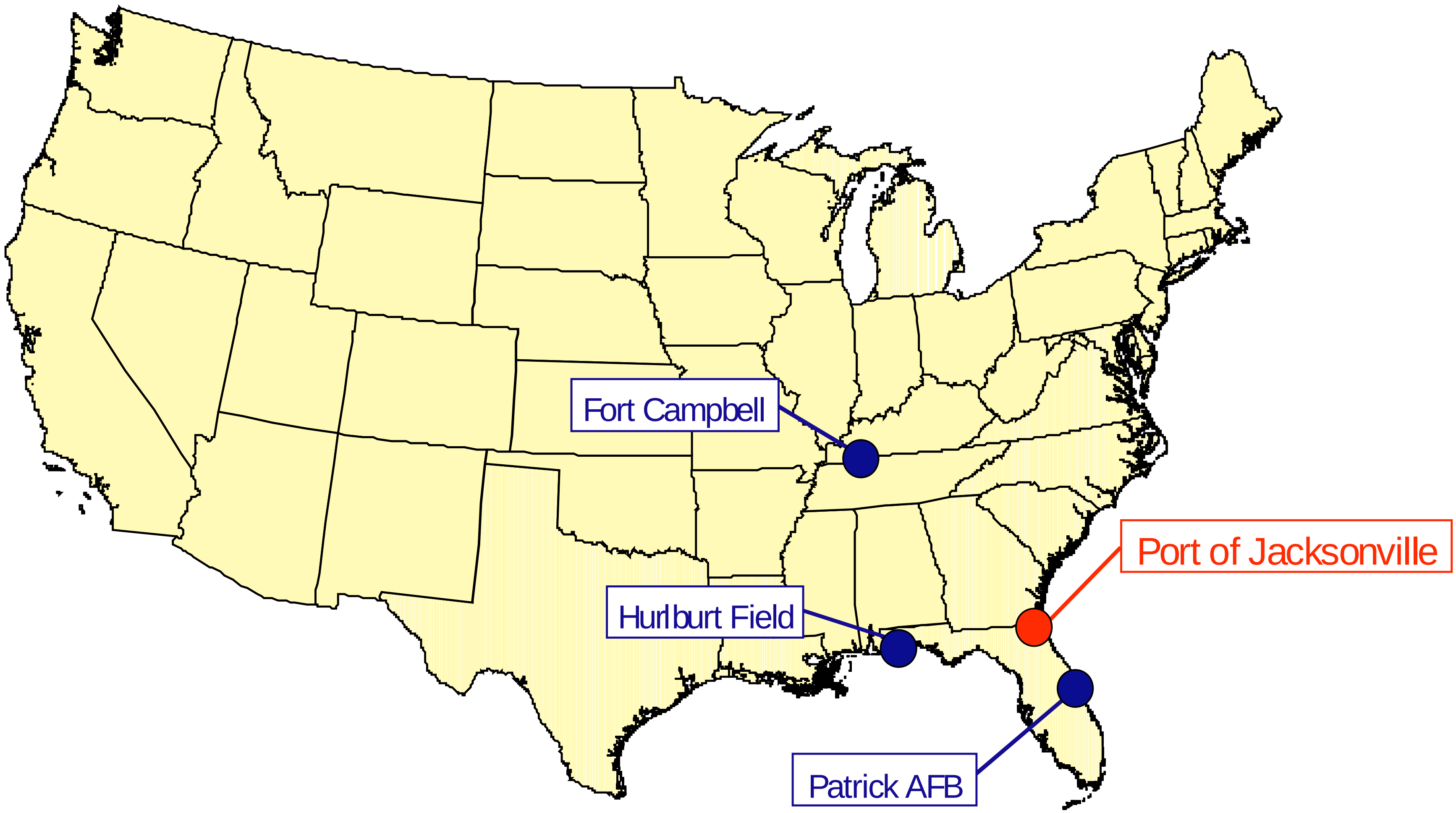


Figure C-1. Cargo Arrives at the Port of Jacksonville from Many Origins

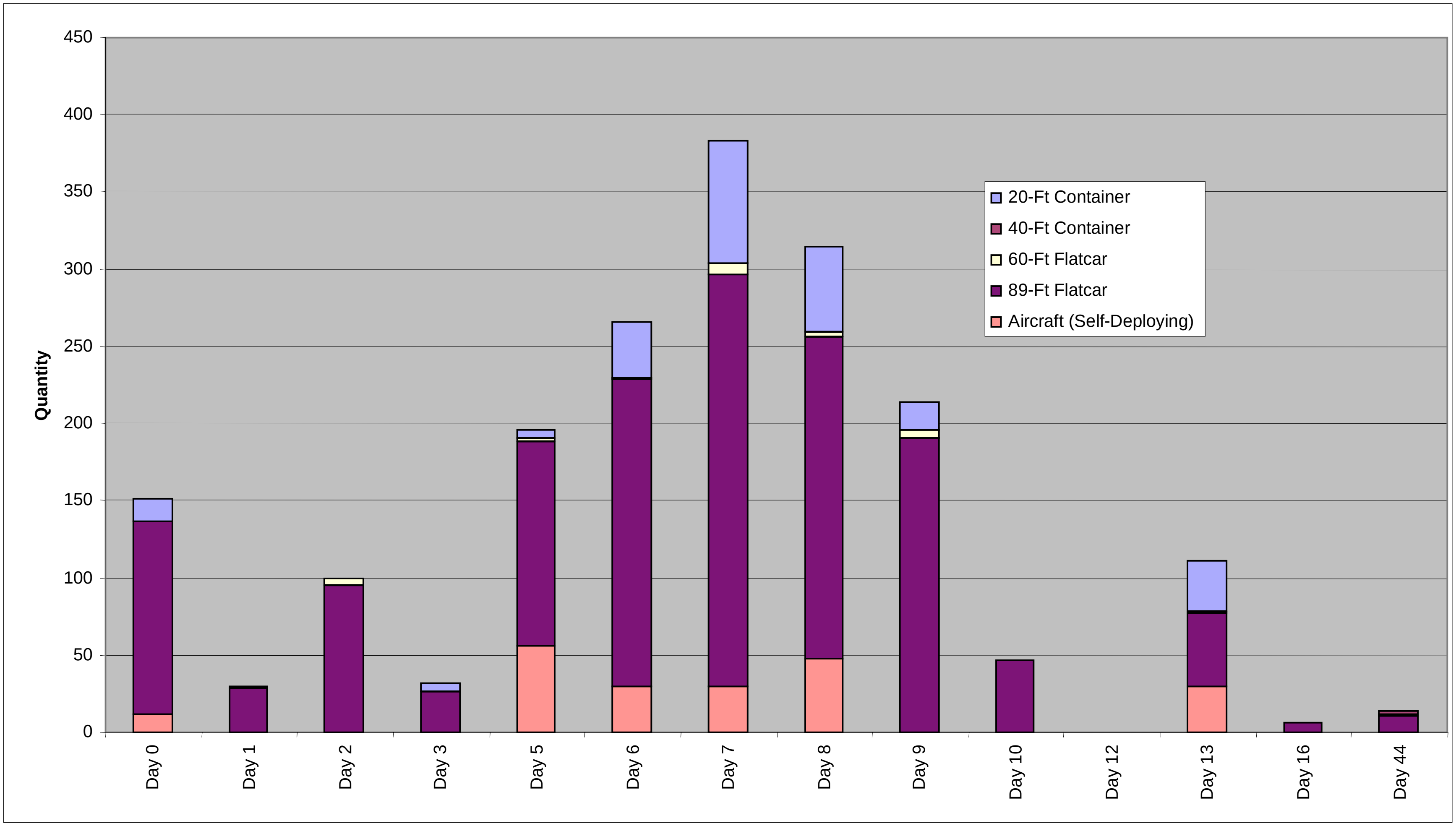


Figure C-2. Total Quantity of Transports Arriving at the Port of Jacksonville

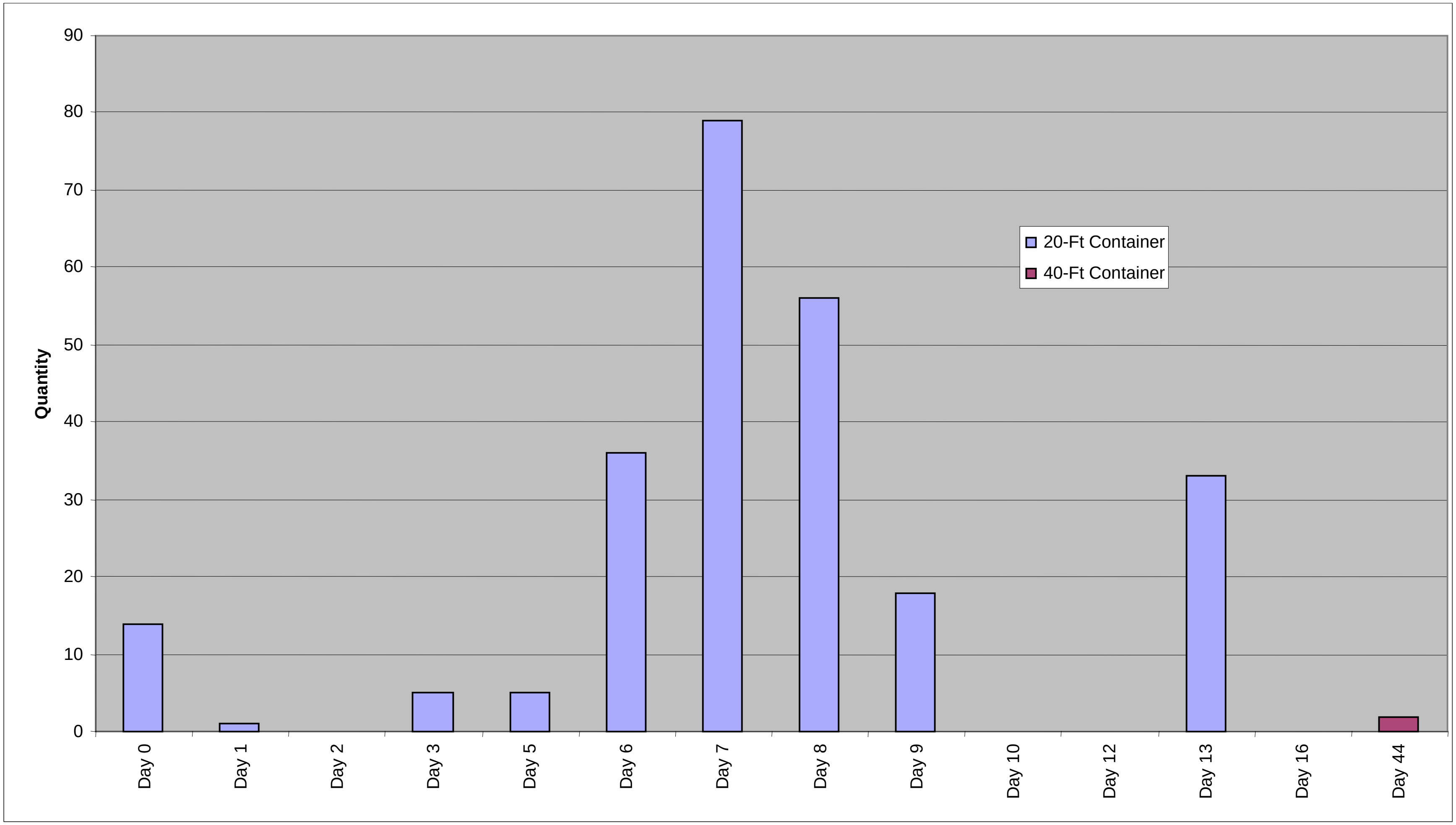


Figure C-3. Quantity of Containers Arriving at the Port of Jacksonville

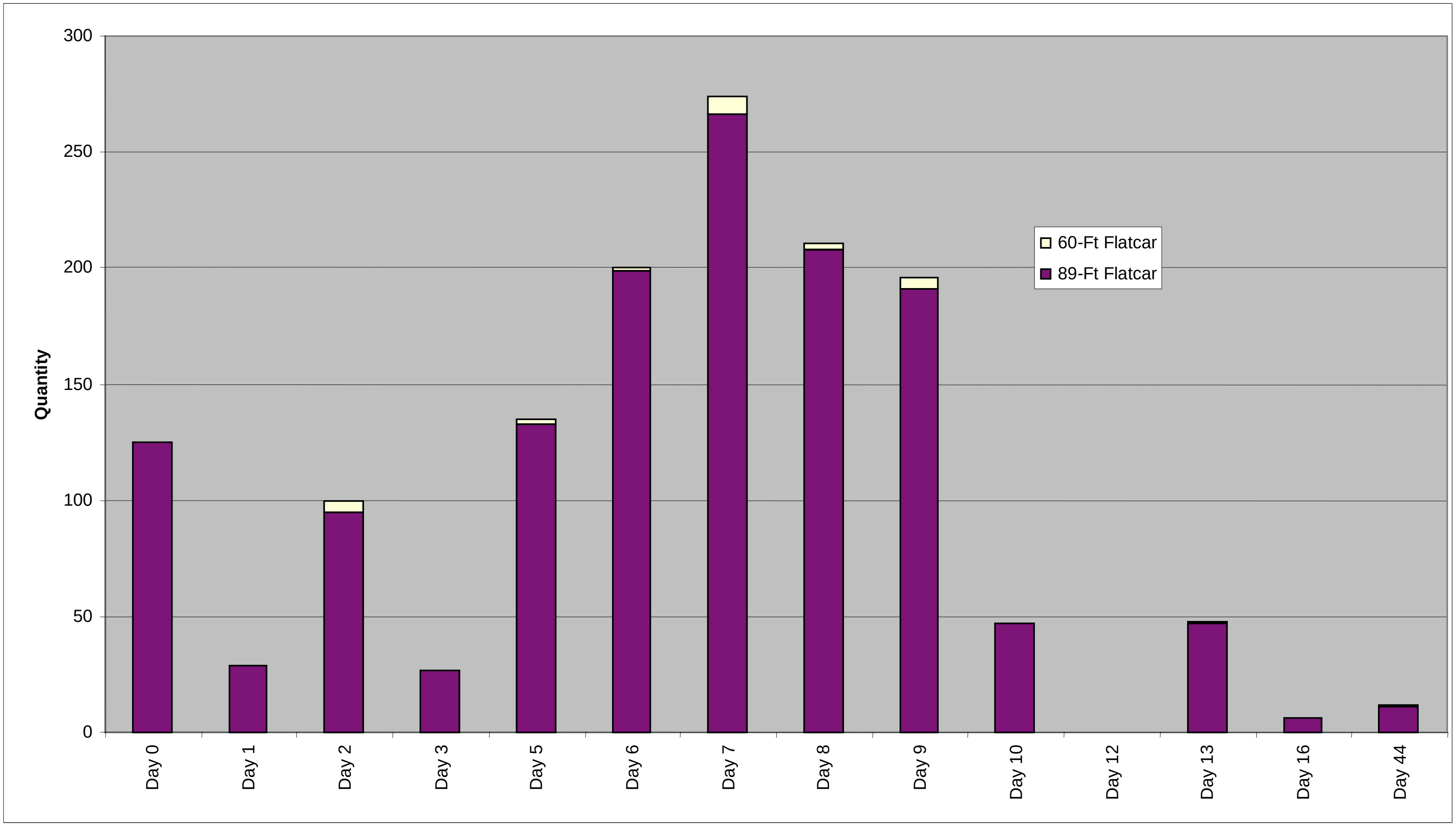


Figure C-4. Quantity of Railcars Arriving at the Port of Jacksonville

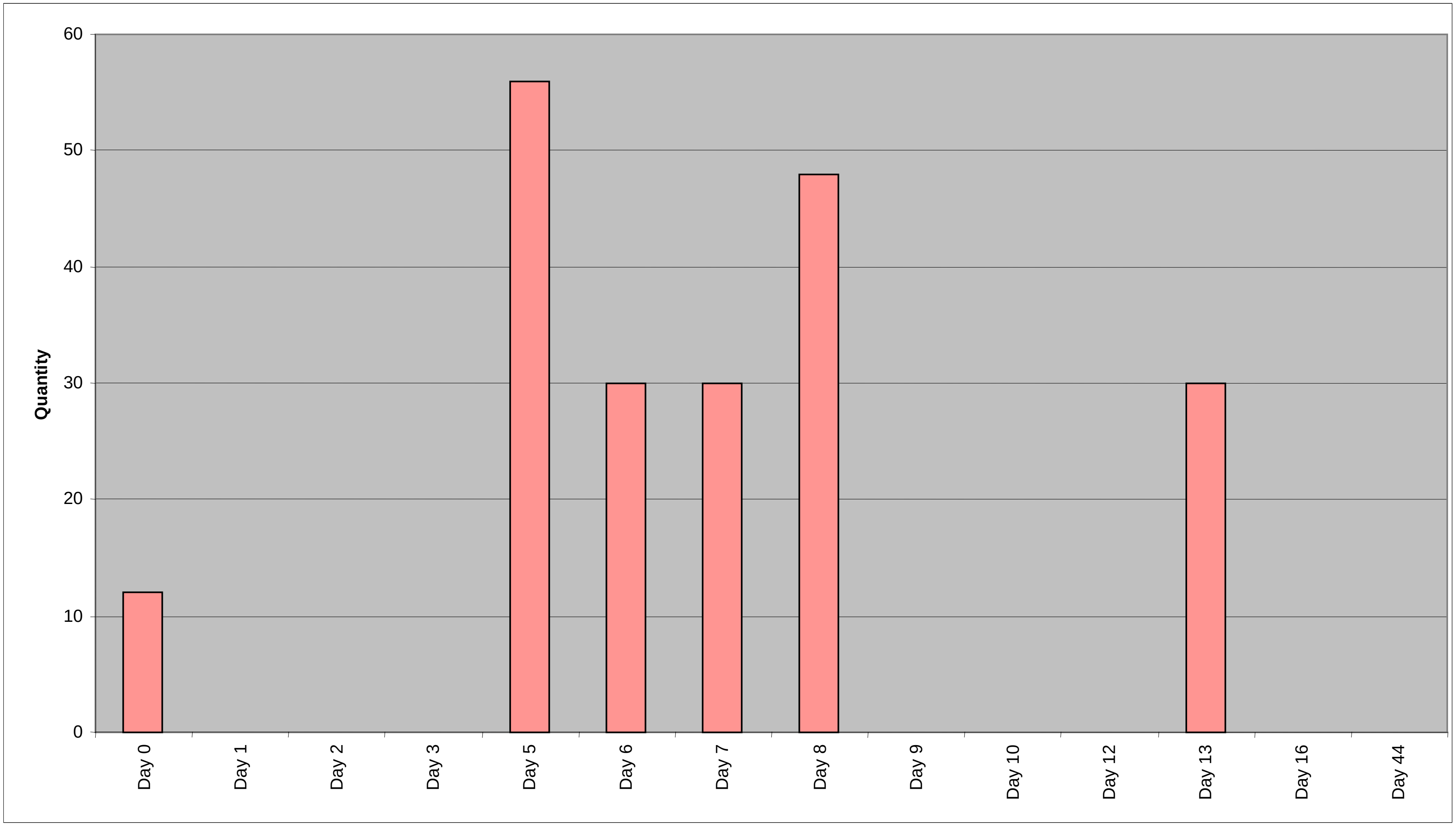


Figure C-5. Quantity of Aircraft Arriving at the Port of Jacksonville

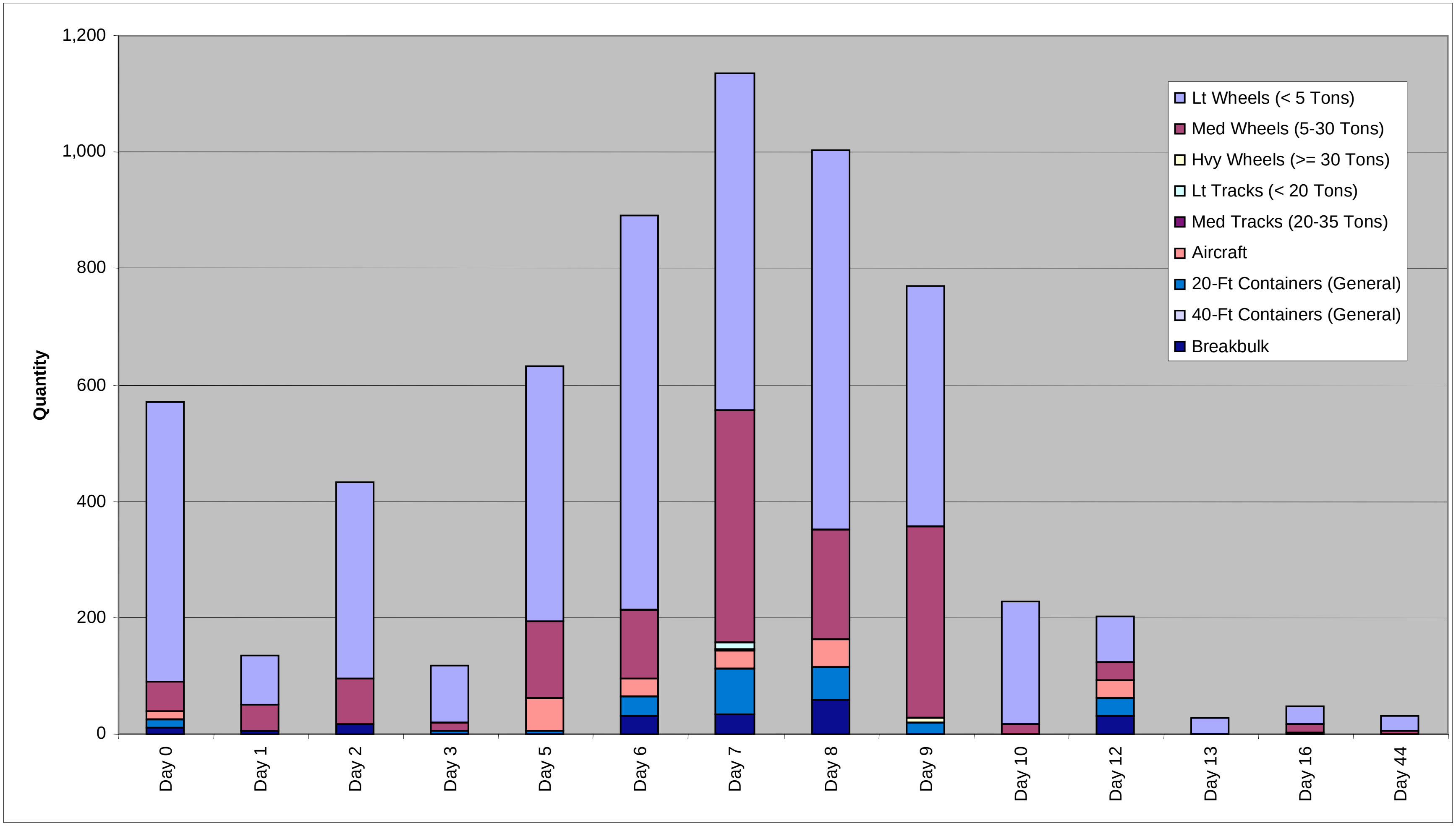


Figure C-6. Total Quantity of Cargo Items Arriving at the Port of Jacksonville

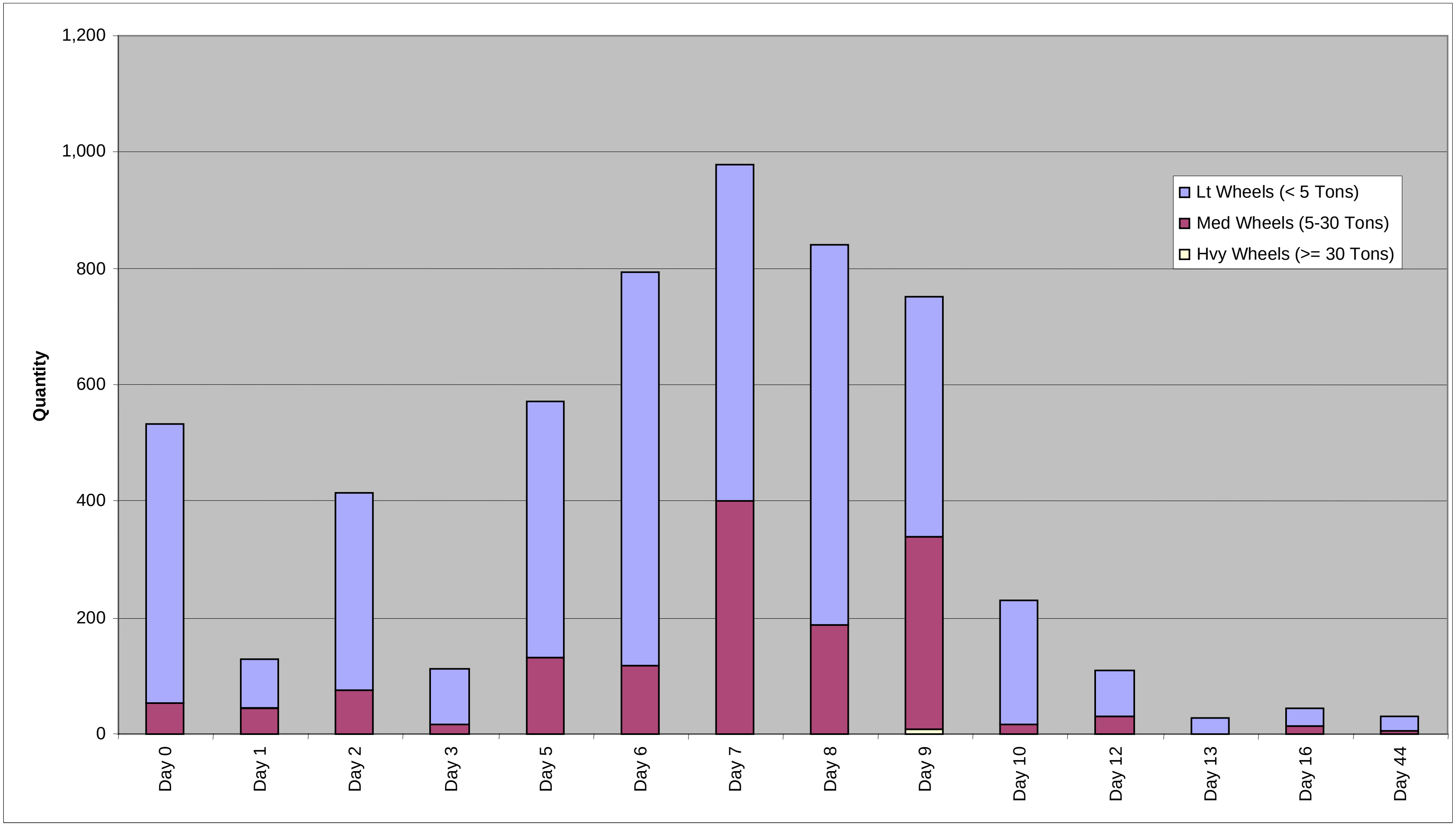


Figure C-7. Quantity of Wheeled Vehicles Arriving at the Port of Jacksonville

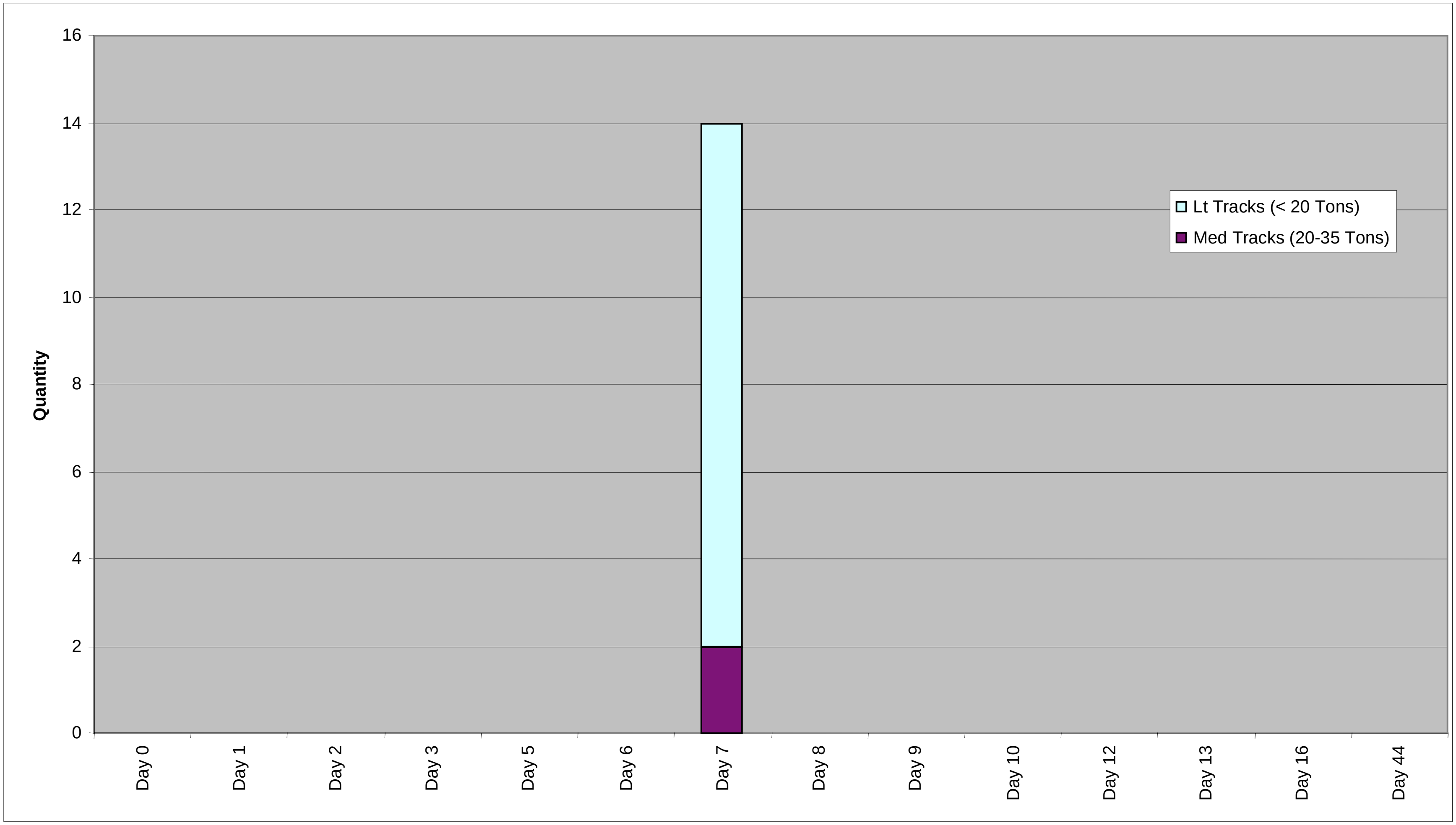


Figure C-8. Quantity of Tracked Vehicles Arriving at the Port of Jacksonville

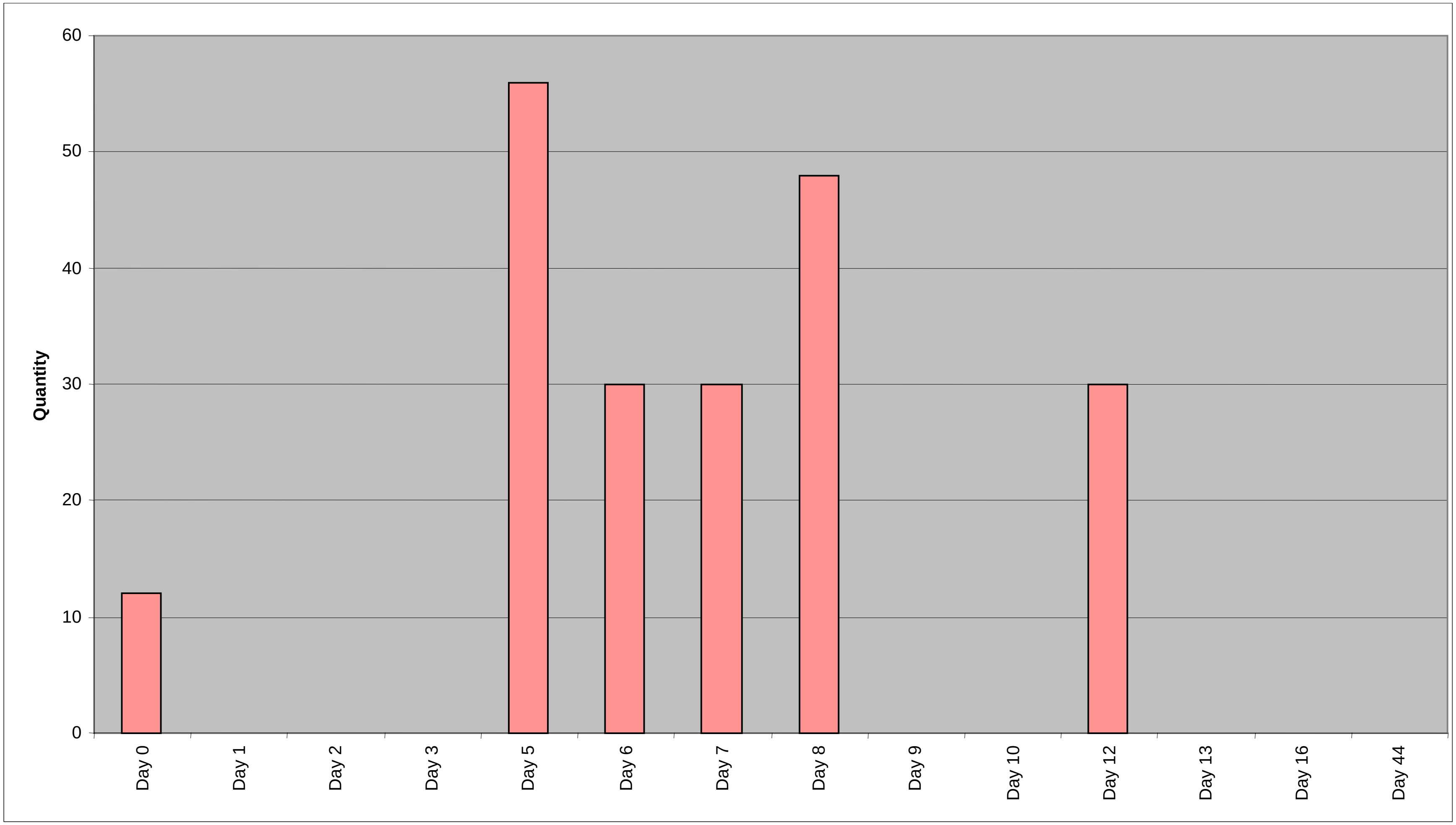


Figure C-9. Quantity of Aircraft Arriving at the Port of Jacksonville

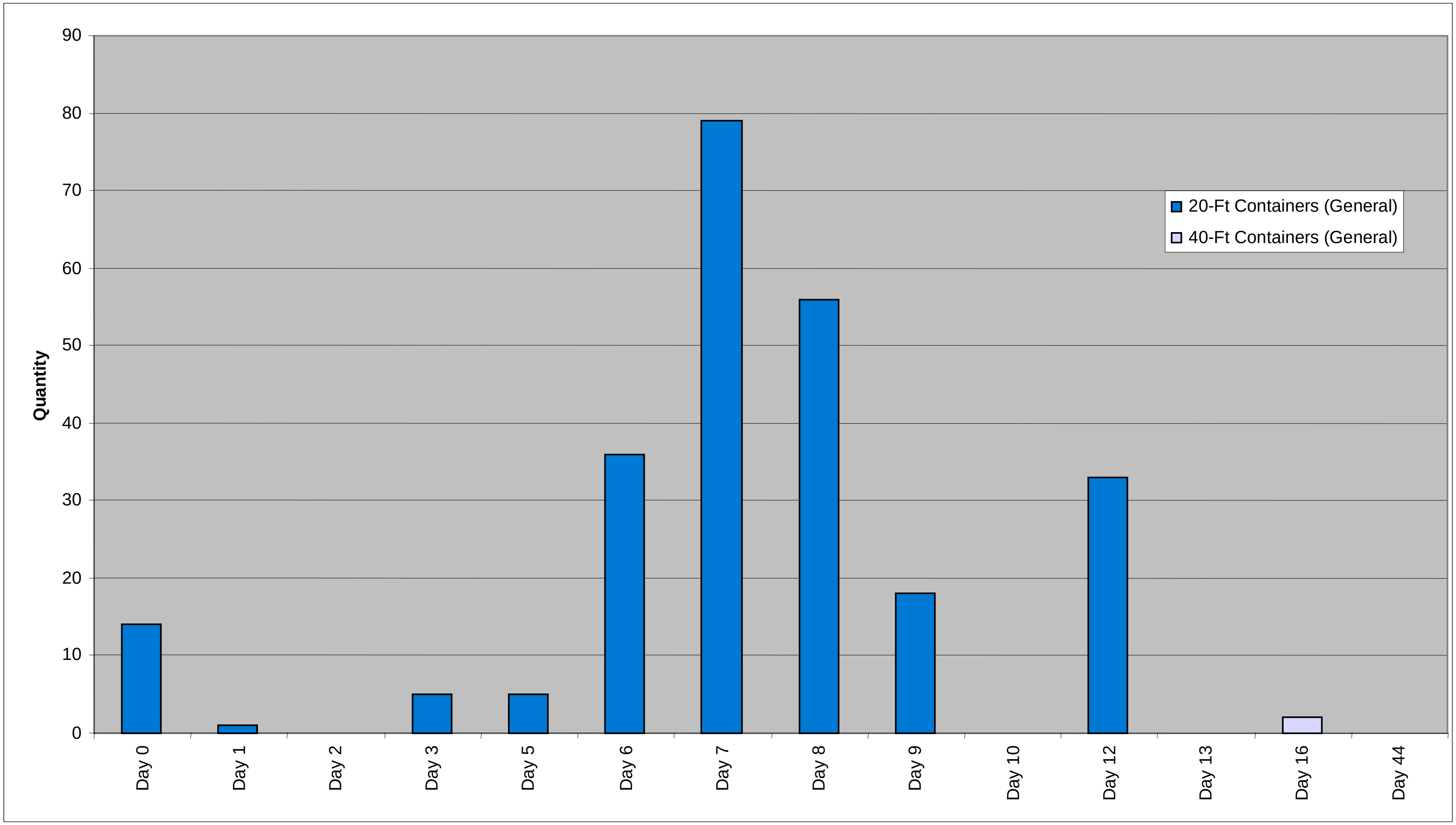


Figure C-10. Quantity of Containers Arriving at the Port of Jacksonville

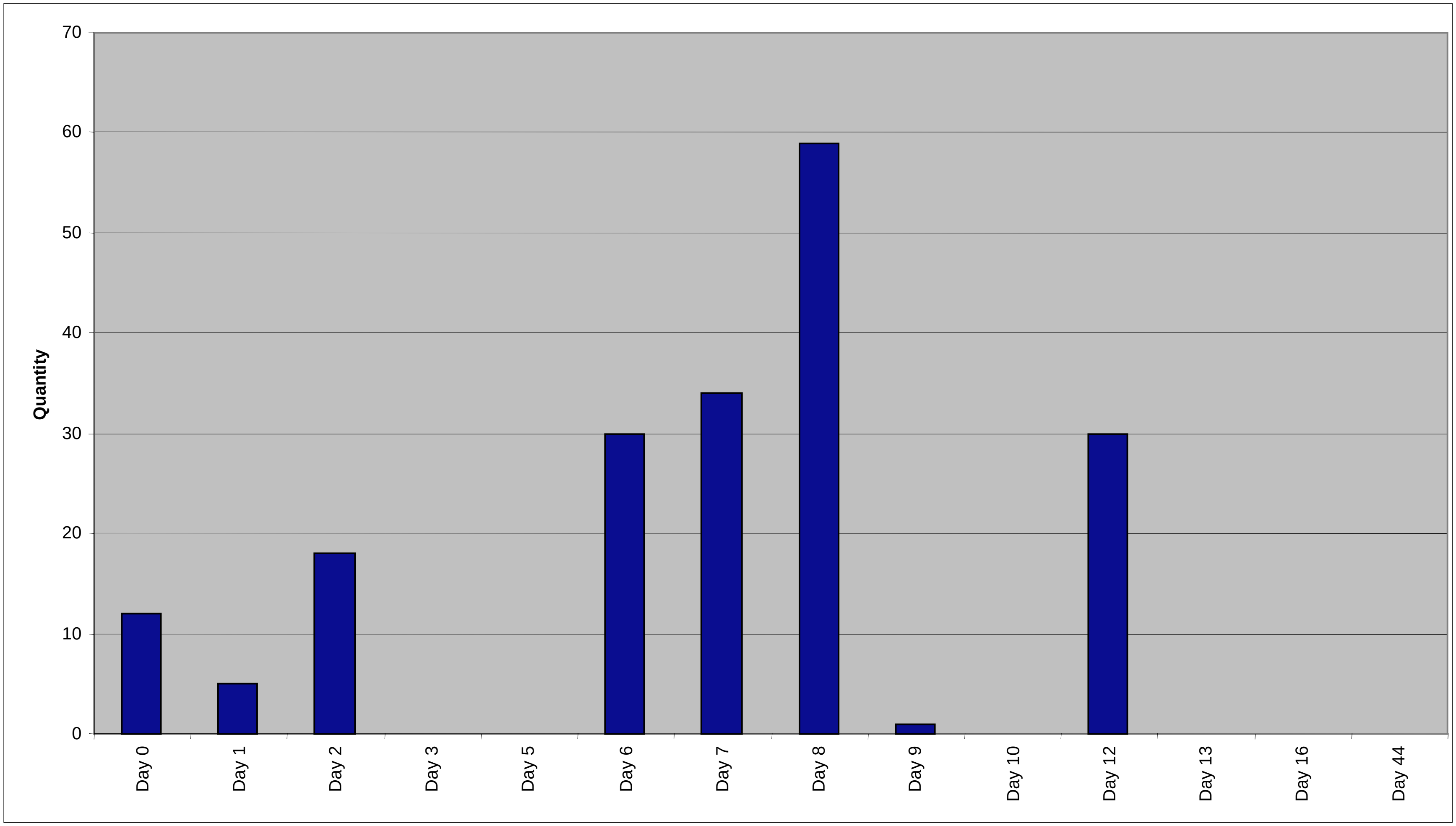


Figure C-11. Quantity of Breakbulk Cargo Items Arriving at the Port of Jacksonville

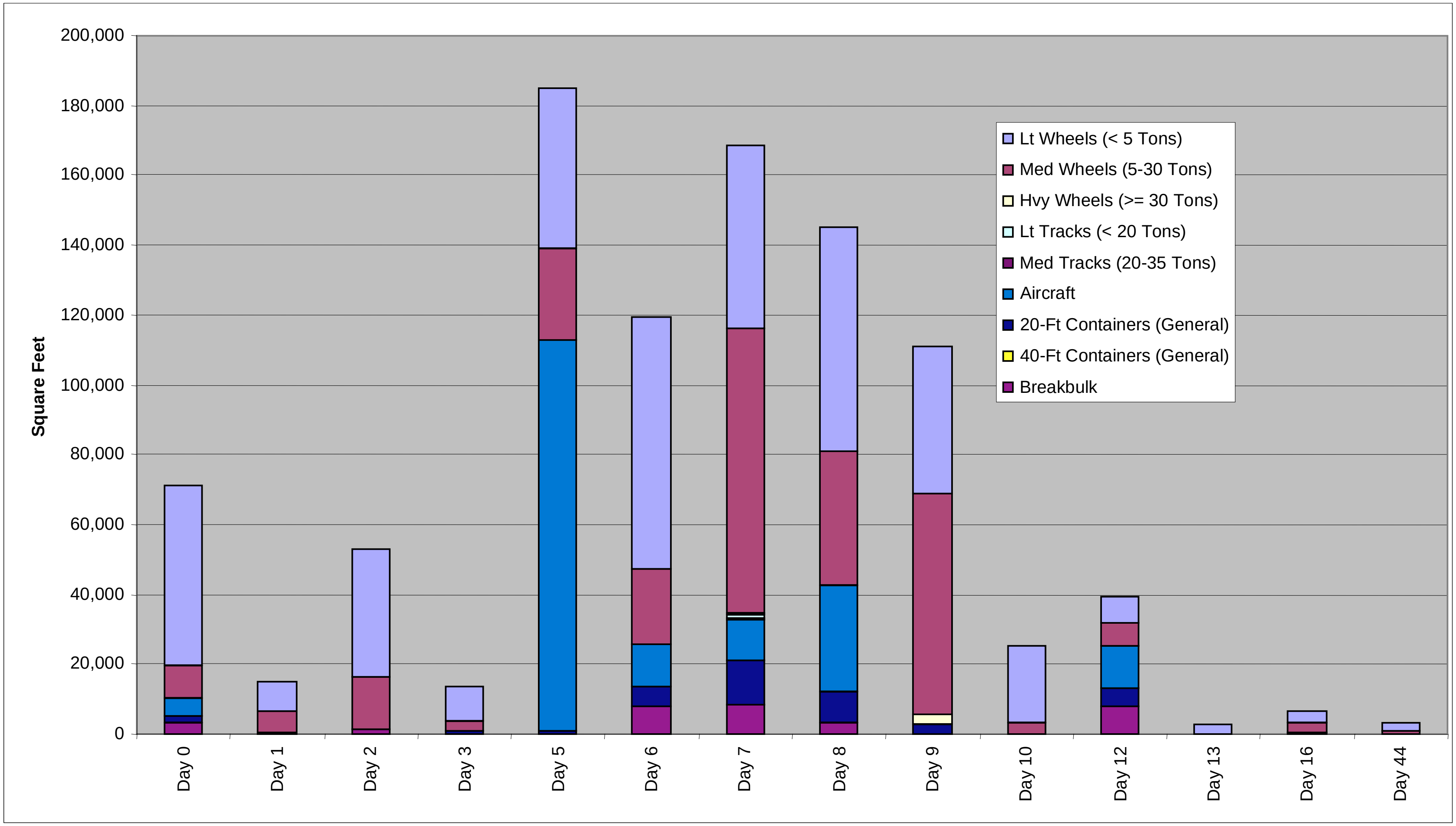


Figure C-12. Total Square Feet of Cargo Arriving at the Port of Jacksonville

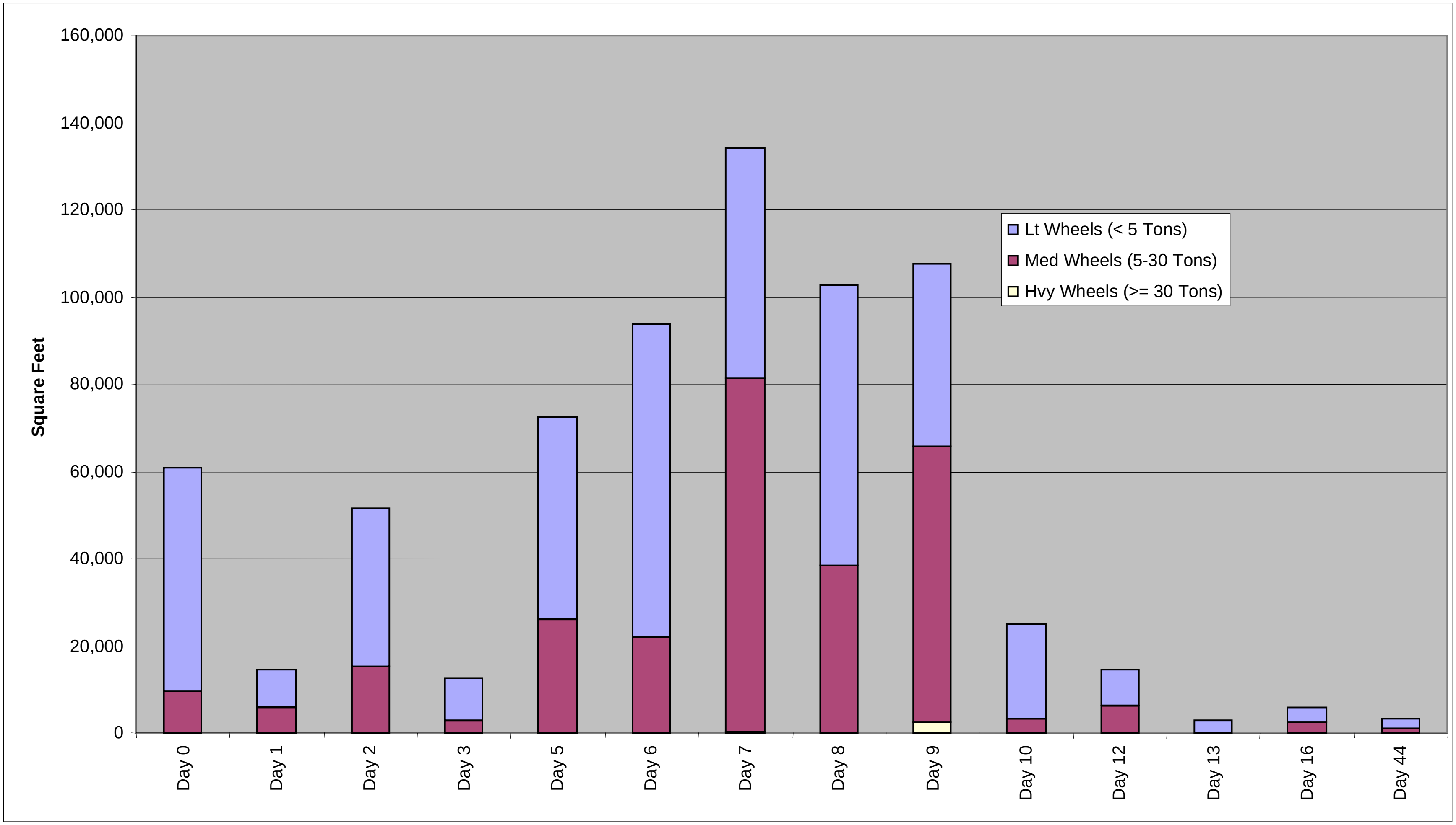


Figure C-13. Square Feet of Wheeled Vehicles Arriving at the Port of Jacksonville

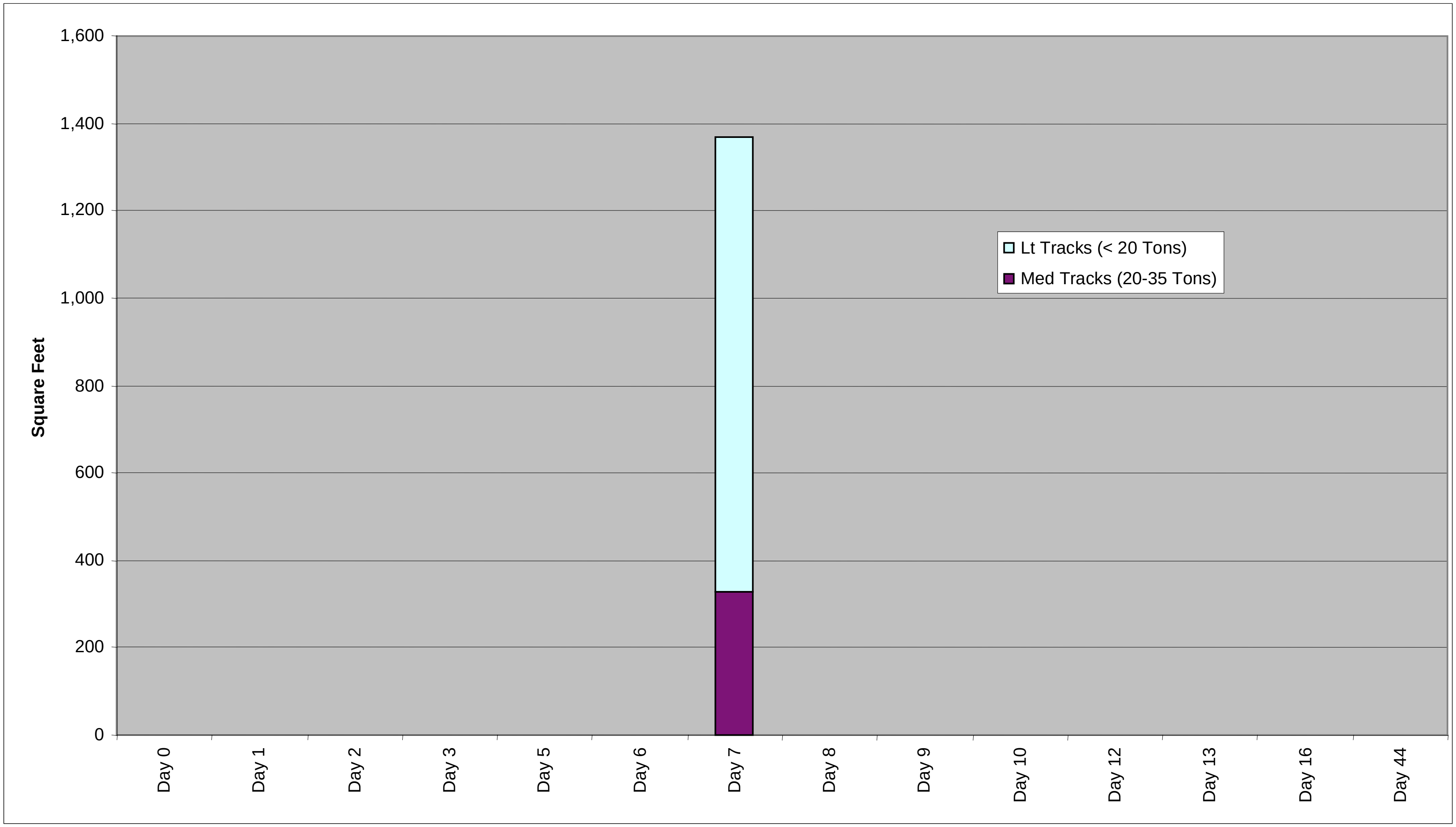


Figure C-14. Square Feet of Tracked Vehicles Arriving at the Port of Jacksonville

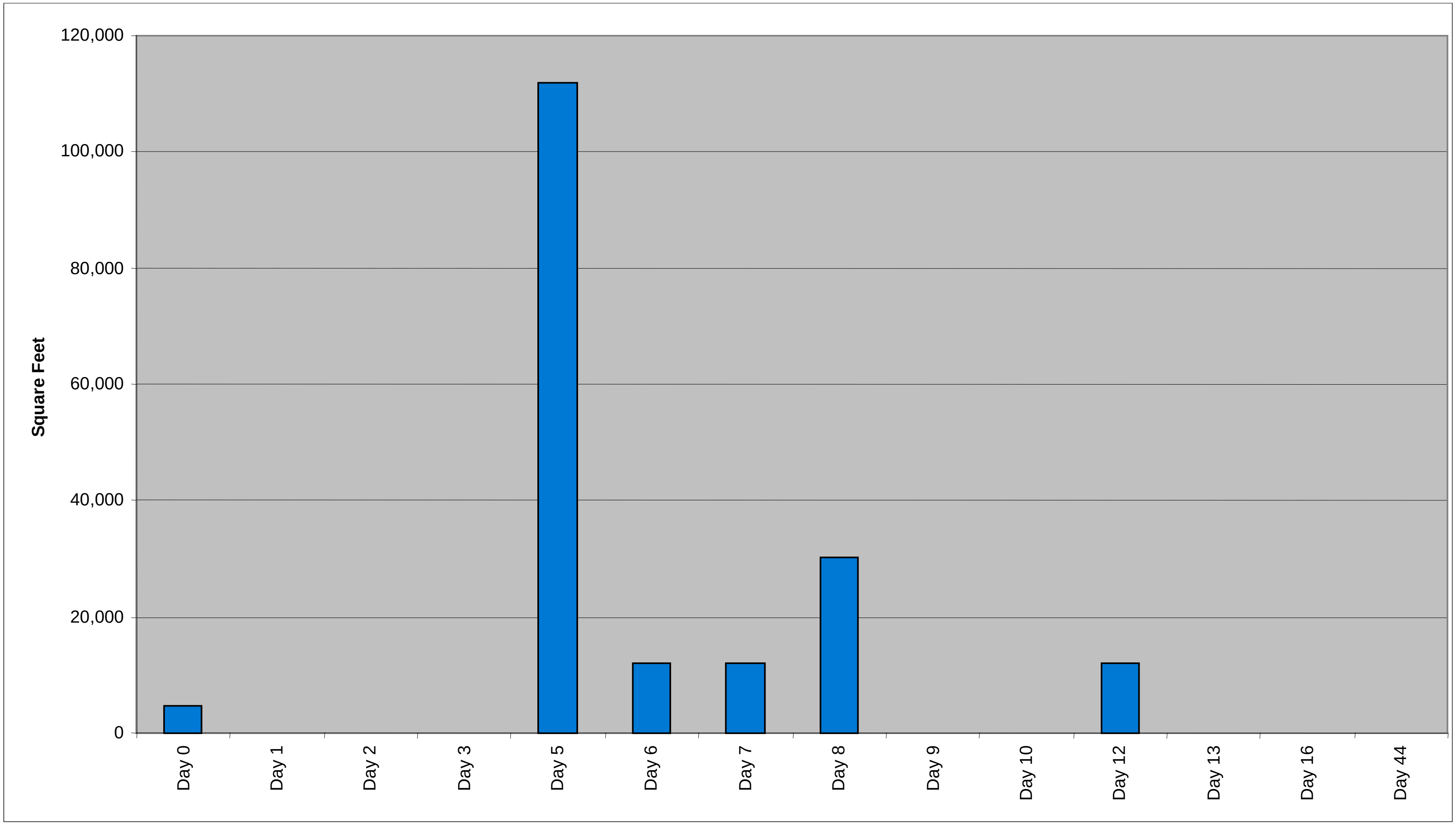


Figure C-15. Square Feet of Aircraft Arriving at the Port of Jacksonville

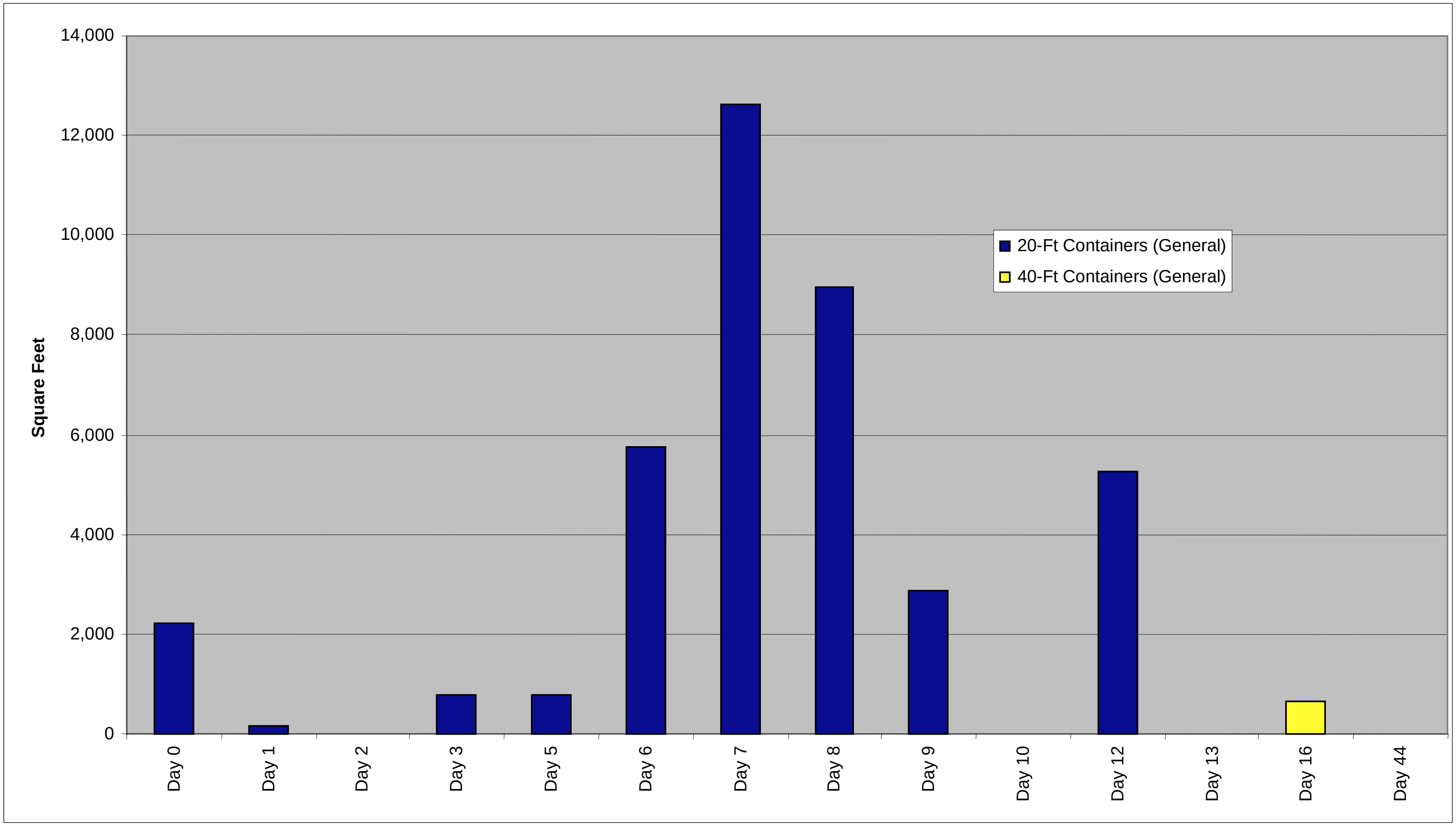


Figure C-16. Square Feet of Containers Arriving at the Port of Jacksonville

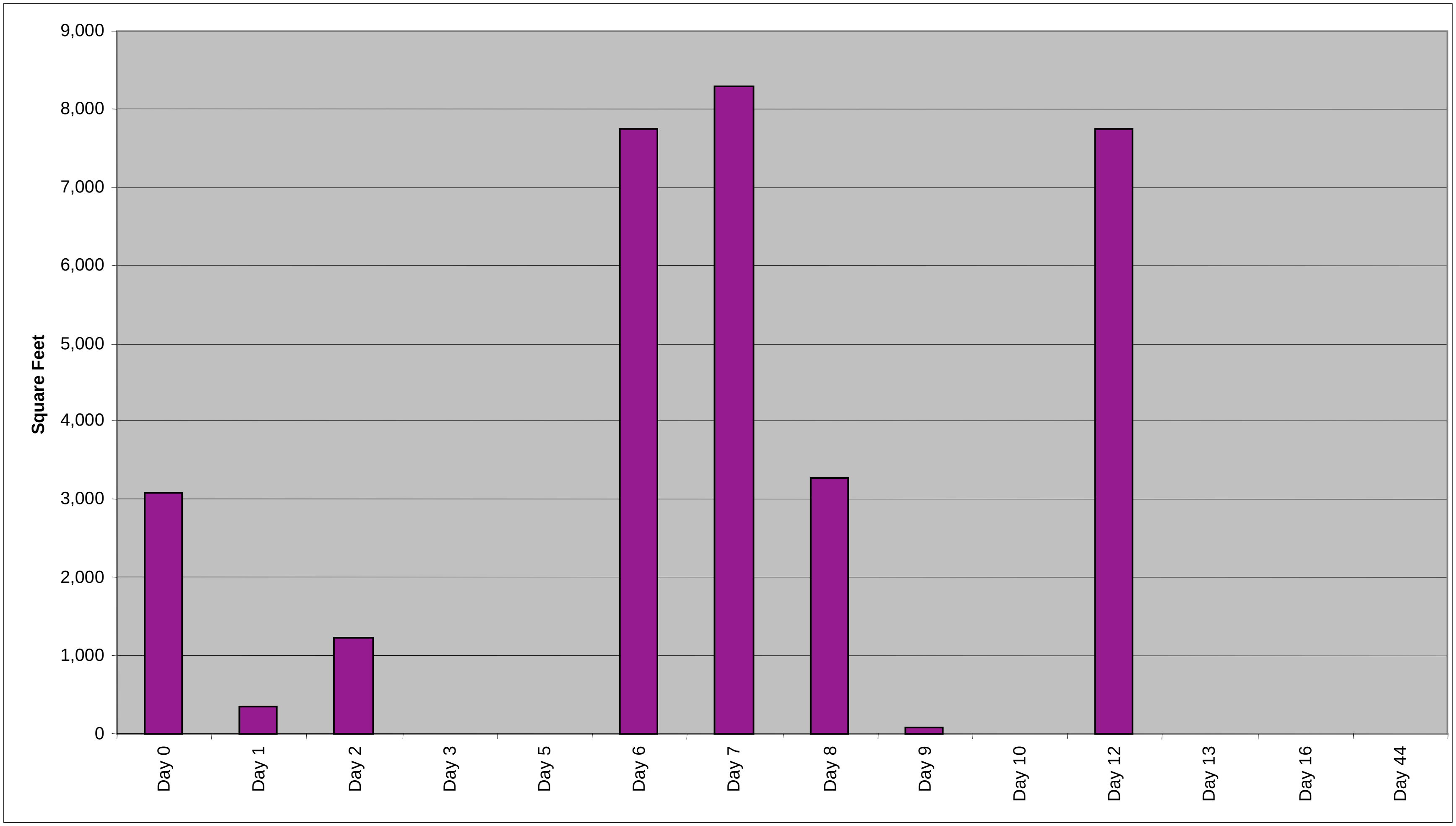


Figure C-17. Square Feet of Breakbulk Cargo Items Arriving at the Port of Jacksonville

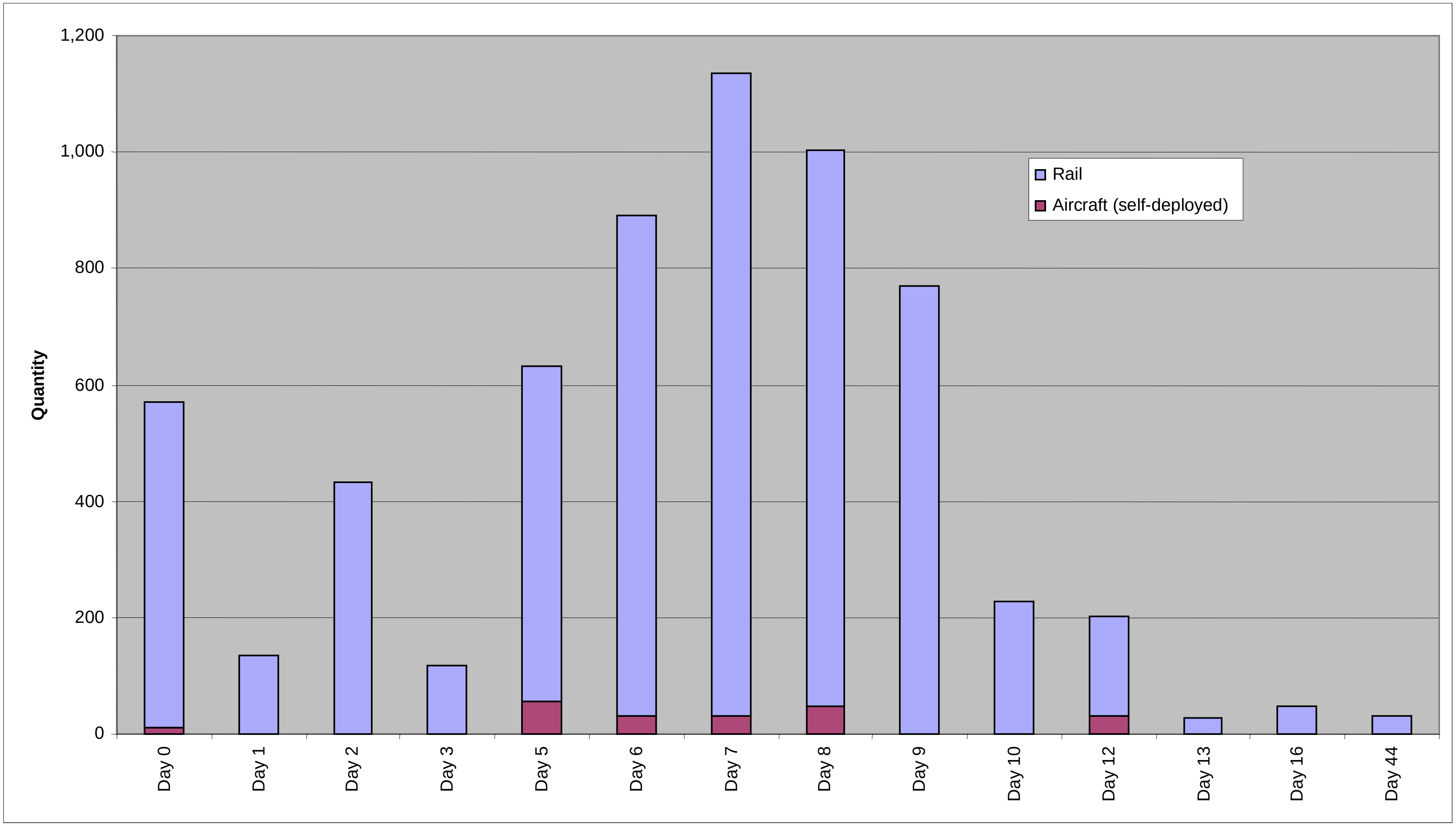


Figure C-18. Quantity of Cargo Items Arriving by Mode to the Port of Jacksonville

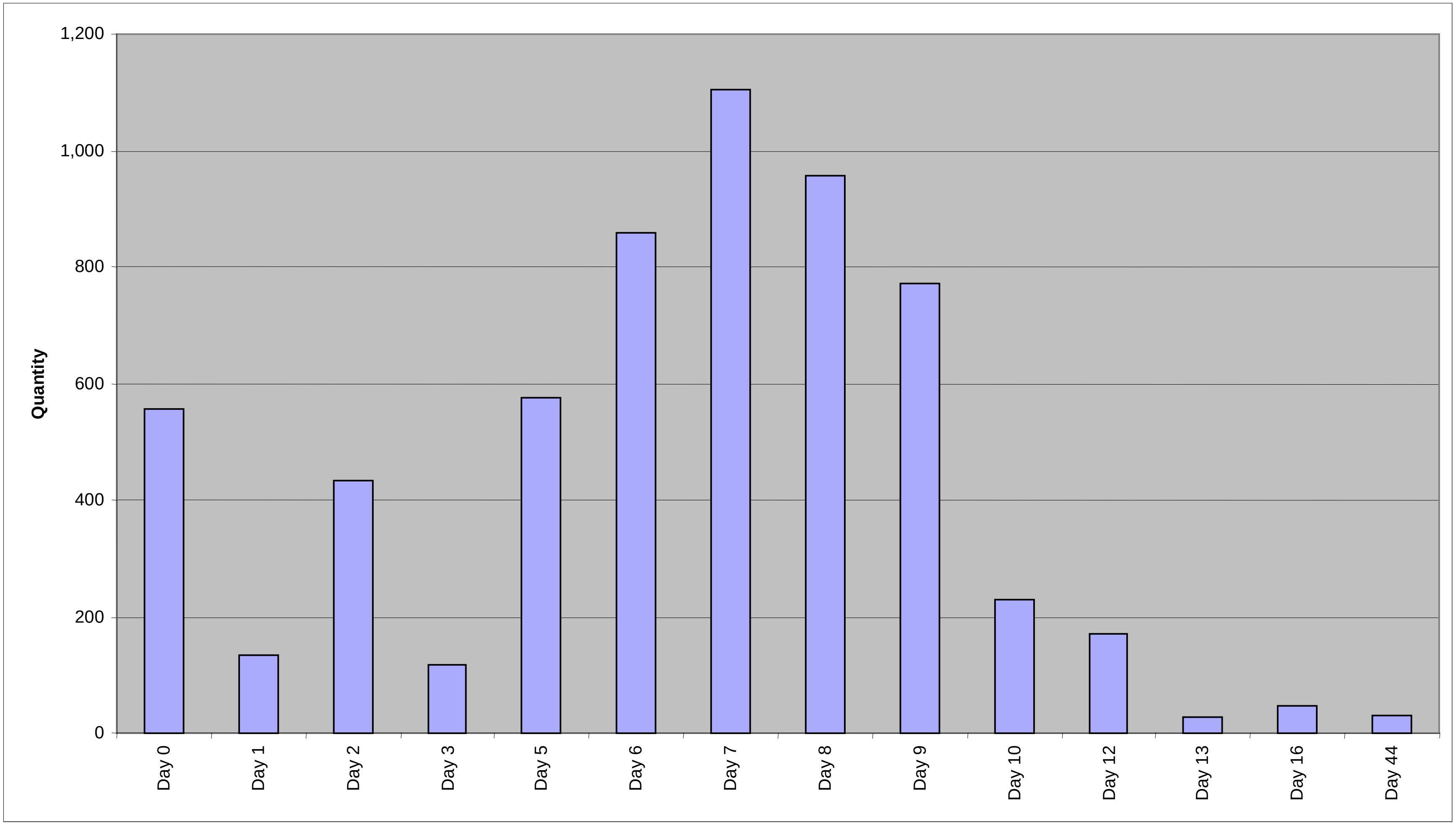


Figure C-19. Quantity of Items Arriving by Rail at the Port of Jacksonville

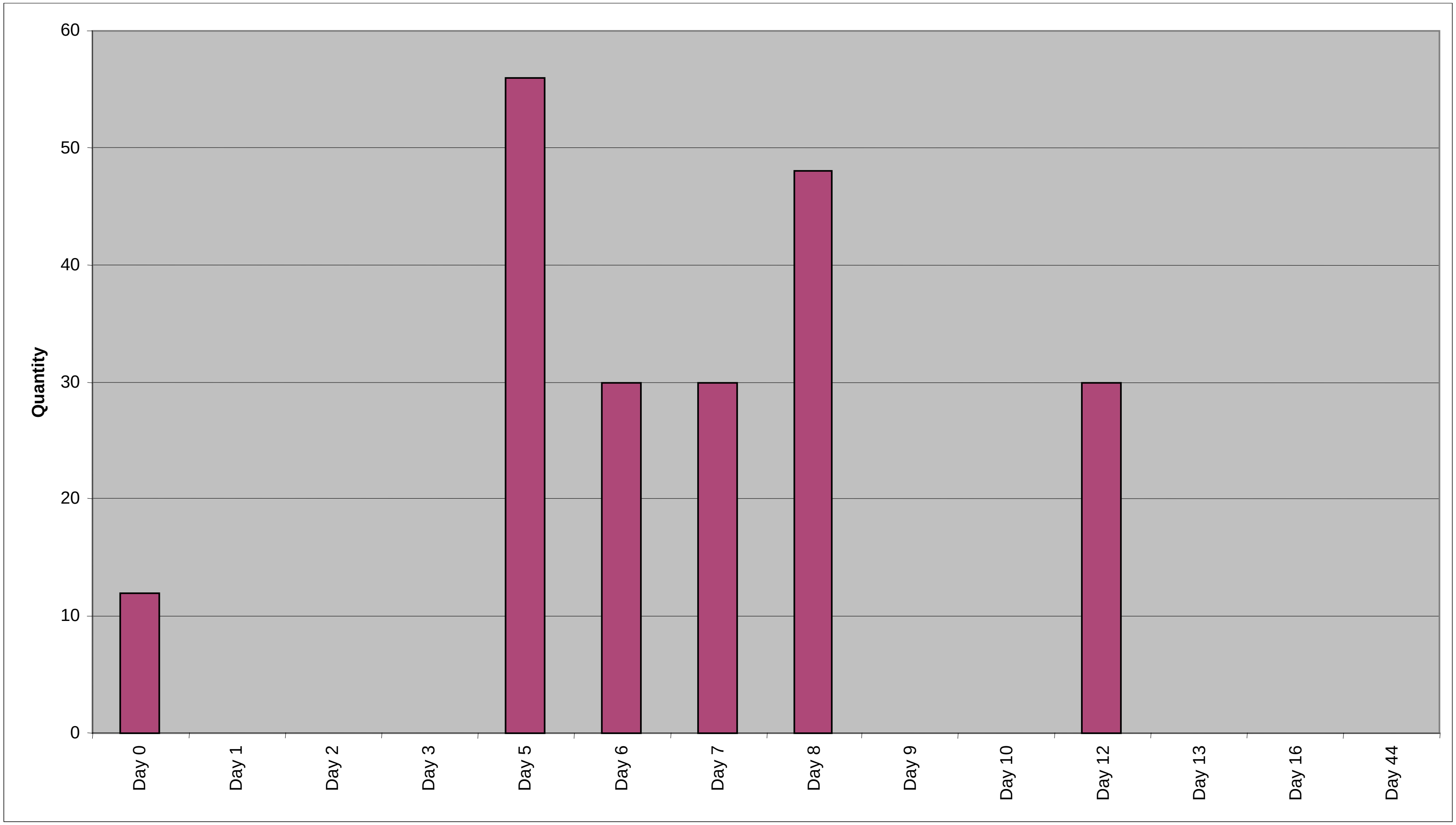


Figure C-20. Quantity of Aircraft Self-Deploying to the Port of Jacksonville

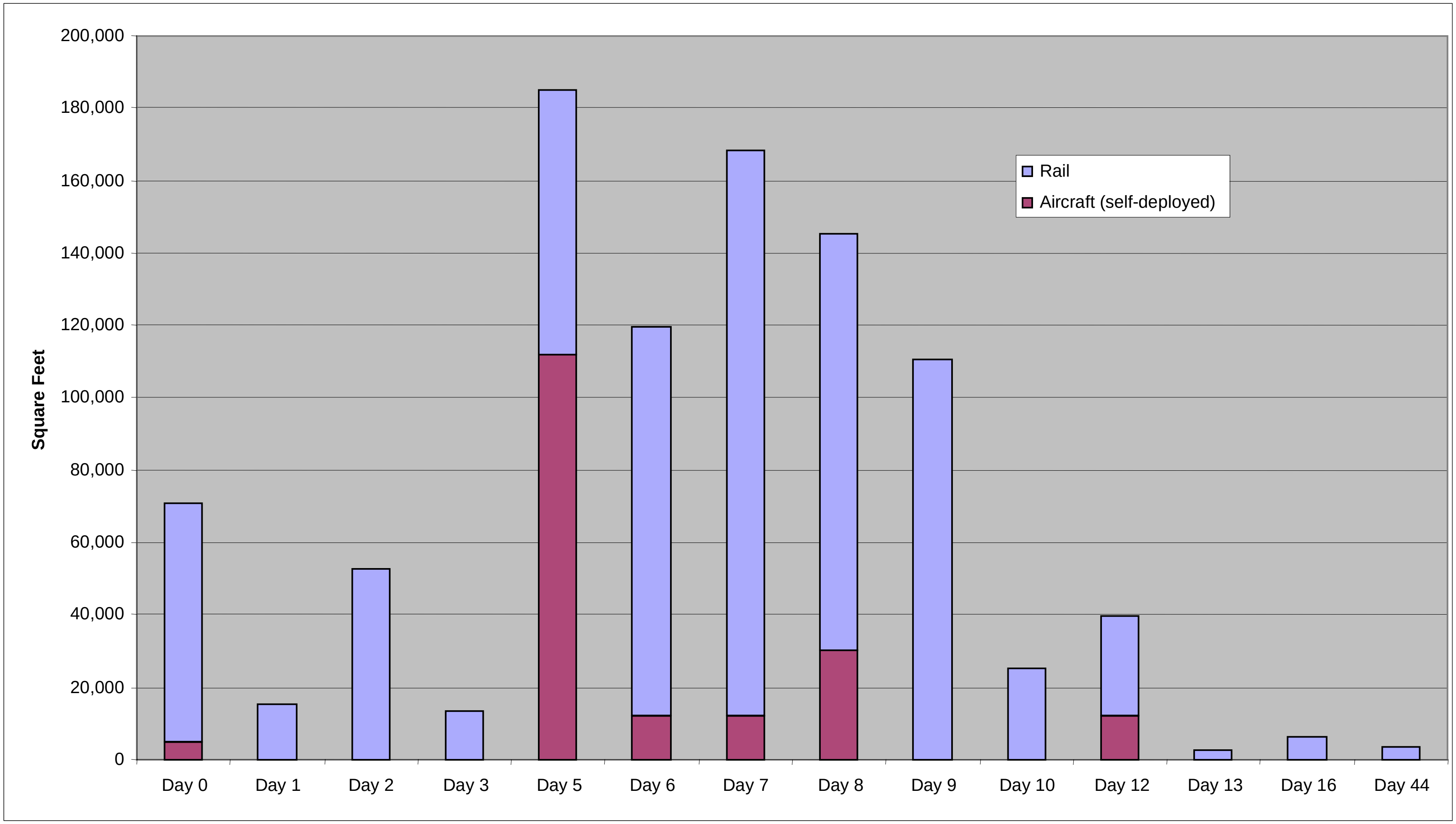


Figure C-21. Square Feet of Cargo Items Arriving by Mode to the Port of Jacksonville

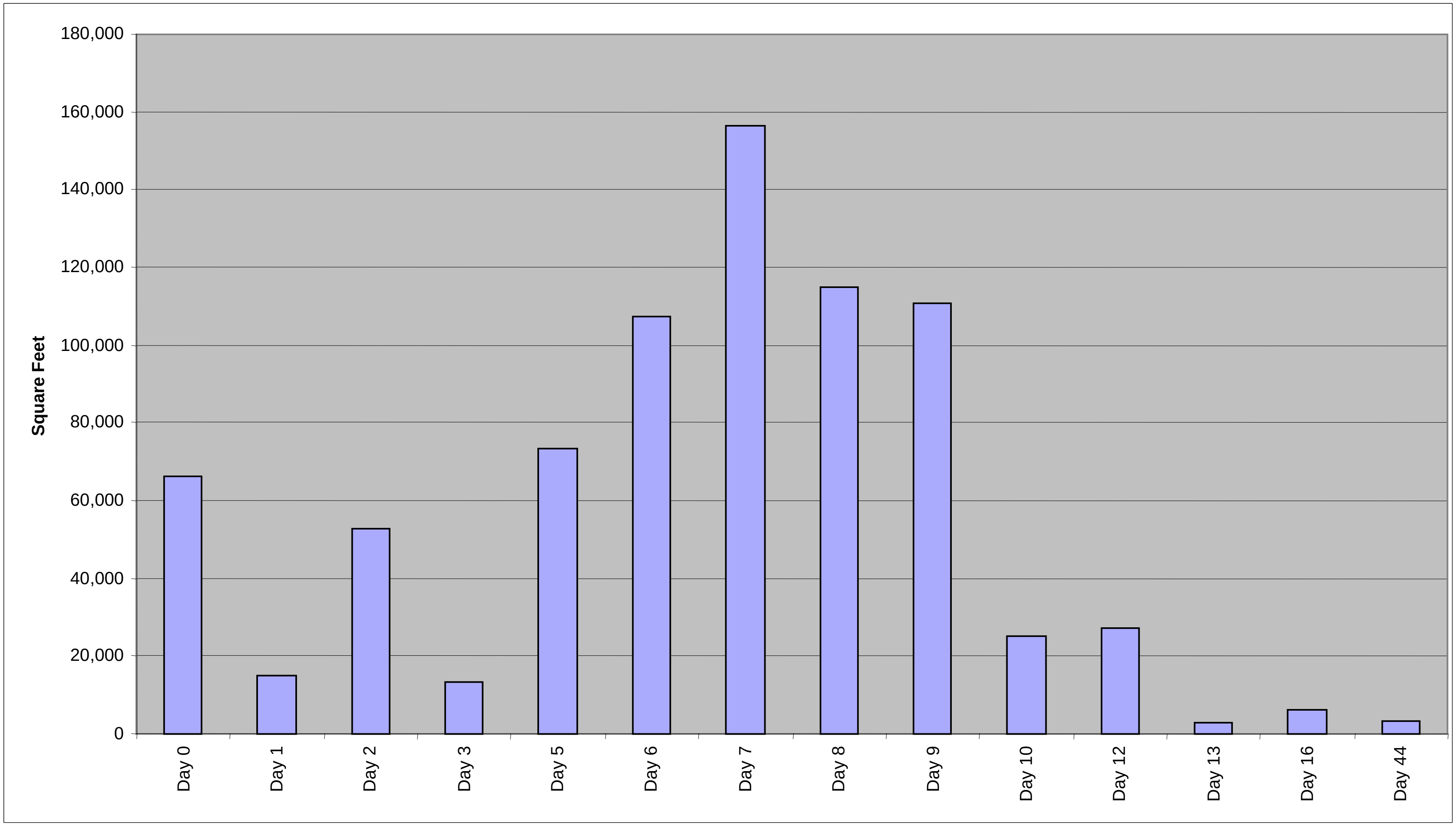


Figure C-22. Square Feet of Cargo Items Arriving by Rail to the Port of Jacksonville

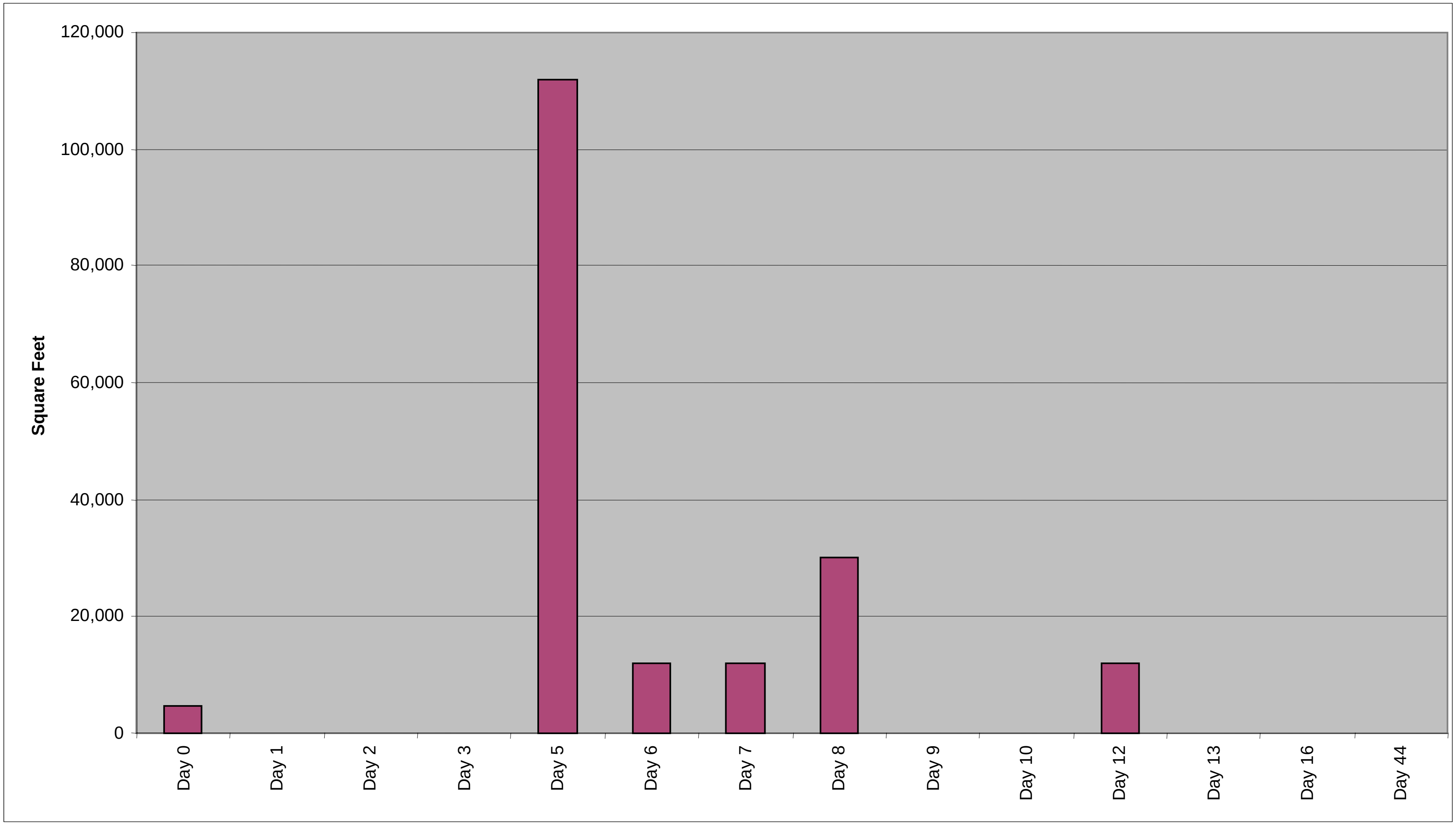


Figure C-23. Square Feet of Aircraft Self-Deploying to the Port of Jacksonville

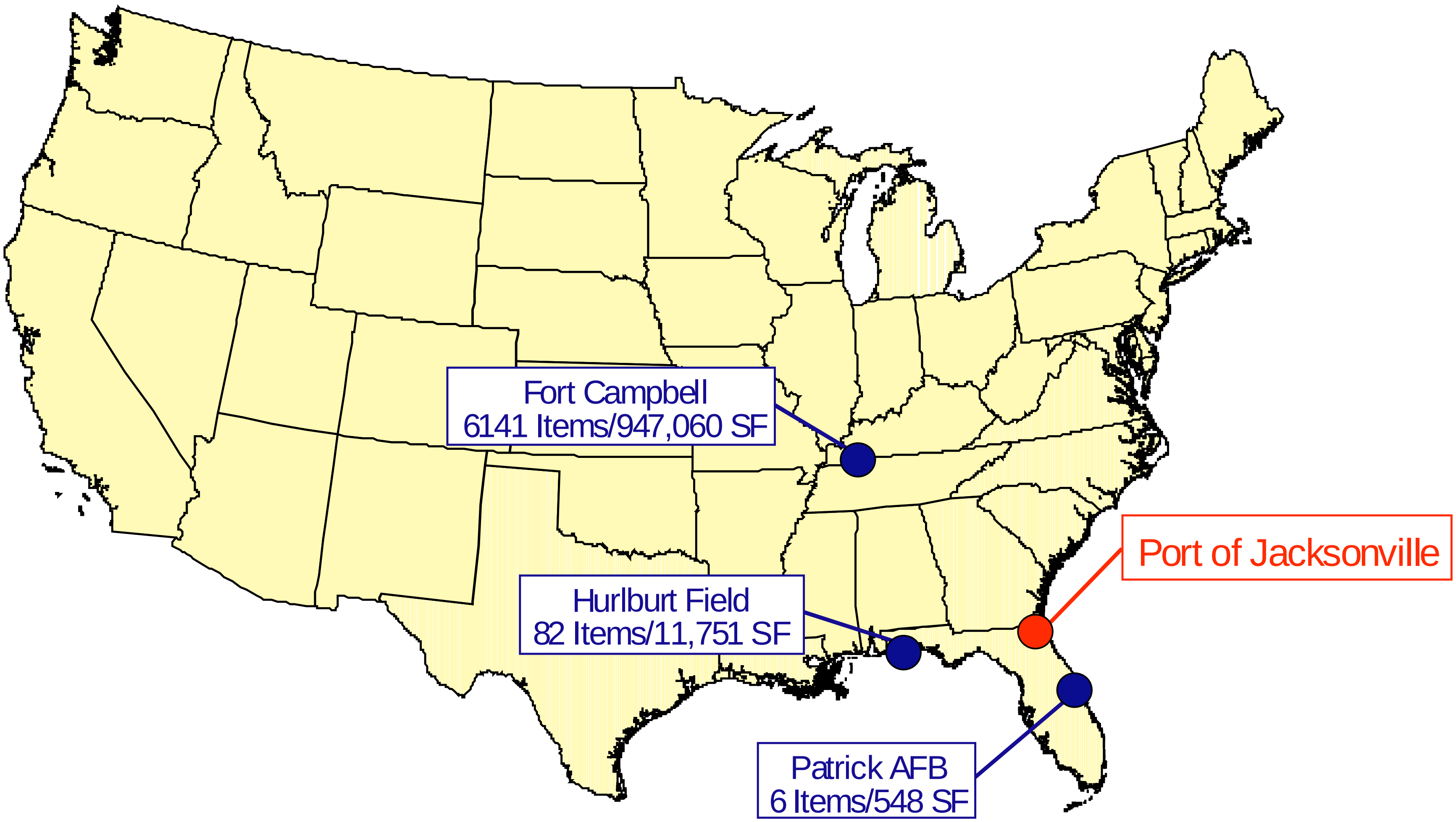


Figure C-24. Amount of Cargo Arriving at the Port of Jacksonville by Origin

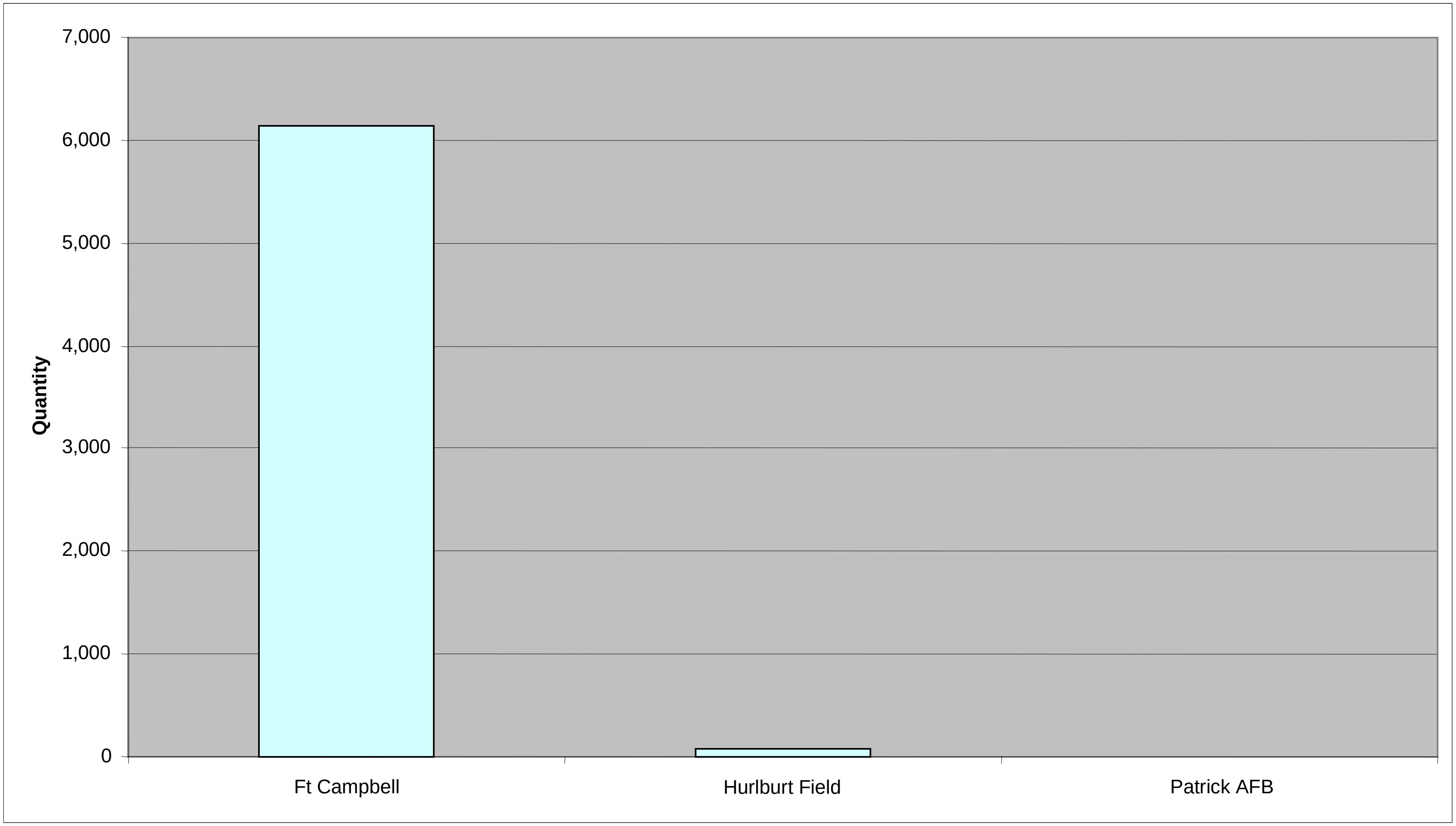


Figure C-25. Quantity of Cargo Items Arriving at the Port of Jacksonville by Origin

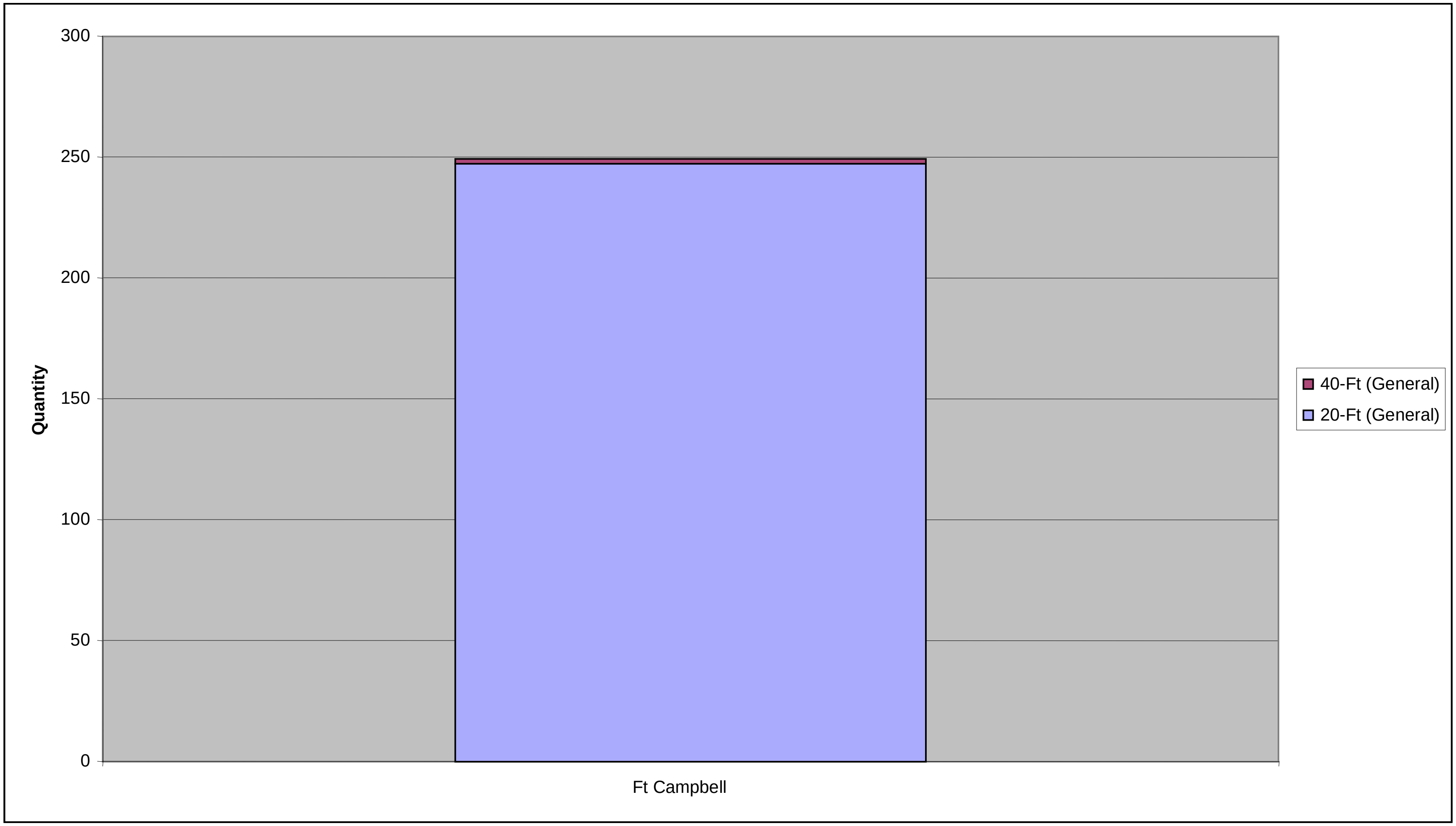


Figure C-26. Quantity of Containers Arriving at the Port of Jacksonville by Origin

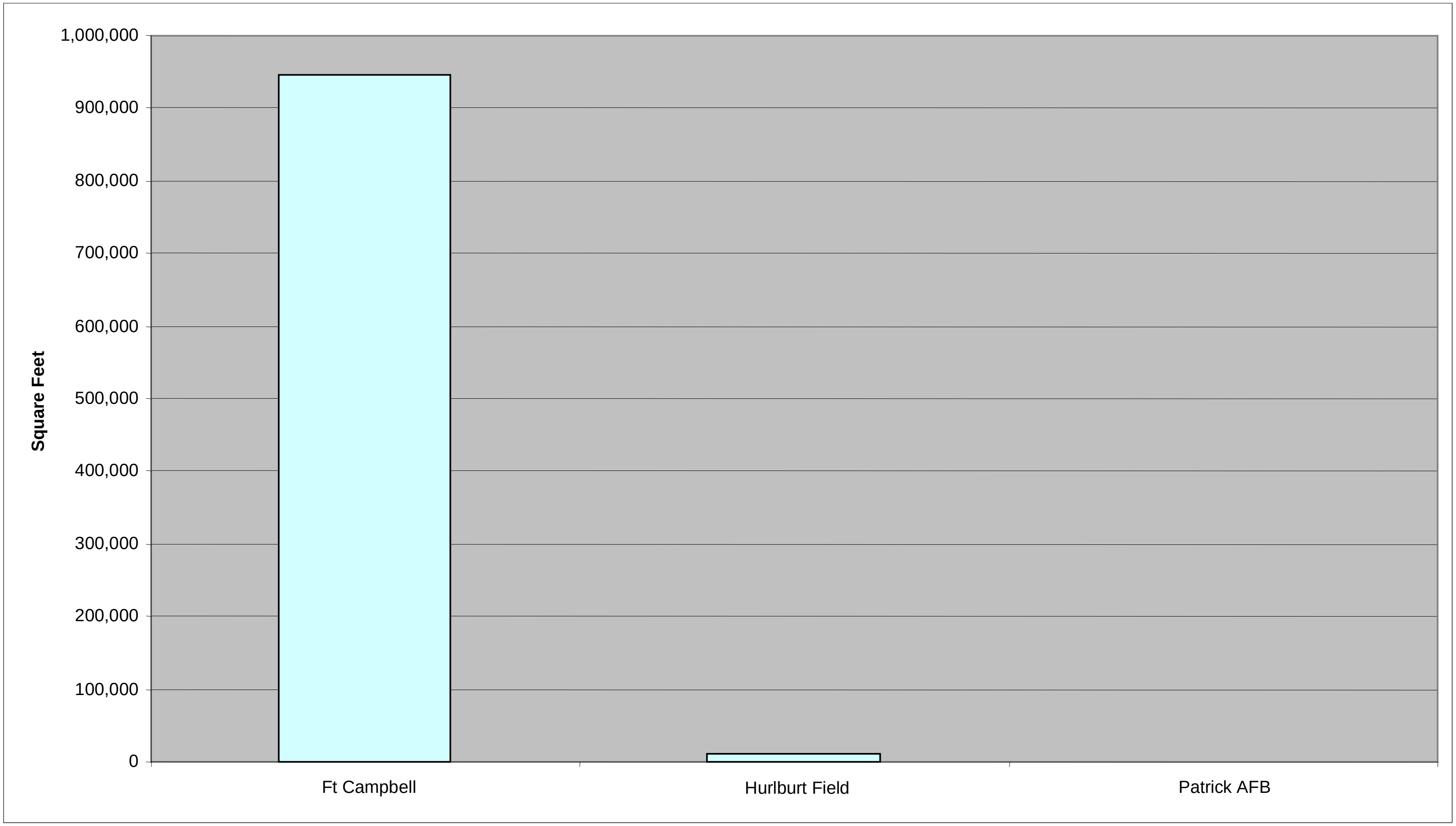
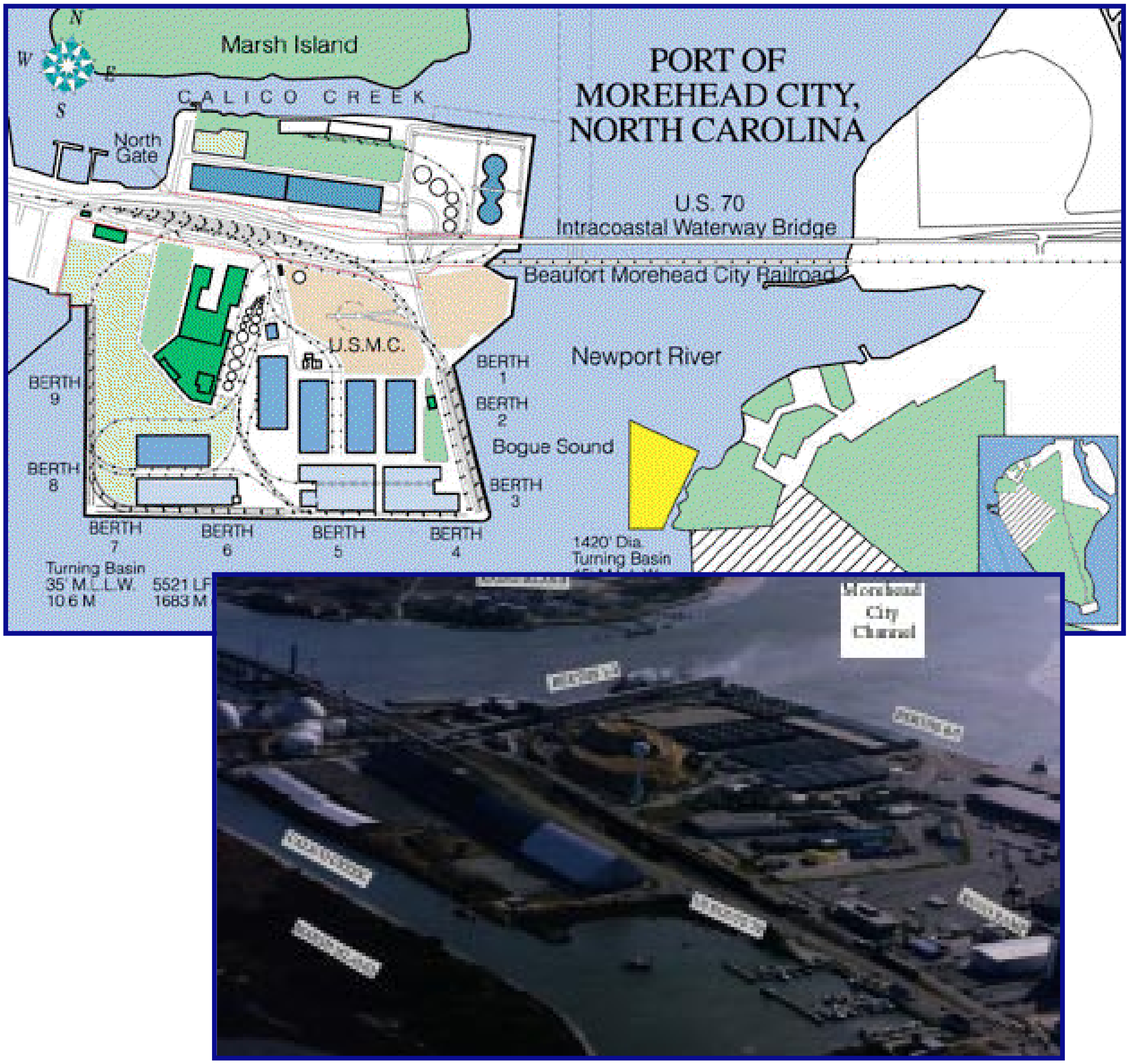


Figure C-27. Square Feet of Cargo Arriving at the Port of Jacksonville by Origin

APPENDIX D

PORT OF MOREHEAD CITY



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The requirements in Appendix D differ from those in the remainder of the report. The objective of this report is to communicate MSC-controlled cargo requirements flowing through each port. However, for the Port of Morehead City, the only requirements in the TPFDD are Marine Corps units that are not MSC-controlled. These units are predominately under the control of the supporting CINC. Instead of eliminating the Port of Morehead City from the report, these “other” requirements are included here.

According to the TPFDD, there are five origins sending cargo to the Port of Morehead City. These origins are shown in Figure D-1. The Port of Morehead City receives entirely Marine Corps cargo. Origins in excess of 400 miles send all of their cargo to the Port Morehead City of by rail. Origins within 400 miles convoy their roadable vehicles to the port and send everything else by rail. All aircraft self-deploy to the port. Figures D-2 through D-6 show the quantity of transports (containers, railcars, self-deploying aircraft, and convoying vehicles) required to move to the Port of Morehead City.

Figures D-7 through D-12 illustrate the quantity of items arriving at the port. Figure D-7 is the total quantity of items. Figures D-8 through D-12 break this down into more detail. Figures D-8 and D-9 are the quantity of vehicles arriving at the port. Figure D-8 outlines the wheeled vehicles and Figure D-9 lays out the tracked vehicles. Figure D-10 shows the quantity of aircraft arriving at the port. These are mostly helicopters, and all self move to the port under their own power. Figures D-11 and D-12 outline the number of containers and breakbulk cargo items, respectively, arriving at the port.

Similar to Figures D-7 through D-12, which lay out the quantity of items arriving, Figure D-13 through D-18 outline the square footage of these categories of cargo.

Figures D-19 through D-26 show how cargo is arriving at the Port of Morehead City. Figure D-19 through D-22 shows the number of cargo items arriving by convoy, rail, or self-deploying. Figures D-23 through D-26 show the square footage of cargo arriving by each mode.

As shown earlier, cargo arrives at the Port of Morehead City from several origins. Figure D-27 shows visually the amount of cargo coming from each origin.

Figures D-28 and D-30 show the quantity and square footage, respectively, of cargo arriving at the Port of Morehead City by origin. Figure D-29 is the quantity of containers arriving at the Port of Morehead City from each origin.

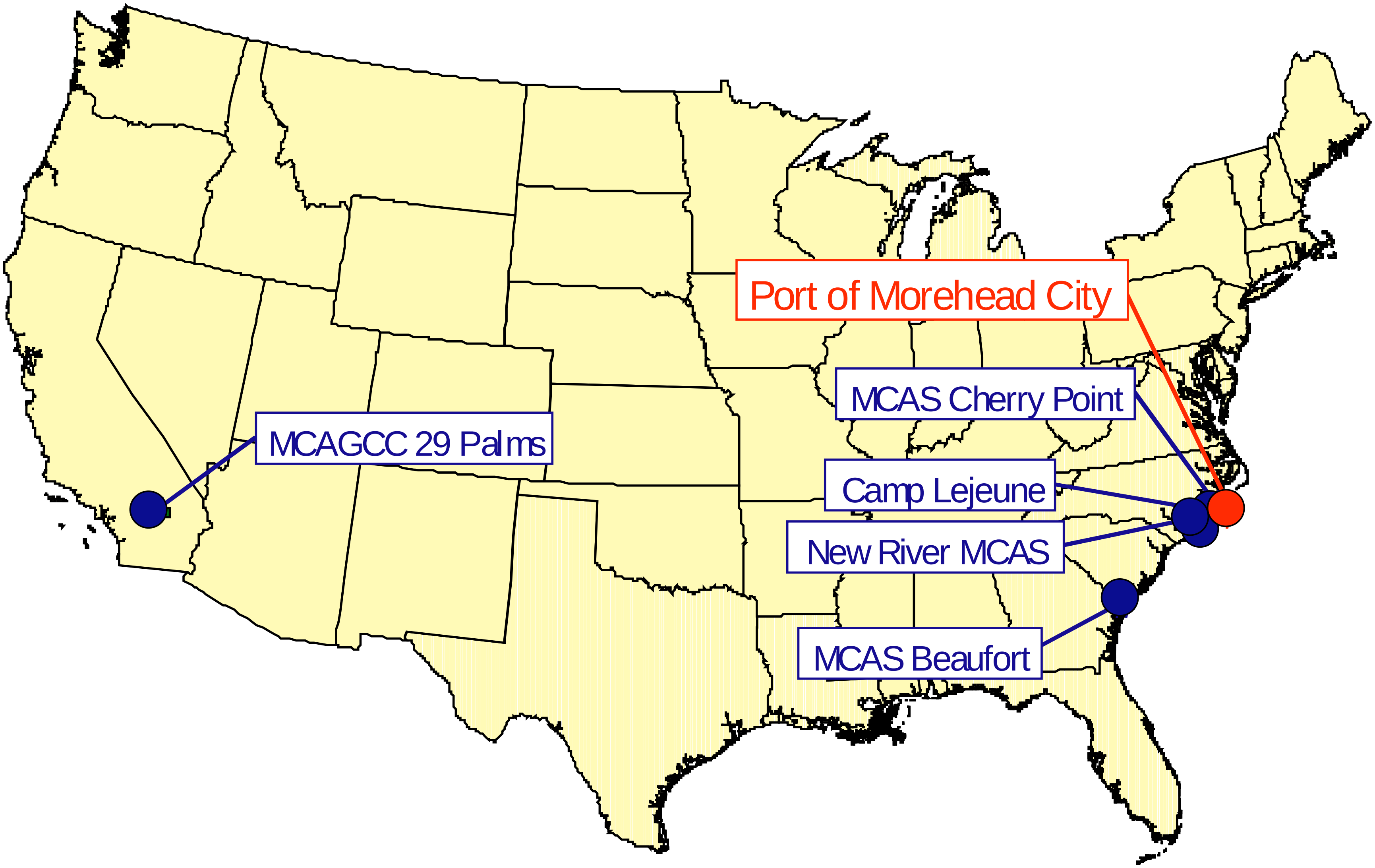


Figure D-1. Cargo Arrives at the Port of Morehead City from Many Origins Cargo

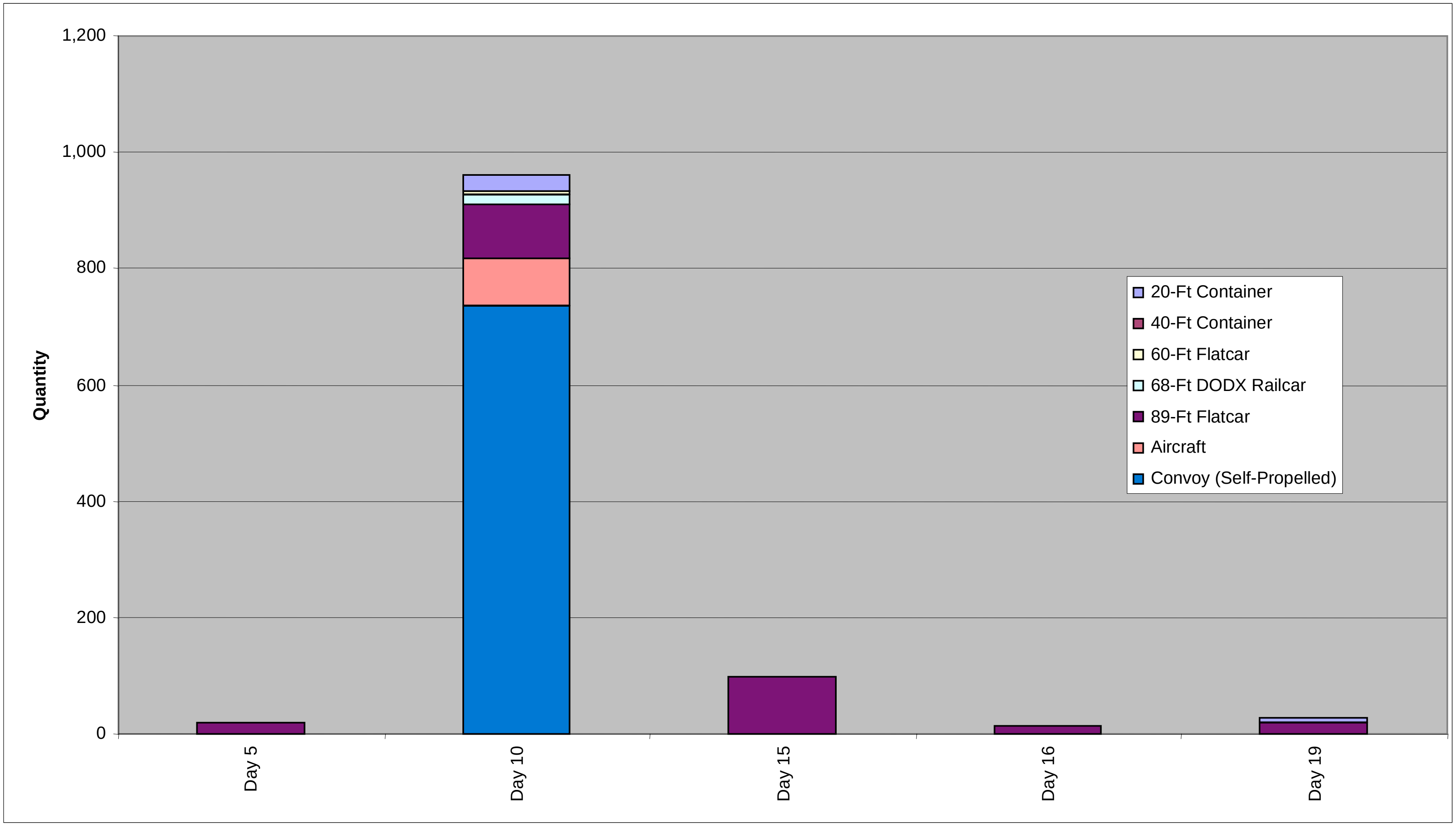


Figure D-2. Total Quantity of Transports Arriving at the Port of Morehead City

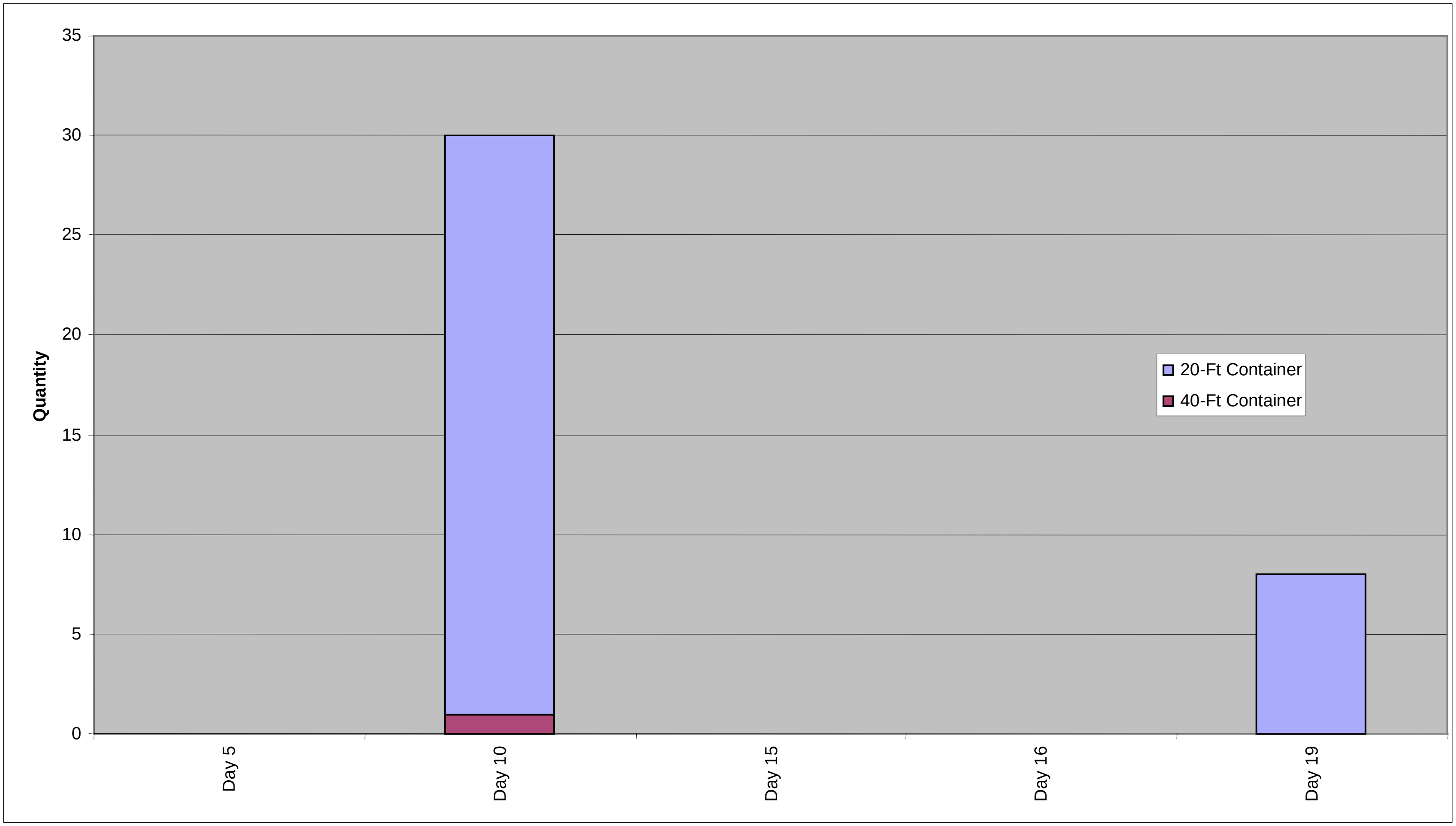


Figure D-3. Quantity of Containers Arriving at the Port of Morehead City

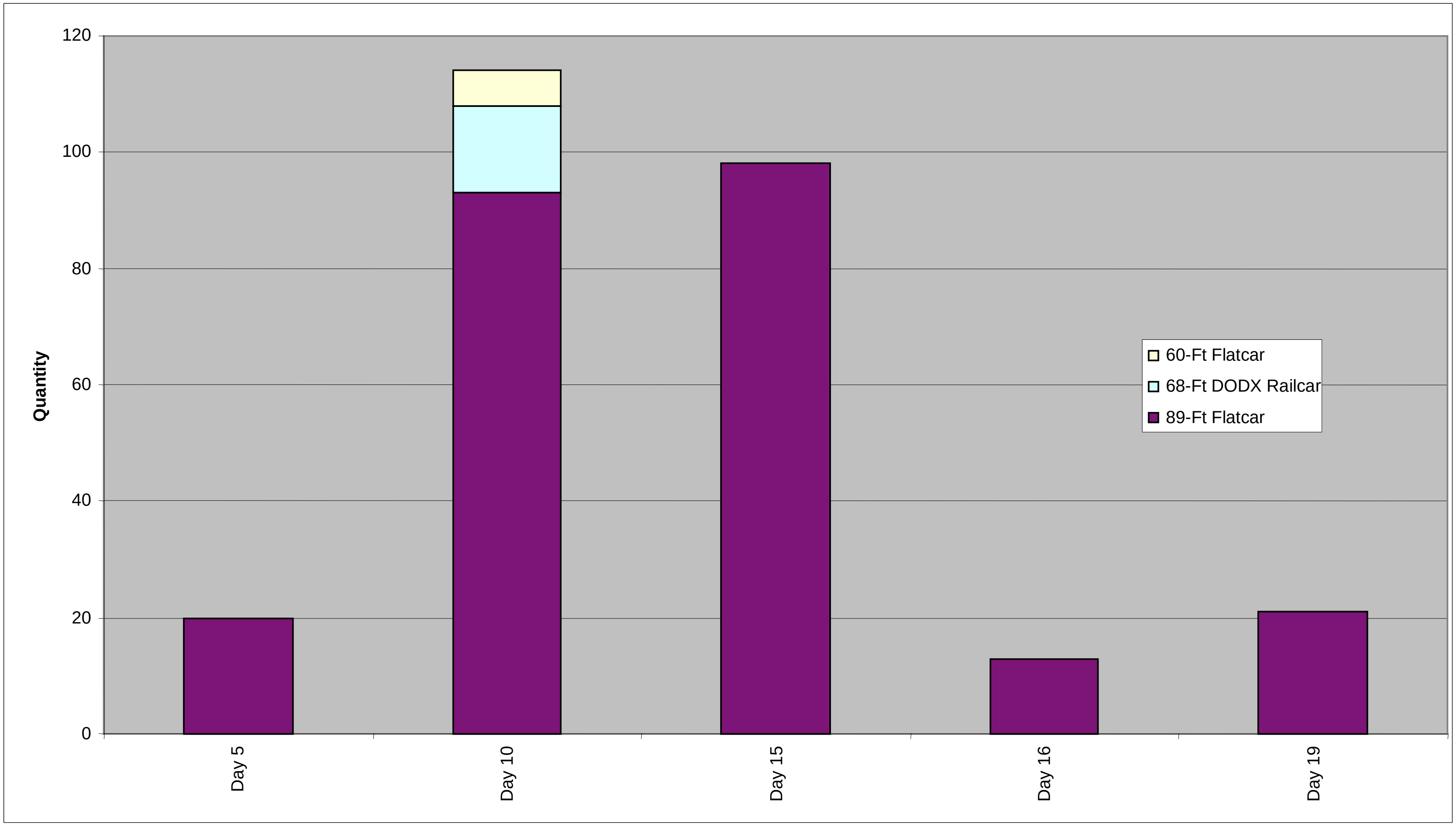


Figure D-4. Quantity of Railcars Arriving at the Port of Morehead City

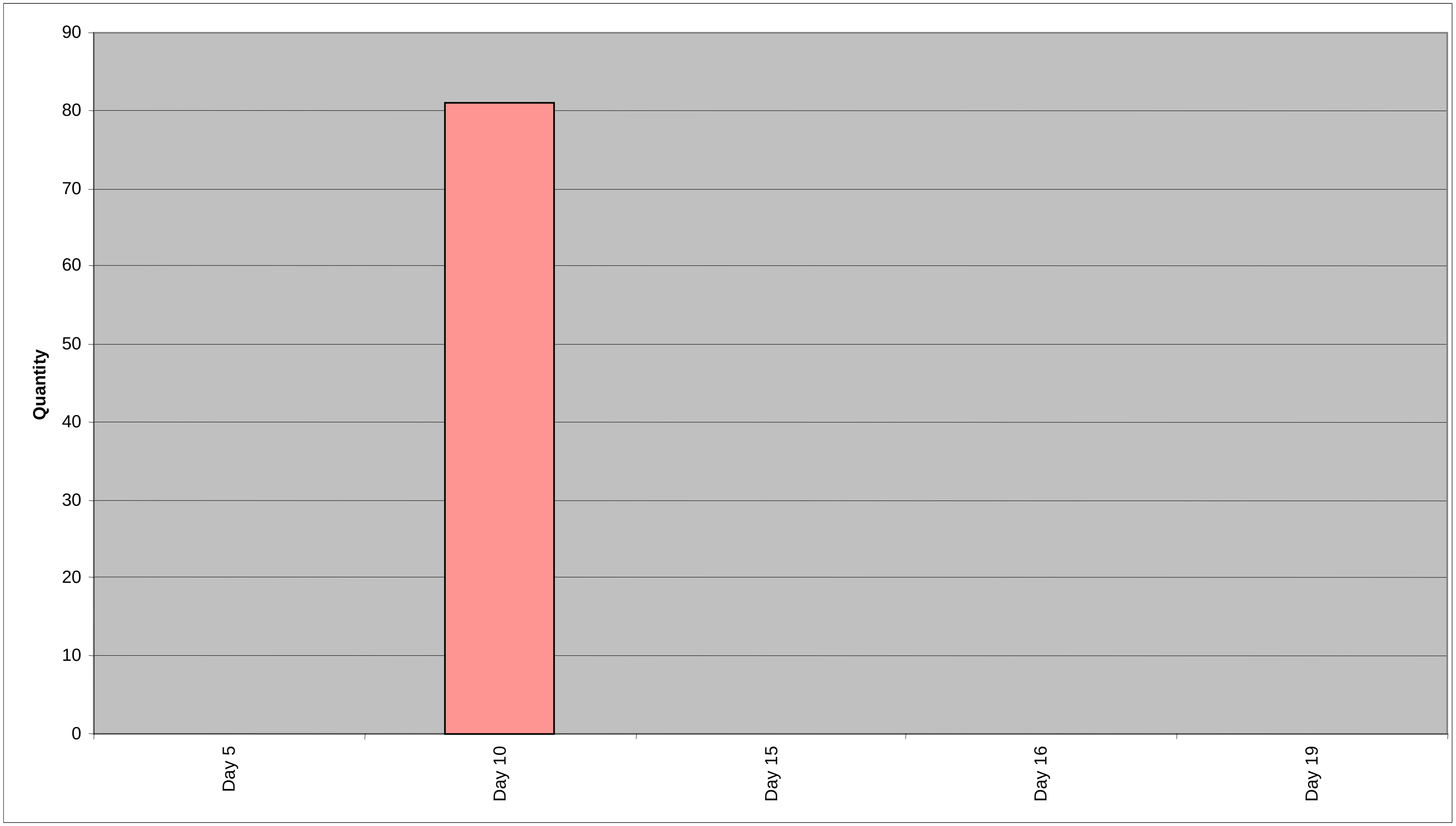


Figure D-5. Quantity of Aircraft Arriving at the Port of Morehead City

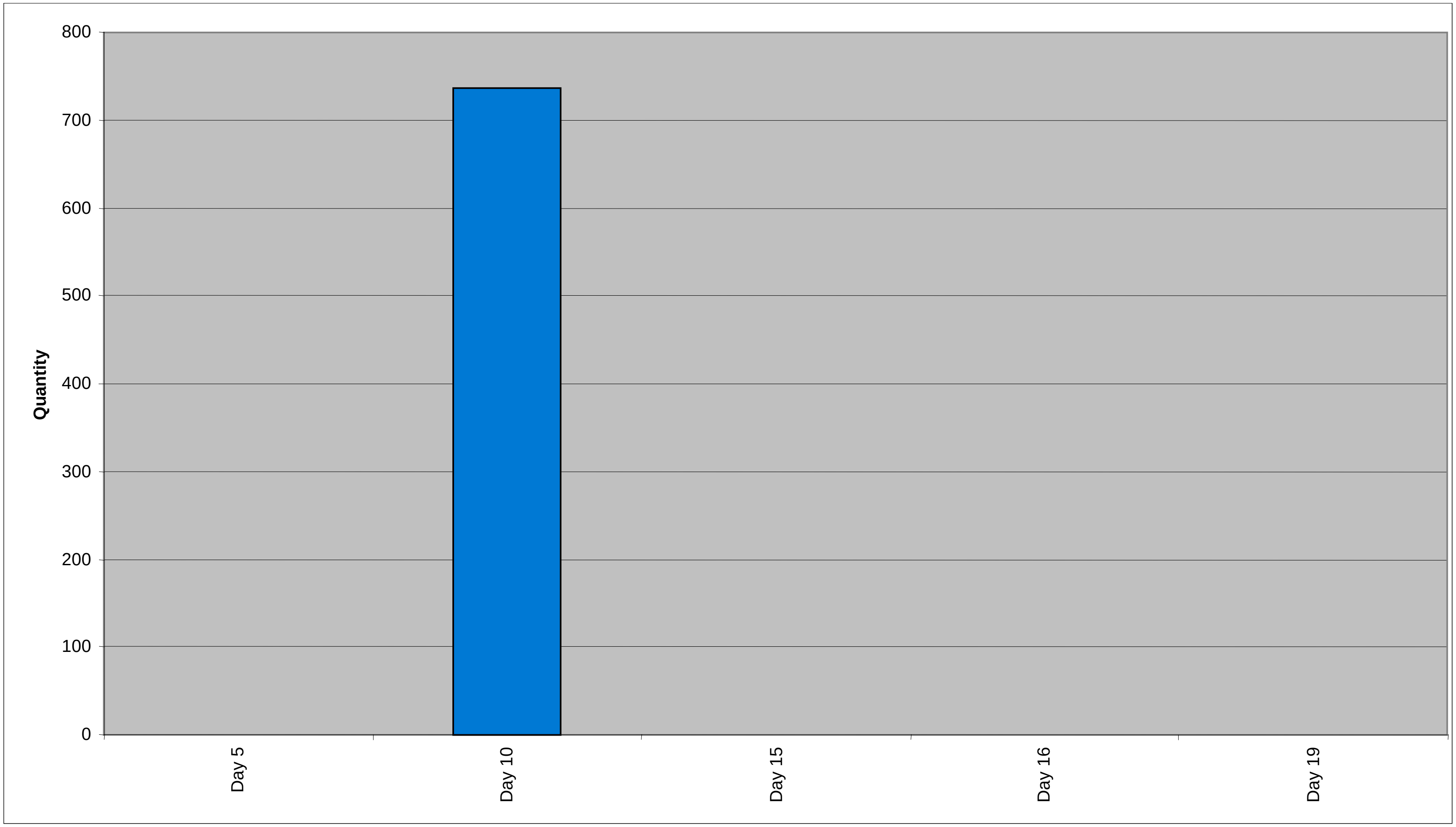
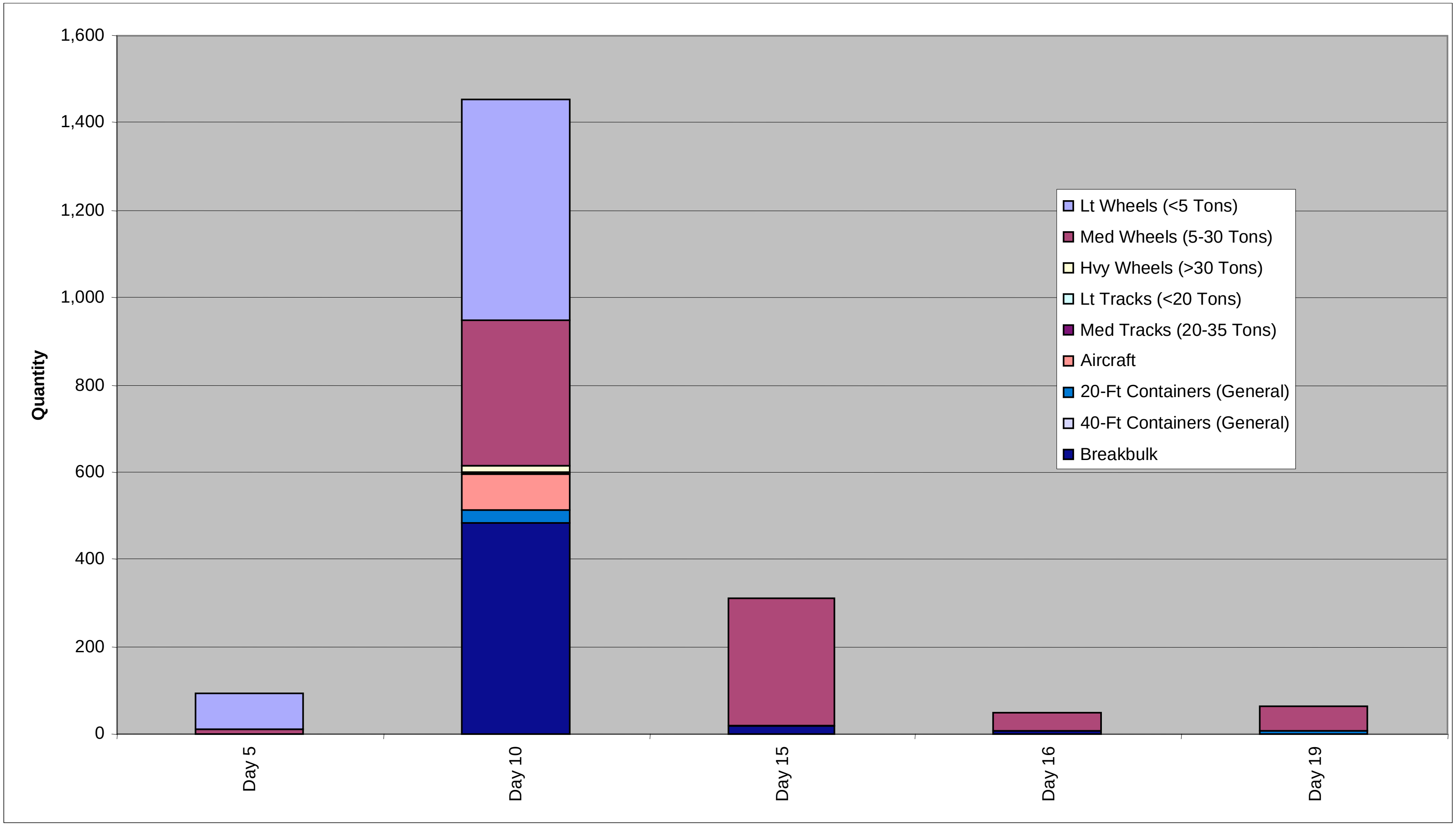


Figure D-6. Quantity of Convoy Vehicles Arriving at the Port of Morehead City



D-7. Total Quantity of Items Arriving at the Port of Morehead City

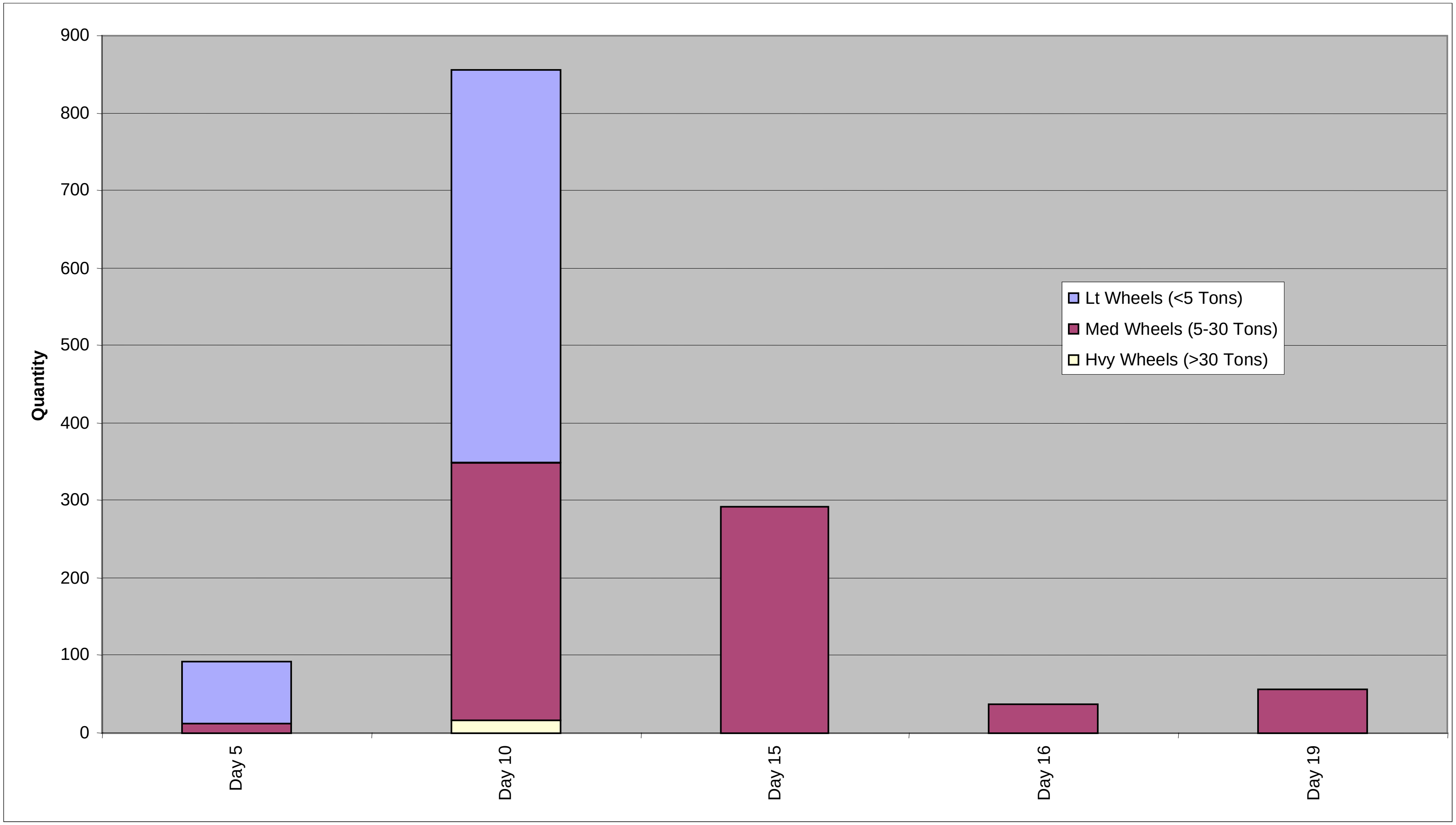


Figure D-8. Quantity of Wheeled Vehicles Arriving at the Port of Morehead City

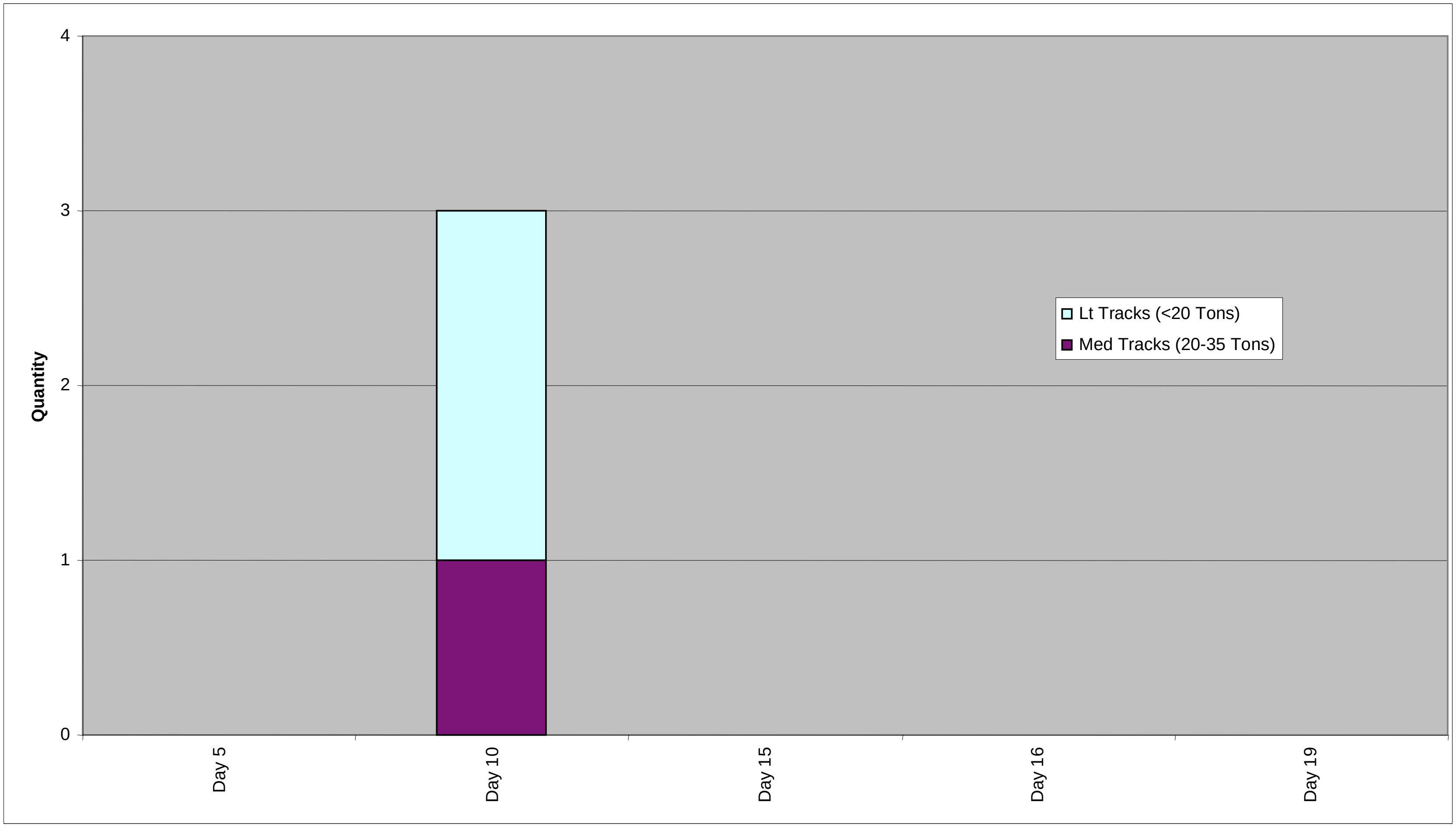


Figure D-9. Quantity of Tracked Vehicles Arriving at the Port of Morehead City

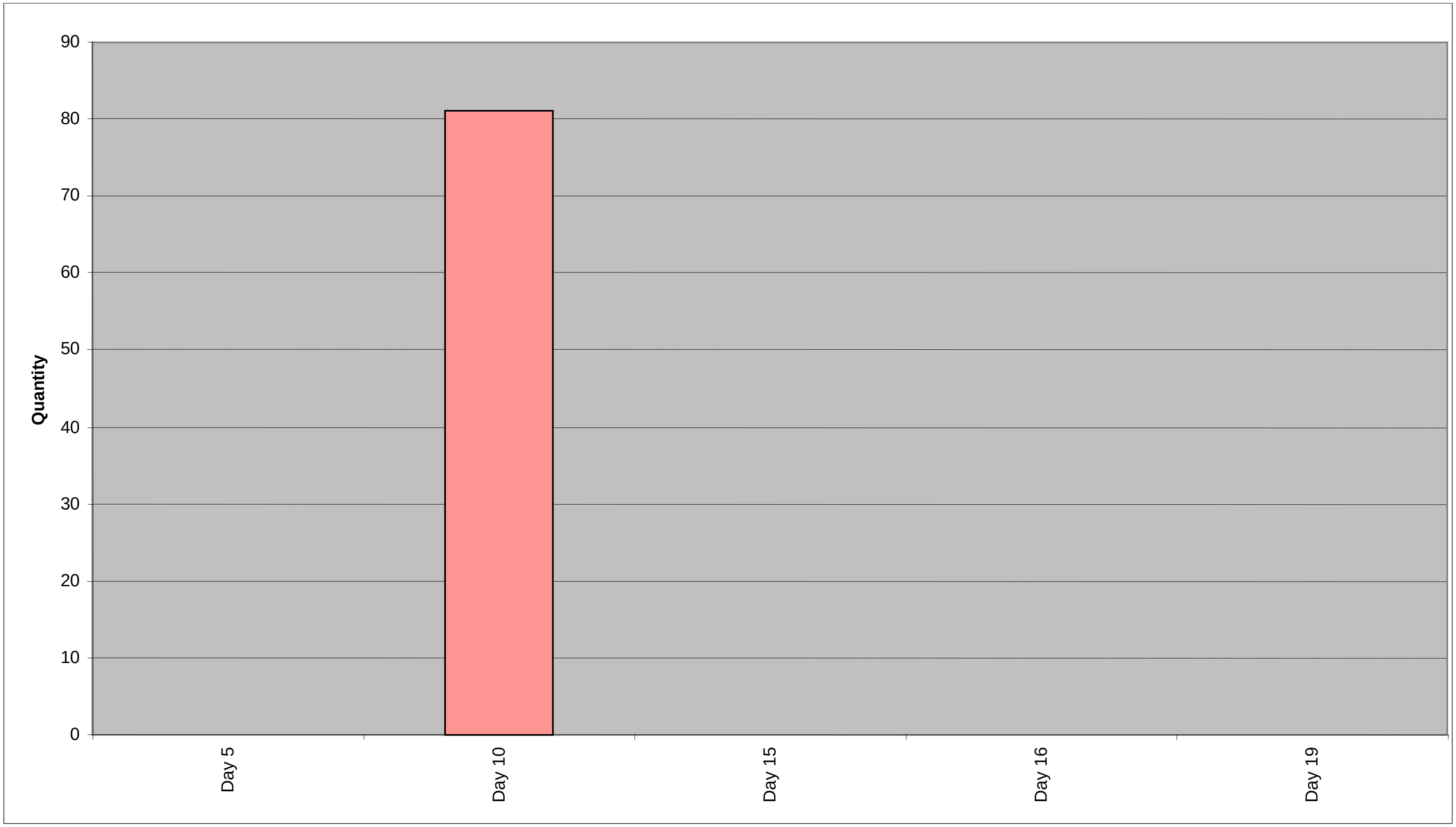


Figure D-10. Quantity of Aircraft Arriving at the Port of Morehead City

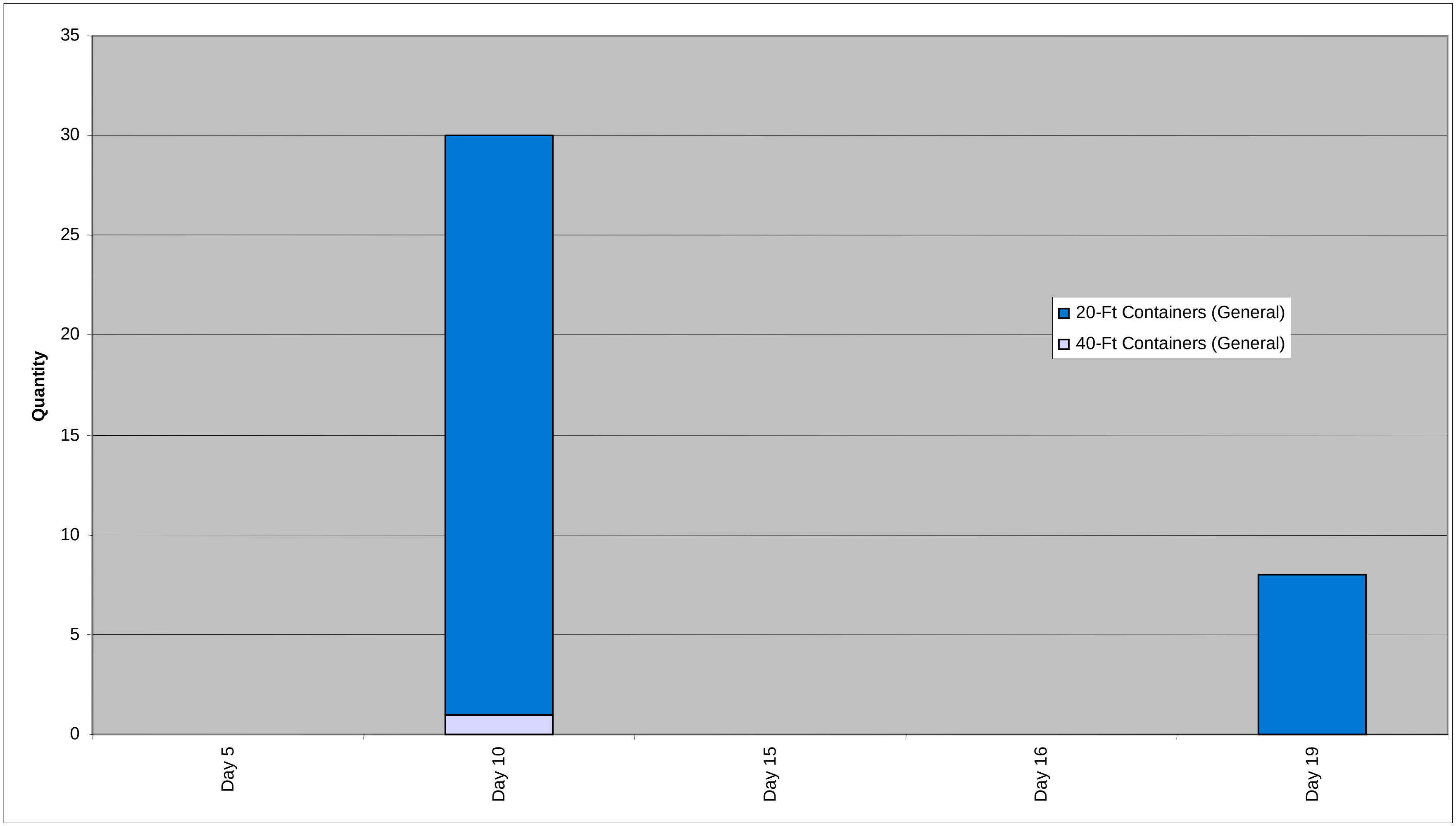


Figure D-11. Quantity of Containers Arriving at the Port of Morehead City

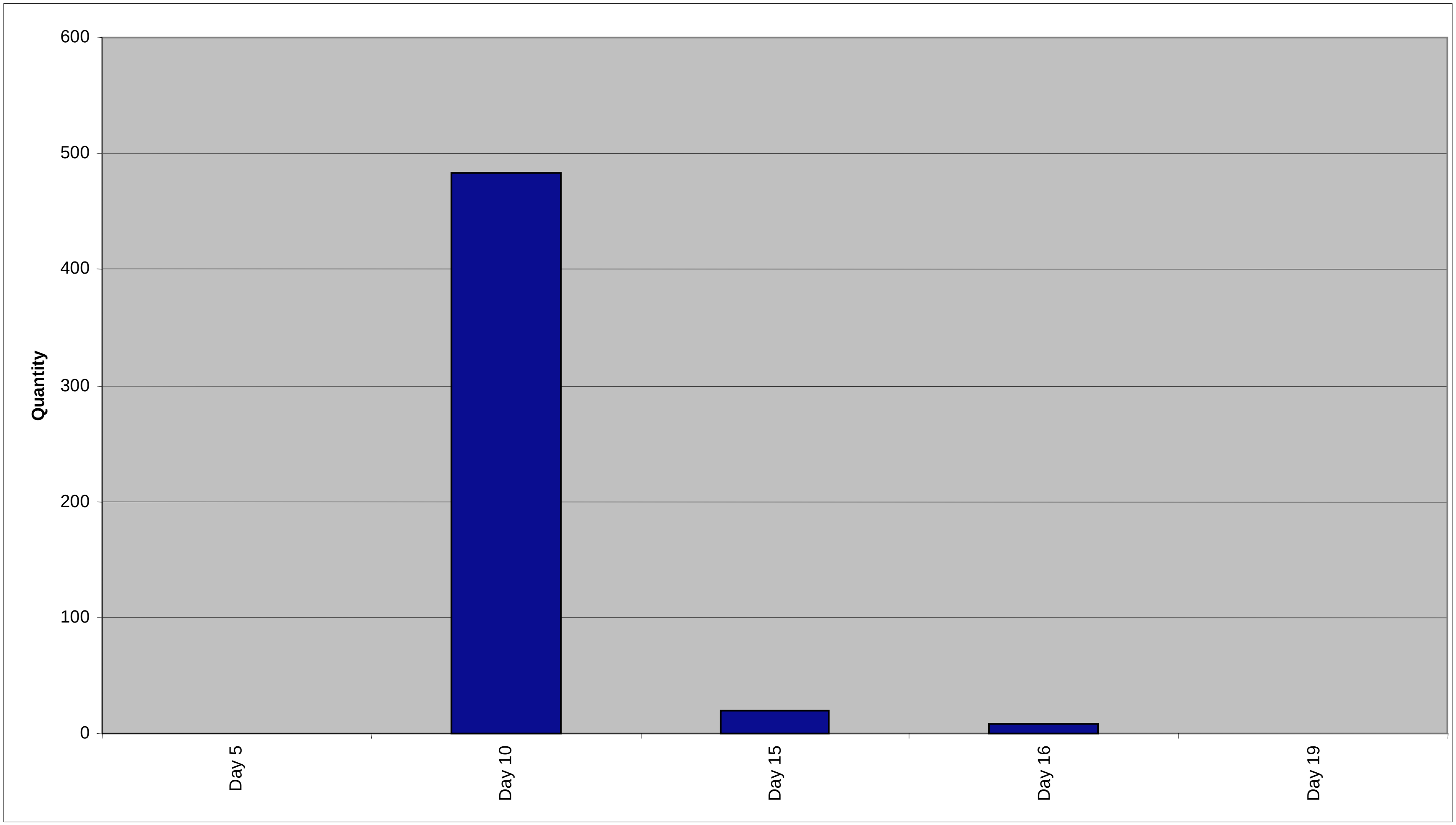


Figure D-12. Quantity of Breakbulk Cargo Items Arriving at the Port of Morehead City

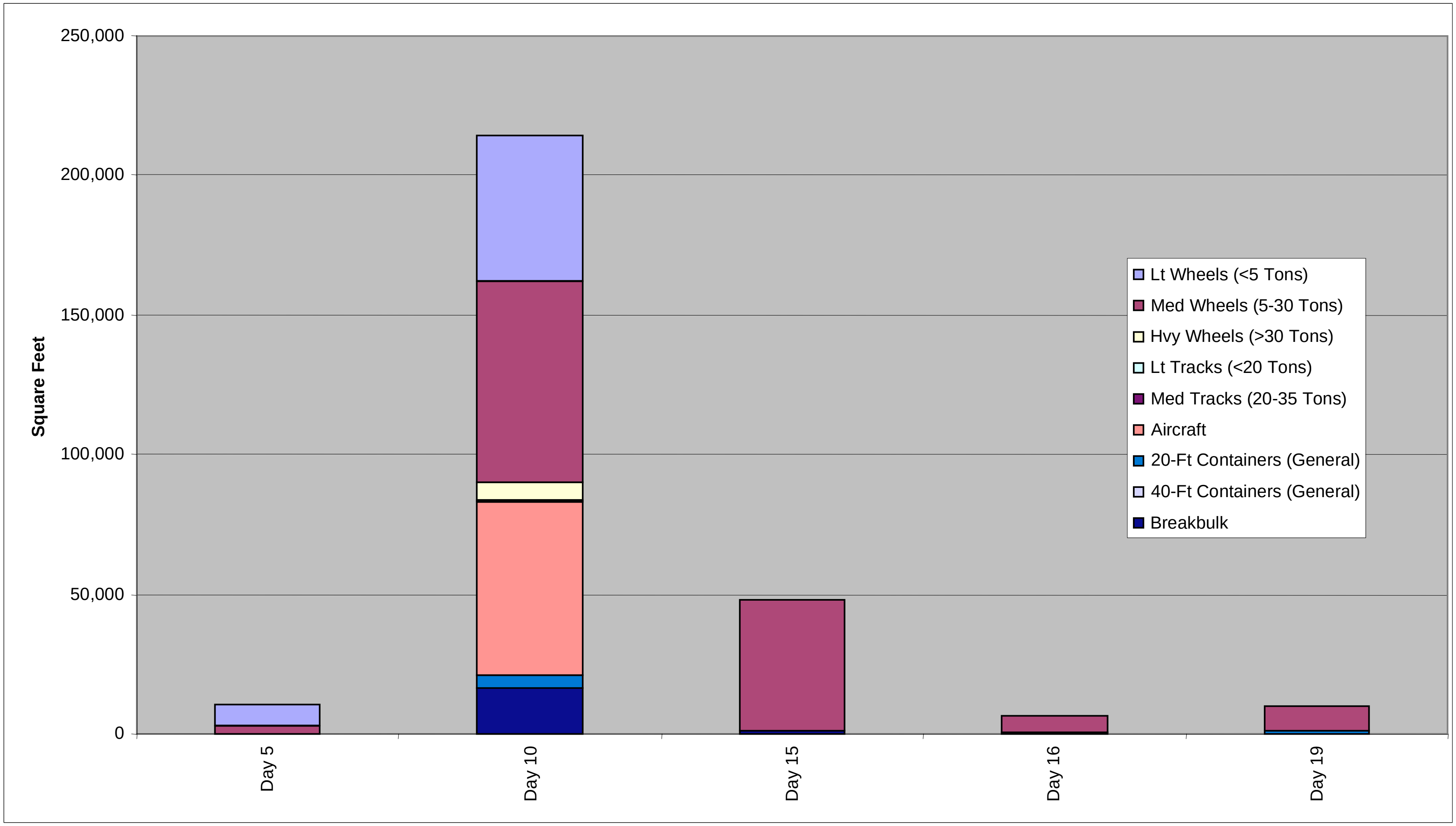


Figure D-13. Total Square Feet of Cargo Arriving at the Port of Morehead City

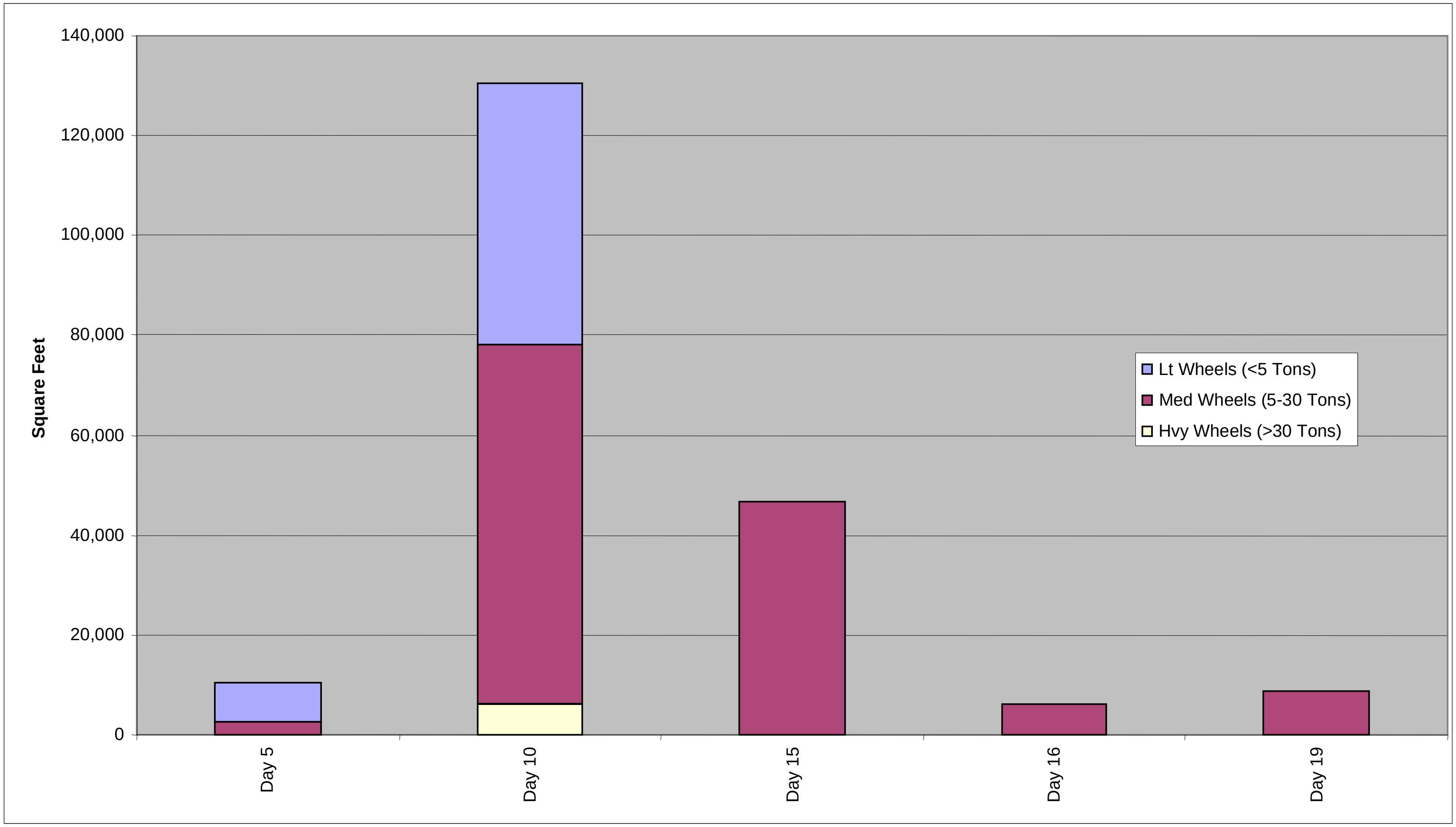


Figure D-14. Square Feet of Wheeled Vehicles Arriving at the Port of Morehead City

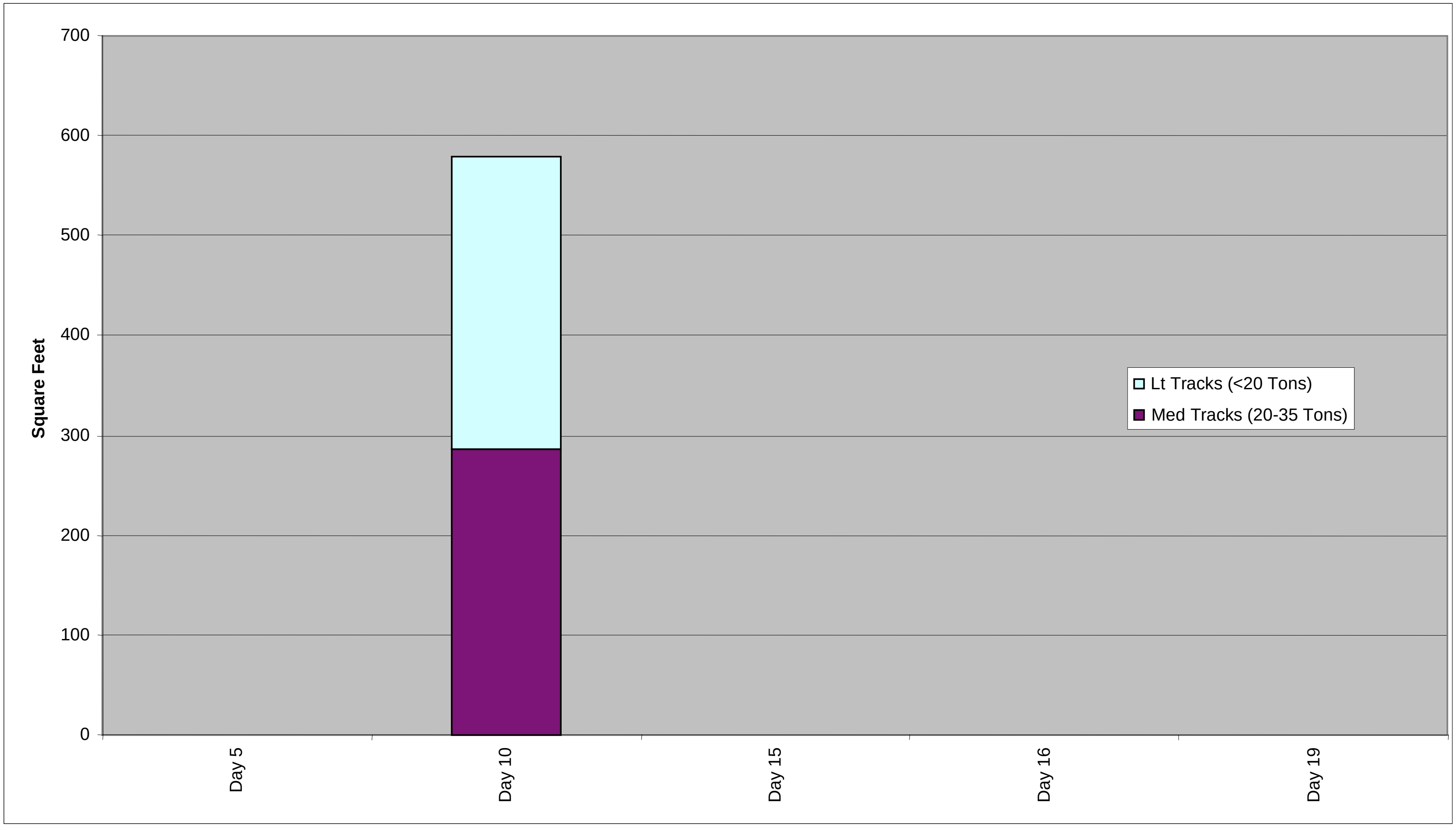


Figure D-15. Square Feet of Tracked Vehicles Arriving at the Port of Morehead City

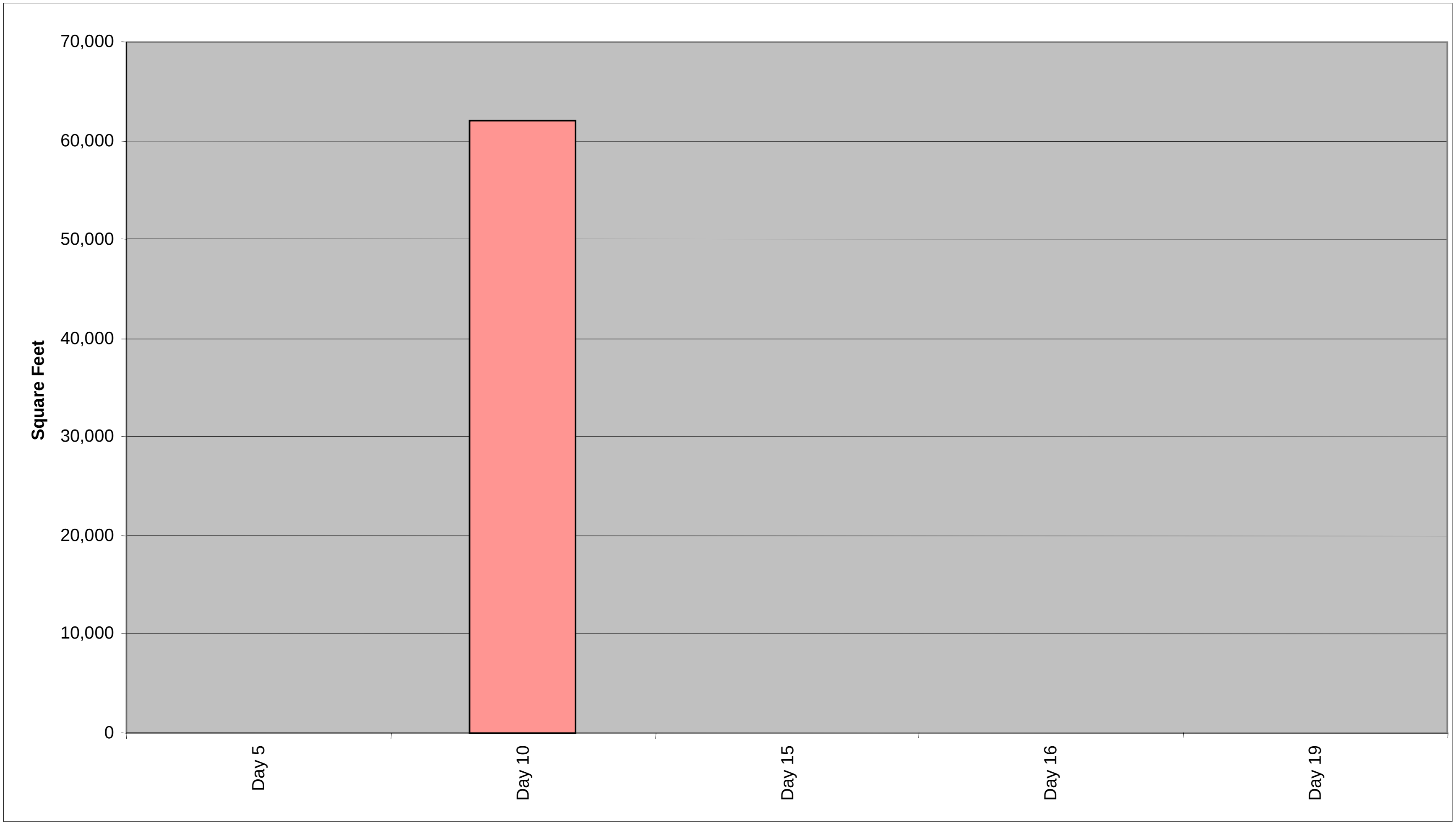


Figure D-16. Square Feet of Aircraft Arriving at the Port of Morehead City

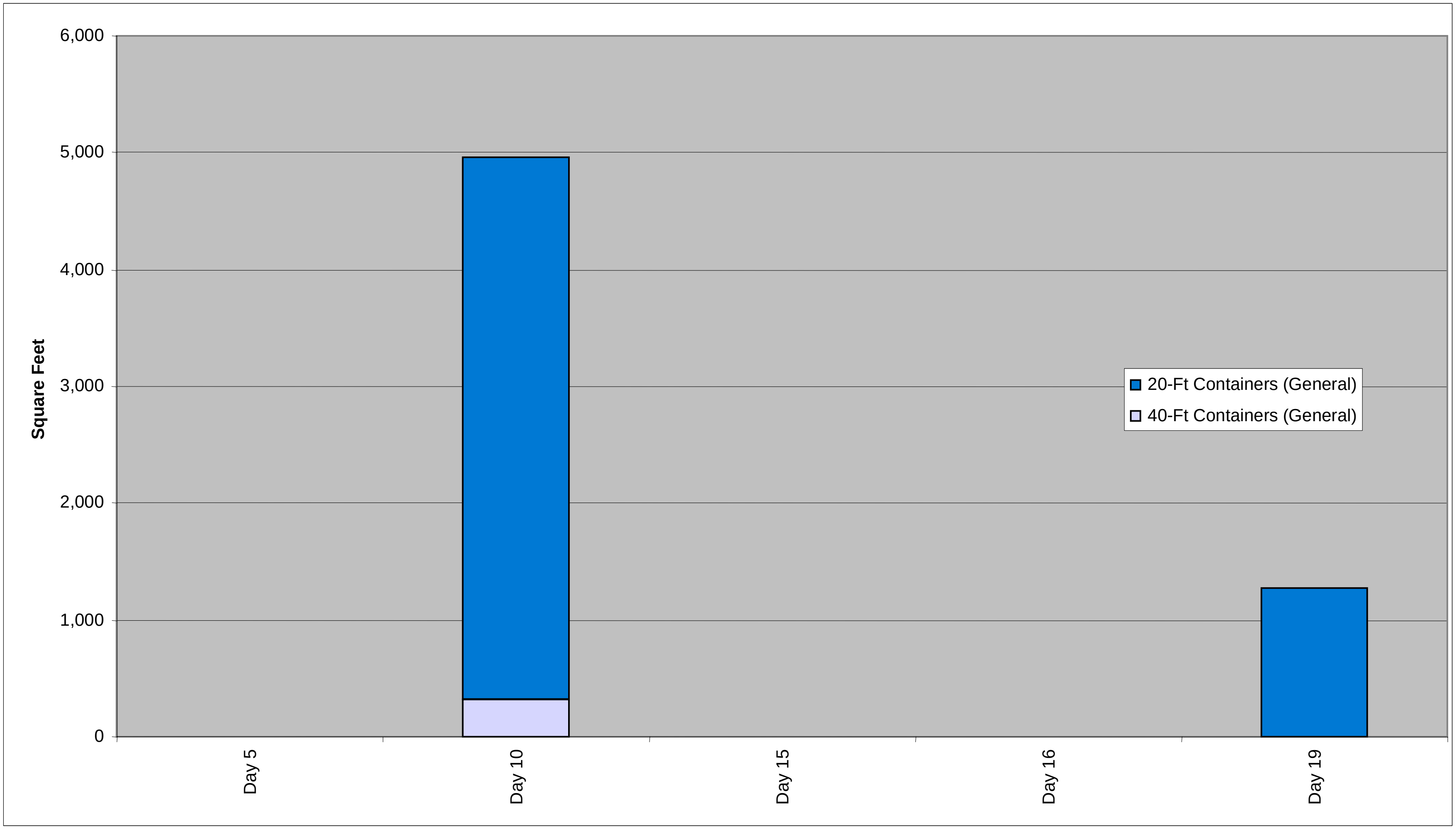


Figure D-17. Square Feet of Containers Arriving at the Port of Morehead City

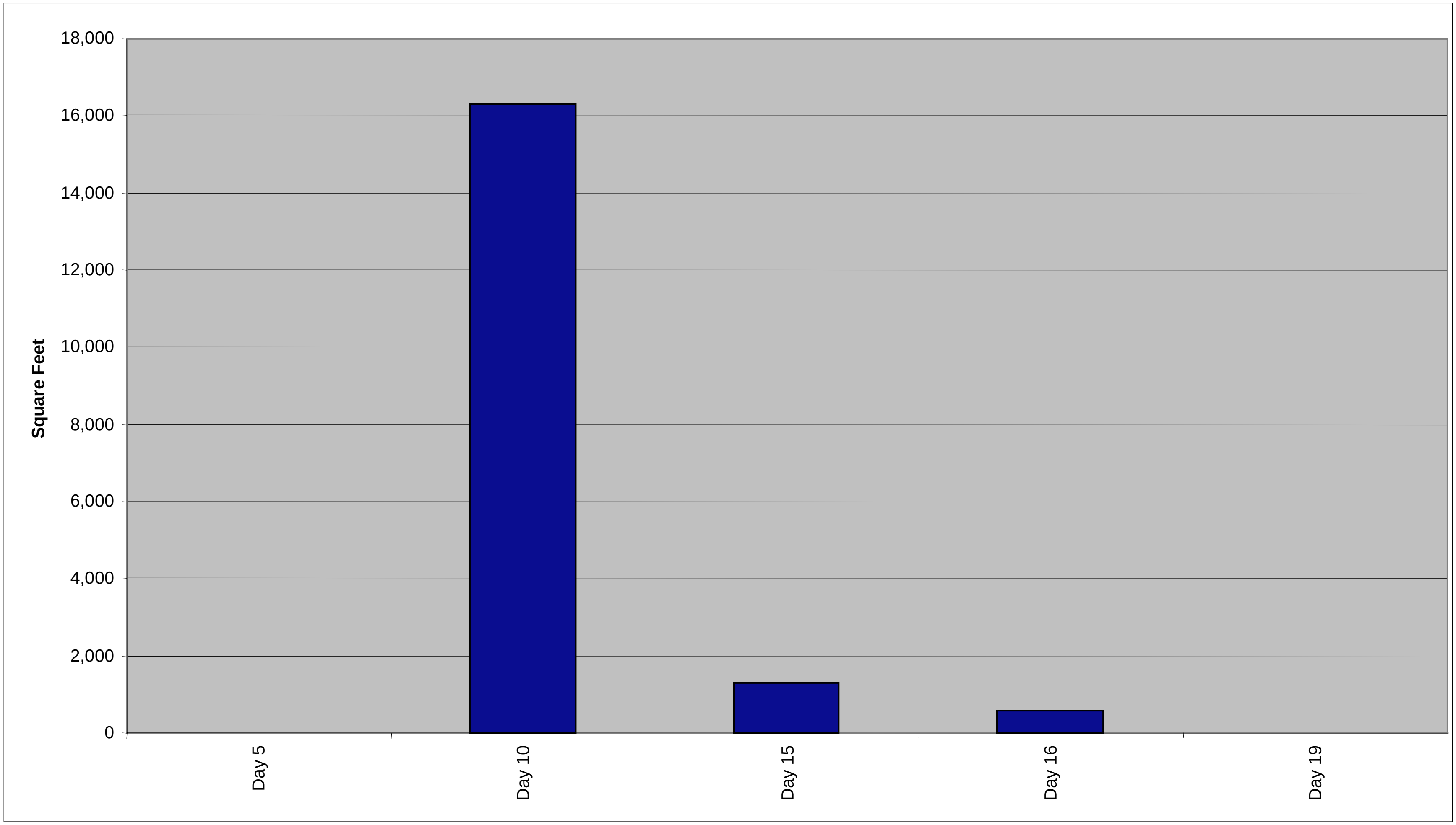


Figure D-18. Square Feet of Breakbulk Cargo Items Arriving at the Port of Morehead City

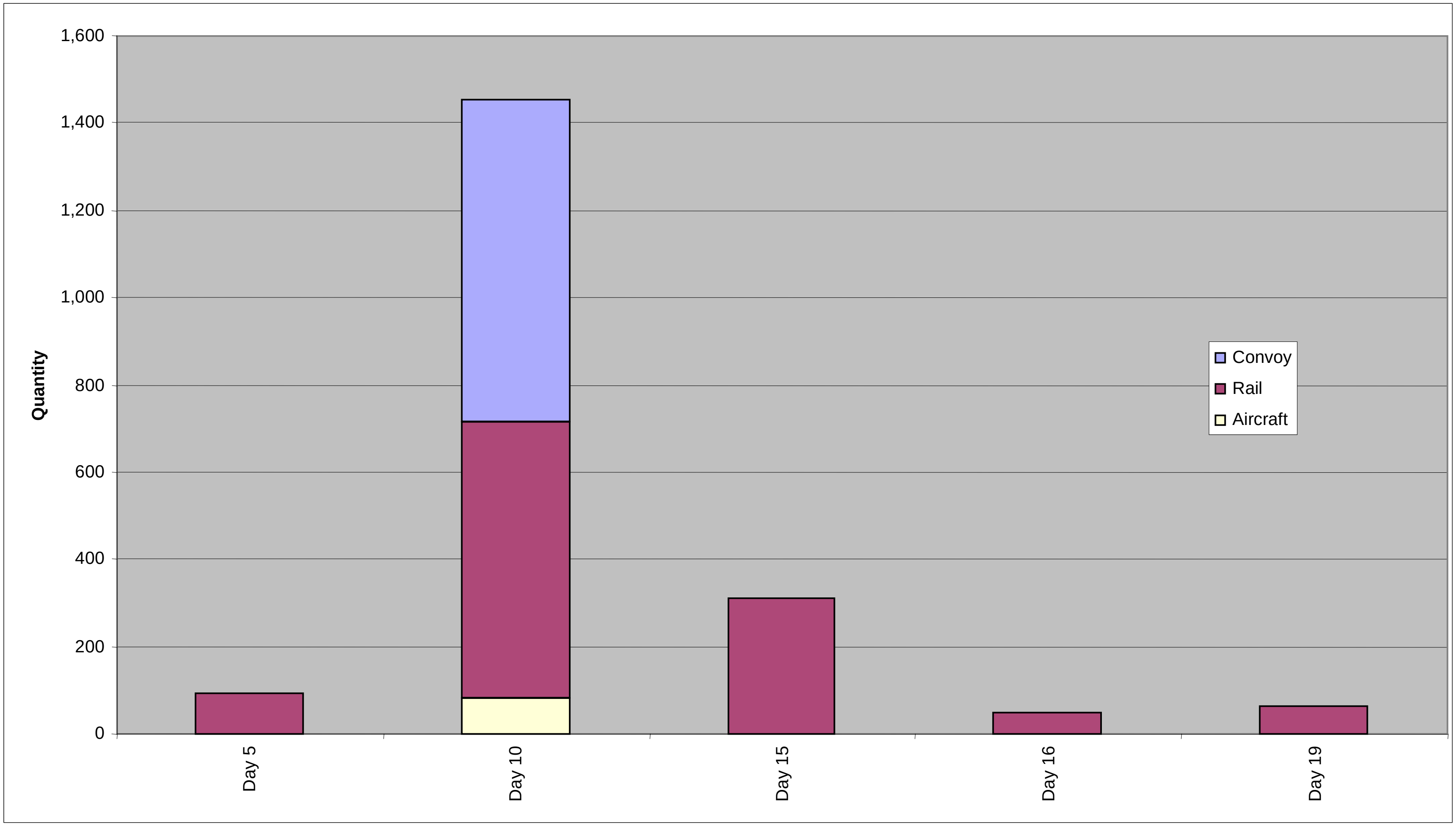


Figure D-19. Quantity of Cargo Items Arriving by Mode to the Port of Morehead City

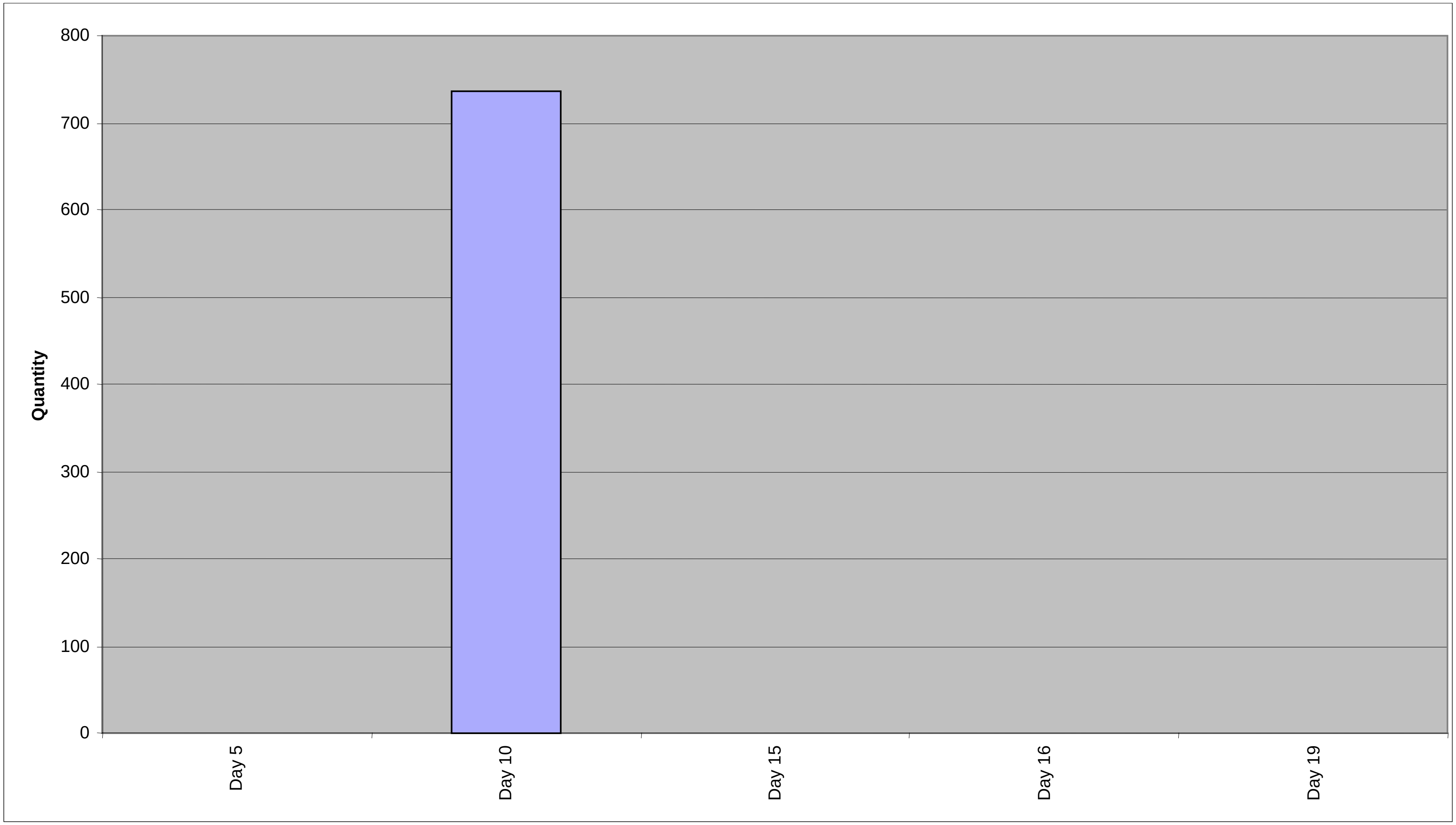


Figure D-20. Quantity of Wheeled Vehicles Convoying to the Port of Morehead City

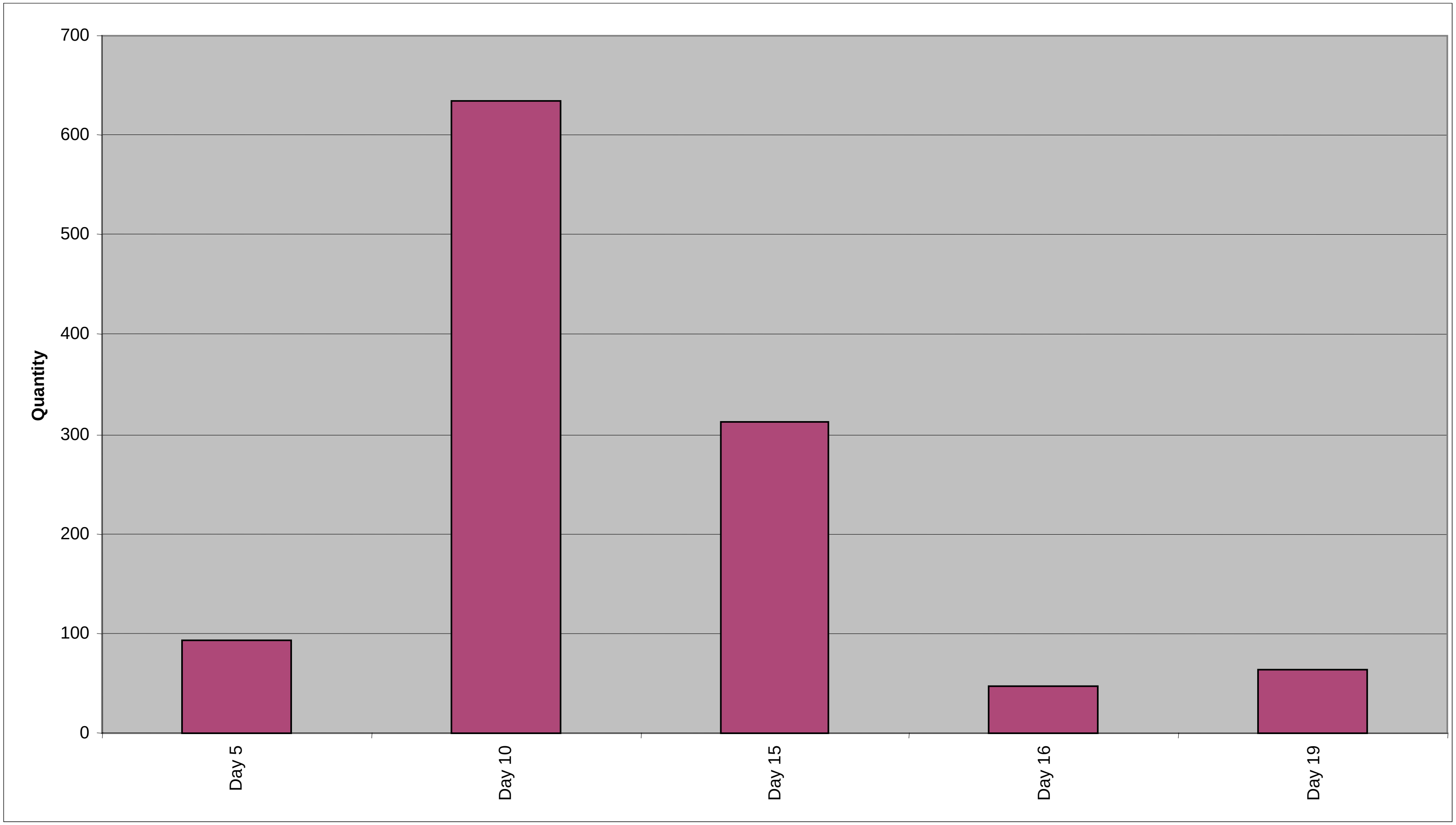


Figure D-21. Quantity of Items Arriving by Rail to the Port of Morehead City

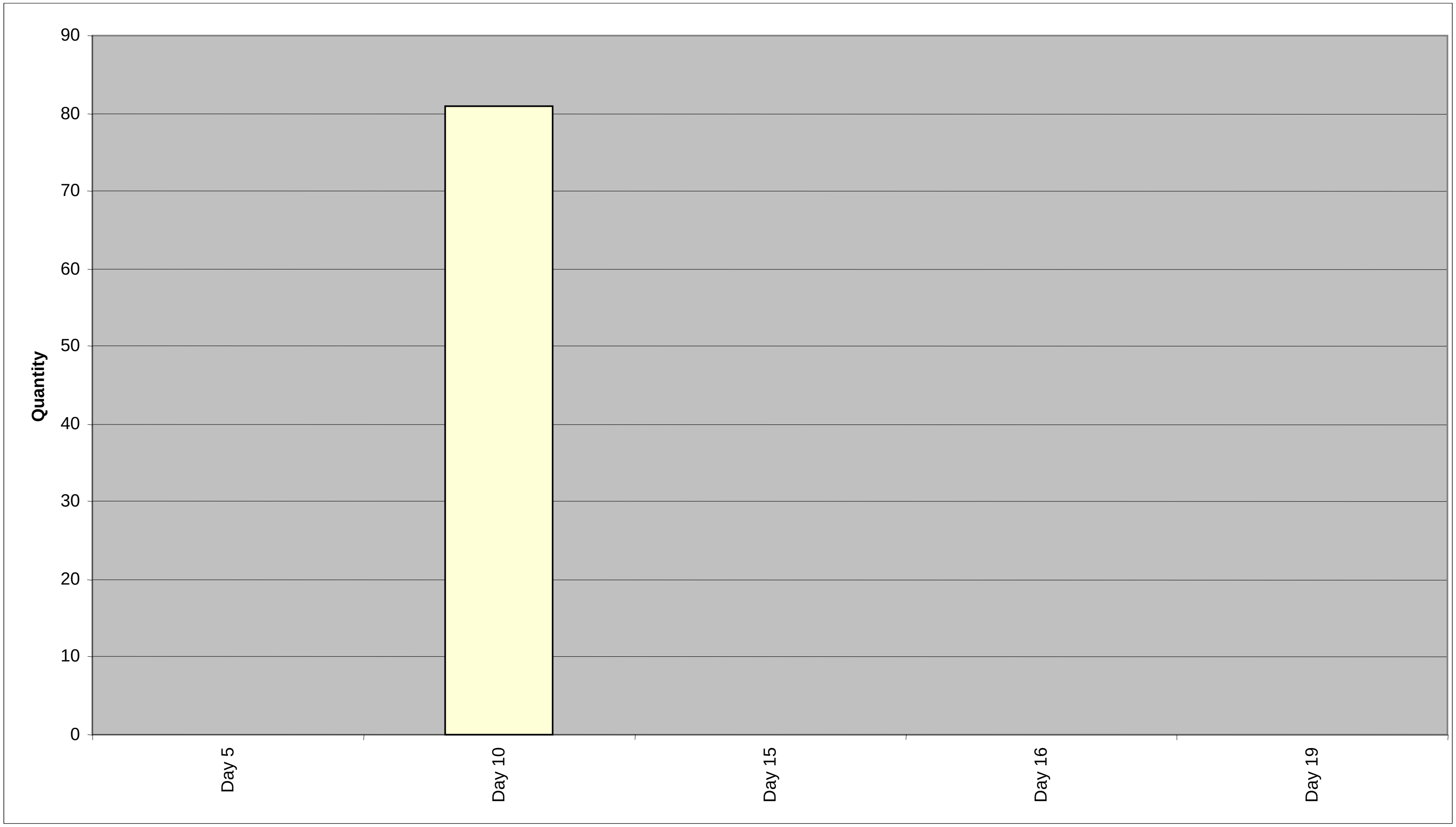


Figure D-22. Quantity of Aircraft Self-Deploying to the Port of Morehead City

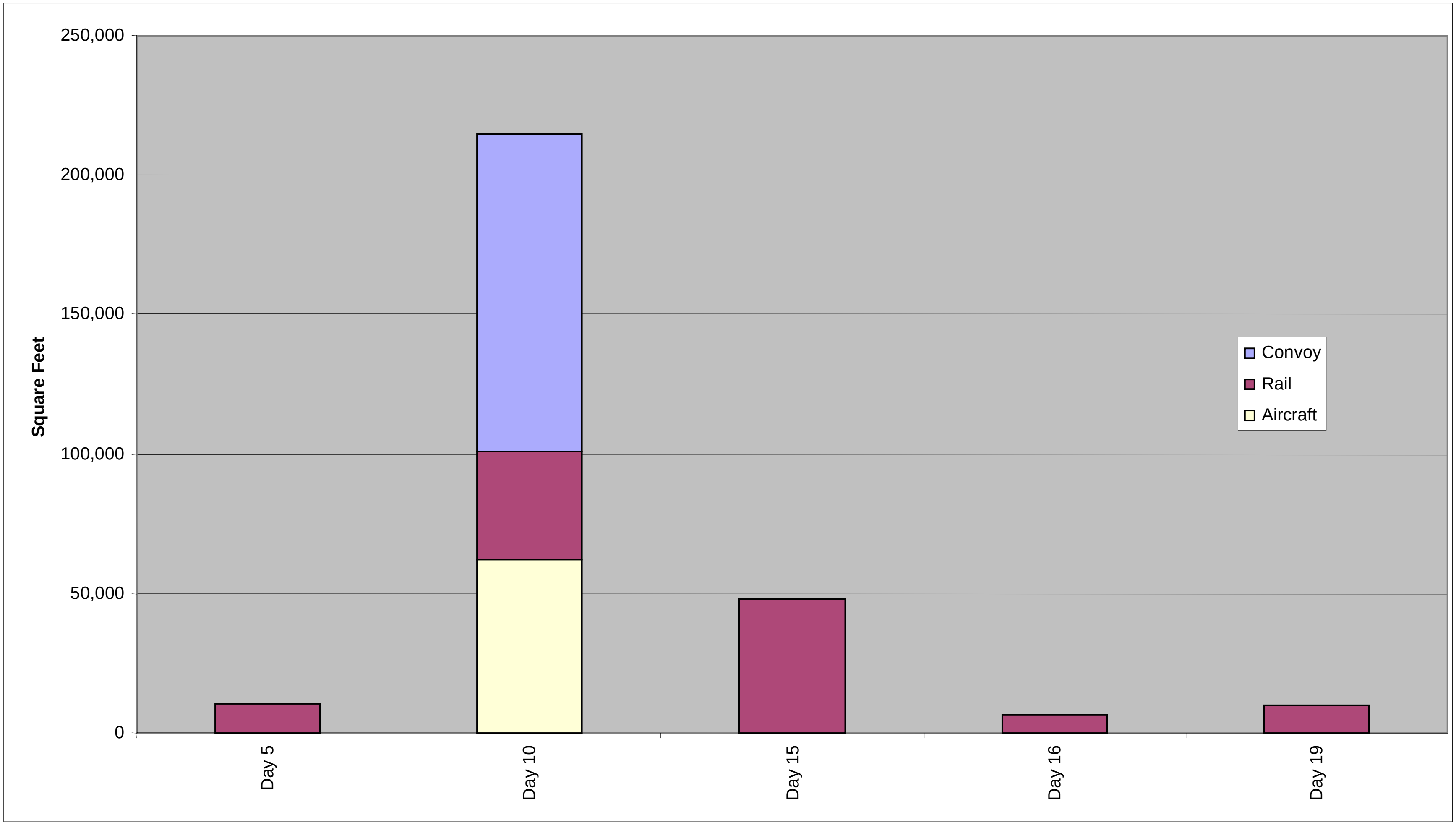


Figure D-23. Square Feet of Cargo Items Arriving by Mode tothe Port of Morehead City

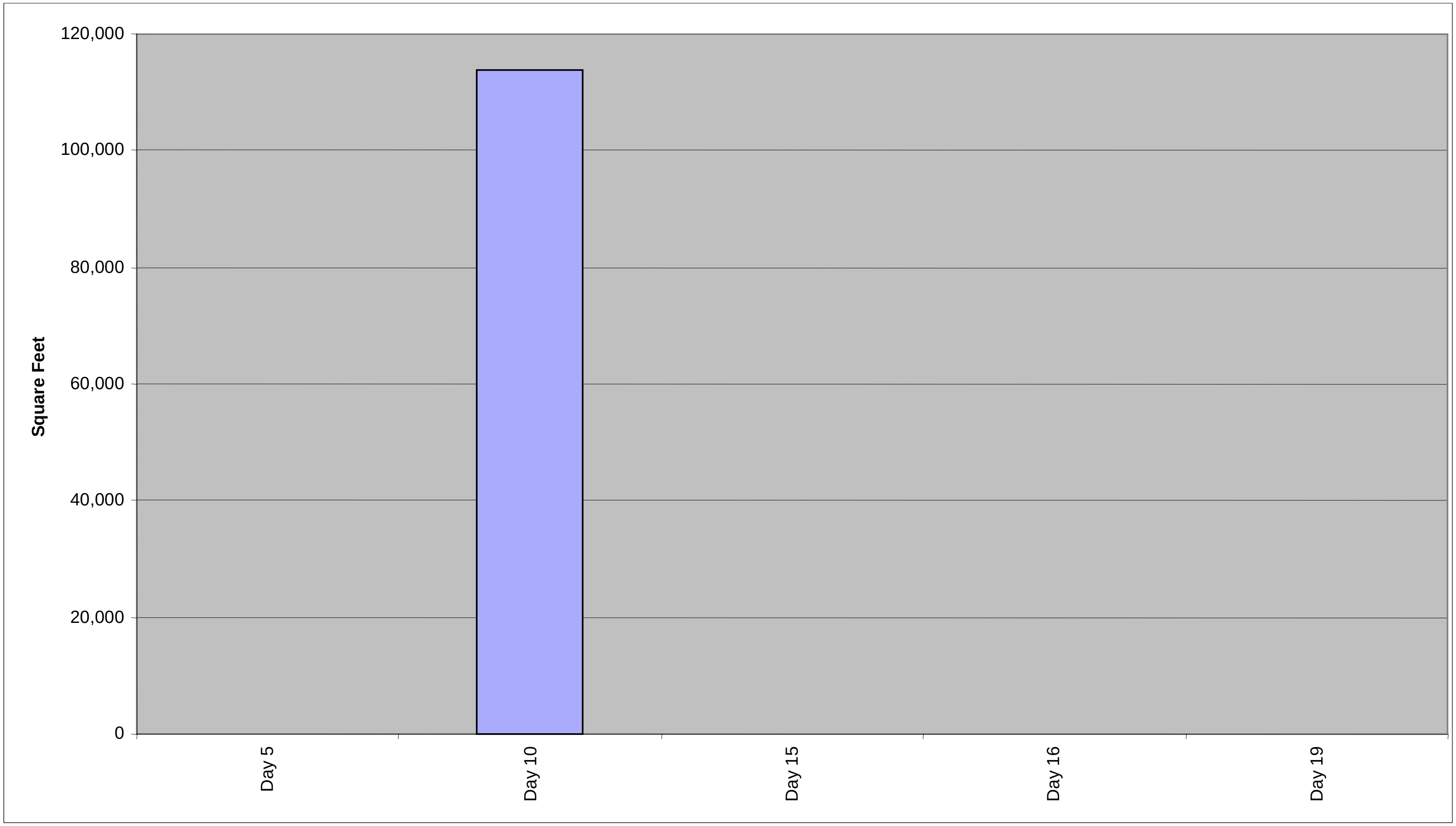


Figure D-24. Square Feet of Wheeled Vehicles Convoying to the Port of Morehead City

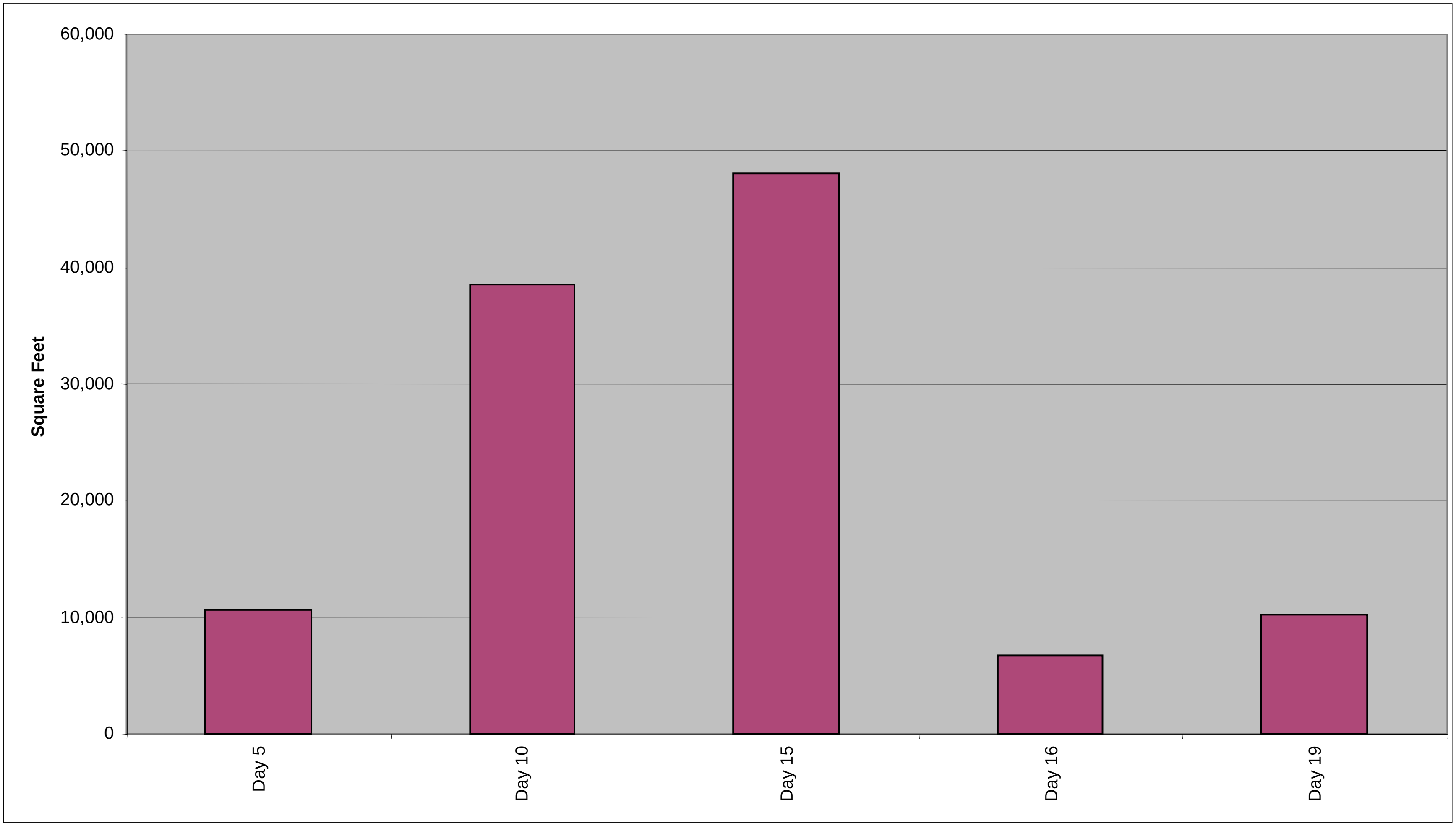


Figure D-25. Square Feet of Cargo Items Arriving by Rail to the Port of Morehead City

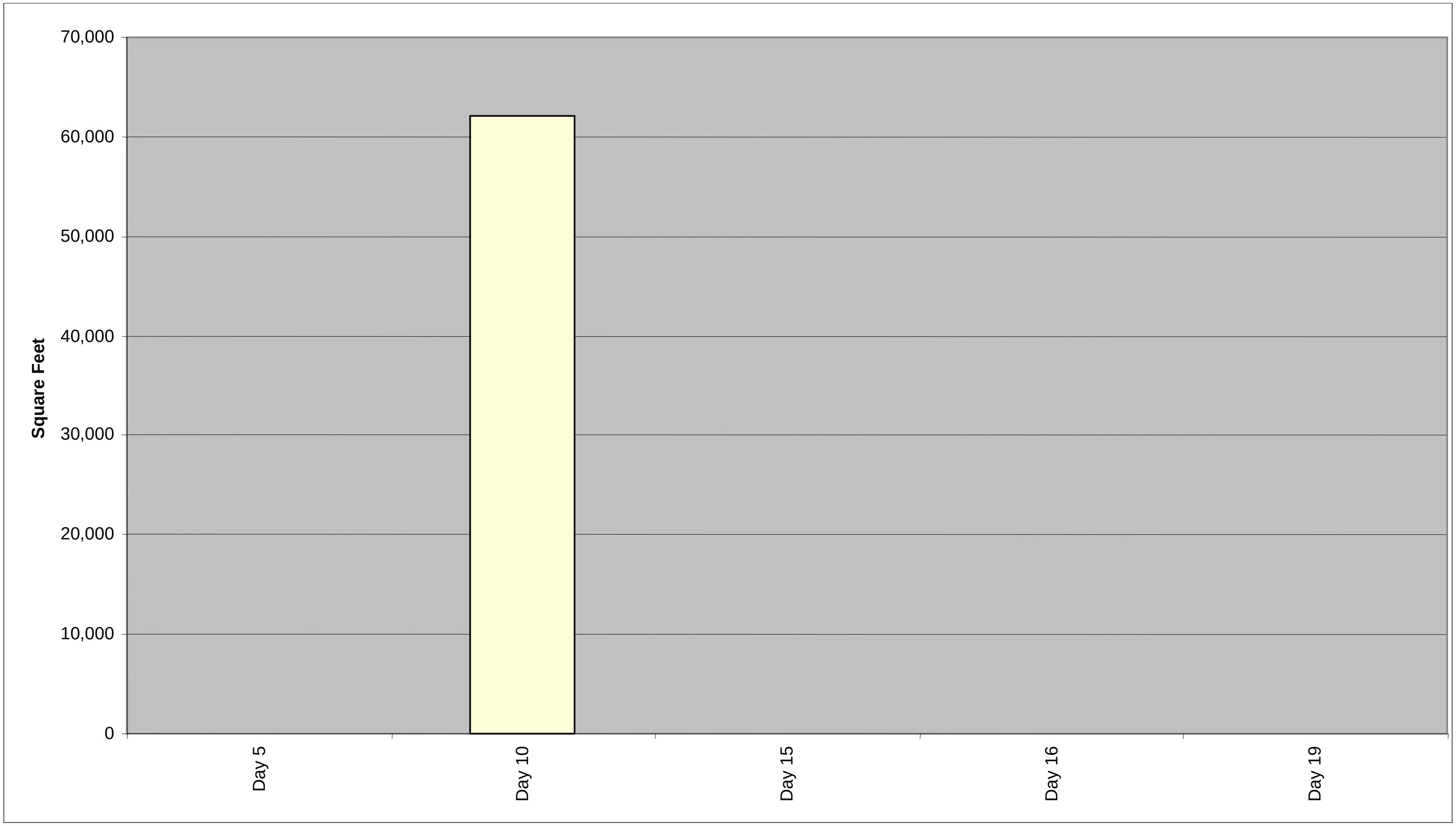


Figure D-26. Square Feet of Aircraft Self-Deploying to the Port of Morehead City

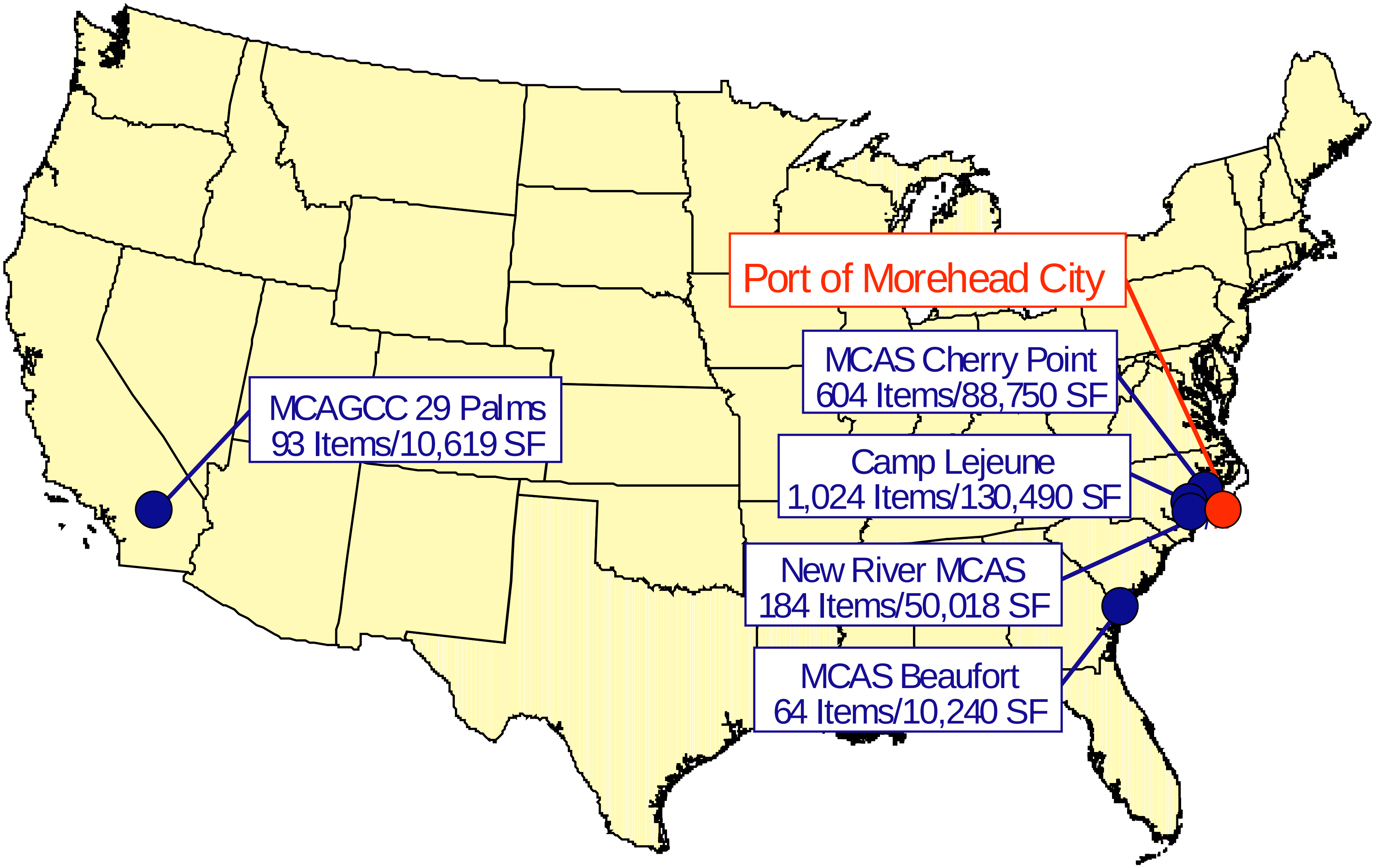


Figure D-27. Amount of Cargo Arriving at the Port of Morehead City by Origin

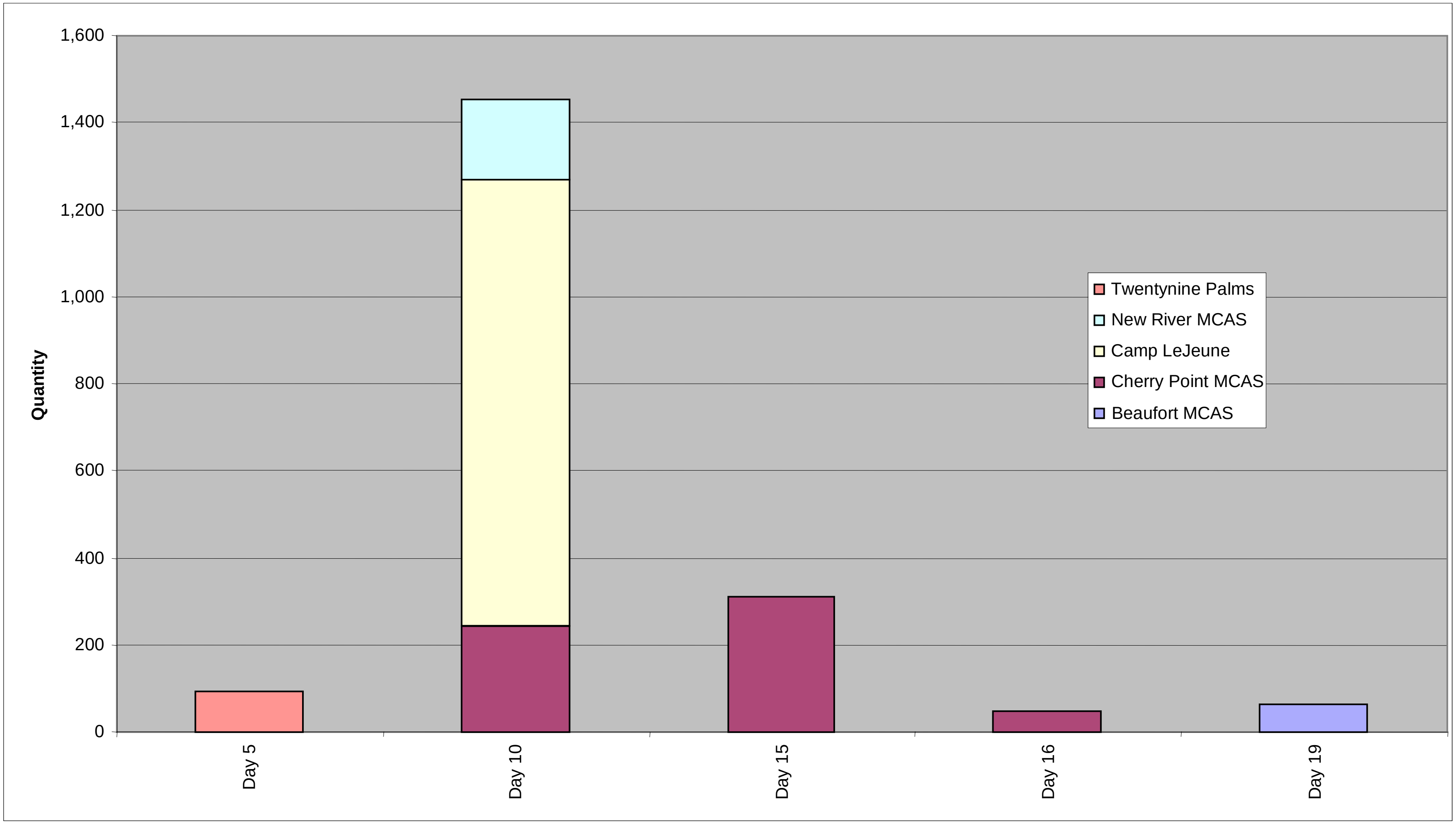


Figure D-28. Quantity of Items Arriving at the Port of Morehead City by Origin

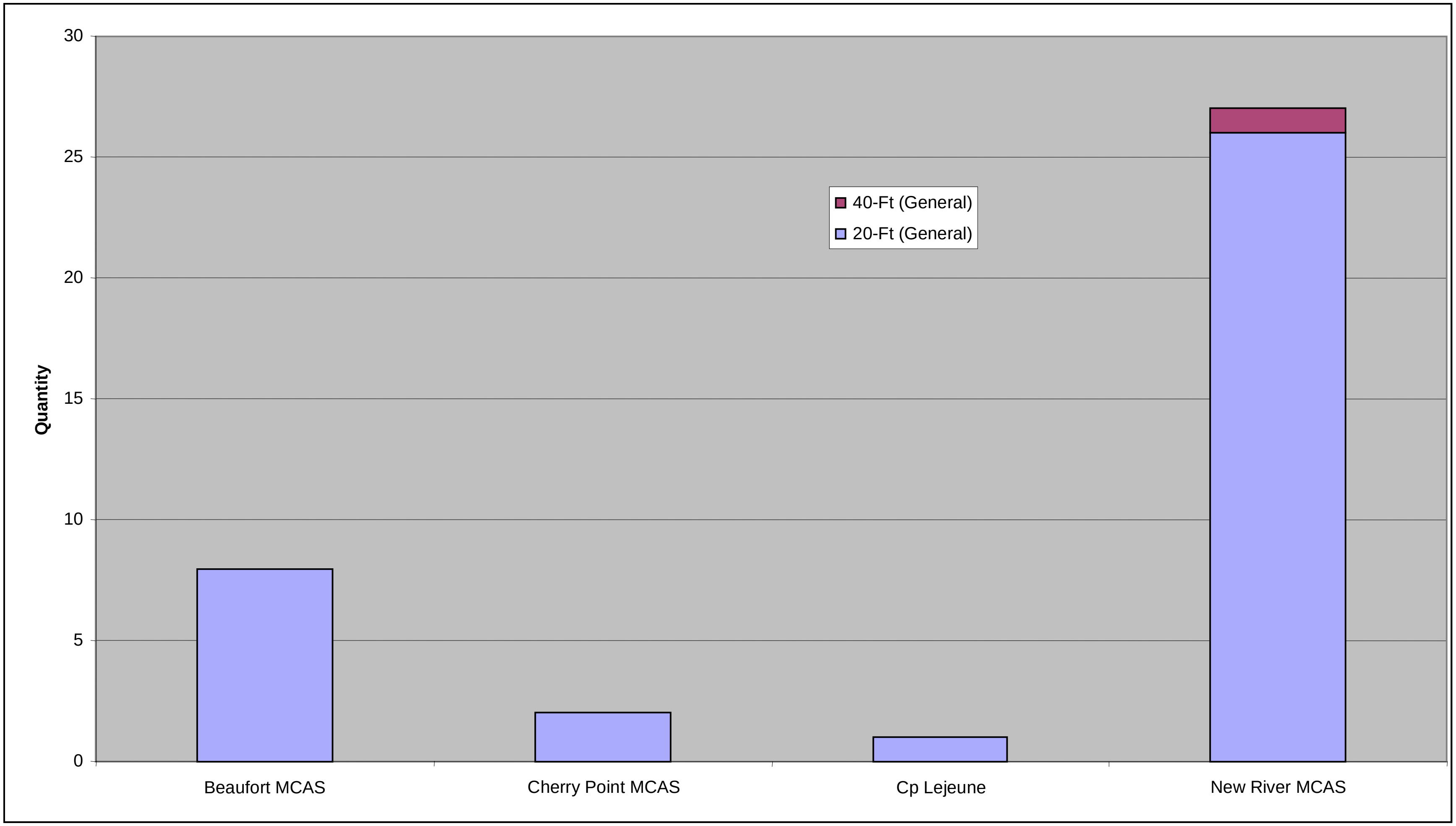


Figure D-29. Quantity of Containers Arriving at the Port of Morehead City by Origin

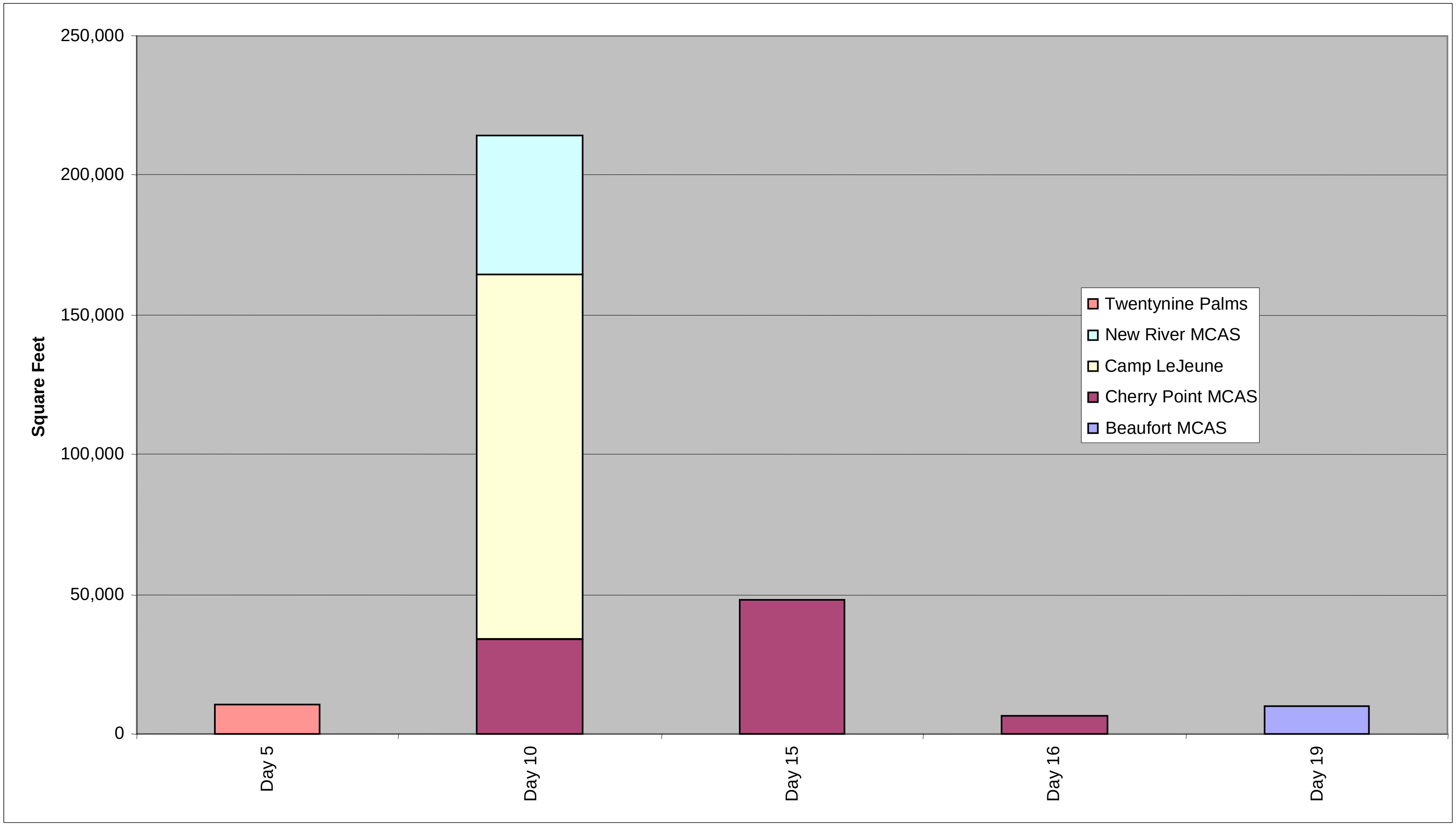


Figure D-30. Square Feet of Cargo Arriving at the Port of Morehead City by Origin

APPENDIX E

PORT OF NEW YORK/NEW JERSEY

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As a general rule, the Port Workload Requirements are derived directly from the TPFDD. Some necessary editing, in the form of "cleaning up" data, is performed. This, however, does not in any way change the intent of the requirement spelled out in the TPFDD. Instead, it contributes to the accuracy of the final result. This is not the case for the analysis of cargo deploying through the Port of New York/New Jersey. For a variety of reasons, the TPFDD does not show units from Fort Drum deploying through the Port of New York/New Jersey. These units, instead, are scheduled to deploy through the Port of Wilmington, North Carolina. Based on discussions with MTMC HQ, MTMC DSC, and others, we decided to "adjust" the requirements for the Port of New York/New Jersey to include units from Fort Drum. We believe this enhances both the accuracy and the integrity of the port's workload requirements.

According to the TPFDD, there are in excess of 20 origins sending cargo to the Port of New York/New Jersey, as shown in Figure E-1. The Port of New York/New/Jersey receives a mix of Army, Navy, Air Force, Marine Corps, and Joint sustainment cargo. All aircraft self-deploy to the port. Origins in excess of 400 miles send all of their cargo to the port by rail. Origins within 400 miles convoy their roadable vehicles to the port and send everything else by rail. Figures E-2 through E-6 show the quantity of transports (containers, railcars, self-deploying aircraft, and convoying vehicles) scheduled to move to the Port of New York/New Jersey.

Figures E-7 through E-12 illustrate the quantity of items arriving at the port. Figure E-7 is the total quantity of items. Figures E-8 through E-12 break this down into more detail. Figures E-8 and E-9 are the quantity of vehicles arriving at the port. Figure E-8 outlines the wheeled vehicles and Figure E-9 lays out the tracked vehicles. These vehicles are further broken into categories, as shown in Table 1. Figure E-10 shows the quantity of aircraft arriving at the port. These are all UH-60 helicopters, and all move to the Port of New York/New Jersey under their own power. Figures E-11 and E-12 outline the number of containers and breakbulk cargo items, respectively, arriving at the port.

Similar to Figures E-7 through E-12, which lay out the quantity of items arriving, Figures E-13 through E-18 outline the square footage of these categories of cargo.

Figures E-19 through E-26 show how cargo is arriving at the Port of New York/New Jersey. Figures E-19 through E-22 show the number of cargo items arriving by convoy, rail, or self-deploying (aircraft). Figures E-23 through E-26 show the square footage of cargo arriving by each mode.

As shown in Figure E-1, cargo arrives at the Port of New York/New Jersey from many origins. Figure E-27 shows the amount of cargo coming from each of those origins.

Figures E-28 and E-30 show the quantity of square footage, respectively, of cargo arriving at the Port of New York/New Jersey by origin. Figure 29 is the quantity of containers arriving at the port from each origin.

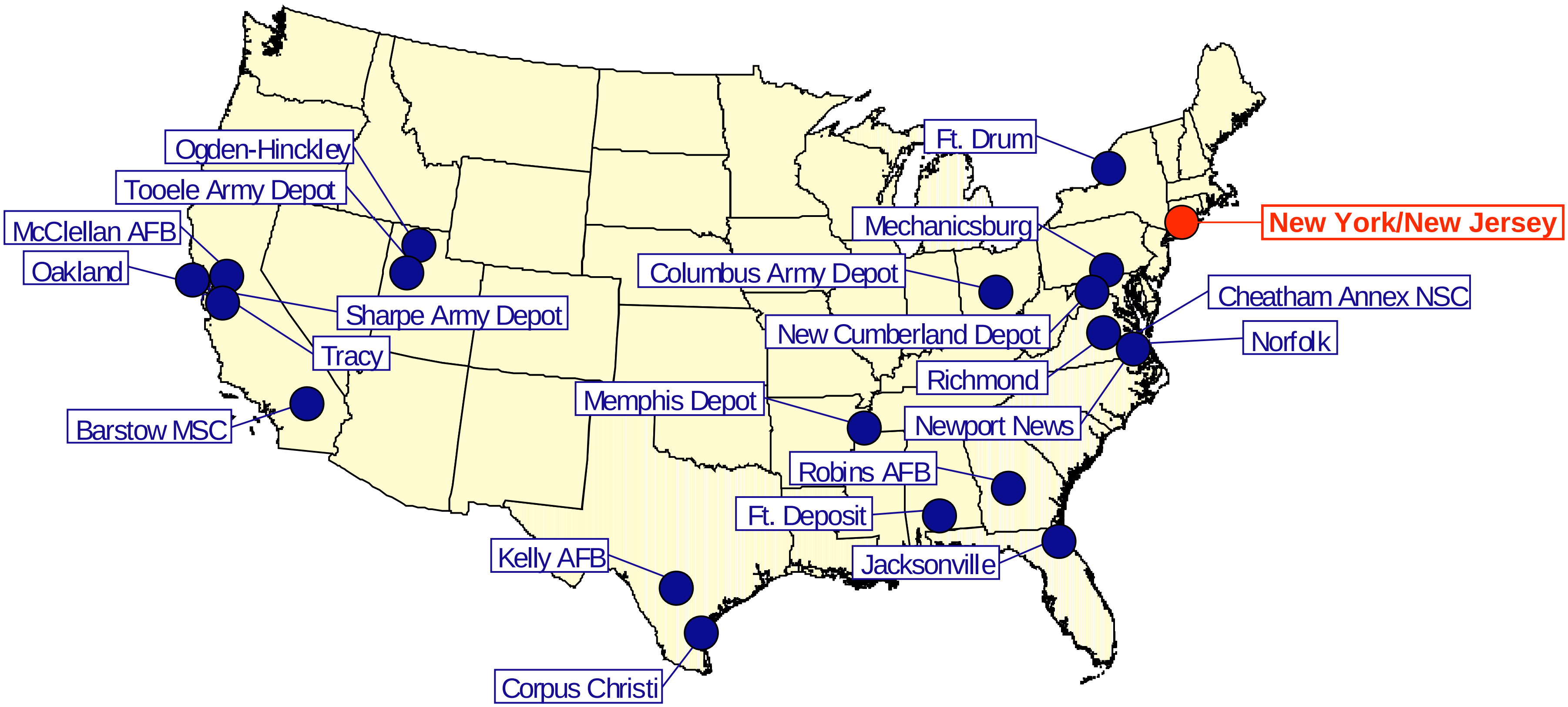


Figure E-1. Cargo Arrives at the Port of New York/New Jersey from many Origins

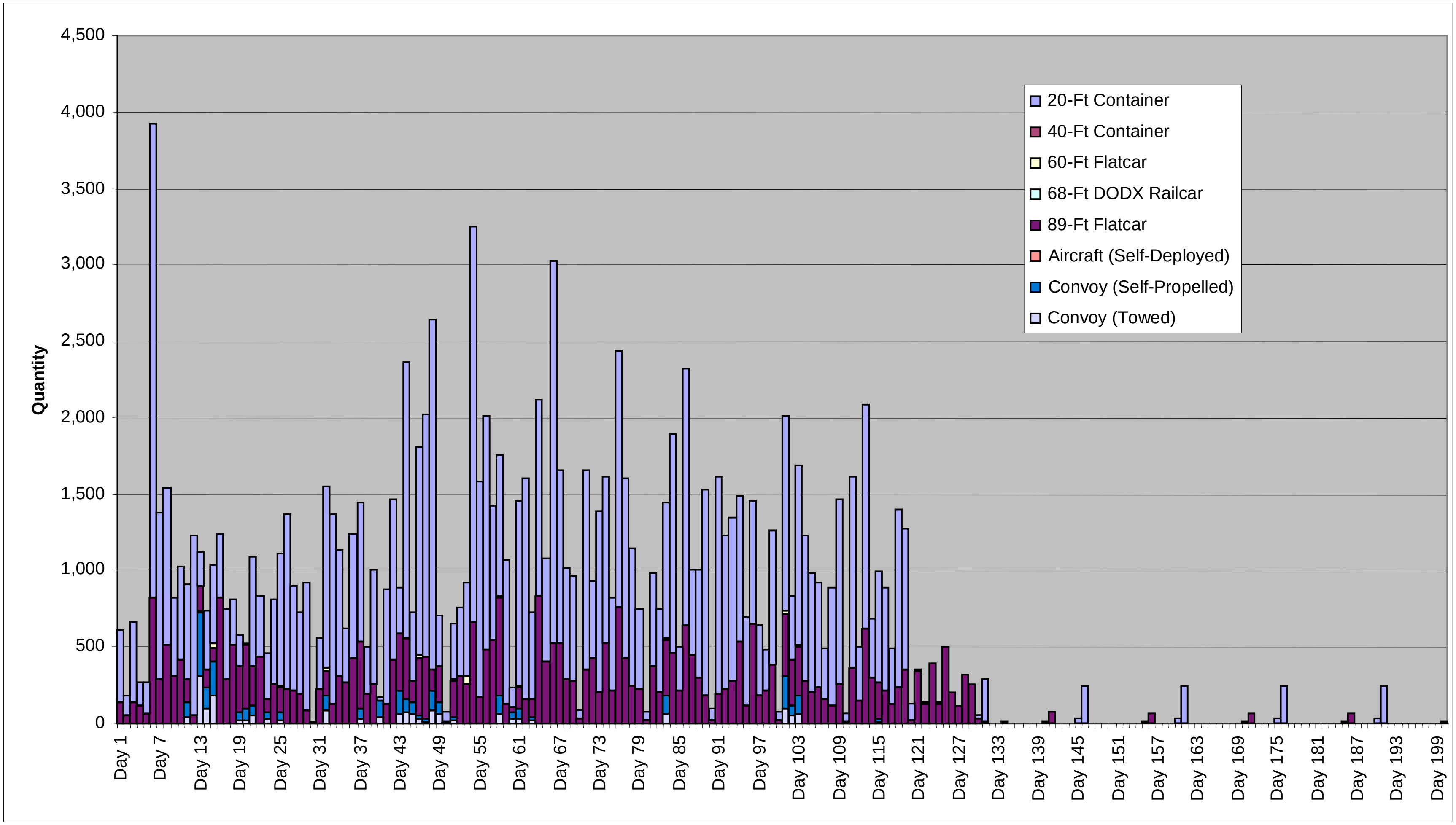


Figure E-2. Total Quantity of Transports Arriving at the Port New York/New Jersey

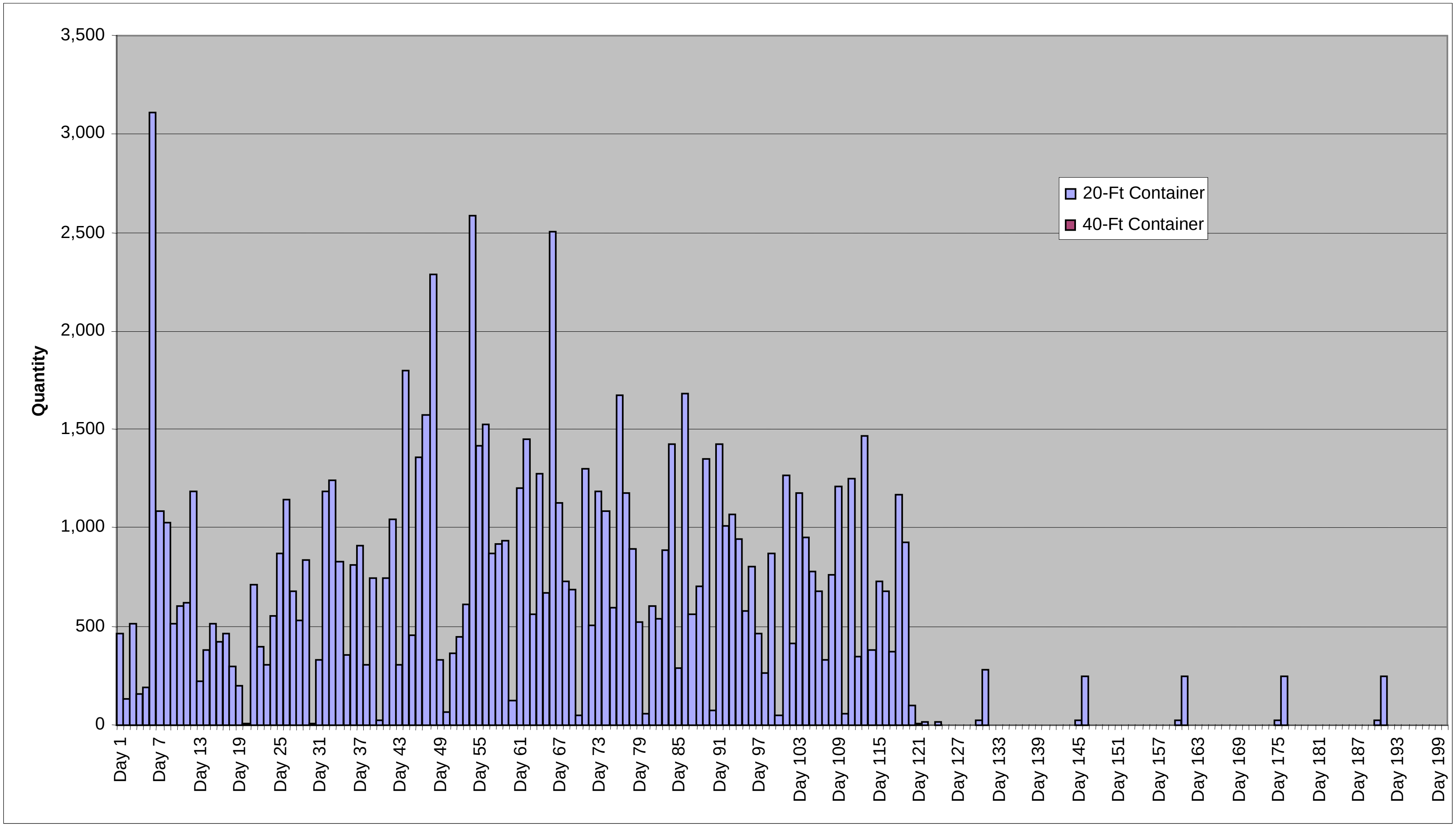


Figure E-3 – Quantity of Containers Arriving at the Port of New York/New Jersey

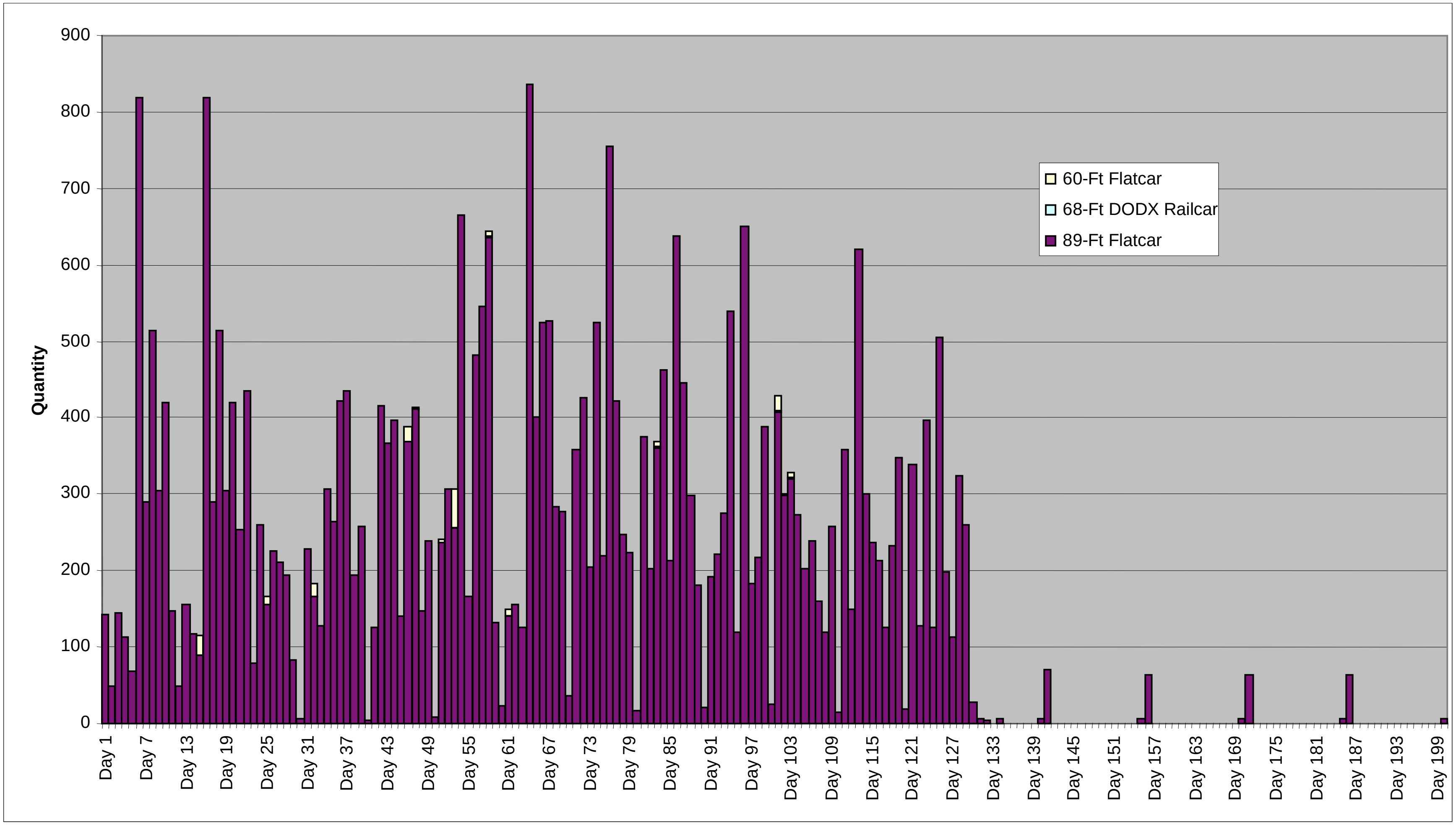


Figure E-4. Quantity of Railcars Arriving at the Port New York/New Jersey

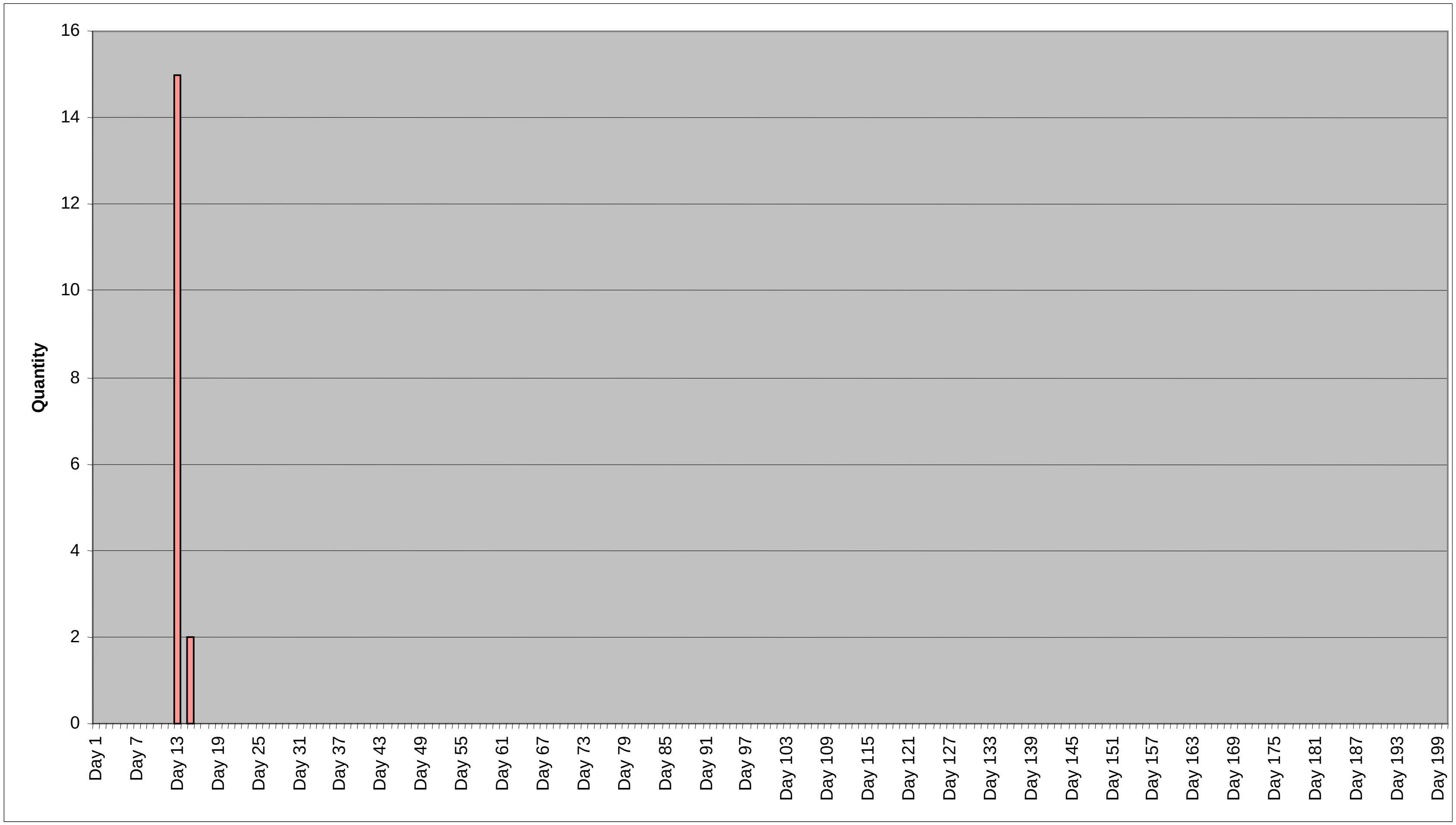


Figure E-5. Quantity of Aircraft Arriving at the Port New York/New Jersey

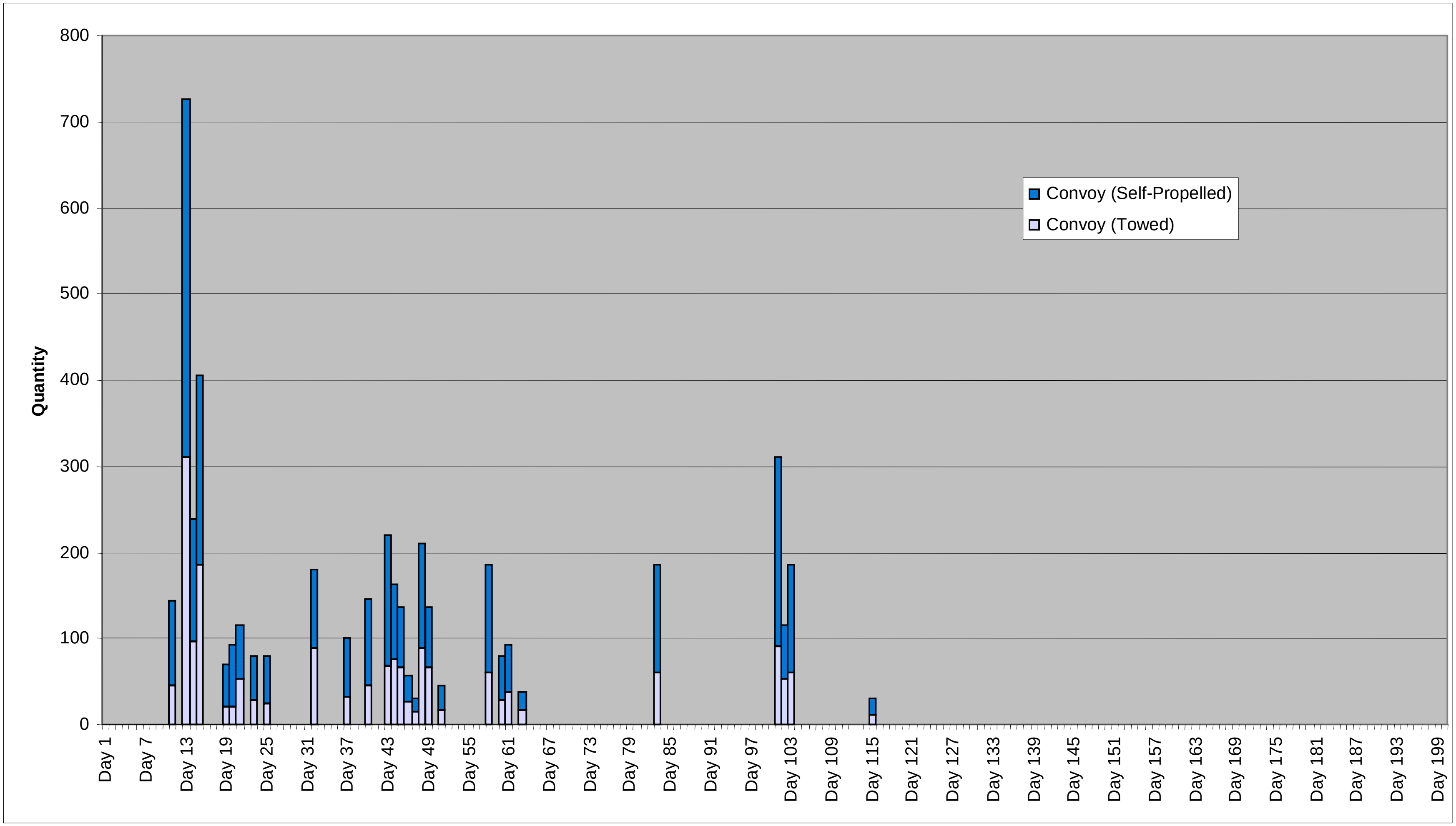


Figure E-6. Quantity of Convoy Vehicles Arriving at the Port New York/New Jersey

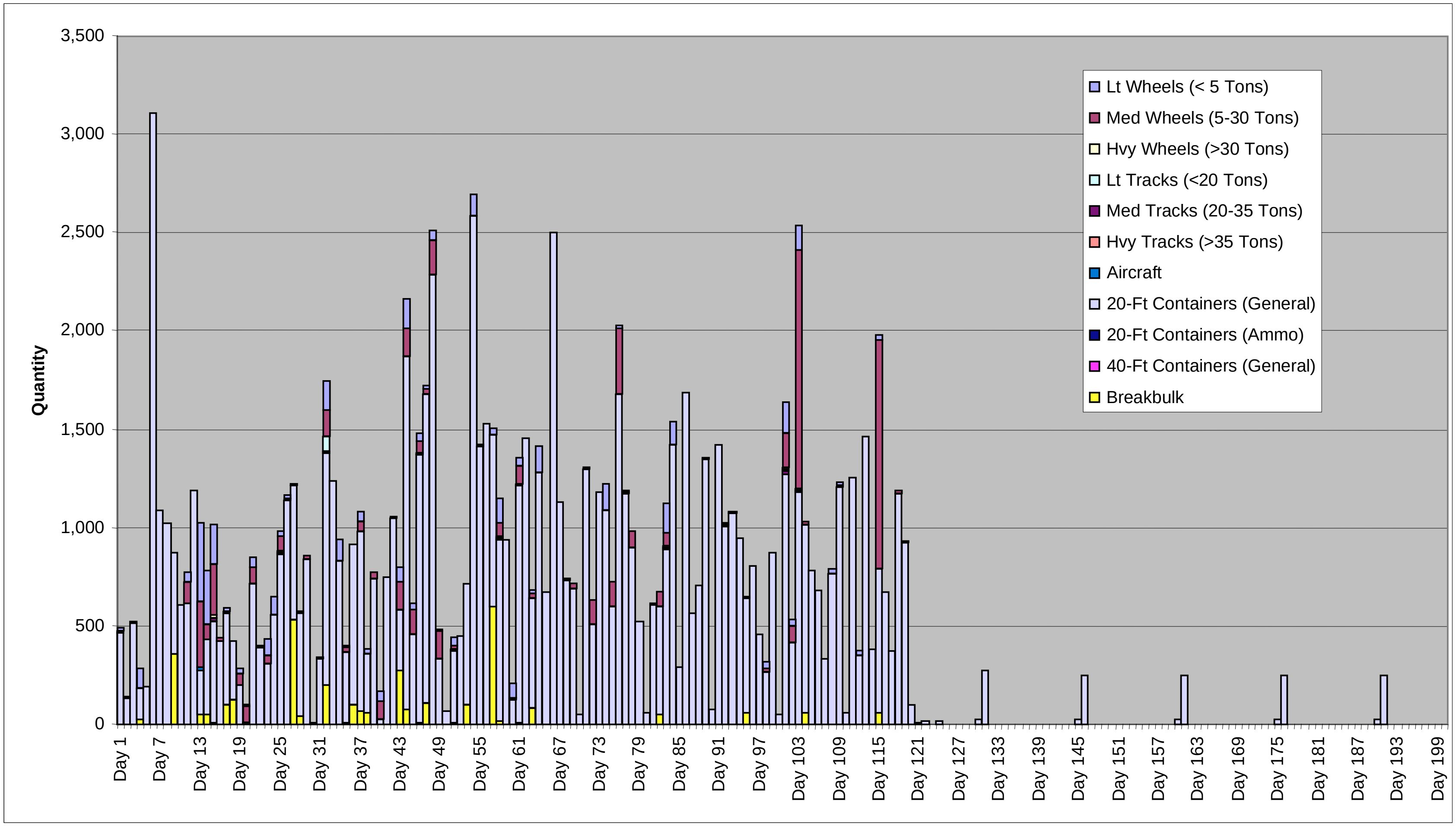


Figure E-7. Total Quantity of Items Arriving at the Port New York/New Jersey

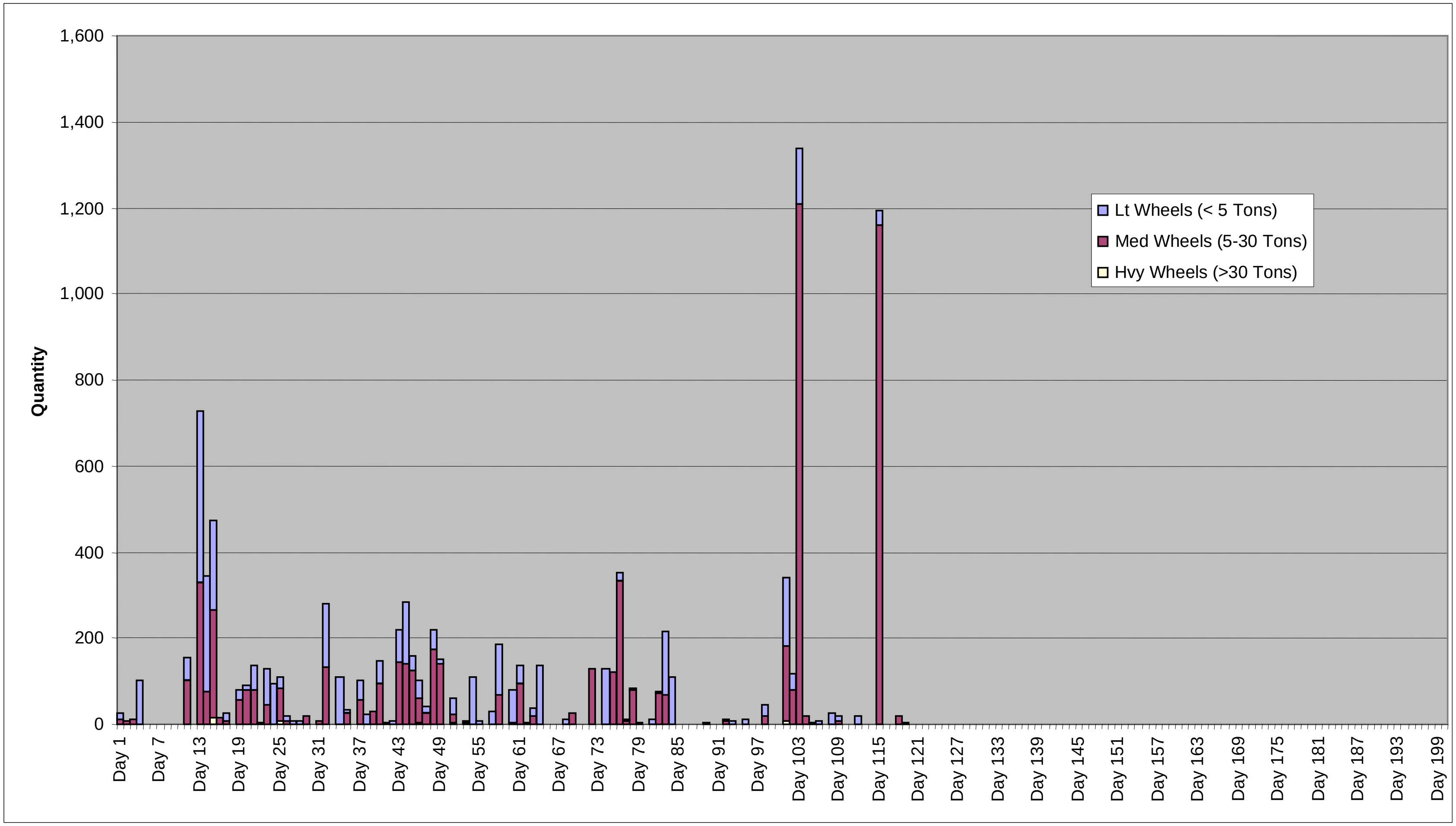


Figure E-8. Quantity of Wheeled Vehicles Arriving at the Port New York/New Jersey

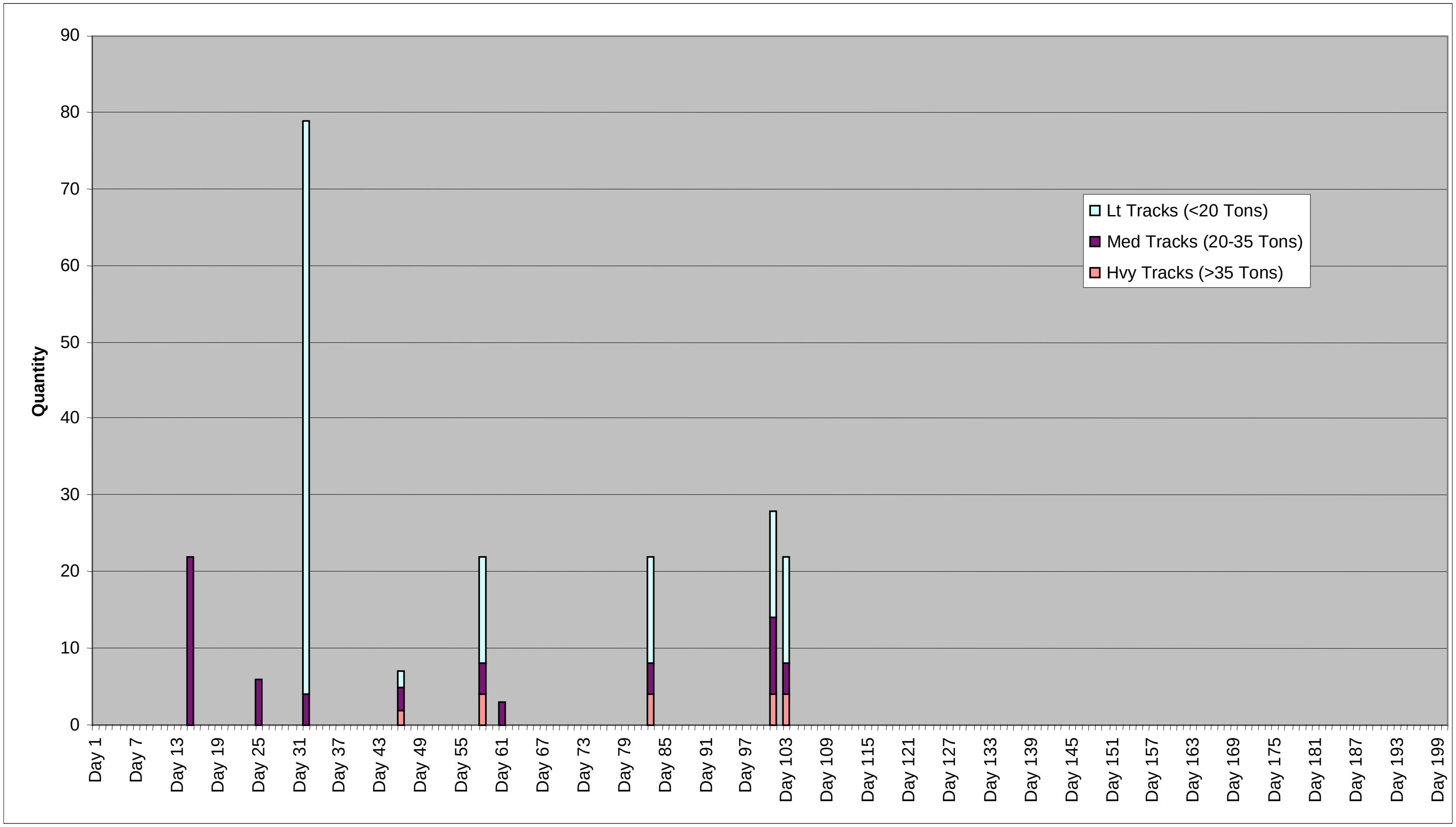


Figure E-9. Quantity of Tracked Vehicles Arriving at the Port New York/New Jersey

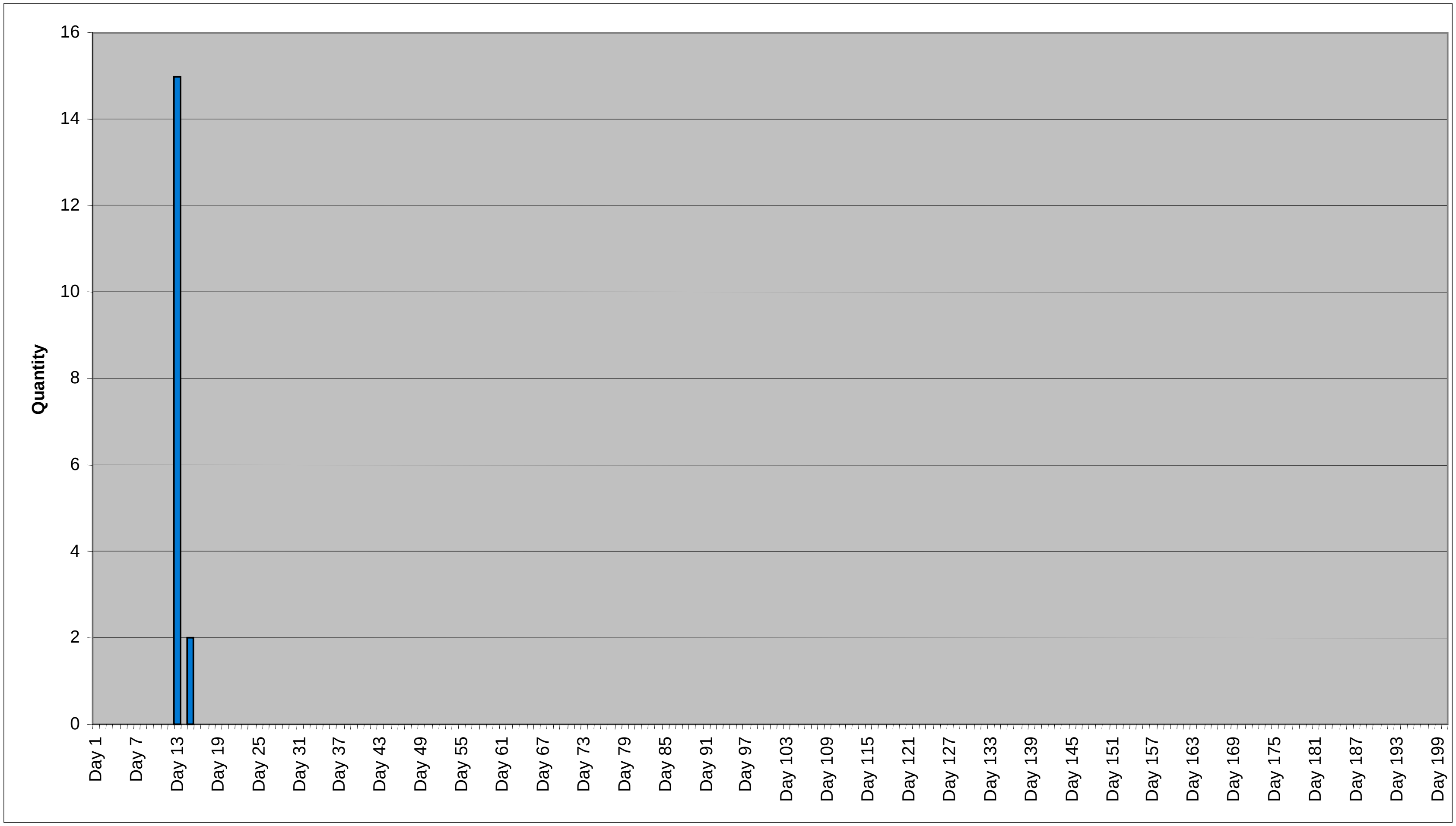


Figure E-10. Quantity of Aircraft Arriving at the Port New York/New Jersey

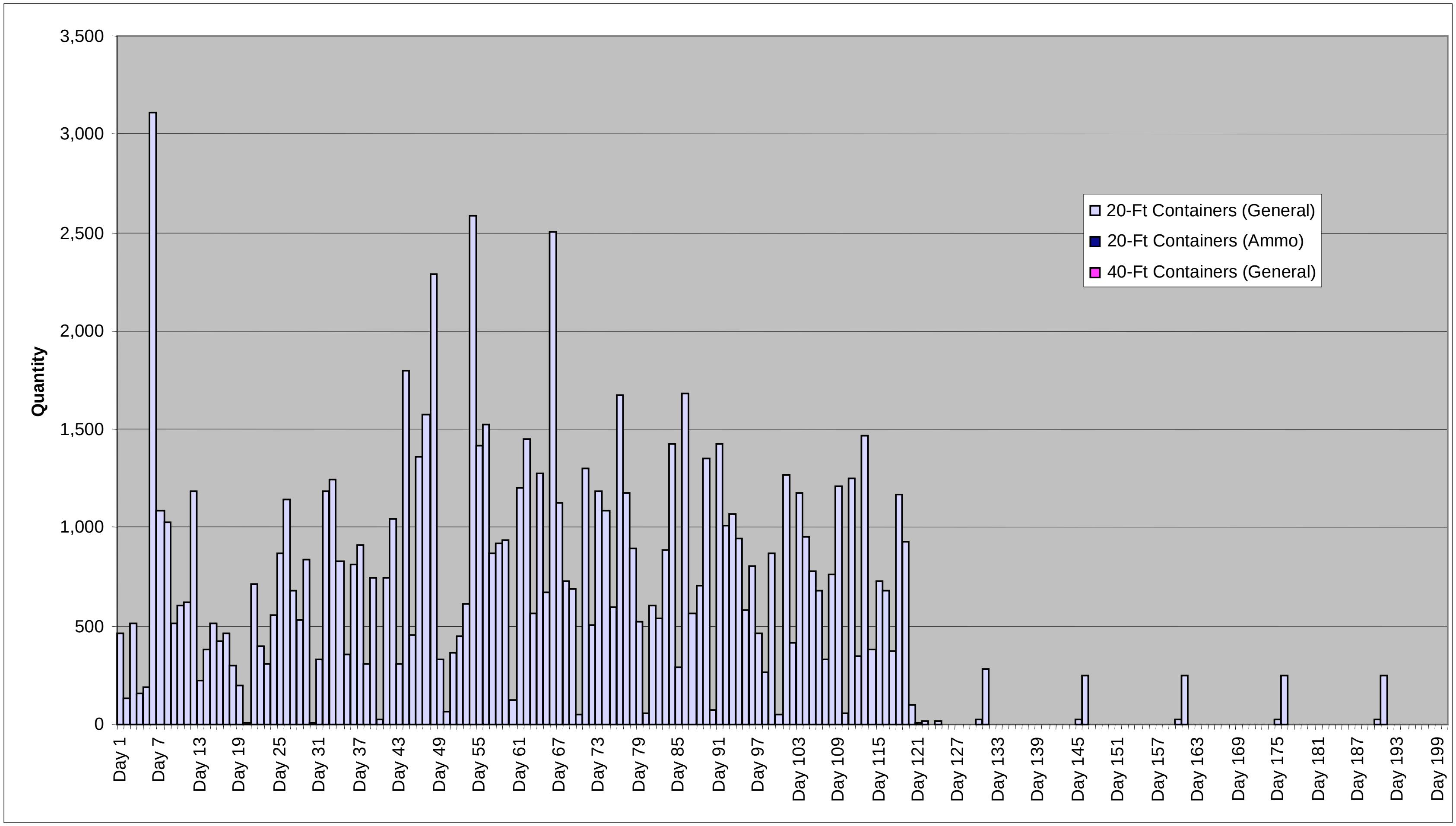


Figure E-11. Quantity of Containers Arriving at the Port New York/New Jersey

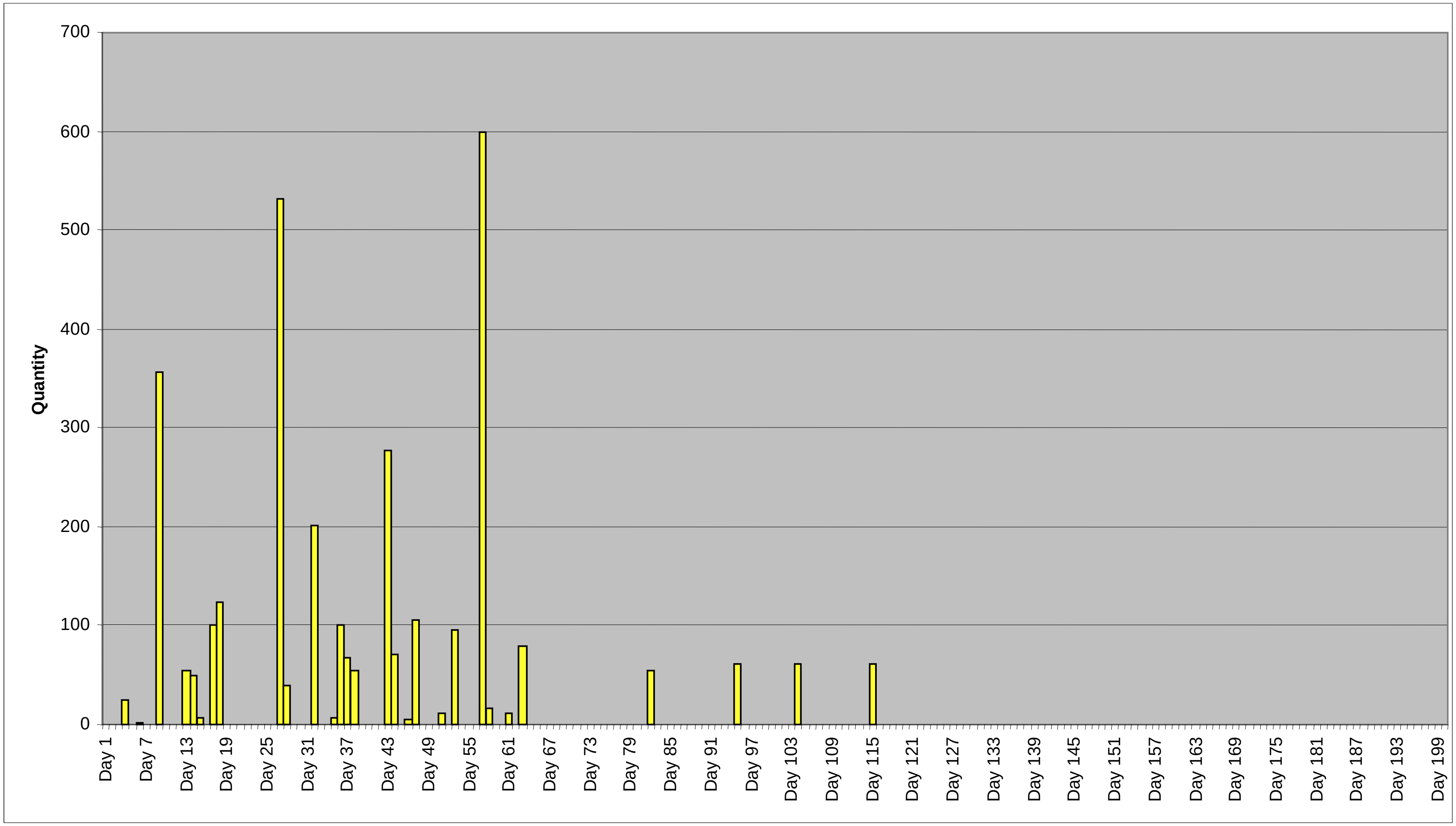


Figure E-12. Quantity of Breakbulk Cargo Items Arriving at the Port New York/New Jersey

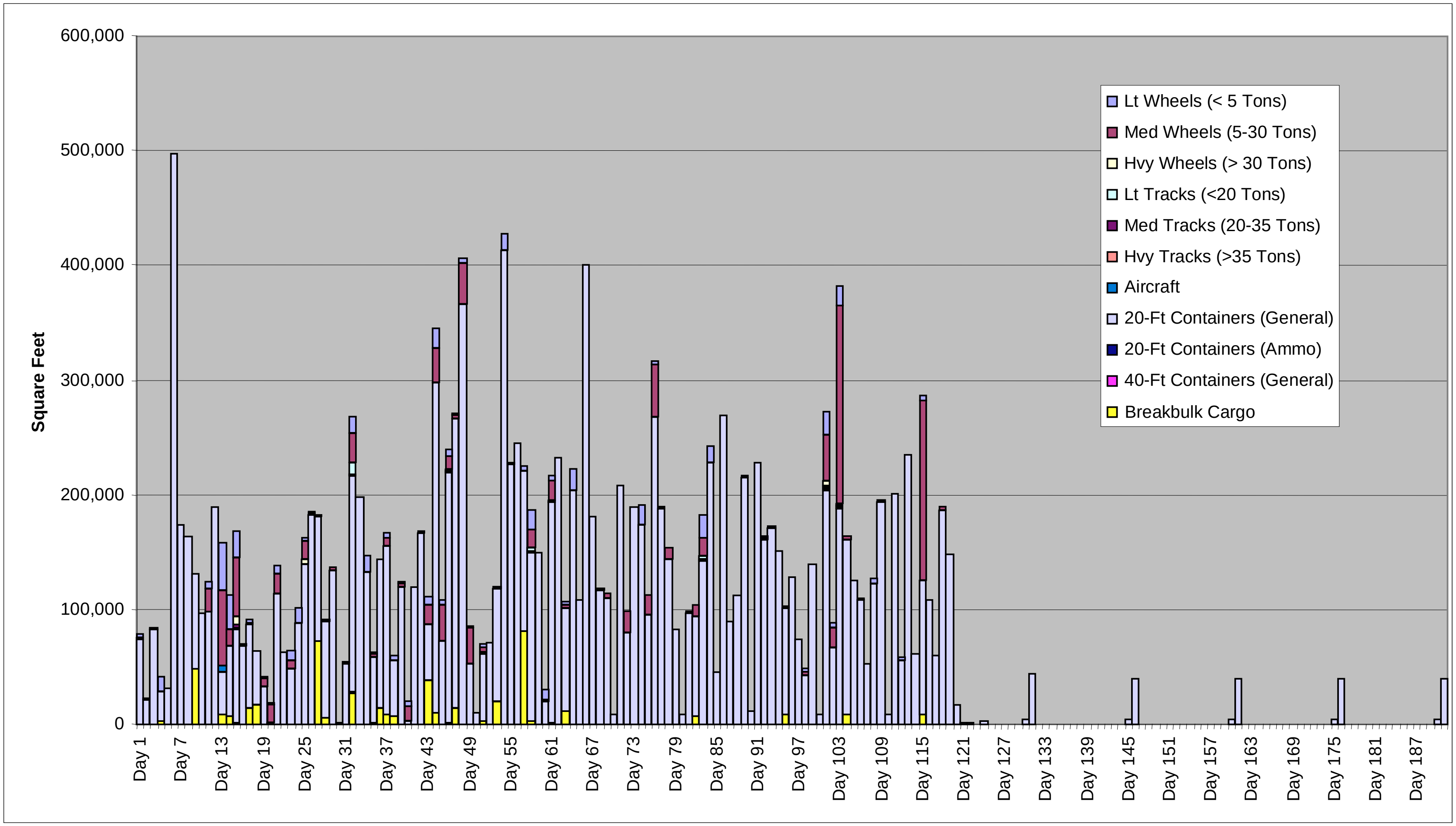


Figure E-13. Total Square Feet of Cargo Arriving at the Port New York/New Jersey

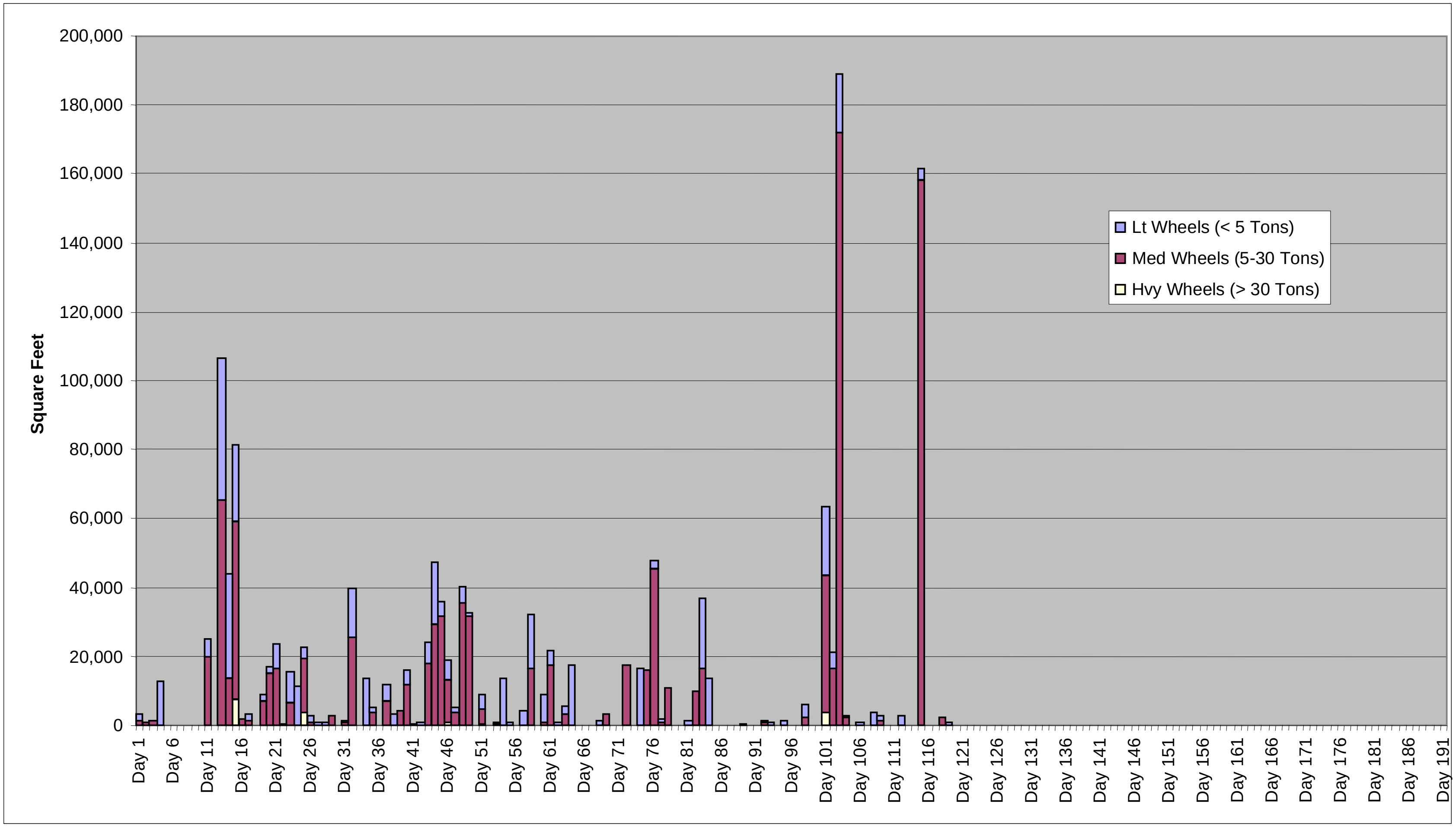


Figure E-14. Square Feet of Wheeled Vehicles Arriving at the Port New York/New Jersey

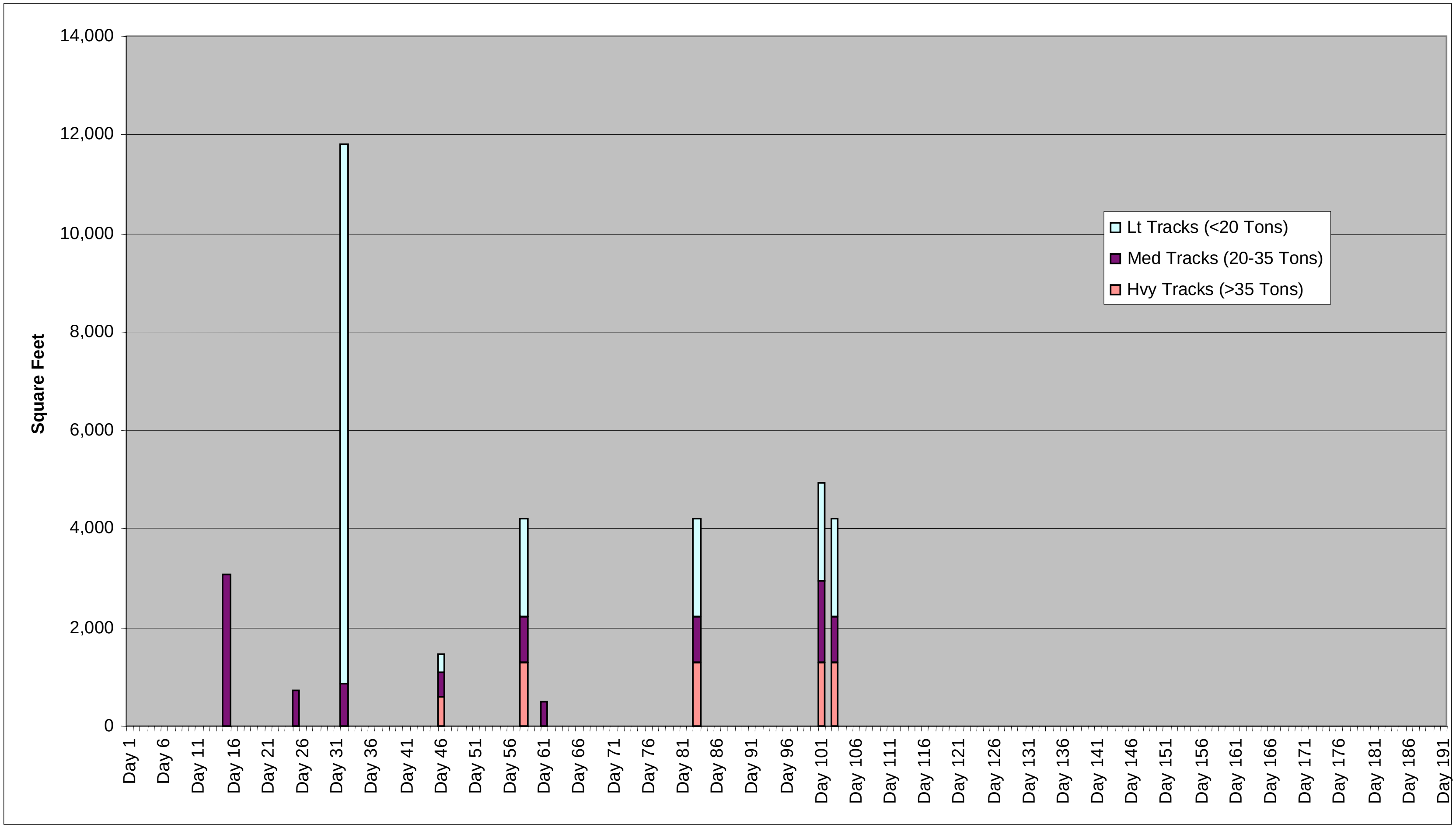


Figure E-15. Square Feet of Tracked Vehicles Arriving at the Port New York/New Jersey

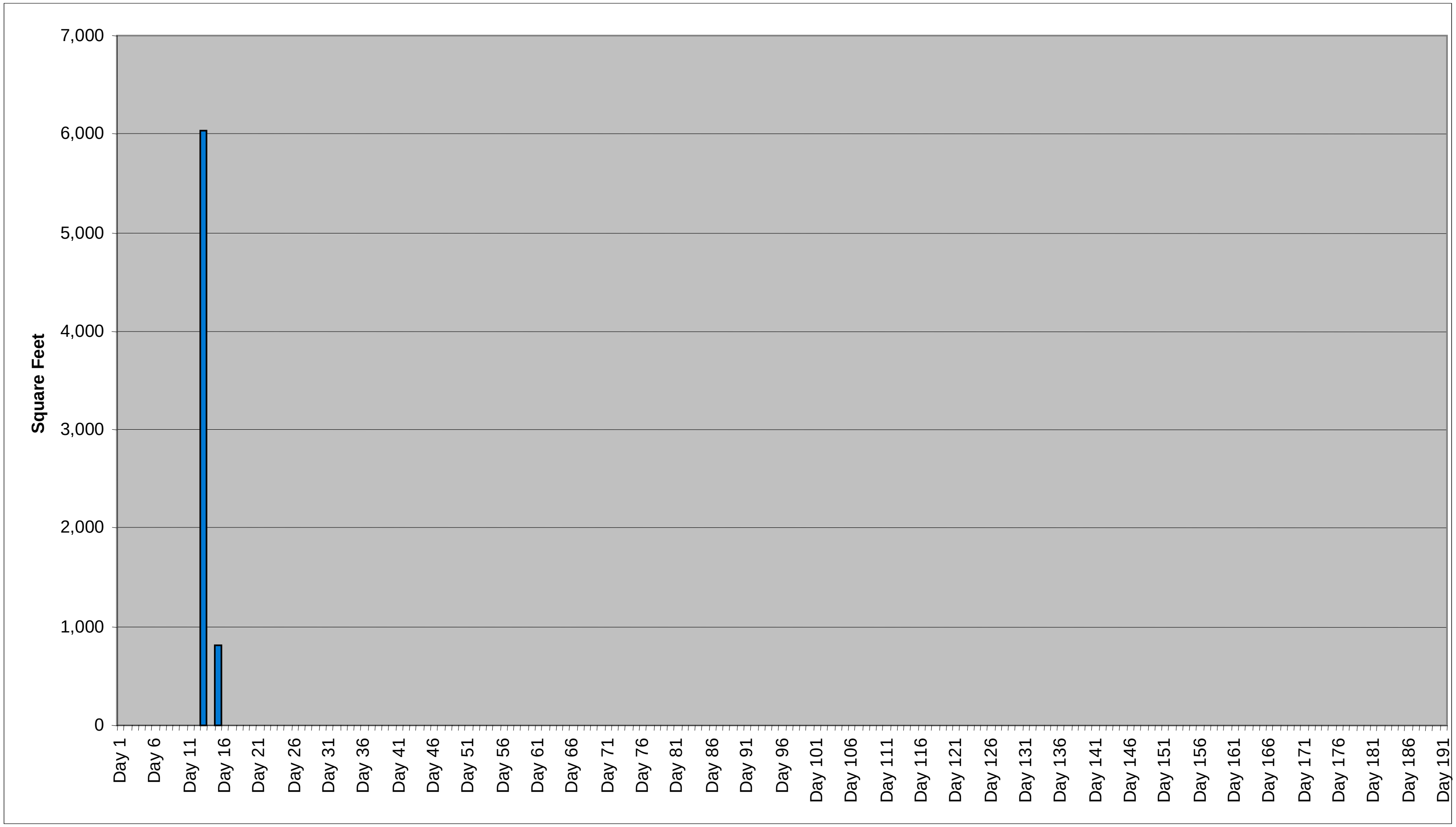


Figure E-16. Square Feet of Aircraft Arriving at the Port New York/New Jersey

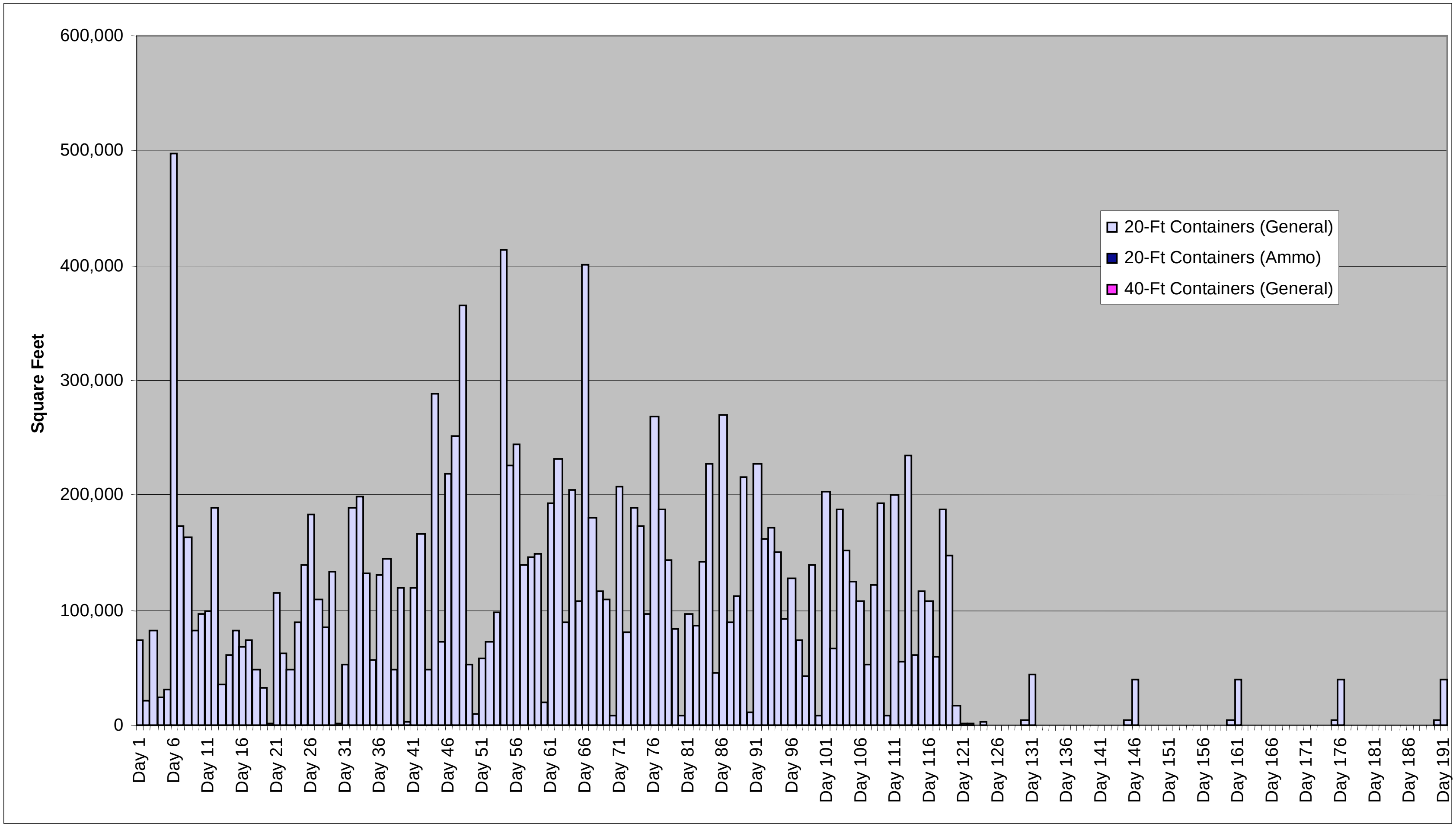


Figure E-17. Square Feet of Containers Arriving at the Port New York/New Jersey

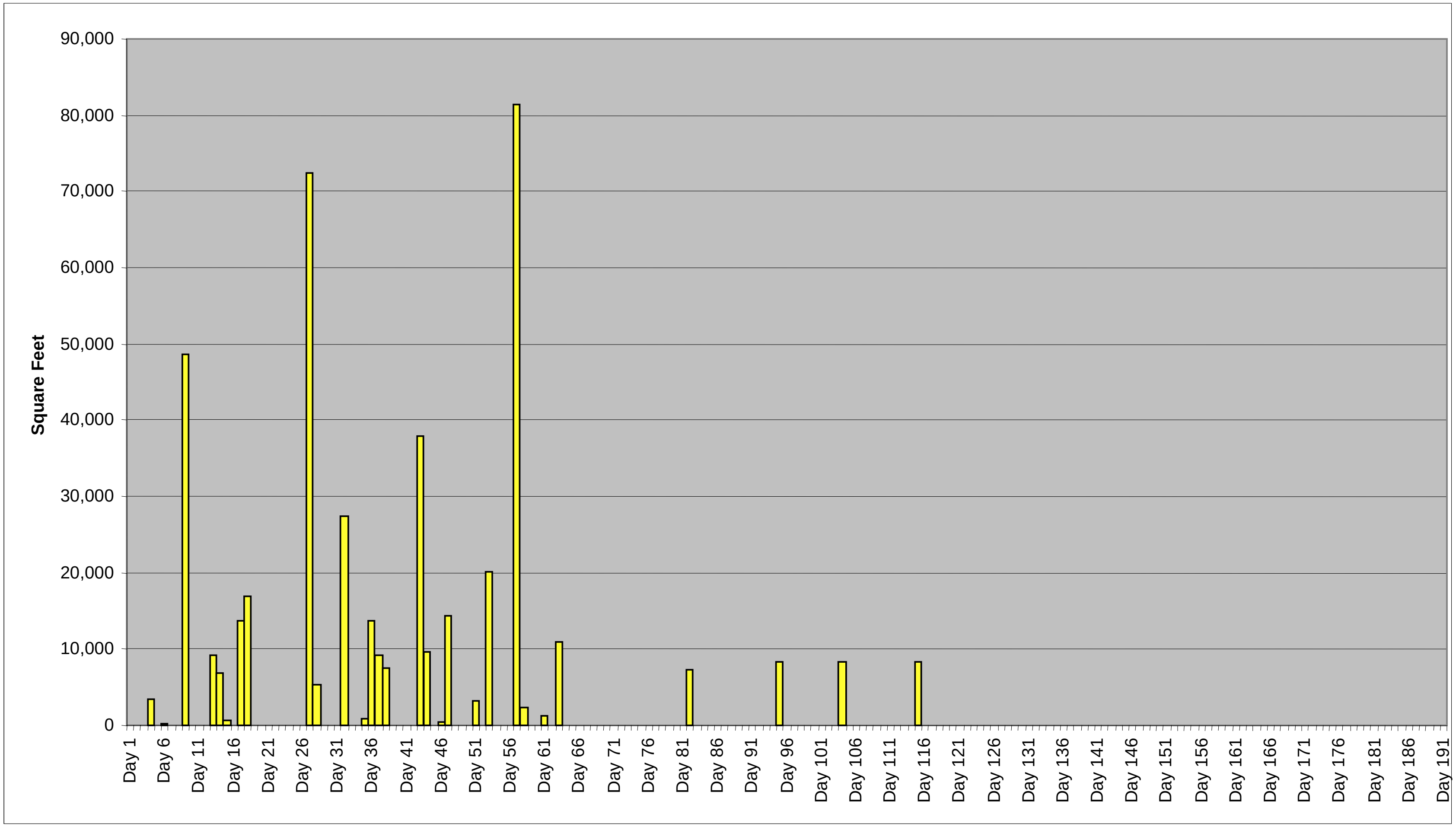


Figure E-18. Square Feet of Breakbulk Cargo Items Arriving at the Port New York/New Jersey

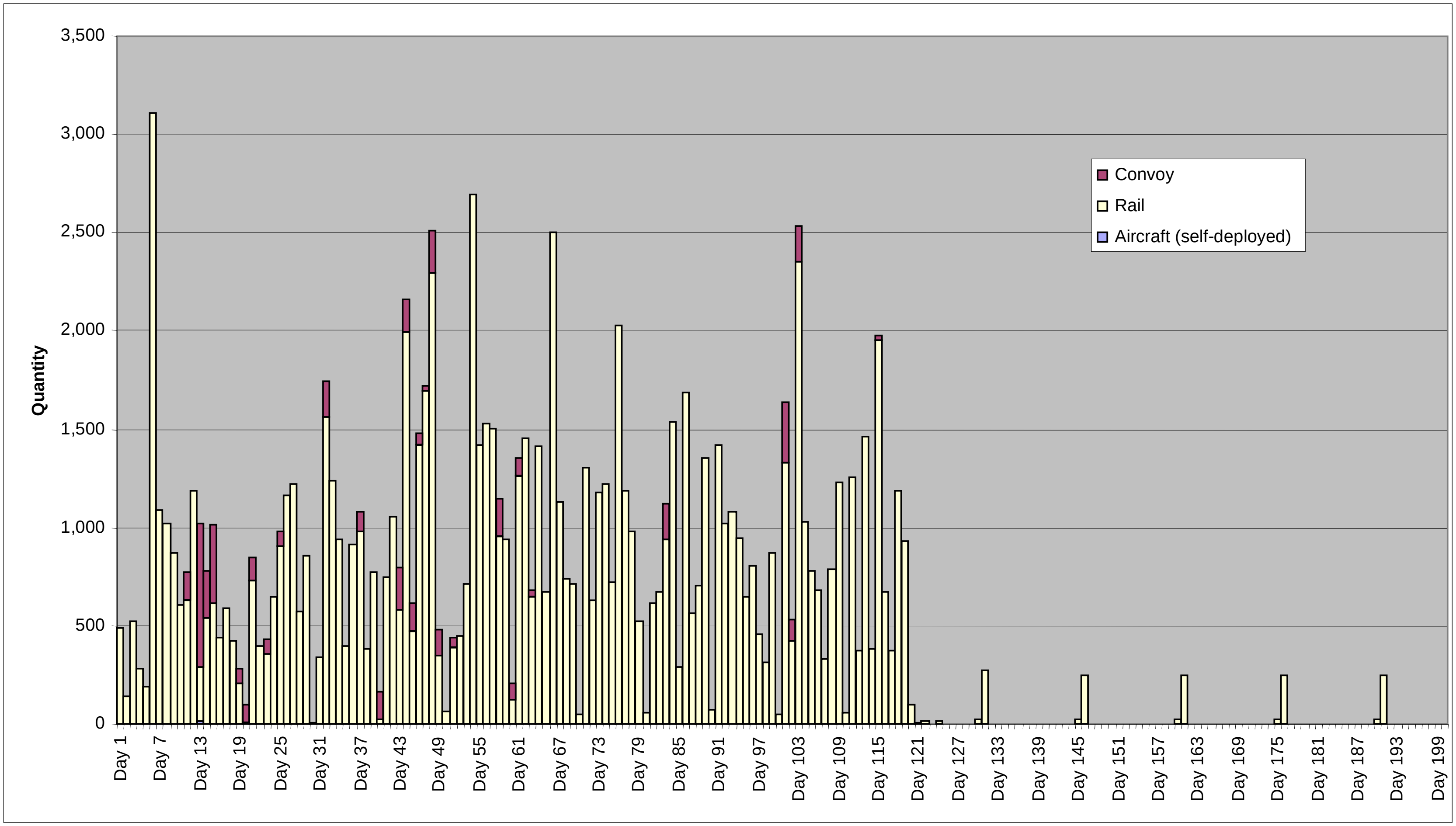


Figure E-19. Quantity of Items Arriving by Mode to the Port New York/New Jersey

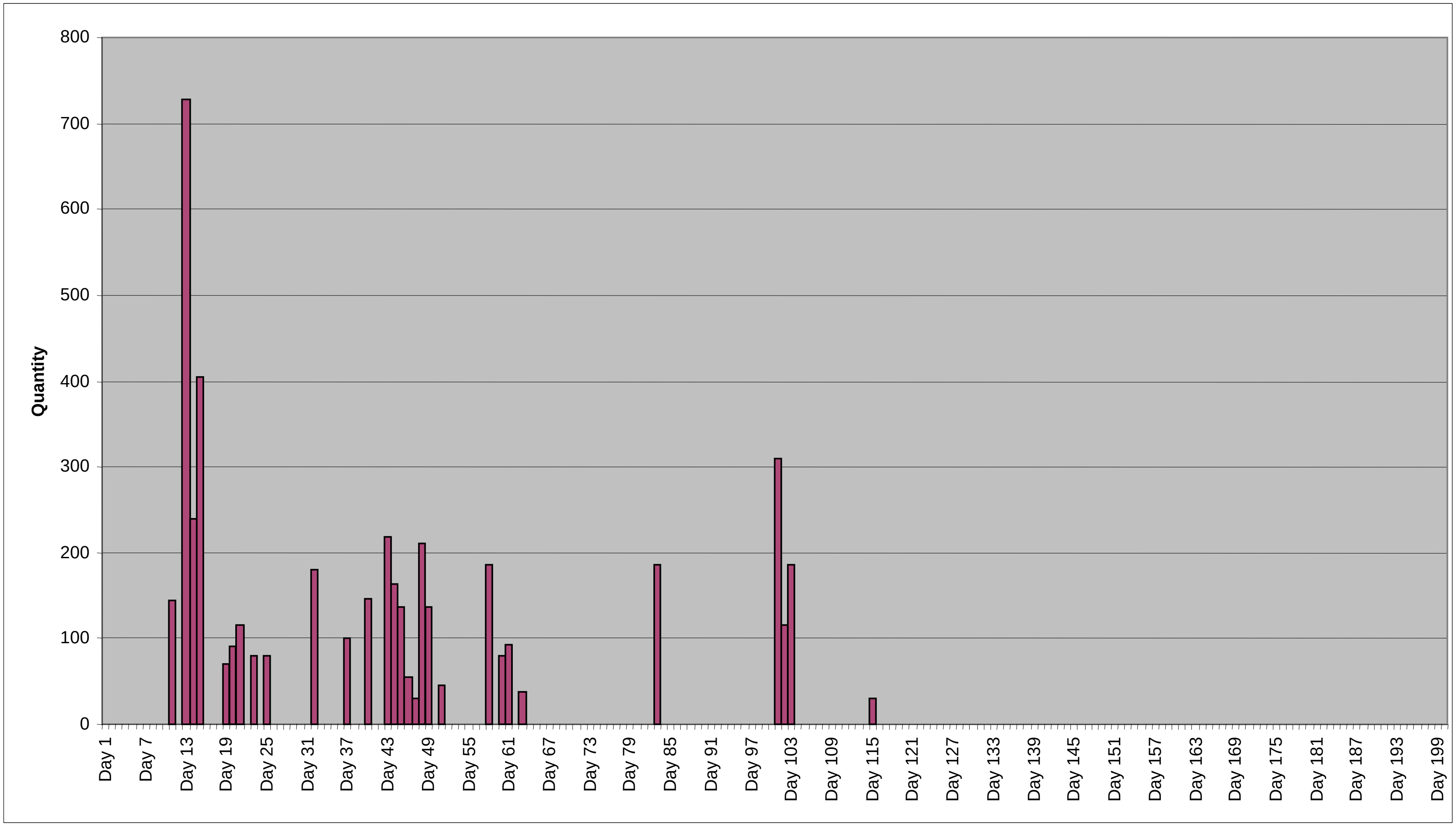


Figure E-20. Quantity of Wheeled Vehicles Convoying to the Port New York/New Jersey

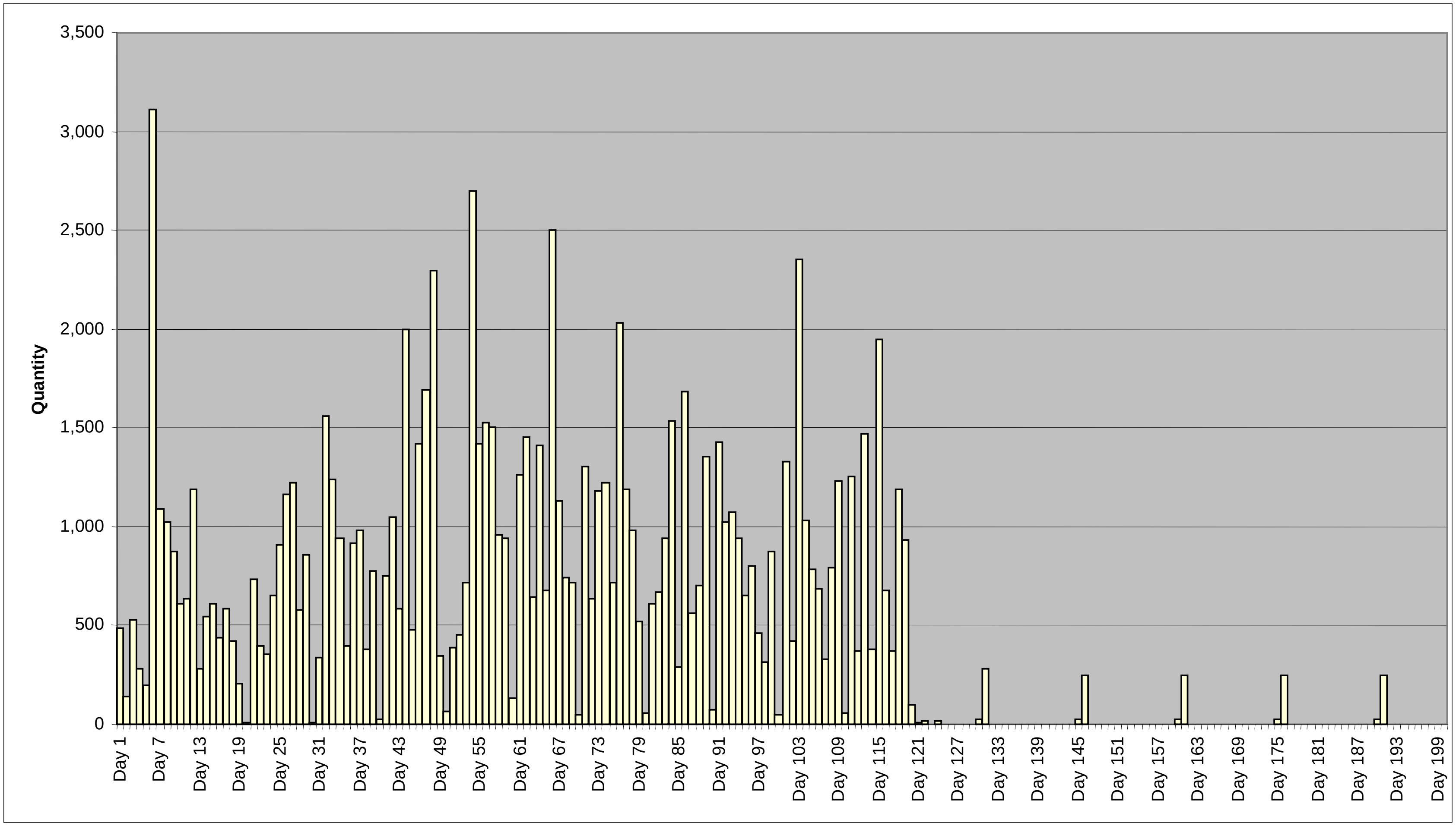


Figure E-21. Quantity of Items Arriving by Rail to the Port New York/New Jersey

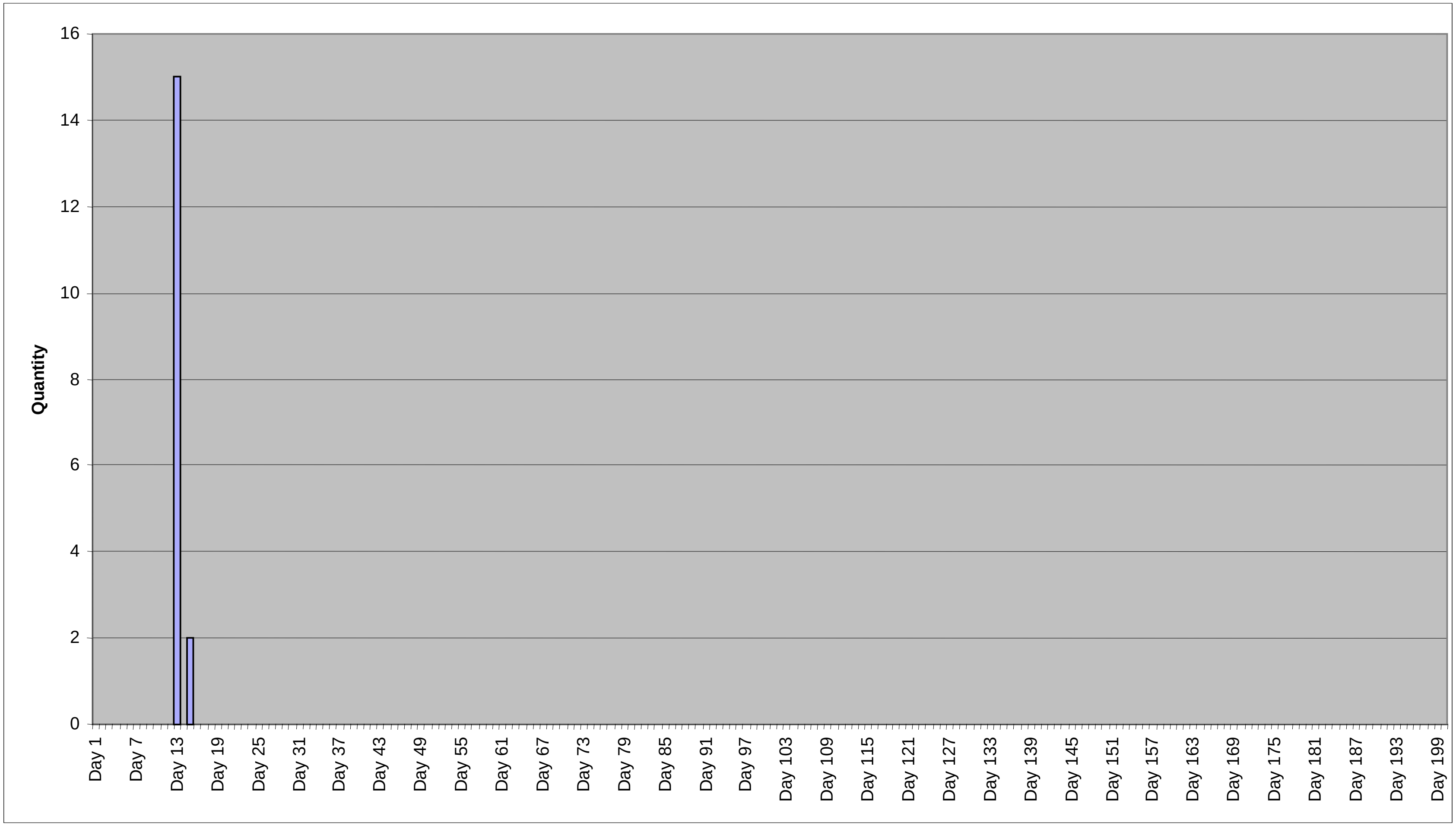


Figure E-22. Quantity of Aircraft Self-Deploying to the Port New York/New Jersey

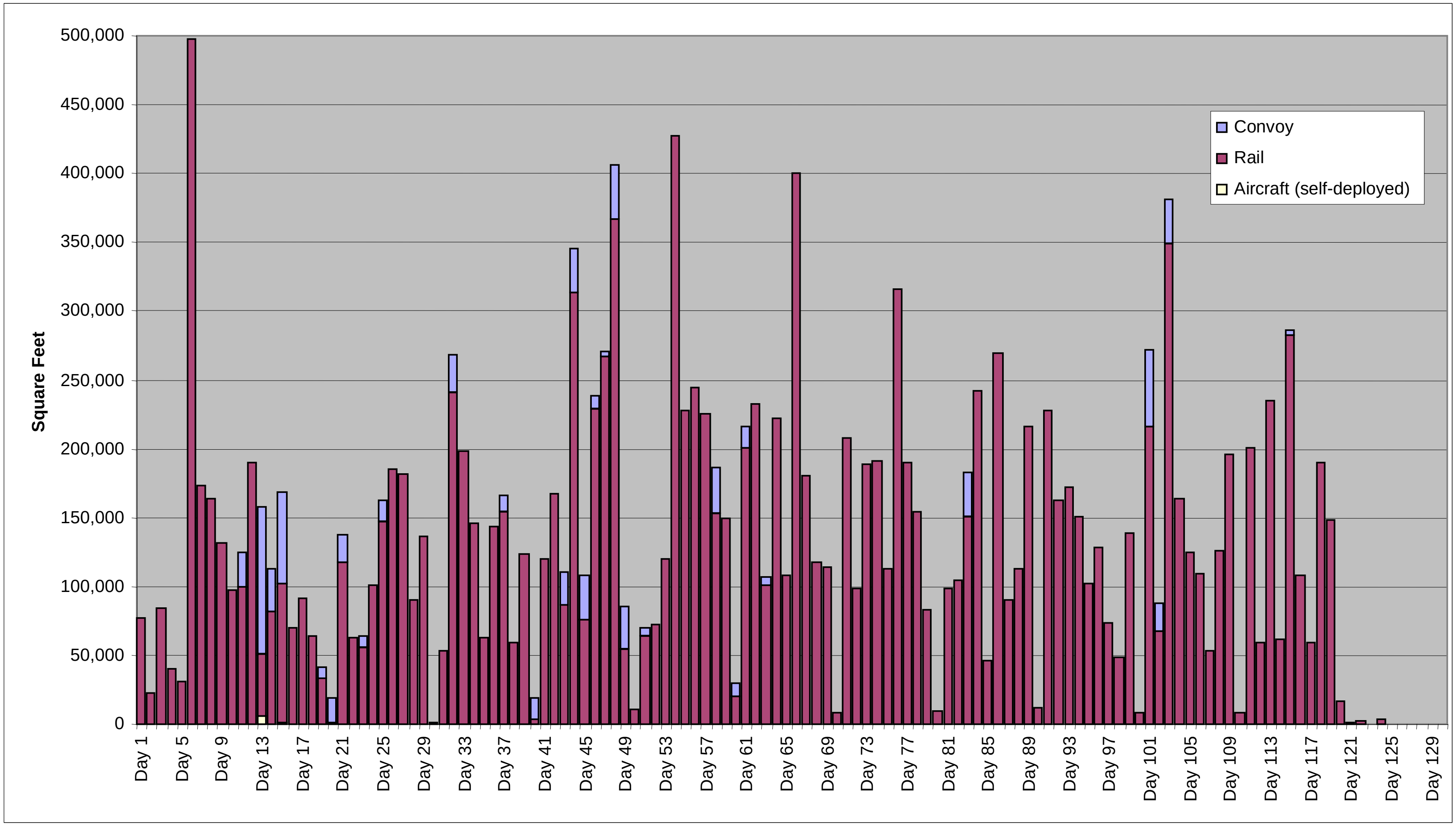


Figure E-23. Square Feet of Cargo Items Arriving by Mode to the Port New York/New Jersey

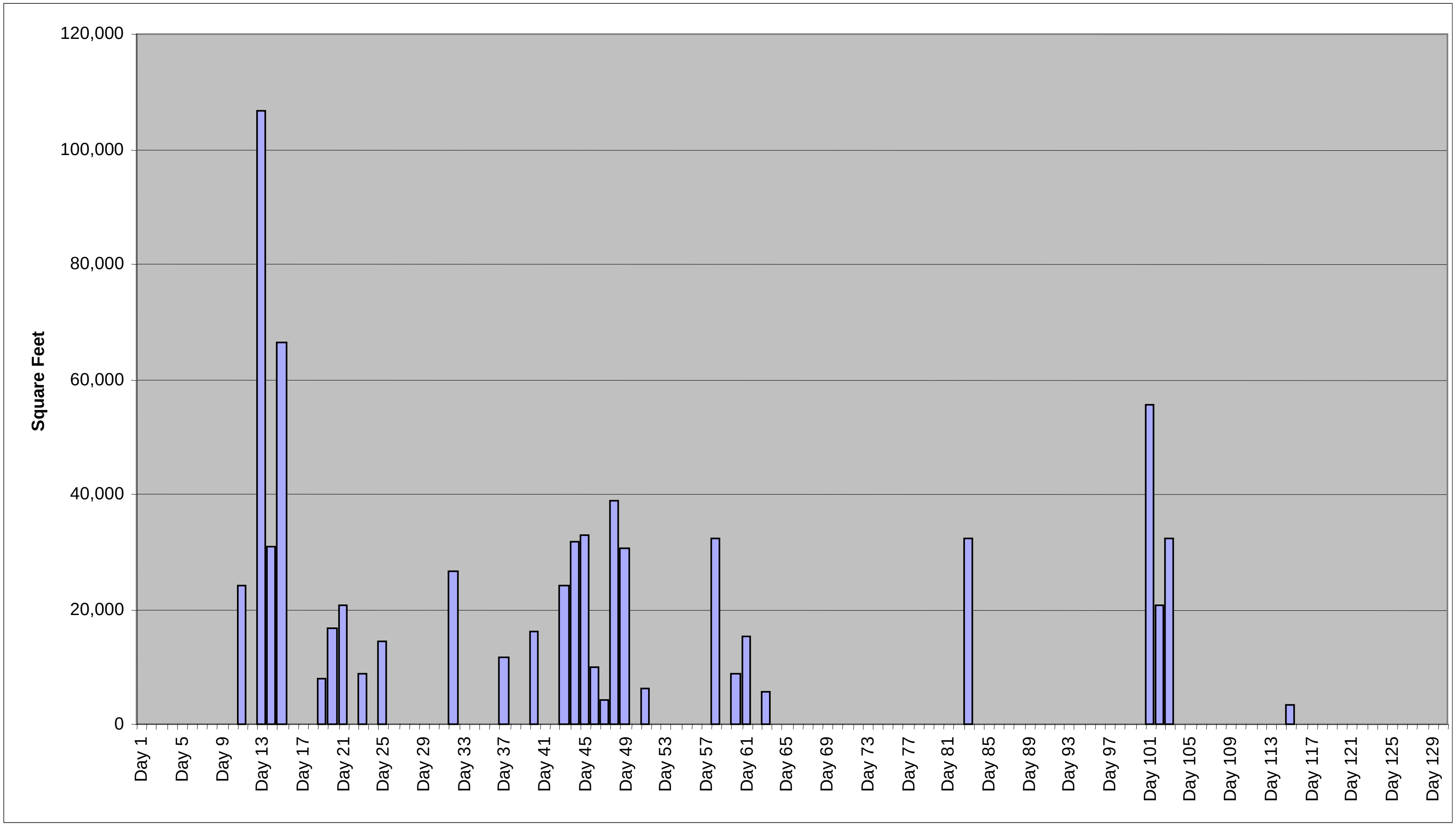


Figure E-24. Square Feet of Wheeled Vehicles Convoying to the Port New York/New Jersey

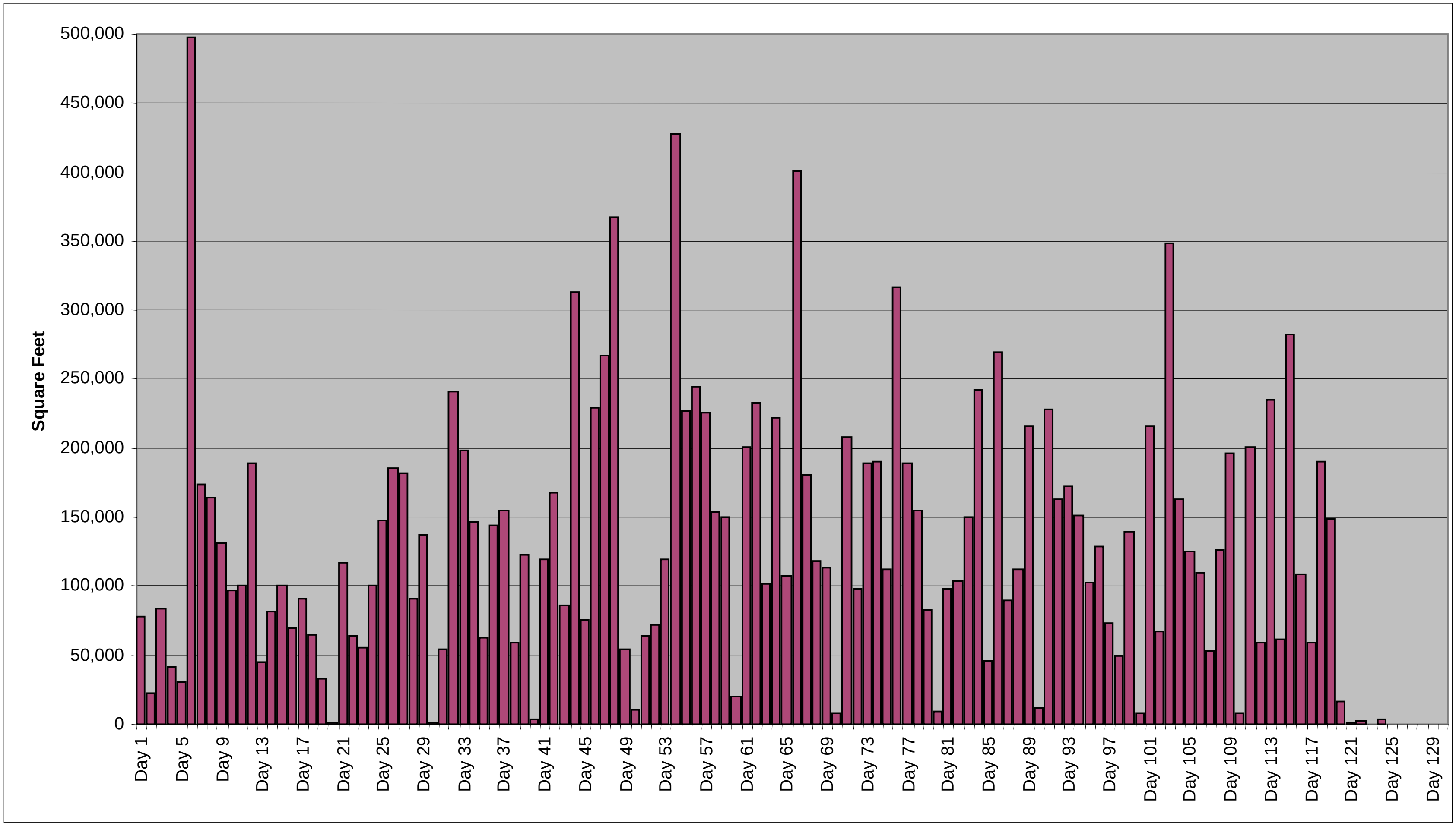


Figure E-25. Square Feet of Cargo Items Arriving by Rail to the Port New York/New Jersey

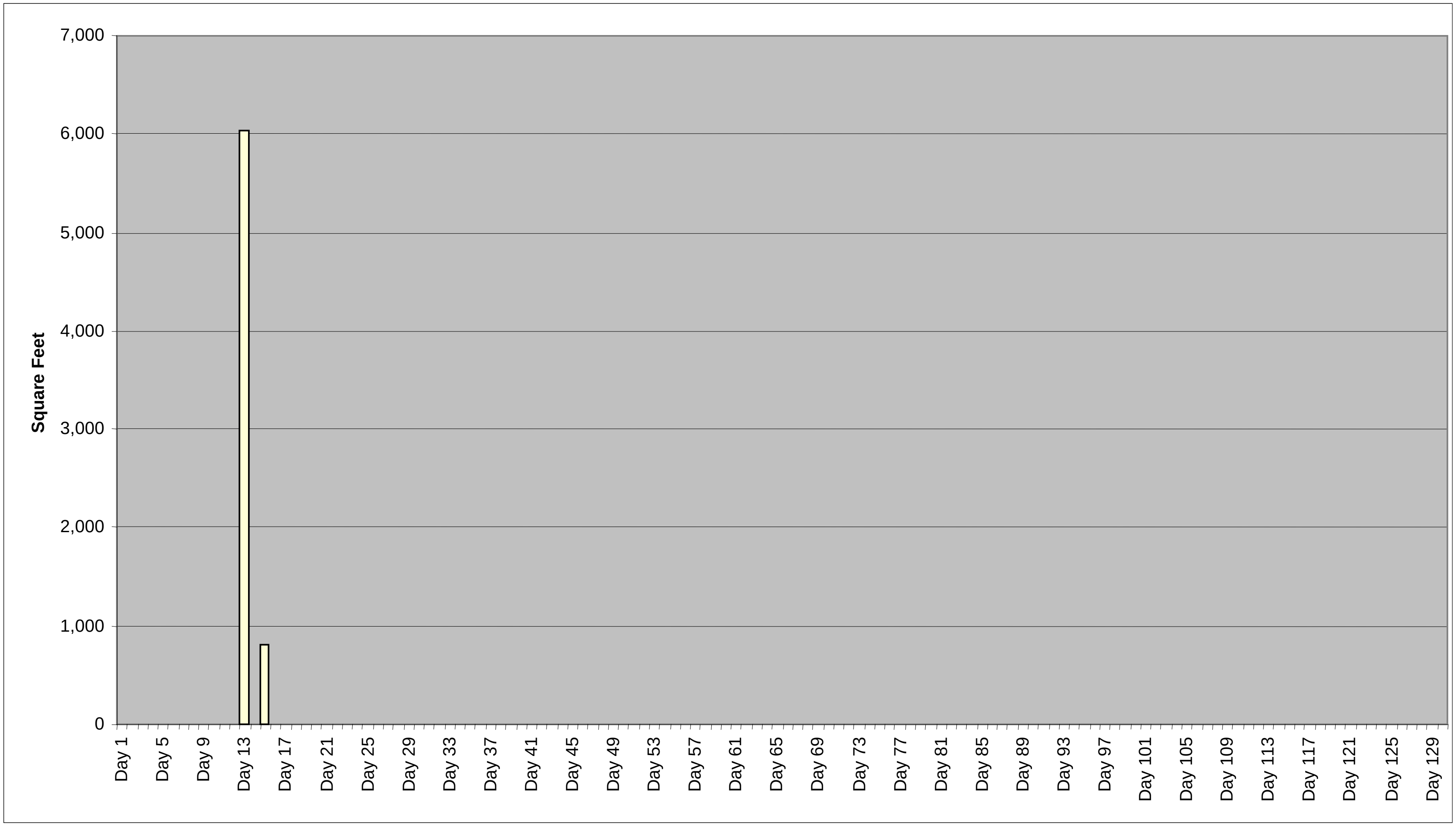


Figure E-26. Square Feet of Aircraft Self-Deploying to the Port New York/New Jersey

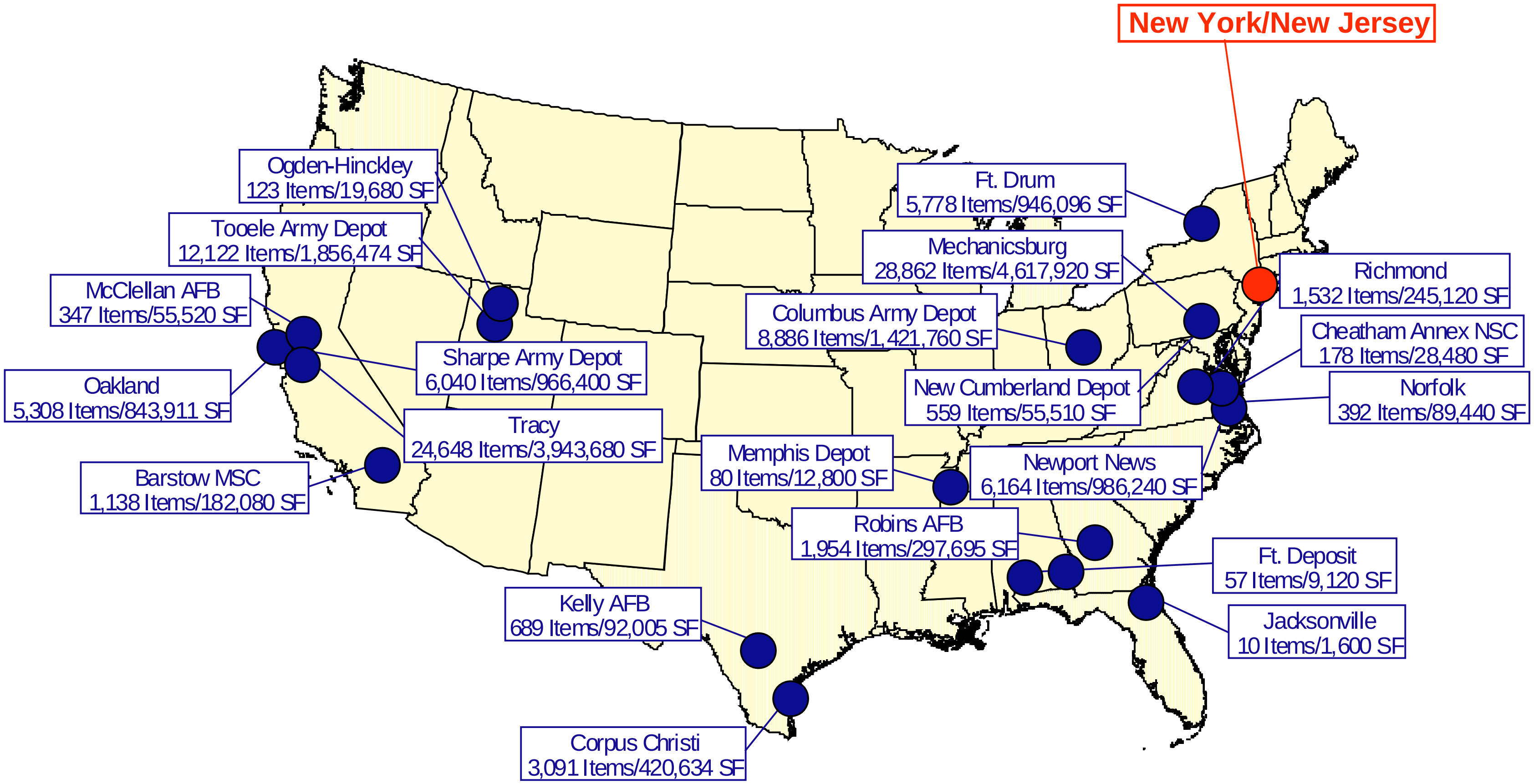


Figure E-27. Amount of Cargo Arriving at the Port New York/New Jersey by Origin

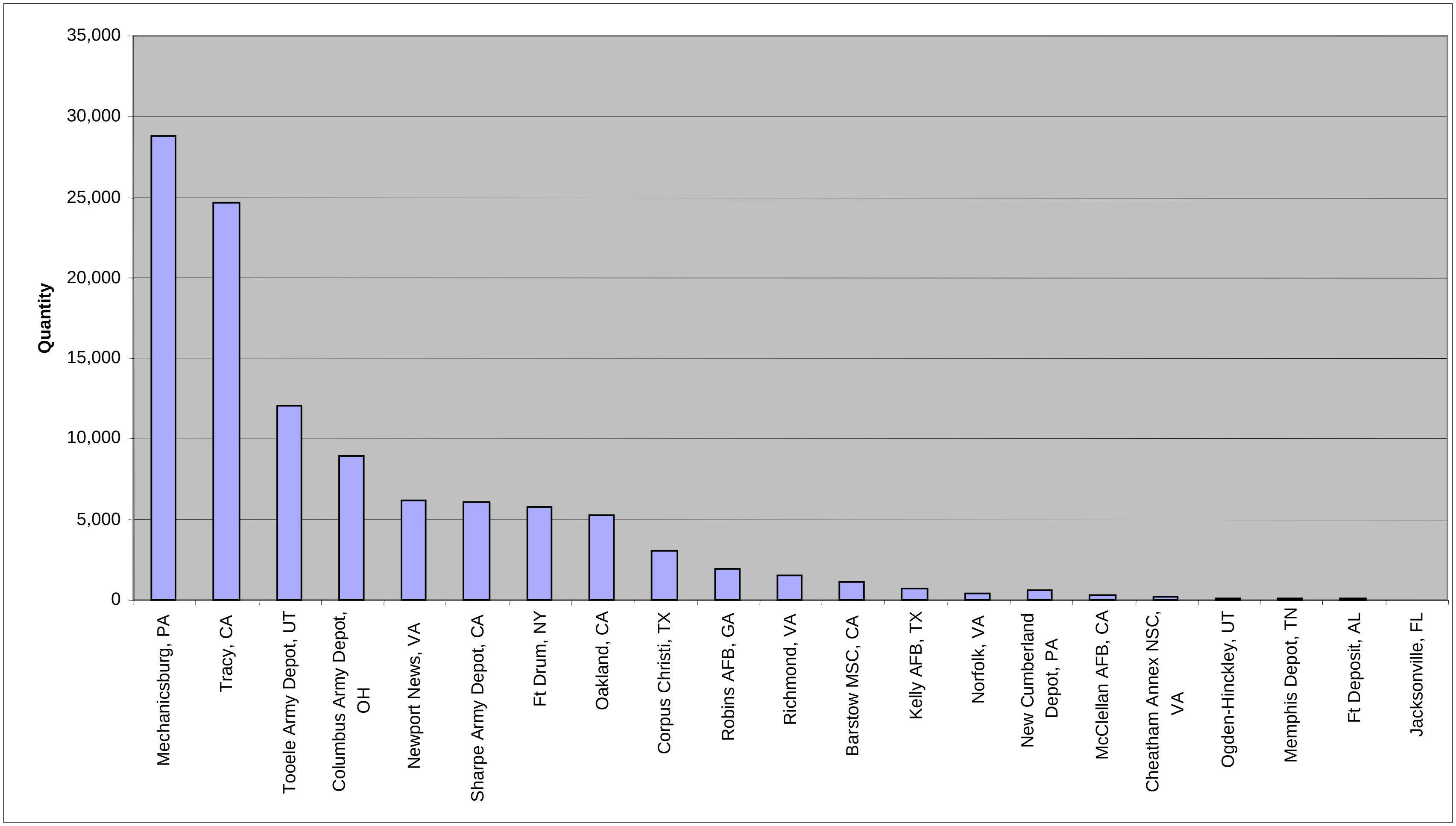


Figure E-28. Quantity of Items Arriving at the Port New York/New Jersey by Origin

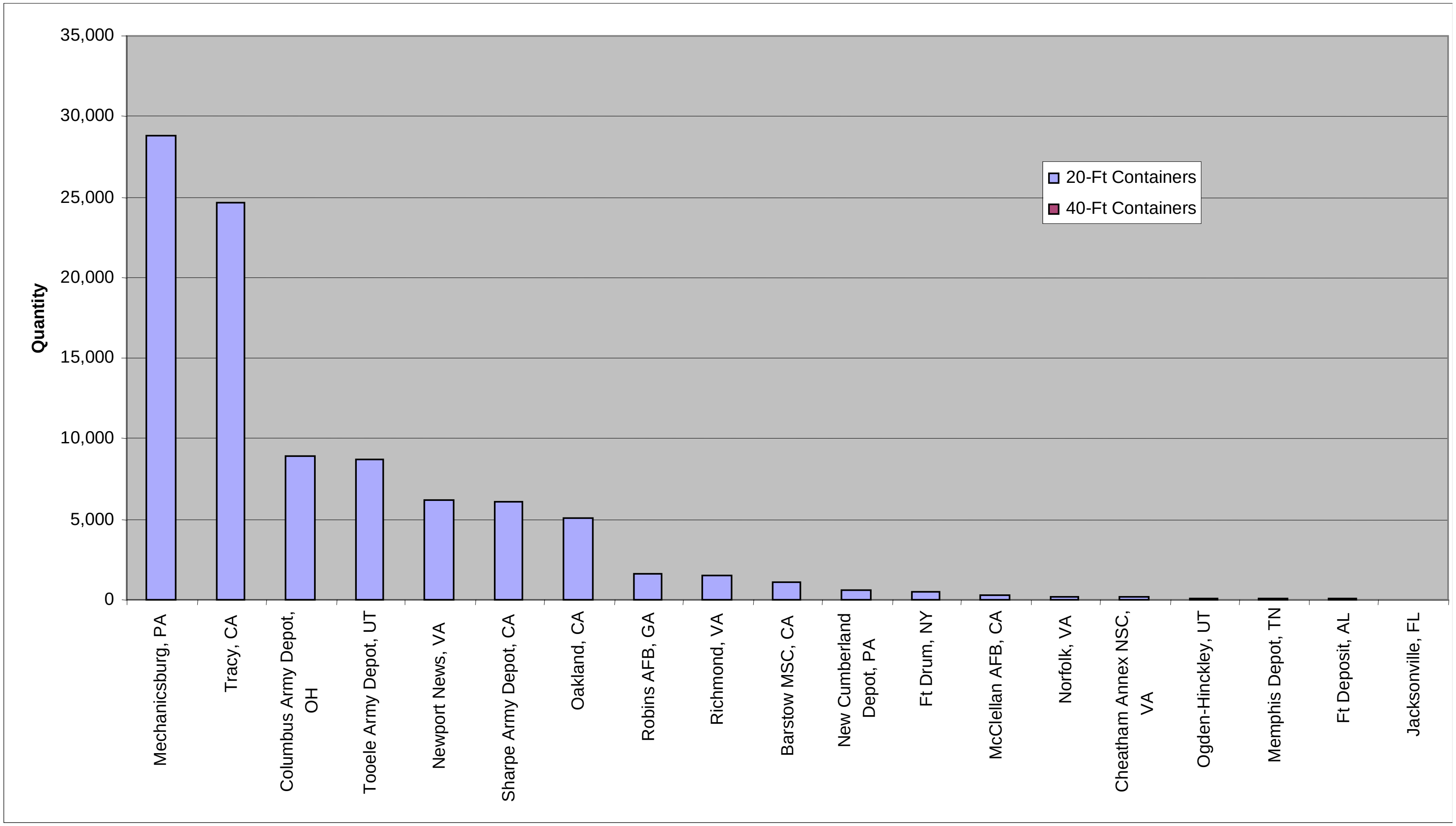


Figure E-29. Quantity of Containers Arriving at the Port New York/New Jersey by Origin

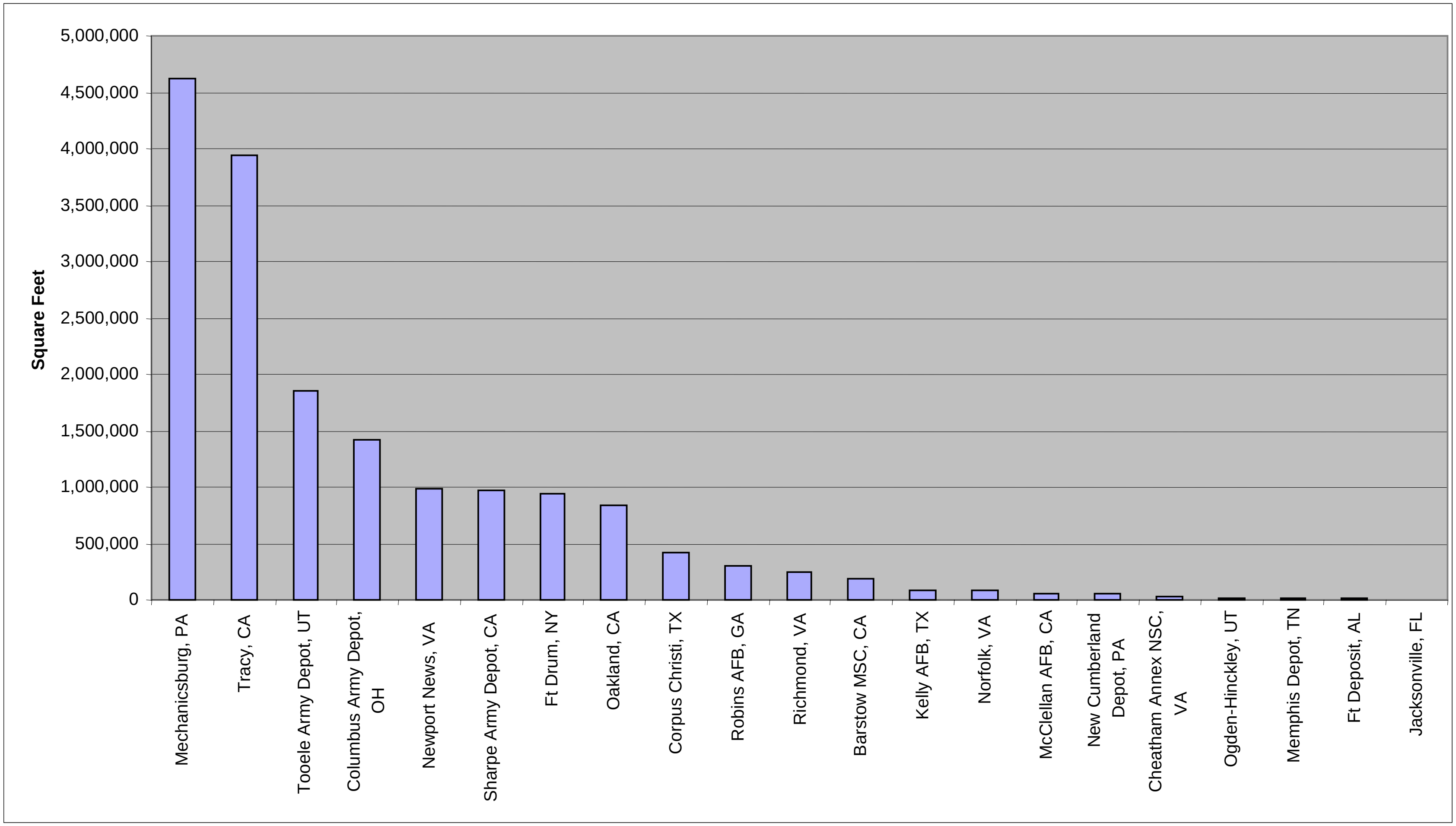
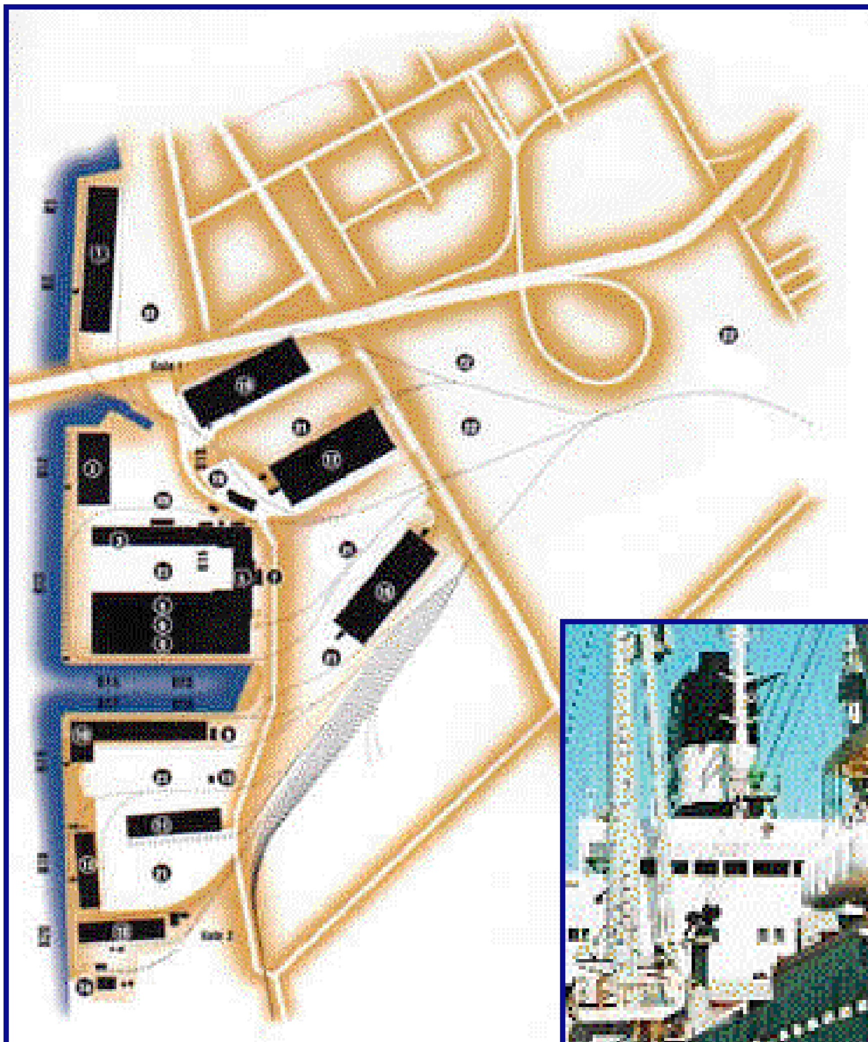


Figure E-30. Square Feet of Cargo Arriving at the Port New York/New Jersey by Origin

APPENDIX F

PORT OF SAVANNAH



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According to the TPFDD, there are over 50 origins sending cargo to the Port of Savannah. The major origins are shown in Figure F-1. Origins sending less than 50 items are listed in Table F-1. The Port of Savannah receives mostly Army cargo, with some Navy, Air Force, and Marine Corps cargo. Origins in excess of 400 miles send all of their cargo to the Port Savannah of by rail. Origins within 400 miles convoy their roadable vehicles to the port and send everything else by rail. All aircraft self-deploy to the port. Figures F-2 through F-6 show the quantity of transports (containers, railcars, self-deploying aircraft, and convoying vehicles) required to move to the Port of Savannah.

Figures F-7 through F-13 illustrate the quantity of items arriving at the port. Figure F-7 is the total quantity of items. Figures F-8 through F-13 break this down into more detail. Figures F-8 and F-9 are the quantity of vehicles arriving at the port. Figure F-8 outlines the wheeled vehicles and Figure F-9 lays out the tracked vehicles. Figure F-10 shows the quantity of aircraft arriving at the port. These are mostly helicopters, and all self move to the port under their own power. Figure F-11 is the number of floating craft arriving at the Port of Savannah. Figures F-12 and F-13 outline the number of containers and breakbulk cargo items, respectively, arriving at the port.

Similar to Figures F-7 through F-13, which lay out the quantity of items arriving, Figure F-14 through F-20 outline the square footage of these categories of cargo.

Figures F-21 through F-28 show how cargo is arriving at the Port of Savannah. Figure F-21 through F-24 shows the number of cargo items arriving by convoy, rail, or self-deploying. Figures F-25 through F-28 show the square footage of cargo arriving by each mode.

As shown earlier, cargo arrives at the Port of Savannah from many origins. Figure F-29 shows visually the amount of cargo coming from the major origins.

Figures F-30 and F-32 show the quantity and square footage, respectively, of cargo arriving at the Port of Savannah by origin. Figure F-31 is the quantity of containers arriving at the Port of Savannah from each origin.

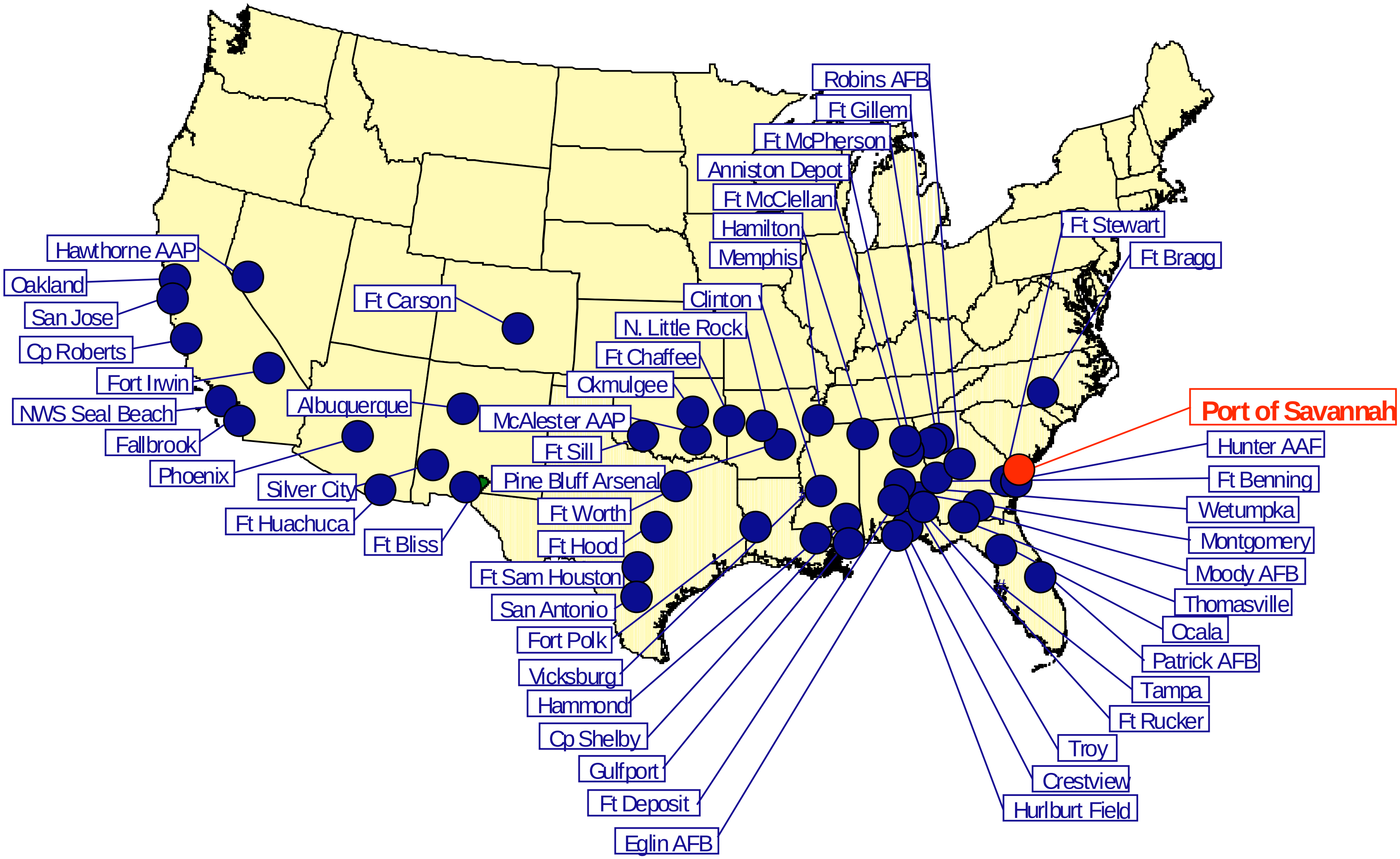


Figure F-1. Cargo Arrives at the Port of Savannah from Many Origins

Table F-1
Origins Sending Cargo to the Port of Savannah
(Origins not in Figure F-1)

Montgomery, AL
Concord NWS, GA
Fort Gillem, GA
Patrick AFB, FL
Pine Bluff Arsenal, AK
Anniston Army Depot, AL
Phoenix, AZ
Silver City, NM
Hammond, LA
Fallbrook, CA
Seal Beach NWS, CA

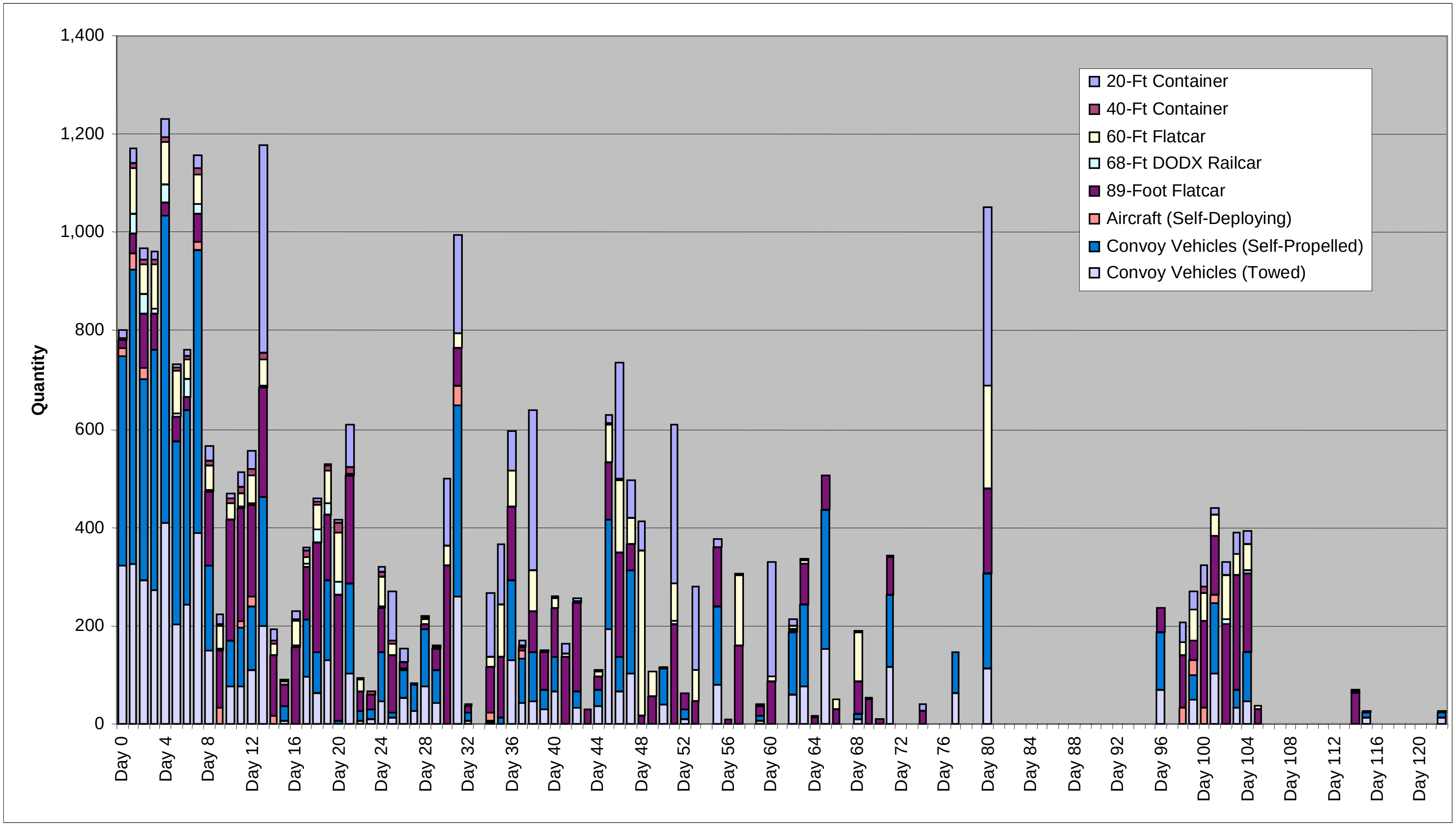


Figure F-2. Total Quantity of Transports Arriving at the Port of Savannah

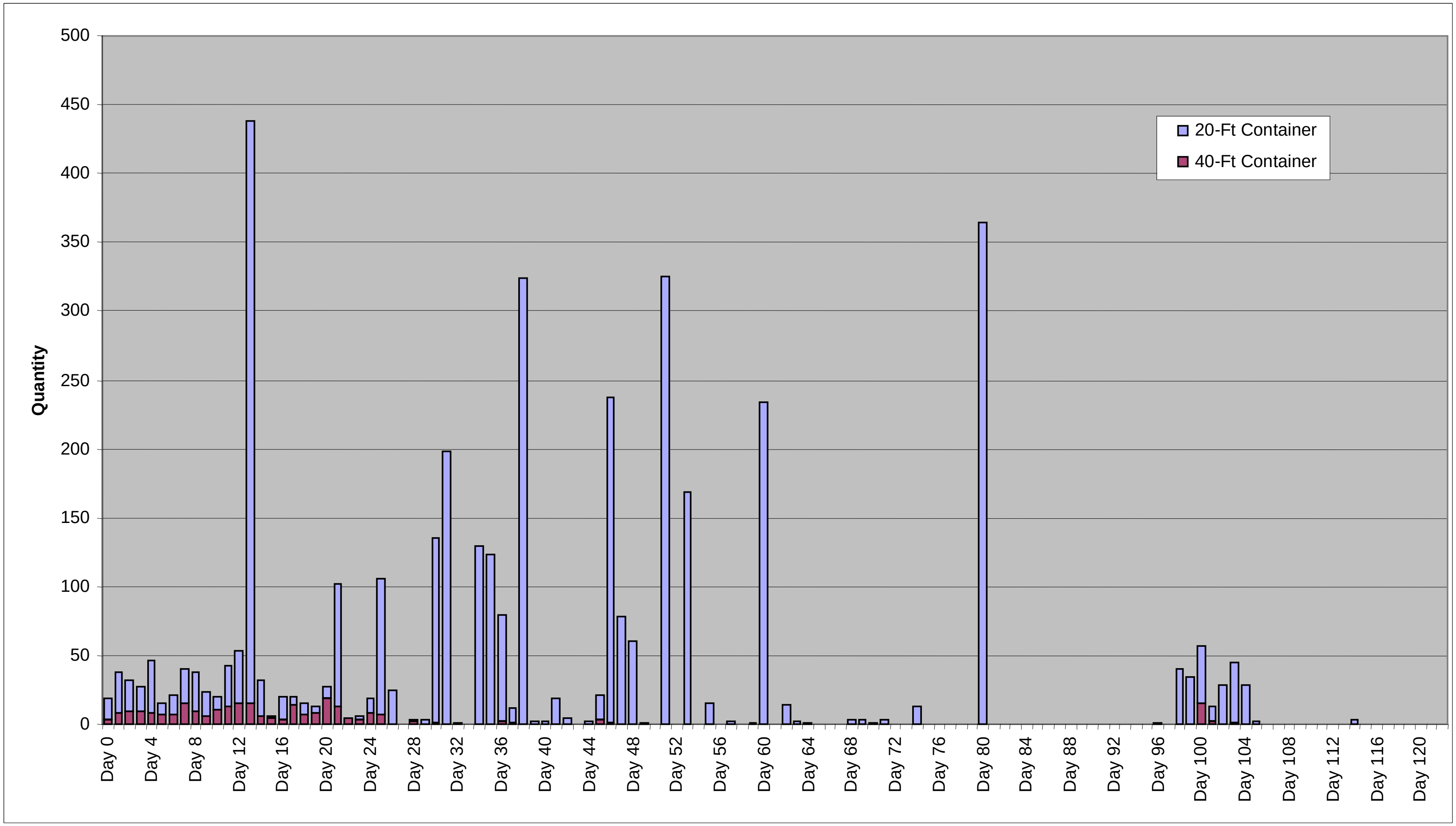


Figure F-3. Quantity of Containers Arriving at the Port of Savannah

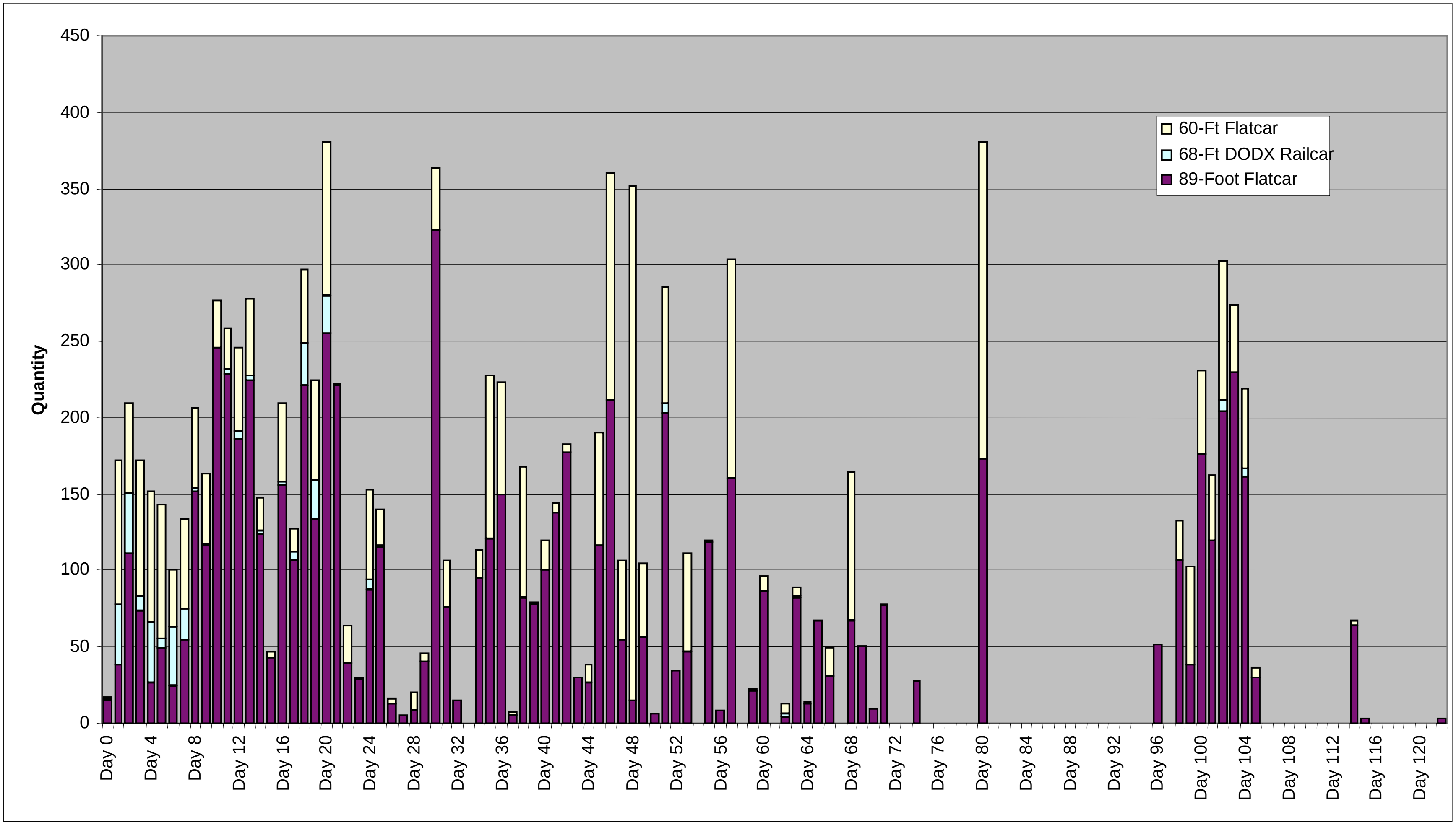


Figure F-4. Quantity of Railcars Arriving at the Port of Savannah

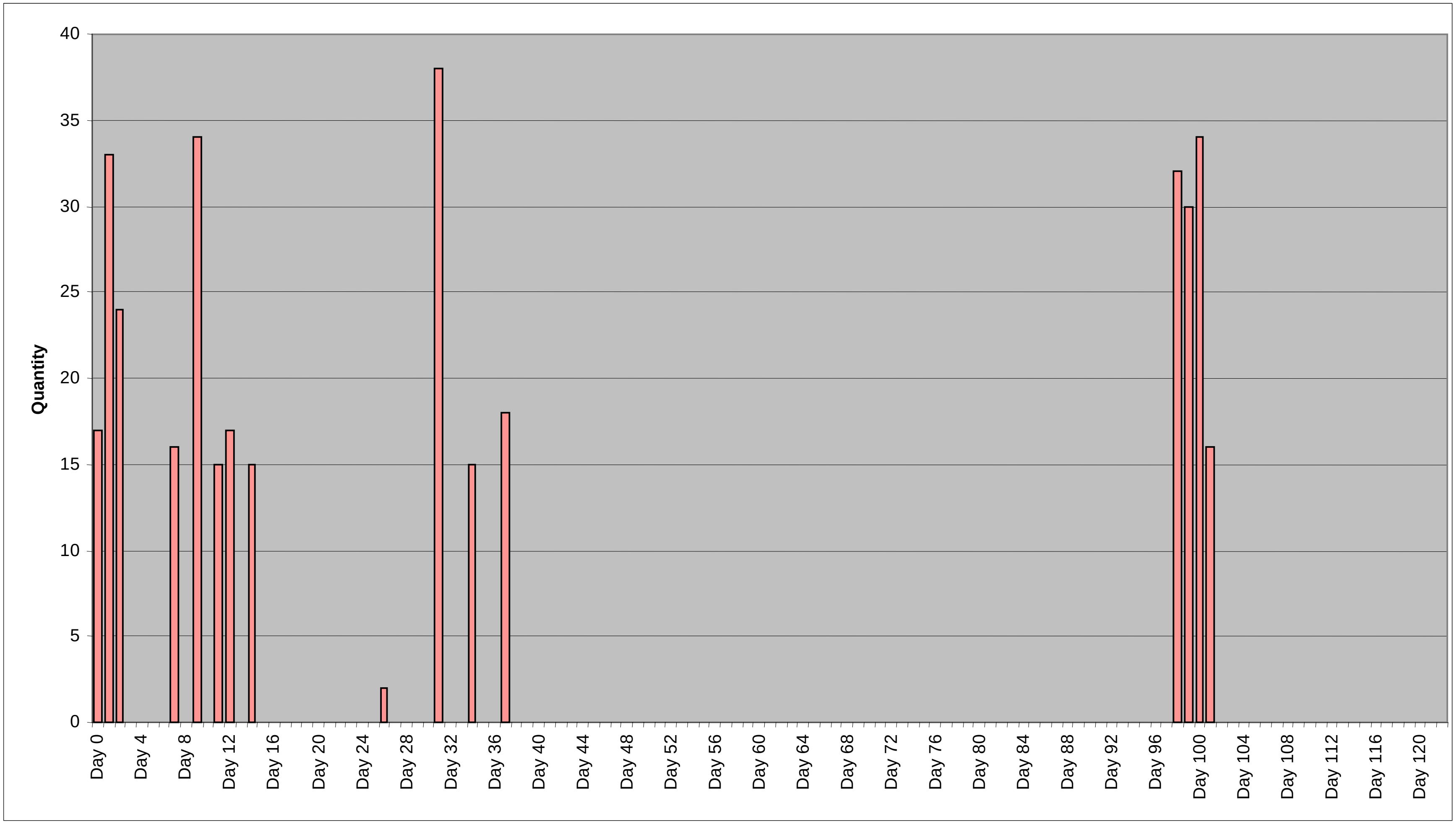


Figure F-5. Quantity of Aircraft Arriving at the Port of Savannah

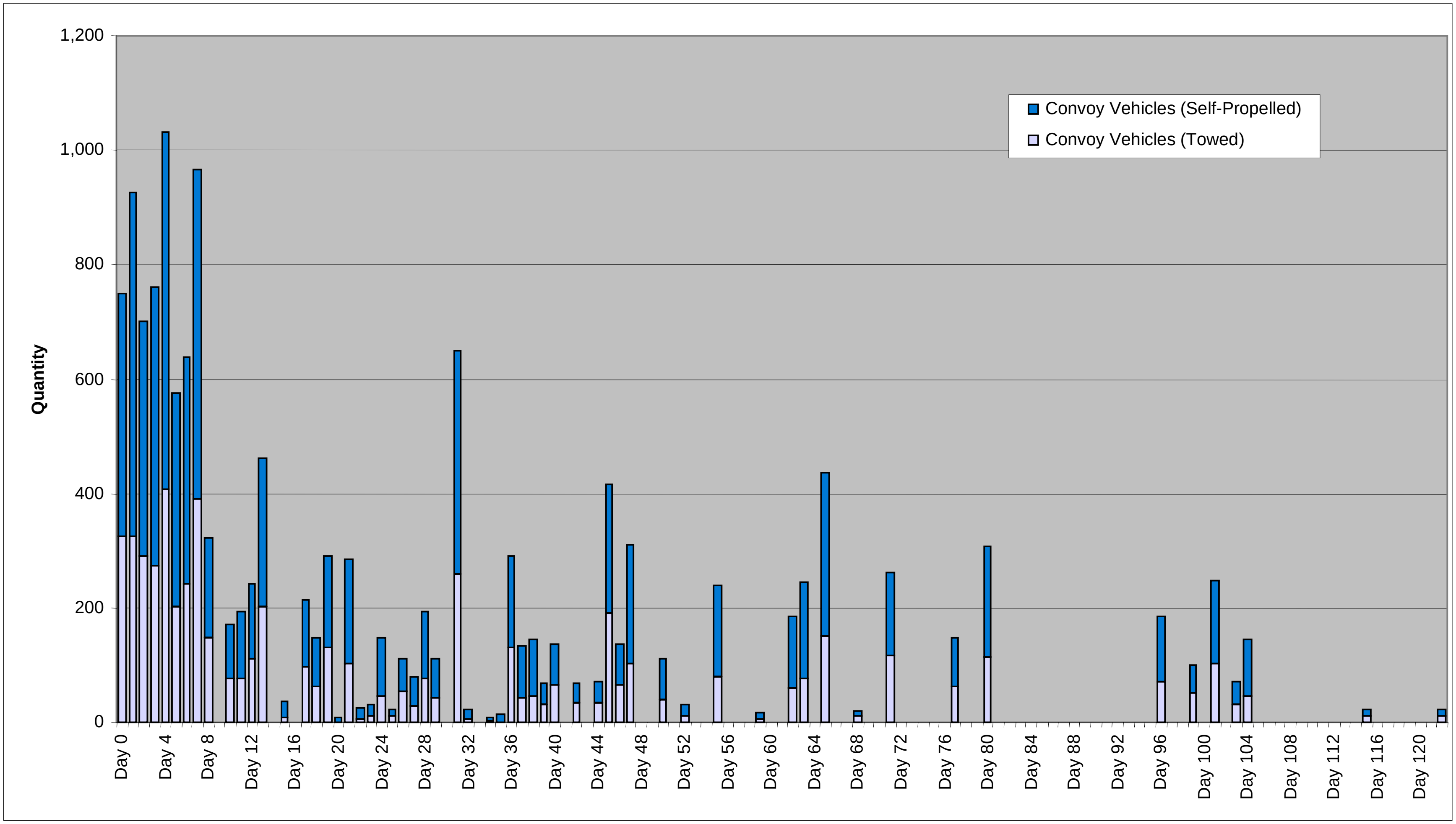


Figure F-6. Total Quantity of Convoy Vehicles Arriving at the Port of Savannah

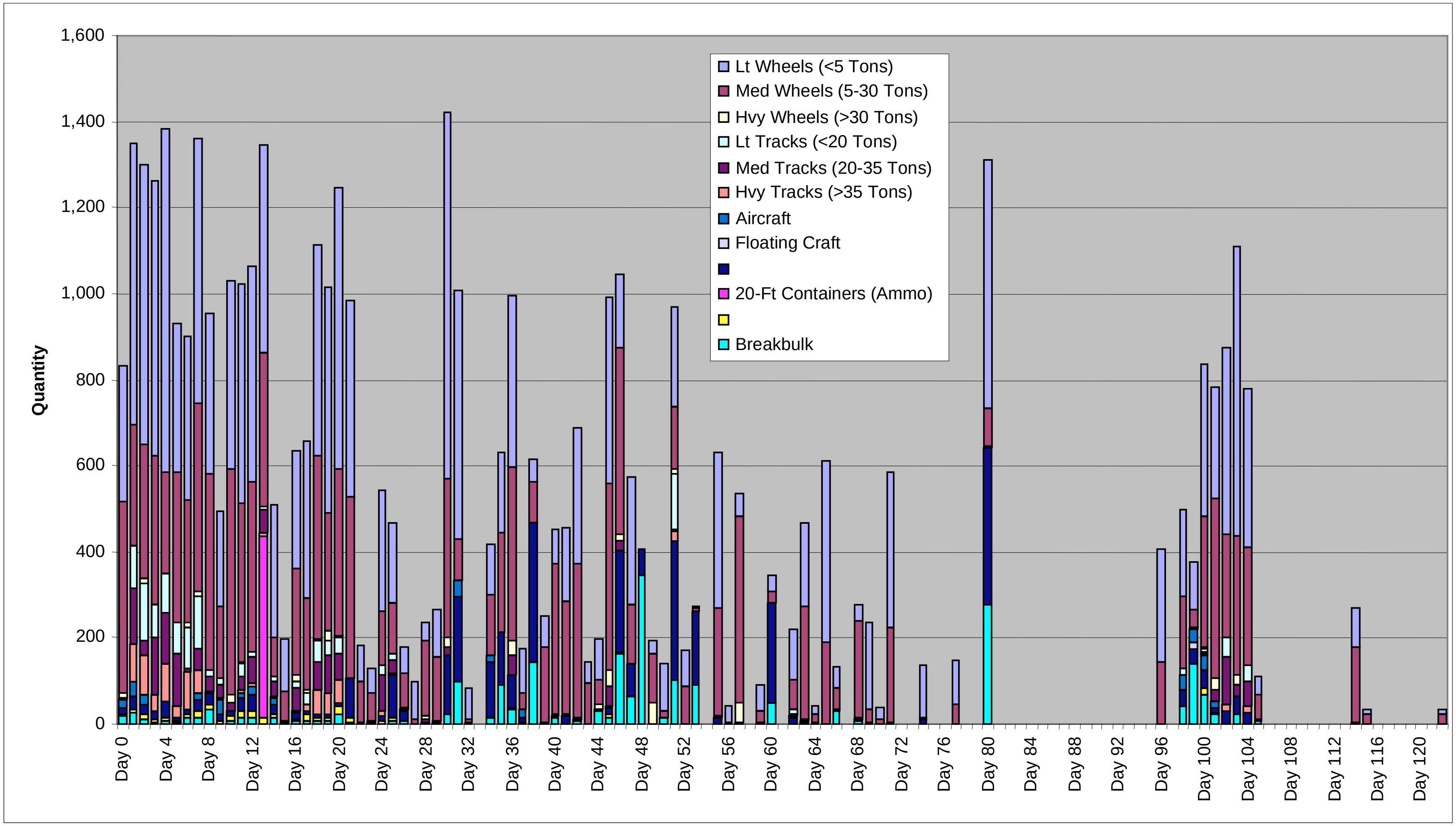


Figure F-7. Quantity of Items Arriving at the Port of Savannah

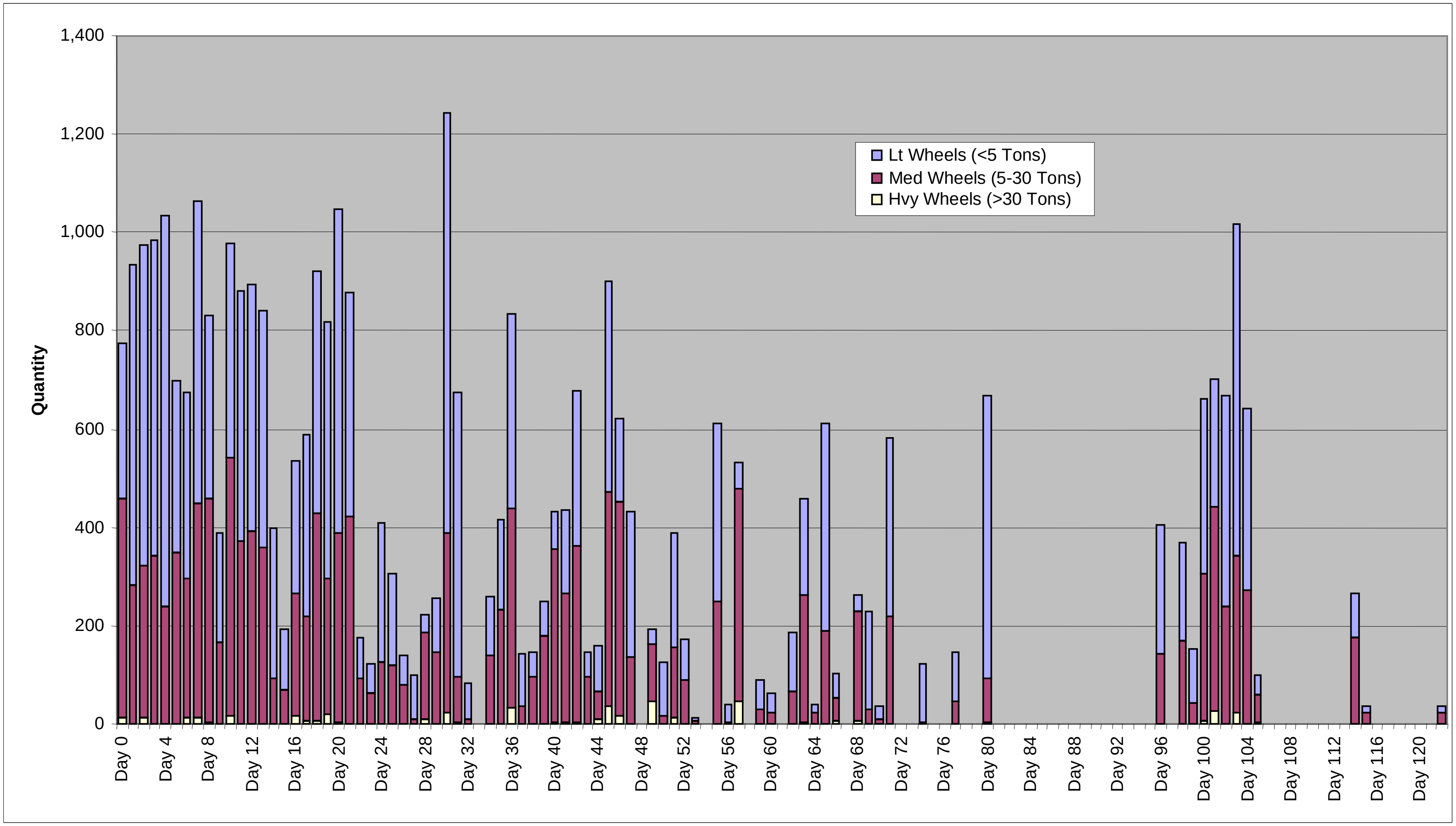


Figure F-8. Quantity of Wheeled Vehicles Arriving at the Port of Savannah

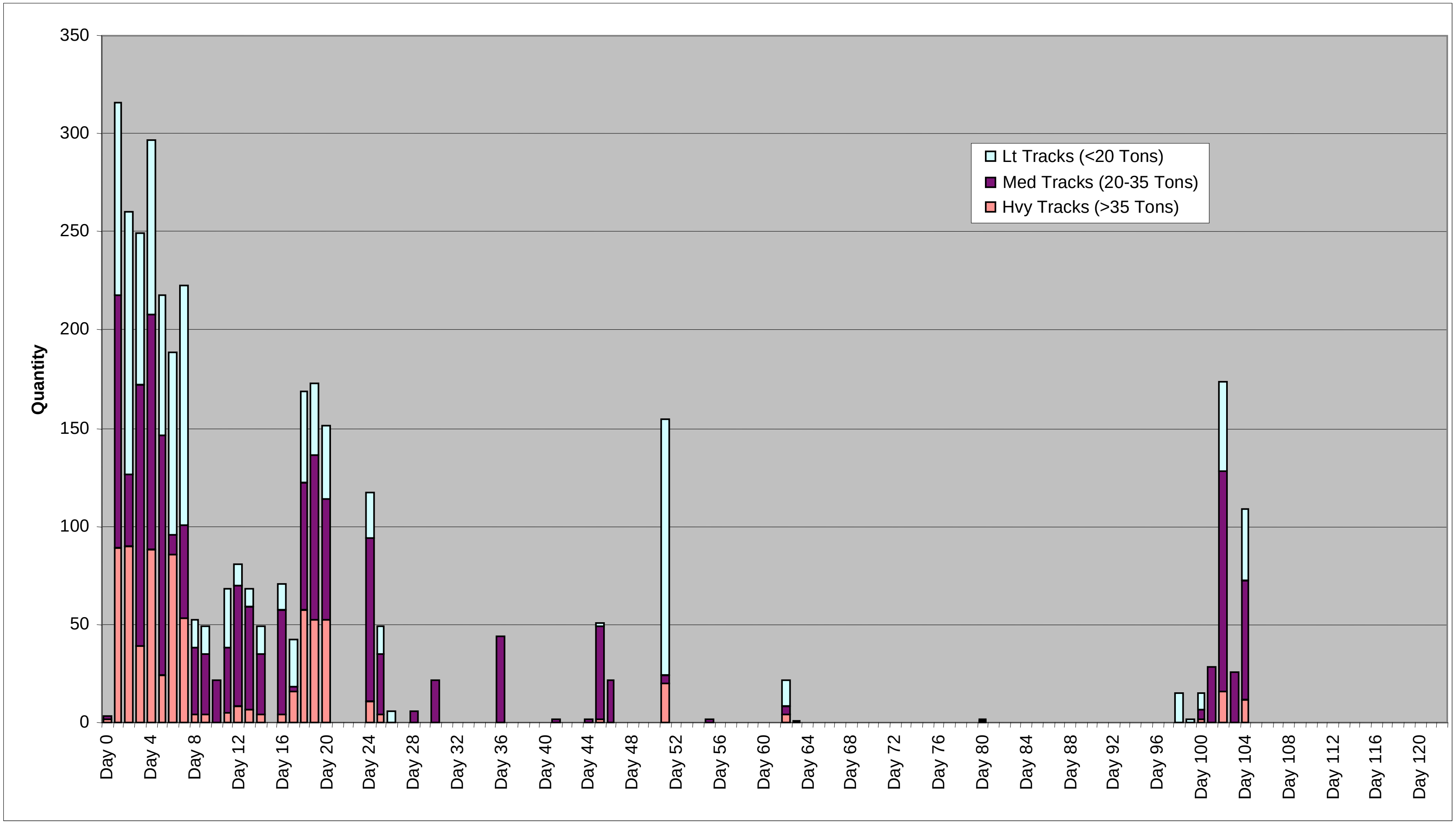


Figure F-9. Quantity of Tracked Vehicles Arriving at the Port of Savannah

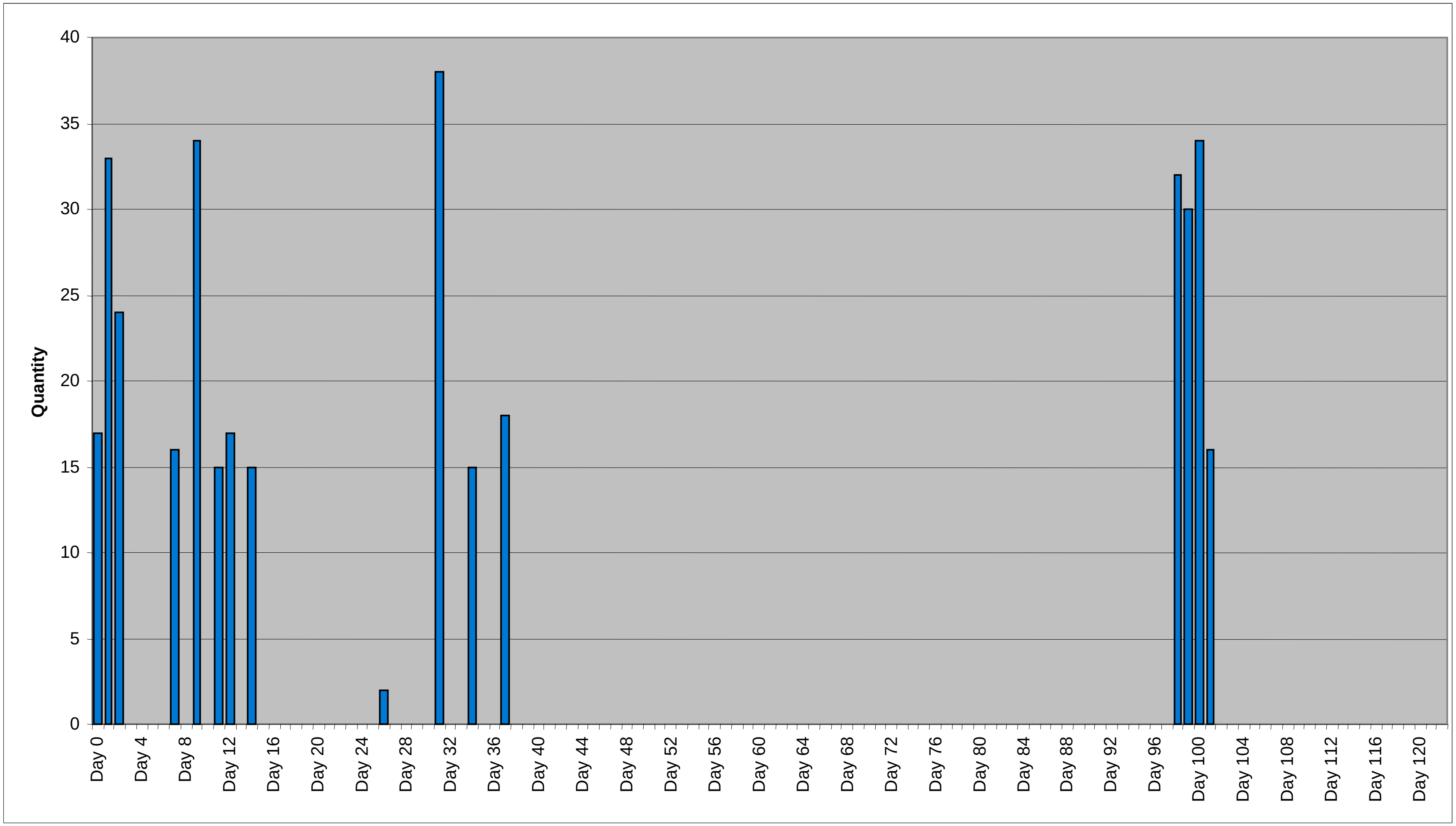


Figure F-10. Quantity of Aircraft Arriving at the Port of Savannah

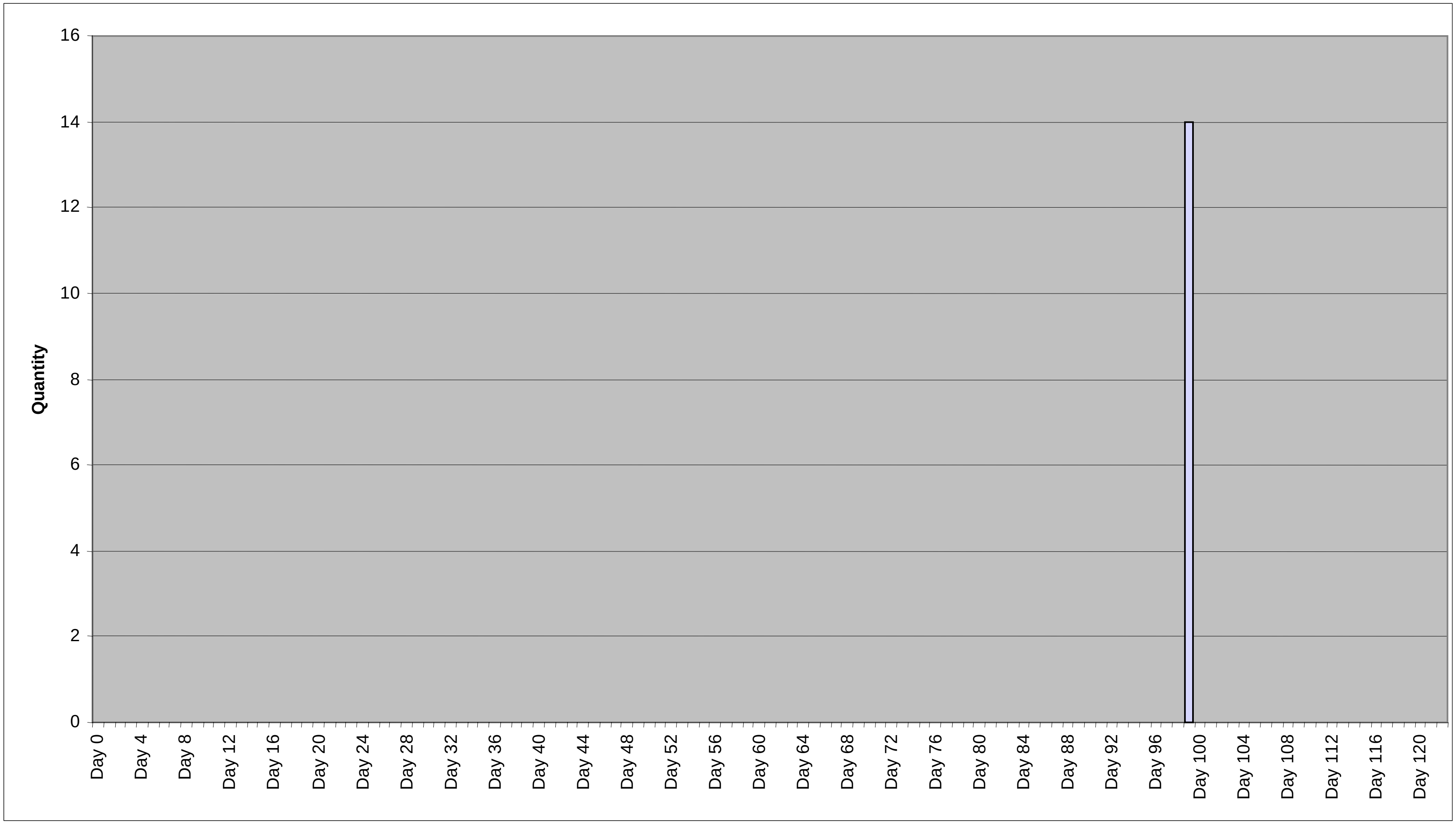


Figure F-11. Quantity of Floating Craft Arriving at the Port of Savannah

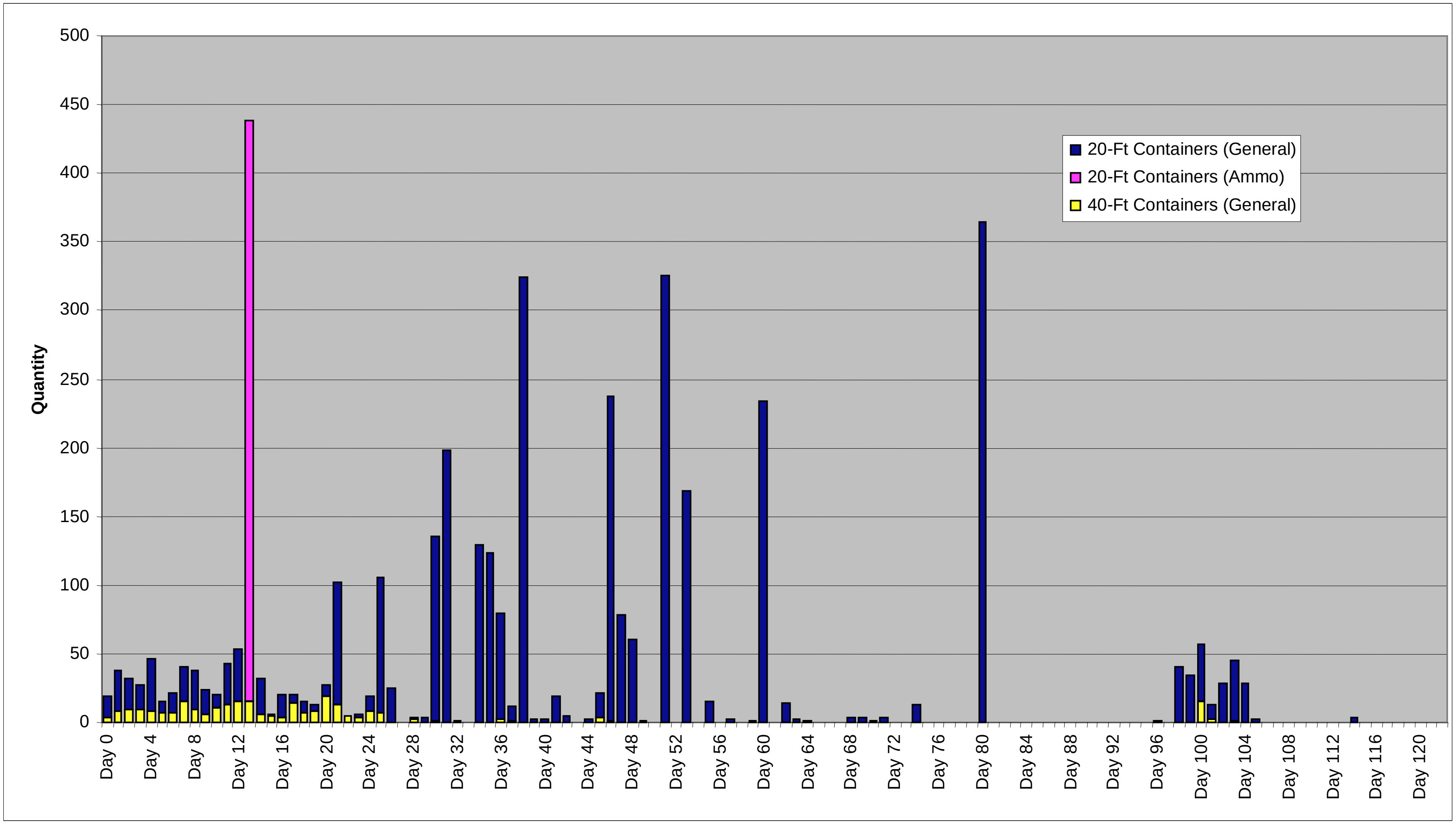


Figure F-12. Quantity of Containers Arriving at the Port of Savannah

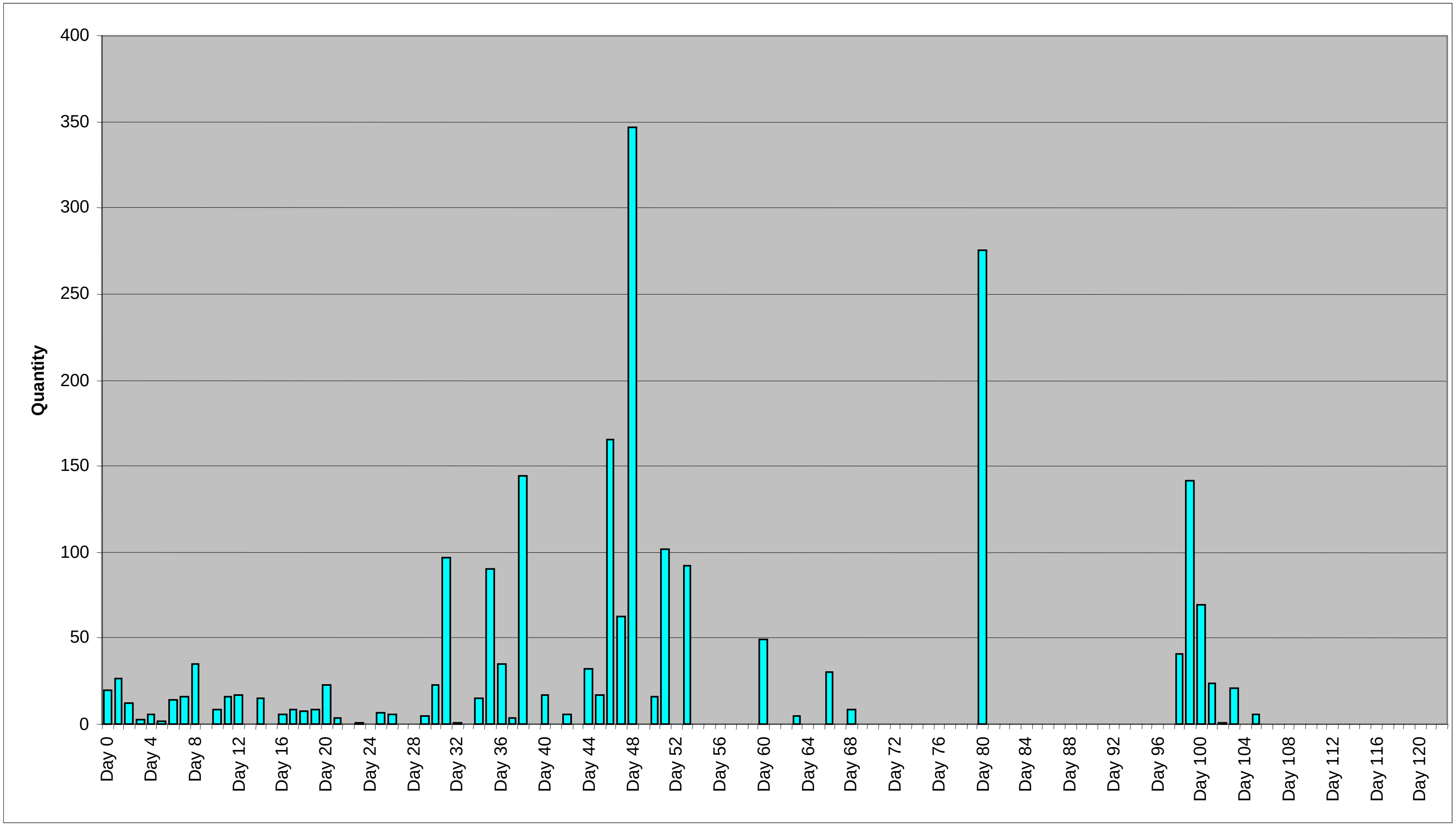


Figure F-13. Quantity of Breakbulk Cargo Items Arriving at the Port of Savannah

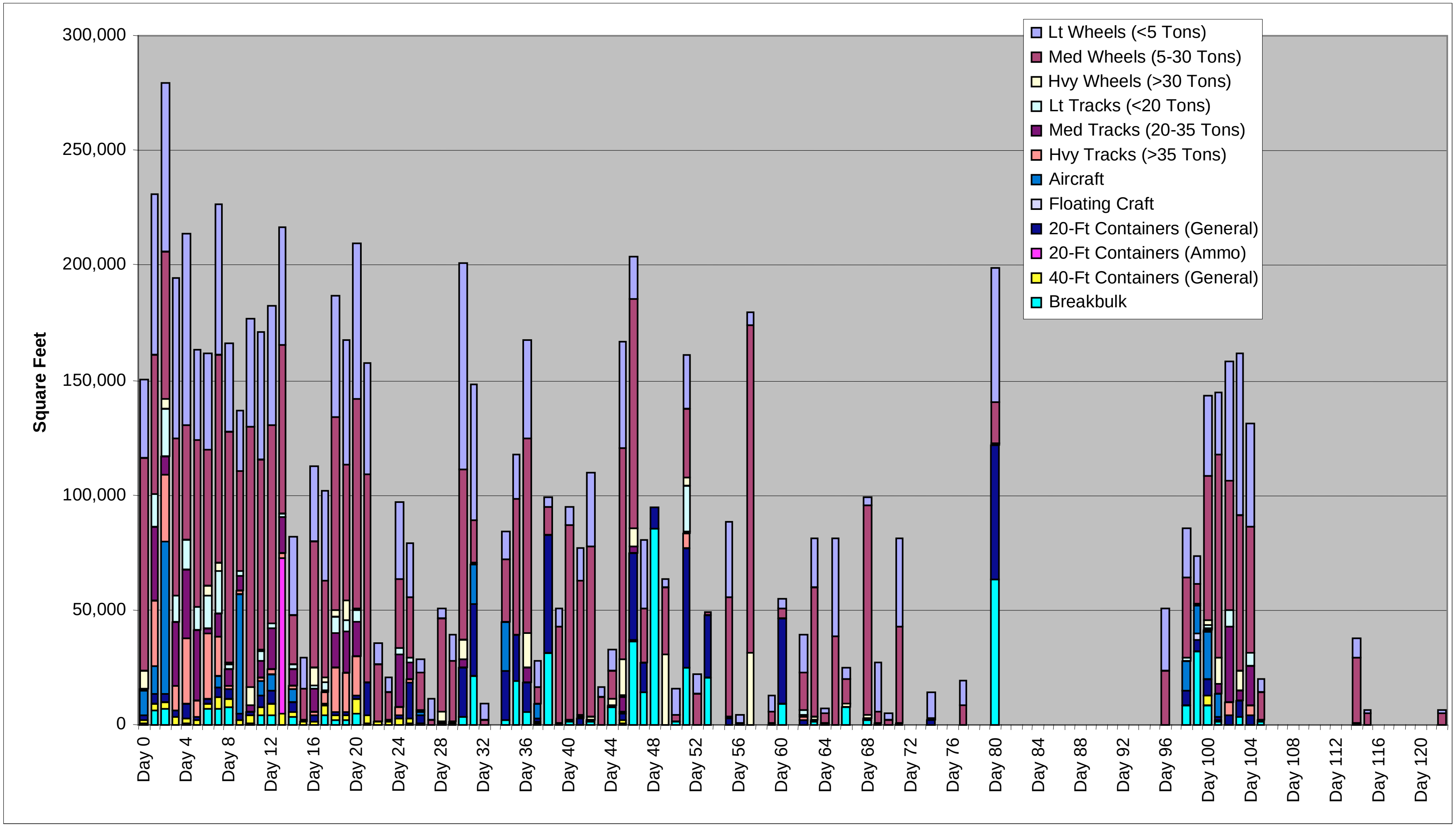


Figure F-14. Total Square Feet of Cargo Arriving at the Port of Savannah

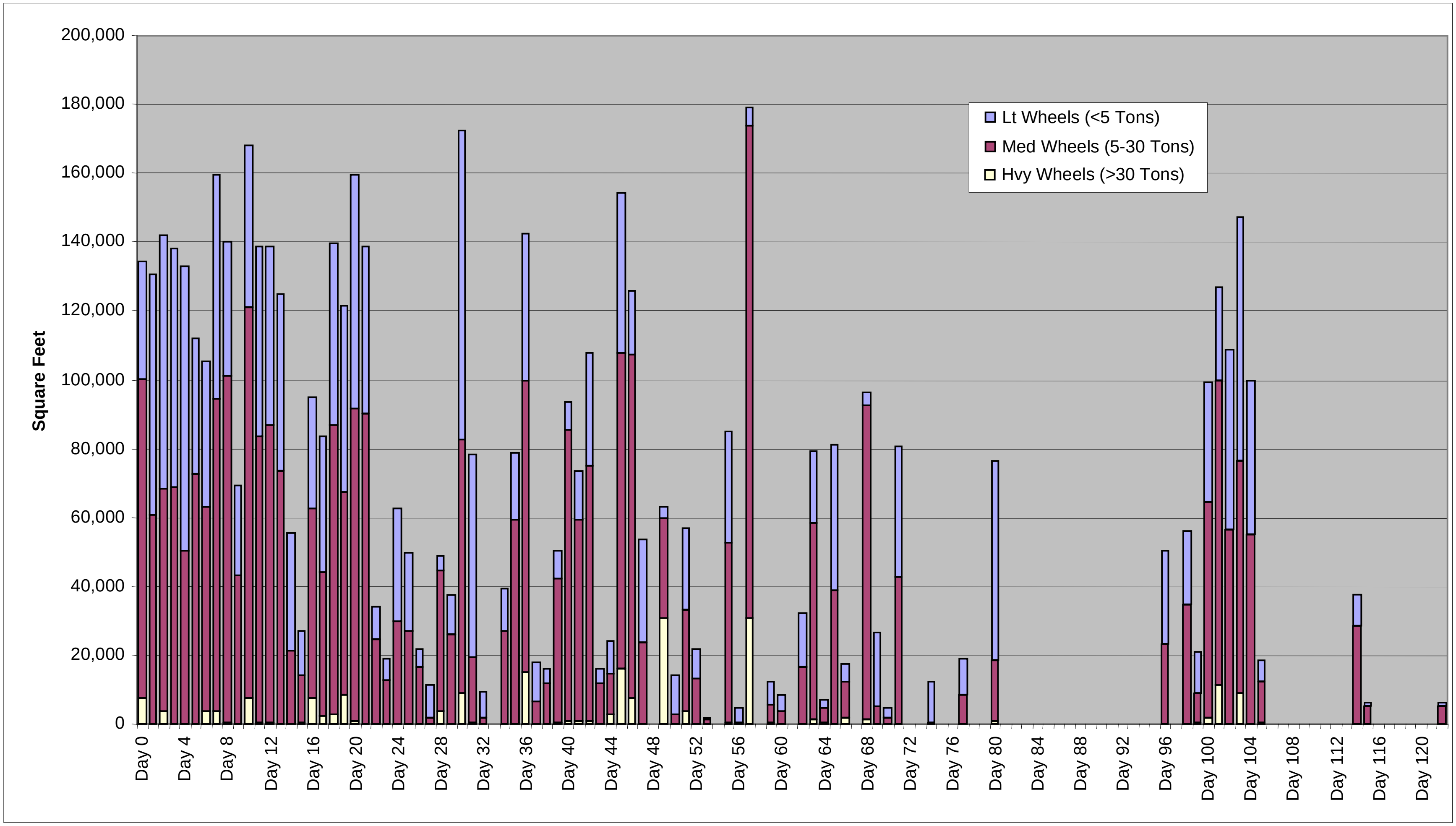


Figure F-15. Square Feet of Wheeled Vehicles Arriving at the Port of Savannah

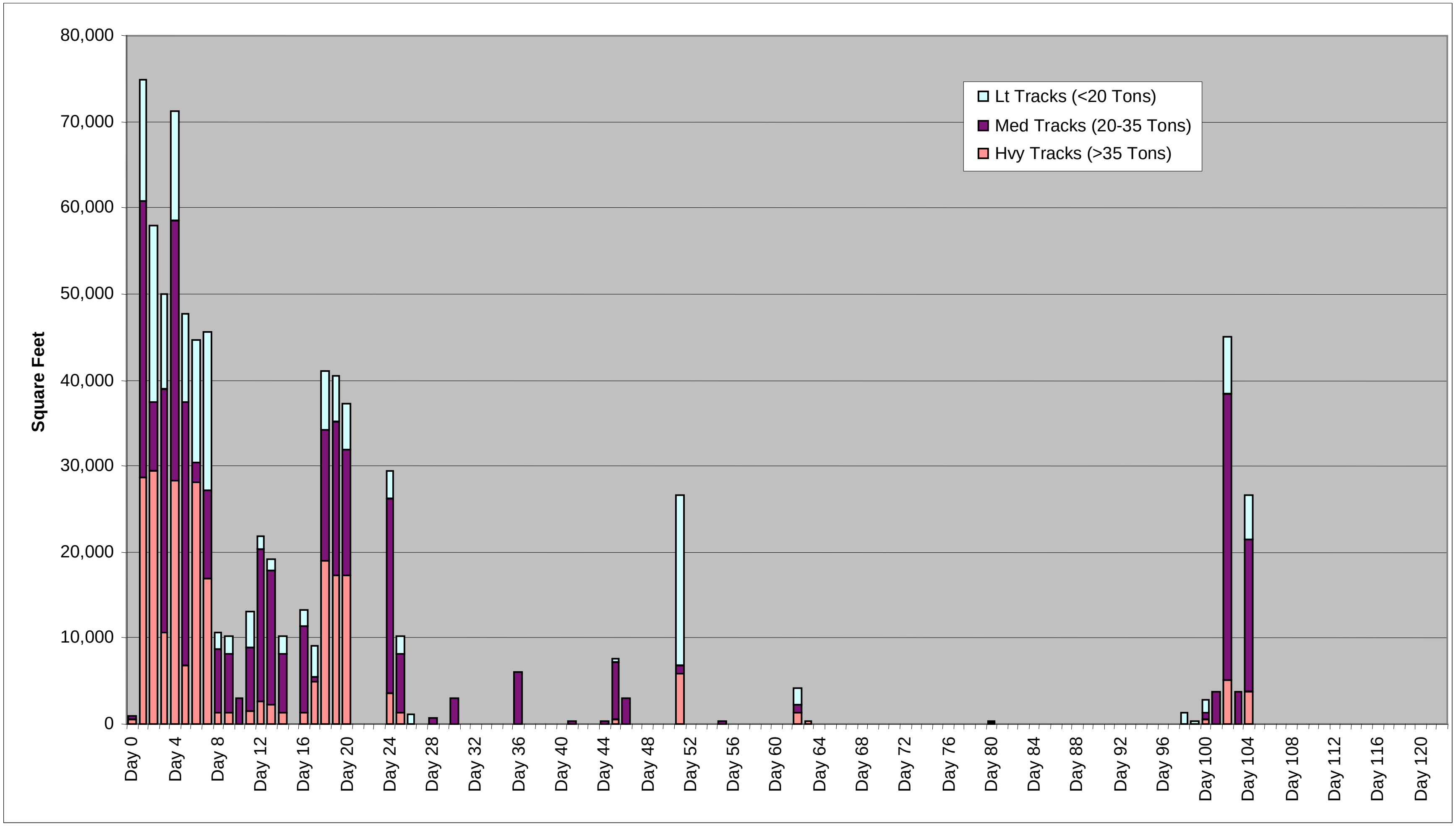


Figure F-16. Square Feet of Tracked Arriving at the Port of Savannah

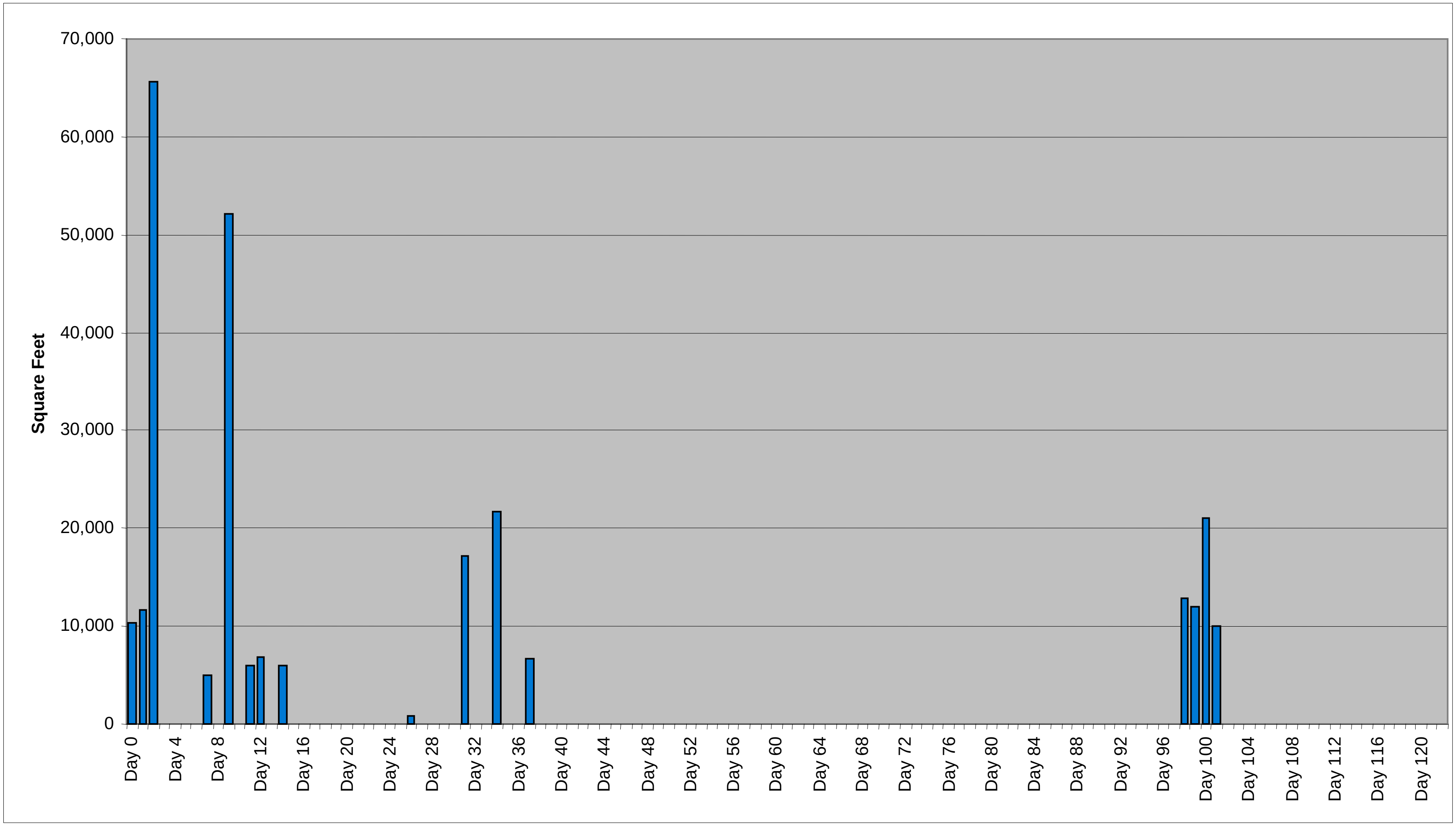


Figure F-17. Square Feet of Aircraft Arriving at the Port of Savannah

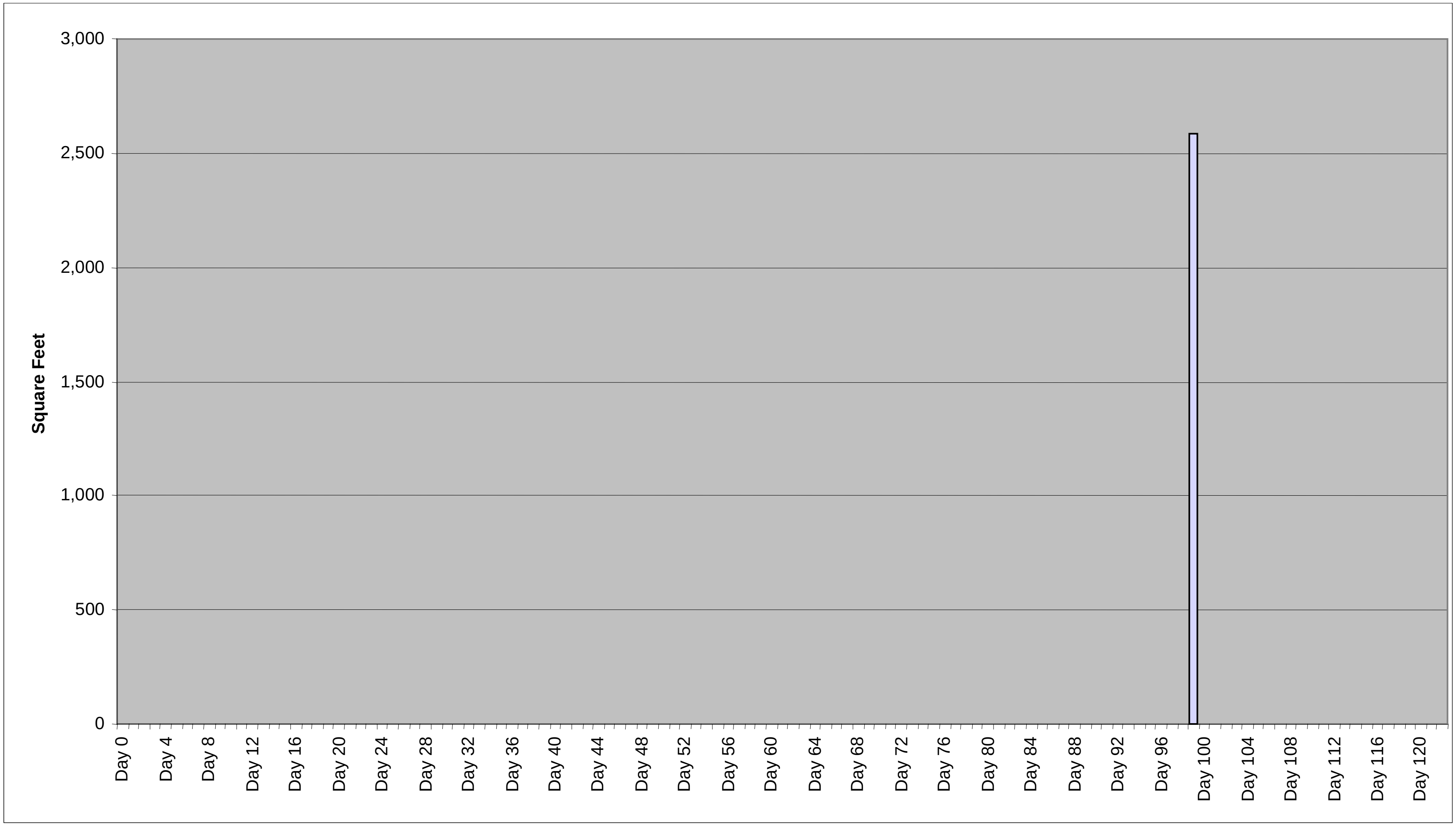


Figure F-18. Square Feet of Floating Craft Arriving at the Port of Savannah

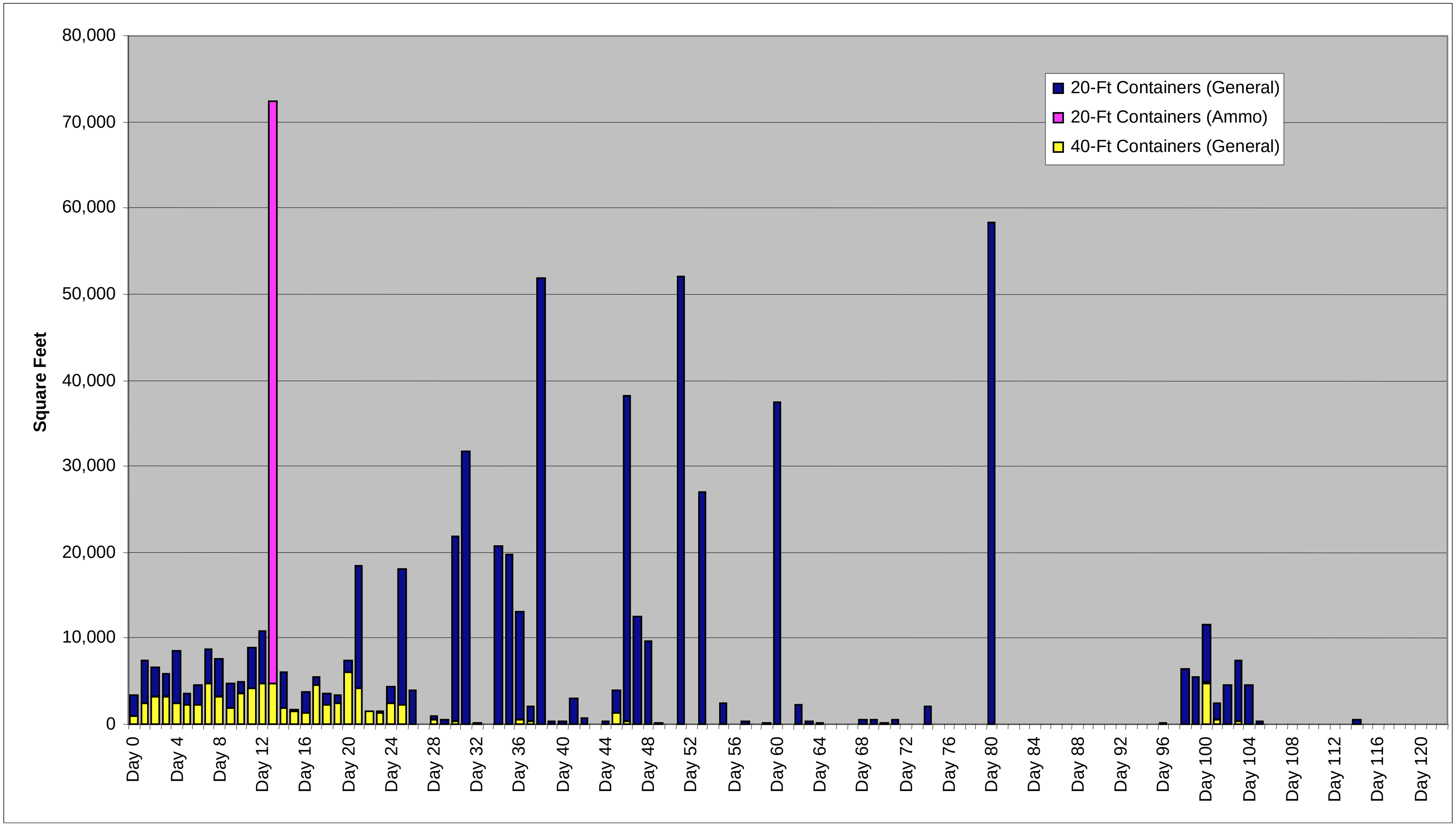


Figure F-19. Square Feet of Containers Arriving to the Port of Savannah

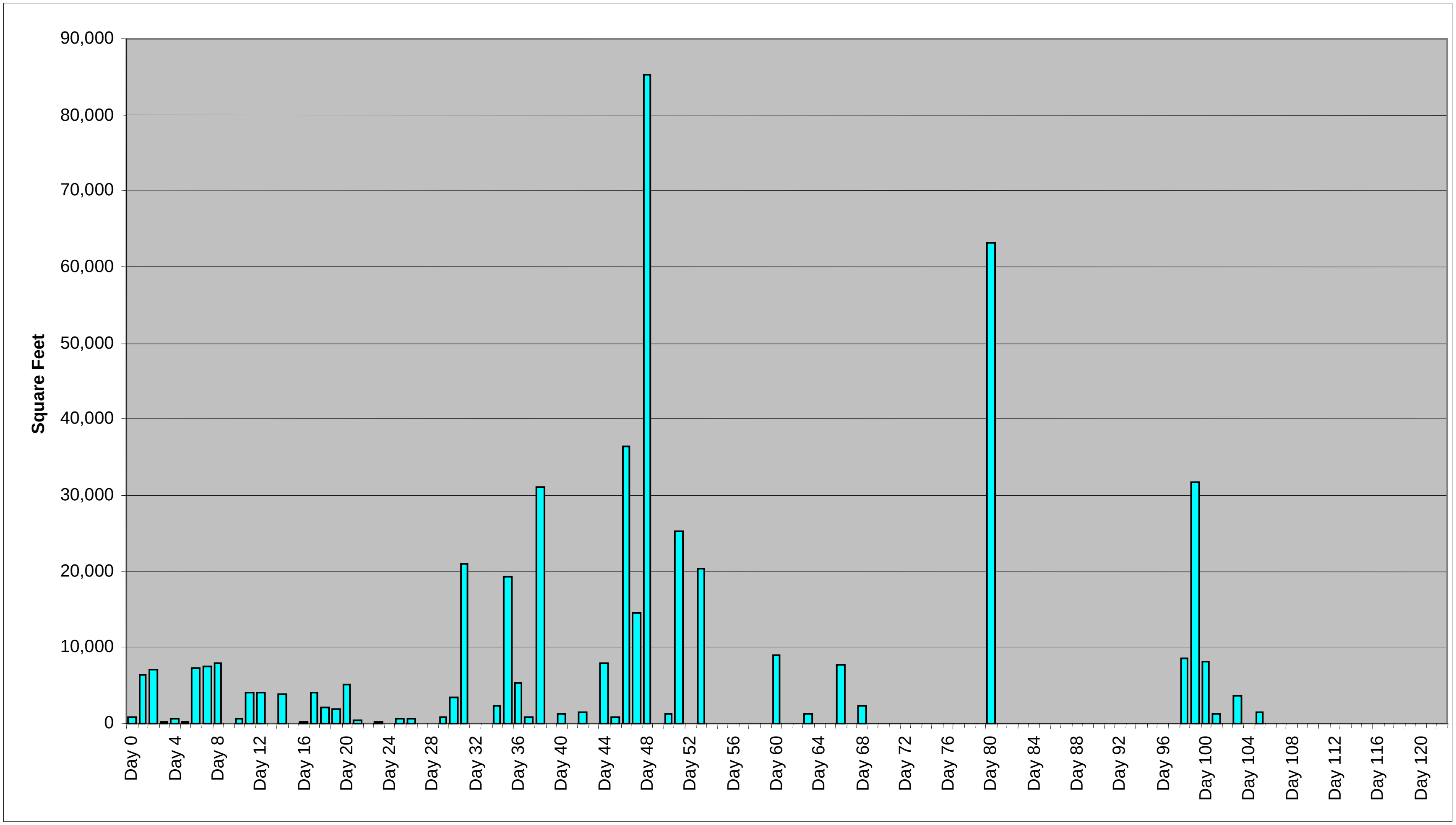


Figure F-20. Square Feet of Breakbulk Cargo Items Arriving at the Port of Savannah

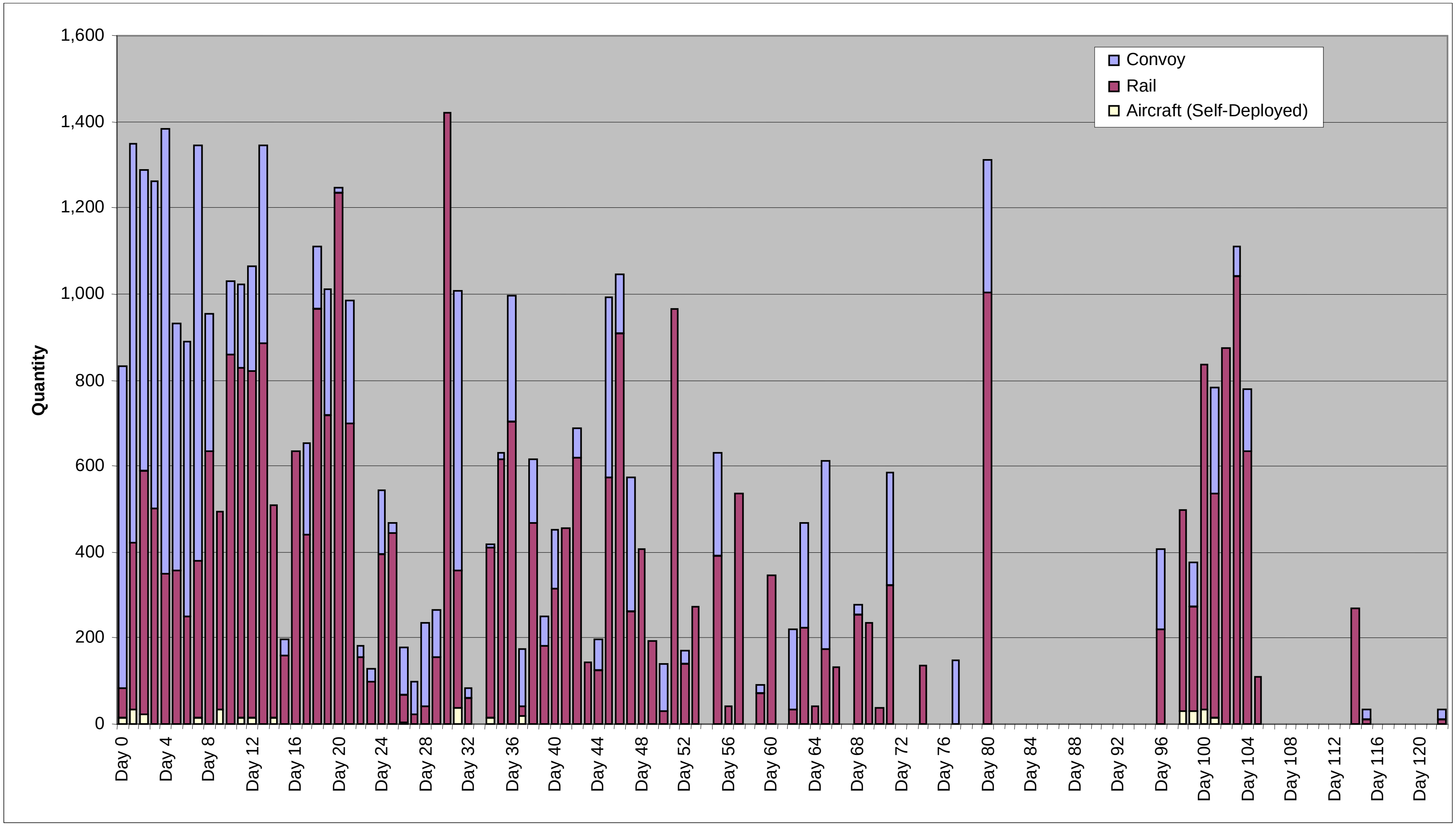


Figure F-21. Quantity of Cargo Items Arriving by Mode at the Port of Savannah

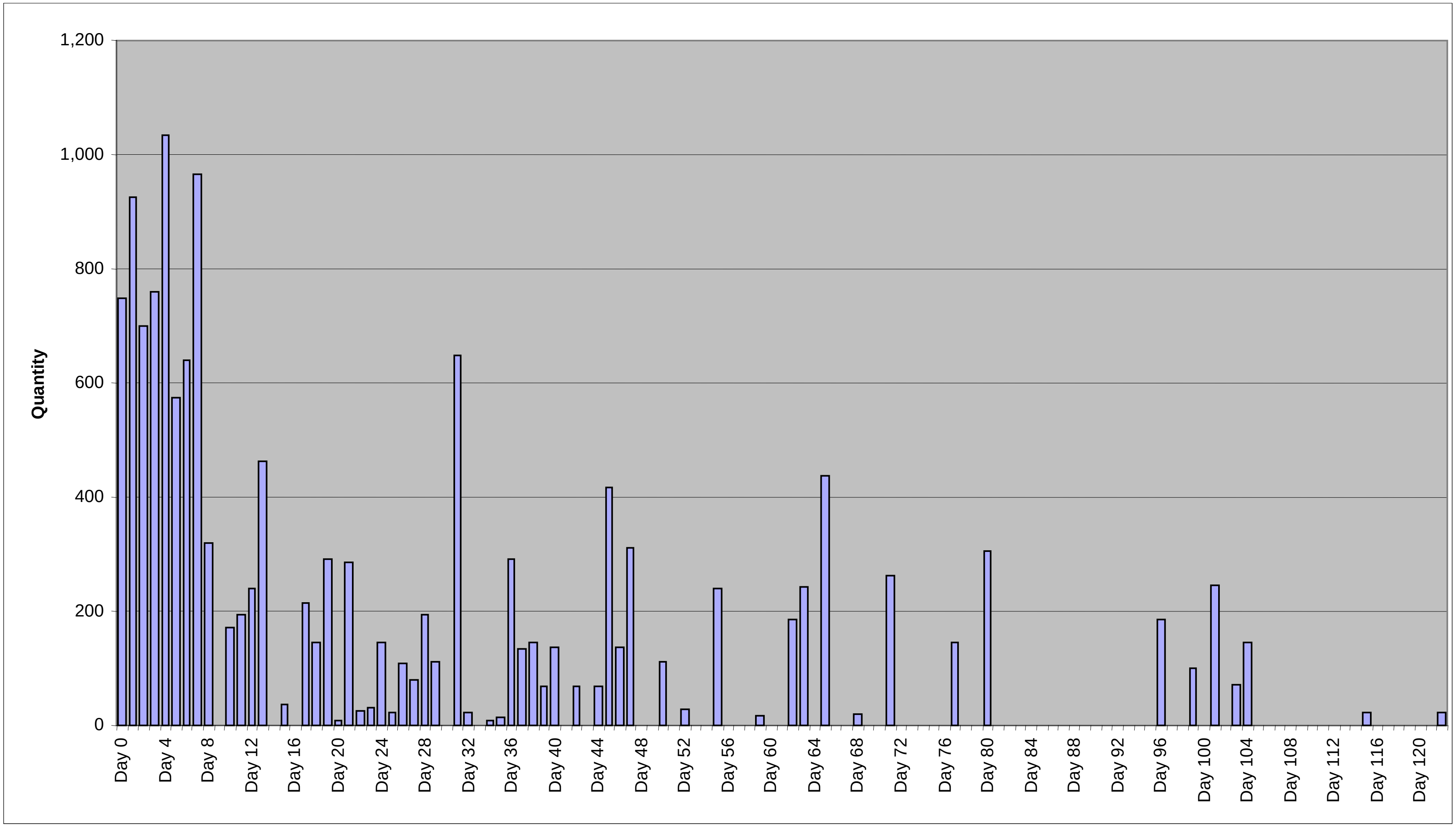


Figure F-22. Quantity of Wheeled Vehicles Convoying to the Port of Savannah

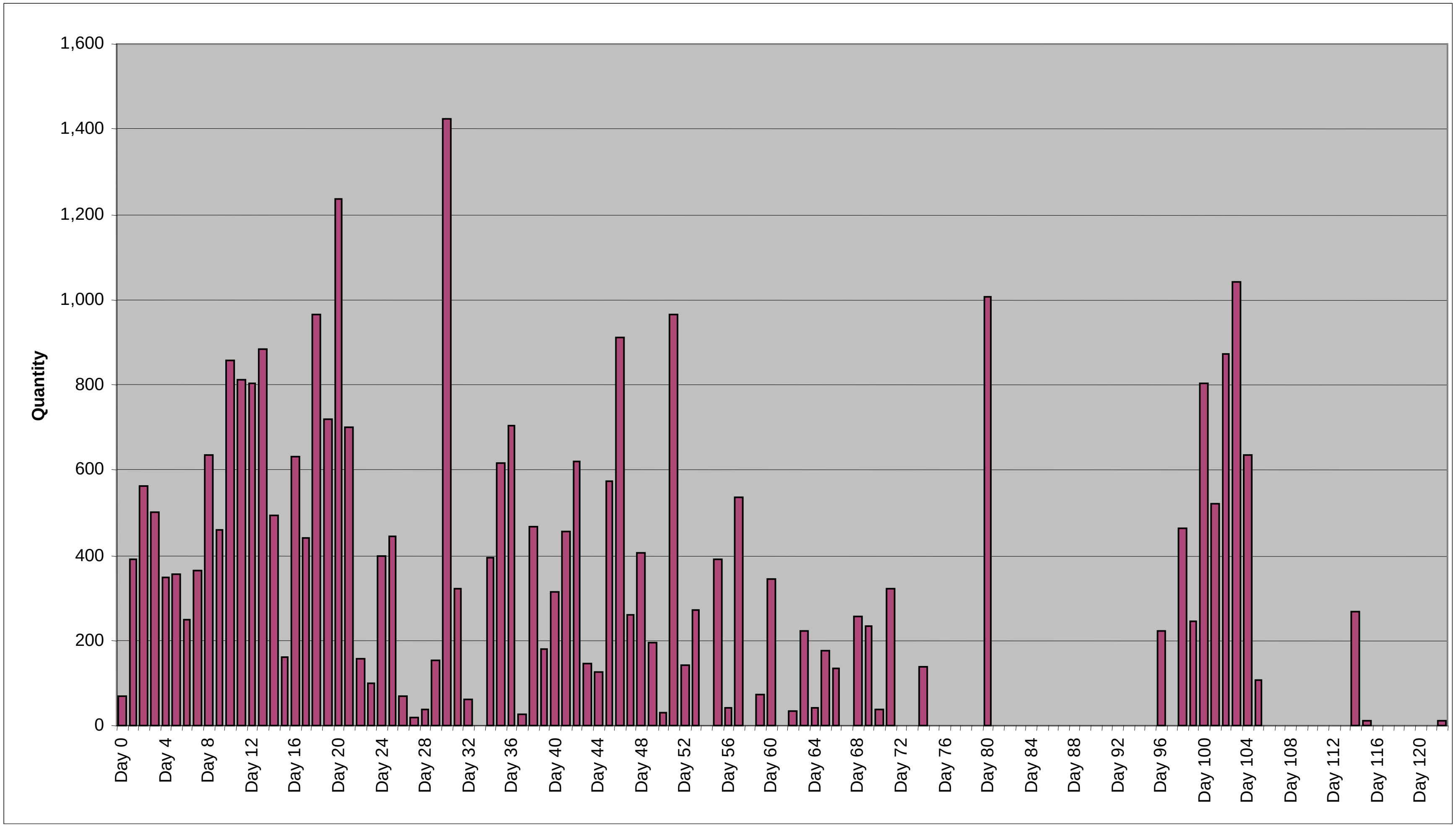


Figure F-23. Quantity of Items Arriving by Rail to the Port of Savannah

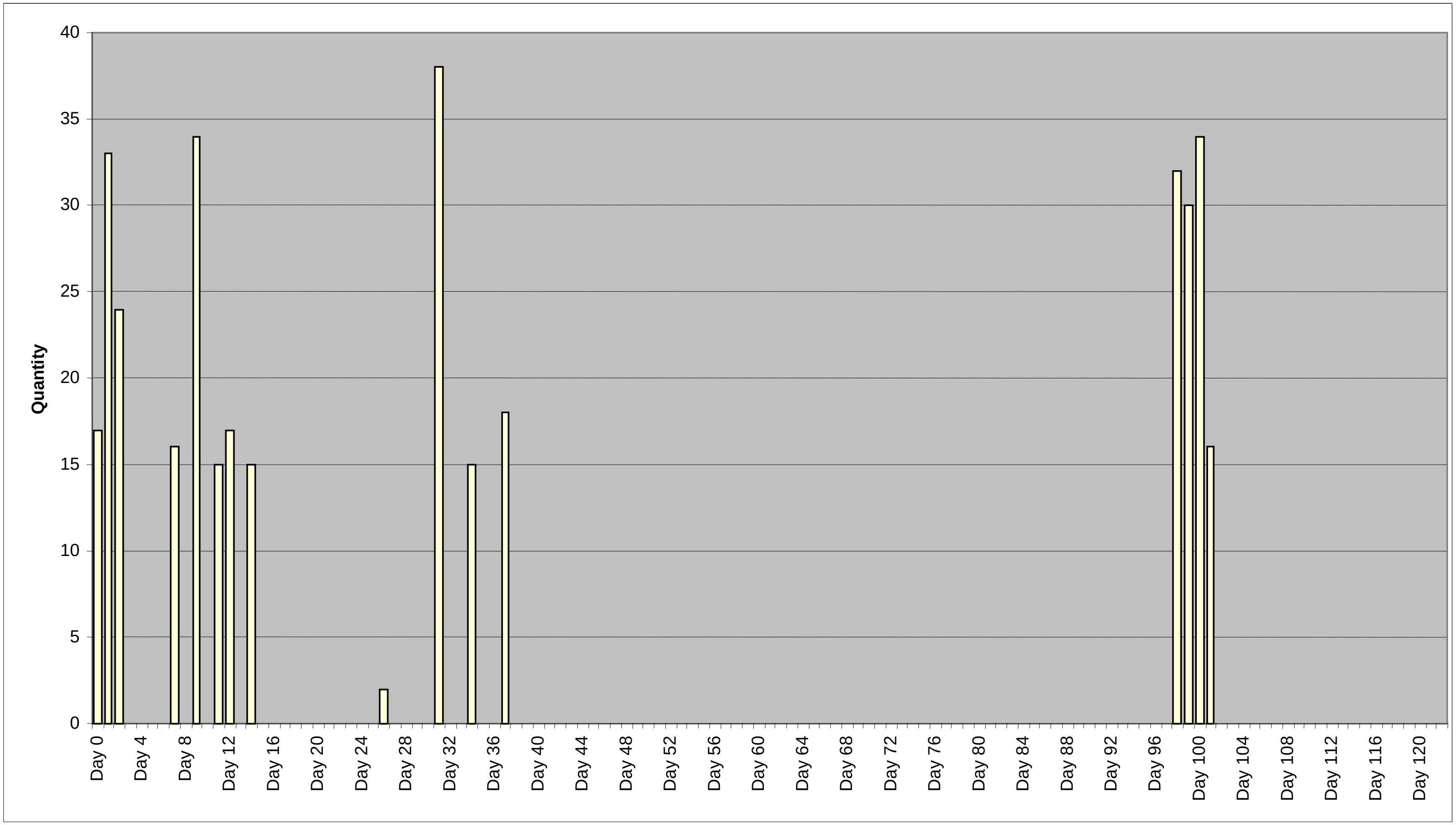


Figure F-24. Quantity of Aircraft Self-Deploying to the Port of Savannah

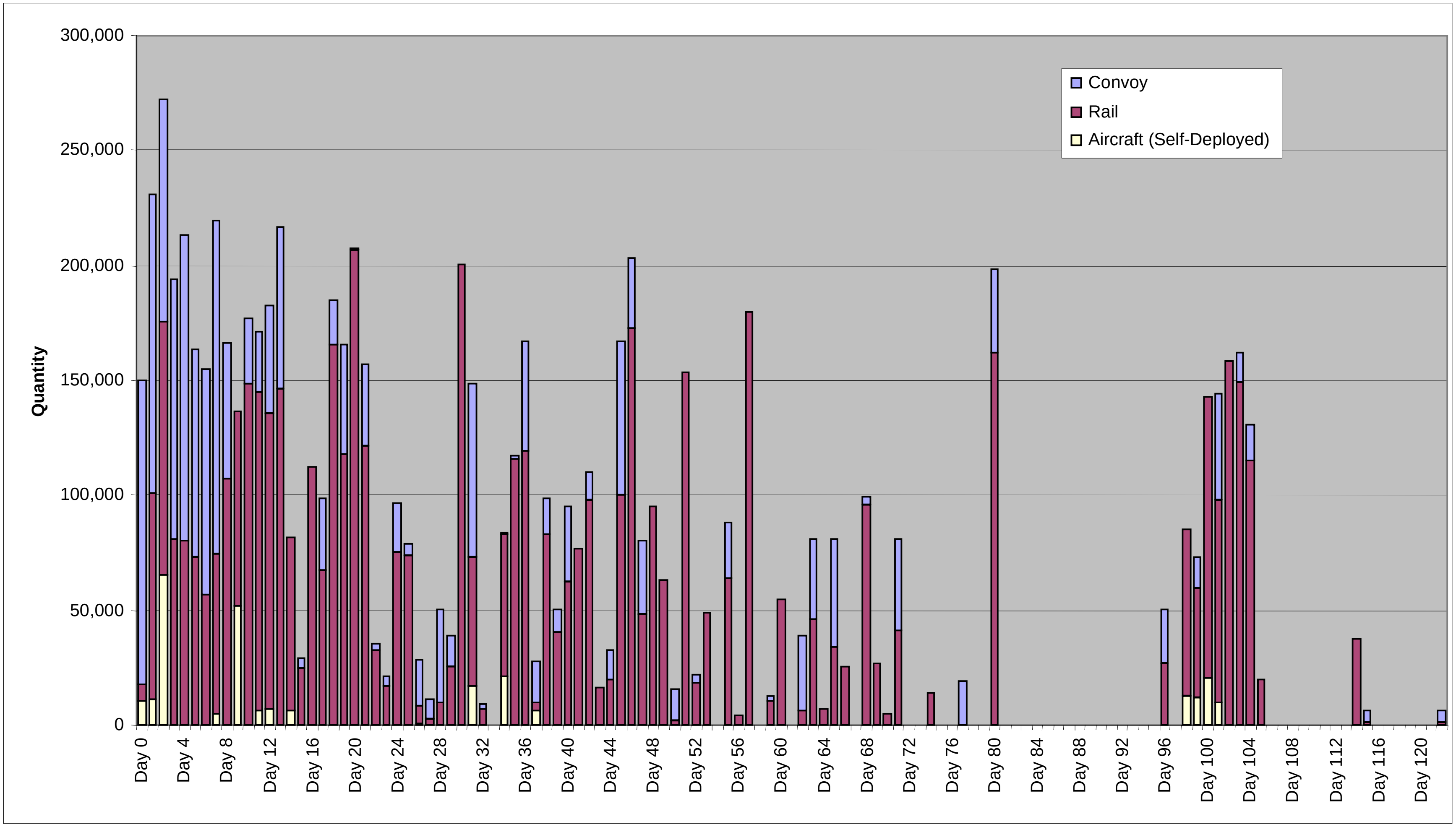


Figure F-25. Square Feet of Cargo Items Arriving by Mode to the Port of Savannah

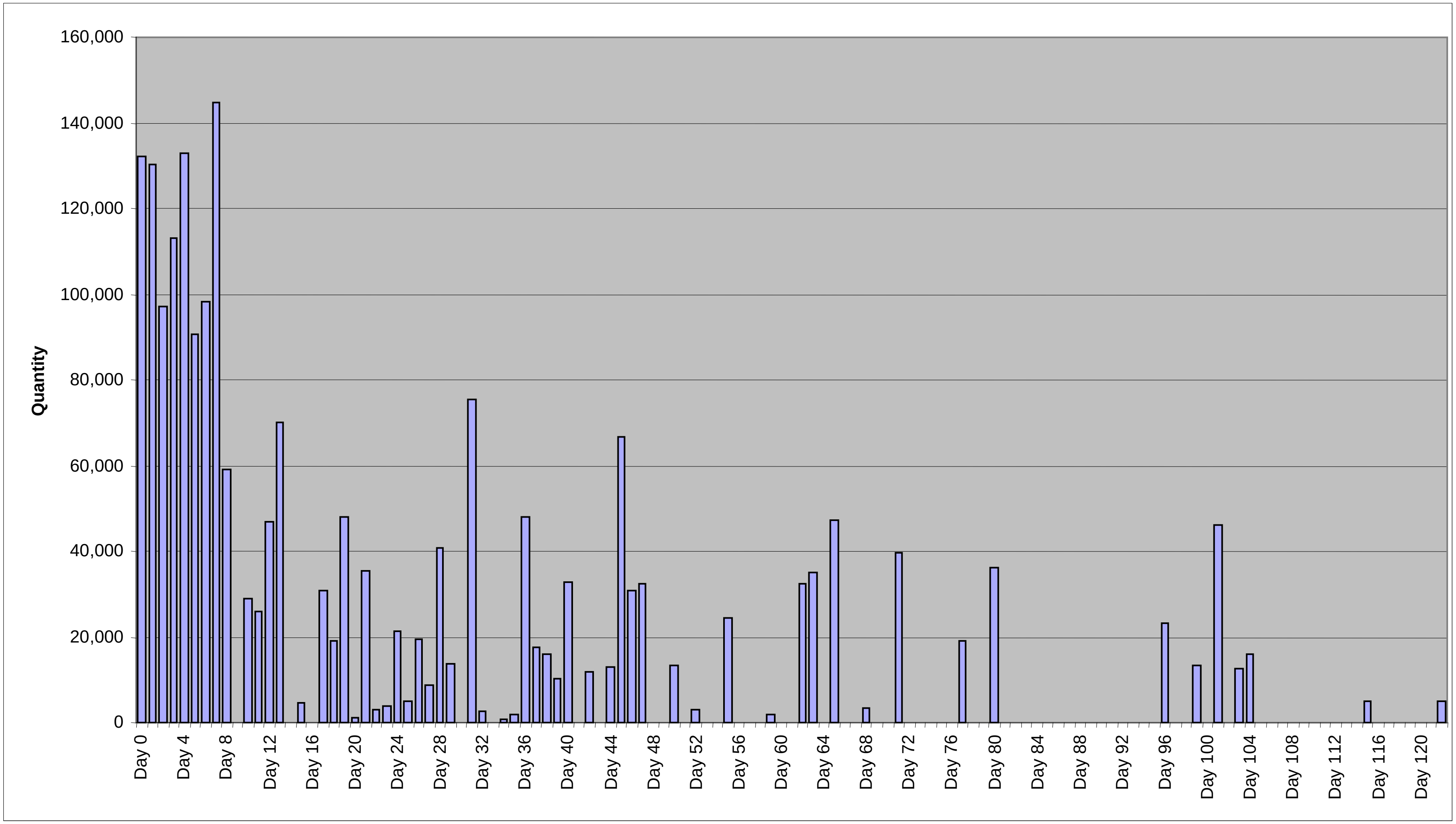


Figure F-26. Square Feet of Wheeled Vehicles Convoying to the Port of Savannah

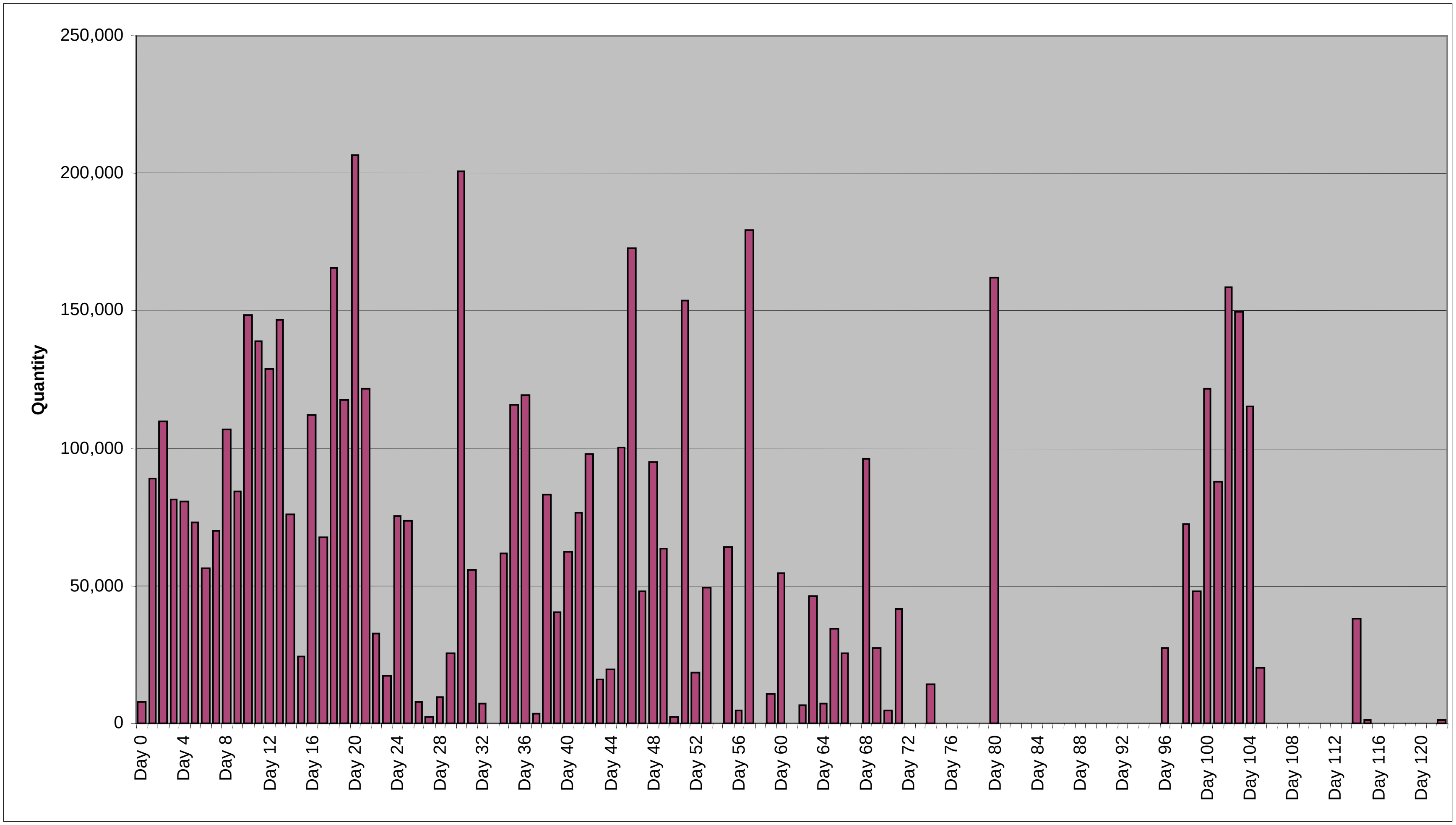


Figure F-27. Square Feet of Cargo Items Arriving by Rail to the Port of Savannah

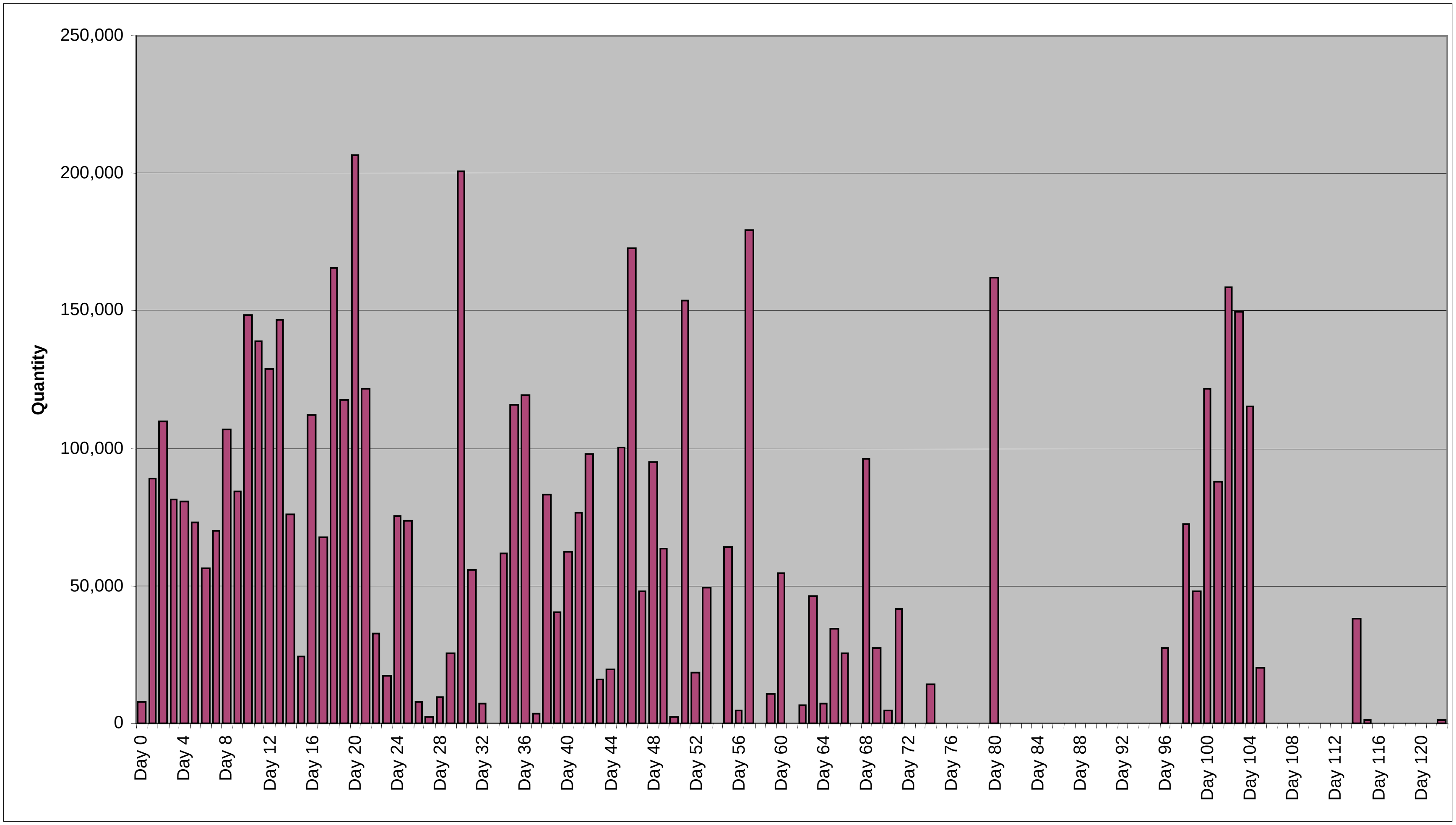


Figure F-28. Square Feet of Aircraft Self-Deploying to the Port of Savannah

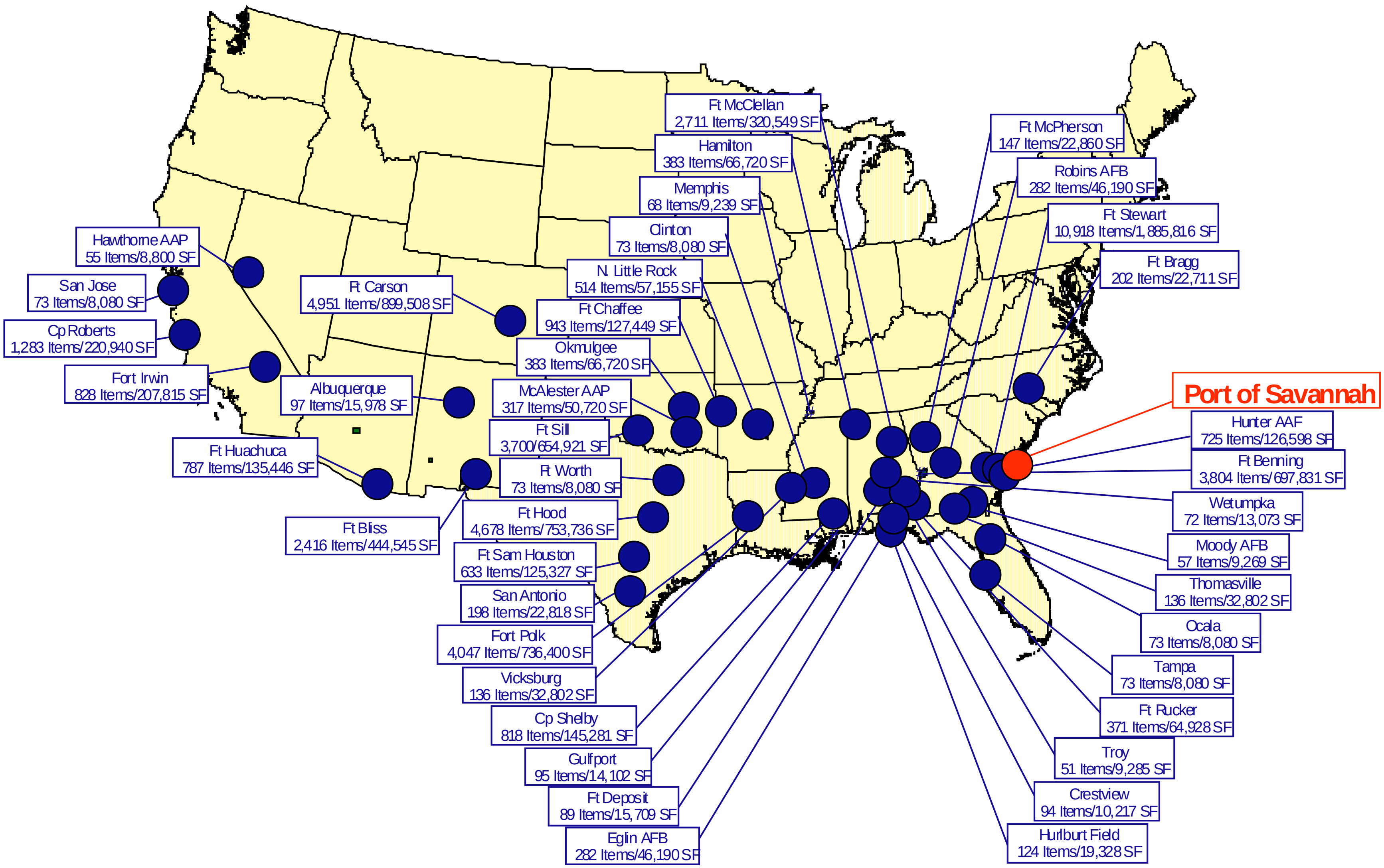


Figure F-29. Amount of Cargo Arrivcing at the Port of Savannah by Origin

Table F-2
Amount of Cargo Arriving at the Port of Savannah by Origin
(Origins not in Figure F-29)

Origin	Quantity	Square Feet
Montgomery, AL	42	7,051
Concord NWS, CA	30	4,800
Fort Gillem, GA	24	2,850
Patrick AFB, FL	24	2,850
Pine Bluff Arsenal AK	24	2,850
Anniston Army Depot, AL	17	2,720
Phoenix, AZ	12	1,952
Silver City, NM	12	1,952
Hammond, LA	11	1,250
Fallbrook, CA	3	480
Seal Beach NWS, CA	1	160

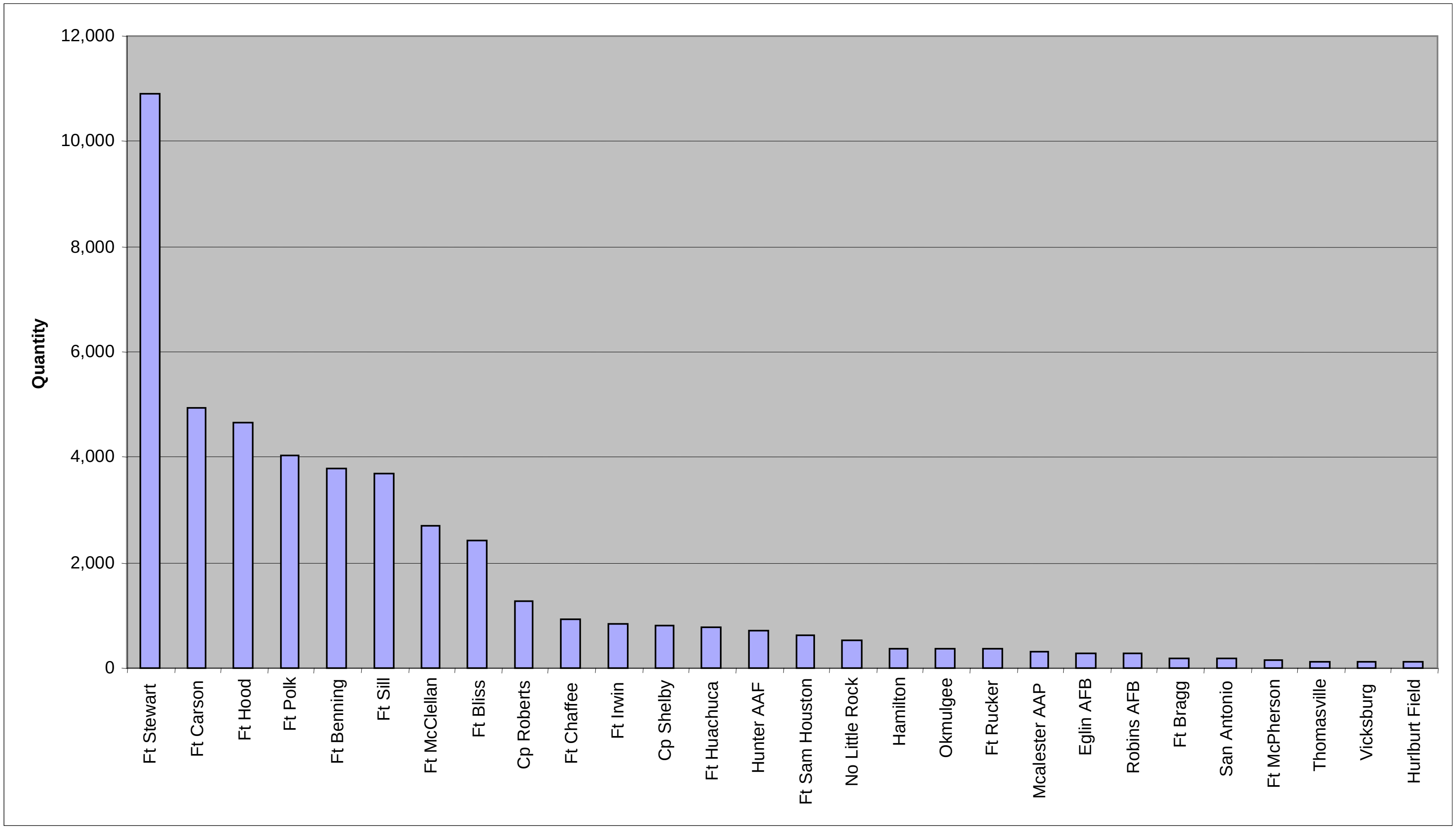


Figure F-30. Quantity of Items Arriving at the Port of Savannah by Origin

Table F-3
Amount of Cargo Arriving at the Port of Savannah by Origin
(Origins not in Figure F-30)

ORIGIN	QUANTITY
Albuquerque, NM	97
Gulfport, MS	95
Crestview, FL	94
Fort Deposit, AL	89
Clinton, MS	73
Fort Worth, TX	73
Ocala, FL	73
San Jose, CA	73
Tampa, FL	73
Wetumpka, AL	72
Memphis, TN	68
Moody AFB, GA	57
Hawthorne AAP, NV	55
Troy, AL	51
Montgomery, AL	42
Concord NWS, CA	30
Fort Gillem, GA	24
Patrick AFB, FL	24
Pine Bluff Arsenal, AK	24
Anniston Army Depot, AL	17
Phoenix, AZ	12
Silver City, NM	12
Hammond, LA	11
Fallbrook, CA	3
Seal Beach NWS, CA	1

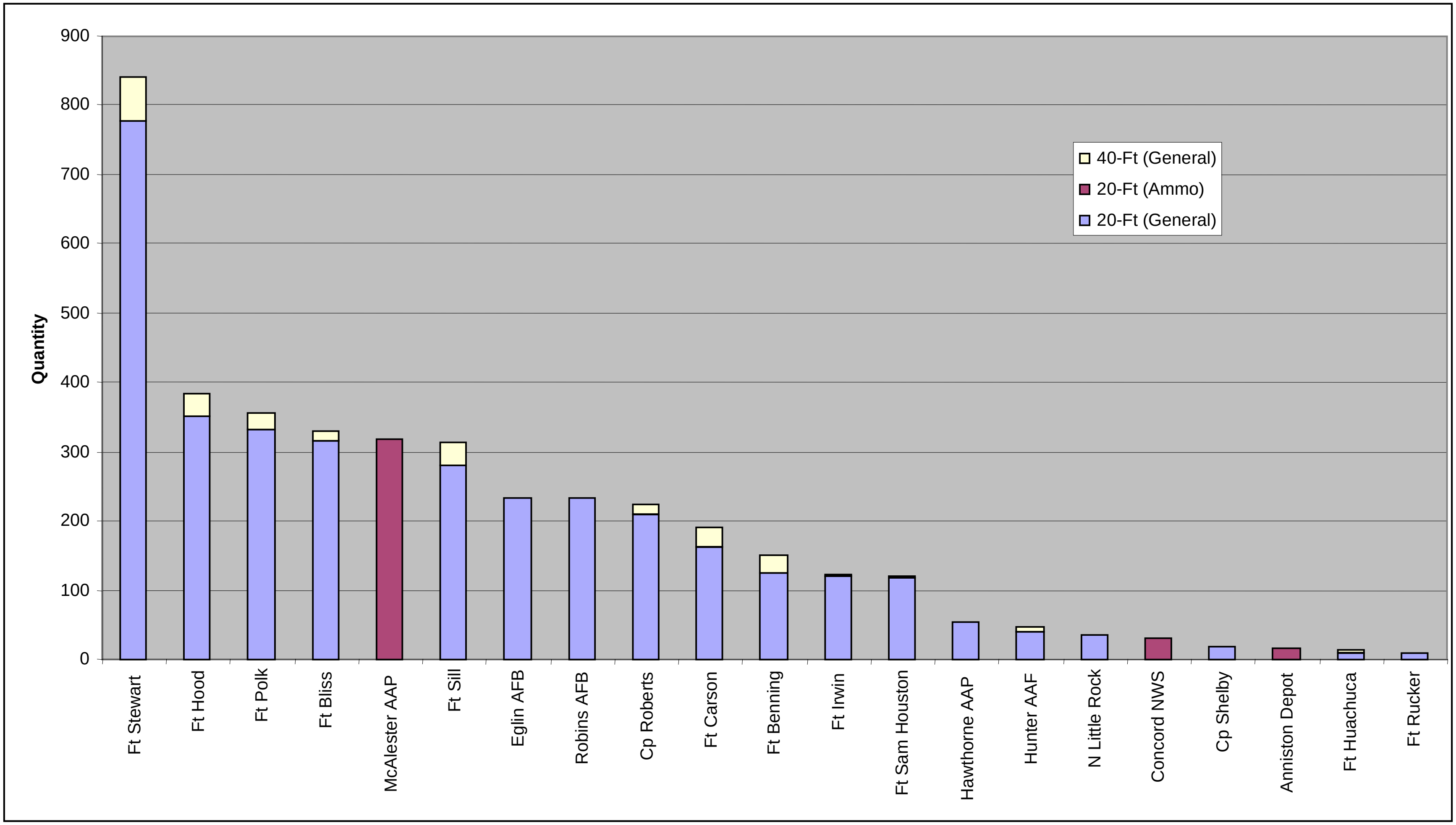


Figure F-31. Quantity of Containers Arriving at the Port of Savannah by Origin

Table F-4
Quantity of Containers Arriving at the Port of Savannah by Origin
(Origins not in Figure F-31)

ORIGIN	20-FT (General)	20-FT (Ammo)	40-FT (General
Fort McClellan, AL			7
Fort Chaffee, AK	5		1
Hamilton, AL	5		1
Omulgee, OK	5		1
Fort Bragg, NC	5		
Fort McPherson, GA	3		2
Fallbrook, CA		3	
Fort Deposit, AL	2		
Gulfport, MS	2		
Hurlburt Field, FL	2		
Troy, AL	2		
Albuquerque, NM	1		
Fort Gillem, GA			1
Memphis, TN			1
Montgomery, AL	1		
Patrick AFB, FL			1
Pine Bluff Arsenal, AK			1
Seal Beach NWS, CA		1	
Wetumpka, AL			1

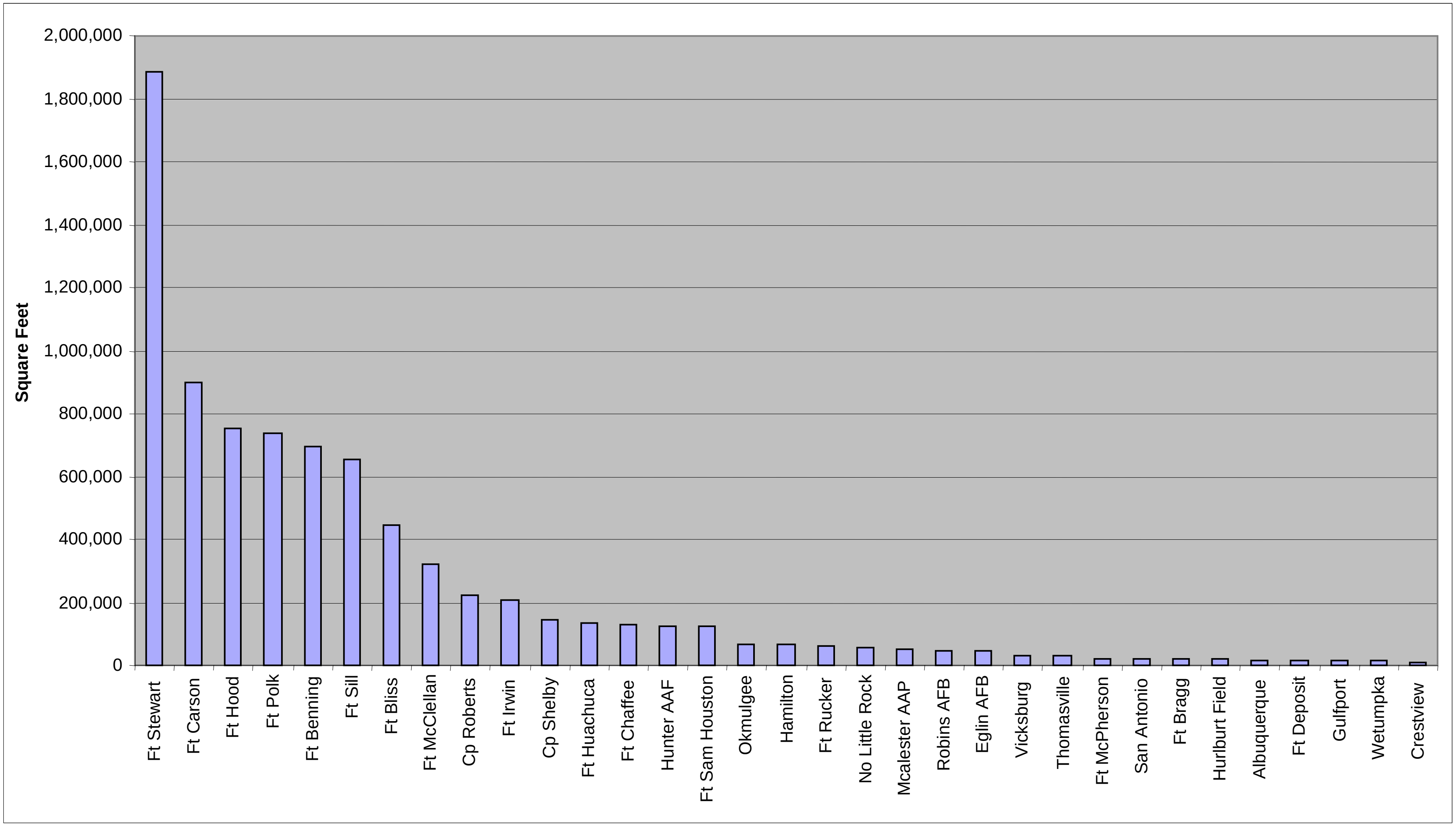


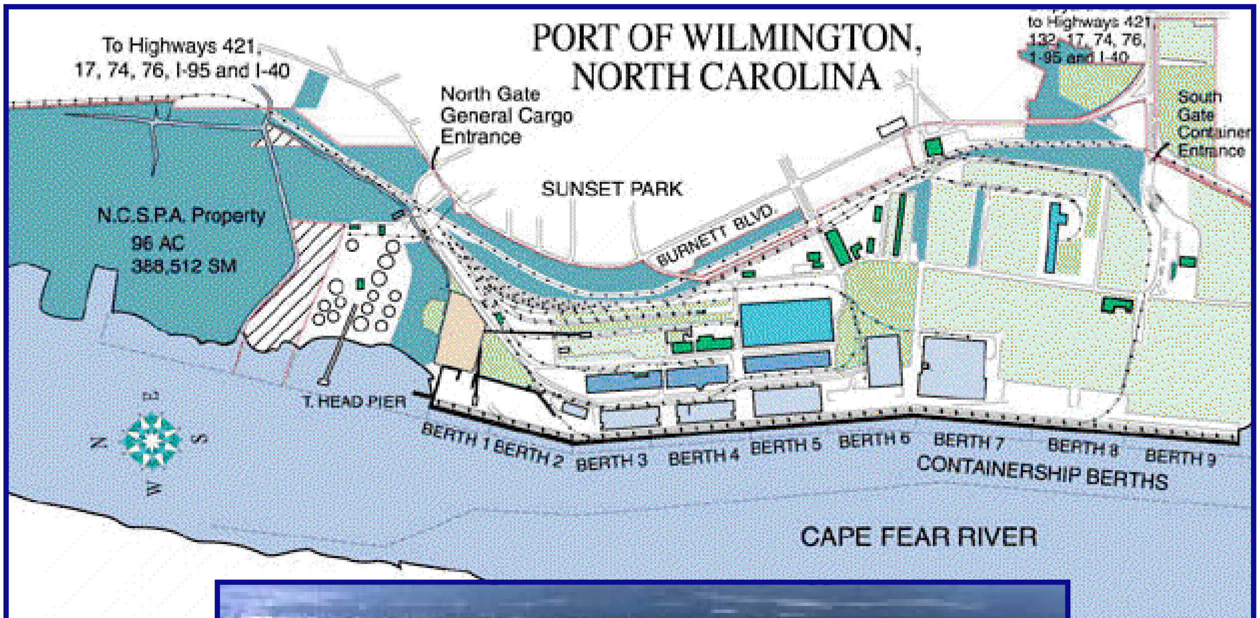
Figure F-32. Square Feet of Cargo Arriving at the Port of Savannah by Origin

Table F-5
Amount of Cargo Arriving at the Port of Savannah by Origin
(Origins not in Figure F-32)

ORIGIN	SQUARE FEET
Troy, AL	9,285.1
Moody AFB, GA	9,269.0
Memphis, TN	9,238.8
Hawthorne AAP, NV	8,800.0
Tampa, FL	8,080.2
San Jose, CA	8,080.2
Ocala, FL	8,080.2
Fort Worth, TX	8,080.2
Clinton, MS	8,080.2
Montgomery, AL	7,051.2
Concord NWS, CA	4,800.0
Pine Bluff Arsenal, AK	2,849.8
Patrick AFB, FL	2,849.8
Fort Gillem, GA	2,849.8
Anniston Army Depot, AL	2,720.0
Silver City, NM	1,952.3
Phoenix, AZ	1,952.3
Hammond, LA	1,250.2
Fallbrook, CA	480.0
Seal Beach NWS, CA	160.0

APPENDIX G

PORT OF WILMINGTON



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According to the TPFDD, there are 16 origins sending cargo to the Port of Wilmington. These origins are shown in Figure G-1. Wilmington receives a mix of Army and Marine Corps cargo, with the bulk of the workload being Marine Corps cargo. Origins in excess of 400 miles send all of their cargo to the Port of Wilmington by rail. Origins within 400 miles convoy their roadable vehicles to the port and send everything else by rail. All aircraft self-deploy to the port. Figures G-2 through G-6 show the quantity of transports (containers, railcars, self-deploying aircraft, and convoying vehicles) required to move to the Port of Charleston.

Figures G-7 through G-12 illustrate the quantity of items arriving at the port. Figure G-7 is the total quantity of items. Figures G-8 through G-13 break this down into more detail. Figures G-8 and G-9 are the quantity of vehicles arriving at the port. Figure G-8 outlines the wheeled vehicles and Figure G-9 lays out the tracked vehicles. Figure G-10 shows the quantity of aircraft arriving at the port. These are mostly helicopters, and all self move to the port under their own power. Figures G-11 and G-12 outline the number of containers and breakbulk cargo items, respectively, arriving at the port.

Similar to Figures G-7 through G-12, which lay out the quantity of items arriving, Figure G-13 through G-18 outline the square footage of these categories of cargo.

Figures G-19 through G-26 show how cargo is arriving at the Port of Wilmington. Figure G-19 through G-22 shows the number of cargo items arriving by convoy, rail, or self-deploying. Figures G-23 through G-26 show the square footage of cargo arriving by each mode.

As shown earlier, cargo arrives at the Port of Wilmington from many origins. Figure G-27 shows visually the amount of cargo coming from the major origins.

Figures G-28 and G-30 show the quantity and square footage, respectively, of cargo arriving at the Port of Wilmington by origin. Figure G-29 is the quantity of containers arriving at the Port of Wilmington from each origin.

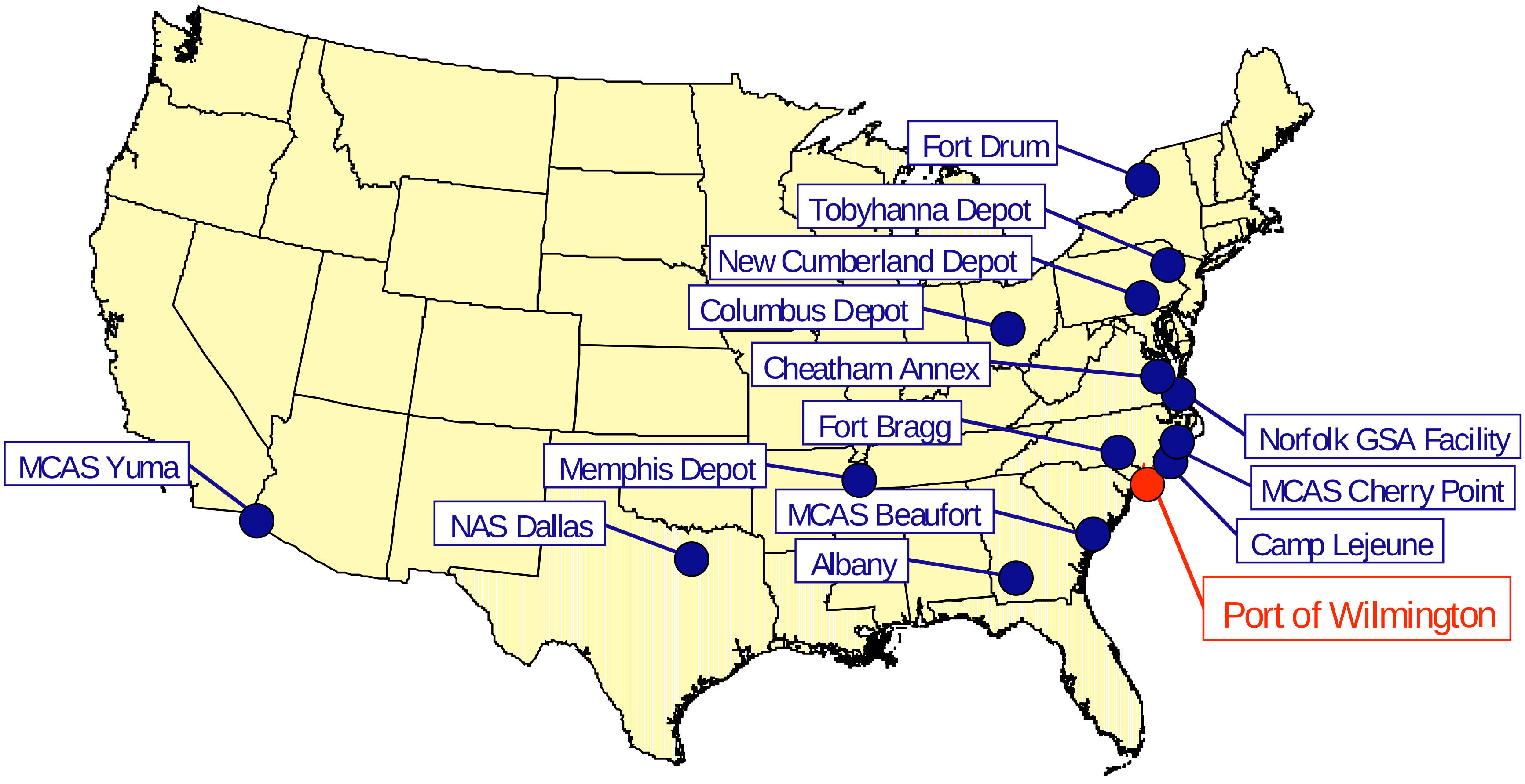

Figure G-1. Cargo Arrives at the Port of Wilmington from Many Origins

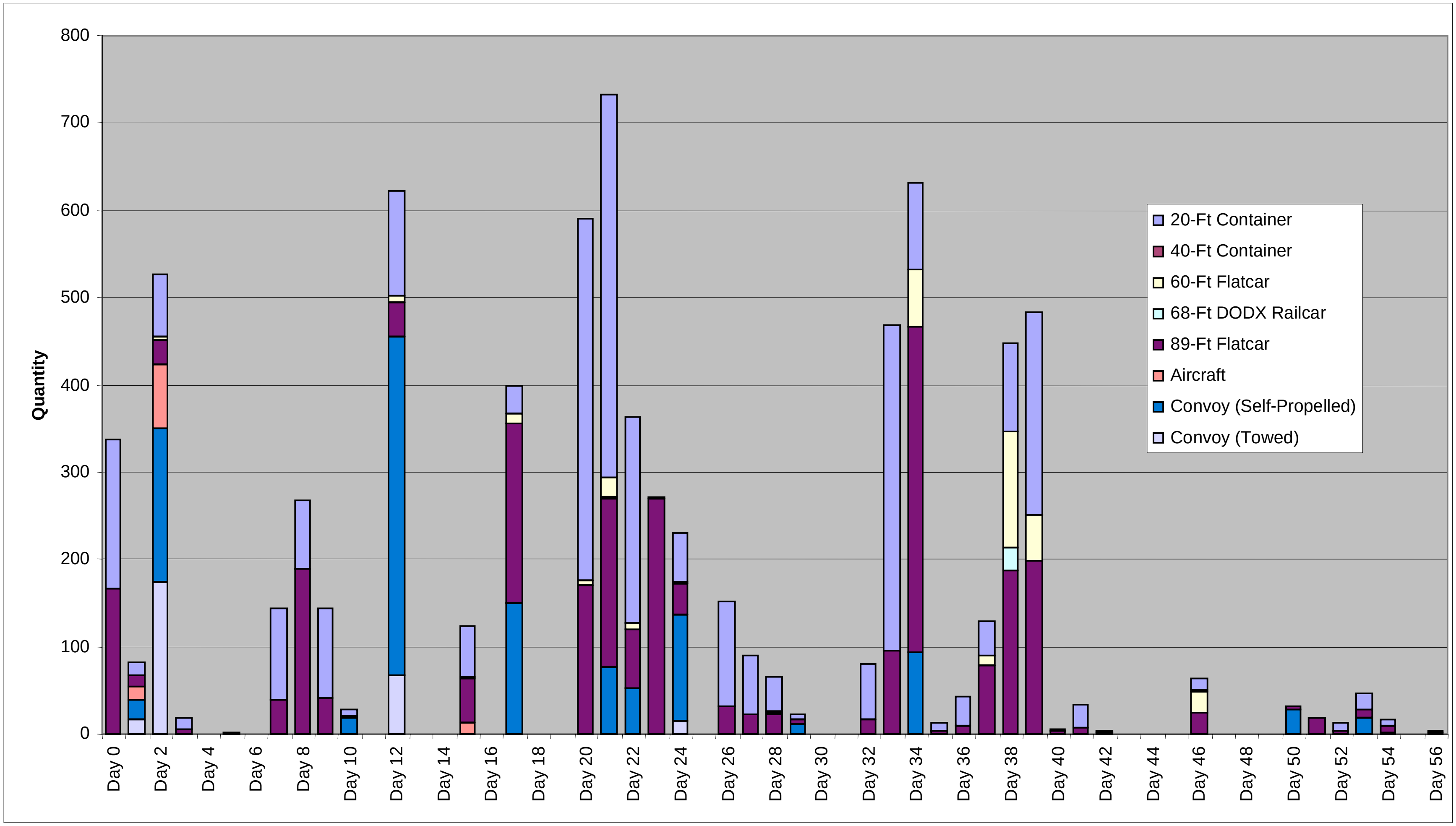

Figure G-2. Total Quantity of Transports Arriving at the Port of Wilmington

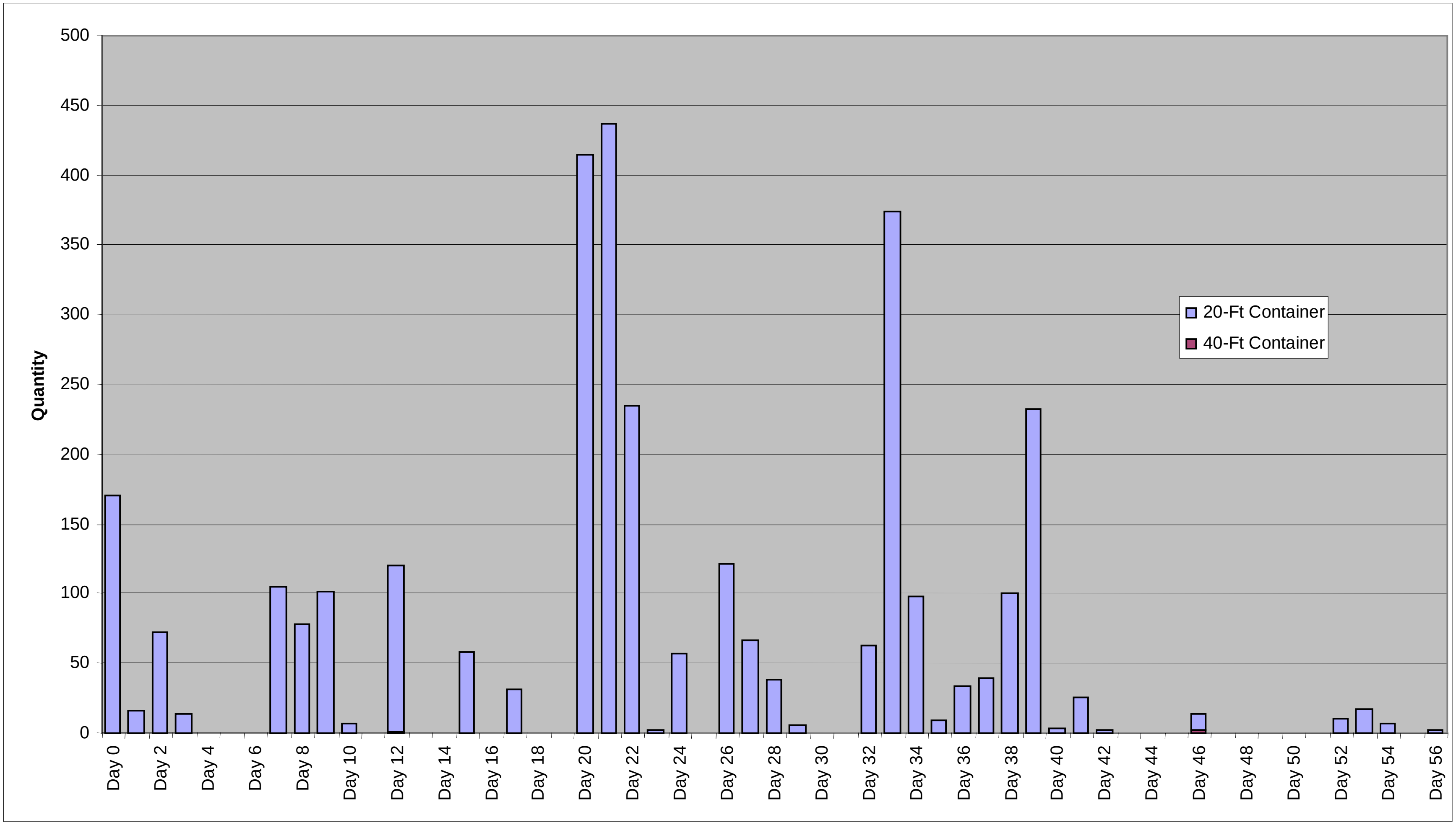

Figure G-3. Quantity of Containers Arriving at the Port of Wilmington

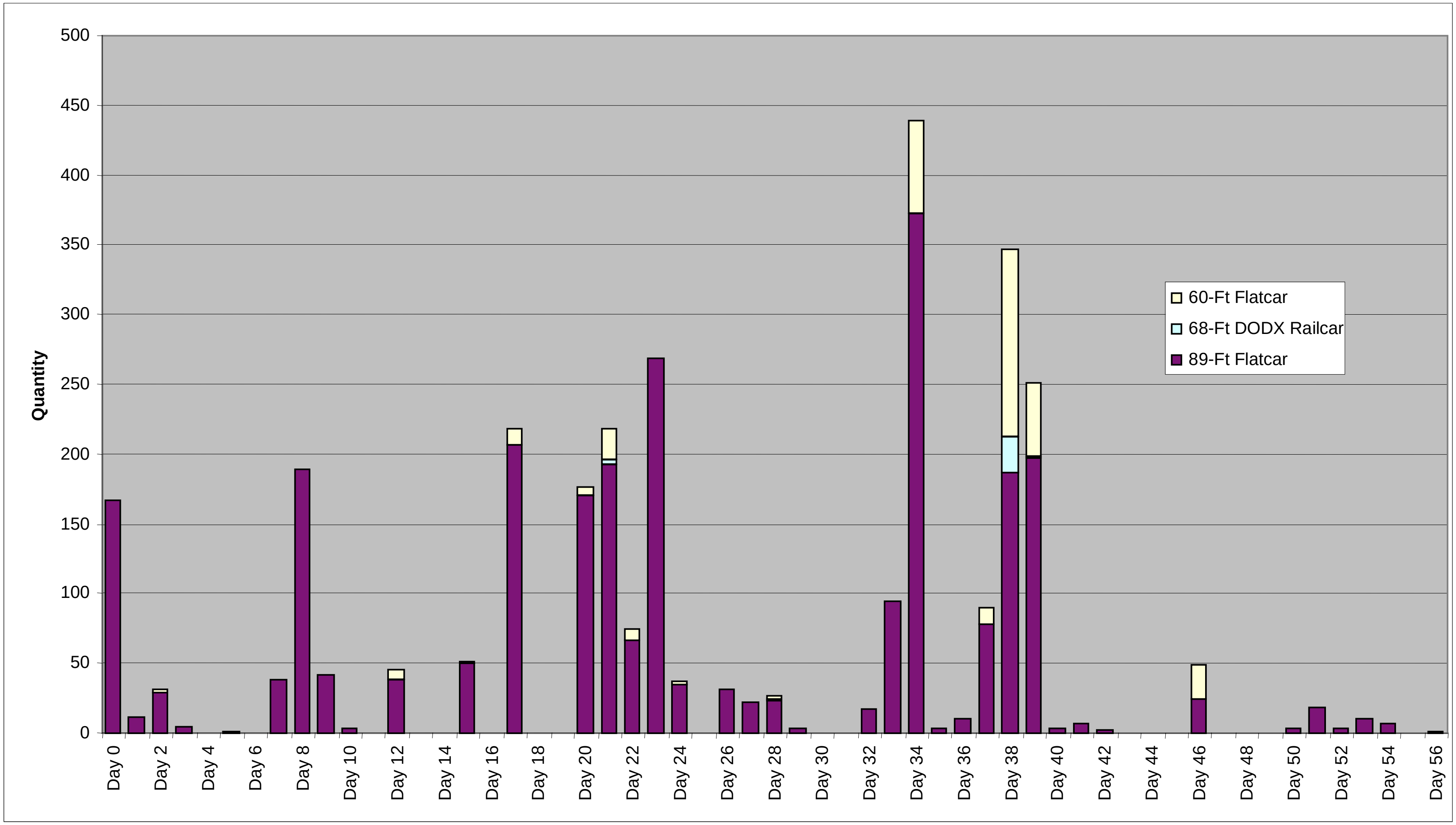

Figure G-4. Quantity of Railcars Arriving at the Port of Wilmington

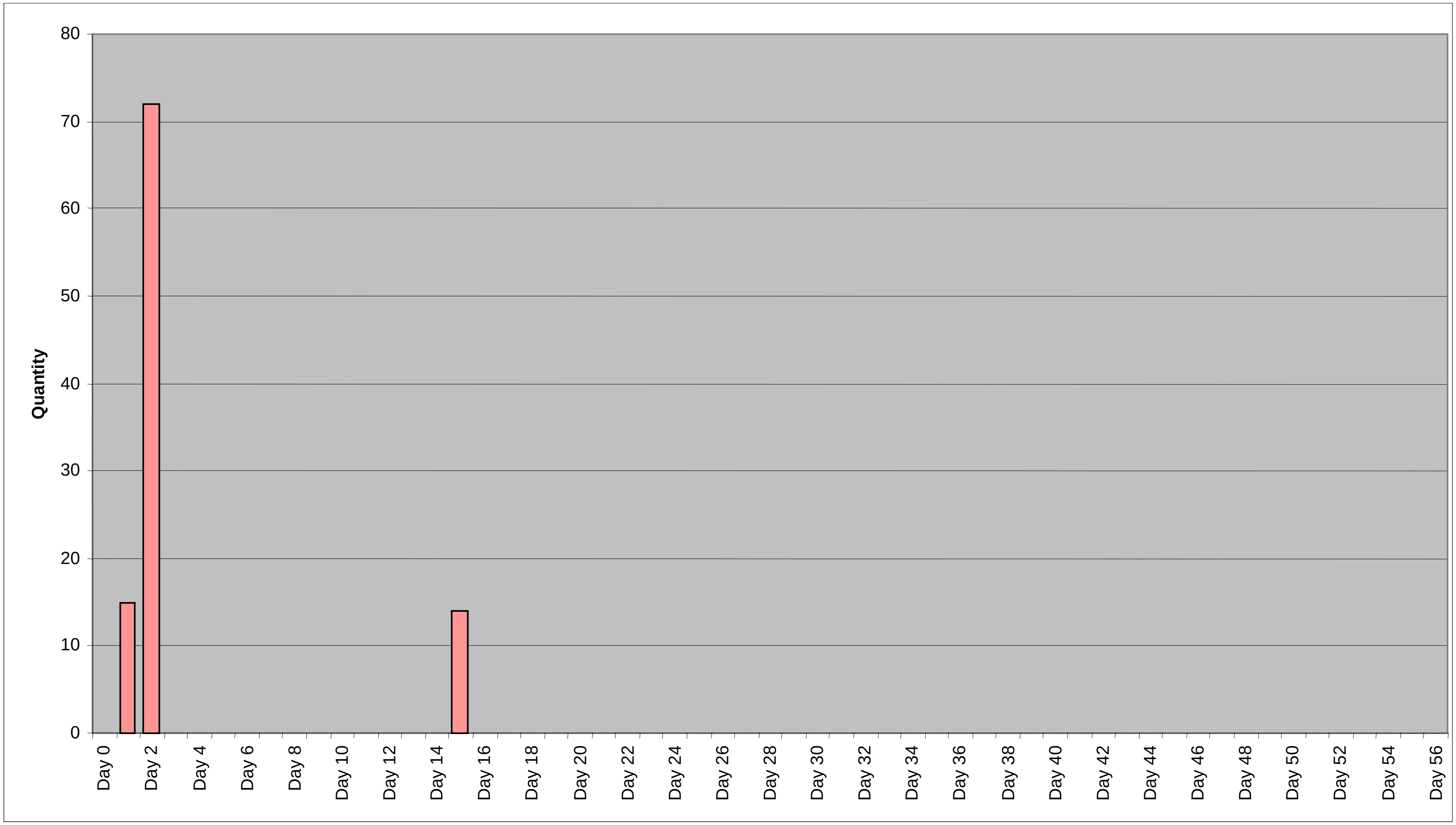

Figure G-5. Quantity of Aircraft Arriving at the Port of Wilmington

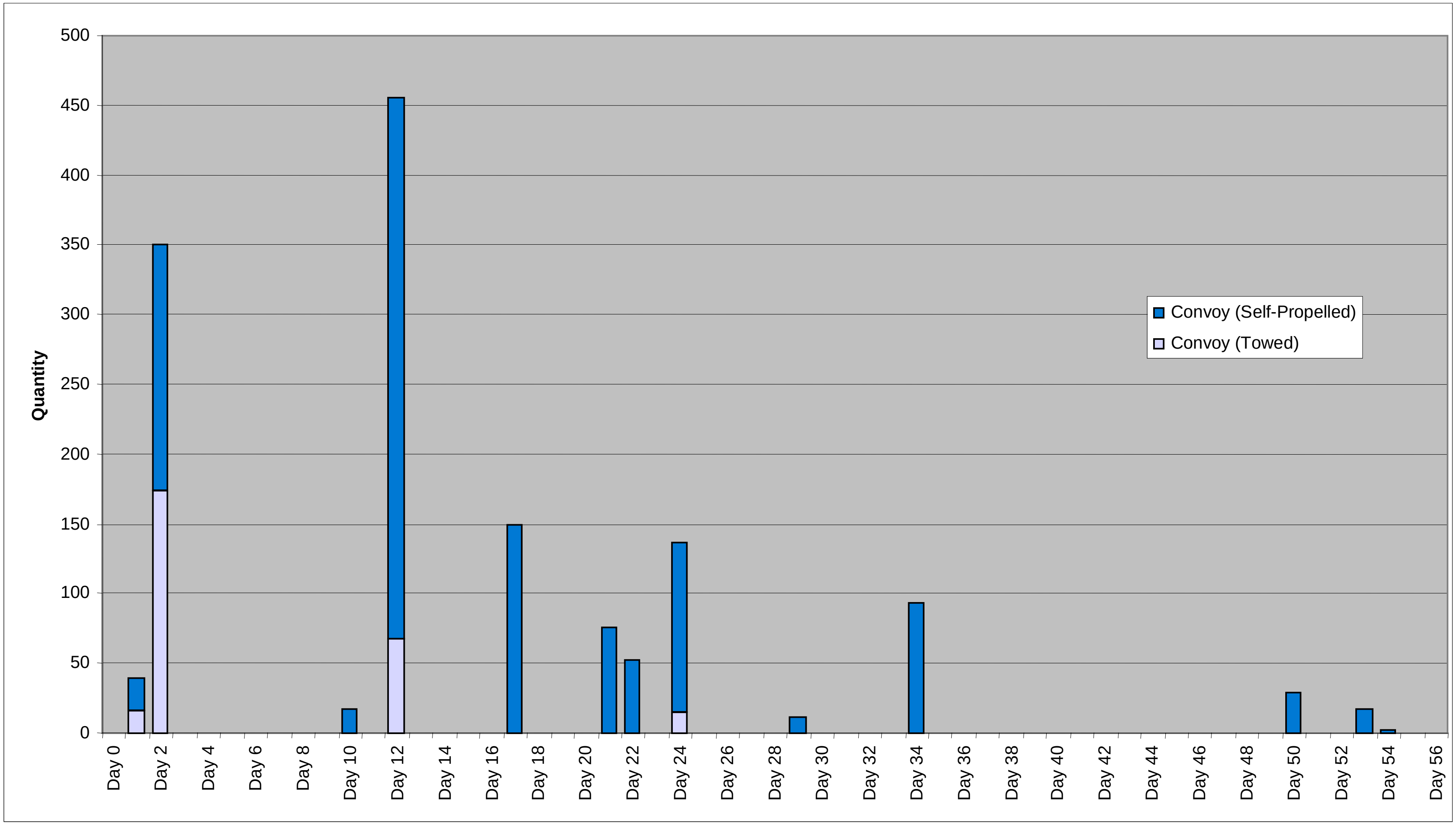

Figure G-6. Quantity of Convoy Vehicles Arriving at the Port of Wilmington

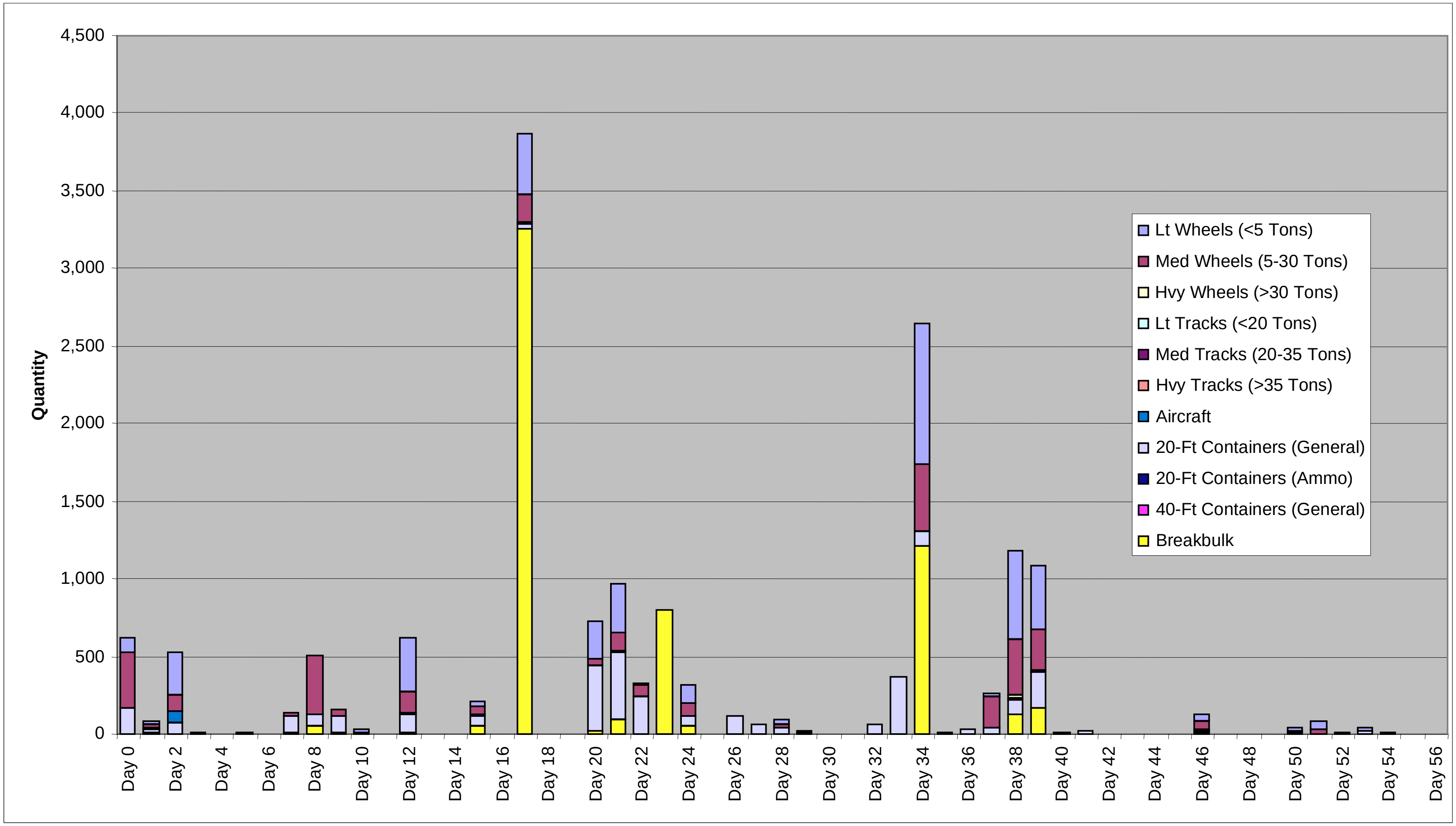

Figure G-7. Total Quantity of Items Arriving at the Port of Wilmington

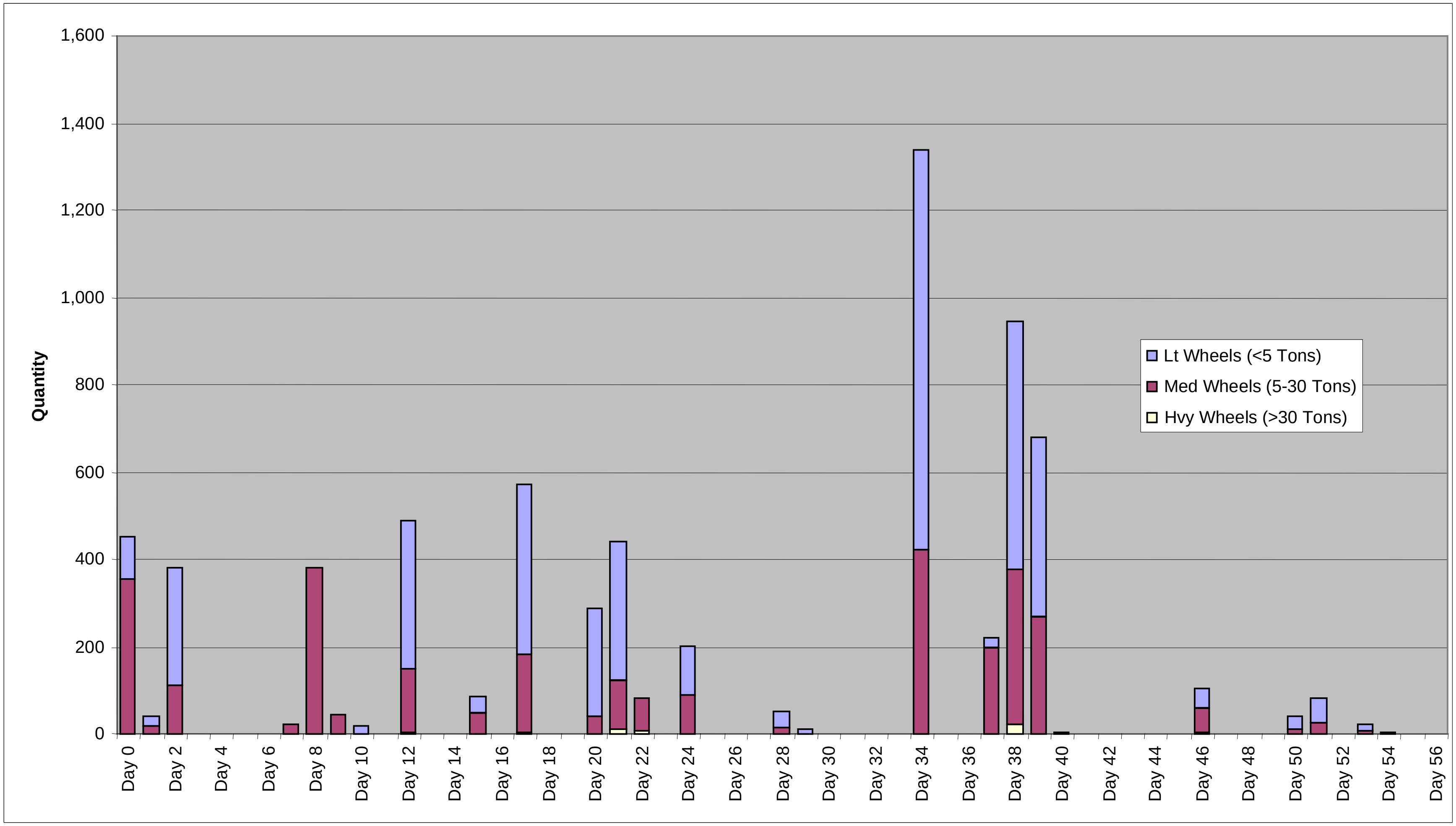

Figure G-8. Quantity of Wheeled Vehicles Arriving at the Port of Wilmington

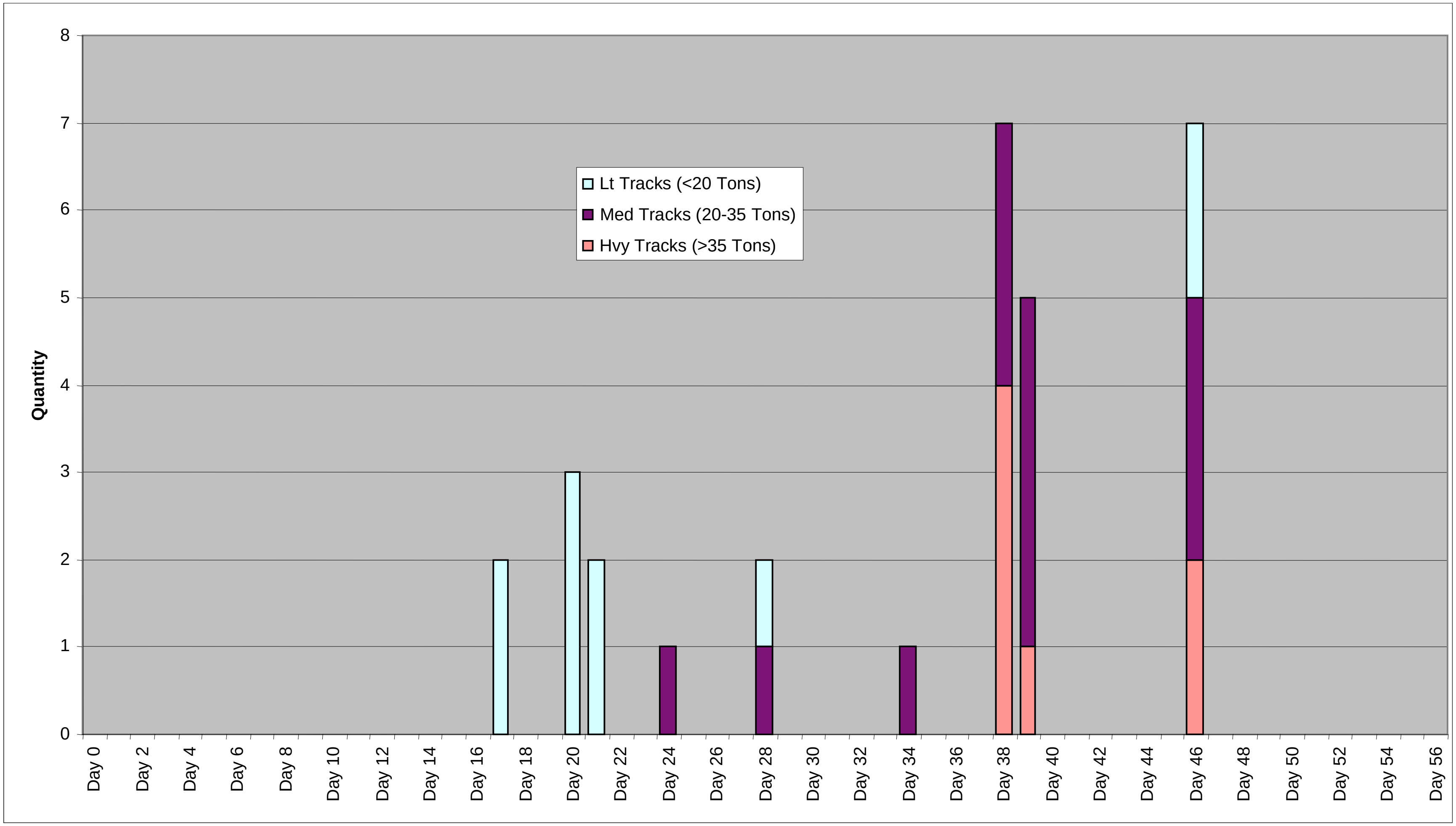

Figure G-9. Quantity of Tracked Vehicles Arriving at the Port of Wilmington

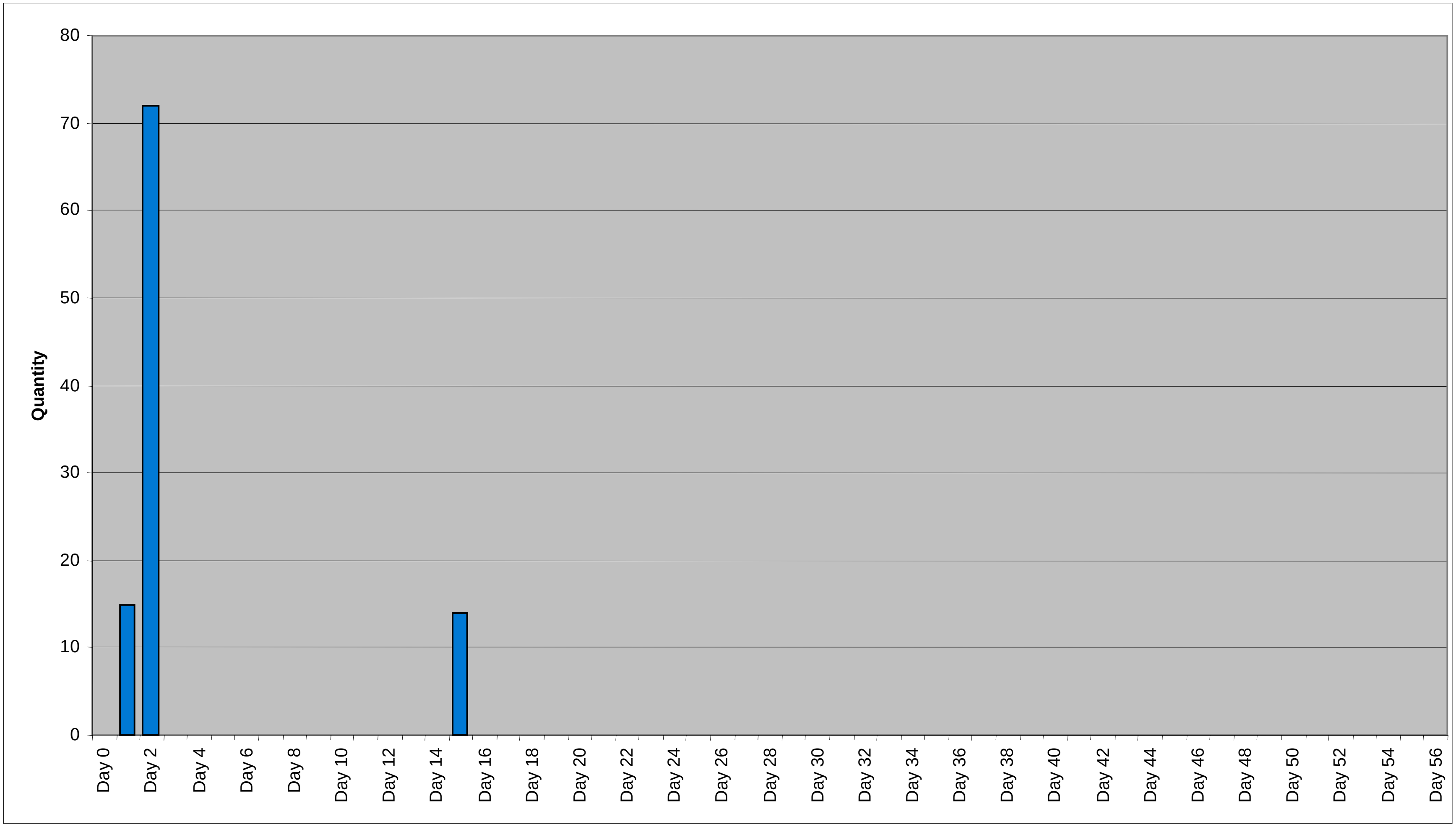

Figure G-10. Quantity of Aircraft Arriving at the Port of Wilmington

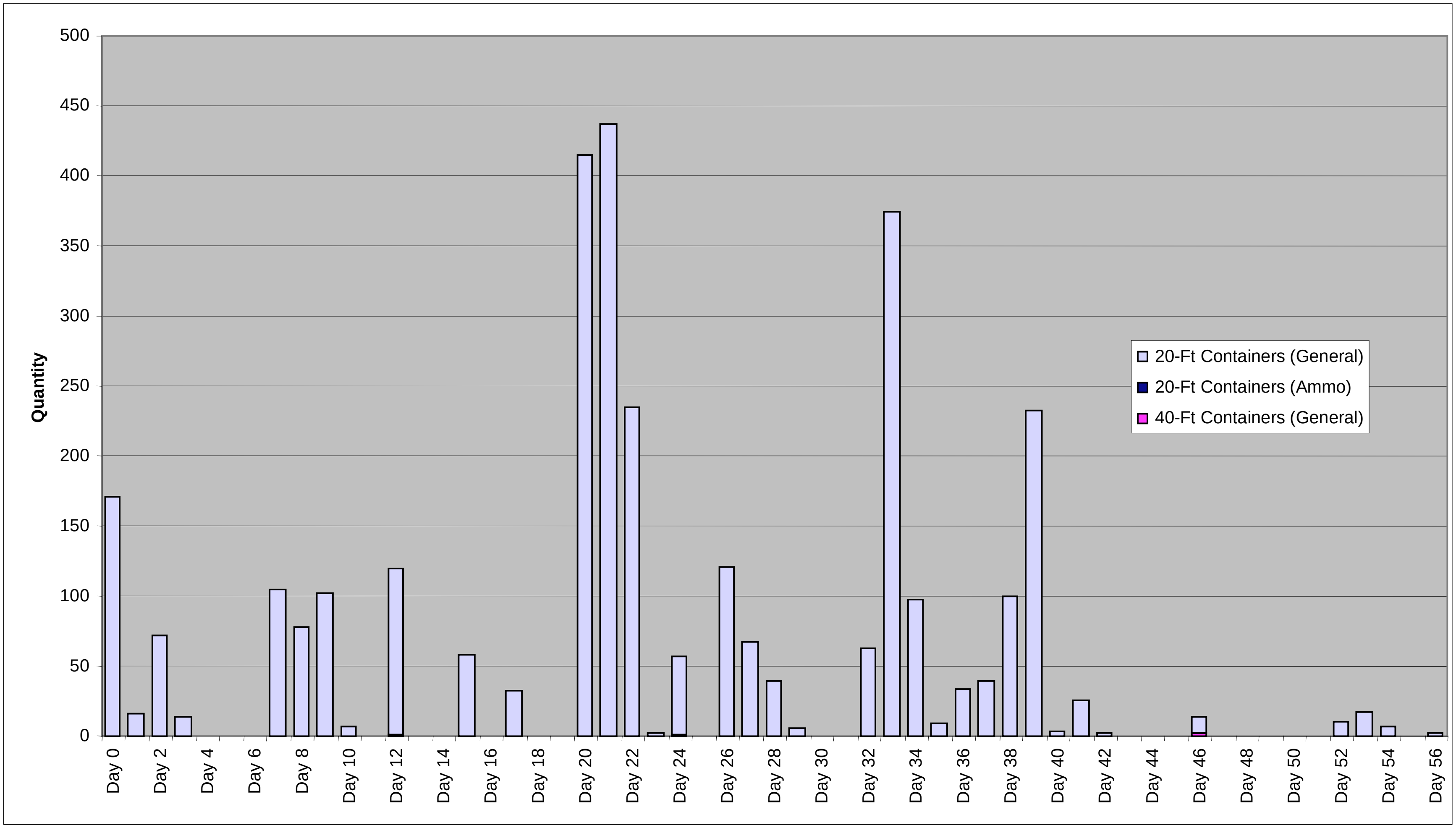

Figure G-11. Quantity of Containers Arriving at the Port of Wilmington

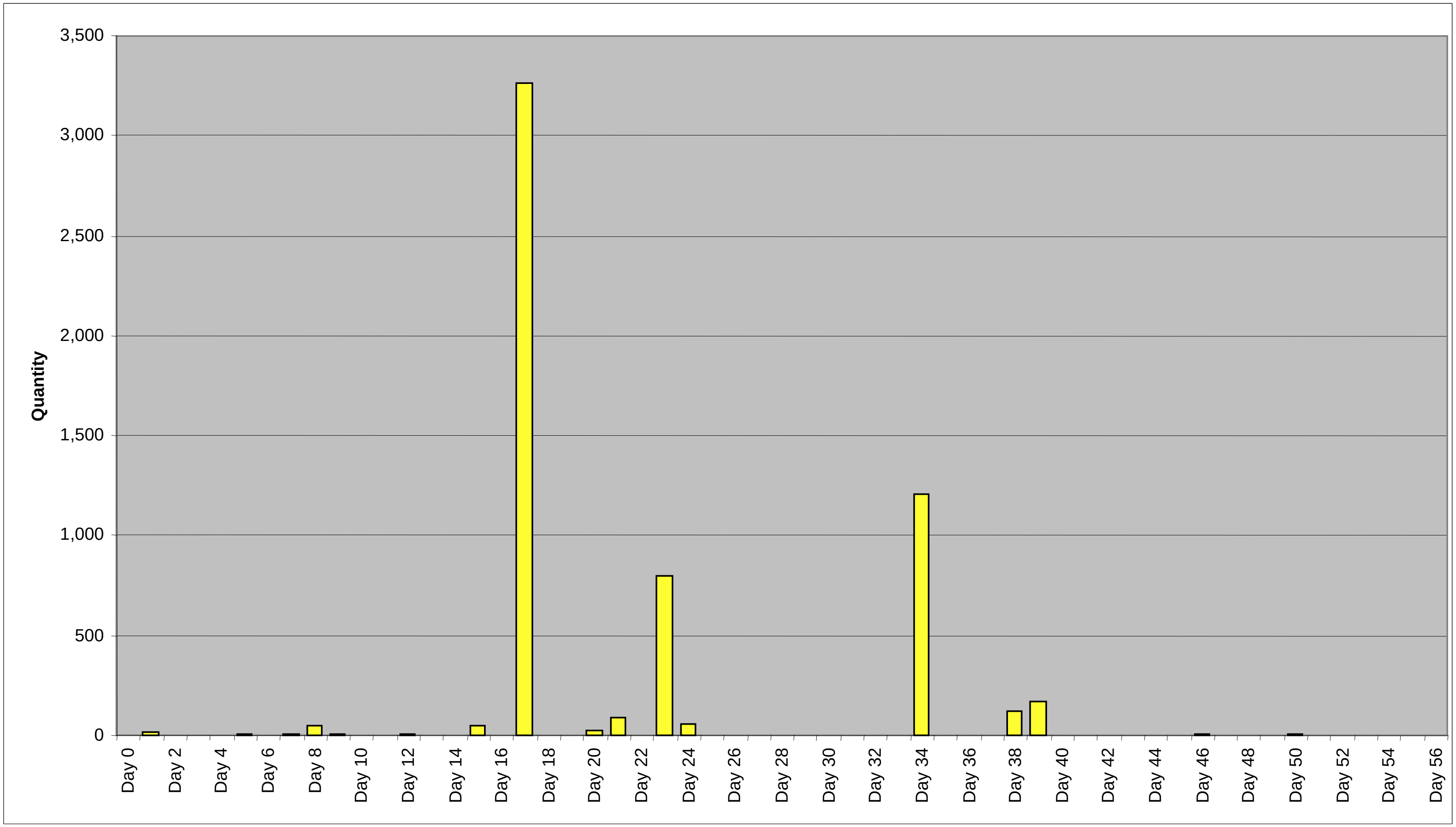

Figure G-12. Quantity of Breakbulk Cargo Arriving at the Port of Wilmington

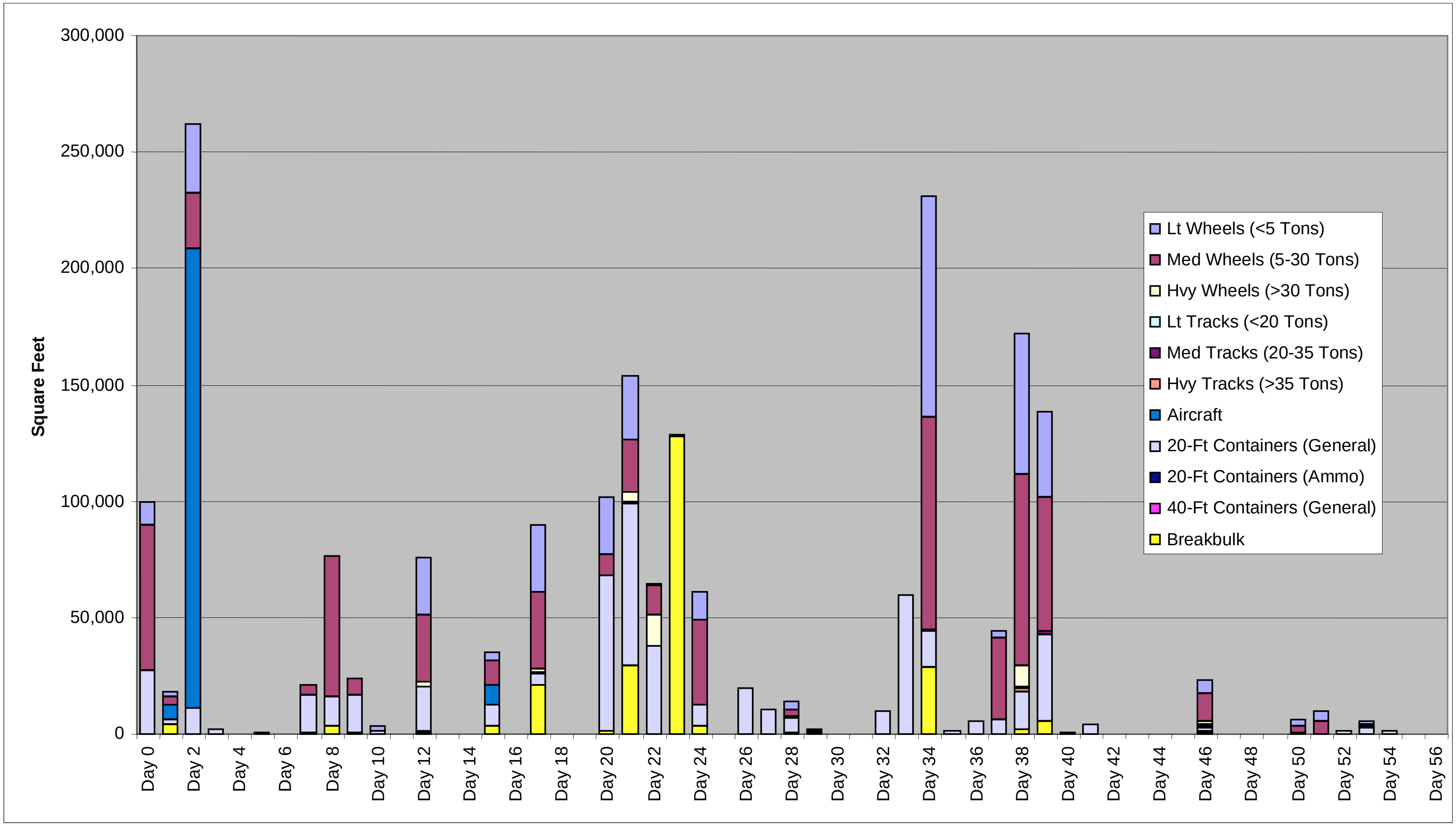

Figure G-13. Total Square Feet of Cargo Arriving at the Port of Wilmington

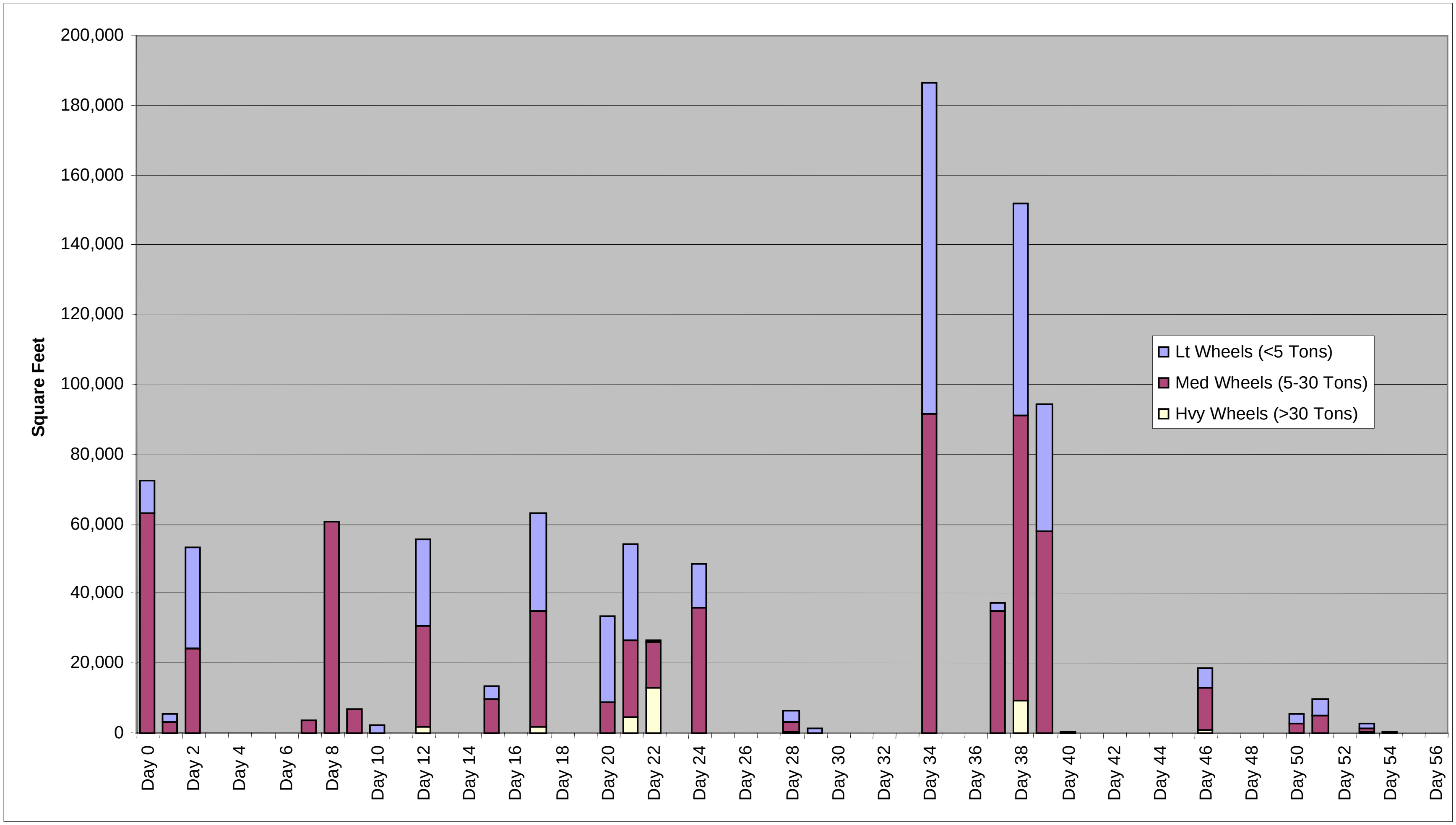

Figure G-14. Square Feet of Wheeled Vehicles Arriving at the Port of Wilmington

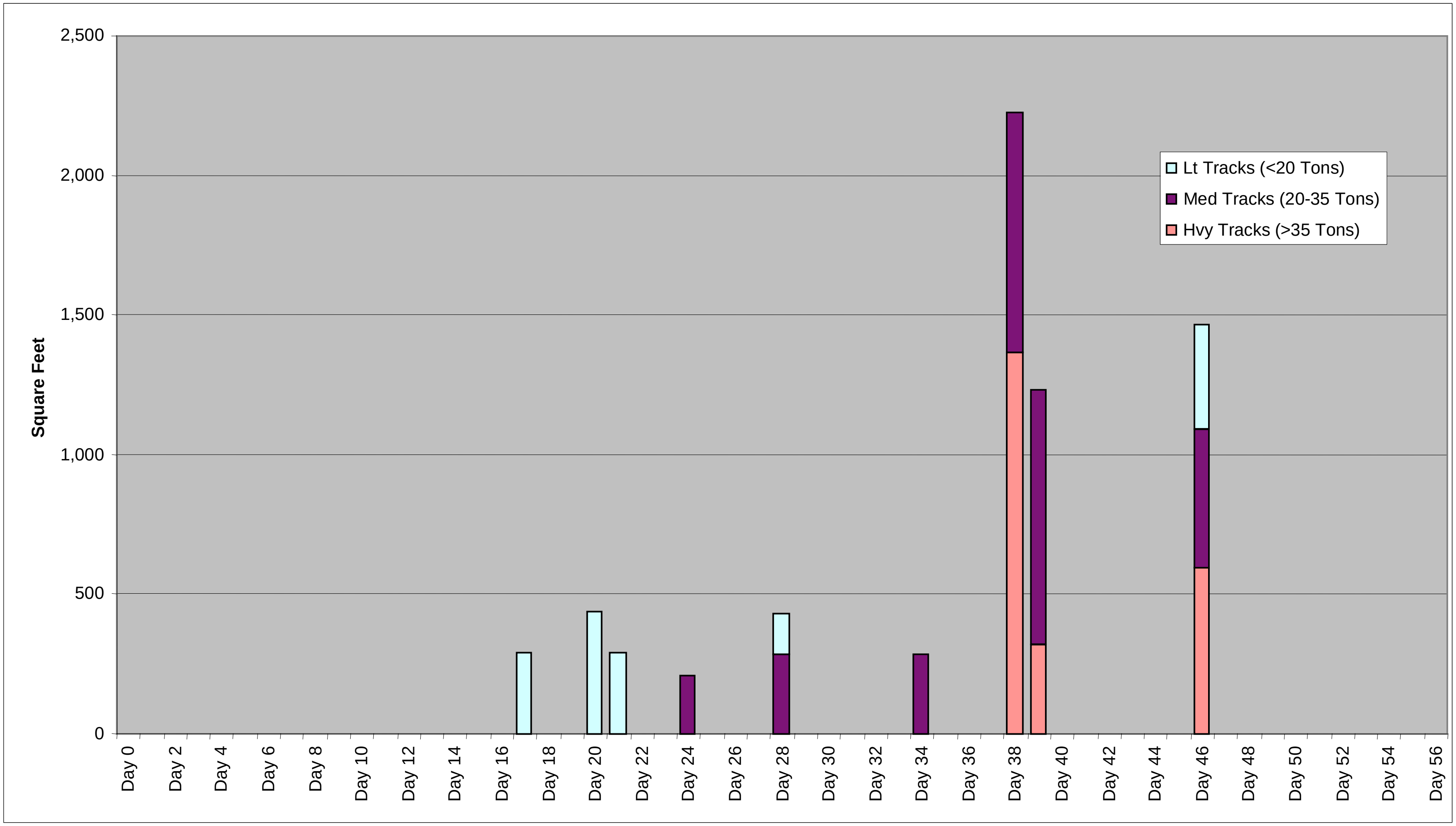

Figure G-15. Square Feet of Tracked Vehicles Arriving at the Port of Wilmington

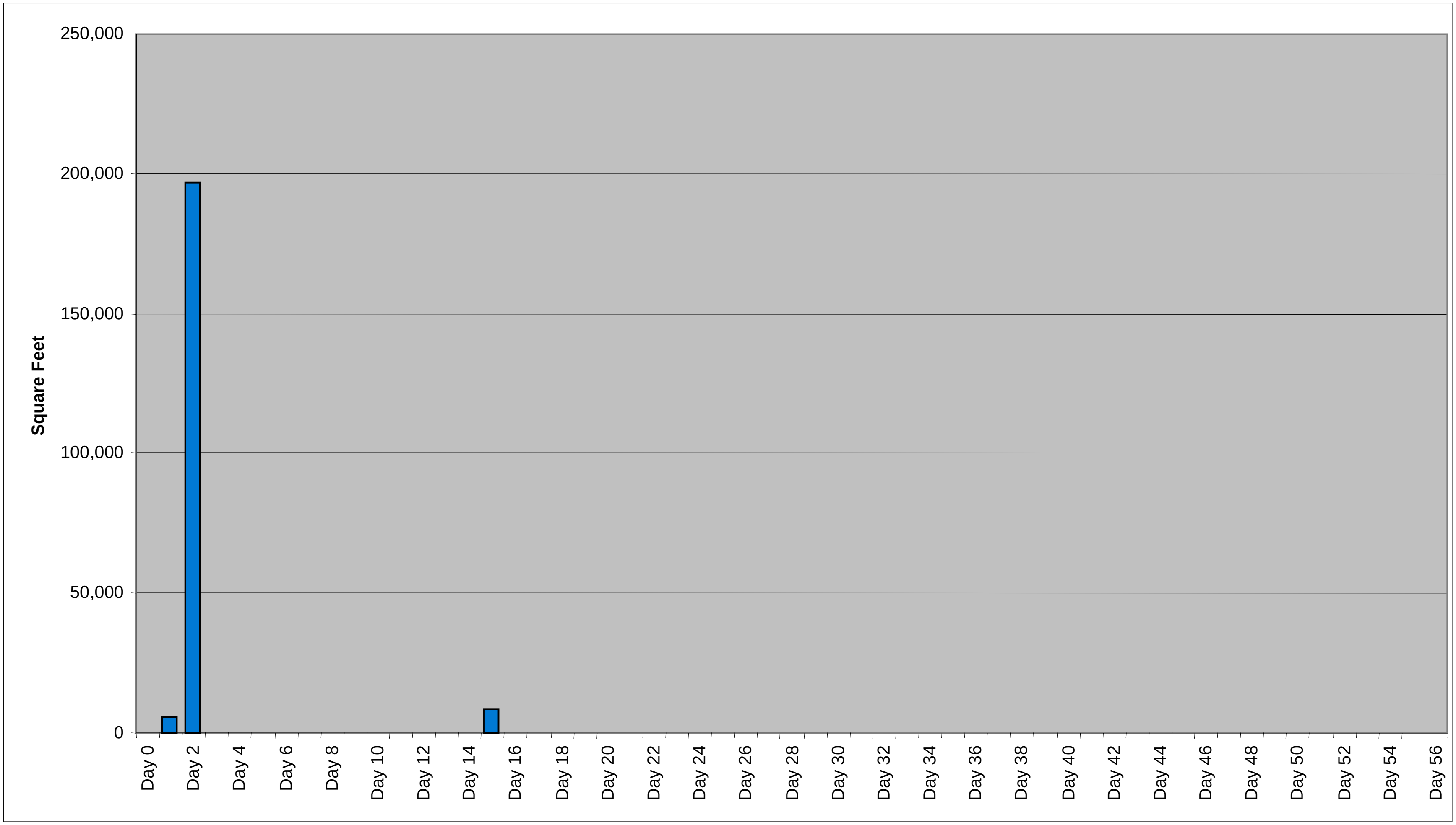

Figure G-16. Square Feet of Aircraft Arriving at the Port of Wilmington

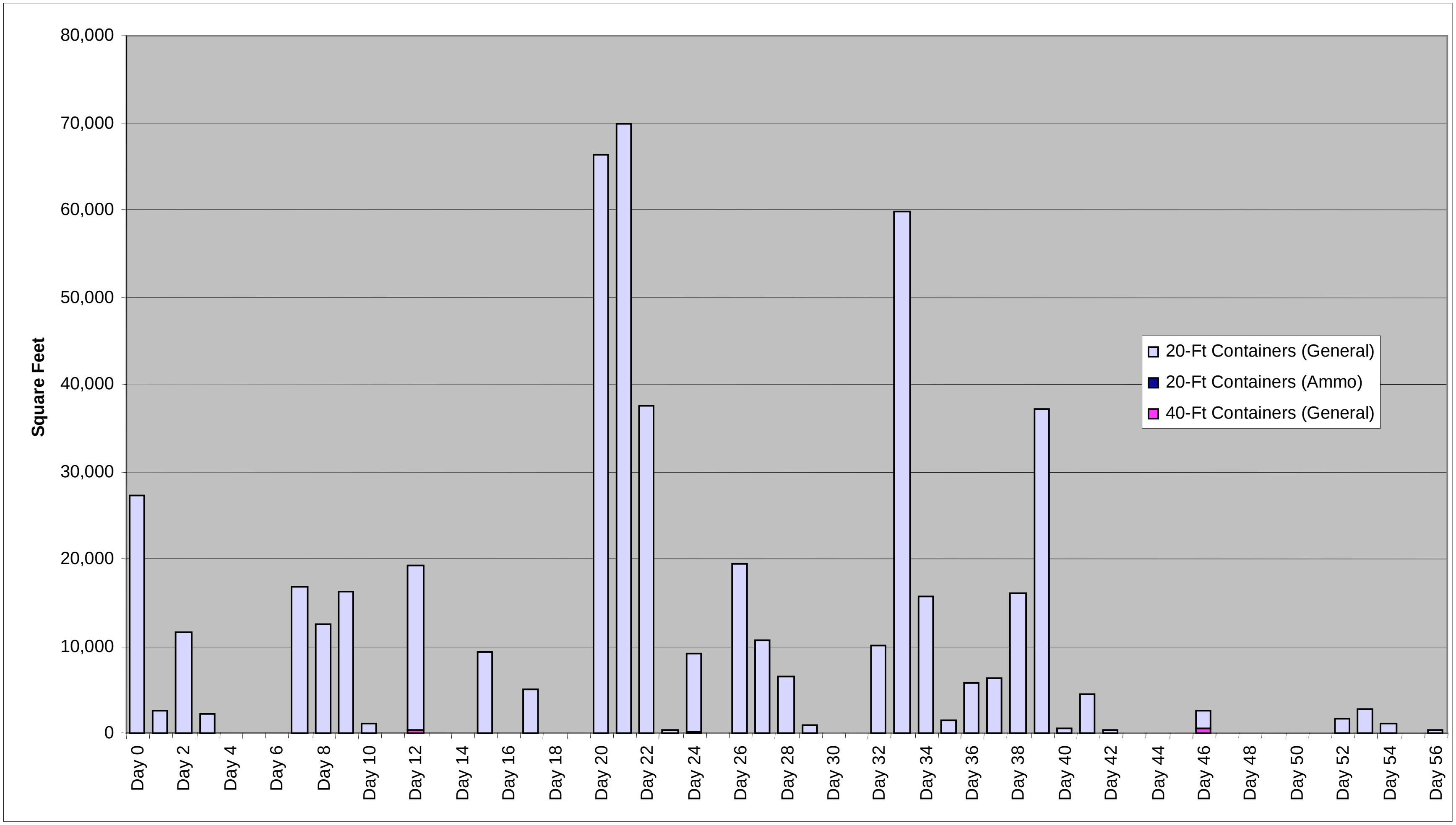

Figure G-17. Square Feet of Containers Arriving at the Port of Wilmington

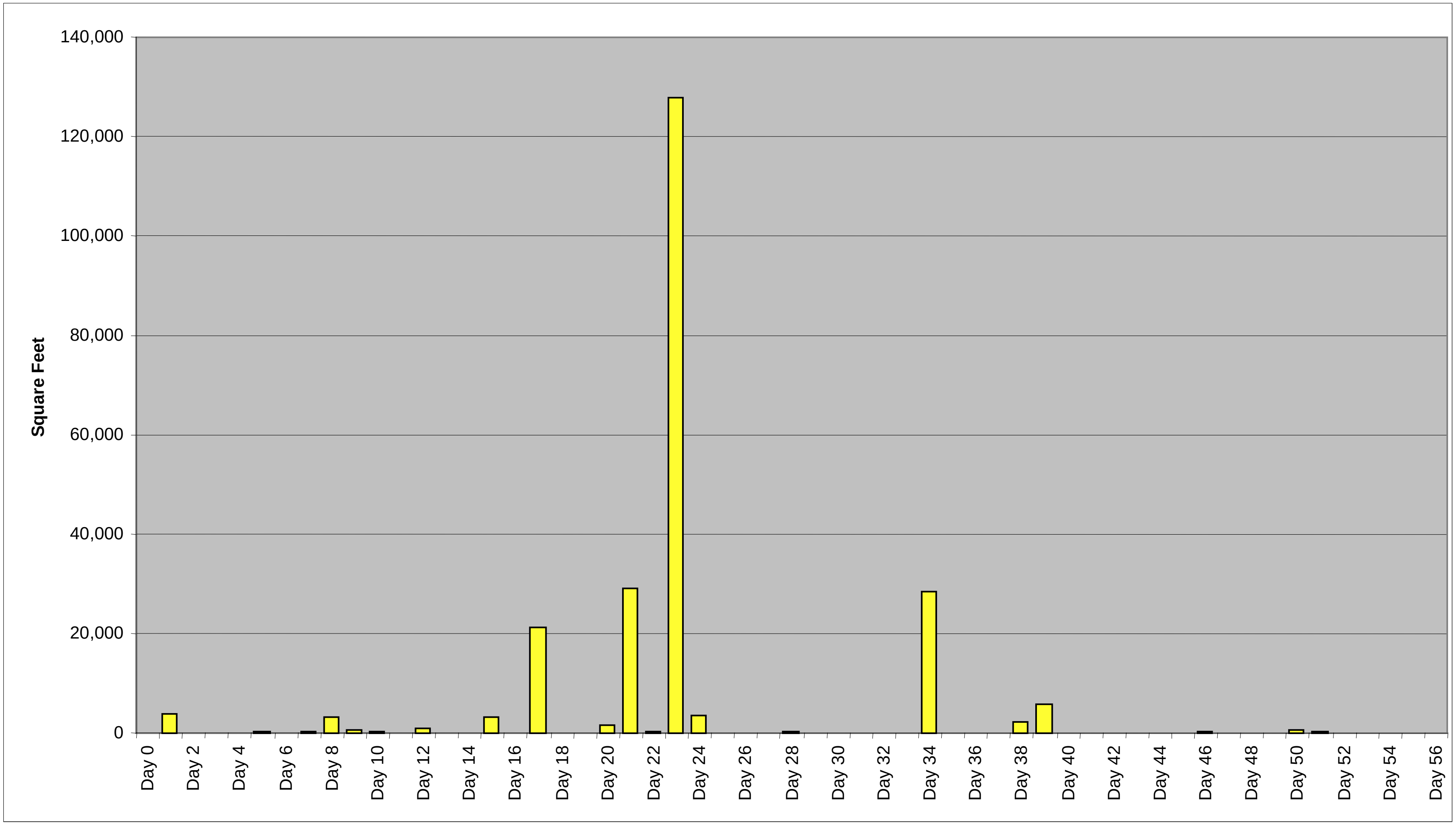

Figure G-18. Square Feet of Breakbulk Cargo Items Arriving at the Port of Wilmington

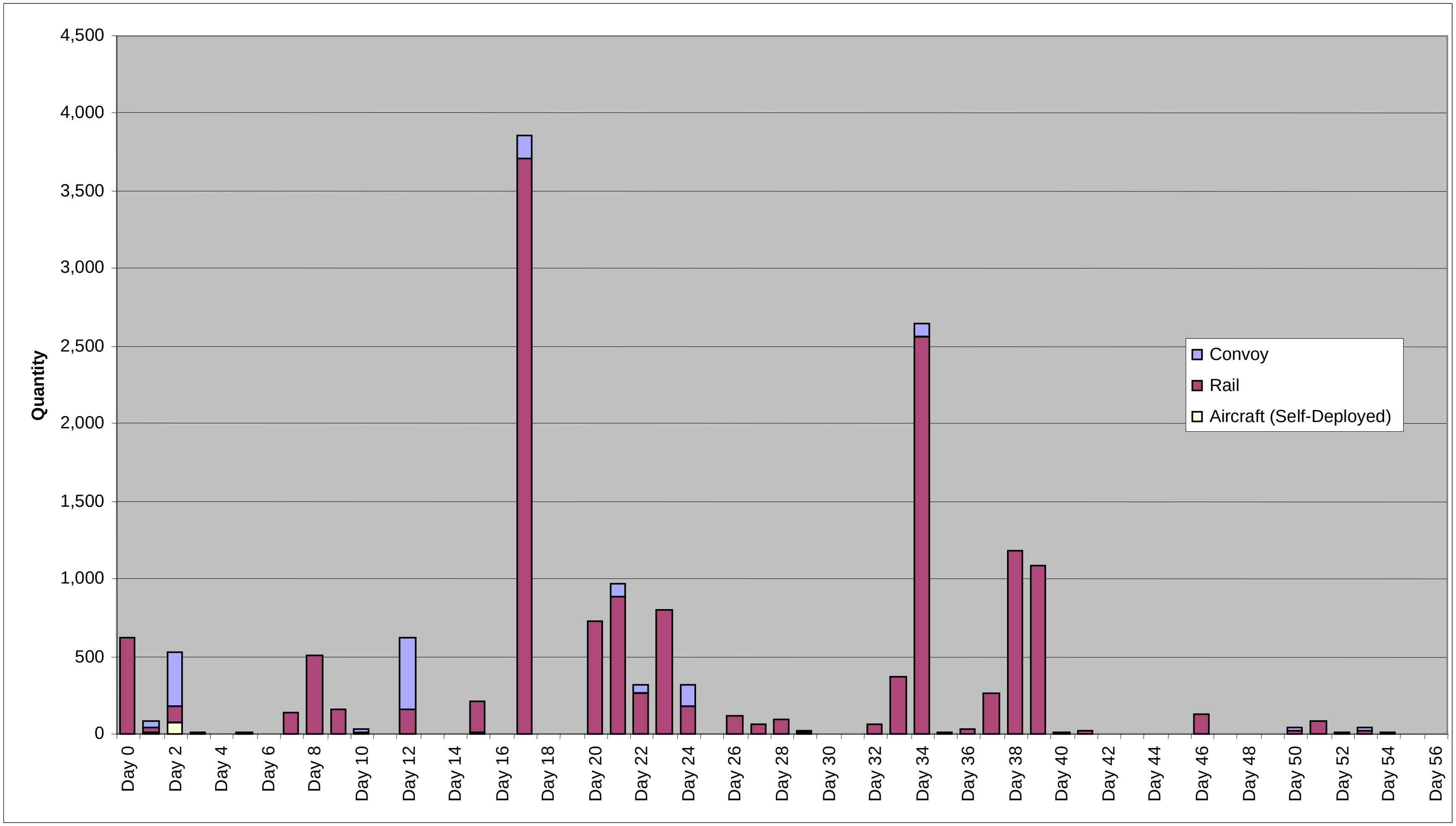

Figure G-19. Quantity of Cargo Items Arriving by Mode to the Port of Wilmington

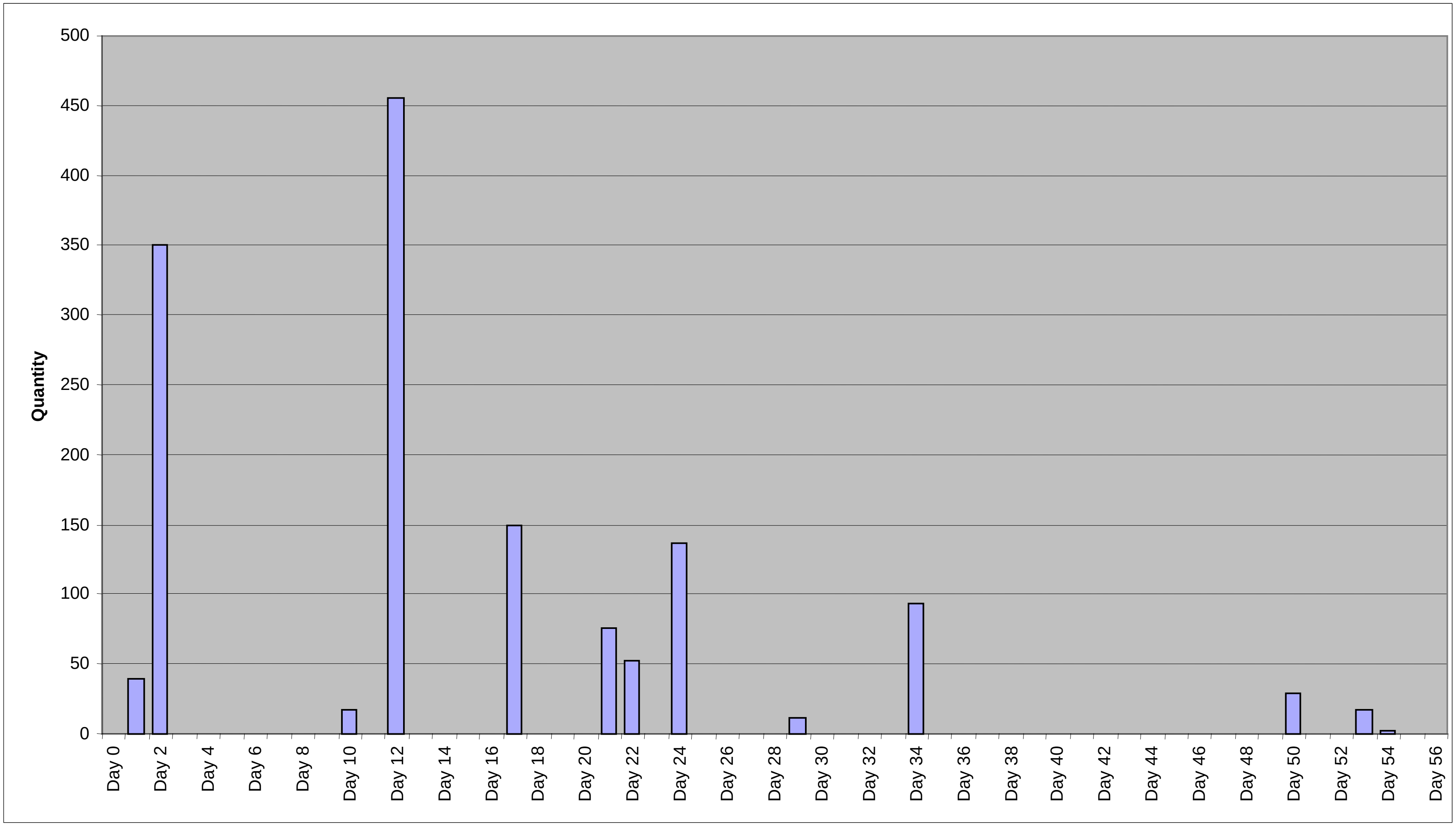

Figure G-20. Quantity of Wheeled Vehicles Convoying to the Port of Wilmington

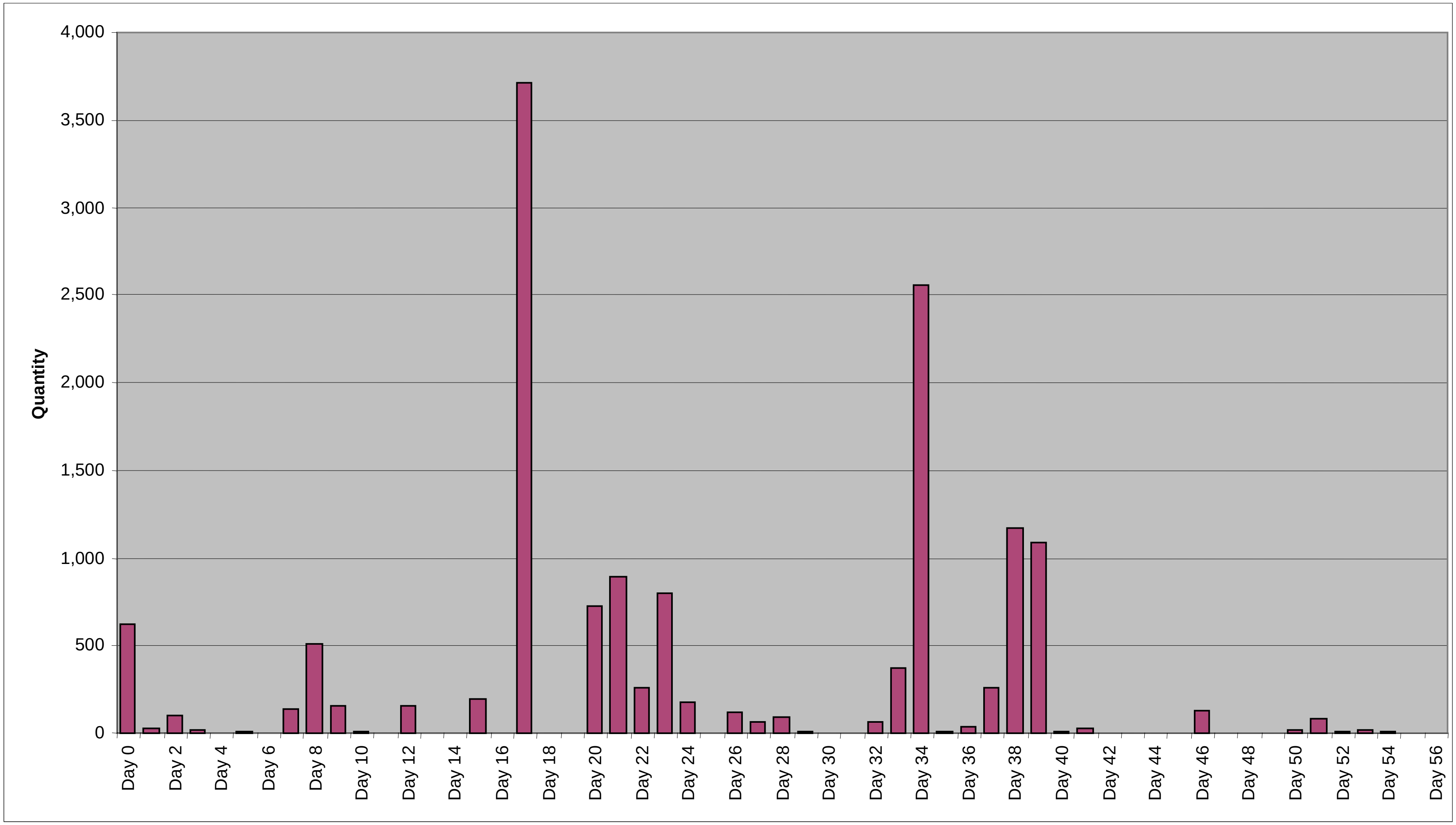

Figure G-21. Quantity of Items Arriving by Rail to the Port of Wilmington

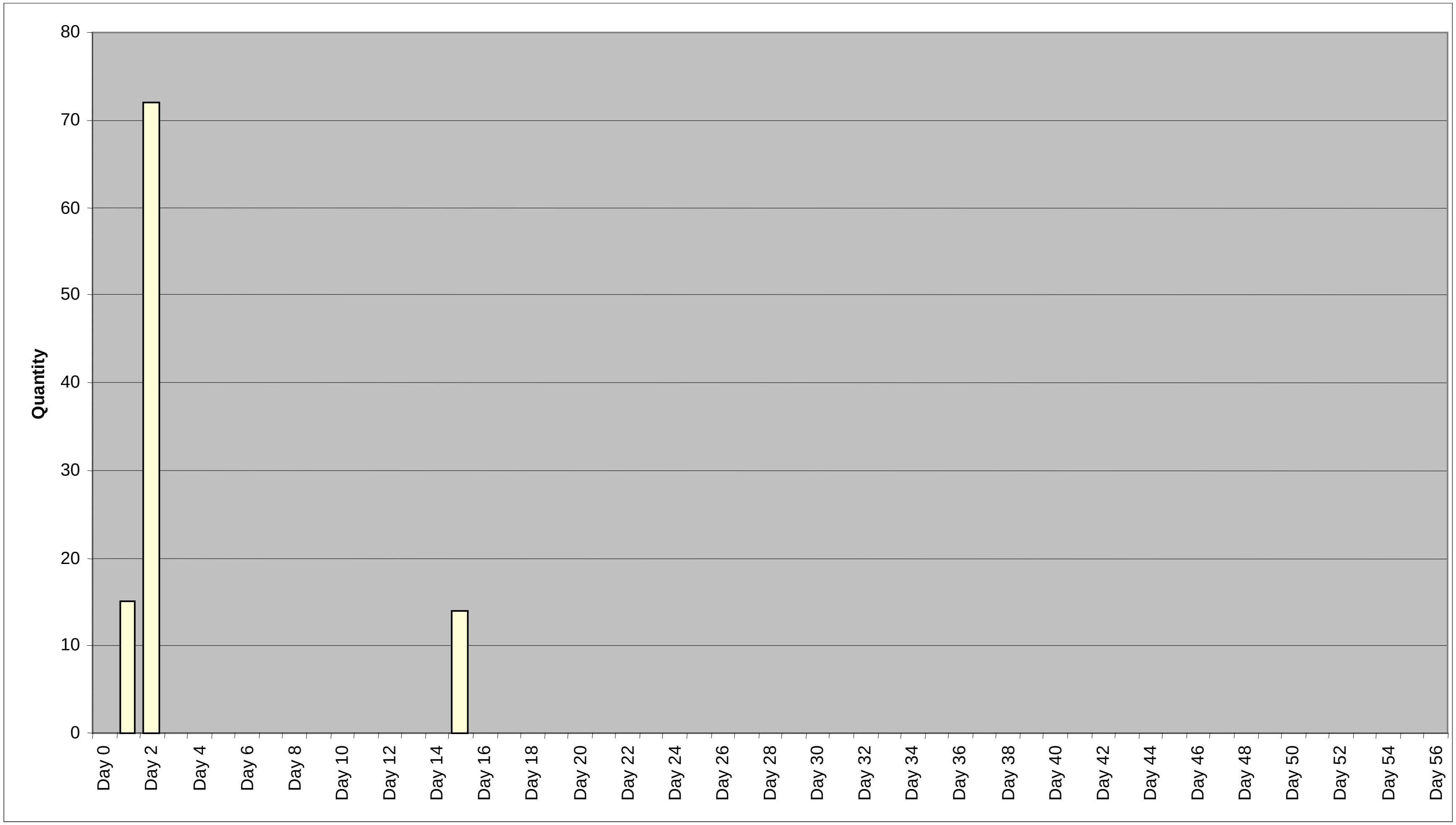

Figure G-22. Quantity of Aircraft Self-Deploying to the Port of Wilmington

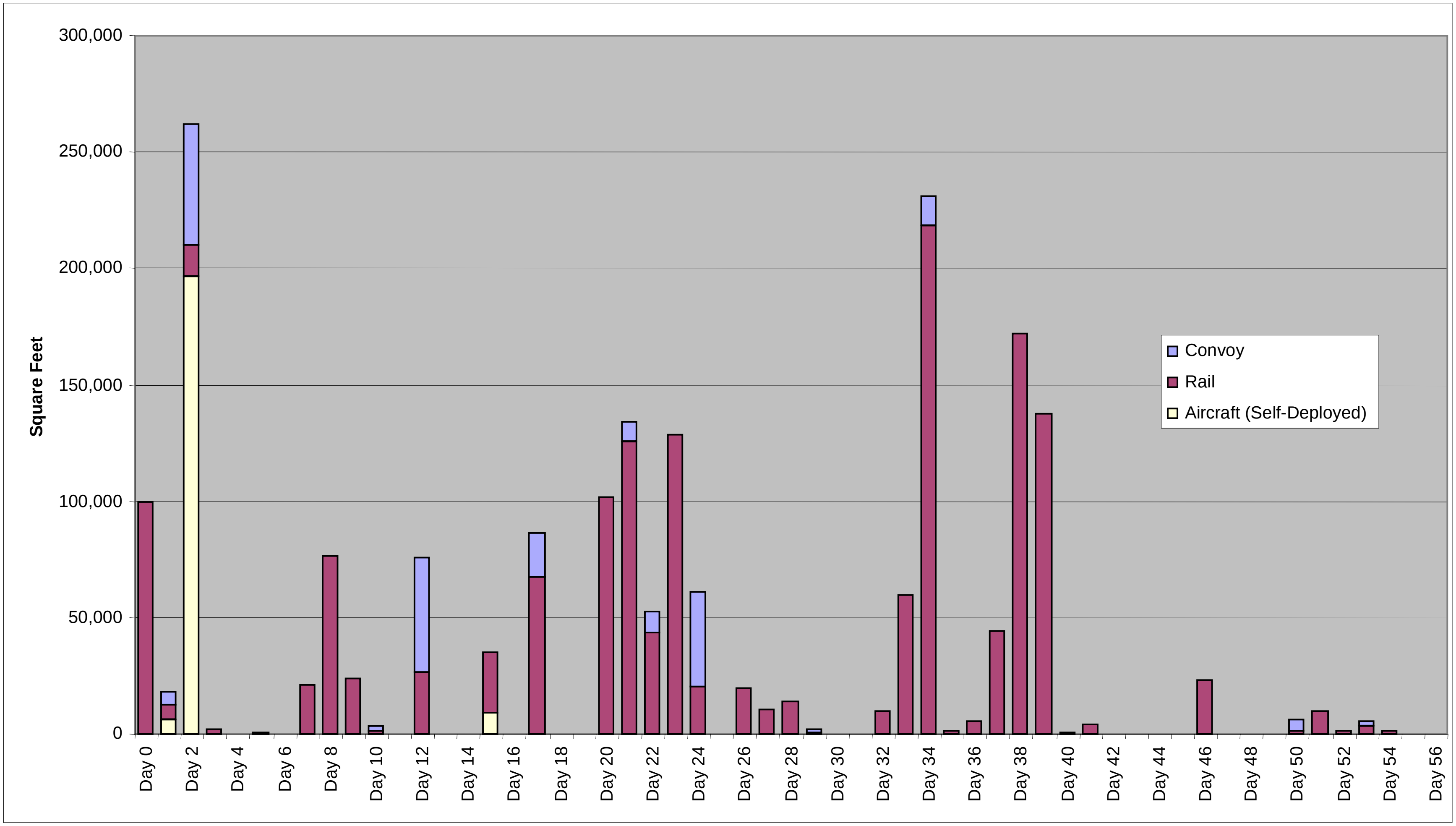

Figure G-23. Square Feet of Cargo Items Arriving by Mode to the Port of Wilmington

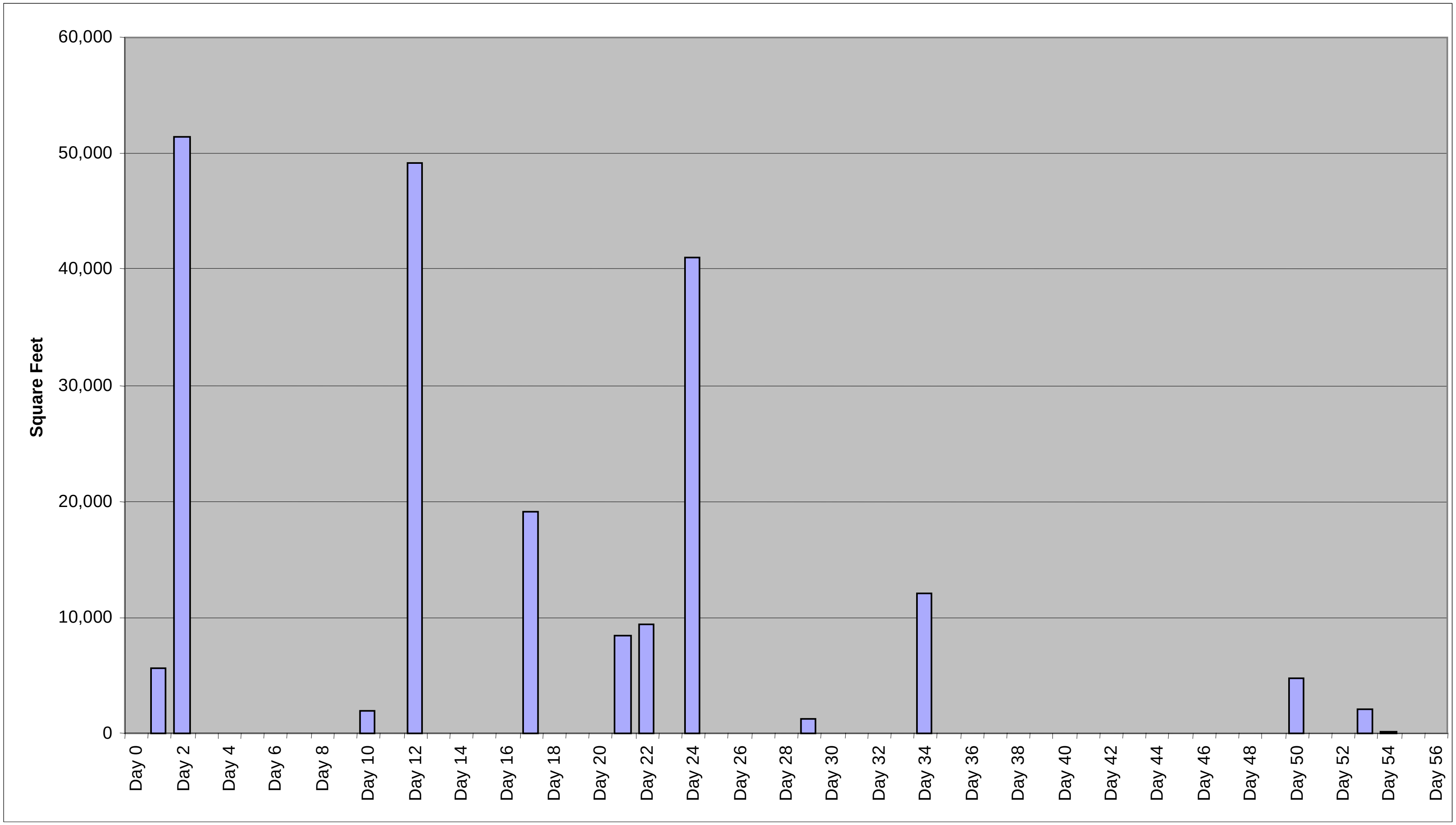

Figure G-24. Square Feet of Wheeled Vehicles Convoying to the Port of Wilmington

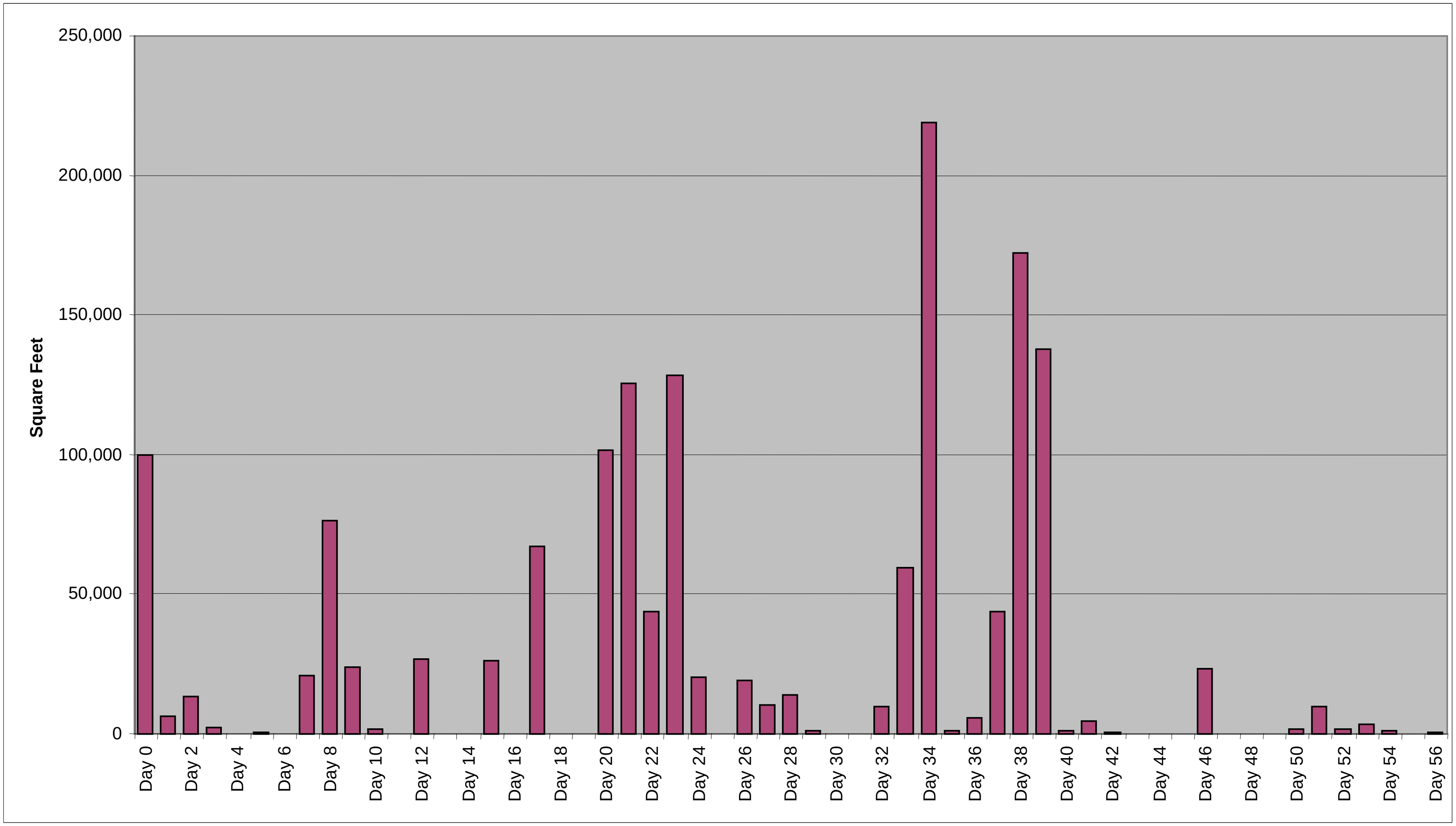

Figure G-25. Square Feet of Cargo Items Arriving by Rail to the Port of Wilmington

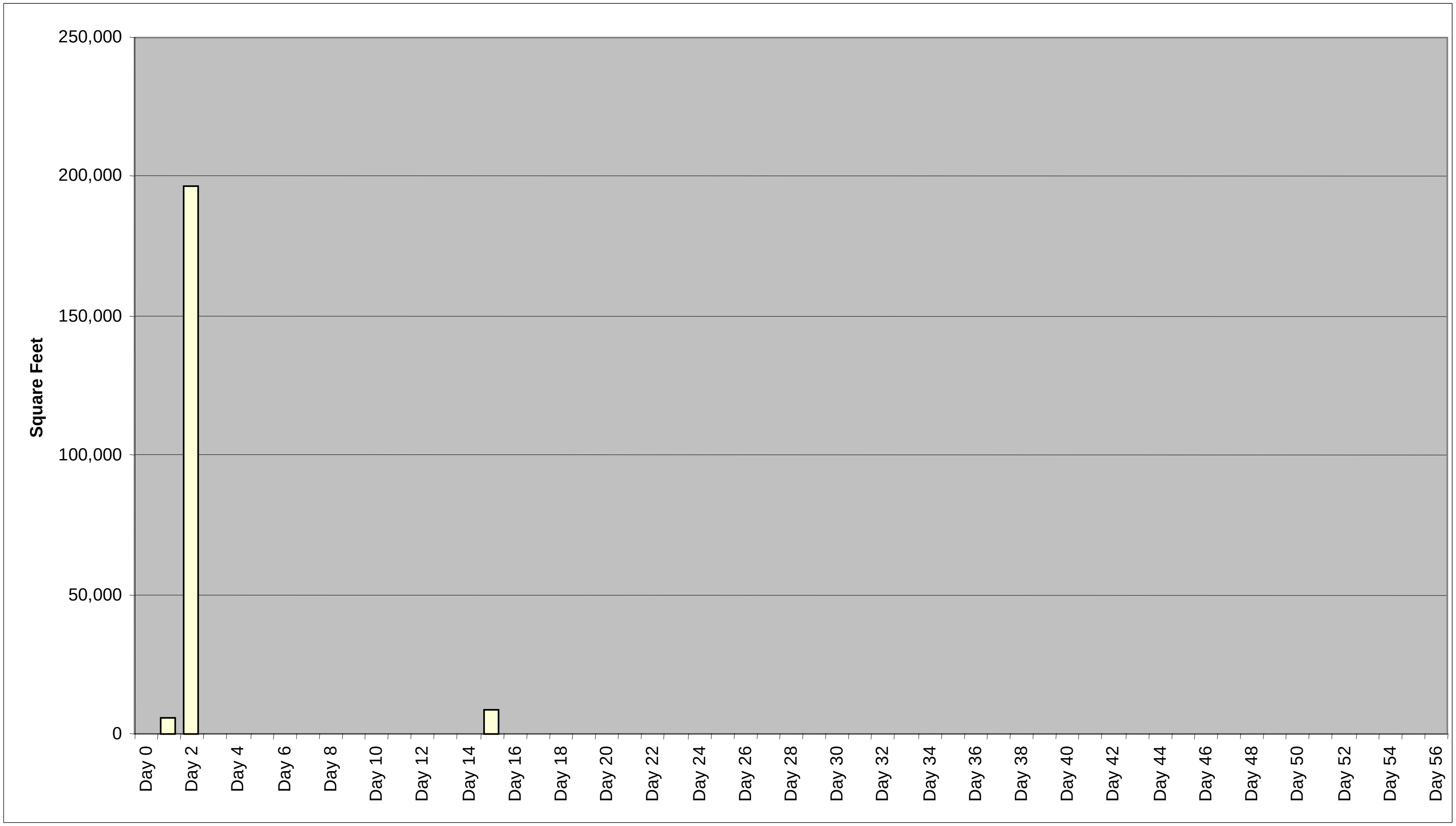

Figure G-26. Square Feet of Aircraft Self-Deploying to the Port of Wilmington

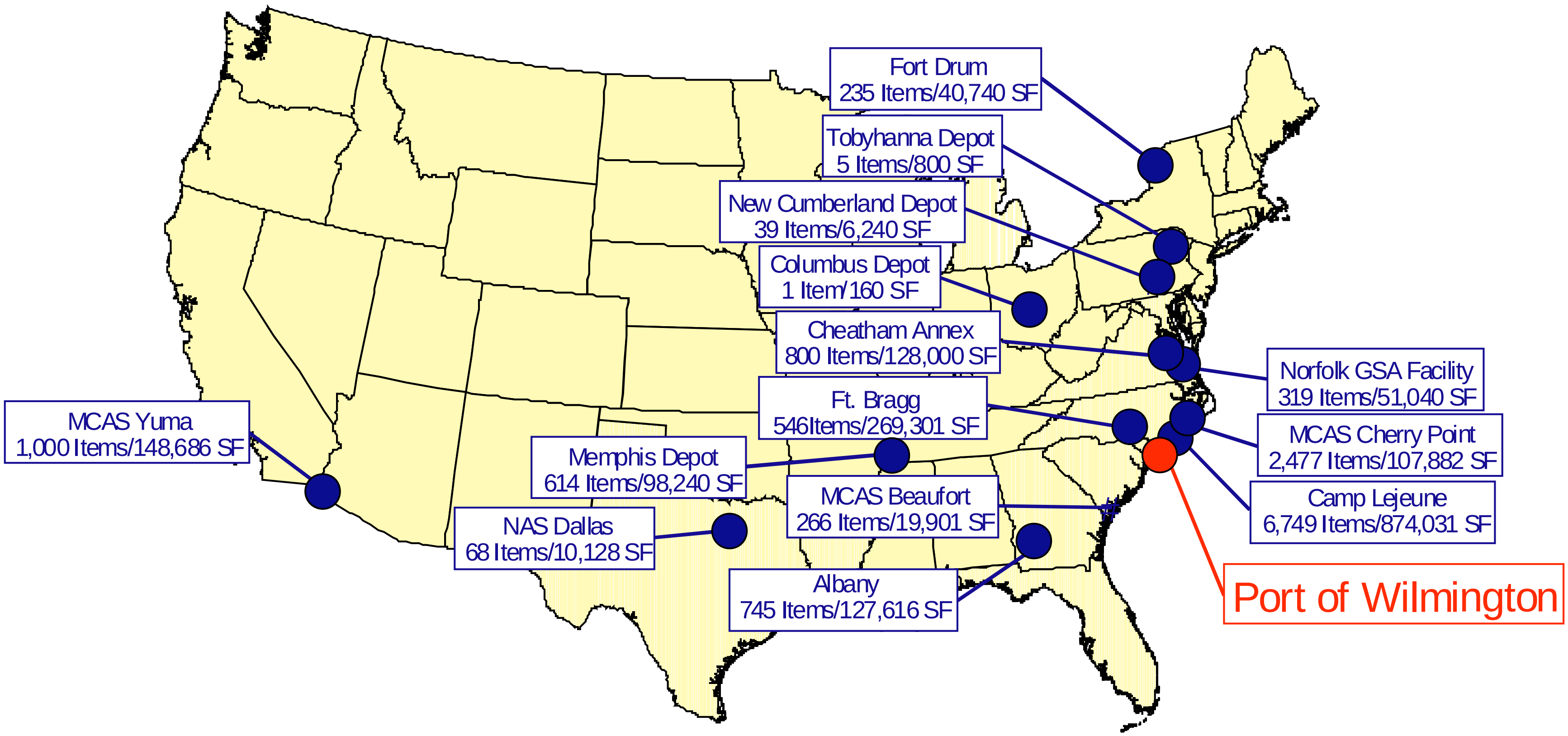

Figure G-27. Amount of Cargo Arriving at the Port of Wilmington by Origin

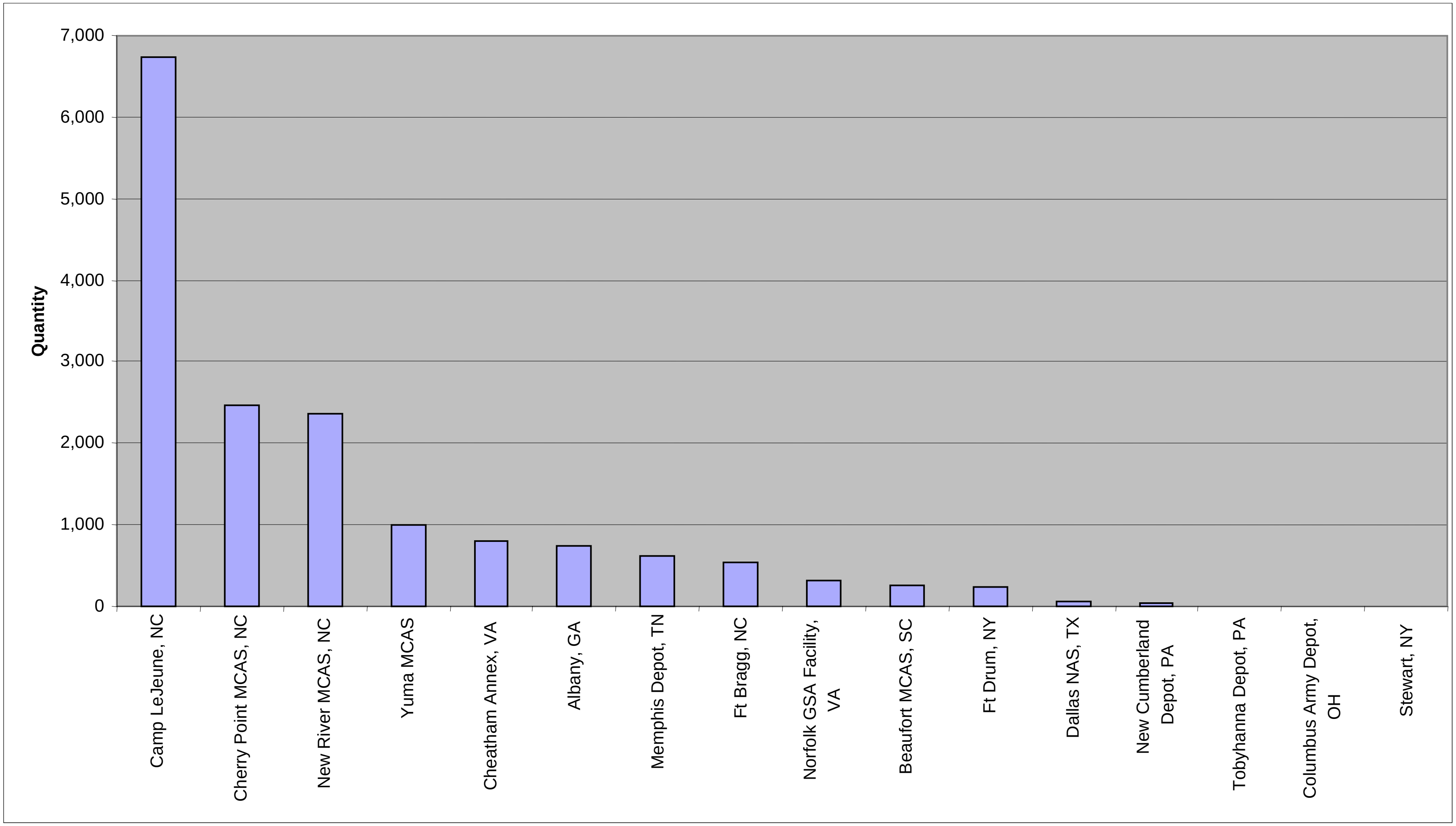

Figure G-28. Quantity of Items Arriving at the Port of Wilmington by Origin

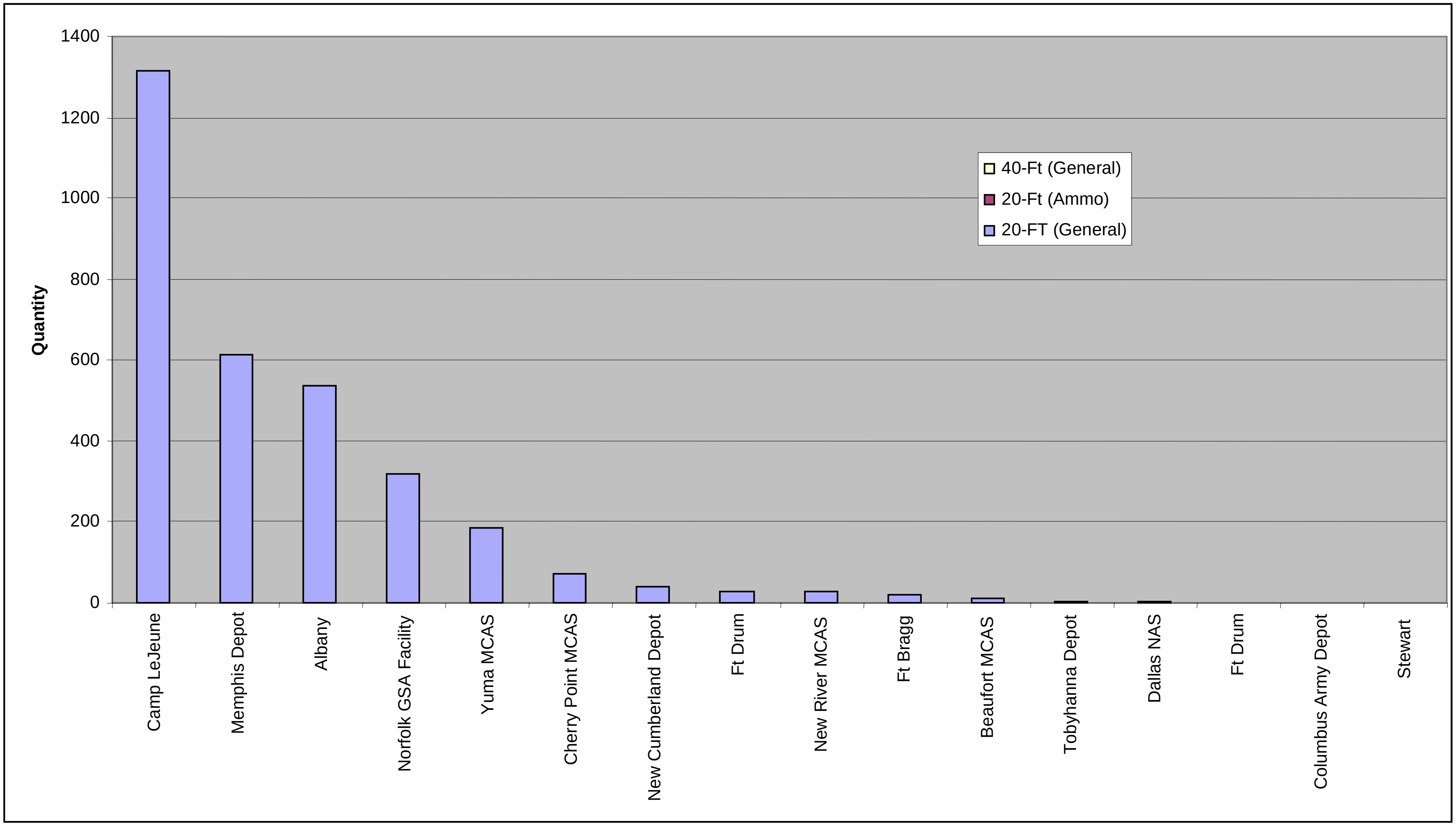

Figure G-29. Quantity of Containers Arriving at the Port of Wilmington by Origin

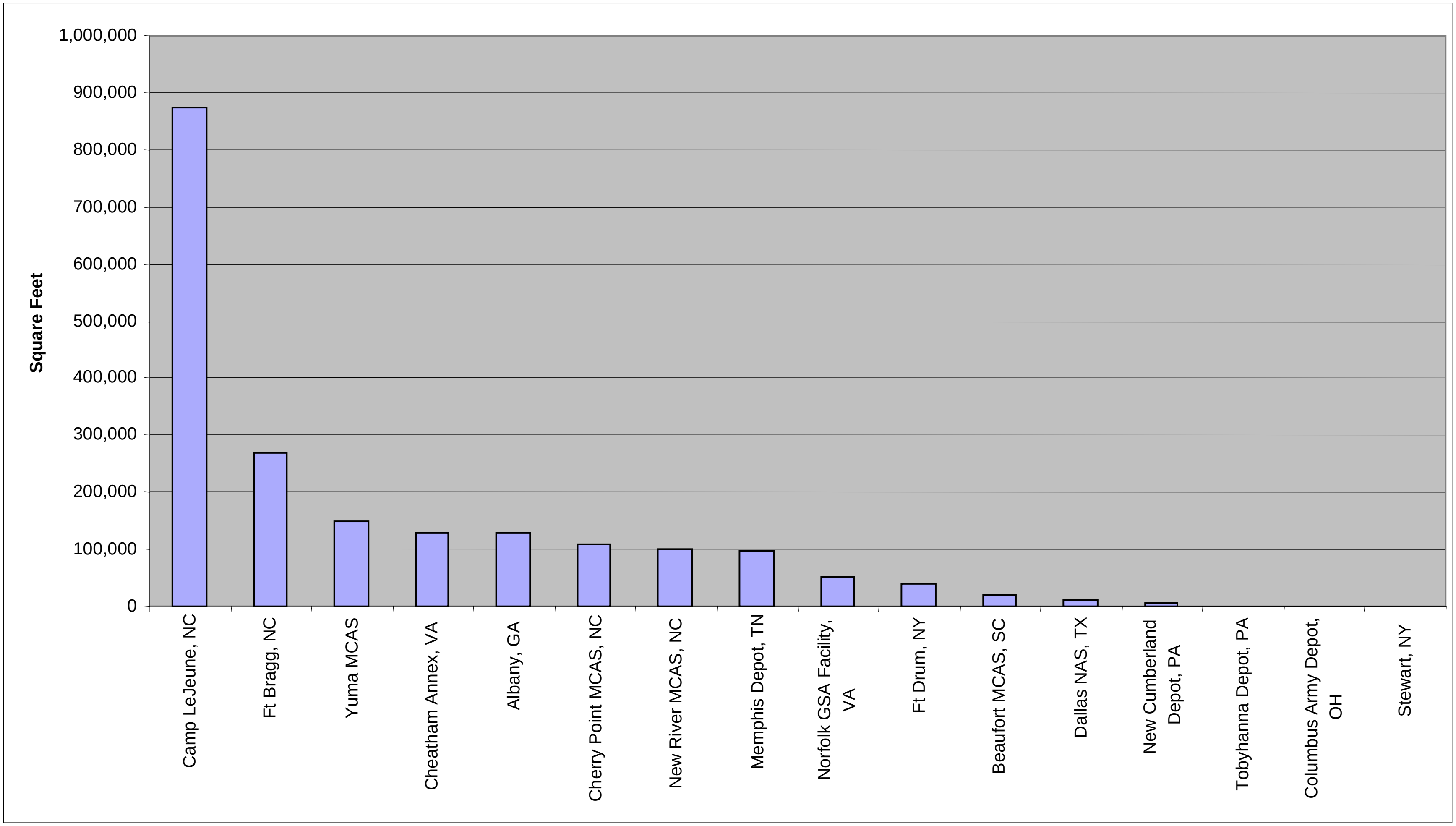

Figure G-30. Square Feet of Cargo Arriving at the Port Wilmington by Origin

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Newport News, Virginia 23606-4537

1-800-727-0727

April 2000

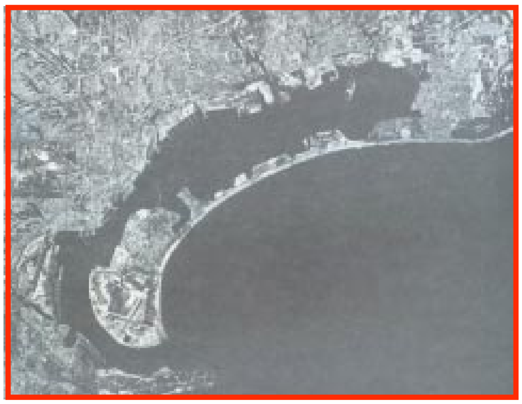
Port Enhancement Analysis

Phase I:

Port Workload Requirements for the West Coast Ports

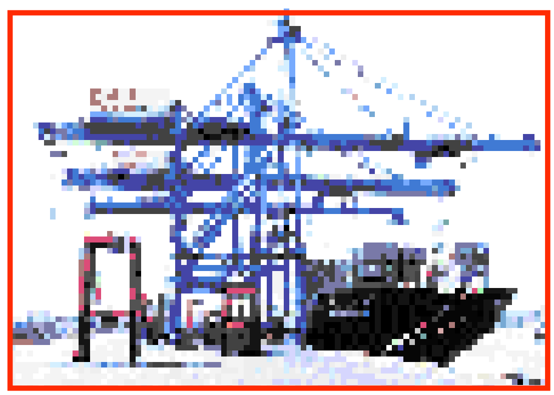
Port of Long Beach

Port of Seattle



Port of San Diego

Port of Oakland



Port of Tacoma

Carol M. Caldwell
Jennifer K. Casto
Diane L. Buescher

Military Traffic Management Command
Transportation Engineering Agency

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INTRODUCTION

This is Phase I of a two-phased study.

- Phase I identifies the quantity of cargo DOD plans to send through the strategic seaport, and
- Phase II considers the ports' ability to handle their assigned workload.

The Military Traffic Management Command's Transportation Engineering Agency (TEA) has analyzed ports for years. With our Ports for National Defense Program, we survey the ports that are important to national defense, defining their capabilities. We then compare these capabilities to the demand imposed by a notional unit deploying through the port. Based on this comparison, we assess the port's ability to meet its requirements. This methodology has suited us well in the past. However, as the deployment windows continue to shrink, we are forced to get our CONUS-based forces through the ports faster than ever before. Compound this with the continued economic expansion in many of these areas, and it is becoming a challenge for the ports to dedicate the real estate and facilities to respond to our requirements.

As a result, TEA realized the need for a more precise assessment of each port's ability to meet its requirements. We realized the need to base each port's requirements on the most demanding operation plan (OPLAN) for that port. Using our modeling capability, we can work with the tremendous quantity of information in an OPLAN time-phased force deployment data (TPFDD), massage the data, and extract the detail needed to get an accurate picture of the deployment through each port.

Port of Oakland

Port of Tacoma

OBJECTIVES

The objectives of this initiative are:

Phase I:

(1) Define the OPLAN-based time-phased flow of cargo through the port during a demanding deployment. This flow is defined in terms of quantity and square feet.

(2) Allow planners to assign Transportation Terminal Brigades/Battalions (TTBs) to ports based on workload.

(3) Allow TTBs to adequately prepare for deployment operations.

(4) Validate the need for deploying units to support Sea Ports of Embarkation (SPOEs).

Phase II:

(1) Assist the port commander in quantifying real estate and facility support needed from the port.

(2) In instances where the port cannot meet their requirements, provide the quantitative basis to help both DOD and commercial planners assess potential "fixes." These fixes could include:

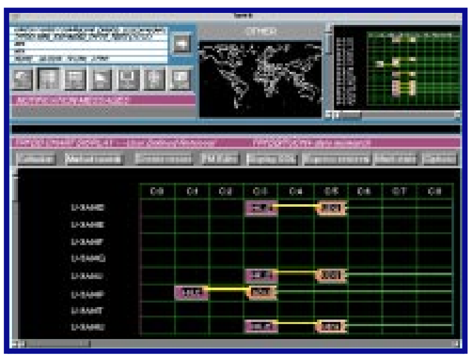
- Re-routing cargo to another port in the region,
- Re-timing the flow, or even
- Working through the local and metropolitan planning organizations to solicit federal funds.

METHODOLOGY

When practical, ports are analyzed on a regional basis. This allows planners to examine an entire region at one time, evaluating peaks and valleys at groups of neighboring ports. This study includes requirements for the ports of Long Beach, Oakland, San Diego, Seattle and Tacoma. There is only a small requirement at Port Hueneme and is therefore not included in this study.

The following tools are utilized to analyze port workload:

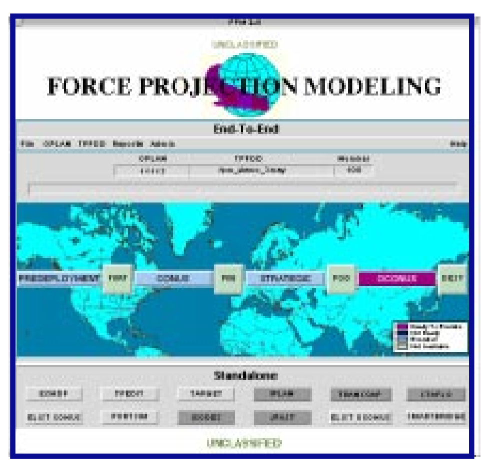
TPEDIT (TPFDD Editor) – An integrated set of automated processing tools that provides time-phased force deployment data (TPFDD) editing and analysis capability. TPEDIT allows the analyst to:

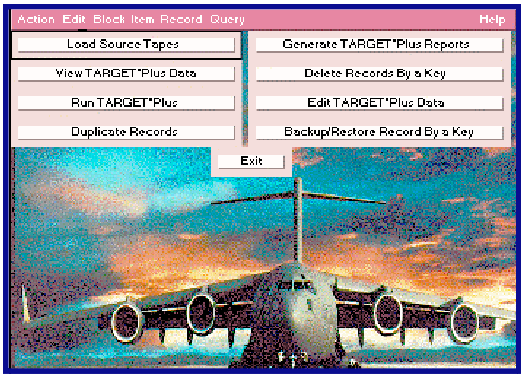


- View the TPFDD graphically.
- Extract information for the seaport of embarkation (SPOE) of interest.
- Edit the TPFDD. Remove "on-call" and "shortfalled" records. Clean-up data issues.
- Review data to determine the amount of cargo (number of ULNs/CINs, quantity, square feet, short tons, measurement tons) flowing through the port.

EXPANDED TPFDD - A database shared by the simulation models and used for tracking movement requirements at the individual item level of detail. Using the expanded TPFDD the analyst can:

- Load the TPFDD into the Oracle database management system.
- "Expand" the TPFDD cargo detail within Oracle to Level 6 for the SPOE of interest.





TARGET (Transportability Analysis Reports Generator) – A system of models and programs that provide the capability to generate movement requirements at the individual item level of detail (Level 6). The system merges force structure data from the Table of Organization and Equipment (TOE) or the Modified TOE (MTOE) with equipment characteristics from the Department of the Army Standard Equipment Characteristic File (ECF) to create unit equipment tables. With TARGET, the analyst:

- Assigns transport modes by ULN/CIN (convoy/rail).
- Selects transport assets.
  Containers (20' and 40')
  Railcars (89' flatcars, 60' flatcars, 68' DODX railcars)
- Determines convoy, rail, and container requirements.

FPM REPORTS – A set of customized reports extract detailed cargo information from TARGET output files. These reports, when imported into Microsoft Excel, are the foundation of the port workload effort. The graphs are included in the results section of this report.

ASSUMPTIONS

- The requirements in this report represent:
  - The entire duration of the flow through the ports of Long Beach, Oakland, San Diego, Seattle, and Tacoma as defined by the operation plan (OPLAN).
  - All records in the plan scheduled to move by sea under Military Sealift Command's (MSC) control.
  - The most demanding plan for each port. As a result, the same OPLAN was not used for all ports. The plans may not necessarily be representative of the flow during an actual deployment.
- TPFDD Records not included in this analysis:
  - "On-call" records. These records are in the plan but are not scheduled to move – they appear with an available to load date (ALD) of 999.
  - "Shortfalled" records. These records are in the plan but are not sourced – they have not been matched with a specific unit.
  - Bulk petroleum, oils, and lubricants (POL) records (packaged POL is included).
- TARGET uses the following transport assets:
  Containers (20-foot, 40-foot)
  Convoy Vehicles (self-propelled, towed)
  Railcars (89-foot flatcars, 60-foot flatcars, 68-foot DODX railcars)
  NOTE: Commercial Motor was not utilized
- Containers are stuffed at their origin.
- TARGET stuffs containers and loads railcars with unit integrity. In addition, TARGET will not mix unit equipment and containers on the same railcar. This may, in some instances, give a high estimate of containers and railcars for each unit.
- If the origin is less than 400 miles from the seaport of embarkation (SPOE), roadable vehicles convoy from origin to SPOE. If the origin is greater than 400 miles from the SPOE, roadable vehicles are loaded onto railcars for transport to the SPOE. All nonroadable vehicles are loaded onto railcars for transport to the SPOE.
- The breakbulk category includes cargo coded in the TPFDD as containerizable with dimensions exceeding the allowable dimensions of a 20-foot container and nonvehicular cargo coded as noncontainerizable.

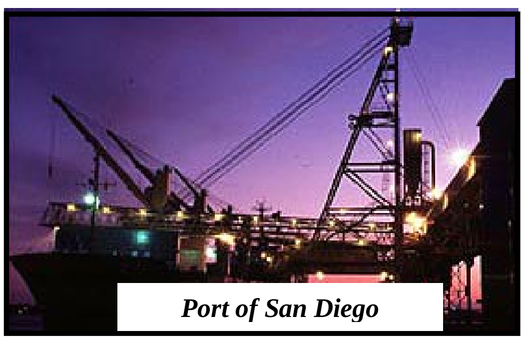
RESULTS

The charts in this report represent the daily cargo arrival in terms of quantity and square feet at the respective port. The cargo consists of containers, wheeled vehicles, tracked vehicles, floating craft, aircraft, and breakbulk.

The wheeled and tracked vehicles are categorized by weight as shown in table below.

Table 1
Categories of Vehicles

	Wheeled Vehicles	Tracked Vehicles
Light	Less than 5 ST	Less than 20 ST
Medium	5-30 ST	20-35 ST
Heavy	Greater than 30 ST	Greater than 35 ST



Port of San Diego

This study includes the following ports: Appendix A - Port of Long Beach, Appendix B - Port of Oakland, Appendix C - Port of San Diego and Appendix D - Port of San Diego Assault Follow on Echelon (AFOE), Appendix E – Port of Seattle and Appendix F – Port of Tacoma. The requirements for the Port of San Diego are presented in appendices C and D. Cargo to be transported via Military Sealift Command (MSC) ship is presented in Appendix C. In addition, there is a Marine Corps AFOE scheduled to arrive at the port. Navy amphibious ships will most likely transport the AFOE, but the requirements still need to be taken into consideration since they will compete for resources at the port.

The study does not include Port Hueneme since there is only a small requirement moving by sea via MSC ship. This requirement is Marine Corps AM-2 Matting. There are additional requirements scheduled for Port Hueneme, however, the U.S. Navy is scheduled to transport those requirements.

Port of Seattle

APPENDIX A

PORT OF LONG BEACH

The graphs below represent the cargo scheduled to arrive at the Port of Long Beach as outlined in the TPFDD. Cargo is scheduled to arrive at the port starting on day 2 and continuing through day 142.

The Port of Long Beach is scheduled to receive cargo from 27 separate origins. Figure A-1 shows all the origins in the TPFDD scheduled to send cargo to the Port of Long Beach. Figure A-2 provides the quantity of railcars required to transport the cargo to the port. Figures A-3 through A-6 illustrate the quantity of items arriving at the port. The large breakbulk spike on C+20 in Figure A-6 consists of cargo items for the Marine Corps that are coded non-containerizable such as refrigerators, loaded warehouse pallets, field desks, chain saws, and generators. Figures A-7 through A-10 illustrate the square footage of the cargo arriving at the port.

Figures A-11 through A-13 provide a breakdown of the quantity of items arriving at the port according to the mode of transportation (convoy and rail). Similarly, Figures A-14 through A-16 reflect the same information presented in terms of square footage.

Figure A-17 shows the quantity and square footage of items arriving at the port for each origin scheduled in the TPFDD. The bar graph in Figure A-18 reflects origins with more than 20 items and provides the total quantity of items by origin. The remaining origins not included in the graph are listed in Table A-1. The bar graph in Figure A-19 shows the quantity of containers arriving at the port for each origin scheduled in the TPFDD.

Figure A-20 provides cargo scheduled to arrive at the port for each origin in terms of square feet. The graph reflects origins with a total of 4,000 square feet or more. The remaining origins not included in the graph are provided in Table A-2.

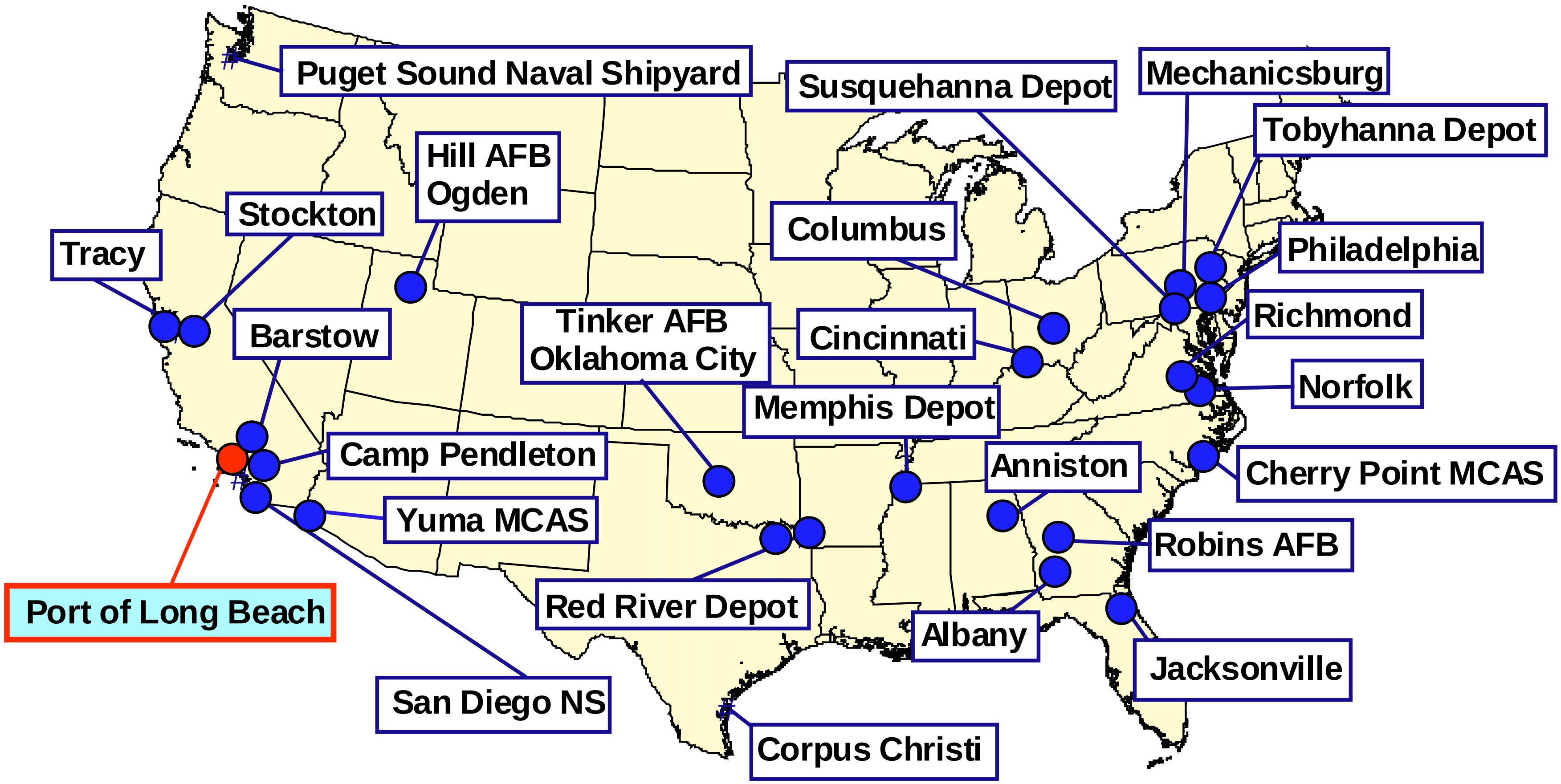


Figure A-1. Cargo Arrives at the Port of Long Beach from Many Origins

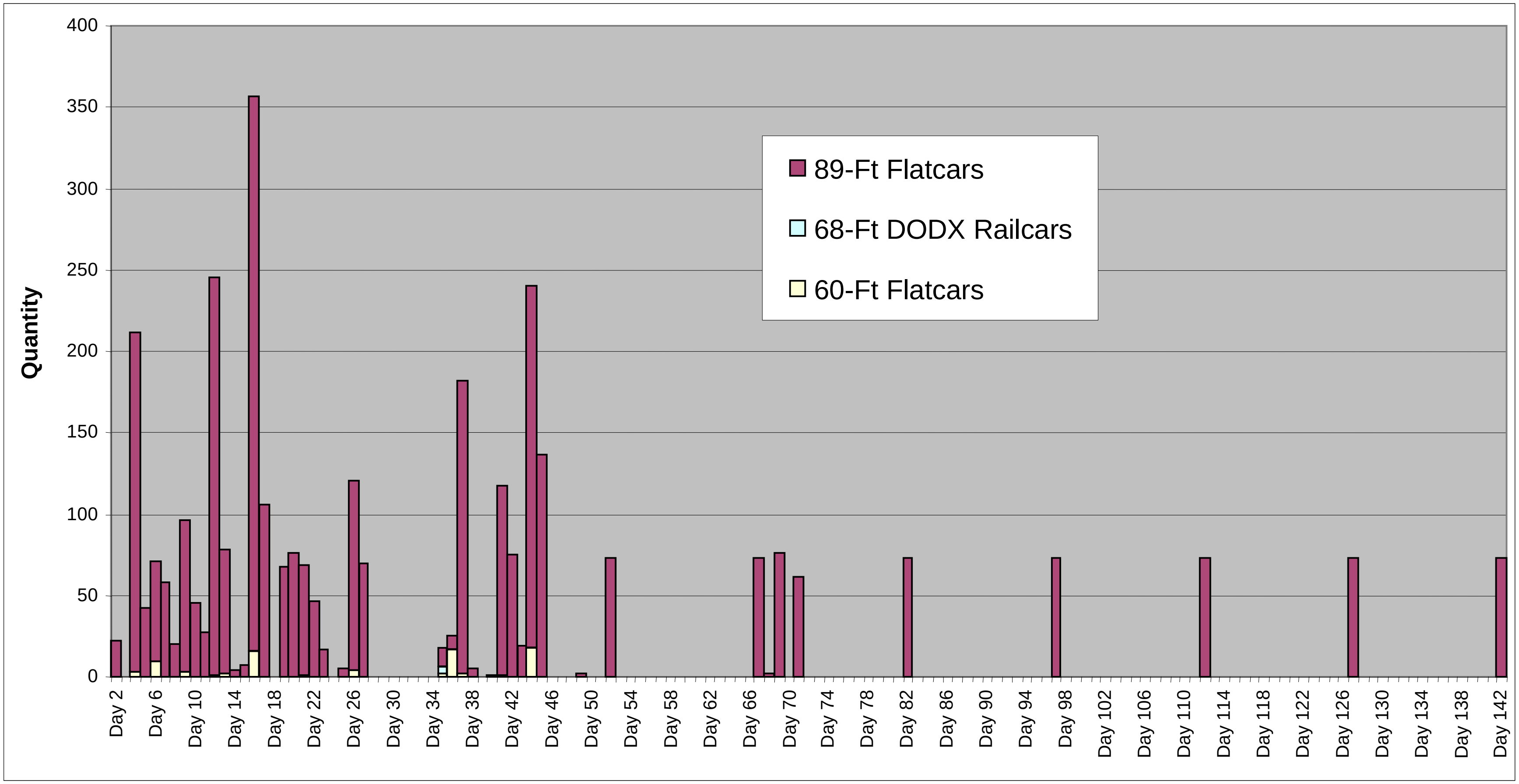


Figure A-2. Quantity of Railcars Arriving at the Port of Long Beach

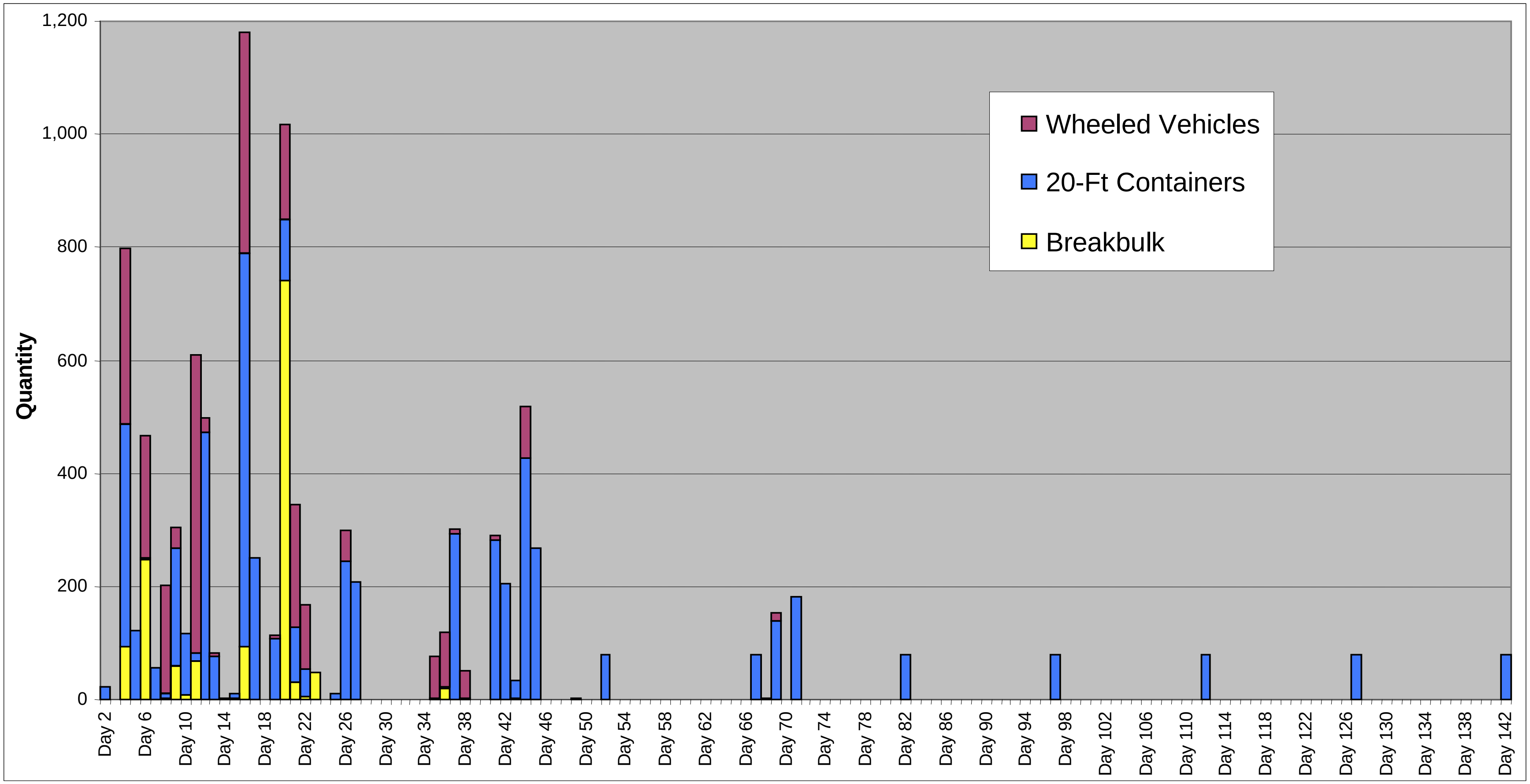


Figure A-3. Total Quantity of Items Arriving at the Port of Long Beach

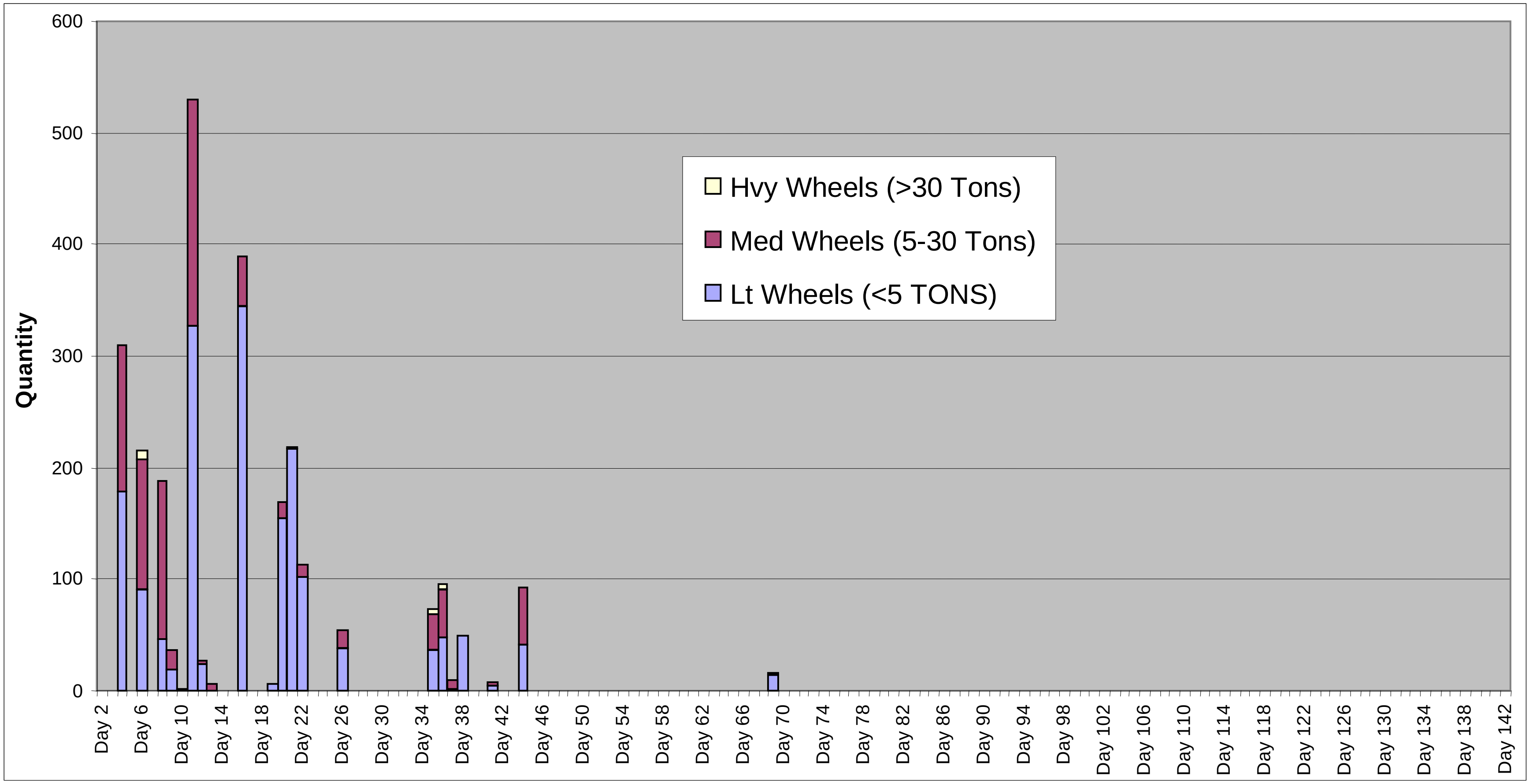


Figure A-4. Quantity of Wheeled Vehicles Arriving at the Port of Long Beach

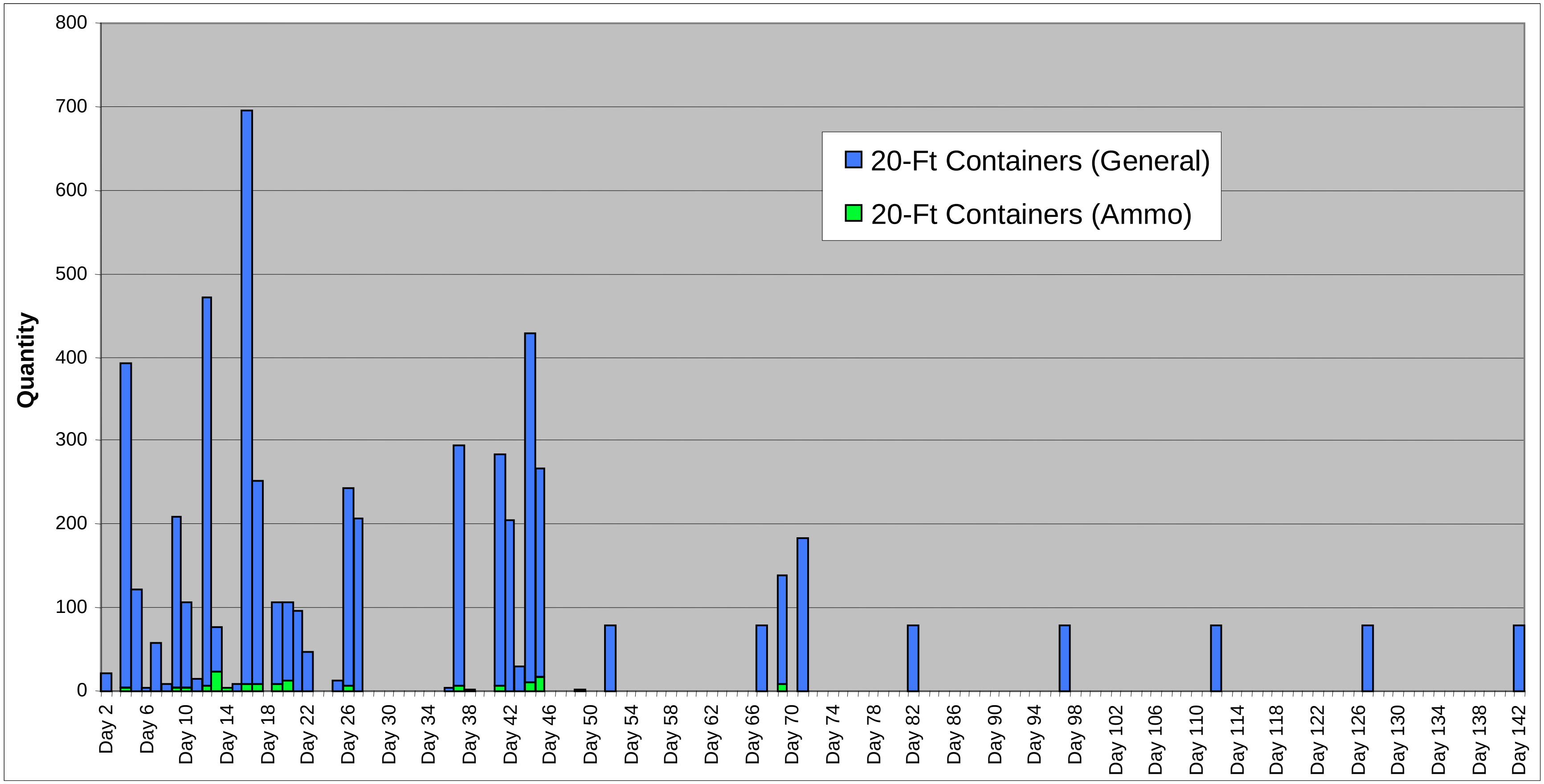


Figure A-5. Quantity of Containers Arriving at the Port of Long Beach

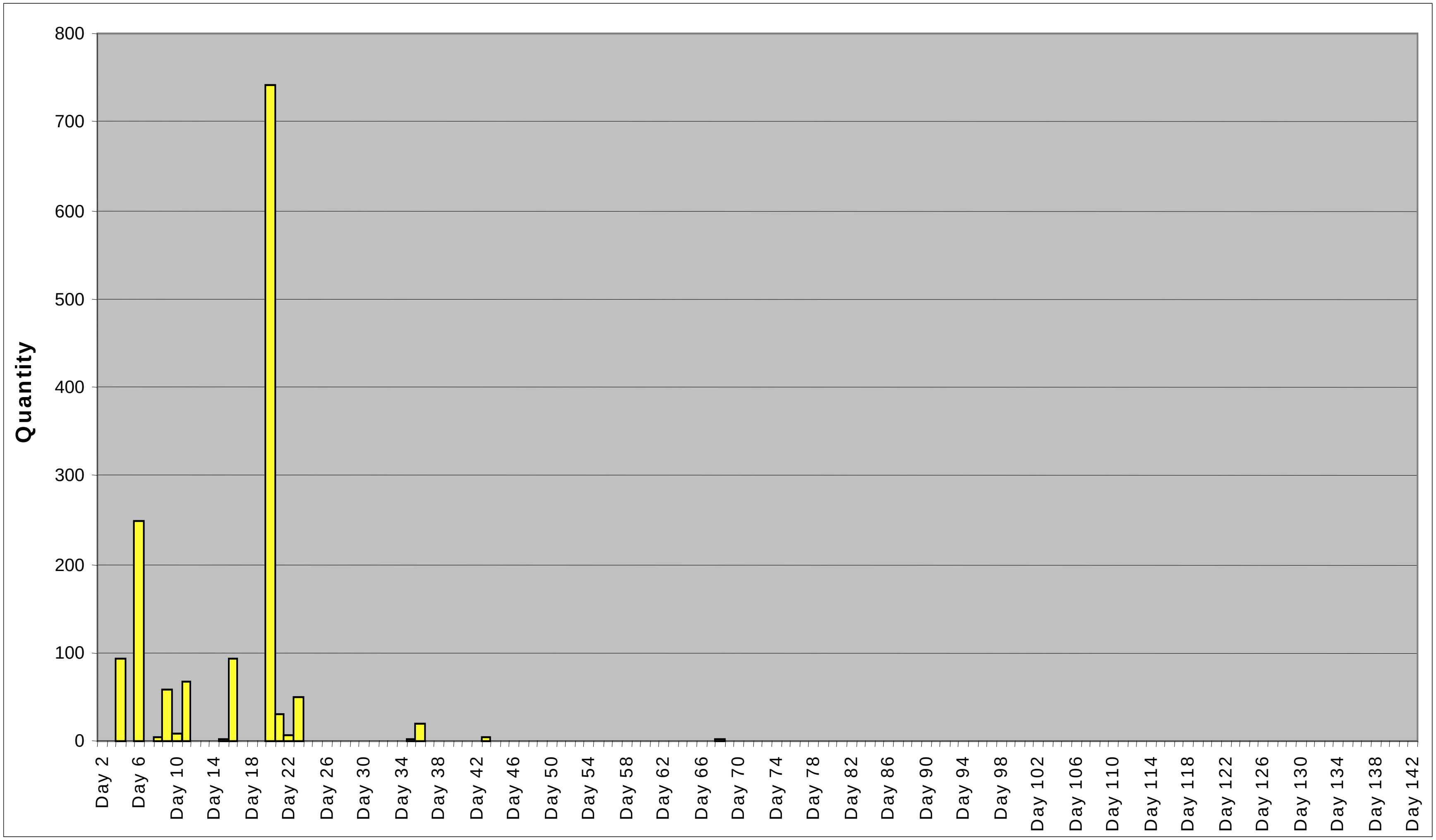


Figure A-6. Quantity of Breakbulk Items Arriving at the Port of Long Beach

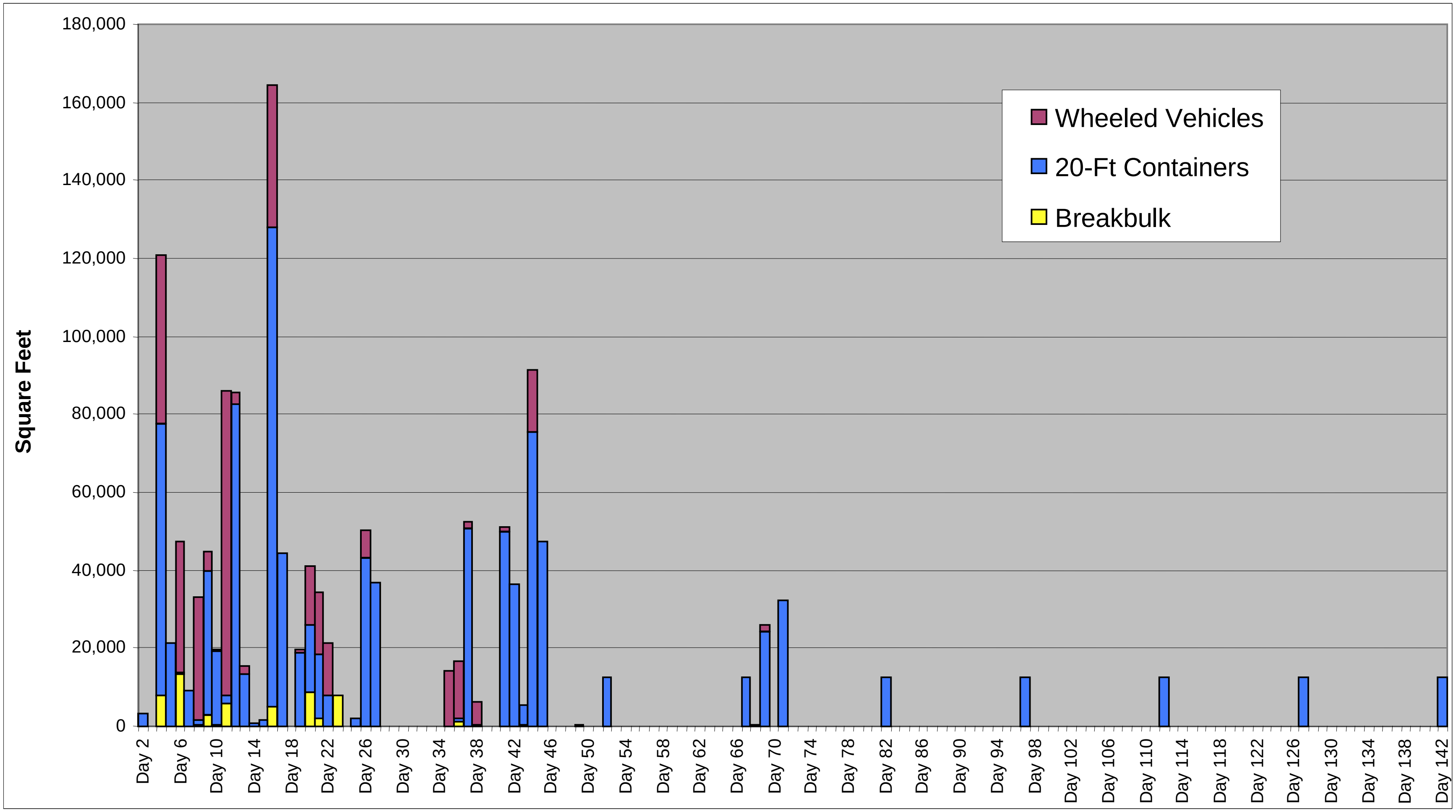


Figure A-7. Total Square Feet of Cargo Arriving at the Port of Long Beach

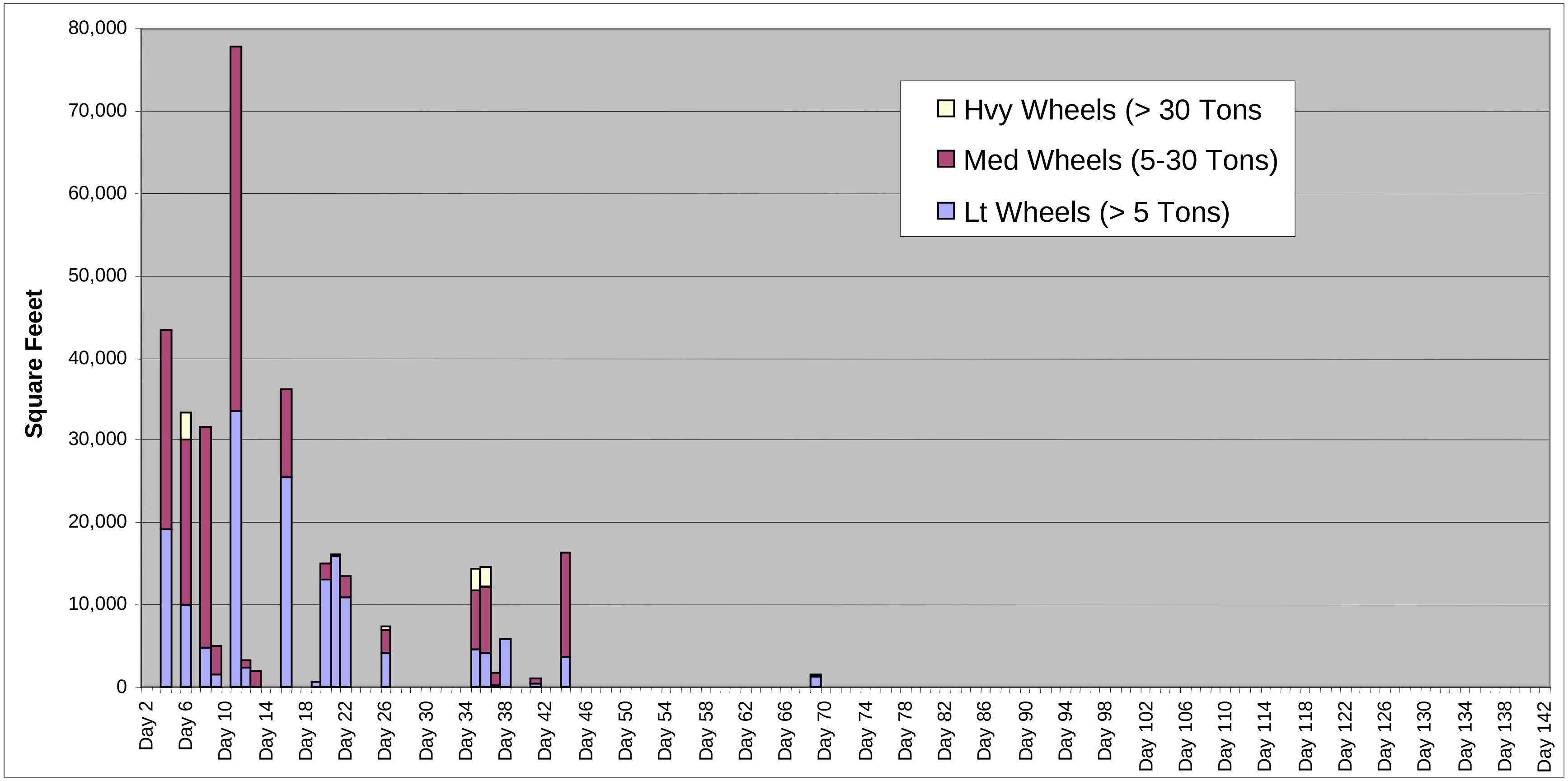


Figure A-8. Square Feet of Wheeled Vehicles Arriving at the Port of Long Beach

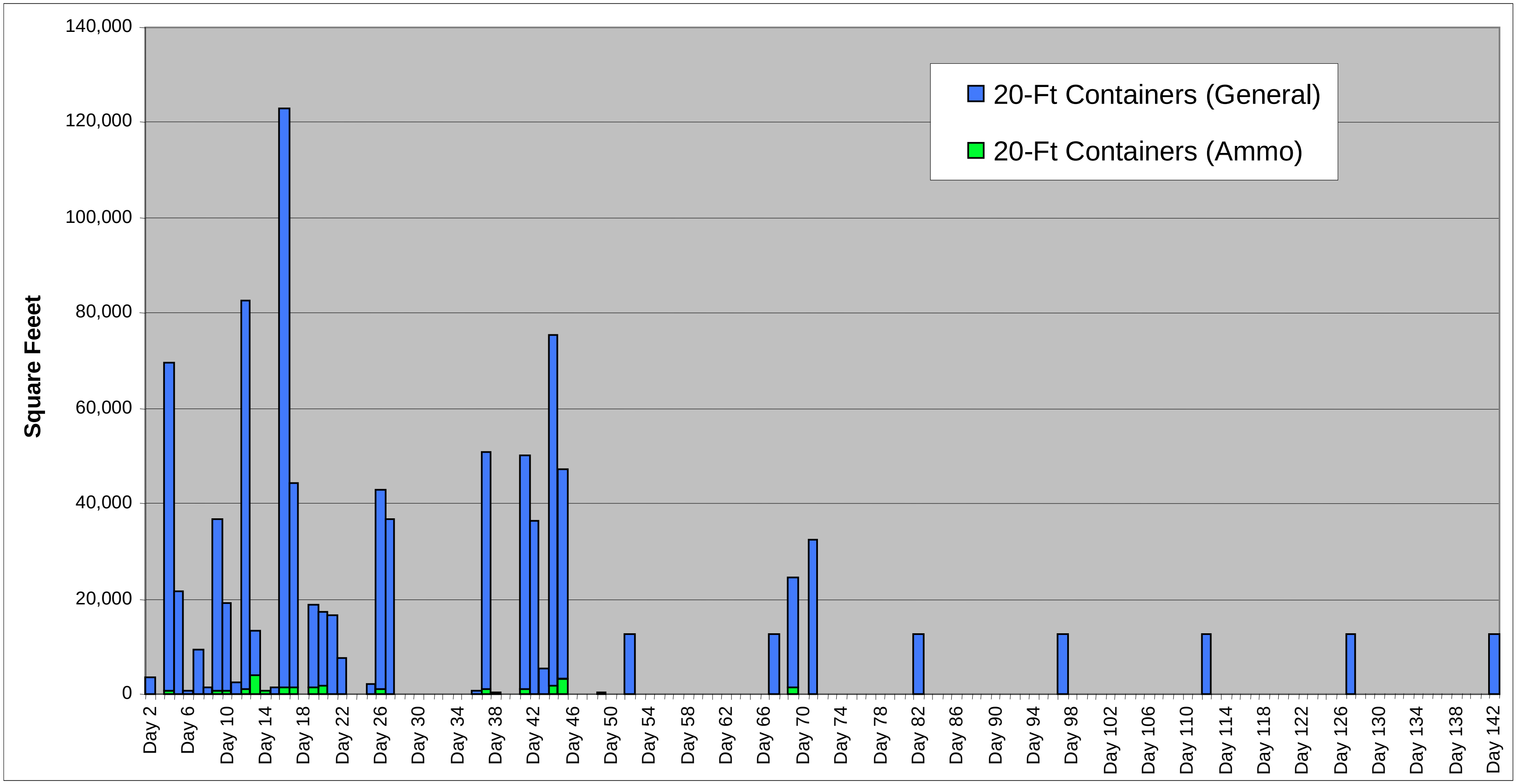


Figure A-9. Square Feet of Containers Arriving at the Port of Long Beach

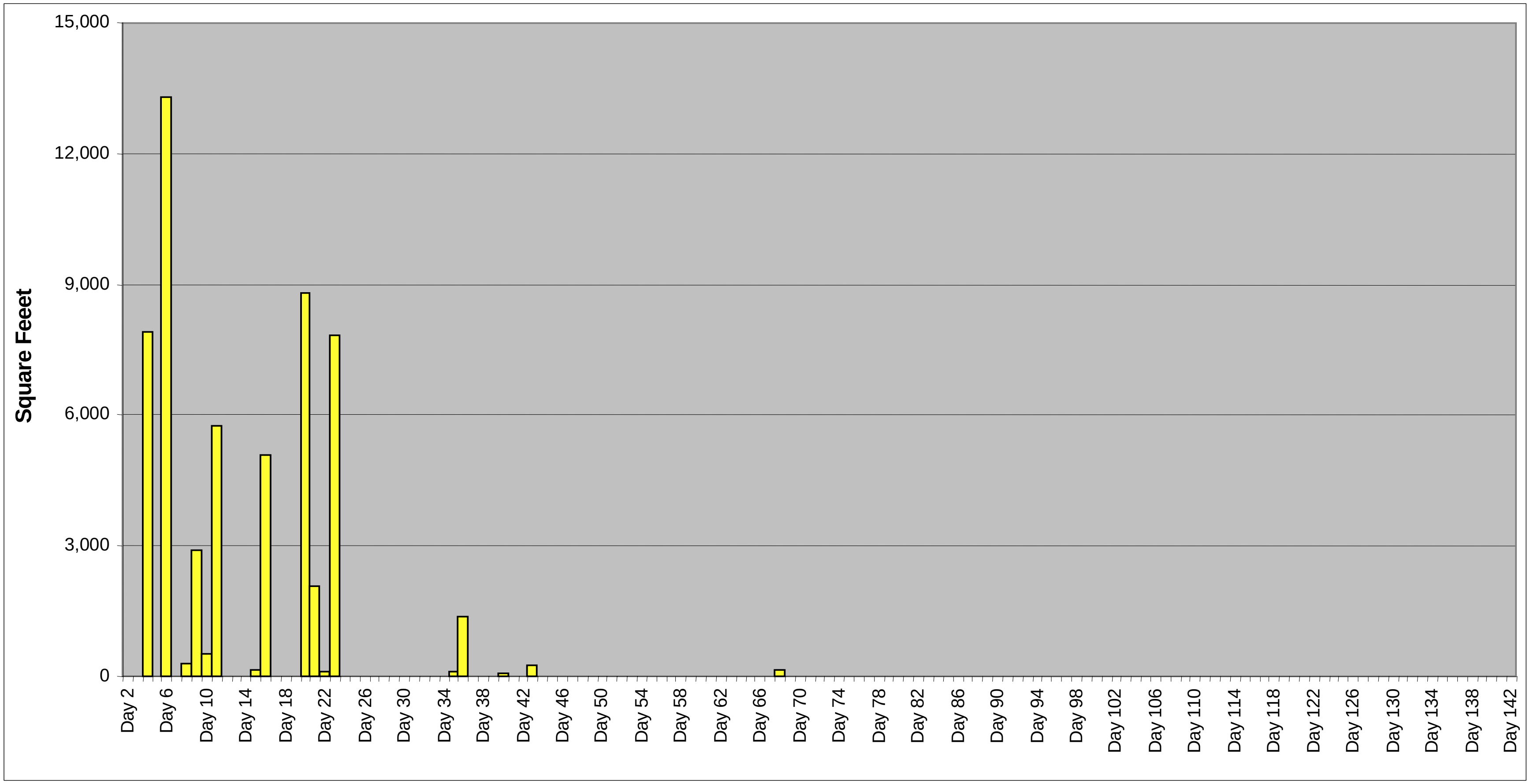


Figure A-10. Square Feet of Breakbulk Cargo Arriving at the Port of Long Beach

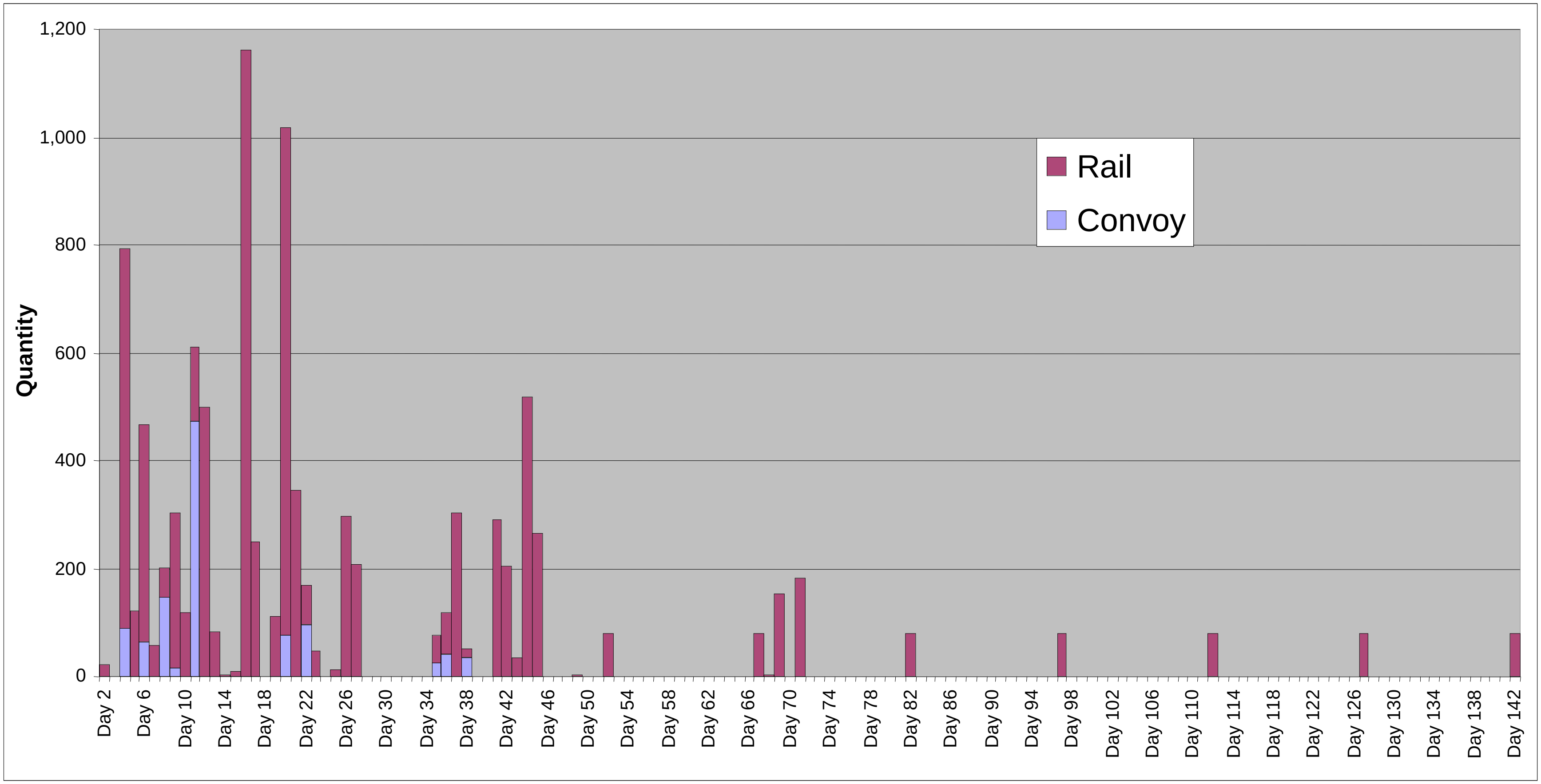


Figure A-11. Quantity of Items Arriving by Mode to the Port of Long Beach

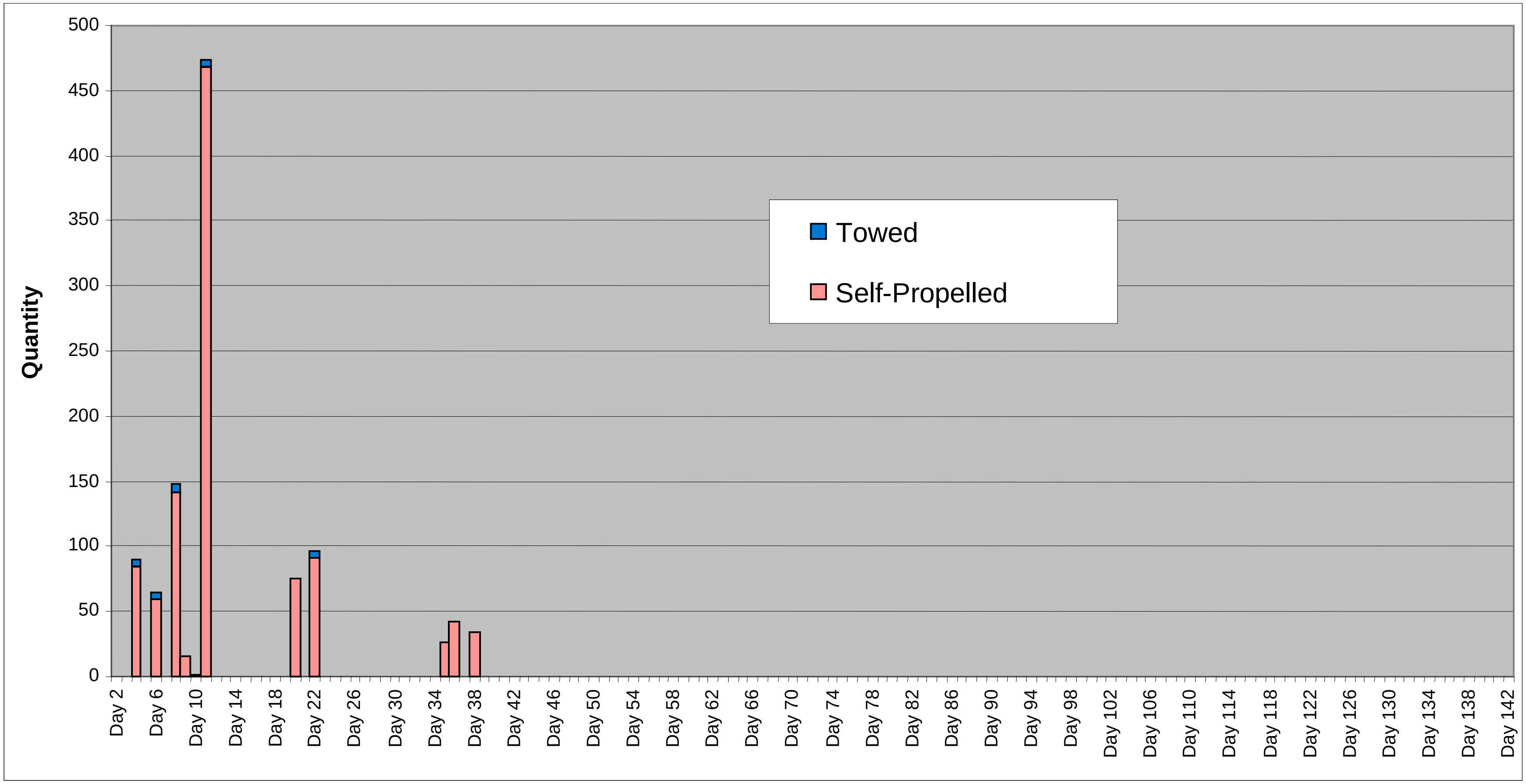


Figure A-12. Quantity of Wheeled Vehicles Convoying to the Port of Long Beach

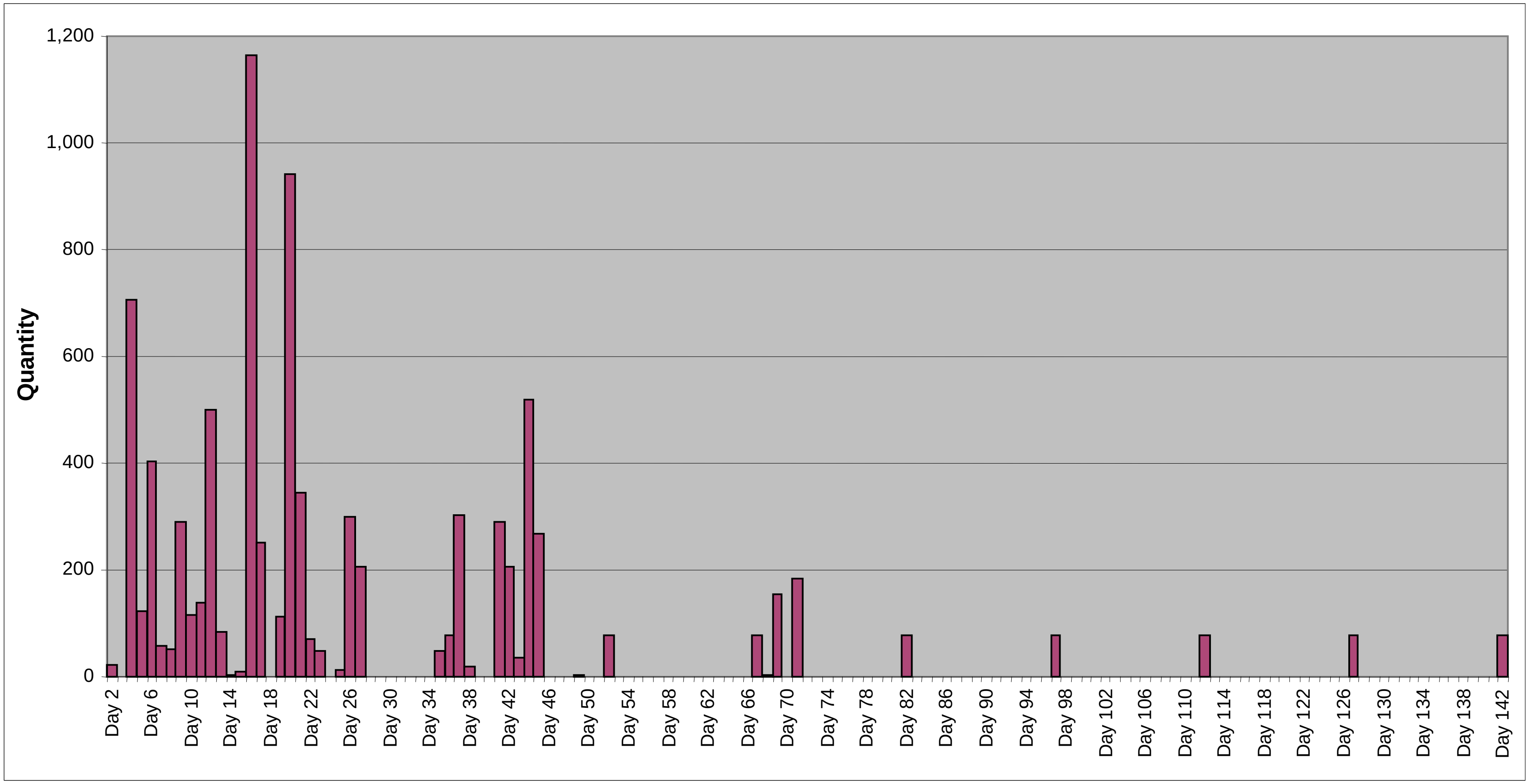


Figure A-13. Quantity of Items Arriving by Rail to the Port of Long Beach

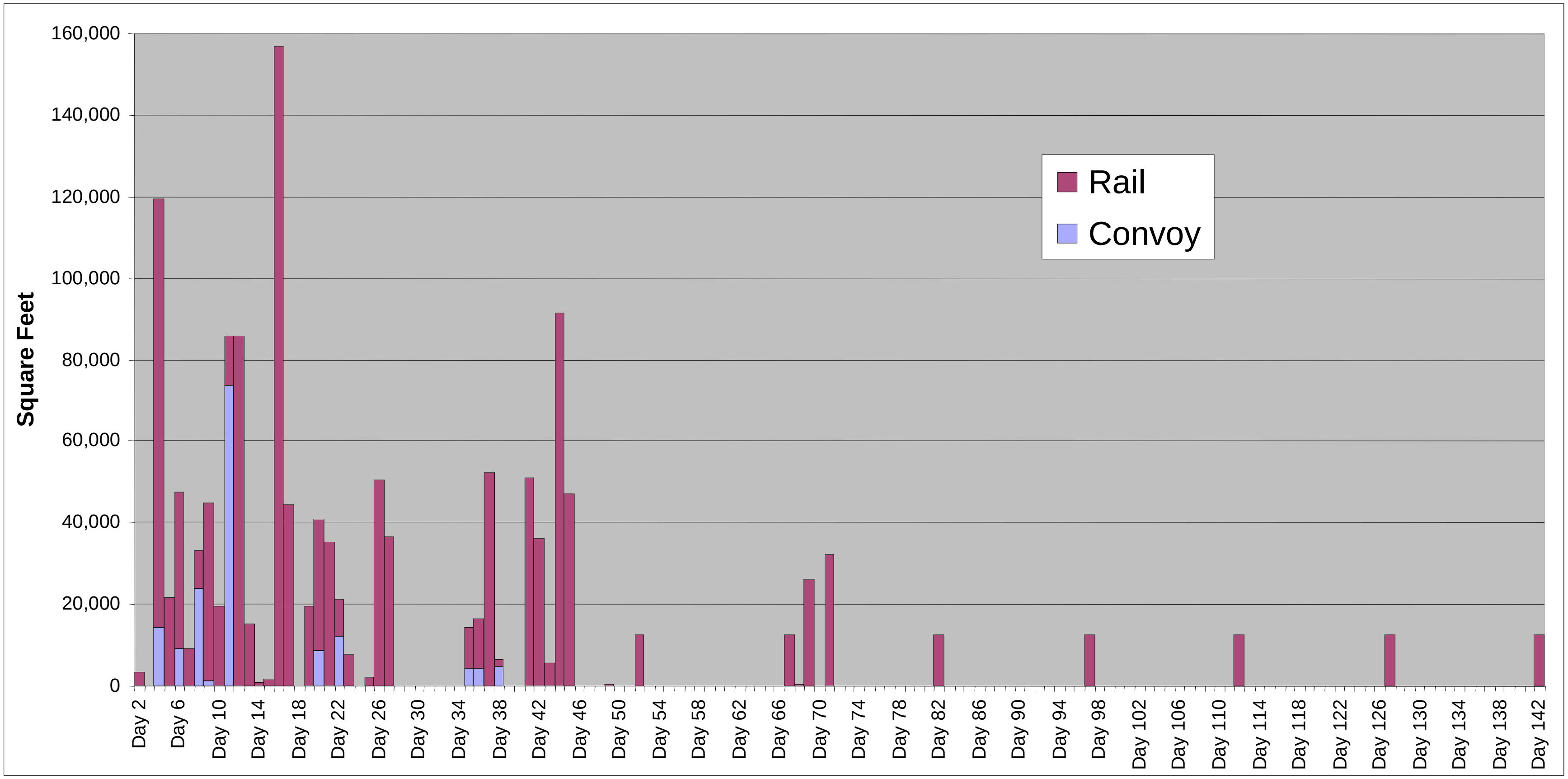


Figure A-14. Square Feet of Cargo Arriving by Mode to the Port of Long Beach

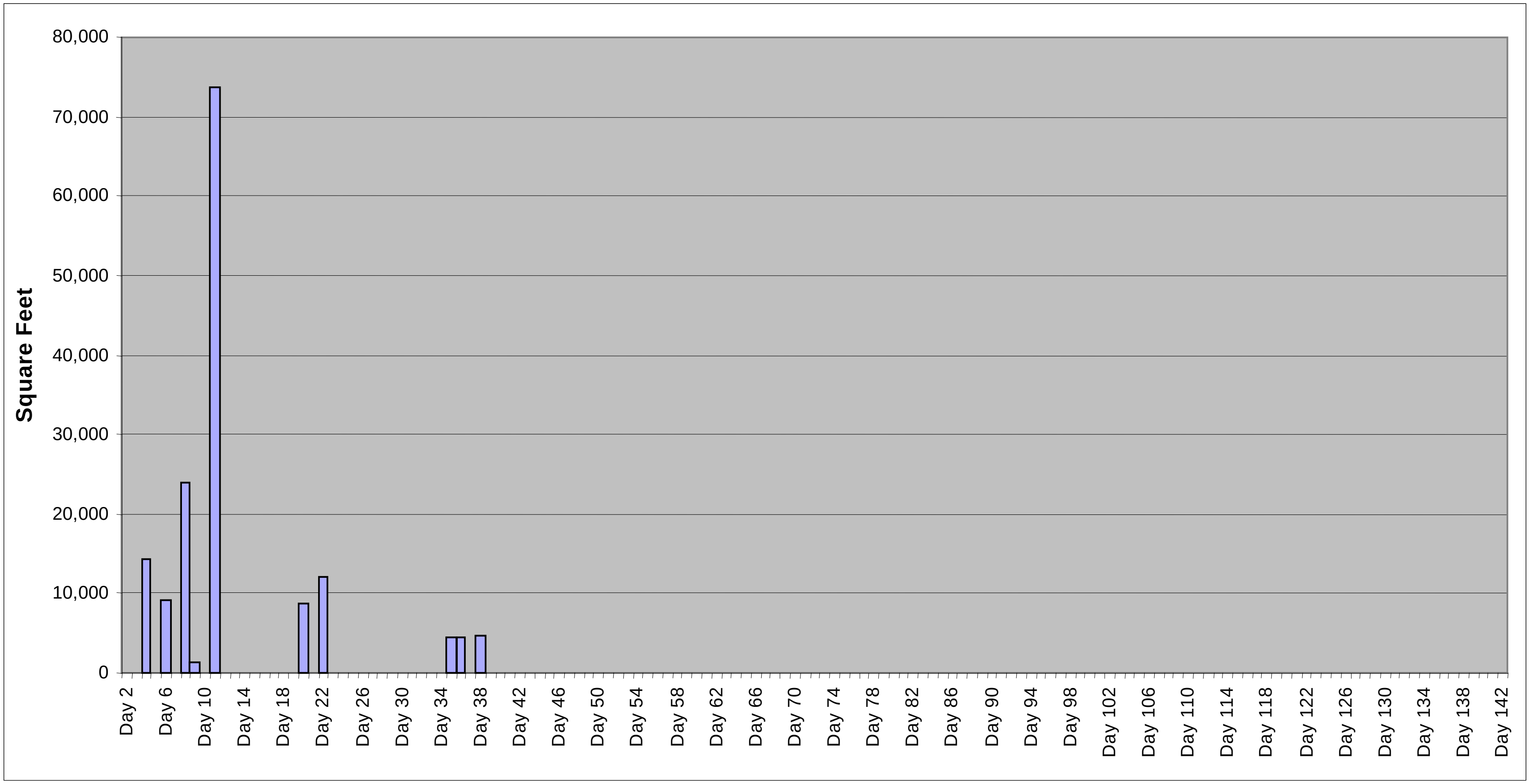


Figure A-15. Square Feet of Wheeled Vehicles Convoying to the Port of Long Beach

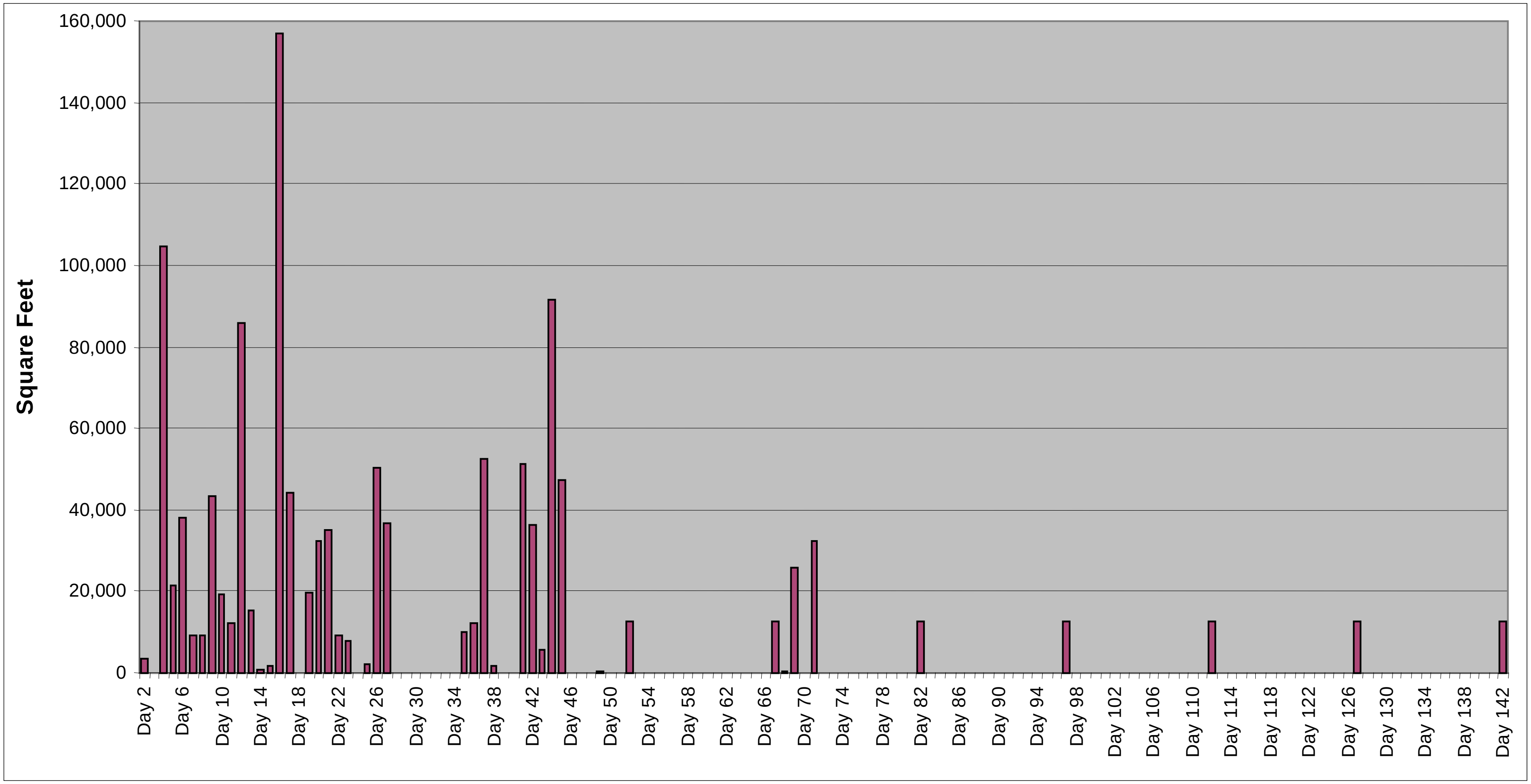


Figure A-16. Square Feet of Cargo Arriving by Rail to the Port of Long Beach

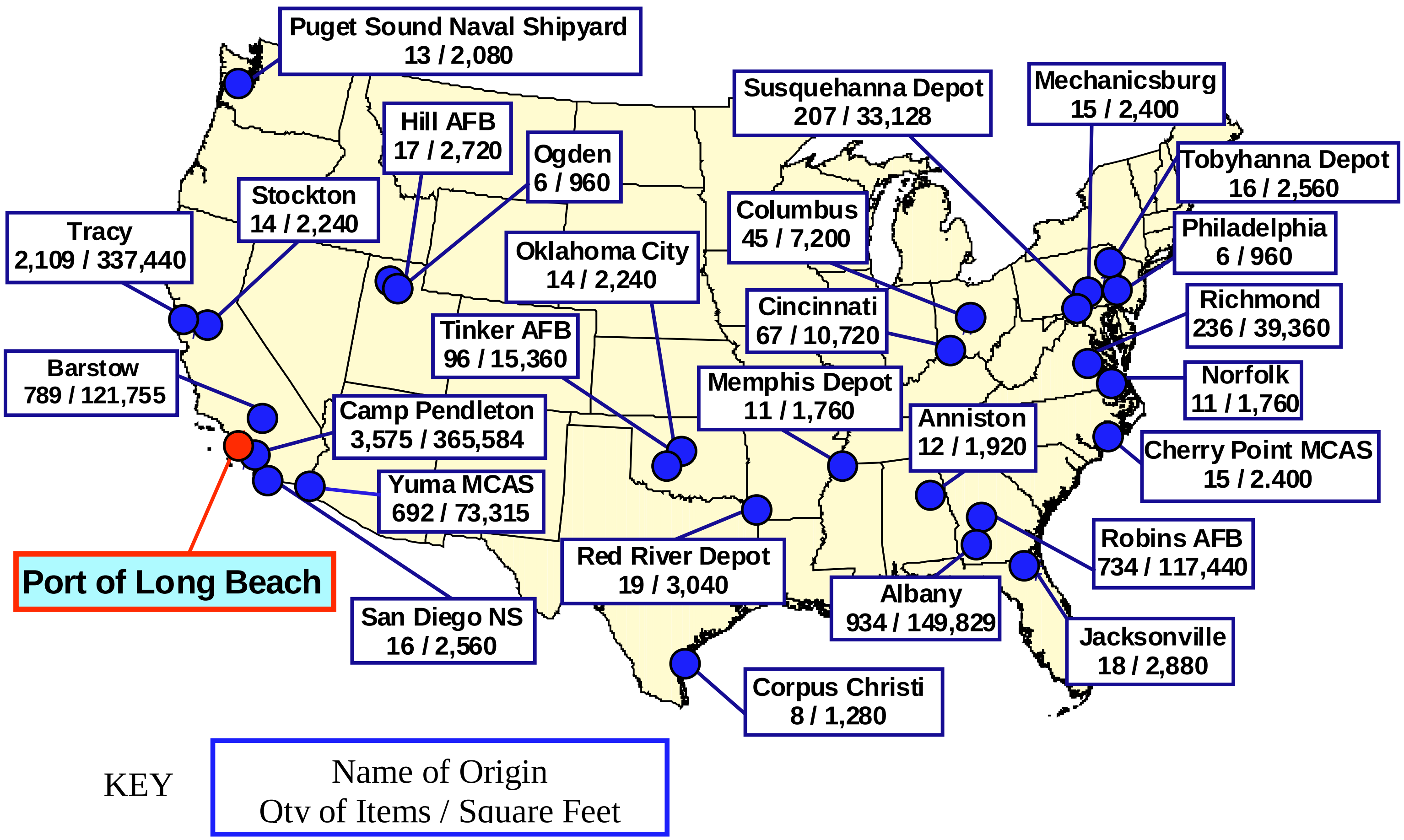


Figure A-17. Amount of Cargo Arriving at the Port of Long Beach by Origin

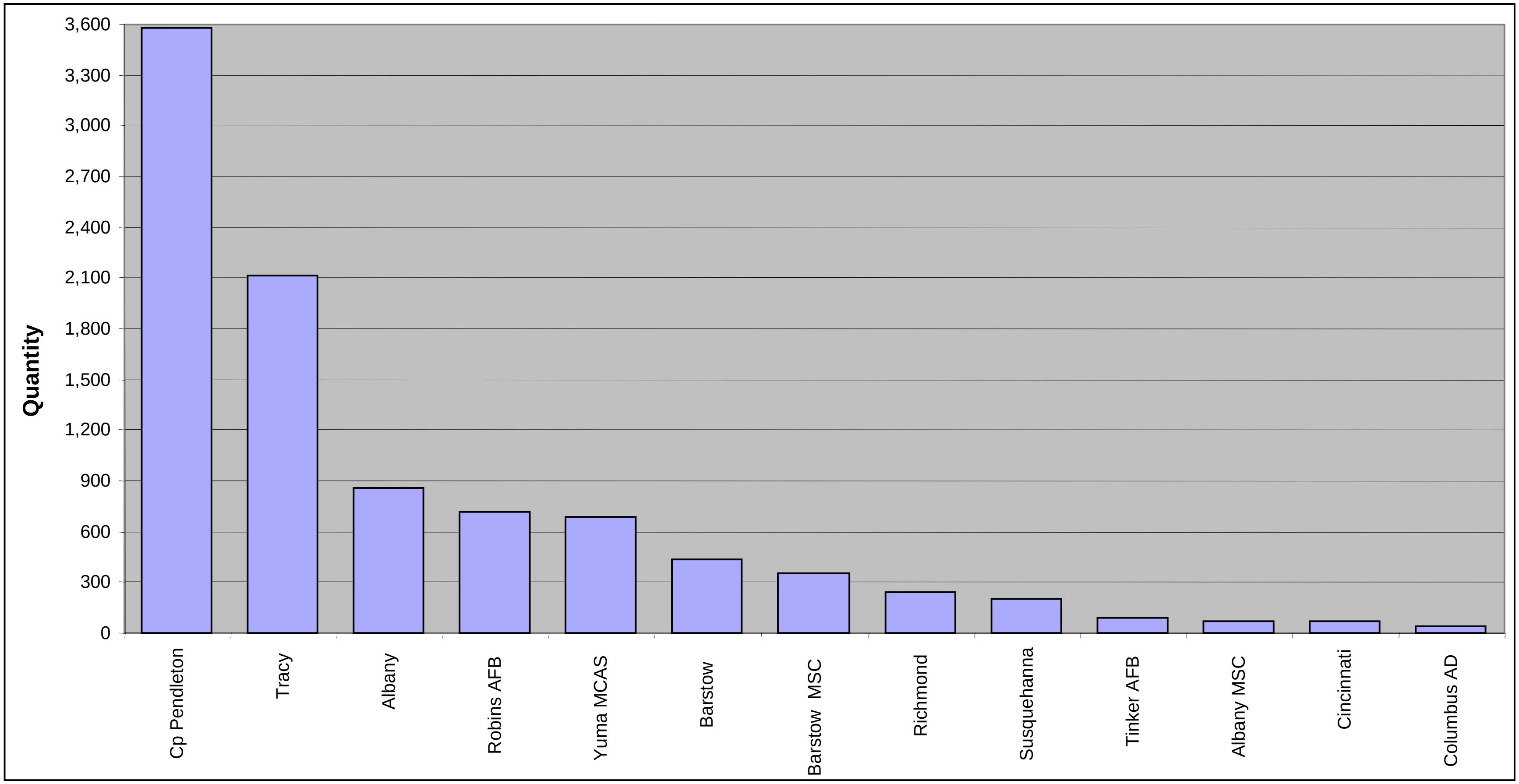


Figure A-18. Quantity of Items Arriving at the Port of Long Beach by Origin

Table A-1
Quantity of Items Arriving at the Port of Long Beach by Origin
(origins not in graph)

Quantity	Origin	State
19	Red River Depot	Texas
18	Jacksonville	Florida
17	Hill Air Force Base	Utah
16	San Diego NSC	California
16	Tobyhanna Depot	Pennsylvania
15	MCAS Cherry Point	North Carolina
15	Mechanicsburg	Illinois
14	Oklahoma City	Oklahoma
14	Stockton GSA	California
13	Puget Sound	Washington
13	Warner Robins	Georgia
12	Anniston	Alabama
11	Memphis Depot	Tennessee
11	Norfolk GSA	Virginia
8	Corpus Christi	Texas
8	Richmond Def Sup	Virginia
6	Columbus	Ohio
6	Ogden	Utah
6	Philadelphia DPSC	Pennsylvania

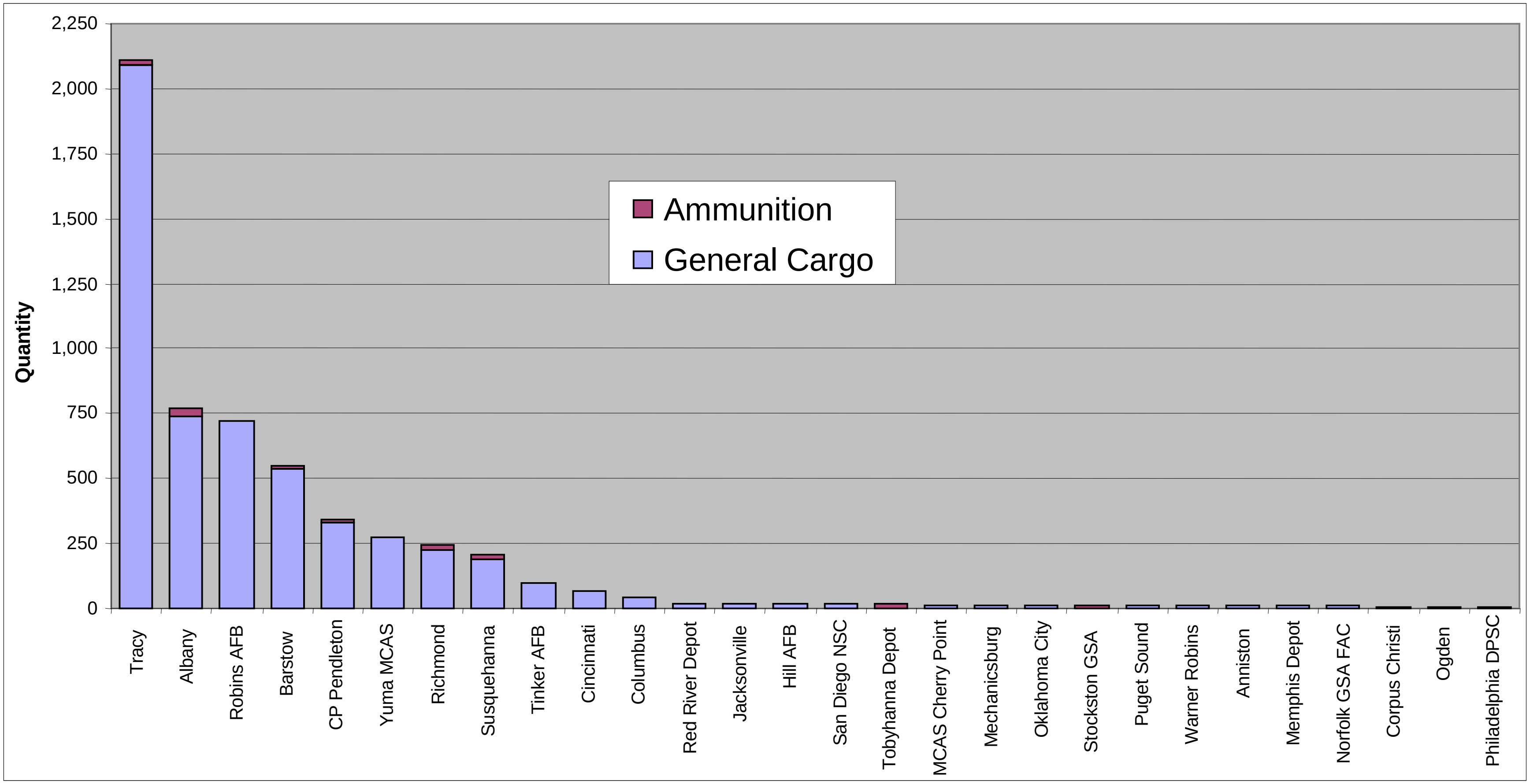


Figure A-19. Quantity of Containers Arriving at the Port of Long Beach by Origin

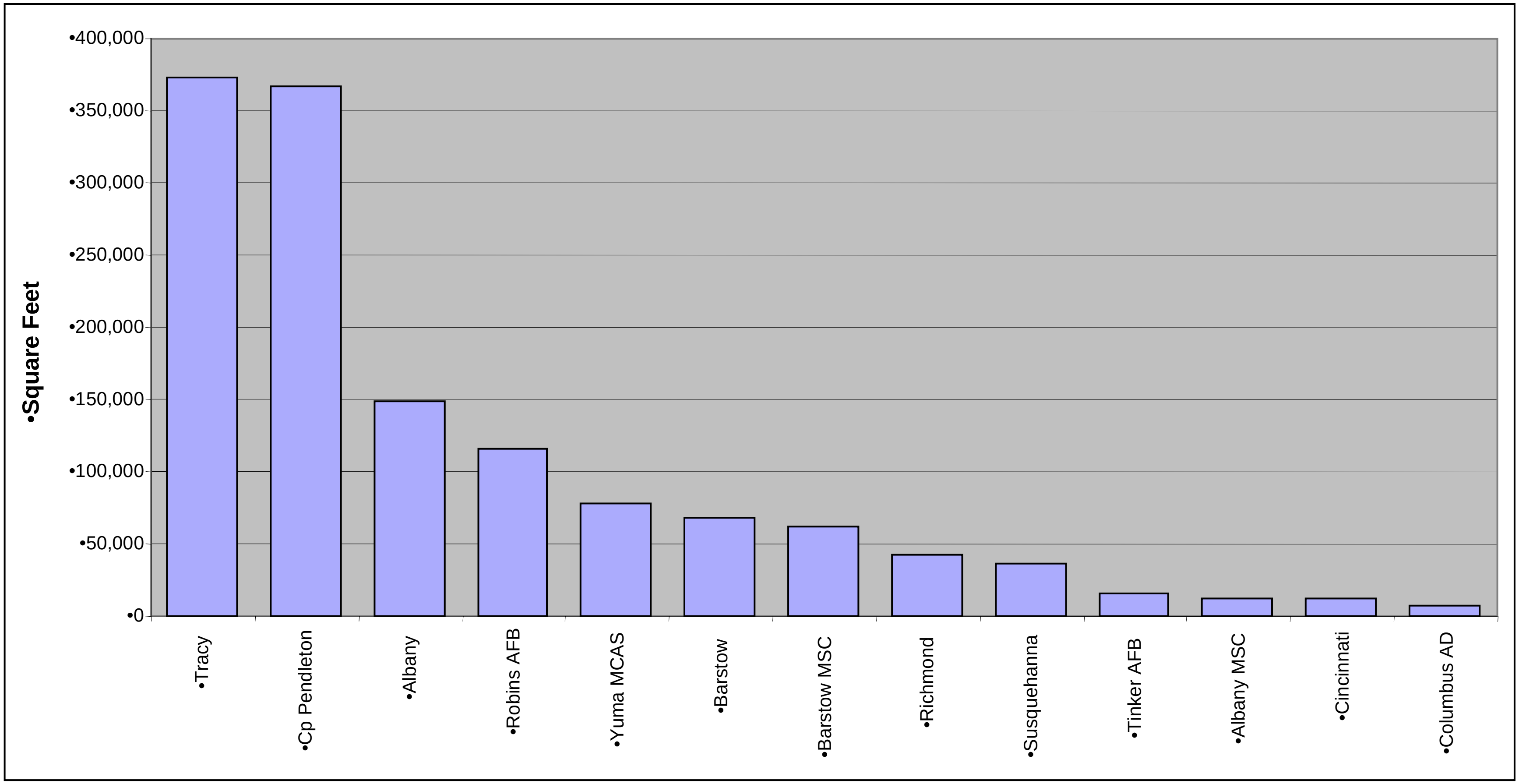


Figure A-20. Square Feet of Cargo Arriving at the Port of Long Beach by Origin

Table A-2
Square Feet of Cargo Arriving at the Port of Long Beach by Origin
(origins not in graph)

Square Feet	Origin	State
3,363	Red River Depot	Texas
3,188	Jacksonville	Florida
3,011	Hill Air Force Base	Utah
2,834	San Diego NSC	California
2,833	Tobyhanna Depot	Pennsylvania
2,656	MCAS Cherry Point	North Carolina
2,656	Mechanicsburg	Illinois
2,479	Oklahoma City	Oklahoma
2,479	Stockton GSA	California
2,302	Puget Sound	Washington
2,302	Warner Robins	Georgia
2,125	Anniston	Alabama
1,948	Memphis Depot	Tennessee
1,948	Norfolk GSA	Virginia
1,417	Corpus Christi	Texas
1,417	Richmond Def Sup	Virginia
1,063	Ogden	Utah
1,063	Columbus	Ohio
1,063	Philadelphia DPSC	Pennsylvania

APPENDIX B

PORT OF OAKLAND

The graphs below represent the cargo scheduled to arrive at the Port of Oakland as outlined in the TPFDD. Cargo is scheduled to arrive at the port starting on day 2 and continuing through day 147.

The Port of Oakland is scheduled to receive unit equipment and sustainment cargo from approximately 60 origins. A map of the origin locations is provided in Figure B-1. The quantity of railcars arriving at the Port of Oakland is provided in Figure B-2. Figures B-3 through B-9 show the quantity of items by category arriving at the port. Figures B-10 through B-16 show the same information in terms of square footage.

Figure B-6 provides the quantity of floating craft scheduled to arrive at the Port of Oakland. The large spike of 69 floating craft on C+9 is Navy floating craft arriving from Coronado, California. There are 48 causeway sections, 12 landing craft, mechanized (LCM6), and 9 warping tugs. Since Coronado is located on the West Coast, some of these floating craft may self deploy to the Port of Oakland.

Figures B-17 through B-20 provide a breakdown of the quantity of items arriving at the port according to the mode of transportation (convoy, rail, and self-deployed aircraft). Similarly, Figures B-21 through B-24 reflect the same information presented in terms of square footage.

Figure B-25 shows the amount of cargo in terms of quantity and square feet for each origin scheduled in the TPFDD. The bar graph in Figure B-26 provides the total quantity of items for each origin and includes origins with a total of 200 or more items. The remaining origins not included in the graph are listed in Table B-1. Port Angeles has a requirement for one 110-foot WPB Patrol Cutter as shown in Figure B-25 and will most likely self-deploy to the port.

The quantity of 20-foot containers arriving at the port from each origin is provided in Figure B-27. The largest container requirement will be arriving at the port from Tracy, California. The graph includes those origins with more than 10 containers. The remaining origins with 10 containers or less are listed in Table B-2. Figure B-28 provides the number of 40-foot containers by origin with the largest number of 40-foot containers arriving from Sierra Depot, California.

Figure B-29 shows the square feet of cargo by origin. The graph reflects origins with a total of 30,000 square feet or more. The remaining origins not included in the graph are provided in Table B-3.

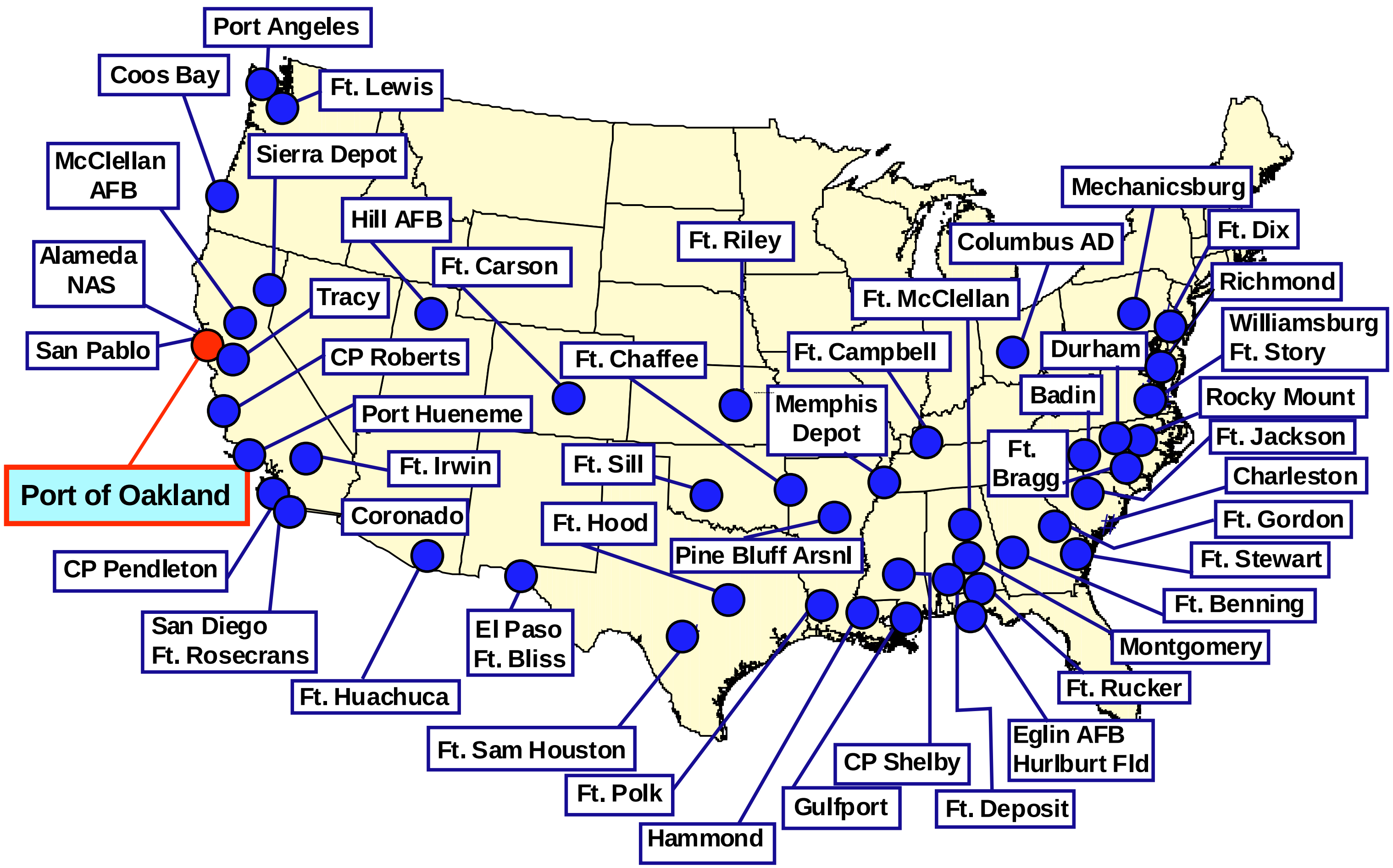


Figure B-1. Cargo Arrives at the Port of Oakland from Many Origins

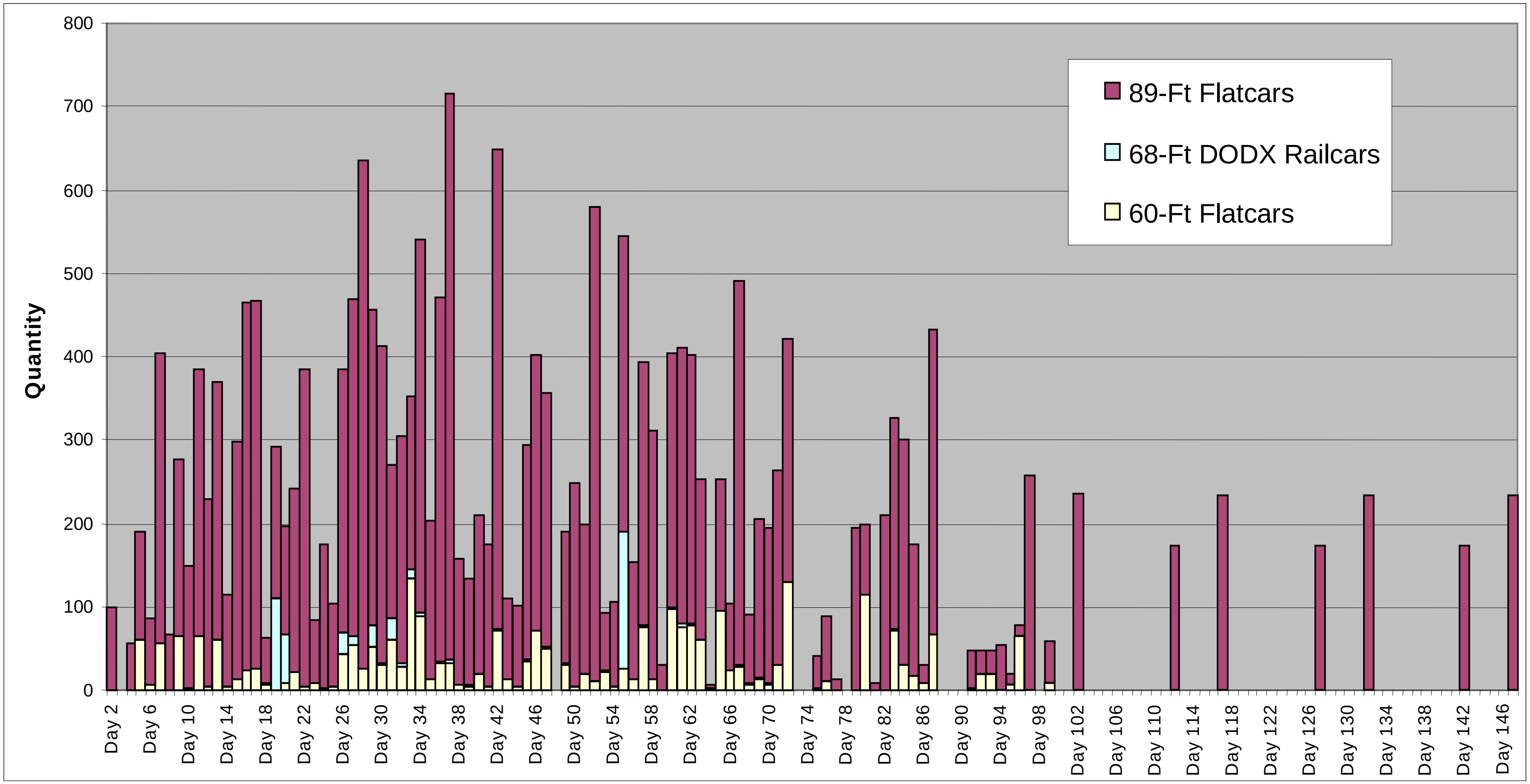


Figure B-2. Quantity of Railcars Arriving at the Port of Oakland

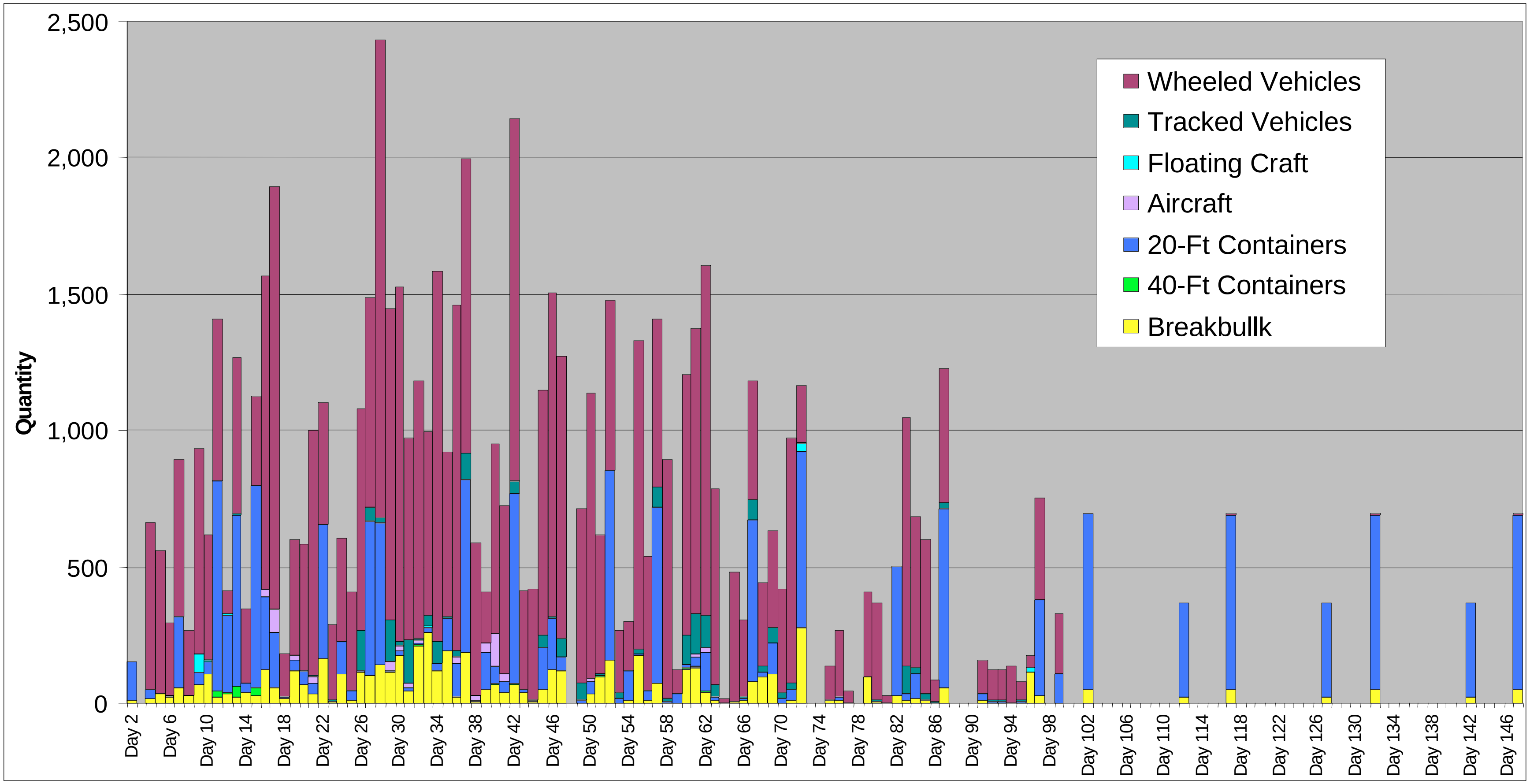


Figure B-3. Total Quantity of Items Arriving at the Port of Oakland

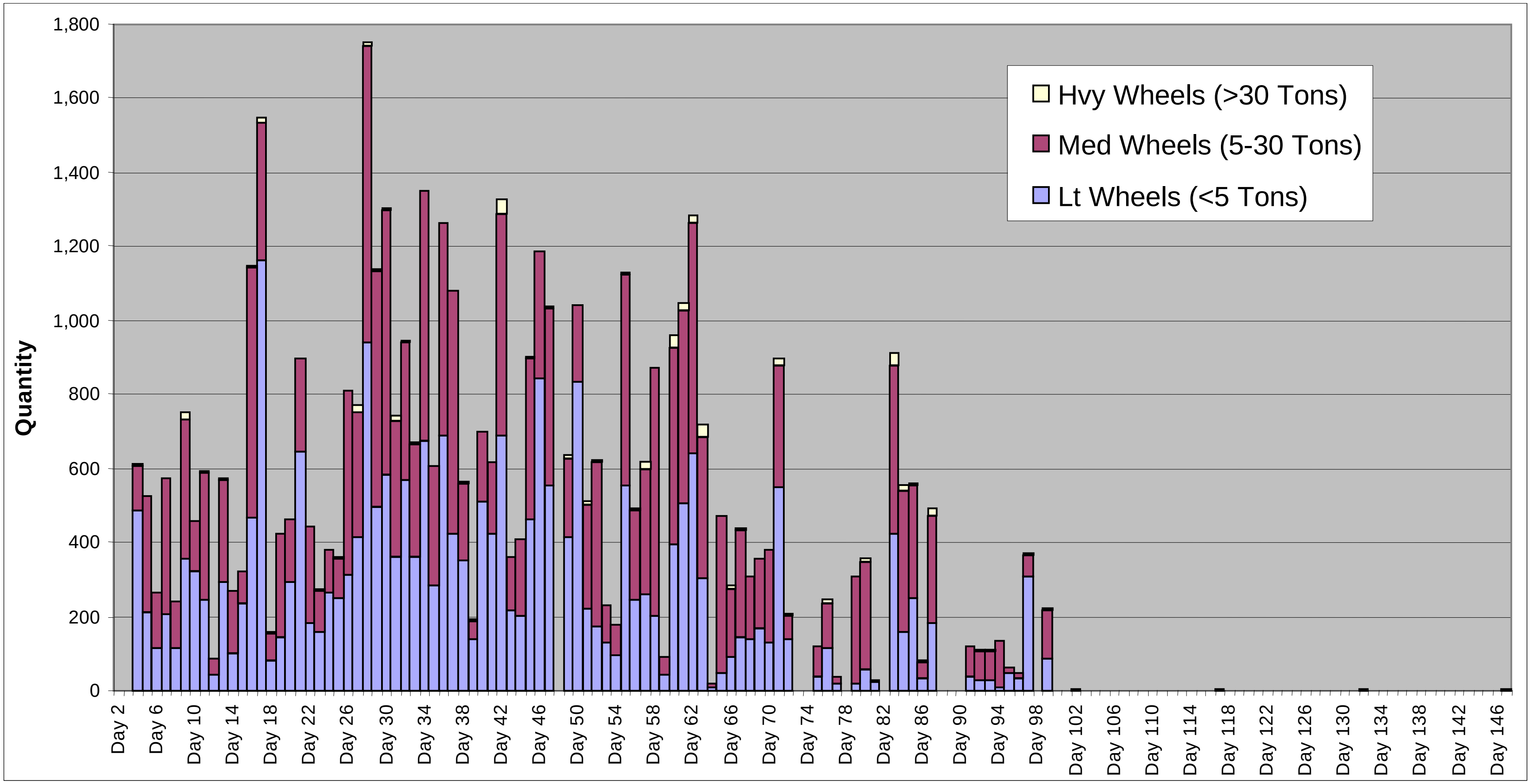


Figure B-4. Quantity of Wheeled Vehicles Arriving at the Port of Oakland

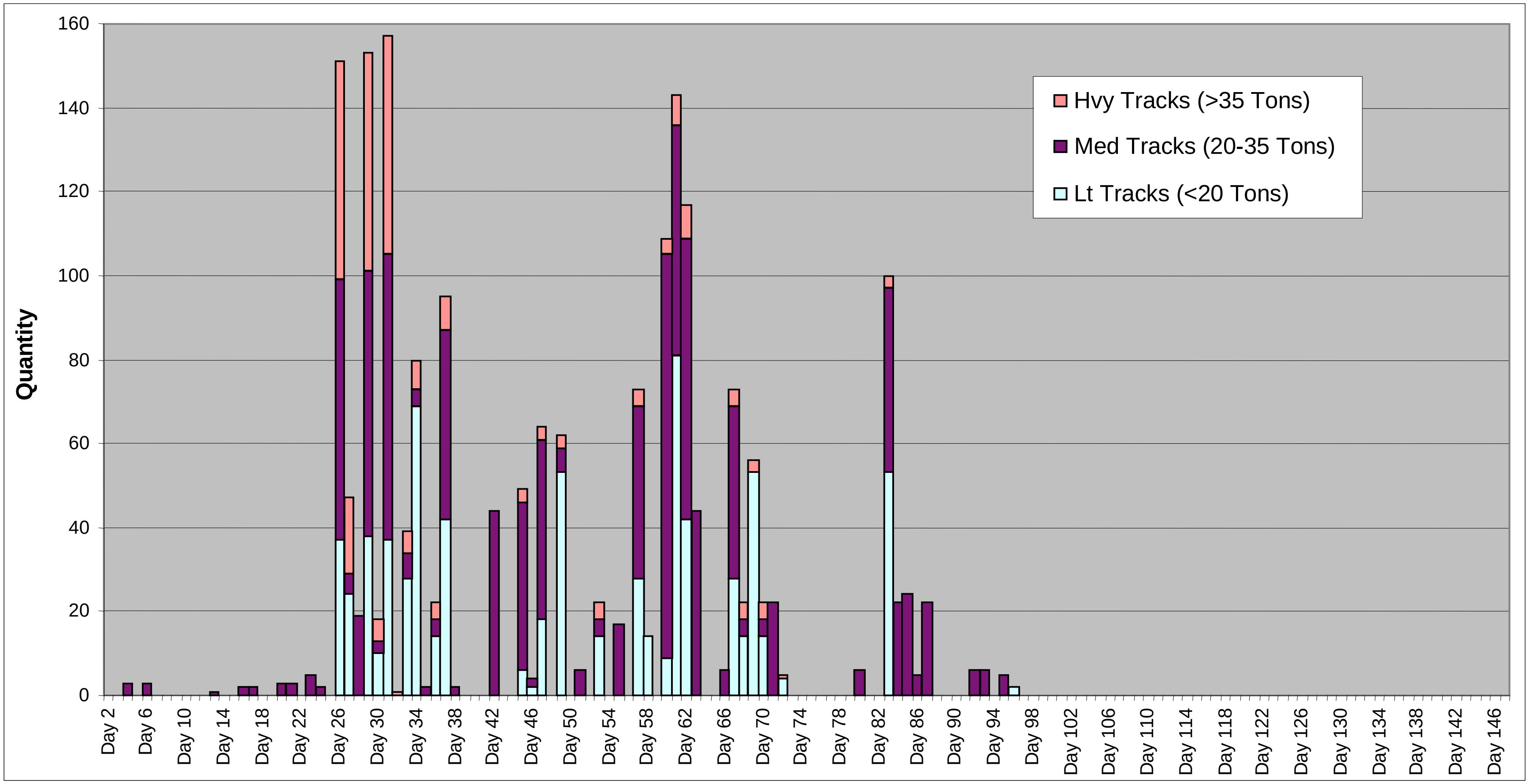


Figure B-5. Quantity of Tracked Vehicles Arriving at the Port of Oakland

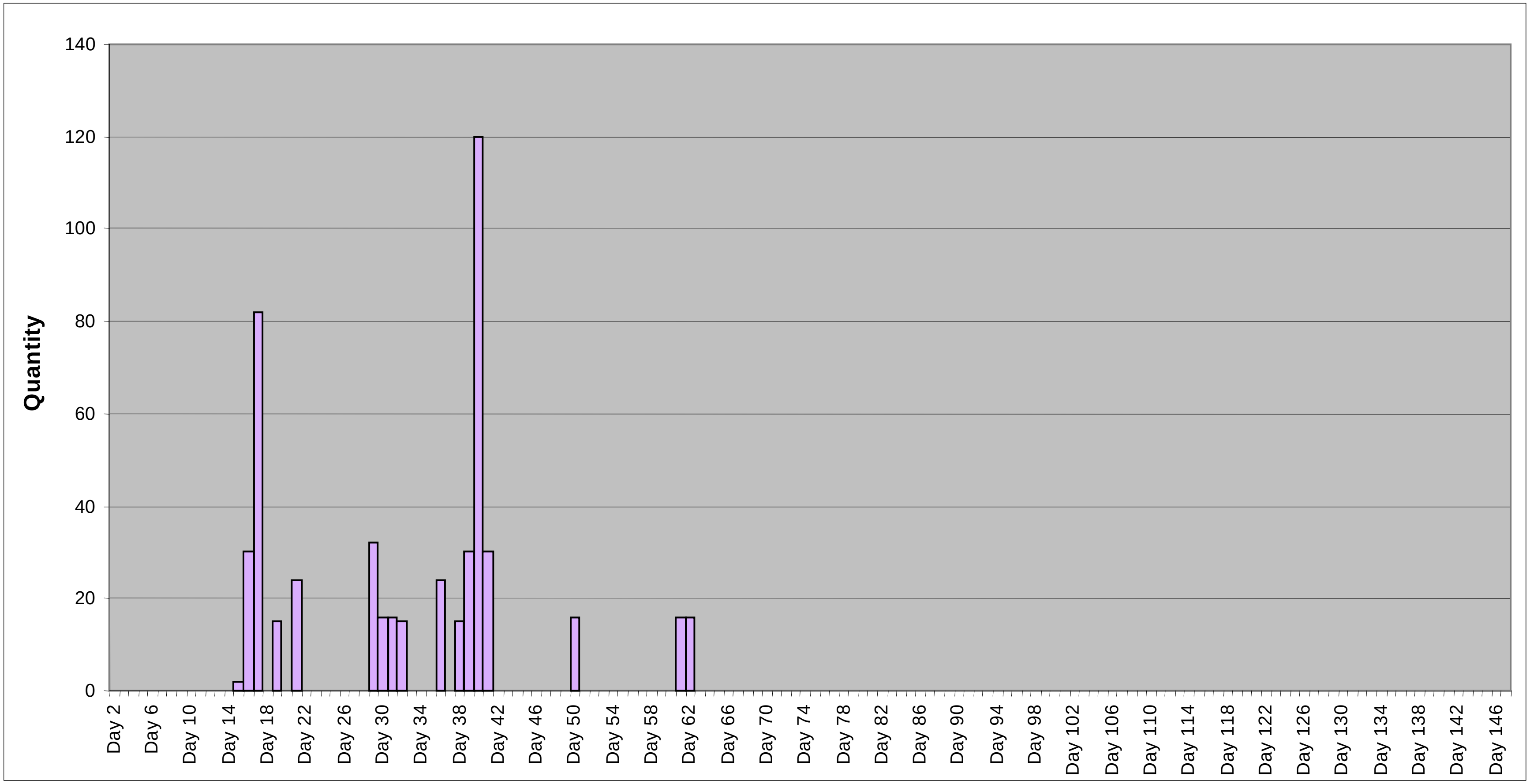


Figure B-6. Quantity of Aircraft Arriving at the Port of Oakland

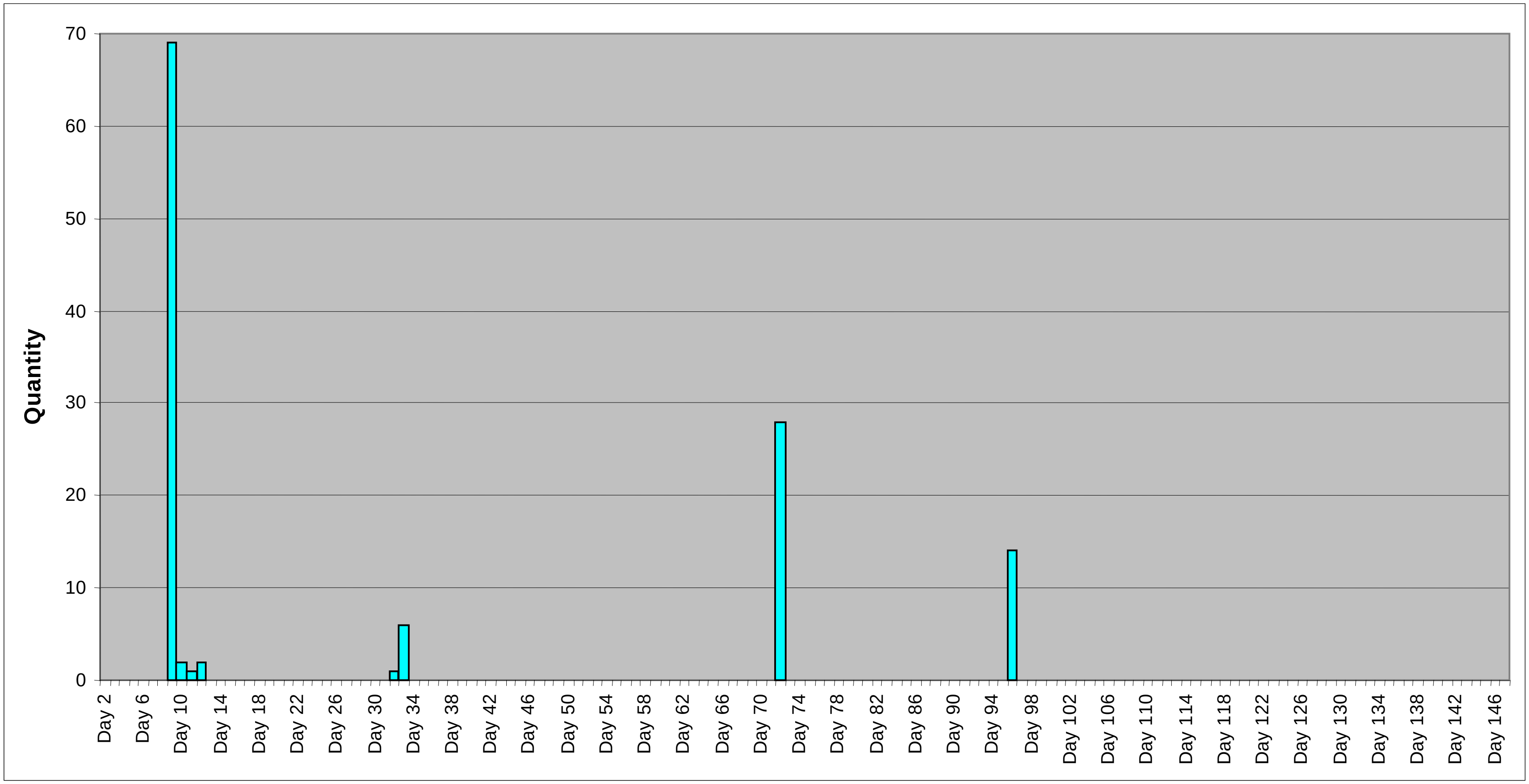


Figure B-7. Quantity of Floating Craft Arriving at the Port of Oakland

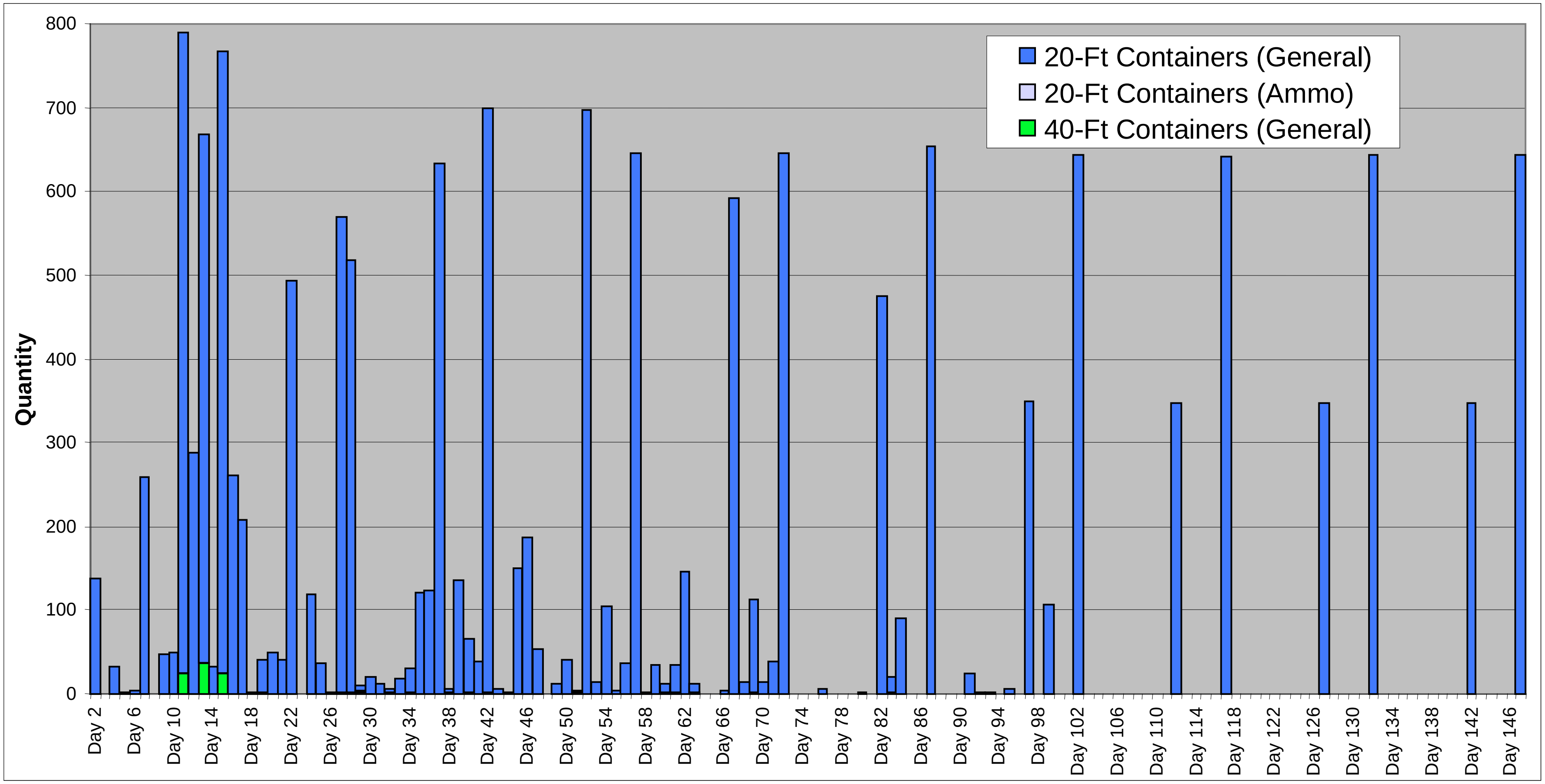


Figure B-8. Quantity of Containers Arriving at the Port of Oakland

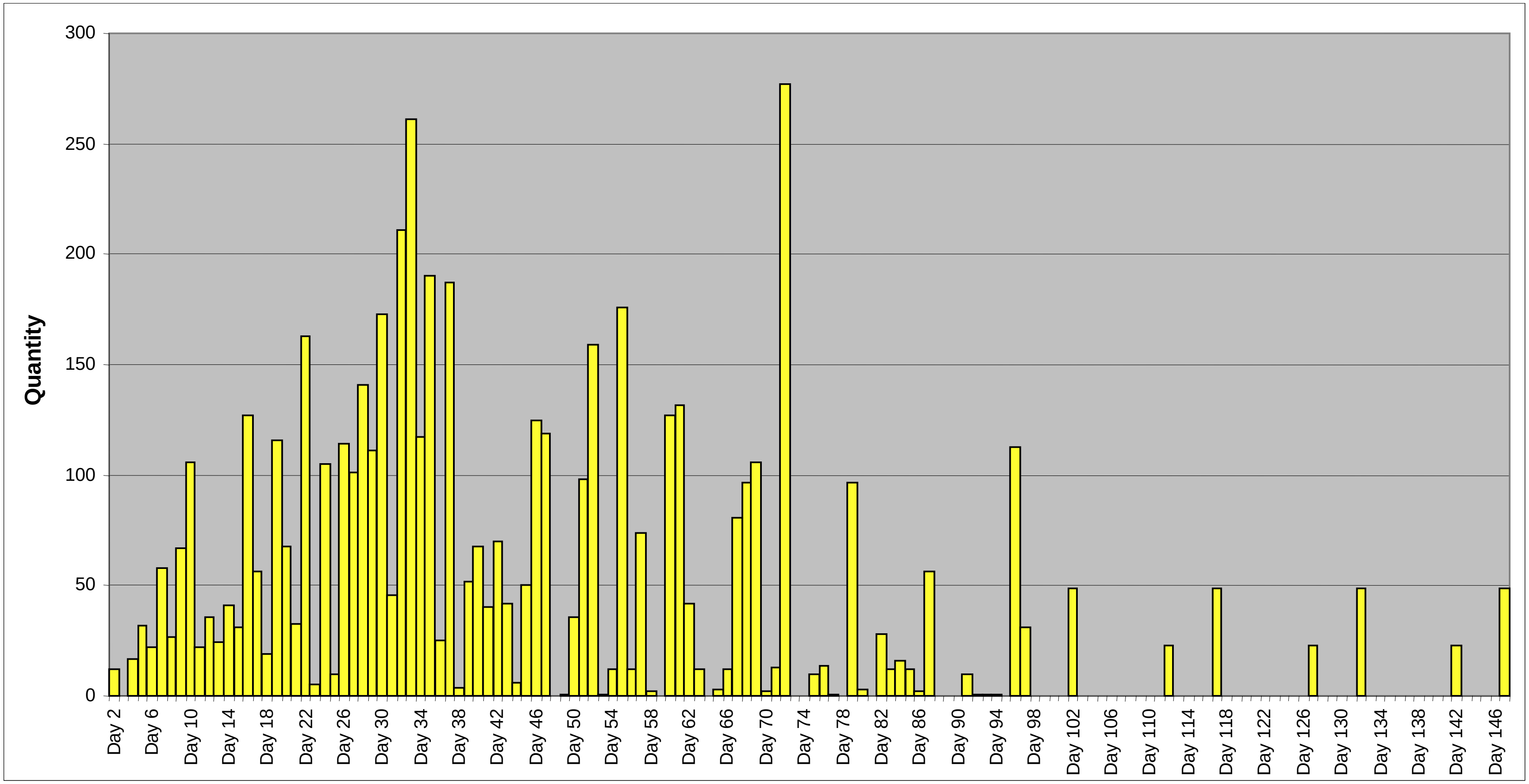


Figure B-9. Quantity of Breakbulk Items Arriving at the Port of Oakland

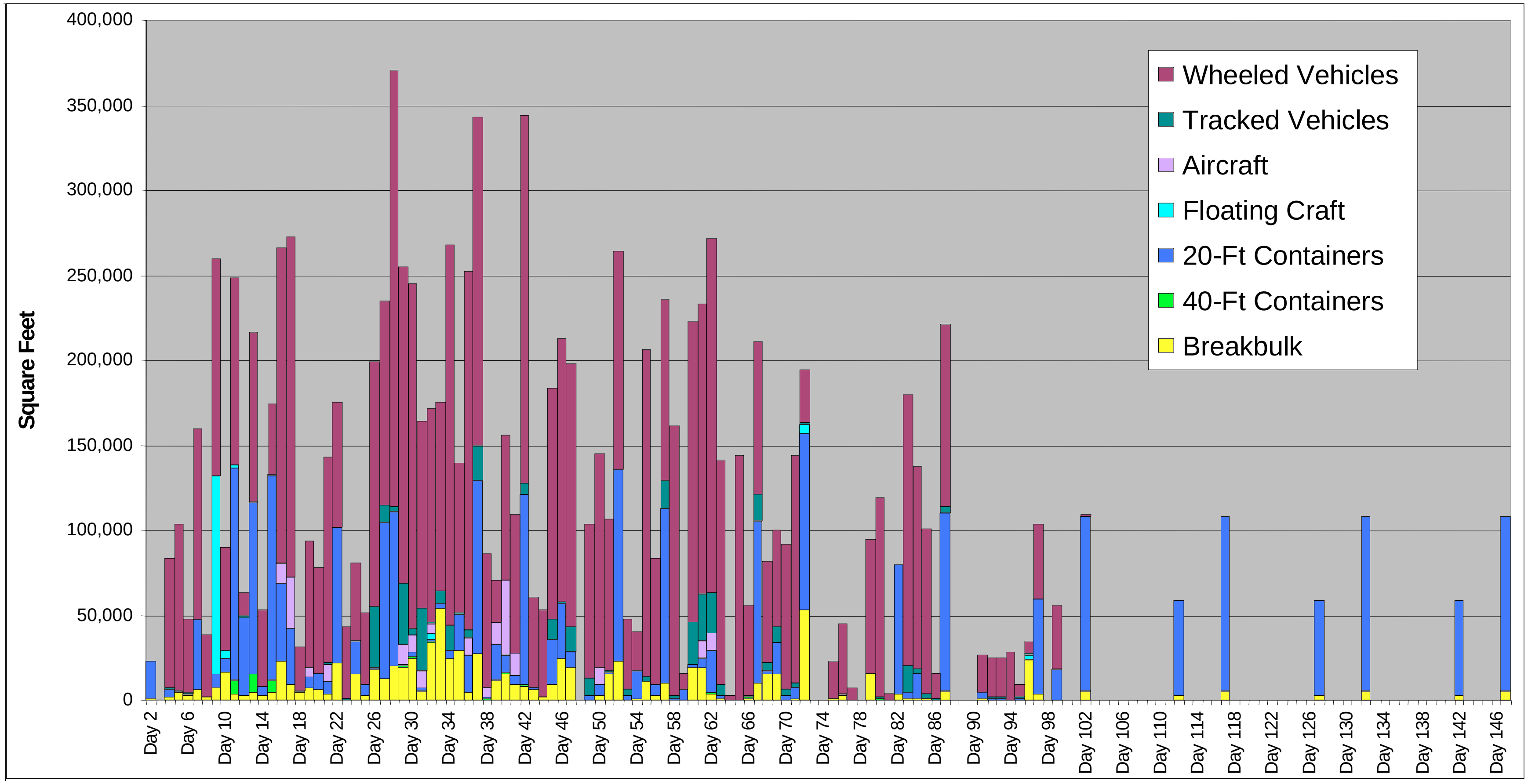


Figure B-10. Total Square Feet of Cargo Arriving at the Port of Oakland

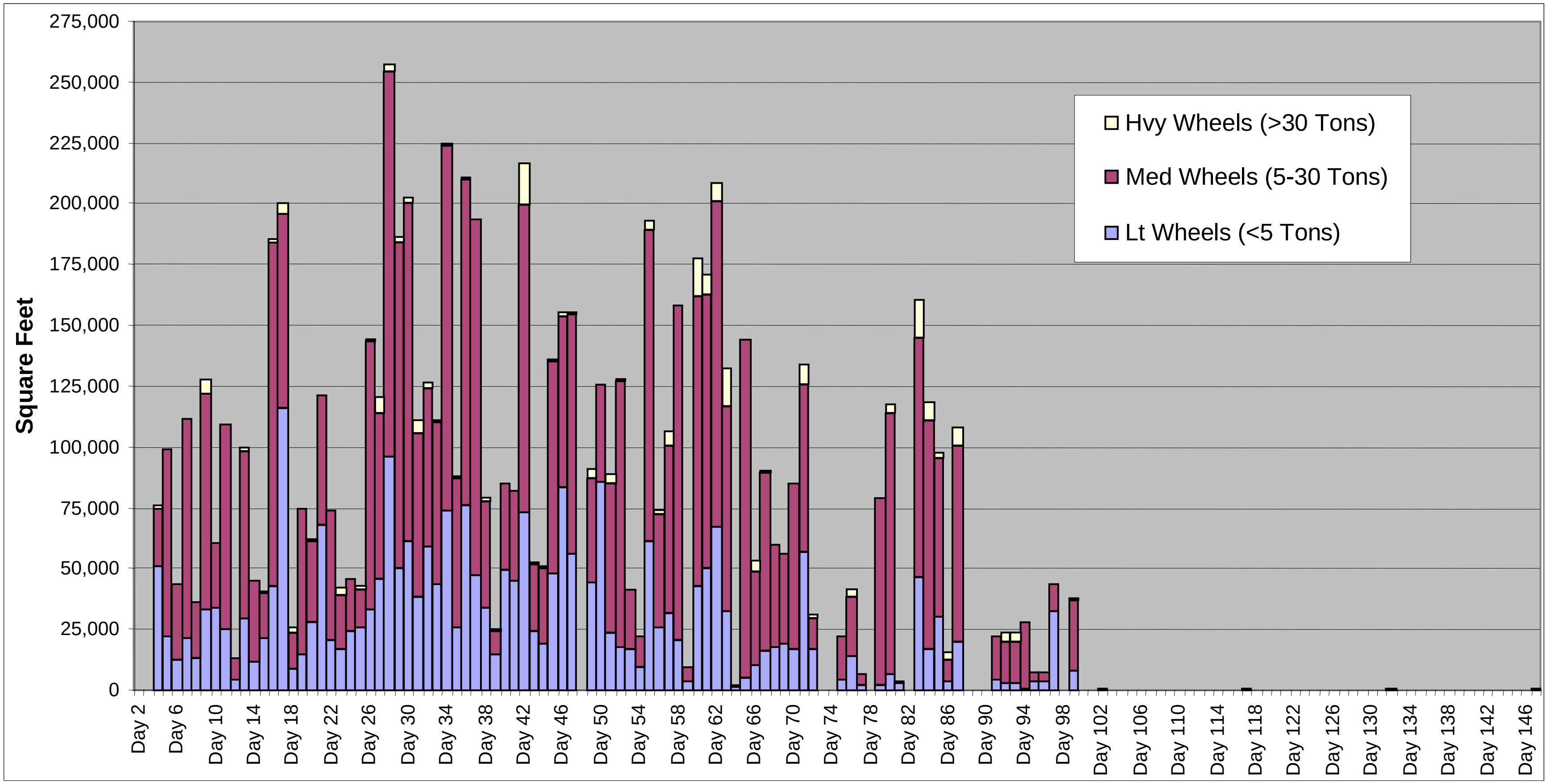


Figure B-11. Square Feet of Wheeled Vehicles Arriving at the Port of Oakland

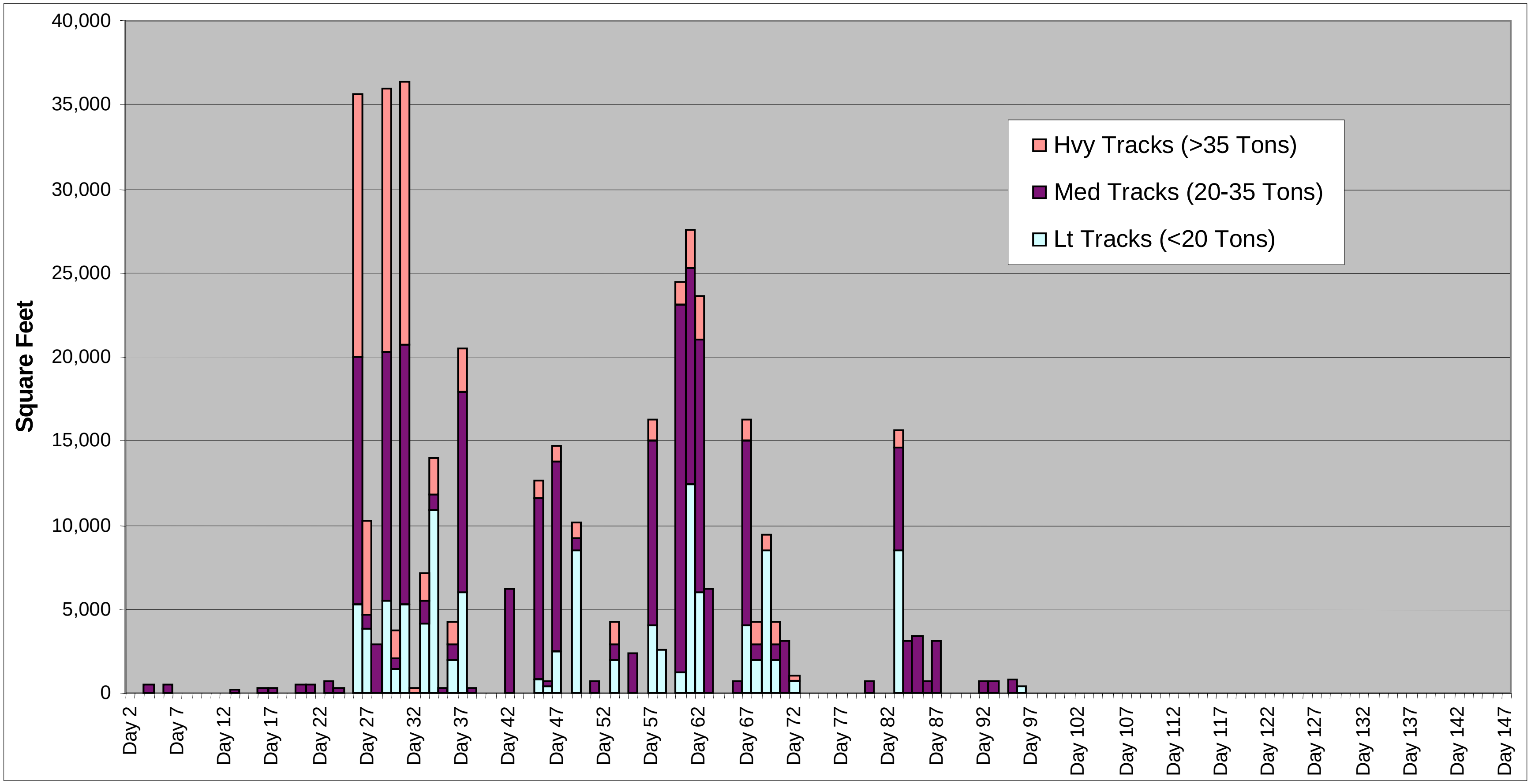


Figure B-12. Square Feet of Tracked Vehicles Arriving at the Port of Oakland

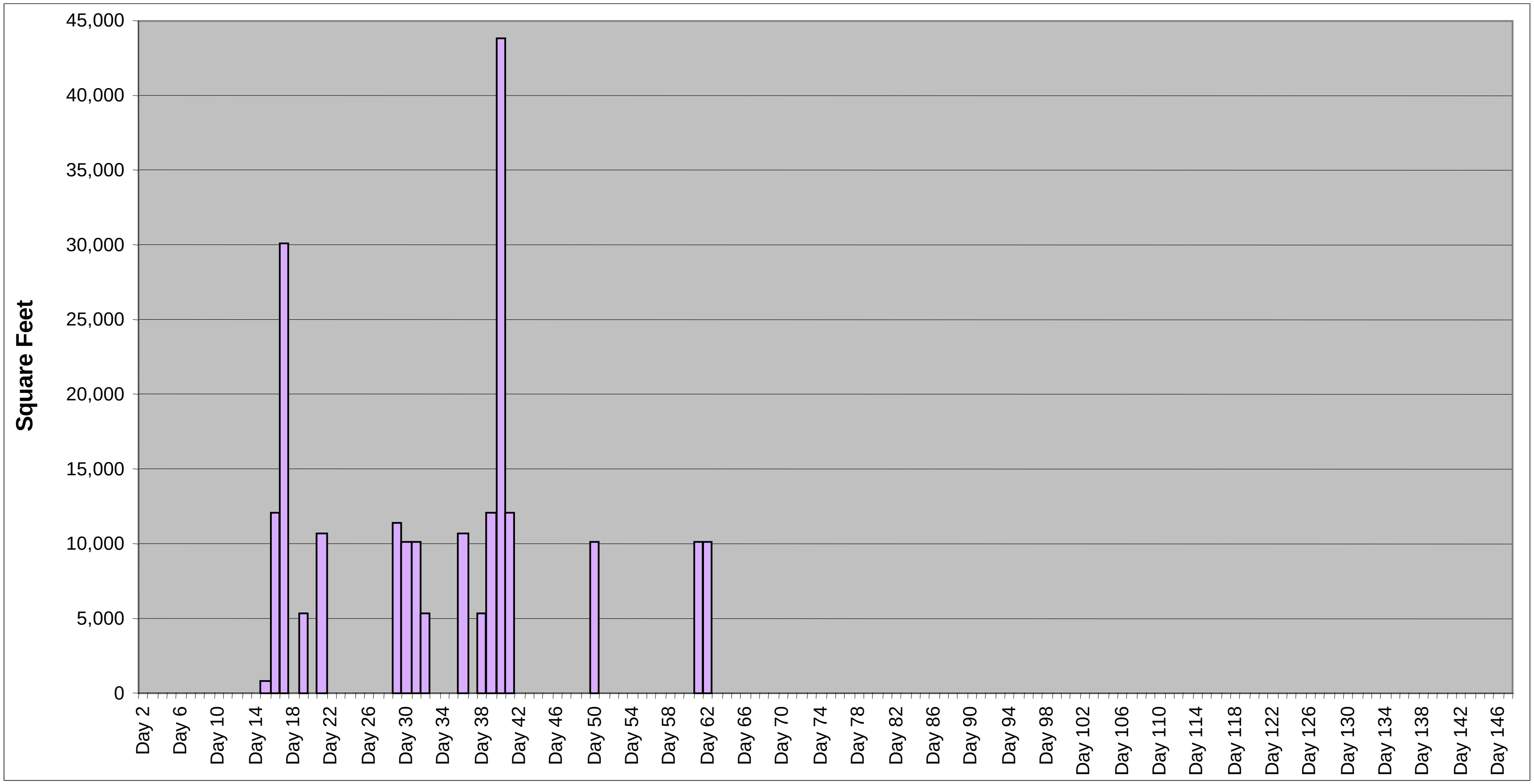


Figure B-13. Square Feet of Aircraft Arriving at the Port of Oakland

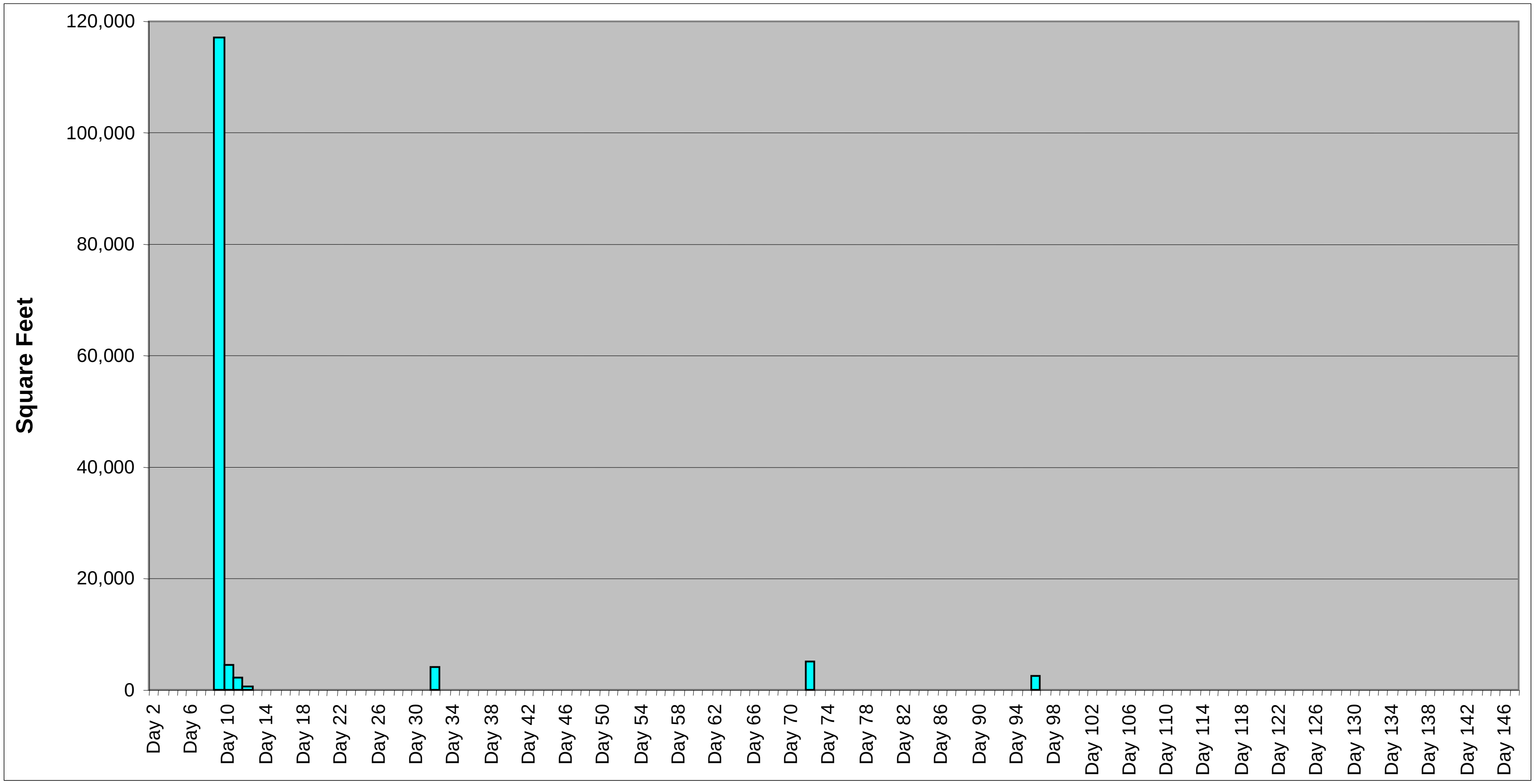


Figure B-14. Square Feet of Floating Craft Arriving at the Port of Oakland

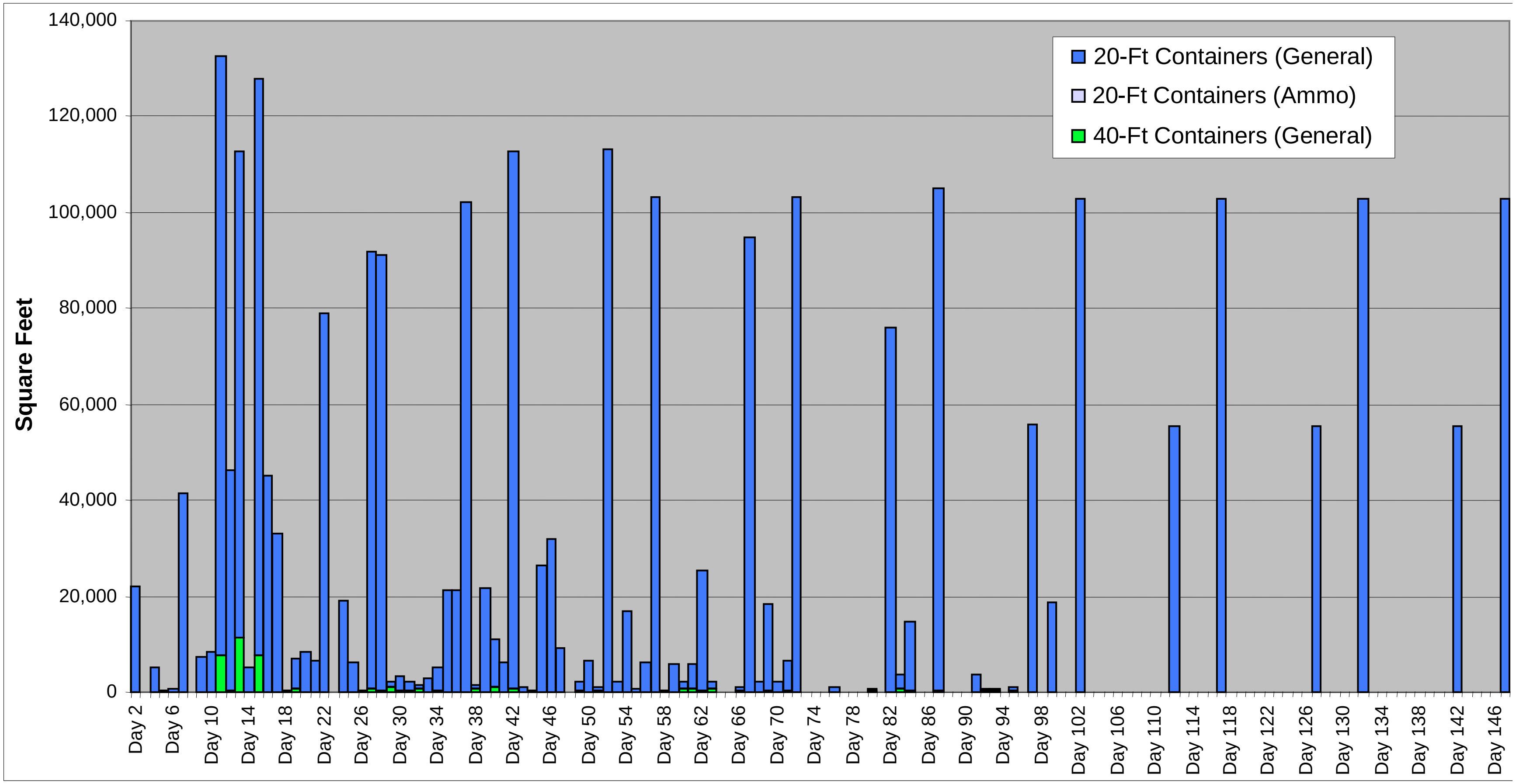


Figure B-15. Square Feet of Containers Arriving at the Port of Oakland

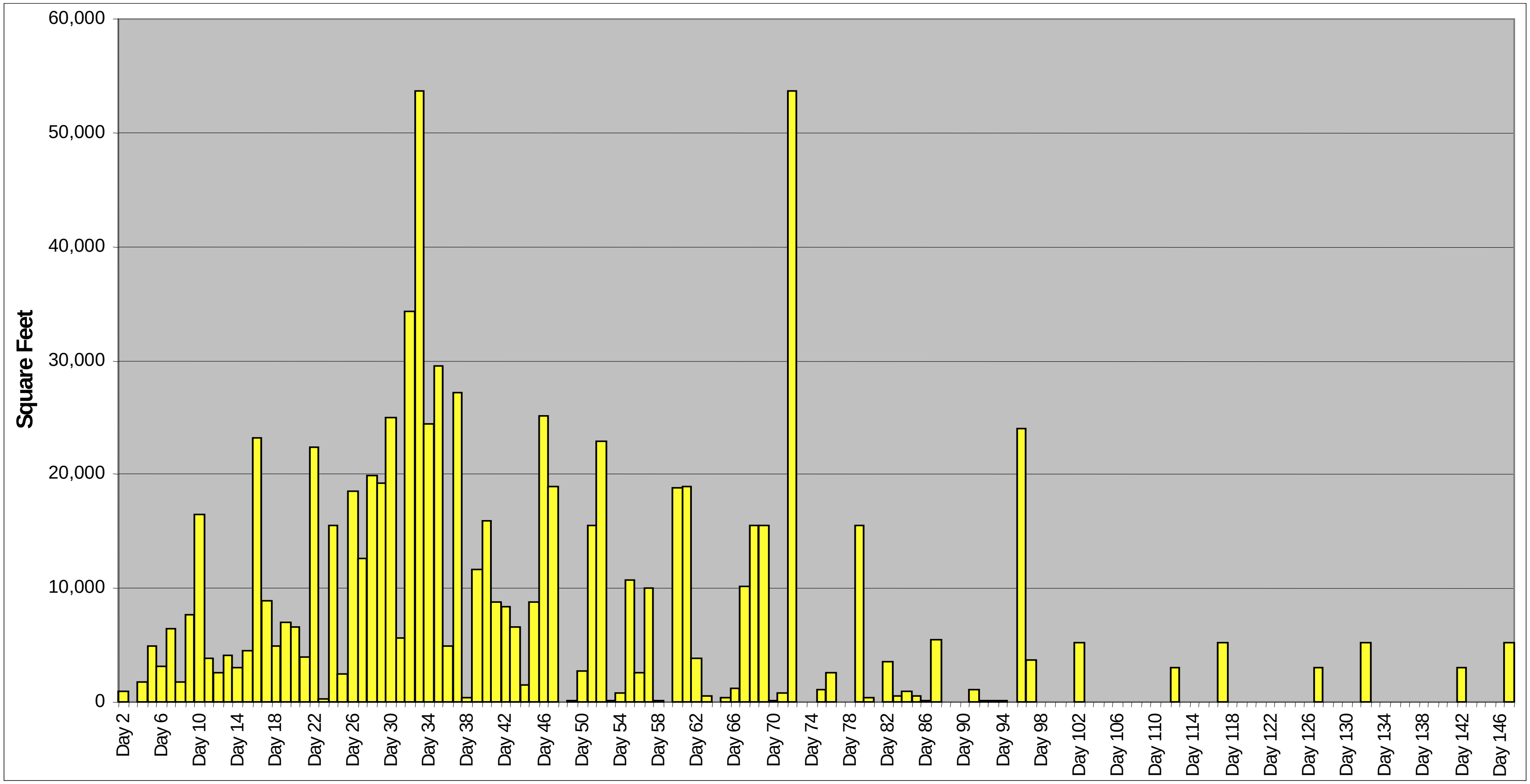


Figure B-16. Square Feet of Breakbulk Cargo Arriving at the Port of Oakland

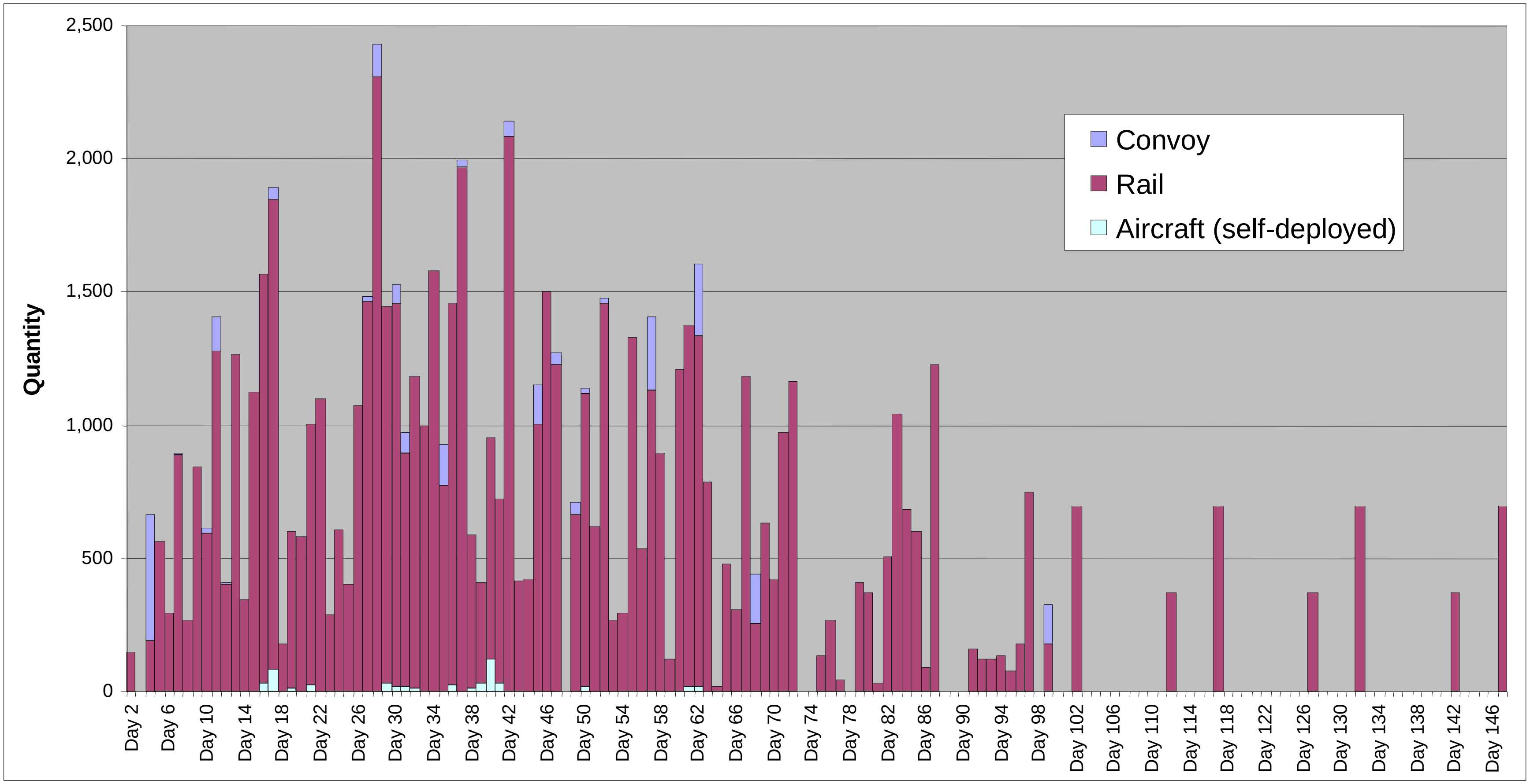


Figure B-17. Quantity of Items Arriving by Mode to the Port of Oakland

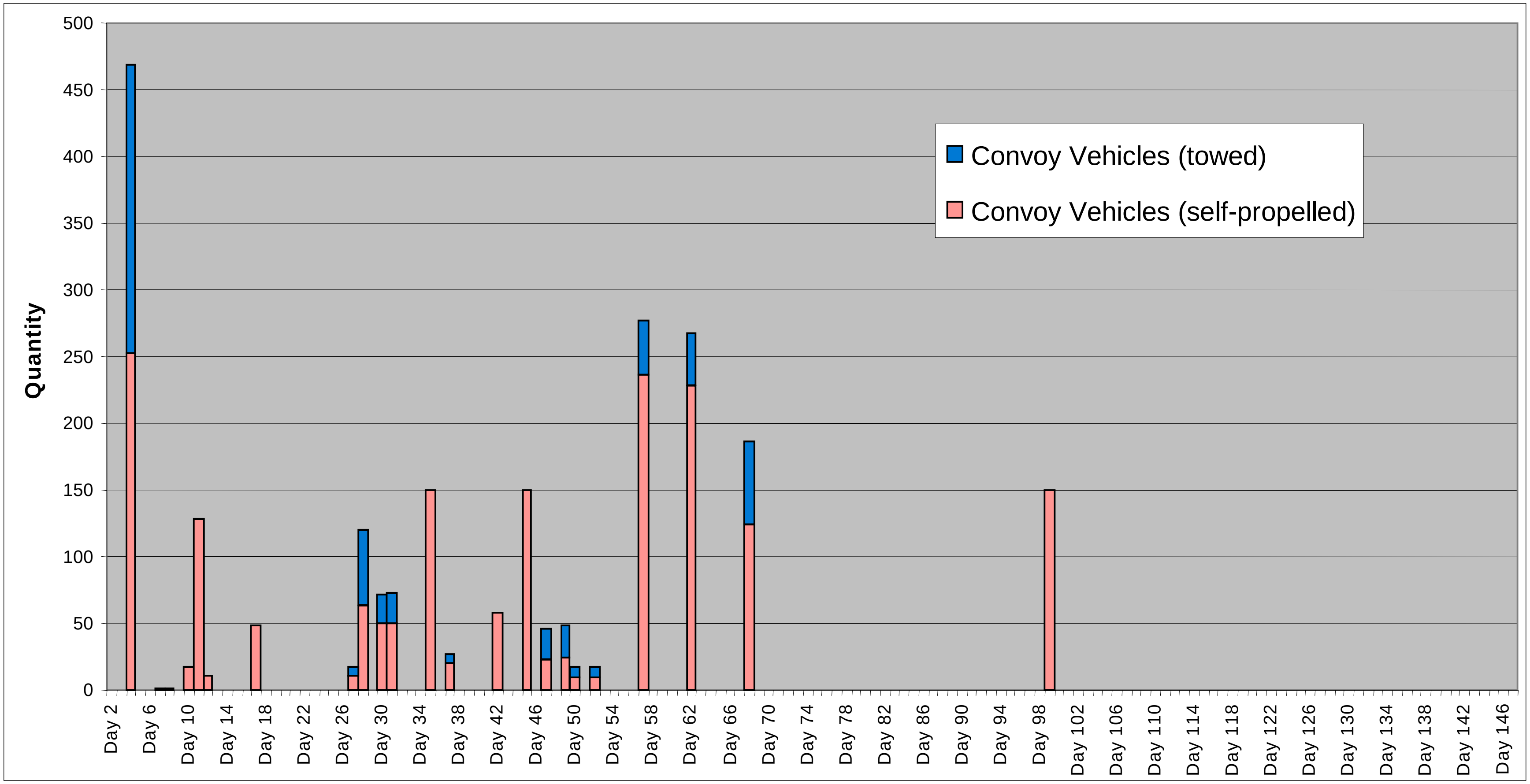


Figure B-18. Quantity of Wheeled Vehicles Convoying to the Port of Oakland

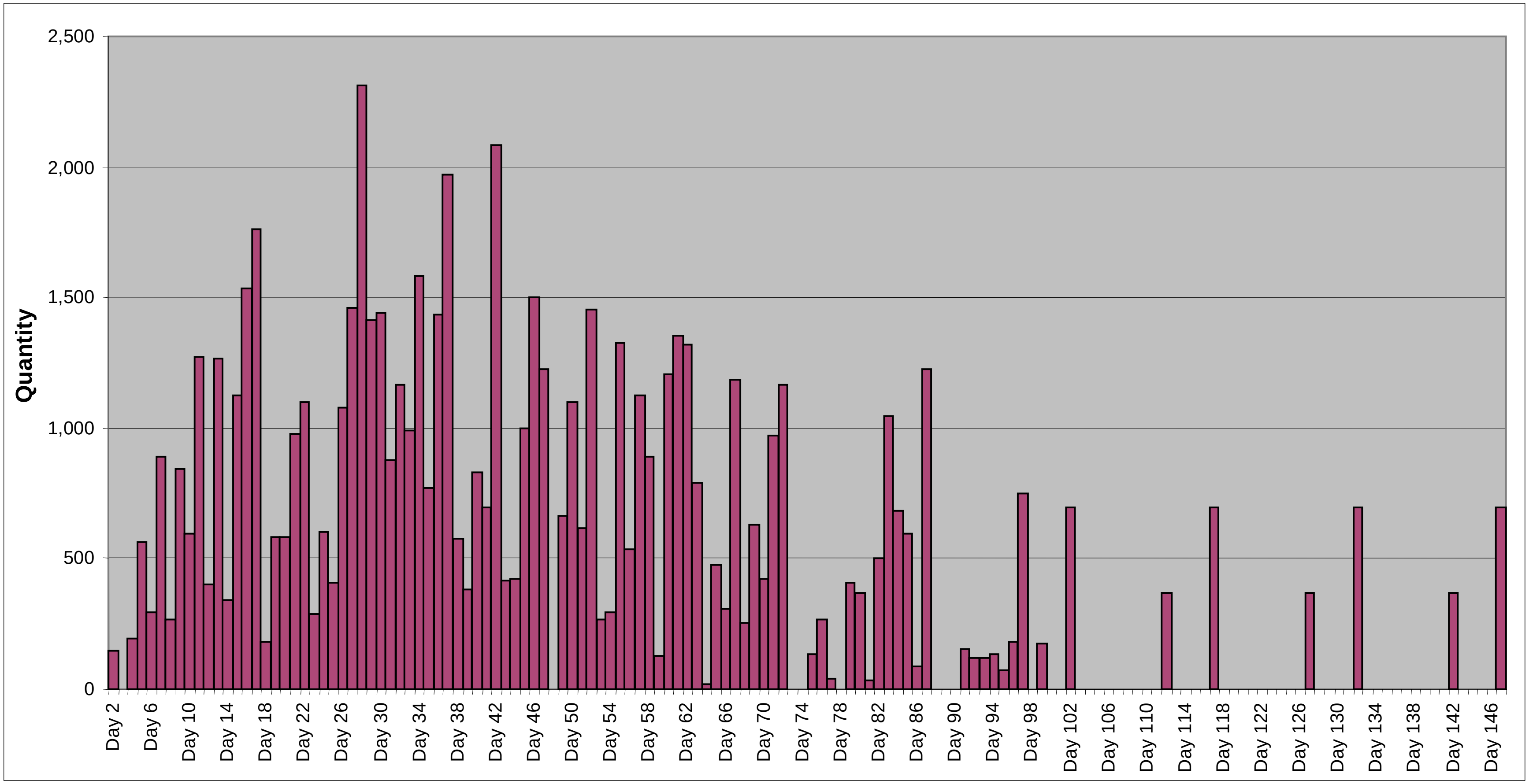


Figure B-19. Quantity of Items Arriving by Rail to the Port of Oakland

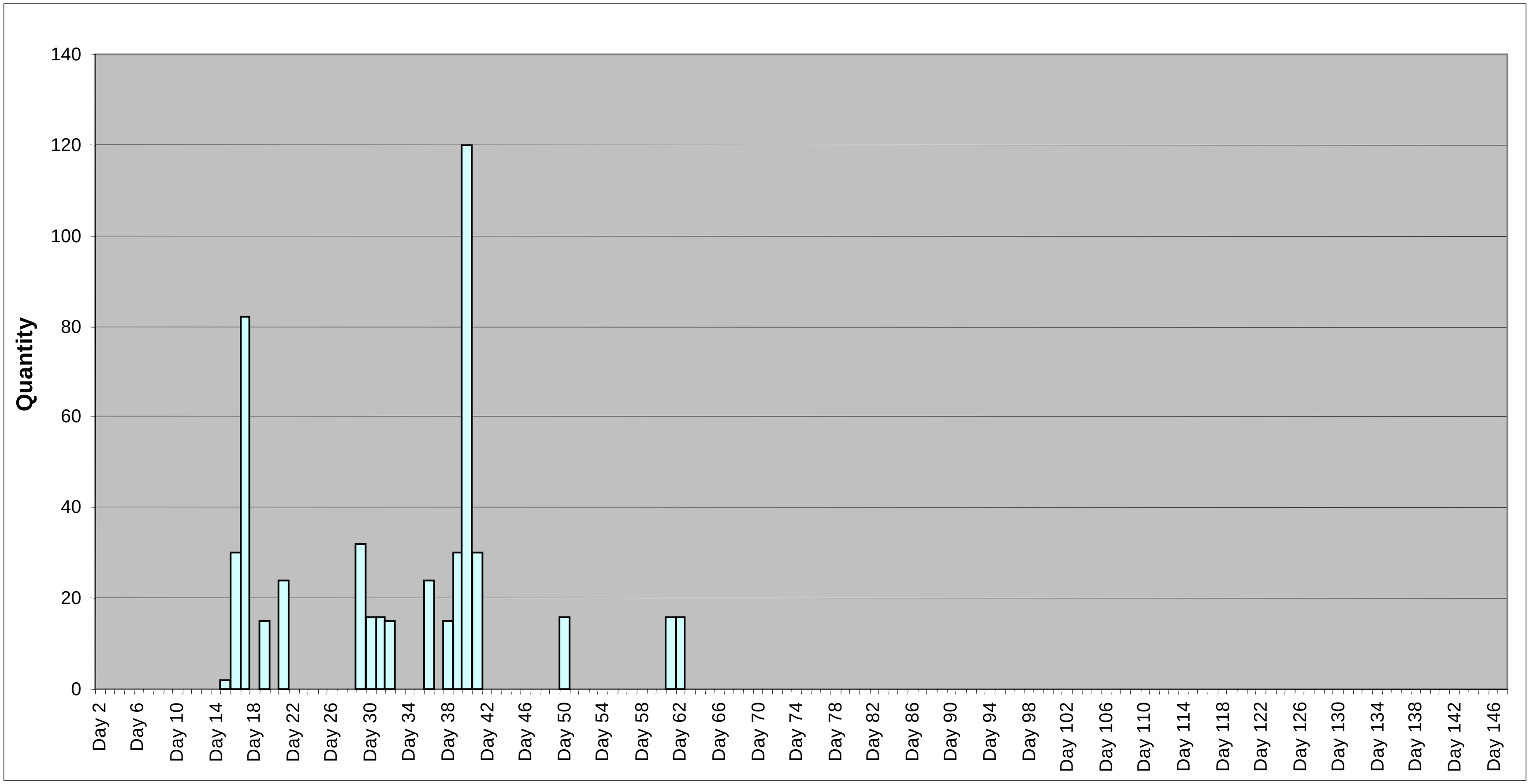


Figure B-20. Quantity of Aircraft Self-Deploying to the Port of Oakland

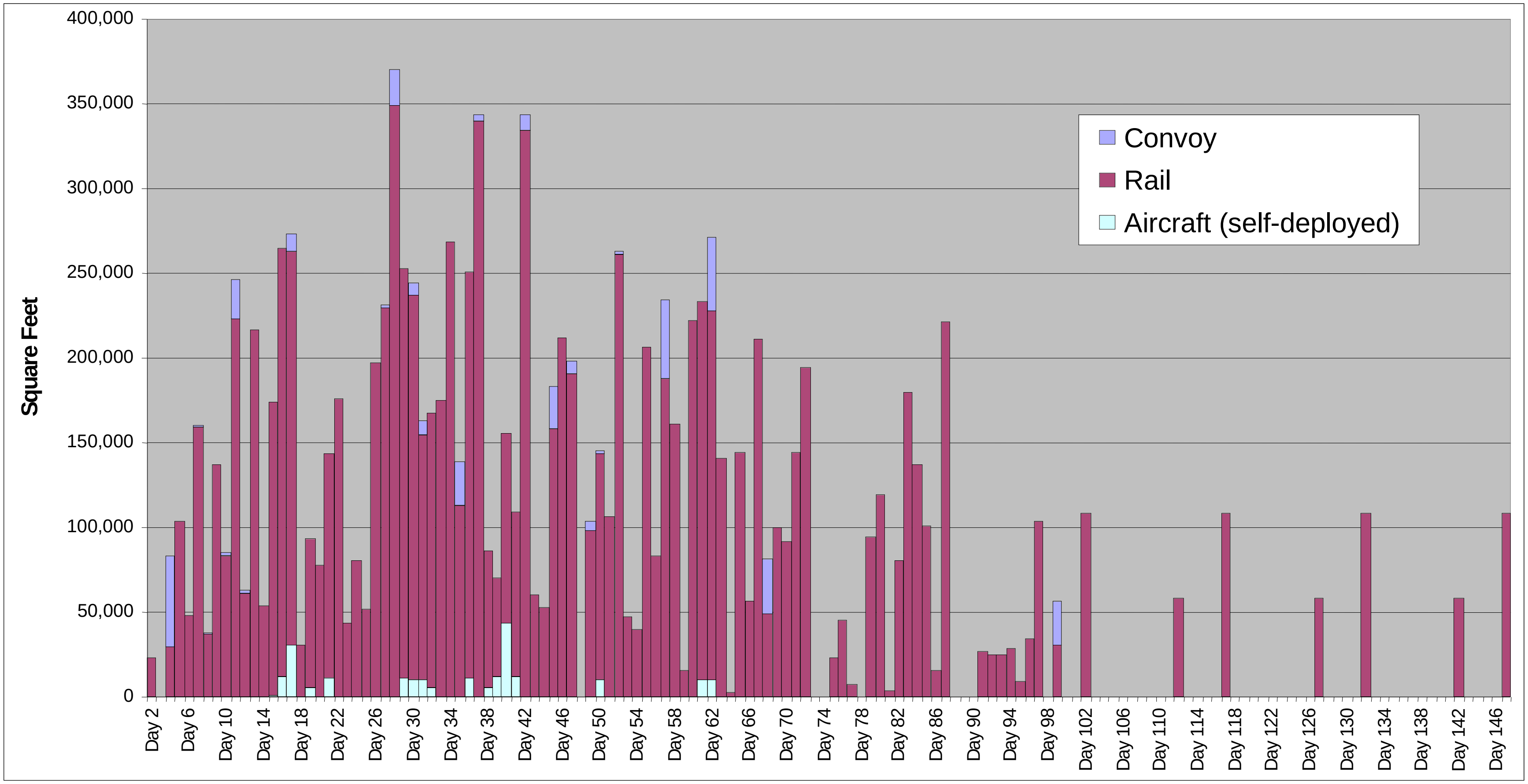


Figure B-21. Square Feet of Cargo Arriving by Mode to the Port of Oakland

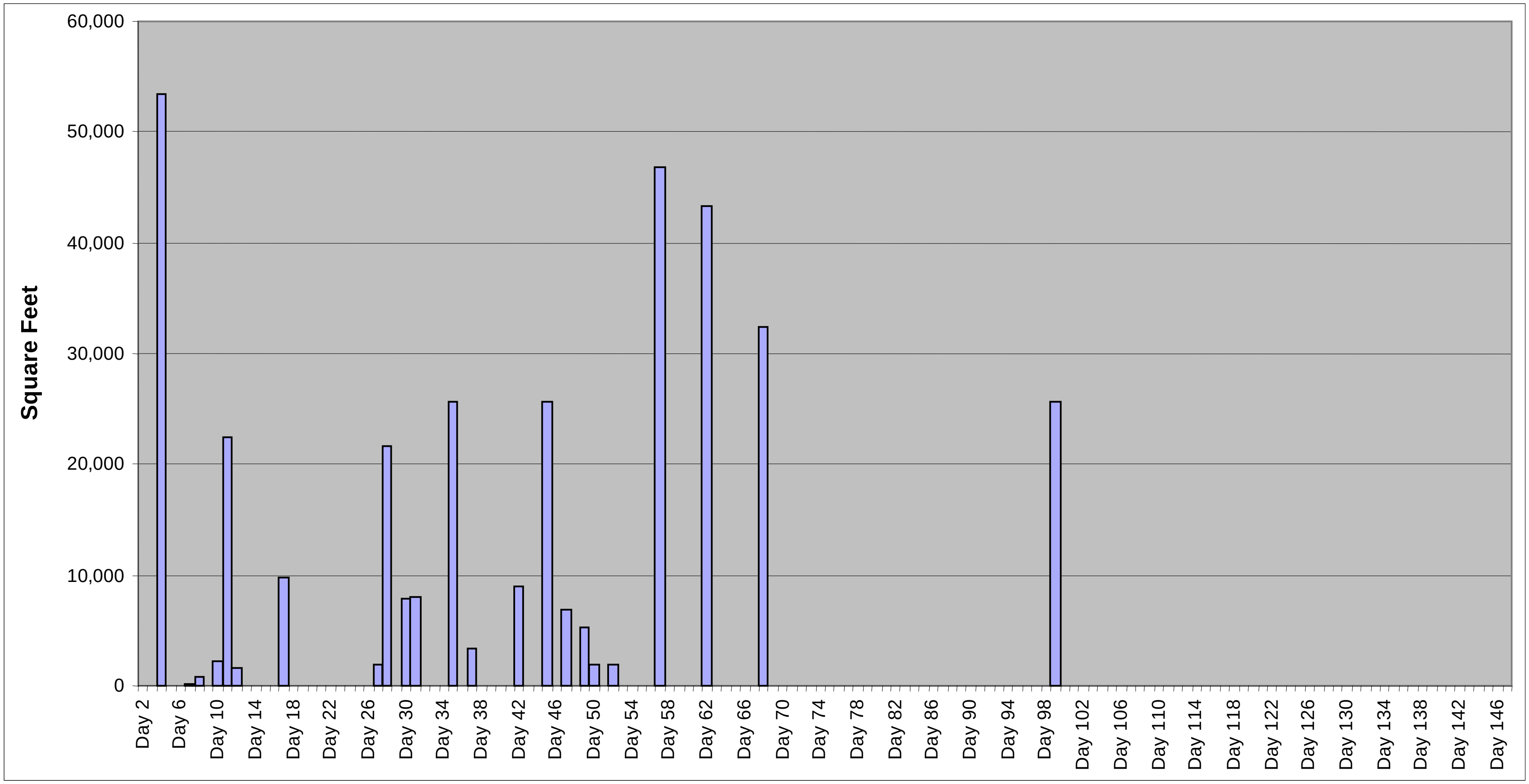


Figure B-22. Square Feet of Wheeled Vehicles Convoying to the Port of Oakland

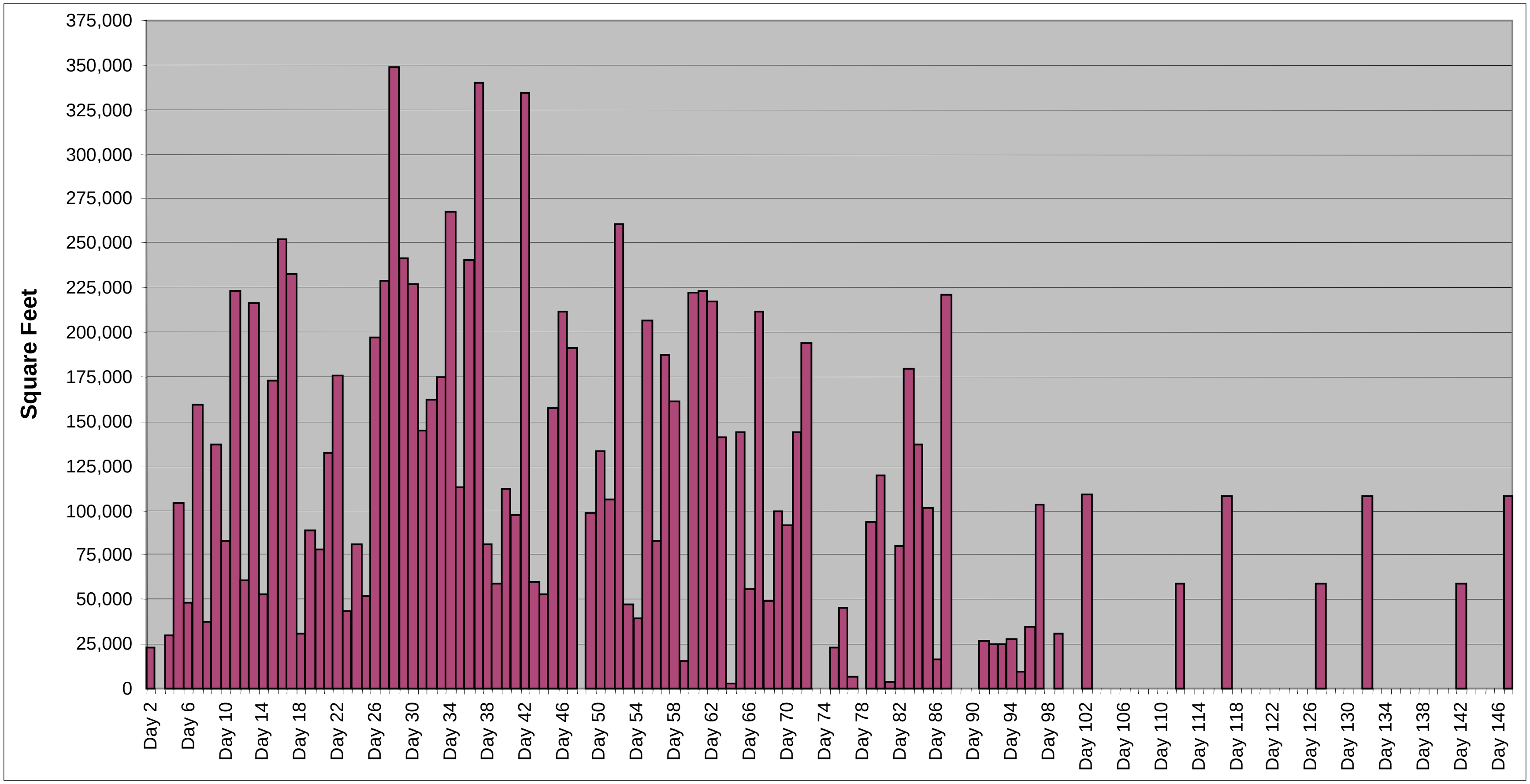


Figure B-23. Square Feet of Cargo Arriving by Rail to the Port of Oakland

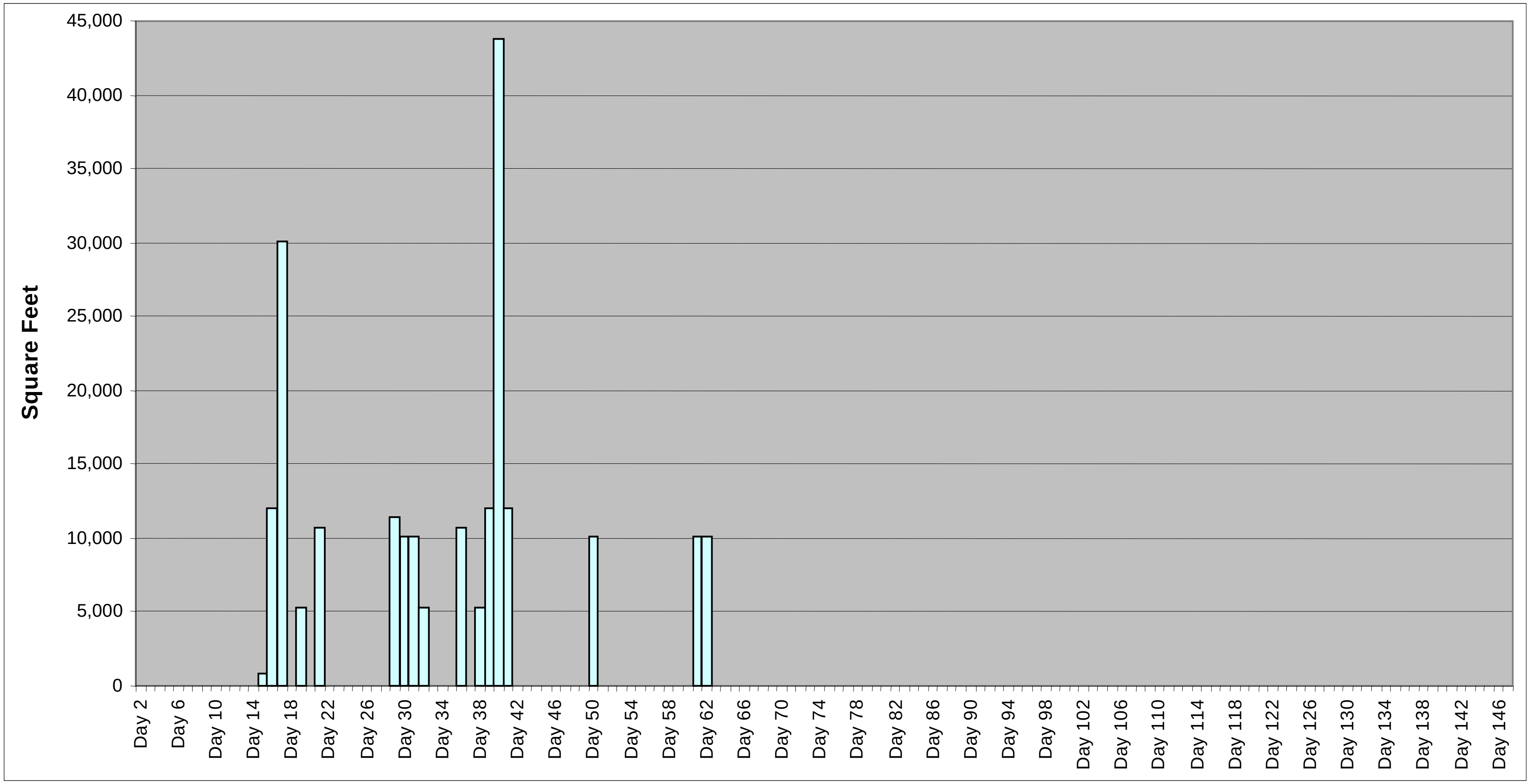


Figure B-24. Square Feet of Aircraft Self-Deploying to the Port of Oakland

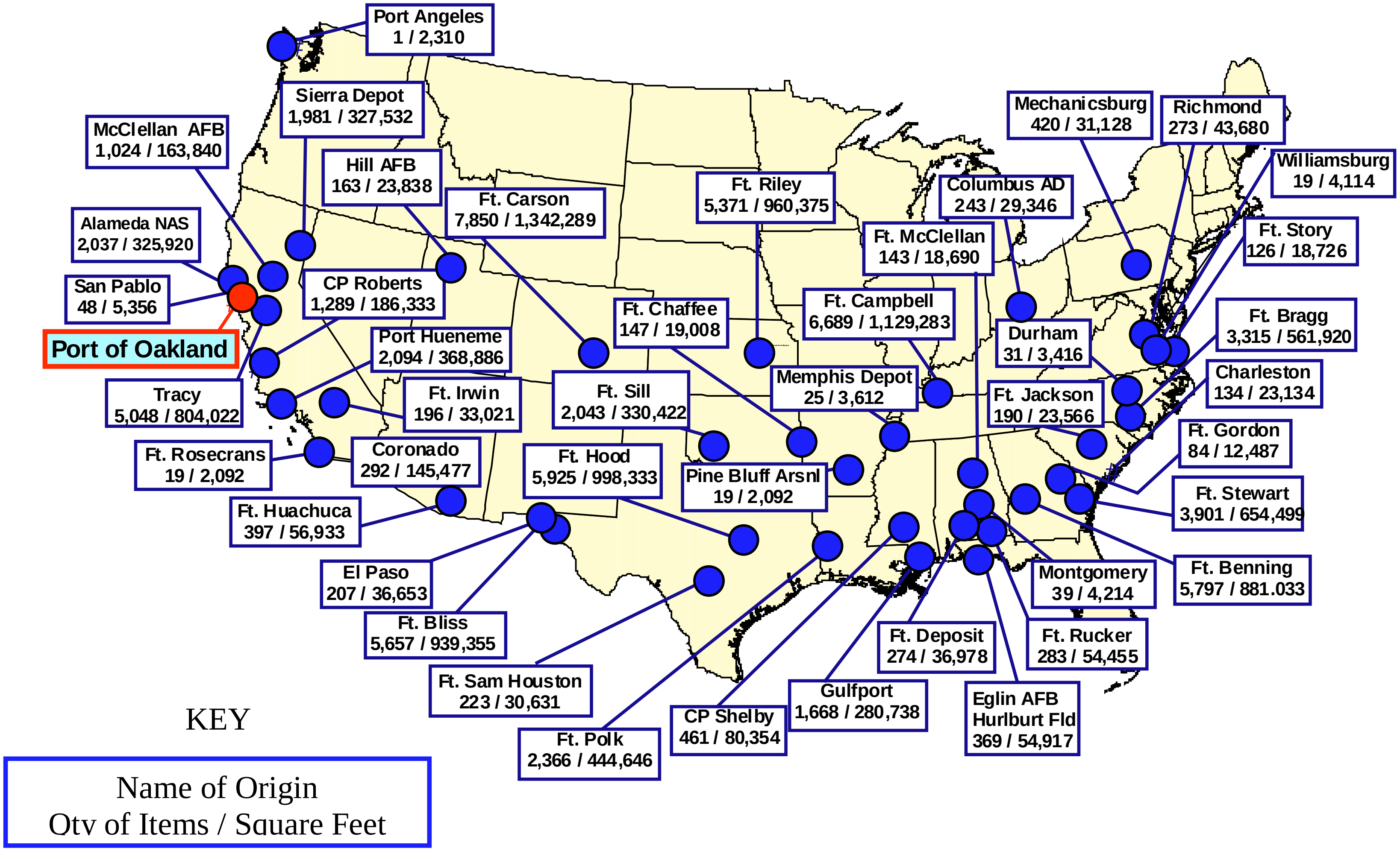


Figure B-25. Amount of Cargo Arriving at the Port of Oakland by Origin

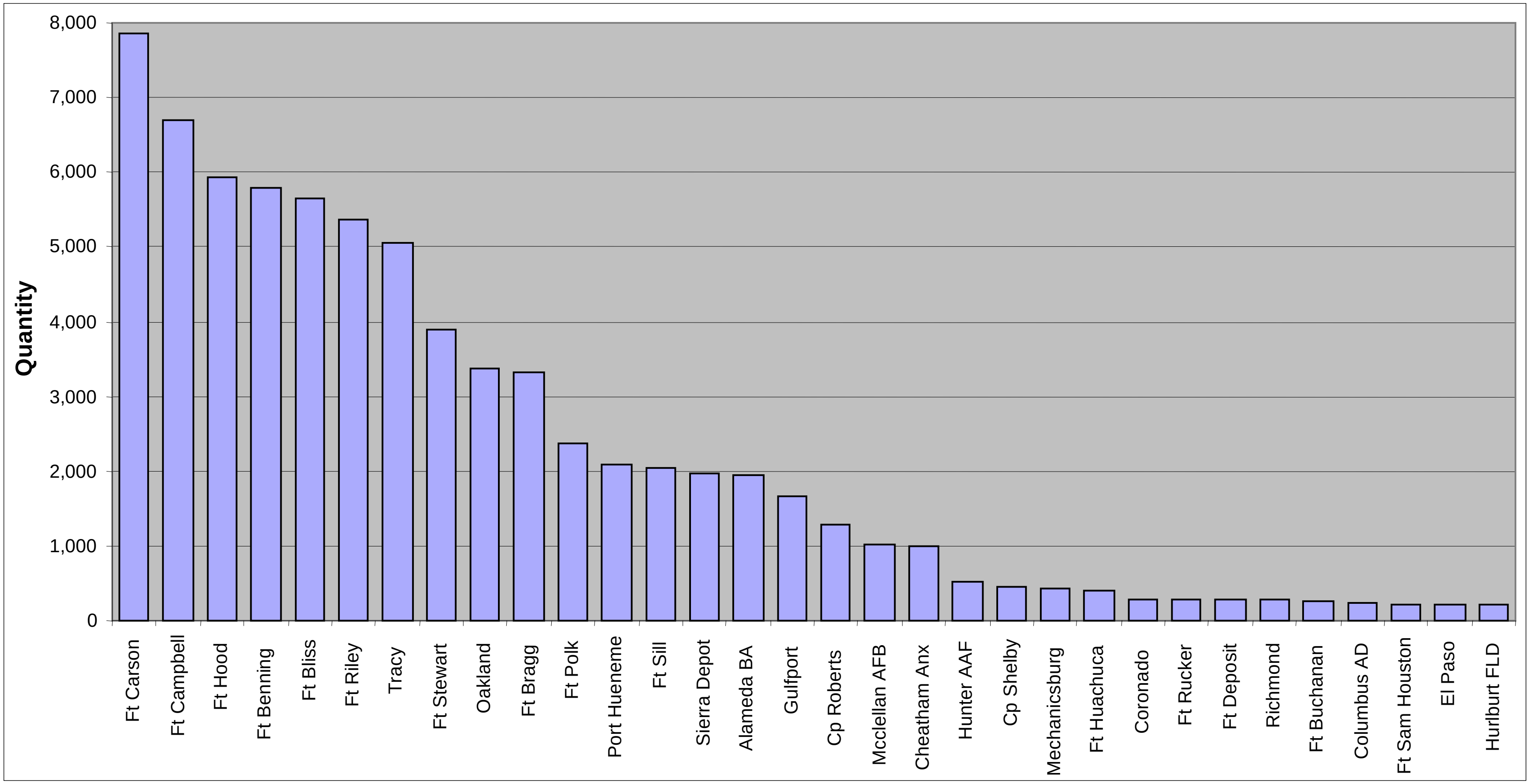


Figure B-26. Quantity of Items Arriving at the Port of Oakland by Origin

Table B-1
Quantity of Items Arriving at the Port of Oakland by Origin
(Origins not in Figure B-26)

Quantity	Origin	State
196	Fort Irwin	California
190	Fort Jackson	South Carolina
163	Elgin Air Force Base	Florida
163	Hill Air Force Base	Utah
155	Oakland Army Base	California
147	Fort Chaffee	Arkansas
143	Fort McClellan	Alabama
134	Charleston	South Carolina
126	Fort Story	Virginia
101	Alameda NAS	California
84	Fort Gordon	Georgia
73	Guam Intl	Guam
48	San Pablo	California
43	Ogden Ordnance Plant	Utah
39	Montgomery	Alabama
31	Durham	North Carolina
27	Tracy Municipal Airport	California
25	Memphis Depot	Tennessee
19	Fort Rosecrans	California
19	Pine Bluff Arsenal	Arkansas
19	Williamsburg	Virginia
6	Badin	North Carolina
6	Camp Pendleton	California
6	Fort Dix	New Jersey
6	Patrick Air Force Base	Florida
5	Hammond	Louisiana
5	Key Field	Mississippi
3	San Diego-NAVSTA	California
1	Coos Bay	Oregon
1	Port Angeles	Washington
1	San Diego	California

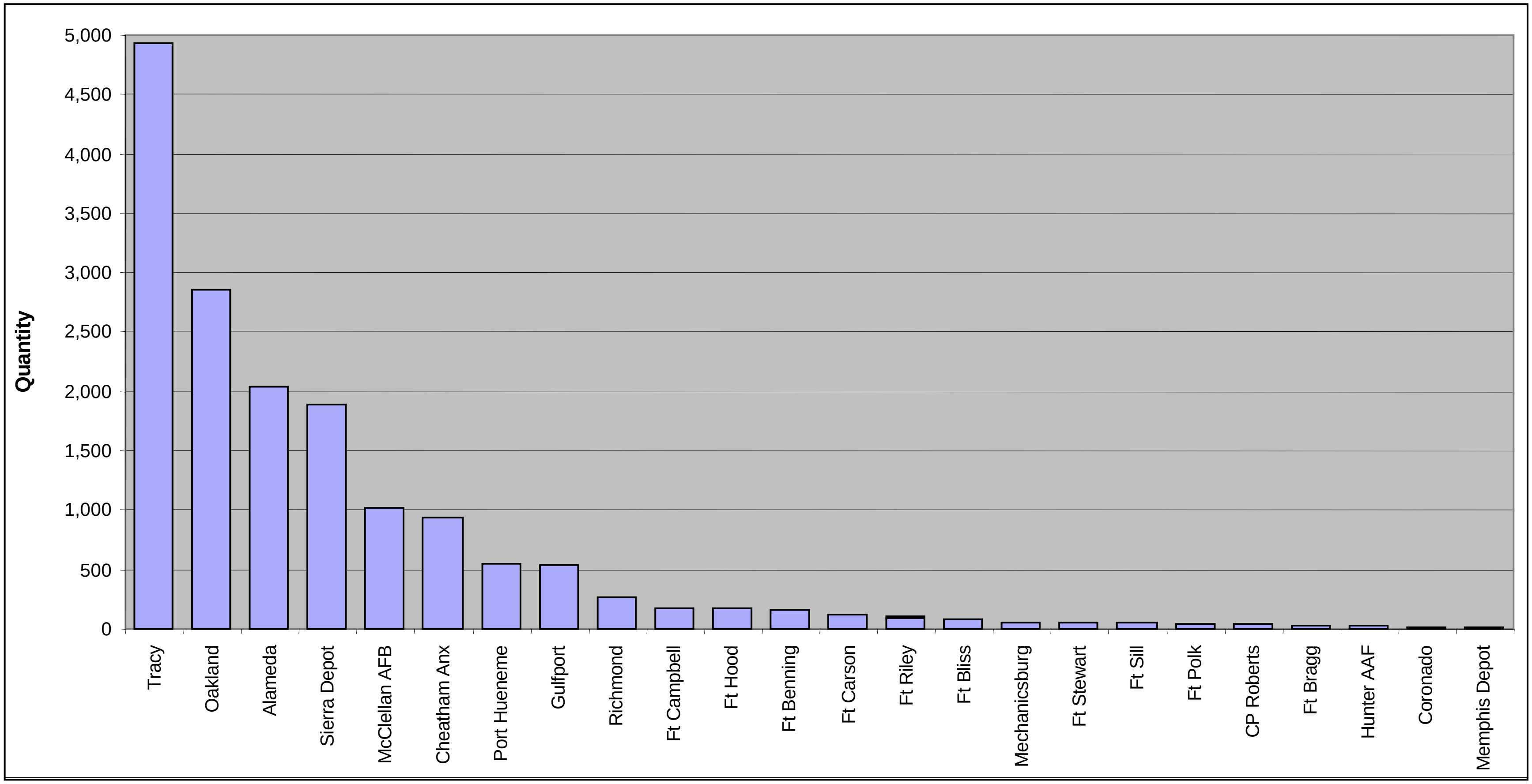


Figure B-27. Quantity of 20-Foot Containers Arriving at the Port of Oakland by Origin

Table B-2
Quantity of 20-Foot Containers
Arriving at the Port of Oakland by Origin
(Origins not in Figure B-27)

Quantity	Origin	State
7	Fort Rucker	Alabama
6	Camp Shelby	Mississippi
5	Fort Deposit	Alabama
4	Fort Gordon	Georgia
2	Charleston	South Carolina
2	Fort Huachuca	Arizona
2	Fort Irwin	California
2	Hurlburt Field	Florida
1	Williamsburg	Virginia

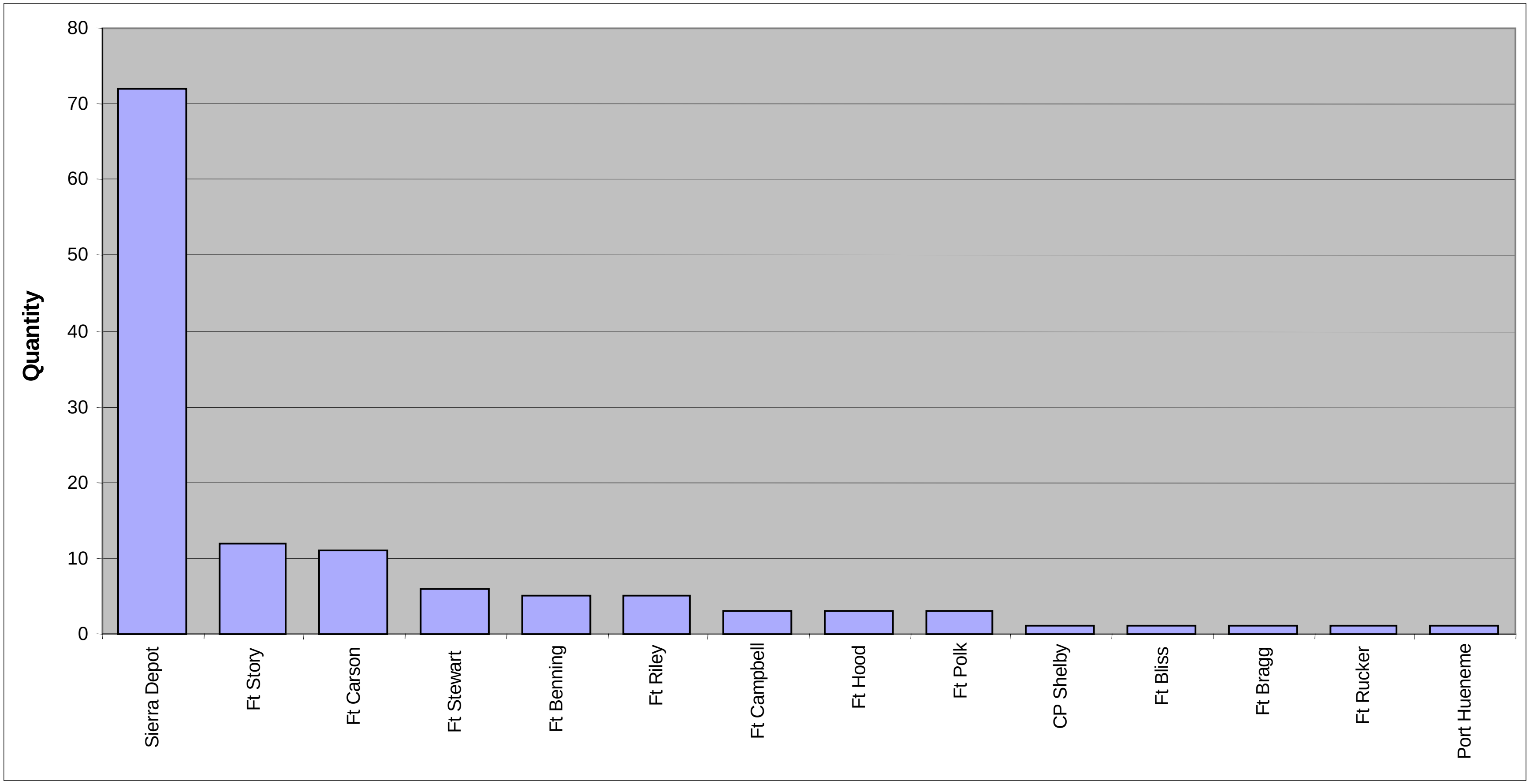


Figure B-28. Quantity of 40-Foot Containers Arriving at the Port of Oakland by Origin

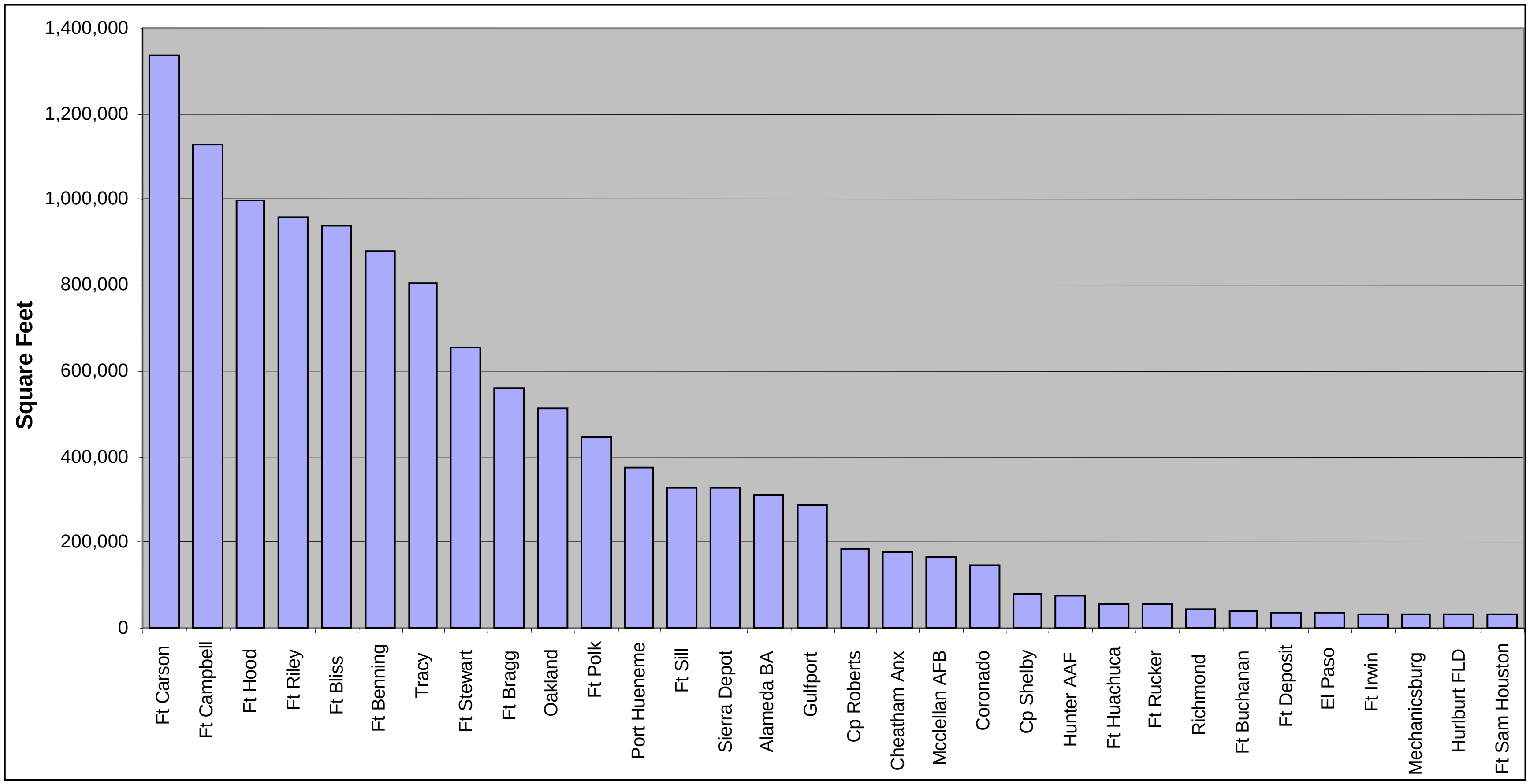


Figure B-29. Square Feet of Cargo Arriving at the Port of Oakland by Origin

Table B-3
Square Feet of Cargo Arriving at the Port of Oakland by Origin
(Origins not in Figure B-29)

Square Feet	Origin	State
29,346	Columbus Army Depot	Ohio
23,838	Elgin Air Force Base	Florida
23,838	Hill Air Force Base	Utah
23,566	Fort Jackson	South Carolina
23,270	Charleston	South Carolina
23,146	Oakland Army Base	California
19,008	Fort Chaffee	Arkansas
18,724	Fort Story	Virginia
18,690	Fort McClellan	Alabama
16,160	Alameda NAS	California
11,483	Fort Gordon	Georgia
8,080	Guam Intl	Guam
5,356	San Pablo	California
4,214	Montgomery	Alabama
4,114	Williamsburg	Virginia
3,612	Memphis Depot	Tennessee
3,416	Durham	North Carolina
2,310	Coos Bay	Oregon
2,310	Port Angeles	Washington
2,310	San Diego	California
2,091	Fort Rosecrans	California
2,092	Pine Bluff Arsenal	Arkansas
1,261	Ogden Ordnance Plant	Utah
984	San Diego-NAVSTA	California
756	Fort Dix	New Jersey
663	Tracy Municipal Airport	California
616	Badin	North Carolina
574	Hammond	Louisiana
574	Key Field	Mississippi
548	Patrick Air Force Base	Florida
149	Camp Pendleton	California

APPENDIX C

PORT OF SAN DIEGO

The graphs below represent the cargo scheduled to arrive at the Port of San Diego as outlined in the TPFDD. Cargo is scheduled to arrive at the port starting on day 0 and continuing through day 71.

This appendix includes cargo to be transported via Military Sealift Command (MSC) ship. There is also a Marine Corps Assault Follow on Echelon (AFOE) scheduled in the TPFDD to arrive at the port. The graphs for the AFOE are provided in appendix D.

The Port of San Diego is scheduled to receive cargo from seven separate origins. The cargo consists entirely of unit equipment and is mainly Marine Corps requirements. A map of the origin locations is provided in Figure C-1. The quantity of railcars arriving at the Port of San Diego is provided in Figure C-2. Figures C-3 through C-7 show the quantity of items by category arriving at the port. Figures C-8 through C-12 show the same information in terms of square footage.

The heavy tracked vehicles in Figure C-5 are all arriving from Camp Pendleton and consist of 10 recovery vehicles and 4 armored vehicle bridge launchers. The breakbulk spike on C+0 shown in Figure C-12 is four-170' patrol coastal ships from San Diego Naval Station and will most likely self-deploy to the port.

Figures C-13 through C-15 provide a breakdown of the quantity of items arriving at the port according to the mode of transportation (convoy and rail). Similarly, Figures C-16 through C-18 reflect the same information presented in terms of square footage.

Figure C-19 shows the amount of cargo in terms of quantity and square feet for each origin scheduled in the TPFDD. The bar graph in Figure C-20 provides the total quantity of items for each origin. The quantity of 20-foot containers arriving at the port from each origin is provided in Figure C-21. The largest container requirement will be arriving at the port from Miramar NAS, California. Figure C-22 shows the square feet of cargo by origin.

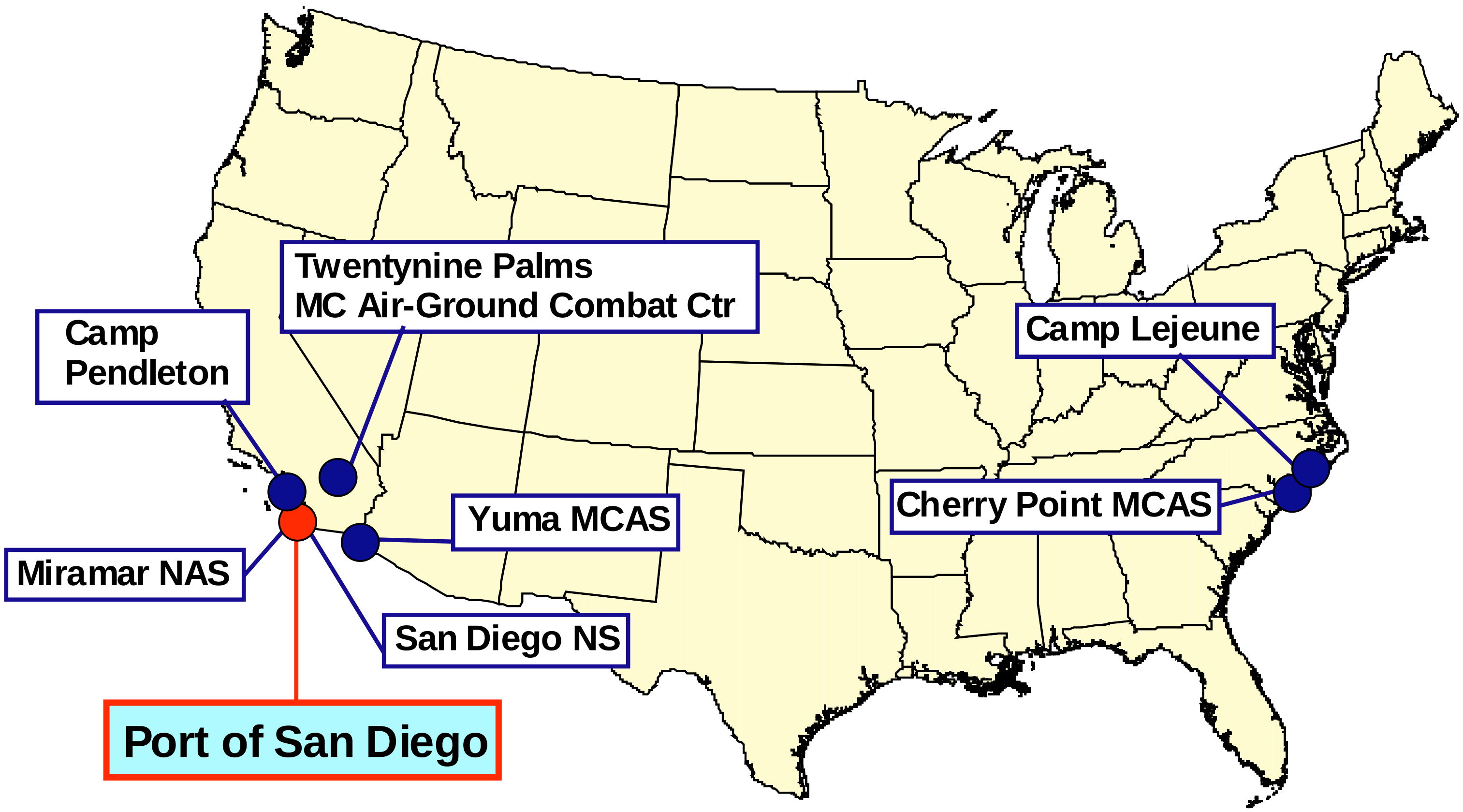


Figure C-1. Cargo Arrives at the Port of San Diego from Seven Origins

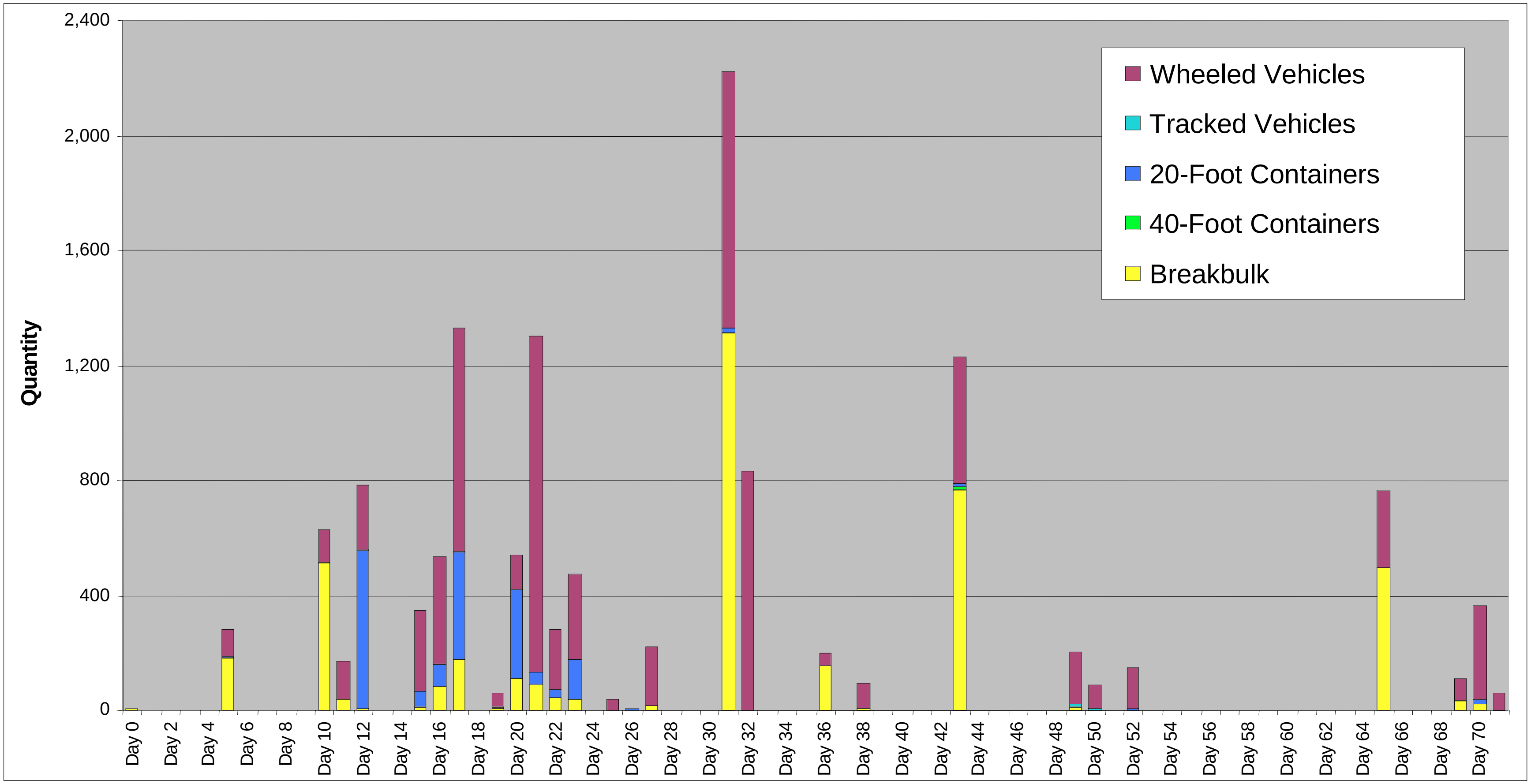


Figure C-2. Quantity of Railcars Arriving at the Port of San Diego

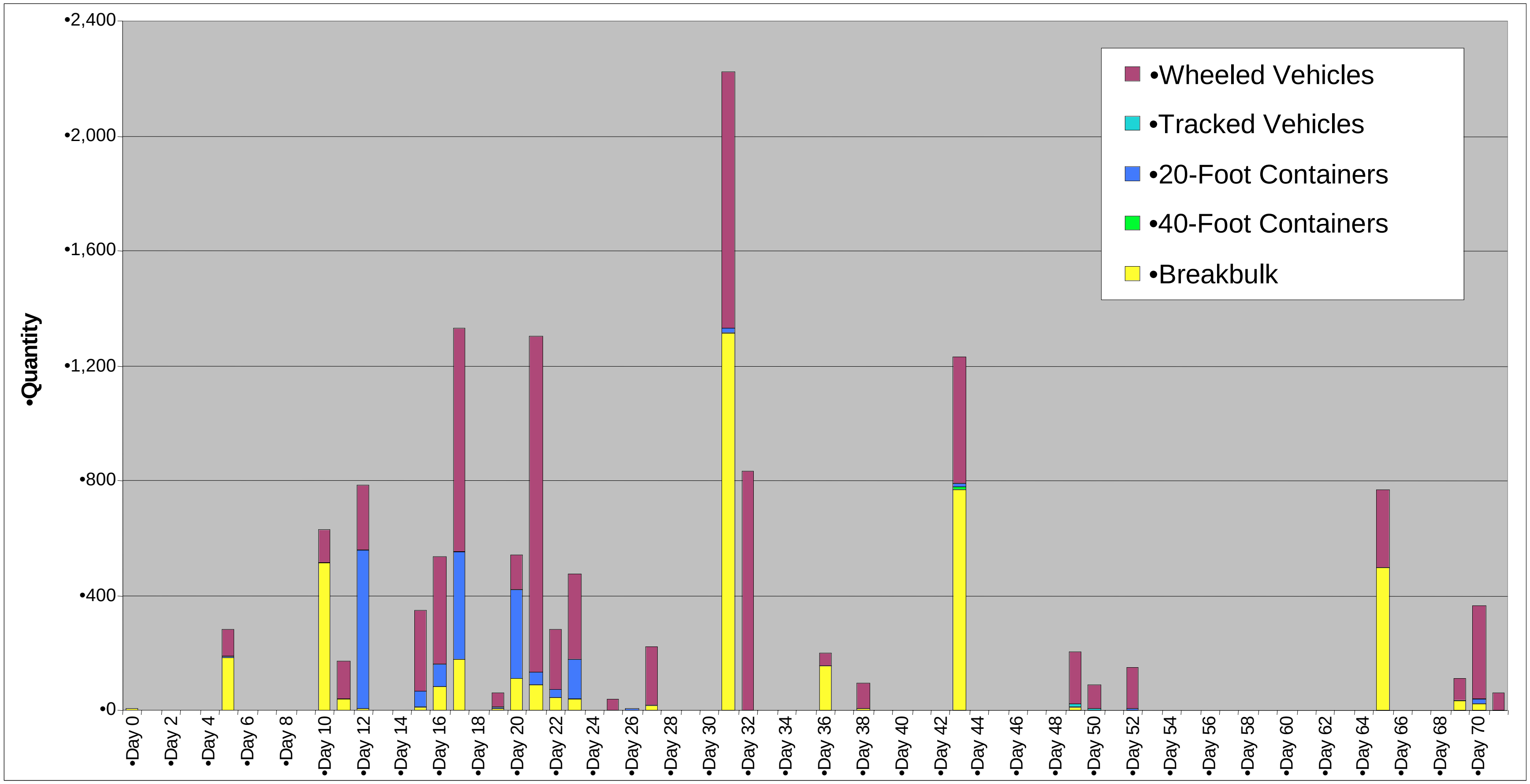


Figure C-3. Total Quantity of Items Arriving at the Port of San Diego

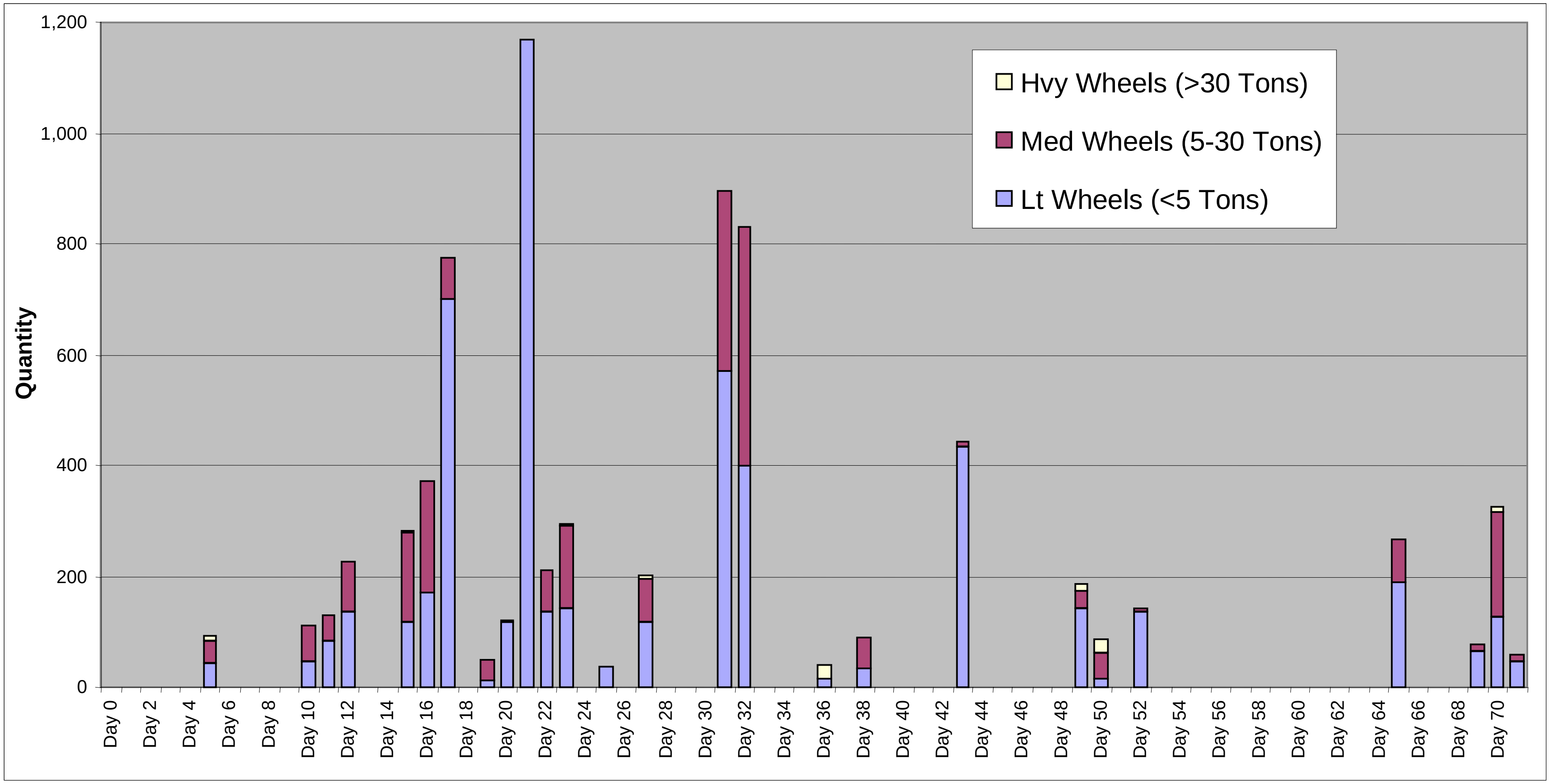


Figure C-4. Quantity of Wheeled Vehicles Arriving at the Port of San Diego

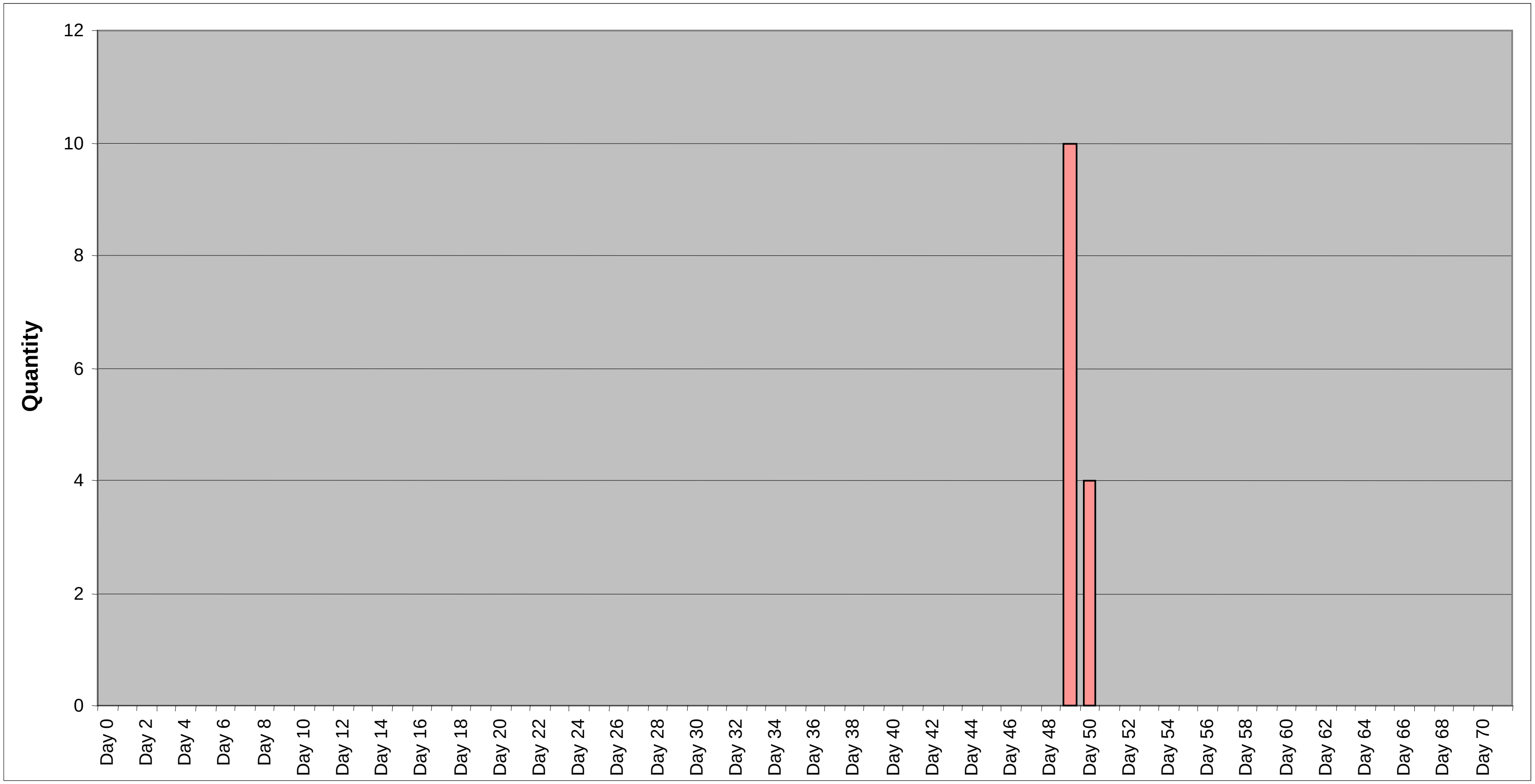


Figure C-5. Quantity of Tracked Vehicles Arriving at the Port of San Diego

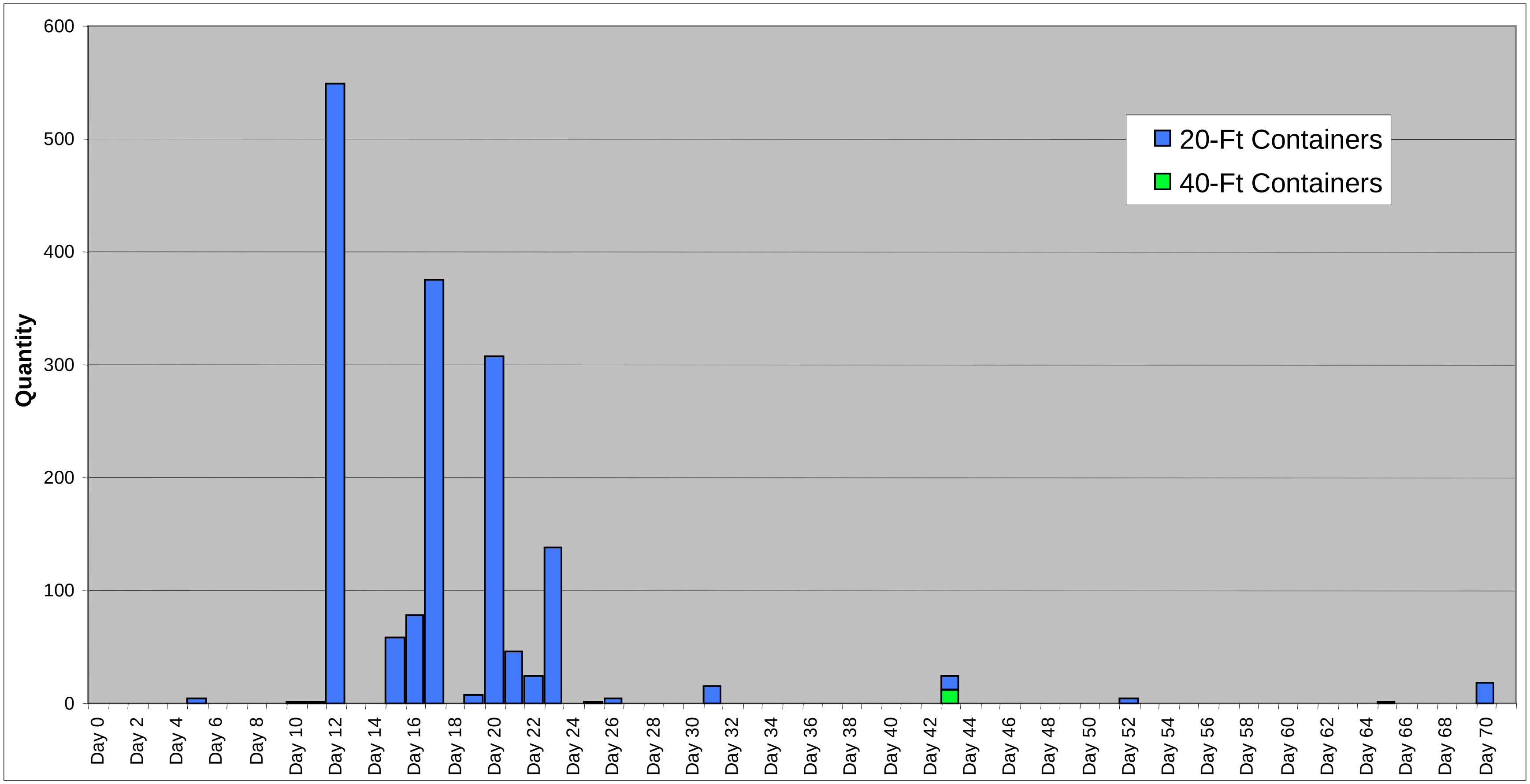


Figure C-6. Quantity of Containers Arriving at the Port of San Diego

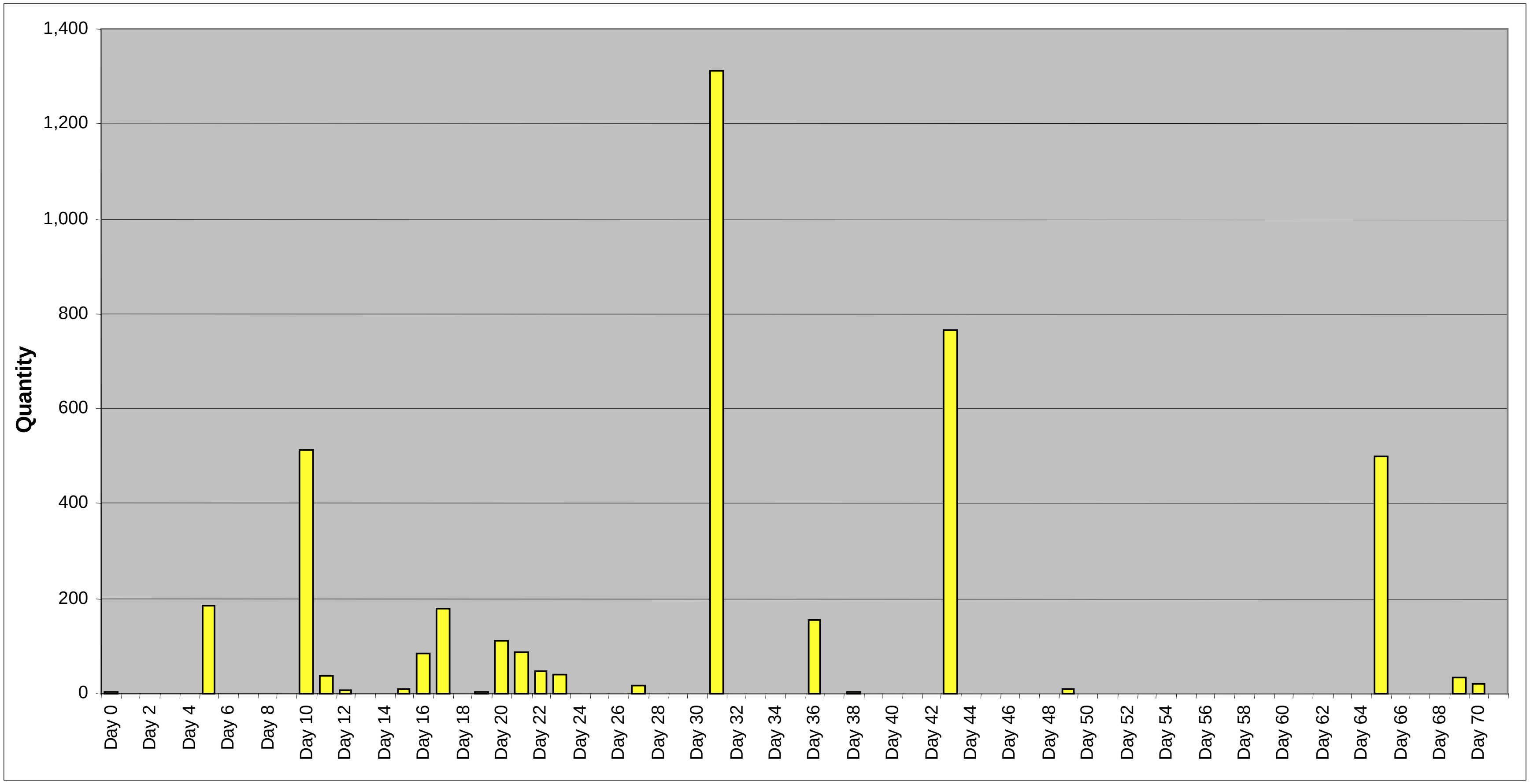


Figure C-7. Quantity of Breakbulk Items Arriving at the Port of San Diego

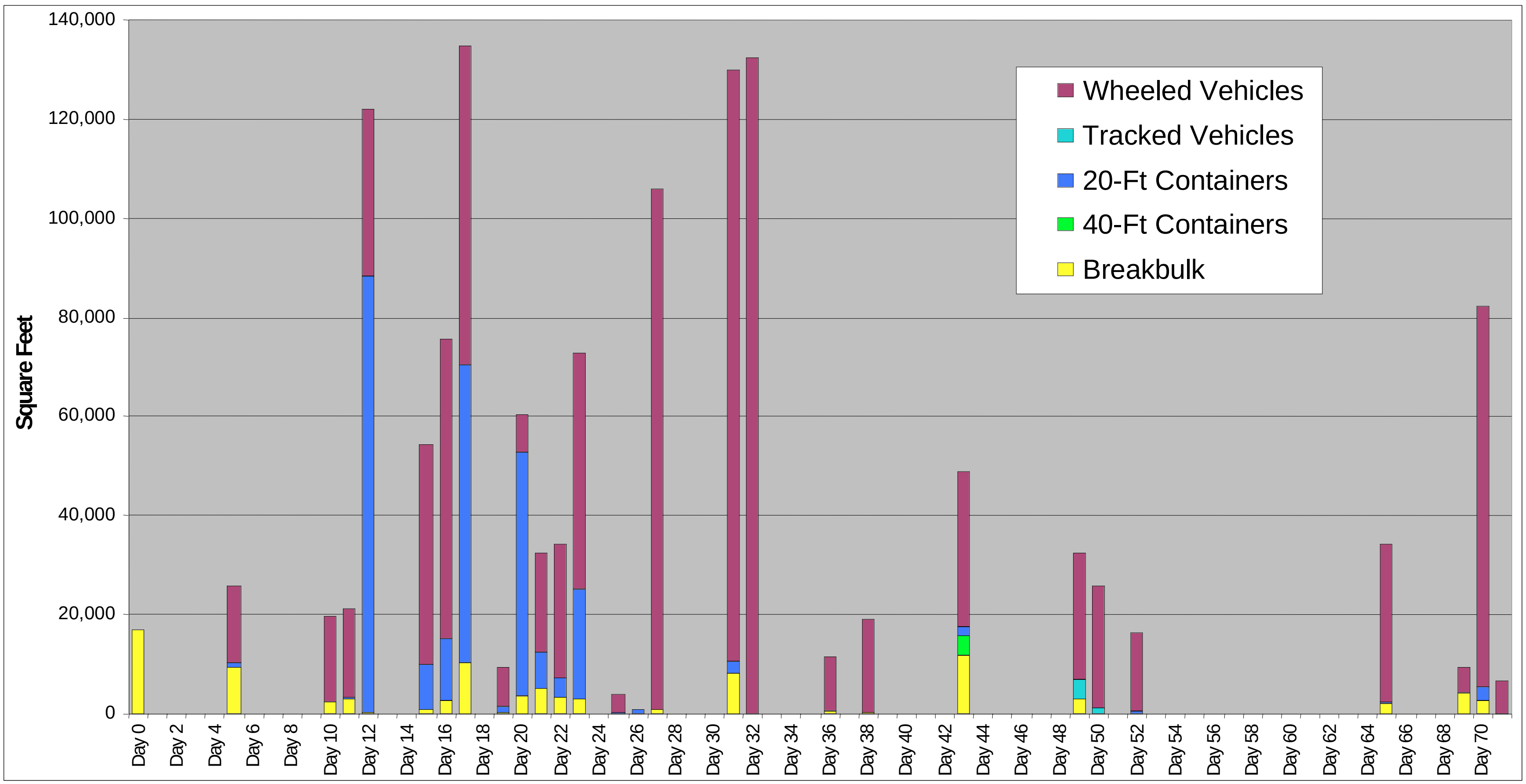


Figure C-8. Total Square Feet of Cargo Arriving at the Port of San Diego

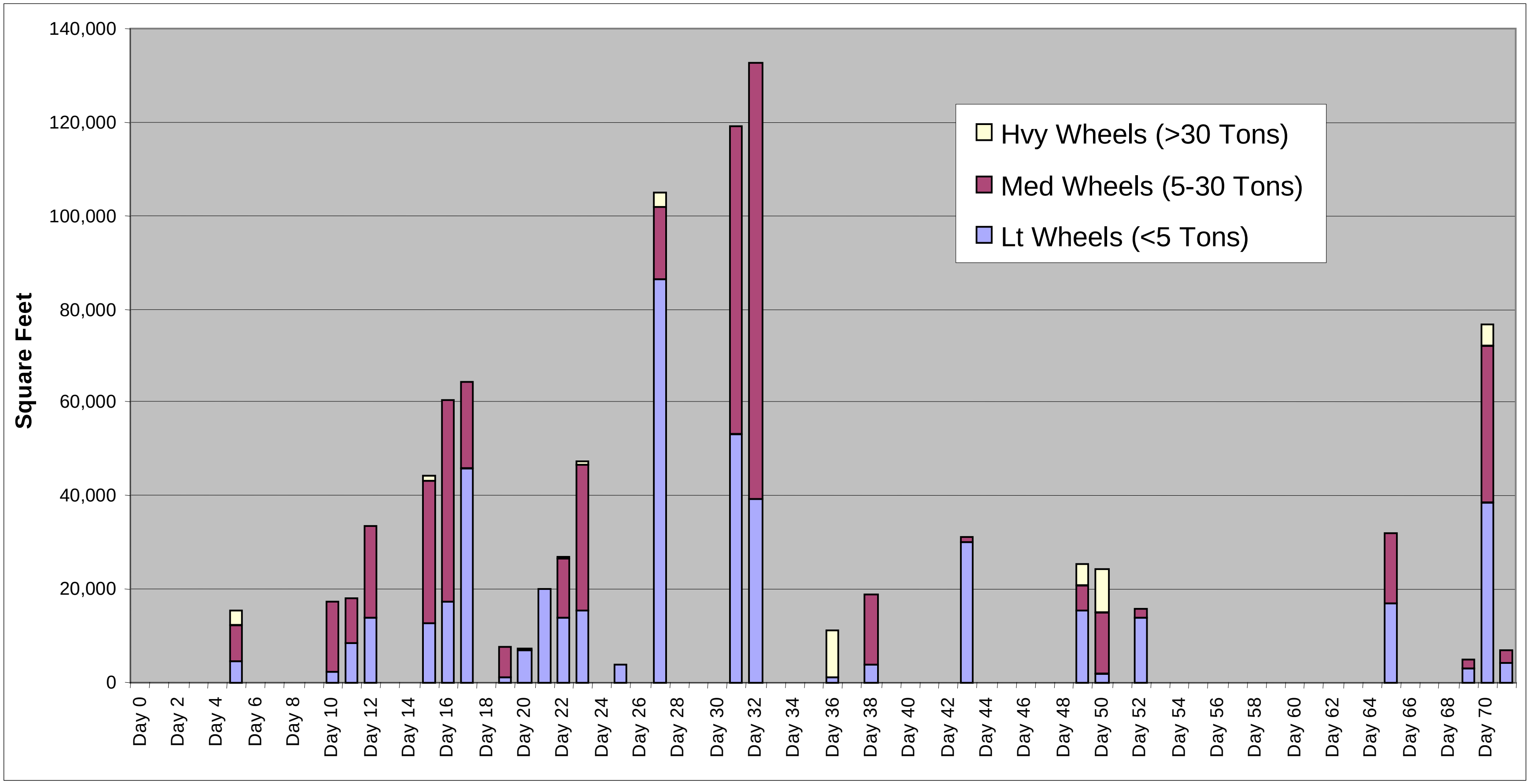


Figure C-9. Square Feet of Wheeled Vehicles Arriving at the Port of San Diego

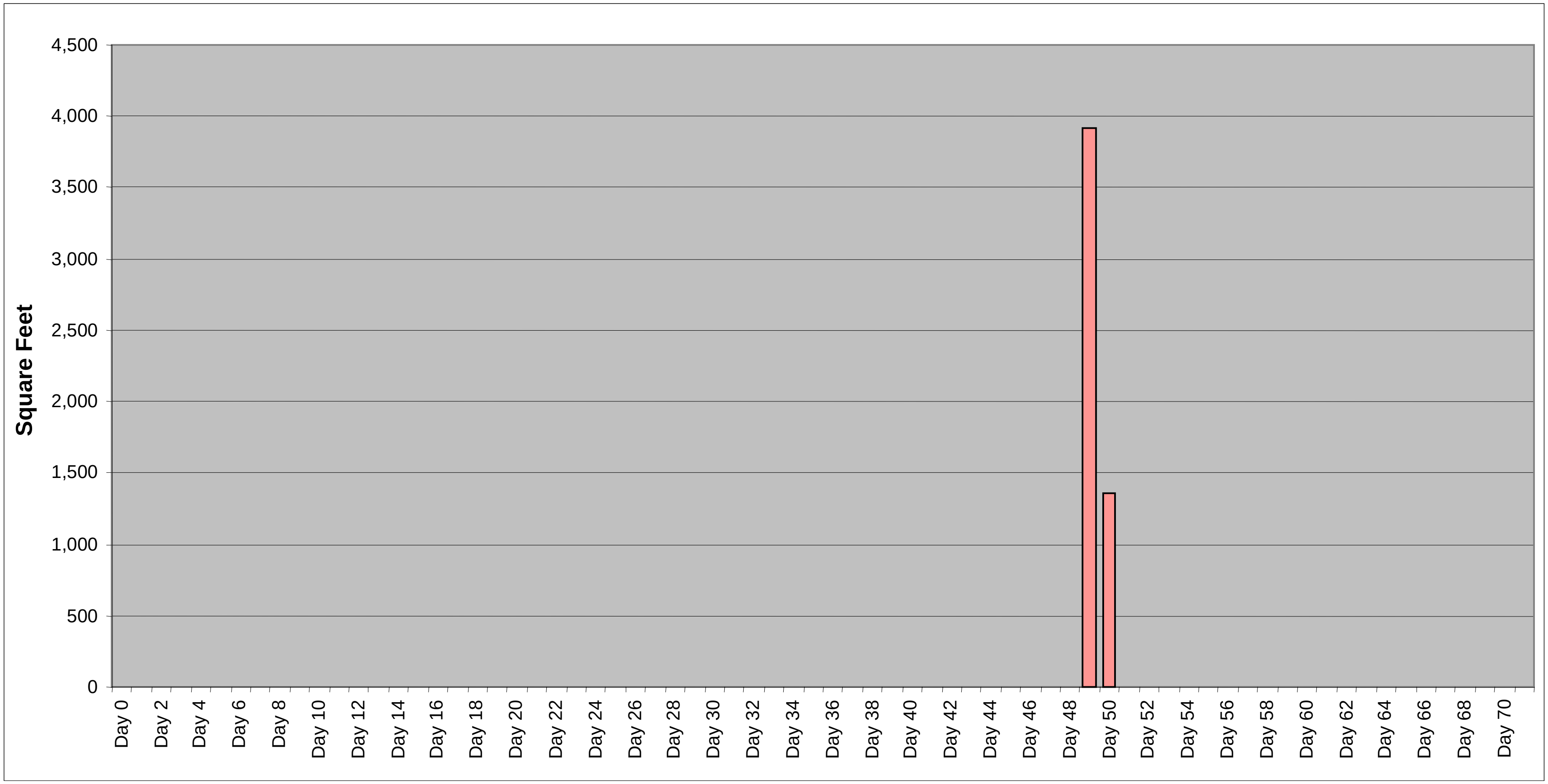


Figure C-10. Square Feet of Heavy Tracked Vehicles Arriving at the Port of San Diego

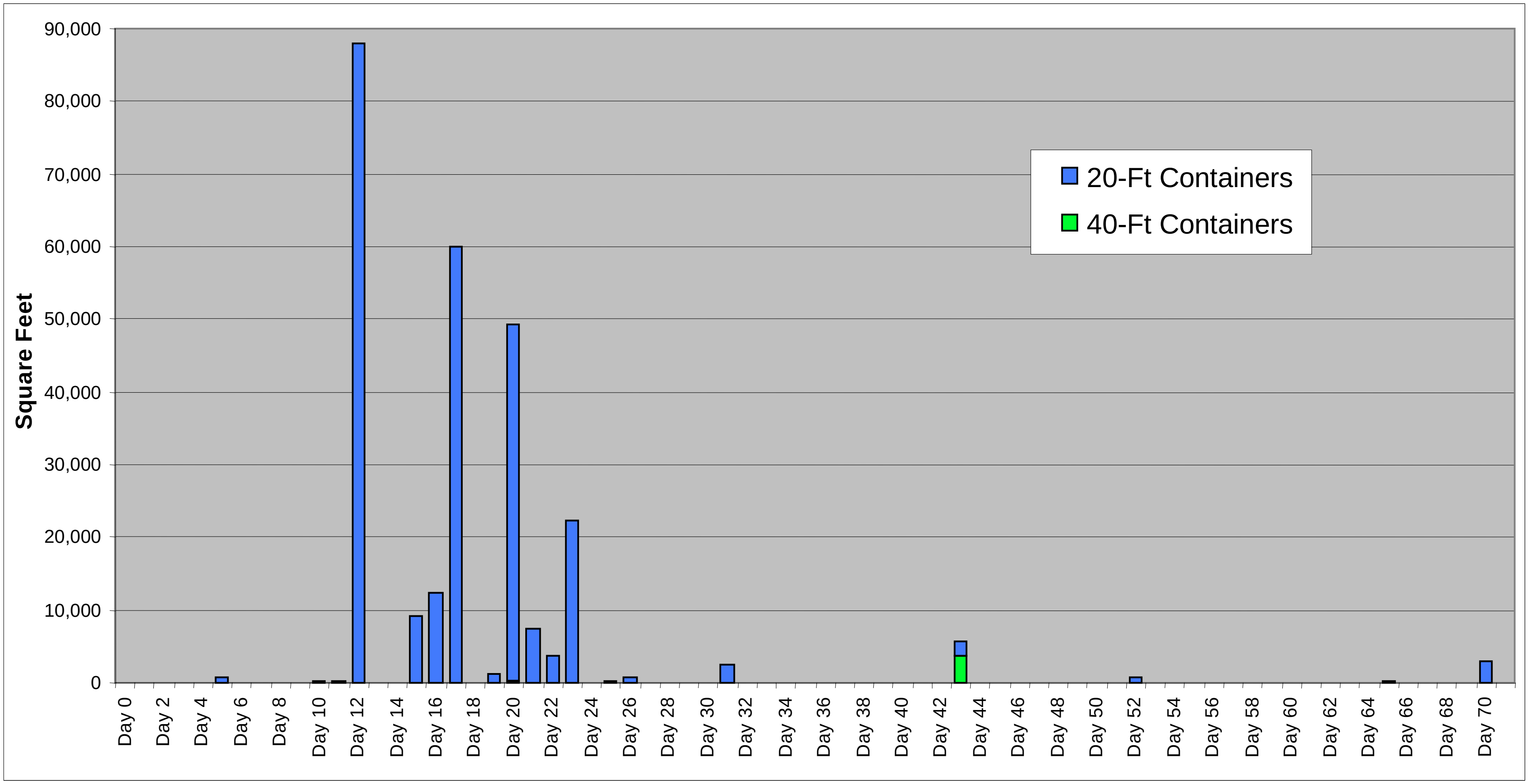


Figure C-11. Square Feet of Containers Arriving at the Port of San Diego

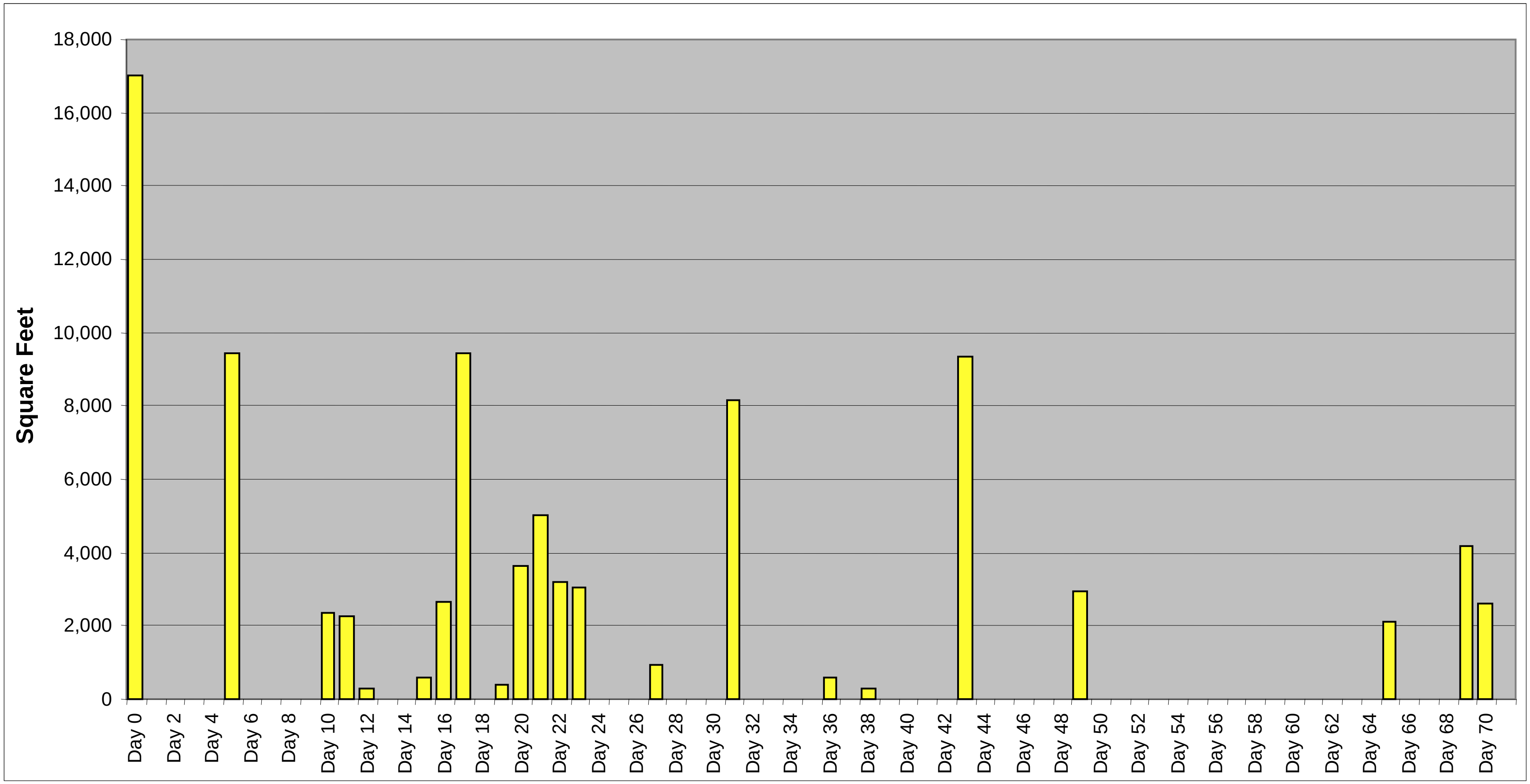


Figure C-12. Square Feet of Breakbulk Cargo Arriving at the Port of San Diego

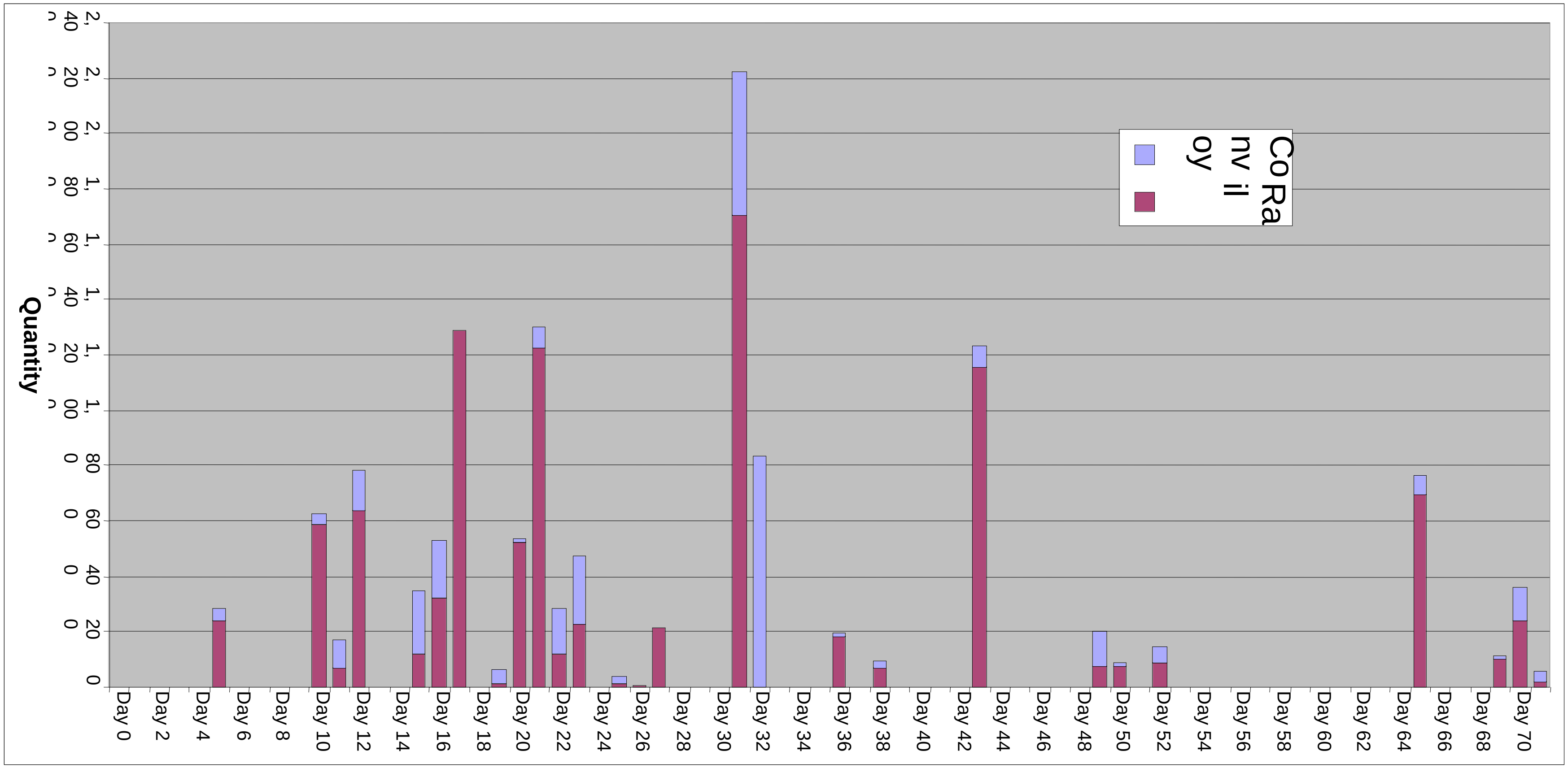


Figure C-13. Quantity of Items Arriving by Mode to the Port of San Diego

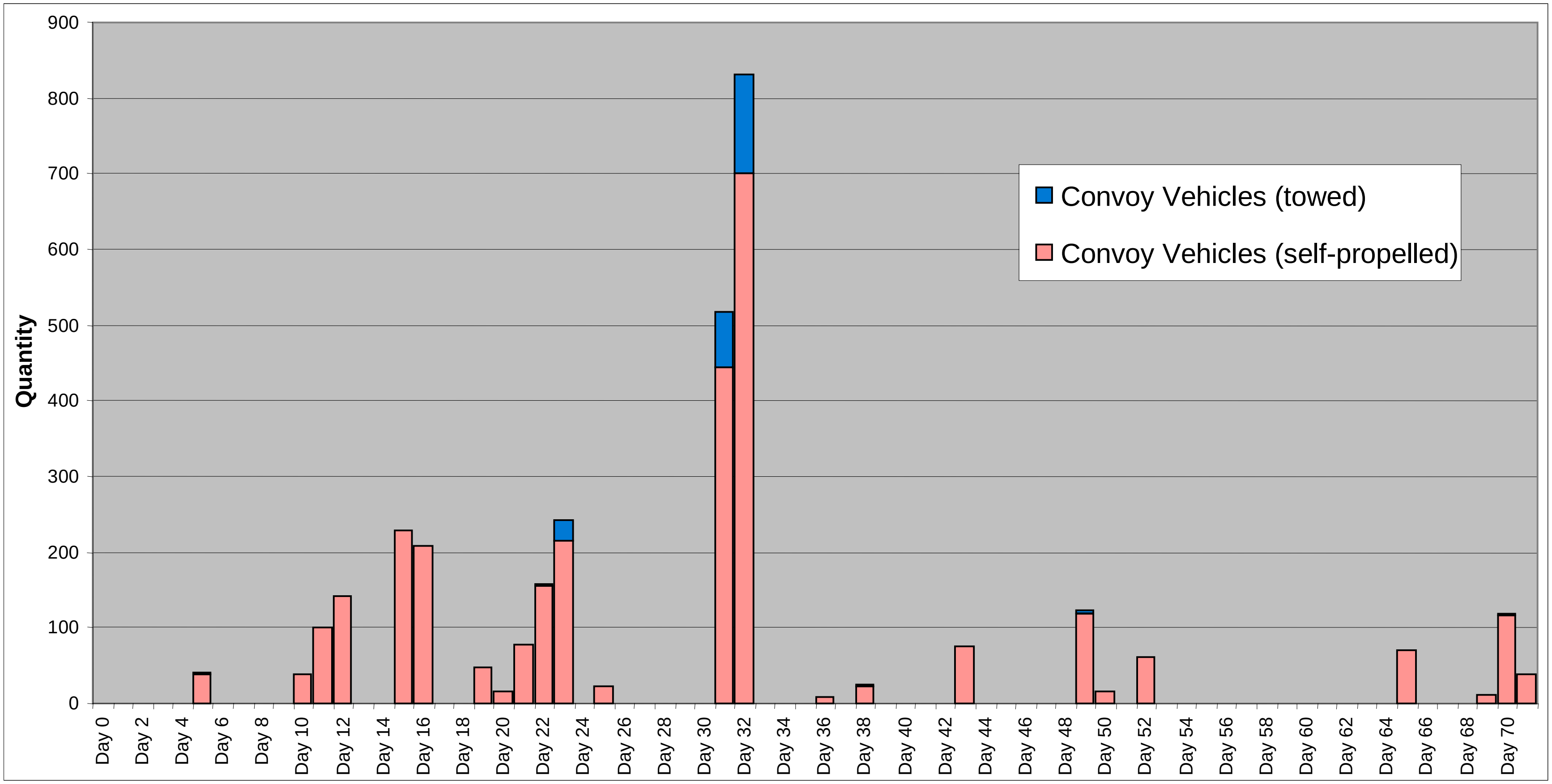


Figure C-14. Quantity of Wheeled Vehicles Convoying to the Port of San Diego

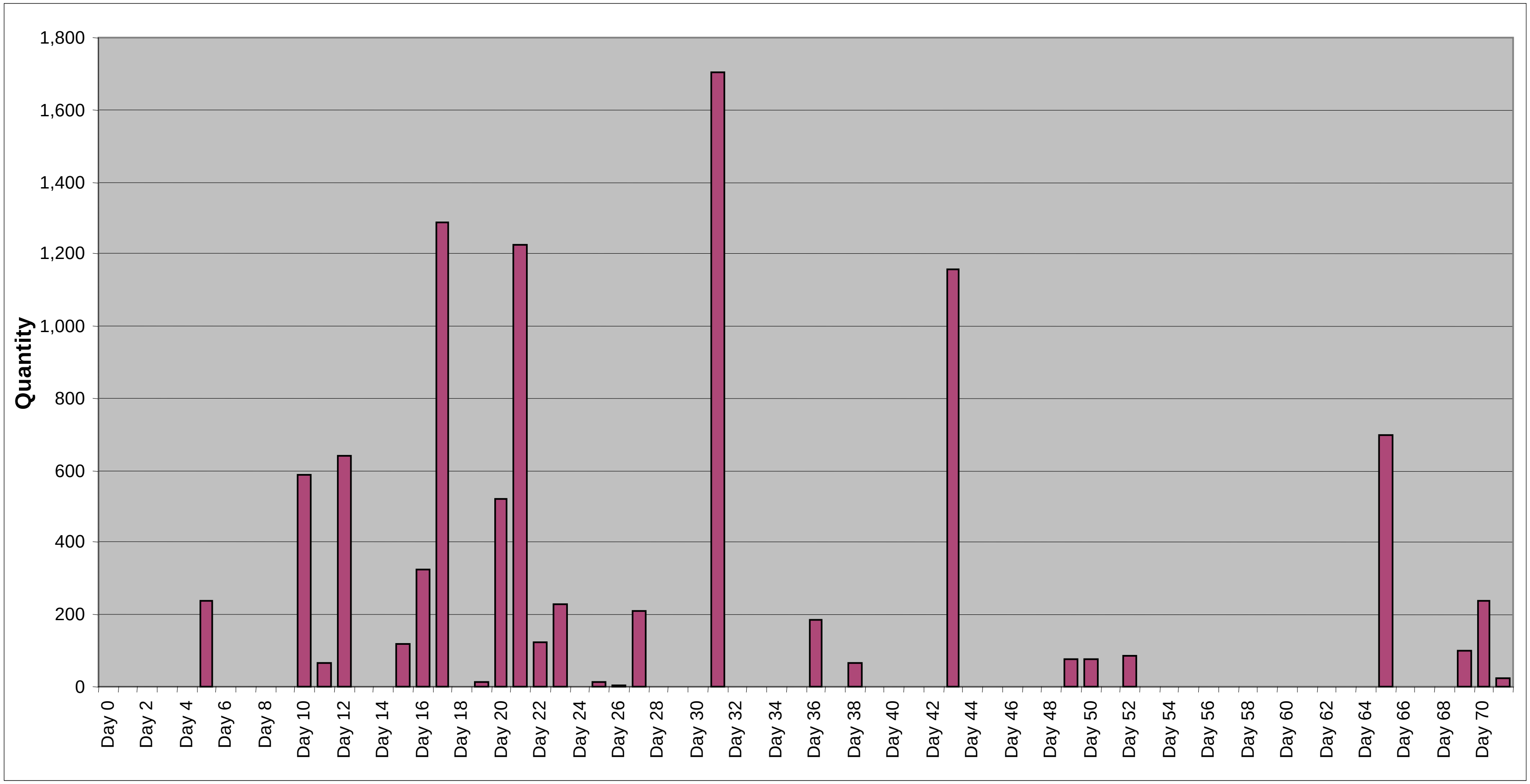


Figure C-15. Quantity of Items Arriving by Rail to the Port of San Diego

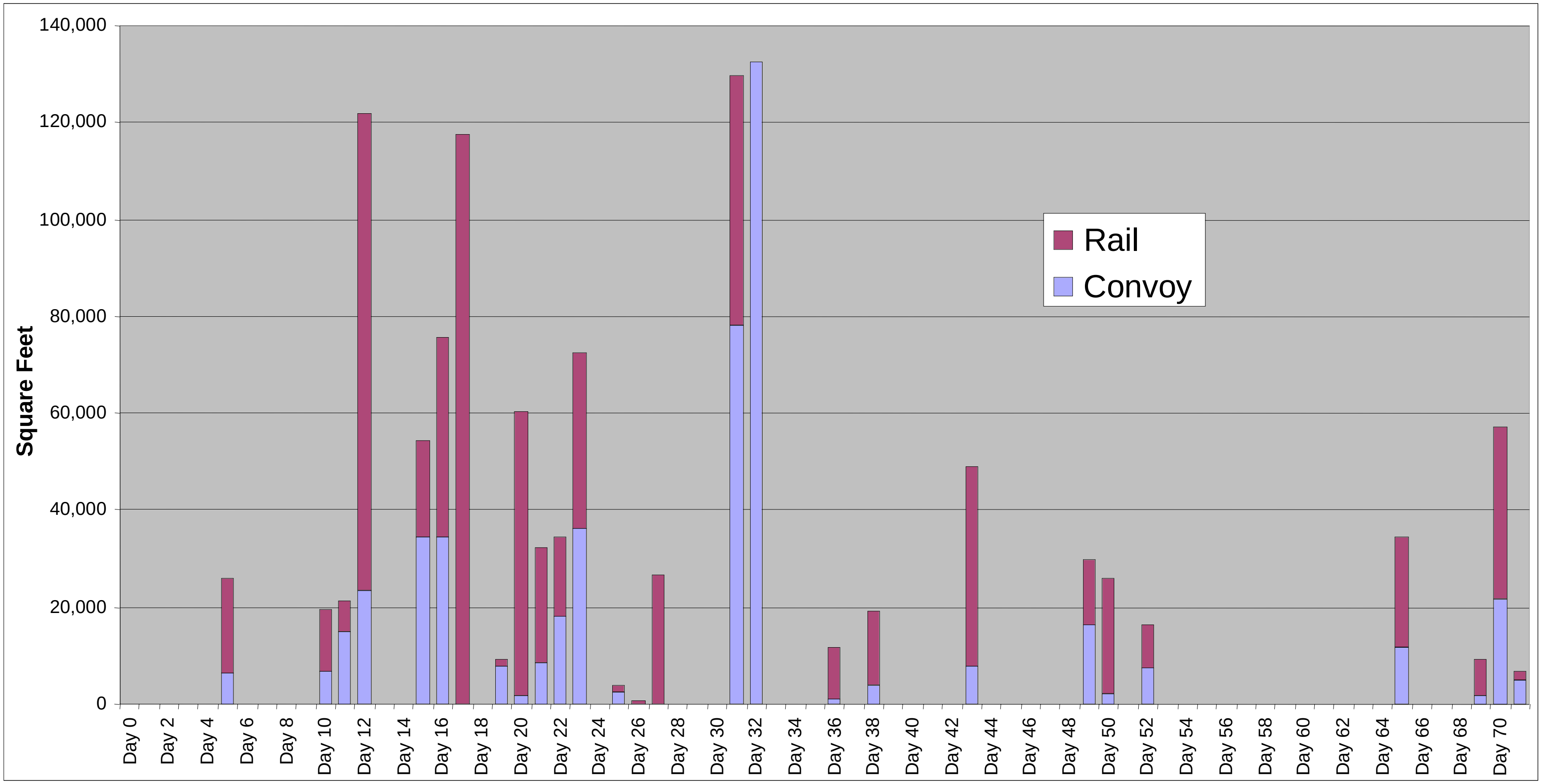


Figure C-16. Square Feet of Cargo Arriving by Mode to the Port of San Diego

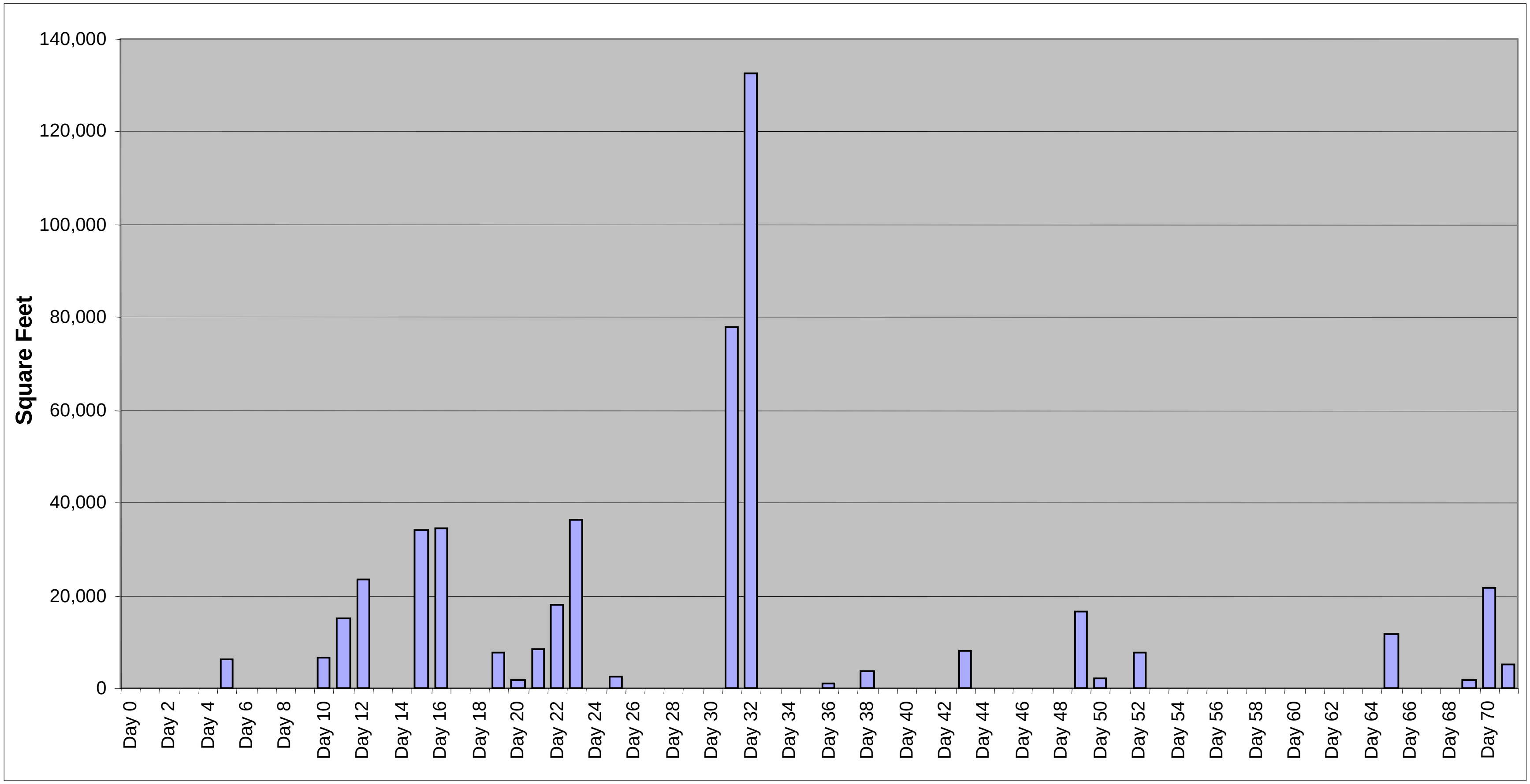


Figure C-17. Square Feet of Wheeled Vehicles Convoying to the Port of San Diego

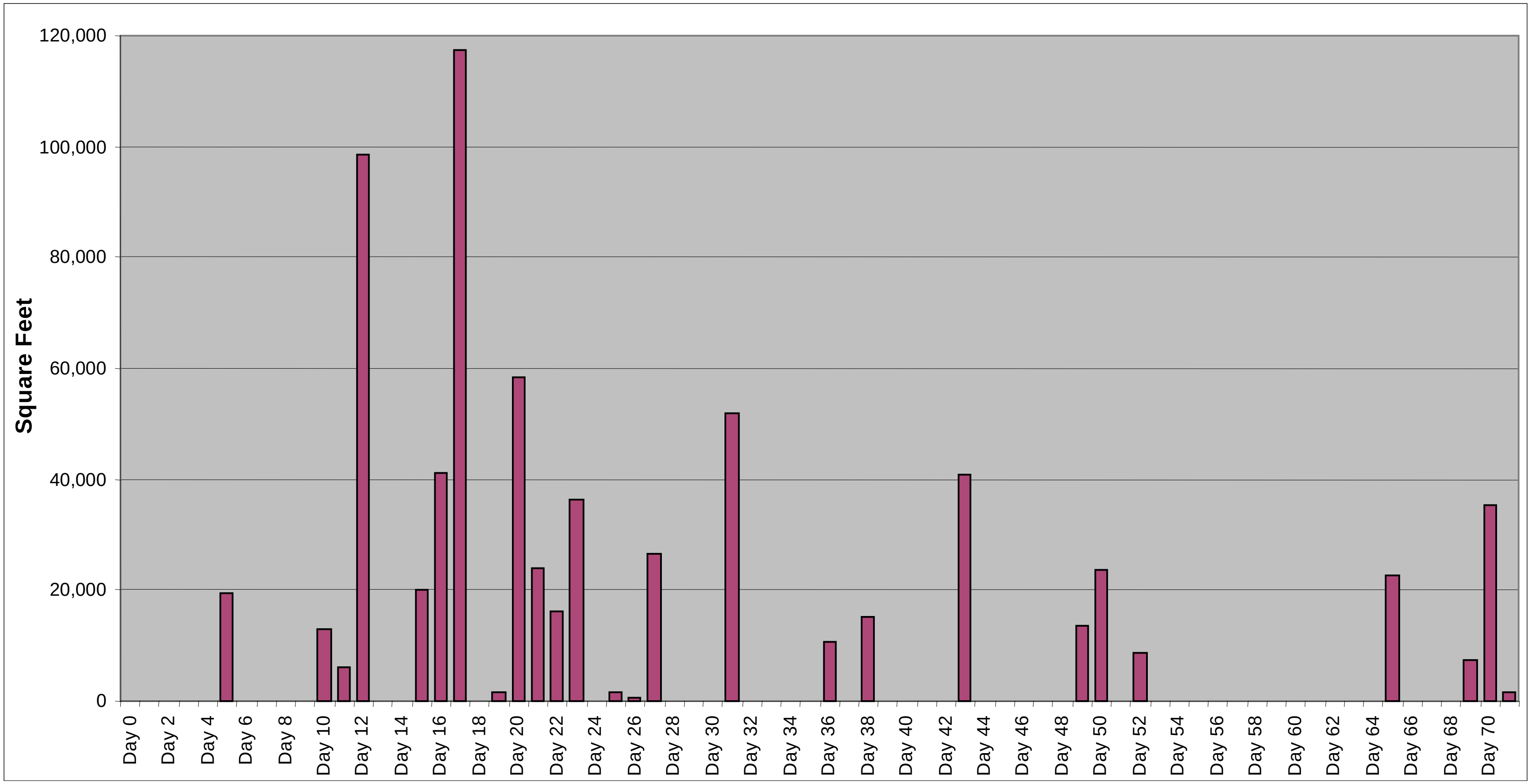
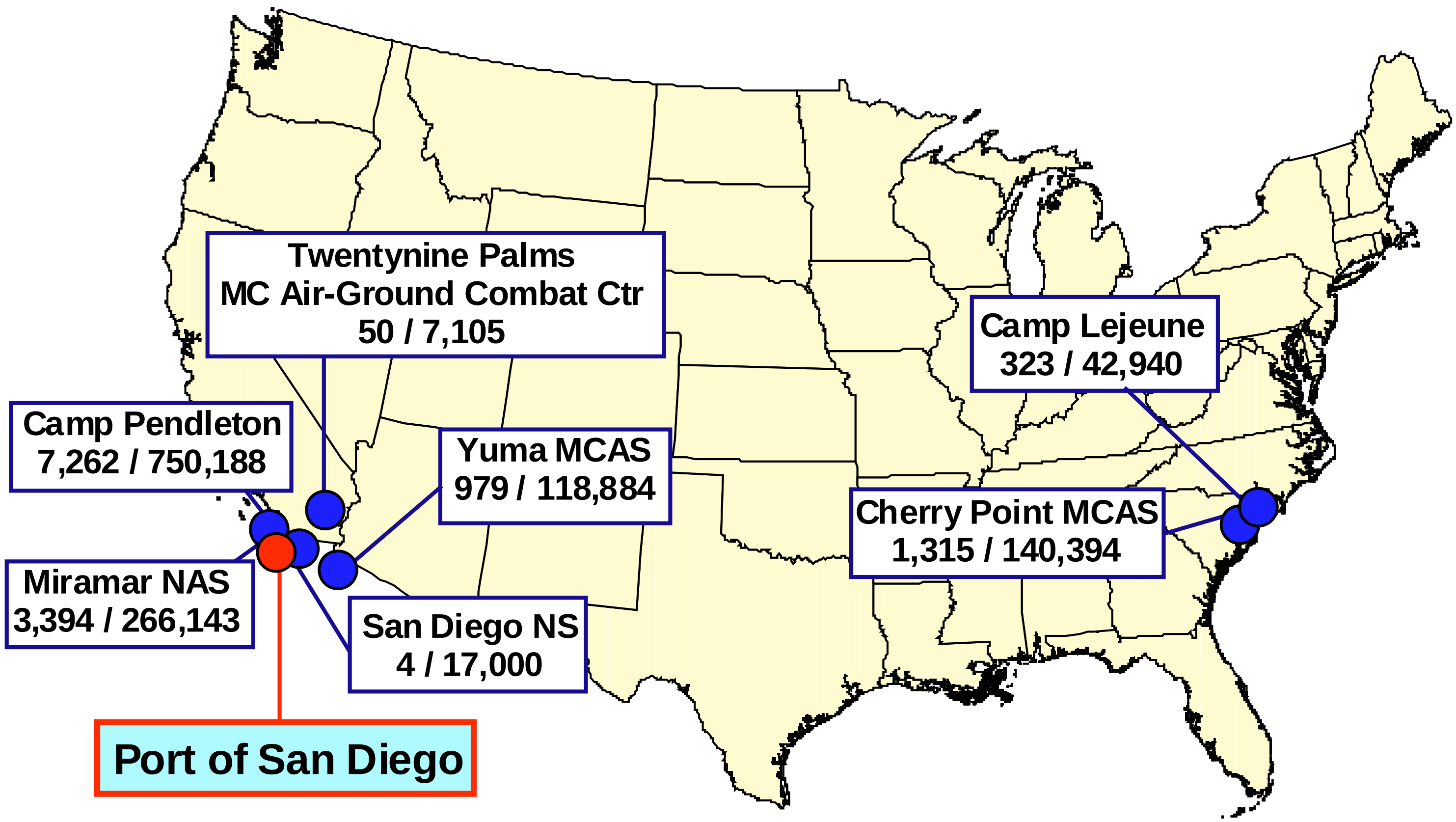


Figure C-18. Square Feet of Cargo Arriving by Rail to the Port of San Diego



KEY

Name of Origin
Qty of Items / Square Feet

Figure C-19. Amount of Cargo Arriving at the Port of San Diego by Origin

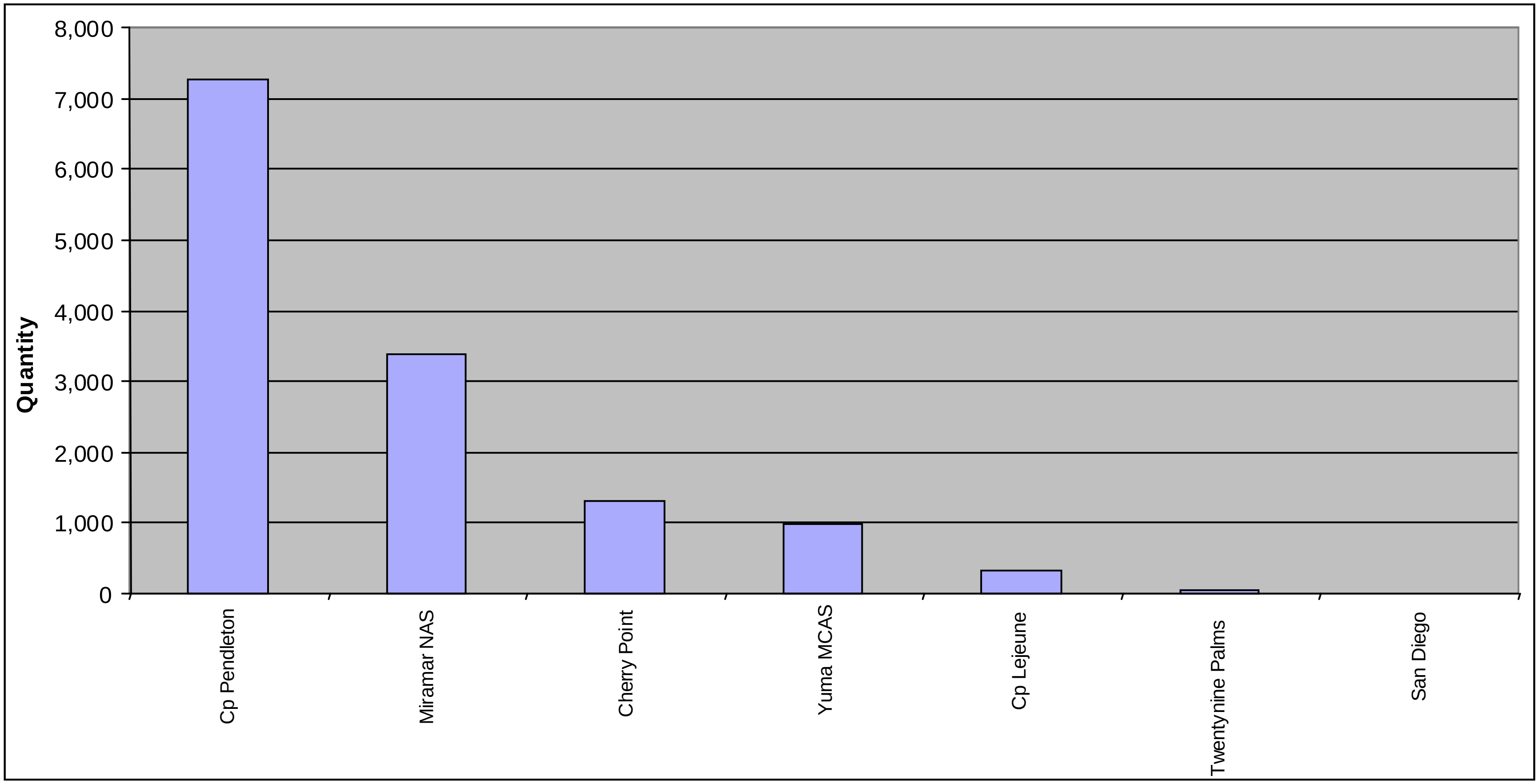


Figure C-20. Quantity of Items Arriving at the Port of San Diego by Origin

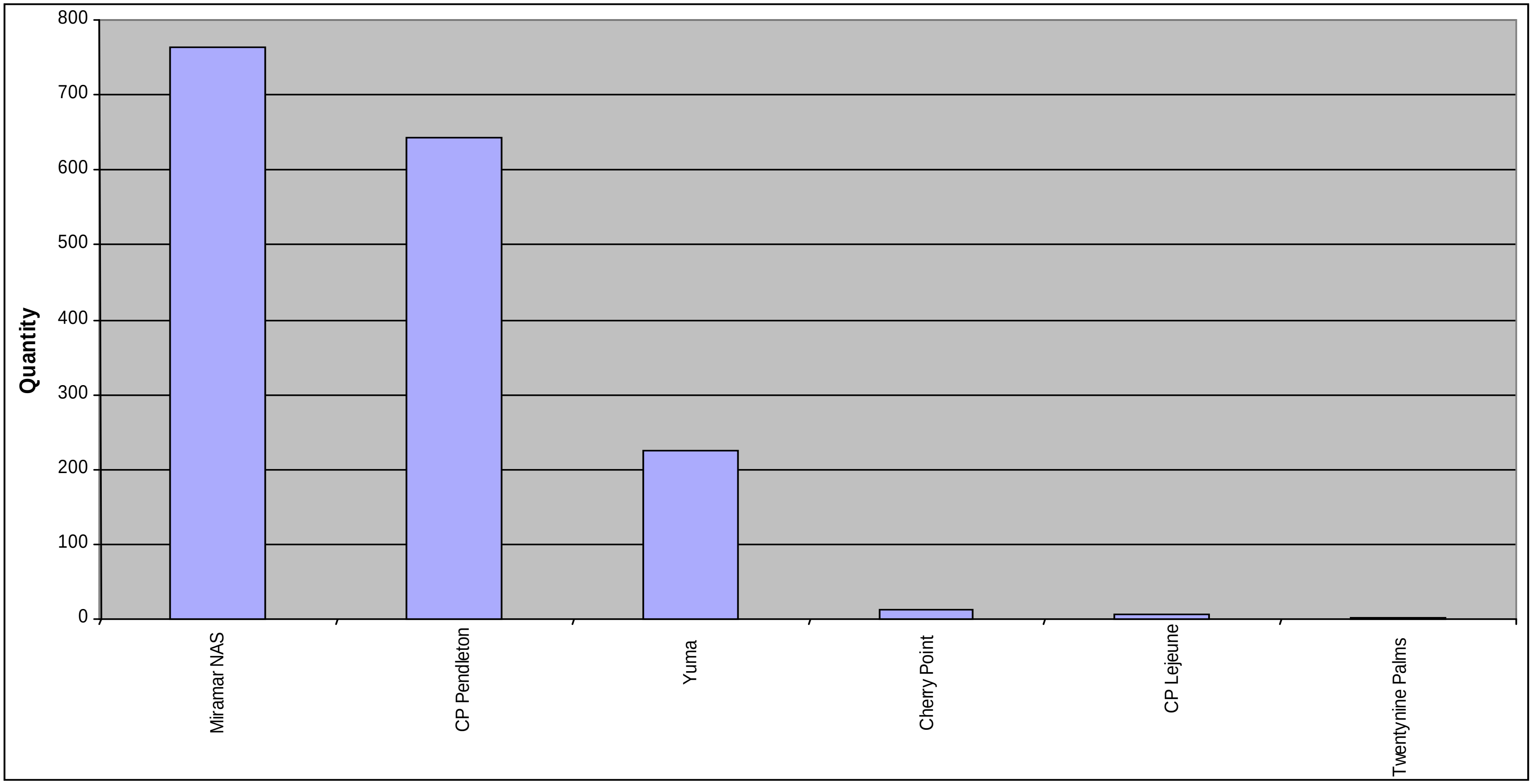


Figure C-21. Quantity of 20-Foot Containers Arriving at the Port of San Diego by Origin

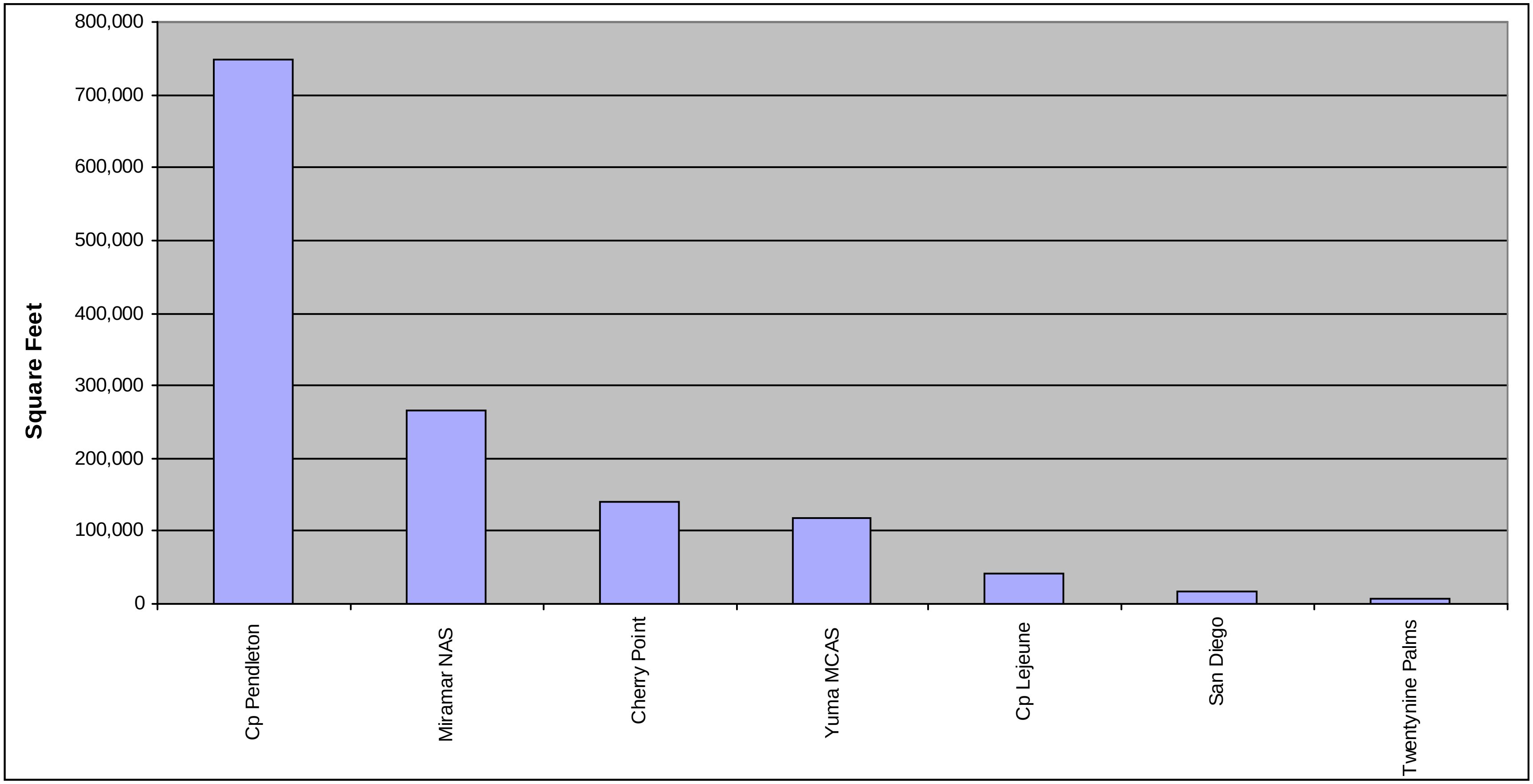


Figure C-22. Square Feet of Cargo Arriving at the Port of San Diego by Origin

APPENDIX D

PORT OF SAN DIEGO
Assault Follow On Echelon

The graphs in this appendix represent the cargo scheduled to arrive at the Port of San Diego for the Marine Corps Assault Follow on Echelon (AFOE) as outlined in the TPFDD. Cargo for the AFOE is scheduled to arrive at the port starting on day 15 and continuing through day 40.

Navy amphibious ships will most likely transport the assault echelon, but the requirement still needs to be taken into consideration as the AFOE may compete for resources at the port. Graphs for cargo scheduled to be transported via MSC ship from the Port of San Diego are provided in Appendix C.

The Port of San Diego is scheduled to receive cargo from 11 separate origins. The cargo consists entirely of unit equipment.

A map of the origin locations is provided in Figure D-1. The quantity of railcars arriving at the Port of San Diego is provided in Figure D-2. Figures D-3 through D-6 show the quantity of items by category arriving at the port. Figures D-7 through D-10 show the same information in terms of square footage.

The breakbulk spike on C+38 shown in Figure D-6 consists mainly of small containers (57"x96"x82"), repair kits, and chemical suits all coded as non-containerizable.

Figures D-11 through D-13 provide a breakdown of the quantity of items arriving at the port according to the mode of transportation (convoy and rail). Similarly, Figures D-14 through D-16 reflect the same information presented in terms of square footage.

Figure D-17 shows the amount of cargo in terms of quantity and square feet for each origin scheduled in the TPFDD. The bar graph in Figure D-18 provides the total quantity of items for each origin. The quantity of containers arriving at the port from each origin is provided in Figure D-19. The largest container requirement will be arriving at the port from Camp Pendleton, California. Figure D-20 shows the square feet of cargo by origin.

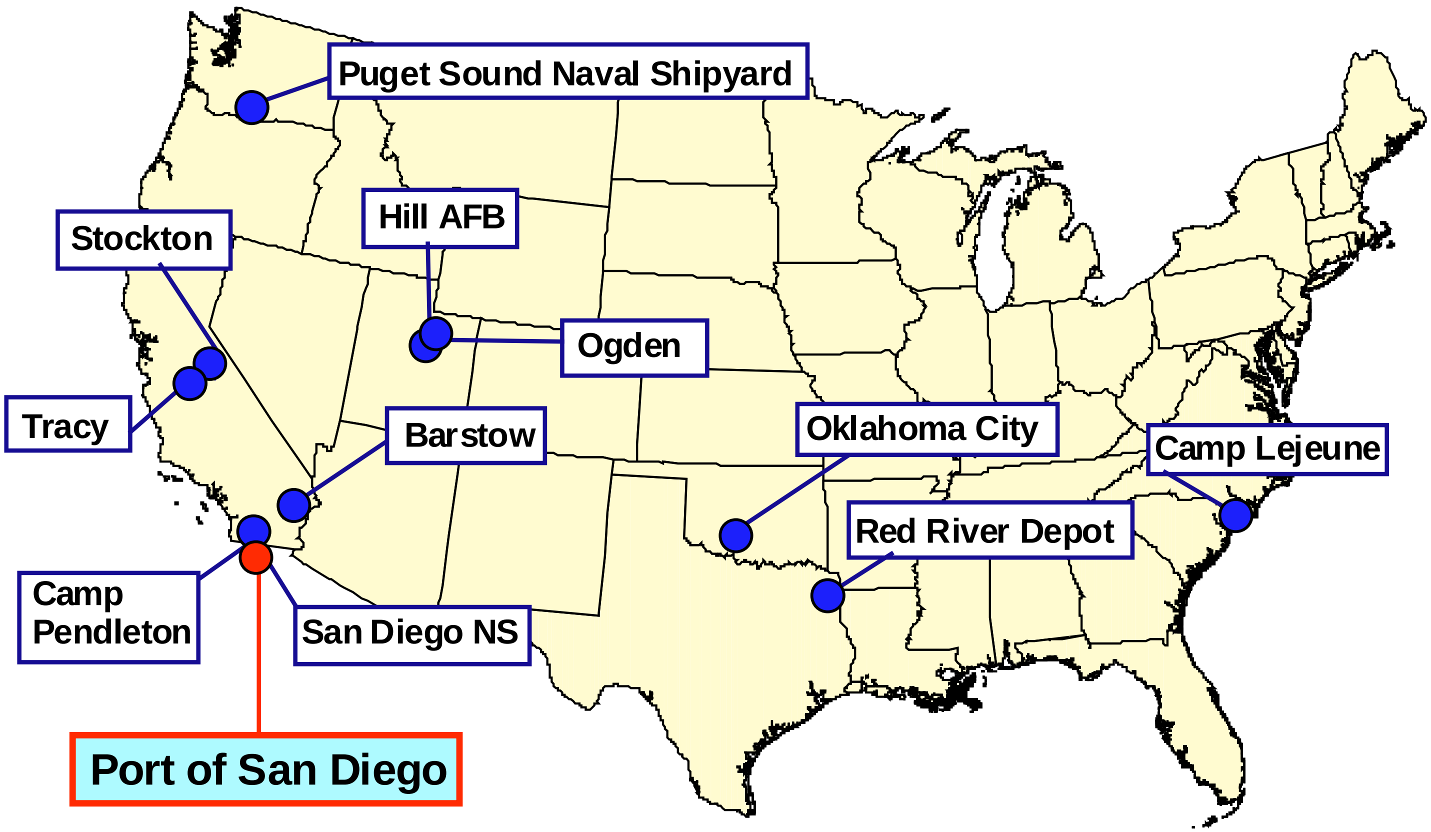


Figure D-1. Cargo Arrives at the Port of San Diego from Seven Origins (Assault Follow on Echelon)

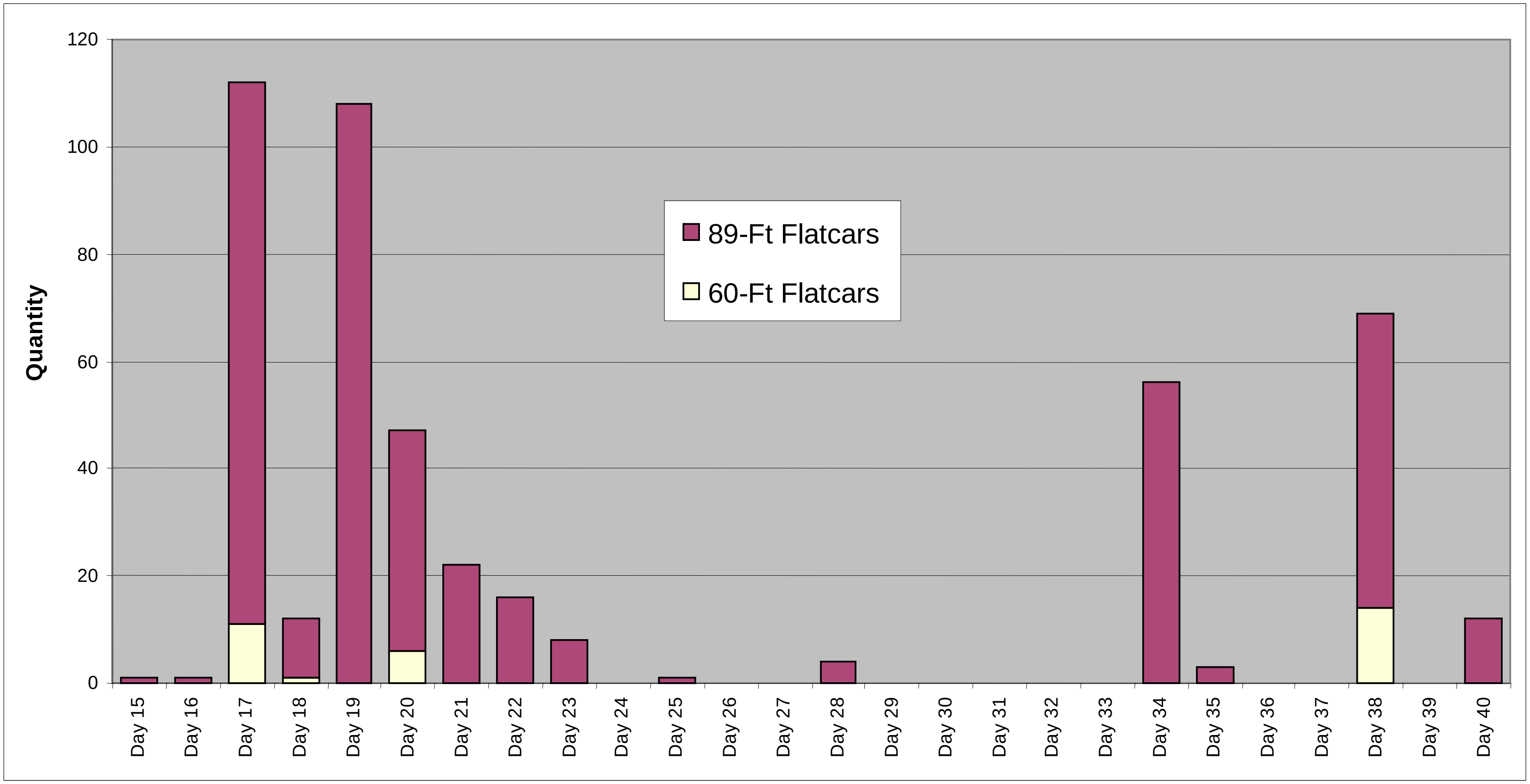


Figure D-2. Quantity of Railcars Arriving at the Port of San Diego (AFOE)

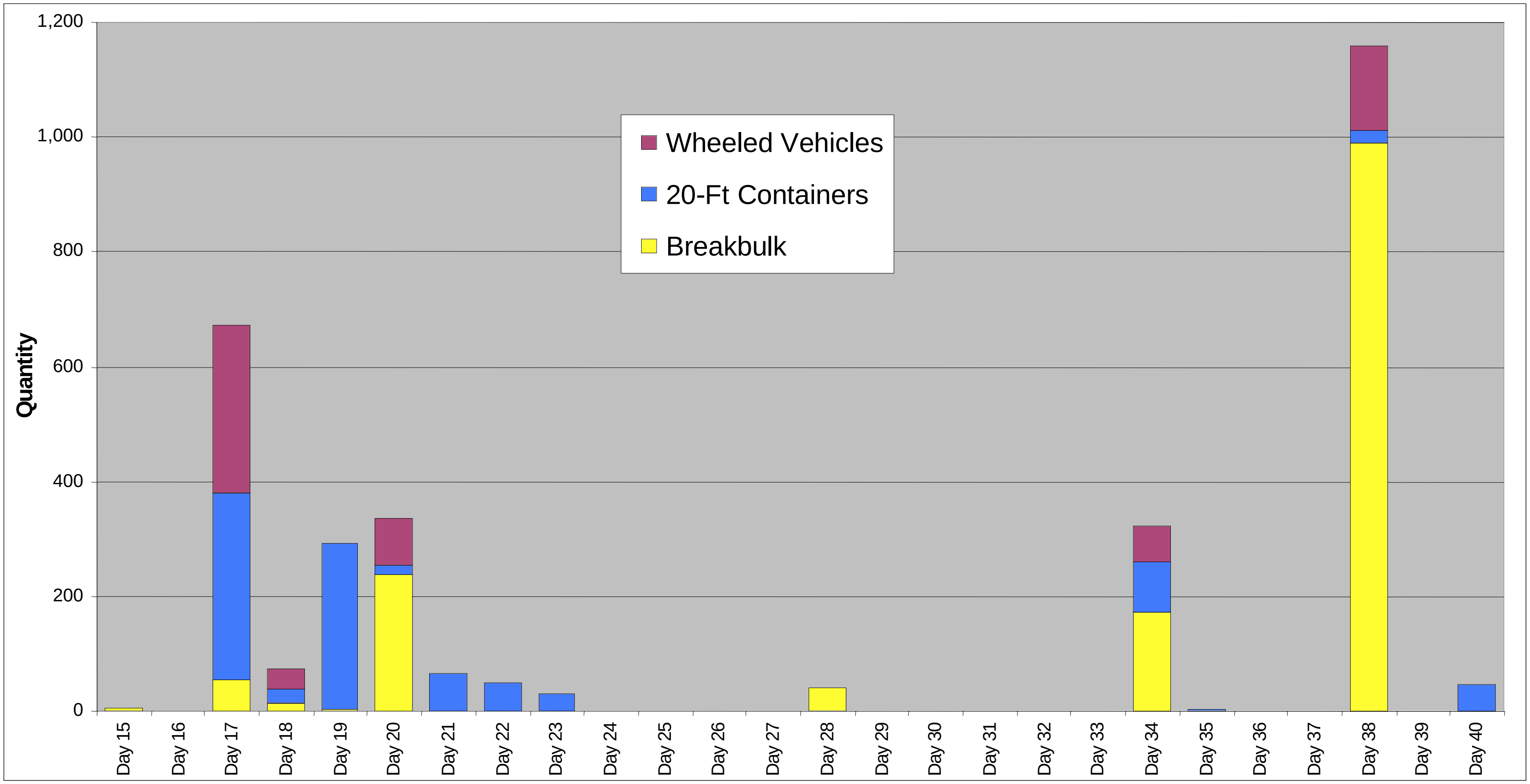


Figure D-3. Total Quantity of Items Arriving at the Port of San Diego (AFOE)

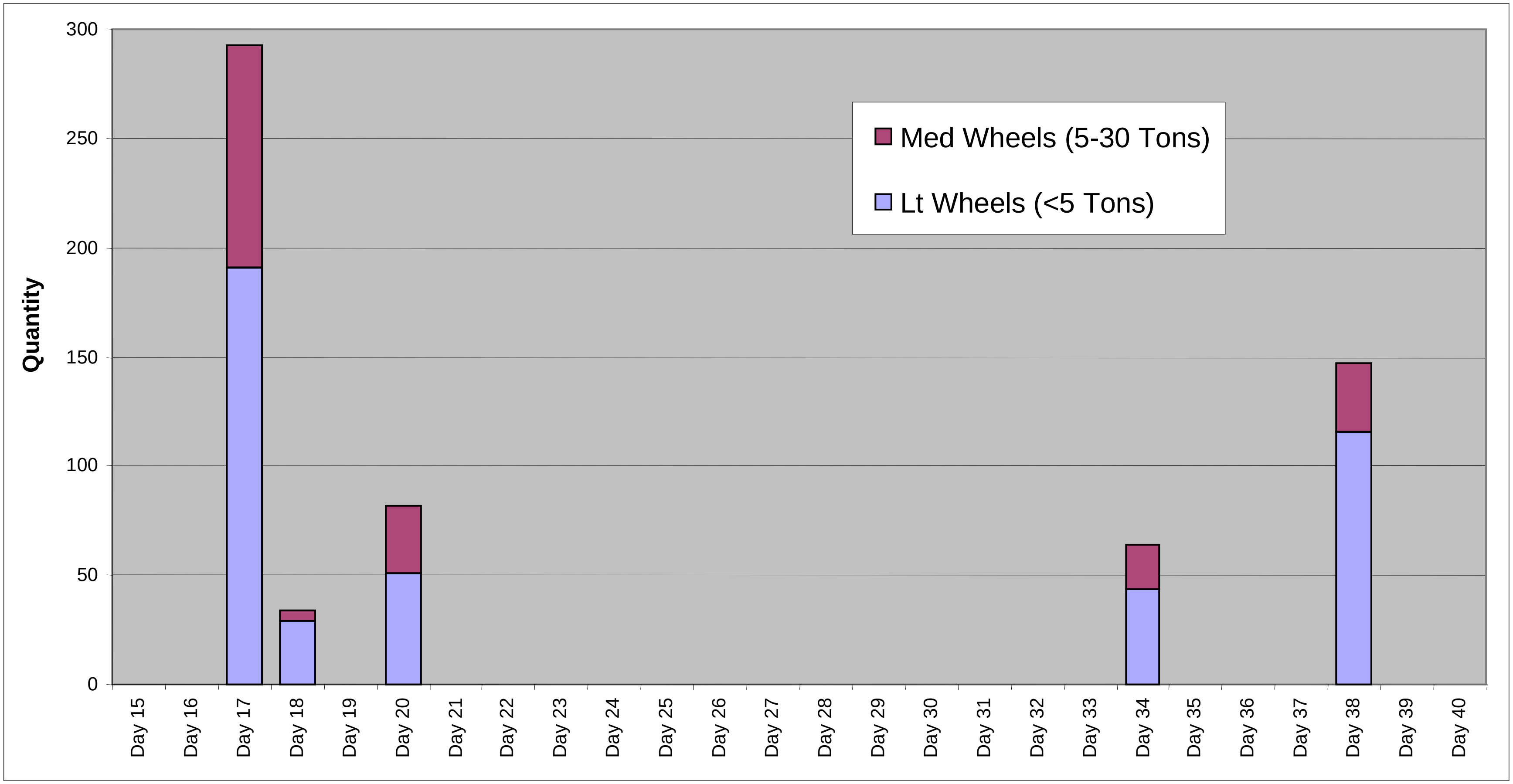


Figure D-4. Quantity of Wheeled Vehicles Arriving at the Port of San Diego (AFOE)

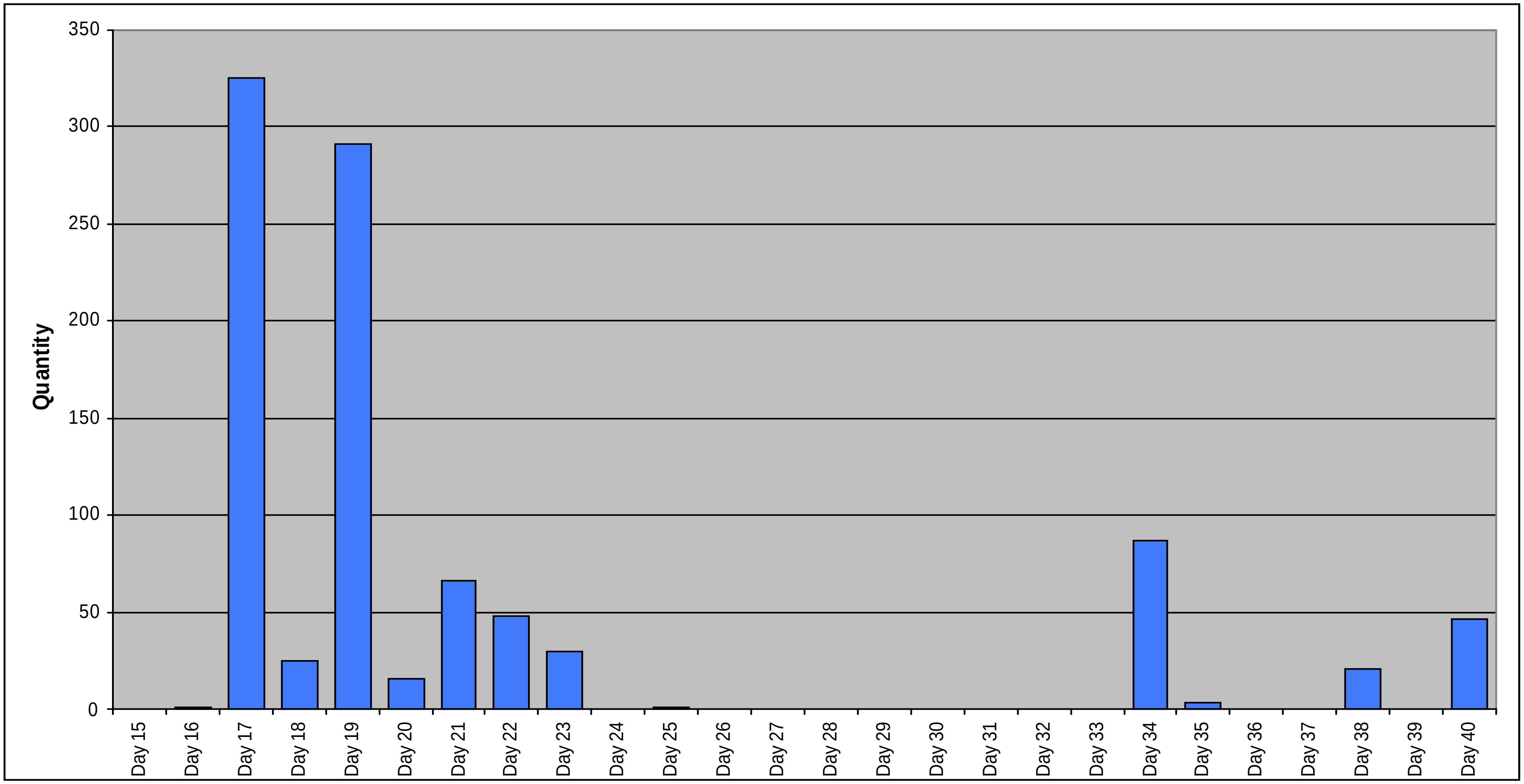


Figure D-5. Quantity of Containers Arriving at the Port of San Diego (AFOE)

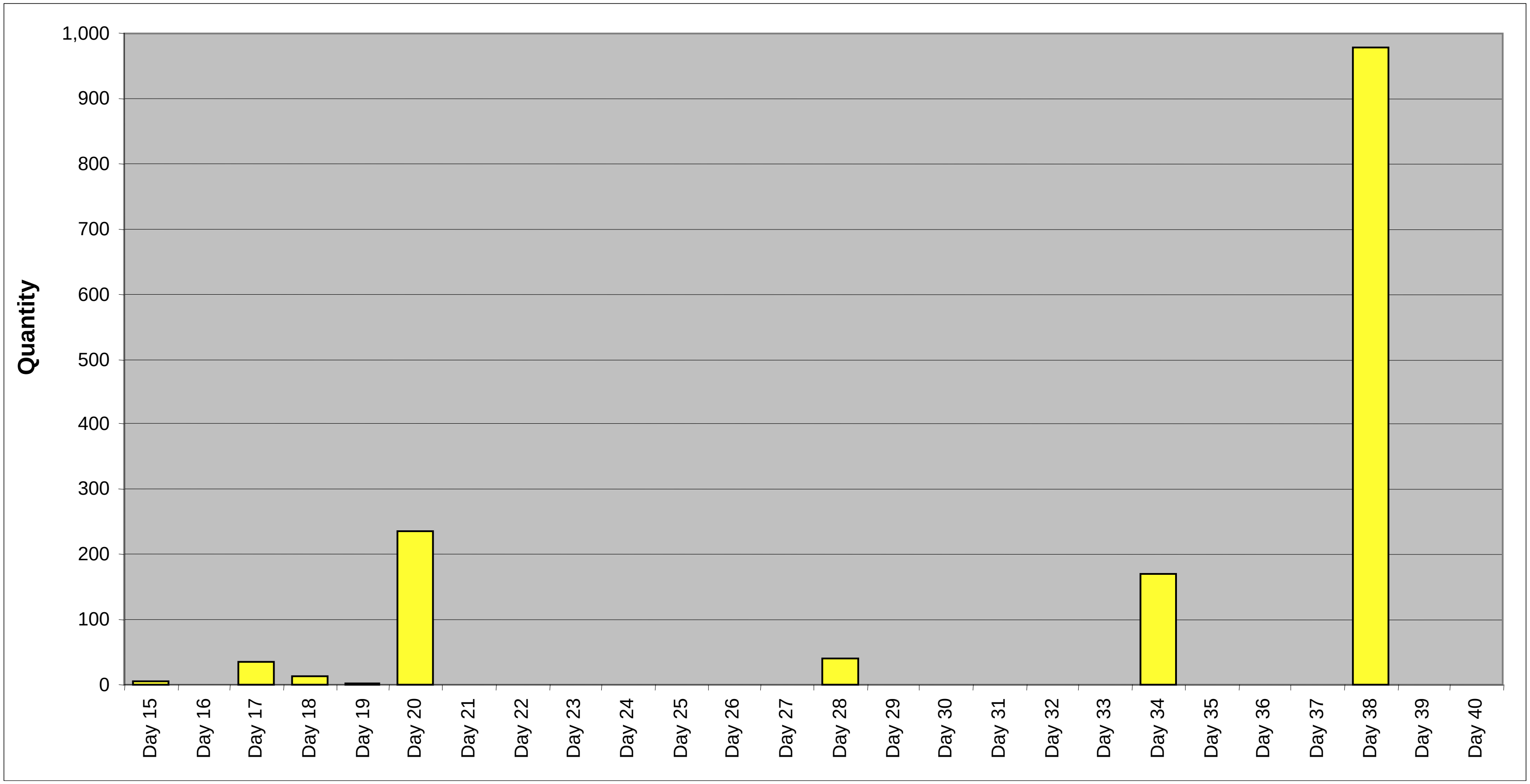


Figure D-6. Quantity of Breakbulk Items Arriving at the Port of San Diego (AFOE)

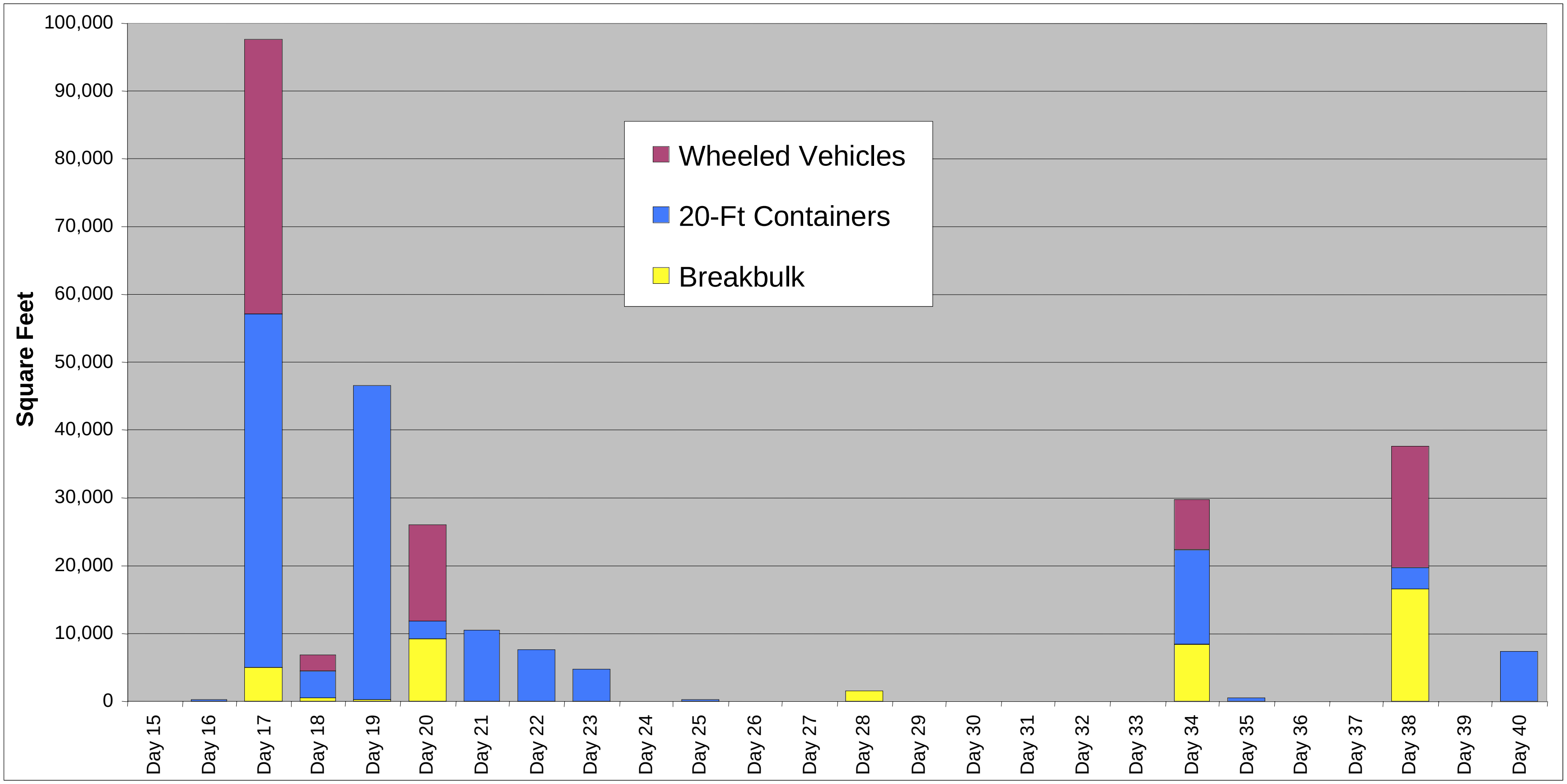


Figure D-7. Total Square Feet of Cargo Arriving at the Port of San Diego (AFOE)

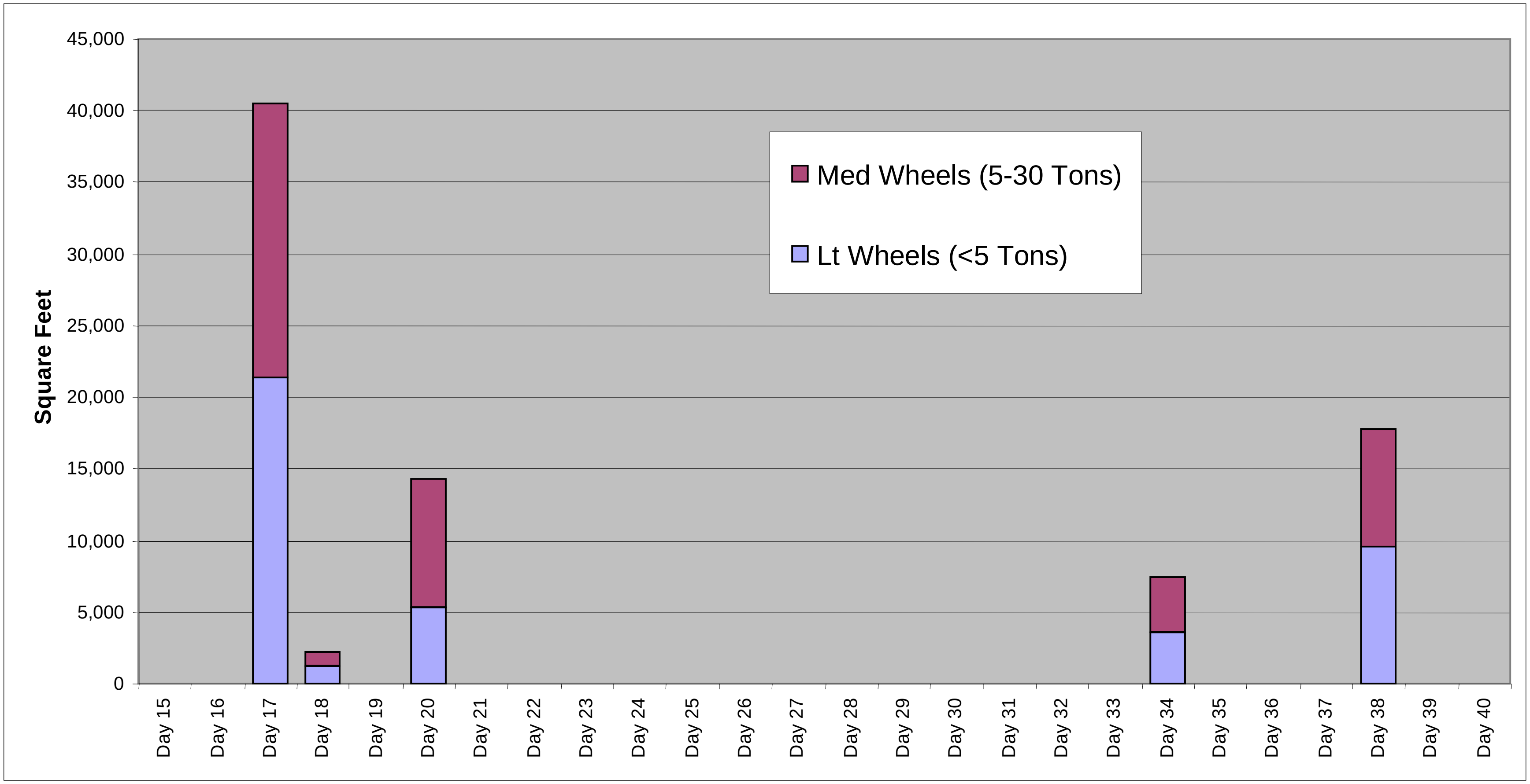


Figure D-8. Square Feet of Wheeled Vehicles Arriving at the Port of San Diego (AFOE)

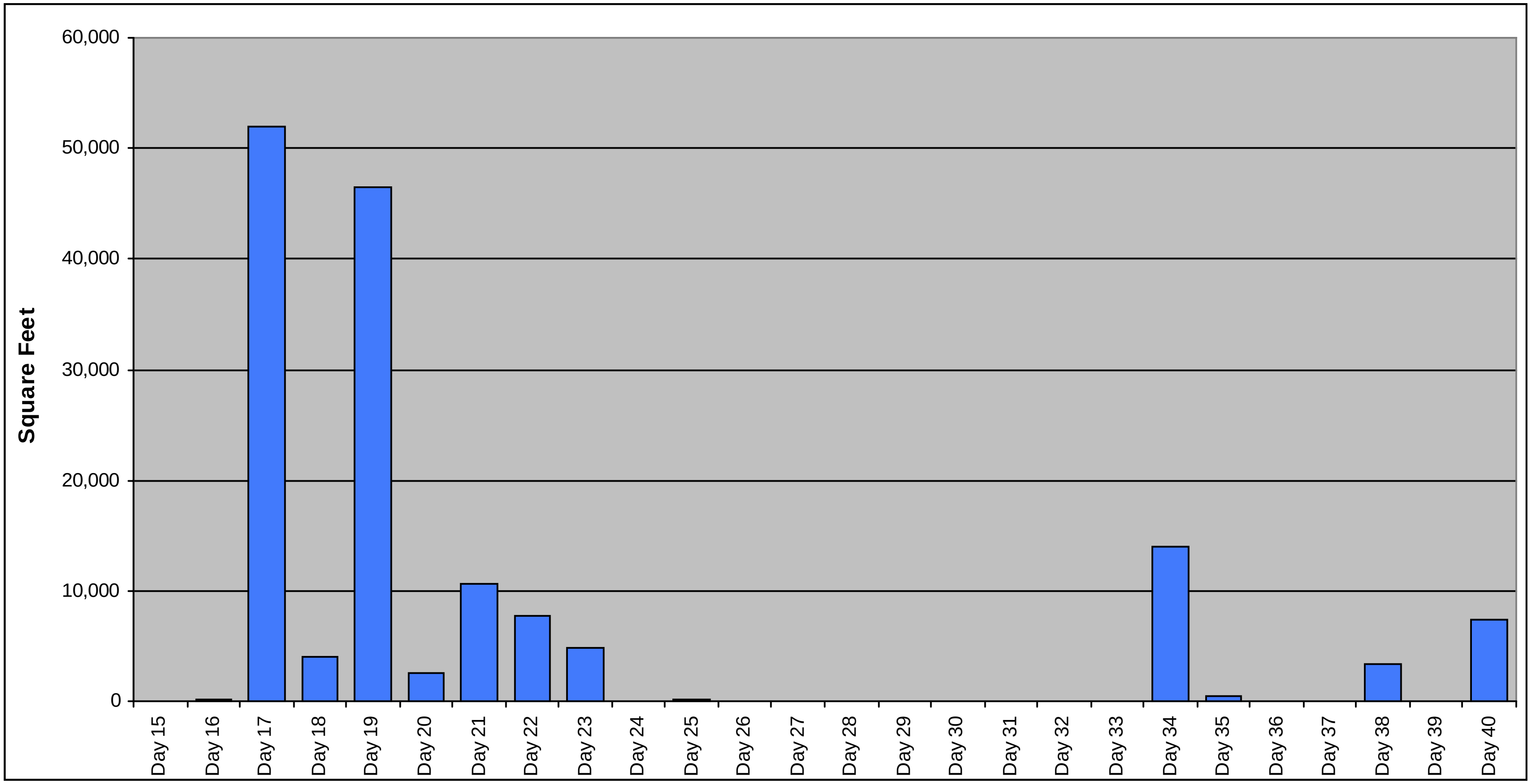


Figure D-9. Square Feet of Containers Arriving at the Port of San Diego (AFOE)

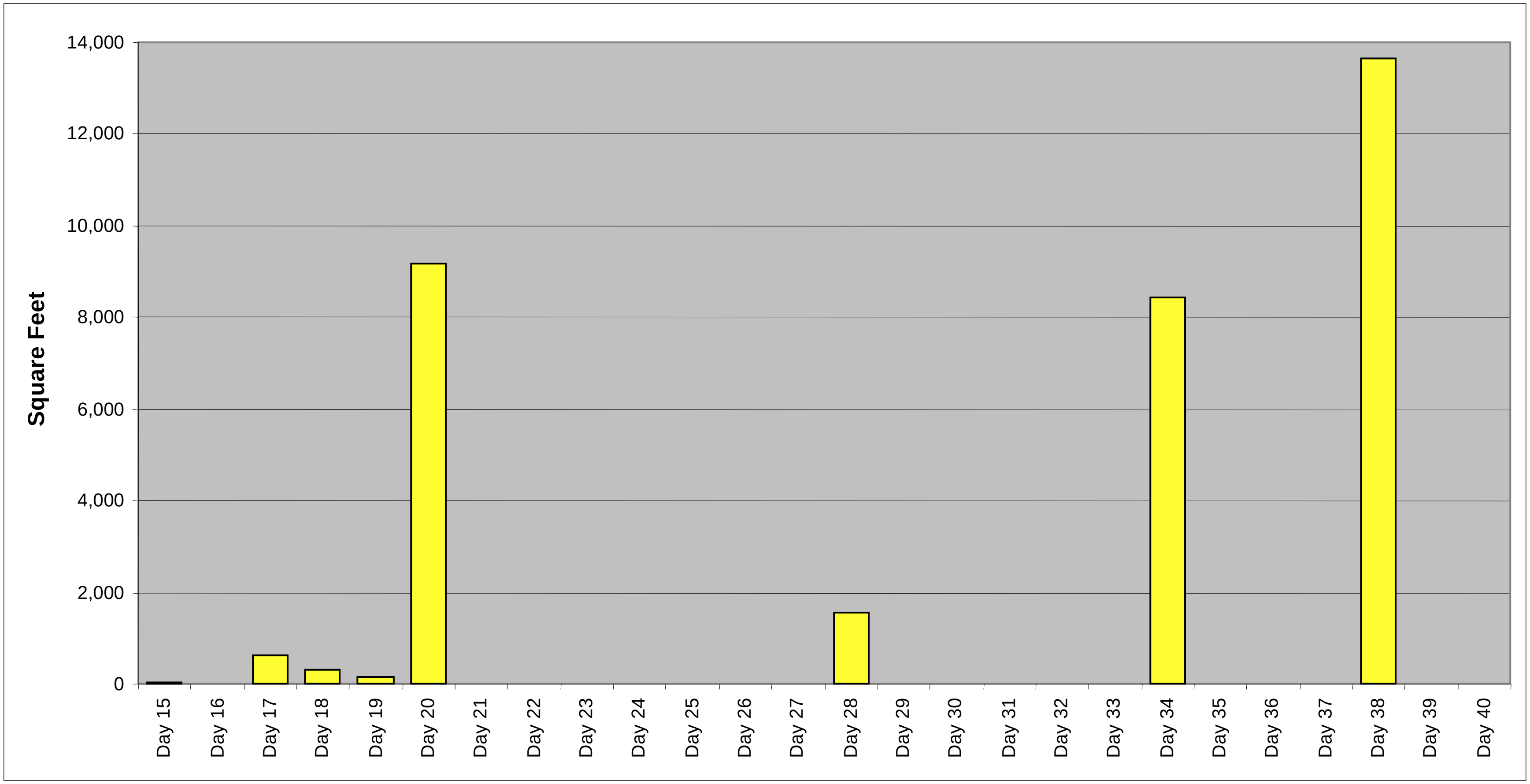


Figure D-10. Square Feet of Breakbulk Cargo Arriving at the Port of San Diego (AFOE)

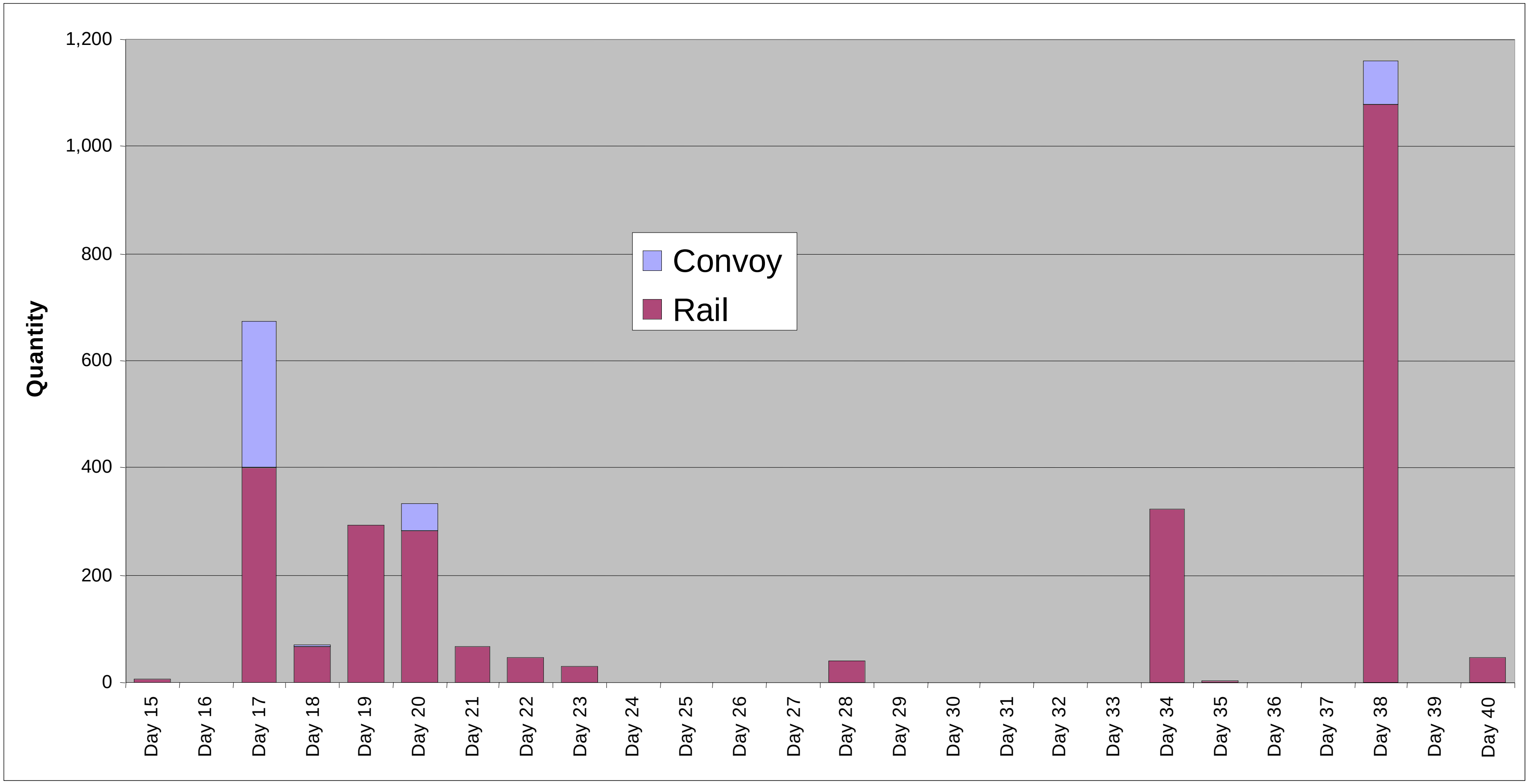


Figure D-11. Quantity of Items Arriving by Mode to the Port of San Diego (AFOE)

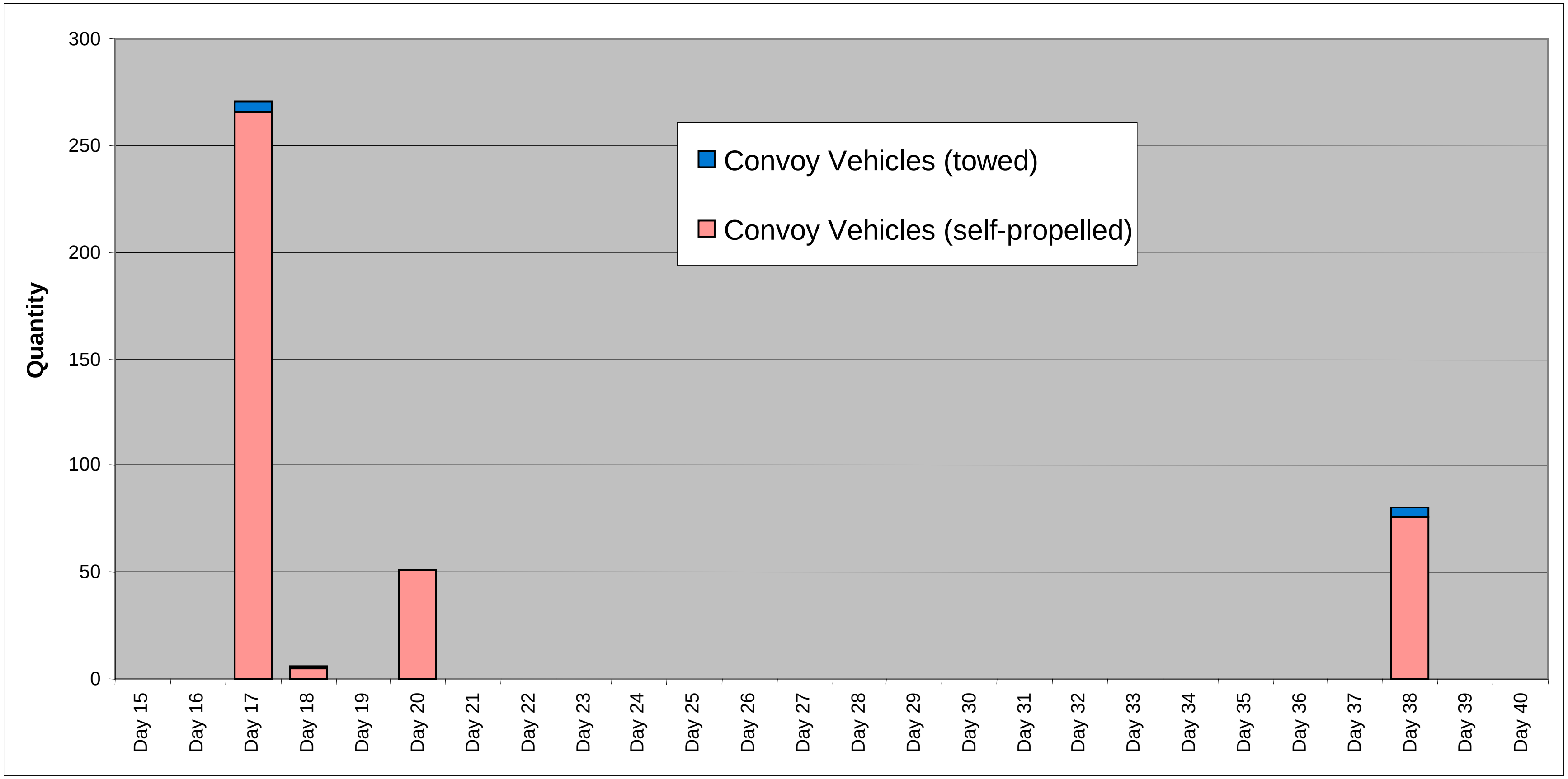


Figure D-12. Quantity of Wheeled Vehicles Convoying to the Port of San Diego (AFOE)

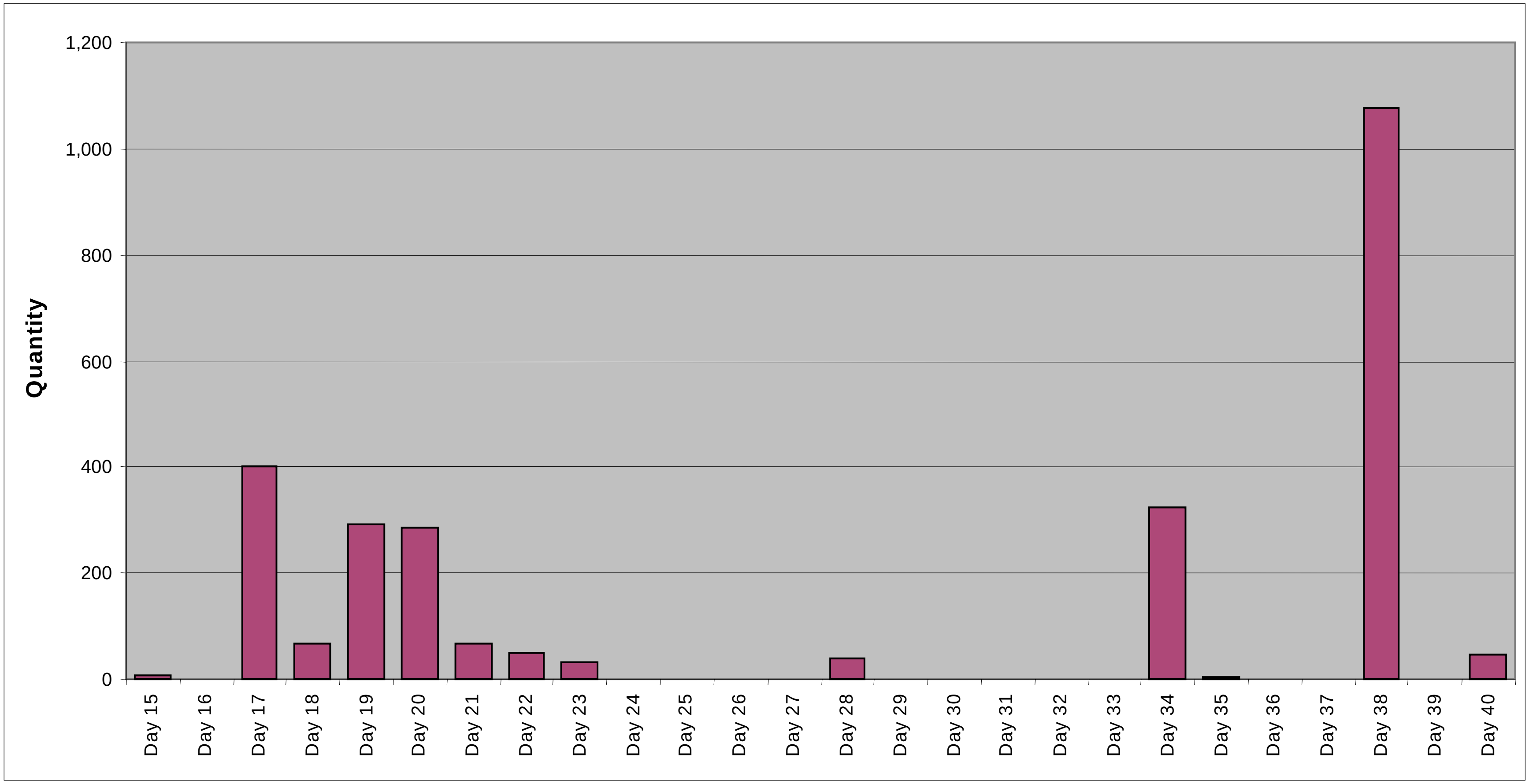


Figure D-13. Quantity of Items Arriving by Rail to the Port of San Diego (AFOE)

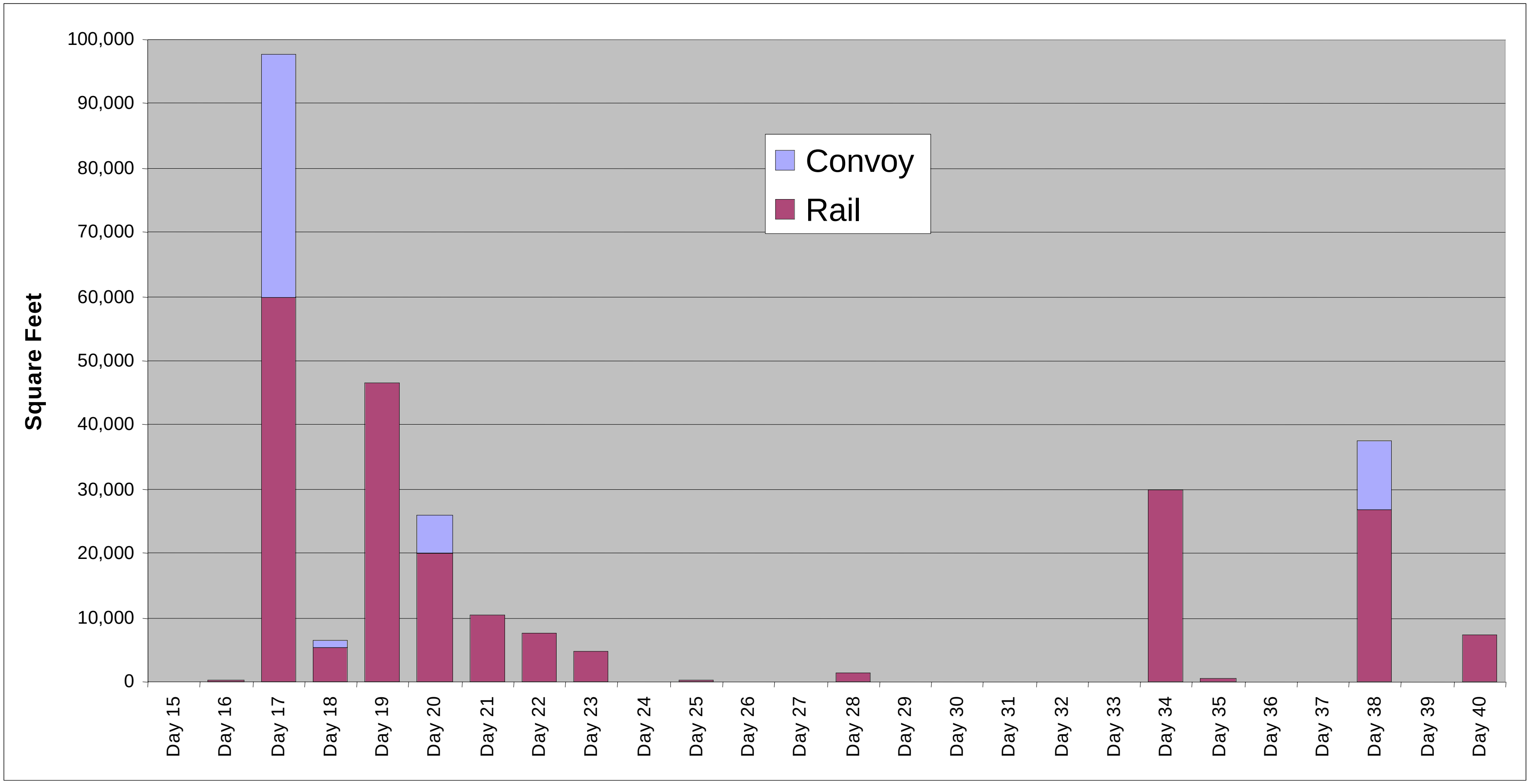


Figure D-14. Square Feet of Cargo Arriving by Mode to the Port of San Diego (AFOE)

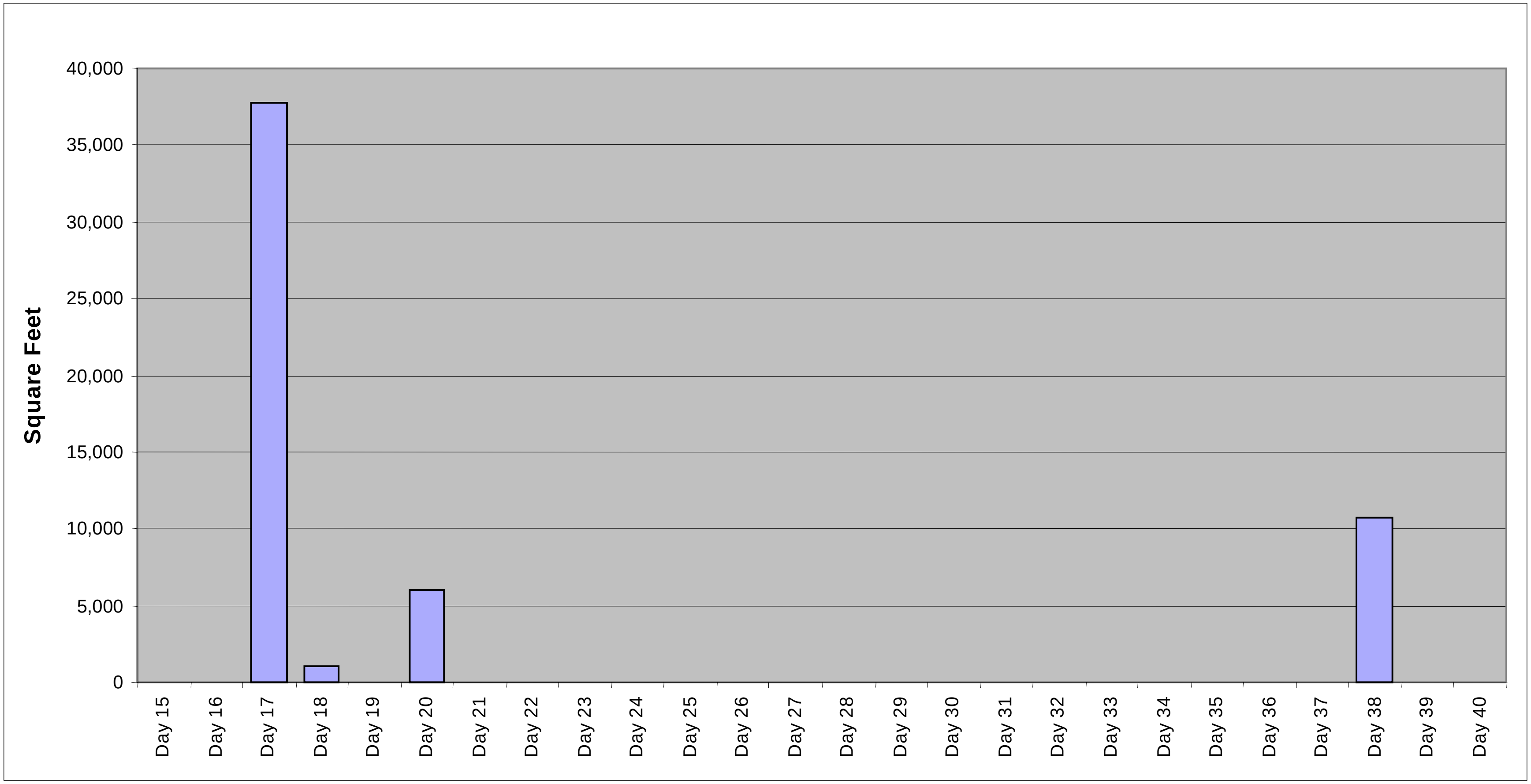


Figure D-15. Square Feet of Wheeled Vehicles Convoying to the Port of San Diego (AFOE)

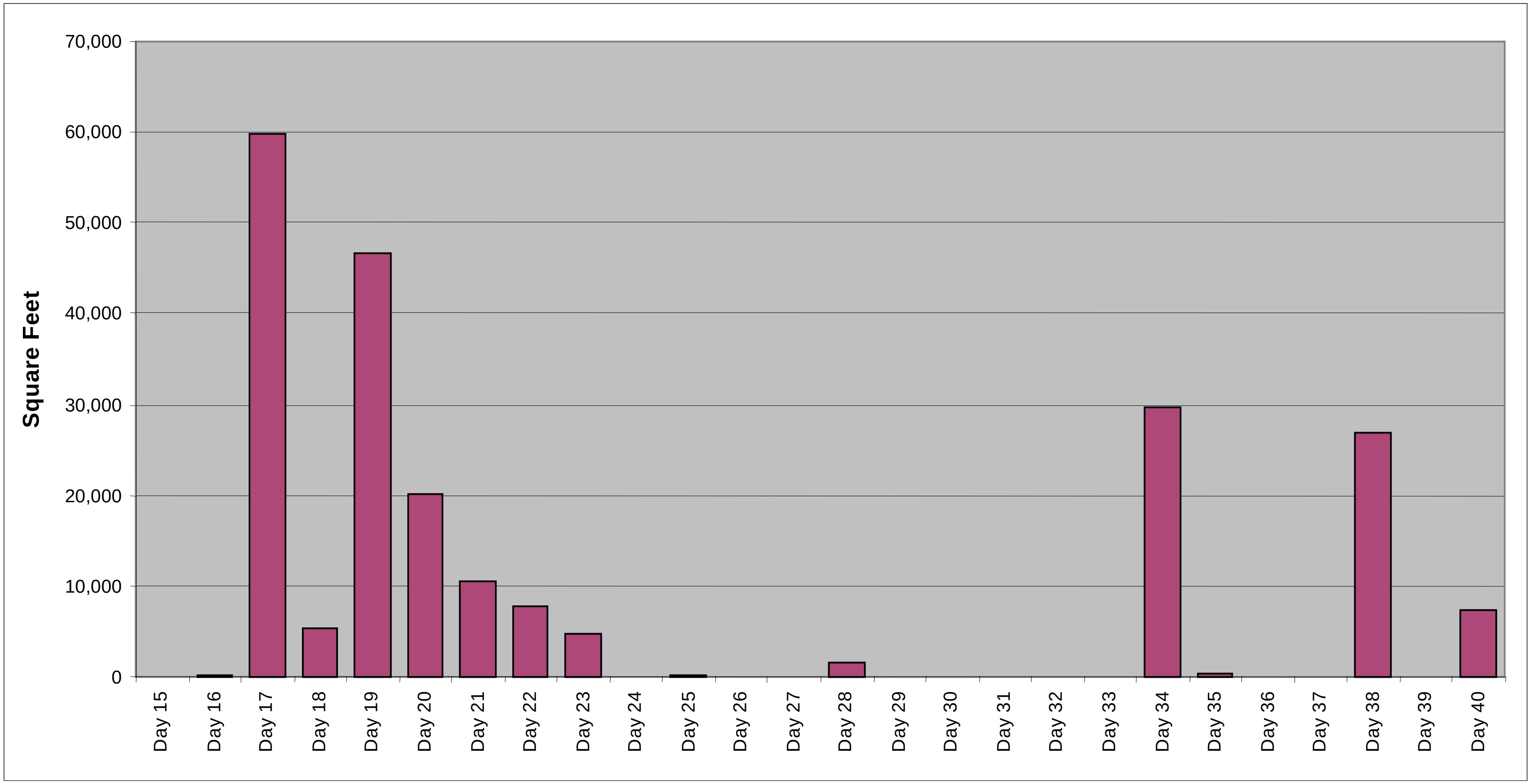


Figure D-16. Square Feet of Cargo Arriving by Rail to the Port of San Diego (AFOE)

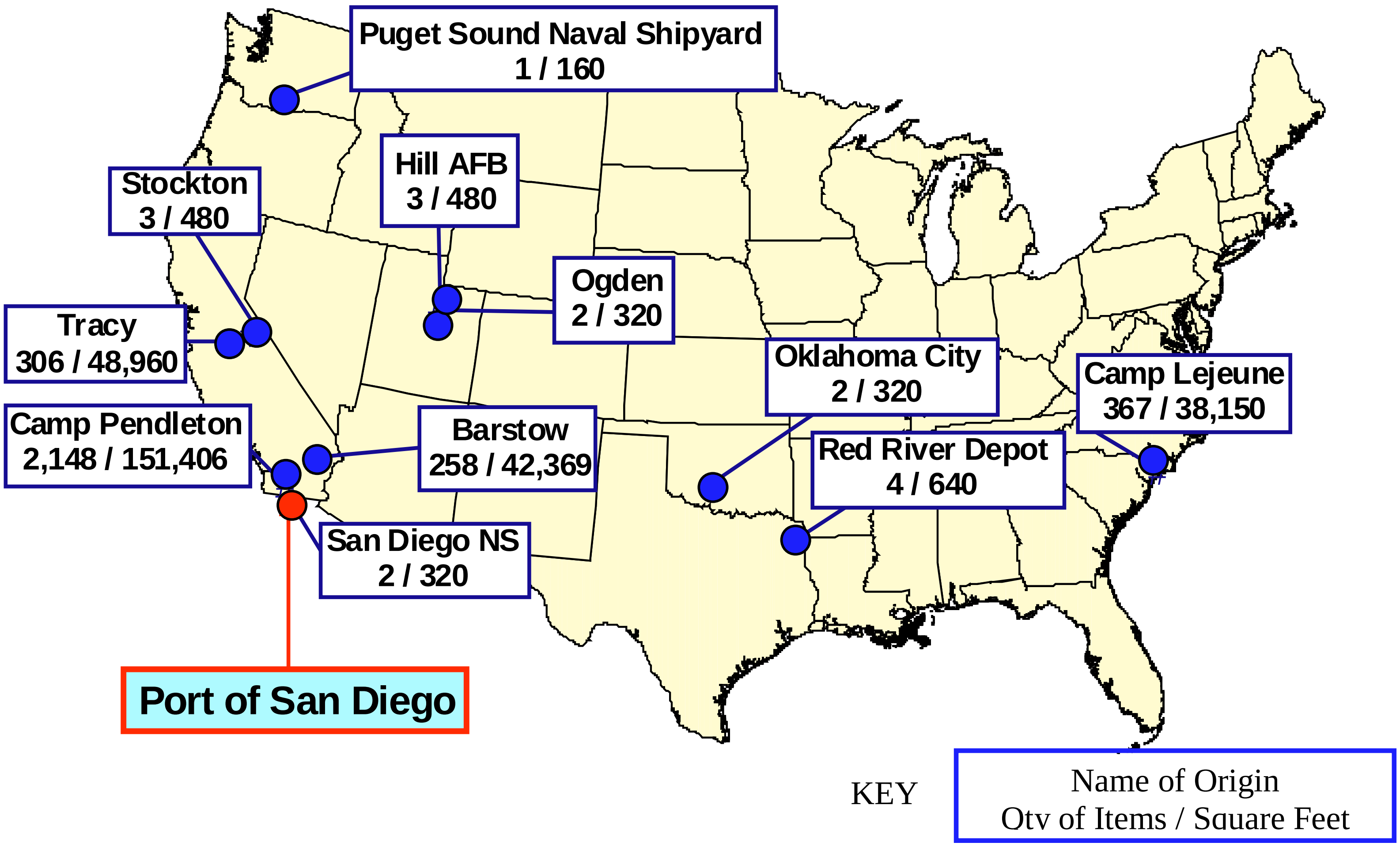


Figure D-17. Cargo Arrives at the Port of San Diego by Origin (Assault Follow on Echelon)

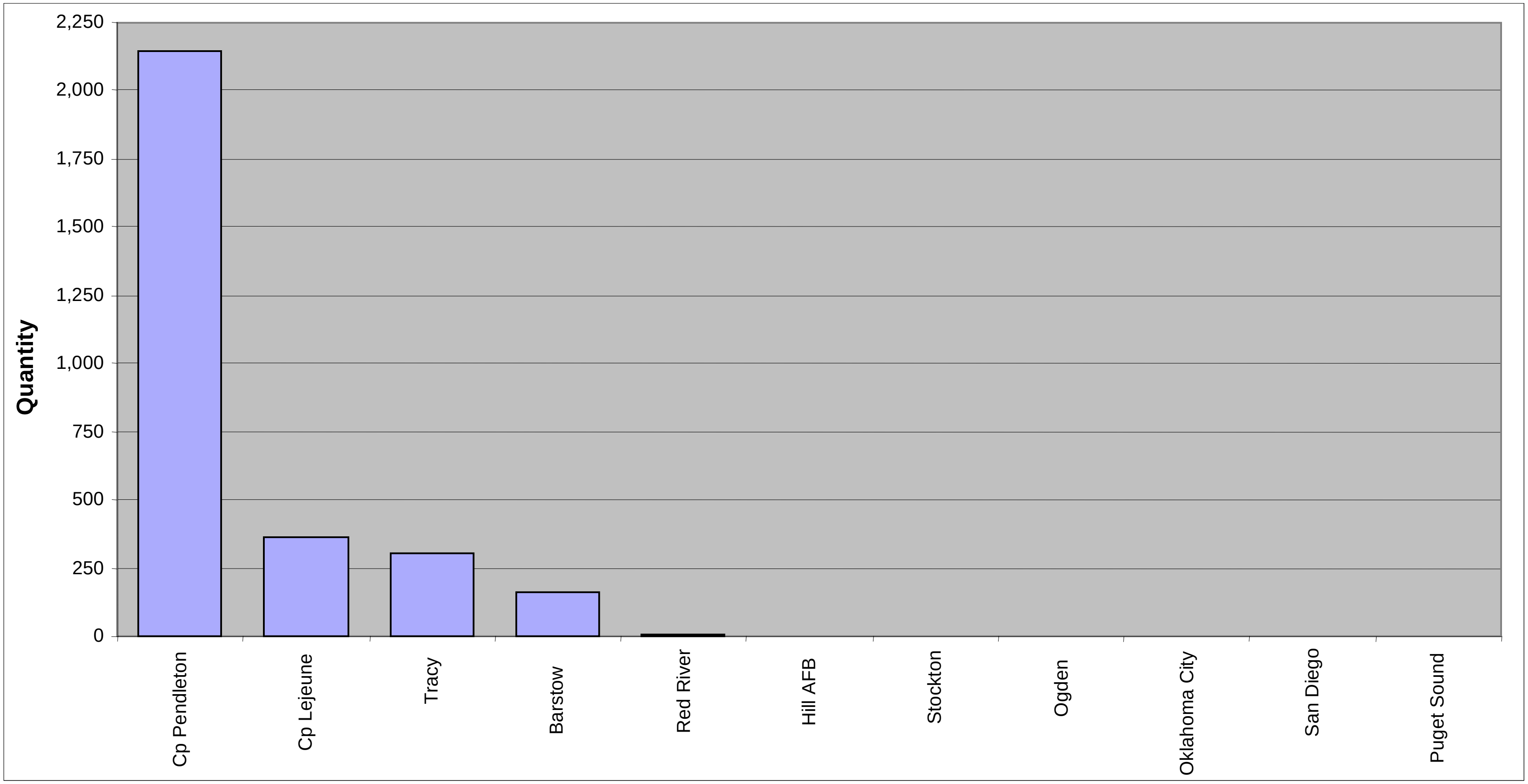


Figure D-18. Quantity of Items Arriving at the Port of San Diego by Origin (AFOE)

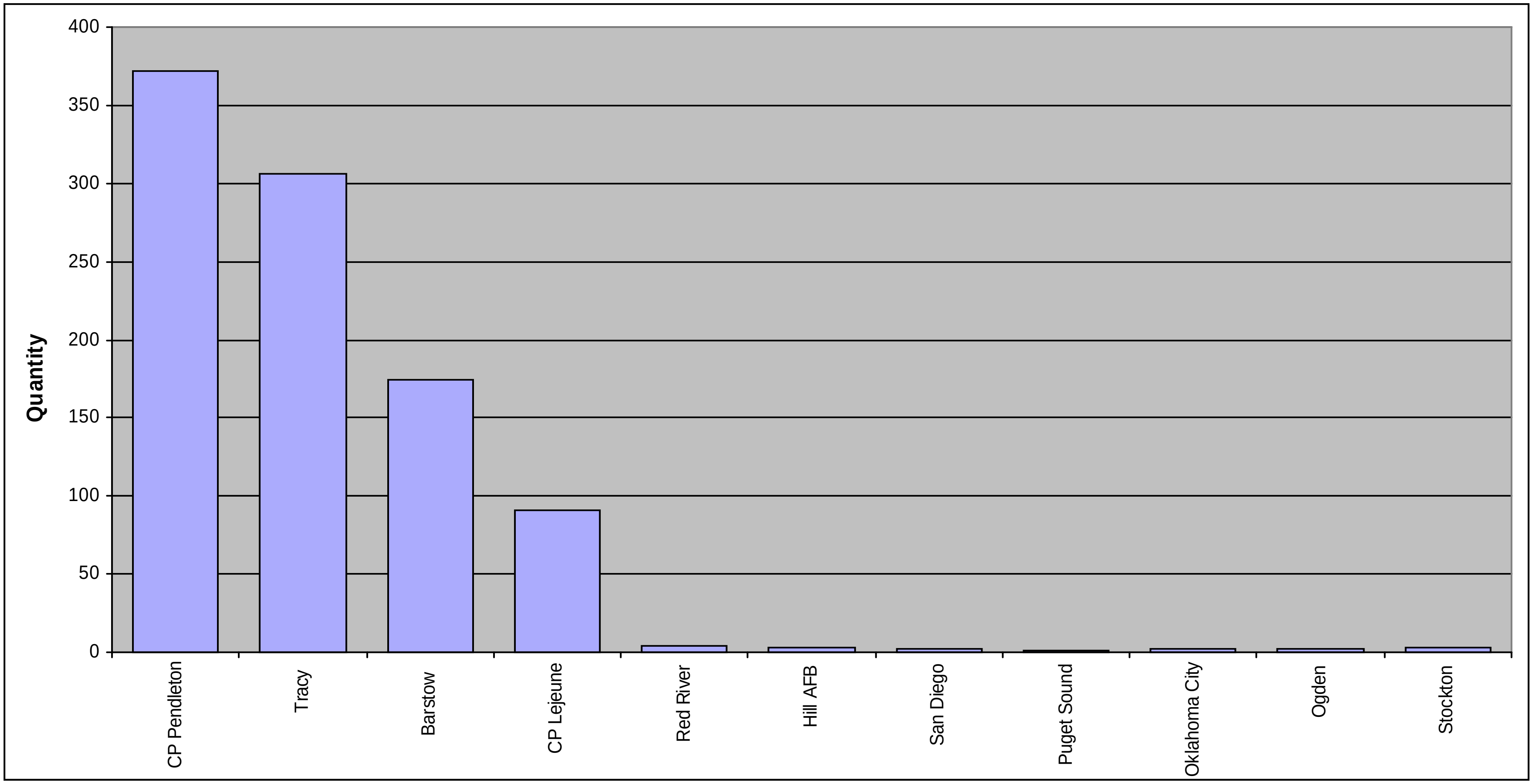


Figure D-19. Quantity of Containers Arriving at the Port of San Diego by Origin (AFOE)

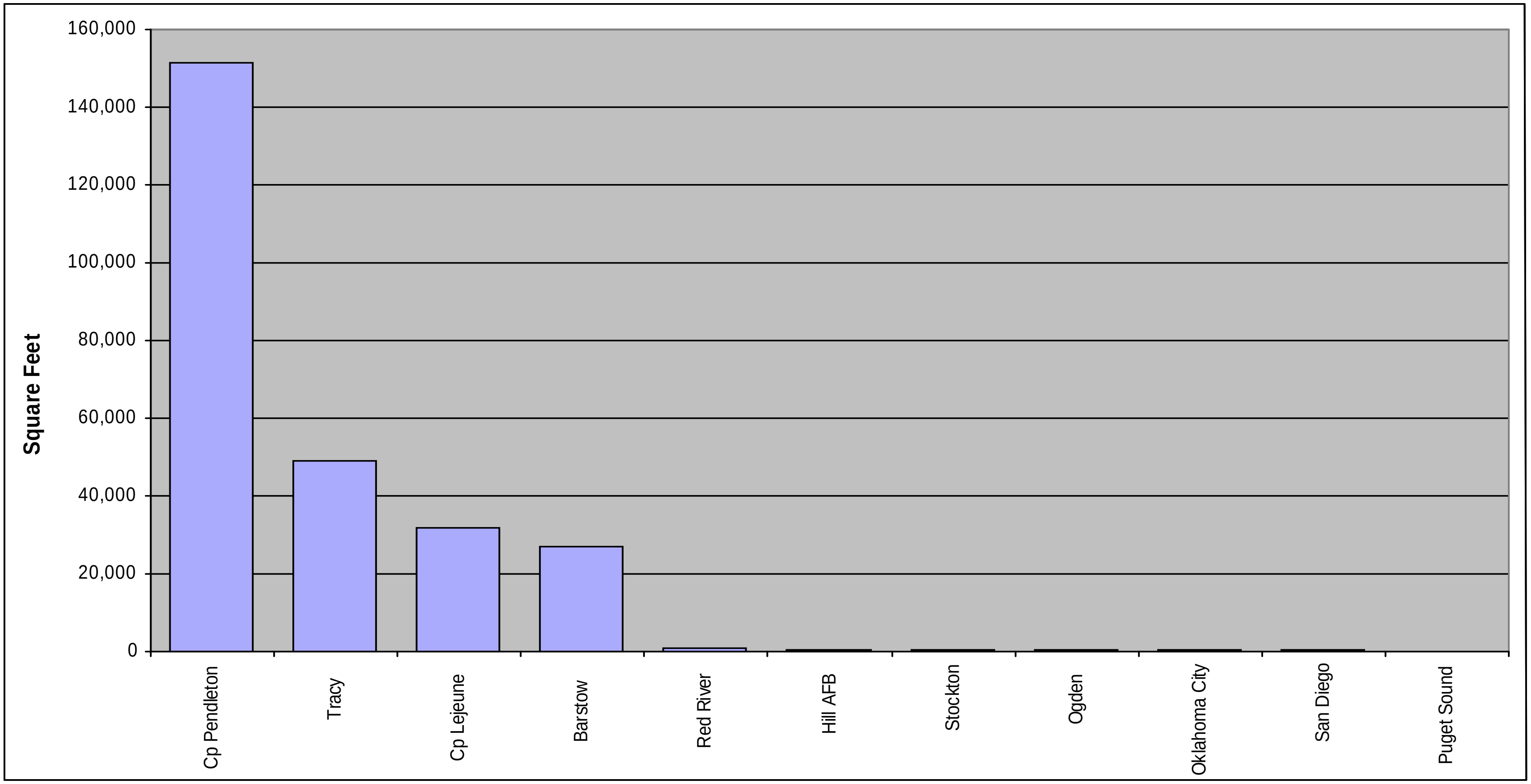


Figure D-20. Square Feet of Cargo Arriving at the Port of San Diego by Origin (AFOE)

APPENDIX E

Port of Seattle

According to the TPFDD, there are fourteen origins sending cargo to the Port of Seattle (Figure E-1). This cargo is a mix of Army, Navy, Air Force, Marine Corps, and Joint sustainment cargo. Since all of the origins are in excess of 400 miles away, all of the cargo is arriving at the Port of Seattle by rail. Figures E-2 through E-4 show the quantity of transports (containers and railcars) required to move cargo to the Port of Seattle.

Figures E-5 through E-8 illustrate the quantity of items arriving at the port. Figure E-5 is the total quantity of items. Figures E-6 through E-8 break this down into more detail. Figure E-6 is the quantity of vehicles. Normally, vehicles are broken into categories. However, based on the details given in the TPFDD, there is no way to determine if these are wheeled or tracked vehicles, much less specific vehicle identification. Therefore, for this report they are simply categorized as "vehicles." Figure E-7 gives the quantity of containers arriving at the Port of Seattle. These are standard eight-and-one-half-foot high twenty-foot containers that TARGET has stuffed with small pieces of containerizable equipment. The remaining items, shown in Figure E-8, are either (1) too large to fit inside a container or (2) considered "not containerizable."

Similar to Figures E-5 through E-8, which lay out the quantity of items arriving, Figures E-9 through E-12 outlines the square footage of these categories of cargo.

As shown earlier, cargo arrives at the Port of Seattle from fourteen distinct origins. Figure E-13 shows visually the amount of cargo coming from each origin.

Figures E-14 and E-16 show the quantity and square footage, respectively, of cargo arriving at the Port of Seattle by origin. Figure E-15 is the quantity of containers arriving at the Port of Seattle from each origin.

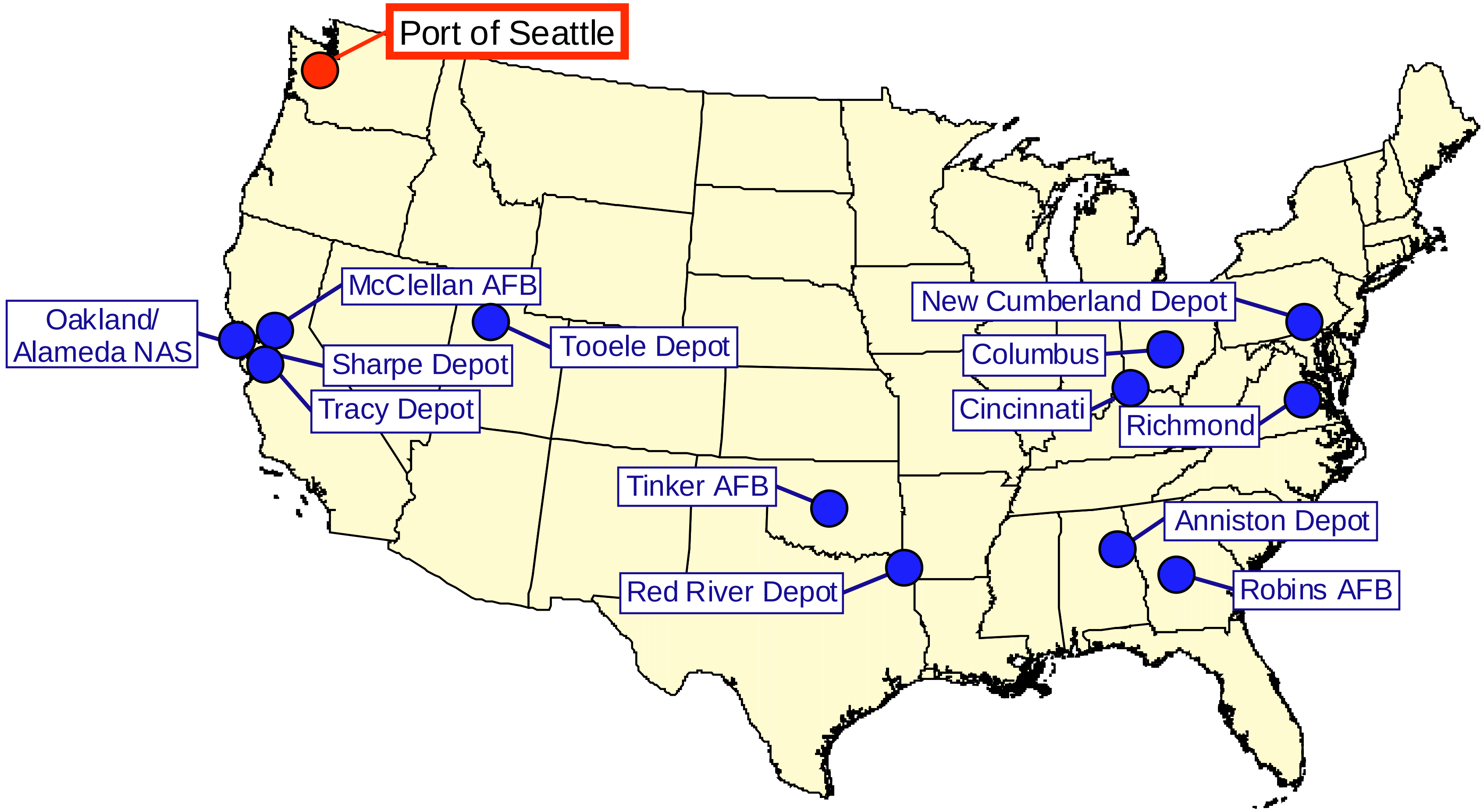


Figure E-1. Cargo Arrives at the Port of Seattle from Many Origins

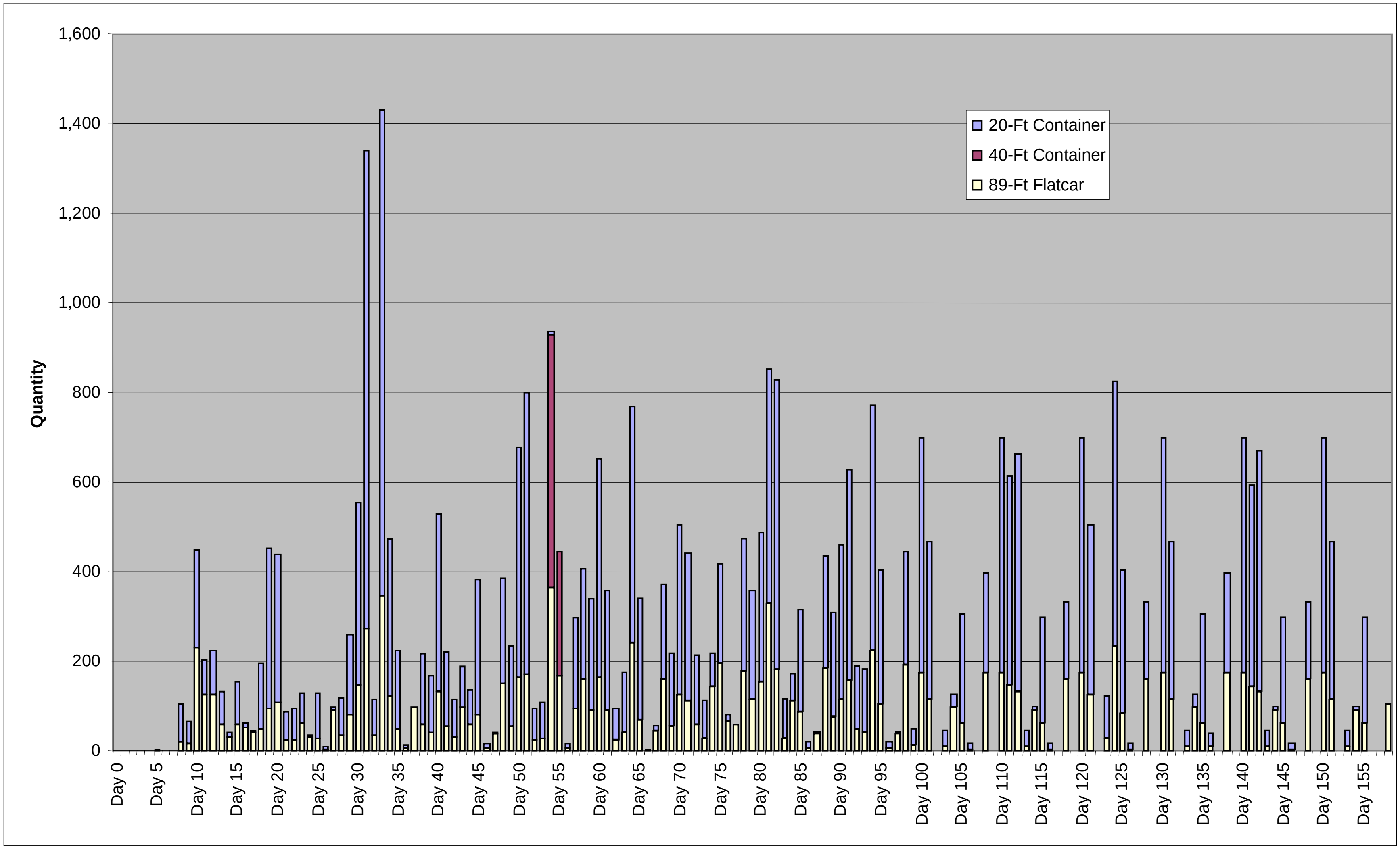


Figure E-2. Total Quantity of Transports Arriving at the Port of Seattle

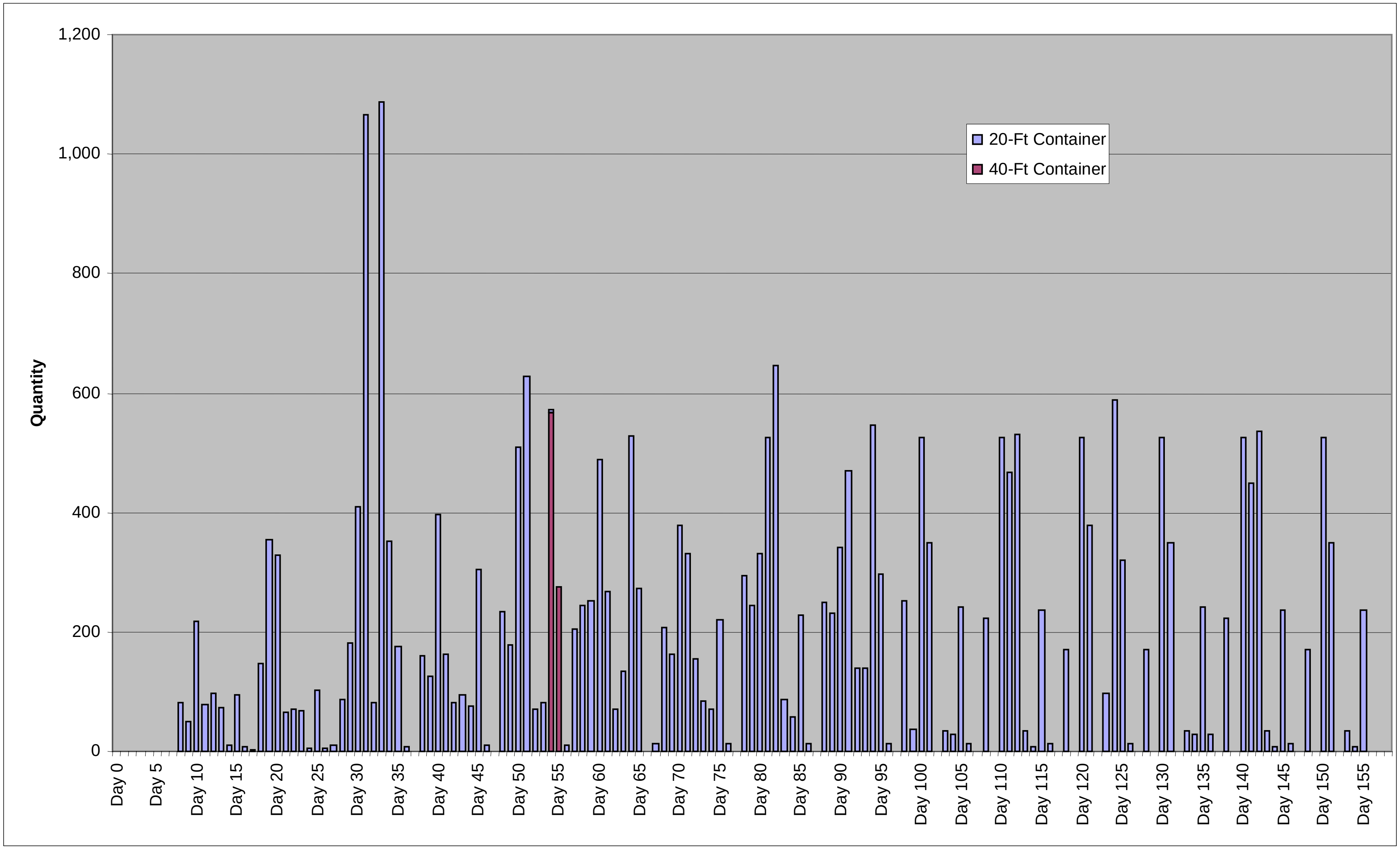


Figure E-3. Quantity of Containers Arriving at the Port of Seattle

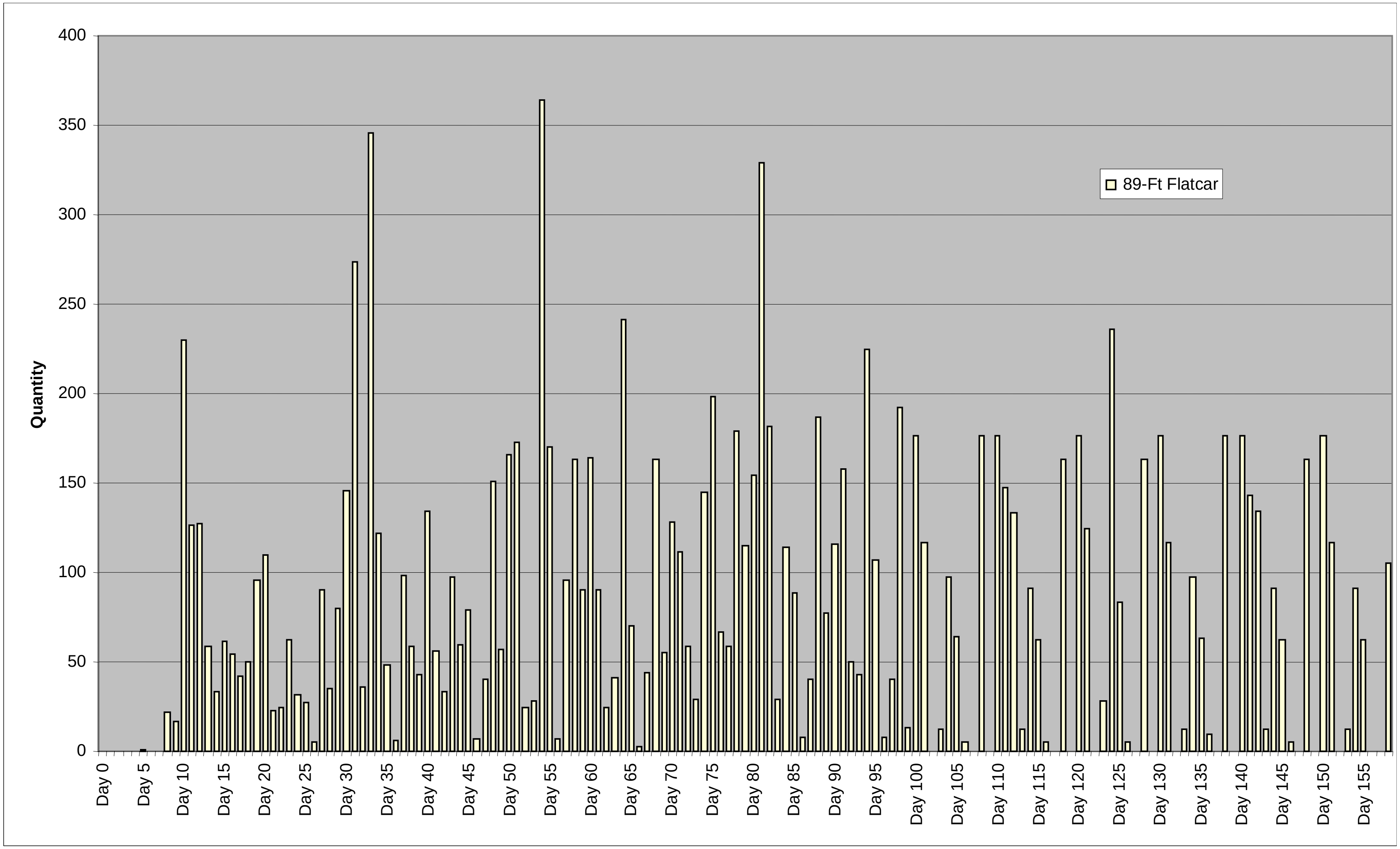


Figure E-4. Quantity of Railcars Arriving at the Port of Seattle

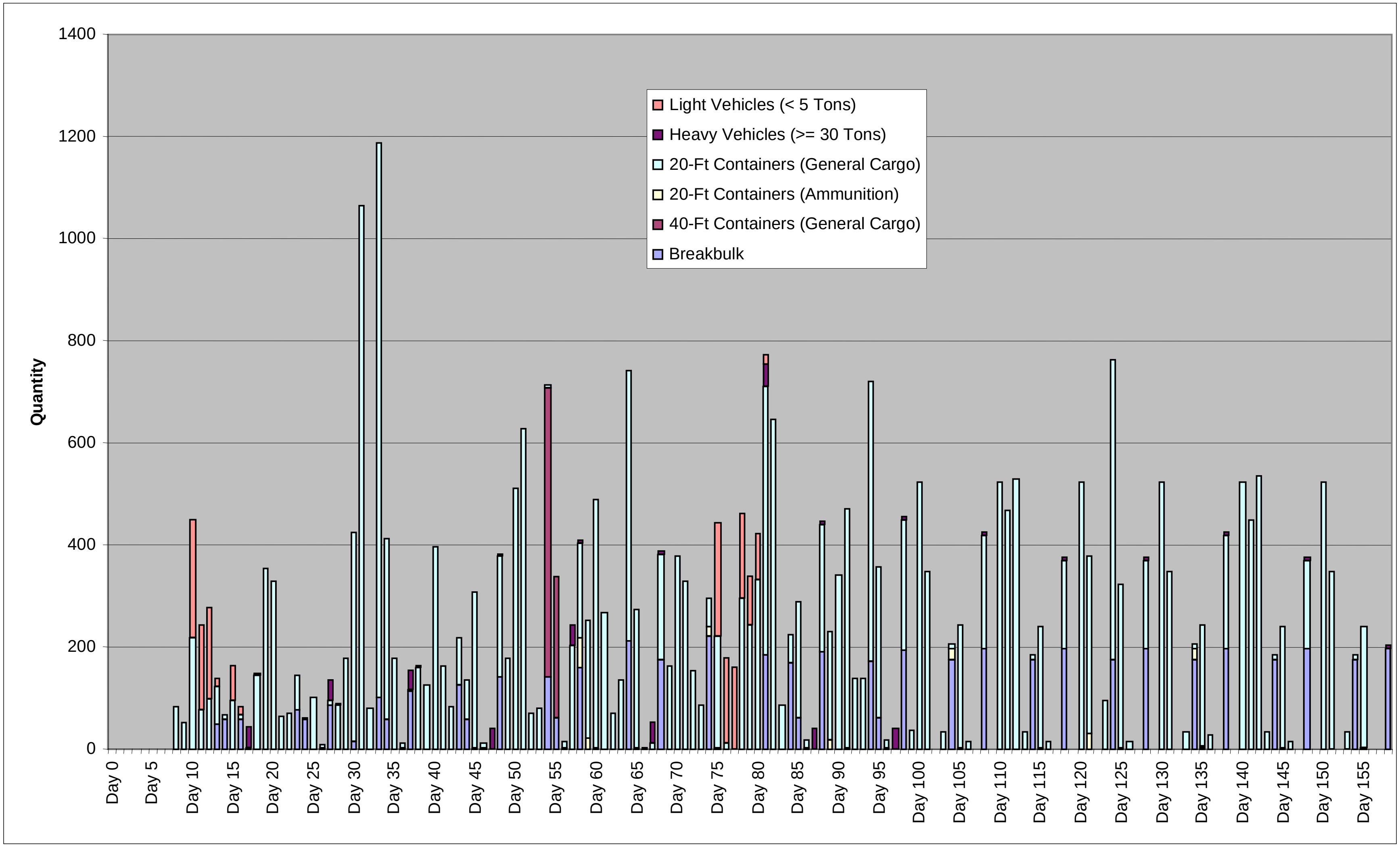


Figure E-5. Total Quantity of Cargo Items Arriving at the Port of Seattle

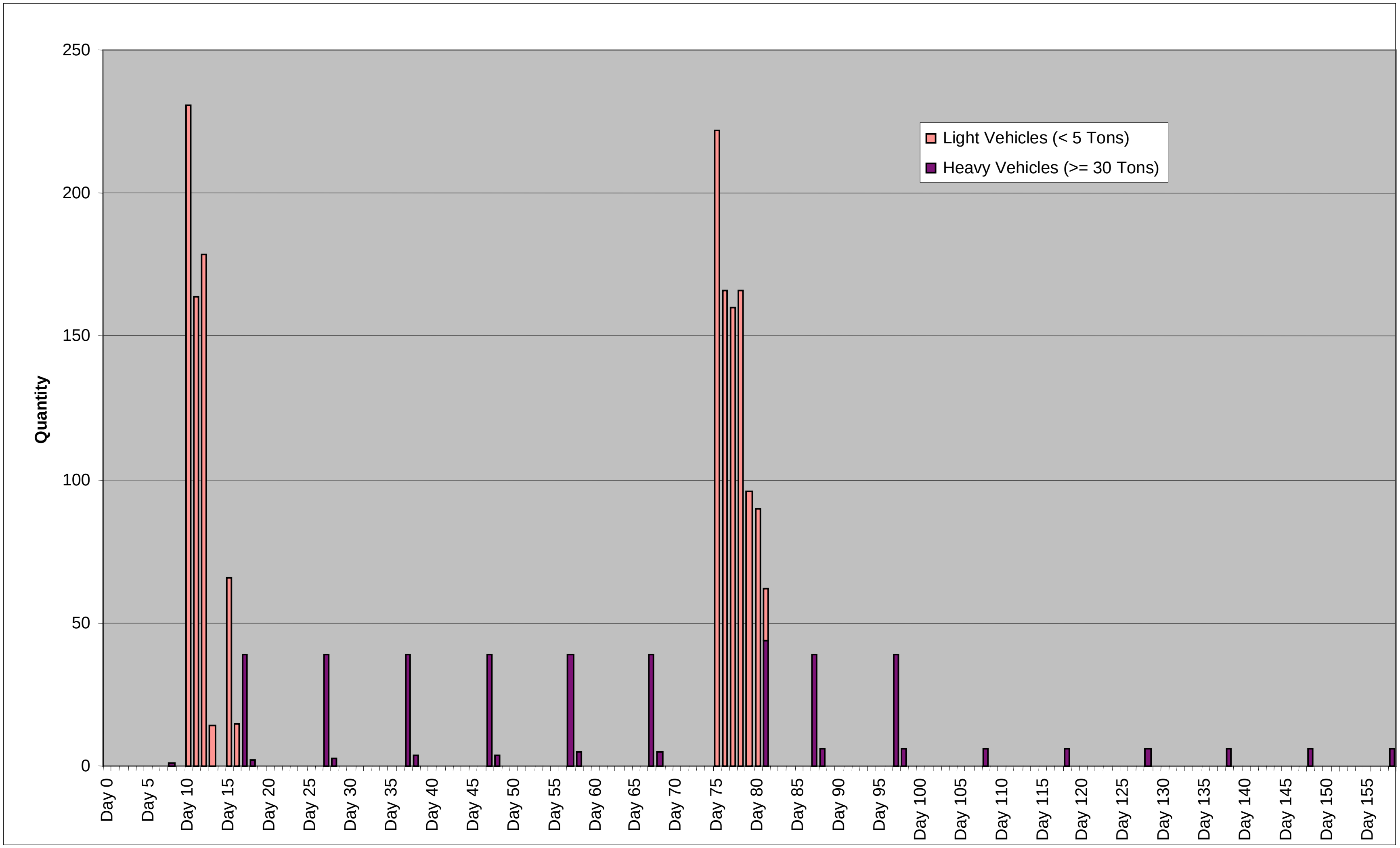


Figure E-6. Quantity of Vehicles Arriving at the Port of Seattle

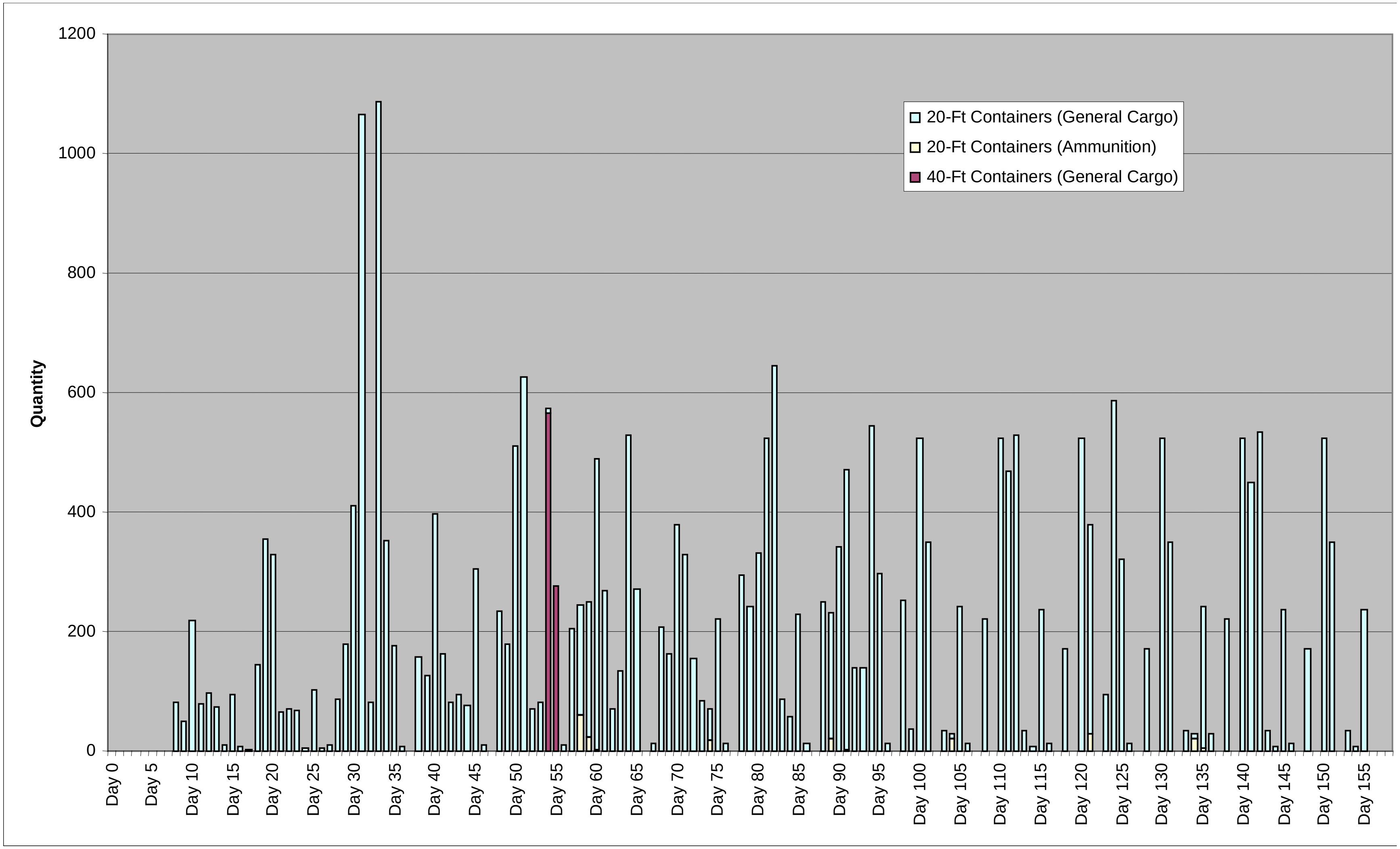


Figure E-7. Quantity of Containers Arriving at the Port of Seattle

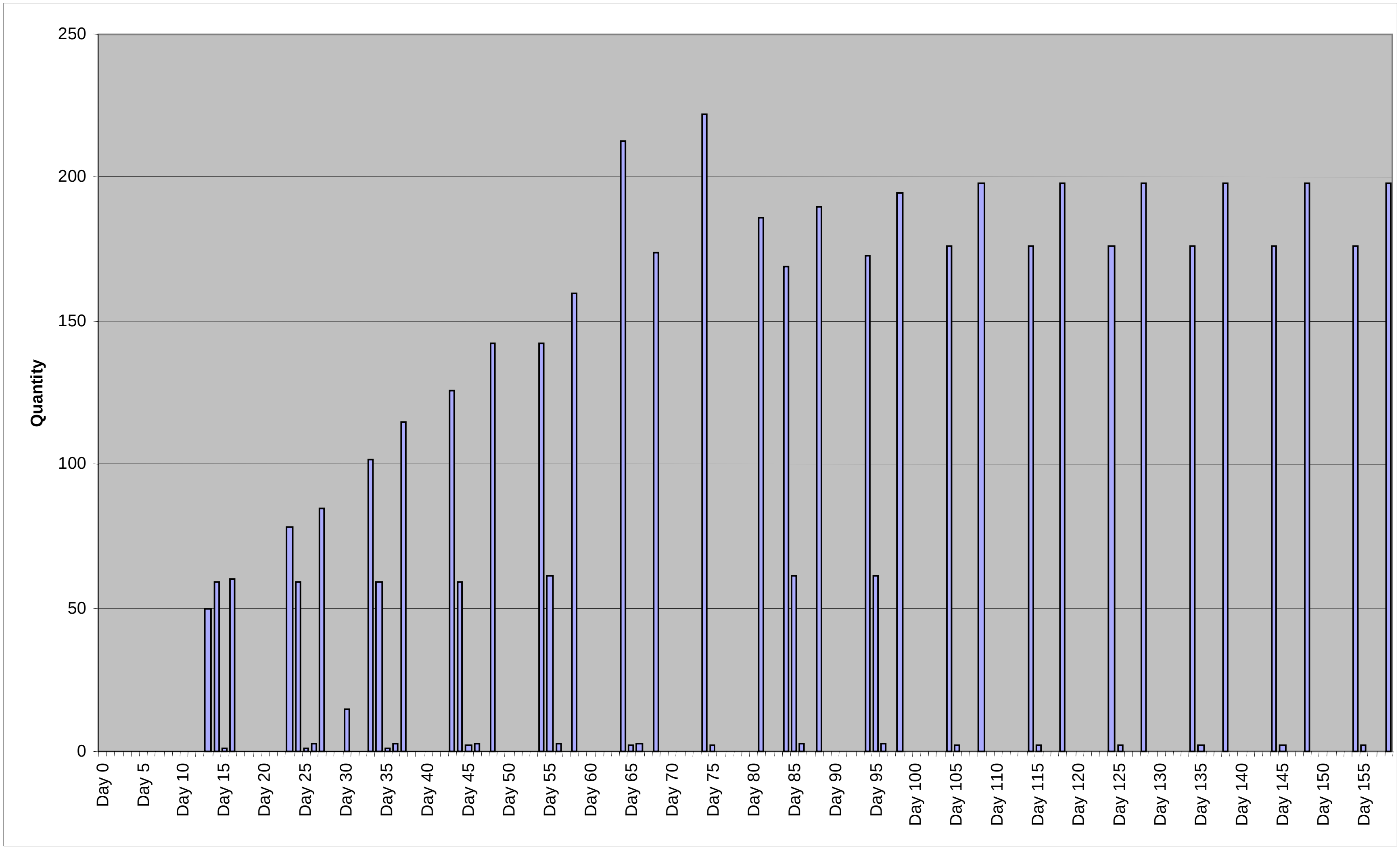


Figure E-8. Quantity of Breakbulk Items Arriving at the Port of Seattle

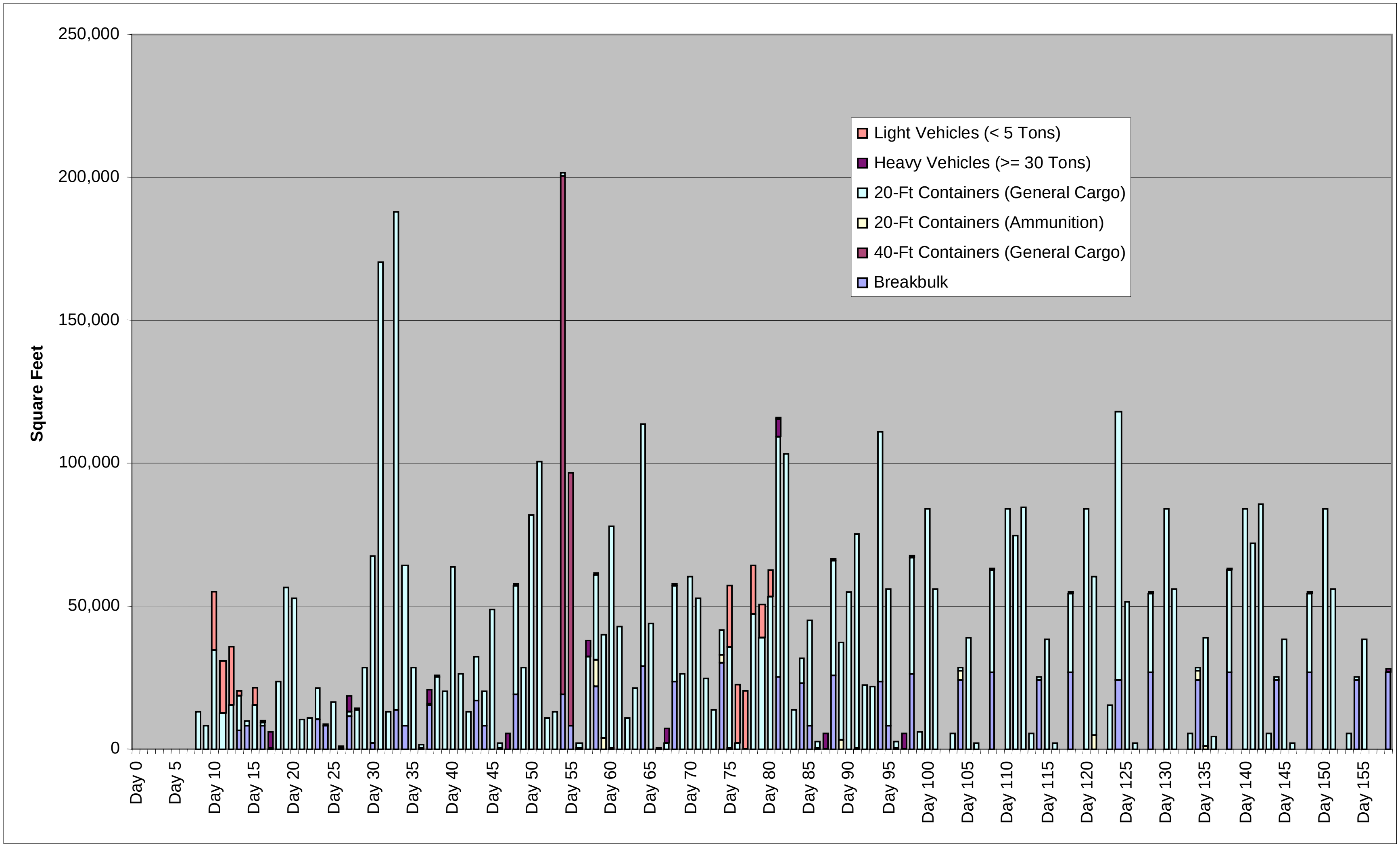


Figure E-9. Total Square Feet of Cargo Arriving at the Port of Seattle

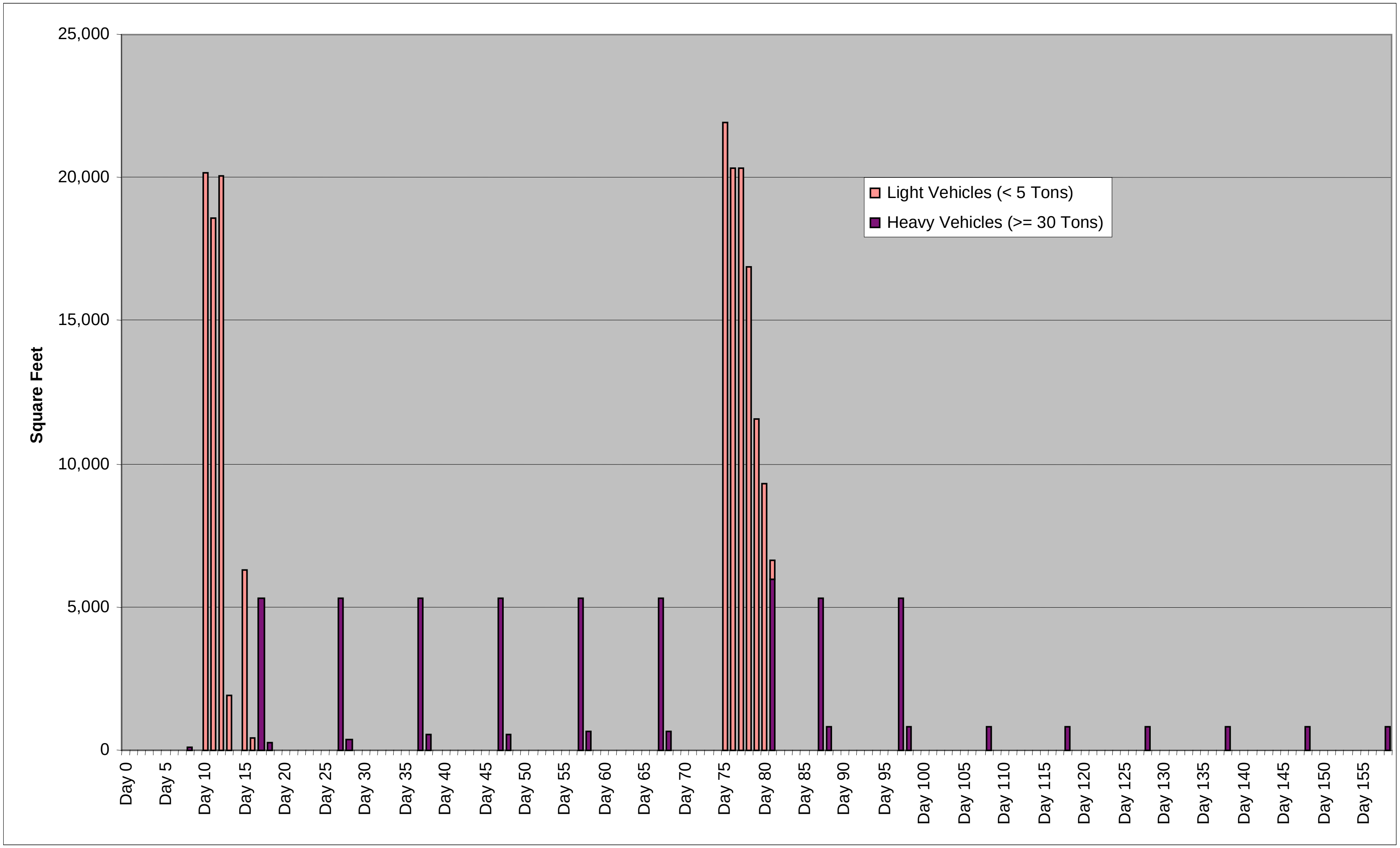


Figure E-10. Square Feet of Vehicles Arriving at the Port of Seattle

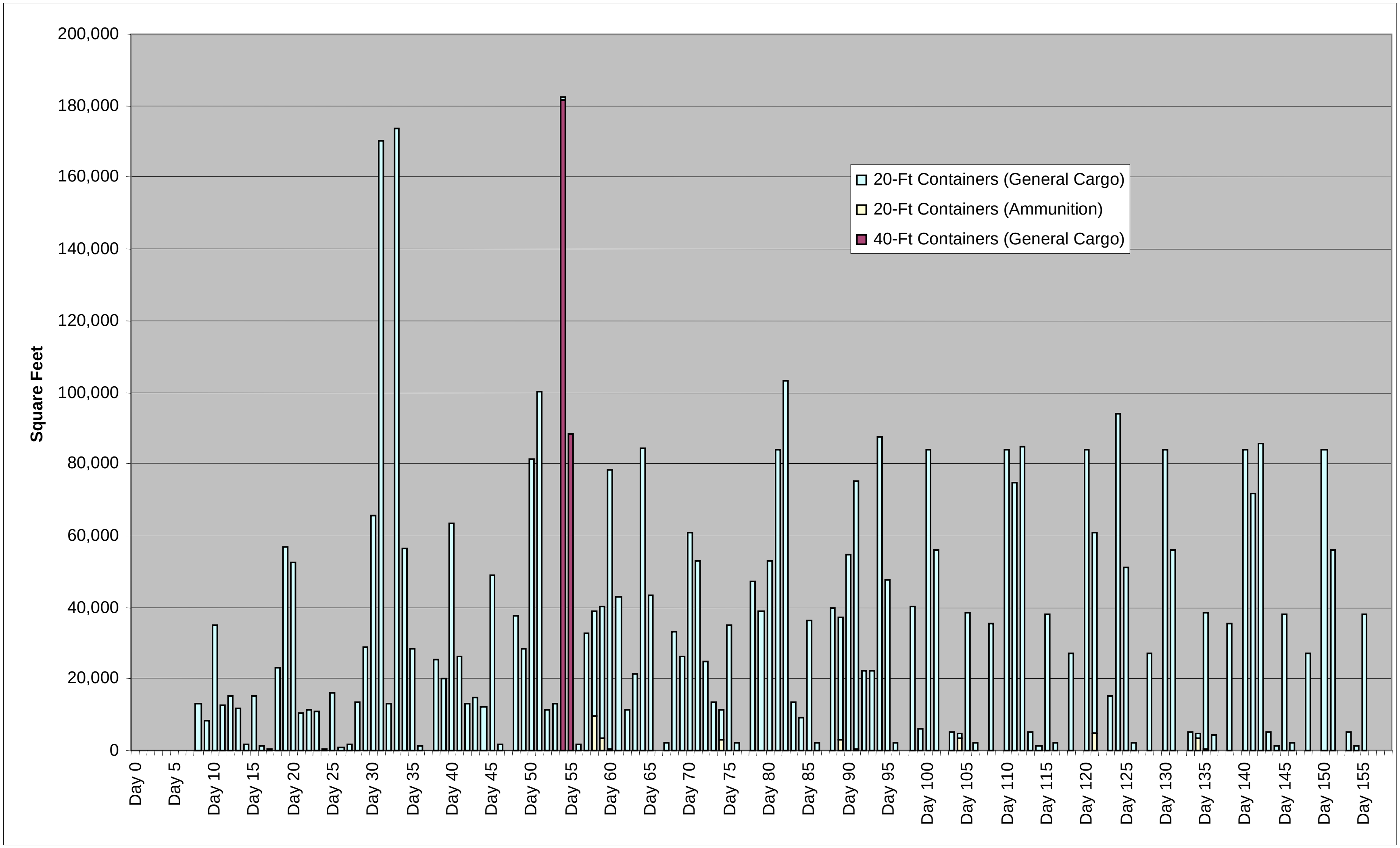


Figure E-11. Square Feet of Containers Arriving at the Port of Seattle

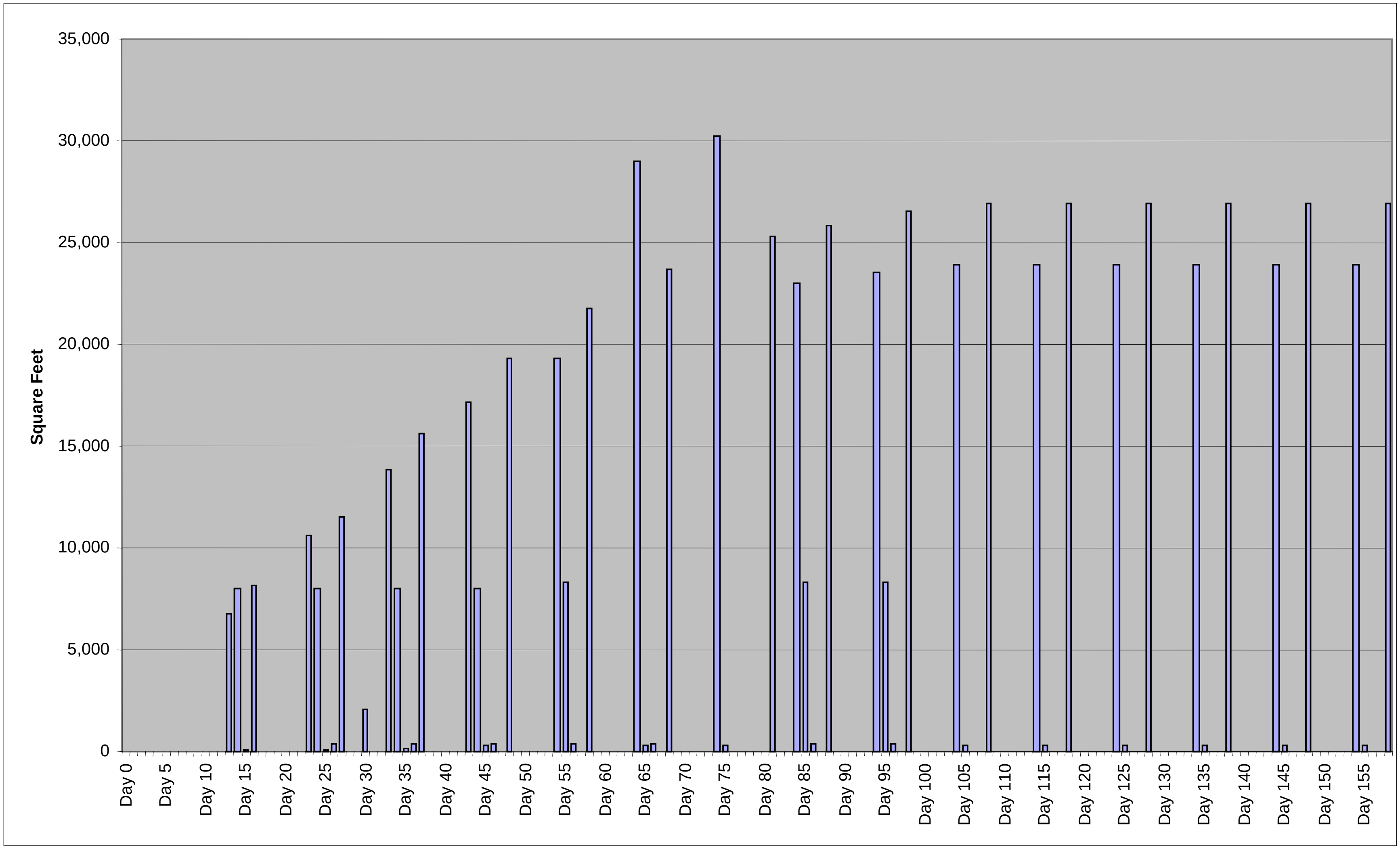


Figure E-12. Square Feet of Breakbulk Cargo Arriving at the Port of Seattle

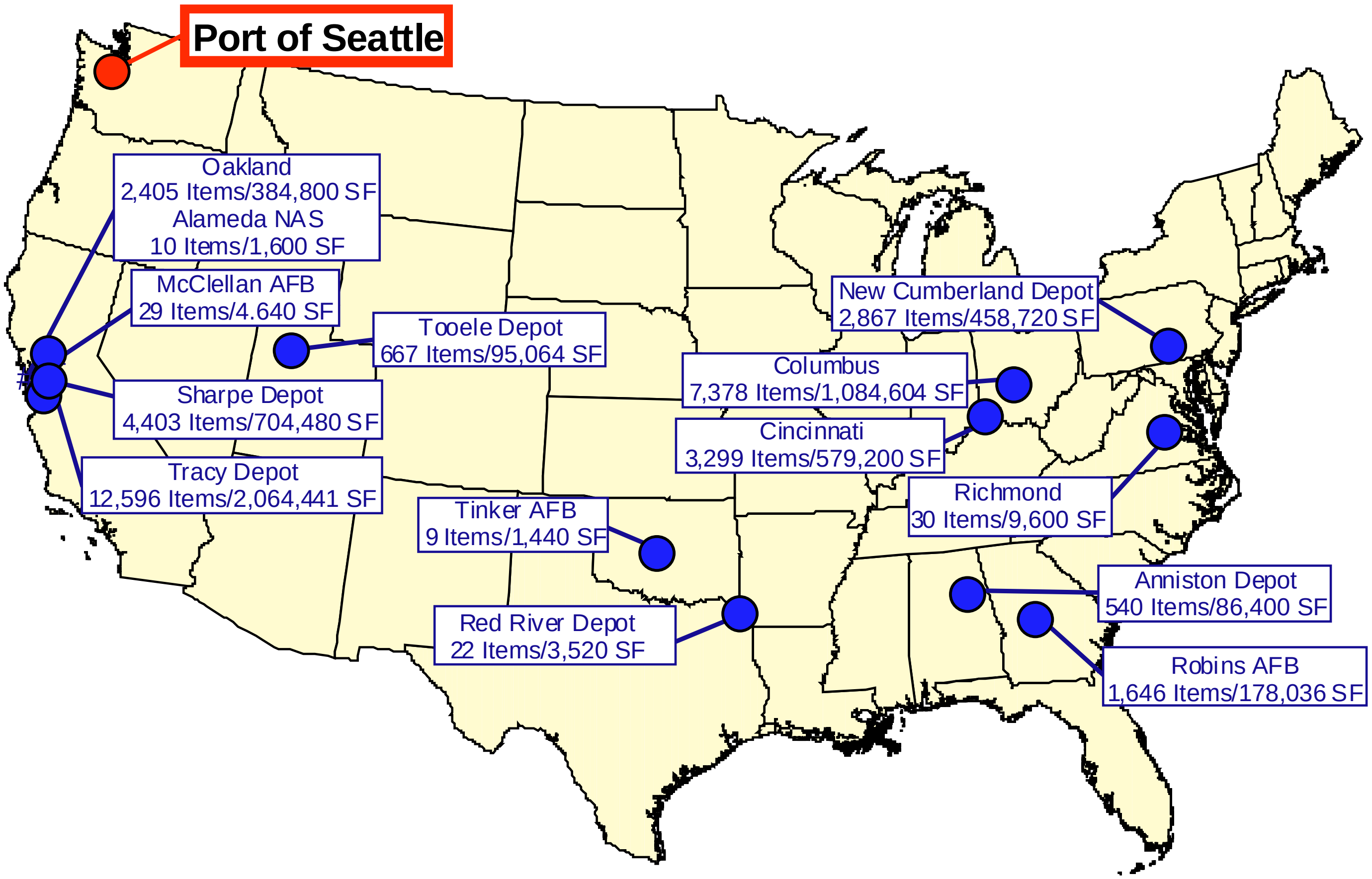


Figure E-13. Amount of Cargo Arriving at the Port of Seattle by Origin

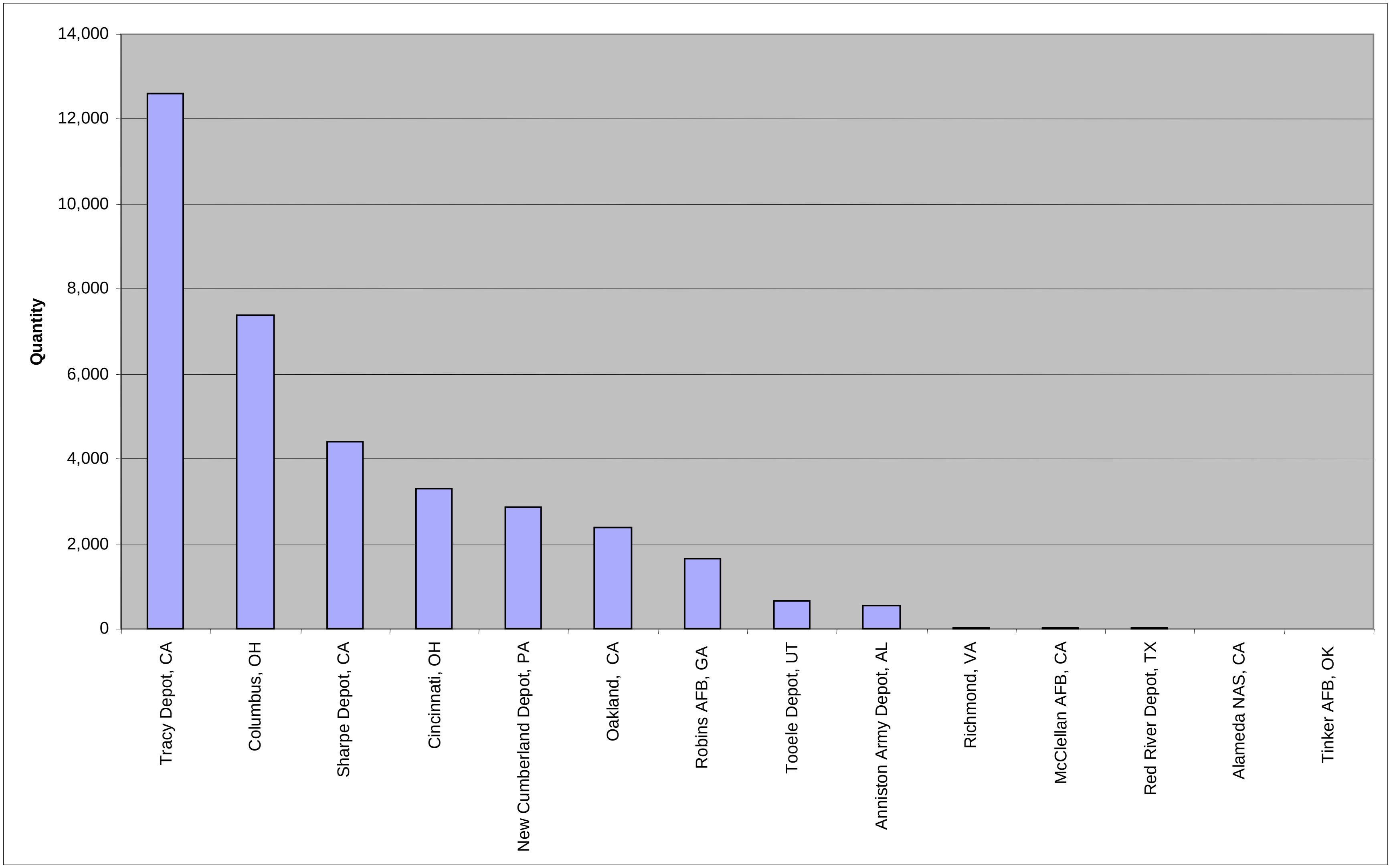


Figure E-14. Quantity of Items Arriving at the Port of Seattle by Origin

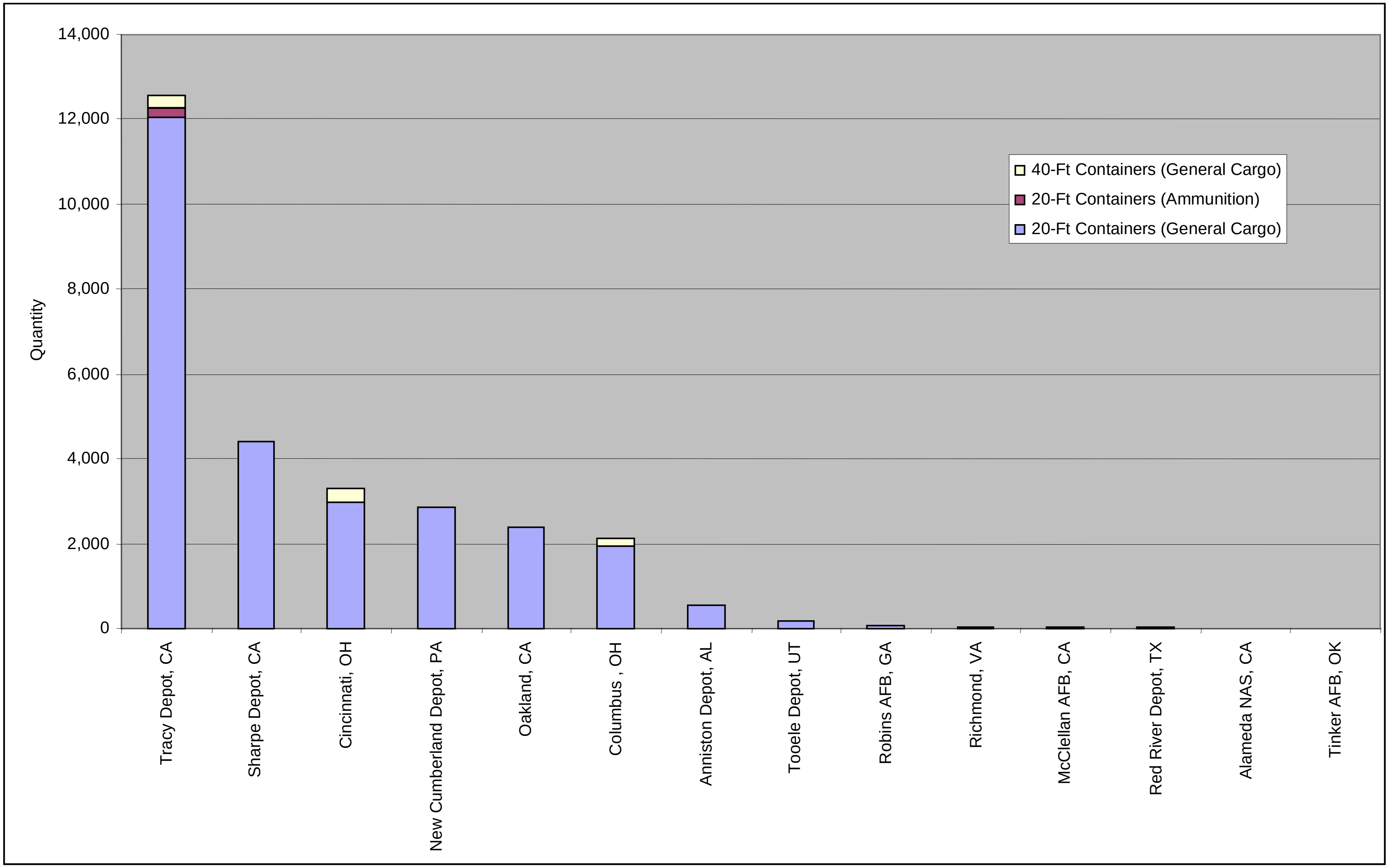


Figure E-15. Quantity of Containers Arriving at the Port of Seattle by Origin

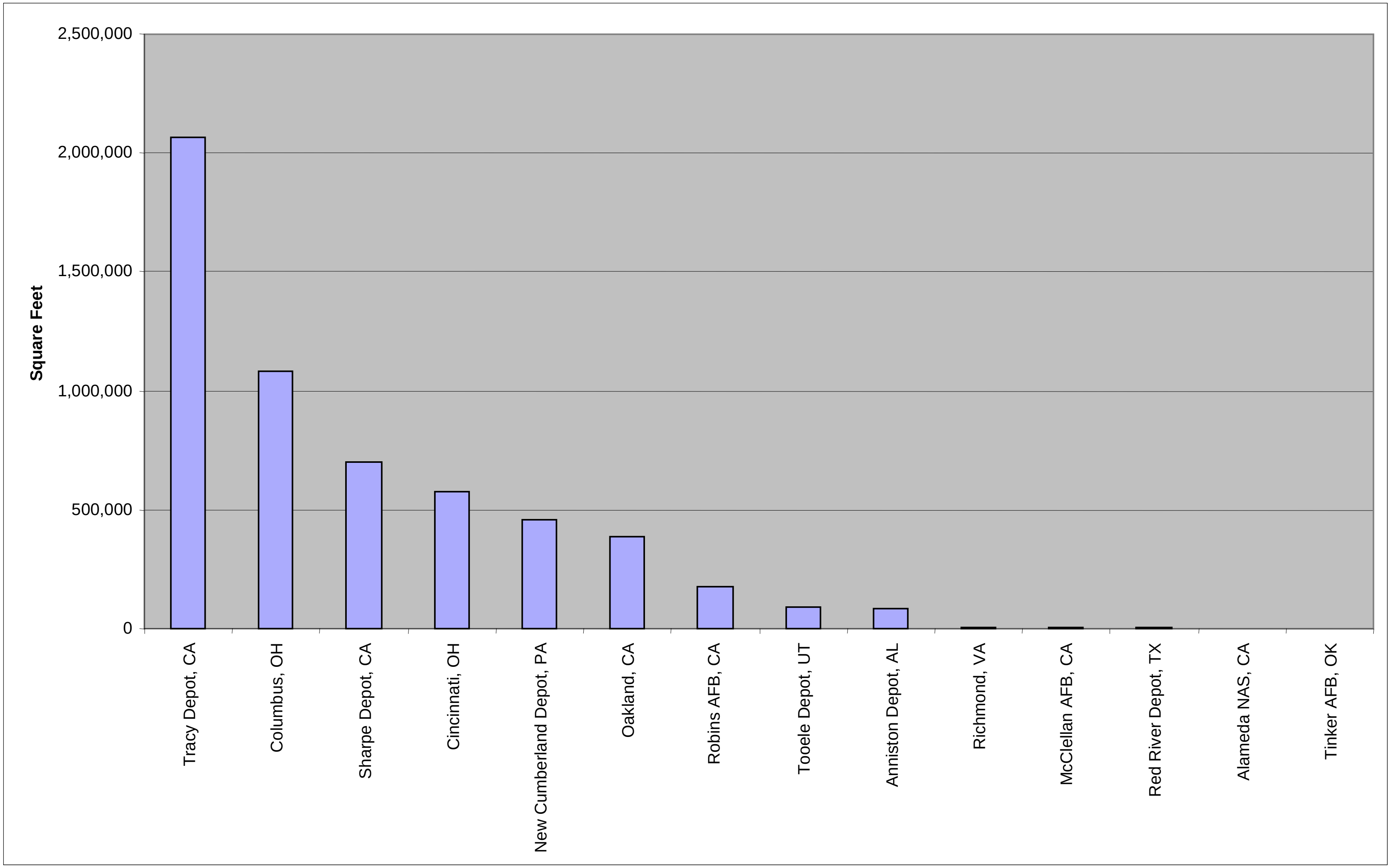


Figure E-16. Square Feet of Cargo Arriving at the Port of Seattle by Origin

APPENDIX F

Port of Tacoma

According to the TPFDD, there are thirty-three origins sending cargo to the Port of Tacoma. Figure F-1 shows the top twenty-five of these origins – those sending more than 100 items or more than 10,000 square feet of cargo. This cargo is primarily Army unit equipment.

Figures F-2 through F-6 represent how the cargo will arrive at the Port of Tacoma. Most of these origins are in excess of 400 miles away. Therefore, the majority of the cargo is arriving by rail (Figure F-4). There are aircraft that self-deploy to the port (Figure F-5), and a some vehicles will convoy to the port (Figure F-6).

Figures F-7 through F-13 illustrate the quantity of items arriving at the port. Figure F-7 is the total quantity of items arriving at the port. Figures F-8 and F-9 are the quantity of wheeled and tracked vehicles, respectively. The quantity of aircraft and floating craft are in Figures F-10 and F-11, respectively. Figure F-12 is the quantity of containers arriving at the port, and Figure F-13 is the quantity of breakbulk cargo items arriving at the port.

Similar to Figures F-7 through F-13, which lay out the quantity of items arriving, Figures F-14 through F-20 outline the square footage of these categories of cargo.

Figure F-21 illustrates the quantity of items arriving at the Port of Tacoma by mode. Figure F-22 through 24 shows the breakdown of items convoying, arriving by rail, and flying to the port.

Similar to Figures F-21 through F-24, Figures F-25 through F-28 show the square footage of the cargo convoying, arriving by rail, and flying to the Port of Tacoma.

As shown earlier, cargo arrives at the Port of Tacoma from many distinct origins. Figure F-29 shows visually the amount of cargo coming from each of the major contributing origins. Figures F-30 and F-32 show the quantity and square feet, respectively, of cargo arriving at the Port of Tacoma by origin, and Figure F-31 outlines the quantity of containers arriving at the port from each origin. Origins sending less than 100 items or 10,000 square feet of cargo are listed in Tables F-1 through F-3

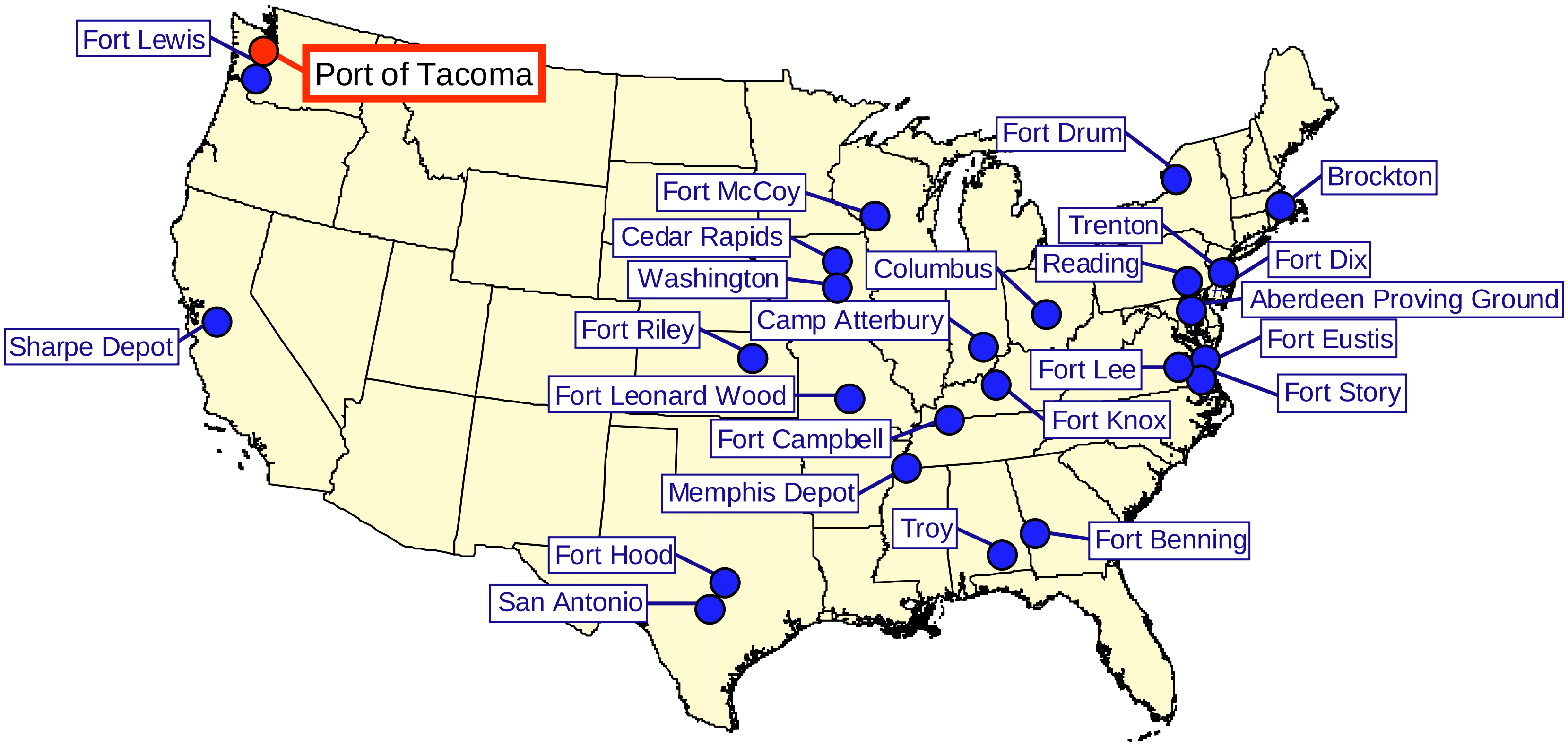


Figure F-1. Cargo Arrives at the Port of Tacoma from Many Origins

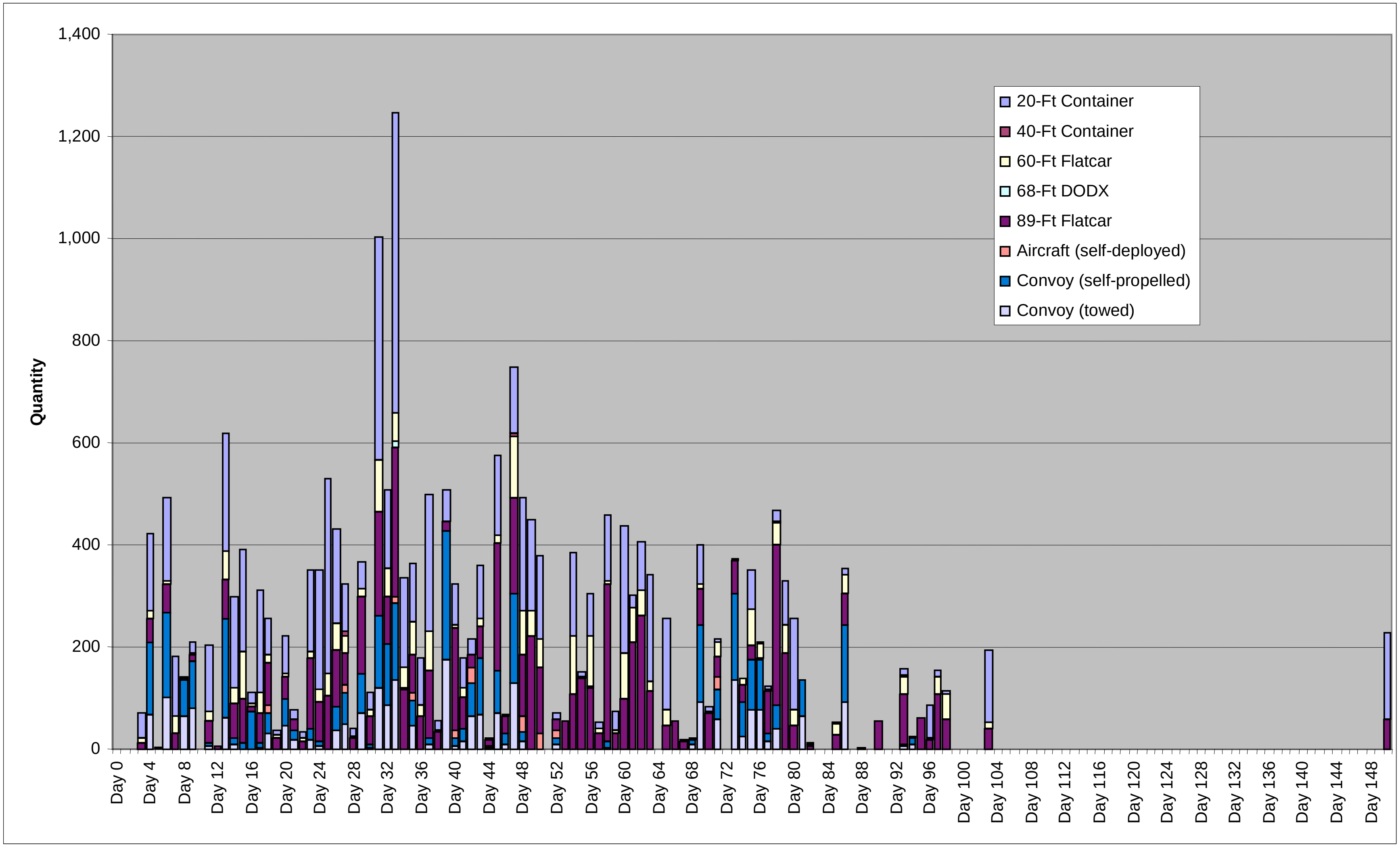


Figure F-2. Total Quantity of Transports Arriving at the Port of Tacoma

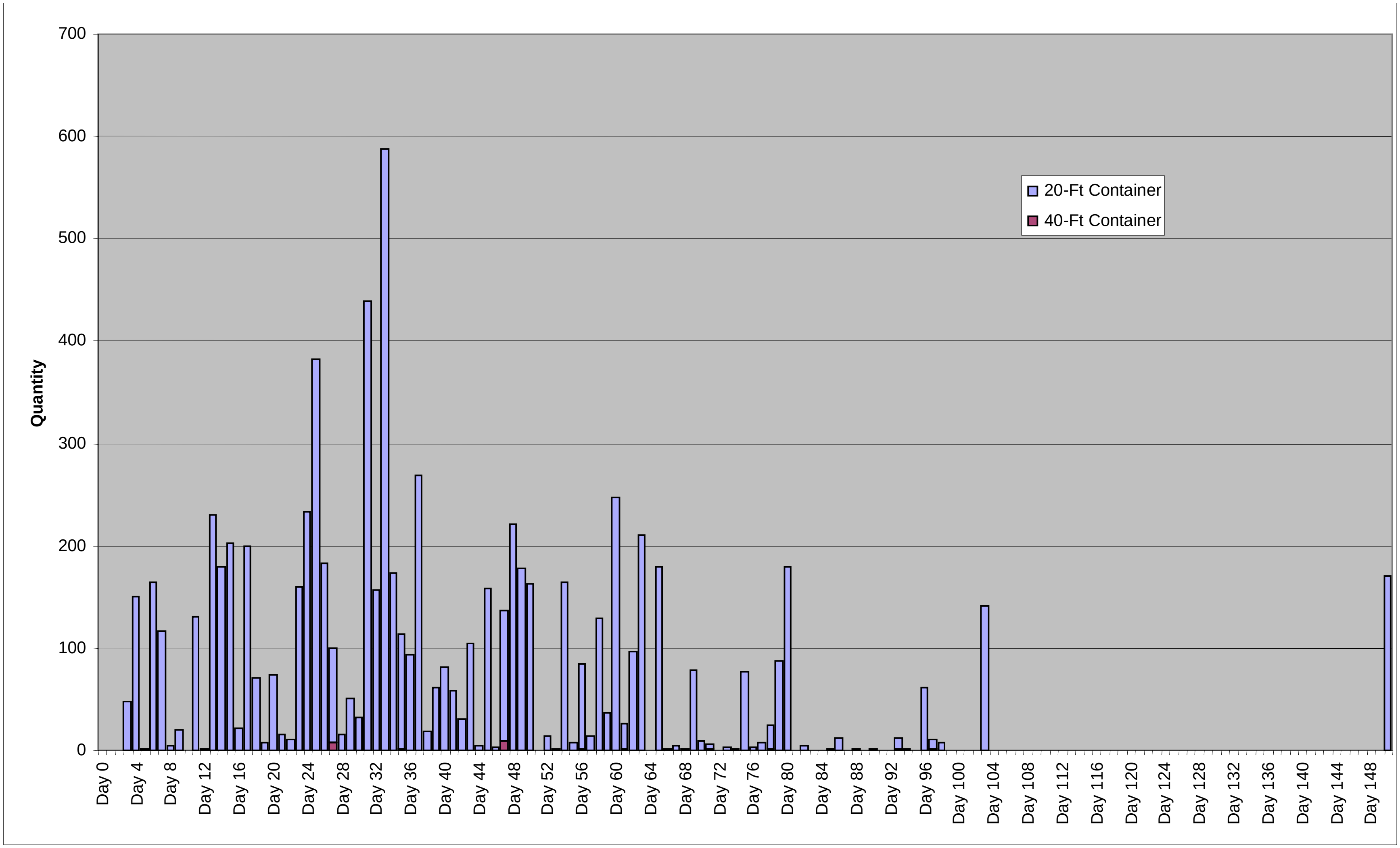


Figure F-3. Quantity of Containers Arriving at the Port of Tacoma

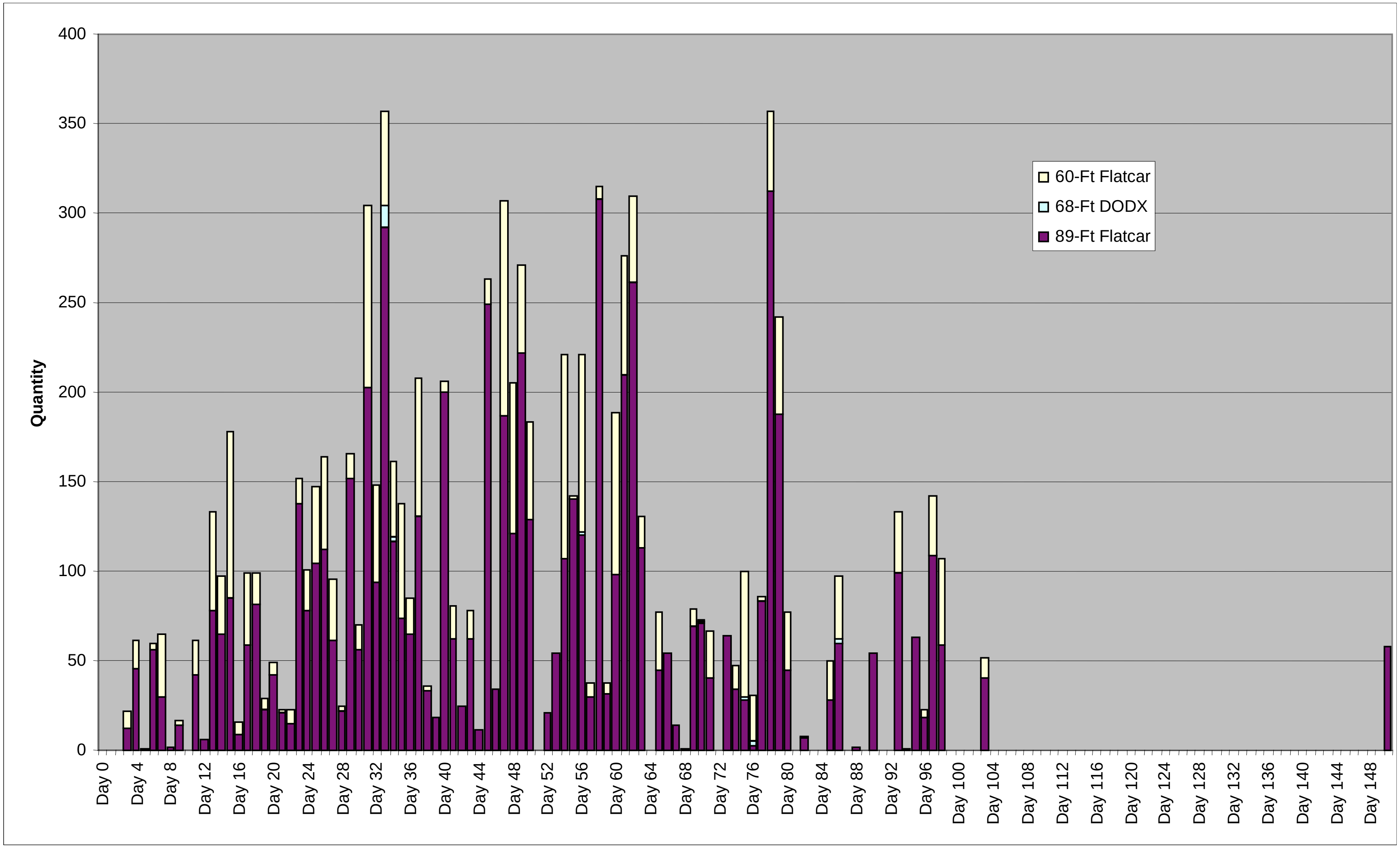


Figure F-4. Quantity of Railcars Arriving at the Port of Tacoma

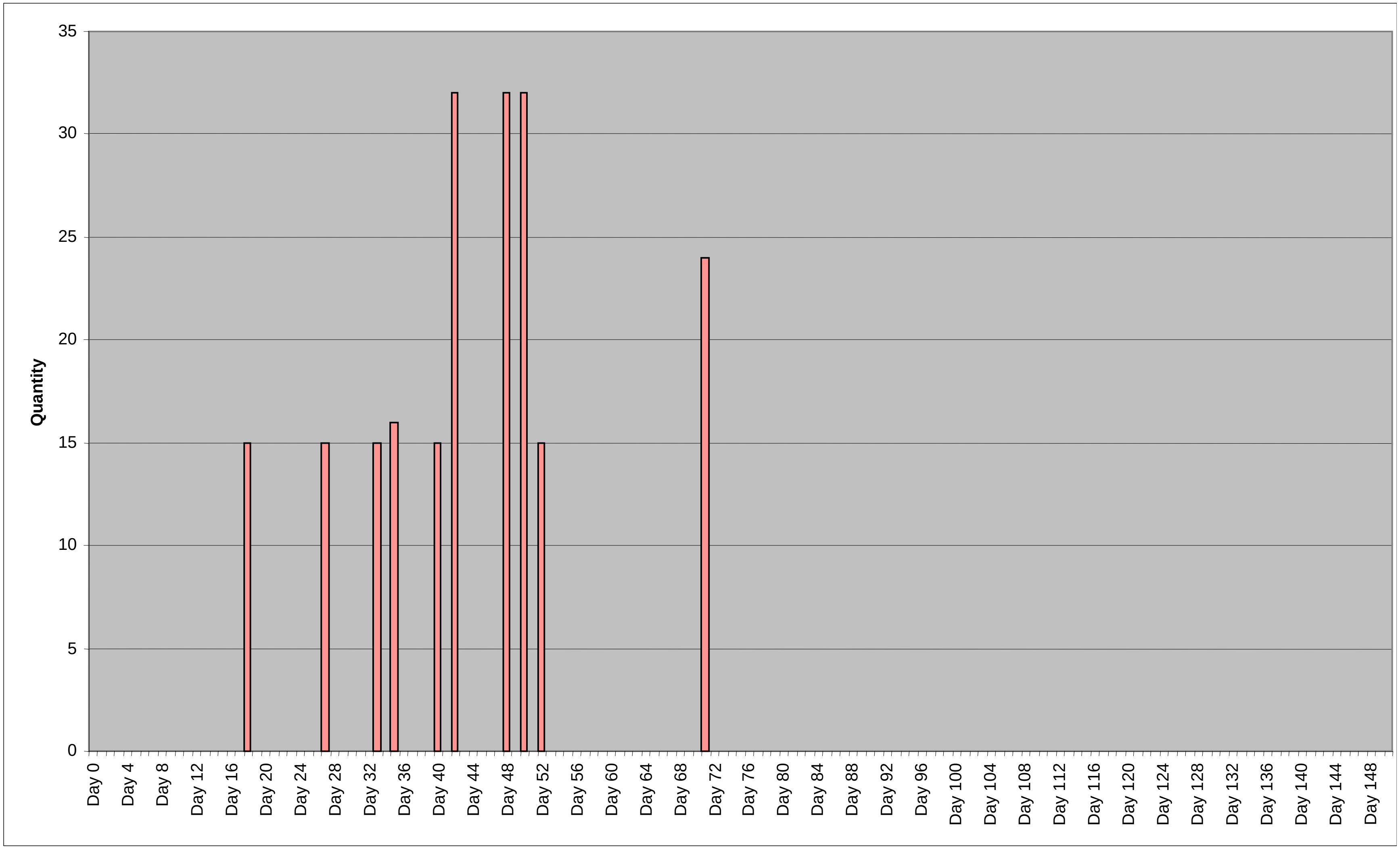


Figure F-5. Quantity of Aircraft Arriving at the Port of Tacoma

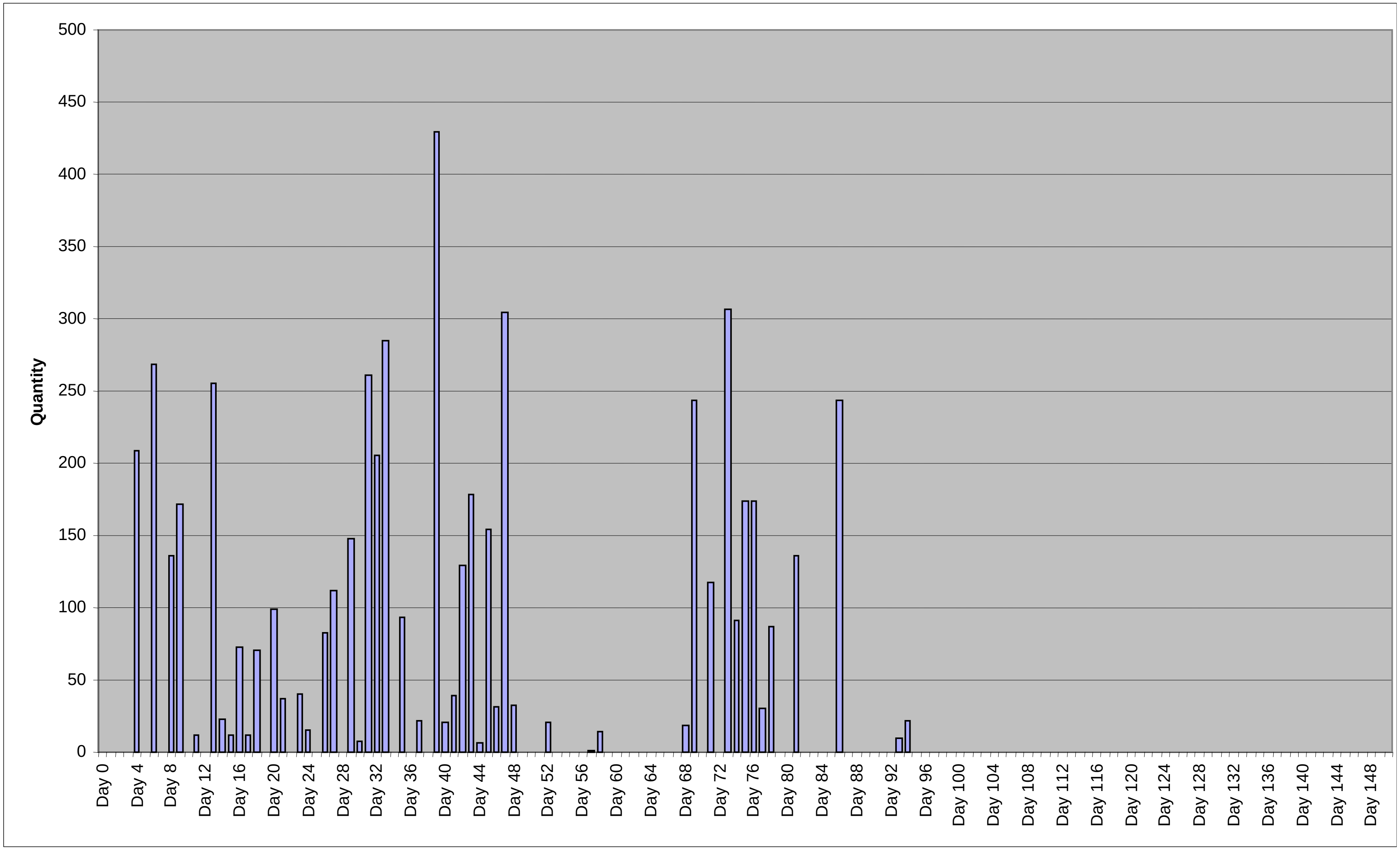


Figure F-6. Quantity of Convoy Vehicles Arriving at the Port of Tacoma

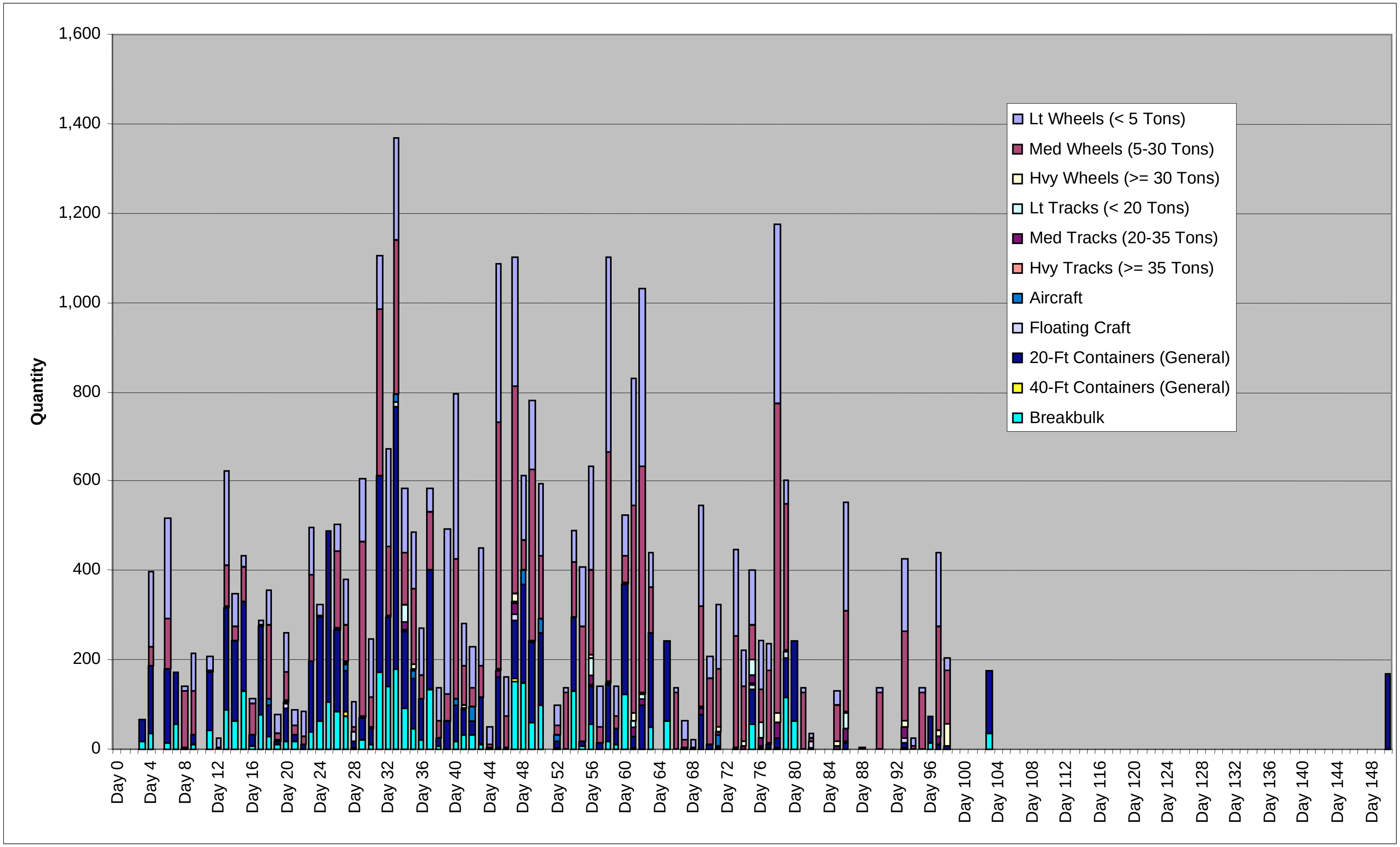


Figure F-7. Total Quantity of Cargo Items Arriving at the Port of Tacoma

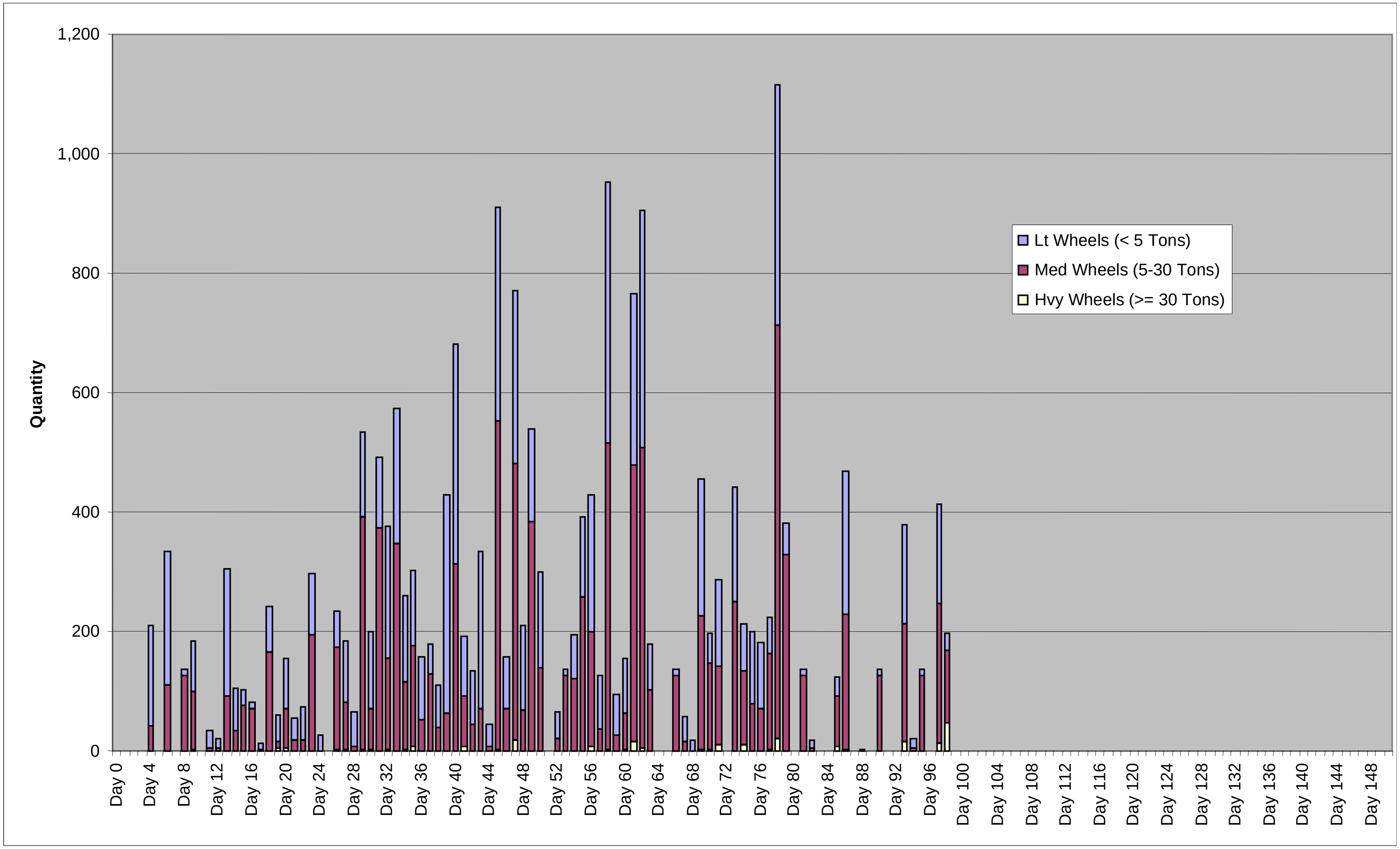


Figure F-8. Quantity of Wheeled Vehicles Arriving at the Port of Tacoma

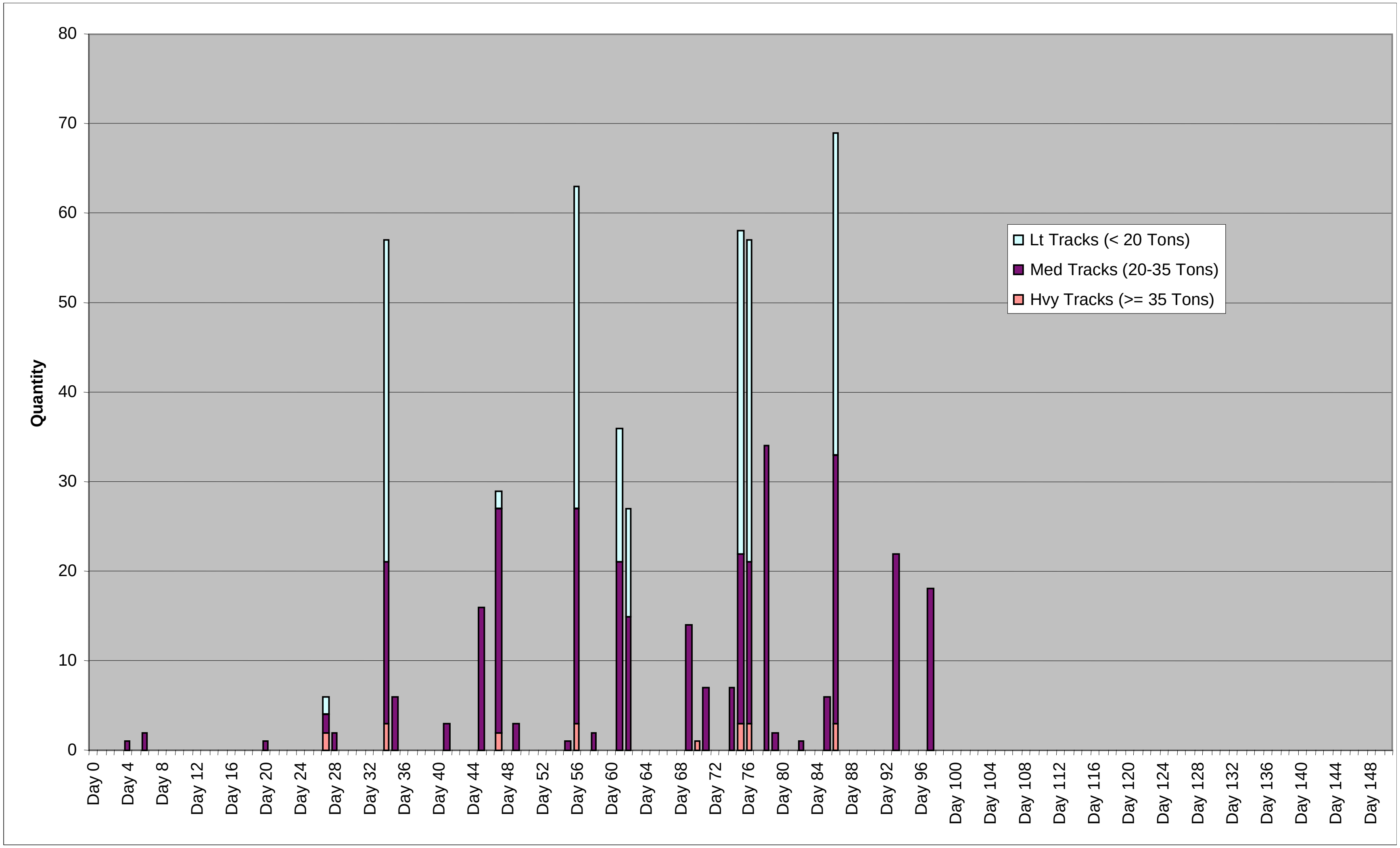


Figure F-9. Quantity of Tracked Vehicles Arriving at the Port of Tacoma

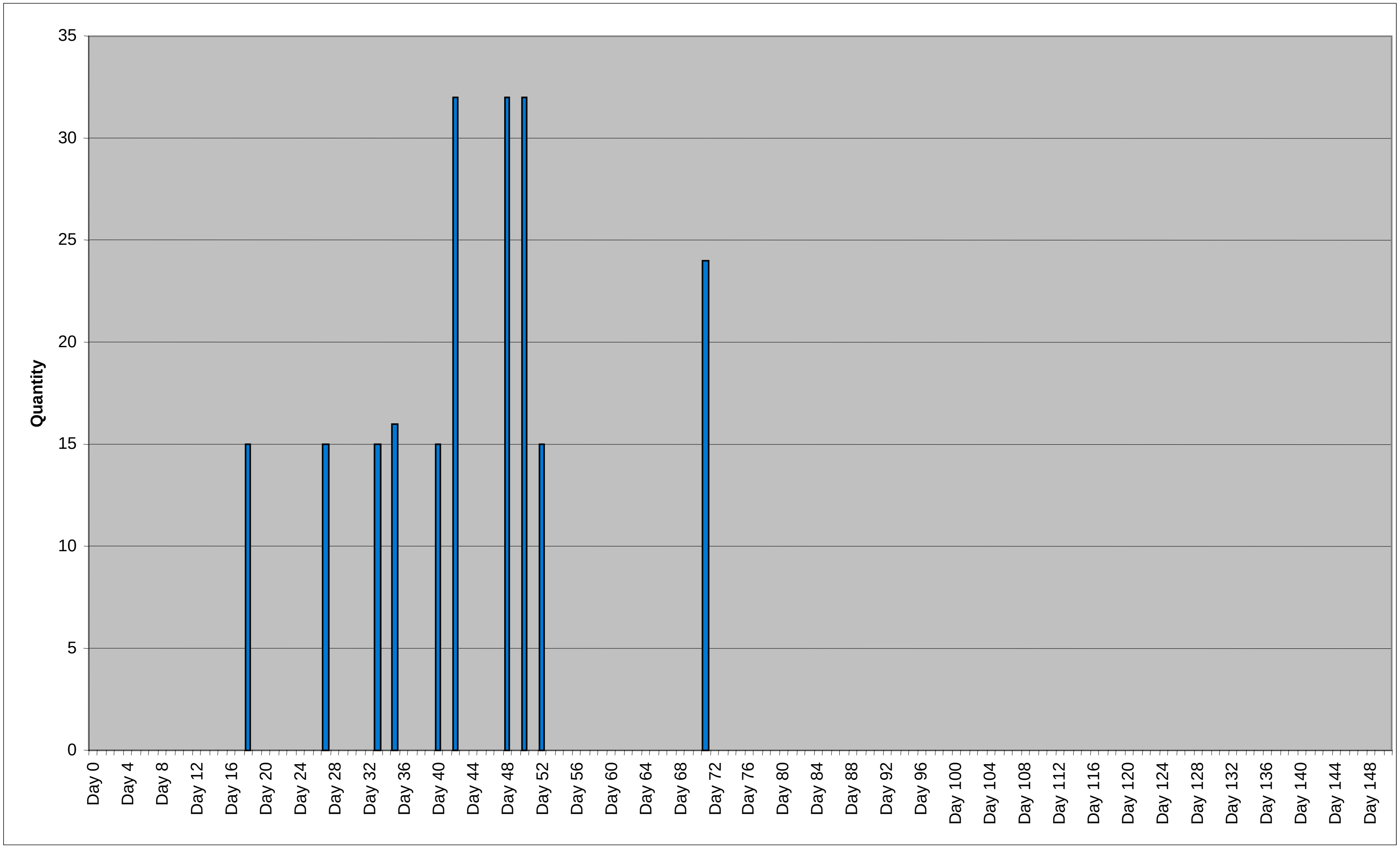


Figure F-10. Quantity of Aircraft Arriving at the Port of Tacoma

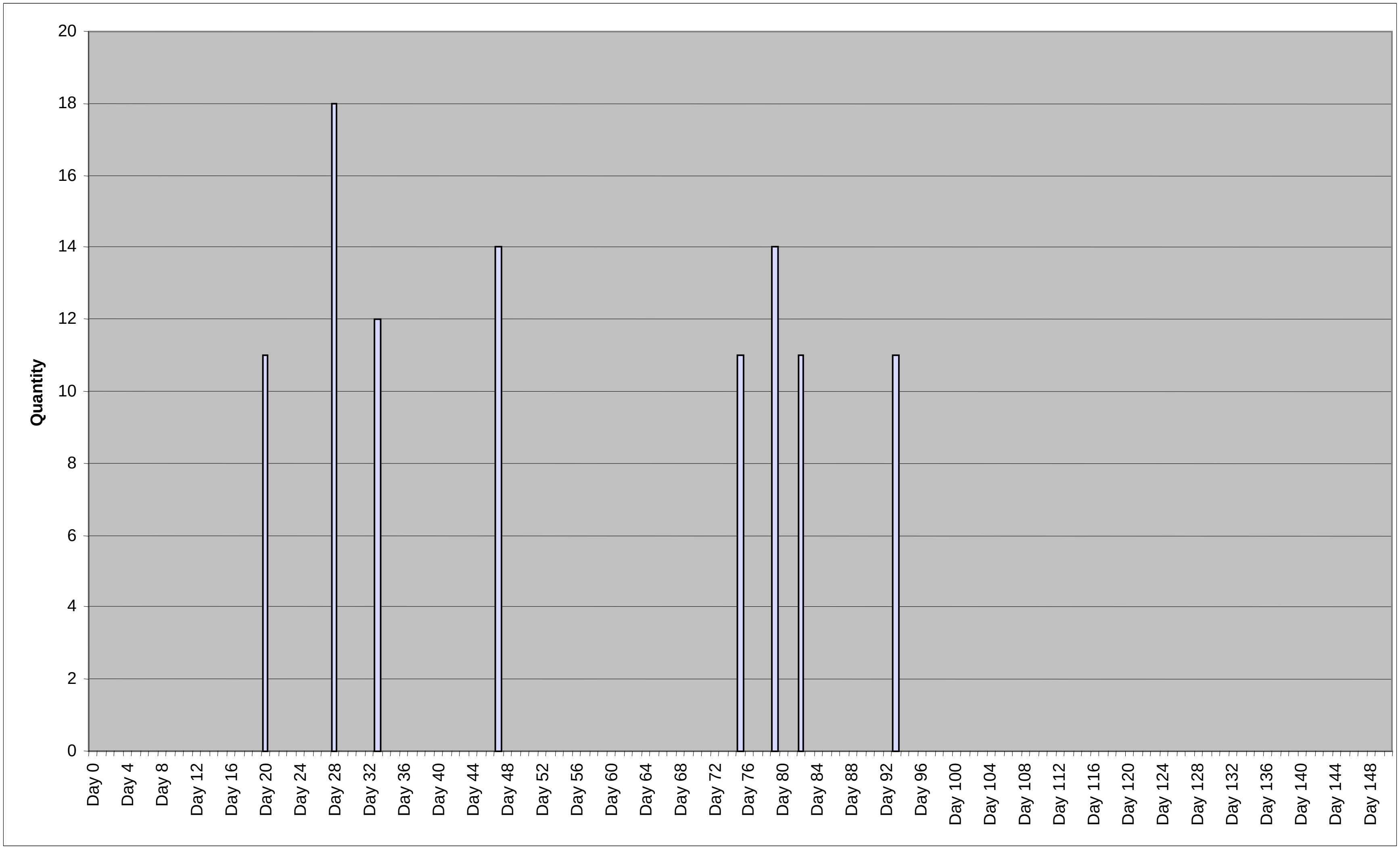


Figure F-11. Quantity of Floating Craft Arriving at the Port of Tacoma

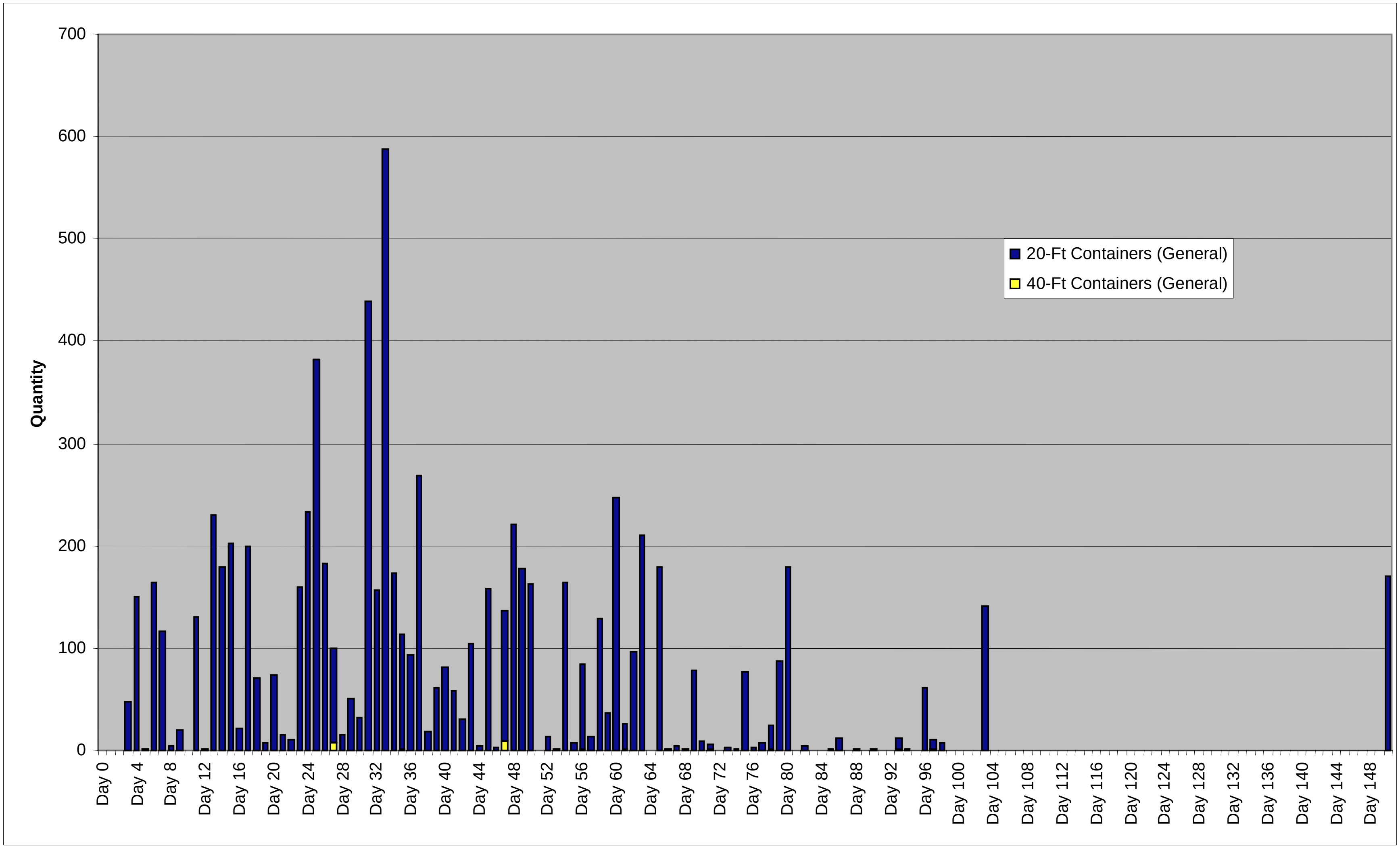


Figure F-12. Quantity of Containers Arriving at the Port of Tacoma

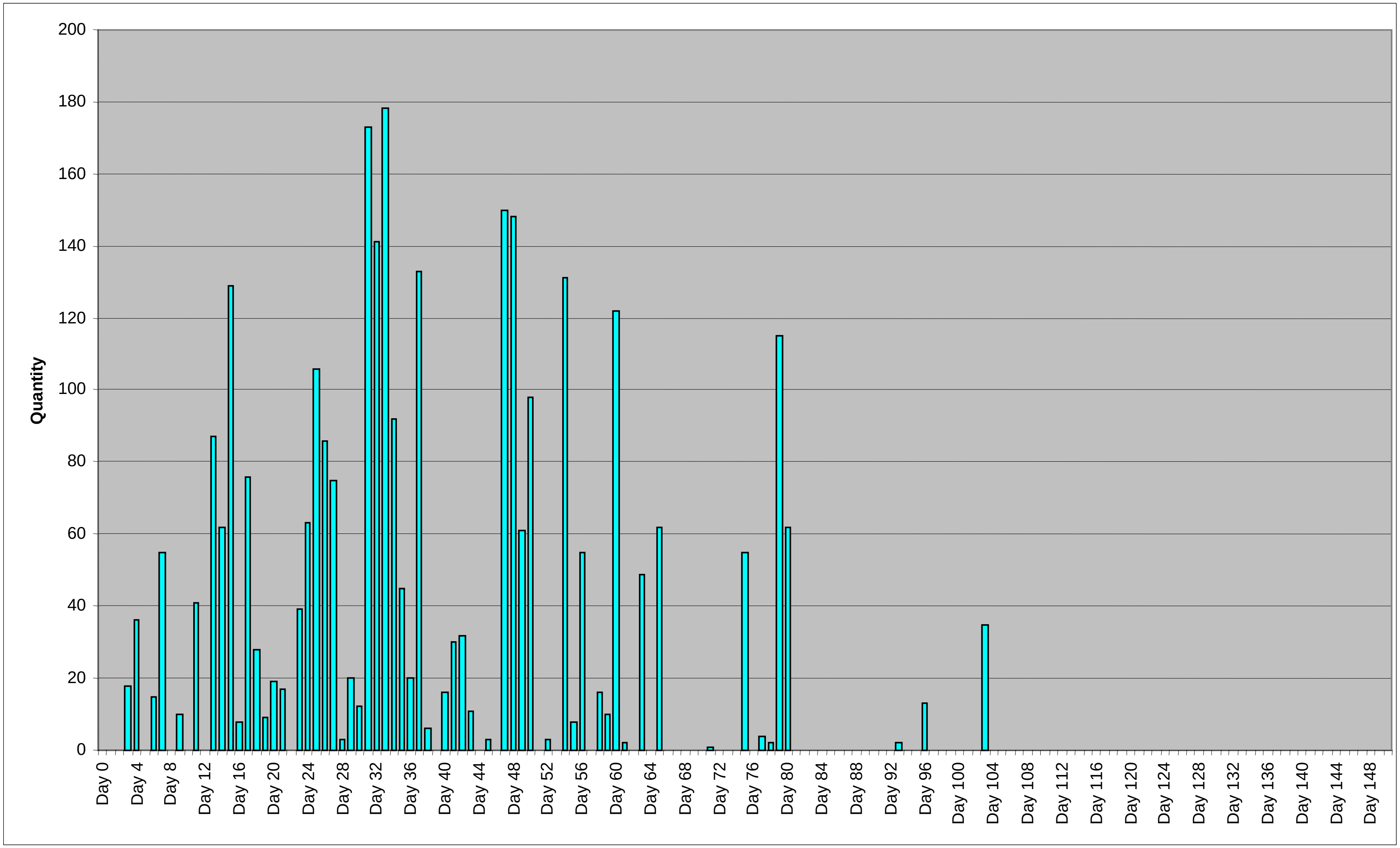


Figure F-13. Quantity of Breakbulk Items Arriving at the Port of Tacoma

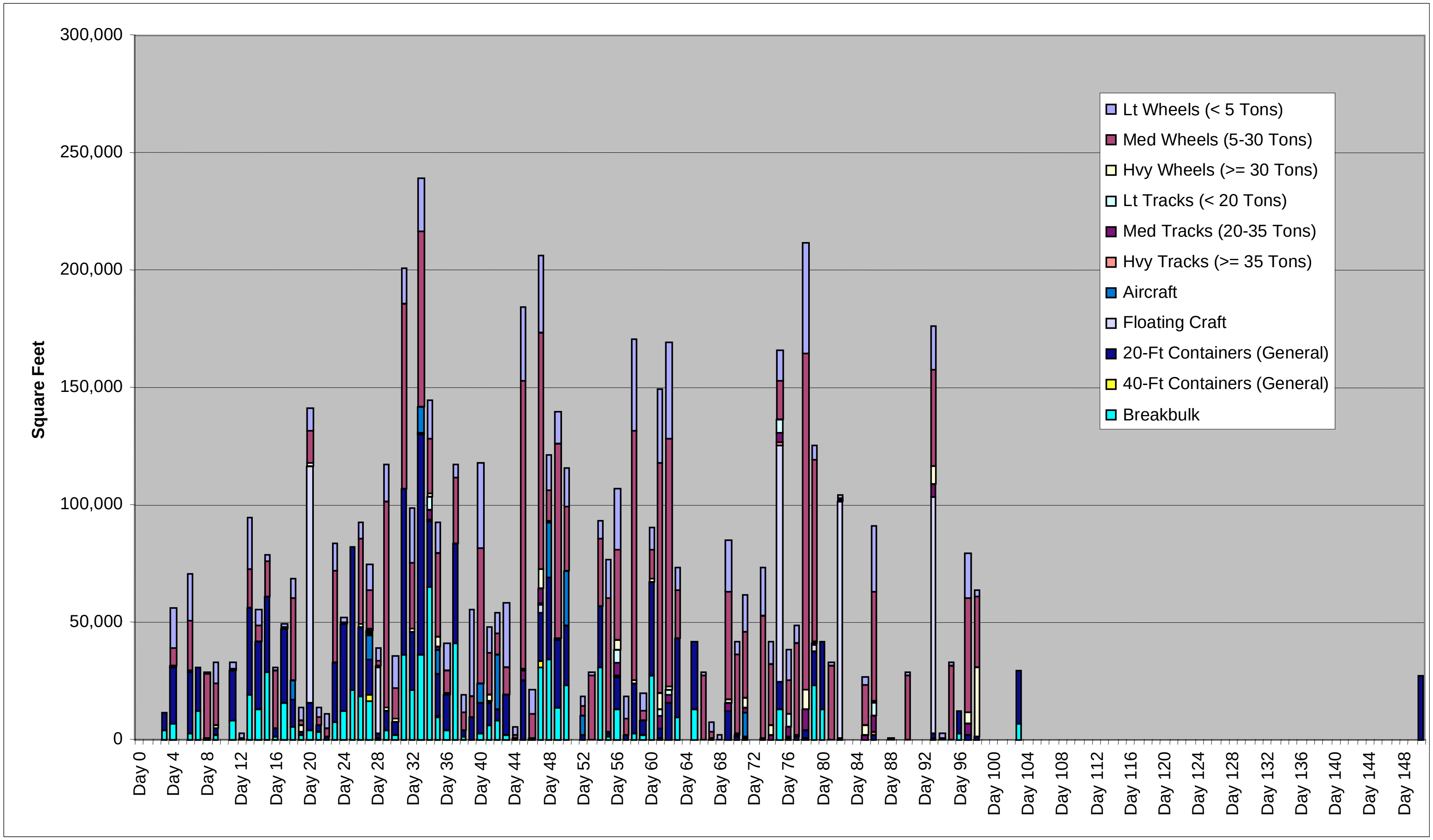


Figure F-14. Total Square Feet of Cargo Arriving at the Port of Tacoma

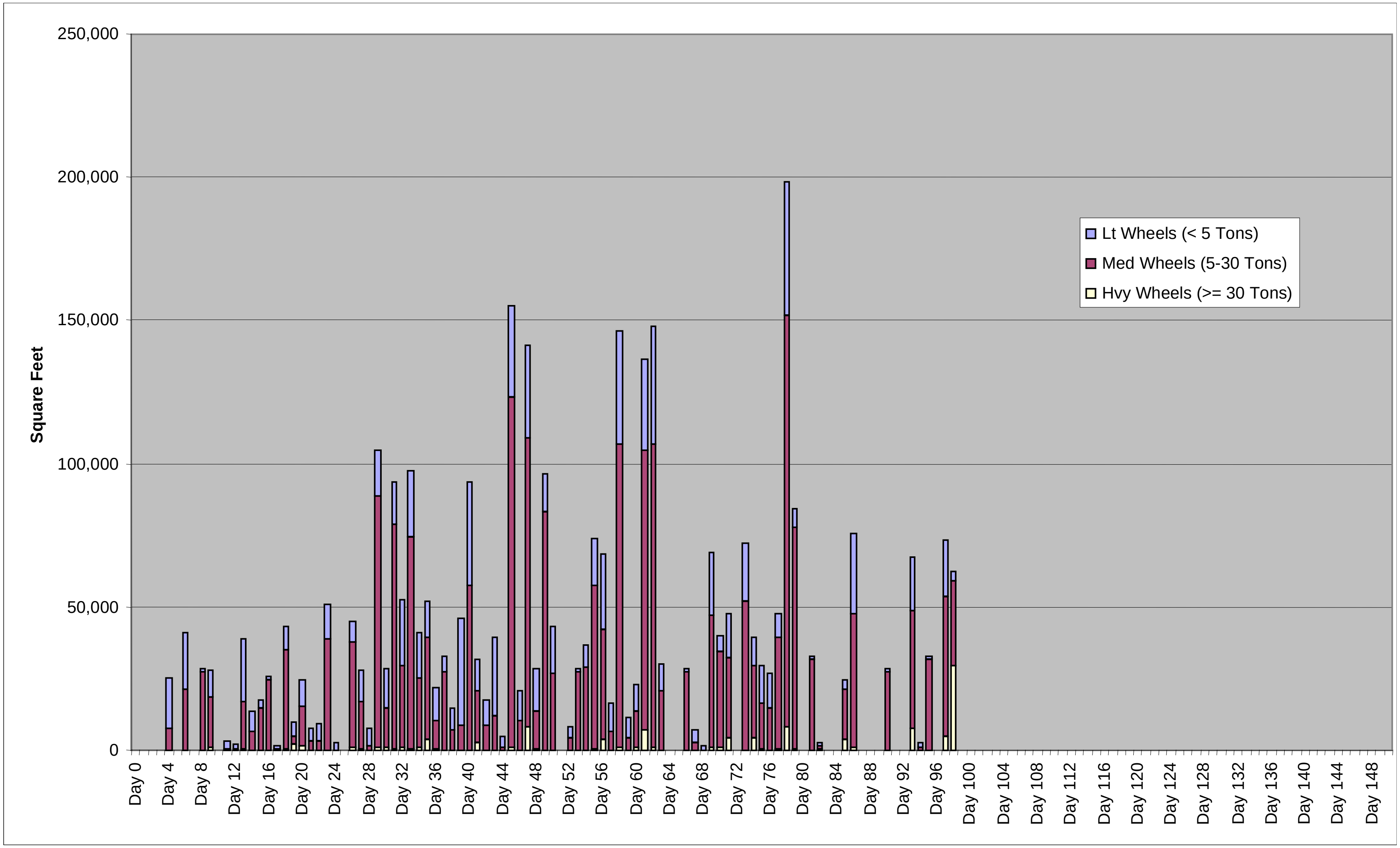


Figure F-15. Square Feet of Wheeled Vehicles Arriving at the Port of Tacoma

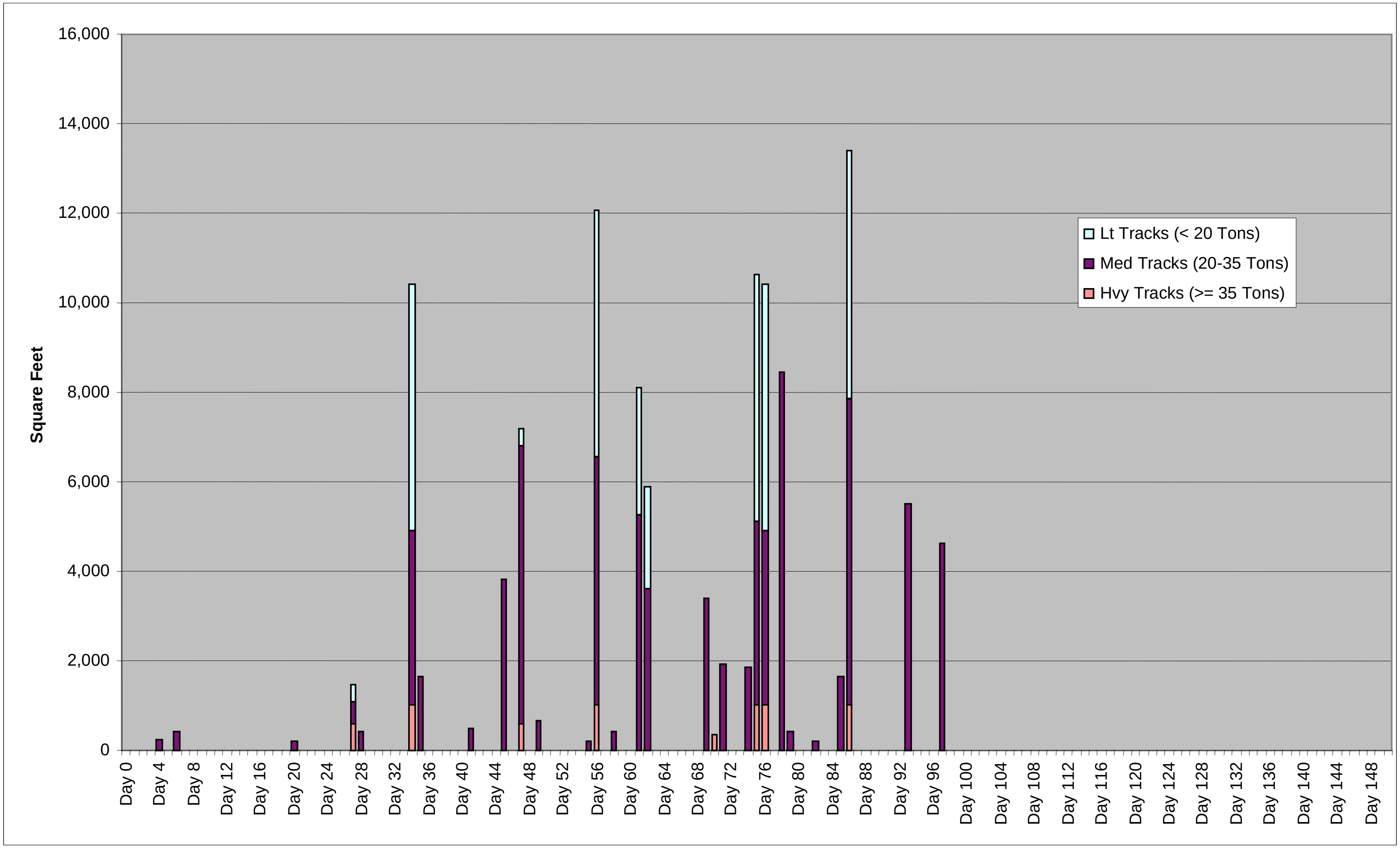


Figure F-16. Square Feet of Tracked Vehicles Arriving at the Port of Tacoma

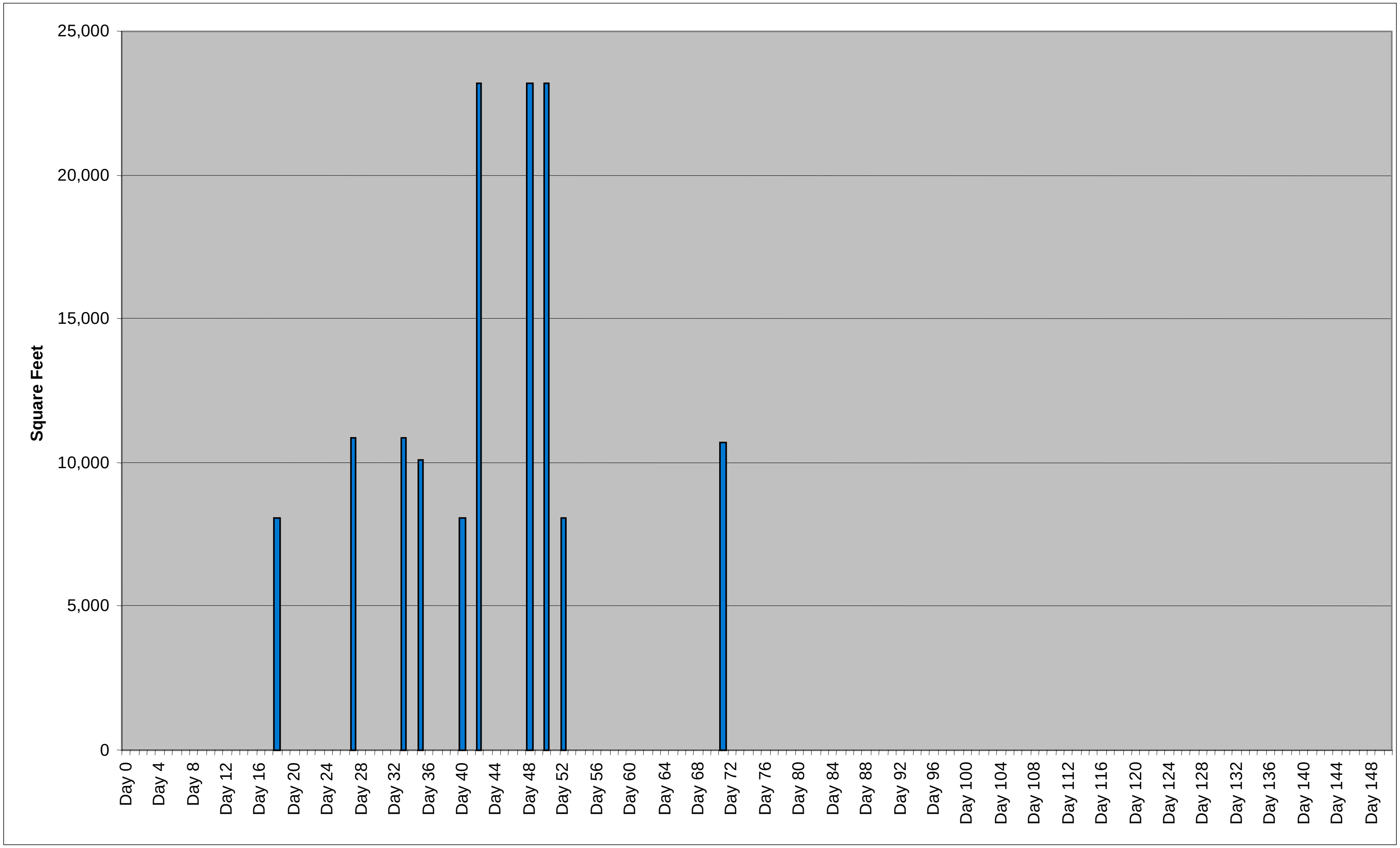


Figure F-17. Square Feet of Aircraft Arriving at the Port of Tacoma

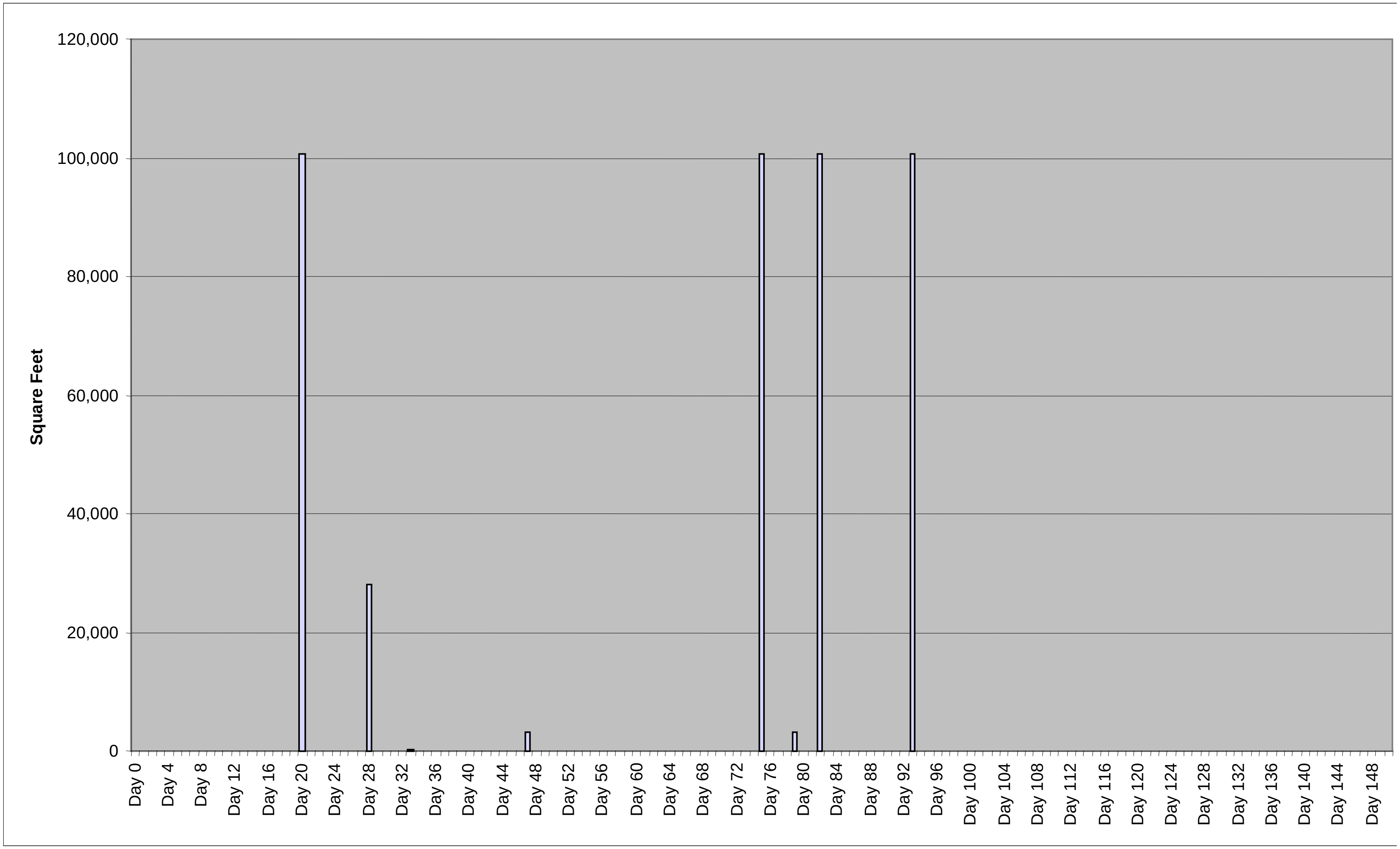


Figure F-18. Square Feet of Floating Craft Arriving at the Port of Tacoma

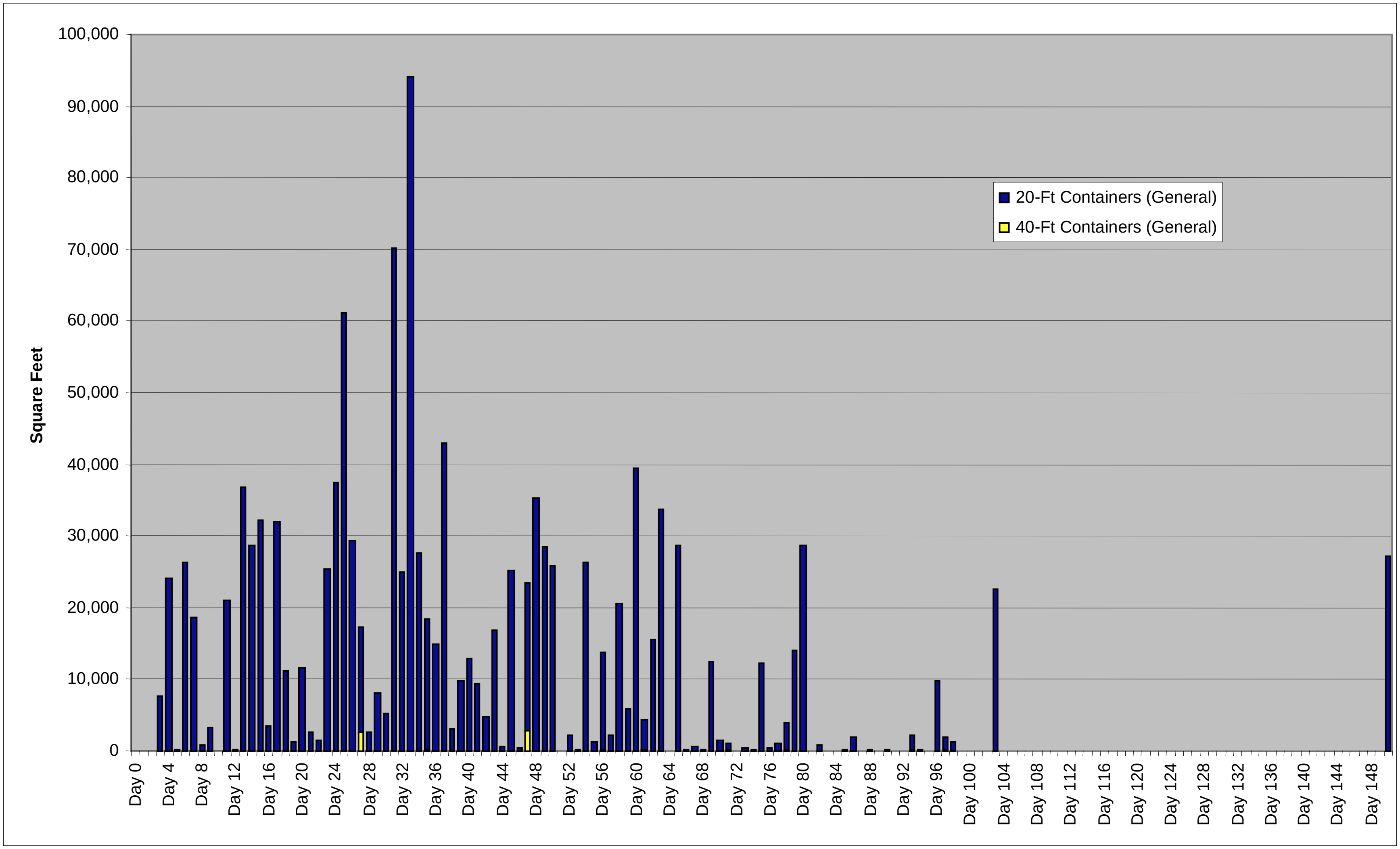


Figure F-19. Square Feet of Containers Arriving at the Port of Tacoma

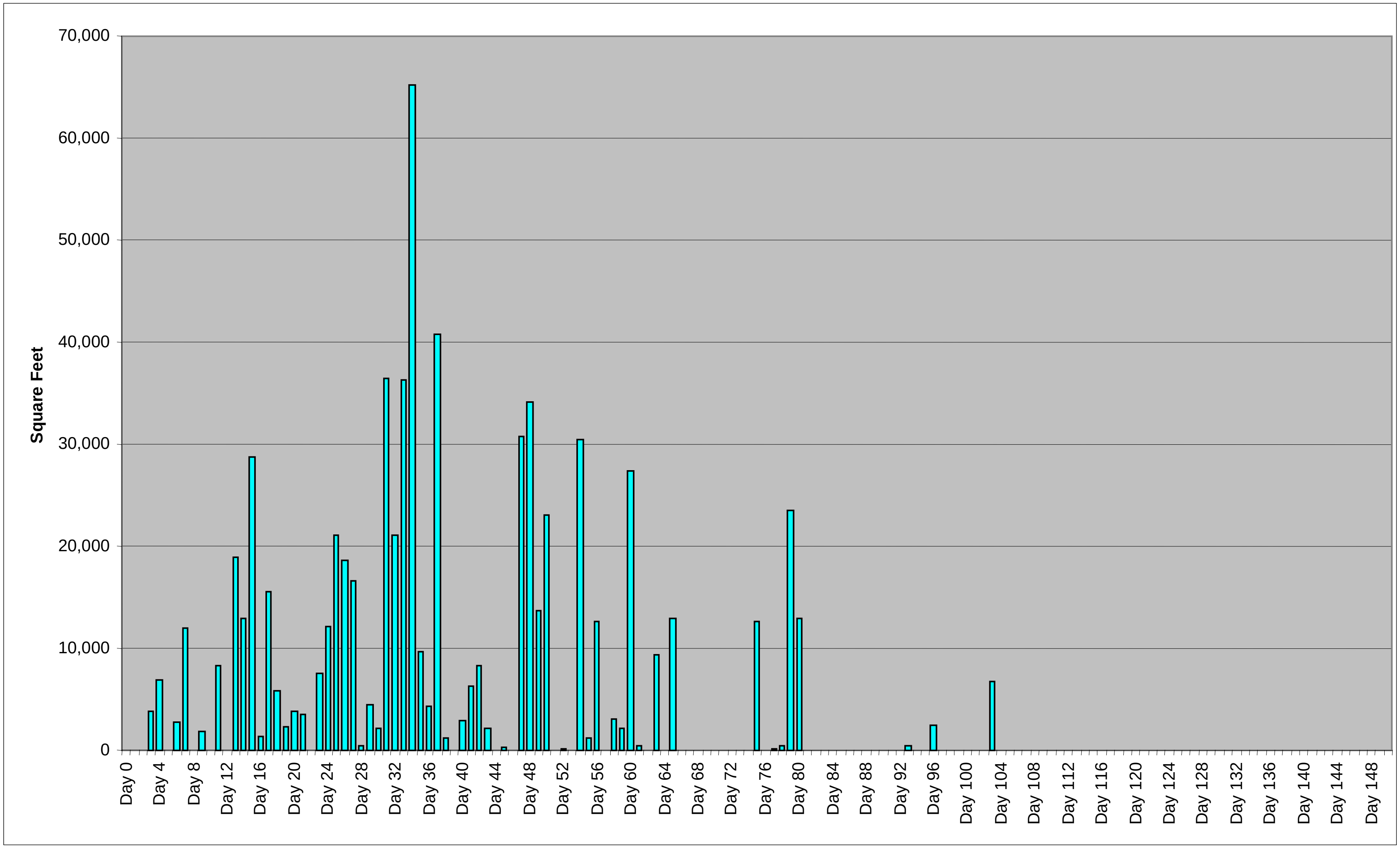


Figure F-20. Square Feet of Breakbulk Cargo Arriving at the Port of Tacoma

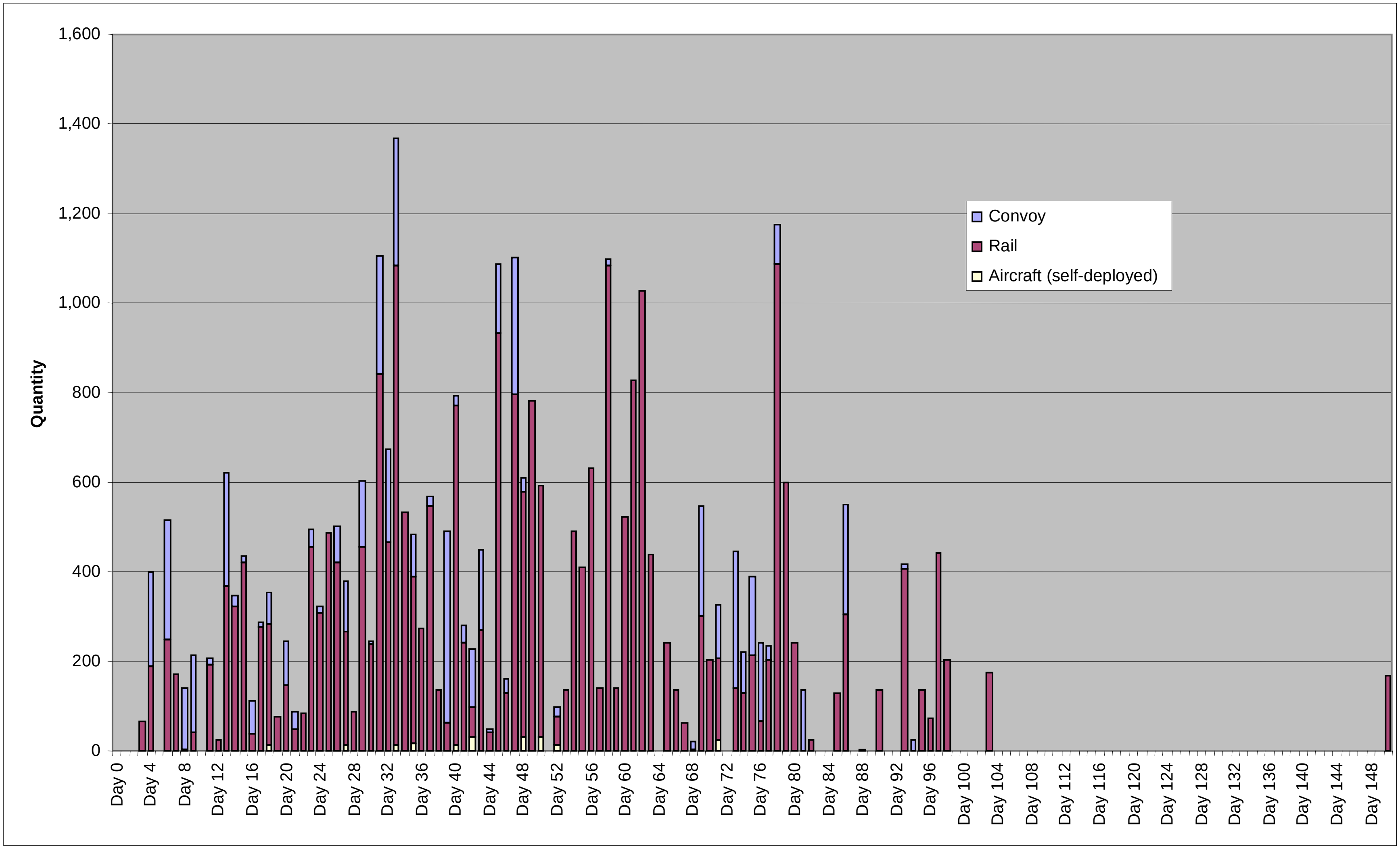


Figure F-21. Quantity of Cargo Items Arriving by Mode to the Port of Tacoma

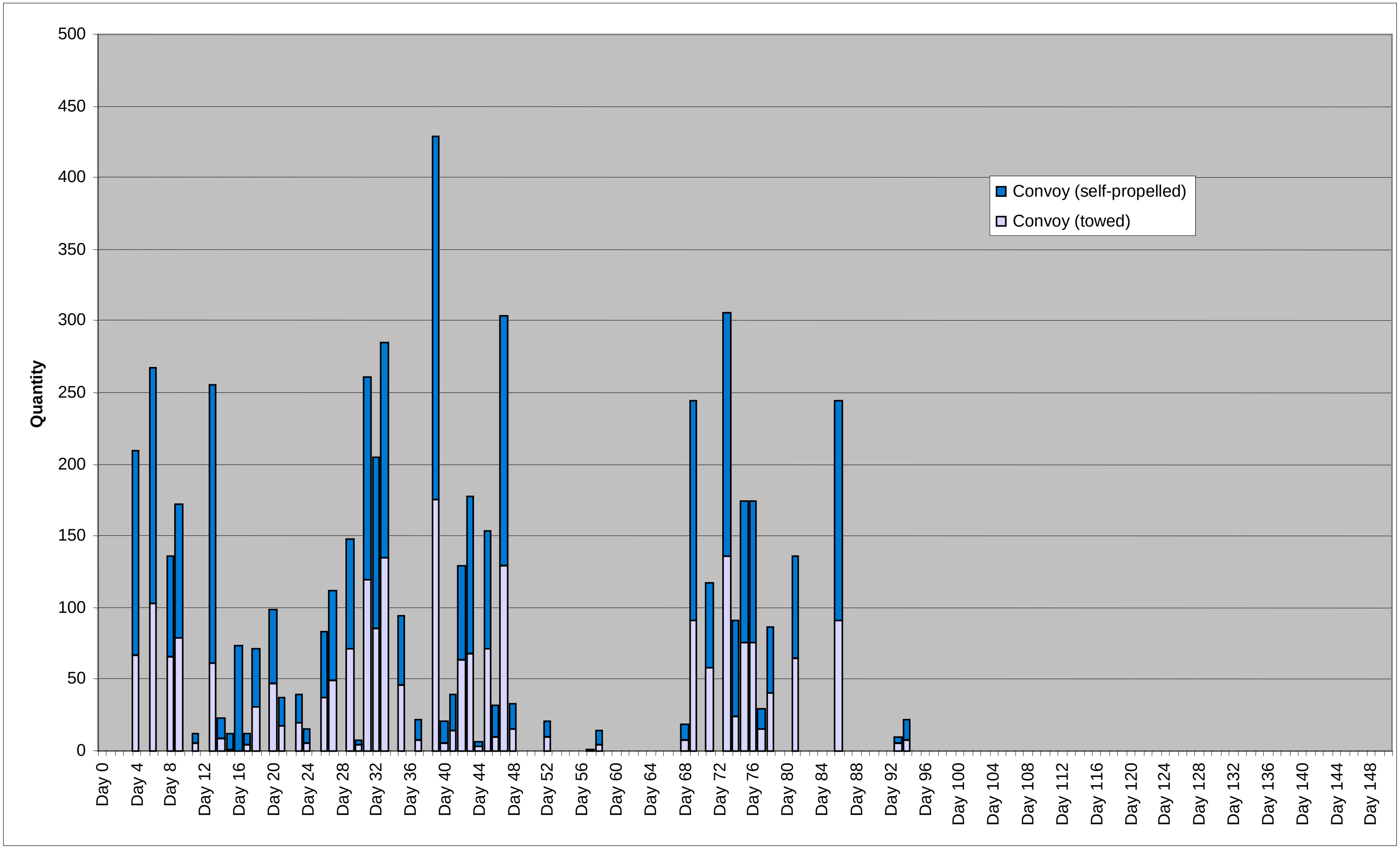


Figure F-22. Quantity of Wheeled Vehicles Convoying to the Port of Tacoma

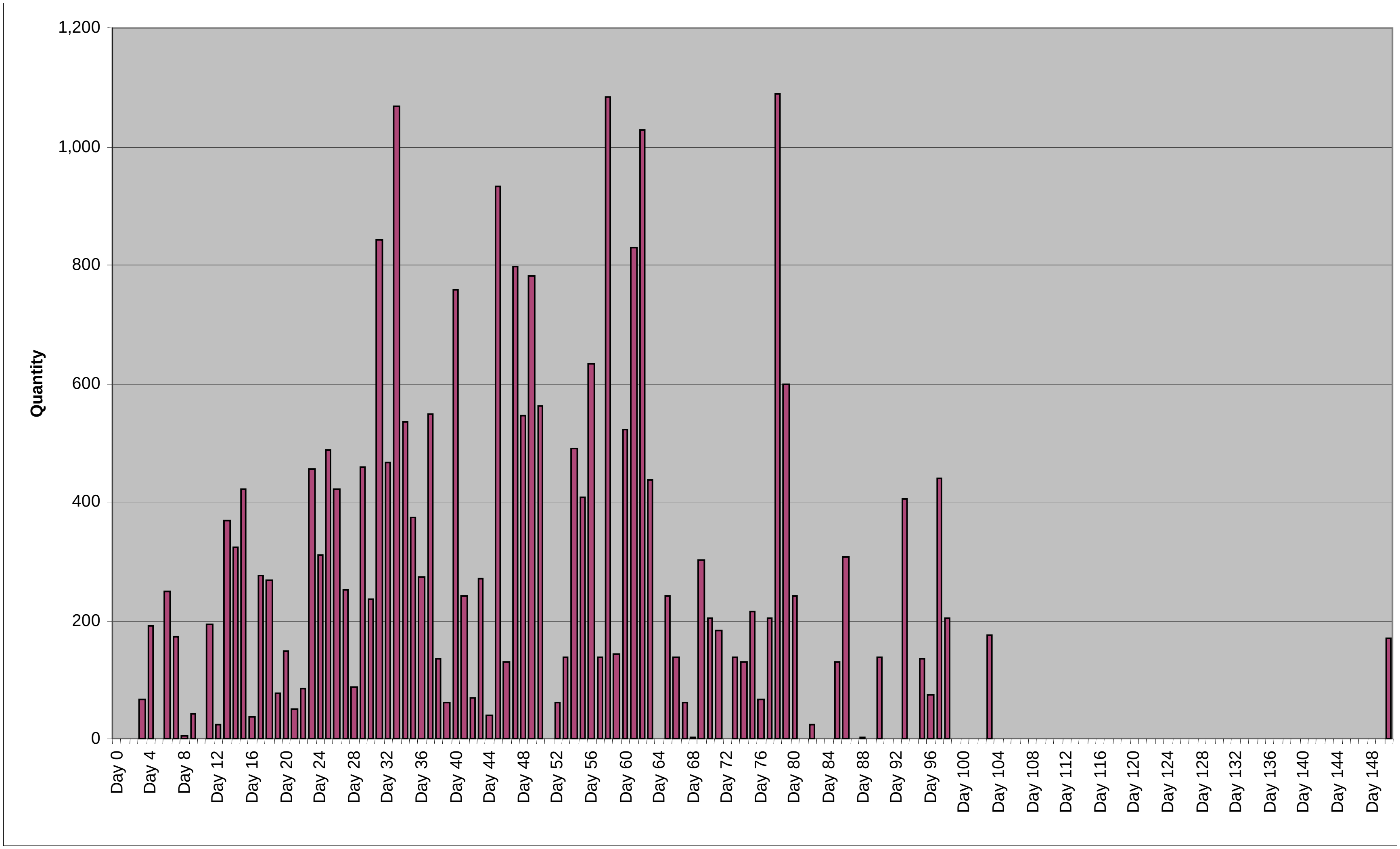


Figure F-23. Quantity of Items Arriving by Rail to the Port of Tacoma

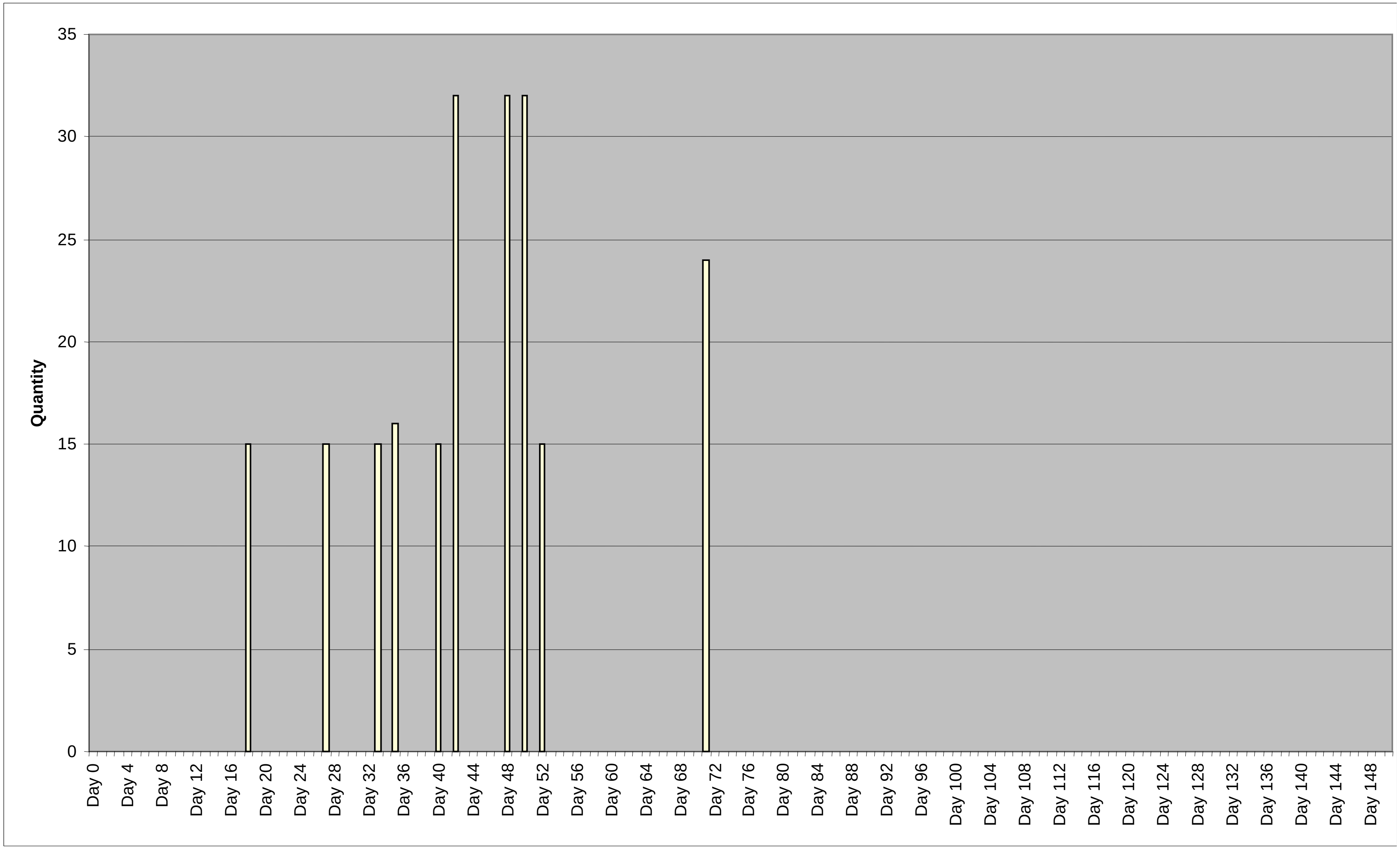


Figure F-24. Quantity of Aircraft Self-Deploying to the Port of Tacoma

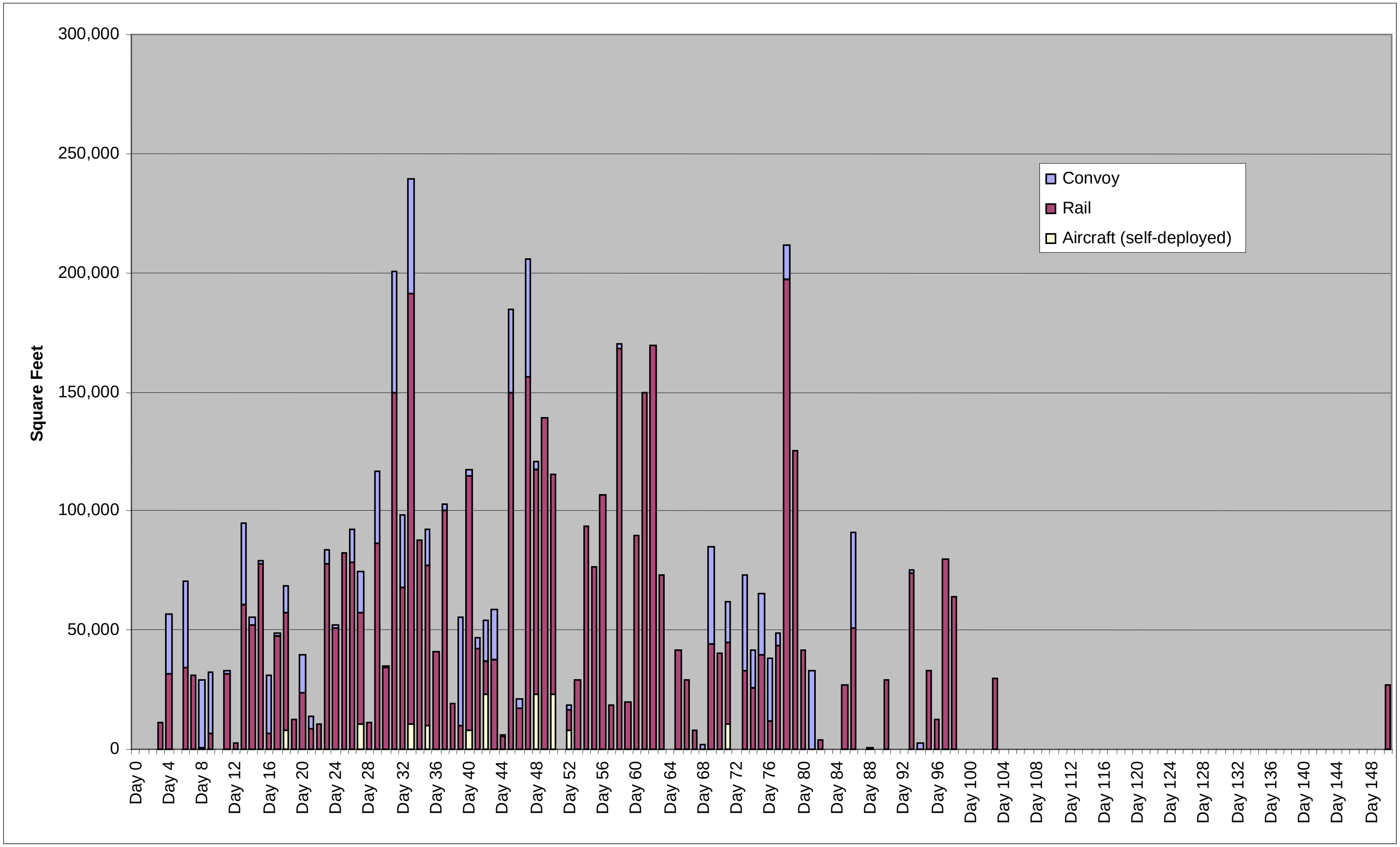


Figure F-25. Square Feet of Cargo Arriving by Mode to the Port of Tacoma

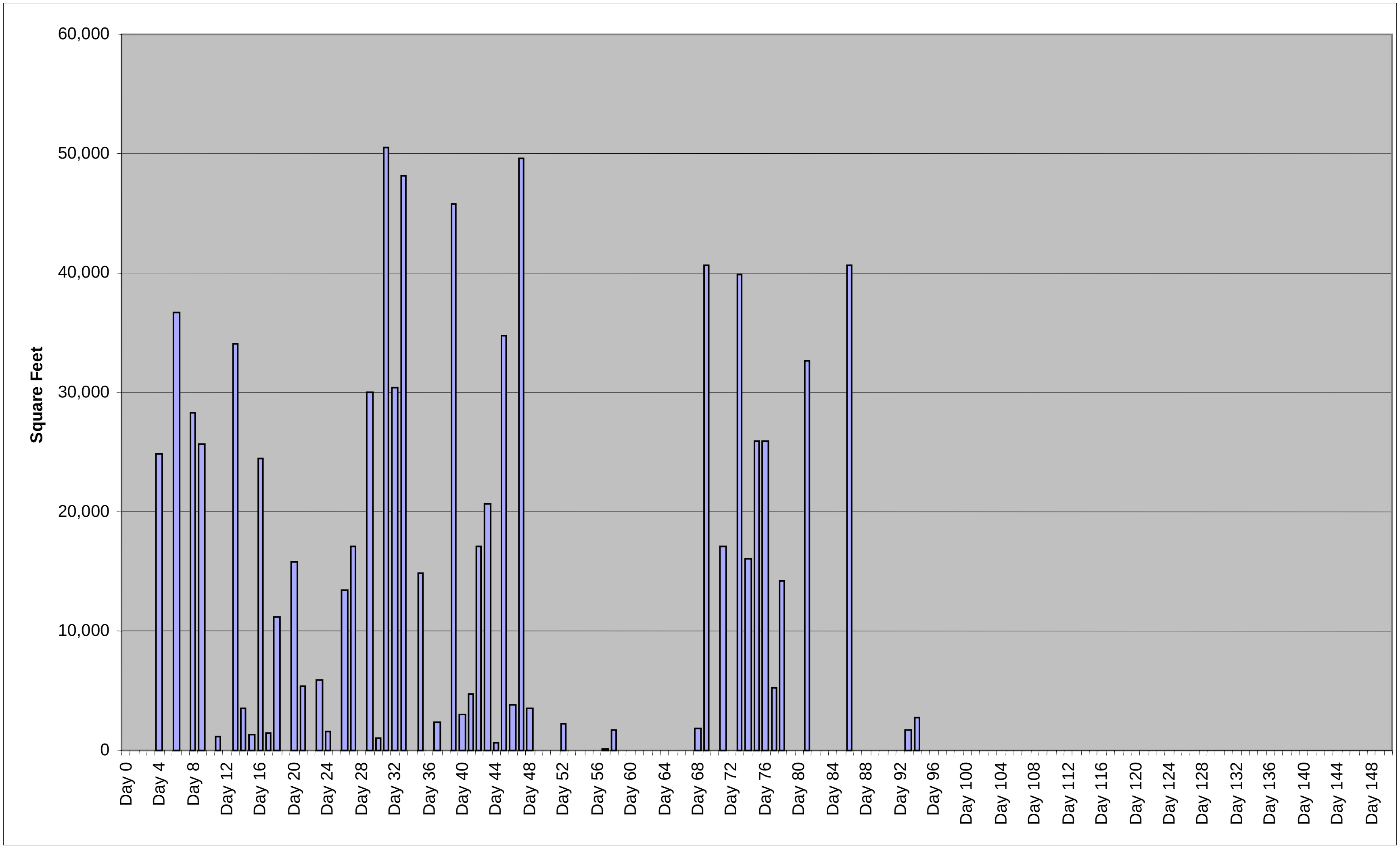


Figure F-26. Square Feet of Wheeled Vehicles Convoying to the Port of Tacoma

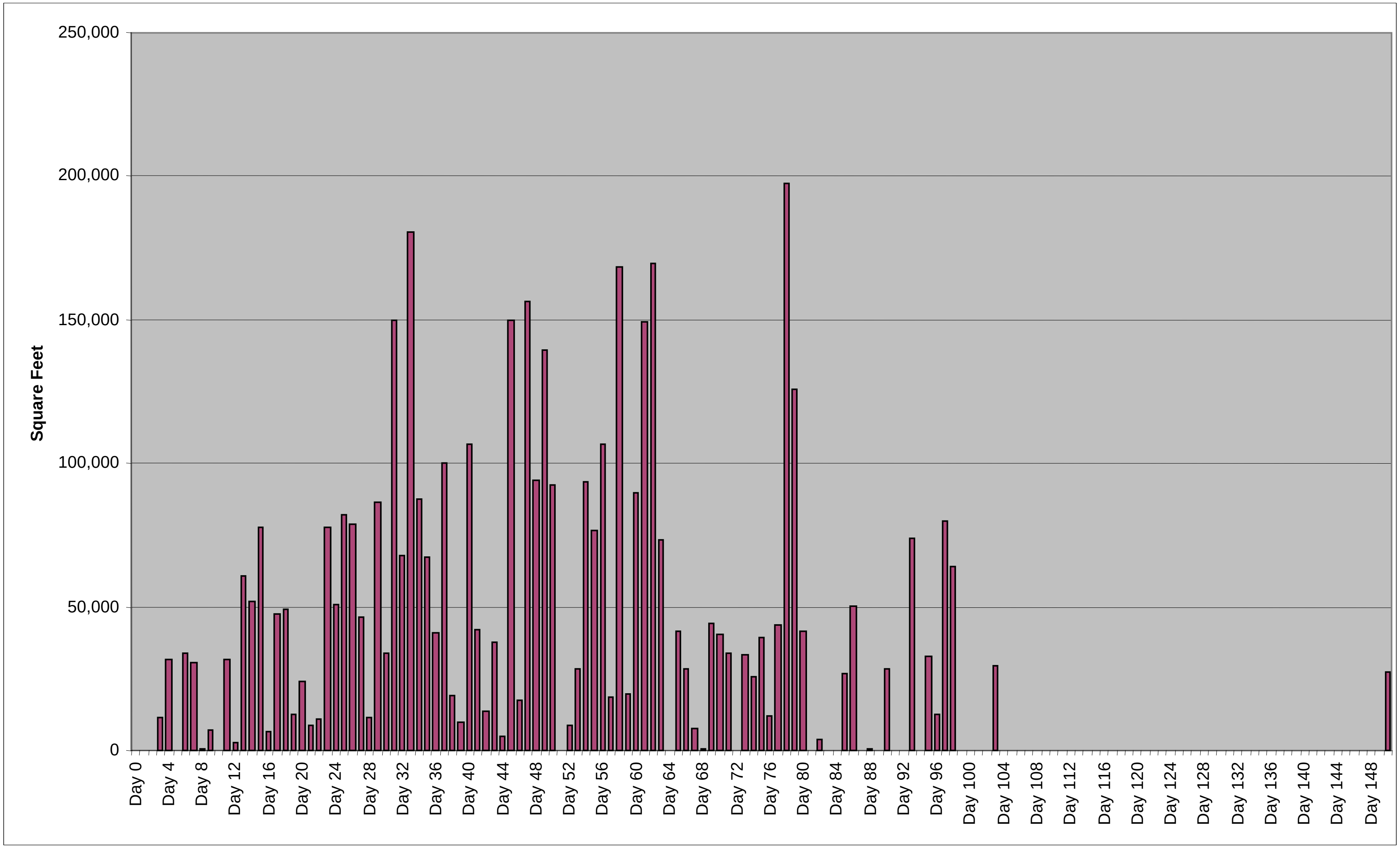


Figure F-27. Square Feet of Cargo Arriving by Rail to the Port of Tacoma

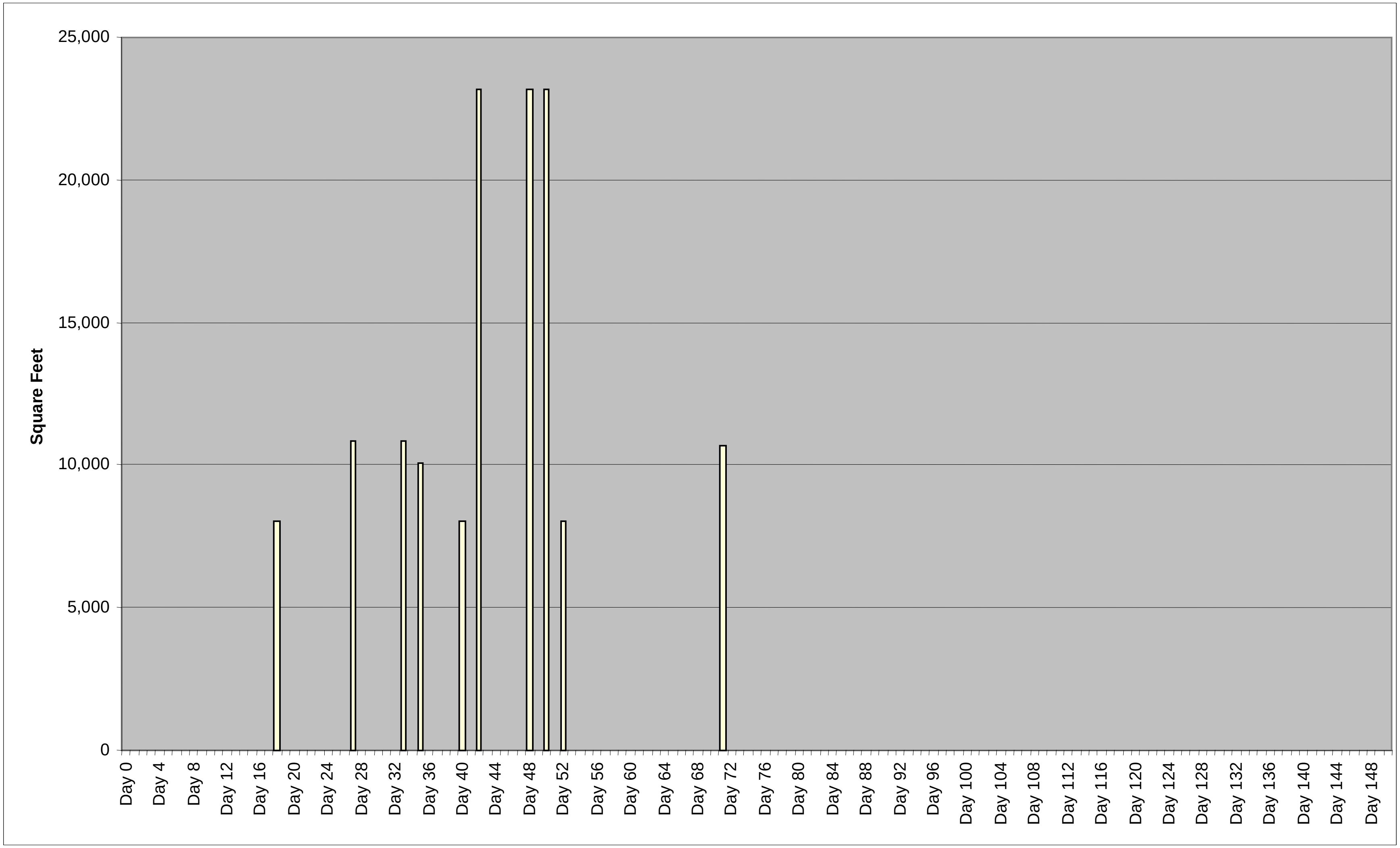


Figure F-28. Square Feet of Aircraft Self-Deploying to the Port of Tacoma

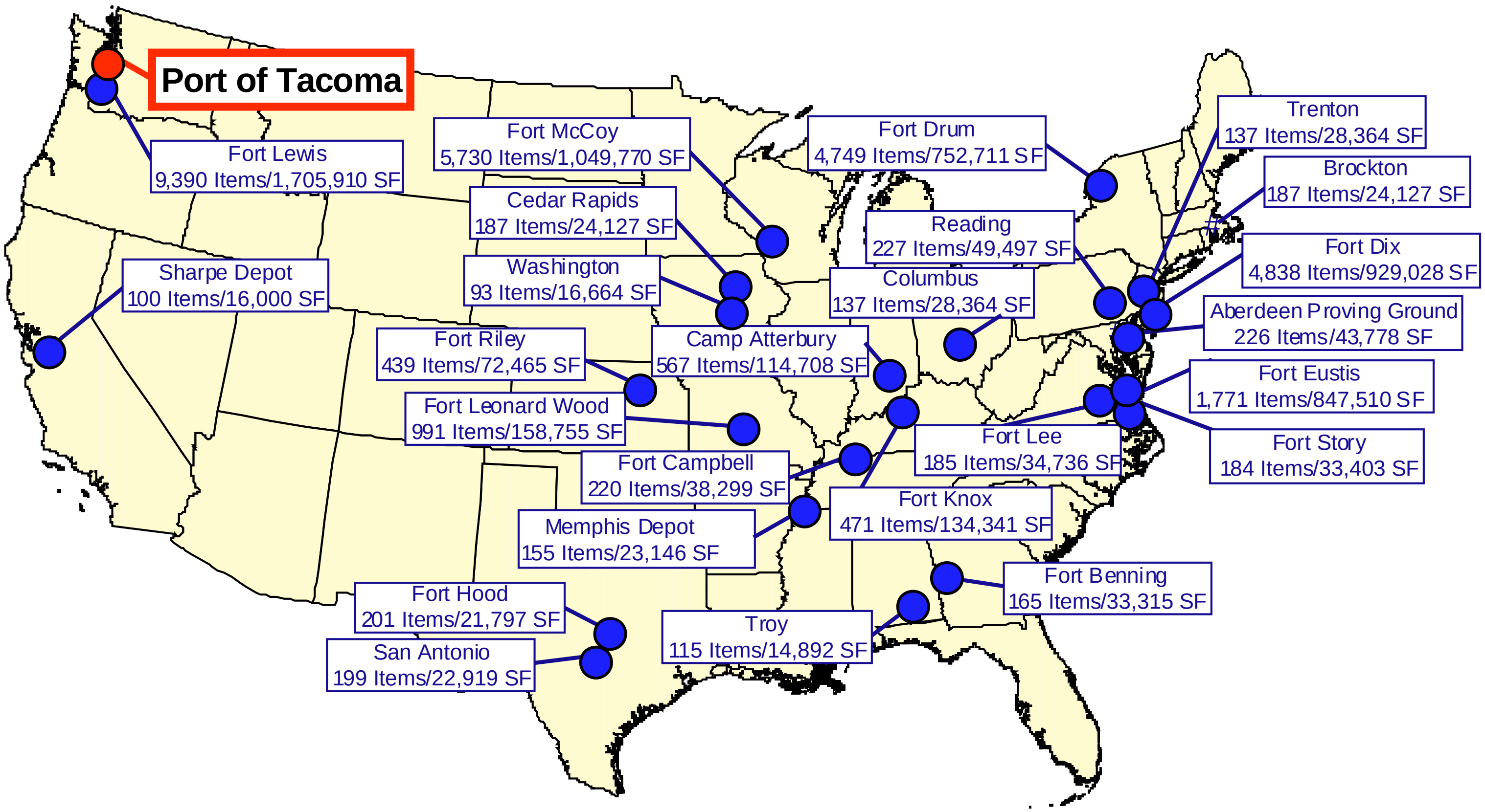


Figure F-29. Amount of Cargo Arriving at the Port of Tacoma by Origin

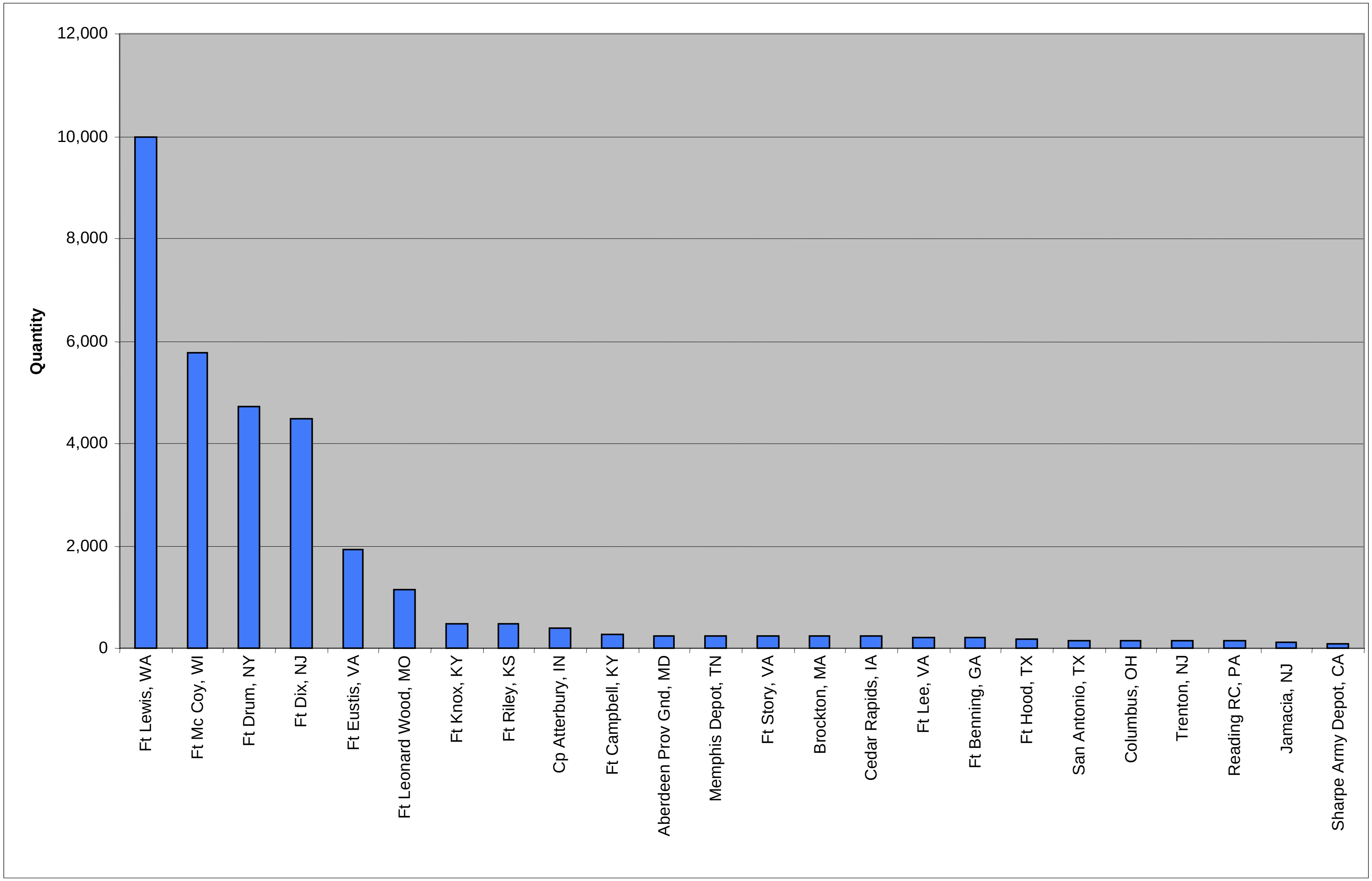


Figure F-30. Quantity of Items Arriving at the Port of Tacoma by Origin

Table F-1
Quantity of Items Arriving at the Port of Tacoma by Origin
(Origins not in Figure F-30)

Origin	Quantity
Troy, AL	96
Washington, IA	96
Fort Carson, CO	91
Davenport, IA	87
Camp Murray, WA	74
Kansas City, KS	46
Camp Ripley, MN	42
New Cumberland Depot, PA	36
Chicago, IL	35
Anniston Army Depot, AL	34
Fort Lawton, WA	23
Independence, MO	23
Selfridge ANGB, MI	23
Tooele Army Depot, UT	23
Yakima Firing Center, WA	23
Fort Detrick, MD	14
Little Creek, VA	12
Salt Lake City, UT	5

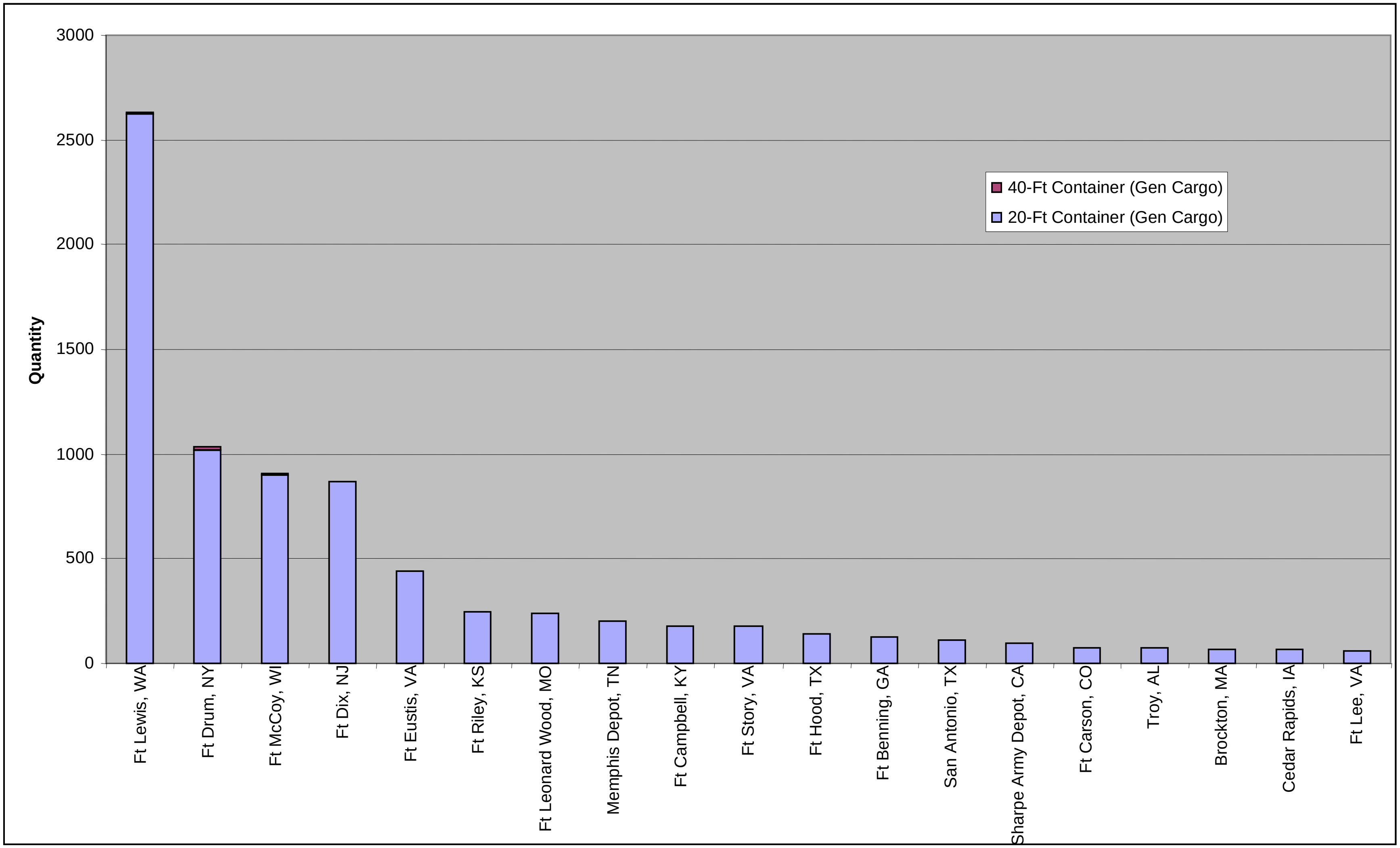


Figure F-31. Quantity of Containers Arriving at the Port of Tacoma by Origin

Table F-2
Quantity of Containers Arriving at the Port of Tacoma by Origin
(Origins not in Figure F-31)

Origin	20-Ft Containers	40-Ft Containers
Fort Knox, KY	2	
New Cumberland Depot, PA	2	
Anniston Army Depot, AL	2	
Aberdeen Proving Ground, MD	0	1

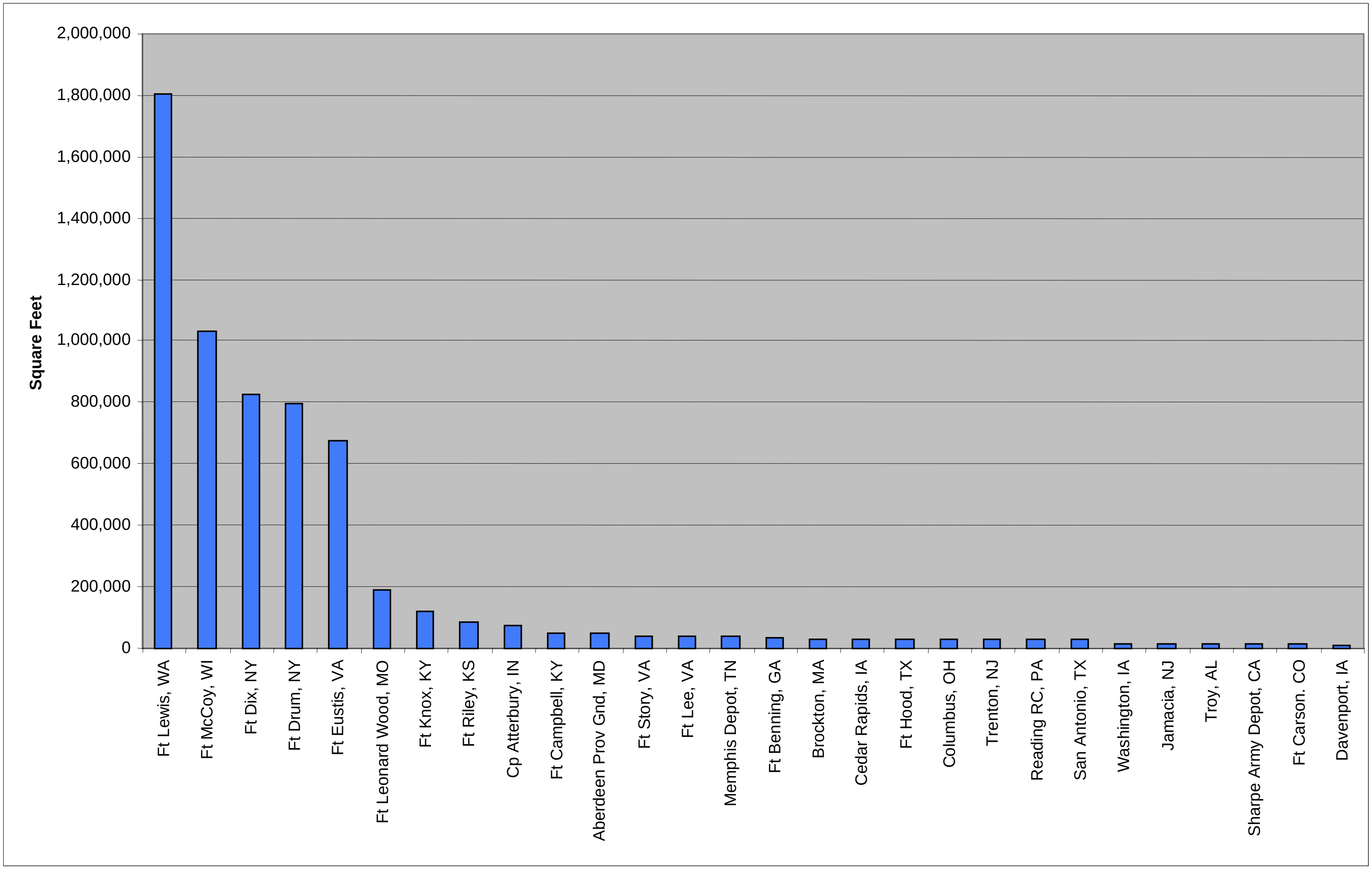


Figure F-32. Square Feet of Cargo Arriving at the Port of Tacoma by Origin

Table F-3
Square Feet of Cargo Arriving at the Port of Tacoma by Origin
(Origins not in Figure F-32)

Origin	Square Feet
Camp Murray, WA	9475.2
New Cumberland Depot, PA	5760.0
Anniston Army Depot, AL	5440.0
Kansas City, KS	5290.6
Chicago, IL	4577.0
Camp Ripley, MN	4339.4
Fort Lawton, WA	3965.3
Independence, MO	3965.3
Selfridge ANGB, MI	2536.9
Tooele Army Depot, UT	2536.9
Yakima Firing Center, WA	2536.9
Fort Detrick, MD	2253.8
Salt Lake City, UT	727.1
Little Creek, VA	297.0

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Port Enhancement Analysis

Phase I:

Port Workload Requirements for the CONUS Ammunition Ports

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Jennifer K. Casto
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Military Traffic Management Command
Transportation Engineering Agency

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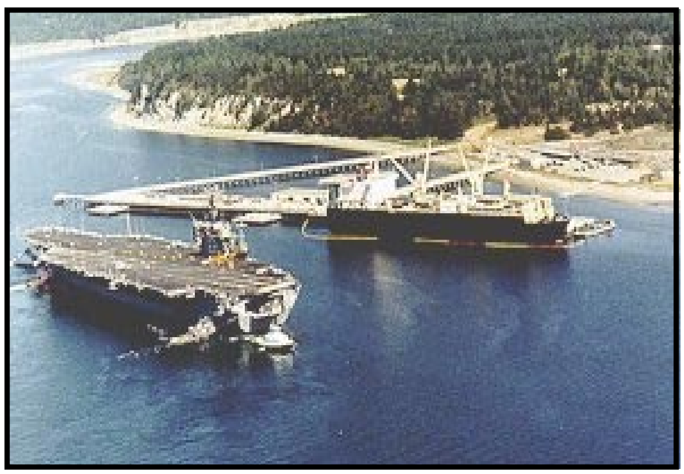
INTRODUCTION

This is Phase I of a two-phased study.

- Phase I identifies the quantity of cargo DOD plans to send through the strategic seaport, and

- Phase II considers the ports' ability to handle their assigned workload.

The Military Traffic Management Command's Transportation Engineering Agency (TEA) has analyzed ports for years. With our Ports for National Defense Program, we survey the ports that are important to national defense, defining their capabilities. We then compare these capabilities to the demand imposed by a notional unit deploying through the port. Based on this comparison, we assess the port's ability to meet its requirements. This methodology has suited us well in the past. However, as the deployment windows continue to shrink, we are forced to get our CONUS-based forces through the ports faster than ever before. Compound this with the continued economic expansion in many of these areas, and it is becoming a challenge for the ports to dedicate the real estate and facilities to respond to our requirements. This is particularly true in the early days of a contingency.



As a result, TEA realized the need for a more precise assessment of each port's ability to meet its requirements. We realized the need to base each port's requirements on the most demanding operation plan (OPLAN) for that port. Using our modeling capability, we can work with the tremendous quantity of information in an OPLAN time-phased force deployment data (TPFDD), massage the data, and extract the detail needed to get an accurate picture of the deployment through each port.

OBJECTIVES

The objectives of this initiative are:

Phase I:

(1) Define the OPLAN-based time-phased flow of cargo through the port during a demanding deployment. This flow is defined in terms of quantity and square feet.

(2) Allow planners to assign Transportation Terminal Brigades/Battalions (TTBs) to ports based on workload.

(3) Allow TTBs to adequately prepare for deployment operations.

(4) Validate the need for deploying units to support Sea Ports of Embarkation (SPOEs).

Phase II:

(1) Assist the port commander in quantifying real estate and facility support needed from the port.

(2) In instances where the port cannot meet their requirements, provide the quantitative basis to help both DOD and commercial planners assess potential "fixes." These fixes could include:

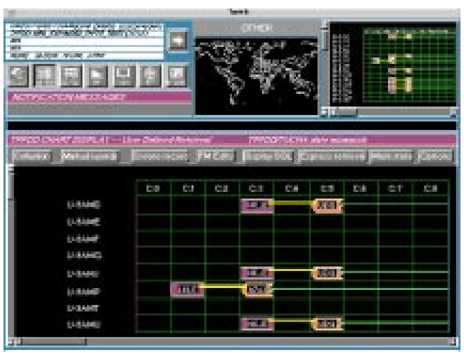
- Re-routing cargo to another port in the region,
- Re-timing the flow, or even
- Working through the local and metropolitan planning organizations to solicit federal funds.

METHODOLOGY

When practical, ports are analyzed on a regional basis. This allows planners to examine an entire region at one time, evaluating peaks and valleys at groups of neighboring ports. Although they are not located in the same geographical region, the three ammunition ports were grouped together because of the uniqueness of their mission. The same TPFDD was not used for the three ports.

The following tools are utilized to analyze port workload:

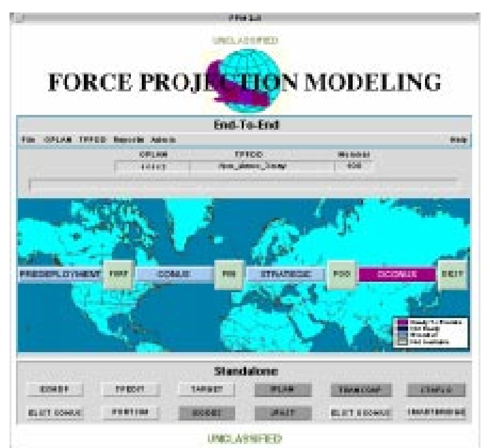
TPEDIT (TPFDD Editor) – An integrated set of automated processing tools that provides TPFDD editing and analysis capability. TPEDIT allows the analyst to:

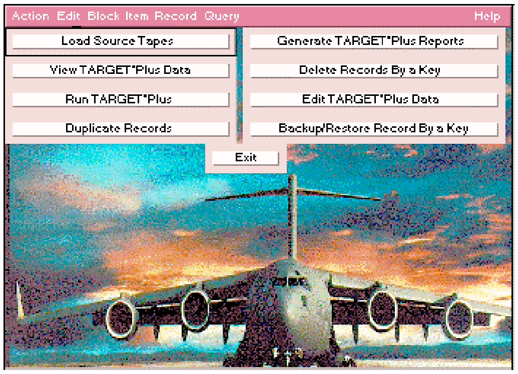


- View the TPFDD graphically.
- Extract information for the seaport of embarkation (SPOE) of interest.
- Edit the TPFDD. Remove "on-call" and "shortfalled" records. Clean-up data issues.
- Review data to determine the amount of cargo (number of ULNs/CINs, quantity, square feet, short tons, measurement tons) flowing through the port.

EXPANDED TPFDD - A database shared by the simulation models and used for tracking movement requirements at the individual item level of detail. Using the expanded TPFDD the analyst can:

- Load the TPFDD into the Oracle database management system.
- "Expand" the TPFDD cargo detail within Oracle to Level 6 for the SPOE of interest.





TARGET (Transportability Analysis Reports Generator) – A system of models and programs that provide the capability to generate movement requirements at the individual item level of detail (Level 6). The system merges force structure data from the Table of Organization and Equipment (TOE) or the Modified TOE (MTOE) with equipment characteristics from the Department of the Army Standard Equipment Characteristic File (ECF) to create unit equipment tables. With TARGET, the analyst:

- Assigns transport modes by ULN/CIN (convoy/rail).

- Selects transport assets.
  Containers (20' and 40')
  Railcars (89' flatcars, 60' flatcars, 68' DODX railcars)

- Determines convoy, rail, and container requirements.

FPM REPORTS – A set of customized reports extracts detailed cargo information from TARGET output files. These reports, when imported into Microsoft Excel, are the foundation of the port workload effort. The graphs are included in the results section of this report.

ASSUMPTIONS

- The requirements in this report represent:
  - The entire duration of the flow through Port Hadlock, NWS Concord, and Sunny Point as defined by the OPLAN.
  - All records in the plan scheduled to move by sea under Military Sealift Command's (MSC) control.
  - The most demanding plan for each port. As a result, the same OPLAN was not used for all three ammunition ports. The plans may not necessarily be representative of the flow during an actual deployment.
- TPFDD Records not included in this analysis:
  - "On-call" records. These records are in the plan but are not scheduled to move – they appear with an available to load date (ALD) of 999.
  - "Shortfalled" records. These records are in the plan but are not sourced – they have not been matched with a specific unit.
  - Bulk petroleum, oils, and lubricants (POL) records (packaged POL is included).
- TARGET uses the following transport assets:
  Containers (20-foot, 40-foot)
  Railcars (89-foot flatcars)
  NOTE: Commercial Motor was not utilized
- Containers are stuffed at their origin.
- TARGET stuffs containers and loads railcars with unit integrity. This may, in some instances, give a high estimate of containers and railcars for each unit.
- The breakbulk category includes cargo coded in the TPFDD as containerizable with dimensions exceeding the allowable dimensions of a 20-foot container and nonvehicular cargo coded as noncontainerizable.

RESULTS

The charts in this report represent the daily cargo arrival in terms of quantity and square feet at the respective port. The cargo for these three ports consists entirely of container eligible ammunition, general container eligible cargo, and container outsize cargo.

PORT HADLOCK NAVAL ORDNANCE CENTER

The graphs below represent the cargo arriving at Port Hadlock Naval Ordnance Center as outlined in the TPFDD. Cargo arrives at the port starting on day 3 and continuing through day 158.

All cargo scheduled to arrive at Port Hadlock Naval Ordnance Center is assumed to arrive by rail. The railcars will arrive at the Naval Submarine Base (SUBASE) Bangor Container Transfer Facility, south of Port Hadlock. At the facility, containers will be transferred to a chassis and transported to Port Hadlock.

Port Hadlock has two categories of cargo scheduled to arrive in the TPFDD:

- 20-Foot Container Eligible Ammunition
- Breakbulk Cargo

Figure 1 is the number of 89-foot railcars arriving at Port Hadlock by day.

Figure 2 displays the quantity of 20-foot containers arriving at Port Hadlock.

Figure 3 shows how much of the cargo arriving at Port Hadlock is containerizable ammunition and how much is too large for 20-foot containers (container outsize).

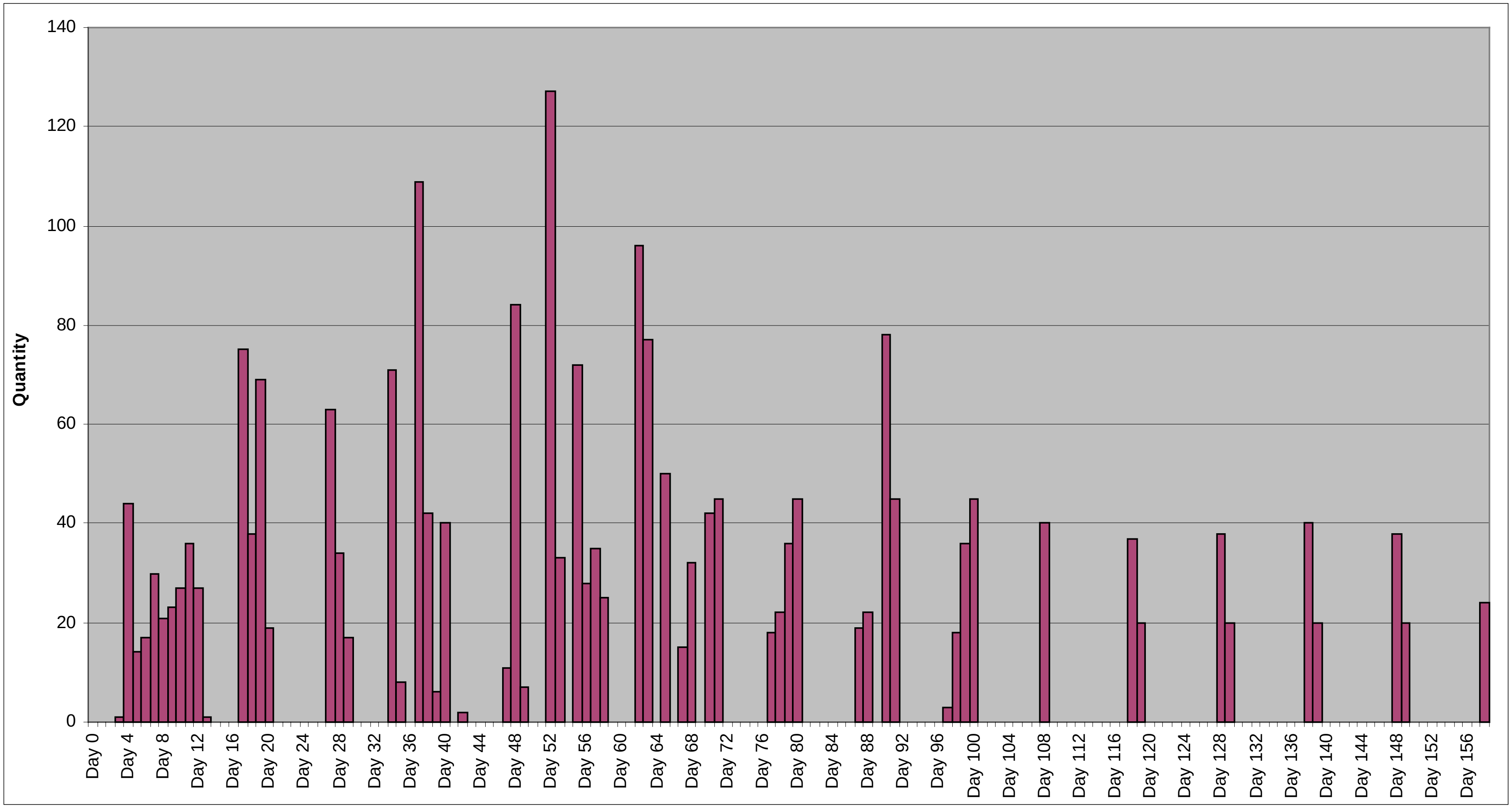


Figure 1. Quantity of 89-Foot Railcars Arriving at Port Hadlock.

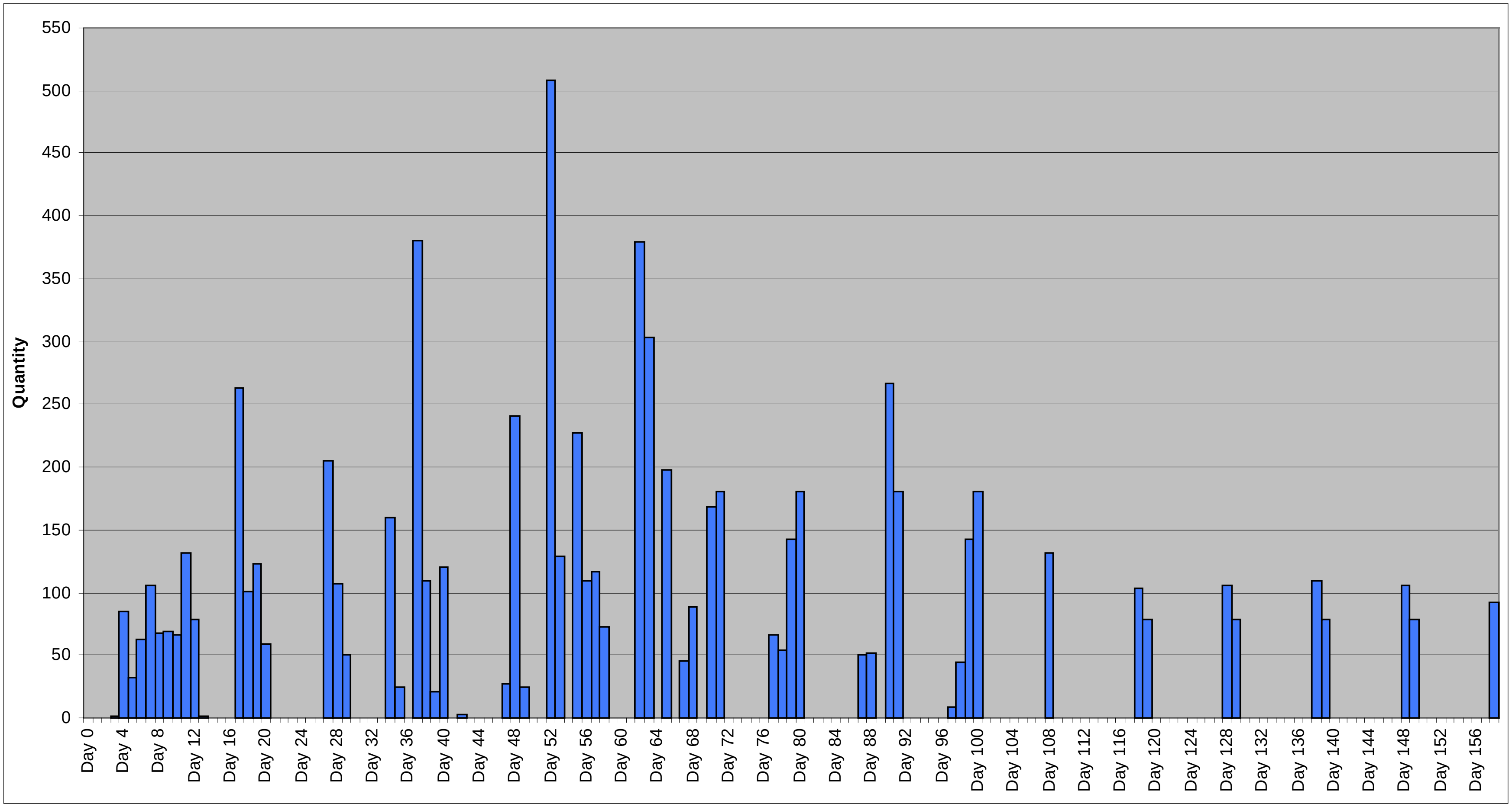


Figure 2. Quantity of 20-Foot Containers Arriving at Port Hadlock.

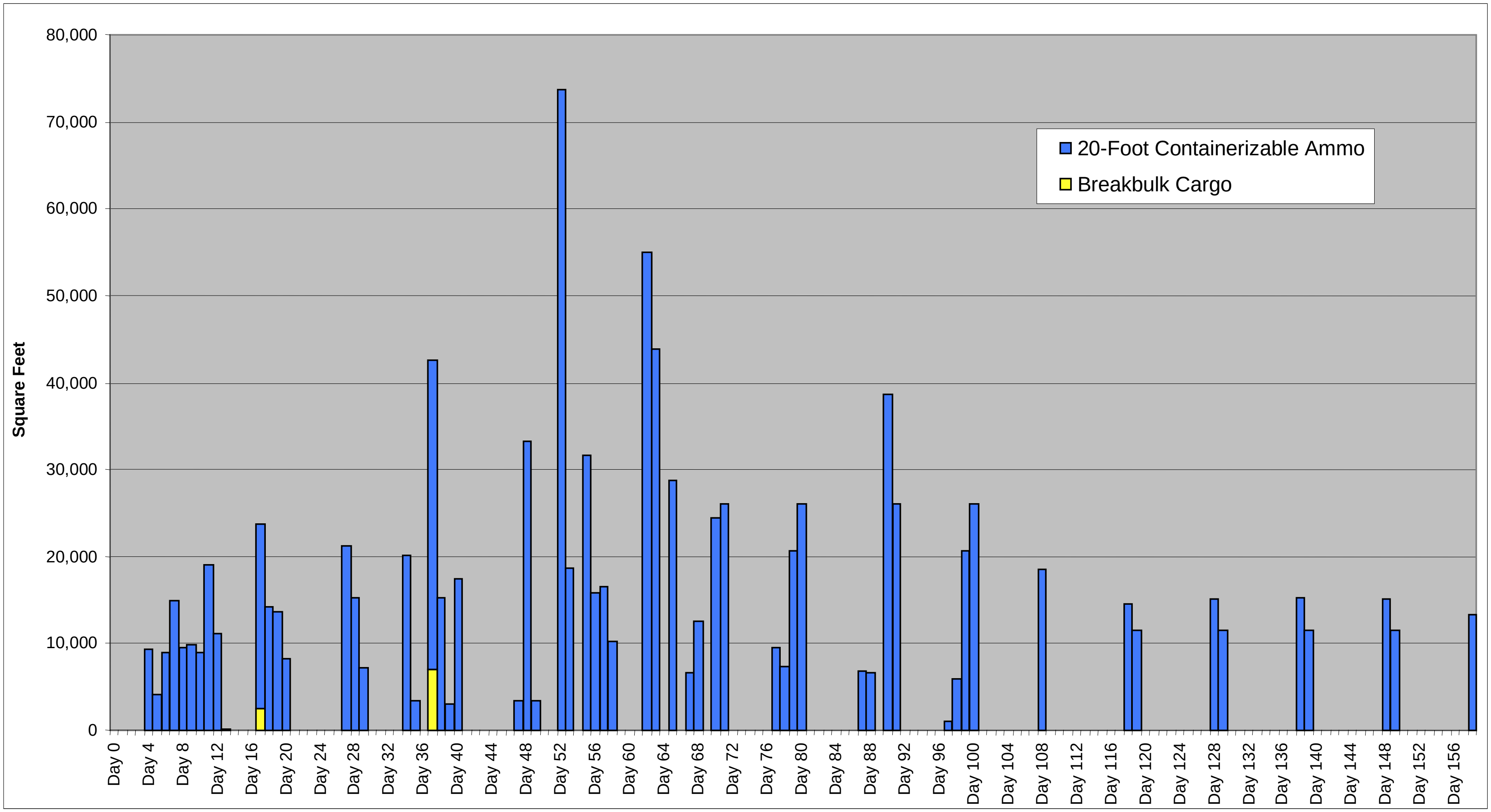


Figure 3. Total Square Feet of Cargo Arriving at Port Hadlock.

NAVAL WEAPONS STATION CONCORD

The graphs below represent the cargo arriving at the Naval Weapons Station Concord as outlined in the TPFDD. Cargo arrives at the port starting on day 2 and continuing through day 147.

All cargo scheduled to arrive at NWS Concord will arrive by rail. NWS Concord has two categories of cargo scheduled to arrive in the TPFDD:

- 20-Foot Container Eligible Ammunition
- Breakbulk Cargo

Figure 4 illustrates the quantity of 89-foot railcars arriving at NWS Concord each day.

The quantity of 20-foot containers arriving at the NWS Concord by day is shown in Figure 5.

Figure 6 represents the total square footage of cargo arriving at NWS Concord. It shows how much of the cargo is containerizable ammunition and how much is too large for a 20-foot container (container outsize). The container outsize cargo in figure 6 is 233 J143 rockets that are too wide to fit in a container. They originate at Concord, so it shouldn't be a real problem transporting to the port.

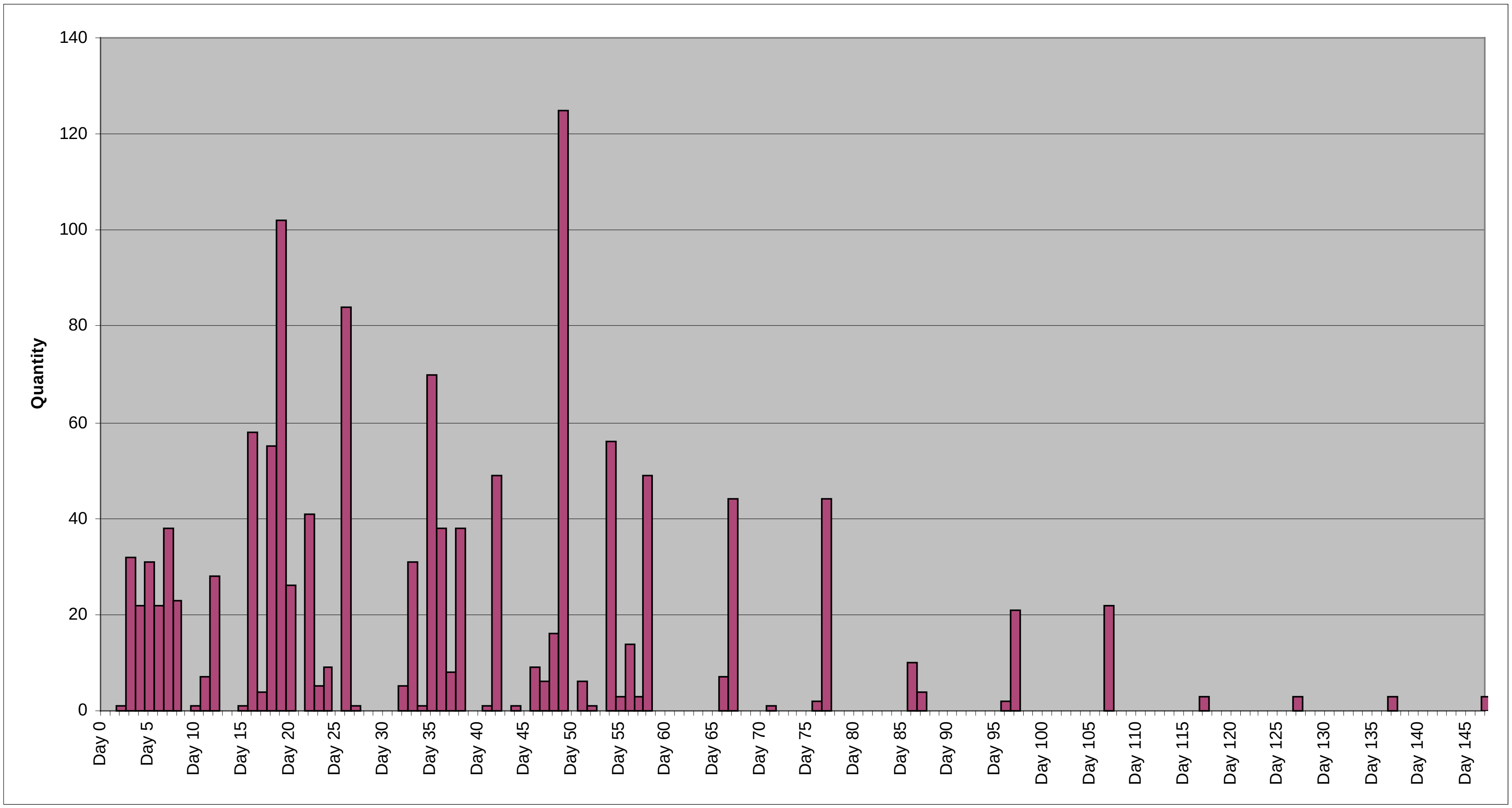


Figure 4. Quantity of 89-Foot Railcars Arriving at NWS Concord.

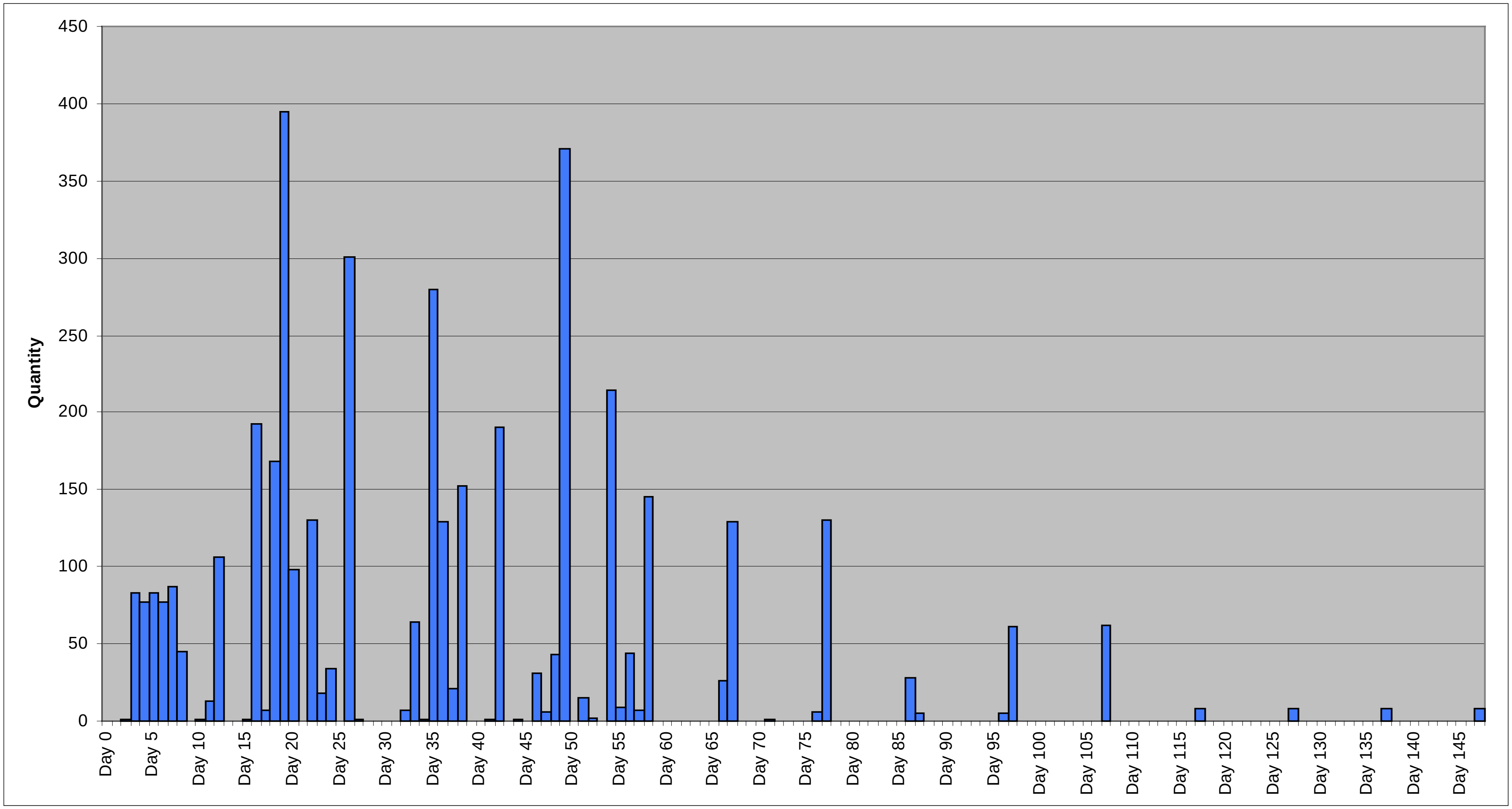


Figure 5. Quantity of 20-Foot Containers Arriving at NWS Concord.

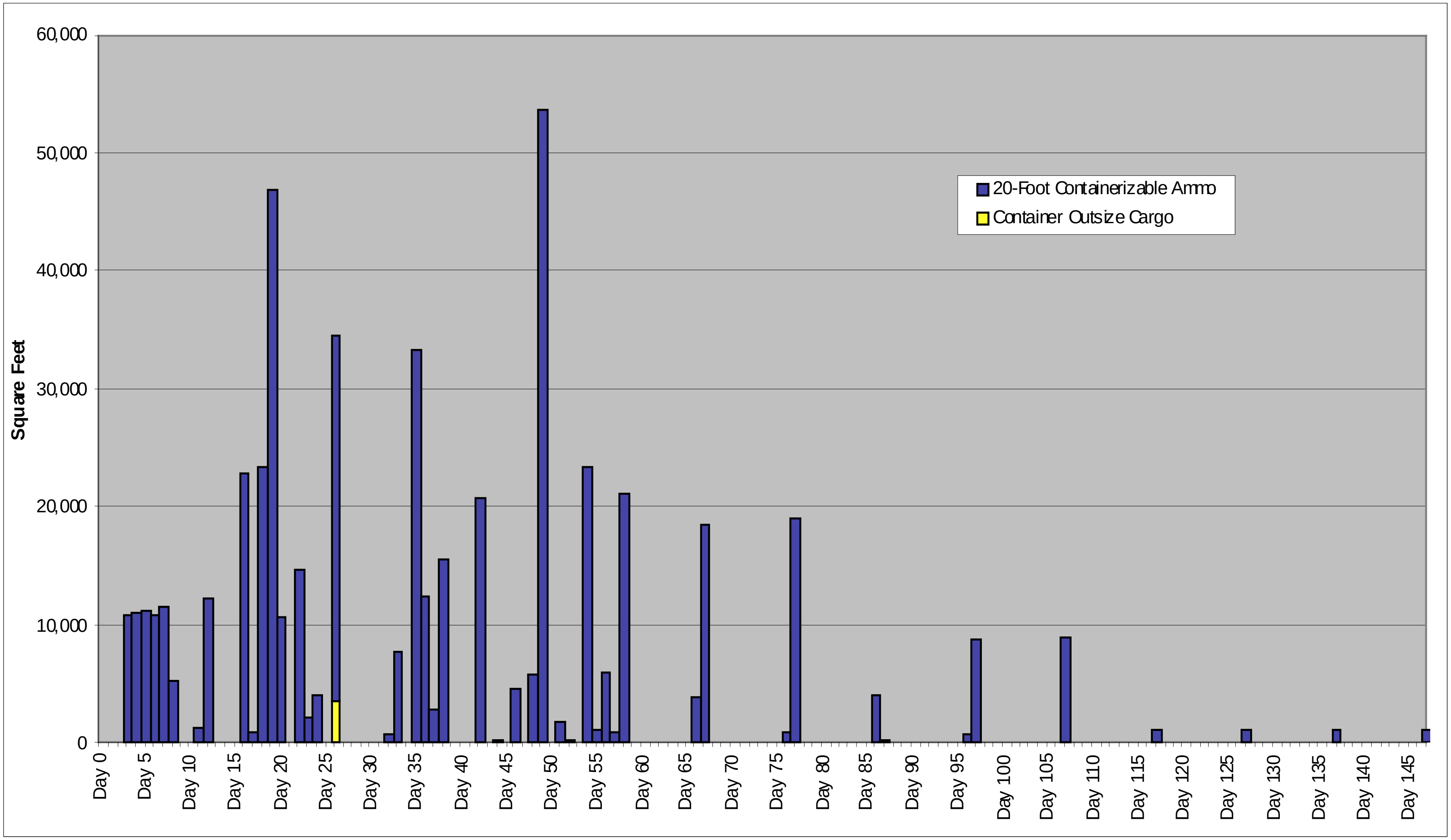


Figure 6. Total Square Feet of Cargo Arriving at NWS Concord.

MILITARY OCEAN TERMINAL SUNNY POINT

The graphs below represent the cargo arriving at the Military Ocean Terminal Sunny Point (MOTSU) as outlined in the TPFDD. Cargo arrives at the port starting on day –2 and continuing through day 73. All cargo scheduled to arrive at the Military Ocean Terminal Sunny Point will arrive by rail.

Sunny Point has two categories of cargo scheduled to arrive in the TPFDD:

- 20-Foot Container Eligible Ammunition
- Breakbulk Cargo

Figure 7 is the quantity of 89-foot railcars expected to arrive at Sunny Point each day.

Figure 8 displays the quantity of containers arriving at Sunny Point. The largest number of containers is scheduled to arrive at the port on day 55, with a total number of containers exceeding 1,700.

Figure 9 shows the total square footage of cargo arriving at Sunny Point. It shows how much of the cargo is containerizable and how much is not containerized. Figures 10 and 11 give the same information in more detail.

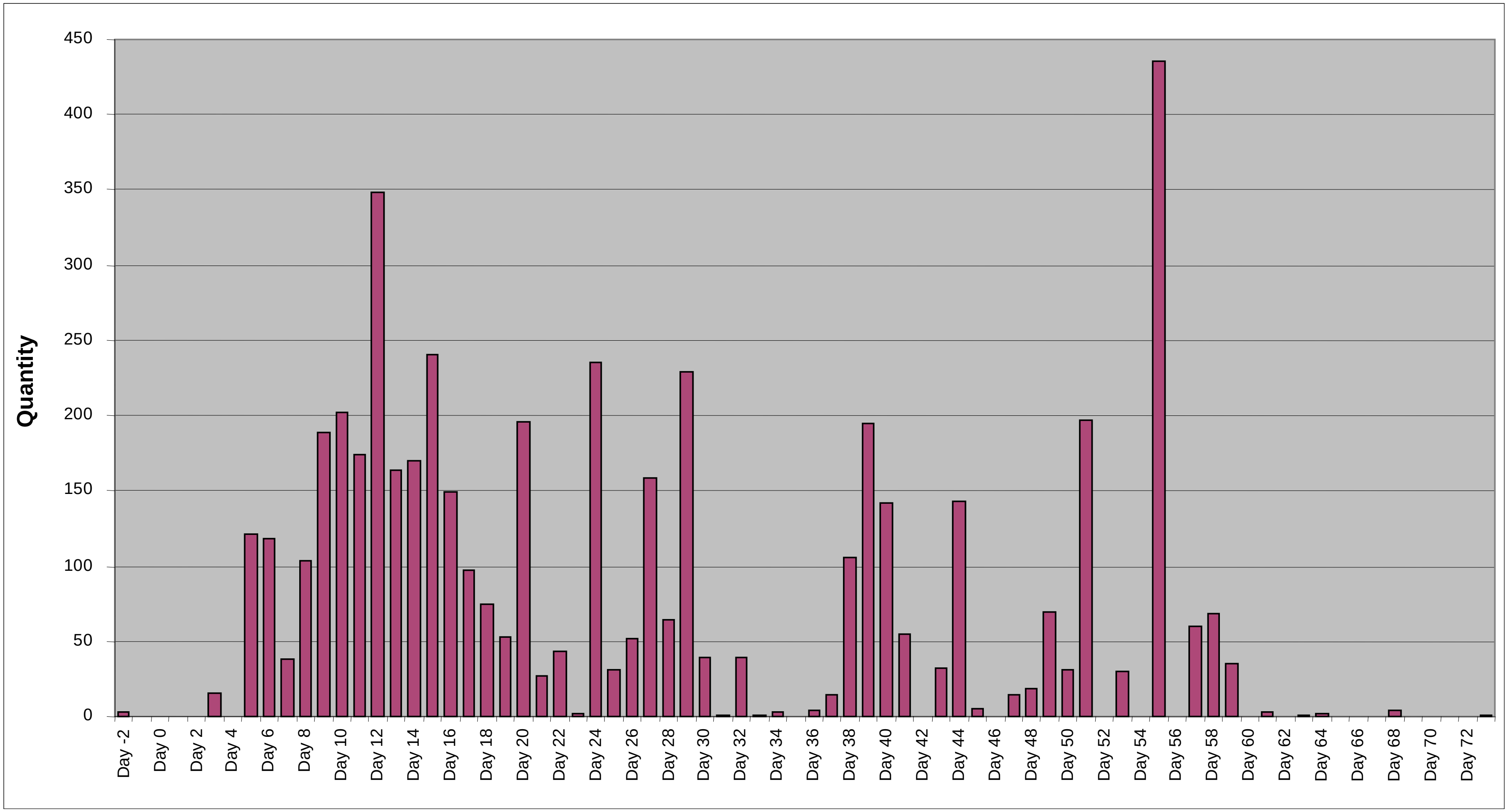


Figure 7. Quantity of 89-Foot Railcars Arriving at Sunny Point.

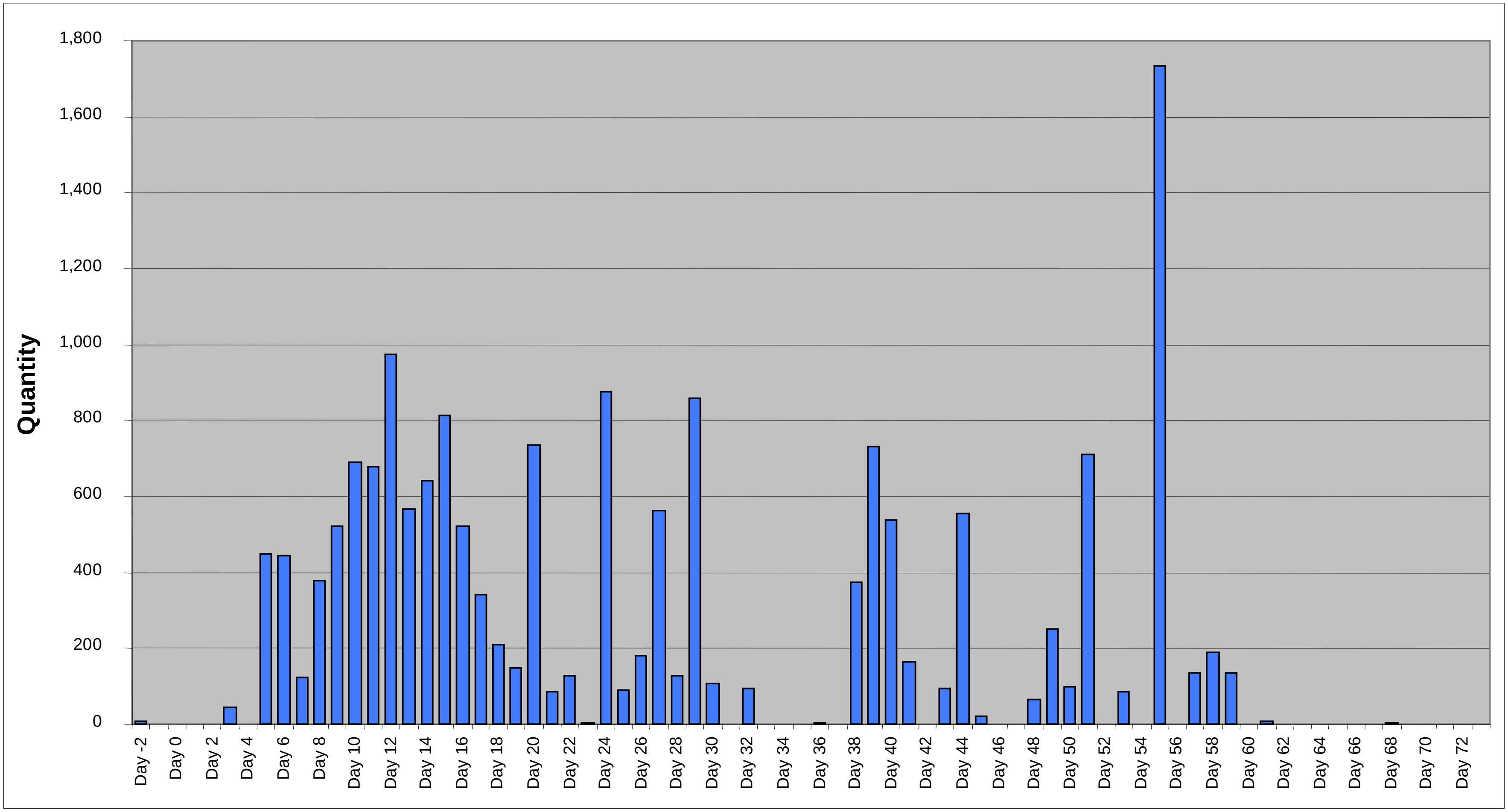


Figure 8. Quantity of 20-Foot Containers Arriving at Sunny Point.

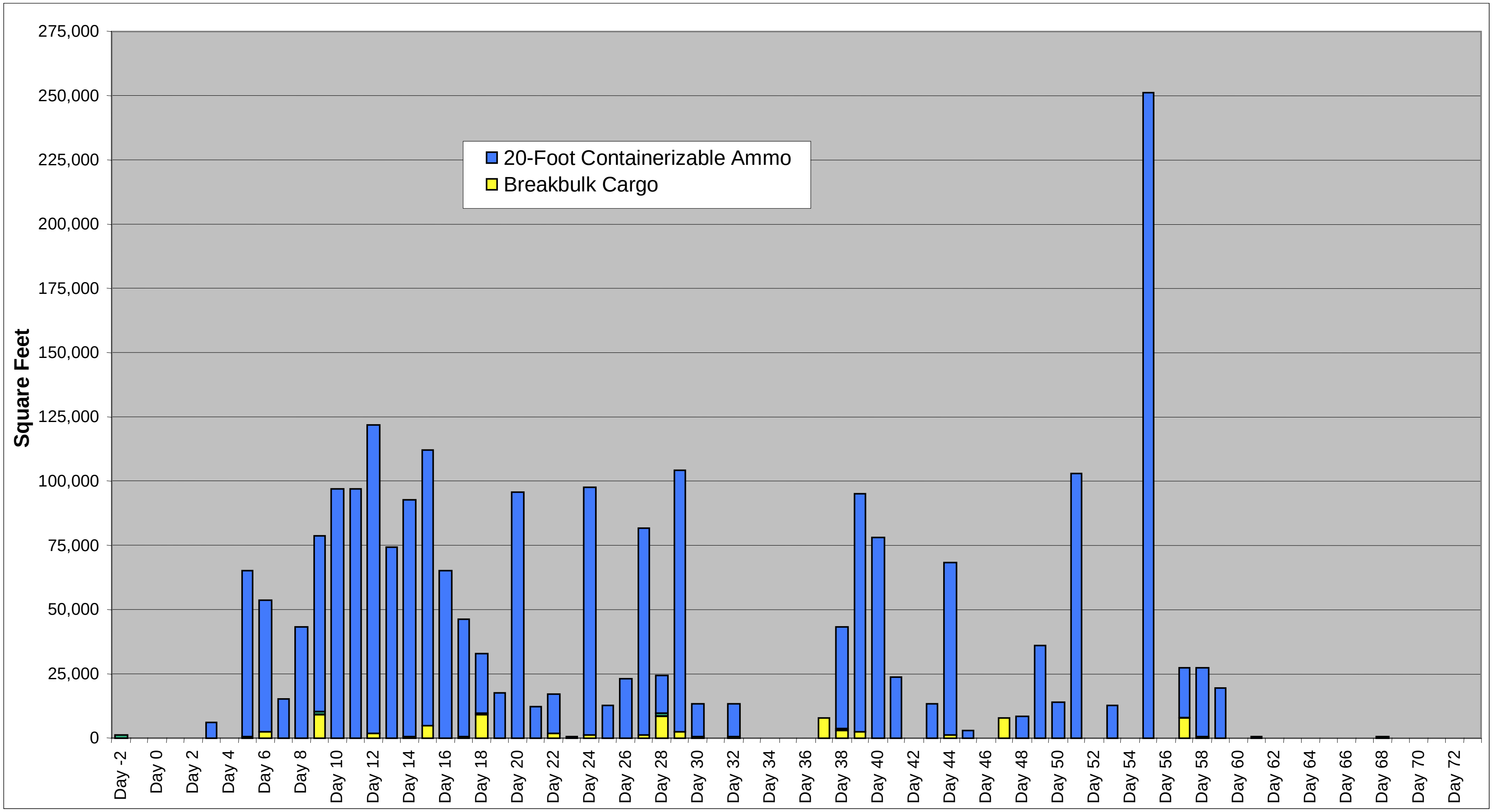


Figure 9. Total Square Feet of Cargo Arriving at Sunny Point.

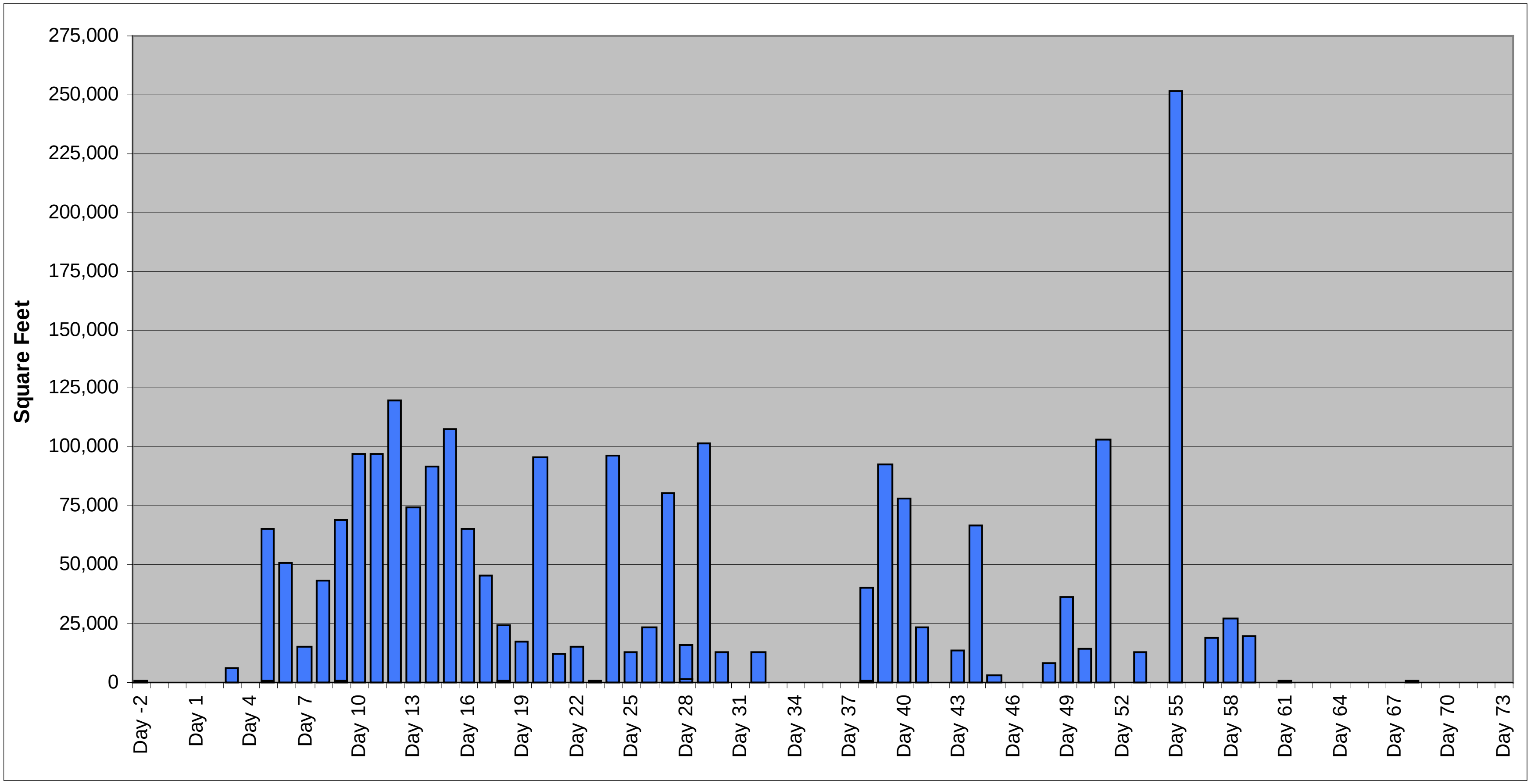


Figure 10. Square Feet of Containerized Cargo Arriving at Sunny Point.

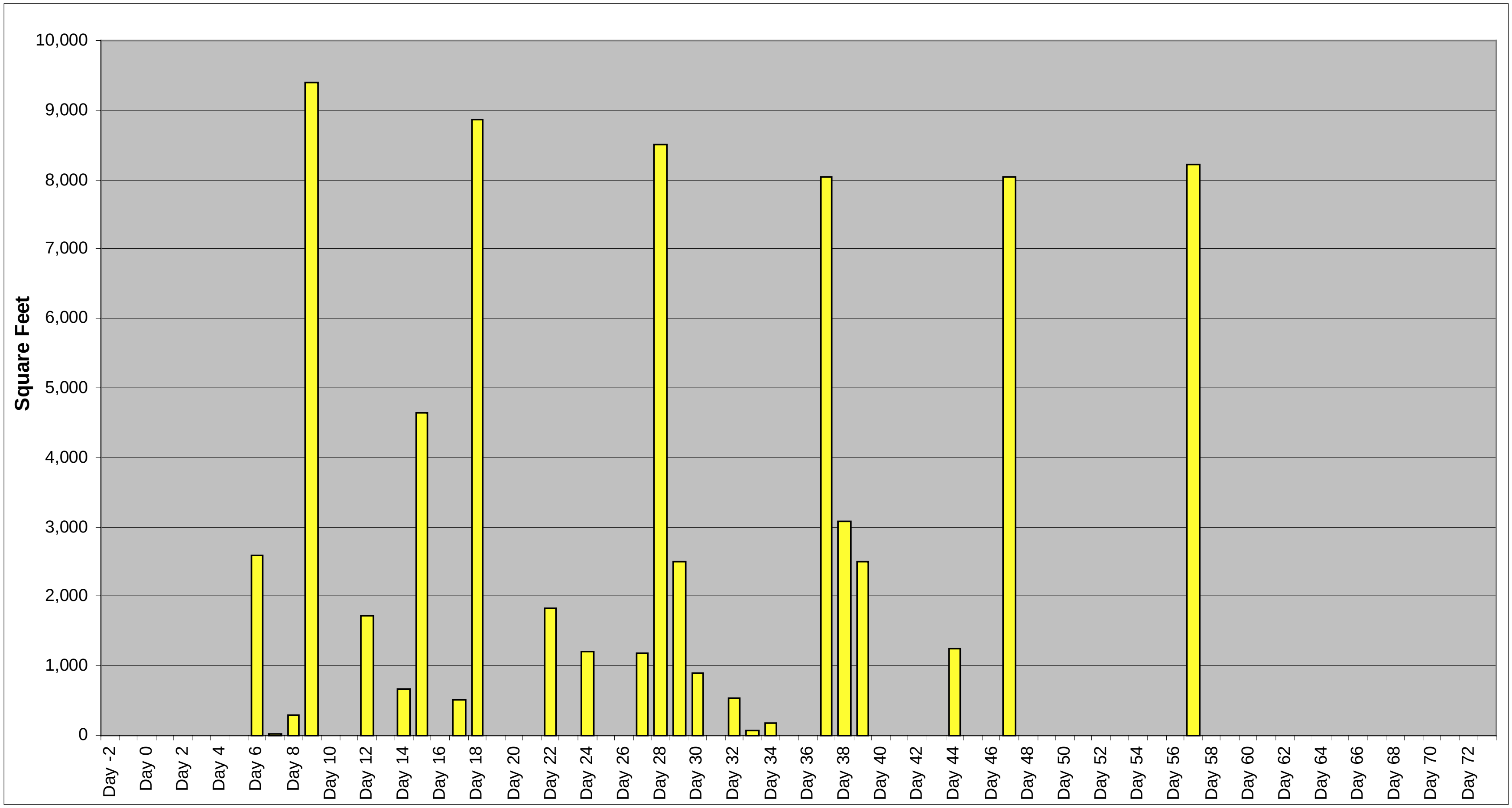


Figure 11. Square Feet of Non-Containerized Cargo Arriving at Sunny Point.

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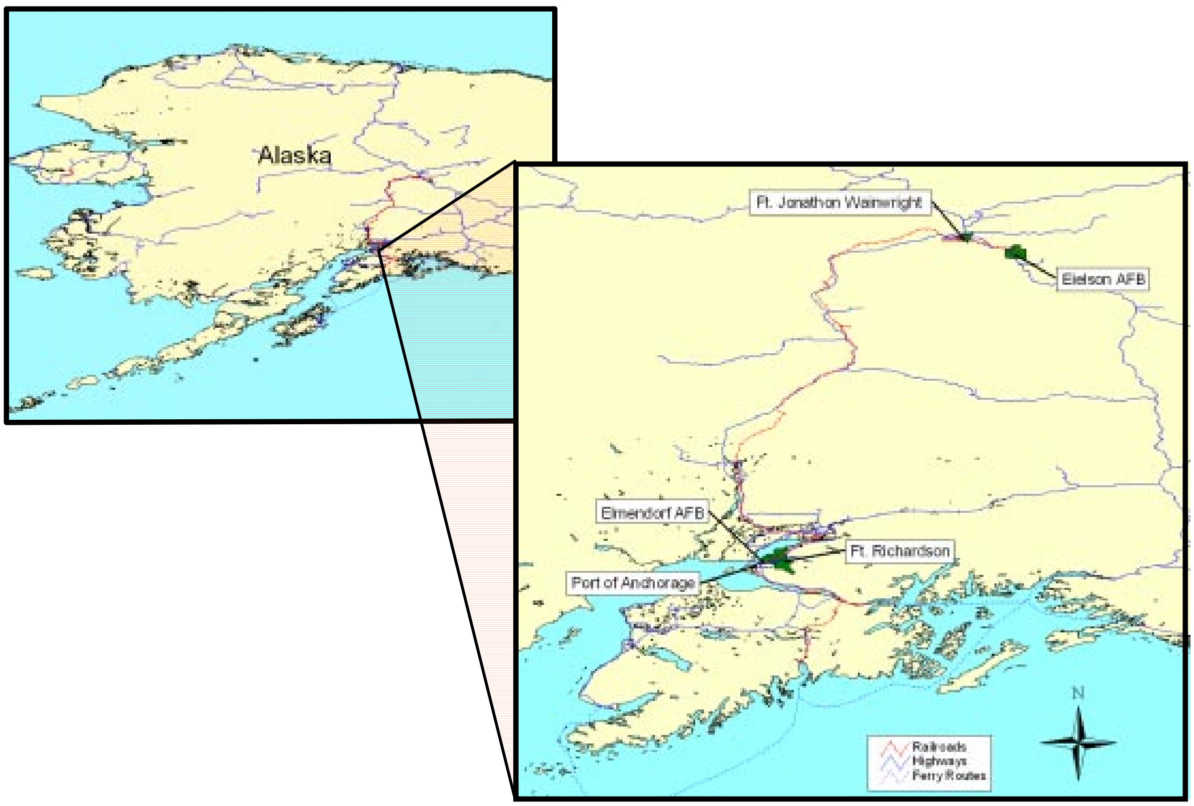
Port Enhancement Analysis

Phase I:

Port Workload Requirements for the Port of Anchorage, Alaska



Carol M. Caldwell
Jennifer K. Casto
Diane L. Buescher

Military Traffic Management Command
Transportation Engineering Agency

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INTRODUCTION

This is Phase I of a two-phase study.

- Phase I identifies the quantity of cargo DOD plans to send through the seaport, and
- Phase II considers the ports' ability to handle their assigned workload.

The Military Traffic Management Command's Transportation Engineering Agency (TEA) has analyzed ports for years. With our Ports for National Defense Program, we survey the ports that are important to national defense, defining their capabilities. We then compare these capabilities to the demand imposed by a notional unit deploying through the port. From this, we assess the port's ability to meet its requirements. This methodology has suited us well in the past. However, as the deployment windows continue to shrink, we are forced to get our CONUS-based deploying forces through the ports faster than ever before. Compound this with the continued economic expansion in many of these areas, and it is becoming a challenge for the ports to dedicate real estate and facilities to respond to our requirements. This is particularly true in the early days of a contingency.

As a result, TEA realized the need for a more precise assessment of each port's ability to meet its requirements. We realized the need to base each port's requirements on the most demanding operation plan (OPLAN) for that port. Using our modeling capability, we can work with the tremendous quantity of information in an OPLAN time-phased force deployment data (TPFDD), massage the data, and extract the detail needed to get an accurate picture of the deployment through each port.

OBJECTIVES

The objectives of this initiative are:

Phase I:

(1) Define the OPLAN-based time-phased flow of cargo through the port during a demanding deployment. This flow is defined in terms of quantity and square feet.

(2) Allow planners to assign Transportation Terminal Brigades/Battalions (TTBs) to ports based on workload.

(3) Allow TTBs to adequately prepare for deployment operations.

(4) Validate the need for deploying units to support Sea Ports of Embarkation (SPOEs).

Phase II:

(1) Assist the port commander in quantifying real estate and facility support needed from the port.

(2) In instances where the port cannot meet their requirements, provide the quantitative basis to help both DOD and commercial planners assess potential "fixes." These fixes could include:

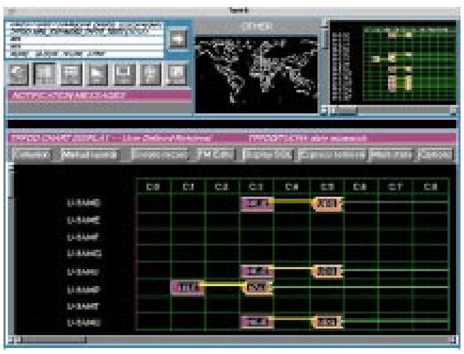
- Re-routing cargo to another port in the region,
- Re-timing the flow, or even
- Working through the local and metropolitan planning organizations to solicit federal funds.

METHODOLOGY

When practical, ports are analyzed on a regional basis. This allows planners to examine an entire region at one time, evaluating peaks and valleys at groups of neighboring ports. In this case, the Port of Anchorage is the only Alaskan port represented in the TPFDD. Therefore, it is a stand-alone analysis.

The following tools are utilized to analyze port workload:

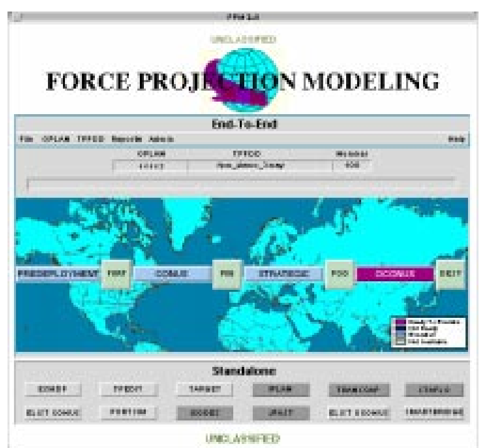
TPEDIT (TPFDD Editor) – An integrated set of automated processing tools that provides TPFDD editing and analysis capability. TPEDIT allows the analyst to:

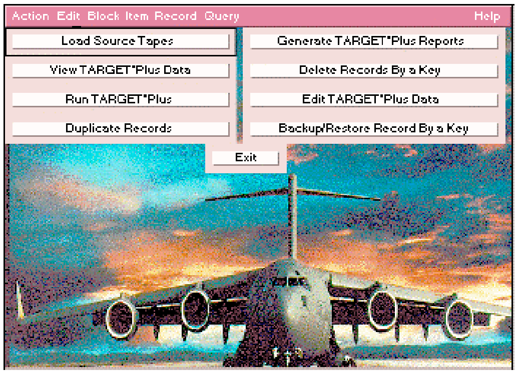


- View the TPFDD graphically.
- Extract information for the seaport of embarkation (SPOE) of interest.
- Edit the TPFDD. Remove "on-call" and "shortfalled" records. Clean-up data issues.
- Review data to determine the amount of cargo (number or ULNs/CINs, quantity, square feet, short tons, measurement tons) flowing through the port.

EXPANDED TPFDD - A database shared by the simulation models and used for tracking movement requirements at the individual item level of detail. Using the Expanded TPFDD the analyst can:

- Load the TPFDD into the Oracle database management system.
- "Expand" the TPFDD cargo detail within Oracle to Level 6 for the SPOE of interest.





TARGET (Transportability Analysis Reports Generator) – A system of models and programs that provide the capability to generate movement requirements at the individual item level of detail (Level 6). The system merges force structure data from the Table of Organization and Equipment (TOE) or the Modified TOE (MTOE) with equipment characteristics from the Department of the Army Standard Equipment Characteristic File (ECF) to create unit equipment tables. With TAREGT, the analyst:

- Assigns transport modes by ULN/CIN (convoy/rail).
- Selects transport assets.
  Containers (20' and 40')
  Railcars (89' flatcars, 60' flatcars, 68' DODX railcars).
- Determines convoy, rail, and container requirements.

FPM REPORTS – A set of customized reports extracts detailed cargo information from TARGET output files. These reports, when imported into Microsoft Excel, are the foundation of the port workload effort. The graphs are included in the results section of this report.

ASSUMPTIONS

- The requirements in this report represent:
  - The entire duration of the flow through the Port of Anchorage, as defined by the OPLAN.
  - All records in the plan scheduled to move by sea under Military Sealift Command's (MSC) control.
  - The most demanding plan for the port. The plan may not necessarily be representative of the flow during an actual deployment.
- TPFDD records not included in this analysis:
  - "On-call" records. These records are in the plan but are not scheduled to move – they appear with an available to load date (ALD) of 999.
  - "Shortfalled" records. These records are in the plan but are not sourced – they have not been matched with a specific unit.
  - Bulk petroleum, oils, and lubricants (POL) records (packaged POL is included).
- TARGET uses the following transport assets:
  Containers (20-foot, 40-foot)
  Convoy vehicles (self-propelled, towed), and
  Railcars (89-foot flatcars, 60-foot flatcars, 68-foot DODX railcars).
- Containers are stuffed at their origin.
- TARGET stuffs containers and loads railcars with unit integrity. In addition, TARGET will not mix unit equipment and containers on the same railcar. This may, in some instances, give a high estimate of container and railcar requirements.
- If the origin is less than 400 miles from the seaport of embarkation (SPOE), roadable vehicles convoy from origin to SPOE. If the origin is greater than 400 miles from the SPOE, roadable vehicles are loaded onto railcars for transport to the SPOE. All non-roadable vehicles are loaded onto railcars for transport to the SPOE.
- The breakbulk category includes cargo coded in the TPFDD as containerizable with dimensions exceeding the allowable dimensions of 20-foot containers and nonvehicular cargo coded as noncontainerizable.

RESULTS

The following graphs represent the cargo arriving at the Port of Anchorage as outlined in the TPFDD. Cargo arrives at the port from four origins, as shown in Figure 1. Two of the origins (Elemendorf AFB and Fort Richardson) are located adjacent to the port. Depending on the circumstances, the cargo from these origins will either (1) depoy to the port where it is staged and later loaded aboard the ship, or (2) stage at the origin and be called forward directly to the ship.

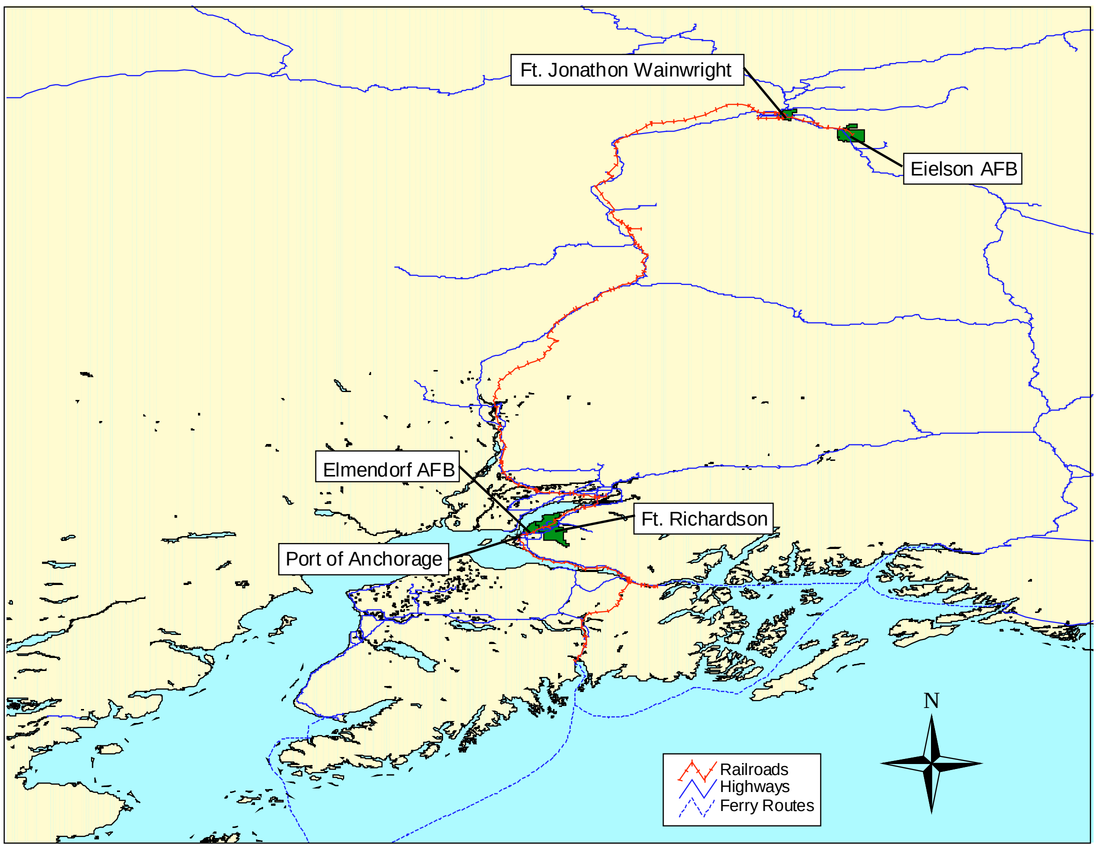


Figure 1 - Cargo Arrives at the Port of Anchorage from Four Origins.

The data in this report represents the more demanding option for the port - option one. However, the data for option two is more appropriate in some instances and is included as Appendix A.

The first set of graphs (Figures 2 and 3) show the transport assets arriving at the Port of Anchorage. They indicate the actual number of railcars and convoy vehicles, respectively, flowing to the port.

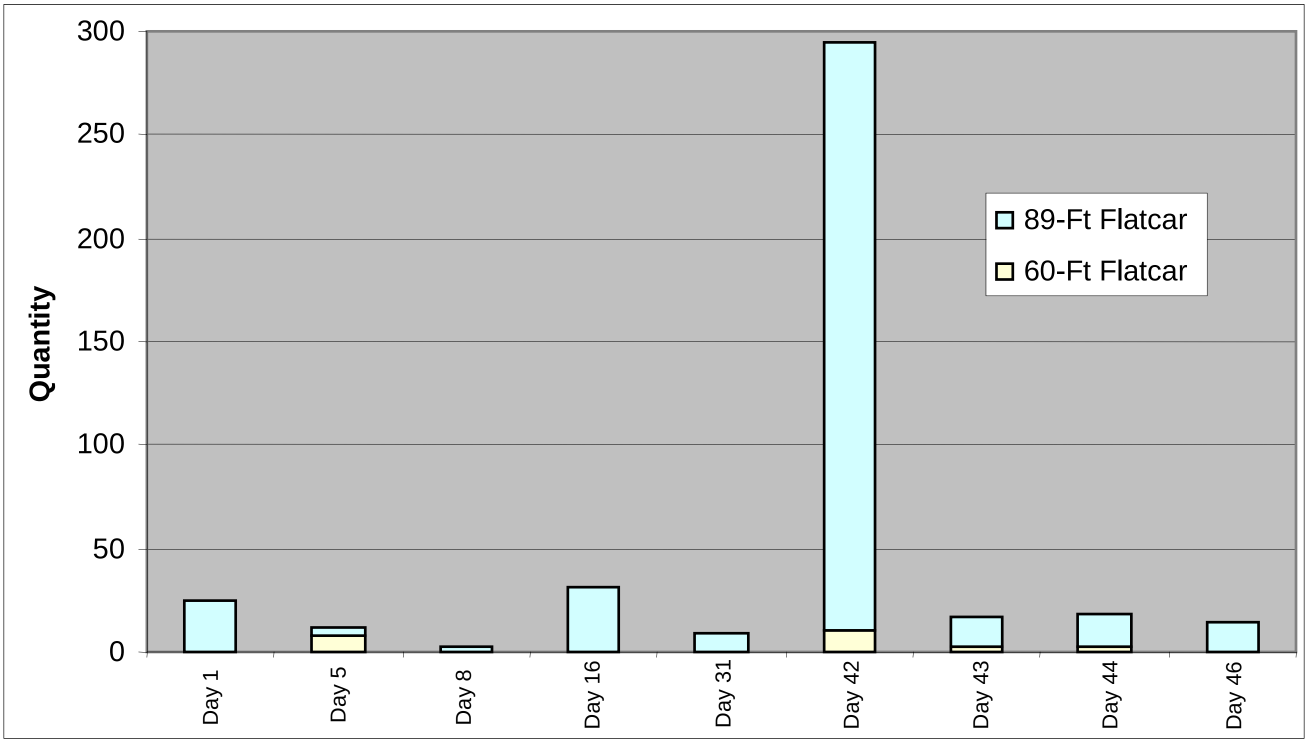


Figure 2 - Quantity of Railcars Arriving at the Port of Anchorage.

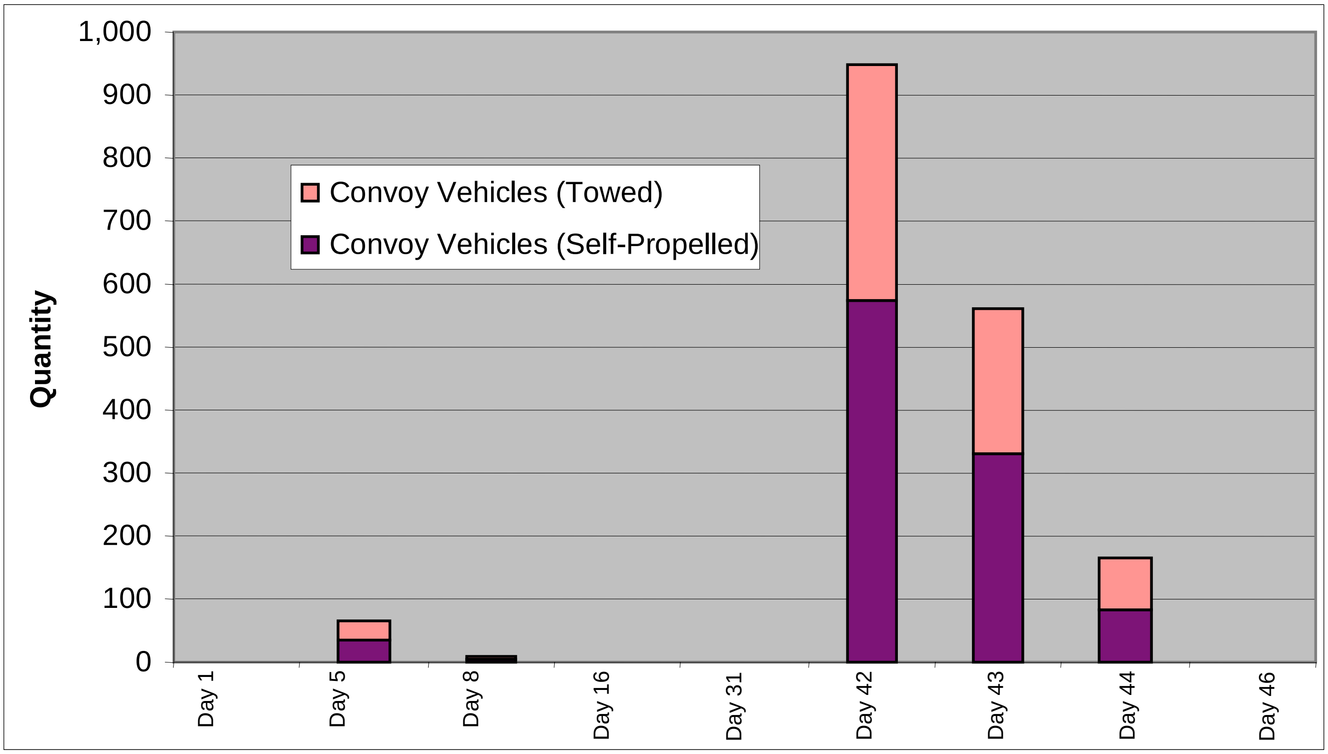


Figure 3 - Quantity of Convoy Vehicles Arriving at the Port of Anchorage.

The next set of graphs (Figures 4-8) illustrate the quantity of vehicles (both wheeled vehicles and tracked vehicles), containers, and aircraft arriving at the Port of Anchorage. Realizing that heavier vehicles may require special staging, the vehicles are divided into categories based on their weight, as shown in Table 1.

Table 1
Categories of Vehicles

	Wheeled Vehicles	Tracked Vehicles
Light	Less than 5 ST	Less than 20 ST
Medium	5-30 ST	20-35 ST
Heavy	Greater than 30 ST	Greater than 35 ST

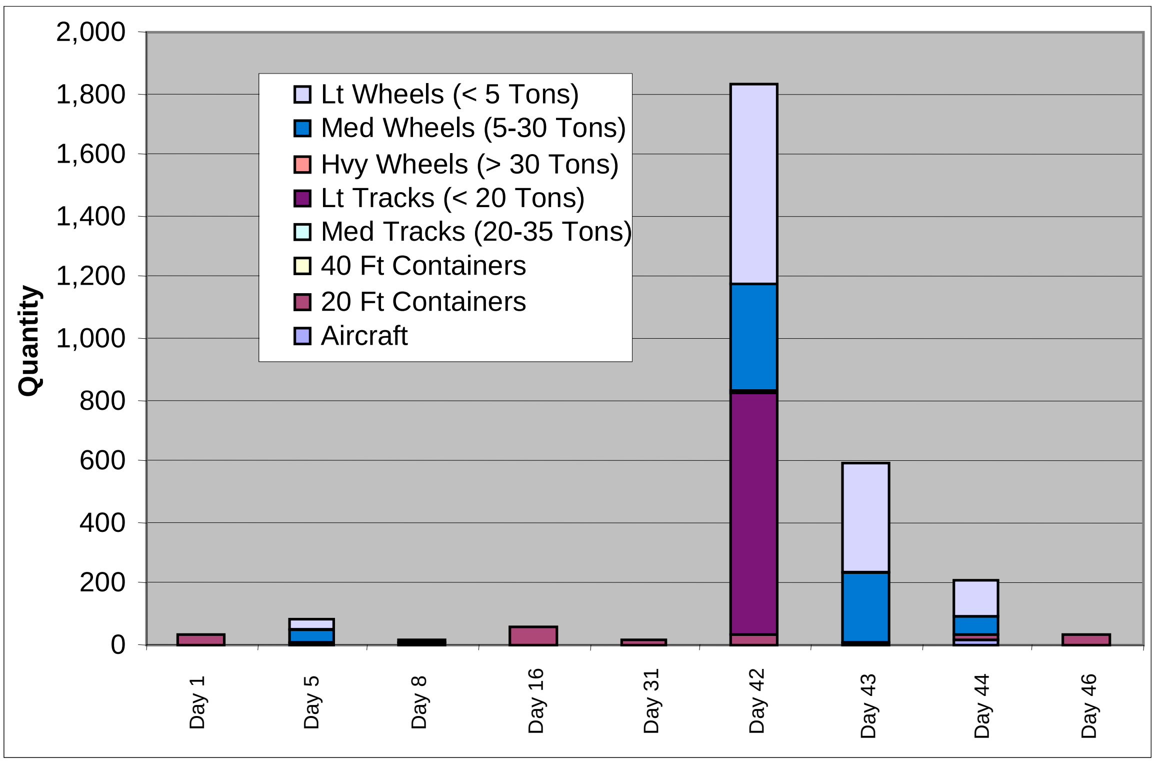


Figure 4 - Total Quantity of Items Arriving at the Port of Anchorage.

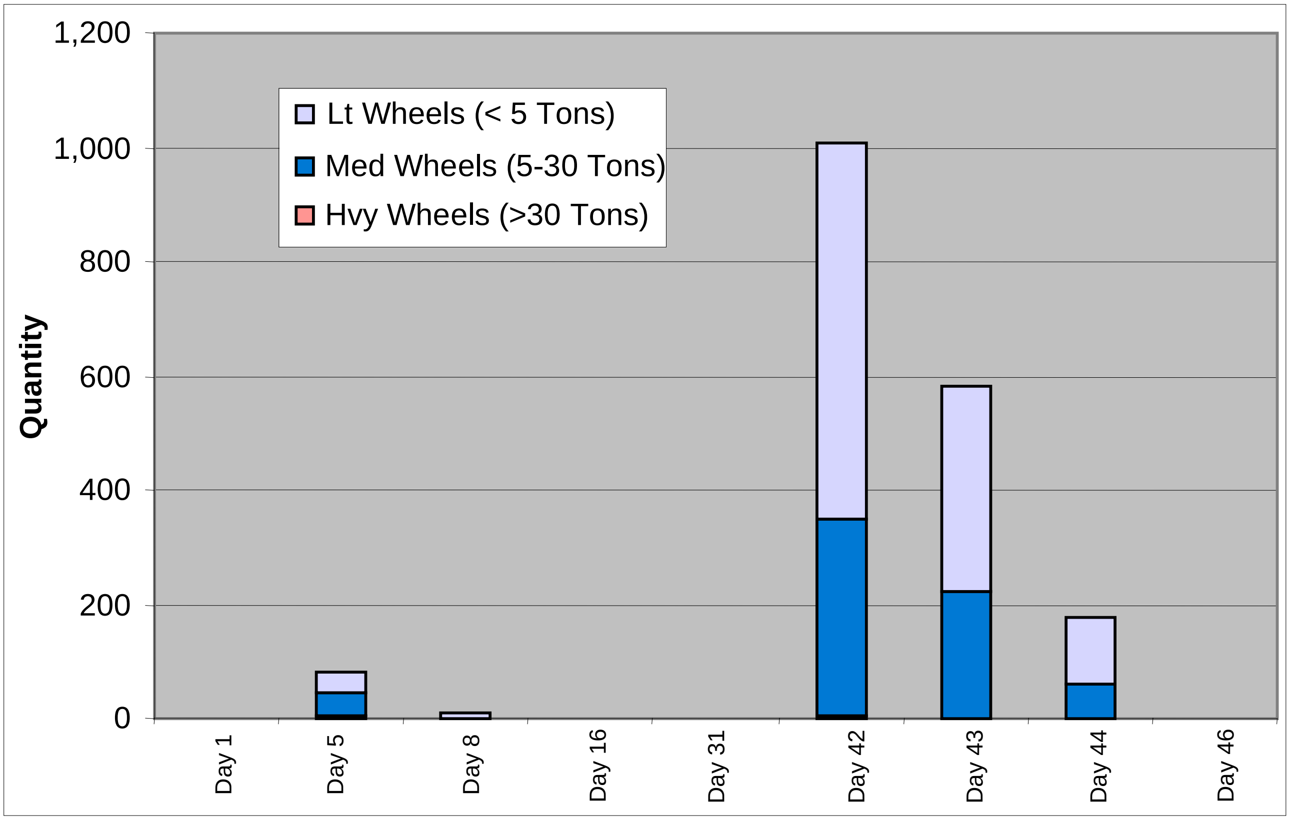


Figure 5 - Quantity of Wheeled Vehicles Arriving at the Port of Anchorage.

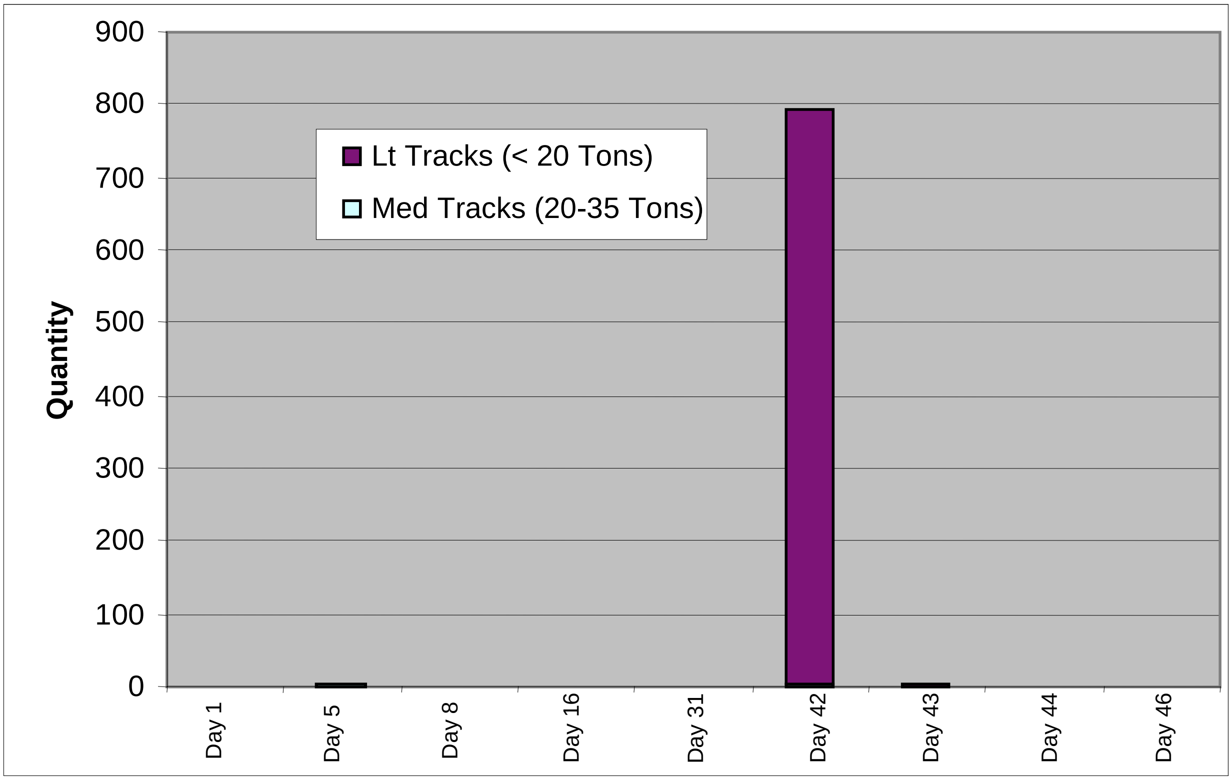


Figure 6 - Quantity of Tracked Vehicles Arriving at the Port of Anchorage.

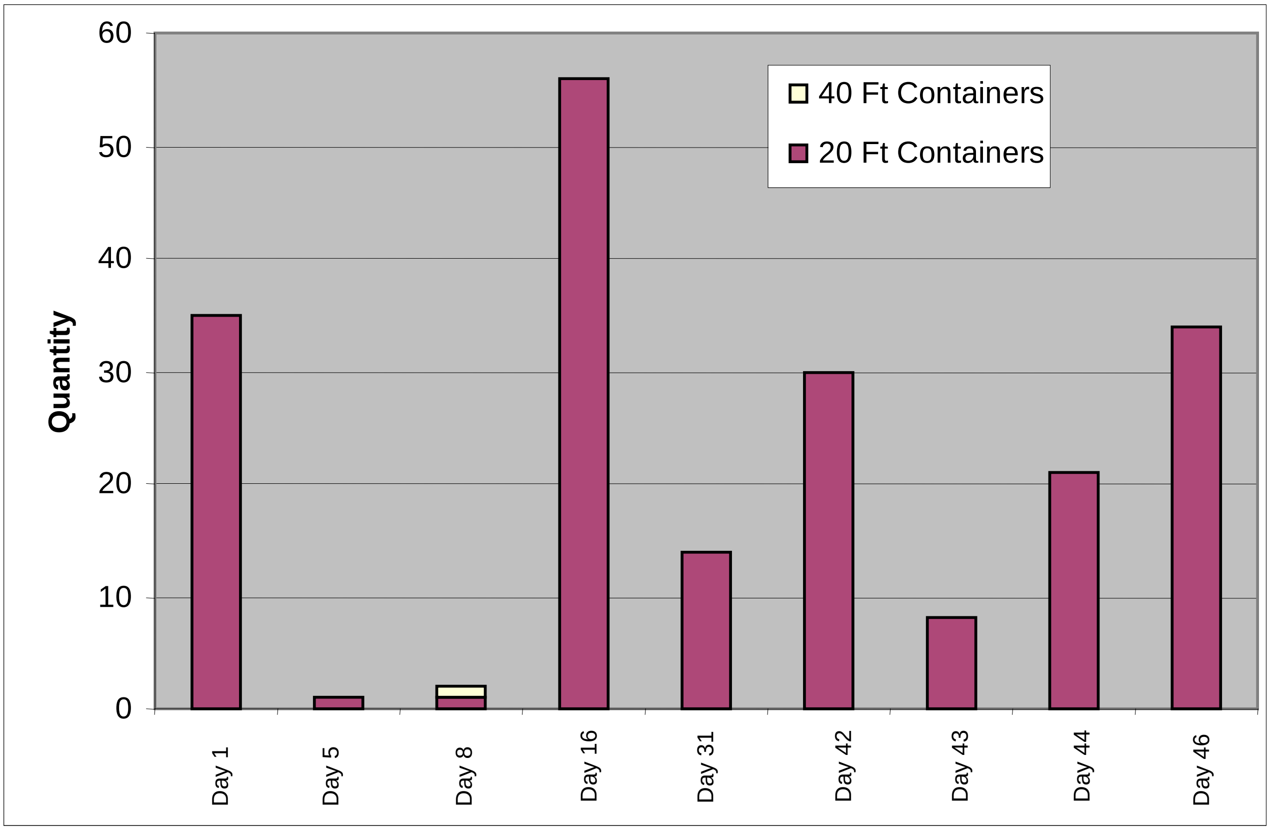


Figure 7 - Quantity of Containers Arriving at the Port of Anchorage.

The aircraft in Figure 8 are all helicopters. They will self-deploy to the port, where they will be reduced and shrink-wrapped. On day 8, there are 6 CH-47's and on day 44 there are 16 UH-1's.

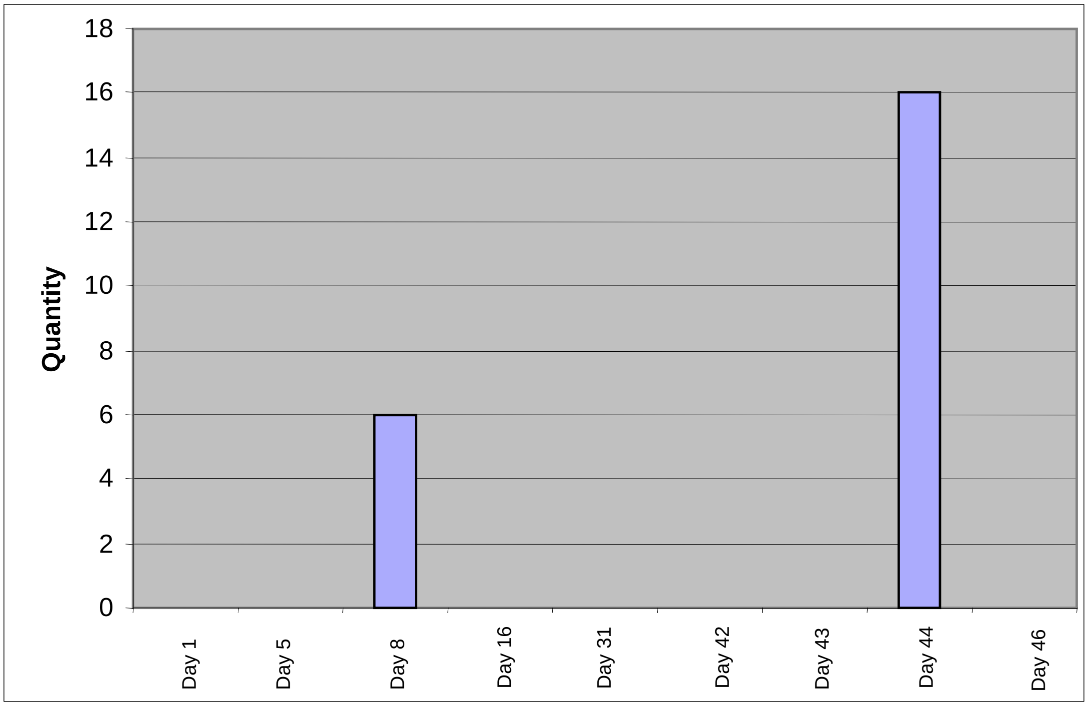
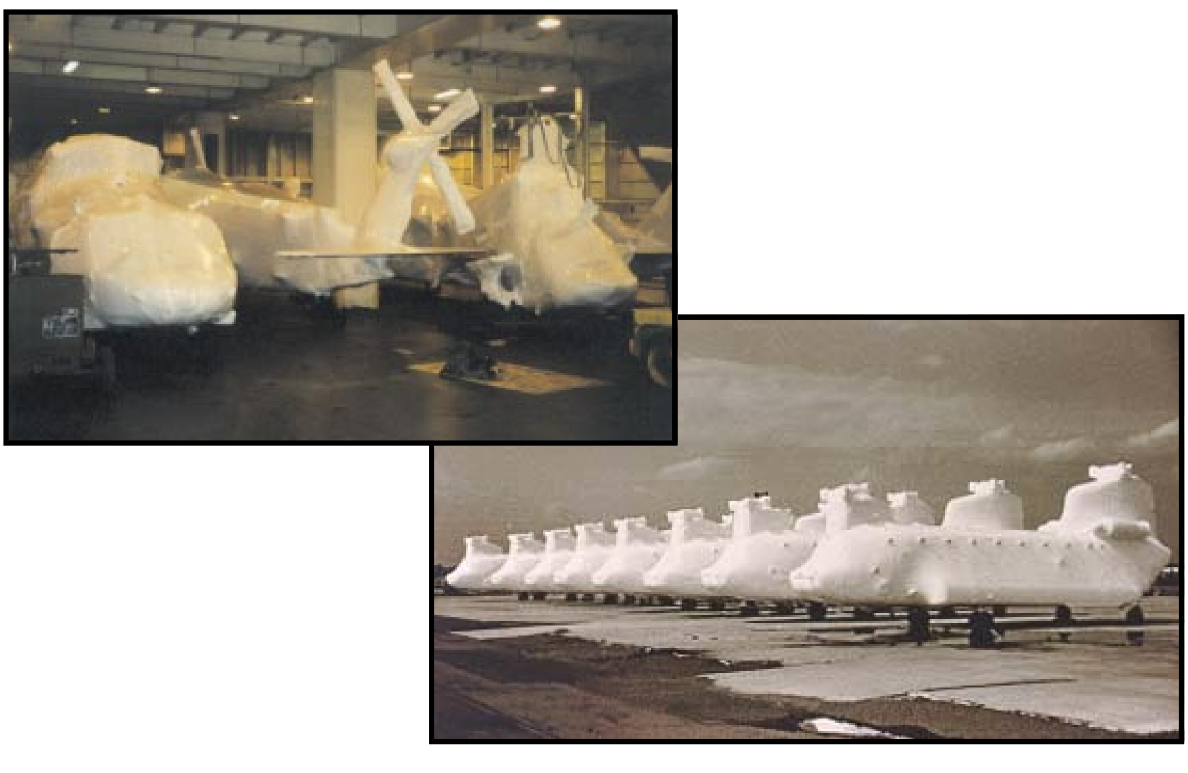


Figure 8 - Quantity of Aircraft Arriving at the Port of Anchorage.



Similar to Figures 4-8, which are the quantities of items flowing to the port, the following set of graphs (Figures 9-13) represent the square footage of the cargo flowing to the Port of Anchorage. There is a rather subtle difference in the content of these graphs. Where the previous set of graphs show vehicles, containers, and aircraft, the following set of graphs show vehicles, outsize cargo (cargo which does not fit into a 20-foot container), and aircraft. These graphs do not include the square footage of the containers or of the containerized cargo.

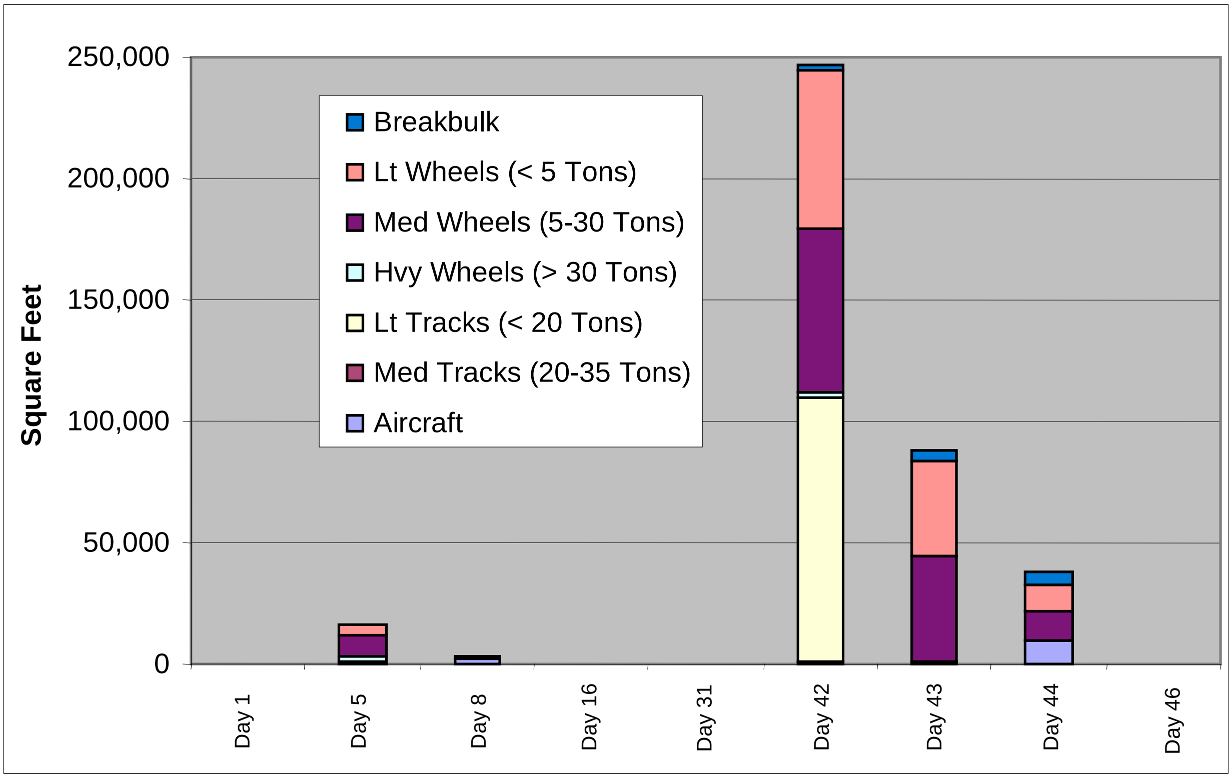


Figure 9 - Total Square Feet of Cargo Arriving at the Port of Anchorage.

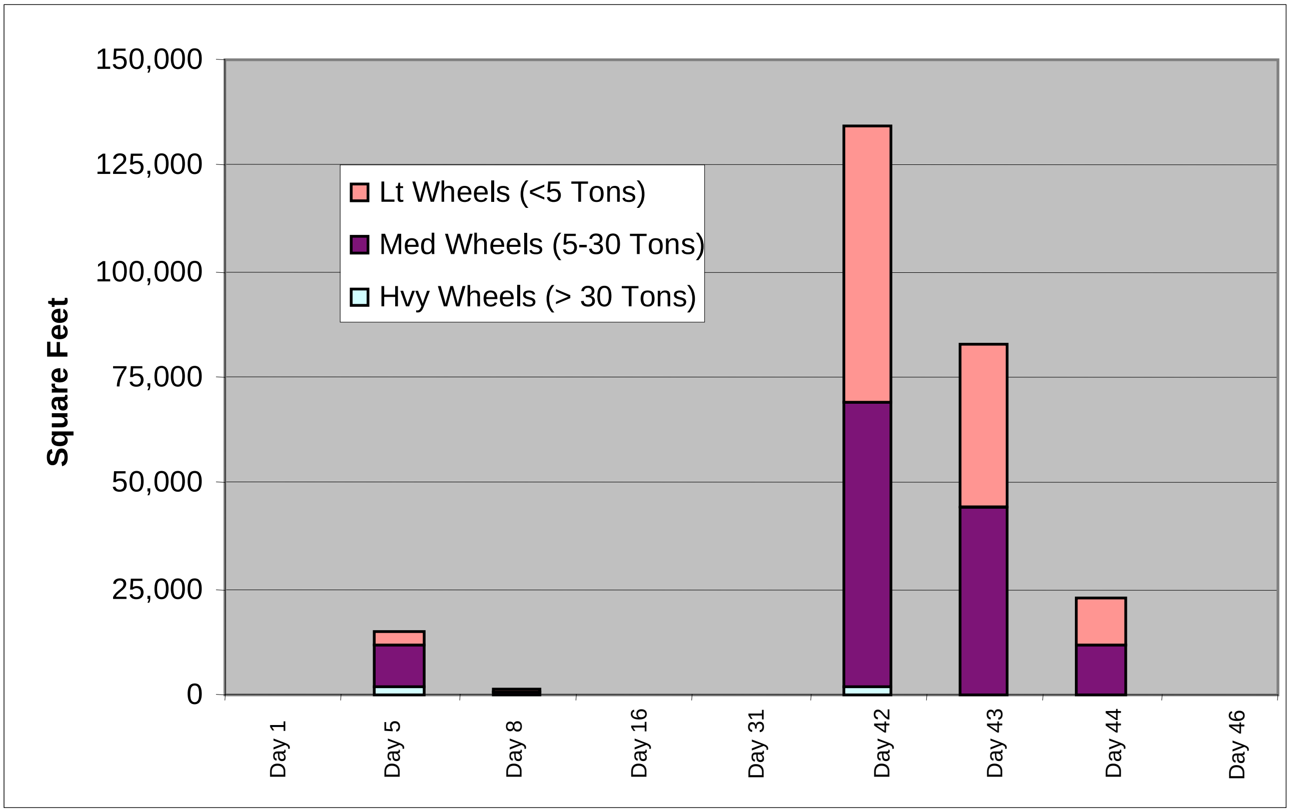


Figure 10 - Square Feet of Wheeled Vehicles Arriving at the Port of Anchorage.

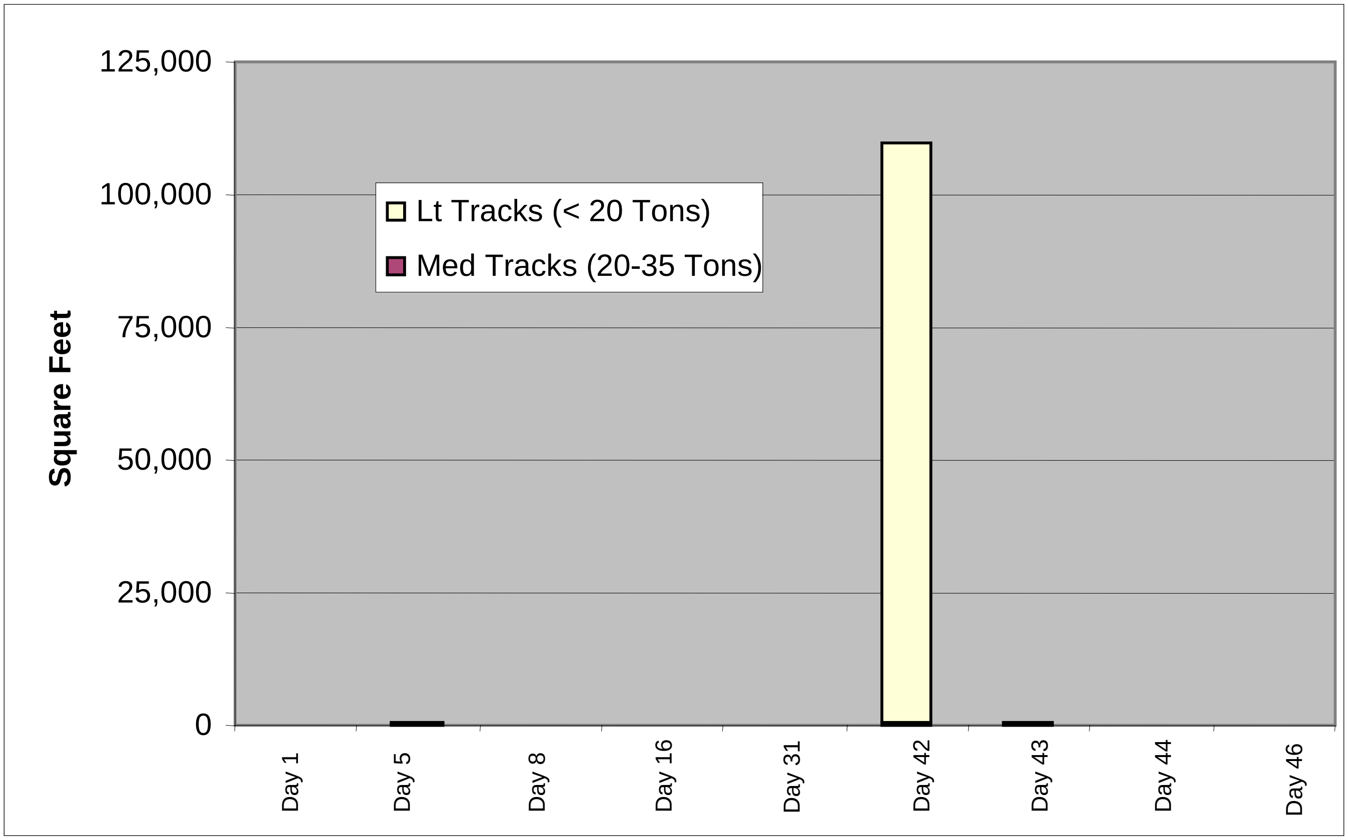


Figure 11 - Square Feet of Tracked Vehicles Arriving at the Port of Anchorage.

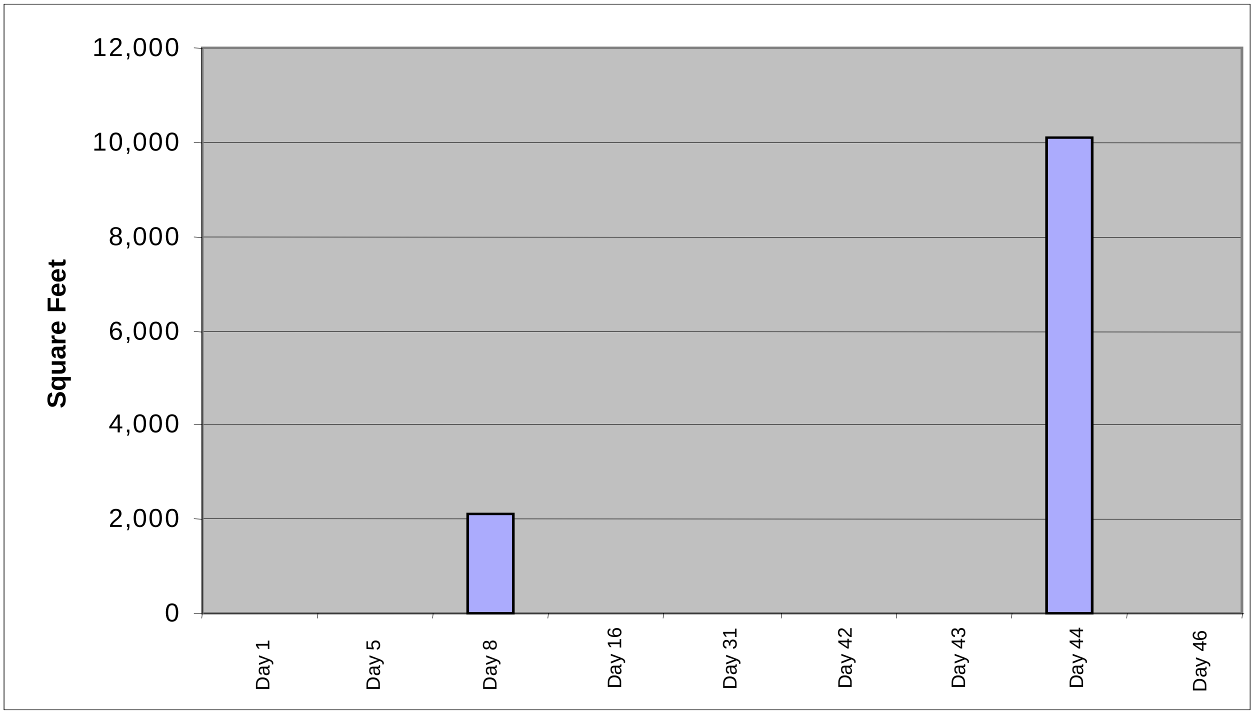


Figure 12 - Square Feet of Aircraft Arriving at the Port of Anchorage.

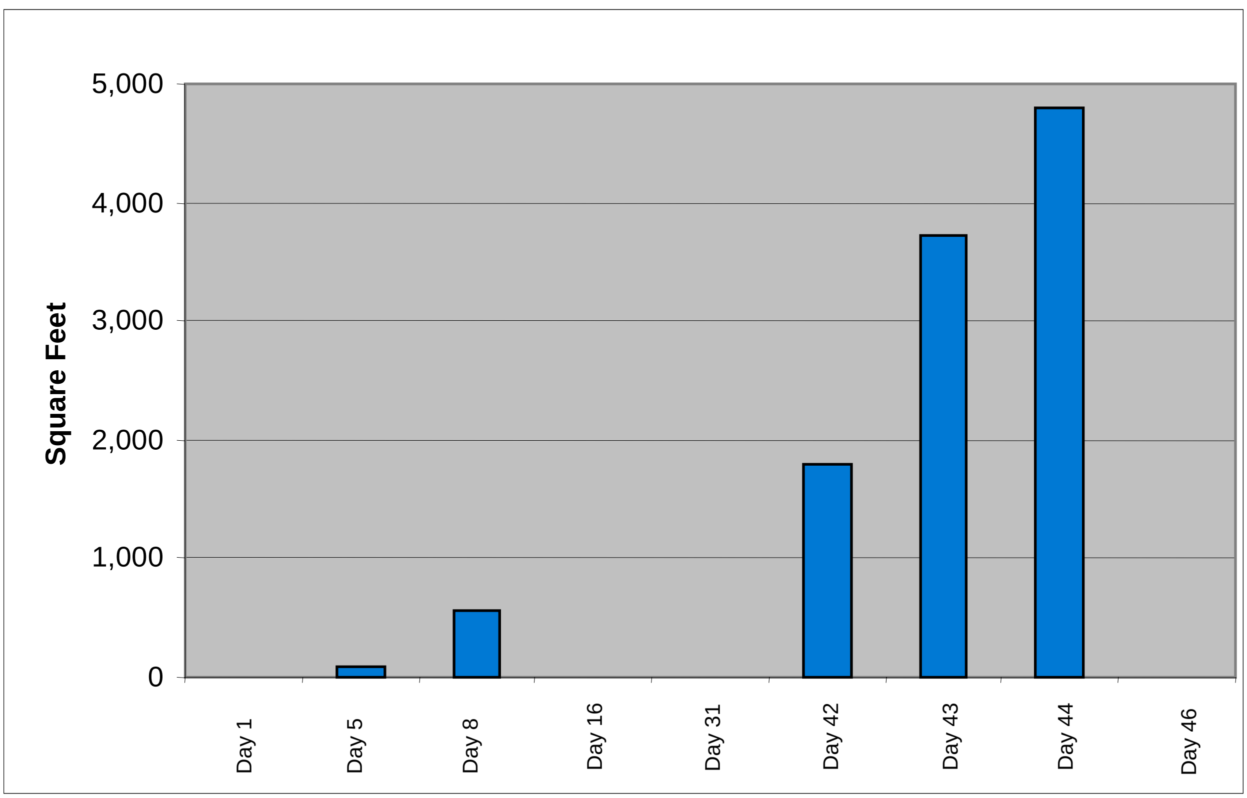


Figure 13 - Square Feet of Breakbulk Cargo Arriving at the Port of Anchorage

All of the cargo flowing through the Port of Anchorage originates in one of four places: Eielson AFB, Elmendorf AFB, Ft. Wainwright or Ft. Richardson. The next two graphs (Figures 15 and 16) outline the quantity and square footage of cargo arriving from each origin by day. With respect to the containerized cargo, Figure 15 shows the number of containers moving through the port and Figure 16 shows the square footage of cargo that is in those containers (not the footprint of the containers).

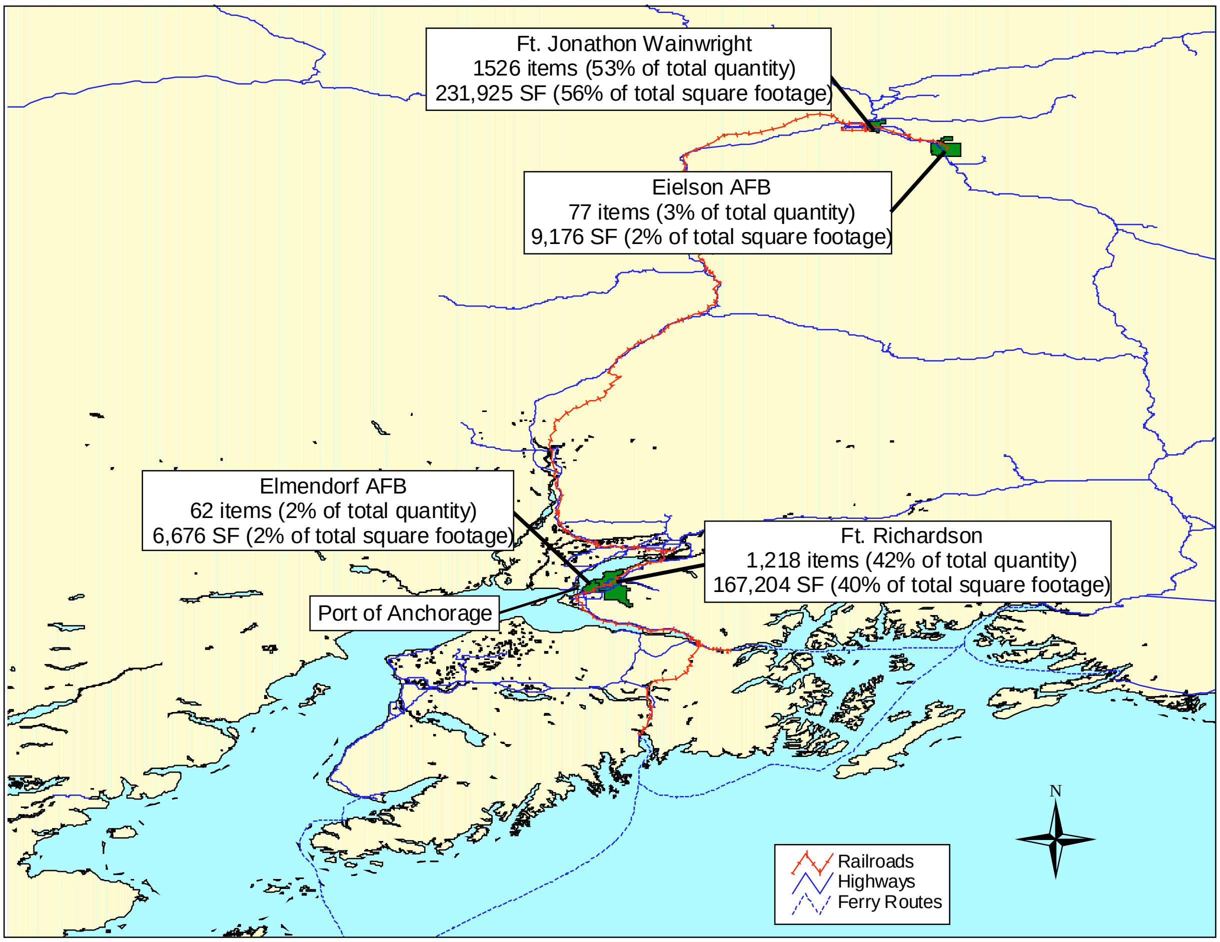


Figure 14 - Amount of Cargo Arriving at the Port of Anchorage from Each Origin.

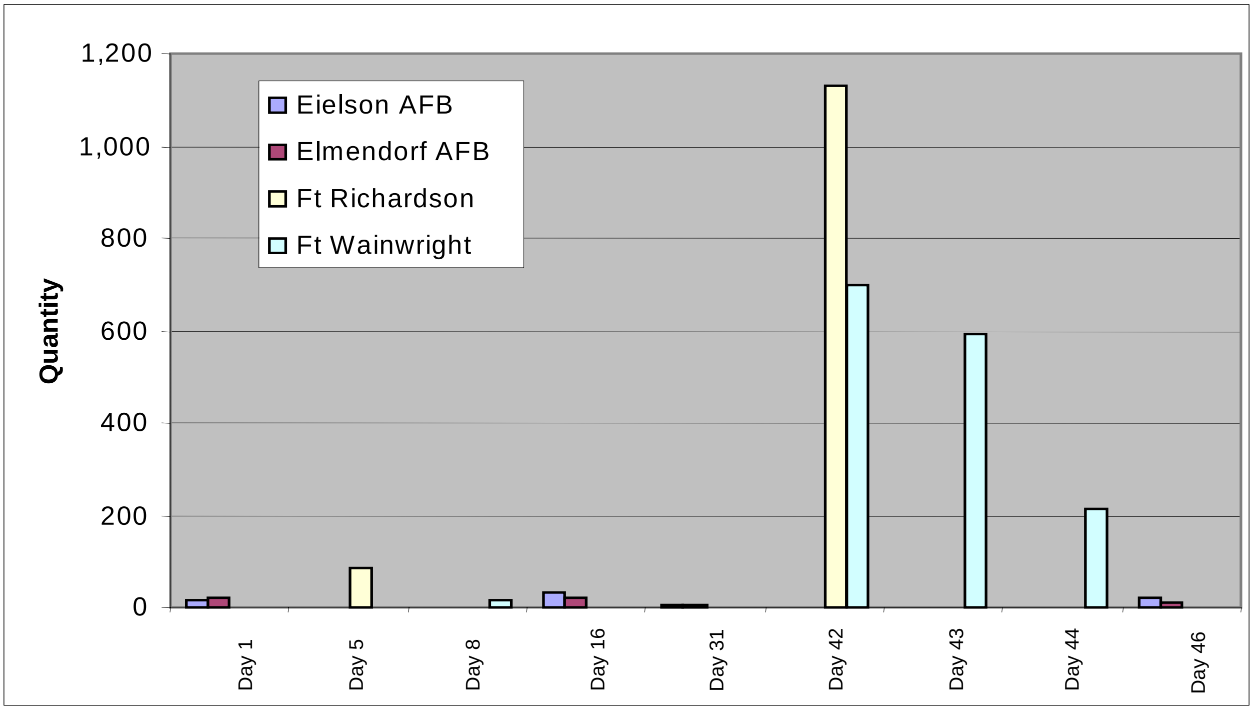


Figure 15 - Quantity of Cargo Arriving at the Port of Anchorage from Each Origin.

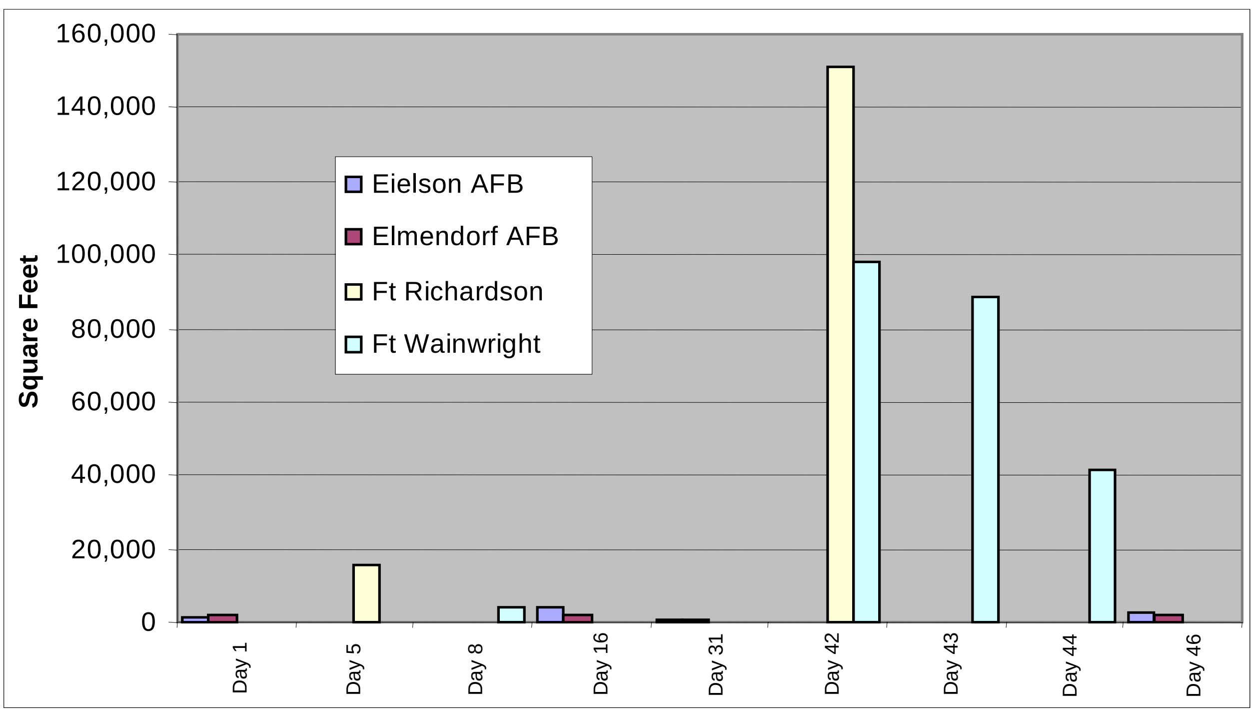


Figure 16 - Square Feet of Cargo Arriving at the Port of Anchorage from Each Origin.

This study assumes that all cargo (except aircraft which self-deploy) either convoys to the Port of Anchorage or arrives by rail. The following graphs show the quantity (Figures 17-19) and square footage (Figures 20-21) of cargo arriving by each mode.

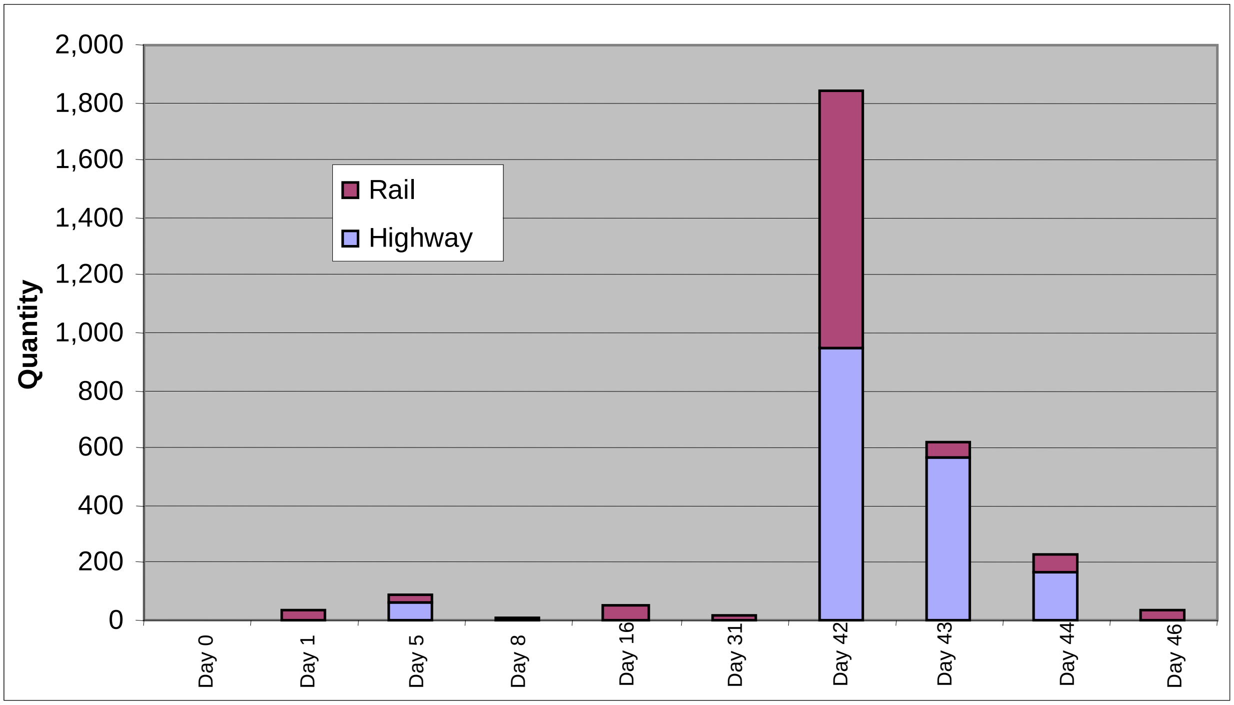


Figure 17 - Arrival Mode of Cargo at the Port of Anchorage (Quantity).

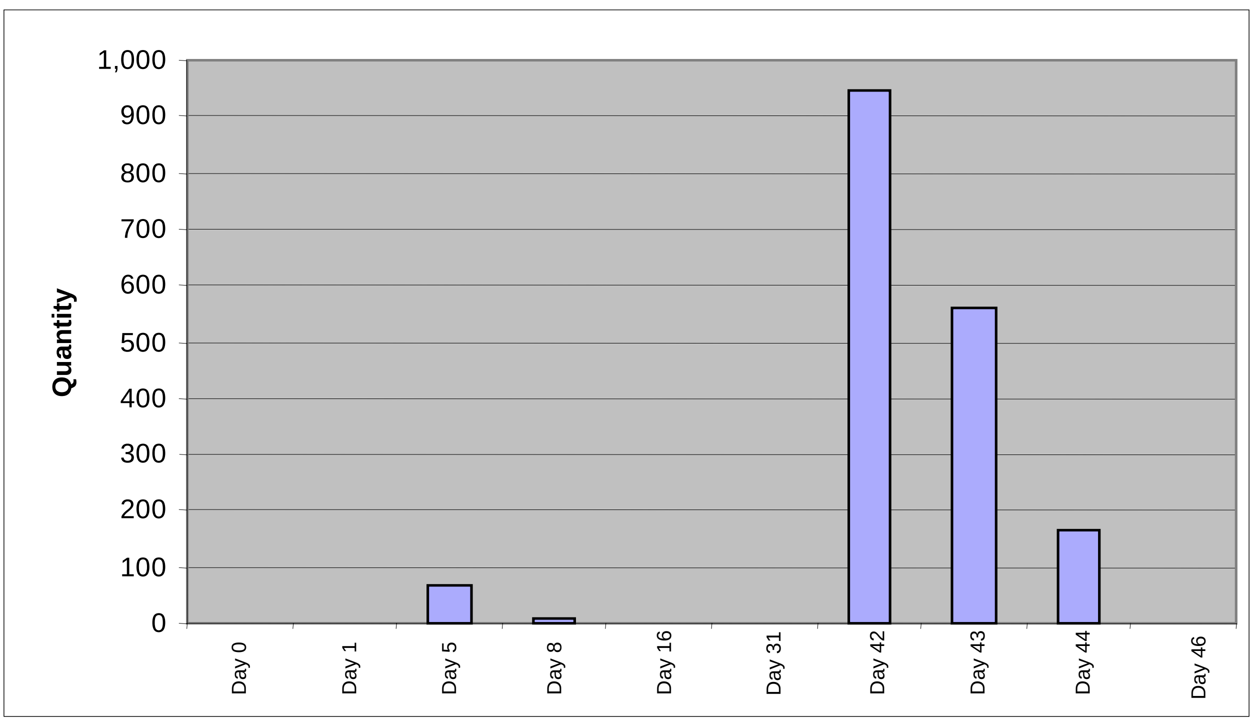


Figure 18 - Quantity of Cargo Arriving by Highway at the Port of Anchorage.

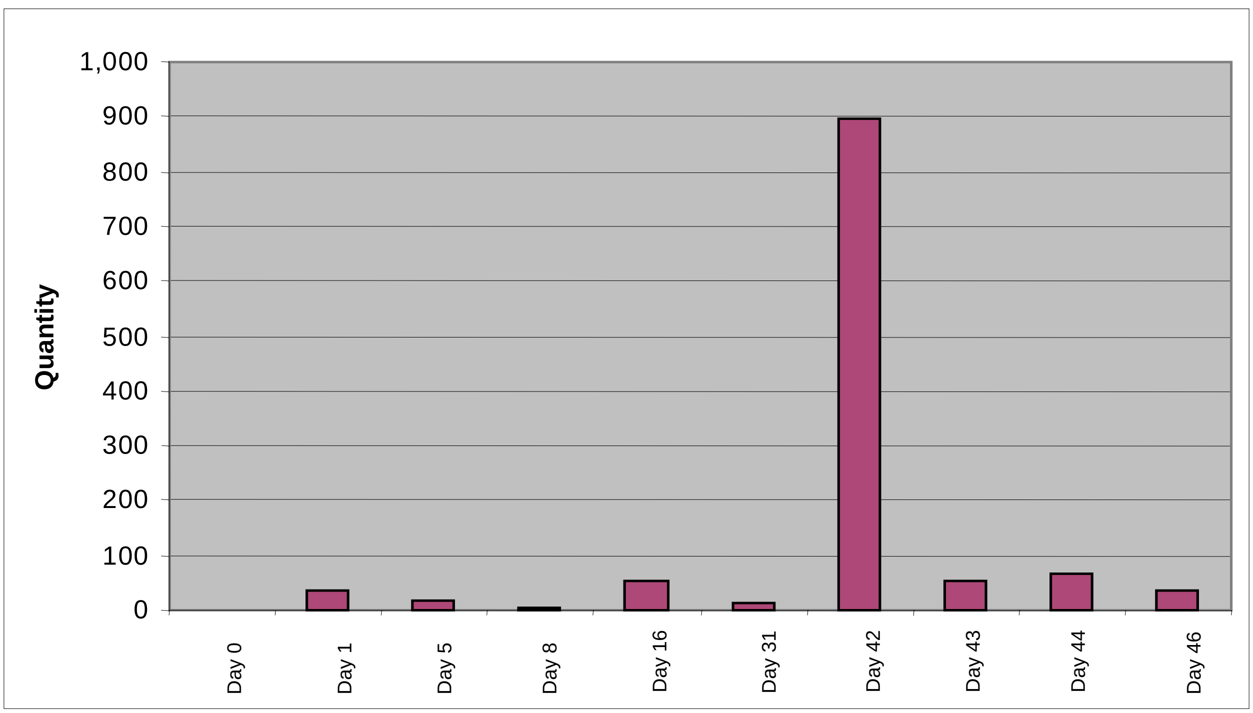


Figure 19 - Quantity of Cargo Arriving by Rail at the Port of Anchorage.

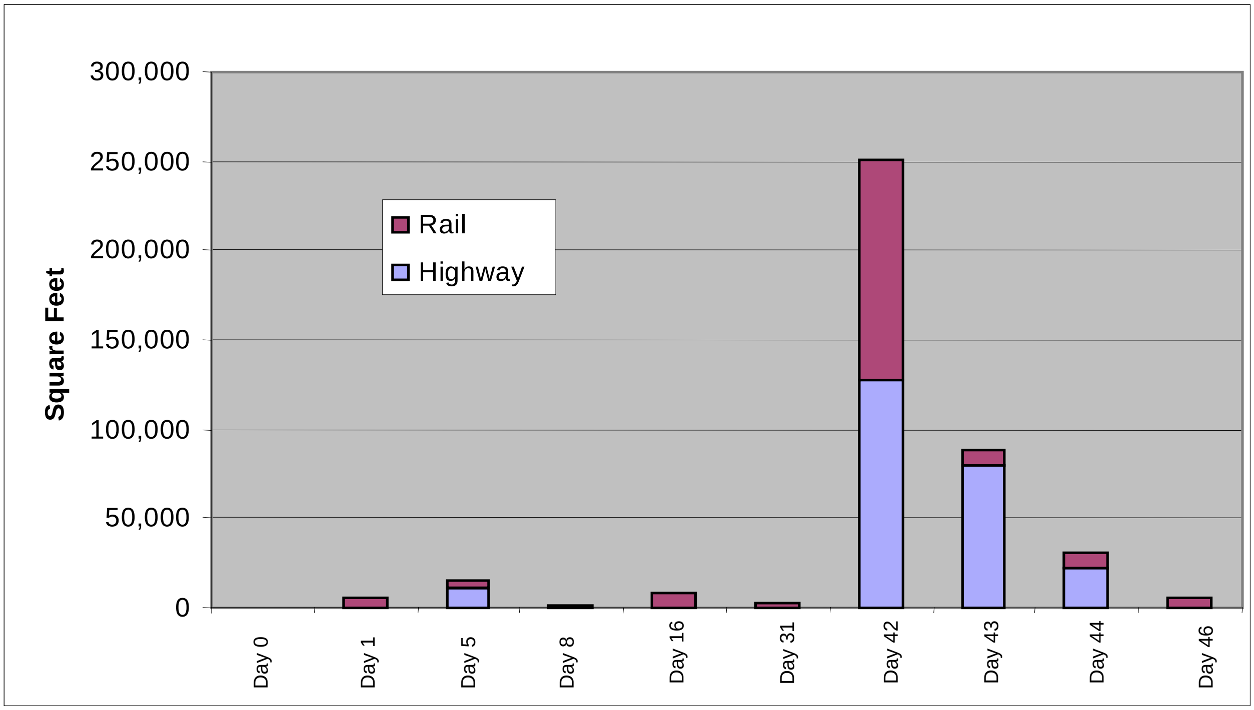


Figure 20 - Arrival Mode of Cargo at the Port of Anchorage (Square Feet).

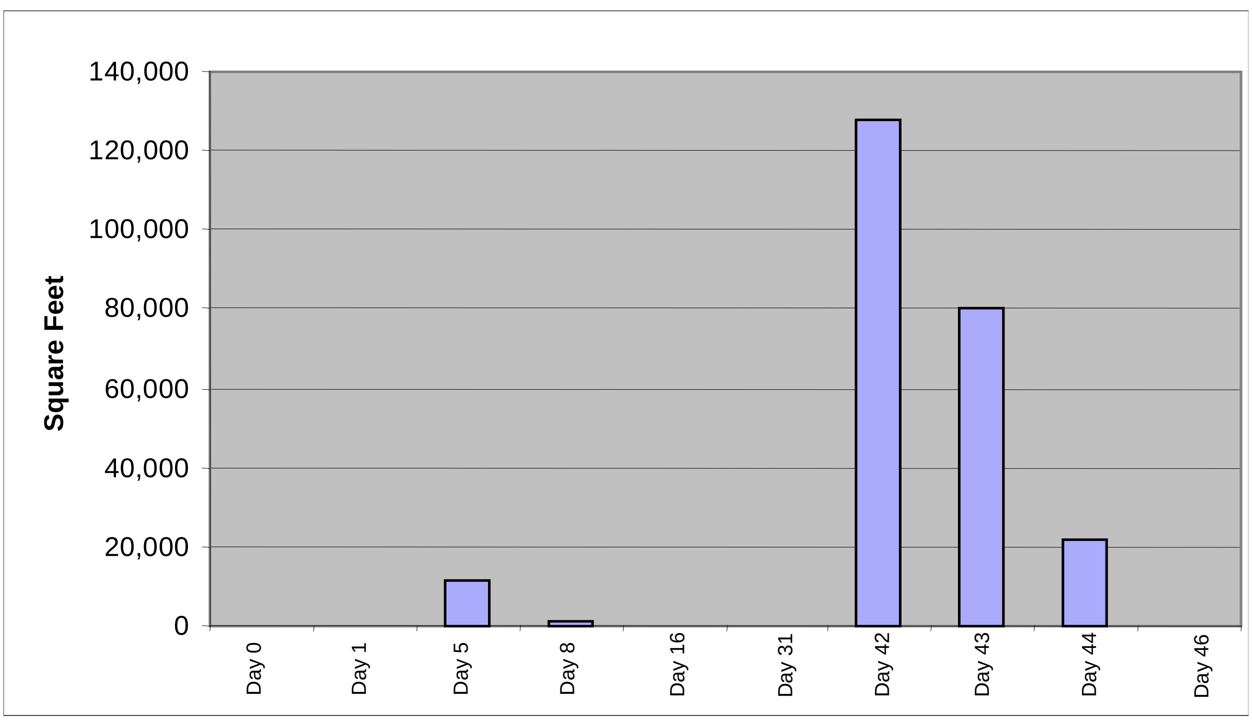


Figure 21- Square Feet of Cargo Arriving by Highway at the Port of Anchorage.

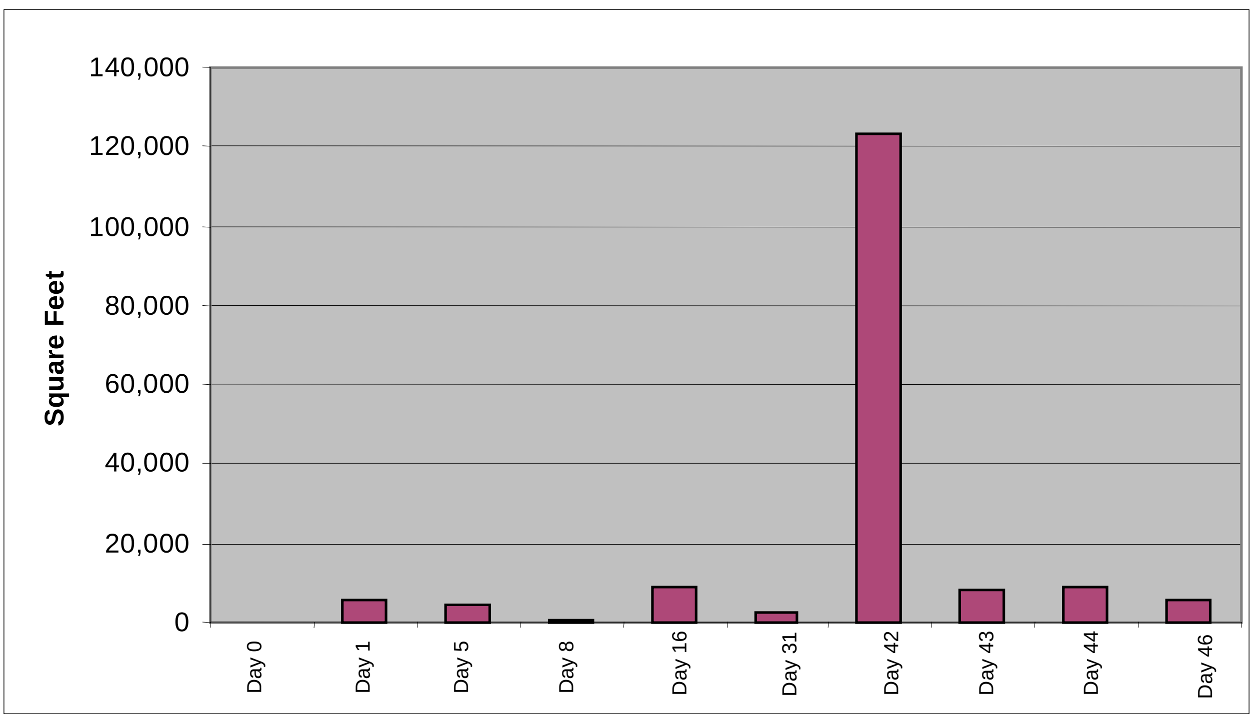


Figure 22 - Square Feet of Cargo Arriving by Rail at the Port of Anchorage.

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APPENDIX A

Elmendorf AFB and Fort Richardson are located adjacent to the Port of Anchorage. During a large deployment, cargo from these origins will likely stage at their origin. The cargo will probably be called forward for ship loading from its origin. In this situation, the port will only be required to receive and stage the cargo from Eielson AFB and Fort Wainwright. The information in this Appendix represents the requirement placed upon the port if only the cargo originating from Eielson AFB and Fort Wainwright is received and staged at the Port of Anchorage.

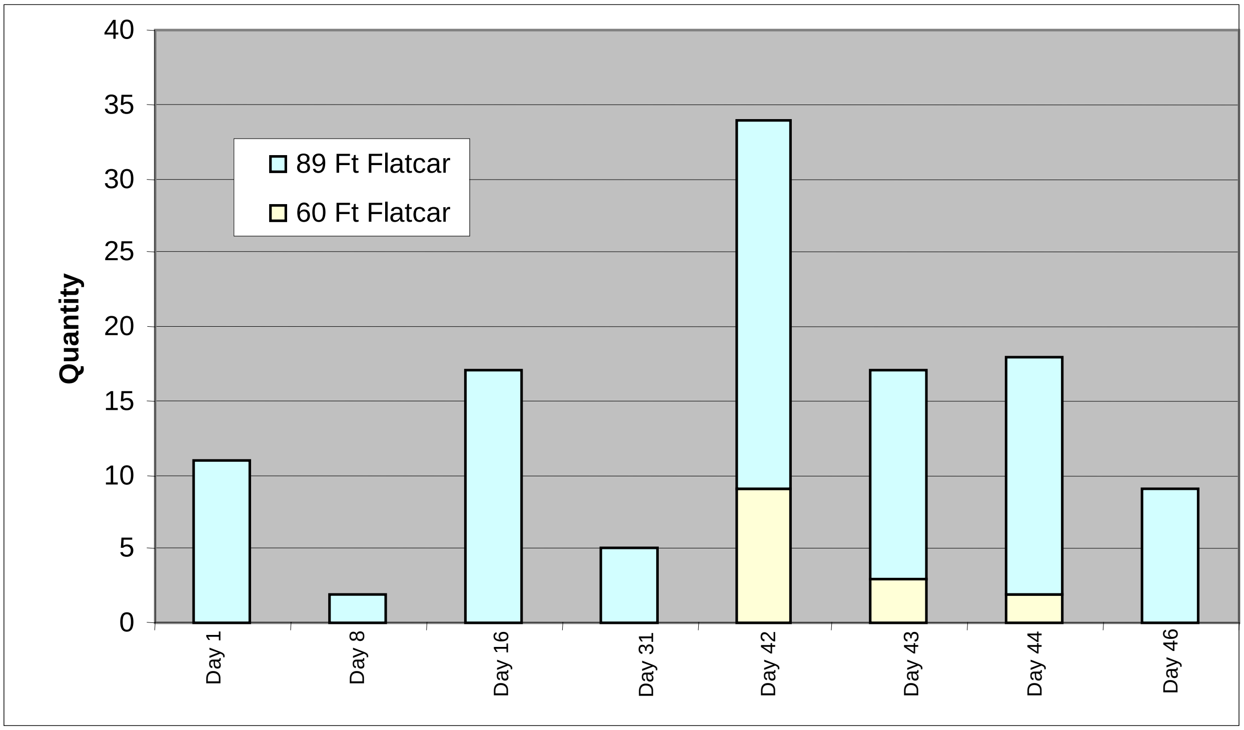

Figure A-1 - Quantity of Railcars Arriving at the Port of Anchorage.

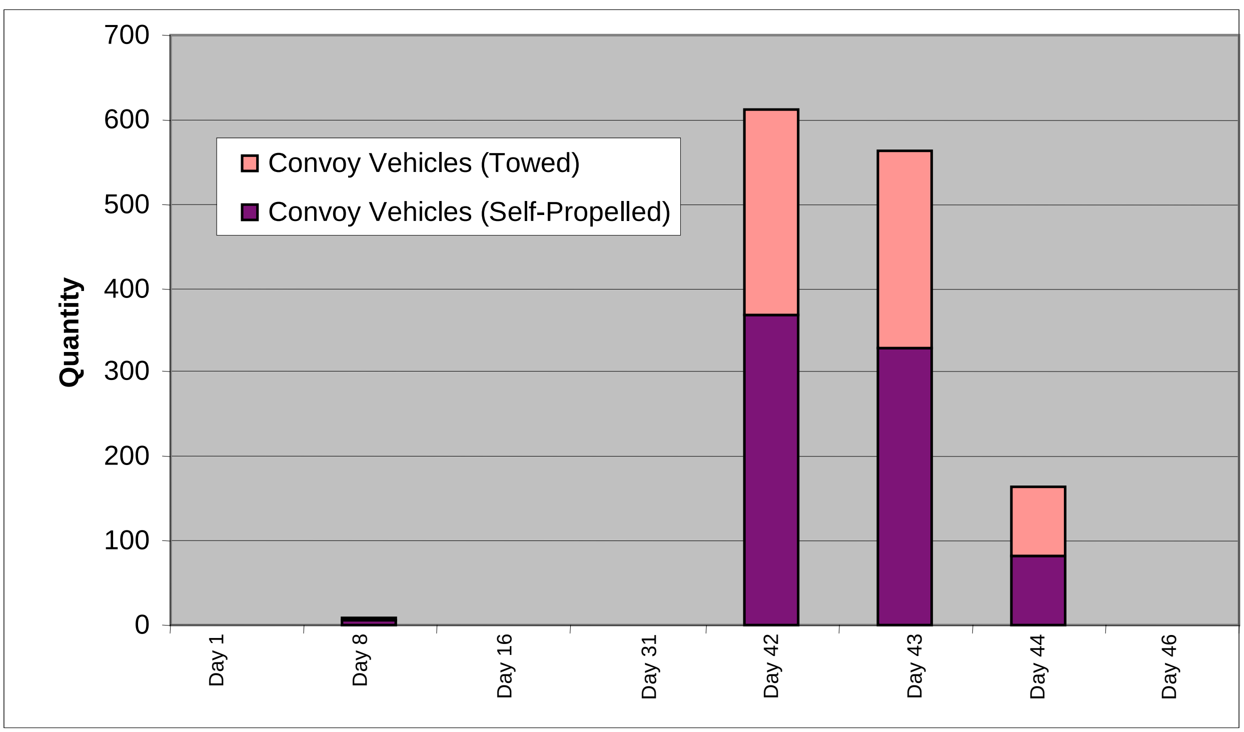

Figure A-2 - Quantity of Convoy Vehicles Arriving at the Port of Anchorage.

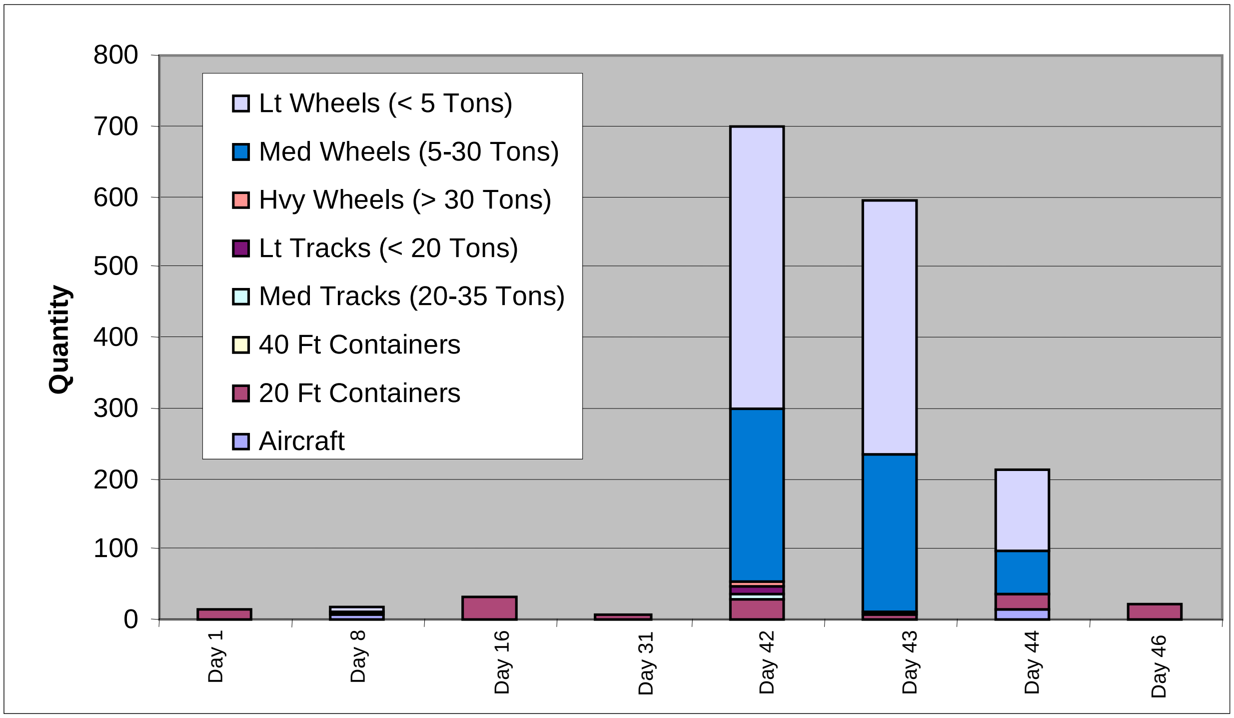

Figure A-3 - Total Quantity of Items Arriving at the Port of Anchorage.

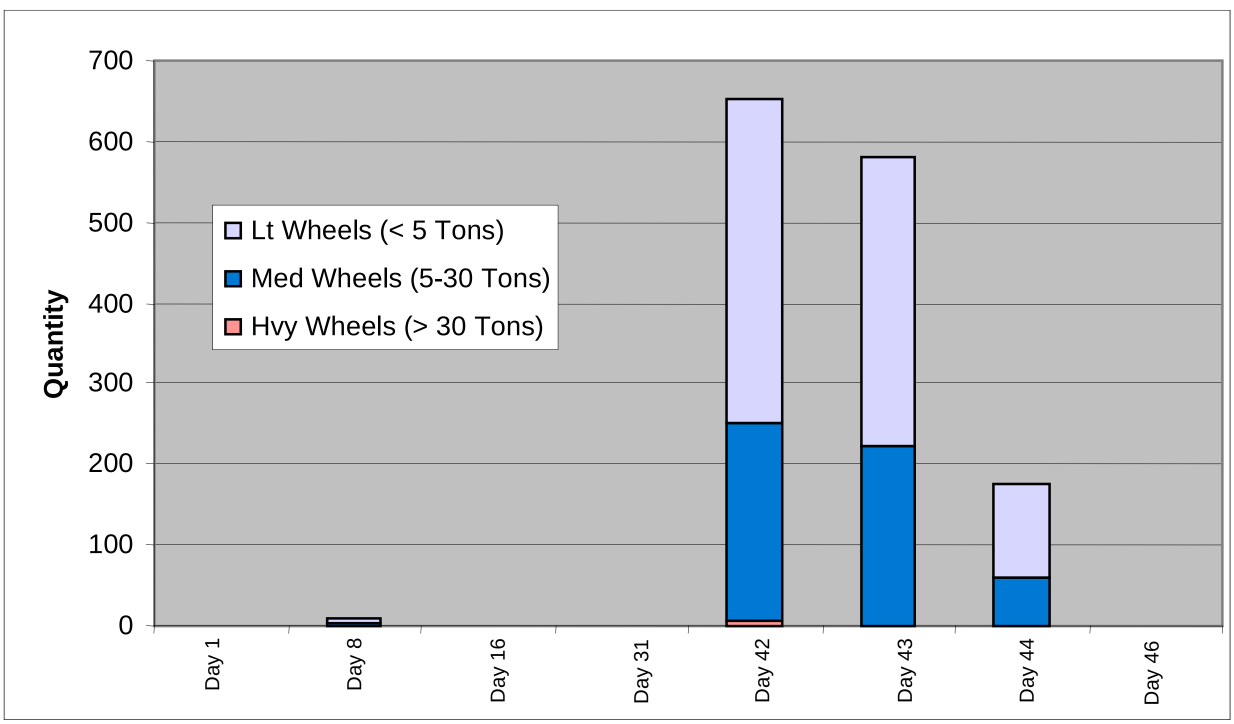

Figure A-4 - Quantity of Wheeled Vehicles Arriving at the Port of Anchorage.

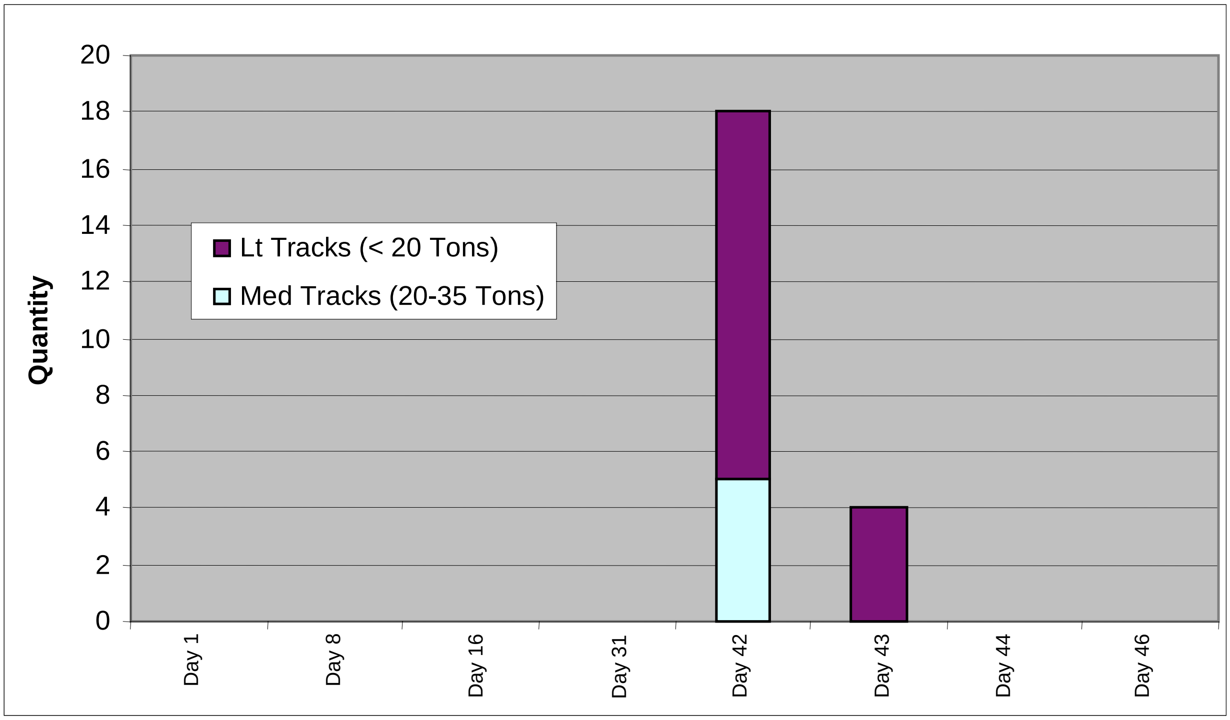

Figure A-5 - Quantity of Tracked Vehicles Arriving at the Port of Anchorage.

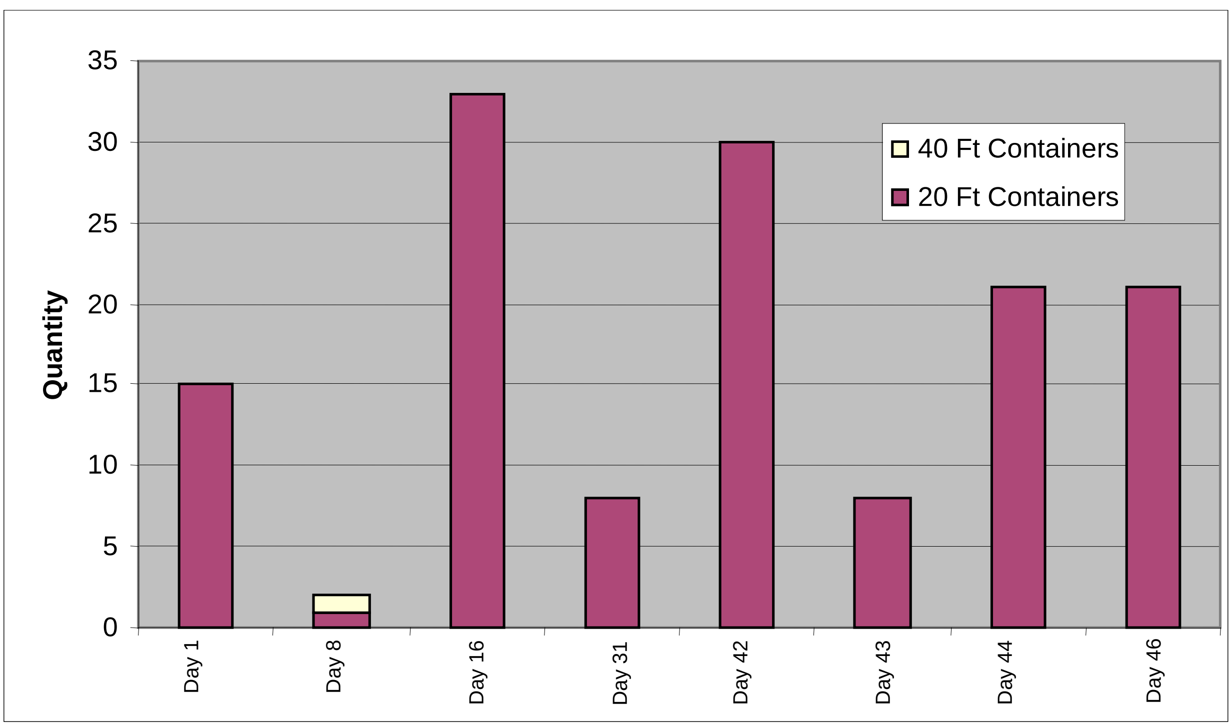

Figure A-6 - Quantity of Containers Arriving at the Port of Anchorage.

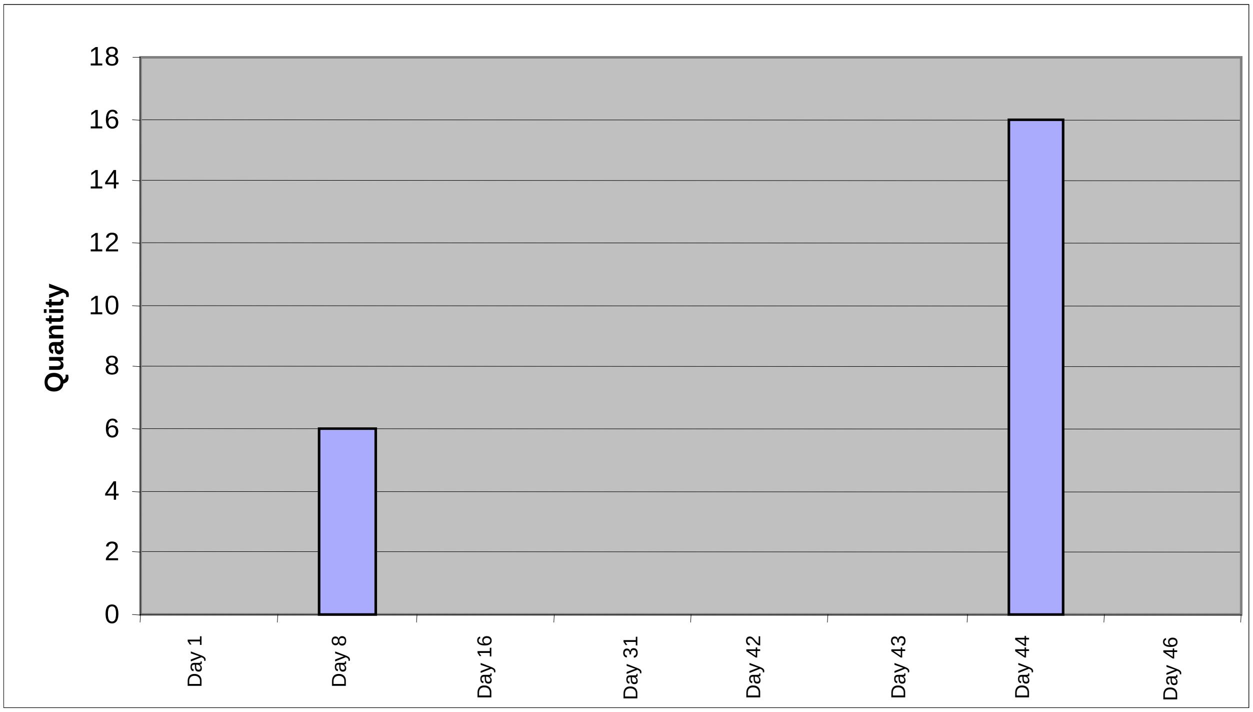

Figure A-7 - Quantity of Aircraft Arriving at the Port of Anchorage.

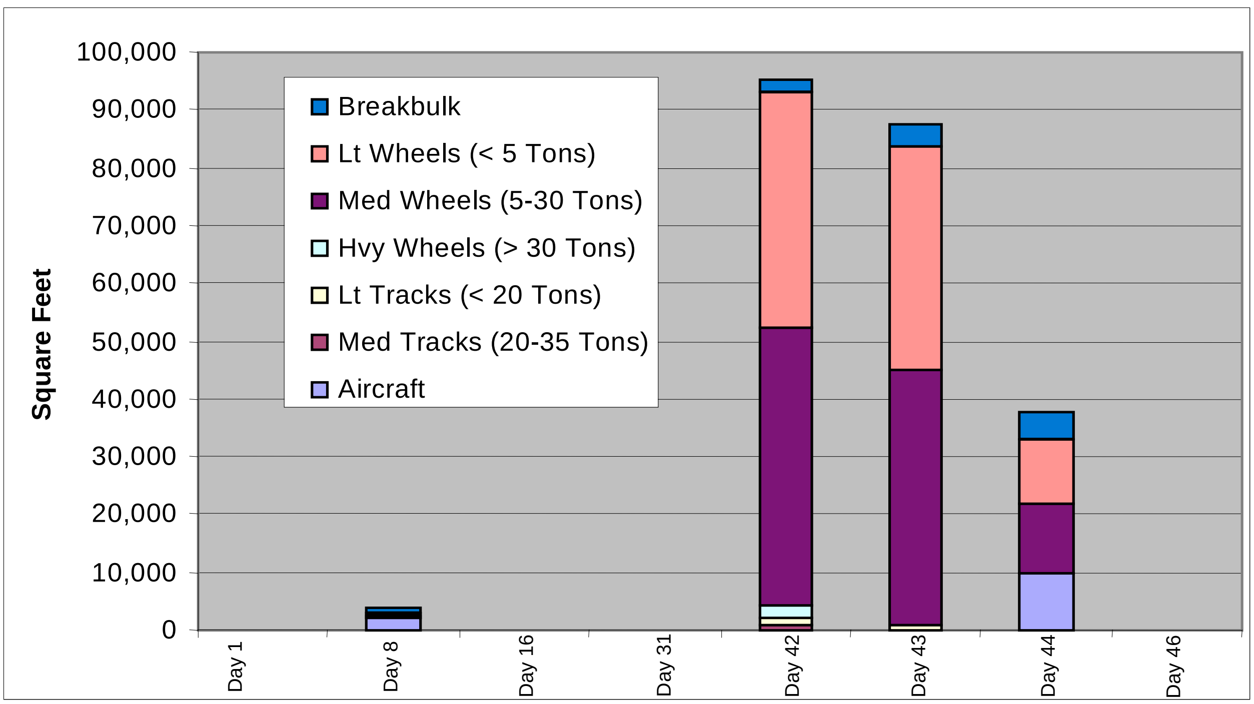

Figure A-8 - Total Square Feet of Cargo Arriving at the Port of Anchorage.

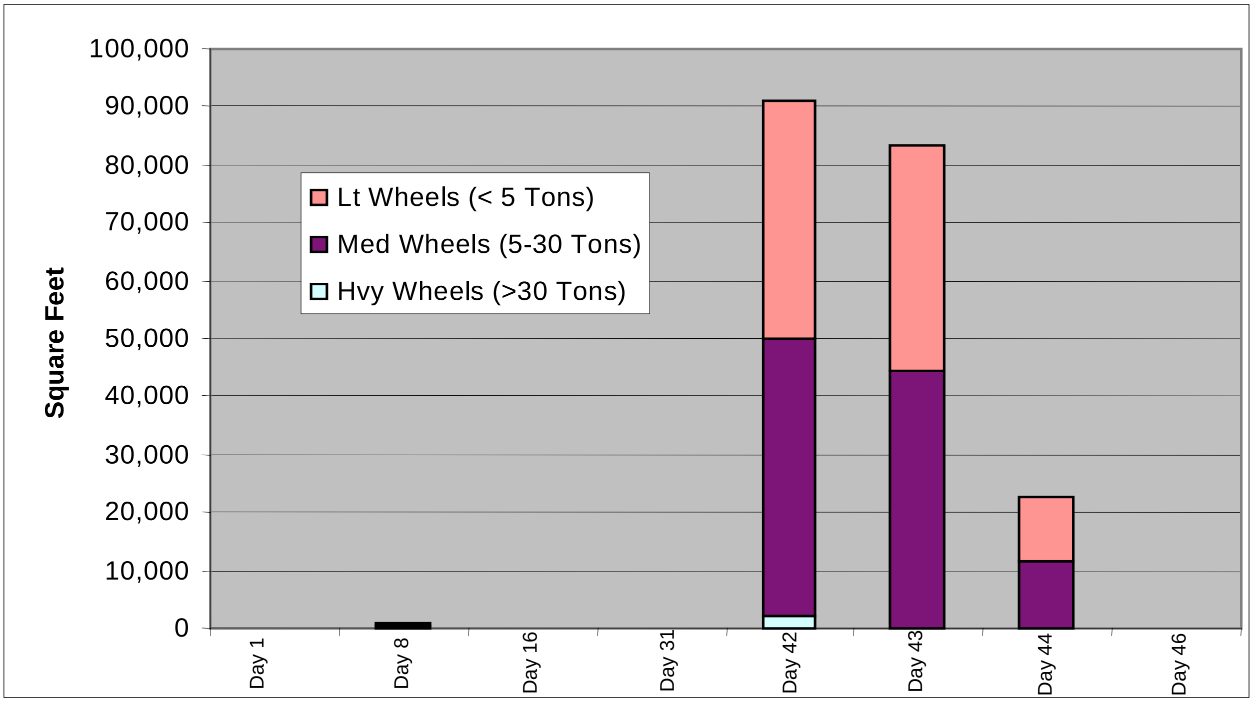

Figure A-9 - Square Feet of Wheeled Vehicles Arriving at the Port of Anchorage.

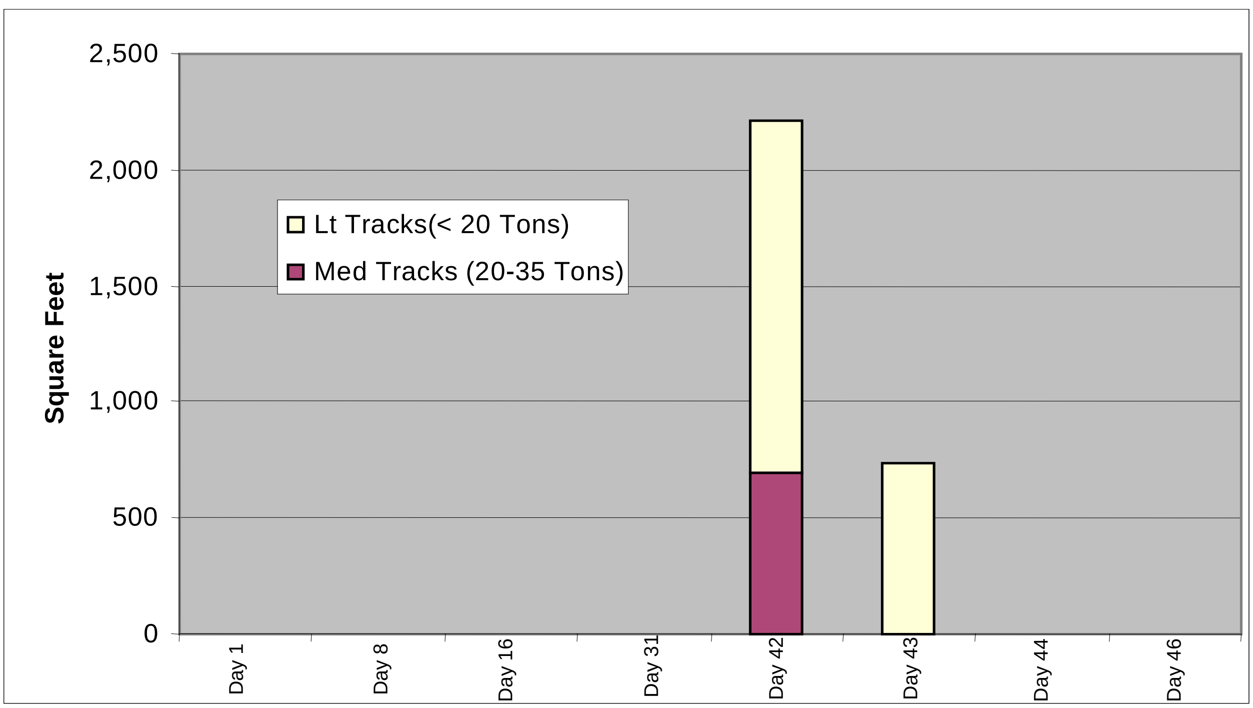

Figure A-10 - Square Feet of Tracked Vehicles Arriving at the Port of Anchorage.

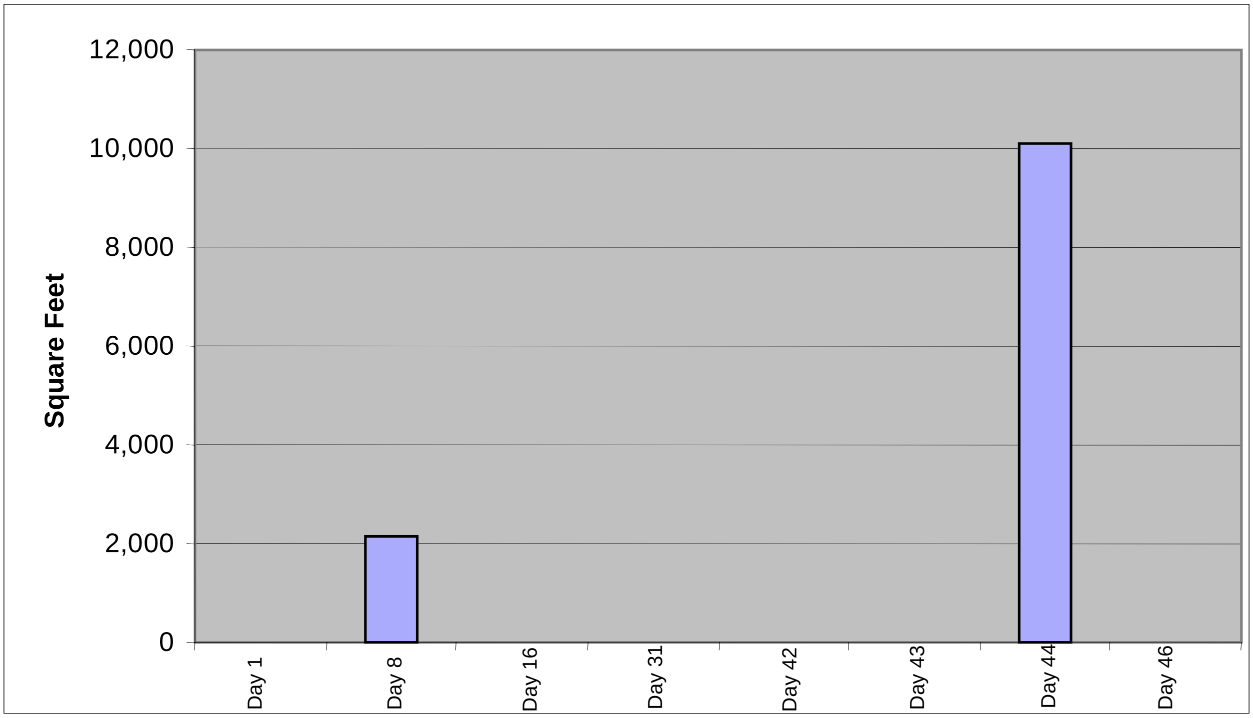

Figure A-11 - Square Feet of Aircraft Arriving at the Port of Anchorage.

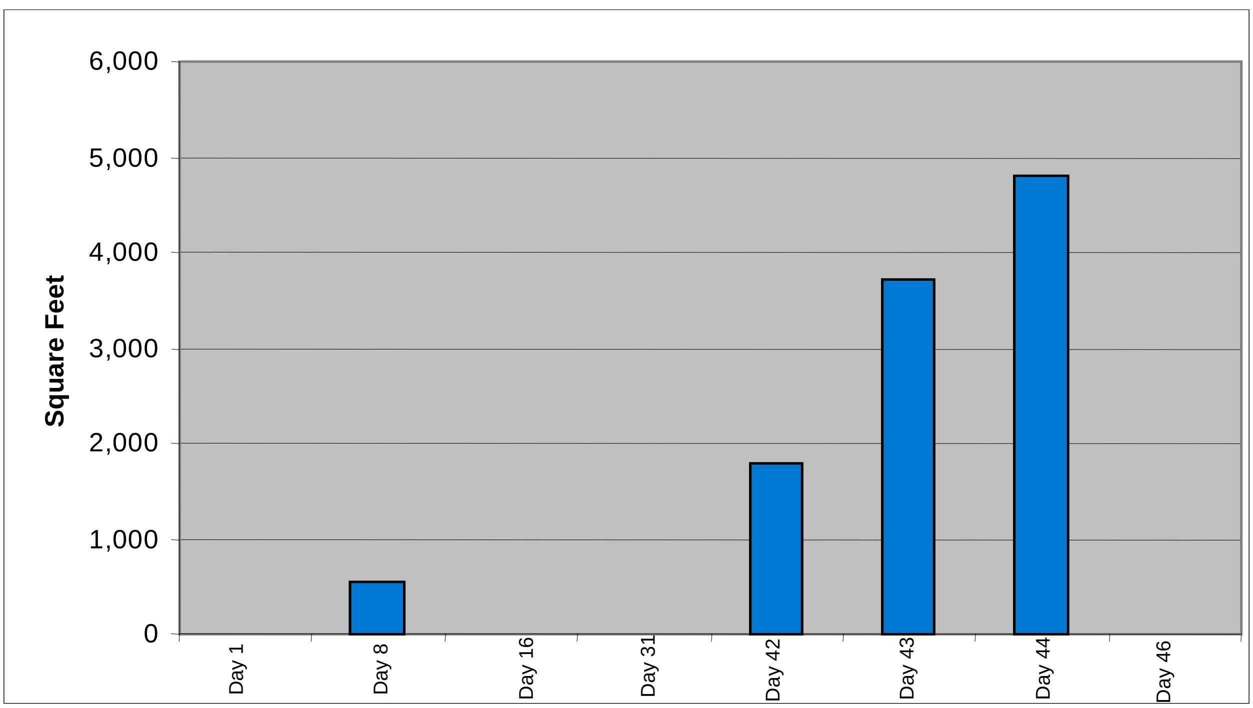

Figure A-12 - Square Feet of Breakbulk Cargo Arriving at the Port of Anchorage.

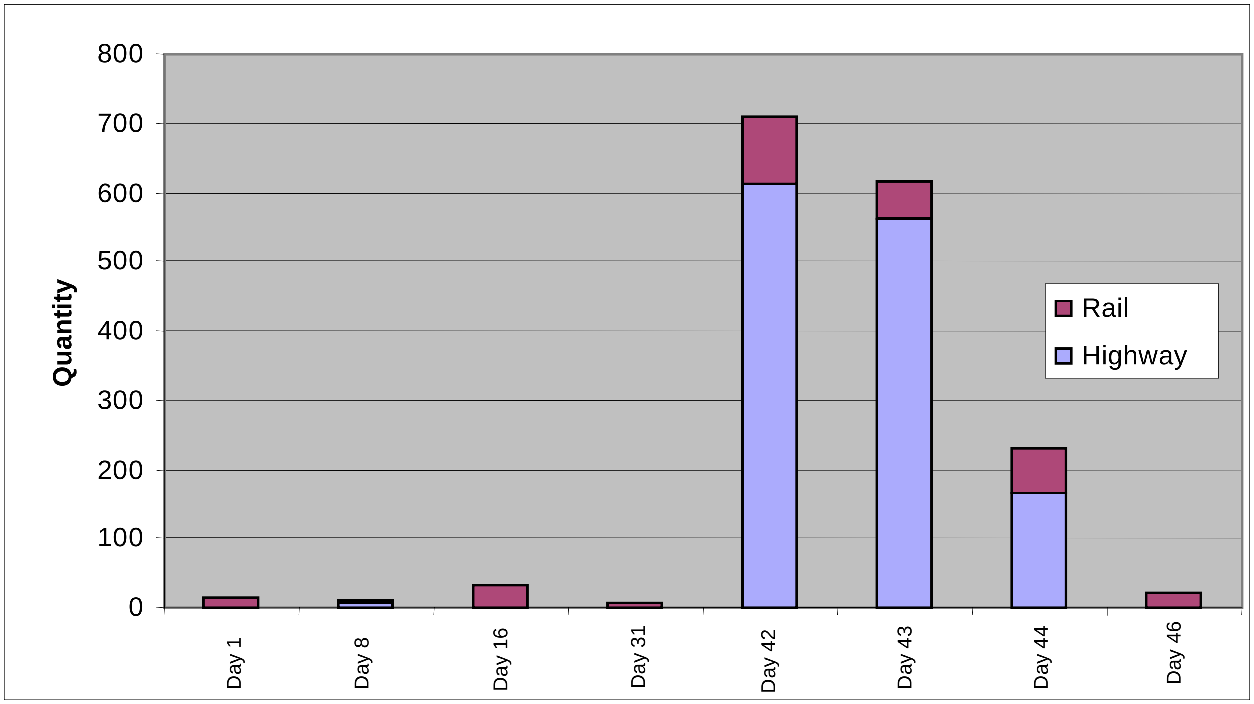

Figure A-13 - Arrival Mode of Cargo at the Port of Anchorage (Quantity).

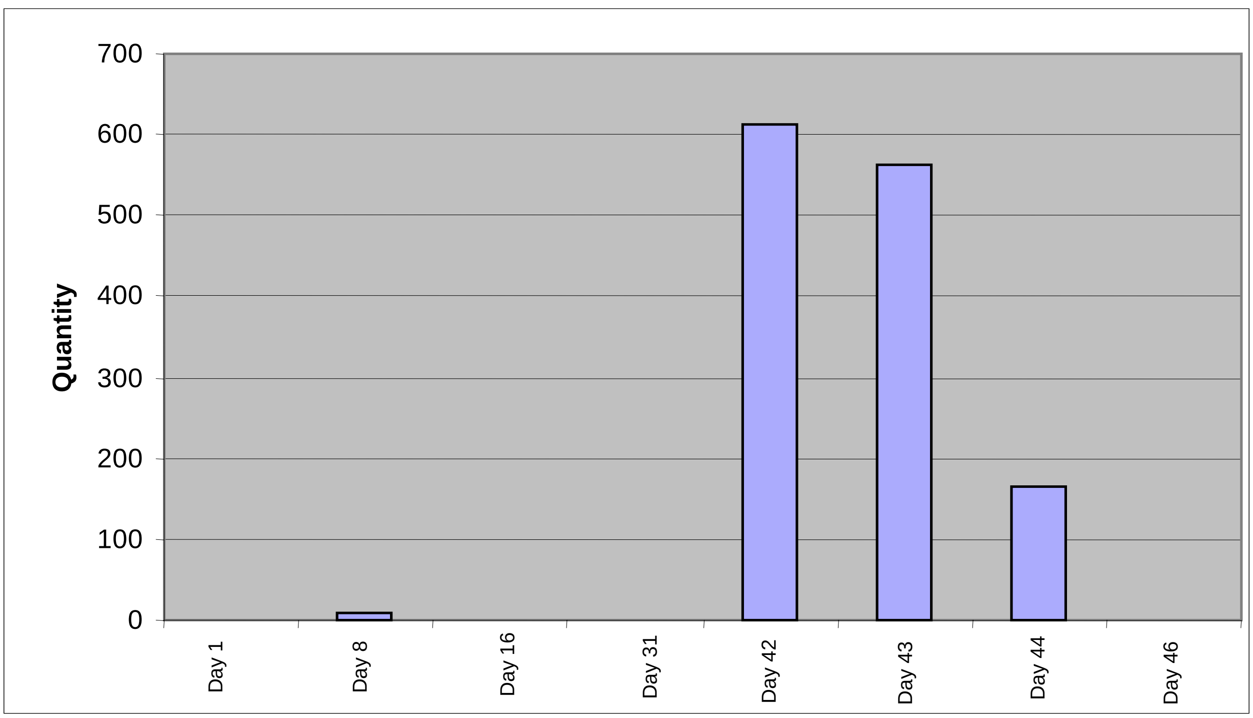

Figure A-14 - Quantity of Cargo Arriving by Highway at the Port of Anchorage.

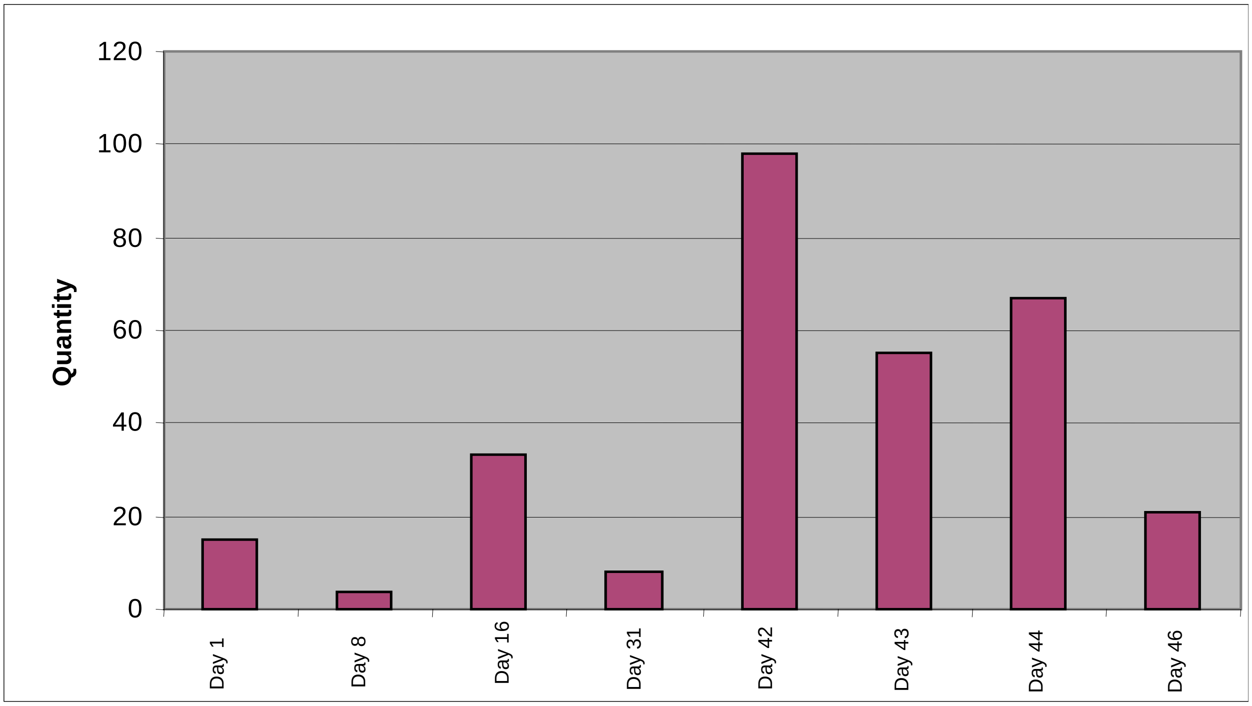

Figure A-15 - Quantity of Cargo Arriving by Rail at the Port of Anchorage.

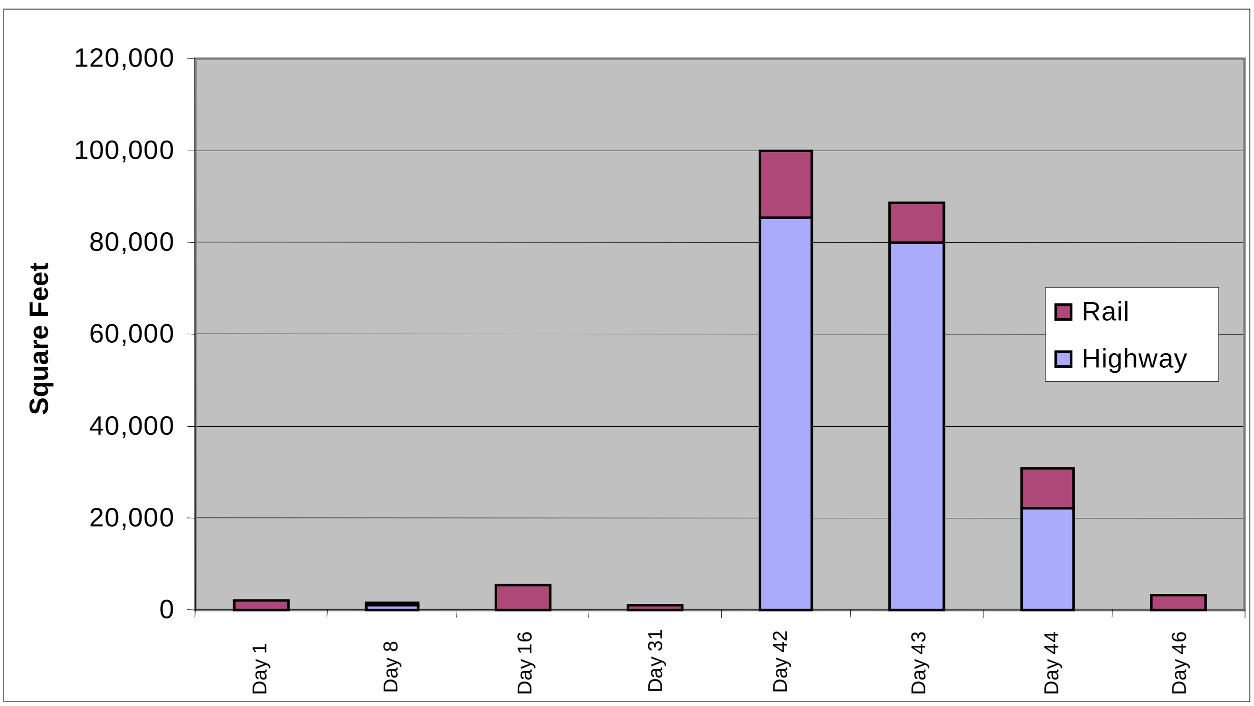

Figure A-16 - Arrival Mode of Cargo at the Port of Anchorage (Square Feet).

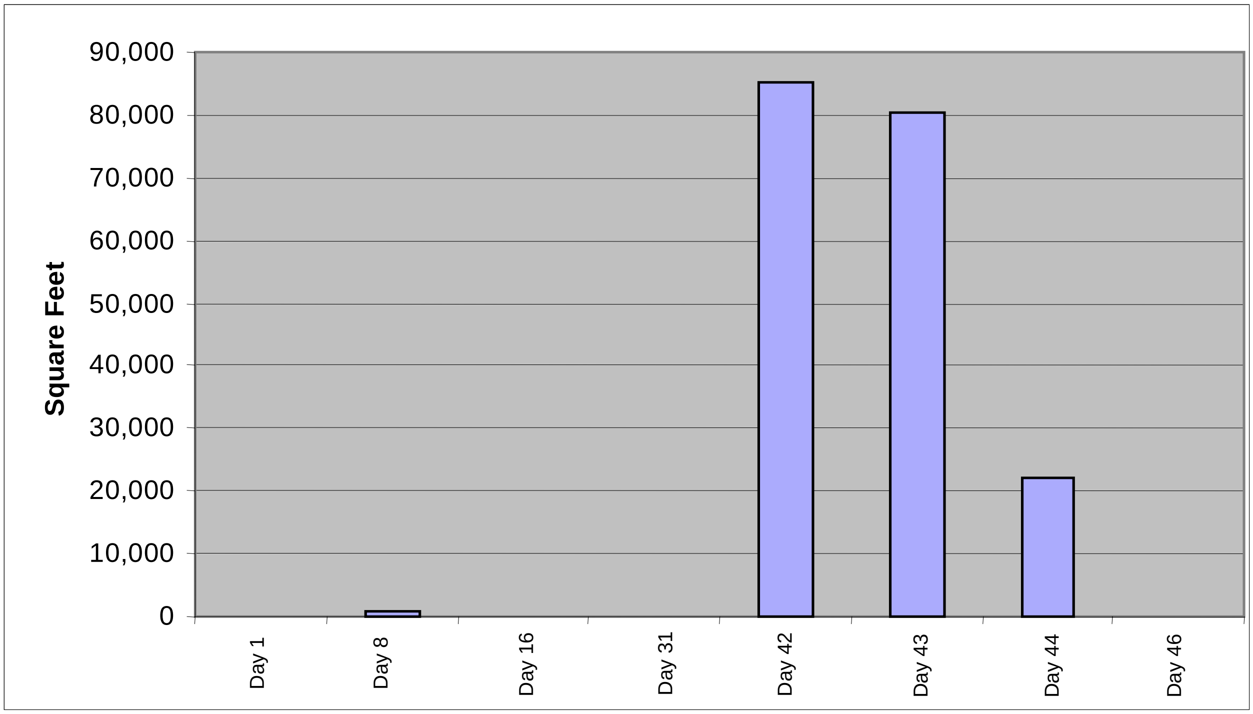

Figure A-17 - Square Feet of Cargo Arriving by Highway at the Port of Anchorage.

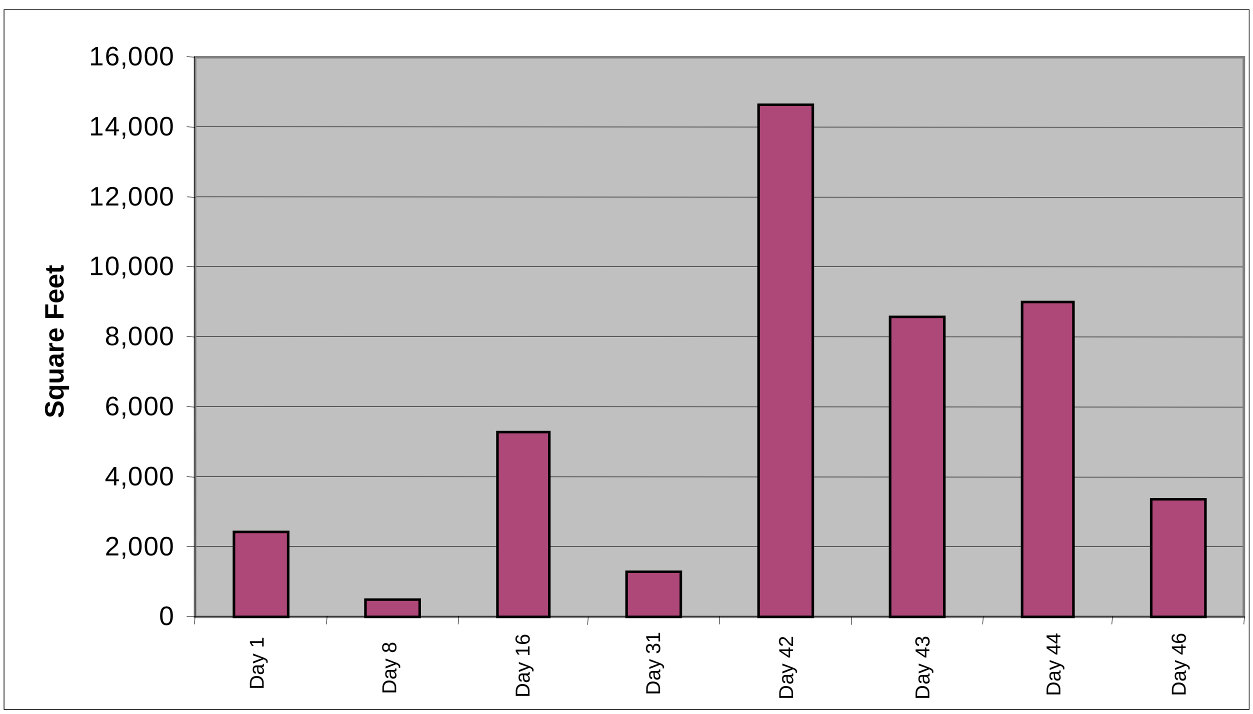

Figure A-18 - Square Feet of Cargo Arriving by Rail at the Port of Anchorage.

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Transportation Engineering Agency
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Newport News, Virginia 23606-4537

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East Coast Ports

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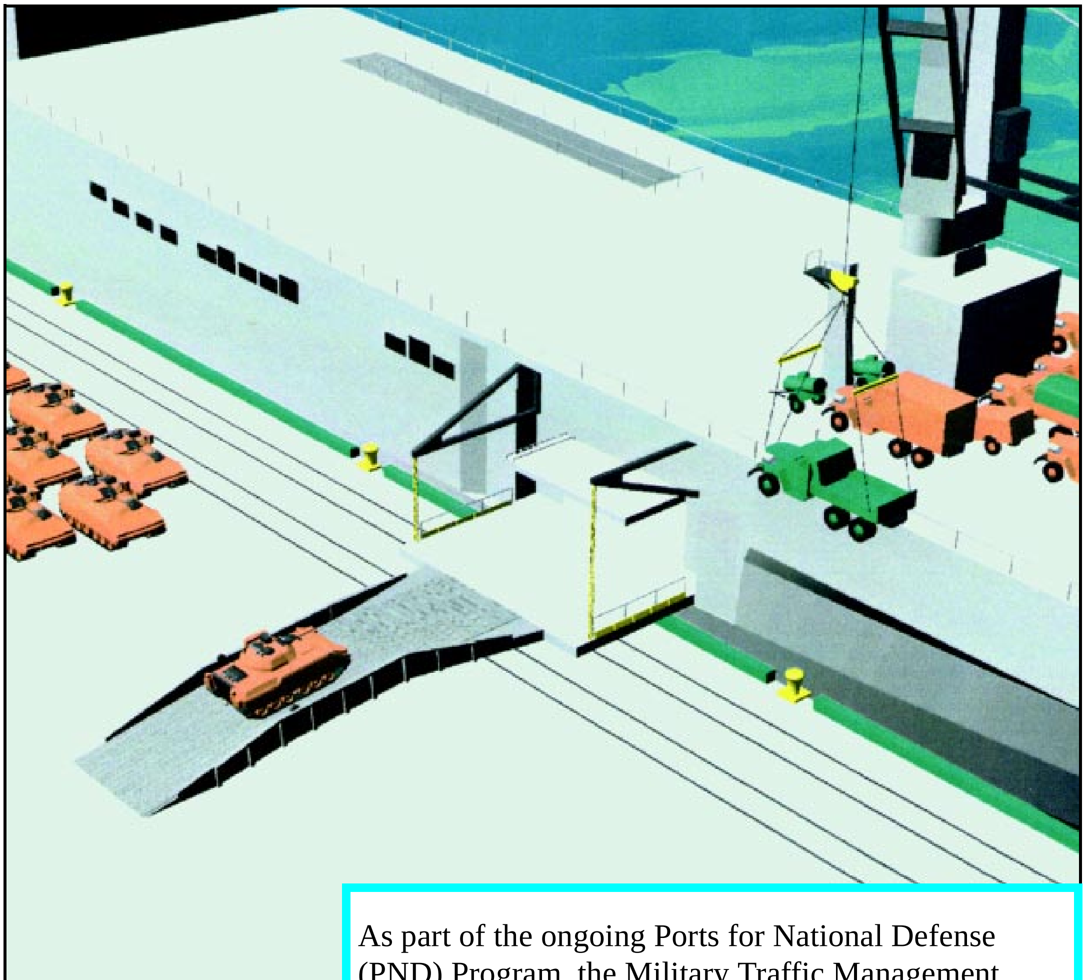
INTRODUCTION



As part of the ongoing Ports for National Defense (PND) Program, the Military Traffic Management Command Transportation Engineering Agency (MTMCTEA) revised information for selected east coast ports. The objectives of this report are to:

- *Identify* the port facilities and equipment needed to support a deployment.

- *Determine* the port throughput capability in MTON per day.

- *Determine* the ability of MARAD designated facilities to meet the deployment of specific units.

March 96

PORT OF CHARLESTON, SC

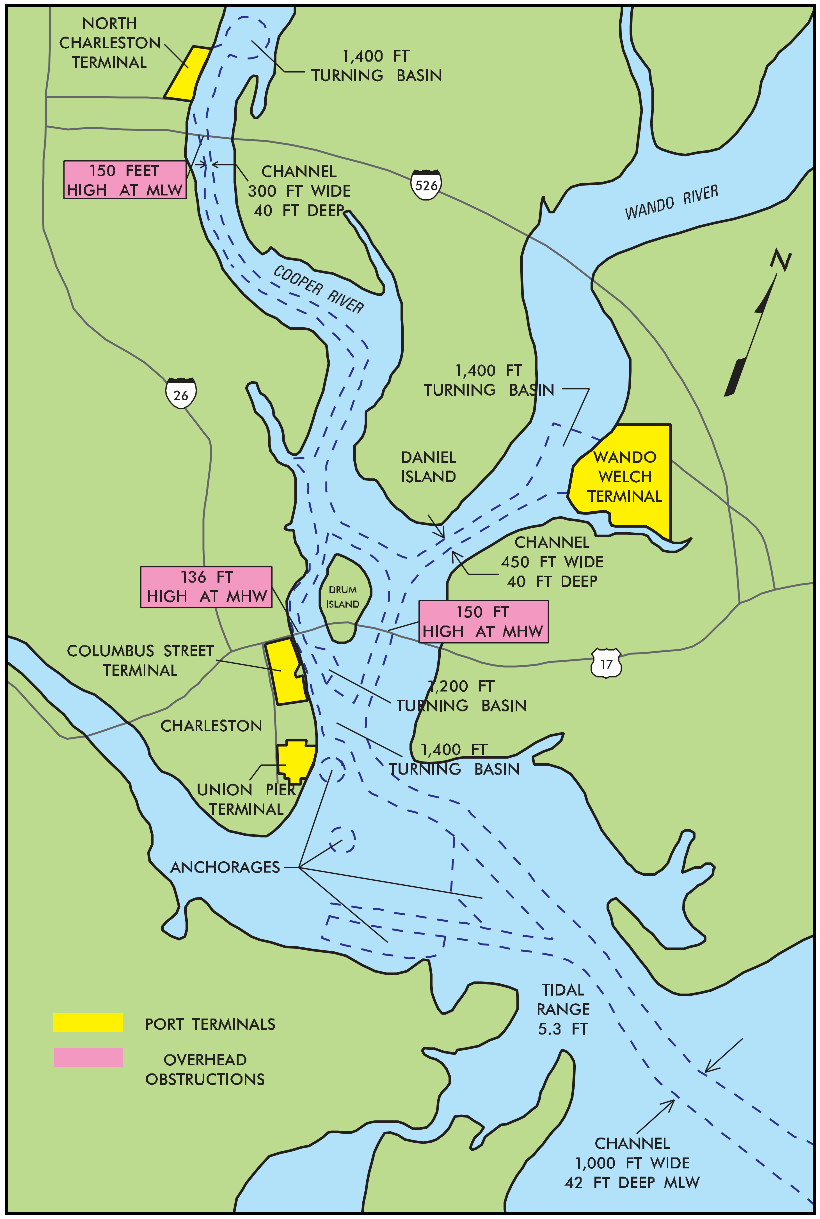
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The terminals of the Port of Charleston are within 2 hours sailing time from the Atlantic Ocean. Four anchorages and four turning basins are in the harbor area. Three bridges cross the channel to the North Charleston Terminal and the adjacent South Atlantic Outport. The first two bridges, just above Columbus Street Terminal, are side by side with an overhead clearance of 150 feet high at mean high water (MHW), with 1,000 feet of deep channel width. The third bridge is just below the North Charleston Terminal, on Interstate 526 (I-526). It is 150 feet above the water at MHW, with 300 feet of deep channel width.

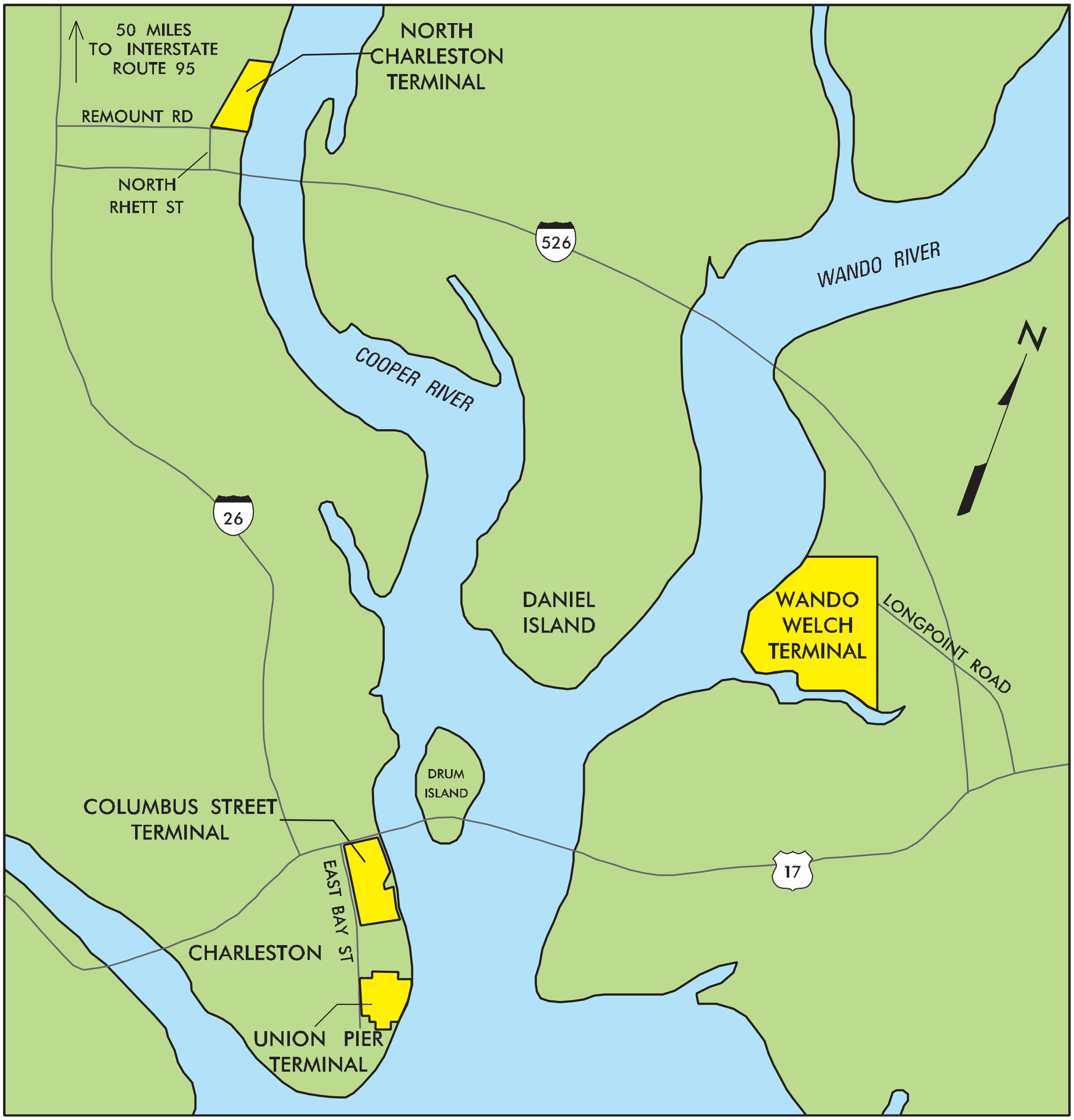
All channels are at least 40 feet deep at mean low water (MLW). The channel near the entrance is 42 feet deep.



Water Access

Highway

The major highway to the Port of Charleston from the northwest is Interstate Route 26 (I-26). Charleston is about 50 miles from Interstate Route 95 (I-95), the major east coast north-south artery. US Route 17 connects Charleston with nearby coastal cities.



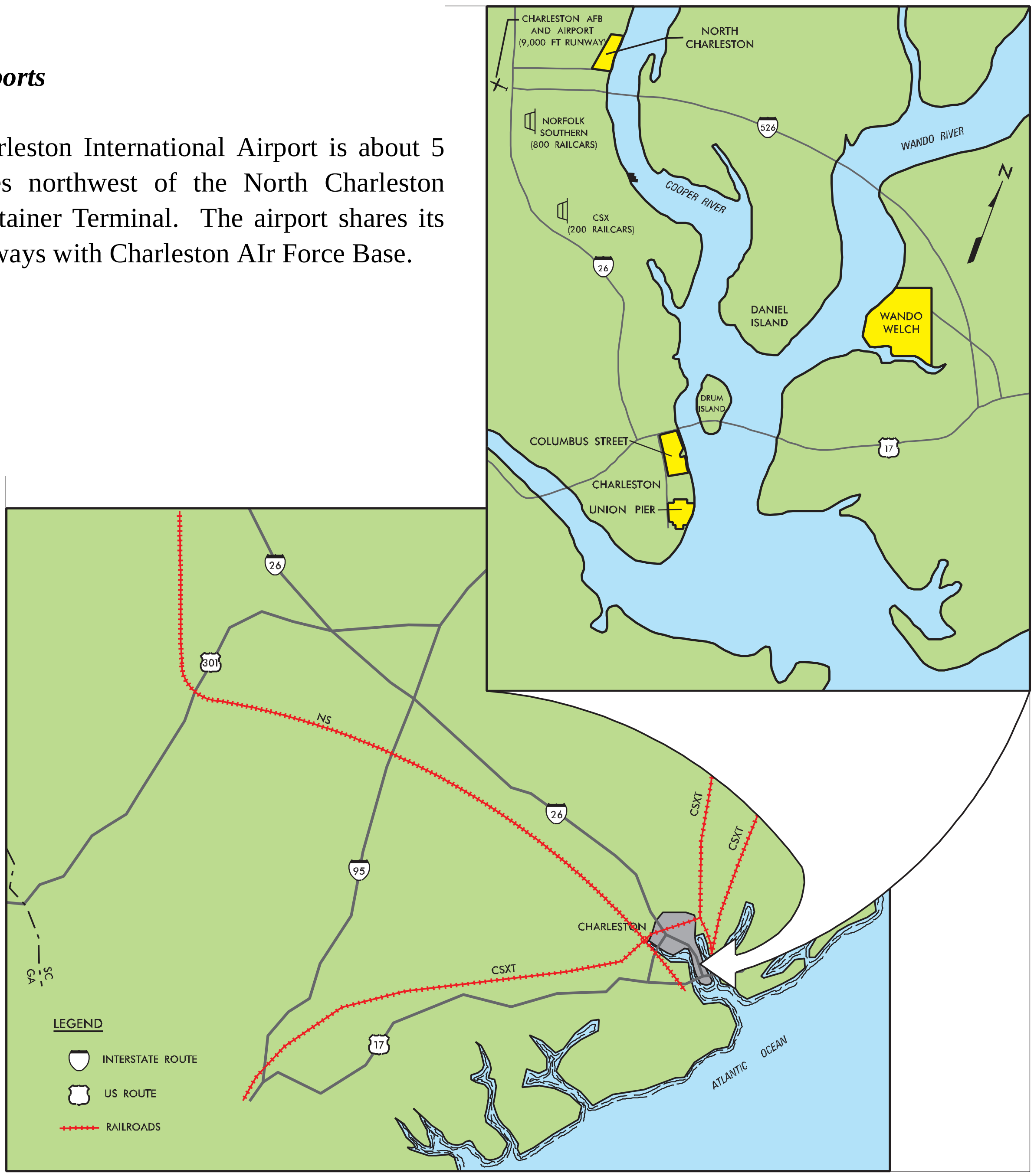
Highway Access

Rail

Norfolk Southern and FSX provide rail serviceto the Port of Charleston. These major railyards are in the port area. Two are located 2 miles southwest of the North Charleston Terminal. Inter/ intra terminal switching is handled by the South Carolina Public Railways Commission's switch locomotives, except at the MTMC South Atlantic Outport, at the north end of North Carleston Terminal.

Airports

Charleston International Airport is about 5 miles northwest of the North Charleston Container Terminal. The airport shares its runways with Charleston AIr Force Base.



Rail and Air Access

PORT FACILITIES

Berthing

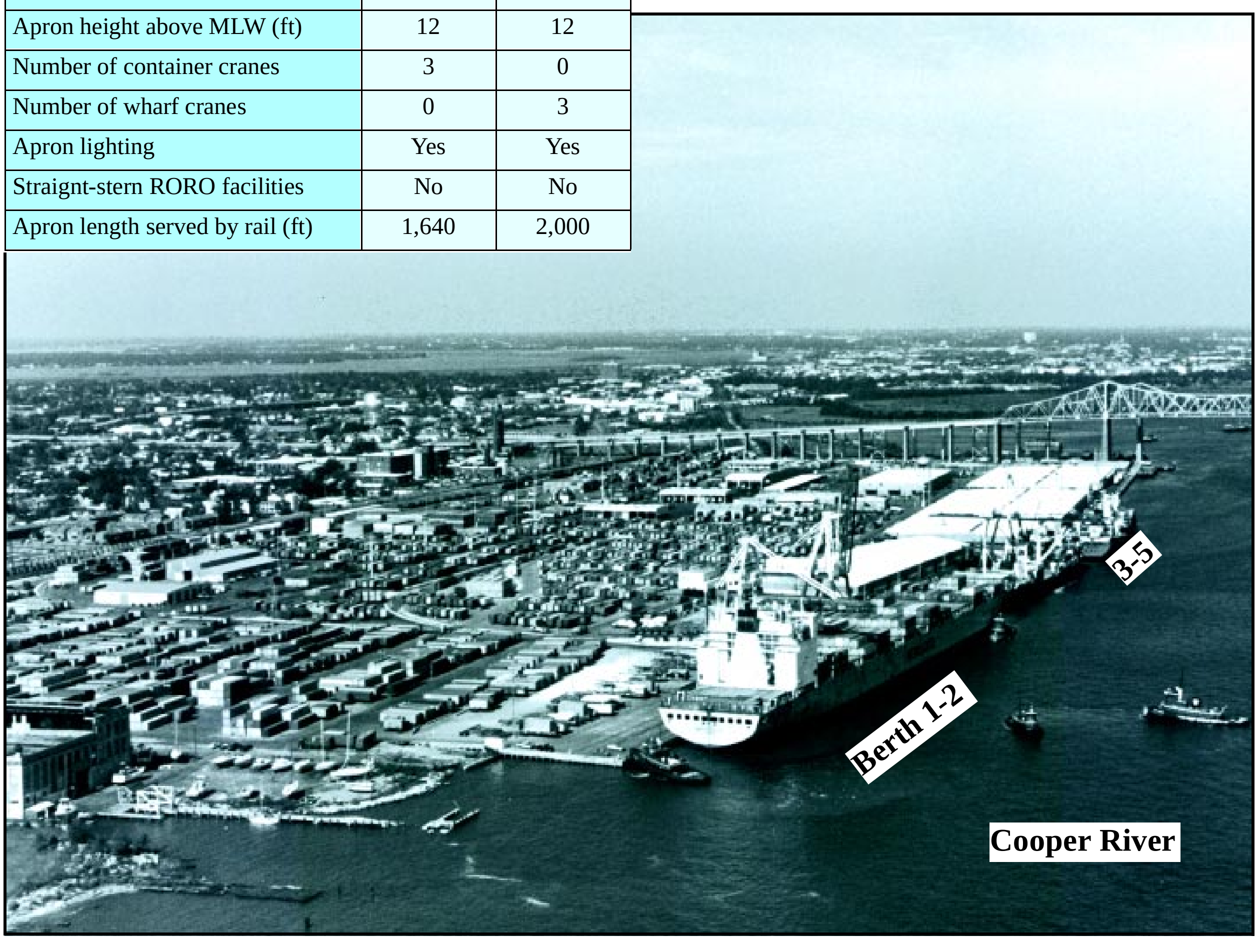
This report covers Columbus Street, Union Pier, North Charleston, and Wando Welch Terminals. These terminals are suitable for military operations. Union Pier is generally a breakbulk facility, with transit sheds along most of the wharf. All other terminals handle containers, with few or no transit sheds.

BERTHING CHARACTERISTICS OF COLUMBUS STREET TERMINAL

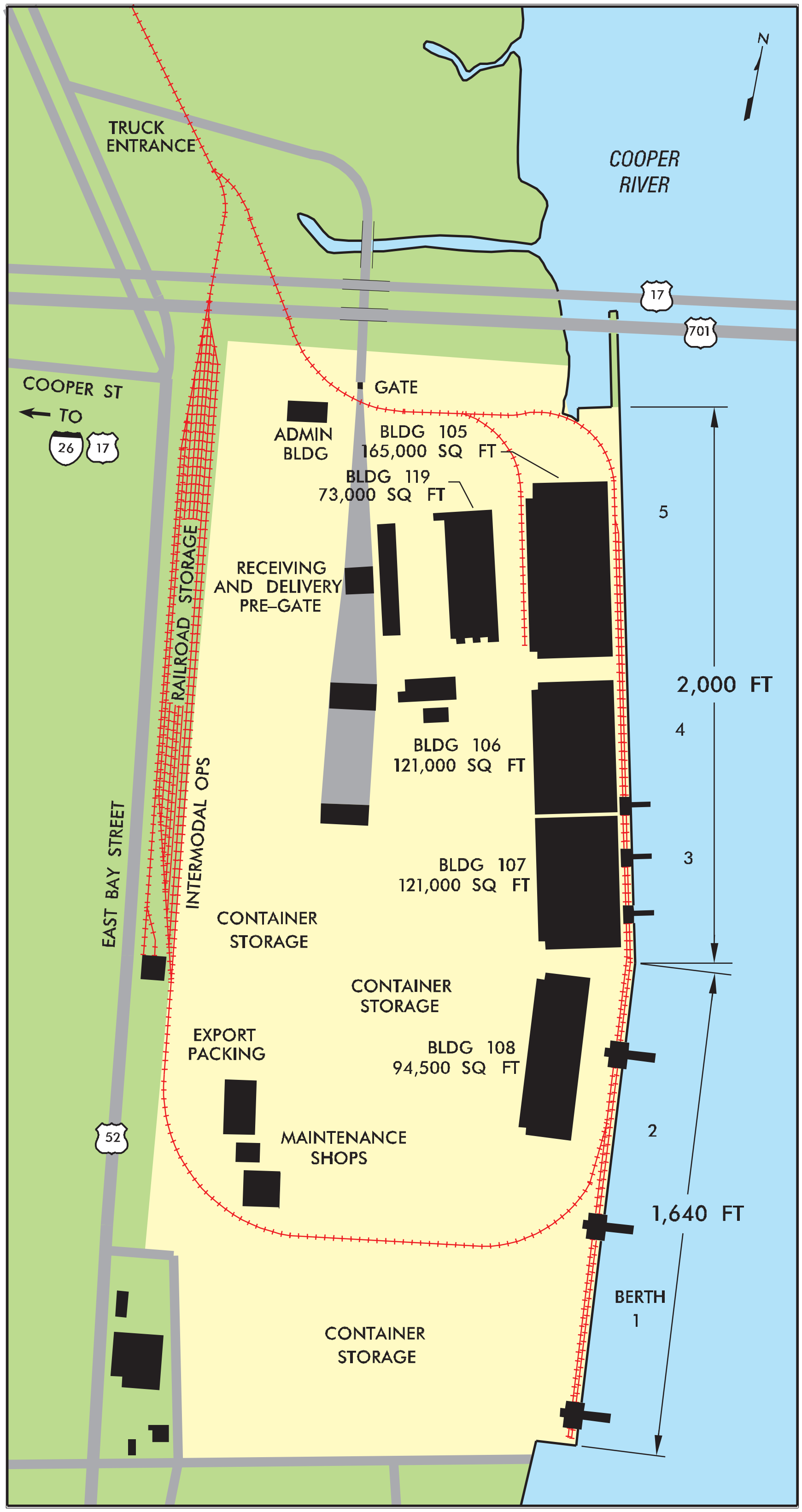
Characteristics	Berths	
	1-2	3-4
Length (ft)	1,640	2,000
Depth alongside at MLW (ft)	40	40
Deck strength (psf)	1,000	600
Apron width (ft)	Open	45
Apron height above MLW (ft)	12	12
Number of container cranes	3	0
Number of wharf cranes	0	3
Apron lighting	Yes	Yes
Straignt-stern RORO facilities	No	No
Apron length served by rail (ft)	1,640	2,000

Pier construction is generally concrete piles, with concrete decking, and timber fenders. All terminals have lighting for night operations.

Below are land-use maps and aerial views of the terminals. Tables identify berth characteristics.

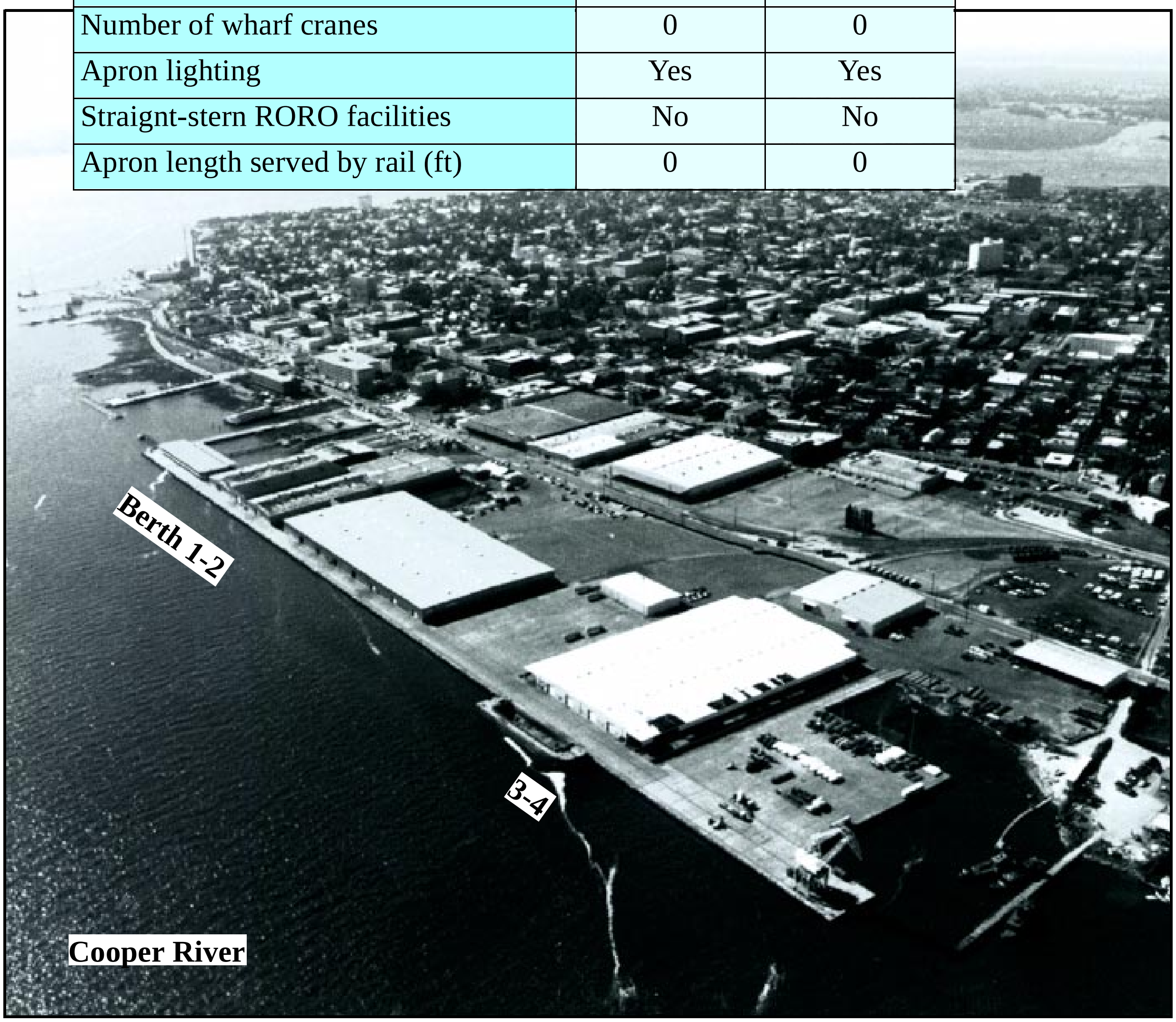


Columbus Street Terminal (Northeastward view)

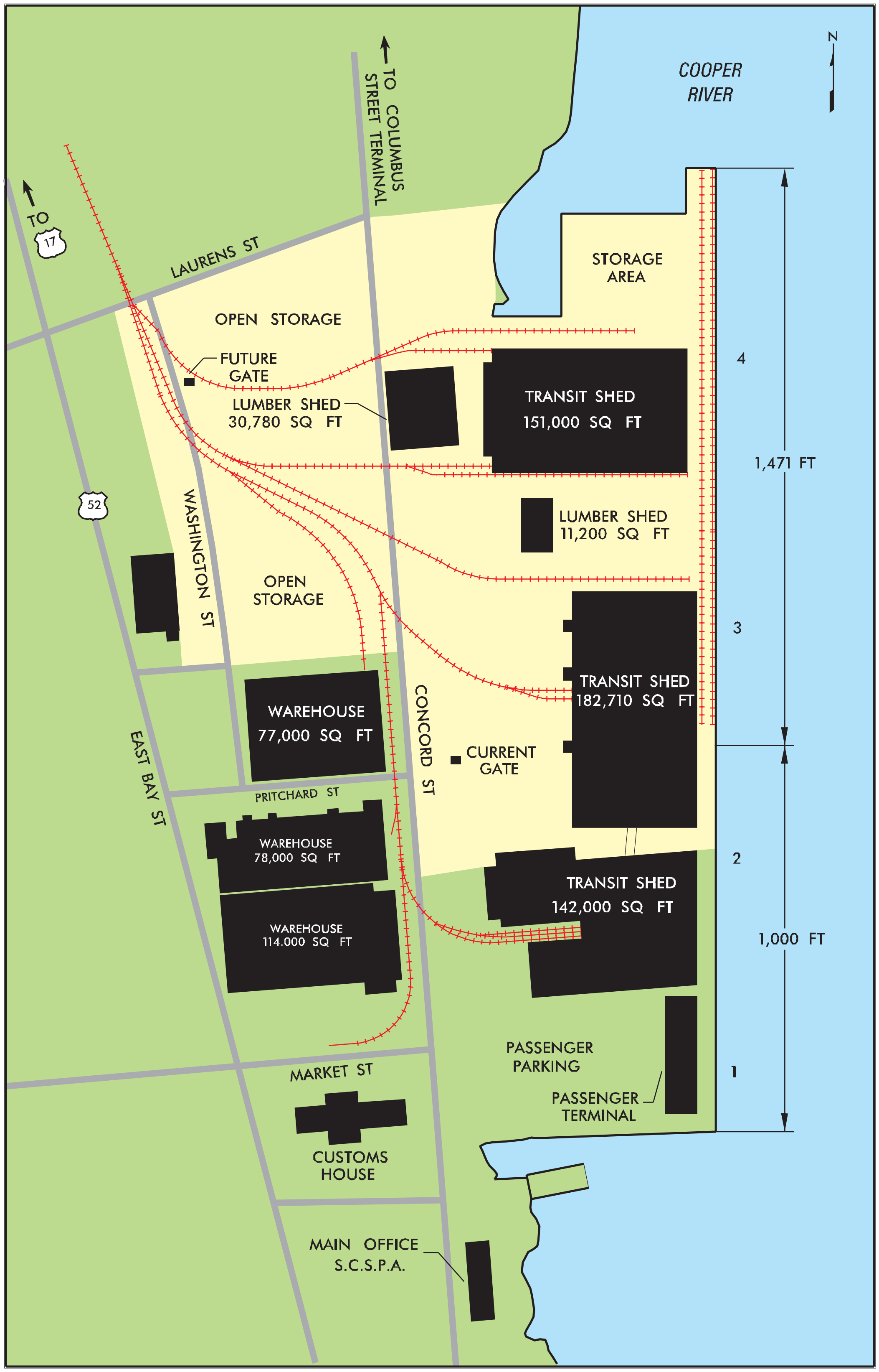


Columbus Street Terminal Land-Use Map

BERTHING CHARACTERISTICS OF UNION PIER TERMINAL		
Characteristics	**Berths**	
	1-2	**3-4**
Length (ft)	1,000	1,471
Depth alongside at MLW (ft)	40	40
Deck strength (psf)	400	1,000
Apron width (ft)	45	Open
Apron height above MLW (ft)	12	12
Number of container cranes	0	0
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straignt-stern RORO facilities	No	No
Apron length served by rail (ft)	0	0



Union Pier Terminal (Southwestward view)

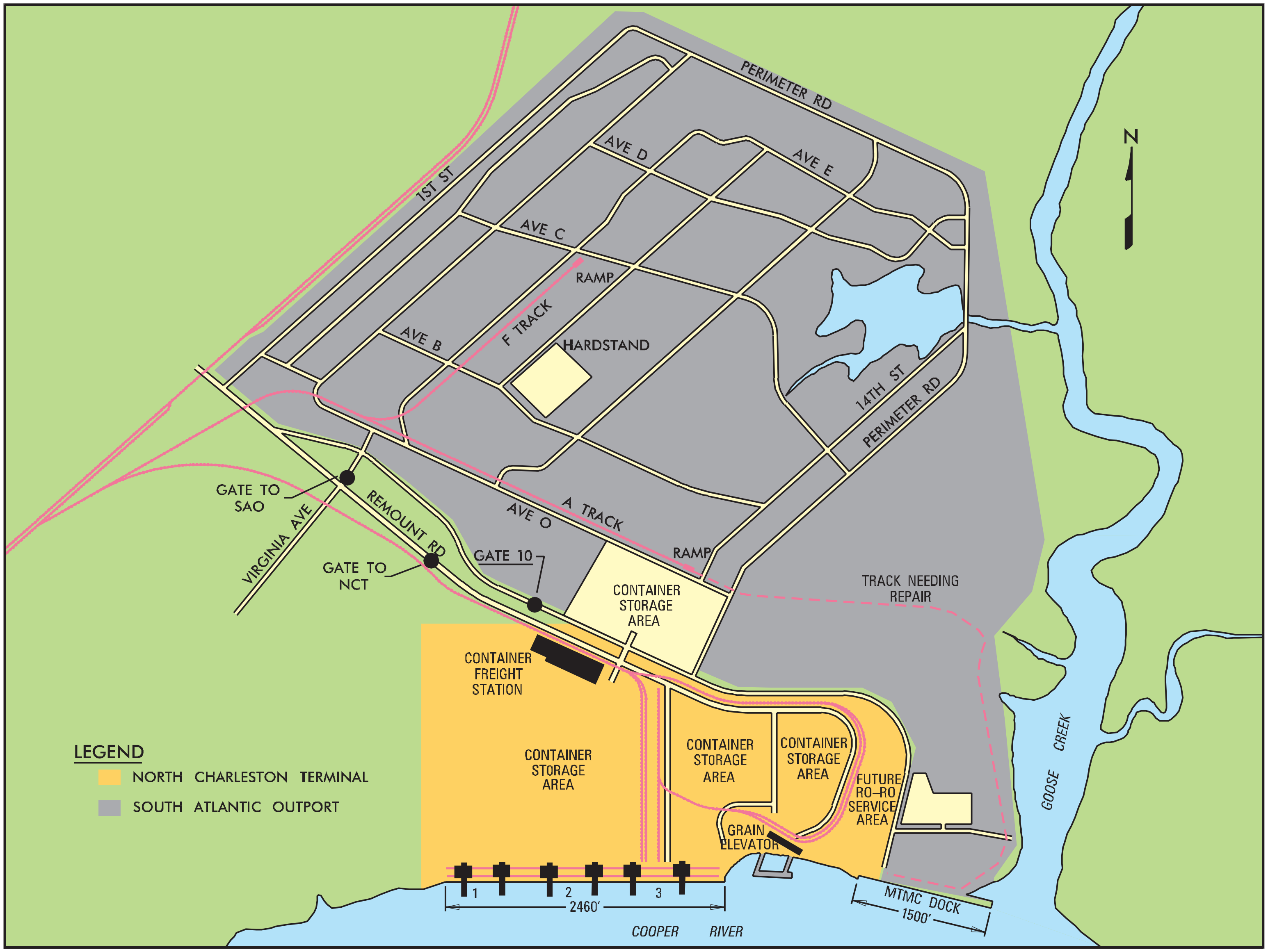


Union Pier Land-Use Map

BERTHING CHARACTERISTICS OF NORTH CHARLESTON TERMINAL

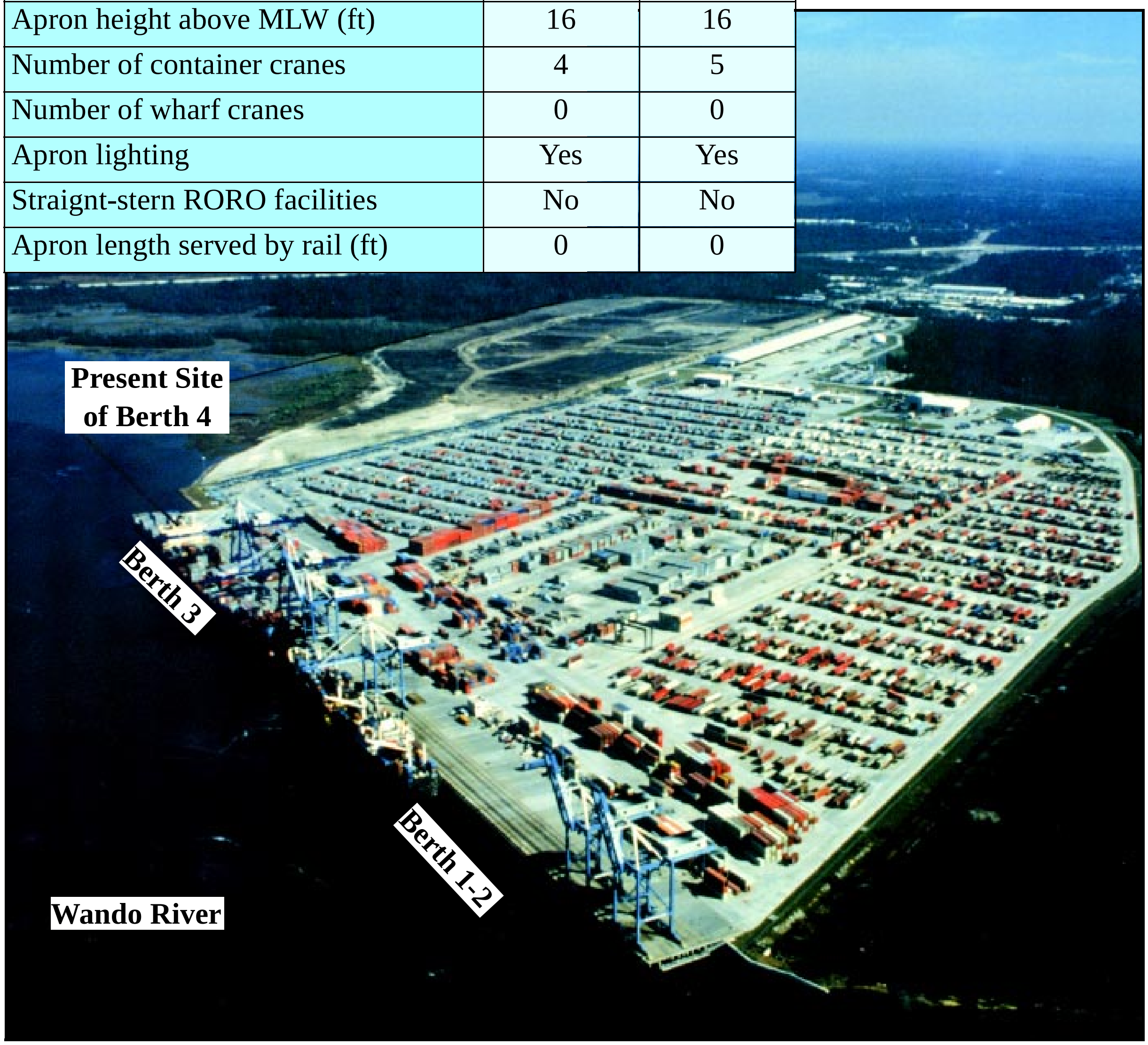
Characteristics	Berths	
	1-3	MTMC
Length (ft)	2,460	1,500
Depth alongside at MLW (ft)	40	40
Deck strength (psf)	1,000	700
Apron width (ft)	100	100
Apron height above MLW (ft)	12	12
Number of container cranes	6	0
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straignt-stern RORO facilities	No	No
Apron length served by rail (ft)	0	1,500

North Charleston Terminal (Westward view)

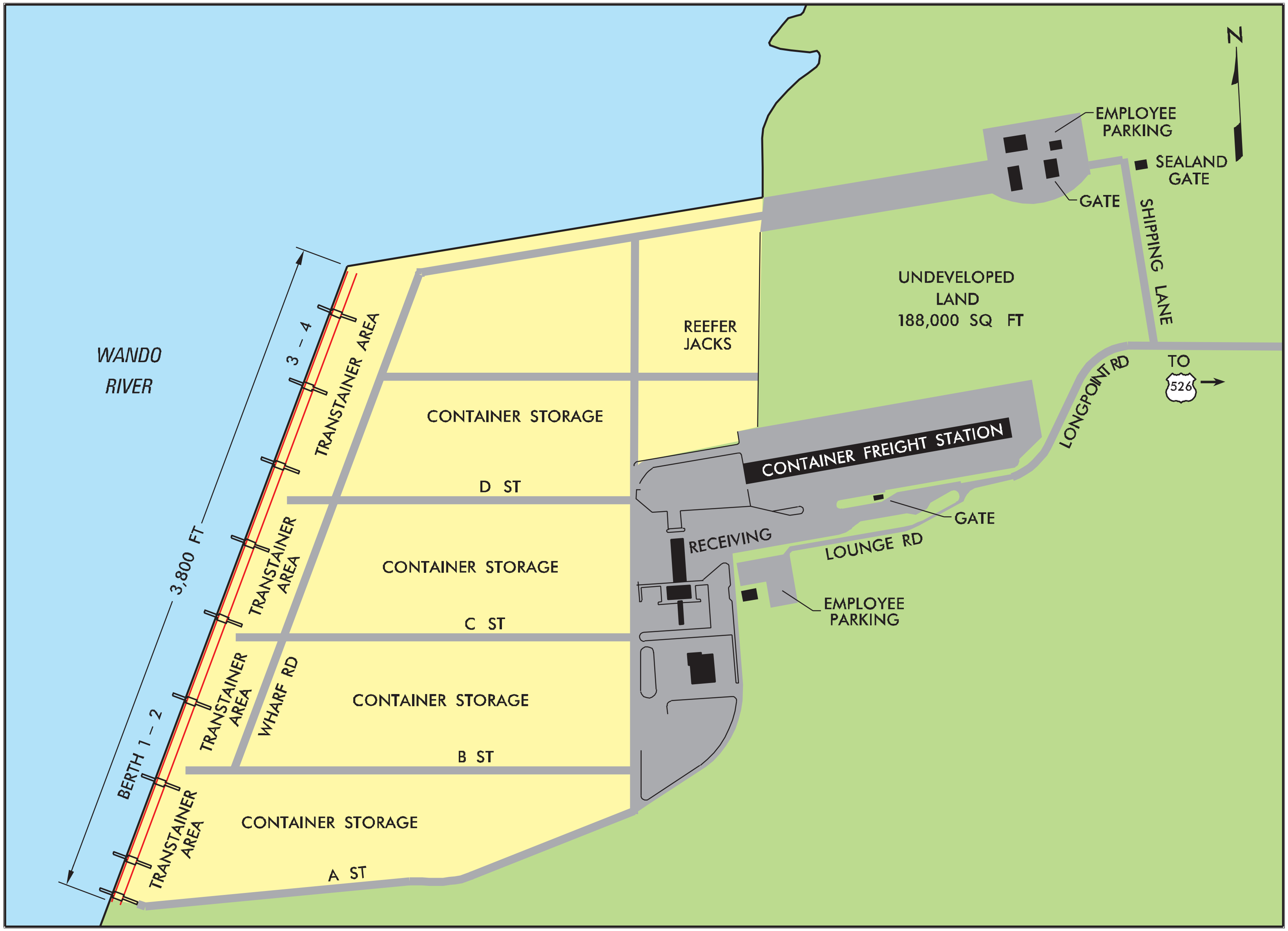


North Charleston Terminal

BERTHING CHARACTERISTICS OF WANDO WELCH TERMINAL		
Characteristics	**Berths**	
	1-2	**3-4**
Length (ft)	1,800	2,000
Depth alongside at MLW (ft)	40	40
Deck strength (psf)	1,000	1,000
Apron width (ft)	Open	Open
Apron height above MLW (ft)	16	16
Number of container cranes	4	5
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straignt-stern RORO facilities	No	No
Apron length served by rail (ft)	0	0



Wando Welch Terminal (Eastward view)
(Photo taken before Berth 4 expansion)



Wando Welch Land-Use Map

Staging

Open Staging. The terminals in this report have a total of 409 acres of paved open staging. Open staging is used for containers and general cargo.

Terminal	Staging Acres
Columbus Street	15
Union Pier	69
North Charleston	130
Wando Welch	195

Open Staging at Berth 3 of the North Charleston Terminal (Northeastward view)

Covered Staging. The terminals of this report have about 20 buildings with more than 1-1/2 million square feet of covered storage. Other buildings are set up for manufacturing, passenger, or repair operations, and would not support military operations.

Rail

Rail trackage links the railyards to the port's apron tracks, transit sheds, and storage tracks. The South Carolina Public Railway Commission performs switching. Norfolk Southern (NS) and CSX provide rail service. Three major railyards are in the port area and two of them are 2 miles southwest of the North Charleston Terminal.

Abrams Tanks Ready for Offloading
During Desert Storm, at North Charleston Terminal

Unloading/loading Positions

Ramps. The only fixed rail end ramp is at the South Atlantic Outport, just north of the North Charleston Terminal. At least two portable rail end ramps are available from local stevedore and rental companies that can be used at any of the terminals. Several locations can support portable end ramp operations.

Portable Rail End Ramps

Docks. Altogether, the terminals have about 385 truck handling positions and 7,900 linear feet of track for boxcar operations.

Truck Docks at Wando Welch Container Freight Station

Marshaling Areas

Within port. There are no marshaling areas within the port area. All open area within the port is required for staging military or commercial cargo. Just north of the North Charleston Terminal, however, is the MTMC South Atlantic Outport (SAO). This facility has about 85 acres of open area available for marshaling. The MTMC SAO is often used to support ammunition loading.

Navy Base. Between the Columbus Street and North Charleston Terminals is a closing Navy base with about 1,500 acres that could be used for marshaling. Plans in accordance with President Clinton's policy to revitalize communities include private shipbuilding and repair, other heavy industry, and housing for the homeless. In spite of the overall size of the base, the landfill may be the only open area that will remain available for future marshaling. About 25 acres of grass covered open area can be used to marshal military vehicles.

MATERIAL HANDLING EQUIPMENT (MHE)

The terminals have a total of 18 container cranes. Half of these are at the Wando Welch Terminal. The Union Pier Terminal has no rail-mounted cranes at all. The port owns and operates all the MHE in the chart below.

Although our throughput analysis does not account for the floating RORO ramp, the portable ramp can greatly increase RORO shipping throughput. The ramp can handle vehicles up to 100 tons and can operate at any of the four terminals, with less than a day's notice. The ramp is designed to allow two ships to rapidly load or discharge RORO cargo onto it at the same time, at any tidal condition.

Floating RORO ramp

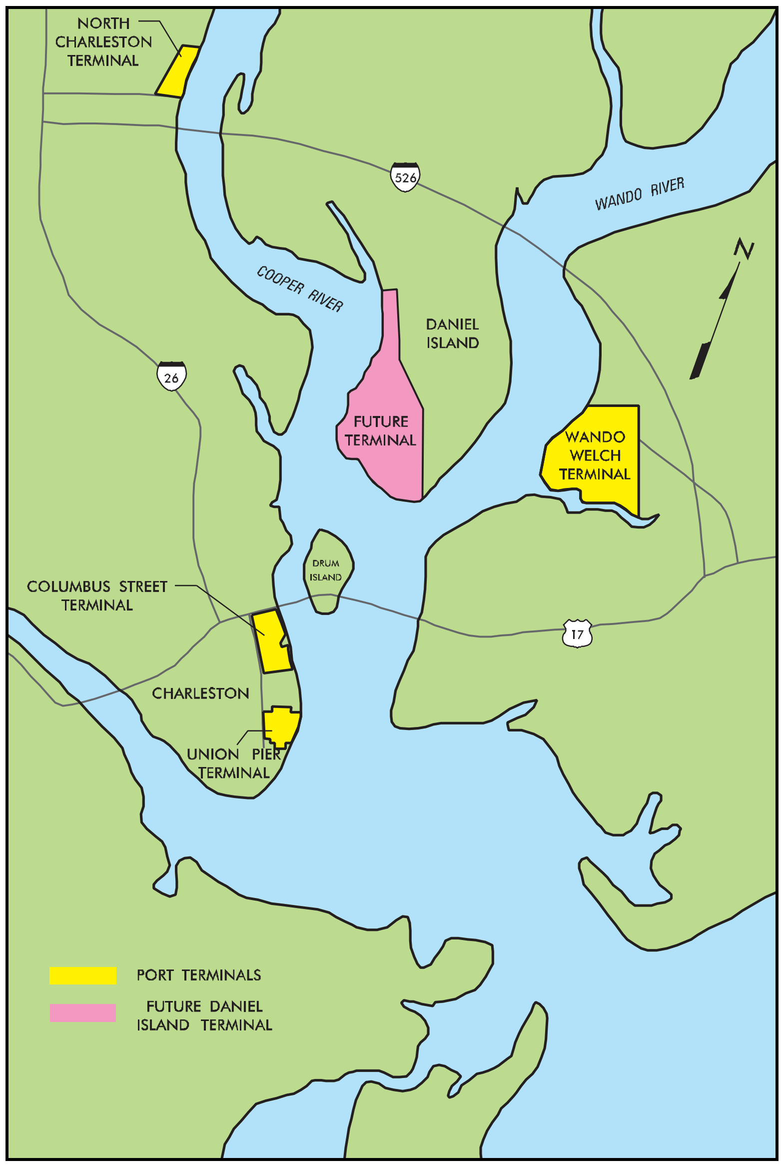
TYPE OF EQUIPMENT	CAPACITY (STONS)	QTY
Container Handlers	40	32
Transtainers	33-44	7
Mobile Cranes	30-150	3
Floating Cranes	67	1
Floating RORO Ramp	100	1

INTERMODAL FACILITIES

The North Charleston Terminal has an onsite intermodal yard with two 1,200-foot spurs. Container handlers regularly offload containers from double stack railcars directly inland of berth 3. Both CSX and NS have intermodal yards in the Charleston area. The Columbus Street Terminal also has an intermodal area, approximately 1,200 linear feet, that is now regularly handling containers to and from double stack railcars.

FUTURE DEVELOPMENT

The port hopes to develop 800 acres of land on the southwest section of Daniel Island. This island, between Wando Welch and North Charleston Terminals, will be developed in phases. Eventually, the port expects CSX and/or NS to provide double stack service to the new container facility. Trucks will have easy access to I-526.

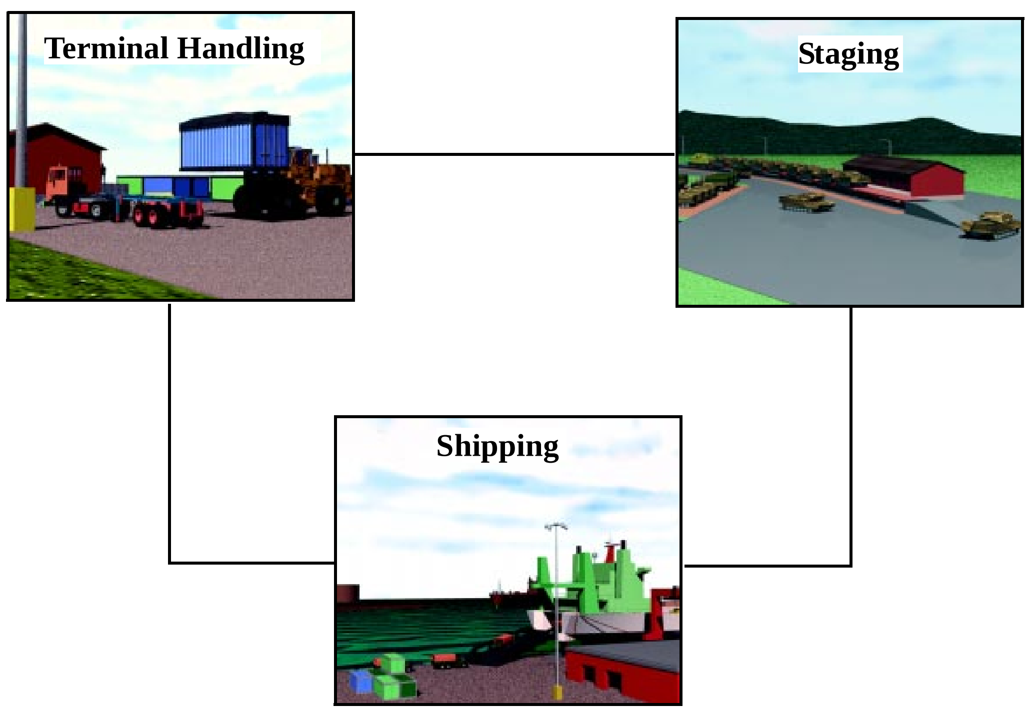


Future Daniel Island Terminal

II. THROUGHPUT ANALYSIS

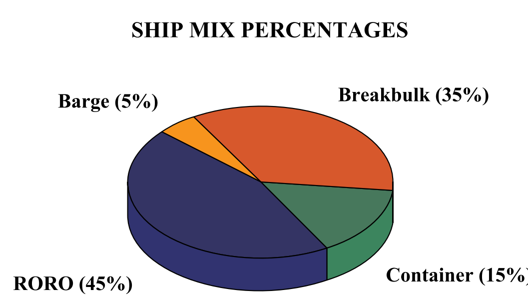
GENERAL

This section evaluates the throughput capability of the Port of Charleston using the port operational performance simulator (POPS) computer model. The model is based on a weak- link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



Terminal Throughput Subsystems

This analysis assumes a maximum of 80 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL RECEPTION/HANDLING

Highway

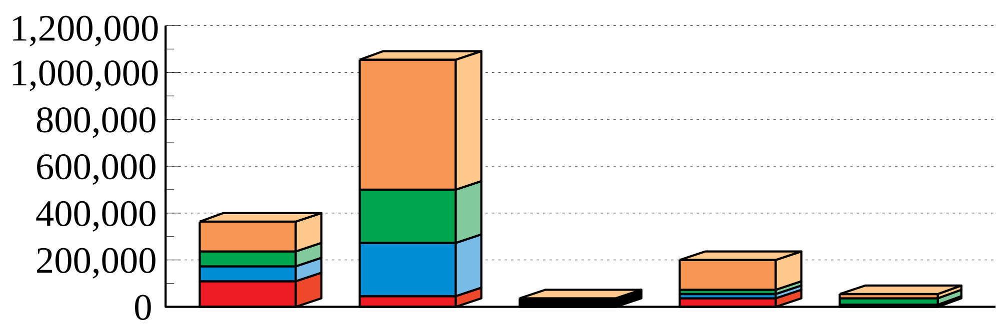
I-26 and -526 provide access to the port terminals. Each terminal has a designated entrance for trucks. The road network in and out of the terminals, including the gate processing of vehicles, could handle about 290,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable ramps. There are no permanent truck end ramps at any of the terminals. Our analysis assumes the port can acquire or build two portable or temporary truck ramps at each of the four terminals. These ramps could offload more than 38,000 MTON from flatbed trailers per day.

Supplies in van semitrailers will proceed to roughly 220 van-handling positions. These docks can offload more than 198,000 MTON of van semitrailer-shipped materials per day. This report assumes there are 10 rented container handlers for chassis operations that can offload about 53,000 MTON of chassis cargo per day.

HIGHWAY RECEPTION / HANDLING CAPABILITY

MTON / DAY



SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS*	DOCKS	CONTAINERS**
COLUMBUS STREET	110,000	45,000	9,600	38,000	11,000
UNION PIER	57,000	230,000	9,600	19,000	0
NORTH CHARLESTON	73,000	230,000	9,600	13,000	20,000
WANDO WELCH	120,000	550,000	9,600	128,000	22,000

*8 portable or temporary ramps are assumed available.

**10 container handlers are assumed available.

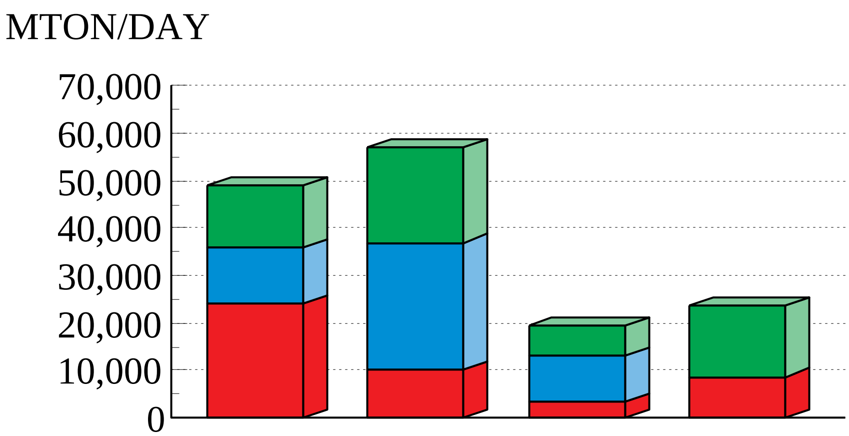
Rail

Rail reception at the port is good with two major railroad companies accessing Charleston. The North Charleston Terminal has the best rail facilities. There are no tracks accessing the Wando Welch Terminal. This analysis assumes the port can rent, build, or provide six portable or temporary rail end ramps. These would be placed at tangential tracks 500 to 1,500 feet long. Columbus Street Terminal could support a 1,500-foot track at the inland railyard or along the apron.

Terminal	Train Length (railcars)	Trains Per Day
Columbus Street	60	4
Union Pier	60	2
North Charleston	60	2
Wando Welch	-	-

Boxcars could offload at the transit sheds where about 135 boxcar handling positions are available.

RAIL RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	TRACKAGE	END-RAMPS*	DOCKS	COFC**
COLUMBUS STREET	24,000	10,000	3,300	8,700
UNION PIER	12,000	27,000	9,800	0
NORTH CHARLESTON	13,000	20,000	6,500	15,000
WANDO WELCH	0	0	0	0

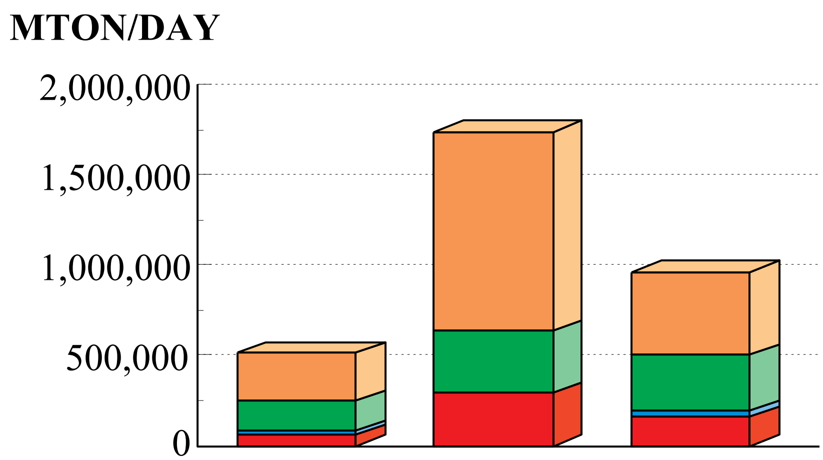
*6 portable or temporary ramps are assumed available.

**6 container handlers are assumed available.

STAGING

The terminals of this report have a total of about 400 acres of open paved staging. There is also more than 1-1/2 million square feet of covered storage.

OPEN STAGING CAPABILITY



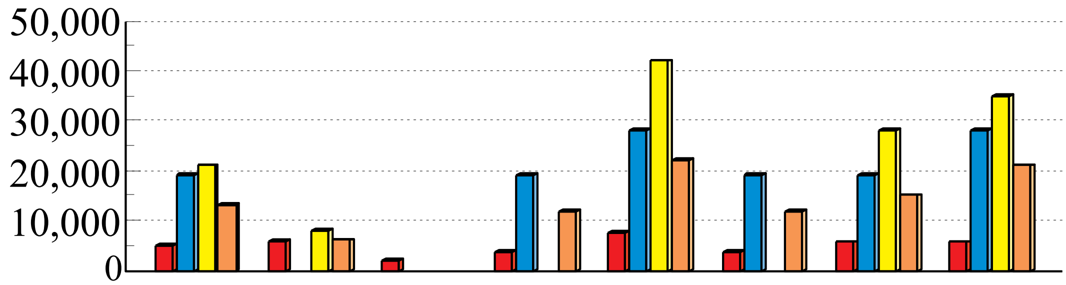
VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
COLUMBUS STREET	64,000	290,000	160,000
UNION PIER	19,000	0	37,000
NORTH CHARLESTON	170,000	350,000	310,000
WANDO WELCH	260,000	1,100,000	460,000

SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used, loading, operational, and berth usage rates, as well as berth/ship compatibility.

BERTH THROUGHPUT CAPABILITY

MTON/DAY



BERTH	C1-2	C3-4	U1-2	U3-4	N1-3	MTMC	W1-2	W3-4
BREAKBULK	4,900	5,900	1,900	3,800	7,500	3,800	5,600	5,600
RORO	19,000	0	0	19,000	28,000	19,000	19,000	28,000
CONTAINER	21,000	8,000	0	0	42,000	0	28,000	35,000
MIXED	13,000	6,100	0	12,000	22,000	12,000	15,000	21,000

C = Columbus Street U = Union Pier
N = North Charleston W = Wando Welch

CONVERSION FACTORS	
Breakbulk	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON

The type of ship preferred at each berth is based on the methodology described in Appendix B. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation to the right gives no considerations for enhancements, such as equipment. The floating RORO ramp was not considered. If it is available for military operations, it would greatly improve RORO loading at any of the berths. The lower the number for a berth, the better the berth is suitable for the loading operation.

The Wando Welch berths are well suited for loading any type of ship. They are highly rated on the chart because of the cranes, container freight station, and age. However, when rail access is considered, the Columbus Street Terminal berth 1-2 is the best choice for military operations. Furthermore, the Wando Welch aprons are 16 feet above MLW. This prevents fully RORO loading an FSS with dense cargo (such as ammunition) at low tide.

FSS operations are recommended at Columbus Street Terminal berth 1-2, Union Pier Terminal berth 3-4, North Charleston Terminal berth 1-3, and any Wando Welch berth. Because of their stern ramps, we believe LMSRs will be able to load at any Port of Charleston berth in this report except Union Pier Terminal berth 1-2. The buildings and weak pavement of this berth restrict all RORO loading.

PREFERENCE BERTH SELECTION

Berth	BB	RORO	CNTNR
Columbus Street			
1-2	3	1	4
3-5	4	-	5
Union Pier			
1-2	7	-	-
3-4	6	5	-
North Charleston			
1-3	5	5	1
MTMC	8	4	-
Wando Welch			
1-2	2	2	3
3-4	1	2	2

SUMMARY OF BERTHING CAPABILITIES OF COLUMBUS STREET AND UNION PIER TERMINALS				
Vessel	Berths C = Columbus Street U = Union Pier			
	C1-2	C3-5	U1-2	U3-4
Breakbulk				
C3-S-33a	3	3	1	2
C3-S-37c2	3	3	1	2
C3-S-37d	3	3	1	2
C3-S-38a	3	3	1	2
C4-S-1a	2	3	1	2
C4-S-1qb and 1u	2	3	1	2
C4-S-58a	2	3	1	2
C4-S-65a	2	3	1	2
C4-S-66a	2	3	1	2
C4-S-69b	2	3	1	2
Seatrain				
GA and PR-class	2	3	1	2
Barge				
LASH C8-S-81b	1	2	1	1
LASH C9-S-81d	1	2	1	1
LASH lighter	11	14	7	10
SEABEE C8-S-82a	1	2	1	1
SEABEE barge	8	10	5	7
RORO				
Comet	d,i,j	d,o	d,o	d,i,j
C7-S-95a/Maine-class	2	b	b	1
Ponce-class	h	b,h	b,h	h
Great Land-class	h	b,h	b,h	h
Cygnus/Pilot-class	2	b	b	2
Meteor	d,i,j	d,o	d,o	j,i,j
AmEagle/Condor	i,j	b	b	i,j
MV Ambassador	d	d	d	d
FSS-class	l	b	b	l
Cape D-class	i,j	b	b	i,j
Cape H-class	2	b	b	l
LMSR	l	b	b	l
Container				
C6-S-lw	2	2,e	1,e	2,c
C7-S-68e	2	2,e	1,e	2,e
C8-S-85c	1	2,e	1,e	1,e
Combination				
C5-S-78a	2	3,e	1,e	2,e
C5-S-37e	2	3,e	1,e	2,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF NORTH CHARLESTON AND WANDO WELCH TERMINALS

Vessel	Berths N = North Charleston		W = Wando Welch	
	N1-3	N-MTMC	W1-2	W3-4
Breakbulk				
C3-S-33a	4	2	3	3
C3-S-37c2	4	2	3	3
C3-S-37d	4	2	3	3
C3-S-38a	4	2	3	3
C4-S-1a	4	2	3	3
C4-S-1qb and 1u	4	2	3	3
C4-S-58a	4	2	3	3
C4-S-65a	4	2	3	3
C4-S-66a	4	2	3	3
C4-S-69b	4	2	3	3
Seatrain				
GA and PR-class	4	4	2	3
Barge				
LASH C8-S-81b	2	1	2	2
LASH C9-S-81d	2	1	1	2
LASH lighter	17	10	12	14
SEABEE C8-S-82a	2	1	1	2
SEABEE barge	12	7	8	10
RORO				
Comet	d,i,j	d,i,j	d,i,j	d,i,j
C7-S-95a/Maine-class	3	1	2,i	2i
Ponce-class	h	h	h	h
Great Land-class	h	h	h	h
Cygnus/Pilot-class	3	2	2,i	3,i
Meteor	d,i,j	d,i,j	d,i,j	d,i,j
AmEagle/Condor	i,j	i,j	i,j	i,j
MV Ambassador	d	d	d	d
FSS-class	2	1,n	1,i	2,i
Cape D-class	i,j	i,j	i,j	i,j
Cape H-class	2	1	2,i	2,i
LMSR	2	1,n	1,i	2,i
Container				
C6-S-lw	3	2,e	2	2
C7-S-68e	3	2,e	2	2
C8-S-85c	2	1,e	1	2
Combination				
C5-S-78a	3	2,e	2	3
C5-S-37e	3	2,e	2	3

a=vessel draft limited to berth depth
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Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

III. APPLICATION

GENERAL

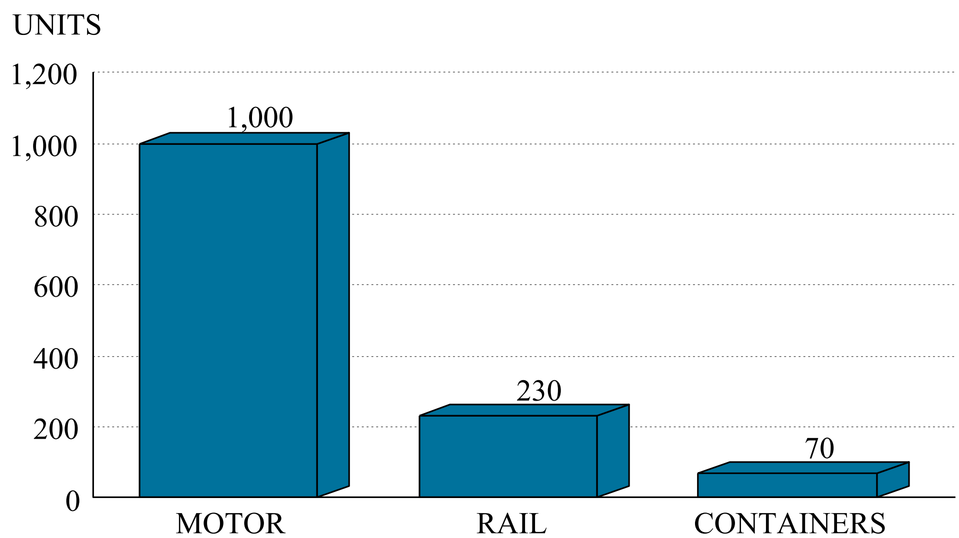
This section of the report will evaluate the port's throughput capability for deploying elements of the XVIIIth Airborne Corps, Corps Support Command from Fort Bragg, North Carolina using primarily FSS vessels, in 6 days of reception and handling. The August 1994 revision for the ***Planning Orders Digest***, issued by MARAD, provided agreements for military use of the Port of Charleston. These agreements have been renewed until 15 June 1996. The Planning Orders call for the use of the following facilities at the North Charleston Terminal: 20 acres open staging and berths 1, 2, and 3 (total 2,430 feet of berthing). The South Atlantic Outport (SAO) is adjacent to the North Charleston Terminal.

REQUIREMENTS

Units making up this "Corps Slice" of the XVIIIth Airborne Corps remain unidentified. For this analysis, we assume the unit will require 6,000 vehicles by convoy (1,000 per day), 1,380 railcars (230 per day), and 420 containers (70 per day).

Three FSS-sized vessels will load simultaneously. Each sustained loading operation will conduct three shiploading cycles, for a total of nine FSS-sized shiploads.

DAILY REQUIREMENTS

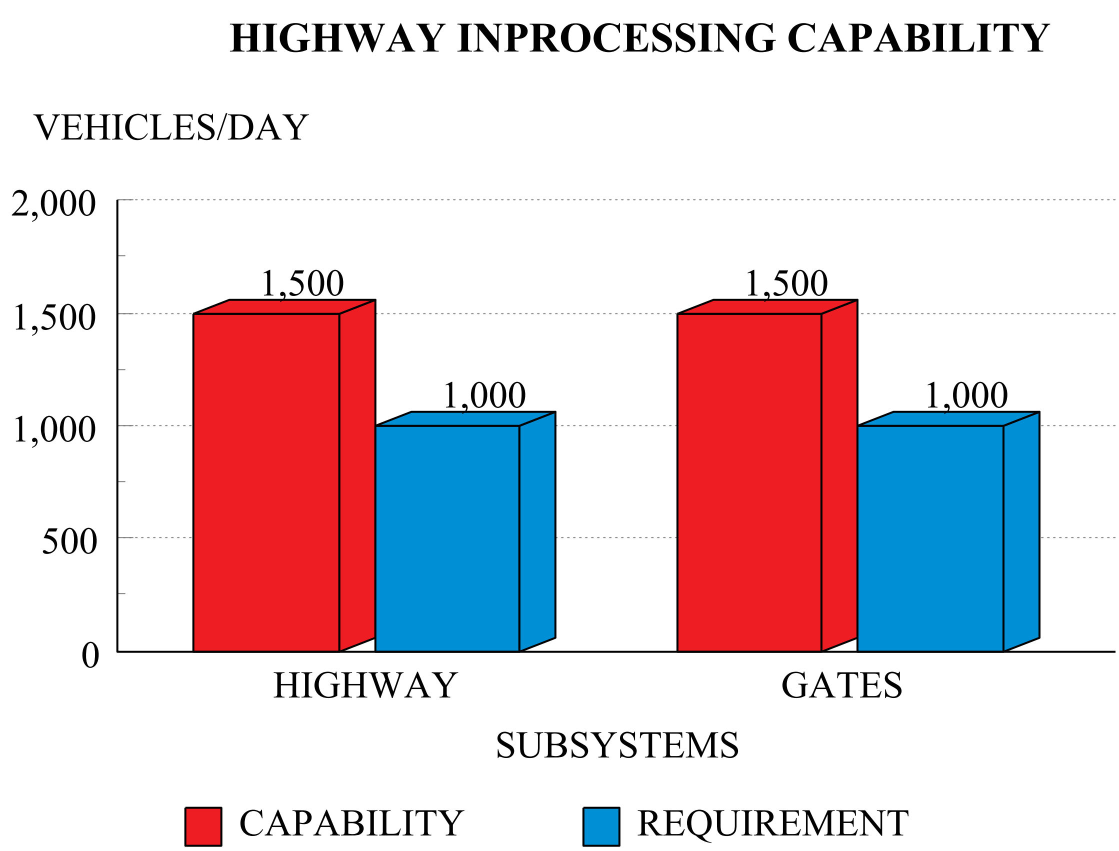


TERMINAL INPROCESSING/HANDLING

Highway

Terminal operators at the North Charleston Terminal should open either of the two gates on Remount Road, directly accessible from Interstate Routes 26 and 526. Depending on the available staging at the time of deployment, convoys would enter the SAO gate or the North Charleston Terminal gate. An exclusive gate between the two areas allows vehicles to traverse from one facility to the other. Remount Road and these two gates can easily handle 1,500 vehicles per day without causing significant delays in traffic. This meets the 1,000 vehicle per day requirement..

As convoys arrive, support personnel account for the vehicles and send them to staging areas or directly to shipside for loading. They direct non-roadable equipment arriving by commercial or military truck or on flatbed trailer to the container stuffing station for unloading and subsequent staging.



Rail

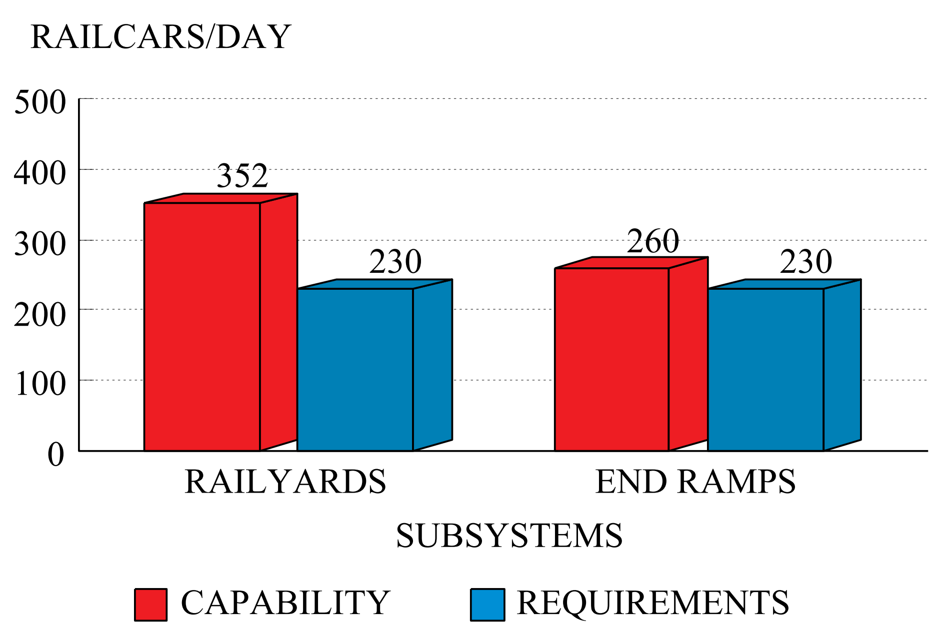
Two major railroads serve the North Charleston Terminal, the Norfolk Southern and the CSX. The North Charleston Terminal can accommodate and unload more than 50 each, 89-foot railcars per cycle. The terminal's general manager states that they can unload four blocks of cars daily. for a total of 200+ cars per day. The SAO's tracks can hold 76, 89-foot railcars. The railroads normally spot a block of cars at the outport at night for working the next day. Providing adequate support by the railroads, the outport can unload at least two blocks of cars or 152 cars per day.

SAO unloads railcars at two ramp positions. The first is located at the foot of "A" track, which is about 2,700 feet long. The second is a ramp on "F" track, which is about 1,800 feet long.

The North Charleston Terminal uses two heavy duty portable ramps rated at 90-tons for unloading wheeled vehicles and tracks from railcars. The terminal places these ramps wherever they choose to do rail offload operations. The two spurs in the open area near berth 3 are each about 1,000 feet long.

Assuming four cycles at each ramp per day, the North Charleston Terminal and SAO together can support offloading about 260 railcars per day.

RAIL INPROCESSING AND HANDLING CAPABILITY



STAGING

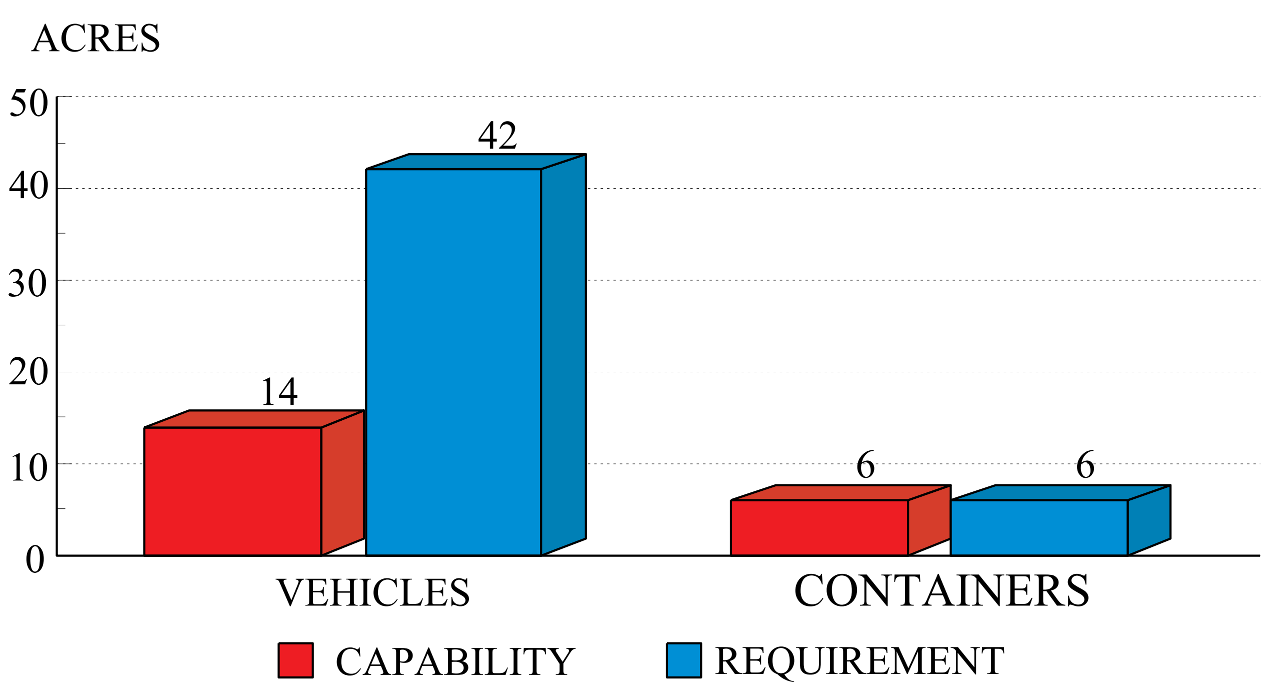
This analysis assumes that nine FSS-sized ships will deploy the unit. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations.

Although an FSS-load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for the staging of the 46 containers for each FSS. The three simultaneous ship loading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers.

The North Charleston Terminal has approximately 185 acres of open staging area. This space is normally used to store/stage containers. About 30% of this area (about 55 acres) is likely to be immediately available to support military deployments.

The South Atlantic Outport (SAO) has more than 85 acres of open area that can be used for staging equipment. We expect the availability of most of SAO's staging area. The staging area at the North Charleston Terminal and the SAO total 140 acres. This exceeds the 48 acres needed to support three FSS/LMSR vessel operations. However, the 20 acres provided in the Planning Orders do not meet the requirements.

OPEN STAGING CAPABILITY

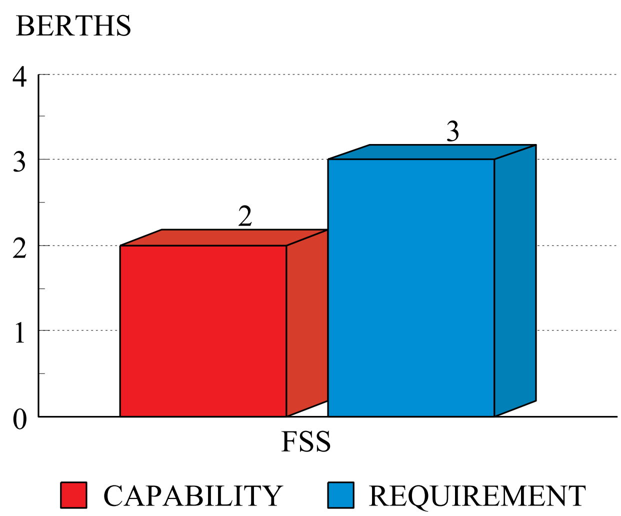


SHIPPING

Although this analysis assumes that nine FSS-sized ships can deploy the unit, the number of ships required depends on the shipping mix selected. The best ship mix would consist of all eight FSS ships, plus one Cape H RORO ship.

The requirement is to work three FSS- or LMSR-sized ships concurrently. Berths 1-3 at the North Charleston Terminal can accommodate two of these ships and the SAO can accommodate one. Together the two facilities can fully support the requirement. However, the 2,430 feet of apron provided in the Planning Orders do not meet the requirement.

FSS SHIPPING CAPABILITY



SUMMARY

The combination of the North Charleston Terminal and the South Atlantic Outport has adequate characteristics to support the deployment of the units. The Planning Orders alone are insufficient.

RECOMMENDATION

In addition to the facilities provided in the Planning Orders, we recommend the military negotiate for the following facilities:

- Berthing for an additional FSS sized vessel
- Staging area of an additional 28 acres
- 5,800 feet of tangential track for rail offloading operations
- 2 to 4 rail end ramps depending on number of spurs

March 96

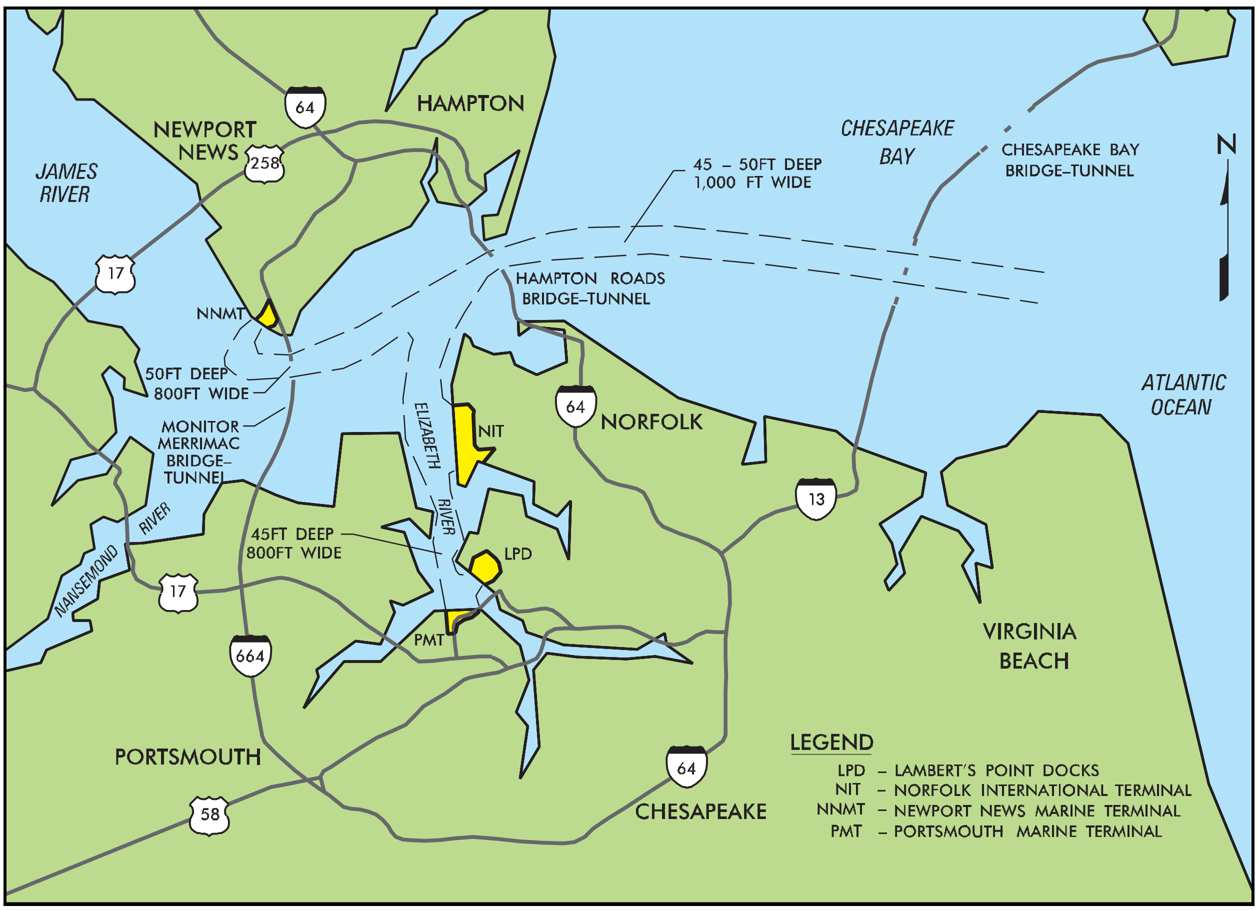
PORT OF HAMPTON ROADS, VA

I. GENERAL DATA

TRANSPORTATION ACCESS

Water

Entry to the deep waters of Hampton Roads is between the Virginia Capes at the lower end of the Chesapeake Bay. The Thimble Shoal entry channel is 50 feet deep by 1,000 feet wide. From Hampton Roads, the 19.6-mile-long southward channel leads to Norfolk International Terminal (NIT), Lambert's Point Docks (LPD), and Portsmouth Marine Terminal (PMT). The southward channel is 50 feet deep by 1,500 feet wide to just south of NIT, where it reduces to 800 feet wide. The 4.8-mile-long northward channel leads to the Newport News Marine Terminal (NNMT). The Newport News Channel is 800 feet wide by 50 feet deep. The mean tides range from 2.5 to 2.8 feet.

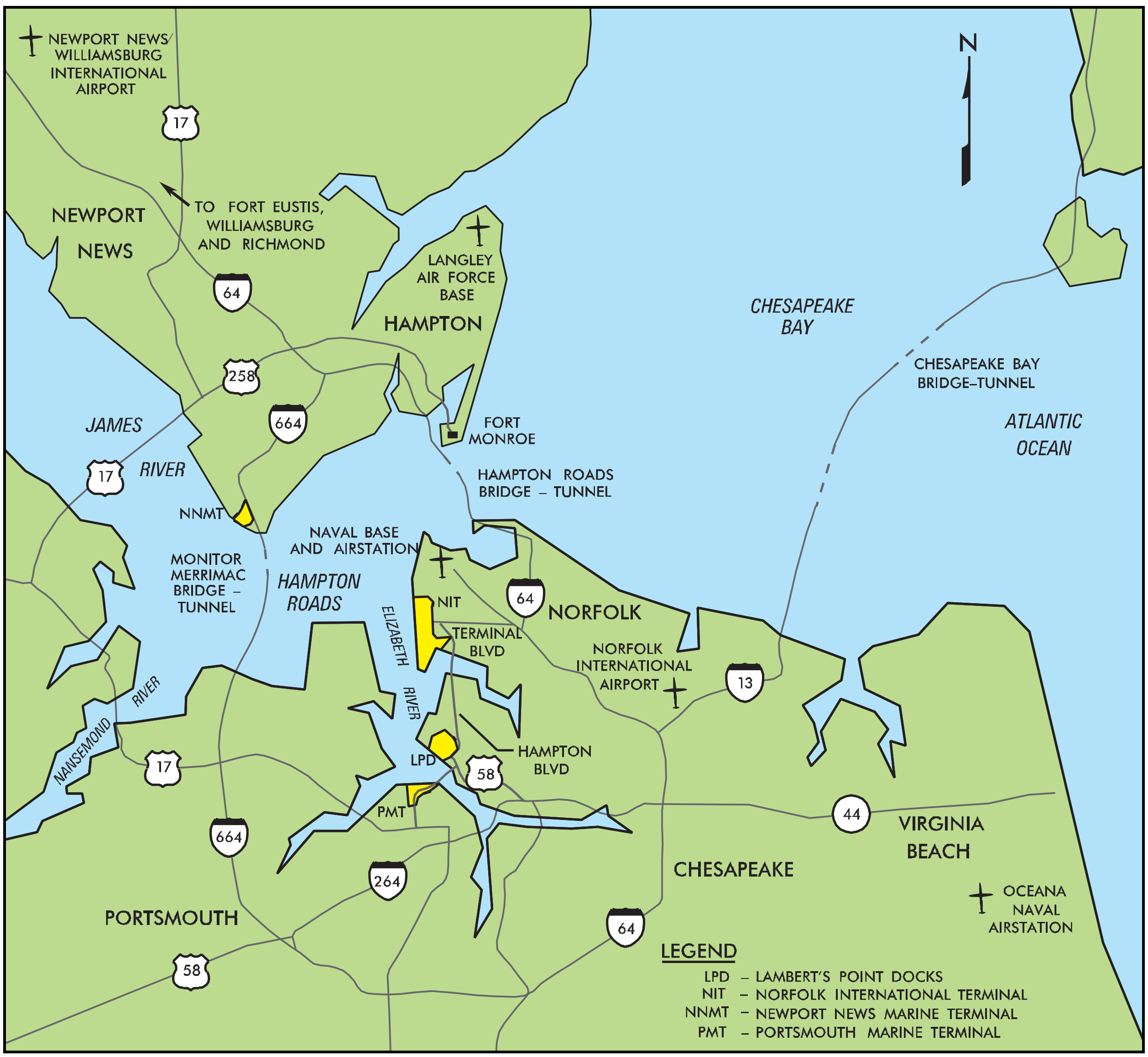


Water Access

Highway

Interstate Routes 64 and 664 (I-64/-664) serve the Hampton Roads terminals. NNMT has direct access to I-664. NIT connects to Terminal Boulevard, which provides direct access to I-64. From NIT to I-64 is less than 5 miles. LPD accesses two local streets, Orapax Street and Raliegh Avenue, to reach Hampton Boulevard, a four-lane road. Hampton Boulevard provides access to Terminal Boulevard to the north or State Route 58 to the south. Traffic follows State Route 58 to Interstate 264 (I-264).

PMT traffic accesses State Route 58 to reach I-264. I-264 provides access to I-664 to the west and I-64 to the east.



Highway Access

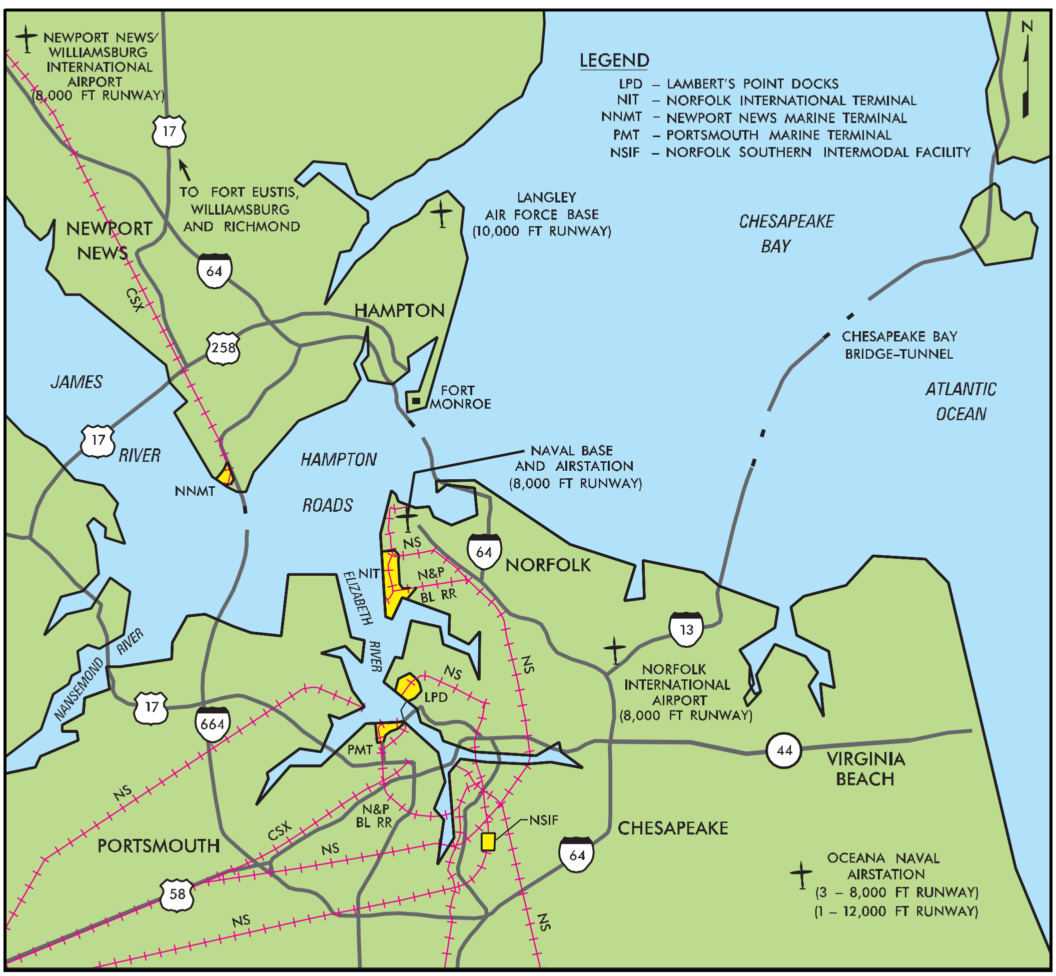
Rail

Three companies comprise the Hampton Roads rail network: Norfolk Southern Corporation (NS), CSX Transportation Inc. (CSX), and the Norfolk and Portsmouth Belt Line Railroad (N&P BL RR). Shipside rail service is available at all four terminals.

CSX provides rail service to NNMT. No interconnecting railway exists between NNMT and the other three terminals. NIT rail access consists of a direct connection with the Norfolk Southern Corporation. CSX serves NIT via the N&P BL RR. NS provides rail service to LPD. PMT rail access consists of a direct connection with CSX and service by NS via the N&P BL RR.

Airports

Newport News/Williamsburg International Airport and Langley Air Force Base are the air receiving sites for NNMT. Norfolk International Airport and Norfolk Naval Air Station support NIT, LPD, and PMT.



Rail and Air Access

PORT FACILITIES

Berthing

This report covers four terminals. The terminals are: Newport News Marine Terminal (NNMT), Norfolk International Terminal (NIT), Lamberts Point Docks (LPD), and Portsmouth Marine Terminal (PMT). These terminals are a mixture of breakbulk and container facilities consisting of marginal wharves and finger piers. Some facilities have transit sheds on the piers to support conventional breakbulk cargo.

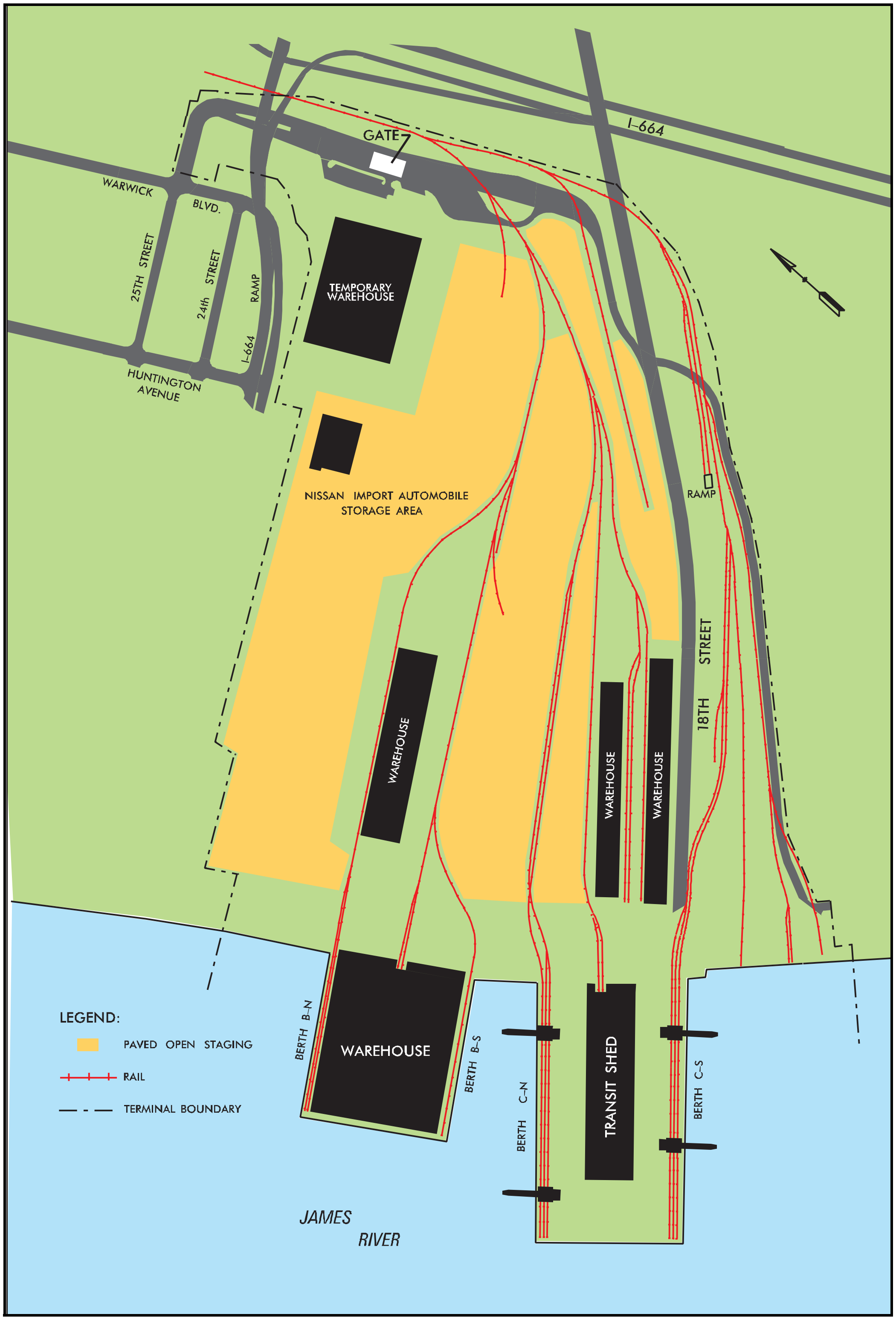
Pier construction varies from terminal to terminal. Many of the terminals have apron tracks as well as wharf and/or container cranes. Water depth ranges from 28 to 40 feet MLW.

This section contains land-use maps and aerial views of the terminals. Also included are tables identifying the berth characteristics.

BERTHING CHARACTERISTICS OF NEWPORT NEWS MARINE TERMINAL

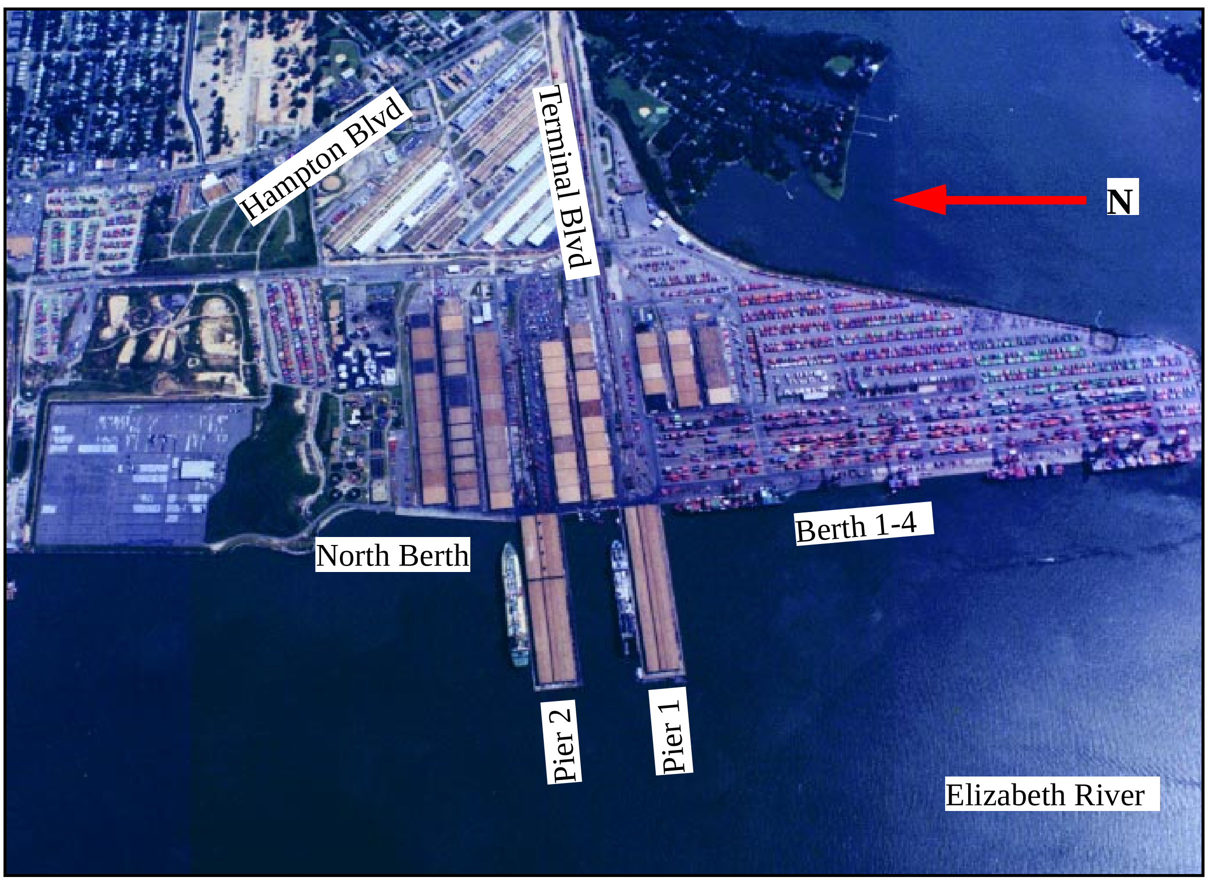
Characteristics	Berths			
	B-N	B-S	C-N	C-S
Length (ft)	620	620	960	960
Depth alongside at MLW (ft)	28	34	40	40
Deck strength (psf)	750	750	750	750
Apron width (ft)	34	34	Open	Open
Apron height above MLW (ft)	13.2	13.2	13.2	13.2
Number of container cranes	0	0	2	2
Number of wharf cranes	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	Yes
Apron length served by rail (ft)	620	620	780	960

Newport News Marine Terminal

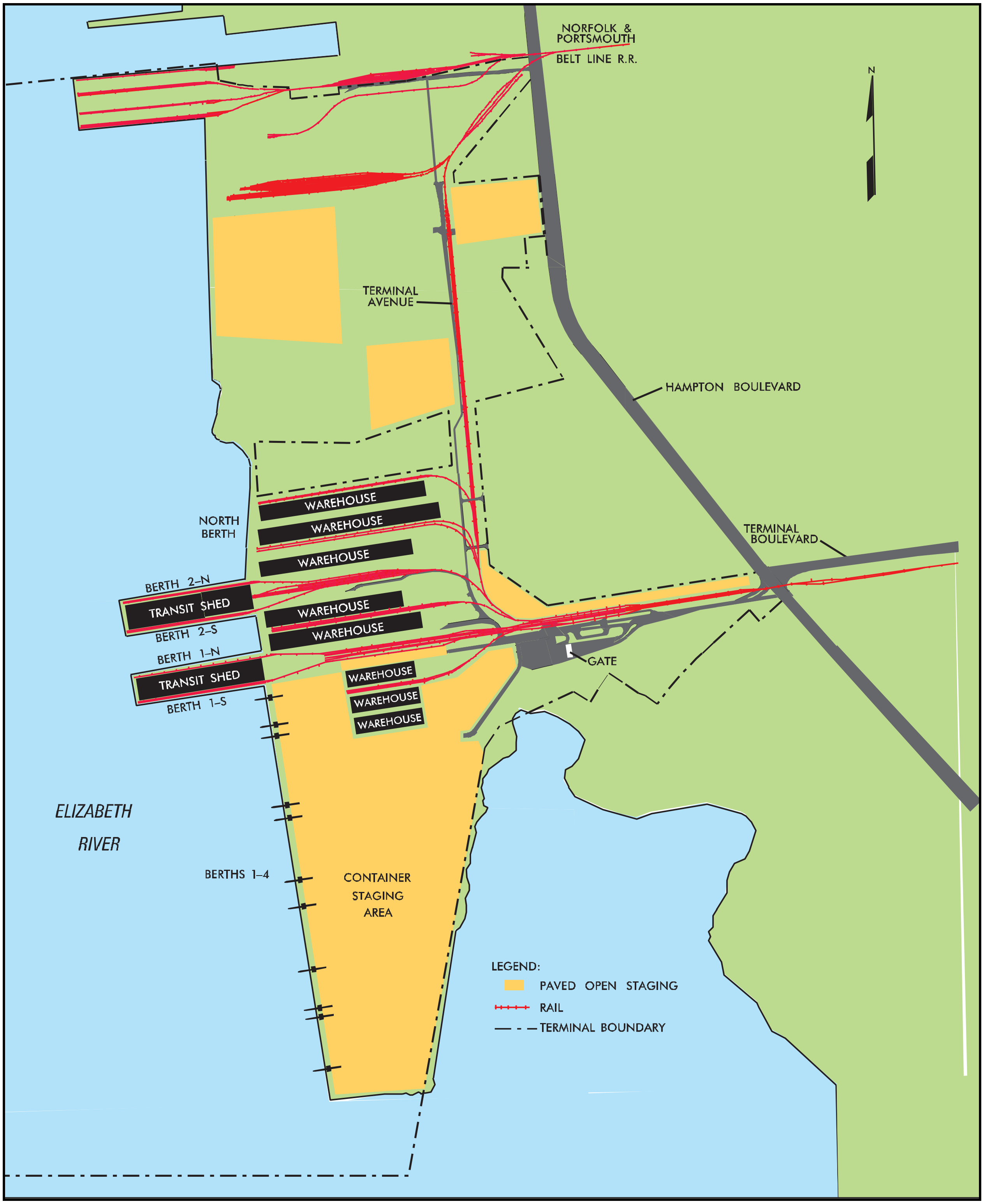


Newport News Marine Terminal Land-Use Map

BERTHING CHARACTERISTICS OF NORFOLK INTERNATIONAL TERMINAL						
Characteristics	**Berths**					
	1-4	**1-S**	**1-N**	**2-S**	**2-N**	**North Berth**
Length (ft)	4,230	1,328	1,328	1,328	1,328	900
Depth alongside at MLW (ft)	39	37	37	33	33	36
Deck strength (psf)	750	750	750	750	750	750
Apron width (ft)	Open	40	40	40	40	80
Apron height above MLW (ft)	9	9	9	9	9	9
Number of container cranes	7	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	Yes	Yes	Yes	Yes	No
Apron length served by rail (ft)	0	1,320	1,320	1,320	1,320	900



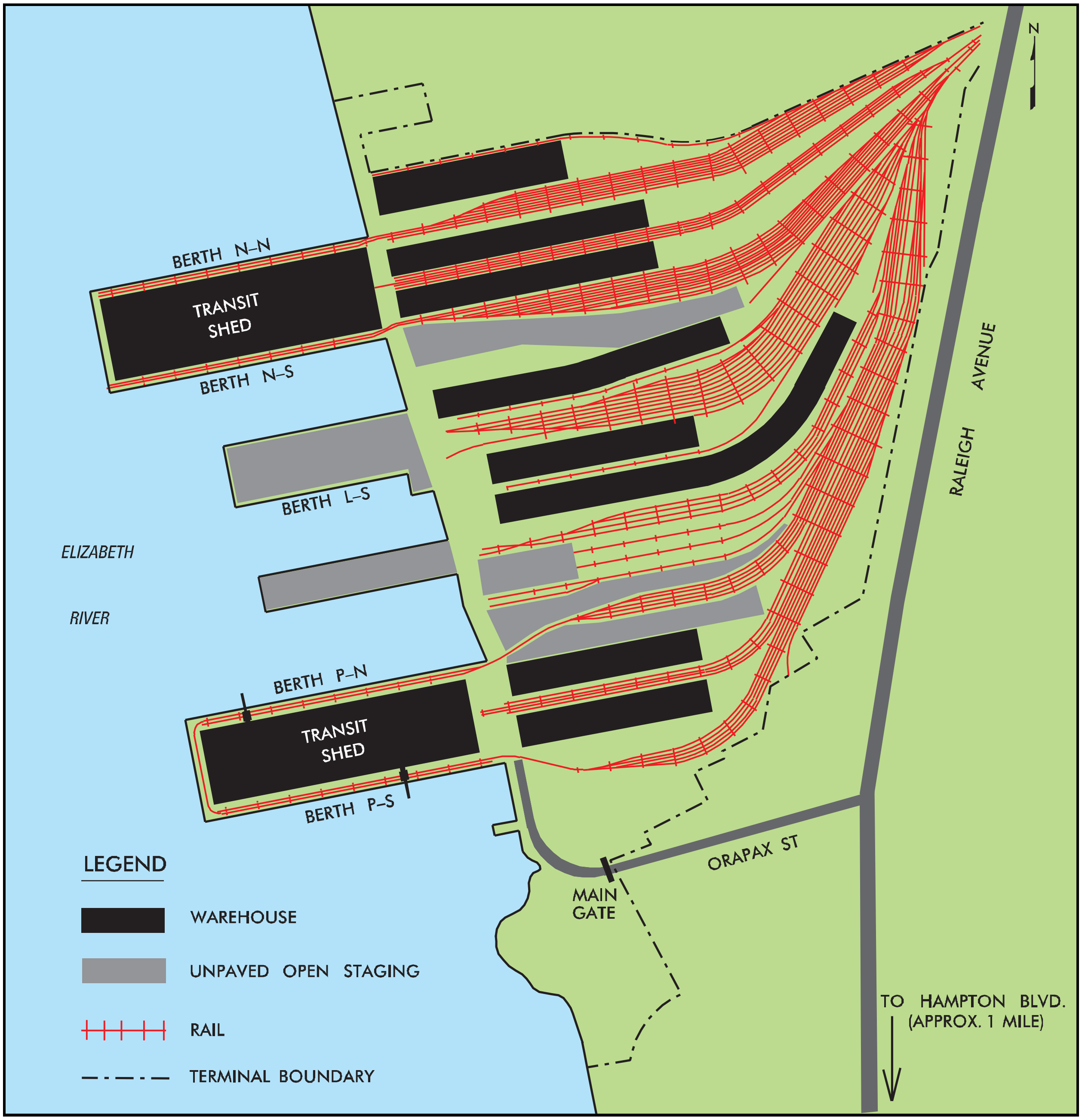
Norfolk International Terminal



Norfolk International Terminal Land-Use Map

BERTHING CHARACTERISTICS OF LAMBERT'S POINT DOCKS TERMINAL					
Characteristics	**Berths**				
	N-S	**N-N**	**L-S**	**P-S**	**P-N**
Length (ft)	1,100	1,100	725	1,200	1,200
Depth alongside at MLW (ft)	32	32	32	32	32
Deck strength (psf)	750	750	650	700	700
Apron width (ft)	35	35	Open	43	43
Apron height above MLW (ft)	11	11	9	11	11
Number of container cranes	0	0	0	0	0
Number of wharf cranes	0	0	0	1	1
Apron lighting	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	Yes	Yes
Apron length served by rail (ft)	1,100	1,100	0	1,200	1,200

Lamberts Point Docks (Southward view)

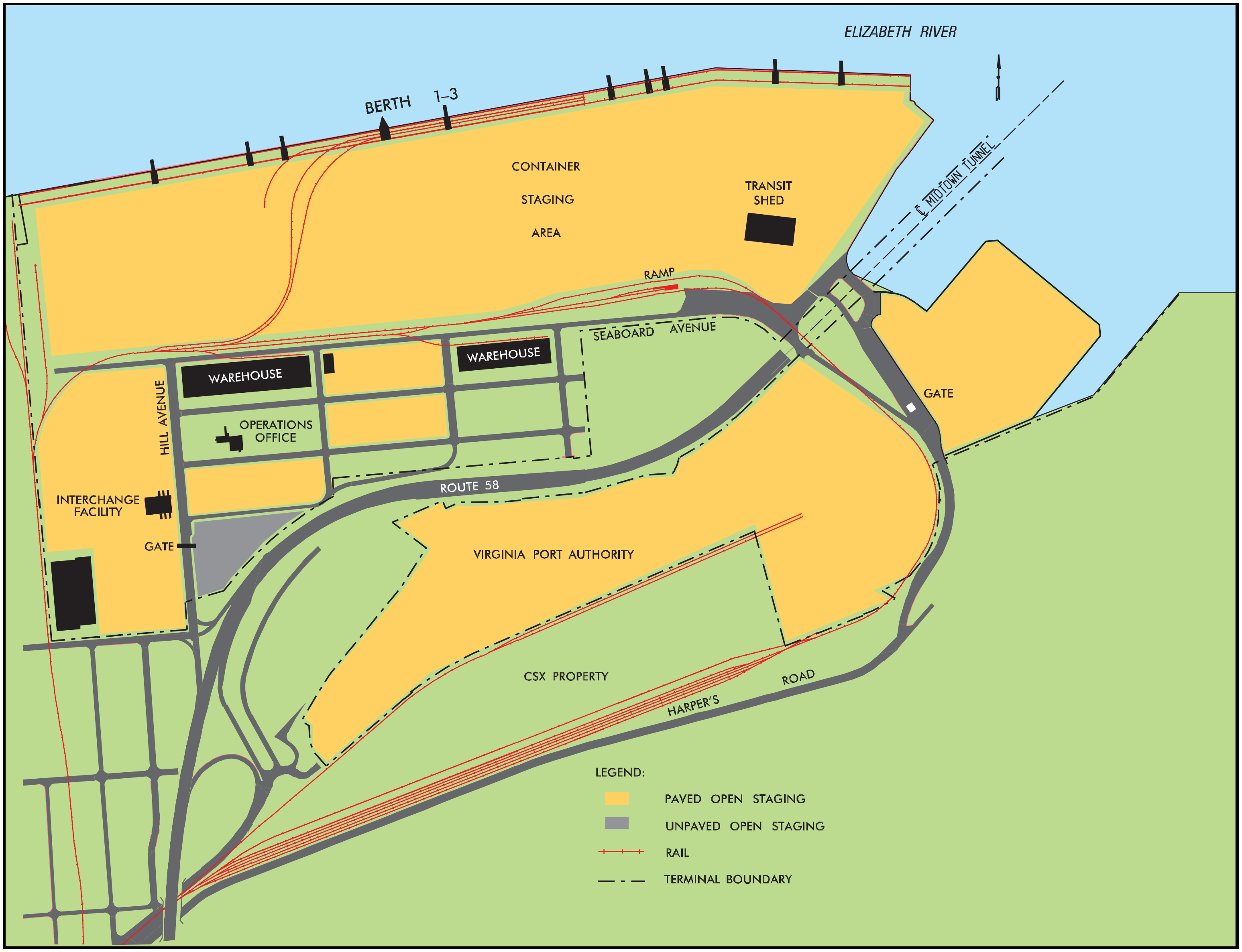


Lamberts Point Docks Land-Use Map

BERTHING CHARACTERISTICS OF PORTSMOUTH MARINE TERMINAL

Characteristics	Berths
	1-3
Length (ft)	3,540
Depth alongside at MLW (ft)	40
Deck strength (psf)	750
Apron width (ft)	Open
Apron height above MLW (ft)	12
Number of container cranes	5
Number of wharf cranes	1
Apron lighting	Yes
Straight-stern RORO facilities	Yes
Apron length served by rail (ft)	2,200

Portsmouth Marine Terminal



Portsmouth Marine Terminal Land-Use Map

Staging

Open Staging. The terminals in this report have a total of 432 acres of open staging, of which 357 acres are paved. Helicopter operations are possible in open storage areas at NNMT, NIT, and PMT. Staging area locations at each terminal are identified below.

Covered Staging. The terminals have a total of 28 covered storage facilities (transit sheds and warehouses) that provide about 3,696,000 square feet of storage. The table below identifies the location of staging areas by terminal.

STAGING AREAS			
TERMINAL	**COVERED (SQ. FT)**	**OPEN PAVED (ACRES)**	**OPEN GRAVEL (ACRES)**
NEWPORT NEWS MARINE TERMINAL	906,000	40	0
NORFOLK INT.TERMINAL	1,025,000	220	0
LAMBERT'S POINT DOCKS	1,605,000	0	25
PORTSMOUTH MARINE TERMINAL	160,400	147	0

Covered Staging at Lamberts Point Docks (eastward view)

Rail

CSX and Norfolk Southern provide service to the four terminals. Rail trackage links the railyards to the terminal's apron tracks, transit sheds, and storage tracks. All the rail serving the terminals is in good condition with no operating restrictions. There are numerous locations that could support offloading with temporary or portable ramps. The table below provides characteristics of the rail facilities at each terminal.

RAIL CHARACTERISTICS				
TERMINAL	**TERMINAL TRACK (FT)***	**STORAGE CAPACITY (89-FT RAIL-CARS)****	**RAMPS (#)**	**DOCK POSITIONS**
NEWPORT NEWS MARINE TERMINAL	20,000	90	NONE	19
NORFOLK INT. TERMINAL	80,000	690	PERMANENT (3)	40
LAMBERT'S POINT DOCKS	130,600	1100	PERMANENT (3)	68
PORTSMOUTH MARINE TERMINAL	6,300	43	PORTABLE (3)	0
* Excluding apron track. **Storage capacity based on rail spurs and sidings.				

Marshaling Areas

No suitable marshaling areas are within or near NNMT, NIT, or LPD. The Virginia Port Authority has access to approximately 160 acres of unimproved area next to PMT. This area could be used to stage equipment, if necessary. Roadable vehicles and equipment could also be marshaled at Fort Eustis, about 19 miles north of NNMT.

MATERIAL HANDLING EQUIPMENT (MHE)

The terminals have a total of 17 container cranes that are at NNMT, NIT and PMT. All have a capacity of at least 30 STON. Various shipping and rental companies in the area own transtainers and other MHE. Mobile cranes with capacities up to 150 STON are available from local stevedore companies. The table below provides the equipment available by terminal.

TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY BY TERMINAL			
		NNMT	NIT	LPD	PMT
Container Cranes	30-200	4	7	0	5
Wharf Cranes	3-35	0	0	2	1
Mobile Cranes	10-150	1	4	3	5
Straddle Carriers	40	0	0	0	26
Transtainers	30-40	5	22	2	0
Top Picks	30-45	3	0	2	2

INTERMODAL FACILITIES

Intermodal container transfers are handled at all four terminals. Norfolk Southern operates a container transfer facility in Chesapeake, about 10 miles south of Norfolk International Terminal and Lambert's Point Docks.

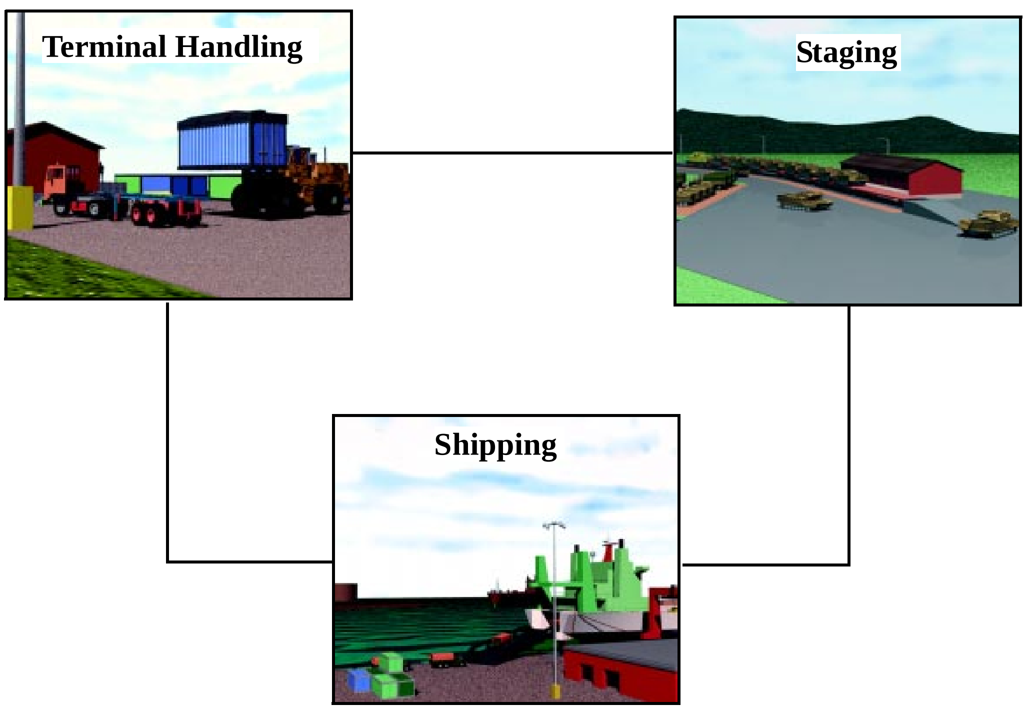
FUTURE DEVELOPMENT

NIT has plans for expansion to the north of the terminal. The expansion includes dock construction, dredging, and a paved container storage and trailer parking area. The north berth will be expanded to create a total of 4,300 feet of wharf for use by containerships.

II. THROUGHPUT ANALYSIS

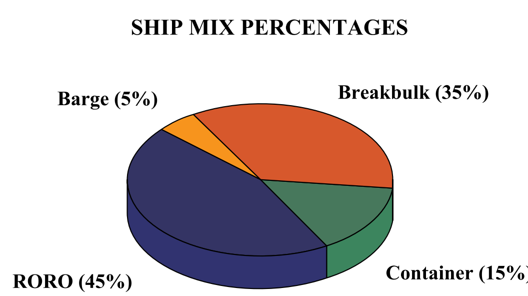
GENERAL

This section evaluates the throughput capability of the Port of Hampton Roads using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in measurement tons (MTON) per day



Terminal Throughput Subsystems

This analysis assumes a maximum of 80 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80 percent facility use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



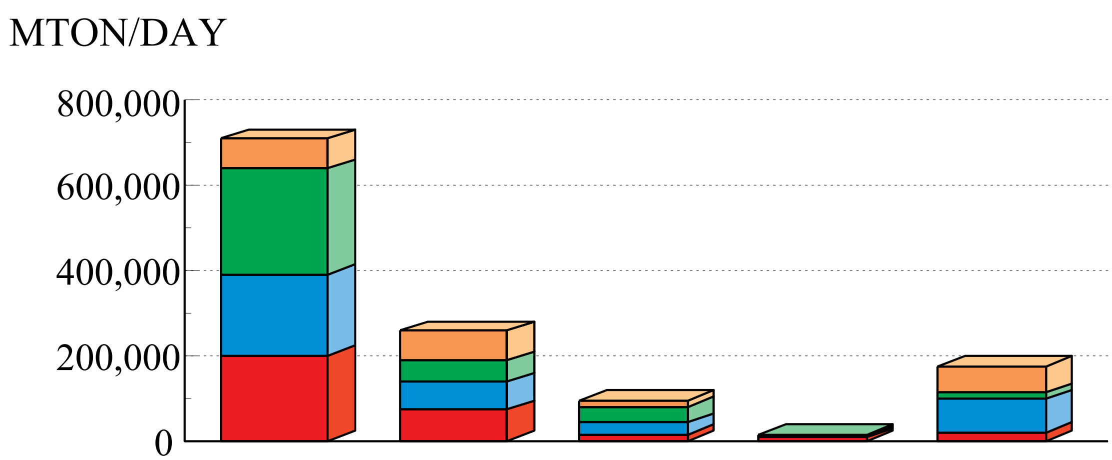
RECEPTION/HANDLING

Highway. I-64, -664, and -264 provide access to the terminals. Each terminal has a designated entrance for trucks. The road network in and out of the terminals, including the gate processing of vehicles, could handle about 260,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at permanent and portable end ramps.

Supplies in van semitrailers will proceed to van-handling positions. These docks can offload more than 1,800 MTON of van semitrailer-shipped material per day. Container handlers can off-load about 146,000 MTON of chassis cargo per day.

HIGHWAY RECEPTION/HANDLING CAPABILITY



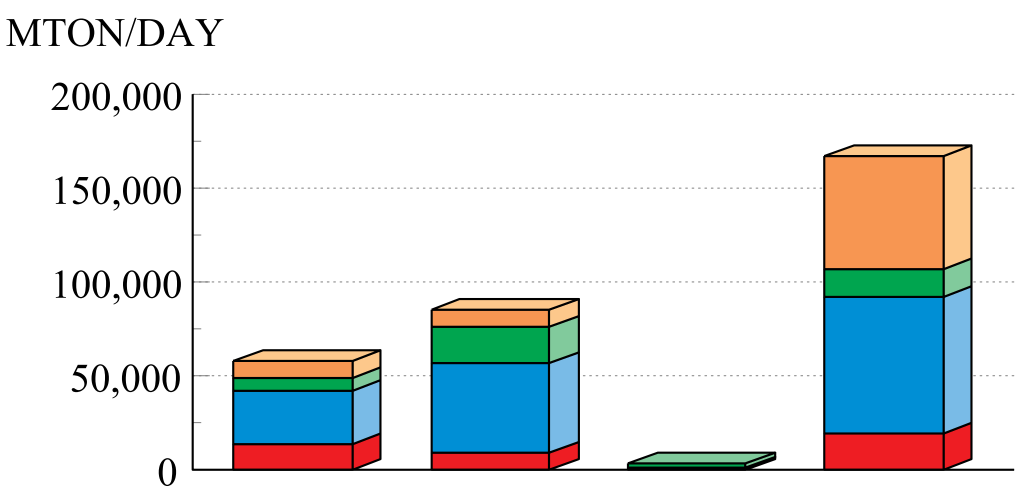
SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS	DOCKS	CONTAINERS
NNMT	200,000	72,000	14,000	7,000	20,000
NIT	190,000	65,000	29,000	4,000	77,000
LPD	250,000	50,000	38,000	4,000	15,000
PMT	70,000	72,000	14,000	0	64,000

Rail

Rail reception at the port is good with three railroad companies accessing the Port of Hampton Roads area. All terminals have good rail service.

Terminal	Train Length (railcars)	Trains Per Day
NNMT	60	2
NIT	60	4
LPD	30	2
PMT	40	2

RAIL RECEPTION/HANDLING CAPABILITY

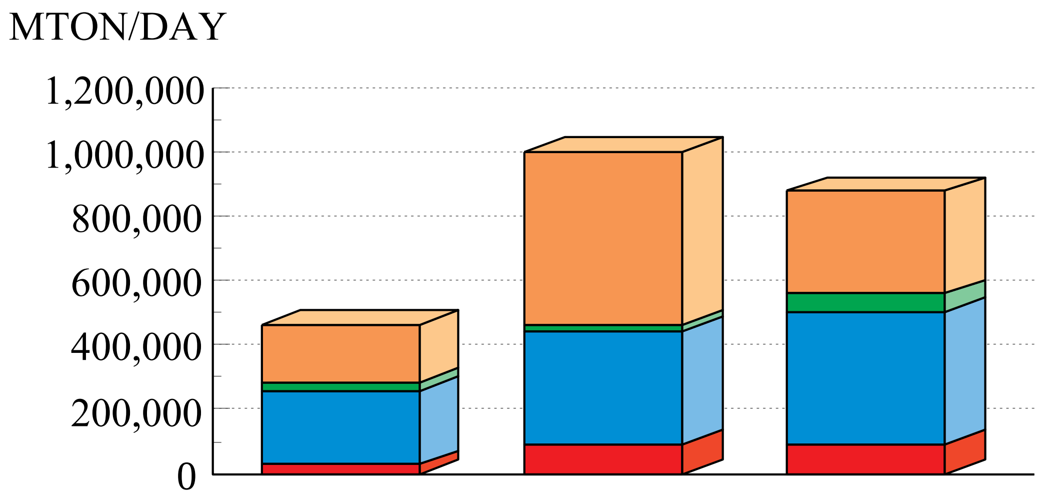


SUBSYSTEMS	TRACKAGE	END-RAMPS	DOCKS	COFC
NNMT	14,000	9,100	680	19,000
NIT	28,000	48,000	600	73,000
LPD	6,900	19,000	1,800	15,000
PMT	8,900	9,100	0	61,000

STAGING

The terminals of this report have a total of about 407 acres of paved open staging. The terminals also have more than 3.2 million square feet of covered storage.

OPEN STAGING CAPABILITY

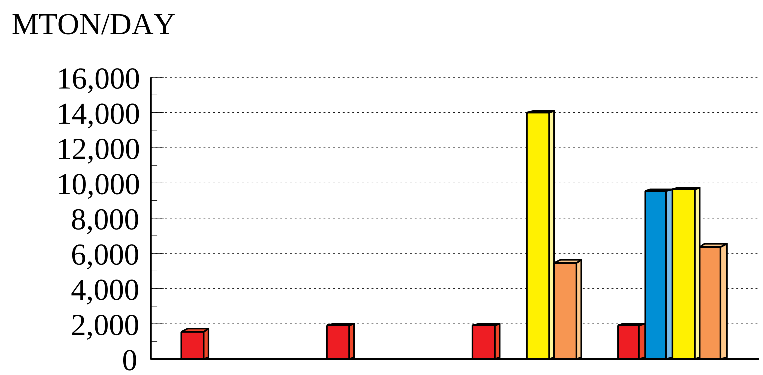


	RORO	CONTAINERS	BREAKBULK
NNMT	29,000	92,000	93,000
NIT	230,000	350,000	410,000
LPD	27,000	22,000	58,000
PMT	180,000	540,000	320,000

SHIPPING

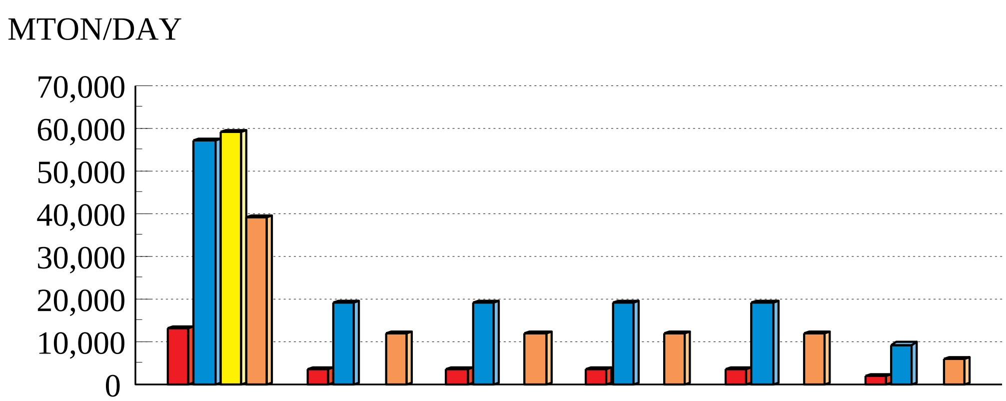
Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility.

NEWPORT NEWS MARINE TERMINAL
BERTH THROUGHPUT CAPABILITY



	PIER B-N	PIER B-S	PIER C-N	PIER C-S
BREAKBULK	1,600	1,900	1,900	1,900
RORO	0	0	0	9,500
CONTAINER	0	0	14,000	9,600
MIXED	0	0	5,500	6,400

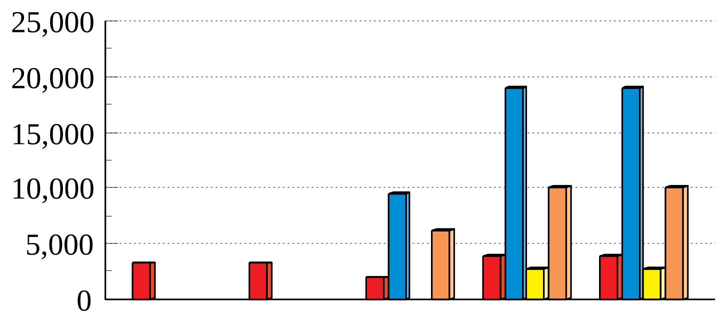
NORFOLK INTERNATIONAL TERMINAL
BERTH THROUGHPUT CAPABILITY



	BERTH 1	PIER 1-S	PIER 1-N	PIER 2-S	PIER 2-N	NORTH BERTH
BREAKBULK	13,000	3,700	3,700	3,700	3,700	1,900
RORO	57,000	19,000	19,000	19,000	19,000	9,400
CONTAINER	59,000	0	0	0	0	0
MIXED	39,000	12,000	12,000	12,000	12,000	6,000

LAMBERT'S POINT DOCKS
BERTH THROUGHPUT CAPABILITY

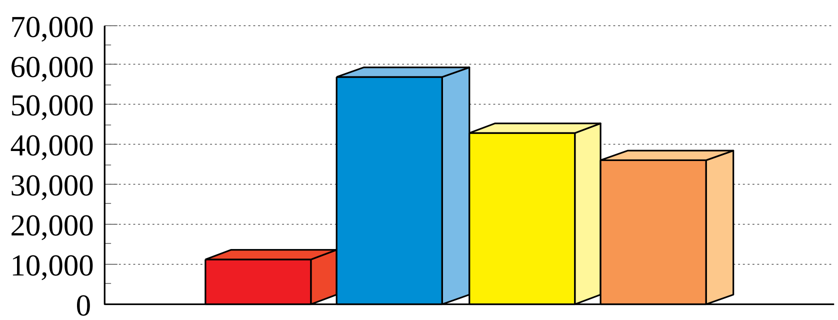
MTON/DAY



	PIER N-S	PIER N-N	PIER L-S	PIER P-S	PIER P-N
BREAKBULK	3,200	3,200	1,900	3,800	3,800
RORO	0	0	9,400	19,000	19,000
CONTAINER	0	0	0	2,700	2,700
MIXED	0	0	6,100	10,000	10,000

PORTSMOUTH MARINE TERMINAL
BERTH THROUGHPUT CAPABILITY

MTON/DAY



	BERTH 1-3
BREAKBULK	11,000
RORO	57,000
CONTAINER	43,000
MIXED	36,000

CONVERSION FACTORS	
Breakbulk:	0.4 STON per MTON
RORO:	.25 STON per MTON
Containers:	0.4 STON per MTON

The type of ship preferred at each berth is based on the methodology described in Appendix B. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for loading and unloading operations.

NIT best supports FSS and LMSR operations. An FSS would likely berth at berth 1-4, with port side to the wharf. LMSR vessels can also load at this berth without loading restrictions.

PREFERENCE BERTH SELECTION			
BERTH	**BB**	**RORO**	**CNTNR**
NNMT			
Pier Bn	-	-	-
Pier Bs	3	-	9
Pier Cn	1	-	10
Pier Cs	2	3	3
NIT			
Berth 1-4	6	1	1
Pier 1	3	4	3
Pier 2	3	5	3
N. Berth	10	2	3
LPD			
Pier N	8	-	8
Pier L	11	-	10
Pier P	8	-	3
PMT			
Berth 1-3	6	6	1

SUMMARY OF BERTHING CAPABILITIES OF NEWPORT NEWS MARINE TERMINAL

Vessel	Berths			
	Pier BN	Pier BS	Pier CN	Pier CS
Breakbulk				
C3-S-33a	a	1	1	1
C3-S-37c	a	1	1	1
C3-S-37d	a	1	1	1
C3-S-38a	1	1	1	1
C4-S-1a	a	1	1	1
C4-S-1qb and 1u	a	1	1	1
C4-S-58a	a	1	1	1
C4-S-65a	a	1	1	1
C4-S-66a	a	1	1	1
C4-S-69b	a	1	1	1
Seatrain				
GA and PR-class	1	1	1	1
Barge				
LASH C8-S-81b	a,c,f	a,c,f	1	1
LASH C9-S-81d	a,c	a,c	1	1
LASH lighter	4	4	6	6
SEABEE C8-S-82a	a,c	a,c	1	1
SEABEE barge	3	3	4	4
RORO				
Comet	d,o	d,o	d,i,,j	i,j
C7-S-95a/Maine-class	a,b,c	b,c	l	1
Ponce-class	b,c,h	b,c,h	h	h
Great Land-class	b,c,h	b,c,h	h	h
Cygnus/Pilot-class	b,c	b,c	l	1
Meteor	a,d,o	d,o	d,i,j	i,j
AmEagle/Condor	a,b,c	b,c	i,j	i,j
MV Ambassador	d	d	d	1
FSS-class	a,b,c	b,c	l	l
Cape D-class	a,b,c	b,c	i,j	i,j
Cape H-class	a,b,c	a,b,c	l	l
LMSR	a,b,c	b,c	l	l
Container				
C6-S-lw	a,c,e	c,e	1	1
C7-S-68e	a,c,e	c,e	1	1
C8-S-85c	a,c,e	c,e	c	1
Combination				
C5-S-78a	a,e	1,e	1	1
C5-S-37e	a,e	1,e	1	1

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF NORFOLK INTERNATIONAL TERMINAL

Vessel	Berths					
	Berth 1-4	Pier 1S	Pier 1N	Pier 2S	Pier 2N	North Berth
Breakbulk						
C3-S-33a	8	2	2	2	2	1
C3-S-37c	8	2	2	2	2	1
C3-S-37d	8	2	2	2	2	1
C3-S-38a	8	2	2	2	2	1
C4-S-1a	7	2	2	2	2	1
C4-S-1qb and 1u	7	2	2	2	2	1
C4-S-58a	7	2	2	2	2	1
C4-S-65a	7	2	2	2	2	1
C4-S-66a	7	2	2	2	2	1
C4-S-69b	7	2	2	2	2	1
Seatrain						
GA and PR-class	7	2	2	2	2	1
Barge						
LASH C8-S-81b	5	1	1	a,f	a,f	1
LASH C9-S-81d	4	a	a	a	a	a
LASH lighter	30	9	9	9	9	6
SEABEE C8-S-82a	4	a	a	a	a	a
SEABEE barge	21	6	6	6	6	4
RORO						
Comet	d,i,j	i,j	i,j	i,j	i,j	d,i,j
C7-S-95a/Maine-class	5	b	b	a,b	a,b	a
Ponce-class	h	b,h	b,h	b,h	b,h	b,h
Great Land-class	h	b,h	b,h	b,h	b,h	b,h
Cygnus/Pilot-class	6	b	b	b	b	1
Meteor	d,i,j	i,j	i,j	i,j	i,j	d,i,j
AmEagle/Condor	i,j	b	b	b	b	i,j
MV Ambassador	d	2,m	2,m	2,m	2,m	d
FSS-class	4	b	b	a,b	a,b	c
Cape D-class	i,j	b	b	b	b	i,j
Cape H-class	5	b	b	a,b	a,b	1
LMSR	4	b	b	a,b	a,b	c
Container						
C6-S-lw	6	1,e	1,e	1,e	1,e	1,e
C7-S-68e	5	1,e	1,e	1,e	1,e	1,e
C8-S-85c	4	1,e	1,e	1,e	1,e	1,e
Combination						
C5-S-78a	6	2,e	2,e	a,e	a,e	1,e
C5-S-37e	6	2,e	2,e	2,e	2,e	1,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth

h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF LAMBERTS POINT DOCKS

Vessel	Berths				
	Pier N-S	Pier N-N	Pier L-S	Pier P-S	Pier P-N
Breakbulk					
C3-S-33a	2	2	1	2	2
C3-S-37c	2	2	1	2	2
C3-S-37d	2	2	1	2	2
C3-S-38a	2	2	1	2	2
C4-S-1a	1	1	1	2	2
C4-S-1qb and 1u	1	1	1	2	2
C4-S-58a	1	1	1	2	2
C4-S-65a	1	1	1	2	2
C4-S-66a	a	a	a	a	a
C4-S-69b	1	1	1	2	2
Seatrain					
GA and PR-class	1	1	1	2	2
Barge					
LASH C8-S-81b	a,f	a,f,	a,c,f	a,f	a,f
LASH C9-S-81d	a	a	a,c	a	a
LASH lighter	7	7	5	8	8
SEABEE C8-S-82a	a	a	a,c	a	a
SEABEE barge	5	5	3	6	6
RORO					
Comet	d,o	d,o	d,i,j	i,j	i,j
C7-S-95a/Maine-class	a,b	a,b	a,c	a,b	a,b
Ponce-class	b,h	b,h	h	b,h	b,h
Great Land-class	b,h	b,h	c,h	b,h	b,h
Cygnus/Pilot-class	b	b	1	b	b
Meteor	d,o	d,o	d,i,j	i,j	i,j
AmEagle/Condor	b	b	1	b	b
MV Ambassador	d	d	d	2,m	2,m
FSS-class	a,b	a,b	a,c	a,b	a,b
Cape D-class	a,b	a,b	a	a,b	a,b
Cape H-class	a,b	a,b	a,c	a,b	a,b
LMSR	a,b	a,b	a,c	a,b	a,b
Container					
C6-S-lw	1,e	1,e	1,e	1,e	1,e
C7-S-68e	1,e	1,e	1,e	1,e	1,e
C8-S-85c	a,e	a,e	a,c,e	a,e	a,e
Combination					
C5-S-78a	a,e	a,e	a,e	a,e	a,e
C5-S-37e	1,e	1,e	1,e	1,e	1,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth

h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF PORTSMOUTH MARINE TERMINAL

Vessel	Berths 1-3
Breakbulk	
C3-S-33a	6
C3-S-37c	6
C3-S-37d	6
C3-S-38a	6
C4-S-1a	6
C4-S-1qb and 1u	6
C4-S-58a	5
C4-S-65a	6
C4-S-66a	5
C4-S-69b	5
Seatrain	
GA and PR-class	6
Barge	
LASH C8-S-81b	4
LASH C9-S-81d	3
LASH lighter	25
SEABEE C8-S-82a	3
SEABEE barge	17
RORO	
Comet	i,j
C7-S-95a/Maine-class	4
Ponce-class	h
Great Land-class	h
Cygnus/Pilot-class	5
Meteor	i,j
AmEagle/Condor	i,j
MV Ambassador	6
FSS-class	3
Cape D-class	i,j
Cape H-class	4
LMSR	3
Container	
C6-S-lw	5
C7-S-68e	4
C8-S-85c	4
Combination	
C5-S-78a	5
C5-S-37e	5

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
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k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

III. APPLICATION

GENERAL

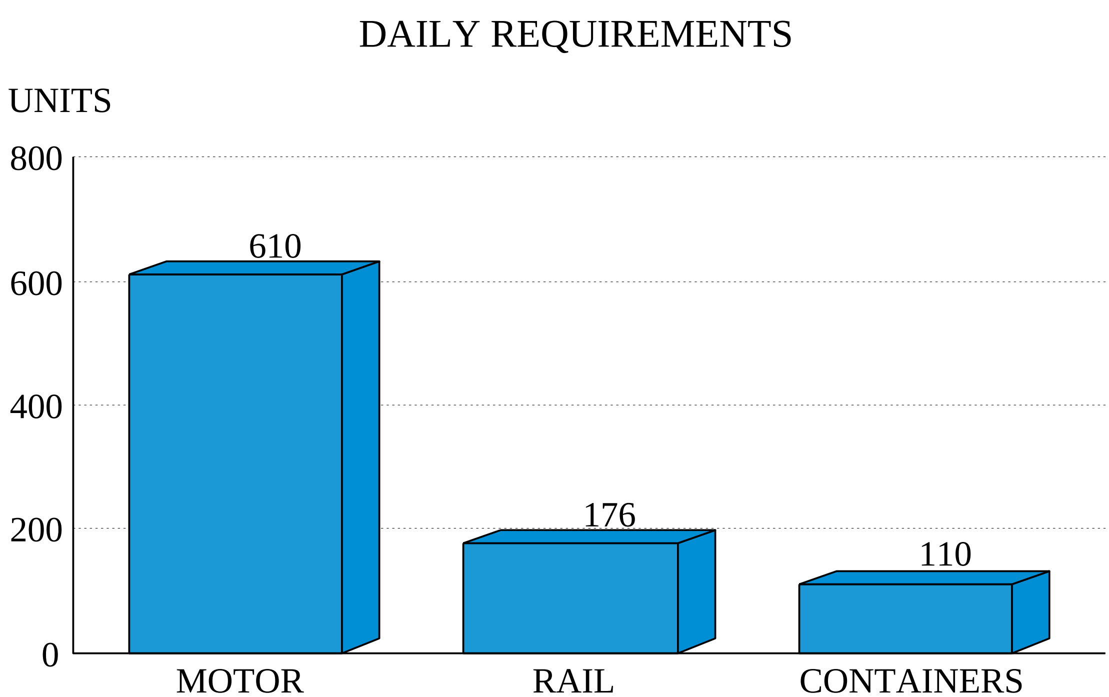
This section evaluates the port's throughput capability for deploying a notional mechanized infantry division by primarily FSS vessels. The August 1994 revision of the ***Planning Orders Digest***, issued by MARAD, provided agreements for military use of the Port of Hampton Roads. The agreements referenced the Norfolk International Terminal to include all of Pier 2, the North Berth, Container Berths 1 and 2, and the paved staging area at the north end of the terminal. The agreements also referenced the NNMT to include all Pier C berths, transit sheds, and up to 200,000 square feet of open staging area. If the military needs to deploy through the Port of Hampton Roads, it will most likely use the NIT berths in Norfolk. The NNMT berth characteristics restrict their use by many of the vessels used for military operations. Furthermore, automobile operations at NNMT usually occupy the majority of open staging.

Norfolk International Terminal

REQUIREMENTS

The likely requirement for the Port of Hampton Roads is to deploy a notional mechanized infantry division in 6 days. The division has to move about 7,800 vehicles and 660 containers. The movement to the port will require 1,055 (176 per day) railcars using the convoy/rail option. Under this option, about 3,650 (610 per day) roadable vehicles would be driven and about 2,320 (387 per day) would be towed.

MECHANIZED INFANTRY DIVISION	
Total Equipment	
Volume	280,000 MTON
Weight	95,000 STON
Area	1,400,000 SQ FT
Vehicles	7,800
Containers	660

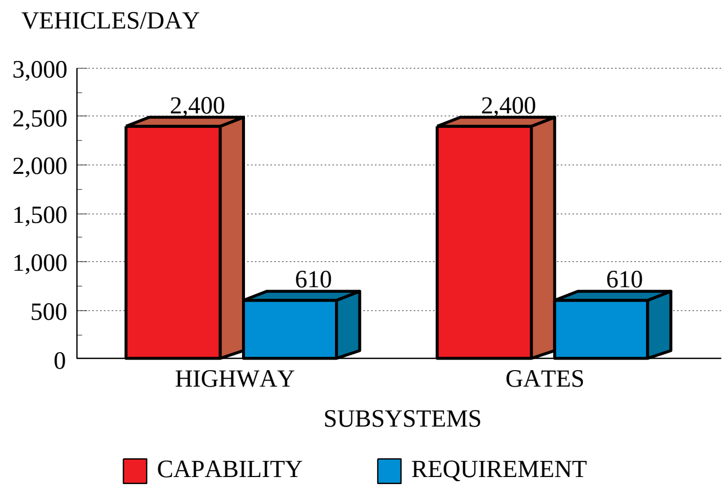


TERMINAL INPROCESSING/HANDLING

Highway

Vehicles and containers on chassis would access the terminals through the gates at Terminal Boulevard. The access roads and gates can handle well over 2,400 vehicles per day. Six portable ramps are available to support truck unloading operations.

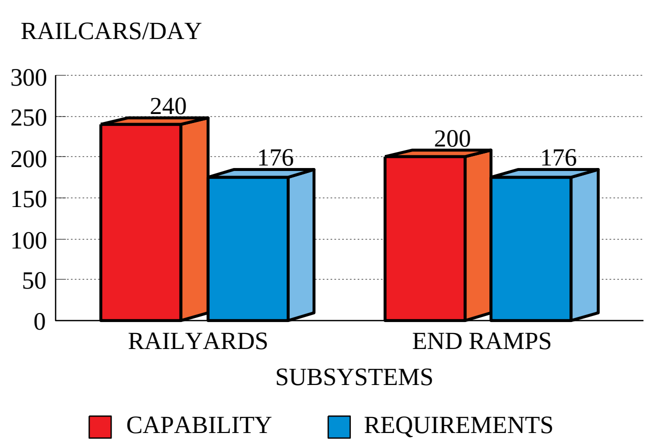
HIGHWAY INPROCESSING CAPABILITY



Rail

The NIT berths can receive about 240 railcars of military equipment per day. This is sufficient to meet the requirements.

RAIL INPROCESSING AND HANDLING CAPABILITY



The terminal has three fixed end ramps with each ramp supporting 600 feet of rail. These ramps can support offloading about 72 railcars per day, assuming four switch cycles per day. Our analysis also assumes the MTMC port operator will provide two portable end ramps. These ramps placed at the 1,600-ft spurs inland of Pier 1 would support offloading an additional 128 railcars per day. The total of 200 railcars per day from all five ramps would meet the requirement.

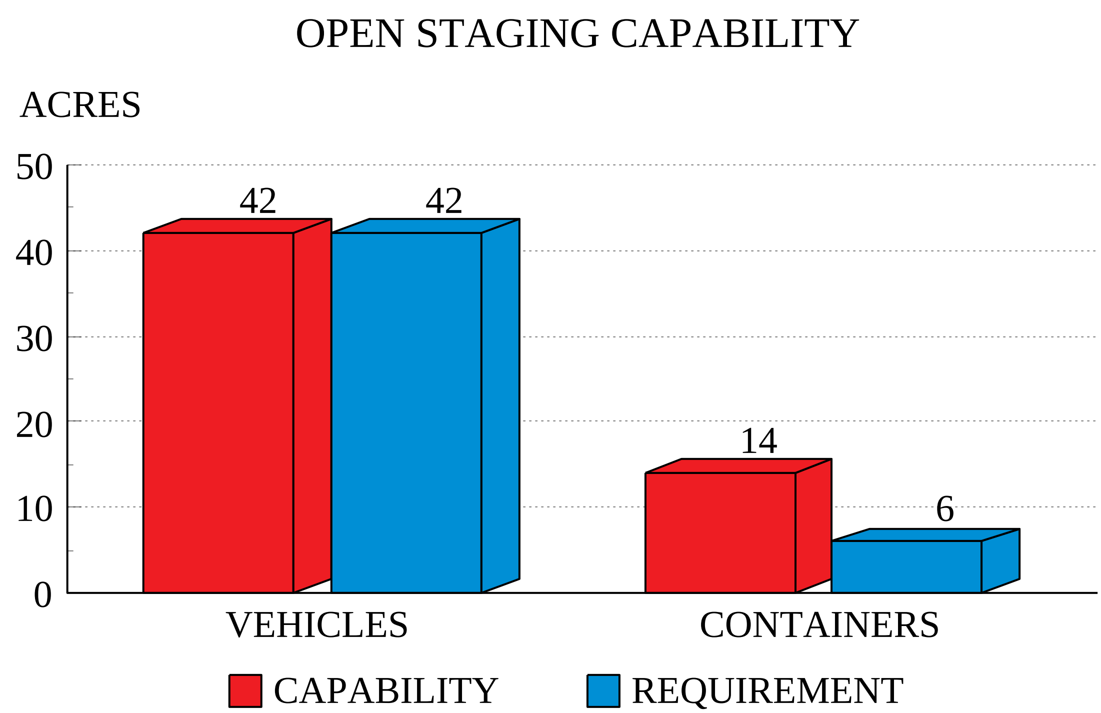
If necessary, the nearby LPD has three fixed and five portable ramps that support more than 3 miles of track. These facilities could be used to support rail operations.

STAGING

This analysis assumes that current downsizing continues, and that nine FSS-sized ships will deploy an entire notional mechanized infantry division. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations.

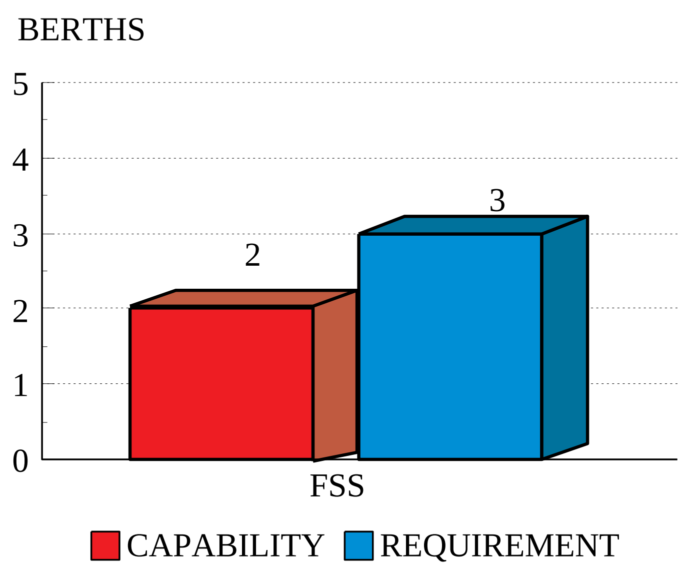
Although an FSS load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for staging of the 73 containers for each FSS. The three simultaneous shiploading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers.

The Planning Orders provide for staging of about 56 acres located at the north end of the terminal. This is enough staging area to satisfy the requirement.



SHIPPING

FSS SHIPPING CAPABILITY



Although this analysis assumes that only nine FSS-sized ships can deploy the notional mechanized infantry division, the table below provides ship quantities for the current division size. The number of ships required depends on the shipping mix selected. The best ship mix would consist of all eight FSS ships, plus two Cape H RORO ships.

The Planning Orders only provide berthing for two FSS-sized vessels (container berth 1-2). The other berths in the Planning Orders can not support FSS operations. Another container berth could be added to meet the requirements to berth three FSS-sized vessels simultaneously.

UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

Loading Condition/ Sample Ship Mix	Vessel Types			
	FSS (RORO/Comb)	Cape H (RORO/Comb)	C3/C4 (Breakbulk)	C6/C7/C8 (Container)
Minimum Containerization:				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization:				
FSS and Container	7.90			2.00
FSS, Cape H, and Container	7.90			2.00
Breakbulk and Container			29.58	2.00

*Only eight FSS vessels are currently available. Unit shipping requirements exceed the capacity of these eight vessels. Other vessels types are required to makeup the shortfall (Cape H or upcoming LMSR).

Legend:
RORO - roll on/roll off
FSS - fast sealift ship

Source: MTMCTEA report OA 90-4f-22, Deployment Planning Guide. Aug 91.

SUMMARY

The Planning Orders provide enough staging area, but not enough berthing to support the deployment of a notional mechanized infantry division. An additional container berth could be added to the Planning Orders to satisfy the requirement.

RECOMMENDATION

We recommend revising the Planning Orders to include an additional FSS-sized berth. The terminal's three fixed rail end ramps and two additional portable ramps must be available to support the rail offloading equipment.

March 96

PORT OF JACKSONVILLE, FL

I. GENERAL DATA

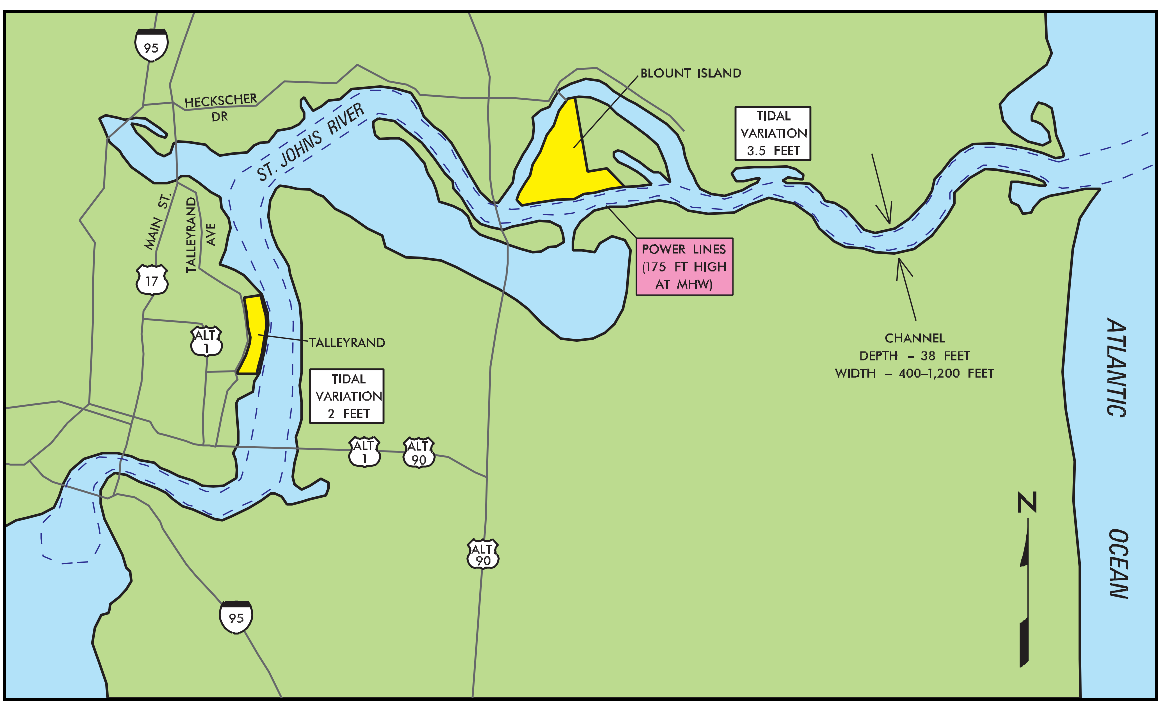
TRANSPORTATION ACCESS

Water

The St. Johns River provides access to the Port of Jacksonville terminals through the Fort George Inlet. The port consists of two main facilities: Blount Island and Talleyrand. Channel depths are 38 feet deep at mean low water (MLW) and range from 550 feet to 1,200 feet wide. Although there are no turning basins, there is sufficient space for vessels to turn in the channel near the terminals. The Talleyrand Terminal is 21 miles from the Atlantic Ocean and the Blount Island Marine Terminal is only 9 miles from open water.

Vessels awaiting entrance to the St. Johns River can anchor north-northeastward of the river entrance jetties in water ranging from 36-50 feet MLW. Also, other anchorages are available near the Talleyrand Terminal. The mean tidal range in the St. Johns River varies from 2 feet at the Talleyrand Terminal to 3.5 feet at the Blount Island Marine Terminal.

There are no bridges on the way to the terminals, but there are some overhead power lines near Blount Island that have a 175-foot vertical clearance at Mean High Water (MHW). These power lines should not cause problems when entering the port.



Water Access

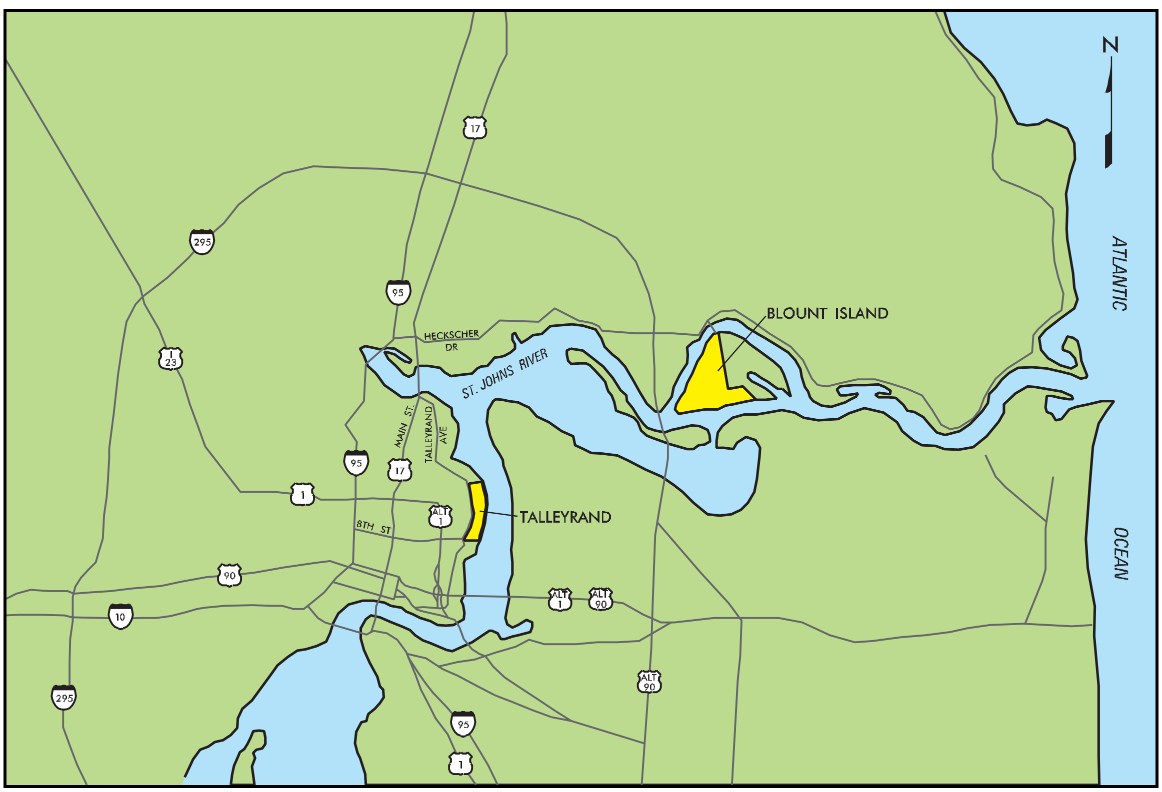
Highway

The Port of Jacksonville is within 350 miles of Miami, Atlanta, and the Orlando/Tampa/St. Petersburg area. Interstate Route 10 (I-10) from the west and Interstate Route 95 (I-95) and US Route 17 (US 17) from the north and south provide access to the Port of Jacksonville.

The berths at the Blount Island Marine Terminal, which is 2 miles off Interstate Route 295 (I-295), are accessed by Heckscher Drive.

The Talleyrand Terminal, which is only 3 miles from I-95, is accessible by Route 1 to Eighth Street and then turning onto Talleyrand Avenue. The main gates to the terminal are off Talleyrand Avenue.

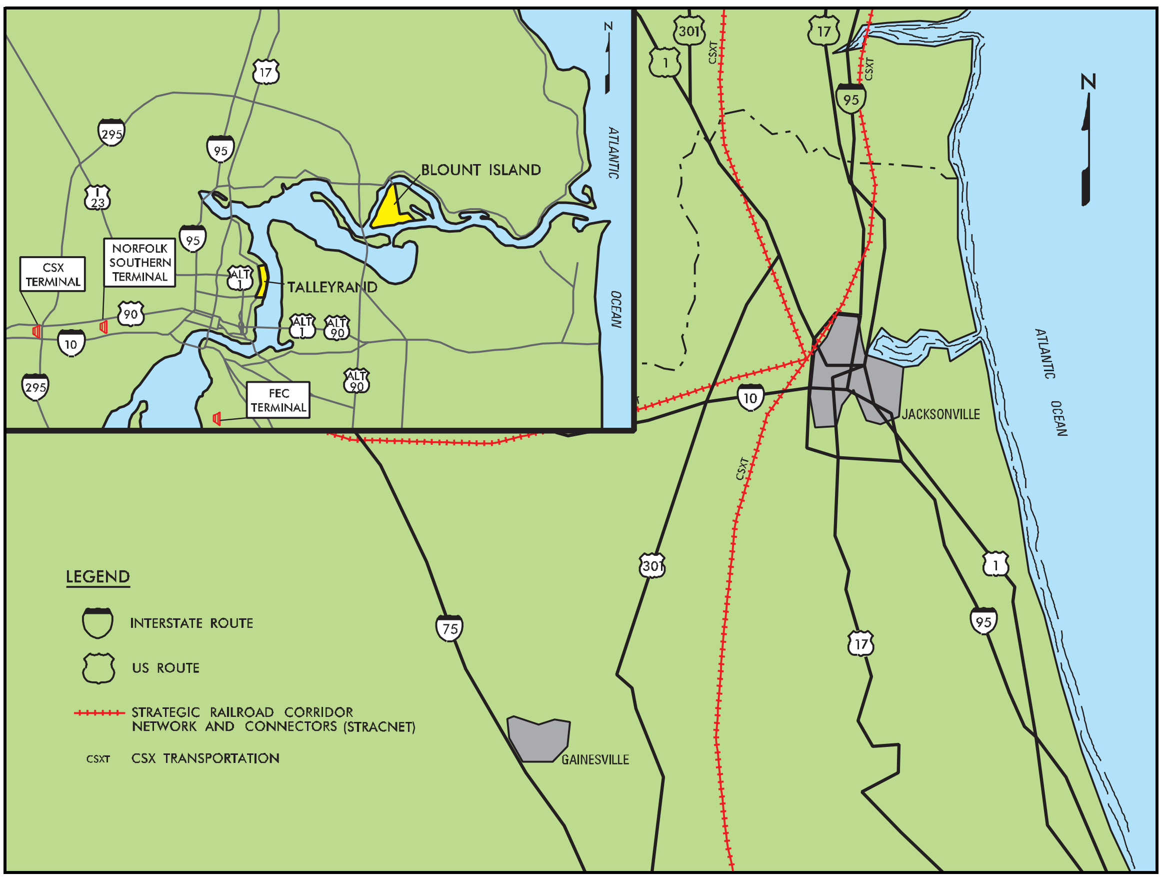
Gate to Blount Island



Highway Access

Rail

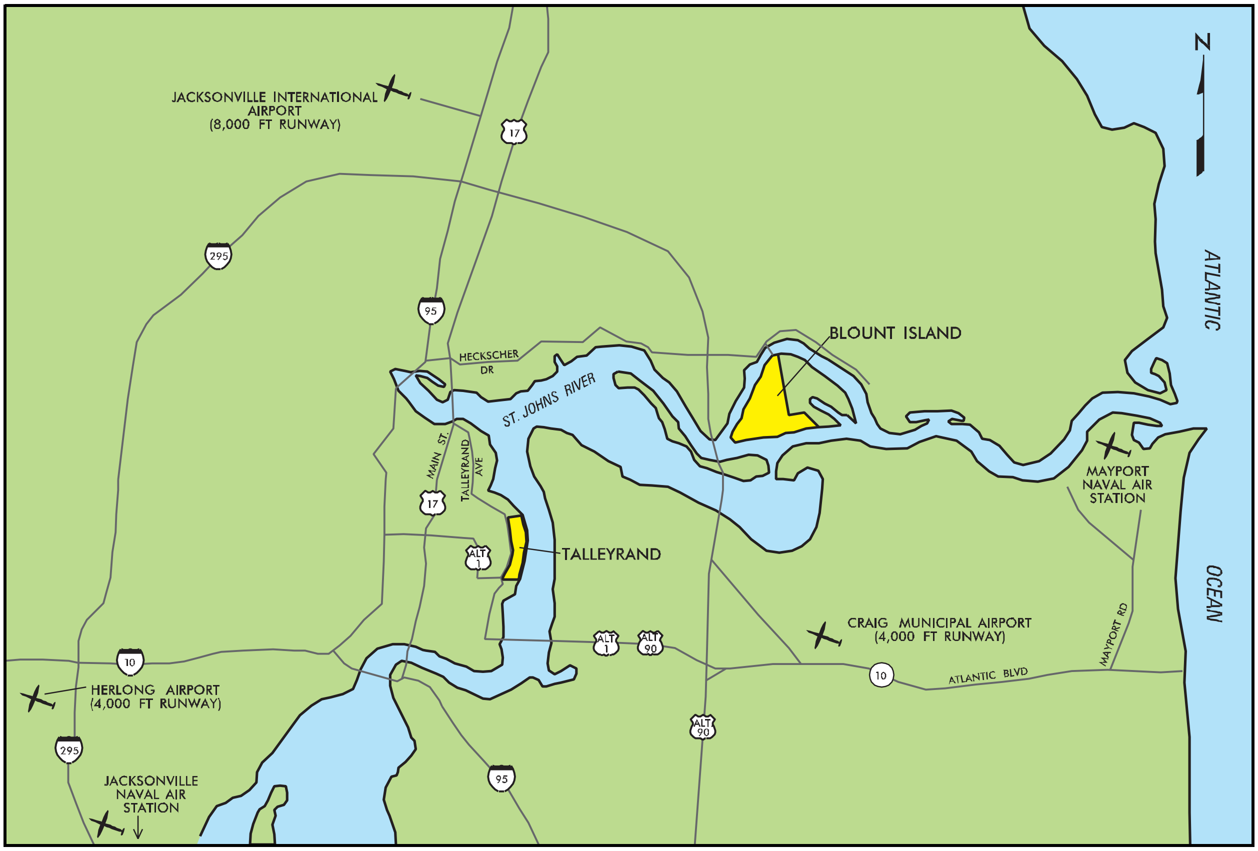
The three major rail companies that serve the Jacksonville area are: Seaboard System Rail (CSX Transportation, Inc.), Florida East Coast Railway, and Norfolk Southern Corporation. These three rail companies offer 32 trains a day to and from Jacksonville. The JAXPORT Terminal Railroad performs switching. Access to the terminals is provided by CSX (one track). Storage railyards include the intermodal facility on Blount Island, CSX Terminal, Norfolk Southern Terminal, and Florida East Coast Terminal.



Rail Access

Airports

Several airports of various sizes and capabilities are within the Jacksonville area. The largest commercial airports are Jacksonville International, Craig Municipal, and Herlong. There are also military airfields which include Mayport Naval Air Station and Jacksonville Naval Air Station.



Air Access

PORT FACILITIES

Berthing

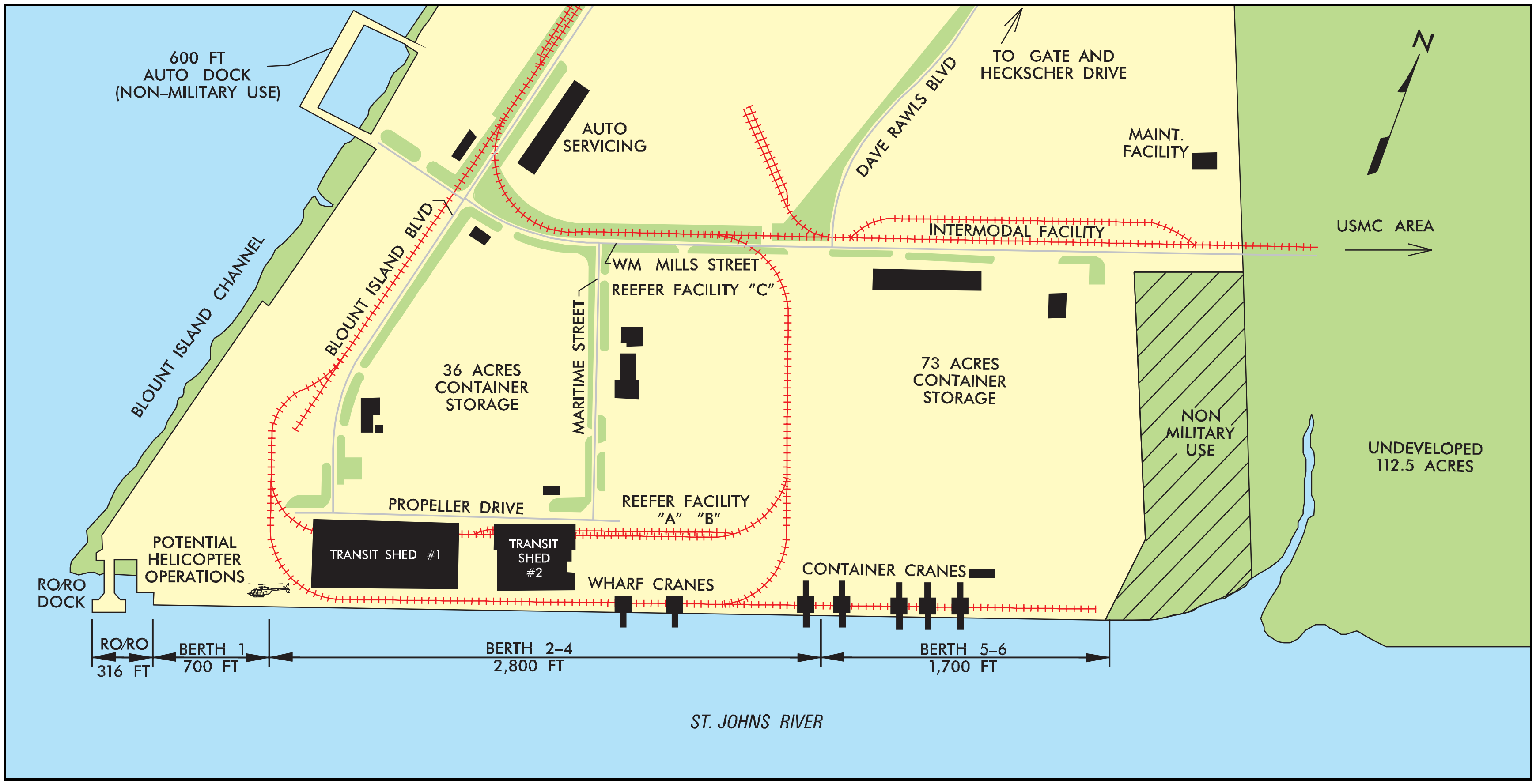
This report covers two areas of the port. Each of these areas is considered a terminal, although each may involve several shipping lines. They are Blount Island and Talleyrand Terminals. These terminals are primarily container and auto import-export facilities. The Blount Island Marine Terminal has two RORO berths for loading and unloading automobiles.

BERTHING CHARACTERISTICS OF BLOUNT ISLAND MARINE TERMINAL

Characteristics	Berths		
	1-2	**2-4**	**5-6**
Length (ft)	700	2,800	1,700
Depth alongside at MLW (ft)	38	38	38
Deck strength (psf)	800	800	800
Apron width (ft)	66	80	Open
Apron height above MLW (ft)	7	9	9
Number of container cranes	0	4	1
Number of wharf cranes	1	1	0
Apron lighting	Yes	Yes	Yes
Straignt-stern RORO facilities	Yes	No	No
Apron length served by rail (ft)	700	2,800	1,000

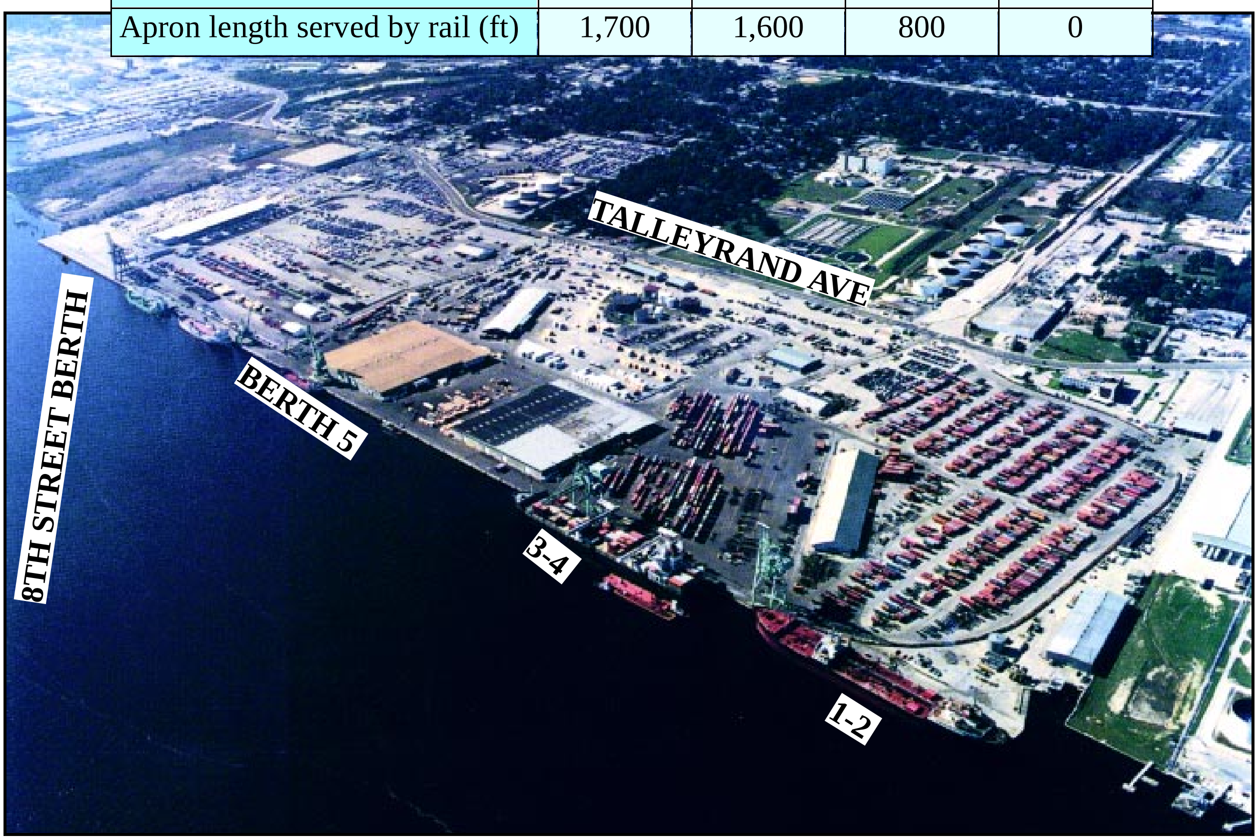
Below are land use maps and aerial views of the terminals. Also included are tables identifying berth characteristics.

Blount Island Terminal
(Northeastward view)

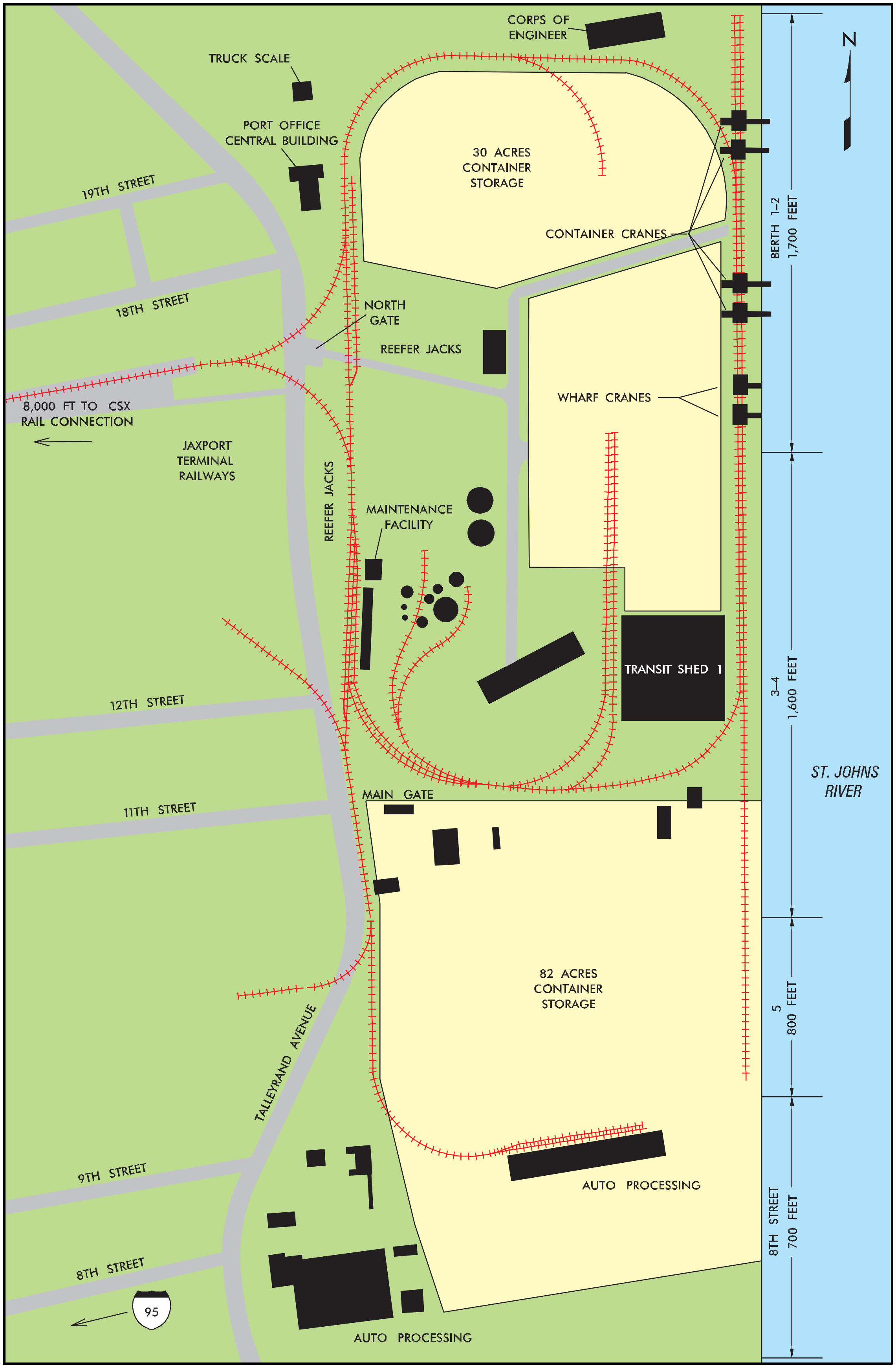


Blount Island Terminal

BERTHING CHARACTERISTICS OF TALLEYRAND TERMINAL				
Characteristics	**Berths**			
	1-2	**3-4**	**5**	**8th Street**
Length (ft)	1,700	1,600	800	700
Depth alongside at MLW (ft)	38	38	38	38
Deck strength (psf)	800	800	800	1,000
Apron width (ft)	80	Open	Open	Open
Apron height above MLW (ft)	9	9	7	9
Number of container cranes	2	2	0	0
Number of wharf cranes	0	2	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straignt-stern RORO facilities	No	No	No	No
Apron length served by rail (ft)	1,700	1,600	800	0



Talleyrand Terminal (Southwestward view)



Talleyrand Terminal

Staging

Open Staging. Blount Island Marine Terminal has about 400 acres of paved staging. Open staging is used mostly for containers and import vehicles.

The Talleyrand Terminal has a total of 173 acres of paved open staging. Berths 1 through 5 at Talleyrand have 91 acres, 11th Street has 28 acres, and 8th Street has 54 acres.

Helicopter landing and staging is available at berth 1 of the Blount Island Terminal and near berth 5 of the Talleyrand Terminal. Craig Air Field can also receive and stage helicopters.

Open Staging at Blount Island

Covered Staging. The Blount Island Marine Terminal has about 360,000 square feet of warehouse space. The Talleyrand Terminal has 120,000 square feet of warehouse space and an additional 40,000 square feet of refrigerated warehousing.

Helicopter Shrink-wrapping

Rail

At both the Blount Island and the Talleyrand Terminals, rail trackage links the railyards to the port's apron tracks, transit sheds, and storage tracks.

Talleyrand has a rail capacity of 150 cars. CSX operates a railyard that can store an additional 215 railcars and is less than 1,000 feet from the terminal's gate. Blount Island Marine Terminal can hold 250 89-foot railcars at once. There is an 11.6 acre intermodal rail facility north of berth 6.

CSX Railyard

Norfolk Southern Train from Chicago

Unloading/loading Positions

Ramps. The Blount Island Marine Terminal has one light-duty rail end ramp, one heavy-duty steel ramp, and at least one bilevel ramp. Vehicles can also offload at two fixed rail end ramps at the adjacent Marine Corps facility, at the east end of the island. There are numerous locations that could support offloading with temporary or portable end ramps.

Bilevel Railcar Operations at Blount Island

Docks. Transit shed 1 at Talleyrand Terminal has six loading positions for commercial trailers. Van unloading docks are available north of the two transit sheds on Blount Island.

Marshaling Areas

Marshaling areas are available within the port area. There are some undeveloped areas in the Talleyrand Terminal. Blount Island has over 100 grass-covered acres that can support marshaling.

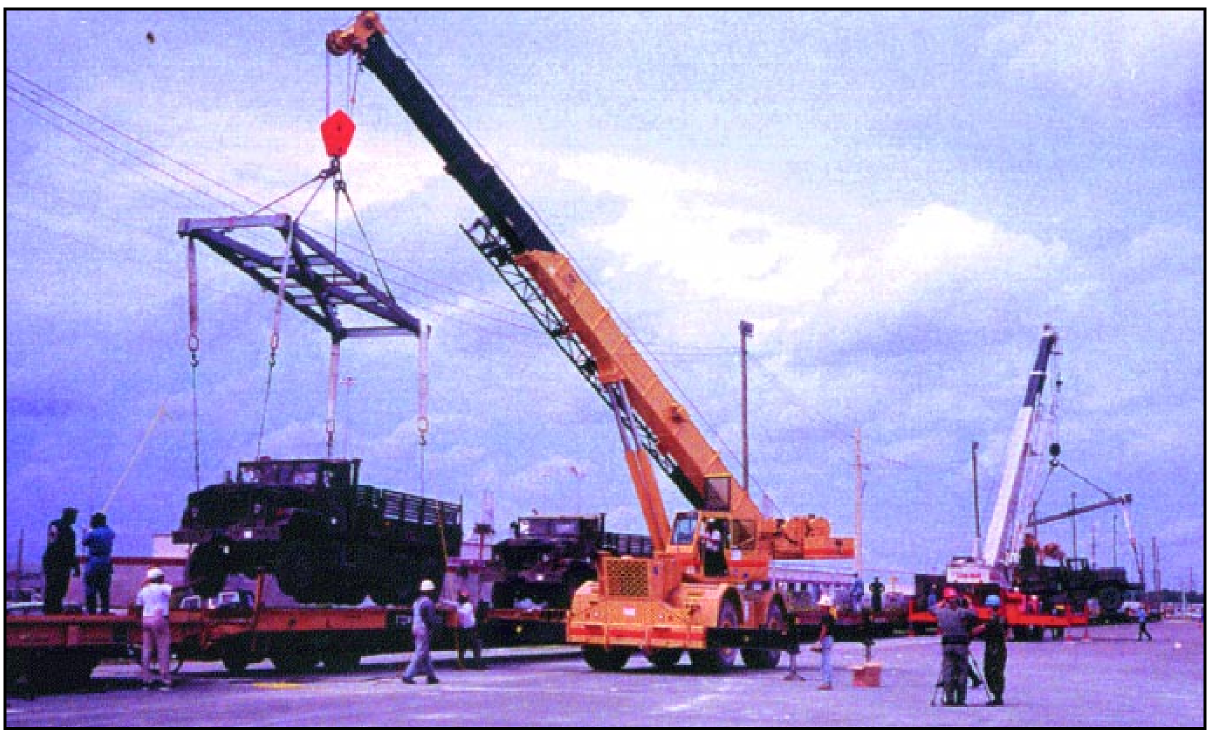
Grass-covered area at Blount Island

MATERIAL HANDLING EQUIPMENT (MHE)

The table below lists the MHE at each of the two terminals. Local stevedore contractors can supply additional MHE.

Type	Capacity (STON)	Blount Island	Talleyrand
Container Stackers	35	2	
Container Stackers	40		3
Container Stackers	45	2	

Side-loader at CSX Sea-Land Intermodal Terminal



Mobile Cranes at Blount Island

INTERMODAL FACILITIES

Blount Island has an 11.6 acre intermodal rail facility north of berth 6. Talleyrand has small intermodal facilities in different areas.

The locations of offsite intermodal facilities are shown on the rail access map earlier in this report. Norfolk Southern has an Intermodal Container Transfer Facility (ICTF) close to the Talleyrand Terminal and I-10. The ICTF has tracks for 60 railcars, three top-lift cranes, and 600 parking spaces.

CSX operates the Duval Terminal, 15 miles from Talleyrand and 18 miles from Blount Island. The Duval Terminal has two loading tracks with a capacity for 80 railcars. It also has seven supporting tracks that can store 200 flatcars. The terminal has three sideloaders. There are 450 paved and 900 unpaved parking spaces.

Florida East Coast Railway has an ICTF on Jacksonville's south side near I-95 and I-295. This facility handles trailers-on-flatcar and containers-on-flatcar cargo.

FUTURE DEVELOPMENT

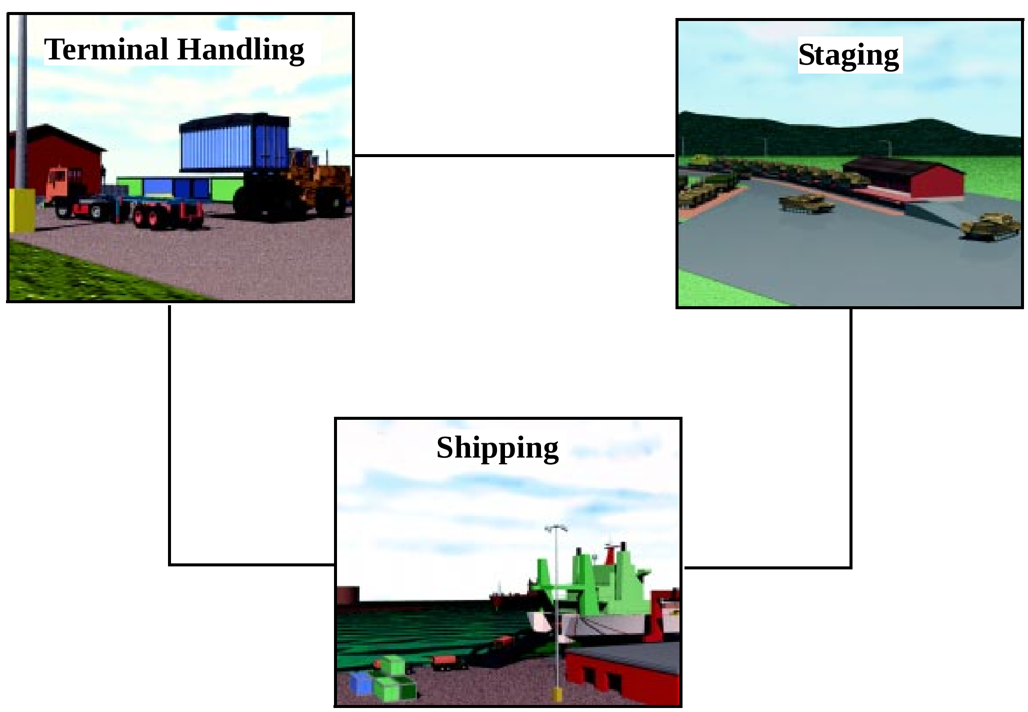
Plans are to develop the Dames Point area west of Blount Island to handle the port's breakbulk, bulk, and vehicle cargos. Talleyrand and Blount Island Terminals would then be improved for increased container operations. About 90 additional acres will be paved on Blount Island's west side for increased container staging over the next ten years. With the USMC operations, there is very little room for expansion on Blount Island's east side.

Over the next ten years, the Talleyrand Terminal will likely add container staging further inland after rerouting Talleyrand Avenue. This will more than double the paved open area of the terminal. The terminal berthage is also expected to extend about 2,000 additional feet to the east.

II. THROUGHPUT ANALYSIS

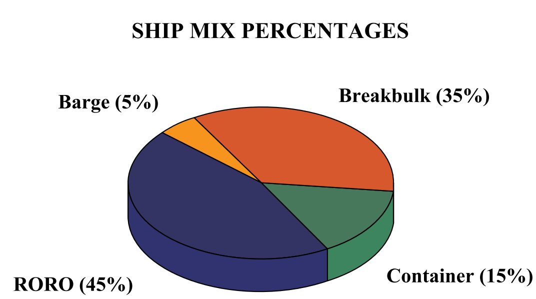
GENERAL

This section evaluates the throughput capability of the Port of Jacksonville using the port operational performance simulator (POPS) computer model. The model is based on a weak link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



Terminal Throughput Subsystems

This analysis assumes a maximum of 80 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



RECEPTION/HANDLING

Highway

Blount Island Marine Terminal is reached by taking I-295 to Heckscher Drive. Eighth and 11th Streets, and Talleyrand Avenue provide access to the Talleyrand Terminal. Each terminal has a designated entrance for trucks. The road network in and out of the terminals, including the gate processing of vehicles, could handle about 190,000 MTON of equipment and supplies per day.

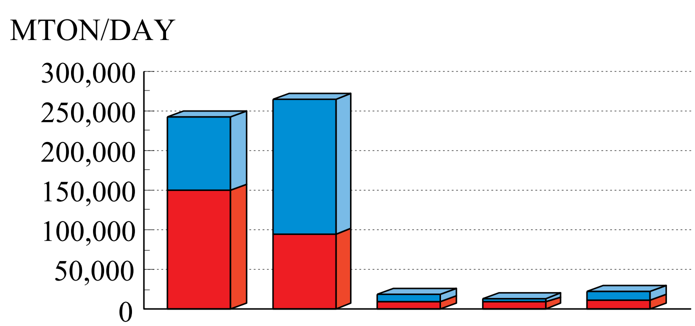
Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable ramps. There are no permanent truck end ramps at the port. Our analysis assumes four portable ramps, two at each terminal. These ramps could offload over 19,000 MTON from flatbed trailers per day.

Supplies in van semitrailers will proceed to the 32 van-handling positions. These docks can offload over 14,000 MTON of van semitrailer-shipped material per day. This report assumes there are four rented container handlers for chassis operations, two at each terminal. These container handlers can offload about 23,000 MTON of cargo from their chassis per day.

Truck Handling Facilities

Terminal	Portable Truck End Ramps	Van Handling Positions	Container Handlers
Blount Island	2	20	2
Talleyrand	2	12	2

HIGHWAY RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS	DOCKS	CONTAINERS
BLOUNT ISLAND	150,000	95,000	9,600	9,000	12,000
TALLEYRAND	92,000	170,000	9,600	5,400	11,000

Rail

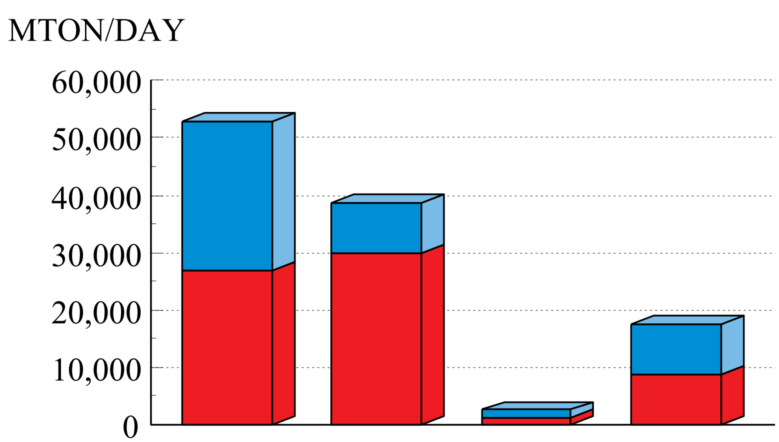
Rail reception at the port is adequate, with three major railroad companies accessing the Jacksonville area.

This analysis assumes both of the fixed ramps in the USMC area east of the Blount Island Terminal and two portable ramps will be available. The total length of track assumed for offloading operations is 4,900 feet. Most of this is in the USMC area. We also assume four container handlers or mobile cranes are available for COFC operations.

Boxcars could offload at the transit sheds where about 24 boxcar handling positions are available.

Rail Facilities					
Terminal	**Trains Per Day**	**Train Length (railcars)**	**Rail End Ramps**	**Boxcar Docks**	**Container Handlers**
Blount Island	4	60	2 fixed 1 portable	12	2
Talleyrand	4	60	1 portable	12	2

RAIL RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	TRACKAGE	END-RAMPS	DOCKS	COFC
BLOUNT ISLAND	27,000	30,000	1,300	8,900
TALLEYRAND	26,000	8,800	1,300	8,600

STAGING

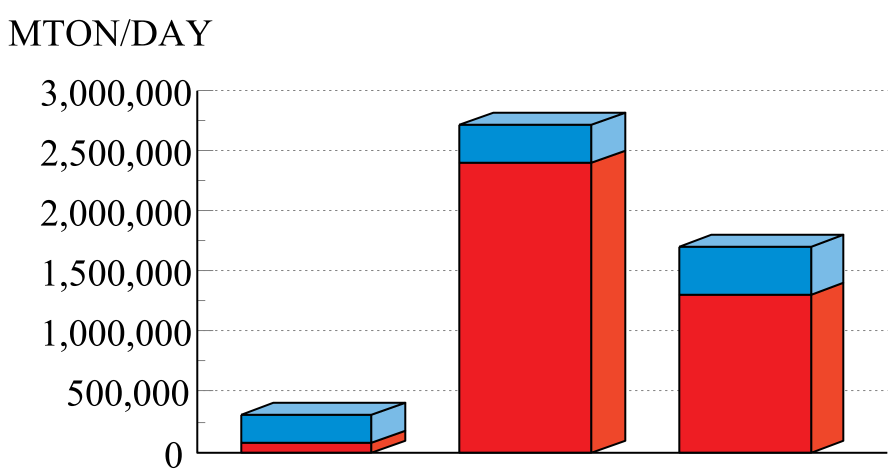
All together, the port has more than 700 acres of open staging. The two terminals have over 520,000 square feet of covered storage.

The port can perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned. The chart below provides the staging capability for the cargo for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.

Staging Areas

Terminal	Open Staging (Acres)	Covered Staging (SQ FT)
Blount Island	566	360,000
Talleyrand	173	160,000

OPEN STAGING CAPABILITY

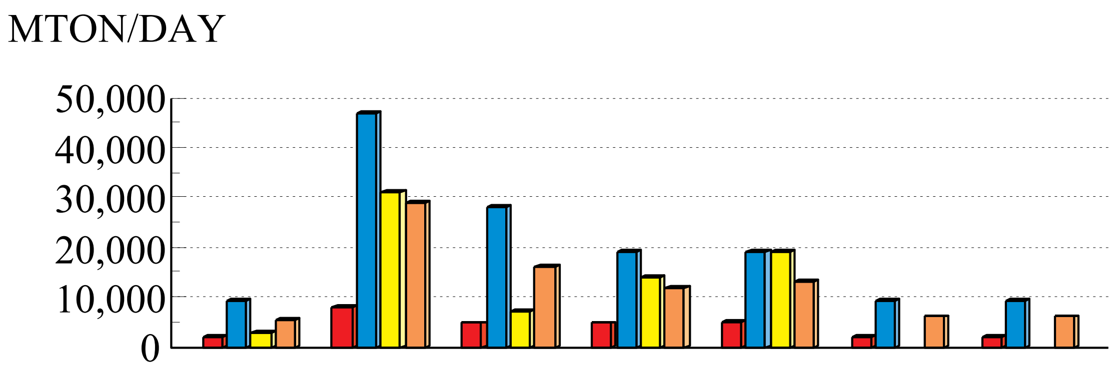


VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
BLOUNT ISLAND (red)	75,000	2,400,000	1,300,000
TALLEYRAND (blue)	230,000	320,000	400,000

SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used, loading, operational, and berth usage rates included in Appendix A.

BERTH THROUGHPUT CAPABILITY



BERTH	B-1	B2-4	B5-6	T1-2	T3-4	T5	8TH ST
BREAKBULK	1,900	8,100	4,800	4,800	5,000	1,900	1,900
RORO	9,400	47,000	28,000	19,000	19,000	9,400	9,400
CONTAINER	2,700	31,000	7,000	14,000	19,000	0	0
MIXED	5,400	29,000	16,000	12,000	13,000	6,100	6,100

B = Blount Island
T = Talleyrand

CONVERSION FACTORS	
Breakbulk	.4 STON per MTON
RORO	.25 STON per MTON

The type of ship preferred at each berth is based on the methodology described in Appendix B. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation to the right gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for the loading operation.

Berths 1 through 6 at Blount Island can support FSS and LMSR operations. During Desert Shield/Storm these berths handled four FSS vessels. This is mostly due to the open apron.

PREFERENCE BERTH SELECTION			
Berth	**BB**	**RORO**	**CNTR**
Talleyrand Terminal			
1-2	3	1	1
3-4	1	1	2
5	4	3	3
8th Street	2	4	-
Blount Island Marine Terminal			
1	2	2	3
2-4	1	1	2
5-6	3	3	1

NOTE: Berths marked with a “-” are not recommended for these operations.

The Talleyrand Terminal can support FSS and LMSR operations at berths 3 and 4.

SUMMARY OF BERTHING CAPABILITIES OF BLOUNT ISLAND AND TALLERAND TERMINALS

Vessel	Berth: B = Blount Island B1	B2-4	B5-6	T = Talleyrand T1-2	T3-4	T5	T8th Street
Breakbulk							
C3-S-33a	1	5	3	3	3	1	1
C3-S-37c	1	5	3	3	3	1	1
C3-S-37d	1	5	3	3	3	1	1
C3-S-38a	1	5	3	3	3	1	1
C4-S-1a	1	4	2	2	2	1	1
C4-S-1qb and 1u	1	4	2	2	2	1	1
C4-S-58a	1	4	2	2	2	1	1
C4-S-65a	1	4	2	2	2	1	1
C4-S-66a	1	4	2	2	2	1	1
C4-S-69b	1	4	2	2	2	1	1
Seatrain							
GA and PR-class	1	4	2	2	2	1	1
Barge							
LASH C8-S-81b	c	3	2	2	1	c	c
LASH C9-S-81d	c	3	1	1	1	c	c
LASH lighter	5	20	12	12	11	5	5
SEABEE C8-S-82a	a,c,g	a,g	a,g	a,g	a,g	a,c,g	a,c,g
SEABEE barge	3	14	7	7	7	4	3
RORO							
Comet	l,i	5,d,i	3,d,i	d,i,j	d,i,j	1,d,i	d,i,j
C7-S-95a/Maine-class	c	3	2	2	2	1	c
Ponce-classb,h	b,h	b,h	h	b,h	h	h	h
Great Land-class	b,c,h	b,h	h	b,h	h	h	c,h
Cygnus/Pilot-class	l	4	2	2	2	1	1
Meteor	l,i	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j
AmEagle/Condor	l,i	4,i	2,i	i,j	i,j	i,j	i,j
MV Ambassador	k,m	d	d	d	d	d	d
FSS-class	(1)	(2)	1	1,n	1	(1)	c
Cape D-class	l,i	3,i	2,i	i,j	i,j	i,j	i,j
Cape H-class	(1)	3	2	2	2	1	(1)
LMSR	(1)	2	1	1	1	(1)	(1)
Container							
C6-S-lw	1,e	4	2	2	2	1,e	1,e
C7-S-68e	c,e	3	2	2	2	1,e	c,e
C8-S-85c	c,e	3	1	1	1	c,e	c,e
Combination							
C5-S-78a	1,e	4	2	2	2	1,e	1,e
C5-S-37e	1,e	4	2	2	2	1,e	1,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

III. APPLICATION

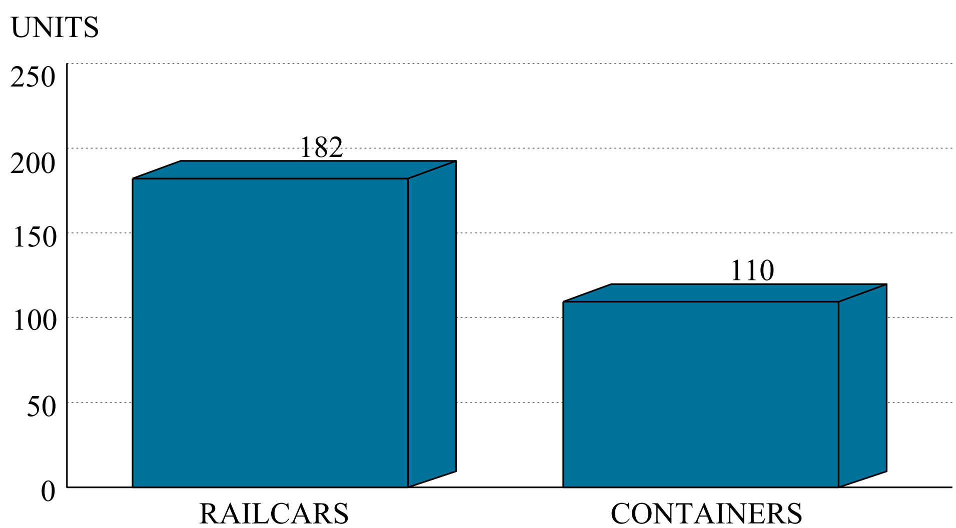
GENERAL

This section of the report will evaluate the port's throughput capability for deploying a notional air assault division using primarily FSS vessels. The August 1994 revision for the ***Planning Orders Digest***, issued by MARAD, provided agreements for military use of the Port of Jacksonville. These agreements have been renewed until 15 June 1996. The Planning Orders call for the use of 13 acres open staging, 3,000 feet of berthing, and adequate warehouse space at the Blount Island Terminal.

REQUIREMENTS

The likely requirement for the Port of Jacksonville is to deploy an air assault division in six days of reception and throughput. The division will likely come from Fort Campbell, Kentucky, about 627 miles from the port. The movement to the port will require 1,095 (182 per day) railcars using the all-rail option. About 110 containers would arrive per day.

DAILY REQUIREMENTS



TERMINAL INPROCESSING/HANDLING

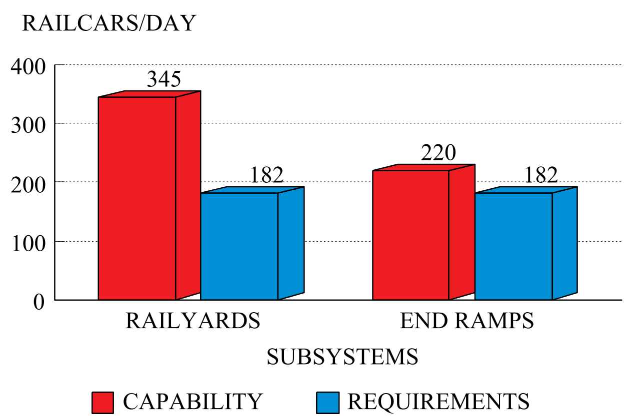
Highway

Should military vehicles arrive by convoy, they will enter the Blount Island Terminal from Heckscher Drive (Florida Route 105) over the bridge linking the island to Dames Point. Heckscher Drive intersects with several highways, including: I-95, I-295, and US 17. The road entering the terminal has four lanes. Port Support Activity personnel assist port police in receiving military vehicles at the terminal gate, and directing them to a processing area.

Rail

CSX railroad serves the Blount Island Terminal directly and switches all railcars on the island. Two other railroads, the Norfolk Southern and the Florida East Coast, have intermodal ramps located only a short distance (7 miles) from the terminal at the Imeson Industrial Park, the city's former airport.

RAIL INPROCESSING AND HANDLING CAPABILITY



CSX also operates the Busch switch yard with a capacity for approximately 250 cars, about 6 miles from the Blount Island Terminal. This yard alone could meet the requirement for rail reception and storage. The terminal can only receive and store about 95 railcars per day, without disrupting commercial operations.

The spurs at the two fixed ramps in the USMC area east of the terminal can each support offloading of about 20 railcars. This analysis will also assume one spur of the intermodal yard is available to support offloading an additional 15 railcars, with a portable ramp. Conducting four switching cycles per day at these three offloading areas would offload about 220 railcars per day. This exceeds the requirement.

Additionally, a dedicated switch engine will assure smooth efficient reception.

STAGING

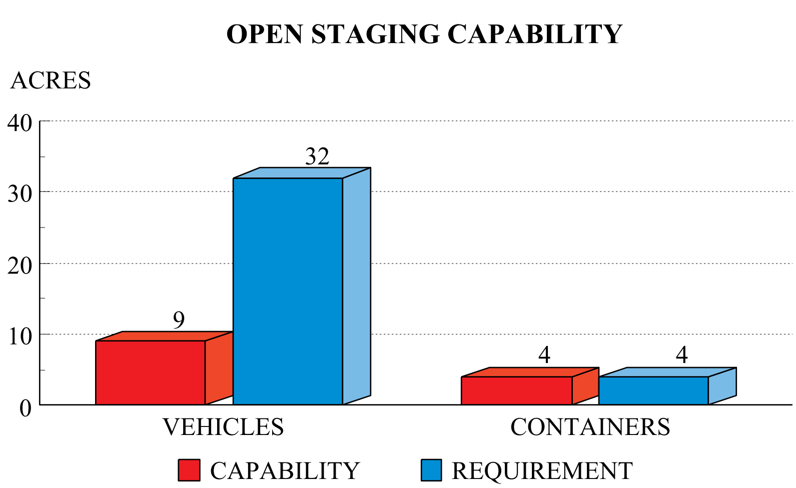
Although an FSS-load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about two acres are required for the staging of the 70 containers for each FSS.

The current size of an Air Assault Division requires 6.2 FSS-sized ships to deploy. We assume 6 FSS vessels and a small notional RORO (Ambassador/Senator class) will be used. This requires the port to simultaneously perform two sustained FSS loading operations (16 acres each) at the same time as a one-time small RORO loading operation (4 acres).

This requirement of 36 acres for staging is conservative for two reasons. We assume the small RORO vessel will load in the early stages of the deployment. The staging requirement would be less if the small RORO would load with the final two FSS-sized vessels. The final two FSS loading operations are no longer sustained operations, and therefore would only require 10 acres each. We also assume the Ambassador/Senator class vessel will sail fully loaded (about 40 percent of an FSS-load). This assumption will allow the final two FSS-sized vessels to sail with less than full loads, or with a reduced stow factor.

The Planning Orders only call for 13 acres of staging. This is not enough to meet the 36-acre requirement, as shown below.

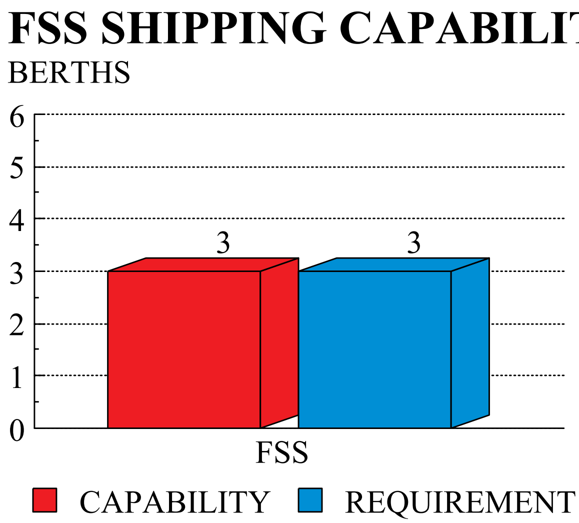
Additional staging to meet the requirement is available at the terminal. The Blount Island Terminal contains over 680 acres, of which more than 400 is open and used for staging commercial cargo. Two transit sheds provide 360,000 square feet of covered staging area. Discussions with personnel from the MTMC Cape Canaveral Outport and port operators indicate that about 75 acres are usually available. The Marine Corps' 160 acres will also likely be available. USMC operations will likely be complete before the division arrives.



SHIPPING

The requirement is to berth three ships simultaneously, for two days. At least two of these ships are to be FSS-sized. The planning orders provide berthing for three FSS-sized vessels. This meets the requirement. The remaining four days of the deployment will only require berthing for two FSS-sized vessels.

Although this analysis assumes 6.2 FSS-sized ships can deploy the air assault division, the table below provides ship quantities for various ship types. The number of ships required depends on the shipping mix selected.



UNIT MOVEMENT REQUIREMENTS, AIRBORNE ASSAULT DIVISION

Vessel Type	Number of Ships
All FSS	6.2
All LMSR	3.5
Notional RORO	11.85
All Breakbulk	24

SUMMARY

The Blount Island Marine Terminal has adequate characteristics to support the deployment of an Air Assault Division. The current Planning Orders do not provide enough staging area. The 3,000 feet of berthing is sufficient to meet the requirement.

RECOMMENDATION

We recommend revising the MARAD Planning Order Digest, to include an additional 23 acres of staging, and 5,500 feet of tangential track.

March 96

PORT OF MOREHEAD CITY, NC

I. GENERAL DATA

TRANSPORTATION ACCESS

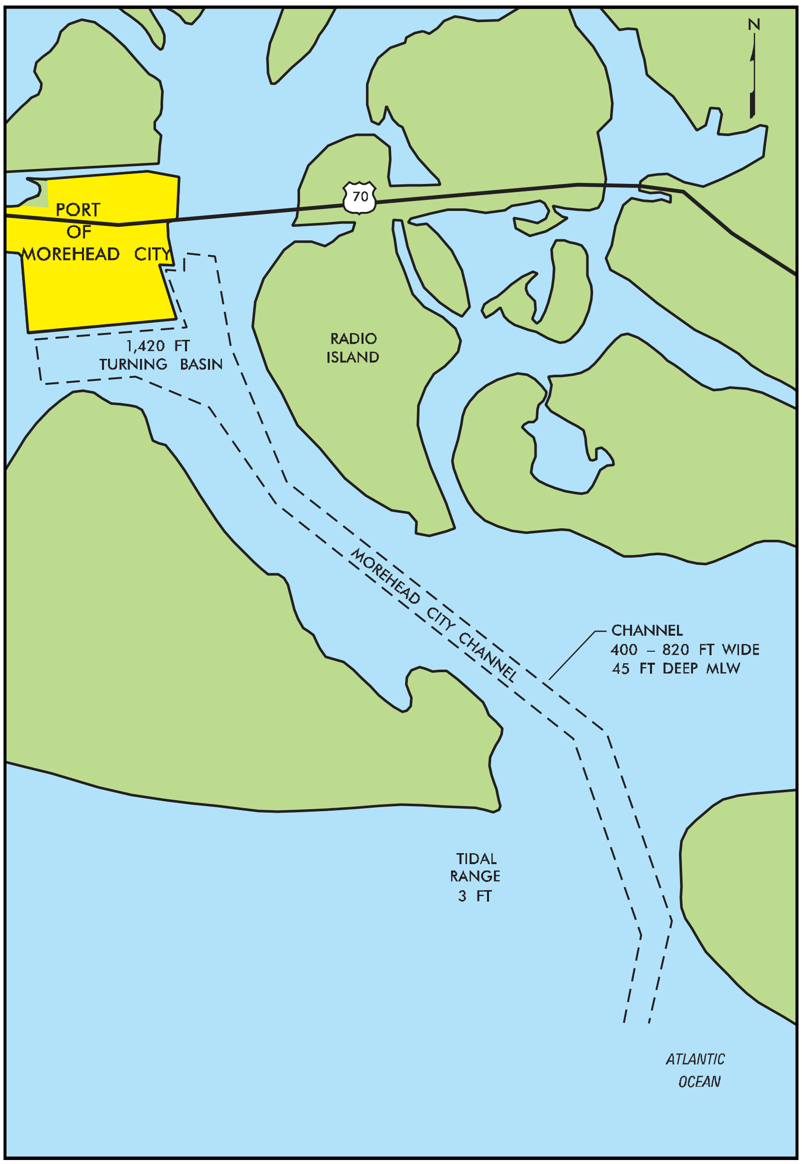
Water

The Port of Morehead City is along the Newport River and Bogue Sound. It is only 4 miles from open water. The channel that provides access to the port starts at the ocean bar channel at a depth of 47 feet deep mean low water (MLW) and is 450 feet wide. The inside channel is 45 feet deep and varies from 400 to 820 feet wide.

The mean tidal range at Morehead City is 2.9 feet.

There are no bridges on the way to the port. Ships may turn in either the east turning basin, which has a diameter of 1,420 feet at 45 feet MLW or the west turning basin off berths 7 and 8, which has a water depth of 35 feet MLW.

The port has no designated anchorage location. Vessels may wait near the sea buoy or farther east near Cape Lookout.

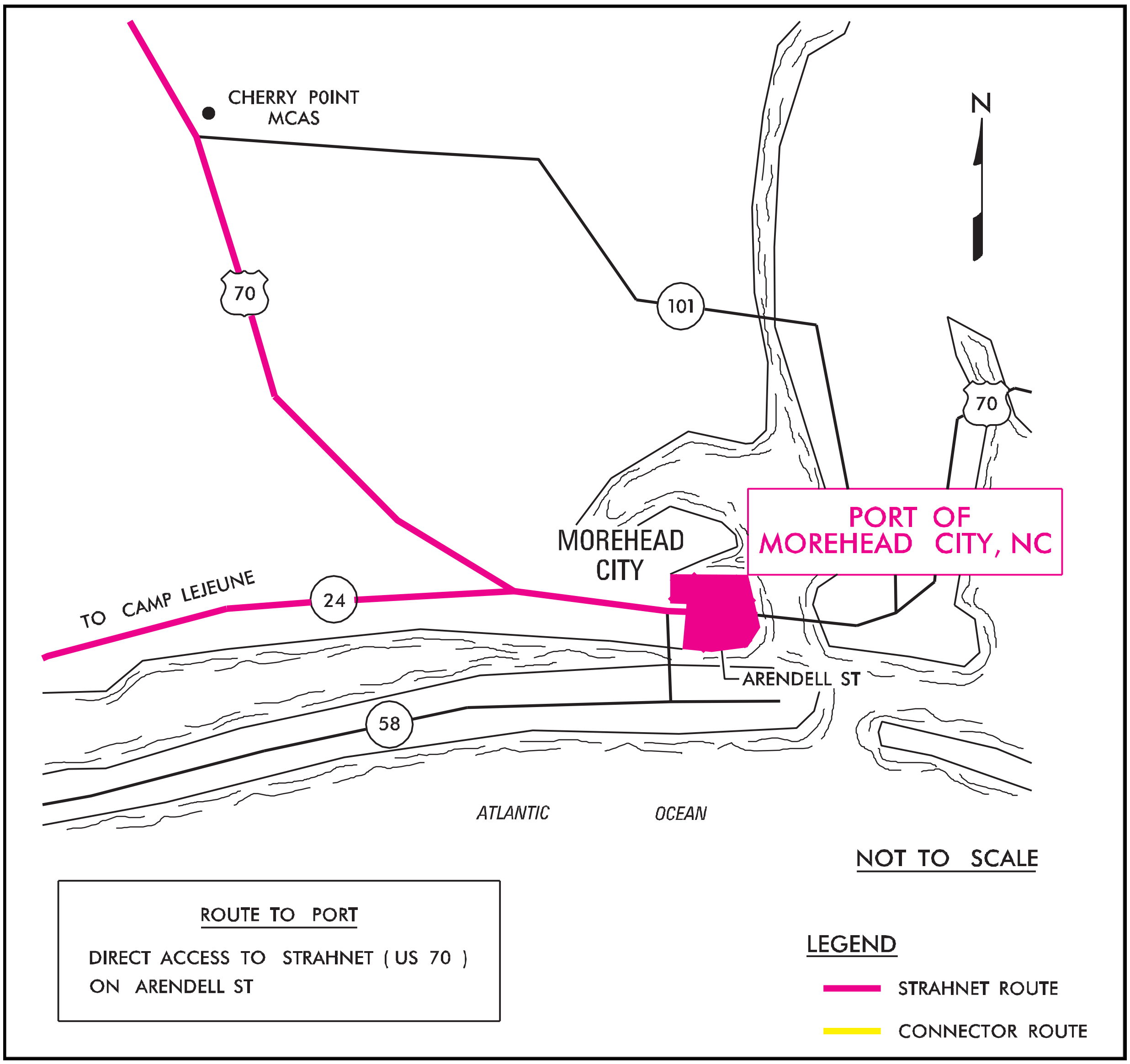


Water Access

Highway

The port lies just east of Havelock and southwest of the Outer Banks of North Carolina. Access to the port is via US Route 70 from the northwest and North Carolina Route 24 from the southwest. Just before reaching the port, North Carolina Route 24 and US 70 become Arendell Street, which then continues through Morehead City and into the port.

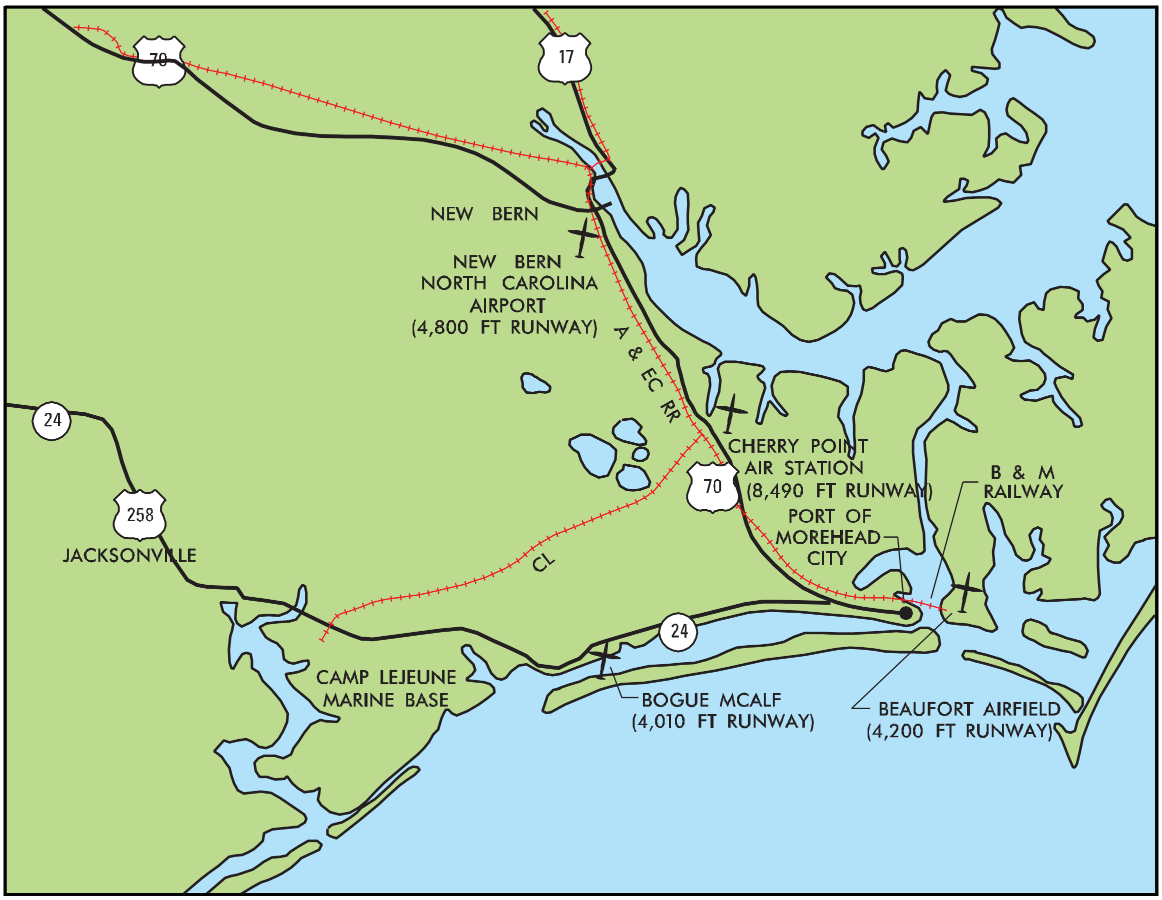
North Carolina Route 24 links the port to the Marine Corps Base, Camp Lejeune, and US 70 leads to the Marine Corps Air Station, Cherry Point.



Highway Access

Rail

The Port of Morehead City is served by the Norfolk Southern Railway and is linked with the Beaufort Morehead City Railroad (B&M). The switching railroad is owned by the North Carolina Ports Railway Commission. The railyards within the port have the capability to store 200 railcars. Areas west of the port and the nearby Radio Island, can hold more than 125 cars.



Air and Rail Access

Airports

The nearest commercial airport is the New Bern North Carolina Airport. It is approximately 30 miles northwest of Morehead City and has a 4,800-foot runway. Beaufort Airfield, which is a private airport, has 4,220 feet of runway. The nearest military airfields are Cherry Point Air Station, 20 miles from the port, and Bogue Marine Corps Air Landing Facility (MCALF).

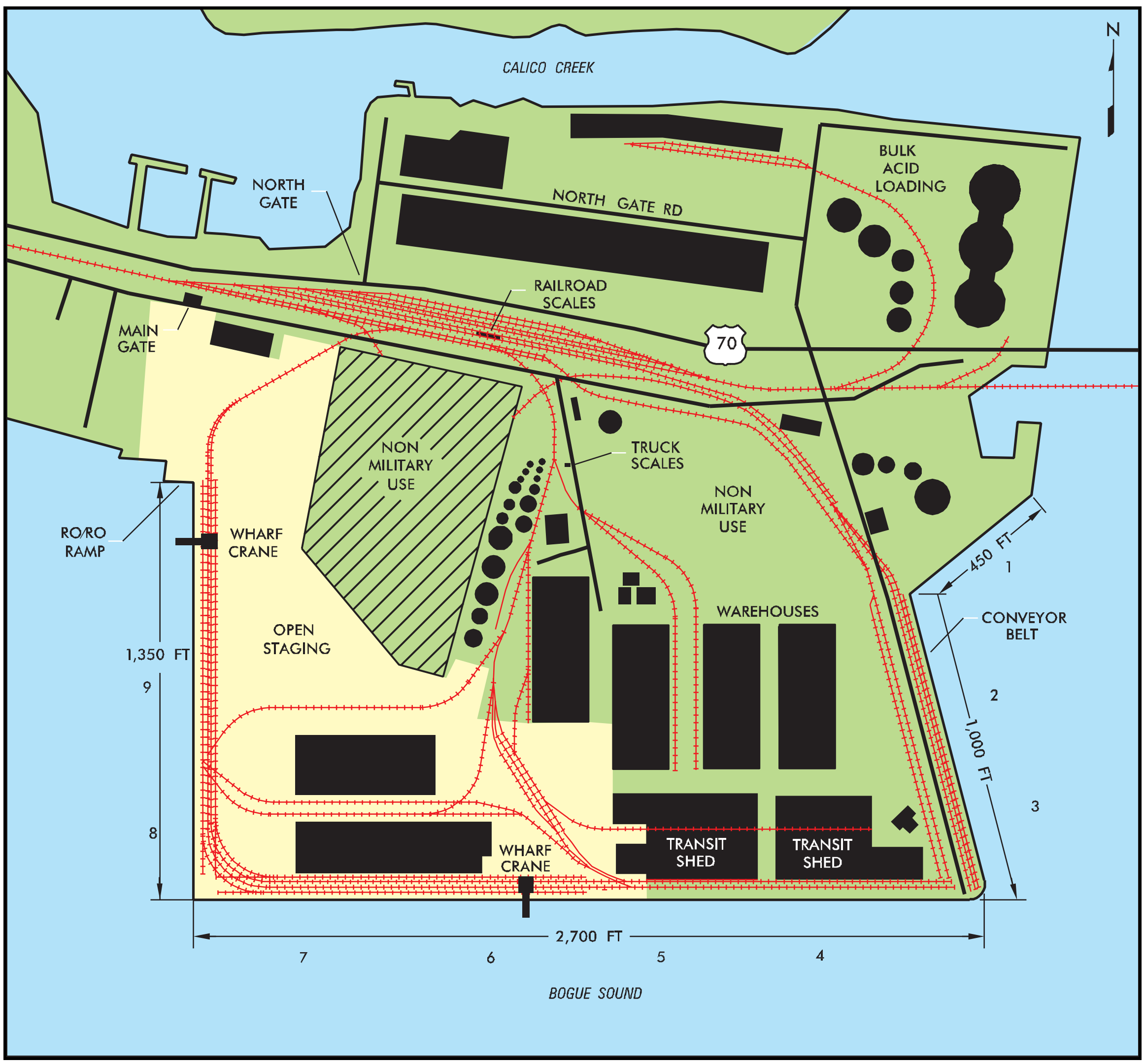
PORT FACILITIES

Berthing

The Port of Morehead City has one main terminal. Berths 2 and 3 have a conveyor for loading bulk cargo. Berth 4-7 has transit sheds to support conventional breakbulk cargo. Berth 8-9 is mainly used for RORO operations.

The deck strength varies throughout the port. Rubber fenders are on the bulkheads. The apron height averages 10 feet above MLW. Lighting is sufficient throughout the port to support night operations.

Below are land-use maps, aerial views of the port, and tables identifying the berth characteristics.



Port of Morehead City

BERTHING CHARACTERISTICS				
Characteristics	**Berths**			
	1	**2-3**	**4-7**	**8-9**
Length (ft)	500	1,000	2,700	1,350
Depth alongside at MLW (ft)	45	45	35	35
Deck strength (psf)	1,000	1,000	1,000	1,000
Apron width (ft)	Open	50	45	Open
Apron height above MLW (ft)	10	10	10	10
Number of container cranes	0	0	0	0
Number of wharf cranes	0	0	1	1
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No
Apron length served by rail (ft)	0	1,000	2,700	1,350

Port of Morehead City
(Southeastward View)

Staging

Open Staging. The Port of Morehead City has 14 acres of paved open staging. An additional 10 acres of open staging areas are on the nearby Radio Island, although most of it is undeveloped.

Open Storage adjacent to Berth 8-9 (Southward view)

Covered Staging. The port has three transit sheds along berth 4-7 that have more than 353,000 square feet of covered staging area. There are also five warehouses and two phosphate storage areas that have 457,000 and 223,000 square feet of storage, respectively.

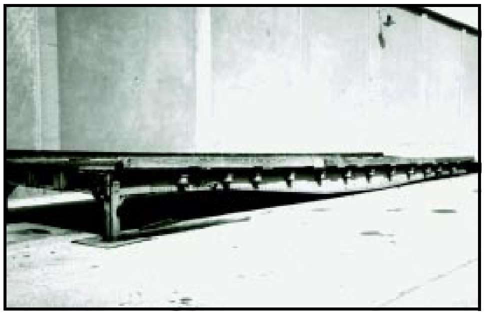
Rail

Rail trackage links the railyards to the port's apron tracks, transit sheds, and storage tracks. The port has a rail scale in the storage yard. The berths are served by two surface tracks, two platform level tracks, and two depressed tracks at the rear of the sheds.

Apron Tracks at Berths 6 and 7

Unloading/loading Positions

Ramps. The port has one fixed rail end ramp west of warehouse 6 and one portable steel end ramp. It also has a portable steel truck ramp for vans and flatbeds.



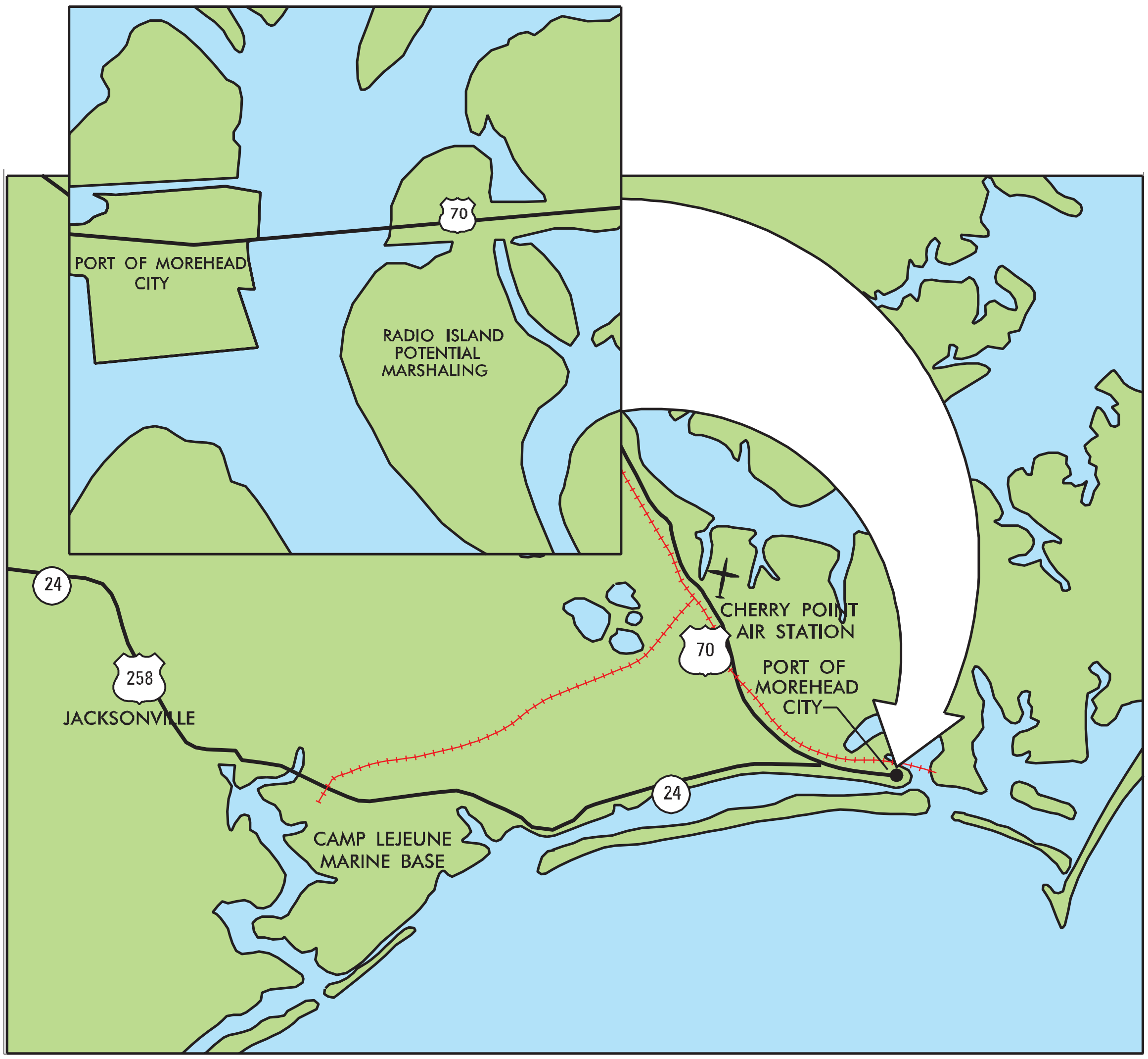
Portable End Ramp

Docks. Transit sheds 1 through 3 each have a truck dock at one end. Altogether, the terminals have 89 truck and 52 boxcar handling positions.

Marshaling Areas

Within Port. A possible marshaling area is at the north end of the port, near Calico Creek.

Outside of Port. The nearby Radio Island has unused and undeveloped land that could be a possible marshaling area. There is also the possibility of using Camp Lejeune and Cherry Point for additional marshaling areas. Each of these offsites could provide 5 to 10 acres.



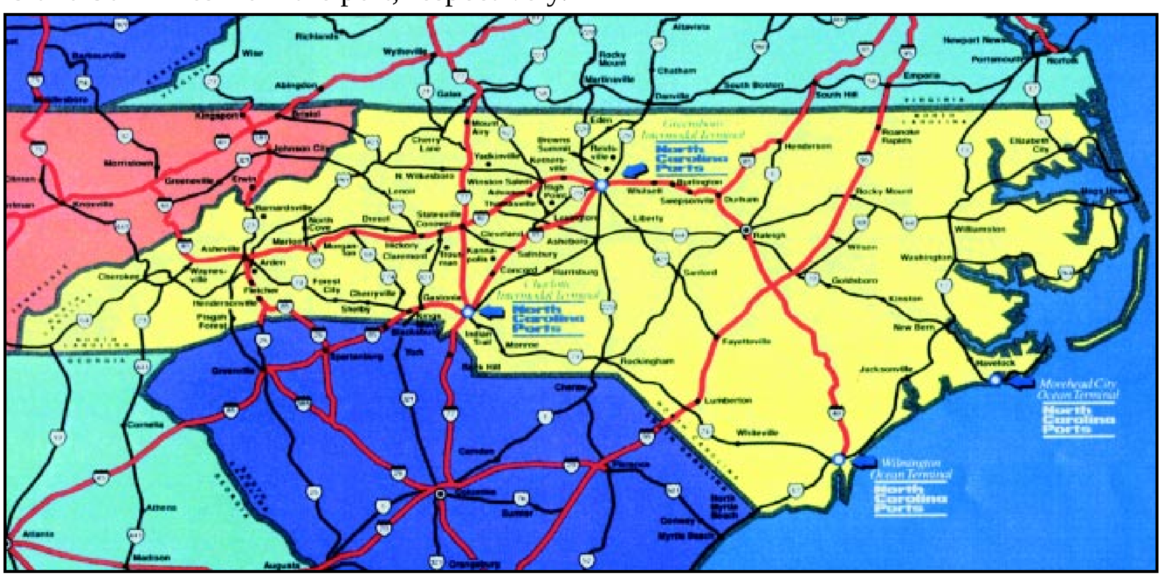
Potential Marshaling Areas

MATERIAL HANDLING EQUIPMENT (MHE)

The Port of Morehead City has two gantry cranes with a 115-ton capacity. Both cranes are at the southwest side of the port. One is used by berth 6-7 and the other is used by berth 8-9. Other MHE includes 36 lift trucks with capacities ranging from 4,000 to 15,000 pounds, forklifts, yard tractors, road tractors, road trailers, a pair of front end loaders, flat trailers, and portable conveyors.

INTERMODAL FACILITIES

Two facilities in the North Carolina area are the Greensboro and Charlotte Terminals, located 219 and 307 miles from the port, respectively.



Intermodal Terminals

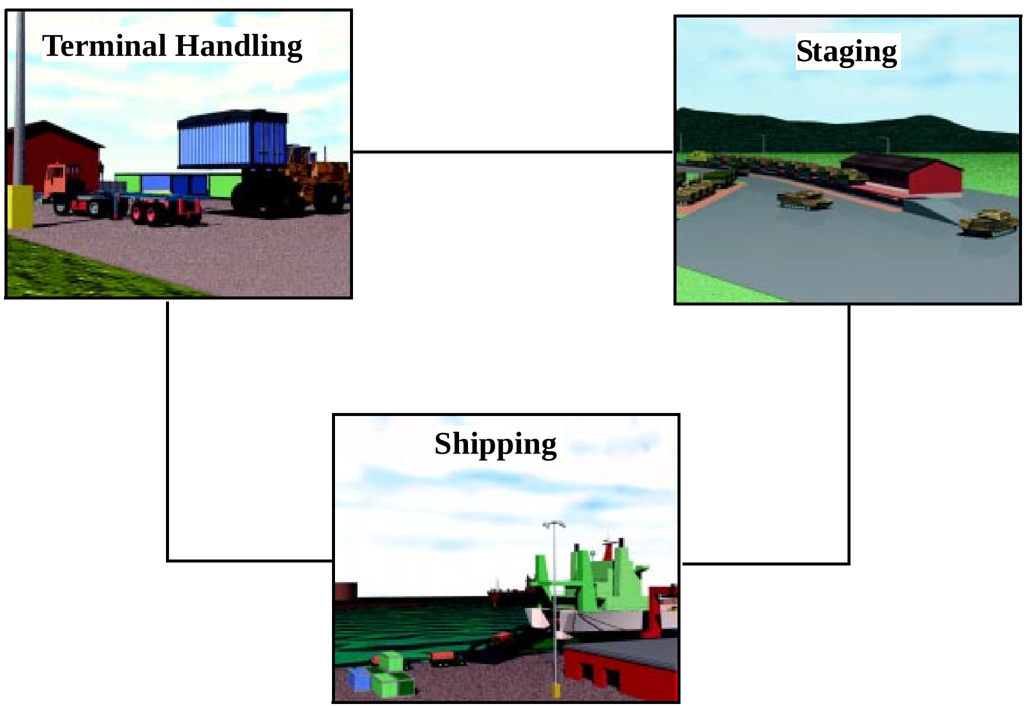
FUTURE DEVELOPMENT

Presently, no plans are being developed for future growth. However, some undeveloped acreage surrounds the port. There is more land available for development on Marsh Island to the north and Radio Island to the east.

II. THROUGHPUT ANALYSIS

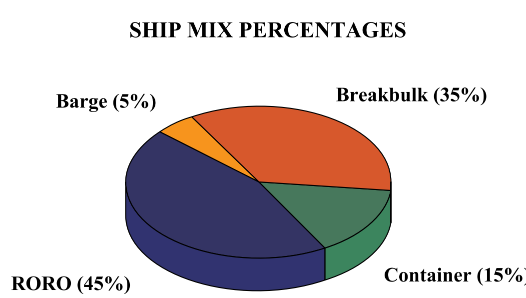
GENERAL

This section evaluates the throughput capability of the Port of Morehead City using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



Terminal Throughput Subsystems

The analysis assumes a maximum of 80 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80 percent facility use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



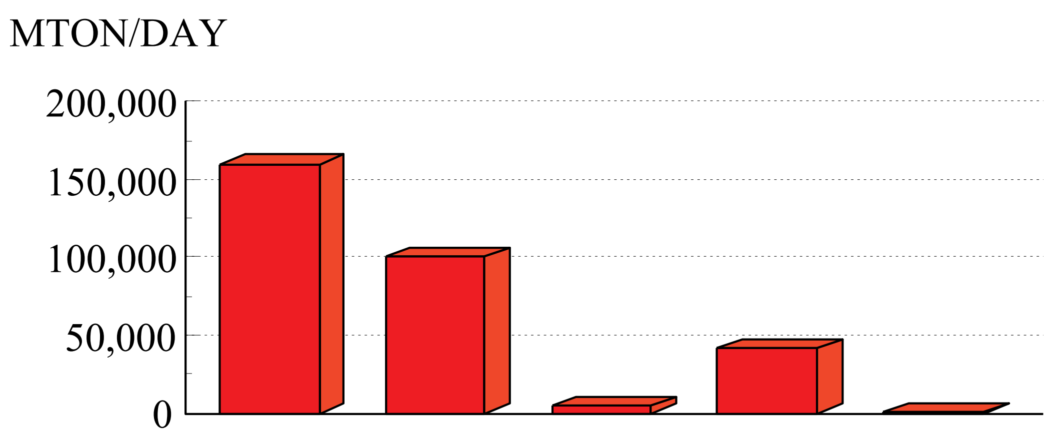
TERMINAL RECEPTION/HANDLING

Highway. US Route 70 and North Carolina Route 24 provide access to the port. The terminal has a designated entrance for trucks. The road network in and out of the terminal, including the gate processing of vehicles, could handle about 100,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload using the portable truck ramp. There are no permanent truck end ramps at the port.

Supplies in van semitrailers will proceed to the van-handling positions. These docks can offload more than 42,000 MTON of van semitrailer-shipped materials per day.

HIGHWAY RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS*	DOCKS	CONTAINERS
MOREHEAD CITY	160,000	100,000	4,800	42,000	1,100

*1 portable or temporary ramp is assumed available.

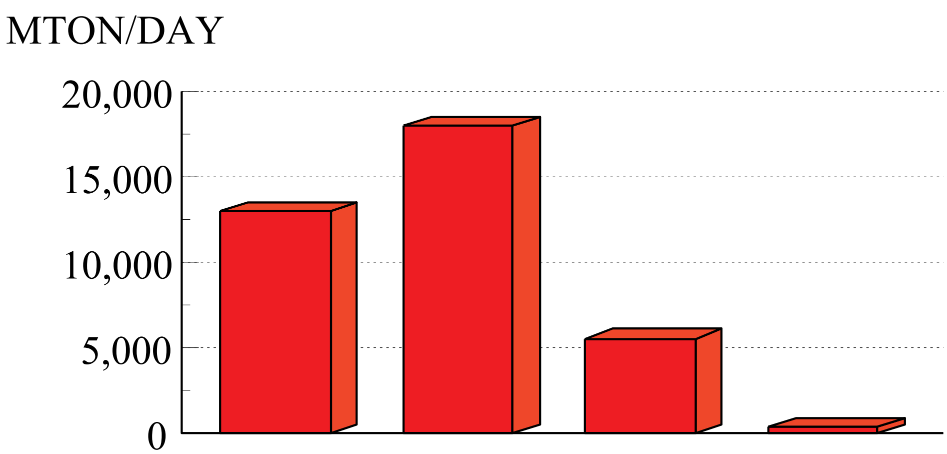
Rail

Rail reception at the port is fairly good with two railroad companies accessing the area. The berths have two surface tracks, two platform level tracks, and two depressed tracks at the rear of the transit sheds.

This analysis assumes the port's portable rail end ramp is available. This would be in addition to the ramp regularly used. We assume the portable ramp would be used near covered storage or at the rail storage location, with 650 feet of tangential track.

Boxcars could offload at the transit sheds where about 52 boxcar handling positions are available.

RAIL RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	TRACKAGE	END-RAMPS*	DOCKS	COFC
MOREHEAD CITY	13,000	18,000	5,600	370

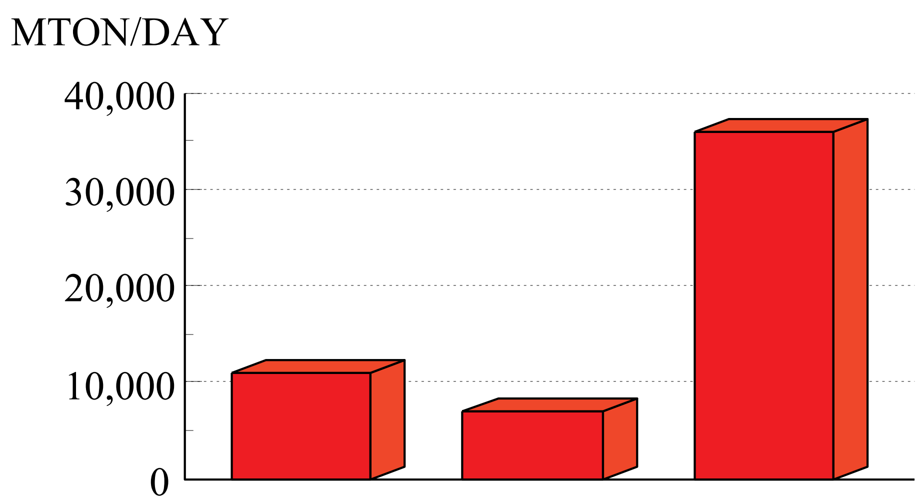
*1 fixed ramp and 1 portable ramp are assumed available.

STAGING

The port has a total of about 14 acres of open paved staging. There is also about one-half million square feet of covered sprinklered storage.

The terminal can perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned. The chart below provides the staging capability for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.

OPEN STAGING CAPABILITY

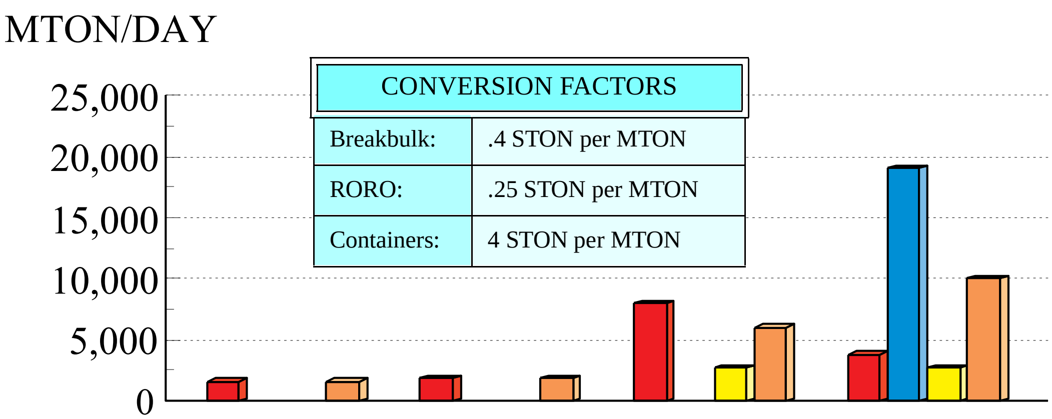


VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
MOREHEAD CITY	11,000	7,000	36,000

SHIPPING

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility. We indicate these factors in Appendix A.

BERTH THROUGHPUT CAPABILITY



BERTH	B-1	B2-3	B4-7	B8-9
BREAKBULK	1,600	1,900	8,000	3,800
RORO	0	0	0	19,000
CONTAINER	0	0	2,700	2,700
MIXED	1,600	1,900	6,000	10,000

The type of ship preferred at each berth is based on the methodology described in appendix B. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation to the right gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for the loading operation.

PREFERENCE BERTH SELECTION

BERTH	BB	RORO	CNTNR
1	4	-	-
2-3	3	-	3
4-7	1	-	2
8-9	2	1	1

Berth 8-9 can support FSS and LMSR operations. Although water depth is greater at the other berths, the aprons are obstructed by buildings and/or conveyor systems, which makes them unsuitable for FSS and LMSR operations.

SUMMARY OF BERTHING CAPABILITIES

Vessel	Berths 1	Berths 2-3	Berths 4-7	Berths 8-9
Breakbulk				
C3-S-33a	1	1	5	2
C3-S-37c	1	1	5	2
C3-S-37d	1	1	5	2
C3-S-38a	1	1	5	2
C4-S-1a	c	1	4	2
C4-S-1qb and 1u	c	1	4	2
C4-s-58a	c	1	4	2
C4-S-65a	c	1	4	1
C4-S-66a	c	1	4	2
C4-S-69b	c	1	4	2
Seatrain				
GA and PR-class	c	1	4	2
Barge				
LASH C8-S-8lb	c	1	3	1
LASH C9-S-81d	c	1	a	a
LASH lighter	3	7	19	9
SEABEE C8-S-82a	c,g	g	a,g	a,g
SEABEE barge	2	5	13	6
RORO				
Comet	d,i,j	d,o	d,o	i,j
C7-S-95a/Maine-class	c	b	b	1
Ponce-class	c,h	b,h	b,h	h
Great Land-class	c,h	b,h	b,h	h
Cygnus/Pilot-class	c	b	b	2
Meteor	c,d	d,o	d,o	i,j
AmEagle/Condor	c	b	b	i,j
MV Ambassador	c,d	d	d	2,m
FSS-class	c	b	b	l
Cape D-class	c	b	b	i,j
Cape-H class	c	b	a,b	a
LMSR	c	b	l	l
Container				
C6-S-1w	c,e	1,e	3,e	1,e
C7-S-68e	c,e	1,e	3,e	1,e
C8-S-85c	c,e	1,e	3,e	1,e
Combination				
C5-S-78a	c,e	1,e	4,e	2,e
C5-S-37c	c,e	1,e	4,e	2,e

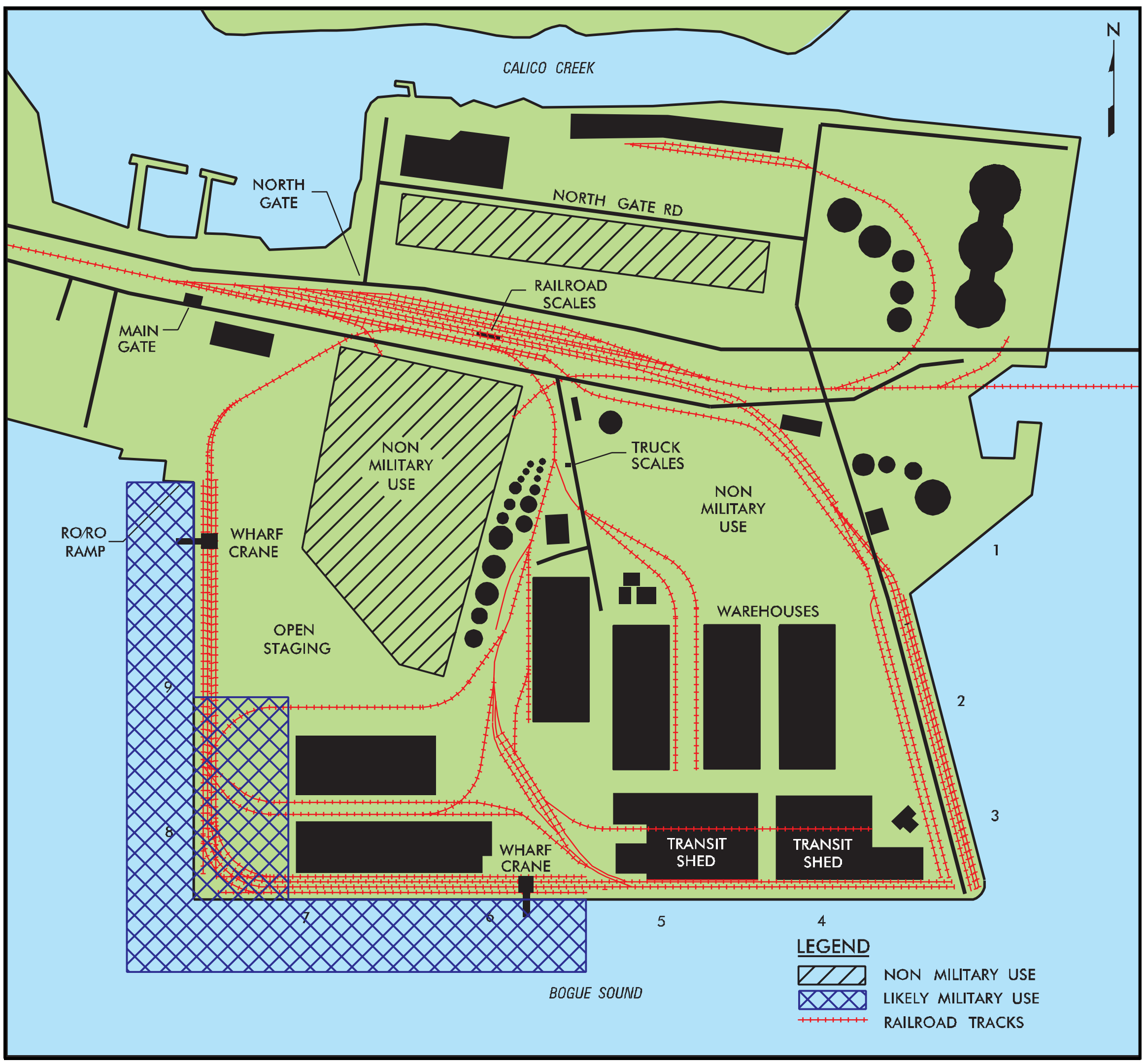
a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel drafts.
( ) indicates vessels assigned by analyst

III. APPLICATION

GENERAL

This section will evaluate the port's throughput capability for deploying a notional mechanized infantry brigade using primarily FSS vessels. The August 1994 revision for the ***Planning Orders Digest***, issued by MARAD, provided an agreement for the military to use the Port of Morehead City. It called for use of berth 6-7, berth 8-9, and 7 acres of adjacent open storage. Although these agreements expired 1 July 1995, we expect they will be renewed without significant change, until 15 June 1997. New planning orders are being considered at the time of this publication.



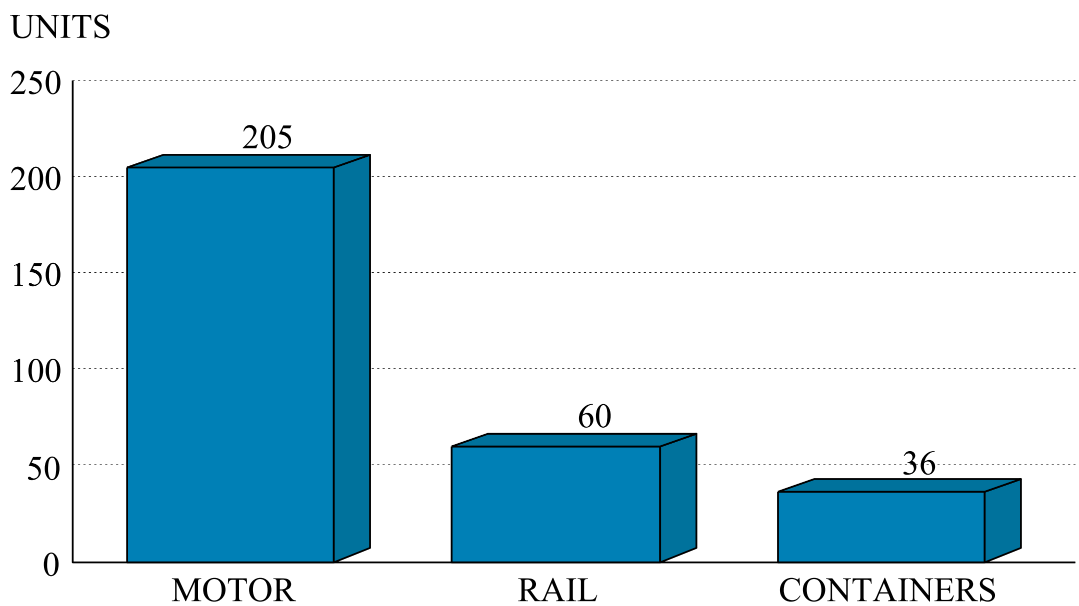
Facilities likely to be used for Military Operations

REQUIREMENTS

The likely requirement for the Port of Morehead City is to deploy a notional mechanized infantry brigade in 6 days. The brigade has to move about 2,600 vehicles and 220 containers. The movement to the port will require 360 railcars (60 per day) using the convoy/rail option. Under this option, about 1,200 (205 per day) roadable vehicles would be driven and about 775 (130 per day) would be towed.

MECHANIZED INFANTRY BRIGADE	
Total Equipment	
Volume	91,506 MTON
Weight	31,670 STON
Area	474,300 SQ FT
Vehicles	2,600
Containers	220

DAILY REQUIREMENTS

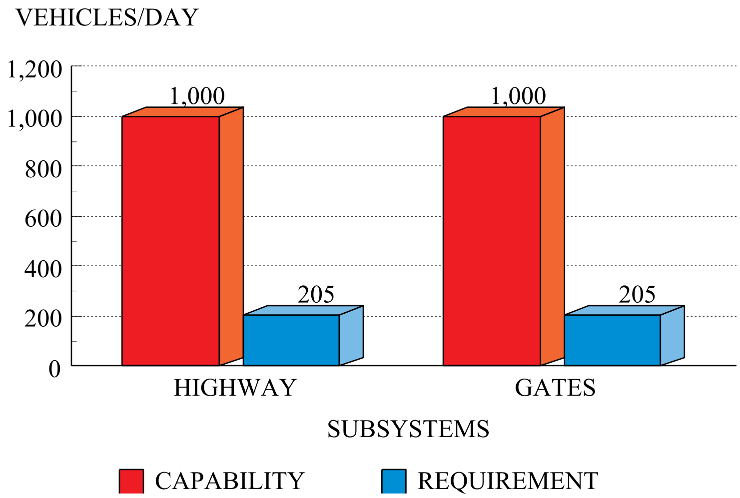


TERMINAL HANDLING

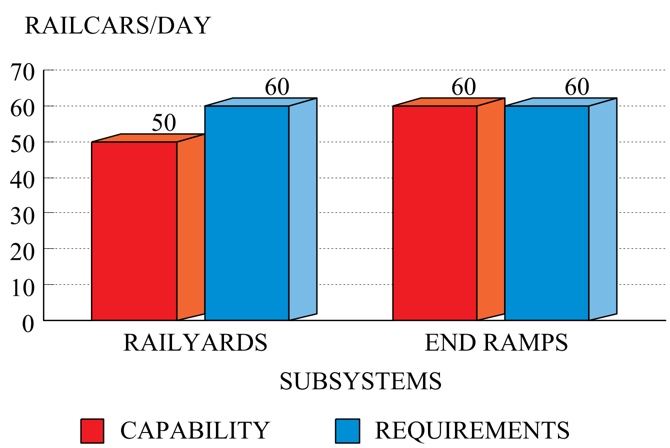
Highway

The major connector routes to the port are US Route 70 and North Carolina Route 24. Vehicles and containers on chassis would access the terminal through the main gate via Arendell Street. The access roads and gates can handle well over 1,000 vehicles per day.

HIGHWAY INPROCESSING CAPABILITY



RAIL INPROCESSING AND HANDLING CAPABILITY



Rail

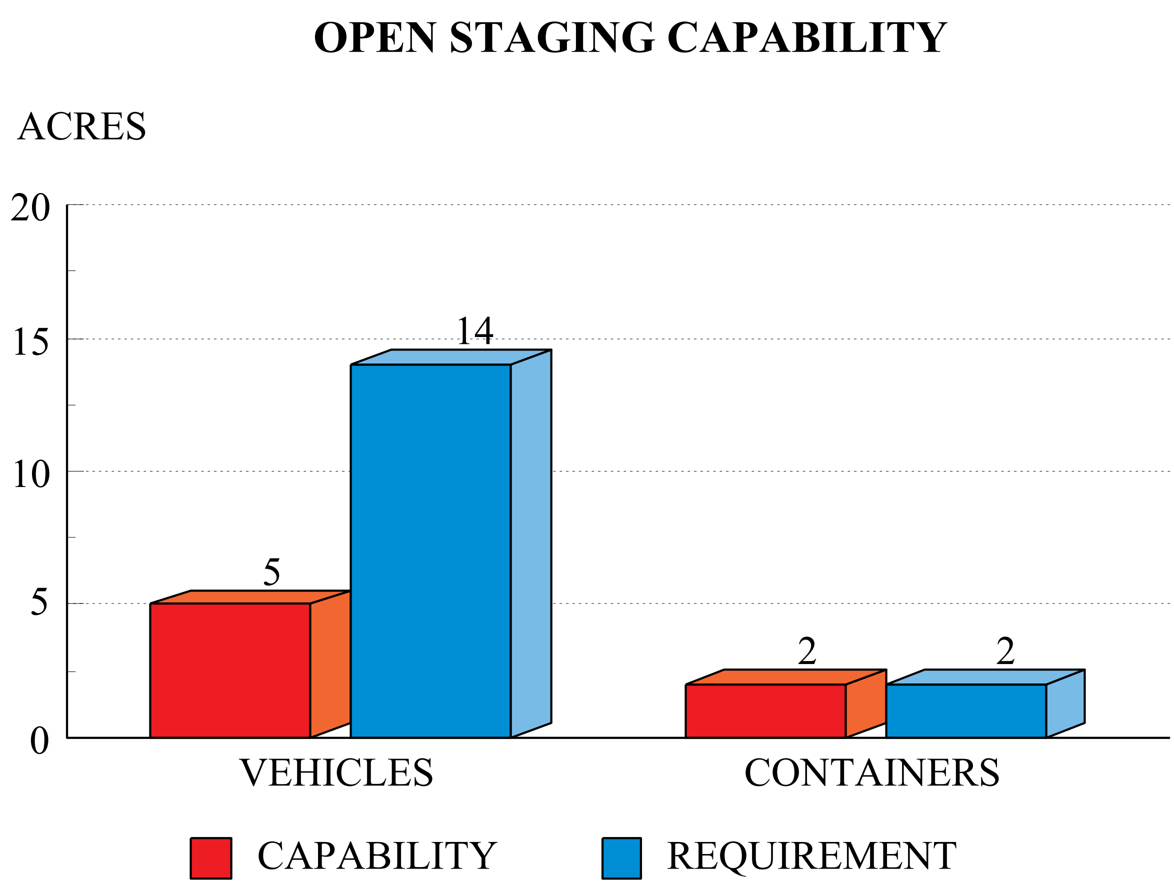
The railyard within the port area can receive only about 50 railcars without disrupting the simultaneous commercial operations. This does not meet the requirement of the unit. There are other railcar storage locations on Radio Island and areas west of the port that could store in excess of 125 cars.

The fixed ramp west of warehouse 6 can support offloading eight railcars. The port's portable end ramp can easily support offloading seven additional railcars at any of several locations. We recommend using the adjacent track (also west of warehouse 6) if available. Offloading these 15 railcars every 5 hours will meet the 60 railcar per day requirement.

STAGING

This analysis assumes that current downsizing continues, and that three FSS-sized ships will deploy an entire notional mechanized infantry brigade. One ship will depart every two days.

Although an FSS load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for staging containers. In addition to the acreage in the August 1994 Planning Orders, nine more acres are required. If the acreage on the port is not available, the adjacent Radio Island could provide offsite staging to meet the 16 acre requirement.



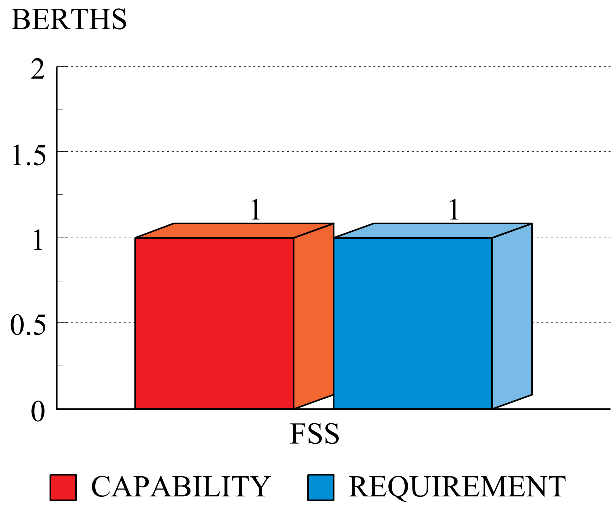
SHIPPING

Although this analysis assumes that three FSS-sized ships can deploy the notional mechanized infantry brigade, the table below provides ship quantities for the current brigade size. The number of ships required depends on the shipping mix selected. Berth 8-9 can support FSS and LMSR operation. This berth alone meets the requirement.

The apron of berth 6-7 is too narrow for FSS side ramp operations, but LMSR vessels can load by placing the stern ramp between the transit sheds.

This berthing capability meets the one-FSS berthing requirement. If LMSR vessels are used, the berthing capability exceeds the requirement.

FSS SHIPPING CAPABILITY



UNIT MOVEMENT REQUIREMENTS
MECHANIZED BRIGADE

Loading Condition/ Sample Ship Mix	Vessel Types			
	FSS (RORO/Comb)	Cape H (RORO/Comb)	C3/C4 (Breakbulk)	C6/C7/C8 (Container)
Minimum Containerization:				
All FSS	3.33			
FSS and Cape H	2.22	1.00		
All Breakbulk			12.57	
Maximum Containerization:				
FSS, and Container	2.64			0.67
FSS, Cape H, and Container	1.54	1.00		0.67
Breakbulk and Container			9.86	0.67

Legend:
RORO - roll on/roll off
FSS - fast sealift ship
Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide. Aug 91.

SUMMARY

The Port of Morehead City has adequate characteristics to support the deployment of a brigade as long as 9 acres are added to the 7 acres provided by the Planning Orders. Berth 8-9 is best suited for all-around operations due to crane access, adjacent open storage, and available RORO ramp.

The port harbor east turning basin, which has a diameter of 1,420 feet, is large enough for FSS, LSMR, and Cape H vessels to turn

RECOMMENDATION

We recommend use of the Port of Morehead City for deploying a mechanized infantry brigade as long as the following conditions are met:

- Nine staging acres are added to those called for by the now expired Planning Orders.
- Ten railcar per day offsite reception is available to supplement the capability of the port's railyard.
- The port's portable rail ramp is available to supplement the fixed rail end ramp of the port.

PORT OF NEW YORK/NEW JERSEY

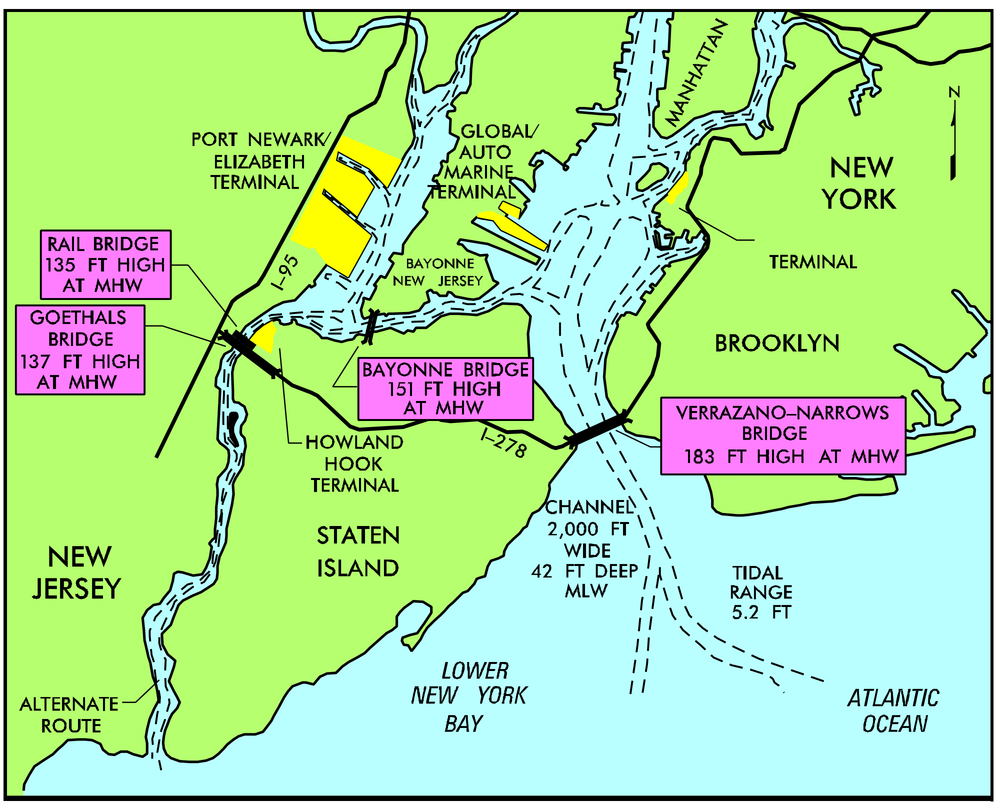
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of New York and New Jersey is the largest port on the east coast and consists of several terminals. The port consists of more than 2,100 acres, 8 miles of berthing, and 76 miles of railroad tracks. The channel that provides access to the Port of New York and New Jersey has a water depth ranging from 35 feet in the smaller waterways to 40+ feet throughout the rest of the Upper and Lower New York Bay at mean low water (MLW). The port is only 9 miles from the Atlantic Ocean. The mean tidal range throughout the port is 5.2 feet. This report will only consider the Port Newark/Elizabeth, Global Marine, Auto Marine, Red Hook, and Howland Hook Terminals.

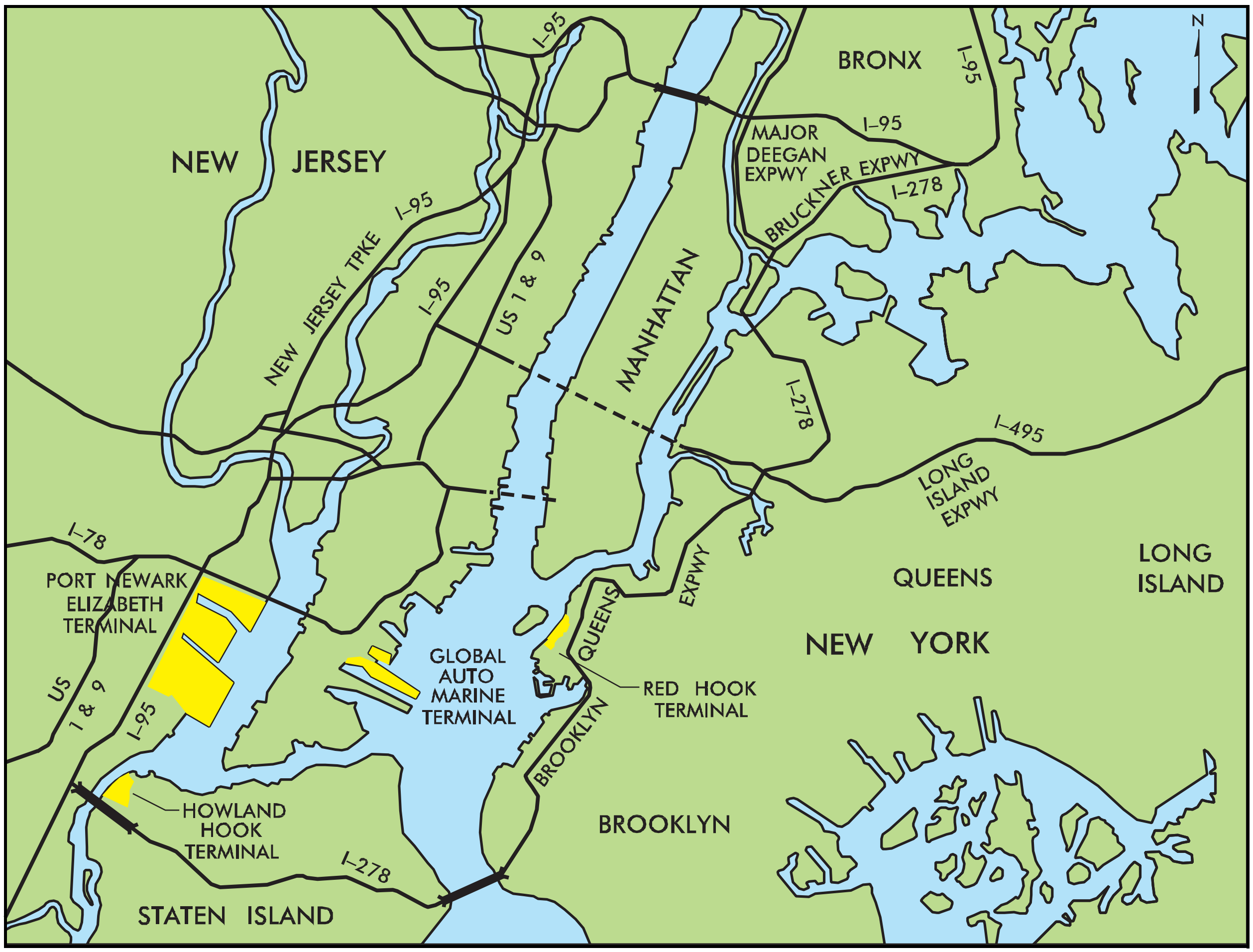
The only overhead obstruction for the terminals of this report is the Verrazano-Narrows Bridge with a vertical clearance of 183 feet at mean high water (MHW). The channel leading to the Port Newark/Elizabeth and Howland Hook Terminals is crossed by the Bayonne Bridge, with a clearance of 151 feet MHW. Neither of these bridges restrict ships.



Water Access

Highway

The Port of New York and New Jersey is in a heavily populated region. Anticipate heavy but moving traffic when using any route named in this report. Highways accessing the port area are Interstate Routes 95 (New Jersey Turnpike), 495, and 278; US Routes 1 and 9; and. The numerous toll plazas make highway travel throughout the region even more difficult. I-78 leads directly into the Port Newark Terminal.



Highway Access

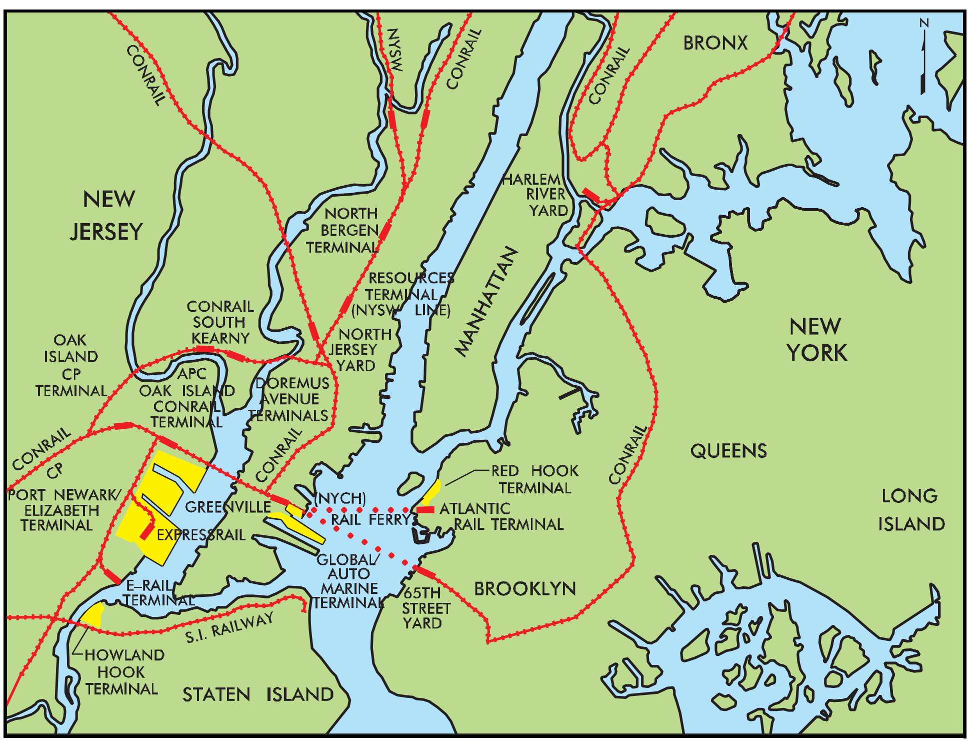
Rail

Rail Service		
Terminal	Rail Reception	
	Trains per Day	Railcars per Train
Port Newark	2	60
Port Elizabeth	2	60
Global Marine	1	60
Red Hook	1 (indirect)	60
Howland Hook	2 (expected)	60

The main rail carrier for the Port of New York and New Jersey is Conrail. Both Conrail and the New York, Susquehanna and Western Railway have double-stack capability. The port is served by more double-stack rail service than all others on the east coast. Maher Terminal at Port Elizabeth operates ExpressRail, which links on-dock rail service to many major midwestern and Canadian cities on a daily basis. This double stack intermodal terminal gives quick and efficient rail access and can connect to any point in the United States.

Rail service varies from day to day. The values in the table at right are conservative for the full capability of each terminal. These values were used for this analysis.

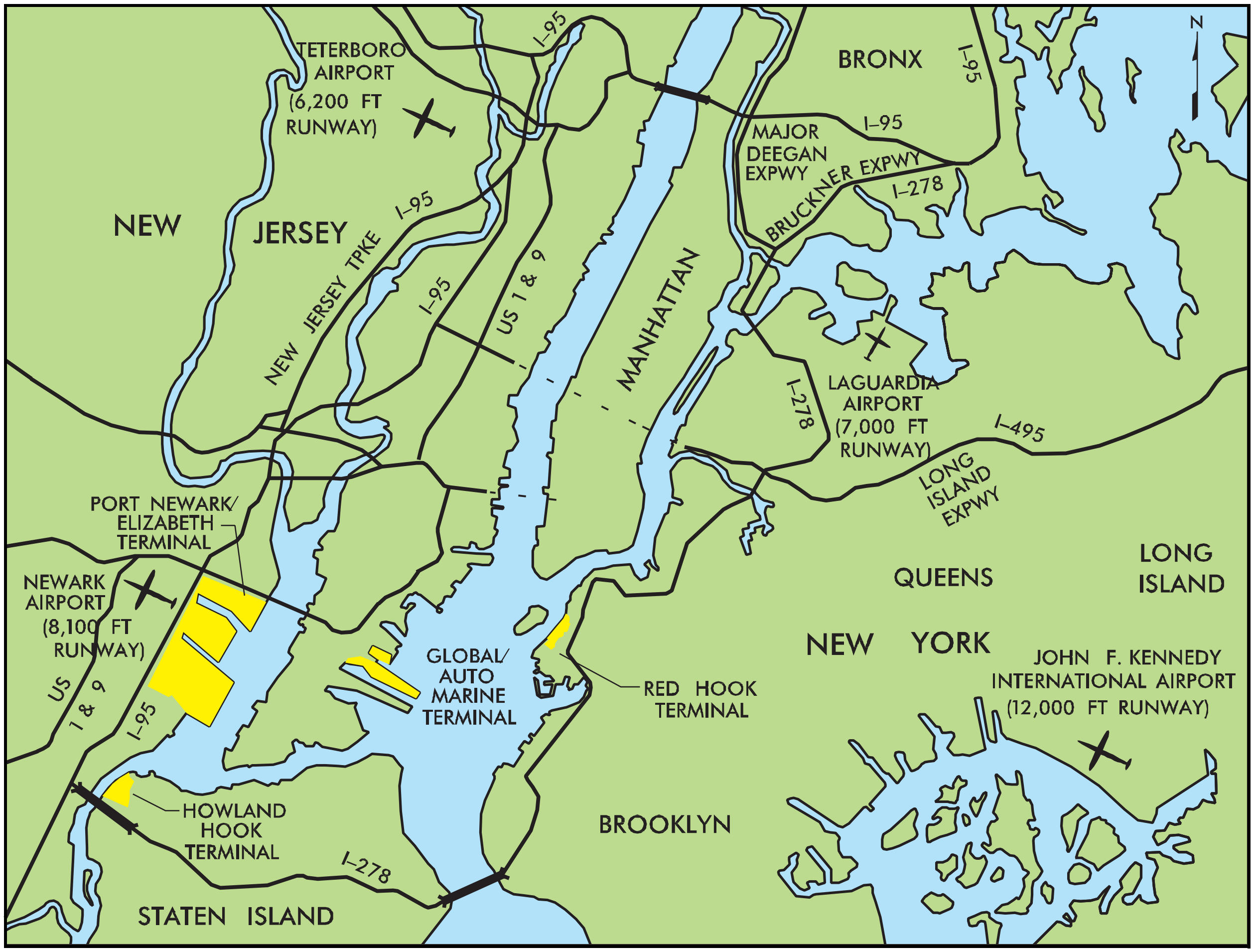
The Howland Hook Terminal rail access is out of service at time of publication. The Port Authority expects the service to be restored in late 1996 or 1997. We expect the line will support full DoD clearance and weight requirements, but we cannot be certain until the restoration is complete. Of the remaining terminals, only the Red Hook and Auto Marine Terminals do not have direct rail access. Rail-transported cargo is drayed less than a mile to the Red Hook Terminal, and from the adjacent Global Terminal to access the Auto Marine Terminal.



Rail Access

There are several railyards throughout the port to accommodate over 1,000 railcars.

Three major airports are in the port area. The two largest are Newark International, which is separated from the Port Newark/Elizabeth Terminal by I-95 less than a mile away; and John F. Kennedy International, located in Queens. The other, LaGuardia Airport, is northeast of the port. The smaller commuter Teterboro Airport is north of the port.

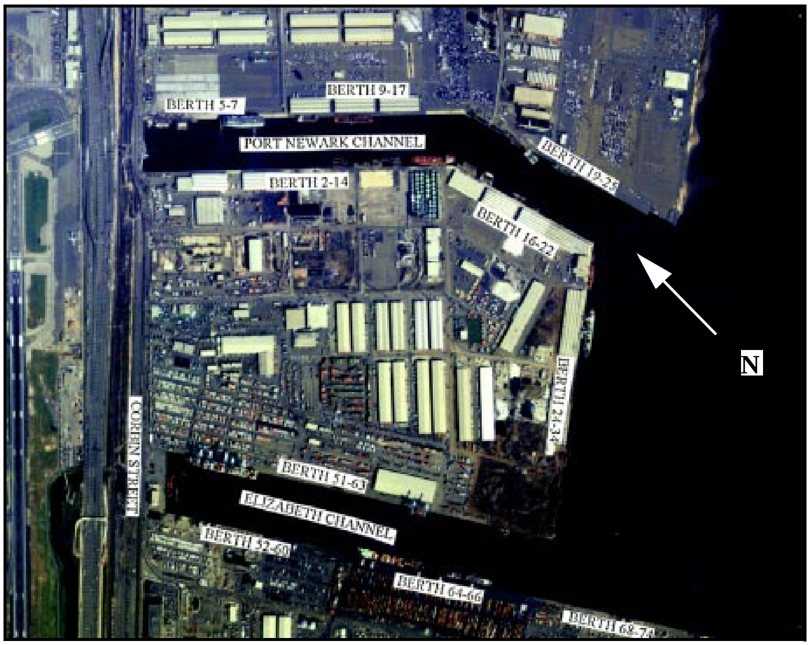


Air Access

PORT FACILITIES

Berthing

This report covers five areas of the port. Each area is considered a terminal, although each may involve several shipping lines. For this report, we will consider the Port Newark/Elizabeth, Global Marine, Auto Marine, Red Hook, and Howland Hook Terminals.



These terminals are primarily container facilities. Some facilities have transit sheds to support conventional breakbulk cargo. The Auto Marine Terminal is used mainly for RORO operations of small vehicles.

Pier construction is generally concrete retaining walls with asphalt-surfaced solid fill over concrete relieving platforms. These relieving platforms are supported by steel, concrete, or timber piles. Fenders are generally timber. All container terminals have lighting for night operations. Portable lighting is available from local stevedore companies.

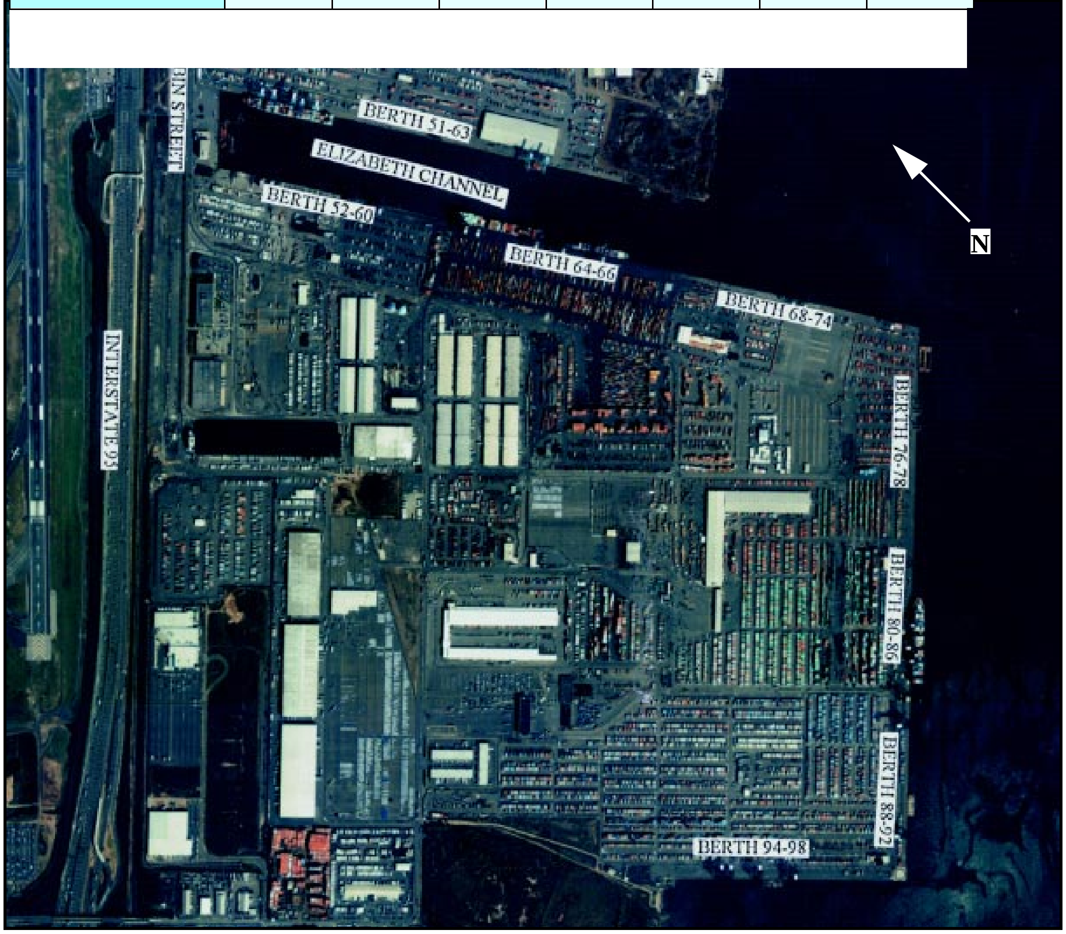
BERTHING CHARACTERISTICS OF PORT NEWARK TERMINAL

Characteristics	Berths						
	5-7	9-17	19-25	2-14	16-22	24-35	51-63
Length (ft)	1,374	2,923	2,790	4,144	2,150	4,010	5,308
Depth alongside at MLW (ft)	35	35	35	35	35	35	37
Deck strength (psf)	500	500	500	1,000	500	500	500
Apron width (ft)	Open	56	Open	Open	50	50	Open
Apron height above MLW (ft)	11	11	11	11	11	11	11
Number of container cranes	0	0	0	0	0	0	10
Number of wharf cranes	0	0	0	0	0	0	0
Apron lighting	No	Yes	No	No	No	No	No
Straight-stern RORO facilities	No	No	No	No	No	No	No
Apron served by rail (ft)	0	2,923	2,150	2,500	0	2,000	3,822

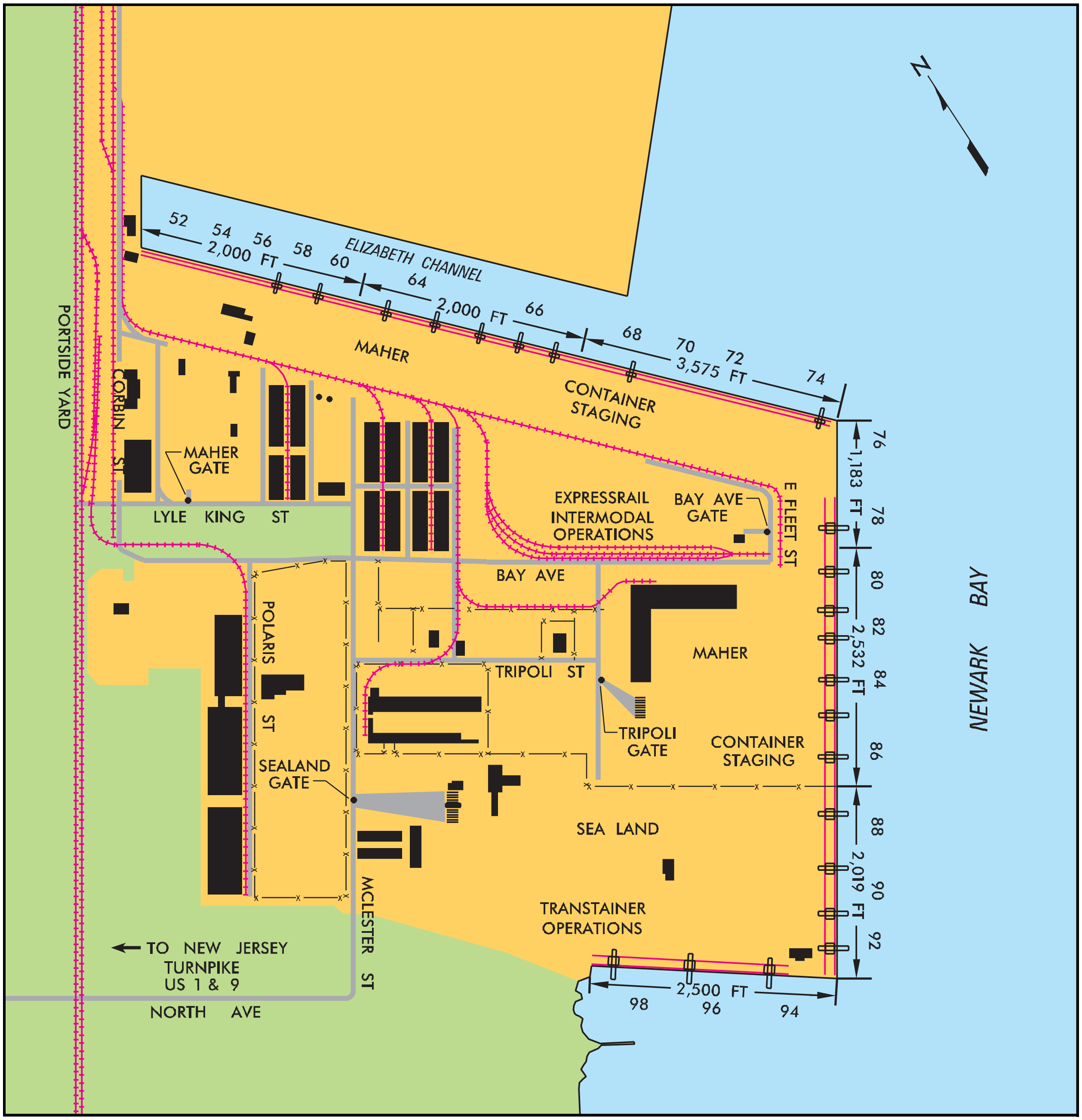
Below are land-use maps and aerial views of the terminals of this report. Also included are tables identifying berth characteristics.

Port Newark Terminal

BERTHING CHARACTERISTICS OF PORT ELIZABETH TERMINAL							
Characteristics	**Berths**						
	52-60	**64-66**	**68-74**	**76-78**	**80-86**	**88-92**	**94-98**
Length (ft)	2,200	2,000	3,575	1,183	2,532	2.019	2,500
Depth alongside at MLW (ft)	35	35	35	38	38	38	40
Deck strength (psf)	500	500	500	500	500	500	500
Apron width (ft)	Open	Open	Open	Open	Open	Open	Open
Apron height above MLW (ft)	12	12	12	12	12	12	12
Number of container cranes	4	3	1	0	7	4	3
Number of wharf cranes	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	No	No	No	No	No	No

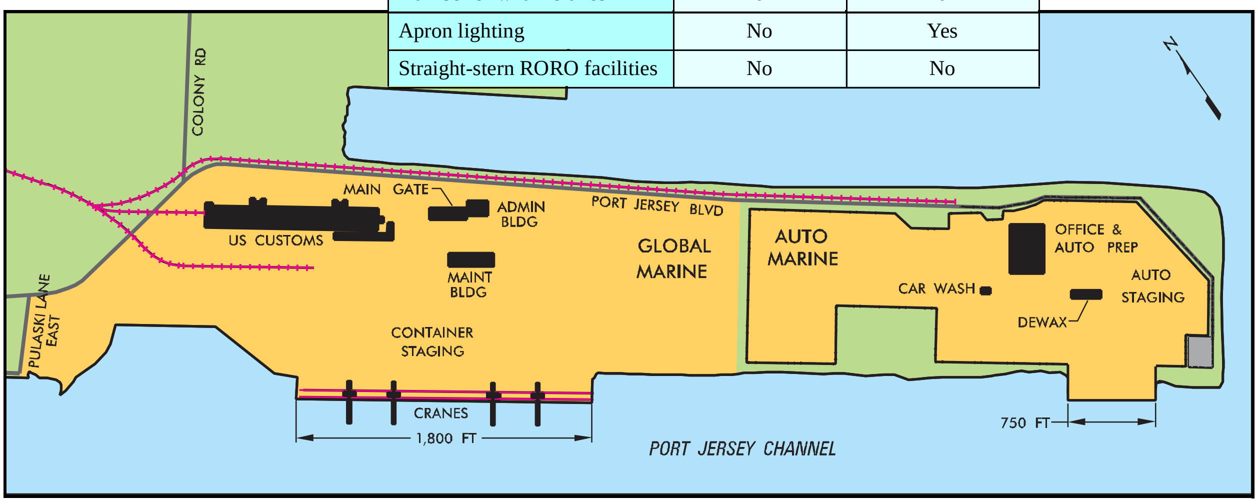


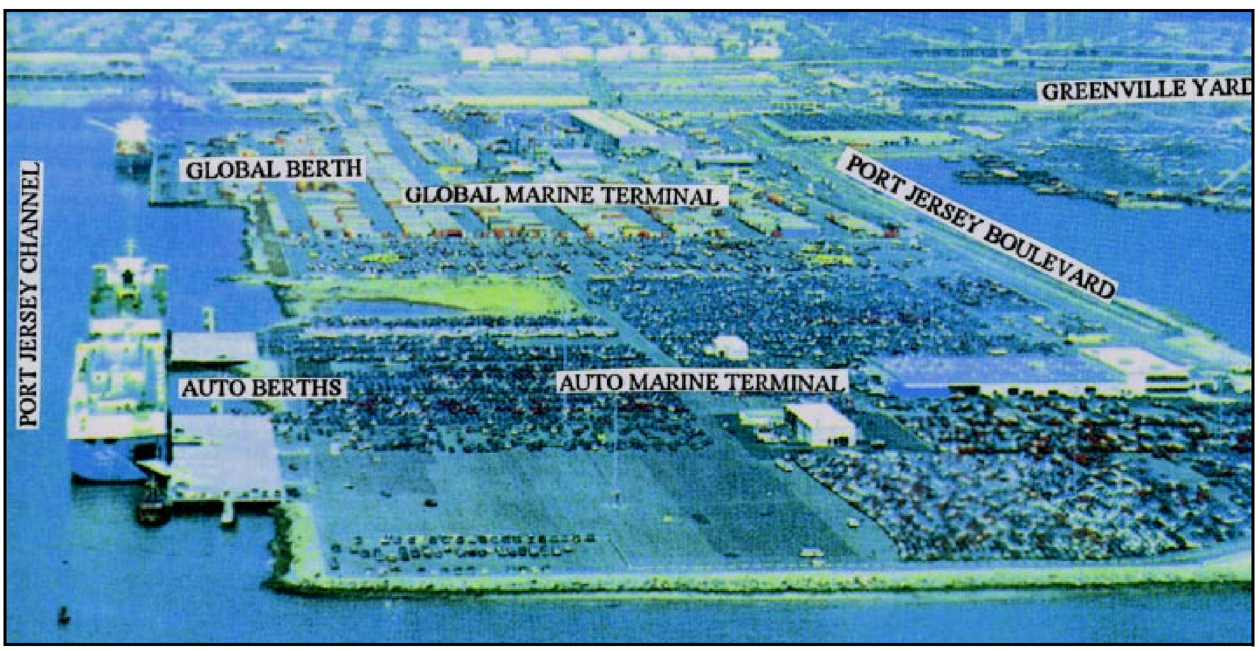
Port Elizabeth Terminal



Port Elizabeth Terminal

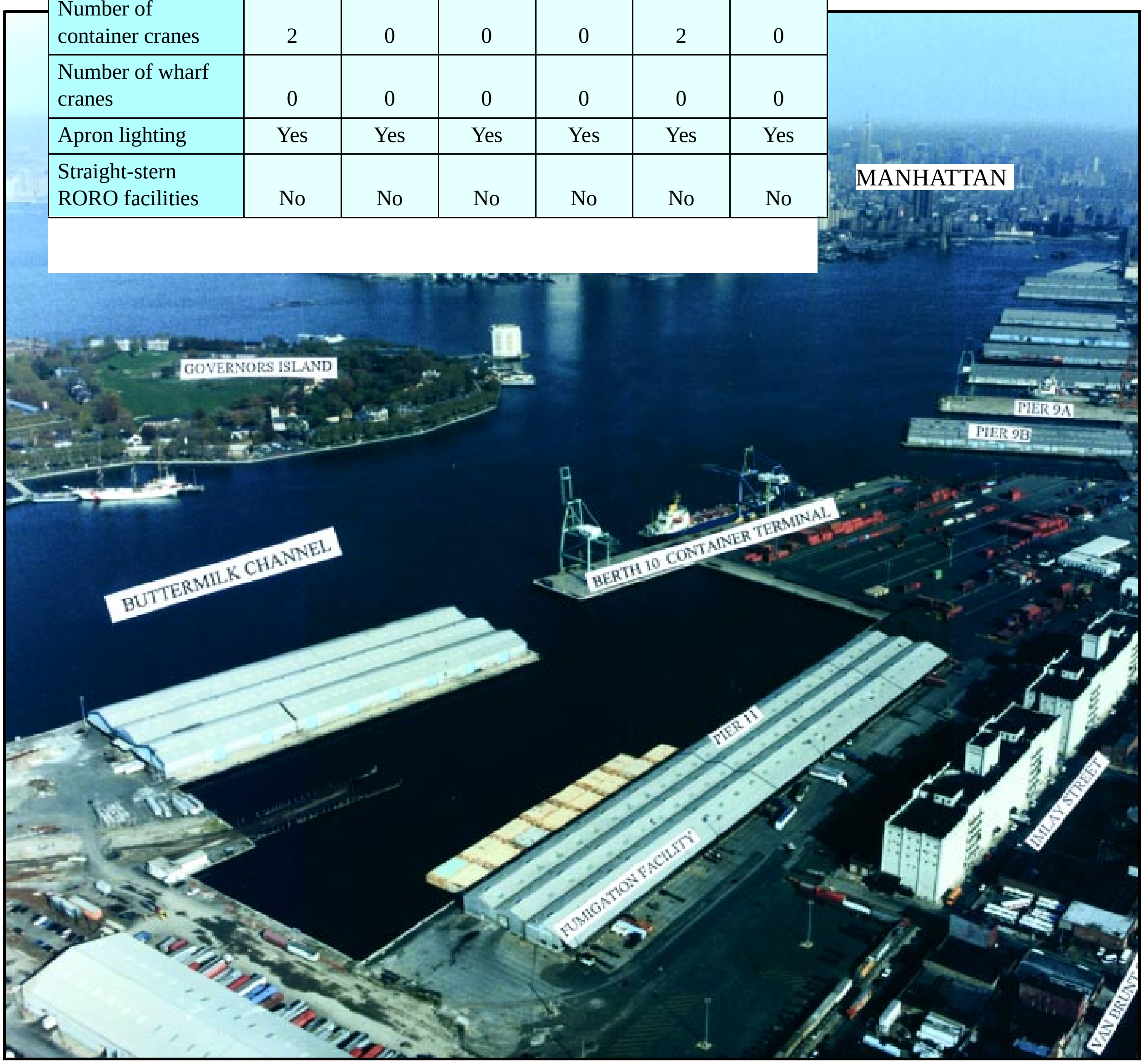
BERTHING CHARACTERISTICS OF GLOBAL MARINE AND AUTO MARINE TERMINALS		
Characteristics	**Terminal**	
	Auto Marine	**Global Marine**
Length (ft)	1,374	2,923
Depth alongside at MLW (ft)	35	35
Deck strength (psf)	500	500
Apron width (ft)	Open	56
Apron height above MLW (ft)	11	11
Number of container cranes	0	0
Number of wharf cranes	0	0
Apron lighting	No	Yes
Straight-stern RORO facilities	No	No



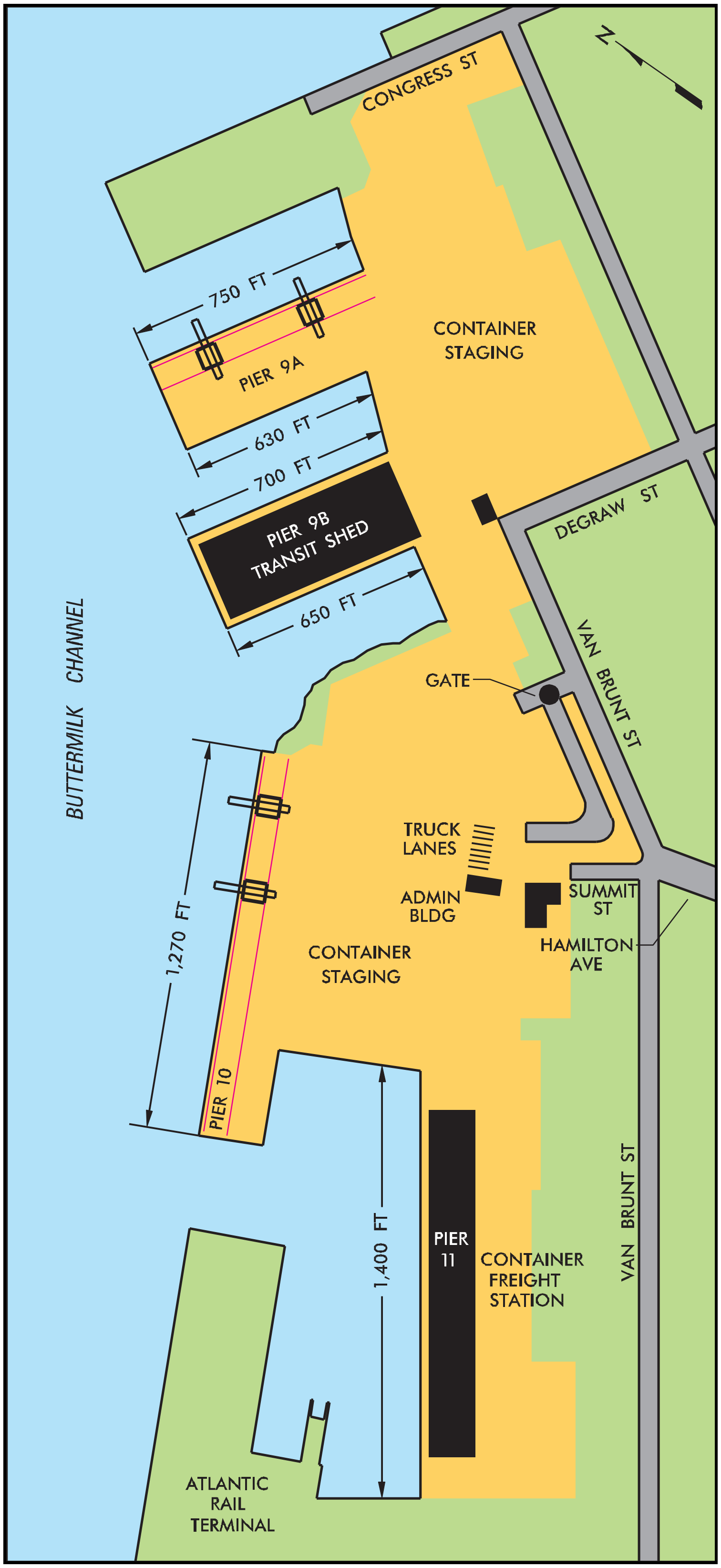


Global/Auto Marine Terminals
(Northwestward view)

BERTHING CHARACTERISTICS OF RED HOOK TERMINAL						
Characteristics	**Berths**					
	Pier 9A North	**Pier 9A South**	**Pier 9B North**	**Pier 9B South**	**Pier 10**	**Pier 11**
Length (ft)	750	630	700	650	1.270	1,400
Depth alongside at MLW (ft)	35	35	35	35	42	35
Deck strength (psf)	500	500	500	500	500	500
Apron width (ft)	Open	Open	30	30	Open	25
Apron height above MLW (ft)	12	12	12	12	12	12
Number of container cranes	2	0	0	0	2	0
Number of wharf cranes	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No	No	No

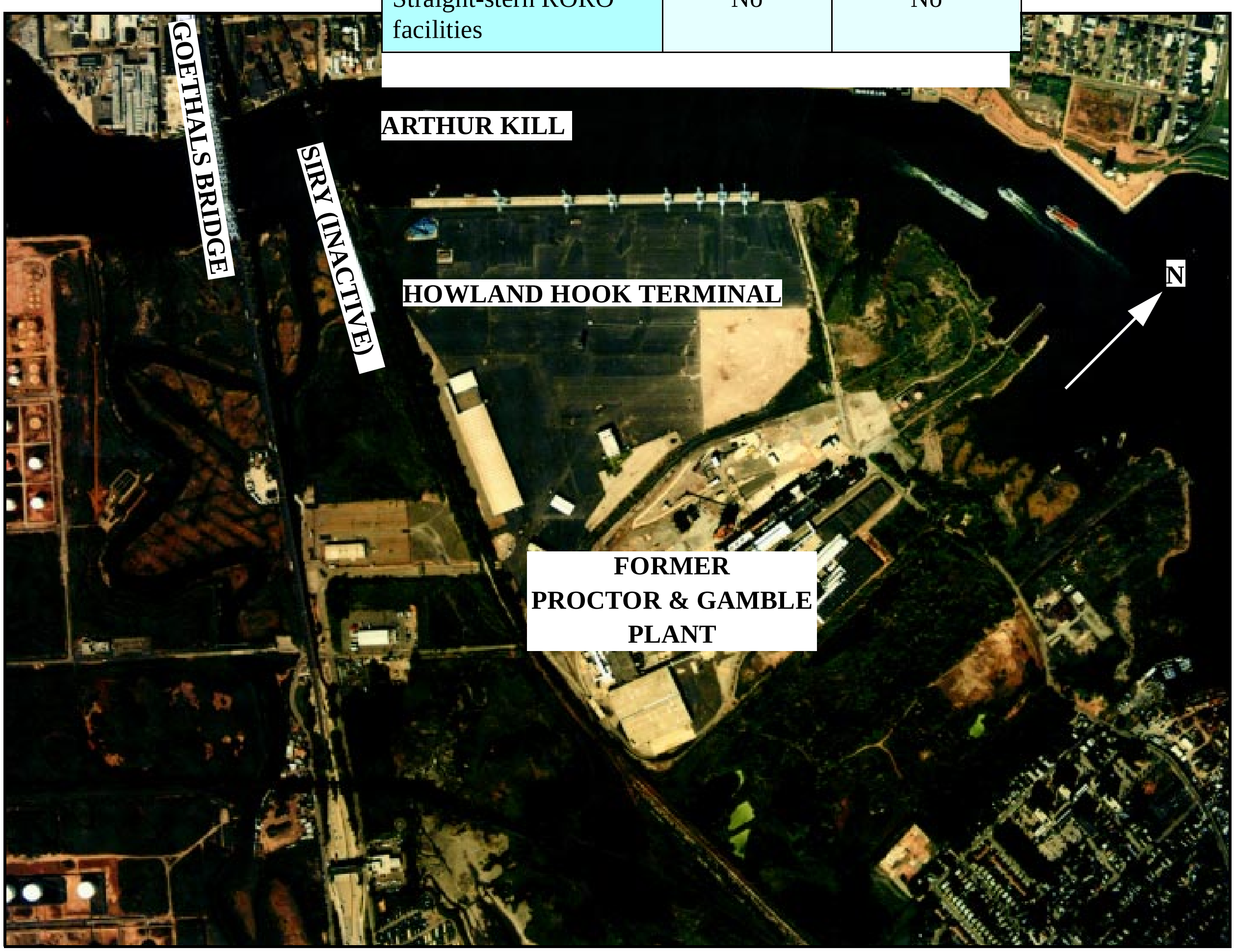


Red Hook Terminal (Northward view)

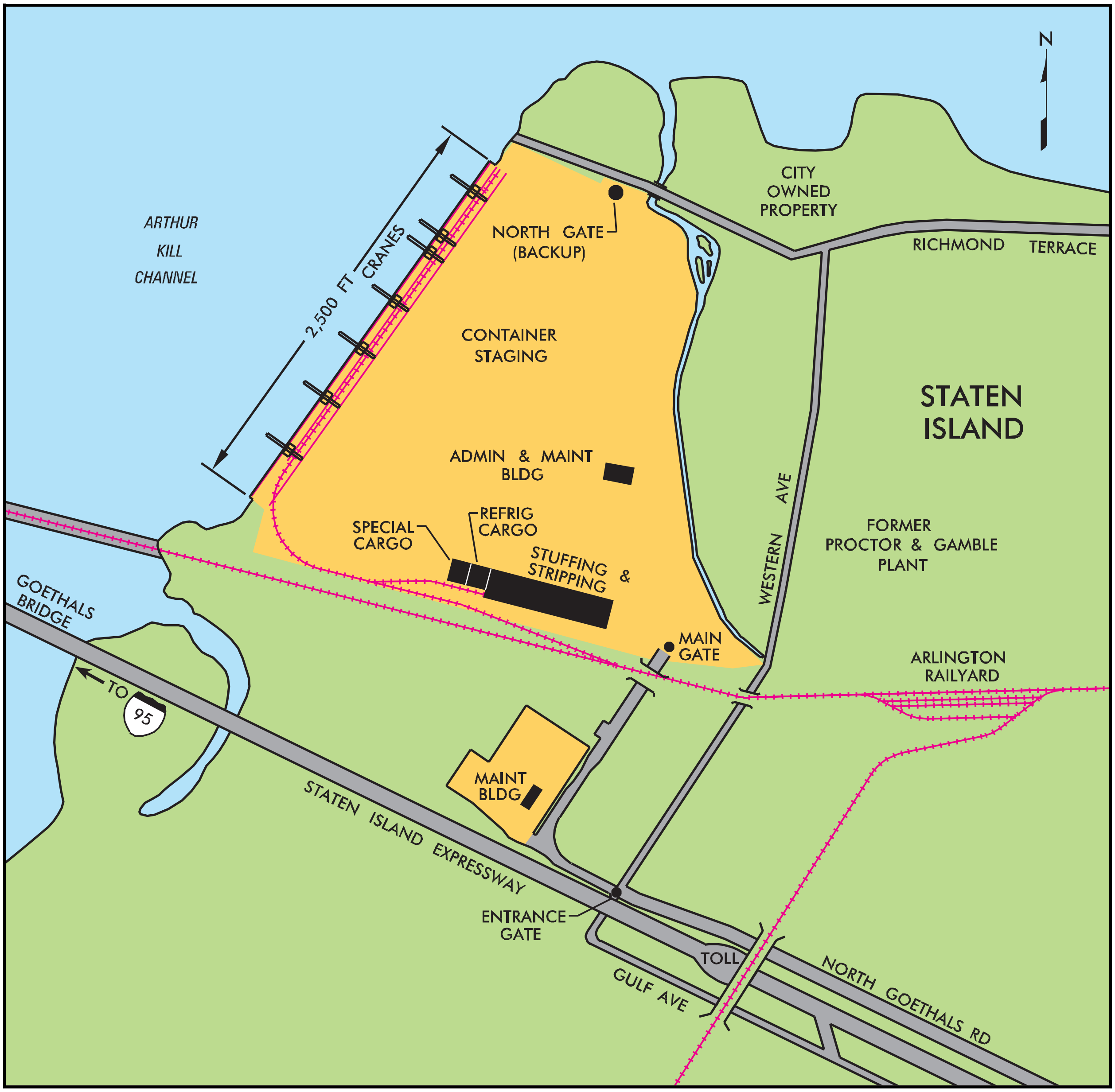


Red Hook Terminal

BERTHING CHARACTERISTICS OF HOWLAND HOOK TERMINAL		
Characteristics	Berths	
	1	2
Length (ft)	2,000	500
Depth alongside at MLW (ft)	40	35
Deck strength (psf)	500	500
Apron width (ft)	Open	Open
Apron height above MLW (ft)	12	12
Number of container cranes	7	0
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straight-stern RORO facilities	No	No



Howland Hook Terminal



Howland Hook Terminal

Staging

Open Staging at Howland Hook Terminal

Open Staging

The terminals in this report have more than 1,100 acres of open staging. This land is used mainly for containers and vehicles.

Covered Staging at Port Newark/Elizabeth Terminal

Terminal	Open Staging (Acres)	Covered Staging (SQ FT)
Port Newark	240	3,100,000
Port Elizabeth	520	2,200,000
Global Marine	100	None
Auto Marine	143	100,000
Red Hook	70	340,000
Howland Hook	187	180,000

Covered Staging

The port has warehouse buildings throughout the terminals. All covered staging at the Global/Auto Marine Terminal is used for automobile processing and container stuffing.

Rail

Rail trackage at Port Newark/Elizabeth links the railyards to the port's apron tracks, transit sheds, and storage tracks.

With 12 intermodal container transfer facilities, and the new ExpressRail terminal, the port has a vast capacity and fast turnaround.

Portside Conrail Terminal, near the Port Elizabeth Terminal

Unloading/Loading Positions

Ramps. The Port Authority has no portable or permanent rail end ramps. Plans should call for the military to bring or build ramps, or rent from local stevedore or equipment companies.

Docks. All covered storage facilities at the Port Newark/Elizabeth Terminal have boxcar and van handling positions. Several other buildings throughput the port also have boxcar and van handling positions.

Marshaling Areas

Within port. With the exception of the Howland Hook Terminal, there are no marshaling areas within or adjacent to the terminals. Howland Hook has over 50 acres of adjacent marshaling area. One area is an abandoned factory just inland of the terminal. Additional undeveloped land is east of the terminal.

Outside of Port. A possible marshaling area is about 10 miles north of the Port Newark/Elizabeth Terminal. The Meadowlands Sports Complex (home of the Giants Stadium) totals about 750 acres and has 24,500 parking spaces. This area is not likely to be available during football season. All lots have lighting and stormwater drainage.

Two views of the Meadowlands Sports Complex, located north of the Port Newark/ Elizabeth Terminal

MATERIAL HANDLING EQUIPMENT (MHE)

The terminals have a total of 47 container cranes. These container cranes are located throughout the terminals and range in strength from 30 to 50 STON. Various shipping and rental companies in the area own transtainers and other MHE. This includes straddle carriers, truck cranes, Kalmar stackers, yard hustlers, top loaders, flatbeds, empty handlers, and a variety of forklifts. Mobile cranes with larger capacities are available from local stevedore companies. The nearby Weeks Marine Inc. and Don Jon Marine have a large supply of equipment that includes many types of barges, carfloats, hydraulic dredges, tugboats, floating cranes, heavy lift cranes, and other marine equipment.

TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY
Port Newark/Elizabeth Terminal		
Stackers	5-30	6
Toploader	40	22
Clark Straddle Carrier	31	25
Ottawa Hustler	25-125	15
P&H Truck Crane	90	1
Global Marine Terminal		
Toploaders	30	4+
Sideloaders	8	4+
Auto Marine Terminal - no equipment		
Red Hook Terminal		
Yard Hustlers	-	4+
Sideloaders	8	2+
Top Handlers	45	2+
Howland Hook Terminal		
Toploaders	45	8
Sideloaders	8	2

Weeks Marine Inc. Barge Crane

INTERMODAL FACILITIES

With daily help of the ExpressRail on-dock intermodal terminal, nearly centered in the Port Elizabeth Terminal, the rail connections link the port to any customer in the United States with speed, quality, and cost competitiveness.

There are 12 intermodal container transfer terminals near the port to allow large railcar capacity and quick turnaround. These rail facilities are shown on the rail access map in the beginning of this report.

FUTURE DEVELOPMENT

The New York/New Jersey metropolitan area is very highly developed. Only the Howland Hook Terminal has adjacent land for significant expansion. The Port Authority expects to extend the wharf of the Howland Hook Terminal northeastward another 1,000 feet into the adjacent undeveloped land. The inland abandoned Proctor & Gamble plant will likely be developed into paved open staging area to support Howland Hook as well.

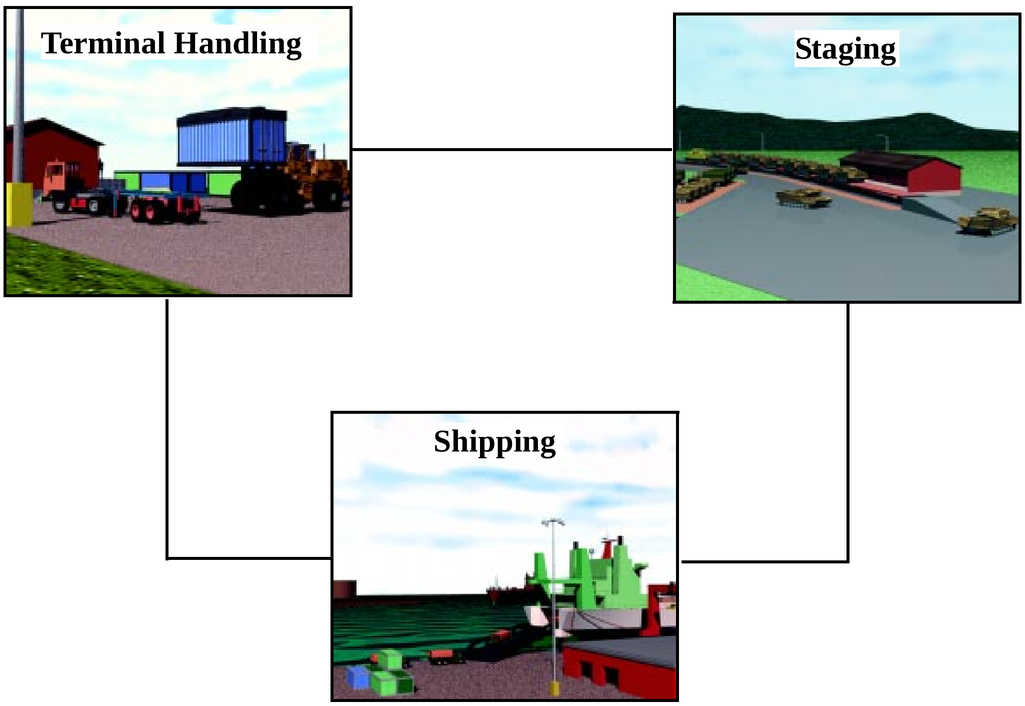
Environmental concerns have prevented the Port Authority from dredging to the full project depths, especially at the Port Newark/Elizabeth Terminals. Because of this, the many berths have silted to depths lower than those provided earlier in this report. Once proper permits are in place, the depths of this report will be restored. The Port Authority expects to resume dredging in 1996 or 1997.

The Military Ocean Terminal in Bayonne, New Jersey, is sighted for closure. At present, there are no firm plans for its commercial development.

II. THROUGHPUT ANALYSIS

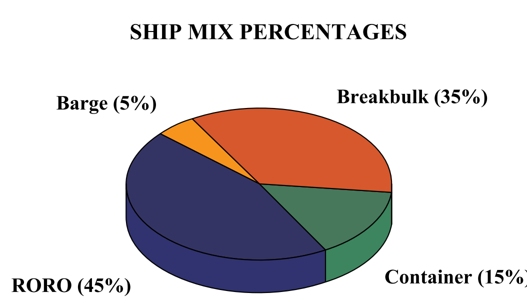
GENERAL

This section evaluates the throughput capability of the five selected terminals of the Port of New York and New Jersey. We determined the throughput capabilities using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



Terminal Throughput Subsystems

This analysis assumes a maximum of 80 percent of the port facilities at each terminal can be made available at any one time. For this reason, we ran all port analyses using an 80 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



RECEPTION/HANDLING

Highway

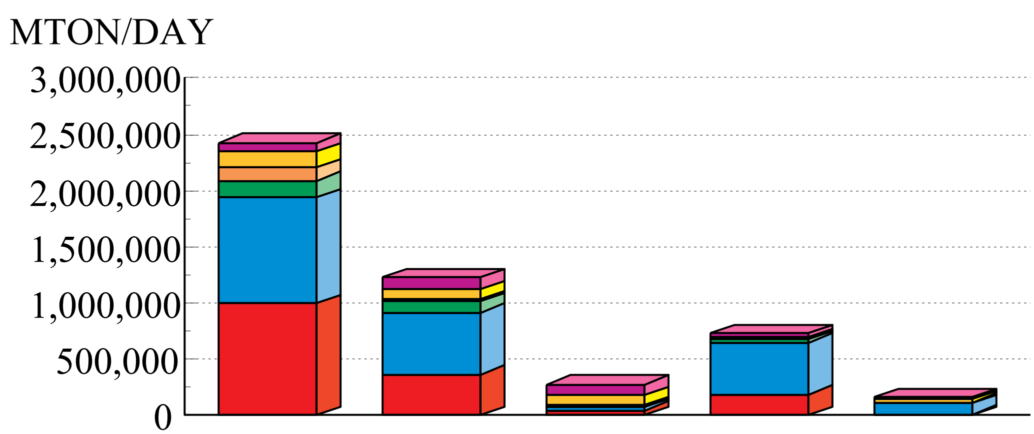
I-95, 278, and 78 provide access to the port. Each terminal has a designated entrance for trucks. The road network in and out of the terminals, including the gate processing of vehicles, could handle a total of about 2,200,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable ramps. We assume each terminal can support the portable truck ramps, truck docks, and here are no permanent truck end ramps at the port.

Truck Handling Facilities			
Terminal	**Portable Truck End Ramps**	**Van Handling Positions**	**Container Handlers**
Port Newark	10	389	2
Port Elizabeth	6	1,021	20
Global Marine	None		
Auto Marine	2	77	2
Red Hook	2	28	8
Howland Hook	2	50	2

Supplies in van semitrailers will proceed to the van-handling positions at warehouses, transit sheds, and container freight stations.

HIGHWAY RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS	DOCKS	CONTAINERS
PORT NEWARK	1,000,000	370,000	48,000	190,000	13,000
ELIZABETH	940,000	550,000	29,000	460,000	94,000
GLOBAL	150,000	95,000	9,600	34,000	11,000
AUTO	120,000	25,000	4,800	0	0
RED HOOK	140,000	87,000	96,000	18,000	33,000
HOWLAND HK	83,000	100,000	96,000	32,000	13,000

Rail

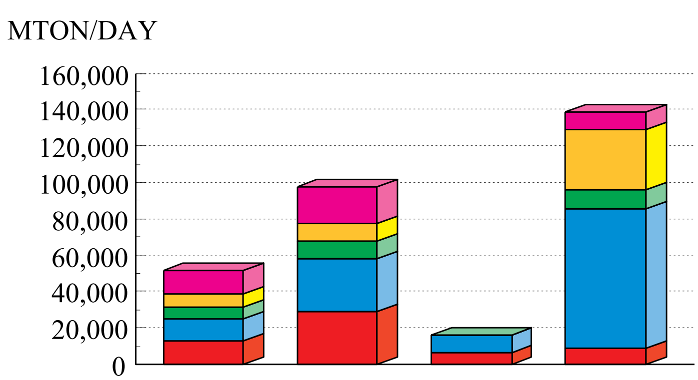
Rail reception at the port is one of the best on the east coast. The numerous intermodal yards and storage locations for railcars make the port very efficient. Conrail and the New York, Susquehanna and Western Railway provide trains to the port. The best rail service is at the Port Newark and Elizabeth Terminals due to their size, container operations, and on-site ExpressRail terminal.

Red Hook does not have direct rail access. Rail operations for the Red Hook Terminal occur at the adjacent Atlantic Rail Terminal.

This analysis assumes the terminals can support the facilities as listed in the table below.

Rail Facilities					
Terminal	**Trains Per Day**	**Train Length (railcars)**	**Portable Ramps**	**Boxcar Docks**	**Container Handlers**
Port Newark	2	60	3	62	2
Port Elizabeth	2	60	3	88	20
Global Marine	1	60	1	4	7
Auto Marine	None				
Red Hook	1	60	1	0	9
Howland Hook	2 (expected)	60	2	0	2

RAIL RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	TRACKAGE	END-RAMPS	DOCKS	COFC
PORT NEWARK	13,000	29,000	6,700	9,200
ELIZABETH	12,000	29,000	9,500	76,000
GLOBAL	7,000	9,600	430	11,000
AUTO	0	0	0	0
RED HOOK	7,200	9,900	0	33,000
HOWLAND HK	13,000	20,000	0	9,200

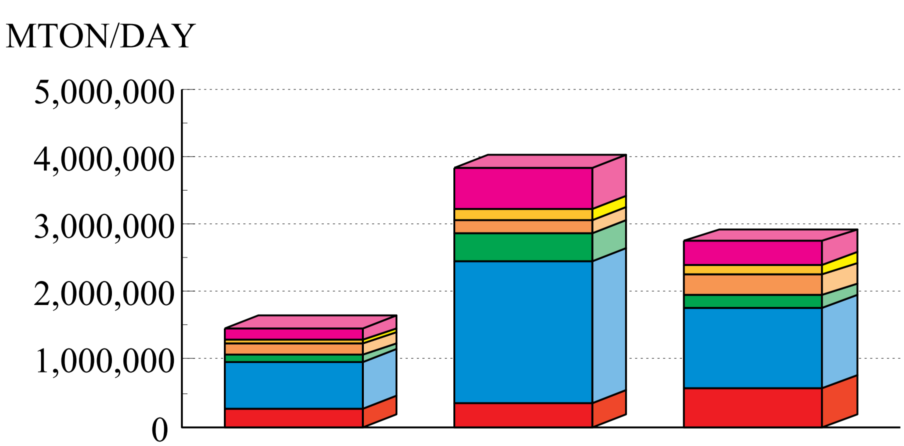
STAGING

The terminals of this report have a total of more than 1,000 acres of open paved staging. There is also over five million square feet of covered storage.

The terminal can perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned. The chart below provides the staging capability for the cargo for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.

Staging Facilities		
Terminal	**Open Staging (Acres)**	**Covered Staging (Sq Ft)**
Port Newark	240	3,100,000
Port Elizabeth	520	2,200,000
Global Marine	78	125,00027
Auto Marine	128	0
Red Hook	70	340,000
Howland Hook	146	200,000

OPEN STAGING CAPABILITY

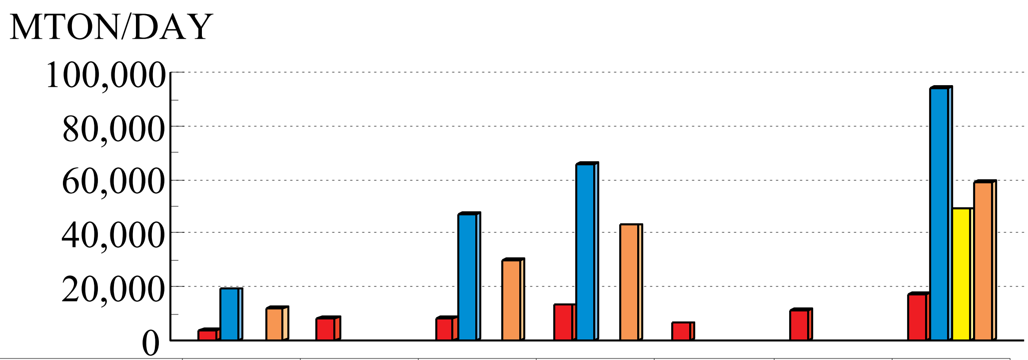


VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
PORT NEWARK	270,000	350,000	570,000
ELIZABETH	690,000	2,100,000	1,200,000
GLOBAL	100,000	430,000	180,000
AUTO	170,000	180,000	300,000
RED HOOK	57,000	180,000	160,000
HOWLAND HK	180,000	610,000	340,000

SHIPPING

Throughputs for each berth are shown below. They are based on various factors including MHE utilized, loading, operational, and berth utilization rates as well as berth/ship compatibility.

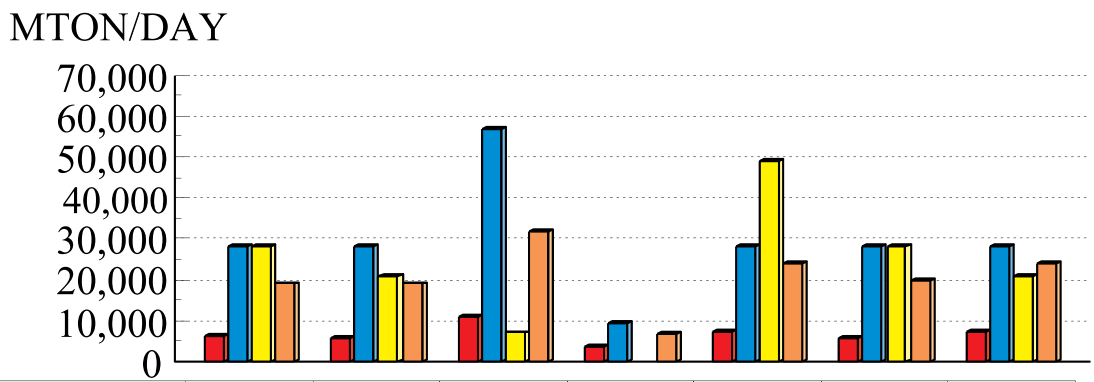
BERTH THROUGHPUT CAPABILITY
PORT NEWARK TERMINAL



BERTH	5-7	9-17	19-25	2-14	16-22	24-34	51-63
BREAKBULK	3,700	8,000	8,000	13,000	6,400	11,000	17,000
RORO	19,000	0	47,000	66,000	0	0	94,000
CONTAINER	0	0	0	0	0	0	49,000
MIXED	12,000	0	30,000	43,000	0	0	59,000

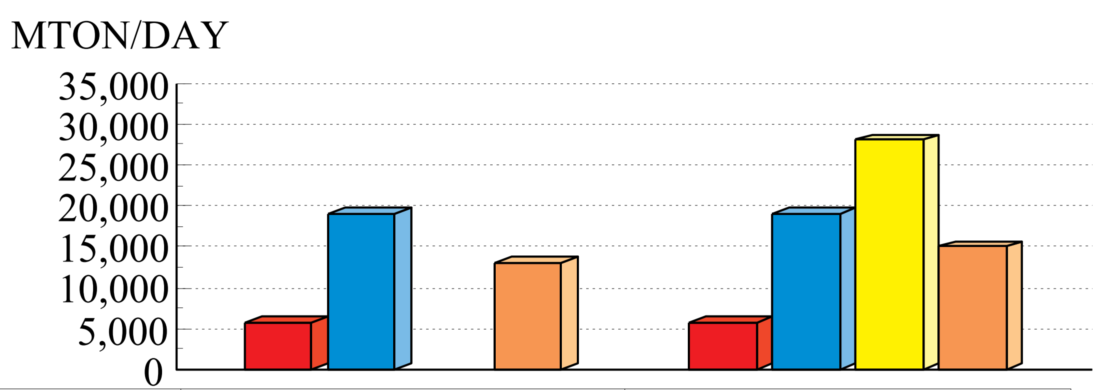
CONVERSION FACTORS	
Breakbulk	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON

BERTH THROUGHPUT CAPABILITY
PORT ELIZABETH TERMINAL



BERTH	52-60	64-66	68-74	76-78	80-86	88-92	94-98
BREAKBULK	6,400	5,600	11,000	3,700	7,400	5,600	7,400
RORO	28,000	28,000	57,000	9,400	28,000	28,000	28,000
CONTAINER	28,000	21,000	7,000	0	49,000	28,000	21,000
MIXED	19,000	19,000	32,000	6,900	24,000	20,000	24,000

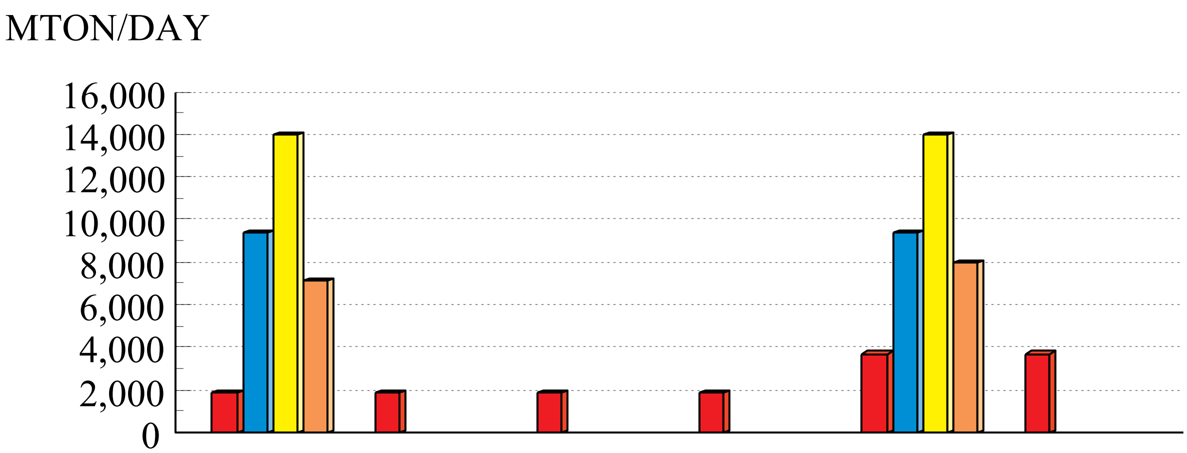
BERTH THROUGHPUT CAPABILITY
GLOBAL AND AUTO MARINE TERMINALS



BERTH	AUTO	GLOBAL
BREAKBULK	5,700	5,700
RORO	19,000	19,000
CONTAINER	0	28,000
MIXED	13,000	15,000

BERTH THROUGHPUT CAPABILITY

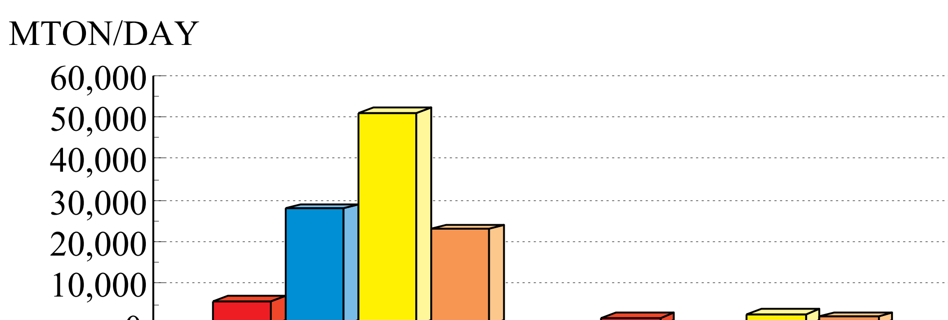
RED HOOK TERMINAL



BERTH	9A-N	9A-S	9B-N	9B-S	CONTR	11
BREAKBULK	1,900	1,900	1,900	1,900	3,700	3,700
RORO	9,400	0	0	0	9,400	0
CONTAINER	14,000	0	0	0	14,000	0
MIXED	7,100	0	0	0	8,000	0

BERTH THROUGHPUT CAPABILITY

HOWLAND HOOK TERMINAL



BERTH	HH-1	HH-2
BREAKBULK	5,700	1,700
RORO	28,000	0
CONTAINER	51,000	2,700
MIXED	23,000	2,000

The type of ship preferred at each berth is based on the methodology described in Appendix B. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The lower the number for a berth, the better the berth is suitable for the loading operation.

We do not include the Auto Marine, Global Marine, and Howland Hook Terminals because they only have one berth.

Many of the berths are suited for FSS and LSMR operations. Those berths that are not capable of this type of loading have low water depth and/or apron obstructions.

PREFERENCE BERTH SELECTION			
BERTH	**BB**	**RORO**	**CNTNR**
Red Hook Terminal			
Pier 9A - North	5	2	2
Pier 9A - South	6	3	4
Pier 9B - North	2	-	-
Pier 9B - South	4	-	-
Pier 10	3	1	1
Pier 11	1	-	3

Note: Berths marked with a "-" are not recommended for these operations.

PREFERENCE BERTH SELECTION			
BERTH	**BB**	**RORO**	**CNTNR**
Port Newark/Elizabeth Terminal			
5-7	7	2	9
9-17	1	8	-
19-25	1	11	9
2-14	3	6	9
16-22	4	-	-
24-34	4	16	13
51-63	6	1	2
52-60	14	7	3
64-66	7	2	1
68-74	9	4	3
76-78	9	8	3
80-86	9	8	6
88-92	9	8	6
94-98	9	4	6

SUMMARY OF BERTHING CAPABILITIES OF PORT NEWARK TERMINAL							
Vessel	Berths						
	5-7	9-17	19-25	2-14	16-22	24-34	51-63
Breakbulk							
C3-S-33a	2	5	5	8	4	7	10
C3-S-37c	2	5	5	7	4	7	10
C3-S-37d	2	5	5	7	4	7	10
C3-S-38a	2	5	5	8	4	7	10
C4-S-1a	2	4	4	7	3	6	9
C4-S-1qb and 1u	2	4	4	7	3	6	8
C4-S-58a	2	4	4	6	3	6	8
C4-S-65a	2	4	4	7	3	6	9
C4-S-66a	2	5	4	7	3	7	9
C4-S-69b	2	4	4	6	3	6	8
Seatrain							
GA and PR-class	2	4	4	7	3	6	9
Barge							
LASH C8-S-81b	1	3	3	4	2	4	6
LASH C9-S-81d	a	a	a	a	a	a	a
LASH lighter	9	20	19	29	15	28	37
SEABEE C8-S-82a	a	a	a	a	a	a	a
SEABEE barge	6	14	13	20	10	20	26
RORO							
Comet	2,d,i	d,o	5,d,i	7,d,i	d,o	d,o	10,d,i
C7-S-95a/Maine-class	1	b	3	5	b	b	6
Ponce-class	h	b,h	h	h	b,h	b,h	h
Great Land-class	h	b,h	h	h	b,h	b,h	h
Cygnus/Pilot-class	2	b	4	6	b	b	8
Meteor	d,i,j	d,o	d,i,j	d,i,j	d,o	d,o	d,i,j
AmEagle/Condor	2,i	b	4,i	6,i	b	b	8,i
MV Ambassador	d	d	d	d	d	d	d
FSS-class	1	b	2	4	b	b	5
Cape D-class	1,i	b	3,i	5,i	b	b	7,i
Cape H-class	a	a,b	a	a	a,b	a,b	6
LMSR	1	b	2	4	b	b	5
Container							
C6-S-lw	2,e	4,e	4,e	6,e	3,e	5,e	7
C7-S-68e	1,e	4,e	3,e	5,e	2,e	5,e	7
C8-S-85c	1,e	3,e	3,e	4,e	2,e	4,e	6
Combination							
C5-S-78a	2,e	4,e	4,e	6,e	3,e	6,e	8
C5-S-37e	2,e	4,e	4,e	6,e	3,e	6,e	8

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF PORT ELIZABETH TERMINAL

Vessel	Berths						
	52-60	64-66	68-74	76-78	80-86	88-92	94-98
Breakbulk							
C3-S-33a	4	3	4	2	4	3	4
C3-S-37c	4	3	4	2	4	3	4
C3-S-37d	4	3	4	2	4	3	4
C3-S-38a	4	3	4	2	4	3	4
C4-S-1a	3	3	3	2	4	3	4
C4-S-1qb and 1u	3	3	3	2	4	3	4
C4-S-58a	3	3	3	1	4	3	4
C4-S-65a	3	3	3	2	4	3	4
C4-S-66a	3	3	4	2	4	3	4
C4-S-69b	3	3	3	1	4	3	4
Seatrain							
GA and PR-class	3	3	3	2	4	3	4
Barge							
LASH C8-S-81b	2	2	2	1	2	2	2
LASH C9-S-81d	a	a	2	1	2	2	2
LASH lighter	15	14	16	8	18	14	17
SEABEE C8-S-82a	a	a	2	1	2	2	2
SEABEE barge	11	10	11	5	12	10	12
RORO							
Comet	i,j	d,i,j	i,j	d,i,j	d,i,j	d,i,j	i,j
C7-S-95a/Maine-class	2	2	2	1	3	2	3
Ponce-class	h	h	h	h	h	h	h
Great Land-class	h	h	h	h	h	h	h
Cygnus/Pilot-class	3	3	3	1	3	3	3
Meteor	i,j	d,i,j	i,j	d,i,j	d,i,j	d,i,j	i,j
AmEagle/Condor	i,j	i,j	i,j	i,j	i,j	i,j	i,j
MV Ambassador	3,m	d	3,m	d	d	d	4,m
FSS-class	2	2	2	1	2	2	2
Cape D-class	1,j	i,j	i,j	i,j	i,j	i,j	i,j
Cape H-class	a	a	2	1	3	2	3
LMSR	2	2	2	1	2	d	2
Container							
C6-S-lw	3	2	3	1	3	2	3
C7-S-68e	3	2	3	1	3	2	3
C8-S-85c	2	2	2	1	2	2	2
Combination							
C5-S-78a	3	3	3	1	4	3	3
C5-S-37e	3	3	3	1	4	3	4

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF RED HOOK, GLOBAL MARINE, AND AUTO MARINE TERMINALS								
Vessel	Berths							
	RH PIER 9A-N	RH PIER 9A-S	RH PIER 9B-N	RH PIER 9B-S	RH PIER 10	RH PIER 11	GLOBAL	AUTO
Breakbulk								
C3-S-33a	1	1	1	1	2	2	3	3
C3-S-37c	1	1	1	1	2	2	3	3
C3-S-37d	1	1	1	1	2	2	3	3
C3-S-38a	1	1	1	1	2	2	3	3
C4-S-1a	1	1	1	1	2	2	3	3
C4-S-1qb and 1u	1	1	1	1	2	2	3	3
C4-S-58a	1	1	1	1	2	2	3	3
C4-S-65a	1	1	1	1	2	2	3	3
C4-S-66a	1	1	1	1	2	2	3	a
C4-S-69b	1	1	1	1	2	2	2	2
Seatrain								
GA and PR-class	1	1	1	1	2	2	3	3
Barge								
LASH C8-S-81b	c	c	c	c	1	1	2	a,f
LASH C9-S-81d	a,c,g	a,c,g	a,c,g	a,c,g	g	a,g	g	a,g
LASH lighter	5	4	5	4	9	10	12	12
SEABEE C8-S-82a	a,c,g	a,c,g	a,c,g	a,c,g	g	a,g	g	a,g
SEABEE barge	3	3	3	3	6	7	9	9
RORO								
Comet	d,i,j	d,i,j	d,o	d,o	d,i,j	d,o	d,i,j	d,i,j
C7-S-95a/Maine-class	1	c	b,c	b,c	1	b	2	a
Ponce-class	h	c,h	b,h	b,c,h	h	b,h	h	h
Great Land-class	c,h	c,h	b,c,h	b,c,h	b	b,h	h	h
Cygnus/Pilot-class	1	c	b	b	1	b	2	2
Meteor	d,i,j	d,i,j	d,o	d,o	d,i,j	d,o	d,i,j	d,i,j
AmEagle/Condor	i,j	c	b	b	i,j	b	i,j	i,j
MV Ambassador	d	d	d	d	d	d	d	d
FSS-class	c	c	b,c	b,c	1	b	1	a
Cape D-class	i,j	c	b	b,c	i,j	b	i,j	a
Cape H-class	a	a,c	a,b,c	a,b,c	1	a,b	2	a
LMSR	c	c	b.c	b,c	1	b	1	9
Container								
C6-S-lw	1	c,e	1,e	c,e	1	2,e	2	2,e
C7-S-68e	1	c,e	c,e	c,e	1	1,e	2	2,e
C8-S-85c	c	c,e	c,e	c,e	1	1,e	2	a,e
Combination								
C5-S-78a	1	1,e	1,e	1,e	2	2,e	2	a,e
C5-S-37e	1	1,e	1,e	1,e	2	2,e	2	2,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on [illegible]
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF HOWLAND HOOK TERMINAL

Vessel	Berths	
	How Hk-1	How Hk-2
Breakbulk		
C3-S-33a	3	1
C3-S-37c	3	1
C3-S-37d	3	1
C3-S-38a	3	1
C4-S-1a	3	c
C4-S-1qb and 1u	3	c
C4-S-58a	3	c
C4-S-65a	3	c
C4-S-66a	3	c
C4-S-69b	3	c
Seatrain		
GA and PR-class	3	c
Barge		
LASH C8-S-81b	2	c
LASH C9-S-81d	2	a,c
LASH lighter	14	3
SEABEE C8-S-82a	2	a,c
SEABEE barge	10	2
RORO		
Comet	d,i,j	d,i,j
C7-S-95a/Maine-class	2	c
Ponce-class	h	c,h
Great Land-class	h	c,h
Cygnus/Pilot-class	3	c
Meteor	d,i,j	c,d
AmEagle/Condor	i,j	c
MV Ambassador	d	c,d
FSS-class	2	c
Cape D-class	i,j	c
Cape H-class	2	a,c
LMSR	2	c
Container		
C6-S-lw	2	c,e
C7-S-68e	2	c,e
C8-S-85c	2	c,e
Combination		
C5-S-78a	3	c,e
C5-S-37e	3	c,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
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k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

III. APPLICATION

GENERAL

This section will evaluate the port's throughput capability for deploying a notional mechanized infantry division using primarily FSS vessels. In January 1996, MARAD and the Port Authority of New York/New Jersey agreed on planning orders as shown below.

Planning Order Facilities

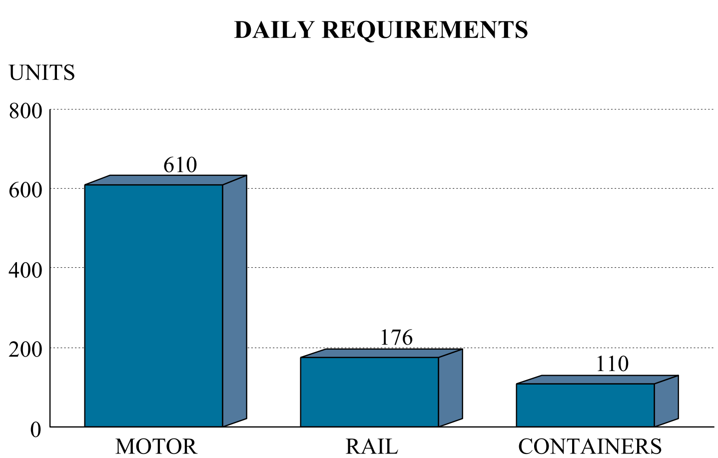
Terminal	Berthing Space (ft)	Open Staging (acres)	Warehouse Space (sq ft)	Covered Maintenance Area (sq ft)	Administration Space (sq ft)
Howland Hook	1,000	35	80,000	2,900	2,500
Port Newark/Elizabeth	1,000 at berth 96	35	80,000	2,900 in Bldg 5000	2,500

REQUIREMENTS

This analysis assumes the requirement for the Port of New York and New Jersey is to deploy a notional mechanized infantry division in 6 days of reception and throughput. The division has to move about 7,800 vehicles and 660 containers. The movement to the port will require 1,055 (176 per day) railcars using the convoy/rail option. Under this option, about 3,650 (610 per day) road-able vehicles would be driven and about 2,320 (387 per day) would be towed.

Total Equipment	
Volume	280,000 MTON
Weight	95,000 STON
Area	1,400,000 SQ FT
Vehicles	7,800
Containers	660

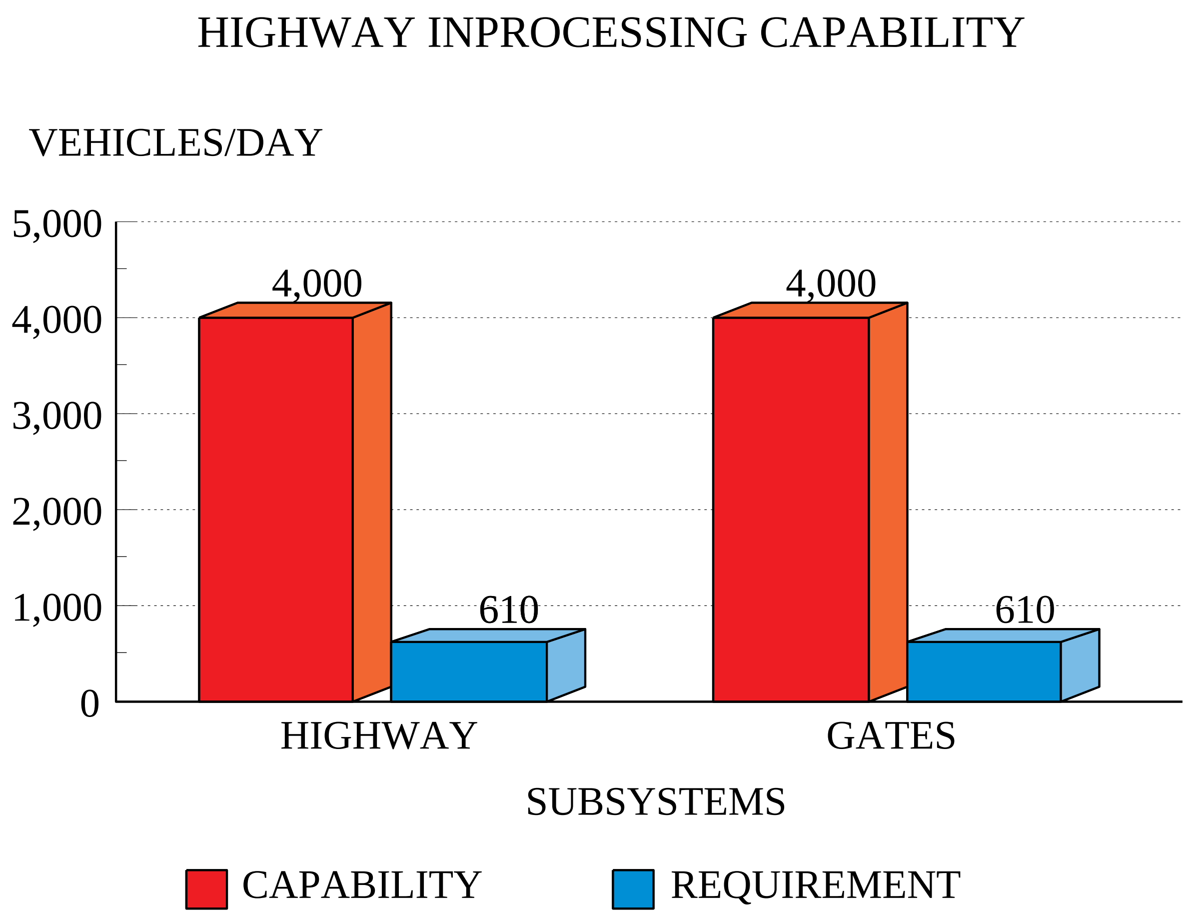
MECHANIZED INFANTRY DIVISION



TERMINAL INPROCESSING/HANDLING

Highway

Although four bridges access Staten Island, we assume military vehicles will cross the Goethals Bridge, just outside the Howland Hook Terminal. From there, vehicles would enter one of several gates, depending on the congestion at the terminal. Military vehicles would likely enter the Sea-Land section (berth 96) of the Port Elizabeth Terminal via McLester Street. The access roads and gates to both terminals together can handle well over 4,000 vehicles per day.



Rail

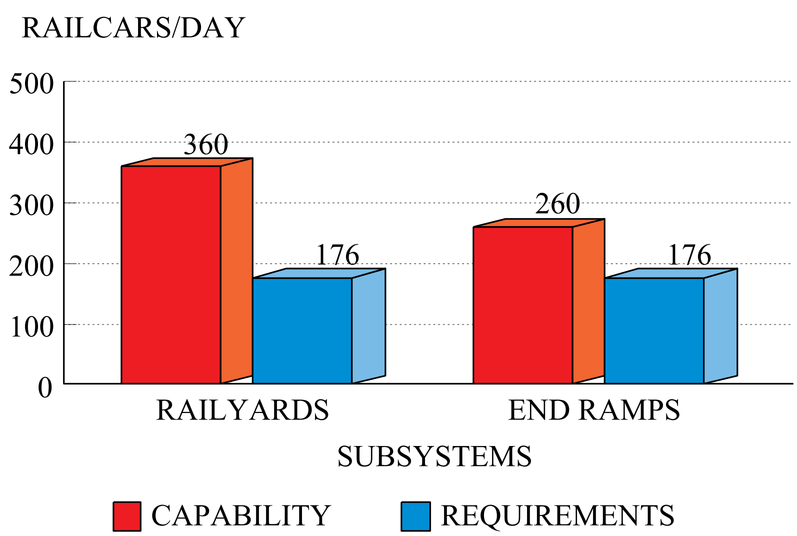
At present the rail capability of the Howland Hook Terminal is uncertain. Access from the Conrail line in New Jersey to Staten Island has been inactive for several years. MTMC believes the rail line will be restored to meet the DoD clearance and weight requirements, in late 1996 or 1997. Once rail access is fully restored, the Howland Hook Terminal and the Arlington Railyard on Staten Island could together receive more than 120 railcars per day.

The railyards in and around the Port Newark and Elizabeth Terminals can receive about 240 railcars of military equipment per day. This capacity along with the capacity on Staten Island is sufficient to meet the requirement.

The only location at the Howland Hook Terminal that can support rail offloading is along the wharf, just inland of the container cranes. Placing a portable or temporary rail end ramp at the end of each of the two spurs, and conducting four switching cycles per day, would offload about 160 railcars per day. The MTMC port operator should insure the rail offloading operations leave access to the shiploading area. If necessary. the container cranes could be used for direct loading from the railcars to the ship.

The land-use map for the Port Elizabeth Terminal shows numerous rail spurs that might support flatcar offloading. This analysis assumes the tracks along the warehouses at the north end of terminal will be available. Two portable or temporary rail end ramps at these spurs can support offloading a total of about 25 railcars at the same time. Assuming four cycles per day, these ramps could offload about 100 railcars per day. These ramps and those at the Howland Hook Terminal could offload a total of about 260 railcars per day. This capability meets the requirement.

RAIL INPROCESSING AND HANDLING CAPABILITY

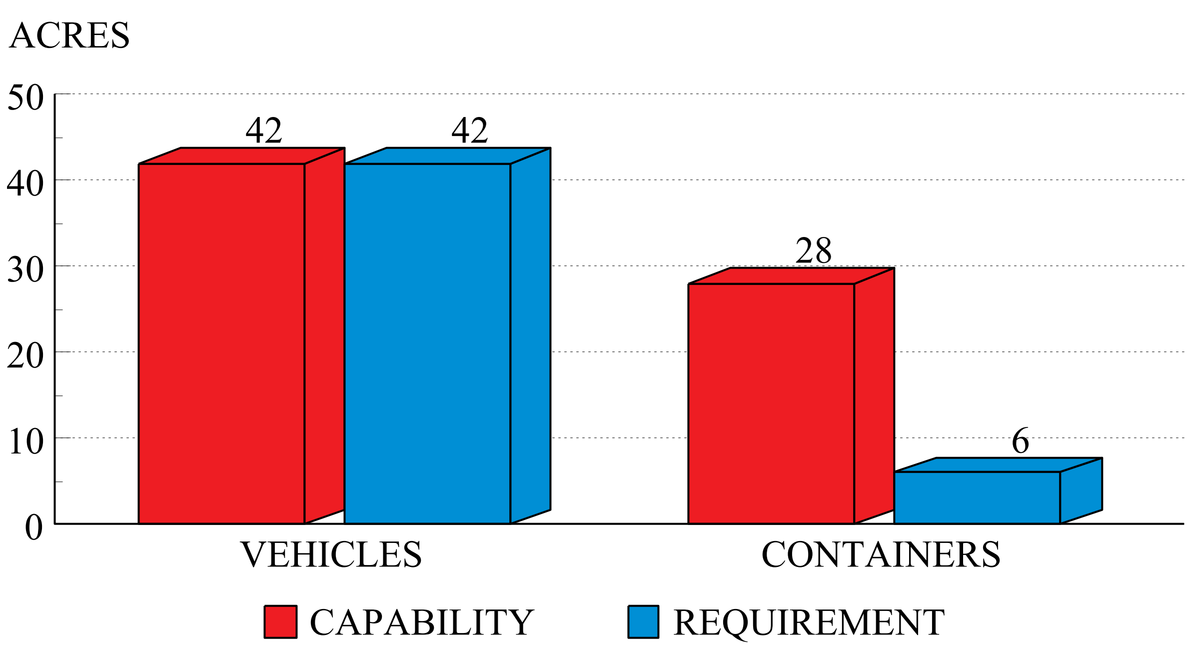


STAGING

This analysis assumes that current downsizing continues, and that nine FSS-sized ships will deploy an entire notional mechanized infantry division. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations, two at the Howland Hook Terminal and one at berth 96 of the Port Elizabeth Terminal (Sea-Land).

Although an FSS load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for staging the 73 containers for each FSS. The three simultaneous shiploading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers. This analysis assumes the military will use 32 acres at the Howland Hook Terminal, and 16 acres at the Port Elizabeth Terminal (berth 96). The Planning Orders allocates 35 acres to the Howland Hook Terminal and another 35 to the Port Elizabeth Terminal. This exceeds the requirement.

OPEN STAGING CAPABILITY



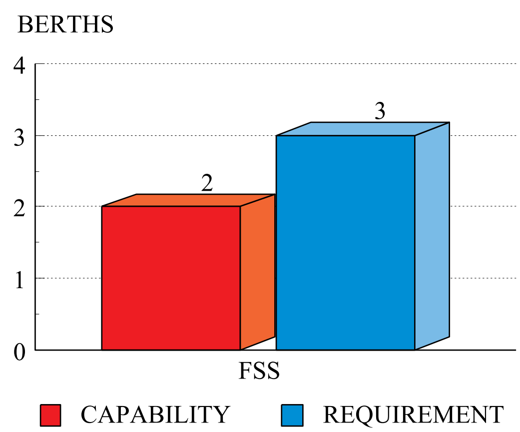
SHIPPING

Although this analysis assumes that only nine FSS-sized ships can deploy the notional mechanized infantry division. The number of ships required depends on the shipping mix selected. The best ship mix would consist of all eight FSS ships, plus two Cape H RORO ships.

The requirement is to berth two FSS-sized vessels at the Howland Hook Terminal, and one at berth 96 of the Port Elizabeth Terminal. The Berthing Capabilities tables earlier in this report show the port has over 25 berths capable of supporting FSS operations. Most of these are at the Port Newark/Elizabeth Terminal. The Planning Orders, however, only provide for two FSS berths; one at Howland Hook and one at berth 96 of the Port Elizabeth Terminal. This does not meet the requirement

.

FSS SHIPPING CAPABILITY



UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

Loading Condition/Sample Ship Mix	Vessel Types			
	FSS (RORO Comb)	Cape H (RORO Comb)	C3/C4 (Breakbulk)	C6/C7/C8 (Container)
Minimum Containerization:				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization				
FSS and Container	7.90			2.00
FSS, Cape H, and Container	7.90			2.00
Breakbulk and Container			29.58	2.00

* Only eight FSS vessels are currently available. Unit shipping requirements exceed the capacity of these eight vessels. Other vessel types are required to makeup the shortfall (Cape H or upcoming LMSR).
Legend:
RORO - roll on/roll off
FSS - fast sealift ship
Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide. Aug 91

SUMMARY

The port can easily support the deployment of the division. The Planning Orders, however, do not allow for enough berthing space.

RECOMMENDATION

We recommend revising the Planning Orders as follows:

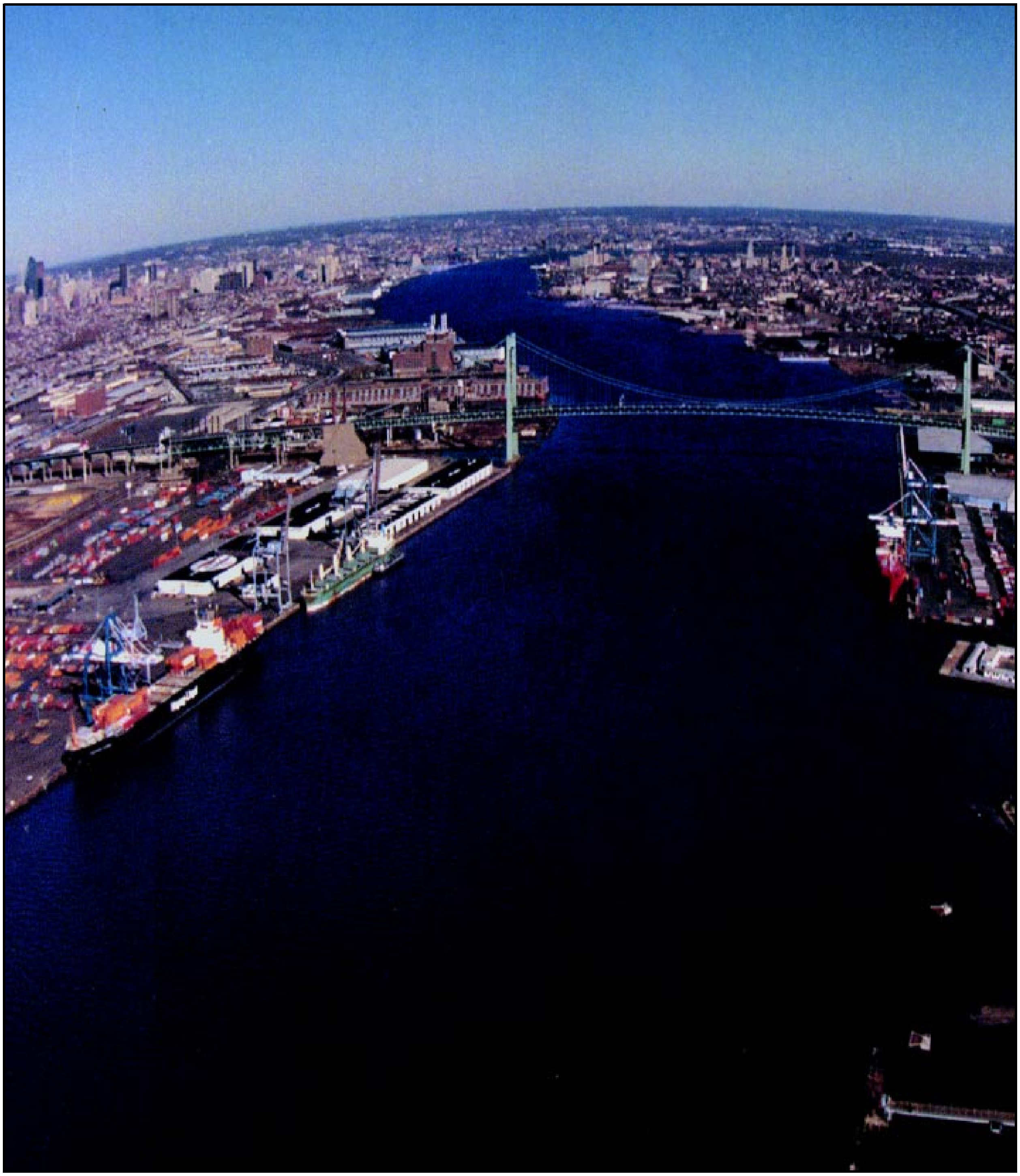
1. Add berthing for another FSS-sized vessel at the Howland Hook Terminal.

2. Reduce the open staging area at the Port Elizabeth Terminal to only 16 acres.

The MTMC port operator should acquire at least four portable rail end ramps.

March 96

PORT OF PHILADELPHIA, PA



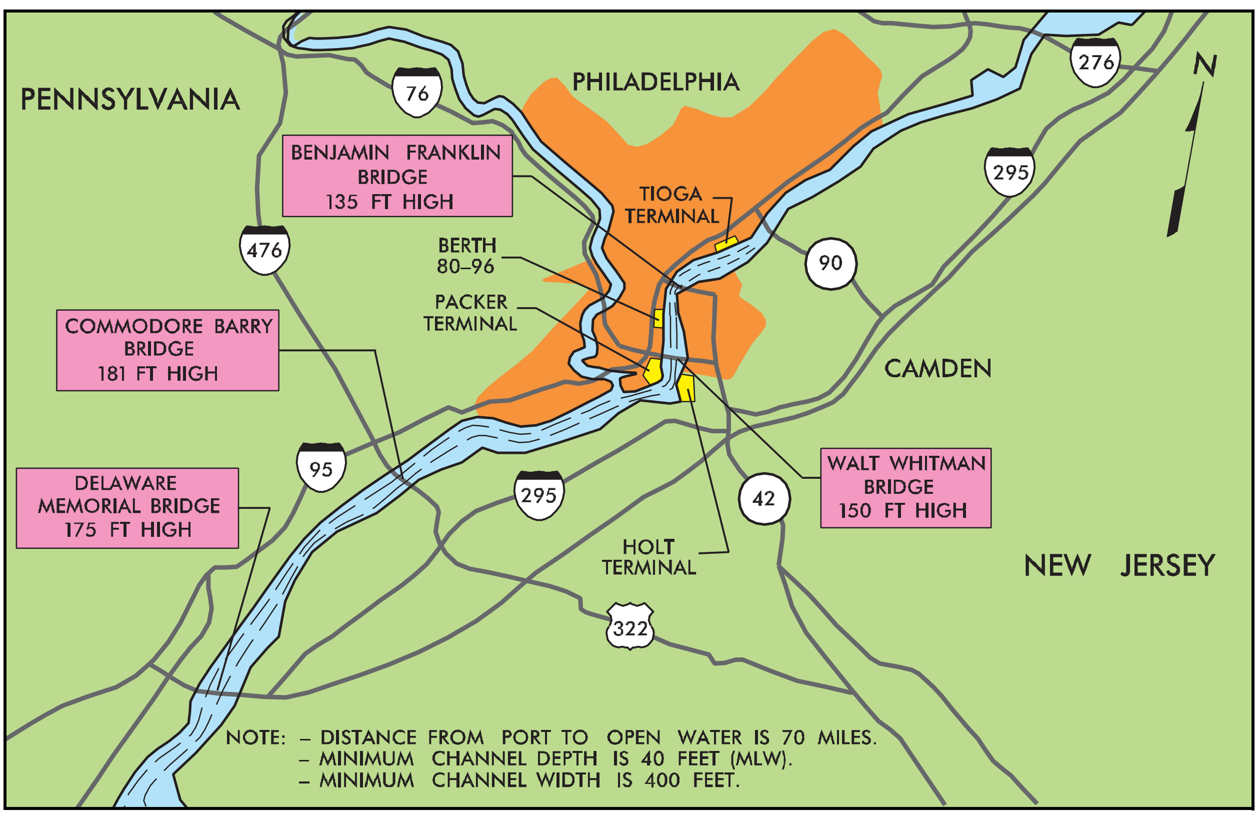
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Philadelphia is along the Delaware River about 80 nautical miles above the Delaware Capes. From the 10-mile wide entrance to the Delaware Bay, a 40-foot-deep channel leads upstream to the terminals. Four bridges spanning the Delaware River impose height restrictions ranging from 135 to 181 feet above the river at mean high water (MHW). Anchorage is available in the river and the bay. The mean tidal range is 5.7 feet at the port. The velocity of spring tidal currents at the terminals is 2-1/2 knots.

This report looks at four terminal complexes within the Port of Philadelphia. Three of the complexes are along the west bank of the Delaware River: Piers 80-96; Tioga Container Terminal; and Packer Avenue Marine Terminal. The fourth complex, Holt Marine Terminal, is on the east bank of the river and beneath the Walt Whitman Bridge.



Water Access

Highway

Interstate Route 95 from the north and south and Interstate Route 76 from the east and west serve the port. Delaware Avenue, a four-lane urban street, connects all the terminals on the west side of the river.

Entry to the Packer Avenue Marine Terminal is 1 mile south of the Walt Whitman Bridge. Piers 80-96 are 2 miles north of this bridge, on Delaware Avenue. The Tioga Container Terminal is located 20 miles past the Benjamin Franklin Bridge.

From the city of Philadelphia, access to the Holt Marine Terminal, in Gloucester City, New Jersey, is via I-76 across the Walt Whitman Bridge to the Morgan Boulevard exit ramp. This exit leads into the terminal.

Highway Access

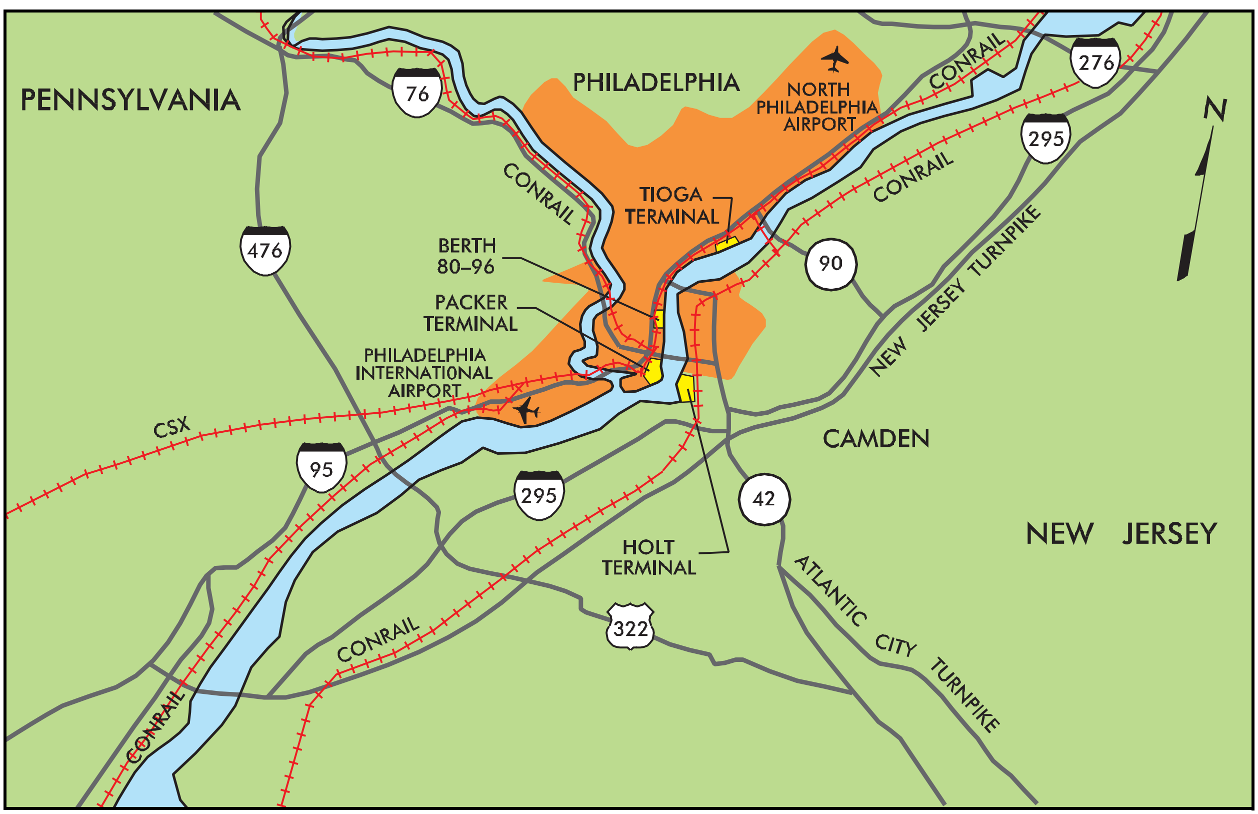
Rail

Three trunkline railroads serve the city of Philadelphia and surrounding areas: Conrail, CP Rail System (CP Rail), and CSX Transportation, Inc. (CSX). The city has one belt line, the Philadelphia Belt Line Railroad, that performs switching and operates transfer facilities for the railroad lines within the city.

Philadelphia has four major classification yards: 44th Street, Frankford Junction, Pavonia, and Greenwich. The Greenwich yard can store 1,800 cars. The other three have a combined capacity of 5,000 cars.

Airports

Philadelphia has two commercial airports that could receive incoming military aircraft. One is the Philadelphia International Airport, located southwest of the Packer Avenue Terminal and near all the terminals. The other is Northeast Philadelphia Airport, which is the closer airport to the Tioga Terminal.



Rail and Air Access

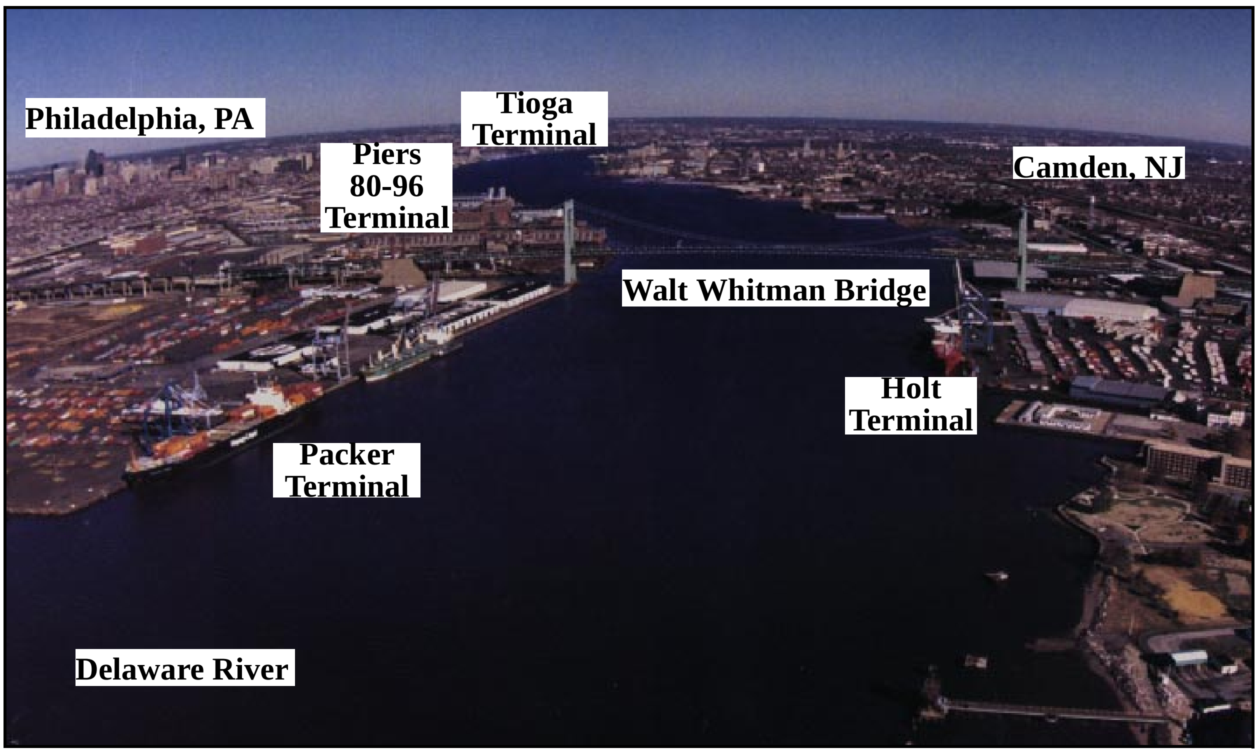
PORT FACILITIES

Berthing

This report covers four terminals. The terminals are: Piers 80-96; Tioga Container Terminal; Packer Avenue Marine Terminal; and Holt Marine Terminal. These terminals are a mixture of breakbulk and container facilities consisting of marginal wharves and finger piers. Some facilities have transit sheds on the piers to support conventional breakbulk cargo.

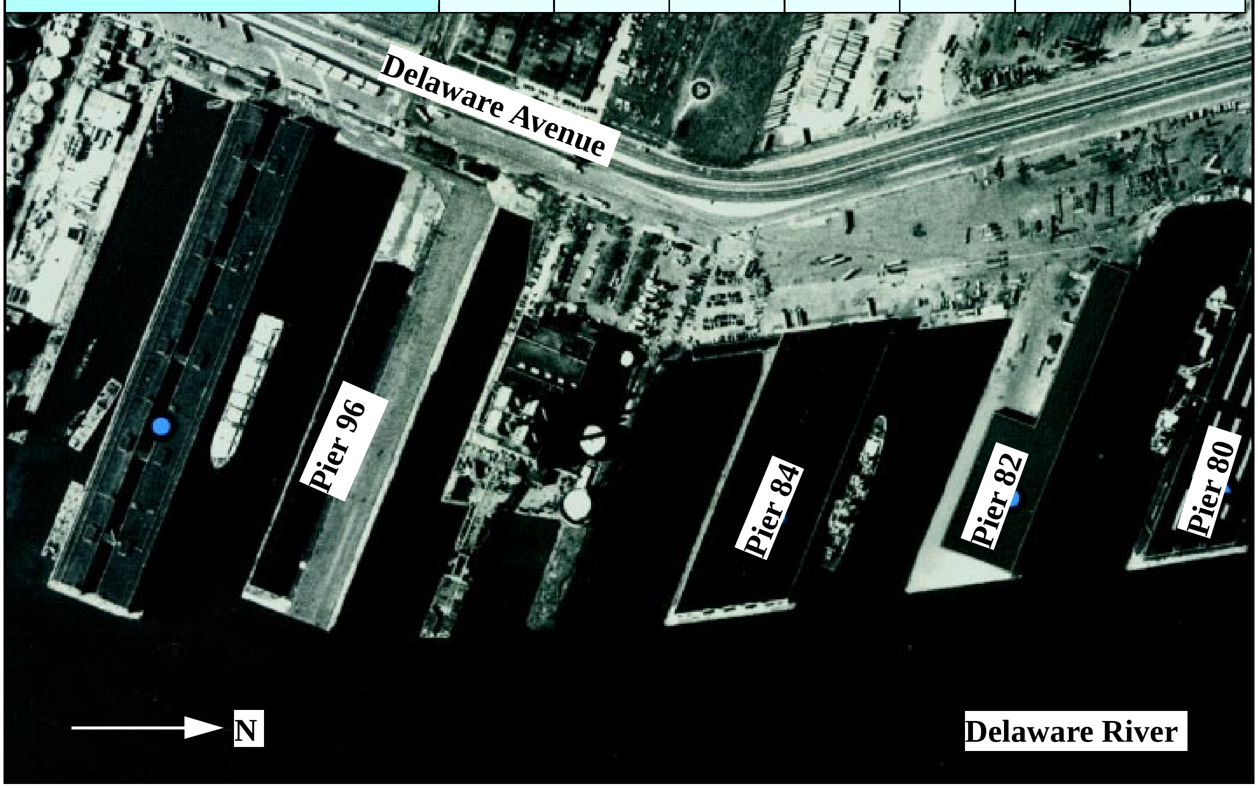
Pier construction varies from terminal to terminal. Many of the terminals have apron tracks as well as wharf and/or container cranes. Water depth ranges from 30 to 40 feet MLW.

This section contains land-use maps and aerial views of the terminals. Also included are tables identifying the berth characteristics at each terminal.

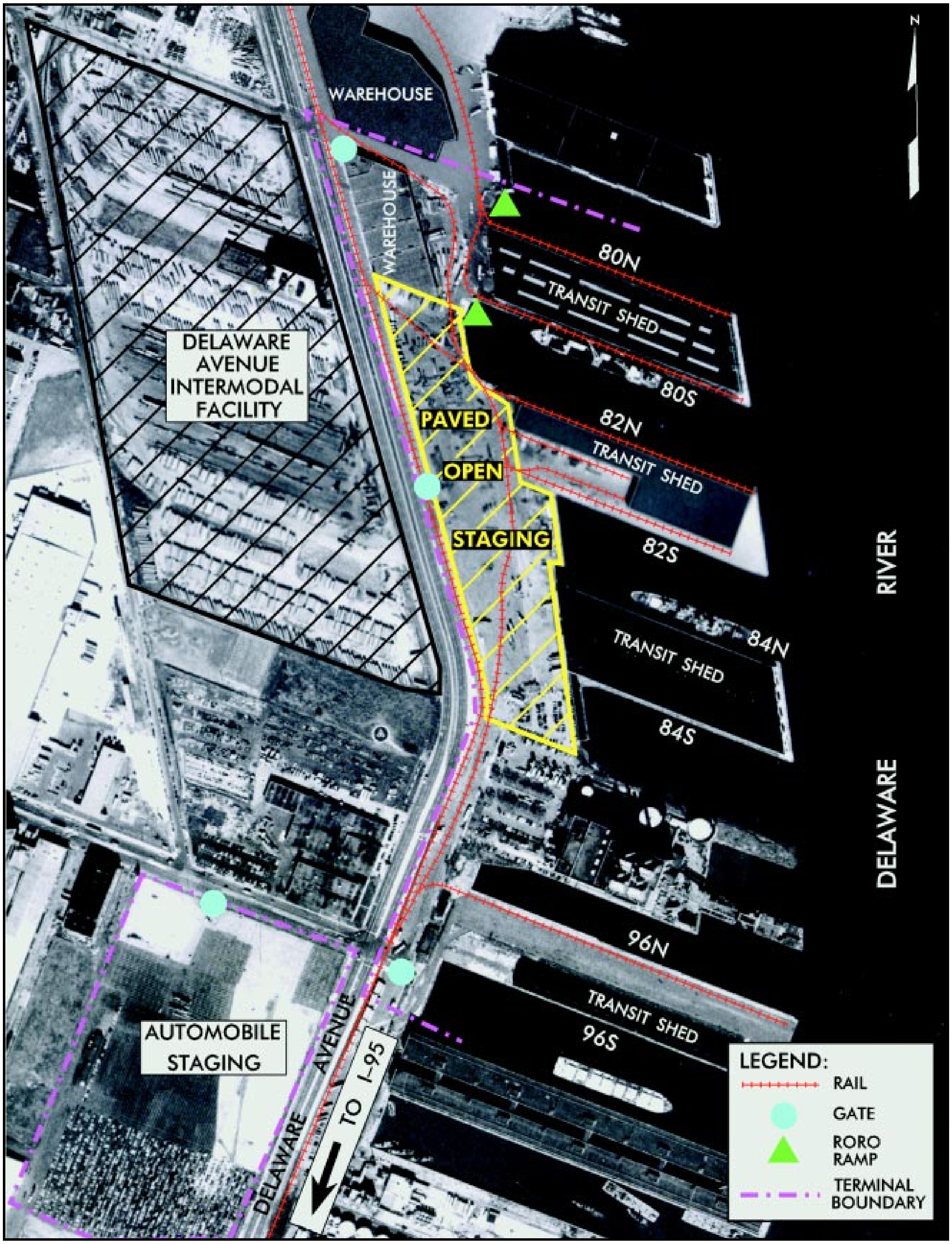


Terminal Locations (Northward view)

BERTHING CHARACTERISTICS OF PIERS 80-96							
Characteristics	**Berths**						
	80N	**80S**	**82N**	**82S**	**84N**	**84S**	**96N**
Length (ft)	994	1,144	1,139	855	855	855	1,320
Depth alongside at MLW (ft)	35	35	30	30	30	30	30
Deck strength (psf)	1,000	1,000	800	800	800	800	500
Apron width (ft)	38	38	30	110	23	23	110
Apron height above MLW (ft)	11	11	12	8	10	10	14
Number of container cranes	0	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	Yes	No	No	No	No	No
Apron length served by rail (ft)	990	1,140	1,135	850	0	0	1,320

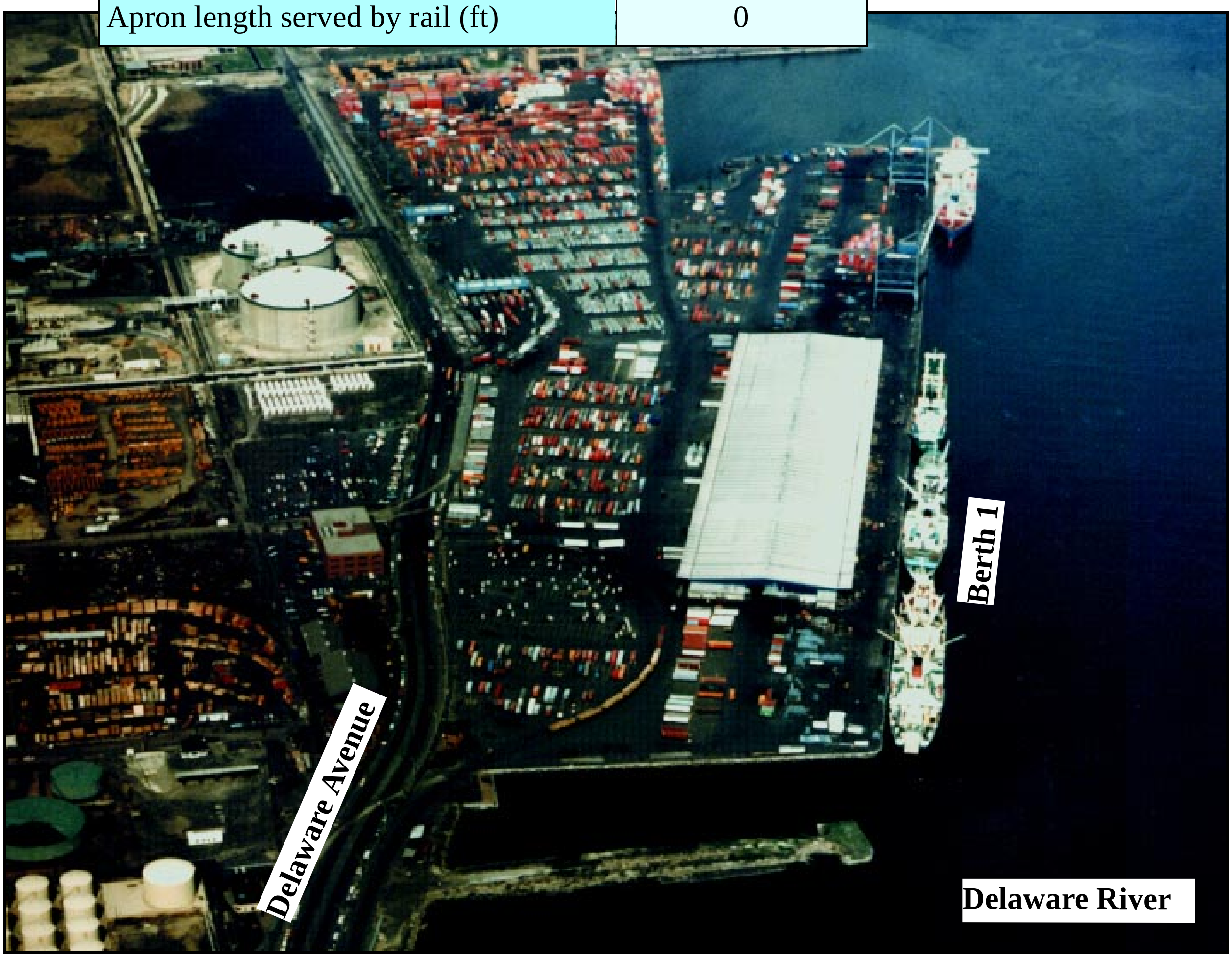


Piers 80-96



Piers 80-96 Terminal Land-Use Map

BERTHING CHARACTERISTICS OF TIOGA CONTAINER TERMINAL	
Characteristics	**Berth**
	1
Length (ft)	1,425
Depth alongside at MLW (ft)	40
Deck strength (psf)	1,000
Apron width (ft)	Open
Apron height above MLW (ft)	12
Number of container cranes	2
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

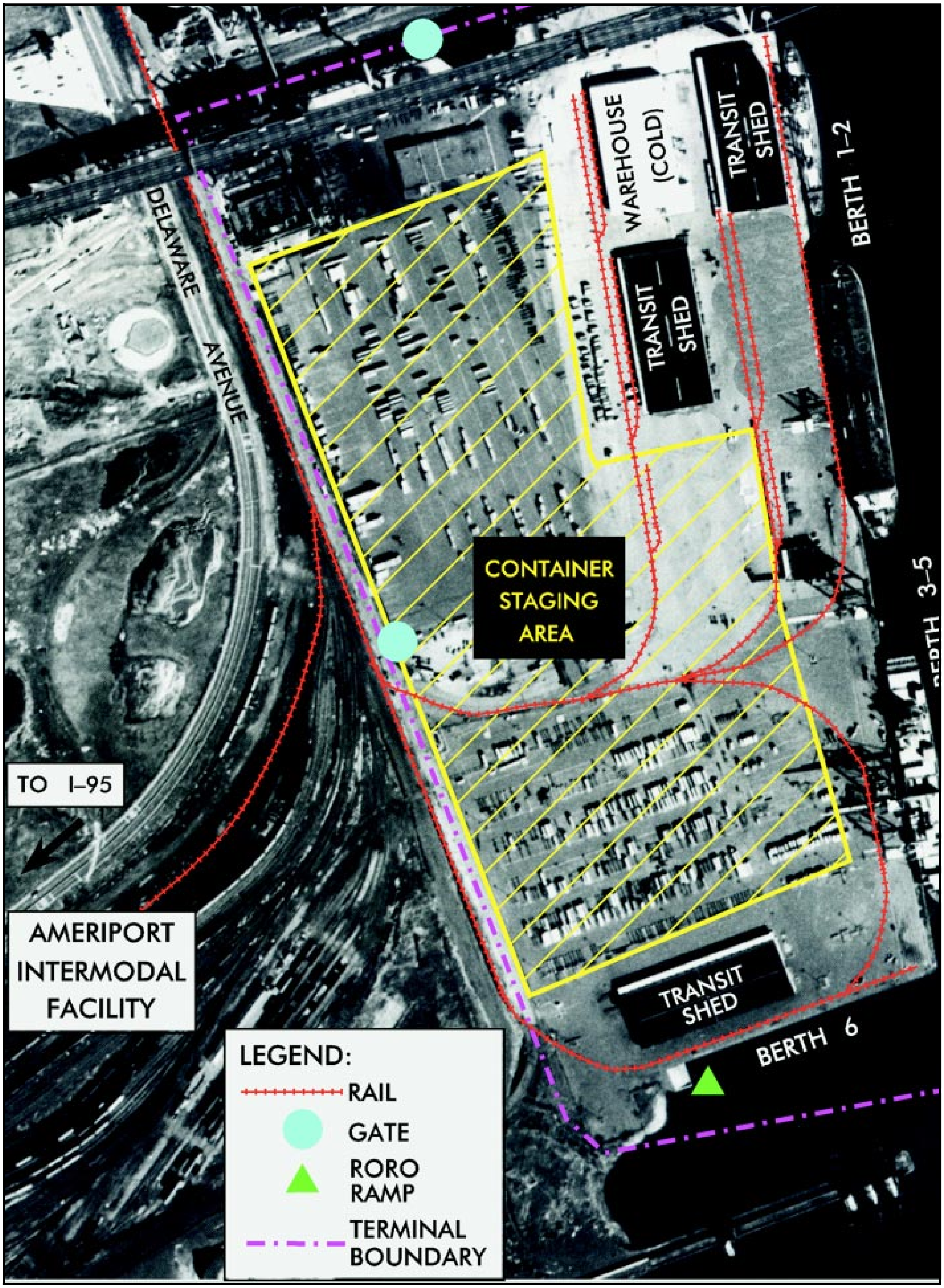


Tioga Container Terminal (Eastward view)

Tioga Container Terminal Land-Use Map

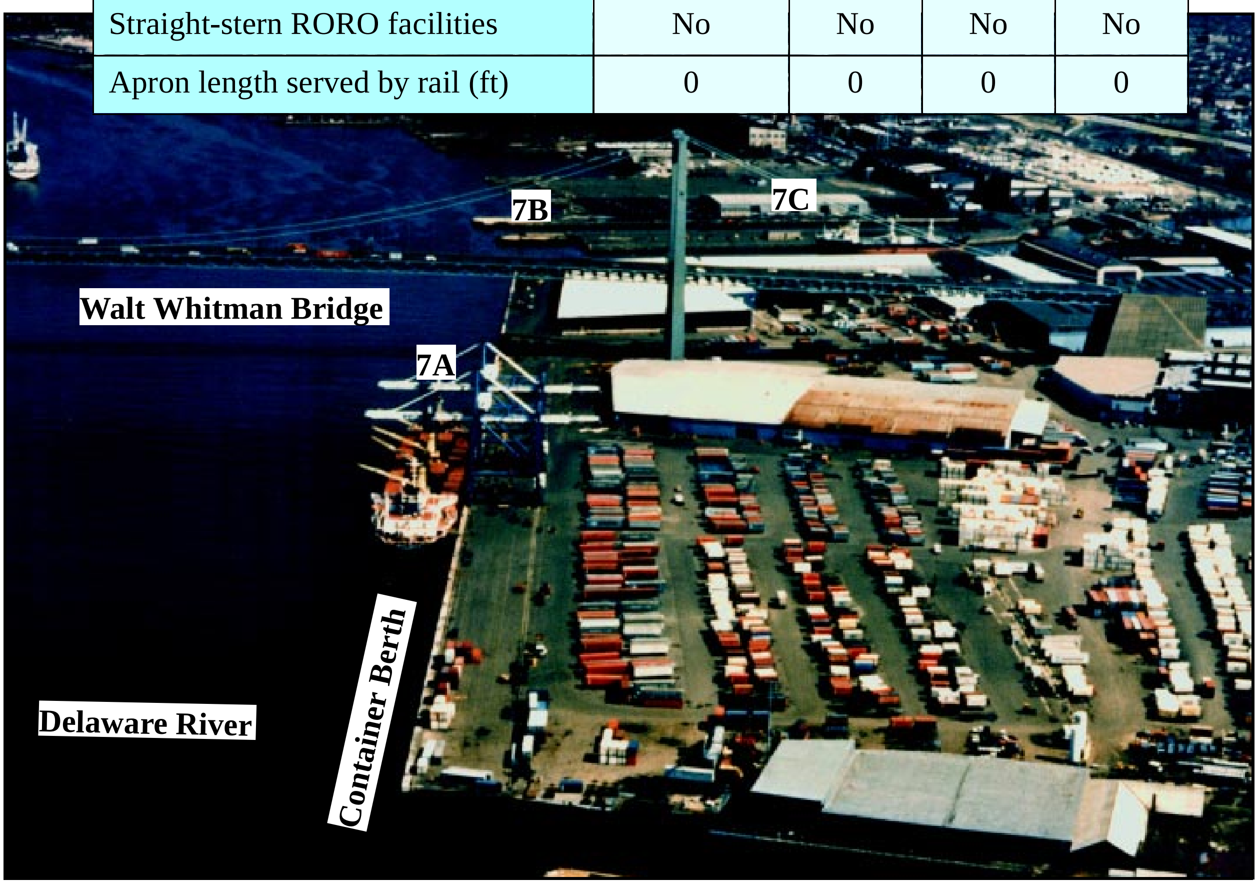
BERTHING CHARACTERISTICS OF PACKER AVENUE MARINE TERMINAL			
Characteristics	Berths		
	1-2	3-5	6
Length (ft)	1,240	1,860	816
Depth alongside at MLW (ft)	40	40	40
Deck strength (psf)	1,000	1,000	1,000
Apron width (ft)	40	Open	40
Apron height above MLW (ft)	13	13	13
Number of container cranes	0	5	1
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	Yes
Apron length served by rail (ft)	1,240	1,860	810

Packer Avenue Marine Terminal (Northward view)

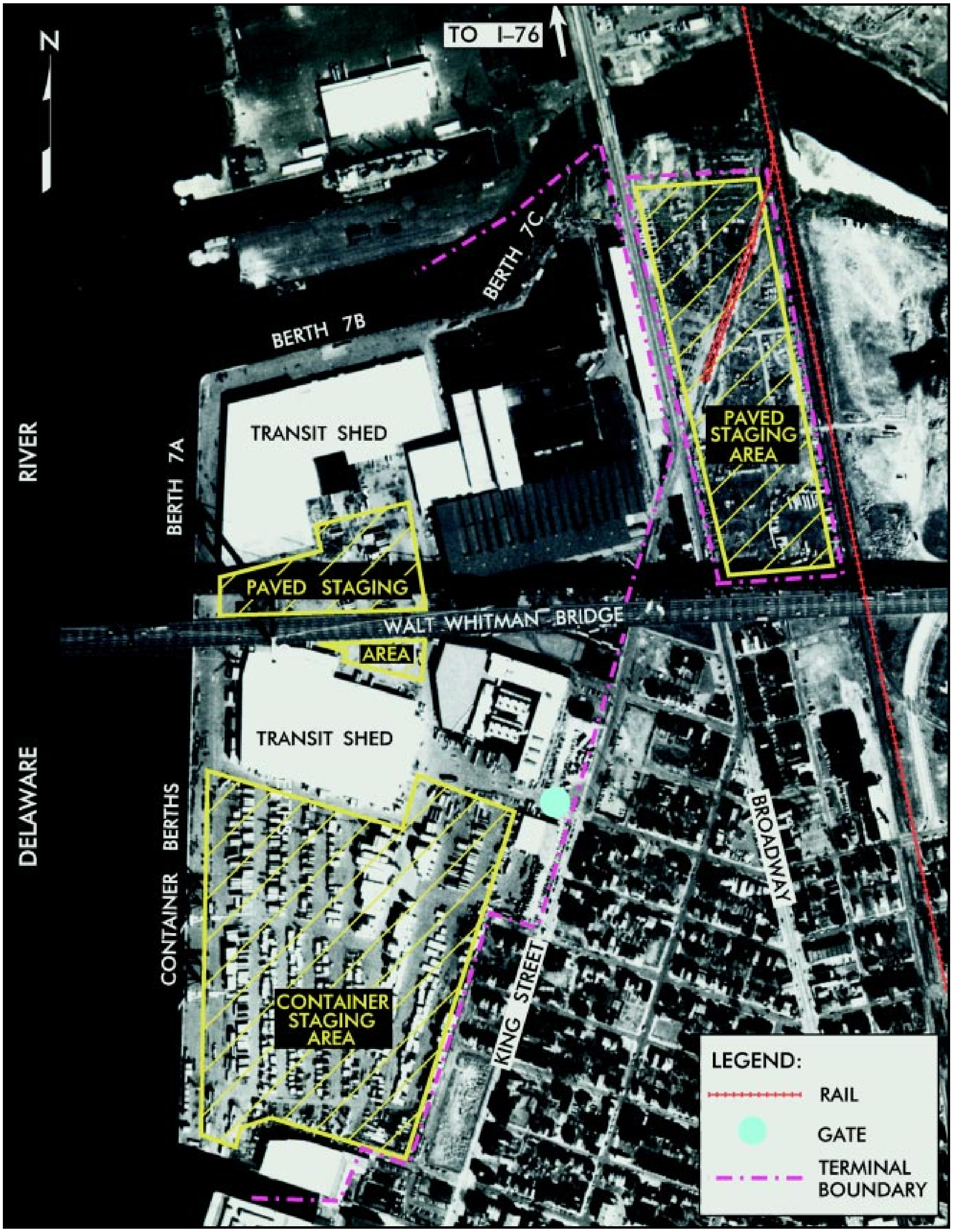


Packer Avenue Marine Terminal Land-Use Map

BERTHING CHARACTERISTICS OF HOLT MARINE TERMINAL				
Characteristics	Berths			
	Container	7A	7B	7C
Length (ft)	2,100	900	1,325	400
Depth alongside at MLW (ft)	40	40	40	40
Deck strength (psf)	1,000	1,000	1,000	1,000
Apron width (ft)	Open	75	75	Open
Apron height above MLW (ft)	12	12	12	12
Number of container cranes	2	0	0	0
Number of wharf cranes	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No
Apron length served by rail (ft)	0	0	0	0



Holt Marine Terminal (Northward view)



Holt Marine Terminal Land-Use Map

Staging

Open Staging. The terminals in this report have a total of 279 acres of paved open staging. Helicopter operations are possible in open staging areas at Tioga Container Terminal and Holt Marine Terminal. Staging areas at each terminal are identified below.

Covered Staging. The terminals have a total of 12 covered storage facilities (transit sheds and warehouses) that provide about 2,190,000 square feet of storage. The table below identifies the location of staging areas by terminal.

STAGING AREAS

TERMINAL	COVERED (SQ FT)	OPEN PAVED (ACRES)	OPEN GRAVEL (ACRES)
Piers 80-96	800,000	29	0
Tioga Container Terminal	300,000	83	0
Packer Avenue Marine Terminal	290,000	63	0
Holt Marine Terminal	800,000	104	0

Rail

Rail trackage links the railyards to the terminal's apron tracks, transit sheds, and storage tracks. All the rail serving the terminals is in good condition with no operating restrictions. There are numerous locations that could support offloading with temporary or portable ramps. The table below provides characteristics of the rail facilities at each terminal.

RAIL CHARACTERISTICS

TERMINAL	TERMINAL TRACK (FT)*	STORAGE CAPACITY (89-FT RAILCARS) **	RAMPS (#)	DOCK POSITIONS
Piers 80-96	3,000	15	0	40
Tioga Container Terminal	7,000	56	0	0
Packer Avenue Marine Terminal	7,000	22	0	36
Holt Marine Terminal	2,500	15	0	0

*Excluding apron track.
**Storage capacity based on rail spurs and sidings.

Marshaling Areas

Mustin Airfield, a Naval Yard, is about 4 miles southwest of the central harbor area. Roadable vehicles and equipment could be marshaled here. Veterans Stadium is located just north of Mustin Airfield and has about 5.5 acres of paved parking available. This area could be used to stage equipment, if necessary.

MATERIAL HANDLING EQUIPMENT (MHE)

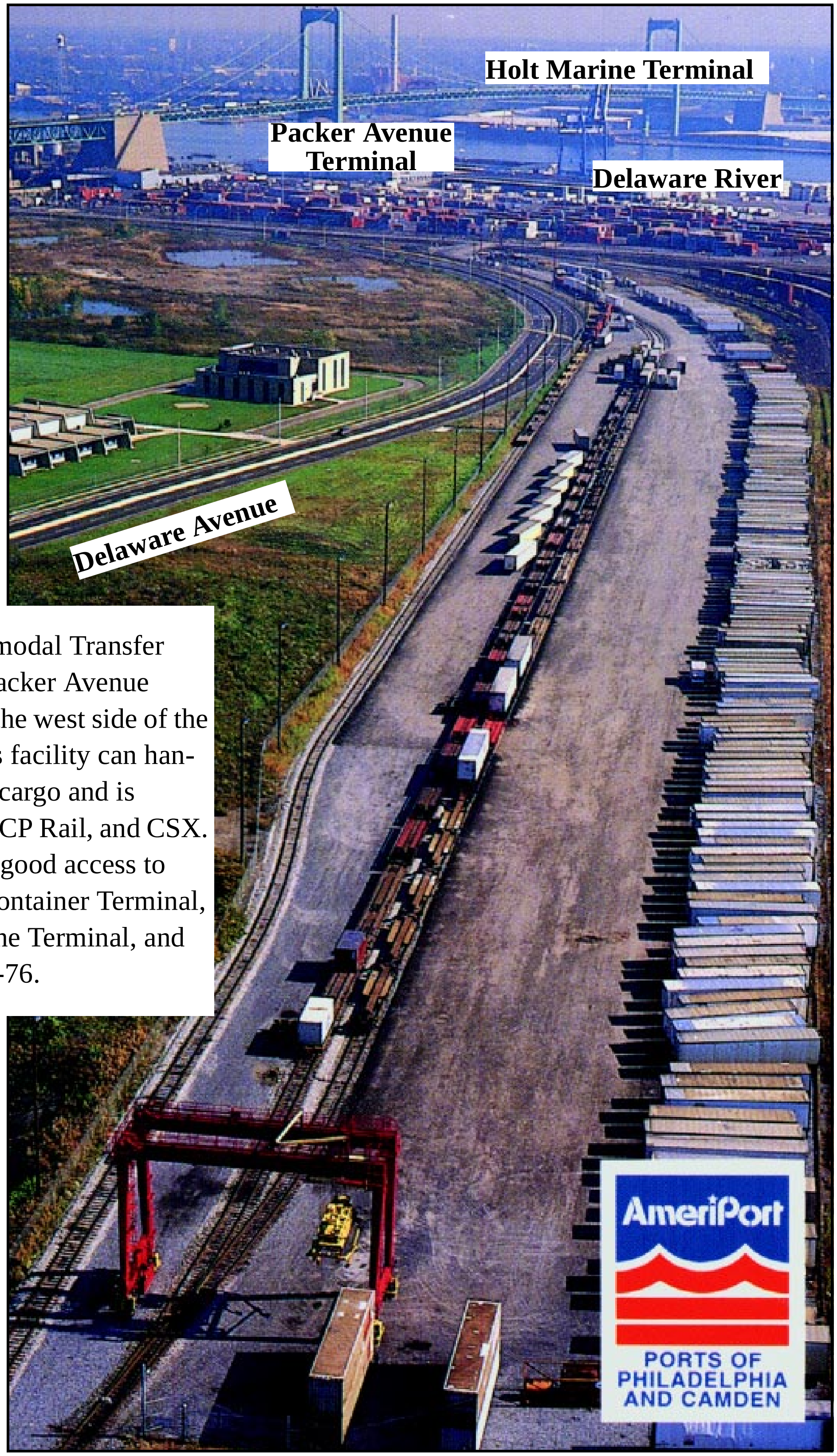
The terminals have a total of 10 container cranes that are at Packer Avenue Marine Terminal, Tioga Container Terminal, and Holt Marine Terminal. All have a capacity of at least 35 STON. Various shipping and rental companies in the area own transtainers and other MHE. Mobile cranes with capacities up to 150 STON and other MHE are available from local stevedore companies. The table below provides the equipment available by terminal.

TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY BY TERMINAL			
		PIERS 80-96	TIOGA	PACKER	HOLT
Container Cranes	30-200	0	2	6	2
Mobile Cranes	10-150	1	0	3	4
Top Picks	30-45	0	4	11	0
Forklifts	1.5-25	25	1	100	5
Yard Hustlers	-	20	25	20	20

INTERMODAL FACILITIES

Holt Marine Terminal is an intermodal container transfer facility. It has good highway connections to I-95 and I-76. Conrail provides service to the terminal.

The Delaware Avenue Intermodal Facility is located across Delaware Avenue from Piers 82 and 84. It is owned and operated by CSX and Sealand. The terminal area is 46 acres. Eleven track spurs provide storage for about 100 89-foot railcars.



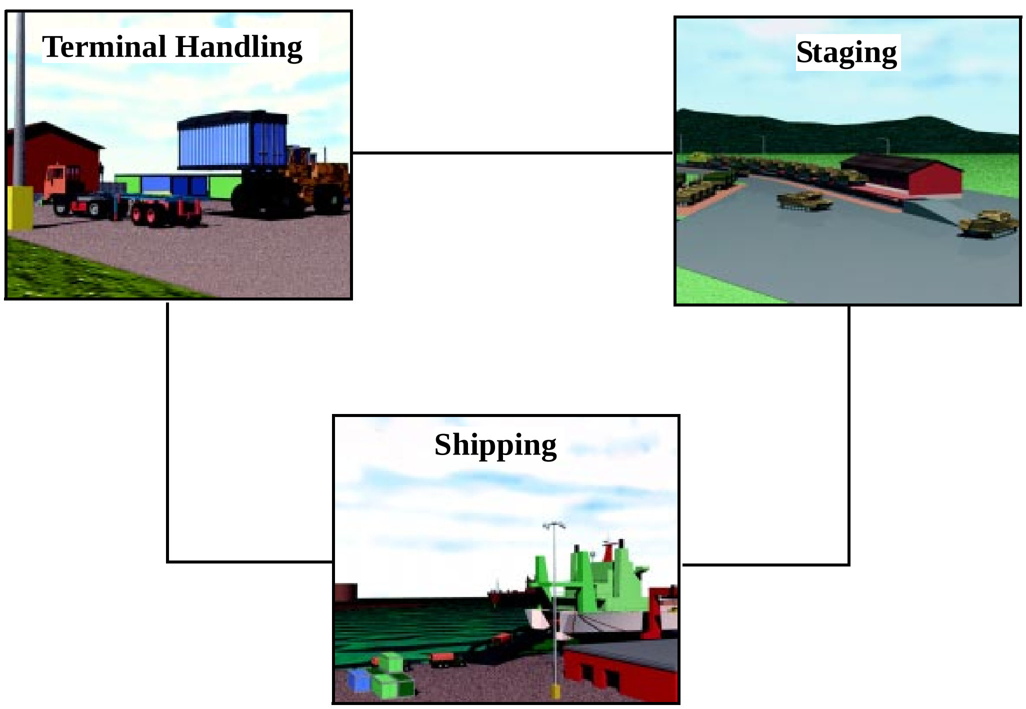
Ameriport Intermodal Transfer Yard (Eastward view)

The Ameriport Intermodal Transfer Yard is adjacent to Packer Avenue Marine Terminal on the west side of the Delaware River. This facility can handle all containerized cargo and is accessed by Conrail, CP Rail, and CSX. Its location provides good access to Piers 80-96, Tioga Container Terminal, Packer Avenue Marine Terminal, and Highways I-95 and I-76.

II. THROUGHPUT ANALYSIS

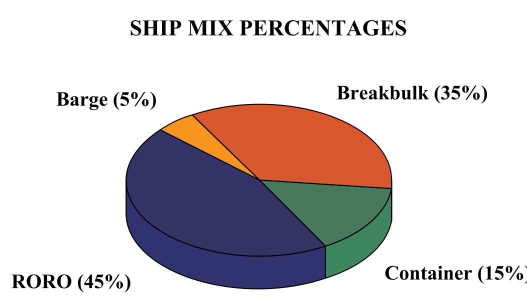
GENERAL

This section evaluates the throughput capability of the Port of Philadelphia using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in measurement tons (MTON) per day.



Terminal Throughput Subsystems

This analysis assumes a maximum of 80 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80 percent facility use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



RECEPTION/HANDLING

Highway

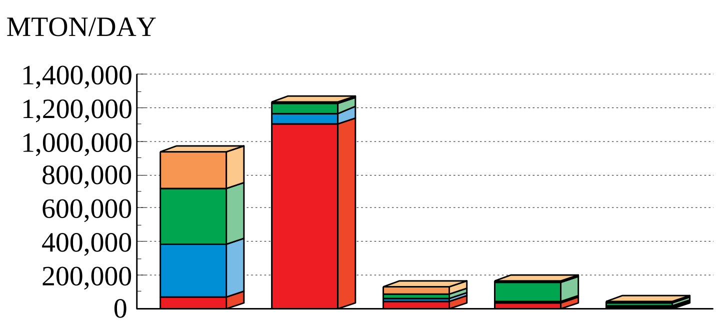
I-95 and I-76 provide access to the terminals. Each terminal has a designated entrance for trucks. The road network in and out of the terminals, including the gate processing of vehicles, could handle about 270,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable end ramps.

Supplies in van semitrailers will proceed to van-handling positions. These docks can offload more than 55,000 MTON of van semitrailer-shipped material per day. Container handlers can off-load about 158,000 MTON of chassis cargo per day.

Truck Handling Facilities			
Terminal	**Truck End Ramps**	**Van Handling Positions**	**Container Handlers**
Piers 80-96	8	60	2
Tioga	10	33	10
Packer Avenue	5	66	10
Holt Marine	10	33	10

HIGHWAY RECEPTION/HANDLING CAPABILITY



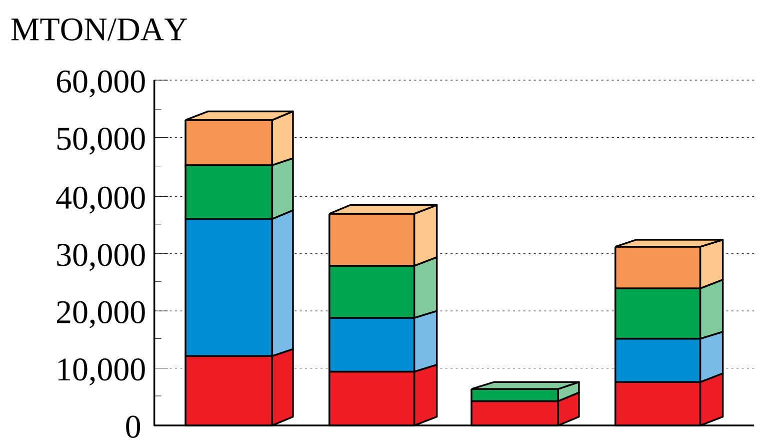
SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS	DOCKS	CONTAINERS
PIERS80 - 96	66,000	1,100,000	38,000	30,000	8,000
TIOGATERMINAL	320,000	70,000	19,000	13,000	9,000
PACKERTERMINAL	330,000	59,000	24,000	111,000	12,000
HOLTTERMINAL	220,000	6,000	48,000	11,000	9,000

Rail

Rail reception at the port is good with three railroad companies accessing the Port of Philadelphia area. All terminals have good rail service.

Terminal	Train Length (railcars)	Trains Per Day	Rail End Ramps	Boxcar Docks	Container Handlers
Piers 80-96	60	2	1 (portable)	40	2
Tioga	100	2	1 (portable)	0	2
Packer Avenue	50	3	1 (portable)	36	2
Holt Marine	35	3	1 (portable)	0	2

RAIL RECEPTION/HANDLING CAPABILITY



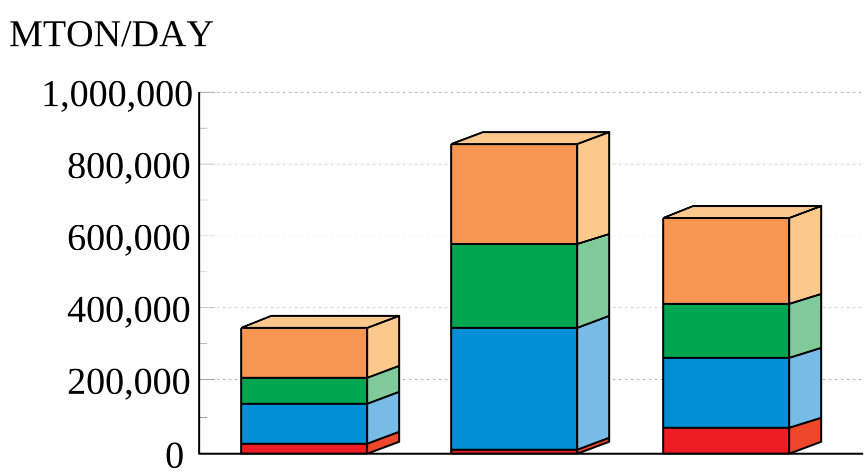
SUBSYSTEMS	TRACKAGE	END-RAMPS	DOCKS	COFC
PIERS 80 - 96	12,000	9,300	4,300	7,600
TIOGA TERMINAL	24,000	9,300	0	7,400
PACKER TERMINAL	9,300	9,300	2,000	9,000
HOLT TERMINAL	8,000	9,000	0	7,000

Staging

The terminals of this report have a total of about 279 acres of paved open staging. The terminals also have more than 2.7 million square feet of covered storage.

Terminal	Covered (Sq Ft)	Open Paved (Acres)	Open Gravel (Acres)
Piers 80-96	800,000	29	0
Tioga	300,000	83	0
Packer Avenue	290,000	63	0
Holt Marine	800,000	104	0

OPEN STAGING CAPABILITY



VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
PIERS 80 - 96	28,000	8,000	68,000
TIOGA TERMINAL	110,000	340,000	194,000
PACKER TERMINAL	72,000	230,000	150,000
HOLT TERMINAL	140,000	280,000	240,000

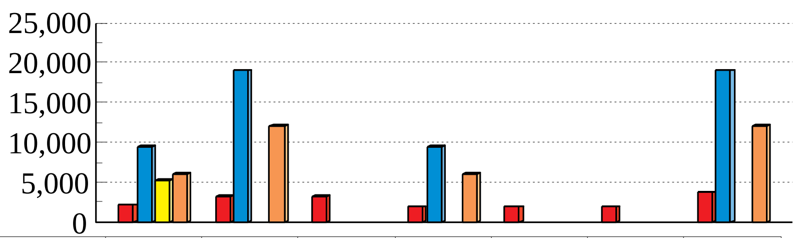
Shipping

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility.

PIERS 80 - 96

BERTH THROUGHPUT CAPABILITY

MTON/DAY

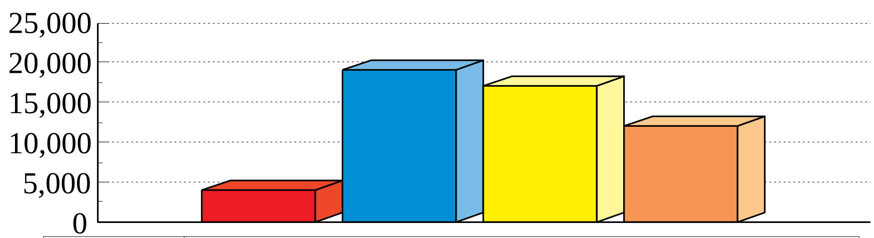


BERTH	80N	80S	82N	82S	84N	84S	96N
BREAKBULK	2,100	3,200	3,200	1,900	1,900	1,900	3,700
RORO	9,400	19,000	0	9,400	0	0	19,000
CONTAINER	5,300	0	0	0	0	0	0
MIXED	6,100	12,000	0	6,100	0	0	12,000

TIOGA CONTAINER TERMINAL

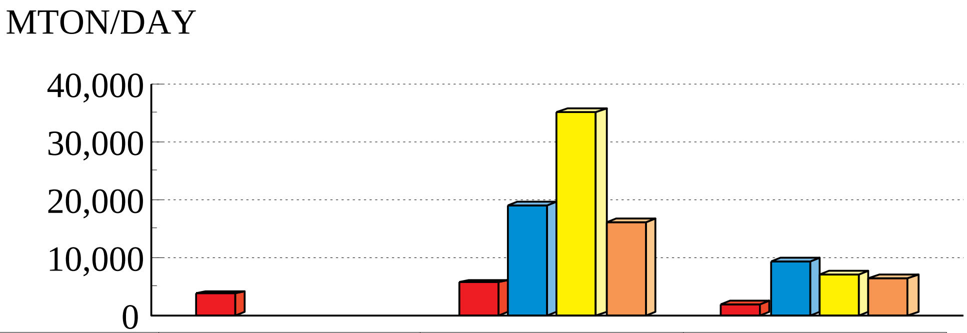
BERTH THROUGHPUT CAPABILITY

MTON/DAY



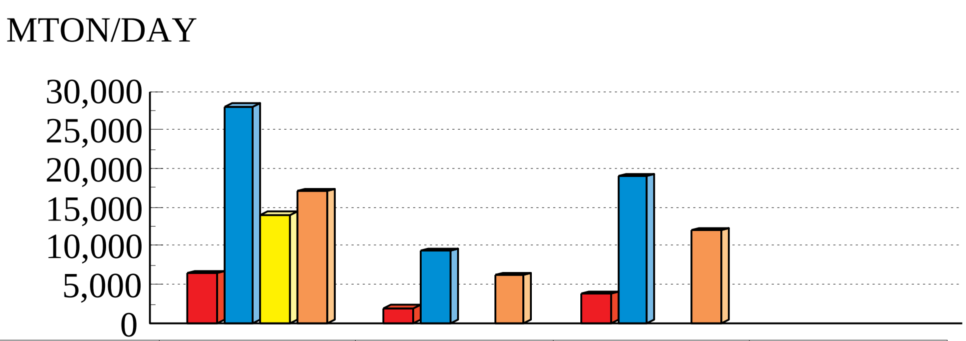
BERTH	BERTH 1
BREAKBULK	4,000
RORO	19,000
CONTAINER	17,000
MIXED	12,000

PACKER AVENUE MARINE TERMINAL
BERTH THROUGHPUT CAPABILITY



BERTH	1-2	3-5	6
BREAKBULK	3,700	5,600	1,900
RORO	0	19,000	9,400
CONTAINER	0	35,000	7,000
MIXED	0	16,000	6,300

HOLT MARINE TERMINAL
BERTH THROUGHPUT CAPABILITY



BERTH	CONTAINER	7A	7B	7C
BREAKBULK	6,500	2,000	3,800	0
RORO	28,000	9,400	19,000	0
CONTAINER	14,000	0	0	0
MIXED	17,000	6,200	12,000	0

CONVERSION FACTORS	
Breakbulk	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON

The type of ship preferred at each berth is based on the methodology described in Appendix B. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for loading and unloading operations.

Packer Avenue Marine Terminal best supports FSS and LMSR operations. An FSS would likely berth at Berth 3-5, with port side to the wharf. LMSR vessels can also load at this berth without loading restrictions.

PREFERENCE BERTH SELECTION

BERTH	BB	RORO	CNTNR
PIERS 80-96			
80	2	7	5
82	4	-	9
84	6	-	11
96	4	-	10
TIOGA			
Berth 1	8	6	4
PACKER			
1-2	1	-	1
3-5	6	1	1
6	2	2	6
HOLT			
Container	9	3	3
7A	10	3	8
7B	10	3	7
7C	-	-	-

SUMMARY OF BERTHING CAPABILITIES OF PIERS 80 AND 82				
Vessel	**Berths**			
	Pier 80N	**Pier 80S**	**Pier 82N**	**Pier 82S**
Breakbulk				
C3-S-33a	1	2	a	a
C3-S-37c	1	2	a	a
C3-S-37d	1	2	2	1
C3-S-38a	1	2	2	1
C4-S-1a	1	1	1	1
C4-S-1qb and 1u	1	1	a	a
C4-S-58a	1	1	a	a
C4-S-65a	1	1	1	1
C4-S-66a	1	2	a	a
C4-S-69b	1	1	a	a
Seatrain				
GA and PR-class	1	1	1	1
Barge				
LASH C8-S-81b	1	1	a,f	a,f
LASH C9-S-81d	a	a	a	a,c
LASH lighter	7	8	8	6
SEABEE C8-S-82a	a	a	a	a,c
SEABEE barge	4	5	5	4
RORO				
Comet	1,i	2,i	d,o	1,d,i
C7-S-95a/Maine-class	b	b	a,b	a
Ponce-class	b,h	b,h	b,h	h
Great Land-class	b,h	b,h	b,h	b
Cygnus/Pilot-class	b	b	b	1
Meteor	i,j	i,j	d,o	1,d,i
AmEagle/Condor	b	b	b	l,i
MV Ambassador	l,m	l,m	d	d
FSS-class	b	b	a,b	a,c
Cape D-class	b	b	a,b	a
Cape H-class	a,b	a,b	a,b	a
LMSR	b	b	a,b	a,c
Container				
C6-S-lw	1,e	1,e	1,e	1,e
C7-S-68e	1,e	1,e	a,e	a,e
C8-S-85c	1,e	1,e	a,e	a,e
Combination				
C5-S-78a	1,e	1,e	a,e	a,e
C5-S-37e	1,e	1,e	1,e	1,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF PIERS 84 AND 86

Vessel	Berths		
	Pier 84N	**Pier 84S**	**Pier 96N**
Breakbulk			
C3-S-33a	a	a	a
C3-S-37c	a	a	a
C3-S-37d	1	1	2
C3-S-38a	1	1	2
C4-S-1a	1	1	2
C4-S-1qb and 1u	a	a	a
C4-S-58a	a	a	a
C4-S-65a	1	1	2
C4-S-66a	a	a	a
C4-S-69b	a	a	a
Seatrain			
GA and PR-class	1	1	2
Barge			
LASH C8-S-81b	a,f	a,f	a,f
LASH C9-S-81d	a,c	a,c	a
LASH lighter	6	6	9
SEABEE C8-S-82a	a,c	a,c	a
SEABEE barge	4	4	6
RORO			
Comet	d,o	d,o	d,i,j
C7-S-95a/Maine-class	a,b	a,b	a
Ponce-class	b,h	b,h	h
Great Land-class	b,h	b,h	h
Cygnus/Pilot-class	b	b	2
Meteor	d,o	d,o	d,i,j
AmEagle/Condor	b	b	i,j
MV Ambassador	d	d	d
FSS-class	a,b,c	a,b,c	a
Cape D-class	a,b	a,b	a
Cape H-class	a,b	a,b	a
LMSR	a,b,c	a,b,c	a
Container			
C6-S-lw	1,e	1,e	1,e
C7-S-68e	a,e	a,e	a,e
C8-S-85c	a,e	a,e	a,e
Combination			
C5-S-78a	a,e	a,e	a,e
C5-S-37e	1,e	1,e	2,e

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
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h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF TIOGA CONTAINER TERMINAL

Vessel	Berths
	Berth 1
Breakbulk	
C3-S-33a	2
C3-S-37c	2
C3-S-37d	2
C3-S-38a	2
C4-S-1a	2
C4-S-1qb and 1u	2
C4-S-58a	2
C4-S-65a	2
C4-S-66a	2
C4-S-69b	2
Seatrain	
GA and PR-class	2
Barge	
LASH C8-S-81b	1
LASH C9-S-81d	1
LASH lighter	10
SEABEE C8-S-82a	1
SEABEE barge	7
RORO	
Comet	d,i,j
C7-S-95a/Maine-class	1
Ponce-class	h
Great Land-class	h
Cygnus/Pilot-class	2
Meteor	d,i,j
AmEagle/Condor	i,j
MV Ambassador	d
FSS-class	1
Cape D-class	i,j
Cape H-class	1
LMSR	1
Container	
C6-S-lw	2
C7-S-68e	1
C8-S-85c	1
Combination	
C5-S-78a	2
C5-S-37e	2

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF PACKER AVENUE MARINE TERMINAL			
Vessel	**Berths**		
	1-2	**3-5**	**6**
Breakbulk			
C3-S-33a	2	3	1
C3-S-37c	2	3	1
C3-S-37d	2	3	1
C3-S-38a	2	3	1
C4-S-1a	2	3	1
C4-S-1qb and 1u	2	3	1
C4-S-58a	2	3	1
C4-S-65a	2	3	1
C4-S-66a	2	3	1
C4-S-69b	2	3	1
Seatrain			
GA and PR-class	2	3	1
Barge			
LASH C8-S-81b	1	2	c
LASH C9-S-81d	1	2	c
LASH lighter	8	13	5
SEABEE C8-S-82a	1	2	c
SEABEE barge	6	9	4
RORO			
Comet	d,o	d,i,j	i,j
C7-S-95a/Maine-class	b	2	1
Ponce-class	b,h	h	h
Great Land-class	b,h	h	h
Cygnus/Pilot-class	b	2	1
Meteor	d,o	d,i,j	i,j
AmEagle/Condor	b	i,j	i,j
MV Ambassador	d	d	1,m
FSS-class	b	1	c
Cape D-class	b	i,j	i,j
Cape H-class	b	2	1
LMSR	b	1	c
Container			
C6-S-lw	1,e	2	1
C7-S-68e	1,e	2	1
C8-S-85c	1,e	2	c
Combination			
C5-S-78a	1,e	2	1
C5-S-37e	2,e	3	1

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
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e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES OF HOLT MARINE TERMINAL

Vessel	Berths			
	Container	7A	7B	7C
Breakbulk				
C3-S-33a	4	1	2	c
C3-S-37c	4	1	2	c
C3-S-37d	4	1	2	c
C3-S-38a	4	1	2	c
C4-S-1a	3	1	2	c
C4-S-1qb and 1u	3	1	2	c
C4-S-58a	3	1	2	c
C4-S-65a	3	1	2	c
C4-S-66a	3	1	2	c
C4-S-69b	3	1	2	c
Seatrain				
GA and PR-class	3	1	2	c
Barge				
LASH C8-S-81b	2	1	1	c
LASH C9-S-81d	2	1	1	c
LASH lighter	15	6	9	2
SEABEE C8-S-82a	2	1	1	c
SEABEE barge	10	4	6	2
RORO				
Comet	d,i,j	d,i,j	d,i,j	c,d
C7-S-95a/Maine-class	2	1	1	c
Ponce-class	h	b,h	b,h	c,h
Great Land-class	h	b,h	b,h	c,h
Cygnus/Pilot-class	3	1	2	c
Meteor	d,i,j	d,o	d,o	c,d
AmEagle/Condor	i,j	i,j	i,j	c
MV Ambassador	d	d	d	c,d
FSS-class	2	c	1,n	c
Cape D-class	i,j	i,j	i,j	c
Cape H-class	2	1	1	c
LMSR	2	c	1,n	c
Container				
C6-S-lw	3	1,e	1,e	c,e
C7-S-68e	2	1,e	1,e	c,e
C8-S-85c	2	1,e	1,e	c,e
Combination				
C5-S-78a	3	2,e	2,e	c,e
C5-S-37e	3	2,e	2,e	c,e

a=vessel draft limited to berth depth
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Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

III. APPLICATION

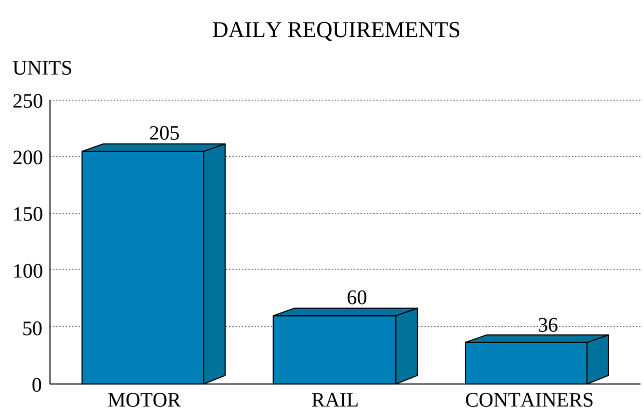
GENERAL

This section will evaluate the port's throughput capability for deploying a notional mechanized infantry brigade using primarily FSS vessels. There are currently no planning orders in effect for the Port of Philadelphia. Of the terminals in this report, only the Pier 80-96 Terminal is incapable of performing FSS operations. Light FSS vessels are unable to clear the 135 foot high Benjamin Franklin Bridge to access the Tioga Terminal. Of the remaining two terminals, the Packer Avenue Marine Terminal has the best rail facilities. For this reason, this analysis assumes the Packer Avenue terminal will be used for military operations.

REQUIREMENTS

The likely requirement for the Port of Philadelphia is to deploy a notional mechanized infantry brigade in 6 days. The brigade has to move about 2,600 vehicles and 220 containers. The movement to the port will require 360 railcars (60 per day) using the convoy/rail option. Under this option, about 1,200 (205 per day) roadable vehicles would be driven and about 775 (130 per day) would be towed.

MECHANIZED INFANTRY BRIGADE	
Total Equipment	
Volume	91,506 MTON
Weight	31,670 STON
Area	474,300 Sq Ft
Vehicles	2,600
Containers	220

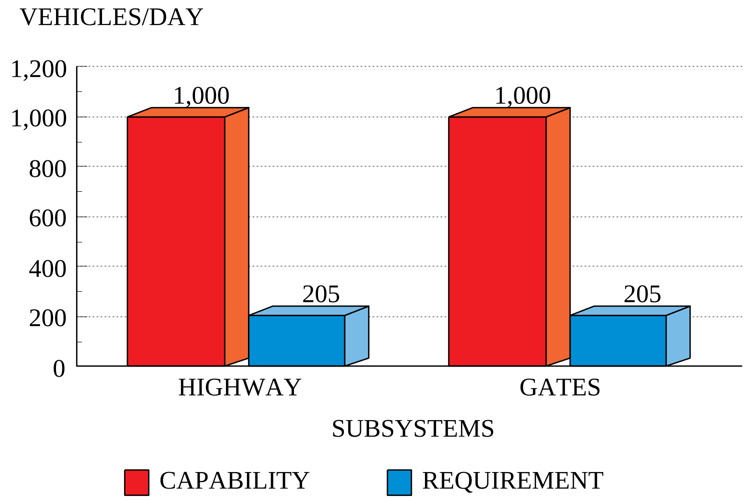


TERMINAL HANDLING

Highway

The highway routes to the port are Interstate Routes 95 and 76. Vehicles and containers on chassis would access the Packer Avenue Terminal via four-laned Delaware Avenue/Columbus Boulevard. These access roads and the gates can handle well over 1,000 vehicles per day.

HIGHWAY INPROCESSING CAPABILITY

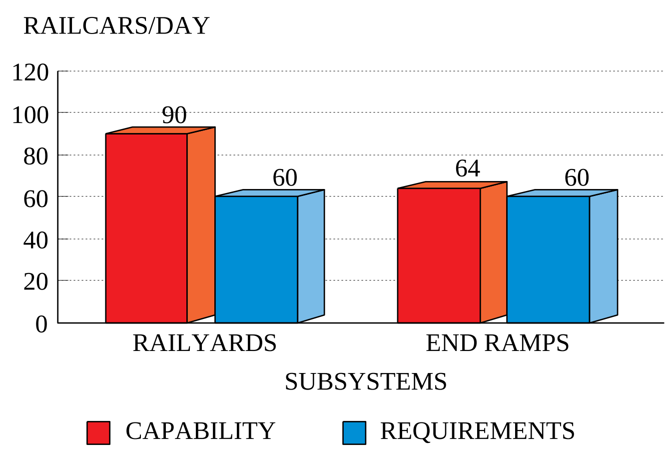


Rail

Railyards in the Philadelphia area can easily accommodate 90 railcars per day without disrupting simultaneous commercial operations. Railcars would then be switched into the port as the spurs are available to support offloading.

Two spurs that can support offloading operations are inland of the warehouses. If neither is available, the Ameriport Intermodal Transfer Yard, located across the street from the terminal, might be used for offloading operations. For this analysis, we assume that one of the 1,600-foot spurs inland of the warehouses is available. A portable or temporary ramp at the northwest corner of the refrigerated warehouse can support offloading 16 railcars. Offloading these 16 railcars every 5 hours will meet the 60 railcar per day requirement.

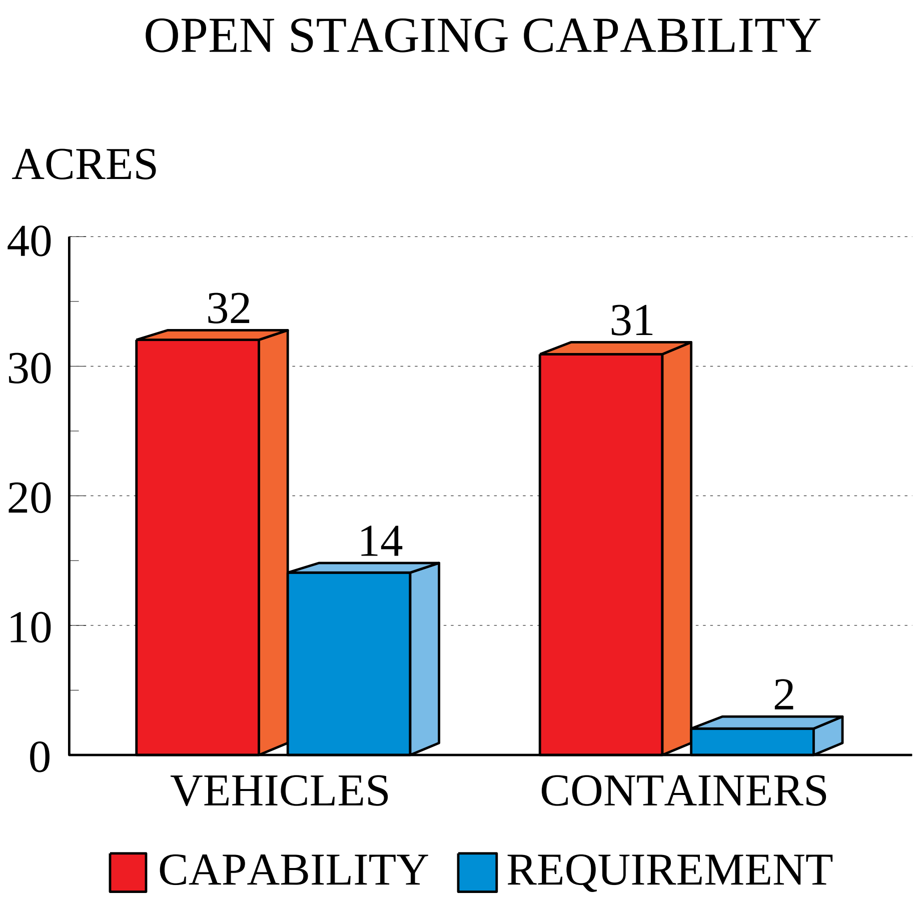
RAIL INPROCESSING AND HANDLING CAPABILITY



Staging

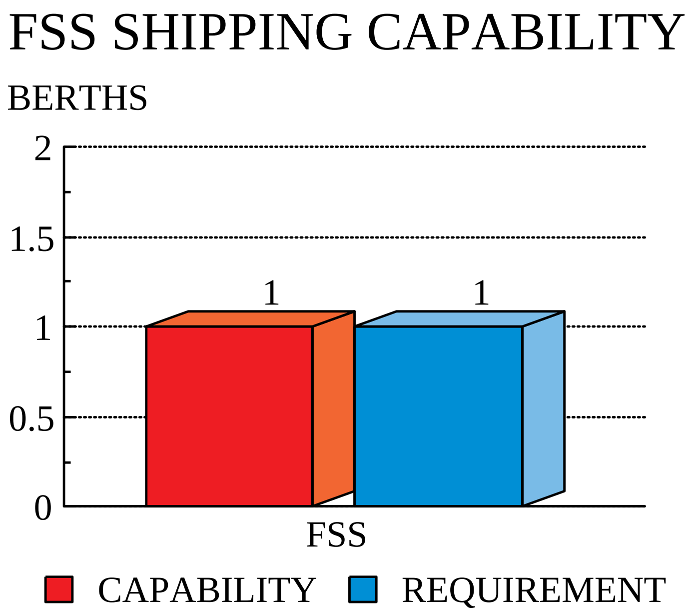
This analysis assumes that current downsizing continues, and that three FSS-sized ships will deploy an entire notional mechanized infantry brigade. One ship will depart every two days.

Although an FSS load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for staging containers. The Packer Avenue Terminal has about 63 acres of paved open staging. This exceeds the requirement.



Shipping

Although this analysis assumes that three FSS-sized ships can deploy the notional mechanized infantry brigade, the table below provides ship quantities for the current brigade size. The number of ships required depends on the shipping mix selected. Berth 3-5 is 1,860 feet long and can easily support FSS and LMSR operations. This capability meets the requirement for FSS berthing.



UNIT MOVEMENT REQUIREMENTS, MECHANIZED BRIGADE

Loading Condition/ Sample Ship Mix	Vessel Types			
	FSS (RORO/Comb)	Cape H (RORO/Comb)	C3/C4 (Breakbulk)	C6/C7/C8 (Container)
Minimum Containerization:				
All FSS	3.33			
FSS and Cape H	2.22	1.00		
All Breakbulk			12.57	
Maximum Containerization:				
FSS, and Container	2.64			0.67
FSS, Cape H, and Container	1.54	1.00		0.67
Breakbulk and Container			9.86	0.67

Legend:
RORO - roll on/roll off
FSS - fast sealift ship
Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide. Aug 91.

SUMMARY

The Port of Philadelphia has adequate characteristics to support the deployment of a brigade. Berth 3-5 of the Packer Avenue Terminal is the best choice due to its berthing capabilities, bridge clearance, and rail facilities.

RECOMMENDATION

We recommend use of the Port of Philadelphia for deploying at least a mechanized infantry brigade.

One portable rail ramp must be obtained.

March 96

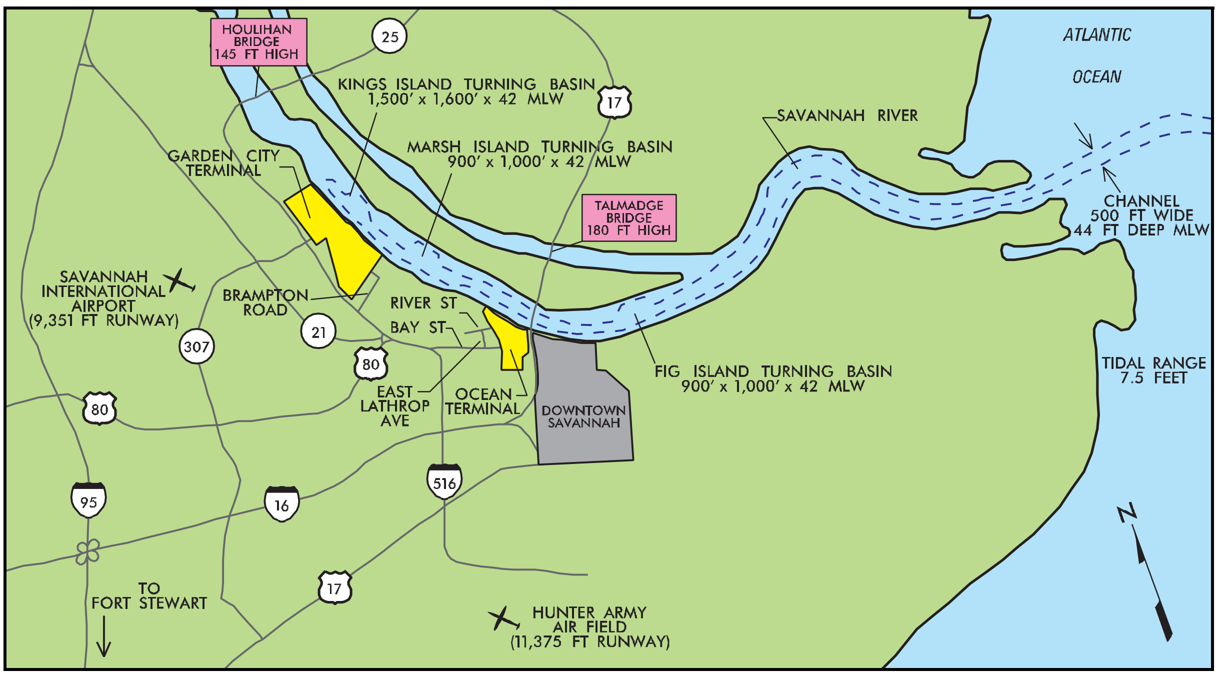
PORT OF SAVANNAH, GA

I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Savannah is on the Savannah River, about 25 miles from the Atlantic Ocean. Its two main facilities, Ocean and Garden City Terminals, are about four miles apart. Silting is a serious problem and dredging is carried out on a continuous basis. Ships only pass under the Talmadge Bridge (US 17), which is 180 feet above the water at mean high water (MHW).



Water and Highway Access

Highway

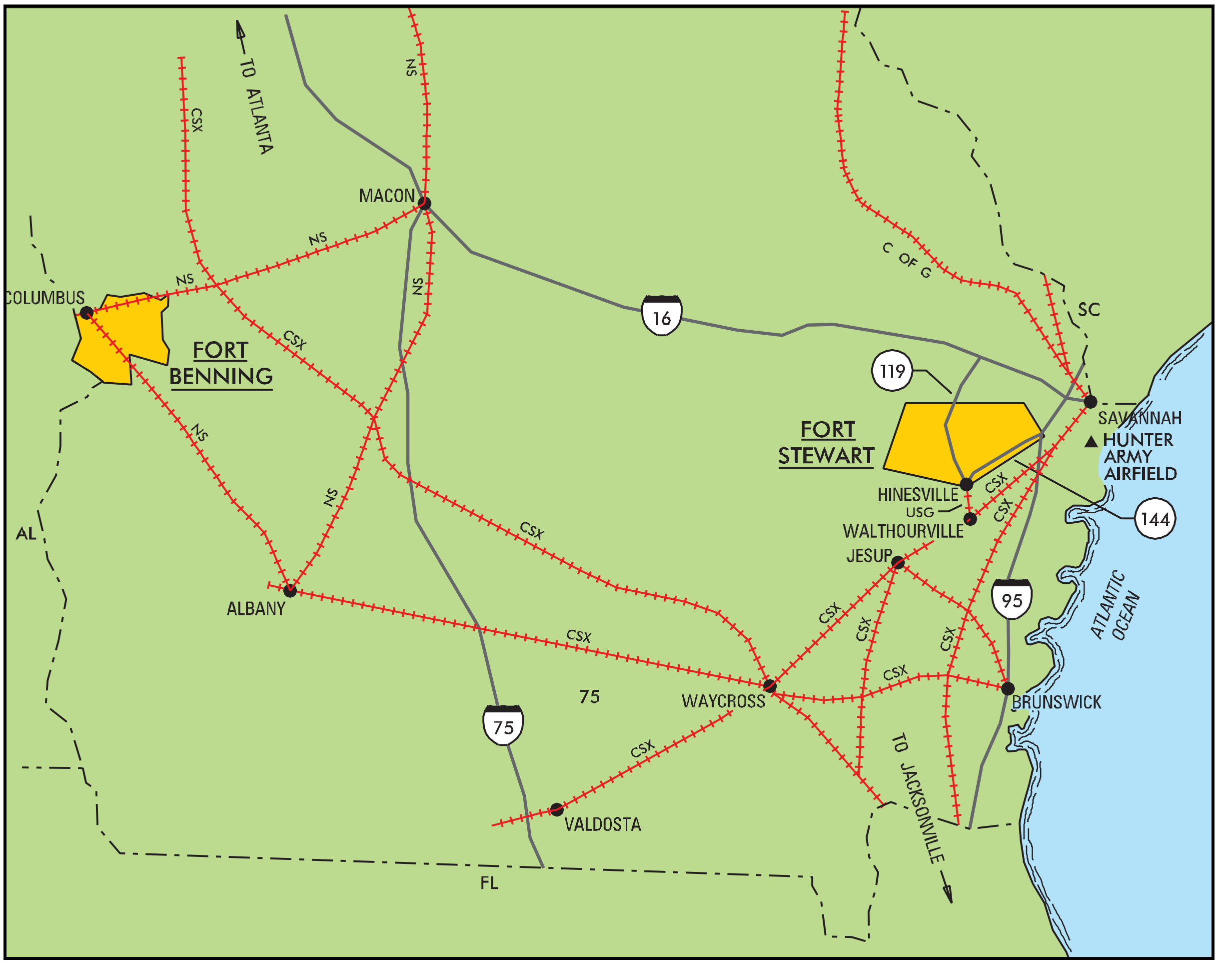
The major highway access to the port is Interstate Route 16 (I-16). I-16 joins I-75 to Atlanta, Georgia. Just a few miles from Savannah, I-16 joins I-95, the major north-south corridor. To reach Ocean Terminal from I-16, exit onto four-lane I-516, to Bay Street/US17, then to two-lane East Lathrop Avenue to the main gate on River Street.

To access the Garden City Terminal, take I-95 to Highway 21 south exit to Georgia Route 307 to Gate 1. From I-16, take I-516 to Georgia Route 25 to Brampton Road to Gate 2.

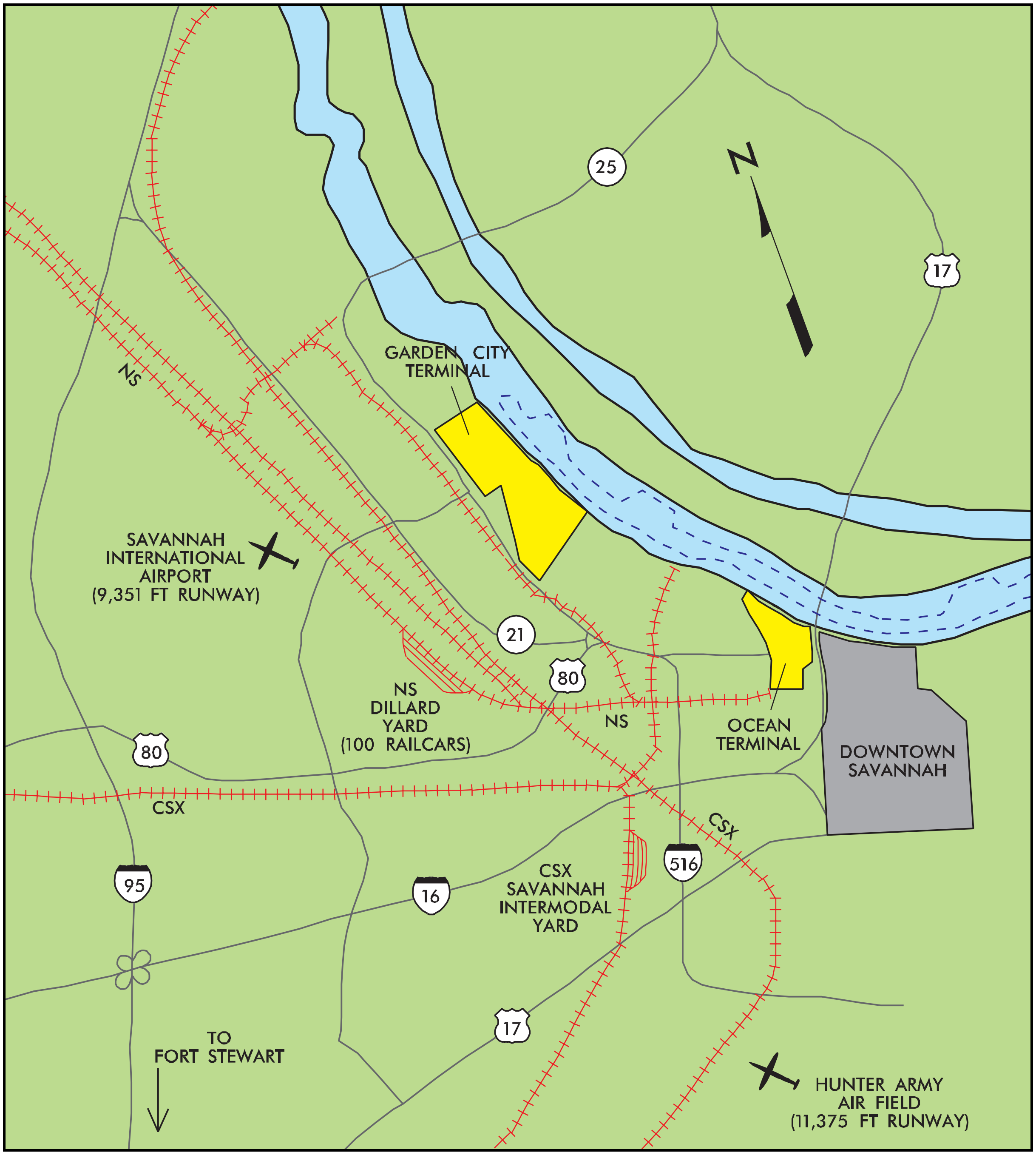
Rail

Rail reception at the Port of Savannah is good. The Norfolk Southern (NS) and CSX provide rail service to Savannah. The Savannah State Docks Railroad, owned by the Georgia Ports Authority, performs switching at the Garden City Terminal with three switch engines.

CSX and NS offsite facilities, 5 miles from the port, provide additional storage for 4,000 railcars. These facilities also perform intermodal operations.



Rail Access



Air Access and Local Railyards

Airports

Savannah International Airport is 5 miles west of Garden City Terminal. The airport is about 10 miles northwest of Ocean Terminal. The nearest military airfield is Hunter Army Airfield, just south of downtown Savannah.

PORT FACILITIES

Berthing

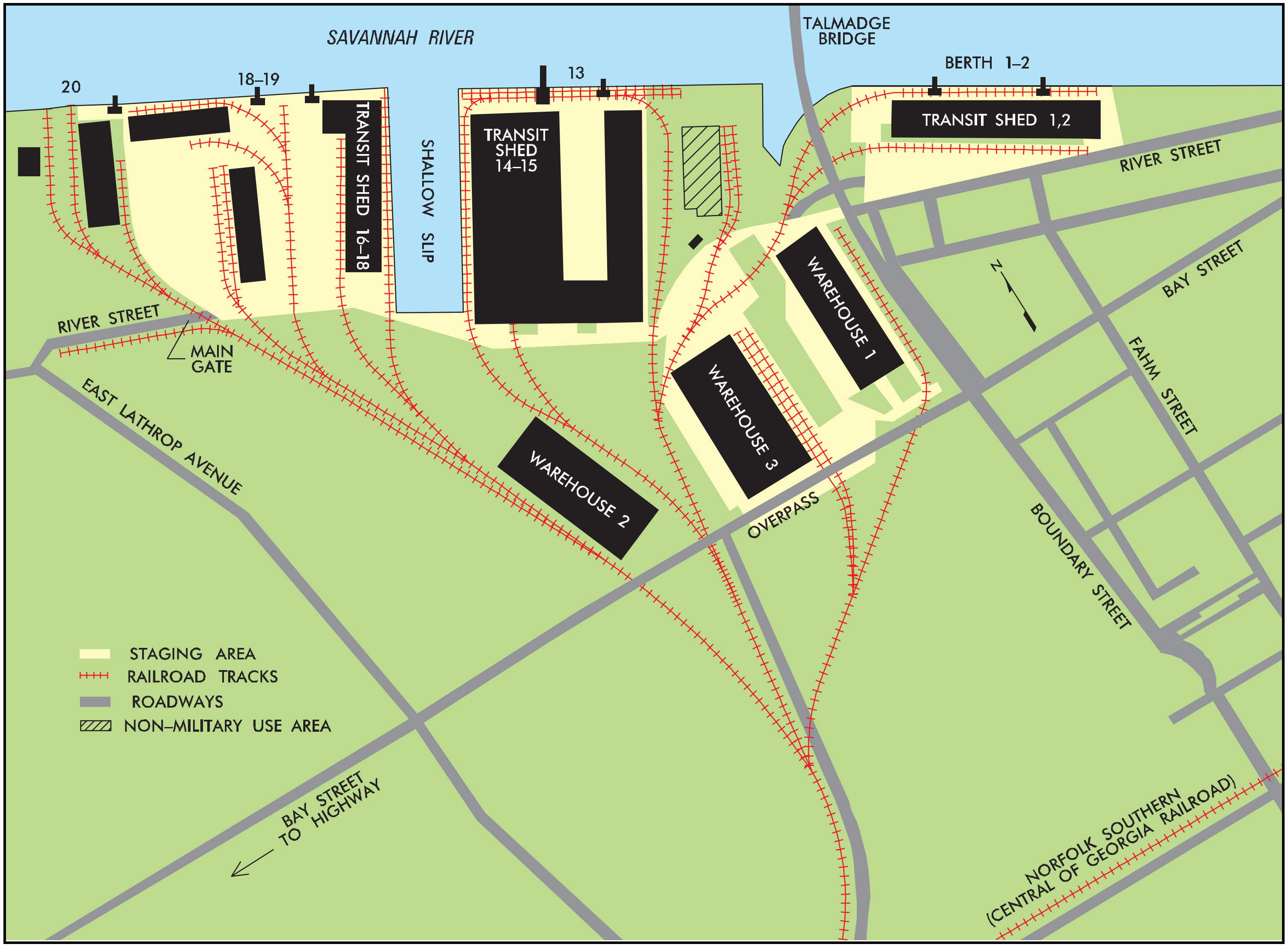
Ocean Terminal is generally a breakbulk terminal, with limited container capability. The slip at Ocean Terminal has silted and gotten to be too shallow for anything but barge loading.

Pier construction is concrete piles, with a sheet-steel bulkhead. Fendering is usually timber, and the surface is generally concrete. All terminals have lighting for night operations.

BERTHING CHARACTERISTICS OF OCEAN TERMINAL

Characteristics	Berths 1-2	13	18-19	20
Length	1,178	975	1,102	564
Depth alongside at MLW (ft)	42	42	42	38
Deck strength (psf)	1,000	1,000	1,000	1,000
Apron width (ft)	57	Open	57	57
Apron height above MLW (ft)	15	15	15	15
Number of container cranes	0	1	0	0
Number of wharf cranes	2	1	2	1
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No

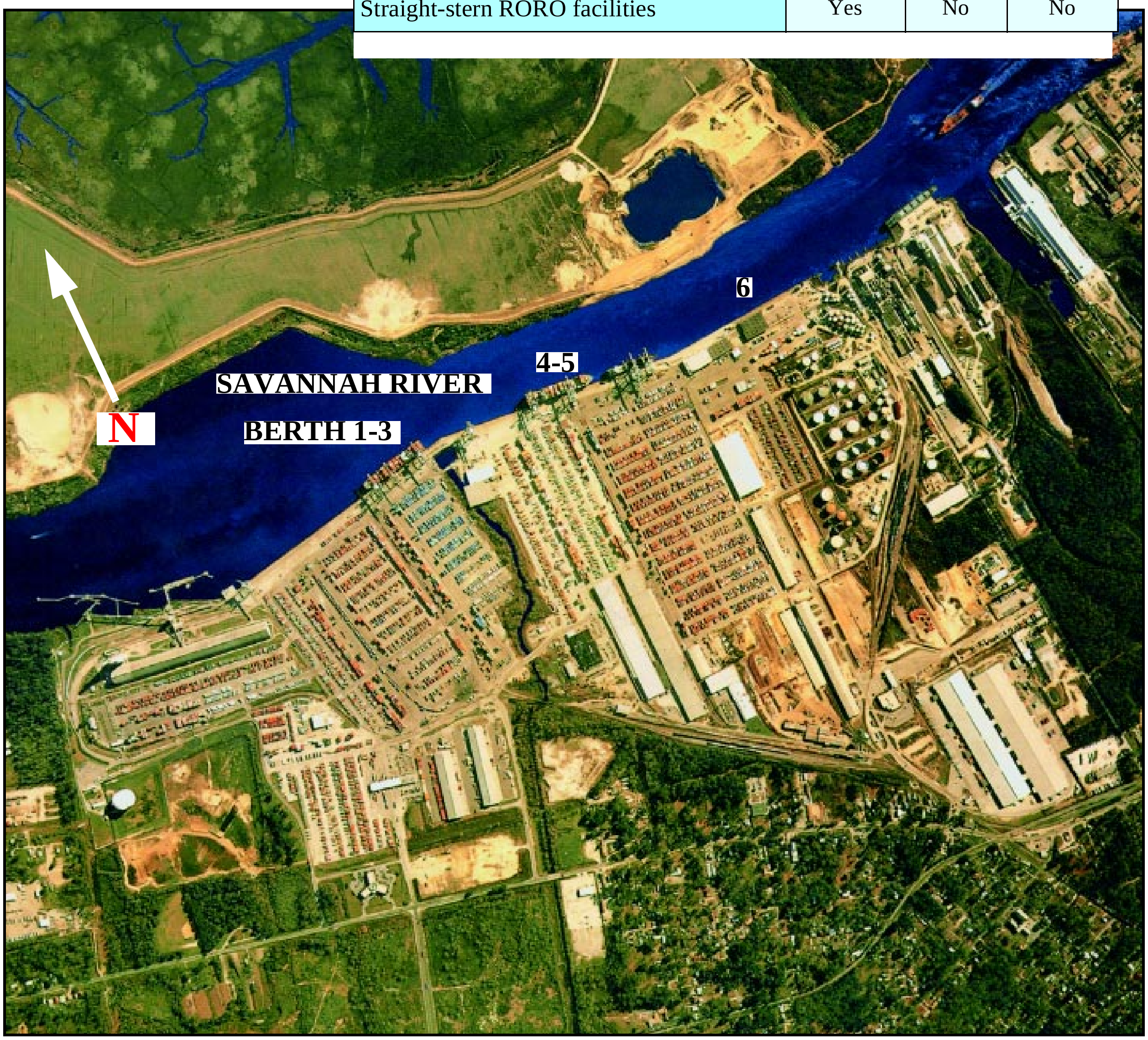
Ocean Terminal



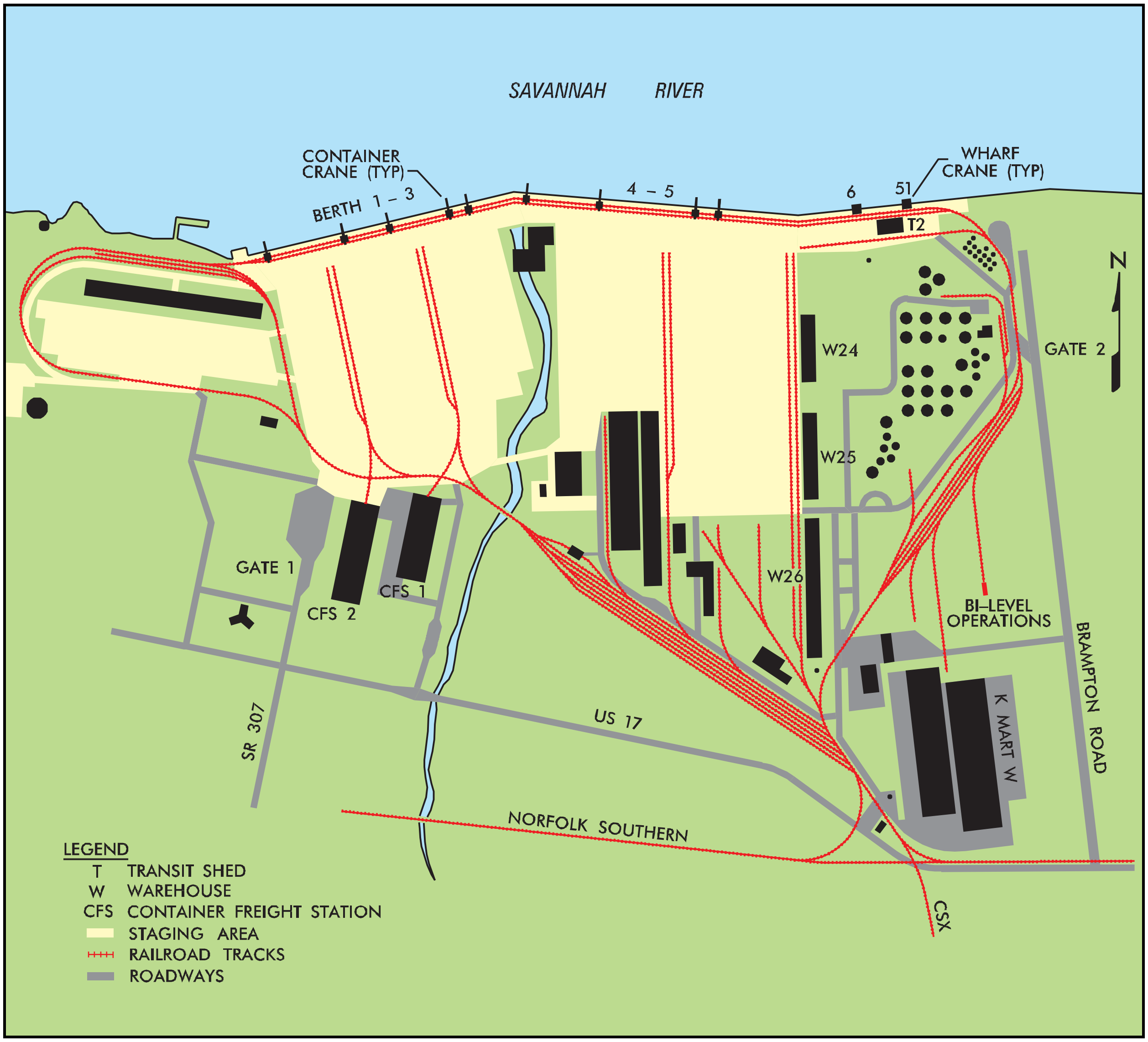
Ocean Terminal

Garden City Terminal is primarily a container facility with cranes, container handlers, and open aprons. The far south end is used for liquid bulk cargoes, and is not considered in this report for military operations.

BERTHING CHARACTERISTICS OF GARDEN CITY TERMINAL			
Characteristics	**Berths**		
	1-3	**4-5**	**6**
Length (ft)	2,402	2,273	1,690
Depth alongside at MLW (ft)	42	42	42
Deck strength (psf)	1,000	1,000	1,000
Apron width (ft)	Open	Open	Open
Apron height above MLW (ft)	15	15	15
Number of container cranes	5	3	2
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	No	No



Garden City Terminal



Garden City Terminal

Staging

a. ***Open Staging***. The Ocean Terminal has 82 acres of open staging. The Garden City Terminal has about 314 acres of open staging. Open staging is mostly used for containers.

The open area inland of berth 6 has supported helicopter operations in previous military operations

Helicopter Operations Inland of Berth 6,
of the Garden City Terminal

b. ***Covered Staging***. The two terminals have about 20 transit sheds and warehouses. These buildings provide nearly three million square feet of covered staging. Other buildings are set up for refrigeration, manufacturing, or repair operations, and would not support military operations.

Covered Staging at the Garden City Terminal

Rail

The Garden City Terminal has two pairs of rail spurs at berth 1-3 that have been used to offload railcars of military equipment.

NS and CSX tracks connect with the port tracks at Garden City Terminal. Savannah State Docks Railroad, which is owned by the port, performs onsite switching. Garden City can stage about 600 railcars.

Ocean Terminal does not have onsite railcar storage, but the adjacent NS Railyard can hold 600 railcars.

Norfolk Southern Railyard inland from Ocean Terminal

Highway

Both Terminals have well maintained roads. There are no clearance problems. Most roads are four-laned.

UNLOADING/LOADING POSITIONS

Ramps. The port has no permanent rail ramps, but Garden City Terminal has two portable end ramps available. On occasion, railcars have also been converted to work as ramps by removing the truck under one end. The intermodal spurs at Garden City berth 1-3 are good locations for portable end ramp operations. NS has one portable bilevel ramp that has been used at Garden City Terminal during deployments and exercises.

The only fixed truck ramp is at the Garden City Terminal near berth 6. This ramp can handle three trucks at a time. There are numerous portable ramps capable of offloading equipment on flatbed semitrailers.

Fixed-Truck Ramp at Garden City Terminal

MTMCTEA Designed Portable Ramps at Garden City Terminal

Rail-Mounted Bilevel Ramp

Docks. All together, the port has 440 trucks and 186 boxcar handling positions. The two container freight station buildings at Garden City Terminal provide more than a third of the truck docks for stuffing and unstuffing containers.

MARSHALING AREAS

Within Port. No marshaling areas exist. All open areas within the terminals are required for staging military or commercial cargo.

Hunter Army Airfield. The airfield is less than 30 minutes from the port. It has three fixed rail end ramps with tangential lengths from 1,400 to 2,200 feet, and a portable bilevel ramp. These facilities are used to support airlift deployments. and may not be available for sealift support. All together, the airfield has at least 50 acres of potential marshaling areas.

Fort Stewart. Fort Stewart is about 40 miles west of the port. It has ten fixed rail end ramps with tangential lengths from 1,000 to 8,100 feet. All together, the installation has at least 75 acres of potential marshaling areas, in several areas.

MATERIAL HANDLING EQUIPMENT (MHE)

TYPE OF EQUIPMENT	CAPACITY (STON)	OCEAN TERMINAL	GARDEN CITY
Transtainers	45	0	13
Mobile Cranes	35	0	1
Container Handlers	40-45	3	15
Switch Engines	-	3	

Container Handlers at Garden City Terminal

INTERMODAL FACILITIES

Most of the port intermodal traffic is handled at Garden City Terminal around-the-clock 6 days per week. NS performs limited TOFC/COFC operations at their Dillard Yard, about 3 miles from the Garden City Terminal. CSX also performs intermodal operations at their Savannah Intermodal Yard, about 5 miles from Garden City Terminal.

Intermodal Operations at Garden City Terminal

FUTURE DEVELOPMENT

The port has already begun developing berth 7 with 147 acres of container staging, just west of the Garden City Terminal.

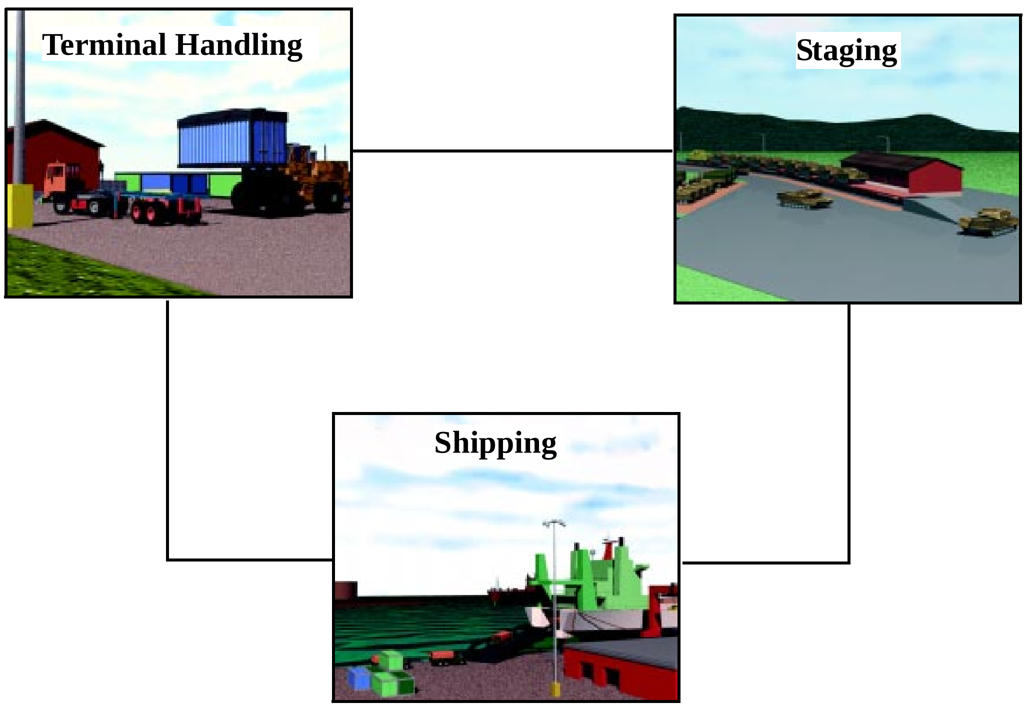
Future Berth 7 at Garden City Terminal

The port also hopes to develop 2,200 acres about 5 miles above the Garden City Terminal, within a mile of I-95. Mulberry Grove may develop into eight container berths, with each berth supported by 100 acres of paved open storage. Construction is expected to begin in the late 1990's.

II. THROUGHPUT ANALYSIS

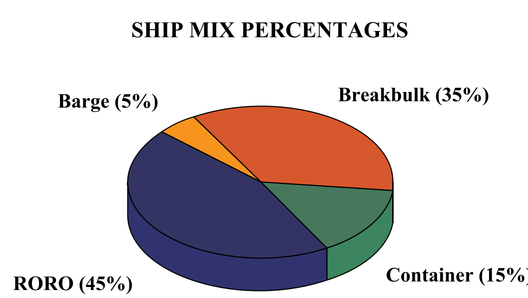
GENERAL

This section evaluates the throughput capability of the Port of Savannah using the port operational performance simulator (POPS) computer model. The model is based on a weak- link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



Terminal Throughput Subsystems

This analysis assumes a maximum of 80% of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80% facility use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL RECEPTION/HANDLING

Highway. Brampton Road and River Street provide access to Garden City and Ocean Terminal main gates, respectively. Each road has two lanes. The road network in and out of the terminals, including the gate processing of vehicles, should handle about 250,000 MTON of equipment and supplies per day.

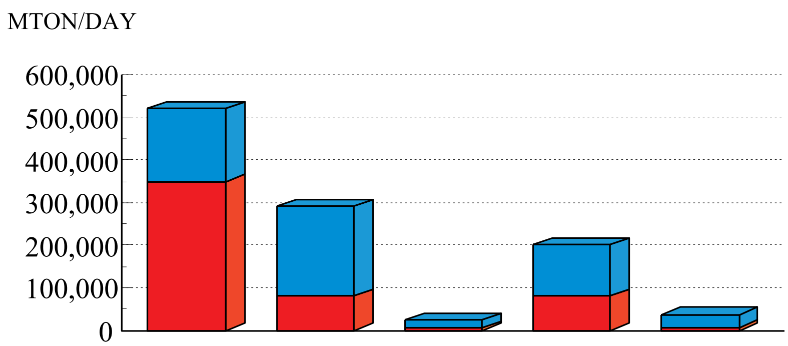
Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable ramps. Our analysis assumes two portable ramps are available in open areas, in addition to the three-truck fixed-ramp at Garden City Terminal. These ramps could offload about 23,000 MTON from flatbed trailers per day.

Supplies in van semitrailers will proceed to the 440 van-handling positions. These docks can offload more than 200,000 MTON of van semitrailer-shipped material per day. This report assumes seven container handlers are available for chassis operations. These container handlers can offload about 37,000 MTON of chassis cargo per day.

Assumptions for Chart Below

Terminal	Ocean	Garden City
Fixed Ramp	0	3
Portable Ramp	1	1
Van Positions	180	260
Container Handlers	1	6

HIGHWAY RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS	DOCKS	CONTAINERS
OCEAN	350,000	80,000	4,800	81,000	7,500
GARDEN CITY	170,000	210,000	19,000	120,000	30,000

Rail. Rail reception at the port is fair, with two major railroad companies accessing the Savannah area. The infrastructure could support 20 percent additional traffic.

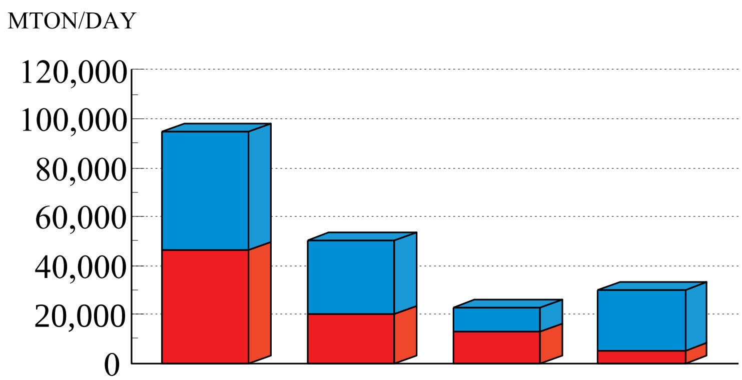
Of the two terminals, the Garden City Terminal has the best rail storage. This analysis uses five portable or temporary rail end ramps, each have 1,000 to 1,200 feet of tangential track. The container storage areas at the Garden City Terminal could support most or all of these ramps. Ocean Terminal could support portable rail ramp operations along several sheds.

This analysis also assumes seven container handlers are available.

Railcar Delivery		
Terminal	**Ocean**	**Garden City**
Trains Per Day	4	4
Train Length (railcars)	60	60

Assumptions for Chart Below		
Terminal	Ocean	Garden City
Fixed Ramp	0	0
Portable Ramps	2	3
Boxcar Positions	95	91

RAIL RECEPTION/HANDLING CAPABILITY



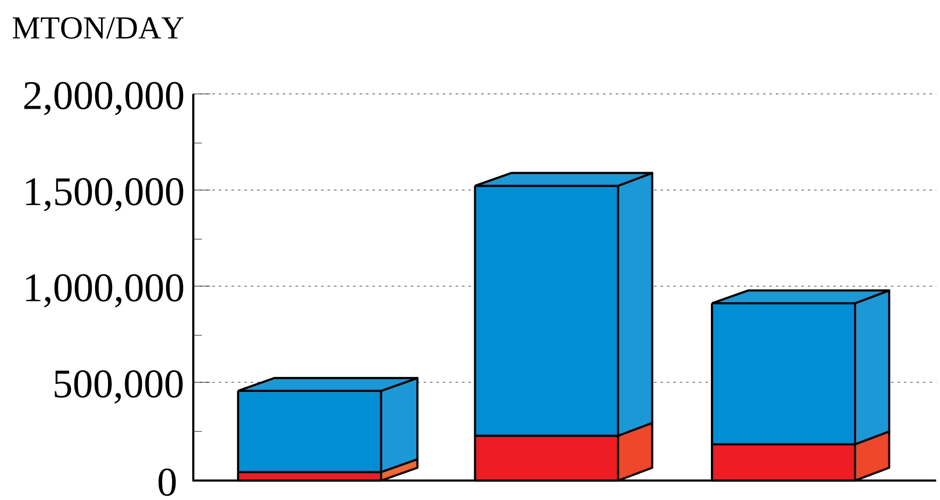
SUBSYSTEMS	TRACKAGE	END-RAMPS	DOCKS	COFC
OCEAN	46,000	20,000	13,000	4,800
GARDEN CITY	49,000	30,000	9,800	25,000

STAGING

The Ocean Terminal has about 82 acres of open staging area. The Garden City Terminal has about 314 acres. Both terminals combined have about three million square feet of covered storage. Most of it is at the Ocean Terminal.

The chart below indicates the staging throughput, assuming only one ship type at the terminal. If combination ships or multiple ship types operate at the terminal/s, a portion of each ship type is totaled for the overall staging throughput.

OPEN STAGING CAPABILITY



VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
OCEAN	43,000	230,000	190,000
GARDEN CITY	420,000	1,300,000	730,000

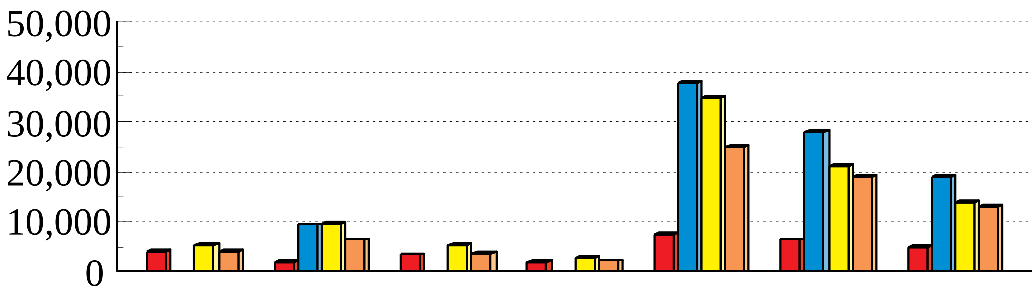
SHIPPING

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility. The parameters used for the POPS analysis are provided in the appendix.

CONVERSION FACTORS	
Breakbulk:	**.4 STON per MTON**
RORO:	**.25 STON per MTON**
Containers:	**.4 STON per MTON**

BERTH THROUGHPUT CAPABILITY

MTON/DAY



BERTH	O1-2	013	O18-19	O20	GC1-3	GC4-5	GC6
BREAKBULK	3,900	1,900	3,400	1,900	7,400	6,400	4,800
RORO	0	9,400	0	0	38,000	28,000	19,000
CONTAINER	5,300	9,600	5,300	2,700	35,000	21,000	14,000
MIXED	4,000	6,400	3,700	2,100	25,000	19,000	13,000

O = Ocean Terminal

GC = Garden City

The type of ship preferred at each berth is based on the methodology described in the appendix. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for the loading operation. The container berths at Garden City (1-3 and 4-5) are the best for all types of shiploading. Although the apron height limits the draft at low tide, these berths and berth 13 at the Ocean Terminal can support FSS loading. LMSRs can also load at these berths without restrictions.

PREFERENCE BERTH SELECTION			
BERTH	BB	**RORO**	**CNTNR**
Ocean			
1-2	5	-	-
13	4	3	3
18-19	6	-	-
20	7	-	-
Garden City			
1-3	1	1	1
4-5	1	1	1
6	3	4	1

SUMMARY OF BERTHING CAPABILITIES

Vessel	01-2	013	018-019	020	GC1-3	GC4-5	GC6
	Berths O = Ocean Terminal GC = Garden City Terminal						
Breakbulk							
C3-S-33a	2	1	2	1	4	4	3
C3-S-37c	2	1	2	1	4	4	3
C3-S-37d	2	1	2	1	4	4	3
C3-S-38a	2	1	2	1	4	4	3
C4-S-1a	2	1	1	1	4	3	2
C4-S-lqb and 1u	1	1	1	c	4	3	2
C4-S-58a	1	1	1	c	4	3	2
C4-S-65a	2	1	1	1	4	3	2
C4-S-66a	2	1	1	1	4	4	2
C4-S-69b	1	1	1	c	3	3	2
Seatrain							
GA and PR-class	2	1	1	1	4	3	2
Barge							
LASH C8-S-8lb	1	1	1	c	2	2	2
LASH C9-S-81d	1	1	1	c	2	2	1
LASH lighter	8	6	7	4	17	16	12
SEABEE C8-S-82a	1	1	1	a,c	2	2	1
SEABEE barge	5	4	5	2	12	11	8
RORO							
Comet	d,o	d,i,j	d,o	d,o	i,j	d,i,j	d,i,j
C7-S-95a/Maine-class	b	1	b	b,c	3	2	2
Ponce-class	b,h	h	b,h	b,c,h	h	h	h
Great Land-class	b,h	h	b,h	b,c.h	h	h	h
Cygnus/Pilot-class	b	l	b	b,c	3	3	2
Meteor	d,o	d,i,j	d,o	d,o	i,j	d,i,j	d,i,j
AMEagle/Condor	b	i,j	b	b,c	i,j	i,j	i,j
MV Ambassador	d	d	d	d	4,m	d	d
FSS-class	b	l,i	b	b,c	2,i	2,i	l.j
Cape D-class	b	i,j	b	b,c	i,j	i,j	i,j
Cape H-class	b	i,i	b	b,c	3,i	2,i	2,i
LMSR	b	i,i	b	b,c	2	2	1
Container							
C6-S-qw	1,e	1	1,e	c,e	3	3	2
C7-S-68c	1,e	1	1,e	c,e	3	3	2
C8-S-85c	1,e	1	1,e	c,e	2	2	1
Combination							
C5-S-78s	1,e	1	1,e	c,e	3	3	2
C5-S-37e	1,e	1	1,e	c,e	3	3	2

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

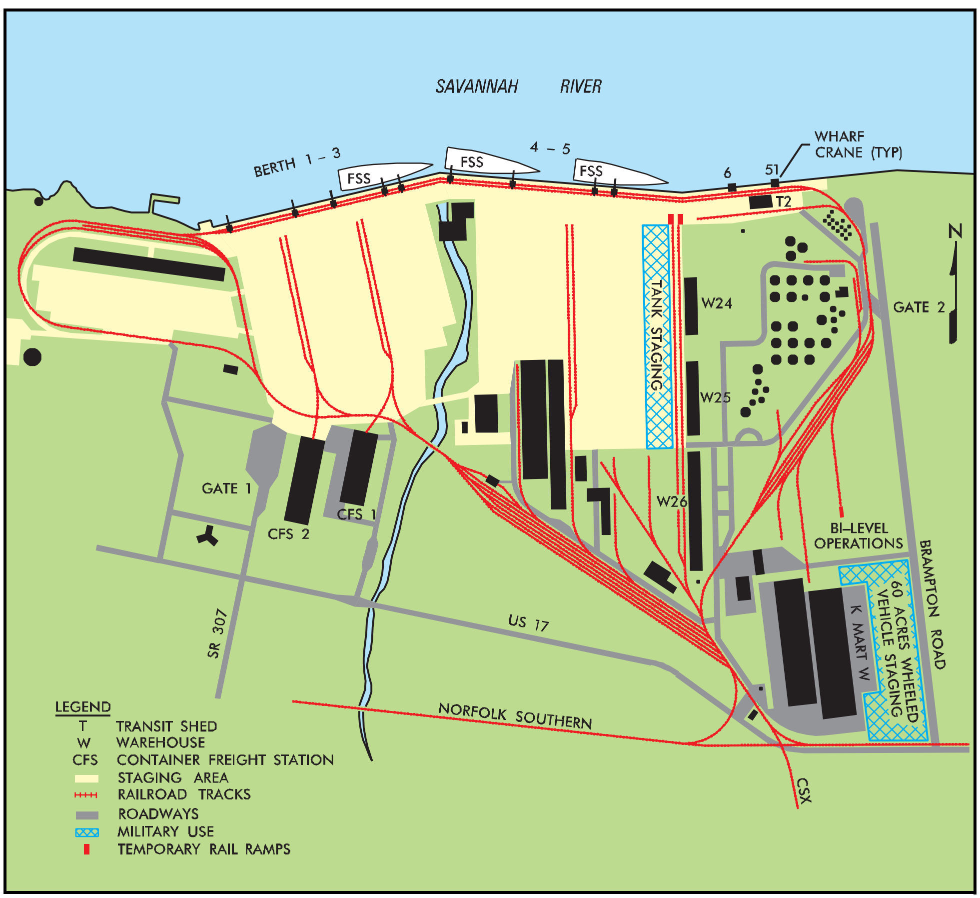
III. APPLICATION

GENERAL

This section of the report will evaluate the port's throughput capability for deploying a notional mechanized infantry division using primarily FSS vessels. The August 1994 revision for the Planning Orders Digest, issued by MARAD, provided agreements for military use of the Port of Savannah. Although these agreements expired 1 July 1995, we expect they will be renewed without significant change, until 15 June 1996. Past military operations have been at the Garden City Terminal. We expect future military vehicles will stage at Garden City due to the 1,000 feet of berthing in the Planning Order, however some vehicles will convoy to Ocean Terminal.

Current Planning Orders for Port of Savannah

	Ocean Terminal	Garden City Terminal
Berths	1,000 ft	2,000 ft
Covered Storage	Adjacent shed	Adjacent sheds
Open Staging	None	23 acres



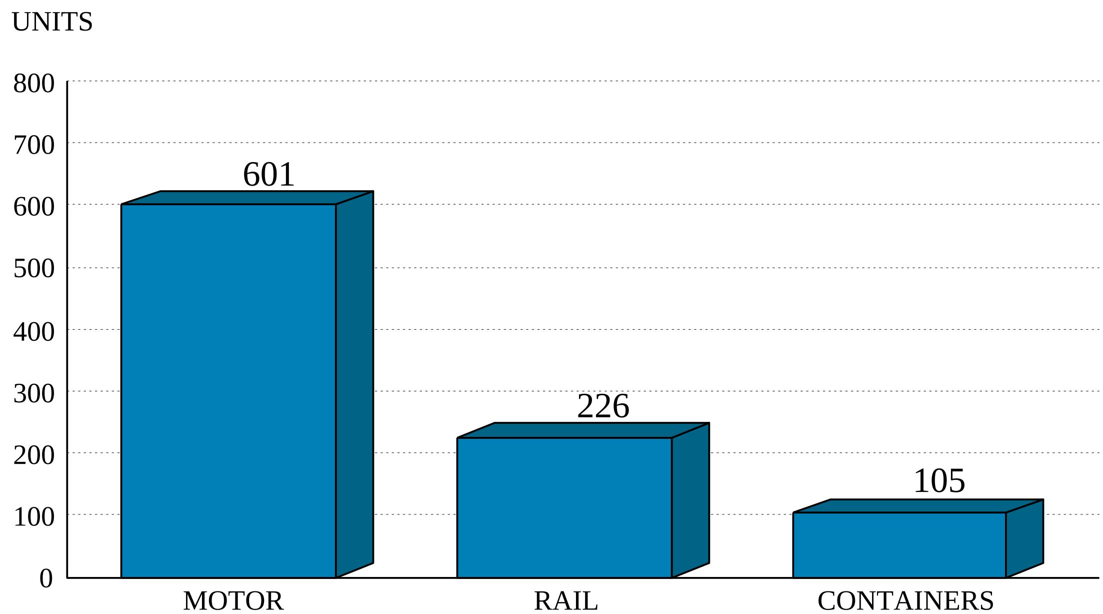
Facilities that may support military operations, if available.

REQUIREMENTS

The likely requirement for the Port of Savannah is to deploy a notional mechanized infantry division in six days of reception and throughput. The division has to move about 7,800 vehicles and 630 containers. The movement to the port will require 1,356 (226 per day) railcars using the convoy/rail option. Under this option, about 3,606 roadable vehicles (601 per day) would be driven into the gate, towing 2,274 trailers (379 per day). About 105 containers would arrive per day.

MECHANIZED INFANTRY DIVISION	
Total Equipment	
Volume	280,000 MTON
Weight	95,000 STON
Area	1,400,000 SQ FT
Vehicles	7,800
Containers	630

DAILY REQUIREMENTS

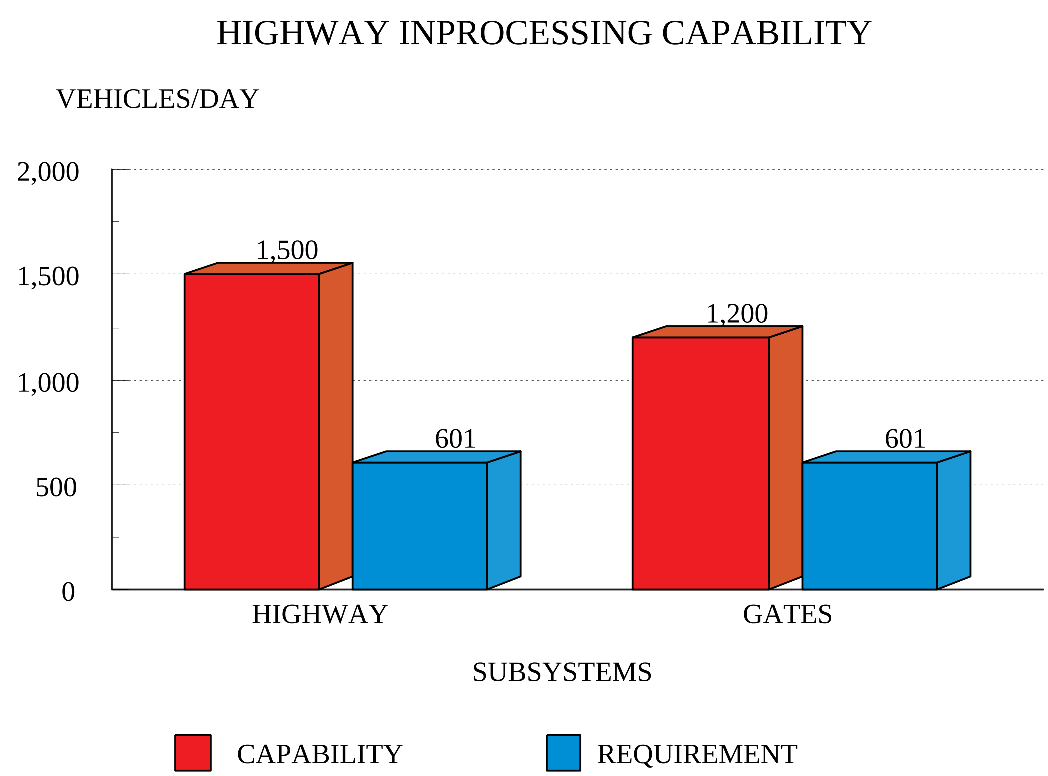


TERMINAL INPROCESSING/HANDLING

HIGHWAY

Terminal operators at Garden City Terminal should open the gate on Brampton Road for military vehicles and equipment arriving by convoy. Brampton Road offers access from Georgia Route 25. This arrangement allows unimpeded reception of military traffic into the terminal. Both the access roads and gate processing subsystems could handle more than 1,500 and 1,200 additional vehicles per day, respectively.

PSA personnel direct commercial or military vehicles carrying other vehicles to the three-truck fixed ramp adjacent to transit shed 1 for unloading. This fixed truck ramp could offload at least 300 non-roadable vehicles/equipment from flatbed trailers per day.



RAIL

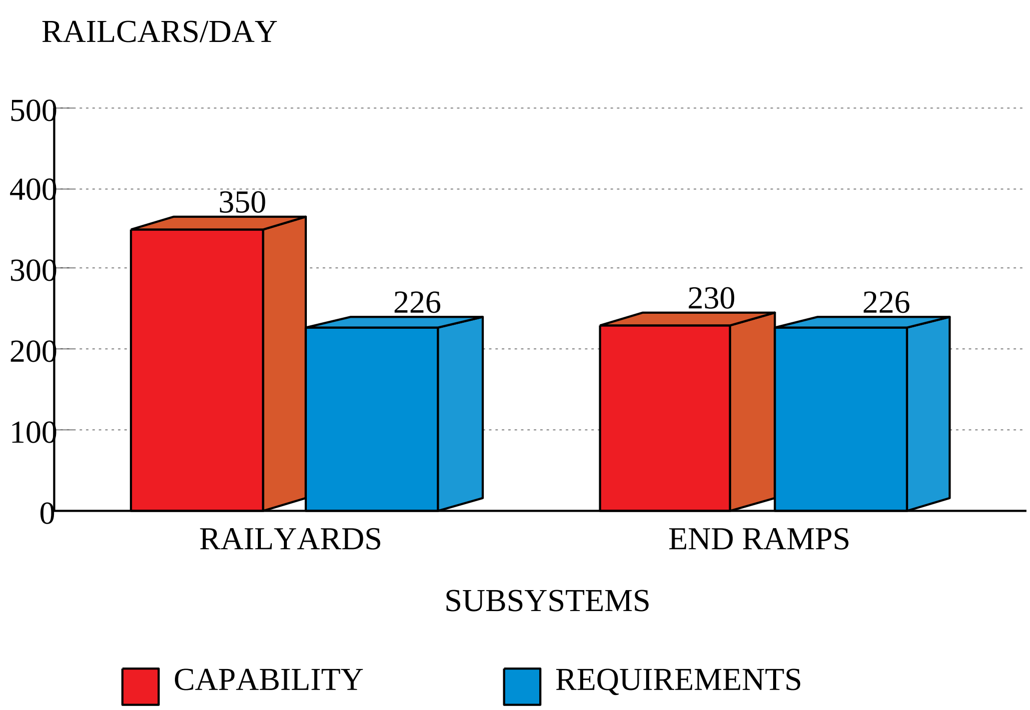
Both NS and CSX serve the Garden City Terminal. CSX serves Fort Benning and NS serves Fort Benning.

These carriers will need to move four trains per day (about 60 railcars per train) from the forts to the port. These carriers can meet this demand if railcars are available.

The terminal has two large interchange yards with a holding capacity of about 600 railcars. By applying an operational factor of 60 percent, these railyards can process more than 350 railcars daily. Once arrived, switch engines can move as many as 46 cars at a time to the two tracks (23 per track) along warehouses 24, 25, and 26 for unloading. Experience shows that these two sites could easily offload the 46 railcars every 4 hours or 230 per day (including switching time). Other rail offloading sites could be made available if needed. Another 20 cars (10 per track) can be worked on the double tracks located on berth 4-5. Cars here could be switched in/out at the same rate as those on the other tracks. With two more portable end ramps, support personnel could unload 100 additional railcars per day. These two positions would help prevent a slowdown in rail reception in the event of unforseeable circumstances.

The terminal uses a bilevel ramp to offload military vehicles from multilevel railcars. The ramp is on the rail spur leading into the large unpaved area east of the K-MART warehouse.

RAIL INPROCESSING AND HANDLING CAPABILITY

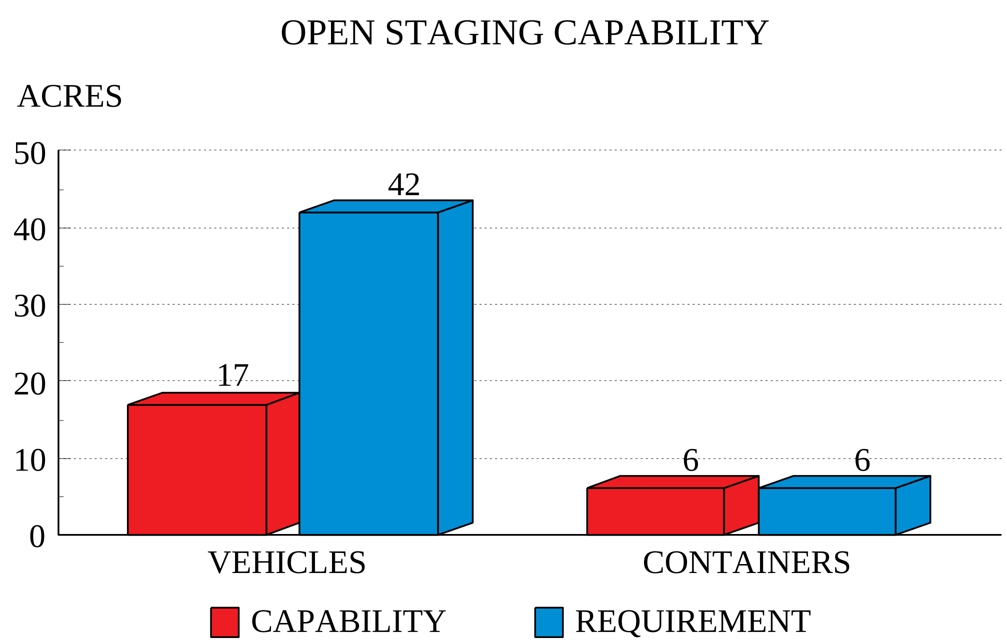


STAGING

This analysis assumes that current downsizing continues, and that nine FSS-sized ships will deploy an entire notional mechanized infantry division. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations.

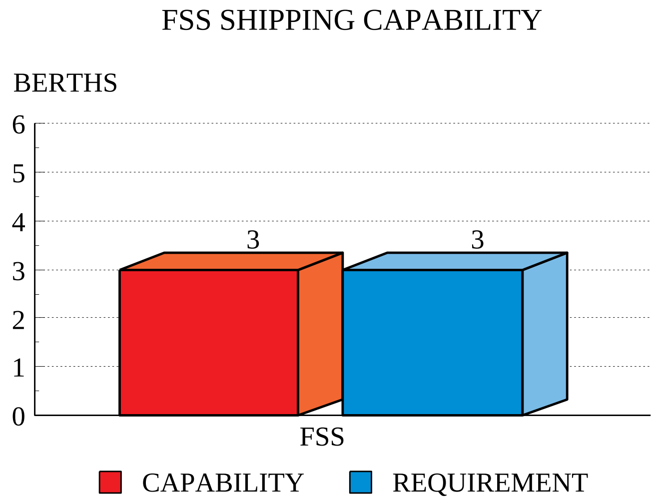
Although an FSS-load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for the staging of the 70 containers for each FSS. The three simultaneous shiploading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers.

The Garden City Terminal contains over 300 acres of open staging area. The Planning Orders, however, only provide for 23 open acres of staging. This is not sufficient to meet the requirement of 48 acres.



Staging area within the terminal is more than adequate, if available. Military vehicles have staged on the 60 acres east of the K-MART warehouse. This area is unpaved and not suitable for heavy-tracked vehicles. Tanks have staged on the aprons.

SHIPPING



Although this analysis assumes that only nine FSS-sized ships can deploy the notional mechanized infantry division, the table below provides ship quantities for the current division size. The number of ships required depends on the shipping mix selected. The best ship mix would consist of all eight FSS ships, plus two Cape H RORO ships.

The Planning Orders provide berthing of two FSS-sized vessels at the Garden City Terminal, and one at the Ocean Terminal. Although the average apron width is too narrow, berth 18-19 of the Ocean Terminal can support side-ramp operations, if the vessel is carefully positioned. Although the Planning Orders divide the operations into two terminals, they meet the requirement to berth three FSS-sized vessels. The apron height of 15 feet above MLW might prevent RORO operations at

UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

Loading Condition/Sample Ship Mix	**Vessel Types**			
	FSS (RORO/ Comb)	**Cape H (RORO/ Comb)**	**C3/C4 (Breakbulk)**	**C6/C7/C8 (Container)**
Minimum Containerization:				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization:				
FSS and Container	7.90			2.00
FSS, Cape H, and Container	7.90			2.00
Breakbulk and Container			29.58	2.00

*Only eight FSS vessels are currently available. Unit shipping requirements exceed the capacity of these eight vessels. Other vessels types are required to makeup the shortfall (Cape H or upcoming LMSR).
Legend:
RORO - roll on/roll off
FSS - fast sealift ship
Source: MTMCTEA report OA 90-4f-22, Deployment Planning Guide. Aug 91.

SUMMARY

The Planning Orders do not provide enough staging area to support the deployment. The port can, however, satisfy the requirement if enough staging area is available.

RECOMMENDATION

We recommend negotiating for an additional (third) FSS berth at the Garden City Terminal, 25 additional acres of open staging, and the rail spurs along warehouses 24, 25, and 26, or equivalent. At least two portable ramps will be required.

March 96

PORT 0F WILMINGTON, NC

I. GENERAL DATA

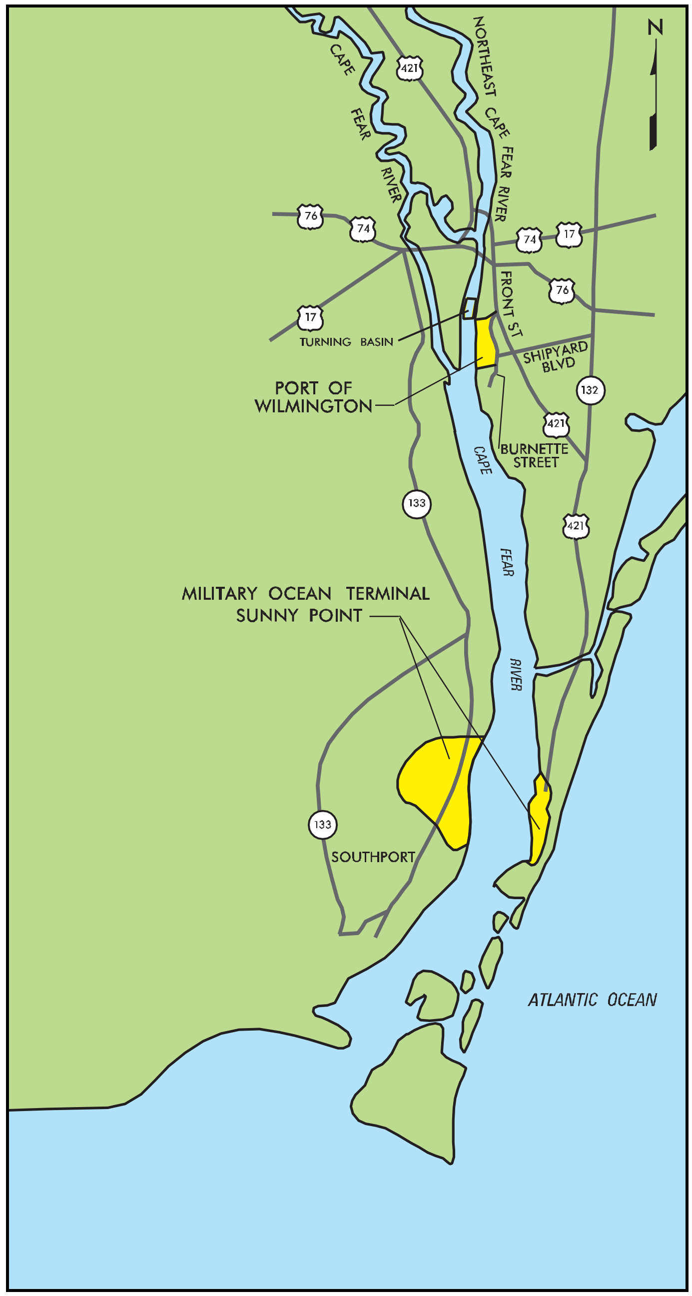
TRANSPORTATION ACCESS

Water

The Port of Wilmington, North Carolina, is on the east bank of the Cape Fear River, about 3 miles south of the junction of the Cape Fear and Northeast Cape Fear Rivers. It is 25 miles from the Atlantic Ocean and 17 miles north of Military Ocean Terminal, Sunny Point. The port lies 170 miles northeast of the Port of Charleston and 100 miles to the southwest of the Port of Morehead City.

Access to the port from the Atlantic Ocean is via a 38-foot-deep, at mean low water (MLW), and 500-foot-wide channel. The turning basin is 38 feet deep and 1,200 feet wide. Good anchorage is also available downstream in the Southport area of the river. Anchorage's are suitable for instream loading operations.

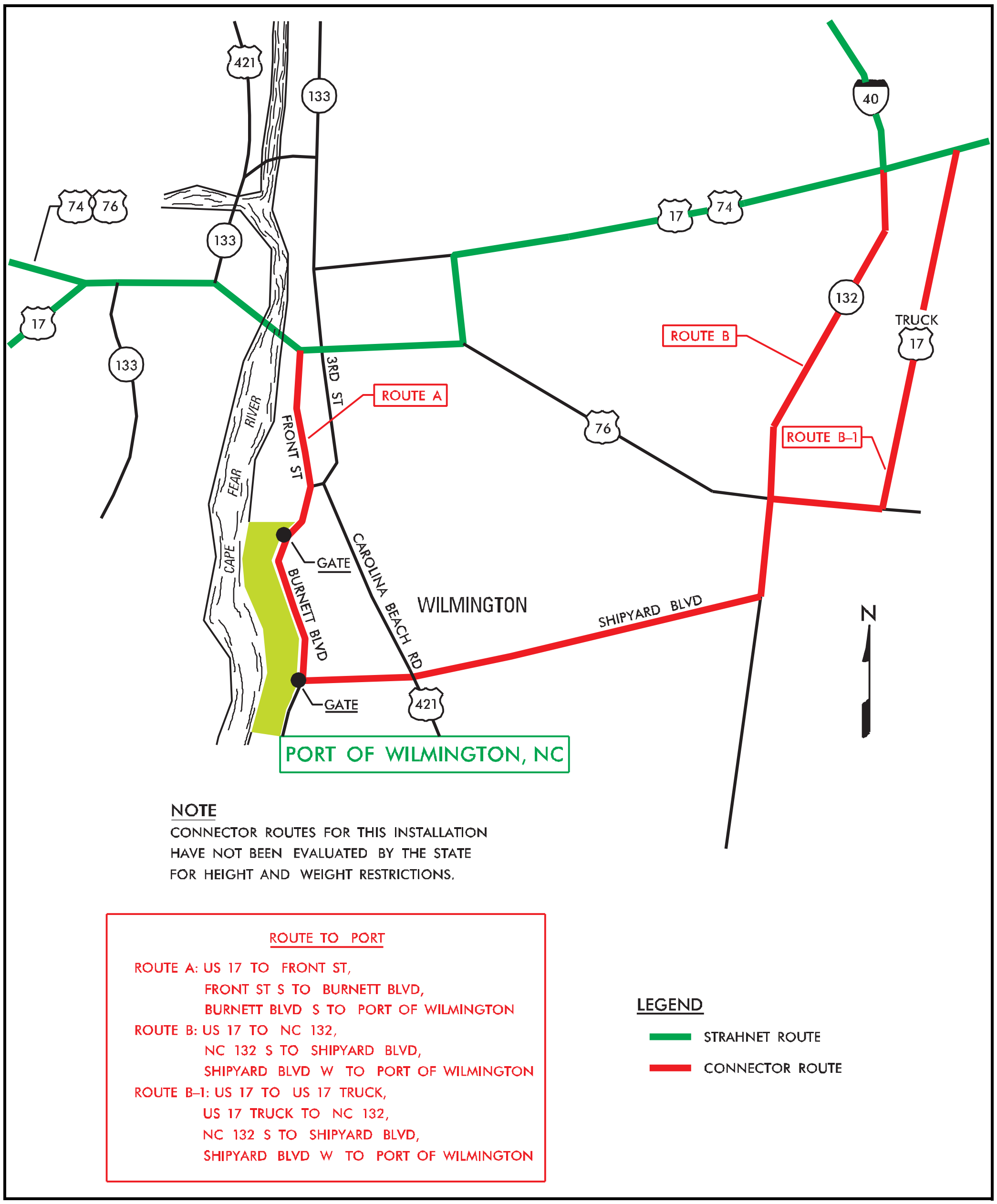
The mean tidal range at Port of Wilmington is 4.2 feet, with tidal currents averaging 1.7 knots at floodtide and 1.5 knots at ebbtide. No bridges cross the Cape Fear River downstream of the terminal. However, an overhead power cable crosses the river about 2.5 miles south of the port, thereby restricting sailing headroom to 176 feet above mean high water (MHW).



Water Access

Highway

The main highways into Wilmington are US Routes 17, 74, 76, and 421. All four highways provide good highway access to the port. Interstate 40 ends just north of Wilmington in New Hanover County and Interstate 95 is about 80 miles west of the port via US 74. Traffic coming from I-40 would continue south on US Route 132, then take Shipyard Boulevard West, which dead-ends directly into the port.



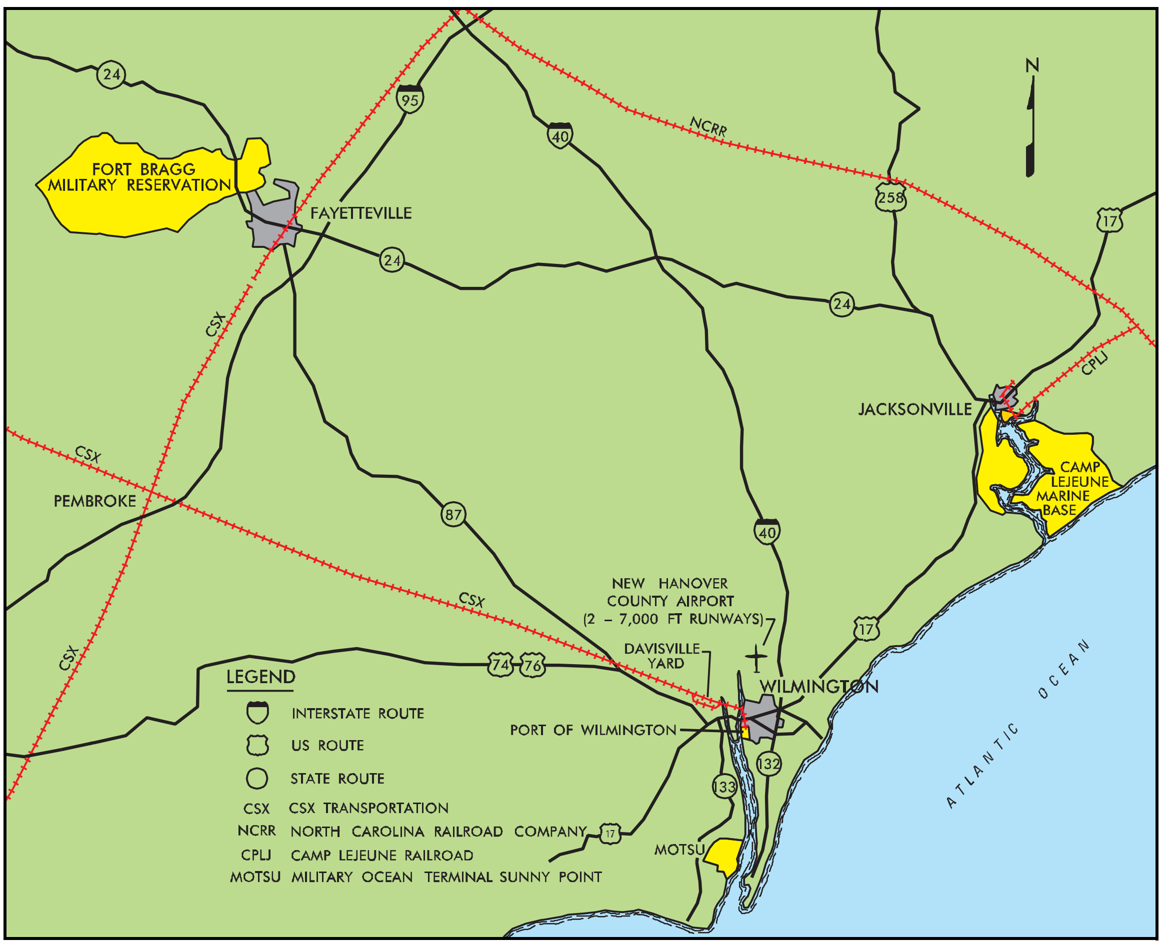
Highway Access

Rail

Rail accessibility at the Port of Wilmington is good. The CSX Railroad provides rail service to the Wilmington area. CSX normally calls on the port daily. Trackage on the terminal is owned and operated by the North Carolina Ports Railway Commission (NCPRC).

Airports

The New Hanover County Airport is about 6 miles north of the port. The airport has two major runways over 7,000 feet long. This airport routinely handles large cargo carriers and helicopters.



Highway, Rail and Air Access

PORT FACILITIES

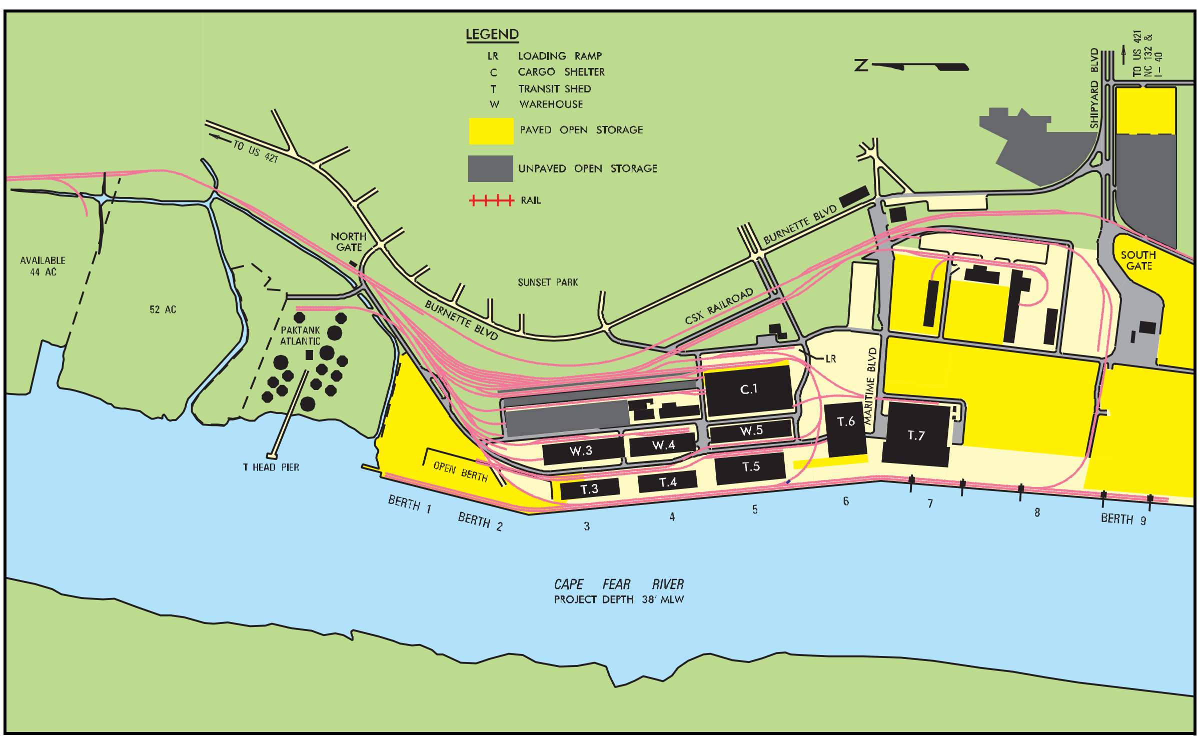
Berthing

Wilmington is a multicargo port with about 6,750 feet of continuous concrete wharf. It has nine berths along the east bank of the Cape Fear River. The berths range in length from 600 to 900 feet. Dock height averages 12 feet above MLW and berth depths are 38 feet MLW. Apron widths range from 46 feet along berths 3 through 5 to 100 feet or more along the other berths.

Below is an aerial view of the terminal. Also included is a land use map and a table identifying the berth characteristics.

Port of Wilmington (Northward view)

BERTHING CHARACTERISTICS OF THE PORT OF WILMINGTON						
Characteristics	**Berths**					
	1-2	**3-5**	**6**	**7**	**8**	**9**
Length (ft)	1,213	2,200	700	850	900	900
Depth alongside at MLW (ft)	38	38	38	38	38	38
Deck strength (psf)	1,000	375	375	540	540	1,000
Apron width (ft)	Open	46	Open	Open	Open	Open
Apron height above MLW (ft)	12	12	12	12	12	12
Number of container cranes	0	0	1	1	1	2
Number of wharf cranes	1	2	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No	No	No



Port of Wilmington Land Use Map

Staging

Open Staging. The Port of Wilmington has about 100 acres of paved open staging and nearly 25 acres of semi-improved open storage accessible by rail or truck.

Open Staging near Berths 1-2 (Northward View)

Covered Staging. Six transit sheds and four warehouses provide a total of over 1,000,000 square feet of covered storage. Most military cargoes are worked through transit sheds 3 and 5.

Rail

Rail yards on the port have the capacity to store about 400 railcars. The nearest railyard to the port is the Davisville classification yard at Navassa, about 15 miles west of the port. This rail yard has the capacity to hold about 1,070 (89-foot) flatcars.

Unloading/loading Positions

Ramps. The port has two permanent rail end ramps. One is a double loading ramp at the end of the tracks 11 and 12, each side of which will hold 12 89-foot flatcars. The other permanent ramp is at the end of track 16 and will hold five 89-foot flatcars.

Docks. Container traffic usually enters and leaves the port through the seven-lane South Gate. North Gate is used mainly for trucks carrying general cargo. Both of these gate areas have a weight scale. An Emergency Gate is located north of the South Gate on Burnett Boulevard. This gate is closed to daily traffic.

All warehouses and transit sheds have multiple depressed roadway stations for offloading. An open dock with four loading positions is available at berth 1-2 to offload trucks.

Marshaling Areas

Three sites are available near the port for marshaling areas. The Legion Stadium area, consisting of 27.5 acres, is 2 miles from the port. New Hanover County Fairgrounds has 20 unpaved acres. It is 3 miles south of Legion Stadium on Carolina Beach Road. The National Guard Armory, on North Kerr Avenue, is a 40-acre complex. It consists of a 3-story masonry building, 14 primary storage areas, and an ammunition storage area. The complex also has its own water supply treatment plant and emergency power supply.

Legion Stadium

MATERIAL HANDLING EQUIPMENT

TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY
Wharf Cranes	15-131	3
Mobile Cranes	140	1
Top Lifts	50	9
Forklifts	2-26	65

INTERMODAL FACILITIES

The Port of Wilmington is served by both CSX Intermodal and Norfolk Southern. Both carriers operate a transparent through service between points on their nationwide networks to the Wilmington pier. Shipments are covered by one bill of lading.

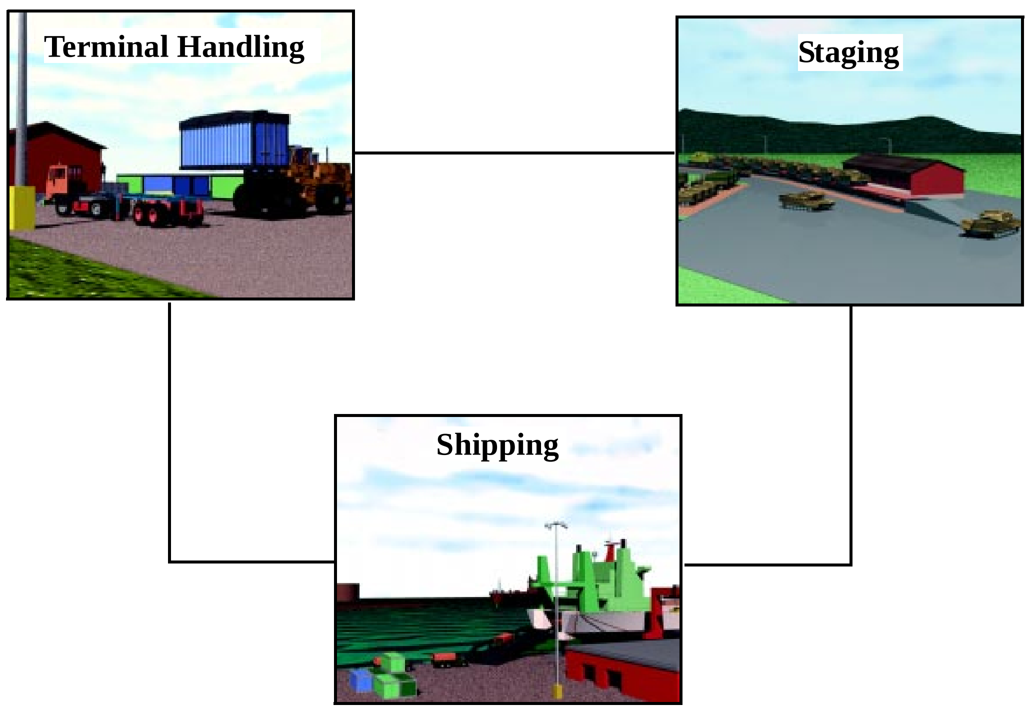
FUTURE DEVELOPMENT

The Port of Wilmington plans to expand berth 1 about 150 feet to the north. The expansion will provide 1,363 feet of continuous berth at berth 1-2 and is planned for 1996-97.

II. THROUGHPUT ANALYSIS

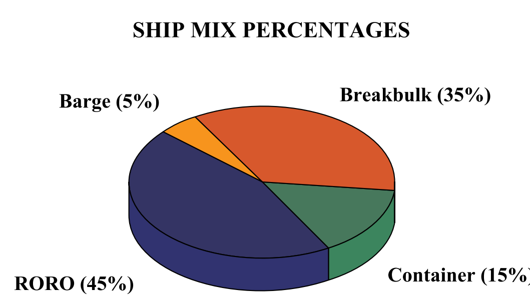
GENERAL

This section evaluates the throughput capability of the Port of Wilmington using the port operational performance simulator (POPS) computer model. The model is based on a weak link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



Terminal Throughput Subsystems

This analysis assumes a maximum of 80% of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80% facility use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



RECEPTION/HANDLING

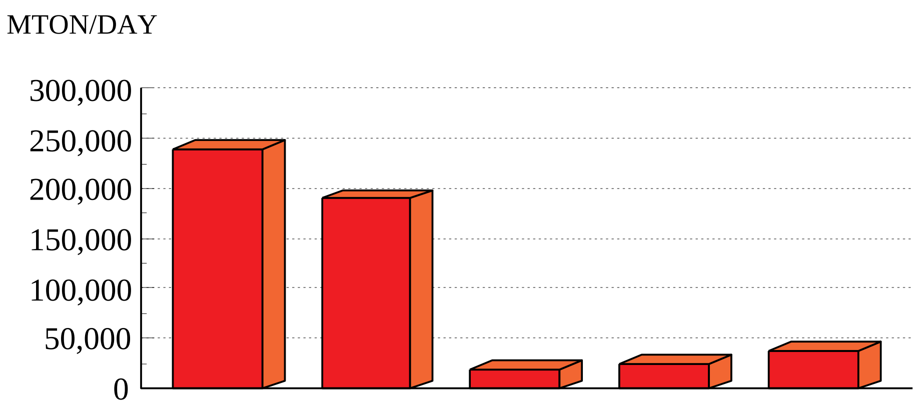
Highway

US 17, 74, 76, and 421 provide good highway access to the port. The road network into and out of the port, including the gate processing of the vehicles, could handle about 190,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at port ramps. The port has a permanent ramp with four handling positions at berth 1-2. This ramp could offload about 19,000 MTON from flatbed trailers per day.

Supplies in van semitrailers will proceed to the 52 van handling positions. These docks can offload over 25,000 MTON of van semitrailer-shipped material per day. Container handlers can offload about 38,000 MTON of cargo from their chassis per day.

HIGHWAY RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	HIGHWAY	GATES	END-RAMPS	DOCKS	CONTAINERS
WILMINGTON	240,000	190,000	19,000	25,000	38,000

Rail

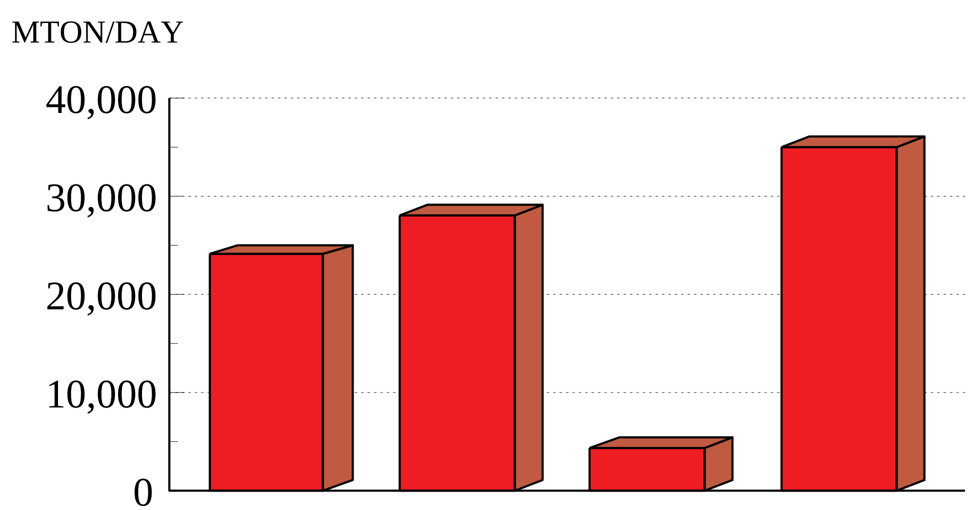
Rail clearance at the port is very good.

Railyards within the port could store about 400 railcars. Additional storage of railcars is just outside the port. This railyard can store 1,070 railcars.

Vehicles on flatcars would require end ramps to offload. The port has two fixed concrete end ramps. The fixed end ramps support a total of 1,700 feet of track.

Terminal	Train Length (railcars)	Trains Per Day
Wilmington	29	9

RAIL RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	TRACKAGE	END-RAMPS	DOCKS	COFC
WILMINGTON	24,000	28,000	4,300	35,000

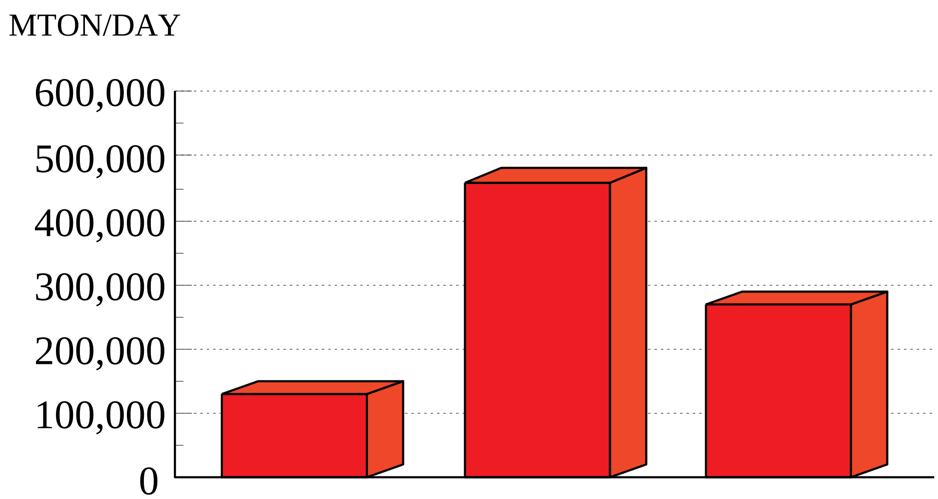
STAGING

The port has about 100 acres of paved open storage and nearly 25 acres of semi-improved open storage accessible by rail or truck.

The port has six covered transit sheds totaling 647,000 square feet. Most military cargoes are worked through transit sheds 3 and 5.

The port can perform operations on container or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a container ship is planned. The chart below provides the staging capability for the cargo for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.

OPEN STAGING CAPABILITY



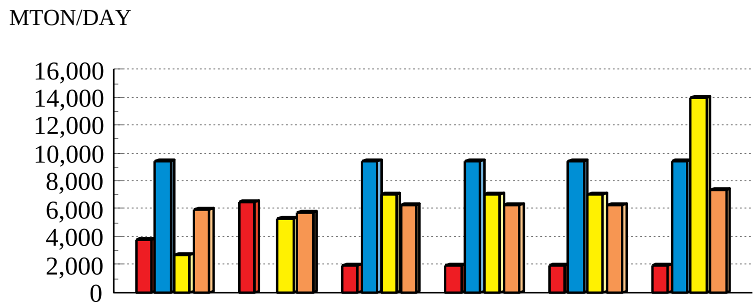
VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
WILMINGTON	130,000	460,000	270,000

SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. Appendix A shows the values used for these factors.

CONVERSION FACTORS	
Breakbulk:	.4 STON per MTON
RORO:	.25 STON per MTON

BERTH THROUGHPUT CAPABILITY



BERTH	1-2	3-5	6	7	8	9
BREAKBULK	3,800	6,500	1,900	1,900	1,900	1,900
RORO	9,400	0	9,400	9,400	9,400	9,400
CONTAINER	2,700	5,300	7,000	7,000	7,000	14,000
MIXED	6,000	5,700	6,300	6,300	6,300	7,400

The type of ship preferred at each berth is based on the methodology described in the Appendix. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for the loading operation.

PREFERENCE BERTH SELECTION

BERTH	BB	RORO	CNTNR
1-2	1	4	5
3-5	2	-	4
6	6	-	6
7	3	2	2
8	3	2	2
9	3	1	1

SUMMARY OF BERTHING CAPABILITIES				
Vessel	**Berths**			
	1-2	**3-4**	**5-6**	**7-9**
Breakbulk				
C3-S-33a	2	3	2	5
C3-S-37c2	2	3	2	5
C3-S-37d	2	3	2	5
C3-S-38a	2	3	2	5
C4-S-1a	2	3	2	4
C4-S-1qb and 1u	2	3	2	4
C4-S-58a	2	3	2	4
C4-S-65a	2	3	2	4
C4-S-66a	2	3	2	4
C4-S-69b	2	2	1	4
Seatrain				
GA and PR-class	2	3	2	4
Barge				
LASH C8-S-81b	1	2	1	3
LASH C9-S-81d	1	1	1	2
LASH lighter	8	12	8	18
SEABEE C8-S-82a	a,g	a,g	a,g	a,g
SEABEE barge	6	9	6	13
RORO				
Comet	d,i,j	d,o	d,i,j	d,i,j
C7-S-95a/Maine-class	1	b	1	3
Ponce-class	h	b,h	h	h
Great Land-class	h	b,h	h	h
Cygnus/Pilot-class	1	b	1	4
Meteor	d,i,j	d,o	d,i,j	d,i,j
AmEagle/Condor	i,j	b	i,j	i,j
MV Ambassador	d	d	d	d
FSS-class	1	b	1	2
Cape D-class	i,j	b	i,j	i,j
Cape H-class	1	b	1	3
LMSR	1	b	1	2
Container				
C6-S-lw	1,e	2,e	1	3
C7-S-68e	1,e	2,e	1	3
C8-S-85c	1,e	2,e	1	3
Combination				
C5-S-78a	1,e	2,e	1	4
C5-S-37e	1,e	2,e	1	4

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

III. APPLICATION

GENERAL

This section of the report will evaluate the port's throughput capability for deploying a notional mechanized infantry division using primarily FSS vessels.

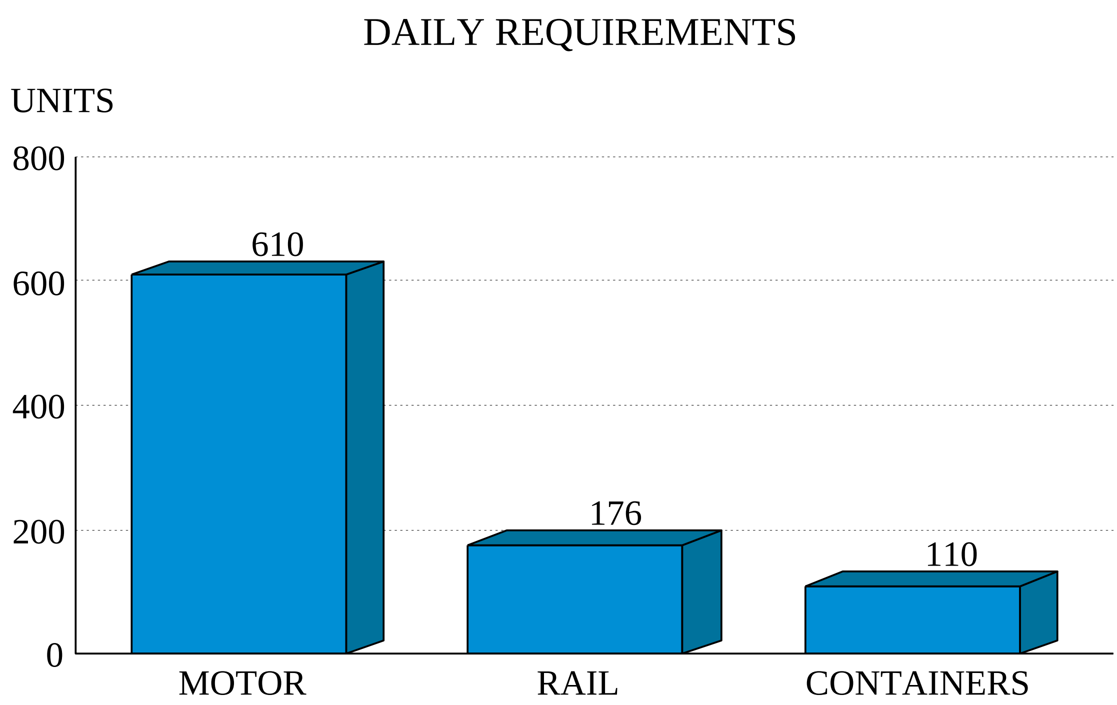
The August 1994 revision for the ***Planning Orders Digest***, issued by MARAD, provided agreements for military use of the Port of Wilmington. The agreement referenced berths 1-2 and 6, the north half of transit shed 3, transit shed 5, and 28 acres of staging area. The planning order revision of August 1995 supports the MARAD facility requirements without identifying specific berths, sheds or staging areas. The revision identifies three berths, transit sheds 3 and 5, and 25 acres of staging and loading space at the Port of Wilmington for *PRIORITY* and *EXCLUSIVE USE* for military deployments. If the military needs to deploy through the Port of Wilmington, it will most likely use berths 1 and 2 or berths 7-9.

Berths 1 and 2 (Northward view)

REQUIREMENTS

The likely requirement for the Port of Wilmington is to deploy a notional mechanized infantry division in six days of reception and throughput. The division has to move about 7,800 vehicles and 660 containers. The movement to the port will require 1,055 (176 per day) railcars using the convoy/rail option. Under this option, about 3,650 (610 per day) roadable vehicles would be driven and about 2,320 (387 per day) would be towed.

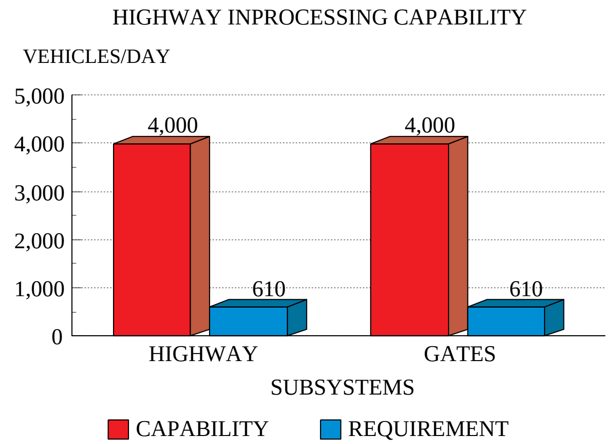
MECHANIZED INFANTRY DIVISION	
Total Equipment	
Volume	280,000 MTON
Weight	95,000 STON
Area	1,400,000 SQ FT
Vehicles	7,800
Containers	660

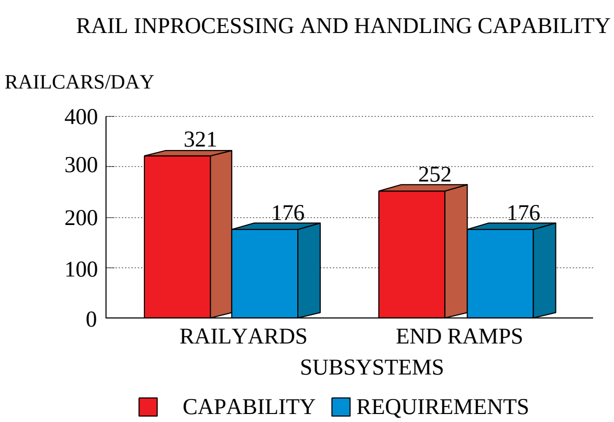


TERMINAL INPROCESSING/HANDLING

Highway

Vehicles and containers on chassis would access the terminals through the South or North Gates. Both gates are located on Burnett Boulevard. The access roads and gates can handle well over 4,000 vehicles per day.





Rail

Rail reception at the Port of Wilmington is good. CSX normally calls on the port nine times daily. Trackage on the terminal is owned and operated by the North Carolina Ports Railway Commission (NCPRC).

The nearest classification yard is the Davisville yard at Navassa, about 15 miles west of the port. This railyard has capacity to hold about 1,070 (89-foot) flatcars. Using a railyard usage factor of 70 percent leaves an available storage capability of 321 railcars. This capability exceeds the 176 cars per day rail requirement.

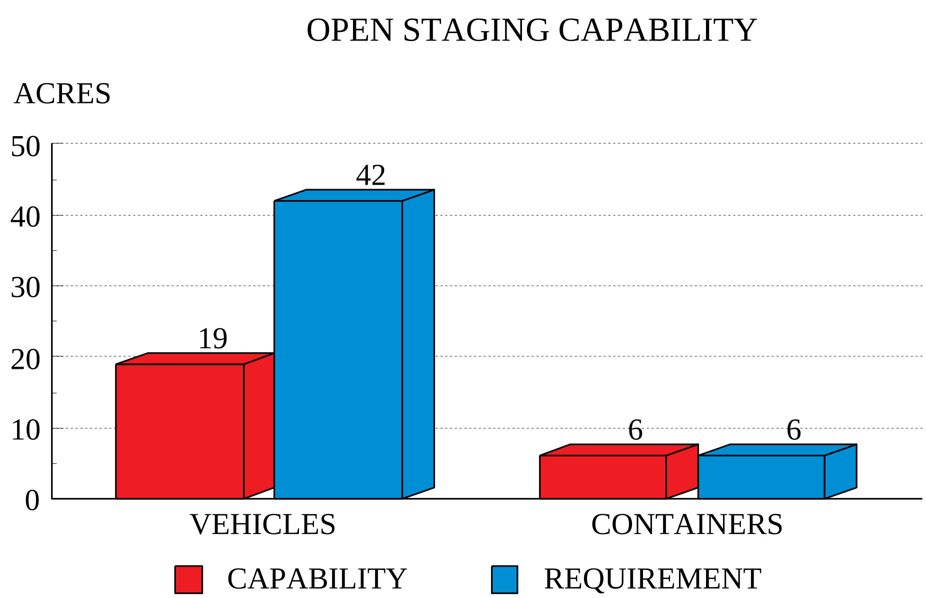
The port has two permanent rail end ramps. One of the ramps is a double loading ramp on the end of tracks 11 and 12, which will hold 12 (89-foot) railcars each. The other permanent ramp is at the end of track 16. It will hold five (89-foot) railcars. Tracks 10 and 13 both require the use of portable end ramps and will hold 14 and 20 (89-foot) railcars, respectively. Using all five offloading sites the port could handle a total of 63 flatcars per cycle. Therefore, it could reasonable offload 252 flatcars by accomplishing four cycles per day. This exceeds the requirement of 176 railcars per day.

STAGING

This analysis assumes that current downsizing continues, and that nine FSS-sized ships will deploy an entire notional mechanized infantry division. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations.

Although an FSS-load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for the staging of the 73 containers for each FSS. The three simultaneous ship loading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers.

The Port of Wilmington contains about 100 acres of open staging area. The Planning Orders, however, only provide for 25 open acres of staging. This is not sufficient to meet the requirement of 48 acres.

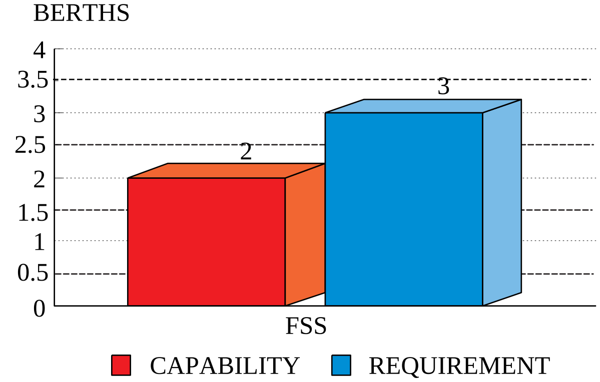


SHIPPING

Although this analysis assumes that only nine FSS-sized ships can deploy the notional mechanized infantry division, the table below provides ship quantities for the current division size. The number of ships required depends on the shipping mix selected. The best ship mix would consist of all eight FSS ships, plus two Cape H RORO ships.

Although the current Planning Orders provide for three berths, the military can expect to berth only two FSS-sized vessels. This does not meet the requirement to berth three FSS-sized vessels.

FSS SHIPPING CAPABILITY



UNIT MOVEMENT REQUIREMENTS MECHANIZED DIVISION				
Loading Condition/Sample Ship Mix	**Vessel Types**			
	FSS (RORO/Comb)	**Cape H (RORO/Comb)**	**C3/C4 (Breakbulk)**	**C6/C7/C8 (Container)**
Minimum Containerization:				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization:				
FSS and Container	7.90			2.00
FSS, Cape H, and Container	7.90			2.00
Breakbulk and Container			29.58	2.00

Only eight FSS vessels are currently available. Unit shipping requirements exceed the capacity of these eight vessels. Other vessels types are required to makeup the shortfall (Cape H or upcoming LMSR).

Legend:

RORO - roll on/roll off

FSS - fast sealift ship

Source: MTMCTEA report OA 90-4f-22, Deployment Planning Guide. Aug 91.

SUMMARY

The Planning Orders for the Port of Wilmington are insufficient to meet the requirement of deploying a mechanized infantry division with 6 days of ship loading. Depending on the availability of the fixed rail end ramps, one or two portable end ramps may be required.

RECOMMENDATION

We recommend the Planning Orders for the Port of Wilmington be revised to include 23 additional acres of staging and another berth for FSS-sized vessel operations. The military port operator should plan to acquire at least one portable rail end ramp.

SUMMARY OF BERTH THROUGHPUTS

East Coast Ports	Totals for Entire Port			Port Planning Orders		
	Depth/s (ft-MLW)	Wharfage (ft)	Throughput (STON/ MTON)	Depth/s (ft-MLW)	Wharfage (ft)	Throughput (STON/ MTON)
Charleston	40	13,871	32,000/ 101,000	40	2,460	6,800/ 22,000
Hampton Roads	28-45	22,287	52,000/ 167,000	32-39	7,361	18,000/ 54,000
Jacksonville	38	10,000	25,000/ 88,000	38	3,000	8,300/ 29,000
Morehead City	35-45	5,550	6,600/ 20,000	35	2,700	4,000/ 13,000
New York/ New Jersey	32-40	45,000	110,000/ 380,000	40	2,000	6,700/ 22,000
Philadelphia	30-40	17,228	35,000/ 110,000	N/A		
Savannah	38-42	10,184	23,000/ 73,000	42	3,000	7,600/ 19,000
Wilmington	38	6,863	12,000/ 38,000	38	1,813	3,000/ 10,000

APPENDIX A

THROUGHPUT PARAMETERS

SHIP OPERATIONAL RATES	STON/HR	MTON/HR
Breakbulk Rates		
Ship Crane	15.0	37.5
Dockside Cranes	20.0	50.0
Barge	20.0	50.0
RORO Rates	200.0	800.0
Container Lift Rates	21.0 Lifts/Hr Container Crane	8.0 Lifts/Hr Wharf Crane
Berth Utilization Factor= 0.8		

Ship Mix Percentages	%
BreakBulk	35.0
Barge	5.0
RORO	45.0
Container	15.0

Minimum Mobile-Crane Size	STON
Breakbulk	40.0
Barge	20.0
Container	100.0

Ship Cargo Mix			
	Breakbulk	RORO	Container
Roadable Vehicles	43%	90%	-
Nonroadable Vehicles	7%	10%	-
Container	15%	-	100%
Noncontainer	35%	-	-

Staging Data:	
Staging Dwell Time	3 Days
Space Utilization Factor	
Open	60%
Covered	60%
Facility Use Factor	80%

Stacking Height	Feet
Open - General	24
Covered	10
Open - Vehicle	7.6

Motor Vehicle Parameters	STON	MTON
Convoy	3.5	17.0
Flatbed	20.0	60.0
Van	16.0	40.0
Chassis	16.0	40.0
Railcar Parameters	STON	MTON
Flatcar	50.0	150.0
Boxcar	30.0	75.0
COFC	24.0	60.0
Container (TEU) Capacity	8.0	20.0

Truck Handling Rates	Trucks/Hr
End Ramps	4.0
Van Docks	1.0
Railcar Handling Rates	Railcars/Hr
End Ramps	4.0
Boxcar Docks	0.3
Length of Flatcars	95 Feet
Productive Work Hours	20 Hours

Mode Mix	%	%
Roadable Veh: Convoy/Flatcar	90	10
Nonroadable Veh: HETs/Flatcars	10	90
General Cargo:		
Van/Box	35	15
Flatbed/Flatcar	35	15
Container:		
Chassis/COFC	75	25

APPENDIX B

BERTH EVALUATION METHODOLOGY

GENERAL

This appendix provides a technique for accomplishing a comparative analysis of individual berths. The first step is to evaluate the individual berths within a port to determine their potential for breakbulk, RORO, and container vessel operations.

INDIVIDUAL BERTH EVALUATION

For the individual berth evaluation, a comparison is made of the characteristics of each berth and the list of ideal factors required to support the different ship mixes. Tables B-1 through B-3 give the ideal factors for breakbulk, RORO, and containership mix operations. As the tables show, points are awarded for each factor. These are then used to compare the potential for each factor. These are then used to compare the potential of each berth to support the three ship mixes. A ranking of individual berths is established for each type of ship mix operation, based on a comparison of total points accumulated by each berth.

The berth receiving the highest accumulation of points is assigned a value of 1, and the remaining berths are ranked accordingly.

TABLE B-1
IDEAL BREAKBULK BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Transit Shed**	
Quay or marginal	10	Available	15
Pier	7	None	0
Berth Length (ft)		**Deck Strength (lb per ft^2)**	
Greater than 750	20	Greater than 800	10
700 to 750	18	600 to 800	9
600 to 699	16	400 to 599	5
500 to 599	10	Less than 400	2
Less than 500	5		
Water Depth (ft) MLW		**Ship Service Facilities**	
Greater than 35.0	20	Power, water, and telephone	6
32.0 to 35.0	18	Power and water	5
30.0 to 31.9	16	Water only	4
28.0 to 29.9	14	None	0
Less than 28.0	12		
Apron Width (ft)		**Cranes**	
20.0 or greater	15	Wharf	10
Less than 20.0	5	Heavy-lift mobile ($\geq$100 STON)	9
		Mobile	5
		None	0
Apron Tracks		**Conditional Age**	
2	10	New	10
1	7	10 years old	8
None	0	20 years old	4
		30 years old	1

TABLE B-2
IDEAL RORO BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Apron Tracks**	
Quay or marginal	10	2	10
Pier	5	1	7
		None	0
Berth Length (ft)		**Deck Strength (lb per ft^2)**	
Greater than 1,000	20	Greater than 800	10
900 to 1,000	18	600 to 800	9
800 to 899	16	400 to 599	5
700 to 799	10	Less than 400	2
600 to 699	6		
Less than 600	2		
Water Depth (ft) MLW		**Ship Service Facilities**	
Greater than 35.0	20	Power, water, and telephone	6
32.0 to 35.0	18	Power and water	5
30.0 to 31.9	16	Water only	4
28.0 to 29.9	14	None	0
Less than 28.0	12		
Apron Width (ft)		**Vehicle Access**	
Greater than 60.0	20	Uncongested	10
40.0 to 60.0	15	Congested	5
30.0 to 39.9	5		
Less than 30.0	0		
RORO Ramp Operation		**Conditional Age**	
Side, slewed, straight	10	New	10
Side, slewed-stern	6	10 years old	8
Slewed-stern	4	20 years old	4
Starboard-slewed-stern	2	30 years old	1
None	0		
Tidal Range (ft)			
0 to 3.9	10		
4.0 to 7.9	8		
8.0 to 11.9	6		
12.0 to 16.0	4		
Greater than 16.0	0		

TABLE B-3
IDEAL CONTAINER BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Deck Strength (lb per ft^2)**	
Quay or marginal	10	Greater than 1,000	10
Pier	5	800 to 999	8
		600 to 799	5
		400 to 599	3
		Less than 400	1
Berth Length (ft)		**Ship Service Facilities**	
Greater than 1,000	20	Power, water, and telephone	6
900 to 1,000	18	Power and water	5
800 to 899	16	Water only	4
700 to 799	10	None	0
600 to 699	6		
Less than 600	2		
Water Depth (ft) MLW		**Container Cranes**	
Greater than 40.0	20	Specialized container crane	20
35.0 to 40.0	18	Mobile gantry	16
32.0 to 34.9	16	Mobile crane (200-ton)	12
30.0 to 31.9	14	Mobile crane (100-ton)	8
Less than 28.0	12	None	0
Apron Width (ft)		**Container Handling Equipment**	
Greater than 60.0	20	Straddle cranes	10
40.0 to 60.0	15	Straddle trucks	9
30.0 to 39.9	5	Front/side-loading forklifts	8
20.0 to 29.9	2	Mobile cranes	5
Less than 20.0	1	None	0
Apron Tracks		**Conditional Age**	
2	10	New	10
1	7	10 years old	8
None	0	20 years old	4
		30 years old	1
Consolidated Shed			
Available	10		
None	0		

PORT OF BEAUMONT
TEXAS

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a site survey of the Port of Beaumont in September 1997. This Ports for National Defense study is based on that site survey and 1999 - 2000 validation with the Beaumont Port Authority. This is a strategic port that can throughput a division-size unit and can accommodate vessels as large as the LMSR or FSS.

The port is made up of five wharf areas – Berths 1, 2-4, 5-7, Harbor Island Marine Terminal (HIMT), and Carroll Street Wharf (CSW). Berths of importance for deployment are HIMT, CSW, and 2-4. These three berths each have a water depth of at least 38 feet and length of at least 1,200 feet. Berths HIMT, CSW, and 2-4 are all called out in the Port Planning Orders issued by the Maritime Administration.

The Port of Beaumont is capable of breakbulk, RORO, container, and barge operations. This port is rail accessible by the Burlington Northern/Santa Fe, Union Pacific, and Kansas City Southern rail lines and has an airport about 10 miles away. The nearest airport can handle C-130 aircraft. Available MHE include a wharf crane, a floating crane, mobile cranes of various capacity and type, a container handler, and various forklifts for palletized cargo. Some of the MHE is available through local stevedores. The port also has both truck and rail end ramps for offloading semitrailers and railcars.

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of about 21,760 STON (total port) per day. RORO and container throughputs are 25,800 STON and 6,960 STON per day, respectively.

The U.S. Military will most likely use HIMT, CSW, and Berths 2-4 with associated open storage areas for an actual deployment. For this application, we analyzed a notional armored division deploying from the Port of Beaumont on LMSR ships using Berths 2-4, HIMT, and CSW. A notional armored division has 101,350 STON of vehicles and equipment. To meet a port closure requirement of 6 days, a deploying notional armored division needs to throughput 16,900 STON (101,350 STON in 6 days) of vehicles and equipment (that includes 90 containers) each day at the Port of Beaumont. When the six LMSRs are available for loading, the port has the potential to meet the shipping requirements if all facilities and resources are available. Smaller ships will require additional time and/or berths.

For sustained deployment operations, about 25 acres of open staging are desired per LMSR, for a total of 75 acres per day for three LMSR berths. The desired open staging for an FSS is about 16 acres per ship for deployment, for a total of 48 acres per day for 3-berth operations. The port has a total of 83 acres of open staging dispersed throughout the port. Almost all of the 83 acres are either paved, gravel, or stabilized. These staging areas are not contiguous and may cause disruptions in traffic flow during an all out deployment.

The notional armored division will require 169 railcars per day for a convoy/rail deployment. Rail traffic to the port was two trains per day (two in and two out) in September 1997 with a maximum of 85 railcars per train. The 596th U.S. Army Transportation Terminal Group estimates rail traffic to Beaumont during a deployment to be about 225 – 275 railcars per day. The estimates and past experience indicate that the port can meet the minimum rail requirements.

A computer simulation showed that the port is capable of achieving closure for throughputting a notional armored division in 8 plus days using LMSR vessels. This estimate falls on the conservative side of a 5.5 – 8.2 day closure range based on several computer simulations performed for Beaumont. The ship transfer time, noncontiguous open staging, and lack of specialized container handling equipment are among the various factors that could contribute to extending port closure from 6 days to over 8 days. The Port of Beaumont can easily handle a heavy armored cavalry regiment within 6 days if all facilities and resources are available.

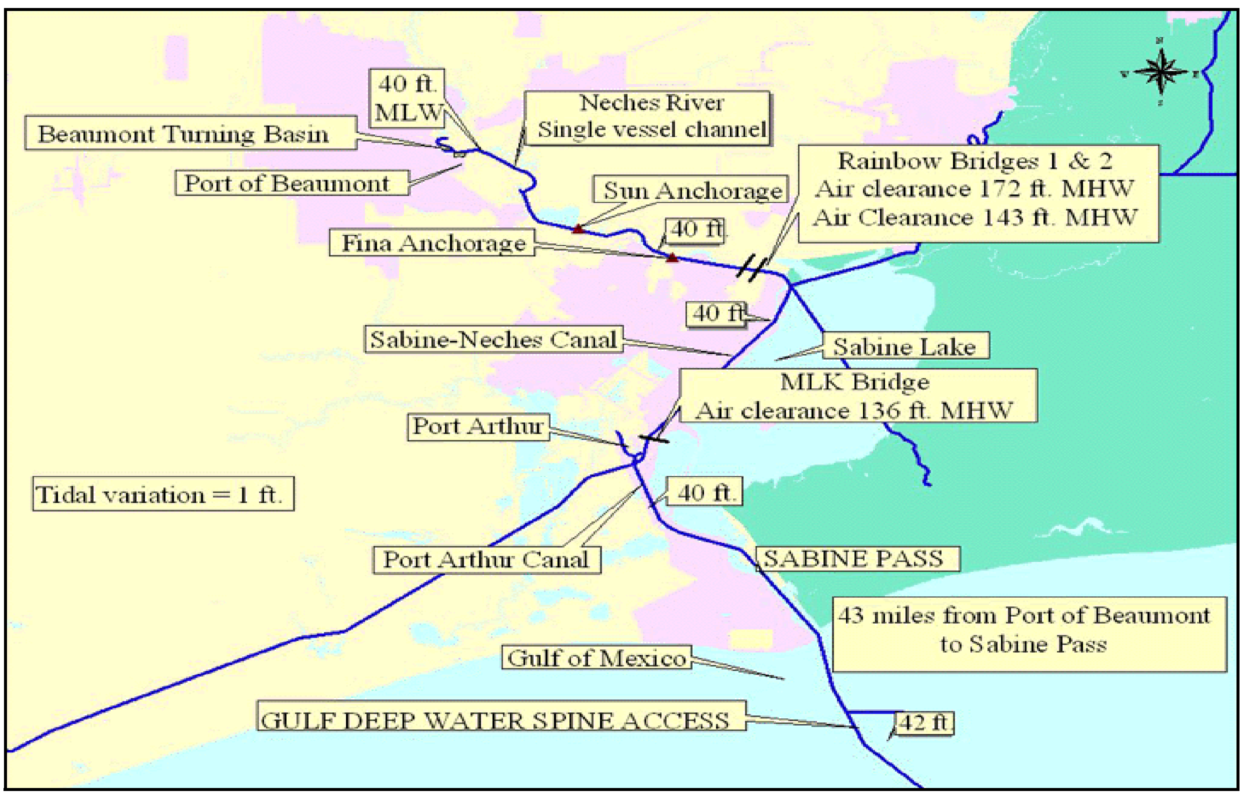
II. GENERAL DATA

The Port of Beaumont is a strategic port on the U.S. Gulf Coast that has been used by the U.S. Military for numerous exercises and deployments. A team from the Military Traffic Management Command conducted a site survey in September 1997. This information was validated December 1999 - January 2000. Information on port characteristics was obtained from port officials.

TRANSPORTATION ACCESS

Water

The Port of Beaumont (latitude 30° 04.733' north, longitude 94° 05.133' west, (BBNV)) is in southeastern Texas, on the Neches River, about 80 miles east of Houston. The distance from the port to the Gulf of Mexico is about 43 miles down the Neches River. Entrance to the port is via the Sabine Pass, the Port Arthur and Sabine-Neches Canals, and the Neches River. The minimum water depth of the channels and turning basin is 40 feet mean low water (MLW) and the minimum channel width is 400 feet. The water depth for the Port of Beaumont ship berths ranges from 30 to 40 feet.



Water Access Map

Three bridges cross the main shipping channels between the Gulf of Mexico and the Port of Beaumont. The first, on the Sabine-Neches Canal, is the Martin Luther King Memorial Bridge on Martin Luther King Boulevard, Texas Route 82. It has a horizontal clearance of 400 feet and a vertical clearance of 136 feet above mean high water (MHW).

The second bridge is next to the third bridge, along Texas 87. Both bridges span the Neches River, 18 miles downstream of the Port of Beaumont. The downstream bridge (Rainbow Bridge II) has a horizontal clearance of 400 feet and a vertical clearance of 143 feet above MHW. The upstream bridge (Rainbow Bridge I) has a horizontal clearance of 600 feet and a vertical clearance of 172 feet above MHW.

Besides the bridges, four power cables cross the Neches River. The authorized clearances for these cables are 164, 183,164, and 187 feet.

All vessels approaching and entering the port require pilots. The port authority reports that 19 pilots and 4 apprentices are available. Also available are a range of 7-10 tugboats. Because vessels cannot pass each other in the Neches River ship channel, the port must schedule ships carefully to avoid delays in receiving ships.

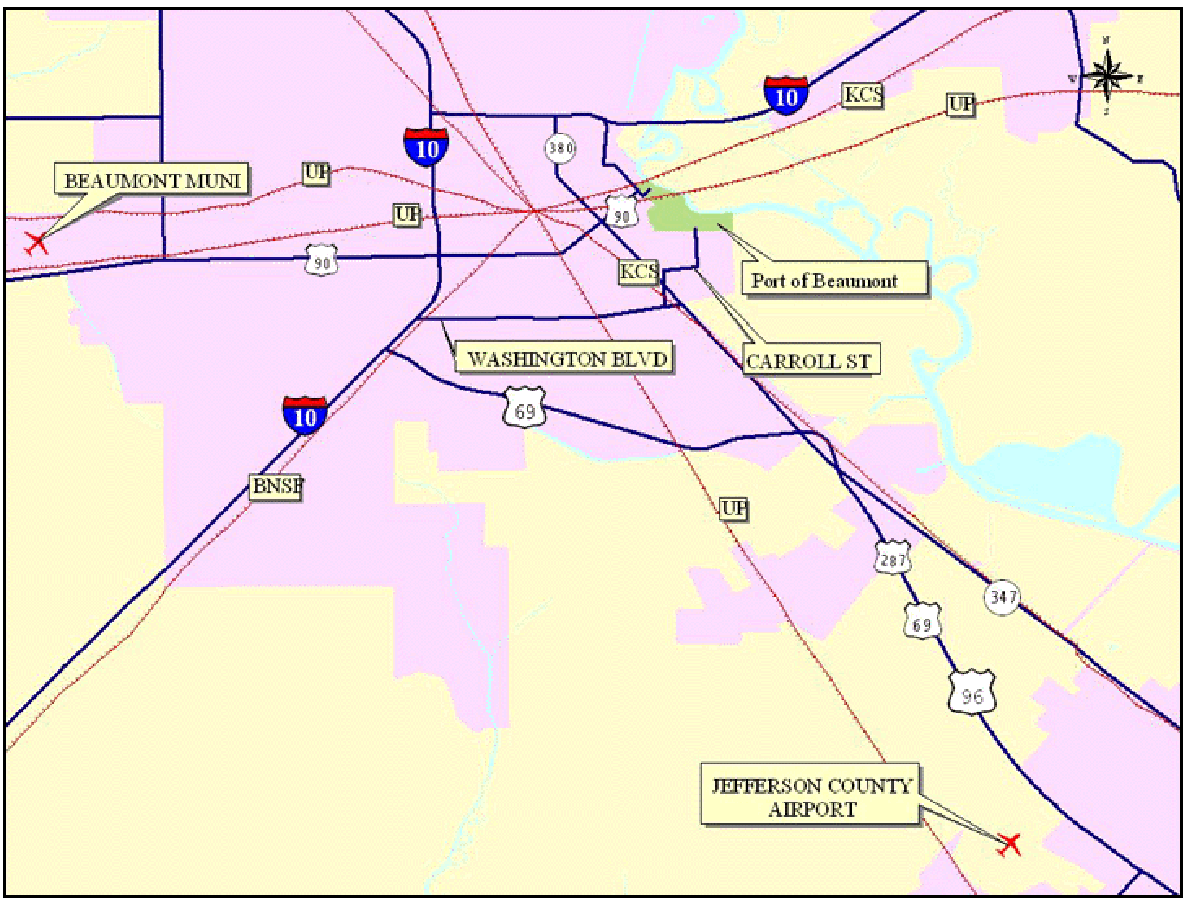
The Port of Beaumont does not have any deep-water anchorages, but does have three emergency anchorages available in the Neches River ship channel. The deepest is the Fina Anchorage, which has a water depth of only 27 feet. The turning basin, located in the Neches River just out from the ship berths, has a water depth of 40 feet and a diameter of 1,100 feet. According to Navy standard operating procedures, ships do not normally turn in an area that is less than 1.5 times their length. Based on this guideline, the turning basin will be tight for FSS/LMSR vessels (about 950 feet in length). Tidal variation is about 1 foot.

Clearance Under Martin Luther King Bridge

Highway

The Port of Beaumont has ample access to major highway routes. The port has access to Interstate 10 and U.S. Routes 69, 90, 96, and 287. Near Beaumont, U.S. 287 and 96 run along U.S. Route 69. The port authority lists two gates to the port, the Main Street gate is about 1 mile from I-10/U.S. 90, and the Carroll Street gate is about a mile further south of the Main Street gate. These gates have one lane in and one lane out. Main Street and Carroll Street are two-lane roads (one lane each direction). Main Street has a speed limit of 30 mph and has some traffic congestion. Other important highway arteries include Calder Street, College Street, and Franklin Street.

Main Gate



Road, Rail, and Air Access Map

Rail

The Burlington Northern/Santa Fe (BNSF), Union Pacific (UP), Kansas City Southern (KCS), and TexMex (through arrangement with KCS) railroad companies serve the Port of Beaumont. These carriers have railyards near the port. The Port of Beaumont's railyard can store about 278 89-foot railcars. The commercial railyards in the area can store a total of about 950 89-foot railcars; however, all railyards were operating at least 60 percent full at the time of the September 1997 visit. Only one of the three major rail lines coming into the port has restrictions. The BNSF rail line has 17-foot 3.5-inch and 16-foot 8.5-inch clearance restrictions in the horizontal and vertical directions, respectively. The port is capable of bilevel and trilevel operations on the other two lines. The Port of Beaumont provides the rail switching service between the commercial railyards and the port.

Rail trackage links the railyards to the port's apron tracks, transit sheds, and storage tracks. Apron tracks are along Berths 2-4, 5-7, and HIMT. Rail service at the time of the visit was two trains in and two trains out per day with a maximum of 85 railcars per train. Fixed end ramps are available at the Port of Beaumont (tracks 5 and 6) and the BNSF railyard. The fixed end ramps on port can hold ten 89-foot railcars each while the dirt ramp at the BNSF railyard can accommodate only three 89-foot railcars. The fixed end ramps at the port are located inland of the transit sheds for Berths 2-4 and 5-7. Four portable 70 STON nominal rating end ramps are also available. The port has several rail spurs at least 1,000 feet in length for offloading using portable end ramps.

Port of Beaumont Railyard

UP Railyard off Lindbergh Drive

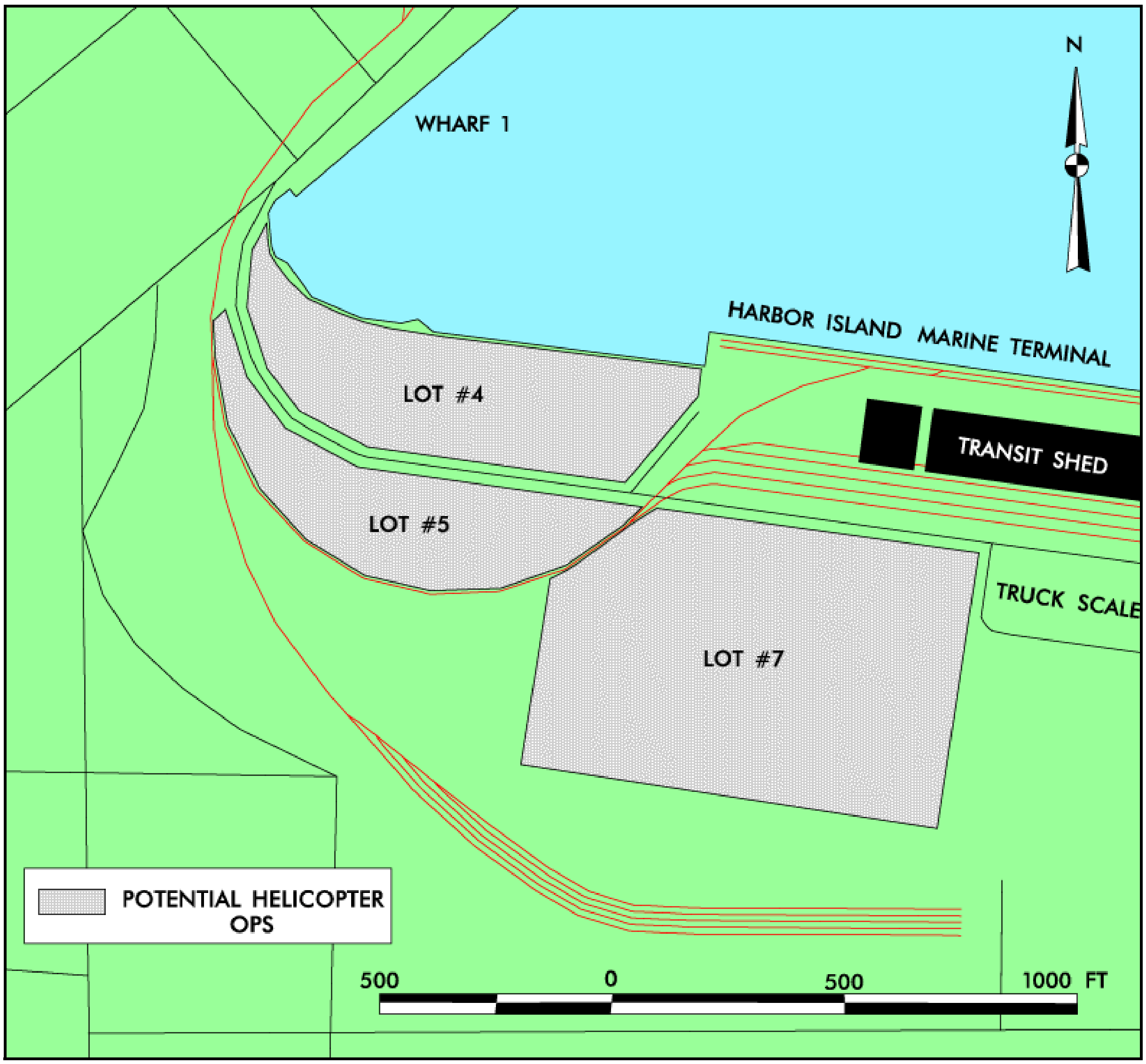
Air

The nearest commercial airport is Jefferson County Airport. It is about 10 miles southeast of the Port of Beaumont and has two commercial runways. The longest runway is 6,750 feet long and 150 feet wide. This is long enough to handle C-130 aircraft.

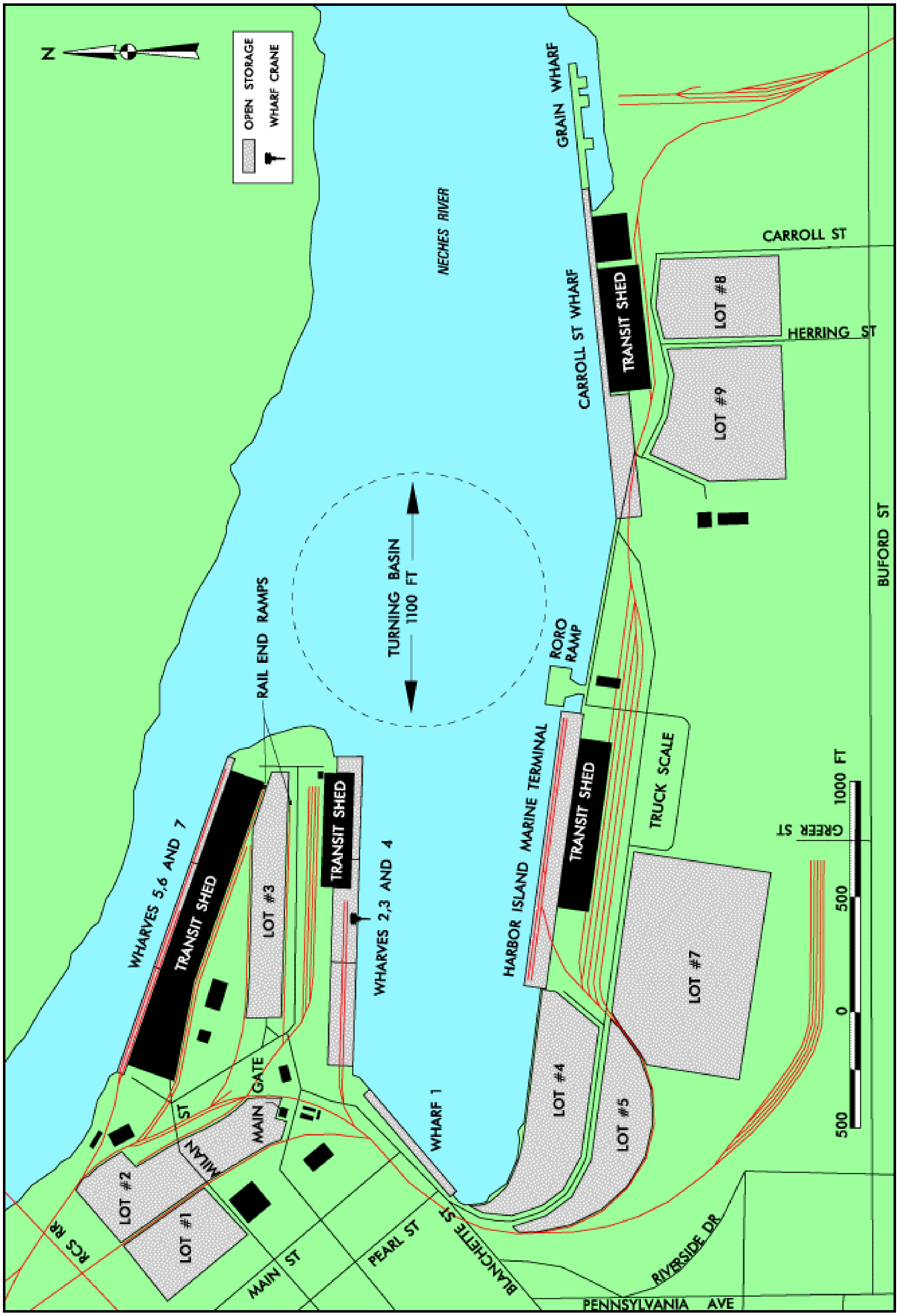
Houston Intercontinental Airport is about 80 miles west of the Port of Beaumont. It has four runways. The longest runway is 12,000 feet long and 150 feet wide. This is long enough for C-5 aircraft.

The nearest military airfield, at Ellington Air Force Base, is about 80 miles southwest of the port. It has three runways. The longest runway is 9,000 feet long and 150 feet wide.

The Port of Beaumont Port Authority indicates that helicopter operations could take place at Lots 4, 5, and 7 (open staging areas) near the Harbor Island Marine Terminal (HIMT).



Potential Areas for Helicopter Operations


N
OPEN STORAGE
WHARF CRANE
NECHES RIVER
GRAIN WHARF
CARROLL ST
LOT #8
HERRING ST
TRANSIT SHED
CARROLL ST WHARF
LOT #9
BUFORD ST
TURNING BASIN
1100 FT
RAIL END RAMPS
RORO RAMP
TRUCK SCALE
HARBOR ISLAND MARINE TERMINAL
TRANSIT SHED
GREER ST
1000 FT
500
0
500
LOT #7
WHARVES 5,6 AND 7
TRANSIT SHED
LOT #3
TRANSIT SHED
WHARVES 2,3 AND 4
GATE
MAIN ST
MILAN ST
WHARF 1
LOT #4
LOT #5
LOT #2
LOT #1
RCS RR
MAIN ST
PEARL ST
BLANCHETTE ST
RIVERSIDE DR
PENNSYLVANIA AVE

Land-Use Map

PORT FACILITIES

Berthing

The Port of Beaumont is a multicargo port capable of breakbulk, roll on/roll off (RORO), container, and barge operations. The port has many berths capable of supporting military operations. The premier berths at the port are Berths 2-4, HIMT, and Carroll Street Wharf (CSW). These berths are capable of RORO, breakbulk, and limited container operations. All of these berths are at least 1,200 feet long and have a water depth of at least 38 feet MLW (FSS and LMSR capable). Also, these berths have immediate access to open staging as well as a transit shed. Rail end ramp offloading can occur near each of the premier berths. Each of these berths is considered to have an open apron, allowing ample space for RORO ship ramps. The CSW apron is open only at the extension end. This means that FSS side-ramp operations are not likely feasible on the 33-foot apron at the CSW. A 60 STON wharf crane is available at Berths 2-4. The Port of Beaumont does not have container cranes, therefore, loading containers on board ship requires appropriate mobile cranes and/or ship cranes. Berth characteristics for all berths are in the following tables.

BERTH CHARACTERISTICS FOR THE PORT OF BEAUMONT					
	Berths				
Characteristics	**CSW**	**HIMT**	**1**	**2-4**	**5-7**
Length feet (meters)	1,435 (437.4)	1,200 (365.8)	580 (176.9)	1,342 (409.0)	1,450 (442.0)
Depth alongside at MLW feet (meters)	40 (12.2)	40 (12.2)	30 (9.1)	38 (11.6)	36 (11.0)
Deck Strength psf (metric tons per square meters)	500 (2.44)	1,200 (5.86)	350 (1.71)	400 (1.95)	350 (1.71)
Apron width feet (meters)	Open	97 (29.6)	Open	Open	33 (10.1)
Apron height range feet (meters)	16 (4.88)	16 (4.88)	16 (4.88)	16 (4.88)	16 (4.88)
Number of container cranes	0	0	0	0	0
Number of wharf cranes	0	0	0	1	0
Apron Lighting	Yes	Yes	No	Yes	Yes
Straight-stern RORO Ramp	No	Yes	No	Yes	No
Apron length served by rail feet (meters)	0	1,200 (365.8)	0	784 (239.0)	1,450 (442.0)

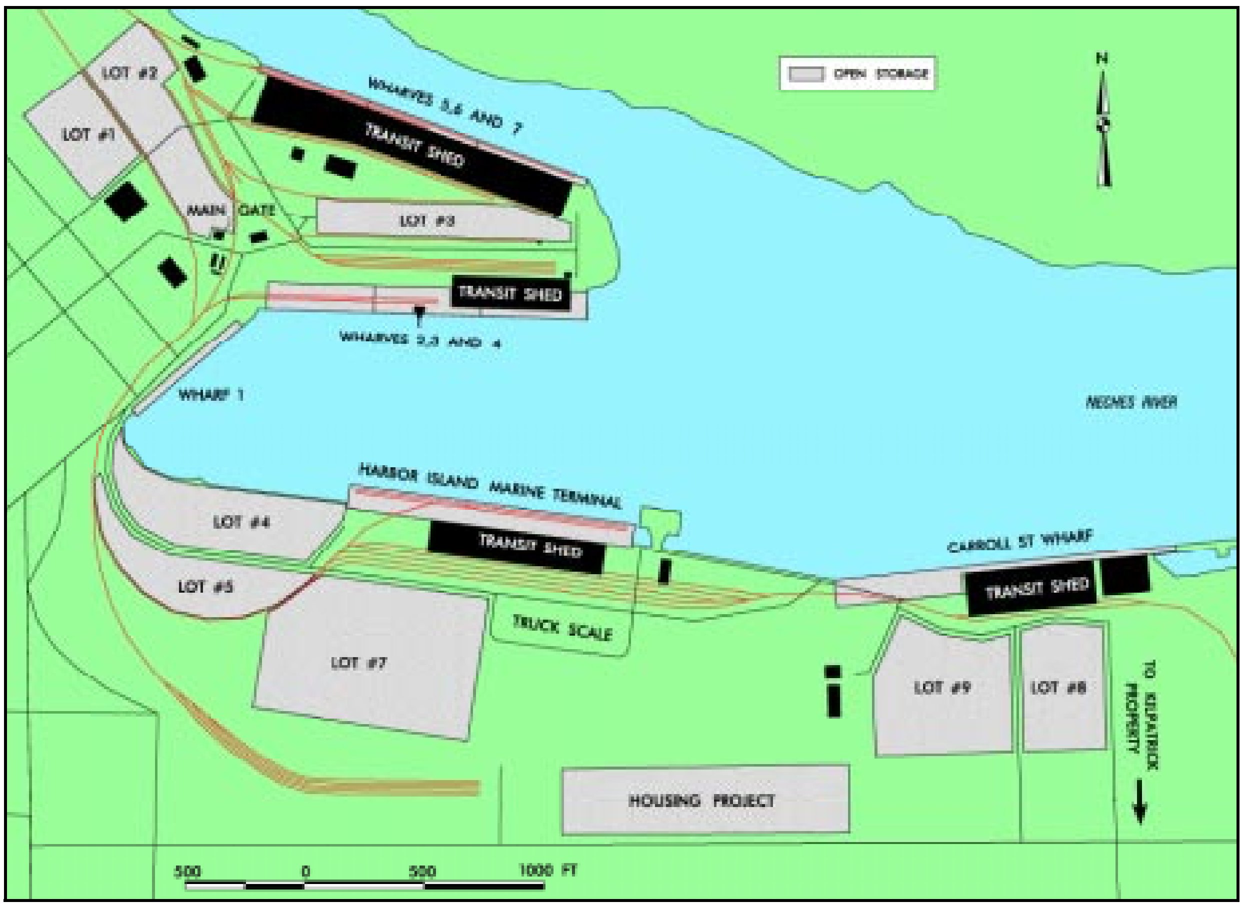
SUMMARY OF BERTHING CAPABILITIES FOR PORT OF BEAUMONT							
Vessels		Berths					
TYPE	CLASS	Carroll Street Wharf	HIMT	1	2-4	5-7	*NOTES:*
BREAKBULK	C3-S-38a	2	2	1	2	2	The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.
	C4-S-58a	2	2	1,a	2	2	
	C4-S-66a	2	2	1,a	2	2	
	C5-S-37e	2	1	c	2	2	
SEATRAIN	GA and PR	2	2	1	2	2	
BARGE	LASH C8-S-81b	1	1	a,c,f	1	1	The letters in the columns to the left indicate limitations as described below.
	LASH C9-S-81d	1	1	a,c,f	1	1,a,f	
	LASH Lighter	7	6	2	6	7	
	SEABEE C8-S-82a	1	1	a,c,f	1,a,f	1,a,f	
	SEABEE Barge	7	6	2	6	7	
RORO	COMET	2,d,i,j	2,i,j	1,d,i,j	2,i,j	2,d,o	a-vessel draft limit
	METEOR	2,d,i,j	2,i,j	1,d,i,j	2,i,j	2,d,o	b-inadequate apron width
	Cape Gnome	2,d,i,j	1,i,j	a,c,d,i,j	2,i,j	2,d,o	c-inadequate berth length
	C7-S-95A	1,i	1,i	a,c	1,i	1,b	d-no straight stern ramp
	Cape Taylor	2,i	1,i	c	2,i	2,b	e-no container handling equipment
	Cape Orlando	2,i,j	1,i,j	c	2,i,j	2,b	f-anchorage depth OK, berth depth inadequate
	MV Ambassador	2,d	2	1,d	2	2,d	g-inadequate channel depth
	Callaghan	1,d,i,j	1,i,j	c,d,i,j	1,i,j	2,d,o	h-no shore based ramps
	Cape Lambert	2,i,j	1,i,j	a,c	1,i,j	2,b	i-low tide insufficient ramp clearance
	LMSR Class	1	1	a,c	1	1,b	j-high tide insufficient ramp clearance
	FSS	1	1	a,c	1	1,a,b	k-excessive ramp angle low tide
	Cape E-Class	2,i,j	1,i,j	a,c	1,i,j	2,b	m-excessive ramp angle high tide
	Cape D-Class	2,i,j	1,i,j	a,c	1,i,j	2,b	n-parallel ramp operation ONLY
	Cape H	1,i,j	1,i,j	a,c	1,i,j	1,b	o-insufficient apron width for side ramp
RORO	Cape Texas	2,i,j	1,i,j	c	2,i,j	2,b	
	Cape R	2,d	1,i,j	a,c,d	1,i,j	2,b,d,o	
	Cape I-class	2,i,j	1,i,j	a,c	1,i,j	2,b	Ramp clearance and angle based on Maximum vessel draft
	Cape Victory	2,i,j	1,i,j	c	2,i,j	2,b	
CONTAINER	C6-M-147a	2,e	1,e	c,e	1,e	2,b,e	
	C7-S-69c	2,e	1,e	a,c,e	1,e	2,b,e	♦ **May Prevent Operation**
	C7-S-68c	1,e	1,e	a,c,e	1,e	2,b,e	
	C8-S-85c	1,e	1,e	a,c,e	1,e	1,b,e	
	C9-M-132b	1,e	1,e	a,c,e	1,e	1,b,e	♦ **May Limit Operation**
	C9-M-F141a	1,e	1,e	a,c,e	1,e	1,a,b,e	
TACS	C6-S-1qd	2	1	a,c	1	2,b	
	C5-S-MA73c	2	1	a,c	2	2,b	
	C6-S-MA60d	2	1	a,c	1	2,b	
MPS	C7-S-133a	1	1	a,c	1	1,b	
	Maersk	1	1	a,c	1	1,b	
	AmSea	2	1	a,c	1	2,b	

STAGING

Open Staging

The Port of Beaumont has a total of about 83 acres of open storage. The staging is distributed throughout the port area as shown in the table on this page. Lots 4, 5, and 7 have potential for helicopter operations. None of the open storage areas have lighting for night operations.

STAGING AREA	ACREAGE	SURFACE MATERIAL
Lot 1	2	Limestone
Lot 2	5	Limestone
Lot 3	3	Slab
Lot 4	4	Asphalt
Lot 5	4	Asphalt
Lot 6	1.5	Asphalt
Lot 7	10	Asphalt
Lot 9	5.5	Limestone
Housing Project	12	Partial Paved, Partial Grass
Kilpatrick Property	36	Gravel, Paved, Stabilized
TOTAL	**83**	-----

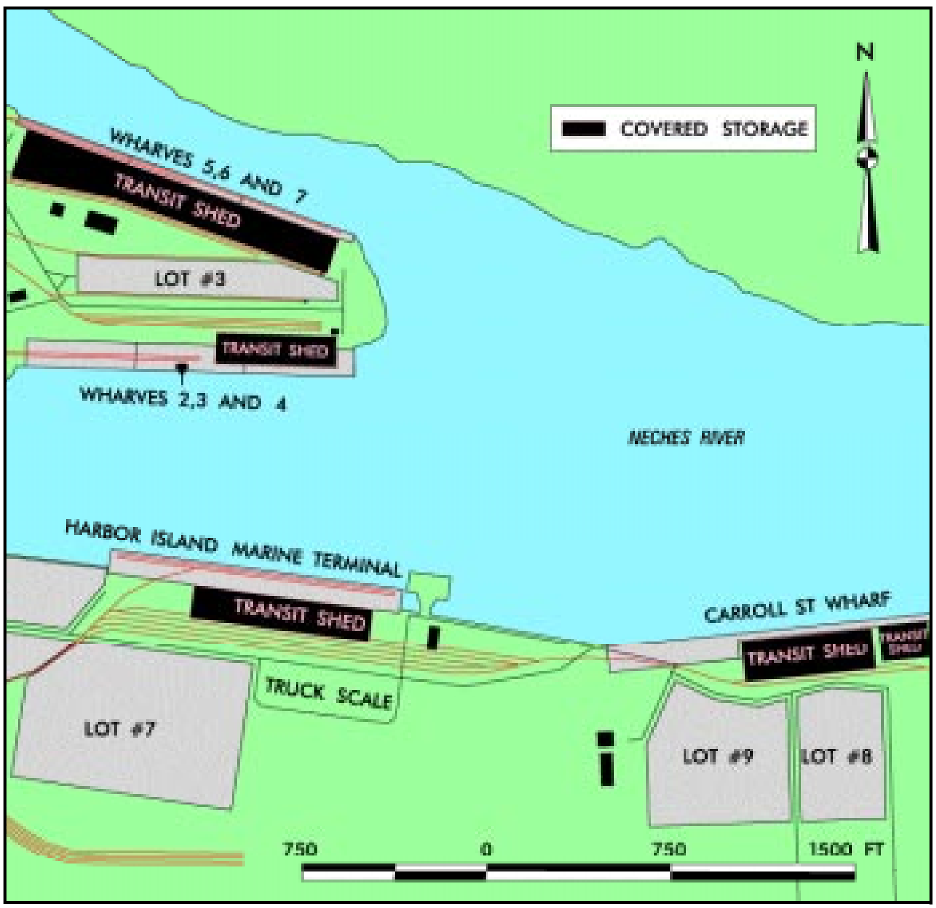


Open Staging Areas

Covered Staging

The port has ample covered storage available for general cargo and container stuffing/unstuffing operations. Storage facilities are located near each of the berths. The following table shows the distribution of covered storage facilities.

STORAGE FACILITY	BERTH SERVED	TOTAL AREA (SQ FT)
Shed #4	4	57,700
Shed #5 & #6	5 & 6	126,000
Shed #7	7	82,500
HIMT – West	HIMT	20,000
HIMT – East	HIMT	120,000
CSW – West	CSW	20,000
CSW – East	CSW	82,000
TOTAL	**------**	**508,200**



Covered Storage Area

UNLOADING/LOADING POSITIONS

Ramps and Docks

Fixed End Ramp at the Port of Beaumont

The Port of Beaumont has six rail end ramps (two fixed and four portable) and six truck end ramps (two of these are portable lightweight ramps). The two fixed end ramps are located on tracks 5 and 6 inland of the transit sheds for Berths 2-4 and 5-7. These end ramp facilities have been used many times over the years for military exercises and deployments. The best locations for the portable 70-ton nominal rating rail end ramps are the spurs near the open storage areas at HIMT. The BNSF railyard also has a dirt rail end ramp, north of the port that can accommodate three railcars at one time. The fixed truck end ramps are located at Berth 4, HIMT, and CSW and provide a total of 14 truck positions. The port also has 15 truck docks and 55 boxcar docks distributed among various covered storage facilities. The three truck docks at Shed #4 cannot be used when railcars are on the nearby spur.

Marshaling Areas

The port authority lists two possibilities that have potential for off-port marshaling. The first is the South Texas State Fairgrounds (60 acres) located 3 miles from the port, north of I-10. The second is Lamar University, acreage available is unknown.

South Texas State Fairgrounds

MATERIALS HANDLING EQUIPMENT (MHE)			
Type of Equipment	**Capacity (STON)**	**Quantity**	**Owner/Wharf Assignment**
Floating Crane	500	1	privately owned
Mobile Crane– rubber tired	220	1	port owned
Truck Crane	140	4	port owned
Truck Crane	70	5	port owned
Wharf Gantry Crane	60	1	port owned - Berths 2-4
Lorrain Mobile Crane	50	1	port owned
Linkbelt Crawler Crane	20	1	port owned
Container Forklift	40	1	port owned
Forklift	15	6	privately owned
Forklift	5-15	30	privately owned
Note: The port authority indicates that other equipment is available through local stevedores.			

Wharf Crane at Berths 2-4

FUTURE DEVELOPMENT

The port authority for the Port of Beaumont lists four developments that will occur in the near future.

1. The HIMT Berth will be extended 800 feet westward of existing berth, with completion scheduled sometime in 1999 - 2000.

2. The Orange County property across the Neches River will be developed to provide a new lay berth and a roadway will connect this area to I-10.

3. Rail lines will be extended into the housing project property purchased by the Port of Beaumont (see open staging area graphic for location). This property will be accessible by a new road to be built in the near future, Leonard Street.

4. The port authority plans to develop the Kilpatrick property (see open staging area graphic for approximate location).

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

The Port of Beaumont has handled explosives/hazardous cargo in the past, but not on a routine basis. The shipper must make application with the U.S. Coast Guard, providing details of the operation with regard to the Port of Beaumont. Arrangements must be made with the Beaumont Fire Department to determine the volume that can be handled. For incoming vessels, explosives/hazardous cargo must be the first off the ship and arrangements must be made to truck the cargo out of the port immediately. For outgoing vessels, explosives/hazardous cargo will be loaded last on the ship and the ship must set sail within 2 hours of completion of loading.

STEVEDORES

The Port of Beaumont contracts out to PC Pfeiffer for warehouse operations. For shiploading, four stevedoring firms are represented in the area. They are: James Flanagan, Stevedoring Services of America (SSA), Cooper T Smith, and Fairway. Labor from these firms covers the Ports of Beaumont, Port Arthur, Lake Charles, and Orange.

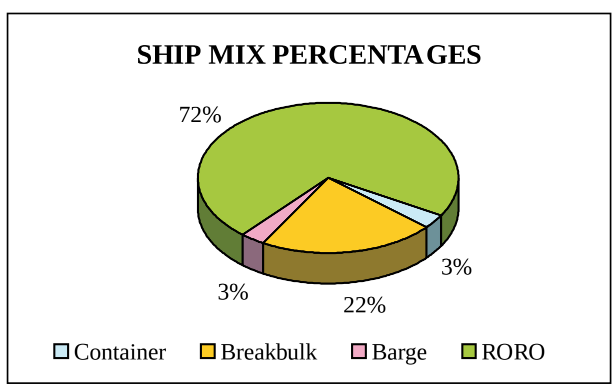
III. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Beaumont. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON.

Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 70 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

Highway

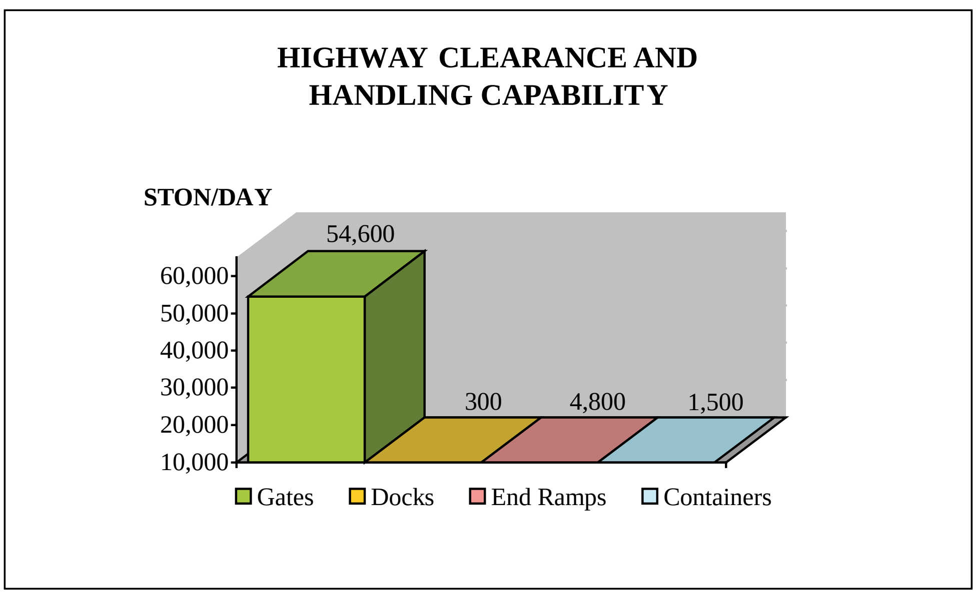
The port is connected to I-10 via two gates (Main and Carroll Street) and linking roadways (Main and Buford Streets). The two gate processing systems (one lane in and one lane out for each) can handle almost 54,600 STON of cargo per day. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or leave the port on each lane of the highway.

Roadable vehicles will move through the terminal gates in manageable convoys from staging areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. If not available, deploying units/military port operators must either build or acquire the necessary ramps. For this study, we assumed three portable ramps would be used for offloading operations. These ramps can handle 4,800 STON of military vehicles and equipment per day.

The port has 15 handling positions to load/unload supplies in van semitrailers. These positions can load/unload at least 300 STON of shipped material per day.

The Port of Beaumont has one container forklift available. This container forklift is estimated to handle about 1,500 STON per day.

Maximum daily handling capability for the port is a mixed total of the three types of handling (docks, end ramps, and containers), each up to its maximum, not to exceed the daily gate limit of at least 54,600 STON.



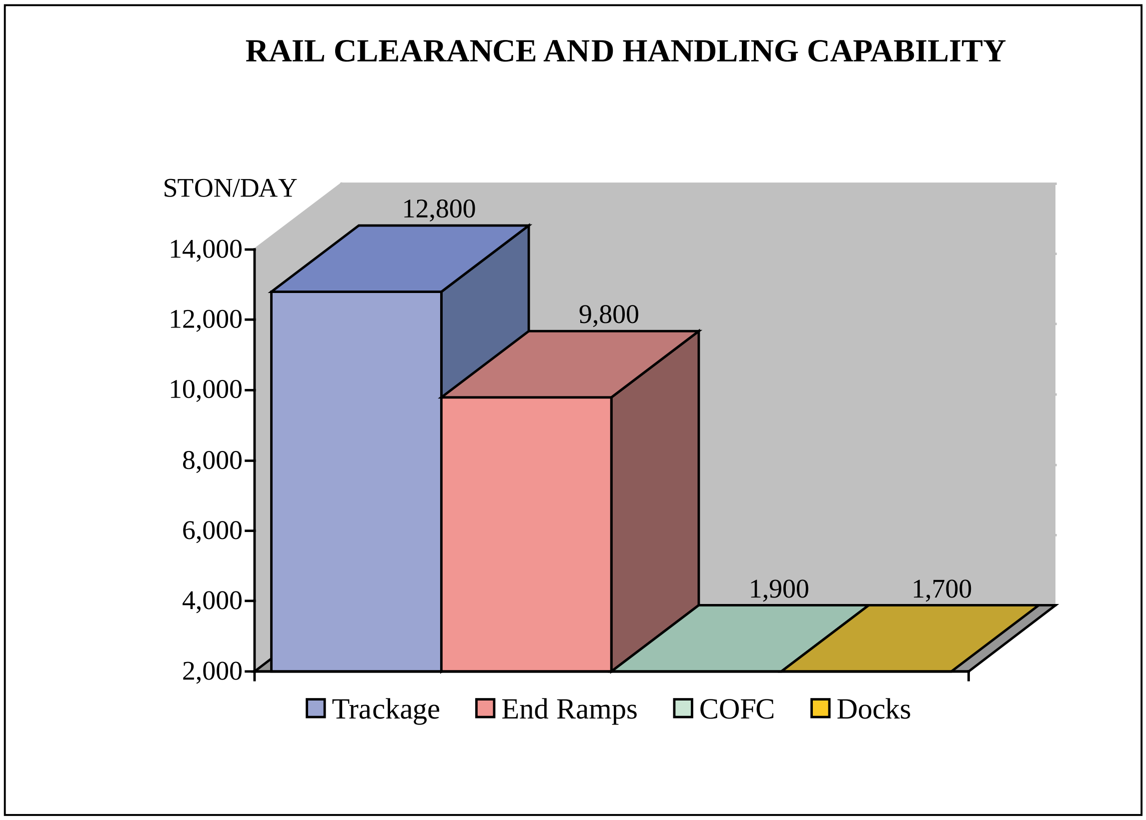
Rail

Rail reception is good, with the BNSF, UP, KCS, and TexMex (via arrangement with KCS) railroads providing rail service directly to the port. At the time of the port survey (September 1997), the port authority reported that the rail service into the port was two trains per day with a maximum of 85 railcars per train. Currently, the 596th U.S. Army Transportation Terminal Group estimates rail traffic to Beaumont during a deployment to be about 225-275 railcars per day. These trains can handle almost 12,800 STON per day.

We assumed vehicles on flatcars will offload in the port on three rail end ramps, two fixed, and one portable. The end ramps can handle at least 9,800 STON per day.

Boxcars will load/offload at the storage buildings. The port has 55 rail handling positions available for loading/unloading boxcars. These docks can handle at least 1,700 STON per day.

Based on using a mobile crane for offloading containers from railcars, the port can offload over 1,900 STON of containerized equipment and supplies from railcars per day based on a mobile crane lift rate of 12 lifts per hour and 8 STON per container.



Staging

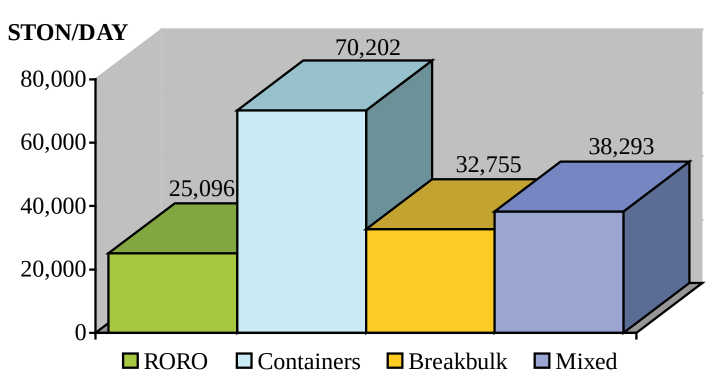
The port has a total of 83 acres of open staging area. This total is distributed throughout the port via various lots. Availability of the staging area will vary with work at the port, but generally the Port of Beaumont has been able to accommodate military movement in the past. For purposes of this analysis, we assumed a facility use factor of 100 percent.

The port has about 508,200 square feet of covered storage space. This is ample covered storage to accommodate breakbulk operations. About 10,200 STON of breakbulk cargo can be staged in the covered area.

The chart on this page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of the capability for each type of cargo operation involved should be assumed.

The table shows the STON of cargo, by type, the port can expect to handle. The dwell time used in these computations was 3 days and the open space utilization percentage was 60 percent. The container storage throughput capability is the highest with 70,200 STON per day. The ability to stack containers three high in the paved open storage areas contributes to the high staging throughput value. The RORO storage available is 25,100 STON per day. The breakbulk staging throughput capability is about 32,800 STON per day.

OPEN STAGING CAPABILITY



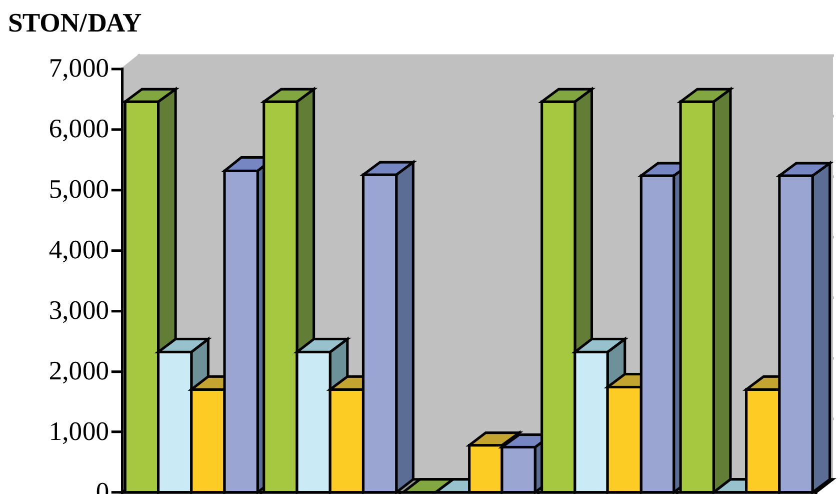
Note: Container staging area can also be used for RORO staging as needed.

Shipping

Daily shipping subsystem totals for the terminal berths are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types.

Berths 2-4, HIMT, and CSW are the best choices based on berth length, water depth, apron width, and all-around capability. Transit sheds are available at these three berths, thereby supporting breakbulk operations.

BERTH THROUGHPUT CAPABILITY



	CSW	HIMT	1	2-4	5-7
RORO	6,451	6,451	0	6,451	6,451
Container	2,320	2,320	0	2,320	0
Breakbulk	1,703	1,703	774	1,741	1,703
Mixed	5,318	5,246	743	5,231	5,230

DAILY THROUGHPUT SUMMARY					
Characteristic or Throughput	Berths				
	Carroll Street Wharf	Harbor Island Marine Terminal	1	2-4	5-7
Length (feet)	1,435	1,200	580	1,342	1,450
Depth Alongside (feet)	40	40	30	38	36
Breakbulk Throughput STON (MTON)	1,703 (4,257)	1,703 (4,257)	774 (1,935)	1,741 (4,354)	1,703 (4,257)
RORO Throughput STON (MTON)	6,451 (25,804)	6,451 (25,804)	0	6,451 (25,804)	6,451 (25,804)
RORO Square feet (est)[1]	129,020	129,020	0	129,020	129,020
RORO Pieces[2]	759	759	0	759	759
Container Throughput STON (MTON)	2,320 (5,800)	2,320 (5,800)	0	2,320 (5,800)	0
Container Throughput (TEU)[3]	580	290	0	0	0
Barge Throughput STON (MTON)	0	0	516 (1,290)	1,548 (3,870)	1,806 (4,515)
Mixed Throughput STON (MTON)	5,318 (20,477)	5,246 (20,298)	743 (1,857)	5,231 (20,260)	5,230 (20,258)

SUMMARY

The port is multioperational with the capability to handle all types of vessels: container, RORO, breakbulk, and barges.

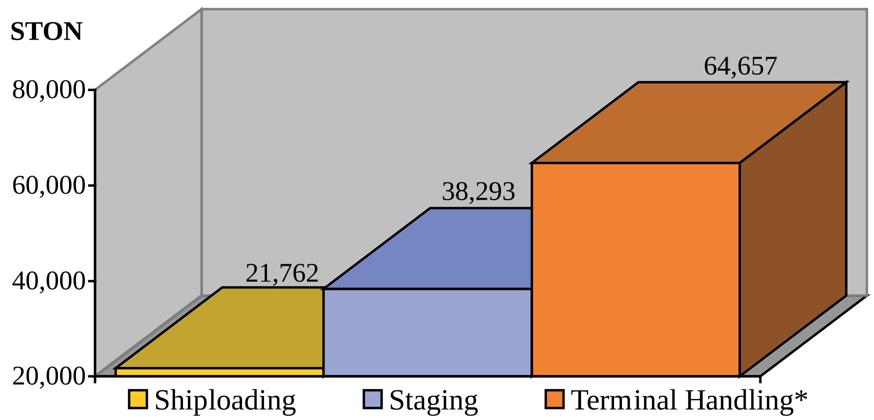
The Port of Beaumont is capable of supporting U.S. Military deployment operations and has done so in various exercises and deployment in the past. Except for one 40-STON container handling forklift, the port does not have specialized container handling equipment. Lift-on/lift-off operations must occur using mobile cranes. For lift-on/lift-off operations at Berths 2-4, shiploading can also occur using the wharf crane.

[1]Based on the 20 square feet per STON average accomplished during Operation Desert Shield/Storm.
[2]Based on the 170 square feet per piece average accomplished during Operation Desert Shield/Storm.
[3]Based on the 8 STON per TEU average accomplished during Operation Desert Shield/Storm.

The port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table. The CSW, HIMT, and Berths 2-4 are compatible with the LMSR and FSS at maximum draft.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of about 21,800 STON.

DAILY CARGO THROUGHPUT CAPACITY



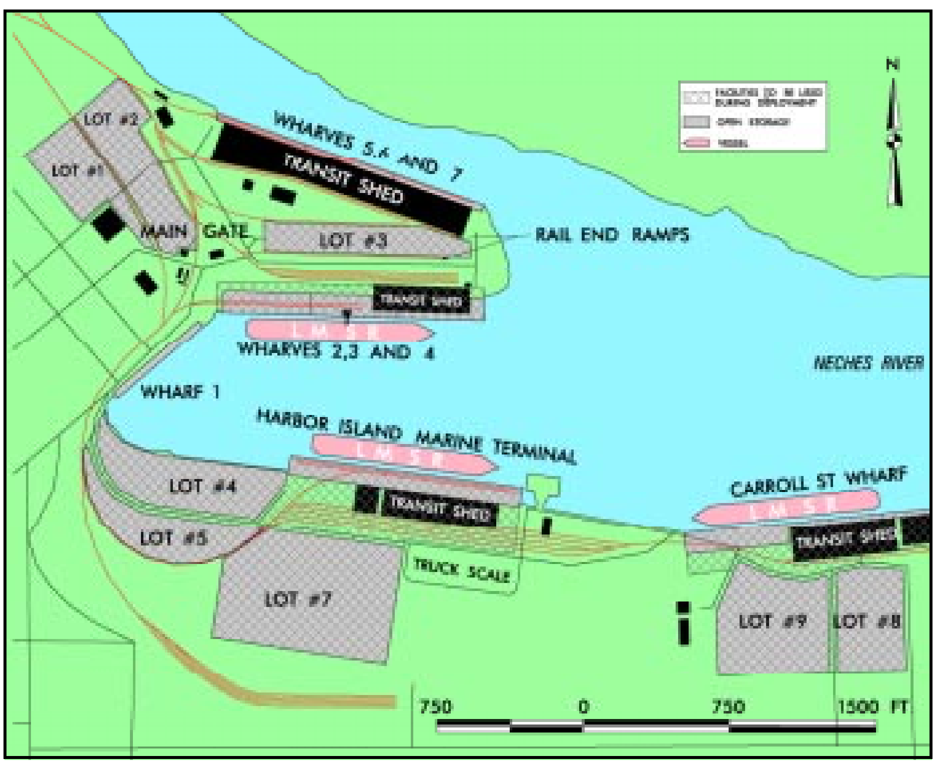
***Terminal handling is the sum of the highway (56,179 STON) and rail (8,478 STON)**

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored division using primarily LMSR vessels. We assume that the CSW, HIMT, Berths 2-4, and surrounding staging areas will be available for deployment. We also assume that no other military units will be competing for these facilities during the time that the armored division occupies the port. We further assume that the required assets, both transporters and people will be available to adequately load the ship and clear the port.

To evaluate the port's deployment capability, we used the port simulation (PORTSIM) model to flow unit equipment in the armored division through the port. PORTSIM is a time-stepped, discrete event, stochastic simulation of port operations during a force deployment. The PORTSIM is dynamically modeled for visual monitoring and quick identification of problems and allows the analyst to determine port closure/clearance times. For this simulation, we assume that the deploying division will use the facilities identified in the graphic below during a deployment. Also, we assumed the Port of Beaumont would use the wharf crane at Berths 2-4, mobile cranes, and the 40-STON container-handling forklift during shiploading operations.

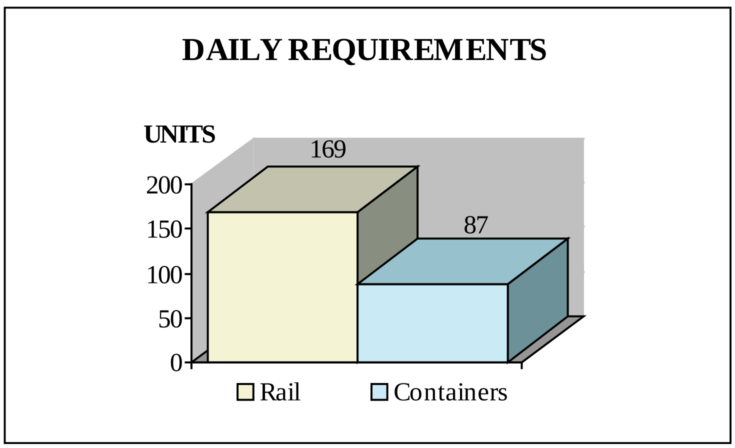


Potential Port Use During Deployment

REQUIREMENTS

To simulate a likely requirement for the Port of Beaumont, we deployed a notional armored division, using 6 days for shiploading and port closure. The division has to move about 8,125 vehicles and 520 containers. Movement of the division to the port will require 1,014 railcars using a convoy/rail option for transport to the port. About 90 containers would arrive daily.

TOTAL EQUIPMENT	
Volume	287,175 MTON
Weight	101,350 STON
Area	1,484,650 SQ FT
Vehicles	8,125
Containers	520
Note: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997.	

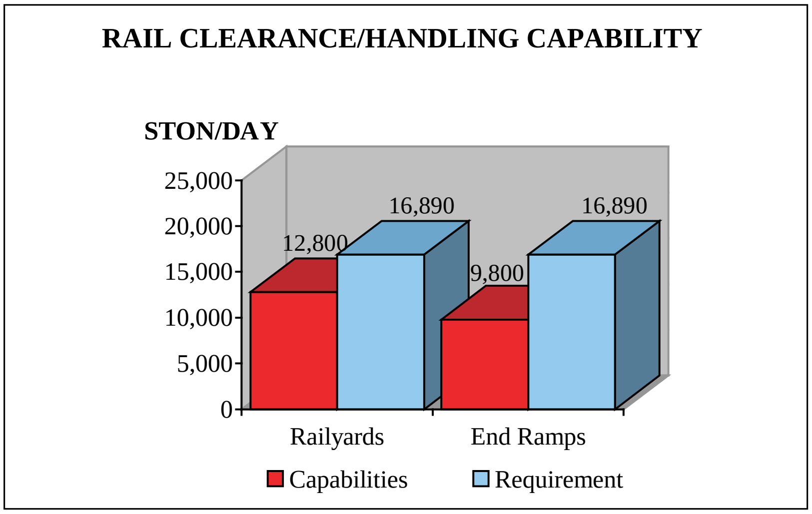


TERMINAL INPROCESSING/HANDLING

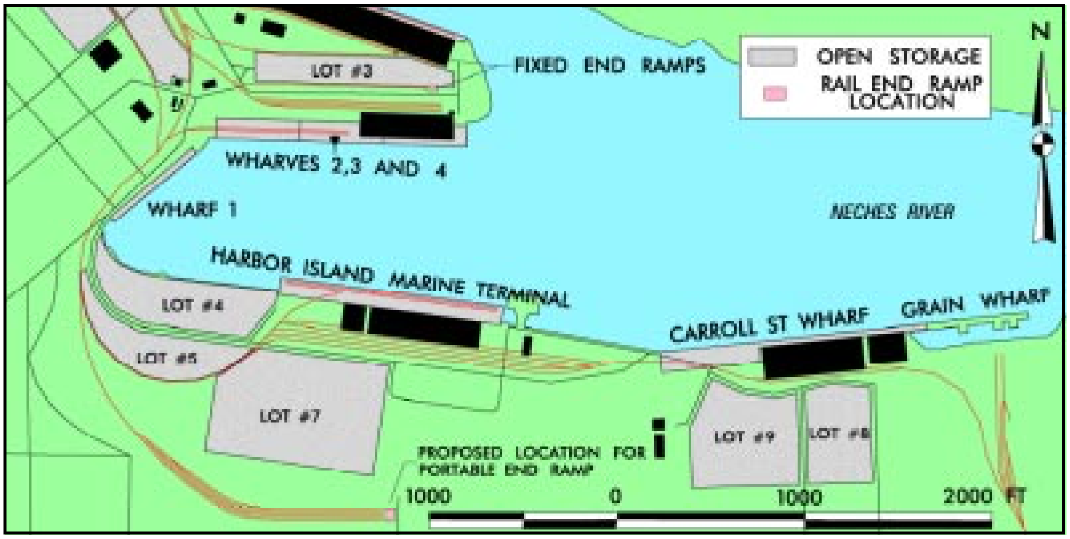
Rail

The BNSF, UP, KCS, and TexMex railroad companies serve the Port of Beaumont. The Port of Beaumont provides the rail switching service between the commercial railyards and the port. An operating speed restriction of 5 mph exists for trackage on the port. Total trackage existing on the port is about 14 miles (73,920 feet) and should be able to handle the incoming rail traffic of a deployment.

For offloading wheeled vehicles from railcars, three rail end ramps will be used. The two fixed end ramps inland of the transit sheds between Berths 2-4 and 5-7 can provide two of those three ramps. The port has numerous locations to perform rail offloading using the portable end ramps. For this analysis, we assumed rail offloading would occur at one of the spurs near HIMT.

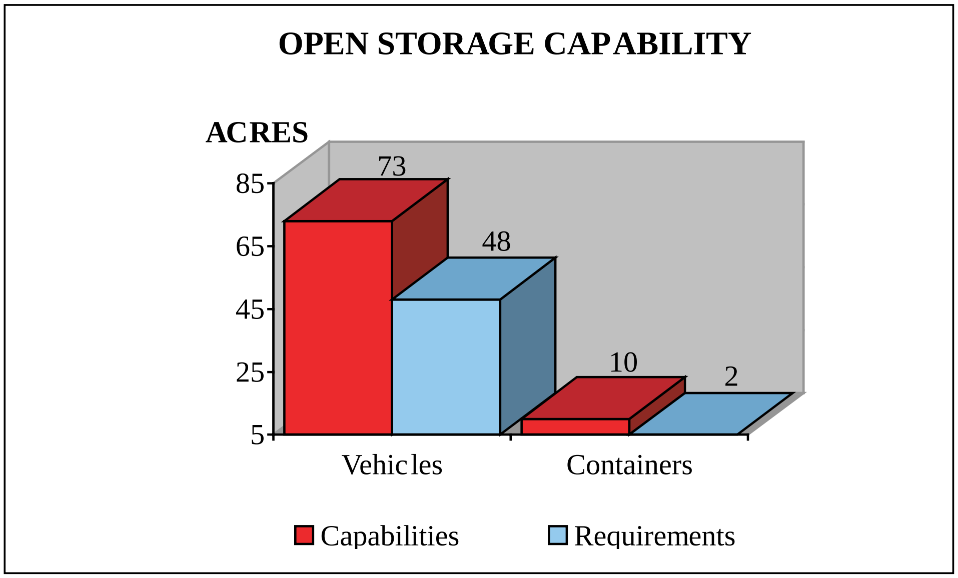


Requirements use total STON of equipment divided by six providing a rail daily requirement. Capabilities for the railyards and end ramps reflect trackage and end ramp daily throughputs, respectively.



Rail End Ramp Locations

Open Storage



The port has a total of 83 acres of open staging. Not all of this staging is contiguous as some of it is located inland away from ship berths. Thirty-one acres of this total could be considered as paved open staging within the ship berth area. The staging area requirement for each LMSR is 25 acres. As the first ship fills up and the staging area empties, there is room to stage equipment for the next LMSR that will be loaded. Loading two LMSR ships at once will require a total of 50 acres for vehicle and container storage. The Port of Beaumont has three berths compatible with the LMSR or FSS vessel. This means that the staging requirement is 75 acres for a sustained simultaneous three LMSR-berth operation and 48 acres for a sustained simultaneous three FSS-berth operation. Although the Port of Beaumont has enough staging to cover the staging requirement, some of this staging will be unimproved (grass or other surface) and noncontiguous to the ship berths.

Unimproved Open Staging

Shipping

Using the LMSRs to transport the division, the three berths (CSW, HIMT, and Berths 2-4) normally could meet the 6-day loading requirement. Based on each LMSR being able to load in about 3 to 4 days, the six LMSRs can be loaded in 6 to 8 days. Berth space is adequate to allow the side and stern ramps on the LMSRs to be used to load the ships. Tidal variation should not cause any problems. If smaller ships are used to deploy the division, then additional time or berths will be required to move the division. Although the port can theoretically meet the 6-day requirement, please note that ship transfer time, the lack of specialized container handling equipment, and noncontiguous open staging can extend port closure to over 8 days.

Deploying by LMSR requires three ships every 3 days; each ramp will have to average about 140 STON per hour for 20 hours to deploy the division in 6 days. This equates to 17 vehicles per hour per ramp. Deploying by FSS requires three ships every 2 days to meet the same requirement; this equates to 33 vehicles per hour per ramp.

SHIP REQUIREMENTS NOTIONAL ARMORED DIVISION				
Loading Condition/ Sample Ship Mix	**FSS (RORO/Comb)**	**LMSR (RORO/Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	9.6			
All LMSR		5.9		
All Breakbulk			29.8	
Maximum Containerization				
FSS/Container	2.9			4.9
LMSR/Container		1.8		4.9
Breakbulk/Container			9.0	4.9
Legend: **RORO – roll on/roll off** **FSS – fast sealift ship** **LMSR – large medium speed roll on/roll off** **Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997**				

SIMULATION RESULTS

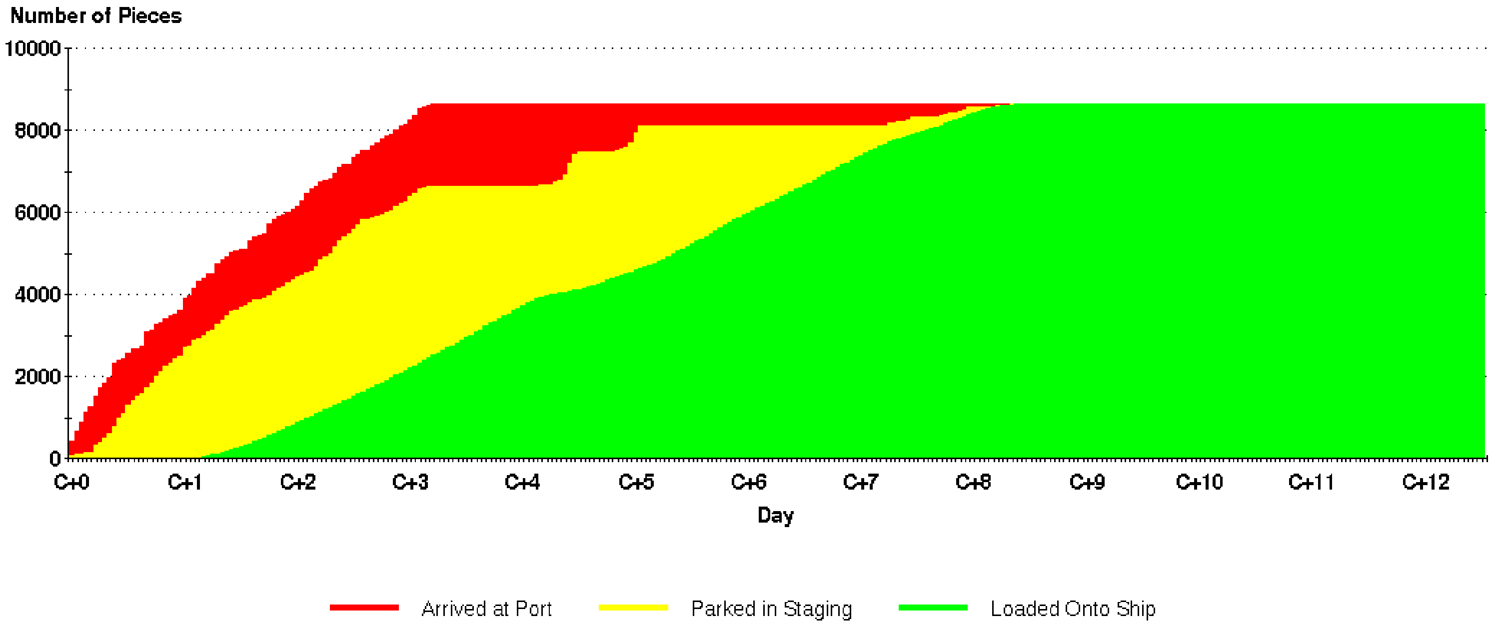
Total deployment time for the division was about 8.5 days with the last 7.5 of those days used for shiploading and the first day for initial reception and staging. LMSR vessels were used to deploy the division. Actual throughput and closure results are shown in the charts at the end of this study.

SUMMARY

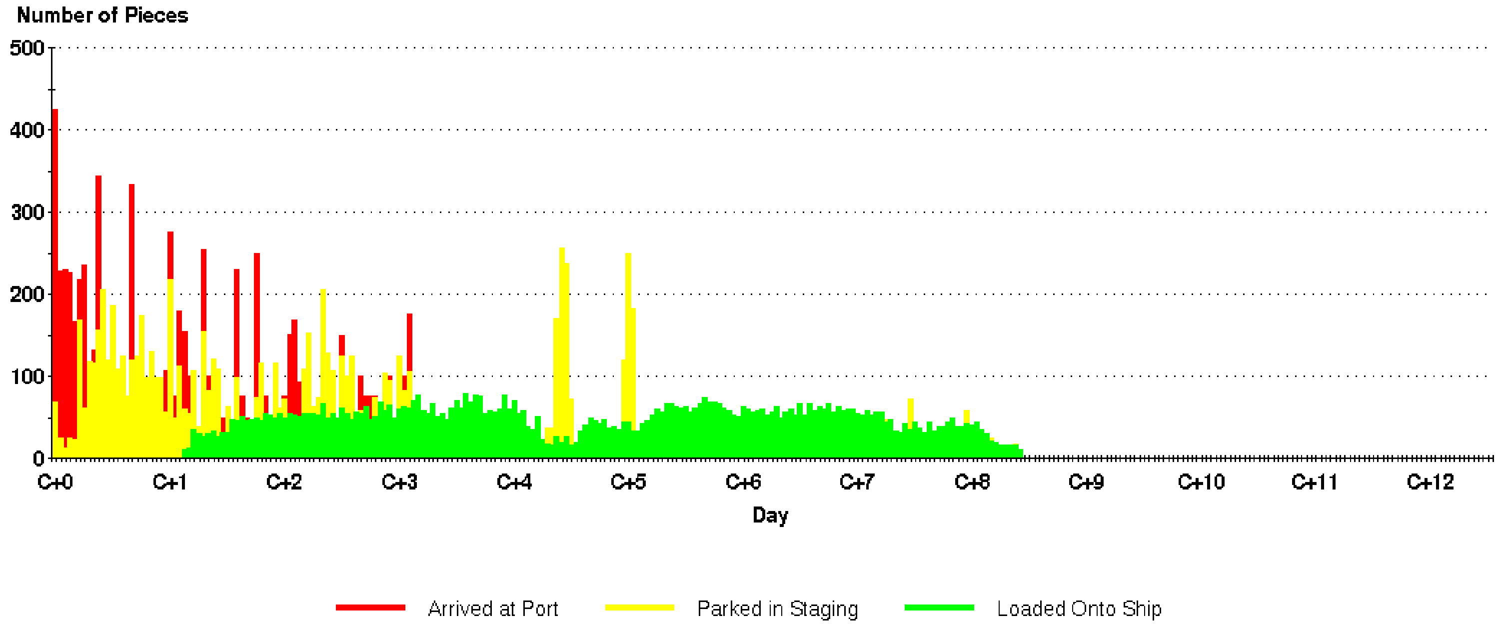
The Port of Beaumont can load and clear a notional armored division within 5.5 - 8.5 days using three berths in the port and six LMSR ships if all facilities and resources are available. When the six LMSRs are available for loading, the port has the potential to meet the shipping requirements if all facilities and resources are available. The lack of specialized container handling equipment and the noncontiguous open staging may contribute to delays in meeting deployment requirements for a notional armored division. If possible, additional container handlers should be obtained for speeding up the process of removing containers from railcars or truck chassis. If other ships are used, additional berths may be required to meet deployment requirements. Loading a heavy armored cavalry regiment in 6 days should not be a problem.

The Port of Beaumont is a viable port for supporting deployment of a notional armored division or notional heavy armored cavalry regiment.

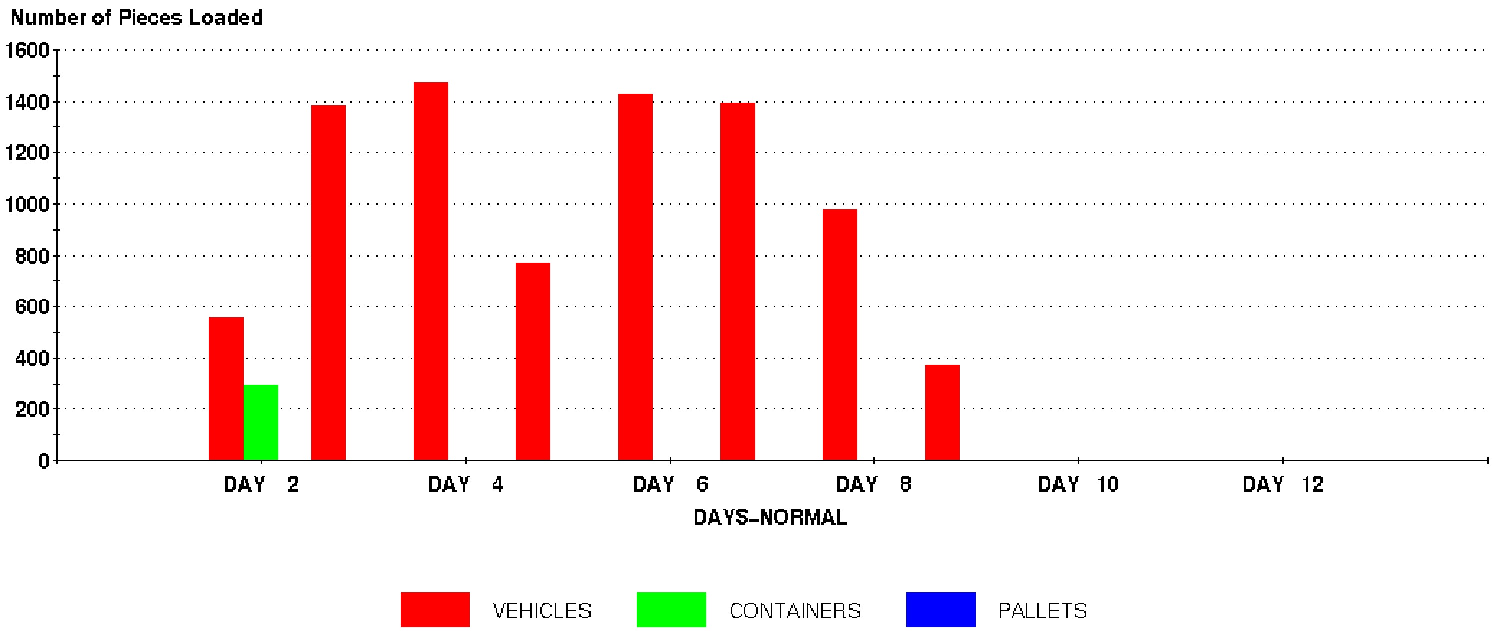
CUMULATIVE CLOSURE PROFILE FOR NOTIONAL ARMORED DIVISION



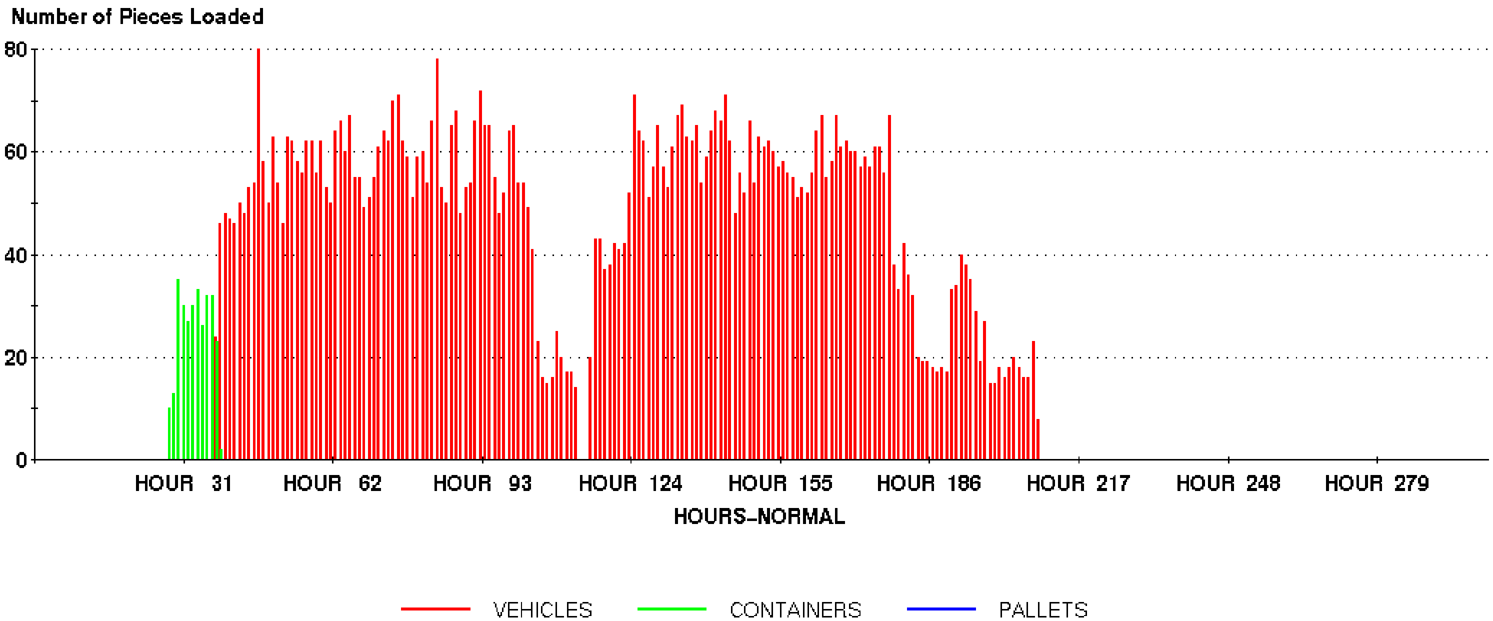
DAILY CLOSURE PROFILE FOR NOTIONAL ARMORED DIVISION



DAILY THROUGHPUT FOR
NOTIONAL ARMORED DIVISION



**DAILY THROUGHPUT FOR
NOTIONAL ARMORED DIVISION**



PORT OF CORPUS CHRISTI
TEXAS

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a site survey of the Port of Corpus Christi in September 1997. This Ports for National Defense study is based on that site survey and 1999 - 2000 validation with the Corpus Christi Port Authority. This is a strategic port that can easily throughput brigade-size units and can accommodate vessels as large as the LMSR.

The port is made up of various marginal wharves. The premier berth, Cargo Dock (CD 8) has a water depth of 45 feet, 1,158 feet of wharf (865 feet of actual wharf plus 293 feet allowable overhang via dolphins), and an open apron. CD 14/15 is adjacent to CD 8 and has a water depth of 36 feet, berth length of 1,158 feet (938 feet of actual wharf plus 220 feet allowable overhang via dolphins), and a transit shed 49 feet from the edge of the wharf. These berths are supported by more than 25 acres of paved open storage. Another wharf of significance is CD 9. It has a berth length of 750 feet (660 feet of actual wharf plus allowable overhang via dolphin) and water depth of 37 feet. CD 9 also has a RORO ramp that can handle various stern ramps (including straight-stern) on vessels and is supported by over 25 acres of open staging (7 acres paved, 18 acres stabilized surface).

The Port of Corpus Christi is capable of breakbulk, RORO, limited container, and barge operations. This port has access to major rail lines (Union Pacific (UP) and Burlington Northern/Santa Fe) and has a commercial airport 8-10 miles away. A naval air station is also located 8-12 miles away. These airports can handle the C-130, C-141, and C-17. These airfields can also handle the C-5 at reduced payloads. Available materials handling equipment include two top lift container handlers for container handling and a 250 STON Manitowac mobile crawler crane. Other mobile cranes are available through local stevedores. The port also has three 70-ton nominal rating portable end ramps for offloading wheeled or tracked vehicles from semitrailers and/or railcars.

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of about 15,950 STON (61,550 MTON) per day. RORO and container throughputs are 19,170 STON and 4,980 STON, respectively.

The U.S. Military would most likely use CDs 8, 9, and 14/15 plus nearby open staging areas and adjacent covered storage for an actual deployment. For this application, we analyzed a notional heavy armored cavalry regiment deploying from the Port of Corpus Christi on LMSR ships using CD 8. We also analyzed port capabilities using the CD 8, 9, and 14/15 facilities for deploying a notional armored division via FSS vessels.

A notional heavy armored cavalry regiment has about 31,350 STON (130,680 MTON) of vehicles and equipment. A notional armored division has about 101,350 STON (287,175 MTON). To meet a port closure requirement of 6 days, a deploying notional heavy armored cavalry regiment requires about 5,210 STON of vehicles and equipment (that includes 24 containers) per day to be loaded. To meet a port closure requirement of 6 days, a deploying notional armored cavalry division requires about 16,900 STON of vehicles and equipment (plus 90 containers) per day to be loaded. When two LMSRs are available for loading in sequence, the port meets the shipping requirements for a notional heavy armored cavalry regiment if all facilities and resources are available. Computer simulations also show that the port is capable of achieving closure for throughputting a notional armored cavalry regiment in about 6 days using LMSR vessels.

The Port of Corpus Christi cannot meet shipping requirements for deploying a notional armored division. To meet a 6-day deployment requirement, the port would need three LMSR ship berths for deployment using LMSR ships. We also analyzed deployment using FSS and other RORO vessels at CD 8, 14/15, and 9. Even with six FSS and three other RORO vessels available for loading, the port does not meet the shipping requirements for a notional armored division. Computer simulations show closure, for a notional armored division, takes over 9 days using FSS and other RORO vessels at CD 8, 14/15, and 9. We consider the 9-day estimate to be on the optimistic side. Smaller ships will require additional time or berths for load-out.

For deployment operations, about 25 acres of staging are desired per LMSR to support daily, sustained loading operations for a division or brigade. The desired staging for an FSS is about 16 acres per ship to support daily, sustained loading operations. CD 8 and 14/15 have more than 25 acres of paved open staging plus an additional 15 acres of stabilized, compacted surface open staging. CD 9 is supported by more than 25 acres of open storage (7 acres paved, 15 acres stabilized surface, plus additional stabilized and unimproved open storage). Another 116.25 acres of stabilized/unimproved open staging exists throughout the port.

The notional heavy armored cavalry regiment will require 54 railcars per day using the rail/convoy option. A notional armored division will require about 170 railcars per day using the rail/convoy option. The port states that they can handle 3 trains per day with a maximum of 200 railcars. Although this shows the port can handle rail requirements, the port cannot deploy a notional armored division in 6 days because it does not have three LMSR berths and cannot load the division aboard the ships in 6 days (9 days optimistically).

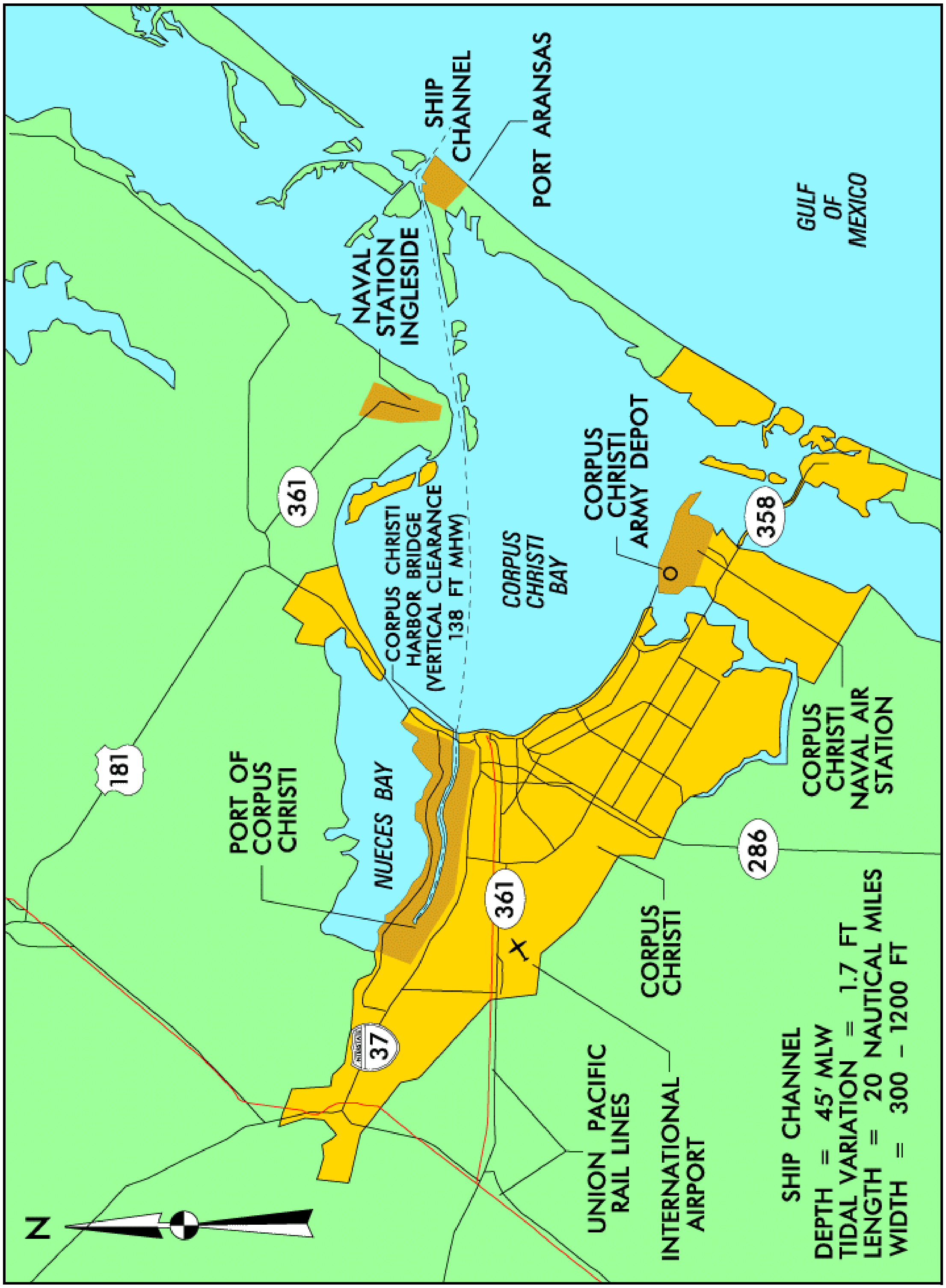
II. GENERAL DATA

The Port of Corpus Christi, Texas, is a strategic port on the U.S. Gulf Coast used for supporting the deployment of military equipment during contingencies. A Military Traffic Management Command team conducted a site survey in September 1997. This information was validated in December 1999 - January 2000. Information on port characteristics was obtained from port officials.

TRANSPORTATION ACCESS

Water

The Port of Corpus Christi (latitude 27° 28’ north, longitude 97° 23’ west, (ENCN)) is on the southeastern coast of Texas, about 150 miles southeast of San Antonio and 210 miles southwest of Houston. The Corpus Christi Ship Channel provides the water access to the port from the Gulf of Mexico. This channel, dredged to 45 feet mean low tide, goes through Corpus Christi Bay, past the Naval Station at Ingleside, and meets the Gulf of Mexico at Port Aransas. The port has only one vertical restriction pertaining to water access. The Corpus Christi Harbor Bridge on U.S. 181 is at the entrance to the inner harbor and has an air draft of 138 feet mean high water (MHW). The Tule Lake Lift Bridge (air draft of 138 feet MHW) is further inland from the main docks and should not impact water access. All vessels approaching and entering the port require pilots. The port authority reports that 12 pilots are available through the Aransas-Corpus Christi Pilots Association. Four tugboats are also available. The port is about 20 nautical miles from open water. The nearest anchorage is in the Gulf of Mexico located 3.5 miles northwest of the Aransas Pass Buoy. The Corpus Christi Turning Basin is the main turning basin and has a depth of 45 feet mean low water, a diameter of 1,000 feet, and is located out from the cargo docks. According to Navy standard operating procedures, ships do not normally turn in an area that is less than 1.5 times their length. Based on this guideline, the turning basin will be tight for FSS/LMSR vessels (about 950 feet in length). Other turning basins include Avery Point (1,100-foot turning radius, 45-foot water depth, 1.5 miles up the ship channel) and the Chemical Turning Basin (1,200-foot turning radius, 45-foot water depth, 2.5 miles up the ship channel). The port authority reports that the Avery Turning Basin has been used by FSS and LMSR ships. Tidal variation is about 1.7 feet maximum (1 foot average).



Channel Graphic

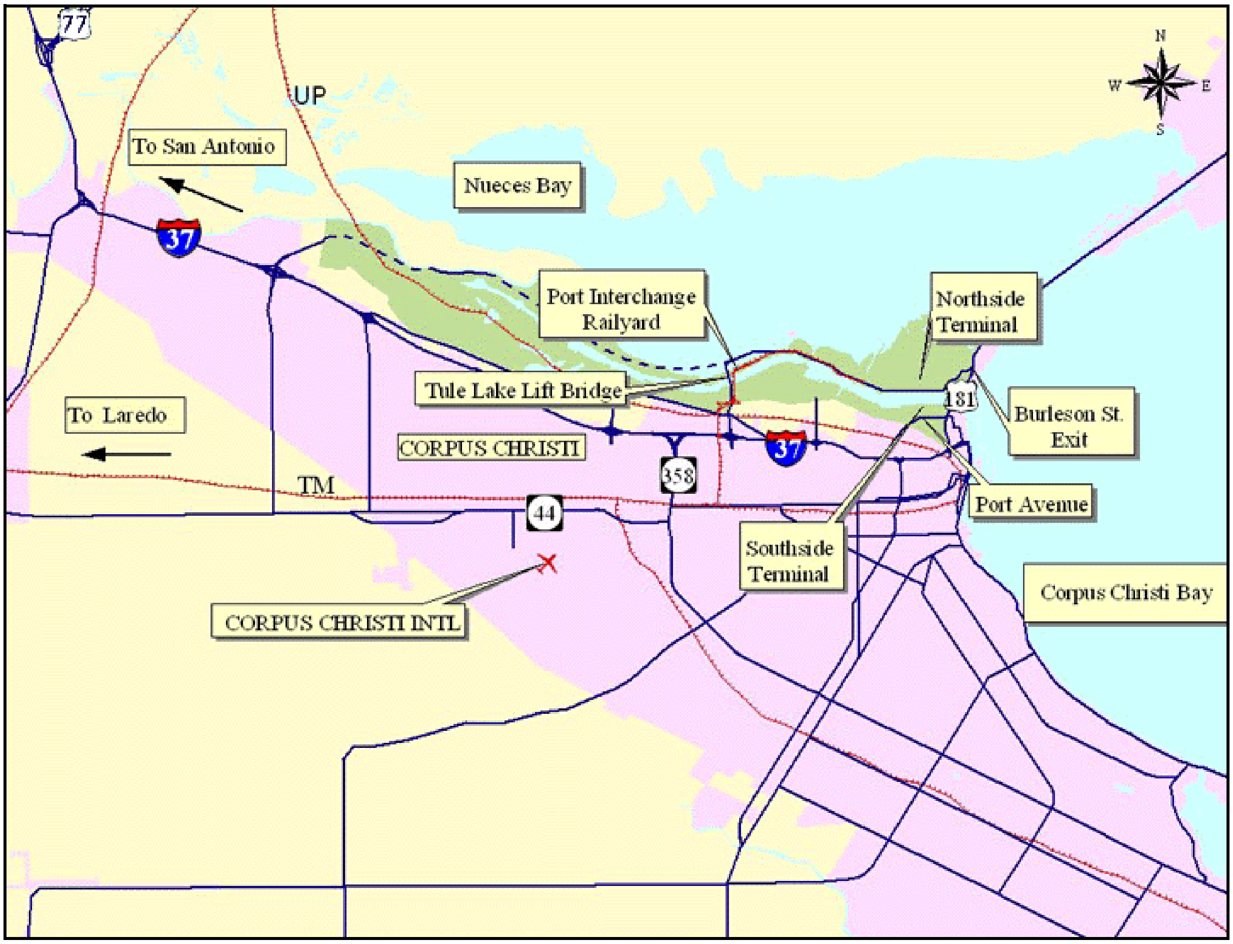
Corpus Christi Ship Channel and Harbor Entrance Bridge (U.S. 181) (LMSR USNS Sisler Accessing Harbor)

Highway

The port has good access to major highway routes. Interstate-37 (I-37) accesses Corpus Christi and connects to other major routes to the north such as I-10 (an east-west interstate) and I-35 (a north-south interstate). The port is divided into two terminals – north and south. Port Avenue, a four-lane road, connects I-37 to the port. Stroman Street and Sam Rankin Road, two-lane roads, provide access to the Southside cargo docks. U.S. Route 181 north provides access to the Northside Terminal from I-37. The Burleson Street exit off U.S. 181 accesses the U.S. 181 Frontage Road, a four-lane road, which leads to the port's Northside Terminal. Breakwater Avenue, Avenue F, and Navigation Boulevard all have two lanes and lead to the wharf areas. Navigation Boulevard, off of I-37, is an alternate route to the Northside Terminal. All gates have one lane in and one lane out. No unusual clearance restrictions exist on the roads accessing the port. Maximum legal limits for height and allowable gross weight in the state of Texas are 14 feet and 80,000 pounds, respectively. Vehicle configurations exceeding these limits will require special permits and/or route analysis by State transportation officials. A highway, rail, and air access map is provided on the following page. U.S. Routes 77 and 181 provide good non-interstate alternatives for accessing the port from Fort Hood in case of a disruption of traffic or other problems on I-37.

Rail

The Union Pacific (UP) and Texas Mexican Railway (TexMex) railroad companies own rail lines serving the city and Port of Corpus Christi. The Burlington Northern/Santa Fe Railroad (BNSF) company also has access to the port via trackage rights. UP and TexMex, combined, have three railyards in the Corpus Christi area. The two UP yards can hold about 1500 89-foot railcars and the TexMex yard can store about 900 railcars. Current usage is about 80 percent. UP also has a 50-railcar storage yard at Sinton, about 30 miles northwest of Corpus Christi. No unusual clearance restrictions exist on the rail lines accessing the port.



Highway, Rail, and Air Access Map

The Corpus Christi Terminal Railroad (CCTR) performs the switching operations. Railcars go to the port interchange railyard before going to the cargo docks. This railyard is port owned and located on the north side of the inner harbor. The Tule Lake Lift Bridge, a single-track railroad bridge, provides access to the port interchange yard from the major rail lines. Special arrangements can be made to route inbound trains directly to the Southside Terminal. The port interchange yard, plus additional sidings and spurs distributed throughout the port, have enough trackage to store about 900 89-foot railcars. The port authority states that the trackage immediately adjacent to the wharf areas is sufficient to offload at least 95 railcars on the south side and 30 railcars on the north side. The port authority also states the ability to store an additional 45 railcars in the terminal area.

Rail lines extend from the interchange yard to the wharf areas. Apron tracks exist on CD 8, 9, 12, and 14/15. The port has three portable 70-STON nominal rating steel end ramps for rail offloading. UP has a fixed ramp serving double tracks less than ½ mile from the port at the UP Office.

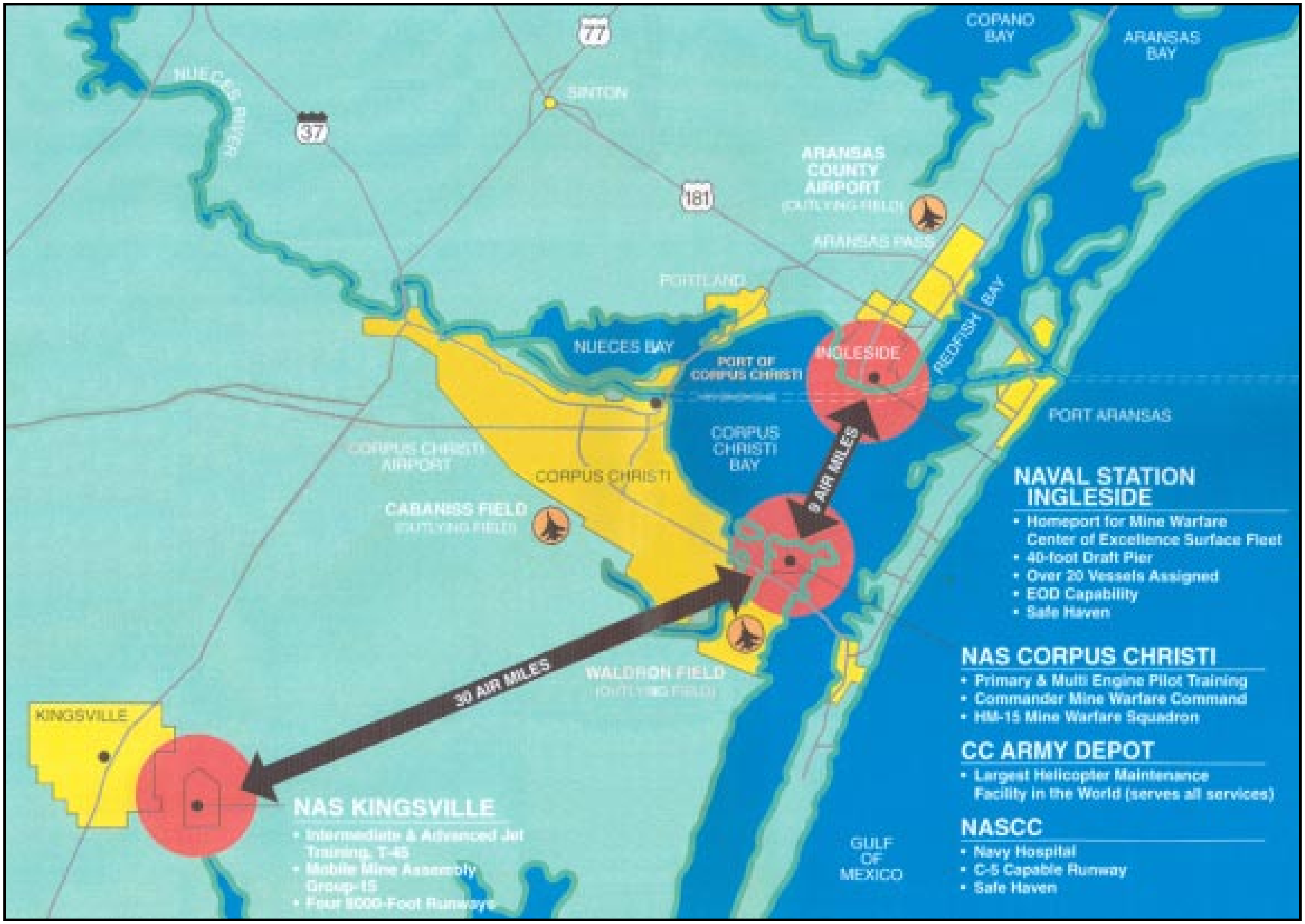
UP Viola Railyard

The port has recently purchased spanners that can be used for direct ship to rail discharge. These spanners were recently used by the British during an exercise.

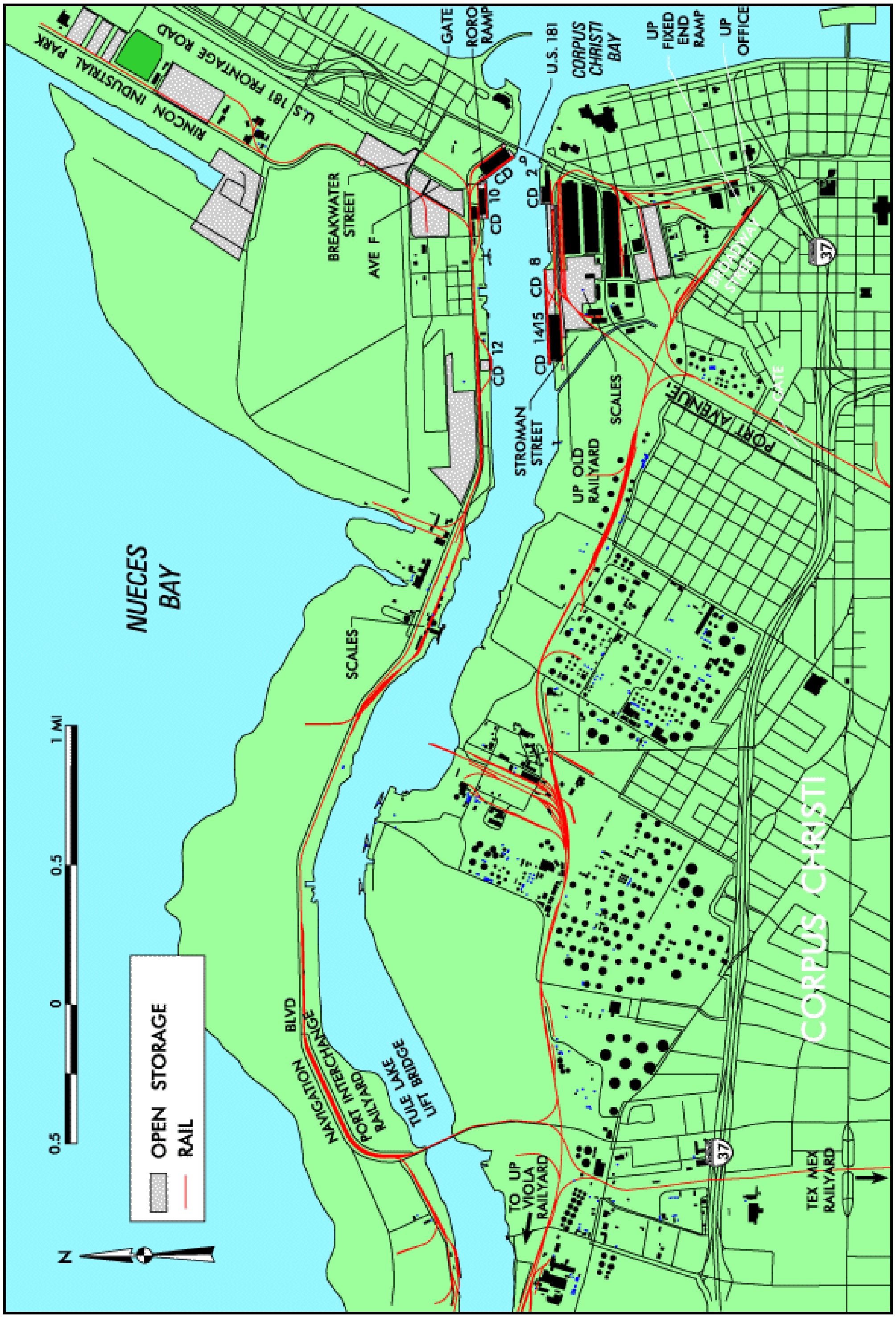
British Using Spanners for Direct Ship-to-Rail Discharge

Air

Corpus Christi International Airport has two runways and is about 8-10 miles southwest of the port. The longest runway is about 7,500 feet long and 150 feet wide. Corpus Christi Naval Air Station, the nearest military airfield, is about 8-12 miles southeast of the port and has one runway 8,000 feet long and 200 feet wide. These airfields can handle C-130, C-141, C-17, and C-5 (reduced payload) aircraft. Helicopter operations can be accomplished at a number of locations, including the paved staging areas at CD 8 on the south side, behind CD 9 and 10 on the north side, and Corpus Christi Army Depot located at the Corpus Christi Naval Air Station. The Depot specializes in the depot level rework of CH-47, OH-58, AH-64, and UH-60 US Military helicopters. In the past, the Depot has sent mechanics to the port to perform safety-of-flight repairs in support of helicopter shipments. Other potential possibilities for landing helicopters in the Corpus Christi area include Cabiniss Field (southwest of Corpus Christi), Waldron Field (south of the Naval Air Station), and Aransas County Airport (north of Nueces Bay).



Potential Landing Fields for Helicopters


NUECES BAY
CORPUS CHRISTI BAY
CORPUS CHRISTI
RINCON INDUSTRIAL PARK
U.S. 181 FRONTAGE ROAD
U.S. 181
GATE
RORO RAMP
UP FIXED END RAMP
UP OFFICE
BREAKWATER STREET
AVE F
CD 10
CD 2
CD 8
CD 14/15
CD 12
STROMAN STREET
UP OLD RAILYARD
SCALES
PORT AVENUE
BROADWAY STREET
GATE
NAVIGATION BLVD
PORT INTERCHANGE RAILYARD
TULE LAKE LIFT BRIDGE
TO UP VIOLA RAILYARD
TEX MEX RAILYARD
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OPEN STORAGE
RAIL

Land-Use Map

PORT FACILITIES

Berthing

The Port of Corpus Christi is a multicargo port with a specialization in handling petroleum products. Ship berths consist of wharves capable of breakbulk, roll-on/roll-off (RORO), limited container, and barge operations. The port does not have specialized container cranes. A 250 STON mobile crawler crane provides the container capability. The North and Southside Terminals are located on either side of the inner harbor. CD 9 (including RORO ramp), 10, and 12 are on the Northside Terminal and CD 2, 8, and 14/15 are on the Southside Terminal.

CD 8, 9, 10, and 14/15 are the wharves with the most potential for military operations. CD 8 is an open wharf with deck strength of 1,500 pounds per square foot (psf) and is ideal for FSS or LMSR RORO operations. CD 14/15 is adjacent to CD 8 and has a transit shed 49 feet from the wharf edge. The wharf has multicargo capabilities, but is primarily suited for breakbulk operations. CD 9 has a special RORO ramp, which is used for offloading vessels equipped with a straight-stern ramp. Both CD 9 and 10 have transit sheds. CD 8, 9, 10, and14/15 have immediate access to ample paved open staging.

CD 8 is the best berth for military operations because it can handle FSS/LMSR vessels. CD 14/15 can handle FSS/LMSR vessels, however, if LMSR vessels are on both CD 8 and CD 14/15, only one of the two vessel stern ramps can be used. CD 8, 9, 12, and 14/15 have apron tracks. Berth characteristics for all berths are in the table below.

BERTH CHARACTERISTICS FOR THE PORT OF CORPUS CHRISTI			
	Berths		
Characteristics	**CD 8**	**CD 9**	**CD 9 RORO**
Length feet (meters)	1,158* (353) 865' wharf + 293' overhang	750* (229) 660' wharf + 90' overhang	130 (40)
Depth alongside at MLW feet (meters)	45 (13.7)	37 (11.3)	38 (11.6)
Deck Strength psf (metric tons per square meter)	1,500 (7.33)	750 (3.66)	760 (3.71)
Apron width feet (meters)	open	58 (17.7)	40 (12.2)
Apron height above MLW feet (meters)	15 (4.57)	15 (4.57)	6.5 (1.98)
Number of container cranes	0	0	--
Number of wharf cranes	0	0	--
Apron Lighting	Yes	Yes	--
Straight-stern RORO Ramp	No	Yes	--
Apron length served by rail feet (meters)	865 (263.7)	600 (182.9)	--

BERTH CHARACTERISTICS FOR THE PORT OF CORPUS CHRISTI - cont			
	Berths		
Characteristics	CD 10	CD 12	CD 14/15
Length feet (meters)	700 (213)	700 (213)	1,158* (353) 938' wharf + 220' overhang
Depth alongside at MLW feet (meters)	32 (9.8)	24 (7.3)	36 (11.0)
Deck Strength psf (metric tons per square meter)	700 (3.42)	800 (3.91)	750 (3.66)
Apron width feet (meters)	60 (18.3)	Open	49 (14.9)
Apron height range feet (meters)	15 (4.57)	12 (3.66)	15 (4.57)
Number of container cranes	0	0	0
Number of wharf cranes	0	0	0
Apron Lighting	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No
Apron length served by rail feet (meters)	0	200 (61.0)	938 (285.9)

RORO Ramp at Cargo Dock (CD) 9

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF CORPUS CHRISTI

Vessels		Berths		
TYPE	**CLASS**	**CD 8**	**CD 9 & RORO**	**CD 10**
BREAKBULK	C3-S-38a	2	1	1
	C4-S-58a	1	1	1
	C4-S-66a	2	1	1,a
	C5-S-37e	1	1	1,
SEATRAIN	GA and PR	1	1	1
BARGE	LASH C8-S-81b	1	c	a,c,f
	LASH C9-S-81d	1	a,c,f	a,c,f
	LASH Lighter	5	3	3
	SEABEE C8-S-82a	1	a,c,f	a,c,f
	SEABEE Barge	5	3	3
RORO	COMET	2,d,i,j	1	1,d,o
	METEOR	2,d,i,j	1	1,d,o
	Cape Gnome	1,d,i,j	1,i,j	1,a,d,o
	C7-S-95A	1	1,b	a,c
	Cape Taylor	1	1,b	1
	Cape Orlando	1,i,j	1,b	1,i,j
	MV Ambassador	2,d	1,k,m	1,d
	Callaghan	1,d,i,j	1	1,d,o
	Cape Lambert	1,i,j	1,b	1,i,j
	LMSR Class	1	b,c	a,b,c
	FSS	1	b,c	a,c
	Cape E-Class	1,i,j	1,b,w	1,i,j
	Cape D-Class	1,i,j	1,b,w	1,a
	Cape H	1,i	b,w	a,c
RORO	Cape Texas	1,i,j	1,b	1,i,j
	Cape R	1,d	1	1,a,d
	Cape I-class	1,i,j	1,b,w	1,i,j
	Cape Victory	1,i,j	1,b	1,i,j
CONTAINER	C6-M-147a	1,e	1,b,e	1,e
	C7-S-69c	1,e	1,b,e	1,e
	C7-S-68c	1,e	1,b,e	1,e
	C8-S-85c	1,e	b,c,e	a,c,e
	C9-M-132b	1,e	b,c,e	a,c,e
	C9-M-F141a	1,e	a,b,c,e	a,c,e
TACS	C6-S-1qd	1	1,b	1
	C5-S-MA73c	1	1,b	1
	C6-S-MA60d	1	1,b	1
MPS	C7-S-133a	1	b,c	a,c
	Maersk	1	b,c	a,c
	AmSea	1	1,b	1

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp
w-Vessel-slewing (right) stern ramp not compatible with CD 9 (left compatible)

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF CORPUS CHRISTI - cont			
Vessels		**Berths**	
TYPE	**CLASS**	**CD 12**	**CD 14/15**
BREAKBULK	C3-S-38a	a	2
	C4-S-58a	a	1
	C4-S-66a	a	2
	C5-S-37e	a	1
SEATRAIN	GA and PR	a	1
BARGE	LASH C8-S-81b	a,c,f	1
	LASH C9-S-81d	a,c,f	1,a,f
	LASH Lighter	3	5
	SEABEE C8-S-82a	a,c,f	1,a,f
	SEABEE Barge	3	5
RORO	COMET	1,a,d,i,j	2,d,o
	METEOR	1,a,d,i,j	2,d,o
	Cape Gnome	1,a,d,i,j	1,d,o
	C7-S-95A	a,c	1,b
	Cape Taylor	1,a	1,b
	Cape Orlando	1,a	1,b
	MV Ambassador	1,d	2,d
	Callaghan	1,a,d,i,j	1,d,o
	Cape Lambert	1,a	1,b
	LMSR Class	a,c	1,b
	FSS	a,c	1,a,b,n
	Cape E-Class	1,a	1,b
	Cape D-Class	1,a	1,b
	Cape H	a,c	1,b
RORO	Cape Texas	1,a	1,b
	Cape R	1,a,d	1,d
	Cape I-class	1,a	1,b
	Cape Victory	1,a	1,b
CONTAINER	C6-M-147a	1,a,e	1,b,e
	C7-S-69c	1,a,e	1,b,e
	C7-S-68c	1,a,e	1,b,e
	C8-S-85c	a,c,e	1,b,e
	C9-M-132b	a,c,e	1,b,e
	C9-M-F141a	a,c,e	1,a,b,e
TACS	C6-S-1qd	1,a	1,b
	C5-S-MA73c	1,a	1,b
	C6-S-MA60d	1,a	1,b
MPS	C7-S-133a	a,c	1,b
	Maersk	a,c	1,b
	AmSea	1,a	1,b

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
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g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

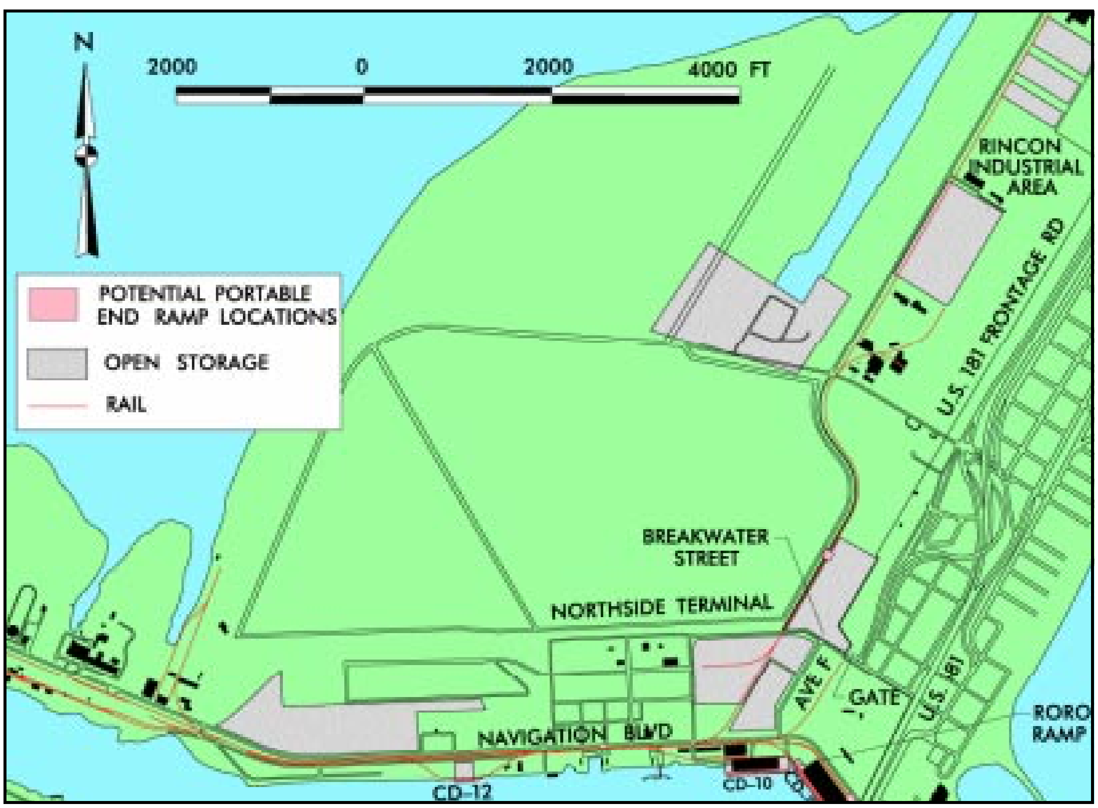
♦ **May Limit Operation**

STAGING

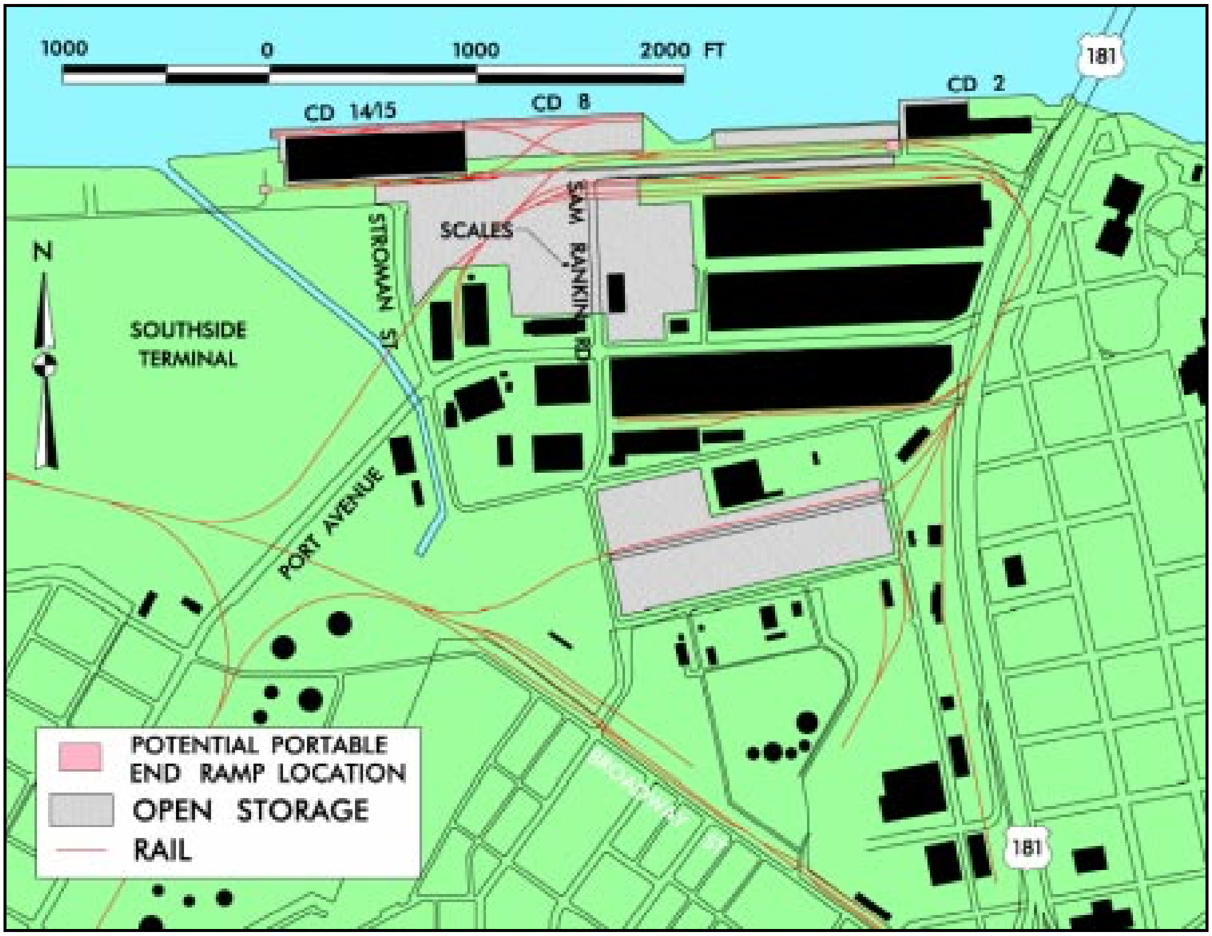
Open Staging

The Port of Corpus Christi has a total of about 162 acres of open storage. Of this total, about 32 acres is paved or aggregate open staging. The distribution of this is about 25 acres for the Southside Terminal and 7 acres for the Northside Terminal. The surfaces for the rest of the open staging vary from stabilized to unimproved. Sufficient open staging exists throughout the port to allow helicopter operations. Potential areas for helicopter operations include the paved open staging areas near the cargo docks in the Northside and Southside Terminals. Another potential area for helicopter operations is the Corpus Christi Army Depot at the Corpus Christi Naval Air Station. This facility specializes in the rework of U.S. Military helicopters.

Paved Open Storage, Northside Terminal



Open Staging Area, Northside Terminal



Open Staging, Southside Terminal

Paved Open Storage, Southside Terminal

Covered Staging

The port has ample covered storage available for general cargo, helicopter operations, and container stuffing/unstuffing operations. Transit sheds are located at CDs 9 and 14/15. The Port of Corpus Christi has a total of 350,900 square feet of available covered storage distributed among transit sheds and transfer sheds. The majority of this storage space is on CD 9 and 14/15. Deploying units can expect at least 80 percent of this storage space to be available during deployment.

Covered Staging Area for Transit Shed at CD 14/15 and Shrink-Wrapped Helicopters

UNLOADING/LOADING POSITIONS

Ramps and Docks

The Port of Corpus Christi has three Military Traffic Management Command Transportation Engineering Agency's design 70-ton nominal rating portable end ramps for use in rail offloading operations. The port also has a lightweight ramp that could be used for offloading light equipment. The port has several spurs with straight track in both the Northside and Southside Terminals that are suitable for rail offloading. Also, some added capability exists for rail offloading via end ramps. A concrete end ramp serving double tracks is available at the UP Office, less than a mile from the port. Truck ramps are available at the transfer shed, transit sheds on CD 9 and 14/15, and truck terminal. These ramps also serve as truck docks.

The Port of Corpus Christi has several truck and rail docks for offloading vans, flatbed trucks, and boxcars. Combined, the port has over 50 boxcar positions and over 100 van/flatbed handling positions.

Marshaling Areas

The port lists several areas, both within and outside the port, with potential for marshaling. The best option is to marshal in the 115 acres of unimproved open storage areas within the port. The majority of this acreage (almost 87 acres) is in the RINCON Industrial Park in the Northside Terminal. Most of the unimproved open storage is accessible by rail as well as by roadways. Another alternative for marshaling is the Corpus Christi Naval Air Station. This facility, to include the Corpus Christi Army Depot, is 8-12 miles southeast of the port and has many areas that have potential for marshaling. Naval Station Ingleside, the Navy's command for mine warfare, provides a third alternative for marshaling. This facility is 17 miles northeast of the port and has a pier and quay for ship berthing and provides a capability to handle ordnance. The Naval Station Ingleside has rail access. The port also lists Waldron Field/Cabiniss Field, a U.S. Navy facility as a fourth alternative for marshaling.

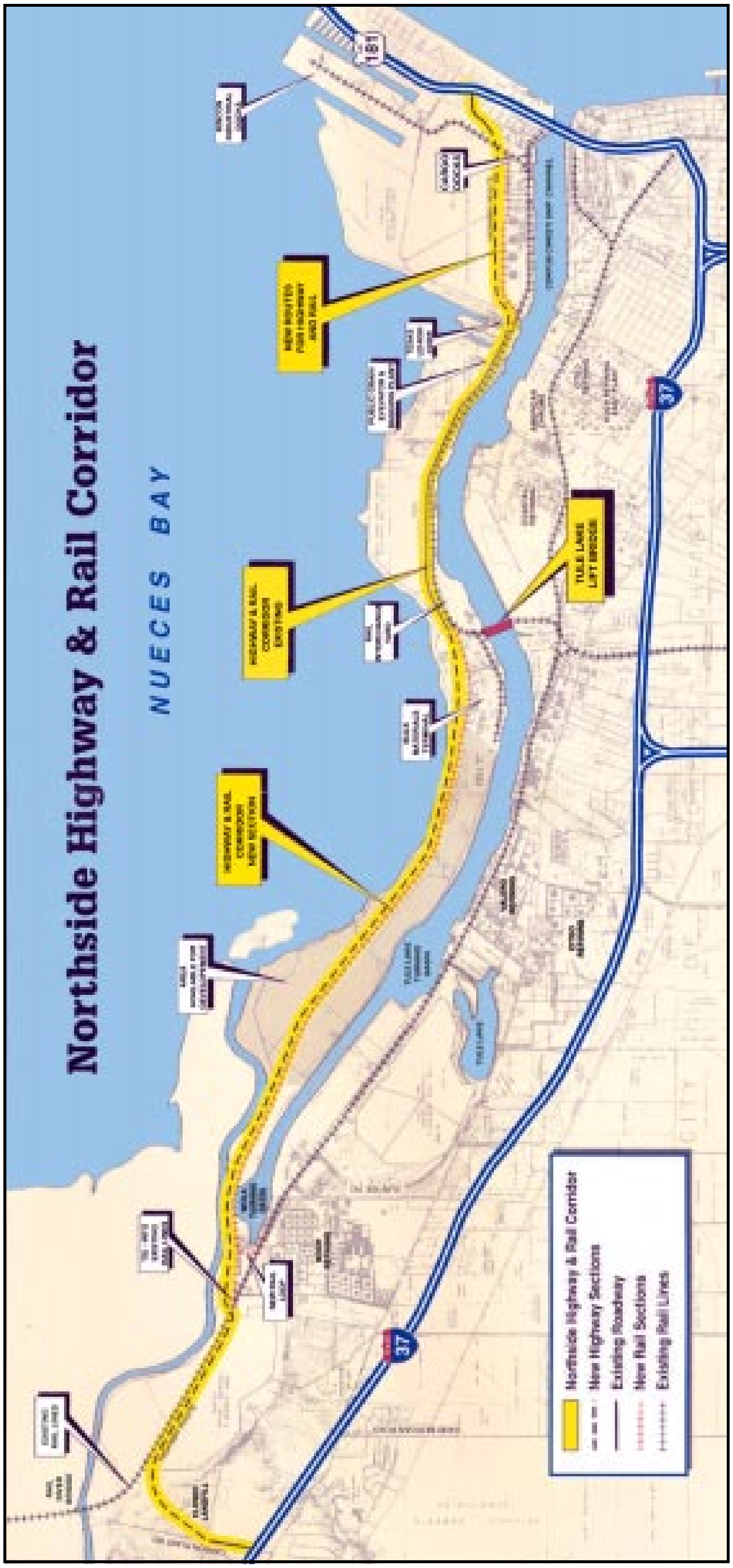
Potential Marshaling Area at Corpus Christi Naval Air Station

MATERIALS HANDLING EQUIPMENT (MHE)			
Type of Equipment	**Capacity (STON)**	**Quantity**	**Wharf Assignment**
Manitowac 250 Mobile Crawler Crane	250	1	CD 8
Taylor Container Carrier Top Lift	40	1	CD 8
Kalmar Container Carrier Top Lift	40	1	CD 8
NOTE: The table above represents equipment owned by the port. The port authority indicates that other equipment is available through local stevedores.			

FUTURE DEVELOPMENT

The Port of Corpus Christi expects to implement a highway and rail transportation improvement project for the Northside Terminal. This project features a new two-lane highway and rail line running along the Northside Terminal. The highway will intersect U.S. 181 near the Corpus Christi harbor bridge and join I-37 west of the Viola Turning Basin. The new northside road and rail project will route around the end of the ship channel and provide an additional crossing to the Tule Lake Lift Bridge. Currently, the Tule Lake Lift Bridge is the only access for highway and rail in the area west-northwest of the main cargo docks. Frequent Tule Lake Lift Bridge interruptions cause delays and disruptions in both road and rail traffic. The rail line crossing the Tule Lake Lift Bridge is single track. No timetable has been established for project completion. See the graphic on the following page showing the highway and rail transportation improvement project.

Another development within the last year is the availability of Berry Dock, a private terminal located west of the main port area between the Tule Lake Lift Bridge and the head of the ship channel. In the past, this dock served as an iron carbide processing plant facility. Due to bankruptcy of the plant, Berry Dock does not have sustained use. Current estimated facility use is 10 percent. Even if the plant resumes operations, the Berry Dock owner estimates usage will be about 22-25 percent. This dock could serve as another alternative for deployment at the Port of Corpus Christi, if needed. According to the Dock owner, Berry Dock is 1,080 feet long and has a water depth of 45 feet mean low tide (MLT). Consisting of a concrete structure, Berry Dock also has a concrete surface 14 feet above MLT with a minimum deck strength of 792 psf. Berry Dock also has a small slip used for RORO operations of vessels with a draft of no more than 35 feet. A 39 STON wharf crane traverses the dock and 20 acres of open storage supports operations at the dock. Offices for operations are also available.



Future Development

EXPLOSIVES AND HAZARDOUS CARGO OPERATIONS

The port has a limited potential for shipping explosives and/or hazardous materials. The maximum amount of explosives authorized to be handled in the port shall be limited to 120,000 pounds Net Explosive Weight (NEW) during peacetime. This limit can be handled only during night operations. The daytime NEW is 50,000 pounds, peacetime. Shipments of explosives and/or hazardous materials must adhere to various rules and procedures including closing nearby public roads, such as Port Avenue along the Southside Terminal. Each shipment of explosives into or out of the port shall receive written approval from the Texas Department of Public Safety and the local Fire Marshal.

Naval Station Ingleside has a limited potential for handling and shipping ammunition. This facility has a 1,200-foot-long pier for ship berthing. The NEW for this pier is 30,000 pounds at a 1,250-foot arc. A 35 STON hydraulic crane is available for handling ammunition. Naval Station Ingleside does not have any crane operators certified for handling explosives; therefore, deploying units must make arrangements to provide a certified crane operator. The NEW arc for roadways at Naval Station Ingleside is 750 feet.

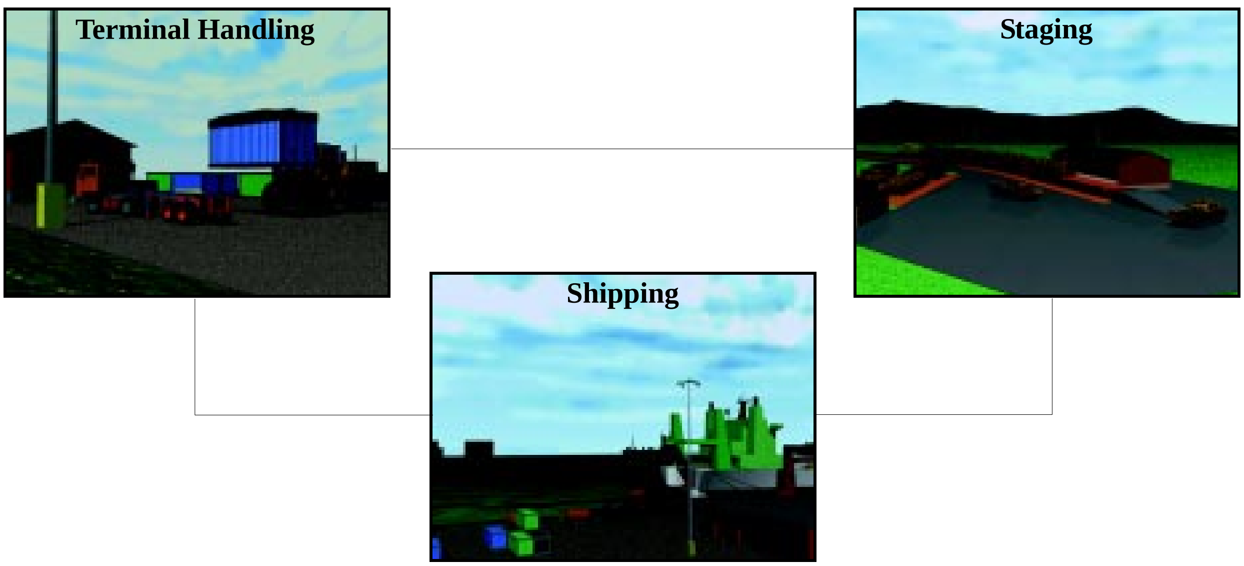
STEVEDORES

The Port of Corpus Christi lists two stevedoring firms in the Corpus Christi area. They are the Boyd-Campbell Company, Inc., and Dix-Fairway Terminals, LLC. The port also lists four stevedoring firms in the Houston area. Firms in the Houston area would also be called on to support the Ports of Houston, Galveston, Beaumont, and Port Arthur during deployment.

III. THROUGHPUT ANALYSIS

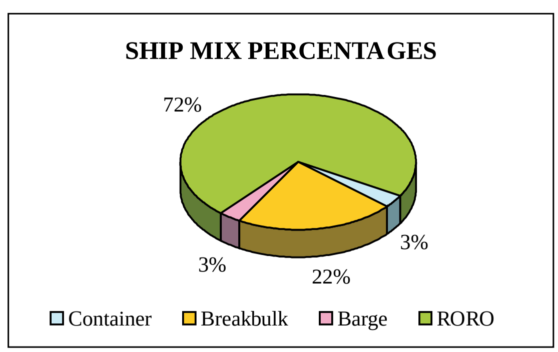
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Corpus Christi. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal reception/handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON.



Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 80 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

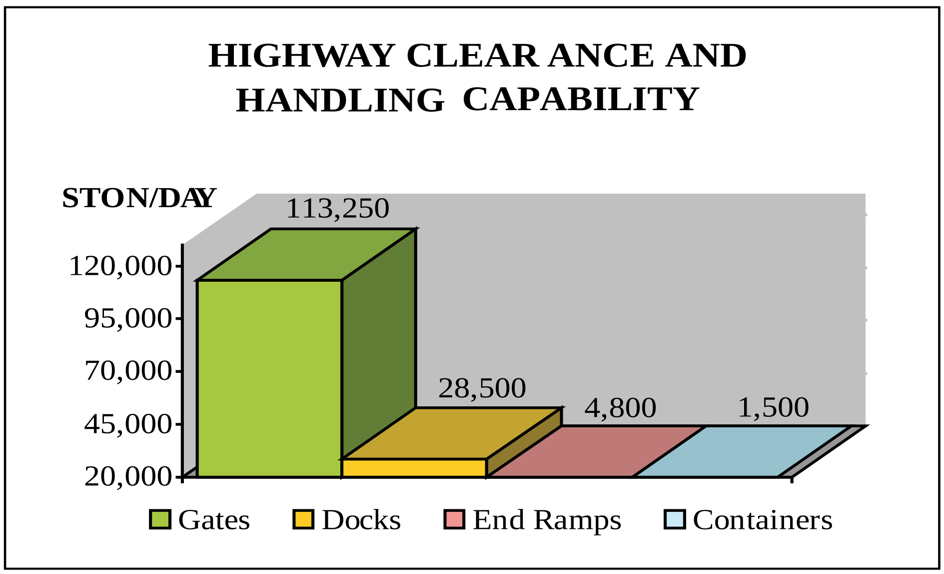
Highway

Port Avenue and the U.S. 181 Frontage Road are the major roadways connecting the port to I-37 and U.S. 181. Roads leading to the wharf areas, including the gates, are two-laned (one lane for each direction). The gate network can handle at least 113,250 STON of cargo per day. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or leave the port on each lane of the highway.

Roadable vehicles will move through the terminal gates in manageable convoys to staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for offloading vehicles, must use portable ramps. The port has truck end ramps at the transfer sheds, the transit sheds, and the truck terminal. Also available are three portable, 70 STON nominal rating, end ramps that can be used for offloading semitrailers or railcars. For this study, we assumed that one ramp is available at the transfer sheds, transit sheds, and truck terminal (three total). These three ramps can handle 4,800 STON of military vehicles and equipment per day.

The port has 140 handling positions to load/unload supplies in van semitrailers. These positions can load/unload at least 28,500 STON of shipped material per day.

The Port of Corpus Christi has two container handlers available. By using one of the container handlers, the port can handle at least 1,500 STON of containerized equipment and supplies per day.



Maximum daily handling capability for the port is a mixed total of the three types of handling (docks, end ramps, and containers), each up to its maximum, not to exceed the daily gate limit of at least 113,250 STON.

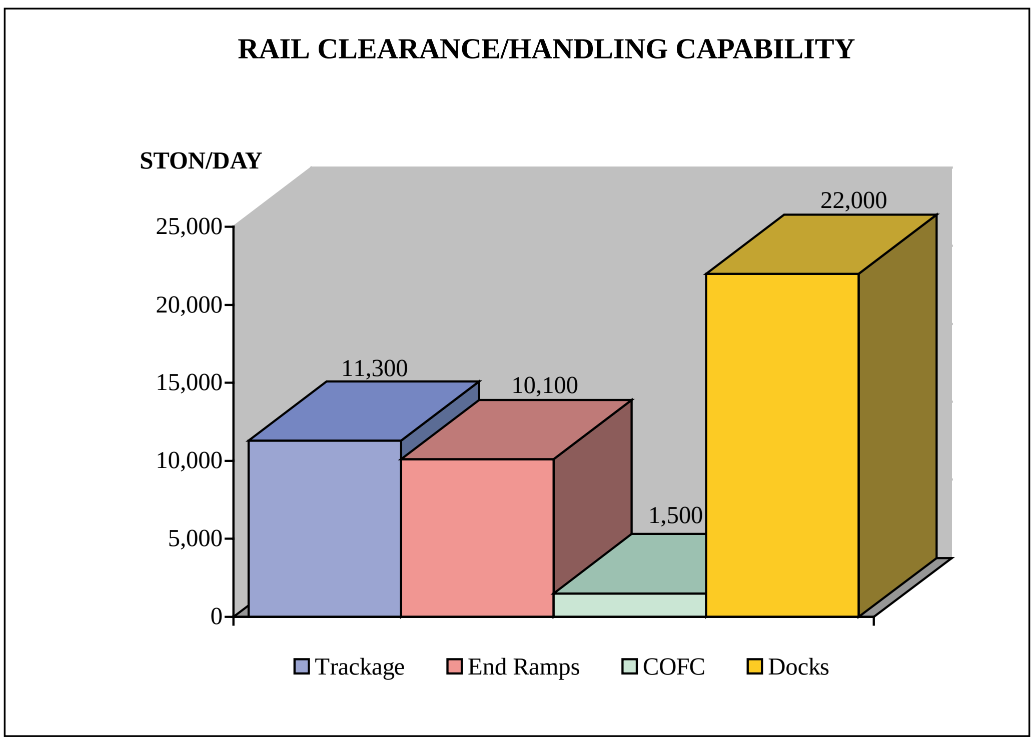
Rail

The Port of Corpus Christi has ample rail reception with two major (BNSF and UP) and one local (TexMex) railroads providing rail service. The CCTR performs the switching operations to deliver the railcars from the commercial carrier to the port. Current rail service can support a capability of three trains per day (up to 200 railcars handled per day). These trains can handle almost 11,300 STON per day.

Vehicles on flatcars will offload in the port on the three available 70-ton nominal rating portable rail end ramps. These end ramps can handle about 10,100 STON per day. The fixed end ramp at the UP Railroad office (serving double tracks) is available to provide additional capability, if needed. The port also has a lightweight portable end ramp available for light equipment, if needed.

Boxcars will load/offload at the storage buildings. The port has 70 rail handling positions available for loading/unloading boxcars. These docks can handle about 22,000 STON per day.

Based on using one of the two container handlers for offloading containers from railcars, the port can offload at least 1,500 STON of containerized equipment and supplies from railcars per day.



Staging

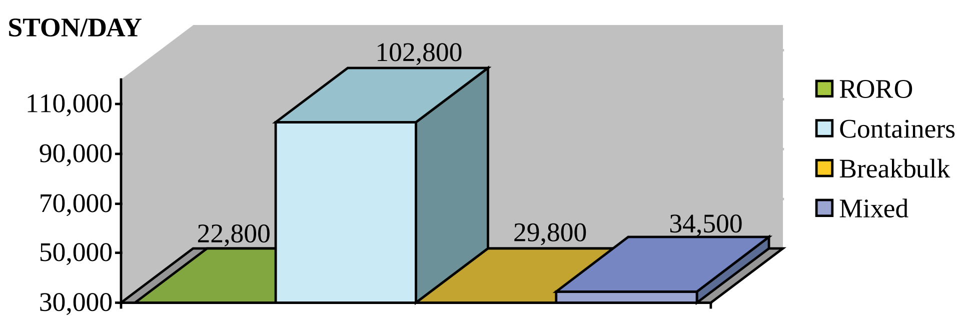
The port has 47 acres of paved open staging area. Another 115 acres of stabilized/unimproved open storage is also available. We assumed the use of Open Storage Sites 1, 2, and 3 on the Southside and 1, 2, 3, and 4 on the Northside for this study. For purposes of determining a staging capability, we assumed a facility use factor of 100 percent.

The port lists 451,480 square feet of covered storage space. About 9,000 STON of breakbulk cargo can be staged in the covered area.

The chart on this page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of capability for each type cargo operation involved should be assumed.

The chart below shows the STON of cargo, by type, the port can expect to handle. The dwell time used in these computations was 3 days and the open space utilization percentage is 60 percent. The container storage throughput capability is the highest with over 102,800 STON. The ability to stack containers three high in the paved/stabilized open storage areas contributes to the high staging throughput value. The RORO storage throughput is about 22,800 STON. The breakbulk staging throughput is about 29,800 STON.

OPEN STAGING CAPABI LITY



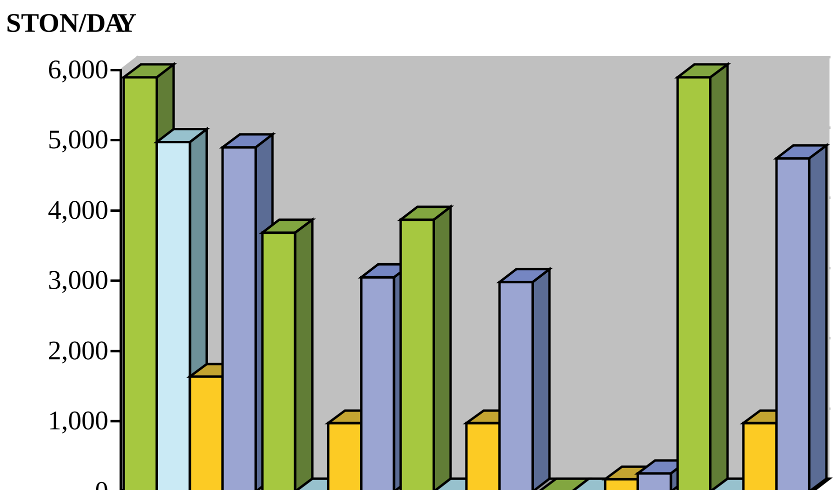
Note: Container staging area can also be used for RORO staging as needed.

Shipping

Daily shipping subsystem totals for the terminal berths are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types.

CD 8 is the best choice for performing RORO operations due to the ample berth length and apron width. This berth also uses the Manitowac 250 mobile crawler crane for heavy lifts and container loading/offloading. Almost 25 acres of paved open storage are immediately adjacent to CD 8.

BERTH THROUGHPUT CAPABILITY



	CD-8	CD-9	CD-10	CD-12	CD-14/15
RORO	5,898	3,686	3,868	0	5,898
Container	4,976	0	0	0	0
Breakbulk	1,636	973	973	176	973
Mixed	4,902	3,051	2,983	260	4,745

DAILY THROUGHPUT SUMMARY

BERTH	LENGTH (feet) (meters)	DEPTH ALONGSIDE (feet) (meters)	BREAKBULK THROUGHPUT (STON) (MTON)	RORO THROUGHPUT (STON) (MTON)	RORO SQUARE FT[1] (EST)	RORO PIECES[2]	CONTAINER THROUGHPUT (STON) (MTON) (TEU)[3]	BARGE THROUGHPUT (STON) (MTON)	MIXED THROUGHPUT (STON) (MTON)
CD 8	1,158 (353)	45 (13.72)	1,640 (4,090)	5,900 (23,590)	118,000	694	4,980 (12,440) (622)	0	4,900 (18,800)
CD 9	750 (228)	37 (11.28)	970 (2,430)	3,690 (14,750)	73,800	434	0	0	3,050 (11,860)
CD 10	700 (213)	32 (9.75)	970 (2,430)	3,690 (14,750)	73,800	434	0	590 (1,470)	2,980 (11,560)
CD 12	700 (213)	24 (7.32)	180 (440)	0	0	0	0	880 (2,210)	260 (650)
CD 14/15	1,158 (353)	36 (10.97)	970 (2,430)	5,900 (23,590)	118,000	694	0	0	4,750 (18,640)

[1]Based on the 20 square foot per STON average accomplished during Operation Desert Shield/Storm.
[2]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.
[3]Based on the 8 STON per TEU average accomplished during Operation Desert Shield/Storm.

SUMMARY

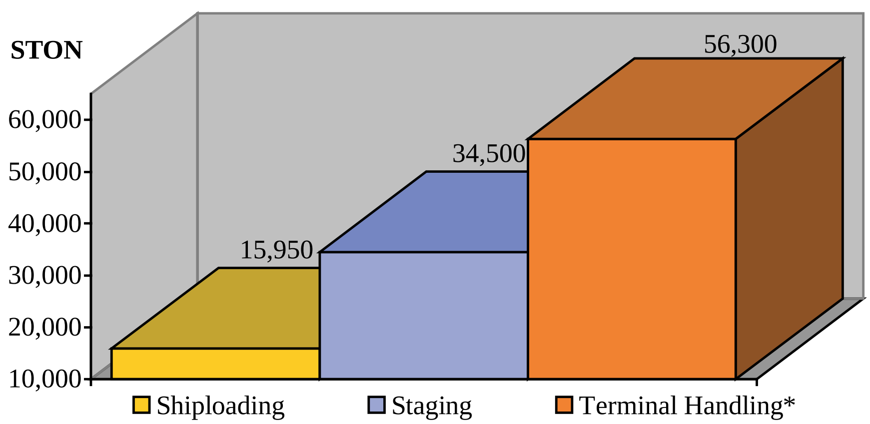
The port is multioperational with the capability to handle all types of vessels: container, RORO, breakbulk, and barges. Since the port has no specialized container cranes, the container capability is limited.

The Port of Corpus Christi is fully capable of supporting U.S. Military deployment operations. Shiploading must occur using mobile cranes and/or ship cranes. The Manitowac 250-crawler crane furnished by the port and mobile cranes furnished by local stevedores will perform the lift-on/lift-off operations. The port has two top lift container handlers to perform container handling operations.

The port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of at least 15,950 STON.

DAILY CARGO THROUGHPUT CAPACITY



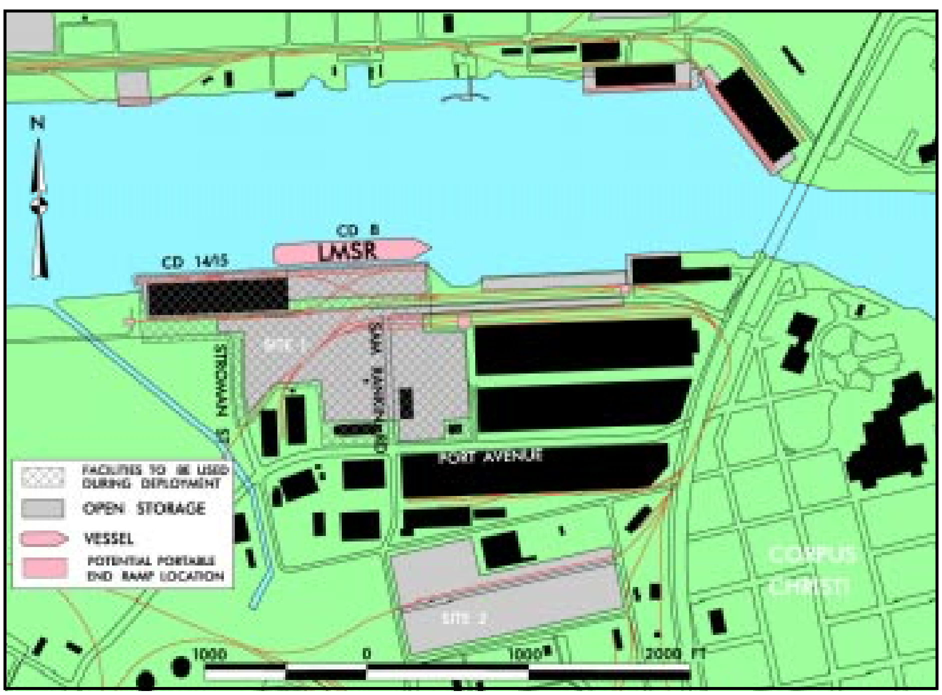
Terminal handling is the sum of the highway (45,009 STON) and rail (11,258 STON)

IV. APPLICATION

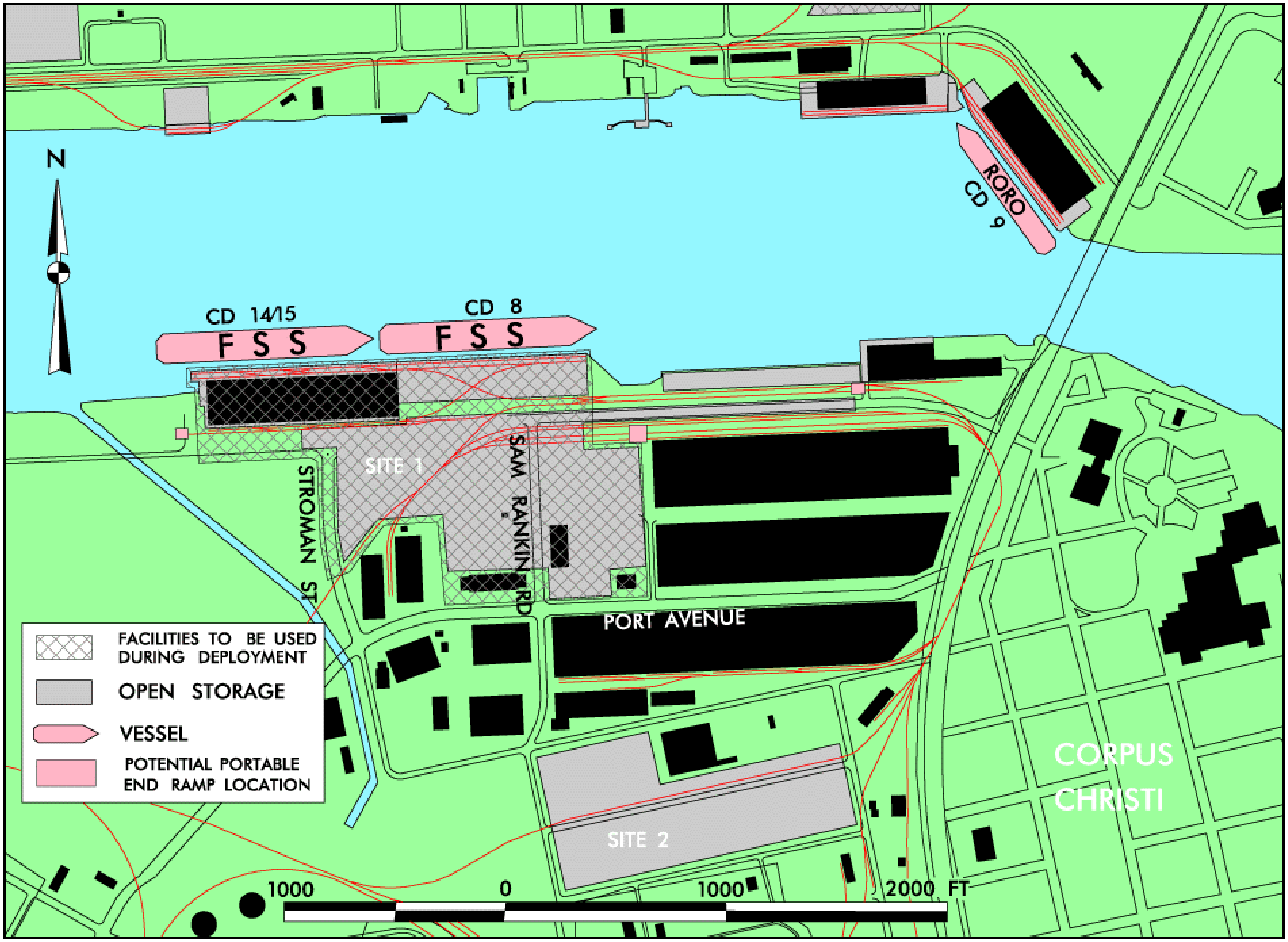
GENERAL

This section evaluates the port's throughput capability for deploying a notional armored cavalry regiment using primarily LMSR vessels and a notional armored division using primarily FSS vessels. We assume that CD 8, 9, and 14/15 and the supporting staging areas will be available for deployment. We also assume that no other military units will be competing for these facilities during the time that the deploying unit occupies the port. We further assume that the required assets, both transporters and people will be available to adequately load the ship and clear the port.

To evaluate the port's deployment capability, we used the port simulation (PORTSIM) model to flow unit equipment in the armored cavalry regiment and armored division through the port. PORTSIM is a time-stepped, discrete event, stochastic simulation of port operations during a force deployment. The PORTSIM is dynamically modeled for visual monitoring and quick identification of problems and allows the analyst to determine port closure/clearance times. For this simulation, we assume that the deploying regiment or division will use the facilities identified in the graphic below during a deployment. Also, we assumed that the Port of Corpus Christi would use the Manitowac crawler crane, the two container handlers, three portable end ramps, and local stevedore MHE during shiploading.



Potential Port Use During Deployment of Heavy Armored Cavalry Regiment



Potential Port Use During Deployment of Notional Armored Division

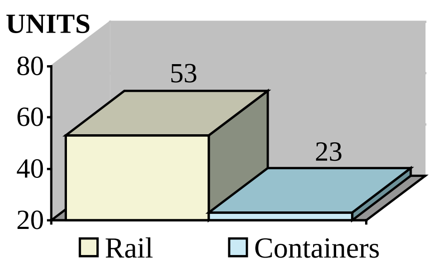
REQUIREMENTS

To simulate a likely requirement for the Port of Corpus Christi, we deployed a notional armored cavalry regiment, using 6 days for shiploading and port closure. The regiment has to move 2,138 vehicles and 140 containers. Movement of the regiment to the port will require 319 railcars (53 per day) using a convoy/rail option for transport to the port. About 23 containers would arrive daily. Additionally, using the same 6-day timeline, we simulated the deployment of a notional armored division to determine the port's capability to handle a division. The division has to move 8,125 vehicles and 520 containers. Movement of the division to the port will require 1,014 railcars using a convoy/rail option for transport to the port. About 90 containers would arrive daily.

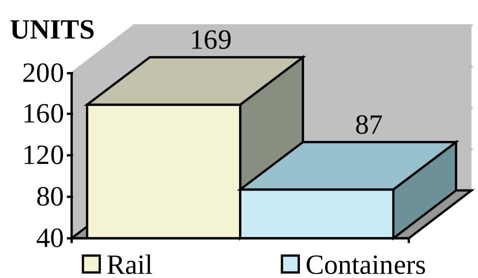
TOTAL EQUIPMENT (REGIMENT)	
Volume	84,440 MTON
Weight	31,267 STON
Area	433,658 SQ FT
Vehicles	2,138
Containers	140
Note: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997	

TOTAL EQUIPMENT (DIVISION)	
Volume	287,175 MTON
Weight	101,350 STON
Area	1,484,650 SQ FT
Vehicles	8,125
Containers	520
Note: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997	

DAILY REQUIREMENTS FOR HEAVY ARMORED CAVALRY REGIMENT



DAILY REQUIREMENTS FOR NOTIONAL ARMORED DIVISION



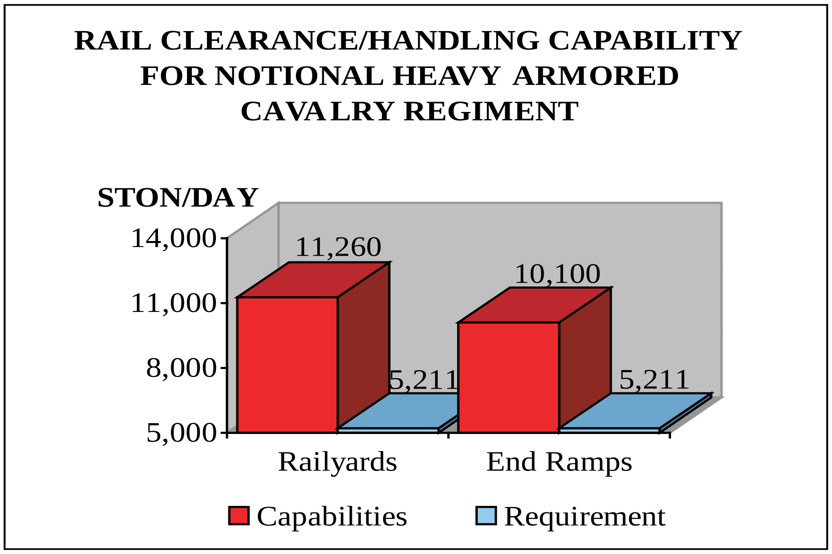
Manitowac 250 Crawler Crane at Cargo Dock 8

40 STON Container Handler

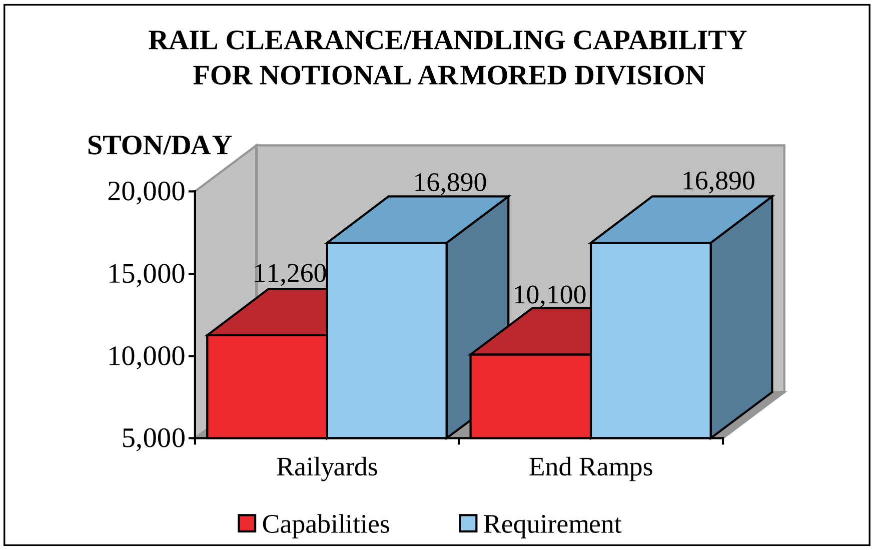
TERMINAL INPROCESSING/HANDLING

Rail

The BNSF, UP, and TexMex railroads serve the Port of Corpus Christi. The CCTR performs the switching operations for the port. The port rail spurs and Corpus Christi area railyards (storage capability of at least 1,800 89-foot railcars) can handle up to 200 incoming rail cars per day.



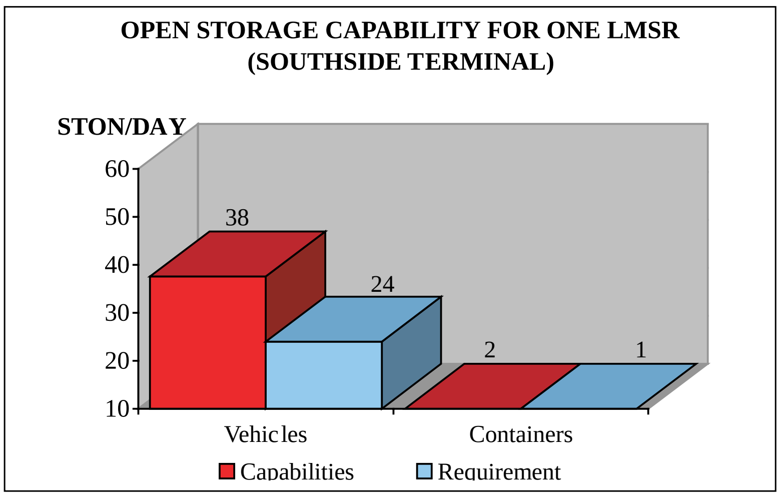
For offloading wheeled and tracked vehicles from railcars, three portable rail end ramps will be used. The port has numerous locations to perform rail offloading using those end ramps. For this analysis, we assumed rail offloading operations will occur in the Southside Terminal for deployment of the regiment and both Northside and Southside for deployment of a division. Because two of the three ship berths for this application study are in the Southside Terminal (deployment of division), two of the three portable end ramp offloading operations will also occur in the Southside Terminal. All three ramps are used in the Southside Terminal for deployment of the regiment.

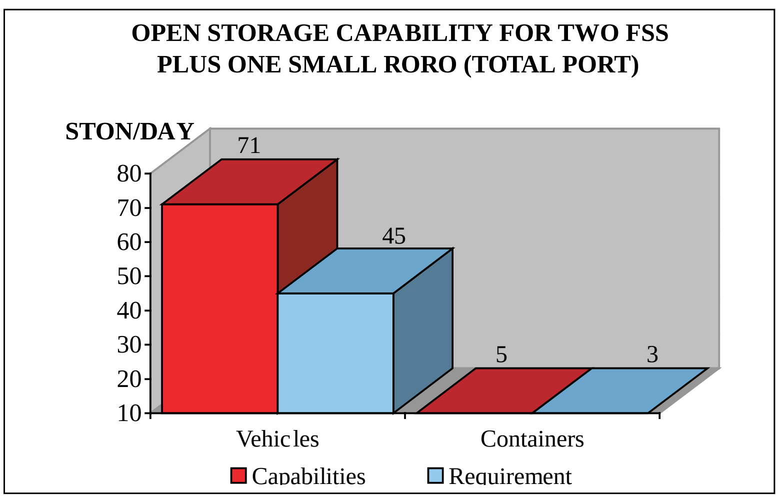


Requirements use total STON of equipment divided by six providing a rail daily requirement. Capabilities for the railyards and end ramps reflect trackage and end ramp daily throughputs respectively. Even if the additional capability of the UP fixed end ramp is added to that of the three portable end ramps, the capability will not meet the division requirements.

Open Storage

The port has about 40 acres of open storage area in the Southside Terminal near CD 8 and 14/15. The Northside Terminal has about 36 acres in storage sites 1 through 5. The staging area needed for each LMSR is 25 acres. Open storage requirements are dependent on cargo arrival to the port, smooth loading operations on the cargo vessel, and ship arrival. As the first ship fills up and the staging area empties, there is room to stage equipment for the next LMSR that will be loaded. This means that the staging area in the Southside Terminal near CD 8 and 14/15 is adequate to support one LMSR vessel, but not two. A deployment scenario for the Port of Corpus Christi will likely call for the use of CD 8, which is capable of berthing one LMSR vessel. Therefore, 25 acres are needed to support a sustained one-LMSR loading operation. A sustained two-FSS vessel loading operation (CD 8 and 14/15) requires 32 acres. The acreage in the Northside Terminal is more than enough to handle staging requirements for CD 9.





Shipping

Using the LMSRs to transport the regiment, CD 8 will allow the ships to meet the 6-day loading requirement if all facilities and resources are available. Based on each LMSR being able to load in about 3 to 4 days, the two LMSRs can be loaded in 6 to 8 days if all facilities and resources are available. Berth space is adequate at CD 8 to allow the side and stern ramps on the LMSR to be used to load the ships. To transport the division, deployment will occur through CD 8, 9, and 14/15. Due to the 49-foot apron width at CD 14/15, alternative loading procedures, such as parallel ramp operations, will be required for FSS ship loading. CD 9 does not have adequate berth length for berthing an LMSR or FSS. If smaller ships are used for deployment, then additional time or berths will be required to move the regiment.

Deploying by LMSR requires one ship every 3 to 4 days; each ramp will have to average about 130 STON per hour for 20 hours to deploy the regiment in 6 days. This equates to 15 vehicles per hour per ramp. Deploying by FSS requires one ship every 2 days to meet the same requirement; this equates to 30 vehicles per hour per ramp. Deploying a division by LMSR requires three ships every 3 days; each ramp will have to average about 140 STON per hour for 20 hours to deploy the division in 6 days. This equates to 17 vehicles per hour per ramp. Since the Port of Corpus Christi does not have three LMSR capable berths, it cannot meet the 6-day loading requirement for a division. Deploying by FSS and other ROROs requires three ships every 2 days to meet the 6-day loading requirement; this equates to 33 vehicles per hour per ramp. Using the FSS and other RORO ships does not help the Port of Corpus Christi meet the 6-day deployment requirement (optimistically, at least 9 days).

SHIP REQUIREMENTS NOTIONAL ARMORED CAVALRY REGIMENT

Loading Condition/ Sample Ship Mix	FSS (RORO/ Comb)	LMSR (RORO/ Comb)	C3/C4 (Breakbulk or Containers)	C6/C7/C8 (Container)
Minimum Containerization				
All FSS	2.8			
All LMSR		1.7		
All Breakbulk			8.7	
Maximum Containerization				
FSS/Container	1.1			1.2
LMSR/Container		.7		1.2
Breakbulk/Container			3.5	1.2

Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

SHIP REQUIREMENTS NOTIONAL ARMORED DIVISION				
Loading Condition/ Sample Ship Mix	**FSS (RORO/ Comb)**	**LMSR (RORO/ Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	9.6			
All LMSR		5.9		
All Breakbulk			29.8	
Maximum Containerization				
FSS/Container	2.9			4.9
LMSR/Container		1.8		4.9
Breakbulk/Container			9.0	4.9

Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

SIMULATION RESULTS

Total deployment time for the regiment was about 6 days with the last 5 of those days used for shiploading and the first day used for initial reception and staging. LMSR vessels were used to deploy the regiment. Actual throughput and closure results are shown in the following charts. Total deployment time for a division was over 9 days with the last 8 of those days used for shiploading and the first day used for initial reception and staging. FSS vessels were used for deploying the division. Throughput and closure results are in the following charts.

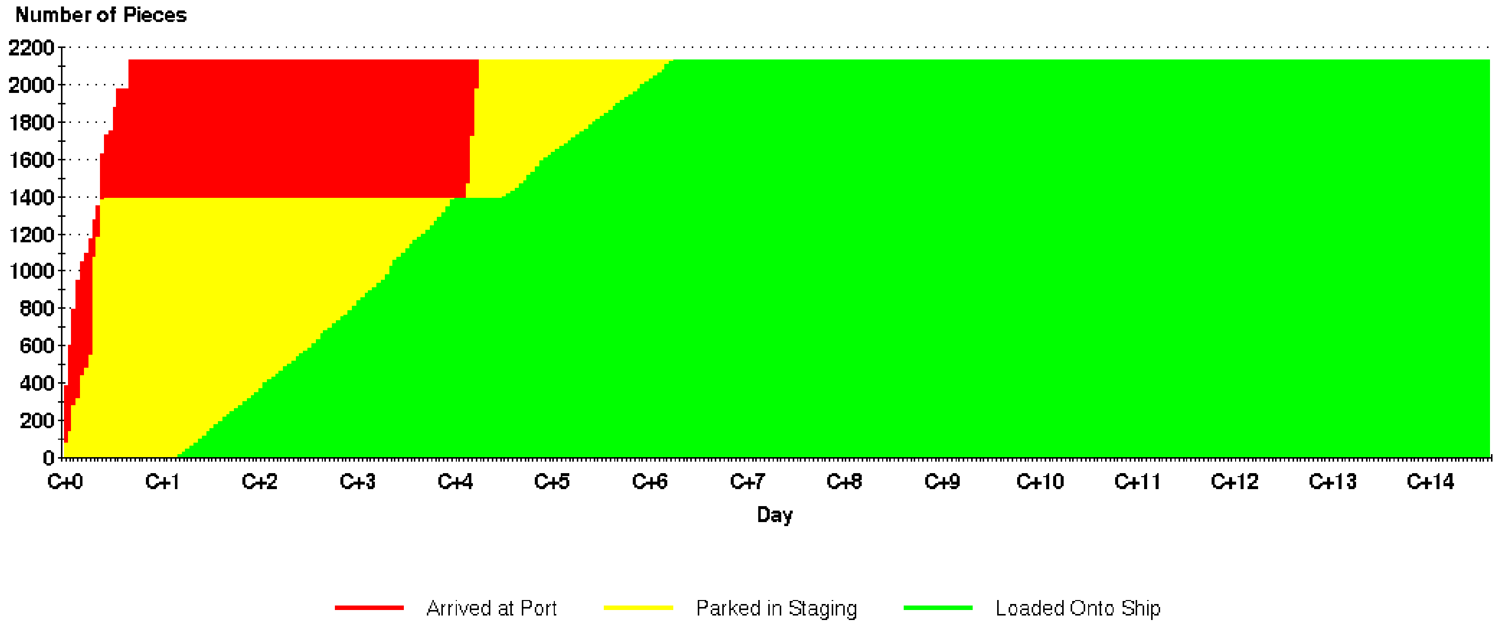
SUMMARY

The Port of Corpus Christi can load and clear a notional armored cavalry regiment in about 6 days using CD 8, the supporting staging area, and LMSR ships. If other ships are used, additional berths may be required to meet the 6-day requirement.

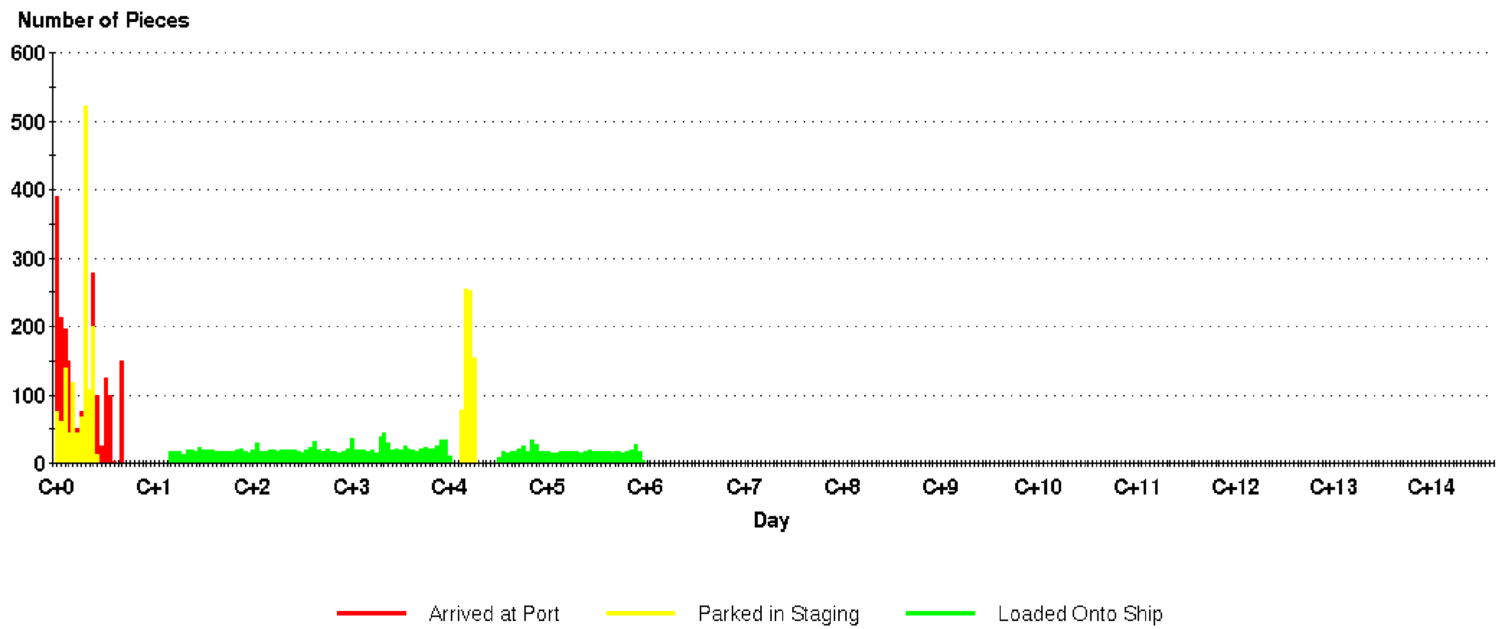
The Port of Corpus Christi cannot load and clear a notional armored division within 6 days using CD 8, 14/15, and 9, the supporting staging areas, and FSS and other RORO ships.

To load out a division using LMSR vessels, the port needs to widen a portion of the apron width at CD 14/15 to accommodate the LMSR ship ramp. Also, the port will have to come up with an additional 11 acres of open storage on the Southside to support the 50-acre requirement for two LMSR ships. The acreage on the Southside is adequate to support two FSS ships (39.43 acres capability versus 32-acre requirement for an FSS). Open storage requirements are dependent on cargo arrival to the port, smooth loading operations on the cargo vessel, and ship arrival. If the FSS is used, the port has only two FSS capable berths (CD 8 and 14/15). The port must also use CD 9 for deploying a division. CD 9 does not have sufficient length to accommodate FSS/LMSR vessels. Simulation results show that the port will need at least 9 days to load out a division using FSS ships at CD 8 and 14/15 and other RORO ships at CD 9.

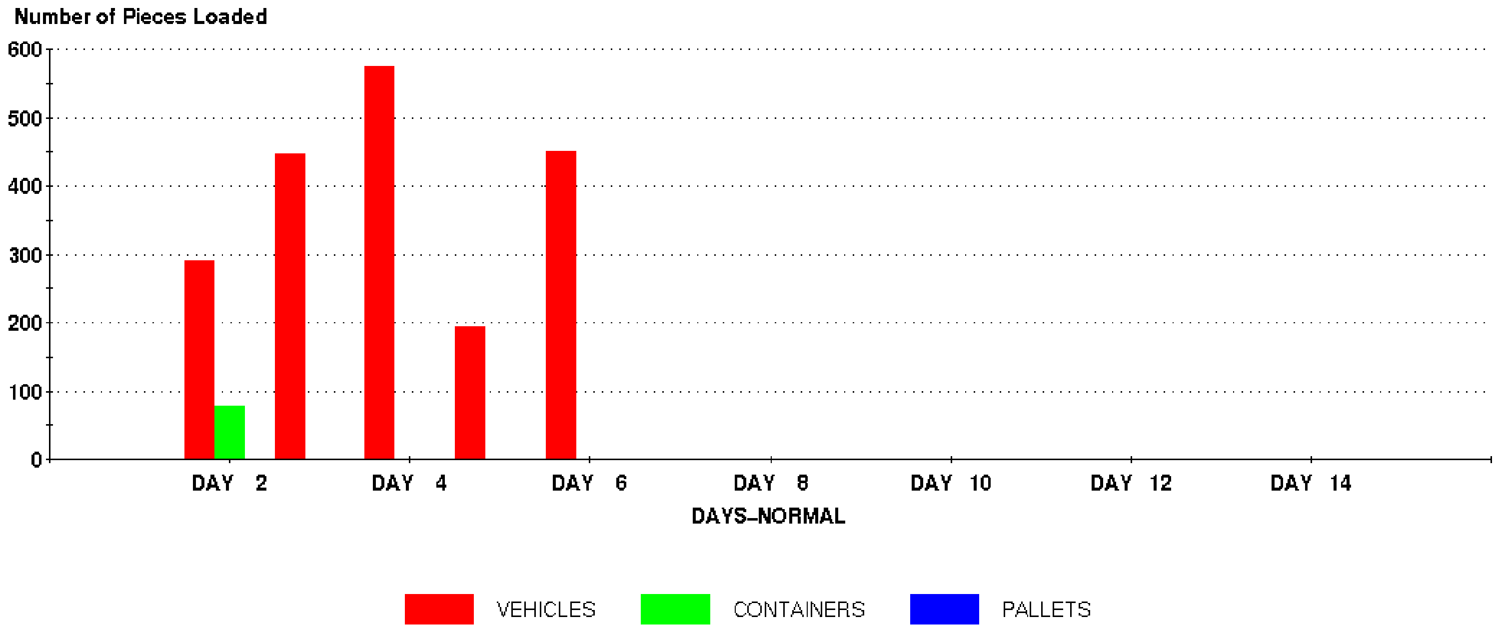
CUMULATIVE CLOSURE PROFILE FOR A NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



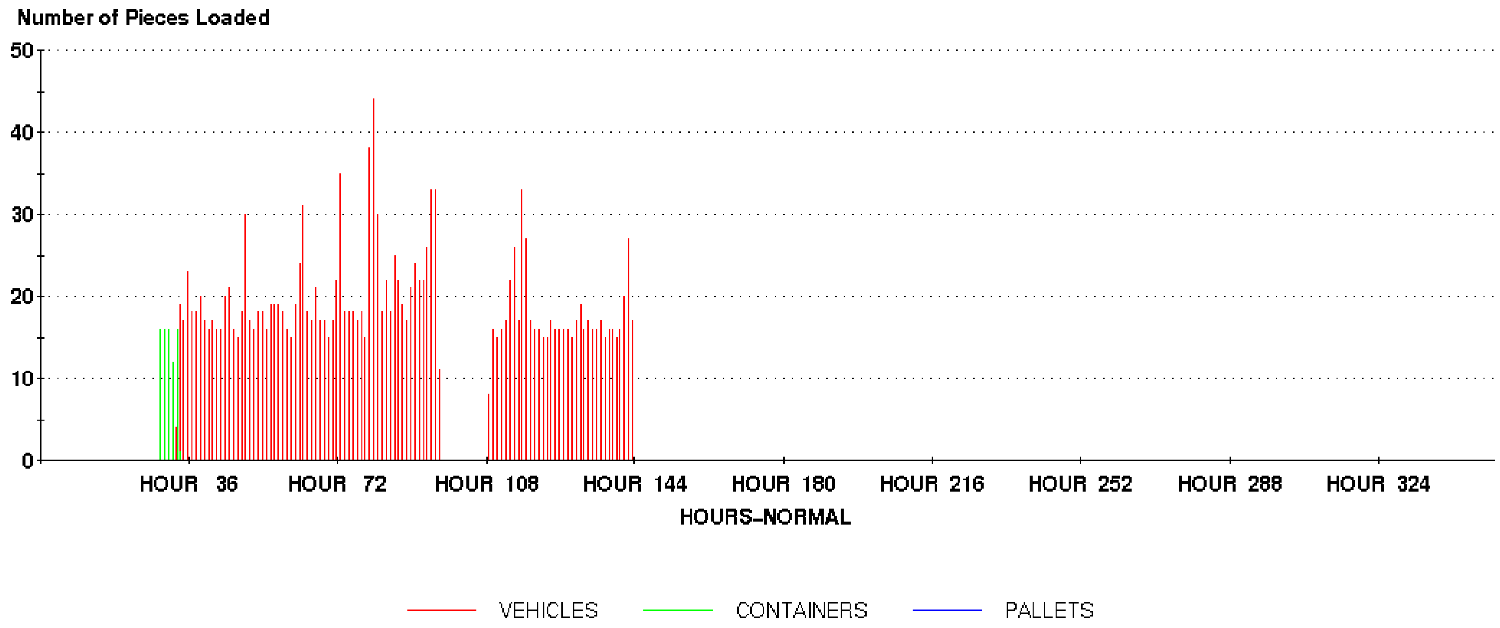
DAILY CLOSURE PROFILE FOR A
NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



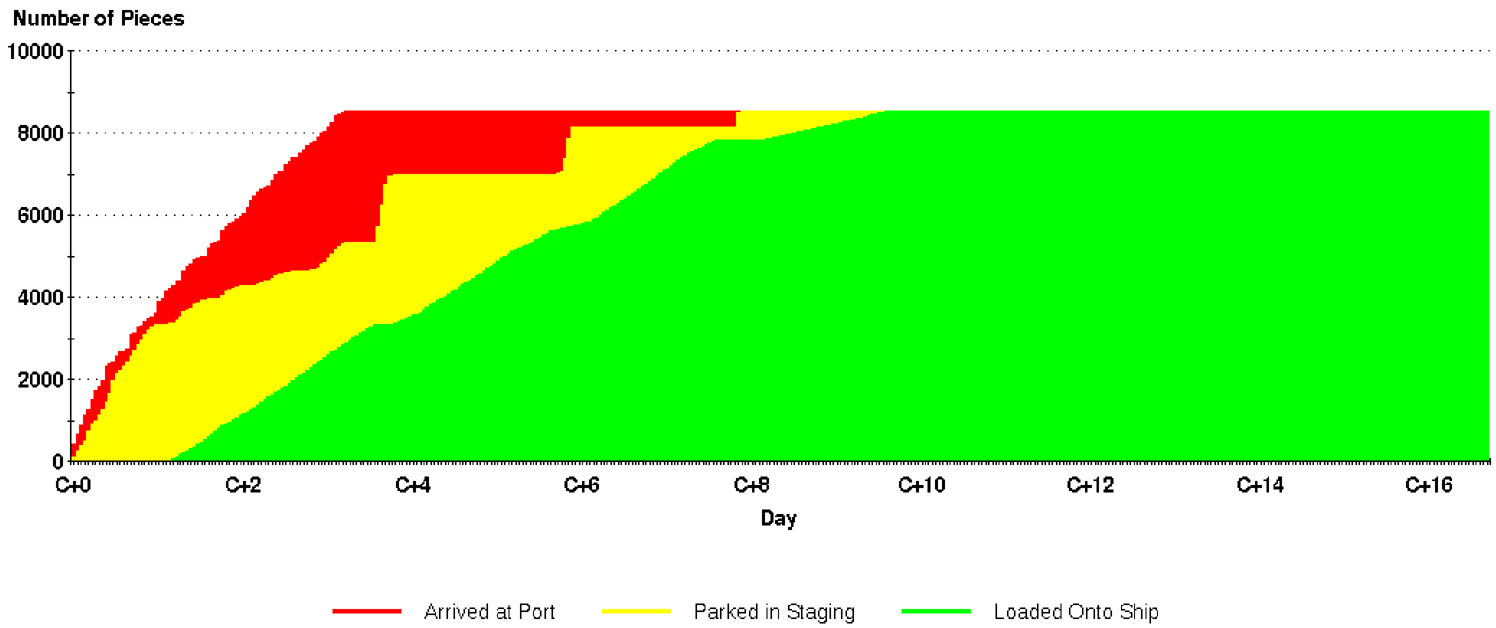
DAILY THROUGHPUT FOR A NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



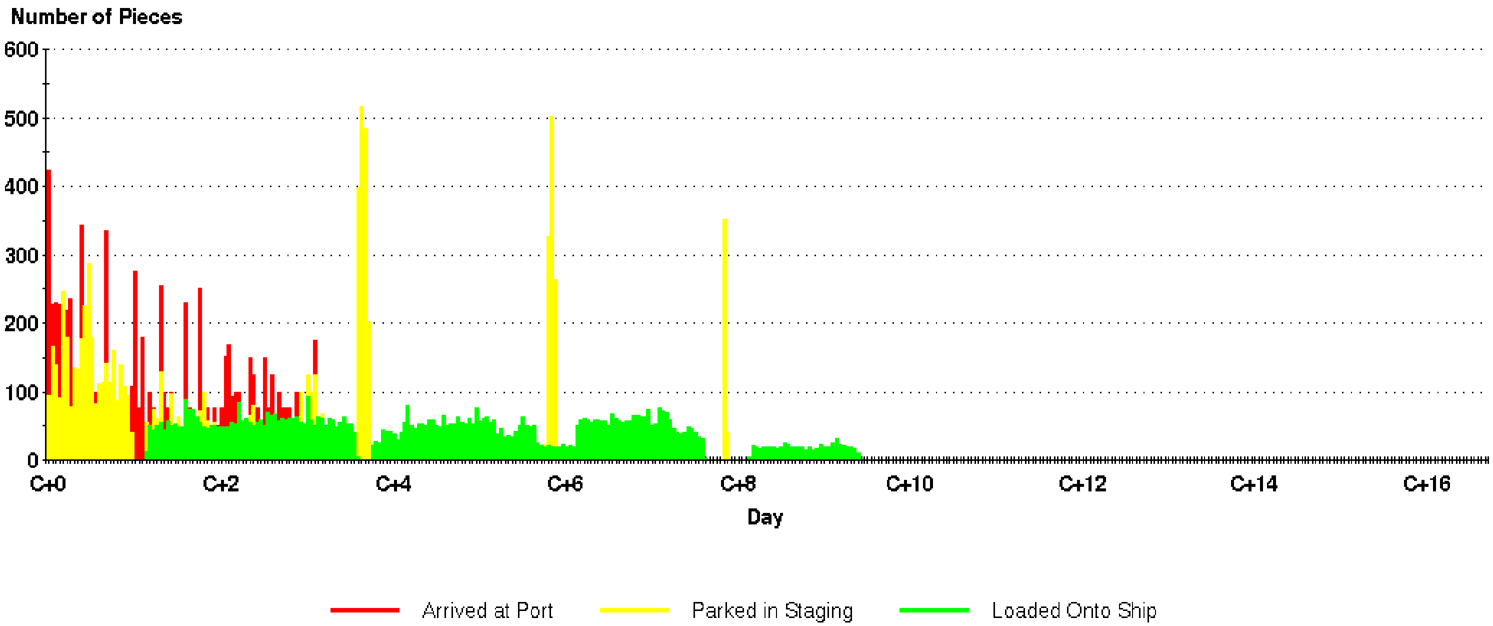
HOURLY THROUGHPUT FOR A NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



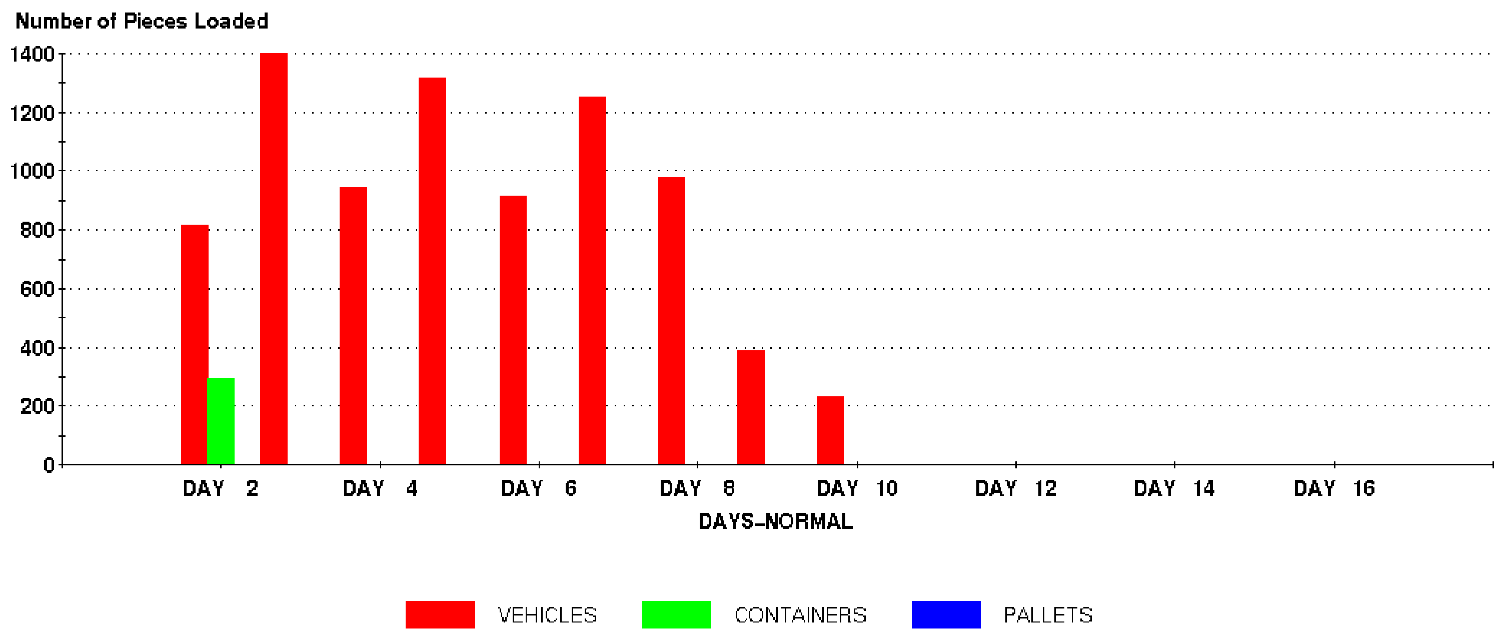
CUMULATIVE CLOSURE PROFILE FOR NOTIONAL ARMORED DIVISION



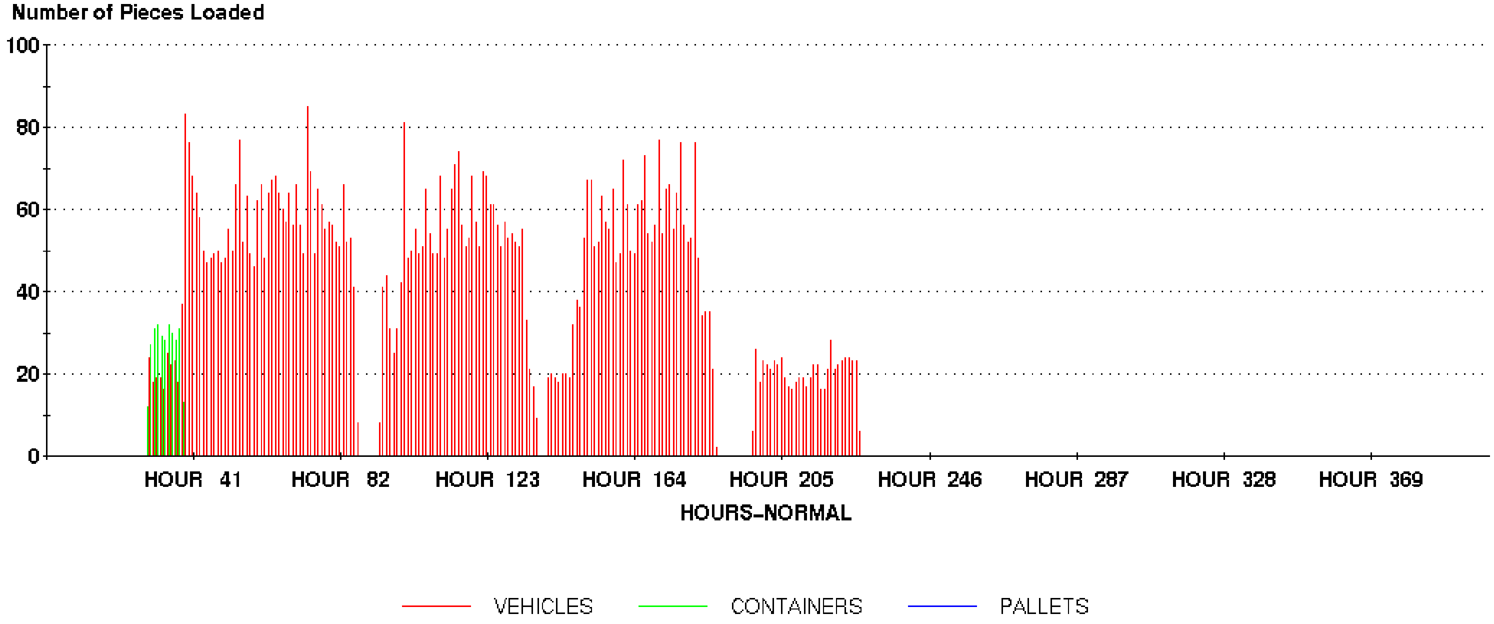
DAILY CLOSURE PROFILE FOR
NOTIONAL ARMORED DIVISION



**DAILY THROUGHPUT FOR
NOTIONAL ARMORED DIVISION**



HOURLY THROUGHPUT FOR NOTIONAL ARMORED DIVISION



PORT OF GALVESTON
TEXAS

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a site survey of the Port of Galveston in September 1997. This Ports for National Defense study is based on that site survey and 1999 - 2000 validation with the Galveston Port Authority. This port, a medium-size port located on Galveston Island, can easily throughput brigade-size units and can accommodate vessels as large as the LMSR.

The port is made up of various piers and quays. The premier berth (Berth 10) is 1,346 feet long with a water depth of 40 feet and has four container cranes. It also has 44 acres of paved open storage. This berth has potential for outloading Army brigades, but is also currently subleased by the Port of Houston for container operations to supplement those at Barbour's Cut in Houston.

The Port of Galveston is capable of breakbulk, RORO, container, and barge operations. This port is rail accessible by the Burlington Northern/Santa Fe and Union Pacific rail lines and has an airport 5 miles away. The airport has handled C-130s and B-727s in the past. Available materials handling equipment include a transtainer and port packers for container handling plus forklifts for palletized cargo. Mobile cranes are available through local stevedores. The port also has both truck and rail end ramps for offloading semitrailers and railcars.

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of about 40,930 STON (157,130 MTON) per day. RORO and container throughputs are about 48,400 STON and 14,500 STON per day, respectively. Computer simulations show that the port is capable of achieving closure for throughputting a notional armored cavalry regiment in about 6 days if all facilities and resources are available.

The U.S. Military would most likely use Berth 10 plus surrounding open staging area and adjacent covered storage for an actual deployment. For this application, we analyzed a notional heavy armored cavalry regiment deploying from the Port of Galveston on LMSR ships using Berth 10. A notional heavy armored cavalry regiment has about 31,350 STON (130,680 MTON) of vehicles and equipment. To deploy a notional heavy armored cavalry regiment in 6 days, the port must throughput about 5,210 STON of vehicles and equipment (that includes 24 containers) per day. When two LMSRs are available for loading in sequence, the port meets the shipping requirements. Smaller ships will require additional time or berths.

For sustained deployment operations, 25 acres of open staging per LMSR are desired to support daily sustained loading operations. The desired staging for an FSS is about 16 acres per ship to support daily sustained loading operations. Berths 10 and 14 combined have 50 acres.

The notional heavy armored cavalry regiment will require 54 railcars per day using the rail/convoy option. The port states that they can handle between 4-8 trains per day at 100 railcars per train.

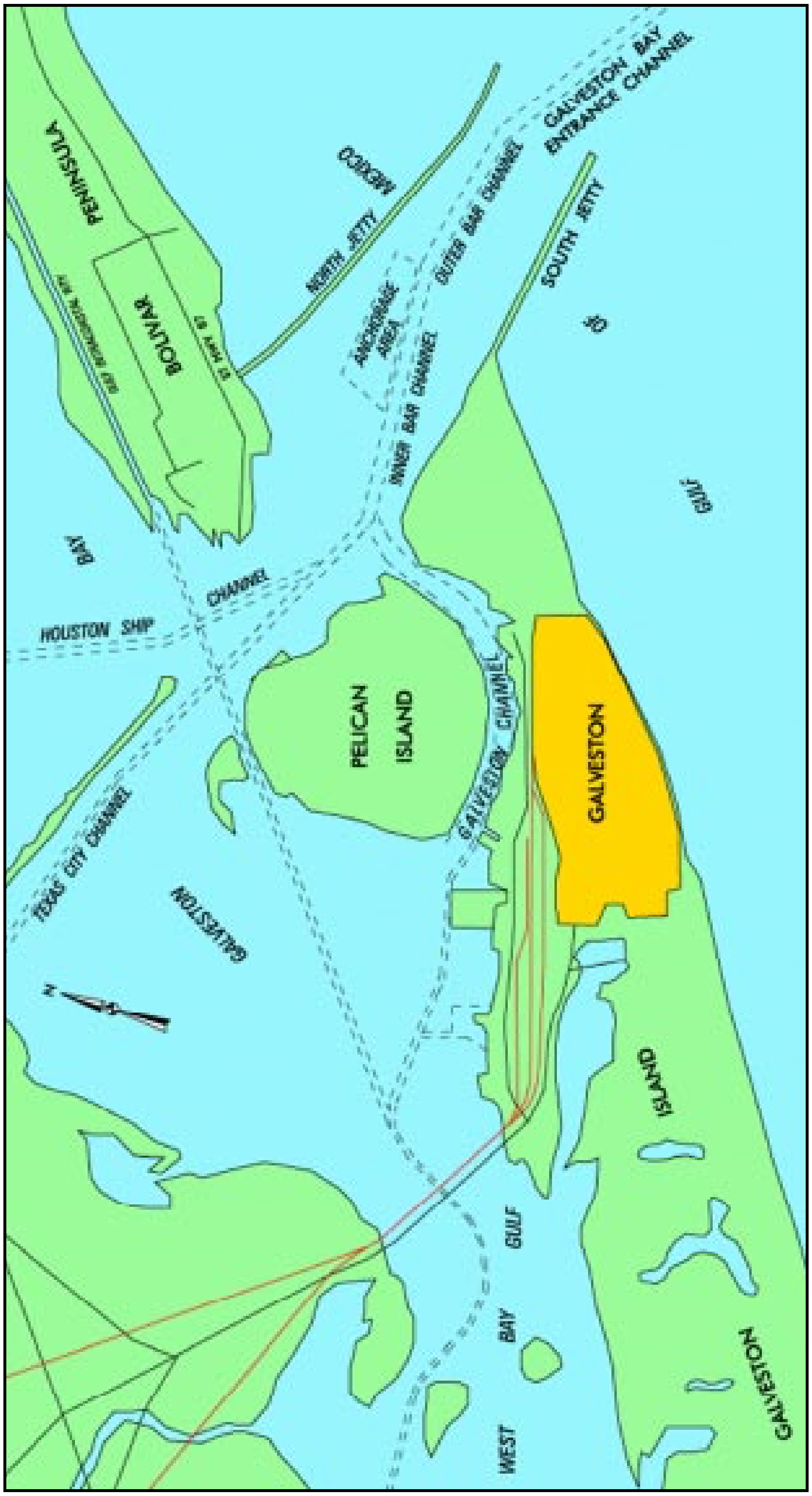
II. GENERAL DATA

The Port of Galveston, Texas, is a port on the U.S. Gulf Coast considered for use in deploying military equipment during contingencies. A team from the Military Traffic Management Command conducted a site survey in September 1997. This information was validated December 1999 - January 2000. Information on port characteristics was obtained from port officials.

TRANSPORTATION ACCESS

Water

The Port of Galveston (latitude 29.2° north, longitude 94.5° west, (HQLL)) is in southeastern Texas, about 50 miles southeast of Houston. The port is on the south side of Galveston Channel on Galveston Island. Galveston Channel connects Galveston Bay with the Gulf of Mexico. Entrance to the port is via four channels. These channels vary from 40 to 42 feet deep and 800 to 1,125 feet wide. No bridges cross the main ship channels between the Gulf of Mexico and the Port of Galveston. All vessels approaching and entering the port require pilots. The port authority reports that plenty of pilots and five tugboats are available. The port has not experienced any delays in the past in receiving vessels. The nearest anchorage is the Galveston Anchorage Basin (34 feet max draft at mean low water (MLW); area is 3,100 feet wide by 1.9 miles long). Vessels with deeper draft must anchor in the Gulf of Mexico. The turning basin has a depth of 40 feet MLW, a diameter of 1,125 feet, and is located in Galveston Channel. According to Navy standard operating procedures, ships do not normally turn in an area that is less than 1.5 times their length. Based on this guideline, the turning basin will be tight for FSS/LMSR vessels (about 950 feet in length). Tidal variation ranges from 1.5-2 feet in the summer and 1-3 feet in the winter.

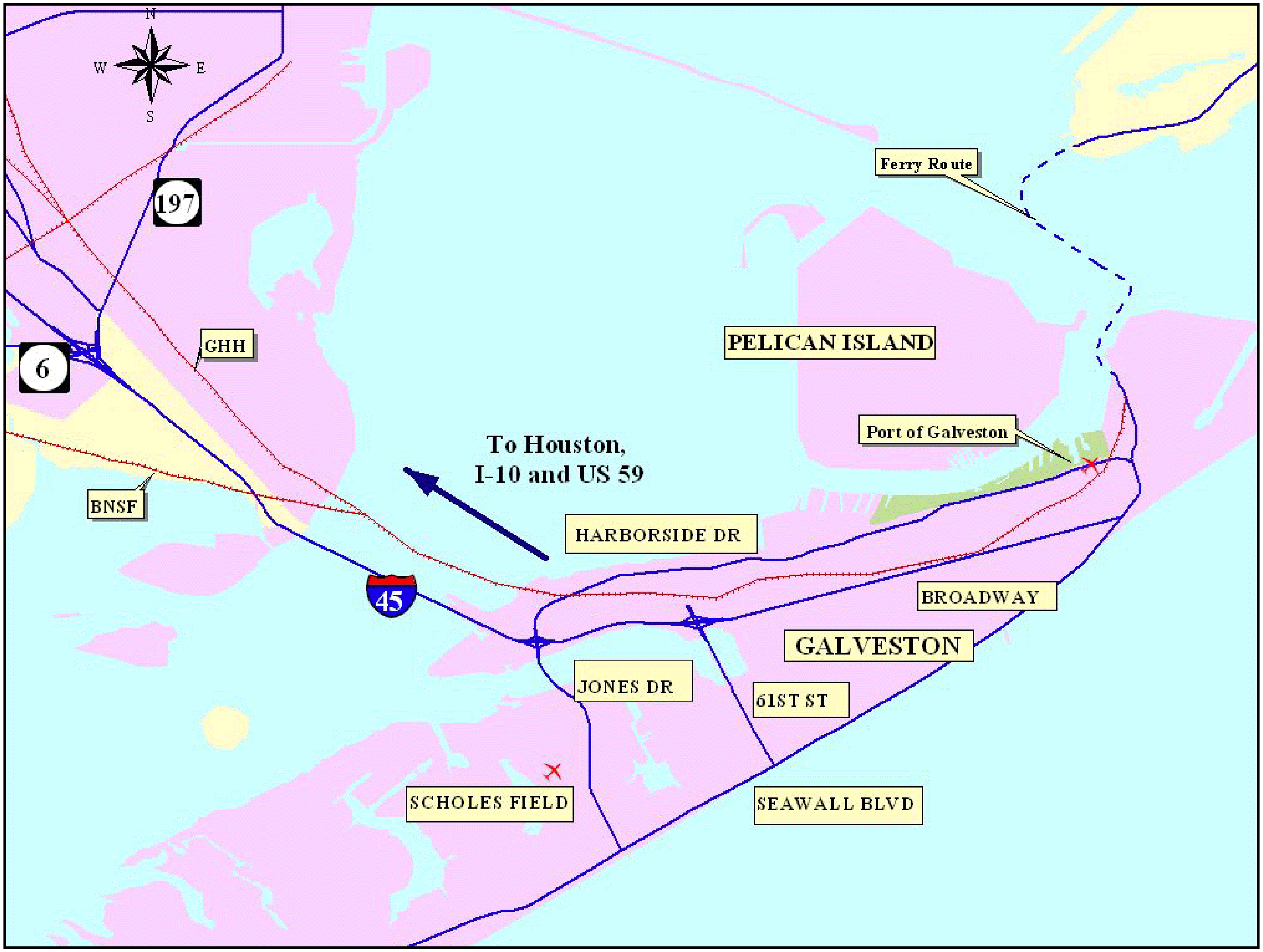


Water Access Map

Galveston's Channel

Highway

The port has good access to major highway routes. Interstate-45 (I-45) accesses Galveston Island and connects to other major routes to the north on the Texas mainland such as I-10 and U.S. Route 59. Harborside Drive (State Road 275) connects I-45 to the port. Harborside Drive is a two-lane road with speed limit of 45 mph. The 10^{th} and 16^{th} Streets gates provide access to the port. These gates have two lanes, one in each direction. Bridge clearance on Harborside Drive is 14 feet 7 inches.



Highway, Rail, and Air Access Map

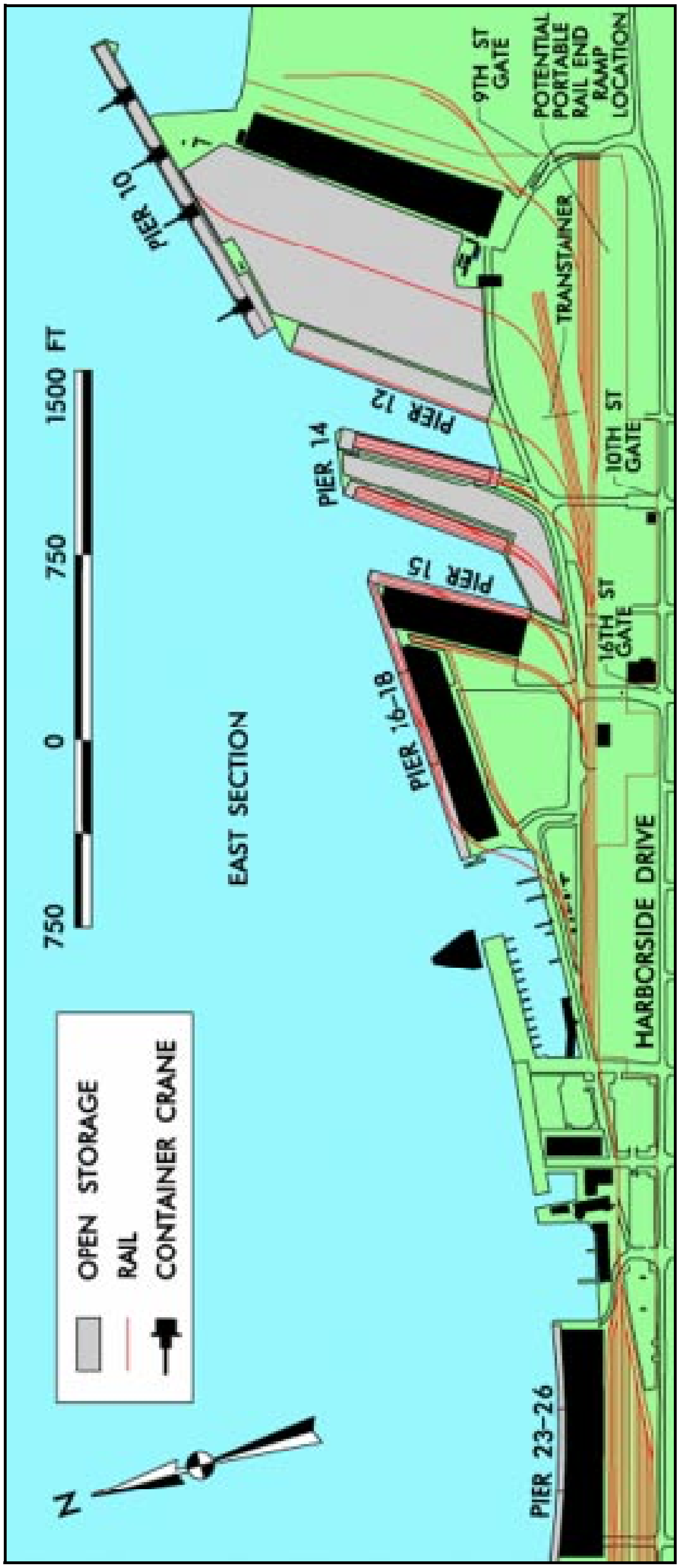
Rail

The Burlington Northern/Santa Fe (BNSF) and Union Pacific (UP) railroad companies provide service to the Port of Galveston. These carriers have railyards near the port. Rail clearances are sufficient for bilevel and trilevel railcars to access the port. The Galveston Railroad Company performs the switching operations for the major railroad companies. Commercial railyards near the port can store over 830 89-foot flatcars. The Port of Galveston spurs can store over 400 89-foot flatcars. Although used infrequently, the port reports that the storage spurs are in usable condition. These railyards were uncongested during the September 1997 visit. Rail trackage links the railyards to the port's apron tracks, transit sheds, and storage tracks. Apron tracks are along piers 10, 14W, 15, 16-18, 36, 37, 38, and 41. Rail service capability is estimated to be in the range of four-eight trains per day. A total of five rail end ramps exist at the port. One of the end ramps is a fixed end ramp located at Plant 3 with 600 feet of straight track. The other four ramps are portable. Two are light-duty (10 STON capacity) and constructed of aluminum. The other two are constructed of timber and used to offload Caterpillar crawler tractors.

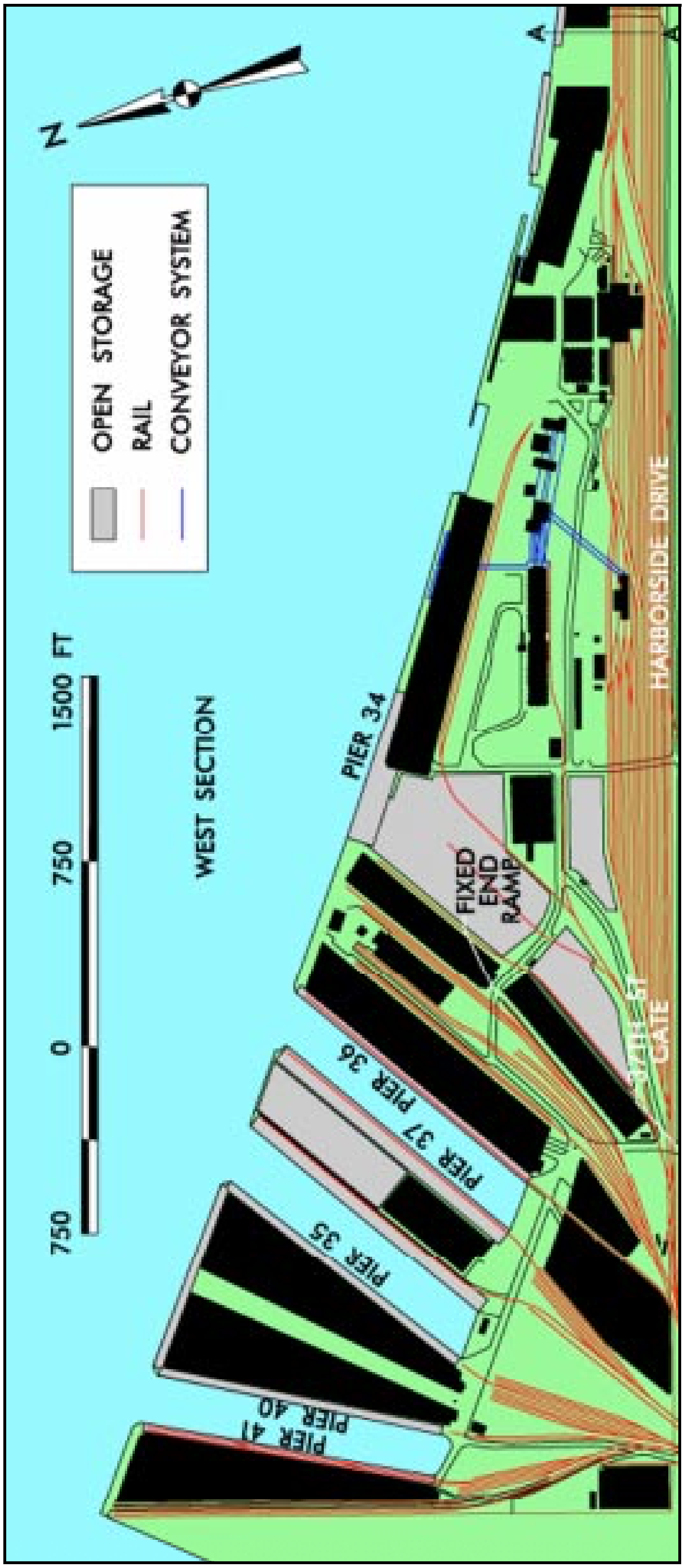
Railyard at the Port of Galveston

Air

Scholes Field is 5 miles southwest of the port and has three commercial runways. The longest is about 6,000 feet long, 150 feet wide, and has handled C-130 and B-727 aircraft. The port lists Piers 10, 34, and 37 as potential areas for helicopter operations. Pier 10 is ideal for helicopter operations as it has 44 acres of open storage and a transit shed nearby. The nearest military air-field is Ellington Air Force Base, approximately 25 miles north of the port on Highway 3, south-east of Houston.



Land-Use Map (eastward)



Land-Use Map (westward)

PORT FACILITIES

Berthing

The Port of Galveston is a multicargo port consisting of marginal wharves and finger piers capable of breakbulk, RORO, container, and barge operations.

Pier 10 is the premier wharf at the port and can handle RORO and container ships. It has a water depth of 40 feet MLW, a length of 1,346 feet (FSS and LMSR capable), an open apron, a transit shed, and four container cranes. Forty-four of the port's 57.5 acres of open storage are located at Pier 10. Currently, the Port of Houston has leased this pier as an extension of their container operations at the Barbour's Cut Terminal in Houston. Piers 12, 14E, and 14W are near Pier 10. Pier 12 adjoins Pier 10 and shares the staging area. Piers 14E and 14W have 6 acres of open storage. Piers 15, 16-18, 23-26, 34, 36, 37, 39, 40, and 41 are primarily suited for breakbulk operations. In general, these piers have transit sheds alongside and minimal apron width. Piers 34 and 37 have an open apron and a combined 7.5 acres of open storage.

Pier 10 is the best berth for military operations as it can handle FSS/LMSR vessels and can perform both RORO and container operations. This wharf has open and covered storage and direct rail access. Intermodal operations are possible at this berth. Berth characteristics for all berths are in the table below.

BERTH CHARACTERISTICS FOR THE PORT OF GALVESTON				
	Berths			
Characteristics	**10**	**12**	**14E**	**14W**
Length feet (meters)	1,346 (410.3)	845 (257.6)	663 (202.1)	689 (210.0)
Depth alongside at MLW feet (meters)	40 (12.19)	32 (9.75)	34 (10.36)	33 (10.06)
Deck Strength psf (metric tons per square meter)	600 (2.93)	500 (2.44)	500 (2.44)	500 (2.44)
Apron width feet (meters)	Open	Open	Open	Open
Apron height above MLW feet (meters)	11 (3.35)	11 (3.35)	14 (4.27)	10 (3.05)
Number of container cranes	4	0	0	0
Number of wharf cranes	0	0	0	0
Apron Lighting	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No	No
Apron length served by rail feet (meters)	0	0	0	689 (210.0)

BERTH CHARACTERISTICS FOR THE PORT OF GALVESTON - cont						
	Berths					
Characteristics	**15**	**16-18**	**23-26**	**34**	**36**	**37**
Length feet (meters)	663 (202.1)	1,203 (366.7)	1,415 (431.3)	632 (192.6)	1,206 (367.6)	1,163 (354.5)
Depth alongside at MLW feet (meters)	33 (10.06)	32 (9.75)	30 (9.14)	32 (9.75)	31 (9.45)	32 (9.75)
Deck Strength psf (metric tons per square meter)	500 (2.44)	500 (2.44)	500 (2.44)	600 (2.93)	500 (2.44)	500 (2.44)
Apron width feet (meters)	46 (14.02)	46 (14.02)	32 (9.75)	Open	35 (10.67)	Open
Apron height range feet (meters)	12 (3.66)	12 (3.66)	12 (3.66)	9 (2.74)	11 (3.35)	11 (3.35)
Number of container cranes	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0
Apron Lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No	No	No	No
Apron length served by rail feet (meters)	663 (202.1)	0	0	0	0	1,163 (354.5)

BERTH CHARACTERISTICS FOR THE PORT OF GALVESTON - cont			
	Berths		
Characteristics	**39**	**40**	**41**
Length feet (meters)	1,173 (357.5)	1,164 (354.8)	1,195 (364.2)
Depth alongside at MLW feet (meters)	32 (9.75)	32 (9.75)	32 (9.75)
Deck Strength psf (metric tons per square meters)	500 (2.44)	500 (2.44)	500 (2.44)
Apron width feet (meters)	38 (11.58)	40 (12.19)	35 (10.67)
Apron height range feet (meters)	11 (3.35)	11 (3.35)	11 (3.35)
Number of container cranes	0	0	0
Number of wharf cranes	0	0	0
Apron Lighting	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No
Apron length served by rail feet (meters)	0	0	1,195 (364.2)

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF GALVESTON

Vessels		Berths			
TYPE	**CLASS**	**10**	**12**	**14E**	**14W**
BREAKBULK	C3-S-38a	2	1	1	1
	C4-S-58a	2	1	1	1
	C4-S-66a	2	1,a	1	1
	C5-S-37e	2	1	1	1
SEATRAIN	GA and PR	2	1	1	1
BARGE	LASH C8-S-81b	1	1,a	a,c	a,c
	LASH C9-S-81d	1	a,c	a,c	a,c
	LASH Lighter	6	4	3	3
	SEABEE C8-S-82a	1	a,c	a,c	a,c
	SEABEE Barge	6	4	3	3
RORO	COMET	2,d,i,j	1,d,i,j	1,d,i,j	1,d,i,j
	METEOR	2,d,i,j	1,d,i,j	1,d,i,j	1,d,i,j
	Cape Gnome	2,d,i,j	1,a,d,i,j	1,d,i,j	1,a,d,i,j
	C7-S-95A	1	1,a	c	a,c
	Cape Taylor	2	1	1	1
	Cape Orlando	2,i,j	1,i,j	1,i,j	1,i,j
	MV Ambassador	2,d	1,d	1,d	1,d
	Callaghan	1,d,i	1,d,i	c,d,i,j	c,d
	Cape Lambert	1,i,j	1,i,j	c	1,i,j
	LMSR Class	1	a,c	a,c	a,c
	FSS	1	a,c	a,c	a,c
	Cape E-Class	1,i,j	1,i,j	1,i,j	1,i,j
	Cape D-Class	1,i,j	1,a	c	1,i,j
	Cape H	1	1,a	a,c	a,c
RORO	Cape Texas	2,i,j	1,i,j	1,i,j	1,i,j
	Cape R	2,d	1,a,d	1,d	1,d
	Cape I-class	1,i,j	1,i,j	c	1,i,j
	Cape Victory	2,i	1,i	1,i,j	1,i
CONTAINER	C6-M-147a	1	1,e	1,e	1,e
	C7-S-69c	1	1,e	c,e	1,e
	C7-S-68c	1	1,e	c,e	c,e
	C8-S-85c	1	1,a,e	c,e	c,e
	C9-M-132b	1	a,c,e	a,c,e	a,c,e
	C9-M-F141a	1	a,c,e	a,c,e	a,c,e
TACS	C6-S-1qd	1	1	c	1
	C5-S-MA73c	2	1	1	1
	C6-S-MA60d	1	1	c	1
MPS	C7-S-133a	1	1,a	c	c
	Maersk	1	1,a	c	c
	AmSea	1	1	c	1

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF GALVESTON - cont								
Vessels		**Berths**						
TYPE	**CLASS**	**15**	**16-18**	**23-26**	**34**	**36**	**37**	
BREAKBULK	C3-S-38a	1	2	2	1	2	2	***NOTES:***
	C4-S-58a	1	2	2,a	1	2	1	
	C4-S-66a	1	2,a	2,a	1,a	2,a	2,a	The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.
	C5-S-37e	1	1	2	1	1	1	
SEATRAIN	GA and PR	1	2	2	1	2	1	
BARGE	LASH C8-S-81b	a,c	1,a	1,a	a,c	1,a	1,a	
	LASH C9-S-81d	a,c	1,a	1,a	a,c	1,a	1,a	The letters in the columns to the left indicate limitations as described below.
	LASH Lighter	3	6	7	3	6	5	
	SEABEE C8-S-82a	a,c	1,a	1,a	a,c	1,a	1,a	
	SEABEE Barge	3	6	7	3	6	5	
RORO	COMET	1,d,o	2,d,o	2,d,o	1,d,i	2,d,o	2,d,i,j	
	METEOR	1,d,o	2,d,o	2,d,o	1,d,i	2,d,o	2,d,i,j	a-vessel draft limit
	Cape Gnome	1,a,d,o	1,a,d,o	2,a,d,o	1,a,d,i,j	1,a,d,o	1,a,d,i,j	b-inadequate apron width
	C7-S-95A	a,b,c	1,a,b	1,a,b	a,c	1,a,b	1,a	c-inadequate berth length
	Cape Taylor	1,b	1,b	2,b	c	1,b	1	d-no straight stern ramp
	Cape Orlando	1,b	1,b	2,b	c	1,b	1,i,j	e-no container handling equipment
	MV Ambassador	1,d	2,d	2,d	1,d	2,d	2,d	
	Callaghan	c,d,o	1,d,o	1,d,o	c,d	1,d,o	1,d,i	f-anchorage depth OK, berth depth inadequate
	Cape Lambert	b,c	1,b	2,a,b	c	1,b	1,i,j	g-inadequate channel depth
	LMSR Class	a,b,c	1,a,b	1,a,b	a,c	1,a,b	1,a	h-no shore based ramps
	FSS	a,b,c	1,a,b	1,a,b	a,c	1,a,b	1,a	i-low tide insufficient ramp clearance
	Cape E-Class	1,b	1,b	2,a,b	c	1,a,b	1,i,j	j-high tide insufficient ramp clearance
	Cape D-Class	b,c	1,a,b	2,a,b	a,c	1,a,b	1,a	
	Cape H	a,b,c	1,a,b	1,a,b	a,c	1,a,b	1,a	k-excessive ramp angle low tide
RORO	Cape Texas	1,b	1,b	2,b	c	1,b	1,i,j	m-excessive ramp angle high tide
	Cape R	1,d	1,a,d	2,a,b,d,o	a,c,d	1,a,b,d	1,a,d	n-parallel ramp operation ONLY
	Cape I-class	b,c	1,b	1,a,b	c	1,a,b	1,i,j	
	Cape Victory	1,b	1,b	2,b	1	1,b	1,i	o-insufficient apron width for side ramp
CONTAINER	C6-M-147a	1,b,e	1,b,e	2,b,e	c,e	1,b,e	1,e	
	C7-S-69c	b,c,e	1,b,e	2,a,b,e	c,e	1,b,e	1,e	Ramp clearance and angle based on maximum vessel draft
	C7-S-68c	b,c,e	1,b,e	1,a,b,e	c,e	1,a,b,e	1,e	
	C8-S-85c	b,c,e	1,a,b,e	1,a,b,e	a,c,e	1,a,b,e	1,a,e	
	C9-M-132b	a,b,c,e	1,a,b,e	1,a,b,e	a,c,e	1,a,b,e	1,a,e	♦ **May Prevent Operation**
	C9-M-F141a	a,b,c,e	1,a,b,e	1,a,b,e	a,c,e	1,a,b,e	1,a,e	
TACS	C6-S-1qd	b,c	1,b	2,a,b	c	1,b	1	
	C5-S-MA73c	1,b	1,b	2,a,b	1	1,b	1	♦ **May Limit Operation**
	C6-S-MA60d	b,c	1,b	2,a,b	c	1,a,b	1	
MPS	C7-S-133a	b,c	1,a,b	1,a,b	a,c	1,a,b	1,a	
	Maersk	b,c	1,a,b	1,a,b	a,c	1,a,b	1,a	
	AmSea	b,c	1,b	2,a,b	c	1,a,b	1	

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF GALVESTON - cont				
Vessels		**Berths**		
TYPE	**CLASS**	**39**	**40**	**41**
BREAKBULK	C3-S-38a	2	2	2
	C4-S-58a	1	1	2
	C4-S-66a	2,a	2,a	2,a
	C5-S-37e	1	1	1
SEATRAIN	GA and PR	2	1	2
BARGE	LASH C8-S-81b	1,a	1,a	1,a
	LASH C9-S-81d	1,a	1,a	1,a
	LASH Lighter	5	5	5
	SEABEE C8-S-82a	1,a	1,a	1,a
	SEABEE Barge	5	5	5
RORO	COMET	2,d,o	2,d,o	2,d,o
	METEOR	2,d,o	2,d,o	2,d,o
	Cape Gnome	1,a,d,o	1,a,d,o	1,a,d,o
	C7-S-95A	1,a,b	1,a,b	1,a,b
	Cape Taylor	1,b	1,b	1,b
	Cape Orlando	1,b	1,b	1,b
	MV Ambassador	2,d	2,d	2,d
	Callaghan	1,d,o	1,d,o	1,d,o
	Cape Lambert	1,b	1,b	1,b
	LMSR Class	1,a,b	1,a,b	1,a,b
	FSS	1,a,b	1,a,b	1,a,b
	Cape E-Class	1,b	1,b	1,b
	Cape D-Class	1,a,b	1,a,b	1,a,b
	Cape H	1,a,b	1,a,b	1,a,b
RORO	Cape Texas	1,b	1,b	1,b
	Cape R	1,a,b,d	1,a,b,d	1,a,b,d
	Cape I-class	1,b	1,b	1,b
	Cape Victory	1,b	1,b	1,b
CONTAINER	C6-M-147a	1,b,e	1,b,e	1,b,e
	C7-S-69c	1,b,e	1,b,e	1,b,e
	C7-S-68c	1,b,e	1,b,e	1,b,e
	C8-S-85c	1,a,b,e	1,a,b,e	1,a,b,e
	C9-M-132b	1,a,b,e	1,a,b,e	1,a,b,e
	C9-M-F141a	1,a,b,e	1,a,b,e	1,a,b,e
TACS	C6-S-1qd	1,b	1,b	1,b
	C5-S-MA73c	1,b	1,b	1,b
	C6-S-MA60d	1,b	1,b	1,b
MPS	C7-S-133a	1,a,b	1,a,b	1,a,b
	Maersk	1,a,b	1,a,b	1,a,b
	AmSea	1,b	1,b	1,b

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight stern ramp
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g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

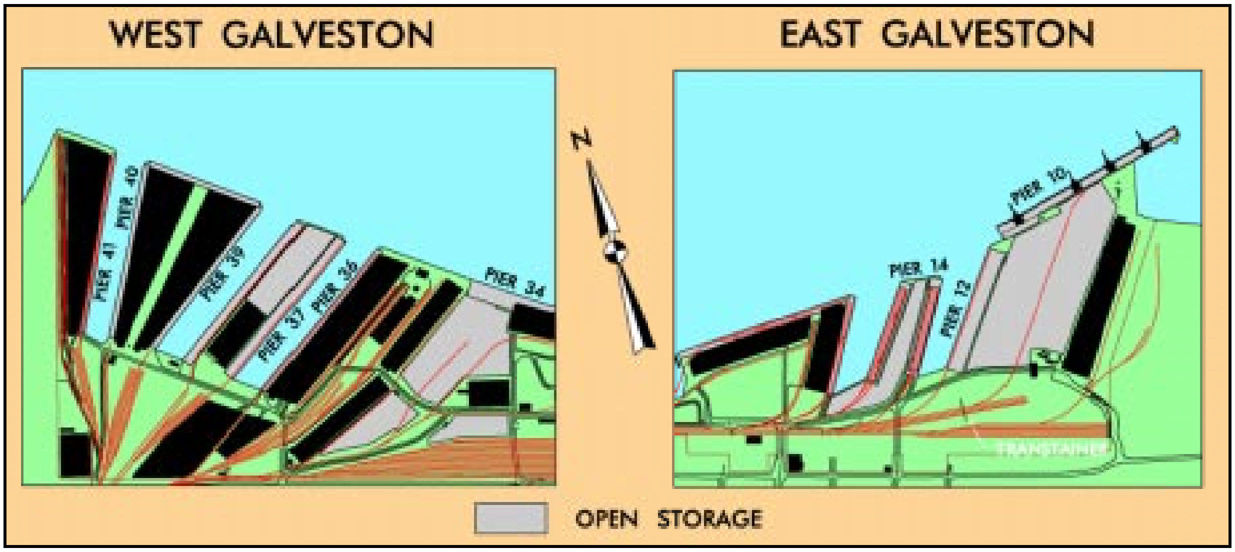
♦ **May Prevent Operation**

♦ **May Limit Operation**

STAGING

Open Staging

The Port of Galveston has about 57.5 acres of paved open storage. Most of this staging (50 acres) is distributed in the Pier 10 area, adjacent to Berths 10, 12, 14E, and 14W. The rest of the acreage is evenly distributed among Piers 34 and 37. Sufficient open staging exists in these areas to allow helicopter operations.



Open Staging Areas

Open Staging Area at Pier 10

Covered Staging

The port has ample covered storage available for general cargo, helicopter operations, and container stuffing/unstuffing operations. Transit sheds are located at or near each of the berths. The Port of Galveston has a total of 1,328,538 square feet of available covered storage

Covered Staging Area at Pier 10 Transit Shed

UNLOADING/LOADING POSITIONS

Ramps and Docks

Ramps and docks are located throughout the port. The port has one fixed rail end ramp constructed of timber at Plant 3. Six hundred feet of straight track serves this ramp. Four other portable end ramps are also available at the port. Two are light-duty (10 STON-capacity) constructed of aluminum and two are made of timber and used for loading/offloading Caterpillar crawler tractors. The port authority also lists a steel truck end ramp at Pier 37. This end ramp can accommodate two truck positions.

Eight of the transit sheds have truck-level docks that provide 86 truck handling positions. Most of these buildings have railcar-level platforms. These platforms provide about 165 railcar handling positions.

Marshaling Areas

The port states that Army equipment could park curbside along a five-block section of Harborside Drive between 30th and 37th Streets. This area amounts to about 11.4 acres.

MATERIALS HANDLING EQUIPMENT (MHE)			
Type of Equipment	**Capacity (STON)**	**Quantity**	**Wharf Assignment**
Container Cranes	50	3	Pier 10
Container Crane	60	1	Pier 10
Transtainer	40	1	Piers 10, 12, 14E, and 14W
Port Packer	36	2	
Port Packer	42	3	
Port Packer	42.5	3	
Forklifts	31	2	
NOTE: The table above represents equipment owned by the port. The port authority indicates that other equipment is available through local stevedores.			

FUTURE DEVELOPMENT

The Port of Galveston reports three developments that will occur in the near future.

1. The port plans to tear down the transit shed on Pier 36 to make 220,000 square feet of open storage.

2. Dredging will occur on a yearly basis instead of biyearly.

3. The BNSF railyard will be removed.

EXPLOSIVES AND HAZARDOUS CARGO OPERATIONS

During the September 1997 visit, the port's fire marshal stated that Pier 10 was the preferred berth for any explosives and hazardous cargo operations. The fire marshal further stated that the military was exempt from restrictions. If contractors are used, the fire marshal needs to coordinate with the contractor to verify handling procedures. The port authority states that 20 acres of additional storage for explosives exist on the west side of Pier 41.

STEVEDORES

The port authority reports that as much labor as needed is available through local stevedores licensed by the Port of Galveston/Houston.

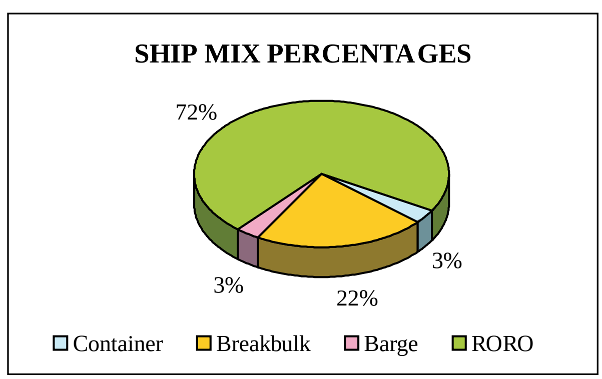
III. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Galveston. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal reception/handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON.

Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 70 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

Highway

Harborside Drive is the roadway that connects the Port of Galveston to I-45. Two gates provide access to the port from Harborside Drive. These gates can handle at least 51,200 STON of cargo per day. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or leave the port on each lane of the highway.

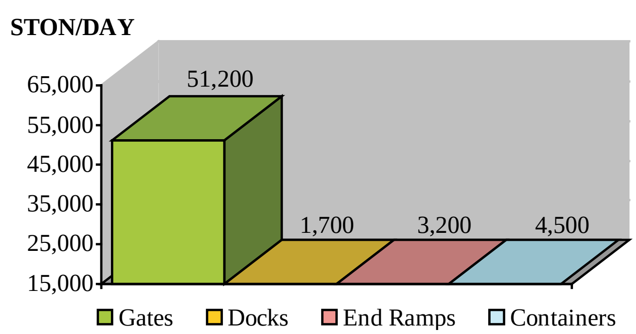
Roadable vehicles will move through the terminal gates in manageable convoys to staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for offloading vehicles, must use portable ramps. If not available, deploying units/military port operators must either build or acquire the necessary ramps. For this study, we assumed that the portable truck end ramp at Pier 37 would be used for offloading operations. This ramp can handle 3,200 STON of military vehicles and equipment per day.

The port has 86 handling positions to load/unload supplies in van semitrailers. These positions can load/unload at least 1,700 STON of shipped material per day.

The Port of Galveston has three port packers available. By using the port packers for container handling, the port can handle at least 4,500 STON of containerized equipment and supplies per day.

Maximum daily handling capability for the port is a mixed total of the three types of handling (docks, end ramps, and containers), each up to its maximum, not to exceed the daily gate limit of at least 51,200 STON.

HIGHWAY CLEARANCE AND HANDLING CAPABILITY



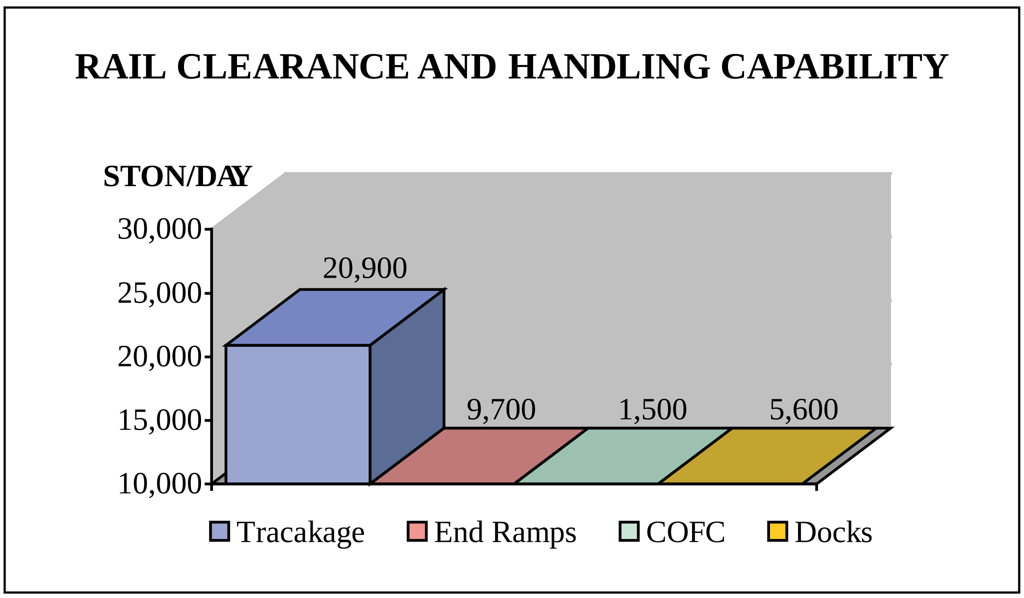
Rail

The Port of Galveston has ample rail reception with the BNSF and UP railroads providing rail service. The Galveston Railroad Company performs the switching operations to deliver the railcars from the commercial carrier to the port. Current rail service can support a range of four-eight trains per day (up to 100 railcars per train). These trains can handle at least 20,900 STON per day.

Vehicles on flatcars will offload in the port on the three available rail end ramps (one fixed and two portable). The end ramps can handle about 9,700 STON per day.

Boxcars will load/offload at the storage buildings. The port has about 180 rail handling positions available for loading/unloading boxcars. These docks can handle about 5,600 STON per day.

Based on using the transtainer for offloading railcars, the port can offload at least 1,500 STON of containerized equipment and supplies from railcars per day.



Staging

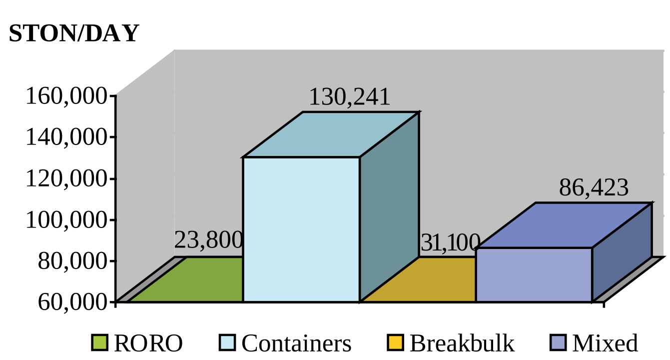
The port has 57.5 acres of suitable open staging area. Fifty acres of this total is located at Piers10-14. Because the Port of Houston has subleased this area, availability is questionable. However, for purposes of determining a staging capability, we assumed the entire area would be available (facility use factor of 100 percent).

The port lists 1,328,538 square feet of covered storage space. Although some of this space will support container operations at Pier 10 and breakbulk operations in other covered facilities, the port should still have plenty to support military operations. About 26,600 STON of breakbulk cargo can be staged in the covered area.

The chart on this page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of the capability for each type cargo operation involved should be assumed.

The table shows the STON of cargo, by type, the port can expect to handle. The dwell time used in this computation was 3 days and the open space utilization percentage was 60 percent. The container storage throughput capability is the highest with 130,241 STON. The ability to stack containers three high in the paved open storage areas contributes to the high staging throughput value. The RORO storage throughput is about 23,800 STON. The breakbulk staging throughput is about 31,100 STON.

OPEN STAGING CAPABILITY



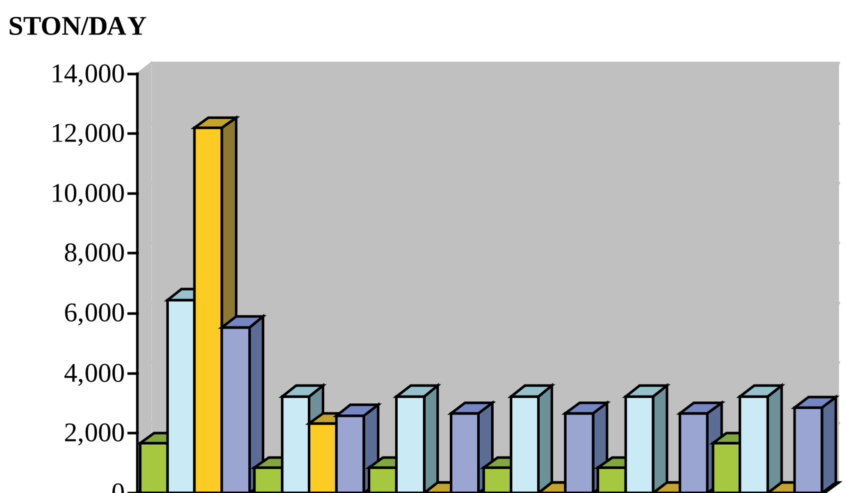
Note: Container staging area can also be used for RORO staging as needed.

Shipping

Daily shipping subsystem totals for the terminal berths are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types.

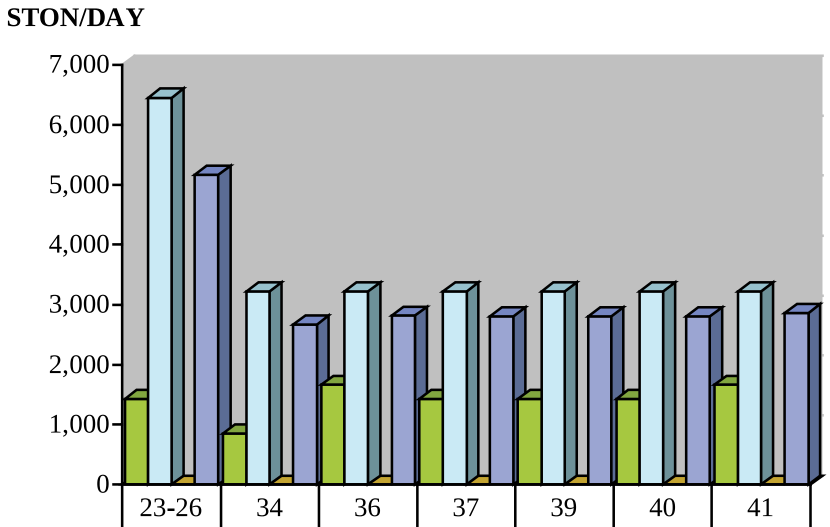
Pier 10 is the best choice for performing RORO operations due to the ample berth length, apron width, and apron height. This pier also has the port's only container cranes and is the obvious choice for container operations. The nearby transit shed also supports breakbulk operations at Pier 10, making this the most versatile wharf at the Port of Galveston.

BERTH THROUGHPUT CAPABILITY



	10	12	14E	14W	15	16-18
RORO	1,664	851	851	851	851	1,664
Container	6,451	3,225	3,225	3,225	3,225	3,225
Breakbulk	12,192	2,320	0	0	0	0
Mixed	5,542	2,594	2,669	2,669	2,669	2,859

BERTH THROUGHPUT CAPABILITY - cont



	23-26	34	36	37	39	40	41
RORO	1,432	851	1,664	1,432	1,432	1,432	1,664
Container	6,451	3,225	3,225	3,225	3,225	3,225	3,225
Breakbulk	0	0	0	0	0	0	0
Mixed	5,169	2,669	2,819	2,805	2,805	2,805	2,859

DAILY THROUGHPUT SUMMARY

BERTH	LENGTH (feet) (meters)	DEPTH ALONGSIDE (feet) (meters)	BREAKBULK THROUGHPUT (STON) (MTON)	RORO THROUGHPUT (STON) (MTON)	RORO SQUARE FT[1] (EST)	RORO PIECES[2]	CONTAINER THROUGHPUT (STON) (MTON) (TEU)[3]	BARGE THROUGHPUT (STON) (MTON)	MIXED THROUGHPUT (STON) (MTON)
10	1,346 410.3	40 12.2	1,664 4,161	6,451 25,804	129,020	759	12,192 30,480 1,524	0	5,542 21,039
12	845 257.6	32 9.75	851 2,128	3,225 12,902	64,500	379	2,320 5,800 290	516 1,290	2,594 9,970
14E	663 202.1	34 10.4	851 2,128	3,225 12,902	64,500	379	0	0	2,669 10,380
14W	689 210.0	33 10.06	851 2,128	3,225 12,902	64,500	379	0	0	2,669 10,380
15	663 202.1	33 10.06	851 2,128	3,225 12,902	64,500	379	0	0	2,669 10,380
16-18	1,203 366.7	32 9.75	1,664 4,161	3,225 12,902	64,500	379	0	0	2,859 10,856
23-26	1,415 431.3	30 9.14	1,432 3,580	6,451 25,804	129,020	759	0	1,806 4,515	5,169 20,105
34	632 192.6	32 9.75	851 2,128	3,225 12,902	64,500	379	0	0	2,669 10,380
36	1,206 367.6	31 9.45	1,664 4,161	3,225 12,902	64,500	379	0	1,548 3,870	2,819 10,640
37	1,163 354.5	32 9.75	1,432 3,580	3,225 12,902	64,500	379	0	0	2,805 10,720
39	1,173 357.5	32 9.75	1,432 3,580	3,225 12,902	64,500	379	0	0	2,805 10,720
40	1,164 354.8	32 9.75	1,432 3,580	3,225 12,902	64,500	379	0	0	2,805 10,720
41	1,195 364.2	32 9.75	1,664 4,161	3,225 12,902	64,500	379	0	0	2,859 10,856

[1]Based on the 20 square foot per STON average accomplished during Operation Desert Shield/Storm.
[2]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.
[3]Based on the 8 STON per TEU average accomplished during Operation Desert Shield/Storm.

SUMMARY

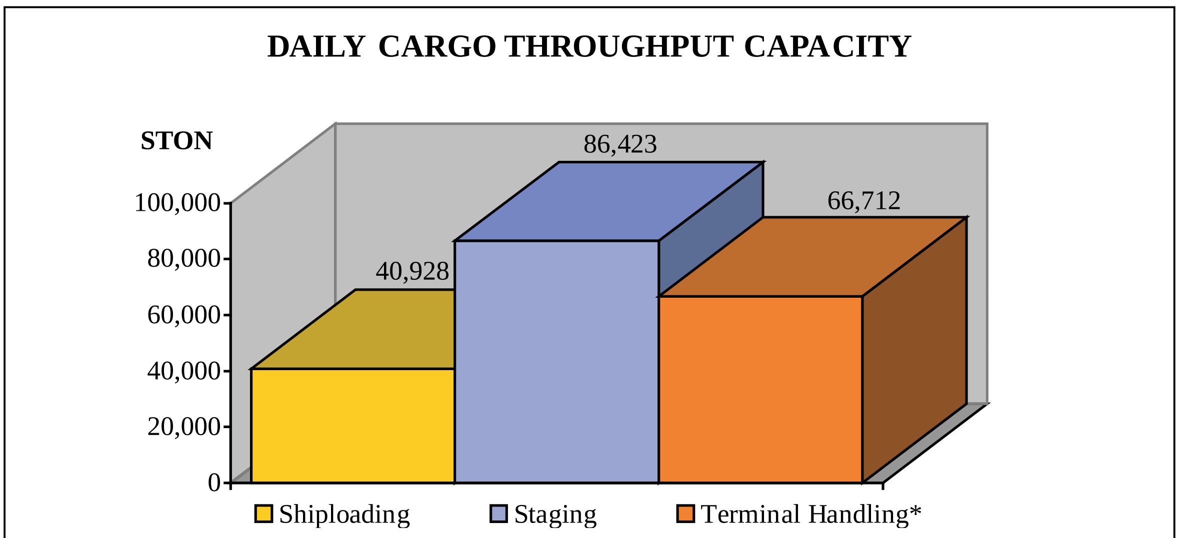
The port is multioperational with the capability to handle all types of vessels: container, RORO, breakbulk, and barges.

The Port of Galveston is fully capable of supporting U.S. Military deployment operations. Due to the Port of Houston subleasing Port of Galveston facilities, primarily Pier 10, the availability of Pier 10 and the surrounding open and covered staging areas during a contingency is questionable. The port may experience difficulty in clearing staging areas in sufficient time to adequately support military operations.

Pier 10 can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of at least 40,900 STON.

During the September 1997 visit, rail traffic into the port appeared uncongested even though other ports in the Texas/Louisiana region experienced congestion due to the rail mergers. Also, area railyards appeared uncongested. This would indicate that the Port of Galveston can readily handle an increase in rail traffic due to a military deployment.



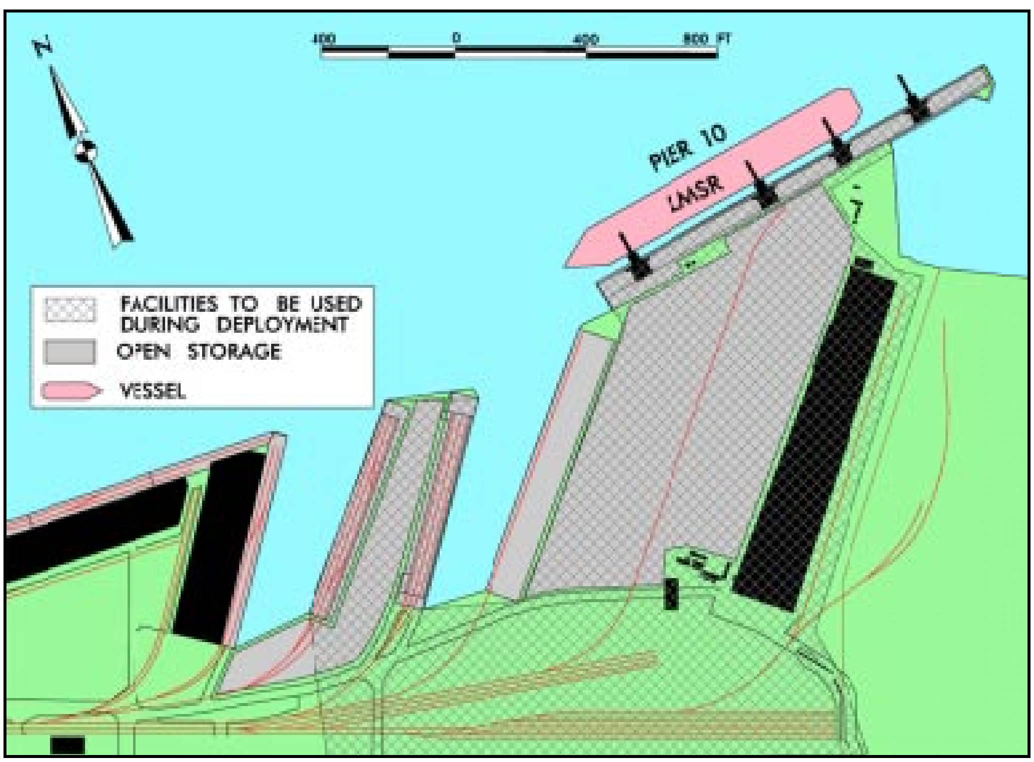
Terminal handling is the sum of the highway (51,212 STON) and rail (15,500 STON)

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored cavalry regiment using primarily LMSR vessels. We assume that Pier 10 and the surrounding staging area will be available for deployment. We also assume that no other military units will be competing for these facilities during the time that the armored cavalry regiment occupies the port. We further assume that the required assets, both transporters and people will be available to adequately load the ship and clear the port.

To evaluate the port's deployment capability, we used the port simulation (PORTSIM) model to flow unit equipment in the armored cavalry regiment through the port. PORTSIM is a time-stepped, discrete event, stochastic simulation of port operations during a force deployment. The PORTSIM is dynamically modeled for visual monitoring and quick identification of problems and allows the analyst to determine port closure/clearance times. For this simulation, we assume that the deploying regiment will use the facilities identified in the graphic below during a deployment. Also, we assumed that the Port of Galveston would use two container cranes, the transtainer, and the three port packers during shiploading.

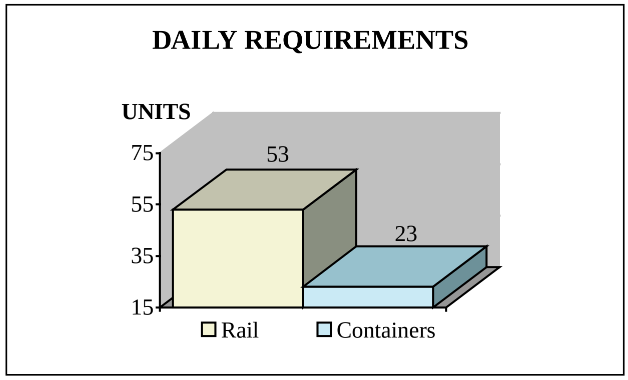


Potential Port Use During Deployment

REQUIREMENTS

To simulate a likely requirement for the Port of Galveston, we deployed a notional armored cavalry regiment, using 6 days for shiploading and port closure. The regiment has to move 2,138 vehicles and 140 containers. Movement of the regiment to the port will require 319 railcars using a convoy/rail option for transport to the port. About 23 containers would arrive daily.

TOTAL EQUIPMENT	
Volume	84,440 MTON
Weight	31,267 STON
Area	433,658 SQ FT
Vehicles	2,138
Containers	140
Note: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997	



SIMULATION RESULTS

Total deployment time for the regiment was about 6 days with the last 5 of those days used for shiploading and the first day used for initial reception and staging. LMSR vessels were used to deploy the regiment. Actual throughput and closure results are shown in the charts at the end of this study.

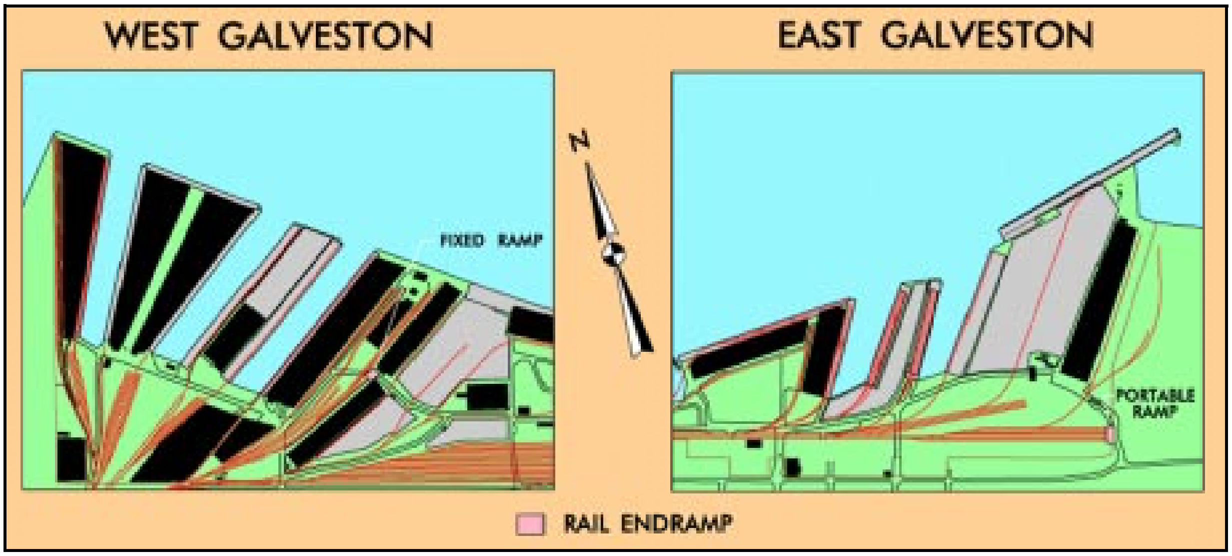
TERMINAL INPROCESSING/HANDLING

Rail

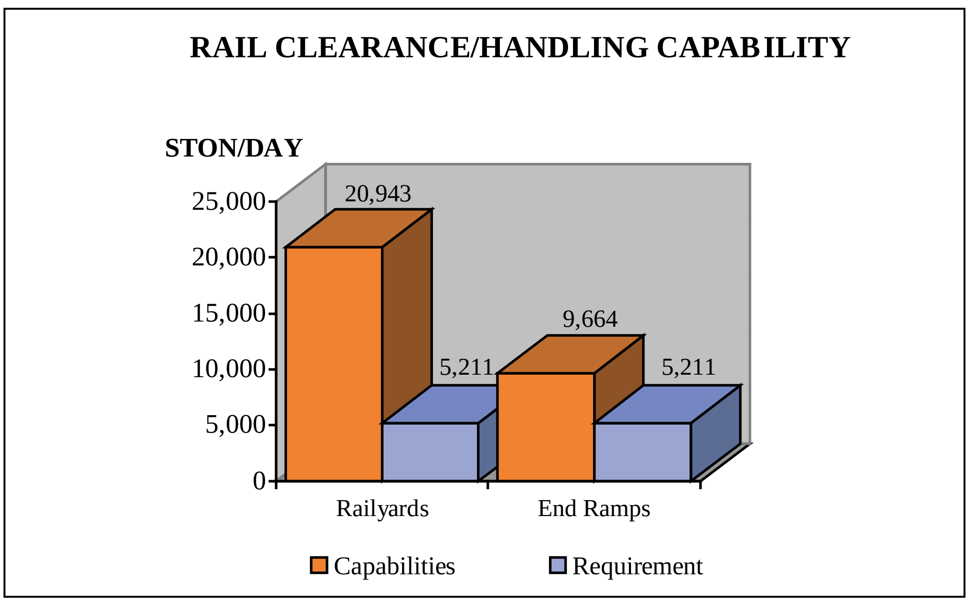
The BNSF and UP railroads serve the Port of Galveston. The Galveston Railroad Company performs the switching operations for the port. A speed restriction of 5 mph exists for trackage accessing the port. The port's rail spurs and railyard (total of 50,000 feet of usable track) can handle the incoming rail traffic.

For offloading wheeled vehicles from railcars, three rail end ramps will be used. One of the rail end ramps is the fixed ramp at Plant 3 and the other two will be the timber portable ramps. The port has numerous locations to perform rail offloading using the portable end ramps. For this analysis, we assumed rail offloading would occur at the railyard near Pier 10.

Requirements use total STON of equipment divided by six providing a rail daily requirement. Capabilities for the railyards and end ramps reflect trackage and end ramp daily throughputs, respectively.

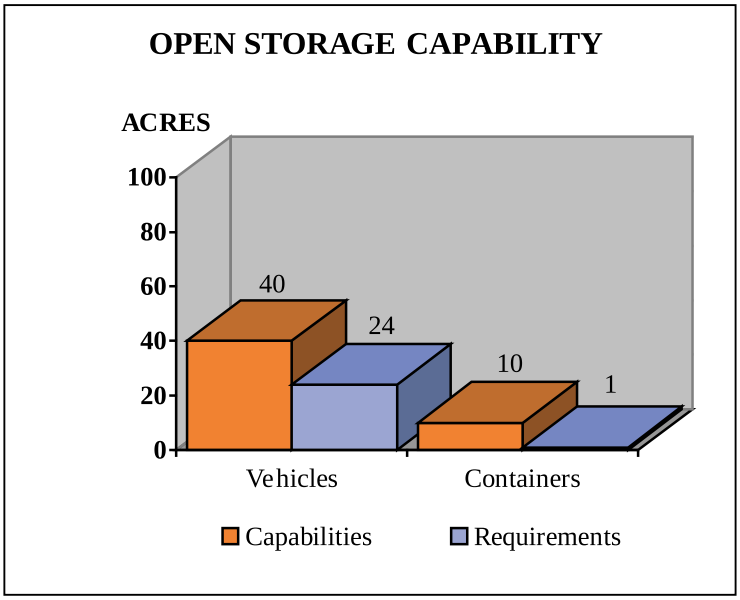


Rail End Ramp Locations



Open Storage

The port has 57.5 acres of open storage area (50 acres are at or near Pier 10). The staging area requirement for each LMSR is 25 acres. As the first ship fills up and the staging area empties, there is room to stage equipment for the next LMSR that will be loaded. This means that the staging area around Pier 10 is adequate to support two LMSR vessels. A deployment scenario for the Port of Galveston will likely call for the use of Pier 10, which is capable of berthing one LMSR vessel. Therefore, the 50 acres around Pier 10 should be more than enough to support a sustained LMSR loading operation. If needed, the port authority states that about 11.4 acres of off-port marshaling exists along a five block section of Harborside Drive between 30th and 37th Streets.



Pier 10 at the Port of Galveston

Shipping

Using the LMSRs to transport the regiment, Pier 10 will allow the ships to meet the 6-day loading requirement. Based on each LMSR being able to load in about 3 to 4 days, the two LMSRs can be loaded in 6 to 8 days. Berth space is adequate to allow the side and stern ramps on the LMSRs to be used to load the ships. If smaller ships are used for deployment, then additional time or berths will be required to move the regiment.

Deploying by LMSR requires one ship every 3 to 3.5 days. Each ramp on the LMSR will have to average about 130 STON per hour for 20 hours each day to meet the 6-day loading requirement. This equates to 15 vehicles per hour per ramp. Using a standard 400-STON-per-hour loading rate for an LMSR (two ramps used), the port should be able to meet the 6-day loading requirement if all facilities and resources are available. Deploying by FSS requires one ship every 2 days (total of three ships) to meet the same requirement. The FSS loading rate will have to be 260 STON per hour (one ramp) for 20 hours each day to meet the same 6-day requirement. This equates to 30 vehicles per hour for the ramp. The FSS loading rate is about 250 STON per hour. Therefore, loading the regiment on FSS vessels will take a little over 6 days if all facilities and resources are available.

SHIP REQUIREMENTS NOTIONAL ARMORED CAVALRY REGIMENT				
Loading Condition/ Sample Ship Mix	**FSS (RORO/Comb)**	**LMSR (RORO/Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	2.8			
All LMSR		1.7		
All Breakbulk			8.7	
Maximum Containerization				
FSS/Container	1.1			1.2
LMSR/Container		.7		1.2
Breakbulk/Container			3.5	1.2

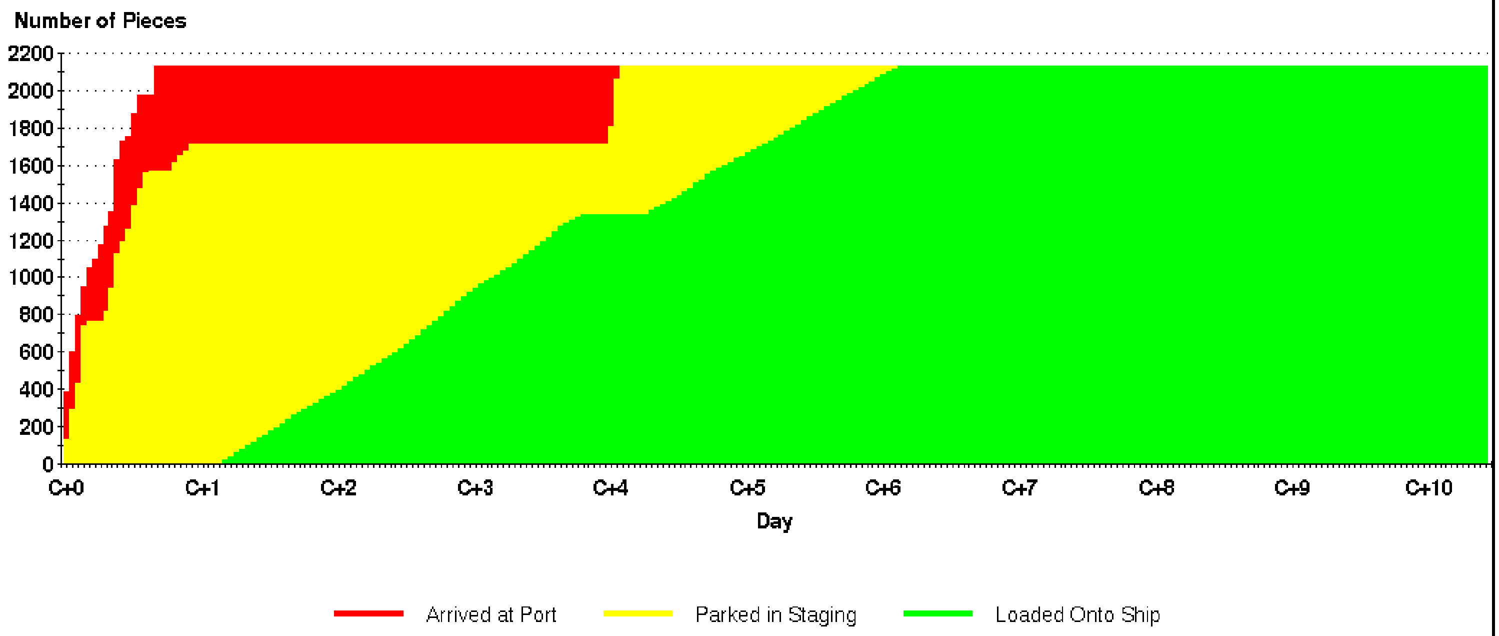
Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

SUMMARY

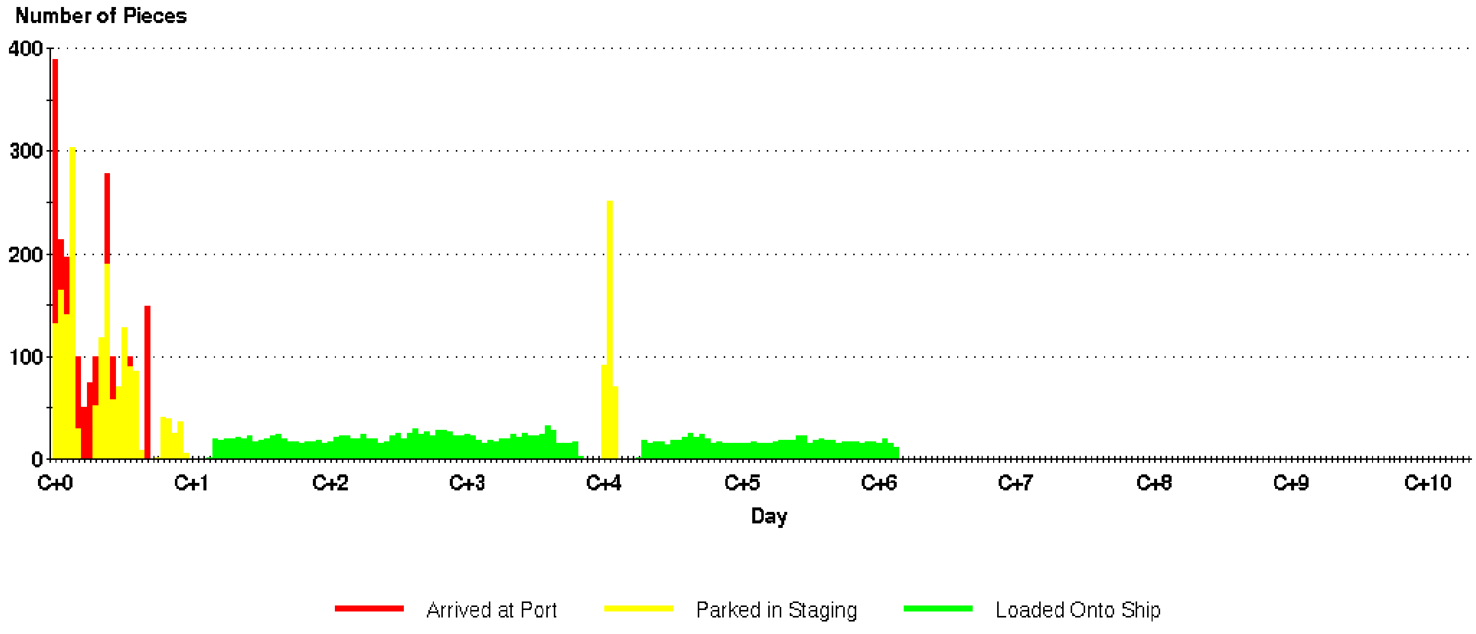
The Port of Galveston can load and clear a notional armored cavalry regiment in about 6 days using Pier 10 and LMSR ships. If other ships are used, additional berths may be required to meet the 6-day requirement.

The Port of Galveston is a viable port for supporting deployment of a notional armored cavalry regiment provided Pier 10 and the surrounding staging area are available for U.S. Military deployments.

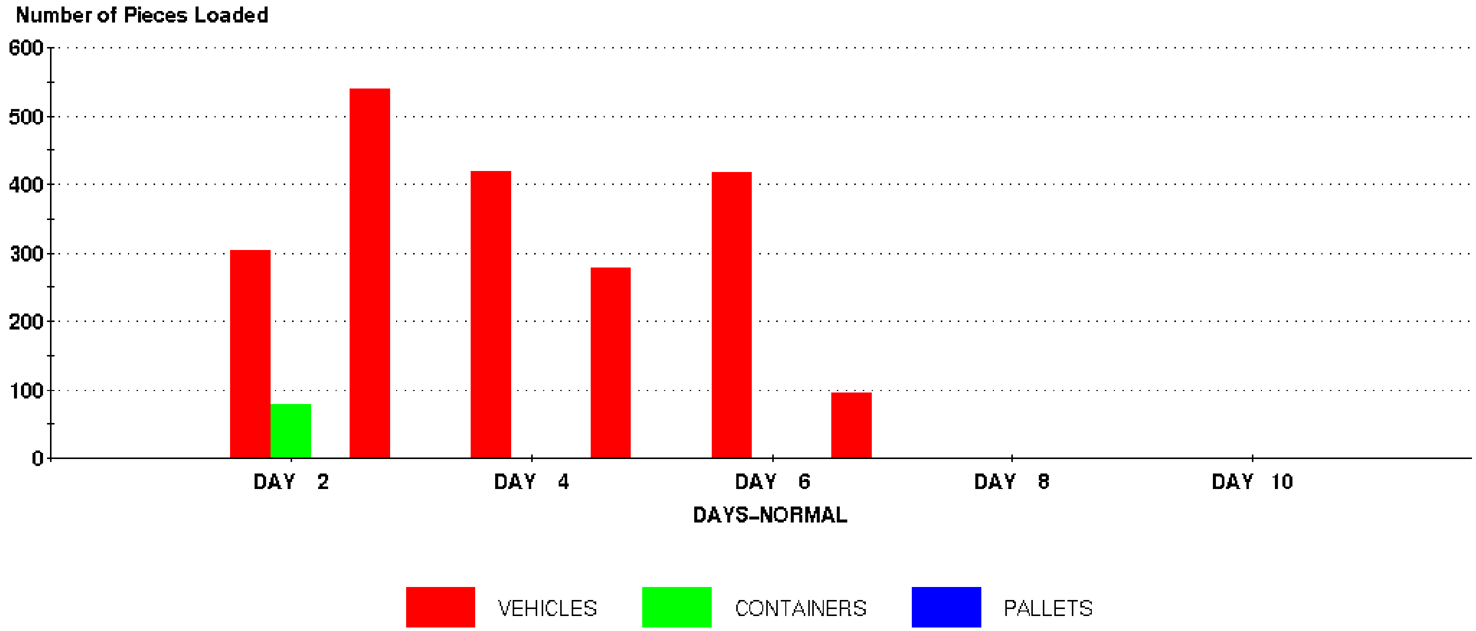
CUMULATIVE CLOSURE PROFILE FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



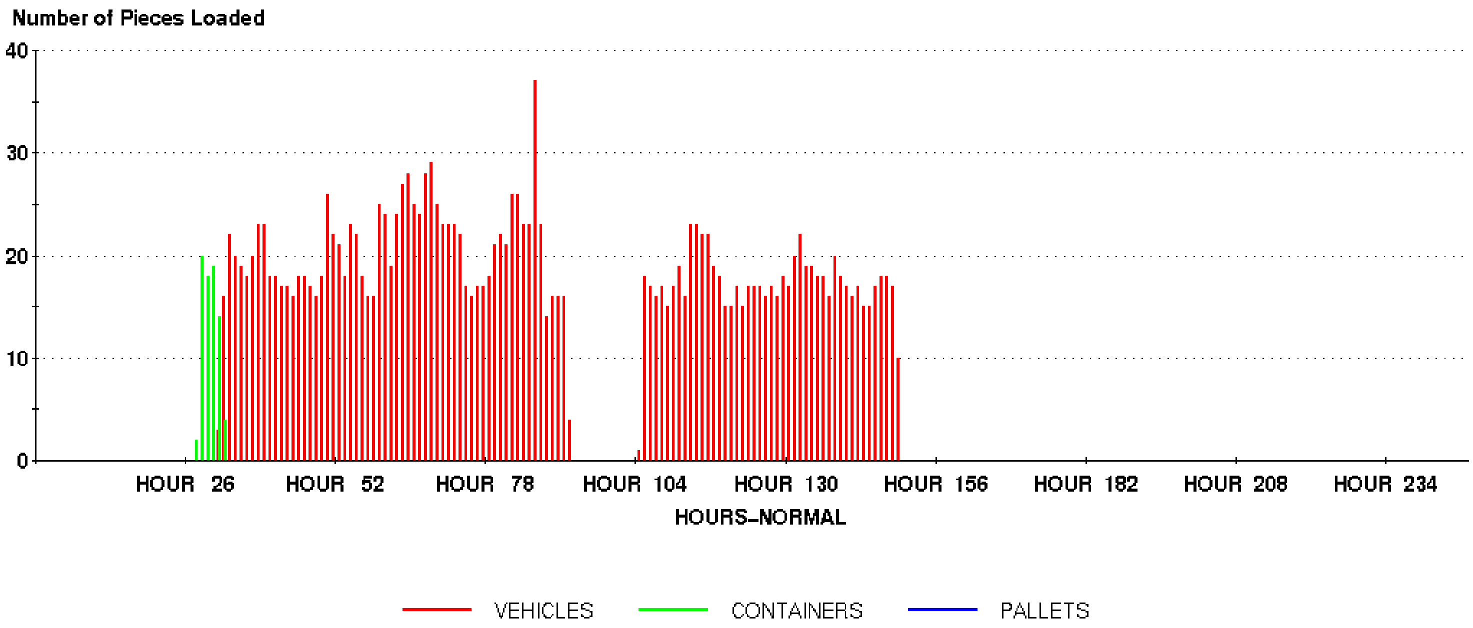
DAILY CLOSURE PROFILE FOR
NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



DAILY THROUGHPUT FOR
NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



HOURLY THROUGHPUT FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



PORT OF GALVESTON
TEXAS

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a site survey of the Port of Galveston in September 1997. This Ports for National Defense study is based on that site survey and 1999 - 2000 validation with the Galveston Port Authority. This port, a medium-size port located on Galveston Island, can easily throughput brigade-size units and can accommodate vessels as large as the LMSR.

The port is made up of various piers and quays. The premier berth (Berth 10) is 1,346 feet long with a water depth of 40 feet and has four container cranes. It also has 44 acres of paved open storage. This berth has potential for outloading Army brigades, but is also currently subleased by the Port of Houston for container operations to supplement those at Barbour's Cut in Houston.

The Port of Galveston is capable of breakbulk, RORO, container, and barge operations. This port is rail accessible by the Burlington Northern/Santa Fe and Union Pacific rail lines and has an airport 5 miles away. The airport has handled C-130s and B-727s in the past. Available materials handling equipment include a transtainer and port packers for container handling plus forklifts for palletized cargo. Mobile cranes are available through local stevedores. The port also has both truck and rail end ramps for offloading semitrailers and railcars.

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of about 40,930 STON (157,130 MTON) per day. RORO and container throughputs are about 48,400 STON and 14,500 STON per day, respectively. Computer simulations show that the port is capable of achieving closure for throughputting a notional armored cavalry regiment in about 6 days if all facilities and resources are available.

The U.S. Military would most likely use Berth 10 plus surrounding open staging area and adjacent covered storage for an actual deployment. For this application, we analyzed a notional heavy armored cavalry regiment deploying from the Port of Galveston on LMSR ships using Berth 10. A notional heavy armored cavalry regiment has about 31,350 STON (130,680 MTON) of vehicles and equipment. To deploy a notional heavy armored cavalry regiment in 6 days, the port must throughput about 5,210 STON of vehicles and equipment (that includes 24 containers) per day. When two LMSRs are available for loading in sequence, the port meets the shipping requirements. Smaller ships will require additional time or berths.

For sustained deployment operations, 25 acres of open staging per LMSR are desired to support daily sustained loading operations. The desired staging for an FSS is about 16 acres per ship to support daily sustained loading operations. Berths 10 and 14 combined have 50 acres.

The notional heavy armored cavalry regiment will require 54 railcars per day using the rail/convoy option. The port states that they can handle between 4-8 trains per day at 100 railcars per train.

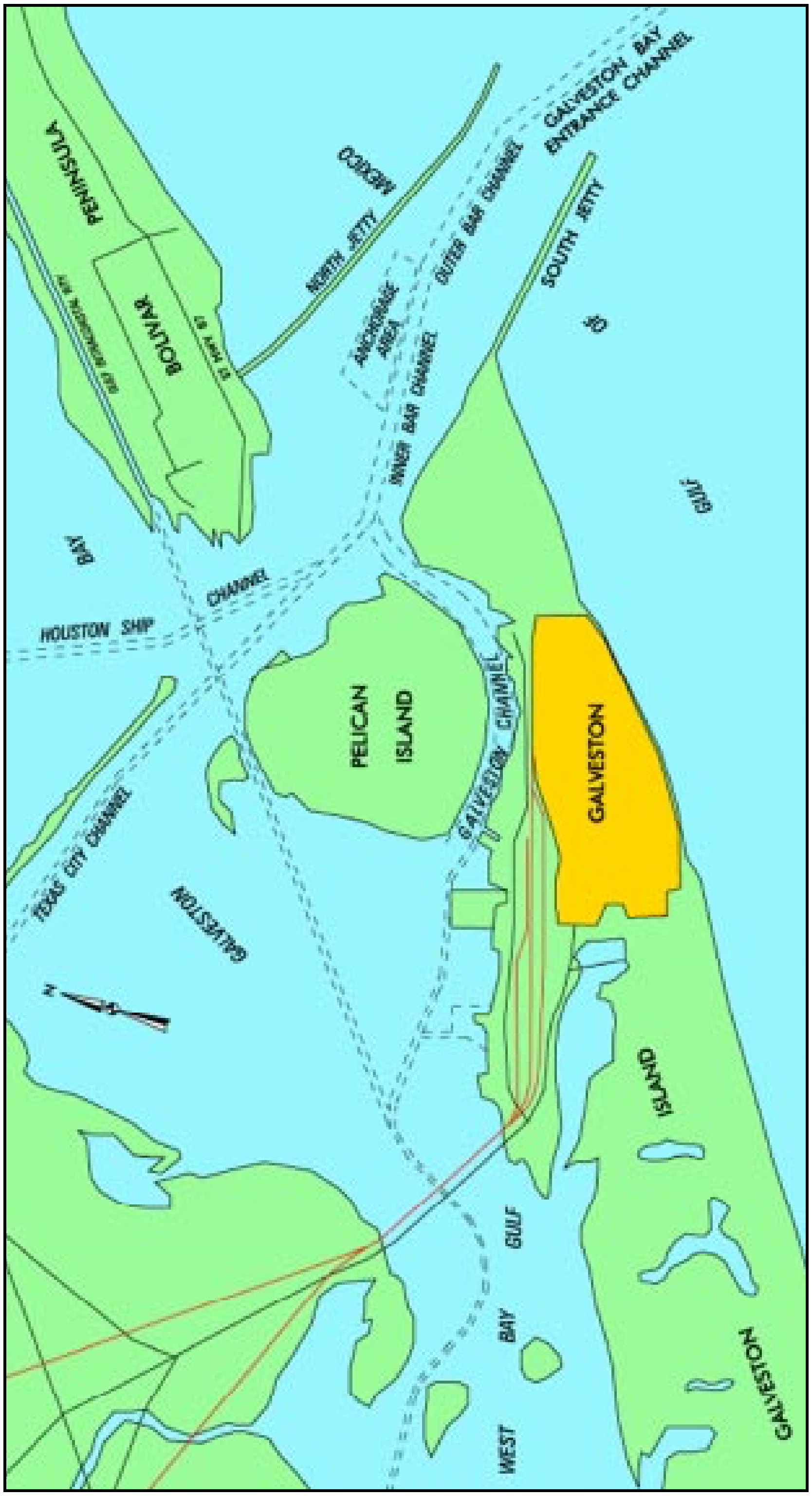
II. GENERAL DATA

The Port of Galveston, Texas, is a port on the U.S. Gulf Coast considered for use in deploying military equipment during contingencies. A team from the Military Traffic Management Command conducted a site survey in September 1997. This information was validated December 1999 - January 2000. Information on port characteristics was obtained from port officials.

TRANSPORTATION ACCESS

Water

The Port of Galveston (latitude 29.2° north, longitude 94.5° west, (HQLL)) is in southeastern Texas, about 50 miles southeast of Houston. The port is on the south side of Galveston Channel on Galveston Island. Galveston Channel connects Galveston Bay with the Gulf of Mexico. Entrance to the port is via four channels. These channels vary from 40 to 42 feet deep and 800 to 1,125 feet wide. No bridges cross the main ship channels between the Gulf of Mexico and the Port of Galveston. All vessels approaching and entering the port require pilots. The port authority reports that plenty of pilots and five tugboats are available. The port has not experienced any delays in the past in receiving vessels. The nearest anchorage is the Galveston Anchorage Basin (34 feet max draft at mean low water (MLW); area is 3,100 feet wide by 1.9 miles long). Vessels with deeper draft must anchor in the Gulf of Mexico. The turning basin has a depth of 40 feet MLW, a diameter of 1,125 feet, and is located in Galveston Channel. According to Navy standard operating procedures, ships do not normally turn in an area that is less than 1.5 times their length. Based on this guideline, the turning basin will be tight for FSS/LMSR vessels (about 950 feet in length). Tidal variation ranges from 1.5-2 feet in the summer and 1-3 feet in the winter.

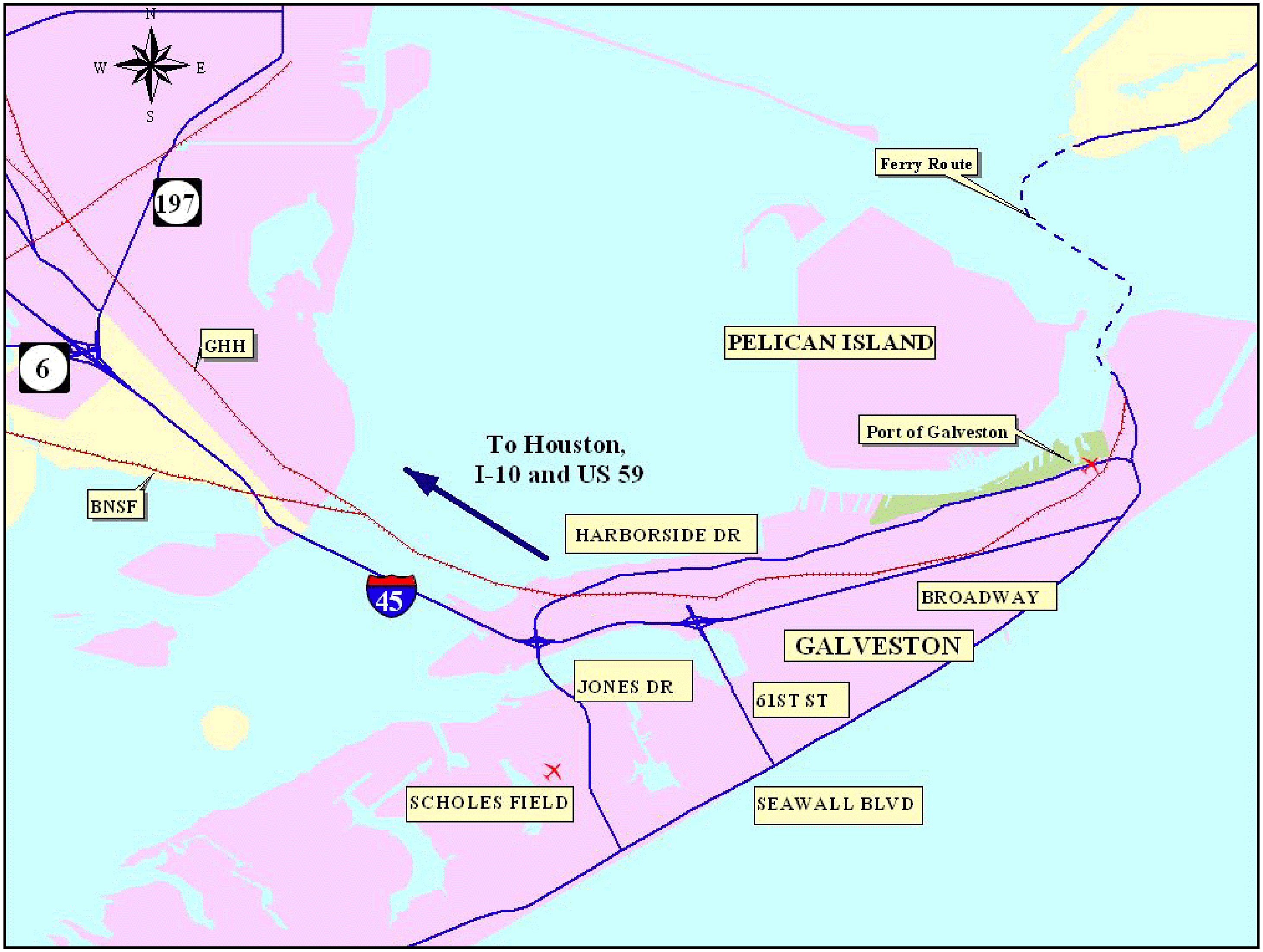


Water Access Map

Galveston's Channel

Highway

The port has good access to major highway routes. Interstate-45 (I-45) accesses Galveston Island and connects to other major routes to the north on the Texas mainland such as I-10 and U.S. Route 59. Harborside Drive (State Road 275) connects I-45 to the port. Harborside Drive is a two-lane road with speed limit of 45 mph. The 10th and 16th Streets gates provide access to the port. These gates have two lanes, one in each direction. Bridge clearance on Harborside Drive is 14 feet 7 inches.



Highway, Rail, and Air Access Map

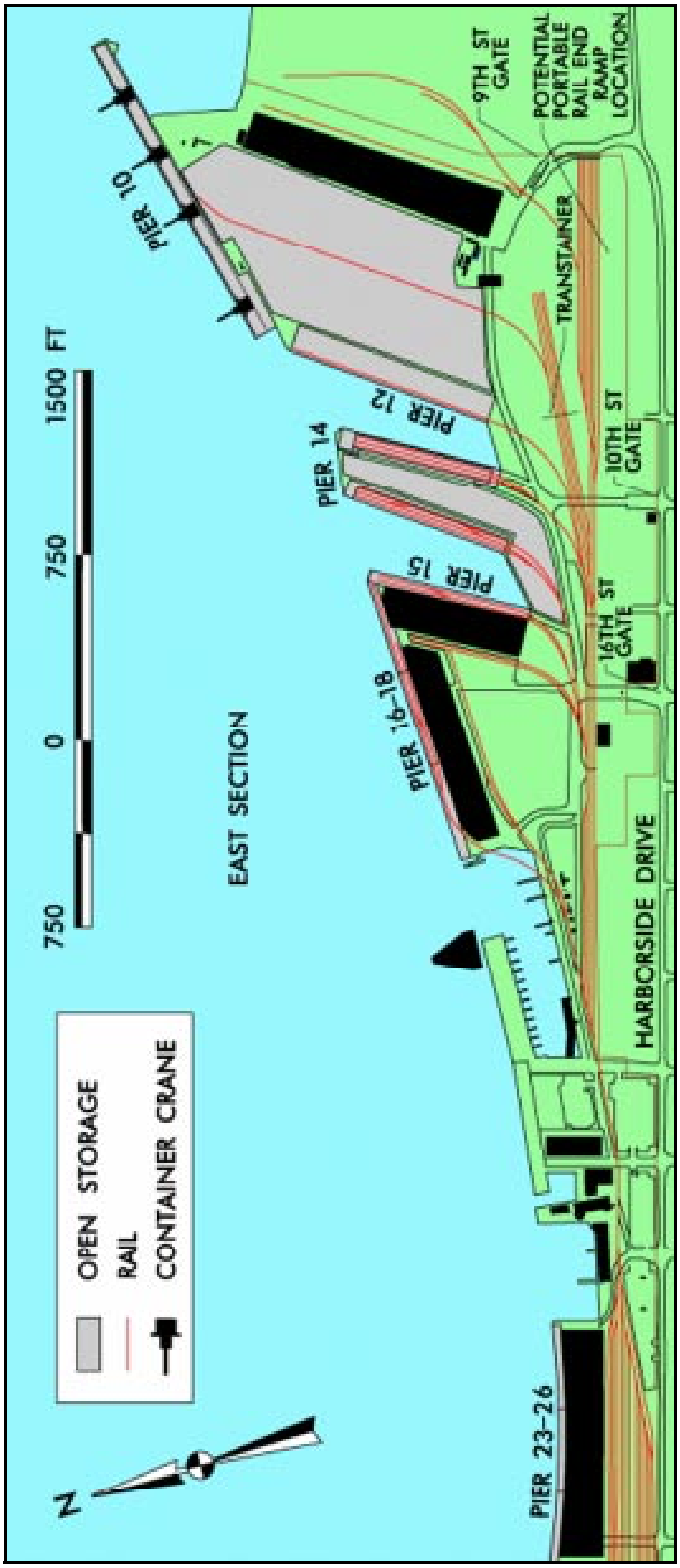
Rail

The Burlington Northern/Santa Fe (BNSF) and Union Pacific (UP) railroad companies provide service to the Port of Galveston. These carriers have railyards near the port. Rail clearances are sufficient for bilevel and trilevel railcars to access the port. The Galveston Railroad Company performs the switching operations for the major railroad companies. Commercial railyards near the port can store over 830 89-foot flatcars. The Port of Galveston spurs can store over 400 89-foot flatcars. Although used infrequently, the port reports that the storage spurs are in usable condition. These railyards were uncongested during the September 1997 visit. Rail trackage links the railyards to the port's apron tracks, transit sheds, and storage tracks. Apron tracks are along piers 10, 14W, 15, 16-18, 36, 37, 38, and 41. Rail service capability is estimated to be in the range of four-eight trains per day. A total of five rail end ramps exist at the port. One of the end ramps is a fixed end ramp located at Plant 3 with 600 feet of straight track. The other four ramps are portable. Two are light-duty (10 STON capacity) and constructed of aluminum. The other two are constructed of timber and used to offload Caterpillar crawler tractors.

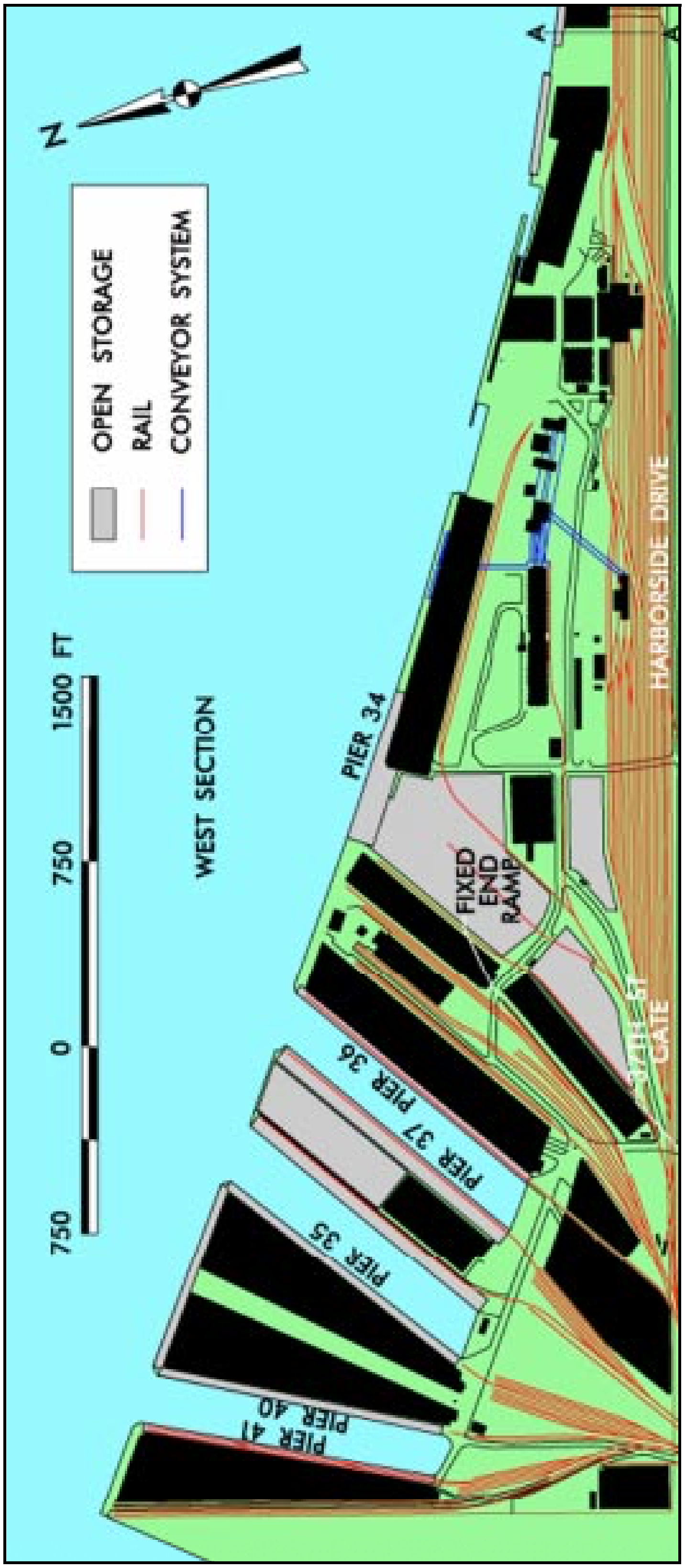
Railyard at the Port of Galveston

Air

Scholes Field is 5 miles southwest of the port and has three commercial runways. The longest is about 6,000 feet long, 150 feet wide, and has handled C-130 and B-727 aircraft. The port lists Piers 10, 34, and 37 as potential areas for helicopter operations. Pier 10 is ideal for helicopter operations as it has 44 acres of open storage and a transit shed nearby. The nearest military airfield is Ellington Air Force Base, approximately 25 miles north of the port on Highway 3, southeast of Houston.



Land-Use Map (eastward)



Land-Use Map (westward)

PORT FACILITIES

Berthing

The Port of Galveston is a multicargo port consisting of marginal wharves and finger piers capable of breakbulk, RORO, container, and barge operations.

Pier 10 is the premier wharf at the port and can handle RORO and container ships. It has a water depth of 40 feet MLW, a length of 1,346 feet (FSS and LMSR capable), an open apron, a transit shed, and four container cranes. Forty-four of the port's 57.5 acres of open storage are located at Pier 10. Currently, the Port of Houston has leased this pier as an extension of their container operations at the Barbour's Cut Terminal in Houston. Piers 12, 14E, and 14W are near Pier 10. Pier 12 adjoins Pier 10 and shares the staging area. Piers 14E and 14W have 6 acres of open storage. Piers 15, 16-18, 23-26, 34, 36, 37, 39, 40, and 41 are primarily suited for breakbulk operations. In general, these piers have transit sheds alongside and minimal apron width. Piers 34 and 37 have an open apron and a combined 7.5 acres of open storage.

Pier 10 is the best berth for military operations as it can handle FSS/LMSR vessels and can perform both RORO and container operations. This wharf has open and covered storage and direct rail access. Intermodal operations are possible at this berth. Berth characteristics for all berths are in the table below.

BERTH CHARACTERISTICS FOR THE PORT OF GALVESTON				
	Berths			
Characteristics	**10**	**12**	**14E**	**14W**
Length feet (meters)	1,346 (410.3)	845 (257.6)	663 (202.1)	689 (210.0)
Depth alongside at MLW feet (meters)	40 (12.19)	32 (9.75)	34 (10.36)	33 (10.06)
Deck Strength psf (metric tons per square meter)	600 (2.93)	500 (2.44)	500 (2.44)	500 (2.44)
Apron width feet (meters)	Open	Open	Open	Open
Apron height above MLW feet (meters)	11 (3.35)	11 (3.35)	14 (4.27)	10 (3.05)
Number of container cranes	4	0	0	0
Number of wharf cranes	0	0	0	0
Apron Lighting	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No	No
Apron length served by rail feet (meters)	0	0	0	689 (210.0)

BERTH CHARACTERISTICS FOR THE PORT OF GALVESTON - cont						
	Berths					
Characteristics	**15**	**16-18**	**23-26**	**34**	**36**	**37**
Length feet (meters)	663 (202.1)	1,203 (366.7)	1,415 (431.3)	632 (192.6)	1,206 (367.6)	1,163 (354.5)
Depth alongside at MLW feet (meters)	33 (10.06)	32 (9.75)	30 (9.14)	32 (9.75)	31 (9.45)	32 (9.75)
Deck Strength psf (metric tons per square meter)	500 (2.44)	500 (2.44)	500 (2.44)	600 (2.93)	500 (2.44)	500 (2.44)
Apron width feet (meters)	46 (14.02)	46 (14.02)	32 (9.75)	Open	35 (10.67)	Open
Apron height range feet (meters)	12 (3.66)	12 (3.66)	12 (3.66)	9 (2.74)	11 (3.35)	11 (3.35)
Number of container cranes	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0
Apron Lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No	No	No	No
Apron length served by rail feet (meters)	663 (202.1)	0	0	0	0	1,163 (354.5)

BERTH CHARACTERISTICS FOR THE PORT OF GALVESTON - cont			
	Berths		
Characteristics	**39**	**40**	**41**
Length feet (meters)	1,173 (357.5)	1,164 (354.8)	1,195 (364.2)
Depth alongside at MLW feet (meters)	32 (9.75)	32 (9.75)	32 (9.75)
Deck Strength psf (metric tons per square meters)	500 (2.44)	500 (2.44)	500 (2.44)
Apron width feet (meters)	38 (11.58)	40 (12.19)	35 (10.67)
Apron height range feet (meters)	11 (3.35)	11 (3.35)	11 (3.35)
Number of container cranes	0	0	0
Number of wharf cranes	0	0	0
Apron Lighting	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No
Apron length served by rail feet (meters)	0	0	1,195 (364.2)

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF GALVESTON

Vessels		Berths			
TYPE	CLASS	10	12	14E	14W
BREAKBULK	C3-S-38a	2	1	1	1
	C4-S-58a	2	1	1	1
	C4-S-66a	2	1,a	1	1
	C5-S-37e	2	1	1	1
SEATRAIN	GA and PR	2	1	1	1
BARGE	LASH C8-S-81b	1	1,a	a,c	a,c
	LASH C9-S-81d	1	a,c	a,c	a,c
	LASH Lighter	6	4	3	3
	SEABEE C8-S-82a	1	a,c	a,c	a,c
	SEABEE Barge	6	4	3	3
RORO	COMET	2,d,i,j	1,d,i,j	1,d,i,j	1,d,i,j
	METEOR	2,d,i,j	1,d,i,j	1,d,i,j	1,d,i,j
	Cape Gnome	2,d,i,j	1,a,d,i,j	1,d,i,j	1,a,d,i,j
	C7-S-95A	1	1,a	c	a,c
	Cape Taylor	2	1	1	1
	Cape Orlando	2,i,j	1,i,j	1,i,j	1,i,j
	MV Ambassador	2,d	1,d	1,d	1,d
	Callaghan	1,d,i	1,d,i	c,d,i,j	c,d
	Cape Lambert	1,i,j	1,i,j	c	1,i,j
	LMSR Class	1	a,c	a,c	a,c
	FSS	1	a,c	a,c	a,c
	Cape E-Class	1,i,j	1,i,j	1,i,j	1,i,j
	Cape D-Class	1,i,j	1,a	c	1,i,j
	Cape H	1	1,a	a,c	a,c
RORO	Cape Texas	2,i,j	1,i,j	1,i,j	1,i,j
	Cape R	2,d	1,a,d	1,d	1,d
	Cape I-class	1,i,j	1,i,j	c	1,i,j
	Cape Victory	2,i	1,i	1,i,j	1,i
CONTAINER	C6-M-147a	1	1,e	1,e	1,e
	C7-S-69c	1	1,e	c,e	1,e
	C7-S-68c	1	1,e	c,e	c,e
	C8-S-85c	1	1,a,e	c,e	c,e
	C9-M-132b	1	a,c,e	a,c,e	a,c,e
	C9-M-F141a	1	a,c,e	a,c,e	a,c,e
TACS	C6-S-1qd	1	1	c	1
	C5-S-MA73c	2	1	1	1
	C6-S-MA60d	1	1	c	1
MPS	C7-S-133a	1	1,a	c	c
	Maersk	1	1,a	c	c
	AmSea	1	1	c	1

NOTES:

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c-inadequate berth length
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e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ May Prevent Operation

♦ May Limit Operation

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF GALVESTON - cont							
Vessels		Berths					
TYPE	CLASS	15	16-18	23-26	34	36	37
BREAKBULK	C3-S-38a	1	2	2	1	2	2
	C4-S-58a	1	2	2,a	1	2	1
	C4-S-66a	1	2,a	2,a	1,a	2,a	2,a
	C5-S-37e	1	1	2	1	1	1
SEATRAIN	GA and PR	1	2	2	1	2	1
BARGE	LASH C8-S-81b	a,c	1,a	1,a	a,c	1,a	1,a
	LASH C9-S-81d	a,c	1,a	1,a	a,c	1,a	1,a
	LASH Lighter	3	6	7	3	6	5
	SEABEE C8-S-82a	a,c	1,a	1,a	a,c	1,a	1,a
	SEABEE Barge	3	6	7	3	6	5
RORO	COMET	1,d,o	2,d,o	2,d,o	1,d,i	2,d,o	2,d,i,j
	METEOR	1,d,o	2,d,o	2,d,o	1,d,i	2,d,o	2,d,i,j
	Cape Gnome	1,a,d,o	1,a,d,o	2,a,d,o	1,a,d,i,j	1,a,d,o	1,a,d,i,j
	C7-S-95A	a,b,c	1,a,b	1,a,b	a,c	1,a,b	1,a
	Cape Taylor	1,b	1,b	2,b	c	1,b	1
	Cape Orlando	1,b	1,b	2,b	c	1,b	1,i,j
	MV Ambassador	1,d	2,d	2,d	1,d	2,d	2,d
	Callaghan	c,d,o	1,d,o	1,d,o	c,d	1,d,o	1,d,i
	Cape Lambert	b,c	1,b	2,a,b	c	1,b	1,i,j
	LMSR Class	a,b,c	1,a,b	1,a,b	a,c	1,a,b	1,a
	FSS	a,b,c	1,a,b	1,a,b	a,c	1,a,b	1,a
	Cape E-Class	1,b	1,b	2,a,b	c	1,a,b	1,i,j
	Cape D-Class	b,c	1,a,b	2,a,b	a,c	1,a,b	1,a
	Cape H	a,b,c	1,a,b	1,a,b	a,c	1,a,b	1,a
RORO	Cape Texas	1,b	1,b	2,b	c	1,b	1,i,j
	Cape R	1,d	1,a,d	2,a,b,d,o	a,c,d	1,a,b,d	1,a,d
	Cape I-class	b,c	1,b	1,a,b	c	1,a,b	1,i,j
	Cape Victory	1,b	1,b	2,b	1	1,b	1,i
CONTAINER	C6-M-147a	1,b,e	1,b,e	2,b,e	c,e	1,b,e	1,e
	C7-S-69c	b,c,e	1,b,e	2,a,b,e	c,e	1,b,e	1,e
	C7-S-68c	b,c,e	1,b,e	1,a,b,e	c,e	1,a,b,e	1,e
	C8-S-85c	b,c,e	1,a,b,e	1,a,b,e	a,c,e	1,a,b,e	1,a,e
	C9-M-132b	a,b,c,e	1,a,b,e	1,a,b,e	a,c,e	1,a,b,e	1,a,e
	C9-M-F141a	a,b,c,e	1,a,b,e	1,a,b,e	a,c,e	1,a,b,e	1,a,e
TACS	C6-S-1qd	b,c	1,b	2,a,b	c	1,b	1
	C5-S-MA73c	1,b	1,b	2,a,b	1	1,b	1
	C6-S-MA60d	b,c	1,b	2,a,b	c	1,a,b	1
MPS	C7-S-133a	b,c	1,a,b	1,a,b	a,c	1,a,b	1,a
	Maersk	b,c	1,a,b	1,a,b	a,c	1,a,b	1,a
	AmSea	b,c	1,b	2,a,b	c	1,a,b	1

NOTES:

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o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF GALVESTON - cont				
Vessels		Berths		
TYPE	CLASS	39	40	41
BREAKBULK	C3-S-38a	2	2	2
	C4-S-58a	1	1	2
	C4-S-66a	2,a	2,a	2,a
	C5-S-37e	1	1	1
SEATRAIN	GA and PR	2	1	2
BARGE	LASH C8-S-81b	1,a	1,a	1,a
	LASH C9-S-81d	1,a	1,a	1,a
	LASH Lighter	5	5	5
	SEABEE C8-S-82a	1,a	1,a	1,a
	SEABEE Barge	5	5	5
RORO	COMET	2,d,o	2,d,o	2,d,o
	METEOR	2,d,o	2,d,o	2,d,o
	Cape Gnome	1,a,d,o	1,a,d,o	1,a,d,o
	C7-S-95A	1,a,b	1,a,b	1,a,b
	Cape Taylor	1,b	1,b	1,b
	Cape Orlando	1,b	1,b	1,b
	MV Ambassador	2,d	2,d	2,d
	Callaghan	1,d,o	1,d,o	1,d,o
	Cape Lambert	1,b	1,b	1,b
	LMSR Class	1,a,b	1,a,b	1,a,b
	FSS	1,a,b	1,a,b	1,a,b
	Cape E-Class	1,b	1,b	1,b
	Cape D-Class	1,a,b	1,a,b	1,a,b
	Cape H	1,a,b	1,a,b	1,a,b
RORO	Cape Texas	1,b	1,b	1,b
	Cape R	1,a,b,d	1,a,b,d	1,a,b,d
	Cape I-class	1,b	1,b	1,b
	Cape Victory	1,b	1,b	1,b
CONTAINER	C6-M-147a	1,b,e	1,b,e	1,b,e
	C7-S-69c	1,b,e	1,b,e	1,b,e
	C7-S-68c	1,b,e	1,b,e	1,b,e
	C8-S-85c	1,a,b,e	1,a,b,e	1,a,b,e
	C9-M-132b	1,a,b,e	1,a,b,e	1,a,b,e
	C9-M-F141a	1,a,b,e	1,a,b,e	1,a,b,e
TACS	C6-S-1qd	1,b	1,b	1,b
	C5-S-MA73c	1,b	1,b	1,b
	C6-S-MA60d	1,b	1,b	1,b
MPS	C7-S-133a	1,a,b	1,a,b	1,a,b
	Maersk	1,a,b	1,a,b	1,a,b
	AmSea	1,b	1,b	1,b

NOTES:

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Ramp clearance and angle based on maximum vessel draft

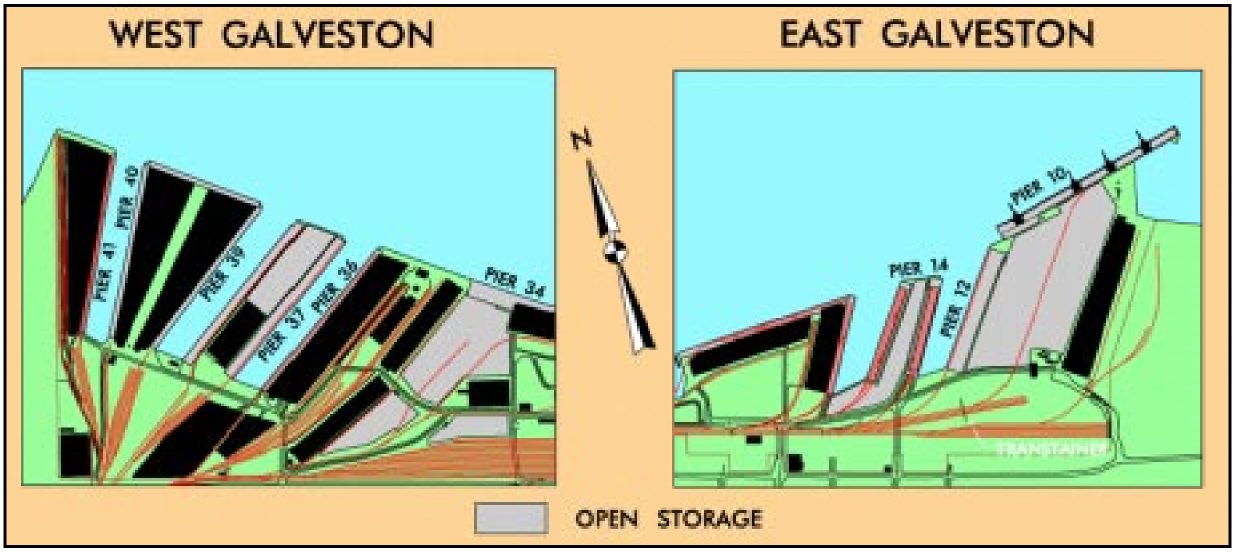
♦ **May Prevent Operation**

♦ **May Limit Operation**

STAGING

Open Staging

The Port of Galveston has about 57.5 acres of paved open storage. Most of this staging (50 acres) is distributed in the Pier 10 area, adjacent to Berths 10, 12, 14E, and 14W. The rest of the acreage is evenly distributed among Piers 34 and 37. Sufficient open staging exists in these areas to allow helicopter operations.



Open Staging Areas

Open Staging Area at Pier 10

Covered Staging

The port has ample covered storage available for general cargo, helicopter operations, and container stuffing/unstuffing operations. Transit sheds are located at or near each of the berths. The Port of Galveston has a total of 1,328,538 square feet of available covered storage

Covered Staging Area at Pier 10 Transit Shed

UNLOADING/LOADING POSITIONS

Ramps and Docks

Ramps and docks are located throughout the port. The port has one fixed rail end ramp constructed of timber at Plant 3. Six hundred feet of straight track serves this ramp. Four other portable end ramps are also available at the port. Two are light-duty (10 STON-capacity) constructed of aluminum and two are made of timber and used for loading/offloading Caterpillar crawler tractors. The port authority also lists a steel truck end ramp at Pier 37. This end ramp can accommodate two truck positions.

Eight of the transit sheds have truck-level docks that provide 86 truck handling positions. Most of these buildings have railcar-level platforms. These platforms provide about 165 railcar handling positions.

Marshaling Areas

The port states that Army equipment could park curbside along a five-block section of Harborside Drive between 30th and 37th Streets. This area amounts to about 11.4 acres.

MATERIALS HANDLING EQUIPMENT (MHE)			
Type of Equipment	**Capacity (STON)**	**Quantity**	**Wharf Assignment**
Container Cranes	50	3	Pier 10
Container Crane	60	1	Pier 10
Transtainer	40	1	Piers 10, 12, 14E, and 14W
Port Packer	36	2	
Port Packer	42	3	
Port Packer	42.5	3	
Forklifts	31	2	
NOTE: The table above represents equipment owned by the port. The port authority indicates that other equipment is available through local stevedores.			

FUTURE DEVELOPMENT

The Port of Galveston reports three developments that will occur in the near future.

1. The port plans to tear down the transit shed on Pier 36 to make 220,000 square feet of open storage.

2. Dredging will occur on a yearly basis instead of biyearly.

3. The BNSF railyard will be removed.

EXPLOSIVES AND HAZARDOUS CARGO OPERATIONS

During the September 1997 visit, the port's fire marshal stated that Pier 10 was the preferred berth for any explosives and hazardous cargo operations. The fire marshal further stated that the military was exempt from restrictions. If contractors are used, the fire marshal needs to coordinate with the contractor to verify handling procedures. The port authority states that 20 acres of additional storage for explosives exist on the west side of Pier 41.

STEVEDORES

The port authority reports that as much labor as needed is available through local stevedores licensed by the Port of Galveston/Houston.

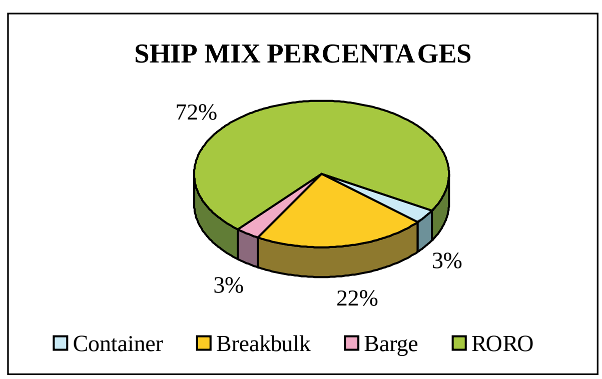
III. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Galveston. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal reception/handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON.

Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 70 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

Highway

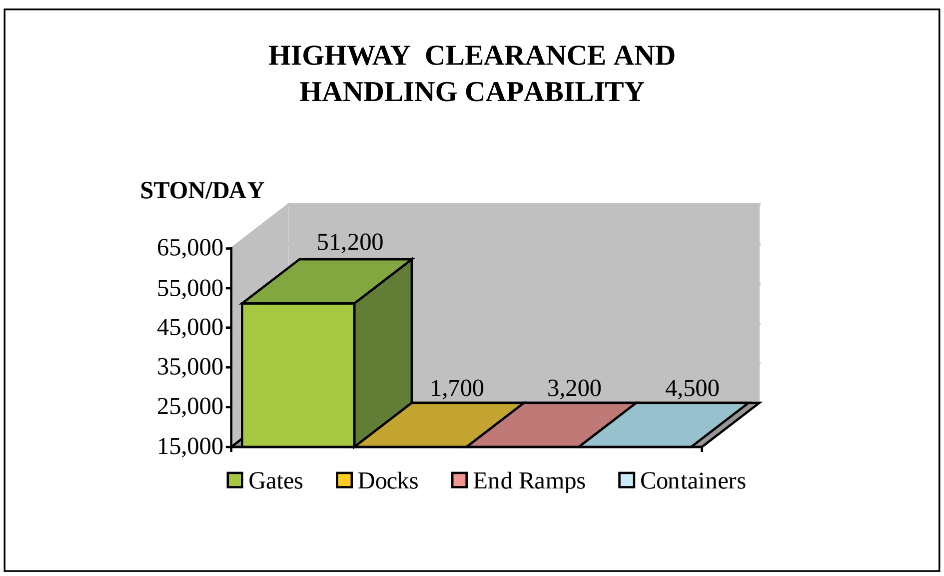
Harborside Drive is the roadway that connects the Port of Galveston to I-45. Two gates provide access to the port from Harborside Drive. These gates can handle at least 51,200 STON of cargo per day. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or leave the port on each lane of the highway.

Roadable vehicles will move through the terminal gates in manageable convoys to staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for offloading vehicles, must use portable ramps. If not available, deploying units/military port operators must either build or acquire the necessary ramps. For this study, we assumed that the portable truck end ramp at Pier 37 would be used for offloading operations. This ramp can handle 3,200 STON of military vehicles and equipment per day.

The port has 86 handling positions to load/unload supplies in van semitrailers. These positions can load/unload at least 1,700 STON of shipped material per day.

The Port of Galveston has three port packers available. By using the port packers for container handling, the port can handle at least 4,500 STON of containerized equipment and supplies per day.

Maximum daily handling capability for the port is a mixed total of the three types of handling (docks, end ramps, and containers), each up to its maximum, not to exceed the daily gate limit of at least 51,200 STON.



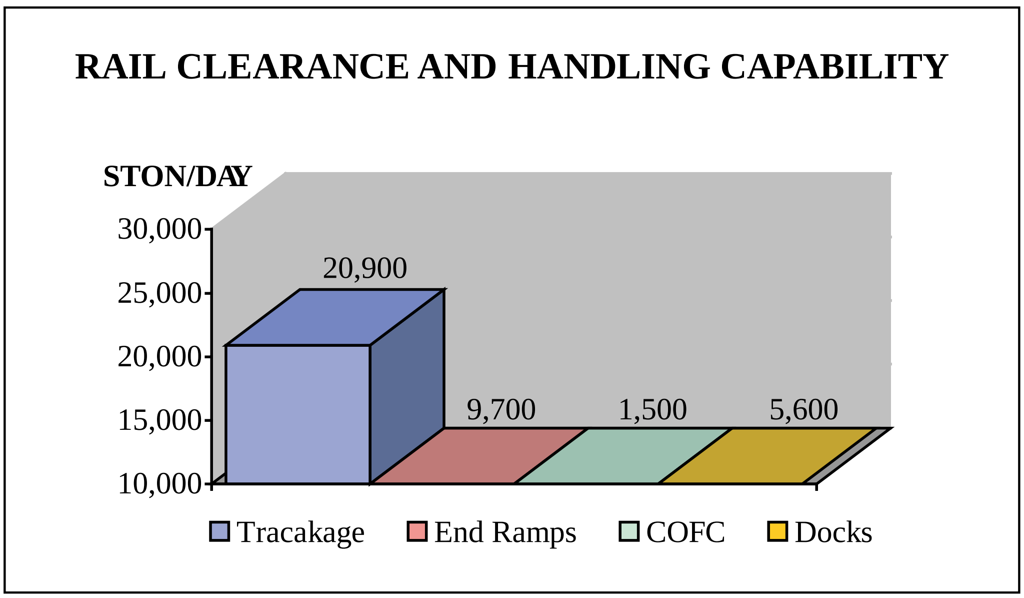
Rail

The Port of Galveston has ample rail reception with the BNSF and UP railroads providing rail service. The Galveston Railroad Company performs the switching operations to deliver the railcars from the commercial carrier to the port. Current rail service can support a range of four-eight trains per day (up to 100 railcars per train). These trains can handle at least 20,900 STON per day.

Vehicles on flatcars will offload in the port on the three available rail end ramps (one fixed and two portable). The end ramps can handle about 9,700 STON per day.

Boxcars will load/offload at the storage buildings. The port has about 180 rail handling positions available for loading/unloading boxcars. These docks can handle about 5,600 STON per day.

Based on using the transtainer for offloading railcars, the port can offload at least 1,500 STON of containerized equipment and supplies from railcars per day.



Staging

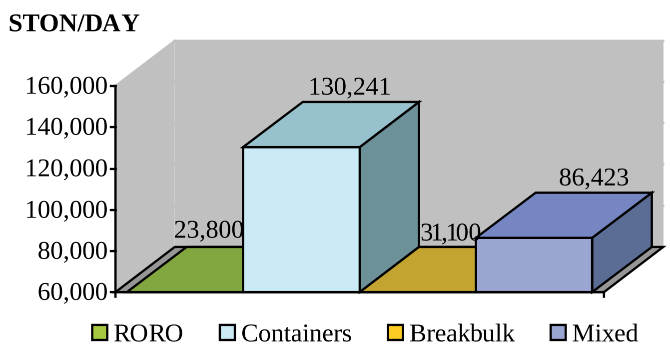
The port has 57.5 acres of suitable open staging area. Fifty acres of this total is located at Piers10-14. Because the Port of Houston has subleased this area, availability is questionable. However, for purposes of determining a staging capability, we assumed the entire area would be available (facility use factor of 100 percent).

The port lists 1,328,538 square feet of covered storage space. Although some of this space will support container operations at Pier 10 and breakbulk operations in other covered facilities, the port should still have plenty to support military operations. About 26,600 STON of breakbulk cargo can be staged in the covered area.

The chart on this page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of the capability for each type cargo operation involved should be assumed.

The table shows the STON of cargo, by type, the port can expect to handle. The dwell time used in this computation was 3 days and the open space utilization percentage was 60 percent. The container storage throughput capability is the highest with 130,241 STON. The ability to stack containers three high in the paved open storage areas contributes to the high staging throughput value. The RORO storage throughput is about 23,800 STON. The breakbulk staging throughput is about 31,100 STON.

OPEN STAGING CAPABILITY



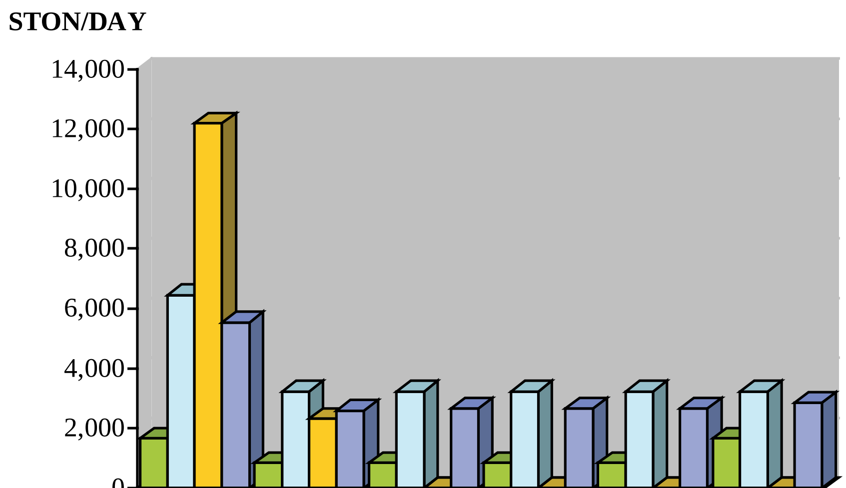
Note: Container staging area can also be used for RORO staging as needed.

Shipping

Daily shipping subsystem totals for the terminal berths are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types.

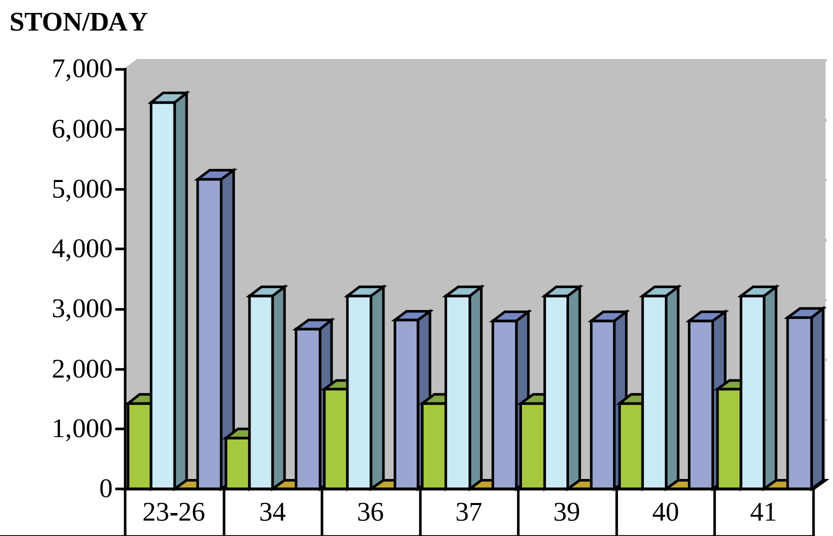
Pier 10 is the best choice for performing RORO operations due to the ample berth length, apron width, and apron height. This pier also has the port's only container cranes and is the obvious choice for container operations. The nearby transit shed also supports breakbulk operations at Pier 10, making this the most versatile wharf at the Port of Galveston.

BERTH THROUGHPUT CAPABILITY



	10	12	14E	14W	15	16-18
RORO	1,664	851	851	851	851	1,664
Container	6,451	3,225	3,225	3,225	3,225	3,225
Breakbulk	12,192	2,320	0	0	0	0
Mixed	5,542	2,594	2,669	2,669	2,669	2,859

BERTH THROUGHPUT CAPABILITY - cont



	23-26	34	36	37	39	40	41
RORO	1,432	851	1,664	1,432	1,432	1,432	1,664
Container	6,451	3,225	3,225	3,225	3,225	3,225	3,225
Breakbulk	0	0	0	0	0	0	0
Mixed	5,169	2,669	2,819	2,805	2,805	2,805	2,859

DAILY THROUGHPUT SUMMARY

BERTH	LENGTH (feet) (meters)	DEPTH ALONGSIDE (feet) (meters)	BREAKBULK THROUGHPUT (STON) (MTON)	RORO THROUGHPUT (STON) (MTON)	RORO SQUARE FT[1] (EST)	RORO PIECES[2]	CONTAINER THROUGHPUT (STON) (MTON) (TEU)[3]	BARGE THROUGHPUT (STON) (MTON)	MIXED THROUGHPUT (STON) (MTON)
10	1,346 410.3	40 12.2	1,664 4,161	6,451 25,804	129,020	759	12,192 30,480 1,524	0	5,542 21,039
12	845 257.6	32 9.75	851 2,128	3,225 12,902	64,500	379	2,320 5,800 290	516 1,290	2,594 9,970
14E	663 202.1	34 10.4	851 2,128	3,225 12,902	64,500	379	0	0	2,669 10,380
14W	689 210.0	33 10.06	851 2,128	3,225 12,902	64,500	379	0	0	2,669 10,380
15	663 202.1	33 10.06	851 2,128	3,225 12,902	64,500	379	0	0	2,669 10,380
16-18	1,203 366.7	32 9.75	1,664 4,161	3,225 12,902	64,500	379	0	0	2,859 10,856
23-26	1,415 431.3	30 9.14	1,432 3,580	6,451 25,804	129,020	759	0	1,806 4,515	5,169 20,105
34	632 192.6	32 9.75	851 2,128	3,225 12,902	64,500	379	0	0	2,669 10,380
36	1,206 367.6	31 9.45	1,664 4,161	3,225 12,902	64,500	379	0	1,548 3,870	2,819 10,640
37	1,163 354.5	32 9.75	1,432 3,580	3,225 12,902	64,500	379	0	0	2,805 10,720
39	1,173 357.5	32 9.75	1,432 3,580	3,225 12,902	64,500	379	0	0	2,805 10,720
40	1,164 354.8	32 9.75	1,432 3,580	3,225 12,902	64,500	379	0	0	2,805 10,720
41	1,195 364.2	32 9.75	1,664 4,161	3,225 12,902	64,500	379	0	0	2,859 10,856

[1]Based on the 20 square foot per STON average accomplished during Operation Desert Shield/Storm.
[2]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.
[3]Based on the 8 STON per TEU average accomplished during Operation Desert Shield/Storm.

SUMMARY

The port is multioperational with the capability to handle all types of vessels: container, RORO, breakbulk, and barges.

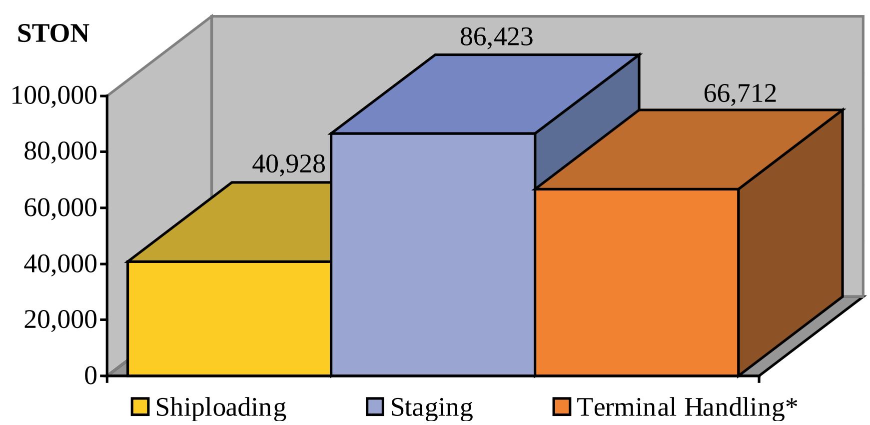
The Port of Galveston is fully capable of supporting U.S. Military deployment operations. Due to the Port of Houston subleasing Port of Galveston facilities, primarily Pier 10, the availability of Pier 10 and the surrounding open and covered staging areas during a contingency is questionable. The port may experience difficulty in clearing staging areas in sufficient time to adequately support military operations.

Pier 10 can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of at least 40,900 STON.

During the September 1997 visit, rail traffic into the port appeared uncongested even though other ports in the Texas/Louisiana region experienced congestion due to the rail mergers. Also, area railyards appeared uncongested. This would indicate that the Port of Galveston can readily handle an increase in rail traffic due to a military deployment.

DAILY CARGO THROUGHPUT CAPACITY



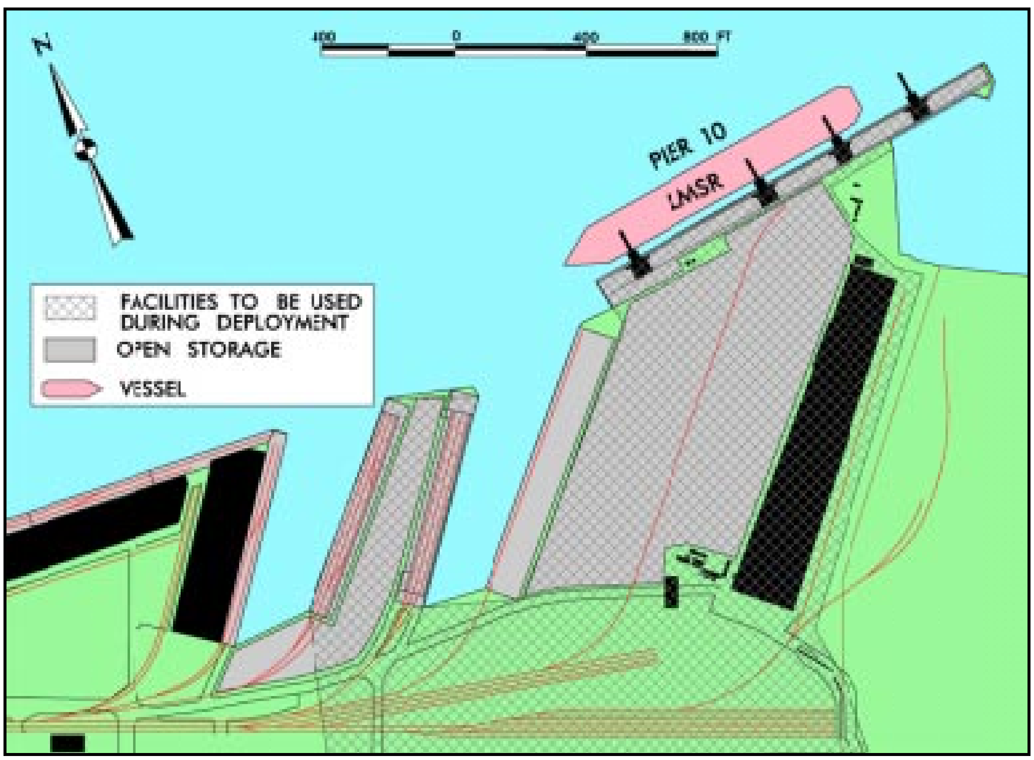
Terminal handling is the sum of the highway (51,212 STON) and rail (15,500 STON)

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored cavalry regiment using primarily LMSR vessels. We assume that Pier 10 and the surrounding staging area will be available for deployment. We also assume that no other military units will be competing for these facilities during the time that the armored cavalry regiment occupies the port. We further assume that the required assets, both transporters and people will be available to adequately load the ship and clear the port.

To evaluate the port's deployment capability, we used the port simulation (PORTSIM) model to flow unit equipment in the armored cavalry regiment through the port. PORTSIM is a time-stepped, discrete event, stochastic simulation of port operations during a force deployment. The PORTSIM is dynamically modeled for visual monitoring and quick identification of problems and allows the analyst to determine port closure/clearance times. For this simulation, we assume that the deploying regiment will use the facilities identified in the graphic below during a deployment. Also, we assumed that the Port of Galveston would use two container cranes, the transtainer, and the three port packers during shiploading.



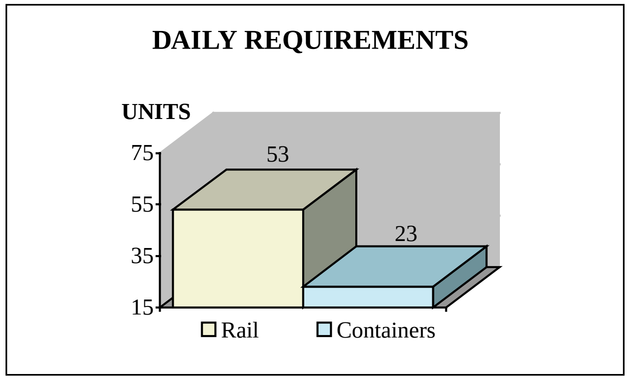
Potential Port Use During Deployment

REQUIREMENTS

To simulate a likely requirement for the Port of Galveston, we deployed a notional armored cavalry regiment, using 6 days for shiploading and port closure. The regiment has to move 2,138 vehicles and 140 containers. Movement of the regiment to the port will require 319 railcars using a convoy/rail option for transport to the port. About 23 containers would arrive daily.

TOTAL EQUIPMENT	
Volume	84,440 MTON
Weight	31,267 STON
Area	433,658 SQ FT
Vehicles	2,138
Containers	140

Note: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997



SIMULATION RESULTS

Total deployment time for the regiment was about 6 days with the last 5 of those days used for shiploading and the first day used for initial reception and staging. LMSR vessels were used to deploy the regiment. Actual throughput and closure results are shown in the charts at the end of this study.

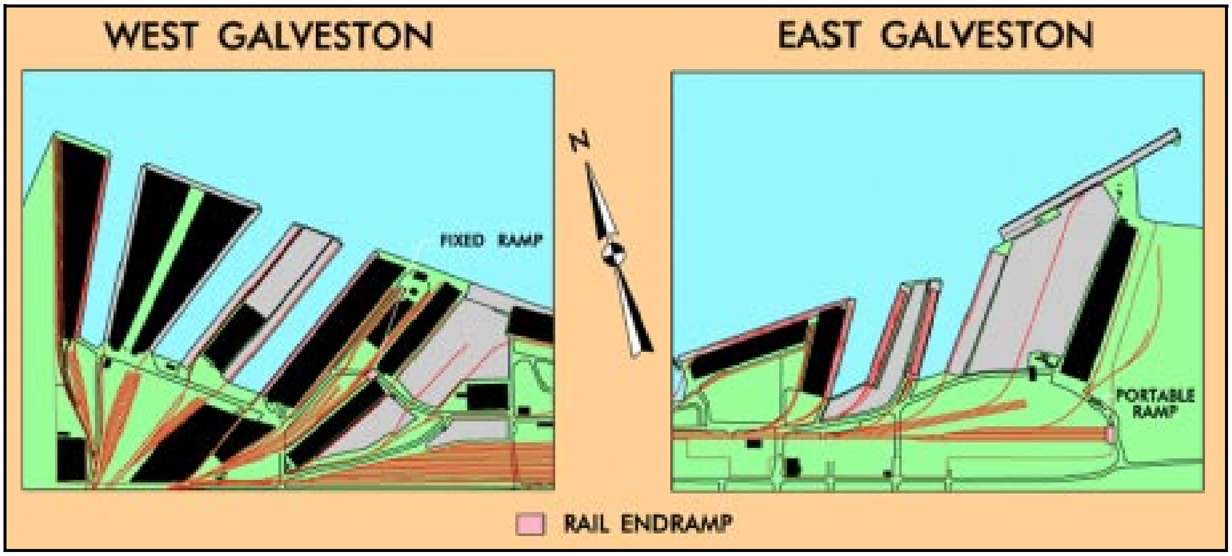
TERMINAL INPROCESSING/HANDLING

Rail

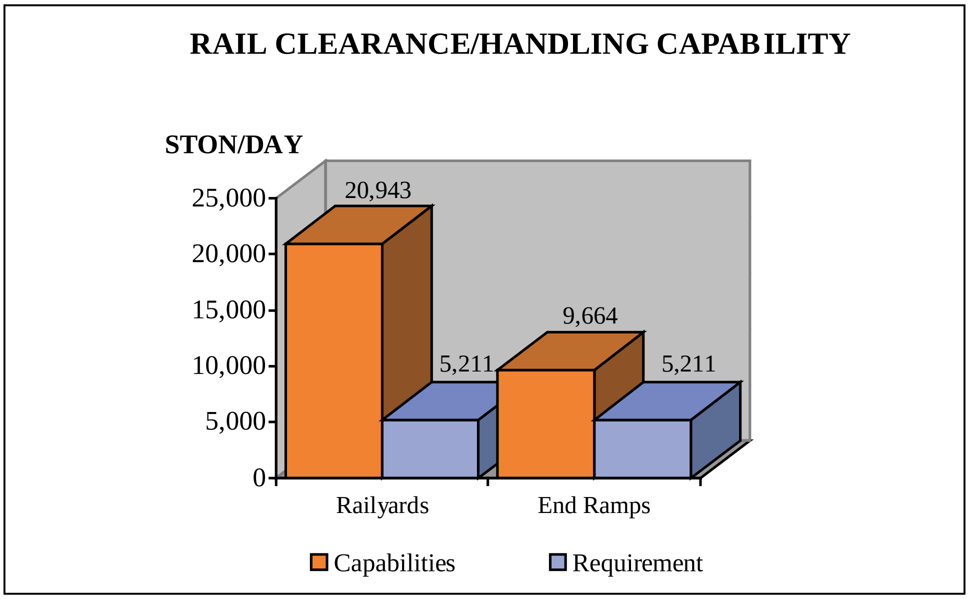
The BNSF and UP railroads serve the Port of Galveston. The Galveston Railroad Company performs the switching operations for the port. A speed restriction of 5 mph exists for trackage accessing the port. The port's rail spurs and railyard (total of 50,000 feet of usable track) can handle the incoming rail traffic.

For offloading wheeled vehicles from railcars, three rail end ramps will be used. One of the rail end ramps is the fixed ramp at Plant 3 and the other two will be the timber portable ramps. The port has numerous locations to perform rail offloading using the portable end ramps. For this analysis, we assumed rail offloading would occur at the railyard near Pier 10.

Requirements use total STON of equipment divided by six providing a rail daily requirement. Capabilities for the railyards and end ramps reflect trackage and end ramp daily throughputs, respectively.

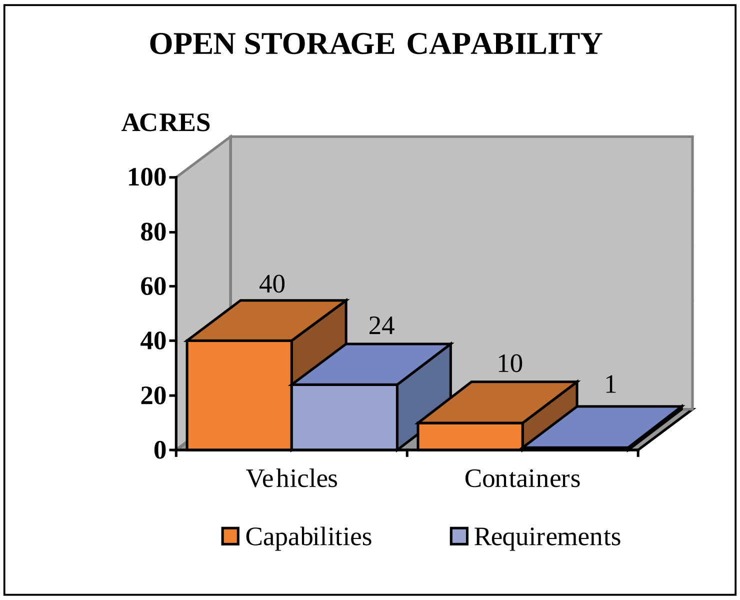


Rail End Ramp Locations



Open Storage

The port has 57.5 acres of open storage area (50 acres are at or near Pier 10). The staging area requirement for each LMSR is 25 acres. As the first ship fills up and the staging area empties, there is room to stage equipment for the next LMSR that will be loaded. This means that the staging area around Pier 10 is adequate to support two LMSR vessels. A deployment scenario for the Port of Galveston will likely call for the use of Pier 10, which is capable of berthing one LMSR vessel. Therefore, the 50 acres around Pier 10 should be more than enough to support a sustained LMSR loading operation. If needed, the port authority states that about 11.4 acres of off-port marshaling exists along a five block section of Harborside Drive between 30th and 37th Streets.



Pier 10 at the Port of Galveston

Shipping

Using the LMSRs to transport the regiment, Pier 10 will allow the ships to meet the 6-day loading requirement. Based on each LMSR being able to load in about 3 to 4 days, the two LMSRs can be loaded in 6 to 8 days. Berth space is adequate to allow the side and stern ramps on the LMSRs to be used to load the ships. If smaller ships are used for deployment, then additional time or berths will be required to move the regiment.

Deploying by LMSR requires one ship every 3 to 3.5 days. Each ramp on the LMSR will have to average about 130 STON per hour for 20 hours each day to meet the 6-day loading requirement. This equates to 15 vehicles per hour per ramp. Using a standard 400-STON-per-hour loading rate for an LMSR (two ramps used), the port should be able to meet the 6-day loading requirement if all facilities and resources are available. Deploying by FSS requires one ship every 2 days (total of three ships) to meet the same requirement. The FSS loading rate will have to be 260 STON per hour (one ramp) for 20 hours each day to meet the same 6-day requirement. This equates to 30 vehicles per hour for the ramp. The FSS loading rate is about 250 STON per hour. Therefore, loading the regiment on FSS vessels will take a little over 6 days if all facilities and resources are available.

SHIP REQUIREMENTS NOTIONAL ARMORED CAVALRY REGIMENT				
Loading Condition/ Sample Ship Mix	**FSS (RORO/Comb)**	**LMSR (RORO/Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	2.8			
All LMSR		1.7		
All Breakbulk			8.7	
Maximum Containerization				
FSS/Container	1.1			1.2
LMSR/Container		.7		1.2
Breakbulk/Container			3.5	1.2

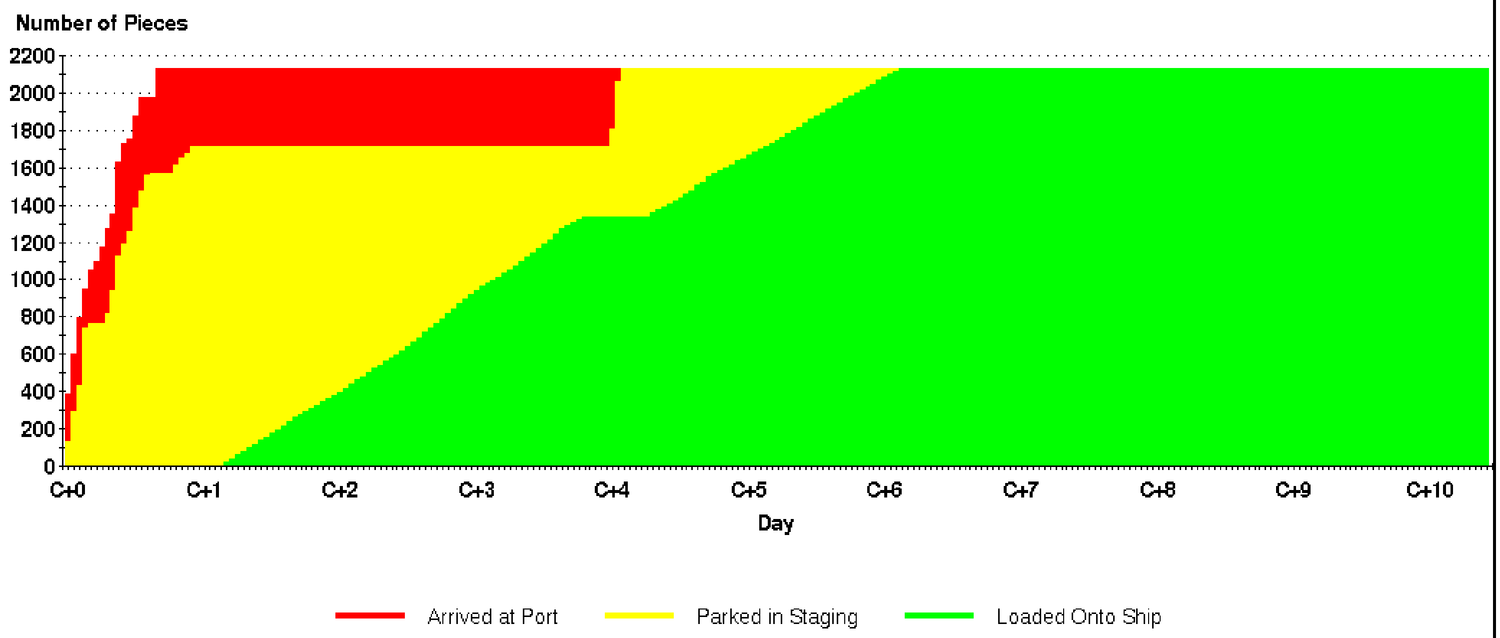
Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

SUMMARY

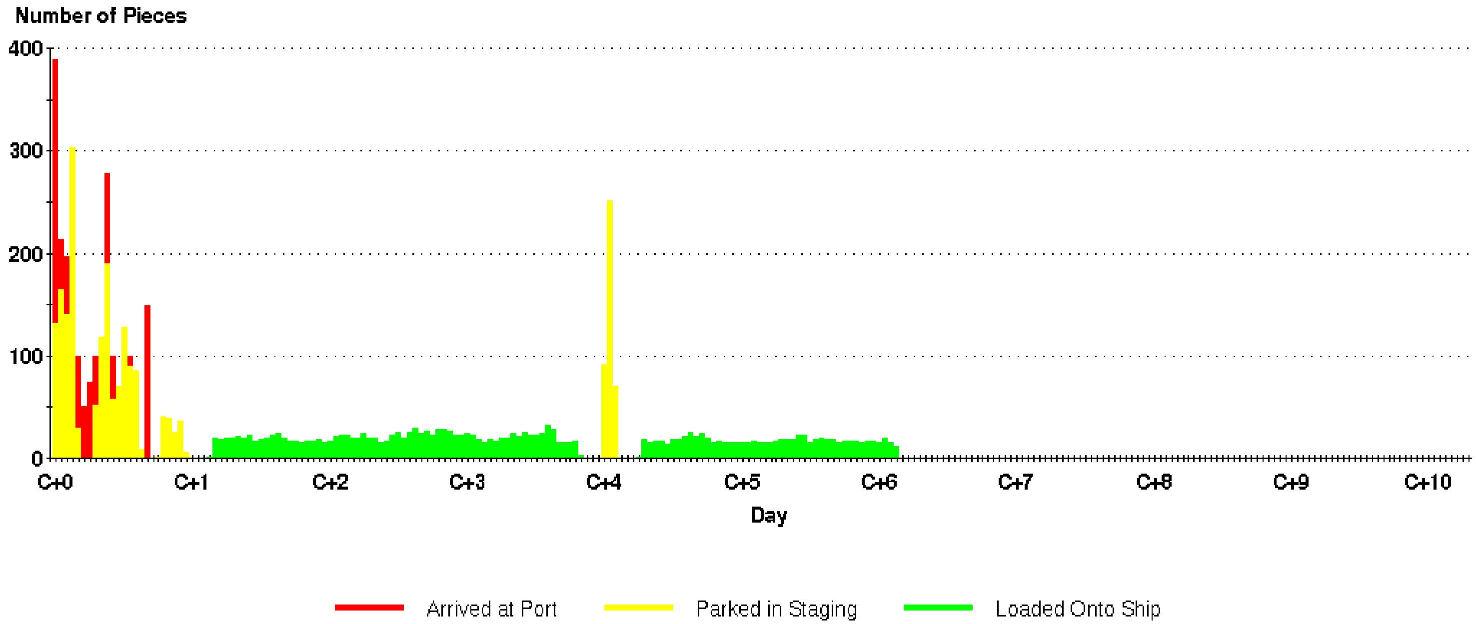
The Port of Galveston can load and clear a notional armored cavalry regiment in about 6 days using Pier 10 and LMSR ships. If other ships are used, additional berths may be required to meet the 6-day requirement.

The Port of Galveston is a viable port for supporting deployment of a notional armored cavalry regiment provided Pier 10 and the surrounding staging area are available for U.S. Military deployments.

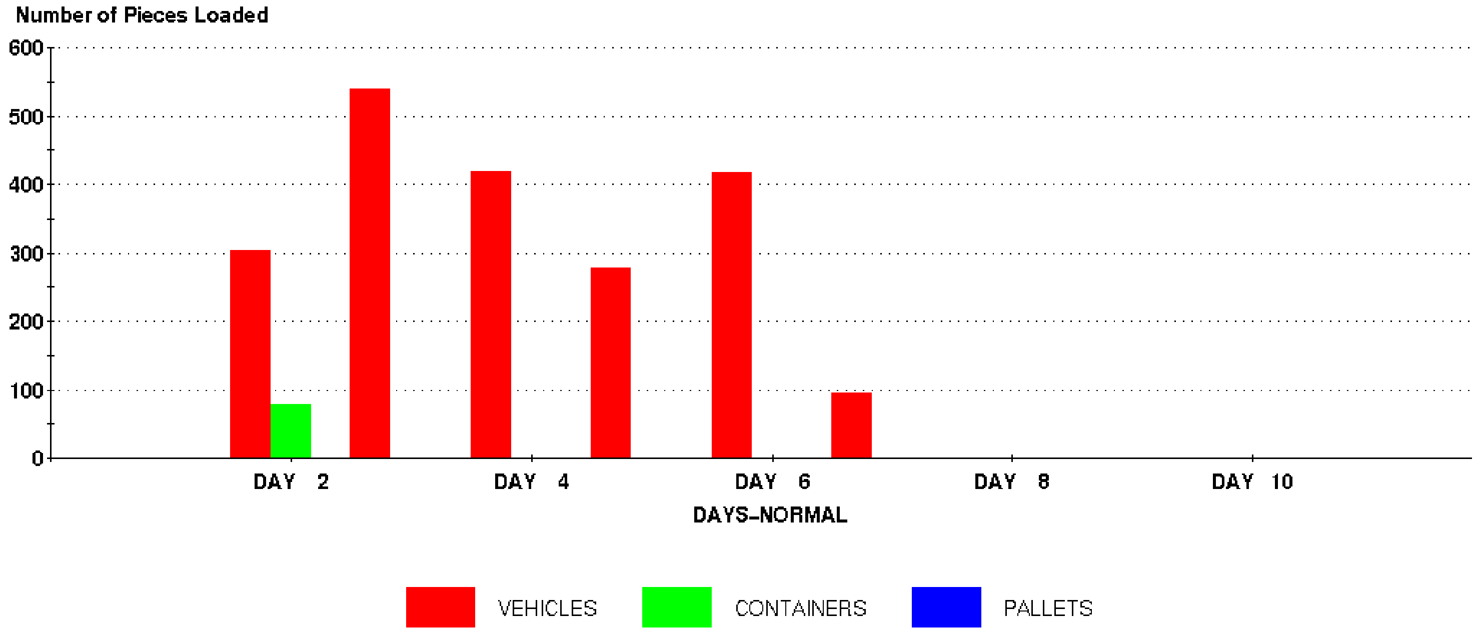
CUMULATIVE CLOSURE PROFILE FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



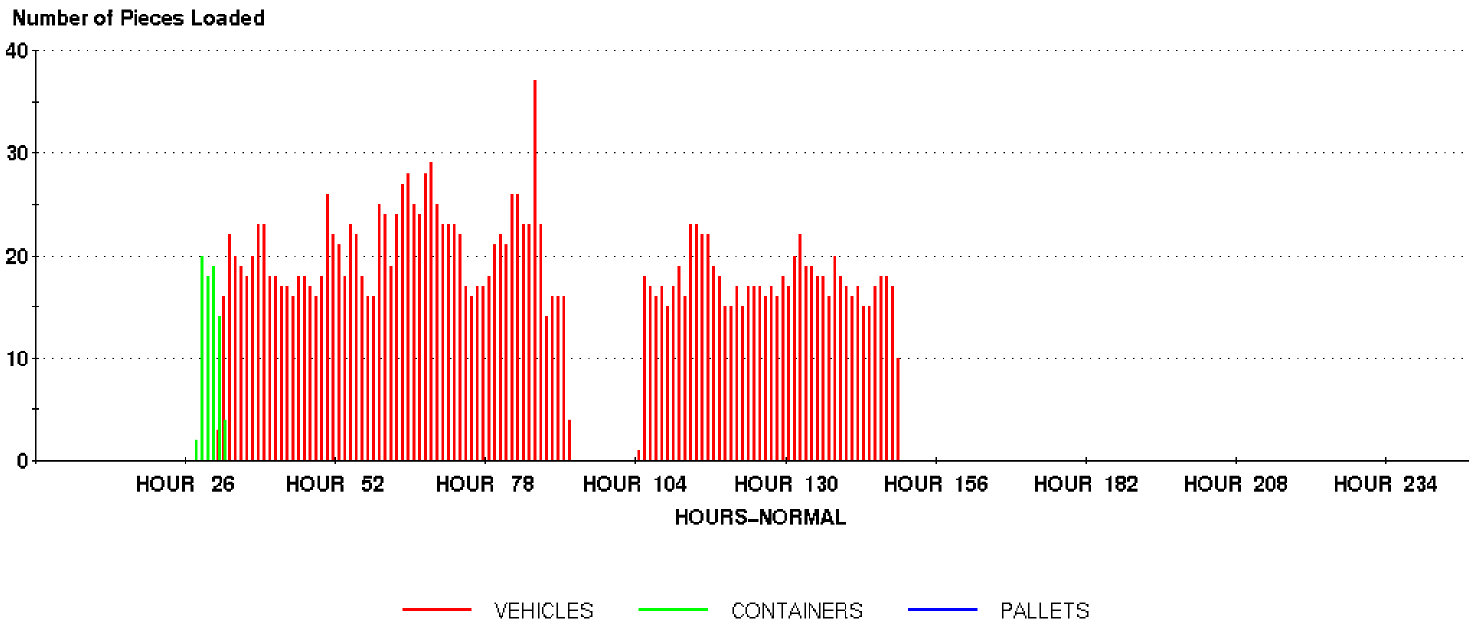
DAILY CLOSURE PROFILE FOR
NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



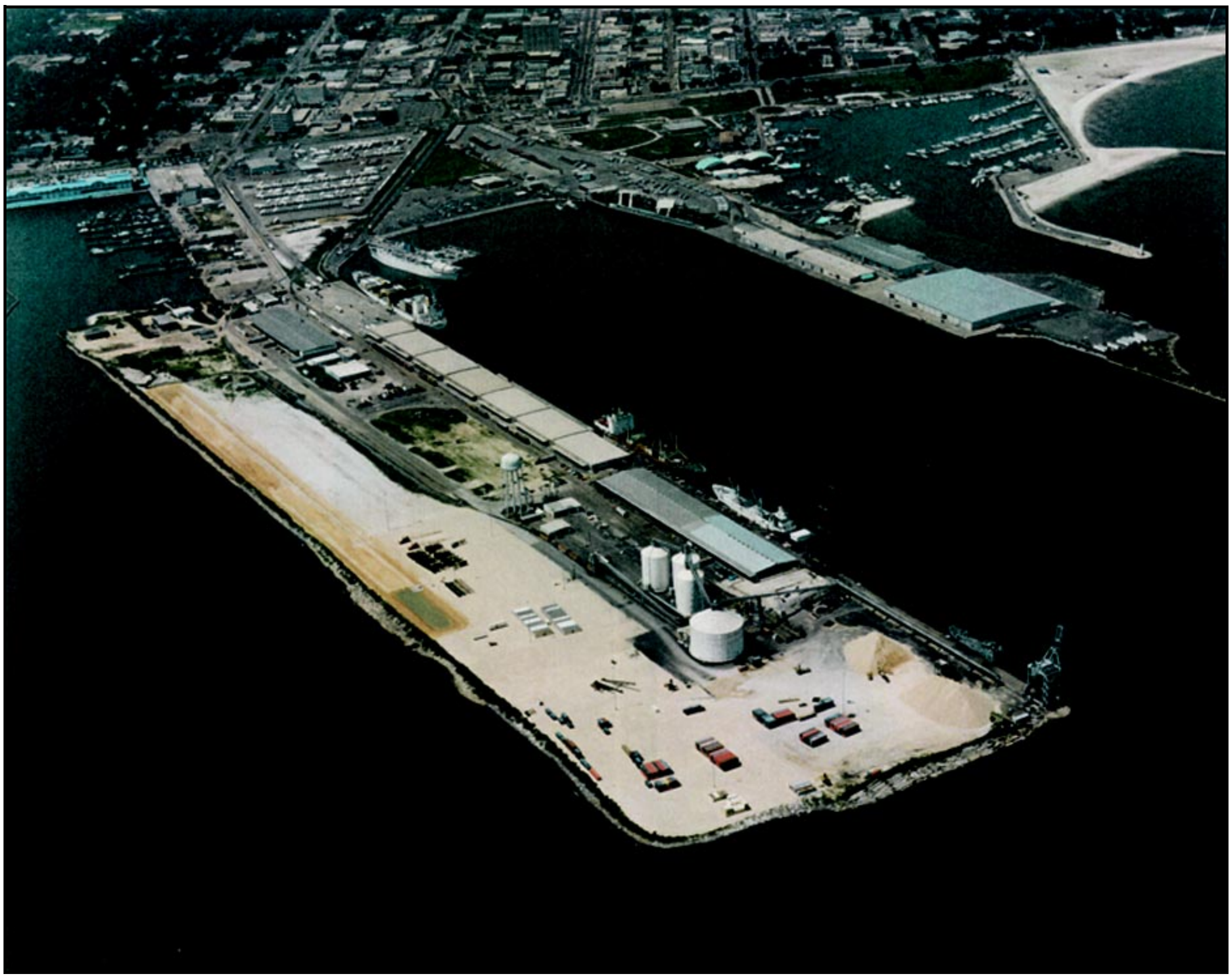
**DAILY THROUGHPUT FOR
NOTIONAL HEAVY ARMORED CAVALRY REGIMENT**



HOURLY THROUGHPUT FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



PORT OF GULFPORT
MISSISSIPPI



I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Gulfport, Mississippi, 14 September 1999. Gulfport is a state-owned, contractor-operated port fully capable of handling RORO, container, and breakbulk ships and barges.

The port has 5,974 feet of quay, and can accommodate vessels as large as the LMSR and FSS. The port has the capability of supporting U.S. Military cargo shipment operations. It can load or offload a mixed throughput of at least 14,300 STON a day. The port has a 2.5-foot tidal range.

Gulfport has two container cranes and the stevedoring companies can provide the needed mobile cranes. It has 36 acres of open staging. An FSS requires about 16 acres per day of staging to load/offload the ship and an LMSR requires about 25 acres per day of staging for continuous operation.

Gulfport is a viable port for supporting deployments of a notional armored brigade, provided Berths WP5-WP6 are available for U.S. Military deployments. A notional armored brigade has a total of 27,970 STON of vehicles and equipment and could be loaded on 1.4 LMSRs in about 4 days of actual shiploading. The brigade will require use of the port for about 7 days. The first 6 days for rail and highway arrival and offloading and the last 4 for ship loading. This overlaps rail operations and ship loading on the 3 middle days.

WP5-6 is the only berth suitable for LMSR and FSS vessels. Other berths can handle smaller RORO vessels.

The staging area limits the size of the force and number of ships that can be loaded at a time. This limits the size of a unit that can deploy through the port at a time to the equivalent of an Army armored brigade

II. GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Gulfport, MS, 14 September 1999. Gulfport is a state-owned, contractor-operated port capable of handling RORO, container, and breakbulk ships and barges. Information was obtained from the Gulfport Port Officials.

TRANSPORTATION ACCESS

Water

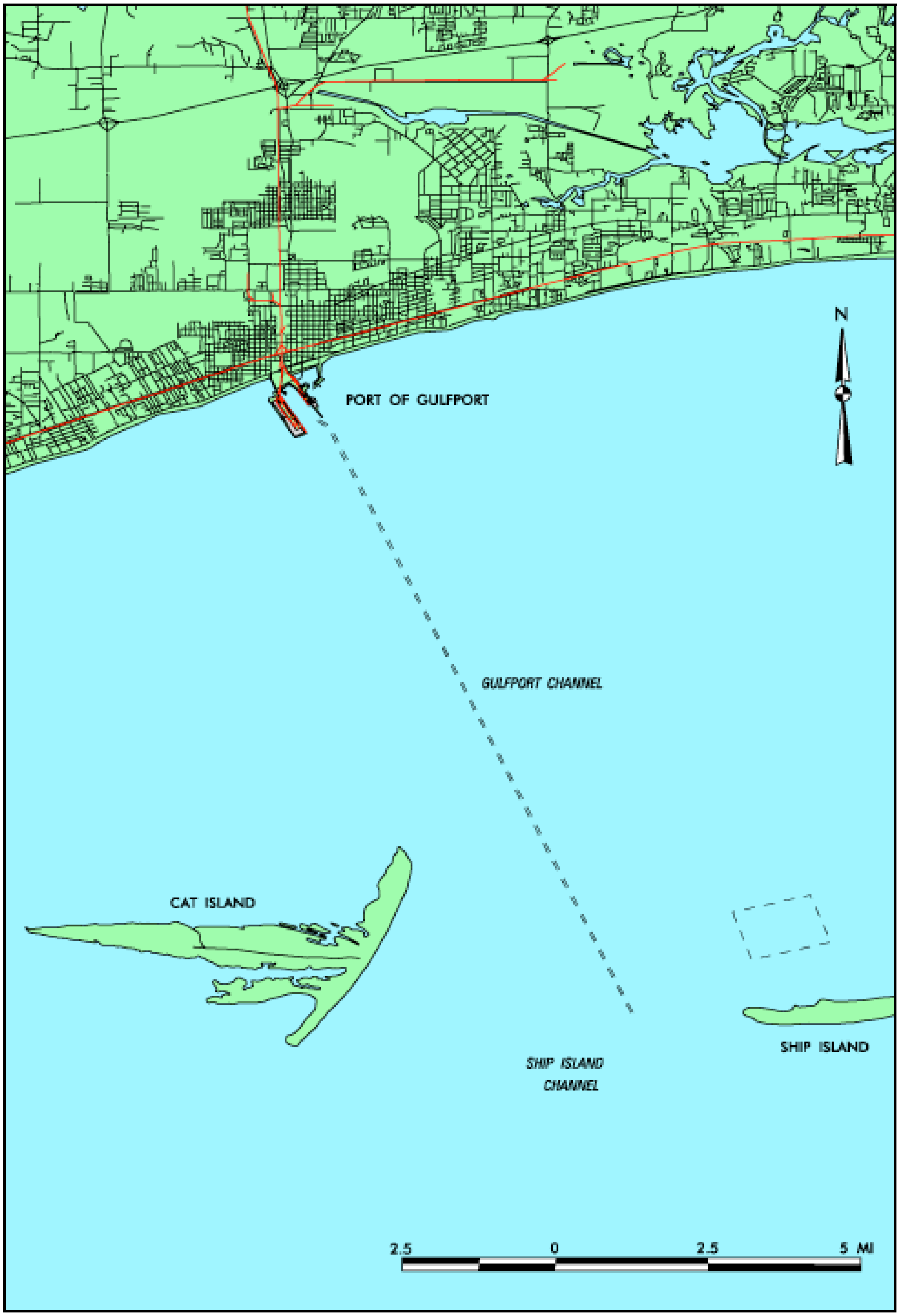
The Port of Gulfport (latitude 30° 21' north, longitude 89° 05'west, (JTVH - GEO location code) time zone GMT-6) is on the northern shore of the Mississippi Sound in the southeast portion of the State of Mississippi, approximately 81 miles from New Orleans. It is about 19 miles from the deep water of the Gulf of Mexico. A series of barrier islands separate the Mississippi Sound from the Gulf of Mexico. The two main islands south of Gulfport are Ship and Cat.

Gulfport Harbor consists of a manmade, rectangular-shaped basin. Two parallel piers (east and west) spaced about ¼ mile apart and extending ¾ mile into the Mississippi Sound form the basin.

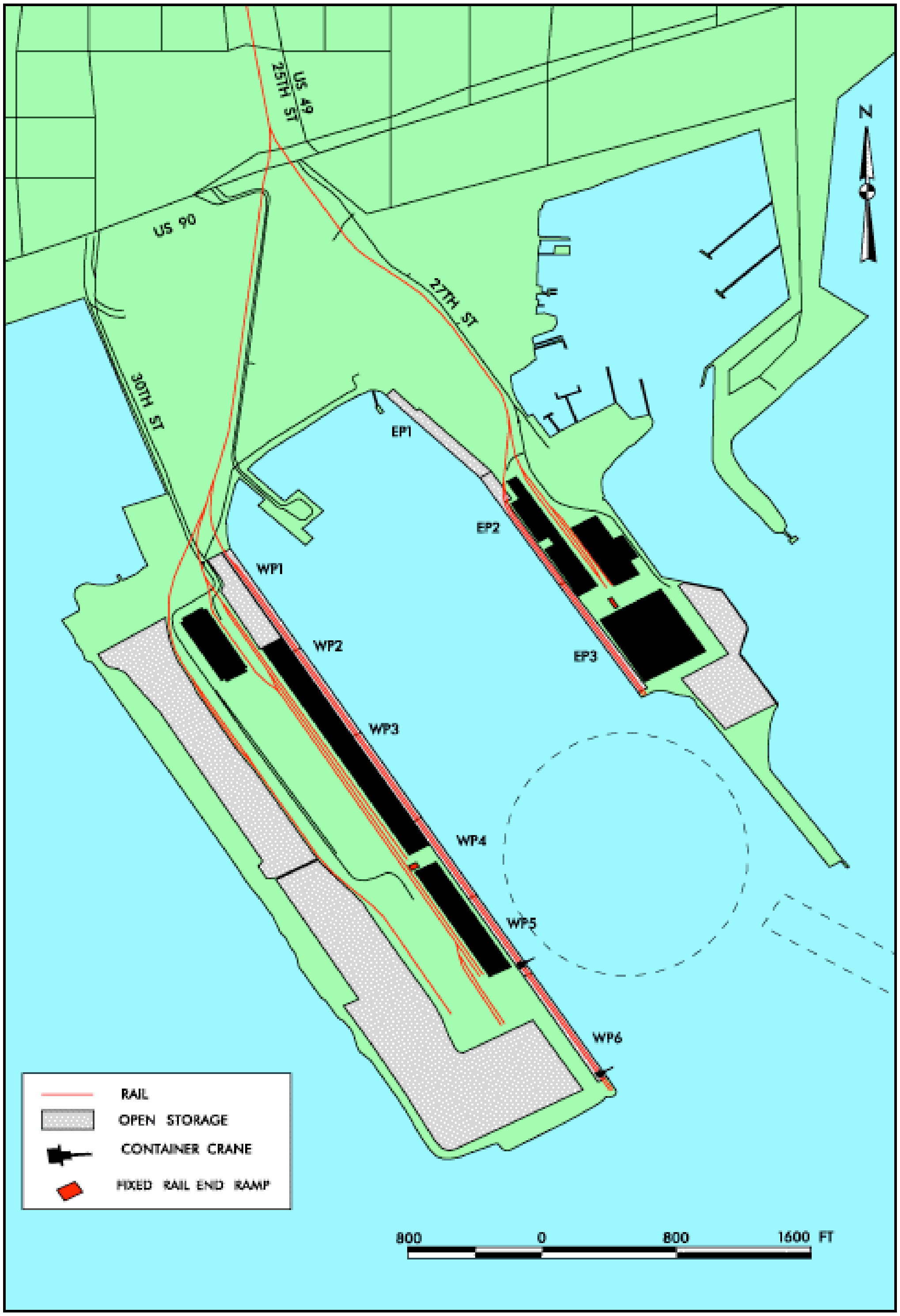
Passage from the Gulf of Mexico to the Port of Gulfport requires passage through two channels. The first, Ship Island Channel, provides passage from the Gulf of Mexico to the Mississippi Sound. This channel is 400 feet wide, 38 feet deep at mean low water (MLW), and about 8 miles long. Gulfport Channel provides access from the Mississippi Sound to the harbor basin. Gulfport channel is 225 feet wide, 36 feet deep at MLW, and 12 miles long. The depth in the harbor and along wharves is 36 feet with a 2.5 feet tidal variation. There are no entry restrictions at this time. Pilots are compulsory.

Length of vessel is restricted to about 900 feet by the turning basin, no breadth restrictions. There should be no problem docking LMSR and FSS since the end berth will be used. The port has experience with FSS. To have the easiest access to the side and stern ramps on the LMSR, the ship should be turned around after it is loaded when it is departing.

There are no overhead restrictions in the ship channels leading to the harbor or within the harbor.



Channel Graphic


US 49
25TH ST
US 90
27TH ST
30TH ST
N
EP1
EP2
EP3
WP1
WP2
WP3
WP4
WP5
WP6
RAIL
OPEN STORAGE
CONTAINER CRANE
FIXED RAIL END RAMP
800
0
800
1600 FT

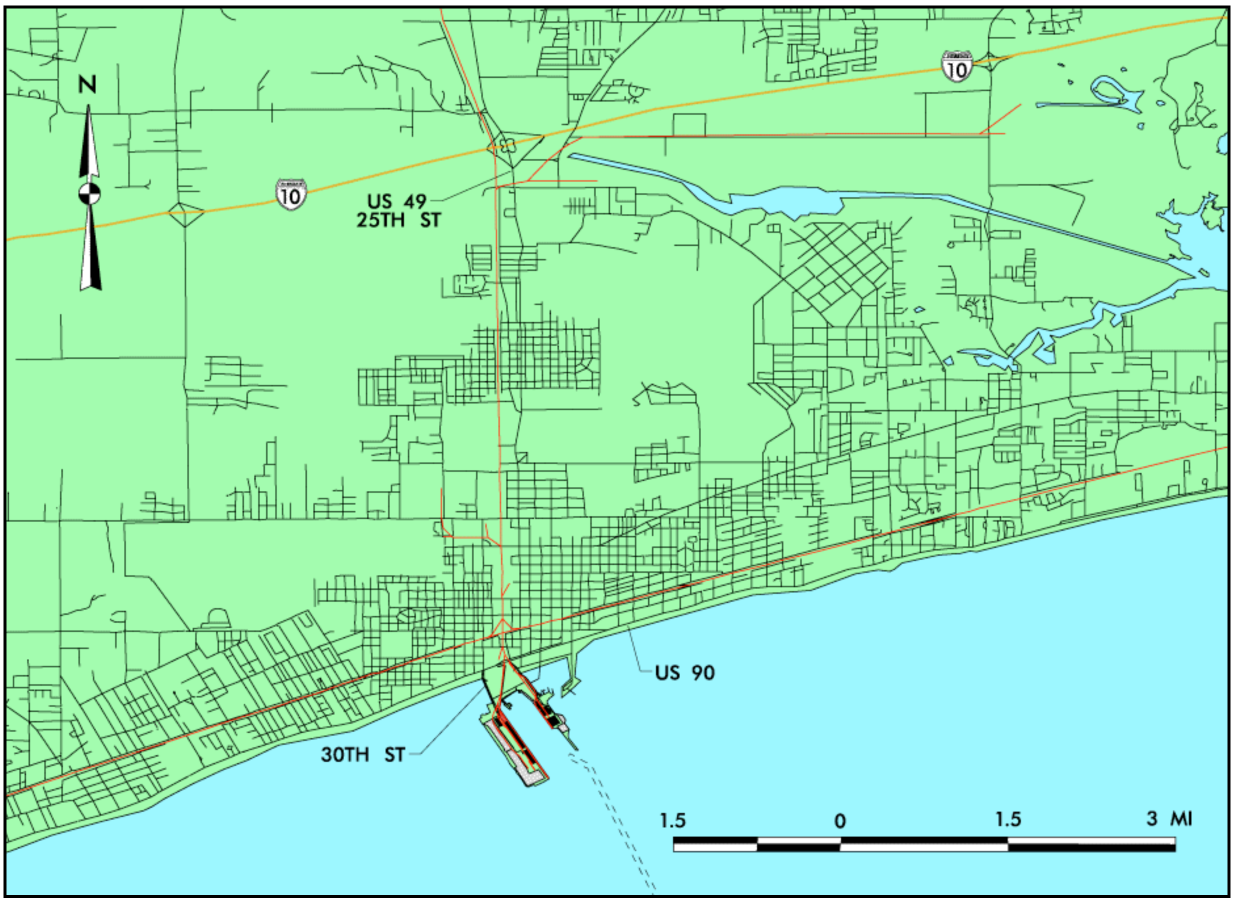
Land-Use Map

The Port of Gulfport connects with the Inland and Intracoastal Waterway in the U.S. to form an effective inland water network. Barge transport can be used to move items too large for unrestricted transport by highway and rail modes. Barges can be used to transport U.S. Military equipment to the port.

Canal and Barge Routes

Highway

Two main gates provide access to the port. From U.S. Route 90, 30th Avenue to West Pier Gate and 27th Avenue to East Pier Gate extensions provide direct access to the port. Two additional private gates (Chiquita and Dole) are off the 30th and 27th Avenue extensions, respectively. These gates are used for importing bananas and other fruits. Although not normally available to the military, the Army may be able to arrange for use of these gates to support military operations in emergency situations. One block west of the port, U.S. Route 49 intersects U.S. 90. U.S. 49 provides access to Interstate Routes 10, 20, and 59 and U.S. Routes 98 and 84.



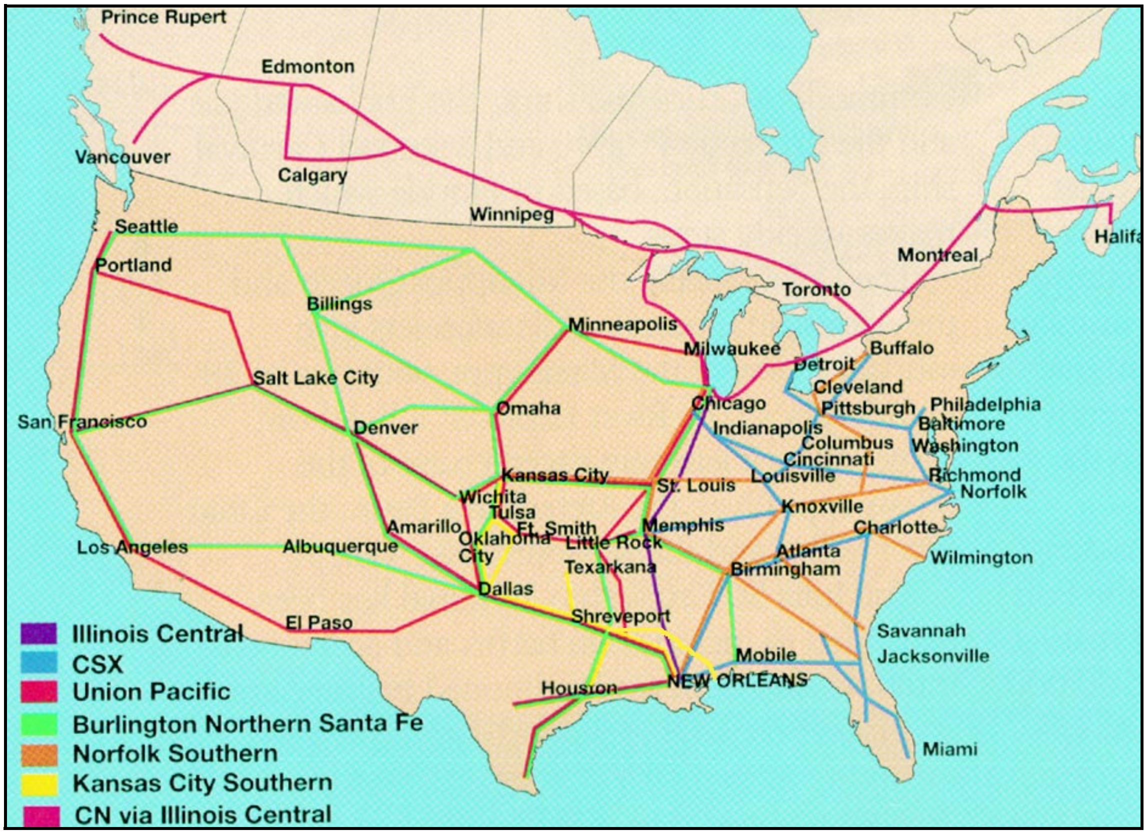
Highway Map

West Pier Gate (looking in)

East Gate (looking in)

Rail

One track goes to each of the two piers at the port. The port has no switching yards. About 1.25 miles from the port is a railyard with an 800-railcar capacity. The port owns and operates a track-mobile for railcar placement within port areas. Kansas City Southern provides access to the port and CSX provides rail services going east/west.



Rail Map

Air

Two airports, one commercial and one military, are within service range of the port. The Gulfport-Biloxi Regional Airport is about 3.8 miles northeast of the port. It has two asphalt runways, one runway is 9,000 feet long and 150 feet wide, the other is 5,000 feet long and 150 feet wide.

Keesler Air Force Base is about 13 miles east of the port. It has one asphalt runway that is 5,030 feet long and 150 feet wide.

PORT FACILITIES

Berthing

Two piers, east and west, provide 11 berths. The East Pier (EP1, EP2, and EP3) has 2,234 feet of continuous berthing space. The West Pier (WP1, WP2, WP3, WP4, WP5, and WP6) has 3,740 feet of continuous berthing space. Individual berths range in length from 550 to 767 feet. Apron width varies from 30 feet to open. The depth alongside all the berths is 36 feet at MLW. See berth characteristics on the next page.

STAGING

Open Staging

The Port of Gulfport has about 36 acres of open storage. Open storage is located at EP3 and WP 6. A container yard is located behind WP1-WP6.

Covered Staging

The port has 600,000 square feet of covered storage. Of this covered storage, 160,000 square feet is refrigerated space. Cold storage is located near WP1 and WP 5. The refrigerated covered storage and associated truck and rail docks are not available for military use. However, if needed, the Army can arrange for use of these facilities provided they are available.

BERTH CHARACTERISTICS FOR PORT OF GULFPORT									
Characteristics	**Berths**								
	EP1	**EP2**	**EP3**	**WP1**	**WP2**	**WP3**	**WP4**	**WP5**	**WP6**
Length feet	700	767	767	700	600	600	550	550	740
Depth alongside at MLW feet	36	36	36	36	36	36	36	36	36
Deck strength pounds per square feet	1,000	1,000	1,000	1,000	750	1,000	1,000	1,000	1,000
Apron width feet	30	40	Open	65	40	40	60	60	Open
Apron height above MLW feet	10	10	11	11	11	11	11	11	11
Number of container cranes	0	0	0	0	0	0	0	0	2
Number of wharf cranes, STON	0	0	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO ramp	No	No	No	No	No	No	No	No	No
Apron length served by rail feet	700	767	767	700	600	600	550	550	740

PORT OF GULFPORT SUMMARY OF BERTHING CAPABILITIES

Vessels		Berths				
TYPE	**CLASS**	**WP1-WP2**	**WP3-WP4**	**WP5-WP6**	**EP1**	**EP2-EP3**
BREAKBULK	C3-S-38a	2	1	2	1	2
	C4-S-58a	2	1	2	1	2
	C4-S-66a	2,a	1	2	1,a	2,a
	C5-S-37e	2	1	2	1	2
SEATRAIN	GA and PR	2	1	2	1	2
BARGE	LASH C8-S-81b	1,a	1	1	a,c	1,a
	LASH C9-S-81d	1,a,g	1,a,g	1,a,g	a,c,g	1,a,g
	LASH Lighter	6	5	7	3	7
	SEABEE C8-S-82a	1,a,g	1,a,g	1,a,g	a,c,g	1,a,g
	SEABEE Barge	6	5	7	3	7
RORO	COMET	2,d,o	1,d,o	2,d,o	1,d,o	2,d,o
	METEOR	2,d,o	1,d,o	2,d,o	1,d,o	2,d,o
	Cape Nome	2,a,d,o	1,d,o	2,d,o	1,a,d,o	2,a,d,o
	C7-S-95A	1,a,b	1,b	1	a,b,c	2,a,b
	Cape Taylor	1,b	1,b	2	1,b	2,b
	Cape Orlando	1,b	1,b	2,i,j	1,b	2,b
	MV Ambassador	2,d	1,d	2,d	1,d	2,d
	Callaghan	1,d,o	1,d,o	2,d,o	1,d,o	2,d,o
	Cape Lambert	1,b	1,b	2,i,j	1,b	2,b
	LMSR Class	1,a,b	1,b	1	a,b,c	1,a,b
	FSS	1,a,b,g	1,a,b,g	1,a,g	a,b,c,g	1,a,b,g
	Cape E-Class	1,b	1,b	2,i,j	1,b	2,b
	Cape D-Class	1,a,b	1,b	2,i,j	1,a,b	2,a,b
	Cape H	1,a,b	1,b	1	a,b,c	1,a,b
RORO	Cape Texas	1,b	1,b	2,i,j	1,b	2,b
	Cape R	1,a,b,d	1,b,d	2,d	1,a,b,d,o	2,a,b,d
	Cape I-class	1,b	1,b	2,i,j	1,b	2,b
	Cape Victory	1,b	1,b	2,i	1,b	2,b
CONTAINER	C6-M-147a	1,b,e	1,b,e	2	1,b,e	2,b,e
	C7-S-69c	1,b,e	1,b,e	2	1,b,e	2,b,e
	C7-S-68c	1,b,e	1,b,e	1	1,b,e	2,b,e
	C8-S-85c	1,a,b,e	1,b,e	1	a,b,c,e	1,a,b,e
	C9-M-132b	1,a,b,e	1,b,e	1	a,b,c,e	1,a,b,e
	C9-M-F141a	1,a,b,e,g	1,a,b,e,g	1,a,g	a,b,c,e,g	1,a,b,e,g
TACS	C6-S-1qd	1,b	1,b	2	1,b	2,b
	C5-S-MA73c	2,b	1,b	2	1,b	2,b
	C6-S-MA60d	1,b	1,b	2	1,b	2,b
MPS	C7-S-133a	1,a,b	1,b	1	a,b,c	1,a,b
	Maersk	1,a,b	1,b	1	a,b,c	1,a,b
	AmSea	1,b	1,b	2	1,b	2,b

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

Highway

Access to the West Pier by commercial truck traffic is by way of the 30th Avenue extension. Access to the East Pier is by way of the 27th Avenue extension. Both roads have two paved asphalt lanes. Entrance to the piers is by two-lane manned gates. The West Pier has a 52-ton truck scale.

Rail

There are two apron tracks on both the east and west piers. There are rail spurs behind all of the transit and backup sheds. All of the transit and backup sheds have railcar-level platforms. These platforms provide 64 railcar handling positions. Rail trackage links the apron tracks and rail spurs to the two rail lines coming into the port. Container-on-flatcar (COFC) and trailer-on-flatcar (TOFC) operations are conducted at the West Pier open storage areas. A railyard located 1.25 miles from the port can store 800 railcars. CSX provides rail service going east/west. Kansas City Southern Railway provides service north connecting to other railroads.

OFFLOADING/LOADING POSITIONS

Ramps and Docks

The East Pier has a concrete truck end ramp at EP3. This ramp can serve 10 trucks at one time. A wood/concrete rail end ramp is on the West Pier. It has a 12-railcar loading capacity.

The transit sheds have eight truck docks. These truck-level docks provide more than 210 truck handling positions. A rail side dock is on the East Pier, behind the apron at EP3. This dock has a nine-railcar loading capacity. Because the truck and rail docks share some handling positions, not all of the truck or rail handling positions are available at the same time. Also, 80 of the truck handling positions and 12 of the railcar positions are used in conjunction with the refrigerated storage.

Marshaling Areas

The land north of the piers, leased by the Dole Fresh Fruit Company and Chiquita Brands Company, are potential marshaling areas. A Naval Construction Battalion Center that could provide a substantial and secure marshaling area is about 2 miles north of the port.

Materials Handling Equipment (MHE)

One 30-ton and one 35-ton container crane serves Berths WP4-WP6 at the south end of the West Pier. Additionally, mobile cranes are available with 48 hours notice by the local stevedoring company. Chiquita's and Dole's containerships normally load/offload their ship using ship's gear about 98 percent of the time. Currently, all containers are handled on chassis in the port.

MATERIALS HANDLING EQUIPMENT (MHE)		
Type of Equipment	**Capacity (STON)**	**Quantity**
Mobile Cranes	65	1
Mobile Cranes	40	1
Mobile Wharf Cranes	25	1
Forklifts	10	2
Forklifts	6	8
Forklifts	4	41
Forklifts	3.5	8
Forklifts	2.5	5
Forklifts, electric	3.5	12
Forklifts, electric	3	7
Front end loader	NA	8
Container tractor	NA	12

INTERMODAL FACILITIES

The port has a limited intermodal capability. The closest dedicated intermodal railyards to the Port of Gulfport are in New Orleans, Louisiana, and Mobile, Alabama. The companies providing intermodal service in the New Orleans area are CSX and Kansas City Southern Railway.

FUTURE DEVELOPMENT

The port has approval from the Corps of Engineers to expand the port open storage up to 84 acres. This expansion will be completed in several phases. The first will be an additional 30 acres to the west side of the West Pier for container storage. The port plans to design the yard with the capability to stack containers and not have to keep them on chassis.

The port is planning to extend the East and West piers 1,000 feet for additional berthing capabilities.

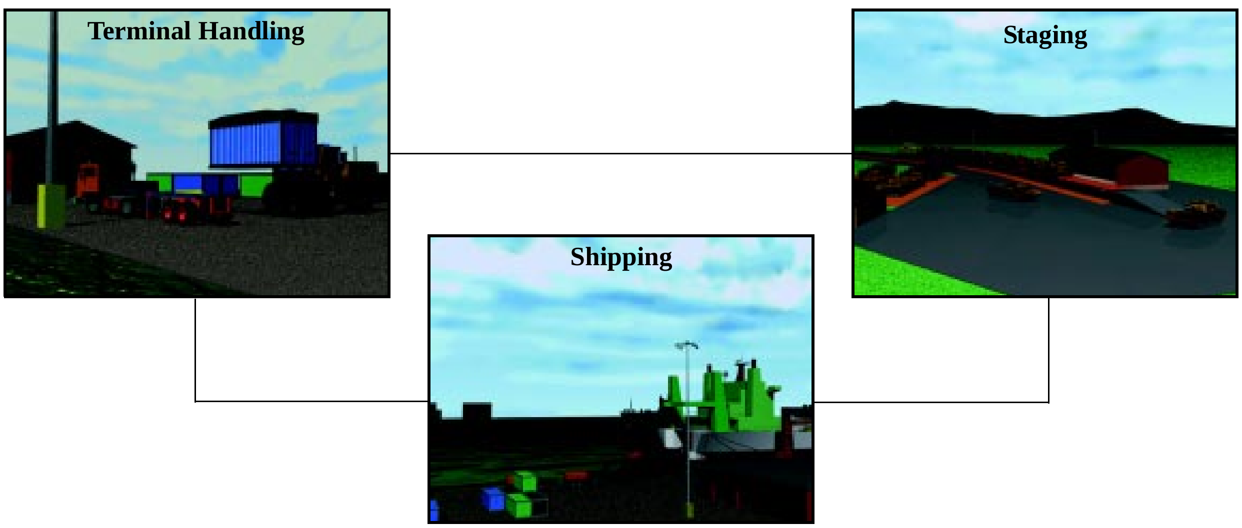
MILITARY EXPERIENCE

The port has some military experience. The Seabee Unit located on the Navy Installation about 2 miles from the port uses the port to deploy and bring equipment to the installation. One ship loaded with Seabee equipment departed the port during Desert Shield/Storm.

III. THROUGHPUT ANALYSIS

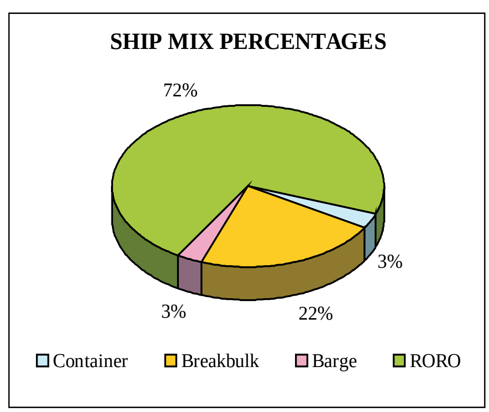
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Gulfport, Mississippi. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems: shiploading or offloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON. Approximate MTON yields can be computed by multiplying the STON amount by three.



Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 70 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.

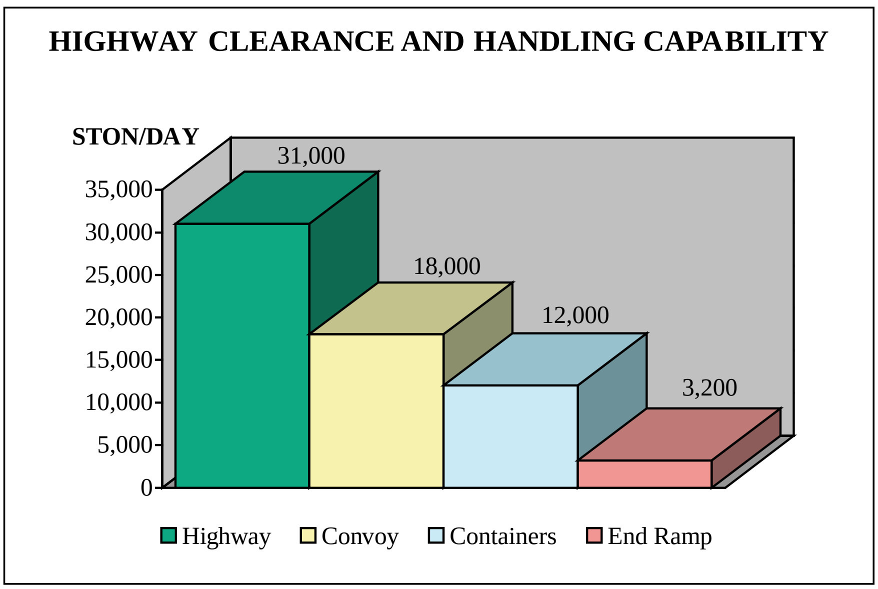


TERMINAL CLEARANCE AND HANDLING

Highway

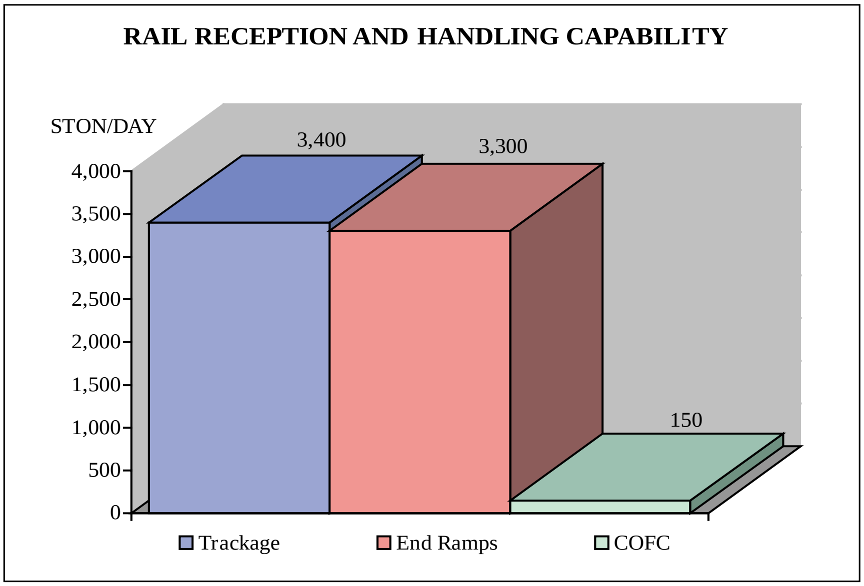
From U.S. Route 90, the 30th and 27th Avenue extensions provide direct access to the port. These two roadways provide access to staging and pier areas. The gate reception capability of these two roadways could handle 31,000 STON of equipment and supplies per day. This capability could be degraded by local traffic. The highway connecting the port with the interstate system goes through the downtown area of Gulfport requiring port traffic to compete with local traffic for the use of the highway system. There are no limited access highways connecting the port to the interstate.

Roadable vehicles in convoys will process directly to staging areas. Vehicles on commercial or military flatbed trailers not equipped with a means for unloading vehicles can offload at the truck end ramp on the East Pier. This ramp could offload about 1,600 STON per day. We also assumed a portable ramp with the same capability would be supplied by the deploying unit or stevedoring company or built in the port.



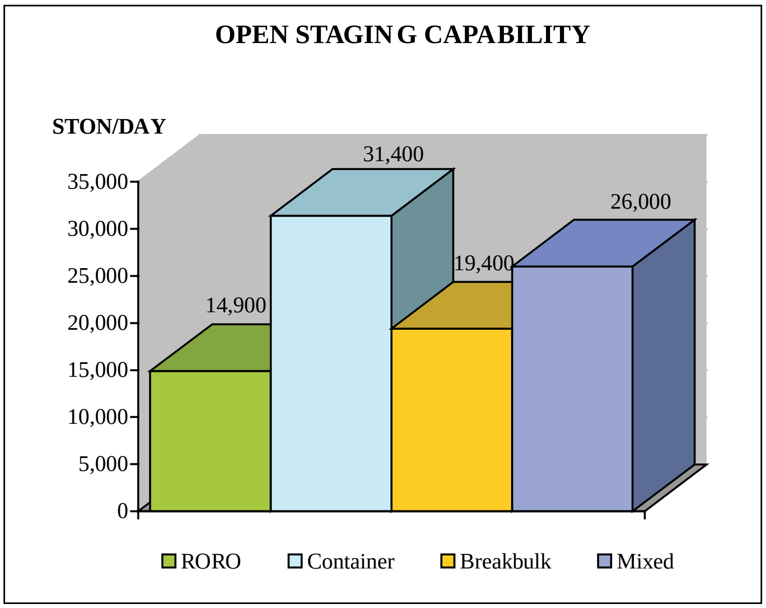
For this study, we assumed that railcars would occupy the truck/railcar docks on the West Pier because the railcar end ramp is on that pier. Although the port has limited container-handling capability, it does not have a dedicated intermodal railyard. Two companies use the port for container operations. Both of these companies use shipboard equipment (98 percent of the time) to load containers onto chassis and move directly out of the port by highway, which requires no container handling equipment except for chassis and yard tractors. For back hauling cargo, they load the container at the truck docks in the port.

Rail



The port has two railroad tracks running along the wharf, allowing direct transfer of cargo from railcar to ship. Also rail spurs are behind all transit and backup sheds. All the sheds have railcar-level platforms, allowing offloading of boxcars. These platforms provide 64 railcar-handling positions. A railcar end ramp on the West Pier serves 12 railcars at a time. Because of this ramp, we assumed rail traffic could be routed to the West Pier, allowing offloading of vans and semitrailers on the docks and at the truck end ramp on the East Pier. Current rail service to the port is 2 trains per day with 40 railcars per train. These railcars are capable of handling at least 3,400 STON per day.

Staging



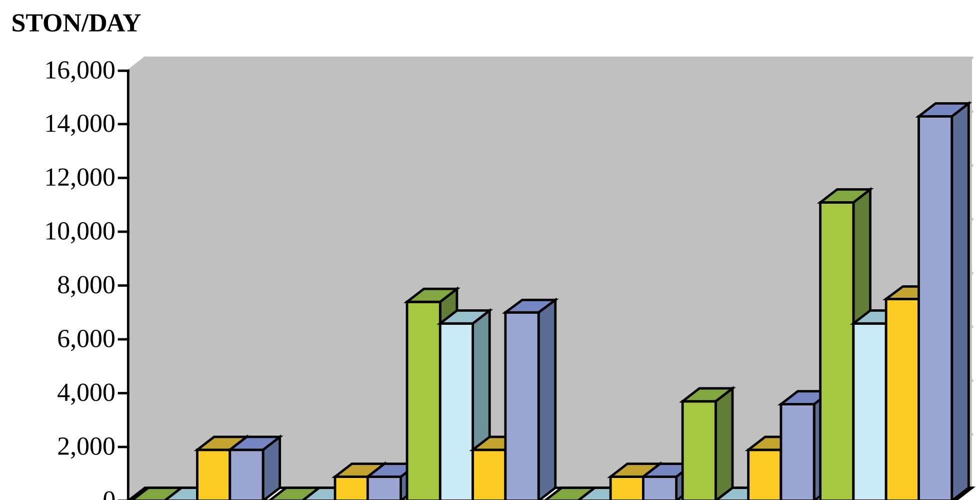
The port has about 36 acres of open storage for vehicles and/or containers. Availability of the staging area will vary with work at the port. This staging area can store about 19,400 STON of breakbulk cargo, 14,900 STON of RORO, or 31,400 STON of containers.

The port has about 600,000 square feet of covered storage space. Like the open area, much of this is subject to contain some of the breakbulk cargo moving through the port. About 8,800 STON of breakbulk cargo can be staged in the covered area.

Shipping

Daily shipping subsystem totals for the berths are catalogued in the table below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types. Shipping is the least capable subsystem in the port.

BERTH THROUGHPUT CAPABILITY



	WP1-WP2	WP3-WP4	WP5-WP6	EP1	EP2-EP3	TOTAL
RORO	0	0	7,400	0	3,700	11,100
Container	0	0	6,600	0	0	6,600
Breakbulk	1,900	900	1,900	900	1,900	7,500
Mixed	1,900	900	7,000	900	3,600	14,300

SUMMARY

The port is multioperational with the capability to handle all types of vessels -- container, RORO, breakbulk, and barges.

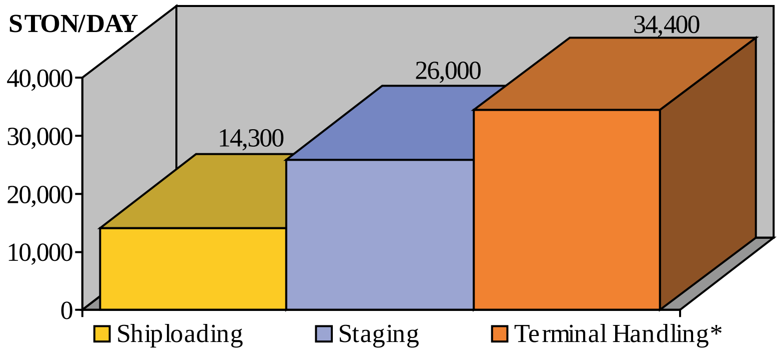
The Port of Gulfport is capable of supporting U.S. Military cargo transshipment operations. It can accommodate vessels as large as the LMSR as shown in the Berthing Characteristics Table.

Of the transportation subsystems analyzed, the least capable is the shiploading. The military useful berths in the port have a mixed throughput capability of at least 14,300 STON.

The inland water network makes barge transport an effective shipping method. The port connects to this network and provides a third alternative for moving items to and from the port.

Commercial operations taking place concurrently in the port will limit actual daily throughput, sustainable over time, by an appropriate percentage of the terminal's overall capability.

DAILY CARGO THROUGHPUT CAPABILITY



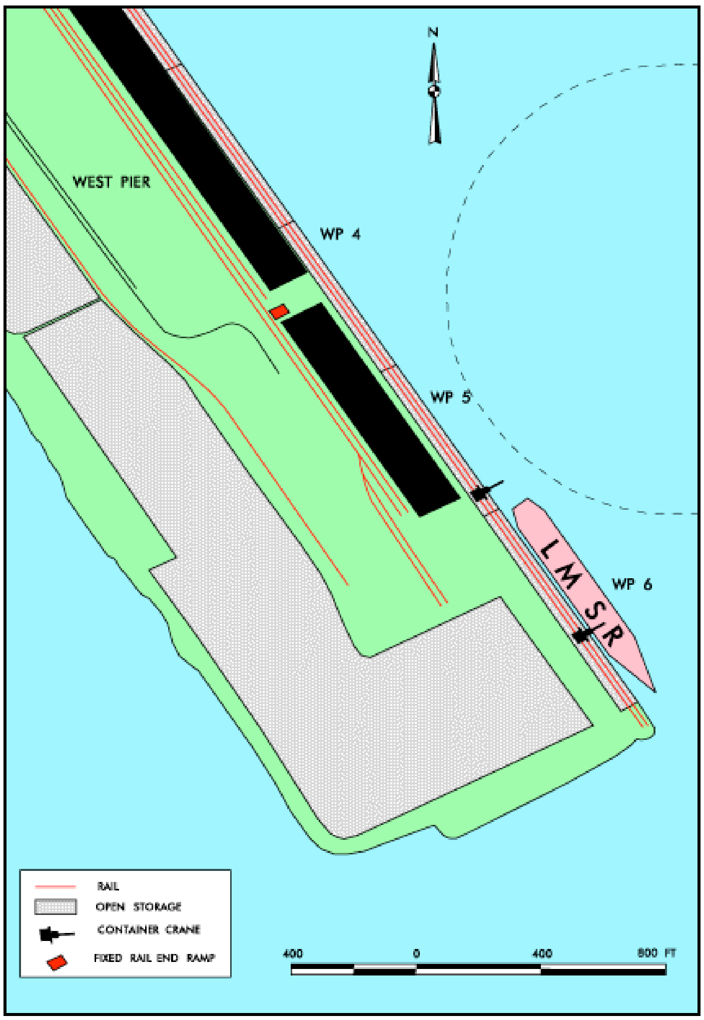
Terminal handling is the sum of the highway (31,000 STON) and rail (3,400 STON) limits.

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored brigade using primarily LMSR and FSS vessels. We also assume that no other military units will be competing for these facilities during the time that the armored brigade occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately load the ship and clear the port. For this analysis, we assume the military will use WP5 and WP6.

There are no designated facilities in the Port of Gulfport in the *Planning Orders Digest*, issued by MARAD.



Potential Port Use During Deployment

REQUIREMENTS

A likely requirement for the Port of Gulfport would be to deploy a notional armored brigade in about 6 days of shiploading. The brigade has to move about 1,820 vehicles and 94 containers. Movement of the brigade to the port will require about 259 railcars (90 heavy-duty 68-foot DODX railcars, 52 89-foot flatcars, and 117 60-foot flatcars), using a convoy/rail option for transport to the port. About 16 containers would arrive daily with the unit arriving in 6 days.

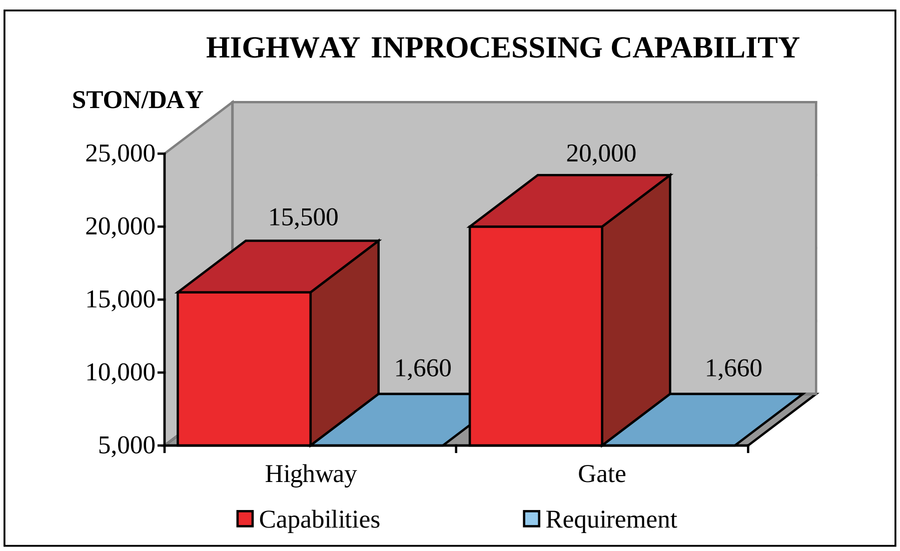
For this application, we assumed a convoy/rail deployment.

TOTAL EQUIPMENT	
Volume	81,600 MTON
Weight	27,970 STON
Area	373,910 SQ FT
Vehicles	1,820
Containers	94
Note: MTMCTEA REFERENCE 97-700-5, Deployment Planning Guide, July 1997	

TERMINAL INPROCESSING/HANDLING

Highway

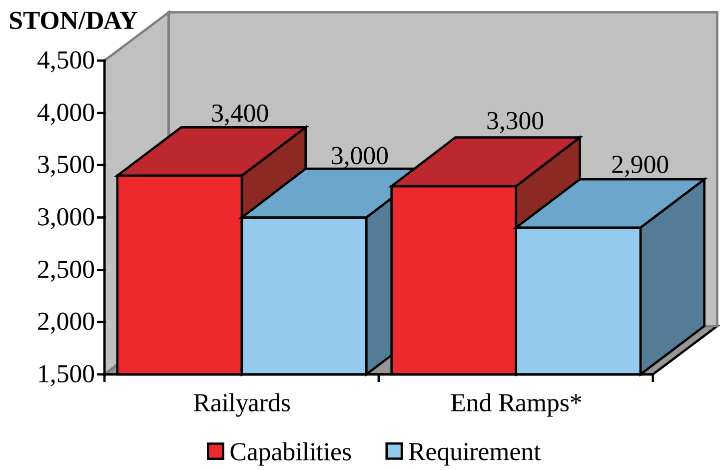
Vehicles would access the West Pier through West Pier Gate on the 30th Avenue extension. Both the access road and West Pier Gate can handle at least 1,500 vehicles per day.



Rail

No classification yards are within the port. However, the port authority indicates that the port area can store about 40 railcars at one time (potentially 80 railcars per day). Also, there is an 800-railcar capacity rail classification yard 1.25 miles from the port. On the West Pier, the wood/concrete railcar ramp can serve 12 railcars at one time. This end ramp could offload about 50 railcars per day. This exceeds the requirement of about 45 railcars per day.

RAIL CLEARANCE/HANDLING CAPABILITY

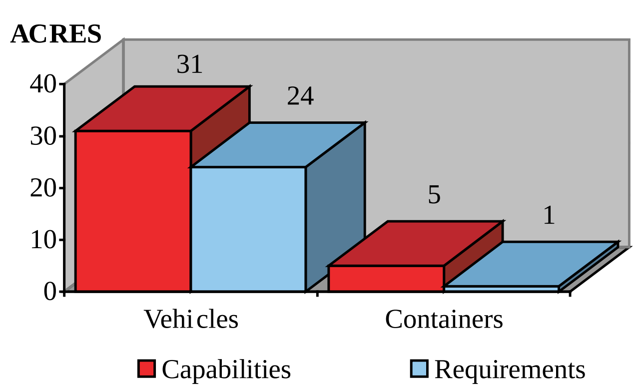


Assumes one rail end ramp can be in place in the terminal for offloading railcars.
To avoid exceeding the berth rail capacity, 6 days are required for the railcars to arrive.
Based on MTMCTEA Reference 97-700-5, 560 STON are loaded in 94 containers.
The containers arrive in the port on the railcars.

Open Storage

The port has plenty of open storage area. The staging area requirement for each LMSR is about 25 acres. Loading one ship at a time will require a total of 25 acres for vehicle and container storage.

OPEN STORAGE CAPABILITY



Shipping

The number of ships needed to load this requirement depends on the shipping mix selected. The best ship mix would require two LMSRs. Berth space is adequate to allow the side and stern ramps on the LMSR to be used to load the ship. If smaller ships are used to deploy the brigade, then additional time or berths will be required to move the brigade.

SHIP REQUIREMENTS NOTIONAL ARMORED BRIGADE

Loading Condition/ Sample Ship Mix	(RORO/ Comb)	LMSR (RORO/ Comb)	C3/C4 (Breakbulk or Containers)	C6/C7/C8 (Container)
Minimum Containerization				
All FSS	2.3			
All LMSR		1.4		
All Breakbulk			7.0	
Maximum Containerization				
FSS/Container	0.8			0.9
LMSR/Container		0.5		0.9
Breakbulk/Container			2.5	0.9

Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

Deploying by LMSR requires two ships. The berthing can support one LMSR or one FSS. Based on preliminary LMSR loading results, we estimate the LMSRs will load about 400 STON per hour. Each LMSR will require an average 34.81 hours to load. The number of days required to load the ship is determined by the hours of work per day (20) and factors for sustainment and nighttime operations. Applying these factors, we get the equivalent of 18.43 hours per day. Based on a loading time of 34.81 hours and 18.43 hours per day productive time, it will require an average of 1.89 days to load each LMSR if the load was divided equally between the two ships. The first ships should arrive no earlier than the third day of equipment arrival and begin loading and the last ship arrives in the port as the first ship departs. This requires a total of 7 days to stage and load the ships.

Deploying by FSS requires three ships. Based on FSS loading time of 250 STON per hour. Each FSS will require an average 37.14 hours to load. The number of days required to load the ship is determined by the hours of work per day (20) and factors for sustainment and nighttime operations. Applying these factors, we get the equivalent of 18.43 hours per day. Based on a loading time of 37.14 hours and 18.43 hours per day productive time, it will require 2.01 days to load the

FSS. Gulfport has berthing for one FSS at a time in the berth. This requires a total of 9 days of staging in the berth area and the first vessel arriving on day 3, the second on day 5 and the last one arriving on day 7.

SUMMARY

The Port of Gulfport can deploy a notional armored brigade in about 7 days using only one berth in the port and two LMSR vessels. If FSS vessels are used, 9 days will be required to deploy the unit through the port.

Because of the lack of railcar storage space at the port, the flow of incoming equipment by rail transport depends on the number of trains coming in per day from the local railyard. The current support is two trains per day.

The port's capability meets rail inprocessing/handling capability requirements.

RECOMMENDATIONS

To meet the time line requirement of 6 days, the armored brigade has to be loaded on LMSR or FSS vessels. If other vessels are used, additional loading time will be required.

PORT OF HOUSTON
TEXAS

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a site survey of the Port of Houston in September 1997. This Ports for National Defense study is based on that site survey and 1999 - 2000 validation with the Houston Port Authority. This port, a huge facility with ample capability in various operations, can easily throughput brigade-size units and can accommodate vessels as large as the FSS or LMSR.

The port is made up of quays at several terminals. The premier terminal is Barbours Cut, a very busy ultramodern intermodal terminal. This terminal has a 6,000-foot long quay and a water depth of 42 feet. It is capable of berthing LMSR and FSS vessels. The apron height (19 feet) is at the upper limit for these vessels. At the time of the port survey, Barbours Cut Terminal was operating at peak capacity and the Houston Port Authority had worked an agreement with the Port of Galveston for subleasing Pier 10.

From a military usefulness standpoint, the other terminals are: Turning Basin, Woodhouse, Care, and Jacintoport. Due to the lack of a large turning basin, none of these terminals are FSS or LMSR capable. Also, the I-610 bridge has an air clearance of only 135 feet at mean high water, which negates FSS accessibility to the Turning Basin Terminal.

The Port of Houston is capable of breakbulk, RORO, container, and barge operations. This port is rail accessible by the Burlington Northern/Santa Fe and Union Pacific rail lines and has two commercial airports and a United States Air Force base within 12 miles of the Turning Basin Terminal. Between these airports, the military services should not encounter any problems for landing/take-off of larger military aircraft. Available materials handling equipment (MHE) include transtainers, container cranes, mobile cranes, container handlers, forklifts, and a floating derrick. Mobile cranes and other MHE are available through local stevedores. The port also has both truck and rail end ramps for offloading semitrailers and railcars.

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a total mixed throughput capability of about 97,800 STON (371,000 MTON) per day. RORO and container throughput capabilities are 114,360 STON and 78,800 STON, respectively.

The terminal most desirable for deployment is Barbours Cut due to the 42-foot water depth, close proximity to open water, and greater ease in ability to turn ships. This terminal is compatible with berthing FSS and LMSR vessels and has ample staging. The Barbours Cut Terminal is also the busiest in the port. Much of the staging area is constantly covered with containers. Use by the military will likely cause a major disruption in the Port of Houston’s commercial container business. For this study, we analyzed a notional heavy armored cavalry regiment deploying from the Port of Houston using two different applications. We analyzed the regiment deploying through one berth at Barbours Cut. We also analyzed the regiment deploying through the Woodhouse Terminal because the Port of Houston's Port Authority suggested Woodhouse Terminal as an alternative for military deployments. Woodhouse Terminal is a small but viable terminal for throughputting a brigade/regiment-size unit. This terminal cannot handle FSS or LMSR vessels because of lack of access to a turning basin. However, vessels as large as the Cape D and Cape H can access the Woodhouse Terminal. A notional heavy armored cavalry regiment has about 31,350 STON (130,680 MTON) of vehicles and equipment. To meet a port closure requirement of 6 days, a deploying notional heavy armored cavalry regiment requires about 5,210 STON of vehicles and equipment (that includes 24 containers) per day to be loaded. When two LMSRs are available for loading in sequence at Barbours Cut Terminal, the port meets the shipping requirements if all facilities and resources are available. Deployment of the regiment using Cape D or H vessels at Woodhouse Terminal does not meet the 6-day requirement, but is within 6.5 days. Smaller ships will require additional time or berths.

For deployment operations, about 25 acres of staging are desired per LMSR to support daily, sustained loading operations. The desired staging for an FSS is about 16 acres per ship to support daily, sustained loading operations. Open storage requirements are dependent upon cargo arrival to the port, smooth loading operations on the cargo vessel, and ship arrival. The Barbours Cut Terminal has about 203 acres, however, almost all of this open storage is used on a daily basis. Woodhouse Terminal has about 17 acres of available paved open storage, sufficient for a Cape H or Cape D vessel.

The notional heavy armored cavalry regiment will require 54 railcars per day using the rail/convoy option. The port states that they handle 42,000 railcars per month or 1,400 per day. The port should easily be able to handle the additional influx of 54 railcars per day.

Computer simulations show that the port is capable of achieving closure for throughputing a notional armored cavalry regiment in about 6 - 6.5 days depending on the terminal (and portions of the terminal) used.

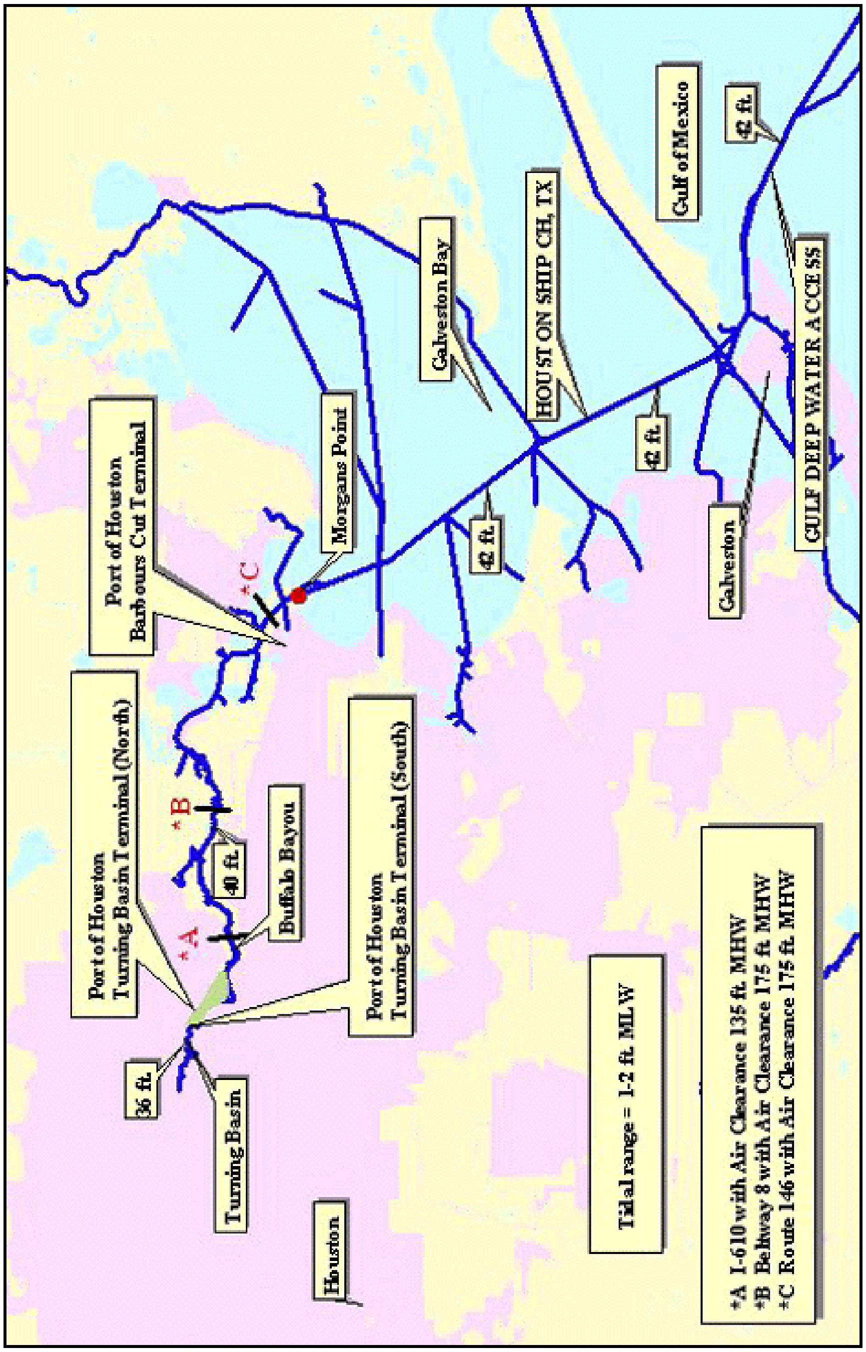
II. GENERAL DATA

The Port of Houston, Texas, is a port on the U.S. Gulf Coast considered for use in deploying military equipment during contingencies. A team from the Military Traffic Management Command conducted a site survey in September 1997. This information was validated December 1999 - January 2000. Information on port characteristics was obtained from port officials.

TRANSPORTATION ACCESS

Water

The Port of Houston (latitude 29° 45’ north, longitude 95° 20’ west, (LCMT)) is in southeastern Texas and consists of multiple terminals along the Houston Ship Channel from Morgan’s Point to the turning basin at the head of Buffalo Bayou. The port’s terminals include Barbours Cut, Turning Basin (north and south), Woodhouse, Care, and Jacintoport. Water depths in the Houston Ship Channel are 36 feet mean low water (MLW) for the Turning Basin Terminal; 40 feet MLW for the Woodhouse, Care, and Jacintoport Terminals; and 42 feet MLW for Barbours Cut. Maximum length of ship is 750 feet for the Turning Basin and Woodhouse Terminals, 860 feet for the Jacintoport and Care Terminals, and 950 feet for Barbours Cut. Channel width varies from 300 feet to 800 feet.



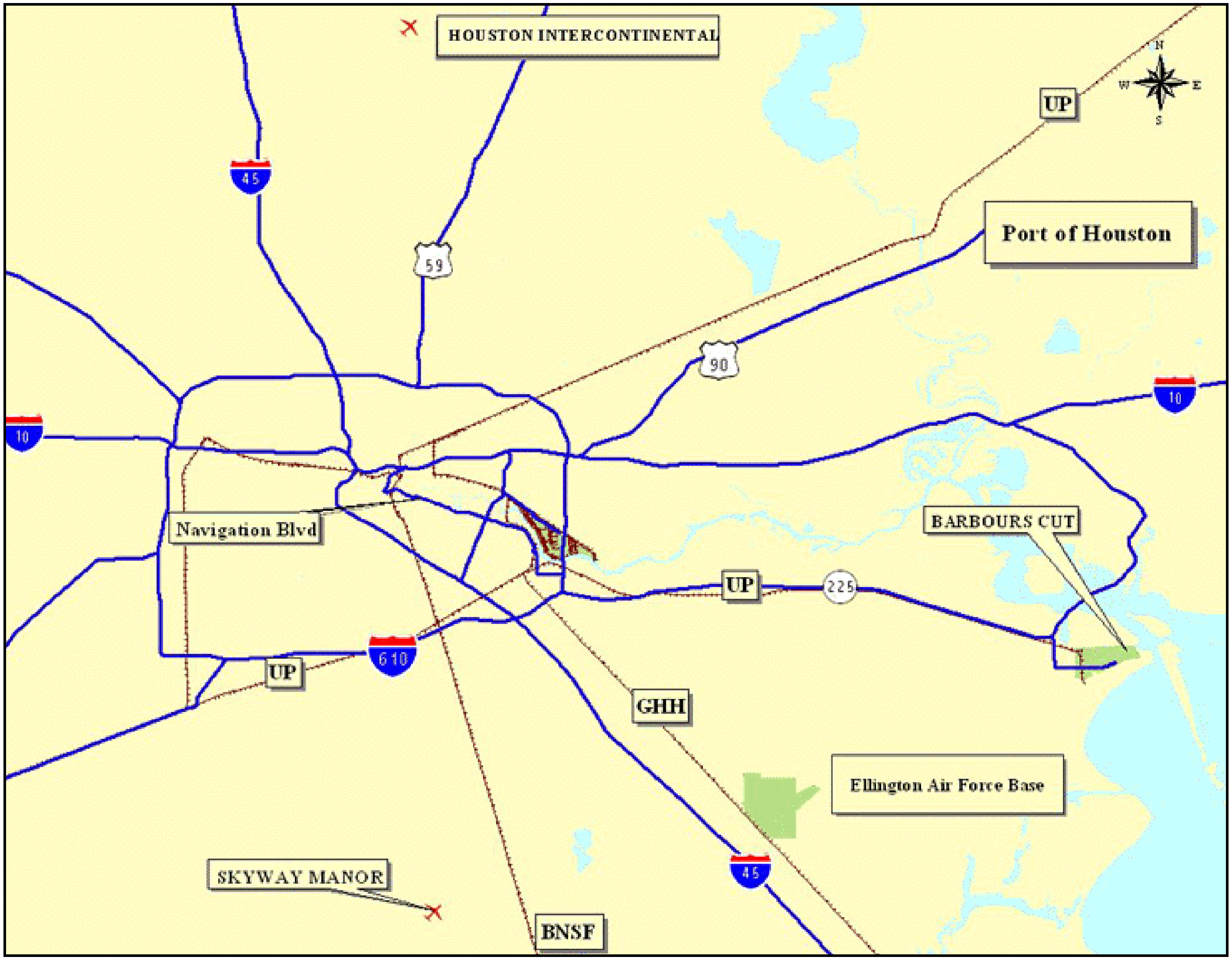
Water Access Map

Turning Basin and Houston Ship Channel (Buffalo Bayou) at Turning Basin Terminal

No bridges cross the main ship channel between the Gulf of Mexico and Barbours Cut. However, three bridges cross the channel between Barbours Cut and the Turning Basin Terminal. These bridges and respective air clearances at mean high water (MHW) are: Texas State Route 146 (175 feet), Beltway 8 (175 feet), and I-610 (135 feet). All vessels entering the port require pilots. The port authority reports that 55 pilots and tugboats are available at all times. The port has not experienced any delays in the past in receiving vessels. Ships over 22 feet in water draft must anchor in the Gulf of Mexico. The port authority lists five turning basins. They are Constitution Bend, Wharf 27/28, Arco, Warren, and Adams Terminals. Constitution Bend and Wharf 27/28 have a water depth of 36 feet MLW and Arco, Warren, and Adams Terminals have a water depth of 40 feet. All of these turning basins can turn a ship with a maximum length of 750 feet, which precludes turning the FSS and LMSR. The FSS and LMSR access into Barbours Cut is feasible via pull in and back out. Distance to open water is about 52 miles and the tidal variation ranges from 1-2 feet.

Highway

The port has excellent access to major highway routes. Interstates 610, 10, and 45 are all within close proximity of the port. Access to the northside of the Turning Basin Terminal is directly off I-610 (east loop), via exit 29 or Clinton Drive. These routes lead to Gates A, 8, 1, and AA. Access to the southside of the Turning Basin Terminal is via Navigation Boulevard to either 75th Street and Gate 15 or 76th Street and Gate 18. Gate 15 is normally closed and not guarded. Gate 18 is guarded during the day. Traffic congestion is heavy at the Turning Basin Terminal. Access to the Barbours Cut Terminal from Texas 225 or 146 is via Barbours Cut Boulevard (Route 410). The terminal has four gates directly off Barbours Cut Boulevard. Traffic congestion is mild in this area. Highway access, as well as air and rail access, is shown on the following map.



Highway, Rail, and Air Access Map

Rail

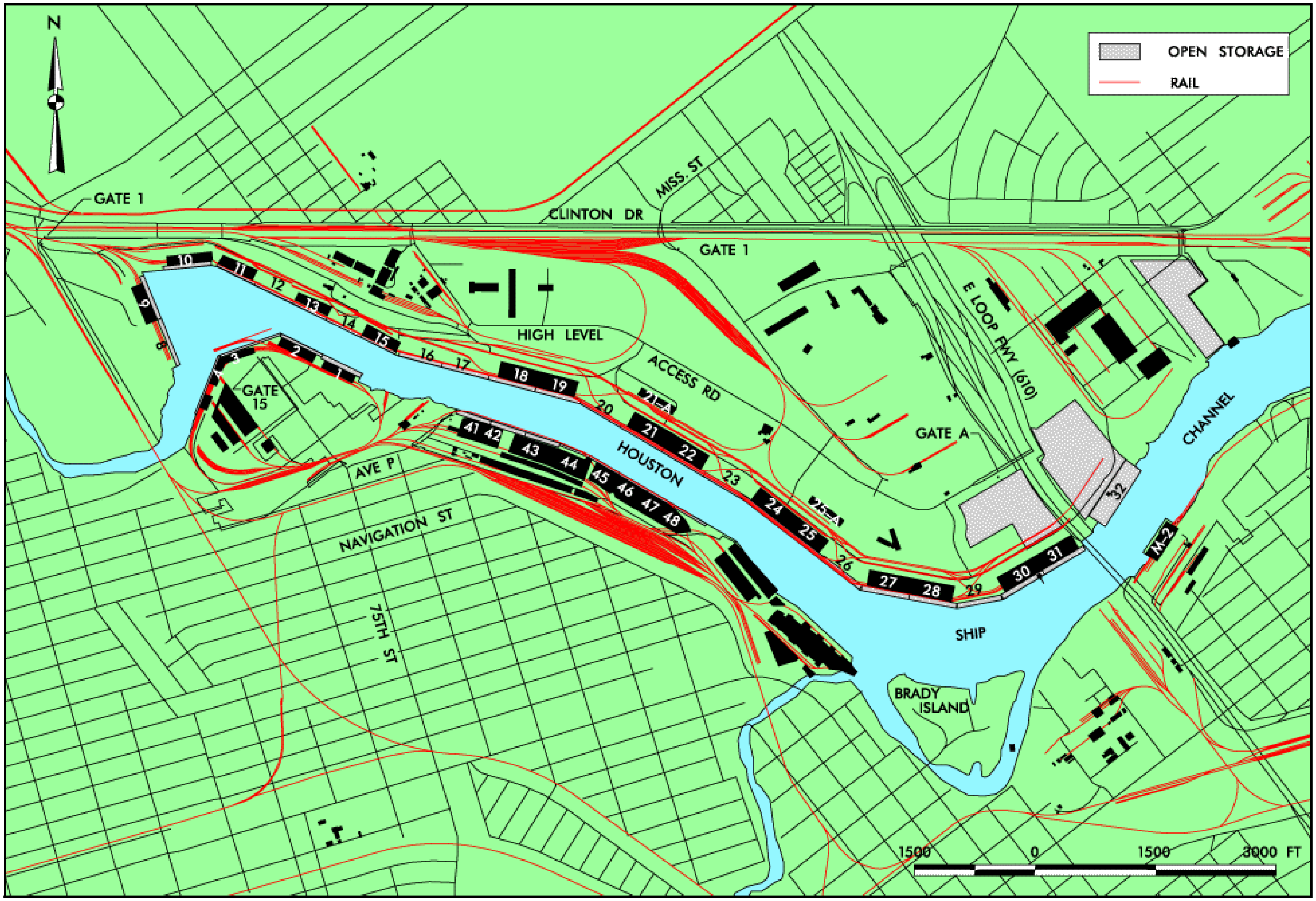
Double-Stacked Railcars at Barbours Cut

The Burlington Northern/Santa Fe (BNSF) and Union Pacific (UP) railroad companies provide service to the Port of Houston. The Port Terminal Railroad Association (PTRA) provides switching for freight cars entering and within the port. The PTRA has 24 locomotives available for use. Several railyards exist in or near the port. These railyards can store over 5,700 89-foot railcars. At the time of the survey, rail traffic and storage had reached capacity in the Houston area. The PTRA was operating at 70-80 percent capacity. Rail clearances are sufficient for bilevel and trilevel railcars to access the port. Rail trackage links the railyards to the port's apron tracks, transit sheds, and storage tracks. Apron tracks are along all the Turning Basin wharves except Berths 1, 2, 4, and 32. None of the Barbours Cut wharves have apron tracks. Jacintoport and Woodhouse Terminals have rail spurs on the aprons, but Care Terminal does not. The port can easily handle 8 trains of 100 railcars each per day. Only one rail end ramp, a concrete fixed ramp, exists in the Port of Houston. This ramp is located at the east end of the Barbours Cut Terminal and serves both railcars and highway trucks. The port does not have any portable end ramps, but does have several spurs, especially in the Barbours Cut Terminal, that are compatible with end ramp offloading. Three intermodal railyards exist in the Houston area. Two are owned by UP and one is owned by BNSF.

Air

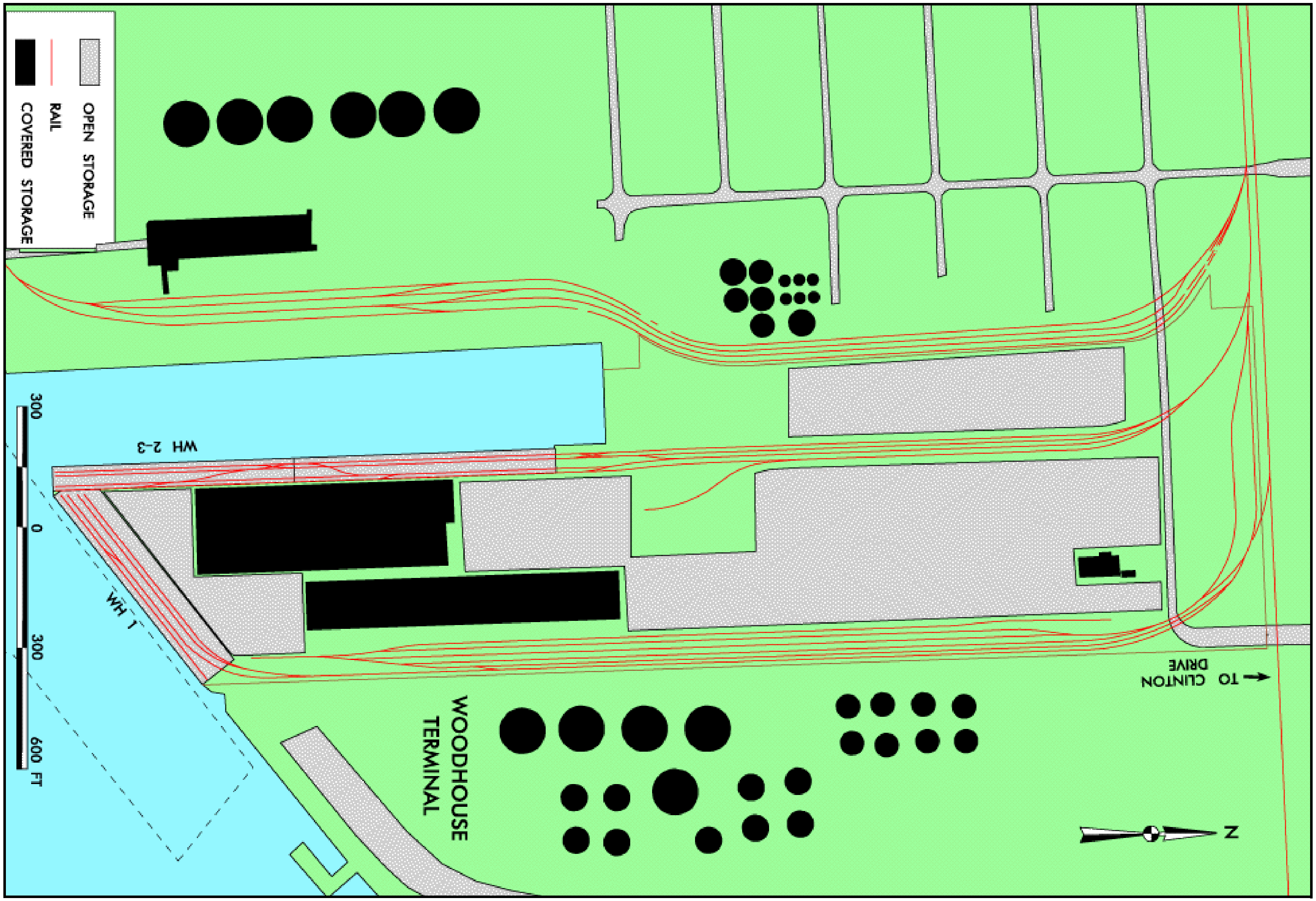
The three largest airports that serve the Port of Houston are Houston Intercontinental Airport, William P. Hobby Airport, and Ellington Air Force Base. All of these are within 12 miles of the Turning Basin Terminal. Between these airports, any military aircraft should be able to access Houston.

Main Runway	Houston International	William. P. Hobby	Ellington AFB
Length (ft)	12,000	7,600	9,000
Width (ft)	150	150	150



Land-Use Map of Turning Basin Terminal

Land-Use Map of Barbours Cut Terminal



Land-Use Map of Woodhouse Terminal

PORT FACILITIES

Berthing

The Port of Houston is a multicargo port consisting of marginal wharves capable of breakbulk, RORO, container, and barge operations.

The Barbours Cut Terminal is the premier terminal at the port and specializes in container operations, but can also handle RORO ships. It has a water depth of 42 feet MLW, and a total contiguous wharf length of 6,000 feet (FSS and LMSR capable). It also has an open apron, two container freight stations, and two container cranes for each 1,000-foot section of wharf. Barbours Cut has a total of 203 acres. Military units deployed through this terminal during Operation Desert Shield/Storm.

The Turning Basin Terminal consists of quays situated along both sides (northside and southside) of the ship channel. With transit sheds along the majority of the berths, the Turning Basin Terminal is primarily suited for breakbulk operations, but can handle other operations including RORO, container, and barge. Open storage is at a premium in the Turning Basin Terminal. Twenty five acres out of the 51.5 acres total are located at Berth 32, the berth most suitable for military operations at the Turning Basin Terminal. This terminal can handle vessels as large as the Cape H.

The Woodhouse Terminal is a small, but versatile terminal that can easily accommodate breakbulk and RORO operations. This terminal has 233,000 square feet of covered storage, 17 acres of open storage, and can handle vessels as large as the Cape H. The Port of Houston's Port Authority suggested this facility for potential military shipment. Jacintoport and Care Terminals are specialized terminals with some ability to handle military operations. Berth characteristics for all berths are shown in the tables on the next three pages.

Woodhouse Terminal

BERTH CHARACTERISTICS FOR THE PORT OF HOUSTON						
Berths						
Characteristics	**BC 1**	**BC 2**	**BC 3**	**BC 4**	**BC 5**	**BC 6**
Length feet (meters)	1,000 (304)	1,000 (304)	1,000 (304)	1,000 (304)	1,000 (304)	1,000 (304)
Depth alongside at MLW feet (meters)	42 (12.8)	42 (12.8)	42 (12.8)	42 (12.8)	42 (12.8)	42 (12.8)
Deck Strength psf (metric tons per square meter)	1,000 (4.89)	1,000 (4.89)	1,000 (4.89)	1,000 (4.89)	1,000 (4.89)	1,000 (4.89)
Apron width feet (meters)	Open	Open	Open	Open	Open	Open
Apron height above MLW feet (meters)	19 (5.79)	19 (5.79)	19 (5.79)	19 (5.79)	19 (5.79)	19 (5.79)
Number of container cranes	2	2	2	2	2	2
Number of wharf cranes	0	0	0	0	0	0
Apron Lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	Yes	No	No	No	No	No
Apron length served by rail feet (meters)	0	0	0	0	0	0
Note: BC = Barbours Cut.						

BERTH CHARACTERISTICS FOR THE PORT OF HOUSTON - cont				
Berths				
Characteristics	**WH 1**	**WH 2-3**	**C 4**	**Jac 1-2**
Length feet (meters)	660 (201)	1,250 (381)	500 (152)	1,230 (375)
Depth alongside at MLW feet (meters)	39 (11.89)	35 (10.67)	38 (11.58)	36 (10.97)
Deck Strength psf (metric tons per square meter)	500 (2.44)	500 (2.44)	500 (2.44)	500 (2.44)
Apron width feet (meters)	100 (30.48)	80 (24.38)	Open	Open
Apron height above MLW feet (meters)	18 (5.49)	18 (5.49)	16 (4.88)	14 (4.27)
Number of container cranes	0	0	0	0
Number of wharf cranes	0	0	0	0
Apron Lighting	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	No	Yes	No	No
Apron length served by rail feet (meters)	660 (201)	1,250 (381)	0	1,230 (375)
Note: WH = Woodhouse. C = Care. Jac = Jacintoport.				

BERTH CHARACTERISTICS FOR THE PORT OF HOUSTON - cont						
Berths						
Characteristics	TB 8-9	TB 10	TB 11-13	TB 14-15	TB 16-17	TB 18-19
Length feet (meters)	1,179 (359)	600 (183)	1,520 (463)	1,006 (307)	1,154 (352)	1,177 (359)
Depth alongside at MLW feet (meters)	34 (10.4)	33 (10.1)	33 (10.1)	35 (10.7)	38 (11.6)	38 (11.6)
Deck Strength psf (metric tons per square meter)	500 (2.44)	500 (2.44)	500 (2.44)	500 (2.44)	750 (3.66)	600 (2.93)
Apron width feet (meters)	Open	48 (14.63)	Open	30 (9.14)	Open	52 (15.85)
Apron height range feet (meters)	18 (5.49)	14 (4.27)	15 (4.57)	14 (4.27)	14 (4.27)	15 (4.57)
Number of container cranes	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0
Apron Lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	Yes	No	No	No	No	No
Apron length served by rail feet (meters)	1,179	600	1,520	1,006	1,154	1,177

BERTH CHARACTERISTICS FOR THE PORT OF HOUSTON - cont						
Berths						
Characteristics	TB 20-21	TB 22-23	TB 24-26	TB 27-28	TB 29	TB 30-31
Length feet (meters)	1,193 (364)	1,200 (366)	1,800 (549)	1,200 (366)	600 (183)	1,200 (366)
Depth alongside at MLW feet (meters)	38 (11.6)	38 (11.6)	38 (11.6)	38 (11.6)	38 (11.6)	38 (11.6)
Deck Strength psf (metric tons per square meters)	600 (2.93)	750 (3.66)	750 (3.66)	750 (3.66)	750 (3.66)	750 (3.66)
Apron width feet (meters)	Open	Open	Open	60 (18.29)	Open	60 (18.29)
Apron height range feet (meters)	15 (4.57)	15 (4.57)	15 (4.57)	15 (4.57)	15 (4.57)	15 (4.57)
Number of container cranes	0	0	1	0	0	1
Number of wharf cranes	0	0	0	0	0	0
Apron Lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No	No	No	No
Apron length served by rail feet (meters)	1,193 (364)	1,200 (366)	1,800 (549)	1,200 (366)	600 (183)	1,200 (366)

BERTH CHARACTERISTICS FOR THE PORT OF HOUSTON - cont						
	Berths					
Characteristics	**TB 32**	**TB 1-2**	**TB 3**	**TB 4**	**TB 41-44**	**TB 45-48**
Length feet (meters)	800 (244)	1,348 (411)	800 (244)	779 (237)	1,653 (504)	1,773 (540)
Depth alongside at MLW feet (meters)	38 (11.6)	33 (10.1)	33 (10.1)	27 (8.2)	31 (9.4)	31 (9.4)
Deck Strength psf (metric tons per square meters)	1,000 (4.89)	250 (1.22)	400 (1.95)	400 (1.95)	500 (2.44)	500 (2.44)
Apron width feet (meters)	Open	54 (16.46)	30 (9.14)	27 (8.23)	31 (9.45)	44 (13.41)
Apron height range feet (meters)	17 (5.18)	13 (3.96)	8 (2.44)	8 (2.44)	14 (4.27)	14 (4.27)
Number of container cranes	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	1	0
Apron Lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No	No	No	No
Apron length served by rail feet (meters)	0	0	800 (244)	0	1,653 (504)	1,773 (540)
Note: TB = Turning Basin.						

Berth 32, Turning Basin Terminal

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF HOUSTON

Vessels		Berths			
Type	**Class**	**BC 1**	**BC 2**	**BC 3**	**BC 4**
BREAKBULK	C3-S-38a	1	1	1	1
	C4-S-58a	1	1	1	1
	C4-S-66a	1	1	1	1
	C5-S-37e	1	1	1	1
SEATRAIN	GA and PR	1	1	1	1
BARGE	LASH C8-S-81b	1	1	1	1
	LASH C9-S-81d	1	1	1	1
	LASH Lighter	5	5	5	5
	SEABEE C8-S-82a	1	1	1	1
	SEABEE Barge	5	5	5	5
RORO	COMET	1,i,j	1,d,i,j	1,d,i,j	1,d,i,j
	METEOR	1,i,j	1,d,i,j	1,d,i,j	1,d,i,j
	Cape Gnome	1,i,j	1,d,i,j	1,d,i,j	1,d,i,j
	C7-S-95A	1,i,j	1,i,j	1,i,j	1,i,j
	Cape Taylor	1,i,j	1,i,j	1,i,j	1,i,j
	Cape Orlando	1,i,j	1,i,j	1,i,j	1,i,j
	MV Ambassador	1,i	1,d	1,d	1,d
	Callaghan	1,i,j	1,d,i,j	1,d,i,j	1,d,i,j
	Cape Lambert	1,i,j	1,i,j	1,i,j	1,i,j
	LMSR Class	1	1	1	1
	FSS	1	1	1	1
	Cape E-Class	1,i,j	1,i,j	1,i,j	1,i,j
	Cape D-Class	1,i,j	1,i,j	1,i,j	1,i,j
	Cape H	1,i,j	1,i,j	1,i,j	1,i,j
RORO	Cape Texas	1,i,j	1,i,j	1,i,j	1,i,j
	Cape R	1,i,j	1,d	1,d	1,d
	Cape I-class	1,i,j	1,i,j	1,i,j	1,i,j
	Cape Victory	1,i,j	1,i,j	1,i,j	1,i,j
CONTAINER	C6-M-147a	1	1	1	1
	C7-S-69c	1	1	1	1
	C7-S-68c	1	1	1	1
	C8-S-85c	1	1	1	1
	C9-M-132b	1	1	1	1
	C9-M-F141a	1	1	1	1
TACS	C6-S-1qd	1	1	1	1
	C5-S-MA73c	1	1	1	1
	C6-S-MA60d	1	1	1	1
MPS	C7-S-133a	1	1	1	1
	Maersk	1	1	1	1
	AmSea	1	1	1	1

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp
Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF HOUSTON - cont								
Vessels		Berths						
Type	Class	BC 5	BC 6	WH 1	WH 2-3	C 4	Jac 1-2	
BREAKBULK	C3-S-38a	1	1	1	2	1	2	*NOTES:*
	C4-S-58a	1	1	1	2	c	2	The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.
	C4-S-66a	1	1	1	2	c	2	
	C5-S-37e	1	1	1	2	c	1	
SEATRAIN	GA and PR	1	1	1	2	c	2	
BARGE	LASH C8-S-81b	1	1	c	1	c	1	
	LASH C9-S-81d	1	1	c	1,a,f	c	1,a,f	The letters in the columns to the left indicate limitations as described below.
	LASH Lighter	5	5	3	6	2	6	
	SEABEE C8-S-82a	1	1	c	1,a,f	a,c,f	1,a,f	
	SEABEE Barge	5	5	3	6	2	6	
RORO	COMET	1,d,i,j	1,d,i,j	1,d,i,j	2,i,j	1,d,i,j	2,d,i,j	a-vessel draft limit
	METEOR	1,d,i,j	1,d,i,j	1,d,i,j	2,i,j	c,d,i,j	2,d,i,j	b-inadequate apron width
	Cape Gnome	1,d,i,j	1,d,i,j	1,d,i,j	1,i,j	c,d,i,j	1,d,i,j	c-inadequate berth length
	C7-S-95A	1,i,j	1,i,j	c	1,i,j	c	1	d-no straight stern ramp
	Cape Taylor	1,i,j	1,i,j	1,i,j	1,i,j	c	1	e-no container handling equipment
	Cape Orlando	1,i,j	1,i,j	1,i,j	1,i,j	c	1,i,j	f-anchorage depth OK, berth depth inadequate
	MV Ambassador	1,d	1,d	1,d	2,i	c,d	2,d	g-inadequate channel depth
	Callaghan	1,d,i,j	1,d,i,j	c,d,i,j	1,i,j	c,d,i,j	1,d,i,j	h-no shore based ramps
	Cape Lambert	1,i,j	1,i,j	c	1,i,j	c	1,i,j	i-low tide insufficient ramp clearance
	LMSR Class	1	1	c,q	q	c,q	q	j-high tide insufficient ramp clearance
	FSS	1	1	c,q	a,q	c,q	a,q	k-excessive ramp angle low tide
	Cape E-Class	1,i,j	1,i,j	1,i,j	1,i,j	c	1,i,j	m-excessive ramp angle high tide
	Cape D-Class	1,i,j	1,i,j	c	1,i,j	c	1,i,j	n-parallel ramp operation ONLY
	Cape H	1,i,j	1,i,j	c	1,a	c	1	o-insufficient apron width for side ramp
RORO	Cape Texas	1,i,j	1,i,j	1,i,j	1,i,j	c	1,i,j	q-insufficient turning basin and air clearance
	Cape R	1,d	1,d	1,d	1,i,j	c,d	1,d	
	Cape I-class	1,i,j	1,i,j	c	1,i,j	c	1,i,j	
	Cape Victory	1,i,j	1,i,j	1,i,j	1,i,j	c	1,i,j	
CONTAINER	C6-M-147a	1	1	1,e	1,e	c,e	1,e	Ramp clearance and angle based on maximum vessel draft
	C7-S-69c	1	1	c,e	1,e	c,e	1,e	
	C7-S-68c	1	1	c,e	1,e	c,e	1,e	♦ May Prevent Operation
	C8-S-85c	1	1	c,e	1,e	c,e	1,e	
	C9-M-132b	1	1	c,e	1,e	c,e	1,e	
	C9-M-F141a	1	1	c,e	1,a,e	c,e	1,a,e	♦ May Limit Operation
TACS	C6-S-1qd	1	1	c	1	c	1	
	C5-S-MA73c	1	1	1	1	c	1	
	C6-S-MA60d	1	1	c	1	c	1	
MPS	C7-S-133a	1	1	c	1	c	1	
	Maersk	1	1	c	1	c	1	
	AmSea	1	1	c	1	c	1	

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF HOUSTON - cont

Vessels		Berths					
Type	**Class**	**TB 8-9**	**TB 10**	**TB 11-13**	**TB14-15**	**TB 16-17**	**TB 18-19**
BREAKBULK	C3-S-38a	2	1	2	1	2	2
	C4-S-58a	1	1	2	1	1	1
	C4-S-66a	2	1	2	1	2	2
	C5-S-37e	1	1	2	1	1	1
SEATRAIN	GA and PR	2	1	2	1	1	2
BARGE	LASH C8-S-81b	1,a,f	a,c,f	1,a,f	1	1	1
	LASH C9-S-81d	1,a,f,g	a,c,f,g	1,a,f,g	1,a,f,g	1,g	1,g
	LASH Lighter	5	3	7	5	5	5
	SEABEE C8-S-82a	1,a,f,g	a,c,f,g	1,a,f,g	1,a,f,g	1,a,f,g	1,a,f,g
	SEABEE Barge	5	3	7	5	5	5
RORO	COMET	2,i,j	1,d,o	2,d,i,j	1,d,o	2,d,i,j	2,d,o
	METEOR	2,i,j	1,d,o	2,d,i,j	1,d,o	2,d,i,j	2,d,o
	Cape Gnome	1,i,j	a,c,d,o	2,a,d,i,j	1,d,o	1,d,i,j	1,d,o
	C7-S-95A	1,i,j	a,b,c	2,a	1,b	1	1,b
	Cape Taylor	1,i,j	b,c	2	1,b	1	1,b
	Cape Orlando	1,i,j	b,c	2,i,j	1,b	1,i,j	1,b
	MV Ambassador	2,i	1,d	2,d	1,d	2,d	2,d
	Callaghan	1,i,j	c,d,o	2,d,i,j	1,d,o	1,d,i,j	1,d,o
	Cape Lambert	1,i,j	b,c	2,i,j	1,b	1,i,j	1,b
	LMSR Class	a,q	a,b,c	a,q	b,q	q	b,q
	FSS	a,g,q	a,b,c,g	a,g,q	a,b,g,q	g,q	b,g,q
	Cape E-Class	1,i,j	b,c	2,i,j	1,b	1,i,j	1,b
	Cape D-Class	1,i,j	b,c	2,i,j	1,b	1,i,j	1,b
	Cape H	1,a	a,b,c	1,a	1,a,b	1	1,b
RORO	Cape Texas	1,i,j	b,c	2,i,j	1,b	1,i,j	1,b
	Cape R	1,i,j	c,d	2,d	1,b,d,o	1,d	1,d
	Cape I-class	1,i,j	b,c	2,i,j	1,b	1,i,j	1,b
	Cape Victory	1,i,	b,c	2,i,j	1,b	1,i,j	1,b
CONTAINER	C6-M-147a	1,e	b,c,e	2,e	1,b,e	1,e	1,b,e
	C7-S-69c	1,e	b,c,e	2,e	1,b,e	1,e	1,b,e
	C7-S-68c	1,e	b,c,e	2,e	1,b,e	1,e	1,b,e
	C8-S-85c	1,e	b,c,e	1,e	1,b,e	1,e	1,b,e
	C9-M-132b	1,a,e	a,b,c,e	1,a,e	1,b,e	1,e	1,b,e
	C9-M-F141a	1,a,e,g	a,b,c,e,g	1,a,e,g	1,a,b,e,g	1,e,g	1,b,e,g
TACS	C6-S-1qd	1	b,c	2	1,b	1	1,b
	C5-S-MA73c	1	b,c	2	1,b	1	1,b
	C6-S-MA60d	1	b,c	2	1,b	1	1,b
MPS	C7-S-133a	1	b,c	1	1,b	1	1,b
	Maersk	1	b,c	1	1,b	1	1,b
	AmSea	1	b,c	2	1,b	1	1,b

NOTES:

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The letters in the columns to the left indicate limitations as described below.

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c-inadequate berth length
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h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp
q-insufficient turning basin and air clearance

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF HOUSTON - cont

Vessels		Berths					
Type	**Class**	**TB 20-21**	**TB 22-23**	**TB 24-26**	**TB 27-28**	**TB 29**	**TB 30-31**
BREAKBULK	C3-S-38a	2	2	3	2	1	2
	C4-S-58a	1	2	3	2	1	2
	C4-S-66a	2	2	3	2	1	2
	C5-S-37e	1	1	2	1	1	1
SEATRAIN	GA and PR	2	2	3	2	1	2
BARGE	LASH C8-S-81b	1	1	2	1	c	1
	LASH C9-S-81d	1,g	1,g	1,g	1,g	c,g	1,g
	LASH Lighter	5	6	9	6	3	6
	SEABEE C8-S-82a	1,a,f,g	1,a,f,g	1,a,f,g	1,a,f,g	a,c,f,g	1,a,f,g
	SEABEE Barge	5	6	9	6	3	6
RORO	COMET	2,d,i,j	2,d,i,j	3,d,i,j	2,d,o	1,d,i,j	2,d,o
	METEOR	2,d,i,j	2,d,i,j	3,d,i,j	2,d,o	1,d,i,j	2,d,o
	Cape Gnome	1,d,i,j	1,d,i,j	2,d,i,j	1,d,o	c,d,i,j	1,d,o
	C7-S-95A	1	1	2	1	c	1
	Cape Taylor	1	1	2	1	c	1
	Cape Orlando	1,i,j	1,i,j	2,i,j	1,i,j	c	1,i,j
	MV Ambassador	2,d	2,d	3,d	2,d	1,d	2,d
	Callaghan	1,d,i,j	1,d,i,j	2,d,i,j	1,d,o	c,d,i,j	1,d,o
	Cape Lambert	1,i,j	1,i,j	2,i,j	1,i,j	c	1,i,j
	LMSR Class	1,q	1,q	1,q	1,b,q	c	1,b,q
	FSS	1,g,q	1,g,q	1,g,q	1,g,q	c,g,q	1,g,q
	Cape E-Class	1,i,j	1,i,j	2,i,j	1,i,j	c	1,i,j
	Cape D-Class	1,i,j	1,i,j	2,i,j	1,i,j	c	1,i,j
	Cape H	1,i	1,i	2,i	1,i	c	1,i
RORO	Cape Texas	1,i,j	1,i,j	2,i,j	1,i,j	c	1,i,j
	Cape R	1,d	1,d	2,d	1,d	c,d	1,d
	Cape I-class	1,i,j	1,i,j	2,i,j	1,i,j	c	1,i,j
	Cape Victory	1,i,j	1,i,j	2,i,j	1,i,j	c	1,i,j
CONTAINER	C6-M-147a	1,e	1,e	2	1,e	c,e	1
	C7-S-69c	1,e	1,e	2	1,e	c,e	1
	C7-S-68c	1,e	1,e	2	1,e	c,e	1
	C8-S-85c	1,e	1,e	2	1,e	c,e	1
	C9-M-132b	1,e	1,e	2	1,e	c,e	1
	C9-M-F141a	1,e,g	1,e,g	1,g	1,e,g	c,e,g	1,g
TACS	C6-S-1qd	1	1	2	1	c	1
	C5-S-MA73c	1	1	2	1	c	1
	C6-S-MA60d	1	1	2	1	c	1
MPS	C7-S-133a	1	1	2	1	c	1
	Maersk	1	1	2	1	c	1
	AmSea	1	1	2	1	c	1

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
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d-no straight stern ramp
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h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp
q-insufficient turning basin and air clearance

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF HOUSTON - cont

Vessels		Berths					
Type	**Class**	**TB 32**	**TB 1-2**	**TB 3**	**TB 4**	**TB 41-44**	**TB 45-48**
BREAKBULK	C3-S-38a	1	2	1	1,a	3	3
	C4-S-58a	1	2	1	1,a	2	2
	C4-S-66a	1	2	1	1,a	2,a	3,a
	C5-S-37e	1	2	1	1,a	2	2
SEATRAIN	GA and PR	1	2	1	1	2	3
BARGE	LASH C8-S-81b	c	1,a,f	a,c,f	a,c,f	1,a,f	2,a,f
	LASH C9-S-81d	c,g	1,a,f,g	a,c,f,g	a,c,f,g	1,a,f,g	1,a,f,g
	LASH Lighter	4	6	4	3	8	8
	SEABEE C8-S-82a	a,c,f,g	1,a,f,g	a,c,f,g	a,c,f,g	1,a,f,g	1,a,f,g
	SEABEE Barge	4	6	4	3	8	8
RORO	COMET	1,d,i,j	2,d,o	1,d,o	1,d,o	3,d,i,j	3,d,o
	METEOR	1,d,i,j	2,d,o	1,d,o	1,a,d,o	2,d,i,j	3,d,o
	Cape Gnome	1,d,i,j	2,a,d,o	1,a,d,o	1,a,d,o	2,a,d,i,j	2,a,d,o
	C7-S-95A	1,i	1,a,b	1,a,b	1,a,b	2,a	2,a,b
	Cape Taylor	1,i	2,b	1,b	1,a,b	2	2,b
	Cape Orlando	1,i,j	2,b	1,b	1,a,b	2,i,j	2,b
	MV Ambassador	1,d	2,d	1,d	1,d	2,d	3,d
	Callaghan	1,d,i,j	1,d,o	1,d,o	1,d,o	2,d,o	2,d,o
	Cape Lambert	1,i,j	1,b	1,b	1,a,b	2,i,j	2,b
	LMSR Class	c,q	1,a,b,q	a,b,c,q	a,b,c,q	1,a,q	1,a,b,q
	FSS	c,g	1,a,b,g	a,b,c,g	a,b,c,g	1,a,g	1,a,b,g
	Cape E-Class	1,i,j	1,b	1,b	1,a,b	2,a	2,a,b
	Cape D-Class	1,i,j	1,b	1,b	1,a,b	2,a	2,a,b
	Cape H	1,i,j	1,a,b	1,a,b	1,a,b	2,a	2,a,b
RORO	Cape Texas	1,i,j	2,b	1,b	1,a,b	2,i,j	2,b
	Cape R	1,d	2,d	1,b,d,o	1,a,b,d,o	2,a,d	2,a,b,d
	Cape I-class	1,i,j	1,b	1,b	1,a,b	2,a	2,a,b
	Cape Victory	1,i,j	2,b	1,b	1,a,b	2,i,j	2,b
CONTAINER	C6-M-147a	1,e	1,b,e	1,b,e	1,b,e	2,e	2,b,e
	C7-S-69c	1,e	1,b,e	1,b,e	1,a,b,e	2,e	2,b,e
	C7-S-68c	1,e	1,b,e	1,b,e	1,a,b,e	2,a,e	2,a,b,e
	C8-S-85c	c,e	1,b,e	b,c,e	a,b,c,e	1,a,e	2,a,b,e
	C9-M-132b	c,e	1,a,b,e	a,b,c,e	a,b,c,e	1,a,e	1,a,b,e
	C9-M-F141a	c,e,g	1,a,b,e,g	a,b,c,e,g	a,b,c,e,g	1,a,e,g	1,a,b,e,g
TACS	C6-S-1qd	1	1,b	1,b	1,a,b	2	2,b
	C5-S-MA73c	1	2,b	1,b	1,a,b	2	2,b
	C6-S-MA60d	1	1,b	1,b	1,a,b	2,a	2,a,b
MPS	C7-S-133a	c	1,b	b,c	a,b,c	1,a	2,a,b
	Maersk	1	1,b	1,b	1,a,b	2,a	2,a,b
	AmSea	1	1,b	1,b	1,a,b	2,a	2,a,b

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp
q-insufficient turning basin and air clearance

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

STAGING

Open Staging

The Port of Houston has about 282 acres of open storage. Most of this staging (203 acres) is at the Barbours Cut Terminal. The rest of the acreage is distributed in various places in the Turning Basin, Woodhouse, Jacintoport, and Care Terminals. A significant portion of the remaining open storage is at Berth 32 in the Turning Basin Terminal (25 acres). The open storage at the Barbours Cut Terminal is the best place for helicopter operations provided the area can be cleared of containers. The 25 acres at Berth 32 also has potential for helicopter operations.

Portion of Open Staging at Berth 32

Covered Staging

The port has ample covered storage available for general cargo, helicopter operations, and container stuffing/unstuffing operations. Altogether, the port has a total of 1,803,411 square feet of available covered storage. The vast majority of this covered storage (1,603,411 square feet) is in the transit sheds in the Turning Basin and Woodhouse Terminals. The Container Freight Station at the Barbours Cut Terminal has 200,000 square feet of covered storage.

UNLOADING/LOADING POSITIONS

Ramps and Docks

The port has one fixed rail end ramp at the east end of Barbours Cut. This ramp also has space next to the rail spur for a flatbed or semitrailer to offload. The spur serving this ramp has almost 5,000 feet of straight track.

Fixed Rail and Truck End Ramp at East End of Barbours Cut

The port has about 138 truck docks and 206 rail docks available for van and boxcar loading/off-loading, respectively. These facilities are located along the transit sheds in the Turning Basin Terminal. Both the truck docks and rail docks are at platform level.

Marshaling Areas

The port lists the Pasadena Fairgrounds, owned by the City of Pasadena, as having potential for marshaling. This area is located about 3 miles southwest of Barbours Cut and has good highway access. This 100-acre facility has both paved and grass surfaces.

Grassy Portion of Marshaling Area at Pasadena Fairgrounds

MATERIALS HANDLING EQUIPMENT (MHE)			
Type of Equipment	**Capacity (STON)**	**Quantity**	**Wharf Assignment**
Container Cranes	30-50	12	Barbours Cut, Berths 23-31
"Big John" Floating Derrick	500	1	Port-wide
Transtainer	40	26	Barbours Cut
Transtainer (Rubber-Tired Gantry)	30	2	Turning Basin Terminal
Mobile Truck Cranes	100-400	130	Port-wide
MT Handlers	15	5	Port-wide
Top Loaders	33	2	Port-wide
NOTE: The table above represents equipment owned by the port. The port authority indicates that other equipment is available through local stevedores.			

FUTURE DEVELOPMENT

The Port of Houston reports two developments that will occur in the near future.

1. The port is in the planning stages for building the Bayport Container Terminal, a terminal similar to Barbours Cut. Scheduled completion is 3 years away.

2. The port plans to build Dock 33, a new ship berth designed for berthing ships up to 1,000 feet long. Because of the restrictions of the channel going into the turning basin, the port will likely place restrictions on navigation of ships longer than 750 feet. Such restrictions could include navigation during daylight hours only and/or no passing traffic. Scheduled completion is 3 years away.

EXPLOSIVES AND HAZARDOUS CARGO OPERATIONS

Any shipment of explosives and/or hazardous materials would require prior agreement with the port.

STEVEDORES

The port authority reports that as much labor as needed is available through local stevedores licensed by the Port of Galveston/Houston.

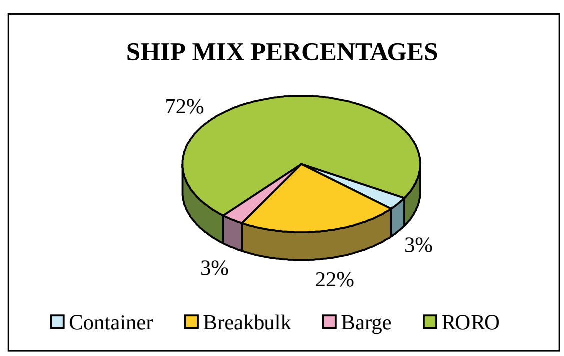
III. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Houston. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal reception/handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON.

Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 70 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

Highway

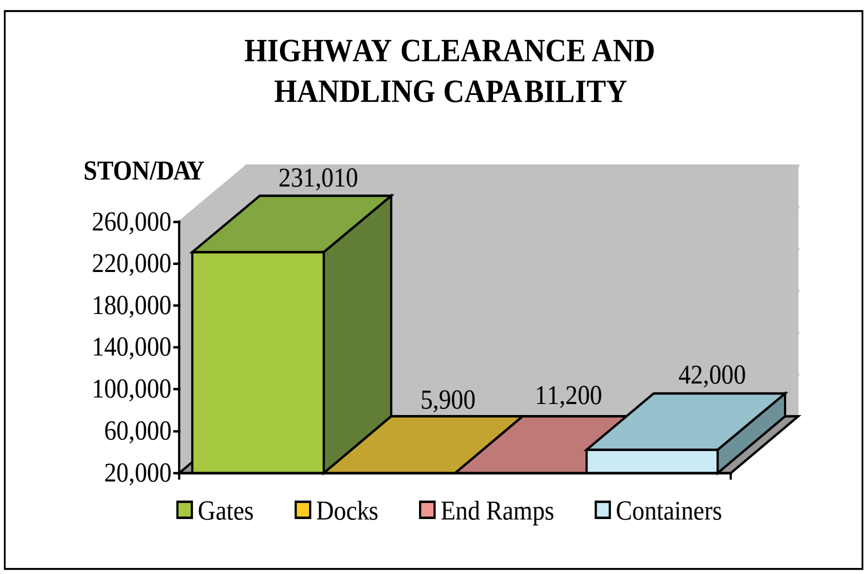
Loop 610 and Clinton Drive provide access to the Turning Basin and Woodhouse Terminals. Avenue P provides access to Turning Basin South and Jacintoport Boulevard provides access to Jacintoport and Care Terminals. Highway 146 provides access to Barbours Cut Terminal. These highways and the gates can handle over 231,000 STON of cargo per day. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or leave the port on each lane of the highway.

Roadable vehicles will move through the terminal gates in manageable convoys to staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for offloading vehicles, must use portable ramps. If not available, deploying units/military port operators must either build or acquire the necessary ramps. With the exception of the fixed combination rail/ truck end ramp at the east end of Barbours Cut, the Port of Houston does not have end ramps. For this study, we assumed that every terminal had at least one portable truck end ramp for offloading operations. The fixed end ramp plus the portable end ramps can handle 11,200 STON of military vehicles and equipment per day.

The port has at least 138 handling positions to load/unload supplies in van semitrailers. These positions can load/unload at least 5,900 STON of shipped material per day.

The Port of Houston has 28 transtainers available (26 at Barbours Cut and 2 at Turning Basin). The port states that all 26 transtainers at Barbours Cut perform highway container operations. Based on this, the container handling capability is 42,000 STON using all 28 transtainers.

Maximum daily handling capability for the port is a mixed total of the three types of handling (docks, end ramps, and containers), each up to its maximum, not to exceed the daily highway limit of at least 231,000 STON.



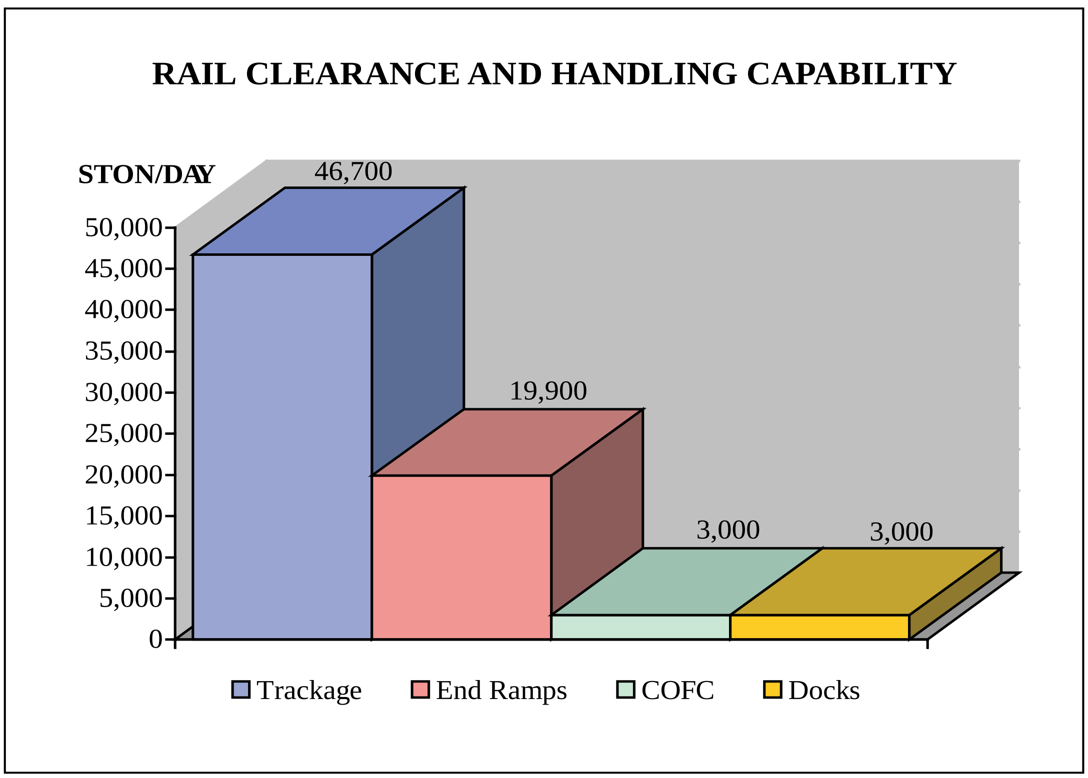
Rail

The Port of Houston has ample rail reception with the BN/SF and UP railroads providing rail service. The PTRA performs the switching operations to deliver the railcars from the commercial carrier to the port. With 24 locomotives available, the current service can easily support a range of 8-12 trains per day (up to 100 railcars per train). These trains can handle at least 46,700 STON per day.

Vehicles on flatcars will offload in the port on rail end ramps. With the exception of the fixed end ramp at Barbours Cut, the port does not have any end ramps. For this study, we assumed a portable ramp is available for operations at all of the terminals. The fixed end ramp plus the portable ramps can handle about 19,900 STON per day.

Boxcars will load/offload at the storage buildings. The port has about 206 rail handling positions available for loading/unloading boxcars. These docks can handle about 3,000 STON per day.

Currently, the contractor loads/unloads containers from railcars at Barbours Cut using two rough terrain gantries at the rail facility. Based on this operation, the two gantries can handle 3,000 STON per day.



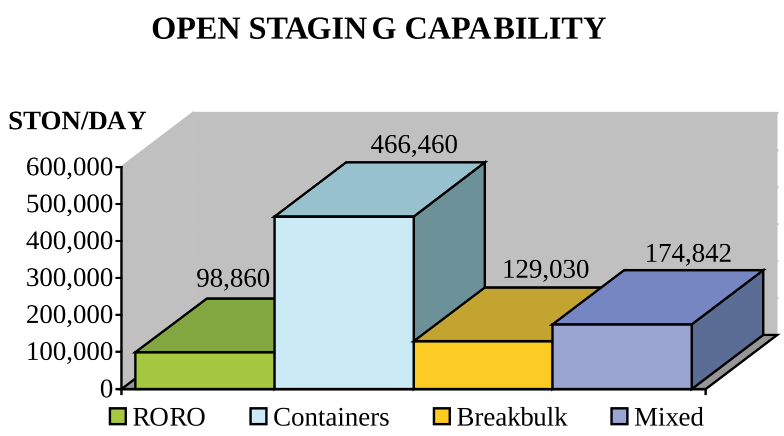
Staging

The port has a total of 282 acres of suitable open staging area. Two hundred three acres of this total is located at Barbours Cut. Because the open staging at this terminal is routinely filled with containers, the availability on a day-to-day basis is questionable. For purposes of determining a staging capability, we assumed a facility use factor of 100 percent.

The port lists 1,803,411 square feet of covered storage space. Although 200,000 square feet of this total is for the container freight station at Barbours Cut and some of the space supports break-bulk operations at the Turning Basin and Woodhouse Terminals, the port should still have plenty to support military operations. About 61,300 STON of breakbulk cargo can be staged in the covered area.

The chart on this page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of the capability for each type cargo operation involved should be assumed.

The chart below shows the STON of cargo, by type, the port can expect to handle. The dwell time used in these computations was 3 days and the open space utilization percentage was 60 percent. The container storage throughput capability is the highest with 466,460 STON. The ability to stack containers three high in the paved open storage areas contibutes to the high staging throughput value. The RORO storage throughput is about 98,860 STON. The breakbulk staging throughput is about 129,030 STON.



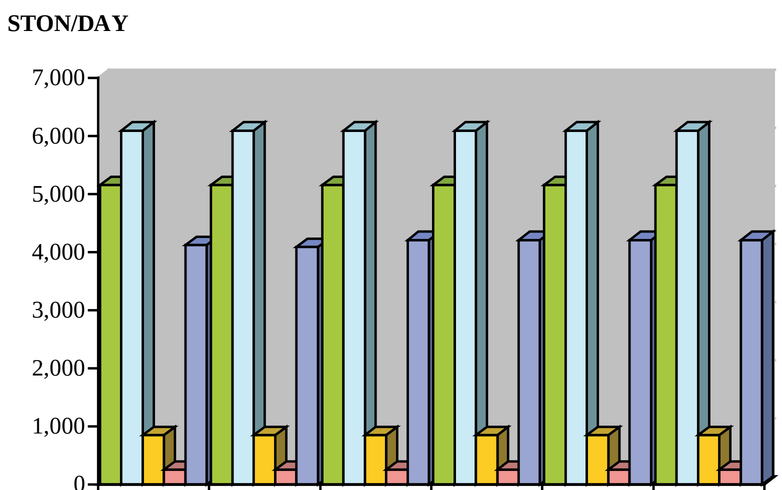
Note: Container staging area can also be used for RORO staging as needed.

Shipping

Daily shipping subsystem totals for the terminal berths are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types.

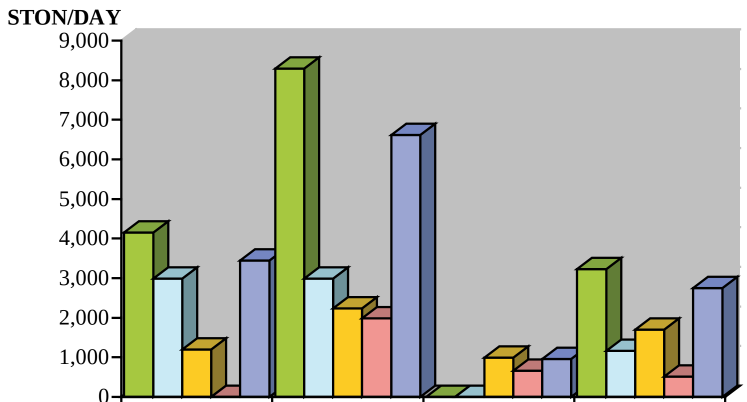
The Barbours Cut Container Terminal is the best choice for performing RORO operations due to the ample berth length, apron width, and ability to handle FSS/LMSR size vessels. This terminal is also the obvious choice for container operations. The berths in the Turning Basin Terminal and Woodhouse Terminal are best for breakbulk operations because of the transit sheds along the wharf.

BARBOURS CUT BERTH THROUGHPUT CAPABILITY



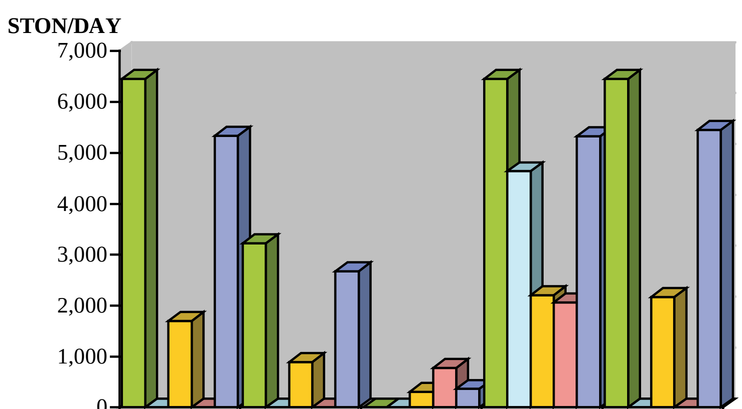
	1	2	3	4	5	6
RORO	5,160	5,160	5,160	5,160	5,160	5,160
Container	6,096	6,096	6,096	6,096	6,096	6,096
Breakbulk	851	851	851	851	851	851
Barge	258	258	258	258	258	258
Mixed	4,124	4,093	4,211	4,211	4,211	4,211

WOODHOUSE, CARE, AND JACINTOPORT BERTH THROUGHPUT CAPABILITY



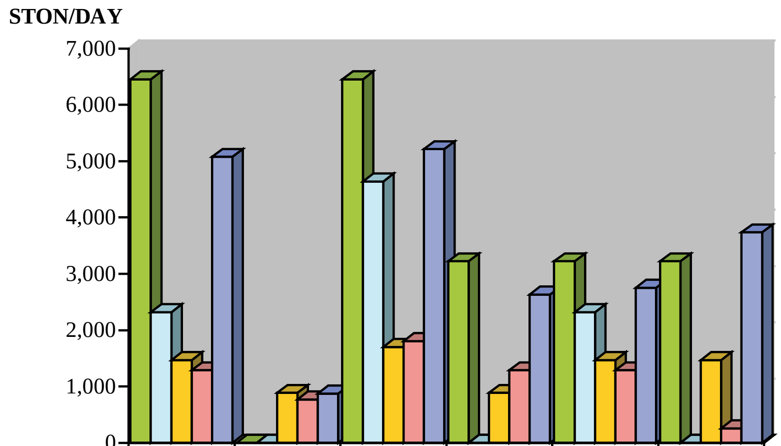
	WH1	WH2-3	C4	J1-J2
RORO	4,147	8,294	0	3,225
Container	2,984	2,984	0	1,160
Breakbulk	1,194	2,239	995	1,703
Barge	0	1,990	663	516
Mixed	3,441	6,613	954	2,745

TURNING BASIN SOUTH BERTH THROUGHPUT CAPABILITY



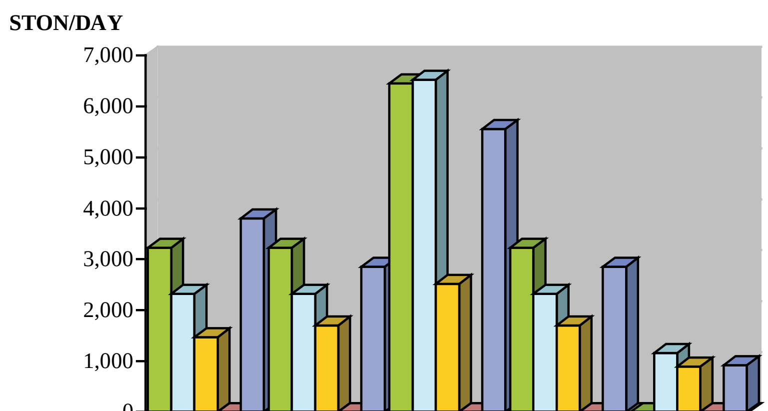
	1-2	3	4	41-44	45-48
RORO	6,451	3,225	0	6,451	6,451
Container	0	0	0	4,640	0
Breakbulk	1,703	890	309	2,206	2,167
Barge	0	0	774	2,064	0
Mixed	5,339	2,678	364	5,331	5,448

TURNING BASIN BERTH THROUGHPUT CAPABILITY



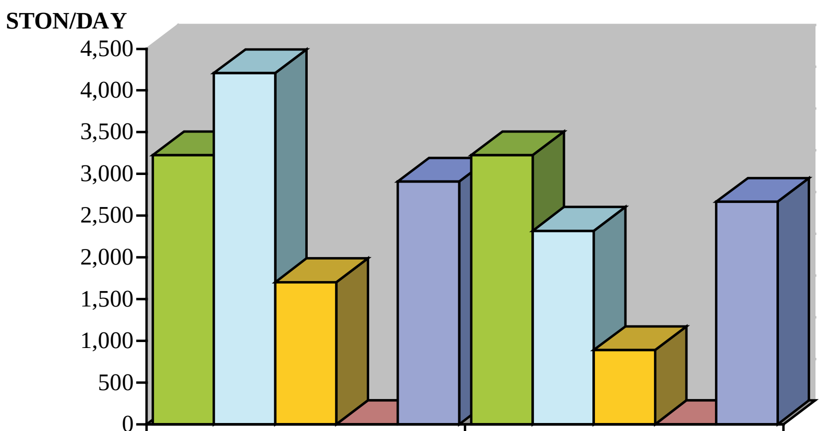
	8-9	10	11-13	14-15	16-17	18-19
RORO	6,451	0	6,451	3,225	3,225	3,225
Container	2,320	0	4,640	0	2,320	0
Breakbulk	1,470	890	1,703	890	1,470	1,470
Barge	1,290	774	1,806	1,290	1,290	258
Mixed	5,076	876	5,212	2,635	2,753	3,735

TURNING BASIN
BERTH THROUGHPUT CAPABILITY - cont



	20-21	22-23	24-26	27-28	29
RORO	3,225	3,225	6,451	3,225	0
Container	2,320	2,320	6,528	2,320	1,160
Breakbulk	1,470	1,703	2,515	1,703	890
Barge	0	0	0	0	0
Mixed	3,798	2,851	5,560	2,851	922

TURNING BASIN
BERTH THROUGHPUT CAPABILITY - cont



	30-31	32
RORO	3,225	3,225
Container	4,208	2,320
Breakbulk	1,703	890
Barge	0	0
Mixed	2,910	2,667

DAILY THROUGHPUT SUMMARY									
BERTH[1]	**LENGTH (feet) (meters)**	**DEPTH ALONGSIDE (feet) (meters)**	**BREAKBULK THROUGHPUT (STON) (MTON)**	**RORO THROUGHPUT (STON) (MTON)**	**RORO SQUARE FT[2] (EST)**	**RORO PIECES[3]**	**CONTAINER THROUGHPUT (STON) (MTON) (TEU)**	**BARGE THROUGHPUT (STON) (MTON)**	**MIXED THROUGHPUT (STON) (MTON)**
BC 1	1,000 (304.8)	42 (12.8)	851 (2,128)	5,160 (20,643)	103,200	607	6,096 (15,240) (762)	258 (645)	4,093 (15,807)
BC 2	1,000 (304.8)	42 (12.8)	851 (2,128)	5,160 (20,643)	103,200	607	6,096 (15,240) (762)	258 (645)	4,093 (15,807)
BC 3	1,000 (304.8)	42 (12.8)	851 (2,128)	5,160 (20,643)	103,200	607	6,096 (15,240) (762)	258 (645)	4,093 (15,807)
BC 4	1,000 (304.8)	42 (12.8)	851 (2,128)	5,160 (20,643)	103,200	607	6,096 (15,240) (762)	258 (645)	4,093 (15,807)
BC 5	1,000 (304.8)	42 (12.8)	851 (2,128)	5,160 (20,643)	103,200	607	6,096 (15,240) (762)	258 (645)	4,093 (15,807)
BC 6	1,000 (304.8)	42 (12.8)	851 (2,128)	5,160 (20,643)	103,200	607	6,096 (15,240) (762)	258 (645)	4,093 (15,807)
WH 1	660 (201.2)	39 (11.9)	1,194 (2,985)	4,147 (16,588)	82,940	488	2,984 (7,460) (373)	0	3,441 (13,220)
WH 2/3	1,250 (381.0)	35 (10.7)	2,239 (5,598)	8,294 (33,177)	165,880	976	2,984 (7,460) (373)	1,990 (4,976)	6,613 (25,492)
C 4	500 (152.4)	38 (11.6)	995 (2,488)	0	0	0	0	663 (1,658)	955 (2,387)
J 1 - J 2	1,230 (374.9)	36 (11.0)	1,703 (4,257)	3,225 (12,902)	64,500	379	1,160 (2,900) (145)	516 (1,290)	2,746 (10,351)

[1]BC = Barbours Cut, WH = Woodhouse, C = CARE, J = Jacintoport, TB = Turning Basin.
[2]Based on the 20 square foot per STON average accomplished during Operation Desert Shield/Storm.
[3]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

DAILY THROUGHPUT SUMMARY - cont									
BERTH[1]	**LENGTH (feet) (meters)**	**DEPTH ALONGSIDE (feet) (meters)**	**BREAKBULK THROUGHPUT (STON) (MTON)**	**RORO THROUGHPUT (STON) (MTON)**	**RORO SQUARE FT[2] (EST)**	**RORO PIECES[3]**	**CONTAINER THROUGHPUT (STON) (MTON) (TEU)**	**BARGE THROUGHPUT (STON) (MTON)**	**MIXED THROUGHPUT (STON) (MTON)**
TB 8-9	1,179 (359.4)	34 (10.4)	1,470 (3,677)	6,451 (25,804)	129,020	759	2,320 (5,800) (290)	1,290 (3,225)	5,076 (19,658)
TB 10	600 (182.9)	33 (10.1)	890 (2,225)	0	0	0	0	774 (1,935)	876 (2,190)
TB 11-13	1,520 (463.3)	33 (10.1)	1,703 (4,257)	6,451 (25,804)	129,020	759	4,640 (11,600) (580)	1,806 (4,515)	5,212 (19,998)
TB 14-15	1,006 (306.6)	35 (10.7)	890 (2,225)	3,225 (12,902)	64,500	379	0	1,290 (3,225)	2,635 (10,181)
TB 16-17	1,154 (351.7)	38 (11.6)	1,470 (3,677)	3,225 (12,902)	64,500	379	2,320 (5,800) (290)	1,290 (3,225)	2,753 (10,369)
TB 18-19	1,177 (358.7)	38 (11.6)	1,470 (3,677)	3,225 (12,902)	64,500	379	0	258 (645)	2,735 (10,430)
TB 20-21	1,193 (363.6)	38 (11.6)	1,470 (3,677)	3,225 (12,902)	64,500	379	2,320 (5,800) (290)	0	2,798 (10,590)
TB 22-23	1,200 (365.8)	38 (11.6)	1,703 (4,257)	3,225 (12,902)	64,500	379	2,320 (5,800) (290)	0	2,851 (10,721)
TB 24-26	1,800 (548.6)	38 (11.6)	2,515 (6,289)	6,451 (25,804)	129,020	759	6,528 (16,320) (816)	0	5,560 (21,084)
TB 27-28	1,200 (365.8)	38 (11.6)	1,703 (4,257)	3,225 (12,902)	64,500	379	2,320 (5,800) (290)	0	2,851 (10,721)

[1]BC = Barbours Cut, WH = Woodhouse, C = CARE, J = Jacintoport, TB = Turning Basin

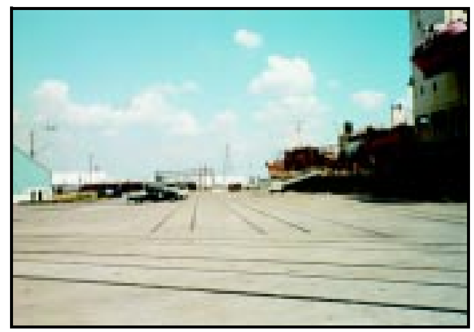
[2]Based on the 20 square foot per STON average accomplished during Operation Desert Shield/Storm.

[3]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

DAILY THROUGHPUT SUMMARY - cont									
BERTH[1]	LENGTH (feet) (meters)	DEPTH ALONGSIDE (feet) (meters)	BREAKBULK THROUGHPUT (STON) (MTON)	RORO THROUGHPUT (STON) (MTON)	RORO SQUARE FT[2] (EST)	RORO PIECES[3]	CONTAINER THROUGHPUT (STON) (MTON) (TEU)	BARGE THROUGHPUT (STON) (MTON)	MIXED THROUGHPUT (STON) (MTON)
TB 29	600 (182.9)	38 (11.6)	890 (2,225)	0	0	0	1,160 (2,900) (145)	0	922 (2,305)
TB 30-31	1,200 (365.8)	38 (11.6)	1,703 (4,257)	3,225 (12,902)	64,500	379	4,208 (10,520) (526)	0	2,910 (10,867)
TB-32	800 (243.8)	38 (11.6)	890 (2,225)	3,225 (12,902)	64,500	379	2,320 (5,800) (290)	0	2,667 (10,260)
TB 1-2	1,348 (410.9)	33 (10.1)	1,703 (4,257)	6,451 (25,804)	129,020	759	0	0	5,339 (20,761)
TB 3	800 (243.8)	33 (10.1)	890 (2,225)	3,225 (12,902)	64,500	379	0	0	2,678 (10,403)
TB 4	779 (237.4)	27 (8.2)	309 (2,206)	0	0	0	0	774 (1,935)	364 (913)
TB 41-44	1,653 (503.8)	31 (9.4)	2,206 (5,515)	6,451 (25,804)	129,020	759	4,640 (11,600) (580)	2,064 (5,160)	5,331 (20,294)
TB 45-48	1,773 (540.4)	31 (9.4)	2,167 (5,419)	6,451 (25,804)	129,020	759	0	0	5,448 (21,033)

Berths 10 and 11 Turning Basin Terminal

Berth 30-31 Turning Basin Terminal



Berth 1 Woodhouse Terminal

[1]BC = Barbours Cut, WH = Woodhouse, C = CARE, J = Jacintoport, TB = Turning Basin

[2]Based on the 20 square foot per STON average accomplished during Operation Desert Shield/Storm.

[3]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

SUMMARY

The port is huge and multioperational with the capability to easily handle all types of vessels: container, RORO, breakbulk, and barges.

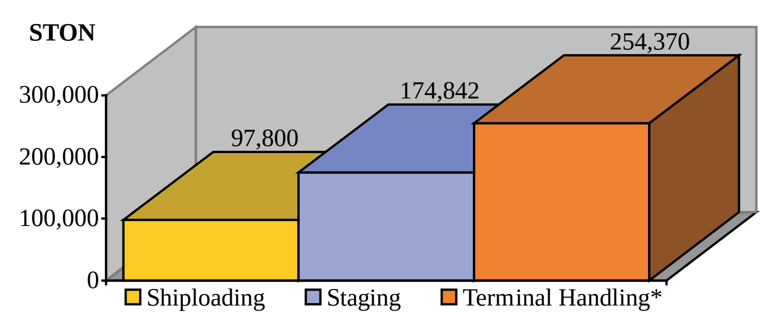
The Port of Houston is fully capable of supporting U.S. Military deployment operations. This port does have several constraints. Currently, the Turning Basin, Woodhouse, Jacintoport, and Care Terminals do not have the capability to turn vessels larger than 750 feet. Also, the air draft going to these same terminals is 135 feet MHW. These constraints appear to limit FSS/LMSR operations solely to the Barbours Cut Terminal. Due to the heavy container business that the Port of Houston does at Barbours Cut, the availability of berths and the surrounding open and covered staging areas during a contingency is questionable. The port may experience difficulty in clearing staging areas at Barbours Cut in sufficient time to adequately support military operations. Undoubtedly, military deployments will likely disrupt commercial business and affect both the port and commercial shippers at Barbours Cut.

The port (Barbours Cut) can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table. Operations at the other terminals require vessels no larger than 750 feet (size of the Cape H). The Woodhouse Terminal appears to have potential for military deployments and exercises. It has ample wharf space, rail access, ample open and covered storage, and appears readily available on a daily basis. The largest ship that can access this terminal is the Cape H.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of at least 97,800 STON.

During the September 1997 visit, rail traffic into the port experienced congestion due to the rail mergers. Still, the rail infrastructure in and surrounding the port appears able to handle the additional rail traffic caused by a deployment.

DAILY CARGO THROUGHPUT CAPACITY



****Terminal handling is the sum of the highway (230,700 STON) and rail (23,700 STON) limits.***

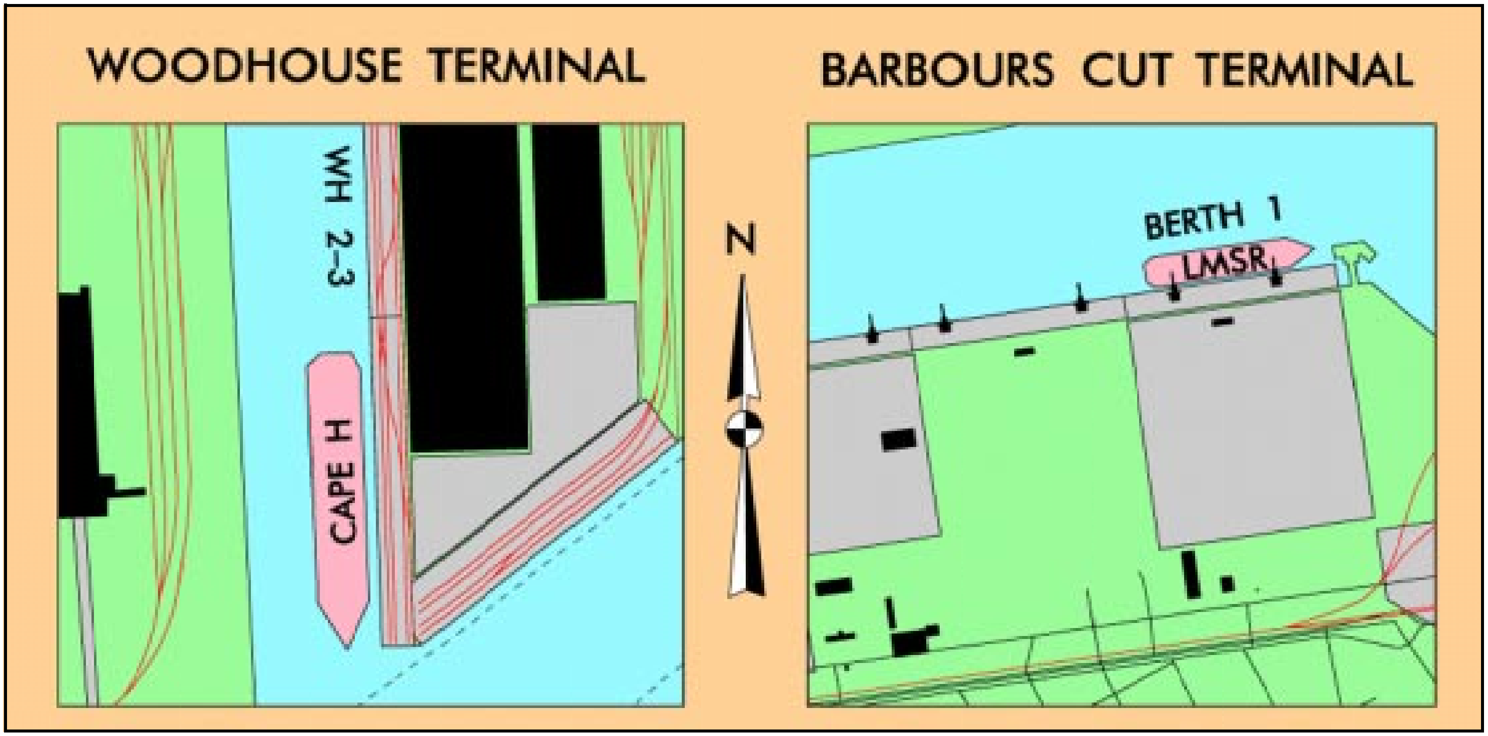
IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional heavy armored cavalry regiment. Our analysis covers two potential deployment scenarios – Barbours Cut and Woodhouse Terminal. Barbours Cut is evaluated because it is the only terminal at the Port of Houston that can currently handle FSS/LMSR size ships. Woodhouse Terminal is also chosen because the port authority suggested this terminal as an alternative for military deployment to the busy Barbours Cut terminal. The port authority's suggestion would prevent disruption of commercial container business at Barbours Cut; however, FSS/LMSR ships are too large and cannot turn around for operations at the Woodhouse Terminal. The Barbours Cut Terminal is large enough to handle a division-size unit but this terminal is heavily used and the military will not likely get access to more than one ship berth.

For this analysis, we assume that no other military units will be competing for these facilities during the time that the heavy armored cavalry regiment occupies the port. We further assume that the required assets, both transporters and people will be available to adequately load the ship and clear the port.

To evaluate the port's deployment capability, we used the port simulation (PORTSIM) model to flow unit equipment in the heavy armored cavalry regiment through the port. PORTSIM is a time-stepped, discrete event, stochastic simulation of port operations during a force deployment. The PORTSIM is dynamically modeled for visual monitoring and quick identification of problems and allows the analyst to determine port closure/clearance times. For this simulation, we assume that the deploying regiment will use one of the facilities identified in the graphic on the next page during a deployment. LMSR vessels were used for the Barbours Cut simulation and Cape H vessels were used for the Woodhouse Terminal.

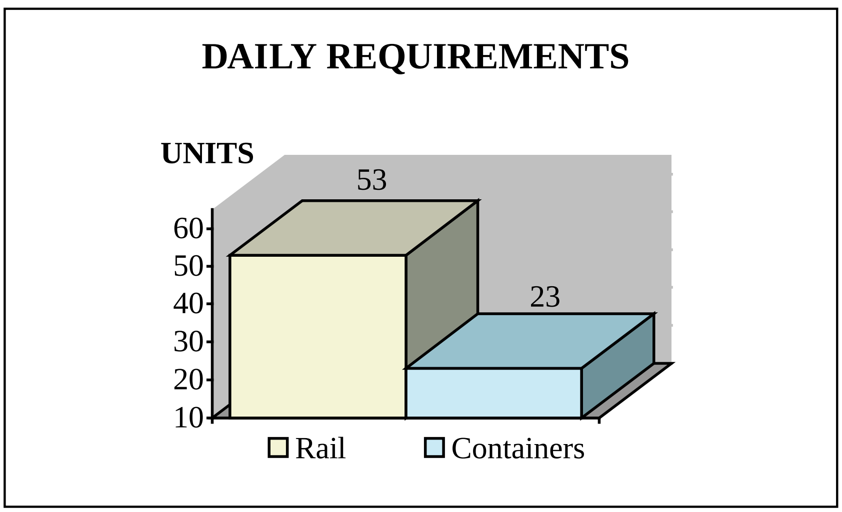


Potential Port Use During Deployment

REQUIREMENTS

To simulate a likely requirement for the Port of Houston, we deployed a notional heavy armored cavalry regiment, using 6 days for shiploading and port closure. The regiment has to move 2,138 vehicles and 140 containers. Movement of the regiment to the port will require 319 railcars using a convoy/rail option for transport to the port. About 23 containers would arrive daily.

TOTAL EQUIPMENT	
Volume	84,440 MTON
Weight	31,267 STON
Area	433,658 SQ FT
Vehicles	2,138
Containers	140
Note: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997.	

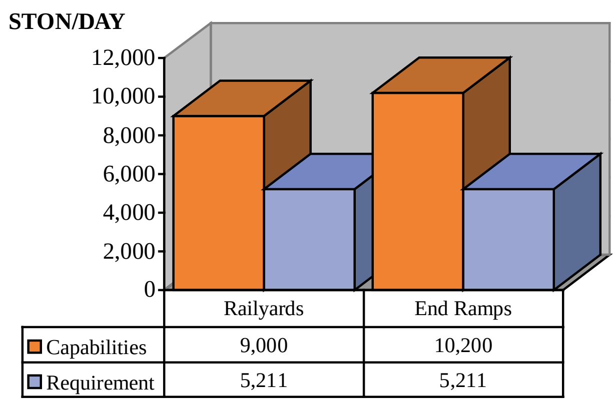


TERMINAL INPROCESSING/HANDLING

Rail

The BN/SF and UP railroads serve the Port of Houston. The PTRA performs the switching operations for the port. The port rail spurs and railyard can handle the incoming rail traffic. At the time of the survey, rail traffic was congested in the Houston area due to the railroad mergers.

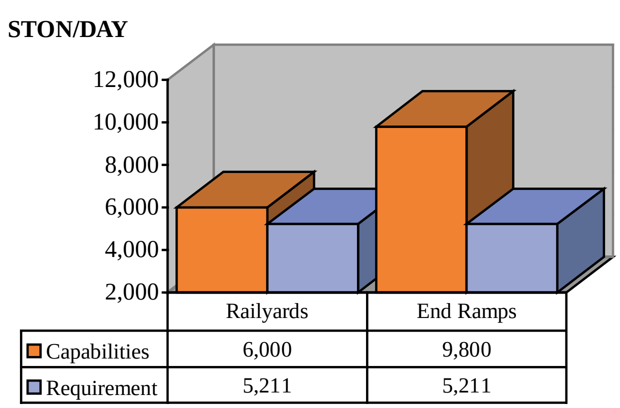
RAIL CLEARANCE/HANDLING CAPABILITY FOR BARBOURS CUT



For offloading wheeled vehicles from railcars, three rail end ramps will be used. If the Barbours Cut facility is used, one of the rail end ramps is the fixed ramp at the east end of the terminal. The port has numerous locations to perform rail offloading using portable end ramps. For this analysis, we assumed rail offloading would occur at the 5,000 foot-long spur serving the fixed end ramp plus two other spurs for Barbours Cut. The Woodhouse Terminal also has rail access and has several spurs for placing three portable end ramps.

Requirements use total STON of equipment divided by six providing a rail daily requirement. Capabilities for the railyards and end ramps reflect trackage and end ramp daily throughputs respectively.

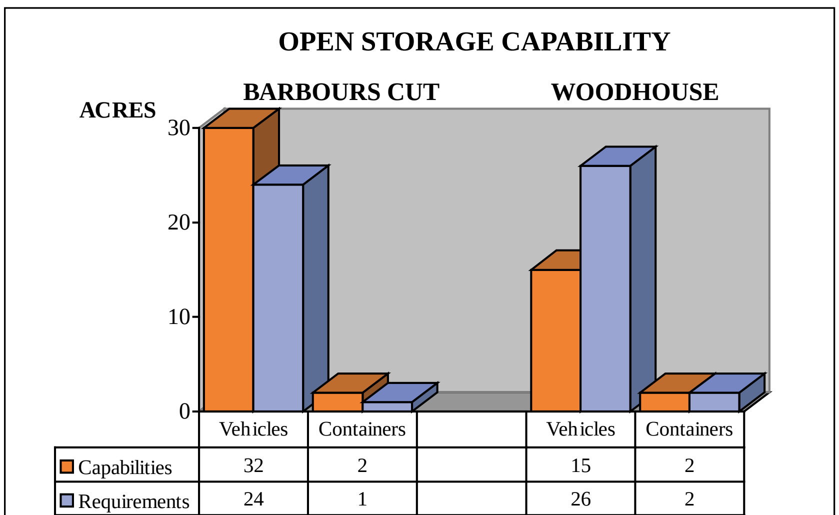
RAIL CLEARANCE/HANDLING CAPABILITY FOR WOODHOUSE TERMINAL



Spur Serving Fixed End Ramp at Barbours Cut

Open Storage

Barbours Cut terminal has 203 acres of open storage and Woodhouse Terminal has over 17 acres of open storage. The staging area requirement for each LMSR is 25 acres. As the first ship fills up and the staging area empties, there is room to stage equipment for the next LMSR that will be loaded. This means that the staging area at Barbours Cut is more than adequate for six LMSR vessels (the entire terminal) provided the terminal could be cleared of containers. The 17 acres of open staging at Woodhouse Terminal is enough for one Cape H ship. For two Cape H ships, equipment would have to be staged at other terminals along the Houston Ship Channel. A deployment scenario for the Port of Houston will likely call for one berth at Barbours Cut, which is capable of berthing one LMSR vessel. One sixth of the 203 acre total is adequate for one LMSR vessel. Woodhouse Terminal will likely call for the use of two Cape H berths. Assuming about 14 acres are needed to stage equipment for the loading of one Cape H ship, Woodhouse Terminal staging is inadequate for staging cargo for a two Cape H ship loading operation.



	Vehicles	Containers		Vehicles	Containers
Capabilities	32	2		15	2
Requirements	24	1		26	2

Note: Includes 22 acres of unimproved open storage.

Shipping

Using the LMSRs to transport the regiment, Barbours Cut will allow the ships to meet the 6-day loading requirement if all facilities and resources are available. Based on each LMSR being able to load in about 3 to 4 days, the two LMSRs can be loaded in 6 to 8 days. Berth space is adequate to allow the side and stern ramps on the LMSRs to be used to load the ships. If smaller ships are used for deployment, then additional time or berths will be required to move the regiment.

Deploying by LMSR requires one ship every 3 days; each ramp will have to average about 130 STON per hour for 20 hours to deploy the regiment in 6 days. This equates to 15 vehicles per hour per ramp. Deploying by FSS requires one ship every 2 days to meet the same requirement; this equates to 30 vehicles per hour for the ramp.

SHIP REQUIREMENTS NOTIONAL HEAVY ARMORED CAVALRY REGIMENT				
Loading Condition/ Sample Ship Mix	**FSS (RORO/Comb)**	**LMSR (RORO/Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	2.8			
All LMSR		1.7		
All Breakbulk			8.7	
Maximum Containerization				
FSS/Container	1.1			1.2
LMSR/Container		.7		1.2
Breakbulk/Container			3.5	1.2

Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

SIMULATION RESULTS

Total deployment time for the regiment at Barbours Cut was about 6 days with the last 5 of those days used for shiploading and the first day used for initial reception and staging. LMSR vessels were used to deploy the regiment. Total deployment time for the regiment at Woodhouse Terminal was about 7 days with the last 6 days used for shiploading and the first day used for initial reception and staging. Actual throughput and closure results are shown in the charts at the end of the study.

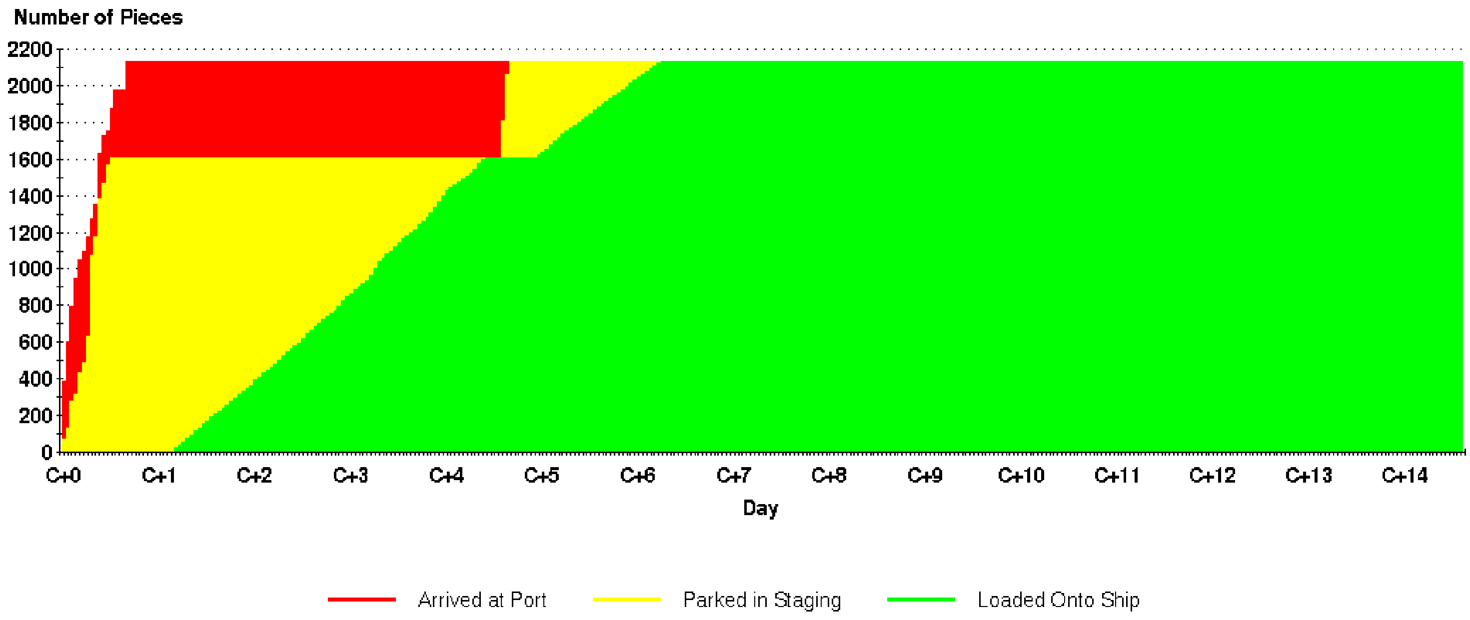
SUMMARY

The Port of Houston can load a notional Heavy Armored Cavalry Regiment in 6 days using Barbours Cut Terminal and LMSR ships. If other ships are used, additional berths may be required to meet the 6-day requirement. A loadout at the Woodhouse Terminal will require 7 days. Woodhouse Terminal has 17 acres of open staging. At least 28 acres of open staging are required for a two Cape H load out. This means the port authority will have to authorize use of other staging (such as at other terminals along the Houston Ship Channel) to make up the difference in meeting staging requirements.

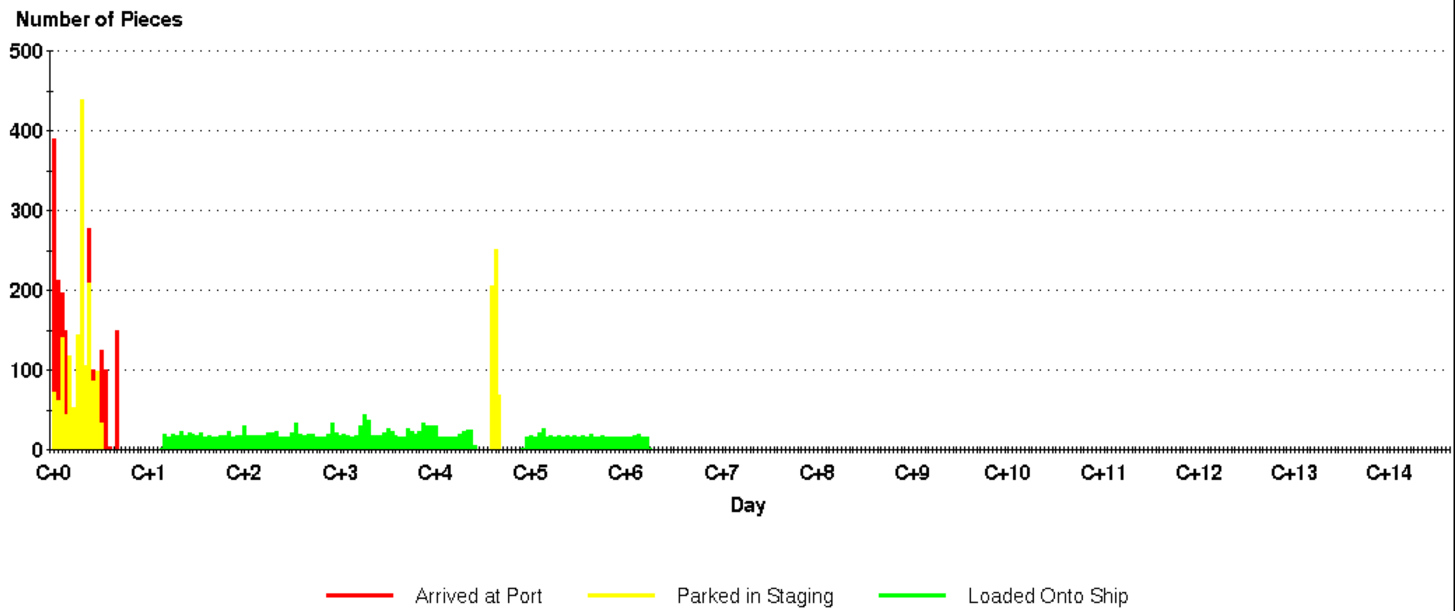
The Port of Houston is a viable port for supporting deployment of a notional Heavy Armored Cavalry Regiment provided a berth and the surrounding staging area are available for U.S. Military deployments at Barbours Cut. Past experience has shown difficulties in disrupting commercial container business at Barbours Cut.

The Port of Houston cannot meet a 6-day loadout requirement if Woodhouse Terminal is used. Still, the Woodhouse Terminal has potential in supporting deployments and exercises and provides rail access.

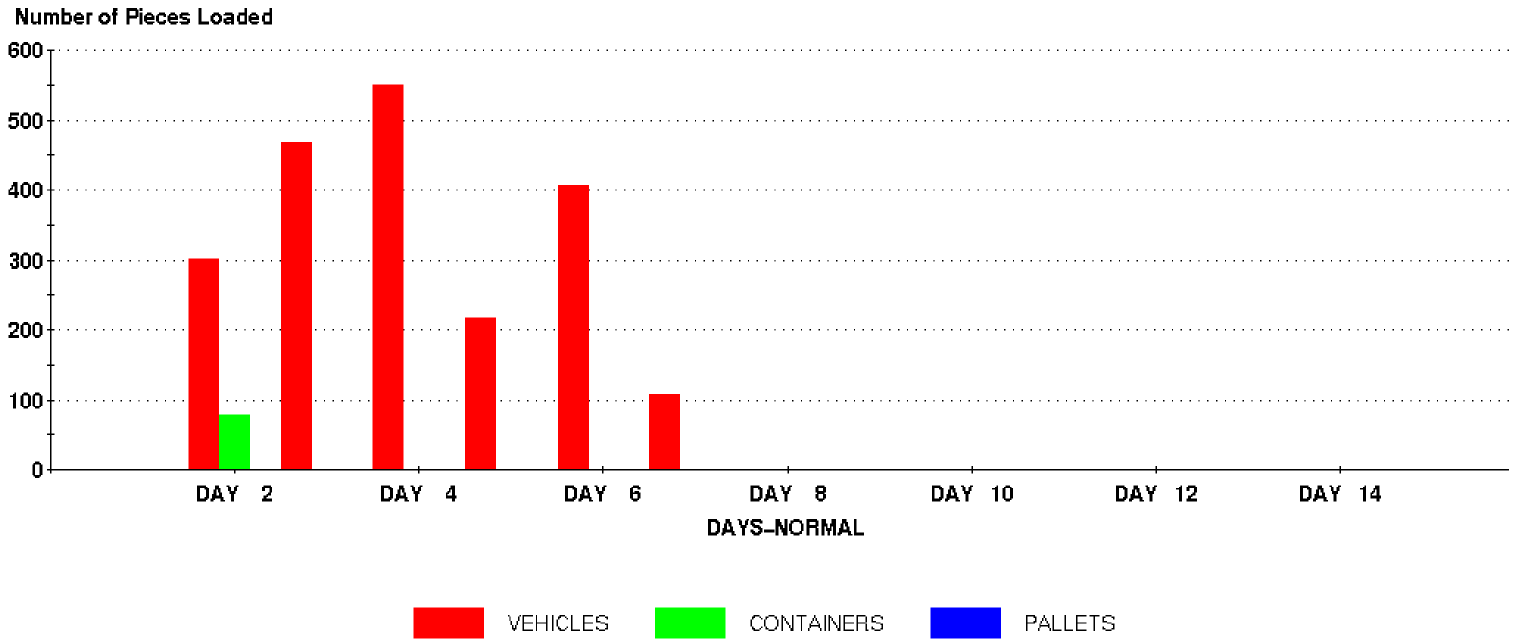
CUMULATIVE CLOSURE PROFILE FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT (BARBOURS CUT)



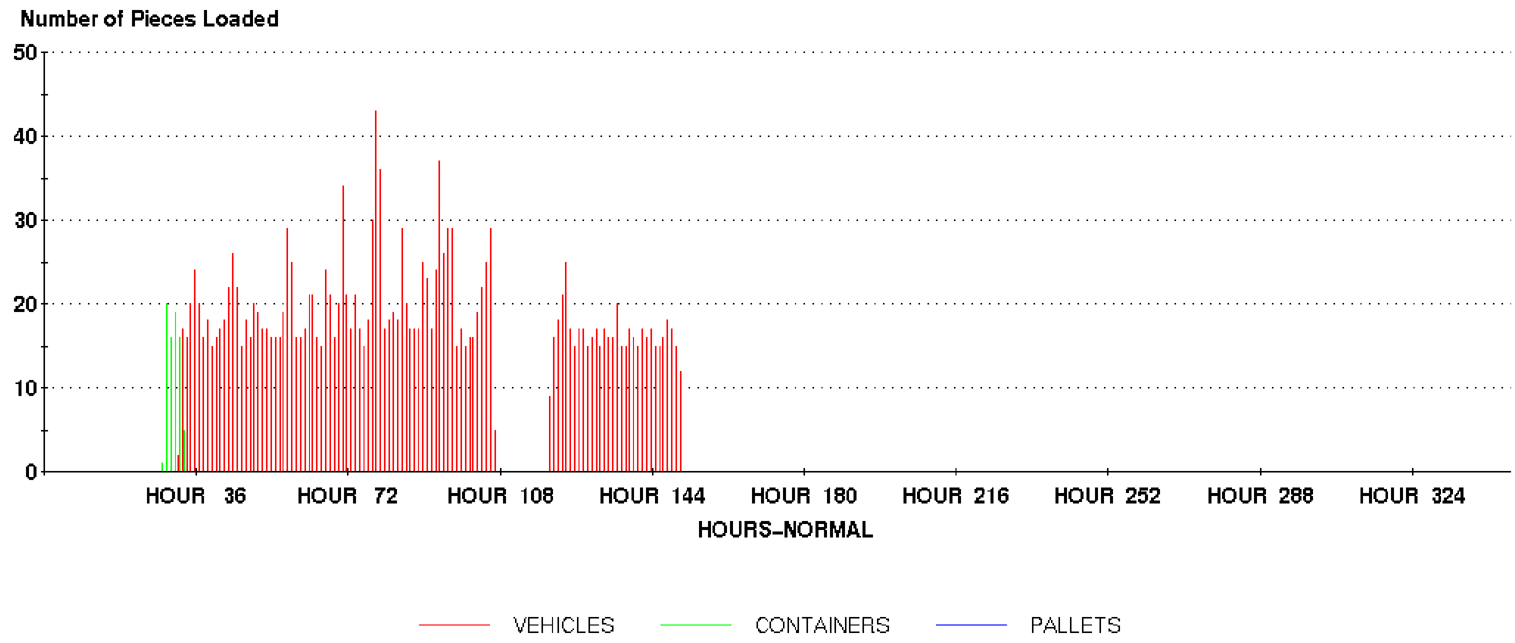
DAILY CLOSURE PROFILE
FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT
(BARBOURS CUT)



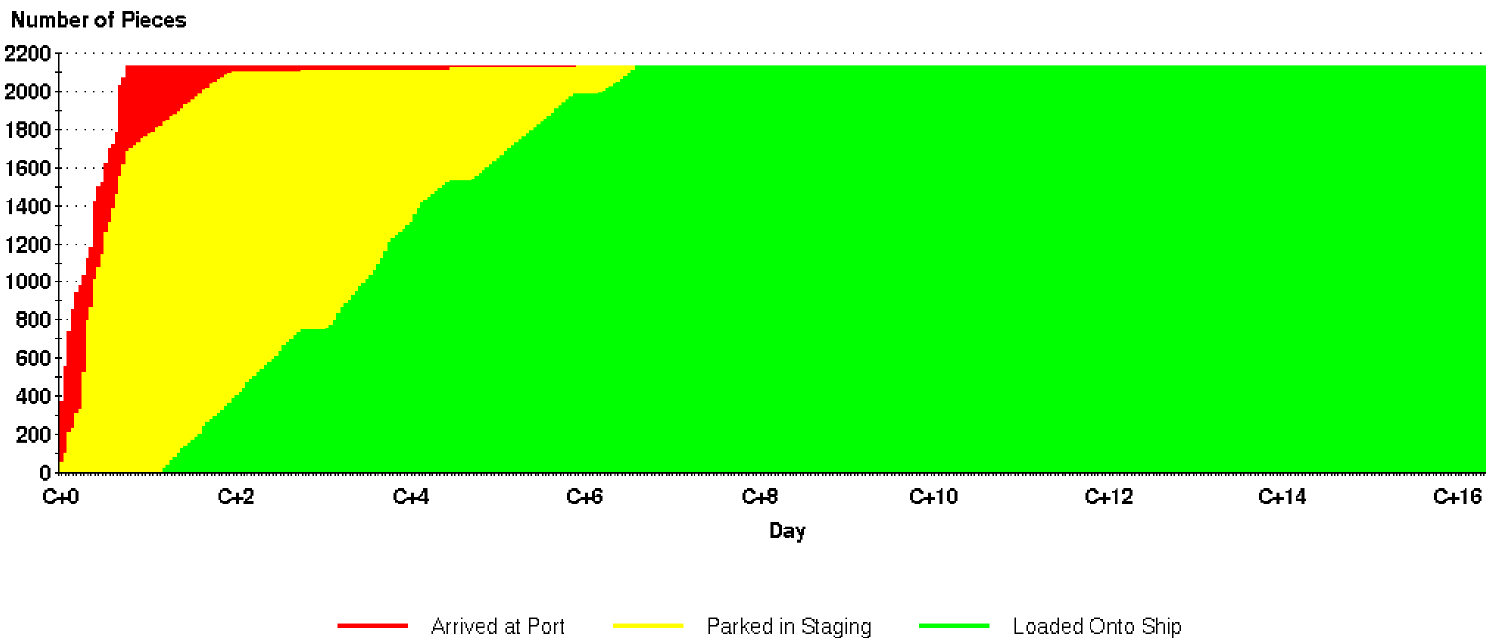
DAILY THROUGHPUT
FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT
(BARBOURS CUT)



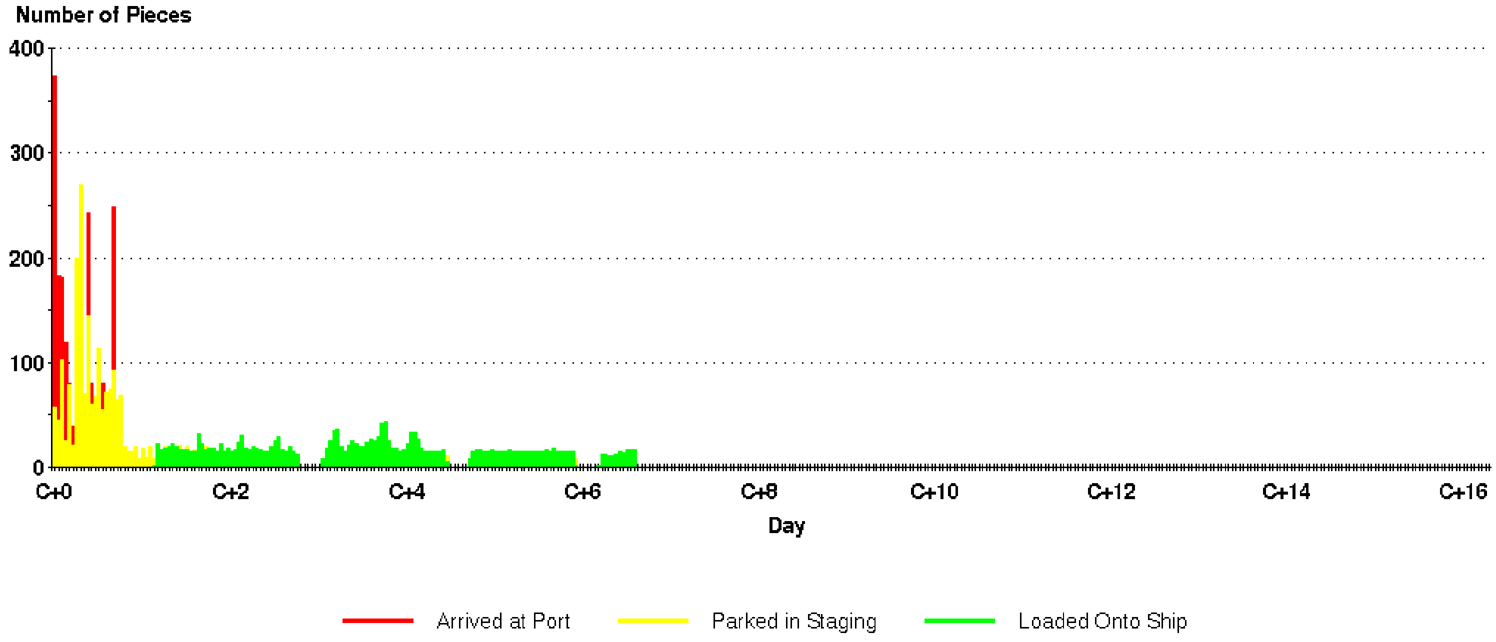
HOURLY THROUGHPUT
FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT
(BARBOURS CUT)



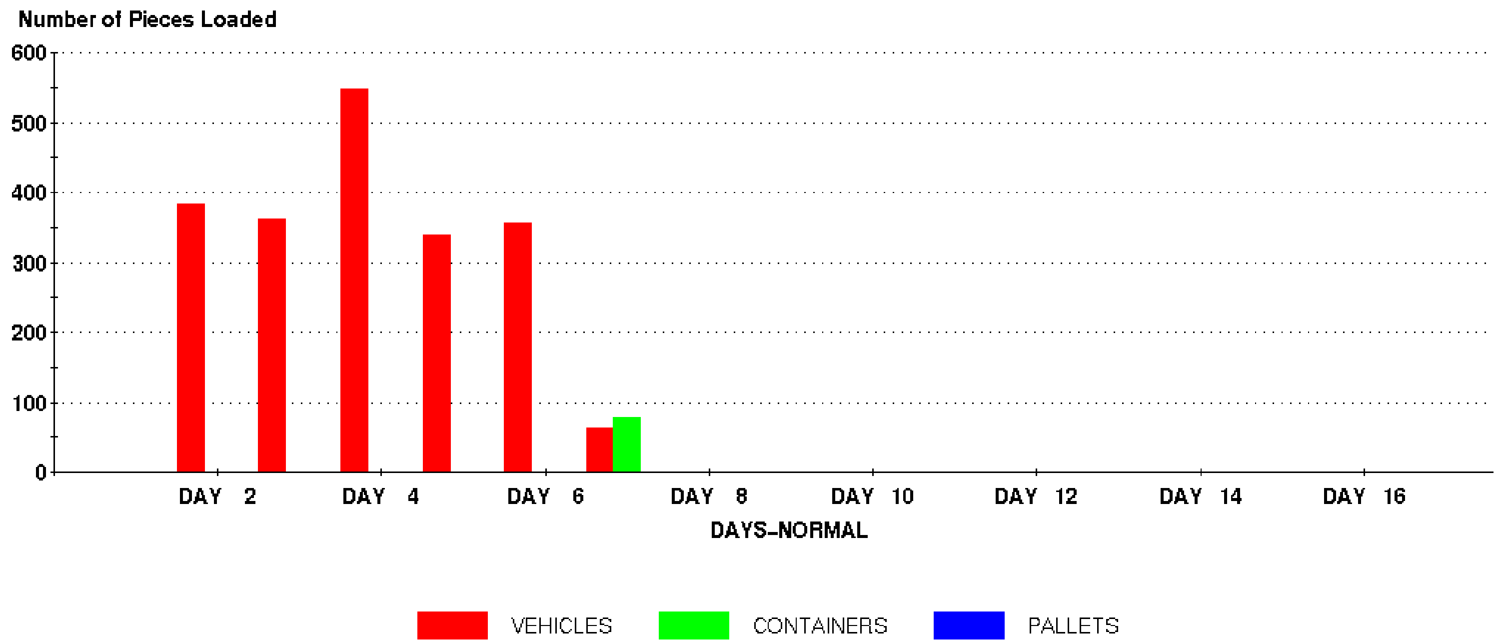
CUMULATIVE CLOSURE
FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT
(WOODHOUSE TERMINAL)



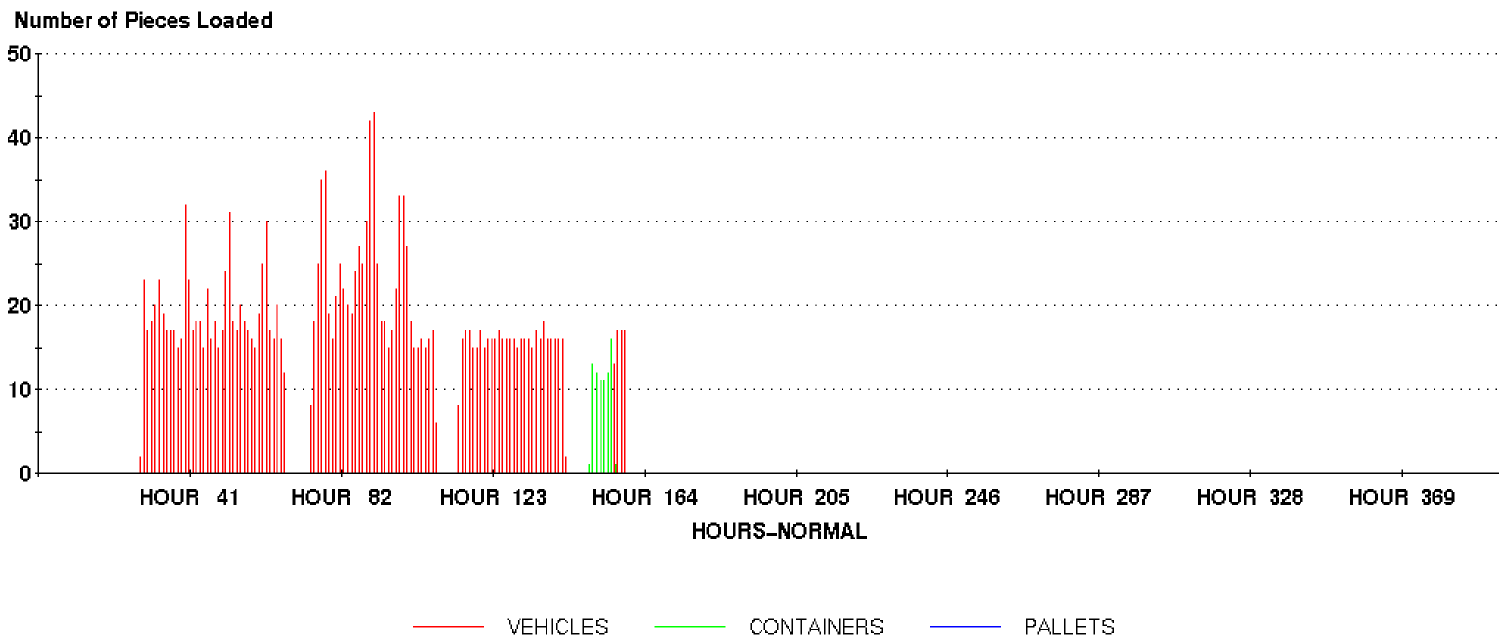
DAILY CLOSURE PROFILE
FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT
(WOODHOUSE TERMINAL)



DAILY THROUGHPUT
FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT
(WOODHOUSE TERMINAL)



HOURLY THROUGHPUT
FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT
(WOODHOUSE TERMINAL)



PORT OF LAKE CHARLES
LOUISIANA

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a site visit at the Port of Lake Charles in September - October 1997. This Ports for National Defense study is based on that site survey and 1999 - 2000 validation with the Lake Charles Port Authority. The port is a capable inland port, 34 miles from the Gulf of Mexico, that can throughput a brigade-size unit and accommodate vessels as large as the LMSR. Located on the Calcasieu River, the port is important as an alternative for deployment. The Port of Lake Charles is not listed in the Port Planning Orders issued by the Maritime Administration.

The port consists of 11 ship berths that can accommodate 10 ships simultaneously and has considerable open storage (total, of 1,477,300 square feet). In general, the water depth is 35 feet mean low water (MLW) (two berths are at 40 feet MLW). The port is capable of breakbulk, RORO, limited container, and barge operations. The Union Pacific (UP), Kansas City Southern, and Burlington Northern/Santa Fe provide rail service to the port with UP performing the rail switching. The port can provide support switching during deployment. The nearest airports are Lake Charles Regional Airport and Chenault Industrial Airpark. According to the port authority, Lake Charles Regional has handled C-5A aircraft and Chenault Industrial Airpark has handled B-52 aircraft. The port does not have any container or wharf cranes, however, mobile cranes are available. Other materials handling equipment are available through local stevedores. The port has a fixed end ramp serving two 700-feet long rail spurs for rail offloading. The only portable end ramps available would be through the local stevedores and/or through the Military Traffic Management Command.

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of about 21,100 STON (80,600 MTON) per day. RORO and container throughputs are about 24,500 STON and 2,320 STON per day, respectively. Computer simulations show that the port is capable of achieving closure for throughputting a notional heavy armored cavalry regiment in about 6 days if all facilities and resources are available.

The U.S. Military will likely use Berths 8 and 9, surrounding staging area, and transit sheds for an actual deployment. Berth 8 has an open wharf to allow placement of an LMSR RORO ramp. For this application, we analyzed a notional heavy armored cavalry regiment deploying from the Port of Lake Charles using LMSR vessels. A notional heavy armored cavalry regiment has about 31,350 STON (130,680 MTON) of vehicles and equipment. To meet a port closure requirement of 6 days, a deploying notional heavy armored cavalry regiment must throughput about 5,210 STON of vehicles and equipment (that includes 24 containers) per day. When the two required LMSRs are available for loading in sequence, the port meets the shipping requirements if all facilities and resources are available. Smaller ships will require additional time or berths.

For sustained deployment operations, about 25 acres of staging are desired per LMSR to support daily loading operations. This requirement depends on cargo arrival, smooth shiploading operations, and ship arrival at the port. The desired open staging for a fast sealift ship is about 16 acres per ship to support daily, sustained loading operations. In September/October 1997, the port reported having about 47 acres of various surfaced open staging. The surface material for the open staging areas varies from unimproved to paved. According to information recently provided by the port, 10 of the available 17 acres at the city docks have been paved. The remaining 7 acres will be paved in the future.

The notional heavy armored cavalry regiment will require 54 railcars per day using the rail/convoy option. The port currently handles one train in and one train out per day, but has handled up to three trains per day (50 railcars per train) in the past. According to UP, the absolute maximum number of 89-foot railcars per train is 100.

II. GENERAL DATA

The Port of Lake Charles, Louisiana, is located on the U.S. Gulf Coast and considered for use as a potential alternative in deploying military equipment during contingencies. A team from the Military Traffic Management Command conducted a site survey in September - October 1997. This information was validated December 1999 - January 2000. Information on port characteristics was obtained from port officials.

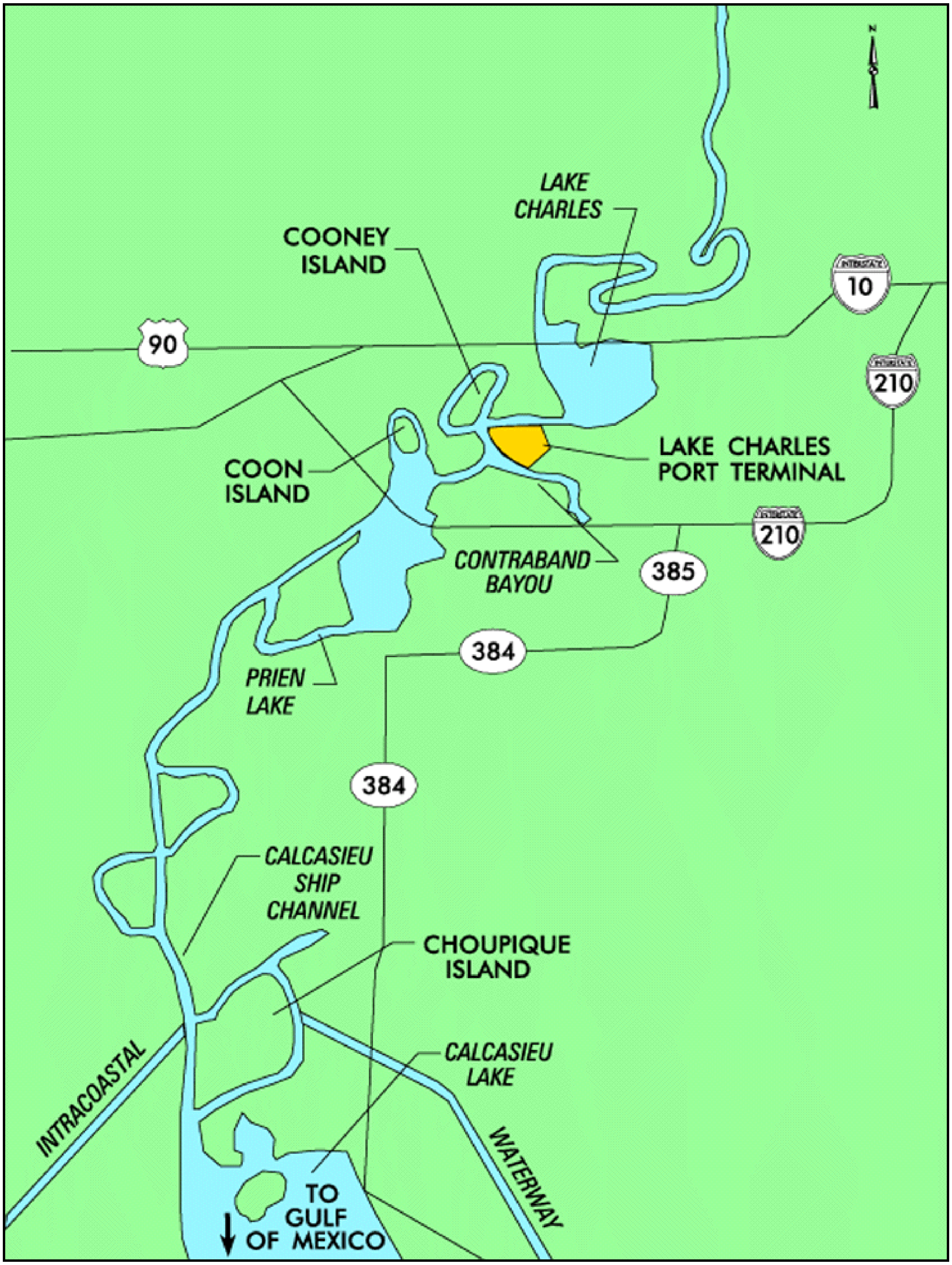
TRANSPORTATION ACCESS

Water

The Port of Lake Charles (latitude 30° 13’ north, longitude 93° 15’ 20” west, (MQTE)) is in southwestern Louisiana about 59 miles east of Beaumont, Texas, and 34 miles inland from the Gulf of Mexico. Access to the port is via the Calcasieu River Ship Channel. The Calcasieu River Ship Channel is at least 40 feet deep at mean low water (MLW) and at least 400 feet wide.

The port has identified four turning basins (water depths 35-40 feet MLW) available for turning ships. The longest is located on the industrial channel accessing the Crowley Terminal, about 5 miles south of the main terminal. It has a diameter of 1,400 feet and a water depth of 40 feet at MLW. According to Navy standard operating procedures, ships do not normally turn in an area that is less than 1.5 times their length.

The only bridge between the Gulf of Mexico and the main terminal is the I-210 bridge. It has a horizontal clearance of 400 feet and a vertical clearance of 135 feet at mean high water (MHW) and crosses the ship channel south of the port.

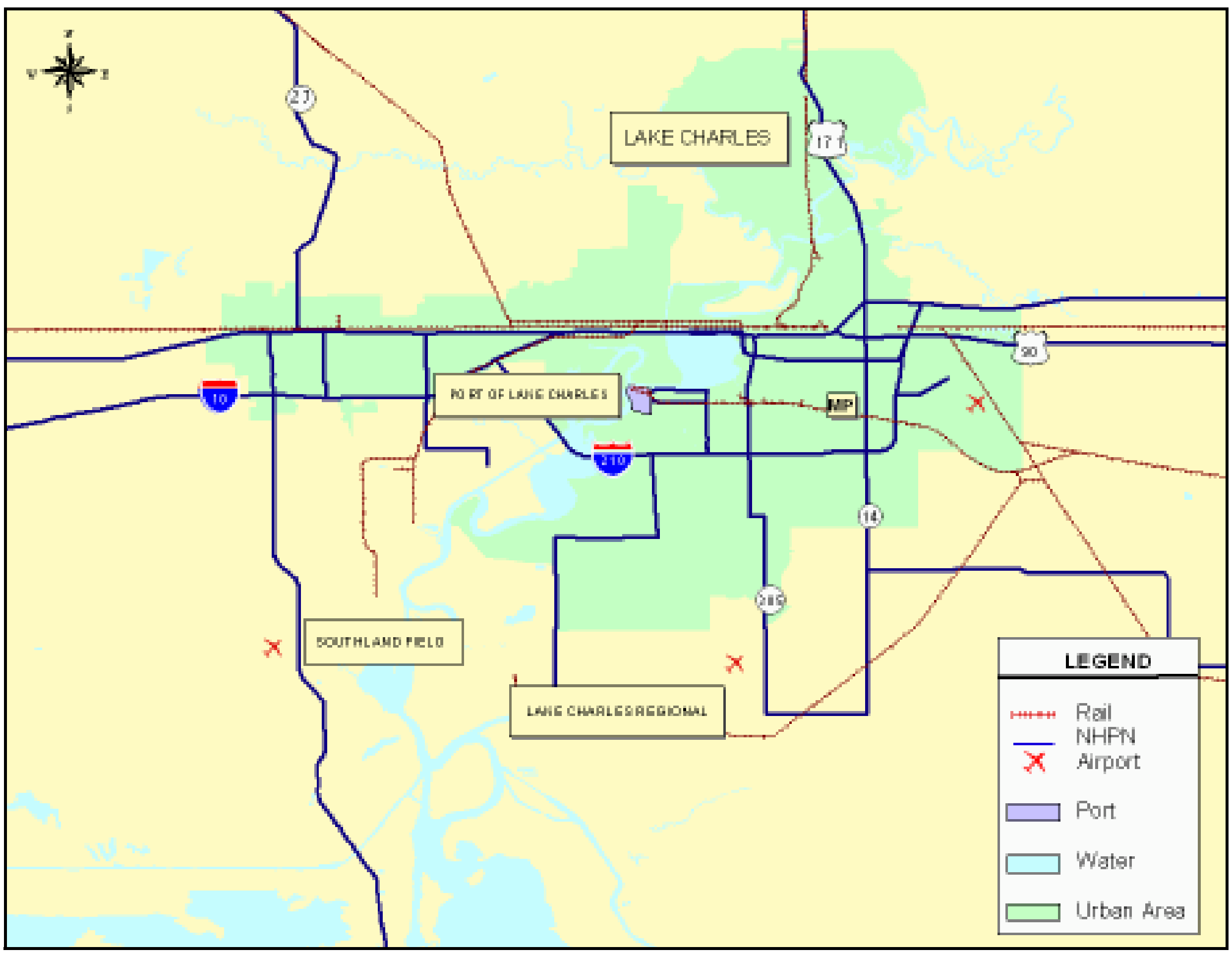


Water Access Map

All vessels approaching and entering the port require pilots. The port authority reports that pilots are available 24 hours each day. Four tugboats are available on this river system. Inclimate weather can cause delays in ship navigation up the Calcasieu River. The port authority reports two anchorages available, both 40 feet deep MLW, near the port. Vessels with a larger draft must anchor in the Gulf of Mexico. Tidal variation is about 1 foot with an extreme of 4 feet.

Highway

Highway access, with at least a 16-foot clearance, is available from Interstate Route 10 via the I-210 loop. From I-210, vehicles take Lake, Sallier, and Marine Streets to reach the port gates. Sallier and Lake Streets have four lanes, but Marine Street has only two lanes. Very little congestion exists along this 2.5-mile route from I-210. All access gates to the port are on Marine Street. In addition to the main gate, two auxiliary gates are operational as needed to provide port access.



Highway, Rail, and Air Access Map

Rail

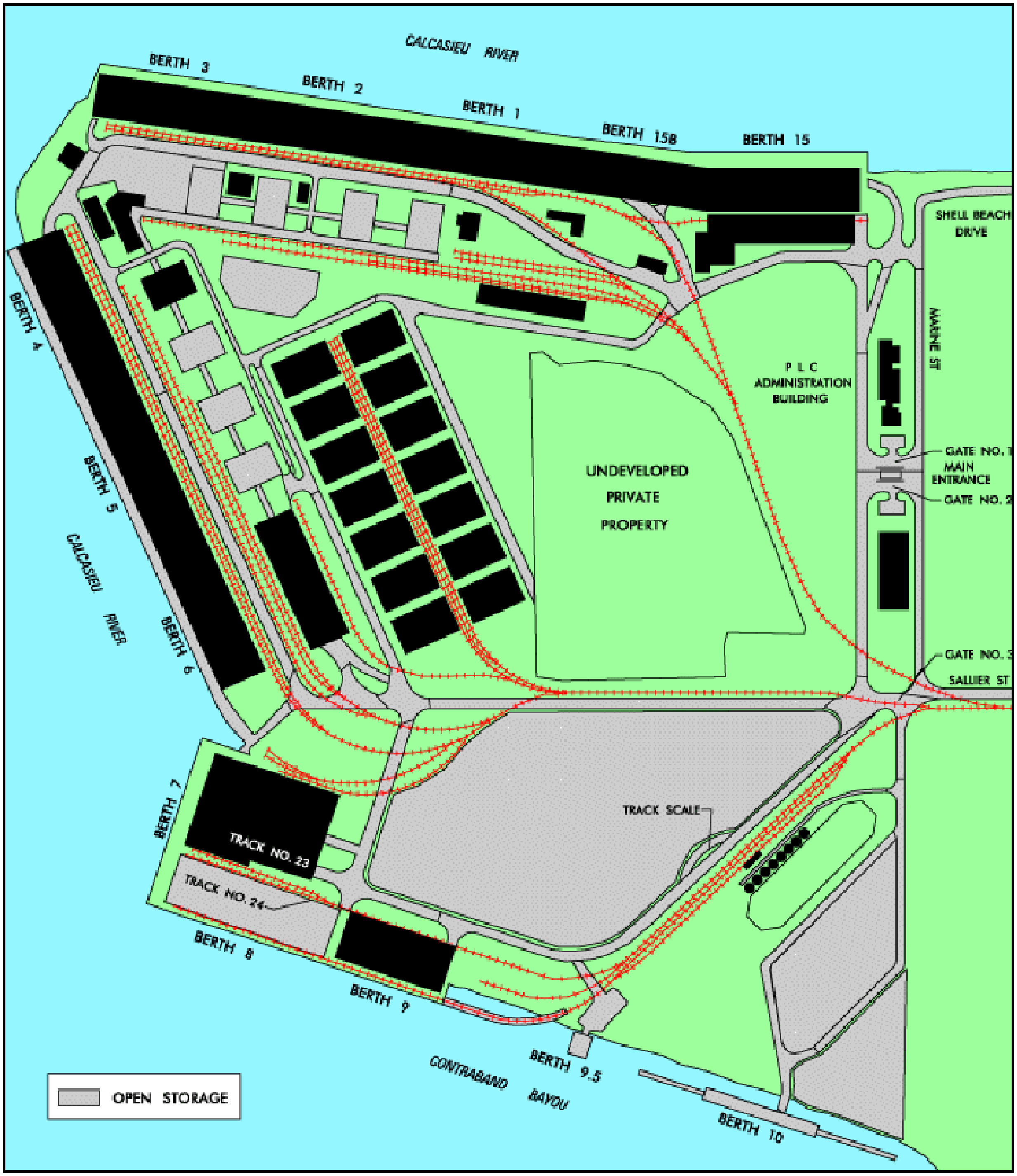
The port owns and maintains its own track system. The Union Pacific (UP), Kansas City Southern (KCS), and Burlington Northern/Santa Fe (BNSF) serve the Lake Charles area with UP providing the rail switching service as well as delivering railcars from the railyards to the port. The port can provide support switching during a deployment. In addition to the spurs on the port, three commercial railyards exist in the Lake Charles area. The commercial railyards can store about 980 89-foot railcars. At the time of the port survey, all except one of these railyards were operating at or near capacity. The exception operated at 75 percent. Spurs on port can provide additional storage for about 700 railcars. Current rail service to the port is one train in and one train out per day. The maximum number of railcars per train is 100. All railyards within the port are maintained to Class 1 standards and have a speed restriction of 10 mph.

No unusual clearance restrictions exist on the rail lines accessing the port. Apron tracks are along Berths 8 and 9. The port has a fixed end ramp near Berths 7 and 8 serving double 700-foot long tracks. No portable end ramps exist at the port. Deploying units would have to purchase or build portable end ramps for additional rail offloading capability. Several spurs, with at least 1,000 feet of straight track, exist within the port.

Fixed End Ramp Serving 700-Foot Long Double Tracks

Air

The port authority lists three airports in the Lake Charles area. They are Lake Charles Regional, Chenault Industrial Airpark, and Southland Airport. Located about 7 miles south of the port, Lake Charles Regional has two runways. The longest is 6,500 feet long, 150 feet wide, and can handle the C-5A at reduced payloads. Chenault Industrial Airpark is about 7 miles from the port, has a runway 15,000 feet long by 200 feet wide, and has handled the B-52. Southland is 18-20 miles away from the port, south of the town of Sulphur, off of State Route 27. It has one runway 5,200 feet long by 150 feet wide, and has handled the DC-9.


CALCASIEU RIVER
BERTH 3
BERTH 2
BERTH 1
BERTH 15B
BERTH 15
SHELL BEACH DRIVE
BERTH 4
MARINE ST
P L C ADMINISTRATION BUILDING
UNDEVELOPED PRIVATE PROPERTY
GATE NO. 1
MAIN ENTRANCE
GATE NO. 2
BERTH 5
CALCASIEU RIVER
BERTH 6
GATE NO. 3
SALLIER ST
BERTH 7
TRACK SCALE
TRACK NO. 23
TRACK NO. 24
BERTH 8
BERTH 9
BERTH 9.5
CONTRABAND BAYOU
BERTH 10
OPEN STORAGE

Land-Use Map

PORT FACILITIES

Berthing

The Port of Lake Charles is a multicargo port with a specialization in breakbulk and bulk operations. In addition to breakbulk operations, the port is also capable of limited roll on/roll off (RORO), limited container, and barge operations. The wharf most suitable for military operations includes Berths 8 and 9. This wharf is compatible with the large medium speed RORO (LMSR) vessel at the design load draft. This wharf has an open apron for conducting RORO operations. The open apron has an area of almost 2 acres. Rail spurs run along the entire length of the apron on Berths 8 and 9. All berths have immediate access to transit sheds providing covered storage. The port does not have any specialized container cranes; therefore, container handling is accomplished using mobile cranes. Lighting is sufficient for night operations.

The port has a unique barge loading facility about 12 miles south of the main terminal on the Industrial Canal. The terminal has one berth, which is 200 feet long, with a depth of 14 feet MLW. This berth was designated to accommodate the Trailer Marine Transport fleet of nine ocean-going RORO barges, which operate weekly to San Juan, Ponce, and Mayaguez, Puerto Rico. At this terminal (Crowley Terminal), the port also conducts RORO operations at the Industrial Canal using a 400-foot barge and spanners to connect the ship to shore. In general, this RORO facility can handle only vessels with straight-stern capability. Berth characteristics for the port are in the table below.

BERTH CHARACTERISTICS FOR THE PORT OF LAKE CHARLES					
	Berths				
Characteristics	**1-15B**	**4-6**	**7**	**8-9**	**15**
Length feet (meters)	1,928 (587)	1,599 (487)	577 (175)	1,010 (307)	697 (212)
Depth alongside at MLW feet (meters)	35-40 (10.7-12.2)	35 (10.7)	35 (10.7)	35 (10.7)	40 (12.2)
Deck Strength psf (metric tons per square meters)	500-1,100 (2.44-5.37)	500 (2.44)	850 (4.15)	650-800 (3.17-3.90)	1,100 (5.37)
Apron width feet (meters)	30-50 (9.14-15.24)	30 (9.14)	51 (15.54)	Open	40 (12.19)
Apron height range feet (meters)	14 (4.27)	14 (4.27)	14 (4.27)	14 (4.27)	14 (4.27)
Number of container cranes	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0
Apron Lighting	Yes	No	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No	No	No
Apron length served by rail feet (meters)	0	0	0	1,010 (307)	0

SUMMARY OF BERTHING CAPABILITIES FOR LAKE CHARLES						
Vessels		Berths				
TYPE	CLASS	1-15B	4-6	7	8-9	15
BREAKBULK	C3-S-38a	3	3	1	1	1
	C4-S-58a	3	2	1	1	1
	C4-S-66a	3	2	1	1	1
	C5-S-37e	3	2	c	1	1
SEATRAIN	GA and PR	3	2	1	1	1
BARGE	LASH C8-S-81b	2	1	c	1	c
	LASH C9-S-81d	2,a,f	1,a,f	a,c,f	1,a,f	c
	LASH Lighter	9	7	2	5	3
	SEABEE C8-S-82a	2,a,f	1,a,f	a,c,f	1,a,f	c
	SEABEE Barge	9	7	2	5	3
RORO	COMET	3,d,o	3,d,o	1,d,o	1,d,i,j	1,d,o
	METEOR	3,d,o	2,d,o	1,d,o	1,d,i,j	1,d,o
	Cape Gnome	3,d,o	2,d,o	c,d,o	1,d,i,j	1,d,o
	C7-S-95A	2,b	2,b	b,c	1	b,c
	Cape Taylor	2,b	2,b	b,c	1	1,b
	Cape Orlando	2,b	2,b	b,c	1,i,j	1,b
	MV Ambassador	3,d	2,d	1,d	1,d	1,d
	Callaghan	2,d,o	2,d,o	c,d,o	1,d,i,j	1,d,o
	Cape Lambert	2,b	2,b	b,c	1,i,j	1,b
	LMSR Class	1,b	1,b	b,c	1	b,c
	FSS	1,a,b,p	1,a,b,p	a,b,c,p	1,a,p	b,c,p
	Cape E-Class	2,b	2,b	b,c	1,i,j	1,b
	Cape D-Class	2,b	2,b	b,c	1,i,j	1,b
	Cape H	2,a,b	2,a,b	a,b,c	1,a	b,c
RORO	Cape Texas	2,b	2,b	b,c	1,i,j	1,b
	Cape R	2,b,d,o	2,b,d,o	c,d	1,d	1,b,d
	Cape I-class	2,b	2,b	b,c	1,i,j	1,b
	Cape Victory	2,b	2,b	b,c	1,i,j	1,b
CONTAINER	C6-M-147a	2,b,e	2,b,e	b,c,e	1,e	1,b,e
	C7-S-69c	2,b,e	2,b,e	b,c,e	1,e	1,b,e
	C7-S-68c	2,b,e	2,b,e	b,c,e	1,e	b,c,e
	C8-S-85c	2,b,e	1,b,e	b,c,e	1,e	b,c,e
	C9-M-132b	2,b,e	1,b,e	b,c,e	1,e	b,c,e
	C9-M-F141a	1,a,b,e	1,a,b,e	a,b,c,e	1,a,e	b,c,e
TACS	C6-S-1qd	2,b	2,b	b,c	1	1,b
	C5-S-MA73c	3,b	2,b	b,c	1	1,b
	C6-S-MA60d	2,b	2,b	b,c	1	1,b
MPS	C7-S-133a	2,b	1,b	b,c	1	b,c
	Maersk	2,b	2,b	b,c	1	b,c
	AmSea	2,b	2,b	b,c	1	1,b

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp
p-inadequate overhead clearance into port

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

STAGING

Open Staging

The port has a total of nearly 47 acres of various-surfaced open storage. Thirty-seven acres of this total is located in the middle of the Port of Lake Charles's facility inland of the docks. The surface for this open storage varies from unimproved to paved. The best place for open storage at the ship berth is the 1.77 acres located at Berth 9. The best location for helicopter operations is the open area in the middle of the port mentioned above. After removing the rotor blades, the port support activity (PSA) can tow the helicopters into any of the transit sheds for further reduction and shrink wrapping. According to the port (January 2000), 10 acres of open storage have recently been paved at the city docks and 7 more acres will be paved in the future. The Crowley Terminal has 28 acres of hard surface area.

Open Staging Area

Covered Staging

The port authority lists eight transit sheds/warehouses totaling 1,273,475 square feet. These facilities are all located close to the ship berths.

Transit Sheds Along Berths 1-15B

UNLOADING/LOADING POSITIONS

Ramps and Docks

The Port of Lake Charles has one fixed end ramp serving two 700-foot rail spurs. This ramp is located near Berths 7 and 8. Other than this ramp, no other end ramps, fixed or portable, exist at the port. The port authority lists a total of 28 truck docks and 145 rail docks. These numbers include six docks that can serve both trucks and boxcars, but not simultaneously.

Boxcar Docks

Marshaling Areas

The port authority lists two areas that have potential for marshaling military equipment. The best area is Chenault Industrial Airpark, about 7 miles east of the port. Formerly a bomber base, this 1,000-acre facility supports aircraft refurbishing and manufacturing activities. About 100 acres of paved, open area is available, but most of the 927,000 square feet of hangar space is leased. This facility is a secure area and provides needed utilities such as electricity and potable water.

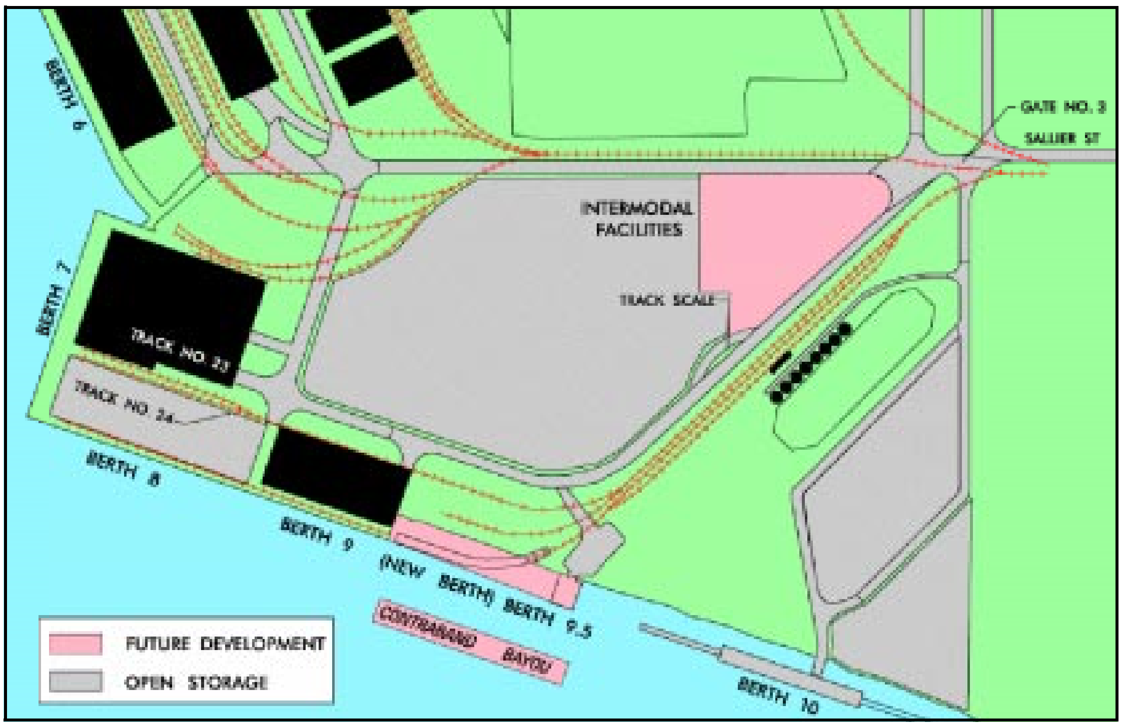
The port also lists 13 acres outside the main gate consisting of old building foundations and unimproved surface area.

Materials Handling Equipment (MHE)

The port authority lists a 31-STON forklift truck and a 60-STON capacity switch engine as the only port owned MHE. Other MHE, such as mobile cranes and forklifts, can be furnished by local stevedores.

FUTURE DEVELOPMENT

The port authority lists three major future developments. The first project is to build Berth 9.5, located between Berths 9 and 10. This expansion will add 926.5 feet onto the existing Berth 9. Estimated completion is around the start of the FY 2001 timeframe. The second project is the dredging of Contraband Bayou to a depth of 40 feet MLW and a width of 450 feet. No timetable has been set for completion of dredging. The third project is the construction of two intermodal facilities on the 17-acre unimproved open storage area. In recent developments (January 2000), the port reports that 10 of the 17 acres have been paved. The remaining 7 acres will be paved in the upcoming months. See the map below showing the areas to be developed.



Future Development Map

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

The port does not have an agreement with the Coast Guard to establish a net explosive weight. However, the port has been allowed to ship explosives in the past at Berth 8.

STEVEDORING

The Port of Lake Charles has it's own labor pool of stevedores.

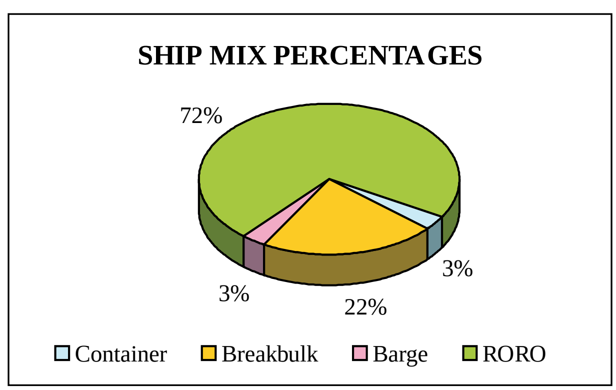
III. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Lake Charles. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON.

Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth 70 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

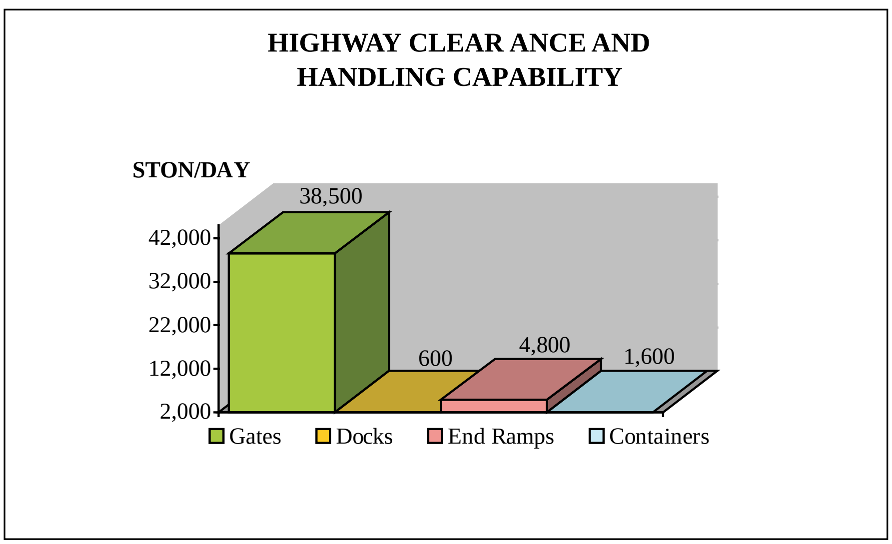
Highway

Sallier Street, a four-lane road, is the highway route to the port from I-210. The port has three gates that allow access to the unloading and staging areas. Gate 3 is at the intersection of Sallier and Marine Streets. The other two gates are on Marine Street, a two-lane road that fronts the port and intersects Sallier Street. The road and gate going into the port can handle about 38,500 STON of cargo per day. This capability includes the throughput for the highway network accessing the Crowley Terminal located in the industrial port south of the main port. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or leave the port on each lane of the highways accessing the port.

Roadable vehicles will move through the terminal gate in manageable convoys to the staging area. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. Since truck end ramps are not available, deploying units/military port operators must either build or acquire the necessary ramps. Since the port has a fixed rail end ramp serving double tracks, we assumed that the using units/stevedores could construct three portable truck end ramps. These end ramps, with one handling position each, can handle 4,800 STON of military vehicles and equipment per day.

This study assumes that one container handler is available for container operations. With one container handler, the Port of Lake Charles could handle 1,600 STON/day. The 28 truck docks (includes the six truck/rail docks) can handle about 600 STON per day.

Maximum daily handling capability for the port is a mixed total of the three types of handling (docks, end ramps, and containers), each up to its maximum, not to exceed the daily highway limit of at least 38,500 STON.



Rail

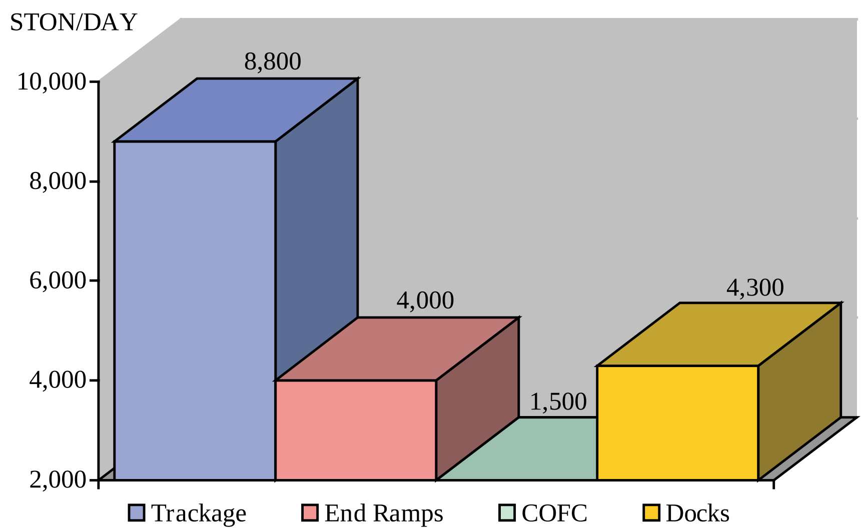
Rail reception is good, with UP, KCS, and BNSF providing rail service to the port. Current rail service is one train in and one train out per day with a maximum of 100 railcars per train. In the past, the port has handled three trains per day. These trains can handle about 8,800 STON per day.

Wheeled and tracked vehicles on flatcars will offload at the port using the fixed rail end ramp serving double tracks. Assuming one portable end ramp is used to supplement the fixed end ramp, the end ramps can handle at least 4,000 STON per day.

The port has 139 boxcar positions (does not include the six truck/rail docks) for rail offloading at the transit sheds. These docks can handle over 4,300 STON per day.

Based on using one container handler for offloading COFC railcars, the port can handle about 1,500 STON of containerized equipment and supplies from railcars per day.

RAIL CLEARANCE AND HANDLING CAPABILITY



Staging

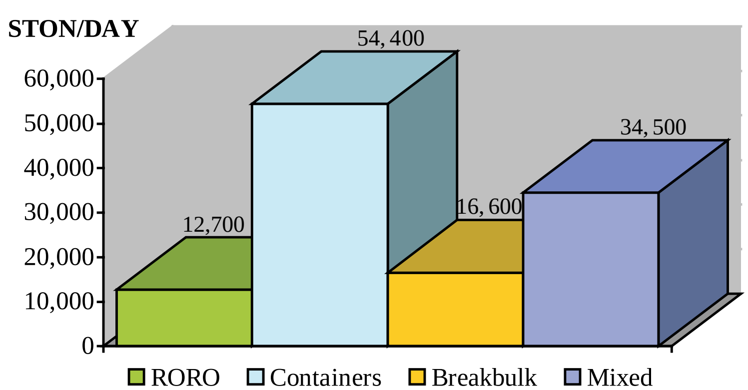
The Port of Lake Charles has identified almost 47 acres of open staging area for vehicles and/or containers.

The transit sheds have a total area of 1,273,475 square feet. The covered staging throughput is almost 19,700 STON per day.

The chart on this page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of each type cargo operation involved should be assumed.

The table shows the STON of cargo, by type, the port can handle. The dwell time used in these computations was 3 days and the open space utilization percentage was 60 percent. The container storage throughput capability is the highest with almost 54,400 STON. The ability to stack containers three high in the open storage areas contributes to the high staging throughput value. Open storage requirements are dependent on cargo arrival to the port, smooth loading operations on the cargo vessel, and ship arrival. The RORO storage throughput is about 12,700 STON. The breakbulk staging throughput is about 16,600 STON.

OPEN STAGING CAPABILITY

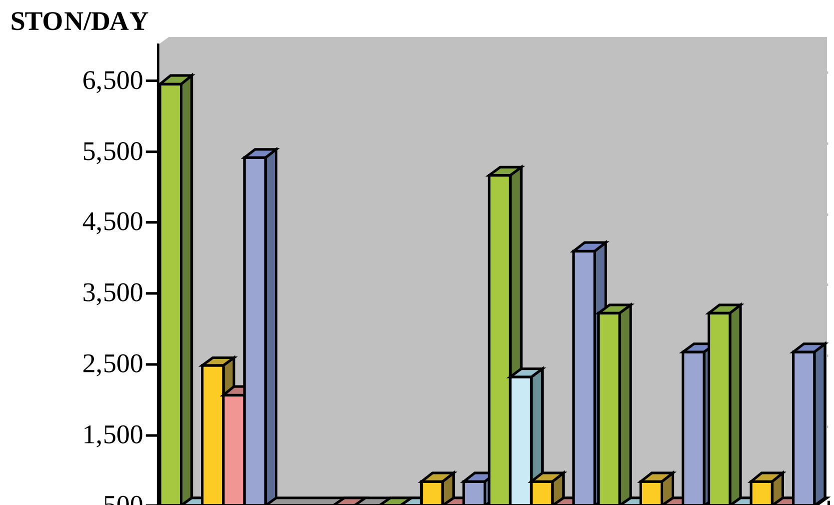


Note: Container staging aea can also be used for RORO staging as needed.

Shipping

Daily shipping subsystem totals for the terminal berths are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types. The port conducts container operations using a mobile crane. The nearby transit sheds support breakbulk operations at all berths. The open apron and nearby open storage area supports RORO operations at Berth 8. The berth length and water depth will allow an LMSR to berth at Berths 8 and 9 at a reduced ship draft.

BERTH THROUGHPUT CAPABILITY



	1-15B	4-6	7	8-9	15	CROWLEY
RORO	6,451	6,451	0	5,160	3,225	3,225
Container	0	0	0	2,320	0	0
Breakbulk	2,477	2,128	851	851	851	851
Barge	2,064	0	0	0	0	0
Mixed	5,413	5,439	851	4,094	2,669	2,669

Note: Throughput includes improvised RORO Berth at Crowley

DAILY THROUG HPUT SUMMARY					
Characteristic or Throughput	**Berths**				
	1-15B	**4-6**	**7**	**8-9**	**15**
Length (feet)	1,928	1,599	577	1,010	697
Depth Alongside (feet)	35-40	35	35	35	40
Breakbulk Throughput STON (MTON)	2,480 (6,190)	2,130 (5,320)	850 (2,130)	850 (2,130)	850 (2,130)
RORO Throughput STON (MTON)	6,450 (25,800)	6,450 (25,800)	0	5,160 (20,640)	3,230 (12,900)
RORO Square feet (est)[1]	129,000	129,000	0	103,200	64,600
RORO Pieces[2]	759	759	0	607	380
Container Throughput STON (MTON)	0	0	0	2,320	0
Container Throughput (TEU)[3]	0	0	0	290	0
Barge Throughput STON (MTON)	2,060 (5,160)	0	0	0	0
Mixed Throughput STON (MTON)	5,410 (20,720)	5,440 (21,010)	850 (2,130)	4,100 (15,980)	2,670 (10,380)

[1] Based on the 20 square feet per STON average accomplished during Operation Desert Shield/Storm.
[2] Based on the 170 square feet per piece average accomplished during Operation Desert Shield/Storm.
[3] Based on the 8 STON per TEU average accomplished during Operation Desert Shield/Storm.

SUMMARY

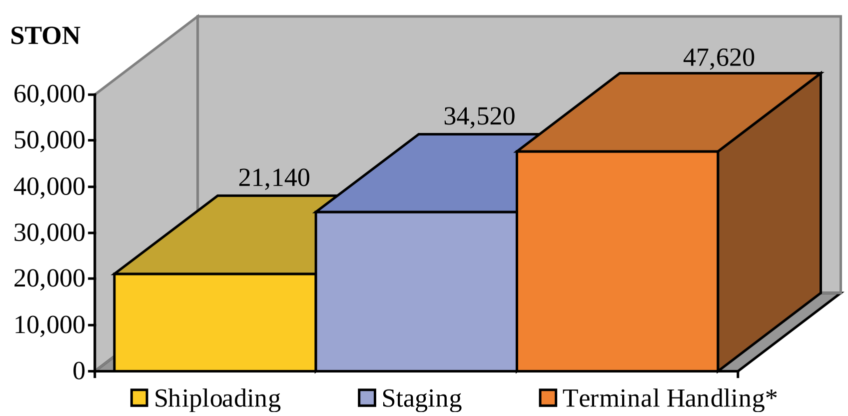
The port is multioperational with the capability to handle all types of vessels: limited container, limited RORO, breakbulk, and barges.

The Port of Lake Charles has the capability to handle a limited amount of military equipment for deployment or exercise. The port does not have any specialized container handling cranes. The majority of the container handling equipment used must come from stevedoring companies. Shiploading will occur using mobile cranes. The loading of containers via mobile cranes is generally slower than using specialized container cranes. In general, RORO operations will be confined to Berths 8 and 9 because the aprons are not wide enough for ramp placement at the other berths.

The port can accommodate vessels as large as the LMSR as shown in the Berthing Characteristics Table. The open apron at Berth 8 and close proximity of the transit sheds allow for a variety of operations. To conduct sustained loading operations on an LMSR, the port needs 25 acres of open staging per LMSR vessel. This open storage requirement depends on cargo arrival, smooth shiploading operations, and ship arrival. The amount of open staging needed for sustained loading operations on a fast sealift ship (FSS) vessel is 16 acres per vessel. The Port of Lake Charles has nearly 47 acres of open staging. Any additional open staging would need to come from marshaling areas outside the port's boundary.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of about 21,100 STON.

DAILY CARGO THROUGHPUT CAPACITY



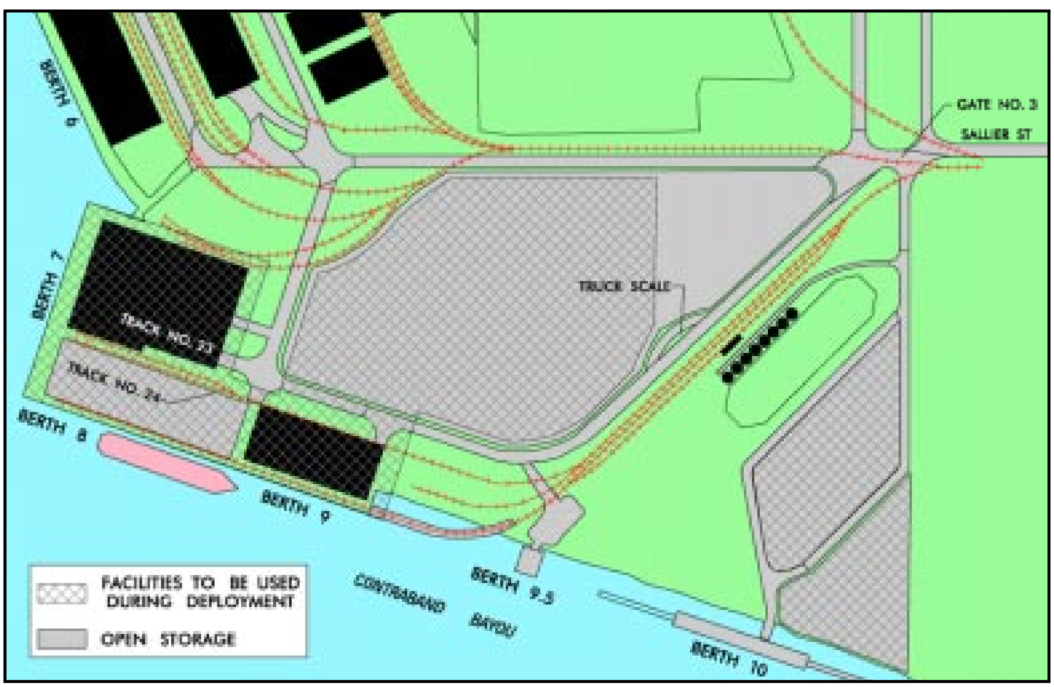
Terminal handling is the sum of the highway (39,268 STON) and rail (8,349 STON)

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional heavy armored cavalry regiment using primarily LMSR vessels. We assume that Berths 8 and 9, 25 acres of open staging, and the transit sheds supporting Berths 8 and 9 are available to the military for deployment. We also assume that no other military units will be competing for these facilities during the time that the regiment occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately load the ship and clear the port.

To evaluate the port's deployment capability, we used the port simulation (PORTSIM) model to flow unit equipment in the regiment through the port. PORTSIM is a time-stepped, discrete event, stochastic simulation of port operations during a force deployment. PORTSIM is dynamically modeled for visual monitoring and quick identification of problems and allows the analyst to determine port closure/clearance times. For this simulation, we assume that the deploying regiment will use the facilities identified in the graphic below during a deployment. Also, we assumed that one container handler and two mobile cranes are available for shiploading. We further assumed that two portable end ramps would be used for deployment (one for rail offloading and one for semitrailer offloading). We also assumed that the off-port marshaling areas would be available if needed.

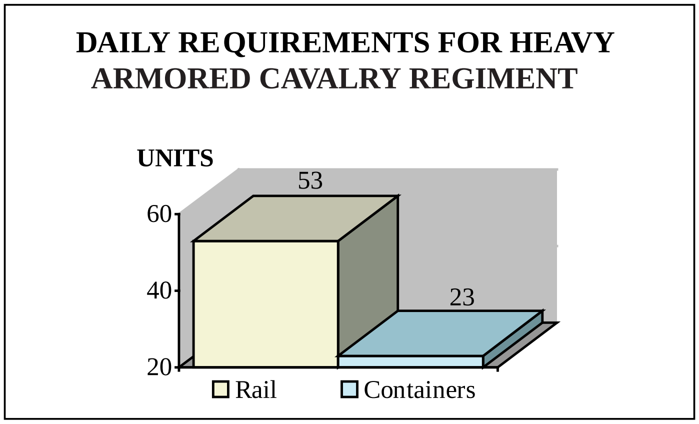


Potential Port Use During Deployment

REQUIREMENTS

To simulate a likely requirement for the Port of Lake Charles, we deployed a notional heavy armored cavalry regiment, using 6 days for shiploading and port closure. The regiment has to move 2,138 vehicles and 140 containers. Movement of the regiment to the port will require 319 railcars using a convoy/rail option for transport to the port. About 23 containers would arrive daily.

TOTAL EQUIPMENT	
Volume	84,440 MTON
Weight	31,267 STON
Area	433,658 SQ FT
Vehicles	2,138
Containers	140
Note: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997.	



SIMULATION RESULTS

Total deployment time for the regiment was about 6 days with the last 5 of those days used for shiploading and the first day used for initial reception and staging. LMSR vessels were used to deploy the regiment. Actual throughput and closure results are shown in the tables at the end of the study.

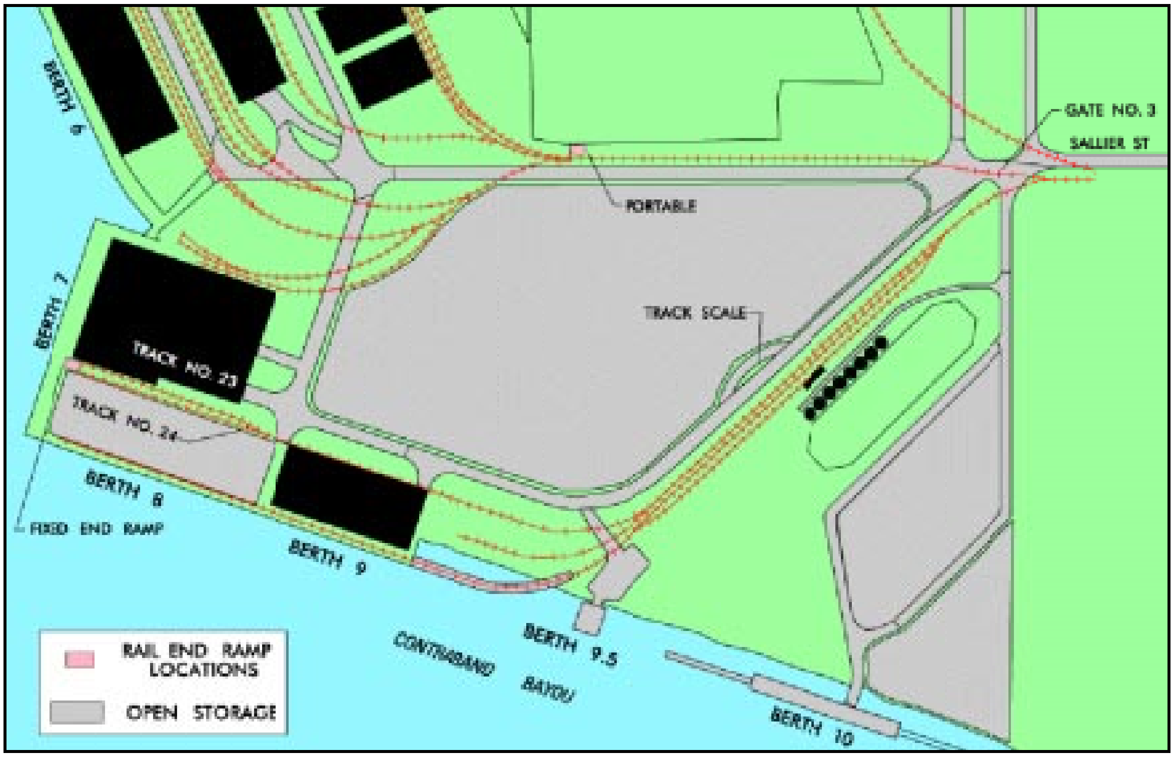
TERMINAL INPROCESSING/HANDLING

Rail

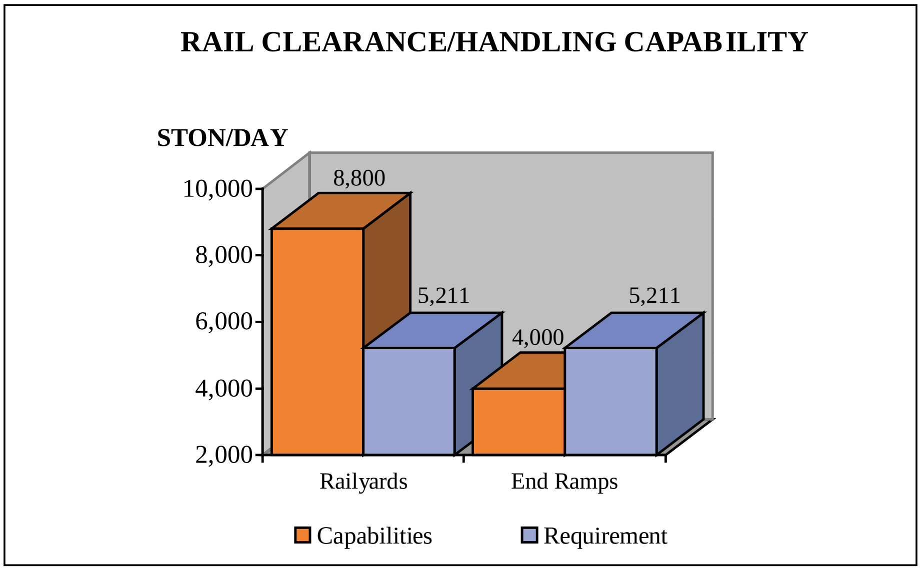
The KCS, UP, and BNSF serve the Port of Lake Charles. The port owns and maintains the 38 miles of track in the port. UP performs all of the switching services as well as delivering trains from the commercial railyards to the port and vice versa. The port can provide support switching. Based on a 6-day loadout, the port railyard (capacity of about 700 89-foot flatcars) could easily handle the additional daily rail traffic (53 railcars per day).

For offloading wheeled and tracked vehicles from railcars, we assume one portable rail end ramp will supplement the fixed end ramp serving double tracks.

Requirements use total STON of equipment divided by six providing a rail daily requirement. Capabilities for the railyard and end ramps reflect trackage and end ramp daily throughputs, respectively. The rail clearance/handling capability assumes that the port can obtain one portable end ramp and can handle three trains per day vice the current one train per day.

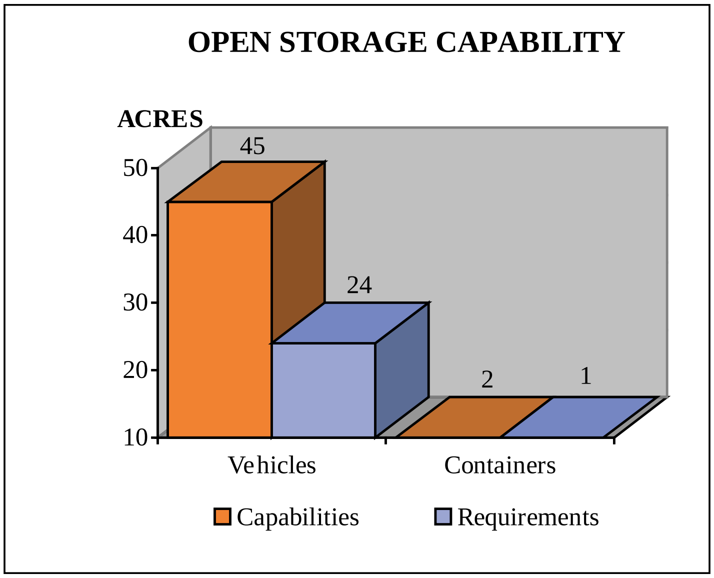


Rail End Ramp Locations



Open Storage

The Port of Lake Charles has identified about 47 acres of open storage area. Assuming the port can provide 25 acres of open storage from the 47 acres, this is enough to support the loading of an LMSR or FSS vessel. The additional off-port marshaling at Chenault Industrial Airpark should provide ample off-port open storage if needed. As the first ship fills up and the staging area empties, there is room to stage equipment for the next LMSR that will be loaded.



Using the 170-square foot-per piece estimate from Operation Desert Shield/ Desert Storm, 363,460 square feet or 8.3 acres are needed to stage 2,138 vehicles. Using a 160 TEU/acre staging requirement (front-end/top pick loader handling method stacking containers two-high), .9 acres are needed to store 140 containers.

Marshaling/Staging Area

Shipping

Using the LMSRs to transport the regiment, Berths 8 and 9 will allow the ships to meet the 6-day loading requirement. Based on each LMSR being able to load in about 3 to 4 days, the two LMSRs can be loaded in 6 to 8 days if all facilities and resources are available. Berth space is adequate to allow the side and stern ramps on the LMSRs to be used to load the ships. If smaller ships are used for deployment, then additional time will be required to move the regiment.

Deploying by LMSR requires one ship every 3 - 3.5 days; each ramp will have to average about 130 STON per hour for 20 hours to deploy the regiment in 6 days. This equates to 15 vehicles per hour per ramp. Deploying by FSS requires one ship every 2 days and the availability of all facilities and resources to meet the same requirement; this equates to 30 vehicles per hour per ramp.

SHIP REQUIREMENTS NOTIONAL HEAVY ARMORED CAVALRY REGIMENT

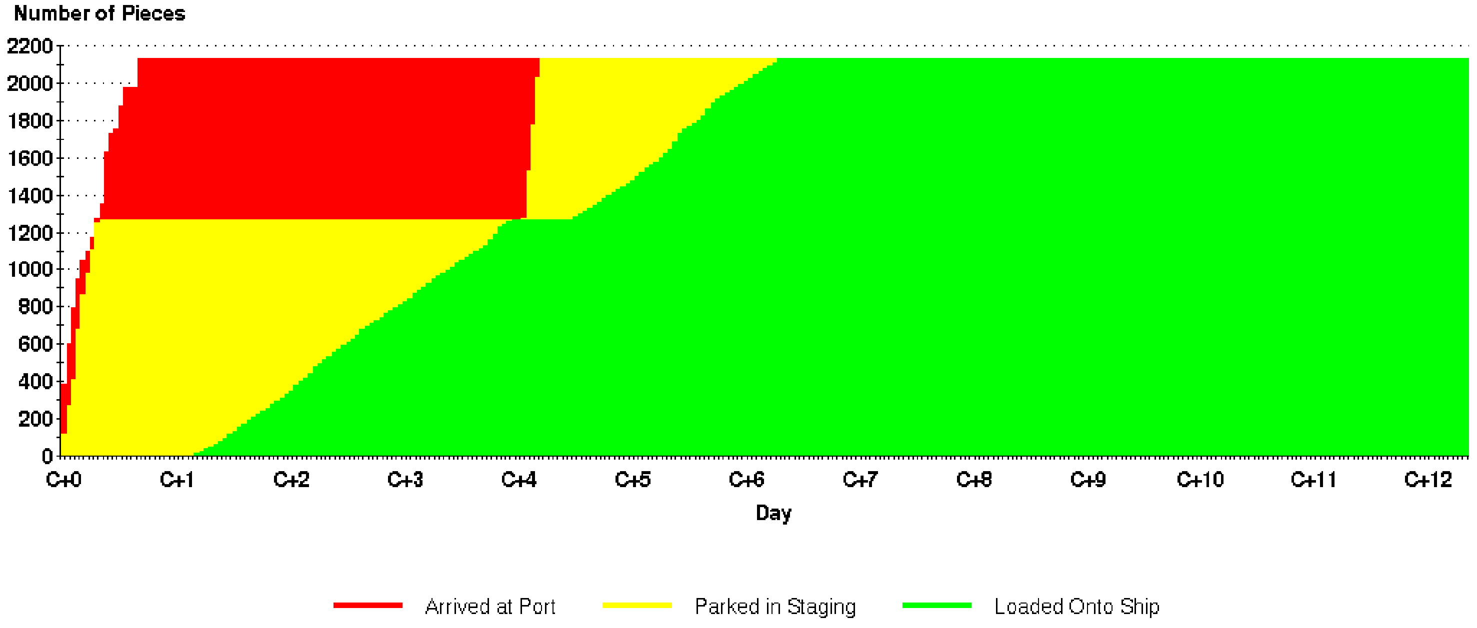
Loading Condition/ Sample Ship Mix	FSS (RORO/ Comb)	LMSR (RORO/ Comb)	C3/C4 (Breakbulk or Containers)	C6/C7/C8 (Container)
Minimum Containerization				
All FSS	2.8			
All LMSR		1.7		
All Breakbulk			8.7	
Maximum Containerization				
FSS/Container	1.1			1.2
LMSR/Container		.7		1.2
Breakbulk/Container			3.5	1.2

Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

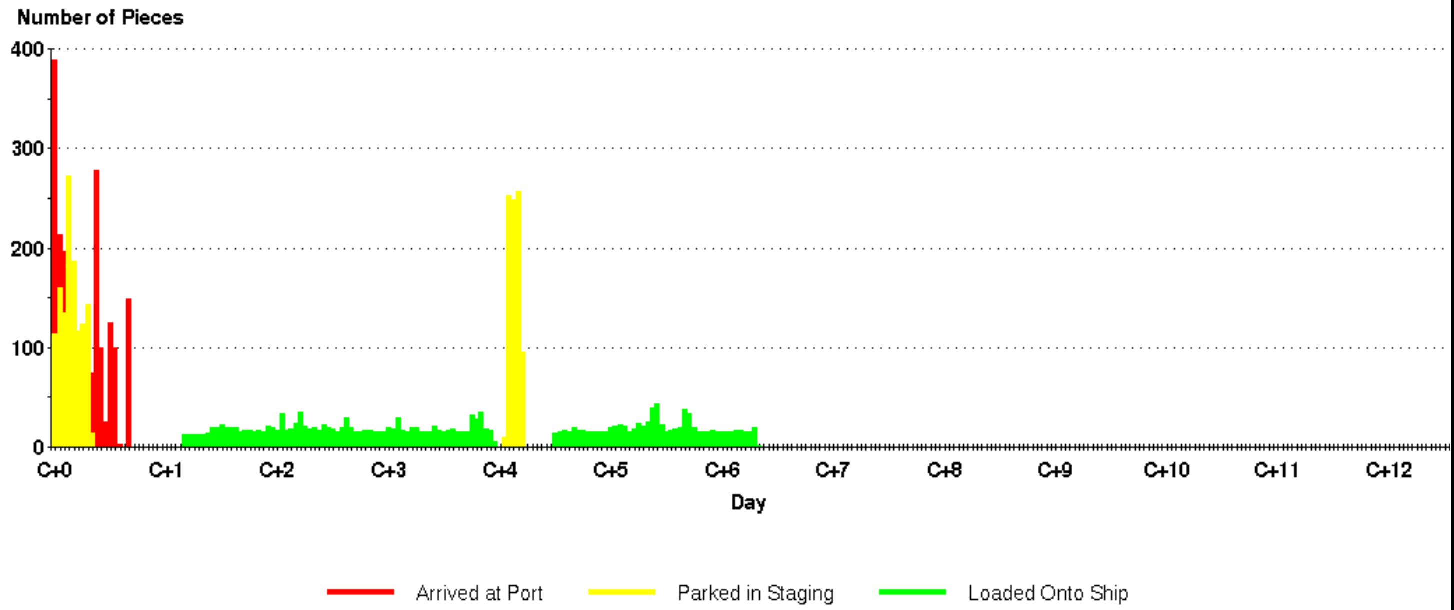
SUMMARY

The Port of Lake Charles can load and achieve closure for a notional heavy armored cavalry armored regiment in about 6 days using Berths 8 and 9 and LMSR ships if all facilities and resources are available. If other ships are used, additional time may be required to achieve port closure. Due to the 135-foot MHW clearance under I-210 going to the port, the Port of Lake Charles is not considered FSS capable. The port is viable for supporting deployment of a notional heavy armored cavalry regiment provided it can provide 25 acres of open storage and support the needed rail traffic into the port. If possible, the open storage area should be paved or aggregate rather than unimproved for use in a deployment. Also, the deploying units must have access to at least two portable end ramps, two mobile cranes, and a container handler to adequately handle the cargo associated with a notional heavy armored cavalry regiment.

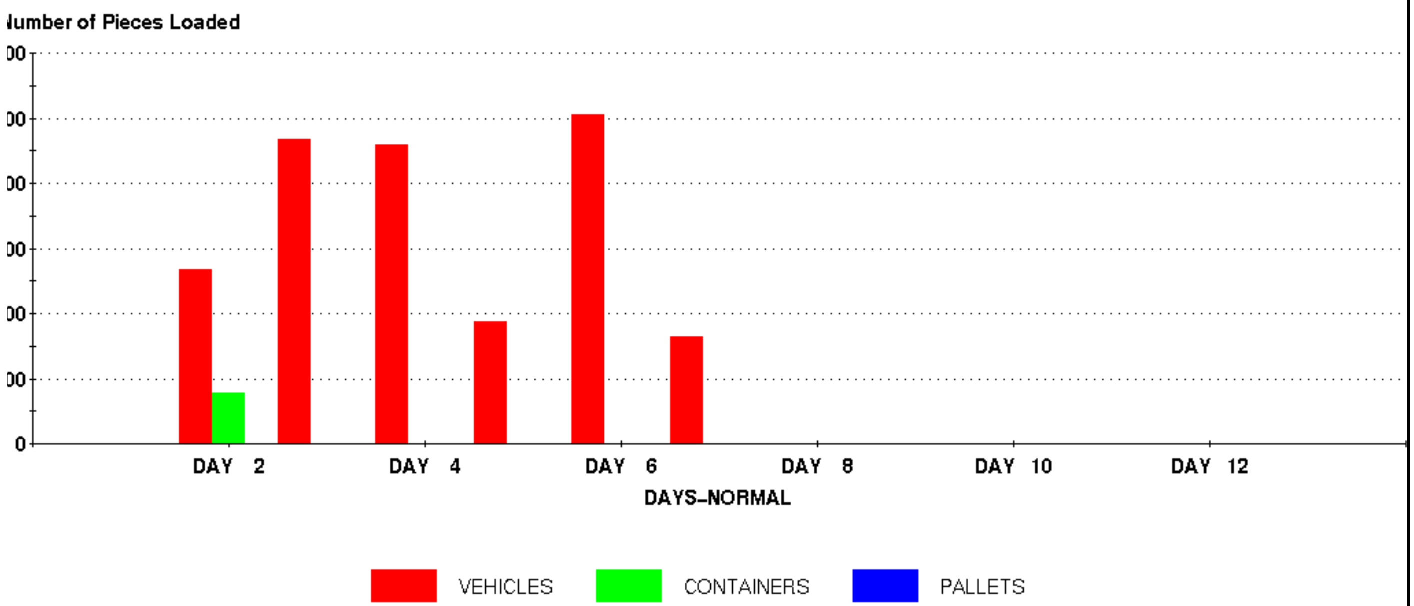
CUMULATIVE CLOSURE PROFILE FOR A NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



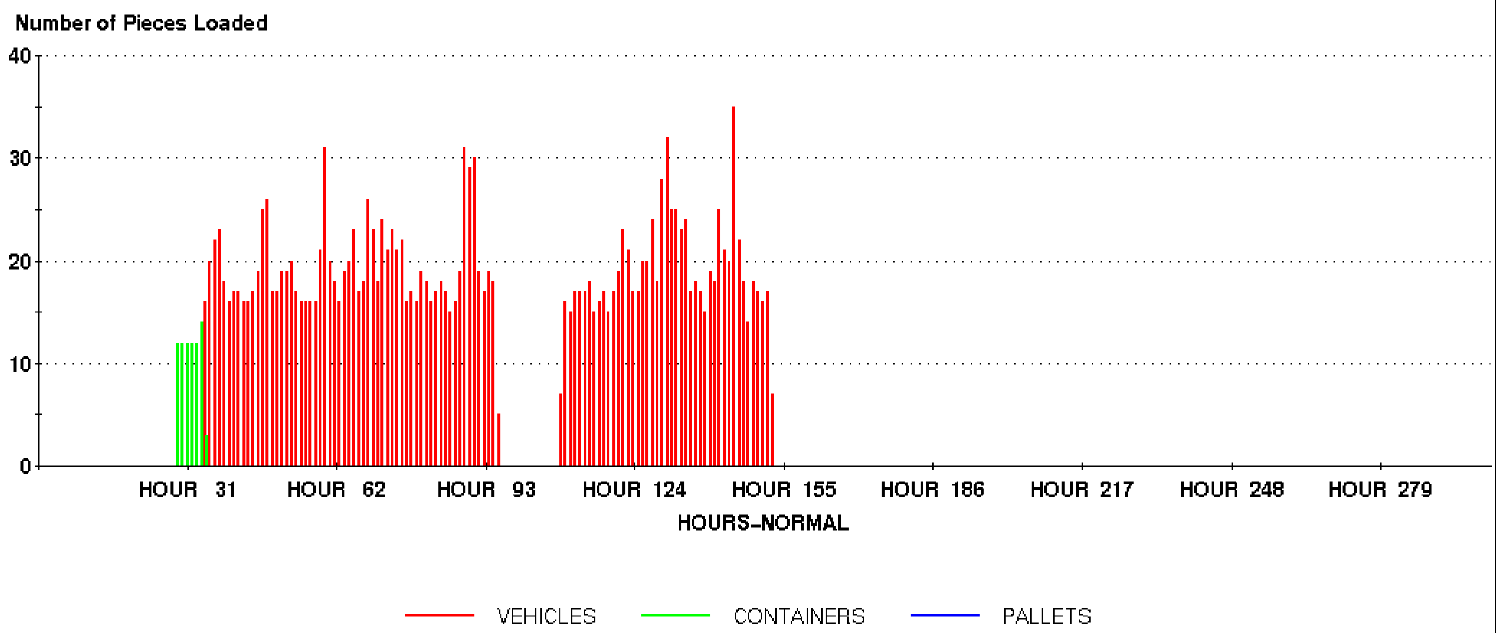
DAILY CLOSURE PROFILE FOR
A NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



DAILY THROUGHPUT FOR
A NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



HOURLY THROUGHPUT FOR A NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



PORT OF MOBILE
ALABAMA

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Mobile, Alabama, on 16 September 1999. The port is fully capable of supporting U.S. Military cargo transshipment operations, and can accommodate vessels as large as the LMSR. The port has up to a 1.5-foot tidal range.

The port has 16,359 feet of quay and can accommodate vessels as large as the FSS and LMSR and capable of supporting U.S. Military cargo shipment operations. It can load or offload a mixed throughput of at least 54,700 STON a day.

The Port of Mobile has mobile cranes available through the local stevedoring companies. It has 60 acres of open staging. An FSS requires about 16 acres per day of staging to load/offload the ship and an LMSR requires about 25 acres per day of staging for continuous operation. If the port was able to free up to 80 percent of the facilities for DOD use, staging would be available for two LMSRs or three FSSs to load simultaneously.

Berth 2 and the open staging behind it are best suited for military operations. Other berths could be used with limitations. Berth 4-6 and Berth E are limited to one ramp loading at a time. Berth B South, C South, and C North could be used with favorable river conditions. Ranking for uses in order of priority are Berth 2, C North, C South, Berth 4-6, Berth E and then Berth B South.

Mobile is a viable port for supporting deployments of a notional armored brigade provided one berth is available for U.S. Military deployments. A notional armored brigade has a total of 27,970 STON of vehicles and equipment and could be loaded on 1.4 LMSRs in about 4 days. The brigade will require use of the port for about 7 days. The first 6 days for rail arrival and offloading and the last 4 for shiploading. This overlaps rail operations and shiploading on the 3 middle days.

II. GENERAL DATA

Mobile, Alabama, is a port that can be used by the U.S. Military for shipping military vehicles and equipment to and from CONUS. The port is public-owned, contractor-operated, and capable of handling RORO, container, and breakbulk ships and barges. A team from Military Traffic Management Command (MTMC) Transportation Engineering Agency, MTMC Deployment Support Command, and the 596th Transportation Battalion conducted a site survey on 16 September 1999. Information was obtained from the Mobile, Alabama, Port Officials.

TRANSPORTATION ACCESS

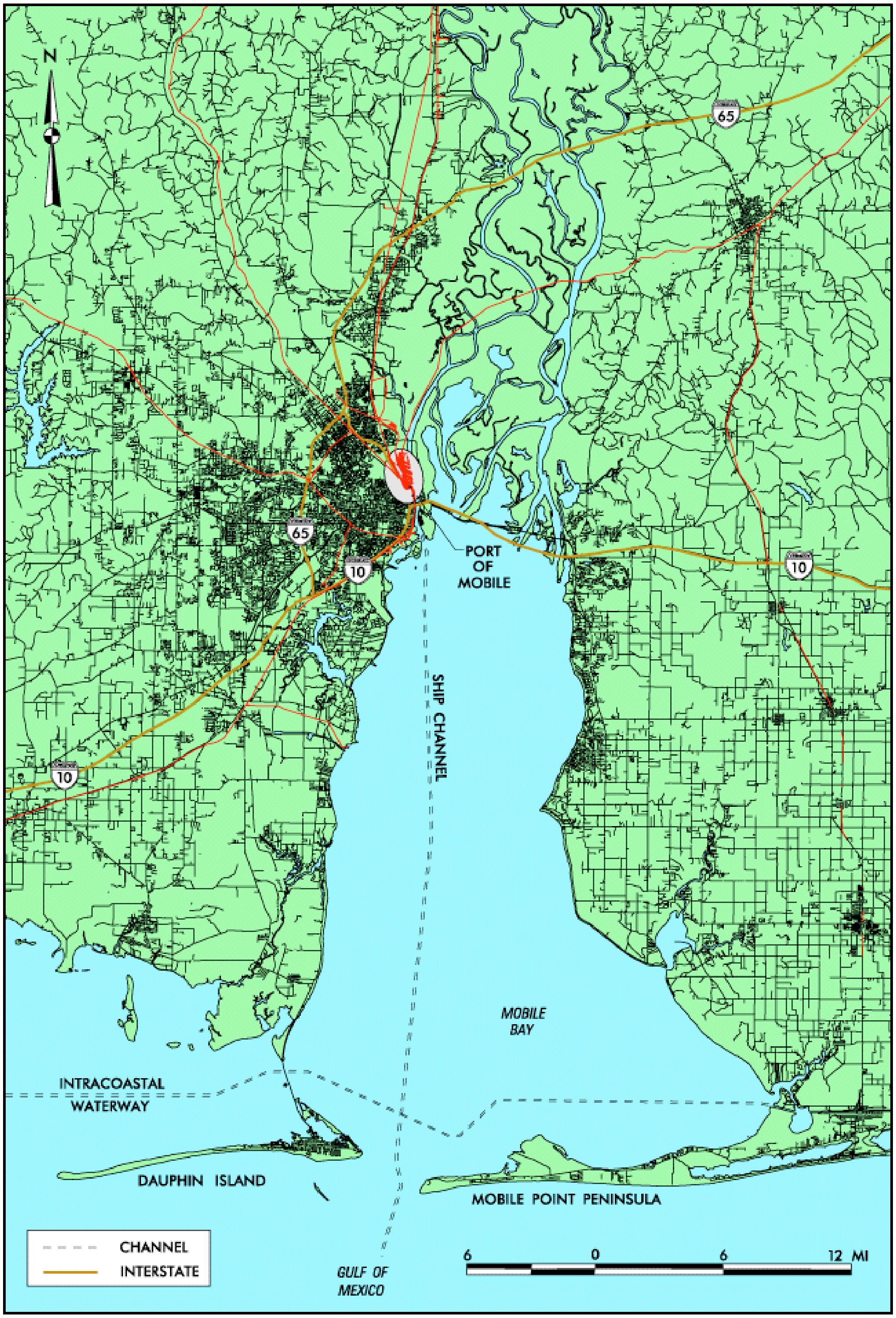
Water

The Port of Mobile (latitude 30° 42’ north, longitude 88° 02” west, (QMFZ - GEO location code) time zone GMT -6) is at the junction of the Mobile River and the head of Mobile Bay. The major port facility is the Alabama State Docks (ASD). This facility is along the last 5 miles of the Mobile River, mainly on the west bank. Mobile Bay is about 29 miles long and about 8 miles wide at its upper portion. Dauphin Island and the Mobile Point Peninsula separate the bay from the Gulf of Mexico. Between these two points of land is a 3-mile-wide access way into the bay. It is about 35 miles from the port to open water.

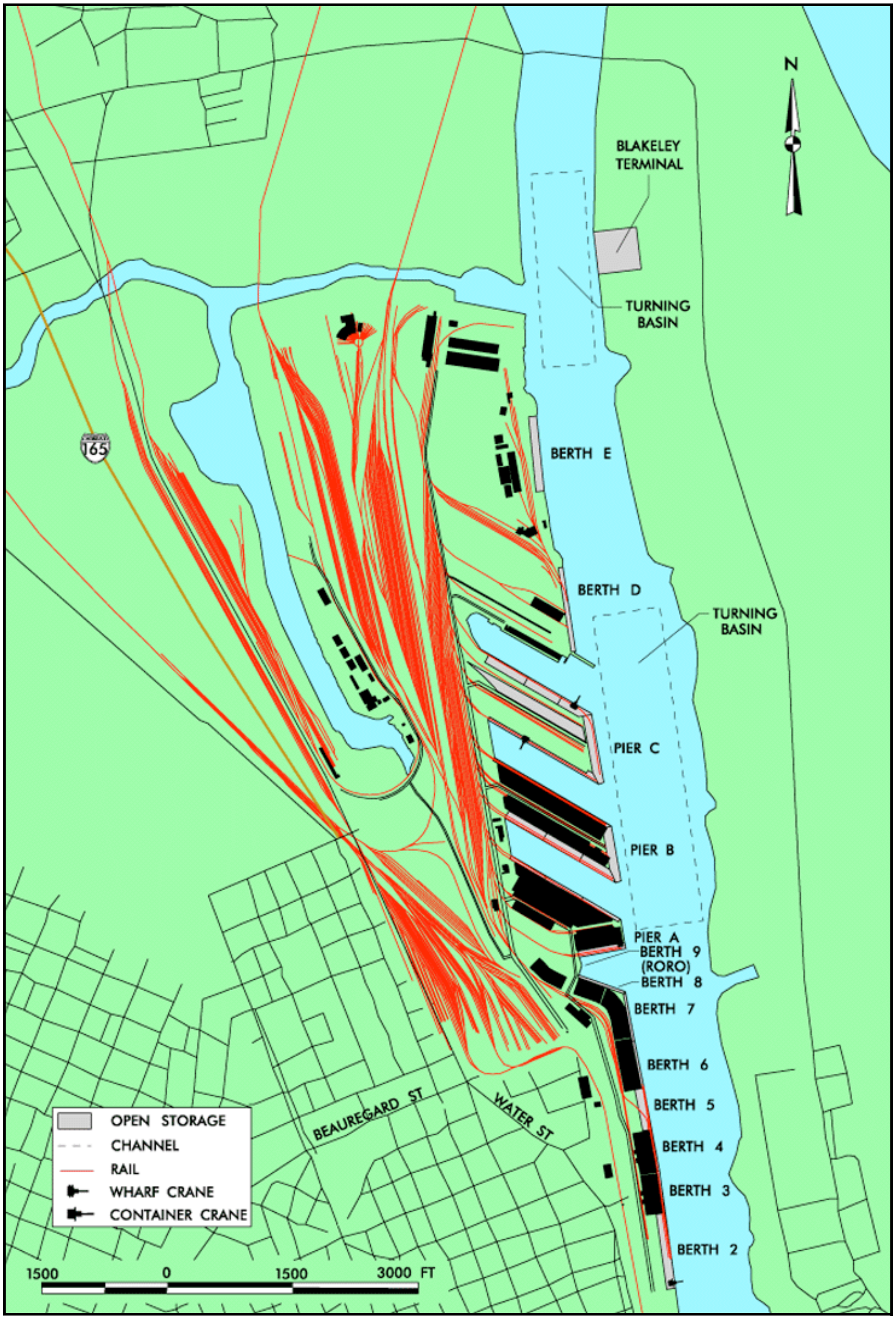
The main entrance into Mobile Bay from the Gulf of Mexico is through a dredged channel across Mobile Bar between Mobile Point and Dauphin Island. The channel depth at mean low water (MLW) is 45 feet. The channel then extends to the Mobile River with a depth at MLW of 45 feet. The water depth, at MLW from the mouth of the river to the turning basin at the north end of the port, is 40 feet. The tidal range is 1.5 feet. Pilots are compulsory across the bar.

Opposite the terminal is a 2,500-foot-long by 800-1,000-foot-wide and 40-foot-deep MLW turning basin with a maximum ship length of 800 feet. There is another turning basin at Three Mile Creek that is 1,200 feet long by 1,000 feet wide and 40 feet deep with a maximum ship length of 950 feet. No overhead restrictions exist between the Port of Mobile and the Gulf of Mexico.

The current in Mobile River from November through March, depending on rain, can make it difficult to turn large ships such as the FSS and LMSR and to dock them at the finger piers. The river conditions should be considered if the finger piers are going to be used by LMSR or FSS.



Channel Graphic


N
BLAKELEY TERMINAL
TURNING BASIN
165
BERTH E
BERTH D
TURNING BASIN
PIER C
PIER B
PIER A
BERTH 9 (RORO)
BERTH 8
BERTH 7
BERTH 6
BERTH 5
BERTH 4
BERTH 3
BERTH 2
BEAUREGARD ST
WATER ST
OPEN STORAGE
CHANNEL
RAIL
WHARF CRANE
CONTAINER CRANE
1500 0 1500 3000 FT

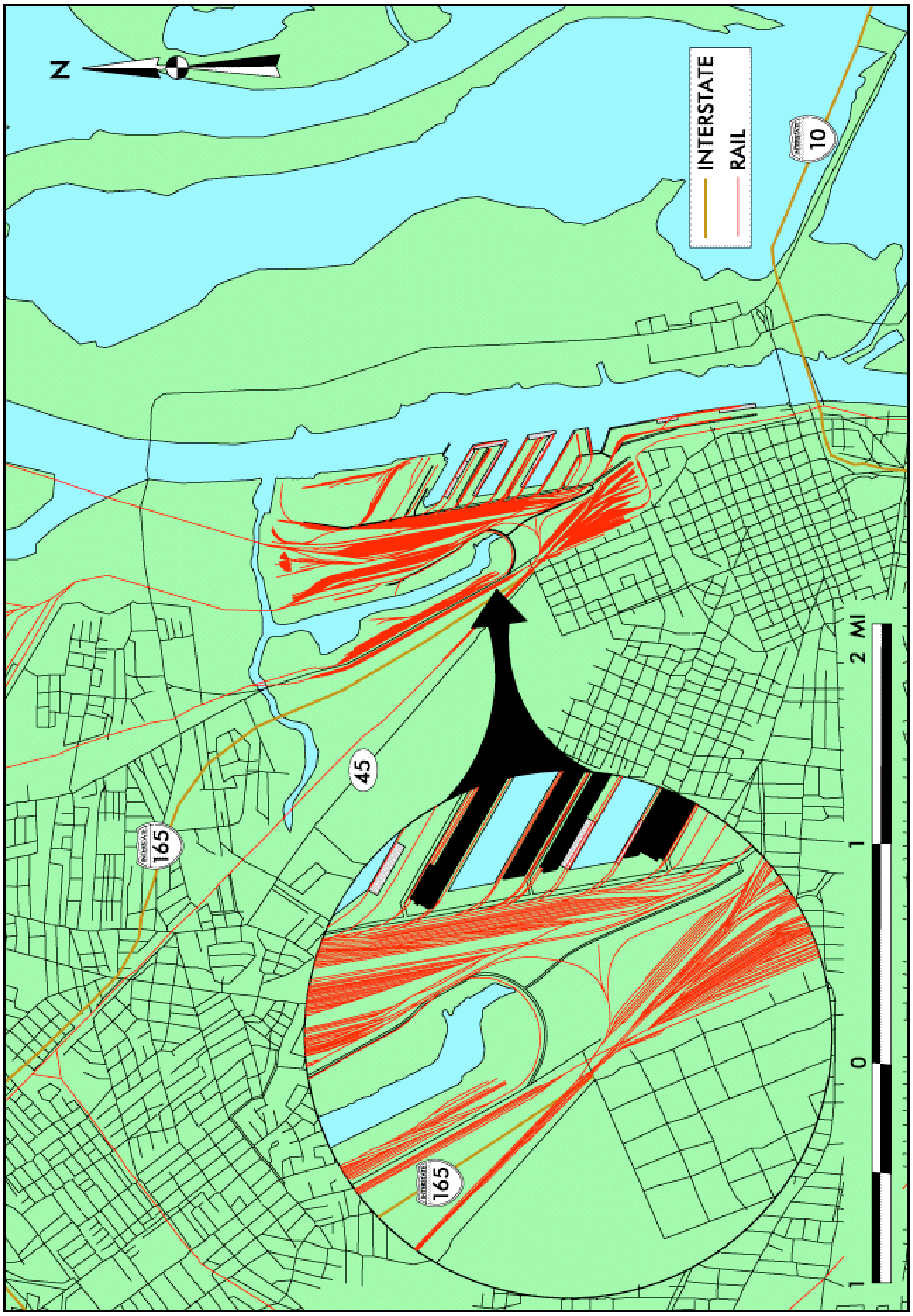
Land-Use Map

The Port of Mobile connects with rivers and the Inland and Intracoastal Waterways in the U.S. to form an effective inland water network. Barge transport can be used to move items too large for unrestricted transport by highway and rail modes. Barges can be used to transport U.S. Military equipment to the port.

Canal and Barge Routes

Highway

Access to a number of interstate and U.S. routes to and from ASD is excellent. Interstate Routes 10, 65, and 165 and U.S. Routes 31, 43, 45, 90, and 98 are all near the terminal. Port entry from these routes is by Water Street to Beauregard Street to the main gate. Beauregard Street has a fly-over above the railroad tracks, so rail movements do not impede traffic flow to the port. The highway leading into the port has a vertical clearance of 14 feet 6 inches. The highway network around the port area has heavy traffic congestion during peak hours.



Highway Map

Rail

Four railroad companies provide one track each to the Port of Mobile. They are the Burlington Northern Santa Fe (BNSF), CSX Transportation, Illinois Central (IC), and Norfolk Southern (NS). The tracks are active and in good condition. All four rail lines have restrictions of 40 feet in the vertical direction and 22 feet in the horizontal direction. Each railroad has a regional railyard adjacent to the port. The capacity of the railyard ranges from 1,025 to 1,800 89-foot railcars (1,600 to 2,800 60-foot railcars). The port operates four railyards with a capacity for 300 to 1,300 railcars.

The ASD terminal railway handles all rail movements and switching within the port complex. It offers shipside service and is responsible for switching cars from the four major railroads to various State dock facilities.

Rail Map

Air

Mobile, Alabama, has two civilian airports in the area. The Mobile Municipal and the Brookley Industrial Complex and Airport. The Mobile Municipal Airport, Bates Field, is on Airport Boulevard, about 12 miles west of the port. Bates Field has three runways that are 4,354 by 150 feet, 4,988 by 150 feet, and 8,527 by 150 feet, respectively.

The Brookley Industrial Complex and Airport, Brookley Field, is 5 miles south of the Port of Mobile. The complex has two main runways and numerous taxiways. The runways are 9,600 by 200 feet, and 8,600 by 150 feet. Brookley Field is a complete transportation complex with direct interstate connections and two railroads.

PORT FACILITIES

Berthing

The ASD is a multicargo marine complex comprising a marginal wharf and wide piers. The wharf and piers provide 28 general cargo berths.

Berths 2 through 8 are along the marginal wharf and Berths 2 through 7 provide about 3,540 feet of continuous berthing space. Berths 2 and 5 are open, while Berths 3, 4, and 6 through 8 have 30-foot-wide aprons. Depth alongside the berths is 38 feet at MLW, and deck strength is 1,000 pounds per square foot (psf).

Piers A through D range in length from 570 to 1,610 feet. Apron width varies from 42 feet to open. Depths alongside the piers range from 30 to 41 feet MLW, and deck strength ranges from 500 to 1,500 psf. Pier E is a RORO pier that currently has no apron except for the RORO ramp.

In general, wharf and pier construction consists of concrete pile, beams, and cross-wall-supported concrete decking. The concrete decks, front steel, sheet pile, and bulkheads have concrete-surfaced solid fill. All berths are fronted with a timber fendering system and are well lit for night operations. Gantry and mobile crane assets serve the terminal.

BERTH CHARACTERISTICS FOR ALABAMA STATE DOCKS						
	Berths					
Characteristics	2	3-4	5	6-7	8	A South
Length feet	898	1,006	499	1,138	584	570
Depth alongside at MLW feet	36	36	38	38	33	34
Deck strength psf	1,000	1,000	1,000	1,000	1,000	1,000
Apron width feet	Open	30	Open	30	30	74
Apron height above MLW feet	11	11	11	11	11	11
Number of container cranes	1	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO ramp	No	No	No	No	No	No
Apron length served by rail feet	800	1,000	499	0	0	500
Open storage, acres	22	2.6		2.5		0

BERTH CHARACTERISTICS FOR ALABAMA STATE DOCK S - cont							
Berths							
Characteristics	A1 North	A2-3 North	A Face	B2-3 South	B North	B Face	Blakeley
Length feet	477	1,025	525	1,007	1,610	650	650
Depth alongside at MLW feet	34	35	27	36	40	40	32
Deck strength psf	500	500	500	500	500	500	500
Apron width feet	42	42	100	100	42	Open	100
Apron height above MLW feet	11	11	11	11	11	11	11
Number of container cranes	0	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO ramp	No	No	No	No	No	No	No
Apron length served by rail feet	477	1,000	525	1,000	1,500	0	0
Open storage, acres	0	0	0	1.7			

BERTH CHARACTERISTICS FOR ALABAMA STATE DOCKS - cont							
	Berths						
Characteristics	C South	C Face	C1 North	C2 North	C3 North	D Face	E Face
Length feet	1,532	820	540	463	408	1000	1000
Depth alongside at MLW feet	41	40	40	40	40	40	34
Deck strength psf	500	1,500	500	500	1,500	500	1,000
Apron width feet	80	Open	Open	Open	Open	40	Open
Apron height above MLW feet	11	11	11	11	11	11	11
Number of container cranes	0	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO ramp	No	No	No	No	No	No	No
Apron length served by rail feet	1,500	400	500	463	408	0	0
Open storage, acres	18					13.1	1

SUMMARY OF BERTHING CAPABILITIES FOR ALABAMA STATE DOCKS							
Vessels		Berths					
TYPE	CLASS	2	3-4	5	6-7	8	NOTES:
BREAKBULK	C3-S-38a	1	1	1	2	1	
	C4-S-58a	1	1	c	1	1	
	C4-S-66a	1	1	c	2	1	
	C5-S-37e	1	1	c	1	c	
SEATRAIN	GA and PR	1	1	c	1	1	
BARGE	LASH C8-S-81b	1	1	c	1	c	
	LASH C9-S-81d	1	1	c	1	c	
	LASH Lighter	4	5	2	5	2	
	SEABEE C8-S-82a	1,a,f	1,a,f	a,c,f	1,a,f	a,c,f	
	SEABEE Barge	4	5	2	5	2	
RORO	COMET	1,d,i,j	1,d,o	1,d,i,j	2,d,o	1,i,j	
	METEOR	1,d,i,j	1,d,o	c,d,i,j	2,d,o	1,i,j	
	Cape Nome	1,d,i,j	1,d,o	c,d,i,j	1,d,o	c	
	C7-S-95A	1	1,b	c	1,b	b,c	
	Cape Taylor	1	1,b	c	1,b	b,c	
	Cape Orlando	1,i,j	1,b	c	1,b	b,c	
	MV Ambassador	1,d	1,d	c,d	2,d	1	
	Callaghan	1,d,i	1,d,o	c,d,i	1,d,o	c	
	Cape Lambert	1,i,j	1,b	c	1,b	b,c	
	LMSR Class	1	1,b	c	1,b	b,c	
	FSS	1	1,b	c	1,b	b,c	
	Cape E-Class	1,i,j	1,b	c	1,b	b,c	
	Cape D-Class	1,i,j	1,b	c	1,b	b,c	
	Cape H	1	1,b	c	1,b	b,c	
RORO	Cape Texas	1,i,j	1,b	c	1,b	b,c	
	Cape R	1,d	1,b,d,o	c,d	1,b,d,o	b,c	
	Cape I-class	1,i,j	1,b	c	1,b	b,c	
	Cape Victory	1,i,j	1,b	c	1,b	b,c	
CONTAINER	C6-M-147a	1	1,b,e	c,e	1,b,e	b,c,e	
	C7-S-69c	1	1,b,e	c,e	1,b,e	b,c,e	
	C7-S-68c	1	1,b,e	c,e	1,b,e	b,c,e	
	C8-S-85c	1	1,b,e	c,e	1,b,e	b,c,e	
	C9-M-132b	1	1,b,e	c,e	1,b,e	b,c,e	
	C9-M-F141a	c	1,b,e	c,e	1,b,e	b,c,e	
TACS	C6-S-1qd	1	1,b	c	1,b	b,c	
	C5-S-MA73c	1	1,b	c	1,b	b,c	
	C6-S-MA60d	1	1,b	c	1,b	b,c	
MPS	C7-S-133a	1	1,b	c	1,b	b,c	
	Maersk	1	1,b	c	1,b	b,c	
	AmSea	1	1,b	c	1,b	b,c	

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight-stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on Maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF BERTHING CAPABILITIES FOR ALABAMA STATE DOCKS – cont					
Vessels		Berths			
TYPE	CLASS	A South	A North	A Face	NOTES:
BREAKBULK	C3-S-38a	1	2	1	The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.
	C4-S-58a	c	2	c	
	C4-S-66a	1	2	c	
	C5-S-37e	c	2	c	
SEATRAIN	GA and PR	1	2	c	The letters in the columns to the left indicate limitations as described below.
BARGE	LASH C8-S-81b	c	1	c	
	LASH C9-S-81d	a,c,f	1	c	a-vessel draft limit
	LASH Lighter	2	7	2	b-inadequate apron width
	SEABEE C8-S-82a	a,c,f	1,a,f	a,c,f	c-inadequate berth length
	SEABEE Barge	2	7	2	d-no straight-stern ramp
RORO	COMET	1,i,j	2,d,o	1,d,i,j	e-no container handling equipment
	METEOR	1,i,j	2,d,o	c,d,i,j	f-anchorage depth OK, berth depth inadequate
	Cape Nome	c	2,d,o	c,d,i,j	g-inadequate channel depth
	C7-S-95A	c	1,b	c	h-no shore based ramps
	Cape Taylor	c	2,b	c	i-low tide insufficient ramp clearance
	Cape Orlando	c	2,b	c	j-high tide insufficient ramp clearance
	MV Ambassador	1	2,d	c,d	k-excessive ramp angle low tide
	Callaghan	c	2,d,o	c,d,i	m-excessive ramp angle high tide
	Cape Lambert	c	2,b	c	n-parallel ramp operation ONLY
	LMSR Class	b,c	1,b	c	o-insufficient apron width for side ramp
	FSS	c	1,b	c	Ramp clearance and angle based on maximum vessel draft
	Cape E-Class	c	2,b	c	♦ May Prevent Operation
	Cape D-Class	c	2,b	c	♦ May Limit Operation
	Cape H	c	1,b	c	
	Cape Texas	c	2,b	c	
	Cape R	c	2,b,d	c,d	
	Cape I-class	c	2,b	c	
	Cape Victory	c	2,b	c	
CONTAINER	C6-M-147a	c,e	2,b,e	c,e	
	C7-S-69c	c,e	2,b,e	c,e	
	C7-S-68c	c,e	2,b,e	c,e	
	C8-S-85c	c,e	1,b,e	c,e	
	C9-M-132b	c,e	1,b,e	c,e	
	C9-M-F141a	a,c,e	1,b,e	c,e	
TACS	C6-S-1qd	c	2,b	c	
	C5-S-MA73c	c	2,b	c	
	C6-S-MA60d	c	2,b	c	
MPS	C7-S-133a	c	1,b	c	
	Maersk	c	1,b	c	
	AmSea	c	2,b	c	

SUMMARY OF BERTHING CAPABILITIES FOR ALABAMA STATE DOCKS - cont

Vessels		Berths		
TYPE	**CLASS**	**B2-3 South**	**B North**	**B Face**
BREAKBULK	C3-S-38a	1	3	1
	C4-S-58a	1	2	1
	C4-S-66a	1	2	1
	C5-S-37e	1	2	1
SEATRAIN	GA and PR	1	2	1
BARGE	LASH C8-S-81b	1	1	c
	LASH C9-S-81d	1	1	c
	LASH Lighter	5	8	3
	SEABEE C8-S-82a	1	1	a,c,f
	SEABEE Barge	5	8	3
RORO	COMET	1,d,i,j	3,d,o	1,d,1,i
	METEOR	1,d,i,j	2,d,o	1,d,1,i
	Cape Nome	1,d,i,j	2,d,o	1,d,1,i
	C7-S-95A	1	2,b	c
	Cape Taylor	1	2,b	1
	Cape Orlando	1,i,j	2,b	1,i,j
	MV Ambassador	1,d	2,d	1,d
	Callaghan	1,d,i	2,d,o	c,d,i
	Cape Lambert	1,i,j	2,b	c
	LMSR Class	1	1,b	c
	FSS	1	1,b	c
	Cape E-Class	1,i,j	2,b	c
	Cape D-Class	1,i,j	2,b	c
	Cape H	1	2,b	c
	Cape Texas	1,i,j	2,b	1,i,j
	Cape R	1,d	2,b,d	1,d
	Cape I-class	1,i,j	2,b	c
	Cape Victory	1,i,j	2,b	1,i,j
CONTAINER	C6-M-147a	1,e	2,b,e	c,e
	C7-S-69c	1,e	2,b,e	c,e
	C7-S-68c	1,e	2,b,e	c,e
	C8-S-85c	1,e	1,b,e	c,e
	C9-M-132b	1,e	1,b,e	c,e
	C9-M-F141a	1,e	1,b,e	c,e
TACS	C6-S-1qd	1	2,b	c
	C5-S-MA73c	1	2,b	1
	C6-S-MA60d	1	2,b	c
MPS	C7-S-133a	1	1,b	c
	Maersk	1	2,b	c
	AmSea	1	2,b	c

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight-stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation** (red)

♦ **May Limit Operation** (blue)

SUMMARY OF BERTHING CAPABILITIES FOR ALABAMA STATE DOCKS - cont				
Vessels		Berths		
TYPE	CLASS	C South	C Face	C North
BREAKBULK	C3-S-38a	2	1	2
	C4-S-58a	2	1	2
	C4-S-66a	2	1	2
	C5-S-37e	2	1	2
SEATRAIN	GA and PR	2	1	2
BARGE	LASH C8-S-81b	1	1	1
	LASH C9-S-81d	1	c	1,a,f
	LASH Lighter	7	4	7
	SEABEE C8-S-82a	1	a,c,f	1,a,f
	SEABEE Barge	7	4	7
RORO	COMET	2,d,i,j	1,d,i,j	2,d,i,j
	METEOR	2,d,i,j	1,d,i,j	2,d,i,j
	Cape Nome	2,d,i,j	1,d,i,j	2,d,i,j
	C7-S-95A	2	1	1
	Cape Taylor	2	1	2
	Cape Orlando	2,i,j	1,i,j	2,i,j
	MV Ambassador	2,d	1,d	2,d
	Callaghan	2,d,o	1,d,i	1,d,i
	Cape Lambert	2,i,j	1,i,j	1,i,j
	LMSR Class	1	c	1
	FSS	1	c	1
	Cape E-Class	2,i,j	1,i,j	2,i,j
	Cape D-Class	2,i,j	1,i,j	1,i,j
	Cape H	1	1	1
	Cape Texas	2,i,j	1,i,j	2,i,j
	Cape R	2,d	1,d	2,d
	Cape I-class	2,i,j	1,i,j	1,i,j
	Cape Victory	2,i,j	1,i,j	2,i,j
CONTAINER	C6-M-147a	2,e	1,e	2,e
	C7-S-69c	2,e	1,e	2,e
	C7-S-68c	2,e	1,e	1,e
	C8-S-85c	1,e	c,e	1,e
	C9-M-132b	1,e	c,e	1,e
	C9-M-F141a	1,e	c,e	1,a,e
TACS	C6-S-1qd	2	1	2
	C5-S-MA73c	2	1	2
	C6-S-MA60d	2	1	2
MPS	C7-S-133a	1	c	1
	Maersk	1	1	1
	AmSea	2	1	2

NOTES:

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g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance an angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF BERTHING CAPABILITIES FOR ALABAMA STATE DOCKS - cont					
Vessels		Berths			
TYPE	CLASS	Blakeley	D Face	E Face	NOTES:
BREAKBULK	C3-S-38a	1	1	1	
	C4-S-58a	1	1	1	
	C4-S-66a	1	1	1	
	C5-S-37e	1	1	1	
SEATRAIN	GA and PR	1	1	1	
BARGE	LASH C8-S-81b	c	1	1	
	LASH C9-S-81d	c	1	1	
	LASH Lighter	3	5	5	
	SEABEE C8-S-82a	c	1	1	
	SEABEE Barge	3	5	5	
RORO	COMET	1,d,i,j	1,d,o	1,d,i,j	
	METEOR	1,d,i,j	1,d,o	1,d,i,j	
	Cape Nome	1,d,i,j	1,d,o	1,d,i,j	
	C7-S-95A	c	1,b	1	
	Cape Taylor	1	1,b	1	
	Cape Orlando	1,i,j	1,b	1,i,j	
	MV Ambassador	1,d	1,d	1,d	
	Callaghan	c,d,i	1,d,o	1,d,i	
	Cape Lambert	c	1,b	1,i,j	
	LMSR Class	c	1,b	1	
	FSS	c	1,b	1	
	Cape E-Class	c	1,b	1,i,j	
	Cape D-Class	c	1,b	1,i,j	
	Cape H	c	1,b	1	
	Cape Texas	1,i,j	1,b	1,i,j	
	Cape R	1,d	1,b,d	1,d	
	Cape I-class	c	1,b	1,i,j	
	Cape Victory	1,i,j	1,b	1,i,j	
CONTAINER	C6-M-147a	c,e	1,b,e	1,e	
	C7-S-69c	c,e	1,b,e	1,e	
	C7-S-68c	c,e	1,b,e	1,e	
	C8-S-85c	c,e	1,b,e	1,e	
	C9-M-132b	c,e	1,b,e	1,e	
	C9-M-F141a	c,e	1,b,e	1,e	
TACS	C6-S-1qd	c	1,b	1	
	C5-S-MA73c	1	1,b	1	
	C6-S-MA60d	c	1,b	1	
MPS	C7-S-133a	c	1,b	1	
	Maersk	c	1,b	1	
	AmSea	c	1,b	1	

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

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g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on Maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

STAGING

Open Staging

The Port of Mobile has about 60 acres of open storage, of which 38 acres is paved. One of the single, largest areas is the container marshaling area behind Berths 2 through 7. This area has 22 acres of paved, lit, open storage. The open storage is mainly used for containers, lumber, steel, military equipment, rolling stock, rubber, and general cargo.

At the west end of Pier North C is 142,500 square feet of open area, with lights, that can be used for helicopter operations. The port has also used the northwest corner of the International Trade Center parking lot for helicopter operations. The International Trade Center parking lot was used primarily for ASD officials during sightseeing tours of the port.

Covered Staging

The Port of Mobile has 19 transit sheds/warehouses that provide 2,279,960 square feet of covered storage.

NUMBER OF UNLOADING POSITIONS (NON-CURRENT USE)				
Storage Facility Designation	**Floor Area (sq ft)**	**Trucks**	**Railcars**	**Current Use**
T-shed 3	100,000	6	16	Plywood
T-shed 4	100,000	6	16	Wood pulp
T-shed 6	100,000	8	6	Plywood
T-shed 7	100,000	2	12	Wood pulp
T-shed 8	68,000	6	8	Lumber
Berth 8 warehouse	68,000	6	2	
T-shed A south	120,000	2	7	Wood pulp
A-18 warehouse	69,000	4	4	
Center A warehouse	50,000	4	7	General cargo
T-shed A north	153,000	4	12	Lumber/general cargo
T-shed B south	175,200	4	30	Lumber/general cargo
T-shed B north	280,800	6	44	Lumber/general cargo
T-shed C south	353,600	6	36	Lumber/general cargo
Pier D warehouse	47,560	4	6	
Pier E warehouses	253,800	4	36	
Blakely Island warehouse	153,000	4	0	Lumber/general cargo
Unit 19	38,000	0	0	Lumber

Highway

All commercial trucks report to the ASD Control Terminal that is west of the port. After processing, trucks proceed to the main gate. Prior arrangements with ASD can preclude the need for reporting to the control terminal. The main gate has two entries and two exit lanes and is controlled 24 hours a day. Two other gates, Sealand and St. Anthony Streets, are available on an as-needed basis.

The Port of Mobile has truck scales available at the grain elevator near Pier D and outside the gate at the truck control area. The port uses these scales for weighing shipments of grain. These scales are available for weighing other items if the grain elevator area is not busy.

Rail

An extensive rail network serves the terminal. More than 75 miles of track serve the berths, transit sheds, warehouses, and other port facilities. The port operates its own fleet of 8 diesel engines and 550 boxcars. Railcar switching and movement within the terminal and joint interchange yard are accomplished with ASD Terminal Railway engines. All berths and piers, except Berth 6 through 8, Face A, B, D, E, and Blakeley have apron trackage.

UNLOADING/LOADING POSITIONS

Ramp and Docks

The port has six end ramps available for unloading trucks and tractor-trailer combinations.

All the transit sheds and warehouses, except unit 19, have rear platform-level rail tracks. Because the Port of Mobile is readily able to specialize in handling cargo requiring covered storage, at least 300 to 350 rail loading positions are available for boxcars.

The Port of Mobile reports that about 58 truck docks could be made available at one time for van offloading operations.

Marshaling Areas

Two sites could serve as marshaling areas for the ASD. The Mobile Civic Center, which is about 1 mile from the terminal, has a 13 acre paved, lit, fenced parking lot. Also, the container marshaling yard behind Berths 2 through 5 has a 22 acre paved, lit area within the port.

Materials Handling Equipment (MHE)

The port has about 15 types of cranes to move cargo around the facility. Additional cargo handling resources, including heavy lift equipment, can be readily acquired from any of the stevedoring companies serving the Port of Mobile. Mobile and floating cranes range in capacity from 200 to 500 tons.

MATERIALS HANDLING EQUIPMENT		
Type of Equipment	**Capacity (STON)**	**Quantity**
Container crane	45	1
Wharf crane	45	1
Mobile crane	35	1
Mobile crane	40	1
Mobile crane	60	1
Mobile crane	70	1
Mobile crane	90	1
Mobile crane	100	1
Mobile crane	140	1
Mobile crane	160	1
Floating crane	25	1
Floating crane	80	1
Gantry crane	50	2
Gantry crane	22.5	1
Container lift	35	1
Container lift	40	1
Container lift	46.6	1
Forklift	1.5-35	258

FUTURE DEVELOPMENT

The port plans to lengthen Pier E by 550 feet. They are currently getting soil samples, and work will begin when the soil sampling is completed. Future plans are to place an apron on Pier E when it is needed. Until then, it will be used as a slewable-stern ramp pier.

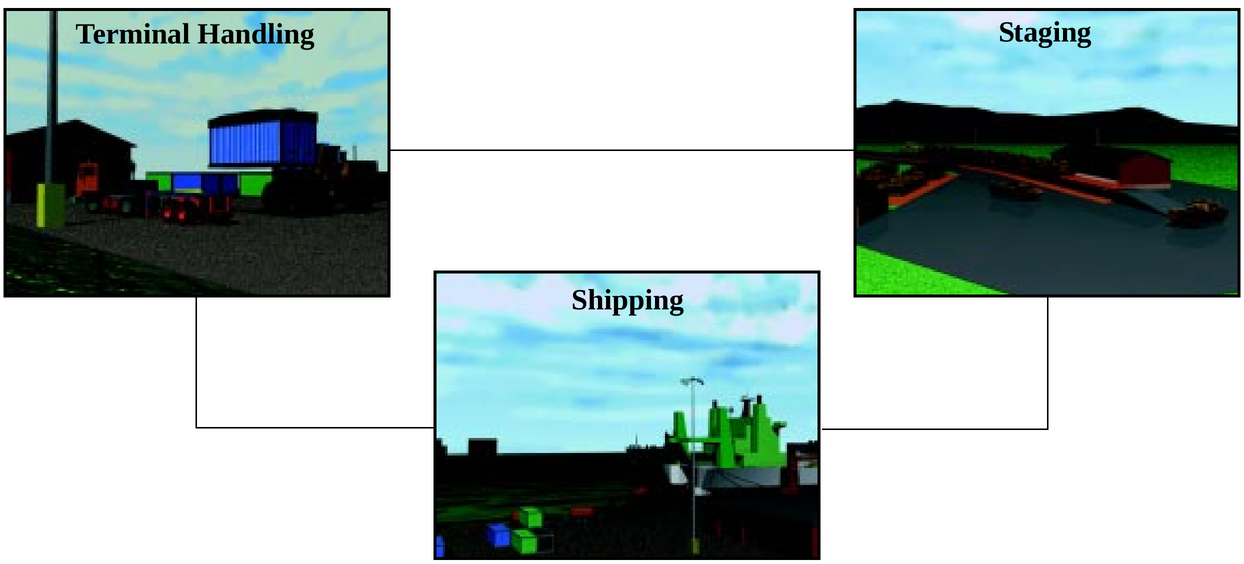
EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

There is no requirement at this time. Traffic has to go through the City of Mobile to get to the port.

III. THROUGHPUT ANALYSIS

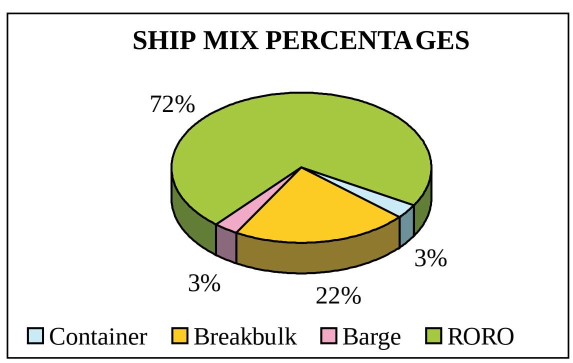
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Mobile, Alabama. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, shiploading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON. Approximate MTON yields can be computed by multiplying the STON amount by three.



Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 80 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.

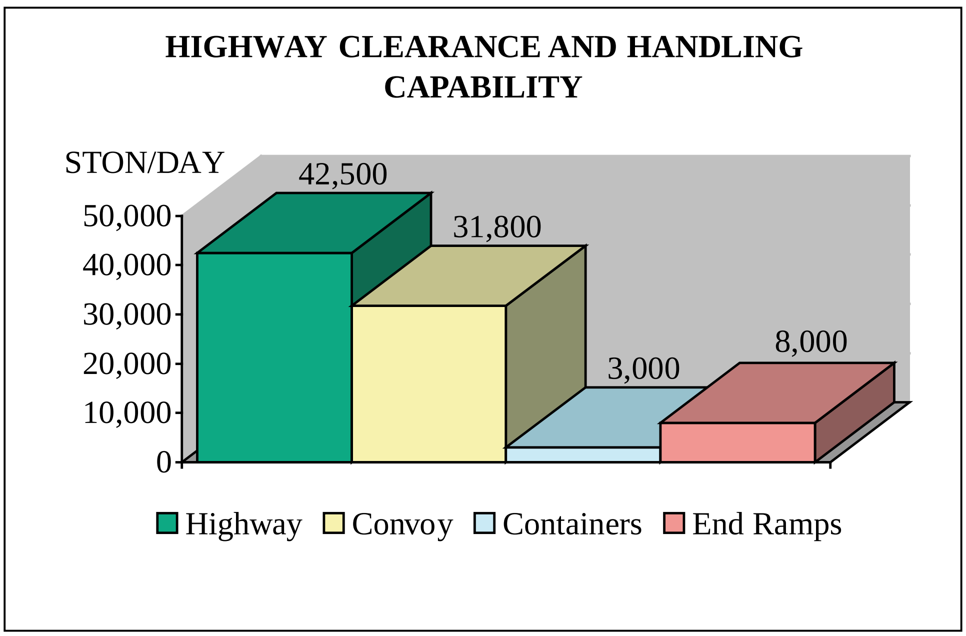


TERMINAL CLEARANCE AND HANDLING

Highway

Interstate Routes 10 and 65, Water and Beauregard Streets all provide good access to the port. Entrance to the port is provided through the main gate off Beauregard Street. Two other gates are available if needed. The port roadways provide access to staging and pier areas from the main gate. The road network in and out of the port, including the gate processing of vehicles, could handle about 42,500 STON of equipment and supplies per day. The highways connecting the port to the interstate go through or close to downtown Mobile. The traffic shares the roads with downtown Mobile traffic, decreasing the port highway throughput during peak hours.

Roadable vehicles in convoys will proceed directly to the staging areas. The port has no end ramps, therefore, the deploying unit or stevedoring company would need to make or supply them to offload vehicles from trailers. Based on the assumption that a deploying unit uses five end ramps, they could be used to offload about 8,000 STON per day. Containers on chassis can move to staging areas or directly to the container loading pier. The container handling facility could off-load 3,000 STON of cargo per day. This would require the chassis to be loaded directly on to the ships since the port does not have any container handling equipment. This capability could be increased if the port/stevedoring company had container handling equipment in the port.

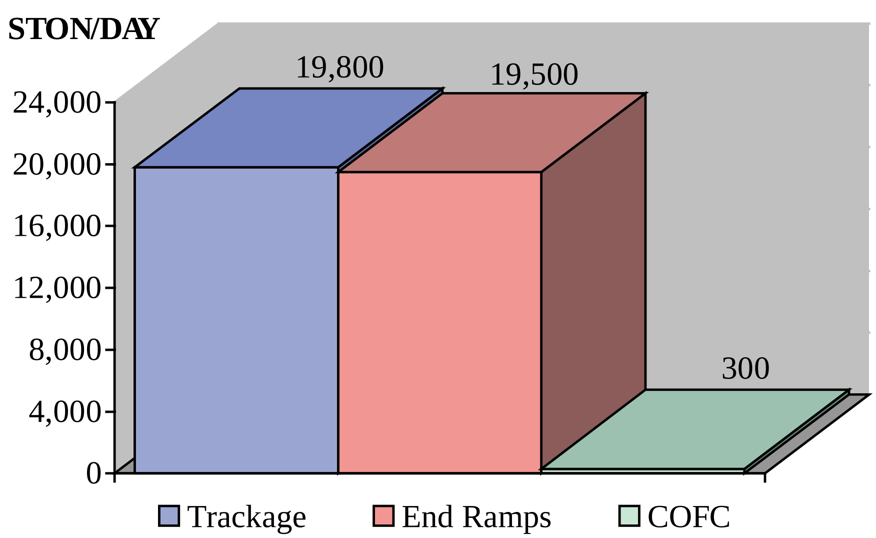


Rail

Rail reception at the port is very good. Four commercial carriers provide access to the port. Railyards within the port could store more than 2,300 railcars. Also, commercial railyards within ½ mile of the port could store more than 5,425 railcars. The port states that they could handle from 60 to 80 railcars per 8-hour period (180 to 240 railcars in a 24-hour period).

Vehicles on flatcars could be offloaded at six locations within the port by using six portable end ramps. The potential location for the use of portable end ramps is on the terminal yard marginal tracks, near Berth North C, and the tracks behind Berth 2. Containers would be offloaded at the container pier directly onto the ship.

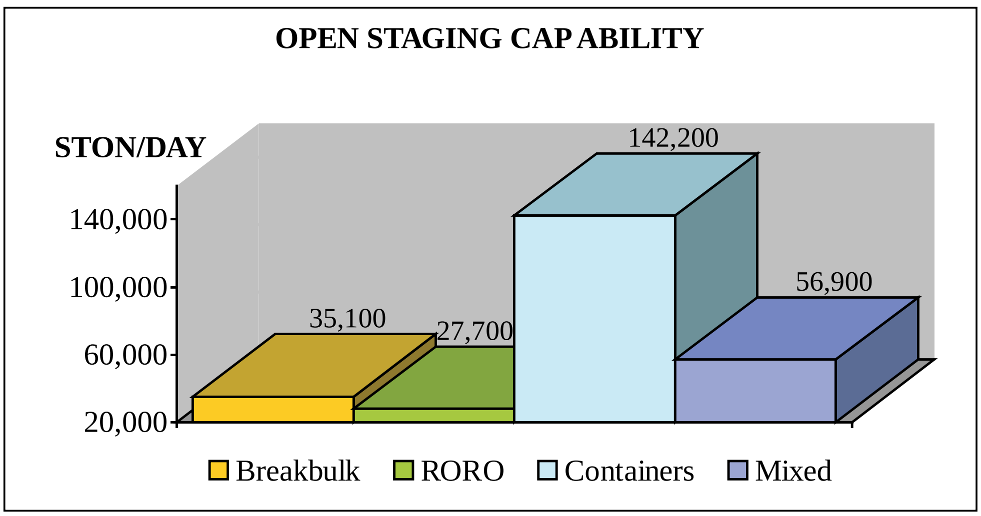
RAIL CLEARANCE AND HANDLING CAPABILITY



Staging

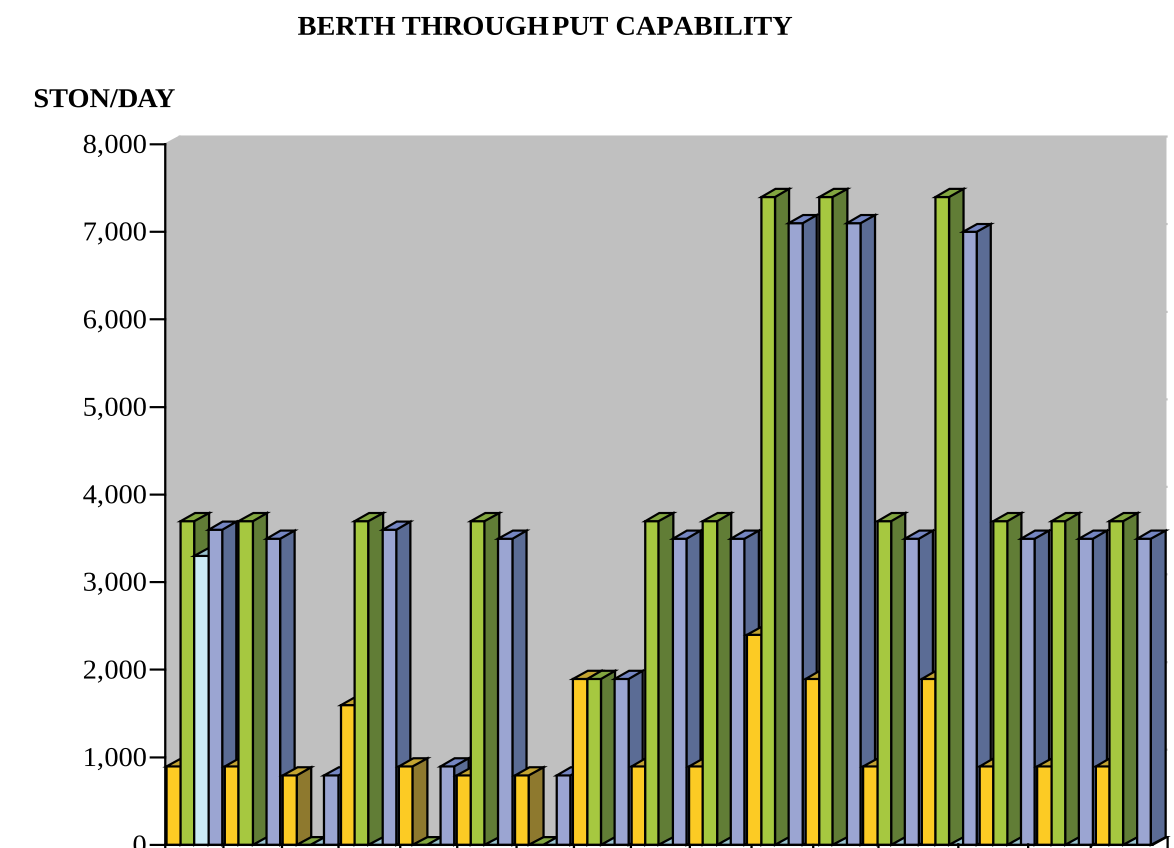
The port has about 60 acres of open storage for vehicles and/or containers. This staging area has a capability to store 35,100 STON of breakbulk cargo, 29,300 STON of RORO, or 146,600 STON of containers. Also, about 2,279,960 square feet of covered storage provides protection for about 40,100 STON of palletized cargo.

OPEN STAGING CAPABILITY (STON)				
	Breakbulk	RORO	Container	Mixed
Berth 2	5,400	4,100	22,500	22,500
Berth 3-4	6,900	5,300	29,100	9,400
Berth 5	1,000	800	4,100	1,100
Berth 6-7	700	500	2,800	700
Berth 8	700	500	2,800	700
A South	400	1,200	1,500	1,200
A Face	100	200	200	200
A North	800	600	2,900	800
B 2-3 South	400	300	1,500	400
B Face	400	300	1,500	400
B North	800	600	2,900	800
C South	3,900	3,000	16,400	4,300
C Face	2,000	1,500	8,100	2,100
C North	3,900	3,000	16,200	4,200
D Face	7,100	5,400	27,400	7,500
E Face	600	400	2,300	600
Blakeley	0	0	0	0
Total	35,100	27,700	142,200	56,900



Shipping

Daily shipping subsystem totals for the terminal berths are compiled in the chart below and the table on the next page. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types.



	Berth 2	Berth 3-4	Berth 5	Berth 6-7	Berth 8	A South	A Face	A North	B Face	B North	C South	C Face	C North	D Face	E Face	Blakeley
Breakbulk	900	900	800	1,600	900	800	800	1,900	900	2,400	1,900	900	1,900	900	900	900
RORO	3,700	3,700	0	3,700	0	3,700	0	1,900	3,700	7,400	7,400	3,700	7,400	3,700	3,700	3,700
Container	3,300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mixed	3,600	3,500	800	3,600	900	3,500	800	1,900	3,500	7,100	7,100	3,500	7,000	3,500	3,500	3,500

DAILY THROUGHPUT SUMMARY

BERTH	LENGTH (feet)	DEPTH ALONGSIDE (feet)	BREAKBULK THROUGHPUT (STON)	RORO THROUGHPUT (STON)	RORO SQUARE FT[1] (EST)	RORO PIECES[2]	CONTAINER THROUGHPUT (STON)	CONTAINER THROUGHPUT (TEU)[3]	MIXED THROUGHPUT (STON)
Berth 2	898	38	900	3,700	74,000	435	3,300	410	3,600
Berth 3-4	1,006	38	900	3,700	74,000	435	0	0	3,500
Berth 5	499	38	800	0	0	0	0	0	800
Berth 6-7	1,138	38	1,600	3,700	74,000	435	0	0	3,600
Berth 8	584	38	900	0	74,000	435	0	0	900
A South	570	37	800	3,700	74,000	435	0	0	3,500
A Face	525	38	800	0	0	0	0	0	800
A North	1,502	38	1,900	1,900	148,000	870	0	0	1,900
B 2-3 South	1,007	41	900	3,700	74,000	435	0	0	3,500
B Face	650	38	900	3,700	74,000	435	0	0	3,500
B North	1,610	40	2,400	3,700	148,000	870	0	0	3,600
C South	1,500	41	1,900	7,400	148,000	870	0	0	7,100
C Face	820	38	900	3,700	74,000	435	0	0	3,500
C North	1,400	37	1,900	7,400	148,000	870	0	0	7,000
D Face	1,000	40	900	0	74,000	435	0	0	900
E Face	1,000	40	900	3,700	74,000	435	0	0	3,500
Blakeley	650	39	900	3,700	74,000	435	0	0	3,500
Total[4]	16,359		20,200	53,700	1,406,000	8,270	3,300	410	54,700

[1]Based on the 20 square foot per STON average accomplished during Operation Deserts Shield/Storm.
[2]Based on the 170 square foot per piece average accomplished during Operation Deserts Shield/Storm.
[3]Based on the 8 STON per TEU average accomplished during Operation Deserts Shield/Storm.
[4]Barge terminal not analyzed.

SUMMARY

The port is multioperational with the capability to handle all types of vessels - container, RORO, breakbulk, and barges.

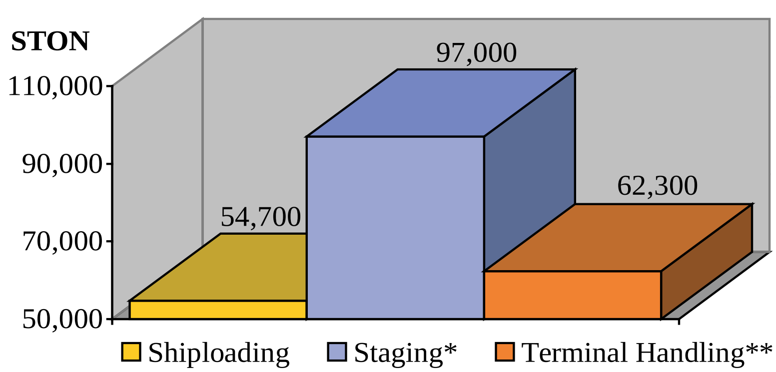
The Port of Mobile is fully capable of supporting U.S. Military cargo transshipment operations. The tidal range of up to 1.5 feet will not limit RORO operations. The port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table. The berth best suited for LMSR and FSS is Berth 2. If Berth E had a deck and not just a rear RORO ramp, this would also be a suitable berth for use. Currently, the side ramp of an FSS or one ramp of an LMSR can use the RORO ramp. Other possible berthing includes: Berth 4-6 could be used with a single ship ramp placed in the opening at Berth 5; the finger piers, B South, C South, and C North if river conditions are favorable.

Of the transportation subsystems analyzed, the least capable is shiploading. The port has a mixed throughput capability of at least 54,700 STON.

The inland water network makes barge transport an effective shipping method. The port connects to this network and provides a third alternative for moving items to and from the port.

Commercial operations taking place concurrently in the port will limit actual daily throughput, sustainable over time, by an appropriate percentage of the terminal's overall capability. If all of the open storage was made available there would be enough open storage to simultaneously load two LMSR or four FSS vessels. However, the best DOD can expect to get is up to 80 percent of available facilities. This would allow us to simultaneously load two LMSR or three FSS vessels.

DAILY CARGO THROUGHPUT CAPACITY

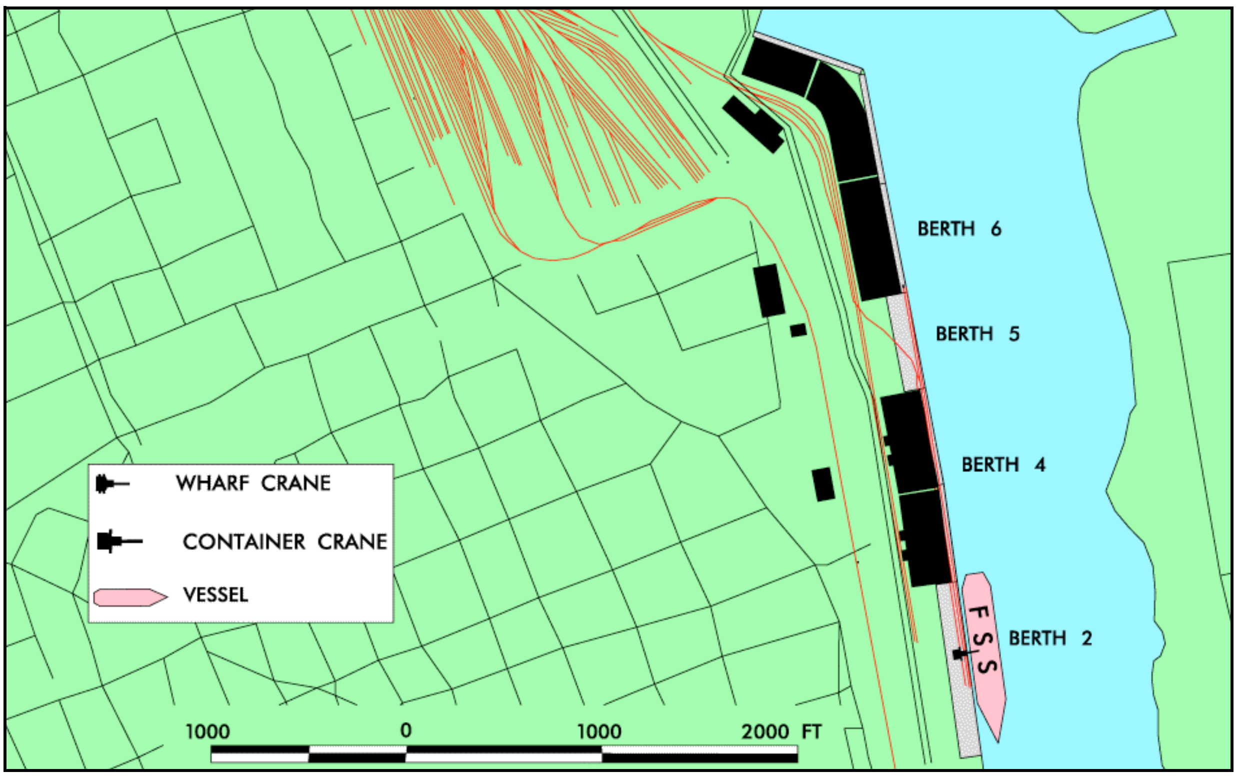


Staging includes open and covered areas.
****Terminal handling is the sum of the highway (42,500 STON) and rail (19,800 STON) limits.***

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored brigade using primarily LMSR and FSS vessels. We also assume that no other military units will be competing for these facilities during the time that the armored brigade occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately load the ship and clear the port. The ***Planning Orders Digest***, issued by MARAD, does not include agreements for military use of the Port of Mobile. This study considers the facilities that would efficiently support military operations in lieu of planning orders.



Potential Port Use During Deployment

REQUIREMENTS

A likely requirement for the Port of Mobile would be to deploy a notional armored brigade in about 6 days of shiploading. The brigade has to move about 1,820 vehicles and 94 containers. Movement of the brigade to the port will require about 259 railcars (90 heavy-duty 68-foot DODX railcars, 52 89-foot flatcars, and 117 60-foot flatcars), using a convoy/rail option for transport to the port. About 16 containers would arrive daily with the unit arriving in 6 days.

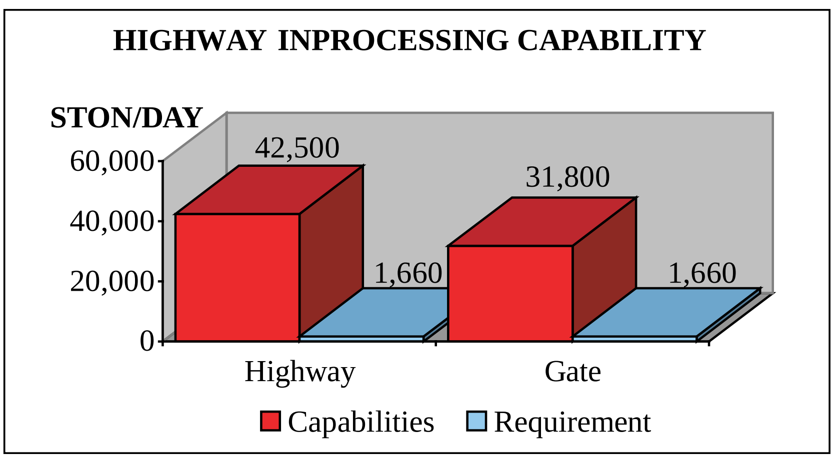
For this application, we assumed a convoy/rail deployment.

TOTAL EQUIPMENT	
Volume	81,600 MTON
Weight	27,970 STON
Area	373,910 SQ FT
Vehicles	1,820
Containers	94
***Note:* MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997**	

TERMINAL INPROCESSING/HANDLING

Highway

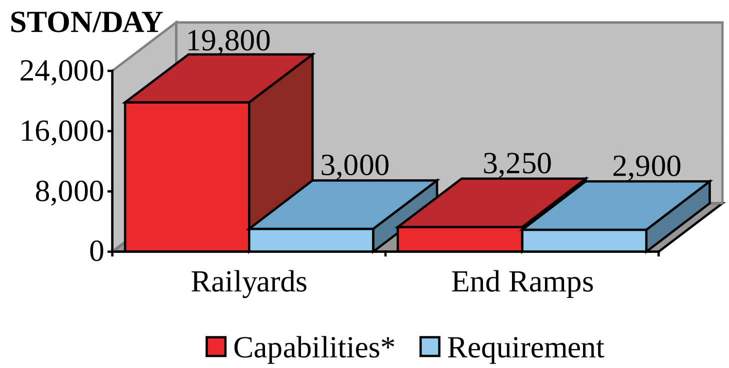
Vehicles would access the port through the main gate. With use of only the main gate, the access roads and gates processing subsystem could handle more than 1,200 vehicles per day.



Rail

The terminal yard within the port could easily handle more than the required 45 railcars per day. Also, one portable end ramp could offload about 45 railcars per day.

RAIL CLEARANCE/HANDLING CAPABILITY

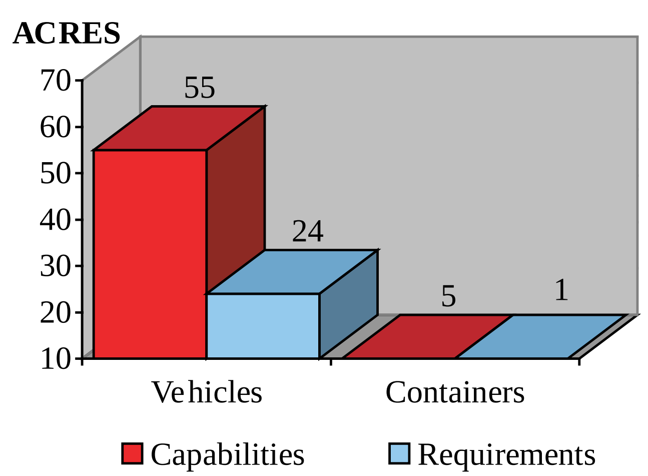


Assumes one portable ramp can be in place in the terminal for offloading railcars. To avoid exceeding the berth rail capability, 6 days are required for the railcars to arrive. Based on MTMCTEA Reference 97-700-5, 560 STON are loaded in 94 containers. The containers arrive in the port on the railcars.

Open Storage

The port has about 60 acres of open staging with 38 acres of open paved storage. The staging area requirement for each LMSR is about 25 acres. Loading one ship at a time will require a total of 25 acres for vehicle and container storage.

OPEN STORAGE CAPABILITY



Shipping

The number of ships needed to load this requirement depends on the shipping mix selected. The best ship mix would require two LMSRs. Berth space at Berth 2 is adequate to allow the side and stern ramps on the LMSR to be used to load the ship. If smaller ships are used to deploy the brigade, then additional time or berths will be required to move the brigade.

SHIP REQUIREMENTS NOTIONAL ARMORED BRIGADE				
Loading Condition/ Sample Ship Mix	**FSS (RORO/ Comb)**	**LMSR (RORO/ Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	2.3			
All LMSR		1.4		
All Breakbulk			7.0	
Maximum Containerization				
FSS/Container	0.8			0.9
LMSR/Container		0.5		0.9
Breakbulk/Container			2.5	0.9
Legend: **RORO – roll on/roll off** **FSS – fast sealift ship** **LMSR – large medium speed roll on/roll off** **Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997**				

Deploying by LMSR requires two ships. The berthing can support up to six LMSRs or FSSs. Based on preliminary LMSR loading results, we estimate the LMSRs will load about 400 STON per hour. Each LMSR will require an average 34.81 hours to load. The number of days required to load the ship is determined by the hours of work per day (20) and factors for sustainment and nighttime operations. Applying these factors, we get the equivalent of 18.43 hours per day. Based on a loading time of 34.81 hours and 18.43 hours per day productive time, it will require an average of 1.89 days to load each LMSR if the load was divided equally between the two ships. The first ships should arrive no earlier than the third day of railcar arrival and begin loading and the last ship arrives in the port as the first ship departs. This requires a total of 7 days to stage and load the ships. The brigade can be loaded using the same berth for both ships.

Deploying by FSS requires three ships, based on an FSS loading time of 250 STON per hour. Each FSS will require an average 37.14 hours to load. The number of days required to load the ship is determined by the number of hours worked per day (20) and factors for sustainment and nighttime operations. By applying these factors, we get the equivalent of 18.43 hours per day. Based on a loading time of 37.14 hours and 18.43 hours per day productive time, it will require 2.01 days to load an FSS. This requires a total of 9 days to stage and load the ships and the first vessel arriving on day 3, the second on day 5, and the last on day 7.

SUMMARY

The Port of Mobile can stage and load a notional armored brigade in about 7 days using only one berth in the port and two LMSR vessels. If FSS vessels are used, 9 days will be required to deploy the unit through the port.

The Port of Mobile is a viable port for supporting deployment of a notional armored brigade provided one berth is available for U.S. Military deployments. The capable berths can support units larger than a brigade, but the available open staging will limit the size of the unit that can deploy through the port at one time. There is enough open staging to support two LMSRs or four FSSs.

RECOMMENDATIONS

1. Designate only one brigade of equipment to deploy through the port at a time.

2. Designate Berth 2 and the open staging behind Berth 2. Other berths could be used with limitations: Berth 4-6 or Berth E, both areas limited to one ramp loading at a time; Berths B South, C South, and C North with favorable river conditions. Ranking for use is Berth 2, C North, C South, Berth 4-6, Berth E, and then Berth B South.

PORT OF NEW ORLEANS
LOUISIANA

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of New Orleans on 20-21 September 1999. The Port of New Orleans is fully capable of supporting U.S. Military cargo transshipment operations, and can accommodate vessels as large as the LMSR. Mississippi River wharves are more than 90 miles above the Head of Passes. The Head of Passes is over 20 miles from the Sea Buoy at Southwest Pass. Wharves reached using the Mississippi Gulf Outlet are about 70 miles from the Sea Buoy.

The port has 24,580 feet of quay and can accommodate vessels as large as the LMSR and FSS. It can load or offload a mixed throughput of at least 111,389 STON per day.

The brigade will require about 25 acres of staging per LMSR for deployment from a port per day. The FSS requires about 16 acres per ship for deployment.

New Orleans is a viable port for supporting deployments of a notional armored brigade provided a berth is available for U.S. Military deployments. A notional armored brigade has a total of 27,970 STON of vehicles and equipment and could be loaded on 1.4 LMSRs in about 4 days of actual shiploading. The brigade will require use of the port for about 7 days. The first 6 for rail and highway arrival and offloading and the last 4 for shiploading. This overlaps rail operations and shiploading on the 3 middle days.

To move an armored brigade, any of the following river terminals' berths could be used: Nashville Avenue A, Nashville Avenue B and C, Napoleon Avenue A and B, or Louisiana Avenue. The river terminals are limited to moving one armored brigade at a time because of the limited number of trains going into the terminals per day.

France Road Terminal Berths 4 and 5 are able to support loading up to two armored brigades at the same time if both berths are available for use. It would be possible to load a single brigade faster if both berths could be made available to load two ships at the same time. If three FSSs are used, 9 days will be required to deploy the unit through the port using one berth. Using two berths to load two FSSs simultaneously, would require 7 days to deploy a brigade through the port.

It will be possible to deploy an armored division through the port and load it in 6 days using Berths 4 and 5 in France Road Terminal and one berth in the river terminals such as Nashville Avenue A. Because of the distances between the terminals it would be like working two ports. Rail traffic into the river terminals will limit the flow and will have to be considered in the planning. The unit moving into the river terminals will require all of the rail assets going into all of the river terminals. Another possibility is to deploy an armored division at France Road Terminal. The loading would be limited to two ships at a time, which would increase the time required to deploy the force to about 9 days.

II. GENERAL DATA

The Port of New Orleans, Louisiana, is a port that could be used by the U.S. Military for shipping military vehicles and equipment to and from CONUS. The port is public-owned, contractor-operated, and capable of handling RORO, container, and breakbulk ships and barges. A team from MTMCTEA conducted a site survey on 20 and 21 September 1999. Information was obtained from the New Orleans Port Officials.

TRANSPORTATION ACCESS

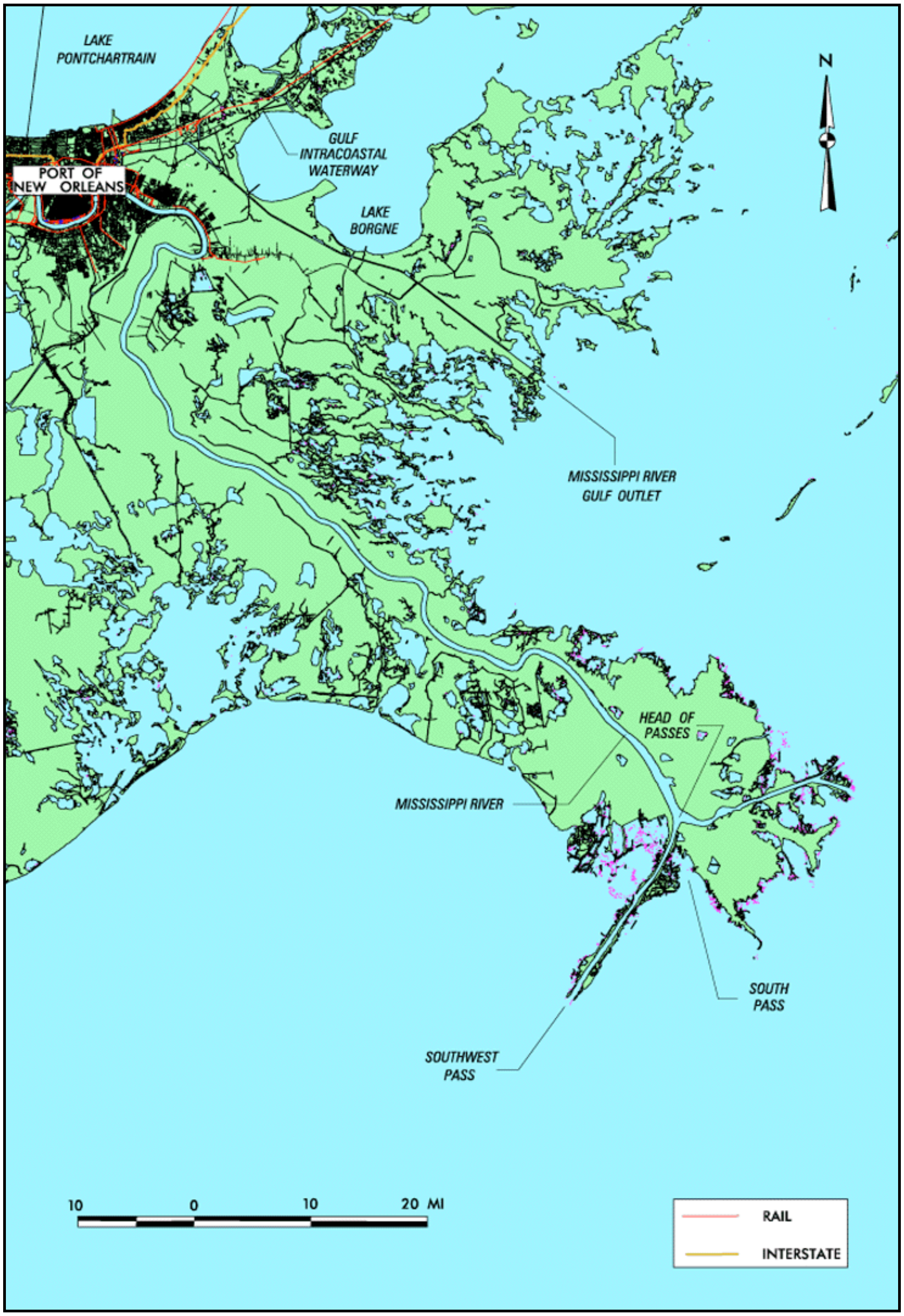
Water

The Port of New Orleans (latitude 29^{o} 57$^{'}$ north, longitude 90^{o} 04$^{''}$ west, (RQNK - GEO location code) time zone GMT -6), Harbor and Terminal District covers the length of the Mississippi from 91.5 miles above Head of Passes (AHP) to 114.9 miles AHP. The Port is in the southwestern part of the state. Vessels entering and leaving the port require pilotage. The Board of Commissioners, Port of New Orleans (Dock Board), controls about 13 miles of wharves that support various cargo types. This report analyzes Henry Clay, Nashville, Napoleon, Louisiana, and Poland Avenues; Harmony, Seventh, First, and Governor Nicholls Streets; and France and Jourdan Roads. The Henry Clay, Nashville, Napoleon, Louisiana, and Poland Avenues; Harmony, Seventh, First, and Governor Nicholls Streets wharves are on the east bank of the Mississippi River. France and Jourdan Roads Terminals are on the Industrial Canal.

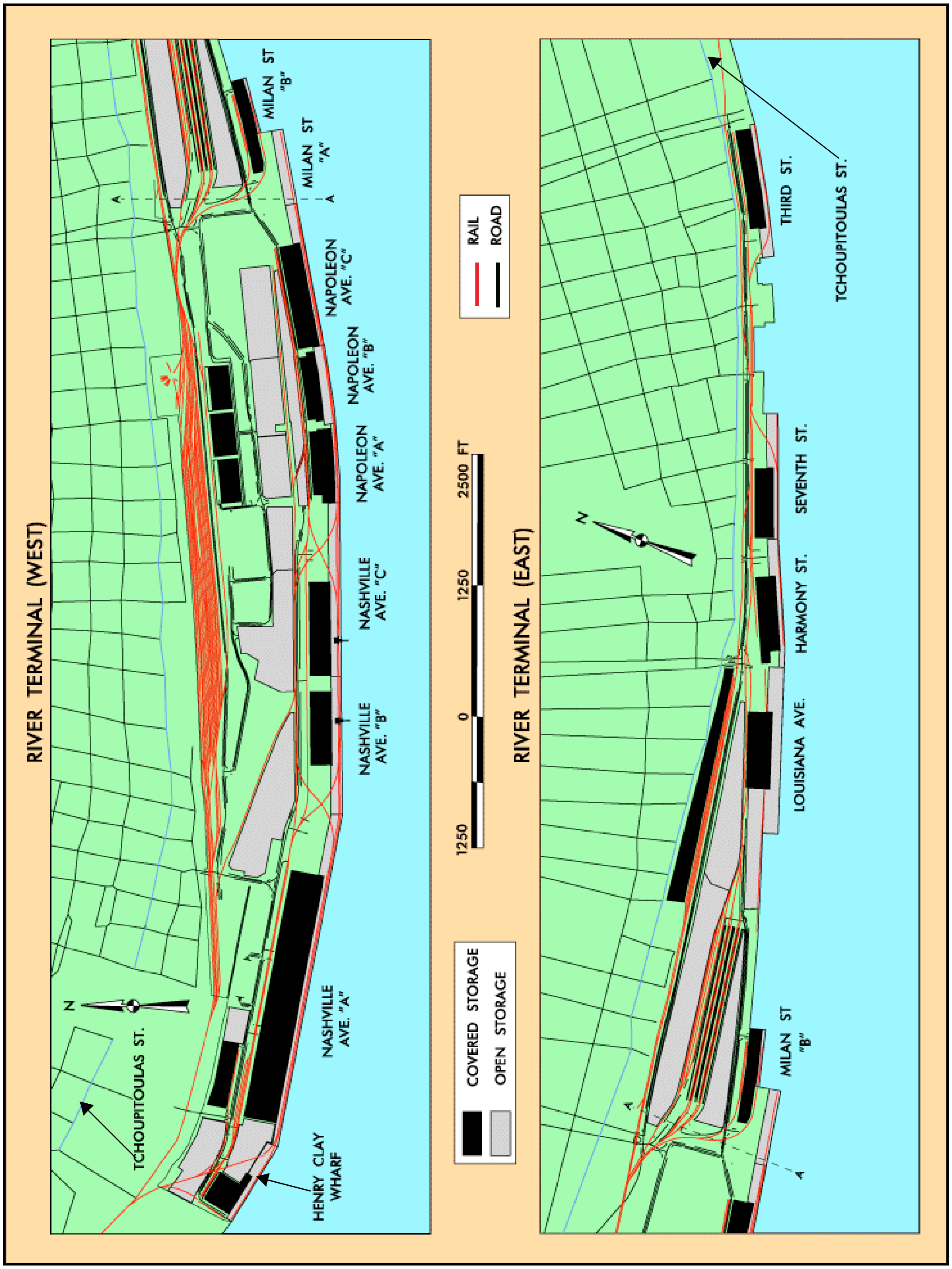
Entrance to the Henry Clay, Nashville, Napoleon, Louisiana, and Poland Avenues; Harmony, Seventh, First, Governor Nicholls, and Alabo Street wharves is by the Southwest Pass and Mississippi River (river terminals). This route from the Gulf of Mexico is at least 45 feet deep and 500 feet wide. A 1,600-foot-wide by 36-foot-deep turning basin is at the confluence of the Mississippi River Gulf Outlet and Industrial Canal.

Access to France and Jourdan Roads Terminals from the Gulf of Mexico is via the Mississippi River Gulf Outlet to the Industrial Canal. This route is maintained at 36 feet deep and 500 feet wide. In spite of their proximity, vessels cannot access the France and Jourdan Roads Terminals from the Mississippi River. This is due to narrow locks between the Industrial Canal and the River. Ships may turn in the Mississippi River near the river wharves.

Three bridges cross downstream of the facilities chosen for analysis. The Greater New Orleans Twin Bridges cross the Mississippi River about 5-1/2 miles below the Henry Clay and Nashville Avenues wharves. Governor Nicholls Street and Poland Avenue wharves are below this bridge. These bridges each have a horizontal clearance of 750 feet and a vertical clearance of 149 feet at mean high water (MHW). The Paris Road Bridge is about 5 miles downstream of France and Jourdan Roads Terminals and crosses the Mississippi River Gulf Outlet. This bridge has a horizontal clearance of 500 feet and a vertical clearance of 137 feet MHW.



Channel Graphic


RIVER TERMINAL (WEST)
MILAN ST "B"
MILAN ST "A"
NAPOLEON AVE. "C"
NAPOLEON AVE. "B"
NAPOLEON AVE. "A"
NASHVILLE AVE. "C"
NASHVILLE AVE. "B"
NASHVILLE AVE. "A"
HENRY CLAY WHARF
TCHOUPITOULAS ST.
N
RAIL
ROAD
2500 FT
1250
0
1250
COVERED STORAGE
OPEN STORAGE
RIVER TERMINAL (EAST)
THIRD ST.
TCHOUPITOULAS ST.
SEVENTH ST.
HARMONY ST.
LOUISIANA AVE.
MILAN ST "B"
N

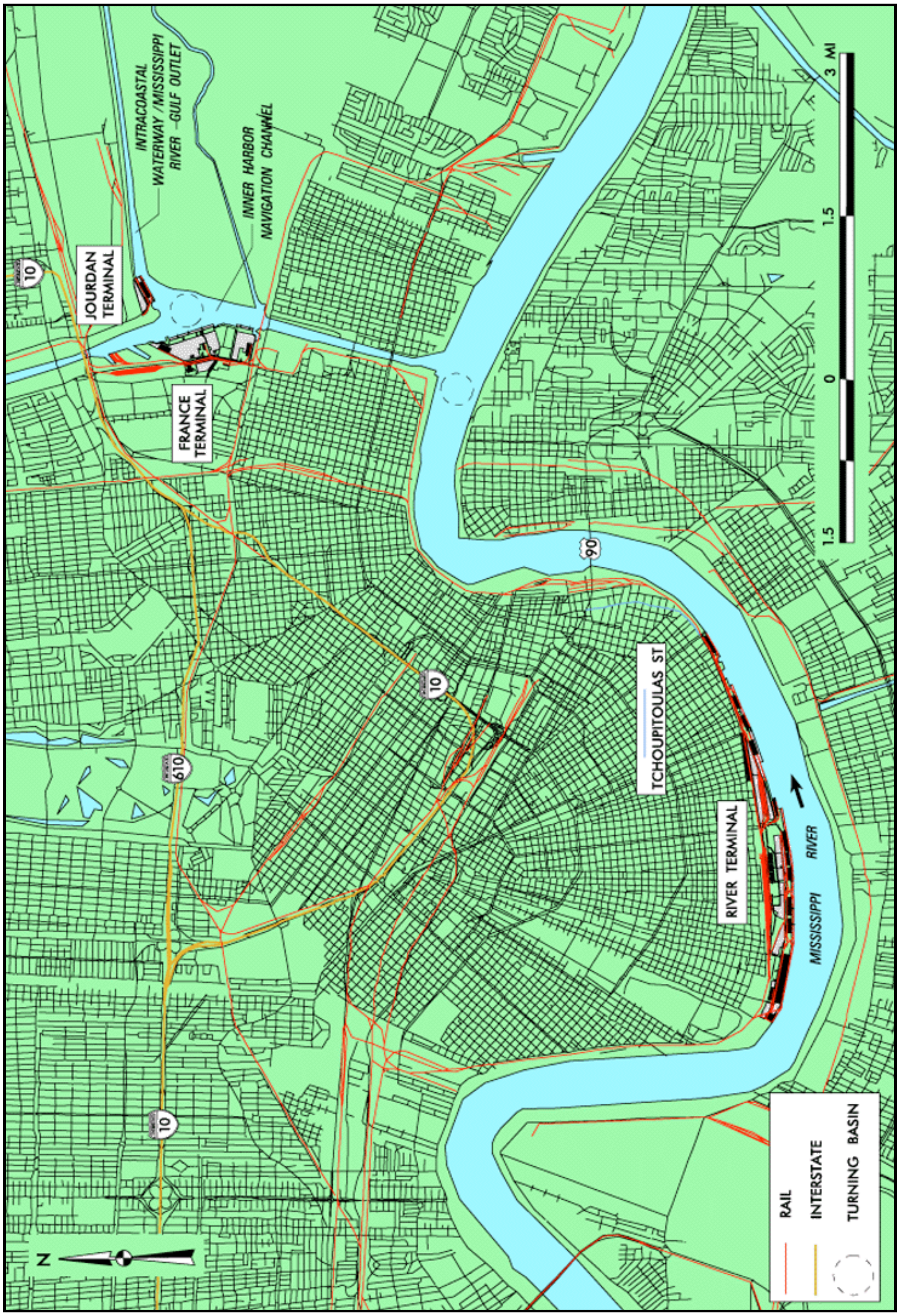
Land-Use Map

The Port of New Orleans connects with the Inland and Intracoastal Waterways in the U.S. to form an effective inland water network. Barge transport can be used to move items too large for unrestricted transport by highway and rail modes. Barges can be used to transport U.S. Military equipment to the port.

Canal and Barge Routes

Highway

An extensive network of highways serves the Port of New Orleans. Interstate Route 10 provides access from the east or west.

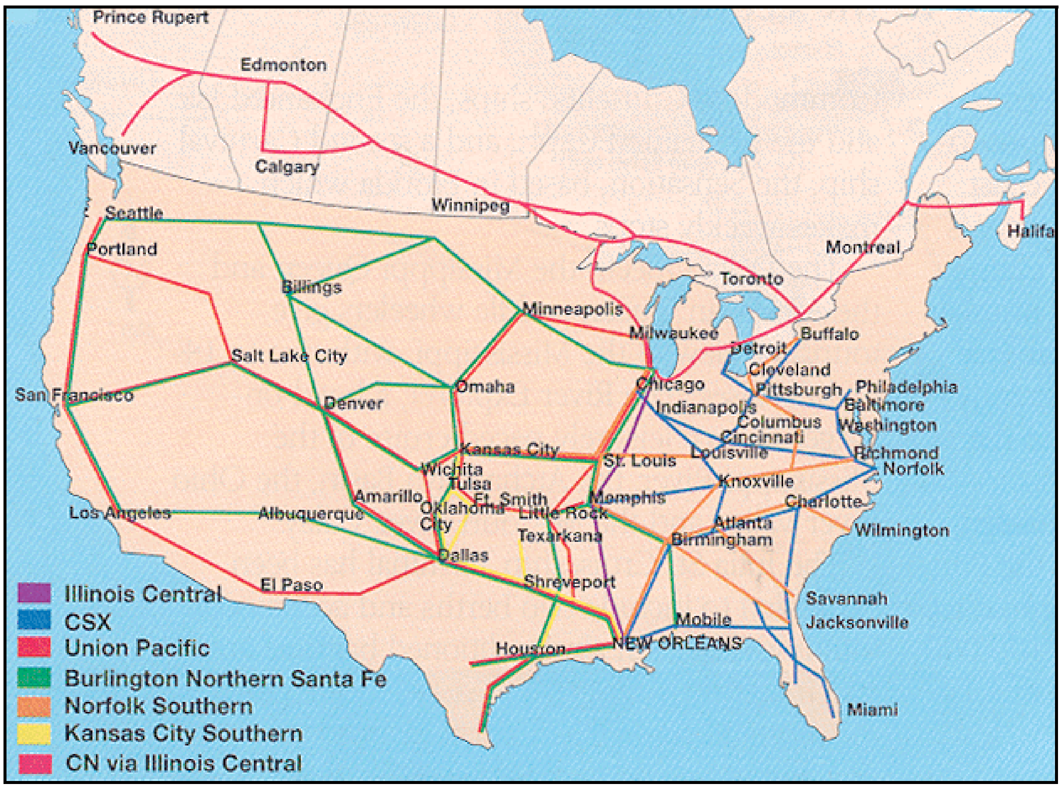


Highway Access Map

Rail

The New Orleans Public Belt Railroad (NOPBR) acts as a switching carrier. The NOPBR serves all public wharves on the Mississippi River and Industrial Canal. NOPBR provides service among the port and six railroads.

Within a 12 mile radius of the port are six regional railyards, ranging in capacity from 900 to 2,000 railcars. The terminal's own rail spurs and sidings provide additional railcar storage. The port is serviced by CSX Transportation, Norfolk Southern, Illinois Central, and Kansas City Southern Railroads on the east bank of the Mississippi and by Union Pacific and Burlington Northern Santa Fe railroads on the west bank of the Mississippi.



Rail Map

Air

Three airports are within a 10 mile radius of the port district of New Orleans. These airports are two commercial fields and one military. The New Orleans International Airport has a runway 9,200 feet long and 150 feet wide. The Lakefront Municipal Airport has a runway 6,700 feet long and 150 feet wide. New Orleans Naval Air Station has a runway 8,000 feet long and 200 feet wide.

PORT FACILITIES

Berthing

The France Road Terminal and Nashville Avenue are equipped to handle containers, while Henry Clay, Napoleon, Louisiana, and Poland Avenues; Harmony, Seventh, First, and Governor Nicholls Streets; and Jourdan Road are multicargo terminals. Pier construction at the terminals is generally concrete-filled steel piles, fronting a sheet-steel bulkhead. Fendering is generally timber. All terminals are lighted for night operations.

BERTH CHARACTERISTICS FOR NEW ORLEANS, LOUISIANA				
Characteristics	**Wharves**			
Terminal	**Henry Clay/Nashville Complex**			
Berth	**Henry Clay**	**Nashville A**	**Nashville B**	**Nashville C**
Length feet	842	2,759	1,785	1,658
Depth alongside at MLW feet	35	35	35	35
Deck strength psf	850	850	1000	1000
Apron width feet	62	62	100	100
Apron height range feet	11	11	11	11
Number of container cranes	0	0	1	1
Number of wharf cranes	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO ramp	No	No	No	No
Apron length served by rail feet	842	2,759	1,785	1,658
Open storage acres	3.9	61.4	61.4	

BERTH CHARACTERISTICS FOR NEW ORLEANS, LOUISIANA - cont		
Characteristics	**Wharves**	
Terminal	**Napoleon Complex**	
Berth	**Napoleon A**	**Napoleon B**
Length feet	759	762
Depth alongside at MLW feet	35	35
Deck strength psf	850	850
Apron width feet	48	108
Apron height range feet	11	11
Number of container cranes	0	0
Number of wharf cranes	0	0
Apron Lighting	Yes	Yes
Straight-stern RORO ramp	No	No
Apron length served by rail feet		
Open storage acres	15.1	13.8

BERTH CHARACTERISTICS FOR NEW ORLEANS, LOUISIANA - cont				
Characteristics	**Wharves**			
Terminal	**Napoleon Ave Milan St Complex**			
Berth	**Napoleon C**	**Napoleon C Lower Open**	**Milan A**	**Milan B**
Length feet	1,000	375	772	1,263
Depth alongside at MLW feet	35	35	35	35
Deck strength psf	350	700	750	700
Apron width feet	43	Open	231	50
Apron height range feet	11	11	11	11
Number of container cranes	0	0	0	0
Number of wharf cranes	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO ramp	No	No	No	No
Apron length served by rail feet	1,000	375	772	1,263
Open storage acres	15	2.7	7.7	

BERTH CHARACTERISTICS FOR NEW ORLEANS, LOUISIANA - cont			
Characteristics	**Wharves**		
Terminal	**Louisiana**		
Berth	**Louisiana**	**Harmony**	**Seventh**
Length feet	1,590	1,231	1,196
Depth alongside at MLW feet	35	35	35
Deck strength psf	750	500	750
Apron width feet	98	49	50
Apron height range feet	11	11	11
Number of container cranes	0	0	0
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO ramp	No	No	No
Apron length served by rail feet	1,590	1,231	1,196
Open storage acres	30.2	2.6	3.1

BERTH CHARACTERISTICS FOR NEW ORLEANS, LOUISIANA - cont				
Characteristics	**Wharves**			
Terminal				
Berth	**First**	**Governor Nicholls**	**Alabo**	**Poland**
Length feet	1,275	1,210	1,313	932
Depth alongside at MLW feet	35	40	35	35
Deck strength psf	750	850	600	500
Apron width feet	50	30	81	35
Apron height range feet	11	11	11	11
Number of container cranes	0	0	0	0
Number of wharf cranes	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO ramp	No	No	No	No
Apron length served by rail feet	1,275	1,210	1,313	932
Open storage acres	2.3	0.9	4.8	2.2

BERTH CHARACTERISTICS FOR NEW ORLEANS, LOUISIANA - cont			
Characteristics	**Wharves**		
Terminal	**France**		**Jourdan**
Berth	**1**	**4 & 5**	**Jourdan**
Length feet	830	2,400	1,400
Depth alongside at MLW feet	30-33	30-33	36
Deck strength psf	750	850	850
Apron width feet	147	Open	70
Apron height range feet	11	11	10
Number of container cranes	2	3	1
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO ramp	No	No	Yes
Apron length served by rail feet	0	0	1,400
Open storage acres	54.7	78	13.6

SUMMARY OF BERTHING CAPABILITIES FOR NEW ORLEANS					
Vessels		**Wharves**			
TYPE	**CLASS**	**Henry Clay**	**Nashville A**	**Nashville B-C**	***NOTES:***
BREAKBULK	C3-S-38a	1	5	6	
	C4-S-58a	1	4	5	The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.
	C4-S-66a	1	4	6	
	C5-S-37e	1	4	5	
SEATRAIN	GA and PR	1	4	5	
BARGE	LASH C8-S-81b	1	3	4	The letters in the columns to the left indicate limitations as described below.
	LASH C9-S-81d	a,c,f	3,a,f	3,a,f	
	LASH Lighter	4	13	17	
	SEABEE C8-S-82a	a,c,f	3,a,f	3,a,f	a-vessel draft limit
	SEABEE Barge	4	13	17	b-inadequate apron width
RORO	COMET	1,d,o	5,d,o	6,d,i,j	c-inadequate berth length
	METEOR	1,d,o	4,d,o	5,d,i,j	d-no straight-stern ramp
	Cape Nome	1,d,o	4,d,o	5,d,i,j	e-no container handling equipment
	C7-S-95A	1	3	4	f-anchorage depth OK, berth depth inadequate
	Cape Taylor	1	4	5	g-inadequate channel depth
	Cape Orlando	1,i,j	4,i,j	5,i,j	h-no shore based ramps
	MV Ambassador	1,d	4,d	6,d	i-low tide insufficient ramp clearance
	Callaghan	1,d,o	3,d,o	4,d,i,j	j-high tide insufficient ramp clearance
	Cape Lambert	1,i,j	3,i,j	4,i,j	k-excessive ramp angle low tide
	LMSR Class	b,c	2,b	3	m-excessive ramp angle high tide
	FSS	a,c	2,a	3,a	n-parallel ramp operation ONLY
	Cape E-Class	1,i,j	4,i,j	5,i,j	o-insufficient apron width for side ramp
	Cape D-Class	1,i,j	3,i,j	4,i,j	Ramp clearance and angle based on maximum vessel draft
	Cape H	1,a	3,a	4,a	♦ May Prevent Operation
RORO	Cape Texas	1,i,j	4,i,j	5,i,j	♦ May Limit Operation
	Cape R	1,d	4,d	5,d	
	Cape I-class	1,i,j	3,i,j	4,i,j	
	Cape Victory	1,i,j	4,i,j	5,i,j	
CONTAINER	C6-M-147a	1,e	4,e	5	
	C7-S-69c	1,e	4,e	4	
	C7-S-68c	1,e	3,e	4	
	C8-S-85c	1,e	3,e	4	
	C9-M-132b	c,e	3,e	3	
	C9-M-F141a	a,c,e	2,a,e	3,a	
TACS	C6-S-1qd	1	3	4	
	C5-S-MA73c	1	4	5	
	C6-S-MA60d	1	3	4	
MPS	C7-S-133a	1	3	4	
	Maersk	1	3	4	
	AmSea	1	3	4	

SUMMARY OF BERTHING CAPABILITIES FOR NEW ORLEANS - cont					
Vessels		Wharves			NOTES:
TYPE	CLASS	Napoleon A-B	Napoleon C	Milian B	
BREAKBULK	C3-S-38a	2	4	2	The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.
	C4-S-58a	2	3	2	
	C4-S-66a	2	3	2	
	C5-S-37e	2	3	2	
SEATRAIN	GA and PR	2	3	2	The letters in the columns to the left indicate limitations as described below.
BARGE	LASH C8-S-81b	1	2	1	
	LASH C9-S-81d	1,a,f	2,a,f	1,a,f	
	LASH Lighter	7	10	6	
	SEABEE C8-S-82a	1,a,f	2,a,f	1,a,f	a-vessel draft limit b-inadequate apron width c-inadequate berth length d-no straight-stern ramp e-no container handling equipment f-anchorage depth OK, berth depth inadequate g-inadequate channel depth h-no shore based ramps i-low tide insufficient ramp clearance j-high tide insufficient ramp clearance k-excessive ramp angle low tide m-excessive ramp angle high tide n-parallel ramp operation ONLY o-insufficient apron width for side ramp Ramp clearance and angle based on maximum vessel draft
	SEABEE Barge	7	10	6	
RORO	COMET	2,d,o	4,d,i,j	2,d,o	
	METEOR	2,d,o	3,d,i,j	2,d,o	
	Cape Nome	2,d,o	3,d,i,j	2,d,o	
	C7-S-95A	2,b	2	1,b	
	Cape Taylor	2,b	3	1,b	
	Cape Orlando	2,b	3,i,j	1,b	
	MV Ambassador	2,d	3,d	2,d	
	Callaghan	2,d,o	2,d,i,j	1,d,o	
	Cape Lambert	2,b	3,i,j	1,b	
	LMSR Class	1,b	2	1,b	
	FSS	1,a,b	2,a	1,a,b	
	Cape E-Class	2,b	3,i,j	1,b	
	Cape D-Class	2,b	3,i,j	1,b	♦ May Prevent Operation
	Cape H	1,a,b	2,a	1,a,b	
	Cape Texas	2,b	3,i,j	1,b	♦ May Limit Operation
	Cape R	2,d	3,d	1,d	
	Cape I-class	2,b	3,i,j	1,b	
	Cape Victory	2,b	3,i,j	1,b	
CONTAINER	C6-M-147a	2,b,e	3,e	1,b,e	
	C7-S-69c	2,b,e	3,e	1,b,e	
	C7-S-68c	2,b,e	3,e	1,b,e	
	C8-S-85c	1,b,e	3,e	1,b,e	
	C9-M-132b	1,b,e	3,e	1,b,e	
	C9-M-F141a	1,a,b,e	2,a,e	1,a,b,e	
TACS	C6-S-1qd	2,b	3	1,b	
	C5-S-MA73c	2,b	3	1,b	
	C6-S-MA60d	2,b	3	1,b	
MPS	C7-S-133a	1,b	2	1,b	
	Maersk	1,b	2	1,b	
	AmSea	2,b	3	1,b	

SUMMARY OF BERTHING CAPABILITIES FOR NEW ORLEANS - cont

Vessels		Wharves		
TYPE	**CLASS**	**Louisiana**	**Harmony**	**Seventh**
BREAKBULK	C3-S-38a	3	4	2
	C4-S-58a	2	4	2
	C4-S-66a	2	4	2
	C5-S-37e	2	3	1
SEATRAIN	GA and PR	2	4	2
BARGE	LASH C8-S-81b	1	2	1
	LASH C9-S-81d	1,a,f	2,a,f	1,a,f
	LASH Lighter	7	12	5
	SEABEE C8-S-82a	1,a,f	2,a,f	1,a,f
	SEABEE Barge	7	12	5
RORO	COMET	3,d,i,j	4,d,o	2,d,o
	METEOR	2,d,i,j	4,d,o	2,d,o
	Cape Nome	2,d,i,j	3,d,o	1,d,o
	C7-S-95A	2	3,b	1,b
	Cape Taylor	2	3,b	1,b
	Cape Orlando	2,i,j	3,b	1,b
	MV Ambassador	2,d	4,d	2,d
	Callaghan	2,d,i,j	3,d,o	1,d,o
	Cape Lambert	2,i,j	3,b	1,b
	LMSR Class	1	2,b	1,b
	FSS	1,a	2,a,b	1,a,b
	Cape E-Class	2,i,j	3,b	1,b
	Cape D-Class	2,i,j	3,b	1,b
	Cape H	2,a	3,a,b	1,a,b
	Cape Texas	2,i,j	3,b	1,b
	Cape R	2,d	3,d	
	Cape I-class	2,i,j	3,b	1,b
	Cape Victory	2,i,j	3,b	1,b
CONTAINER	C6-M-147a	2,e	3,b,e	1,b,e
	C7-S-69c	2,e	3,b,e	1,b,e
	C7-S-68c	2,e	3,b,e	1,b,e
	C8-S-85c	1,e	2,b,e	1,b,e
	C9-M-132b	1,e	2,b,e	1,b,e
	C9-M-F141a	1,a,e	2,a,b,e	1,b,e
TACS	C6-S-1qd	2	3,b	1,b
	C5-S-MA73c	2	3,b	1,b
	C6-S-MA60d	2	3,b	1,b
MPS	C7-S-133a	1	2,b	1,b
	Maersk	2	3,b	1,b
	AmSea	2	3,b	1,b

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight-stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF BERTHING CAPABILITIES FOR NEW ORLEANS - cont				
Vessels		Wharves		
TYPE	CLASS	First	Governor Nicholls	Alabo
BREAKBULK	C3-S-38a	2	2	2
	C4-S-58a	2	2	2
	C4-S-66a	2	2	2
	C5-S-37e	2	1	2
SEATRAIN	GA and PR	2	2	2
BARGE	LASH C8-S-81b	1	1	1
	LASH C9-S-81d	1,a,f	1	1,a,f
	LASH Lighter	6	6	6
	SEABEE C8-S-82a	1,a,f	1	1,a,f
	SEABEE Barge	6	6	6
RORO	COMET	2,d,o	2,d,o	2,d,i,j
	METEOR	2,d,o	2,d,o	2,d,i,j
	Cape Nome	1,d,o	1,d,o	2,d,i,j
	C7-S-95A	1,b	1,b	1
	Cape Taylor	1,b	1,b	1
	Cape Orlando	1,b	1,b	1,i,j
	MV Ambassador	2,d	2,d	2,d
	Callaghan	1,d,o	1,d,o	1,d,o
	Cape Lambert	1,b	1,b	2,d,i,j
	LMSR Class	1,b	1,b	1
	FSS	1,a,b	1,b	1,a
	Cape E-Class	1,b	1,b	1,i,j
	Cape D-Class	1,b	1,b	1,i,j
	Cape H	1,a,b	1,b	1,a
	Cape Texas	1,b	1,b	1,i,j
	Cape R	1,d	1,b,d,o	1,d
	Cape I-class	1,b	1,b	1,i,j
	Cape Victory	1,b	1,b	1,i,j
CONTAINER	C6-M-147a	1,b,e	1,b,e	1,e
	C7-S-69c	1,b,e	1,b,e	1,e
	C7-S-68c	1,b,e	1,b,e	1,e
	C8-S-85c	1,b,e	1,b,e	1,e
	C9-M-132b	1,b,e	1,b,e	1,e
	C9-M-F141a	1,a,b,e	1,b,e	1,a,e
TACS	C6-S-1qd	1,b	1,b	1
	C5-S-MA73c	2,b	1,b	2
	C6-S-MA60d	1,b	1,b	1
MPS	C7-S-133a	1,b	1,b	1
	Maersk	1,b	1,b	1
	AmSea	1,b	1,b	1

NOTES:

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The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight-stern ramp
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g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF BERTHING CAPABILITIES FOR NEW ORLEANS - cont			
Vessels		Wharves	
TYPE	CLASS	France 1	France 4-5
BREAKBULK	C3-S-38a	1	4
	C4-S-58a	1	4
	C4-S-66a	1,a	4,a
	C5-S-37e	1	3
SEATRAIN	GA and PR	1	4
BARGE	LASH C8-S-81b	1,a,f	2,a,f
	LASH C9-S-81d	a,c,g	2,a,g
	LASH Lighter	4	12
	SEABEE C8-S-82a	a,c,g	2,a,g
	SEABEE Barge	4	12
RORO	COMET	1,d,i,j	1,i,j
	METEOR	1,d,i,j	1,i,j
	Cape Nome	1,a,d,i,j	1,a,i,j
	C7-S-95A	1,a	3,a
	Cape Taylor	1	3
	Cape Orlando	1,i,j	3,i,j
	MV Ambassador	1,d	1
	Callaghan	1,d,i,j	1,i,j
	Cape Lambert	1,i,j	3,i,j
	LMSR Class	a,c	2,a
	FSS	a,c,g	2,a,g
	Cape E-Class	1,i,j	3,i,j
	Cape D-Class	1,a	3,a
	Cape H	1,a	3,a
	Cape Texas	1,i,j	3,i,j
	Cape R	1,a,d	1,a
	Cape I-class	1,i,j	3,i,j
	Cape Victory	1,i,j	3,i,j
CONTAINER	C6-M-147a	1	3
	C7-S-69c	1	3
	C7-S-68c	1	3
	C8-S-85c	1,a	2,a
	C9-M-132b	a,c	2,a
	C9-M-F141a	a,c,g	2,a,g
TACS	C6-S-1qd	1	3
	C5-S-MA73c	1	3
	C6-S-MA60d	1	3
MPS	C7-S-133a	1,a	2,a
	Maersk	1,a	2,a
	AmSea	1	3

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight-stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF BERTHING CAPABILITIES FOR NEW ORLEANS - cont			
Vessels		Wharves	
TYPE	CLASS	Poland	Jourdan
BREAKBULK	C3-S-38a	1	2
	C4-S-58a	1	2
	C4-S-66a	1	2
	C5-S-37e	1	2
SEATRAIN	GA and PR	1	2
BARGE	LASH C8-S-81b	1	1
	LASH C9-S-81d	1,a,f	1,a,g
	LASH Lighter	4	7
	SEABEE C8-S-82a	1,a,f	1,a,g
	SEABEE Barge	4	7
RORO	COMET	1,d,o	2,i,j
	METEOR	1,d,o	2,i,j
	Cape Nome	1,d,o	2,i,j
	C7-S-95A	1,b	1
	Cape Taylor	1,b	2
	Cape Orlando	1,b	2,i,j
	MV Ambassador	1,d	2
	Callaghan	1,d,o	1
	Cape Lambert	1,b	1,i,j
	LMSR Class	b,c	1,b
	FSS	a,b,c	1,a,g
	Cape E-Class	1,b	2,i,j
	Cape D-Class	1,b	1,i,j
	Cape H	1,a,b	1
	Cape Texas	1,b	2,i,j
	Cape R	1,b,d	2
	Cape I-class	1,b	1,i,j
	Cape Victory	1,b	2,i,j
CONTAINER	C6-M-147a	1,b,e	2
	C7-S-69c	1,b,e	2
	C7-S-68c	1,b,e	1
	C8-S-85c	1,b,e	1
	C9-M-132b	1,b,e	1
	C9-M-F141a	a,b,c,e	1,a,g
TACS	C6-S-1qd	1,b	2
	C5-S-MA73c	1,b	2
	C6-S-MA60d	1,b	2
MPS	C7-S-133a	1,b	1
	Maersk	1,b	1
	AmSea	1,b	2

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight-stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

STAGING

Open Staging

The 20 berths in this report have about 370 acres of open staging, which are paved. France Road Terminal has the largest area of open staging. Helicopters can land in the open area of the France Road Terminal, or inland of the Jourdan Road Terminal transit shed. Nashville, Napoleon, and Louisiana Avenues Terminals have open areas that could be used for helicopter operations.

Covered Staging

Nineteen sheds provide about 3,258,730 square feet of covered storage. The river terminals have the most covered storage.

NUMBER OF UNLOADING POSITIONS (NON-CURRENT USE)		
Storage Facility Designation	**Floor Area (sq ft)**	**Current Use**
Henry Clay Avenue	95,000	Palletized, containerized, and breakbulk cargoes
Nashville Avenue A	756,000	Palletized, containerized, and breakbulk cargoes
Nashville Avenue B	141,000	Palletized, containerized, and breakbulk cargoes
Nashville Avenue C	179,500	Palletized, containerized, and breakbulk cargoes
Napoleon Avenue A	144,876	Palletized, containerized, and breakbulk cargoes
Napoleon Avenue B	307,015	Palletized and breakbulk cargoes
Napoleon Avenue C	199,859	steel and breakbulk cargoes
Milan Street	107,081	steel, containerized, and breakbulk cargoes
Louisiana Avenue	178,360	Palletized, containerized, and breakbulk cargoes
Harmony Street	125,653	steel cargoes
Seventh Street	119,280	steel, palletized, and breakbulk cargoes
First Street	140,655	Palletized, containerized, and breakbulk cargoes
Governor Nicholls Street	156,617	Palletized, containerized, and breakbulk cargoes
Poland Avenue	84,328	Palletized, containerized, and breakbulk cargoes
France Road 1	67,019	Containerized cargoes
France Road 5	131,200	Containerized and breakbulk cargoes
Jourdan Road	142,400	Palletized, containerized, and breakbulk cargoes
Alabo Street	182,880	Palletized, containerized, and breakbulk cargoes

Highway

The France Road Terminal has two truck scales at Berths 1 and 5, respectively.

Rail

The rail trackage links the railyards to the port's storage yards, transit sheds, and apron tracks. Apron tracks are located on the river terminals and Jourdan Road Terminal. Also, the port railyards can hold 1,800 railcars.

UNLOADING/LOADING POSITIONS

Ramps and Docks

There are no fixed end ramps and docks in the port area; however, numerous locations are available for the construction of temporary ramps. Two portable end ramps are available, which can support the loading of flatcars or flatbed trailers.

All sheds have truck-handling positions. Tracks and fences limit truck access to only one side on some sheds.

The terminals have two parallel railcar-level tracks along the inland side of their sheds. A total of 154 boxcars can be handled if placed on both tracks.

Marshaling Areas

Onsite marshaling areas are in Nashville Avenue and France Road Terminals.

The New Orleans area is highly developed, but has no offsite areas that are readily available for marshaling.

Materials Handling Equipment (MHE)

The Jourdan Road Terminal has a 30-ton container crane and France Road Terminal has five container cranes. Other MHE is available from local stevedore and rental companies. Nashville Avenue B and C wharves have two 40/70-ton multipurpose gantry cranes.

MATERIALS HANDLING EQUIPMENT		
Rental Equipment Available		
Type of Equipment	**Capacity (tons)**	**Quantity**
Mobile Cranes	10	1
	15*	2
	25	1
	35	1
	40	1
Barge Cranes	15	5
	35	1
	40	3
	60	1
	75	1
	80	4
	135	3
Forklifts	various	Over 100
***One is owned by the Port Authority**		

FUTURE DEVELOPMENT

The Corp of Engineers is planning to replace the locks between the Mississippi River and the Intracoastal Waterway. The new lock location will be north of the existing lock on the canal further from the river. The final plans on the size and depth have not been determined.

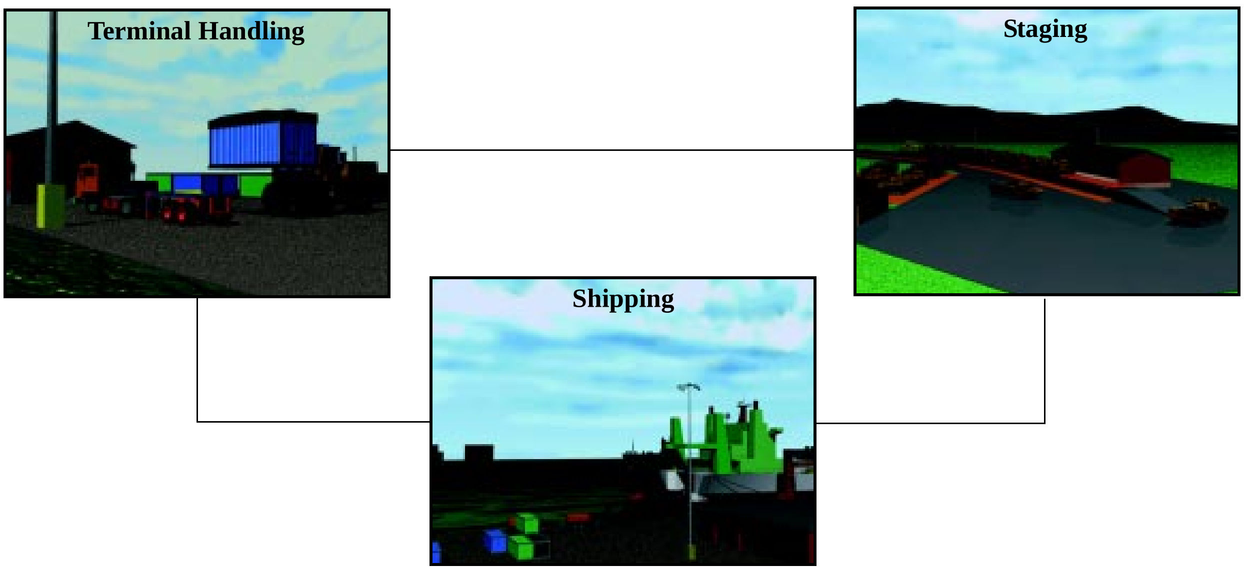
EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

There is no requirement at this time. Traffic has to go through the city of New Orleans to get to the port. Containerized explosives have been shipped through the Port of New Orleans.

III. THROUGHPUT ANALYSIS

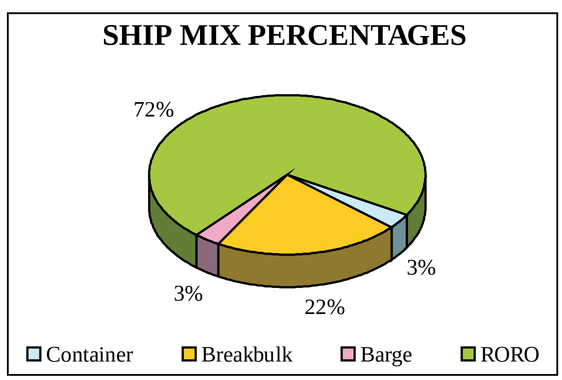
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of New Orleans. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON. Approximate MTON yields can be computed by multiplying the STON amount by three.



Terminal Throughput Subsystems

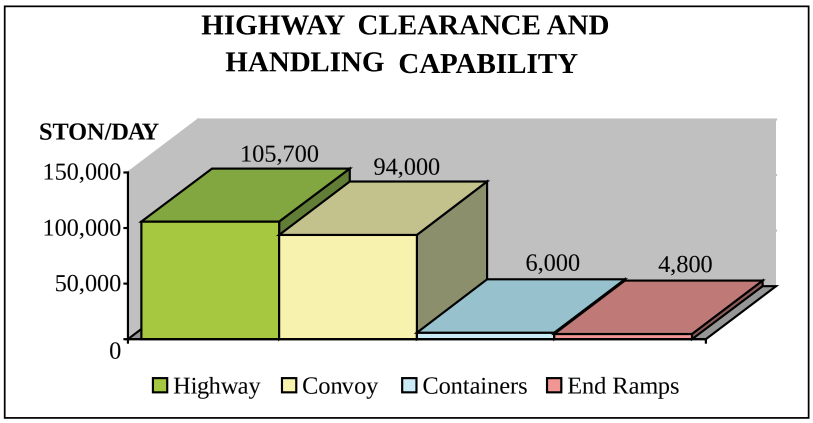
Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 80 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

Highway

Interstate 10 provides access to the Port of New Orleans. Access to Henry Clay, Nashville, Napoleon, and Louisiana Avenues; Harmony, Seventh, and First Streets Berths is by Tchoupitoulas Street to the port's internal Clarence Henry Truckway. Access to Governor Nicholls Street Wharf is by Elysian Fields Avenue. Access to Poland Avenue Wharf is by Poland Avenue. Access to Alabo Street Wharf is by Alabo Street. Access to the France Road Terminal is by France Road. Access to the Jourdan Terminal is by Jourdan Road. Nashville Avenue has one gate with two lanes providing access to the berths. Three gates provide access to France Road Terminal. The road network into and out of the terminals, including the gate processing of vehicles, could handle at least 105,700 STON of equipment and supplies per day.



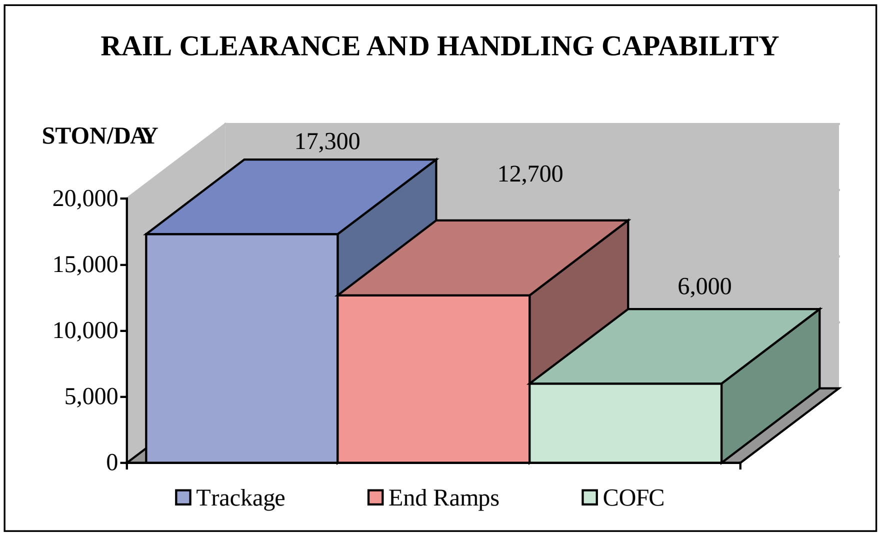
Roadable vehicles will move through the terminal gates in manageable convoys to staging areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a means for unloading vehicles, must use portable ramps. For this study, we assumed four portable ramps would be used for unloading operations, two in France Road Terminal and one in each of the others. These ramps can handle 6,400 STON of military vehicles and equipment per day.

Containers on chassis will move to the staging areas to be offloaded by cranes. We assumed four container handlers would be available to load/unload containers, two in France Road Terminal and one in each of the others and could offload about 6,000 STON of cargo from the chassis per day.

HIGHWAY CLEARANCE AND HANDLING CAPABILITY (STON)				
	Highway	**Convoy**	**Container****	**End Ramps**
River terminals	42,200	36,700	1,500	1,600
France	34,800	33,200	3,000	1,600
Jourdan	28,700	24,100	1,500	1,600
Total*	105,700	94,000	6,000	4,800

***Assumes three portable end ramps will be built to load the lowboy semitrailers.**
****Assumes four container handlers are available to load containers on chassises.**

Rail



Rail reception at all the terminals is good, with six major railroad companies accessing the New Orleans area. NOPBR-owned railyards at or near the terminals can hold about 1,800 railcars. The NOPBR serves all public wharves on the Mississippi River and Industrial Canal providing service between the railroads and the port and railroads. Current rail service is shown in the table below. These trains can handle a mixed load of at least 17,300 STON per day.

Vehicles on flatcars could be offloaded using four portable end ramps. Containers could be off-loaded with a container handler at each terminal. We assumed four container handlers would be available to load/unload containers, two in France Road Terminal and one in each of the others and could offload about 6,000 STON of cargo from the chassis per day.

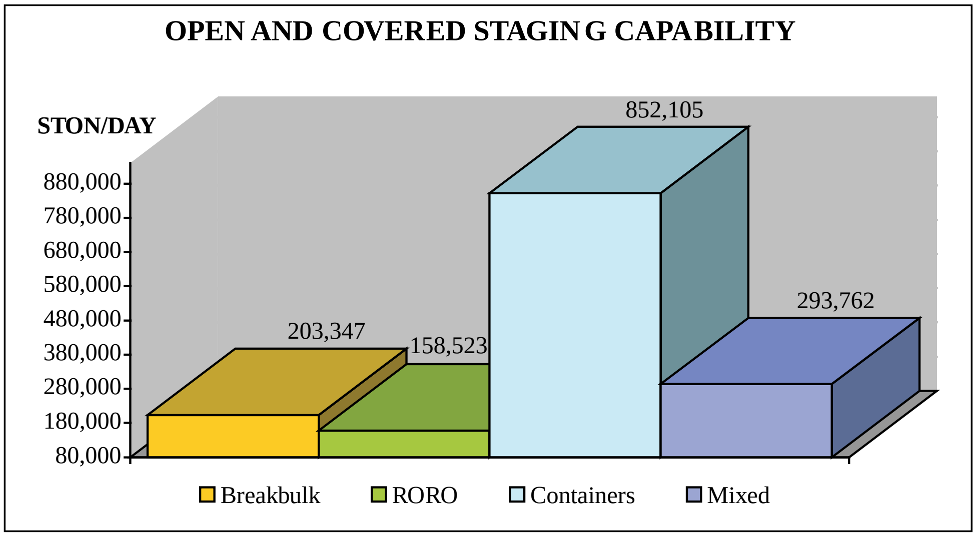
CURRENT RAIL SERVICE CAPACITY			
	Trains/Day	**Railcars/Train**	**Railcar Storage**
River	2	50	20
France	3	80	5/10
Jourdan	1	75	9

RAILCAR CLEARANCE AND HANDLING CAPABILITY (STON)			
	Track	**End Ramp**	**COFC***
River	3,100	3,200	1,500
France	12,000	6,300	3,000
Jourdan	2,200	3,200	1,500
Total	17,300	12,700	6,000
Assumes four container handlers are available to load containers onto railcars.			

Staging

The 20 berths analyzed have about 370 acres of open staging, with 3,258,730 square feet of covered storage.

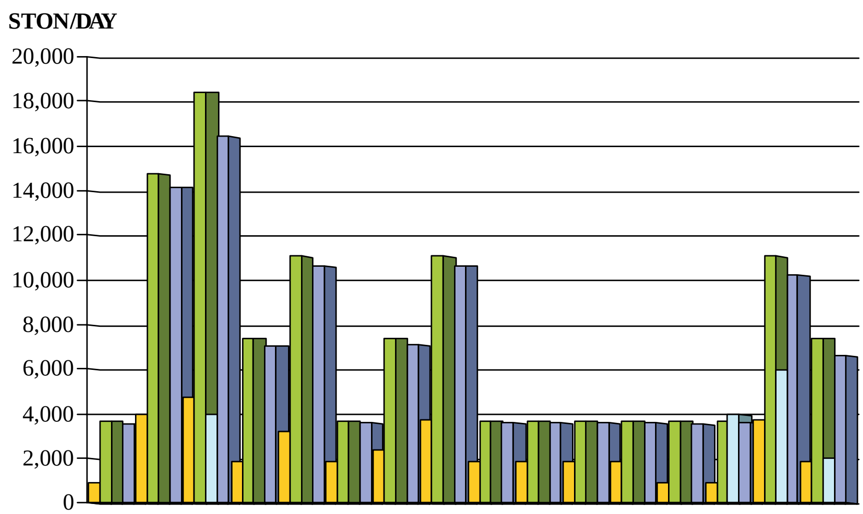
OPEN AND COVERED STAGING CAPABILITY (STON)				
	Breakbulk	RORO	Container	Mixed
Henry Clay Avenue	2,105	1,613	8,833	3,539
Nashville Avenue A	33,164	25,408	139,078	40,957
Nashville Avenue B-C	33,164	25,408	139,078	40,957
Napoleon Avenue A-B	15,609	11,959	65,461	21,198
Napoleon Avenue C	9,560	7,324	40,092	11,444
Milan Street B	4,158	3,186	17,441	5,380
Louisiana Avenue	16,312	12,497	68,406	17,069
Harmony Street	3,078	2,358	12,910	8,487
Seventh Street	1,672	1,281	6,475	1,701
First Street	1,241	951	5,209	42,198
Governor Nicholls Street	485	372	1,881	3,510
Alabo Street	2,592	1,986	10,872	5,676
Poland Avenue	1,187	3,641	4,983	2,611
France Road 1	29,545	22,635	123,902	32,225
France Road 4-5	42,130	32,277	176,679	45,952
Jourdan Road	7,345	5,627	30,805	10,858
Total	203,347	158,523	852,105	293,762



Shipping

Daily shipping subsystem totals for the terminal berths are compiled in the chart below and the table on the next page. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types. The stevedoring company provides MHE to the port. The information on available MHE was limited, which results in reduced throughput for the port.

BERTH THROUGHPUT CAPABILITY



	Henry Clay	Nashville A	Nashville B-C	Napoleon A-B	Napoleon C	Milan B	Louisiana	Harmony	Seventh	First	Governor Nicholls	Alabo	Poland	France 1	France 4-5	Jourdan
Breakbulk	928	3,981	4,777	1,857	3,185	1,857	2,388	3,715	1,857	1,857	1,857	1,857	928	928	3,715	1,857
RORO	3,686	14,745	18,431	7,372	11,059	3,686	7,372	11,059	3,686	3,686	3,686	3,686	3,686	3,686	11,059	7,372
Container	0	0	3,976	0	0	0	0	0	0	0	0	0	0	3,976	5,968	1,984
Mixed	3,532	14,146	16,427	7,065	10,621	3,584	7,095	10,650	3,584	3,584	3,584	3,584	3,532	3,573	10,225	6,603

DAILY THROUGHPUT SUMMARY

BERTH	LENGTH (feet)	DEPTH ALONGSIDE (feet)	BREAKBULK THROUGHPUT (STON)	RORO THROUGHPUT (STON)	RORO SQUARE FT[1] (EST)	RORO PIECES[2]	CONTAINER THROUGHPUT (STON)	CONTAINER THROUGHPUT[3] (TEU)	MIXED THROUGHPUT (STON)
Henry Clay	842	35	928	3,686	73,720	435	0	0	3,532
Nashville A	2,759	35	3,981	14,745	294,900	1,735	0	0	14,146
Nashville B-C	3,443	35	4,777	18,431	368,620	2,168	3,976	199	16,427
Napoleon A-B	1,521	35	1,857	7,372	147,440	867	0	0	7,065
Napoleon C	2,147	35	3,185	11,059	221,180	1,301	0	0	10,621
Milan B	1,263	35	1,857	3,686	73,720	434	0	0	3,584
Louisiana	1,590	35	2,388	7,372	147,440	867	0	0	7,095
Harmony	2,427	35	3,715	11,059	221,180	1,301	0	0	10,650
Seventh	1,196	35	1,857	3,686	73,720	434	0	0	3,584
First	1,275	35	1,857	3,686	73,720	434	0	0	3,584
Governor Nicholls	1,210	40	1,857	3,686	73,720	434	0	0	3,584
Alabo	1,313	35	1,857	3,686	73,720	434	0	0	3,584
Poland	932	35	928	3,686	73,720	434	0	0	3,532
France 1	830	32	928	3,686	73,720	434	3,976	199	3,573
France 4-5	2,400	32	3,715	11,059	221,180	1,301	5,968	298	10,225
Jourdan	1,400	36	1,857	7,372	147,440	867	1,984	99	6,603
Total [4]	**26,548**		**37,544**	**117,957**	**2,359,140**	**13,877**	**15,904**	**795**	**111,389**

[1]Based on the 20 square foot per STON average accomplished during Operation Deserts Shield/Storm.
[2]Based on the 170 square foot per piece average accomplished during Operation Deserts Shield/Storm.
[3]Based on the 8 STON per TEU average accomplished during Operation Deserts Shield/Storm.
[4]Barge terminal not analyzed.

SUMMARY

The port is multioperational with the capability to handle all types of vessels - container, RORO, breakbulk, and barges.

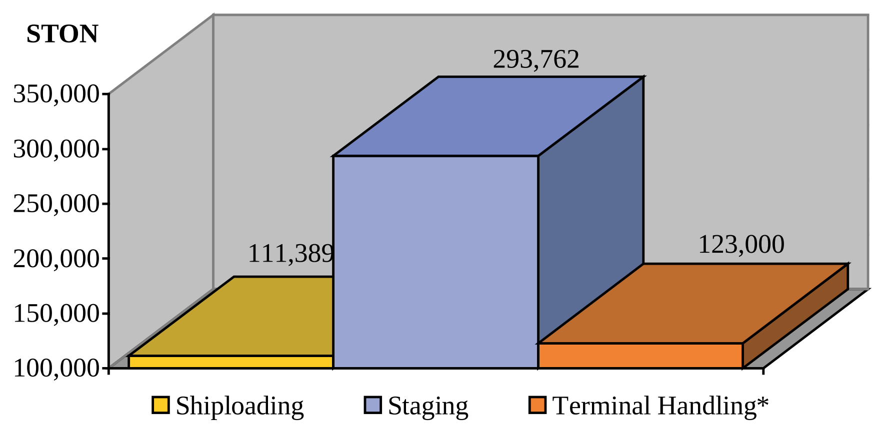
The Port of New Orleans is fully capable of supporting U.S. Military cargo transshipment operations. The port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table. Suitable berths for deployment considering access, open storage, and berthing are ranked in order; France Roads 4 and 5, France Road 1, Nashville Avenue B and C, Nashville Avenue A, Napoleon Avenue A and B, Napoleon Avenue C, Louisiana Avenue, and Jourdan Road.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of at least 111,389 STON.

The inland water network makes barge transport an effective shipping method. The port connects to this network and provides a third alternative for moving items to and from the port.

Commercial operations taking place concurrently in the port will limit actual daily throughput, sustainable over time, by an appropriate percentage of the terminal's overall capability.

DAILY CARGO THROUGHPUT CAPACITY



Terminal handling is the sum of the highway (105, 700 STON) and rail (17,300 STON) limits.

SHIP LOADING SUMMARY							
	Ship Staging		Ship Docking		Military Useful	Berth Capability	
Berth	FSS	LMSR	FSS	LMSR	For FSS or LMSR	FSS	LMSR
Henry Clay Avenue	0	0	0*	0*	No	0	0
Nashville Avenue A	3	2	2*	2*	Yes	2	2
Nashville Avenue B-C	4	2	3*	3	Yes	3	2
Napoleon Avenue A-B	2	1	1*	1*	Yes	1	1
Napoleon Avenue C	1	0	2*	2	Limited	1	0
Milan Street	0	0	0*	0*	No	0	0
Louisiana Avenue	2	1	1*	1	Yes	1	1
Harmony Street	0	0	2*	2*	No	0	0
Seventh Street	0	0	1*	1*	No	0	0
First Street	0	0	1*	1*	No	0	0
Governor Nicholls Street	0	0	1*	1*	No	0	0
Poland Avenue	0	0	0*	0*	No	0	0
France Road 1	3	2	0*	0*	No	0	0
France Road 4 & 5	5	3	2*	2*	Yes	2	2
Jourdan Road	1	0	1*	1*	Limited	1	0
Alabo Street	0	0	1*	1	No	0	0

See notes on **Summary of Berthing Capabilities for New Orleans for limits.*

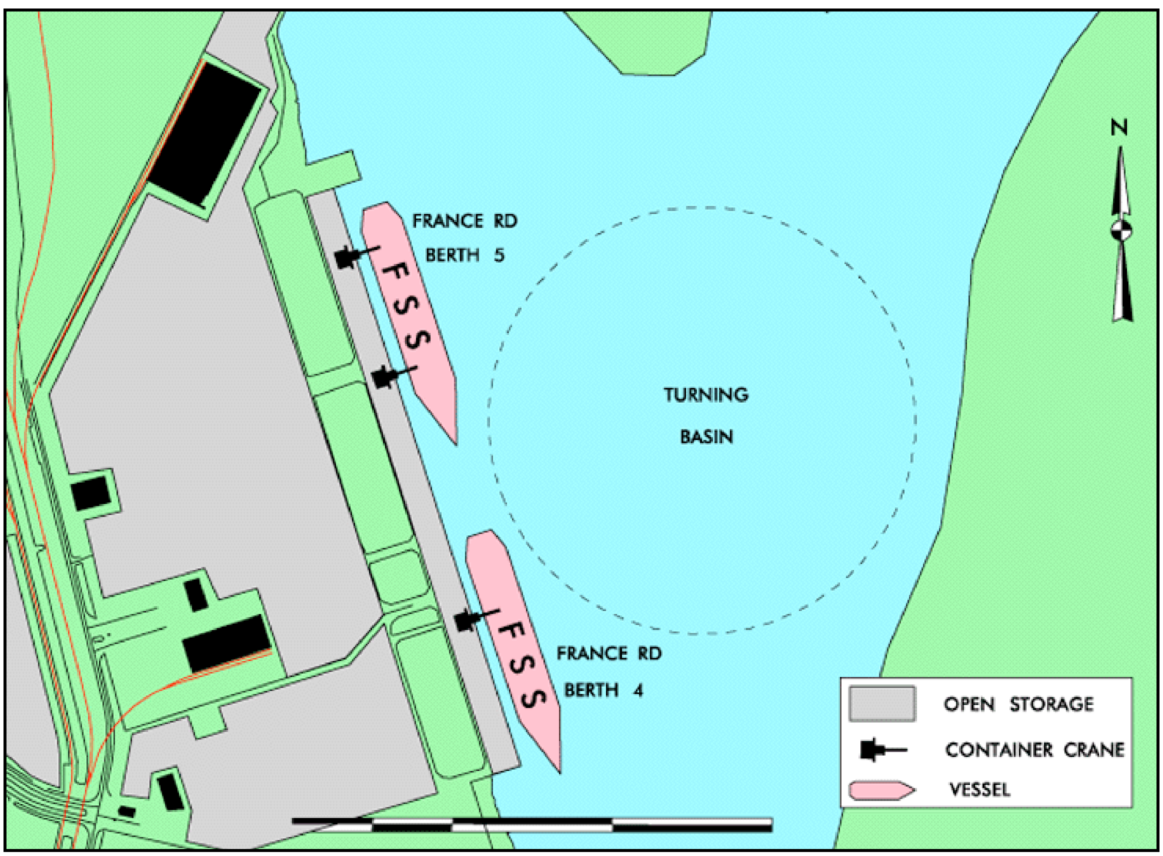
Note: This table shows the number of FSS or LMSR vessels. The number of vessels is not additive.

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored brigade using primarily LMSR or FSS vessels. The ***Planning Orders Digest***, issued by MARAD, does not include agreements for military use of the Port of New Orleans. However, this analysis will consider what facilities would likely support military operations, in place of planning orders. We also assume that no other military units will be competing for these facilities during the time that the armored division occupies the port. We further assume that the required assets, both transporters and people will be available to adequately load the ship and clear the port. For this application, we will use Berths 4 and 5 in France Road Terminal.

There are no designated facilities in the Port of New Orleans in the ***Planning Orders Digest***, issued by MARAD.



Potential Port Use During Deployment

REQUIREMENTS

A likely requirement for the Port of New Orleans would be to deploy a notional armored brigade in about 6 days of shiploading. The brigade has to move about 1,820 vehicles and 94 containers. Movement of the brigade to the port will require about 259 railcars (90 heavy-duty 68-foot DODX railcars, 52 89-foot flatcars, and 117 60-foot flatcars), using a convoy/rail option for transport to the port. About 16 containers would arrive daily with the unit arriving in 6 days. To deploy an armored division would require the port to move about three and one-half times as much equipment as for an armored brigade in the same amount of time.

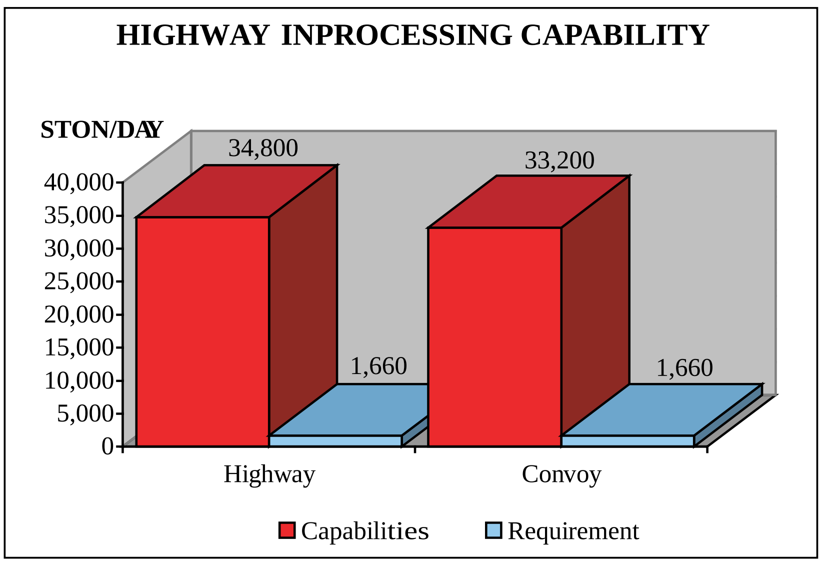
For this application, we assumed a convoy/rail deployment.

TOTAL EQUIPMENT	
Volume	81,600 MTON
Weight	27,970 STON
Area	373,910 SQ FT
Vehicles	1,820
Containers	94
Note: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997.	

TERMINAL HANDLING

Highway

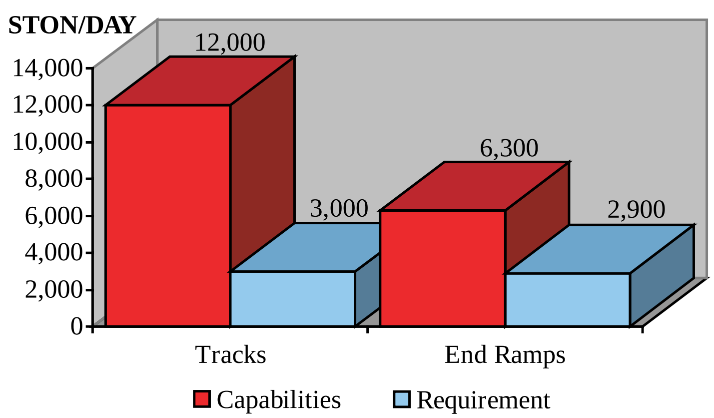
Vehicles and containers on chassis would access the terminal through the three-lane gate at Berths 4 and 5, off France Road. Both the access road and the gate can handle more than 1,500 vehicles per day. The highway capability could handle an armored division.



Rail

The classification yards near the France Road Terminal could receive about 12,000 STON per day. The two portable rail end ramps could offload 6,300 STON per day. This offloading is sufficient to meet the requirement. There is enough track capacity and portable rail end ramps to handle an additional armored brigade. Four portable rail end ramps would be required to offload an armored division. The track capacity is adequate to handle an armored division.

RAIL CLEARANCE/HANDLING CAPABILITY

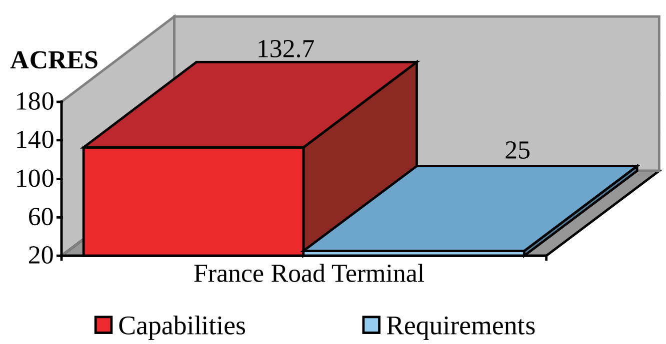


Assumes two rail end ramp can be in place in the terminal for offloading railcars. Based on MTMCTEA Reference 97-700-5, 560 STON are loaded in 94 containers. The containers arrive in the port on the railcars.

Open Storage

France Road Terminal has 132.7 acres of open staging area. Limiting the open storage area used to 25 acres, the requirement for one LMSR should not cause a problem for a deploying force. The France Road Terminal has sufficient open staging to support the requirement. There is enough open storage to support loading an armored division.

OPEN STORAGE CAPABILITY



Note: The terminal should be capable of staging equipment to load one LMSR at the same time.

Shipping

The number of ships needed to load this requirement depends on the shipping mix selected. The best ship mix would require two LMSRs. Berth space at France Road Terminal is adequate to allow the side and stern ramps on the LMSR to be used to load the ship. If smaller ships are used to deploy the brigade, then additional time or berths will be required to move the brigade.

SHIP REQUIREMENTS NOTIONAL ARMORED BRIGADE				
Loading Condition/ Sample Ship Mix	**FSS (RORO/ Comb)**	**LMSR (RORO/ Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	2.3			
All LMSR		1.4		
All Breakbulk			7.0	
Maximum Containerization				
FSS/Container	0.8			0.9
LMSR/Container		0.5		0.9
Breakbulk/Container			2.5	0.9

Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

Deploying by LMSR requires two ships. The berthing can support up to eight LMSRs or nine FSSs. Based on preliminary LMSR loading results, we estimate the LMSRs will load about 400 STON per hour. Each LMSR will require an average 34.81 hours to load. The number of days required to load the ship is determined by the hours of work per day (20) and factors for sustainment and nighttime operations. Applying these factors, we get the equivalent of 18.43 hours per day. Based on a loading time of 34.81 hours and 18.43 hours per day productive time, it will require an average of 1.89 days to load each LMSR if the load was divided equally between the two ships. The first ship should arrive no earlier than the third day of railcar arrival and begin loading and the second ship arrives in the port as the first ship departs. This requires a total of 7 days to stage and load the ship. The brigade can be loaded using the same berth for both ships.

Deploying by FSS requires three ships. Based on FSS loading time of 250 STON per hour. Each FSS will require an average 37.14 hours to load. The number of days required to load the ship is determined by the hours of work per day (20) and factors for sustainment and nighttime operations. Applying these factors, we get the equivalent of 18.43 hours per day. Based on a loading time of 37.14 hours and 18.43 hours per day productive time, it will require 2.01 days to load the FSS. This requires a total of 9 days to stage and load the ships and the first vessel arriving on day 3, the second on day 5, and the last on day 7.

France Road Terminal Berths 4 and 5 have enough berth space to load two LMSRs at the same time or two armored brigades at the same time. To load an armored division in 6 days requires the capability to load three LMSRs at the same time. France Road Terminal Berths 4 and 5 can only berth two LMSRs at a time.

SUMMARY

France Road Terminal at the Port of New Orleans can load a notional armored brigade within 7 days or less using one berth and two LMSR ships. It would be possible to load a single brigade faster if both berths could be made available to load two ships at the same time. If FSSs are used, 9 days will be required to deploy the unit through the port using one berth. If both berths are available, 7 days would be required to deploy an armored brigade by FSS. France Road Terminal Berths 4 and 5 are able to handle two armored brigades at the same time if both berths are available for use.

This is a viable port for supporting deployment of a notional armored brigade provided a berth is available for U.S. Military deployments using LMSR or FSS vessels.

To move an armored brigade, any of the following river terminals' berths could be used and meet the 6-day shiploading limit: Nashville Avenue A, Nashville Avenue B and C, Napoleon Avenue A and B, or Louisiana Avenue. The river terminals are limited to moving one armored brigade at a time because of the limited number of trains going into the terminals per day.

It may be possible to deploy an armored division through the port and load it in 6 days using Berths 4 and 5 in France Road Terminal and one berth in the river terminal such as Nashville Avenue A. Because of the distances between France Road Terminal and the river terminals it would be similar to working two ports. Rail traffic into the river terminals will limit the flow and will have to be considered in the planning. The unit moving into the river terminals will require all of the rail assets going into all of the river terminals.

Another possibility is to deploy an armored division through France Road Terminal. The loading would be limited to two ships at a time increasing the time required to deploy the force to about 9 days.

PORT OF PASCAGOULA
MISSISSIPPI

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Pascagoula, Mississippi, 15 September 1999. Pascagoula, Mississippi, is a public-owned, contractor-operated port fully capable of handling RORO, container, and breakbulk ships and barges.

The port has 5,500 feet of quay and can accommodate vessels as large as the FSS and LMSR. The port has the capability of supporting U.S. Military cargo shipment operations with limitations in staging. It can load or offload a mixed throughput of at least 13,000 STON a day. Also, the port has a 1.6-foot tidal range.

Pascagoula has mobile cranes available. It has 24 acres of open staging of which 22 acres are in the East Harbor. An FSS requires about 16 acres per day of staging to load/offload the ship and an LMSR requires about 25 acres per day of staging for continuous operation. Military port operations will take place in the West Harbor, requiring offsite staging for deployment of a unit. There is a separation of 11 miles between East, where staging area is available, and West Harbors, where shiploading would take place. Homeport Pascagoula is located 3 miles from West Harbor and has 30 acres that could be used for staging. This would have to be coordinated with the Navy prior to use.

Pascagoula is a viable port for supporting deployments of a notional armored brigade provided one berth is available for U.S. Military deployments and the staging requirements can be met. A notional armored brigade has a total of 27,970 STON of vehicles and equipment and could be loaded on 1.4 LMSRs in about 4 days. The brigade will require use of the port for about 7 days to stage and load the ships. To stage and load the ships in the minimum time will take more coordination since the staging area is off the port and may require driving through town during peak traffic times. Travel will be on local two lane roads.

II. GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Pascagoula, Mississippi, 15 September 1999. Pascagoula, Mississippi, is a public-owned contractor operated port capable of handling RORO, container, and breakbulk ships and barges. Information was obtained from the Pascagoula Port Officials.

TRANSPORTATION ACCESS

Water

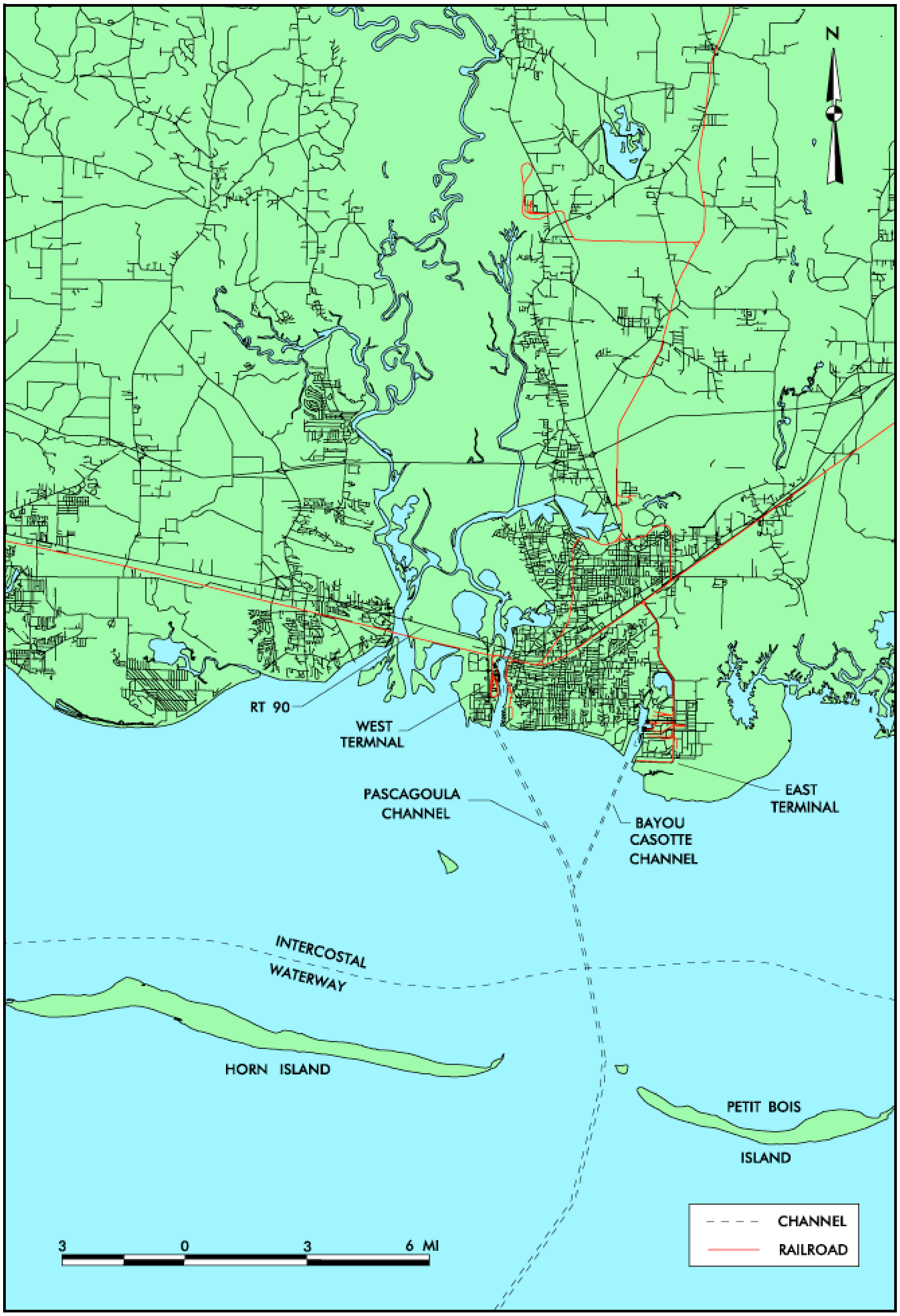
The Port of Pascagoula (latitude 30^{o} 20' north, longitude 88^{o} 34'west, (SWYQ - GEO location code) time zone GMT-6) is in the southeastern tip of Mississippi, about 35 miles southwest of Mobile, Alabama. It consists of two harbors (West and East) that are about 11 miles apart by highway.

The channel from the port cuts through the Mississippi Sound, between two islands (Horn and Petit Bois) to the Gulf of Mexico. From Horn Island Sea Buoy to Horn Island Pass the channel is 450 feet wide by 40 feet deep. From Horn Island Pass to Pascagoula River Turning Basin, the channel is 350 feet wide and 38 feet deep. The Pascagoula River Turning Basin is 950 feet wide and 38 feet deep.

The channel into Bayou Casotte (East Harbor) from Junction Buoy to the mouth of the Bayou Casotte Harbor is 225 feet wide by 38 feet deep at mean low water (MLW). The channel from the Bayou Casotte harbor is 350 feet wide and 42 feet deep at MLW for about a mile to the south end turning basin. Each terminal has a turning basin at its north end. No bridges cross the channel to either terminal.

The only anchorages permitted are in the vicinity of Horn Island Sea Buoy or seaward.

Pilots are compulsory.


N
RT 90
WEST TERMNAL
PASCAGOULA CHANNEL
BAYOU CASOTTE CHANNEL
EAST TERMINAL
INTERCOSTAL WATERWAY
HORN ISLAND
PETIT BOIS ISLAND
CHANNEL
RAILROAD
3 0 3 6 MI

Channel Map

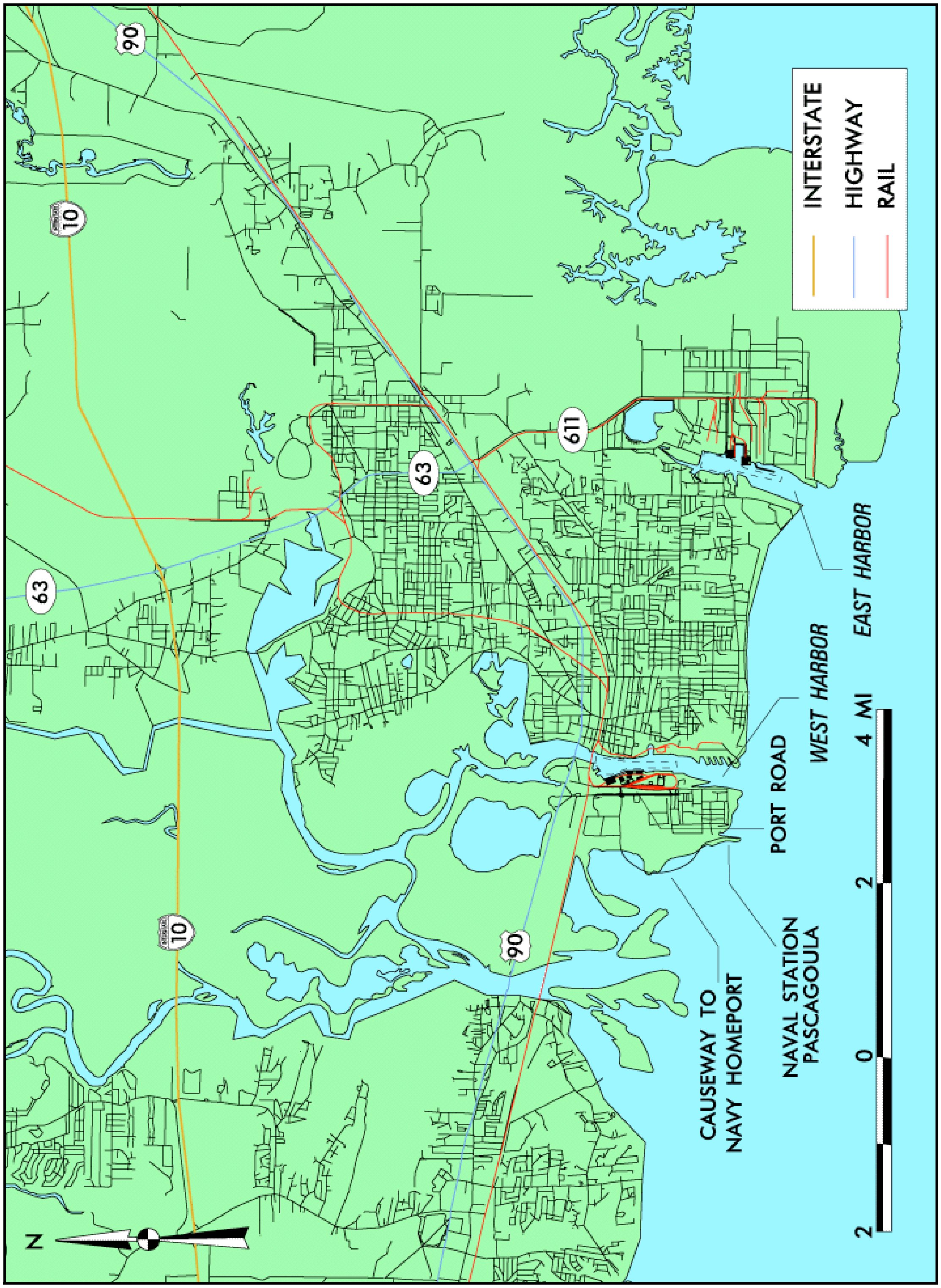
The Port of Pascagoula connects with rivers and the Inland and Intracoastal Waterway in the U.S. to form an effective inland water network. Barge transport can be used to move items too large for unrestricted transport by highway and rail modes. Barges can be used to transport U.S. Military equipment to the port.

Canal and Barge Routes

Highway

The Port of Pascagoula has access to Interstate Route 10 and U.S. Route 90. From the East Harbor, access to I-10 and U.S. 90 is by Mississippi Routes 611 and 63. Access to U.S. 90 from the West Harbor is direct by Port River Road.

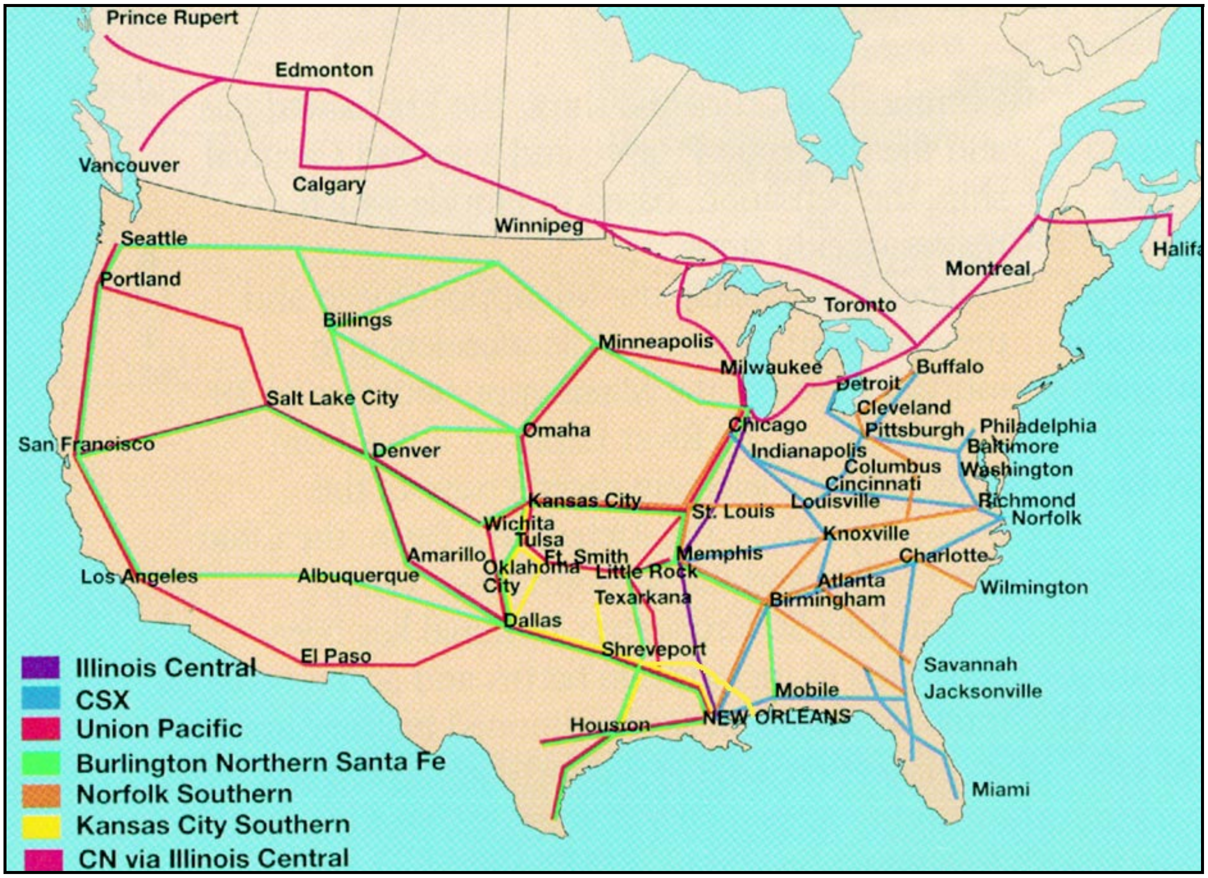
Each terminal has one gate. The roads within the port are generally two lanes. The terminals have very little congestion, except during commuting hours at the West Harbor. Access roads to the West Harbor are shared with the adjacent shipyard.



Highway Access Map

Rail

The CSX Railroad serves the port and provides switching services. One track goes to each of the two terminals. Each terminal has a port-owned railyard, and a CSX railyard within 1 mile. These railyards have a capacity of 35 to 50 railcars. Rail clearances are sufficient for bilevel and trilevel railcars. There are no rail end ramps available.



Rail Map

Airports

Two airports, one commercial and one military, are within service range of the port. Mobile Airport is 35 miles east of the port and has two runways. The runways are 9,600 by 200 feet, and 8,500 by 150 feet.

Keesler Air Force Base is about 25 miles west of the port with a runway 5,030 feet long and 150 feet wide.

PORT FACILITIES

Berthing

The port is a two-harbor multicargo port with marginal wharves. The West Harbor has two general cargo berths, one is 1,044 feet long and the other is 1,450 feet long. The East Harbor has five berths ranging from 516 to 737 feet in length. Wharf construction at both harbors is concrete decking supported by concrete pilings. All berths are fronted with timber fenders. One berth in the West Harbor will require portable lighting for nighttime operations and all others have lighting. The tidal range is 1.6 feet.

BERTH CHARACTERISTICS FOR PORT OF PASCAGOULA

Characteristics	Berths						
	WT A-B	WT C-D	ET E	ET F	ET G	ET G ext.	ET H
Length feet	1,044	1,450	517	737	516	695	556
Depth alongside at MLW feet	38	38	38	38	38	15	38
Deck strength pounds per square feet	600	1000/850	600	600	600	600	600
Apron width feet	30	open	37	55	60	60	34
Apron height above MLW feet	10	12	12	12	12	12	12
Number of container cranes	0	0	0	0	0	0	0
Number of wharf cranes, STON	0	0	0	0	0	0	0
Apron lighting	Yes	No	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO ramp	Yes	No	No	No	No	No	No
Apron length served by rail feet	0	0	0	737	0	0	0

PORT OF PASCAGOULA
SUMMARY OF BERTHING CAPABILITIES

Vessels		Berths			
TYPE	CLASS	WEST A-B	WEST C-D	EAST E	EAST F
BREAKBULK	C3-S-38a	2	2	1	1
	C4-S-58a	1	2	c	1
	C4-S-66a	1	2	c	1
	C5-S-37e	1	2	c	1
SEATRAIN	GA and PR	1	2	c	1
BARGE	LASH C8-S-81b	1	1	c	c
	LASH C9-S-81d	1	1	c	c
	LASH Lighter	5	7	2	3
	SEABEE C8-S-82a	1,a,f,g	1,a,f,g	a,c,f,g	a,c,f,g
	SEABEE Barge	5	7	2	3
RORO	COMET	1,i,j	2,d,i,j	1,d,o	1,d,o
	METEOR	1,i,j	2,d,i,j	c,d,o	1,d,o
	Cape Nome	1,i,j	2,d,i,j	c,d,o	1,d,o
	C7-S-95A	1,b	1	b,c	1,b
	Cape Taylor	1,b	2	b,c	1,b
	Cape Orlando	1,b	2,i,j	b,c	1,b
	MV Ambassador	1,m	2,d	c,d	1,d
	Callaghan	1	2,d,i,j	c,d,o	1,d,o
	Cape Lambert	1,b	2,i,j	b,c	1,b
	LMSR Class	1,b	1	b,c	b,c
	FSS	1,b	1	b,c	b,c
	Cape E-Class	1,b	2,i,j	b,c	1,b
	Cape D-Class	1,b	2,i,j	b,c	1,b
	Cape H	1,b	1	b,c	b,c
RORO	Cape Texas	1,b	2,i,j	b,c	1,b
	Cape R	1,b	2,d	b,c,d	1,d
	Cape I-class	1,b	2,i,j	b,c	1,b
	Cape Victory	1,b	2,i,j	b,c	1,b
CONTAINER	C6-M-147a	1,b,e	2,e	b,c,e	1,b,e
	C7-S-69c	1,b,e	2,e	b,c,e	1,b,e
	C7-S-68c	1,b,e	2,e	b,c,e	1,b,e
	C8-S-85c	1,b,e	1,e	b,c,e	b,c,e
	C9-M-132b	1,b,e	1,e	b,c,e	b,c,e
	C9-M-F141a	1,b,e	1,e	b,c,e	b,c,e
TACS	C6-S-1qd	1,b	2	b,c	1,b
	C5-S-MA73c	1,b	2	b,c	1,b
	C6-S-MA60d	1,b	2	b,c	1,b
MPS	C7-S-133a	1,b	1	b,c	b,c
	Maersk	1,b	1	b,c	b,c
	AmSea	1,b	2	b,c	1,b

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

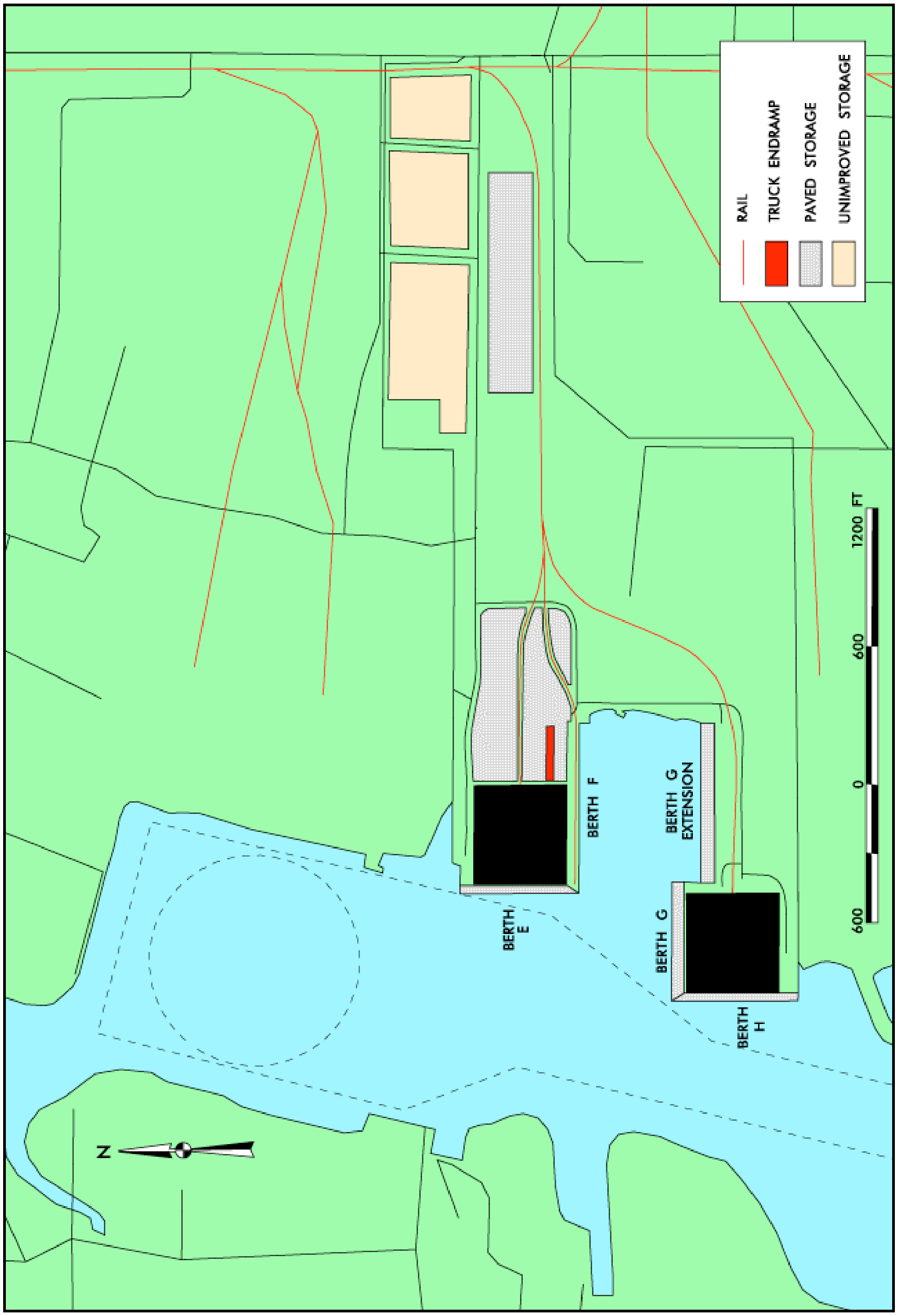
Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

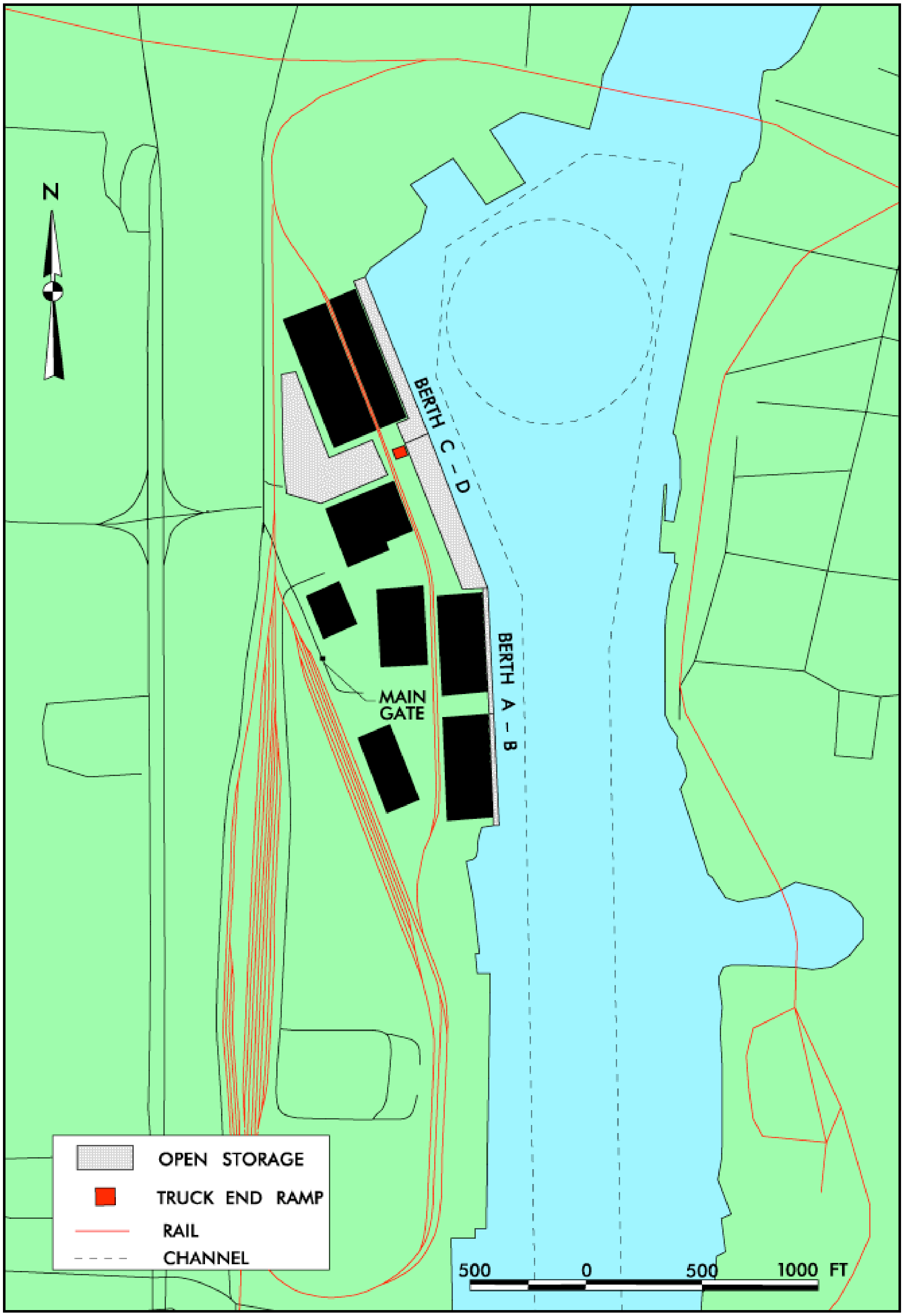
PORT OF PASCAGOULA SUMMARY OF BERTHING CAPABILITIES - cont					
Vessels		Berths			
TYPE	CLASS	EAST G	EAST G ext.	EAST H	NOTES:
BREAKBULK	C3-S-38a	1	1,a	1	The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.
	C4-S-58a	c	1,a	c	The letters in the columns to the left indicate limitations as described below.
	C4-S-66a	c	1,a	1	a-vessel draft limit
	C5-S-37e	c	1,a	c	b-inadequate apron width
SEATRAIN	GA and PR	c	1,a	c	c-inadequate berth length
BARGE	LASH C8-S-81b	c	a,c,f	c	d-no straight stern ramp
	LASH C9-S-81d	c	a,c,f	c	e-no container handling equipment
	LASH Lighter	2	3	2	f-anchorage depth OK, berth depth inadequate
	SEABEE C8-S-82a	a,c,f,g	a,c,f,g	a,c,f,g	g-inadequate channel depth
	SEABEE Barge	2	3	2	h-no shore based ramps
RORO	COMET	1,d,o	1,a,d,o	1,d,o	i-low tide insufficient ramp clearance
	METEOR	c,d,o	1,a,d,o	1,d,o	j-high tide insufficient ramp clearance
	Cape Nome	c,d,o	1,a,d,o	c,d,o	k-excessive ramp angle low tide
	C7-S-95A	c	a,c	b,c	m-excessive ramp angle high tide
	Cape Taylor	c	1,a	b,c	n-parallel ramp operation ONLY
	Cape Orlando	c	1,a	b,c	o-insufficient apron width for side ramp
	MV Ambassador	c,d	1,a,d	1,d	Ramp clearance and angle based on maximum vessel draft
	Callaghan	c,d,o	1,a,d,o	c,d,o	♦ May Prevent Operation
	Cape Lambert	c	1,a	b,c	♦ May Limit Operation
	LMSR Class	b,c	a,b,c	b,c	
	FSS	c	a,c	b,c	
	Cape E-Class	c	1,a	b,c	
	Cape D-Class	c	1,a	b,c	
	Cape H	c	a,c	b,c	
RORO	Cape Texas	c	1,a	b,c	
	Cape R	c,d	1,a,d	b,c,d,o	
	Cape I-class	c	1,a	b,c	
	Cape Victory	c	1,a	b,c	
CONTAINER	C6-M-147a	c,e	1,a,e	b,c,e	
	C7-S-69c	c,e	1,a,e	b,c,e	
	C7-S-68c	c,e	a,c,e	b,c,e	
	C8-S-85c	c,e	a,c,e	b,c,e	
	C9-M-132b	c,e	a,c,e	b,c,e	
	C9-M-F141a	c,e	a,c,e	b,c,e	
TACS	C6-S-1qd	c	1,a	b,c	
	C5-S-MA73c	c	1,a	b,c	
	C6-S-MA60d	c	1,a	b,c	
MPS	C7-S-133a	c	a,c	b,c	
	Maersk	c	a,c	b,c	
	AmSea	c	1,a	b,c	

East Terminal



East Terminal Map

West Terminal



West Terminal Map

STAGING

Open Staging

The Port of Pascagoula has about 24 acres of open staging with 14 paved acres. Most of the paved area is in the East Harbor.

Covered Staging

The port has 10 transit sheds, two with refrigeration. Military equipment would not use cold storage. The West Harbor has 235,000 square feet of covered storage and the East Harbor has 350,000 square feet.

Highway

All roads within the terminals have one lane in each direction with no dimensional restrictions.

Rail

One main track serves the West Harbor. The track is behind Berths A and B Transit Sheds and Berths C and D apron and extends the entire length of the berths. All of Berth D and part of Berth C open storage areas are platform level and provide side railcar loading capability. A covered rail loading platform is between Transit Shed B and Transit Shed B extension.

One track also provides service to East Harbor. The track splits into three rail spurs that serve the transit sheds at Berths G, H, E, F, and the apron at Berth F.

Rail service is provided to the port by CSX Transportation and the Mississippi Export Railroad/ Illinois Central Railroad. CSX provides direct service to the port. A Port Authority owned and operated locomotive is available for shifting railcars on port premises.

OFFLOADING/LOADING POSITIONS

Ramps and Docks

The port has no rail end ramps suitable for military equipment. With modifications, the end of the tracks behind Shed A (West Harbor) could support circus-style offloading.

The West Harbor has a truck end ramp at the inland edge of the apron of Berth C-D. This ramp can accommodate two trucks at a time. The East Harbor has a truck end ramp at the apron extension of Berth F that can accommodate 12 trucks at a time.

All transit sheds have railcar-level platforms for boxcar unloading and truck-level docks for van unloading. The port can handle 57 boxcars and 8 vans simultaneously.

Marshaling Areas

Within Port

No marshaling areas are within the port. All open areas within the port are required for staging.

Homeport Pascagoula

Homeport Pascagoula is built on a dredge-spoil island about 3 miles south of the West Harbor. The only access is a two-lane, 2.8-mile-long causeway. No rail access is available. A total of 180 acres are developed to support the Navy. About 30 acres are available for marshaling; this is broken into several different areas.

Stennis Industrial Park

This 65 acre area is about a mile north of the East Harbor. The former Jackson County Airport land is being developed for industrial use. One CSX rail spur goes into the center of the area. This rail spur is long enough to support the offloading of about 22 railcars. About 345 undeveloped and 15 paved acres are available for marshaling.

Materials Handling Equipment (MHE)

The port does not own any MHE; however, various stevedore companies can provide mobile or floating cranes ranging in capacity from 20 to 80 STON.

INTERMODAL FACILITIES

The nearest intermodal railyards are in Mobile, Alabama. The Mobile Section in the Ports for National Defense report provides information on these facilities.

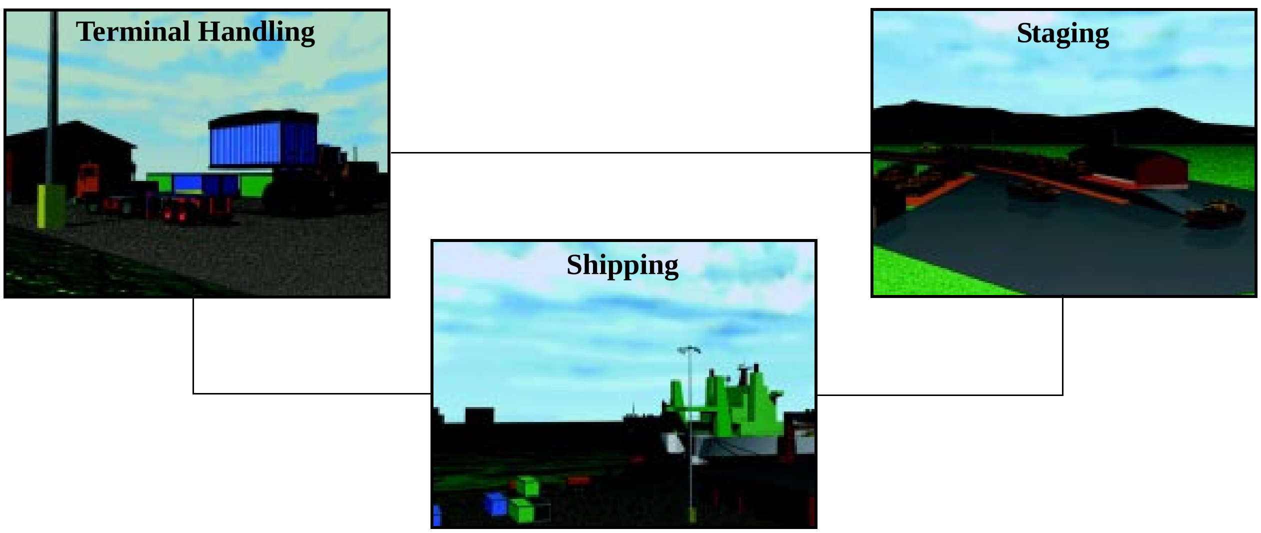
FUTURE DEVELOPMENT

The port is planning to remove the bulk facility in the West Harbor and increase berthing and open storage. No completion date has been established.

III. THROUGHPUT ANALYSIS

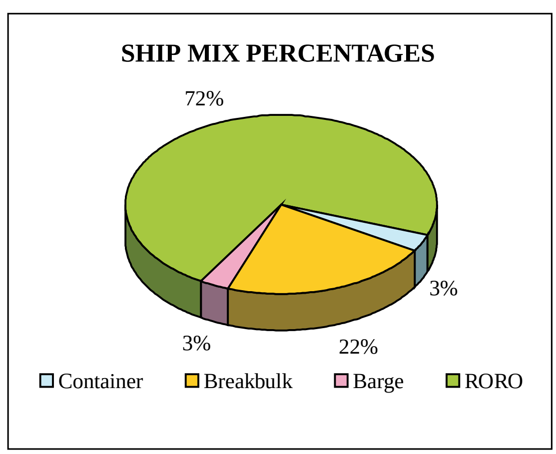
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Pascagoula, Mississippi. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, shiploading or offloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON. Approximate MTON yields can be computed by multiplying the STON amount by three.



Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 80 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.

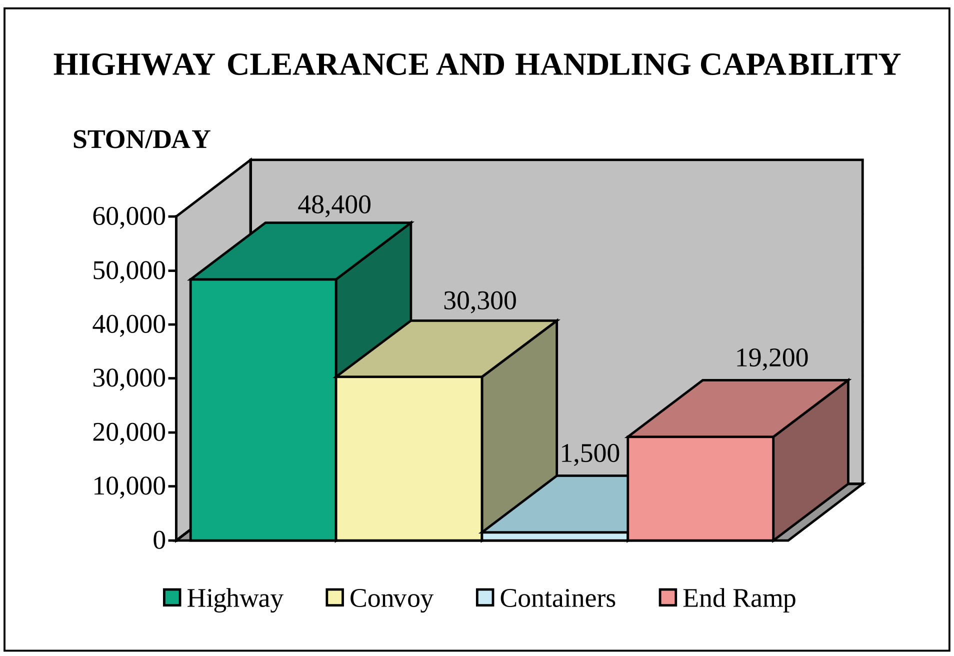


TERMINAL CLEARANCE AND HANDLING

Highway

Two lane roads restrict traffic to and from both terminals. West Harbor access is by Port River Road. East Harbor access is by Mississippi 611 with each terminal having one gate. The road network in and out of the port, including the gate processing of vehicles, could handle at least 48,400 STON of equipment and supplies per day. This capability is almost divided evenly between the two terminals. This traffic could be degraded because of local traffic. Port traffic has to go through the town to get to the Interstate.

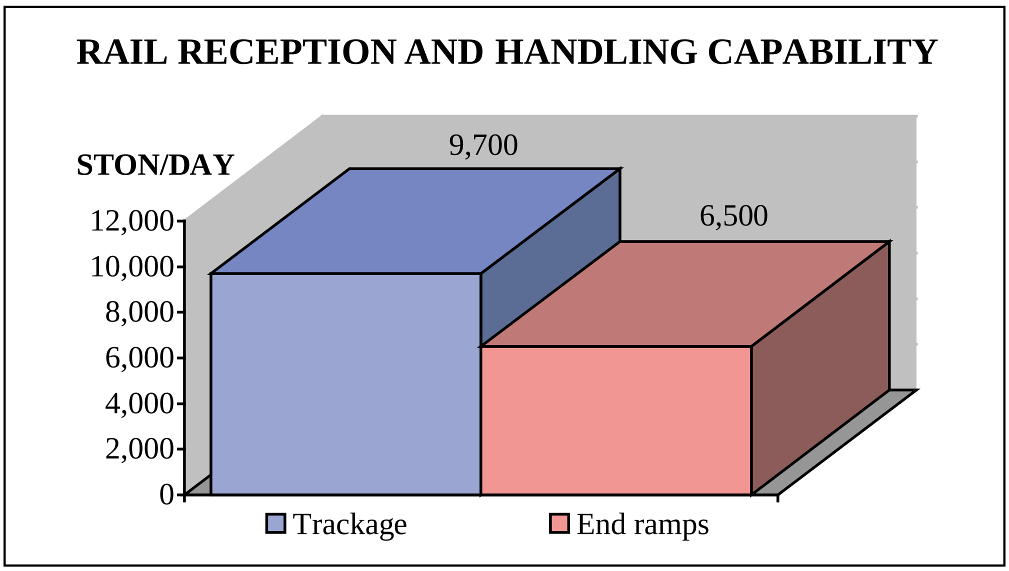
Roadable vehicles will move through the terminal gates in manageable convoys directly to the staging areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a means for offloading vehicles will offload at the two ramps near the railroad tracks just south of Shed D, or the 12 ramps on the edge of the Berth F apron. These ramps can handle 19,200 STON of military vehicles and equipment per day. Containers on trucks will move to the staging area to be offloaded. The port does not have container-handling equipment and arrangements would need to be made with the stevedoring company to lease the needed equipment. The port should be able to offload 1,500 STON in containers from their chassis per day at each terminal.



Rail

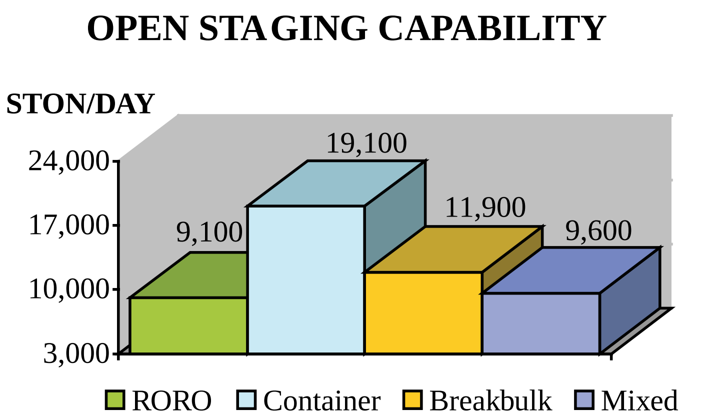
Port-owned railyards could store 82 railcars. Also, commercial railyards within a mile of the port could store 85 additional railcars. Only CSX provides service to the port. Currently, rail service to the port is one 30-railcar train to each terminal. These railcars are capable of handling at least 2,900 STON per day. It is possible to increase train length to 100 railcars. These railcars are capable of handling at least 9,700 STON per day.

With fabricated rail end ramps, vehicles on about 28 flatcars could be offloaded at the ends of the two tracks behind Shed A. The apron track at Berth F could also support offloading of eight rail-cars with a portable end ramp. The port should handle at least 6,500 STON of military vehicles per day using two rail end ramps. A container handler has the capability to offload 1,500 STON in containers from flatcars per day; however, the port has no container handlers. They would have to be provided by the stevedoring company.



Staging

The port has about 24 acres of open staging available for vehicles and/or containers. The West Harbor has 2.8 acres of open staging and the East Harbor has 22 acres. Also about 743,000 square feet of covered staging are available. The West Harbor has 393,000 square feet of covered staging plus 60,000 square feet of freezer storage and the East Harbor has 350,000 square feet of covered storage. Staging is the least capable subsystem in the port.



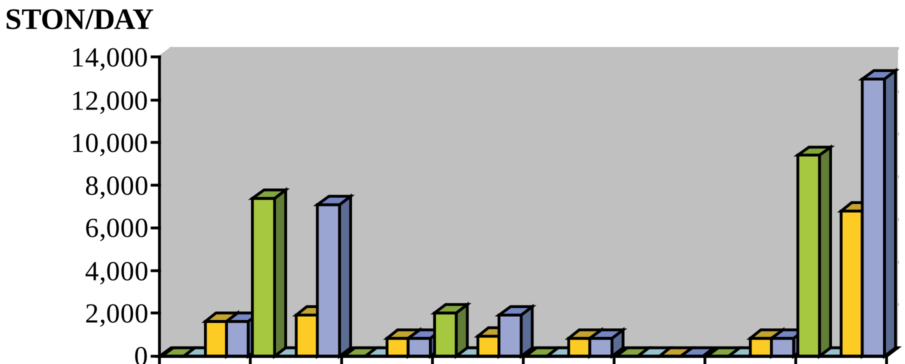
Container staging is not used since container shipping is not used.

	RORO	Container	Breakbulk	Mixed
East Harbor	8,000	16,700	10,400	8,400
West Harbor	1,100	2,400	1,500	1,200
Total	9,100	19,100	11,900	9,600

Shipping

Daily shipping subsystem totals for the berths are catalogued in the graph on the next page. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types.

BERTH THROUGHPUT CAPABILITY



	West A-B	West C-D	East E	East F	East G	East G ext	East H	Total
RORO	0	7,400	0	2,000	0	0	0	9,400
Container	0	0	0	0	0	0	0	0
Breakbulk	1,600	1,900	800	900	800	0	800	6,800
Mixed	1,600	7,100	800	1,900	800	0	800	13,000

SUMMARY

The port is multioperational with the capability to handle RORO, breakbulk, and barge vessels, but is not equipped to handle containers.

The Port of Pascagoula is capable of supporting U.S. Military cargo transshipment operations. It can accommodate vessels as large as the LMSR as shown in the Berthing Characteristics Table. The berths suitable for LMSR and FSS operations are in the West Harbor and most of the open staging is in the East Harbor. Off terminal staging will be required. This may be accomplished by using Homeport Pascagoula, which is 3 miles from West Harbor, or using East Harbor, which is 11 miles from West Harbor. This will require additional coordination to ensure equipment arrives at the berth at the right time for loading.

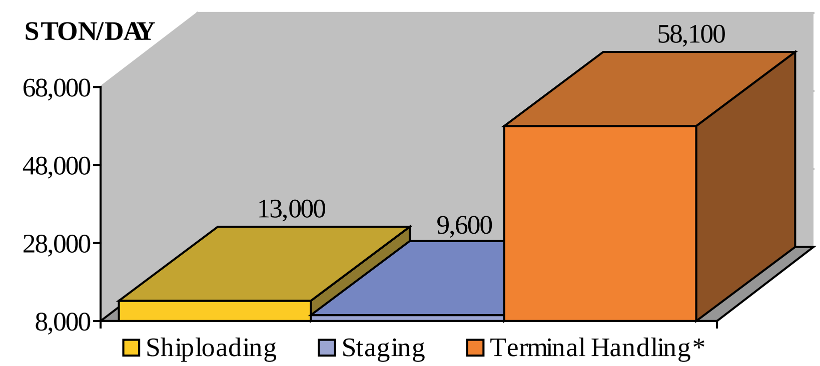
Of the transportation subsystems analyzed, the least capable is the staging. The port has the capability to stage 9,600 STON per day; however, the West Harbor has the capability to stage only 1,200 STON per day.

The military useful berths in the port have a mixed throughput capability of at least 13,000 STON per day.

The inland water network makes barge transport an effective shipping method. The port connects to this network and provides a third alternative for moving items to and from the port.

Commercial operations taking place concurrently in the port will limit actual daily throughput, sustainable over time, by an appropriate percentage of the terminal's overall capability.

DAILY CARGO THROUGHPUT CAPABILITY



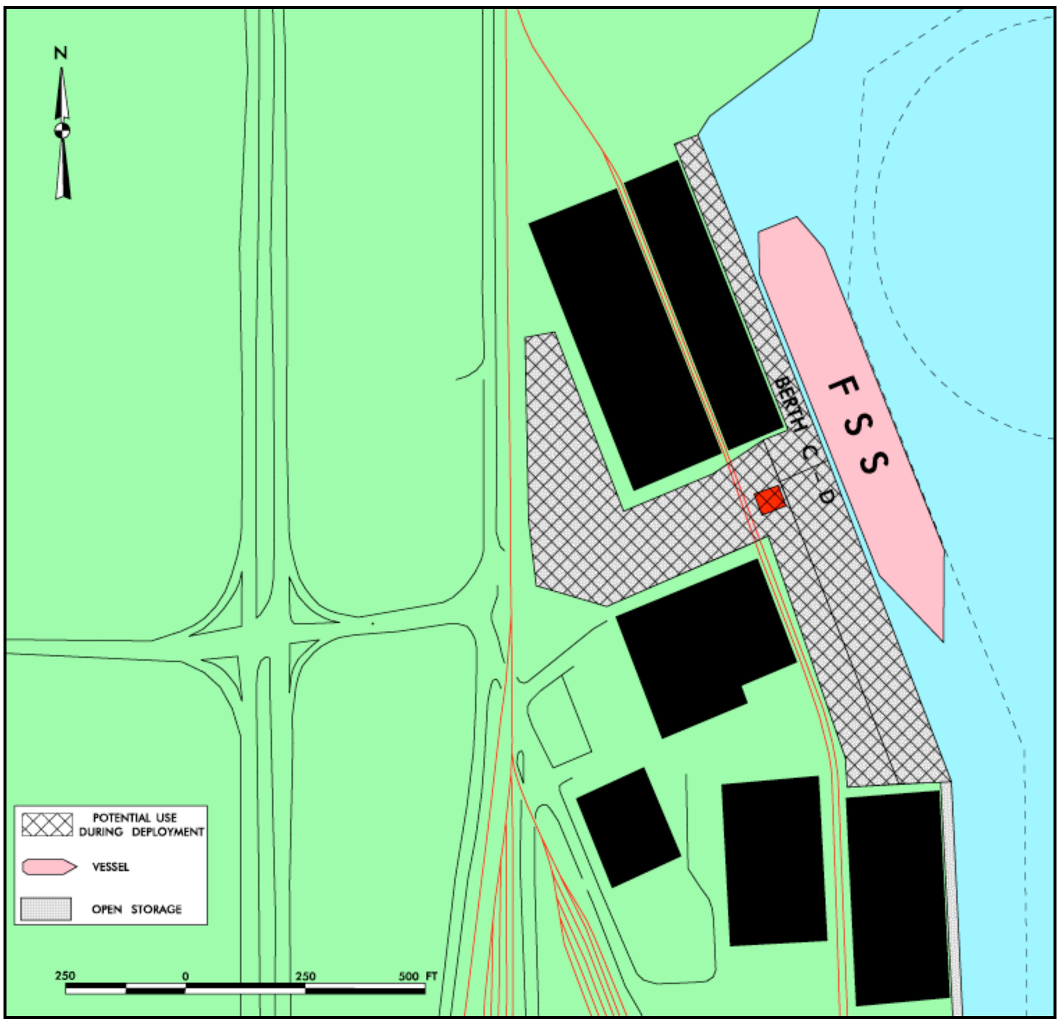
Terminal handling is the sum of the highway (48,400 STON) and rail (9,700 STON) limits.

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored brigade using primarily LMSR and FSS vessels. We also assume that no other military units will be competing for these facilities during the time that the armored brigade occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately load the ship and clear the port. For this analysis we assume the military will use Berths West C-D.

There are no designated facilities in the Port of Gulfport in the *Planning Orders Digest*, issued by MARAD.



Potential Port Use During Deployment

REQUIREMENTS

A likely requirement for the Port of Pascagoula would be to deploy a notional armored brigade in about 6 days of shiploading. The brigade has to move about 1,820 vehicles and 94 containers. Movement of the brigade to the port will require about 259 railcars (90 heavy-duty 68-Foot DODX railcars, 52 89-Foot flatcars, and 117 60-Foot flatcars), using a convoy/rail option for transport to the port. About 16 containers would arrive daily with the unit arriving in 6 days.

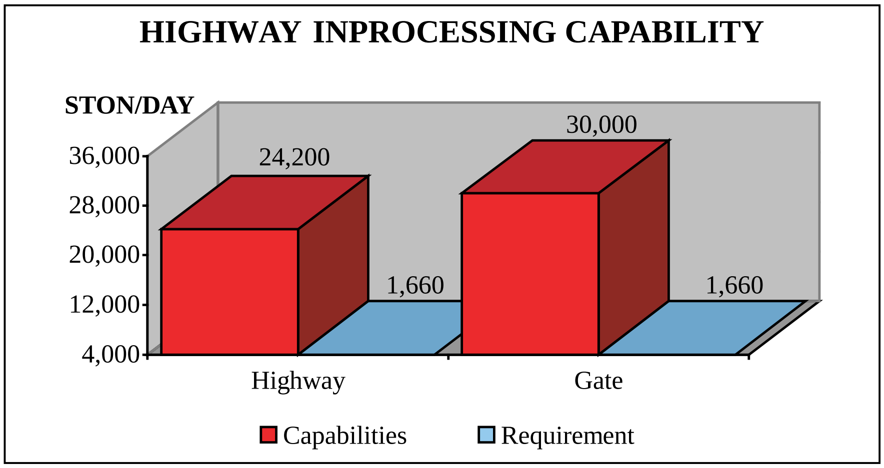
For this application, we assumed a convoy/rail deployment.

TOTAL EQUIPMENT	
Volume	81,600 MTON
Weight	27,970 STON
Area	373,910 SQ FT
Vehicles	1,820
Containers	94
Note: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997	

TERMINAL INPROCESSING/HANDLING

Highway

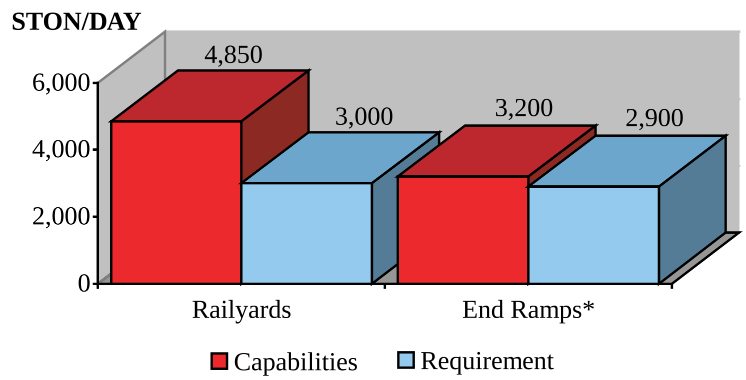
Both the access road and the West Harbor gate can handle 24,200 STON on vehicles per day. The unit arriving over a 6-day period will not affect port highway operations.



Rail

The railyard within the terminal could receive 45 railcars per day of military vehicles and equipment. Also, the rail end ramps could offload 45 flatcars per day.

RAIL CLEARANCE AND HANDLING CAPABILITY



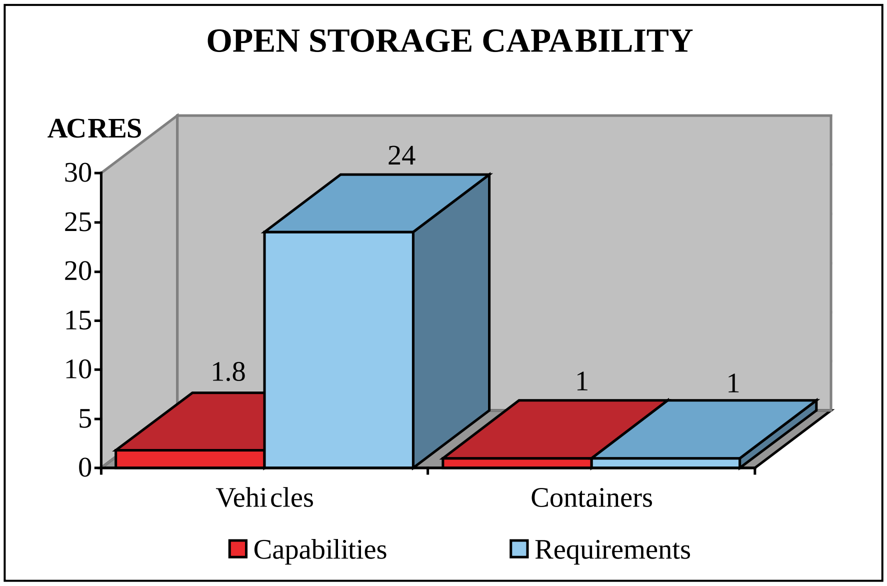
****Assumes one rail end ramp can be in place in the terminal for offloading railcars. To avoid exceeding the berth rail capacity, 6 days are required for the railcars to arrive. Based on MTMCTEA Reference 97-700-5, 560 STON are loaded in 94 containers. The containers arrive in the port on the railcars.***

Open Storage

The port has limited open storage area. The armored brigade will require two LMSR or three FSS vessels to deploy the unit. The staging area requirement for each LMSR is about 25 acres. Loading one ship at a time will require a total of 25 acres for vehicle and container storage.

There are only 2.8 acres of open staging in the West Terminal that could support military operations. Because of this, some vehicles would have to be staged outside the West Harbor. It may be possible to use the roads within the terminal to stage part of the vehicles. This would have to be coordinated with the port authorities. Staging will be required outside West Harbor since it is not available in the terminal. A possible site is Homeport Pascagoula, which is about 180 acres with 30 acres suitable for staging/marshaling, if the Navy approves its use.

Convoy vehicles could use Homeport Pascagoula's grass covered area for the additional staging. The rail-deployed vehicles and containers should receive priority for staging areas within the port. The containers will need to be placed directly on chassis from the railcars. Container handling equipment will need to be rented or in the contract to be supplied by the port operator.



Shipping

The number of ships needed to load this requirement depends on the staging mix selected. The best ship mix would require two LMSRs. Berth space is adequate to allow the side and stern ramps on the LMSR to be used to load the ship. If smaller ships are used to deploy the brigade, then additional time or berths will be required to move the brigade.

SHIP REQUIREMENTS NOTIONAL ARMORED BRIGADE				
Loading Condition/ Sample Ship Mix	**FSS (RORO/ Comb)**	**LMSR (RORO/ Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	2.3			
All LMSR		1.4		
All Breakbulk			7.0	
Maximum Containerization				
FSS/Container	0.8			0.9
LMSR/Container		0.5		0.9
Breakbulk/Container			2.5	0.9

Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

Deploying by LMSR requires two ships. The berthing can support one LMRS or one FSS. Based on preliminary LMSR loading results, we estimate the LMSRs will load about 400 STON per hour. Each LMSR will require an average 34.81 hours to load. The number of days required to load the ship is determined by the hours of work per day (20) and factors for sustainment and nighttime operations. Applying these factors, we get the equivalent of 18.43 hours per day. Based on a loading time of 34.81 hours and 18.43 hours per day productive time, it will require an average of 1.89 days to load each LMSR if the load was divided equally between the two ships. The first ships should arrive no earlier than the third day of railcar arrival and begin loading and the second ship arrives in the port as the first ship departs. This requires a total of 7 days to stage and load the ships. Berthing at Pascagoula will allow one LMSR vessels to dock at a time.

Deploying by FSS requires three ships based on FSS loading time of 250 STON per hour. Each FSS will require an average 37.14 hours to load. The number of days required to load the ship is determined by the hours of work per day (20) and factors for sustainment and nighttime operations. Applying these factors, we get the equivalent of 18.43 hours per day. Based on a loading time of 37.14 hours and 18.43 hours per day productive time, it will require 2.01 days to load the FSS. Pascagoula has berthing for one FSS at a time in the berth. This requires a total of 9 days to stage and load the ships with the first vessel arriving on day 3, the second arriving on day 5, and the third arriving on day 7.

SUMMARY

The berthing restrictions of the Port of Pascagoula limit loading of one LMSR or FSS at a time. The port receiving capability supports LMSR or FSS operations; however, additional staging area is required. Offsite staging will increase the coordination to ensure equipment arrives at the ship and all other operations relating to the deployment. The armored brigade can deploy in a 7-day period using only one berth in the port and two LMSRs, sequentially. If FSSs are used, 9 days will be required to deploy the unit through the port.

RECOMMENDATIONS

1. Designate only one brigade of equipment to deploy through the Port of Pascagoula because of staging limitations and the availability of only one berth for LMSR/FSS vessels.

2. Designate Berths West C-D, all open staging at the West Terminal, and at least 22.2 offsite acres to support one LMSR vessel or 13.2 offsite acres to support one FSS vessel, depending on which vessels will be used.

PORT OF PORT ARTHUR
TEXAS

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a site visit at the Port of Port Arthur in September 1997. This Ports for National Defense study is based on that site survey and 1999 - 2000 validation with the Port Arthur Port Authority. The port is a small, but capable port that can throughput a brigade-size unit and accommodate vessels as large as the FSS or LMSR. Located only 19 nautical miles from the Sabine Pass entrance from the Gulf of Mexico, the port is important as an alternative for deployment. This port is not listed in the Port Planning Orders issued by the Maritime Administration.

The port consists of a 1,200-foot-long berth with water depth of 40 feet mean low water and is capable of breakbulk, RORO, limited container, and barge operations. Kansas City Southern owns all tracks leading into the port and performs all of the rail switching. The nearest airport, Jefferson County Airport, can handle C-130 aircraft. A 75 STON revolving wharf crane is the only port owned materials handling equipment, however, mobile cranes are available through local stevedoring companies. These stevedoring companies are the same ones that serve Houston, Galveston, and Beaumont. The only end ramps available would be through the local stevedores and/or through the Military Traffic Management Command.

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of about 5,400 STON (20,600 MTON) per day. RORO and container throughputs are 6,640 STON and 3,910 STON, respectively.

The U.S. Military will use the 1,200-foot-long berth, surrounding staging area, and transit shed for an actual deployment. For this application, we analyzed a notional heavy armored cavalry regiment deploying from the Port of Port Arthur using LMSR vessels. A notional heavy armored cavalry regiment has about 31,350 STON (130,680 MTON) of vehicles and equipment. To meet a port closure requirement of 6 days, a deploying notional heavy armored cavalry regiment requires about 5,210 STON of vehicles and equipment (that includes 24 containers) per day to be loaded. When the two required LMSRs are available for loading in sequence, the port meets the shipping requirements if all required facilities and resources are available. Computer simulations show that the port is capable of achieving closure for throughputting a notional heavy armored cavalry regiment in about 6 days. Smaller ships will require additional time or berths.

For deployment operations, about 25 acres of staging are desired per LMSR to support daily, sustained loading operations. The desired staging for an FSS is about 16 acres per ship to support daily, sustained loading operations. Open storage requirements are dependent on cargo arrival to the port, smooth loading operations on the cargo vessel, and ship arrival. In September 1997, the port reported having only 3 acres of open staging. Another 18 acres of marshaling exists outside the port boundaries. The surface material for the marshaling areas varies from unimproved to paved.

The notional heavy armored cavalry regiment will require 54 railcars per day using the rail/convoy option. The port states that they can handle up to 4 trains per day at 30 to 65 89-foot railcars per train.

II. GENERAL DATA

The Port of Port Arthur, Texas, is a port on the U.S. Gulf Coast considered for use as a potential alternative in deploying military equipment during contingencies. A team from the Military Traffic Management Command conducted a site survey in September 1997. This information was validated December 1999 - January 2000. Information on port characteristics was obtained from port officials.

TRANSPORTATION ACCESS

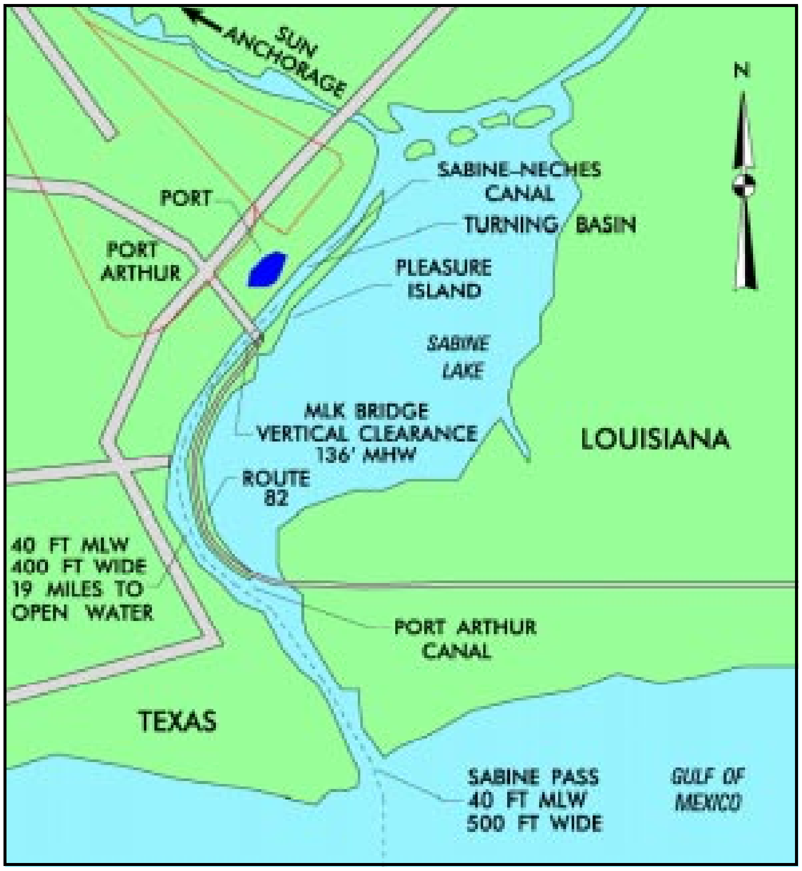
Water

The Port of Port Arthur (latitude 29° 51.08' north, longitude 93° 56.17' west, (TNES)) is in southeastern Texas about 5 miles west of the Texas/Louisiana border and 85 miles east of the Houston city limits. The port is 19 nautical miles above the Sabine Pass entrance from the Gulf of Mexico, on the western side of Sabine Lake. Access to the port is via the Port Arthur and Sabine-Neches Canals. The Sabine Pass entrance from the gulf is at least 40 feet deep at mean low water (MLW) and at least 500 feet wide. The rest of the route to the port is 40 feet deep at MLW and at least 400 feet wide. The channel continues 29 miles above the Port of Port Arthur to the Port of Beaumont.

A 900-foot-diameter turning basin, with a 40-foot depth at MLW, is less than a mile north of the port. According to Navy standard operating procedures, ships do not normally turn in an area that is less than 1.5 times their length. The port reports that this turning basin can handle a maximum ship length of 700 feet.

The only bridge between the Gulf of Mexico and the Port of Port Arthur is on Martin Luther King Boulevard, Texas Route 82. It has a horizontal clearance of 400 feet and a vertical clearance of 136 feet at mean high water. It crosses the Sabine-Neches Canal 1 mile below the port.

All vessels entering the port require pilots. The port authority reports that pilots are available 24 hours each day. Nineteen pilots with an additional four apprentice pilots are available in this area along with eight tugboats. The port authority reports a total of four anchorages available; the deepest (Sun Anchorage) is 29 feet MLW and located 12 miles from the port. Vessels with a larger draft must anchor in the Gulf of Mexico. Tidal variation is about 1-foot.



Water Access Map

Highway

The main routes to the port are U.S. Routes 69, 96, and 287 (from the north-west) and Texas State Routes 87 (from north or south), 73 (from the west), and 82 (from the east). Route 87, in the vicinity of Port Arthur, is a four-lane highway. The main gate is on Lakeshore Drive West and has two lanes (one lane in and one lane out). No unusual vertical clearances impede port access on these routes.

Air Clearance Under Martin Luther King Bridge

Highway, Rail, and Air Access Map

Main Gate to the Port

Rail

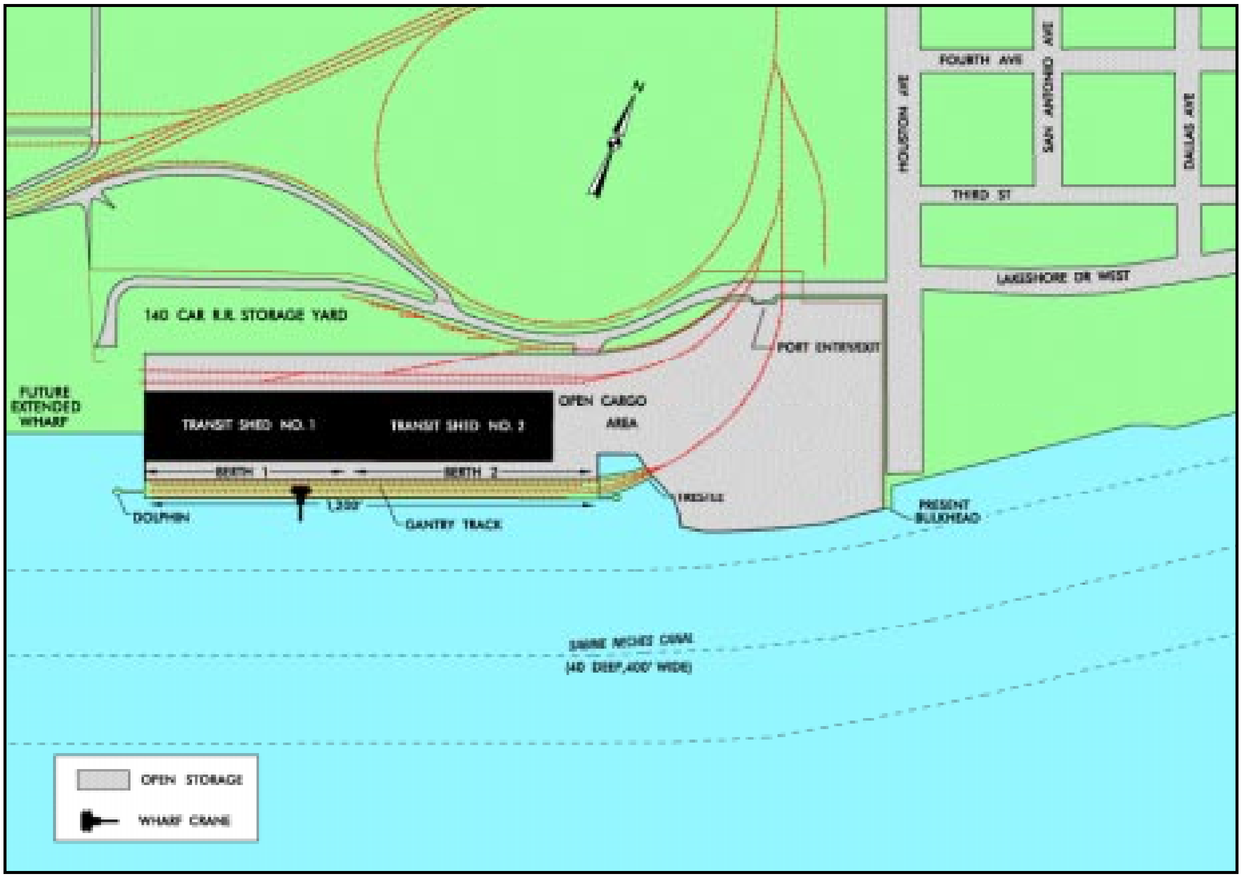
Port Railyard

Kansas City Southern (KCS) serves the port directly, and Union Pacific (UP) serves the port under a long-term reciprocal switching agreement. Although normal rail traffic to the port is two trains per day, the port authority states the port can handle four trains per day. Normally, each train has forty-five 60-foot railcars (thirty 89-foot flatcars), but the port authority states they can handle up to 100 60-foot railcars (sixty-five 89-foot flatcars) per train. Two railyards, one port owned and one commercial, exist in the Port Arthur area. Combined, these railyards can store over 900 89-foot railcars (95 at the port and about 810 at the KCS railyard). These railyards were uncongested at the time of the port survey. Rail clearances are sufficient for bilevel and trilevel railcars to access the port. Rail spurs link the railyards with the port. The wharf apron has three tracks that run the entire length of the wharf. All three of these tracks are within reach of the 75-ton crane providing excellent direct transfer of cargo. A rail spur leads to the inland side of the transit shed and diverges into two platform-level tracks that run the entire length of the transit shed. Another spur leads into the port railyard. The port does not have any fixed or portable rail end ramps at the present time.

KCS Railyard

Air

The nearest airport is the Jefferson County Airport, which has two commercial runways. They are 5,070 and 6,750 feet long, respectively. Both are 150 feet wide. This airport is large enough to handle C-130 military aircraft and has handled the B-707 in the past. The nearest military airfield, at Ellington Air Force Base, is about 80 miles from the Port of Port Arthur.



Land-Use Map

PORT FACILITIES

Berthing

The Port of Port Arthur is a multicargo port consisting of a single marginal wharf with two ship berths. The port is capable of breakbulk, roll on/roll off (RORO), limited container, and barge operations. The wharf is 1,200 feet long and has a depth alongside of 40 feet MLW. This wharf is compatible with large medium speed RORO (LMSR) and fast sealift ship (FSS) at maximum draft. Dolphins allow for ship overhangs at each end of the wharf. The apron is 100 feet wide along Berth 1 and most of Berth 2. At Berth 2, 120 feet of the wharf has an open apron. The port is secure with a 6-foot-high fence around the perimeter and a guard at the main gate 24 hours a day. Lighting exists throughout the port and around the perimeter.

Three acres of open staging are immediately adjacent to the wharf and the transit shed is 100 feet from the edge of the wharf. Three rail spurs run the entire length of the wharf to allow direct transfer of cargo from rail to ship. A 75-ton revolving wharf crane called “Big Arthur” performs the ship loading/offloading operations. The port does not have specialized container cranes but can perform container operations using either “Big Arthur” or other appropriate mobile cranes. The lift rate for “Big Arthur” is about 17 lifts per hour. Berth characteristics are in the table below.

BERTH CHARACTERISTICS FOR THE PORT OF PORT ARTHUR	
Berths	
Characteristics	**1-2**
Length feet (meters)	1,200 (365.8)
Depth alongside at MLW feet (meters)	40 (12.2)
Deck Strength psf (metric tons per square meter)	800 (3.91)
Apron width feet (meters)	Open
Apron height above MLW feet (meters)	15 (4.57)
Number of container cranes	0
Number of wharf cranes	1
Apron Lighting	Yes
Straight-stern RORO Ramp	No
Apron length served by rail feet (meters)	1,200 (365.8)

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF PORT ARTHUR			
Vessels		Berths	
TYPE	CLASS	1-2	
BREAKBULK	C3-S-38a	2	***NOTES:***
	C4-S-58a	2	
	C4-S-66a	2	The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.
	C5-S-37e	1	
SEATRAIN	GA and PR	2	
BARGE	LASH C8-S-81b	1	The letters in the columns to the left indicate limitations as described below.
	LASH C9-S-81d	1	
	LASH Lighter	6	
	SEABEE C8-S-82a	1	
	SEABEE Barge	6	a-vessel draft limit
RORO	COMET	2,d,i,j	b-inadequate apron width
	METEOR	2,d,i,j	c-inadequate berth length
	Cape Gnome	1,d,i,j	d-no straight stern ramp
	C7-S-95A	1	e-no container handling equipment
	Cape Taylor	1	f-anchorage depth OK, berth depth inadequate
	Cape Orlando	1,i,j	g-inadequate channel depth
	MV Ambassador	2,d	h-no shore based ramps
	Callaghan	1,d,i,j	i-low tide insufficient ramp clearance
	Cape Lambert	1,i,j	j-high tide insufficient ramp clearance
	LMSR Class	1	k-excessive ramp angle low tide
	FSS	1	m-excessive ramp angle high tide
	Cape E-Class	1,i,j	n-parallel ramp operation ONLY
	Cape D-Class	1,i,j	o-insufficient apron width for side ramp
	Cape H	1,i	
RORO	Cape Texas	1,i,j	Ramp clearance and angle based on maximum vessel draft
	Cape R	1,d	
	Cape I-class	1,i,j	♦ **May Prevent Operation**
	Cape Victory	1,i,j	♦ **May Limit Operation**
CONTAINER	C6-M-147a	1	
	C7-S-69c	1	
	C7-S-68c	1	
	C8-S-85c	1	
	C9-M-132b	1	
	C9-M-F141a	1	
TACS	C6-S-1qd	1	
	C5-S-MA73c	1	
	C6-S-MA60d	1	
MPS	C7-S-133a	1	
	Maersk	1	
	AmSea	1	

STAGING

Open Staging

The port has 3 acres of paved open staging north of the transit shed. Another 22 acres of unimproved staging exists in the expansion area of the port and 18 acres of marshaling exists outside the gate. The best location for helicopter operations is the staging area north of the transit sheds. After removing the rotor blades, the port support activity can tow the helicopters into the transit shed for further reduction and shrink wrapping.

Open Staging Area

Covered Staging

Covered storage consists of a transit shed with 194,400 square feet of covered storage area.

UNLOADING/LOADING POSITIONS

Ramps and Docks

Currently, the Port of Port Arthur does not have any fixed or portable end ramps. One hundred truck docks are along the transit shed of Berth 2. A ramp allows access to the truck docks. Two platform-level railroad tracks run along the inland side of the transit shed. The transit shed platform allows easy access onto the railcars from the transit shed. The port has a total of 20 boxcar offloading positions. These railcar docks are the same as the 100 truck docks previously mentioned.

Marshaling Areas

The port authority lists three areas of various surface materials outside the port totaling 18 acres. These areas include the abandoned Lake Shore Drive, an old depot next door to the port authority building, and an old parking lot across the street from the port authority building, which is located at 4th and Houston Streets.

Materials Handling Equipment (MHE)

"Big Arthur", the port's 75-STON revolving gantry crane, travels the length of the wharf. The capacity decreases to 60 STON when the boom is extended to 110 feet. Three railroad tracks also run the length of the wharf and are accessible by the crane for direct loading and unloading.

The port does not own any MHE except for the 75-STON gantry crane. Local stevedoring companies furnish all other equipment. The port authority reports that the local stevedores can get various type and capacity MHE sufficient to handle any type of cargo moving across the docks. These local stevedoring companies are the same ones that work at the Ports of Houston, Beaumont, and Galveston.

Big Arthur

FUTURE DEVELOPMENT

The Port of Port Arthur is in the midst of a large expansion project. The port authority is extending the existing wharf by about 1,700 feet (three additional ship berths) toward the southwest to provide a 5-berth wharf at 40 feet deep MLW. Other additions will include a new 225,000 square feet covered storage facility, 25 acres more of paved open staging, additional rail docks (including a covered rail offloading facility), larger transit shed doors (36 feet x 24 feet), apron design loading of 1,200 psf, additional 40-STON gantry crane, additional rail spur connection to the KCS railyard, and 4 rail end ramps at the end of the port railyard.

Wharf Extension

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

The port is not permitted to handle ammunition or other explosive cargo.

STEVEDORING

The shiploading stevedoring companies are the same as the ones serving Beaumont, Lake Charles, and Orange. The port authority reports that International Longeshoreman's Association labor is sufficient to work the maximum number of ships moored at the port.

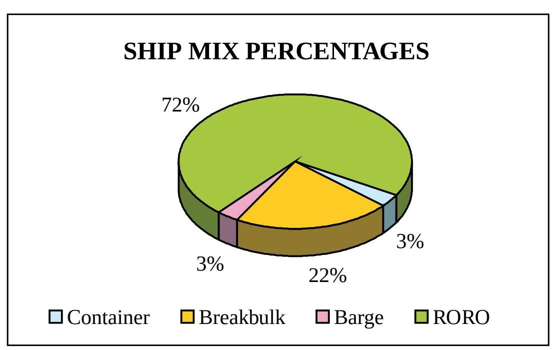
III. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Port Arthur. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON.

Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth 90 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

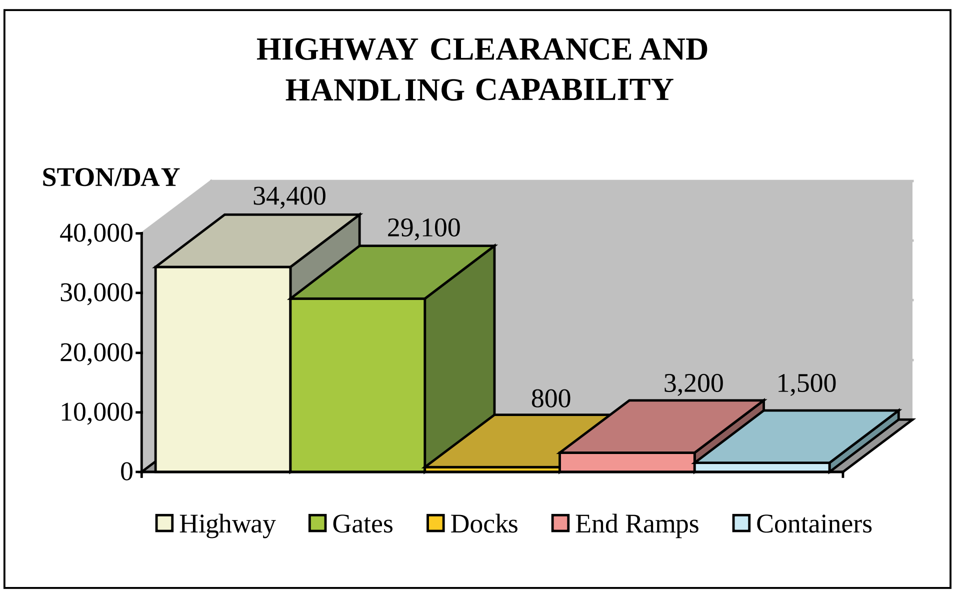
Highway

The main routes to the port are via U.S. Routes 69, 96, and 287 (from the northwest) and Texas Routes 87 (from north or south), and 73 (from the west), and 82 (from the east). The port has one main gate that allows access to the unloading and staging areas. The road and gate going into the port can handle over 29,100 STON of cargo per day. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or leave the port on each lane of the highway.

Roadable vehicles will move through the terminal gate in manageable convoys to the staging area. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. Since end ramps are not available, deploying units/military port operators must either build or acquire the necessary ramps. We assumed that the using units/stevedores would construct at least one portable truck end ramp. One end ramp with two handling positions can handle 3,200 STON of military vehicles and equipment per day.

This study assumes that one container handler can be obtained for container operations. With one container handler, the Port of Port Arthur could handle 1,500 STON/day.

Maximum daily handling capability for the port is a mixed total of the three types of handling (docks, end ramps, and containers), each up to its maximum, not to exceed the daily gate limit of at least 29,100 STON.



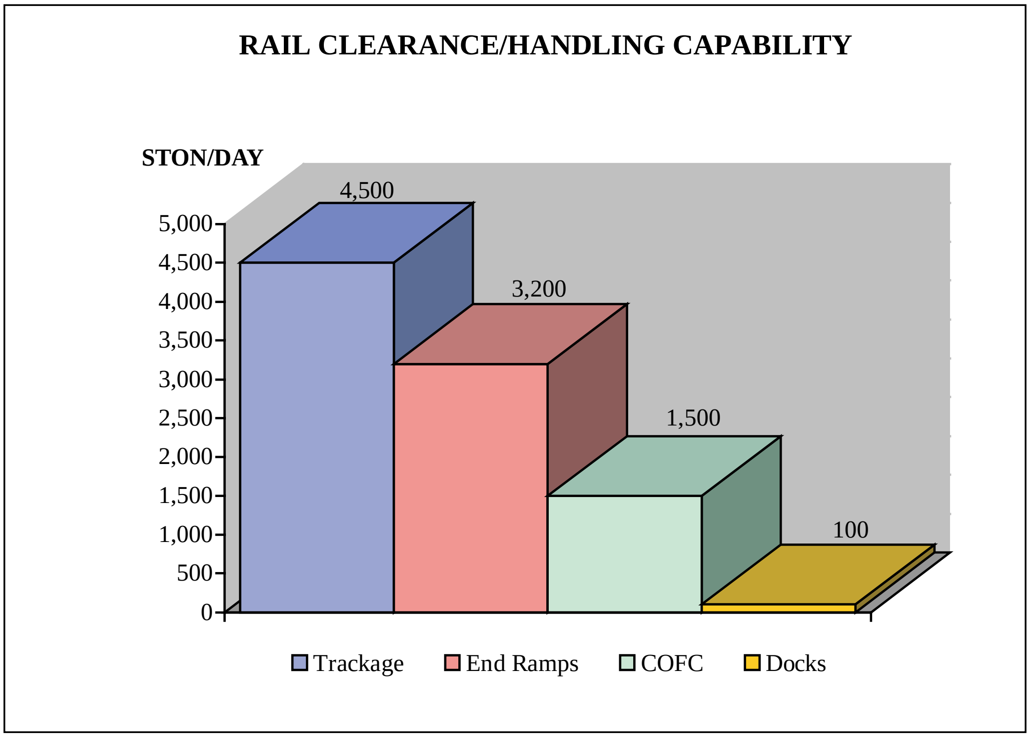
Rail

Rail reception is good, with KCS providing rail service directly to the port. Current rail service can support up to four 100-railcar trains per day. These trains can handle almost 4,500 STON per day.

Wheeled and tracked vehicles on flatcars will offload at the port railyard using one fixed rail end ramp. This end ramp can handle at least 3,200 STON per day.

The port has 20 boxcar positions for rail offloading at the transit shed. These docks can handle about 100 STON per day.

Based on using one container handler for offloading COFC railcars, the port can handle about 1,500 STON of containerized equipment and supplies from railcars per day.



Staging

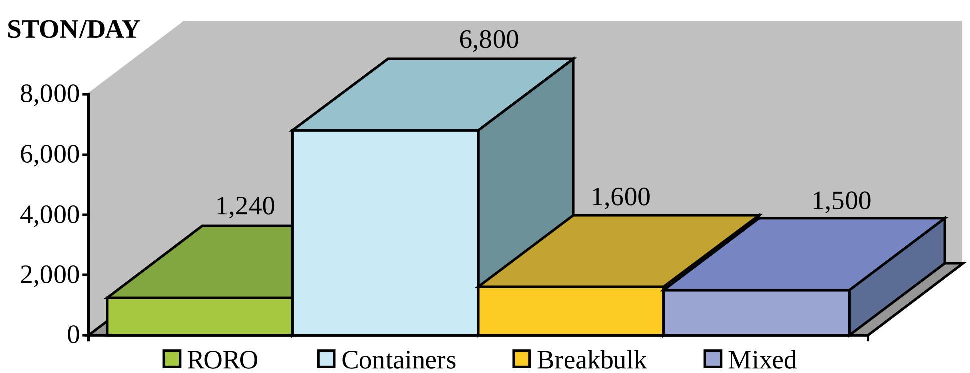
The Port of Port Arthur has identified 3 acres of open staging area for vehicles and/or containers.

The transit shed has a total area of 194,400 square feet. The covered staging throughput is almost 3,900 STON per day.

The chart on this page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of the capability for each type cargo operation involved should be assumed. The facility use factor used in this study was 100 percent.

The table shows the STON of cargo, by type, the port can handle. The dwell time used for this study was 3 days and the open space utilization percentage was 60 percent. The container storage throughput capability is the highest with almost 6,800 STON. A stacking height of 26 feet (three containers high) is a contributing factor to the high container staging throughput. The RORO storage throughput is about 1,250 STON. The breakbulk staging throughput is about 1,600 STON.

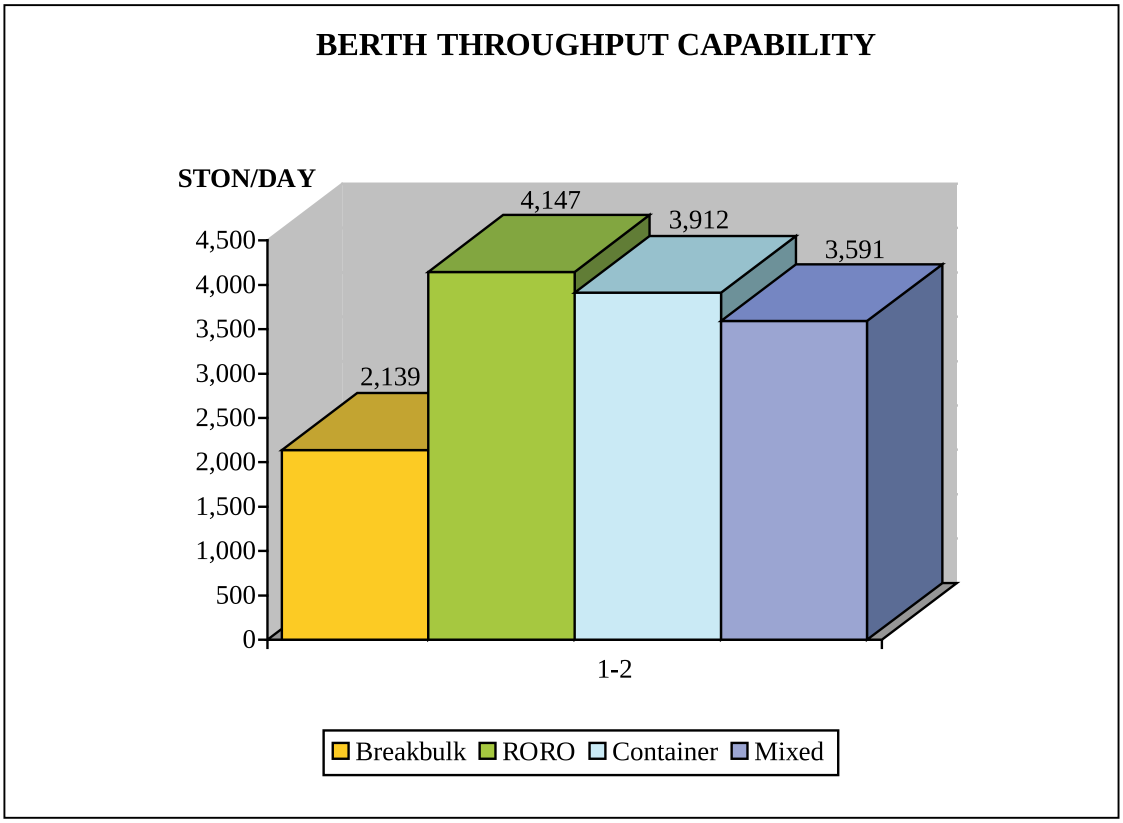
OPEN STAGING CAPABILITY



Note: Container staging area can also be used for RORO staging as needed.

Shipping

Daily shipping subsystem totals for the terminal berth are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types. The port conducts container operations using the wharf crane. The wharf crane provides excellent direct transfer of cargo from railcars to ship. The nearby transit shed supports breakbulk operations and the open apron and nearby open storage area supports RORO operations. The ample berth length (1,200 feet) and water depth (40 feet MLW) allow ships as large as the LMSR or FSS to berth at Port Arthur.



DAILY THROUGHPUT SUMMARY	
Characteristic or Throughput	Berths 1-2
Length (feet)	1,200
Depth Alongside (feet)	40
Breakbulk Throughput (STON) (MTON)	2,100 5,300
RORO Throughput (STON) (MTON)	6,600 26,500
RORO Square feet (EST) [1]	132,700
RORO Pieces [2]	780
Container Throughput (STON) (MTON)	3,900 9,800
Container Throughput (TEU) [3]	490
Barge Throughput (STON) (MTON)	700 1,700
Mixed Throughput (STON) (MTON)	5,400 20,600

Berths 1-2

[1] Based on the 20 square foot per STON average accomplished during Operation Desert Shield/Storm.
[2] Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.
[3] Based on the 8 STON per TEU average accomplished during Operation Desert Shield/Storm.

SUMMARY

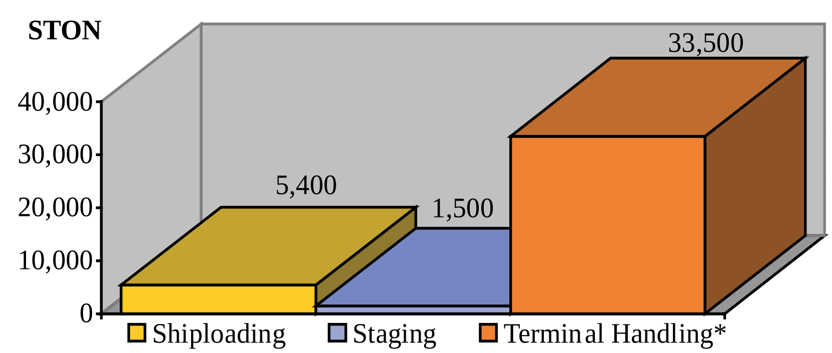
The port is multioperational with the capability to handle all types of vessels: limited container, RORO, breakbulk, and barges.

The Port of Port Arthur has the capability to handle a limited amount of military equipment for deployment or exercise. The port does not have any specialized container handling equipment. Any container handling equipment used must come from stevedoring companies. Shiploading will occur using the 75-ton wharf crane and/or other mobile cranes. The loading of containers via mobile or wharf cranes is generally slower than using specialized container cranes.

The port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table. The open apron and close proximity of the transit shed allow for a variety of operations. To conduct sustained loading operations on an LMSR, the port needs 25 acres of open staging per LMSR vessel. The amount of open staging needed for sustained loading operations on FSS vessel is 16 acres per vessel. Actual open staging requirements are dependent on cargo arrival, smooth shiploading operations, and ship arrival. The Port of Port Arthur has 3 acres of paved open staging near the ship berth. The rest of the open staging would need to come from marshaling areas outside the port boundary.

Of the transportation subsystems analyzed, the least capable is the staging (1,500 STON). If enough off-port marshaling is used to supplement the open staging, then the shiploading subsystem can become the least capable. The port has a mixed throughput capability of about 5,400 STON.

DAILY CARGO THROUGHPUT CAPACITY



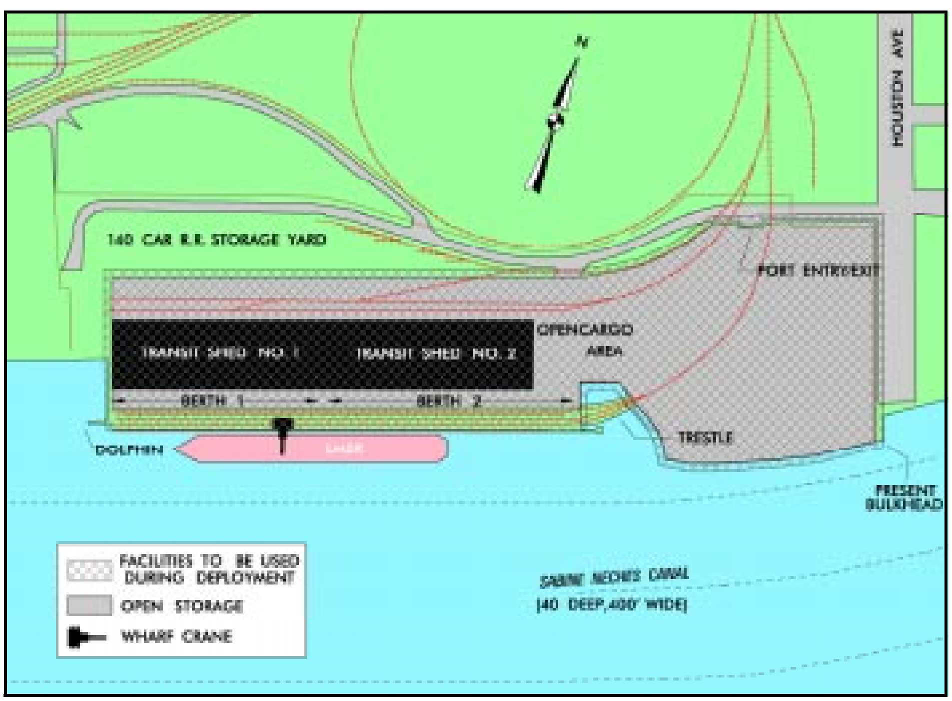
Terminal handling is the sum of the highway (30, 150 STON) and rail (3,365 STON) limits.

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional heavy armored cavalry regiment using primarily LMSR vessels. We assume that Berths 1-2 (to include wharf crane), 3 acres of open staging, 22 acres of unimproved staging, 4 acres of marshaling, and the transit sheds are available to the military for deployment. We also assume that no other military units will be competing for these facilities during the time that the regiment occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately load the ship and clear the port.

To evaluate the port's deployment capability, we used the port simulation (PORTSIM) model to flow unit equipment in the regiment through the port. PORTSIM is a time-stepped, discrete event, stochastic simulation of port operations during a force deployment. The PORTSIM is dynamically modeled for visual monitoring and quick identification of problems and allows the analyst to determine port closure/clearance times. For this simulation, we assume that the deploying regiment will use the facilities identified in the graphic below during a deployment. Also, we assumed that the stevedores would provide one container handler and one mobile crane to supplement the 75-ton wharf crane for shiploading. We further assumed that two portable end ramps would be used for deployment (one for rail and one for semitrailer offloading). We also assumed that the off-port marshaling areas would be available if needed.

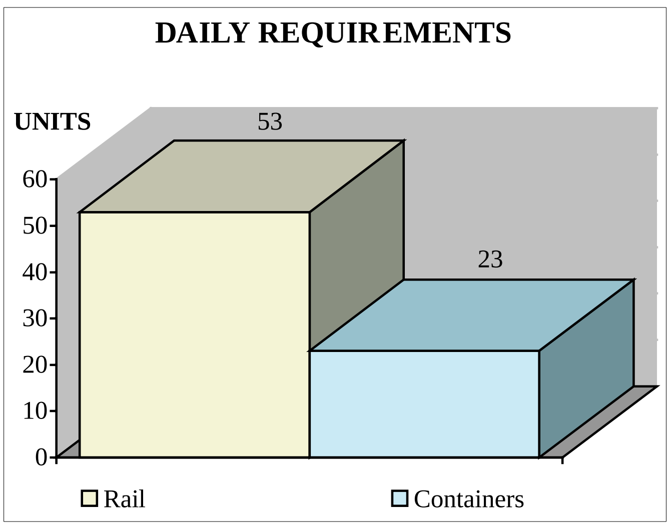


Potential Use During Deployment

REQUIREMENTS

To simulate a likely requirement for the Port of Port Arthur, we deployed a notional heavy armored cavalry regiment, using 6 days for shiploading and port closure. The regiment has to move 2,138 vehicles and 140 containers. Movement of the regiment to the port will require 319 railcars using a convoy/rail option for transport to the port. About 23 containers would arrive daily.

TOTAL EQUIPMENT	
Volume	84,440 MTON
Weight	31,267 STON
Area	433,658 SQ FT
Vehicles	2,138
Containers	140
Note: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997.	



SIMULATION RESULTS

Total deployment time for the regiment was about 6 days with the last 5 of those days used for shiploading and the first day used for initial reception and staging. LMSR vessels were used to deploy the regiment. Actual throughput and closure results are shown in the charts at the end of this study.

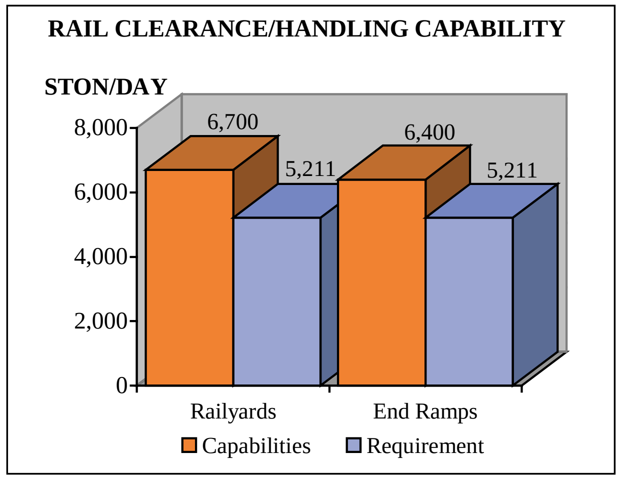
TERMINAL INPROCESSING/HANDLING

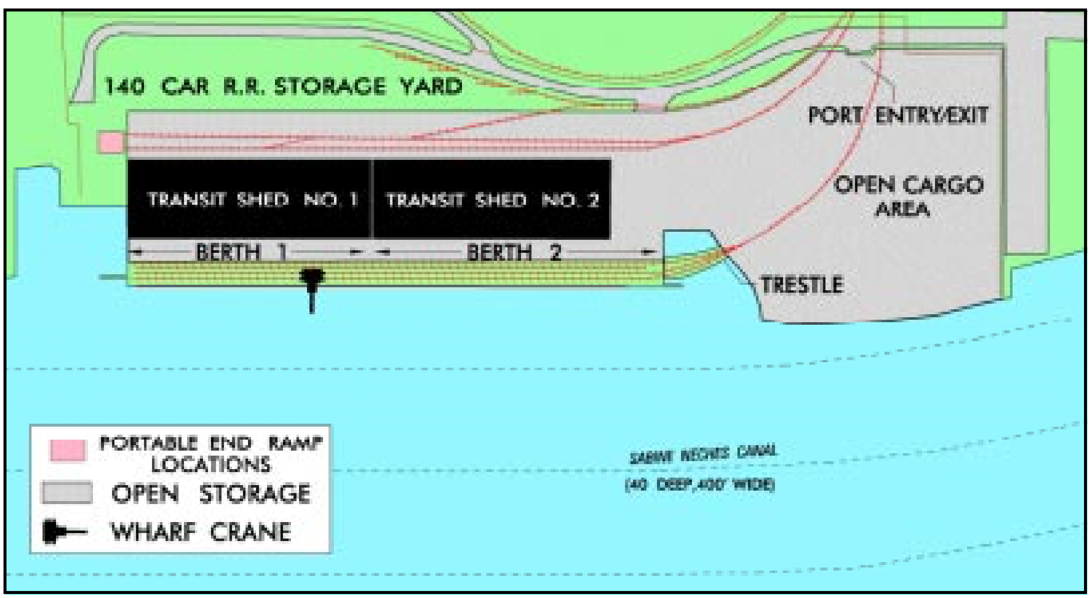
Rail

The KCS and UP both serve the Port of Port Arthur. KCS owns all of the trackage leading into the port and performs all of the switching. UP operates on this trackage via a long-term reciprocal switching agreement. Based on a 6-day loadout, the port's railyard (capacity of about ninety-five 89-foot flatcars) could handle the additional daily rail traffic (53 railcars per day).

For offloading wheeled and tracked vehicles from railcars, we assume two portable rail end ramps will be at the longest spurs in the port's railyard (800 feet long).

Requirements use total STON of equipment divided by six providing a rail daily requirement. Capabilities for the railyards and end ramps reflect trackage and end ramp daily throughputs, respectively. The rail clearance/handling capability assumes that the port can obtain two portable end ramps and can handle three trains per day vice the current two trains per day.





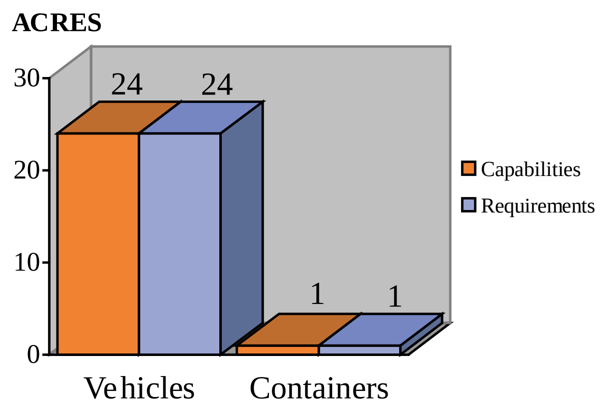
Portable Rail End Ramp Locations

Open Storage

The Port of Port Arthur has identified about 3 acres of immediate open storage area. Assuming the port can provide the additional 22 acres of unimproved open storage, this is enough to support the loading of an LMSR or FSS vessel. The additional off-port marshaling areas provide another 18 acres of open storage if needed. As the first ship fills up and the staging area empties, there is room to stage equipment for the next LMSR that will be loaded.

Using the 170 square foot per piece estimate from Operation Desert Shield/Desert Storm, 363,460 square feet or 8.3 acres are needed to stage 2,138 vehicles. Using a 240 TEU/acre staging requirement (front-end/top pick loader handling method), .6 acres are needed to store 140 containers.

OPEN STORAGE CAPABILITY



Note: Includes 22 acres of unimproved open storage.

Marshaling/Staging Area

Shipping

Using the LMSRs to transport the regiment, Berths 1-2 will allow the ships to meet the 6-day loading requirement if all facilities and resources are available. Based on each LMSR being able to load in about 3 to 4 days, the two LMSRs can be loaded in 6 to 8 days. Berth space is adequate to allow the side and stern ramps on the LMSRs to be used to load the ships. If smaller ships are used for deployment, then additional time will be required to move the regiment.

Deploying by LMSR requires one ship every 3 - 3.5 days; each ramp will have to average about 130 STON per hour for 20 hours to deploy the regiment in 6 days. The LMSR loading rate can be as much as 400 STON per hour. This equates to 15 vehicles per hour per ramp. Deploying by FSS requires one ship every 2 days to meet the same requirement provided all facilities and resources are available; this equates to 30 vehicles per hour per ramp (260 STON per hour).

SHIP REQUIREMENTS
NOTIONAL HEAVY ARMORED CAVALRY REGIMENT

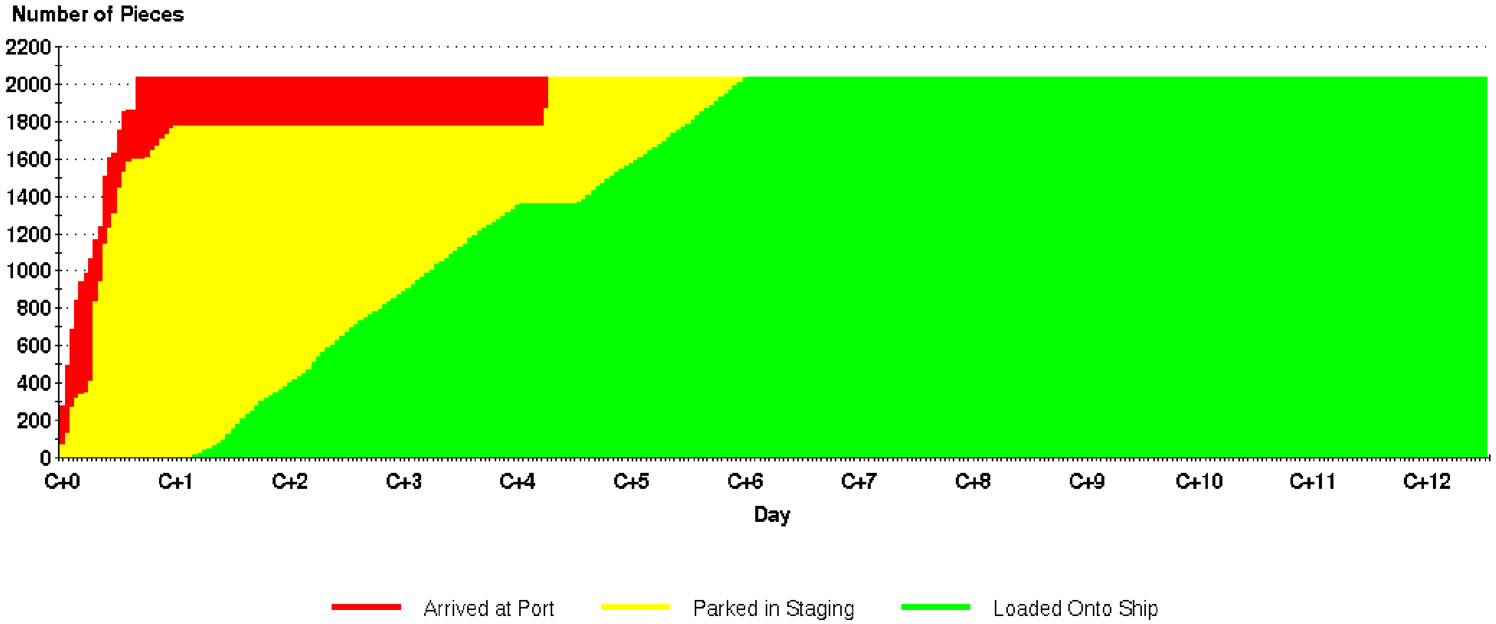
Loading Condition/ Sample Ship Mix	FSS (RORO/ Comb)	LMSR (RORO/ Comb)	C3/C4 (Breakbulk or Containers)	C6/C7/C8 (Container)
Minimum Containerization				
All FSS	2.8			
All LMSR		1.7		
All Breakbulk			8.7	
Maximum Containerization				
FSS/Container	1.1			1.2
LMSR/Container		.7		1.2
Breakbulk/Container			3.5	1.2

Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

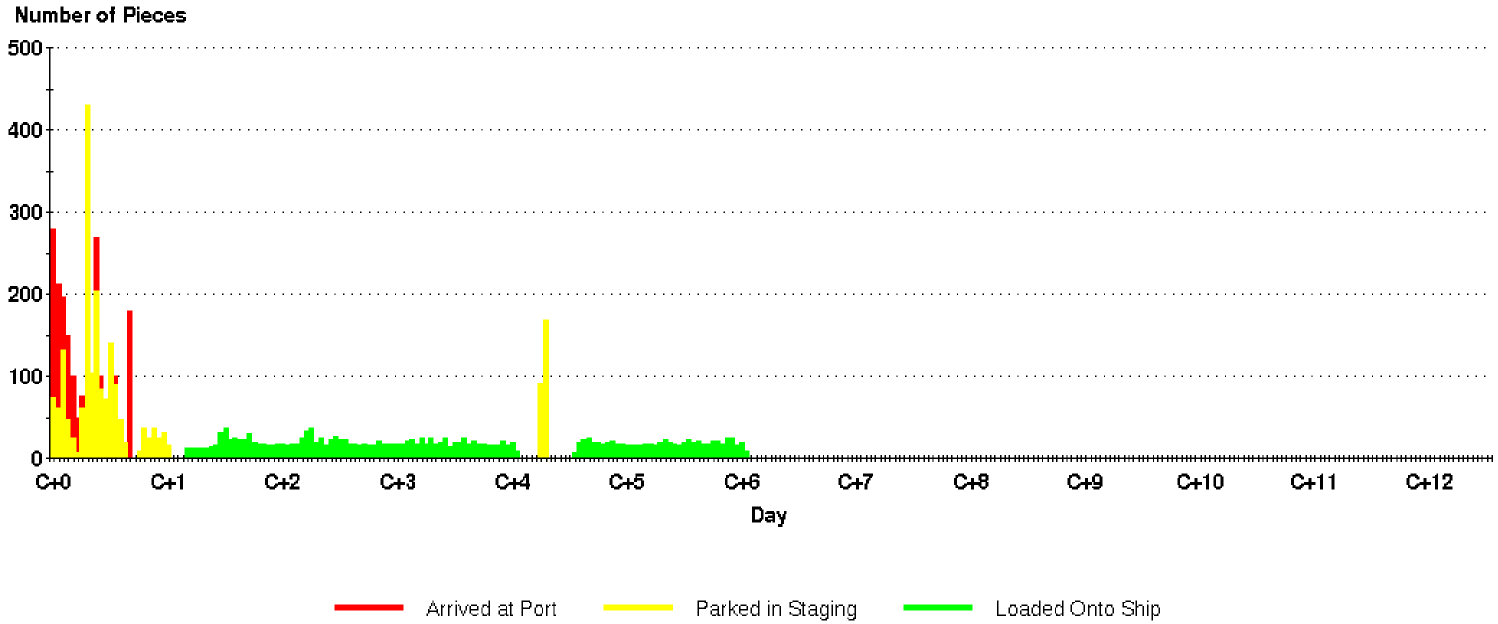
SUMMARY

The Port of Port Arthur can load and achieve closure in about 6 days using Berths 1-2 and LMSR ships. If other ships are used, additional time may be required to achieve port closure. The Port of Port Arthur is a viable port for supporting deployment of a notional heavy armored cavalry regiment provided the port can provide the additional 22 acres of unimproved open storage identified in the port survey. If possible, this storage area should be improved (paved and immediate access to ship berth) for use to load LMSR or FSS vessels during deployment. Also, the deploying units must have access to at least two end ramps, a mobile crane, and a container handler to adequately handle the cargo associated with a notional heavy armored cavalry regiment.

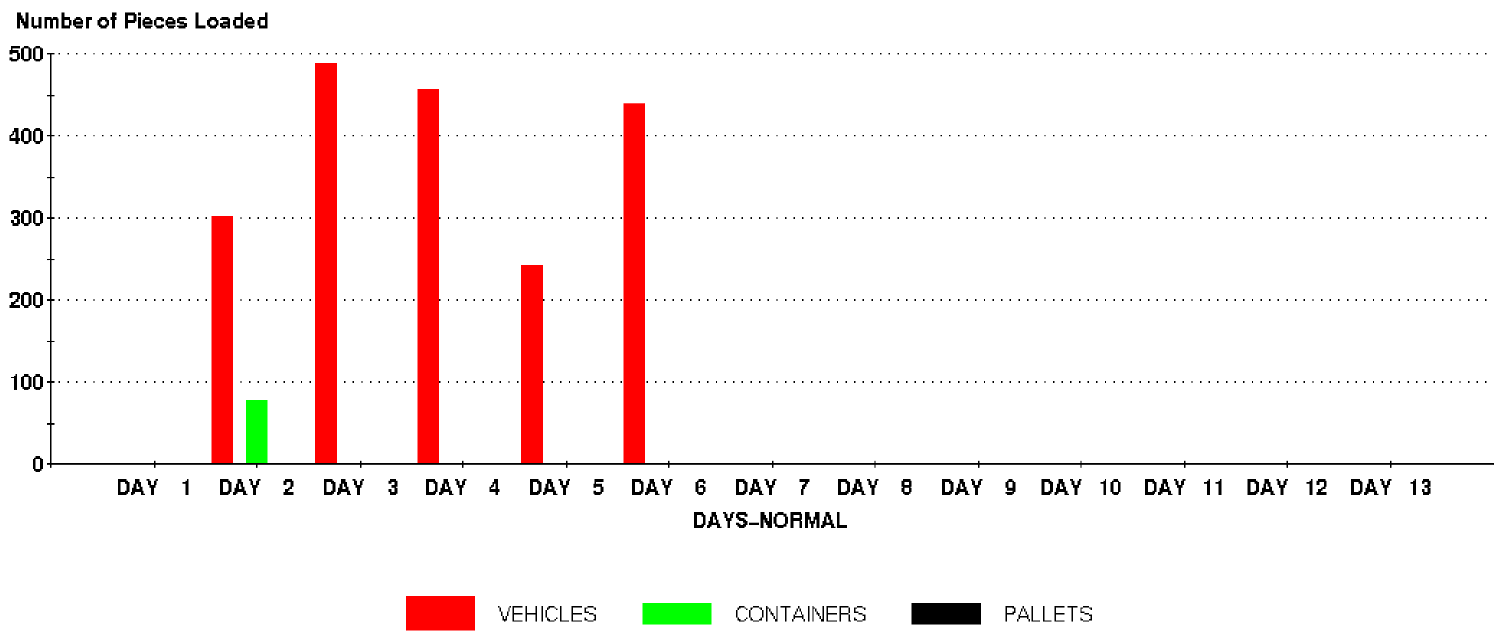
CUMULATIVE CLOSURE PROFILE FOR
NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



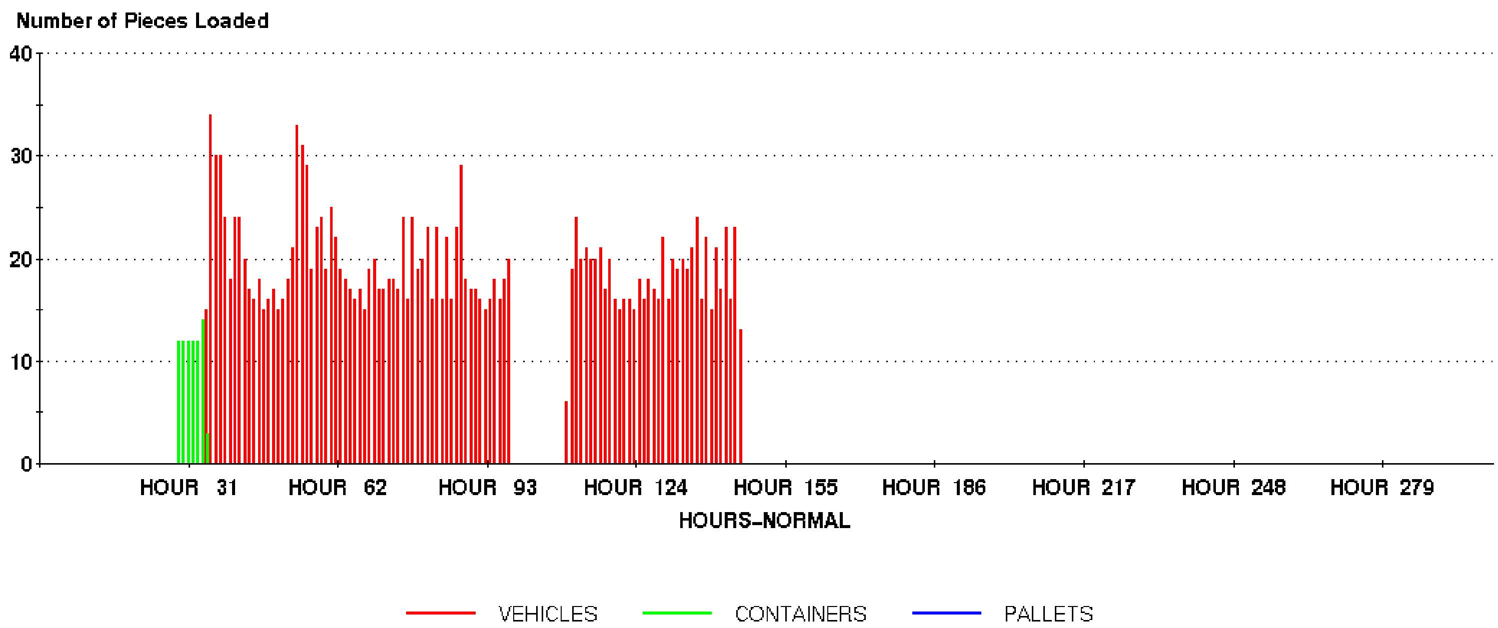
**DAILY CLOSURE PROFILE FOR
NOTIONAL HEAVY ARMORED CAVALRY REGIMENT**



DAILY THROUGHPUT FOR
NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



HOURLY THROUGHPUT FOR
NOTIONAL HEAVY ARMORED CAVALRY REGIMENT



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West Coast Ports

September 1994

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INTRODUCTION

As part of the ongoing Ports for National Defense (PND) Program, the Military Traffic Management Command Transportation Engineering Agency (MTMCTEA) revised information for selected west coast ports. The objectives of this report are to:

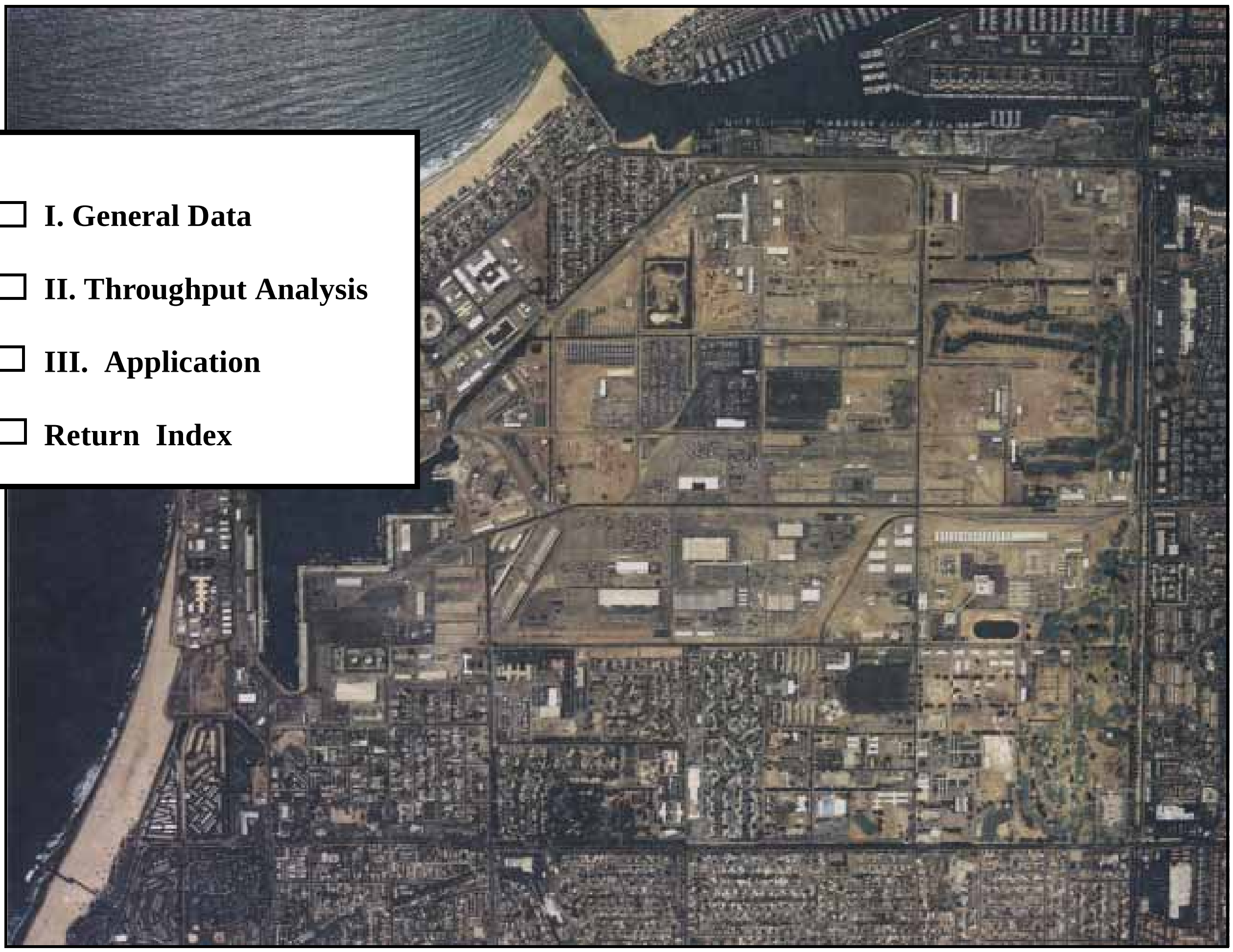
- *Identify* the port facilities and equipment needed to support a deployment.

- *Determine* the port throughput capability in MTON per day.

- *Determine* the ability of MARAD designated facilities to meet the deployment of specific units.

PORT OF PORT HUENEME

PORT HUENEME, CALIFORNIA



I. General Data

II. Throughput Analysis

III. Application

Return Index

I. GENERAL DATA

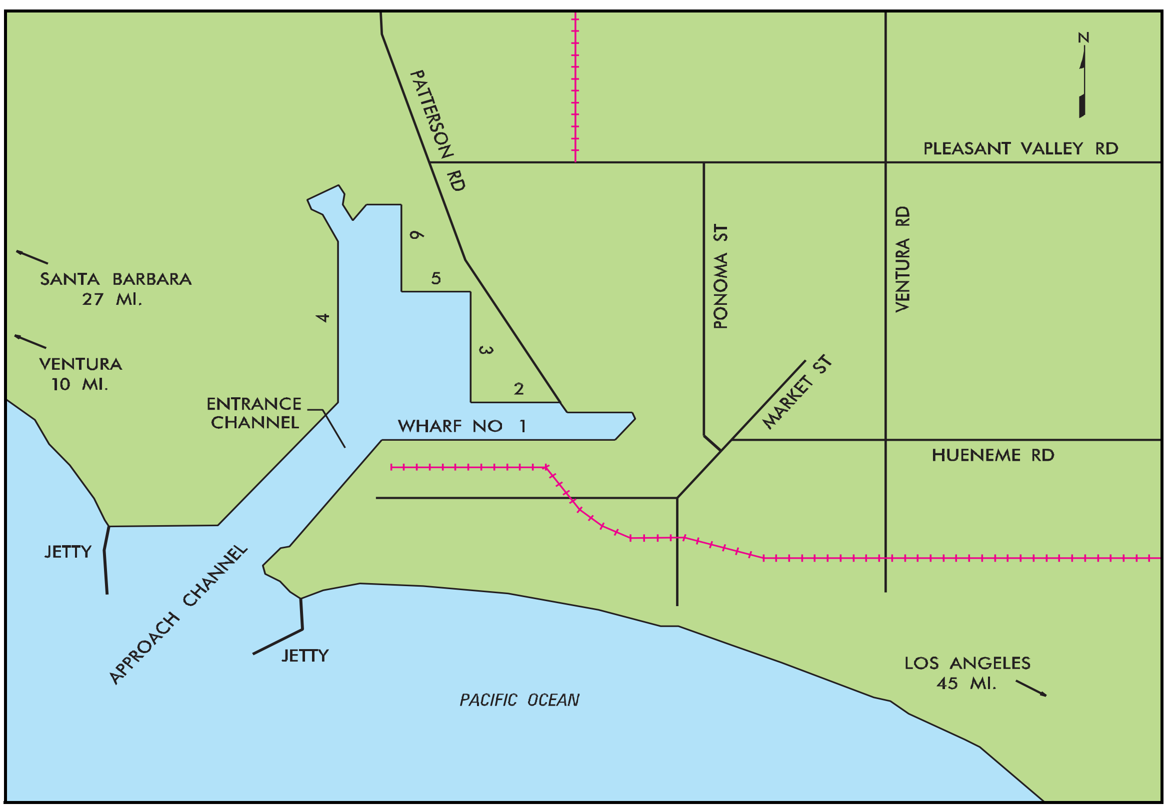
TRANSPORTATION ACCESS

Water

Port Hueneme is in a basin, just inland of the Pacific Ocean. The Oxnard Harbor District owns the south-east portion of the basin and operates it as a commercial deep-draft port. The remainder of the basin is under the control of the US Naval Construction Battalion Center (NCBC).

A dredged approach channel between two jetties leads to the entrance channel. The entrance channel leads to the port harbor. These channels vary from 37 to 40 feet deep mean low water (MLW) and from 330 to 600 feet wide. No overhead restrictions lead into the port.

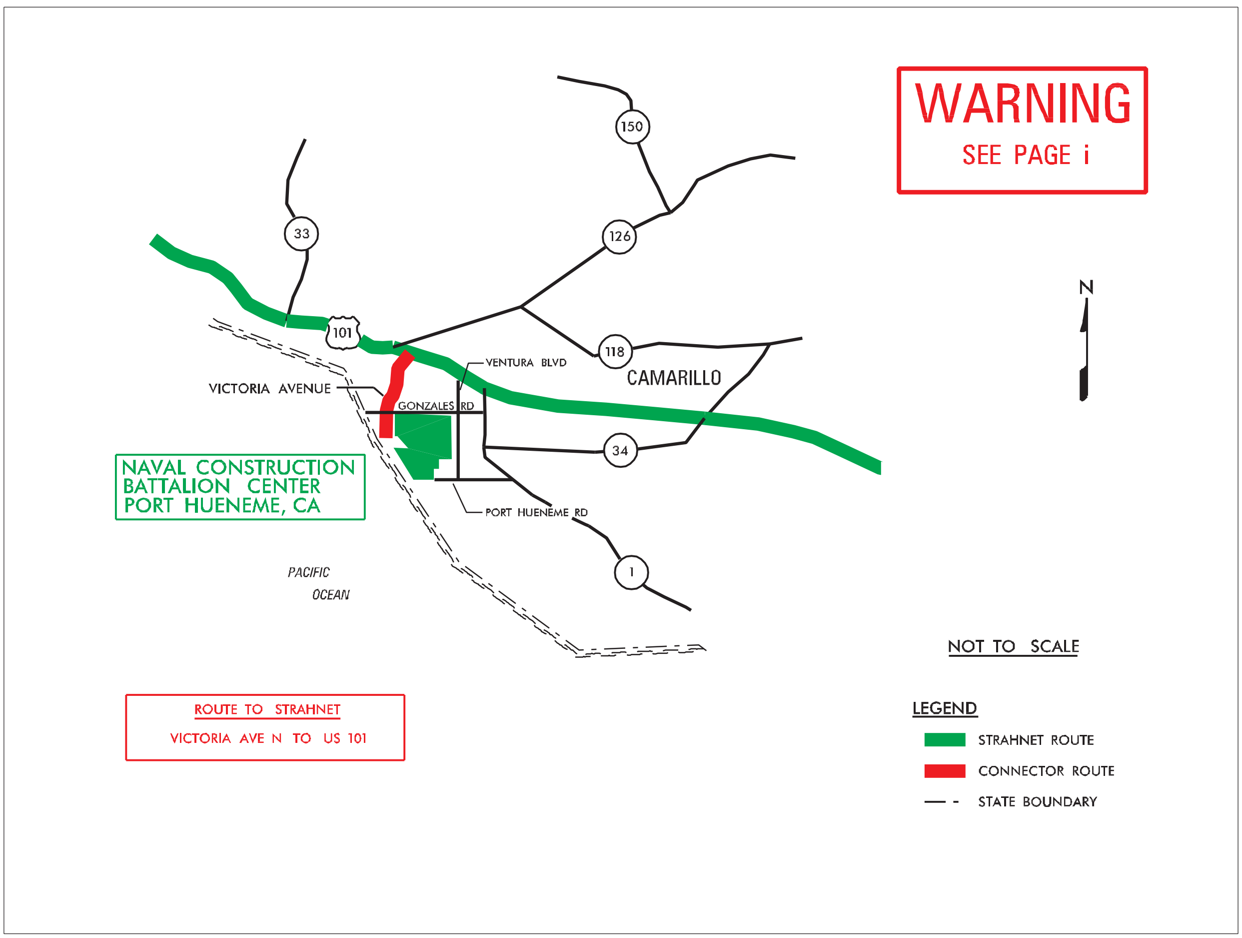
A small turning basin between wharves 3 and 4 will accommodate a ship length of 827 feet. The port has no anchorages; however, offshore anchorages are available about 1.5 miles southwest of the channel entrance. The tidal range is 5.4 feet, with an extreme range of 9 feet.



Water Access

Highway

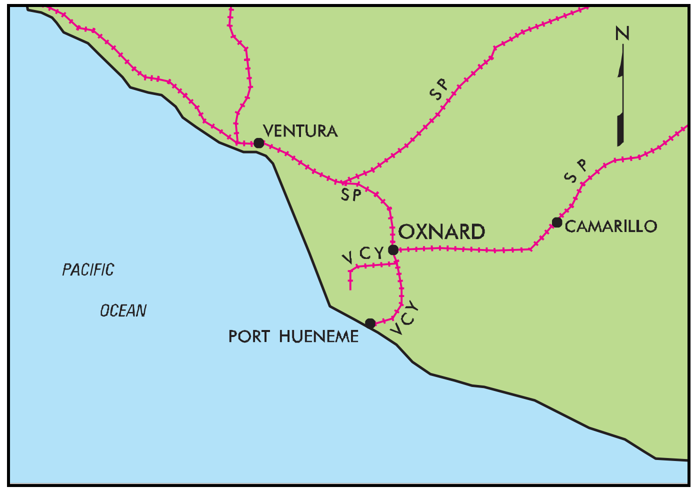
Shown below are the highway routes to the Port of Port Hueneme. The major routes to the Port Hueneme area are Ventura Freeway (US Route 101) and Pacific Coast Highway (California Route 1). Several roads lead from these major routes to the port area - Victoria Avenue and Ventura Road from the north and Port Hueneme Road and Pleasant Valley Road from the east. Victoria and Pleasant Valley Gates provide entrance to the port. Any transport configuration higher than 14 feet and/or wider than 102 inches is an oversize transport item for the State of California.



Highway Access

Rail

The Southern Pacific Transportation Company (SP) provides rail service to the port via the Ventura County Railway (VCY). SP trains bring railcars to the SP Oxnard switching yard. The Oxnard local rail crew switches the railcars to the VCY railyard. VCY then provides the rail service to the NCBC railyard 1 mile from the port. The Navy owns and operates a locomotive on the center to provide an internal switching capability.



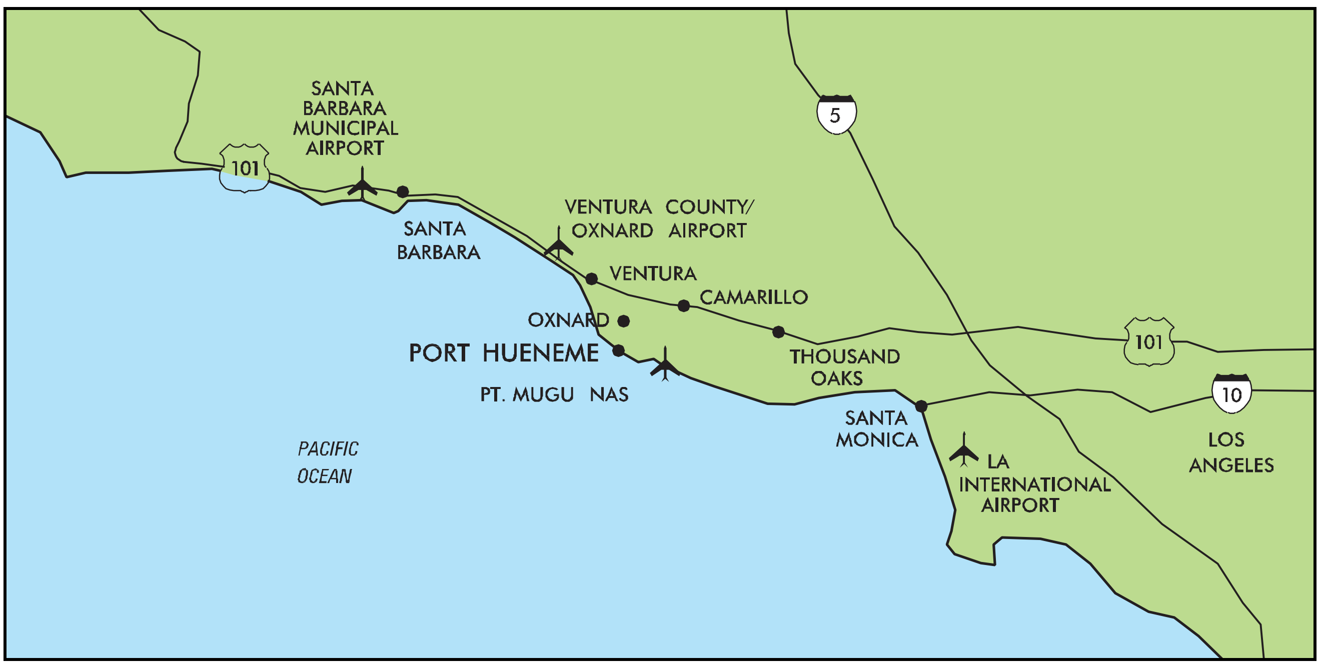
Rail Access

The VCY and NCBC railyards can store railcars. The SP railyard is a short-term holding yard rather than a storage yard. No rail clearance restrictions exist along the port access.


NCBC Railyard

Airport

The nearest airport to the Port of Port Hueneme is Ventura County/Oxnard Airport. It is 3 miles from the port and has one asphalt runway, measuring 5,950 feet long and 100 feet wide. The nearest major airports are LA International (50 miles southeast of the port) and Santa Barbara Municipal (50 miles northwest of the port). The airport at Santa Barbara has three asphalt runways; the longest is 6,050 feet long by 150 feet wide. LA International has four concrete runways; the longest is about 12,100 feet long by 150 feet wide. The nearest military airfield is the Naval Air Weapons Station at Point Mugu. This airfield is 7 miles southeast of the port and has two asphalt runways; the longest is 11,100 feet long by 200 feet wide.



Airport Access

PORT FACILITIES

Berthing

The Port of Port Hueneme is a multicargo terminal consisting of long and short marginal wharves. Pier construction is generally either concrete decking supported by concrete piles or concrete bulkhead with concrete surface solid fill. All berths are fronted with timber or rubber and timber fendering systems. All berths have lights for night operations.

Figures 1 and 2 are land-use maps of the port, which show the berthing and port facilities. Figure 3 shows an aerial view of the port and includes a table identifying berth characteristics.

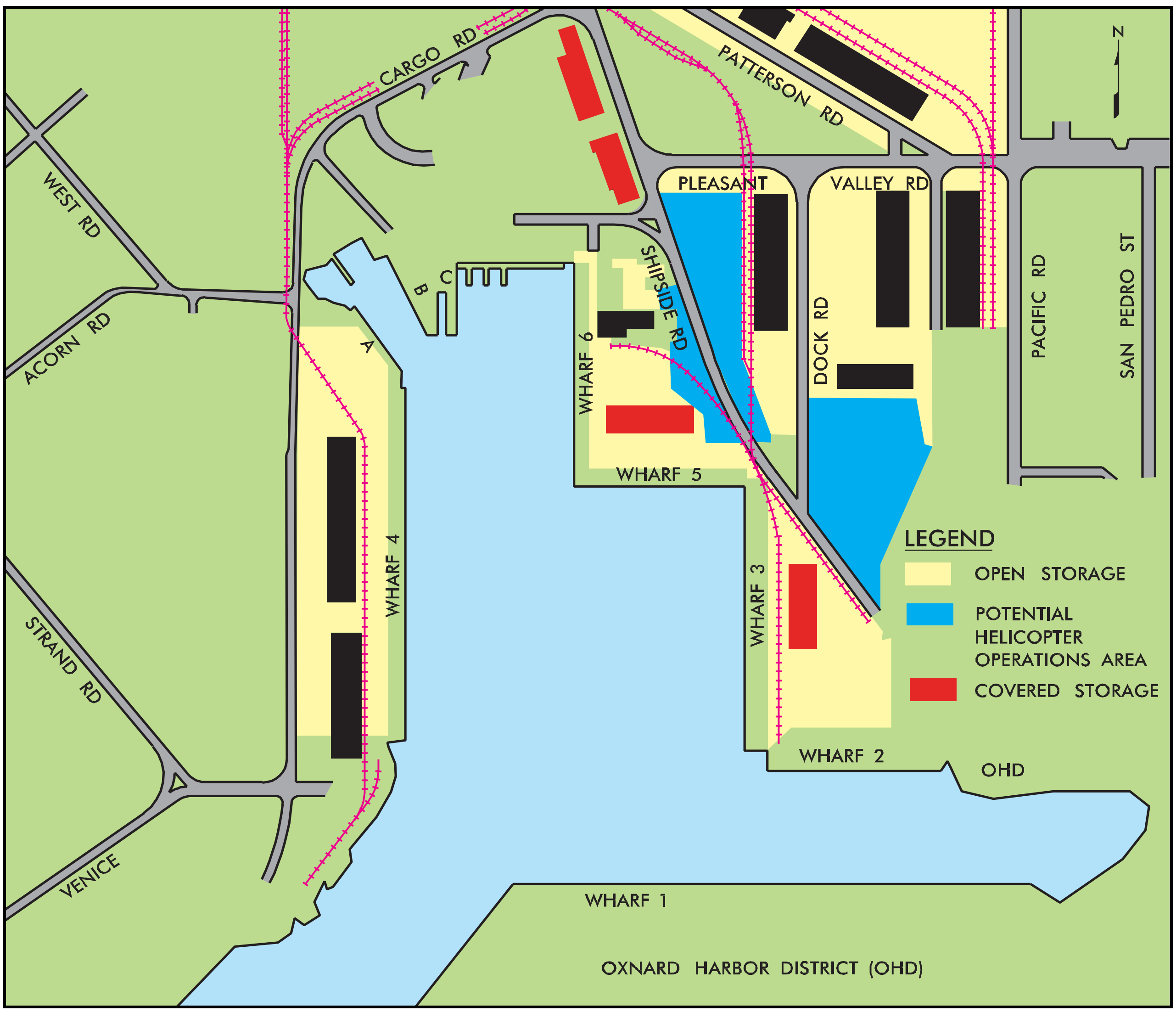
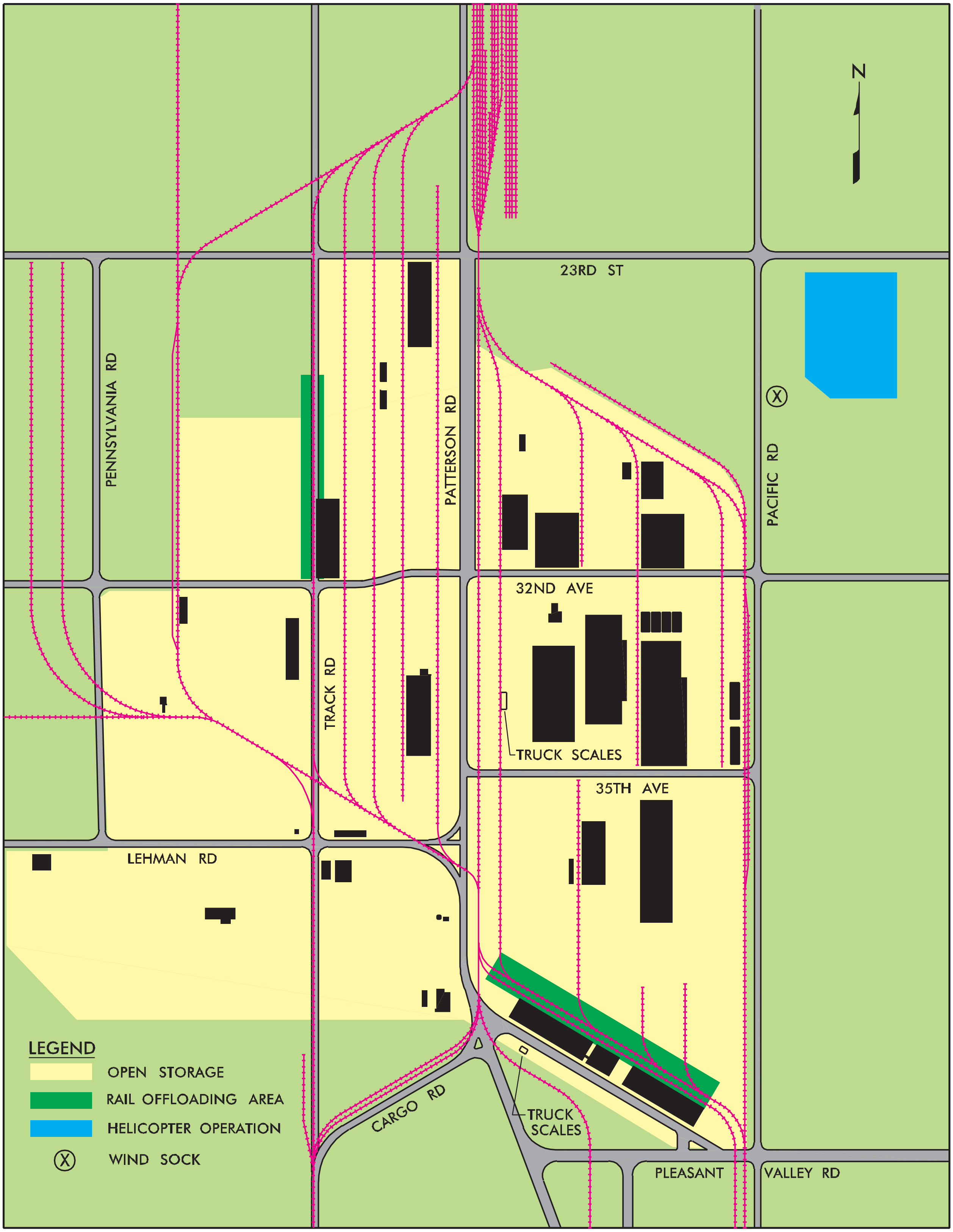


Figure 1. Land-use map for immediate port area.



Fiqure 2. Land-use map for area north of port area.

BERTH CHARCTERISTICS

CHARACTERISTICS	BERTHS								
	1	2	3	4	5	6	A	B	C
Length (ft)	1,800	1,400	1,025	1,202	600	784	250	350	391
Depth alongside at MLW (ft)	35	35	35	35	35	35	16	18	21
Deck strength (psf)	600	600	600	600	600	600	600	600	600
Apron width (ft)	Open	Open	Open	Open	Open	Open	Open	Open	Open
Apron height above MLW (ft)	14	14	14	14	14	14	14	14	14
Number of container cranes	0	0	0	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	Yes	No	No	No	No	No	No
Apron length served by rail (ft)	0	0	0	0	0	0	0	0	0

Notes:
1. Terminal open staging area is 220 acres.
2.Terminal covered storage area is 281,000 square feet.

Figure 3. Port facilities

Staging

OPEN STAGING

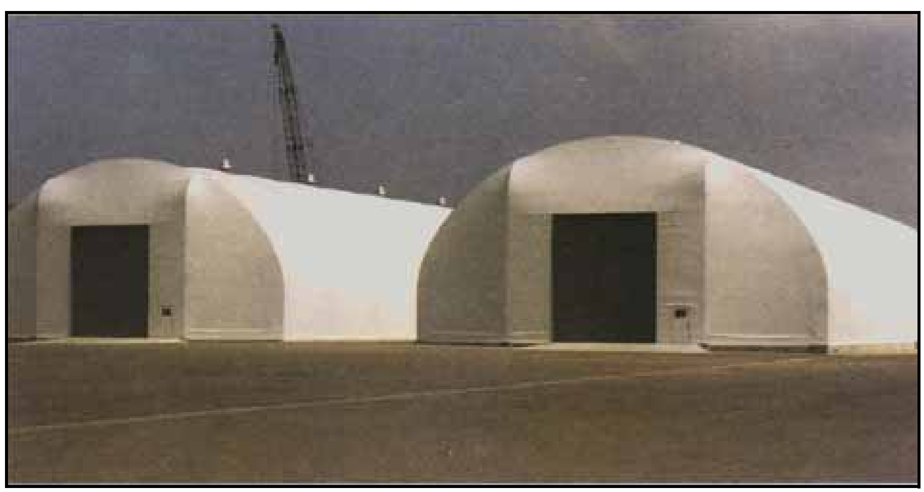
The Port of Port Hueneme has about 35 acres of open storage in the immediate port area. Dispersed throughout NCBC are another 185 acres of available open storage. All open storage areas are paved and provide storage for a variety of cargo. The port has two areas with potential for helicopter operations. One area, 10 acres, is north and east of wharf 5 (fig 1). The other area, 20 acres, is southeast of the intersection of Pacific Road and 23rd Avenue, across the street from Building 372 (fig 2).

COVERED STAGING

Three warehouses and one transit shed are available for covered storage use. These facilities provide 105,090 square feet of covered storage. In addition, the port has three 400- by 80-foot and five 200- by 80-foot tension fabric structures. These structures provide 176,000 square feet of covered storage.

Transit Shed,
Building 546,
Wharf 3

Tension Fabric
Structures



Rail

Rail trackage links the railyards to various rail spurs and storage tracks throughout the installation. The port's wharves do not have apron tracks.

Almost 25 miles of rail are within the NCBC installation. The port railyard has a capacity of about 200 89-foot railcars. Rail spurs and other installation trackage provide storage for about another 200 89-foot railcars.

Highway

The port has about 44 miles of paved roadways. All of these roads, including gate entrances, are two laned with no clearance restrictions.

NCBC has two truck scales. One is at Building 516, off Patterson Road across the street from Building 510. The other, near Building 801, is off Patterson Road between 32nd and 35th Avenues (fig 2).

Truck Entrance, Victoria Gate

Truck Scales, Building 801 Compound

Unloading/loading Positions

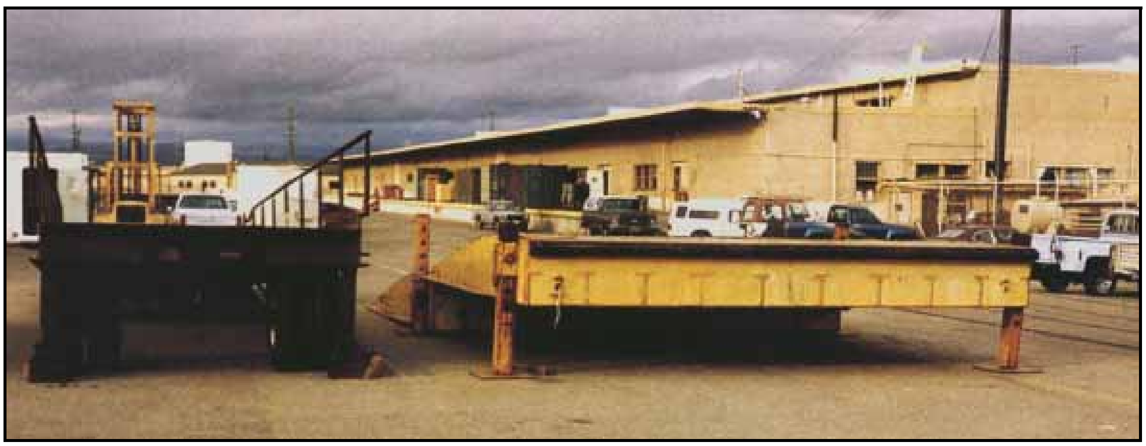
RAMPS

The port has a variety of ramps for railcar and semitrailer offloading operations. The following table provides information on the number and types of ramps, as well as offloading use, available at the Port of Port Hueneme.

END-RAMP INFORMATION

TYPE	QUANTITY	USE (OFFLOAD)
Portable Steel	3	Railcar of Semitrailer
Trilevel	1	Railcars
Fixed Concrete	1	Flatcars/Boxcars/Low-boys/Vans
Forkilift Width, Potable	5	Boxcars/Vans
Bridge Unit Sets	8	Lowboy Semitrailers

The most commonly used rail offloading areas are the rail spur near Buildings 510 and 513, off Patterson Road, and the track at Building 410, off 32nd Avenue (fig 2).



Portable Steel End Ramps

Trilevel End Ramp

Fixed Concrete Ramp Near Building 801

Portable, Forklift-Width Ramp

DOCKS

The port did not identify any docks available for use during a deployment. Many of the buildings on NCBC contain pre-positioned Navy war material and are not readily available for use during deployment. Because the climate in the Port Hueneme area is dry, the port authority states that there is usually little need for covered storage and dock operations. In many cases, the port uses the five narrow, forklift width, portable end ramps as a means for forklifts to offload vans and boxcars instead of using truck or rail docks.

Marshaling Areas

The 185 acres of additional open storage identified in the open staging section could be used for marshaling if desired. There are no designated marshaling areas off the installation.

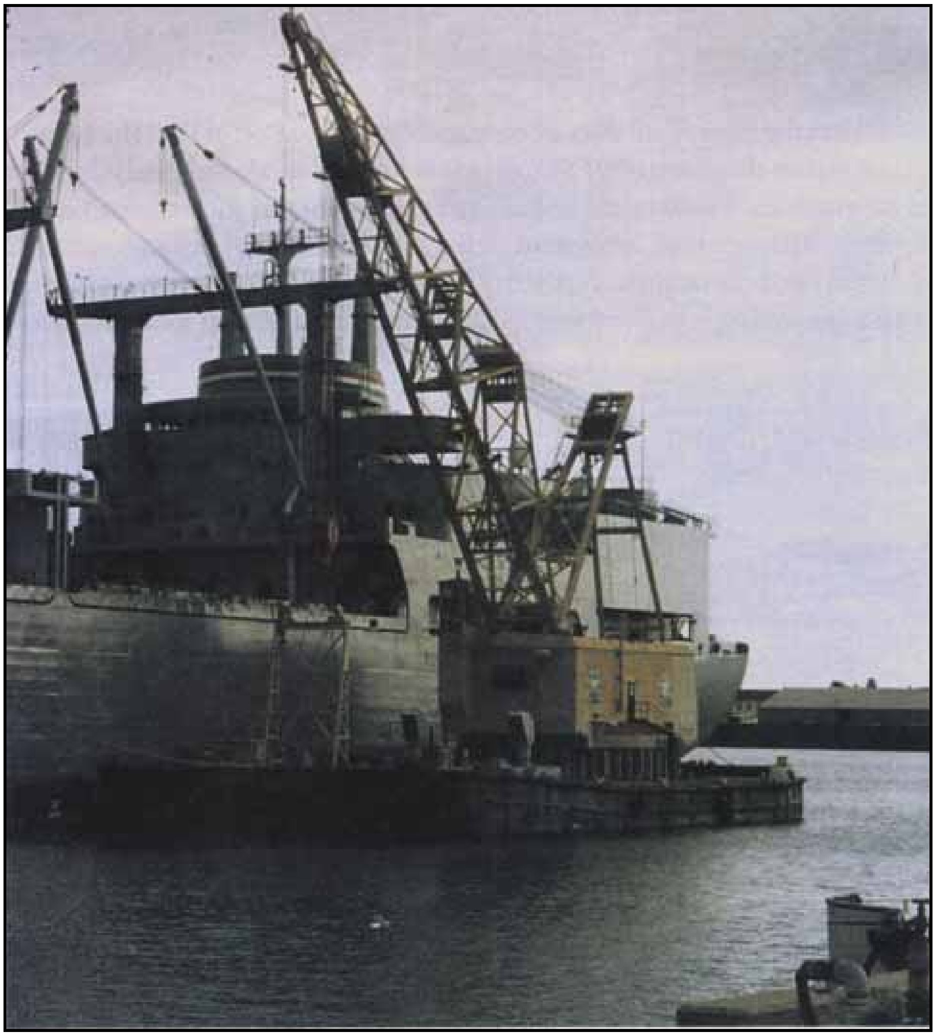
MATERIALS HANDLING EQUIPMENT

The Port of Port Hueneme has one 112-ton floating crane and three mobile cranes available for loading ships. The capacities of the mobile cranes are 140, 50, and 24 tons. Many forklifts are available for materials handling. The largest have 40- and 24-ton capacities. More materials handling equipment (MHE) is available through local stevedore companies.

NAVY-OWNED MHE

EQUIPMENTS TYPE	CAPACITY (STON)	QUANTITY
Container Handlers RT	50	2
Floating Crane	112	1
Mobile Crane	140	1
Mobile Crane	50	1
Mobile Crane	24	1
Forklift	40	1
Forklift	24	1
Forklift	10	8
Forklift	7.5	17
Forklift	5	2
Forklift	3	31
Forklift	2	12
Forklift,electric	2	8
Dock Trailers	25	63

Rough Terrain Container Handler (RTCH)



Floating Crane

INTERMODAL FACILITIES

The nearest intermodal railyards are in the Los Angeles/Long Beach area. The chapters on the Port of Los Angeles/Long Beach provides information on these facilities.

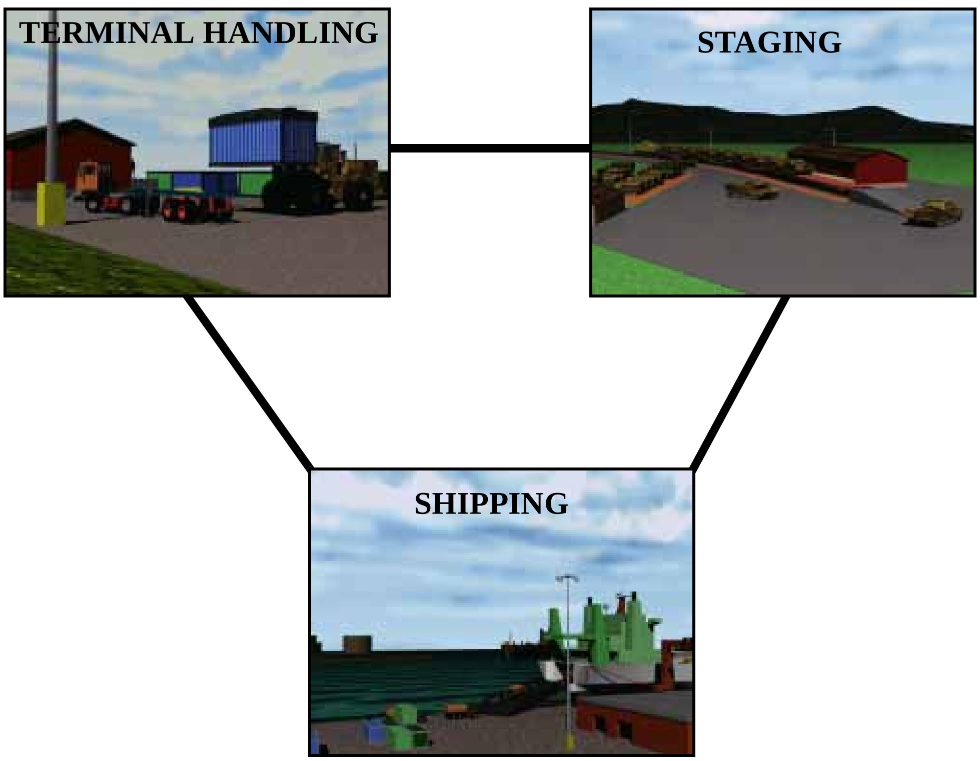
FUTURE DEVELOPMENT

The US Army Corps of Engineers (COE) will conduct a study of the port in 1993. Port officials will ask COE to address recommendations for widening the turning basin, dredging to 45 feet, and adding finger piers.

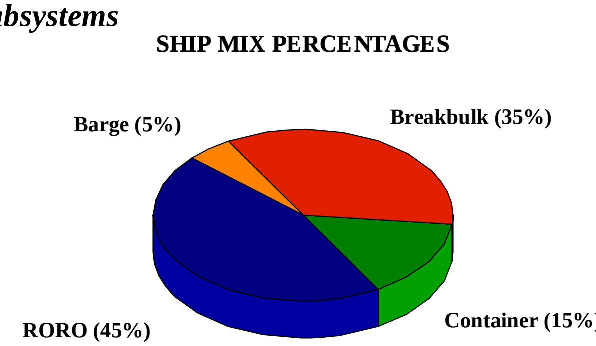
II. THROUGHPUT ANALYSIS

GENERAL

This section evaluates the theoretical throughput capability of the Port of Port Hueneme using the port operational performance simulator (POPS) computer model. A weak-link analysis provides the basis for the model in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in short tons (STON) and measurement tons (MTON) per day.



Terminal Throughput Subsystems



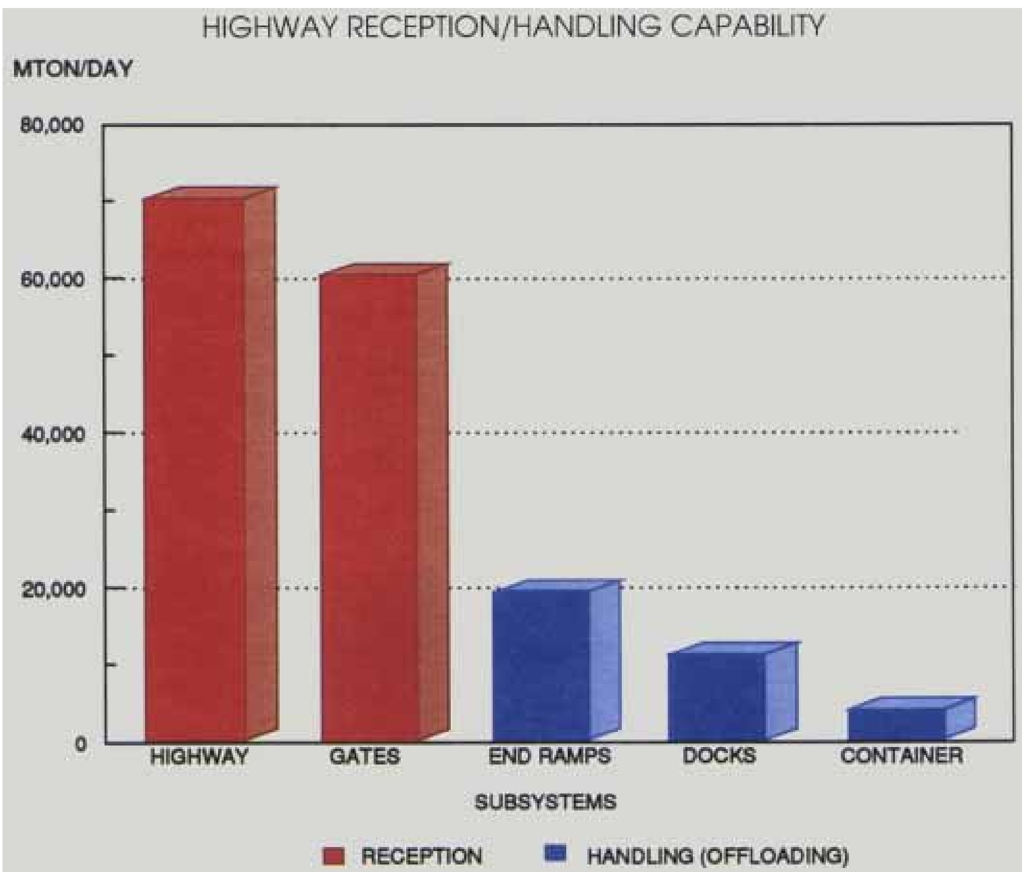
The analysis assumed that 80 percent of the port facilities will support the military deployment. Also, Desert Shield and Desert Storm statistics provide the basis for the ship mix. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.

TERMINAL RECEPTION/ HANDLING

Highway

The major routes (US Route 101 and California Route 1) and connectors (Victoria Avenue and Ventura, Port Hueneme, and Pleasant Valley Roads) provide good access to the port area. Two gates - Victoria Gate (off Victoria Avenue) and Pleasant Valley Gate (off Pleasant Valley Road) - provide entrance to the port. The roadways from these gates provide access to staging and wharf areas. The gate reception of the two roadways providing access/egress could handle about 17,600 STON (60,665 MTON) of equipment and supplies per day.

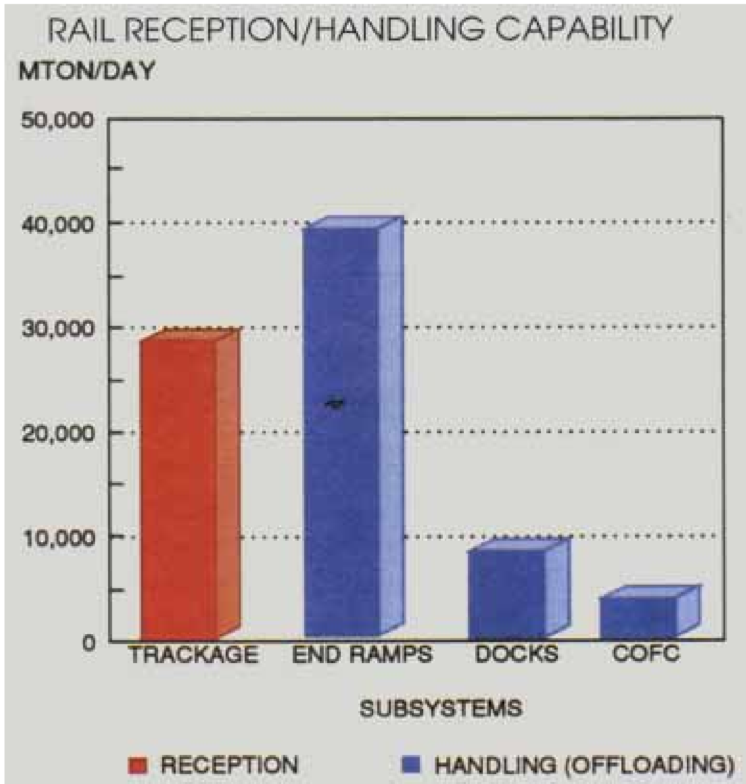
Roadable vehicles in convoys will process directly to staging areas. Vehicles on commercial or military flatbed semitrailers will offload at portable ramp areas. These ramps could offload about 6,400 STON (19,200 MTON) per day. NCBC uses the narrow mobile ramps and forklifts for offloading supplies in van semitrailers. With this method, the van semitrailer offloading rate will be 4,350 STON (10,880 MTON) per day. Containers on trucks would move to a staging area or pier for offloading. Container MHE such as a rough terrain container handler (RTCH) and/or cranes could offload containers at a rate of 1,500 STON (3,750 MTON) per day.



Rail

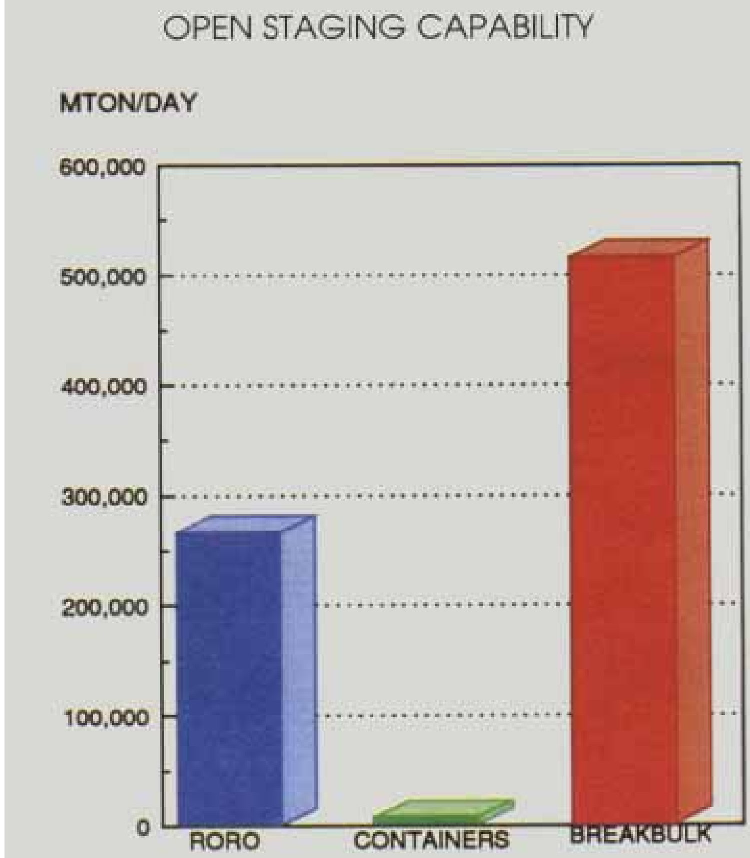
Southern Pacific (SP) provides rail access to the port via Ventura County Railway (VCY). The railyard within the port could store about 200 89-foot railcars. Rail spurs throughout NCBC could store an additional 200 89-foot railcars. The VCY railyard can store about 100 89-foot railcars. Current rail service to the port is about three 80-car trains per day.

Vehicles on flatcars could offload at various locations using portable end ramps. As with van semitrailers, deploying units will offload boxcars by using the narrow ramps for forklift operations. A RTCH and/or crane will offload containers.



STAGING

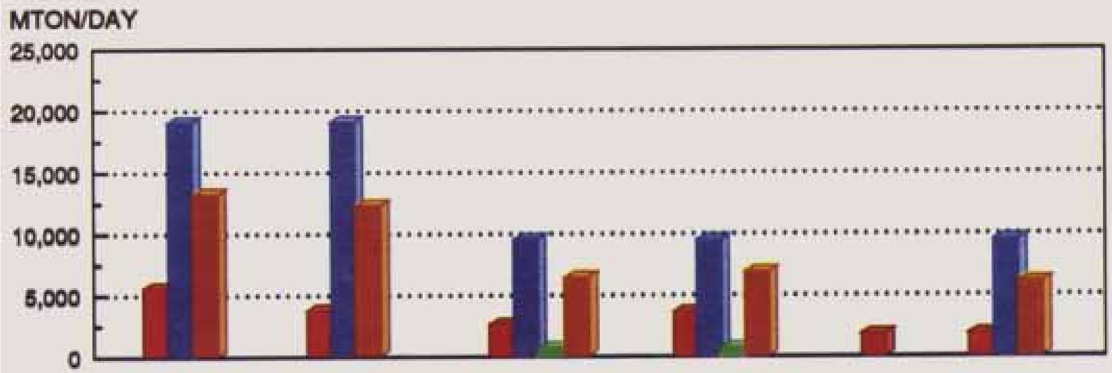
The port has 220 acres of open storage for vehicles and/or containers. Of this total, a 35-acre area is near the port. This staging area can store about 66,504 STON (266,016 MTON) of rolling stock, or 3,000 STON (7,500 MTON) of containers, or 183,614 STON (513,660 MTON) of breakbulk cargo. Also, about 281,090 square feet of covered storage provides protection for about 4,500 STON (11,250 MTON) of palletized cargo.



SHIPPING

We identified the throughput capability per berth in MTON per day for breakbulk, RORO, container, and mixed vessels. Various factors including MHE used; loading, operational, and berth usage rates; and berth/ship compatibility provide the basis for these results.

BERTH THROUGHPUT CAPABILITY



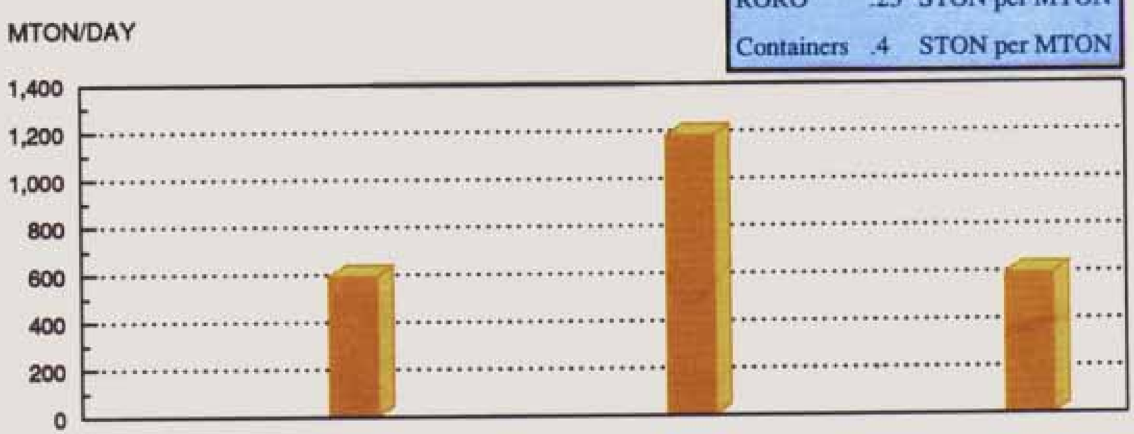
BERTH	1*	2*	3	4	5	6
BREAKBULK	5,574	3,716	2,654	3,716	1,858	1,858
RORO	18,874	18,874	9,437	9,437	0	9,437
CONTAINER	0	0	625	625	0	0
BARGE	0	0	0	0	0	0
MIXED	13,055	12,243	6,470	6,934	0	6,121

*OXNARD HARBOR DISTRICT

BERTH THROUGHPUT CAPABILITY - cont

CONVERSION FACTORS

Breakbulk	.4	STON per MTON
RORO	.25	STON per MTON
Containers	.4	STON per MTON



BERTH	A	B	C
BREAKBULK	0	0	0
RORO	0	0	0
CONTAINER	0	0	0
BARGE	590	1,180	590

Table 1 shows the compatibility for various vessel types. This table shows for each type of ship, the number of vessels that can berth at a particular wharf. Also, it provides the limitations that can hinder shipping operations.

Methodology that gives a snapshot view of the current physical characteristics of the berths and the MHE available provides the basis for the type of ship preferred at each berth. The evaluation gives no considerations for enhancements, such as equipment.

The berth preference analysis shows that wharf 4 is the most compatible for all ship types.

PREFERENCE BERTH SELECTION

LOADING TYPE	BERTHS								
	1*	**2***	**3**	**4**	**5**	**6**	**A**	**B**	**C**
Breakbulk	3	5	3	1	5	1	-	-	-
RORO	3	5	2	1	-	4	-	-	-
Container	2	5	2	1	-	4	-	-	-
Barge	3	5	3	1	5	2	8	7	7

Note:
Berths marked with "-" are not recommended for these operations.
*These berths are commercial wharves in the Oxnard Harbor District and are subject to commercial rates.

TABLE 1
SUMMARY OF PORT HUENEME BERTHING CAPABILITIES

VESSEL	BERTHS 1	2	3	4	5	6
Breakbulk						
C3-S-33a	3	2	2	2	1	1
C3-S-37c	3	2	1	2	1	1
C3-S-37d	3	2	1	2	1	1
C3-S-38a	3	2	1	2	1	1
C4-S-1a	3	2	1	2	1	1
C4-S-1qb and 1u	3	2	1	2	1	1
C4-S-58a	3	2	1	2	1	1
C4-S-65a	3	2	1	2	1	1
C4-S-66a	3	2	1	2	1	1
C4-S-69b	2	2	1	1	1	1
Seatrain						
GA and PR-class	3	2	1	2	1	1
Barge						
LASH C8-S-81b	2	1	1	1	c	c
LASH C9-S-81d	a,g	a,g	a,g	a,g	a,c,g	a,c,g
LASH lighter	12	10	7	8	4	5
SEABEE C8-S-82a	a,g	a,g	a,g	a,g	a,c,g	a,c,g
SEABEE barge	9	7	5	6	3	3
RORO						
Comet	d,i,j	d,i,j	i,j	d,i,j	d,i,j	d,i,j
C7-S-95a/Maine-class	2	1	1	1	c	1
Ponce-class	h	h	h	h	c,h	h
Great Land-class	h	h	h	h	c,h	c,h
Cygnus/Pilot-class	2	2	1	1	c	1
Meteor	d,i,j	d,i,j	i,j	d,i,j	d,i,j	d,i,j
AmEagle/Condor	i,j	i,j	i,j	i,j	c	i,j
MV Ambassador	d	d	1,m	d	d	d
FSS-class	1	1	1	1	c	c
Cape D-class	i,j	i,j	i,j	i,j	c	i,j
Cape H-class	a	a	a	a	a,c	a
Container						
C6-S-lw	2,e	2,e	1,e	1,e	c,e	1.e
C7-S-68e	2,e	1.e	1,e	1,e	c,e	1,e
C8-S-85c	2,e	1,e	1,e	1,e	c,e	c,e
Combination						
C5-S-78a	2,e	2,e	1,e	1,e	c,e	1,e
C5-S-37e	2,e	2,e	1,e	1,e	1,e	1,e

a = maximum vessel draft limited to berth depth
b = inadequate apron width
c = inadequate berth length
d = no straight stern-ramp facilities
e = no container-handling equipment
f = inadequate berth depth, adequate anchorage depth
g = inadequate channel depth
h = no shore-based ramps available
i = insufficient ramp clearance at low tide
j = insufficient ramp clearance at high tide
k = excessive ramp angle at low tide
m = execessive ramp angle at high tide
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

TABLE 1 - cont
SUMMARY OF PORT HUENEME BERTHING CAPABILITIES

VESSEL	BERTHS A	BERTHS B	BERTHS C
Breakbulk			
C3-S-33a	a,c	a,c	a,c
C3-S-37c	a,c	a,c	a,c
C3-S-37d	a,c	a,c	a,c
C3-S-38a	a,c	a,c	a,c
C4-S-1a	a,c	a,c	a,c
C4-S-1qb and 1u	a,c	a,c	a,c
C4-S-58a	a,c	a,c	a,c
C4-S-65a	a,c	a,c	a,c
C4-S-66a	a,c	a,c	a,c
C4-S-69b	a,c	a,c	a,c
Seatrain			
GA and PR-class	a,c	a,c	a,c
Barge			
LASH C8-S-81b	a,c,f	a,c,f	a,c,f
LASH C9-S-81d	a,c,g	a,c,g	a,c,g
LASH lighter	1	2	2
SEABEE C8-S-82a	a,c,g	a,c,g	a,c,g
SEABEE barge	1	1	1
RORO			
Comet	a,c,d	a,c,d	a,c,d
C7-S-95a/Maine-class	a,c	a,c	a,c
Ponce-class	a,c,h	a,c,h	a,c,h
Great Land-class	a,ch	a,c,h	a,c,h
Cygnus/Pilot-class	a,c	a,c	a,c
Meteor	a,c,d	a,c,d	a,c,d
AmEagle/Condor	a,c	a,c	a,c
MV Ambassador	a,c,d	a,c,d	c,d
FSS-class	a,c	a,c	a,c
Cape D-class	a,c	a,c	a,c
Cape H-class	a,c	a,c	a,c
Container			
C6-S-lw	a,c,e	a,c,e	a,c,e
C7-S-68e	a,c,e	a,c,e	a,c,e
C8-S-85c	a,c,e	a,c,e	a,c,e
Combination			
C5-S-78a	a,c,e	a,c,e	a,c,e
C5-S-37e	a,c,e	a,c,e	a,c,e

a = maximum vessel draft limited to berth depth
b = inadequate apron width
c = inadequate berth length
d = no straight stern-ramp facilities
e = no container-handling equipment
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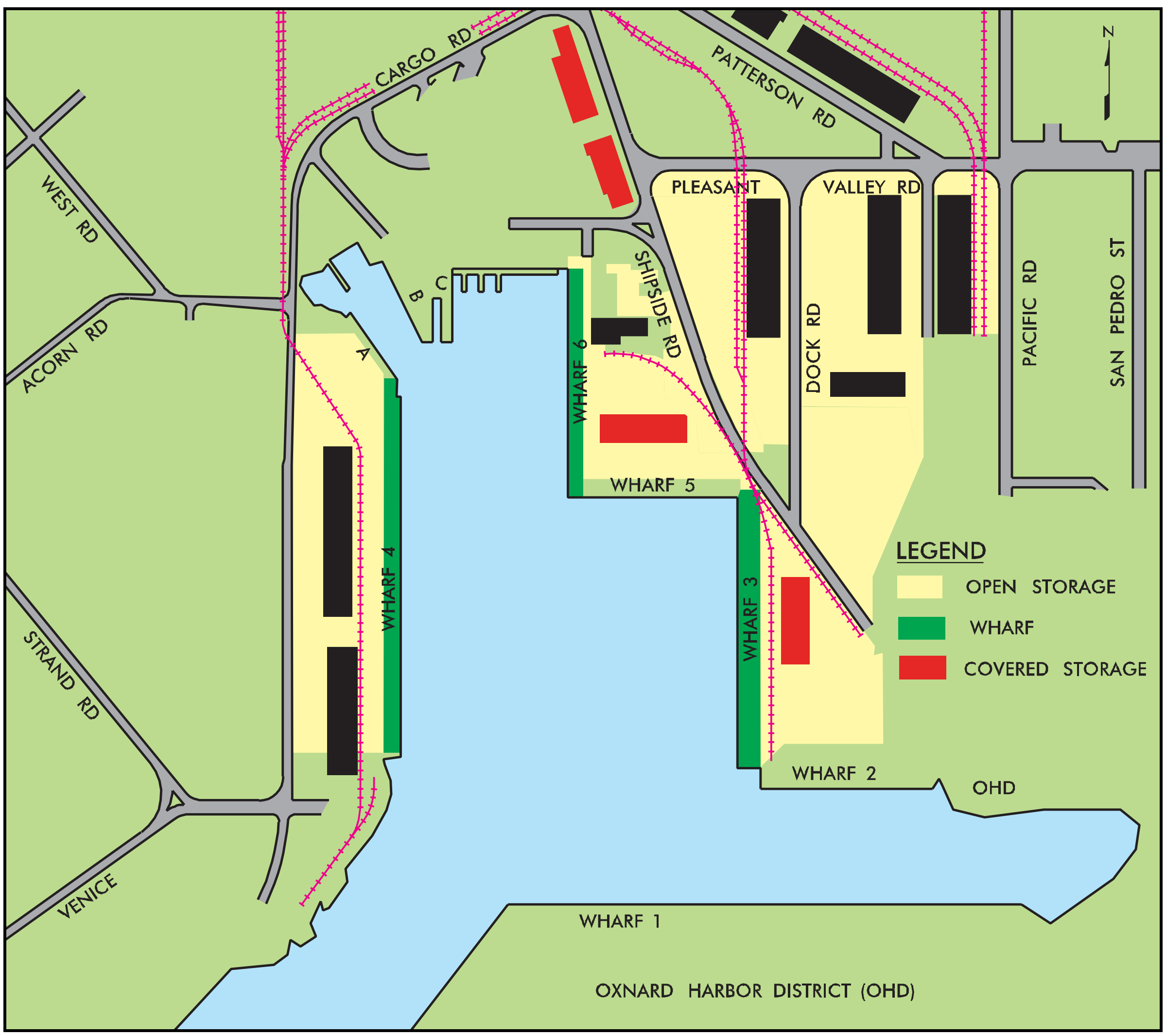
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

III. APPLICATION

GENERAL

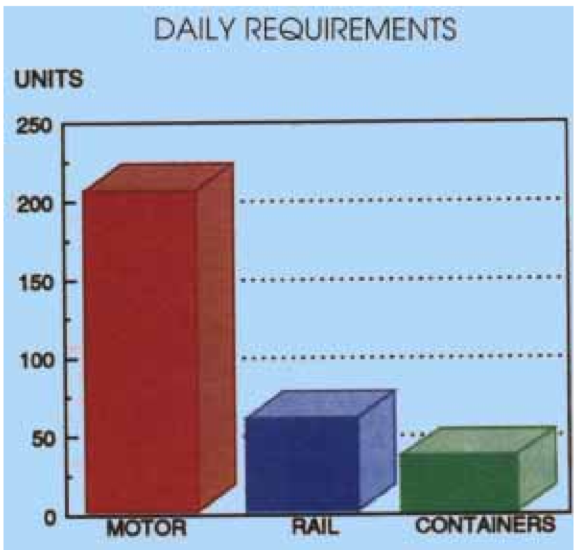
In this section, we evaluate the port's throughput capability for deploying a notional mechanized infantry brigade mainly by FSS vessels. The MARAD *Planning Orders Digest* does not call for use of the Port of Port Hueneme facilities during national emergencies. Therefore, we analyzed only those wharves, including accompanying facilities, that could possibly accommodate an FSS vessel. These include berths 3, 4, and 6. We assumed that the Army will have access to all of the open and covered storage identified in section I of this analysis.



Port Hueneme's Designated Faclities for Berthing FSS Vessels

REQUIREMENTS

The likely requirement for the Port of Port Hueneme is to deploy a notional mechanized infantry brigade in 6 days. The brigade has to move about 2,600 vehicles and 220 containers. Movement of this brigade to the port will require 360 railcars (60 per day) for the convoy/rail option. Under this option, deploying units would drive about 1,220 vehicles (205 per day) and tow another 775 pieces of equipment (130 per day).



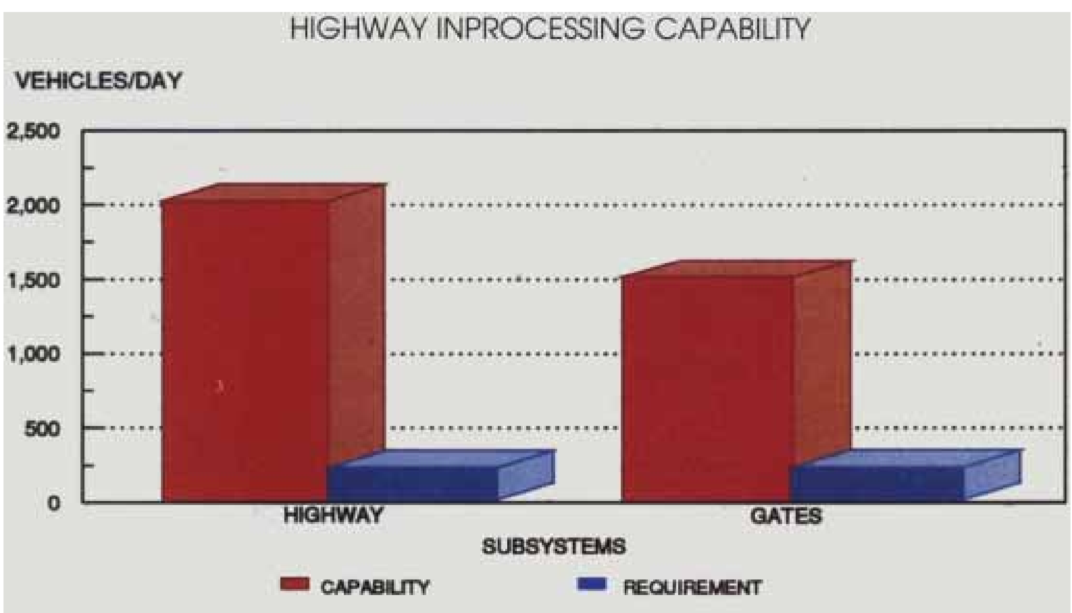
MECHANIZED INFANTRY BRIGADE DEPLOYMENT DATA

Total Equipment	
Volume	91,506 MTON
Weight	316,710 STON
Area	474,300 SQ FT
Vehicles	2,600
Containers (20 ft)	220

TERMINAL HANDLING

Highway

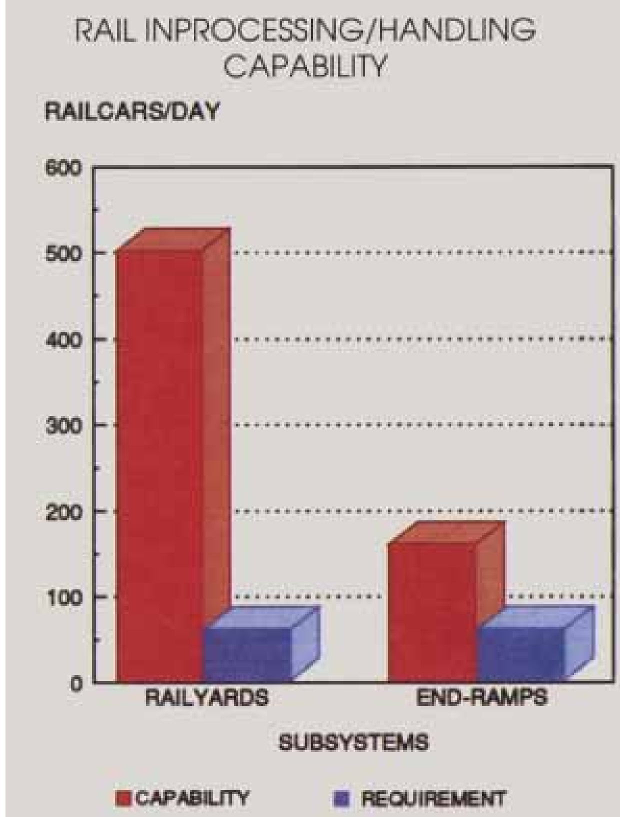
The connector roads to the Port of Port Hueneme are Victoria Avenue and Pleasant Valley, Ventura, and Port Hueneme Roads. Vehicles would enter the port via Victoria and Pleasant Valley Gates for deployment from berths 3, 4, and 6. Both the access roads and gates processing subsystems can handle well over 1,500 vehicles per day.



Rail

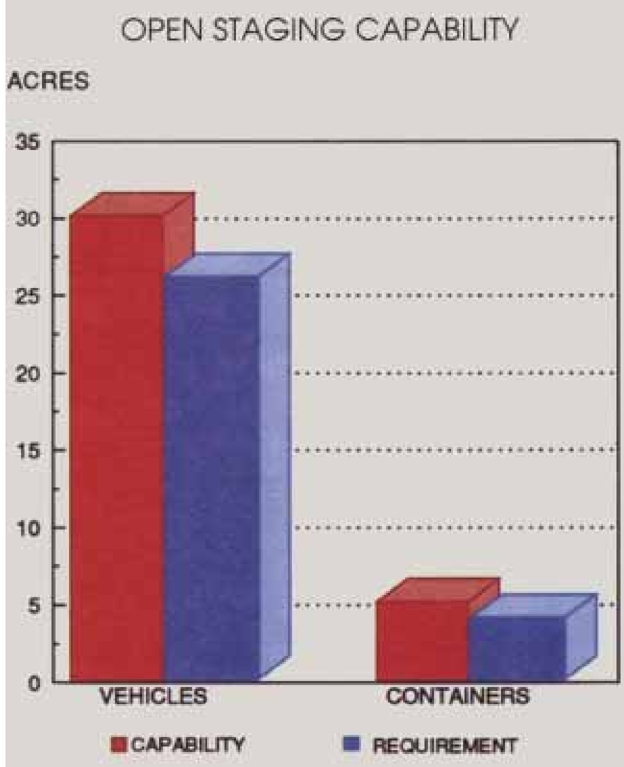
The classification yard and additional rail spurs could store about 400 railcars per day. The VCY railyard could store an additional 100 railcars per day. Current service to the port is about 3 trains per day (potentially 240-300 railcars per day).

The port has a variety of end ramps available for offloading operations. If the port uses four end ramps for offloading, it could offload about 40 railcars every 5 hours, or more than 160 railcars per day.



STAGING

The Port of Port Hueneme has about 220 acres of open storage area (35 acres are near the port) for military operations. We estimate that a mechanized infantry brigade needs at least 30 acres of open staging to support the concurrent nonsustained loading of three FSS vessels. Divided between vehicles and containers, the staging area requirement becomes 4 and 26 acres for containers and vehicles, respectively.



SHIPPING

The number of ships needed to load this requirement depends on the shipping mix selected. The best ship mix would require three FSS vessels and one Cape H RORO ship. However, the port harbor and ship berths are too shallow to allow passage and berthing of a fully loaded FSS or Cape H RORO ship. Based on this, a brigade cannot outload in 6 days using FSS and RORO vessels. However, deploying units could outload using selected breakbulk and containership vessels.

UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

LOADING CONDITION/ SAMPLE SHIP MIX	*VESSEL TYPES*			
	FSS (RORO/COMB)	**CAPE H (RORO/COMB)**	**C3/C4 (BREAKBULK)**	**C6/C7/C8 (CONTAINER)**
Minimum Containerization				
All FSS*	2.67	0.64		
FSS and Cape H	2.22	1.00		
All Breakbulk			12.57	
Maximum Containerization				
FSS and Container	2.64			0.67
FSS,Cape H, and Container	1.54	1.00		0.67
Breakbulk and Container			9.86	0.67

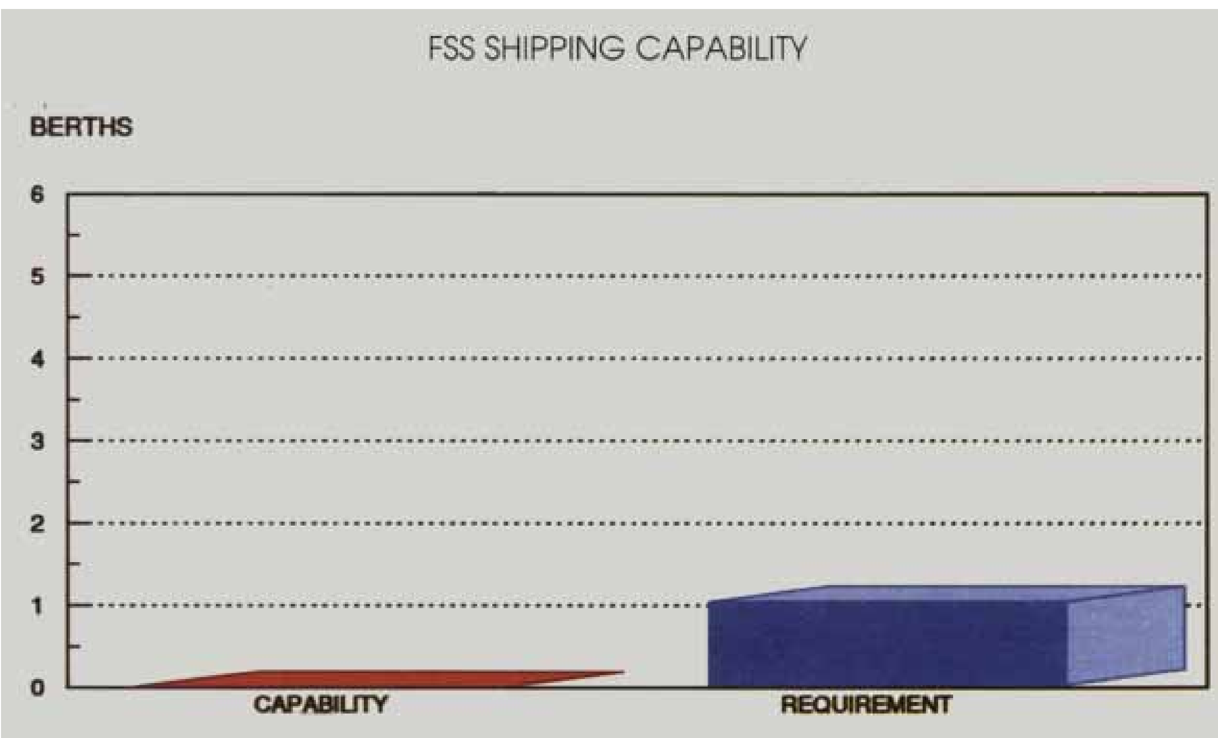
*Only 8 FSSs are available. Unit shipping requirements exceed the capacity of these 8 vessels, Other vessel types are required to make up the FSS shortfall (Cape H).

Legend:

RORO - roll on/roll off

FSS - fast sealift ship

Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide, Aug 91.



SUMMARY

The port harbor and ship berth shallow draft (35 feet MLW) limit the Port of Port Hueneme to selected breakbulk, containership, and RORO vessels unless the Army deploys partial FSS and Cape H shiploads.

Presently, FSS operations have not occurred at the Port of Port Hueneme. The wind and current conditions affect the steering of an FSS vessel when entering the approach channel. The Naval Construction Battalion Center (NCBC) is currently researching wind and current conditions at the port to determine the feasibility of FSS operations.

The port harbor turning basin is too small to accommodate FSS vessels. This limits ship movement to "pull in, back out" operations.

RECOMMENDATIONS

We do not recommend deploying a mechanized infantry brigade from the Port of Port Hueneme unless select ships are available for deployment. The shallow port harbor and ship berths limit deployments to selected breakbulk, RORO, and containership vessels. The wind and current could cause unsafe conditions for steering an FSS vessel when entering the port approach channel. Also, the harbor turning basin is too small to accommodate FSS vessels.

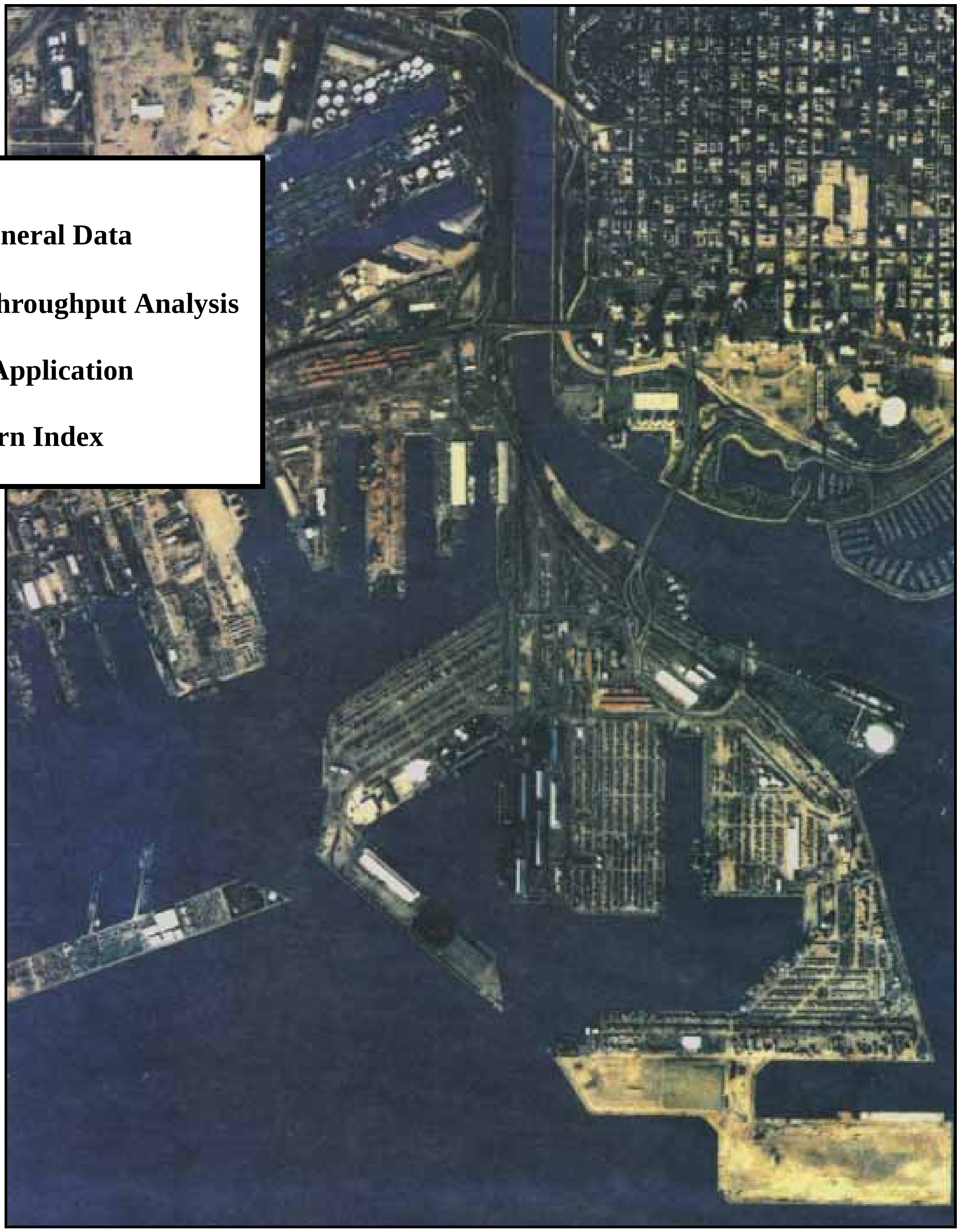
We recommend a reevaluation of the Port of Port Hueneme upon completion of dredging the harbor to 45 feet. The port authority for the Port of Port Hueneme has not established a date for completing the harbor dredging.

We recommend that NCBC continue their research to determine the possibility of FSS operations at the Port of Port Hueneme. Computer simulations have shown that, under appropriate conditions, FSS operations may be possible.

September 94

PORT OF LONG BEACH

LONG BEACH, CALIFORNIA



I. General Data

II. Throughput Analysis

III. Application

Return Index

I. GENERAL DATA

TRANSPORTATION ACCESS

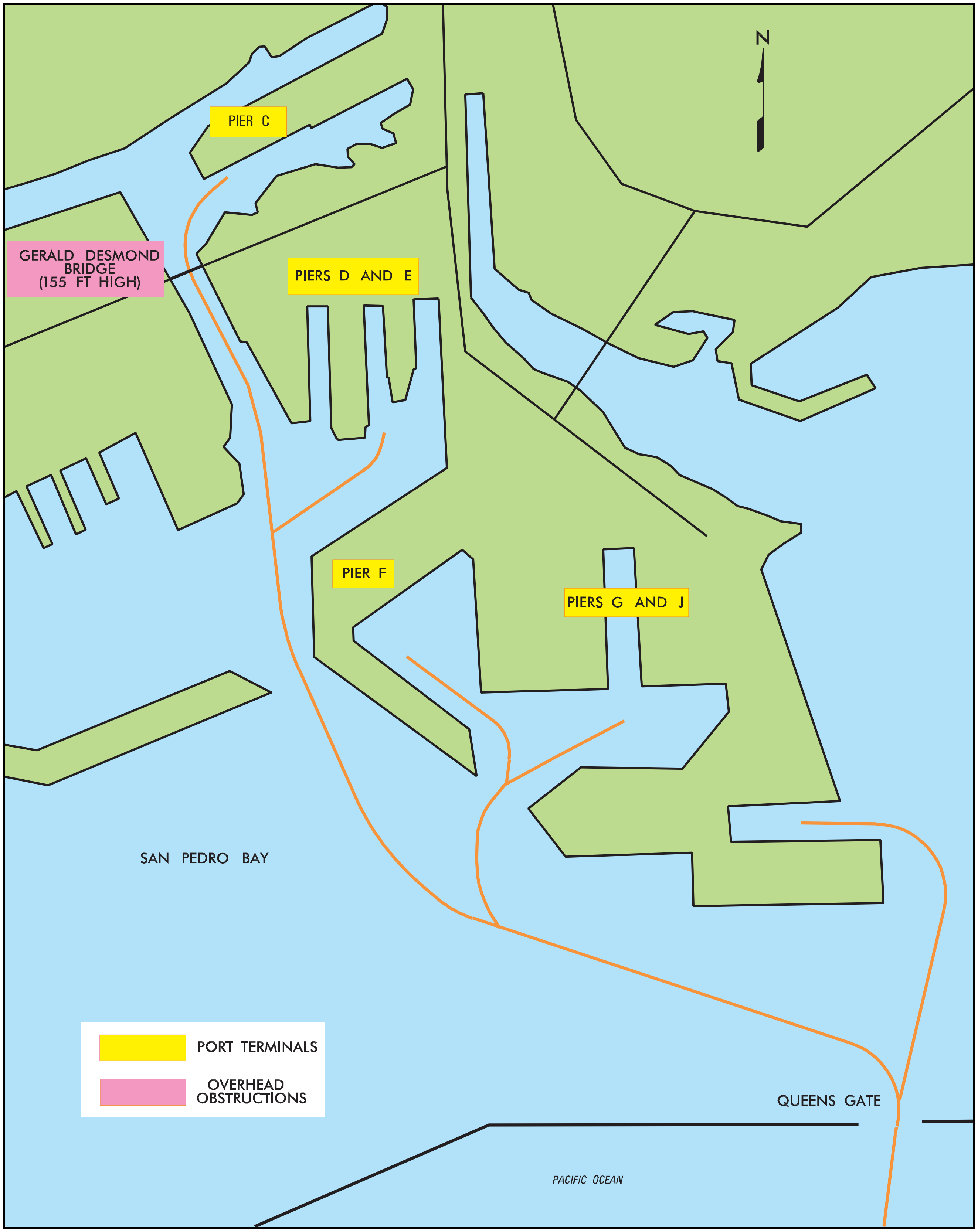
Water

All berths are less than 3 miles from open water. Entrance to the port is through a 12-mile-long breakwater that separates the San Pedro Bay from the Pacific Ocean. The channel provides access to all terminals, through the Queens Gate opening of the breakwater. After passing through the breakwater, ships traverse the San Pedro Bay. Channels are at least 45 feet deep at mean low water (MLW) and 400 feet wide. The main channel is currently 60 feet deep. Plans call for dredging the main channel to 76 feet, to accommodate supertankers.

Access to the Pier C Terminal is limited by the Gerald Desmond Bridge. This bridge restricts the usable width of the channel to 260 feet and the vertical clearance to 155 feet at mean high water (MHW).

The mean tidal range in Long Beach Harbor is 3.7 feet. A range of 9 feet may occur at maximum tide.

This report covers the sections of the port that are applicable to military operations. Passenger and bulk terminals are not included, because they are not easily adapted to support military operations. The terminals are on the water access map on the next page.

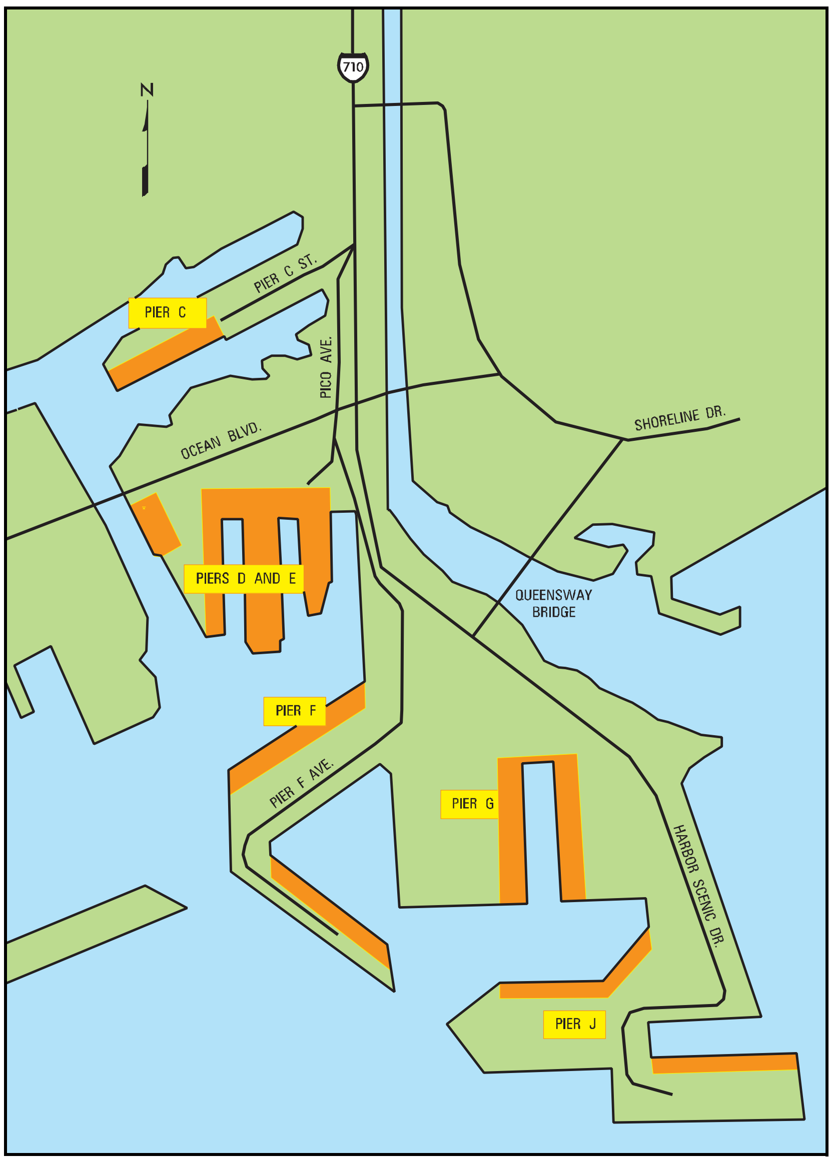


Water Access

Highway

Heavy traffic congestion usually prevails in the Long Beach metropolitan area. The Port of Long Beach has access to Interstate Route 710. Harbor Scenic Drive, Pico Avenue, and Piers C, E, F, and G Streets lead to the terminals.

Years of additions and modifications to port land and thoroughfares have left the port with discontinuous and confusing street names. The Port of Long Beach recently renamed the piers and streets to make it easier for motorists to locate port facilities. To simplify finding berths, the new pier letter precedes the berth number. Aside from the addition of the new pier letter, berth numbers have not changed. This report uses these new names for streets, piers, and berths.



Highway Access

Gate to International Transportation Service (Berths J232 - J234)

Gate to Long Beach Container Terminal (Berths F8 - F10)

Gate to California United Terminal (Piers D and E)

Rail

Three major rail companies serve the Long Beach area. They are Santa Fe (SF), Southern Pacific (SP), and Union Pacific (UP). The SP performs switching for all carriers.

Railyards within 5 miles of the terminals can store more than 1,100 railcars.

Each week, at least 24 double-stack trains carry containers between Long Beach and the Midwest, gulf, and east coasts.

About 50 miles of track are on port property. Most of the trackage is owned by the port.

Rail Access

Airports

Several airports of various sizes and capabilities are within 30 miles of the port. The largest commercial airports are Los Angeles International and Long Beach Municipal. Long Beach Municipal Airport is closer, about 6 miles to the east of the port area. The nearest military airfield is on the Armed Forces Reserve Center, about 10 miles to the east.

MAJOR AIRPORTS NEAR THE PORT

	LOS ANGELES INTERNATIONAL AIRPORT	LONG BEACH MUNICPAL AIRPORT	LOS ALAMITOS NAVAL AIR STATION
Main Runway:			
Length	12,000 ft	10,000 ft	8,000 ft
Width	150 ft	150 ft	200 ft

Air Access

PORT FACILITIES

Berthing

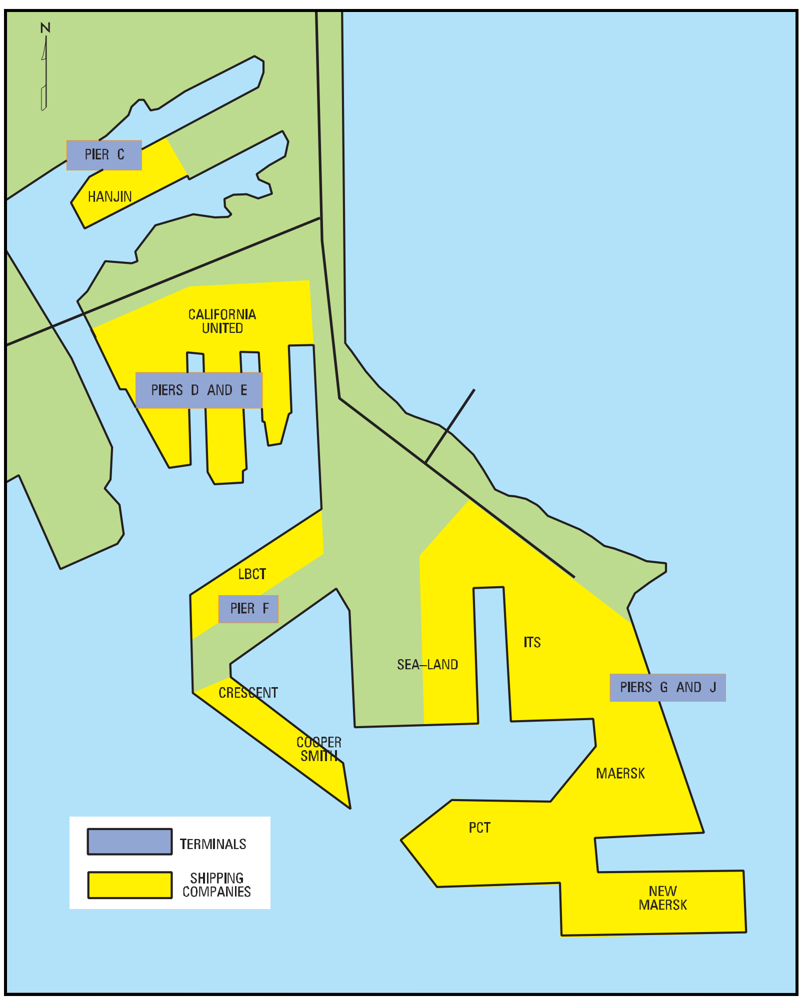
Pier construction is generally concrete piles, fronting a sheet-steel or concrete bulkhead.

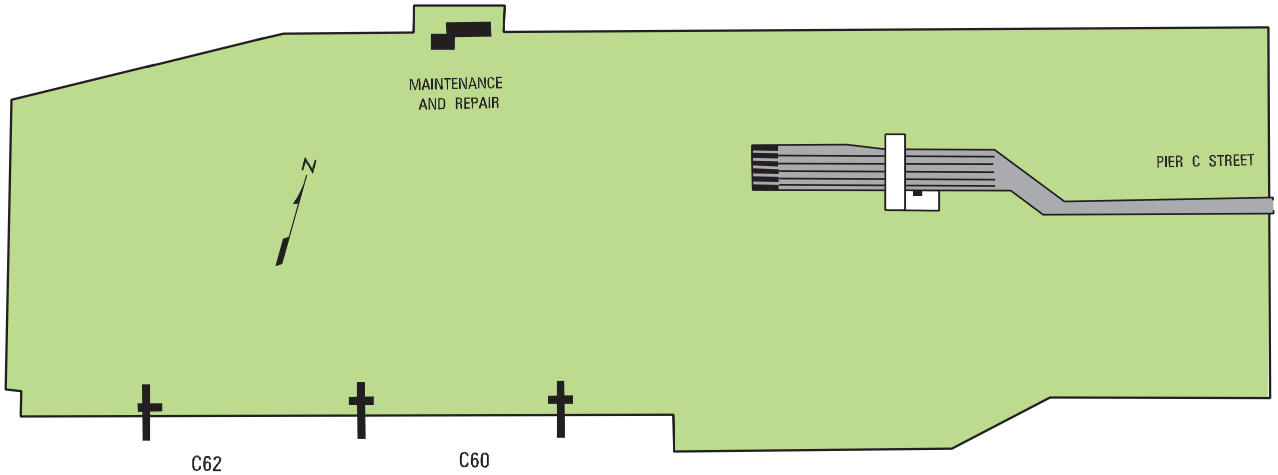
Fendering is generally timber, and the surface is generally asphalt. All terminals have lighting for night operations.

Below are land-use maps, aerial photographs, and tables of characteristics of the terminals. Pier F Terminal and Piers G and J Terminal have multiple lessors. These lessors are shown on the land-use maps.

TERMINAL OPERATIONS

TERMINAL	USE
Pier C	Container
Pier D & E	Multicargo
Pier F	Multicargo
Piers G&J	Container



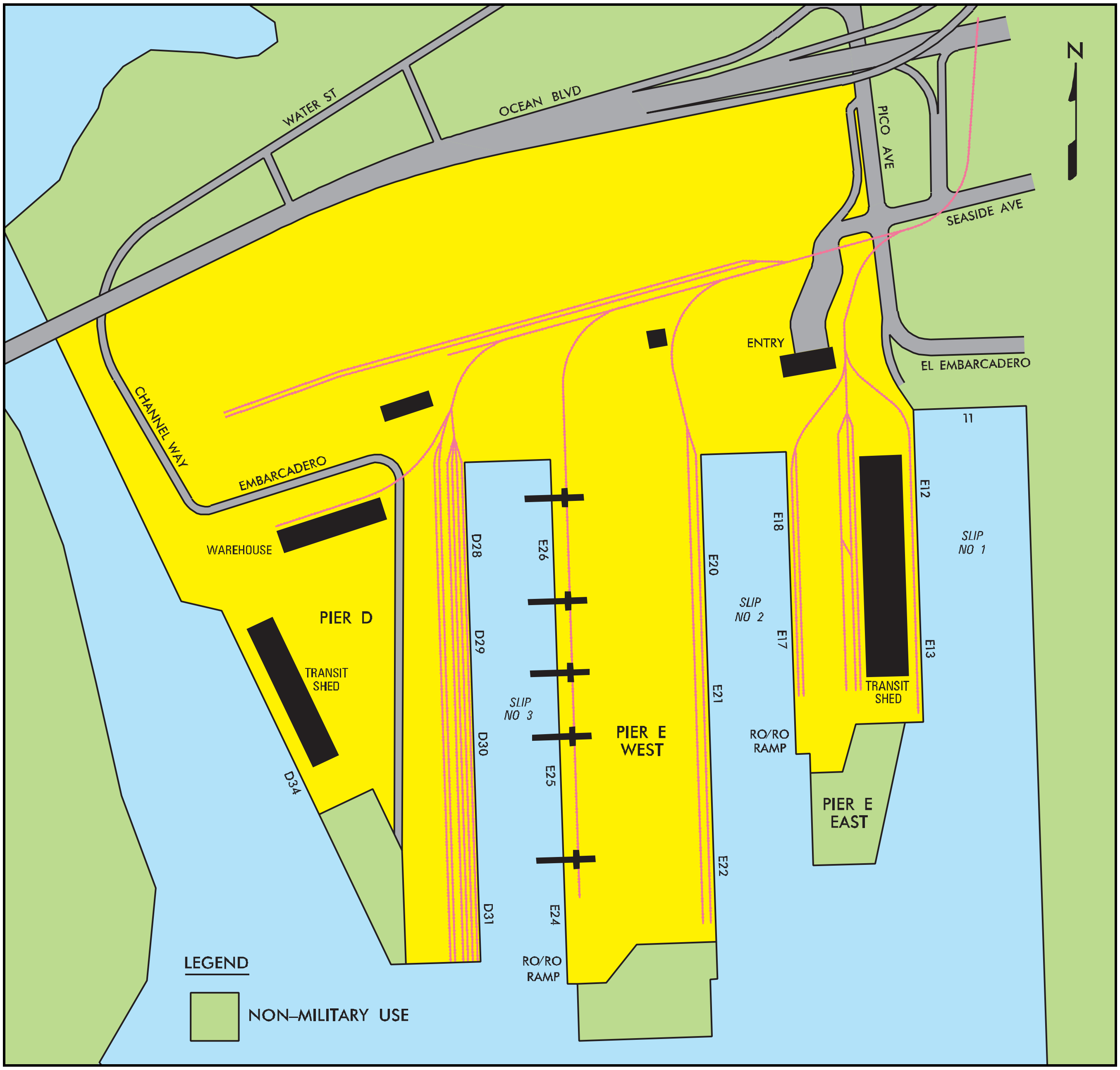


Land-Use Map for Pier C, Leased by Hanjin

PIER C TERMINAL

CHARACTERISTICS	BERTHS C60-C62
Length (ft)	1,804
Depth alongside at MLW (ft)	42
Deck strength (psf)	800
Apron width (ft)	Open
Apron height above MLW (ft)	15
Number of container cranes	3
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

Pier C Terminal



Land-Use Map for Piers D and E Terminal

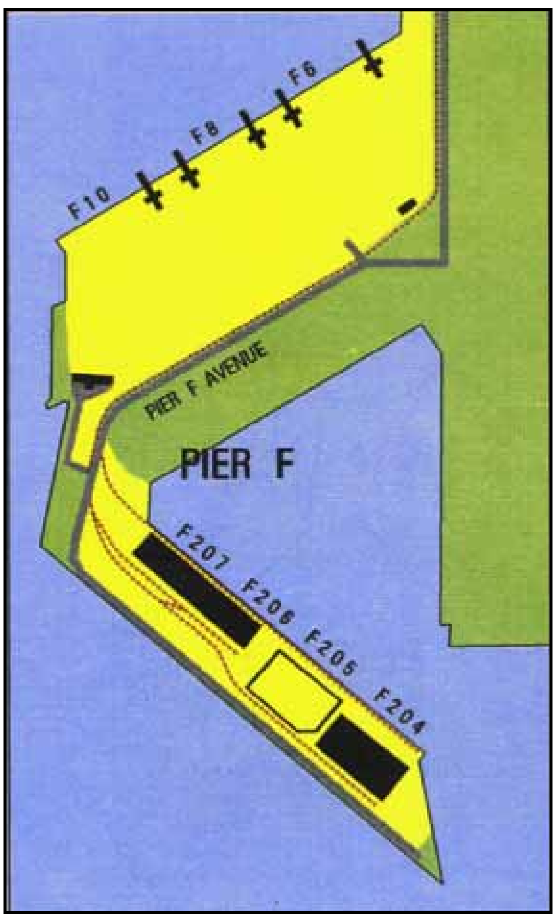
PIERS D AND E TERMINAL

CHARACTERISTICS	BERTHS					
	E12-E13	E17-E18	E20-E22	E24-E26	D28-D31	D34
Length (ft)	1,225	1,200	2,000	1,940	1,995	925
Depth alongside at MLW (ft)	40	39	40	41	45	45
Deck strength (psf)	1,000	1,000	750	750	750	750
Apron width (ft)	45	Open	Open	Open	Open	45
Apron height above MLW (ft)	20	20	16	15	9	11
Number of container cranes	0	0	0	5	0	0
Number of wharf cranes	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	No	No	No	No	No
Apron length served by rail (ft)	1,225	900	2,000	1,940	1,995	925

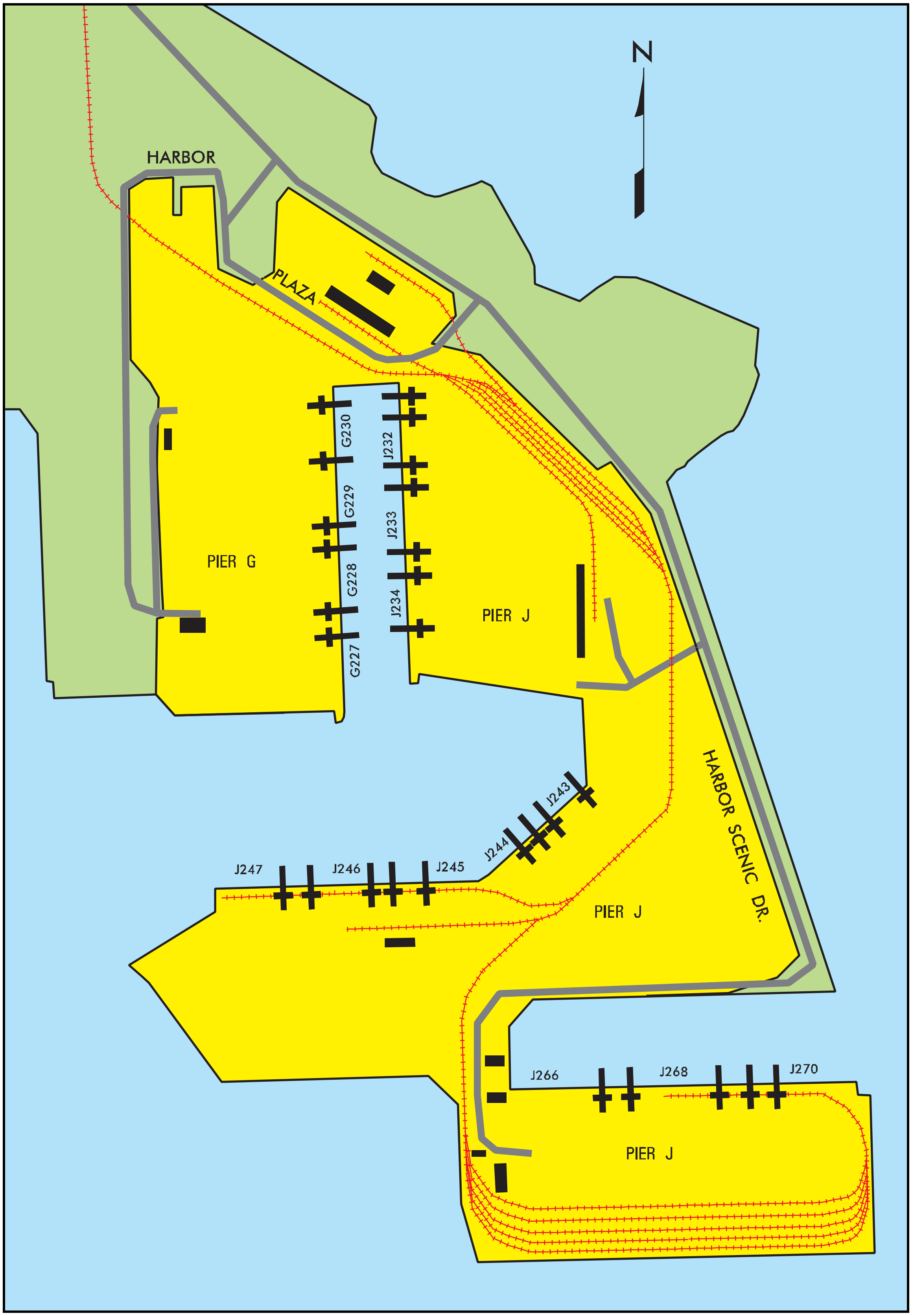
Piers D and E Terminal (Eastward View)

PIER F

CHARACTERISTICS	BERTHS F6-F10	BERTHS F204-F205	BERTHS F206-F207
Length (ft)	2,800	1,265	1,200
Depth alongside at MLW (ft)	50	35	35
Deck strength (psf)	800	800	800
Apron width (ft)	Open	50	50
Apron height above MLW (ft)	15	19	19
Number of container cranes	5	0	0
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No
Apron length served by rail (ft)	0	0	1,200



Land-Use Map and Aerial View of Pier F Terminal



Land-Use Map of Piers G and J Terminal

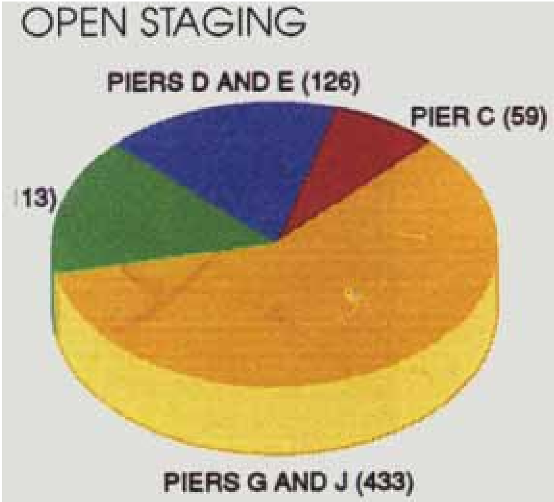
PIERS G AND J TERMINAL

CHARACTERISTICS	BERTHS				
	G227-G230	J232-J234	J243-J244	J245-247	J266-J270
Length (ft)	2,600	2,300	1,200	2,100	2,700
Depth alongside at MLW (ft)	42	36	42	36	48
Deck strength (psf)	800	800	800	800	1,000
Apron width (ft)	Open	Open	Open	Open	Open
Apron height above MLW (ft)	16	16	16	16	14
Number of container cranes	6	7	4	5	5
Number of wharf cranes	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	Yes	No	No	Yes
Apron length served by rail (ft)	0	0	0	2,100	2,000

Piers G and J; New Pier J Under Construction

Staging

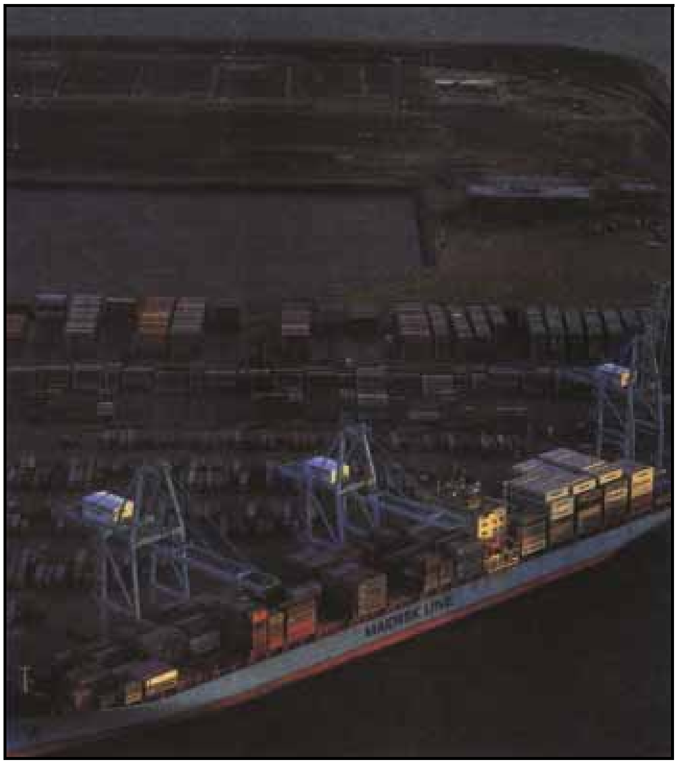
OPEN STAGING



The terminals in this report have about 730 acres of paved open staging. Most of this open area is at the Piers G and J Terminal. It is generally used for container staging.

The transit shed at berth E17-E18 or the transit shed at berth D34 is a good location for helicopter operations.

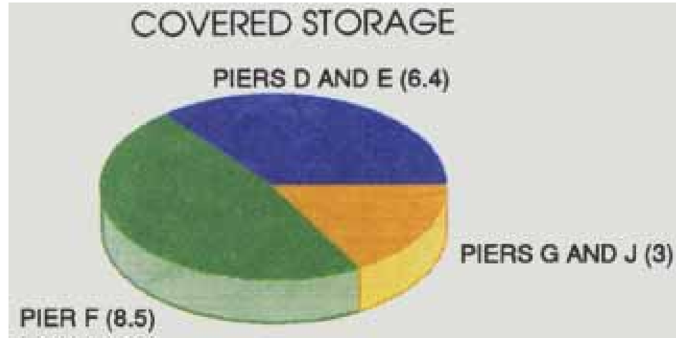
Open Staging at Pier G
(Southward View)



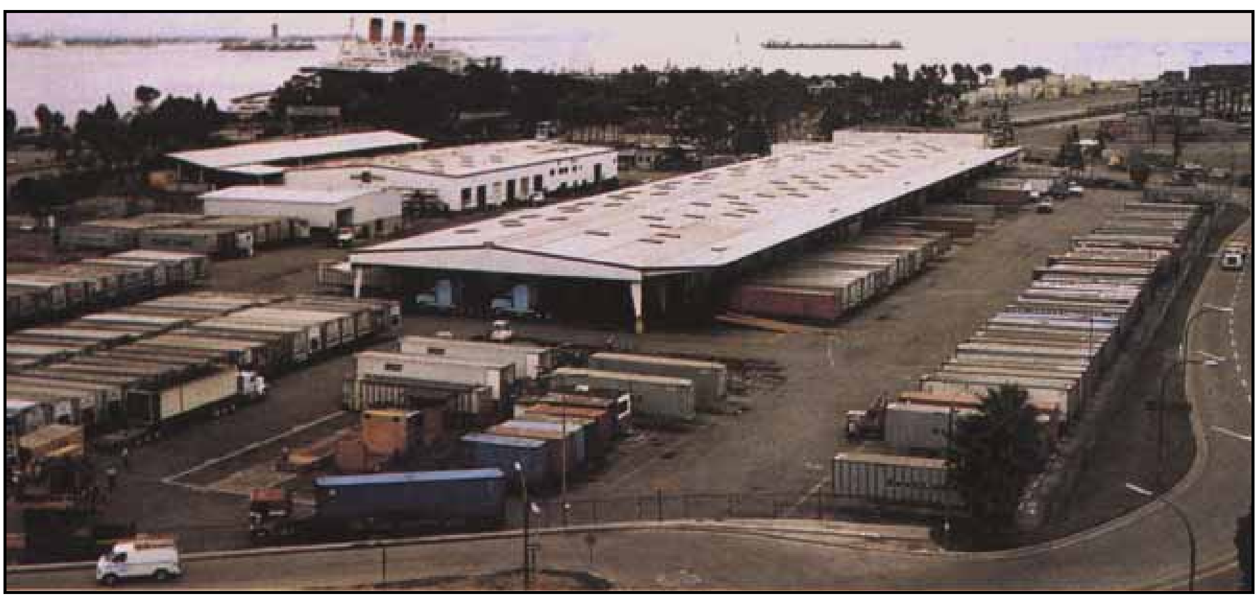
Open Staging at Pier J
(Southward View)

COVERED STAGING

The port has seven covered storage buildings of various sizes. These total about 780,000 square feet. Pier C does not have any buildings for covered staging.



Covered Storage at Piers D and E; California United Terminal, Berths 12-13
(Northward View)



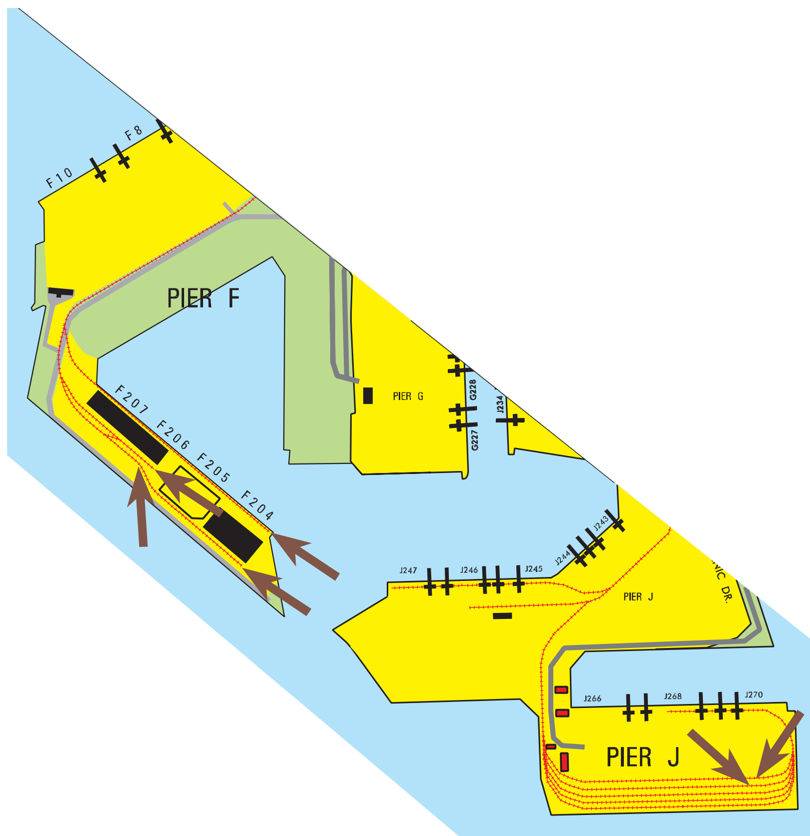
Covered Storage at Piers G and J Terminal; Sea-Land CFS near Berth G230
(Southeastward View)

Rail

Rail trackage links the railyards to port apron tracks, transit sheds, and storage tracks.

Railyards on the port have a capacity of about 400 89-foot railcars. Most of this capability is at the new nine-track Maersk Pier J Terminal. Commercial railyards within 5 miles of the port can store an additional 1,100 89-foot railcars. The Harbor Belt Line owns most of this capacity. The Port of Long Beach is the only Southern California port to offer ondock rail operations for double-stack container trains. The SP performs switching for the port.

No permanent or portable rail ramps are currently on the port. Tenants at the Port of Long Beach have some portable rail ramps that could support the offloading of bilevel railcars. These ramps are not strong enough, however, for offloading heavy vehicles from flatcars. The best locations for temporary or portable rail ramps are at pier F and the new landfill at pier J. Ramps at these locations could support offloading 1,000- to 2,000-foot strings of railcars. Four ramps at pier F and two at pier J could offload eighty-three 89-foot railcars.



Motor Rail Facilities

Highway

No clearance problems exist within the port. The California United Terminal has six truck scales.

Unloading/Loading Positions

RAMPS

The port has no permanent rail or truck end ramps. Numerous locations can support offloading operations with temporary or portable end ramps.

DOCKS

Three covered storage buildings at the Piers D and E Terminal have truck-handling positions. The two container freight stations (CFSs) (Sea-Land and ITS) at the north end of pier J, and the two transit sheds along the south end of pier F are also good places to unload vans.

Boxcar operations can take place at all of the buildings above, except for the transit shed at the far west end of the Piers D and E Terminal, by berth 34. The port can concurrently unstuff about 70 boxcars.

Marshaling Areas

WITHIN PORT

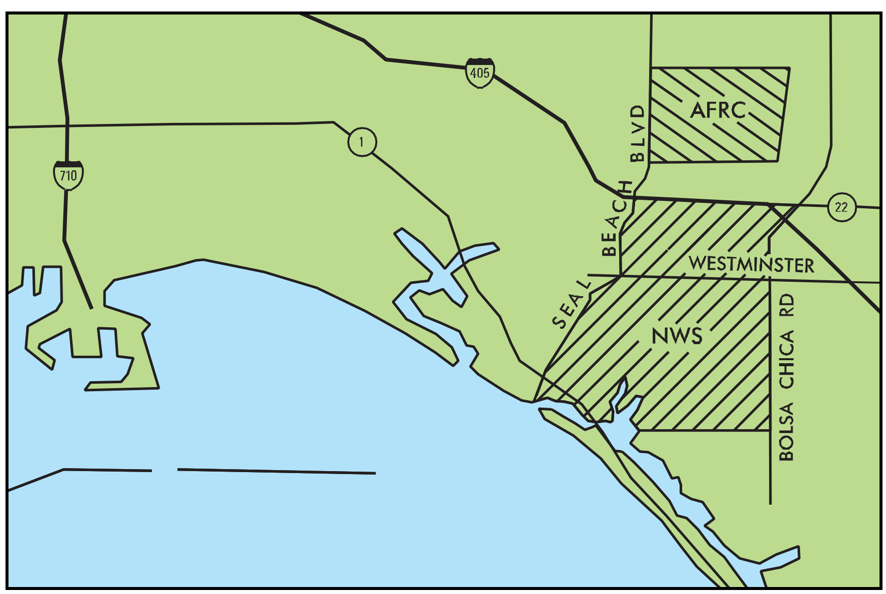
No marshaling areas are within the port area. All open areas within the port are required for staging of military or commercial cargo.

LOS ALAMITOS ARMED FORCES RESERVE CENTER

The Reserve Center is about 10 miles to the east of the port area. It has no rail access, but can provide at least 50 acres of marshaling area. It has a runway about 8,000 feet long, which was previously used by the Naval Air Station.

SEAL BEACH NAVAL WEAPONS STATION

The Naval Weapons Station is just south of the Reserve Center. It has rail access, but very little available open staging.

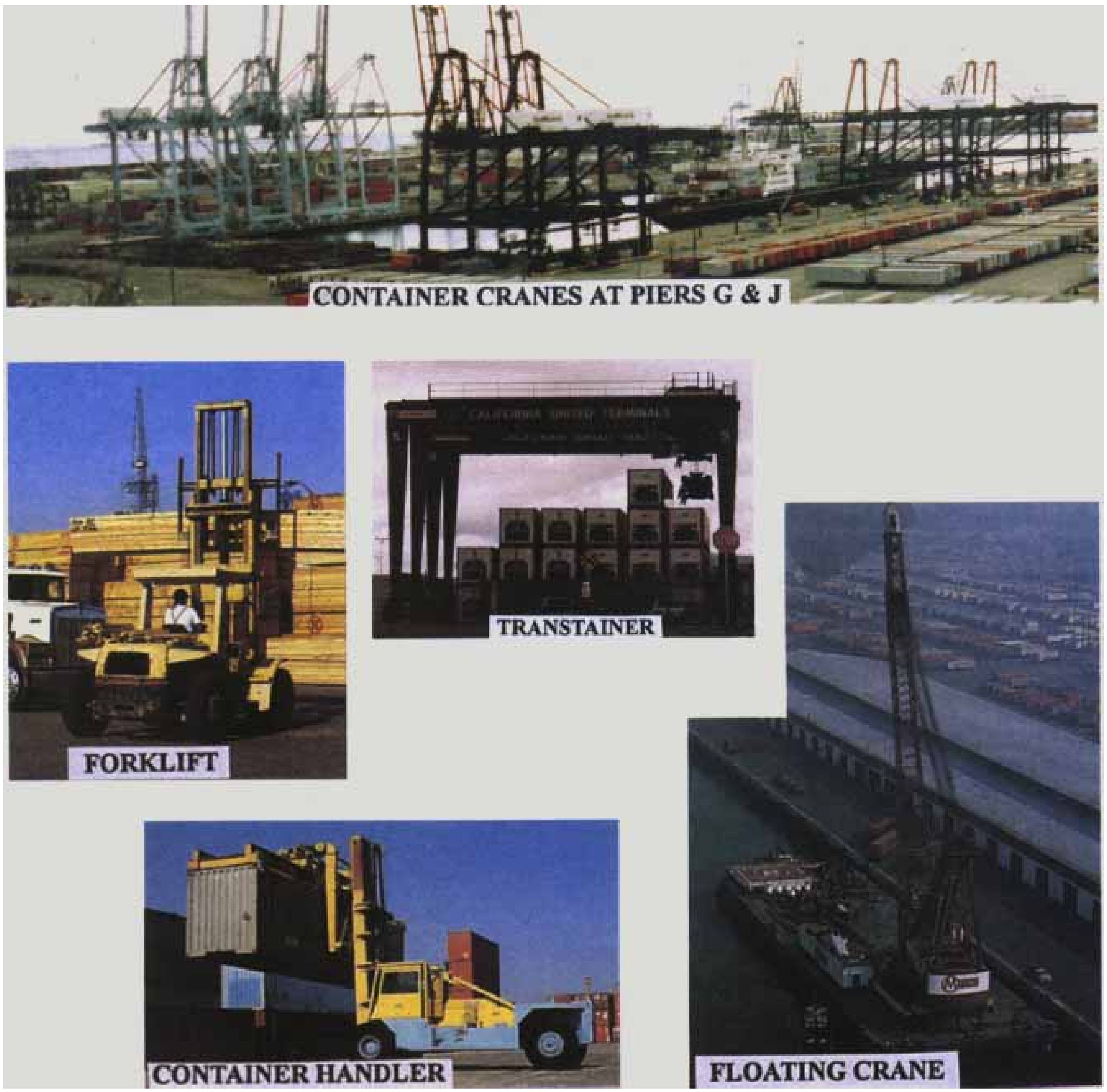


Potential Marshaling Areas

MATERIALS HANDLING EQUIPMENT (MHE)

The identified terminals have 30 container cranes. All of these cranes have a capacity of at least 40 tons. The Piers G and J Terminal has just over half of these cranes (17). The other 13 are about evenly distributed among the remaining 3 terminals.

Various tenants at the Port of Long Beach and the nearby Port of Los Angeles own transtainers and other MHE. Mobile cranes with capacities up to 150 tons are available from local stevedore companies. A 150-ton barge crane (shown below) is also available.

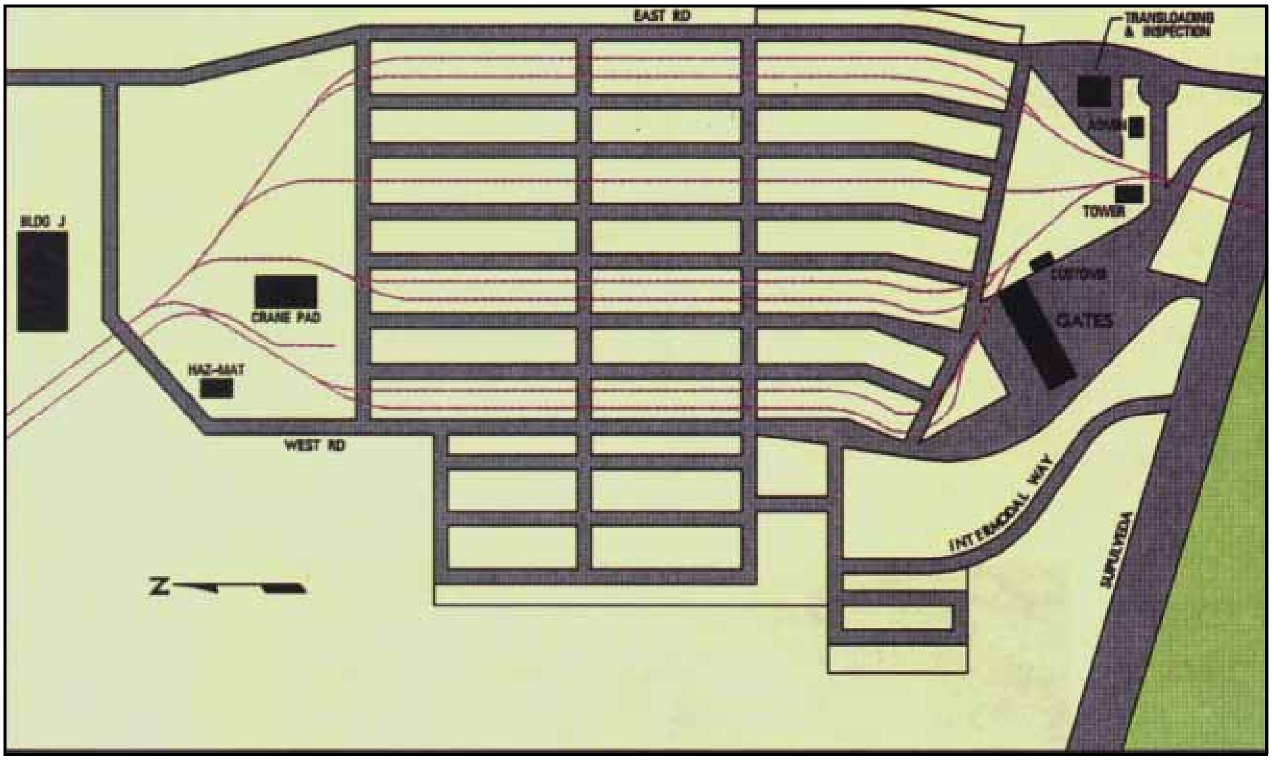


INTERMODAL FACILITIES

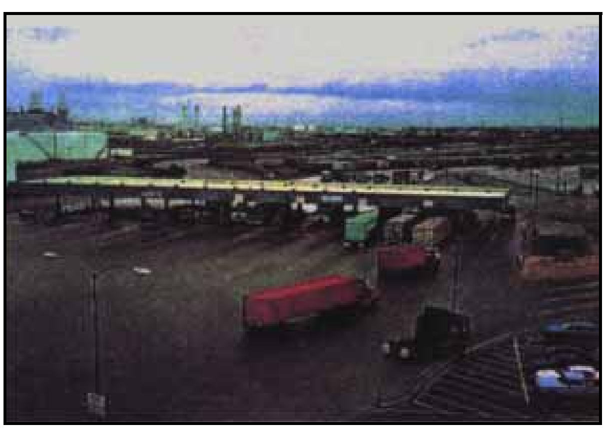
SF, UP, and CSX have intermodal facilities in the Los Angeles/Long Beach area. This report concentrates on another intermodal facility owned in part by both ports. The intermodal container transfer facility (ICTF) is 4 miles north of the port area, and is operated by SP. Frequent signs direct trucks to this modern facility.

CHARACTERISTICS OF THE ICTF

Storage	2,800 spots
Gate	8 inbound lanes with intercoms
MHE	8 transtainers 1 top pick
Throughput	1,400 lifts per day



ICTF Land-Use Map



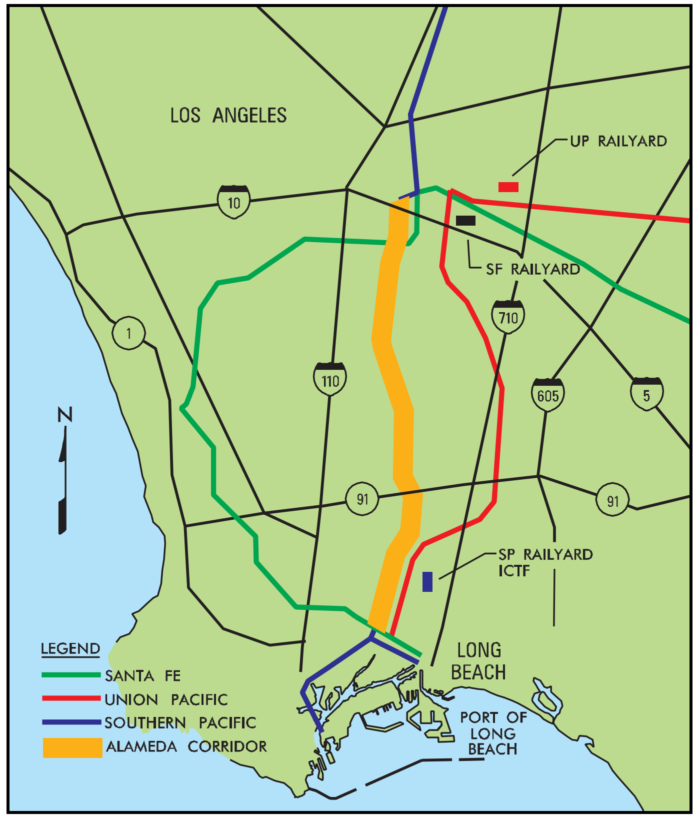
Entrance Gate (View from Control Tower)

Top Pick and Chassis

FUTURE DEVELOPMENT

The Ports of Los Angeles and Long Beach expect to jointly buy 20 miles of land from SP to develop an express transportation corridor for trucks and trains. The Alameda Corridor Project is expected to begin in 1994 and to take 6 years to complete. Once finished, the Alameda Corridor will reduce truck delays. This is because of the rerouting of trains, elimination of at-grade crossings, and widening of Alameda Street to six lanes. Trains will travel at higher speeds and be longer.

The Long Beach Port Authority bought land from UP on which to develop container facilities. This land could increase the container operations of the port by 35 percent.

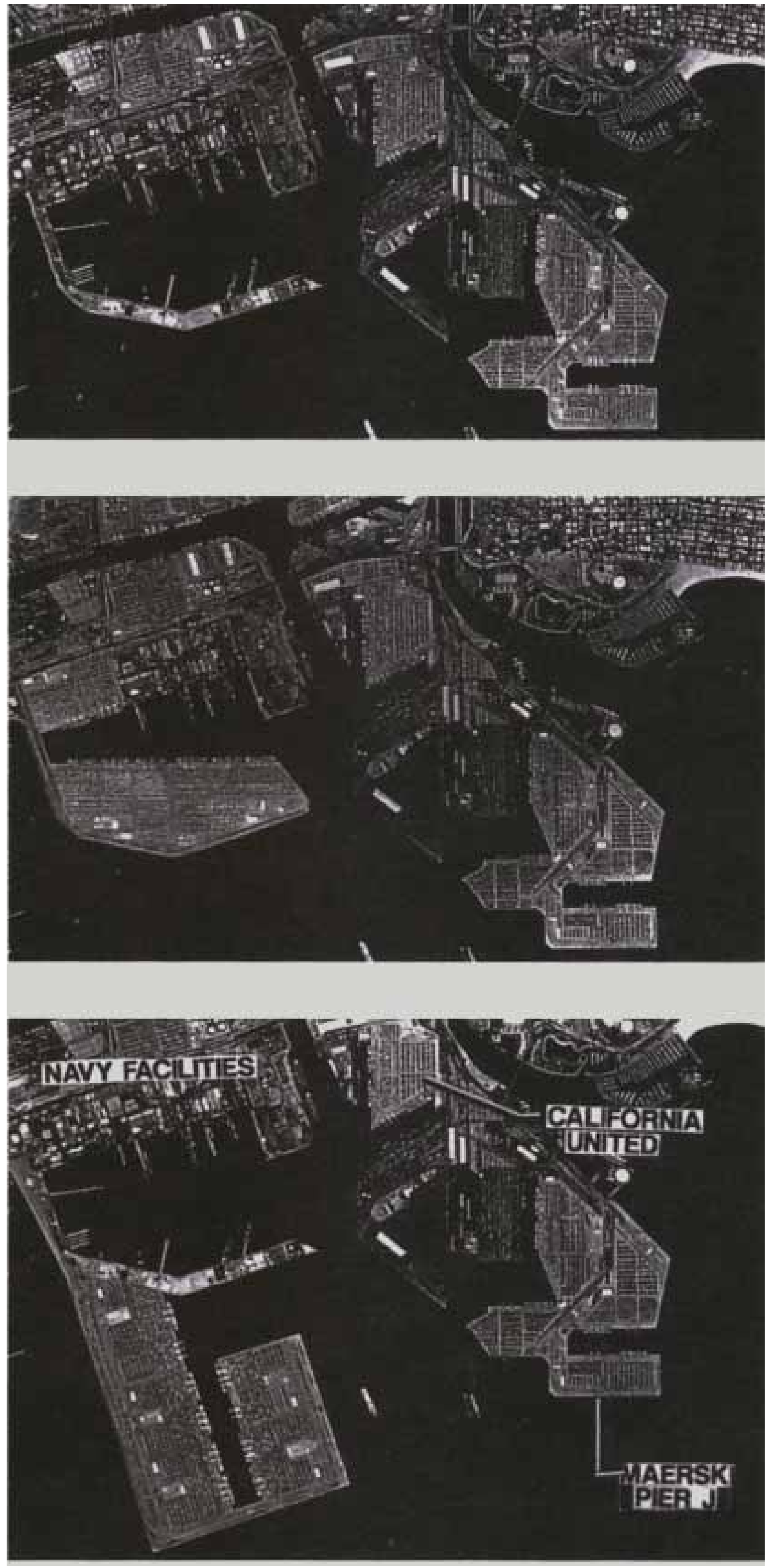


Proposed Alameda Corridor

Future Container Facility at Terminal Island

Planned Development of the California United Terminal

The Port of Long Beach plans to expand existing facilities with dredge spoils. Depending on funding and land availability, the port will eventually look like one of the configurations shown at the right.

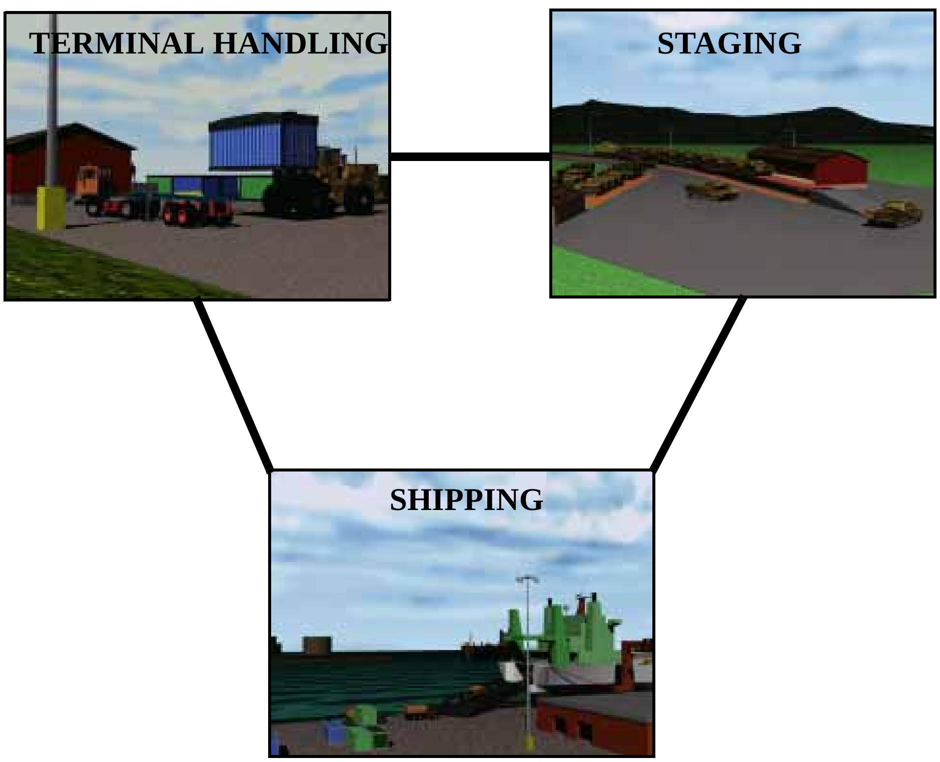


Possible Future Port Configurations at Long Beach

II. THROUGHPUT ANALYSIS

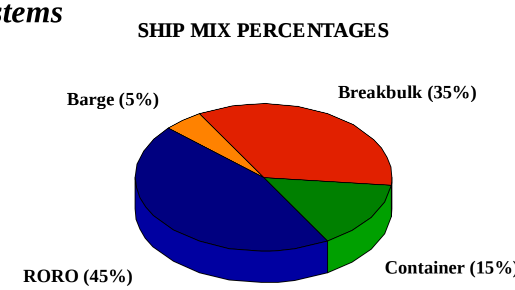
GENERAL

This section evaluates the throughput capability of the Port of Long Beach, using the port operational performance simulator computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in short tons (STON) and measurement tons (MTON) per day.



Terminal Throughput Subsystems

The analysis assumes that 80 percent of the port facilities will support military deployments. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



RECEPTION/HANDLING

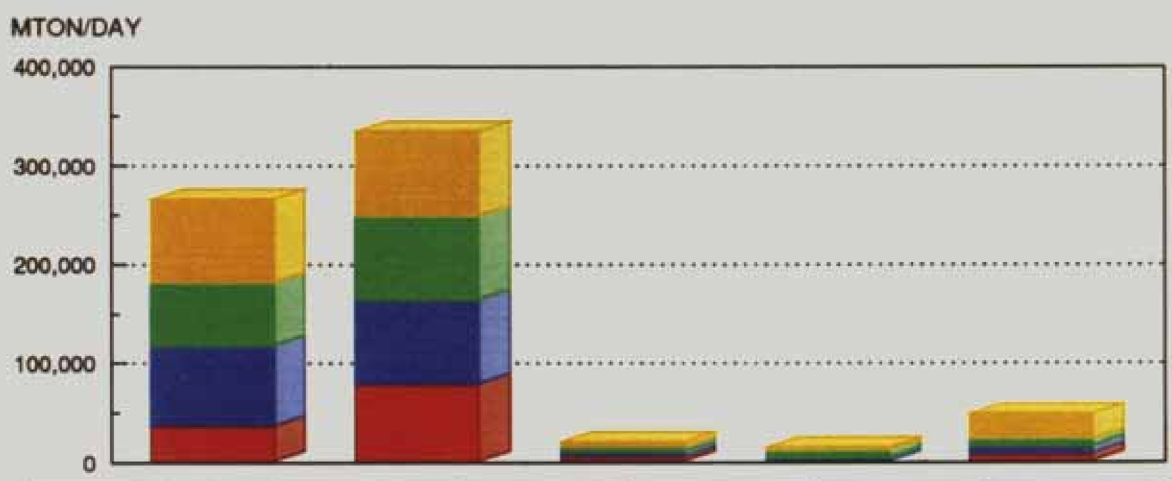
Highway

I-710 and California Route 47 provide access to the port. Each terminal has a designated entrance for trucks. The road network in and out of the terminals limits the highway reception to 265,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable ramps. The port has no permanent truck end ramps. However, our analysis assumes one portable ramp at each terminal. These ramps could offload about 19,000 MTON from flatbed trailers per day.

Supplies in van semitrailers will proceed to the 139 van-handling positions. These docks can offload about 13,500 MTON of van semitrailer-shipped material per day. Containers on chassis will move to the staging areas and offload by cranes. A container handler at each terminal can offload about 3,750 MTON of cargo from chassis per day.

HIGHWAY RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	HIGHWAY	GATES	END RAMPS*	DOCKS	CONTAINERS
PIER C	35,900	78,000	4,800	0	7,200
PIERS D AND E	80,700	85,000	4,800	3,600	7,600
PIER F	63,800	85,000	4,800	7,200	7,600
PIERS G AND J	84,100	85,000	4,800	2,700	25,000

*4 ramps are assumed available.

Rail

Rail reception at the port is fair, with three major railroad companies accessing the Long Beach area. Port-owned railyards at or near the terminals can hold about 400 railcars. Pier C is the only terminal without rail service.

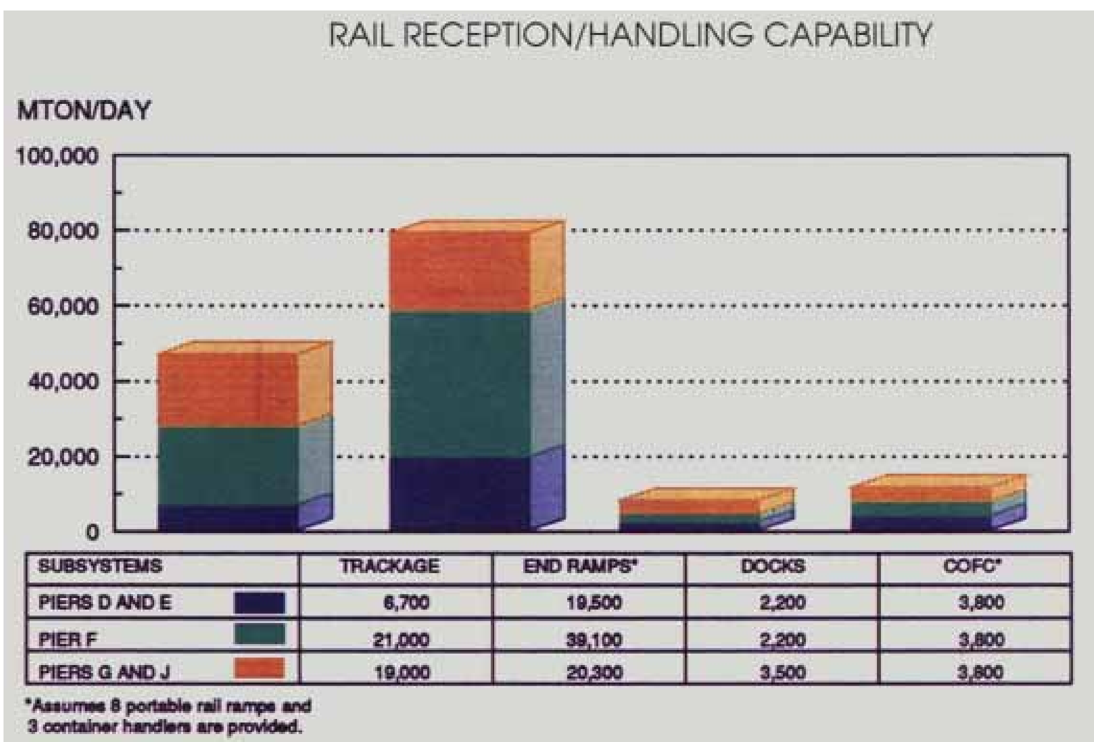
This analysis assumes the ports or units can rent, build, or provide eight portable rail end ramps. It also assumes one container handler will operate at each terminal. Boxcars can offload at all terminals, except for pier C. The port has 72 boxcar-handling positions.

RAIL DELIVERY

TERMINAL	TRAIN LENGTH	TRAINS PER DAY
Piers D&E	60	1
Pier F	60	3
Piers G&J	60	3

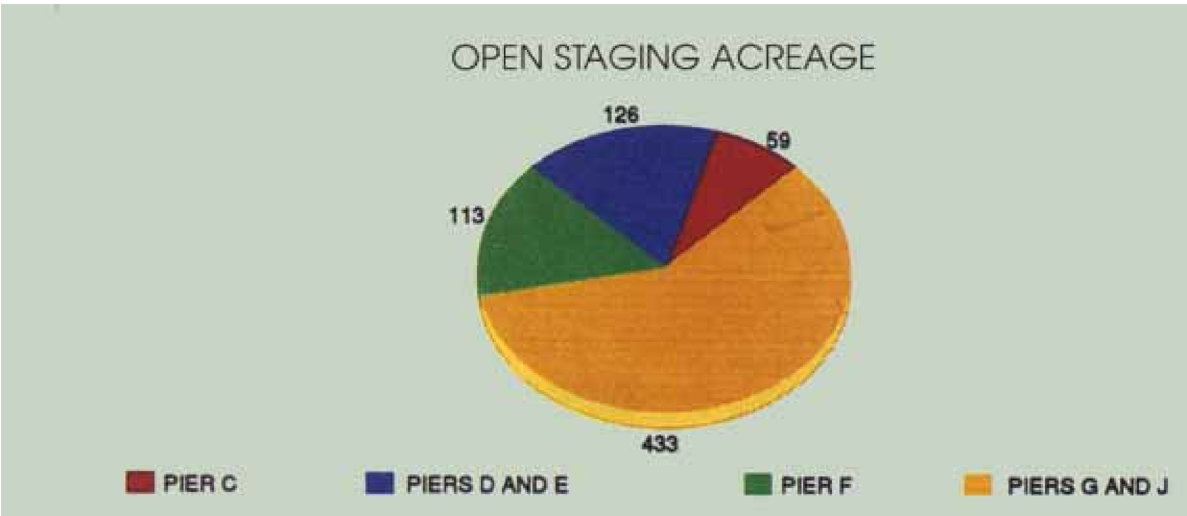
PORTABLE END RAMP LOCATIONS AND LENGTHS

LOCATION	RAILCARS	NUMBER OF POSITIONS
Piers D&E	10	2
Pier F	10	4
Piers G&J	20	2

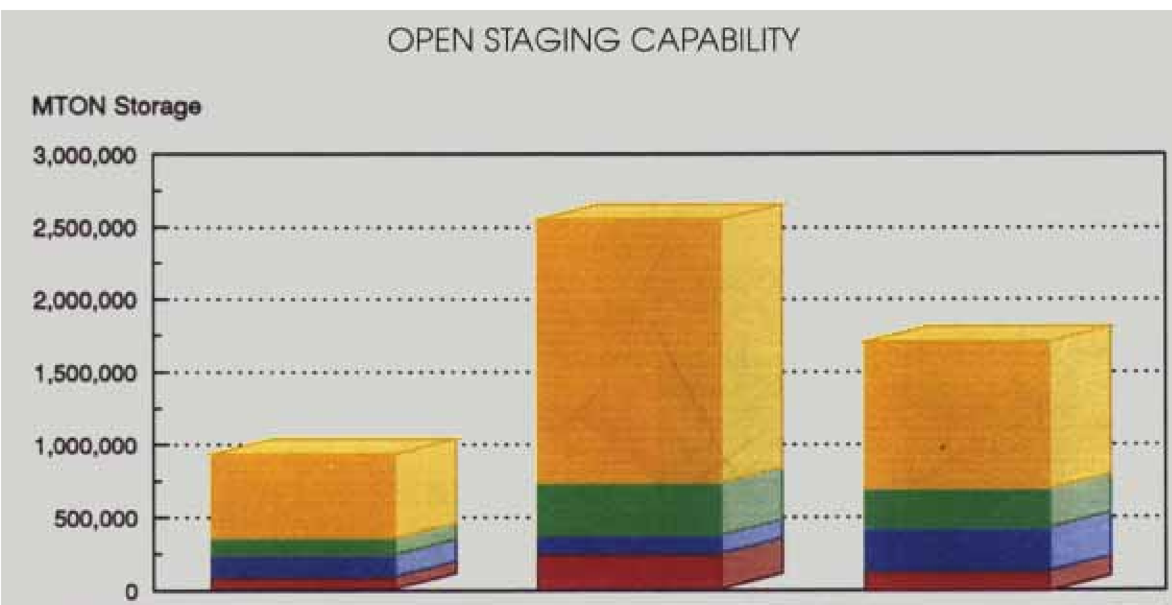


STAGING

The terminals have about 730 acres of open paved staging. Most of it is at piers G and J. The terminals also have about 780,000 square feet of covered storage.



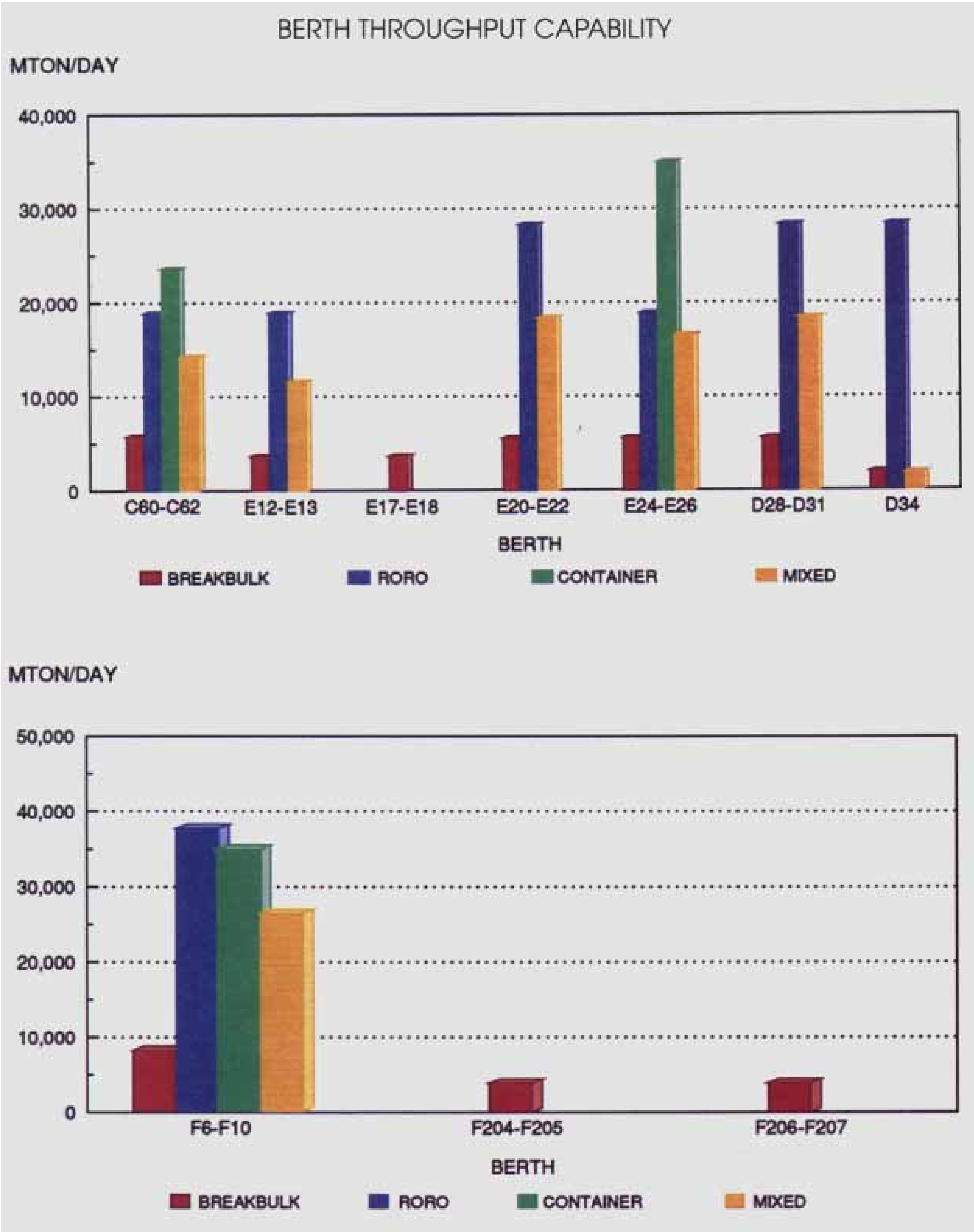
The terminals can perform operations on roll-on/roll-off (RORO), container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a container ship is planned. The chart below provides the staging capability for the cargo for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.

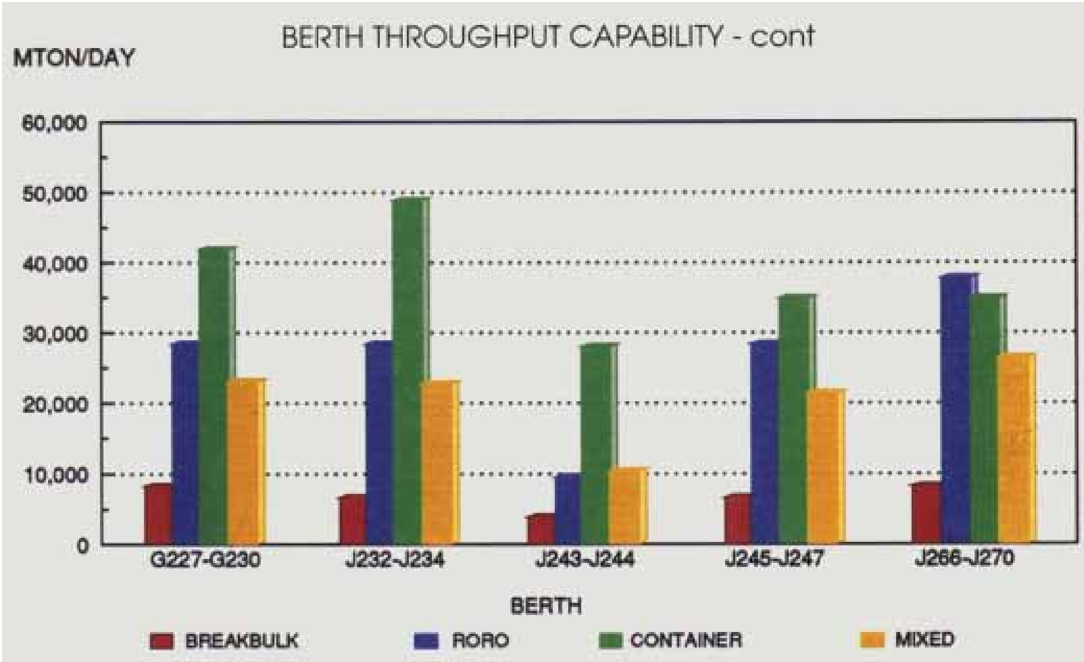


TERMINALS	RORO	CONTAINERS	BREAKBULK
PIER C	77,200	241,900	136,200
PIERS D AND E	153,400	123,200	294,300
PIER F	113,900	359,500	265,300
PIERS G AND J	574,500	1,814,100	1,012,900

SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used, loading, operational, and berth utilization rates, as well as berth/ship compatibility.





CONVERSION FACTORS

Breakbulk	.4	STON per MTON
RORO	.25	STON per MTON
Containners	.4	STON per MTON

The type of ship preferred at each berth is based on the methodology described in the appendix. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation to the right gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better suited the berth is for the loading operation.

Considering the three ship types, berth J232-J234 is the best berth for military operations, because of its length, apron height, and cranes. The water depth may limit the draft of some ships.

Table 1 shows the berth/ship compatibility for various types of vessels. The table indicates for each type of ship the number of vessels each berth can accommodate. The table also provides the limitations that can hinder shipping operations.

PREFERENCE BERTH SELECTION

BERTH	BB	RORO	CONT
C60-C62	8	7	8
E12-E13	9	11	-
E17-E18	14	-	-
E20-E22	15	7	-
E24-E26	4	7	6
D28-D31	13	1	-
D34	12	-	-
F6-F10	6	7	2
F204-F205	10	-	-
F206-F207	10	-	-
G227-G230	2	4	2
J232-J234	1	2	1
J243-J244	7	4	7
J245-J247	4	4	5
J266-J270	3	2	4

TABLE 1
SUMMARY OF LONG BEACH PIER C TERMINAL BERTHING CAPABILITIES

VESSEL	BERTHS C60-C62
Breakbulk	
C3-S-33a	3
C3-S-37c	3
C3-S-37d	3
C3-S-38a	3
C4-S-1a	3
C4-S-1qb and 1u	3
C4-S-58a	3
C4-S-65a	3
C4-S-66a	3
C4-S-69b	2
Seatrain	
GA and PR-class	3
Barge	
LASH C8-S-81b	2
LASH C9-S-81d	1
LASH lighter	12
SEABEE C8-S-82a	2
SEABEE barge	9
RORO	
Comet	d,i,j
C7-S-95a/Maine-class	2
Ponce-class	h
Great Land-class	h
Cygnus/Pilot-class	2
Meteor	d,i,j
AmEagle/Condor	i,j
MV Ambassador	d
FSS-class	l,i
Cape D-class	i,j
Cape H-class	2,i
Container	
C6-S-lw	2
C7-S-68e	2
C8-S-85c	2
Combination	
C5-S-78a	2
C5-S-37e	2

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=inadequate shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft
()indicates vessels assigned by analyst.

TABLE 1 - CONT
SUMMARY OF LONG BEACH PIERS D AND E TERMINAL BERTHING CAPABILITIES

	BERTHS					
VESSEL	**E12-E13**	**E17-E18**	**E20-E22**	**E24-E26**	**D28-D31**	**D34**
Breakbulk						
C3-S-33a	2	2	3	3	3	1
C3-S-37c	2	2	3	3	3	1
C3-S-37d	2	2	3	3	3	1
C3-S-38a	2	2	3	3	3	1
C4-S-1a	2	2	3	3	3	1
C4-S-1qb and 1u	2	2	3	3	3	1
C4-S-58a	2	2	3	3	3	1
C4-S-65a	2	2	3	3	3	1
C4-S-66a	2	2	3	3	3	1
C4-S-69b	2	1	3	3	3	1
Seatrain						
GA and PR-class	2	2	3	3	3	1
Barge						
LASH C8-S-81b	1	1	2	2	2	1
LASH C9-S-81d	1	1	2	2	2	1
LASH lighter	8	8	14	13	14	6
SEABEE C8-S-82a	1	1	2	2	2	1
SEABEE barge	6	6	10	9	9	4
RORO						
Comet	i,j	d,i,j	d,i,j	d,i,j	3,d,j	d,o
C7-S-95a/Maine-class	b	i,j	2,i	2	2	b
Ponce-class	b,h	h	h	h	h	b,h
Great Land-class	b,h	h	h	h	h	b,h
Cygnus/Pilot-class	b	i,j	3,j	2	3	b
Meteor	i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,o
AmEagle/Condor	b	i,j	i,j	i,j	3,i	b
MV Ambassador	2,i	d	d	d	d	d
FSS-class	b	i,j	2,i	1,i	2	b,c
Cape D-class	b	i,j	i,j	i,j	2,i	b
Cape H-class	b	i,j	2,i	2,i	2	b
Container						
C6-S-lw	1,e	1,e	2,e	2	2,e	1,e
C7-S-68e	1,e	1,e	2,e	2	2,e	1,e
C8-S-85c	1,e	1,e	2,e	2	2,e	1,e
Combination						
C5-S-78a	1,e	1,e	3,e	3	3,e	1,e
C5-S-37e	1,e	1,e	3,e	3	3,e	1,e

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=inadequate berth depth, adequate anchorage depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

TABLE 1 - CONT
SUMMARY OF PIER F TERMINAL BERTHING CAPABILITIES

VESSEL	BERTHS F6-F10	F204-F205	F206-F207
Breakbulk			
C3-S-33a	5	2	2
C3-S-37c	5	2	2
C3-S-37d	5	2	2
C3-S-38a	5	2	2
C4-S-1a	4	2	2
C4-S-1qb and 1u	4	2	2
C4-S-58a	4	2	2
C4-S-65a	4	2	2
C4-S-66a	4	2	2
C4-S-69b	4	2	1
Seatrain			
GA and PR-class	4	2	2
Barge			
LASH C8-S-81b	3	1	1
LASH C9-S-81d	3	a	a
LASH lighter	20	9	8
SEABEE C8-S-82a	3	a	a
SEABEE barge	14	6	6
RORO			
Comet	d,i,j	d,o	d,o
C7-S-95a/Maine-class	3	b	b
Ponce-class	h	b,h	b,h
Great Land-class	h	b,h	b,h
Cygnus/Pilot-class	4	b	b
Meteor	d,i,j	d,o	d,o
AmEagle/Condor	i,j	b	b
MV Ambassador	d	d	d
FSS-class	2,i	b	b
Cape D-class	i,j	b	b
Cape H-class	3,i	a,b	a,b
Container			
C6-S-lw	4	1,e	1,e
C7-S-68e	3	1,e	1,e
C8-S-85c	3	1,e	1,e
Combination			
C5-S-78a	4	2,e	1,e
C5-S-37e	4	2,e	1,e

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
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e=no container-handling equipment
f=inadequate berth depth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

TABLE 1 - CONT

SUMMARY OF LONG BEACH PIERS G AND J TERMINAL BERTHING CAPABILITIES

	BERTHS				
VESSEL	**G227-G230**	**J232-J234**	**J243-J244**	**J245-J247**	**J266-J270**
Breakbulk					
C3-S-33a	5	4	2	4	5
C3-S-37c	5	4	2	4	5
C3-S-37d	5	4	2	4	5
C3-S-38a	5	4	2	4	5
C4-S-1a	4	3	2	3	4
C4-S-1qb and 1u	4	3	2	3	4
C4-S-58a	4	3	2	3	4
C4-S-65a	4	3	2	3	4
C4-S-66a	4	4	2	3	4
C4-S-69b	4	3	1	3	4
Seatrain					
GA and PR-class	4	3	2	3	4
Barge					
LASH C8-S-81b	3	2	1	2	3
LASH C9-S-81d	2	a	1	a	2
LASH lighter	18	16	8	15	19
SEABEE C8-S-82a	2	a	1	a	2
SEABEE barge	13	11	6	10	13
RORO					
Comet	d,i,j	i,j	d,i,j	d,i,j	i,j
C7-S-95a/Maine-class	3,i	3,i	1,i	2,i	3
Ponce-class	h	h	h	h	h
Great Land-class	h	h	h	h	h
Cygnus/Pilot-class	3,i	3,i	1,i	3,i	4
Meteor	d,i,j	i,j	d,i,j	d,i,j	i,j
AmEagle/Condor	i,j	i,j	i,j	i,j	i,j
MV Ambassador	d	3	d	d	4
FSS-class	2,i	2,i	1,i	2,i	2
Cape D-class	i,j	i,j	i,j	i,j	i,j
Cape H-class	3,i	2,i	1,i	2,i	3
Container					
C6-S-lw	3	3	1	3	3
C7-S-68e	3	3	1	2	3
C8-S-85c	3	2	1	2	3
Combination					
C5-S-78a	4	3	1	3	4
C5-S-37e	4	3	1	3	4

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k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

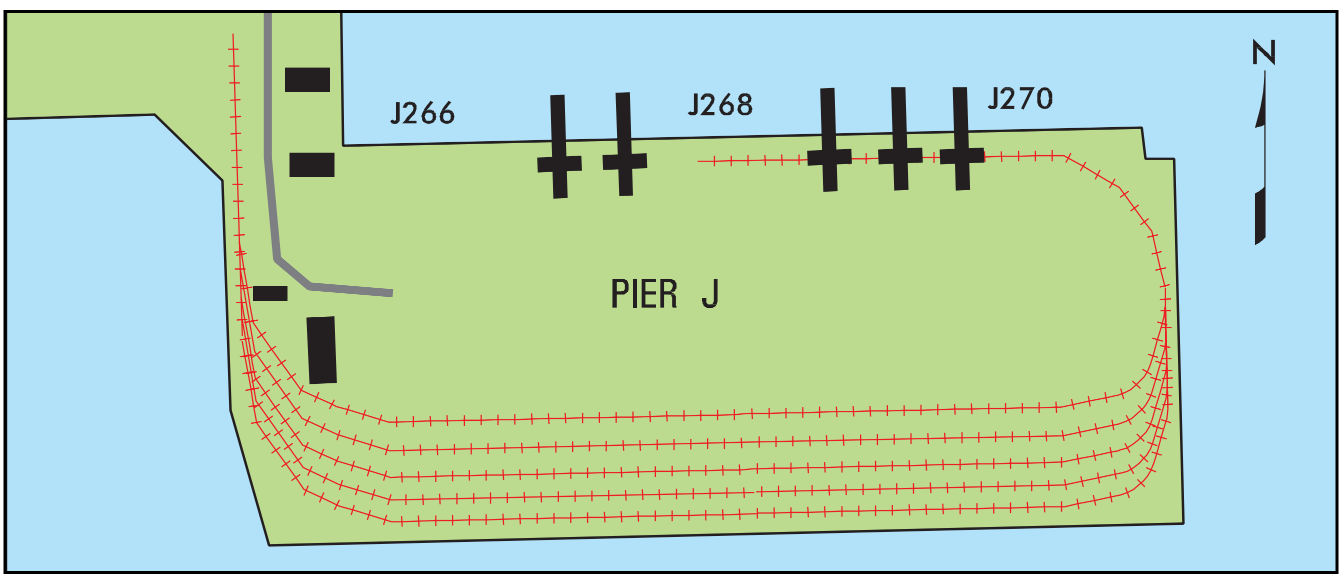
III. APPLICATION

GENERAL

This section of the report will evaluate the throughput capability of the port for deploying a notional mechanized infantry division, chiefly using fast sealift ships (FSS).

Specific planning requirements in response to a military deployment are outlined in the *Port Planning Orders* issued by MARAD. The Port of Long Beach must be prepared to grant priority use of Maersk Marine Terminals, pier J, berths 266, 268, and 270; 15 acres of open storage; about 12,000 square feet of covered storage; and about 300 square feet of office space with receptacles/connections for telephones and computers.

2,700 FT BERTH
15 OPEN ACRES
12,000 COVERED FT^2



NOTE:
FIGURES ARE NOT TO SCALE

Facilities in the Planning Orders Digest

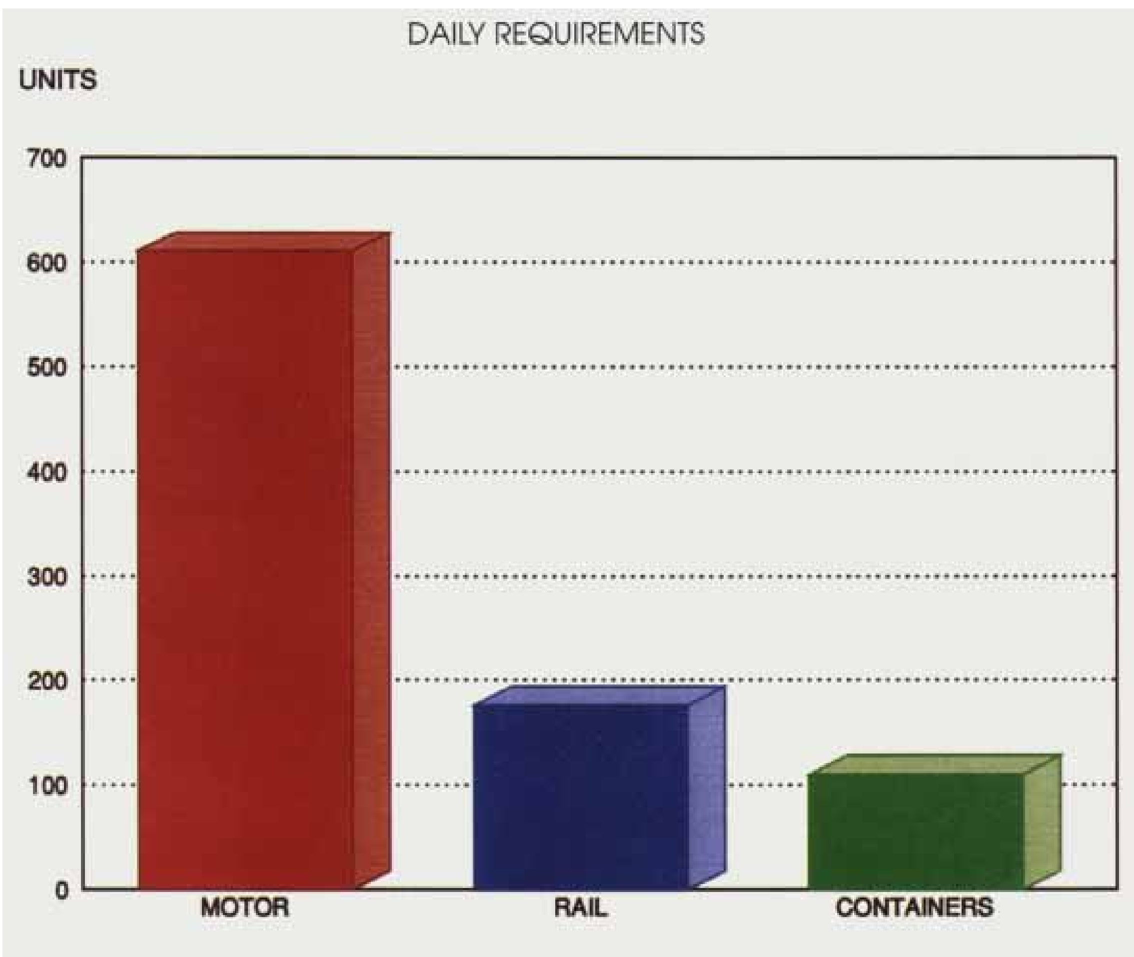
REQUIREMENTS

This report assumes that the facilities expected in the upcoming *Planning Orders Digest* will be used for military operations. Although not clearly specified in the planning orders, this report assumes two 2,000-foot rail spurs inland of berth J266-J270 will also be used.

The likely requirement for the Port of Long Beach is to deploy a notional mechanized infantry division in 6 days of reception and throughput. The division has to move about 7,800 vehicles and 660 containers. The movement to the port will require 1,055 (176 per day) railcars, using the convoy/rail option. Under this option, about 3,650 (610 per day) roadable vehicles would be driven and about 2,320 (387 per day) would be towed.

MECHANIZED INFANTRY DIVISION DEPLOYMENT DATA

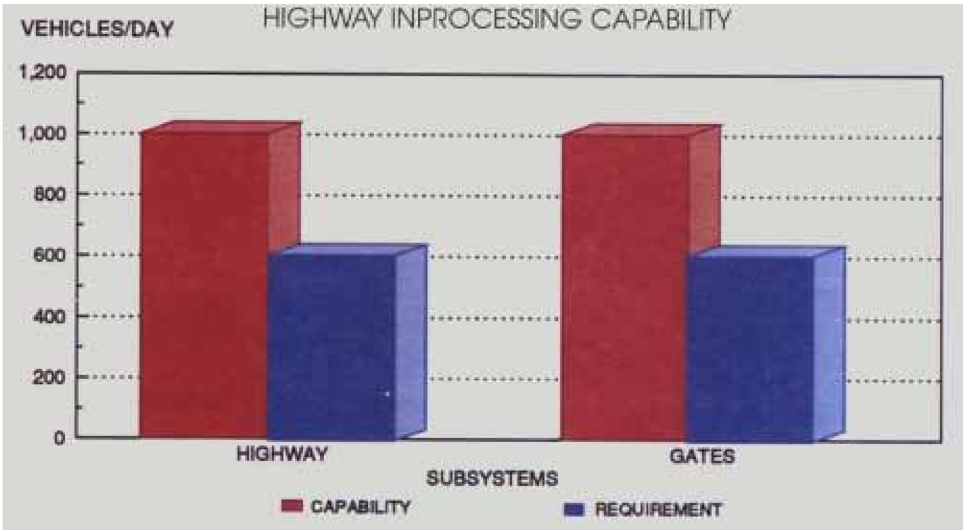
Total Equipment	
Volume	274,518 MTON
Weight	95,010 STON
Area	1,422,844 SQ FT
Vehicles	7,800
Containers	660



TERMINAL HANDLING

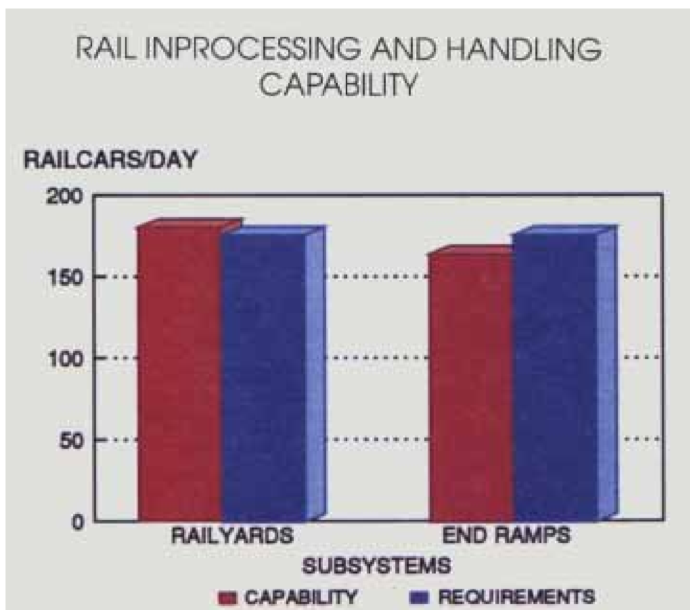
Highway

Vehicles and containers on chassis would access the Piers G and J Terminal through the five-lane gate on Harbor Scenic Drive. Both the access road and the gate can handle more than 1,000 vehicles per day.



Rail

The Piers G and J Terminal can receive 180 railcars per day. Two portable rail end ramps placed along the 2,000-foot railyard at the south side of the terminal could only offload about 164 railcars of military equipment per day. This is within the capability of the rail reception of the facility, but is not sufficient to meet the offloading requirement.



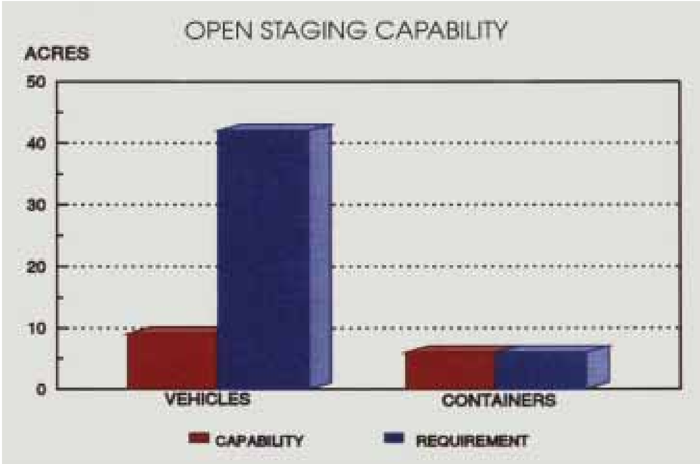
Operations on a third track of the railyard would produce sufficient offloading capability, but might create excessive congestion in the area. Timbers or other provisions are required to allow vehicles to cross tracks.

A possible solution would be to deploy more equipment by highway and less by rail.

STAGING

This analysis assumes that current downsizing continues and that nine FSS-sized ships will deploy an entire notional mechanized infantry division. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations. Although an FSS load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations.

Of these 16 acres, about 2 acres are required for staging the 73 containers for each FSS. The three simultaneous ship-loading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers. The facilities analyzed in this report only include 15 acres of open storage. This does not meet the requirement of 48 acres.



SHIPPING

Although this analysis assumes that nine FSS-sized ships can deploy the notional mechanized infantry division, the table below provides ship quantities for the current division size. The number of ships required depends on the ship mix selected. The best ship mix would consist of all eight FSS ships, plus two Cape H RORO ships.

UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

LOADING CONDITION/ SAMPLE SHIP MIX	VESSEL TYPES			
	FSS (RORO/COMB)	CAPE H (RORO/COMB)	C3/C4 (BREAKBULK)	C6/C7/C8 (CONTAINER)
Minimum Containerization				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization				
FSS and Container	7.90			2.00
FSS,Cape H, and Container	4.62	3.00		2.00
Breakbulk and Container			29.58	2.00

*Only 8 FSSs are available. Unit shipping requirements exceed the capacity of these 8 vessels, Other vessel types are required to make up the FSS shortfall (Cape H).

Legend:

RORO - roll on/roll off

FSS - fast sealift ship

Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide, Aug 91.

Berth J266-J270 can berth two FSS. The requirement to deploy the division requires the berthing capabilities for three FSS. The capability does not satisfy the requirement.

SUMMARY

The facilities expected in the upcoming *Planning Orders Digest* are not adequate to support the deployment of a division using the Army Strategic Mobility Program (ASMP) timelines.

RECOMMENDATION

Supporting the requirement requires additional rail offloading capability, open staging, and berthing for an FSS. We recommend negotiating for the use of facilities at the Piers D and E Terminal, in addition to those expected in the upcoming *Planning Orders Digest.* Berth D28-D31, one 1,000-foot rail spur, and 23 acres would provide the additional facilities to support the requirement.

September 94

PORT OF LOS ANGELES

LOS ANGELES, CALIFORNIA

I. GENERAL DATA

Altogether, the Port of Los Angeles has 28 miles of wharfage and 6.5 square miles (4,100 acres) of land. It handles more containers and cargo value than any other port in the United States. Of the 36 cargo handling terminals, 10 routinely handle containers. This report covers these container facilities and other facilities that are applicable to military operations. Passenger and bulk terminals are not included because they are not easily adapted to support military operations.

TRANSPORTATION ACCESS

WATER

Access to the port is through the Los Angels Gate opening of the 12-mile-long breakwater that separates the San Pedro Bay from the Pacific Ocean. Once in the protected waters, ships can weigh anchor or continue on to berth. After passing through the breakwater, ships traverse the San Pedro Bay to all terminals. Channel depths are at least 45 feet deep at mean low water (MLW) and 400 feet wide.

The harbor consists of an outer and an inner harbor. The outer harbor shoreline consists mainly of San Pedro and Terminal Island. Wilmington borders entirely on the inner harbor. The inner harbor has a total water area of about 950 acres. It consists of a series of channels, basins, slips, and a centrally located turning basin. The Los Angeles Main Channel extends northwest from the San Pedro breakwater for about 1 mile, then north to a turning basin. From the turning basin, a channel extends to West Basin. Extending northeasterly from the turning basin, Main Channel joins East Basin.

The mean tidal range in Los Angeles Harbor is 3.8 feet. The range between mean lower low water and mean higher high water is about 5.4 feet.

Ships need only clear the Vincent Thomas Bridge at California 47 to access the terminals. The bridge is at least 165 feet above mean high water (MHW). Ships may turn in the 1,350- by 1,650-foot turning basin just inland of this bridge.

OVERHEAD OBSTRUCTIONS

Name of Obstruction	Distance from Breakwater (miles)	Clearance (ft MHW)		Name of Channel Spanned
		Horizontal	Vertical	
Vincent Thomas Fixed Bridge	3.0	1,150	185(center)	Main Channel
Commodore Heim Lift Bridge	4.5	180	162	Cherritos Channel
Overhead Cables	5 (about)		155	Cherritos Channel

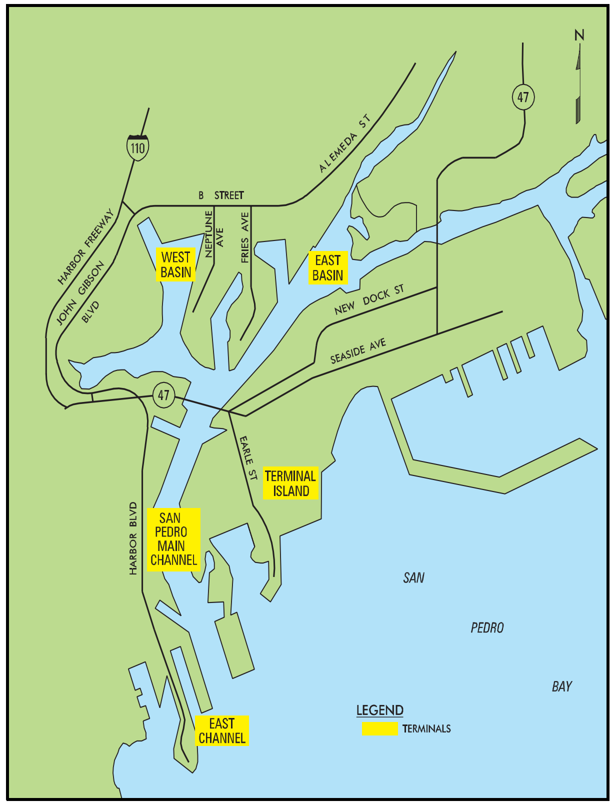
Water Access

HIGHWAY

The Port of Los Angeles is in a heavily populated region. Anticipate traffic congestion when using any route named in this report. Berths within East Channel and those along San Pedro Main Channel on the San Pedro side connect to Harbor Boulevard. Harbor Boulevard then connects to State Highway 47, which intersects with Interstate 110 (I-110) (Harbor Freeway). The distance from Harbor Boulevard along State Highway 47 to I-110 is less than 1 mile.

The berths within West and East Basins access B Street. B Street travels west, then turns southwest and becomes John S. Gibson Boulevard. Continuing southwest about 1 mile, John S. Gibson Boulevard ends upon accessing I-110.

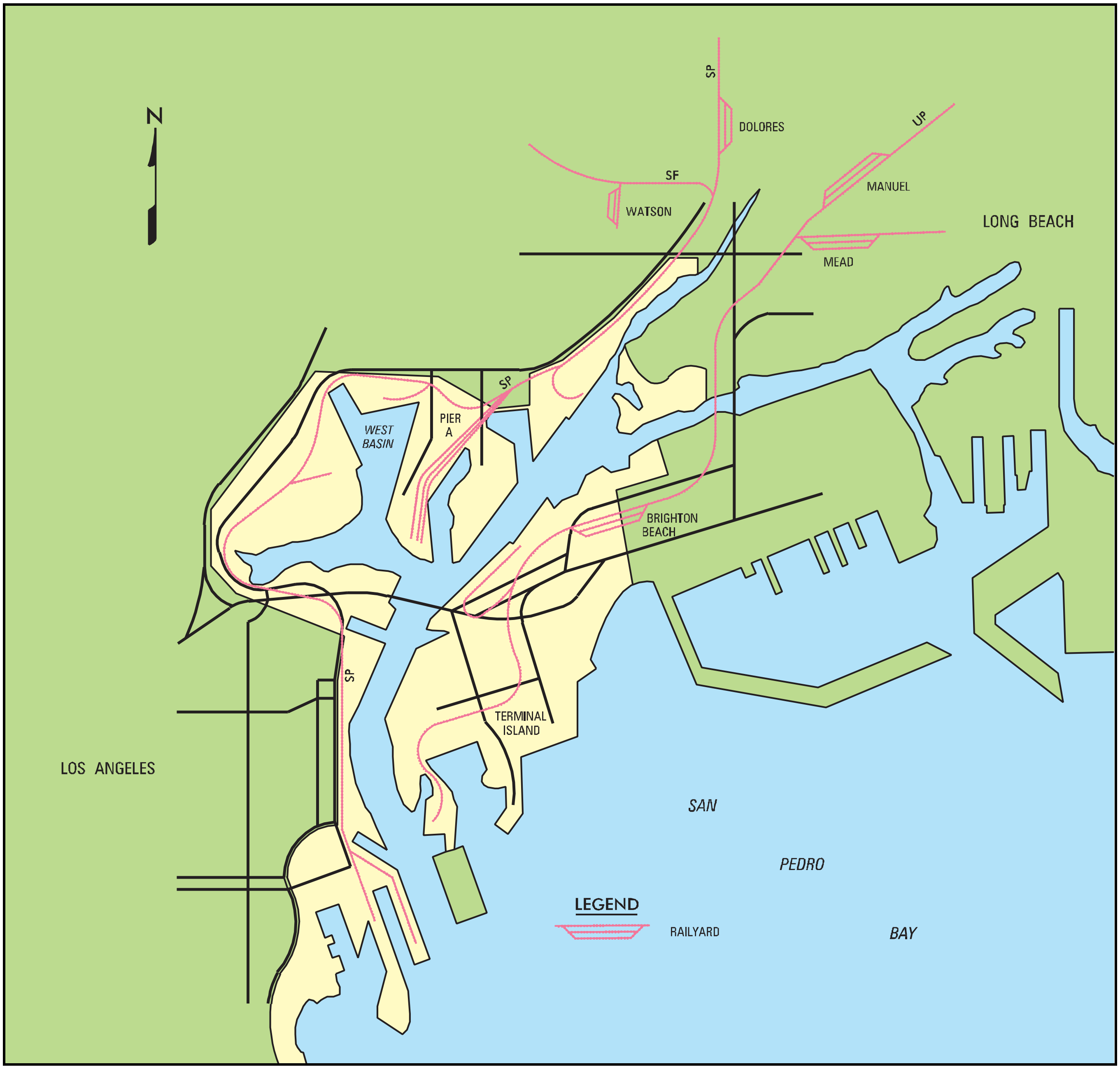
Neptune and Fries Avenues both join B Street at their northern ends. Neptune Avenue serves berths along the east side of West Basin.



Gate to Los Angeles Indies Terminal

RAIL

The three major rail companies that serve the Los Angeles area are the Sante Fe (SF), Southern Pacific (SP), and Union Pacific (UP). The Harbor Belt Line performs switching. The railyards within 5 miles of the ports have storage capacity for more than 1,100 railcars. The nearby Port of Long Beach has additional rail storage yards. Information on those railyards is in the Port of Long Beach report.



Rail Access

AIRPORTS

Several airports of various sizes and capabilities are within 30 miles of the terminals. The largest commercial airports are Los Angeles International and Long Beach Municipal. The nearest military airfield is at the Armed Forces Reserve Center at Los Alamitos.

MAJOR AIRPORTS NEAR THE PORTS OF LOS ANGELES AND LONG BEACH

	Los Angeles International Airport	Long Beach Muncipal Airport	Los Alamitos Naval Air Station
Main Runway:			
Length	12,000 ft	10,000 ft	8,000 ft
Width	150 ft	150 ft	200 ft

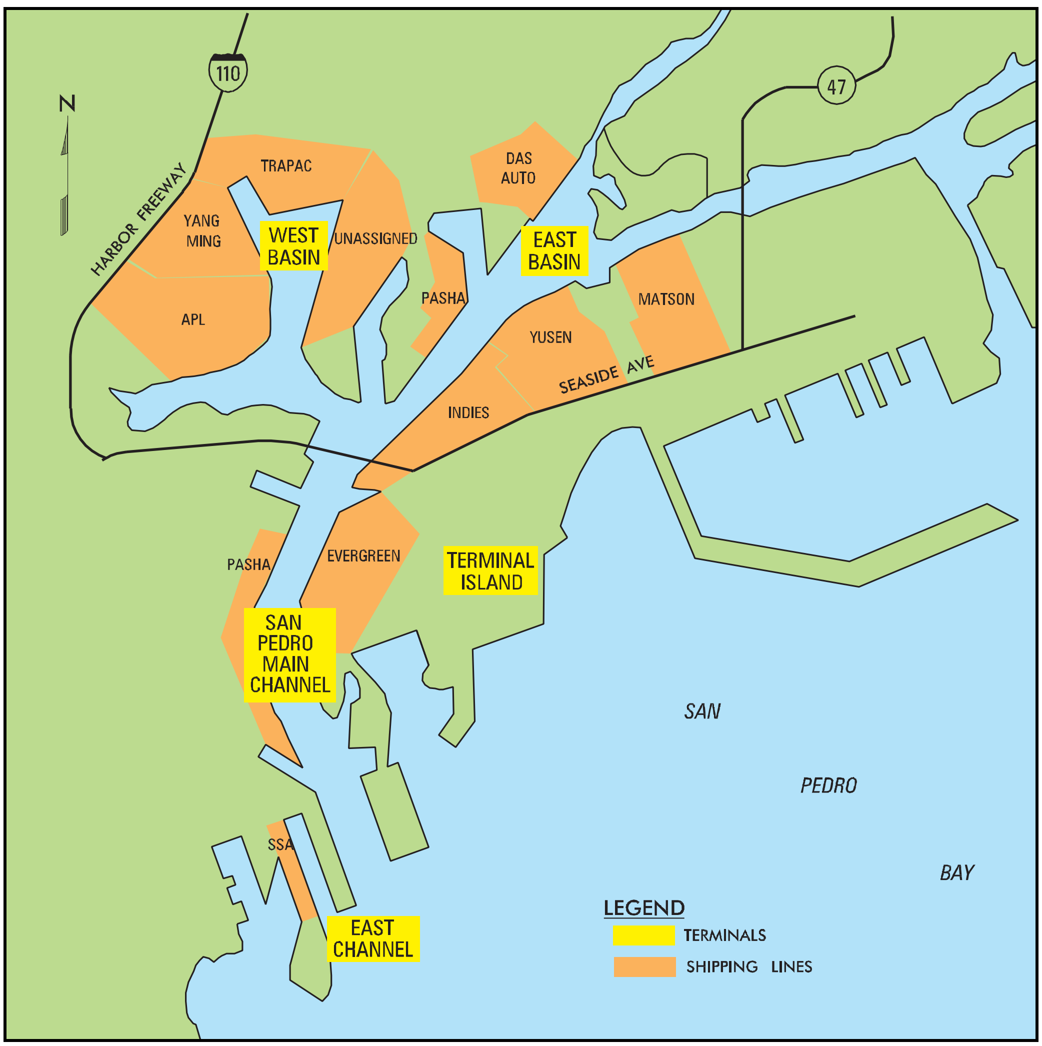
Air Access

PORT FACILITIES
Berthing

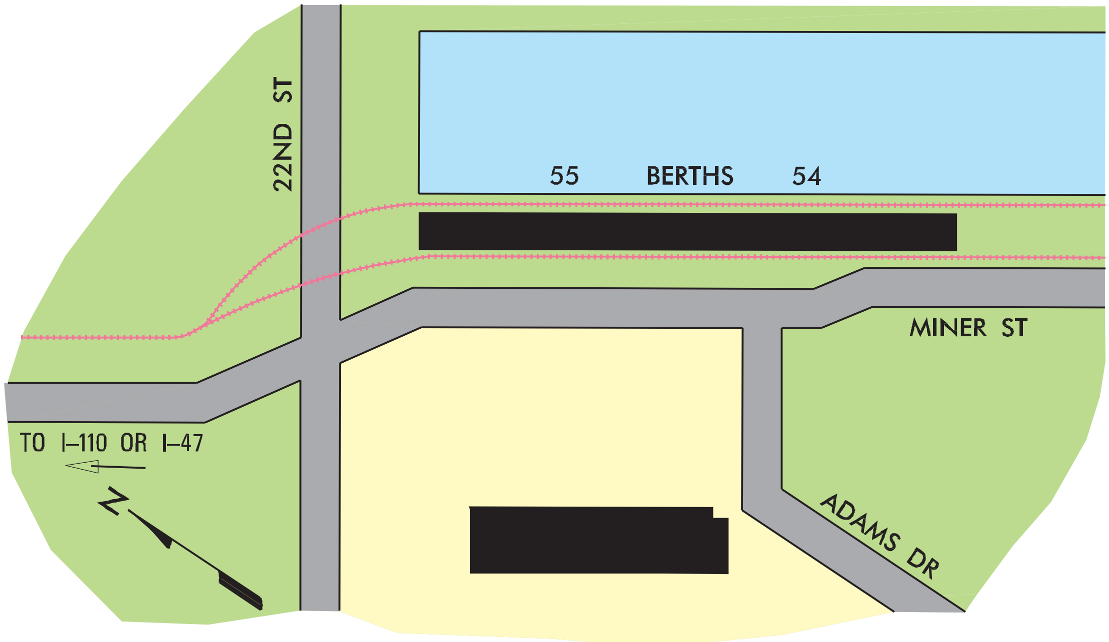
This report covers five areas of the port. Each area is considered a terminal, although each may involve several shipping lines. These terminals are East Channel, San Pedro Main Channel, West Basin, East Basin, and Terminal Island. Most of these terminals are mainly container facilities. Some terminals have transit sheds to support conventional breakbulk cargo. The San Pedro Main Channel and the East Basin Terminals are equipped for RORO operations of import vehicles.

Pier construction is generally concrete piles, fronting a sheet-steel or concrete bulkhead. Fendering is timber or rubber, and the surface is generally asphalt. All terminals have lighting for night operations.

Land-use maps and aerial views of the selected terminals follow. Also included are tables identifying the berth characteristics.



Location of Designated Terminals and Associated Shipping Lines

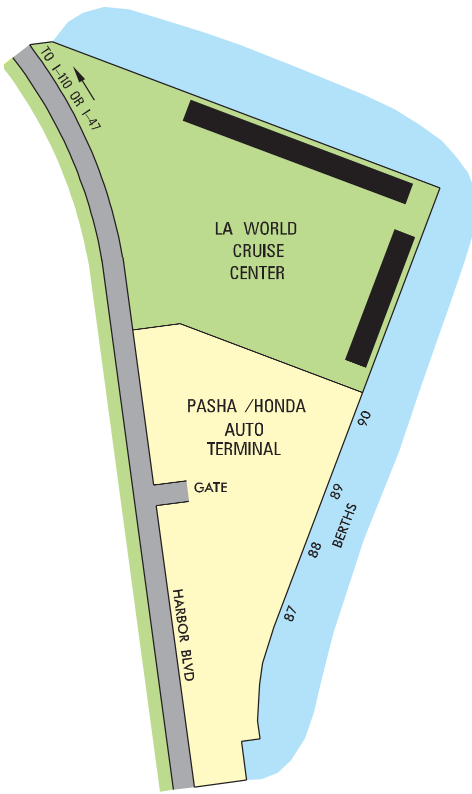


East Channel Terminal

BERTH CHARACTERISTICS OF EAST CHANNEL

CHARACTERISTICS	BERTH 54-55
Length (ft)	1,400
Depth alongside at MLW (ft)	35
Deck strength (psf)	500
Apron width (ft)	47
Apron height above MLW (ft)	12
Number of container cranes	0
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	1,400

East Channel Terminal
(Westward View)



Pasha Terminal

BERTH CHARACTERISTICS OF SAN PEDRO MAIN CHANNEL

CHARACTERISTICS	BERTH 87-90
Length (ft)	1,600
Depth alongside at MLW (ft)	40
Deck strength (psf)	800
Apron width (ft)	Open
Apron height above MLW (ft)	15
Number of container cranes	0
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

San Pedro Main Channel Terminal (Westward View)

West Basin Terminal

BERTH CHARCTERISTICS OF
APL TERMINAL

CHARACTERISTICS	BERTHS 121	BERTHS 126
Length (ft)	959	1,037
Depth alongside at MLW (ft)	45	45
Deck strength (psf)	1,000	1,000
Apron width (ft)	Open	Open
Apron height above MLW (ft)	15	15
Number of container cranes	2	3
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straight-stern RORO facilities	No	No
Apron length served by rail (ft)	0	0

APL Terminal (Westward View)

BERTH CHARACTERISTICS OF YANG MING TERMINAL

CHARACTERISTICS	BERTH 127-131
Length (ft)	1,000
Depth alongside at MLW (ft)	35
Deck strength (psf)	800
Apron width (ft)	Open
Apron height above MLW (ft)	15
Number of container cranes	4
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	1,000

Yang Ming Terminal (Westward View)

BERTH CHARACTERISTICS OF
BERTH 142-146 TERMINAL

CHARACTERISTICS	BERTH 142-146
Length (ft)	2,961
Depth alongside at MLW (ft)	40
Deck strength (psf)	800
Apron width (ft)	Open
Apron height above MLW (ft)	15
Number of container cranes	3
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	2.961

Berth 142-146 Terminal (Northward View)

BERTH CHARACTERISTICS OF TRANS PACIFIC TERMINAL

CHARACTERISTICS	BERTH 136-139
Length (ft)	1,000
Depth alongside at MLW (ft)	45
Deck strength (psf)	1,000
Apron width (ft)	Open
Apron height above MLW (ft)	15
Number of container cranes	4
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	1,800

Trans Pacific Terminal (Northward View)

East Basin Terminal

Pasha Maritime Services Terminal (Northward View)

BERTH CHARACTERISTICS OF PASHA MARITIME SERVICES TERMINAL

	BERTH		
CHARACTERISTICS	**174-176**	**177-179**	**180-181**
Length (ft)	1,312	1,420	925
Depth alongside at MLW (ft)	35	35	35
Deck strength (psf)	1,000	400	400
Apron width (ft)	Open	34	30
Apron height above MLW (ft)	15	15	15
Number of container cranes	2	0	0
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No
Apron length served by rail (ft)	0	0	0

Distribution and Auto Service Terminal (South/East View)

BERTH CHARACTERISTICS OF DISTRIBUTION AND AUTO SERVICE TERMINAL

CHARACTERISTICS	BERTH 195-198
Length (ft)	1,500
Depth alongside at MLW (ft)	40
Deck strength (psf)	500
Apron width (ft)	Open
Apron height above MLW (ft)	15
Number of container cranes	0
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

Terminal Island Terminal

BERTH CHARACTERISTICS OF MATSON TERMINAL

CHARACTERISTICS	BERTH 206-209
Length (ft)	2,000
Depth alongside at MLW (ft)	40
Deck strength (psf)	800
Apron width (ft)	Open
Apron height above MLW (ft)	15
Number of container cranes	5
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

Matson Terminal (Southward View)

BERTH CHARACTERISTICS OF YUSEN TERMINAL

	BERTH	
CHARACTERISTICS	212-214	215-216
Length (ft)	1,200	800
Depth alongside at MLW (ft)	45	45
Deck strength (psf)	1,000	1,000
Apron width (ft)	Open	Open
Apron height above MLW (ft)	15	15
Number of container cranes	2	2
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straight-stern RORO facilities	No	No
Apron length served by rail (ft)	0	0

Yusen Terminal (Southward View)

BERTH CHARACTERISTICS OF INDIES TERMINAL

CHARACTERISTICS	BERTH 217-221	BERTH 222-224	BERTH 227
Length (ft)	900	900	200
Depth alongside at MLW (ft)	45	45	45
Deck strength (psf)	1,000	1,000	1,000
Apron width (ft)	Open	47	Open
Apron height above MLW (ft)	15	15	15
Number of container cranes	4	0	0
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No
Apron length served by rail (ft)	600	900	0

Indies Terminal (Eastward View)

BERTH CHARACTERISTICS OF EVERGREEN TERMINAL

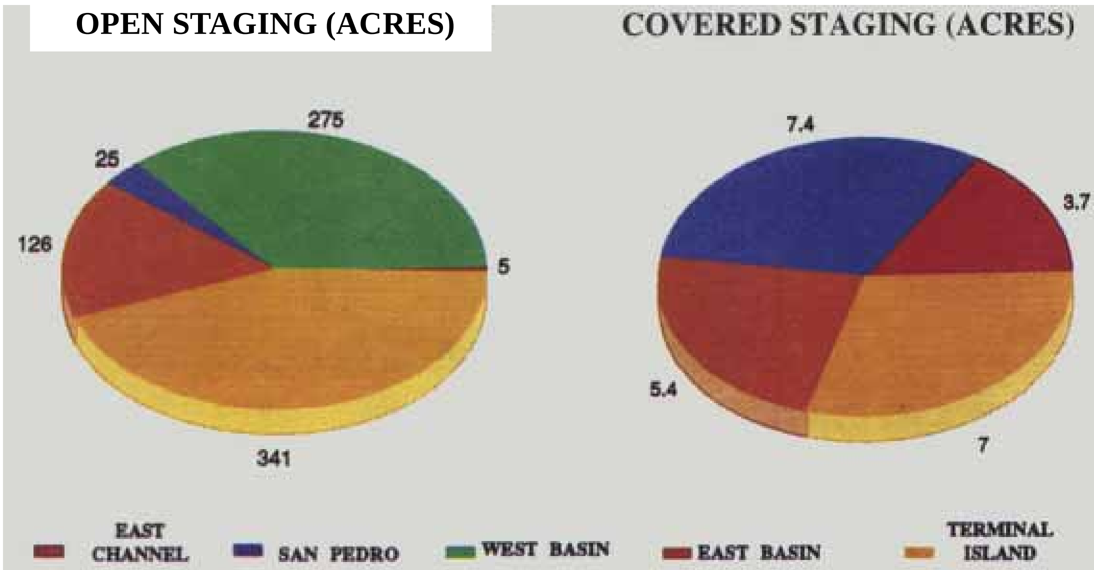
CHARACTERISTICS	BERTH 228-232	BERTH 233-236
Length (ft)	2,564	1,436
Depth alongside at MLW (ft)	45	37
Deck strength (psf)	1,000	1,000
Apron width (ft)	Open	Open
Apron height above MLW (ft)	15	15
Number of container cranes	3	2
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straight-stern RORO facilities	No	No
Apron length served by rail (ft)	0	0

Evergreen Terminal (Eastward View)

Staging

a. ***Open Staging***. The terminals in this report have a total of 770 acres of paved open staging. Open staging is used for containers and import vehicles.

b. ***Covered Staging***. This report covers six covered staging buildings that total more than a million square feet of staging area. Other buildings are set up for manufacturing or repair operations, and would not support military operations.



Covered Storage and Apron Track at Indies Terminal
Berth 222 (Southward View)

Rail

Rail trackage links the railyards to the port's apron tracks, transit sheds, and storage tracks.

The Harbor Belt Line, UP, and SP have railyards adjacent to or near the terminals in this report. These yards can store about 1,000 89-foot railcars. The Harbor Belt Line owns most of this capacity.

Ramps. The port has no permanent rail or truck end ramps. The auto import facilities, however, have at least two rail-mounted bilevel ramps, and three portable bilevel ramps. These ramps will not support heavier military vehicles. Numerous locations are available that could support offloading with temporary or portable end ramps.

Docks. All together, the terminals have 77 truck and 36 boxcar handling positions.

Marshaling Areas

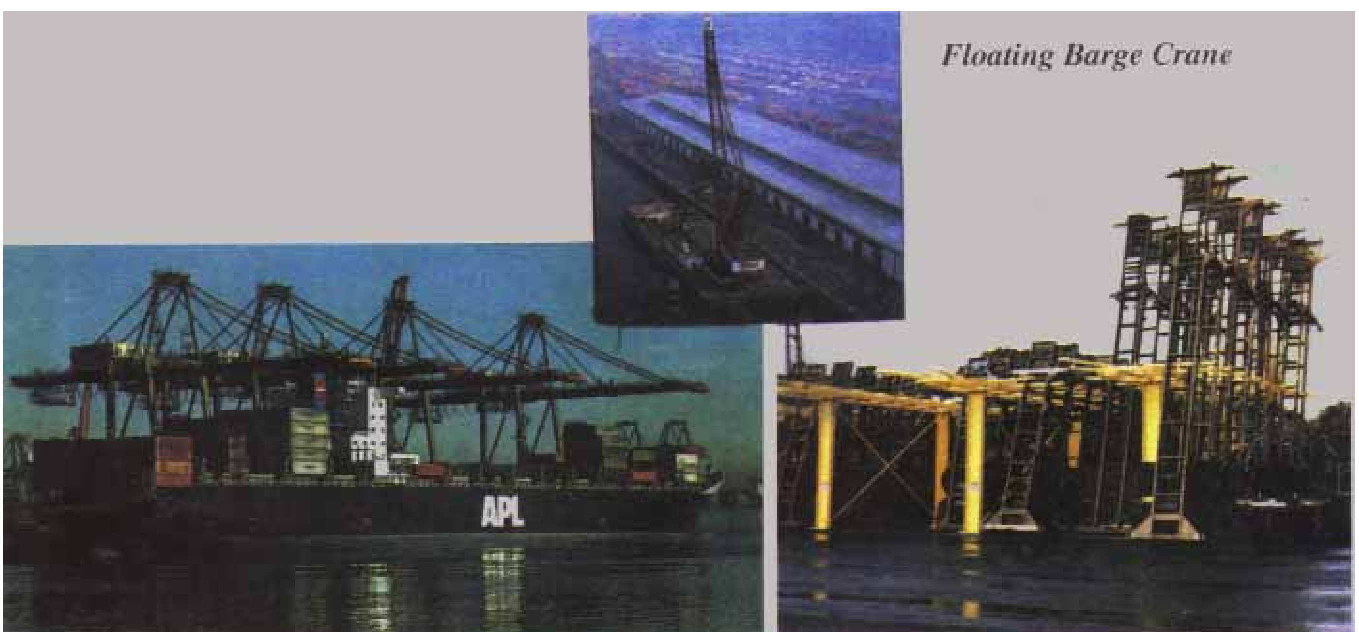
Within Port. No marshaling areas exist. All open areas within the terminals are required for staging military or commercial cargo.

Los Alamitos Armed Forces Reserve Center. The Reserve Center is about 12 miles to the east of the port area. It has no rail access but can provide at least 50 acres of marshaling area. It has a runway about 8,000 feet long, which was previously used by the Naval Air Station.

The Seal Beach Naval Weapons Station, a few miles south of the Reserve Center, has rail access.

MATERIAL HANDLING EQUIPMENT

The terminals have a total of 36 container cranes. These container cranes are all at the West Basin and Terminal Island Terminals. All have a capacity of at least 40 tons. Various shipping and rental companies in the area own transtainers and other MHE. Mobile cranes with capacities up to 150 tons are available from local stevedore companies. A 150-ton floating crane is also available.



Floating Barge Crane

Container Cranes at APL (Berths 122 & 126)

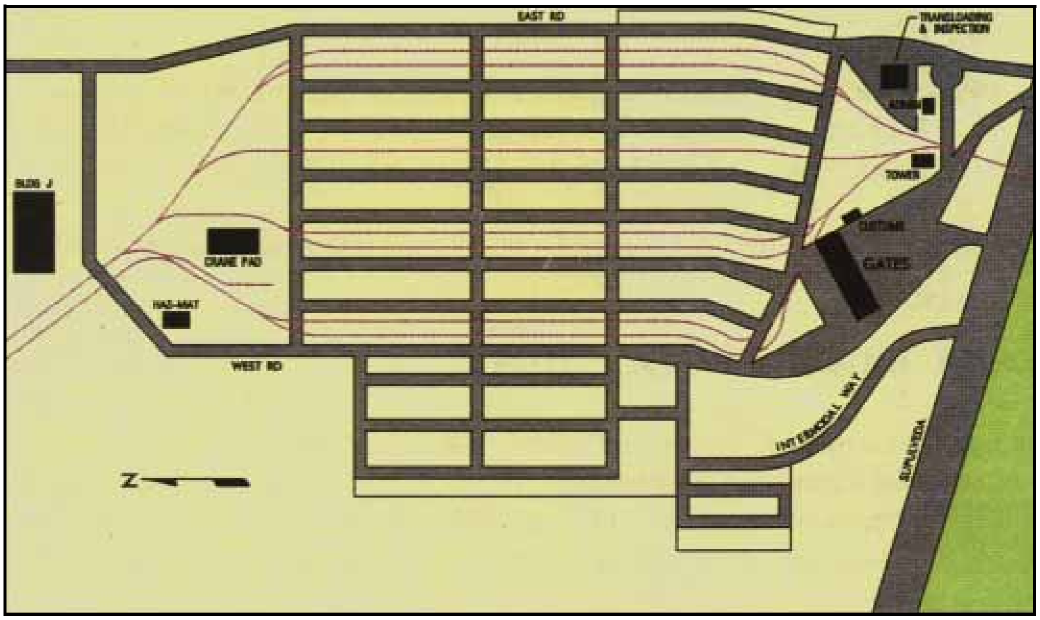
Yusen's Vertical Chassis Racks

INTERMODAL FACILITIES

SF, UP, and CSX have intermodal facilities in the Los Angeles area. However, this report concentrates on the intermodal facility owned in part by the Port of Los Angeles. The Intermodal Container Transfer Facility (ICTF) is 4 miles north of the port area, and is operated by SP. Frequent signs direct trucks to this modern facility.

CHARACTERISTICS OF THE ICTF

Storage	2,800 Spaces
Gate	8 inbound lanes with intercoms
MHE	8 transtainers
	1 top pick
Throughput	1,400 lifts/day



ICTF Land-Use Map

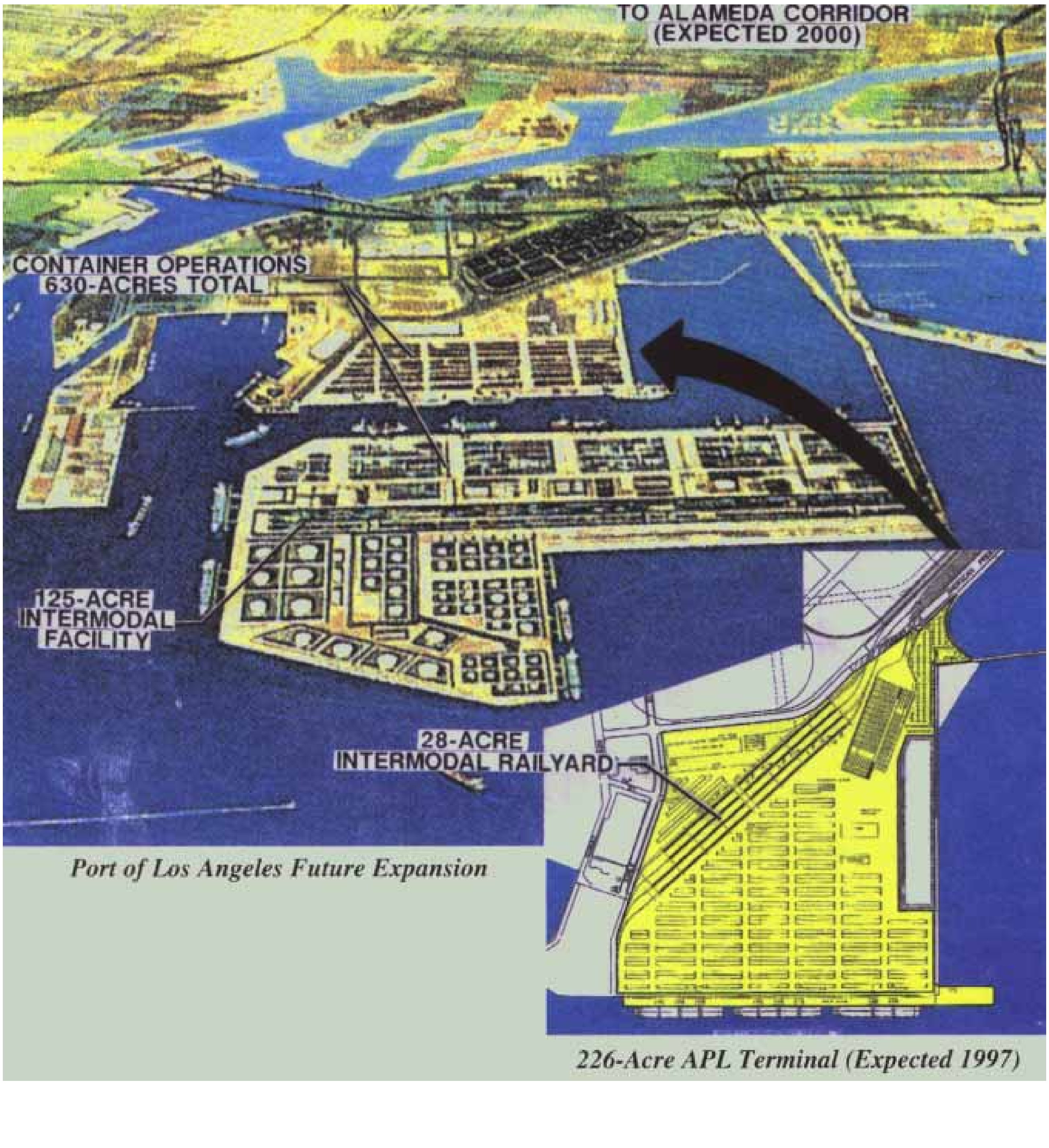
View of Entrance Gate from Control Tower

Top Pick and Chassis

FUTURE DEVELOPMENT

Future development includes developing about 800 acres of the port using dredge spoils.

Also, the Ports of Los Angeles and Long Beach expect to jointly buy 20 miles of land from SP to develop an express transportation corridor for trucks and trains. When finished, the Alameda Corridor will reduce truck delays. This is because of rerouting trains, eliminating at-grade crossings, and widening Alameda Street to six lanes. Trains will have more railcars and will travel at higher speeds.



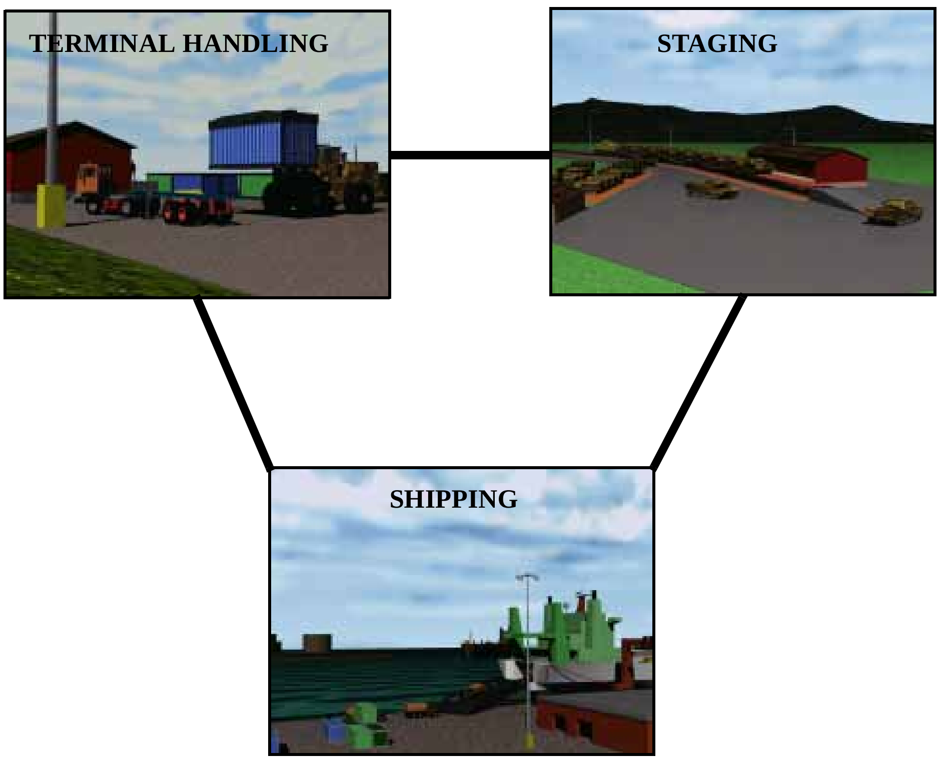
Port of Los Angeles Future Expansion

226-Acre APL Terminal (Expected 1997)

II. THROUGHPUT ANALYSIS

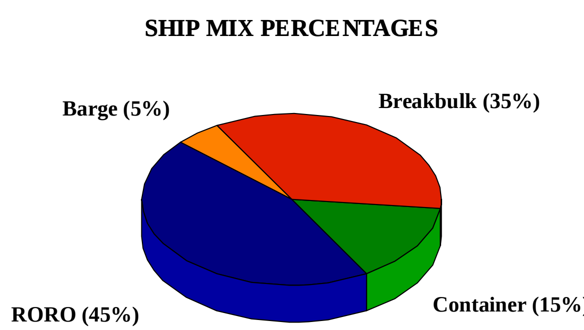
GENERAL

This section evaluates the throughput capability of the Port of Los Angeles using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTONs) per day.



Terminal Throughput Subsystems

The analysis assumes that 80 percent of the port facilities will support military deployments. Also, the ship mix is based on Desert Shield and Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



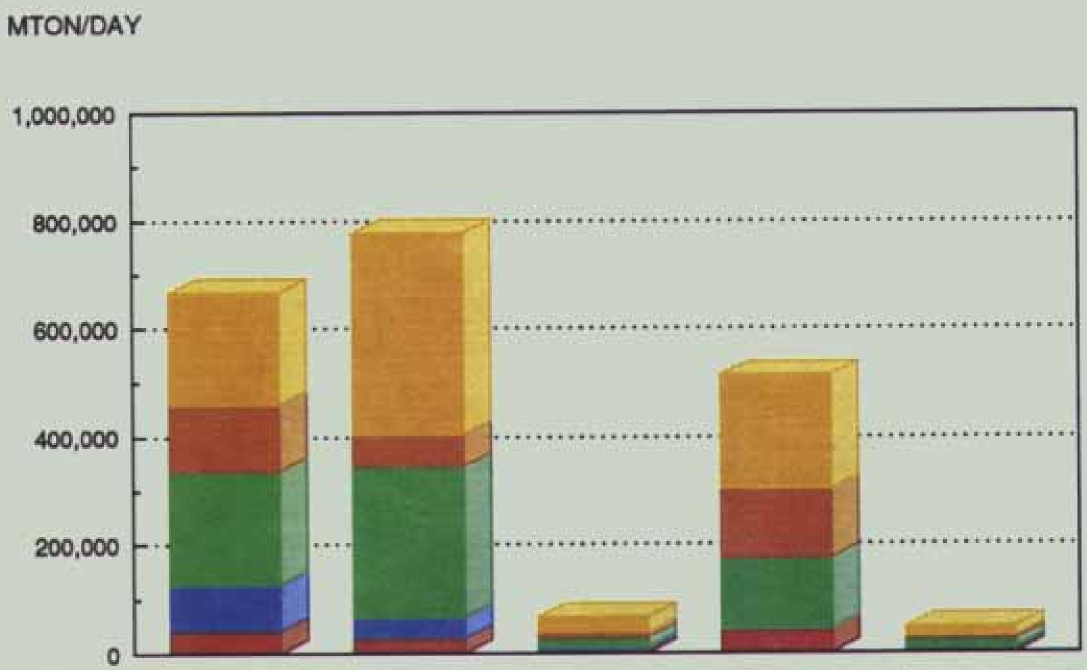
RECEPTION/HANDLING

Highway. I-110 and California 47 provide access to the port. Each terminal has a designated entrance for trucks. The road network in and out of the terminals, including the gate processing of vehicles, could handle about 540,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable ramps. The port has no permanent truck end ramps. Our analysis assumes the port has 14 portable ramps at various locations throughout the port. These ramps could offload more than 7,200 MTON from flatbed trailers per day.

Supplies in van semitrailers will proceed to the 77 van handling positions. These docks can offload more than 512,000 MTON of van semitrailer-shipped material per day. This report assumes that five rented container handlers are available for chassis operations. These container handlers can offload about 48,000 MTON of cargo per day.

HIGHWAY RECEPTION/HANDLING CAPABILITY



SUBSYSTEMS	HIGHWAY	GATES	END RAMPS*	DOCKS	CONTAINERS
EAST CHANNEL	42,100	28,200	4,800	43,500	4,200
SAN PEDRO MC	84,900	38,200	4,800	0	4,200
WEST BASIN	210,900	278,900	19,200	131,200	16,300
EAST BASIN	121,800	58,200	9,600	128,000	5,300
TERM'L ISLAND	208,100	373,800	28,800	209,900	17,900

*14 additional ramps are assumed available.

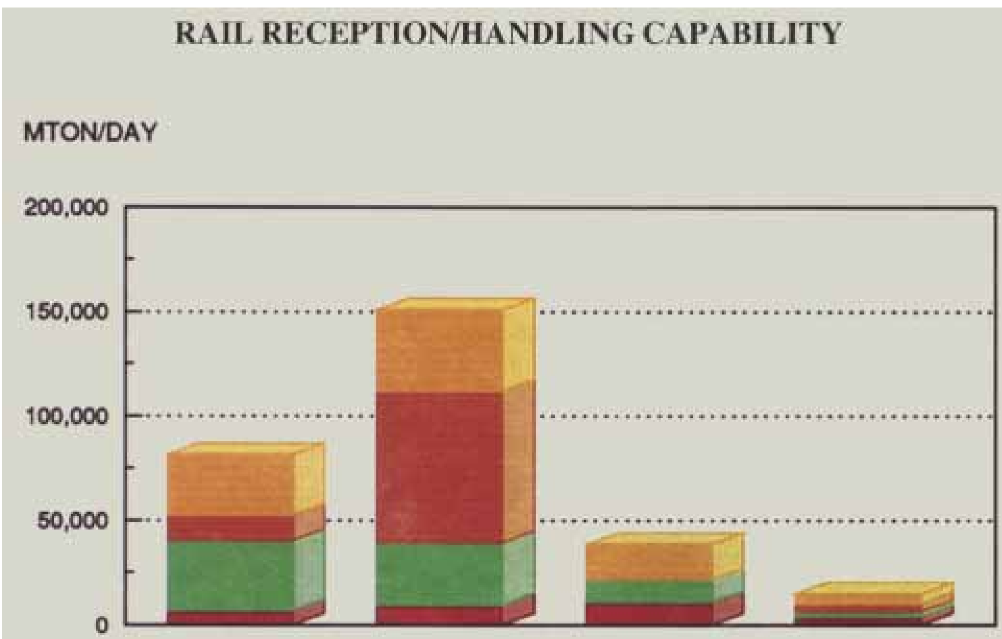
Rail. Rail reception at the port is fair with three major railroad companies accessing the Los Angeles/Long Beach areas. The West Basin section of the port has the best rail service. This is because of the large container business handled by these berths. No tracks access the San Pedro Main Channel Terminal.

This analysis assumes the port or unit can rent, build, or provide 11 portable rail end ramps. These would be in addition to the five ramps regularly used for bilevel operations at the auto import facility at berth 195. We assume the additional portable ramps would be used at the railyard inland of berth 142-146, the spurs inland of berth 174, and the railyard on the north side of Terminal Island. One would be used inland of the shed at berth 54-55.

RAIL DELIVERY

Terminal	Train Length (railcars)	Trains Per Day
East Channel	60	1
San Pedro MC	-	0
West Basin	20	15
East Basin	20	5
Terminal Island	20	5

Boxcars could offload at the transit sheds where about 36 boxcar handling positions are available.

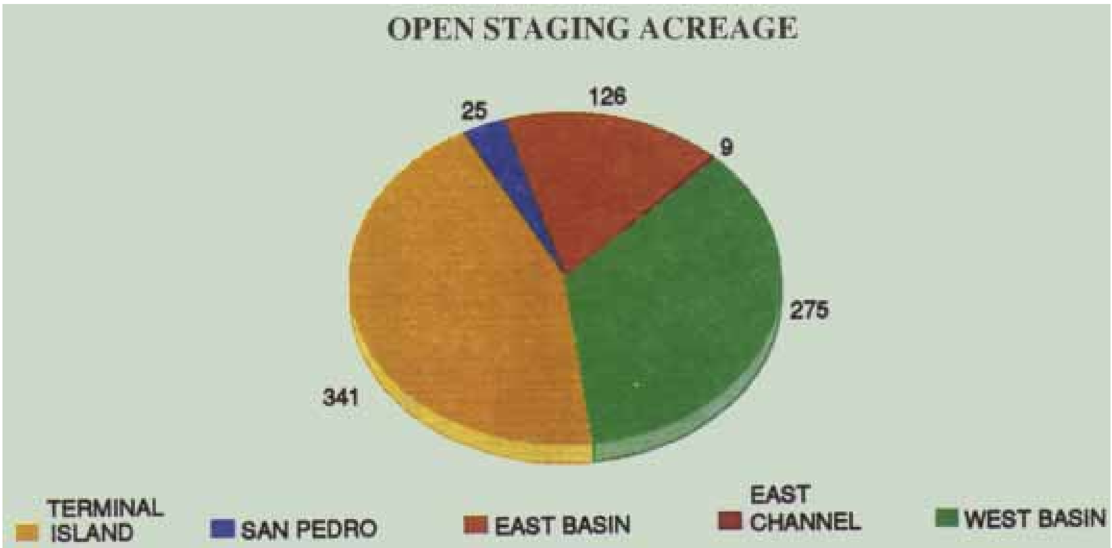


SUBSYSTEMS	TRACKAGE	END RAMPS*	DOCKS	COFC
EAST CHANNEL	6,800	9,300	10,800	3,800
WEST BASIN	33,700	30,100	10,800	2,600
EAST BASIN	12,000	72,500	0	3,750
TERM'L ISLAND	28,900	39,100	17,300	4,800

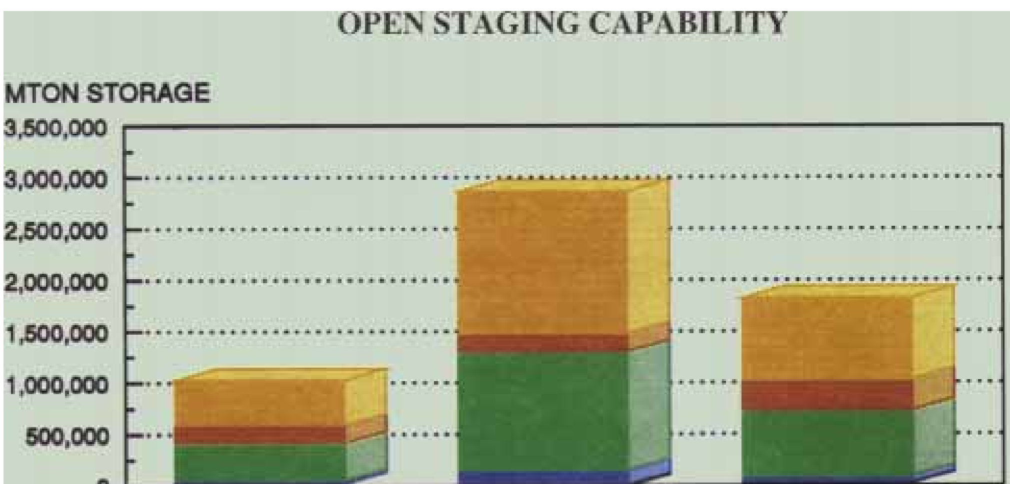
* 5 ramps are available, 11 are assumed to be made available.

STAGING

The terminals have a total of about 770 acres of open paved staging. Also, more than a million square feet of covered storage is available.



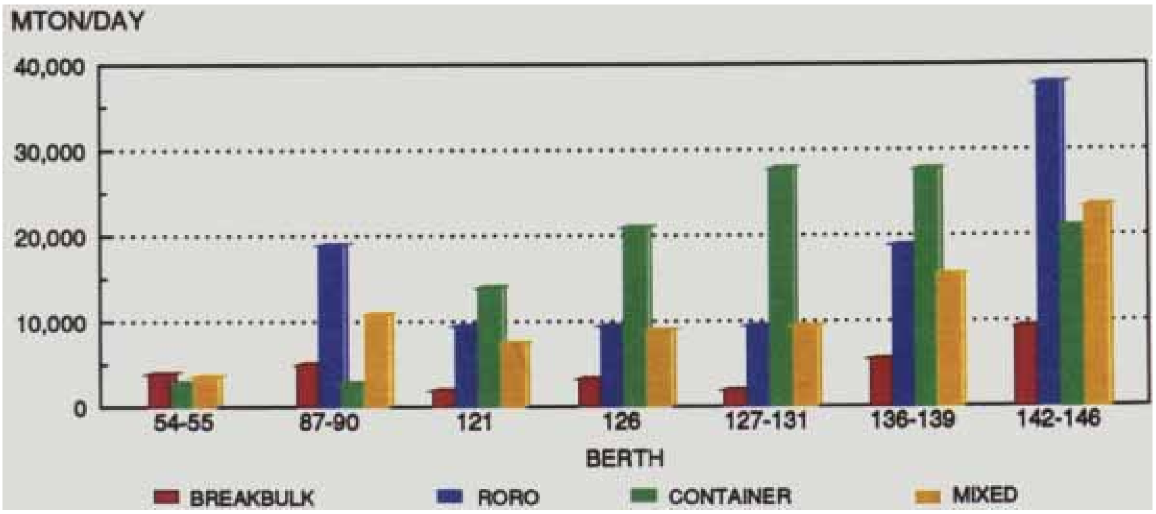
The terminals can perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a container ship is planned. The chart below provides the staging capability for the cargo for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.

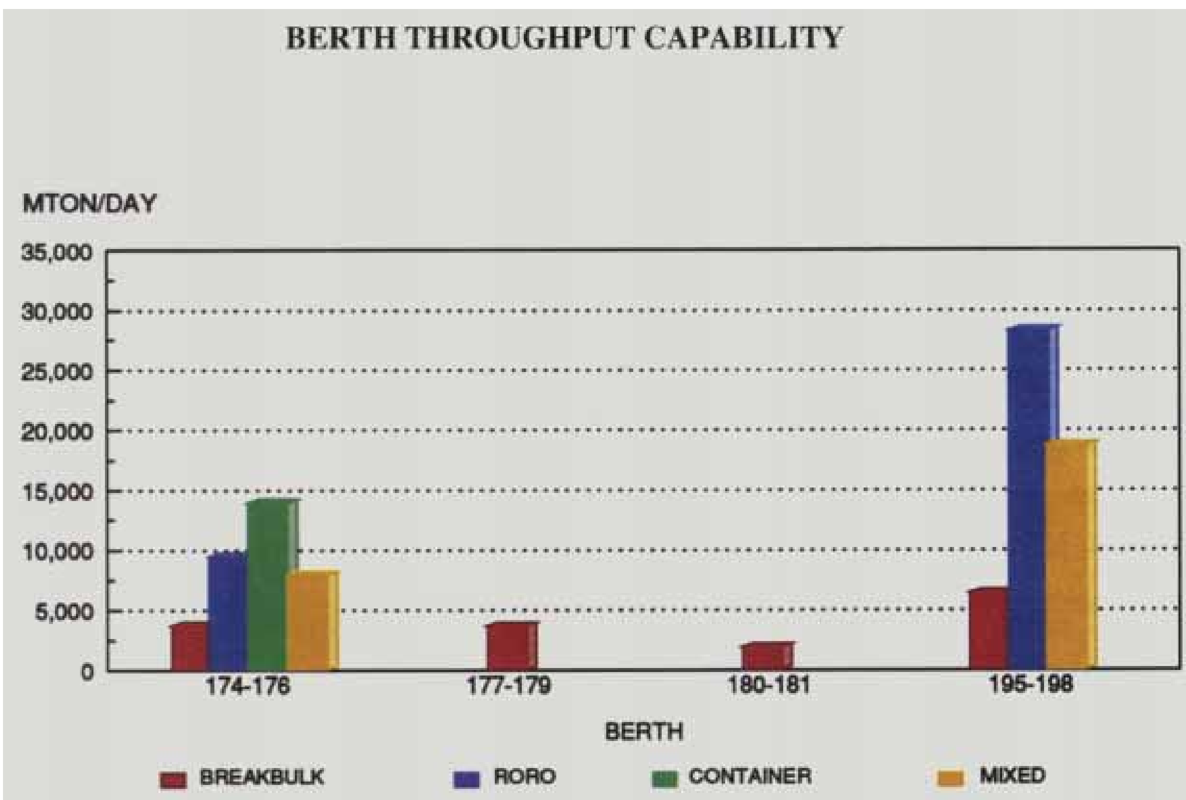


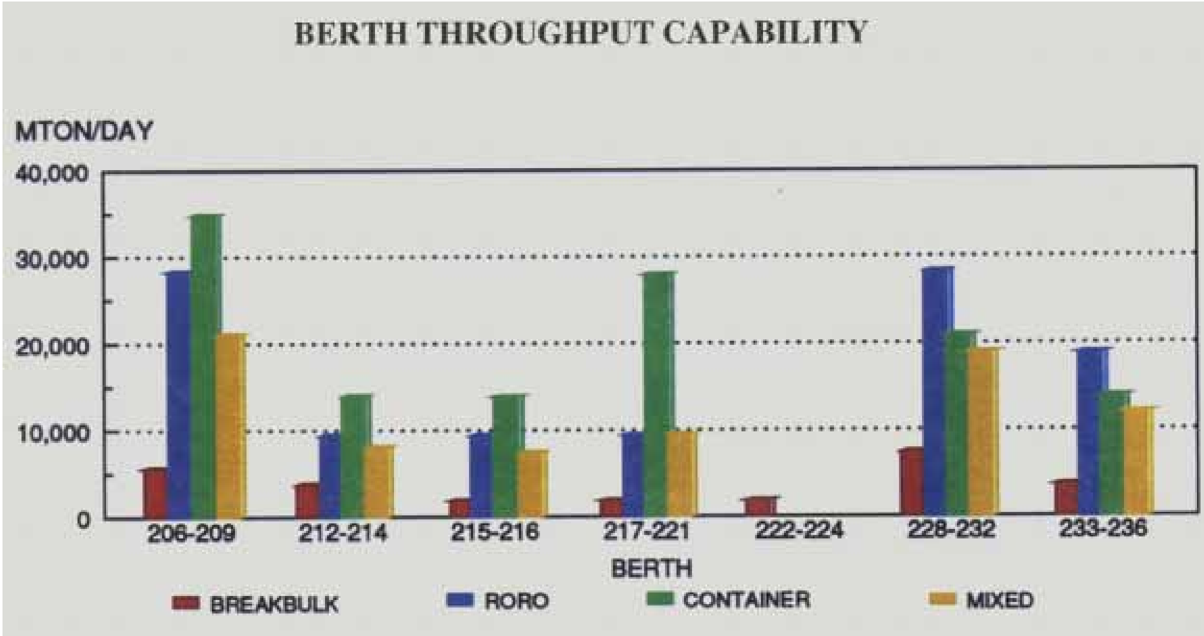
VESSEL TYPE	RORO	CONTAINERS	BREAKBULK
EAST CHANNEL	0	9,200	7,700
SAN PEDRO MC	33,100	139,400	58,400
WEST BASIN	364,800	1,152,000	643,200
EAST BASIN	167,700	184,000	295,700
TERM'L ISLAND	436,700	1,379,000	796,200

SHIPPING

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth and ship compatibility.







CONVERSION		FACTORS
Breakbulk:	0.4	STON per MTON
RORO:	0.25	STON per MTON
Containers	0.4	STON per MTON

PERFERENCE BERTH SELECTION

BERTH	BB	RORO	CNTNR
54-55	14	-	-
87-90	17	9	-
121	9	11	8
126	6	5	7
127-131	5	4	4
136-139	3	1	2
142-146	1	2	6
174-176	13	11	10
177-179	13	11	10
180-181	15	-	-
195-198	18	14	-
206-209	2	9	1
212-214	9	5	9
215-216	9	13	12
217-221	3	3	3
222-224	8	-	-
227	19	-	-
228-232	6	5	5
233-236	9	5	10

The type of ship preferred at each berth is based on the methodology described in the appendix. The evaluation is based on a snap-shot view of the current physical characteristics of the berths and the MHE available. The evaluation to the right gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better it is suitable for loading operations.

Table 1 shows the compatibility for various vessel types. This table indicates for each type of ship the number of vessels that can berth at a particular wharf. The table also provides the limitations that can hinder shipping operations.

TABLE 1 - CONT
SUMMARY OF BERTHING CAPABILITIES OF EAST CHANNEL

Vessel	Berths 54-55
Breakbulk	2
C3-S-33a	
C3-S-37c	
C3-S-37d	2
C3-S-38a	2
C4-S-1a	
C4-S-1qb and 1u	2
C4-S-58a	2
C4-S-65a	2
C4-S-66a	2
C4-S-69b	
Seatrain	
GA and PR-class	2
Barge	
LASH C8-S-81b	1
LASH C9-S-81d	a
LASH lighter	10
SEABEE C8-S-82a	a
SEABEE barge	7
RORO	
Comet	d,o
C7-S-95a/Maine-class	b
Ponce-class	b,h
Great Land-class	b,h
Cygnus/Pilot-class	b
Meteor	d,o
AmEagle/Condor	b
MV Ambassador	d
FSS-class	b
Cape D-class	b
Cape H-class	a,b
Container	
C6-S-lw	2,e
C7-S-68e	1,e
C8-S-85c	1,3
Combination	
C5-S-78a	2,e
C5-S-37e	2,e

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=inadequate berth depth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

TABLE 1 - CONT
SUMMARY OF BERTHING CAPABILITIES OF TERMINAL ISLAND

Vessel	Berths 206-209	212-214	215-216	217-221	222-224	227
Breakbulk						
C3-S-33a	3	2	1	1	1	c
C3-S-37c	3	2	1	1	1	c
C3-S-37d	3	2	1	1	1	c
C3-S-38a	3	2	1	1	1	c
C4-S-1a	3	2	1	1	1	c
C4-S-1qb and 1u	3	2	1	1	1	c
C4-S-58a	3	2	1	1	1	c
C4-S-65a	3	2	1	1	1	c
C4-S-66a	3	2	1	1	1	c
C4-S-69b	3	1	1	1	1	c
Seatrain						
GA and PR-class	3	2	1	1	1	c
Barge						
LASH C8-S-81b	2	1	c	1	1	c
LASH C9-S-81d	2	1	c	1	1	c
LASH lighter	14	8	5	6	6	1
SEABEE C8-S-82a	2	1	c	1	1	c
SEABEE barge	10	6	4	4	4	c
RORO						
Comet	d,i,j	d,i,j	d,i,j	d,i,j	d,o	c,d
C7-S-95a/Maine-class	2	1	1	1	b	c
Ponce-class	h	h	h	h	b,h	c,h
Great Land-class	h	h	h	h	b,h	c,h
Cygnus/Pilot-class	3	1	1	1	b	c
Meteor	d,i,j	d,i,j	d,i,j	d,i,j	d,o	c,d
AmEagle/Condor	i,j	i,j	i,j	i,j	b	c
MV Ambassador	d	d	d	d	d	c,d
FSS-class	2,i	1,i	c	c	b,c	c
Cape D-class	i,j	i,j	i,j	i,j	b	c
Cape H-class	2,i	1,i	1,i	1,i	b	c
Container						
C6-S-lw	2	1	1	1	1,e	c,e
C7-S-68e	2	1	1	1	1,e	c,e
C8-S-85c	2	1	c	1	1,e	c,e
Combination						
C5-S-78a	3	1	1	1	1,e	c.e
C5-S-37e	3	1	1	1	1.e	c,e

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=inadequate berth depth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

TABLE 1 - CONT
SUMMARY OF BERTHING CAPABILITIES OF WEST BASIN

Vessel	Berths 121	126	127-131	136-139	142-146
Breakbulk					
C3-S-33a	1	2	1	3	5
C3-S-37c	1	1	1	3	5
C3-S-37d	1	1	1	3	5
C3-S-38a	1	2	2	3	5
C4-S-1a	1	1	1	3	5
C4-S-1qb and 1u	1	1	1	3	5
C4-S-58a	1	1	1	3	4
C4-S-65a	1	1	1	3	5
C4-S-66a	1	1	1	3	5
C4-S-69b	1	1	1	2	4
Seatrain					
GA and PR-class	1	1	1	3	5
Barge					
LASH C8-S-81b	1	1	1	2	3
LASH C9-S-81d	1	1	a	1	3
LASH lighter	6	7	7	12	21
SEABEE C8-S-82a	1	1	a	1	3
SEABEE barge	4	5	5	9	14
RORO					
Comet	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j
C7-S-95a/Maine-class	1	1	1	2	3
Ponce-class	h	h	h	h	h
Great Land-class	h	h	h	h	h
Cygnus/Pilot-class	1	1	1	2	4
Meteor	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j
AmEagle/Condor	i,j	i,j	i,j	i,j	i,j
MV Ambassador	d	d	d	d	d
FSS-class	1,i	1,i	1,i	1,i	3,i
Cape D-class	i,j	i,j	i,j	i,j	i,j
Cape H-class	1,i	1,i	1,i	1,i	1,i
Container					
C6-S-lw	1	1	1	2	4
C7-S-68e	1	1	1	2	4
C8-S-85c	1	1	1	2	3
Combination					
C5-S-78a	1	1	1	2	4
C5-S-37e	1	1	1	2	4

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f= inadequate berth depth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

TABLE 1 - CONT
SUMMARY OF BERTHING CAPABILITIES OF EAST BASIN

Vessel	Berths 174-176	Berths 177-179	Berths 180-181	Berths 195-198
Breakbulk				
C3-S-33a	2	2	1	4
C3-S-37c	2	2	1	4
C3-S-37d	2	2	1	4
C3-S-38a	2	2	1	4
C4-S-1a	2	2	1	3
C4-S-1qb and 1u	2	2	1	3
C4-S-58a	2	2	1	3
C4-S-65a	2	2	1	3
C4-S-66a	2	2	1	3
C4-S-69b	2	2	1	3
Seatrain				
GA and PR-class	2	2	1	3
Barge				
LASH C8-S-81b	1	1	1	2
LASH C9-S-81d	a	a	a	a
LASH lighter	9	10	6	16
SEABEE C8-S-82a	a	a	a	a
SEABEE barge	6	7	4	11
RORO				
Comet	d,i,j	d,o	d,o	d,i,j
C7-S-95a/Maine-class	1	b	b	2
Ponce-class	h	b,h	b,h	h
Great Land-class	h	b,h	b,h	h
Cygnus/Pilot-class	1	b	b	3
Meteor	d,i,j	d,o	d,o	d,i,j
AmEagle/Condor	i,j	b	b	i,j
MV Ambassador	d	d	d	d
FSS-class	1,i	b	b,c	2,i
Cape D-class	i,j	b	b	i,j
Cape H-class	a	a,b	a,b	2,i
Container				
C6-S-lw	1	2,e	1,e	3,e
C7-S-68e	1	1,e	1,e	3,e
C8-S-85c	1	1,e	1,e	2,e
Combination				
C5-S-78a	2	2,e	1,e	3,e
C5-S-37e	2	2,e	1,e	3,e

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
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j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

TABLE 1 - CONT
SUMMARY OF BERTHING CAPABILITIES OF TERMINAL ISLAND

Vessel	Berths 206-209	212-214	215-216	217-221	222-224	227
Breakbulk						
C3-S-33a	3	2	1	1	1	c
C3-S-37c	3	2	1	1	1	c
C3-S-37d	3	2	1	1	1	c
C3-S-38a	3	2	1	1	1	c
C4-S-1a	3	2	1	1	1	c
C4-S-1qb and 1u	3	2	1	1	1	c
C4-S-58a	3	2	1	1	1	c
C4-S-65a	3	2	1	1	1	c
C4-S-66a	3	2	1	1	1	c
C4-S-69b	3	1	1	1	1	c
Seatrain						
GA and PR-class	3	2	1	1	1	c
Barge						
LASH C8-S-81b	2	1	c	1	1	c
LASH C9-S-81d	2	1	c	1	1	c
LASH lighter	14	8	5	6	6	1
SEABEE C8-S-82a	2	1	c	1	1	c
SEABEE barge	10	6	4	4	4	c
RORO						
Comet	d,i,j	d,i,j	d,i,j	d,i,j	d,o	c,d
C7-S-95a/Maine-class	2	1	1	1	b	c
Ponce-class	h	h	h	h	b,h	c,h
Great Land-class	h	h	h	h	b,h	c,h
Cygnus/Pilot-class	3	1	1	1	b	c
Meteor	d,i,j	d,i,j	d,i,j	d,i,j	d,o	c,d
AmEagle/Condor	i,j	i,j	i,j	i,j	b	c
MV Ambassador	d	d	d	d	d	c,d
FSS-class	2,i	1,i	c	c	b,c	c
Cape D-class	i,j	i,j	i,j	i,j	b	c
Cape H-class	2,i	1,i	1,i	1,i	b	c
Container						
C6-S-lw	2	1	1	1	1,e	c,e
C7-S-68e	2	1	1	1	1,e	c,e
C8-S-85c	2	1	c	1	1,e	c,e
Combination						
C5-S-78a	3	1	1	1	1,e	c,e
C5-S-37e	3	1	1	1	1,e	c,e

a=maximum vessel draft limited to berth depth
b=inadequate apron width
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i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

TABLE 1 - CONT
SUMMARY OF BERTHING CAPABILITIES OF TERMINAL ISLAND

VESSEL		BERTHS	
		228-232	233-236
Breakbulk			
C3-S-33a		5	2
C3-S-37c		4	2
C3-S-37d		4	2
C3-S-38a		4	2
C4-S-1a		4	2
C4-S-1qb and 1u		4	2
C4-S-58a		4	2
C4-S-65a		4	2
C4-S-66a		4	2
C4-S-69b		4	2
Seatrain			
GA and PR-class		4	2
Barge			
LASH C8-S-81b		3	1
LASH C9-S-81d		2	a
LASH lighter		18	10
SEABEE C8-S-82a		2	a
SEABEE barge		12	7
RORO			
Comet		d,i,j	d,i,j
C7-S-95a/Maine-class		3	1
Ponce-class		h	h
Great Land-class		h	h
Cygnus/Pilot-class		3	2
Meteor		d,i,j	d,i,j
AmEagle/Condor		i,j	i,j
MV Ambassador		d	d
FSS-class		2,i	1,i
Cape D-class		i,j	i,j
Cape H-class		3,i	1,i
Container			
C6-S-lw		3	2
C7-S-68e		3	1
C8-S-85c		2	1
Combination			
C5-S-78a		4	2
C5-S-37e		4	2

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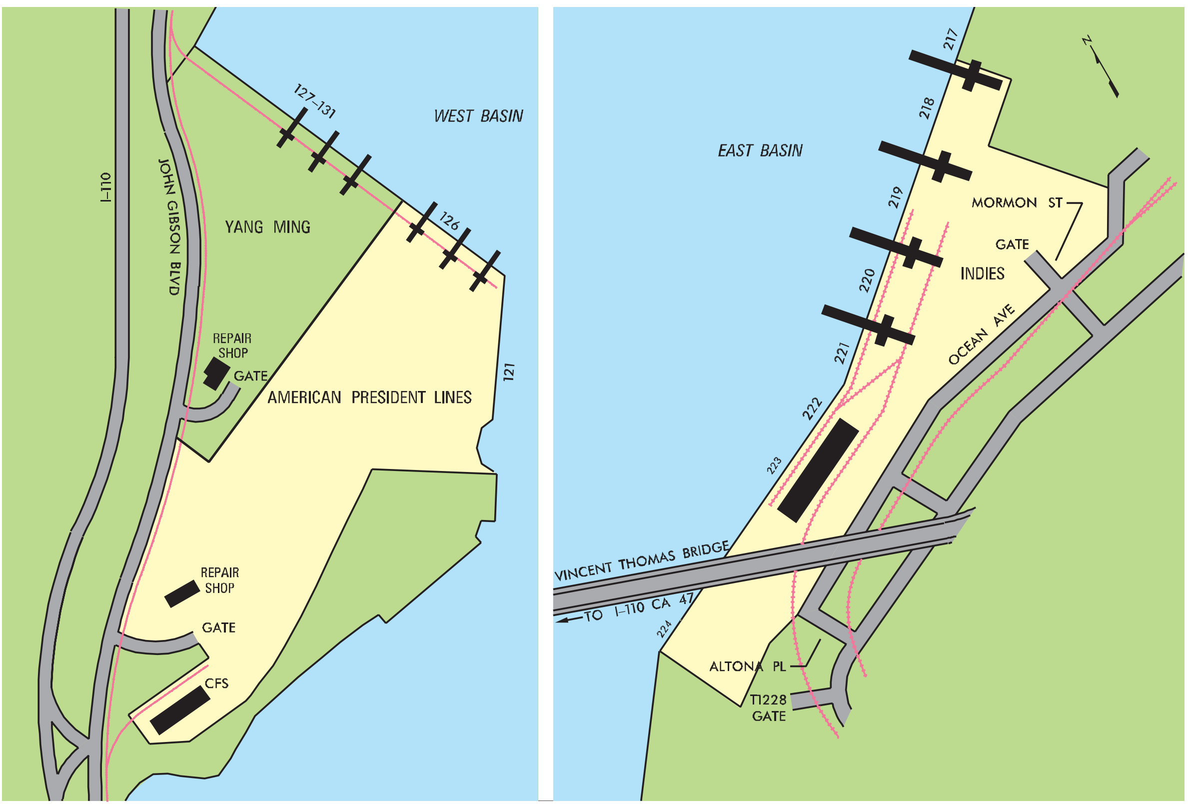
Notes: Ramp clearance and ramp angle based on maximum vessel draft

III. APPLICATION

GENERAL

This section of the report will evalute the port's throughout capability for deploying a notional mechanized infantry division primarily using FSS vessels. The 1988 revision for the Planning Orders Digest, issued by MARAD, provided agreements for the military to use the Port of Los Angeles. The agreements referenced the entire American President Lines Terminal. The upcoming revision will not likely reference any part of the Port of Los Angeles.



Facilities on the July 1988 Planning Order Digest.

If the military needs to deploy through the Port of Los Angeles, it will most likely use the Indies Terminal. The American President Lines Terminal is very busy, and will not likely support the disruption of commercial businesses. This report assumes that all of the Indies Terminal is available for military operations.

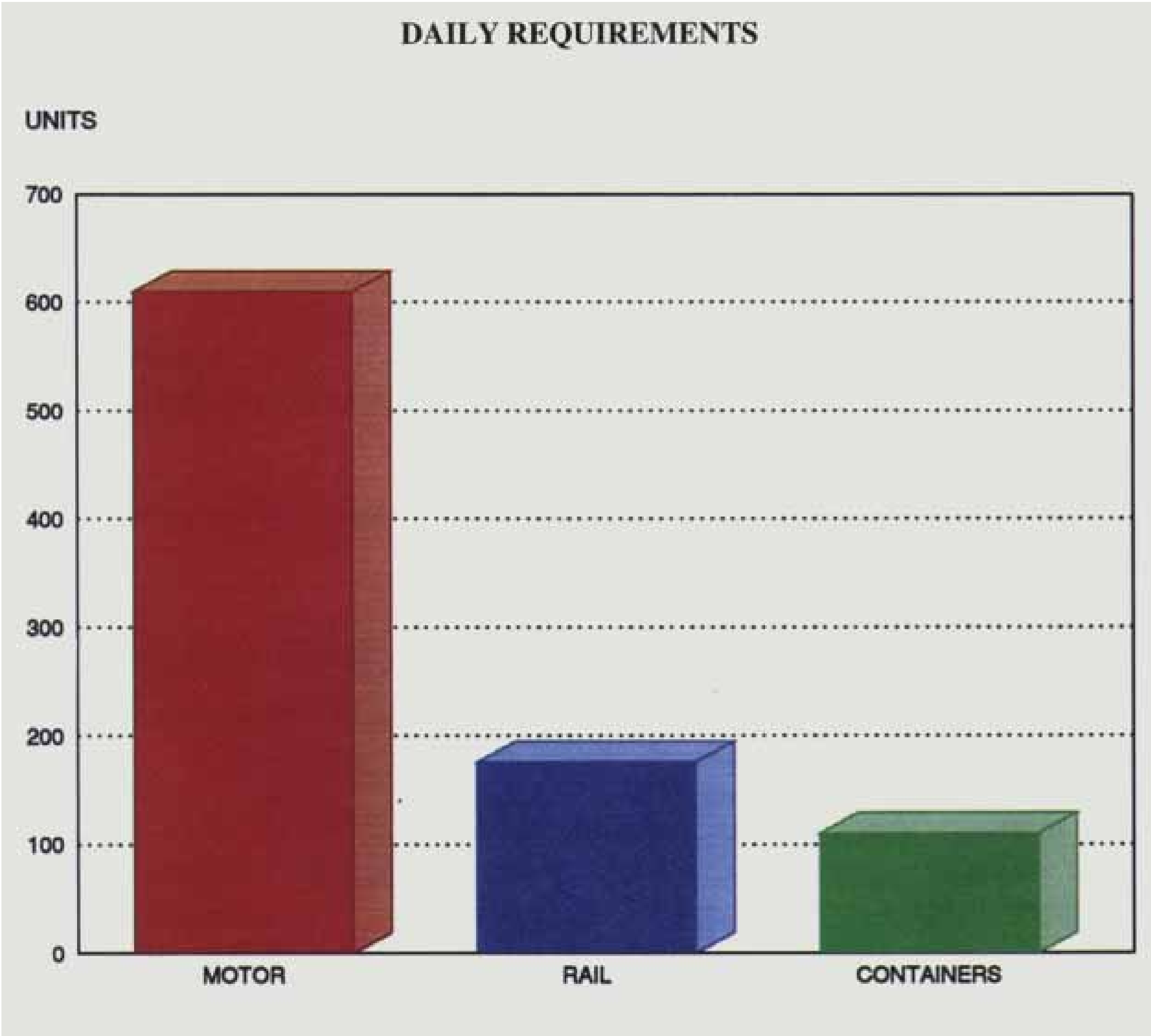
In addition to the Indies Terminal, this analysis assumes the military will negotiate to use the Yusen Terminal. Although the Yusen Terminal is very busy with commercial cargo, its adjacent railyard, FSS capability, and proximity to the Indies Terminal make it a good choice.

REQUIREMENTS

The most likely requirement for the Port of Los Angeles is to deploy a notional mechanized infantry division in 6 days of reception and throughput. The division has to move about 7,800 vehicles and 660 containers. The movement to the port will require 1,055 (176 per day) railcars using the convoy/rail option. Under this option, about 3,650 (610 per day) roadable vehicles would be driven and about 2,320 (387 per day) would be towed.

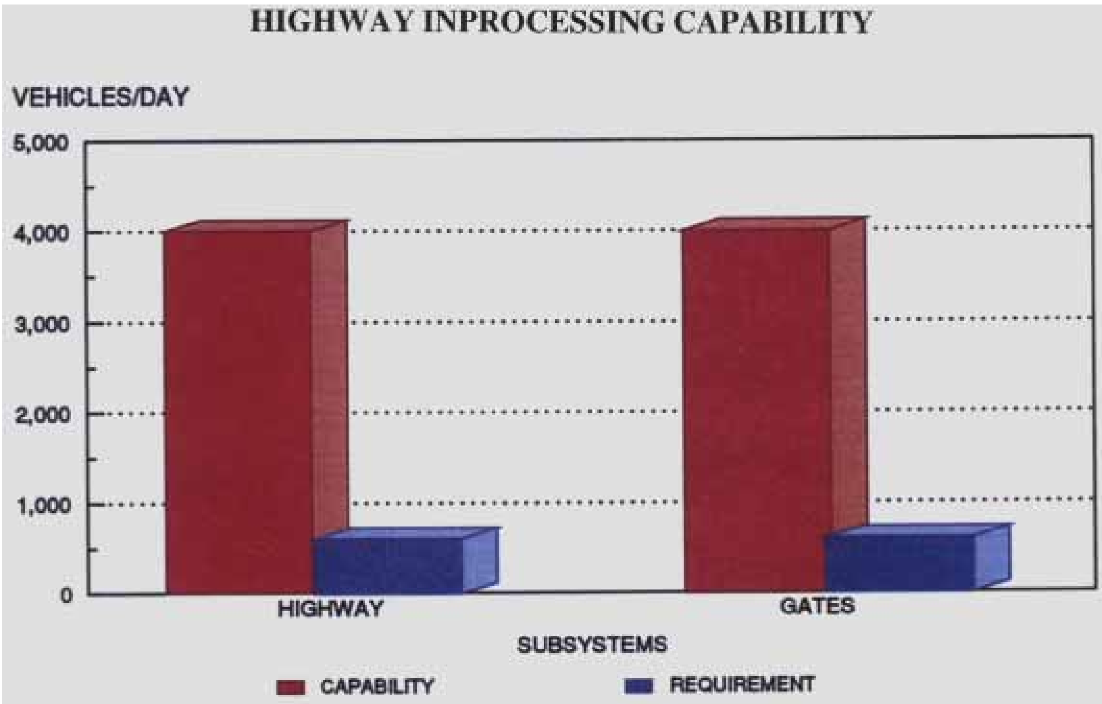
MECHANIZED INFANTRY DIVISION

Total Equipment	
Volume	**274,518 MTON**
Weight	**95,010 STON**
Area	**1,422,844 SQ FT**
Vehicles	**7,800**
Containers	**600**



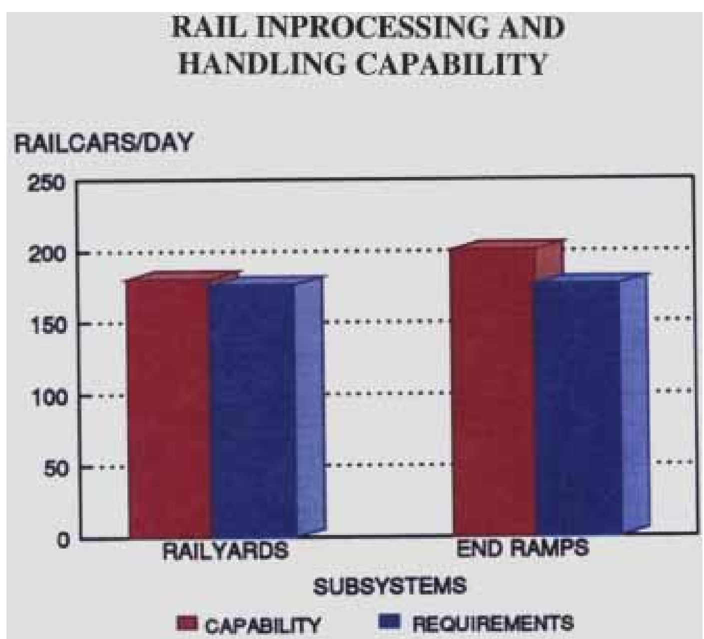
TERMINAL HANDLING

Highway. Vehicles and containers on chassis would access the terminals through the gates at Morman and New Dock Streets. The access roads and gates can handle at least 4,000 vehicles per day.



Rail. The Indies Terminal can receive about 80 railcars per day of military equipment. The railyard inland of the Yusen Terminal can recieve about 100 railcars without disrupting the concurrent commercial operations. This is sufficient to meet the requirement.

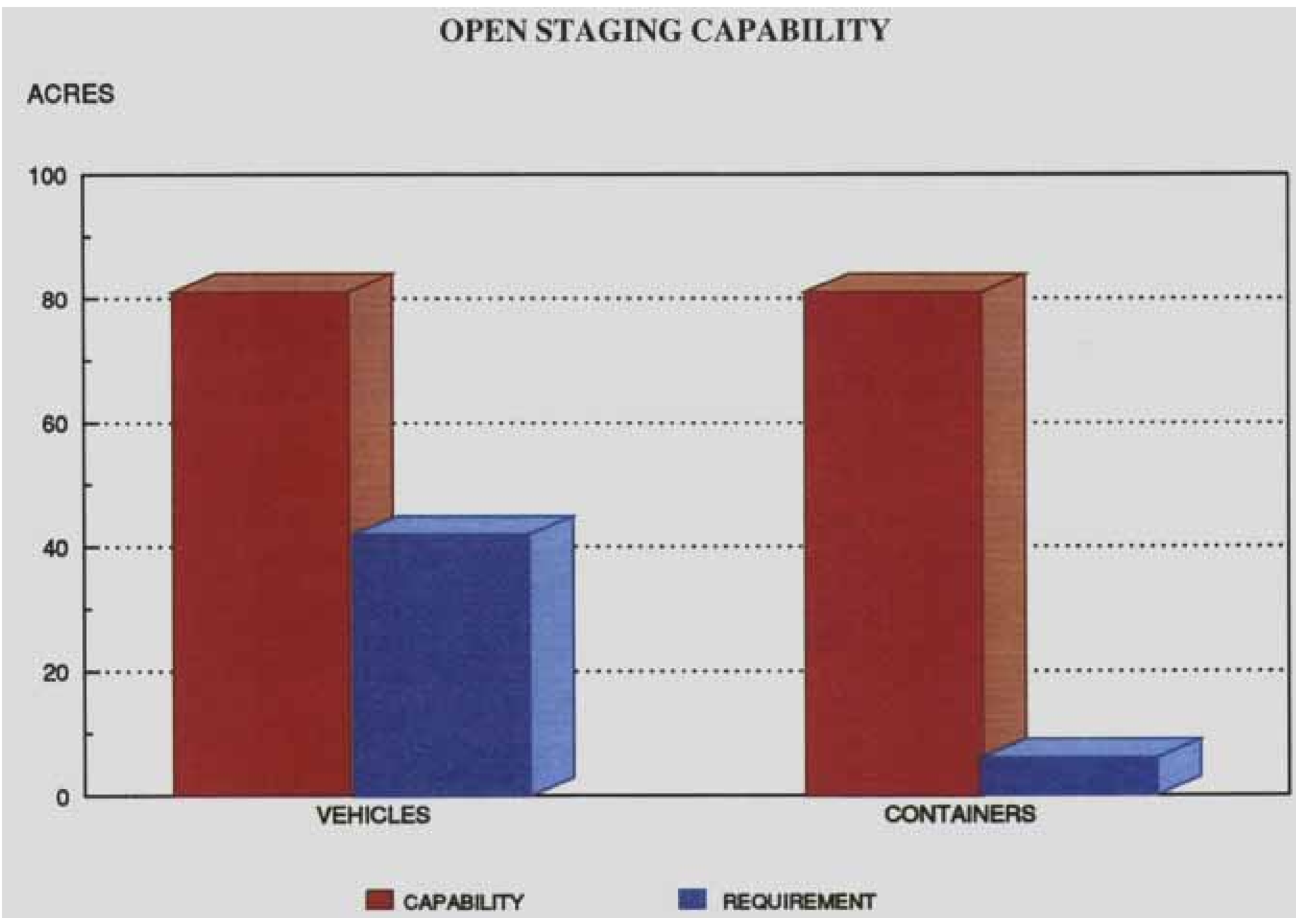
Trackage at the Indies Terminal can only support offloading five railcars at a time, unless apron space is used. Three additional portable ramps (each supporting the offloading of 15 railcars) at the railyard inland of the Yusen Terminal will satisfy the requirement. These four ramps will have the capability to offload 200 railcars per day.



STAGING

This analysis assumes that current downsizing continues, and that nine FSS-sized ships will deploy an entire notional mechanized infantry division. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations.

Although an FSS load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for staging the 73 containers for each FSS. The three simultaneous shiploading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers. There are 162 acres of open staging that could support military operations at the two terminals. This is enough staging area for the deployment.



SHIPPING

Although this analysis assumes that only nine FSS-sized ships can deploy the notional mechanized infantry division, the table below provides ship quantities for the current division size. The number of ships required depends on the shipping mix selected. The best ship mix would consist of all eight FSS ships, plus two Cape H RORO ships.

UNIT MOVEMENT REQUIREMENTS, MECHANISED DIVISION

LOADING CONDITION/ SAMPLE SHIP MIX	VESSEL TYPES			
	FSS (RORO/COMB)	**CAPE H (RORO/COMB)**	**C3/C4 (BREAKBULK)**	**C6/C7/C8 (CONTAINER)**
Minimum Containerization				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization				
FSS and Container	7.90			2.00
FSS,Cape H, and Container	4.62	3.00		2.00
Breakbulk and Container			29.58	2.00

*Only 8 FSSs are available. Unit shipping requirements exceed the capacity of these 8 vessels, Other vessel types are required to make up the FSS shortfall (Cape H).

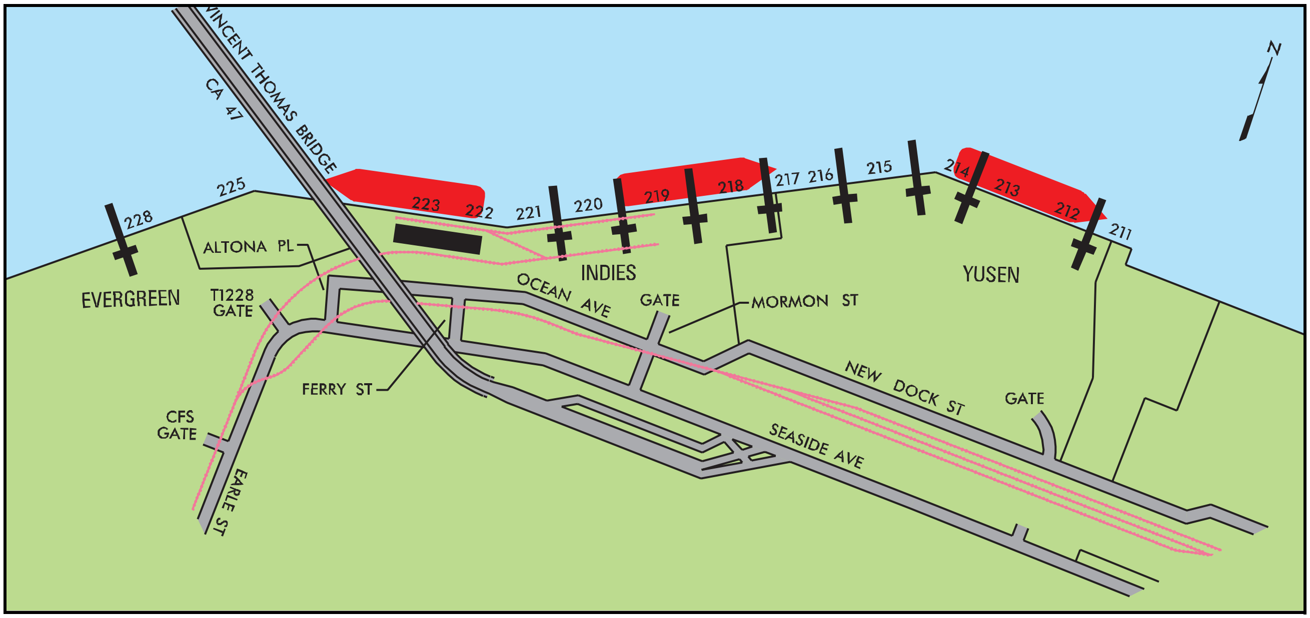
Legend:

RORO - roll on/roll off

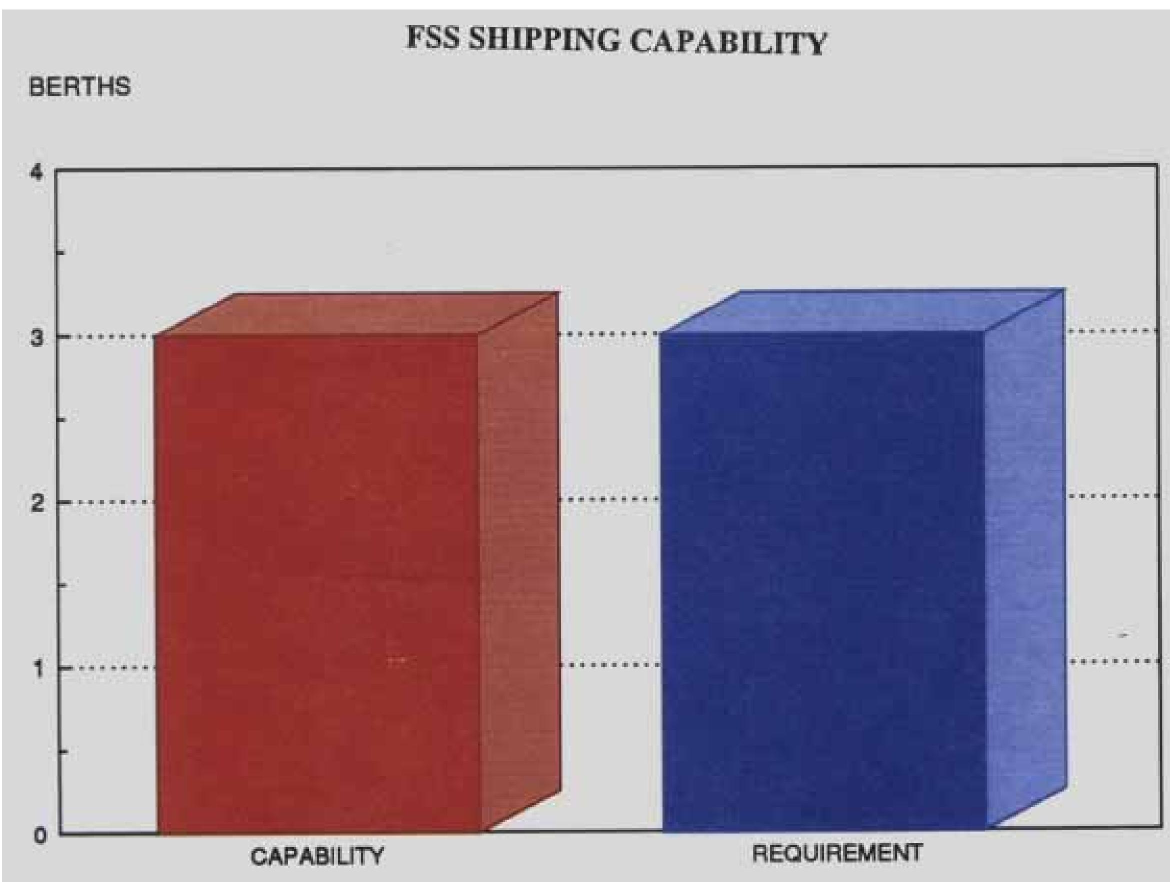
FSS - fast sealift ship

Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide, Aug 91.

The berthing capability at the two terminals is marginal for three simultaneous FSS berthings. The apron height of 15 feet above MLW might prevent RORO operations at low tide.



FSS Berthing



SUMMARY

The Indies and Yusen Terminals have adequate characteristics to support the deployment of a division.

RECOMMENDATION

We recommend negotiating for the use of Indies and Yusen Terminals and three spurs of the UP railyard inland of the Yusen Terminal.

September 94

PORTS OF OAKLAND
AND
1302D MAJOR PORT COMMAND
OAKLAND, CALIFORNIA

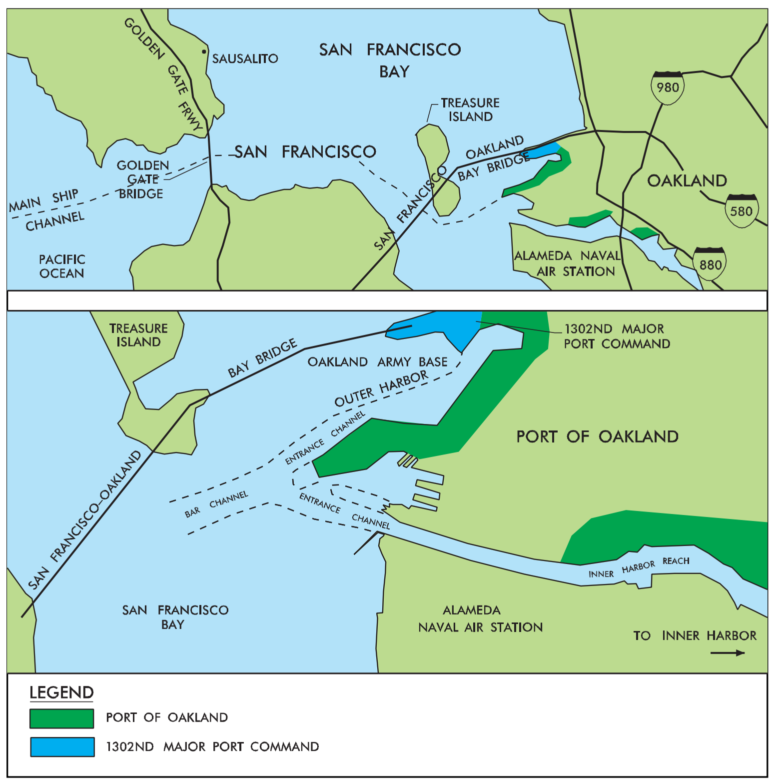
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Ports of Oakland and 1302d Major Port Command (MPC) are on the eastern shore of San Francisco Bay. The Port of Oakland consists of the outer, middle, and inner harbors. MPC is next to the Port of Oakland, on the outer harbor. Access to these ports is via a strait called the "Golden Gate." The Golden Gate varies in width from 1 to 3 miles, has depths up to 350 feet, and is the connection between the Pacific Ocean and San Francisco Bay.

Main Ship Channel provides access to the Golden Gate from the Pacific Ocean. It has a project depth of 56 feet mean low water (MLW) and a width of 2,000 feet. Generally, the depth through the bay is at least 50 feet MLW until the Bar Channel entrance to the Port of Oakland. Bar Channel, Outer Harbor Entrance Channel, and Inner Harbor Entrance Channel to Howard Terminal are at least 400 feet wide and have a depth of 38 feet MLW. Inner Harbor Channel, leading to Ninth Avenue Terminal, is 35 feet deep at MLW.



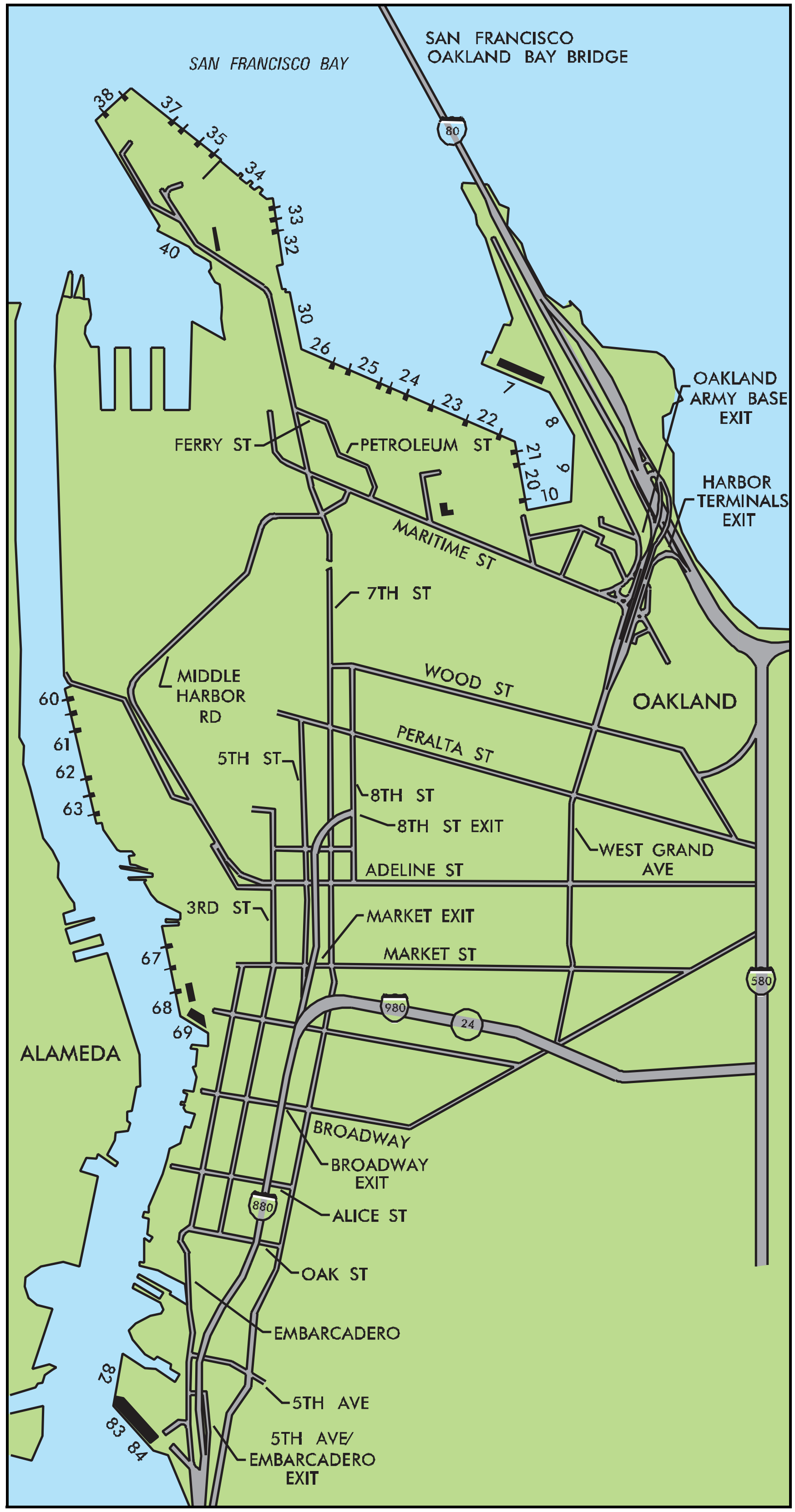
Water Access

The only restrictions leading into the port are the Golden Gate and San Francisco-Oakland Bay Bridges. The most restrictive vertical clearance beneath either bridge is 174 feet mean high water (MHW) (pier A). The most restrictive width is 1,072 feet (pier B-C). The outer and inner harbors have ship turning basins. The middle harbor uses the inner harbor’s turning basin.

Highway

Interstate Routes 80, 580, 880, and 980 provide access to the general area of the ports. MPC is accessible via Burma Road off I-80. The Port of Oakland Outer Harbor Terminals are accessible via Maritime Street off I-80. Seventh Street accesses the Seventh Street Terminals. The entrances to American President Lines (APL) Terminal are off Middle Harbor Road, and Market Street accesses Howard Terminal. The Ninth Avenue Terminal is accessible via Embarcadero.

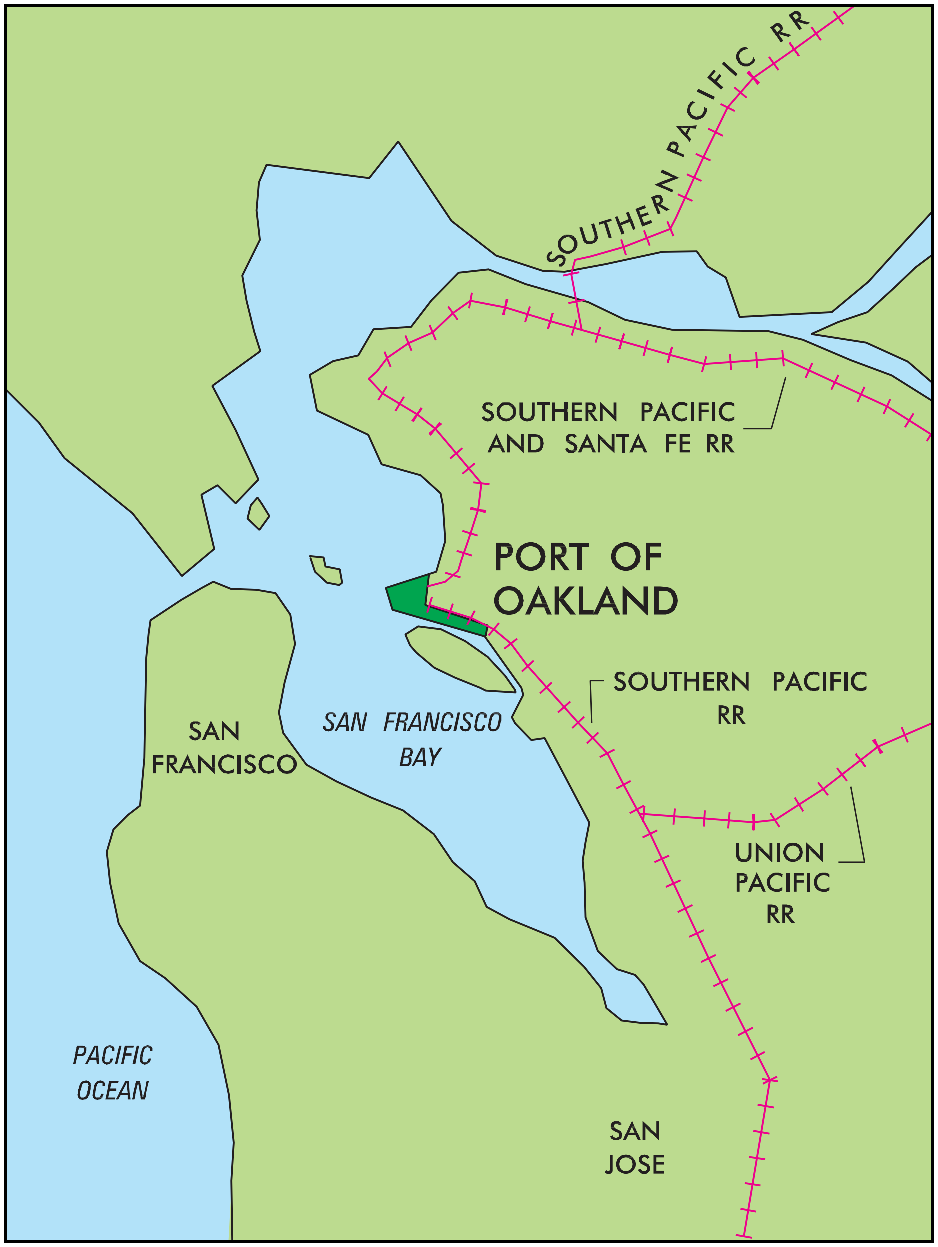
The number of lanes on each of these access roads varies from two to four. Heavy traffic congestion exists in the Oakland area, especially during the peak hours. Any transport configuration that exceeds 14 feet in height and 102 inches in width is considered to be an oversize transport item for the State of California.



Highway Access

Rail

The Atchison, Topeka, and Santa Fe (ATSF) Railway; Southern Pacific Transportation Company (SP); and Union Pacific Railroad (UP) provide rail services to the ports. SP and the Oakland Terminal Railway (OTR) provide switching operations to MPC. The UP, SP, and OTR provide the switching operations for the Port of Oakland. SP and UP have railyards near the ports. ATSF has a railyard in Richmond, California. MPC has two railyards on Oakland Army Base, which is near the ports. Neither port has clearance restrictions. Bilevel and trilevel operations occur at the Port of Oakland. MPC conducts bilevel operations.

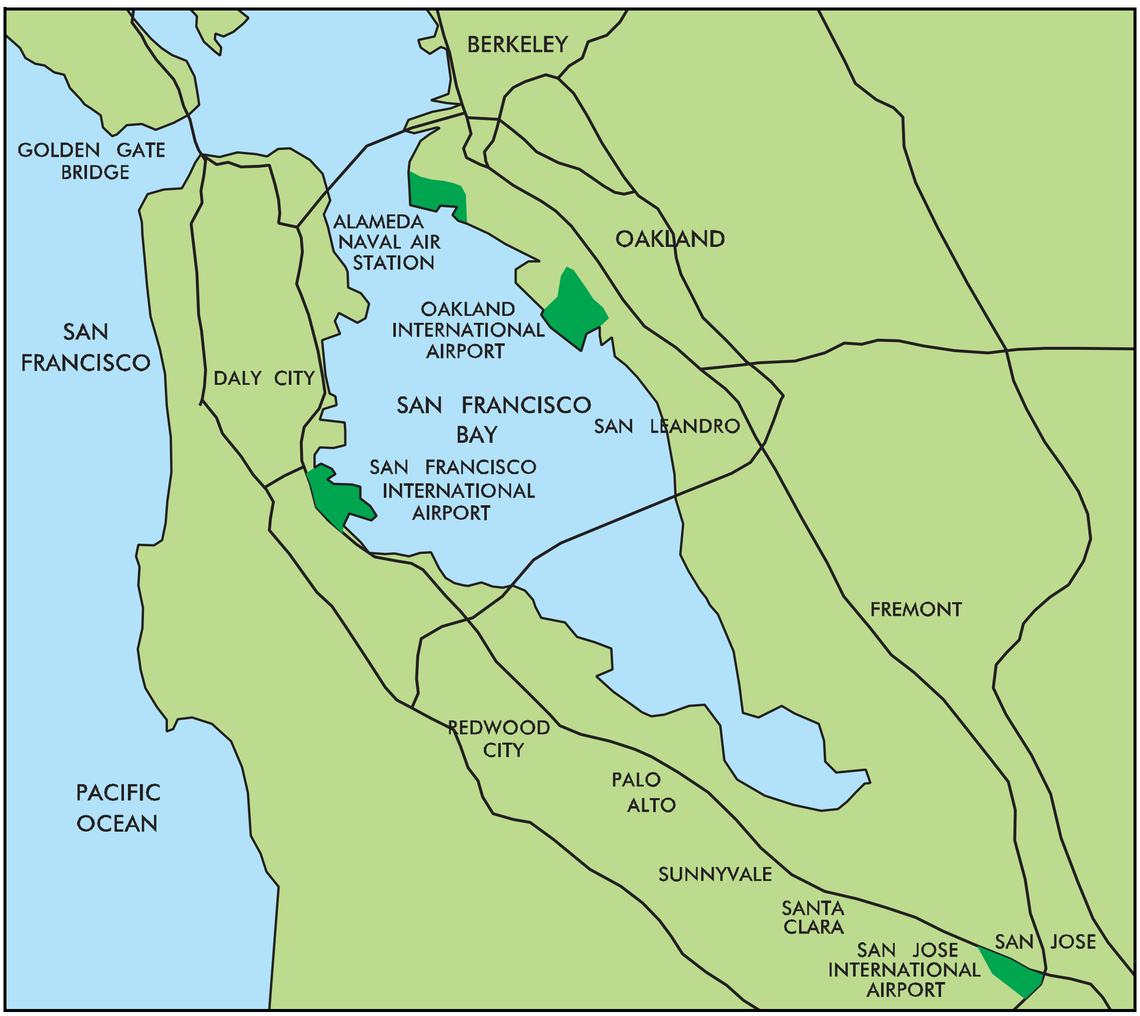


Rail Access

Air

Three commercial airports are within the Port of Oakland and MPC area. They are San Francisco International, Oakland International, and San Jose International. San Francisco International is about 17 miles southwest of the ports and has four asphalt runways, the longest of which is 11,870 feet long by 200 feet wide. Oakland International is 8 miles southeast of the ports and has three asphalt runways, the longest of which is about 10,000 feet long by 150 feet wide. San Jose International is 40 miles southeast of the ports and has two asphalt runways, the longest of which is 8,900 feet long (7,900 feet, using displaced threshold) by 200 feet wide.

The Alameda Naval Air Station, which is the nearest military airfield, is about 5 miles south of the ports. It has two asphalt runways, the longest of which is 8,000 feet long by 200 feet wide. This airfield is listed on the Base Realignment and Closure (BRAC) list. Travis Air Force Base is about 40 miles northeast of the ports and has two concrete runways. Both runways are about 11,000 feet long by 300 feet wide.



Air Access

PORT FACILITIES

Berthing

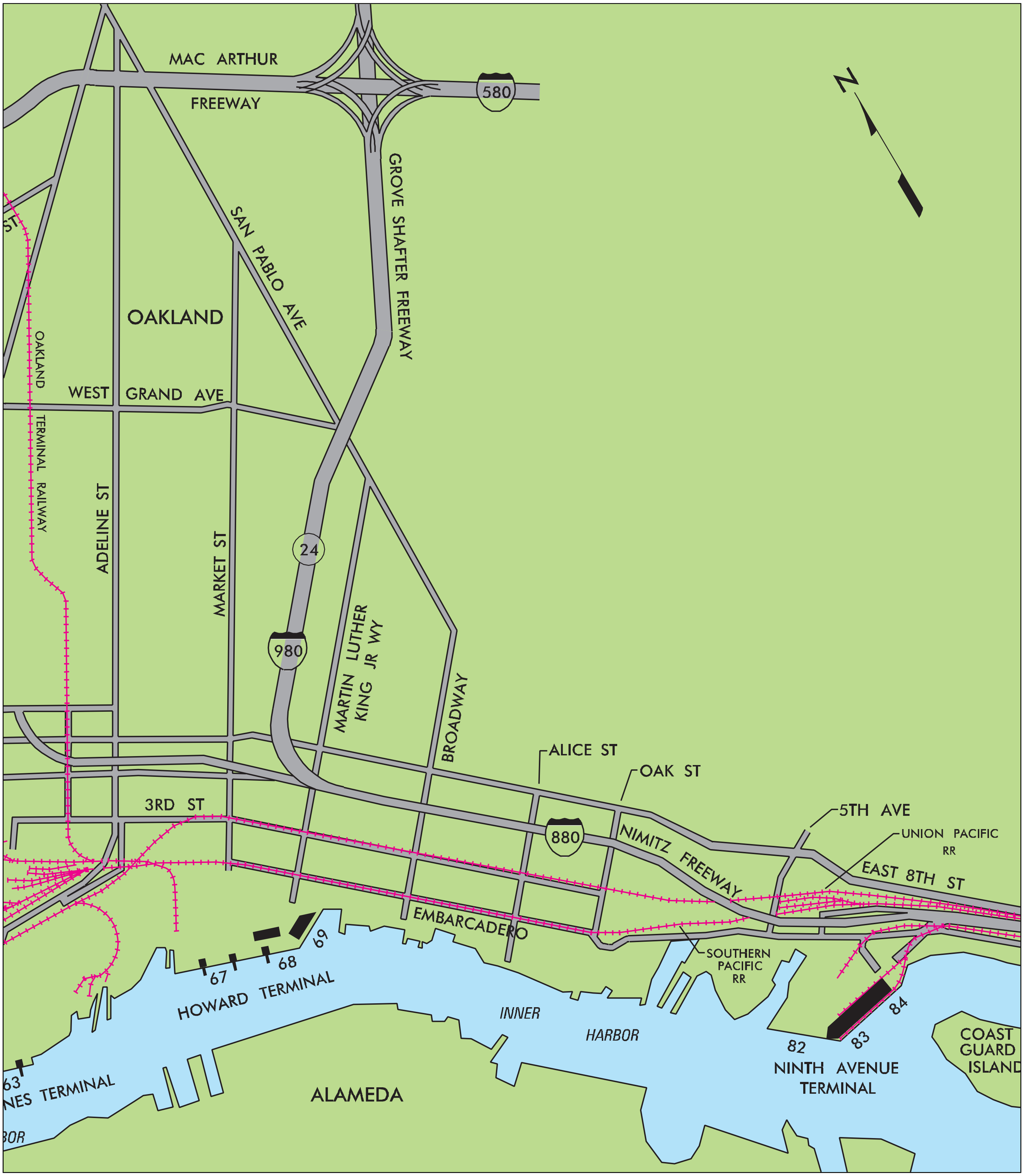
The Port of Oakland is a multicargo port with a specialization in containers. The port consists of several marginal wharf terminals. Wharf construction is generally concrete decking or concrete relieving platform supported by concrete piling extending from a concrete or steel sheet pile bulkhead with solid fill. All wharves have an asphalt surface and a timber or timber and rubber fendering system. Lighting is available for night operations.

MPC is a multicargo terminal consisting of a marginal wharf. Wharf construction is generally concrete decking extending from a concrete bulkhead with solid fill and asphalt surface. Concrete piling supports the decking. The berth is fronted by timber fender piles. The Port of Oakland is improving some of the wharves to allow dissipation of shock caused by earthquakes. Lighting is available for night operations.

Figure 1 is a vicinity map of the Port of Oakland and MPC. Figures 2 through 7 are aerial views of the facilities and include tables that identify the berth characteristics of the ports.

Shock Dissipation Improvements at Matson Terminal

Figure 1. Vininity map of Port of Oakland



and 1302d Major Port Command (MPC).

Figure 2. Port terminals

BERTH CHARACTERISTICS OF SEALAND, YUSEN, MAERSK, AND TCT

	BERTHS				
CHARACTERISTICS	**22**	**20-21**	**23**	**24**	**25-26**
Length (ft)	886	1,170	900	1,046	1,353
Depth alongside at MLW (ft)	40	40	40	40	35
Deck strength (psf)	600	600	1,000	1,000	1,000
Apron width (ft)	Open	Open	Open	Open	Open
Apron height above MLW (ft)	14	14	14	14	14
Number of container cranes	1	3	2	3	2
Number of wharf cranes	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No	No
Apron length served by rail (ft)	0	0	900	1,046	0

Figure 3. Outer harbor port facilities.

BERTH CHARACTERISTICS OF MATSON TRAPAC, AND SEVENTH MCT

CHARACTERISTICS	BERTHS				
	32 -33	34	35	37	38
Length (ft)	1,532	720	900	1,082	862
Depth alongside at MLW (ft)	35	35	39	40	40
Deck strength (psf)	1,000	1,000	1,000	1,000	1,000
Apron width (ft)	Open	Open	Open	Open	Open
Apron height above MLW (ft)	14	14	15	14	14
Number of container cranes	3	0	2	2	2
Number of wharf cranes	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No	No
Apron length served by rail (ft)	1,532	0	0	0	0

Figure 4. Seventh Street port facilities.

BERTH CHARACTERISTICS OF APL

CHARACTERISTICS	BERTHS 60-63
Length (ft)	2,743
Depth alongside at MLW (ft)	38
Deck strength (psf)	1,100
Apron width (ft)	Open
Apron height above MLW (ft)	14
Number of container cranes	5
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

Figure 5. APL port facilities

BERTH CHARACTERISTICS OF HOWARD

CHARACTERISTICS	BERTHS 67-68	BERTHS 69
Length (ft)	1,712	566
Depth alongside at MLW (ft)	40	35
Deck strength (psf)	1,000	600
Apron width (ft)	Open	32
Apron height above MLW (ft)	14	14
Number of container cranes	3	0
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straight-stern RORO facilities	No	No
Apron length served by rail (ft)	1,712	0

Figure 6. Howard port facilities.

BERTH CHARACTERISTICS OF BAY BRIDGE TERMINAL, NINTH AVENUE, AND 1302D MAJOR PORT COMMAND

	BERTHS					
CHARACTERISTICS	**8**	**9**	**10**	**83-84**	**82**	**7 PIER**
Length (ft)	1,000	1,200	839	1,115	950	1.459
Depth alongside at MLW (ft)	35	35	35	35	35	35
Deck strength (psf)	400 [1]	600 [2]	600	600	600	600 [3]
Apron width (ft)	83	Open	Open	30	Open	Open
Apron height above MLW (ft)	14	14	14	14	14	14
Number of container cranes	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	1
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	Yes	Yes	No	No	No
Apron length served by rail (ft)	0	0	0	1,115	0	1,459

1. 1,000 psf from water’s edge to 14 ft from water’s edge.
2. 1,000 psf from water’s edge to 34 ft from water’s edge.
3. 1,000 psf from water’s edge to 46 ft from water’s edge.

Figure 7. Bay Bridge, Ninth, and 1302d Port Facilities.

Staging
OPEN STAGING

The Port of Oakland has about 375 acres available for open staging. All of this acreage is paved and is used mainly for storage of containers and general cargo. This chart shows the distribution of open staging acreage for each terminal.

The Port of Oakland does not identify any areas suitable for landing helicopters and preparing them for shipment.

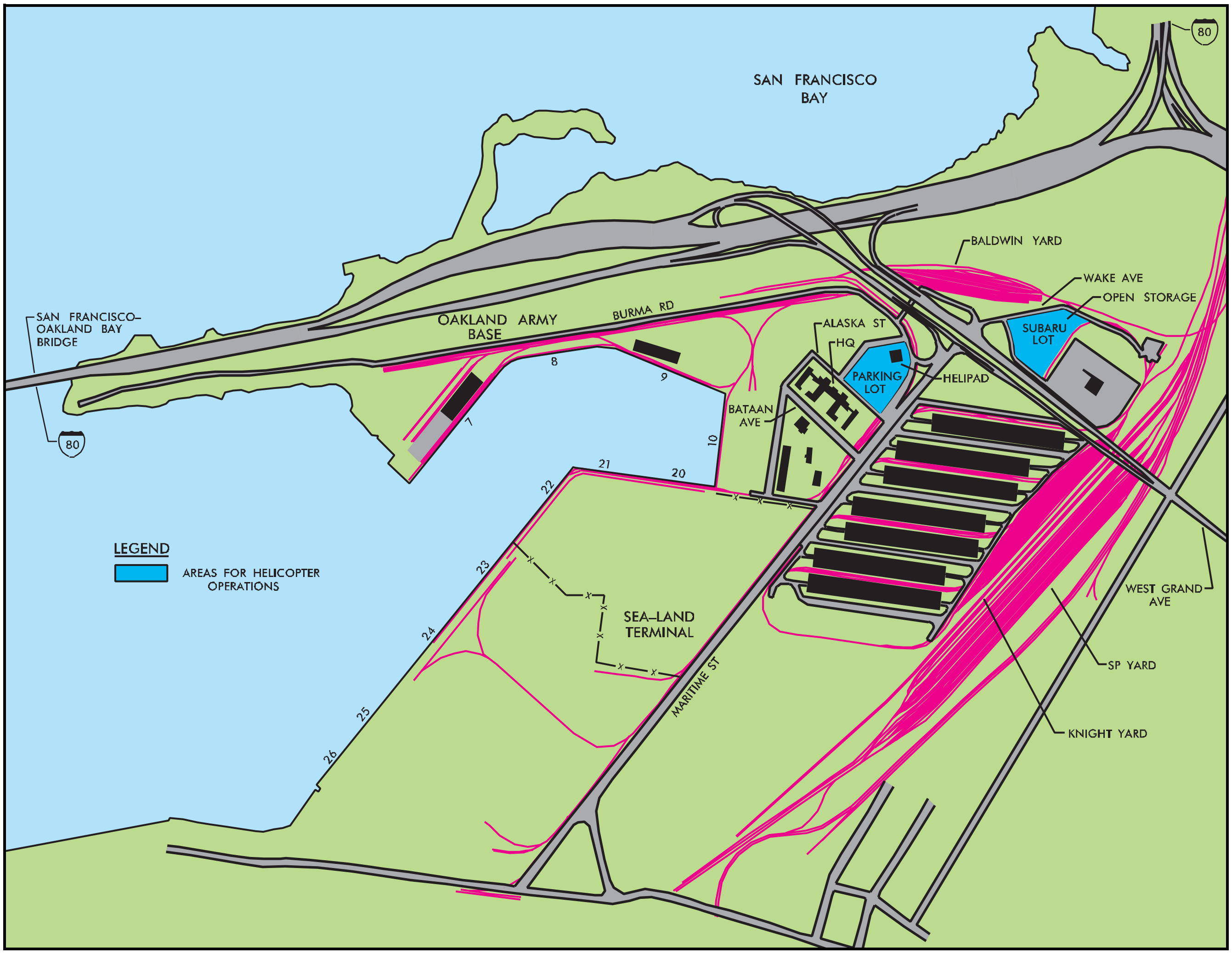
MPC has about 21 acres of open staging for wharf 7. If the Port of Oakland is not using the Subaru and Bay Bridge Terminal open storage lots, another 34 acres are available for use by MPC.

PORT OF OAKLAND
OPEN STAGING DISTRIBUTION

TERMINAL	BERTHS	ACREAGE
Bay Bridge	8-10	43
Sea-Land	20-22	48
Yusen	23	32
Maersk	24	32
TCT	25-26	21
Matson	32-34	46
TRAPAC	35	10
MCT	37-38	28
Berth 40	40	3
APL	60-63	62
Howard	67-69	36
Ninth	82-84	13

Matson Terminal Open Staging Area

MPC identifies the Post Headquarters parking lot as an area for landing helicopters and preparing them for shipment (about 1 acre). This area has landing and obstruction lights; however, it has no adjacent covered storage. Another potential helicopter operations site is the Subaru storage lot. This area was used for landing and preparing Medevac helicopters during Operations Desert Shield and Storm.



Potential Areas for Landing and Preparation of Helicopters

COVERED STAGING

The Port of Oakland has three transit sheds and three container freight stations that provide about 475,180 square feet of covered storage.

MPC has a container freight station with three warehouses and one transit building at wharf 7, opened in November 1993. These four buildings will provide about 763,870 square feet of covered storage.

Rail

Rail trackage links the commercial railyards to the apron tracks and storage sheds at the Port of Oakland, except for those at the APL container freight station. An apron track is along the Ninth, Howard, Matson, Maersk, and berth 40 terminals.

1302d Major Port Command-Owned Knight Railyard

The port has no railyards; however, the nearby commercial railyards (UP and SP) have a combined total of more than 228,800 feet of storage track. Also, ATSF has a railyard 10 to 15 miles north of the port, at Richmond, with 6,000 linear feet of track.

Rail trackage links the commercial railyards to the MPC storage tracks, apron tracks, and storage sheds. MPC has two railyards (fig 1) totaling nearly 48,270 linear feet of track as well as access to the commercial railyards cited above.

Highway

The Port of Oakland has more than 15 miles of paved roadways. In general, these roads are four laned . These roads do not have any clearance restrictions. A gate leads into each terminal of the port. The number of lanes at the gates varies from 2 to 13.

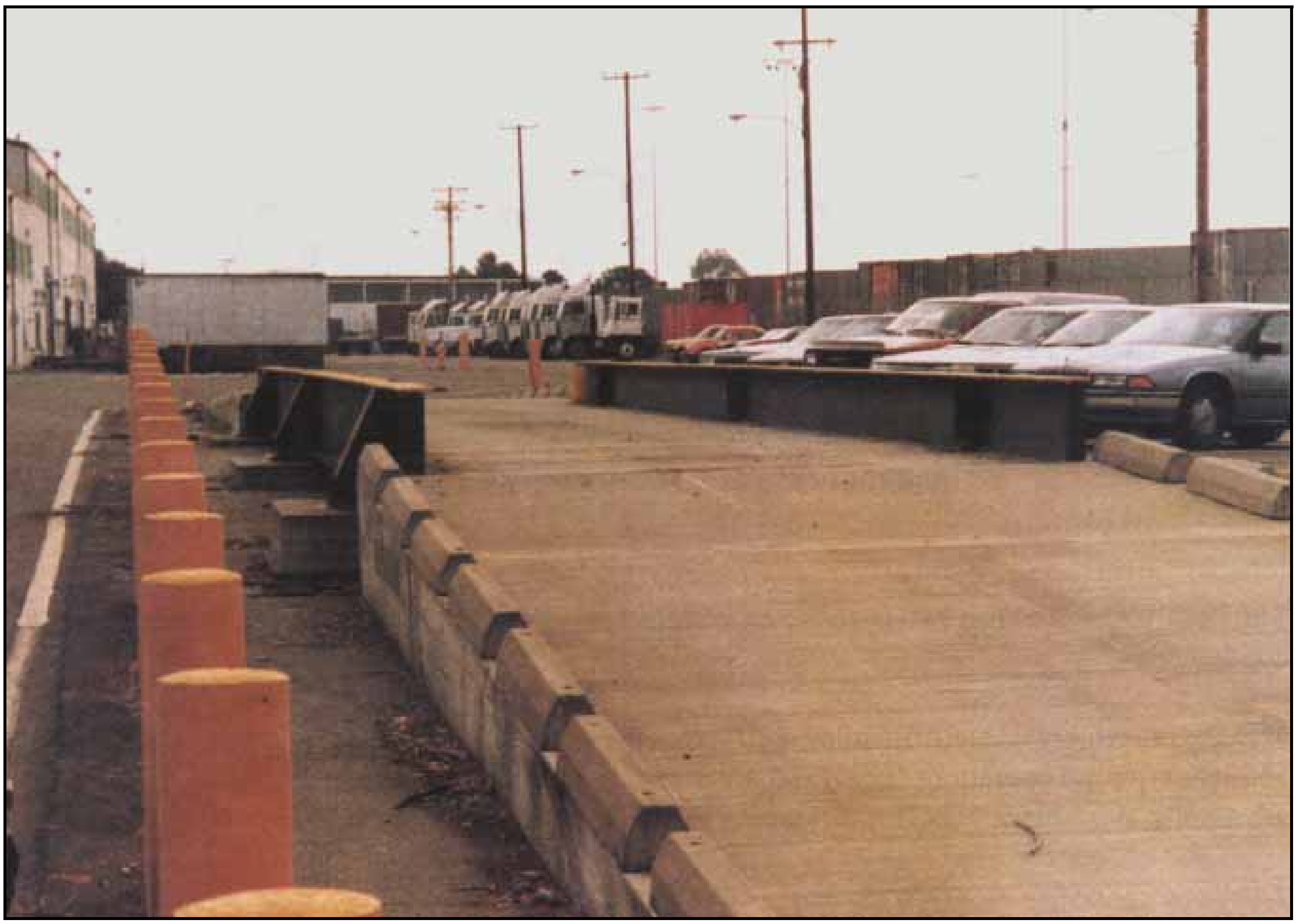
Gate onto Sea-Land Terminal

The Port of Oakland has 25 truck scales. The following chart shows the distribution of these scales.

Burma Road, a two-lane road with no clearance restrictions, provides access to MPC. Truck scales are available.

PORT OF OAKLAND TRUCK SCALE DISTRIBUTION

TERMINAL	NUMBER OF SCALES
Matson	2
TRAPAC	2
7th St	2
Howard	4
Sea-Land	3
Yusen	4
Maersk	2
TCT	3
APL	3



Truck Scales at the 1302d Major Port Command

Unloading/Loading Positions

RAMPS

Railcar offloading operations for the Port of Oakland take place at the commercial railyards near the port. UP has one permanent end ramp and three portable end ramps. The permanent end ramp is at the railyard between Ferro Street and El Dorado, off Middle Harbor Road. The portable ramps are at the automobile facility on Middle Harbor Road. SP has one portable end ramp at its railyard.

UP Intermodal Yard Portable Rail End Ramp

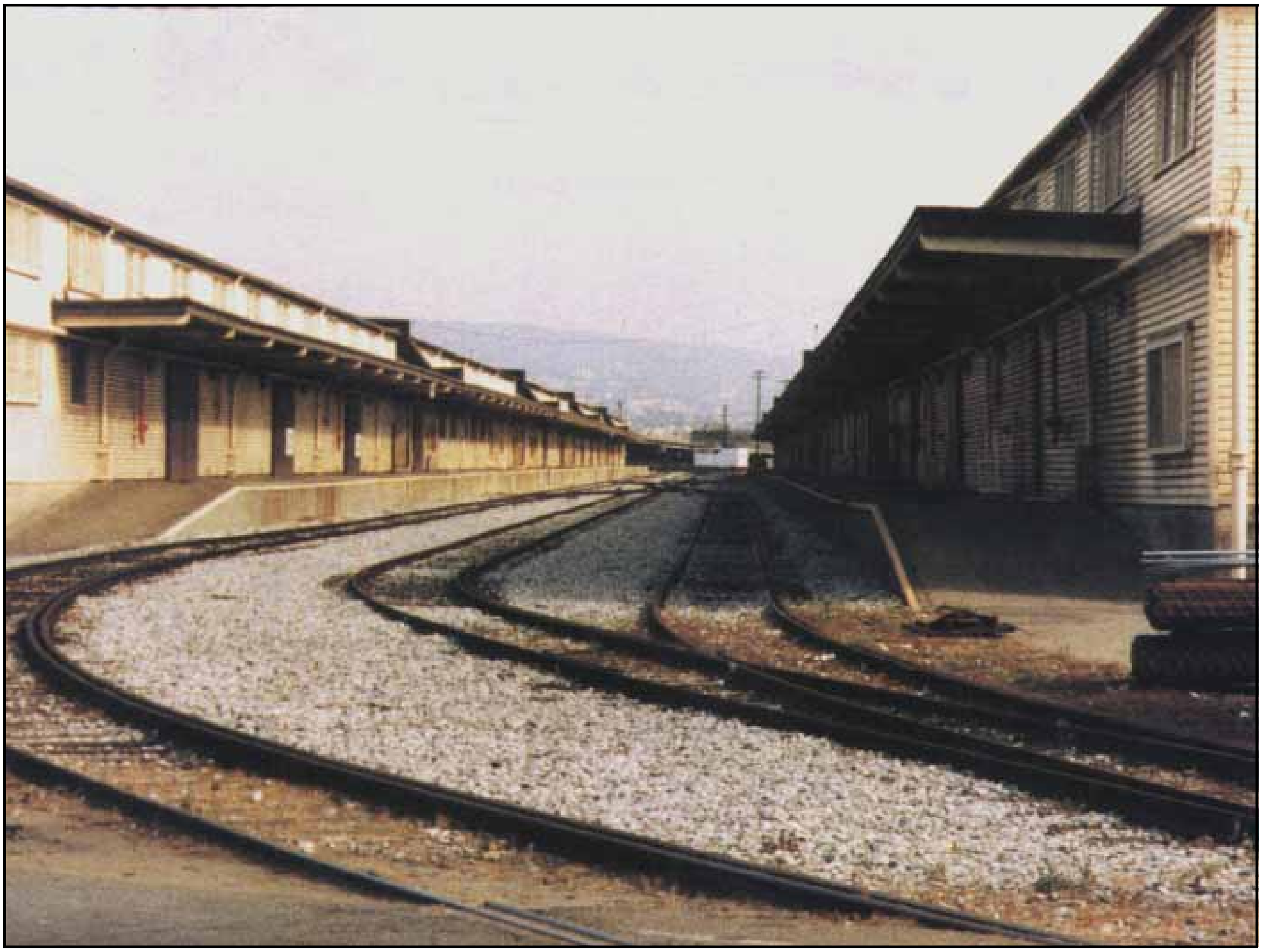
The Port of Oakland has two portable end ramps for offloading trucks or truck tractor/semitrailer combinations.

MPC has a permanent dual offloading end ramp at the wharf 7 open storage area and two steel portable end ramps for rail operations (figs 8 and 9). One of these end ramps is self-propelled. No end ramps are readily available at MPC for offloading trucks or truck tractor/semitrailer combinations.

DOCKS

All storage sheds at the Port of Oakland have truck-level docks, providing a total of 218 handling positions. The Maersk, Ninth Avenue, and Matson Terminals have railcar-level platforms, for a total of 23 handling positions. The Ninth Avenue Terminal also has 10 surface-level rail handling positions.

All storage sheds at MPC have railcar and truck docks. This facility has 65 truck handling positions and 48 surface-level railcar handling positions.



Docks Between Buildings S806 and S807, Oakland Army Base
(eastward view)

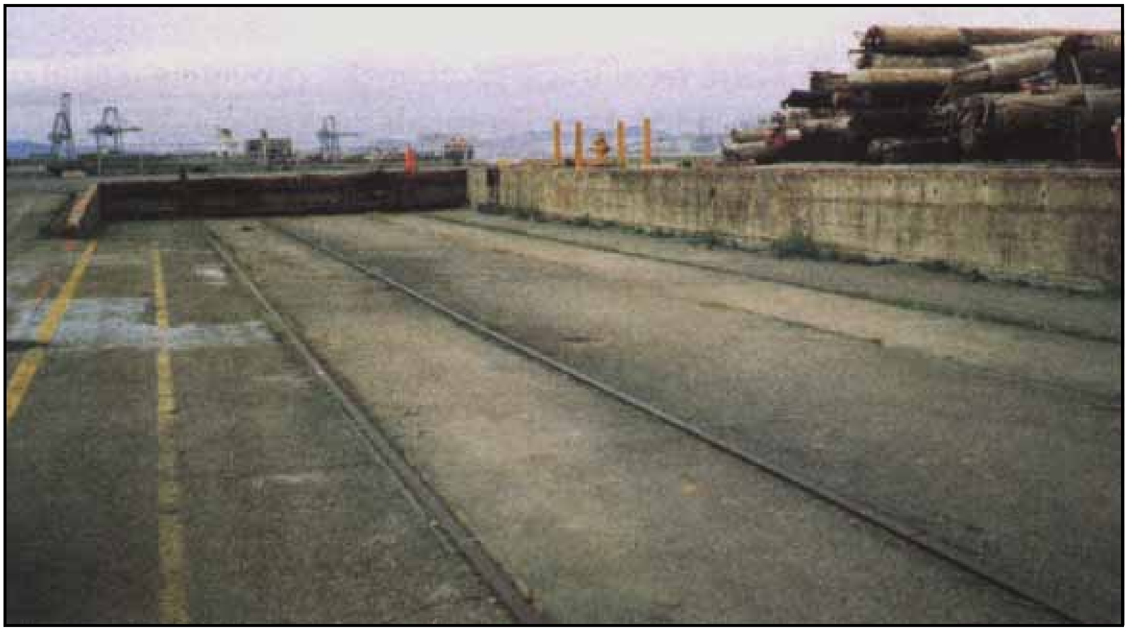


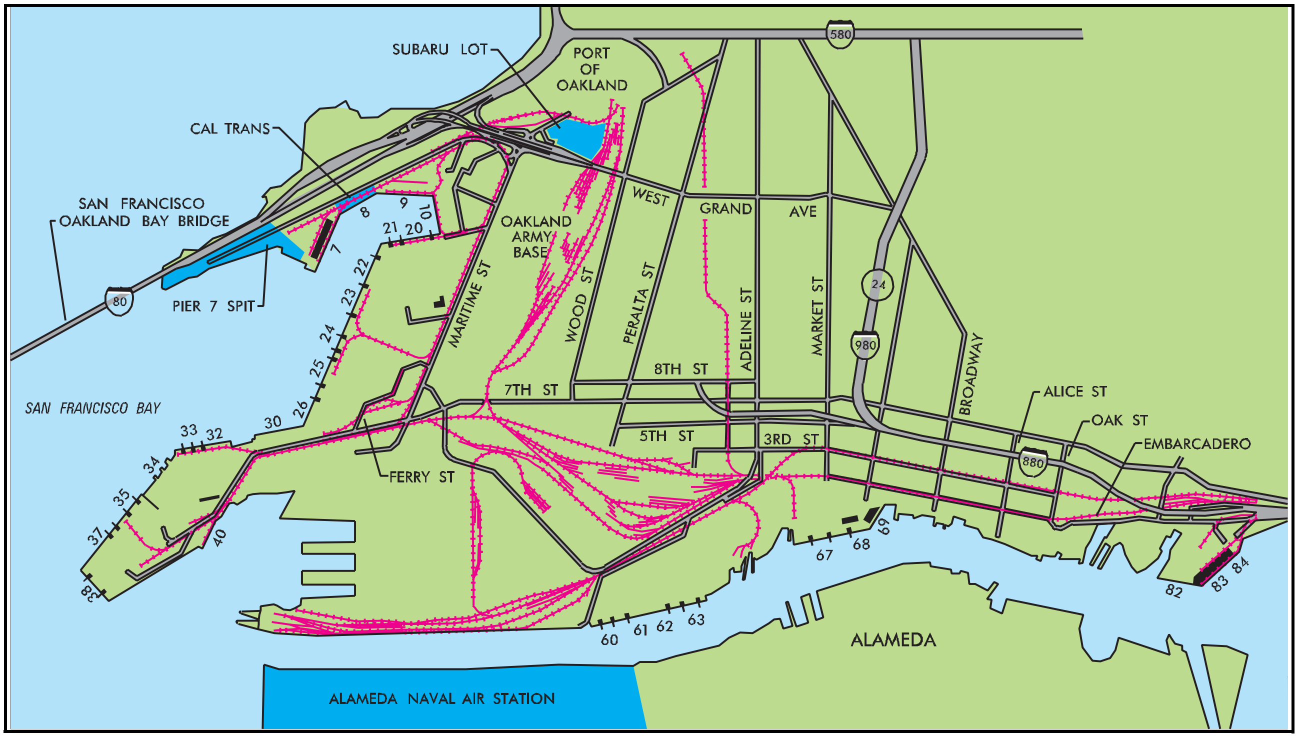
Figure 8. 1302d Major Port Command fixed rail end ramp near berth 7.

Figure 9. 1302d Major Port Command portable rail end ramp.

Marshaling Areas

Potential marshaling areas include the Oakland Coliseum parking lots (about 112 acres), Alameda Naval Air Station (about 174 acres), the Subaru lot (about 21 acres), and the Cal Trans Yard on Oakland Army Base (about 14 acres). In addition, the spit on the west end of pier 7, at MPC, has about 10 acres of unimproved storage area.

Marshaling Areas Near Oakland



Marshaling Areas Near the Port of Oakland

MATERIALS HANDLING EQUIPMENT (MHE)

The Port of Oakland and MPC provide an extensive list of MHE available for port operations. This list includes 28 container cranes. The Port of Oakland lists 10 local stevedoring companies that can provide additional MHE support if needed.

PORT OF OAKLAND
MATERIALS HANDLING EQUIPMENT

EQUIPMENT TYPE	CAPACITY (LTON)	QUANTITY	OWNER
Container Crane	50.0	7	Port and Maersk
Container Crane	45.0	2	Port
Container Crane	40.0	12	Port, Matson, and APL
Container Crane	30.0	6	Port and Matson
Container Crane	30.5	1	Matson
Gantry Crane	35.7	9	Port
Straddle Carrier	35.7	3	Port

Container Cranes at Sea-Land Terminal (southwest view)

MPC
MATERIALS HANDLING EQUIPMENT

EQUIPMENT TYPE	CAPACITY (LTON)	QUANTITY	OWNER
Gantry Crane	100.0	1	USA
Truck Crane	60.0	1	USA
Forklift 30.0K	30.0	2	USA
Forklift 15.0K	15.0	2	USA
Forklift 6.0K	6.0	11	USA
Forklift 4.0K	4.0	5	USA
Forklift 26.0K	26.0	1	Contractor
Forklift 15.5K	15.5	4	Contractor
Forklift 15.0K	15.0	2	Contractor
Forklift 7.5K	7.5	3	Contractor
Forklift 4.0K	4.0	4	Contractor
Forklift 3.0K	3.0	6	Contractor

1302d Major Port Command 60-Ton Truck Crane

INTERMODAL FACILITIES

General

The SP and UP railroad companies operate truck/railcar intermodal facilities in Oakland near the port area (fig 1). ATSF has an intermodal facility in Richmond, California, 11 miles north of the ports.

SP

The SP intermodal facility is off Middle Harbor Road. It is situated on 5 acres and has the capabilitiy to stage about 1,000 40-foot truck chassis. Transfer operations are conducted on 4 tracks that provide 115 89-foot flatcar spots. Container loading operations are conducted with two straddle cranes and one side loader (piggy packer). SP handles trailers on flatcars and double-stacked containers on flatcars. The normal hours of operation are from 0500 to 0200 hours. One portable end ramp is available, although it is rarely used. The current activity level is about 600 lifts per day.

Southern Pacific Intermodal Yard Straddle Crane (Transtainer)

UP

The UP intermodal facility is west of the APL Terminal and south of the Naval Supply Center, at 1750 Ferro Street. This facility is on 95 acres and has the capability to stage about 400 40-foot truck chassis. Transfer operations are conducted on 3 tracks that provide 158 89-foot flatcar lengths. Container loading operations are conducted by using two overhead straddle cranes and two side loaders. Beginning in 1994, UP will not use straddle cranes, but will have four side loaders. UP handles trailers on flatcars and double-stacked containers on flatcars. The UP facility working hours are 0500 to 2400 hours on week-days, 0800 to 2400 hours on Saturdays, and 1200 to 2400 hours on Sundays. The current activity level is about 680 lifts per day.

Union Pacific Intermodal Yard Side Loader (Piggypacker)

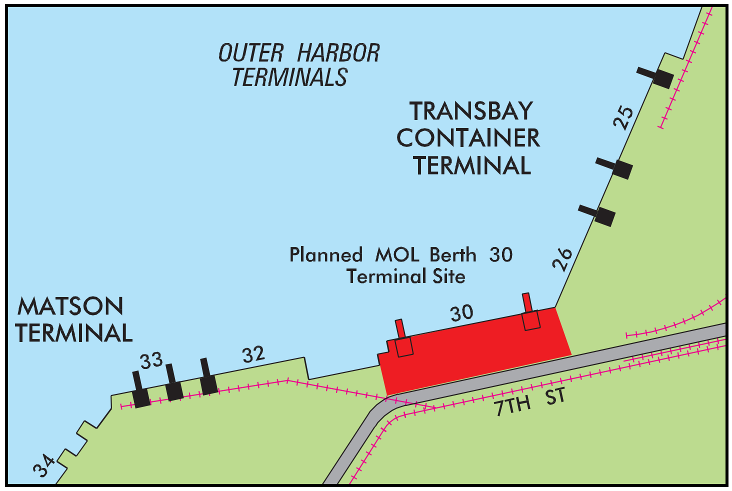
ATSF

ATSF has an intermodal facility at 303 Garrard Street, Richmond, California, about 11 miles north of the ports. This facility is situated on about 70 acres and has the capability to stage about 1,500 40-foot truck chassis. Transfer operations are conducted on 4 tracks that provide 150 89-foot flatcar lengths. Container loading operations are conducted by using two overhead straddle cranes and two side loaders. ATSF handles trailers on flatcars and double-stacked containers on flatcars. The ATSF facility is open 7 days a week, 24 hours a day. The current activity level is about 500 lifts per day.

FUTURE DEVELOPMENT

The Port of Oakland plans to complete construction of a new terminal. This terminal, berth 30, is in between the Matson and Transbay Container Terminals.

The Bay Bridge Terminal will be reconstructed to repair damage caused by the 1989 earthquake. Channels to the port areas will be deepened to 42 feet MLW during the 1994-95 timeframe.



Furture Berth 30 at Port of Oakland

MPC lists several projects that will affect port operations. The first project is the construction of a crossover railroad track over Burma Road, between the Baldwin railyard and the Barnes tracks. The purpose of this crossover is to eliminate the numerous switching and reverse movement operations that are now required because the ATSF Railway and Oakland Terminal Railway own the only tracks exiting the yard's west end. The planned completion date for this project is June 1997.

The second project is to build a deployment staging area that will support heavy tactical wheeled and tracked equipment associated with a typical mechanized infantry division. In addition to enhanced area lighting, new security fencing, and the extension of water distribution and storm sewer systems, the storage area surfacing will consist of rigid and flexible material. The port plans to complete this project by April 1997.

Bay Bridge Terminal

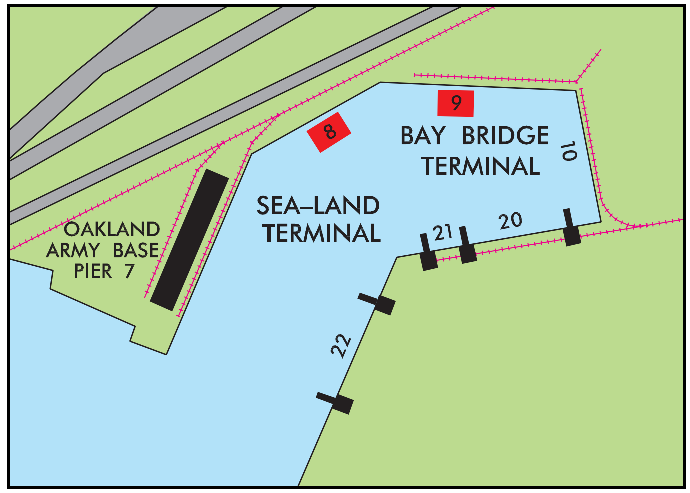
MPC plans to repair 18 miles of the port's railroad tracks to comply with the requirements of the Railroad Track Standards (TM 5-628) and Federal Railroad Administration Class 2 Track Standards. The estimated completion of the project is September 1995.

The California Department of Transportation is performing road construction to improve I-880 and connecting roadway systems near the port. Construction will require a realignment of Army-owned roads and railroad tracks and the re-siting of a Sixth US Army Reserve 400-Member Center and Readiness Group Facility planned for Oakland Army Base. Also, the SP and ATSF local railyards must be reconfigured/relocated because of this construction. The planned completion date of this project is March 1998.

The Port of Oakland and MPC are discussing long-term lease possibilities of berths 8 and 9. These berths are currently under lease to the Port of Oakland through September 1996.

ATSF plans to replace a railroad overpass structure that joins Oakland Army Base. Part of the replacement bridge will be on Army property. Discussions are ongoing for the Army to grant ATSF an easement.

The East Bay Municipal Utility District is attempting to acquire a portion of a 20-acre open storage area on Oakland Army Base for expansion of a sewage treatment facility. Oakland Army Base opposes this acquisition effort, which is now going through Congressional channels.

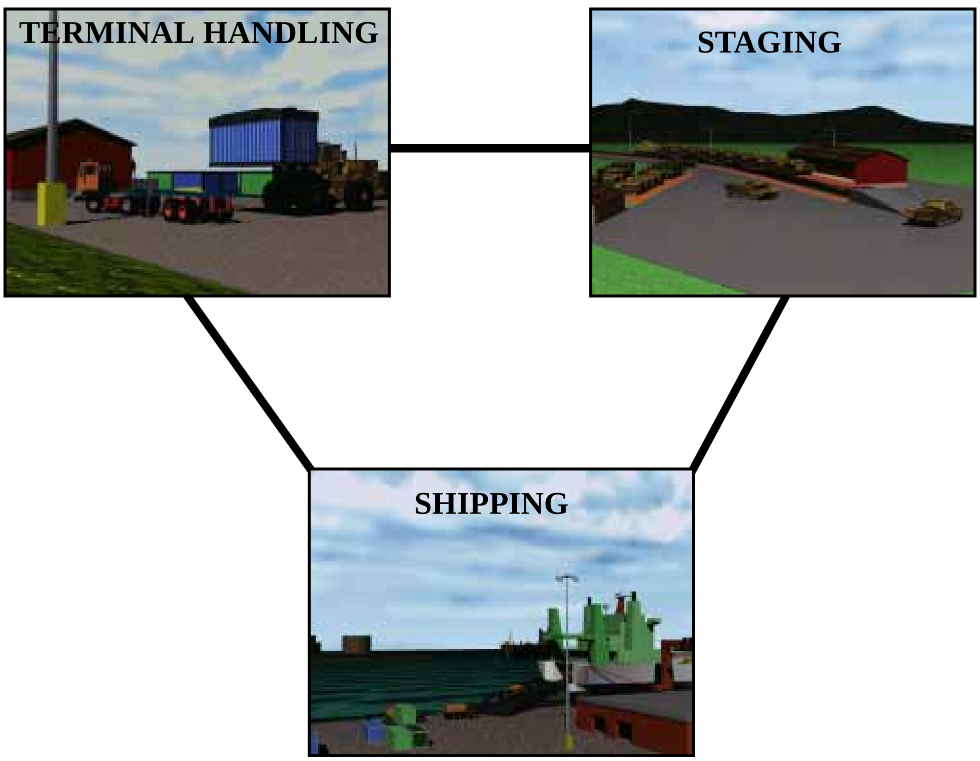


Berths 8 and 9 at Bay Bridge Terminal

II. THROUGHPUT ANALYSIS

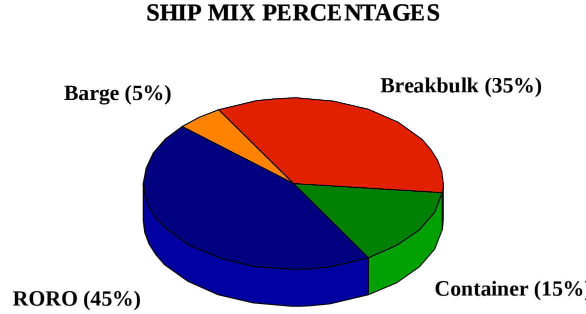
GENERAL

This section evaluates the theoretical throughput capability of the Port of Oakland and MPC, based on the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing and/or handling - in short tons (STON) and measurement tons (MTON) per day.



Terminal Throughput Subsystems

The analysis assumes that 80 percent of the port facilities will support the military deployment. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



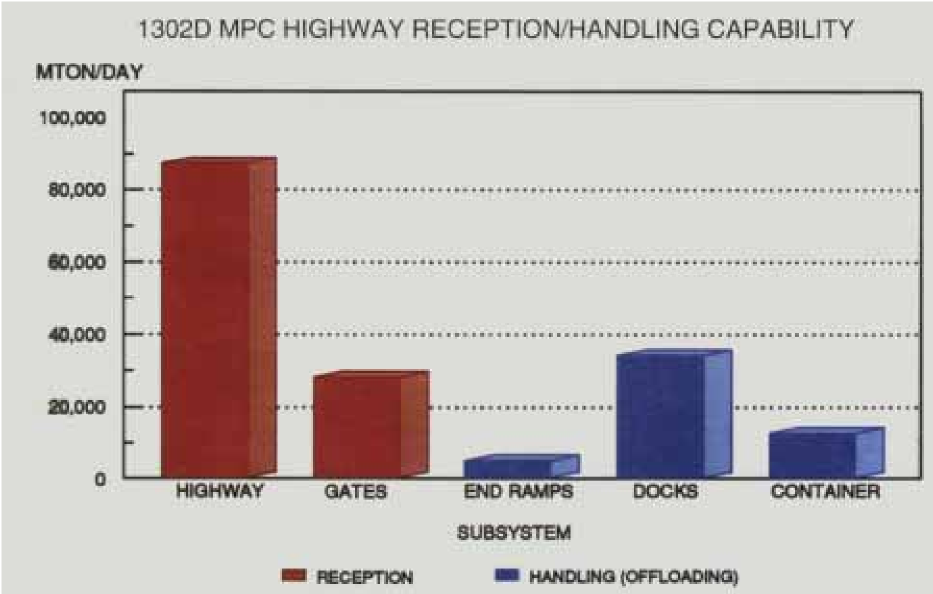
TERMINAL RECEPTION/HANDLING

Highway

I-80 and I-880 and the major connectors (Middle Harbor, Burma, Maritime, and Seventh) provide good access to the ports.

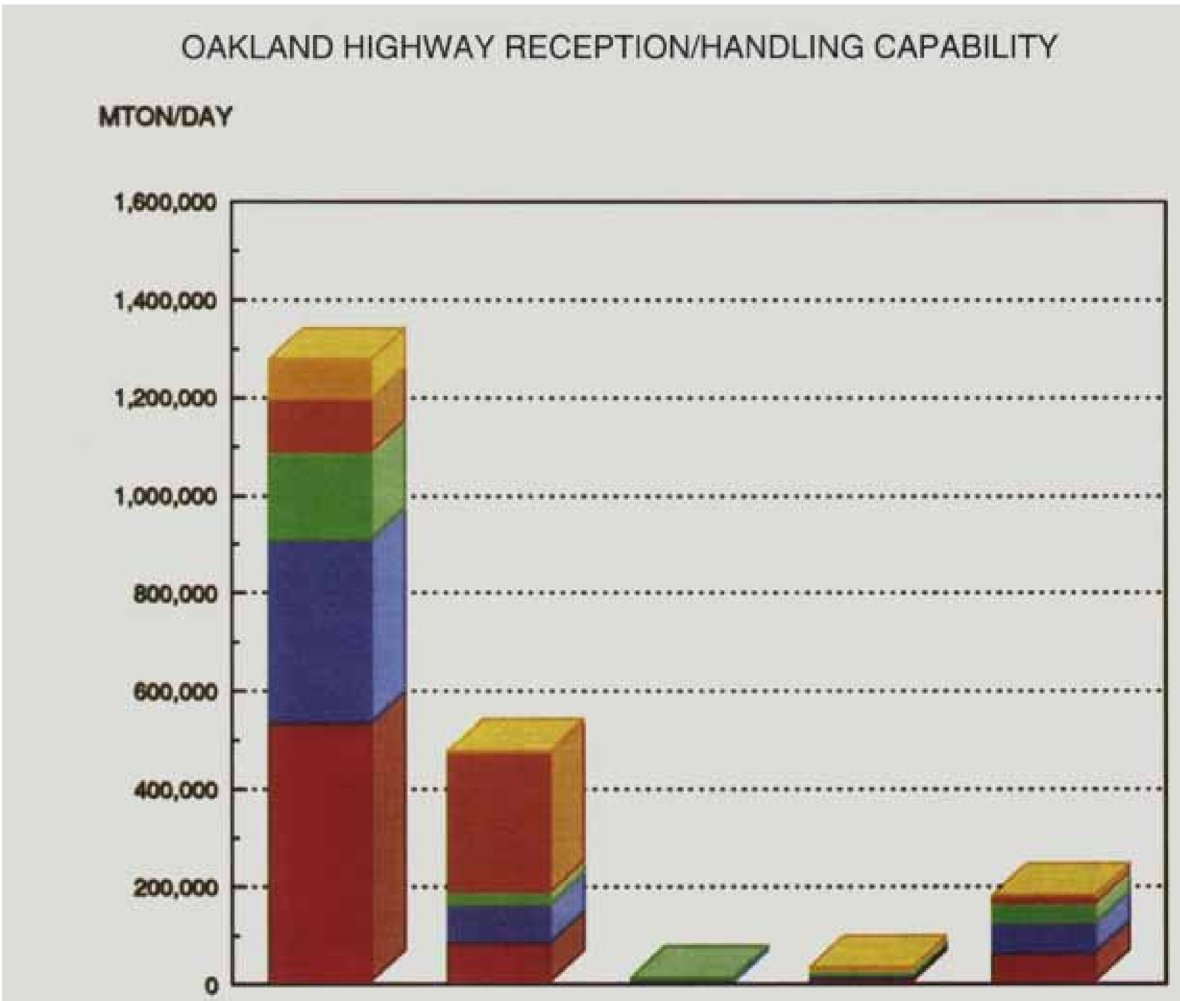
Entrance to MPC and berths 8 through 10 of the Port of Oakland is provided through the Bay Bridge Gate on Burma Road. This roadway provides access to staging and wharf areas. The road network in and out of the port, including the gate processing of vehicles, could handle more than 30,500 MTON of equipment and supplies per day.

For deployment from pier 7 of MPC, roadable vehicles in convoys will process directly to staging areas. MPC does not have truck end ramps for offloading vehicles on commercial or military flatbed trailers. Assuming MPC can arrange for an end ramp, about 4,800 MTON could be offloaded per day by the end-ramp method. Supplies in van semitrailers will proceed to the transit shed docks for offloading. These facilities provide 65 handling positions and could offload about 33,800 MTON of cargo per day. Containers on trucks can proceed to staging areas to be offloaded or go directly to the pier. The facilities at pier 7 could offload about 12,500 MTON of containerized cargo per day.



Entrance to the rest of the Port of Oakland is provided through 11 other gates. They are Sea-Land, Yusen, Maersk, Transbay, Matson, TraPac, Seventh Street, Berth 40, APL, Howard, and Ninth Avenue. The roadways from these gates provide access to staging and wharf areas. The road networks in and out of the port, including the gate processing of vehicles, could handle almost 471,800 MTON of equipment and supplies per day.

For deployment from the Port of Oakland, roadable vehicles in convoys process directly to staging areas. The Port of Oakland has two portable truck end ramps for offloading vehicles on commercial or military flatbed trailers. In this port study, we allocated the two truck end ramps to the APL and Seventh Street Terminals, to prevent interference with rail and container handling operations. These ramps could offload 9,600 MTON per day. Supplies in van semitrailers will proceed to the transit sheds/container freight station docks for offloading. These facilities provide 218 handling positions and could offload about 29,000 MTON of cargo per day. Containers on trucks will proceed to staging areas to be offloaded or will go directly to the container loading piers. The container handling facilities could offload more than 177,600 MTON of cargo per day.

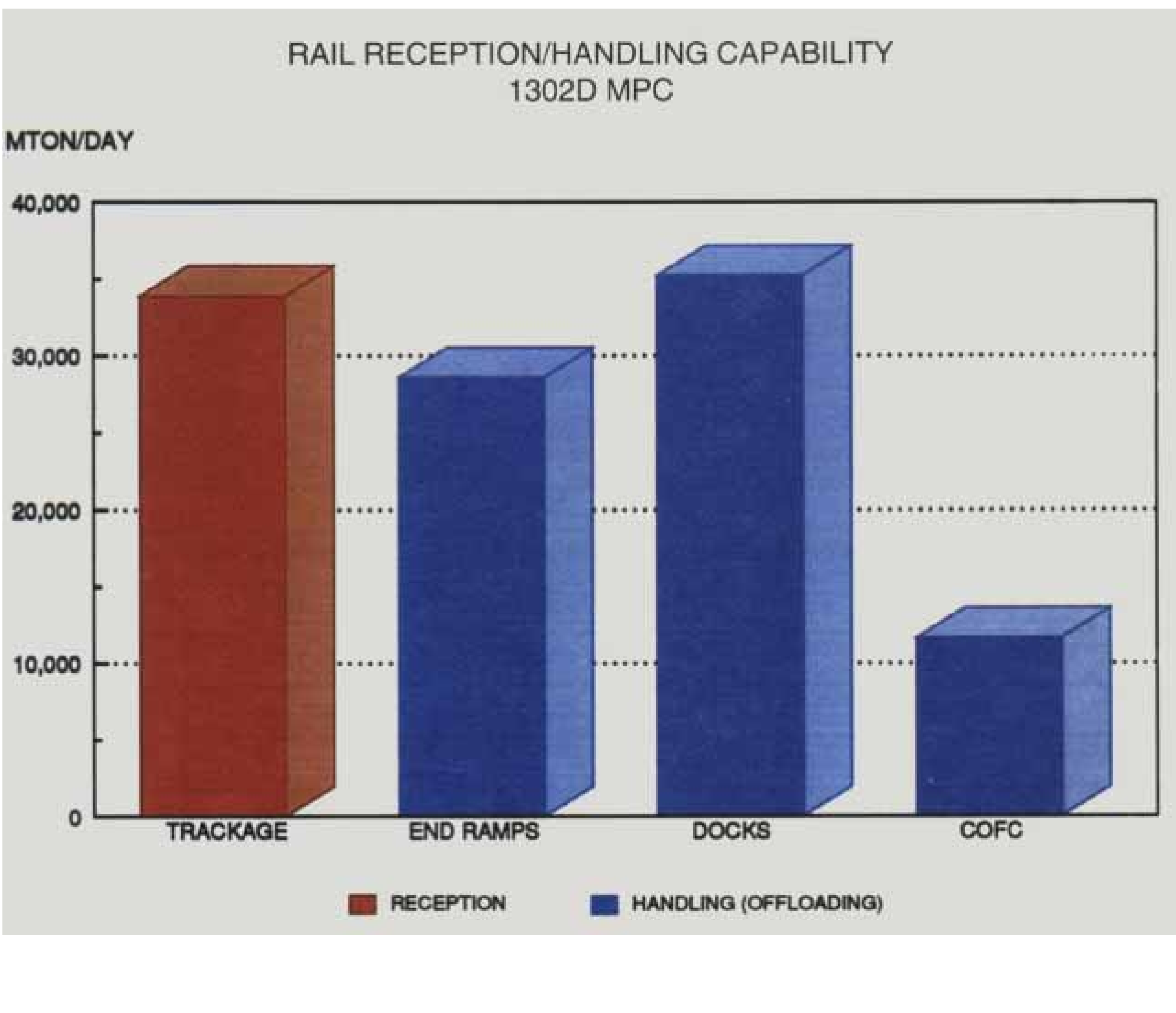


	HIGHWAY	GATES	END RAMPS	DOCKS	CONTAINER
OUTER HARBOR	530,000	81,600	0	7,400	59,900
7TH STREET	373,500	76,800	4,800	6,000	59,600
APL	178,100	24,400	4,800	10,000	39,000
HOWARD	108,900	282,700	0	1,100	17,400
NINTH	79,600	6,300	0	4,500	1,700

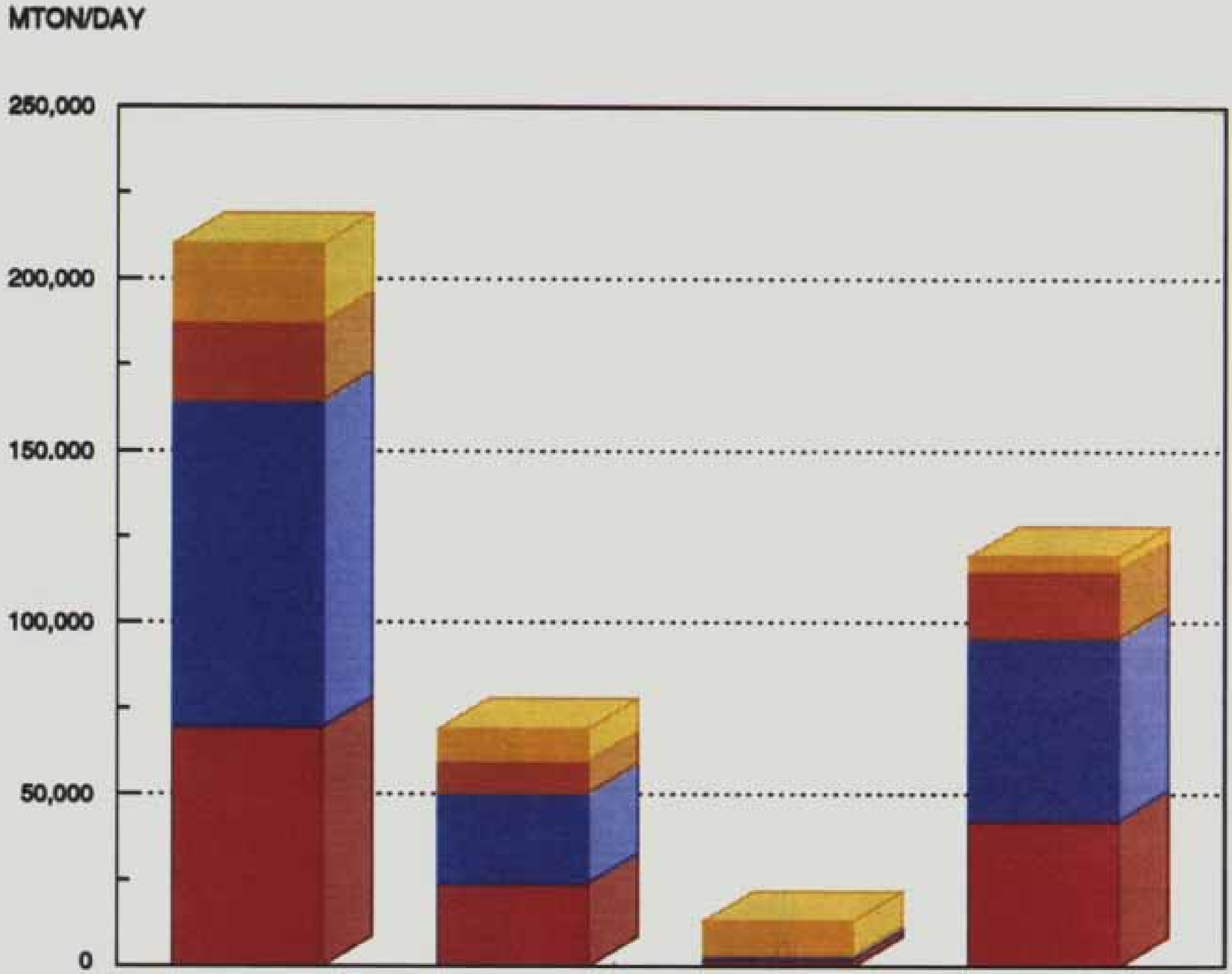
Rail

Rail reception at the ports is very good, with three commercial carriers providing access to the ports. Railyards at MPC can store more than 500 railcars. Also, commercial railyards within 11 miles of the port could store more than 2,500 additional cars. The Port of Oakland does not have any railcar storage tracks. The current rail service to the ports ranges from 18 to 20 trains consisting of 80 to 100 railcars per day.

Vehicles on flatcars could be offloaded at every terminal that is capable of handling rail traffic. The Port of Oakland does not have any rail end ramps; however, both fixed and portable end ramps are available at the nearby railyards. The UP, SP, and ATSF railroad companies have a combined total of six end ramps available for offloading vehicles on flatcars. MPC has a total of four (two fixed and two portable) end ramps for rail offloadings. Boxcars could be offloaded at the transit sheds/container freight stations at the Port of Oakland. The port has 33 rail handling positions available for offloading boxcars. MPC has 48 rail handling positions available at transit sheds on post. Containers would be offloaded at the container handling facilities of both MPC and the Port of Oakland.



OAKLAND RAIL RECEPTION/HANDLING CAPABILITY

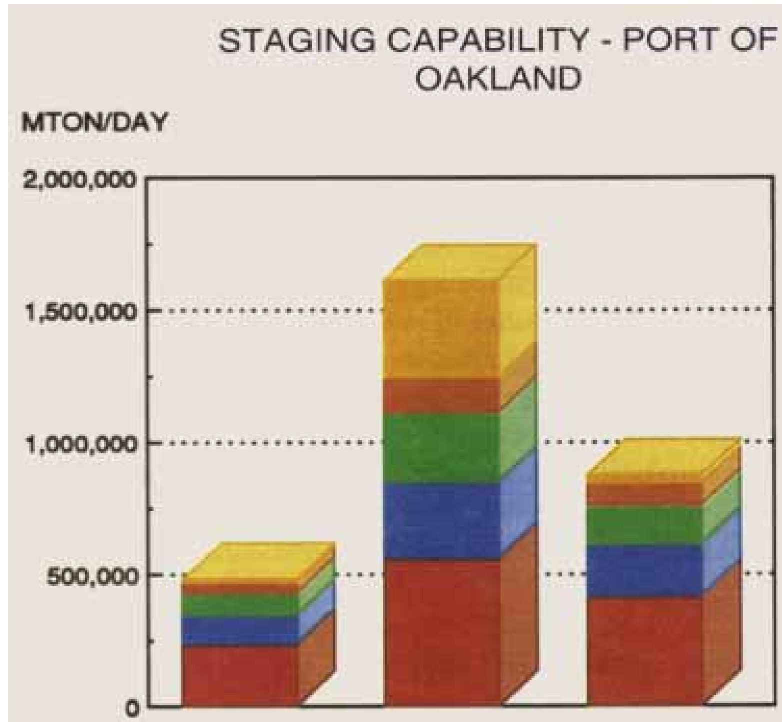


SUBSYSTEMS	TRACKAGE RECEPTION	END RAMPS HANDLING	DOCKS HANDLING	COFC HANDLING
OUTER HARBOR	69,800	24,200	2,000	42,600
7TH STREET	94,800	26,200	1,100	53,300
APL	0	0	0	0
HOWARD	22,900	9,300	0	19,500
NINTH	22,400	9,300	10,200	4,100

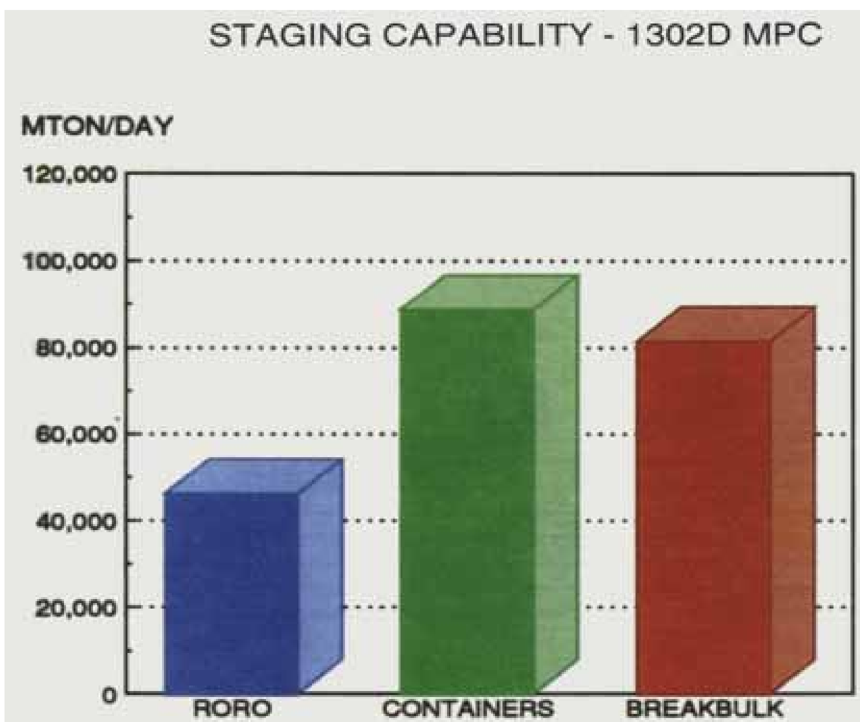
STAGING

The Port of Oakland has about 360 acres of open storage for vehicles and/or containers. This staging area has a capability to store about 483,800 MTON of rolling stock and 1,612,600 MTON of containers. Also, about 475,200 square feet of covered storage provides protection for about 7,600 MTON of palletized cargo.

MPC has about 32 acres of open storage for breakbulk cargo and/or containers. This staging area has a capability to store about 46,200 MTON of rolling stock and 88,700 MTON of containers. Also, about 777,450 square feet of covered storage provides protection for about 38,900 MTON of palletized cargo.



	VEHICLES	CONTAINERS	BREAKBULK
OUTER HARBOR	238,500	562,700	420,500
7TH STREET	110,700	290,000	196,200
APL	82,400	260,400	145,400
HOWARD	41,500	130,900	83,100
NINTH	10,700	368,600	30,700



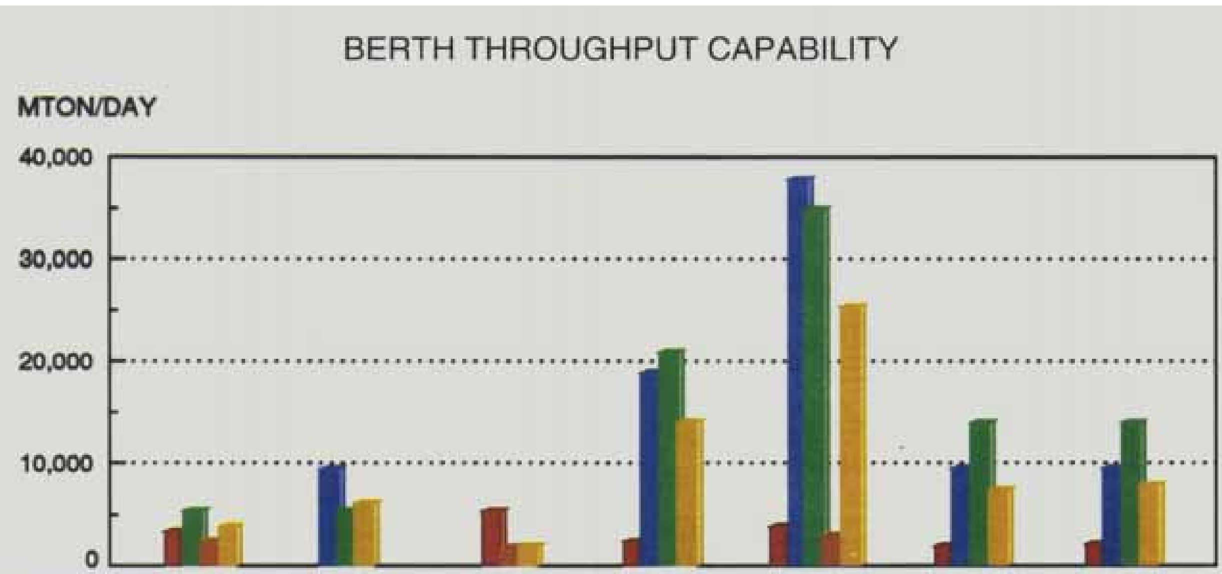
SHIPPING

The following charts show the throughput capability per berth in MTON per day for breakbulk, RORO, container, and mixed vessels. These results are based on various factors, including MHE used and, loading, operational, and berth utilization rates, as well as berth/ship compatibility.

The berth/ship compatibility for various vessel types is shown in table 1. This table indicates, for each type of ship, the number of vessels that can be accommodated at each berth. The table also provides the limitations that can hinder shipping operations.

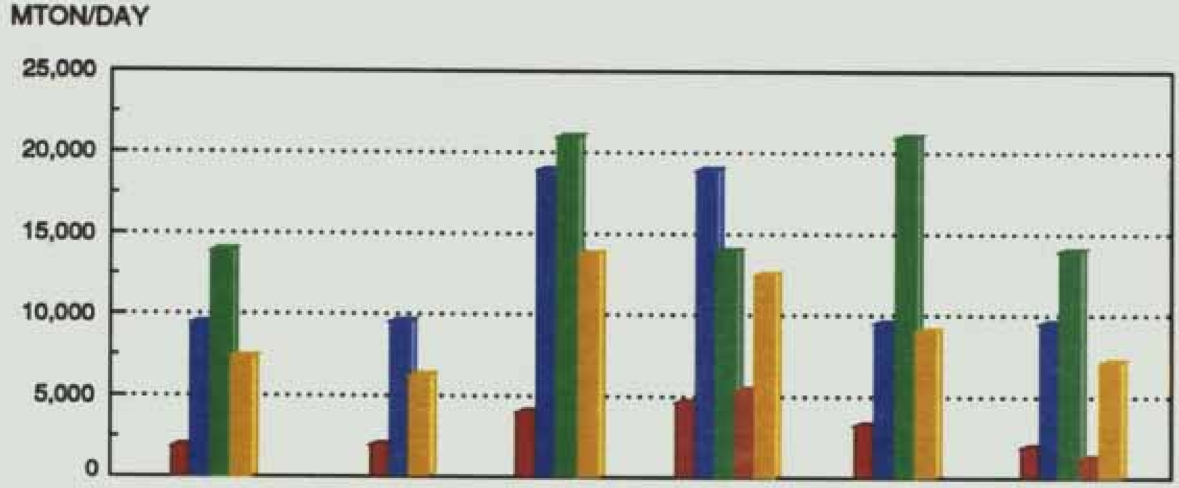
The type of ship preferred at each berth is based on a methodology that compares the characteristics of the ship berth to a list of ideal factors required to support the different ship mixes. The evaluation takes into consideration the current physical characteristics and MHE available for a berth. This evaluation gives no considerations for enhancements, such as equipment.

Berths 32-33, 24, and 67-68, in that order, appear to be the best choices for container operations. The best choices for RORO operations appear to be berths 24, 32-33, and 23. Berth 7 of MPC appears to be the best choice for breakbulk and barge operations. Berths 67-68, 24, and 23 appear to be the best choices for all-around operations.



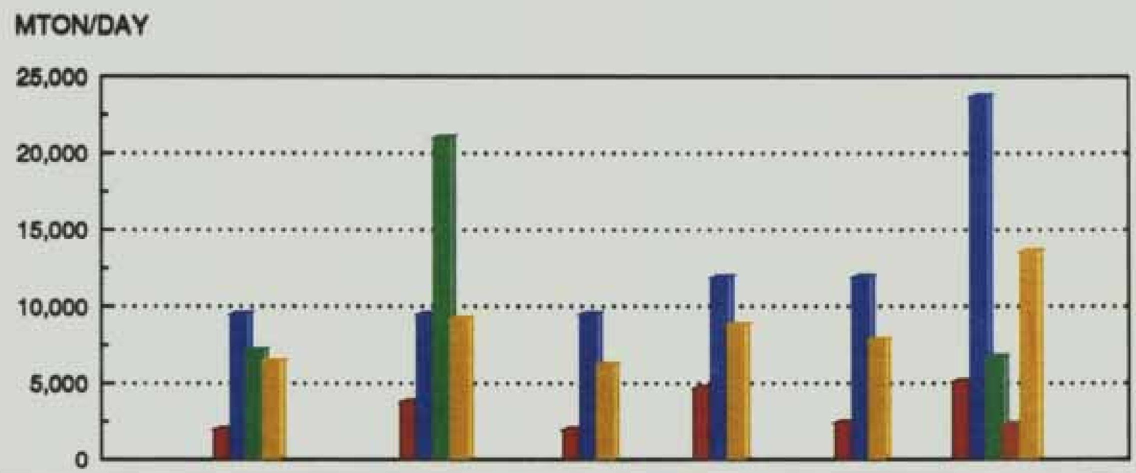
BERTH	83-84	82	69	67-68	60-63	38	37
BREAKBULK	3,400	0	5,300	2,400	3,800	1,900	2,000
RORO	0	9,400	0	18,900	37,700	9,400	9,400
CONTAINER	5,300	5,300	0	20,900	34,800	13,900	13,900
BARGE	2,400	0	1,800	0	2,900	0	0
MIXED	3,800	6,100	1,900	14,000	25,300	7,400	7,800

BERTH THROUGHPUT CAPABILITY



BERTH		35	34	32-33	25-26	24	23
BREAKBULK		1,900	1,900	4,000	4,600	3,200	1,900
RORO		9,400	9,400	18,900	18,900	9,400	9,400
CONTAINER		13,900	0	20,900	13,900	20,900	13,900
BARGE		0	0	0	5,300	0	1,200
MIXED		7,400	6,100	13,700	12,500	8,900	7,000

BERTH THROUGHPUT CAPABILITY



BERTH		22	20-21	10	9	8	PIER 7
BREAKBULK		1,900	3,700	1,900	4,600	2,300	5,000
RORO		9,400	9,400	9,400	11,800	11,800	23,600
CONTAINER		7,000	20,900	0	0	0	6,600
BARGE		0	0	0	0	0	2,200
MIXED		6,300	9,100	6,100	8,700	7,700	13,500

NOTE: The 1302d MPC owns berths 8 and 9, which are currently leased to the Port of Oakland. The current agreement allows the 1302d MPC to operate these berths within 7 days of notification. Hence, the 1302d would gain the throughput of these berths after 7 days.

TABLE 1
PORT OF OAKLAND
SUMMARY OF SEALAND, YUSEN, MAERSK, TCT, AND MATSON BERTHING CAPABILITIES

	BERTHS						
	SEALAND		YUSEN		MAERSK	TCT	MATSON
VESSEL	22	20-21	23	24	25-26	32-33	34
Breakbulk							
C3-S-33a	1	2	1	2	2	3	1
C3-S-37c	1	2	1	2	2	2	1
C3-S-37d	1	2	1	2	2	2	1
C3-S-38a	1	2	1	2	2	2	1
C4-S-1a	1	1	1	1	2	2	1
C4-S-1qb and 1u	1	1	1	1	2	2	1
C4-S-58a	1	1	1	1	2	2	1
C4-S-65a	1	2	1	1	2	2	1
C4-S-66a	1	2	1	1	2	2	1
C4-S-69b	1	1	1	1	2	2	1
Seatrain							
GA and PR-class	1	2	1	1	2	2	1
Barge							
LASH C8-S-81b	1	1	1	1	1	1	c
LASH C9-S-81d	c	1	1	1	a	a	a,c
LASH lighter	6	8	6	7	9	10	5
SEABEE C8-S-82a	g	g	g	g	a,g	a,g	a,c,g
SEABEE barge	4	5	4	5	6	7	3
RORO							
Comet	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j
C7-S-95a/Maine-class	1	1	1	1	1	2	c
Ponce-class	h	h	h	h	h	(1)	(1)
Great Land-class	h	h	h	h	h	(1)	c
Cygnus/Pilot-class	1	1	1	1	2	2	1
Meteor	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j
AmEagle/Condor	i,j	i,j	i,j	i,j	i,j	i,j	i,j
MV Ambassador	d	d	d	d	d	d	d
FSS-class	c	1	c	1	1	1	c
Cape D-class	i,j	i,j	i,j	i,j	i,j	i,j	i,j
Cape H-class	1	1	1	1	a	a	a,c
Container							
C6-S-lw	1	1	1	1	1	2	1,.e
C7-S-68e	1	1	1	1	1	2	1,e
C8-S-85c	1	1	1	1	1	1	c,e
Combination							
C5-S-78a	1	1	1	1	2	2	1,e
C5-S-37e	1	1	1	1	2	2	1,e

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=inadequate berth depth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft.
() indicates vessels assigned by analyst

TABLE 1 - CONT

PORT OF OAKLAND - SUMMARY OF TRAPAC, SEVENTH MCT, APL, AND HOWARD BERTHING CAPABILITIES

VESSEL	BERTHS					
	TRAPAC	SEVENTH MCT		APL		HOWARD
	35	37	38	60 - 63	67 -68	69
Breakbulk						
C3-S-33a	1	2	1	5	3	1
C3-S-37c	1	2	1	5	3	1
C3-S-37d	1	2	1	5	3	1
C3-S-38a	1	2	1	5	3	1
C4-S-1a	1	1	1	4	2	1
C4-S-lqb and lu	1	1	1	4	2	1
C4-S-58a	1	1	1	4	2	c
C4-S-65a	1	1	1	4	2	1
C4-S-66a	1	1	1	4	2	1
C4-S-69b	1	1	1	4	2	c
Seatrain						
GA and PR-class	1	1	1	4	2	1
Barge						
LASH C8-S-81b	1	1	1	3	2	c
LASH C9-S-81d	1	1	c	2	1	a,c
LASH lighter	6	7	6	19	12	4
SEABEE C8-S-82a	g	g	c,g	a,g	g	a,c,g
SEABEE barge	4	5	4	13	8	2
RORO						
Comet	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,o
C7-S-95a/Maine-class	1	1	1	3	2	b,c
Ponce-class	h	h	h	h	h	b,c,h
Great Land-class	h	h	h	h	h	b,c,h
Cygnus/Pilot-class	1	1	1	4	2	b,c
Meteor	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,o
AmEagle/Condor	i,j	i,j	i,j	i,j	i,j	b,c
MV Ambassador	d	d	d	d	d	d
FSS-class	c	1	c	2	1	b,c
Cape D-class	i,j	i,j	i,j	i,j	i,j	b,c
Cape H-class	i,j	1	1	3	2	a,b,c
Container						
C6-S-lw	1	1	1	3	2	c,e
C7-S-68e	1	1	1	3	2	c,e
C8-S-85c	1	1	1	3	2	c,e
Combination						
C5-S-78a	1	1	1	4	2	c,e
C5-S-37e	1	1	1	4	2	c,e

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=inadequate berth depth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

TABLE 1 - cont
PORT OF OAKLAND - SUMMARY OF BAY BRIDGE TERMINAL AND NINTH AVENUE BERTHING CAPABILITIES

VESSEL	BERTHS				
	BAY BRIDGE TERMINAL			NINTH AVENUE	
	8	9	10	83-84	82
Breakbulk					
C3-S-33a	1	2	1	2	1
C3-S-37c	1	2	1	2	1
C3-S-37d	1	2	1	2	1
C3-S-38a	1	2	1	2	1
C4-S-1a	1	2	1	1	1
C4-S-1qb and 1u	1	2	1	1	1
C4-S-58a	1	2	1	1	1
C4-S-65a	1	2	1	1	1
C4-S-66a	1	2	1	1	1
C4-S-69b	1	1	1	1	1
Seatrain					
GA and PR-class	1	2	1	1	1
Barge					
LASH C8-S-81b	1	1	1	1	1
LASH C9-S-81d	a	a	a,c	a,g	a,g
LASH lighter	7	8	5	7	6
SEABEE C8-S-82a	a,g	a,g	a,c,g	a,g	a,g
SEABEE barge	5	6	4	5	4
RORO					
Comet	(1)	(2)	i,j	d,o	d,i,j
C7-S-95a/Maine-class	1	1	1	b	1
Ponce-class	h	h	h	b,h	h
Great Land-class	h	h	h	b,h	h
Cygnus/Pilot-class	1	1	1	b	1
Meteor	(1)	(2)	i,j	d,o	d,i,j
AmEagle/Condor	(1)	(1)	i,j	b	i,j
MV Ambassador	(1)	(2)	1,m	d	d
FSS-class	1,n	1	c	b	1
Cape D-class	(1)	(1)	i,j	b	i,j
Cape H-class	(1)	(1)	a	a,b,g	a,g
Container					
C6-S-lw	1,e	1,e	1,e	1,e	1,e
C7-S-68e	1,e	1,e	1,e	1,e	1,e
C8-S-85c	1,e	1,e	1,e	1,e	1,e
Combination					
C5-S-78a	1,e	1,e	1,e	1,e	1,e
C5-S-37e	1,e	1,e	1,e	1,e	1,e

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=inadequate berth depth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft
() indicates vessels assigned by analyst.

TABLE 1 - cont
PORT OF 1302D MAJOR PORT COMMAND
SUMMARY OF BERTHING CAPABILITIES

VESSEL		BERTHS 7 PIER
Breakbulk		
C3-S-33a		2
C3-S-37c		2
C3-S-37d		2
C3-S-38a		2
C4-S-1a		2
C4-S-1qb and 1u		2
C4-S-58a		2
C4-S-65a		2
C4-S-66a		2
C4-S-69b		2
Seatrain		
GA and PR-class		2
Barge		
LASH C8-S-81b		1
LASH C9-S-81d		a
LASH lighter		10
SEABEE C8-S-82a		a,g
SEABEE barge		7
RORO		
Comet		(2),d,i
C7-S-95a/Maine-class		1
Ponce-class		h
Great Land-class		h
Cygnus/Pilot-class		2
Meteor		(2),d
AmEagle/Condor		(2)
MV Ambassador		(2)
FSS-class		1
Cape D-class		(2)
Cape H-class		(1)
Container		
C6-S-lw		2,e
C7-S-68e		2,e
C8-S-85c		1,e
Combination		
C5-S-78a		2,e
C5-S-37e		2,e

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
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m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft
()indicates vessels assigned by analyst

TABLE 1
PREFERENCE BERTH SELECTION

	BERTHS						
LOADING TYPE	**7**	**8**	**9**	**10**	**20-21**	**22**	**23**
Breakbulk	1	16	16	16	12	12	6
RORO	4	15	4	4	10	14	2
Container	5	18	17	16	13	14	6
Barge	1	18	17	13	13	13	5
	24	**25-26**	**32-33**	**34**	**35**	**37**	**38**
Breakbulk	6	14	15	19	8	8	8
RORO	1	11	2	17	11	7	13
Container	2	9	1	15	11	7	11
Barge	5	9	16	19	9	9	9
			60-63	**67-68**	**69**	**82**	**83-84**
Breakbulk			8	2	5	4	3
RORO			7	7	-	16	-
Container			4	3	-	7	10
Barge			7	2	8	4	3

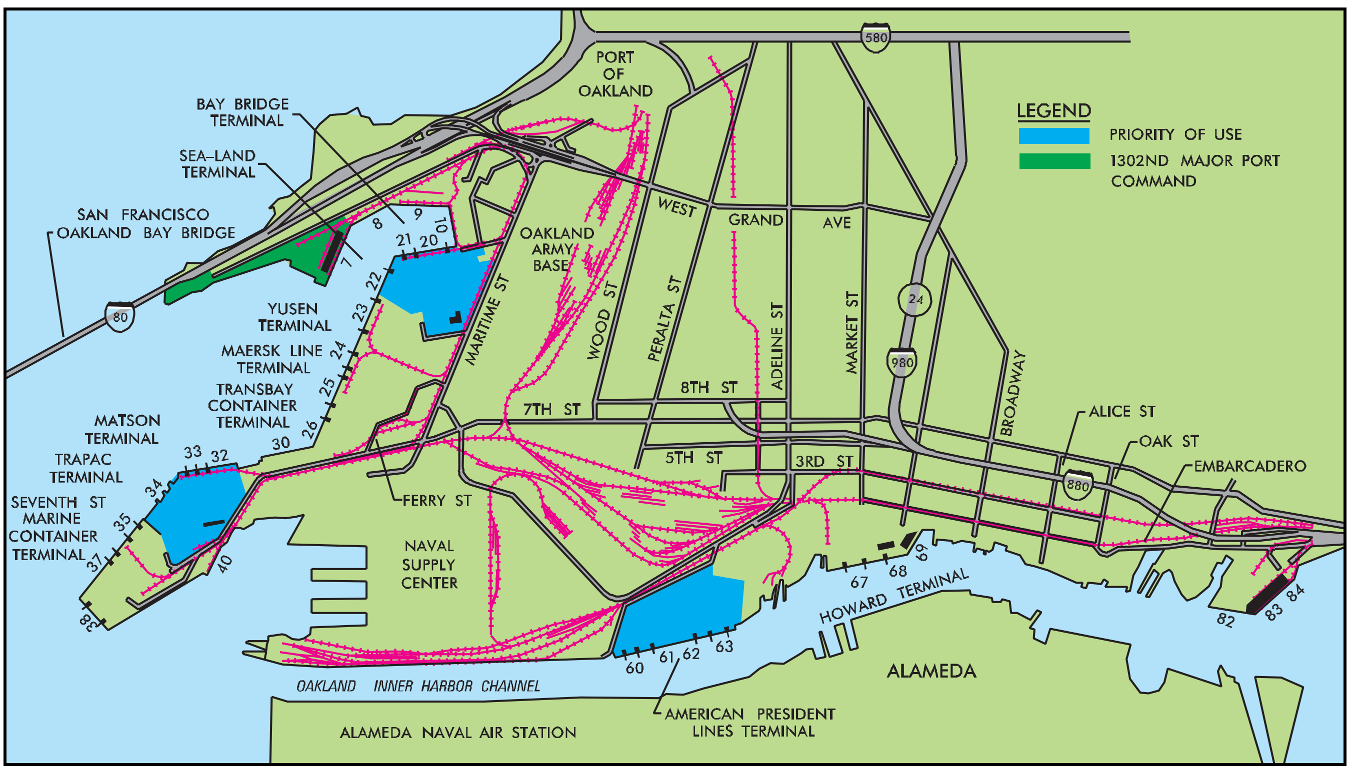
Notes:
Berths marked with "-" are not recommended for these operations.

The numbers refer to the berth ranking in terms of berth preference. For example, berth 7 has a number 1 ranking for breakbulk and barge loadings. Hence, it is the preferred berth for these operations.

III. APPLICATION

GENERAL

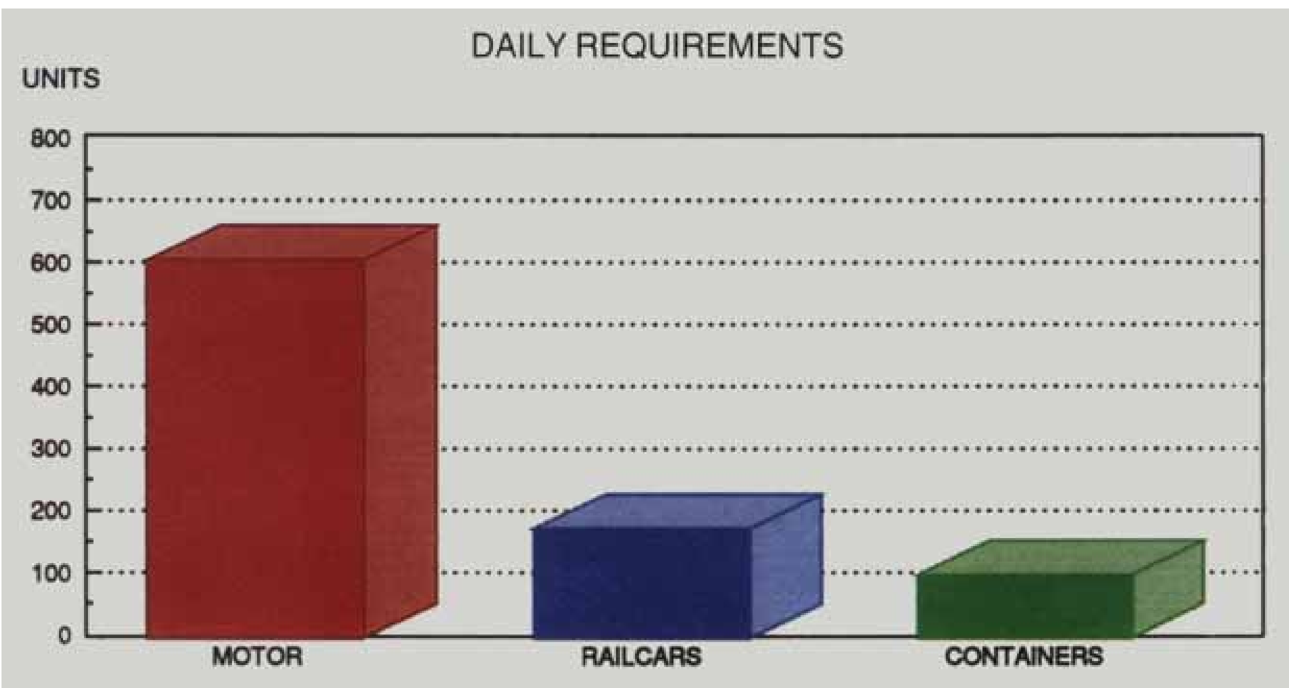
This section of the report will evaluate the port's throughput capability for deploying a notional mechanized infantry division using mainly FSS vessels. The analysis will use only those facilities designated in the 14 February 1994 *Planning Orders Digest*, issued by MARAD, plus MPC. The orders call for the Port of Oakland to grant priority use of certain facilities prior to and during national emergencies. These facilities are the APL, Matson, and Sea-Land Terminals.



REQUIREMENTS

The likely requirement for the Port of Oakland plus MPC is to deploy a notional mechanized infantry division in 6 days. The division has to move about 7,800 vehicles and 660 containers. The movement of this division to the port will require about 1,055 (176 per day) railcars, using a convoy/rail option. Under this option, about 3,650 (610 per day) roadable vehicles would be driven and about 2,320 (387 per day) would be towed.

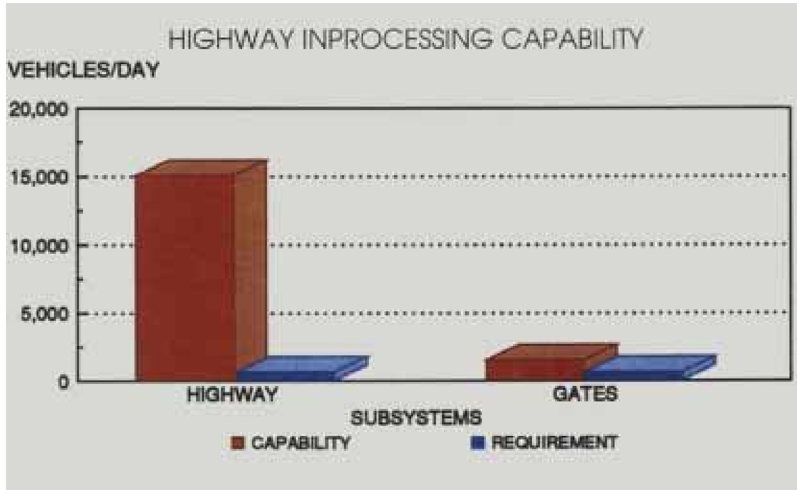
Total Equipment	
Volume	247,518 MTON
Weight	95,010 STON
Area	1,422,844 SQ FT
Vehicles	7,800
Containers (20 ft)	660



TERMINAL HANDLING

Highway

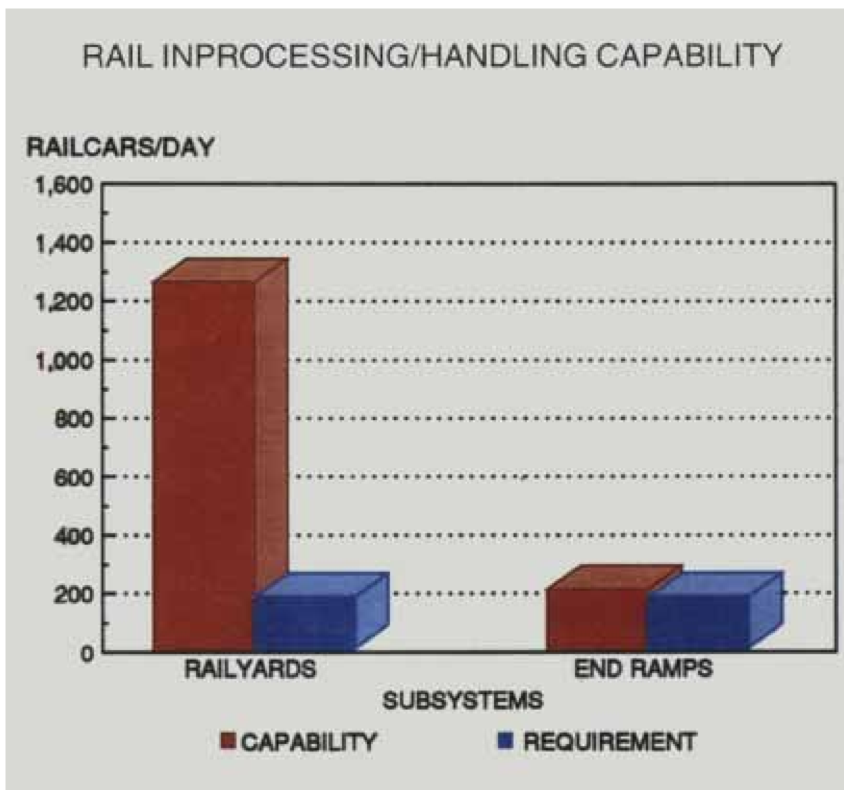
Vehicles would access MPC from Burma Road through the Bay Bridge Gate for deployment from pier 7. Access to the Sea-Land Terminal is by way of Maritime Street through the Sea-Land Gate. The Matson, TRAPAC, and Seventh Street Marine Container Terminals are accessible via Seventh Street through the Matson and Seventh Street Gates.



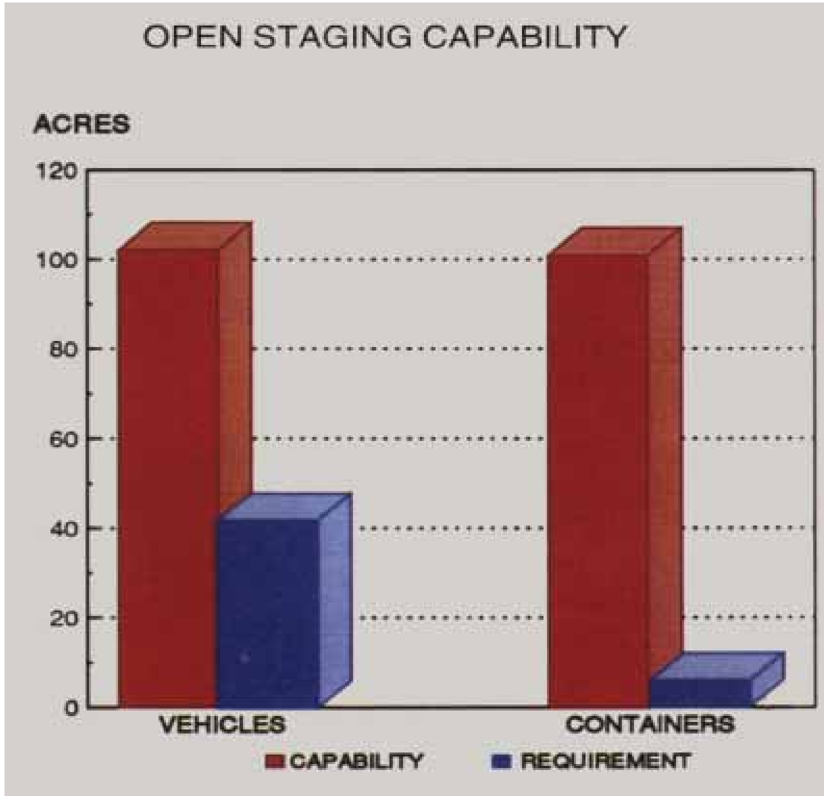
Vehicles can access the APL Terminal from Middle Harbor Road through the APL Gate. Containers on chassis would use all of the above terminals, except pier 7. Both the access roads and gate processing subsystems could handle well over 1,500 vehicles per day.

Rail

The classification yards within MPC and the nearby rail lines could handle more than 1,250 railcars per day (assumes 50 percent of total rail storage at railyards is available for military use). Also, assuming 4 of the 10 available end ramps are used for offloading, the end ramps could offload about 50 railcars every 5 hours, or more than 200 railcars per day. Since not all of the end ramps are used, the capability would be much higher than this 200-railcar-per-day estimate.

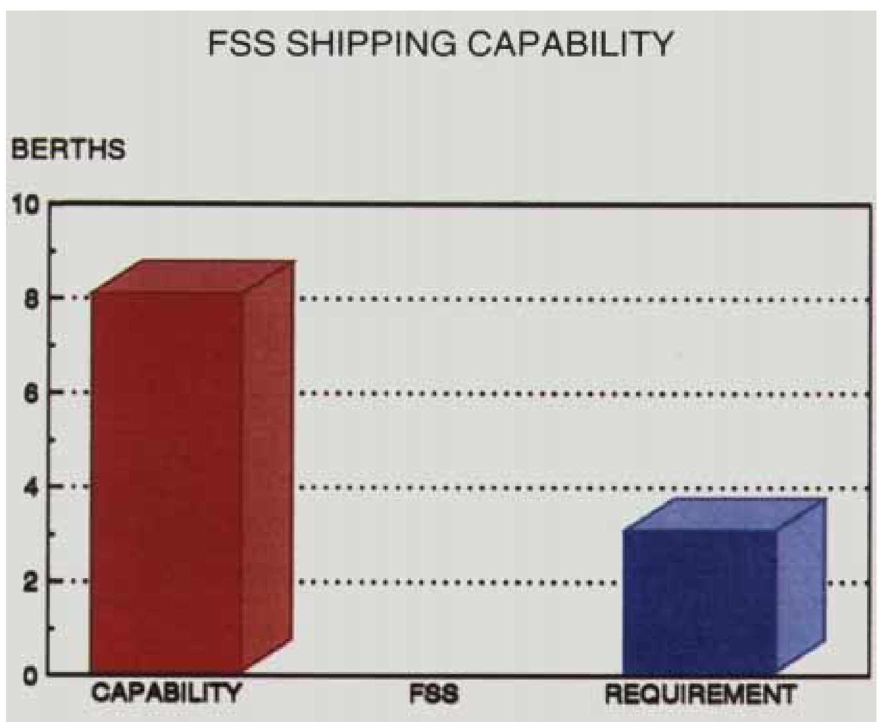


STAGING



Combined, the Port of Oakland and MPC have almost 210 acres of open storage area that could be assigned for military operations. We estimate that a mechanized infantry division needs about 48 acres of open staging to support the concurrent sustained loading of three FSS vessels. Divided between vehicles and containers, the staging area requirement for containers and vehicles becomes 6 and 42 acres, respectively.

SHIPPING



The number of ships needed to load this requirement depends on the shipping mix selected. The best ship mix would require all eight FSSs and two Cape H RORO ships. The MARAD P*lanning Orders Digest* designates eight ship berths that are compatible with FSS vessels. Assuming 2 days to load a ship, a division can easily outload within the 6-day requirement. We estimate a division can outload from the Port of Oakland in about 4 days.

UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

LOADING CONDITION/ SAMPLE SHIP MIX	**FSS (RORO/COMB)**	**CAPE H (RORO/COMB)**	**C3/C4 (BREAKBULK)**	**C6/C7/C8 (CONTAINER)**
	VESSEL TYPES			
Minimum Containerization				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization				
FSS and Container	7.90			2.00
FSS , Cape H, and Container	4.62	3.00		2.00
Breakbulk and Container			29.58	2.00

*Only 8 FSSs are available. Unit shipping requirements exceed the capacity of these 8 vessels, Other vessel types are required to make up the FSS shortfall (Cape H).

Legend:

RORO - roll on/roll off

FSS - fast sealift ship

Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide, Aug 91.

SUMMARY

The Port of Oakland and MPC can outload a mechanized infantry division within the 6-day outloading requirement.

For all except one terminal (Bay Bridge Terminal), the shipping subsystem is the limiting subsystem. For the Bay Bridge Terminal, the terminal handling capability is the limiting subsystem.

Deployment plans show that 1,557,737 MTON of cargo will flow through the Port of Oakland and MPC over a 69-day period. Pier 7 at MPC can handle the daily average of 22,576 MTON per day by itself. The Port of Oakland facilities can be used during peak periods.

RECOMMENDATIONS

We recommend the Port of Oakland as a potential port for outloading a mechanized infantry division within 6 days.

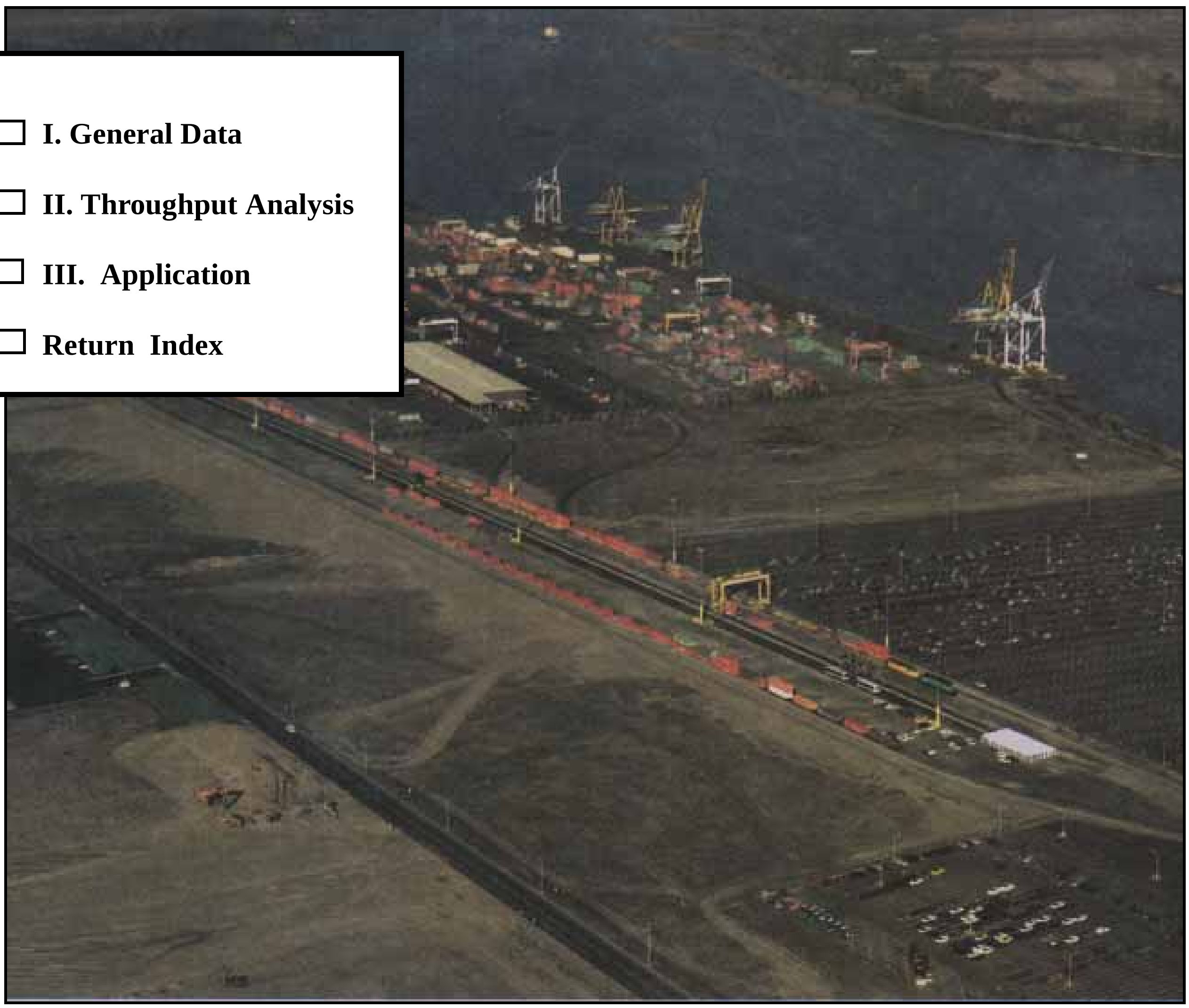
We recommend 48 acres of adjacent open staging area be designated to support the concurrent sustained loading of three FSS vessels.

September 94

PORT OF PORTLAND

PORTLAND, OREGON

- I. General Data
- II. Throughput Analysis
- III. Application
- Return Index

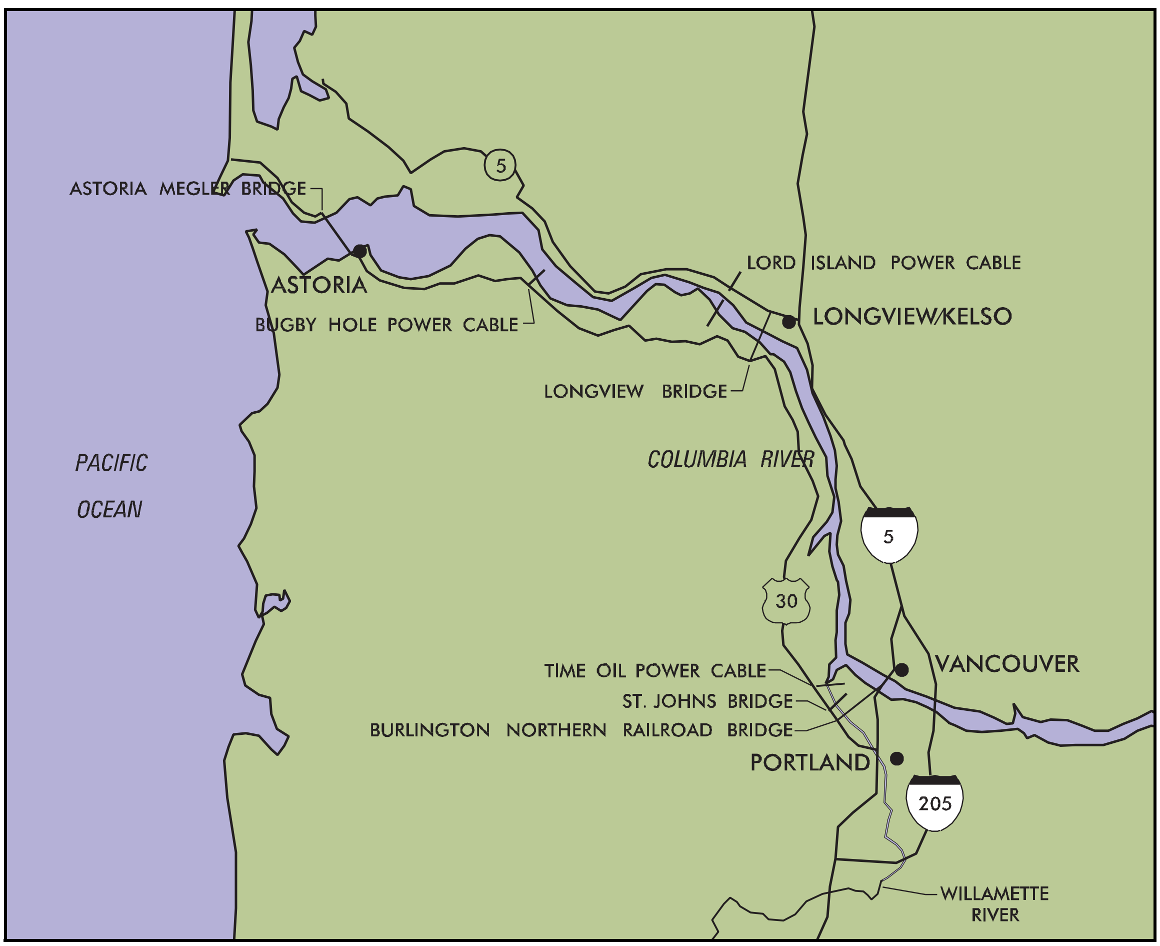


I. GENERAL DATA

TRANSPORTATION ACCESS

WATER

The Port of Portland is in northwest Oregon near the confluence of the Columbia and Willamette Rivers. It is about 100 miles up the Columbia River from the Pacific Ocean. The Columbia and Willamette River channels to Portland have a project depth of at least 40 feet mean low water (MLW). Bridge and overhead power cable restrictions are shown in the figure below and listed in the tables on the following page.



Water Access

WATER ACCESS RESTRICTIONS TO COLUMBIA RIVER

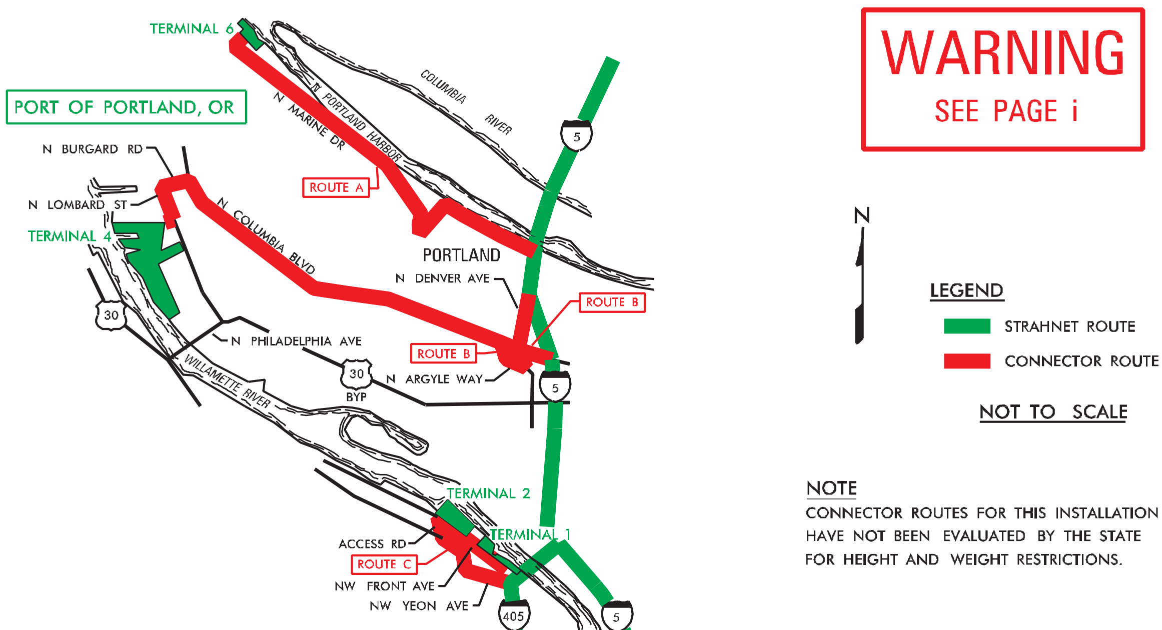
RESTRICTION	RIVER MILE	VERTICAL CLEARANCE (MHW)	HORIZONTAL CLEARANCE
ASTORIA MEGLER BRIDGE	13.5	186 FT	1,070 FT
LONGVIEW BRIDGE	66.1	176 FT	1,085 FT
BUGBY HOLE POWER CABLE	39.9	213 FT	
LORD ISLAND POWER CABLE	62.4	207 FT	

WATER ACCESS RESTRICTIONS TO WILLIAMETTE RIVER

RESTRICTION	RIVER MILE	VERTICAL CLEARANCE (MHW)	HORIZONTAL CLEARANCE
TIME OIL POWER CABLE*	3.3	199 FT	
ST.JOHNS BRIDGE**	6	174 FT	1,068 FT
BURLINGTON NORTHERN RAILROAD BRIDGE***	7	177 FT	489 FT
*Affects terminals 1,2, and 4 only. **Affects terminals 1 and 2 only. ***Affects terminals 1 and 2 only.			

HIGHWAY

The Strategic Highway Corridor Network (STRAHNET) route to the Port of Portland is Interstate 5. North Marine Drive is the major connector from I-5 to terminal 6. North Columbia Boulevard, North Burgard and North Lombard Streets are the major connectors to terminal 4. Interstate 405, Northwest Yeon and Northwest Front Avenues are the major connectors to terminals 1 and 2. Clearances are not a problem on these routes. The Oregon State highway legal limit for height is 14 feet.



ROUTE TO PORT

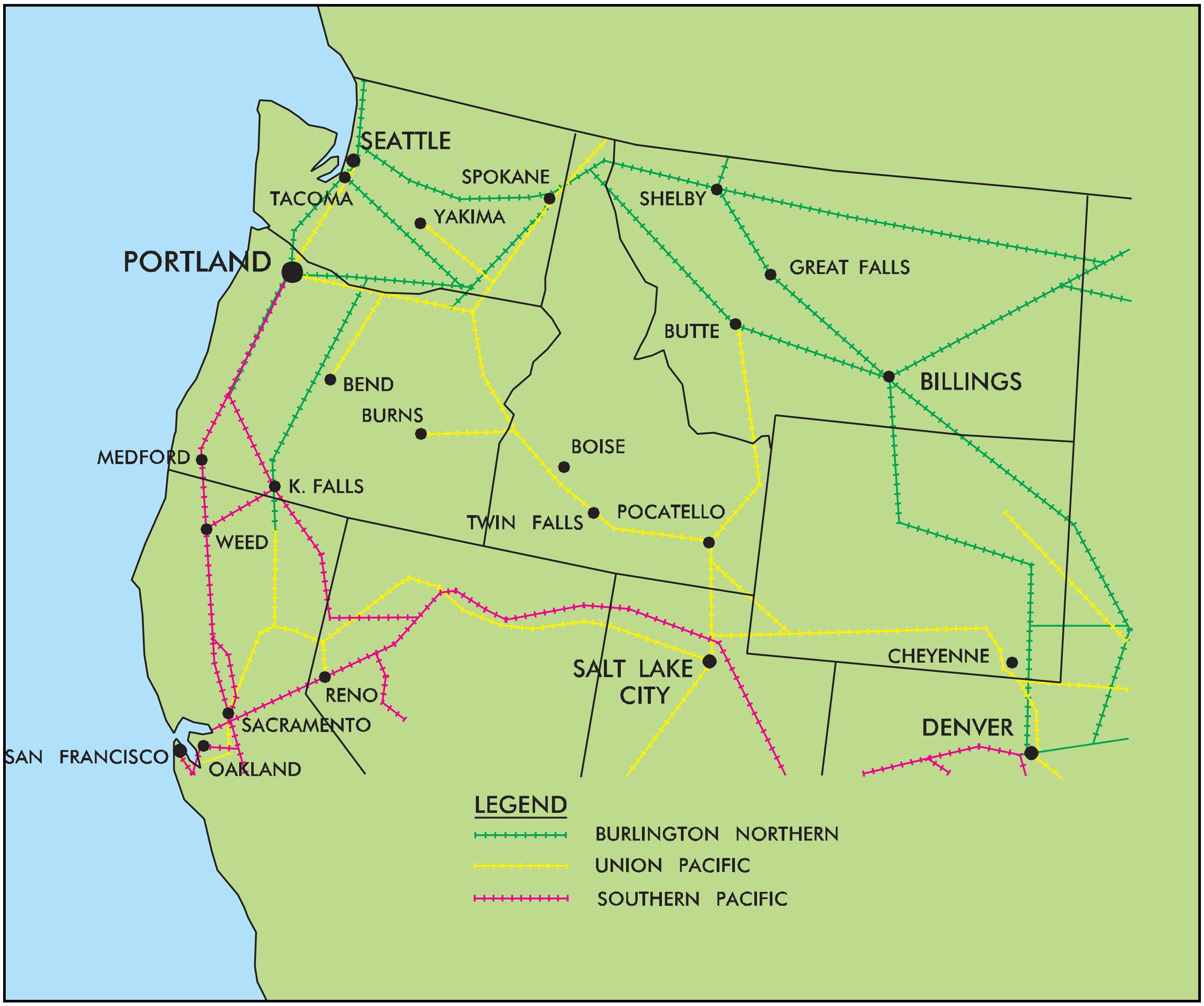
ROUTE A: I–5 TO N MARINE DR,
N MARINE DR W TO PORT OF PORTLAND (TERMINAL 6)

ROUTE B: (NB, WB TRAFFIC)
I–5 TO N COLUMBIA BLVD,
N COLUMBIA BLVD W TO N BURGARD RD,
N BURGARD RD W TO N LOMBARD ST,
N LOMBARD ST S TO PORT OF PORTLAND (TERMINAL 4)
: (SB TRAFFIC)
I–5 TO N DENVER AVE,
N DENVER AVE S TO N ARGYLE WAY,
N ARGYLE WAY W TO N COLUMBIA BLVD,
N COLUMBIA BLVD W TO N BURGARD RD,
N BURGARD RD W TO N LOMBARD ST,
N LOMBARD ST S TO PORT OF PORTLAND (TERMINAL 4)

ROUTE C: I–405 TO NW YEON AVE,
NW YEON AVE NW TO ACCESS RD,
ACCESS RD N TO NW FRONT AVE,
NW FRONT AVE SE TO PORT OF PORTLAND (TERMINALS 1 & 2)

RAIL

The Port of Portland is the only Pacific Northwest port served by three major railroads - Burlington Northern (BN), Union Pacific (UP), and Southern Pacific (SP). All three major railroads have railyards near the port. The Portland Terminal Railyard Company (PTRR) is owned by these railroads and does switching for terminals 1 and 2. Rail access to the other terminals is through reciprocal switching agreements. Rail clearances are sufficient for bilevel and trilevel railcars to access the port.



Rail Access

AIRPORTS

Four commercial airfields are near the Port of Portland. The chart below provides information on these airfields. The Oregon Air National Guard has facilities at Portland International Airport and shares runway space.

AIRFIELDS IN THE PORTLAND AREA

AIRFIELD	NUMBER OF RUNWAYS	LONGEST RUNWAY DIMENSIONS (FT)	DISTANCE FROM PORT (MILES)
PORTLAND INTERNATIONAL	3	11,000 X 150	12
PORTLAND-TROUTDALE	1	5,400 X 100	20
PORTLAND-HILLSBORO	2	6,600 X 150	23
MULINO	1	3,600 X 100	35

Air Access

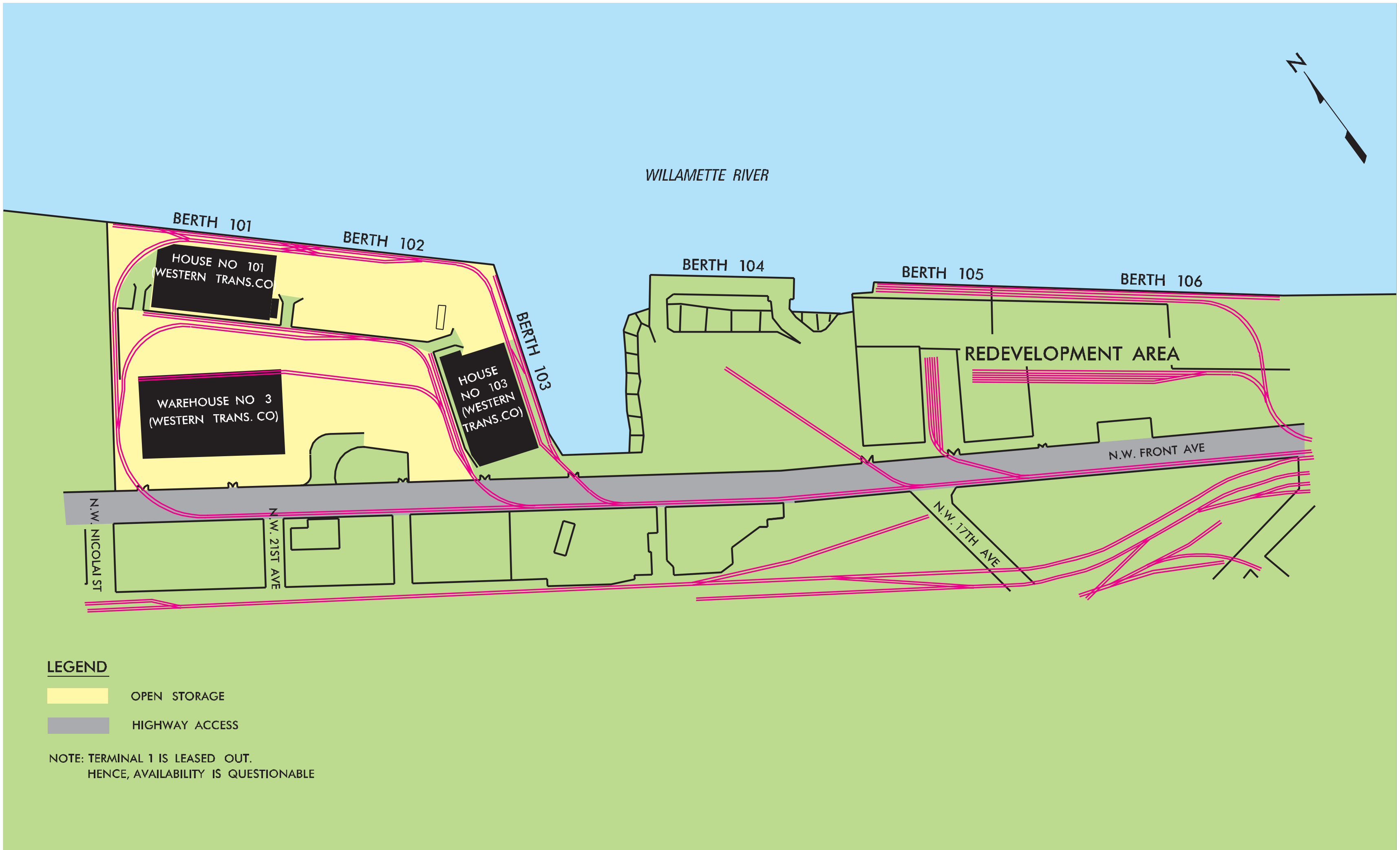
PORT FACILITIES

Berthing

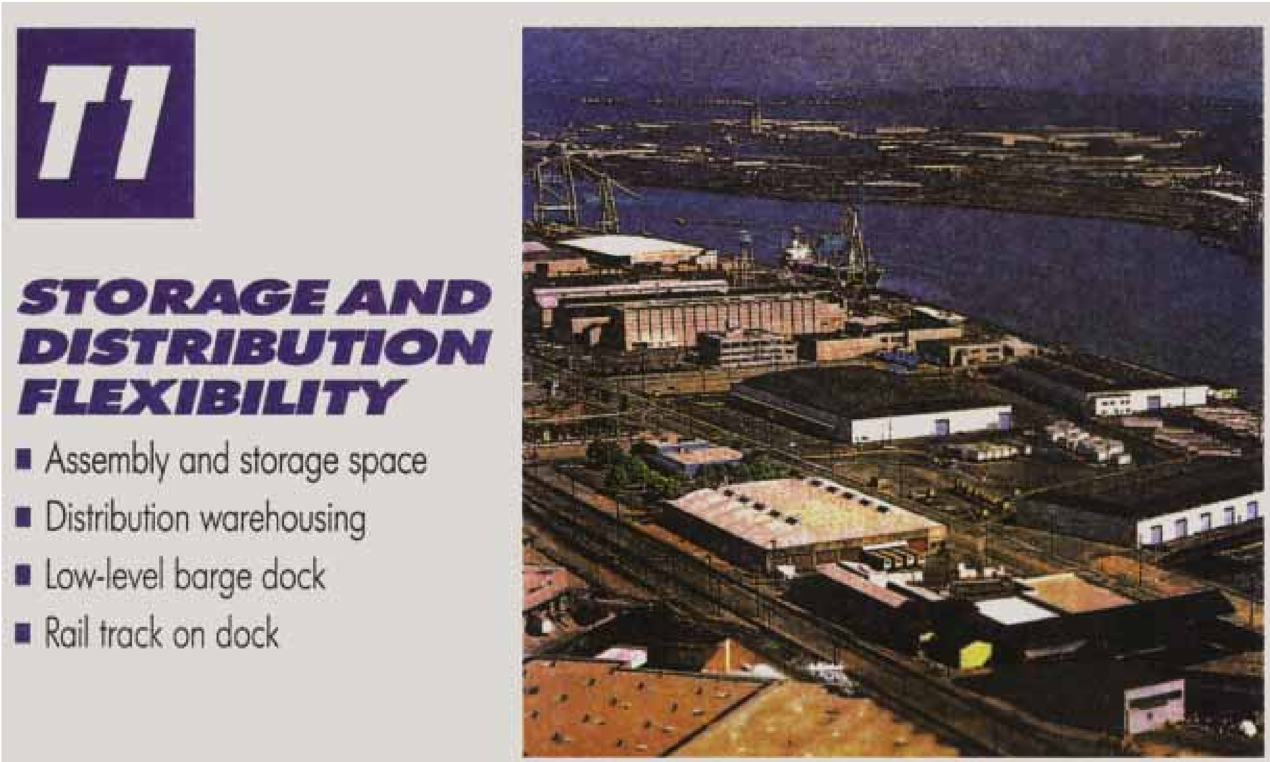
The Port of Portland is a multicargo operation that specializes in shipping containers. The port consists of marginal wharves and finger piers. Pier construction varies from terminal to terminal. Terminal 6 and part of terminal 4 pier construction consists of steel sheet pile and cellular bulkhead with concrete capped solid fill. Part of terminal 4 and terminals 1 and 2 generally consist of timber or concrete piling with concrete decking or timber decking with asphalt surface. All berths have a timber fendering system.

Following are the land-use maps, aerial views, and tables identifying berth characteristics of the port.

Vicinity Map



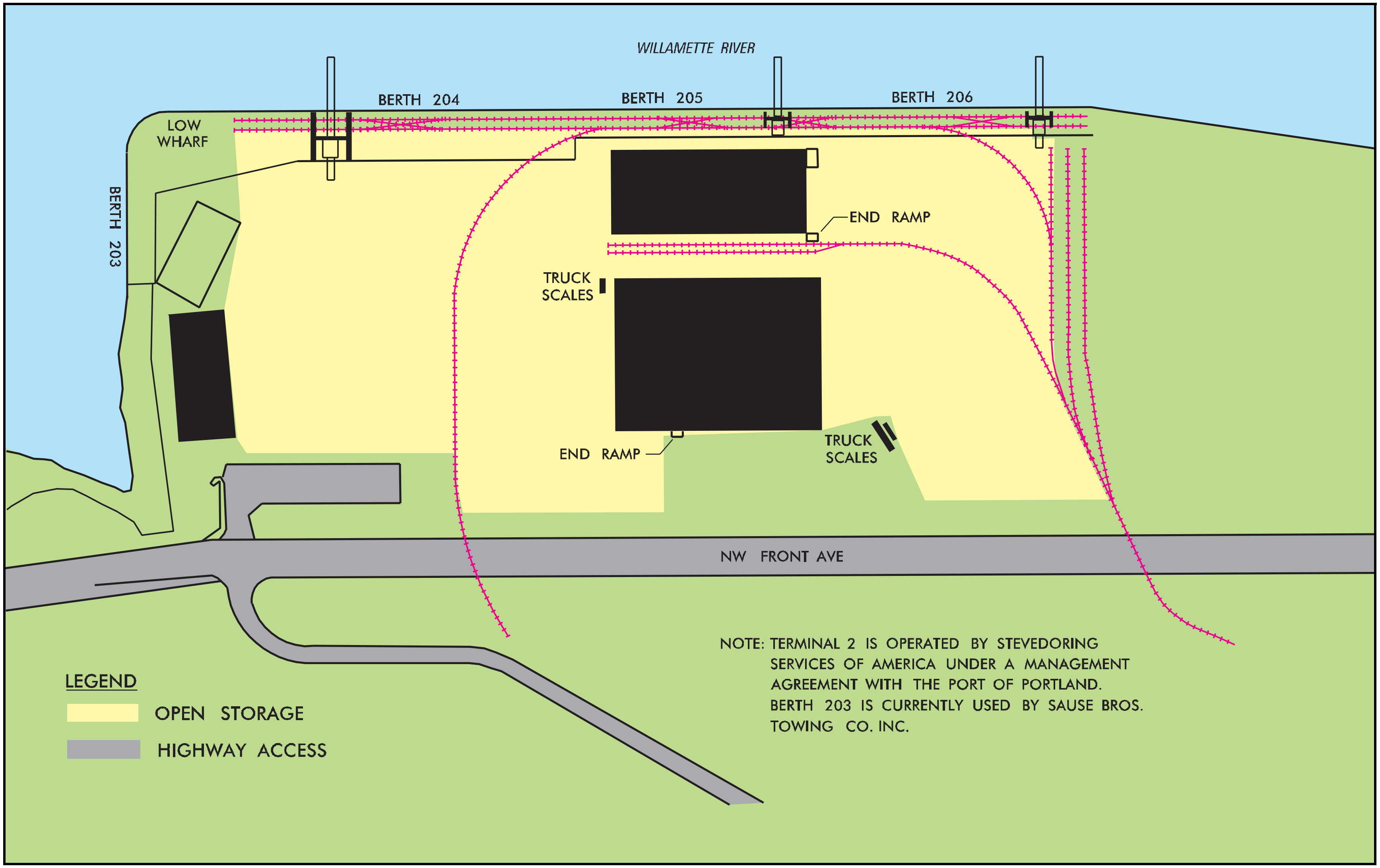
Terminal 1 Site Map



TERMINAL 1

CHARACTERISTICS	BERTHS 101-102	BERTHS 103
Length (ft)	1,100	550
Depth alongside at MIW (ft)	35	22
Deck strength (psf)	500	500
Apron width (ft)	Open	35
Apron height above MLW (ft)	29	29
Number of container cranes	0	0
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straight-stern RORO facilities	No	No
Apron length served by rail (ft)	1,100	550

Notes:
1.Terminal open storage area is 5 acres.
2.Terminal covered storage is 225,596 square feet.

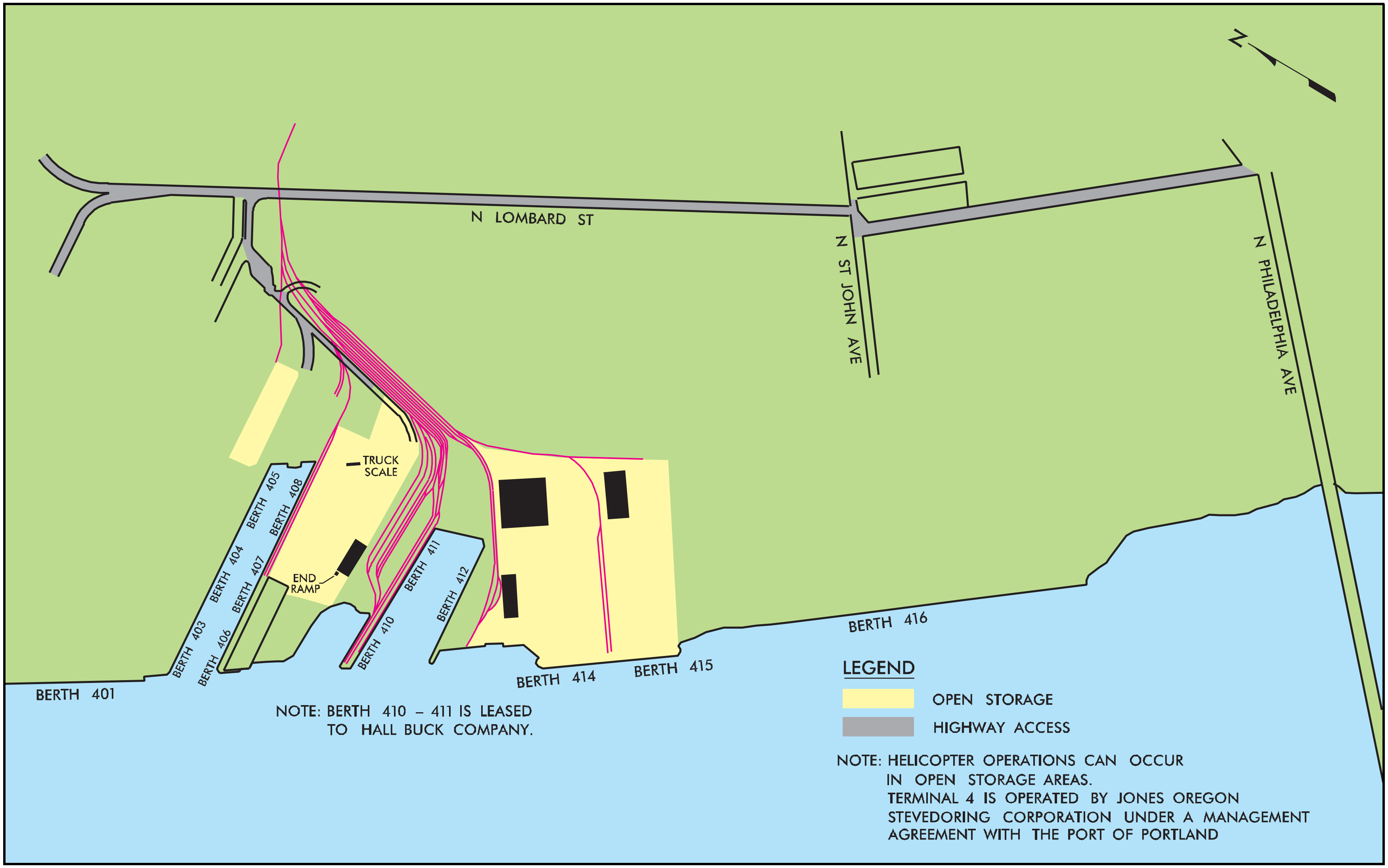


Terminal 2 Site Map

TERMINAL 2

CHARACTERISTICS	BERTHS		
	203	**204-206**	**204 (RORO)**
Length (ft)	400	2,535	1,005
Depth alongside at MLW (ft)	25	40	40
Deck strength (psf)	800	800	800
Apron width (ft)	Open	70 ft to-Open	Open
Apron height above MLW (ft)	20	26	20
Number of container cranes	0	3	0
Number of wharf cranes	1	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No
Apron length served by rail (ft)	0	2,295	0

Notes:
1.Terminal open storage area is 27 acres.
2.Terminal covered storage area is 304,279 square feet.
3.Berth 204 (RORO) is a portion of Berth 204-206.



Terminal 4 Site Map

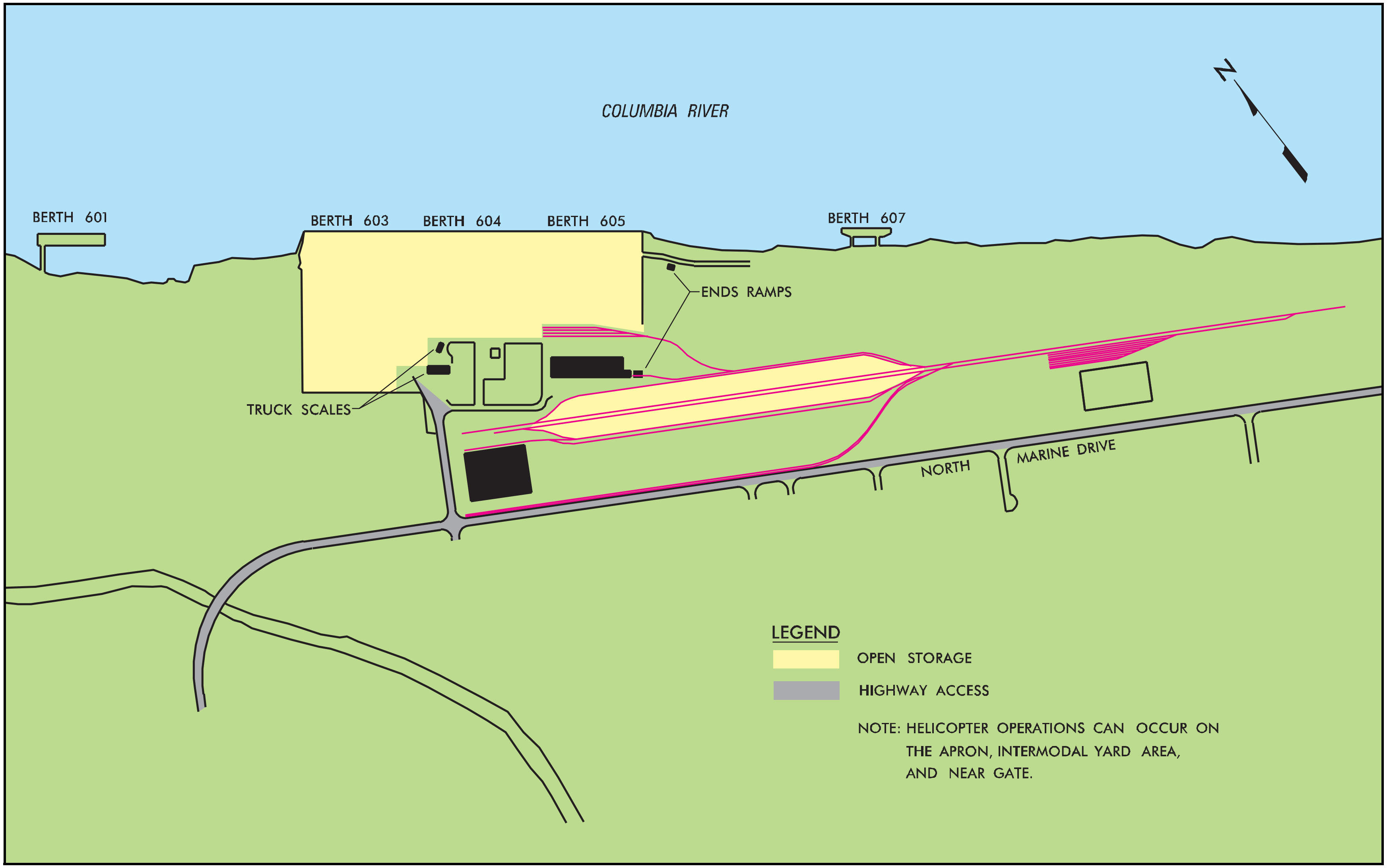
T4

MOST DIVERSE ON WEST COAST

TERMINAL 4

CHARACTERISTICS	BERTHS 403-405	406-408	408 (RORO)	410-411	414-415
Length (ft)	1,500	1,400	98	1,140	944
Depth alongside at MLW (ft)	35	35	35	40	40
Deck strength (psf)	375	650	1,000	450	1,000
Apron width (ft)	23	32	Open	60	Open
Apron height above MLW (ft)	35	30	20	33	25
Number of container cranes	0	1	0	0	0
Number of wharf cranes	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	Yes	No	No
Apron length served by rail (ft)	1,500	1,400	0	1,140	0

Notes:
1. Terminal open storage area is 57 acres.
2. Terminal covered storage area is 206,160 square feet.
3. Berth 408 (RORO) is a part of Berth 408.
4. With dolphins, the length of Berths 414-415 is 1,344 feet.



Terminal 6 Site Map

T6

PORTLAND'S PREMIER CONTAINER FACILITY

TERMINAL 6

CHARACTERISTICS	BERTHS 603-605	601 (RORO)	607 (RORO)
Length (ft)	2,876	400	414
Depth alongside at MLW (ft)	40	35	35
Deck strength (psf)	800	1,000	1,000
Apron width (ft)	Open	101	101
Apron height above MLW (ft)	26	12	12
Number of container cranes	5	0	0
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No
Apron length served by rail (ft)	0	0	0

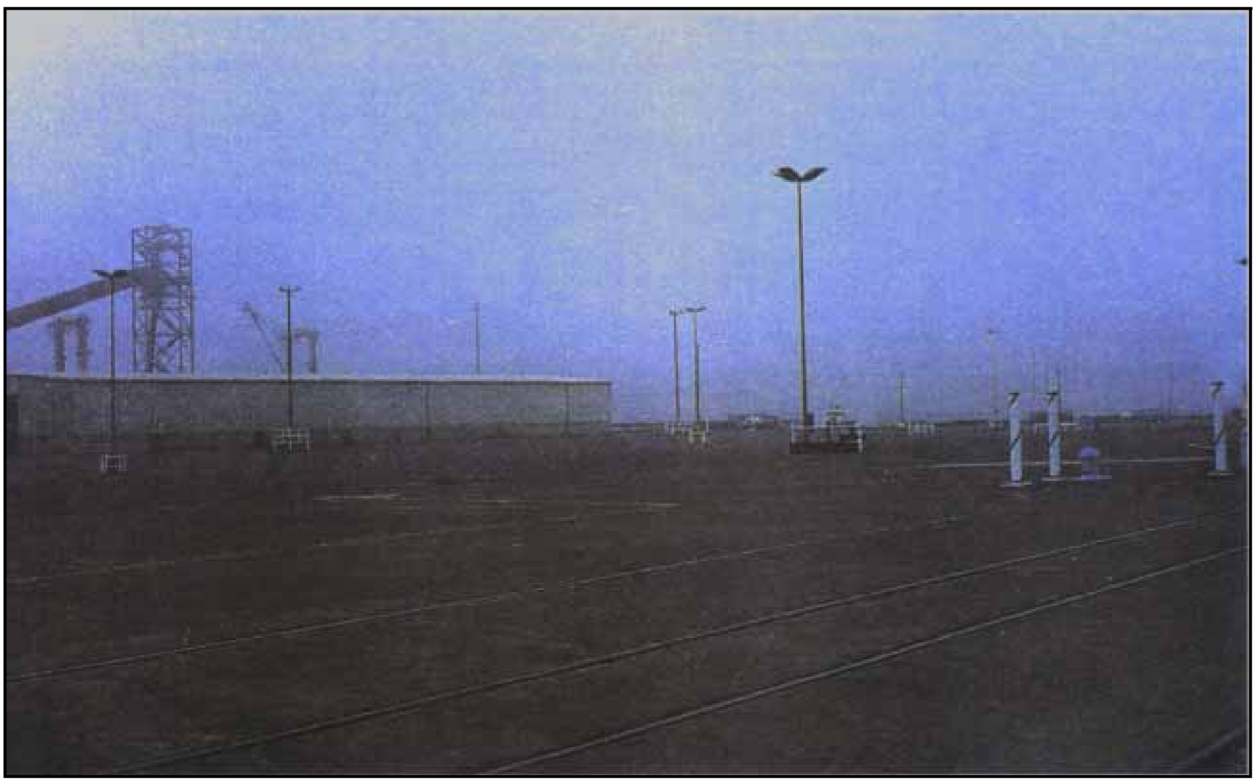
Notes:
1. Terminal open storage is 122 acres.
2. Terminal covered storage is 266,282 square feet.
3. With dolphins, the length of Berth 601 (RORO) is 1,020 feet.
4. With dolphins, the length of Berth 607 (RORO) is 1,014 feet.

STAGING

a. Open Staging. The port has 167.8 acres of open storage of which 154.8 acres are paved. The following chart provides the distribution of open staging acreage per terminal. Helicopter operations are possible at terminal 4, and the dock apron, intermodal yard, and gate areas of terminal 6.

OPEN STAGING

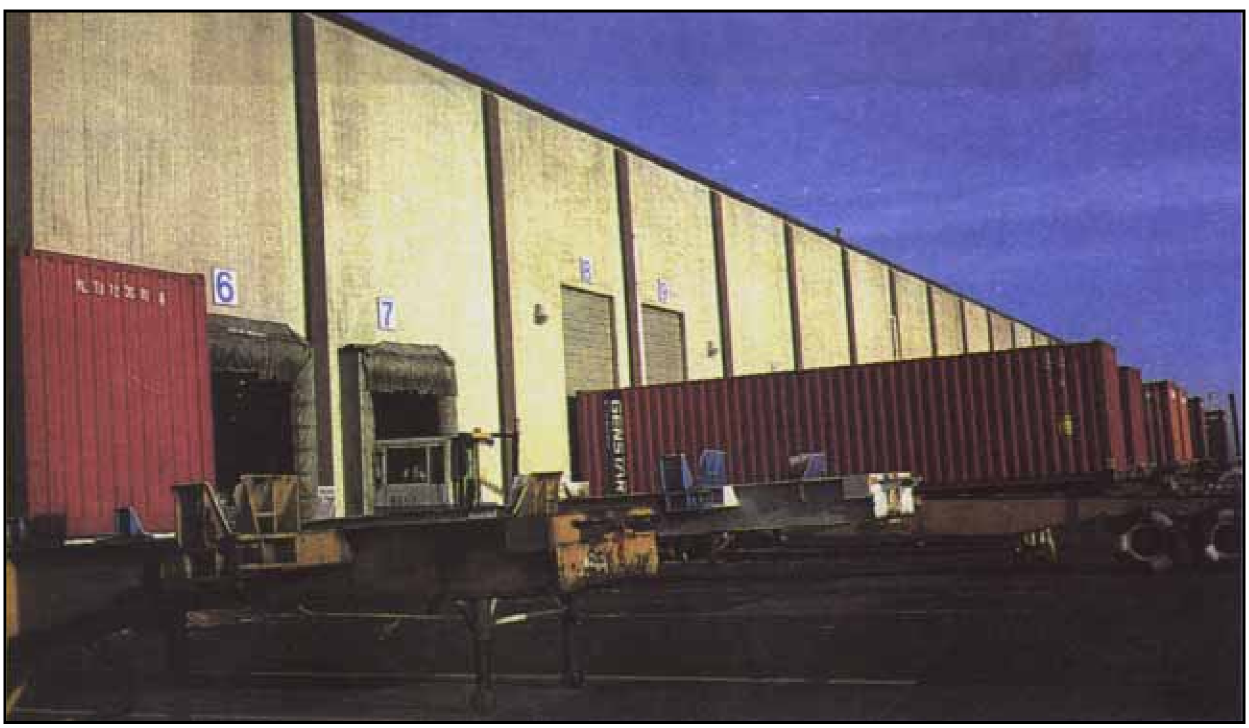
TERMINAL	OPEN STAGING ACREAGE
1	5.3
2	27.3
4	57.0
6	78.0
TOTAL	167.8



Terminal 4 Open Staging (Southwest View)

b. ***Covered Staging***. The Port of Portland has about 13 covered storage facilities (transit sheds, container freight stations, and warehouses) providing 1,002,317 square feet of covered storage.

Warehouse 6, Terminal 4



Dock Operations at Container Distribution Center, Terminal 6

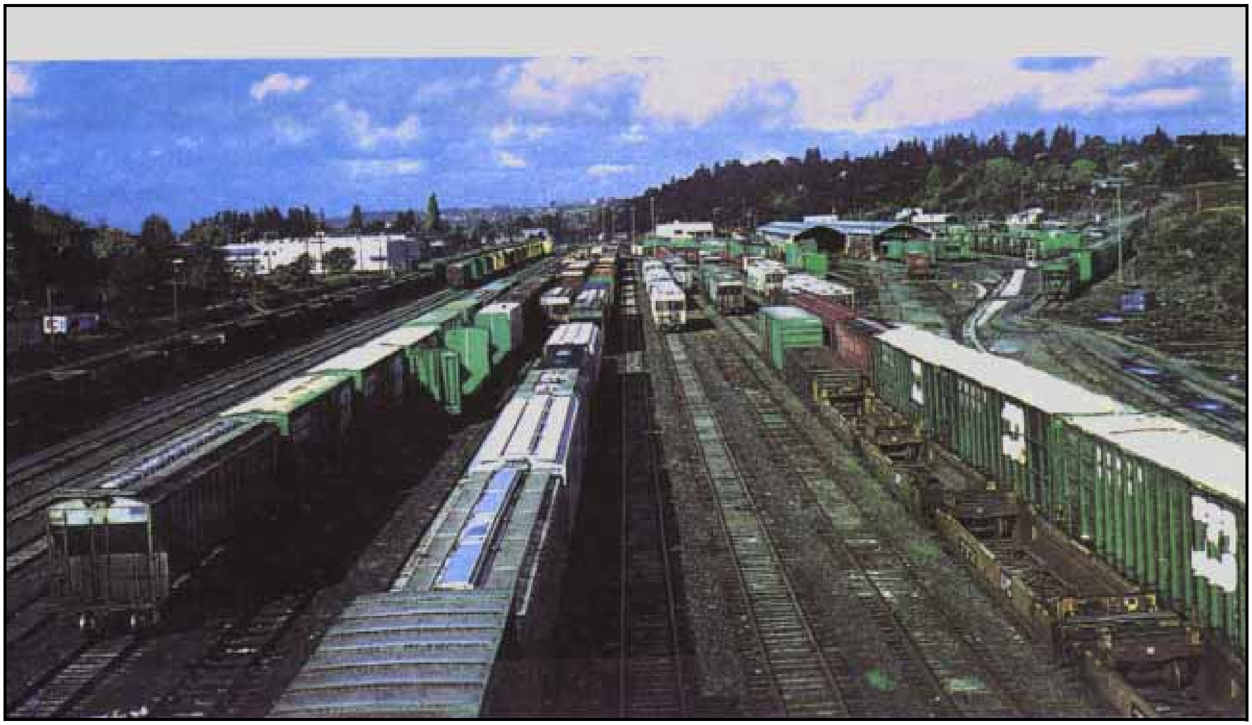
RAIL

Rail trackage links the railyards to the port's apron tracks, storage sheds, and storage tracks. Apron tracks are in terminals 1, 2, and 4. Rail trackage totals about 17.5 miles. The port has three railyards available for temporary railcar storage that can hold about 570 89-foot railcars. The commercial railyards near the port can handle about 4,210 89-foot railcars. Day-to-day availability of this storage space varies. Availability at the port railyards ranges from 25 to 50 percent. Availability at commercial railyards ranges from 10 to 30 percent.

Rail Access

Southern Pacific Brooklyn Yard, 12 Miles South of the Port

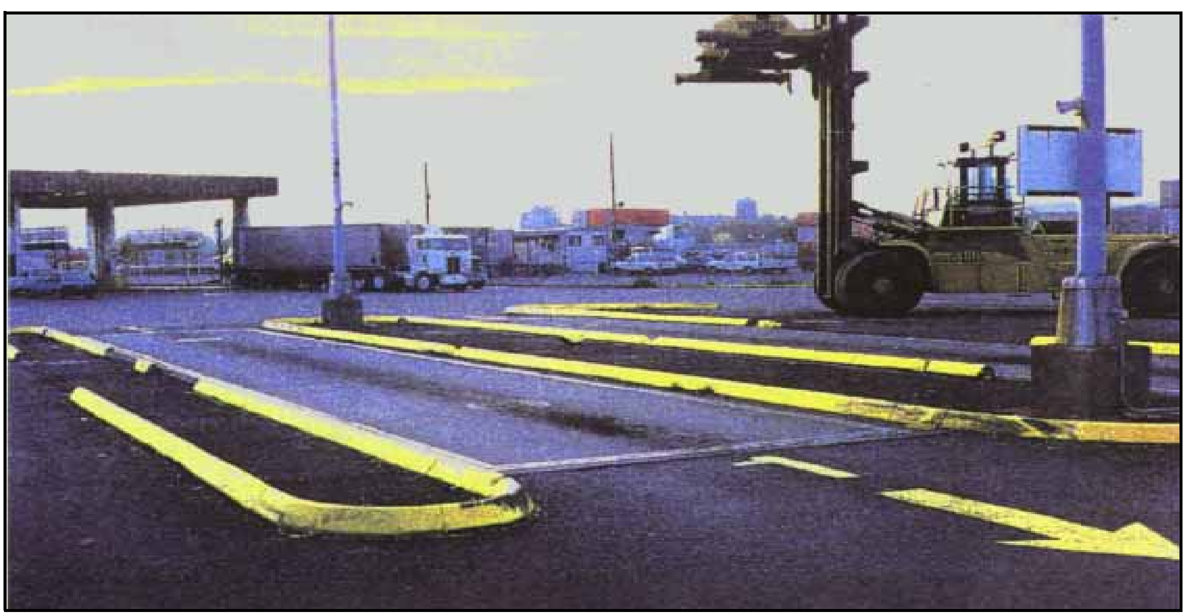
Union Pacific Albina Yard, 8 Miles South of the Port



Burlington Northern Vancouver Yard, 4 Miles North of the Port

HIGHWAY

Highways accessing the port are four lanes, except for North Lombard Street, which is two lanes. Highway clearances vary, but are generally around 14 feet for vertical clearance (Oregon highway legal limit). Truck scales are available at terminals 2, 4, and 6.



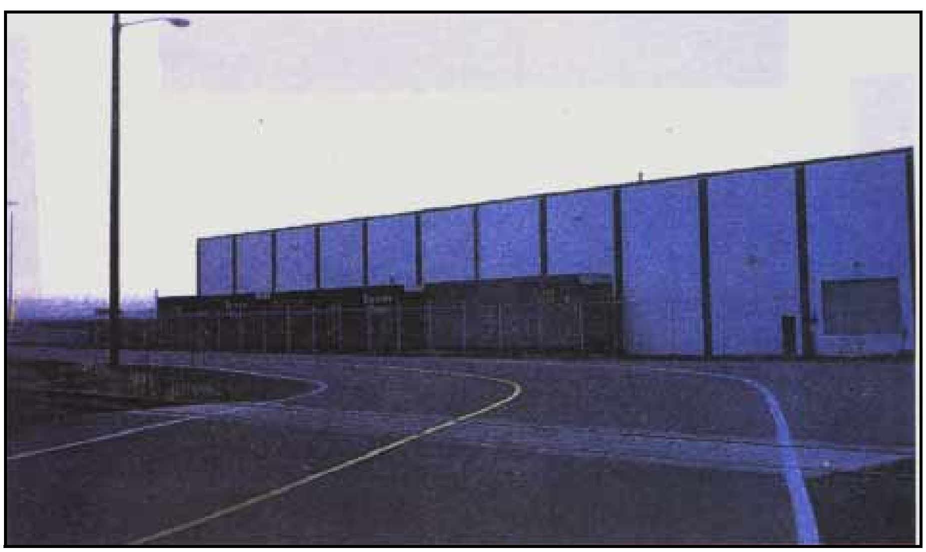
Truck Scales, Terminal 6

Ramps. The Port of Portland has six end ramps, one of which is a light portable ramp. Two of the five permanent end ramps can serve as truck or rail end ramps. The other three end ramps are strictly truck end ramps. The SP Brooklyn Yard south of the port has a permanent rail end ramp. The UP Barnes Yard and BN Vancouver Yard have light portable end ramps. These railyards, however, are not close enough to the port for offloading tracked vehicles. Also, the portable ramps do not have the capacity for offloading heavy vehicles.

Truck Ramp at Terminal 2

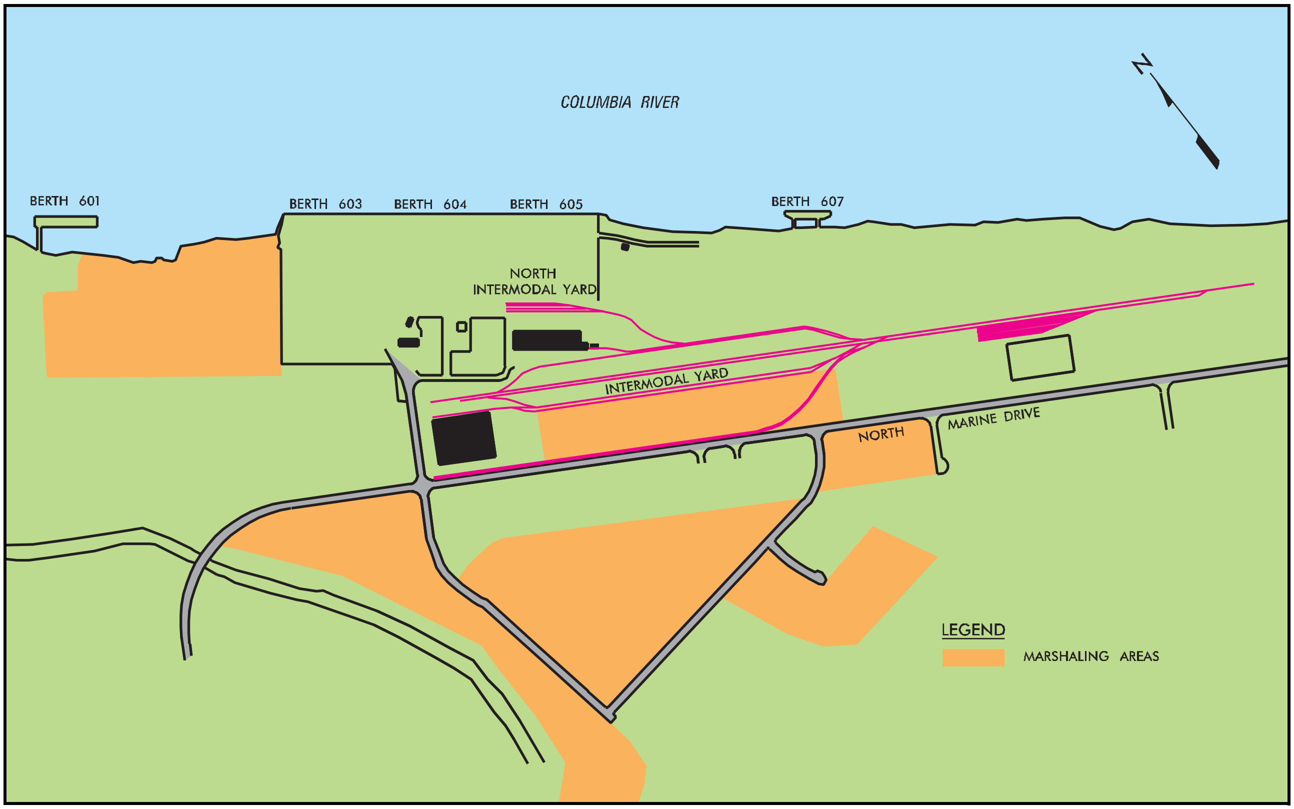
Docks. The Port of Portland has a combined total of 60 truck and rail dock handling positions available for military use. Of this total, 17 of these double as truck or boxcar handling positions. Forty nine of the handling positions are located on terminal 6 at the Container Freight Station (CFS) and Cargo Distribution Center (CDC). Seven positions are at terminal 2 and four are at terminal 4.

Boxcars Docked at CDC Terminal 6



MARSHALING AREAS

The Port of Portland lists almost 290 acres of land that could be used for marshaling. Of this total, 263.4 acres are in vacant sand fill lots in and around terminal 6. The other 26 acres are in the shipyard repair facility near the oil platform modules. The Swan Island Ship Repair Yard is in the vicinity map.



Marshaling Area South of N Marine Drive Near Terminal 6

MATERIAL HANDLING EQUIPMENT

The Portland port has nine container cranes and one wharf crane. Five of the container cranes are at terminal 6, three at terminal 2, and one at terminal 4. The wharf crane is at terminal 2. Capacities on these cranes range from 36 to 85 STON. Other material handling equipment is in the following table for each terminal.

MATERIAL HANDLING EQUIPMENT

TERMINAL	EQUIPMENT	NUMBER	CAPACITY RANGE
2	Forklifts	40	4-40 STON
4	Forklifts	135	2-25 STON
6	Toploaders	18	40 STON
6	Sideloaders	6	6.5 STON
6	Forklifts	36	2.5-26 STON
6	Yard Tractors	42	______
6	Yard Chassis	74	______

Container Cranes at Terminal 6

Toploader at CDC,Terminal 6

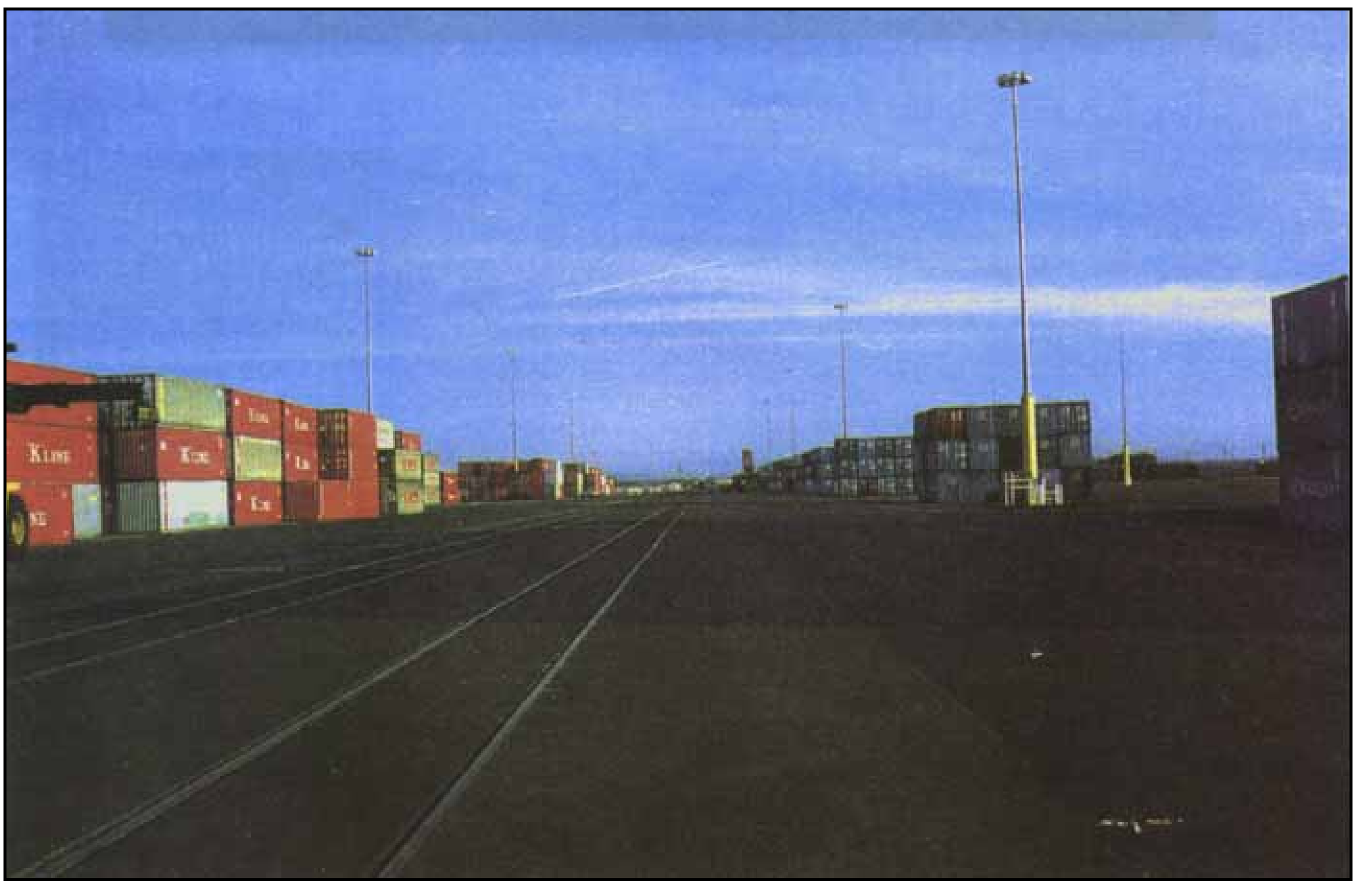
Sideloader at CFS, Terminal 6

INTERMODAL FACILITIES

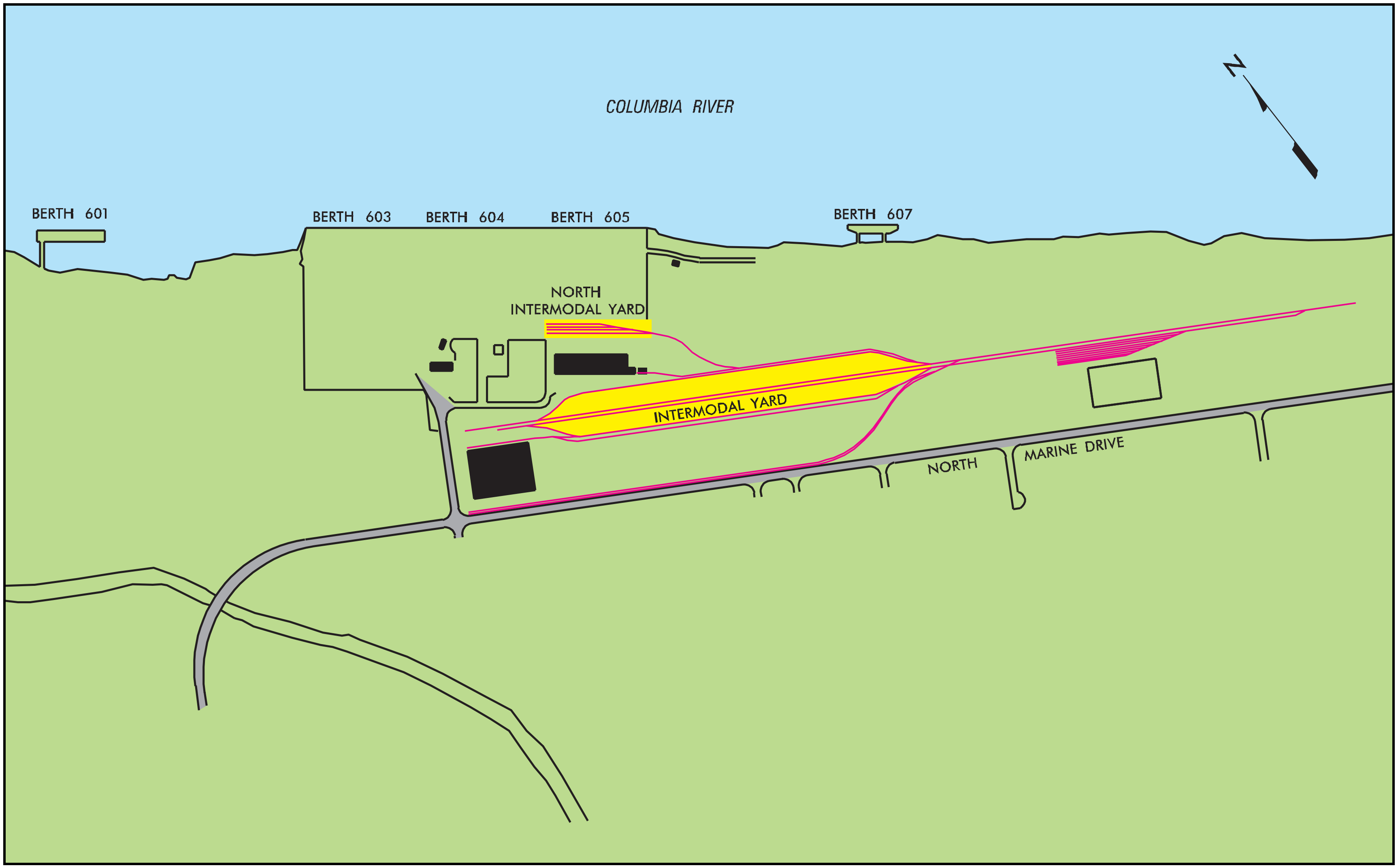
The port has two intermodal facilities at terminal 6 (the new and old intermodal facilities).

The new terminal 6 intermodal yard is on 33.4 acres and has the capability to stage about 360 40-foot truck chassis. Transfer operations occur on 6 tracks providing about 180 89-foot flatcar lengths. This yard has 17 toploaders (3 used at once) available for container operations and can handle both TOFC and double-stacked container operations. The current activity level is 2,000 lifts per month.

The old terminal 6 intermodal yard is on 5 acres and has the capability to stage about sixteen 40-foot truck chassis. Transfer operations occur on five tracks providing a total of about twenty-five 89-foot flat-car lengths. This yard has one toploader available for container operations and can handle both TOFC and double-stacked container operations. The current activity level is 100 lifts per month.



New Intermodal Railyard, Terminal 6



Terminal 6 Intermodal Yards

The SP, UP, and BN are the three commercial rail lines that have intermodal yards near the port.

The SP Brooklyn Yard occupies 21 acres and has the capability to stage about forty-eight 40-foot truck chassis. Transfer operations occur on two tracks providing about twenty-four 89-foot flatcar lengths. This yard has two straddle carriers available for container operations and can handle both TOFC and double-stacked container operations. The current activity level is 9,000 lifts per month.

The UP Albina Yard occupies 20 acres and has the capability to stage about eighty 40-foot truck chassis. Transfer operations occur on two tracks providing about forty 89-foot flatcar lengths. This yard has four sideloaders (piggy packers) available for container operations and can handle both TOFC and double-stacked container operations. The current activity level is 13,000 lifts per month.

The BN Yeon Street Yard is next to the PTRR railyard and is situated on 40 acres. This yard has the capability to stage about 160 40-foot truck chassis. Transfer operations occur on three tracks providing a total of eighty 89-foot flatcar lengths. This yard has four sideloaders available for container operations and can handle both TOFC and double-stacked container operations. The current activity level is 15,000 lifts per month.

SP Brooklyn Intermodal Railyard

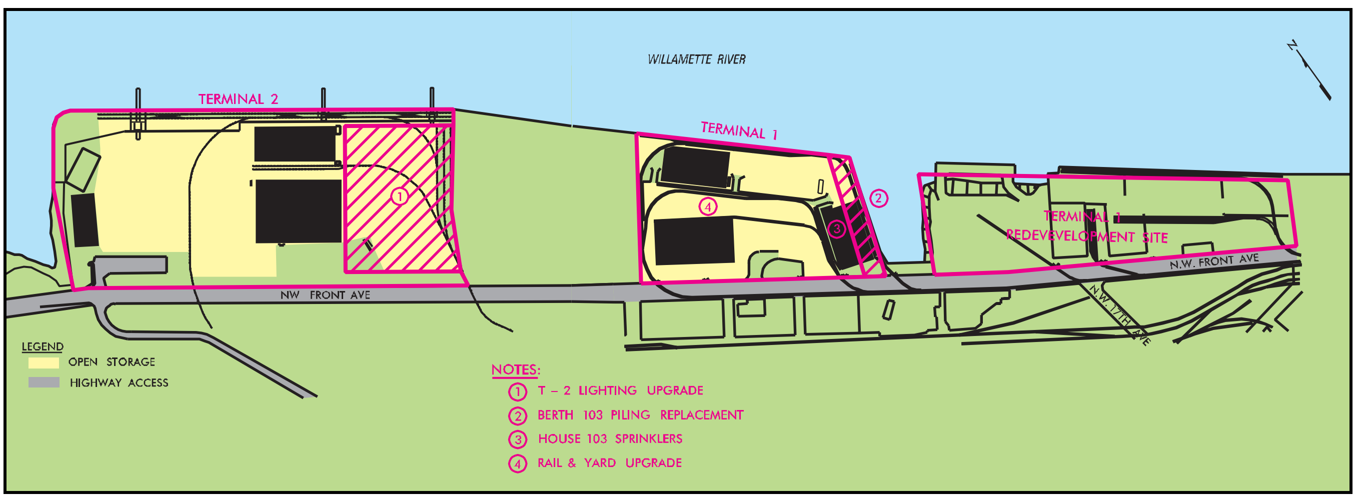
FUTURE DEVELOPMENT

The Port of Portland lists several projects for future development that would impact military deployments.

For terminal 1, the plans are to replace berth 103 piling, repave the storage yard, and upgrade the railroad tracks.

Terminal 2 lighting will be upgraded by installing new high mast poles and fixtures.

Several future developments are planned for terminals 4 and 6.

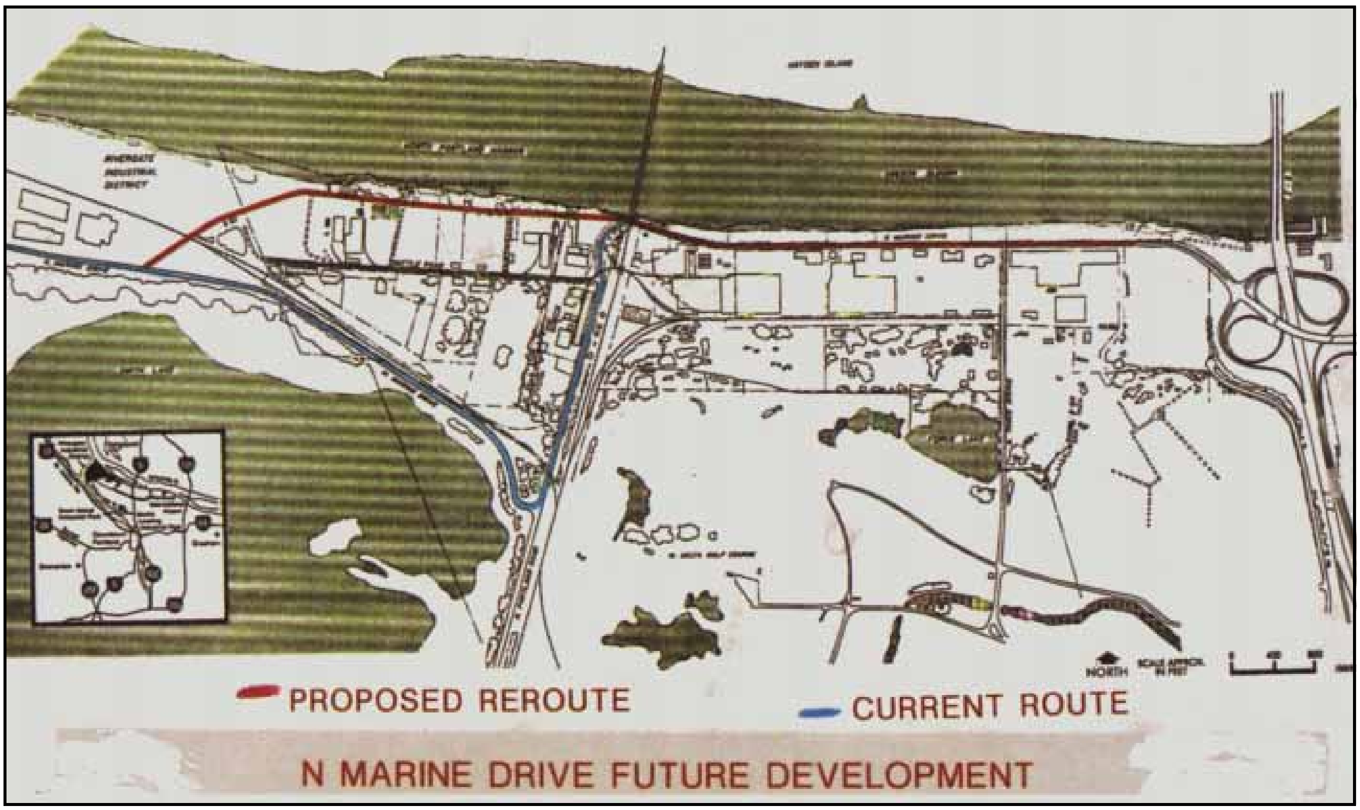


Future Development for Terminals 1 and 2

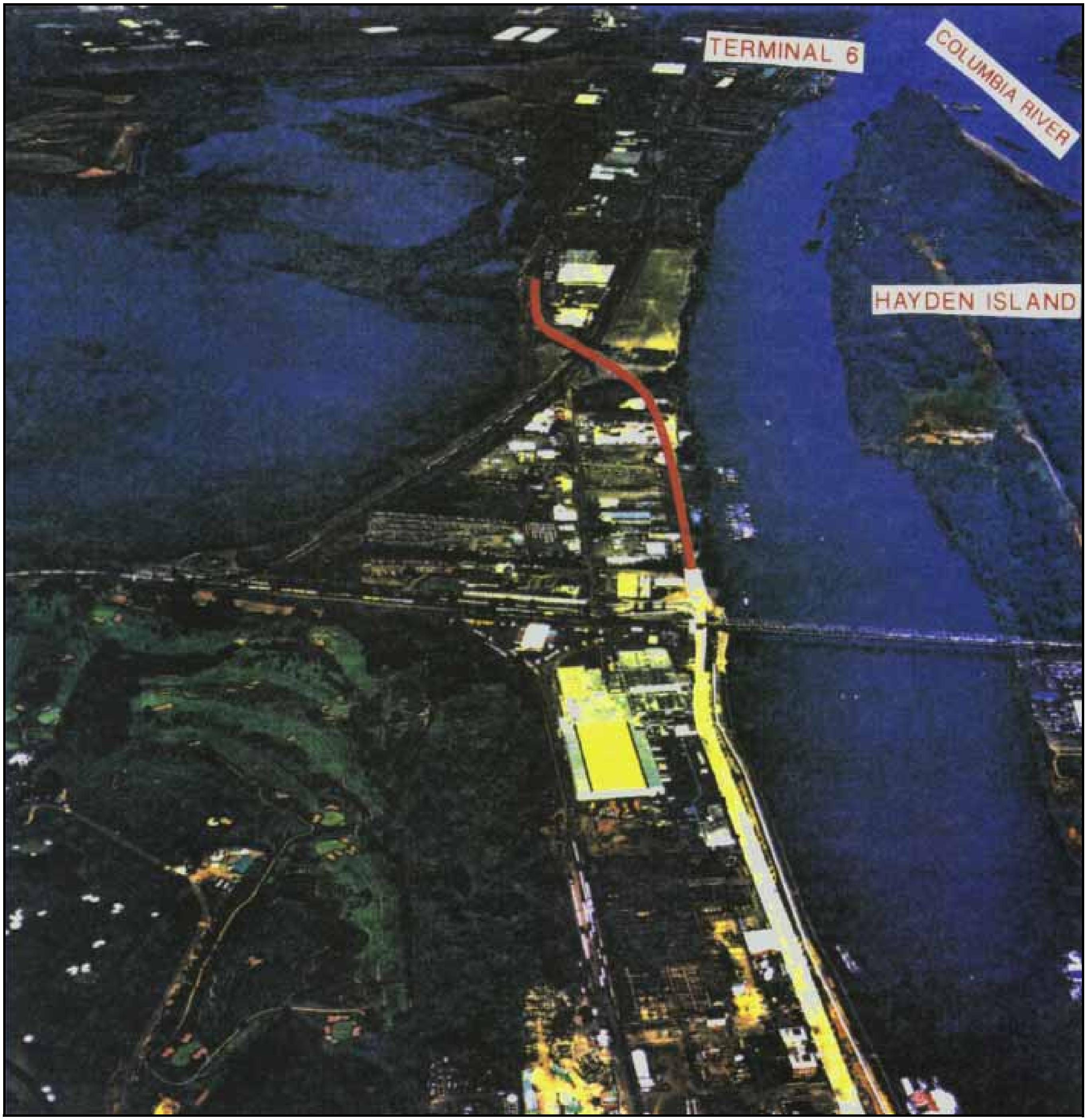
For terminal 4, the plans are to demolish warehouses 1, 2, 3, and 4 along berths 403-405 and the Matson warehouse along berths 406-407. A 25-railcar storage expansion will be located near the demolished warehouses at berths 403-405. The port also plans to demolish berth 412, extend berths 414 and 415, and add a new floating auto RORO dock upstream from berths 414 and 415. The steel yard will be expanded about 10 to 12 acres and a covered storage facility will be constructed in this area. The new covered storage area will have 100,000 square feet of storage space. Other possibilities are to develop another access road to terminal 4 by extending North Roberts Avenue and adding additional apron tracks to berths 414 and 415.

For terminal 6, plans are to widen and straighten North Marine Drive, the main access road to this terminal. This project is scheduled for completion in July 1995.

MARINE DRIVE PROJECT



Other future projects for terminal 6 include extending the east and west ends of the wharf, adding another container crane to the east end of the wharf, expanding the new intermodal facility, and acquiring Hayden Island.

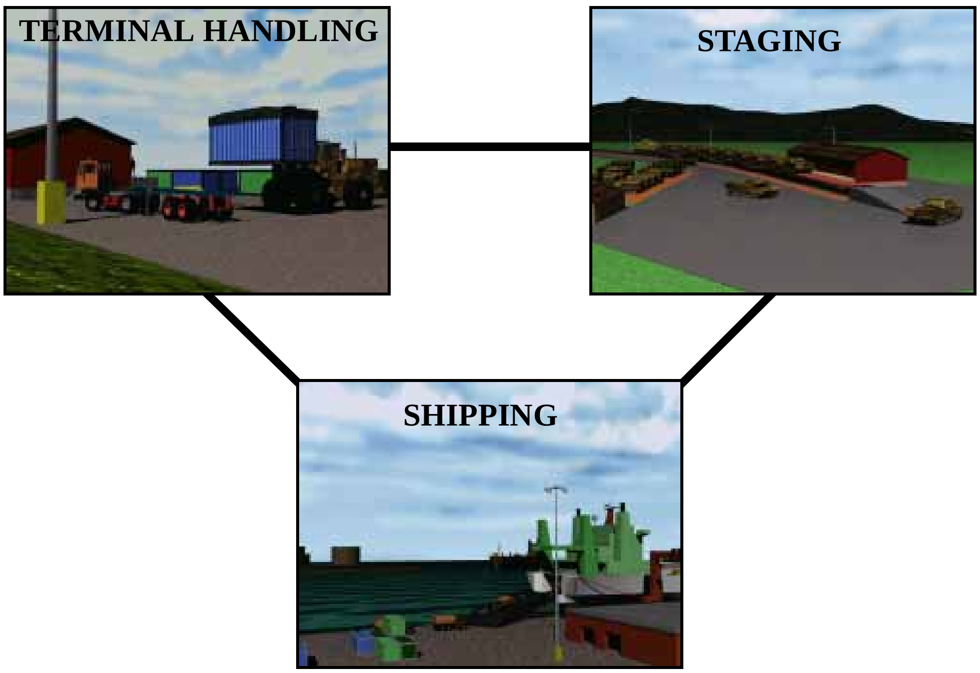


N Marine Drive Reroute and Hayden Island

II. THROUGHPUT ANALYSIS

GENERAL

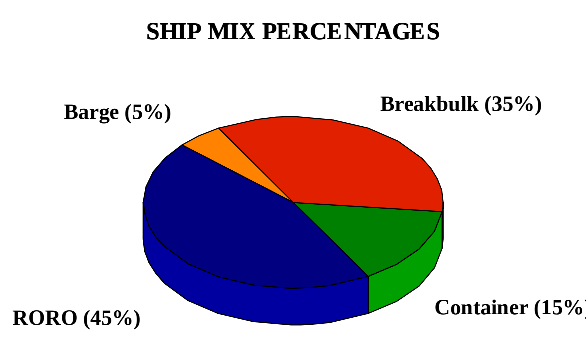
This section evaluates the throughput capability of the Port of Portland with the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput values for three subsystems - shipping, staging, and terminal processing/handling in terms of measurement tons (MTON) per day.



Terminal Throughput Subsystems

The analysis assumes that 80 percent of the port facilities will support military deployments. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.

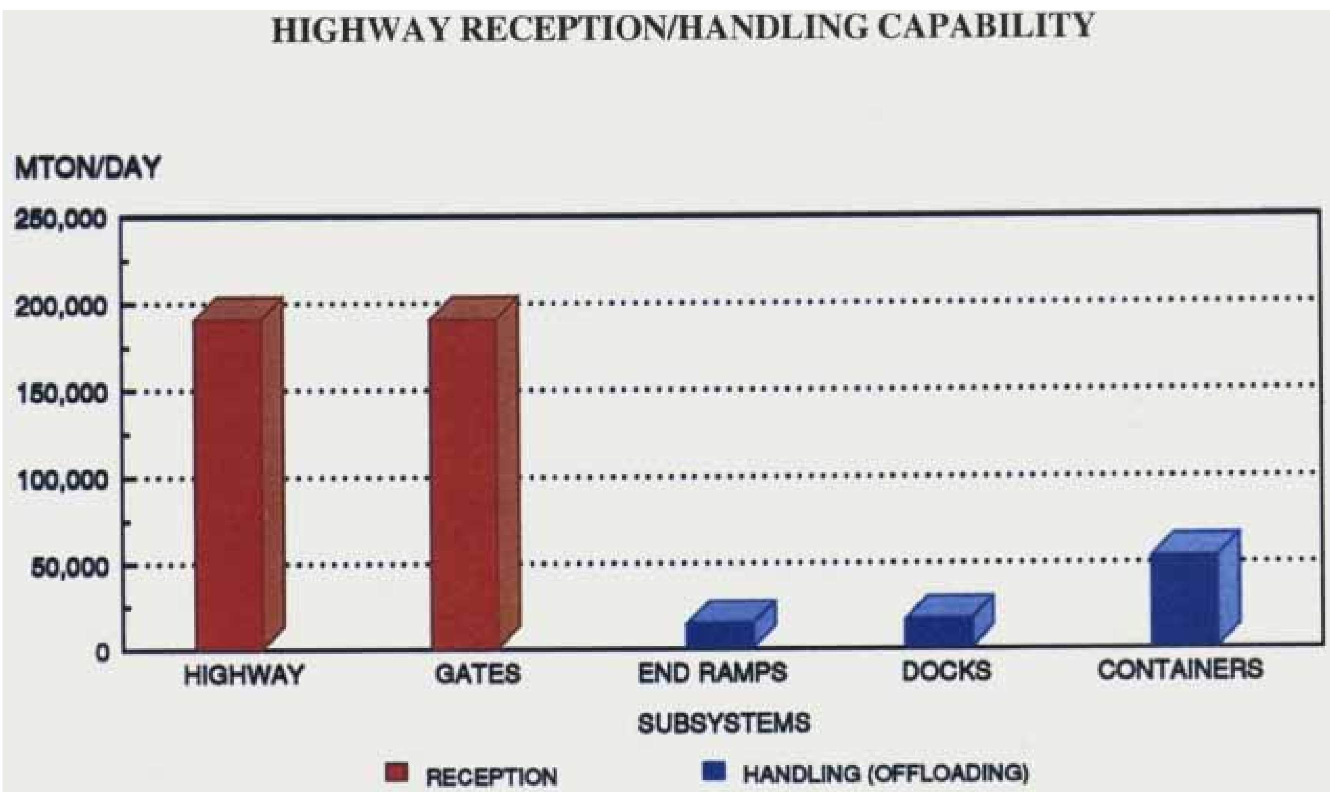
Since Terminal 1 is leased out, we assumed that only 30 percent of the Terminal 1 port facilities will support a military deployment.



TERMINAL RECEPTION/HANDLING

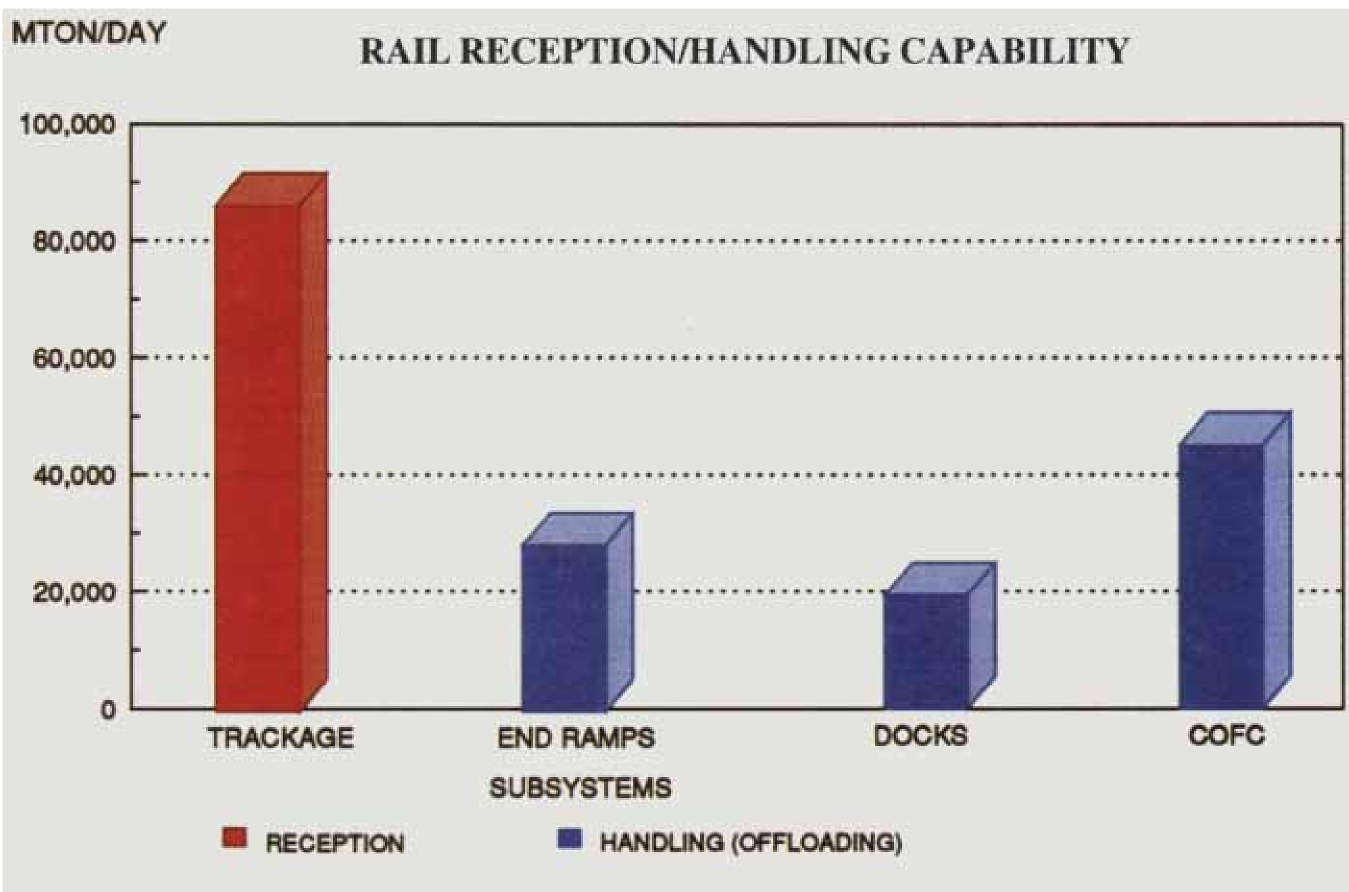
Highway. Interstates 5 and 405, plus the major connectors of North Marine Drive, North Columbia Boulevard, North Burgard and North Lombard Streets, Northwest Yeon, and Northwest Front Avenues all provide good access to the Port of Portland. Each terminal has at least one gate allowing access to the wharf area. The road network in and out of the port, including the gate processing of vehicles, could handle almost 189,730 MTON of equipment and supplies per day.

Roadable vehicles in convoys can proceed directly to staging areas. Vehicles on commercial or military flatbed semitrailers will first offload at the permanent end ramps at terminals 2, 4, and 6. Wide vehicles may have difficulty offloading at the truck end ramp at terminal 2 because of the side rails (see picture in the end ramps portion of section I of this study). The end ramp at terminal 4 is in need of repair. Assuming offloading operations occur at these end ramps, about 14,400 MTON of equipment could be offloaded per day. Supplies in van semitrailers will proceed to the warehouse docks for offloading. These facilities provide 63 handling positions (some of these double as rail dock facilities) and could offload about 16,640 MTON of cargo per day. Containers on trucks will likely proceed to terminal 6, which is specially equipped with container cranes and other container handling equipment. The container handling facilities could offload almost 52,800 MTON of cargo per day.



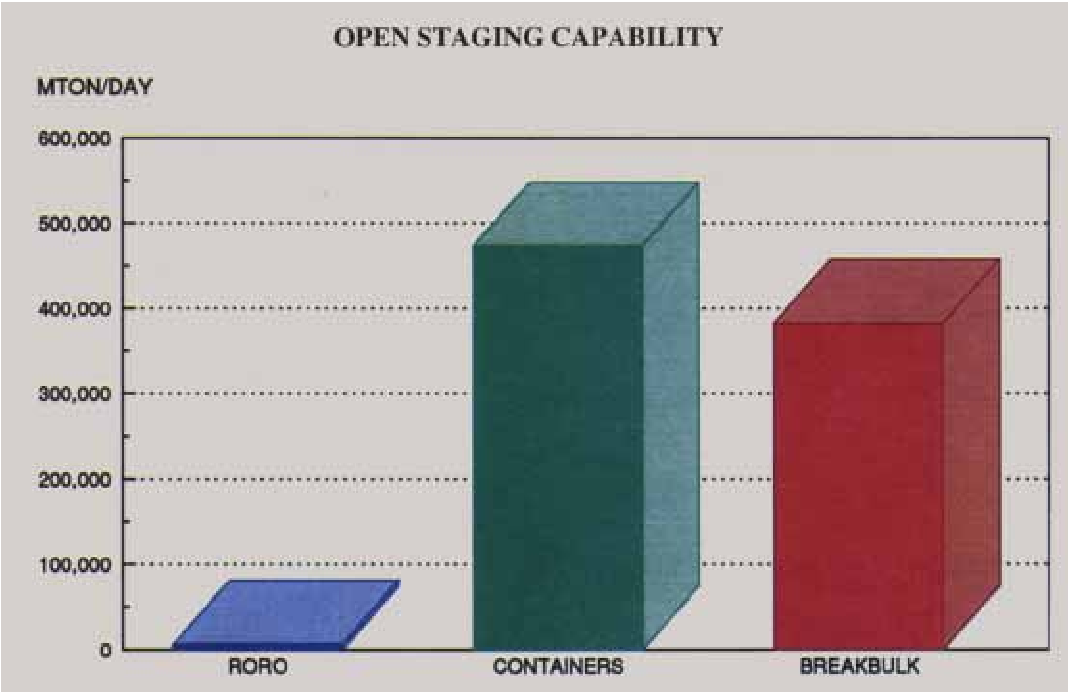
Rail. Rail reception at the Port of Portland is very good with three commercial carriers serving the Portland area. The PTRR performs switching for terminals 1 and 2. The other terminals have reciprocal switching agreements. The port storage tracks could store about 570 railcars. The commercial railyards in the Portland area could store about 4,210 additional railcars. Availability of this storage space varies from 25 to 50 percent for the port yards and 10 to 30 percent for commercial yards. Current rail service to the port (all terminals combined) is about 16 trains per day. The number of cars per train varies from five to sixty 89-foot flatcars to 40 containers-on-flatcars (COFC).

Vehicles on flatcars could offload at two permanent end ramps at terminals 2 and 6 and a light portable end ramp at terminal 4. The light end ramp at terminal 4 is too light for heavy equipment. Because the two permanent end ramps are connected to docks at covered storage facilities, deploying units must exercise care in offloading to avoid hitting posts or other portions of the facility. The end ramp at the SP Brooklyn Yard is too far away from the port to offload tracked equipment. Boxcars could offload at the warehouses where 21 rail handling positions are available. Some of these positions double as truck docks. Containers would offload at any of the container handling facilities.



STAGING

The Port of Portland has about 167.8 acres of open storage for vehicles and/or containers. This acreage has the capability to store about 6,975 MTONs of rolling stock, or 473,555 MTONs of containers, or 382,647 MTONs of breakbulk cargo. Also, 1,002,317 square feet of covered storage provides protection for about 33,525 MTONs of palletized cargo. If a combination cargo mix is expected, then a portion of each involved capability should be assumed.

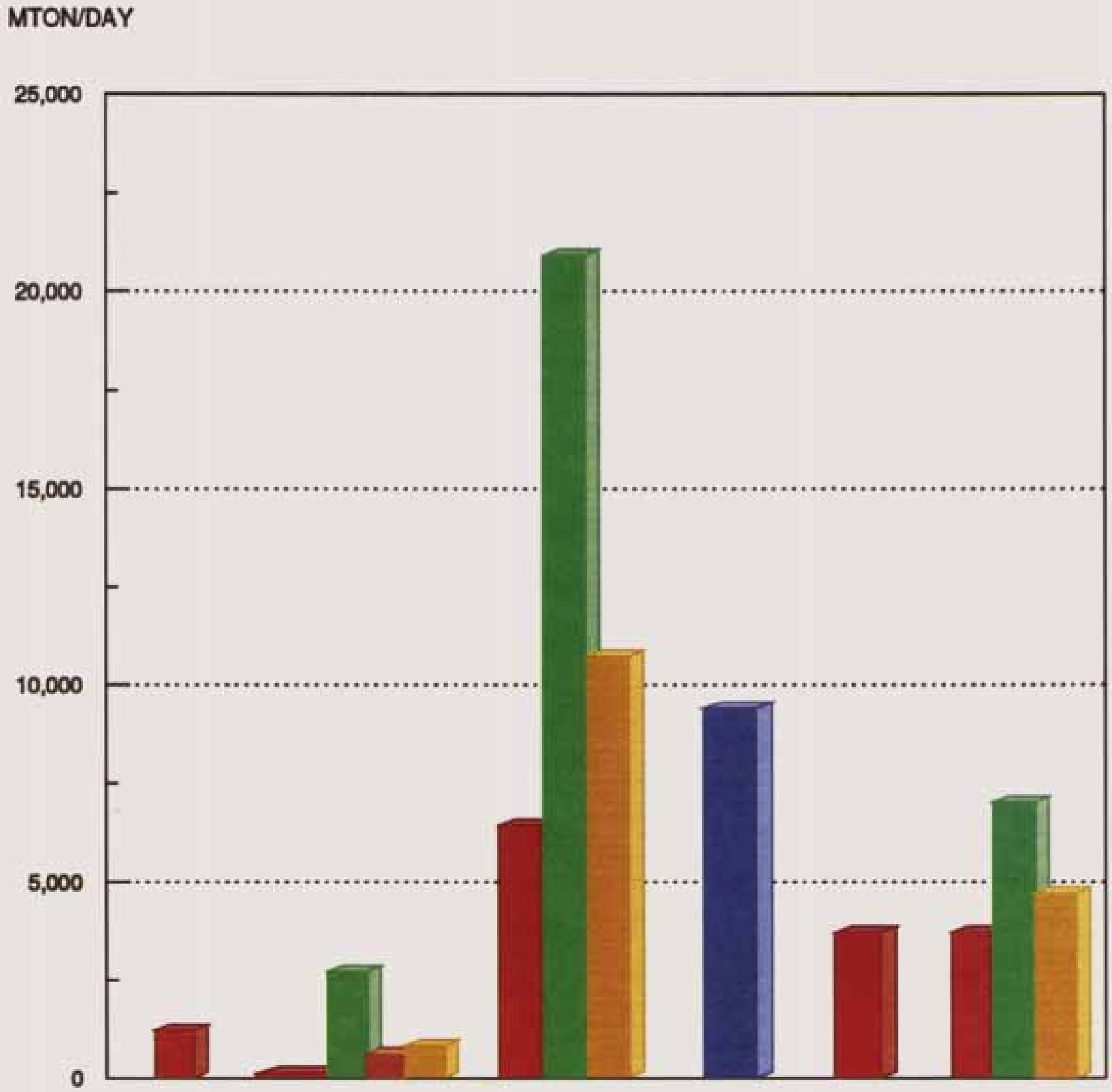


SHIPPING

We identified the throughput capability per berth in MTON per day for breakbulk, RORO, container, and mixed vessels. Various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility provide the basis for these results.

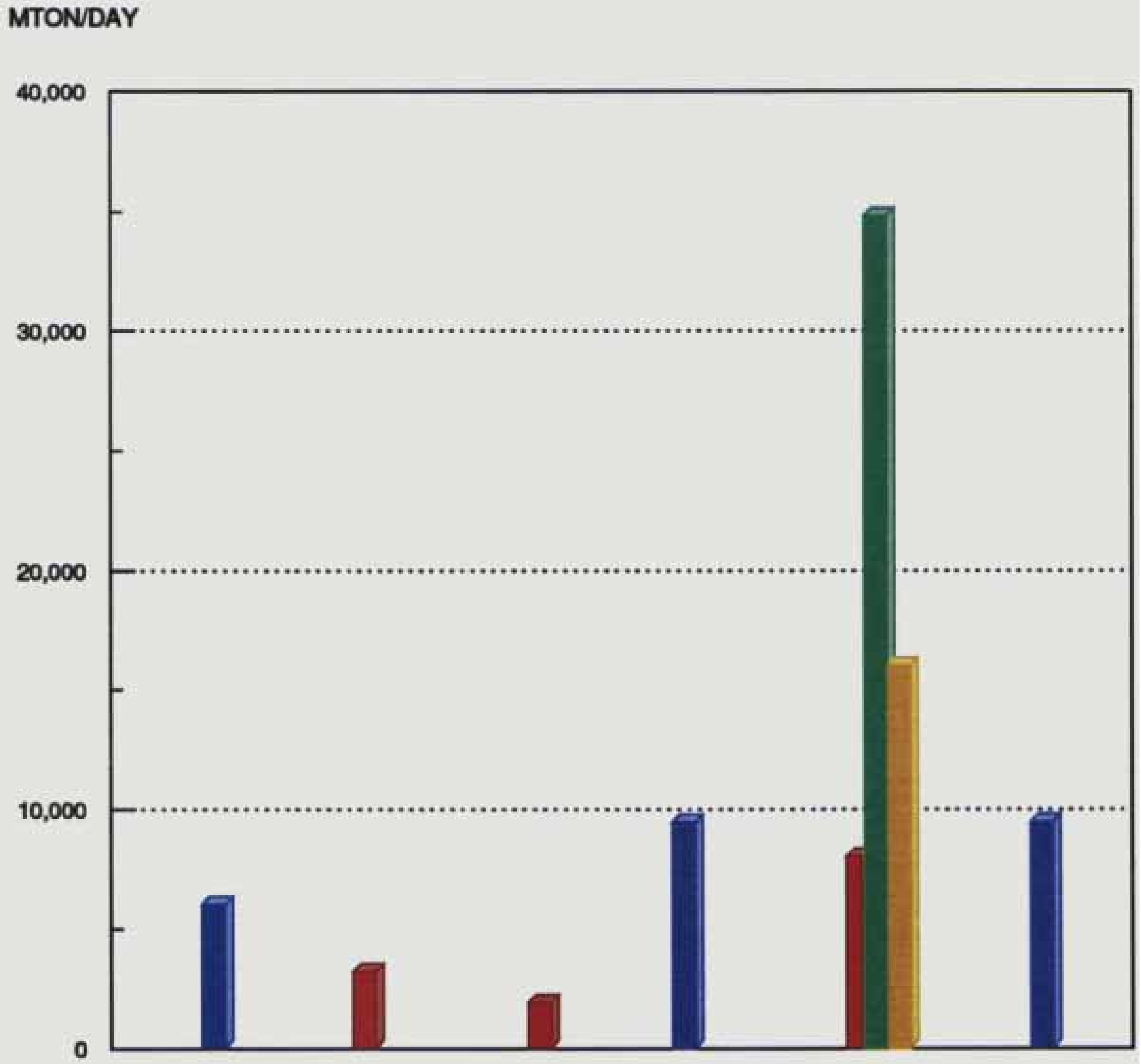
CONVERSION FACTORS		
Breakbulk:	0.4	STON per MTON
RORO:	0.25	STON per MTON
Containers:	0.4	STON per MTON

BERTH THROUGHPUT CAPABILITY



BERTH	101-102	103	203	204-206	204RORO	403-405	406-408
BREAKBULK	1,200	0	100	6,400	0	3,700	3,700
RORO	0	0	0	0	9,400	0	0
CONTAINER	0	0	2,700	20,900	0	0	7,000
BARGE	0	0	600	0	0	0	0
MIXED	1,200	0	800	10,700	9,400	3,700	4,700

BERTH THROUGHPUT CAPABILITY



BERTH	406RORO	410-411	414-415	601RORO	603-605	607RORO
BREAKBULK	0	3,200	1,900	0	8,000	0
RORO	6,000	0	0	9,437	0	9,437
CONTAINER	0	0	0	0	34,800	0
MIXED	0	3,200	1,900	9,437	16,000	9,437

Table 1 shows the compatibility for various vessel types. This table indicates for each type of ship, the number of vessels that can berth at a particular wharf. The table also provides the limitations that can hinder shipping operations.

A methodology that gives a snapshot view of the current physical characteristics of the berths and the MHE available provides the basis for the type of ship preferred at each berth. The evaluation gives no considerations for enhancements, such as equipment.

Terminal 2 berths 204-206 (to include the RORO portion of berth 204) is the best choice for all-around loading operations. Terminal 6 is the best choice for container operations.

PREFERENCE TERMINAL SELECTION

	TERMINALS				
LOADING TYPE	101-102	103	203	204-206	
Breakbulk	2	-	-	1	
RORO	-	-	-	-	
Container	5	-	-	2	
Barge	5	6	4	1	
			TERMINALS		
LOADING TYPE	204 (RORO) (204-206)	403-405	406-408	408 (RORO) (406-408)	
Breakbulk	-	7	4	-	
RORO	1	-	-	4	
Container	-	7	3	-	
Barge	-	9	3	-	
			TERMINALS		
LOADING TYPE	410-411	414-415	601 - (RORO)	603-605	607 (RORO)
Breakbulk	6	5	-	3	-
RORO	-	-	2	-	2
Container	6	4	-	1	-
Barge	7	8	-	2	-

Notes:
1. The numbers refer to the terminal ranking in terms of terminal preference. For example, berth 603-605 has number 1 ranking for container loading. Hence, it is the preferred terminal for these operations.
2. Berths marked with "-" are not recommended for these operations.

TABLE 1
SUMMARY OF BERTHING CAPABILITIES OF PORTLAND 1

VESSEL	BERTHS 101-102	BERTHS 103
Breakbulk		
C3-S-33a	2	a
C3-S-37c	2	a
C3-S-37d	2	a
C3-S-38a	2	a
C4-S-1a	1	a,c
C4-S-1qb and 1u	1	a,c
C4-S-58a	1	a,c
C4-S-65a	1	a,c
C4-S-66a	1	a
C4-S-69b	1	a,c
Seatrain		
GA and PR-class	1	a,c
Barge		
LASH C8-S-81b	1	a,c,f
LASH C9-S-81d	a	a,c
LASH lighter	7	3
SEABEE C8-S-82a	a	a,c
SEABEE barge	5	2
RORO		
Comet	d,i,j	a,d,o
C7-S-95a/Maine-class	i,j	a,b,c
Ponce-class	h	a,b,c,h
Great Land-class	h	a,b,c,h
Cygnus/Pilot-class	i,j	a,b,c
Meteor	d,i,j	a,d,o
AmEagle/Condor	i,j	a,b,c
MV Ambassador	d	c,d
FSS-class	i,j	a,b,c
Cape D-class	i,j	a,b,c
Cape H-class	a	a,b,c
Container		
C6-S-lw	1,e	a,c,e
C7-S-68e	1,e	a,c,e
C8-S-85c	1,e	a,c,e
Combination		
C5-S-78a	1,e	a,c,e
C5-S-37e	1,e	a,c,e

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=inadequate berth depth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o= insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

TABLE 1 - Cont
SUMMARY OF BERTHING CAPABILITIES OF PORTLAND 2

VESSEL	BERTHS		
	203	204-206	204 (RORO)
Breakbulk			
C3-S-33a	a,c	4	
C3-S-37c	a,c	4	
C3-S-37d	a,c	4	
C3-S-38a	a,c	4	
C4-S-1a	a,c	3	
C4-S-1qb and 1u	a,c	3	
C4-S-58a	a,c	3	
C4-S-65a	a,c	3	
C4-S-66a	a,c	4	
C4-S-69b	a,c	3	
Seatrain			
GA and PR-class	a,c	3	
Barge			
LASH C8-S-81b	a,c,f	2	
LASH C9-S-81d	a,c	2	
LASH lighter	2	16	
SEABEE C8-S-82a	a,c	2	
SEABEE barge	2	11	
RORO			
Comet	a,c,d	d,i,j	d,i,j
C7-S-95a/Maine-class	a,c	i,j	1,i
Ponce-class	a,ch	h	h
Great Land-class	a,c,h	h	h
Cygnus/Pilot-class	a,c	i,j	1,i
Meteor	a,c,d	d,i,j	d,i,j
AmEagle/Condor	a,c	i,j	i,j
MV Ambassador	c,d	d	d
FSS-class	a,c	i,j	1,i
Cape D-class	a,c	i,j	i,j
Cape H-class	a,c	i,j	1,i
Container			
C6-S-lw	a,c,e	3	
C7-S-68e	a,c,e	3	
C8-S-85c	a,c,e	2	
Combination			
C5-S-78a	a,c,e	3	
C5-S-37e	a,c,e	3	

a=maximum vessel draft limited to berth depth
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h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

TABLE 1 - Cont
SUMMARY OF BERTHING CAPABILITIES OF PORTLAND 4

VESSEL	BERTHS 403-40	406-408	408(RORO)	410-411	414-415
Breakbulk					
C3-S-33a	2	2		2	1
C3-S-37c	2	2		2	1
C3-S-37d	2	2		2	1
C3-S-38a	2	2		2	1
C4-S-1a	2	2		1	1
C4-S-1qb and 1u	2	2		1	1
C4-S-58a	2	2		1	1
C4-S-65a	2	2		1	1
C4-S-66a	2	2		2	1
C4-S-69b	2	2		1	1
Seatrain					
GA and PR-class	2	2		1	1
Barge					
LASH C8-S-81b	1	1		1	1
LASH C9-S-81d	a	a		1	1
LASH lighter	10	10		8	6
SEABEE C8-S-82a	a	a		1	1
SEABEE barge	7	7		5	4
RORO					
Comet	d,o	d,o	d,i,j	d,o	d,i,j
C7-S-95a/Maine-class	b	b	1	i,j	i,j
Ponce-class	b,h	b,h	h	b,h	h
Great Land-class	b,h	b,h	h	b,h	h
Cygnus/Pilot-class	b	b	1	i,j	i,j
Meteor	d,o	d,o	d,i,j	d,o	d,i,j
AmEagle/Condor	b	b	i,j	i,j	i,j
MV Ambassador	d	d	c,i	d	d
FSS-class	b	b	d	i,j,n	c
Cape D-class	b	b	c	i,j	i,j
Cape H-class	a,b	a,b	a	i,j	i,j
Container					
C6-S-lw	2,e	2		1,e	1,e
C7-S-68e	2,e	1		1,e	1,e
C8-S-85c	1,e	1		1,e	1,e
Combination					
C5-S-78a	2,e	2		1,e	1,e
C5-S-37e	2,e	2		1,e	1,e

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=inadequate berth depth, adequate anchorage depth
g=inadequate channel depth

h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft

TABLE 1 - Cont

SUMMARY OF BERTHING CAPABILITIES OF PORTLAND 6

VESSEL	BERTHS		
	603-605	601 (RORO)	607 (RORO)
Breakbulk			
C3-S-33a	5		
C3-S-37c	5		
C3-S-37d	5		
C3-S-38a	5		
C4-S-1a	5		
C4-S-1qb and 1u	4		
C4-S-58a	4		
C4-S-65a	4		
C4-S-66a	5		
C4-S-69b	4		
Seatrain			
GA and PR-class	4		
Barge			
LASH C8-S-81b	3		
LASH C9-S-81d	3		
LASH lighter	20		
SEABEE C8-S-82a	3		
SEABEE barge	14		
RORO			
Comet	d,i,j	d,i,j	d,i,j
C7-S-95a/Maine-class	i,j	1	1
Ponce-class	h	h	h
Great Land-class	h	h	h
Cygnus/Pilot-class	i,j	1	1
Meteor	d,i,j	d,i,j	d,i,j
AmEagle/Condor	i,j	i,j	i,j
MV Ambassador	d	d	d
FSS-class	i,j	1,n	1,n
Cape D-class	i,j	i,j	i,j
Cape H-class	i,j	a	a
Container			
C6-S-lw	4		
C7-S-68e	3		
C8-S-85c	3		
Combination			
C5-S-78a	4		
C5-S-37e	4		

a=maximum vessel draft limited to berth depth
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c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=inadequate berth depth, adequate anchorage depth
g=inadequate channel depth

h=no shore-based ramps available
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j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o= insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft

III. APPLICATION

GENERAL

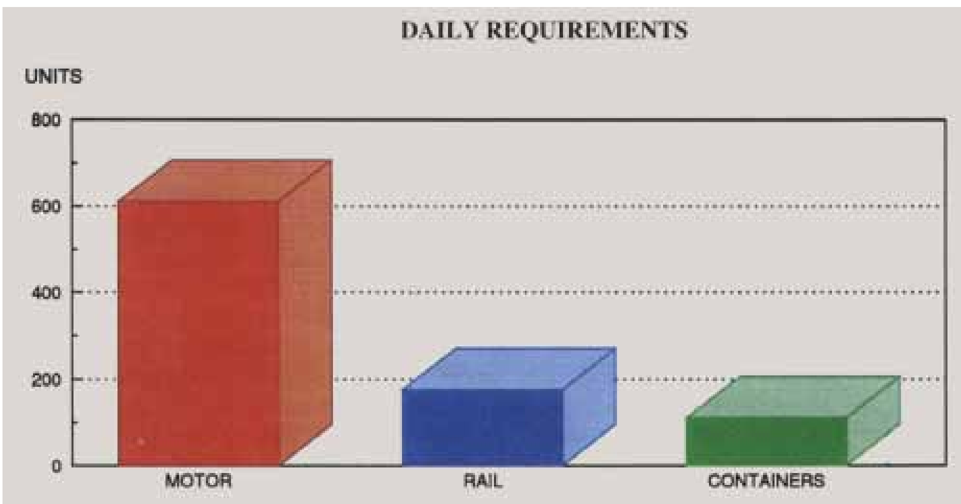
This section of the report will evaluate the throughput capability for deploying a notional mechanized infantry division using primarily FSS vessels. The MARAD Planning Orders Digest does not call for the use of Port of Portland facilities during national emergencies. Therefore, the analysis will use only those berths and accompanying facilities that can accommodate an FSS. These facilities include berths 204-206 of terminal 2, berths 414-415 of terminal 4, and berths 603-605 of terminal 6 (see figs 3 through 5 to locate these facilities).

REQUIREMENTS

The most likely requirement for the Port of Portland is to deploy a notional mechanized infantry division in 6 days. The division has to move about 7,800 vehicles and 660 containers. The movement of this division to the port will require 1,055 (176 per day) railcars using a convoy/rail option. Under this option, the deploying units would drive about 3,650 (610 per day) roadable vehicles and tow another 2,320 (387 per day) pieces of equipment.

MECHANIZED INFANTRY DIVISION DEPLOYMENT DATA

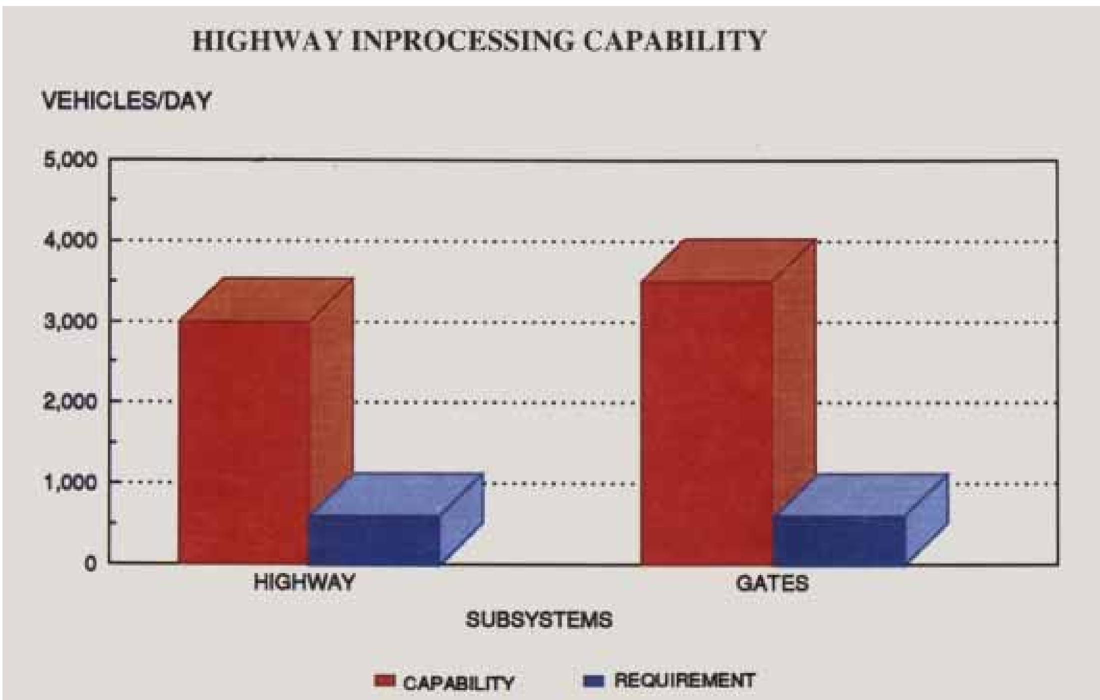
Total Equipment	
Volume	274,518 MTON
Weight	95,010 STON
Area	1,422,844 SQ FT
Vehicles	7,800
Containers	660



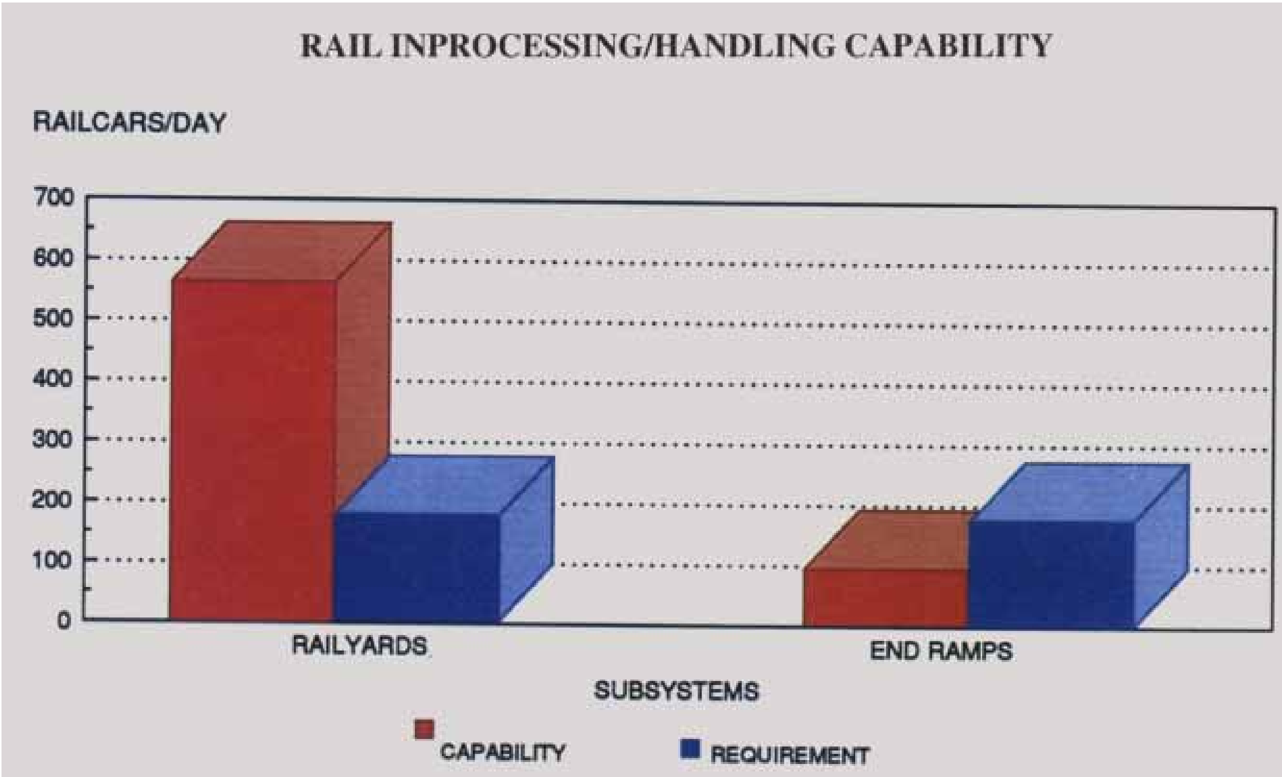
TERMINAL INPROCESSING/HANDLING

Highway. Vehicles would access the Port of Portland using I-5 and North Marine Drive for terminal 6; I-5, North Columbia Boulevard, N Burgard Street, and North Lombard Street for terminal 4; and I-5 and -405, Northwest Yeon and Northwest Front Avenues for terminals 1 and 2. Each terminal has at least one gate providing access to the wharf areas.

We estimate (based on existing traffic volume) that the access roads to the four terminals can handle an additional 3,000 vehicles per day. Also, the terminal gates can handle an additional 3,500 vehicles per day.

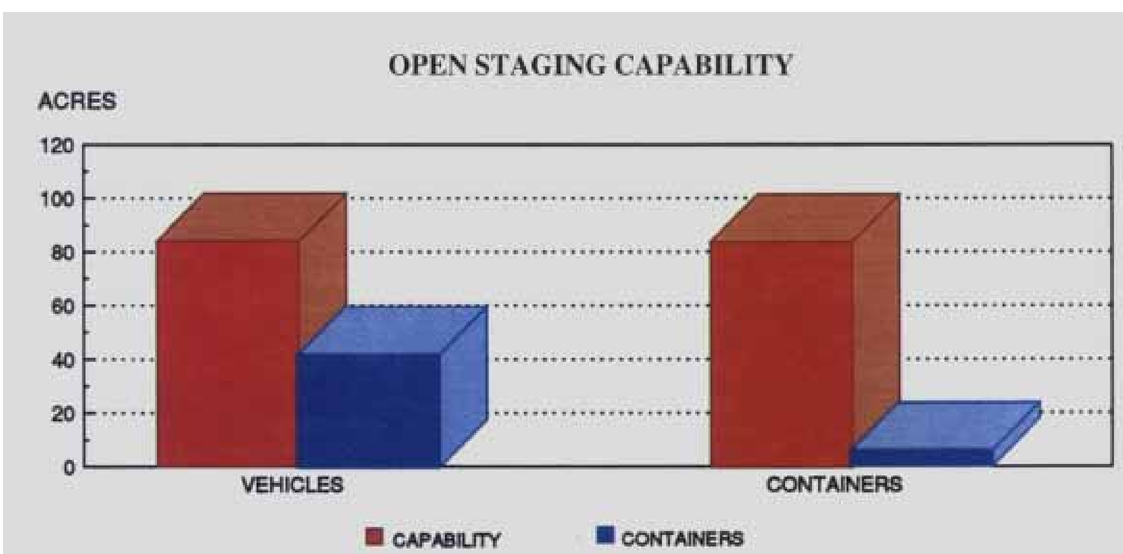


Rail. The classification yards on and off port have a combined total of about 4,780 railcars per day. However, about 25 to 50 percent of the port railyards capacity and only 10 to 30 percent of the commercial railyards capacity would normally be available for military use. This means that normal daily storage would be about 563 railcars per day. With the three available end ramps at the port, stevedores or military personnel could offload about 23 railcars every 5 hours. This equates to 92 railcars per day. We assumed that lighter vehicles will offload at the light portable end ramp at terminal 4 and the heavy vehicles will offload at terminals 2 and 6. At least one additional portable heavy-duty end ramp at terminals 2, 4, and 6 will allow the port to more adequately meet rail reception requirements. The portable end ramp at terminal 4 is too light for offloading heavy equipment. Deploying units must exercise caution in using the permanent end ramps at terminals 2 and 6. These end ramps are part of the rail/truck docks for the warehouses they serve. Heavy military equipment could damage the buildings and/or dock areas at these ramps.



STAGING

The Port of Portland has almost 168 acres of open staging available. We estimate that a mechanized infantry division needs about 48 acres of open staging to support the concurrent sustained loading of three FSS vessels. Divided between vehicles and containers, the staging area requirement becomes 42 and 6 acres for vehicles and containers, respectively.



SHIPPING

The number of ships needed to load this requirement depends on the shipping mix selected. The best ship mix would require all eight FSS's and two Cape H RORO ships. Berths 204-206 (2), 406-408 (1), 414-415 (1), and 603-605 (2) combined can accomodate six FSS vessels. Assuming 2 days to load a ship, a division can outload within the 6-day requirement from the Port of Portland.

UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

LOADING CONDITION/ SAMPLE SHIP MIX	VESSEL TYPES			
	FSS (RORO/COMB)	CAPE H (RORO/COMB)	C3/C4 (BREAKBULK)	C6/C7/C8 (CONTAINER)
Minimum Containerization				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization				
FSS and Container	7.90			2.00
FSS,Cape H, and Container	4.62	3.00		2.00
Breakbulk and Container			29.58	2.00

*Only 8 FSSs are available. Unit shipping requirements exceed the capacity of these 8 vessels, Other vessel types are required to make up the FSS shortfall (Cape H).

Legend:

RORO - roll on/roll off

FSS - fast sealift ship

Source: *MTMCTEA Report OA 90-4f-22, Deployment Planning Guide, Aug 91*.

SUMMARY

Terminal 2 is the preferred terminal of use for deployment because it is the best for all-around operations and has the best RORO shipping capability. Terminal 6 is the preferred terminal for container shipments because it has the most modern facilities, is the easiest to access by highway, and is the most compatible for containerized shipments.

The Port of Portland can outload a mechanized infantry division within the 6-day outloading requirement. This conclusion is contingent upon procurement of at least three (one for each terminal) portable heavy-duty end ramps to complement end ramps already at the port.

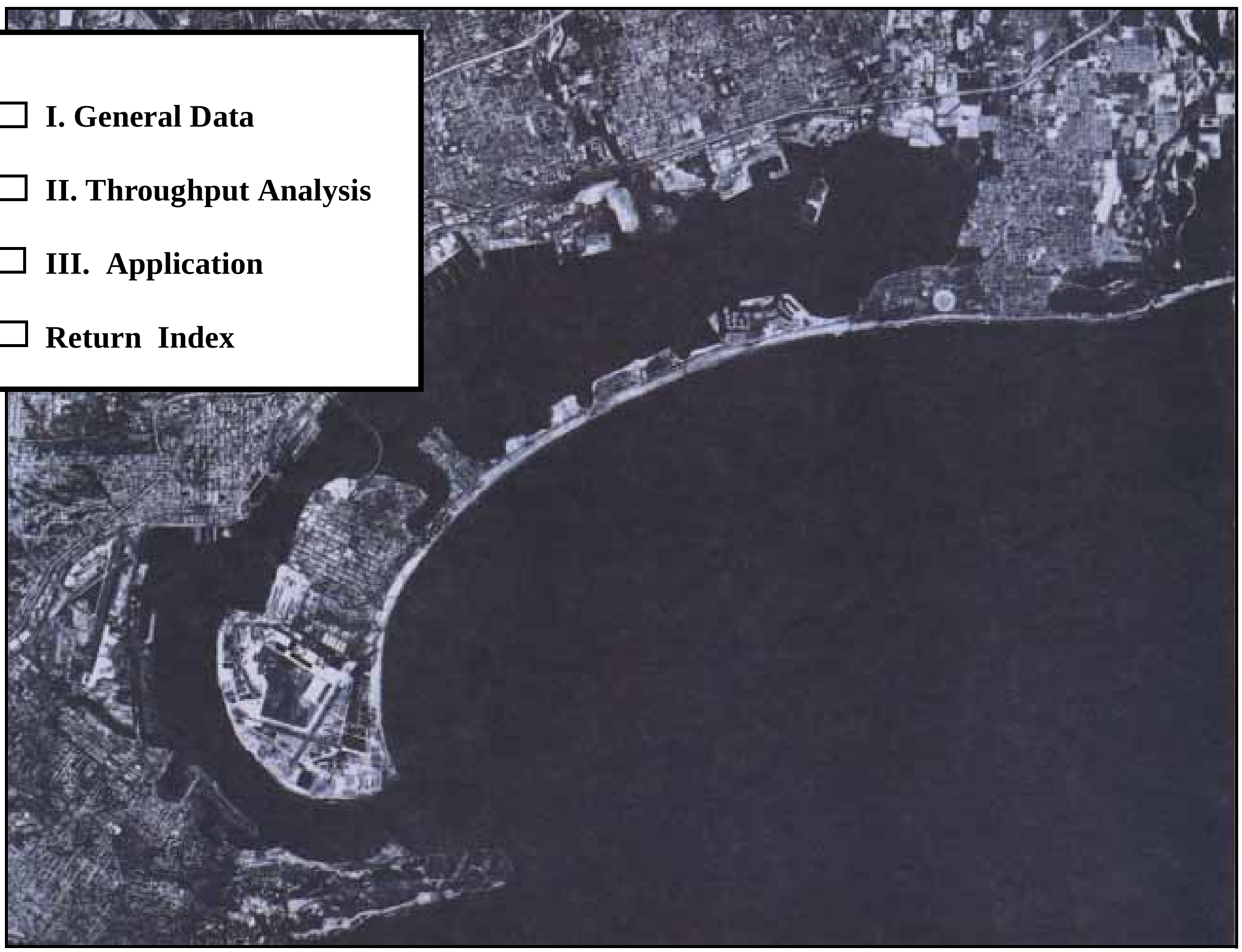
RECOMMENDATIONS

We recommend that the Port of Portland obtains at least three heavy-duty portable end ramps to more adequately meet rail reception requirements and allow flexibility in offloading heavy equipment from both railcars and semitrailers. If desired, the port may construct these end ramps in lieu of purchasing them.

September 94

PORT OF SAN DEIGO

SAN DEIGO, CALIFORNIA



I. GENERAL DATA

TRANSPORTATION ACCESS

Water

This report evaluates two terminals at the Port of San Diego - Tenth Avenue Marine Terminal and National City Marine Terminal. Both terminals are suitable for military operations and may be available if such a need arises. The water access map below shows these terminals.

The Port of San Diego, California, is just north of the Mexican border. The entrance to the channel is 43 feet deep at mean low water (MLW). The channel continues past the two terminals at depths of at least 35 feet. One bridge crosses the channel before a ship can access National City Terminal.

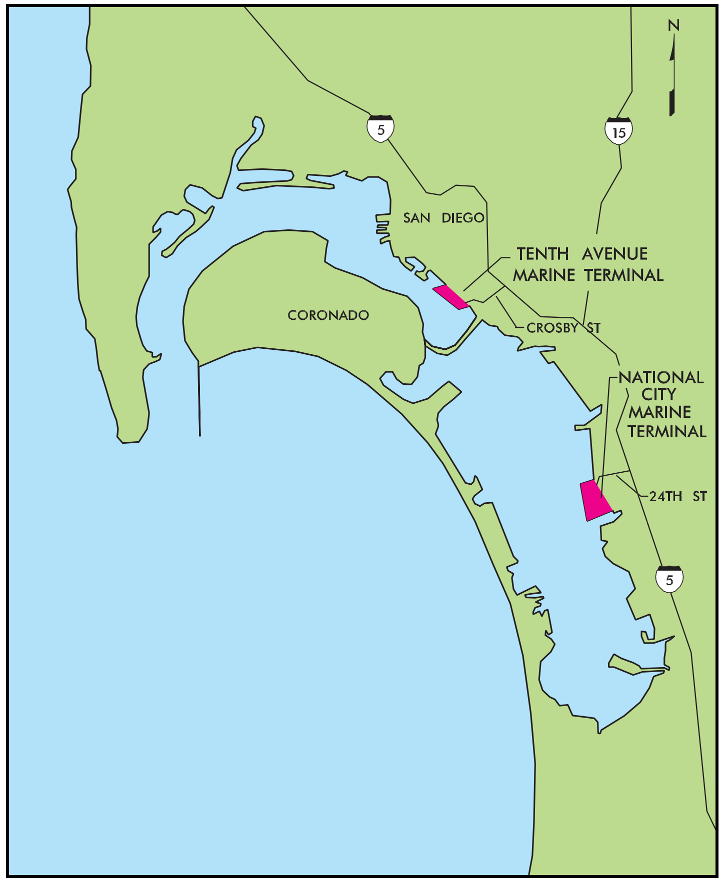
The Coronado Bay Bridge is 195 feet above the water at mean high water (MHW). The channel widens at each of the two terminals to allow ships to turn. The tidal variation is 4.1 feet.

Water Access

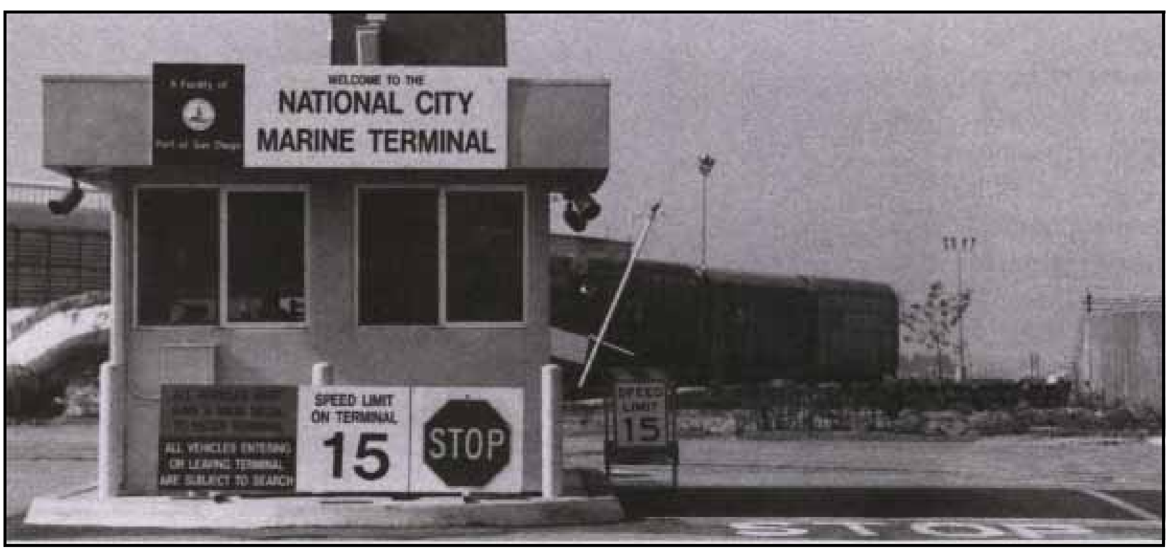
Highway

Heavy highway congestion usually prevails in the San Diego area. Both terminals have access to Interstate Route 5, which is less than 2 miles to the east.

Crosby Street Gate to 10th Avenue Terminal



Highway Access



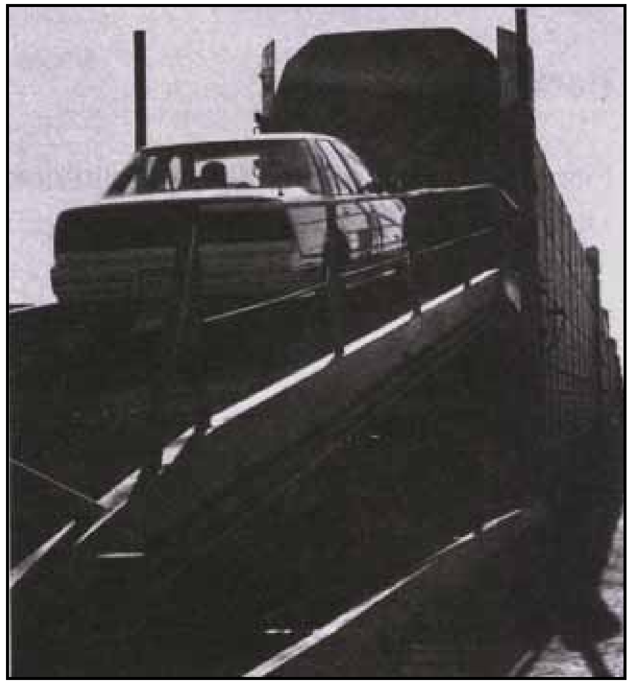
Gate to National City Terminal

Rail

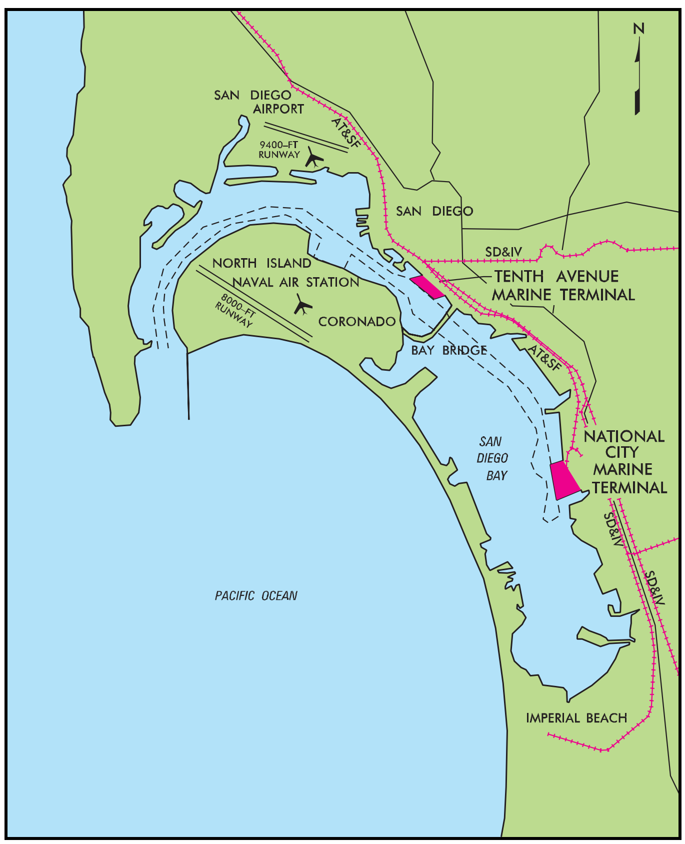
The Atchison, Topeka, and Santa Fe (AT&SF) is the only major railroad that serves the Port of San Diego. The local rail line is the San Diego and Imperial Valley Railway (SDIV). The port and nearby private railyards can store about 500 89-foot railcars. Most of this capacity is at 10th Avenue Marine Terminal.

Air

San Diego International Airport Lindbergh Field is northwest of 10th Avenue Terminal. North Island Naval Air Station is west of 10th Avenue Terminal, across the Coronado Bay Bridge. Both airports are about 5 miles away.



Bilevel POV Loading at the National City Terminal



Rail and Air Access

PORT FACILITIES

Berthing

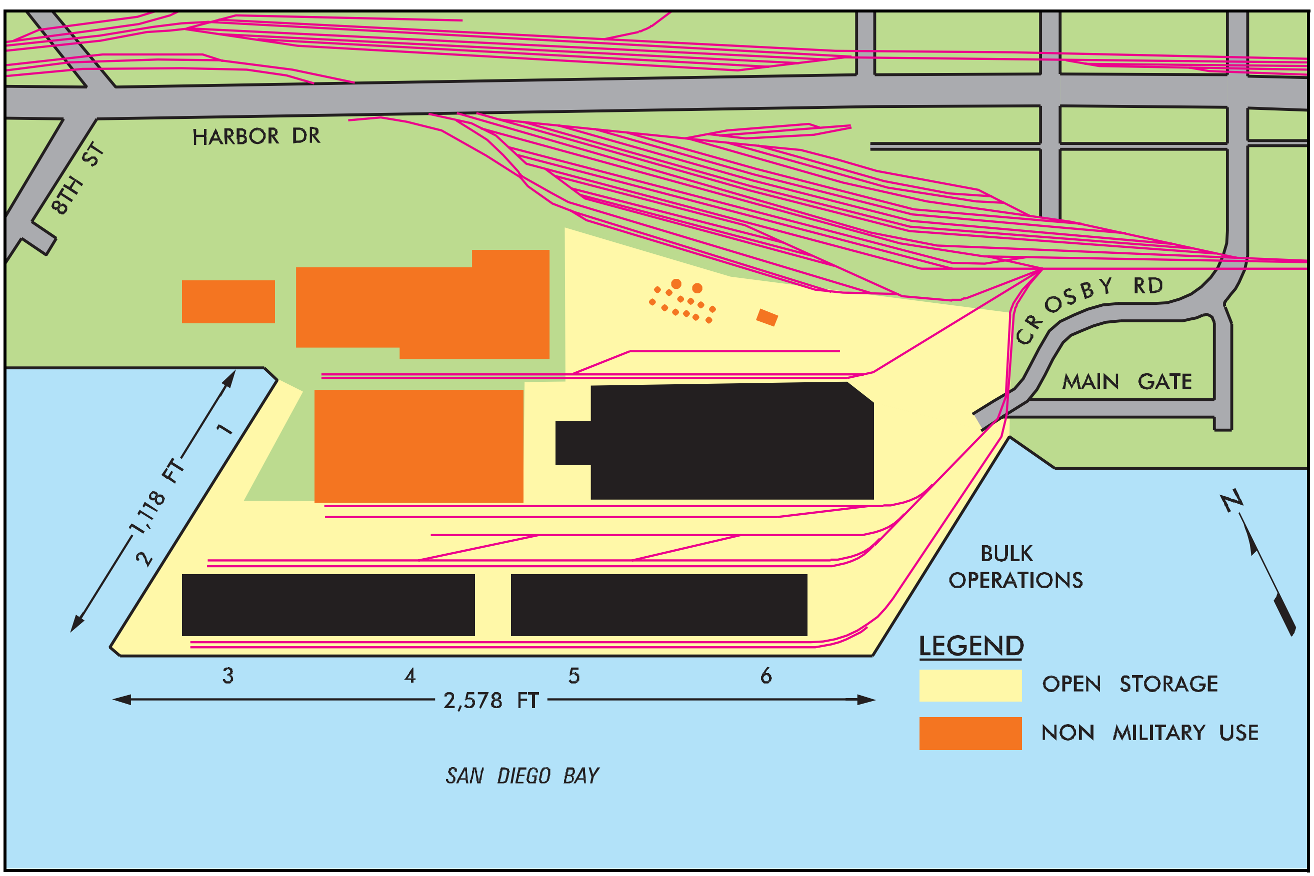
Pier construction is generally concrete piles, fronting a concrete bulkhead. Fendering is generally timber or rubber, and the surface is either asphalt or concrete. Both terminals have lighting for night operations and increased security.

TERMINAL OPERATIONS

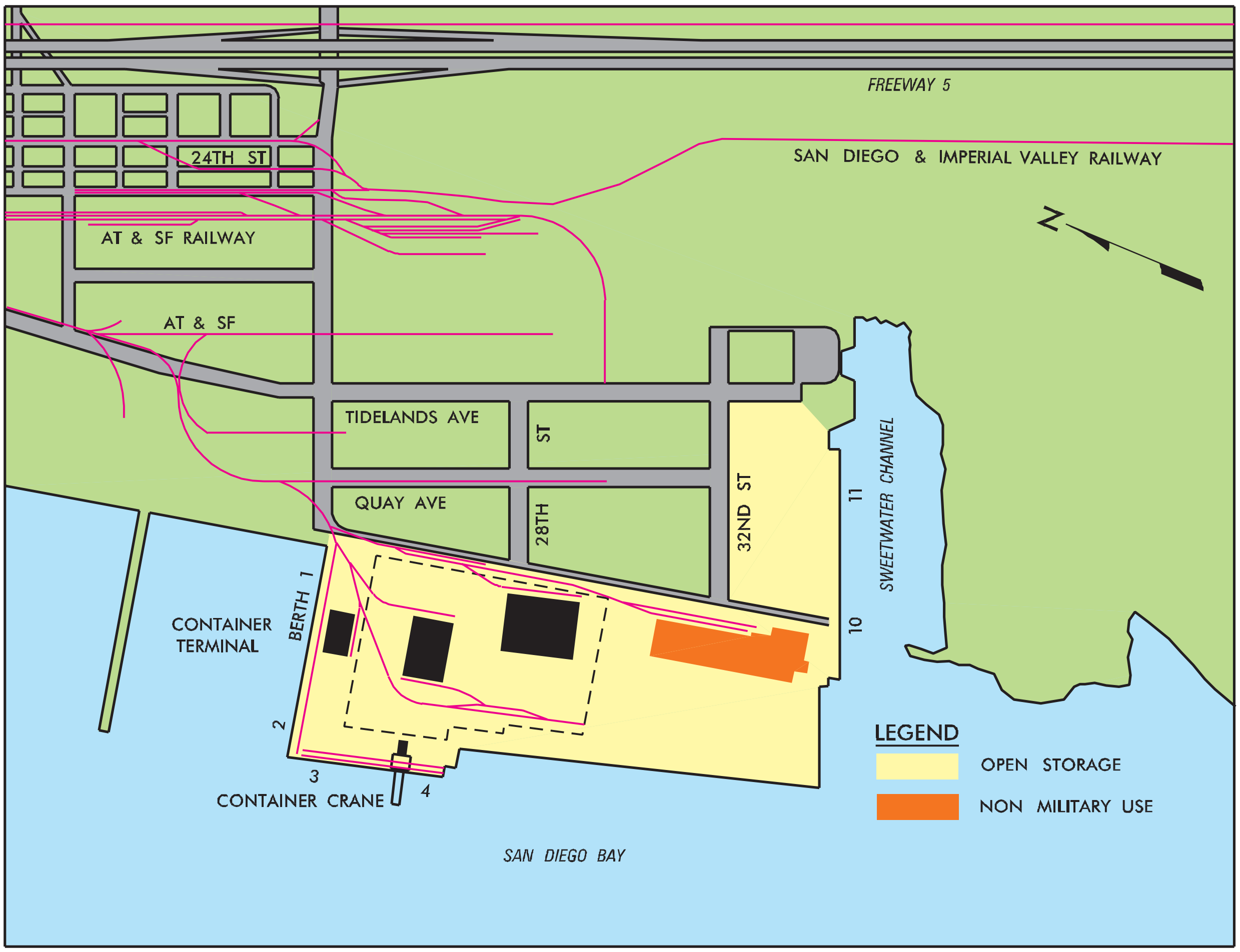
TERMINAL	USE
10th Ave	Breakbulk and bulk
National City	Containers and POV
Legend: POV - privately owned vehicles	

The gates at both terminals are manned 24 hours by port police officers. Both terminals are fenced with 8-foot-high chain link and barbed wire above. The police force includes 125 sworn officers.

Below are land-use maps of the two terminals. Figures 1 and 2 are aerial views of the terminals. They include tables identifying the berth characteristics.



10th Avenue Marine Terminal



National City Marine Terminal

BERTH CHARACTERISTICS OF
TENTH AVENUE TERMINAL

	BERTHS	
CHARACTERISTICS	**1-2**	**3-6**
Length (ft)	1,118	2,578
Depth alongside at MLW (ft)	31	35
Deck strength (psf)	1,000	600
Apron width (ft)	Open	Open
Apron height above MLW (ft)	12	12
Number of container cranes	0	0
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straight-stern RORO facilities	No	No
Apron length served by rail (ft)	0	2,578

Figure 1. Aerial view of 10th Avenue Terminal

BERTH CHARACTERISTICS OF NATIONAL CITY TERMINAL

CHARACTERISTICS	BERTHS 2	BERTHS 3-4	BERTHS 10-11
Length (ft)	720	1,000	1,500
Depth alongside at MLW (ft)	35	35	35
Deck strength (psf)	1,000	1,000	1,000
Apron width (ft)	Open	Open	Open
Apron height above MLW (ft)	12	12	12
Number of container cranes	0	1	0
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No
Apron length served by rail (ft)	0	0	0

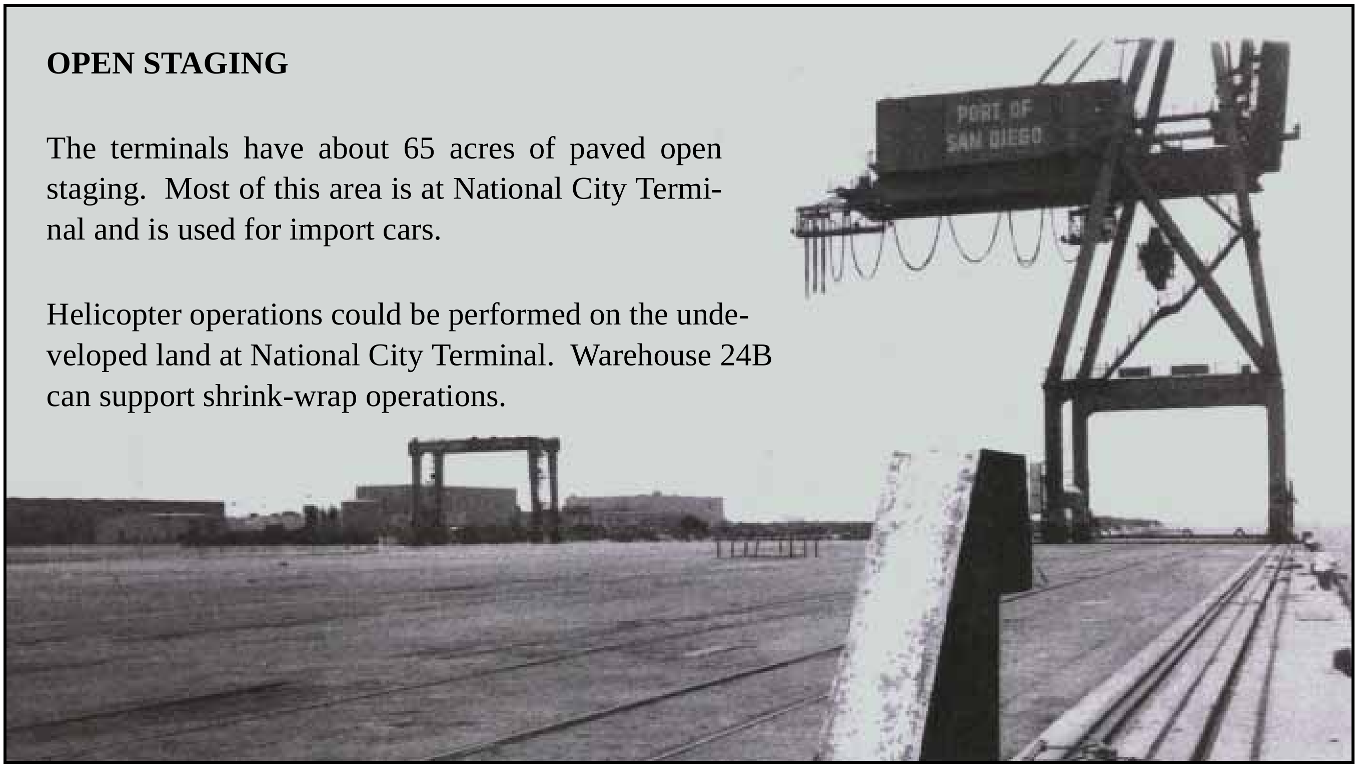
Figure 2. Aerial view of National City Terminal

Staging

OPEN STAGING

The terminals have about 65 acres of paved open staging. Most of this area is at National City Terminal and is used for import cars.

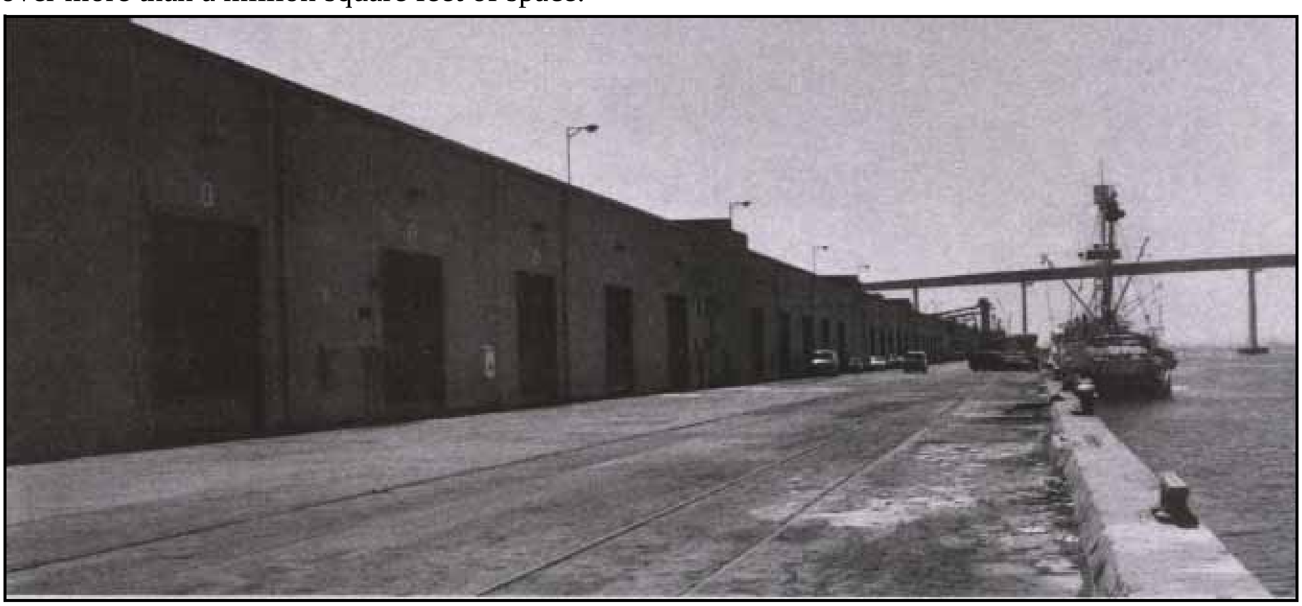
Helicopter operations could be performed on the undeveloped land at National City Terminal. Warehouse 24B can support shrink-wrap operations.



Paved Open Storage at National City Terminal Berth 3-4 (Southward View)

COVERED STAGING

Each terminal has three covered storage buildings that could support military operations. The three buildings at 10th Avenue Terminal are much larger than those at National City Terminal. These six sheds cover more than a million square feet of space.



Covered Storage at 10th Avenue Terminal Berth 3-6 (Southeastward View)

Rail

Railyards on or near the terminals can store about 500 89-foot railcars. Most of this capability is at the 10th Avenue Terminal.

An automobile importer routinely performs bilevel operations at National City Terminal.

The port has no clearance problems.

APRON TRACKS

TERMINAL	BERTH
10th Ave	3-4
National City	2

PRIVATELY OWNED TRUCK SCALES

TERMINAL	SCALES
10th Ave	3
National City	1

Unloading/Loading Positions

RAMPS

Neither terminal has permanent rail or truck end ramps. Several locations exist that could support offloading with temporary or portable end ramps. Some locations block van and boxcar handling stations.

DOCKS

All six covered storage buildings have truck handling positions and platform-level tracks for boxcar operations. These tracks can handle about 65 boxcars.

Marshaling Areas

WITHIN PORT

No marshaling areas are available within the port area. All open areas within the port are required for staging military or commercial cargo.

OFFSITE

San Diego is highly developed. No areas are near the port that could support marshaling. If deploying units need offsite marshaling, they should consider Naval Air Station, Miramar, about 15 miles north of the port. ATSF has a rail spur at the northern edge of the air station. It can support offloading of about 15 railcars.

MATERIALS HANDLING EQUIPMENT (MHE)

The port's only container crane is at berth 3-4 of National City Terminal. National City Terminal also has a transtainer to support container operations. Additional MHE and container handling equipment are available from local rental and stevedore companies. Equipment can also come from the Los Angeles area.

Forklift

Container Crane at National City Terminal

INTERMODAL FACILITIES

ATSF has intermodal railyards just outside 10th Avenue and National City Terminals. Other larger, intermodal railyards are in the Los Angeles or San Bernadino areas.

ATSF INTERMODAL YARD AT 10TH AVENUE TERMINAL

Storage	240 spots
MHE	1 transtainer
Throughput	100 lifts per day

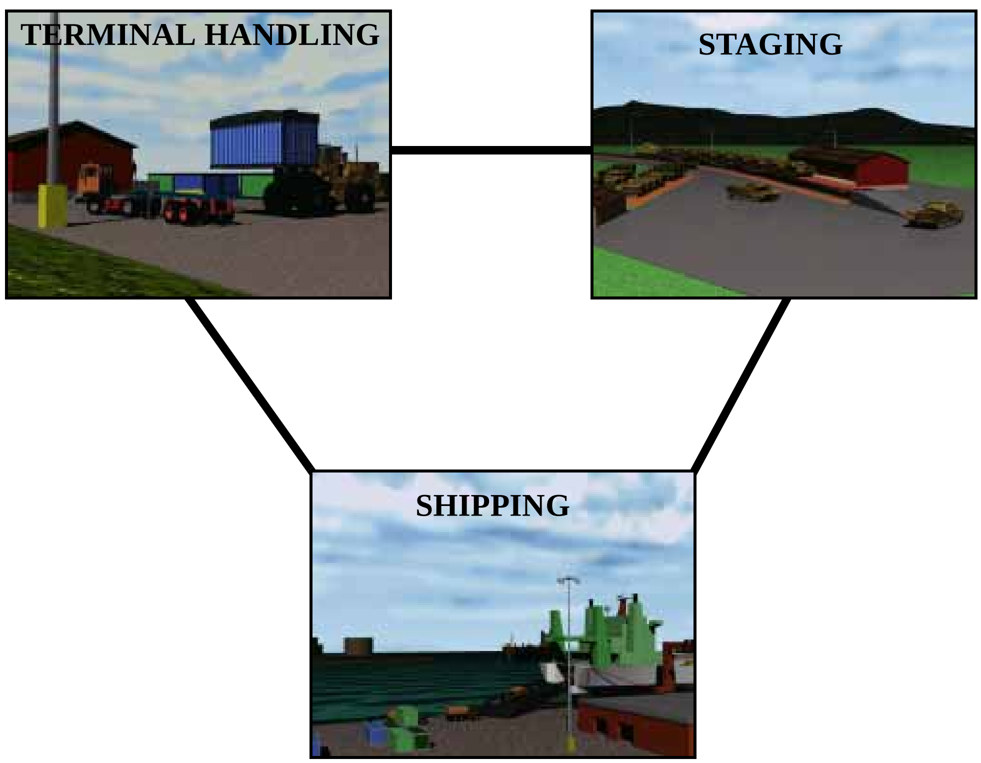
FUTURE DEVELOPMENT

The Port of San Diego expects to develop the 20 acres of unimproved land at National City Terminal. This area will be used for staging import POVs. The development might include an additional 500 feet of wharfage. No estimate of completion is available.

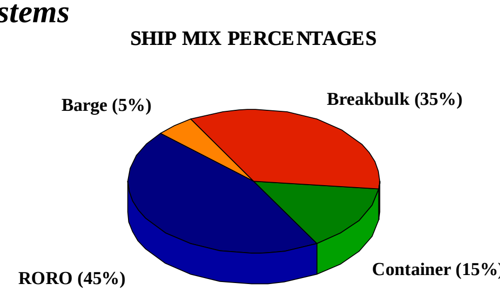
II. THROUGHPUT ANALYSIS

GENERAL

Using the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of San Diego. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in measurement tons (MTON) per day.



Terminal Throughput Subsystems



The analysis assumes that 80 percent of the port facilities will support military deployments. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.

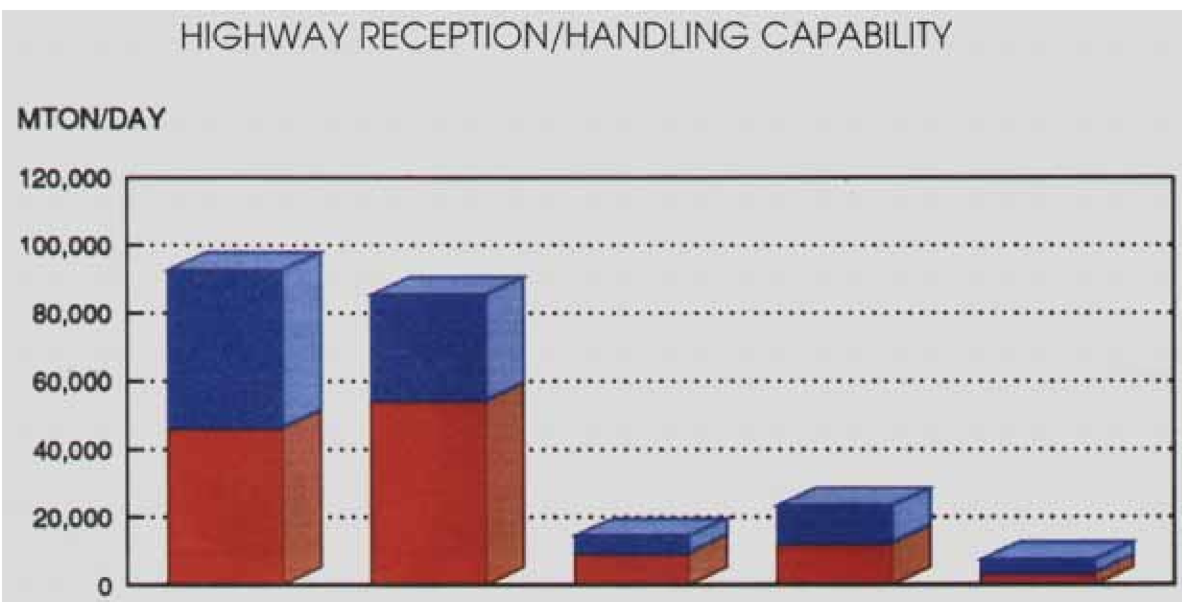
RECEPTION AND HANDLING

Highway

Interstate 5 provides access to both terminals. Each terminal has a designated entrance for trucks. The roads and gates leading into the terminals limit the highway reception to about 77,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable ramps. Neither terminal has permanent truck end ramps. Our analysis assumes one portable ramp is available at each terminal. These ramps could offload about 14,000 MTON of equipment from flatbed trailers per day.

Supplies in van semitrailers will proceed to the 52 van handling positions. These docks can offload about 23,000 MTON of van semitrailer-shipped materials per day. Containers on chassis will move to the staging areas. Two container handlers (one at each terminal) can offload about 7,400 MTON of cargo from chassis per day.



SUBSYSTEMS	HIGHWAY	GATES	END RAMPS*	DOCKS	CONTAINERS
10TH AVENUE	46,400	54,300	9,600	12,500	3,700
NATIONAL CITY	46,400	31,100	4,800	10,800	3,700

*TWO PORTABLE END RAMPS ARE ASSUMED AVAILABLE

Rail

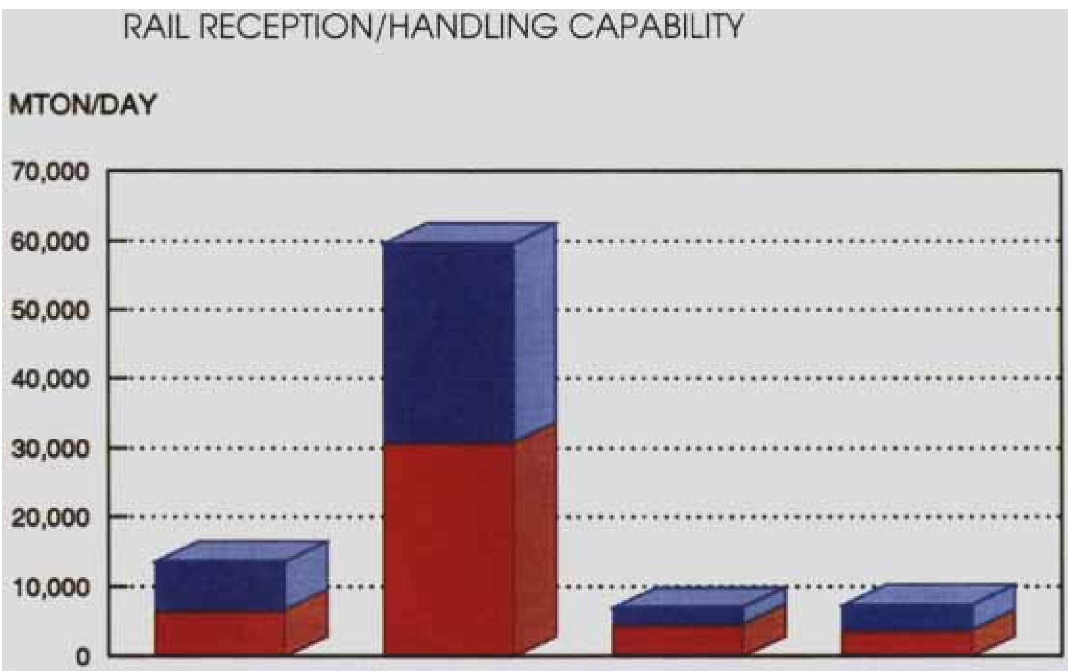
Only one major rail line serves the Port of San Diego. Railyards at or near the two terminals can hold about 500 railcars.

For this analysis, we assumed the ports or units can rent, build, or provide six portable rail end ramps. We also assumed one container handler will operate at each terminal.

Boxcars could offload at either terminal. The two terminals have about 65 boxcar handling positions.

RAIL DELIVERY

TERMINAL	TRAIN LENGTH	TRAINS PER DAY
10th Avenue	60	1
National City	60	1



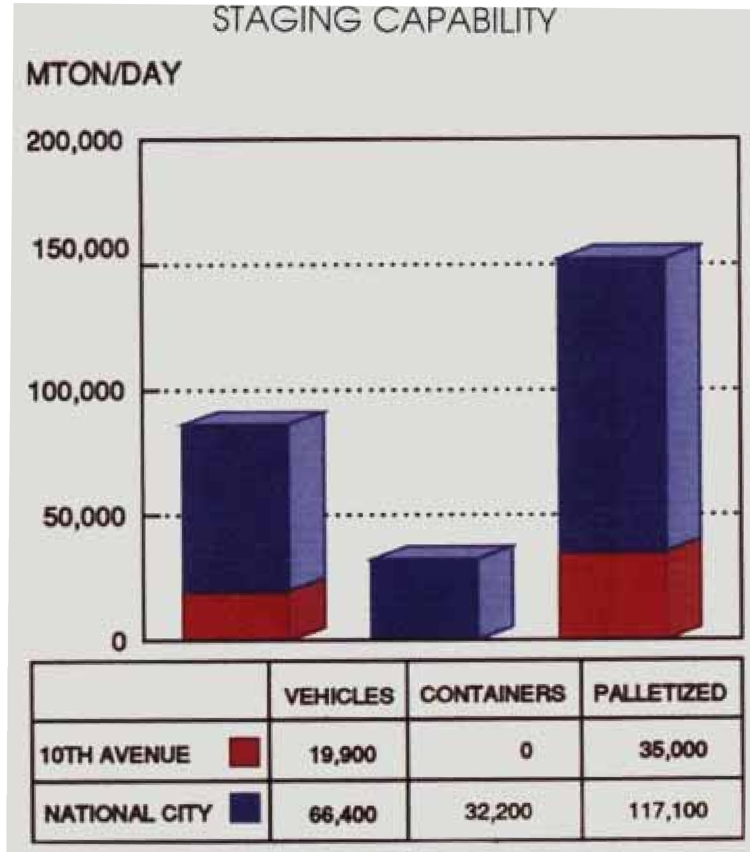
SUBSYSTEMS	TRACKAGE	END RAMPS*	DOCKS	COFC
10TH AVENUE	6,700	30,800	4,600	3,700
NATIONAL CITY	6,900	28,800	2,400	3,700

*SIX PORTABLE END RAMPS ARE ASSUMED AVAILABLE

STAGING

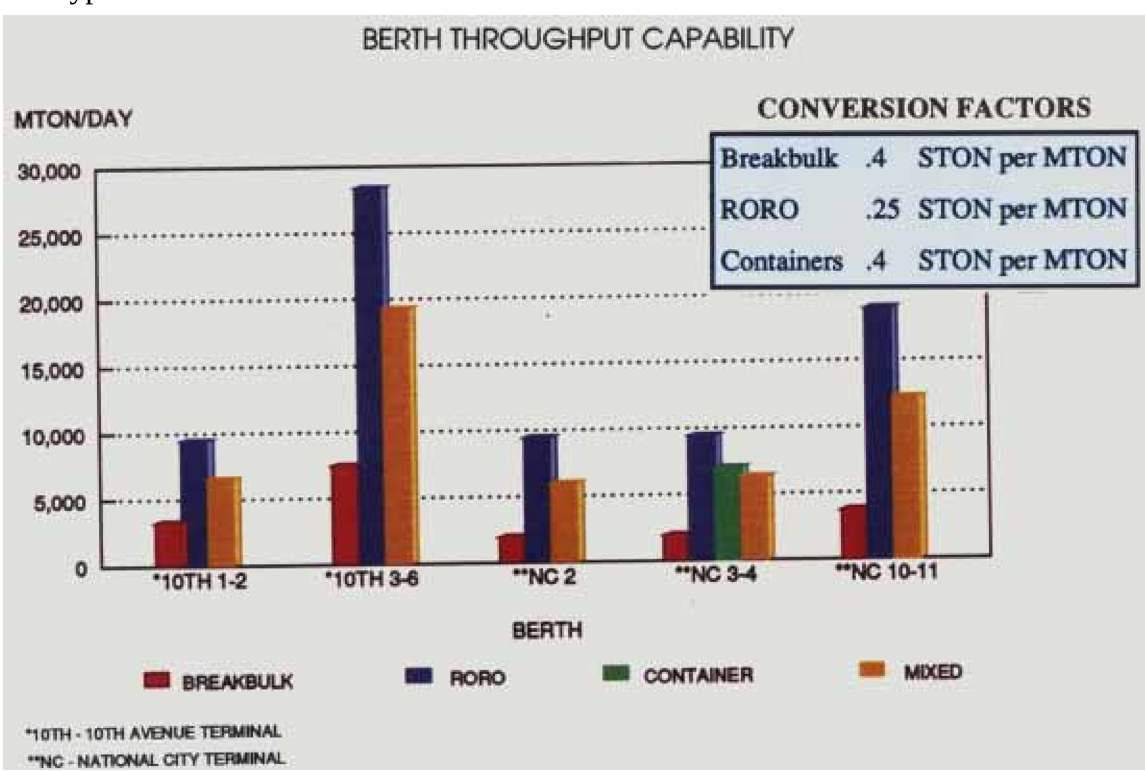
Together, the terminals have about 56 acres of paved open staging that could support military operations. Most of it is at the National City Terminal.

Together, the terminals have more than a million square feet of covered storage. Most of it is at the 10th Avenue Terminal.



SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types.



The type of ship preferred at each berth is based on the methodology described in the appendix. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation on the next page gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suited for the loading operation.

PREFERENCE BERTH SELECTION

BERTH	BB	RORO	CONT
10th Avenue Terminal			
1-2	5	4	-
3-6	1	1	-
National City Terminal			
2	2	3	-
3-4	3	3	1
10-11	4	1	-
Legend: BB - Breakbulk RORO - Roll on/roll off Cont - Container			

SUMMARY OF BERTHING CAPABILITIES OF TENTH AVENUE TERMINAL

VESSEL	BERTH 1-2	BERTH 3-4
Breakbulk		
C3-S-33a	2	5
C3-S-37c	a	4
C3-S-37d	2	4
C3-S-37a	2	4
C4-S-1a	1	4
C4-S-1qb and 1u	a	4
C4-S-58a	1	4
C4-S-65a	1	4
C4-S-66a	a	4
C4-S-69b	a	4
Seatrain		
GA and PR-class	1	4
Barge		
LASH C8-S-81b	a,f	3
LASH C9-S-81d	a	a
LASH lighter	7	18
SEABEE C8-S-82a	a	a
SEABEE barge	5	12
RORO		
Comet	d,i,j	d,o
C7-S-95a/Maine-class	a	3
Ponce-class	h	b,h
Great Land-class	h	b,h
Cygnus/Pilot-class	1	3
Meteor	d,i,j	d,o
AmEagle/Condor	i,j	i,j
MV Ambassador	d	d
FSS-class	a	2,n
Cape D-class	a	i,j
Cape H-class	a	a
Container		
C6-S-lw	1,e	3,e
C7-S-68e	a,e	3,e
C8-S-85c	a,e	3,e
Combination		
C5-S-78a	a,e	4,e
C5-S-37e	1,e	4,e

a = maximum vessel draft limited to berth depth
b = inadequate apron width
c = inadequate berth length
d = no straight stern-ramp facilities
e = no container-handling equipment
f = inadequate berth depth, adequate anchorage depth
g = inadequate channel depth

h = no shore-based ramps available
i = insufficient ramp clearance at low tide
j = insufficient ramp clearance at high tide
k = excessive ramp angle at low tide
m = execessive ramp angle at high tide
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

Notes: Ramp clearance and ramp angle based on maximum vessel draft.

SUMMARY OF BERTHING CAPABILITIES OF NATIONAL CITY TERMINAL

VESSEL	BERTHS 2	BERTHS 3-4	BERTHS 10-11
Breakbulk			
C3-S-33a	1	1	2
C3-S-37c	1	1	2
C3-S-37d	1	1	2
C3-S-37a	1	1	2
C4-S-1a	1	1	2
C4-S-1qb and 1u	1	1	2
C4-S-58a	1	1	2
C4-S-65a	1	1	2
C4-S-66a	1	1	2
C4-S-69b	1	1	2
Seatrain			
GA and PR-class	1	1	2
Barge			
LASH C8-S-81b	c	1	1
LASH C9-S-81d	a,c	a	a
LASH lighter	5	7	10
SEABEE C8-S-82a	a,c	a	a
SEABEE barge	3	5	7
RORO			
Comet	d,i,j	d,i,j	d,i,j
C7-S-95a/Maine-class	c	1	1
Ponce-class	h	h	h
Great Land-class	c,h	h	h
Cygnus/Pilot-class	1	1	2
Meteor	d,i,j	d,i,j	d,i,j
AmEagle/Condor	i,j	i,j	i,j
MV Ambassador	d	d	d
FSS-class	c	1	1
Cape D-class	i,j	i,j	i,j
Cape H-class	a,c	1	1
Container			
C6-S-lw	1,e	1	2,e
C7-S-68e	1,e	1	2,e
C8-S-85c	c,e	1	1,e
Combination			
C5-S-78a	1,e	1	2,e
C5-S-37e	1,e	1	2,e

a = maximum vessel draft limited to berth depth
b = inadequate apron width
c = inadequate berth length
d = no straight stern-ramp facilities
e = no container-handling equipment
f = inadequate berth depth, adequate anchorage depth
g = inadequate channel depth

h = no shore-based ramps available
i = insufficient ramp clearance at low tide
j = insufficient ramp clearance at high tide
k = excessive ramp angle at low tide
m = exececessive ramp angle at high tide
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

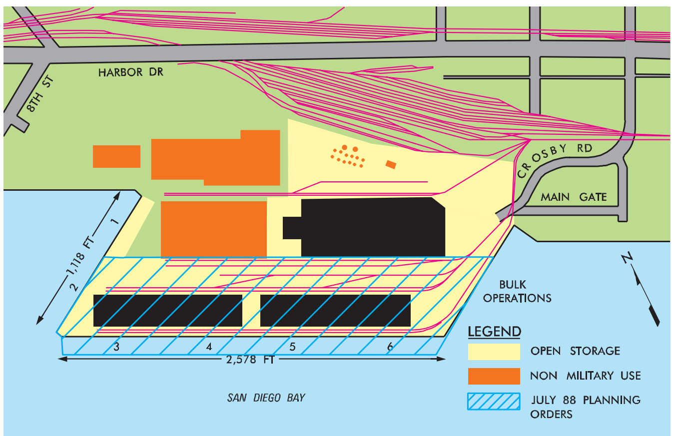
Notes: Ramp clearance and ramp angle based on maximum vessel draft.

III. APPLICATION

GENERAL

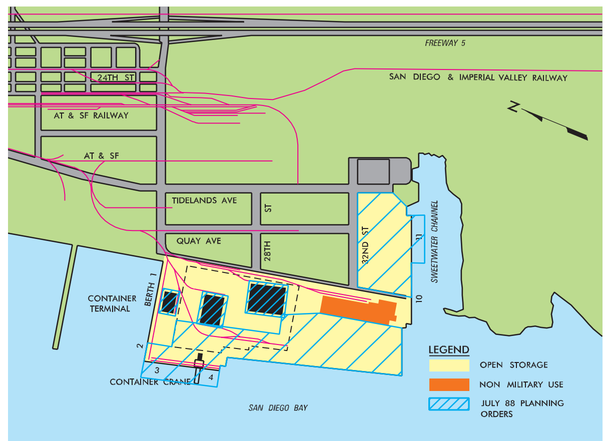
In this section, we evaluate the port's throughput capability for deploying a notional mechanized infantry division mainly by FSS vessels. The MARAD *Planning Orders Digest* provides agreements for military use of the Port of San Diego. The upcoming revision will likely provide for additional open staging area, but less covered staging area. This analysis uses the facilities that are expected to be in the next *Planning Orders Digest*.

TENTH AVENUE



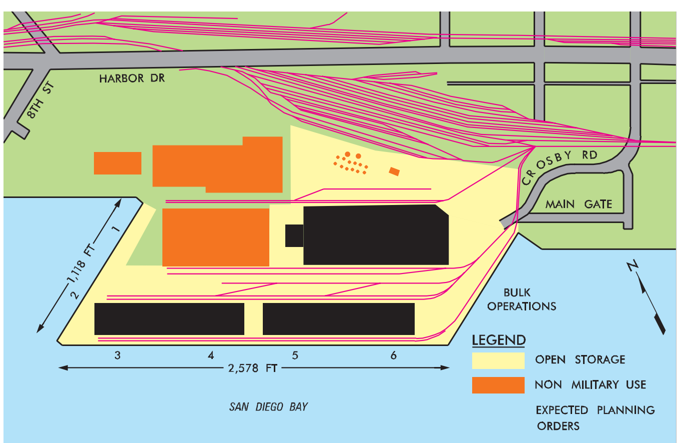
Covered: 424,000 sq ft
Open: 8 acres

NATIONAL CITY

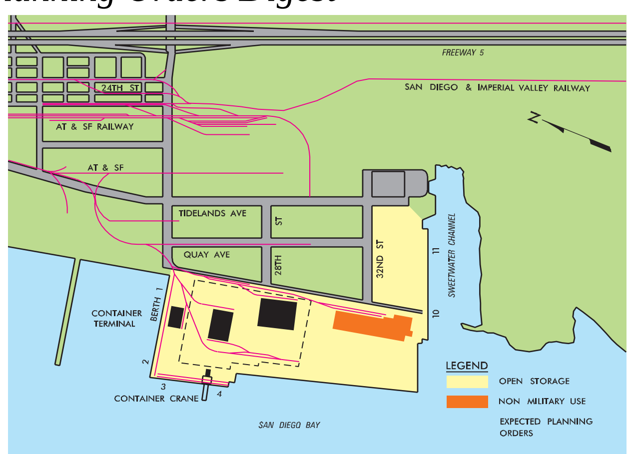


Covered: 330,000 sq ft
Open: 50 acres

Facilities in the July 1988 *Planning Orders Digest*



Covered: 120,000 sq ft
Open: 15 acres



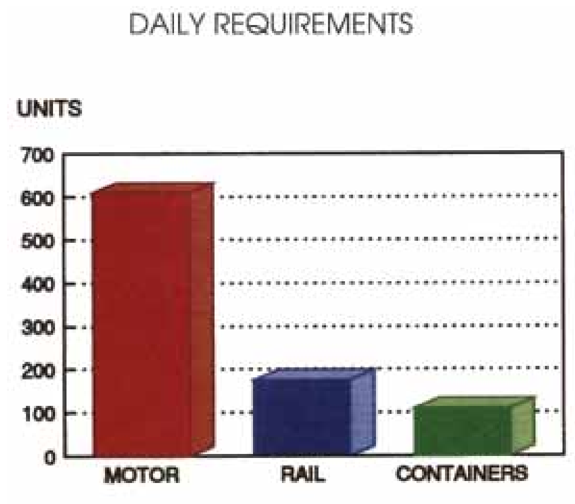
Covered:180,000 sq ft
Open: 50 acres

Facilities Expected in the next Revision of the *Planning Orders Digest*

REQUIREMENTS

MECHANIZED INFANTRY DIVISION

Total Equipment	
Volume	274,518 MTON
Weight	95,010 STON
Area	1,422,844 SQ FT
Vehicles	7,800
Containers (20 ft)	660

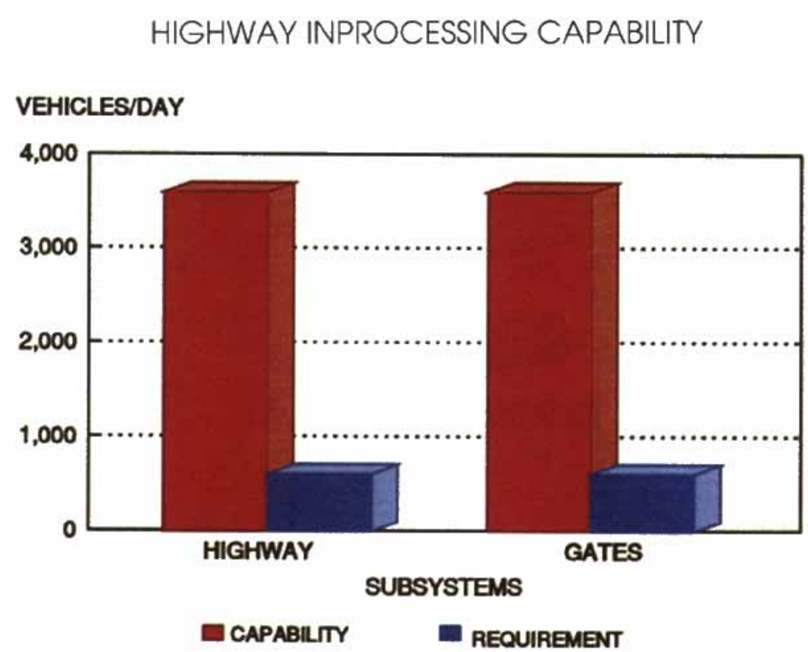


The likely requirement for the Port of San Diego is to deploy a notional mechanized infantry division in 6 days of reception and throughput. The division has to move about 7,800 vehicles and 660 containers. The movement to the port will require 1,055 (176 per day) railcars, using the convoy and rail option. Under this option, about 3,650 (610 per day) roadable vehicles would be driven, and about 2,320 (387 per day) would be towed.

TERMINAL HANDLING

Highway

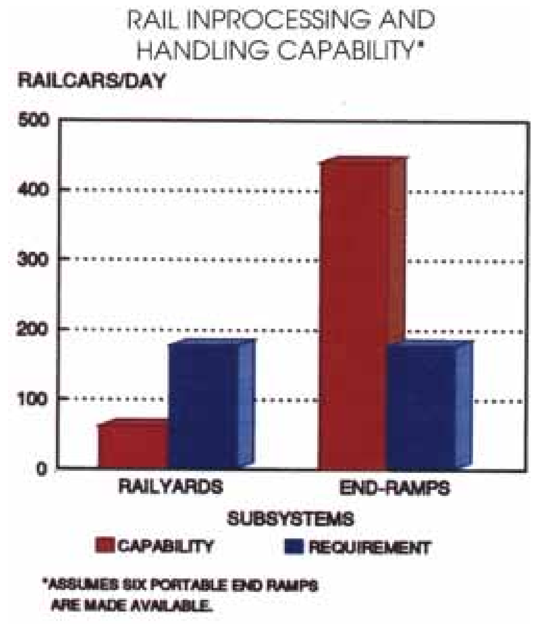
Vehicles and containers on chassis would enter the terminals through the gates. The gate for the 10th Avenue Terminal has two lanes. The gate for the National City Terminal has only one lane. These gates can handle an additional 3,600 vehicles per day.



Rail

Each terminal can receive about 60 railcars of military equipment per day, without disrupting the simultaneous commercial business within the area. This reception is insufficient to meet the requirement.

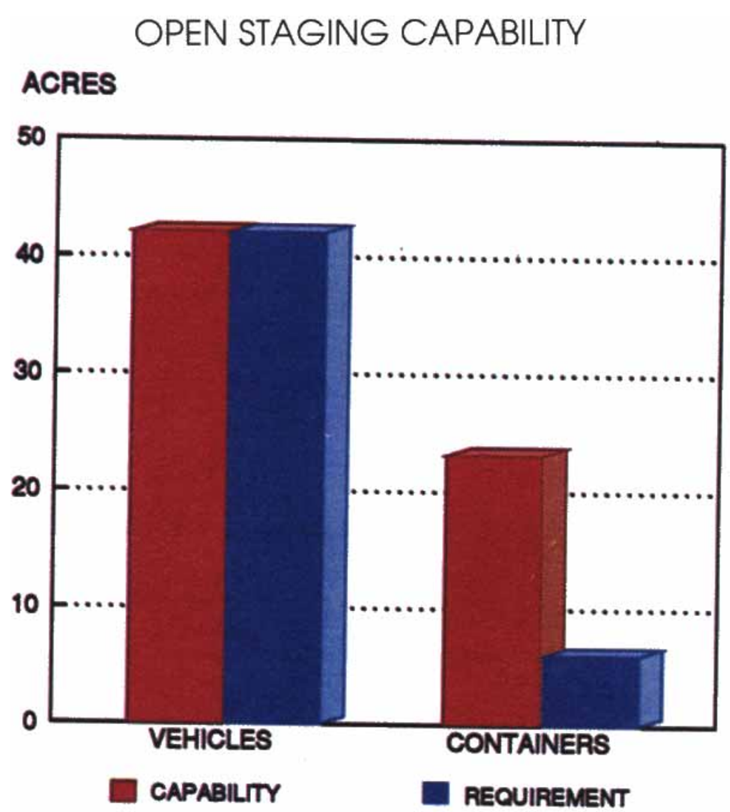
Trackage at the terminals can support offloading about 110 railcars at a time. This will allow for about 440 railcars per day. This offloading capability meets the requirement.



STAGING

This analysis assumes that the current downsizing will continue and nine FSS-sized ships will deploy an entire notional mechanized infantry division. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations. Although an FSS load of cargo can be staged and loaded on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 are required for staging the 73 containers for each FSS. Thus, the three simultaneous shiploading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers.

The terminals have 65 acres available, including grass and unimproved land. Although shiploads may be broken into separate areas, this is enough staging area for the deployment.

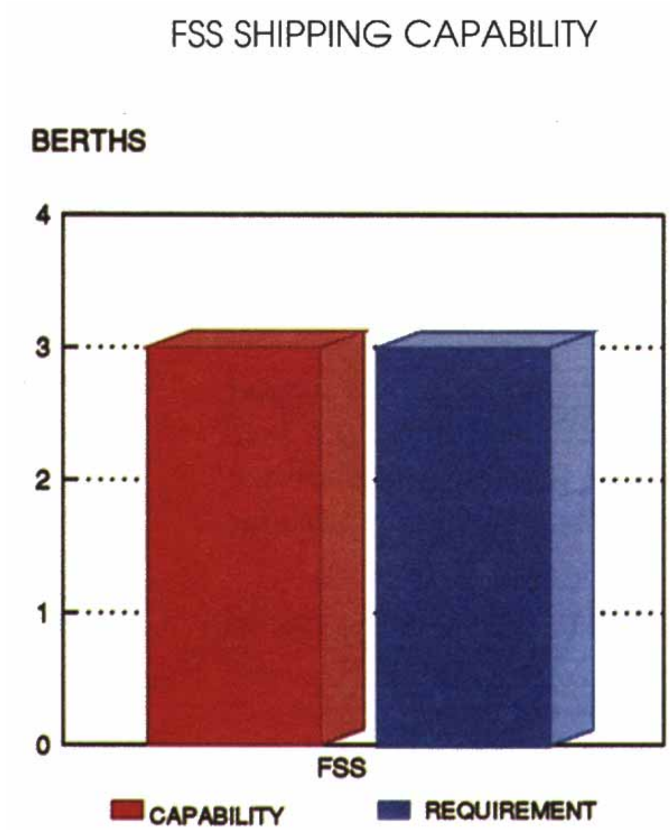


SHIPPING

Although this analysis assumes that nine FSS-sized ships can deploy the notional mechanized infantry division, the table below provides ship quantities for the current division size. The number of ships required depends on the shipping mix selected. The best ship mix would consist of all eight FSS ships, plus two Cape H RORO ships.

Two FSSs can berth at berth 3-6 of the 10th Avenue Terminal. This report assumes only one will berth there. This will allow its ramp to lie between the two sheds, for easier RORO loading.

Two more FSSs can berth at berths 3-4 and 11 of National City Terminal. The capability to berth three FSS's meets the requirement.



UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

LOADING CONDITION/ SAMPLE SHIP MIX	VESSEL TYPES			
	FSS (RORO/COMB)	CAPE H (RORO/COMB)	C3/C4 (BREAKBULK)	C6/C7/C8 (CONTAINER)
Minimum Containerization				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization				
FSS and Container	7.90			2.00
FSS,Cape H, and Container	4.62	3.00		2.00
Breakbulk and Container			29.58	2.00

*Only 8 FSSs are available. Unit shipping requirements exceed the capacity of these 8 vessels, Other vessel types are required to make up the FSS shortfall (Cape H).

Legend:

RORO - roll on/roll off

FSS - fast sealift ship

Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide, Aug 91.

SUMMARY

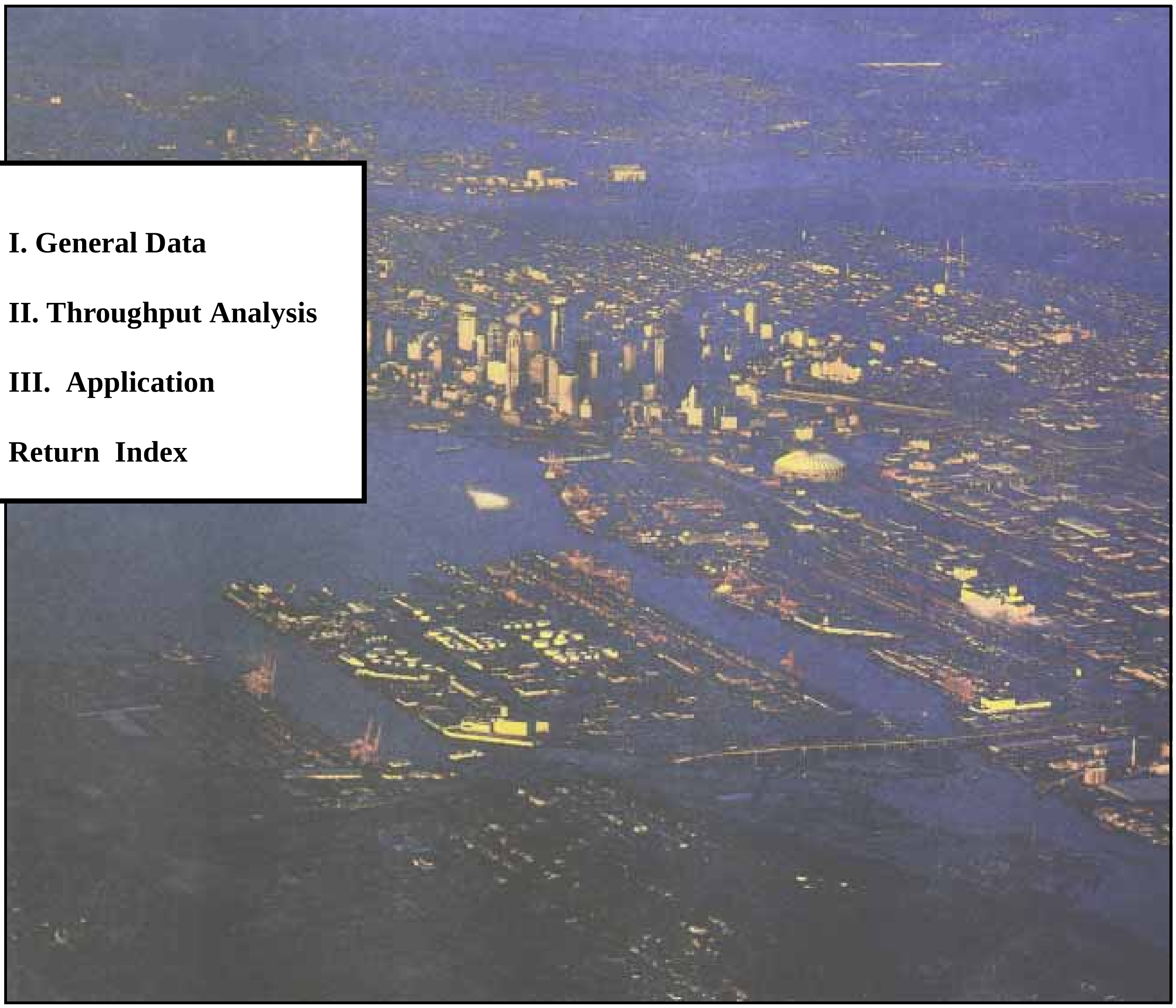
The two terminals together have adequate open storage and berthing to support the deployment of the division. The rail service, however, cannot support the deployment.

RECOMMENDATION

We recommend deploying a larger percentage of the equipment by highway. This will prevent the need for offsite rail offloading facilities.

PORT OF SEATTLE

SEATTLE, WASHINGTON



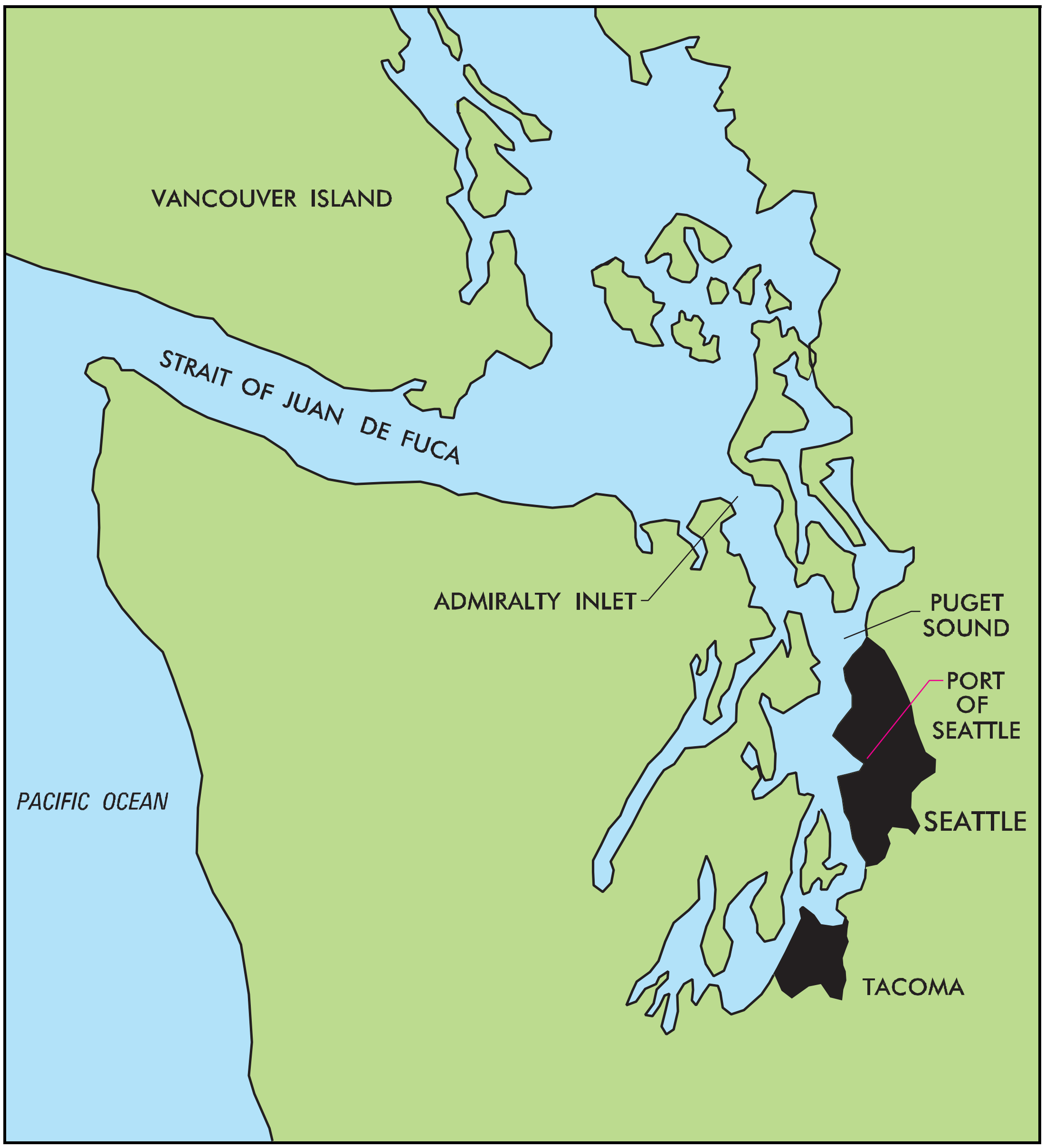
- I. General Data
- II. Throughput Analysis
- III. Application
- Return Index

I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Seattle is in northwest Washington state on Puget Sound. Ships may access this port from the Pacific Ocean via Strait of Juan de Fuca, Admiralty Inlet, and Puget Sound. The Port of Seattle is 124 nautical miles from the Pacific Ocean



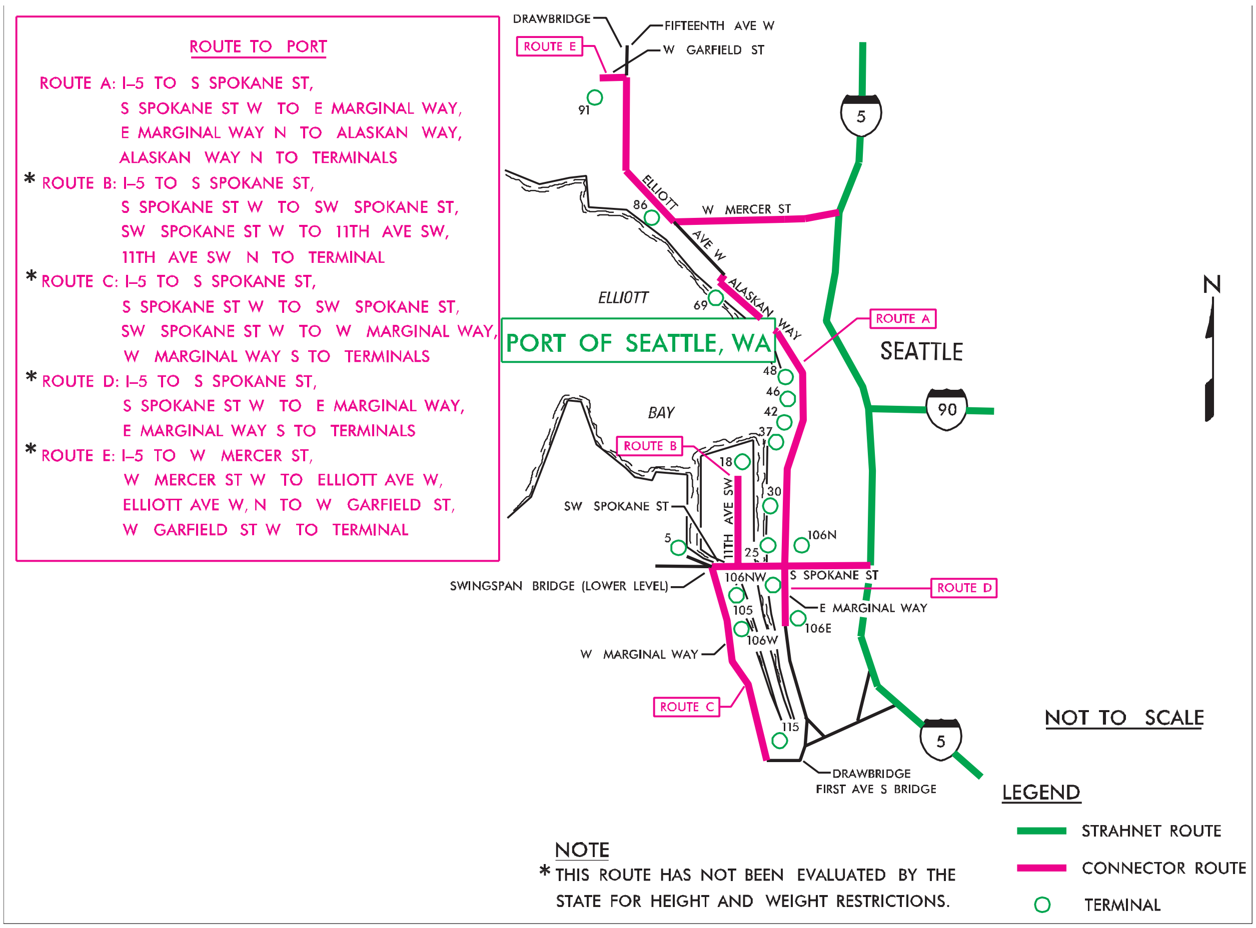
Water Access

The Port of Seattle has three bridge restrictions on the Duwamish Waterway, with 142 feet mean high water (MHW) vertical clearance and 145 feet horizontal clearance being the critical dimensions.

Water Access Restrictions

Highway

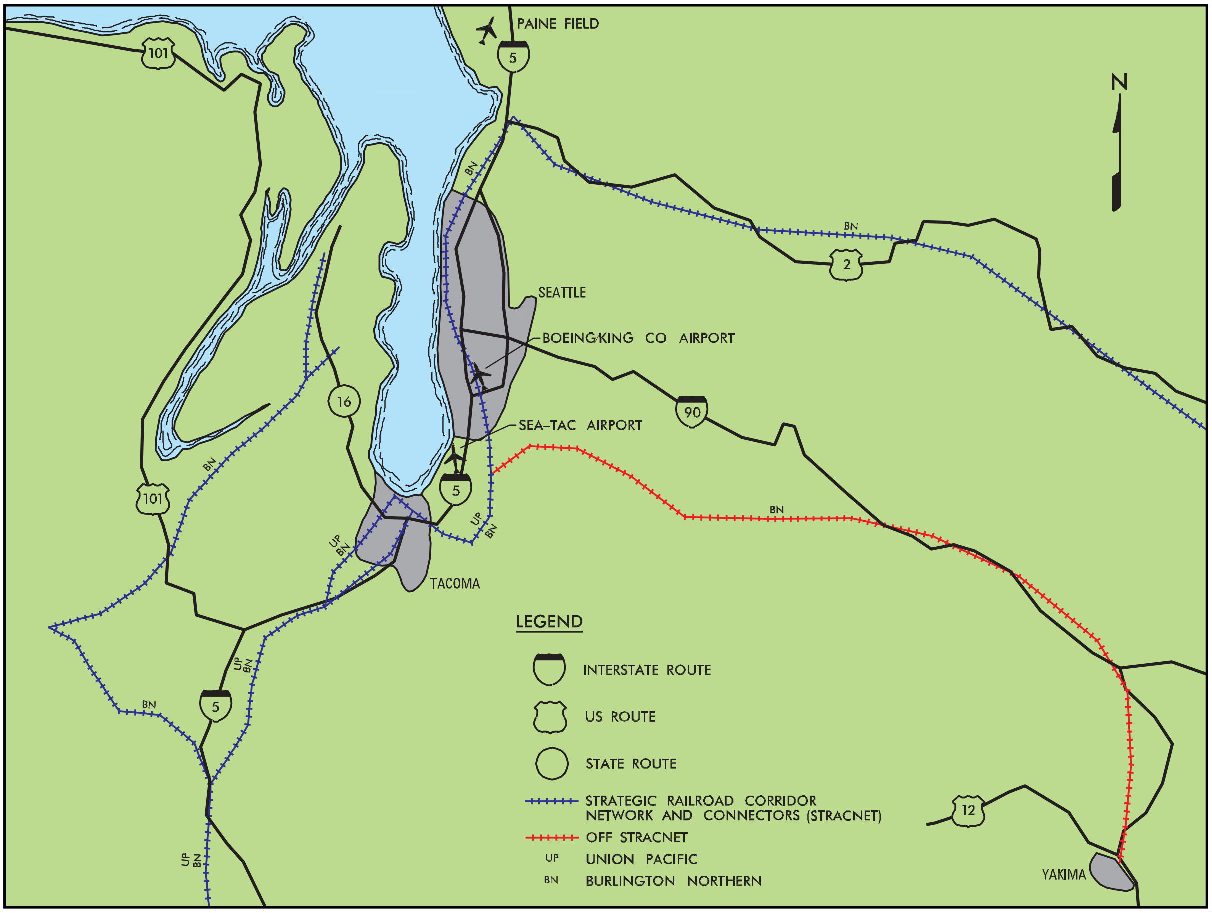
The Strategic Highway Corridor Network (STRAHNET) routes to the Port of Seattle are Interstate Routes 5 and 90. The connector routes to the Port of Seattle are S and SW Spokane Street, E and W Marginal Way, 11th Avenue SW, Alaskan Way, Elliott Avenue W, W Mercer Street, and W Garfield Street. The only highway restrictions are three bridges, which could cause traffic delays when opened for ships. These bridges are First Avenue South Bridge (near Terminal 115), Fifteenth Avenue West Bridge (near Terminal 91), and the low level bridge on SW Spokane Street (near Terminal 5). Traffic can still access Terminal 5 via the high-rise bridge on SW Spokane Street when the low-level swing-span is open.



Highway Access

Rail

The Burlington Northern (BN) and Union Pacific (UP) railroads serve the Port of Seattle. Both railroads have railyards near the port. Rail clearances are sufficient for bilevel and trilevel railcars to access the port.



Rail and Airport Access

Airports

Two commercial airfields and one military airfield are near the Port of Seattle. The following chart provides information on these airfields. (See the Rail and Airport Access Map on the previous page for locations of these airfields.)

AIRFIELDS NEAR SEATTLE

NAME	TYPE	NO. OF RUNWAYS	LONGEST RUNWAY DIM (ft)	DISTANCE FROM PORT (mi)
Sea-Tac	Commercial	2	11,900 x 150	13
Boeing/ King Co	Commercial	2	10,000 x 200	4
Paine Field	Military	4	9,010 x 150	15

PORT FACILITIES

Berthing

The Port of Seattle is a multicargo operation port with a specialization in shipping containers. The port consists of marginal wharves and finger piers. Pier construction varies from terminal to terminal, but generally involves concrete or timber piles, concrete or timber decking, and asphalt, concrete, or timber surfacing. Lighting is good for night operations.

Figure 1 is a land-use map for the Port of Seattle. Figures 2 through 7 are aerial views of the Port of Seattle. These figures include tables identifying berth characteristics.

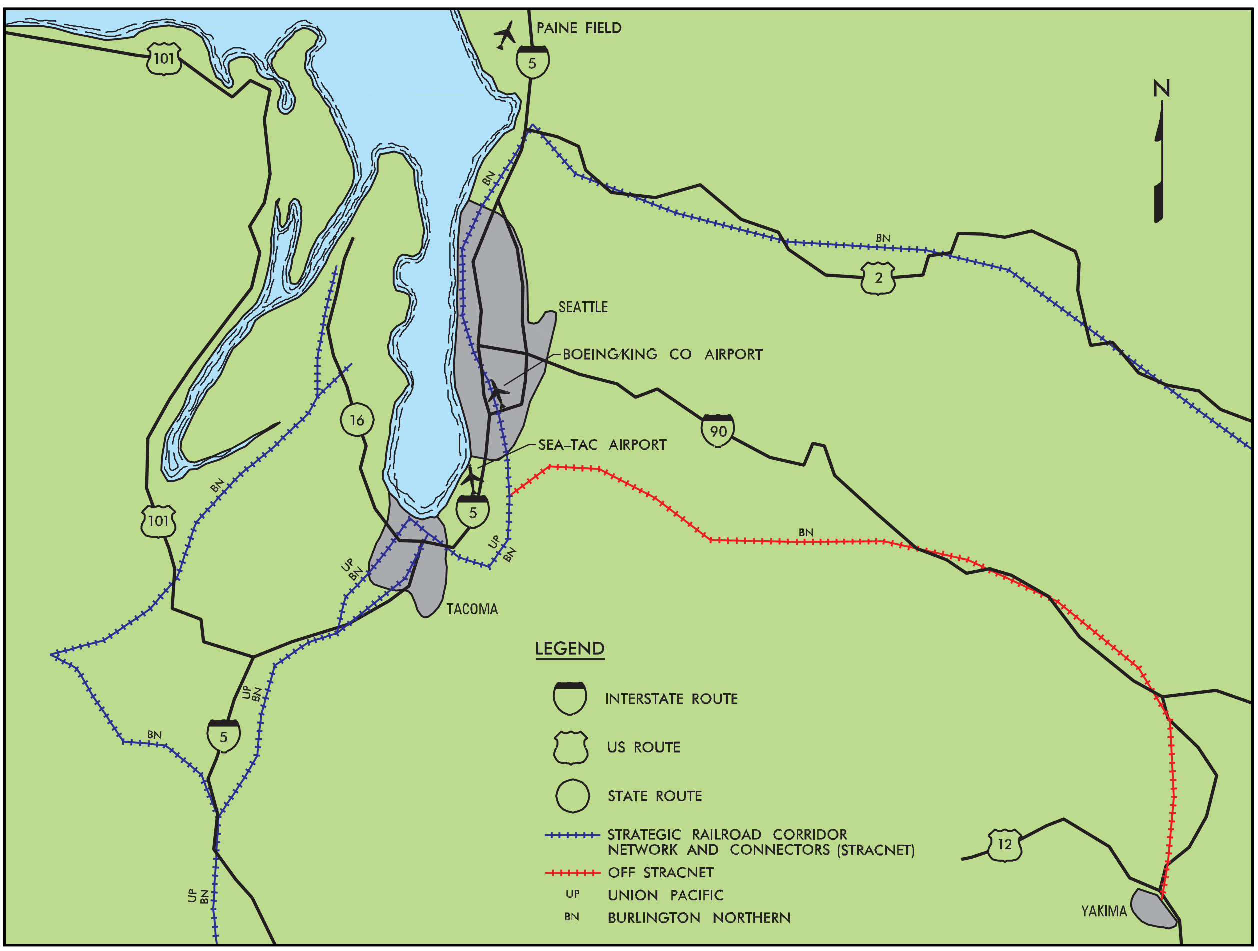


Figure 1. Land-use map

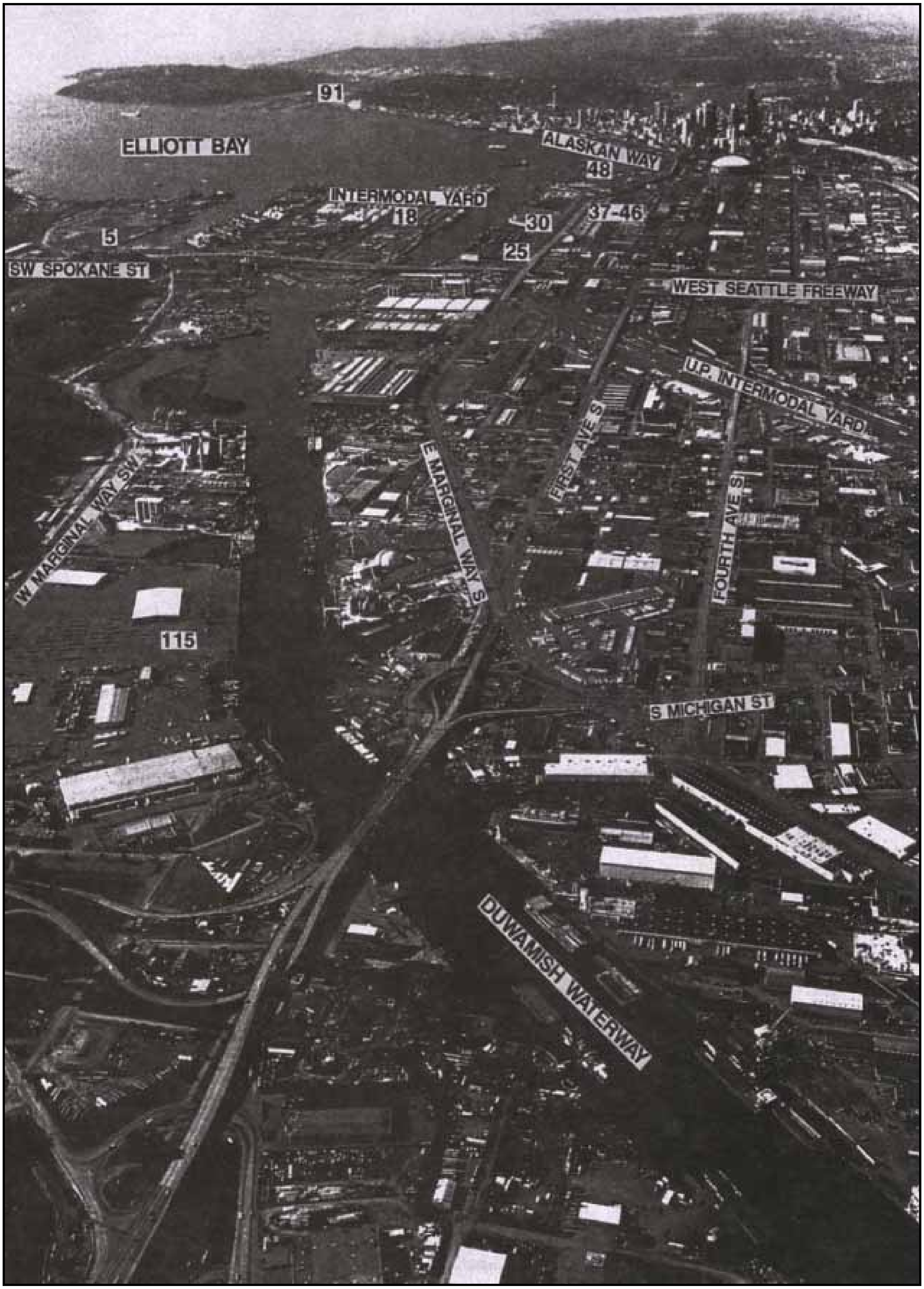
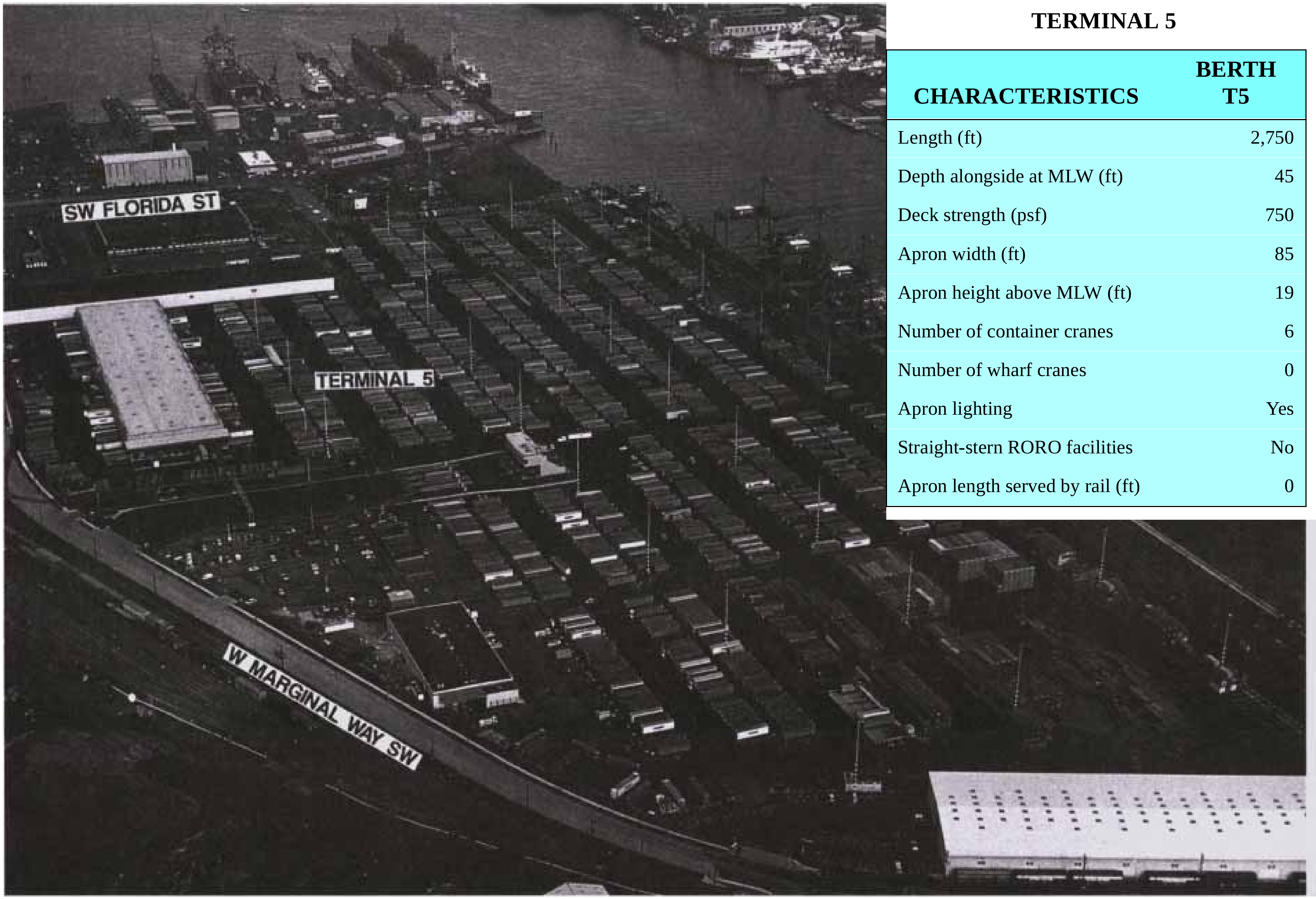


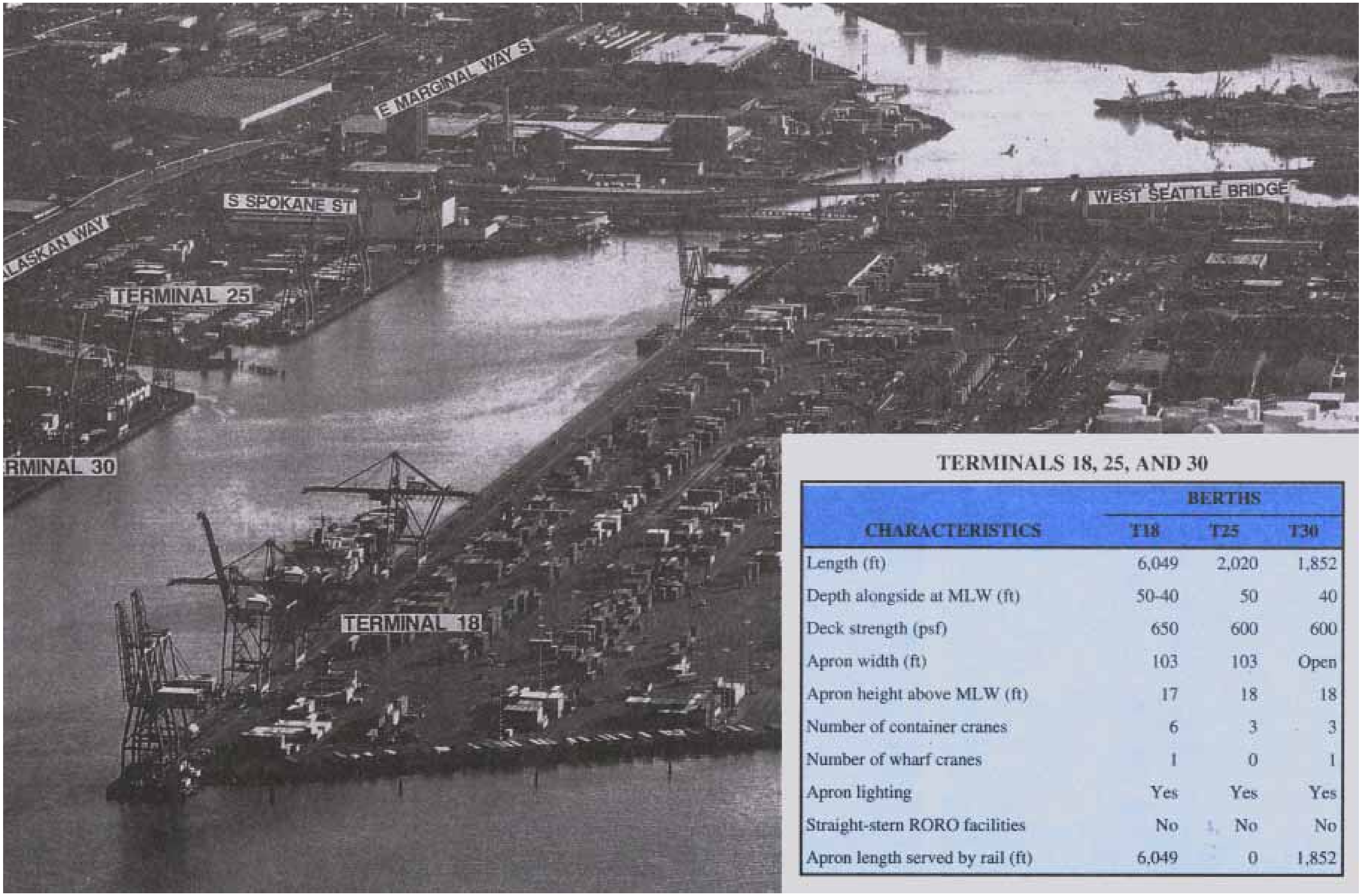
Figure 2. Terminal facilities for Port of Seattle.



TERMINAL 5

CHARACTERISTICS	BERTH T5
Length (ft)	2,750
Depth alongside at MLW (ft)	45
Deck strength (psf)	750
Apron width (ft)	85
Apron height above MLW (ft)	19
Number of container cranes	6
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

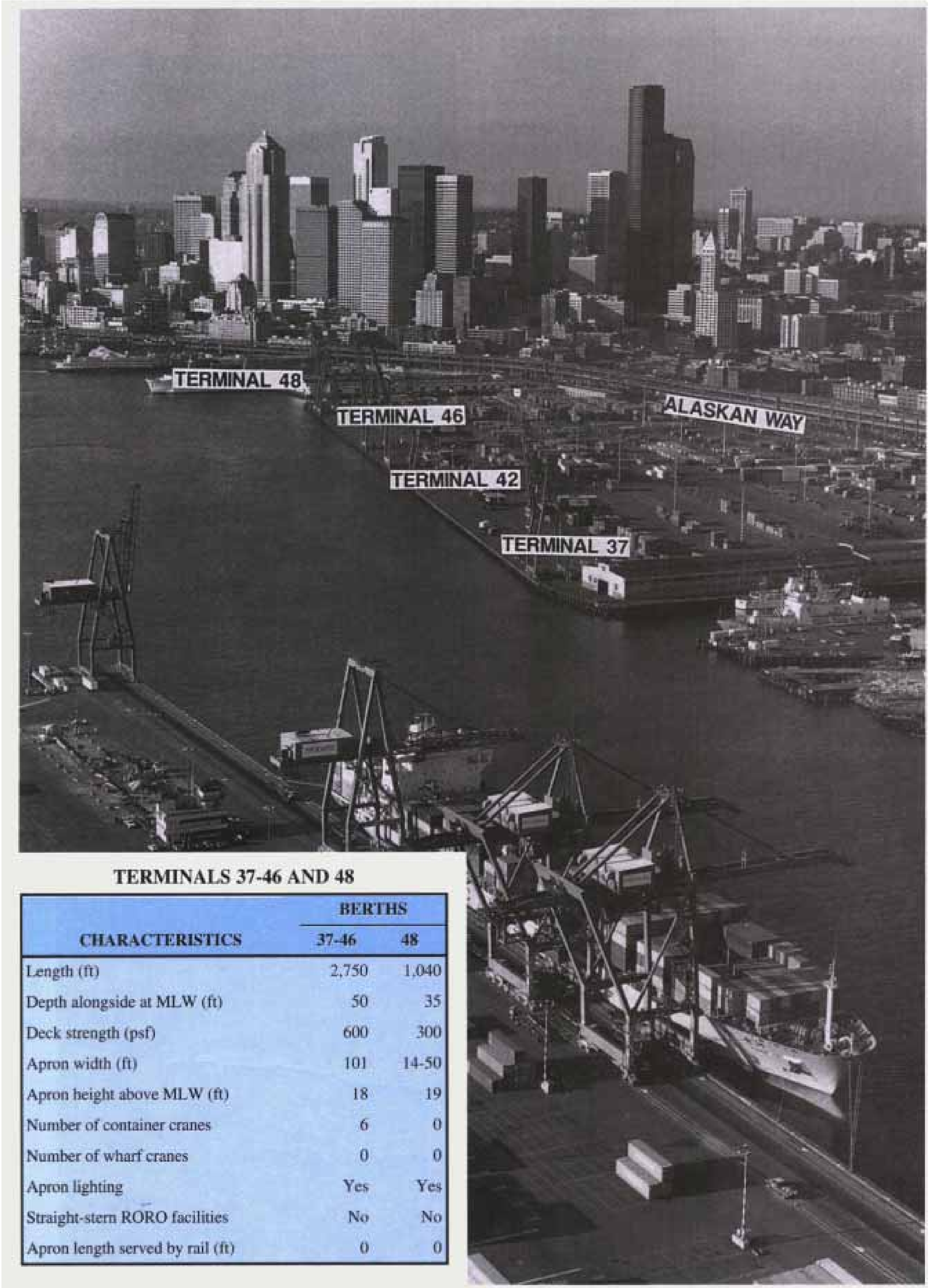
Figure 3. Berth characteristics for Terminal 5 (northeastward view).



TERMINALS 18, 25, AND 30

CHARACTERISTICS	BERTHS T18	T25	T30
Length (ft)	6,049	2,020	1,852
Depth alongside at MLW (ft)	50-40	50	40
Deck strength (psf)	650	600	600
Apron width (ft)	103	103	Open
Apron height above MLW (ft)	17	18	18
Number of container cranes	6	3	3
Number of wharf cranes	1	0	1
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No
Apron length served by rail (ft)	6,049	0	1,852

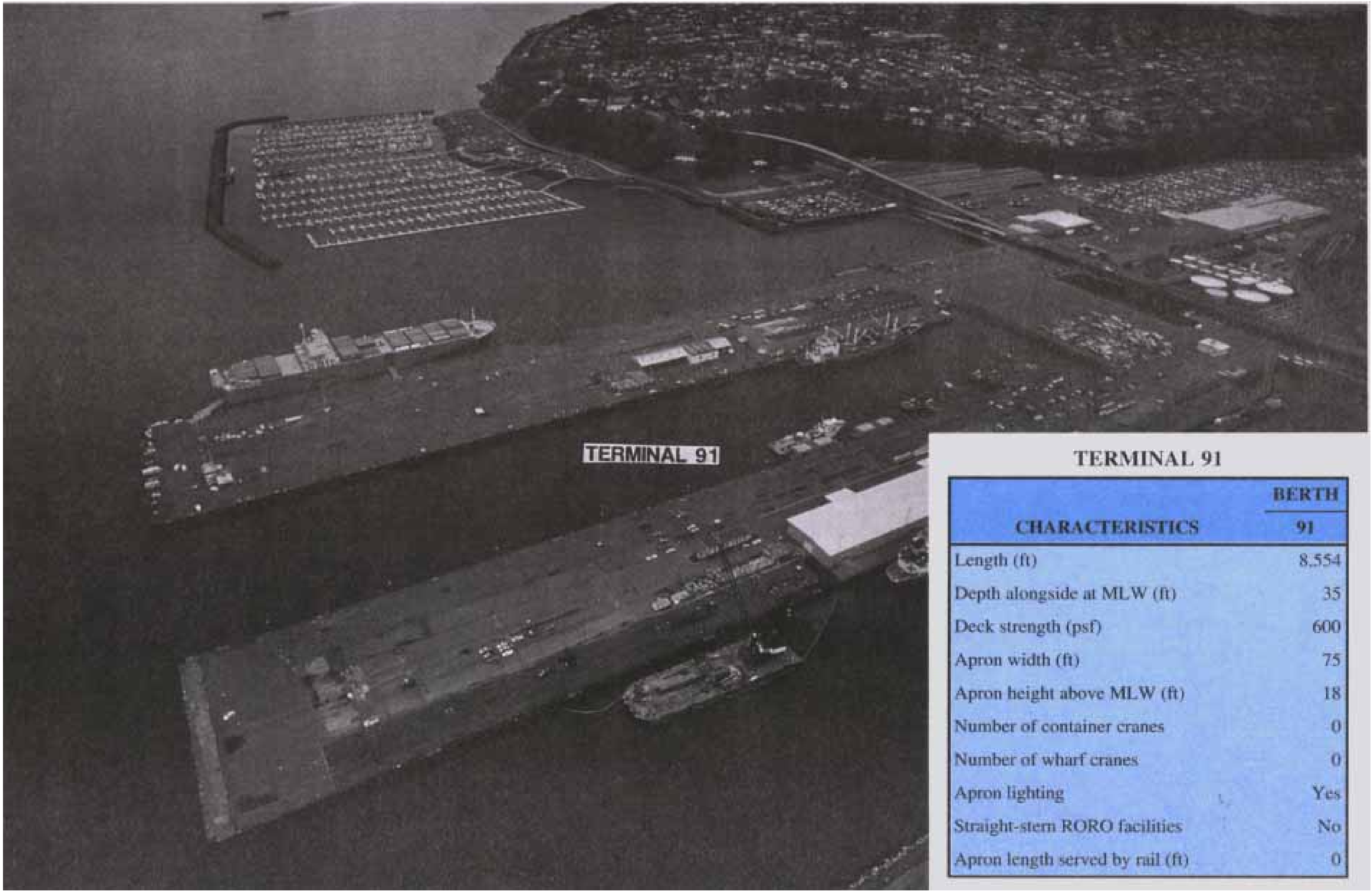
Figure 4. Berth characteristics of Terminals 18, 25, and 30 (southeastward view).



TERMINALS 37-46 AND 48

CHARACTERISTICS	BERTHS 37-46	BERTHS 48
Length (ft)	2,750	1,040
Depth alongside at MLW (ft)	50	35
Deck strength (psf)	600	300
Apron width (ft)	101	14-50
Apron height above MLW (ft)	18	19
Number of container cranes	6	0
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straight-stern RORO facilities	No	No
Apron length served by rail (ft)	0	0

Figure 5. Berth charastics of Terminals 37-46 and 48 (northeastward).



TERMINAL 91

CHARACTERISTICS	BERTH 91
Length (ft)	8,554
Depth alongside at MLW (ft)	35
Deck strength (psf)	600
Apron width (ft)	75
Apron height above MLW (ft)	18
Number of container cranes	0
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

Figure 6. Berth characteristics of Terminal 91 (northwestward) view.

TERMINAL 115

CHARACTERISTICS	BERTH T115
Length (ft)	1,200
Depth alongside at MLW (ft)	30
Deck strength (psf)	600
Apron width (ft)	103
Apron height above MLW (ft)	21
Number of container cranes	0
Number of wharf cranes	1
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

Figure 7. Berth characteristics of Terminal 115 (northward view)

Staging

OPEN STAGING

The Port of Seattle has nearly 550 acres of paved open staging available. The following chart provides the distribution of open staging acreage per terminal. Helicopter operations are possible at all container terminals. Containers may require relocation to allow enough area to conduct helicopter operations.

OPEN STAGING

TERMINAL	OPEN STAGING ACREAGE	BERTH(S) SERVED
5	90	3
18	109	8
25	28	2
30	37	2
37	29	1
46	32	1
91	124	All
115	97	3
	TOTAL 546	

Terminal 18 Staging Area

COVERED STAGING

The port has about 10 covered facilities (transit sheds, container freight stations, and warehouses) providing 804,255 square feet of covered storage.

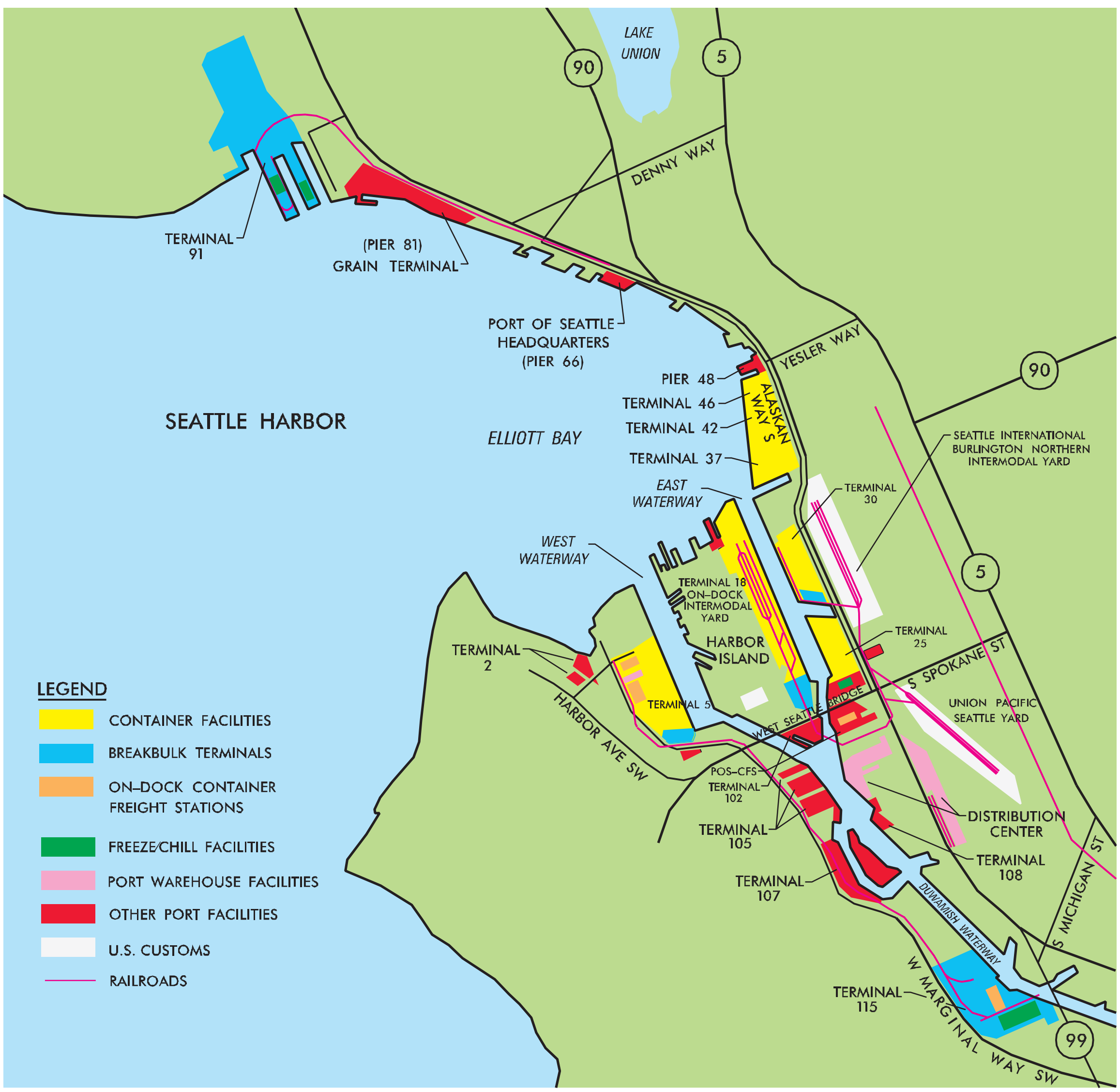
Covered Storage Facilities, Terminal 91

Rail

At the Port of Seattle, rail trackage links the railyards to the apron tracks and transit sheds. Apron tracks are in Terminals 18 and 30. The port has no rail storage yards. The railyards serving the port (BN and UP) total about 203,400 feet of track and can handle about 2,175 89-foot railcars; however, only about 30 percent of these facilities may be available on a day-to-day basis for potential military deployments.

Highway

All the terminal areas are paved. The city roads leading to these terminals are two laned. These roads have no clearance restrictions. All container terminals operate truck scales. The only two terminals that do not have truck scales are Terminals 91 and 115.



Land-Use Map

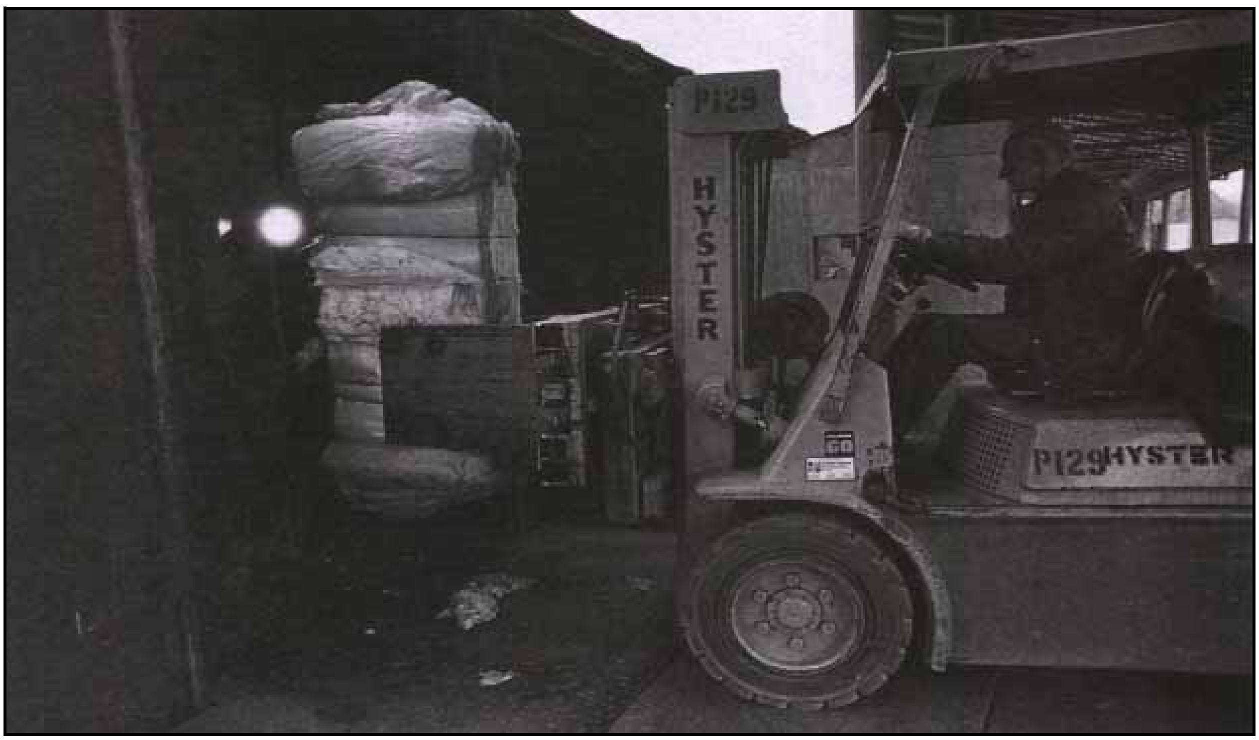
Unloading/loading Positions

RAMPS

The port has no ramps for offloading railcars or semitrailers. Local railyards in the Seattle area have six end ramps.

DOCKS

The port has truck docks totaling at least 315 handling positions; however, many of these positions are at covered storage facilities under lease. This means that offloading could occur, but storage would have to occur at other facilities. Nineteen boxcar docks are available; however, most of these docks are at leased, covered storage facilities such as freeze facilities. Some of the port rail facilities need maintenance. The reason is that the bulk of business at the Port of Seattle is containers. Very few deliveries are via boxcars.



Dock Operations, Terminal 18

Marshaling Areas

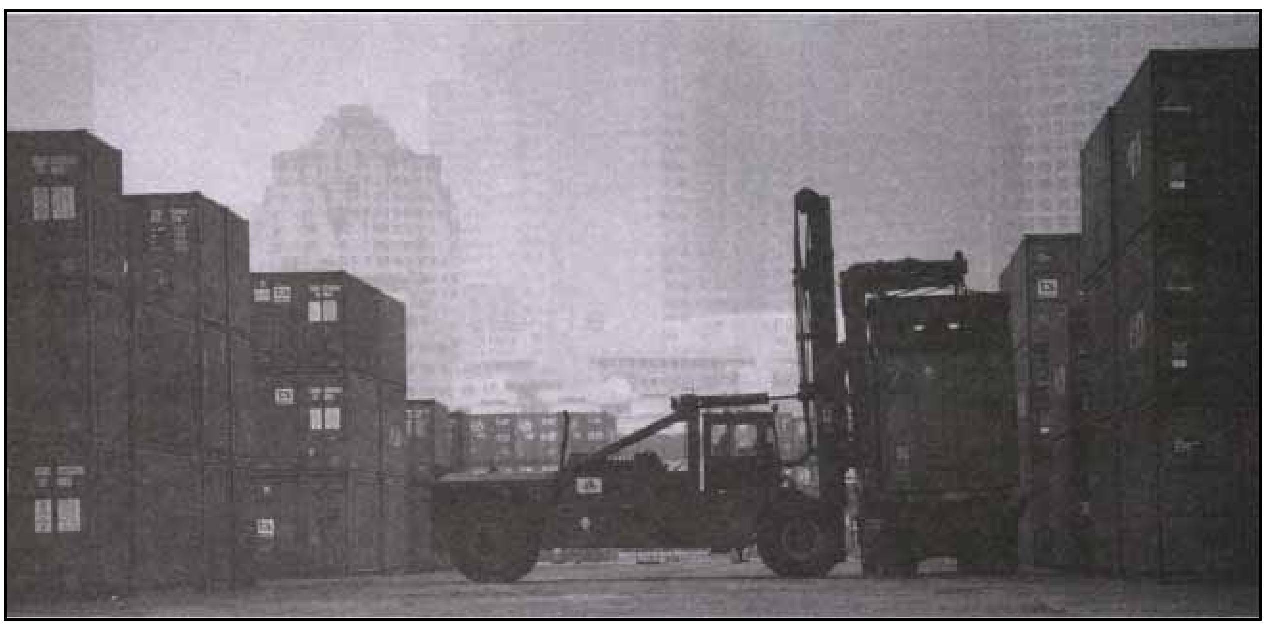
The port does not list any marshaling areas in its vicinity; however, the staging areas could also serve as marshaling areas if needed.

MATERIALS HANDLING EQUIPMENT

The port has 24 container cranes (23 owned by the Port). The following chart shows the various MHE available at the port. Various terminal operators own most of this MHE. Therefore, the availability of this equipment depends on the terminal used for deployment.

MATERIALS HANDLING EQUIPMENT

EQUIPMENT TYPE	CAPACITY (STON)	QUANTITY
Container Cranes	56	9
Container Cranes	44.8	15
Gantry Cranes	50	3
Rough Terrain Container Handler	40	37
Rough Terrain Container Handler	33.6	2
Rough Terrain Container Gantry	33.6	4
Forklift Truck	30	2
Forklift Truck	26	1
Forklift Truck	20	1
Forklift Truck	15	15
Top Pick	30	4
Top Pick	40	1

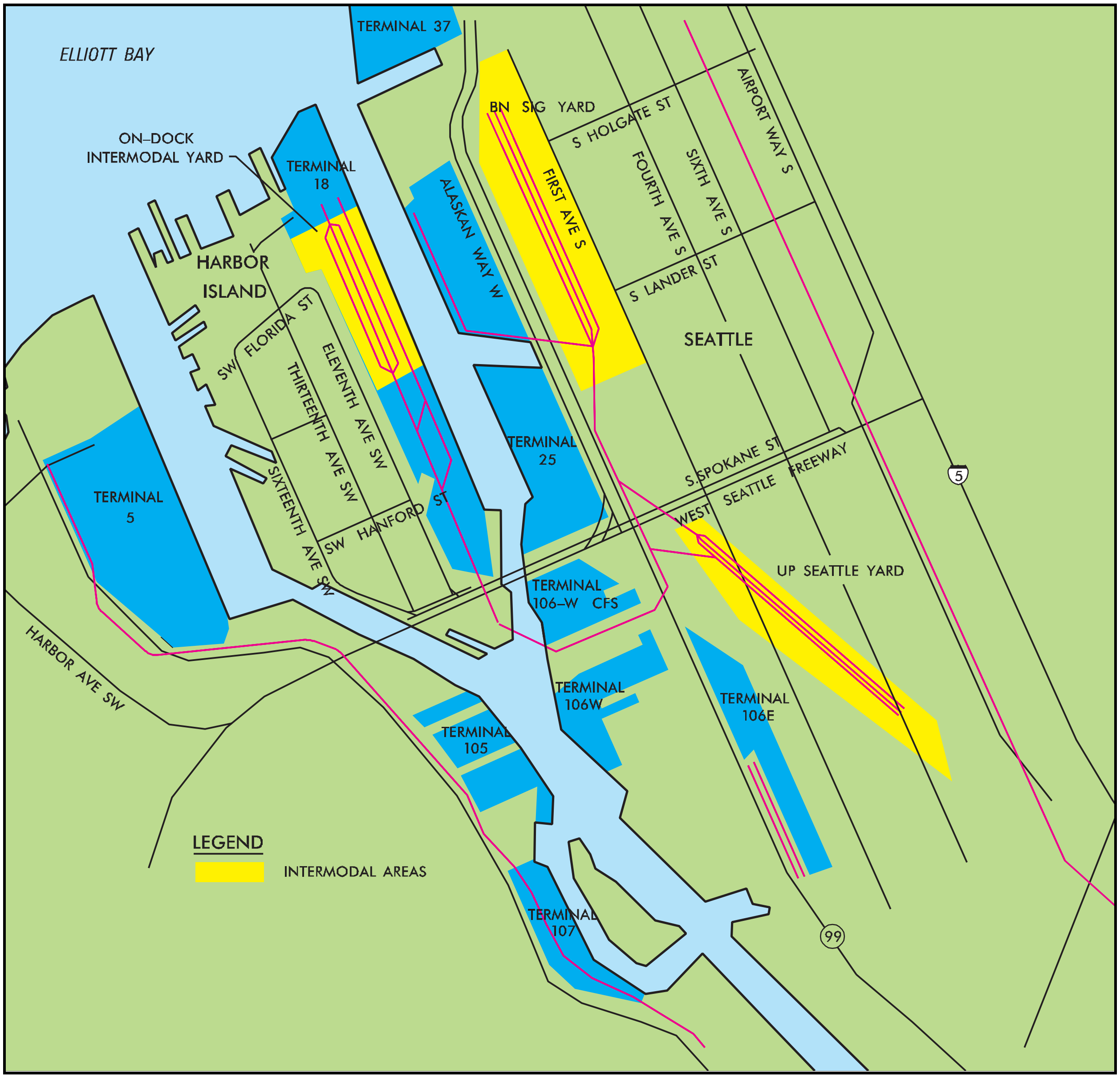


Container Top Pick

Container Crane at Terminal 18

INTERMODAL FACILITIES

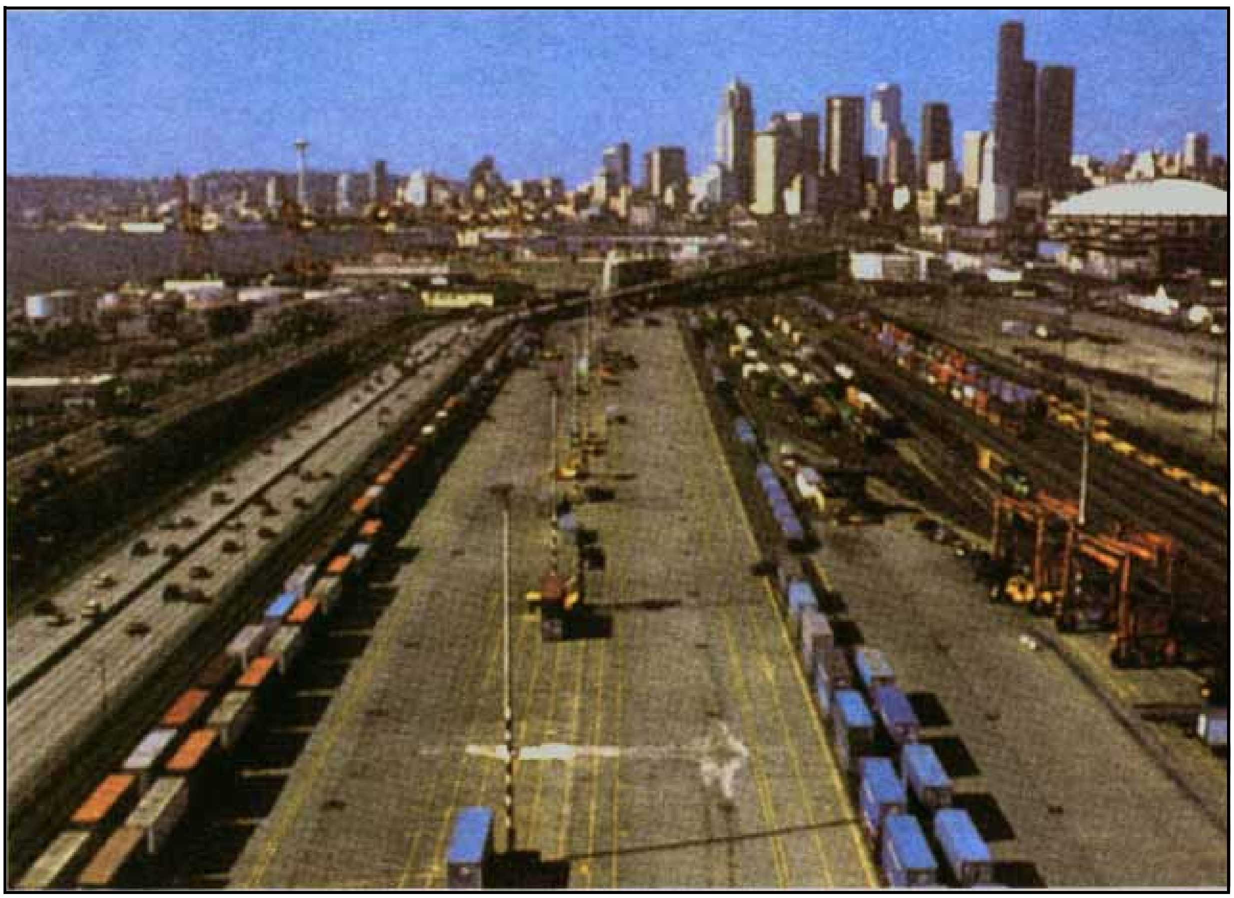
Three intermodal facilities are in the Seattle area. They are the Burlington Northern Seattle International Gateway (SIG) Yard, Union Pacific Seattle Yard, and a small ondock facility at Terminal 18.



Nearby Intermodal Yards

Burlington Northern (BN) SIG Yard

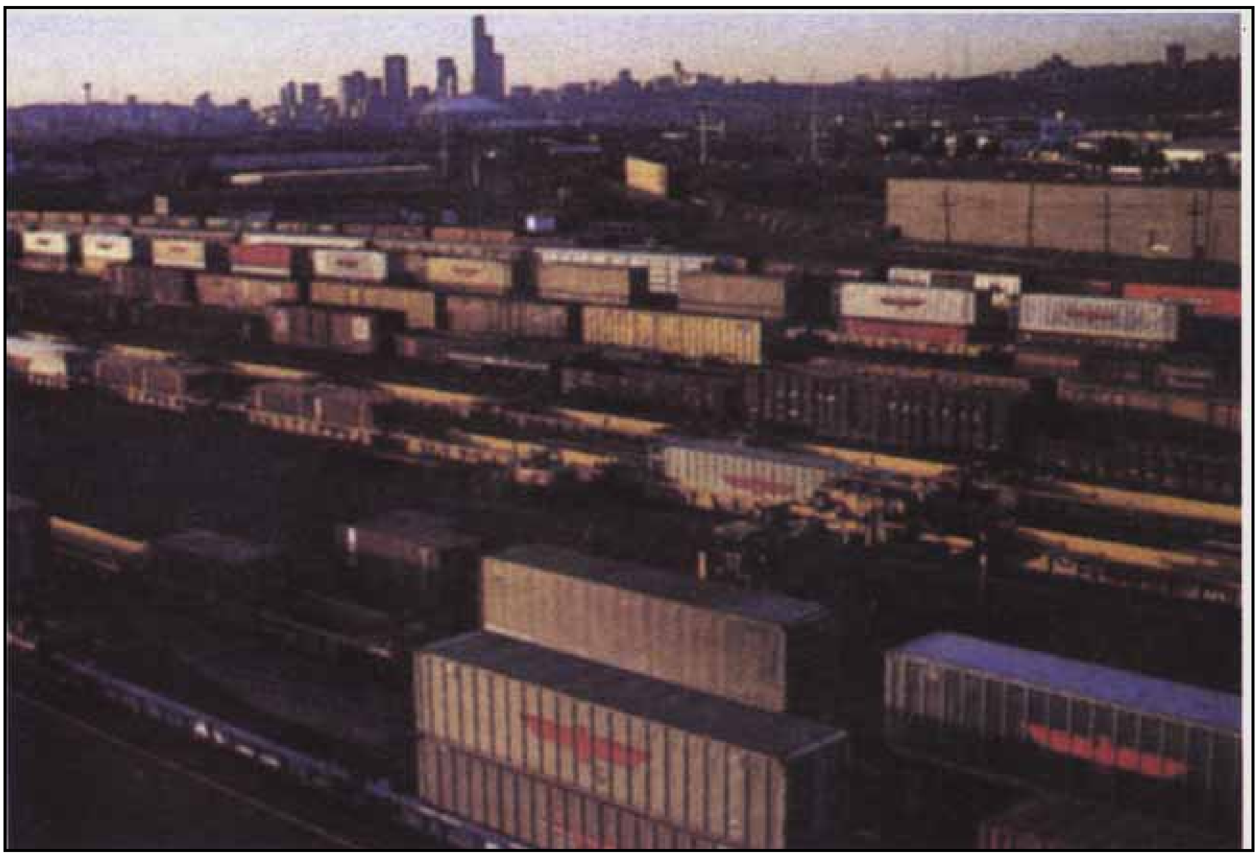
SIG Yard is at 44 South Hanford Street, Seattle. This facility is on 38 acres and can stage 700 40-foot truck chassis. Transfer operations occur on 4 working tracks providing 114 89-foot flatcar lengths. These tracks can also serve 36 double-stacked railcars. BN uses five side loaders (piggy-packers) and two overhead straddle cranes for container loading operations. Although SIG Yard mostly conducts container operations (single and double-stacked containers on flatcars), BN can also handle trailers on flatcars (TOFC). The BN facility working hours are 0800-1700 hours. The current activity level is not available.



Burlington Northern Intermodal Railyard

Union Pacific (UP) Seattle Yard

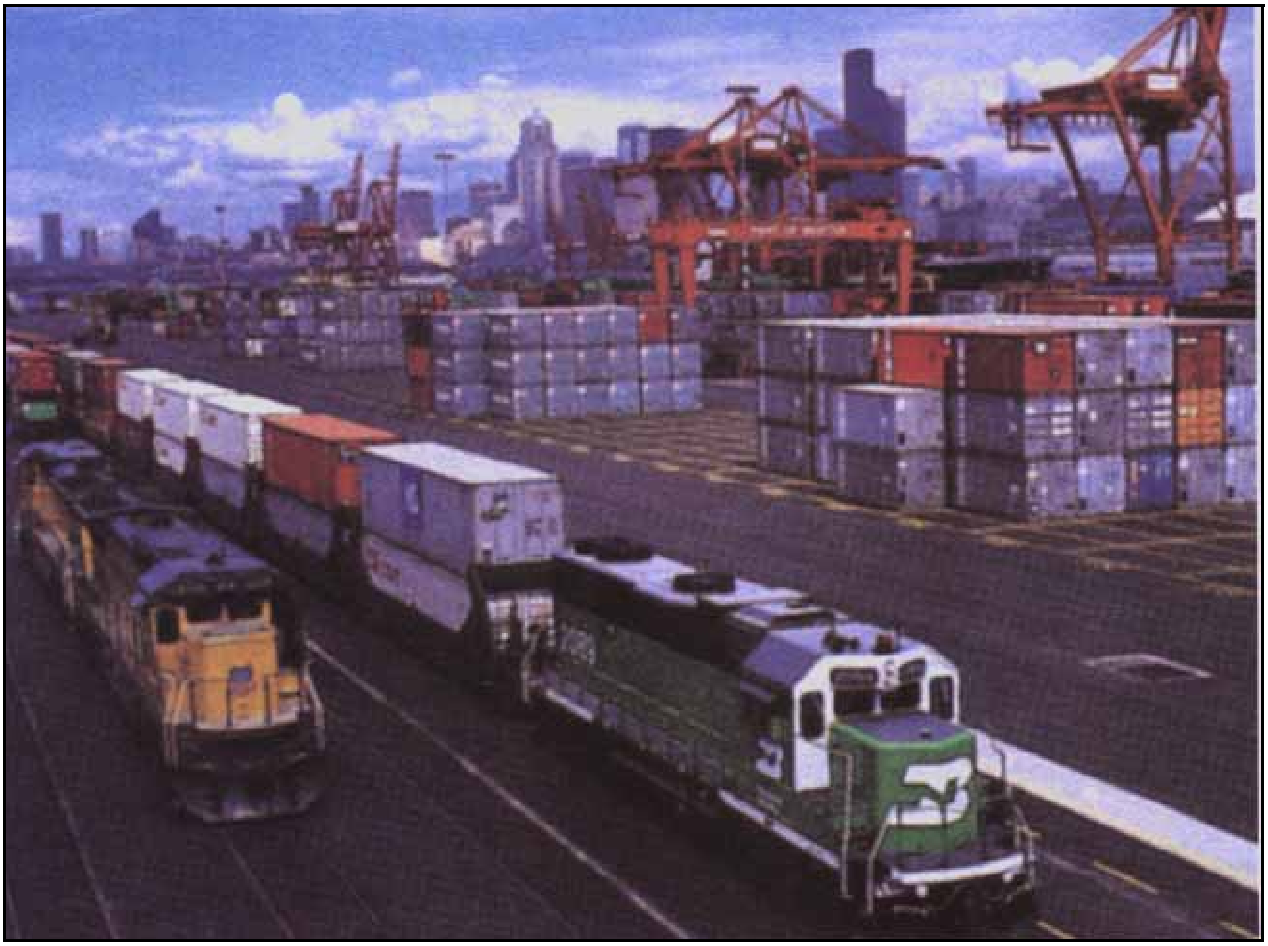
Seattle Yard is at 4700 Denver Avenue South, Seattle. This facility is on 55 acres and can stage 765 40-foot truck chassis. Transfer operations occur on 8 working tracks providing 150 89-foot flatcar lengths. UP uses six side loaders (piggypackers) for container loading operations. The facility has no overhead cranes. UP can handle TOFC operations and double-stacked containers on flatcars (COFC). This facility is open 24 hours a day, 7 days a week. Its current activity level averages about 600 lifts per day.



Union Pacific Intermodal Yard.

Terminal 18 (Ondock Intermodal Yard (IY))

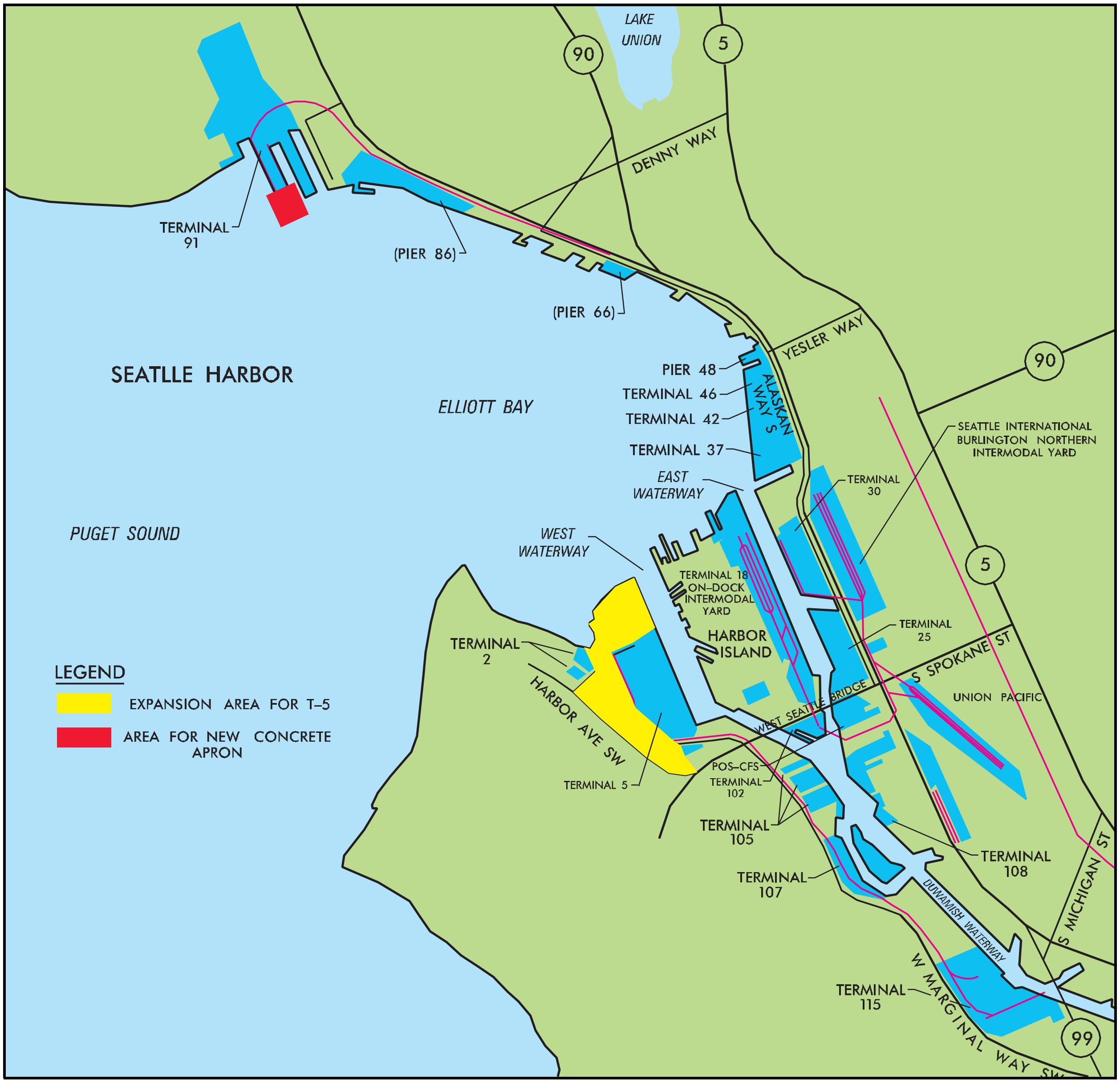
This port-owned intermodal yard is on 8 acres and can stage about 280 40-foot truck chassis. Transfer operations occur on four tracks providing about eighty-four 89-foot flatcar lengths. The IY uses 12 rough terrain container handlers for container loading operations. It can handle both TOFC and double-stacked COFC. This facility is capable of round-the-clock operations. Its current activity level is about 280 lifts per day.



Ondock Intermodal Facilities - Terminal 18

FUTURE DEVELOPMENT

The port plans to expand Terminal 5 (T-5) to about 160 acres. This expansion will take about 3 years to complete. The port also plans to replace a wooden apron with about 1,000 feet of concrete apron on berths H and I of Terminal 91 West. Plans are to complete the new concrete apron by June 1994.

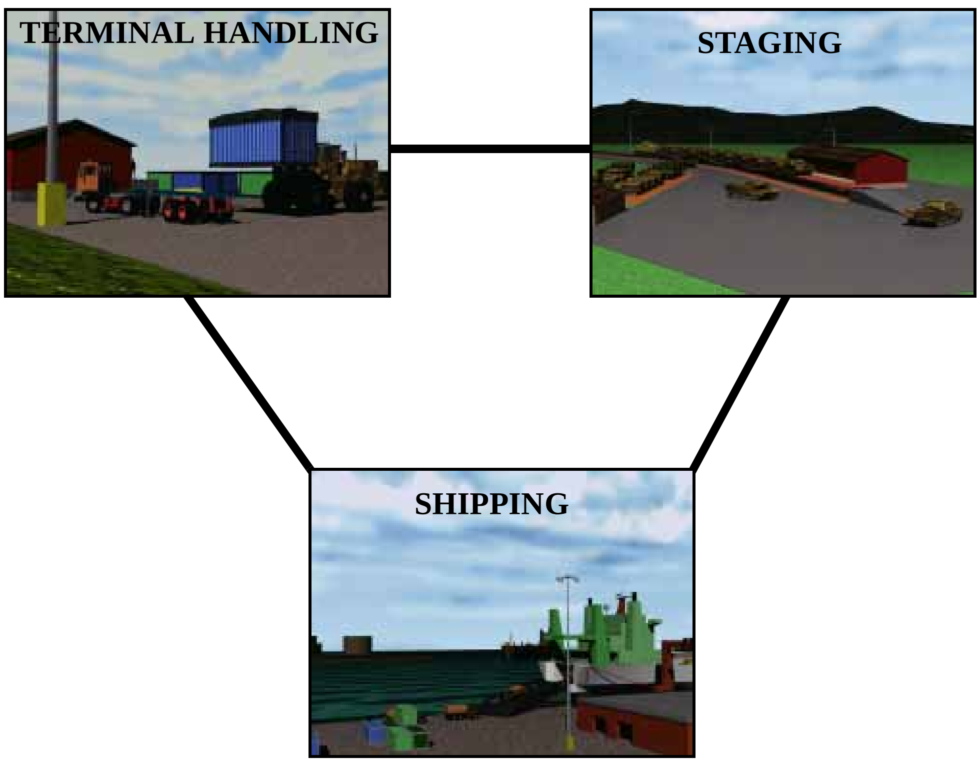


Future Development for Port of Seattle

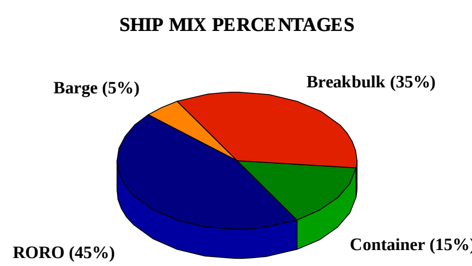
II. THROUGHPUT ANALYSIS

GENERAL

This section evaluates the theoretical throughput capability of the Port of Seattle using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in short tons (STON) and measurement tons (MTON) per day.



Terminal Throughput Subsystems



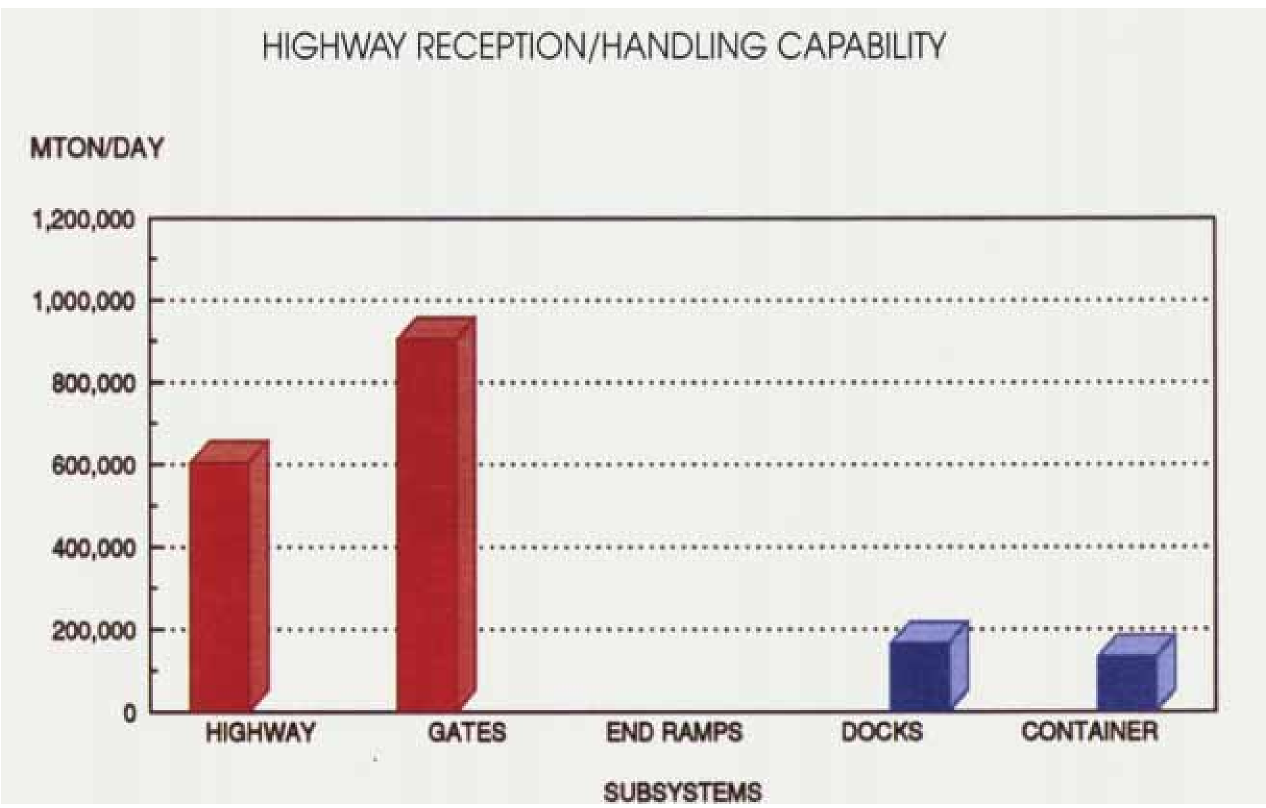
The analysis assumes that 80 percent of the port facilities will support the military deployment. Also, Desert Shield and Desert Storm statistics provide the basis for the ship mix. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.

TERMINAL RECEPTION/HANDLING

Highway

Interstates 5 and 90 and the major connectors (S and SW Spokane Street, E and W Marginal Way, 11th Avenue SW, Alaskan Way, W Mercer Street, Elliott Avenue W, and W Garfield Street) all provide good access to the Port of Seattle. Each of the terminals has at least one gate that provides access to staging and wharf areas. Because of the large number of lanes going through the terminal gates, the port roadways and gate reception can easily handle a large number of vehicles per day.

Roadable vehicles in convoys will process directly to staging areas. The Port of Seattle has no portable or fixed truck ramps. Unless makeshift truck ramps are jury rigged, vehicles on commercial or military flatbed semitrailers must offload at end ramps in local railyards. Although many storage facilities are under lease, the US Army could still potentially use the docks to offload about 165,300 MTON per day. The port specializes in shipping containers and could handle almost 132,200 MTON per day.

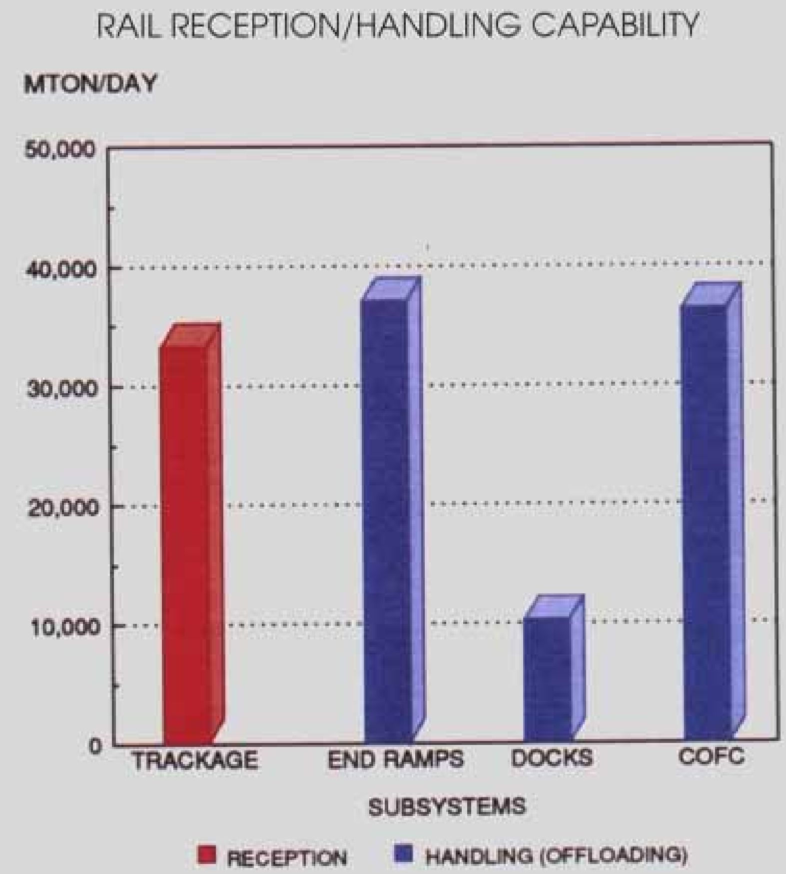


RECEPTION HANDLING (OFFLOADING)

Rail

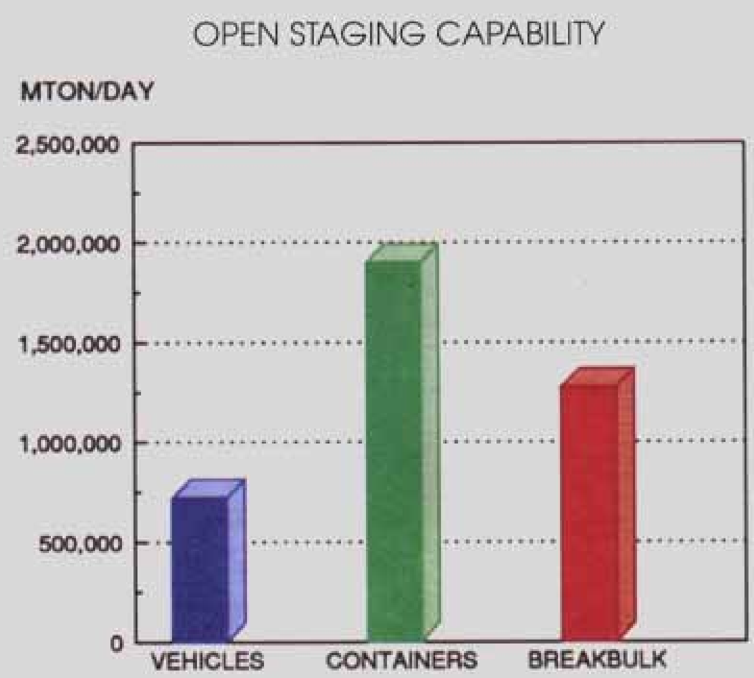
Rail reception at the Port of Seattle is very good, with two commercial carriers serving the Seattle area. No railyards are on the port; however, local railyards could store about 652 89-foot railcars. This is based on 30 percent availability of track space. The current rail service to the port varies, but averages about three trains a day for each of the two carriers.

Since the port has no rail end ramps, offloading must occur at the local railyards. The port receives very few boxcar shipments. Because of this, there are few box-car positions available for offloading. Many of these positions are at covered storage facilities under lease. An RTCH and/or crane will offload containers.



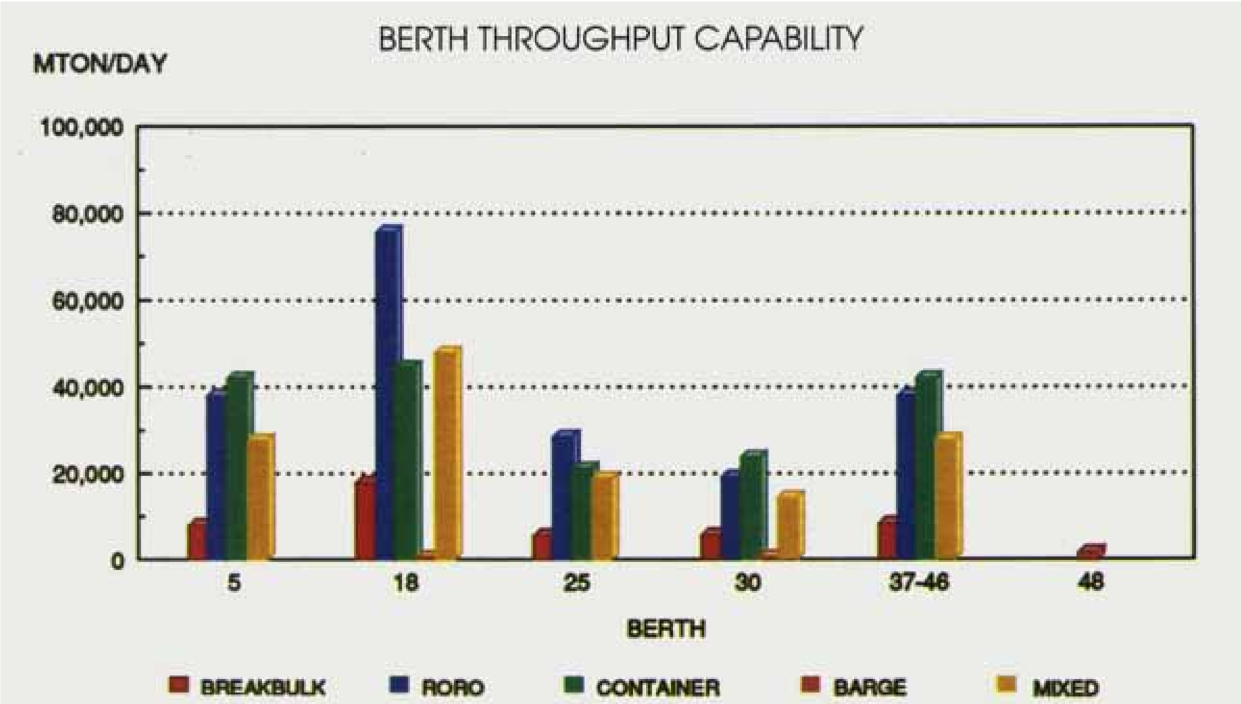
STAGING

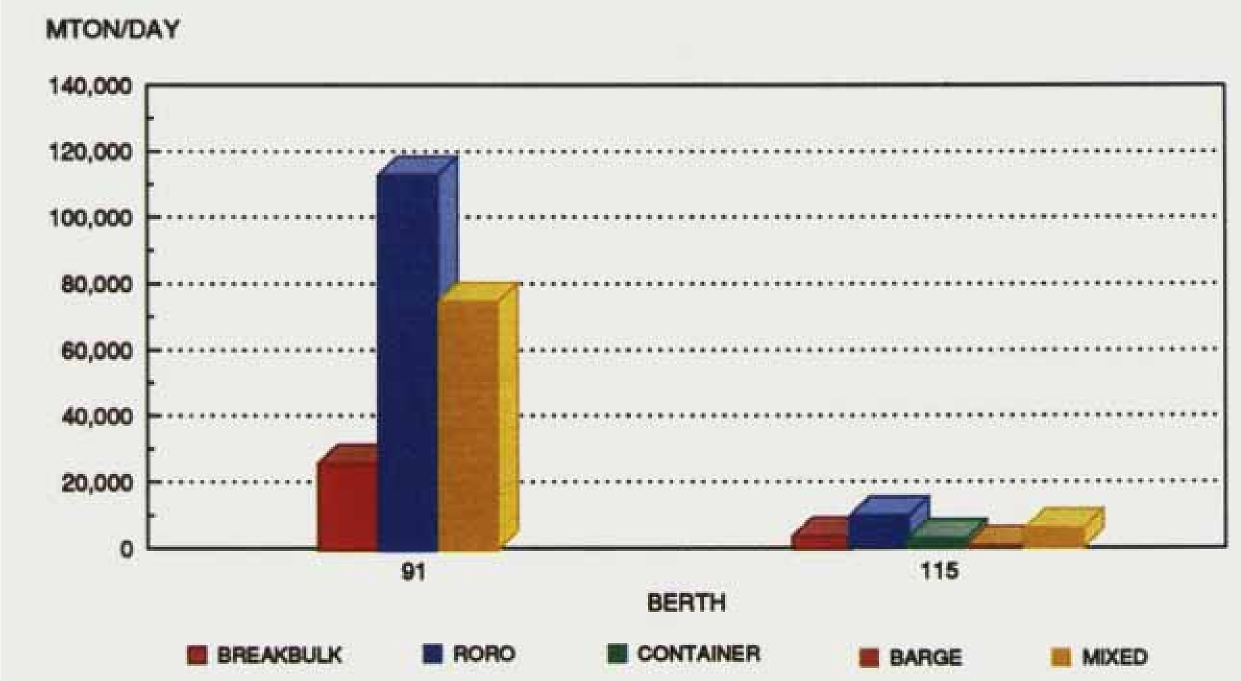
The port has about 550 acres of paved open storage for vehicles and/or containers. This acreage can store about 720,500 MTON of rolling stock, or 1,901,300 MTON of containers, or 1,274,800 MTON of breakbulk cargo. Also, 804,255 square feet of covered storage provides protection for almost 32,200 MTON of palletized cargo.



SHIPPING

The following figures show the throughput capability per terminal in MTON per day for break-bulk, RORO, container, and mixed vessels. These results are based on various factors including MHE used, loading, operational, and terminal usage rates, as well as terminal/ship compatibility.





CONVERSION FACTORS

Breakbulk	.4	STON per MTON
RORO	.25	STON per MTON
Containers	.4	STON per MTON

Table 1 shows the terminal/ship compatibility for various vessel types. This table indicates, for each type of ship, the number of vessels that can berth at a particular terminal. It also provides the limitations that can hinder shipping operations.

A methodology that gives a snapshot view of the current physical characteristics of the berths and the MHE available provides the basis for the type of ship preferred at each berth. The evaluation gives no considerations for enhancements, such as equipment. The analysis results show that berths 18 and 30 are the most compatible for all ship types.

PREFERENCE TERMINAL SELECTION

LOADING TYPE	TERMINALS							
	5	**18**	**25**	**30**	**37-46**	**48**	**91**	**115**
Breakbulk	4	1	4	1	4	7	8	3
RORO	3	1	3	1	3	-	7	6
Container	3	1	3	2	3	-	7	6
Barge	4	1	4	1	4	7	8	3

NOTES:
Terminal marked with "-" are not recommeded for these operations. The numbers refer to the terminal ranking in terms of terminal preference. For example, terminal 18 has a number 1 ranking for container loading; hence, it is the preferred terminal for these operations.

TABLE 1
SUMMARY OF SEATTLE BERTHING CAPABILITIES

Vessel	Berths									
	T5	T18A	T18B	T25	T30	T115	37-46	48A	48B	91
Breakbulk										
C3-S-33a	5	4	7	3	3	a	5	b	1	16
C3-S-37c	5	4	7	3	3	a	5	b	1	16
C3-S-37d	5	4	7	3	3	2	5	b	1	16
C3-S-38a	5	4	7	3	3	2	5	b	1	16
C4-S-1a	4	3	6	3	3	2	4	b,c	c	14
C4-S-1qb and 1u	4	3	6	3	3	a	4	b,c	c	14
C4-S-58a	4	3	6	3	3	a	4	b,c	c	14
C4-S-65a	4	3	6	3	3	2	4	b,c	c	14
C4-S-66a	4	4	6	3	3	a	4	b,c	c	15
C4-S-69b	4	3	6	3	3	a	4	b,c	c	14
Seatrain										
GA and PR-class	4	3	6	3	3	2	4	b,c	c	14
Barge										
LASH C8-S-81b	3	2	4	2	2	a,f	3	c	c	10
LASH C9-S-81d	g	g	g	g	g	a,g	2	a,c	a,c	a
LASH lighter	19	16	27	14	13	8	19	b	3	61
SEABEE C8-S-82a	g	g	g	g	g	a,g	3	a,c	a,c	a
SEABEE barge	13	11	18	10	9	6	13	b	2	42
RORO										
Comet	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	b,d,o	d,o	d,i,j
C7-S-95a/Maine-class	3,i	2,i	4,i	2,i	2,i	a	3,i	b,c	b,c	11,i
Ponce-class	b,h	h	h	h	h	h	h	b,c,h	b,c,h	b,h
Great Land-class	b,h	h	h	h	h	h	h	b,c,h	b,c,h	b,h
Cygnus/Pilot-class	4,i	3,i	5,i	3,i	2,i	1,i	4,i	b,c	b,c	12,i
Meteor	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	b,c,d,o	c,d,o	d,o
AmEagle/Condor	i,j	i,j	i,j	i,j	i,j	i,j	i,j	b,c	b,c	i,j
MV Ambassador	d	d	d	d	d	d	d	b,c,d,o	c,d	d
FSS-class	2,i,n	2,i,n	3,i,n	2,i,n	1,i	a	2,i,n	b,c	b,c	8,i,n
Cape D-class	i,j	i,j	i,j	i,j	i,j	a	i,j	b,c	b,c	i,j
Cape H-class	3,i	2,i	4,i	2,i	2,i	a	3,i	a,b,c	a,b,c	a
Container										
C6-S-lw	4	3	5	2	2	1,e	4	b,c,e	c,e	12,e
C7-S-68e	3	3	5	2	2	a,e	3	b,c,e	c,e	11,e
C8-S-85c	3	2	4	2	2	a,e	3	b,c,e	c,e	10,e
Combination										
C5-S-78a	4	3	6	3	2	a,e	4	b,c,e	c,e	13,e
C5-S-37e	4	3	6	3	2	1,e	4	b,c,e	c,e	13,e

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=inadequate berth depth, adequate anchorage depth
g=inadequate channel depth

h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

III. APPLICATION

GENERAL

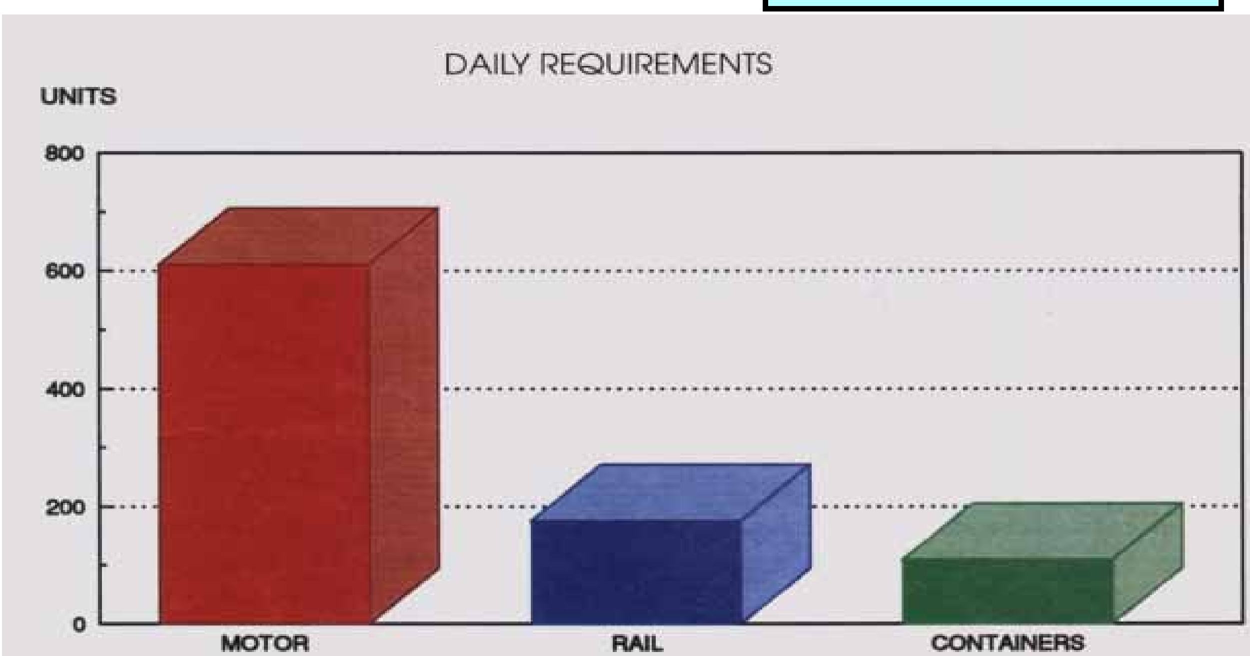
In this section, we evaluate the port's throughput capability for deploying a notional mechanized infantry division mainly by FSS vessels. The MARAD *Planning Orders Digest* does not call for use of the Port of Seattle's facilities during national emergencies. Because most of the port's facilities are leased out, the availability of these facilities may range from 25 to 50 percent during deployment. The Military Traffic Management Command (MTMC) maintains an outport in the Seattle area for coordinating military movements.

REQUIREMENTS

The likely requirement for the Port of Seattle is to deploy a notional mechanized infantry division in 6 days. The division has to move about 7,800 vehicles and 660 containers. The movement of this division to the port will require 1,055 (176 per day) railcars under a convoy/rail option. Under this option, the deploying units would drive about 3,650 (610 per day) roadable vehicles and tow another 2,320 (387 per day) pieces of equipment.

MECHANIZED INFANTRY DIVISION DEPLOYMENT DATA

Total Equipment	
Volume	274,518 MTON
Weight	95,010 STON
Area	1,422,844 SQ FT
Vehicles	7,800
Containers	660

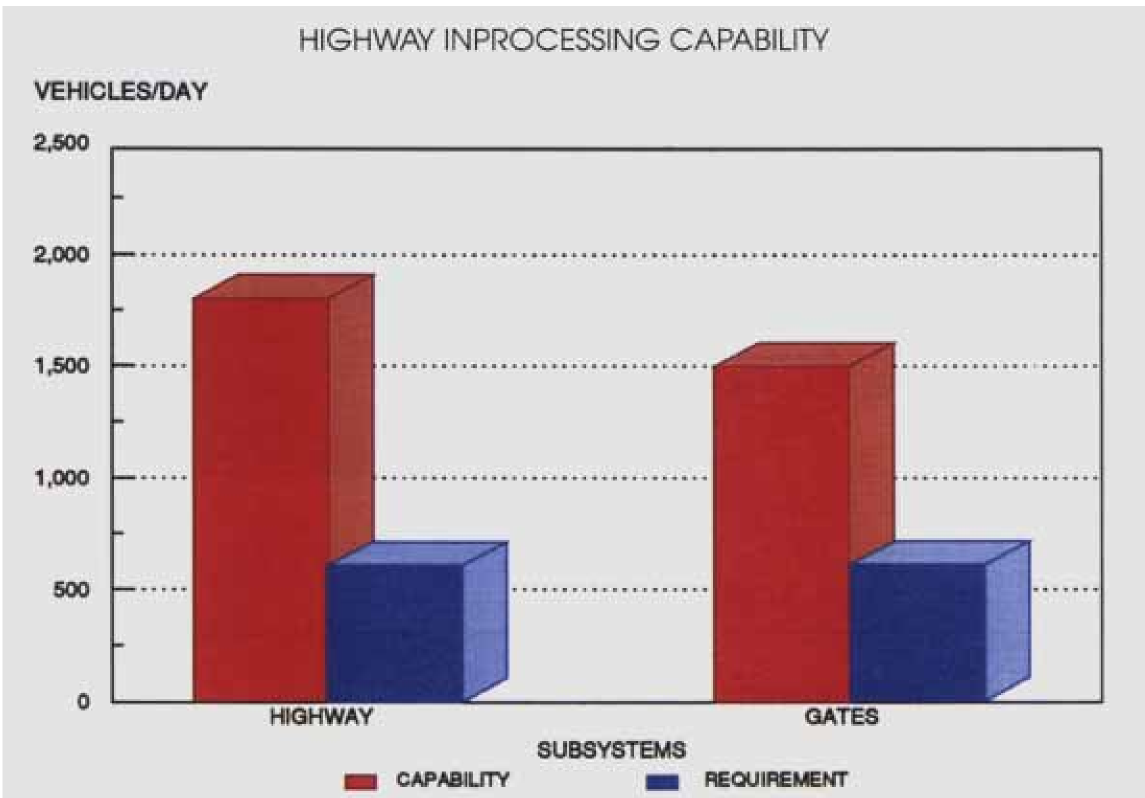


Terminal Handling

Highway

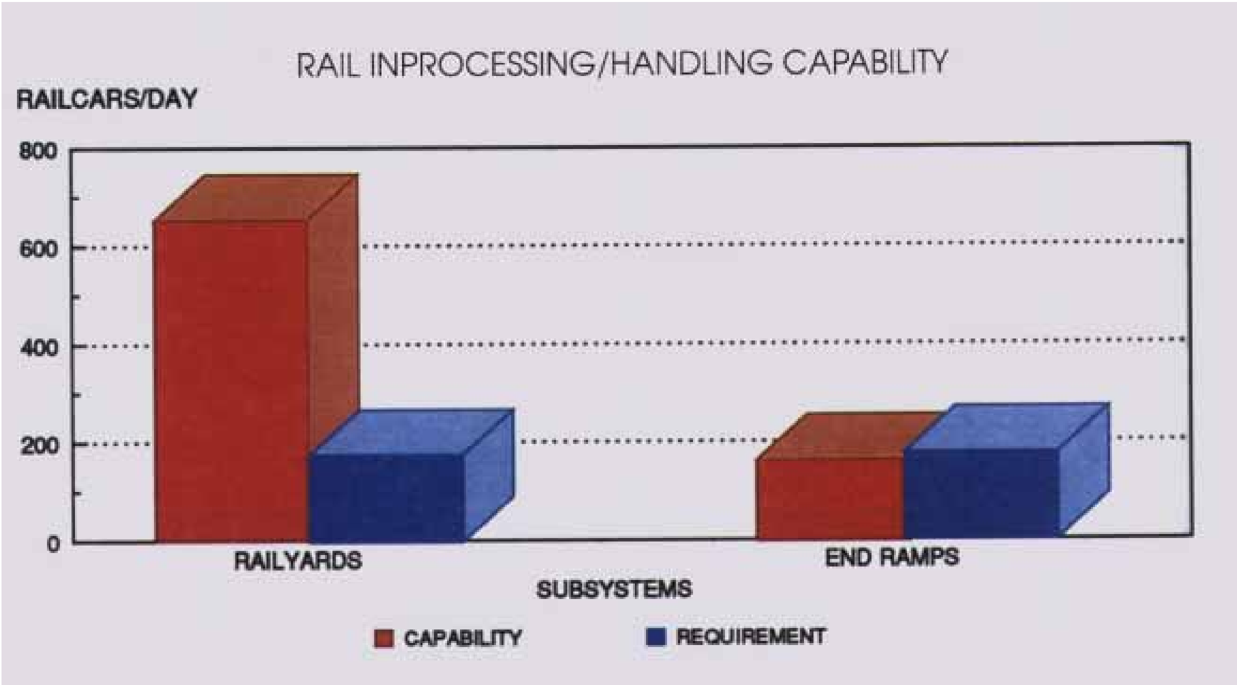
At the Port of Seattle, vehicles and containers on chassis would access Terminal 18 from I-5 via S Spokane Street and 11th Avenue SW. Three gates access Terminal 18 from 11th Avenue SW. Terminal 30 is accessible from I-5 via S Spokane Street and E Marginal Way S (Alaskan Way). Two gates provide access to Terminal 30.

The access roads and gate processing subsystems for the port could handle an additional 4,500 vehicles per day.



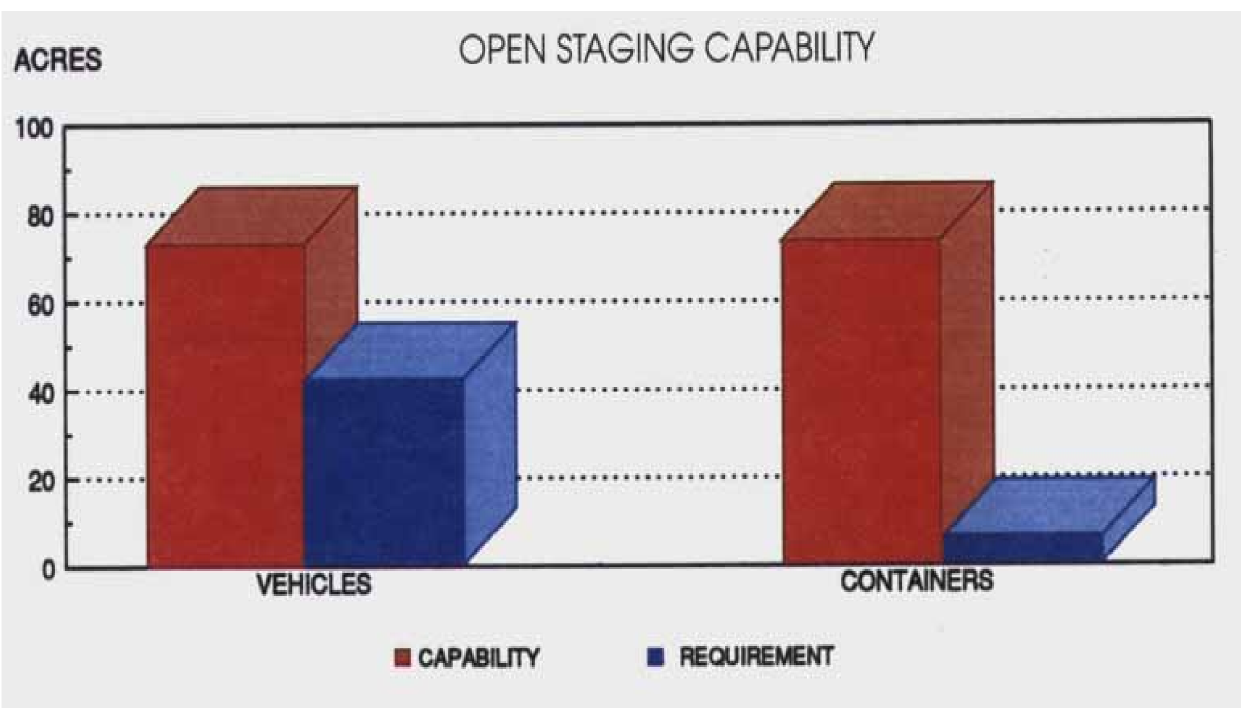
Rail

The classification yards near the ports could handle about 652 railcars per day for Seattle. Using all available end ramps (4 fixed and 2 portable) in the Seattle area (BN and UP railyards), stevedores or military personnel could offload about 41 railcars every 5 hours. This equates to about 164 railcars per day. This conclusion assumes 2 cycles within a 5-hour period at the 4 fixed rail ramps (maximum of 2 railcars per ramp) and 1 cycle every 5-hour period at the 2 portable end ramps (12 railcars per ramp).



STAGING

If 25 percent of the open staging facilities at the Port of Seattle are available to the military for deployment, then deploying units would have access to about 146 acres. We estimate that a mechanized infantry division needs about 48 acres of open staging to support the concurrent sustained loading of three FSS vessels. Divided between vehicles and containers, the staging area requirement becomes 42 and 6 acres for vehicles and containers, respectively.



SHIPPING

The number of ships needed to load this requirement depends on the shipping mix selected. The best ship mix would require all eight FSSs and two Cape H RORO ships.

The preferred terminals for a military deployment are Terminals 5, 18, 25, 30, and 37-46 because of their deck strength and availability of container and wharf cranes. Based on 25 percent availability of port facilities, deploying units would have three ship berths from which to deploy. Based on 2 days to load a ship, a division can outload within the 6-day requirement from the Port of Seattle.

UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

	VESSEL TYPES			
LOADING CONDITION/ SAMPLE SHIP MIX	**FSS (RORO/COMB)**	**CAPE H (RORO/COMB)**	**C3/C4 (BREAKBULK)**	**C6/C7/C8 (CONTAINER)**
Minimum Containerization				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization				
FSS and Container	7.90			2.00
FSS,Cape H, and Container	4.62	3.00		2.00
Breakbulk and Container			29.58	2.00

*Only 8 FSSs are available. Unit shipping requirements exceed the capacity of these 8 vessels, Other vessel types are required to make up the FSS shortfall (Cape H).

Legend:

RORO - roll on/roll off

FSS - fast sealift ship

Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide, Aug 91.

SUMMARY

The Port of Seattle can outload a mechanized infantry division within the 6-day outloading requirement using FSS ships provided the channel and berth depth are adequate for FSS vessels and portable heavy-duty end-ramps are obtained for offloading railcars and semitrailers.

The Port of Seattle does not have any end ramps; therefore, offloading operations must occur at the nearby commercial railyards unless deploying units jury rig some temporary end ramps. This may cause highway congestion leading from the railyards to the port. The Port of Seattle may wish to obtain the MTMCTEA-designed heavy-duty ramps for offloading railcars and semitrailers. These ramps should be available sometime in 1994.

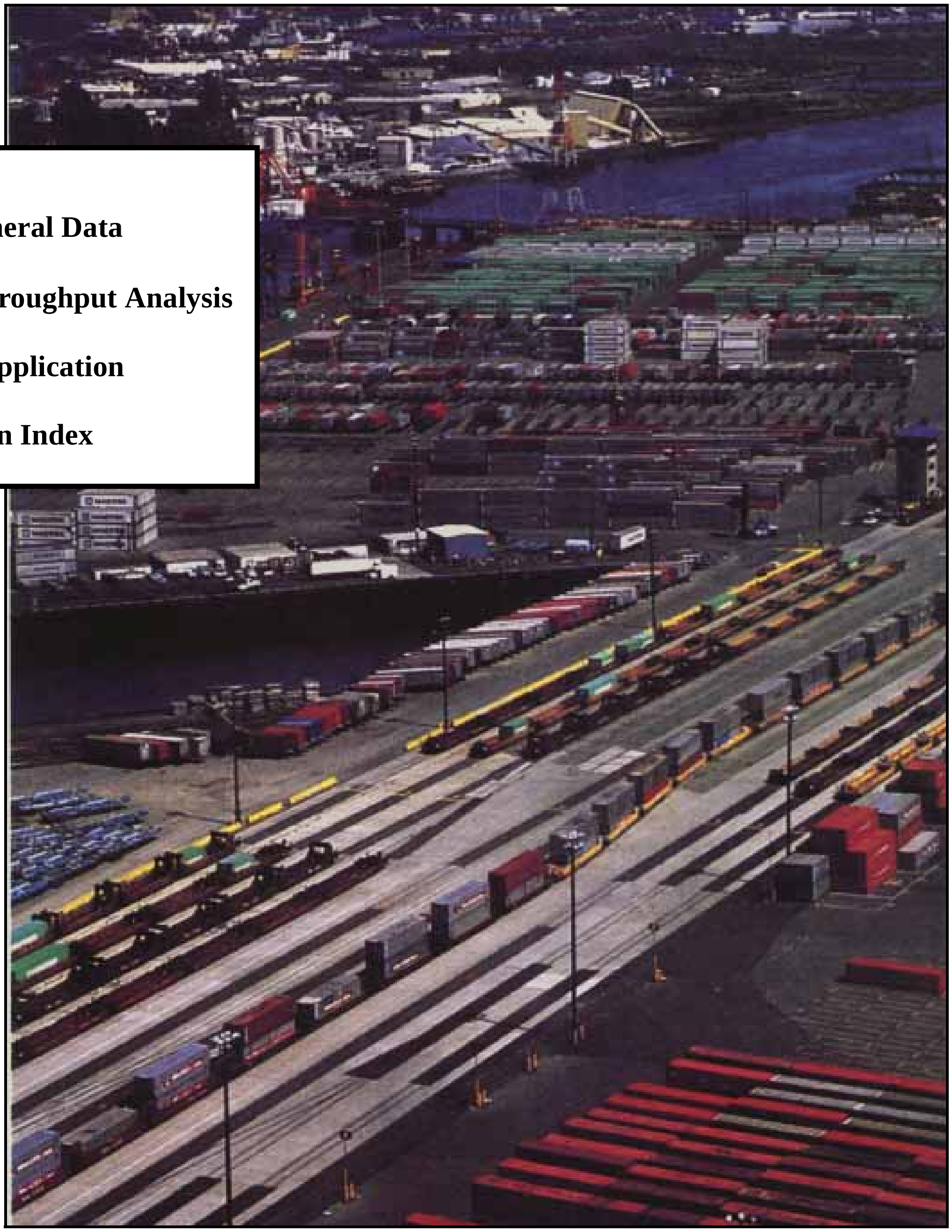
RECOMMENDATIONS

We recommend that the Port of Seattle obtain at least two heavy-duty portable end ramps to allow flexibility in offloading heavy equipment from both railcars and semitrailers. The MTMCTEA-designed end ramp is a potential solution to this recommendation.

September 94

PORT OF TACOMA

TACOMA, WASHINGTON

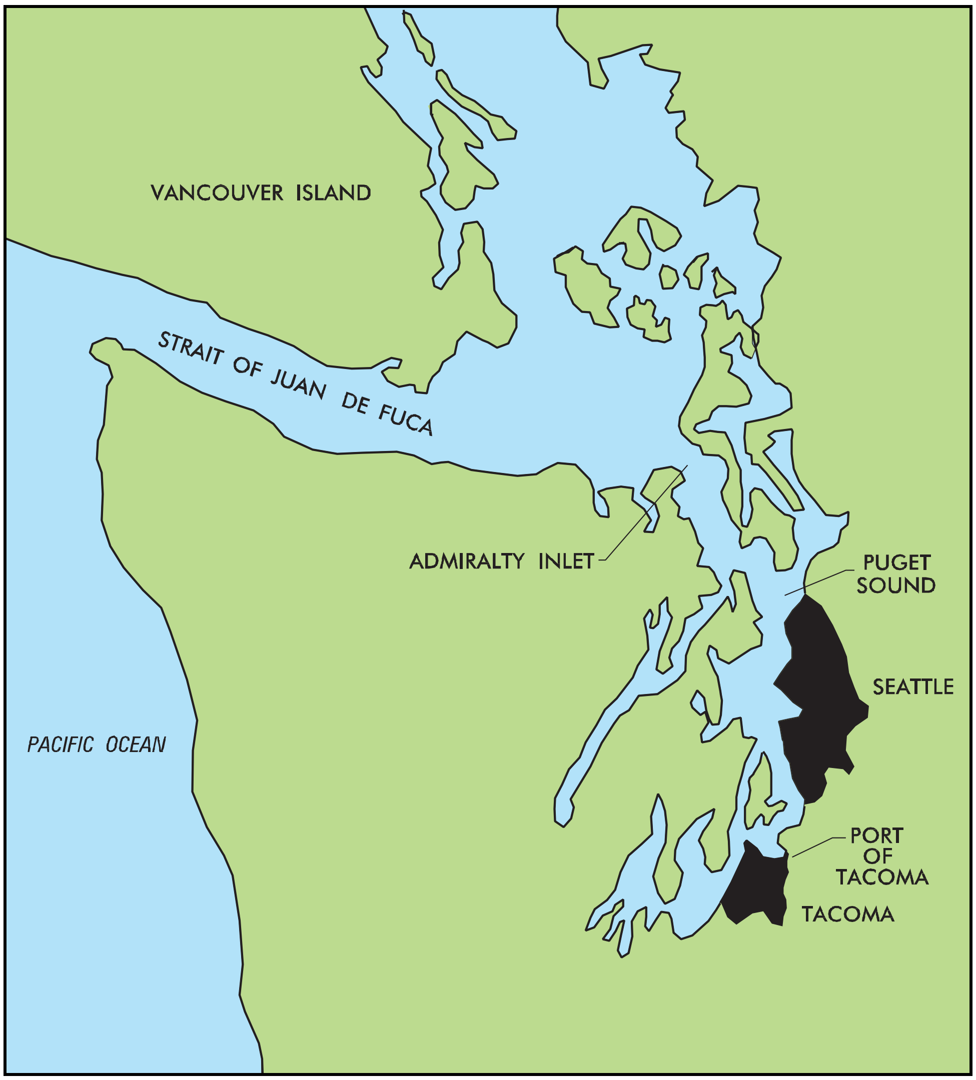


I. GENERAL DATA

TRANSPORTATION ACCESS

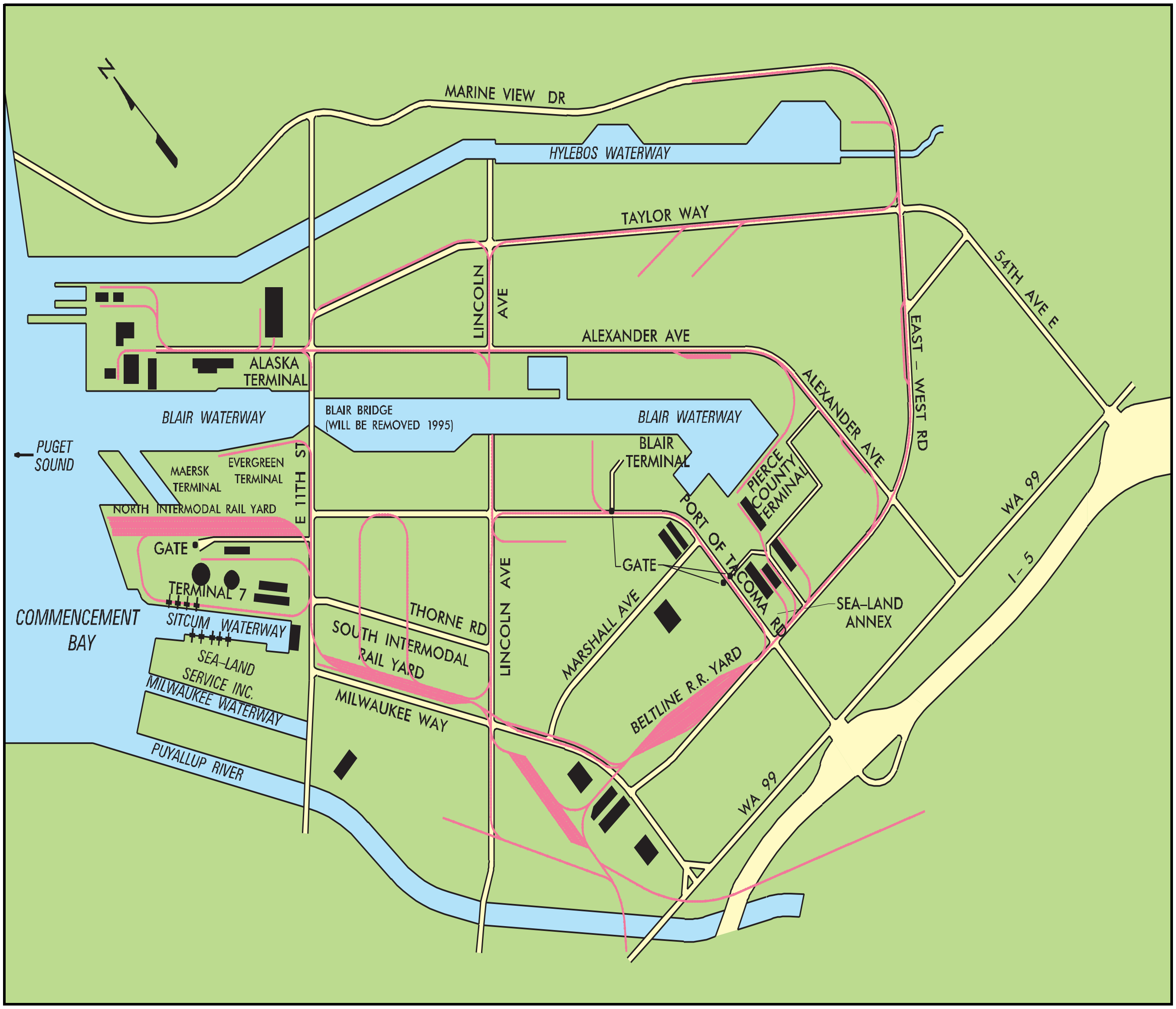
Water

The Port of Tacoma is in northwest Washington State, on Puget Sound. It is about 30 miles south of the Port of Seattle. Ships may access this port from the Pacific Ocean via Strait of Juan de Fuca, Admiralty Inlet, and Puget Sound. The Port of Tacoma is 142 nautical miles from the Pacific Ocean.



Water Access

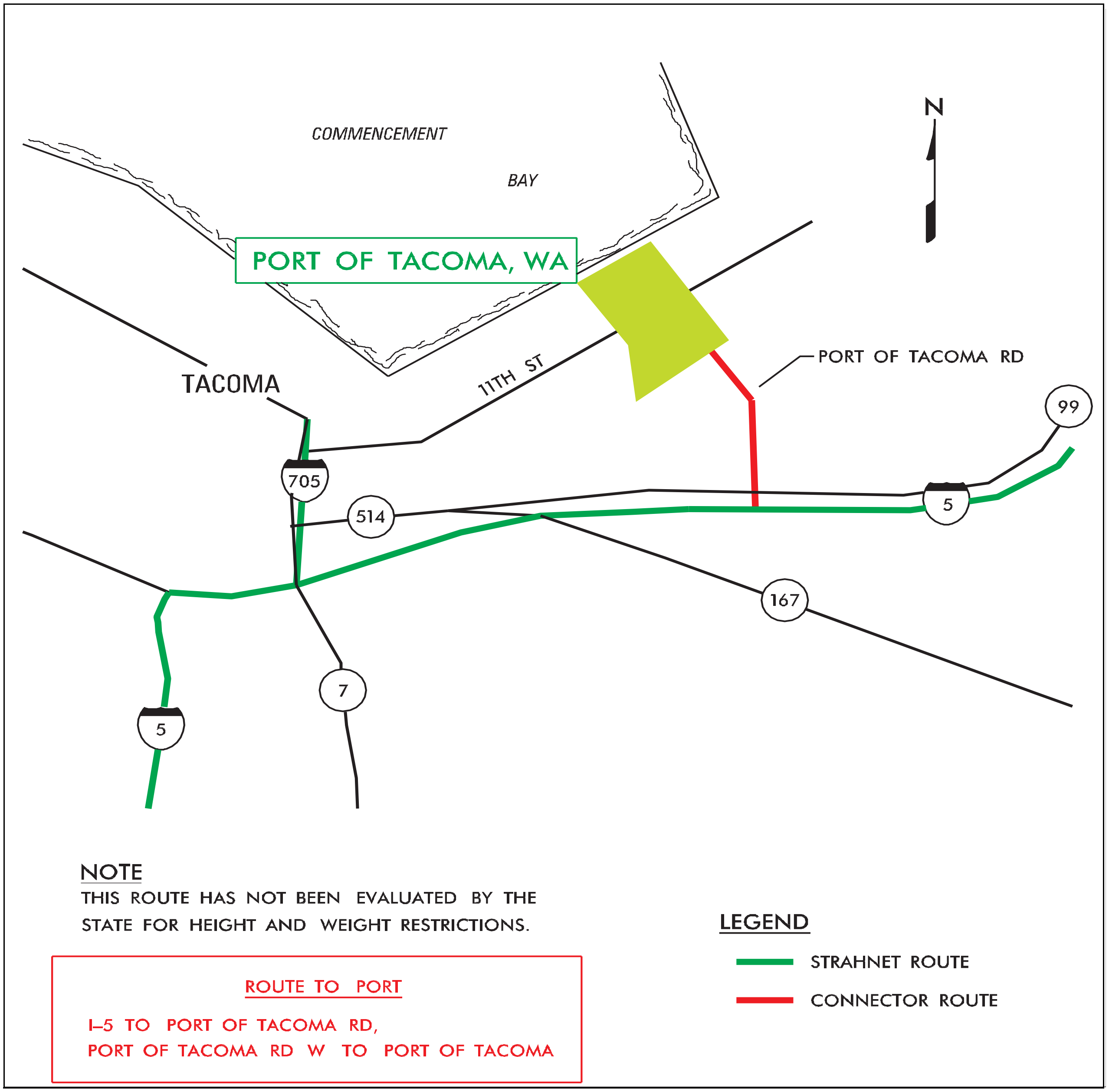
The Port of Tacoma has one bridge restriction, a 150-foot horizontal clearance, across Blair Waterway. This bridge is the 11th Street Drawbridge.



Highway Access

Highway

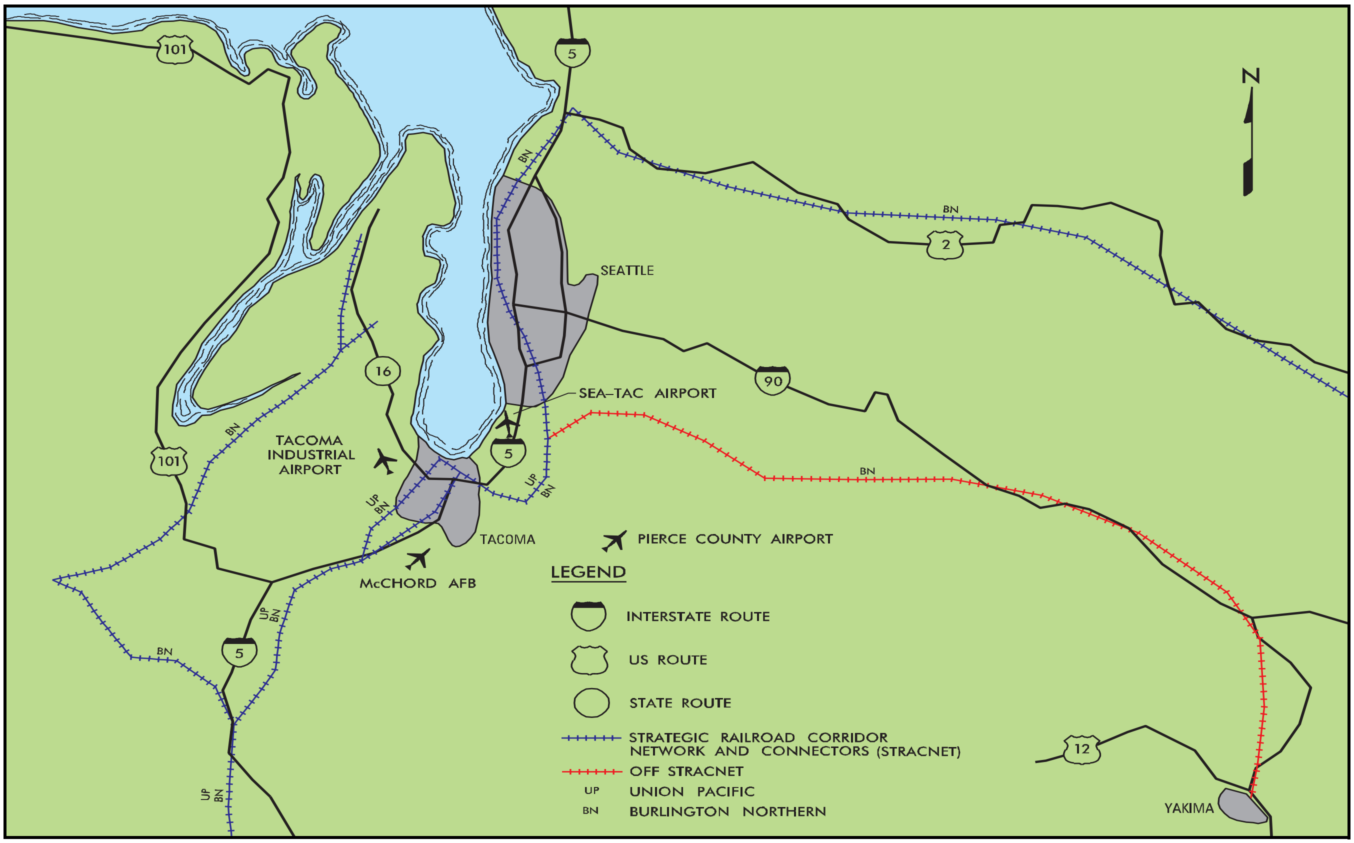
The Strategic Highway Corridor Network (STRAHNET) route to the Port of Tacoma is Interstate Route 5. The connector route is Port of Tacoma Road. Clearances are not a problem on this route. An alternate route to the port from I-5 is Interstate Route 705, connecting with 11th Street. The lowest clearance restriction on the alternate route is 13 feet 11 inches.



Highway Access

Rail

The Burlington Northern (BN) and Union Pacific (UP) railroads serve the Port of Tacoma. The Tacoma Municipal Belt Line Rail Company (TMBR) provides switching services within the port for both UP and BN. TMBR is a city-owned rail operator for the Port of Tacoma. BN, UP, and TMBR all have railyards near the port. Rail clearances are sufficient for bilevel and trilevel railcars to access the port



Airports

Three commercial airfields and one military airfield are near the Port of Tacoma. Information on these airfields appears on the right. (See the Rail and Airport Access Map on the previous page for locations of these airfields.)

AIRFIELDS NEAR TACOMA

NAME	TYPE	NO. OF RUNWAYS	LONGEST RUNWAY DIM (ft)	DISTANCE FROM PORT (mi)
Sea-Tac	Commercial	2	11,900 x 150	16
Tacoma Industrial	Commercial	1	5,002 x 150	15
Pierce Co	Commercial	1	3,600 x 60	15
McChord AFB	Military	1	10,100 x 150	10

PORT FACILITIES

Berthing

The Port of Tacoma is a multicargo operation port with a specialization in shipping containers. The port consists of marginal wharves and finger piers. Pier construction varies from terminal to terminal, but generally involves concrete or timber piles, concrete or timber decking, and asphalt, concrete, or timber surfacing. Lighting is good for night operations.

Figure 1 is a land-use map for the Port of Tacoma. Figures 2 through 6 are aerial views of the Port of Tacoma, with tables identifying berth characteristics.

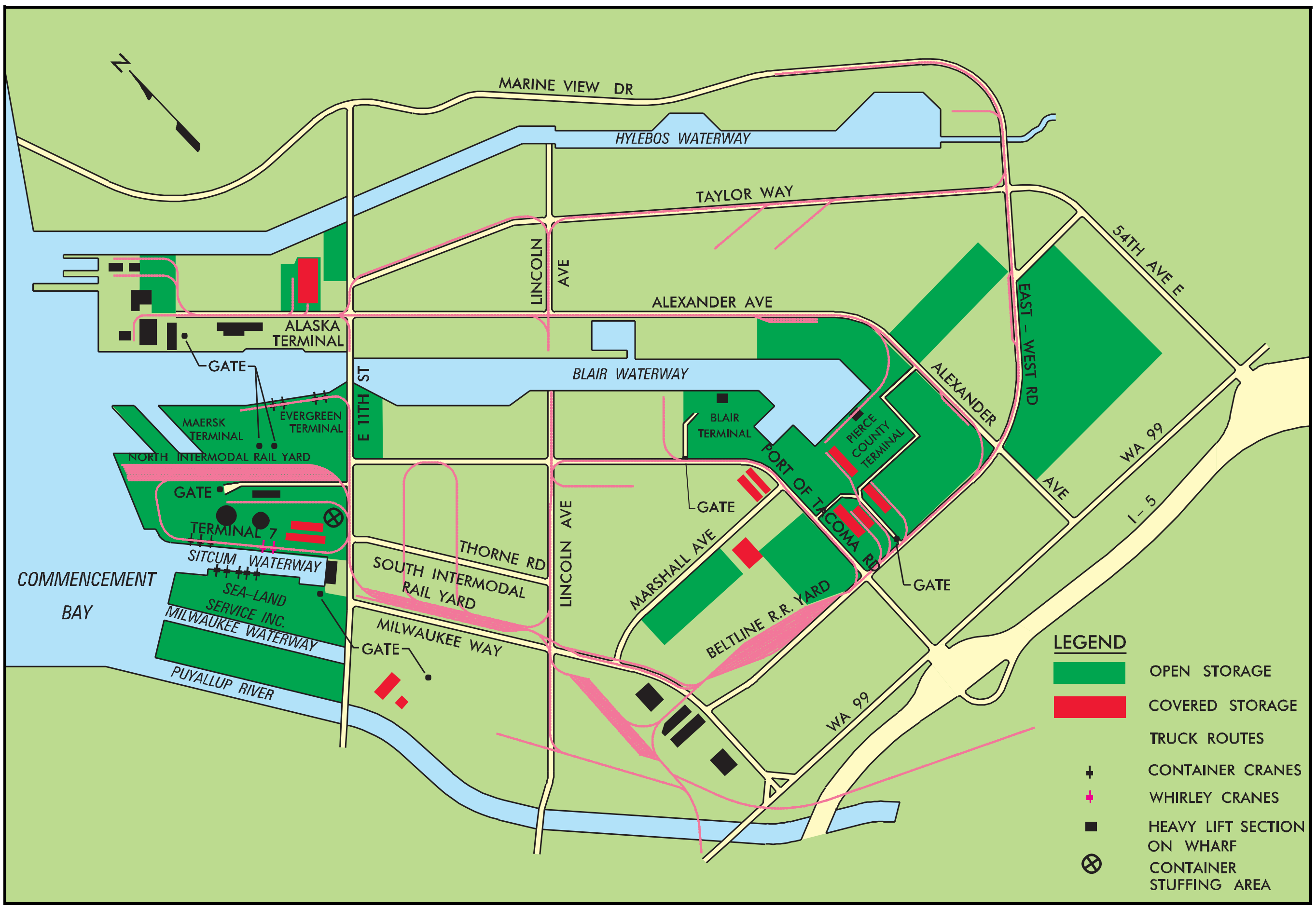


Figure 1. Land-Use map for the Port of Tacoma.

Figure 2. Terminal facilities for Port of Tacoma (aerial view)

PIER 2

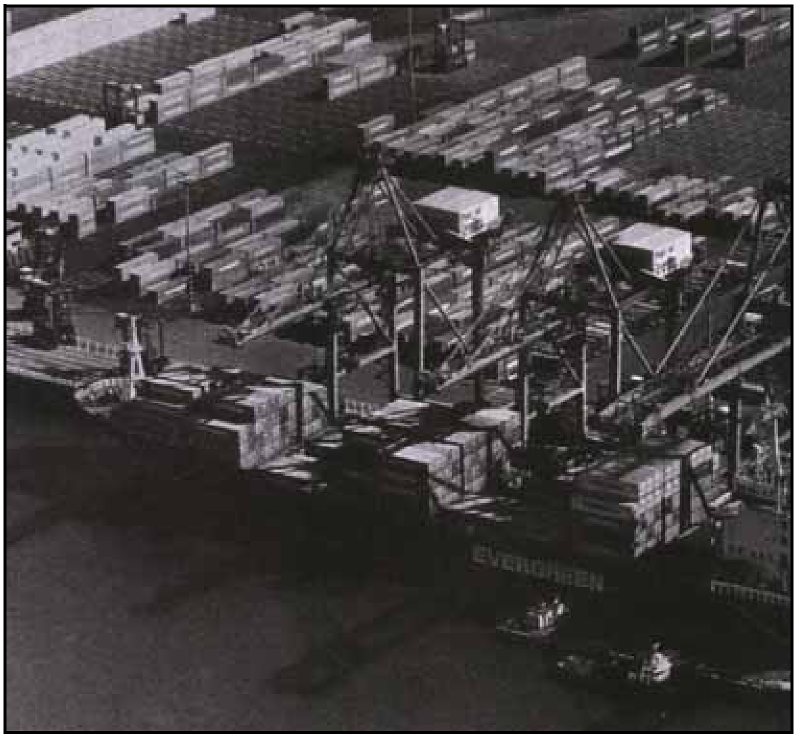
CHARACTERISTICS	BERTH Pier 2
Length (ft)	1,600
Depth alongside at MLW (ft)	35
Deck strength (psf)	Restricted use
Apron width (ft)	35
Apron height above MLW (ft)	22
Number of container cranes	0
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

This facility is currently not in use. The Port of Tacoma plans to fill in this area.

TERMINAL 3 - MAERSK

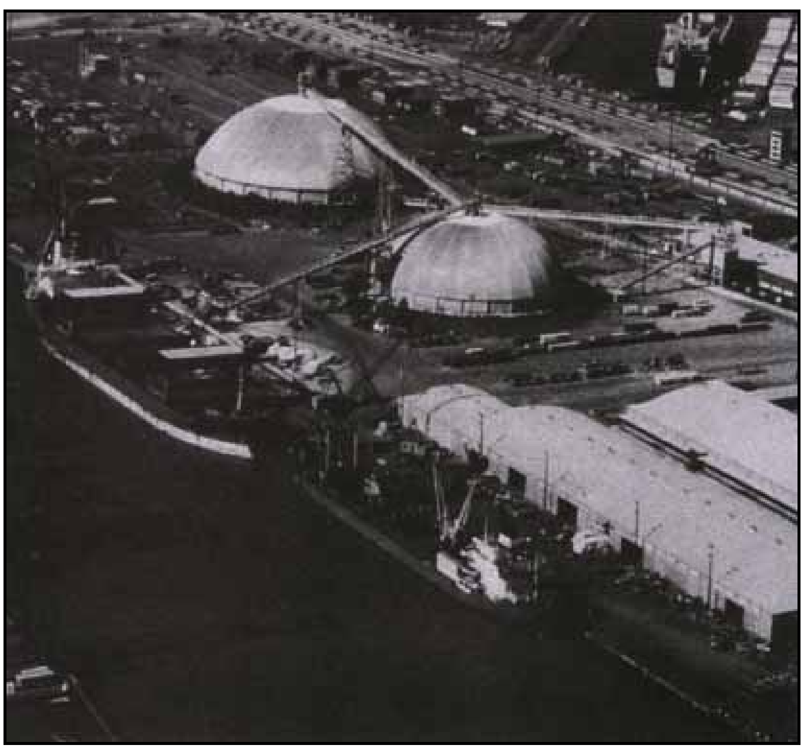
CHARACTERISTICS	BERTH Maersk
Length (ft)	950
Depth alongside at MLW (ft)	42
Deck strength (psf)	2,000
Apron width (ft)	Open
Apron height above MLW (ft)	18
Number of container cranes	3
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

Figure 3. Berth characteristics for Pier 2 and Maersk Terminal, Port of Tacoma.



TERMINAL 3 - EVERGREEN

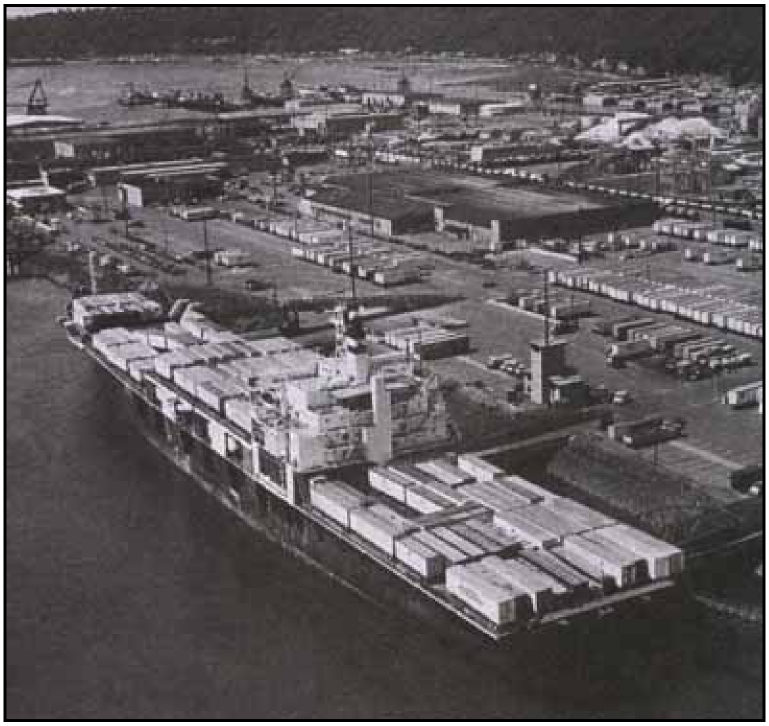
CHARACTERISTICS	BERTH Evergreen
Length (ft)	1,900
Depth alongside at MLW (ft)	40
Deck strength (psf)	600
Apron width (ft)	Open
Apron height above MLW (ft)	18
Number of container cranes	3
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	1,900



TERMINAL 7

CHARACTERISTICS	BERTH 7
Length (ft)	2,700
Depth alongside at MLW (ft)	40
Deck strength (psf)	600
Apron width (ft)	Open
Apron height above MLW (ft)	18
Number of container cranes	3
Number of wharf cranes	3
Apron lighting	Yes
Straight-stern RORO facilities	Yes
Apron length served by rail (ft)	2,700

Figure 4. Berth characteristics for Evergreen and Number 7 Terminals.



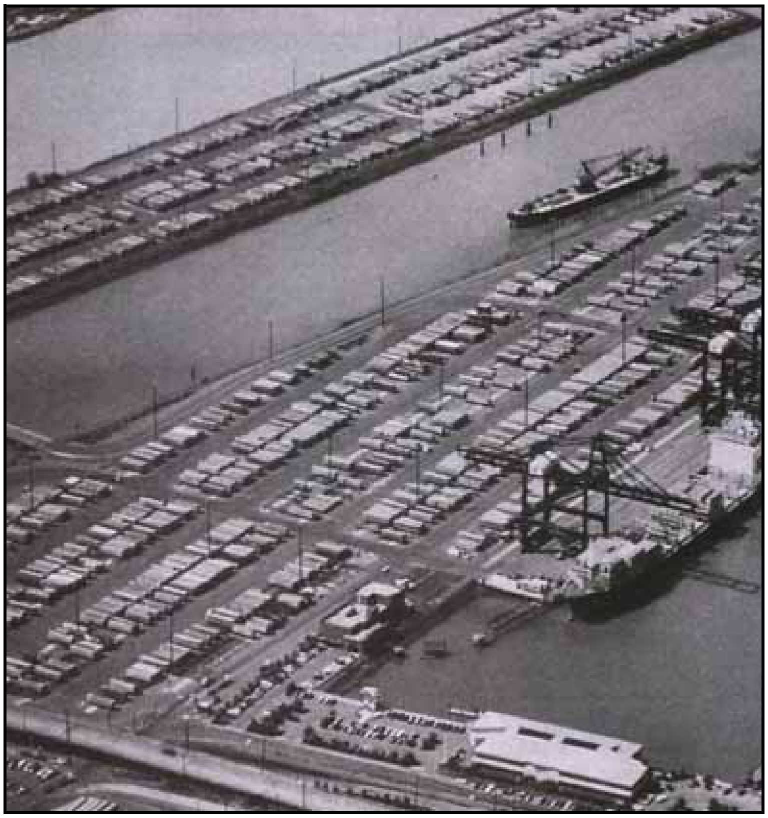
TOTEM OCEAN TRAILER EXPRESS TERMINAL

CHARACTERISTICS	BERTH Alaska
Length (ft)	800
Depth alongside at MLW (ft)	50
Deck strength (psf)	1,000
Apron width (ft)	Open
Apron height above MLW (ft)	18
Number of container cranes	0
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	Yes
Apron length served by rail (ft)	0

BLAIR TERMINAL

CHARACTERISTICS	BERTH Blair
Length (ft)	1,200
Depth alongside at MLW (ft)	35
Deck strength (psf)	1,000
Apron width (ft)	Open
Apron height above MLW (ft)	22
Number of container cranes	0
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

Figure 5. Berth characteristics for Alaska (Totem) and Blair Terminals.



SEA-LAND TERMINAL

CHARACTERISTICS	BERTH SL
Length (ft)	1,600
Depth alongside at MLW (ft)	50
Deck strength (psf)	1,000
Apron width (ft)	Open
Apron height above MLW (ft)	19
Number of container cranes	5
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

PIERCE COUNTY TERMINAL

CHARACTERISTICS	BERTH Pierce Co
Length (ft)	1,420
Depth alongside at MLW (ft)	45
Deck strength (psf)	1,000
Apron width (ft)	Open
Apron height above MLW (ft)	22
Number of container cranes	0
Number of wharf cranes	1
Apron lighting	Yes
Straight-stern RORO facilities	Yes
Apron length served by rail (ft)	1,420

Figure 6. Berth Characteristic for Sea-Land and Pierce County Terminals.

Staging

OPEN STAGING

The Port of Tacoma has about 420 acres of open staging available. Of this total, 410 acres have an asphalt surface. The remaining 10 acres have a surface that is part asphalt and part gravel. The following chart shows the distribution of open staging per terminal. Helicopter operations are possible at several locations. No helicopter pads are on the port; however, helicopters have flown from Terminal 7 and Pierce County Terminal. Areas with potential for helicopter operations are Pierce County Terminal, Terminal 7, Terminal 4 (Evergreen), Sea-Land, and Alaska Terminal. (See fig 1 for locations of these terminals.) The Pierce County Terminal and Terminal 7 have adjacent covered storage.

OPEN STAGING

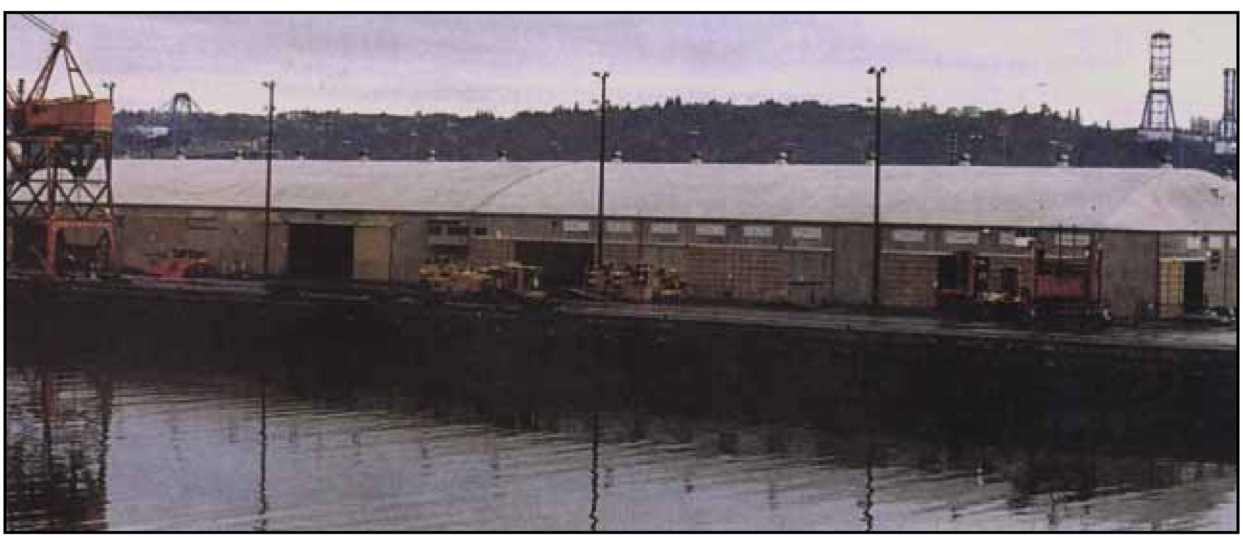
TERMINAL	OPEN STAGING ACREAGE	BERTHS SERVED
Maersk	40	All
Evergreen	26	All
Seven	79	All
Alaska	33	All
Sea-Land	86	All
Blair	10	All
Pierce County	147	All

Open Staging Area at Pierce County Terminal (southeastward view)

COVERED STAGING

The Port of Tacoma has about seven covered facilities (transit sheds, container freight stations, and warehouses) providing 612,400 square feet of covered storage.

Covered Storage Facility, Pierce County Terminal



Covered Storage Facility, Terminal 7

Rail

Rail trackage links the railyards to the Port of Tacoma's apron tracks, transit sheds, and storage tracks. Apron tracks are in the Terminal 7 and Evergreen and Pierce County Terminals.

Apron Tracks at Terminal 7

Railyards on the port (not including the intermodal yards) total about 2,640 feet of track. This trackage can hold about twenty-eight 89-foot railcars. The commercial railyards near the port, with about 200,000 feet of track, can handle about 2,900 89-foot railcars. Day-to-day availability of this storage space varies but can be as low as 30 percent of the total capacity.

Highway

At the Port of Tacoma, the roads are two laned, except for Port of Tacoma Road. Port of Tacoma Road is four laned, with a turning lane. Highway clearances vary, but are generally around 14 feet for vertical clearance. Truck scales are available at all terminals except Blair and Pierce County Terminals.

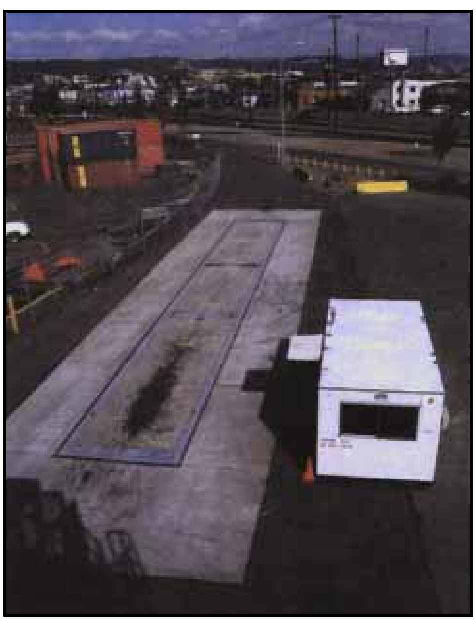
Unloading/loading Positions

RAMPS

The Port of Tacoma has two portable steel end ramps. These ramps can serve as truck or rail end ramps. The capacity of these portable ramps is not available; however, the ramps have been used for offloading tracked commercial vehicles (such as crawler tractors) weighing up to 65 tons. BN has an additional end ramp at its classification yard in Tacoma.

DOCKS

The port has four covered storage facilities with platform-level truck docks providing 132 truck handling positions. Also available are platform-level rail docks providing 114 boxcar handling positions. If needed, these docks provide a drive-through capability for offloading vehicles provided adequate overhead and side clearances exist.



Truck Scales at Terminal 7
(southeast view)

Portable Steel End Ramp

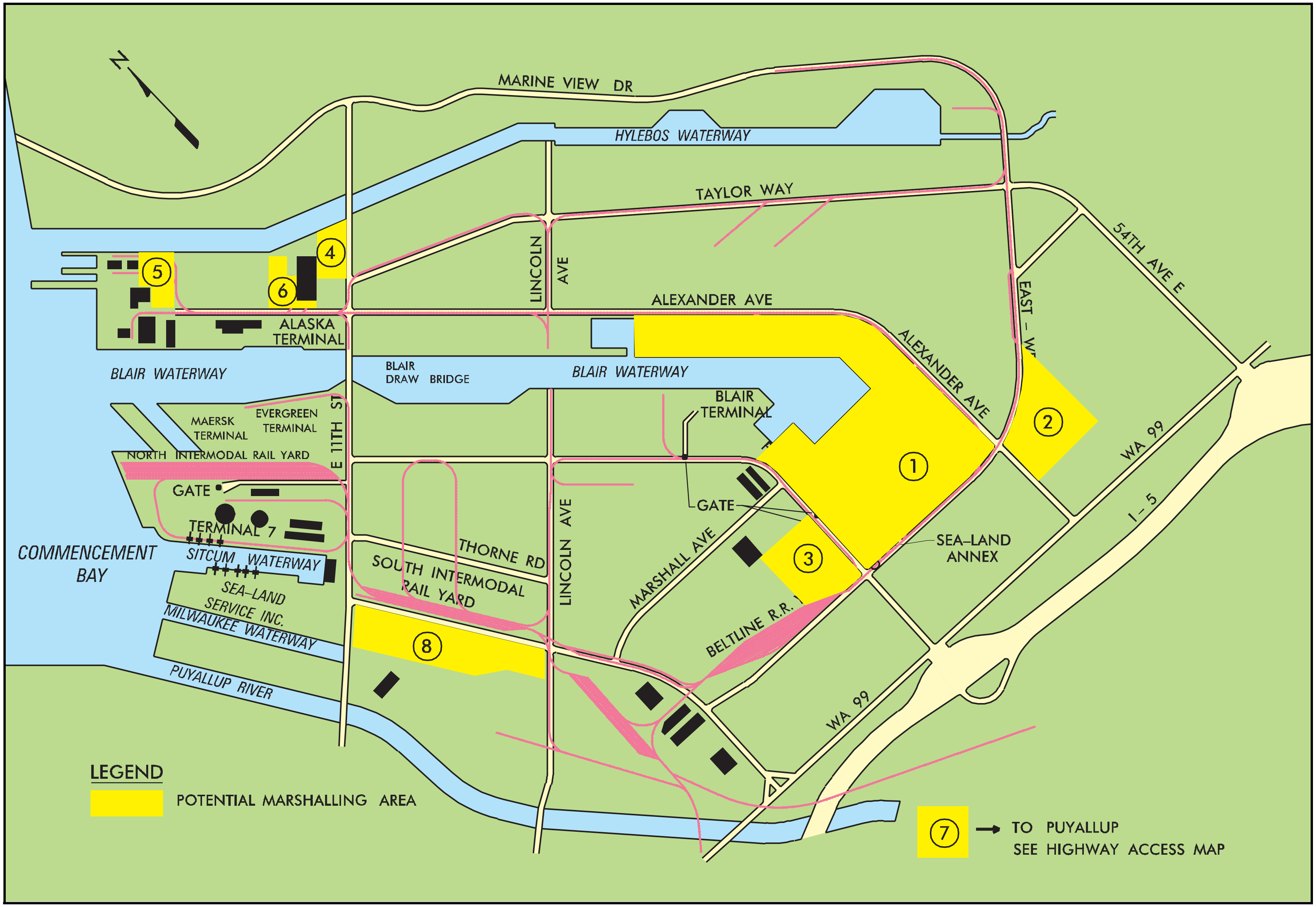
Dock Operations at Container Freight Station Behind Terminal 7 (north view)

Marshaling Areas

The Port of Tacoma lists several areas with potential for use as marshaling areas. All these areas except one are within the port. The areas within the port can double as staging areas as well as provide a marshaling area capability. The following chart and corresponding figure show the potential marshaling areas for the Port of Tacoma.

POTENTIAL MARSHALING AREAS

FIGURE NO.	DESCRIPTION AND LOCATION	ACREAGE
1	Pierce County Terminal - Port of Tacoma Rd and East-West Rd/Alexander Ave	147
2	Area between East-West Rd, Alexander Ave, and 12th St East	20
3	Area bordered by Port of Tacoma Rd on East-West Rd on South	50
4	Area at E 11th and Hylebos Waterway	20
5	Area adjacent to NW property line of Occidental Chemical Co and Alexander Ave	15
6	Area adjacent to E 11th St and 600 ft north of Alexander Ave	15
7	Puyallup Fair Grounds - Parking lots	10
8	Site owned by UP bordered by Lincoln Ave and Milwaukee Way	30



Potential Marshaling Area

MATERIALS HANDLING EQUIPMENT

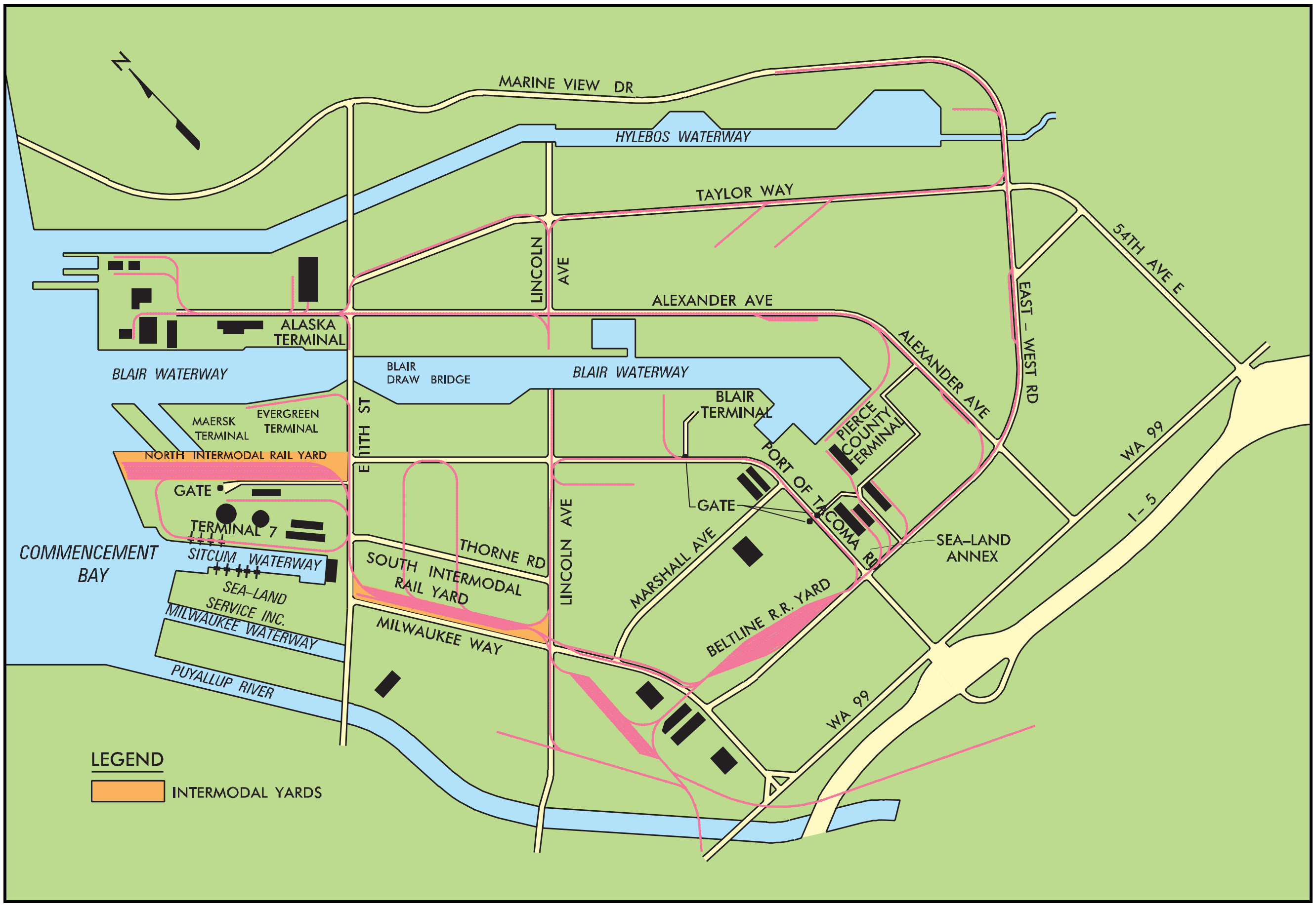
The Port of Tacoma has 14 container cranes. Nine of these cranes are port owned; the other five belong to Sea-Land. Capacities of these container cranes range from 50 to 66 STON. Other port cranes include three gantry cranes and one bulk crane. The port also owns 34 straddle carriers (35 STON capacity) and 119 forklifts (various capacities). Also available are three transtainers owned by Husky-Cooper Stevedores.

Straddle Carriers

Sea-Land Container Cranes at Sea-Land Terminal

INTERMODAL FACILITIES

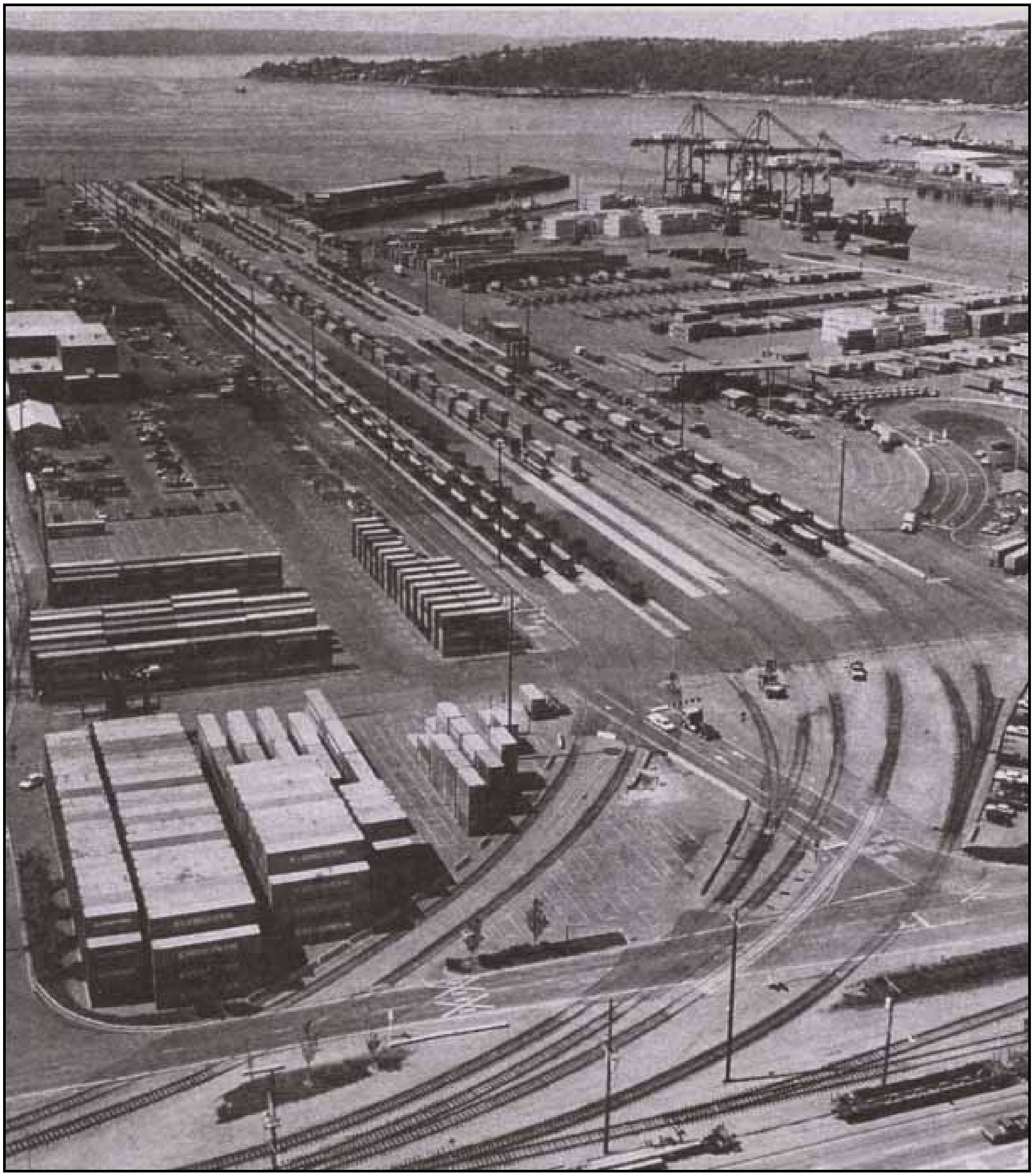
The port has two intermodal facilities - North and South Intermodal Railyards.



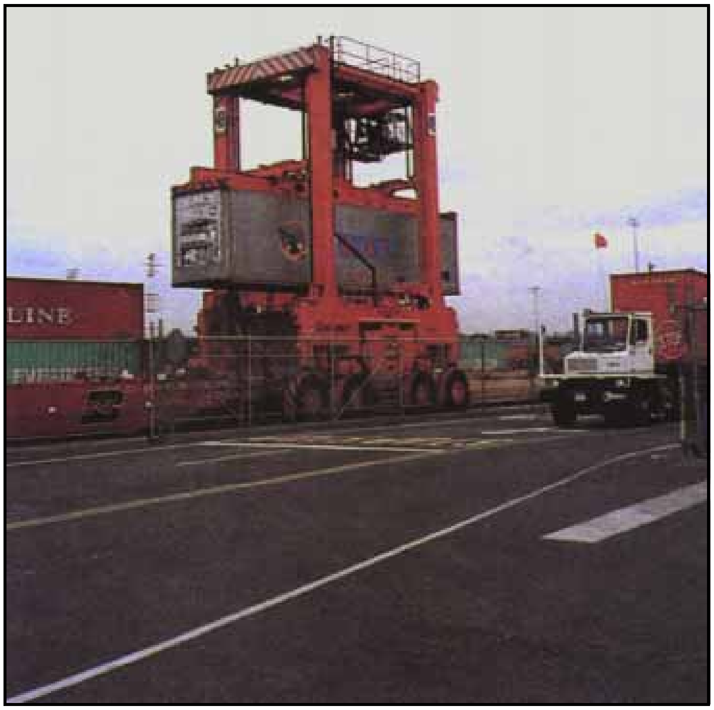
Intermodal Railyard Locations

North Intermodal Railyard

This railyard is at 711 Port of Tacoma Road, Tacoma, and is situated on 26 acres. It has the capability to stage about 150 to 200 40-foot truck chassis provided one track is kept clear. Transfer operations occur on 8 tracks providing about 260 89-foot flatcar lengths. In terms of double-stacked container cars, this yard can provide about 88 double-stacked car lengths. This yard has 34 straddle carriers available for container loading operations. The North Intermodal Railyard handles both TOFC and double-stacked container operations. The current activity level is about 550 lifts per day.



North Intermodal Railyard

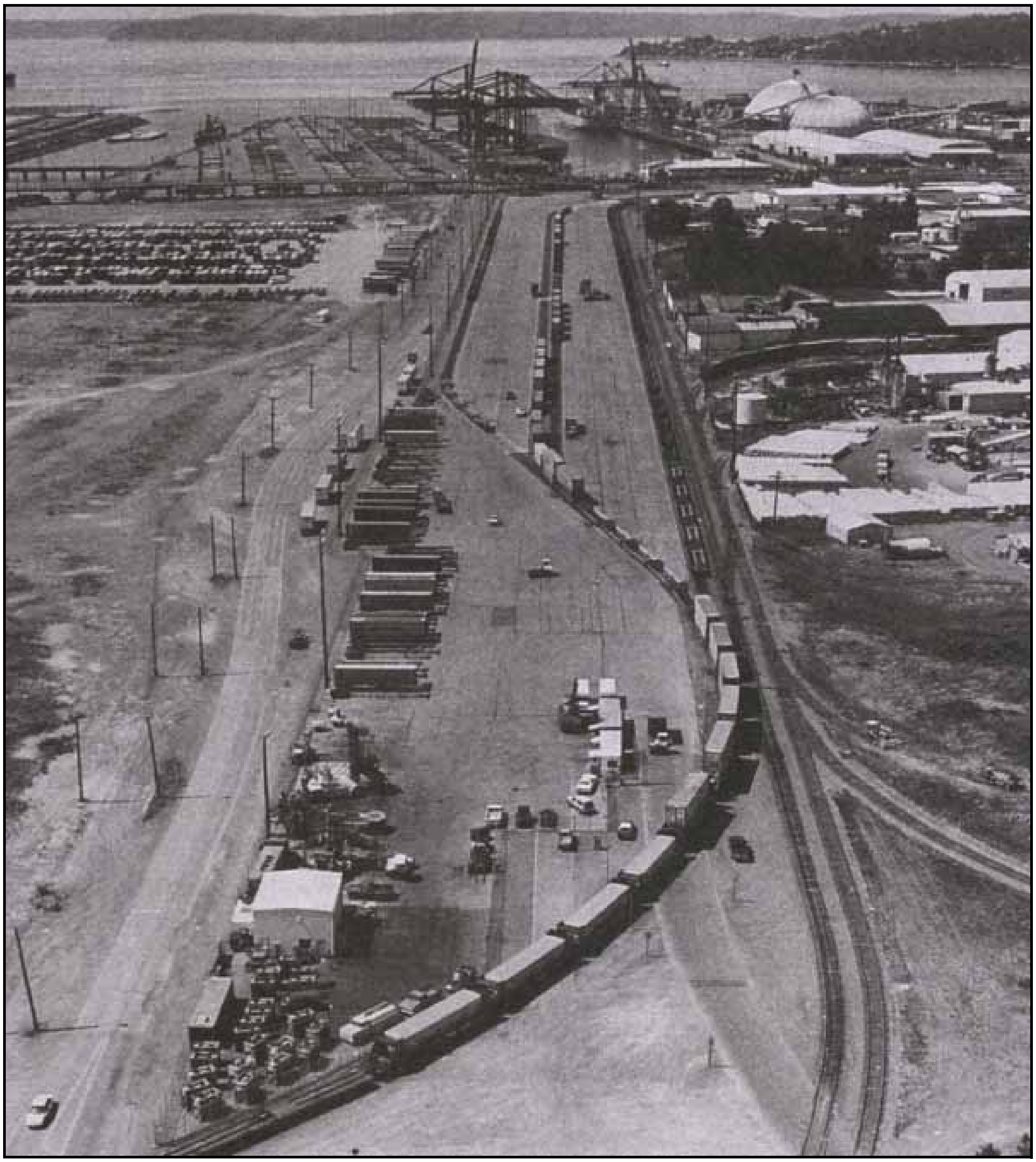


Container Handling Operations, North Intermodal Yard

Straddle Carrier at North Intermodal Yard

South Intermodal Railyard

The South Intermodal Railyard is at 1101 Milwaukee Way, Tacoma. This facility, on 25 acres, can stage about 400 40-foot truck chassis. Transfer operations occur on four tracks with about ninety- one 89-foot flatcar lengths. This yard conducts its operations with five side loaders. The South Intermodal Railyard can handle both TOFC and double-stacked container operations. The current activity level is about 250 lifts per day.



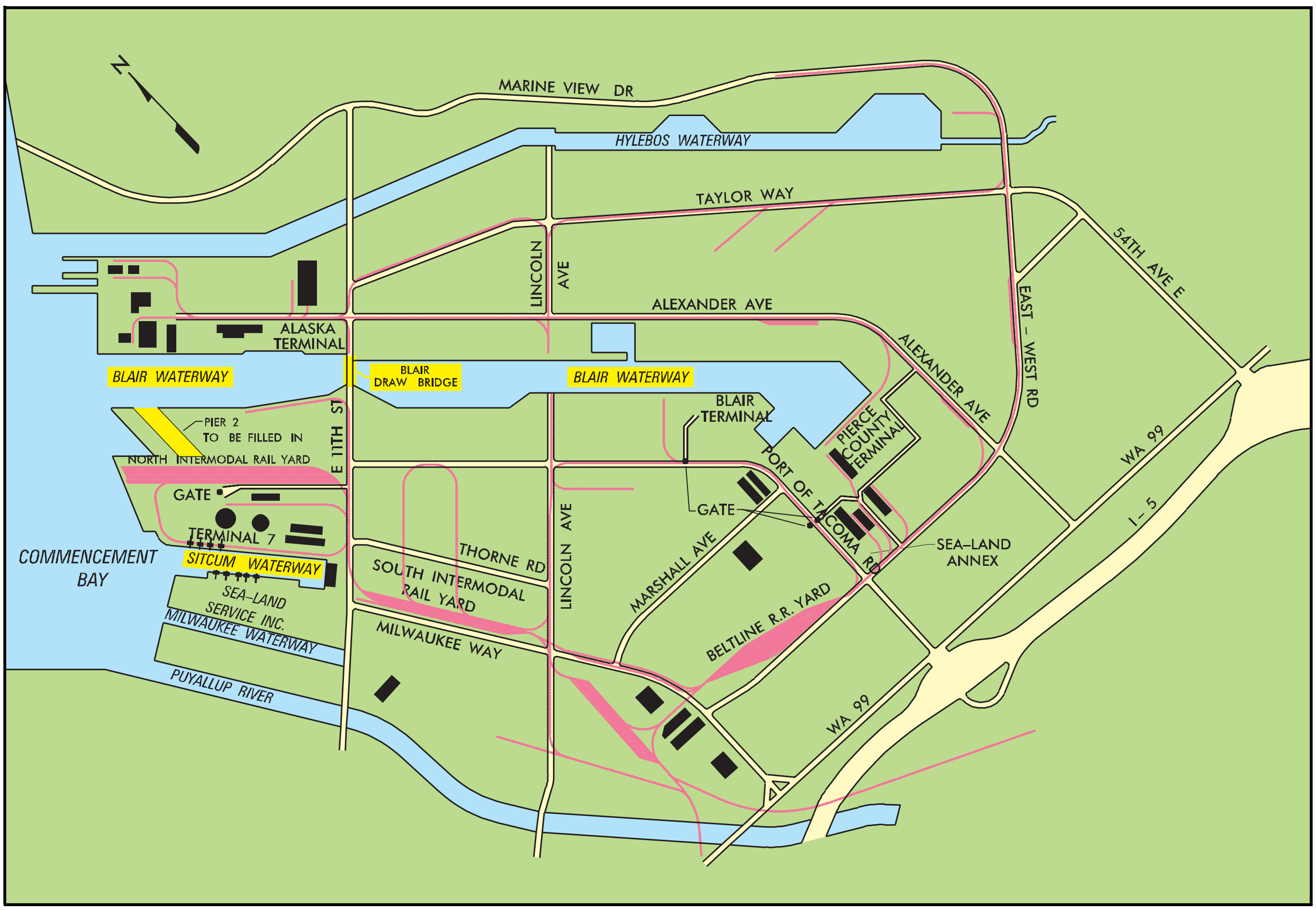
South Intermodal Railyard

FUTURE DEVELOPMENT

The Port of Tacoma plans to dredge and deepen Blair Waterway to 48 feet mean low water (MLW) in the outer two-thirds of the channel and 45 feet MLW for the rest of the channel. The scheduled completion date for this project is 1995. The port also plans to deepen Sitcum Waterway to 45 feet MLW.

In an effort to improve navigation through Blair Waterway, the port plans to remove the Blair Bridge at 11th Street. The scheduled completion date for this project is 1995.

Because of facility degradation, pier 2 is currently not in operation. The port plans to fill in the pier 2 area. Scheduled completion is 1997.

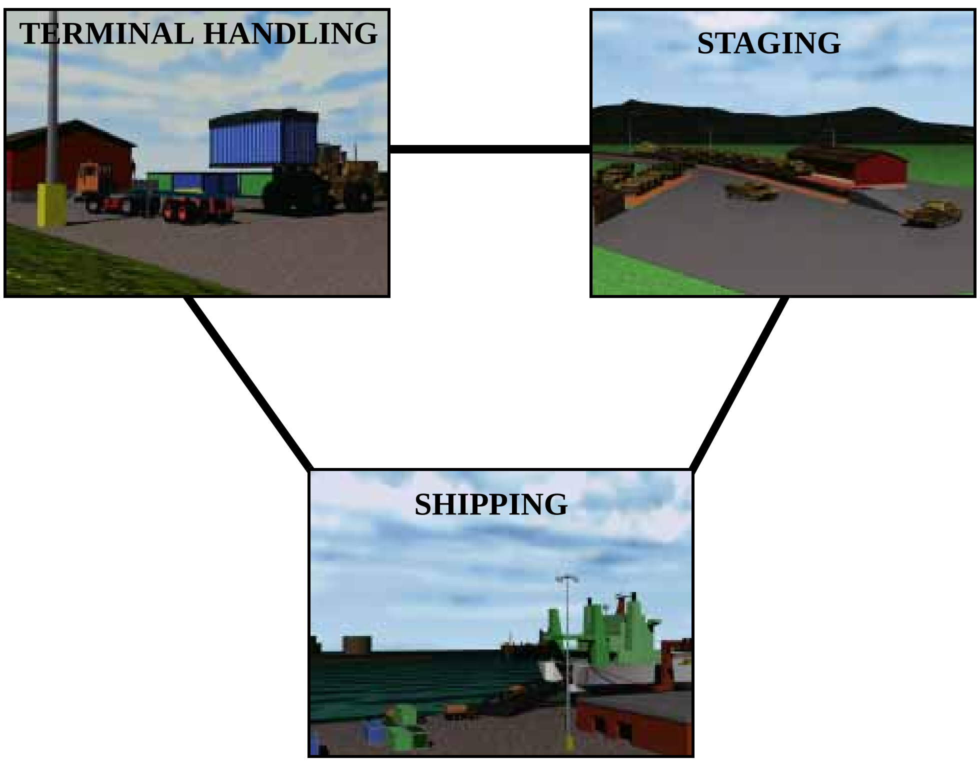


Future Development

II. THROUGHPUT ANALYSIS

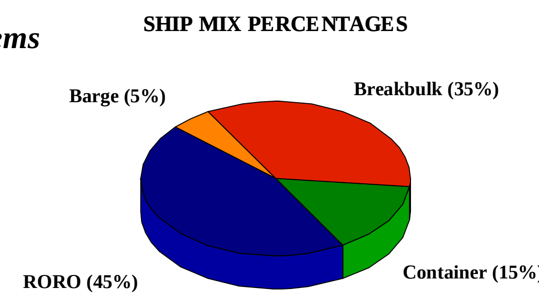
GENERAL

This section evaluates the theoretical throughput capability of the Port of Tacoma using the port operational performance simulator (POPS) computer model. A weak-link analysis is the basis for the computer model in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in short tons (STON) and measurement tons (MTON) per day.



Terminal Throughput Subsystems

The analysis assumed that 80 percent of port facilities will support the military deployment. Also, Desert Shield and Desert Storm statistics provide the basis for the ship mix. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.

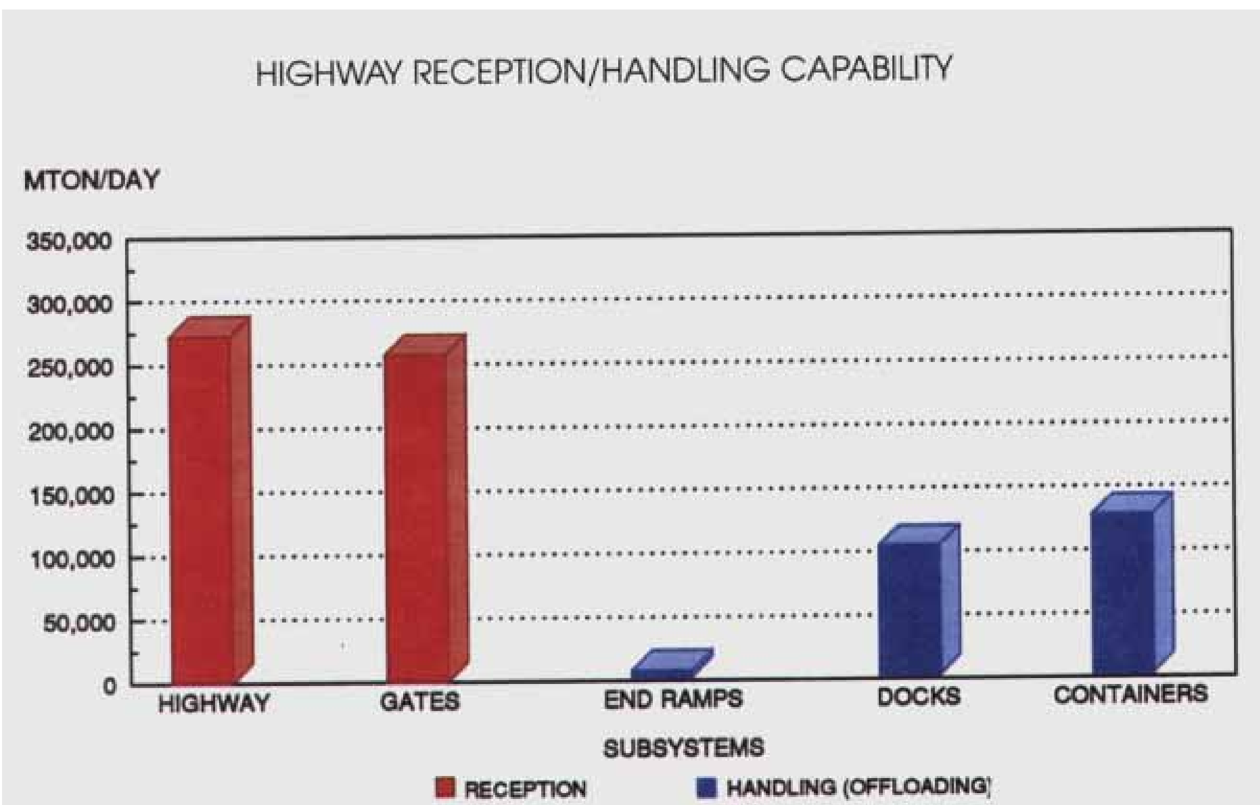


TERMINAL RECEPTION/HANDLING

Highway

Interstate Routes 5 and 705, Port of Tacoma Road, and 11th Street all provide good access to the Port of Tacoma. Seven gates lead to the terminal areas. The applicable gates are T-3 (Maersk), T-4 (Evergreen), T7-D (Husky), TOTE (Alaska), Sea-Land Domestic, Sea-Land International, and Pierce County. Blair Terminal is an open terminal. The gates and roadways provide access to staging and wharf areas in the terminals. The road network in and out of the port, including the gate processing of vehicles, could handle almost 257,000 MTON of equipment and supplies per day.

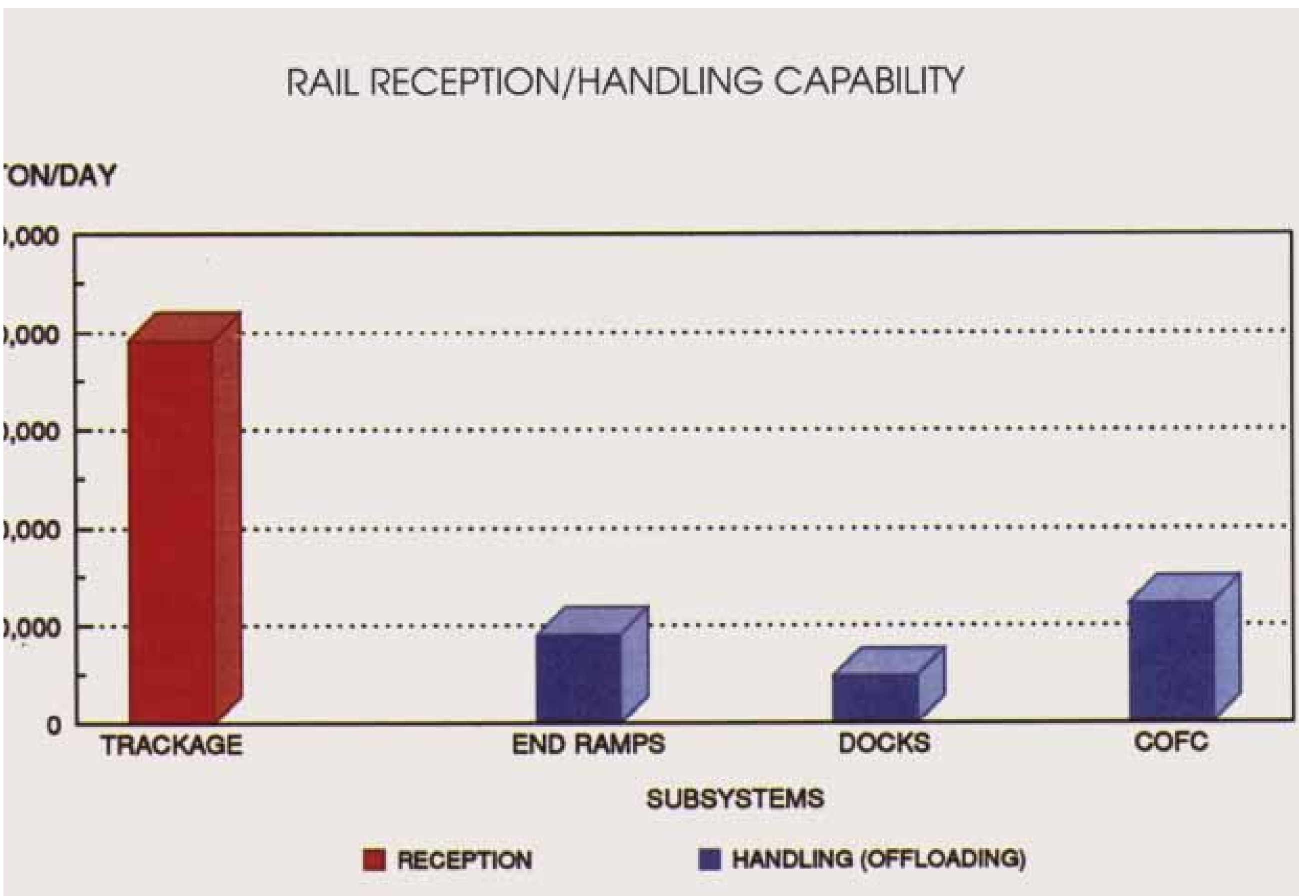
Roadable vehicles in convoys can process directly to staging areas. Vehicles on commercial or military flatbed semitrailers will offload at the portable ramp area. This ramp could offload about 4,800 MTON per day. Supplies in van semitrailers will proceed to the transit shed docks for offloading. These facilities provide about 218 handling positions and could offload more than 101,500 MTON of cargo per day. Containers on trucks will proceed to the container terminals - Maersk, Evergreen, 7-D, and Sea-Land. These terminals are specially equipped with container cranes and other container handling equipment. The container handling facilities could offload almost 125,000 MTON of cargo per day.



Rail

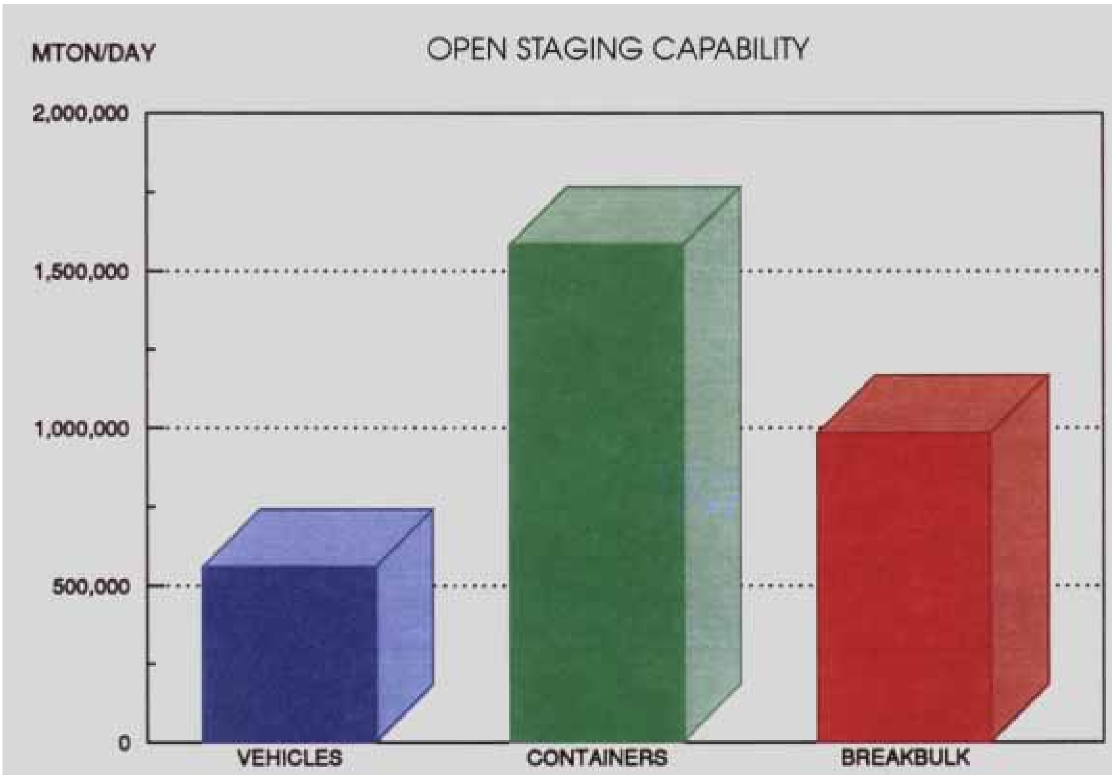
Rail reception at the Port of Tacoma is very good, with two commercial carriers serving the Tacoma area. The Tacoma Municipal Beltline Rail Company (TMBRC) performs all switching to unloading/loading sites. The TMBRC railyard and port storage tracks could store more than 950 railcars. Also, commercial railyards within the Tacoma area could store more than 1,900 additional railcars. Current rail service to the port is about six trains per day. The number of cars per train varies from twenty-five to forty 89-foot flatcars to 100 containers on flatcars (COFC).

Vehicles on flatcars could offload at three locations using two portable end ramps and the fixed end ramp at the nearby BN railyard. For this study, we assumed one of the portable end ramps would be used for offloading semitrailers, leaving two end ramps for offloading railcars. Boxcars could offload at the transit sheds, where about 58 rail handling positions are available. Containers would offload at any of the container handling facilities.



STAGING

The port has about 420 acres of open storage for vehicles and/or containers. This storage can accommodate about 557,500 MTON of rolling stock, or 1,580,700 MTON of containers, or 983,000 MTON of breakbulk cargo. Also, 612,400 square feet of covered storage provides protection for almost 24,500 MTON of palletized cargo.



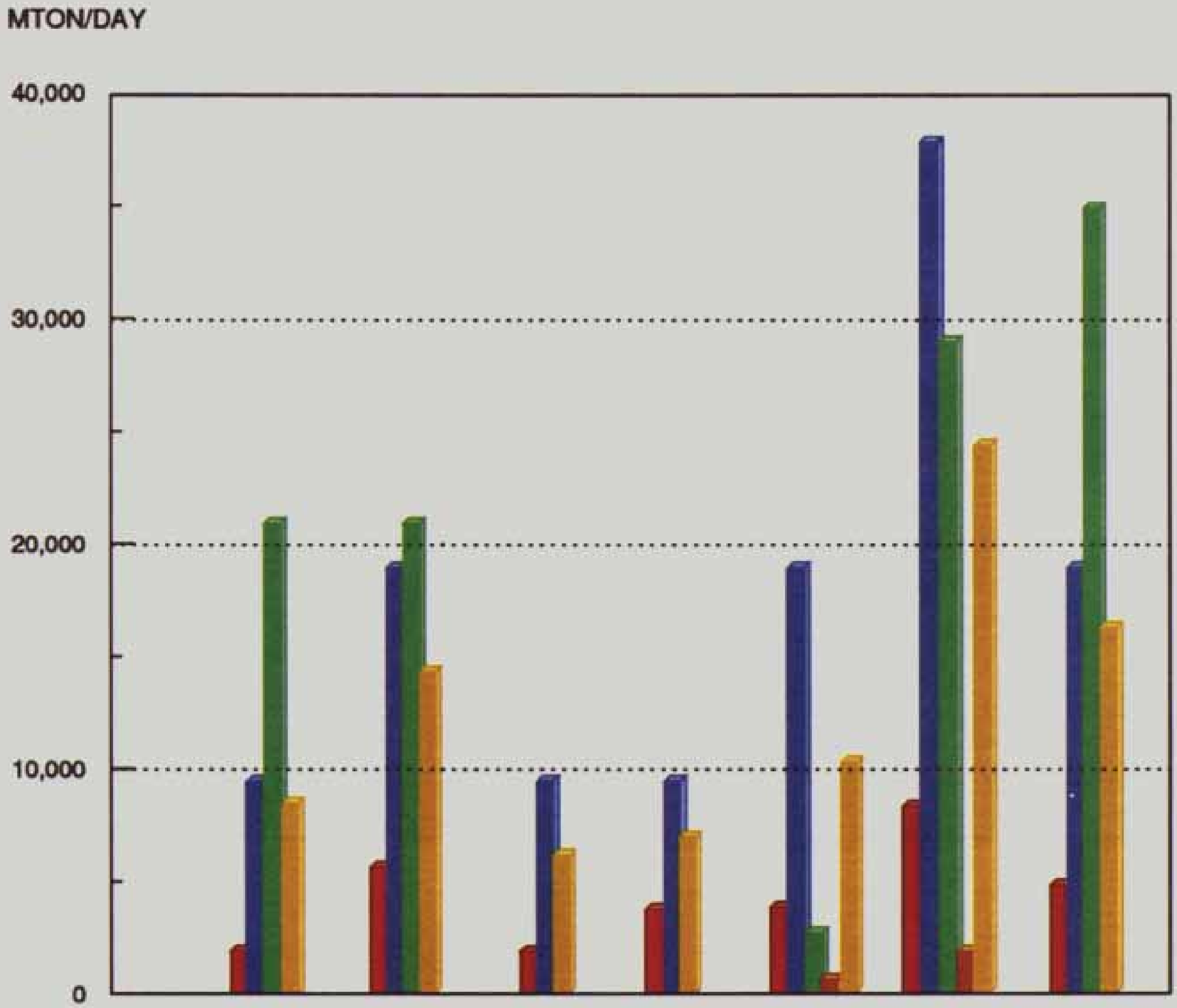
SHIPPING

We identified the throughput capability per berth in MTON per day for breakbulk, RORO, container, and mixed vessels. Various factors, including MHE used; loading, operational, and berth usage rates; and berth/ship compatibility, provide the basis for these results.

CONVERSION FACTORS

Breakbulk	.4	STON per MTON
RORO	.25	STON per MTON
Containers	.4	STON per MTON

BERTH THROUGHPUT CAPABILITY



BERTH	MAERSK	EVERGREEN	ALASKA	BLAIR	PIERCE CO.	SEVEN	SEA-LAND
BREAKBULK	1,858	5,574	1,858	3,716	3,804	8,228	4,778
RORO	9,437	18,874	9,437	9,437	18,874	37,749	18,874
CONTAINER	20,902	20,902	0	0	2,654	28,865	34,836
BARGE	0	0	0	0	590	1,769	0
MIXED	8,455	14,294	6,121	6,934	10,253	24,285	16,201

Table 1 shows the compatibility for various vessel types. This table indicates, for each type of ship, the number of vessels that can berth at a particular wharf. The table also provides the limitations that can hinder shipping operations.

Methodology that gives a snapshot view of the current physical characteristics of the berths and the MHE available provides the basis for the type of ship preferred at each berth. The evaluation gives no considerations for enhancements, such as equipment.

Pierce County Terminal and Terminal 7 consistently rank 1 and 2, respectively, for all types of shiploading operations.

PREFERENCE BERTH SELECTION

	TERMINALS						
LOADING TYPE	**Maersk**	**Evergreen**	**Alaska**	**Blair**	**Pierce County**	**Seven**	**Sea-Land**
Breakbulk	4	3	6	7	1	2	4
RORO	6	3	4	6	1	2	4
Container	5	4	7	6	1	2	3
Barge	4	3	6	6	1	2	4

NOTES: The numbers refer to the terminal ranking in terms of terminal preference. For example, the Pierce County Terminal has a number 1 ranking for RORO loadings. Hence, it is the preferred terminal for these operations.

TABLE 1
SUMMARY OF TACOMA BERTHING CAPABILITIES

Vessel	BERTHS						
	Maersk	Evergreen	Alaska	Blair	Pierce Co	7	SL
Breakbulk							
C3-S-33a	1	3	1	2	2	5	3
C3-S-37c	1	3	1	2	2	5	3
C3-S-37d	1	3	1	2	2	5	3
C3-S-38a	1	3	1	2	2	5	3
C4-S-1a	1	3	1	2	2	4	2
C4-S-1qb and 1u	1	3	1	2	2	4	2
C4-S-58a	1	3	1	2	2	4	2
C4-S-65a	1	3	1	2	2	4	2
C4-S-66a	1	3	1	2	2	4	2
C4-S-69b	1	3	1	1	2	4	2
Seatrain							
GA and PR-class	1	3	1	2	2	4	2
Barge							
LASH C8-S-81b	1	2	c	1	1	3	1
LASH C9-S-81d	g	g	c,g	a,g	g	2	1
LASH lighter	6	13	5	8	10	19	11
SEABEE C8-S-82a	g	g	c,g	a,g	g	2	1
SEABEE barge	4	9	4	6	7	13	8
RORO							
Comet	d,i,j	d,i,j	i,j	d,i,j	i,j	i,j	d,i,j
C7-S-95a/Maine-class	1,i	2,i	1,i	1.i	1,i	3,i	2,i
Ponce-class	h	h	1	h	h	h	h
Great Land-class	h	h	1	h	h	h	h
Cygnus/Pilot-class	1,i	2,i	1,i	1,i	2,i	4.i	2,i
Meteor	d,i,j	d,i,j	i,j	d,i,j	i,j	i,j	d,i,j
AmEagle/Condor	i,j	i,j	i,j	i,j	i,j	i,j	i,j
MV Ambassador	d	d	1,i	d	2.i	4,i	d
FSS-class	1,i	1,i	C	1,i	1,i	2,i	1,i
Cape D-class	i,j	i,j	i,j	i,j	i,j	i,j	i,j
Cape H-class	g	g	g	a,g	g	3,i	2,i
Container							
C6-S-lw	1	2	1,e	1,e	2,e	3	2
C7-S-68e	1	2	1,e	1,e	1,e	3	2
C8-S-85c	1	2	c,e	1,e	1,e	3	1
Combination							
C5-S-78a	1	3	1,e	1,e	2,e	4	2
C5-S-37e	1	3	1,e	1,e	2,e	4	2

a=maximum vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=inadequate berth depth, adequate anchorage depth
g=inadequate channel depth

h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=insufficient apron width for side-ramp operations

Notes: Ramp clearance and ramp angle based on maximum vessel draft

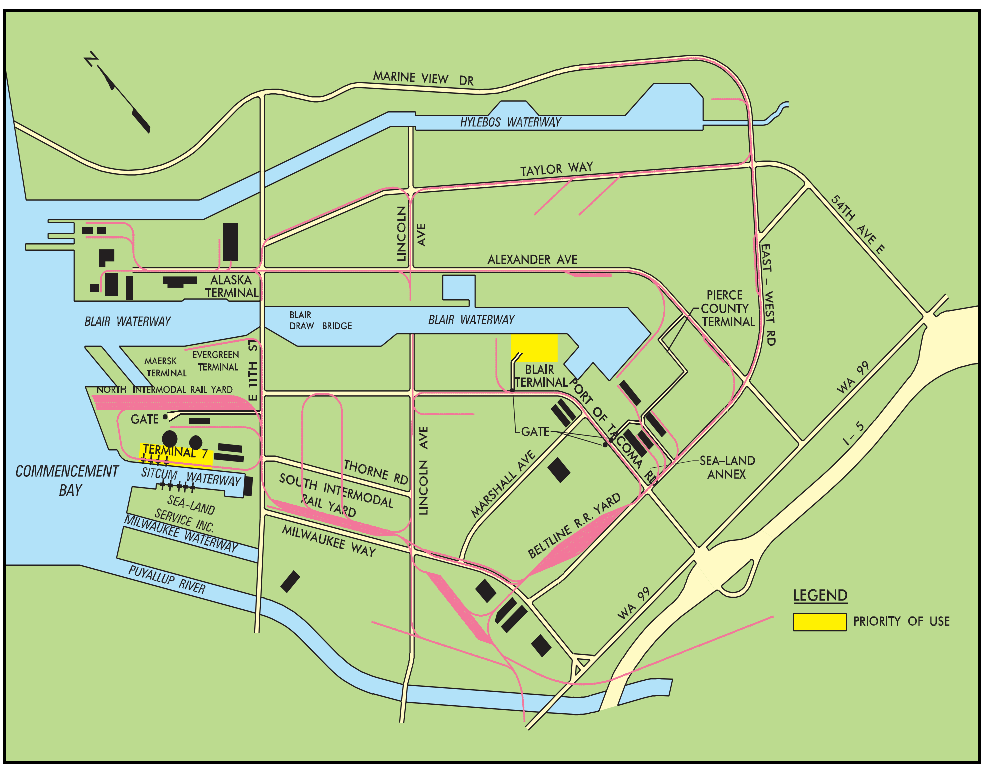
III. APPLICATION

GENERAL

In this section, we evaluate the port's throughput capability for deploying a notional mechanized infantry division mainly by FSS vessels. The analysis uses only those facilities designated in the *Planning Orders Digest*, issued by MARAD. These orders call for the Port of Tacoma to grant either exclusive or priority use of certain facilities before and during national emergencies. These facilities are identified in the following chart and figure. The Military Traffic Management Command (MTMC) maintains an outport in the Seattle area for coordinating military movements.

FACILITIES PLANNED FOR MILITARY USE

TYPE OF USE	TERMINAL	BERTH	OPEN STAGING (ACRES)	COVERED STAGING
Priority	Blair	A & B	12 32 (backup)	
Priority	7	A & B	14	1 warehouse (96,000 sq ft)

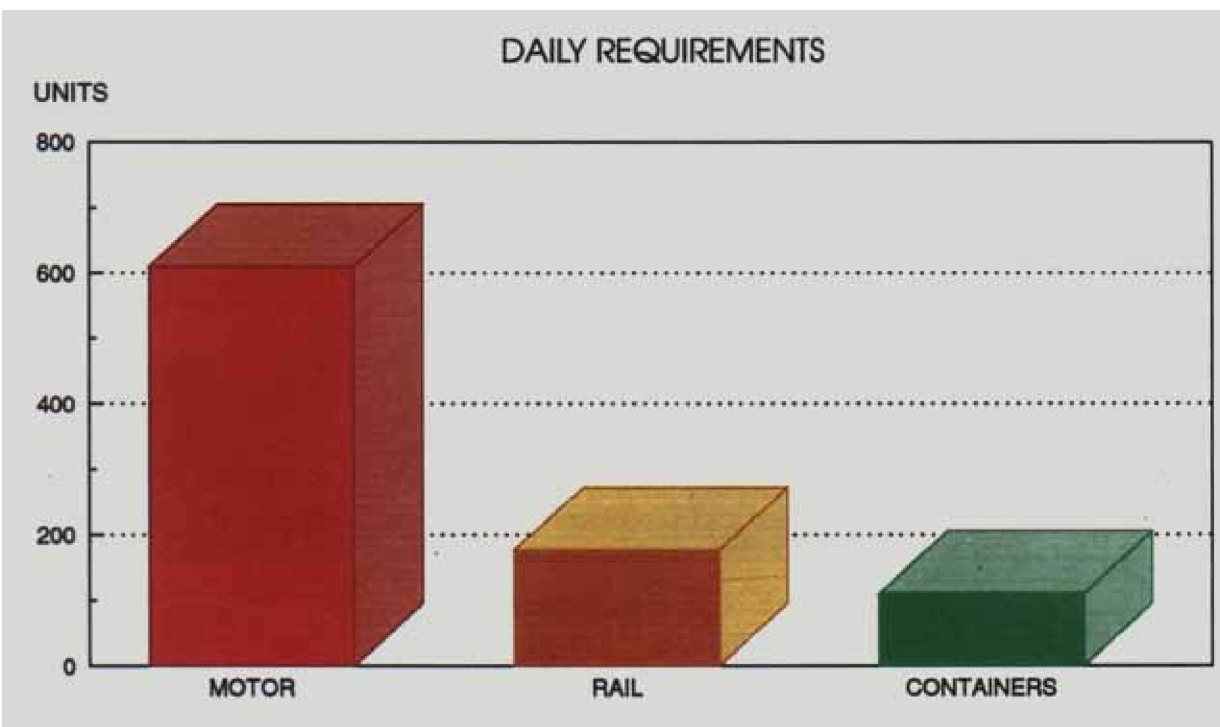


REQUIREMENTS

The likely requirement for the Port of Tacoma is to deploy a notional mechanized infantry division in 6 days. The division has to move about 7,800 vehicles and 660 containers. Movement of this division to the port will require 1,055 railcars (176 per day) for a convoy/rail option. Under this option, the deploying units would drive about 3,650 roadable vehicles (610 per day) and tow another 2,320 pieces of equipment (387 per day).

MECHANIZED INFANTRY DIVISION DEPLOYMENT DATA

Total Equipment	
Volume	274,518 MTON
Weight	95,010 STON
Area	1,422,844 SQ FT
Vehicles	7,800
Containers	600

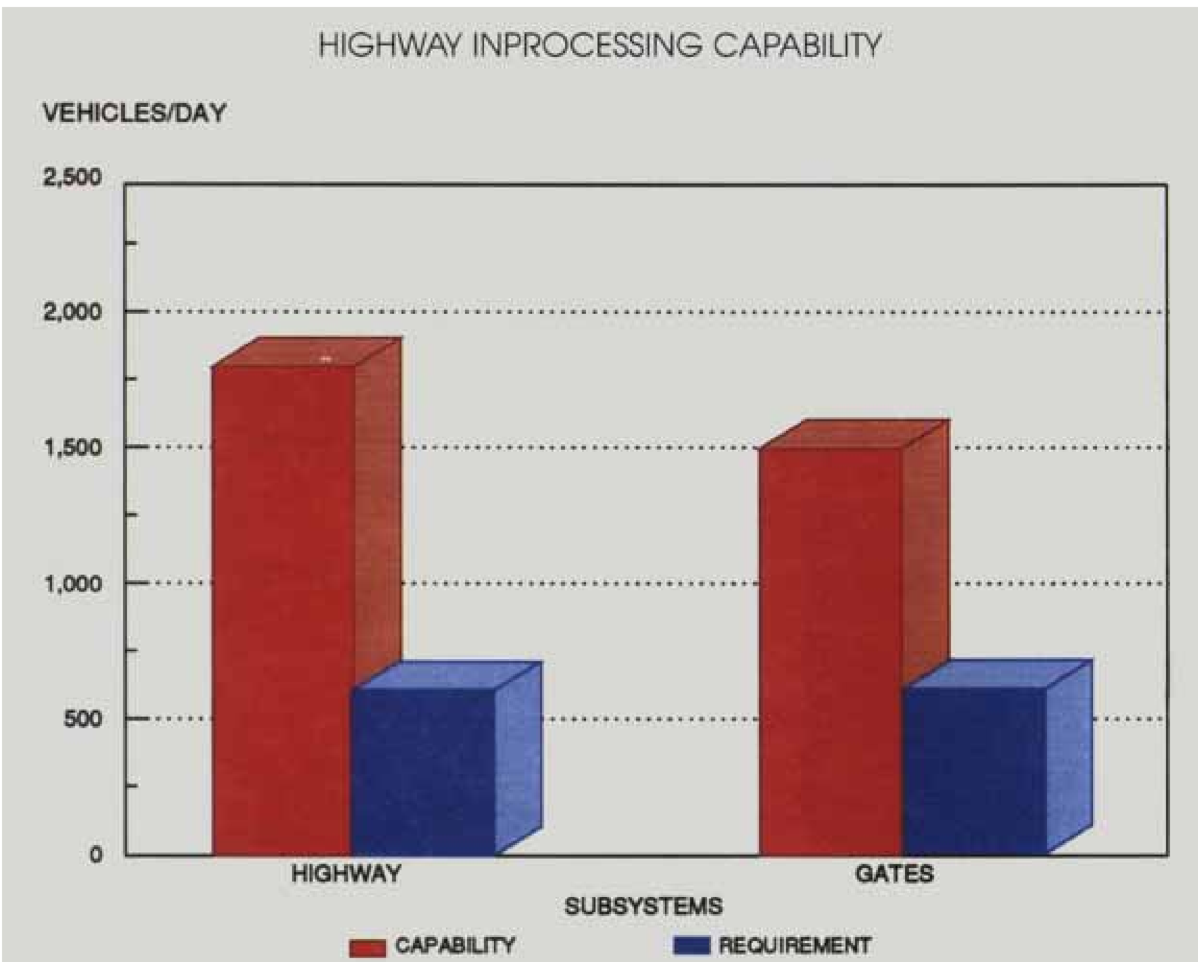


TERMINAL INPROCESSING/HANDLING

Highway

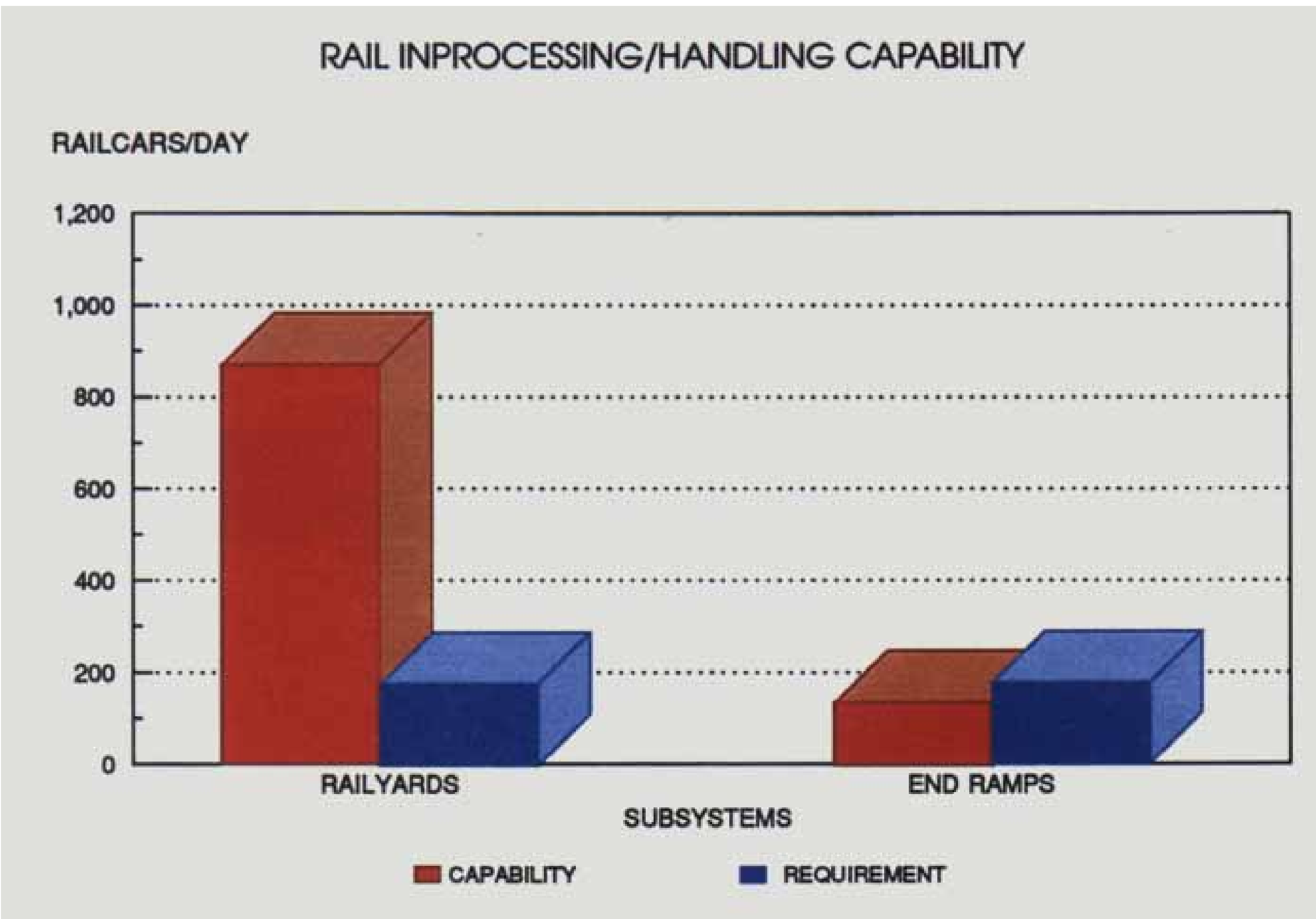
Vehicles and containers on chassis would enter the port via Port of Tacoma Road (connector route) or I-705 and 11th Street (alternate route). Inside the port, Port of Tacoma Road leads directly to Blair Terminal. Sitcum Way, off Port of Tacoma Road, leads to roads accessing Terminal 7. Blair Terminal is an open terminal. Although Terminal 7 has two gates, T7-D (Husky) Gate is the primary access gate to Terminal 7.

We estimate (based on the existing traffic volume) that Port of Tacoma Road, the access road to the three terminals, can handle an additional 5,000 vehicles per day. Also, the terminal gates can handle an additional 1,500 vehicles per day.



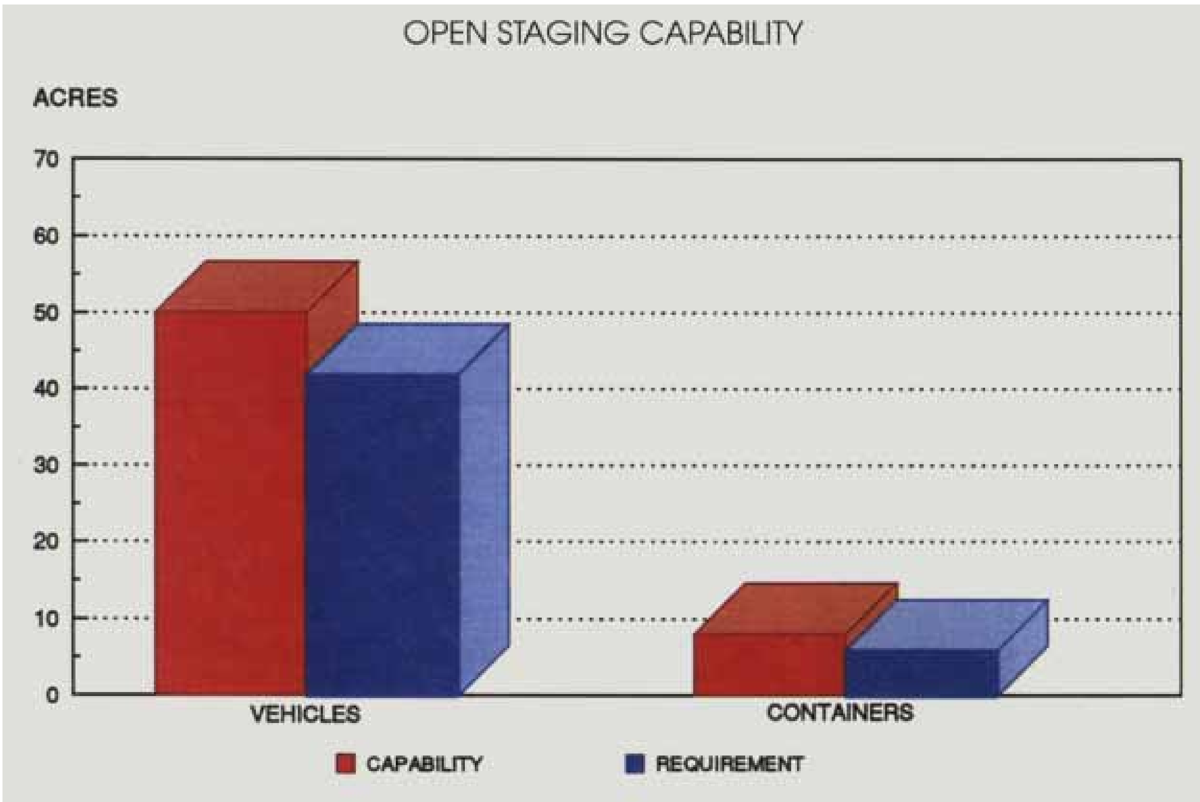
Rail

The classification yards near the port have a capacity of about 2,900 railcars per day. However, only about 30 percent of this capacity (870 railcars) would likely be available for military use. Using the three available end ramps in the Port of Tacoma area, stevedores or military personnel could offload about 34 railcars every 5 hours. This equates to about 136 railcars per day. We assumed that lighter vehicles can offload on the portable end ramps and heavy vehicles will offload at the fixed ramp at the BN railyard. This conclusion also assumes that offloading personnel can achieve 3 cycles within a 5-hour period on the fixed rail end ramp at the nearby BN railyard (300 feet of track at this ramp). With at least one additional portable end ramp, the port could more adequately meet its rail reception requirements.



STAGING

Using the facilities designated by the MARAD *Planning Orders Digest,* the Port of Tacoma has 58 acres of open staging available for military operations. We estimate that a mechanized infantry division needs about 48 acres of open staging to support the concurrent sustained loading of three FSS vessels. Divided between vehicles and containers, the staging area requirement becomes 42 and 6 acres for vehicles and containers, respectively.



SHIPPING

The number of ships needed to load this requirement depends on the shipping mix selected. The best ship mix would require all eight FSSs and two Cape H RORO ships. The MARAD *Planning Orders Digest* designates two terminals at the Port of Tacoma for military use.

One of the terminals at the Port of Tacoma is on Blair Waterway, which is currently undergoing dredging from 35 feet MLW to 45 feet MLW. This dredging will ensure an FSS vessel can navigate Blair Waterway at maximum draft. Based on 2 days to load a ship, a division can outload within the 6-day requirement from the Port of Tacoma. This capability is contingent on completion of the Blair Waterway dredging.

UNIT MOVEMENT REQUIREMENTS
MECHANIZED DIVISION

LOADING CONDITION/ SAMPLE SHIP MIX	VESSEL TYPES			
	FSS (RORO/COMB)	CAPE H (RORO/COMB)	C3/C4 (BREAKBULK)	C6/C7/C8 (CONTAINER)
Minimum Containerization				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
Maximum Containerization				
FSS and Container	7.90			2.00
FSS,Cape H, and Container	4.62	3.00		2.00
Breakbulk and Container			29.58	2.00

*Only 8 FSSs are available. Unit shipping requirements exceed the capacity of these 8 vessels. Other vessel types are required to make up the FSS shortfall (Cape H).

Legend:

RORO - roll on/roll off

FSS - fast sealift ship

Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide, Aug 91.

*The Port of Tacoma FSS shipping capability is contingent upon completing dredging efforts to deepen the Blair Waterway.

SUMMARY

Dredging Blair Waterway to 45 feet MLW will ensure FSS vessels can navigate the waterway at maximum draft.

The available end ramps at the Port of Tacoma may not be enough to meet rail reception requirements.

The Port of Tacoma can outload a mechanized infantry division within the 6-day outloading requirement. This conclusion is contingent upon completion of the Blair Waterway dredging project and procurement of at least two heavy-duty end ramps to complement the portable end ramps already at the port.

The E 11th Street drawbridge across Blair Waterway restricts the channel width to 150 feet. The Military Sealift Command has shown reluctance in the past to navigate past this bridge. This bridge is scheduled for removal in 1995.

RECOMMENDATIONS

We recommend that the Port of Tacoma:

1. Continue to accomplish deepening of Blair Waterway to 45 feet MLW and removal of the E 11th Street drawbridge across Blair Waterway.

2. Obtain at least two heavy-duty portable end ramps to allow flexibility in offloading heavy equipment from both railcars and semitrailers. MTMCTEA is currently designing an end ramp for use in offloading tanks and other heavy equipment from railcars or semitrailers. We expect these ramps to be available sometime in 1994.

PORT OF ANCHORAGE
ALASKA

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a site visit at the Port of Anchorage in June 1999. The port is a compact, but capable facility with the ability to throughput a brigade-size unit within 6 days. This port can accommodate vessels as large as the fast sealift ship (FSS) or large medium speed roll on/roll off (LMSR). Due to a 29-foot average tidal variation (41-foot extreme tidal variation), a 2 ½-hour window exists for conducting roll on/roll off (RORO) operations (ship loading/offloading) twice a day. This restricts RORO ship loading/offloading operations for vessels such as the FSS or LMSR to about 5 hours total per day. The Port of Anchorage is not listed in the Port Planning Orders (PPO) issued by the Maritime Administration (MARAD). Currently, none of the Alaskan ports are listed in the PPO for deploying a notional separate infantry brigade or any other military unit.

The port consists of a 2,221-foot-long “over-the-water” marginal wharf divided into three ship berths. The wharf extends over the water to accommodate the huge tidal variation. The water depth at the ship dock is 35 feet mean lower low water (MLLW) and the port is capable of break-bulk, limited or specialized RORO, container, and barge operations. In general, the channel depth is 35 feet MLLW, however, Knik Arm Shoals at the entrance to Knik Arm has a few shallows limiting the water depth to about 25 feet MLLW. The port currently gets around this by restricting ship traffic to a 6-hour transit time twice daily. In another year, the future channel dredging project will provide a consistent channel depth of 35 feet MLLW.

The Alaska Railroad Corporation (ARRC) owns all tracks leading into the port and performs all of the rail switching. At least three commercial airfields and two military airfields are in the Anchorage area. The two largest, Anchorage International and Elmendorf Air Force Base, can handle C-5 aircraft. The port has three rail-mounted container cranes that primarily support the loading/offloading of containers for Sealand Service, Inc., at Terminals 1 and 2. Two of the container cranes are rated at 30 short ton (STON) and the third is rated at 40 STON. Totem Ocean Trailer Express, Inc., (TOTE) currently operates at Terminal 3, moving RORO cargo between Anchorage and Tacoma, Washington. TOTE successfully negates the effect of the huge tidal variation by using specialized RORO ship ramps stored at the Port of Anchorage that are specially designed to mate up with the TOTE ocean-going vessels. Although the Port of Anchorage does not have materials handling equipment (MHE) other than the container cranes, the North Star Terminal and Stevedore Company can provide other MHE (including mobile cranes up to 300 STON) as required. This stevedoring company is located about ½ mile from the port. The only end ramps available for loading/offloading railcars and/or semitrailers would be through either ARRC or North Star Terminal and Stevedore Company.

A total of 26.57 acres of paved open staging is available at the port. Other open storage areas of various surface material are available either at the port or nearby. About 29,400 square feet of covered storage is also available at the port.

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of about 4,030 STON (13,660 measurement ton (MTON)) per day. RORO and container throughputs are 3,320 STON (13,280 MTON) and 23,510 STON (58,780 MTON) per day, respectively.

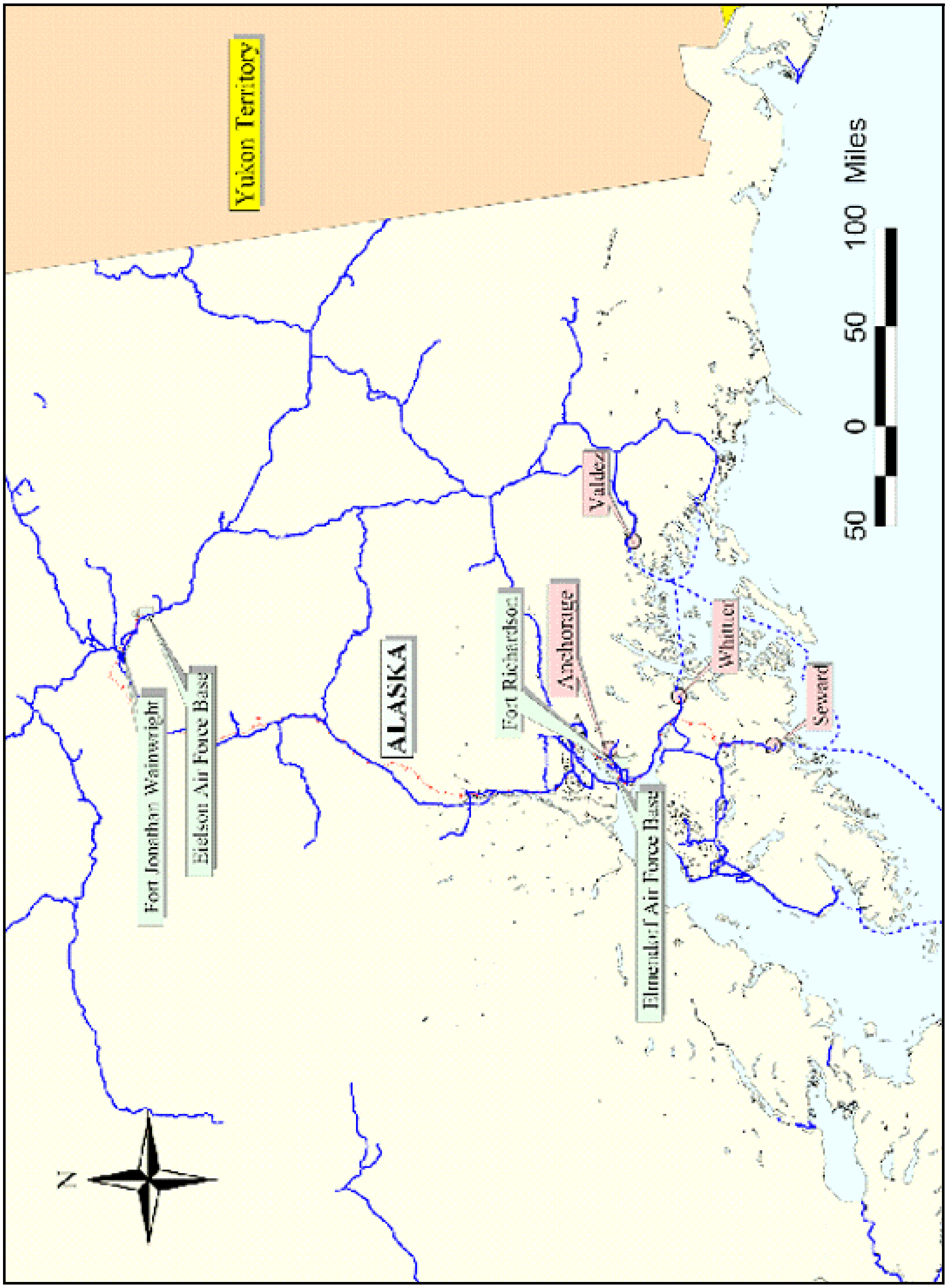
A notional infantry brigade has about 12,940 STON (65,577 MTON) of vehicles and equipment. Estimates show that the port is capable of achieving closure for throughputting a notional infantry brigade in about 6 days. If two FSS can be loaded simultaneously (.6 load per ship), the brigade can be loaded in 5 days. Although the port can easily achieve closure in 6 days, peak day requirements may be as much as 8,350 STON (TEA Port Enhancement Analysis, Phase I, 1999) in the reception and handling subsystem. This would exceed the RORO shipping subsystem capability (2,500 STON per day for a two FSS vessel loading). This means that equipment may require marshaling in various areas including Elmendorf Air Force Base (AFB) and Fort Richardson.

For deployment operations, about 25 acres of open storage are desired per LMSR to support daily, sustained loading operations. An entire notional separate infrantry brigade can be loaded on three quarters of an LMSR, therefore, about 16.5 acres are needed to stage the brigade. The desired staging for an FSS, is about 16 acres of open storage per ship to support daily, sustained loading operations. The notional infantry brigade will require a second FSS with a small partial load (or both ships containing .6 of a load). The 26.57 acres of paved open storage can meet the LMSR requirement, provided at least 16.5 acres are available for deployment. Movement of the deploying units by rail will require 79 railcars per day using a rail/convoy option. The ARRC states that they can handle up to two-three trains per day at seventy-five to eighty 53-foot railcars per train.

The U.S. military would likely require 2,000 feet of ship berth (either Terminal 2 or 3 or Terminals 1 and 2), 16 acres of paved open staging, and the transit shed for an actual deployment. For an application, we analyzed a notional separate infantry brigade deploying from the Port of Anchorage using one LMSR vessel or two FSS vessels. To deploy a notional infantry brigade in 6 days, the port must throughput about 2,160 STON of vehicles and equipment (that includes 10 containers) per day. When the required LMSR is available for loading, the port meets the shipping requirements if the needed facilities and resources are available. Smaller ships will require additional time or berths.

Units from Fort Richardson can easily access the Port of Anchorage by highway either through Elmendorf AFB or via the Glenn Highway. Either way, the port is just minutes from Fort Richardson. Fort Wainwright is about 360 miles from Anchorage. Units at Fort Wainwright have the option of accessing the Port of Anchorage either via highway or rail.

The port can meet deployment requirements provided the required ship berth, open storage, and transit shed are available at the time needed. As previously stated, no agreement is in place requiring the port to provide these facilities during deployment. Although the port has successfully worked with DOD in the past to provide the needed facilities, increases in future commercial business from Sealand and TOTE may present difficulties for the port to immediately provide needed facilities in the future. The port authority expects a 2.1 percent increase in container traffic per year.


Yukon Territory
ALASKA
Fort Jonathan Wainwright
Eielson Air Force Base
Fort Richardson
Anchorage
Elmendorf Air Force Base
Valdez
Whittier
Seward
50 0 50 100 Miles
N

II. GENERAL DATA

The Port of Anchorage, located on the south central Alaskan coast, is considered a potential seaport of embarkation for deploying Alaskan military units during contingencies. A team from the Military Traffic Management Command conducted a site survey in June 1999. Information on port characteristics was obtained from port officials.

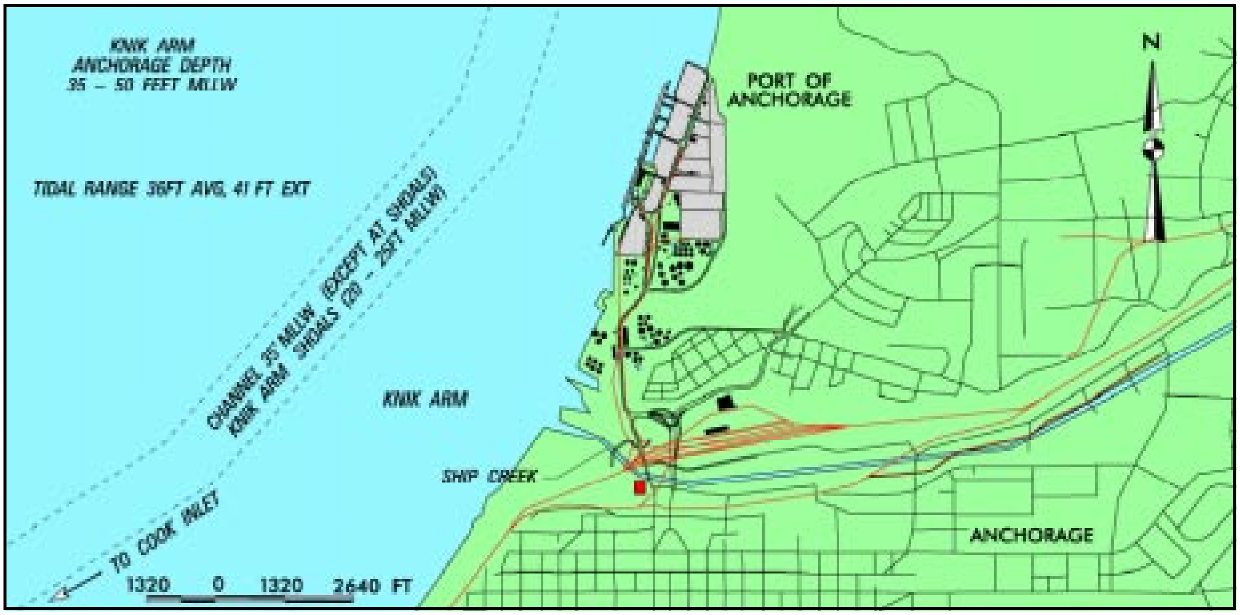
TRANSPORTATION ACCESS

Water

The Port of Anchorage (latitude 61° 14’ 34” north, longitude 149° 53’ 05” west, (AJBR)) is on the south central Alaskan coast on the east-side of Knik Arm in upper Cook Inlet. Cook Inlet provides direct access to the Gulf of Alaska. In general, Knik Arm has a channel depth of 35 feet mean lower low water (MLLW) and leads to Cook Inlet, a deep-water inlet. The only navigation obstacle restricting access to the port is Knik Arm Shoals, which is 6.5 miles southwest of the port where Knik Arm connects with Cook Inlet. These shoals have a water depth in the range of 20-25 feet MLLW at low tide. The port currently avoids problems with the shoals by controlling ship traffic to periods of high tide (6-hour transit times twice daily). Once inside the shoals, the channel depth and ship berths are no less than 35 feet MLLW. No overhead clearance restrictions exist for seaport access.

A key feature of the Port of Anchorage is the huge tidal variation. The tidal range varies from an average of 36 feet to an extreme of 41 feet. This tidal variation has a major influence on roll on/roll off (RORO) operations on RORO-type ships. Access to the port is not ice-free, but the natural flow of the huge tidal variation keeps the ice broken up. A reinforced ship bow to combat icy conditions is recommended to access the port during the winter. Knik Arm is both wide enough and deep enough to provide a turning basin for any ship including fast sealift ship (FSS) and large medium speed RORO (LMSR) vessels. Ships can anchor in Knik Arm in depths ranging from 35-50 feet MLLW.

All vessels require pilots for navigation between Homer Pilot Station and Anchorage. The port authority reports that pilots are available 24 hours each day. Twelve pilots are available in the Homer/Anchorage area. Two tugboats are available at the Port of Anchorage and others are in the surrounding area if needed.



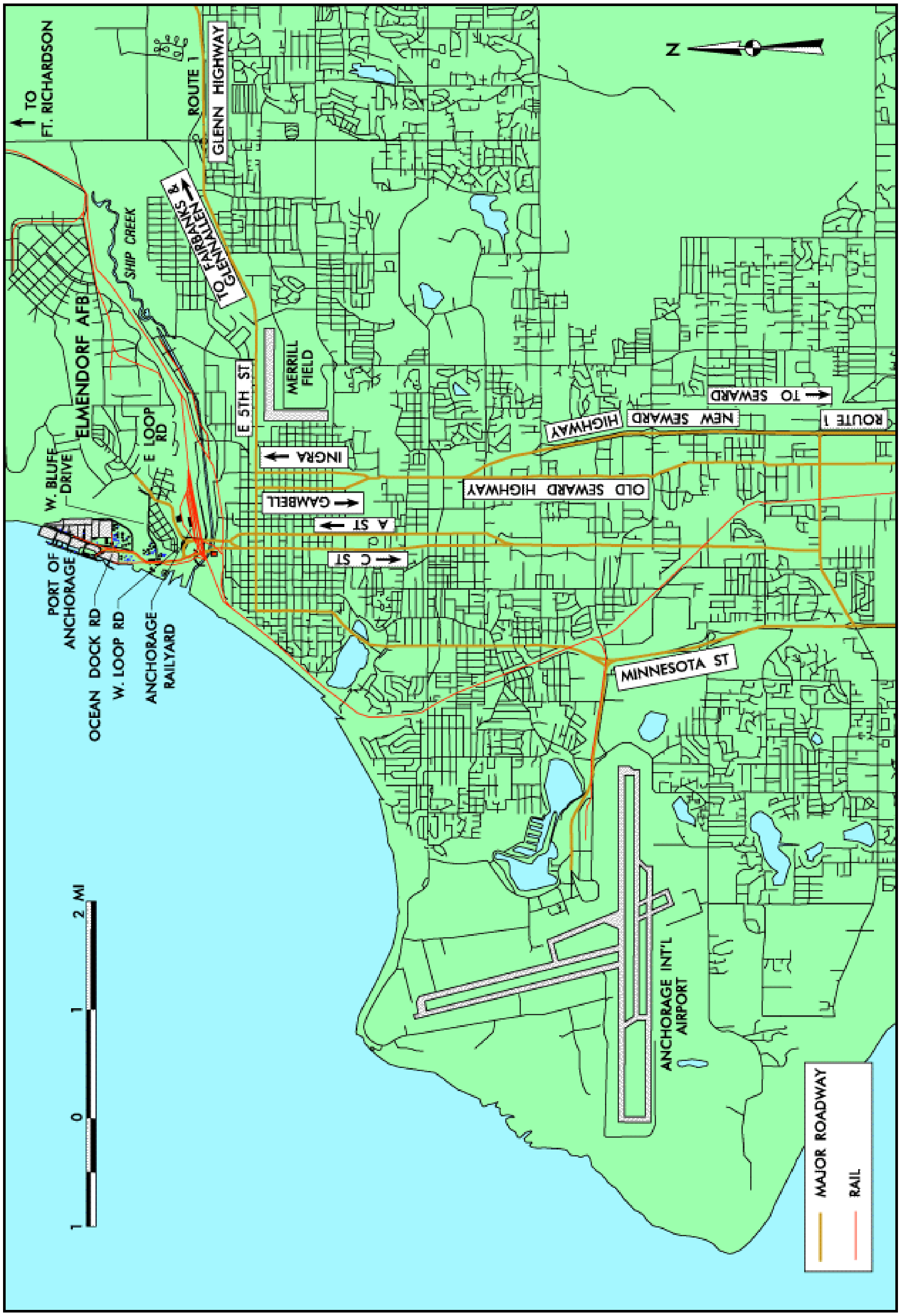
Channel Graphic

Knik Arm Channel

Highway

Alaskan Route 1 (Glenn Highway) is the major highway accessing the port. Equipment deploying from Fort Wainwright/Eielson Air Force Base (AFB) (about 360 miles from Anchorage) can access the Glenn Highway by traveling south on Route 3 (Parks Highway). The Glenn Highway is a six-lane highway just north of Anchorage, but becomes a four-lane highway within the Anchorage City limits. Roads leading from the Glenn Highway to the port are E 5th and A Streets and W Loop and Ocean Dock Roads in that order. These routes vary between two and four lanes. Ocean Dock Road, a two-lane road, provides the sole highway access into the port and has several railroad crossings, which can block highway traffic when trains come into the port. The gate into the port has two lanes (one in and one out). No unusual vertical clearances impede port access on these routes. Equipment from Fort Richardson has the option of accessing the port either by the Glenn Highway or by taking the road network through adjacent Elmendorf AFB to E Loop Road, which connects to W Loop Road near Ocean Dock Road. West Bluff Drive also provides a connection from Elmendorf AFB to Ocean Dock Road.

Ocean Dock Road with One of the Railroad Crossings



Highway, Rail, and Air Access Map

Rail

The Alaska Railroad Corporation (ARRC) provides the rail service to the port. The ARRC states that they could provide about 2-3 trains per day at 75-80 railcars per train for units transiting from Fort Wainwright to the port. About 250 flatcars are in the ARRC inventory and 130 of these are 53-foot flatcars. The ARRC reports that 89-foot flatcars are unavailable in Alaska.

A major classification railyard exists about 1 mile southeast of the port. This railyard can store over 500 railcars, but operates at about 75 percent capacity on a daily basis. Railcars can also be stored on Fort Richardson (about 500), on the port (about 90), various industrial spurs in the Anchorage vicinity (about 500), and in the Portage classification railyard about 60 miles southeast of the port (about 150). These railyards were uncongested at the time of the port survey. Rail clearances meet the Association of American Railroads diagram. Rail spurs link the railyards with the port. The rail line accessing the port crosses Ocean Dock Road several times. Sending trains directly to the port can result in railcars blocking Ocean Dock Road, the only road accessing the port. The wharf apron at the port has one set of tracks that run the entire length of the wharf.

The port does not have any fixed or portable rail end ramps at the present time, but the ARRC can provide three end ramps (two fixed and one portable) in the vicinity of the port. Also, the North Star Terminal and Stevedore Company can provide two portable end ramps. Another ARRC fixed rail side/end ramp (Klatt Road Ramp) serving two tracks is available on the southside of Anchorage about 8 miles from the port.

Alaska Railroad Corporation Railyard

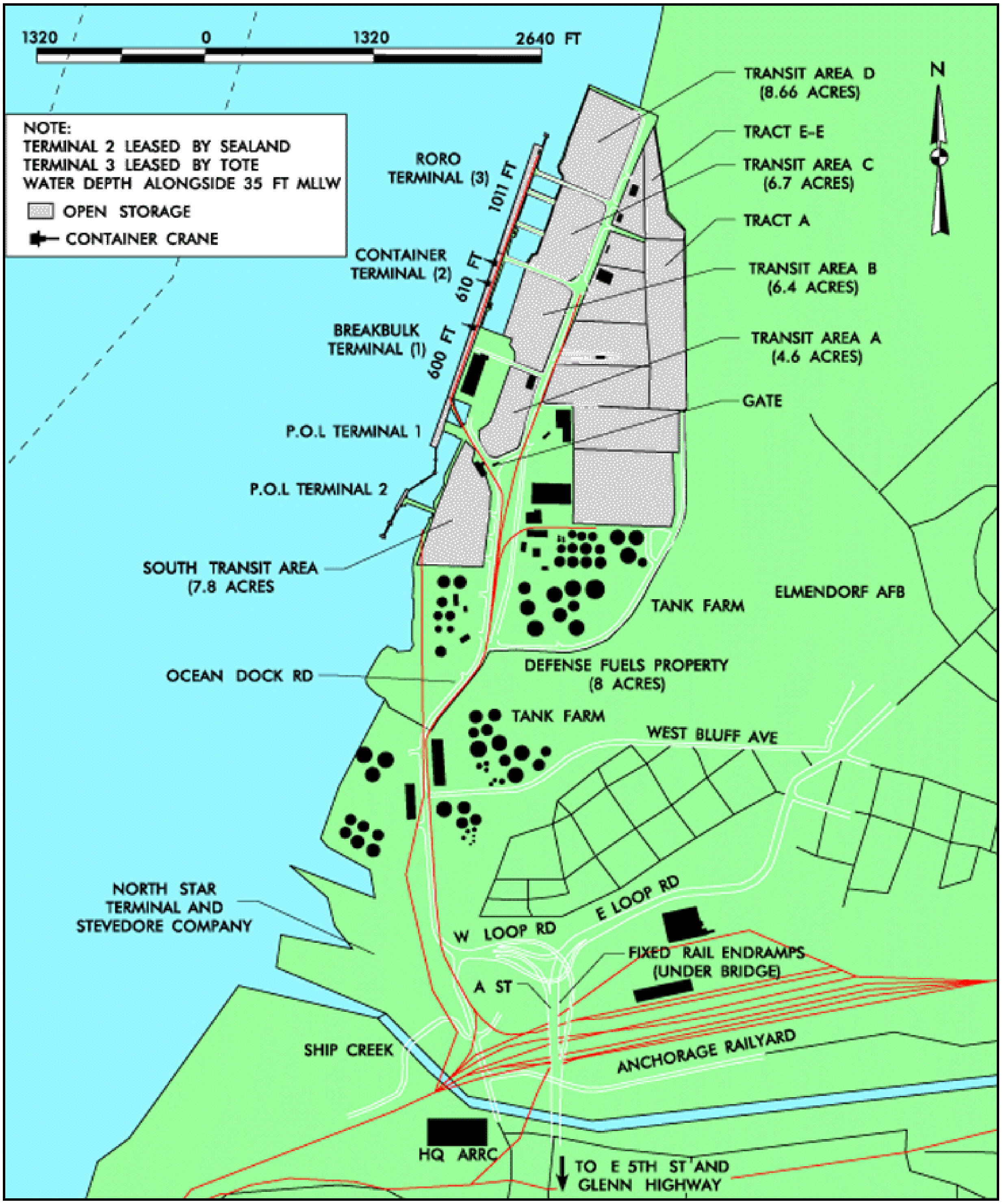
Alaska Railroad Corporation Portable End Ramp

Air

Several airports exist near the Port of Anchorage. The largest two, Anchorage International and Elmendorf AFB, have multiple runways and are large enough to land C-5 Aircraft. A table listing the airport name, number of runways, length of longest runway, and location from port is provided below.

Airport Name	Number of Runways	Length of Longest Runway (ft)	Location
Anchorage International (includes Kulus Air Guard Field)	3	10,900	4 miles southwest of port
Elmendorf Air Force Base	2	10,000	1 mile east of port
Merrill Field	2	4,000	2.5 miles southeast of port
Birchwood Field	1	4,000	15 miles northeast of port
Bryant Army Airfield	1	2,900	8 miles east of port

The Port Authority at the Port of Anchorage states that helicopter operations can occur at various open storage areas inside the port.


1320
0
1320
2640 FT
NOTE:
TERMINAL 2 LEASED BY SEALAND
TERMINAL 3 LEASED BY TOTE
WATER DEPTH ALONGSIDE 35 FT MLLW
OPEN STORAGE
CONTAINER CRANE
N
RORO TERMINAL (3)
1011 FT
CONTAINER TERMINAL (2)
610 FT
BREAKBULK TERMINAL (1)
600 FT
P.O.L TERMINAL 1
P.O.L TERMINAL 2
SOUTH TRANSIT AREA (7.8 ACRES
OCEAN DOCK RD
NORTH STAR TERMINAL AND STEVEDORE COMPANY
SHIP CREEK
TRANSIT AREA D (8.66 ACRES)
TRACT E-E
TRANSIT AREA C (6.7 ACRES)
TRACT A
TRANSIT AREA B (6.4 ACRES)
TRANSIT AREA A (4.6 ACRES)
GATE
TANK FARM
ELMENDORF AFB
DEFENSE FUELS PROPERTY (8 ACRES)
TANK FARM
WEST BLUFF AVE
E LOOP RD
W LOOP RD
FIXED RAIL ENDRAMPS (UNDER BRIDGE)
A ST
ANCHORAGE RAILYARD
HQ ARRC
TO E 5TH ST AND GLENN HIGHWAY

Land-Use Map

PORT FACILITIES

Berthing

The Port of Anchorage is a multi-cargo port consisting of an over-the-water marginal wharf with three ship berths (Terminals 1-3). The over-the-water feature is designed to accommodate the huge tidal variation at the port. Although the port specializes in container traffic and liquid petroleum exports, it is also capable of breakbulk, limited RORO, and barge operations. Two steamship lines currently operate at the port. Sealand Service, Inc., does container lift-on/lift-off operations at Terminal 2 via the specialized container cranes. Totem Ocean Trailer Express, Inc., (TOTE) also does container operations via RORO.

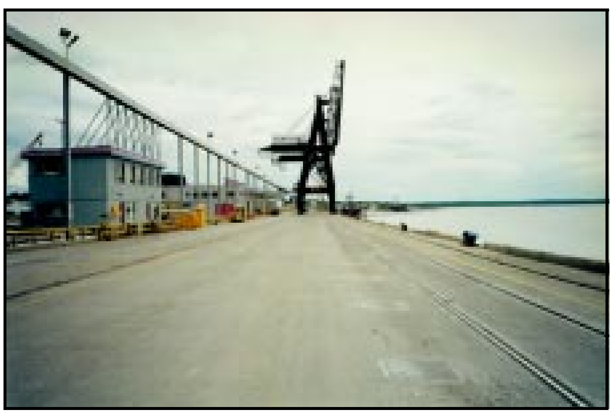
The wharf is 2,221 feet long, has a depth alongside of 35 feet MLLW, and has a new energy-absorbing fendering system. This wharf is compatible with LMSR ships and can also accommodate FSS vessels provided the FSS ship draft does not exceed 35 feet. The maximum ship draft for the FSS is 37 feet. A dolphin allows for ship overhang at Terminal 3.

Since the wharf is fixed and the port experiences huge tidal variations, RORO operations are constrained to two loading/offloading windows of about 2 ½ hours each during the day. An exception is TOTE, which has its own specially designed RORO ramps, that can allow for tidal variation, stored at the port. These ramps are designed to be compatible only with TOTE-owned ships. The wharf apron is 70 feet wide and has four access roadways. Lighting exists throughout the port. The deck strength is rated at 600 pounds per square foot (psf). The original portion of the wharf at Terminal 1 has proven durable as it withstood the 1964 Alaskan earthquake.

About 26.5 acres of available open staging are near the wharf (12.4 acres immediately adjacent to the wharf). A transit shed is available at Terminal 1. A rail spur runs the entire length of the wharf to allow direct transfer of cargo from rail to ship. Three container cranes (two 30-ton Pacecos and one 40-ton Mitsubishi) are at the wharf and can travel the entire wharf length.

Port of Anchorage Wharf (Terminals 1-3) at Low Tide

BERTH CHARACTERISTICS FOR THE PORT OF ANCHORAGE	
Terminals	
Characteristics	**1-3**
Length feet (meters)	2,221 (677)
Depth alongside at MLLW feet (meters)	35 (10.67)
Deck Strength psf (metric tons per square meter)	600 (2.93)
Apron width feet (meters)	70 (21.34)
Apron height above MLLW feet (meters)	36-40 (10.97-12.19)
Number of container cranes	3
Number of wharf cranes	0
Apron Lighting	Yes
Straight-stern RORO Ramp	No
Apron length served by rail feet (meters)	2,126 (648)



Wharf (Terminals 1-3)

TOTE Specialized RORO Ship Ramp

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF ANCHORAGE		
Vessels		Berths
TYPE	CLASS	Terminals 1-3
BREAKBULK	C3-S-38a	4
	C4-S-58a	3
	C4-S-66a	3
	C5-S-37e	3
SEATRAIN	GA and PR	3
BARGE	LASH C8-S-81b	2
	LASH C9-S-81d	2, a, f, g
	LASH Lighter	11
	SEABEE C8-S-82a	2, a, f, g
	SEABEE Barge	11
RORO	COMET	4, d, o
	METEOR	3, d, o
	Cape Gnome	3, d, i, j, k, m
	C7-S-95A	2, i, j, k, m
	Cape Taylor	3, i, j, k, m
	Cape Orlando	3, i, j, k, m
	MV Ambassador	3, d
	Callaghan	3, d, o
	Cape Lambert	3 i, j, k, m
	LMSR Class	2, b, i, j, k, m
	FSS	2, a, g, i, j, k, m
	Cape E-Class	3, i, j, k, m
	Cape D-Class	3, i, j, k, m
	Cape H	2, a, g, i, j, k, m
RORO	Cape Texas	3, i, j, k, m
	Cape R	3, d
	Cape I-class	3, i, j, k, m
	Cape Victory	3, i, j, k, m
CONTAINER	C6-M-147a	3
	C7-S-69c	3
	C7-S-68c	3
	C8-S-85c	2
	C9-M-132b	2
	C9-M-F141a	2, a, g
TACS	C6-S-1qd	3
	C5-S-MA73c	3
	C6-S-MA60d	3
MPS	C7-S-133a	2
	Maersk	2
	AmSea	3

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp
Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

Open Staging

The port authority lists 26.57 acres of paved open storage available for military use. Of this total, 12.4 acres (Transit Area A and South Transit Area) are next to the wharf area. Tracts A and E-E are less than 1,000 feet inland of Transit Area A and provide easy access to the wharf. Another 21.76 acres of open storage exists in Transit Areas B, C, and D. However, these open storage areas are currently used by TOTE and Sealand and are routinely filled to capacity on a daily basis. The port states that helicopter operations can occur at Transit Area A, South Transit Area, and Tracts A and E-E. After removing the rotor blades, the port support activity can tow the helicopters into the transit shed at Terminal 1 for further reduction and shrink-wrapping. Due to recent expansion and development within Sealand and TOTE, the Anchorage Port Authority expects future yearly increase in container traffic of 2.1 percent per year into the future. This may reduce the amount of open storage currently available.

Open Staging Area (South Transit Area)

Open Staging Areas Occupied by Sealand and TOTE

Covered Staging

Covered storage consists of a transit shed with an inside area of 27,000 square feet. Also available is an old equipment shop with about 2,400 square feet of covered storage space.

UNLOADING/LOADING POSITIONS

Ramps and Docks

Currently, the Port of Anchorage does not have any fixed or portable end ramps. Ramps can be provided by the ARRC and North Star Terminal and Stevedore Company. The North Star Terminal and Stevedore Company has a portable end ramp and a concrete structure that could be used to make a portable end ramp. The ARRC has three fixed end/side ramps available and one portable end ramp. Specifics on the three fixed end ramps are shown in the table below. For van/boxcar operations, 11 truck/rail docks are along the transit shed at Terminal 1.

Ramp Name	Type Ramp	Location	# of Railcars Served
OVL Ramp	Fixed Double End Ramp	Southwest of ARRC HQ Bldg. off of W Ship Creek Ave.	60
Anchorage Railyard Ramp	Fixed End Ramp	Anchorage Railyard off of Port Access Highway	15
Klatt Road Ramp	Fixed End/Side Double Ramp	8 miles south of the port	50

Marshaling Areas

The port authority lists two areas of various surface materials near the port that have potential for marshaling. They are the Defense Fuels Property (about 8 acres of gravel/unimproved surface) at the port and the Anchorage Railyard (available acreage unknown), owned by the ARRC, outside the port. The Military Traffic Management Command is currently investigating use of the Defense Fuels Property for military use.

Defense Fuels Property at the Port of Anchorage

Materials Handling Equipment (MHE)

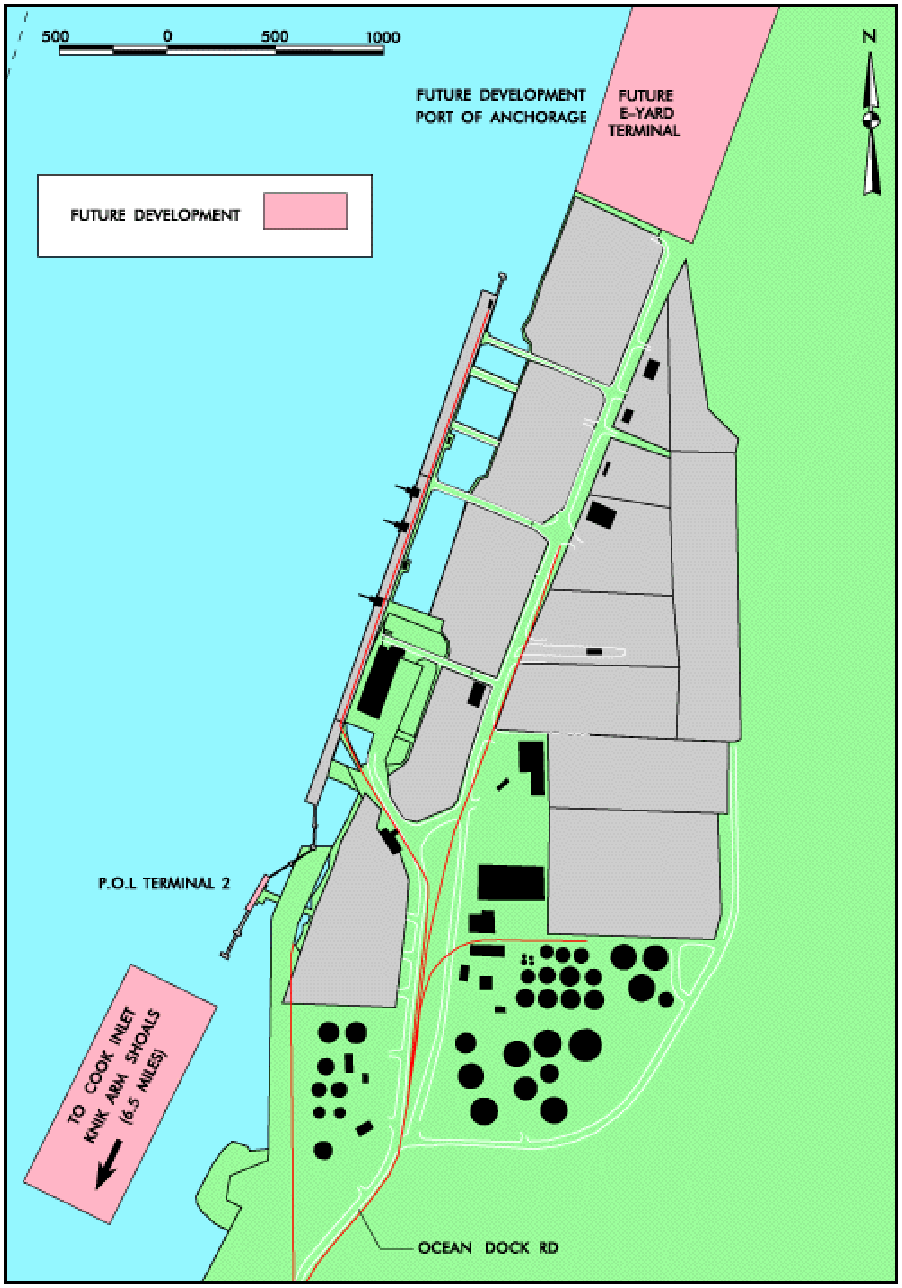
The only MHE owned by the port are three container cranes used for loading/offloading containers from ships. Two of the container cranes are 30-ton Paceco cranes and the third crane is a 40-ton Mitsubishi container crane. The North Star Terminal and Stevedore Company, located less than 1 mile from the port, provides equipment and stevedoring services. A list of typical equipment is provided in the table below. Other MHE is available through ARRC and Sealand.

MATERIALS HANDLING EQUIPMENT		
MHE Type	**Capacity STON (tonne)**	**Quantity**
Mobile Crane	300 (272)	1
Mobile Crane	230 (209)	1
Mobile Crane	150 (136)	3
Mobile Crane	140 (127)	1
Mobile Crane	100 (90)	1
Top Pick	43 (39)	1
Fork Lift	32.5 (29)	3
Fork Lift	31 (28)	5
Fork Lift	26 (23)	1
Fork Lift	15 (13)	1
Fork Lift	9 (8)	9
Fork Lift	4 (3)	1
Fork Lift	2.5 (2)	4
Fork Lift	2 (1)	1
D 65 Dozers		3
Michigan Loader/Forklift combination		1
68-foot Reach Manlift		1
Yard Tractors		7

FUTURE DEVELOPMENT

The Port of Anchorage Port Authority lists three future development projects. The first project is the Cook Inlet Navigation Project, which will feature the dredging of the Knik Arm Shoals that currently restrict ship traffic to 6-hour transit times twice a day (periods of high tide). After dredging, the channel will be at least 43 feet deep MLLW and 1,300 feet wide. See the water access map at the beginning of this study for a location of the shoals. Completion date for this project is June 2000. The second project is the conversion of the POL 2 Terminal to a general cargo terminal. Projected completion for this project is 5 years (2004). The third project is to build a new terminal (E-Yard), which will be a 40-acre facility north of the port. This is a long-term project and expected completion is about 2009. Part of the reason for the port expansion is the port authority expects an increase of 2.1 percent per year in container traffic.

The ARRC also lists a future development that also impacts the port. This project is the Ocean Dock Realignment Project, which is a federal/state project designed to minimize the number of railroad crossings on Ocean Dock Road (only highway access to the port). No completion date was given for this improvement.



Future Development for the Port of Anchorage

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

Ammunition or other explosive cargo would require permission from the appropriate port and DOT officials for transport through the port. Handling procedures would have to be established prior to bringing in explosive or hazardous cargo.

STEVEDORING

The Anchorage area has a large pool of longshoremen. North Star Terminal and Stevedore Company quotes 100 registered longshoremen and 80 casual longshoremen.

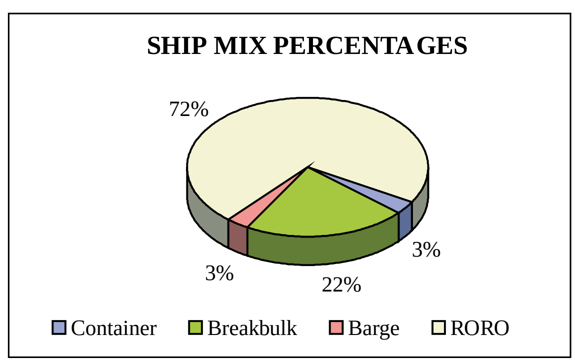
III. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity for the Port of Anchorage. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON.

Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth 90 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

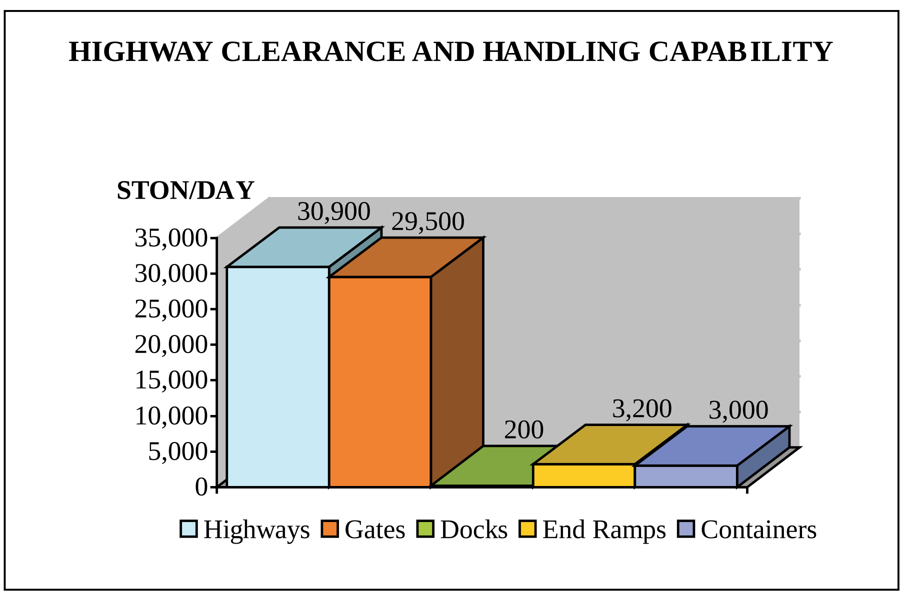
Highway

All routes going to the port from the Glenn Highway (E 5th Street to A Street to W Loop Road; road network through Elmendorf AFB to E Loop Road; or West Bluff Road) lead to Ocean Dock Road, the sole highway access to the port. The main gate allows access to the unloading and staging areas. The road and gate going into the port can handle over 29,500 STON of cargo per day. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or leave the port using the one lane accessing the port.

Roadable vehicles will move through the terminal gate in manageable convoys to the staging area. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. Since end ramps are not available, deploying units/military port operators must either build or acquire the necessary ramps. We assume that the using units will acquire at least two portable truck end ramps from North Star Terminal and Stevedore Company. Two end ramps with one handling position each can handle 3,200 STON of military vehicles and equipment per day.

North Star Terminal and Stevedore Company has one top pick forklift available. Assuming use of this container handler plus usage of another from Sealand, the Port of Anchorage could handle 3,000 STON/day.

Maximum daily handling capability for the port is a mixed total of the three types of handling (docks, end ramps, and containers), each up to its maximum, not to exceed the daily gate limit of at least 29,500 STON.



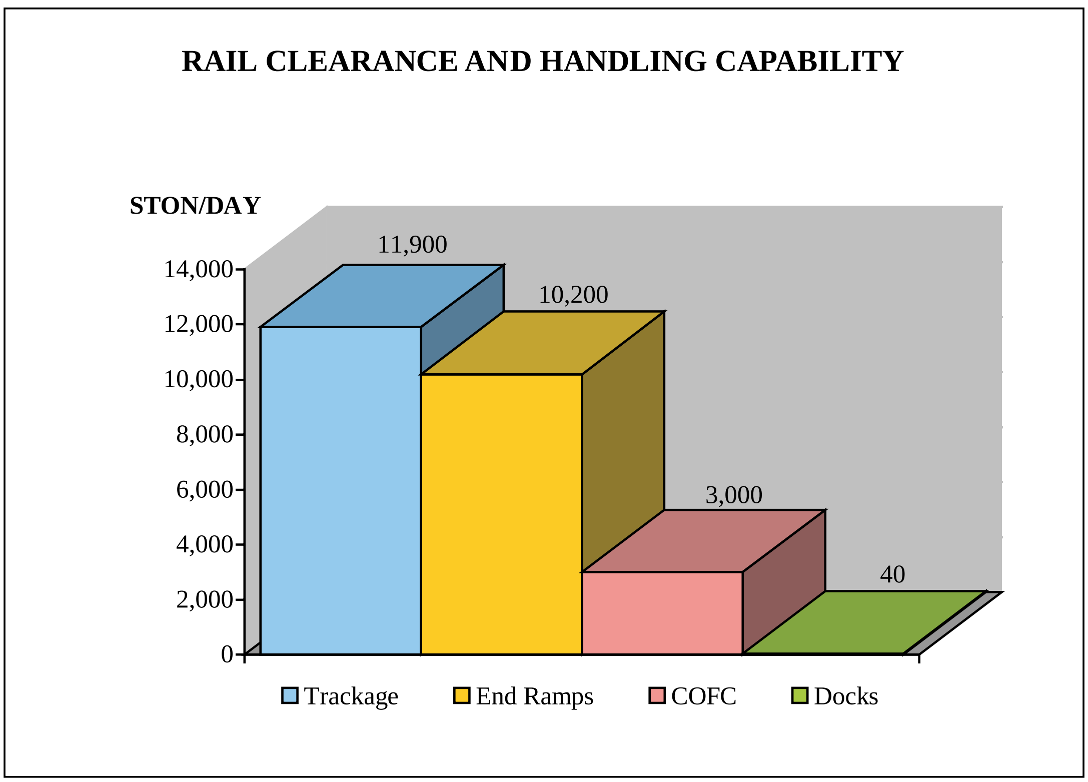
Rail

Rail reception is good, with ARRC providing rail service directly to the port. Current rail service can support from two to three 80-railcar trains per day from Fort Wainwright. These trains can handle over 11,900 STON per day.

Wheeled and tracked vehicles on flatcars will offload at the Anchorage Railyard plus the OVL ramp southwest of the ARRC headquarters building. These end ramps can handle almost 10,200 STON per day.

The port has 11 boxcar/van positions for rail offloading at the transit shed. Assuming five of these docks are used, the port can handle about 40 STON per day.

Based on using two container handlers provided by ARRC for offloading COFC railcars, the port can handle about 3,000 STON of containerized equipment and supplies from railcars per day.



Staging

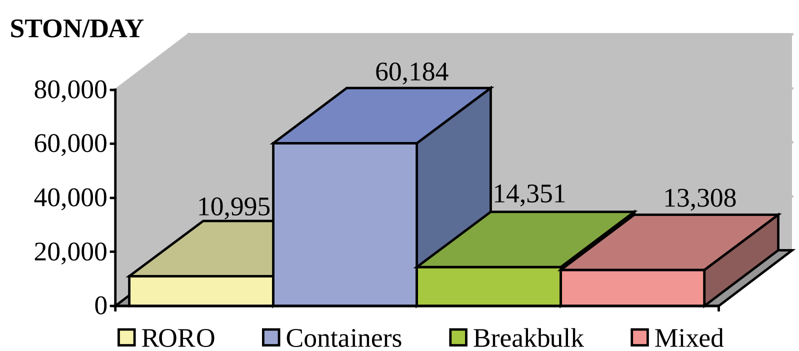
The Port of Anchorage has identified over 26.5 acres of open staging area for vehicles and/or containers.

Total covered storage area is 29,400 square feet. The covered staging throughput is almost 600 STON per day.

The chart on this page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of the capability for each type of cargo operation involved should be assumed.

The table shows the STON of cargo, by type, the port can handle. The dwell time used in these computations was 3 days and the open space utilization percentage was 60 percent. The container storage throughput capability is the highest with almost 60,200 STON. The ability to stack containers three high contributed to the high container open storage throughput. The RORO storage throughput is almost 11,000 STON. The breakbulk staging throughput is about 14,400 STON.

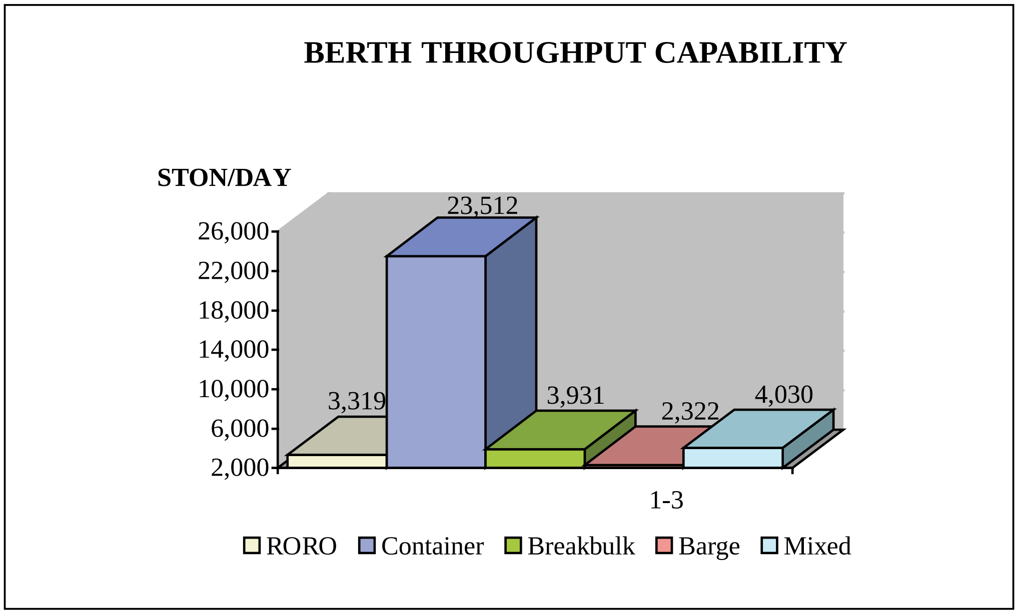
OPEN STAGING CAPABI LITY



Note: Container staging can also be used for RORO staging as needed.

Shipping

Daily shipping subsystem totals for each terminal berth are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types. The port conducts container operations using the container cranes. The nearby transit shed supports breakbulk operations and the open apron and nearby open storage area supports RORO operations. The huge tidal variation severely hinders RORO operations to a daily total of 5 hours unless special RORO ramps that negate the effects of the tide are used. The ample wharf length (2,221 feet) and water depth (35 feet MLLW) allow ships as large as the LMSR or FSS to berth at the Port of Anchorage.



Access to Over-the-Water Wharf (port at low tide)

DAILY THROUGHPUT SUMMARY	
Characteristic or Throughput	**Terminals 1-3**
Length (feet) (meters)	2,221 (677)
Depth Alongside (feet) (meters)	35 (10.67)
Breakbulk Throughput (STON) **(MTON)**	3,931 (9,828)
RORO Throughput[1] (STON) **(MTON)**	3,319 (13,277)
RORO Square feet (EST)[2]	66,380
RORO Pieces [3]	390
Container Throughput (STON) **(MTON)**	23,512 (58,780)
Container Throughput (TEU) [4]	2,939
Barge Throughput (STON) **(MTON)**	2,322 (5,806)
Mixed Throughput (STON) **(MTON)**	4,030 (13,658)

Truck Scales Available at North Star Terminal and Stevedore Company

[1]All RORO values based on a maximum 5-hour per day operation due to tidal variation.
[2]Based on the 20 square foot per STON average accomplished during Operation Desert Shield/Storm.
[3]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.
[4]Based on the 8 STON per TEU average accomplished during Operation Desert Shield/Storm.

SUMMARY

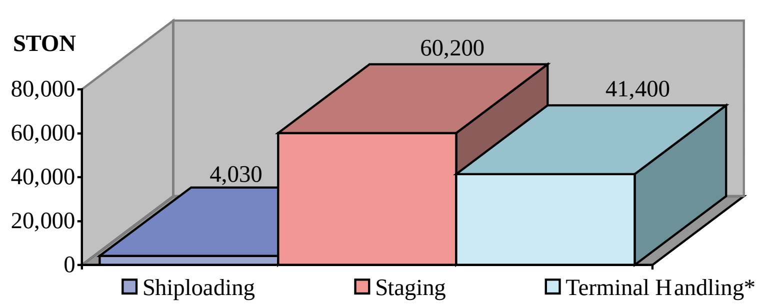
The port is multioperational with the capability to handle all types of vessels: container, limited RORO, breakbulk, and barge.

The Port of Anchorage has the capability to handle military equipment for deployment or exercise. The specialized container cranes can readily load containers and the local stevedores can provide mobile cranes for loading breakbulk/barge cargo. RORO operations will provide the biggest challenge with the 36-41 foot tidal range. Current RORO shiploading operations are constrained to two 2 ½ hour windows (total of 5 hours) during the day. Unless a “floating RORO ramp” similar to the ones used by TOTE is designed for Military Sealift Command owned RORO ships calling on the Port of Anchorage, RORO throughput will be about one-fourth of a normal RORO throughput.

The port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table. The open apron and close proximity of the transit shed allow for a variety of operations. To conduct sustained loading operations on an LMSR, the port needs 25 acres of open staging per LMSR vessel. Since the entire notional separate infantry brigade can be loaded on three-fourth of a single LMSR (assumes an average of 350,000 square feet of usable storage space available on an LMSR), the open staging need becomes about 16.5 acres. The amount of open staging needed for sustained loading operations on the FSS vessel is 16 acres per vessel. The notional infantry brigade will require a second FSS with a small partial load. The Port of Anchorage has 26.57 acres of paved open staging near the ship berth available for military deployments. Any other open staging requirements would need to be met using nearby marshaling areas. Based on the port authority’s projection that container traffic will increase 2.1 percent per year each year in the future, the availability of open storage for future military deployment is questionable.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of about 4,030 STON.

DAILY CARGO THROUGHPUT CAPACITY



Terminal handling is the sum of the highway (29,523 STON) and rail (11,912 STON) limits.

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional separate infantry brigade using primarily LMSR vessels. We assume the Port of Anchorage can make available at least 2,000 feet of berthing space, 16.5 acres of open staging (Transit Area A, South Transit Area, Tract A, and Tract E-E), and the transit shed for military deployment. We also assume that no other military units will be competing for these facilities during the time that the brigade occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately load the ship and clear the port.

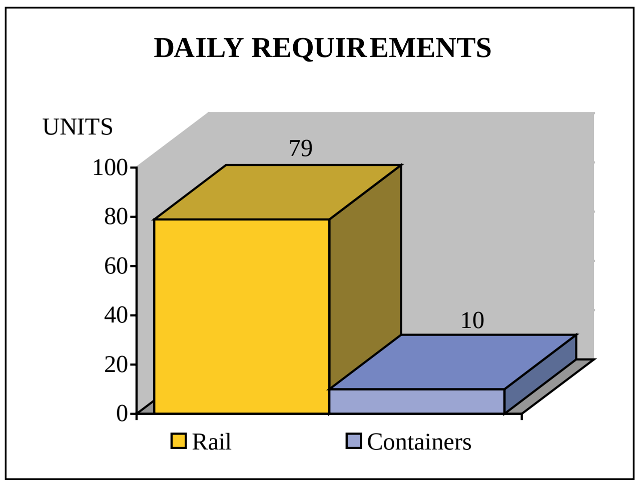
The facilities described in the above paragraph are shown in the following graphic. In addition to these facilities, our evaluation took into consideration the use of one container crane, one mobile crane, two container handlers (one for offloading semitrailers and one for offloading railcars), and three end ramps (one for offloading vans and two for offloading flatcars). We assume that either North Star Terminal and Stevedore Company and/or the ARRC could provide the MHE and end ramps to meet this requirement. We also assumed that off-port marshaling areas in the area are available if needed. Although currently not available, RORO ramps, similar to those used by TOTE and capable of mating with military ships such as the FSS or LMSR, would dramatically increase RORO and mixed throughput capabilities for Anchorage.

Potential Port Use During Deployment

REQUIREMENTS

To simulate a likely requirement for the Port of Anchorage, we deployed a notional separate infantry brigade, using 6 days for shiploading and port closure. The brigade has to move 1,577 roadable vehicles (includes 674 towed vehicles), 835 nonroadable vehicles, and 57 containers. Movement of the brigade to the port will require 470 railcars using a convoy/rail option for transport. Also, deployment will include about 16 helicopters. About 10 containers would arrive daily.

TOTAL EQUIPMENT	
Volume	65,577 MTON
Weight	12,940 STON
Area	355,821 SQ FT
Vehicles	2,412
Containers	57
Note: Figures above denote current requirements.	



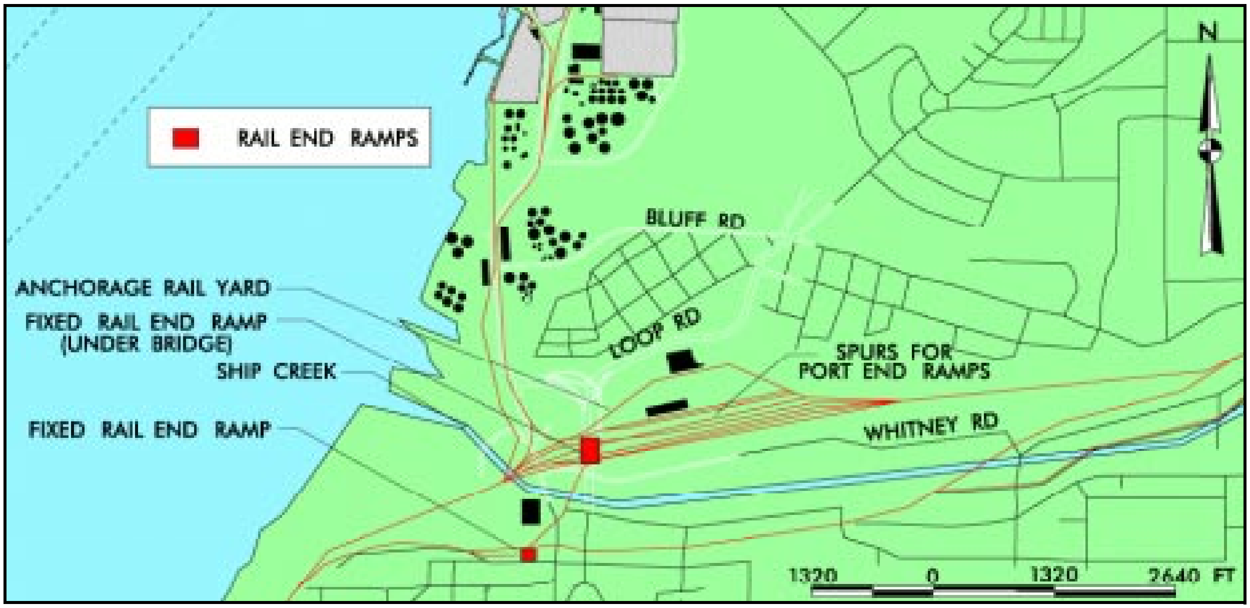
TERMINAL INPROCESSING/ HANDLING

Rail

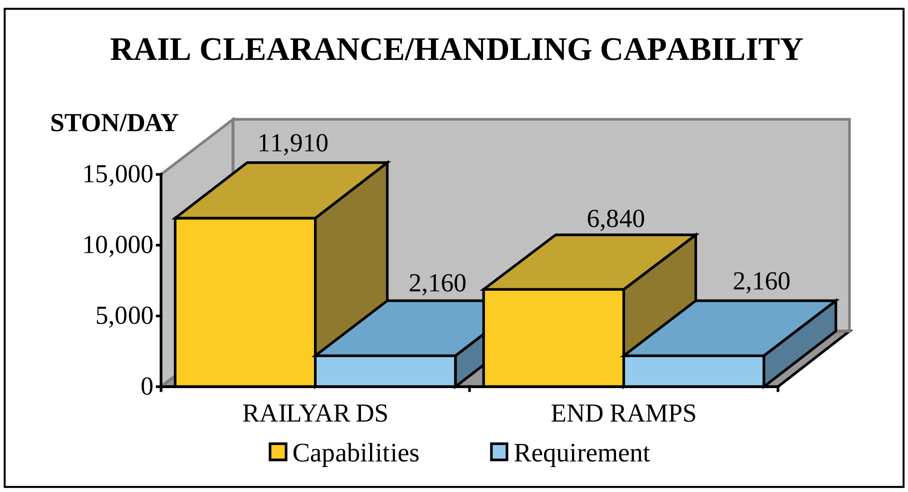
The ARRC serves the Port of Anchorage. It owns all of the trackage leading into the port and performs all of the switching. Based on a 6-day loadout, the port railyard (capacity of about 125 53-foot flatcars based on the current 75 percent usage daily) could handle the additional daily rail traffic (79 railcars per day).

For offloading wheeled and tracked vehicles from railcars, we assume use of two rail end ramps at the Anchorage Terminal Railyard. One of the ARRC fixed ramps available near the ARRC headquarters building can handle about 60 railcars at one time. Several spurs in the railyard can handle the two 80-railcar trains that would access the port each day.

Requirements use total STON (12,940 STON) of equipment divided by six providing a rail daily requirement. Capabilities for the railyard and end ramps reflect trackage and end ramp daily throughputs, respectively. The rail clearance/handling capability assumes the use of two end ramps and the ability to handle three trains per day.



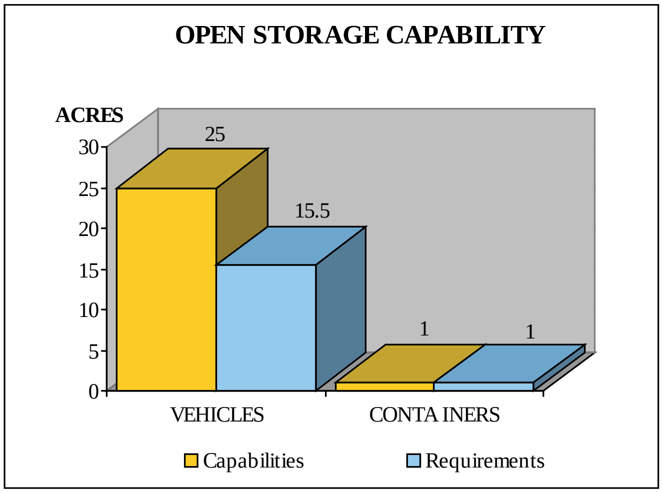
Rail End Ramp Locations



Open Storage

The Port of Anchorage has identified about 26.5 acres of available open storage area near the wharf. Assuming the port can provide this acreage, this is enough to support the loading of an LMSR. Since an entire notional separate infantry brigade can be loaded on three-fourth of a single LMSR (average of 350,000 available square feet on an LMSR), about 16.5 acres are needed for staging. The FSS needs about 16 acres for performing sustained loading operations. The additional off-port marshaling areas provide more open storage if needed. As the first ship fills up and the staging area empties, there is room to stage equipment for the next FSS that will be loaded.

The 16.5 acre requirement considers the available square feet for three-fourth of an LMSR times factors to allow for emergency lanes and vehicle/cargo/container access. In addition to vehicle and container acreage, space is also needed to account for maintenance, access, ramp areas, frustrated cargo, and so forth in loading any ship, including the LMSR. Since the entire notional separate infantry brigade can be loaded on three-fourth of the LMSR, the normal 25 acre requirement for sustained loading operations on an LMSR is reduced to 16.5 acres.



Transit Area A Open Storage

Shipping

Using the LMSRs to transport the brigade, Terminals 1-2 or 2-3 will allow the ships to meet the 6-day loading requirement. Based on each LMSR being able to load in about 6 days (maximum of 5 hours loading time each day), the port can achieve closure in the 6-day loading requirement. Berth space is adequate to allow the side and stern ramps on the LMSR to be used to load the ships.

When deploying by a single LMSR, each LMSR ramp will have to average about 215 STON per hour for 5 hours each day to deploy the brigade in 6 days. This equates to 40 vehicles per hour per ramp. Deploying by FSS requires 1.2 ship loads. If two FSS ships are loaded simultaneously (.6 load per ship), the brigade can load out in 5 days. This equates to 48 vehicles per hour per ramp.

SHIP REQUIREMENTS NOTIONAL SEPARATE INFANTRY BRIGADE				
Loading Condition/ Sample Ship Mix	**FSS (RORO/ Comb)**	**LMSR (RORO/ Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	1.2			
All LMSR		.75		
All Breakbulk			3.8	
Maximum Containerization				
FSS/Container	.04			.94
LMSR/Container		.03		.94
Breakbulk/Container			.14	.94

Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

APPLICATION RESULTS

Total deployment time for the brigade was about 6 days plus reception (5 days for .6 of a load on 2 FSS ships). An LMSR vessel was used to deploy the brigade. Closure results are shown in the chart on the following page. Although the port can handle a separate infantry brigade in 6 days, problems may occur during peak reception of equipment during deployment. Peak day requirements may bring in as much as 8,350 STON. Based on the limiting subsystem in port throughput for Anchorage (shipping subsystem - 4,030 STON/day), the peak influx of equipment may require storage at Fort Richardson and/or Elmendorf Air Force Base until open storage is available at the port.

CLOSURE PROFILE USING SHIPLOADING SUBSYSTEMS FOR PORT OF ANCHORAGE

SUMMARY

The Port of Anchorage can load a notional separate infantry brigade and achieve closure within 6 days using 1,000 feet of berth space and one LMSR ship. If two FSS ships are loaded simultaneously (2,000 feet of berth), the brigade can be loaded in 5 days. The port must ensure that at least 16.5 acres of paved open staging are available for military use. Because the port is experiencing a dramatic increase in commercial container activity, available open storage areas may become scarce for military deployment. If Anchorage is designated as a strategic port for deployment, then the U.S. Government should take action and secure an agreement with the port to ensure needed open storage areas are available during a contingency. MHE and end ramps are readily available from local stevedores and the ARRC. Although the port can achieve closure in 6 days, peak day requirements (as much as 8,350 STON in the equipment reception and handling subsystem) will exceed the shipping subsystem capability (4,030 STON per day mixed shipping capability). This means that equipment may require marshaling in various areas, including Elmendorf AFB and Fort Richardson.

If the port authority can devise a means for negating the effects of the tidal variation, the RORO and mixed throughputs can increase dramatically. Working the ship for a full 20-hour work day (vice the current 5 hours per day), the RORO throughput could increase from 3,319 STON per day to 13,276 STON per day. The mixed throughput could increase from 4,030 STON per day to 11,200 STON per day. Equipment marshaling can occur at Elmendorf AFB, Fort Richardson, Defense Fuels Property (at the port), and/or the Anchorage Railyard (owned by the ARRC). Because the railroad spur accessing the Port of Anchorage crosses Ocean Dock Road (sole highway access into the port) several times, care must be exercised in scheduling trains into the port so that highway traffic is not disrupted. If needed, equipment moving on railcars may have to offload at the Anchorage Terminal Railyard and convoy down Ocean Dock Road to prevent disruptions in highway traffic. The Anchorage vicinity is easily accessible by highway or rail from Fort Wainwright (about 360 miles away).

MTMCTEA

PORT OF SEWARD
ALASKA

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a site visit at the Port of Seward in June 1999. The port is a small port with one general cargo finger pier (two major ship berths) owned by the Alaska Railroad Corporation (ARRC). It has the capability to throughput a brigade-size unit and accommodate vessels as large as the Cape D. The Port of Seward is not large medium size roll on/roll off (RORO) (LMSR) or fast sealift ship (FSS) capable. Although having a general cargo capability, the ARRC pier generally handles cruise ships (especially during the tourist season). The ARRC intends to fully convert the general cargo pier into a cruise terminal and build another general finger pier to handle general cargo. The new ARRC terminal will be adjacent to the old (converted) terminal and ready for operation by May 2000. The Port of Seward is not listed in the Port Planning Orders (PPO) issued by the Maritime Administration (MARAD). Currently, none of the Alaskan ports are listed in the PPO for deployment of a notional separate infantry brigade or any other military unit.

The port consists of a finger pier with a length of 735 feet and width of 200 feet. Dolphins extend out from the pier and cruise ships up to 866 feet in length routinely berth here. A transit shed is on the pier and is converted to a cruise ship ticket office during the tourist season. The conversion to ticket office will be permanent when the new general cargo wharf is completed in May 2000. The water depth alongside the pier is 35 feet mean lower low water (MLLW). The channel depth accessing the port is very deep with minimum depth readings of 84 feet MLLW.

The ARRC owns all tracks leading into the port and performs all rail switching. The ARRC estimates the ability to provide two 80-railcar trains per day going from Fort Wainwright to the Port of Seward. Because the rail line going to Seward is a single rail line, the ARRC would have to manage rail traffic going to and from the Seward area. Also, the rail line coming into Seward has a 2.4 percent grade. The ARRC uses 3-4 locomotives to safely transport trains going into Seward. Both a fixed end ramp and portable end ramp are available at Seward.

Seward has a small commercial airport that has handled C-130 aircraft in the past. The North Star Terminal and Stevedore Company provides equipment and stevedoring services at the Port of Seward. The company reported that 20 longshoremen are available during the summer and 45-50 are available in the winter. Lift-on/lift-off operations for loading/offloading ships are accomplished via mobile cranes. The ARRC Pier does not have wharf or container cranes.

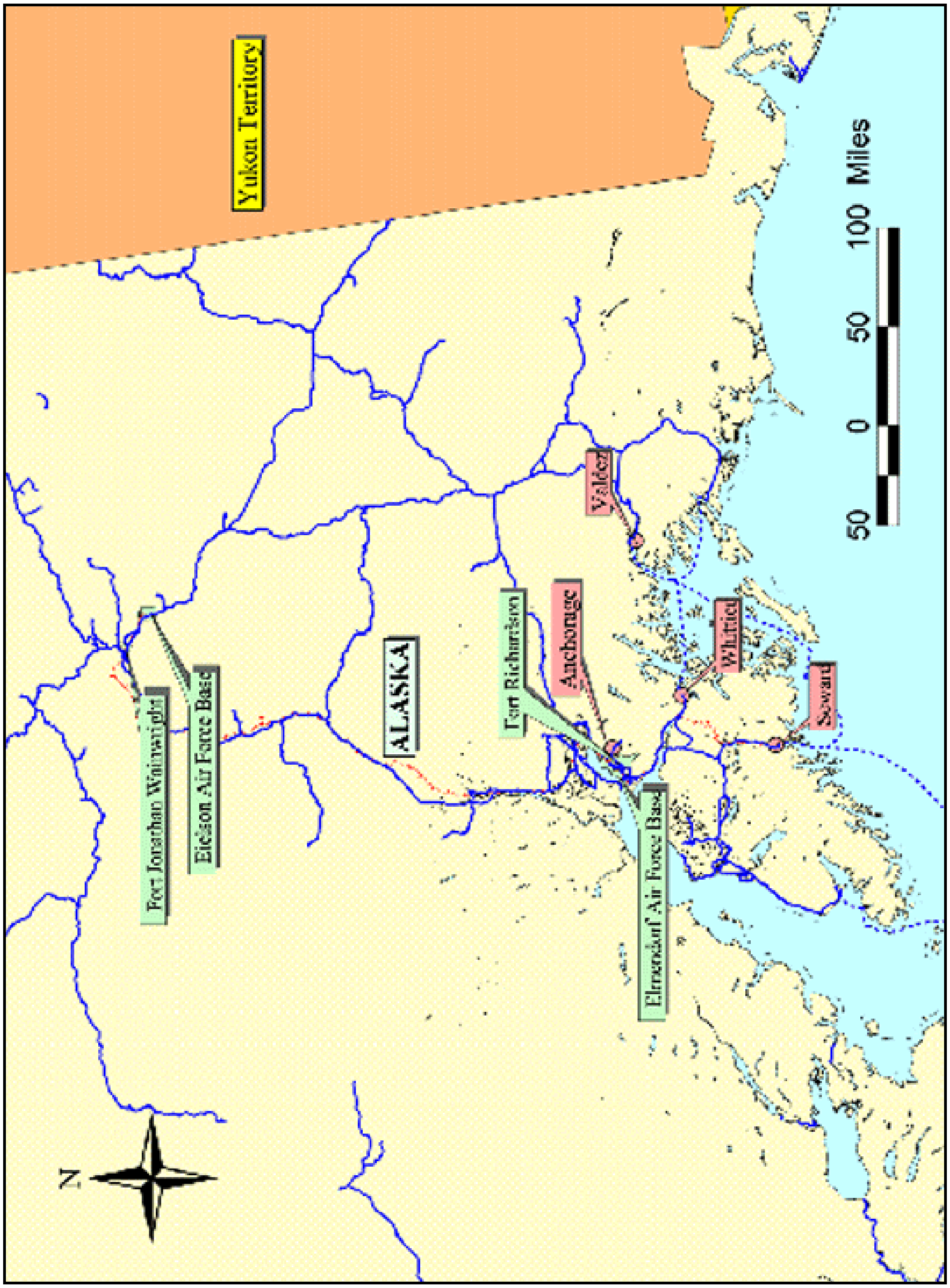
The Port of Seward has about 33 acres of gravel-surface/unimproved open staging. Other potential open storage areas are available in the Seward area. The transit shed with covered storage area of 25,200 square feet is available at the ARRC marginal wharf. At the time of the port visit, all covered storage was converted to cruise line ticket counters.

For deployment, an infantry brigade requires about 14 acres of open storage per Cape D vessel to support daily, sustained loading operations. The 33 acres of open storage easily meets open storage requirements for a Cape D vessel. Several areas exist in and around Seward that could provide an open storage capability should additional staging be needed.

For an application, we analyzed a notional separate infantry brigade deploying through the Port of Seward using three Cape D vessels. To throughput a brigade-size unit out of the Port of Seward by Cape D vessels, deployment will require a ship berth at least 750 feet long, a water depth alongside of 33 feet mean low water, and a wharf apron suitable for RORO operations. A Cape D requires about 14 acres of open storage for staging vehicles. Covered storage will be required to support helicopter shrink-wrapping and protect palletized cargo. At Seward, deploying units will likely use the 866-foot long ship berth, at least 14 acres of the available open storage, and the available end ramps. Because the current transit shed also serves as a cruise ship ticket office during the tourist season, covered storage may not be readily available during a deployment. Open storage areas are not secure; therefore, security measures must be taken to avoid vandalism and theft.

In deploying a notional separate infantry brigade, we estimate that the Port of Seward can achieve closure in about 6 days plus reception. Military units from Forts Richardson and Wainwright can deploy through Anchorage faster than Seward because the travel times for highway and rail decrease by 3.5 hours and 4 hours, respectively by going through Anchorage. The Port of Anchorage has the capability to load 2 FSS (.6 of a load on each FSS) in 5 days plus reception. The distance from Anchorage to Seward is about 130 miles by highway (about 3.5 hours at a 40 miles per hour road march). Also, the Port of Anchorage has the facilities to better handle containers and is less likely to experience labor or materials handling equipment shortages.

Although the port can achieve closure in 6 days, peak day requirements may be as much as 8,350 STON in the reception and handling subsystem. This would exceed the shipping subsystem throughput (3,380 STON per day) based on a one-ship berth loading operation during a contingency. This means that equipment would require marshaling in various areas to avoid port saturation.


Yukon Territory
ALASKA
Fort Jonathan Wainwright
Eielson Air Force Base
Fort Richardson
Anchorage
Valdez
Whittier
Seward
Elmendorf Air Force Base
50 0 50 100 Miles
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II. GENERAL DATA

The Port of Seward, located on the south central Alaskan coast on the Kenai Peninsula, is considered a potential seaport of embarkation for deploying Alaskan military units during contingencies. The Military Traffic Management Command Transportation Engineering Agency (MTMCTEA) conducted a site survey in June 1999. Information on port characteristics was obtained from port officials.

TRANSPORTATION ACCESS

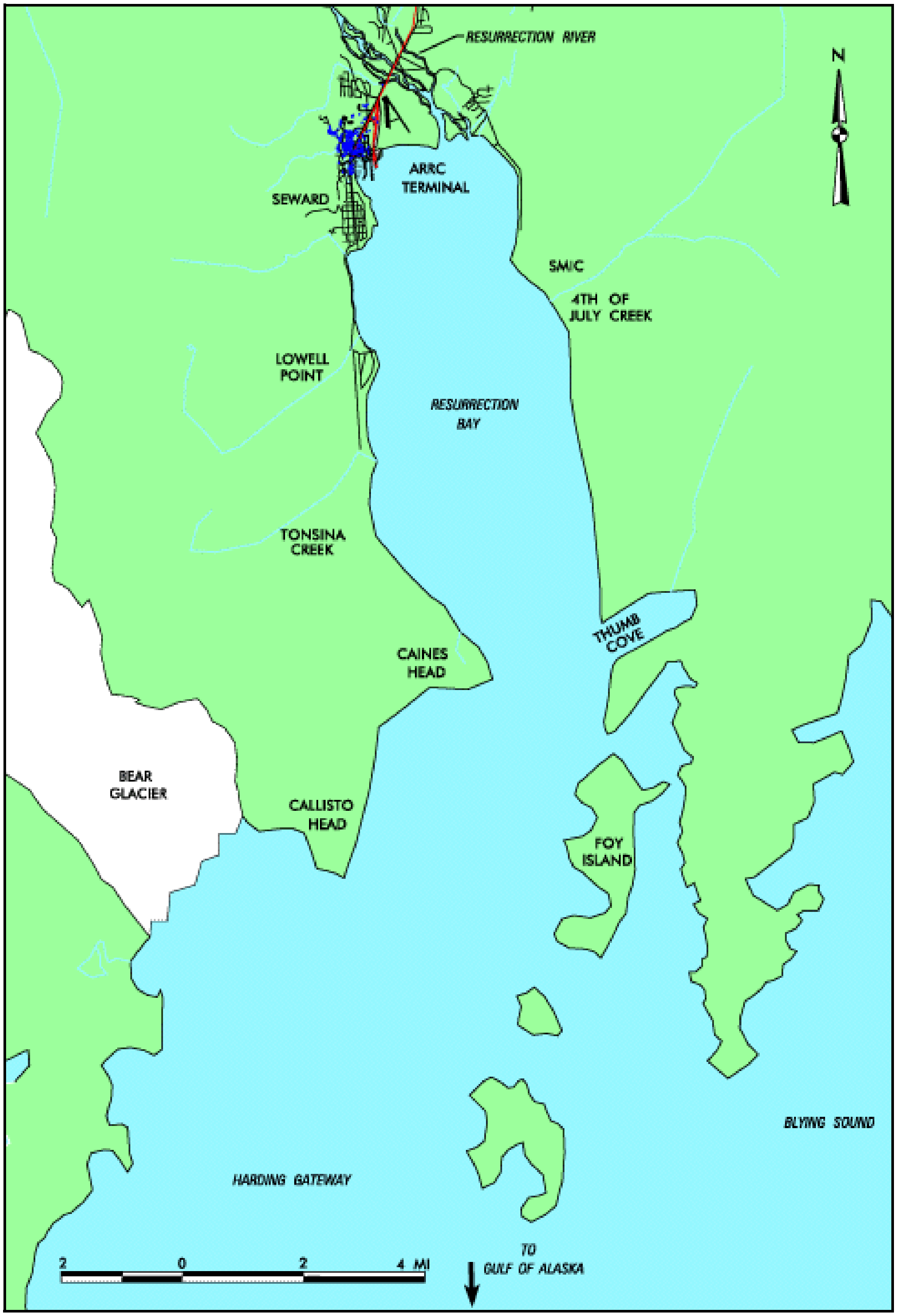
Water

The Port of Seward (latitude 60° 07' north, longitude 149° 26' west, (VJFX)) is located on the southeast side of the Kenai Peninsula, on the northwestern shore and near the head of Resurrection Bay. Water access from the Gulf of Alaska leads through Blying Sound and into Resurrection Bay via Harding Gateway. Channel depths are extremely deep with an average depth of 250 feet mean lower low water (MLLW). The minimum channel depth is 84 feet MLLW and occurs only at a point location near Tonsina Creek. The water depth diminishes rapidly approaching the Cruise Ship and Ferry Dock (ARRC Dock). The water depth alongside the finger pier is 35 feet MLLW. No overhead clearance restrictions exist for seaport access.

Access to the port is ice-free. Resurrection Bay is both wide enough and deep enough to provide a natural turning basin for any ship including fast sealift ship (FSS) and large medium size roll on/roll off (RORO) (LMSR) vessels. Due to the deep water depths, the number of anchorages are limited. Anchorage possibilities include the head of Resurrection Bay northwest of the Seward Marine Industrial Center (SMIC) in 30-35 fathoms (180-210 feet) MLLW and offshore from downtown Seward in 32 fathoms (192 feet) MLLW. The average tidal variation at Seward is 10.5 feet with an extreme of 19 feet.

Ship Channel Accessing the Port of Seward

All vessels calling on the Port of Seward require pilots for navigation. Pilots board vessels calling on the Port of Seward at the Caines Head light. About 12 pilots in the Homer/Anchorage area are available through the Southwest Alaska Pilots Association. Three tugboats are in the Seward area. The horsepower for these are 3,000, 2,400, and 1,200, respectively. These tugboats are provided through Anderson Tug and Barge.



Water Access Map

Highway

Alaska State Route 9 (Seward Highway), a two-lane road, is the highway route accessing the Seward area. From Anchorage, the Glenn Highway (Route 1) leads to Route 9. Port Avenue, a two-lane street, is the road connecting Route 9 to the ARRC Dock at Seward. Traveling by highway, going to Seward adds an additional 3.5 hours of travel time (129 miles at 40 mph road march) from Forts Richardson and Wainwright than going to Anchorage.

Rail

The Alaska Railroad Corporation (ARRC) provides the rail service into Seward. From Seward, the single-track rail line runs north through Portage onward to Anchorage. The ARRC estimates that they could provide 2 trains per day at 75-80 railcars per train for units transiting from Fort Wainwright to the port. About 250 flatcars are in the ARRC inventory and 130 of these are 53-foot flatcars. The ARRC reports that 89-foot flatcars are unavailable in Alaska.

A major classification railyard is within ½ mile from the Port of Seward. This railyard can store about 400 53-foot railcars. Currently, no significant freight comes through the port. Coal represents the vast majority of rail cargo coming to the port. On a daily basis, the Seward railyard is virtually unused. The Portage classification railyard, about 80 miles away, can store about 150 railcars. This railyard is also relatively uncongested. No clearance restrictions exist on the rail line accessing Seward, however, the grades going over Divide Pass and Grand View Pass require the use of more than one ARRC locomotive to ensure safe movement to Seward. Current trains using low horsepower locomotives to haul coal from Anchorage to Seward require 3-4 engines to safely move the load. Because of the single-track line between Portage and Seward, the ARRC must also take care in managing the rail traffic during a contingency. Traveling by rail, going to Seward adds an additional 4 hours of travel time from Forts Richardson and Wainwright than going to Anchorage.

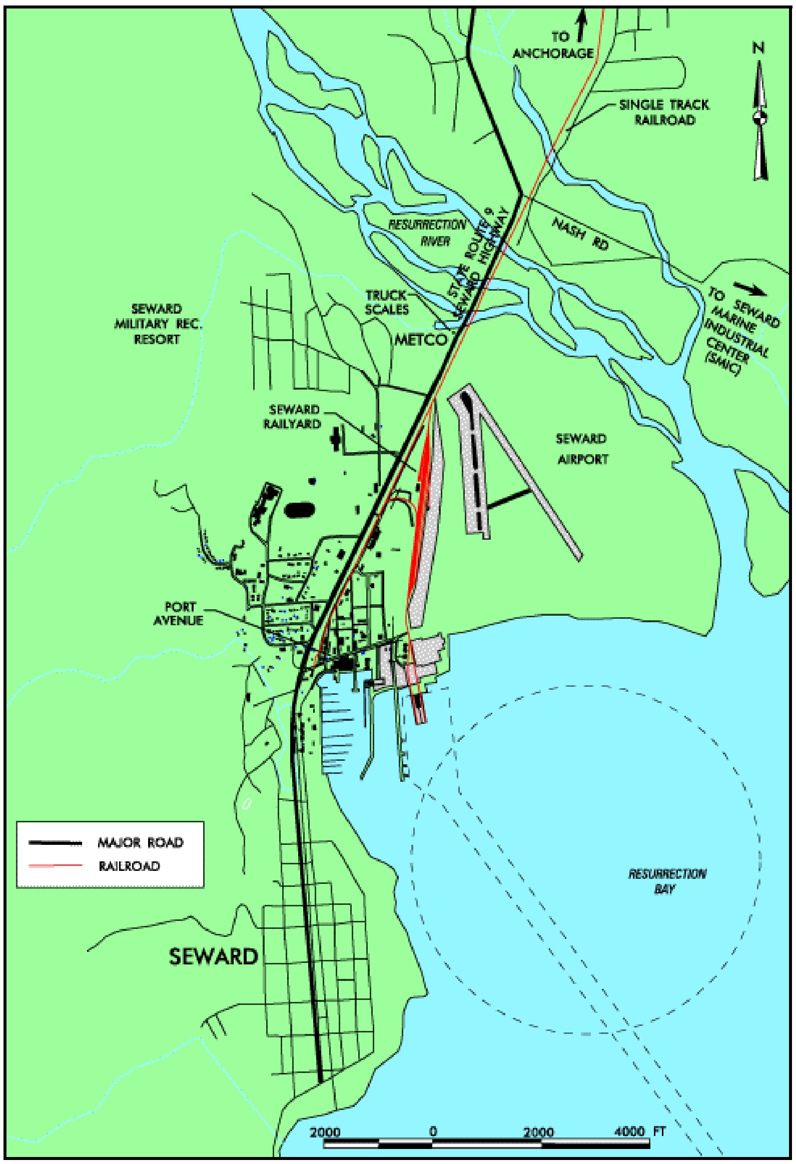
Two rail ramps exist at Seward. One is a fixed end ramp in the Seward railyard and the other is a portable end ramp currently stored near the ARRC Dock. The railyard has several spurs with large amounts of straight track suitable for conducting rail end ramp operations using portable ramps. With adequate notification, additional portable end ramps could be acquired or built for military use. The ARRC and the North Star Terminal and Stevedore Company have portable ramps in the Anchorage area.

Seward Railyard

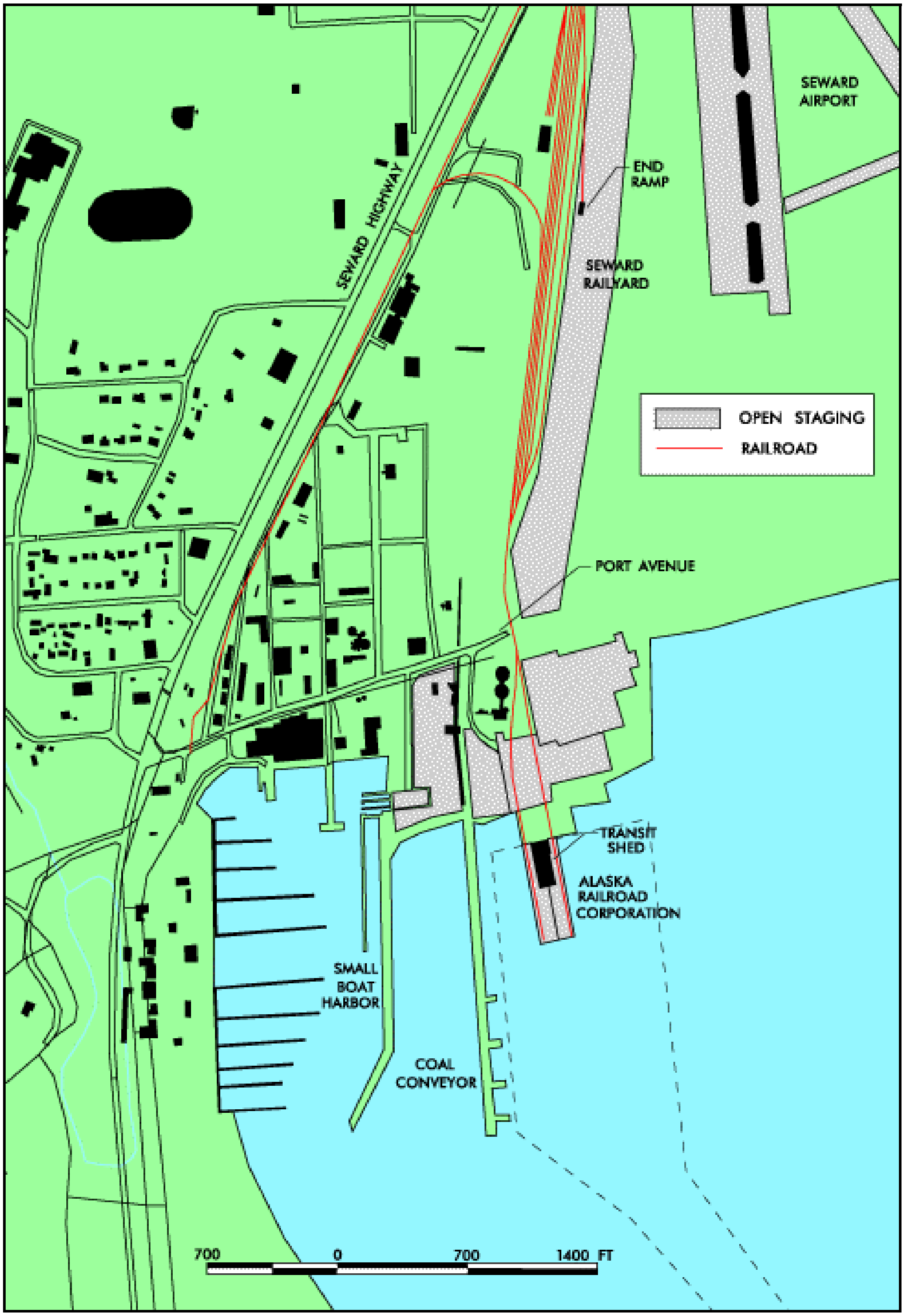
Air

Seward has a small commercial airport two miles northeast of the port. The airport has two runways of which the longest is 4,200 feet long.

According to the port authority, the best areas for helicopter operations are the small fenced-in area off Port Avenue adjacent to the ARRC Dock and on-dock away from the transit shed. Although the area on-dock is near to the transit shed for shrink-wrap operations, it will likely interfere with RORO ship loading operations.



Highway, Rail, and Air Access Map


SEWARD AIRPORT
END RAMP
SEWARD HIGHWAY
SEWARD RAILYARD
OPEN STAGING
RAILROAD
PORT AVENUE
TRANSIT SHED
ALASKA RAILROAD CORPORATION
SMALL BOAT HARBOR
COAL CONVEYOR
700 0 700 1400 FT

Land-Use Map

PORT FACILITIES

Berthing

The Port of Seward is a small port consisting of a small vessel marina, a cruise-ship/ferry dock, and a coal loading dock. The facility of military interest is the Cruise Ship/Ferry Dock, also known as the ARRC Dock, which is 735 feet (224.0 meters) long. One hundred thirty five feet of the 735-foot length is shallow resulting in a pier length of 600 feet (182.9 meters). Current ship berthing procedures allow ships to exceed the 600-foot berth length on both sides. The largest vessel currently capable of berthing at the ARRC Dock is a large cruise ship that is 866 feet (264.0 meters) in length. The water depth alongside the ARRC Dock is 35 feet (10.67 meters) MLLW.

Lighting exists throughout the port. Information provided by the port authority shows 33 acres of available open staging area at the port. All of the open storage, except for that on the pier, has a gravel surface. The ARRC Pier has a transit shed providing covered storage; however, this shed is routinely converted to ticket counters for cruise ships during the tourist season. The current ARRC Pier will be converted into a cruise ship permanently within the year. Therefore, the availability of this transit shed is questionable. Any lift-on/lift-off operations are accomplished via mobile cranes. The largest mobile crane available in the Seward area has a capacity of 600 STON.

BERTH CHARACTERISTICS FOR THE PORT OF SEWARD		
	Berths	
Characteristics	**Side 1**	**Side 2**
Length feet (meters)	866 (264.0)	866 (264.0)
Depth alongside at MLLW feet (meters)	35 (10.67)	35 (10.67)
Deck Strength psf (metric tons per square meter)	550 (2.69)	550 (2.69)
Apron width feet (meters)	200 (61.0)	200 (61.0)
Apron height above MLLW feet (meters)	22 (6.71)	22 (6.71)
Number of container cranes	0	0
Number of wharf cranes	0	0
Apron Lighting	Yes	Yes
Straight-stern RORO ramp	No	No
Apron length served by rail feet (meters)	735 (224.0)	735 (224.0)

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF SEWARD			
Vessels		**Berths**	
Type	**Class**	**Side 1**	**Side 2**
BREAKBULK	C3-S-38a	1	1
	C4-S-58a	1	1
	C4-S-66a	1	1
	C5-S-37e	1	1
SEATRAIN	GA and PR	1	1
BARGE	LASH C8-S-81b	1	1
	LASH C9-S-81d	a,c,f	a,c,f
	LASH Lighter	4	4
	SEABEE C8-S-82a	a,c,f	a,c,f
	SEABEE Barge	4	4
RORO	COMET	1,d,i	1,d,i
	METEOR	1,d,i	1,d,i
	Cape Gnome	1,d,i,j	1,d,i,j
	C7-S-95A	1,i	1,i
	Cape Taylor	1,i	1,i
	Cape Orlando	1,i	1,i
	MV Ambassador	1,d	1,d
	Callaghan	1,d,i	1,d,i
	Cape Lambert	1,i,j	1,i,j
	LMSR Class	c	c
	FSS	a,c	a,c
	Cape E-Class	1,i,j	1,i,j
	Cape D-Class	1,i	1,i
	Cape H	1,a	1,a
RORO	Cape Texas	1,i	1,i
	Cape R	1,d	1,d
	Cape I-class	1,i	1,i
	Cape Victory	1,i	1,i
CONTAINER	C6-M-147a	1,e	1,e
	C7-S-69c	1,e	1,e
	C7-S-68c	1,e	1,e
	C8-S-85c	1,e	1,e
	C9-M-132b	1,e	1,e
	C9-M-F141a	a,c,e	a,c,e
TACS	C6-S-1qd	1	1
	C5-S-MA73c	1	1
	C6-S-MA60d	1	1
MPS	C7-S-133a	1	1
	Maersk	1	1
	AmSea	1	1

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

Cruise Ship/Ferry Dock (ARRC Dock)

Cruise Ship at Side One of ARRC Dock

Open Staging

According to information provided by the port harbor master's office, the Port of Seward has 33 acres of open storage available at the port. This total is not contiguous and is located in various places including along the railyard and in various lots adjacent to the ARRC Dock. The wharves are directly accessible from the open storage areas. Other open storage is available in various places in and around the town of Seward. In general, the surface material on all open storage areas is gravel. The port states that helicopter operations can occur on the dock, away from the transit shed, and behind a fenced-in area off Port Avenue near the ARRC Dock. Although the location near the transit shed is more desirable for helicopter shrink-wrapping, using the area on-dock will likely interfere with ship loading operations.

Open Storage Area Near ARRC Dock
(Louisiana Pacific Mill Shop Area)

Open Area on End of Dock Near Transit Shed, ARRC Dock

Covered Staging

A transit shed exists on the ARRC Dock. This shed has 25,200 square feet of covered storage. During the tourist season, this shed is converted into ticket counters for cruise ships. Since the current ARRC Dock will undergo permanent conversion to a cruise ship dock within a year, availability of the storage space is questionable as the conversion nears conclusion. The cruise line ticket counters were in operation during the MTMCTEA site visit.

Cruise Line Ticket Counters in Operation Inside Transit Shed

UNLOADING/LOADING POSITIONS

Ramps and Docks

The Port of Seward has two rail end ramps for offloading railcars. One is a fixed end ramp located in the Seward Railyard. The other is a portable end ramp located near the ARRC Dock. The length of straight track serving the fixed end ramp is in excess of 1,000 feet. Other rail spurs in the Seward Railyard are in excess of 1,000 feet and appropriate for portable end ramp operations. With adequate notification, portable end ramps could be acquired or built for military use. The ARRC and the North Star Terminal and Stevedore Company have portable ramps in the Anchorage area. A truck end ramp with two handling positions is available at Cook Inlet Processing in the Seward Marine Industrial Center SMIC. About three van docks and three - four boxcar docks are available at the transit shed.

Fixed Rail End Ramp at Seward Railyard

Portable End Ramp

Marshaling Areas

All of the open storage areas identified in the Open Storage section could also serve as marshaling areas if needed. These storage areas are not within the secure area of the ARRC Dock and are easily accessible. Other open storage areas, such as parking lots and private lots, exist throughout the Seward area. The port also has ample open storage in their Seward Marine Industrial Center SMIC. This area is located about 7 miles away from the ARRC Dock across Resurrection Bay (on the east side of Resurrection Bay). In general, all open storage areas have a gravel surface.

Materials Handling Equipment (MHE)

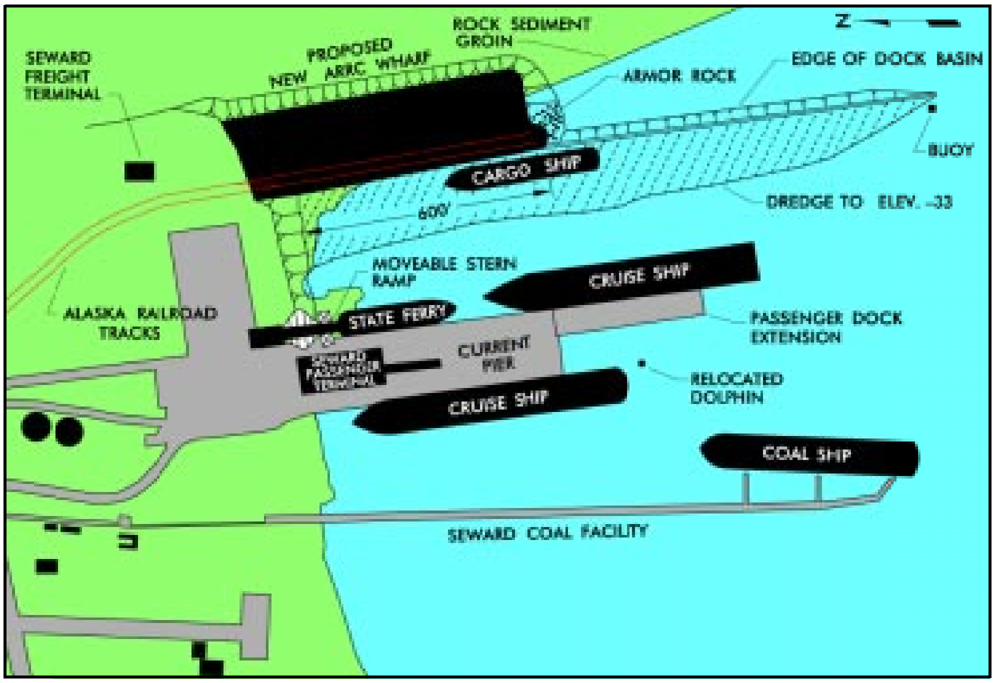
The North Star Terminal and Stevedore Company has a Seward office. They can provide various equipment for handling cargo at the port. Other companies within the area have equipment that could be made available for military use. A list of equipment in the area is provided below.

MATERIALS HANDLING EQUIPMENT		
MHE Type	**Capacity STON (tonne)**	**Quantity**
Crawler Cranes	150 (136.1)	2
Mobile Crane	100 (90.7)	1
Mobile Crane	30 (27.2)	1
Towmotor Forklifts	30 (27.2)	2
Forklifts	2.5-11 (2.3-10.0)	11
Michigan Loader/Plow	--	1
Yard Trucks	--	2
Car pushers	--	2
Pick-Up Trucks	--	3

150-Ton Mobile Crawler Crane at ARRC Dock

FUTURE DEVELOPMENT

The Alaska Railroad Corporation (ARRC) is planning to permanently convert the current ARRC Dock into a cruise ship terminal complete with ticket counters. For shipping general cargo, the ARRC plans to build a single-berth finger pier just east of the current pier. This pier will be about 600-feet long, but capable of berthing vessels up to 800-feet long. The apron width will be 240 feet and the water depth alongside will be 35 feet MLLW. A freight terminal building will be inland of the pier and rail tracks will run onto the pier apron. Completion date is June 2000.



ARRC Site Plan for Seward Dock's Intermodal Improvement Project

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

Any explosives shipped through the Port of Seward must be approved by the port authority and other appropriate government officials.

STEVEDORING

The North Star Terminal and Stevedore Company provides the stevedoring services for the Port of Seward. Information provided by the North Star Terminal and Stevedore Company states that the Seward area has about 20 longshoremen available during the summer and about 45-50 available in the winter.

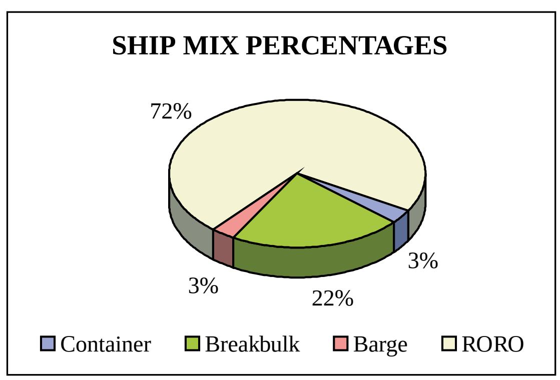
III. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity for the Port of Seward. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON.

Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth 90 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

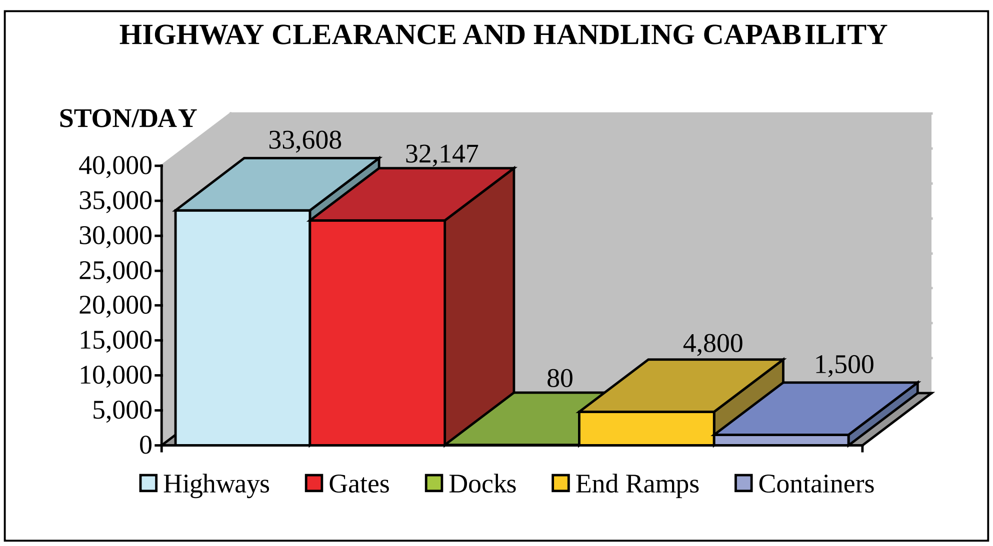
Highway

The road network accessing the port (Seward Highway to Port Avenue to port access road) consists of two-lane highways. A gate allows access to the ARRC Dock. The road and gate going into the port can handle over 32,100 STON of cargo per day. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or leave the port using the one lane accessing the port.

Roadable vehicles will move to the staging areas in manageable convoys. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. A portable end ramp is available near the ARRC Dock. Also, a fixed end ramp with 2 handling positions is available at Cook Inlet Processing in the Seward Marine Industrial Center SMIC. Using these three-end ramp handling positions, the port can handle 4,800 STON of military vehicles and equipment per day.

North Star Terminal and Stevedore Company has two forklifts available with the capacity to handle containers. Assuming use of one of these forklifts, the Port of Seward could handle 1,500 STON/day.

Maximum daily handling capability for the port is a mixed total of the three types of handling (end ramps, containers, and docks), each up to its maximum, not to exceed the daily gate limit of at least 32,100 STON.



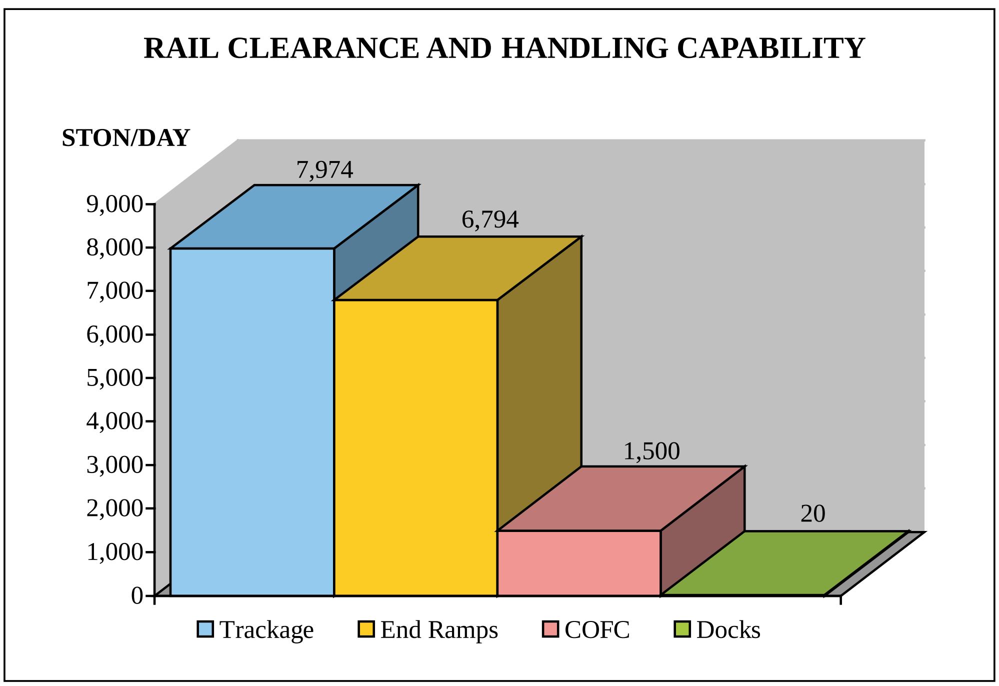
Rail

Rail reception is good, with ARRC providing rail service directly to the port. Current rail service can support about two 80-railcar trains per day from Fort Wainwright. Due to the single-track rail line going to Seward, the ARRC must carefully regulate rail traffic. From Portage to Seward, the grade going upward to Grand View Pass is 3 percent and the grade coming down from Divide Pass is 2.2 percent. This means that rail movement of unit equipment will likely require multiple low-horsepower locomotives. These trains can handle almost 8,000 STON per day.

Wheeled and tracked vehicles on flatcars will likely offload at the Seward Railyard using the fixed ramp plus one portable end ramp. These end ramps can handle almost 6,800 STON per day.

The port has about four boxcar positions for rail dock offloading at the transit shed. Using these docks, the port can handle about 20 STON per day.

Using one container handling forklift, the port can handle about 1,500 STON of containerized equipment and supplies from railcars per day.

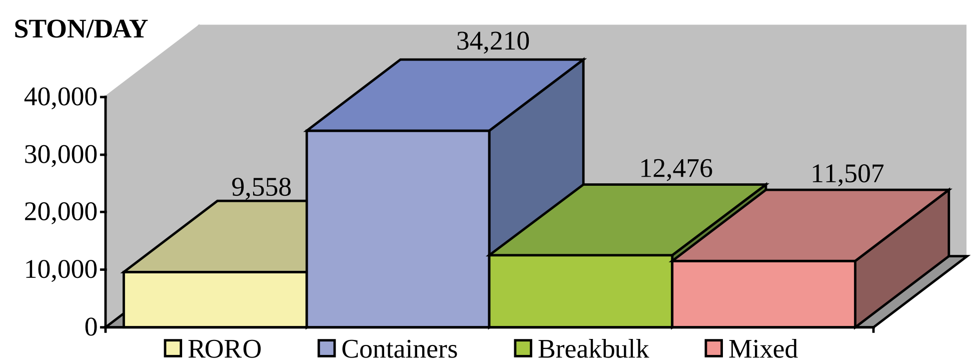


Staging

The Port of Seward has identified 33 acres of open staging area for vehicles and/or containers.

The chart on this page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of the capability for each type cargo operation involved should be assumed.

The table shows the STON of cargo, by type, the port can handle. The dwell time used in these computations was 3 days and the open space utilization factor was 60 percent. The container storage throughput capability is the highest with over 34,200 STON. The ability to stack containers contributed to the high staging throughput value. The RORO storage throughput is almost 9,600 STON. The breakbulk staging throughput is almost 12,500 STON.



Note: Container staging area can also be used for RORO staging as needed.

Shipping

Daily shipping subsystem totals for each berth are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types. The port conducts container operations using mobile cranes. The open apron and nearby open storage area supports RORO operations. The berth length (866 feet) and water depth (35 feet MLW) allow ships as large as the Cape D to berth at the Port of Seward.

DAILY THROUG HPUT SUMMARY		
Characteristic or Throughput	**Berth 1**	**Berth 2**
Length (feet) (meters)	866 (264.0)	866 (264.0)
Depth Alongside (feet) (meters)	35 (10.67)	35 (10.67)
Breakbulk Throughput (STON)	1,094	1,094
(MTON)	2,737	2,737
RORO Throughput (STON)	4,147	4,147
(MTON)	16,588	16,588
RORO Square feet (EST) [1]	82,940	82,940
RORO Pieces [2]	488	488
Container Throughput (STON)	4,472	2,232
(MTON)	11,180	5,580
Container Throughput (TEU) [3]	559	279
Barge Throughput (STON)	663	332
(MTON)	1,659	829
Mixed Throughput (STON)	3,380	3,303
(MTON)	12,930	12,738

[1] Based on the 20 square foot per STON average accomplished during Operation Desert Shield/Storm.
[2] Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.
[3] Based on the 8 STON per TEU average accomplished during Operation Desert Shield/Storm.

SUMMARY

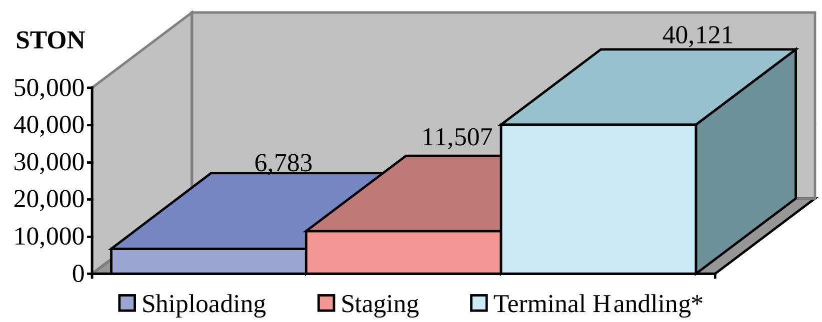
The port is multioperational with the capability to handle all types of vessels: limited container, RORO, breakbulk, and barge.

The Port of Seward has the capability to handle military equipment for deployment or exercise. Mobile cranes, furnished by the local stevedores, can perform the lift-on/lift-off operations required for breakbulk, container, and barge shipping. Container operations will be slower due to the lower handling rates of the mobile cranes vice specialized container cranes.

The port can accommodate vessels as large as the Cape D as shown in the Berthing Characteristics Table. The open apron and close proximity of the open storage area enhances RORO operations. To conduct sustained loading operations on a Cape D, the port needs 14 acres of open staging per Cape D vessel. The Port of Seward has over 33 acres of open storage with gravel surface for military deployments.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of almost 6,800 STON.

DAILY CARGO THROUGHPUT CAPACITY



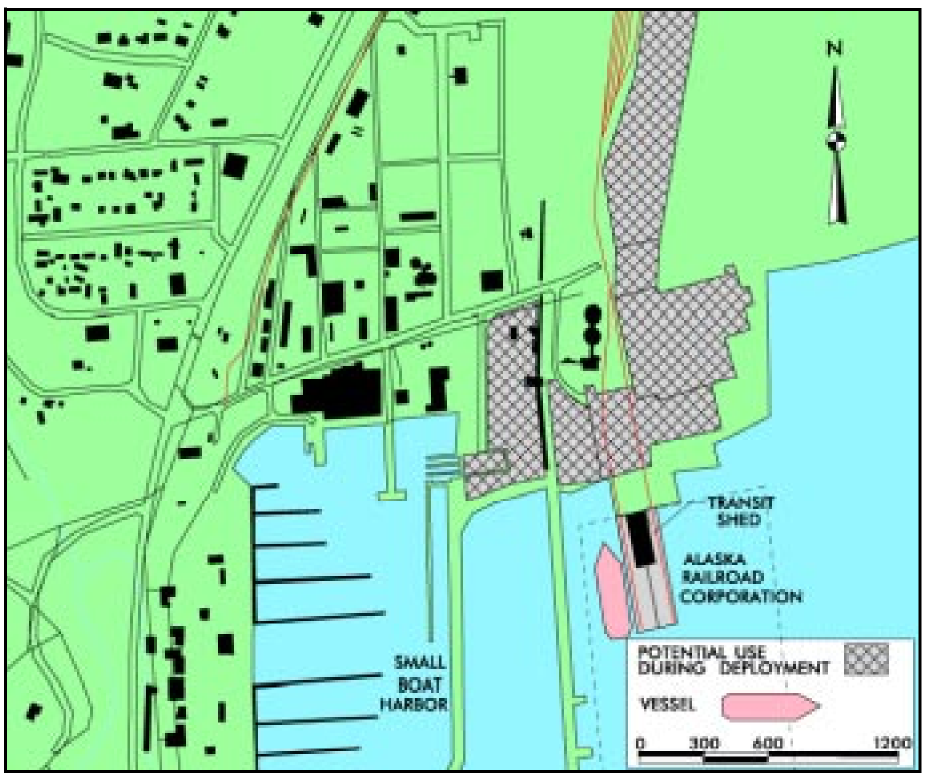
***Terminal handling is the sum of the highway (32,147 STON) and rail (7,974 STON) limits.**

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional separate infantry brigade using primarily CAPE D vessels. The port is not considered LMSR or FSS capable because the length of those ships (950 feet) exceeds the maximum berth length (866 feet). Also, an FSS at maximum draft (37 feet) exceeds the water depth alongside the ship berth (35 feet). We assume that Berth 1 (866-foot-long berth), 14 acres of open staging, and a marshaling area are available to the military for deployment. Because the transit shed becomes a cruise ship terminal during the tourist season, we assume covered storage may not be immediately available during a deployment. We also assume that no other military units will be competing for the port facilities during the time that the brigade occupies the port. We further assume that the required assets, both transporters and people will be available to adequately load the ship and clear the port.

For this application, we assume that the deploying brigade will use the facilities identified in the graphic below during a deployment. Also, we assumed that the stevedores would provide one container handler, two mobile cranes, and various forklifts for cargo handling and shiploading. We further assumed that four portable end ramps would be used for deployment (two for rail offloading and two for semitrailer offloading).

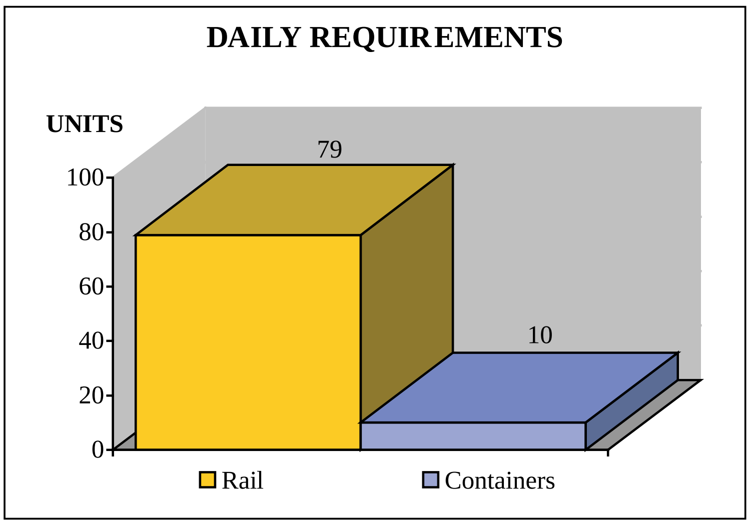


Potential Port Use During Deployment

REQUIREMENTS

To simulate a likely requirement for the Port of Seward, we deployed a notional separate infantry brigade, using 6 days for shiploading and port closure. The brigade has to move 1,577 roadable vehicles (includes 674 towed vehicles), 835 nonroadable vehicles, and 57 containers. Movement of the brigade to the port will require 470 railcars using a convoy/rail option for transport to the port. About 10 containers would arrive daily.

TOTAL EQUIPMENT	
Volume	65,577 MTON
Weight	12,940 STON
Area	355,821 SQ FT
Vehicles	2,412
Containers	57
Note: Figures above denote current requirements.	



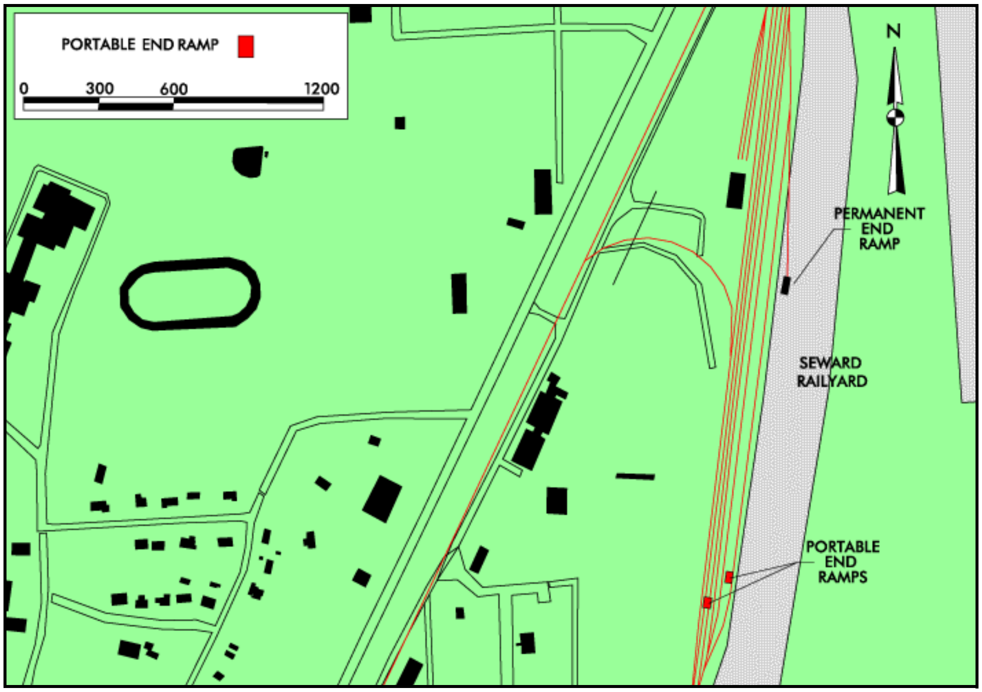
TERMINAL INPROCESSING/ HANDLING

Rail

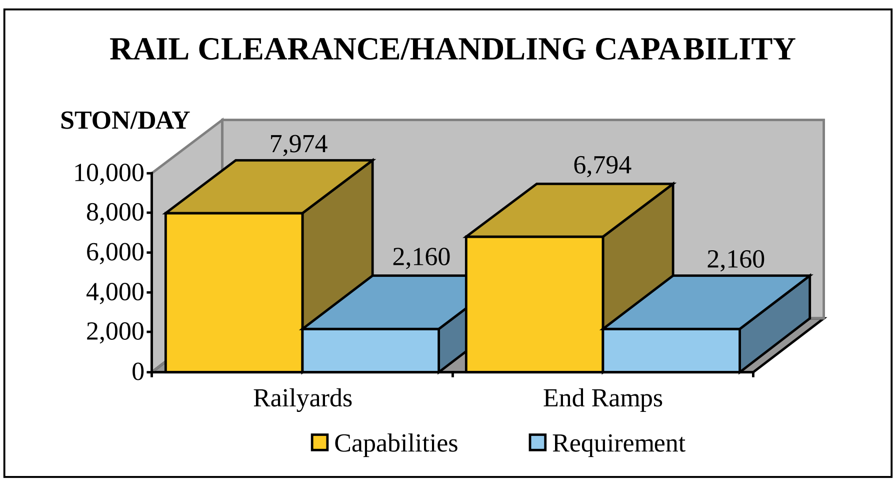
The Alaska Railroad Corporation (ARRC) serves the Port of Seward. ARRC owns all of the trackage leading into the port and performs all of the switching. Based on a 6-day loadout, the port railyard (capacity of about 400 53-foot flatcars) could easily handle the additional daily rail traffic (79 railcars per day).

For offloading wheeled and tracked vehicles from railcars, we assume two portable rail end ramps will be at the longest spurs in the port railyard (at least 2,500 feet long).

Requirements use total STON of equipment (12,940 STON) divided by 6 days providing a rail daily requirement. Capabilities for the railyards and end ramps reflect trackage and end ramp daily throughputs respectively. The rail clearance/handling capability assumes that the port can obtain two portable end ramps and can handle two trains per day.



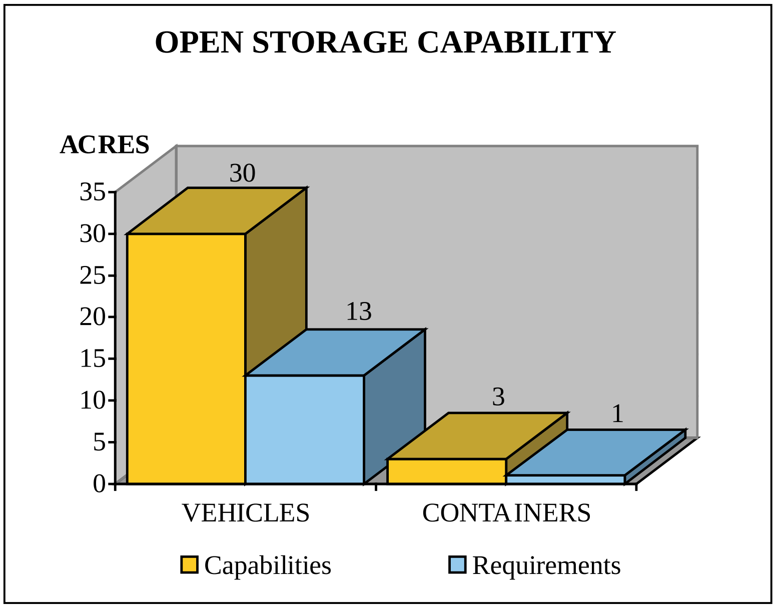
Rail End Ramp Locations



Open Storage

The Port of Seward has identified about 33 acres of open storage area. Most of this open storage is gravel-surfaced or unimproved. The open storage areas are not behind fenced areas and therefore, not secure. Assuming the port can provide at least 14 acres of the total open storage, this is enough to support the loading of a Cape D vessel. The additional open storage and off-port marshaling areas are readily available if needed. As the first ship fills up and the staging area empties there is room to stage equipment for the next Cape D that will be loaded.

The 14-acre requirement considers the available square feet on the Cape D (75 percent stow factor also considered) times factors to allow for emergency lanes and vehicle/cargo/container access and space needed to accept incoming cargo that will be loaded on subsequent ships. In addition to vehicle and container acreage, space is also needed to account for maintenance, access, ramp areas, frustrated cargo, and so forth in loading any ship, including the Cape D.



Shipping

Using the Cape D to transport the brigade, Berth 1 (length of 866 feet) will allow the ships to meet the 6-day loading requirement. Based on each Cape D being able to load in about 2 days, the three Cape Ds can be loaded in about 6 days. The limited number of longshoremen in the Seward area (20 in the summer, 45-50 in the winter) may increase the time to load out the brigade because inexperienced longshoremen would be brought in to make up the difference. If smaller ships are used for deployment, then additional time will be required to move the brigade.

Deploying by Cape D requires one ship every 2 days. This means the ramp loading rate must be about 20 vehicles per hour.

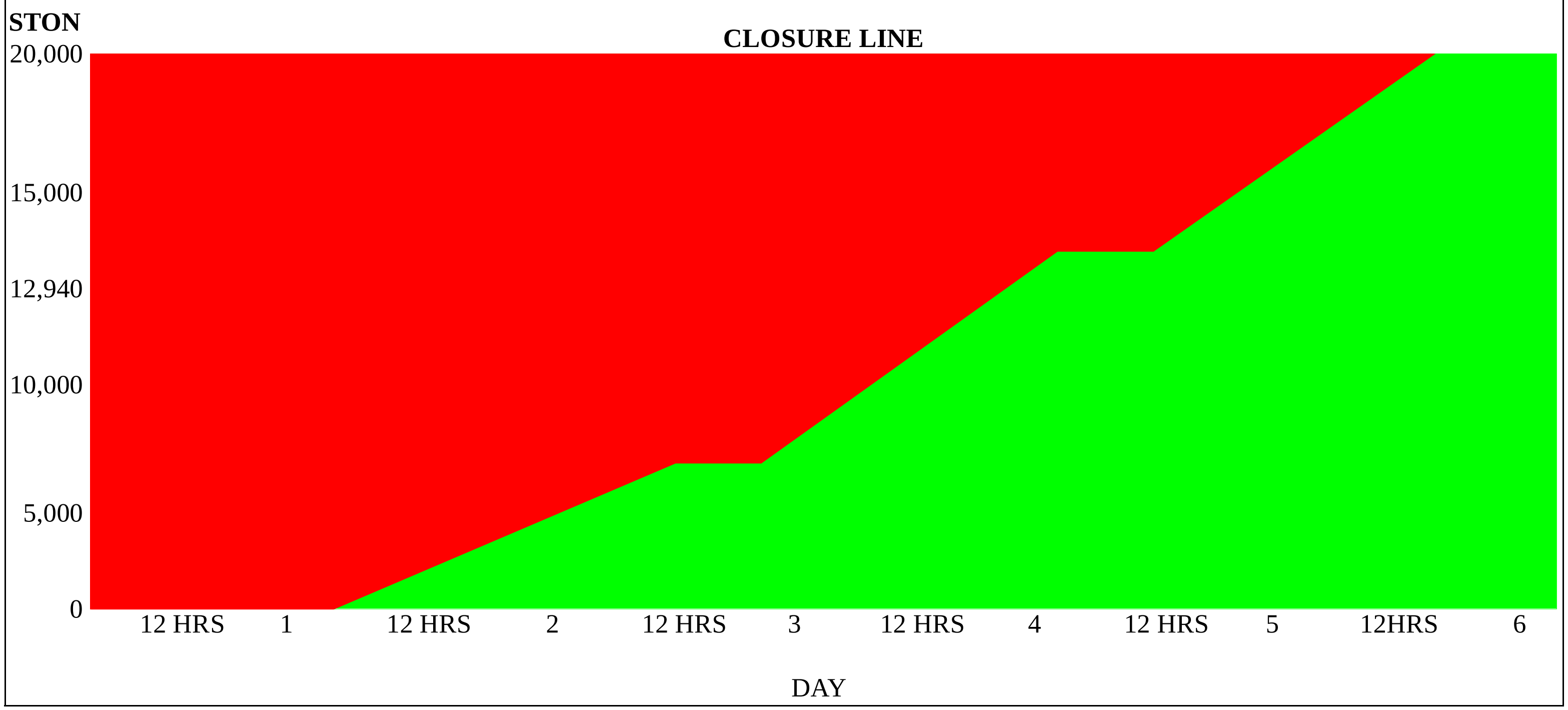
SHIP REQUIREMENTS NOTIONAL SEPARATE INFANTRY BRIGADE				
Loading Condition/ Sample Ship Mix	**FSS (RORO/ Comb)**	**LMSR (RORO/ Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	1.2			
All LMSR		.75		
All Breakbulk			3.8	
Maximum Containerization				
FSS/Container	.04			.94
LMSR/Container		.03		.94
Breakbulk/Container			.14	.94

Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

APPLICATION RESULTS

Total deployment time for the brigade was about 6 days plus initial reception and staging. Since the port cannot berth LMSR or FSS vessels, Cape D vessels were used to deploy the brigade. Although the port can handle a separate infantry brigade in 6 days, problems may occur during peak reception of equipment during deployment. Peak day requirements may bring as much as 8,350 STON. Based on a one-ship berth operation, the shipping subsystem throughput is 3,380 STON per day. This means that equipment may require marshaling in various areas in and around Seward. The limited number of longshoremen in the Seward area may also contribute to increasing the load out time because inexperienced longshoremen may need to be brought in to correct potential shortfalls. Actual closure results are shown in the following table.

CLOSURE PROFILE USING SHIPLOADING SUBSYSTEMS FOR PORT OF SEWARD



SUMMARY

The Port of Seward can load a notional separate infantry brigade and achieve closure in 6 days using one berth and three Cape D ships. This port is not capable of berthing FSS or LMSR ships. The port must ensure that at least 14 acres of open storage are available for military use during a deployment. Because open storage areas are not behind fences, security measures must also be implemented to ensure vandalism and theft are not a problem. MHE and end ramps are available through local stevedores and the ARRC. No container cranes are at the port; therefore, loading containers aboard ships must be accomplished via mobile cranes. Mobile crane handling rates are often ½ of specialized container cranes.

The Port of Seward has both highway and rail access. Equipment deploying from Fort Wainwright will likely deploy by rail because the distance is greater than 400 miles. Because the rail line accessing Seward from Anchorage is single-tracked, the ARRC must carefully schedule trains to avoid rail traffic problems. Also, the steep grades between Anchorage and Seward will likely require the use of 2-3 locomotives to ensure safe movement into Seward.

Equipment at Fort Richardson will likely deploy through the Port of Anchorage unless conditions require an alternative move. The reason for this is that deploying units would not have to prepare the equipment for long distance highway transport. If the Port of Seward is the seaport of embarkation, then movement from Fort Richardson to Seward will likely be by highway because the distance is less than 400 miles. The travel time from Anchorage to Seward is about 3.5 hours by highway (129 miles at 40 mph road march). Equipment at Fort Wainwright will also likely deploy through the Port of Anchorage. The reason is that Anchorage is directly in between Fairbanks and Seward by highway or rail. Deployment through the Port of Anchorage avoids an extra 3.5 hours of travel time by highway and/or 4 hours by rail. Also, the Port of Anchorage has the best facilities for handling containers and berthing LMSR or FSS vessels. Shortages in labor are less likely in Anchorage than Seward and a separate infantry brigade can be loaded in about 5 days as opposed to 6.

Although the port can achieve closure in 6 days, peak day requirements (as much as 8,350 STON in the equipment reception and handling subsystem) may exceed the shipping subsystem capability for a one-berth operation (3,380 STON per day). This means that equipment may require marshaling in various areas in and around Seward.

The current ARRC pier is undergoing conversion into a specialized cruise terminal. This conversion is scheduled for completion in June 2000. A replacement general cargo wharf is undergoing construction and is due for completion in June 2000. This wharf will have one ship berth about 600 feet long, but be capable of berthing ships up to 800 feet long. Because the number of ship berths for general cargo will decrease from two to one, the corresponding overall throughput will also likely decrease to one-half the current value (from 6,683 STON per day to 3,342 STON per day).

PORT OF VALDEZ
ALASKA

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a site visit at the Port of Valdez in June 1999. The port is a small, but capable facility with the ability to throughput a brigade-size unit. This port can accommodate vessels as large as the fast sealift ship (FSS) or large medium speed roll on/roll off (RORO) (LMSR). This port is equipped with a floating dock to allow for the 12-foot tidal variation. The Port of Valdez is not listed in the Port Planning Orders (PPO) issued by the Maritime Administration (MARAD). Currently, none of the Alaskan ports are listed in the PPO for deployment of a notional separate infantry brigade or any other military unit.

The port consists of a 1,200-foot-long floating dock that negates the effects of tidal variation. This wharf and surrounding facilities are called the Container Terminal. The water depth at the ship dock is 55 feet mean low water (MLW) and the port is capable of breakbulk, RORO, limited container, and barge operations. The channel accessing the port is extremely deep with a water depth of 77 fathoms (462 feet) MLW.

Access into Valdez is via the Richardson Highway (Route 4), a two-lane highway. This highway is very capable of handling the additional traffic of a deployment, but does have the potential for avalanches in the winter and early spring around the Keystone Canyon and Thompson Pass areas. Valdez does not have rail access. Valdez has a commercial airport near the port. Valdez Airport has one runway with a length of 6,500 feet and has handled C-130 and B-707 aircraft in the past. The North Star Terminal and Stevedore Company provides materials handling equipment (MHE) and longshoremen to perform the port operations. Available MHE includes 3 mobile cranes with capacities between 140-230 STON. The North Star Terminal and Stevedore Company, Valdez office, is located on port. The port does not have any end ramps for offloading semitrailers. With adequate notice, the North Star Terminal and Stevedore Company could build an end ramp.

A total of 21 acres of open staging is available at the port. Of this total, about 3 acres are paved for the staging of containers and other cargo. The remainder of the open storage area consists of a rock and gravel base with gravel surface. Other open storage areas of various surface materials are available nearby. The port does not have any covered storage available for military use.

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of about 5,400 STON (20,800 MTON) per day. RORO and container throughputs are 6,640 STON (26,540 MTON) and 4,470 STON (11,180 MTON), respectively.

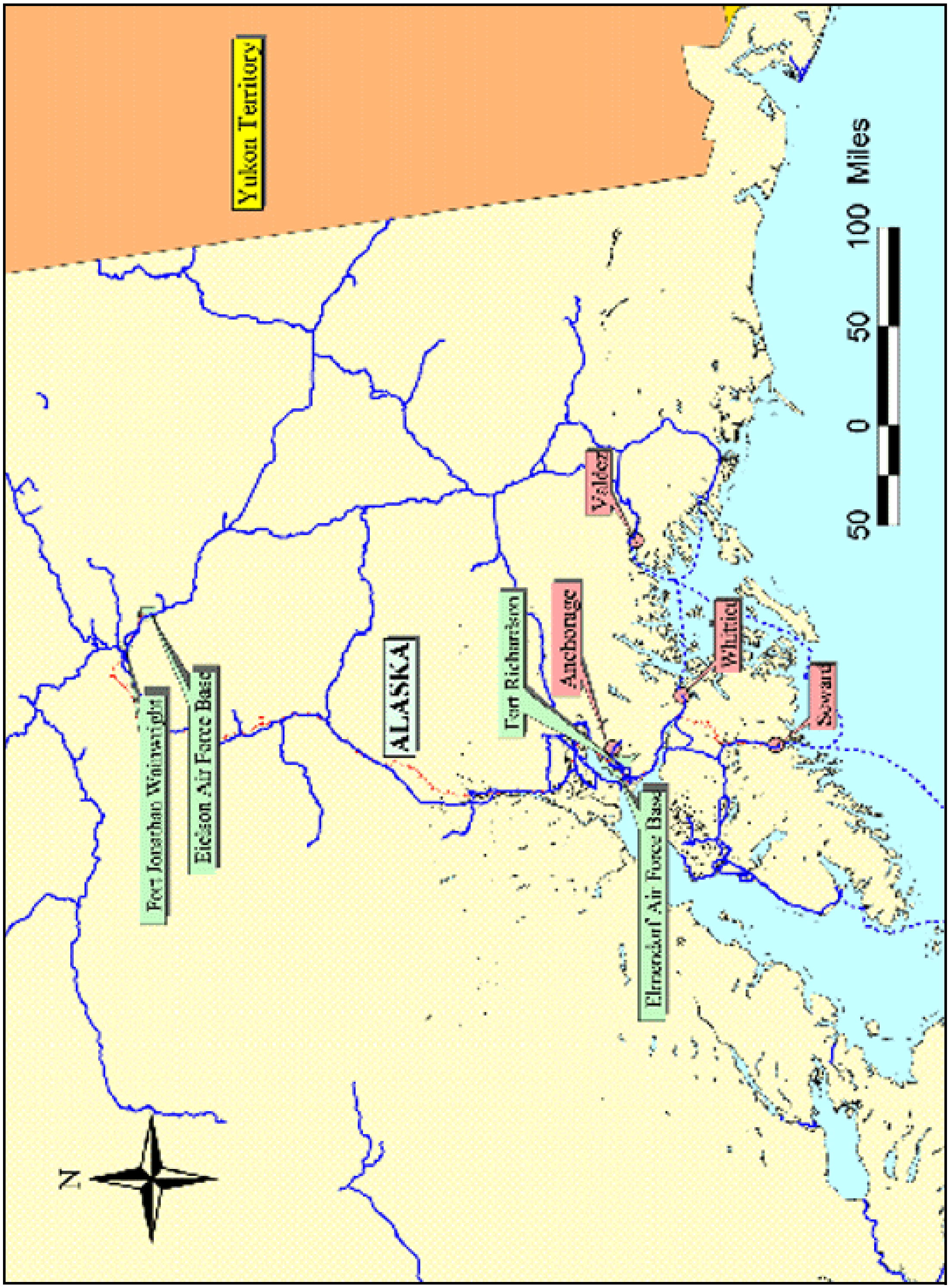
For deployment operations, about 25 acres of open storage are desired per LMSR to support daily shiploading operations. Since the entire notional separate infantry brigade can be loaded on three-fourth of an LMSR, the open storage requirement is reduced to 16.5 acres. The desired staging for an FSS is about 16 acres per ship to support daily, sustained loading operations. The 21 acres of open storage can meet the FSS and LMSR staging needs provided at least 16.5 acres of the total are available during a deployment.

To deploy out of the Port of Valdez, a notional separate infantry brigade will require not only the 1,200-foot ship berth, but 16.5 acres of open storage available at the Container Terminal. For an application, we analyzed a notional separate infantry brigade deploying from the Port of Valdez using one LMSR vessel. To meet a port closure requirement of 6 days, a deploying notional separate infantry brigade must throughput about 2,160 STON of vehicles and equipment (that includes 10 containers) per day through the port. When the required LMSR is available for loading, the port meets the shipping requirements. Smaller ships will require additional time.

A notional separate infantry brigade has about 12,940 STON (65,577 MTON) of vehicles and equipment. Estimates show that the port is capable of achieving closure for throughputting a notional infantry brigade within 3-4 days. The port can meet deployment requirements provided the required ship berth and open storage are available at the time of need and the cargo can be shipped to the port by highway. In addition, covered storage will be required for shrink-wrapping helicopters and protecting palletized cargo. Although the port can achieve closure well within 6 days, peak day requirements may be as much as 8,350 STON (TEA Port Enhancement Analysis, March 1999) in the reception and handling subsystem. This would exceed the shipping subsystem throughput (5,400 STON per day). This means that equipment may require marshaling in various off-port areas to avoid port saturation.

As previously stated, no agreement is in place requiring the port to provide these facilities during deployment. Although the port has successfully worked with DOD in the past to provide the needed facilities, there are no guarantees that these facilities can be made readily available during a contingency.

Deployment mileage from Fort Wainwright to Valdez (355 miles) is comparable to that from Fort Wainwright to Anchorage (about 360 miles). The mileage from Anchorage to Valdez is about 290 miles, which adds about 7.25 hours (based on a 40 mph road march) to the deployment time for units coming from Fort Richardson to Valdez. Because Valdez is accessible only by highway, 886 commercial HETS/flatbeds are needed to transport the nonroadable vehicles for the entire brigade. Commercial resources may not be able to furnish the 886 flatbeds/HETS.


Yukon Territory
ALASKA
Fort Jonathan Wainwright
Eielson Air Force Base
Fort Richardson
Anchorage
Valdez
Whittier
Seward
Elmendorf Air Force Base
50 0 50 100 Miles
N

II. GENERAL DATA

The Port of Valdez, located on the south central Alaskan coast, is considered a potential seaport of embarkation for deploying Alaskan military units during contingencies. MTMCTEA conducted a site survey in June 1999. Information on port characteristics was obtained from port officials.

TRANSPORTATION ACCESS

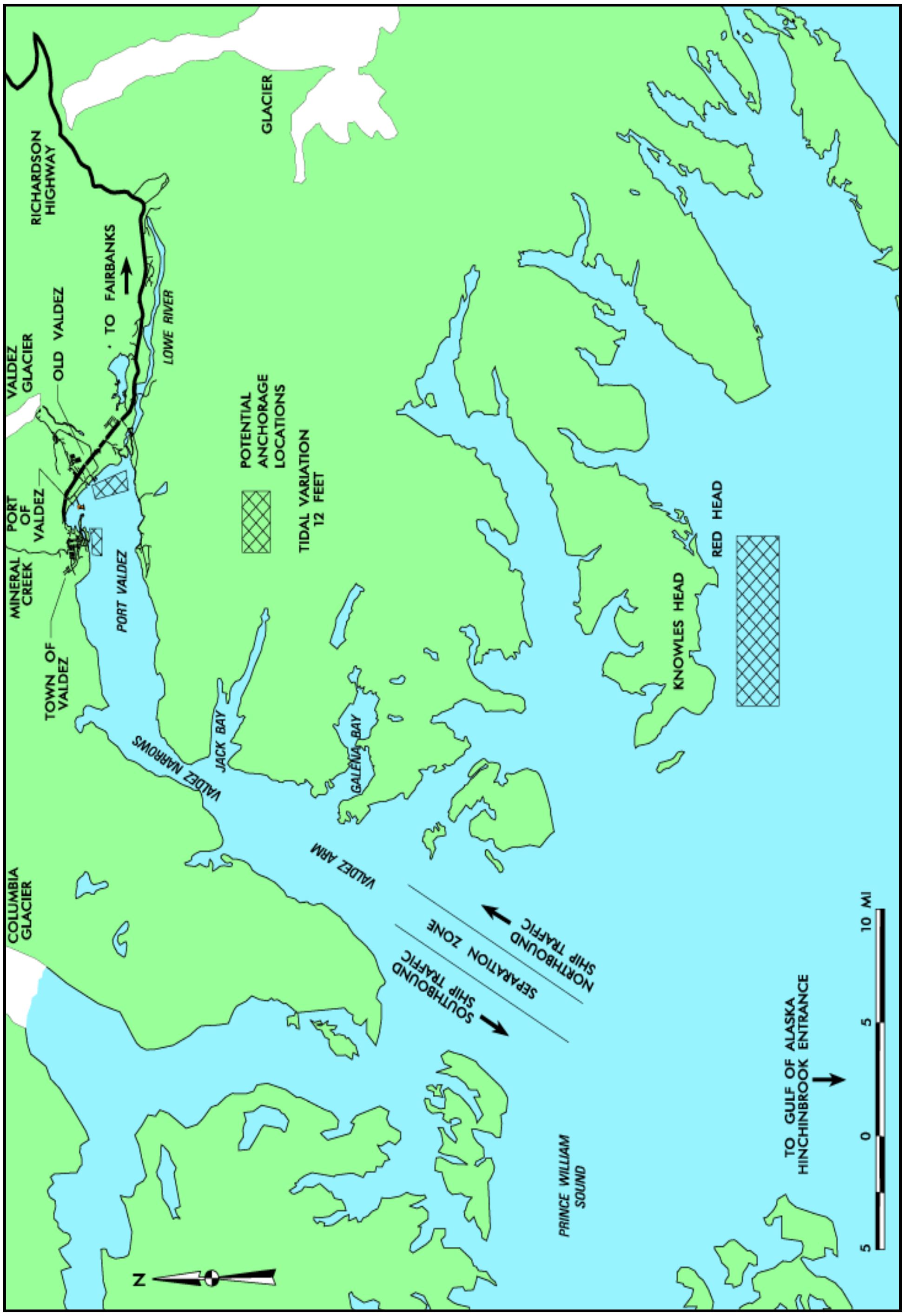
Water

The Port of Valdez (latitude 61° 08' north, longitude 146° 21' west, (XRRT)) is on the south-central Alaskan coast near the head of Port Valdez east of the mouth of Mineral Creek. Access to the port from the Gulf of Alaska is via Hinchinbrook Entrance through Prince William Sound, and thence to Port Valdez via Valdez Arm and the Valdez Narrows. Channel depths are extremely deep with reported depths of at least 77 fathoms (462 feet). The facility with potential for military operations is the Container Terminal, which is located east of the City of Valdez and west of "Old Valdez". "Old Valdez" is the site of the original port, destroyed by the 1964 earthquake. Water depth alongside the Container Terminal is 55 feet mean low water (MLW). No overhead clearance restrictions exist for seaport access.

Ship Channel Accessing the Port of Valdez

A key feature of the Container Terminal at the Port of Valdez is the floating dock, which negates the effects of the 12-foot tidal variation on roll-on/roll-off (RORO) operations. Access to the port is ice-free. Port Valdez is both wide enough and deep enough to provide a natural turning basin for any ship including FSS and LMSR vessels. Due to the deep water depths, the number of anchorages are limited. Anchorage possibilities include the head Port Valdez near "Old Valdez" and near the mouth of Mineral Creek. These areas have water depths of at least 55 feet MLW. Because the area at the head of Port Valdez is tide-dependent, care should be used when anchoring in this area. Another option is to anchor outside the Port Valdez area at either Knowles Head or Red Head in Prince William Sound.

All vessels calling on the Port of Valdez require pilots for navigation. The port authority reports that about 3-4 pilots are available 24 hours each day in the Valdez area. Five tugboats with horsepower (hp) ranging from 5,700-7,200 and 2 tractor tugs with 10,200 hp are available at the Port of Valdez. These tugboats are provided through Crowley Marine Services, Inc.



Water Access Map

Highway

Main Gate, Truck Scales, and Access Way to the Port of Valdez (looking out from the port area)

Alaskan Route 4 (Richardson Highway) provides the sole highway access to the port. This highway is two-laned. Fairbanks is about 355 miles from Valdez. Although well maintained by the Alaska Department of Highways, this highway is susceptible to avalanches in the Thompson Pass and Keystone Canyon areas during the winter and early spring. Equipment deploying from Fort Wainwright/ Eielson Air Force Base can access the Richardson Highway at Delta Junction by traveling south on Route 2 (Alaska Highway). The road network leading from the Richardson Highway to the port is Mineral Creek Loop Road to the port access road. These roadways are 2-lane highways. The gate into the port has two lanes (1 in and 1 out). No unusual vertical clearances impede port access on these routes. Truck scales are located at the gate. Access into the Port of Valdez is provided on the Highway and Air Access graphic. Valdez is about 290 miles from Anchorage. This means the travel time from Fort Richardson is about 7.25 hours based on a road march at 40 miles per hour (mph).

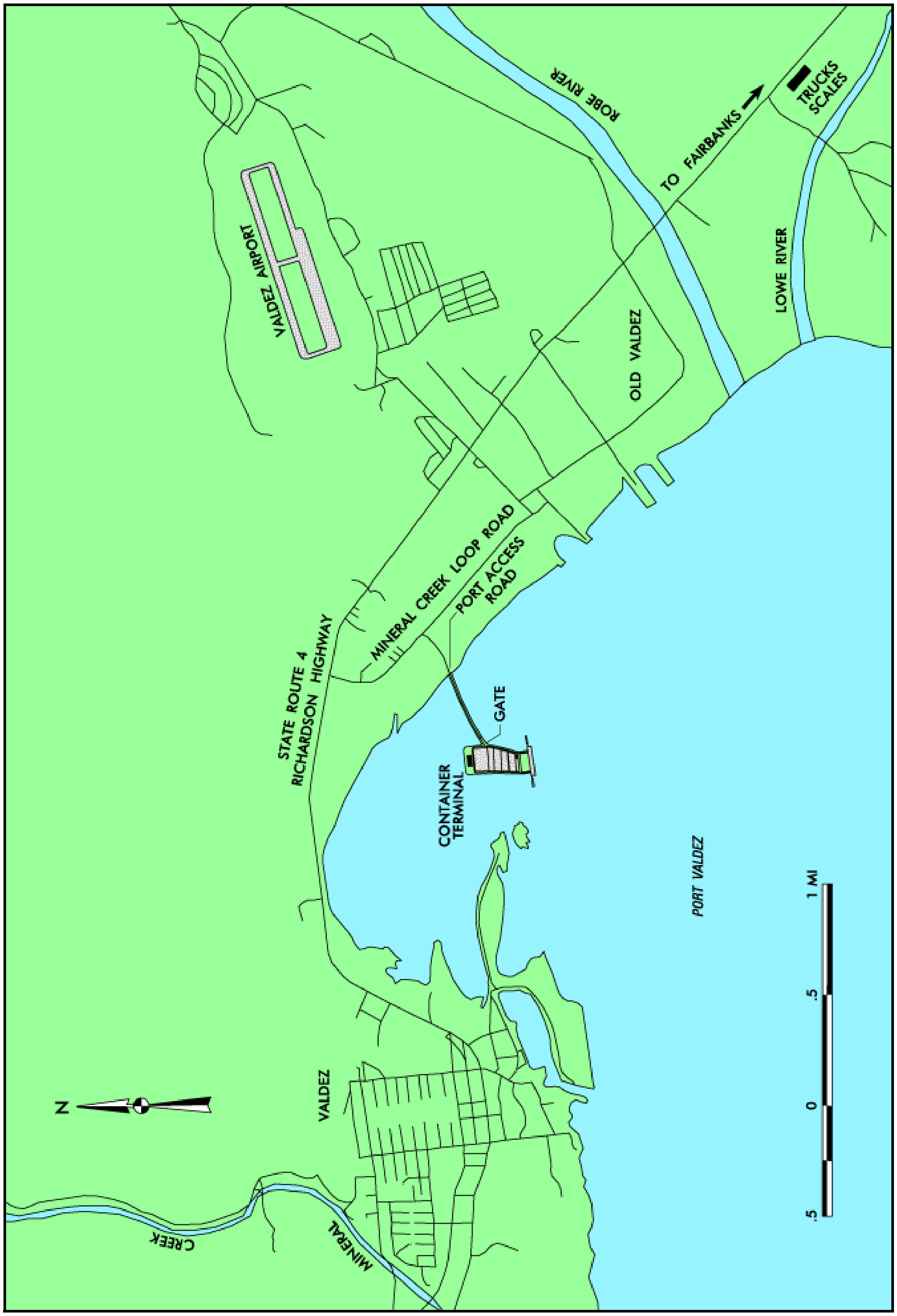
Rail

The Port of Valdez does not have rail access.

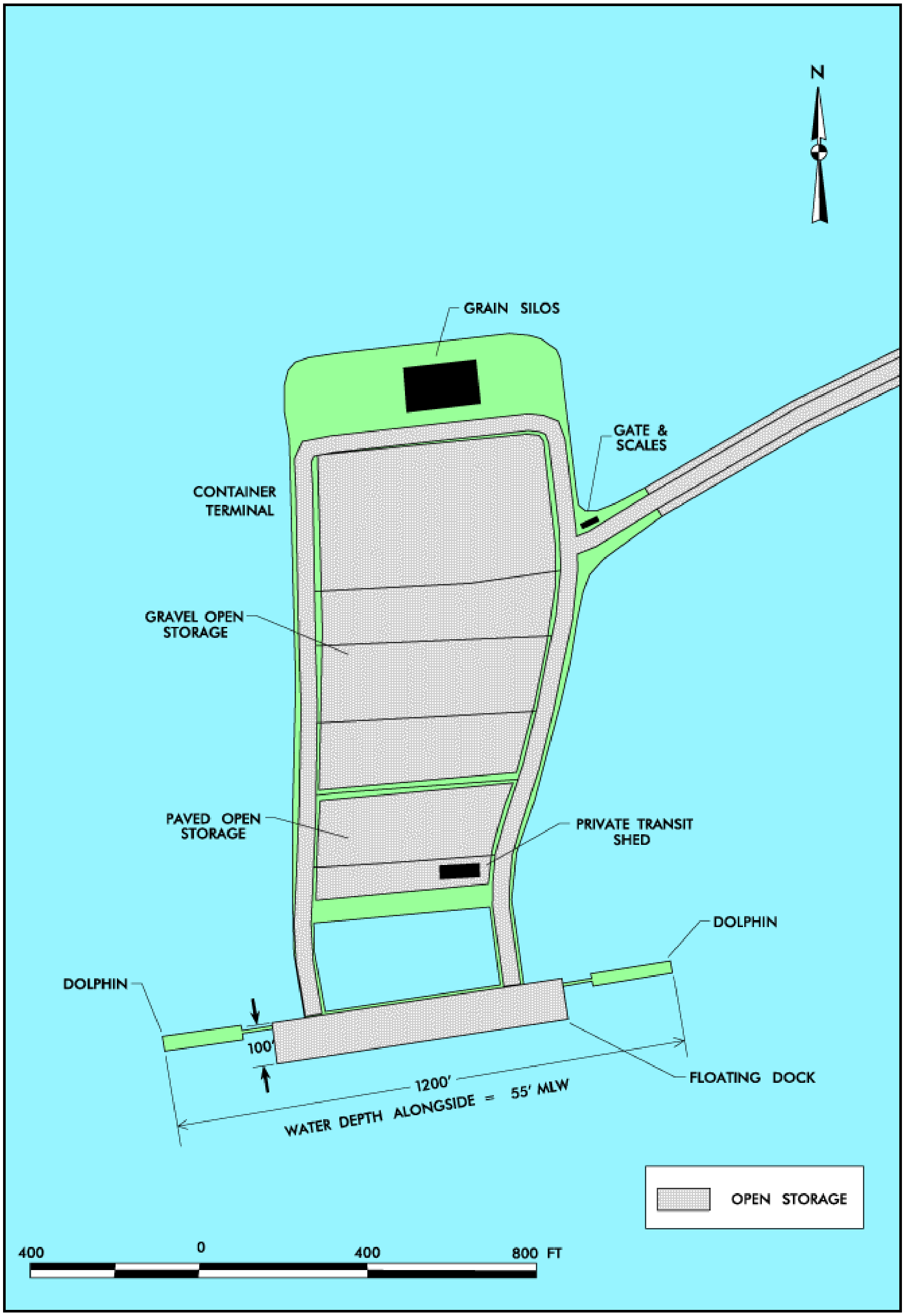
Air

Valdez Airport is about 3-4 miles north of the Container Terminal. It has one runway about 6,500 feet long by 150 feet wide. This airport has handled C-130 and B-707 aircraft.

The port authority at the Port of Valdez states that helicopter operations can occur at the various open storage areas inside and outside the port.



Highway and Air Access Map


N
GRAIN SILOS
GATE & SCALES
CONTAINER TERMINAL
GRAVEL OPEN STORAGE
PAVED OPEN STORAGE
PRIVATE TRANSIT SHED
DOLPHIN
DOLPHIN
100'
1200'
WATER DEPTH ALONGSIDE = 55' MLW
FLOATING DOCK
OPEN STORAGE
400
0
400
800 FT

Land-Use Map

PORT FACILITIES

Berthing

The Port of Valdez is a multi-cargo port consisting of a floating dock with concrete surface. The floating dock feature negates the effects of the tidal variation and provides a consistent apron height of 16 feet mean low water (MLW). Two 200-foot steel ramps connect the floating dock to the shore.

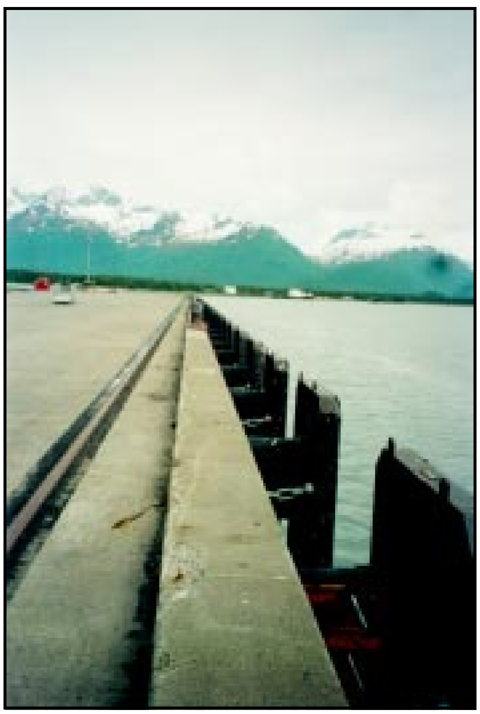
The wharf is 700 feet long, but two mooring dolphins on either side of the dock provide an overall berth length of 1,200 feet. A rubber-cushion fendering system provides protection to both the wharf and ships docking at this facility. The Container Terminal has a deck strength of 300 pounds per square foot (psf) over the entire dock surface, equivalent to 9,375 long tons (lt). Load intensities may be as much as 1,000 psf provided the total load does not exceed the 9,375-lt-total listed above. The floating dock acts similar to a ship; therefore, load placement is also important. The water depth at the Container Terminal is 55 feet MLW. Although the port specializes in petroleum products and general freight, it is also capable of roll-on/roll-off (RORO), container, and barge operations. The wharf apron is 100 feet wide and lighting exists throughout the port.

One of the Two Road Access to the Floating Dock

About 21 acres of available open staging are in the Container Terminal area. About 3 acres of the total staging are paved. The port does not have any available covered storage. Lift-on/lift-off operations are accomplished via mobile cranes.

Ground-Level View of Container Terminal Wharf

BERTH CHARACTERISTICS FOR THE PORT OF VALDEZ	
Terminals	
Characteristics	Container
Length feet (meters)	1,200 (365.8)
Depth alongside at MLW feet (meters)	55 (16.8)
Deck Strength psf (metric tons per square meter)	300 psf (1.46 tonne/sq meter) uniformly distributed over the entire wharf, equivalent to 9,375 lt (9,525 tonne) total load. Load intensity may be as high as 1,000 psf (4.88 tonne/sq meter), provided total load does not exceed 9,375 lt
Apron width feet (meters)	100 (30.5)
Apron height above MLW feet (meters)	16 (4.9)
Number of container cranes	0
Number of wharf cranes	0
Apron Lighting	Yes
Straight-stern RORO Ramp	No
Apron length served by rail feet (meters)	Not Applicable



Rubber-Cushion Fendering System at the Port of Valdez

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF VALDEZ		
Vessels		Berths
Type	Class	Container Terminal
BREAKBULK	C3-S-38a	2
	C4-S-58a	2
	C4-S-66a	2
	C5-S-37e	1
SEATRAIN	GA and PR	2
BARGE	LASH C8-S-81b	1
	LASH C9-S-81d	1
	LASH Lighter	6
	SEABEE C8-S-82a	1
	SEABEE Barge	6
RORO	COMET	2,d
	METEOR	2,d
	Cape Gnome	1,d
	C7-S-95A	1
	Cape Taylor	1
	Cape Orlando	1
	MV Ambassador	2,d
	Callaghan	1,d
	Cape Lambert	1
	LMSR Class	1
	FSS	1
	Cape E-Class	1
	Cape D-Class	1
	Cape H	1
RORO	Cape Texas	1
	Cape R	1,d
	Cape I-class	1
	Cape Victory	1
CONTAINER	C6-M-147a	1,e
	C7-S-69c	1,e
	C7-S-68c	1,e
	C8-S-85c	1,e
	C9-M-132b	1,e
	C9-M-F141a	1,e
TACS	C6-S-1qd	1
	C5-S-MA73c	1
	C6-S-MA60d	1
MPS	C7-S-133a	1
	Maersk	1
	AmSea	1

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ May Prevent Operation

♦ May Limit Operation

Open Staging

The port authority lists 21 acres of open storage available in the Container Terminal. Of this total, 3 acres are paved. The wharf is directly accessible from the open storage area via the access ways. Other open storage is available in the Valdez Industrial Park, which is located outside the port in "Old Valdez" about 2-3 miles away. Although the port authority lists 3,000 acres available in Valdez Industrial Park, surface material ranges from gravel to unimproved. Some of the Industrial Park area is currently unusable. Other options are the Pipeyard (about 20-25 acres) and the gravel pits (about 15-20 acres). These areas are no more than 3 miles from the Container Terminal and can also act as marshaling areas. The port states that helicopter operations can occur at all open storage areas.

Paved Open Storage Area at the Container Terminal

Unpaved Open Storage Area at the Port of Valdez (gravel surface)

Covered Staging

Although the Port of Valdez has covered storage, these facilities are currently used by the North Star Terminal and Stevedore Company for equipment maintenance and are not available for military use.

UNLOADING/LOADING POSITIONS

Ramps and Docks

Currently, the Port of Valdez does not have any fixed or portable end ramps. The North Star Terminal and Stevedore Company can provide 2 to 3 ramps, if ample notice is given. The North Star Terminal and Stevedore Company would likely either transport available end ramps from their facility in Anchorage or construct a ramp from available material in Valdez. No van or boxcar docks are available at the port.

Marshaling Areas

As previously mentioned in the Open Storage section, the Valdez Industrial Yard and/or other areas could double as marshaling areas as well as serving as staging areas. The Valdez Industrial Yard consists of about 3,000 acres (much of it unusable/unimproved) and is located in the “Old Valdez” area. The Pipeyard (20-25 acres) and gravel pit (15-20 acres) areas are the other options.

Materials Handling Equipment (MHE)

The North Star Terminal and Stevedore Company (Valdez office), located on the port, furnishes equipment and stevedoring services. Available equipment is listed in the table below.

MATERIALS HANDLING EQUIPMENT		
MHE Type	**Capacity STON (tonne)**	**Quantity**
Manitowoc 4100 Mobile Crane (tracked)	230 (209)	1
Manitowoc 4000 Mobile Crane (tracked)	150 (136)	1
Manitowoc 3900 Mobile Crane (rubber-tired)	140 (127)	1
Hyster Fork Lift	34.5 (31.3)	1
Clark Fork Lift	31 (28.1)	1
Hyster Fork Lift	30.5 (27.7)	1
Fork Lift	10.5 (9.5)	1
Fork Lift	9 (8.2)	3
Fork Lift	4 (3.6)	1
Fork Lift	2.5 (2.3)	4
Michigan Loader/Forklift combination	34.5 (31.3)	1
Wagner Log Loader	64.5 (58.5)	1
Wagner Log Loader	45.0 (40.8)	1

Manitowoc Tracked Mobile Crane

FUTURE DEVELOPMENT

The Port of Valdez port authority lists two future development projects. The first project is to complete paving of the open storage. Currently, 3 of the 21 acres are paved. The projected completion date for this is June 2000. The second project is to refender the city docks located in the town of Valdez. These docks are light-duty and currently used for handling light cargo and ferries. The improvement to the city docks is a long-term project and not scheduled for completion until about 2009.

Open Storage Area at the Port of Valdez (to be paved)

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

The Port of Valdez has handled ammunition/explosives in the past. The Container Terminal is an ideal location for ammunition handling due to it's location away from public facilities. Net Explosive Weights (NEW) are provided in the following table.

NET EXPLOSIVES	
Class/Division	**NEW (lbs)**
1.1	190,000
(18) 1.2	500,000
(12) 1.2	500,000
(08) 1.2	No Limit
(04) 1.2	No Limit
1.3	1,000,000
1.4	No Limit
12 containers	500,000

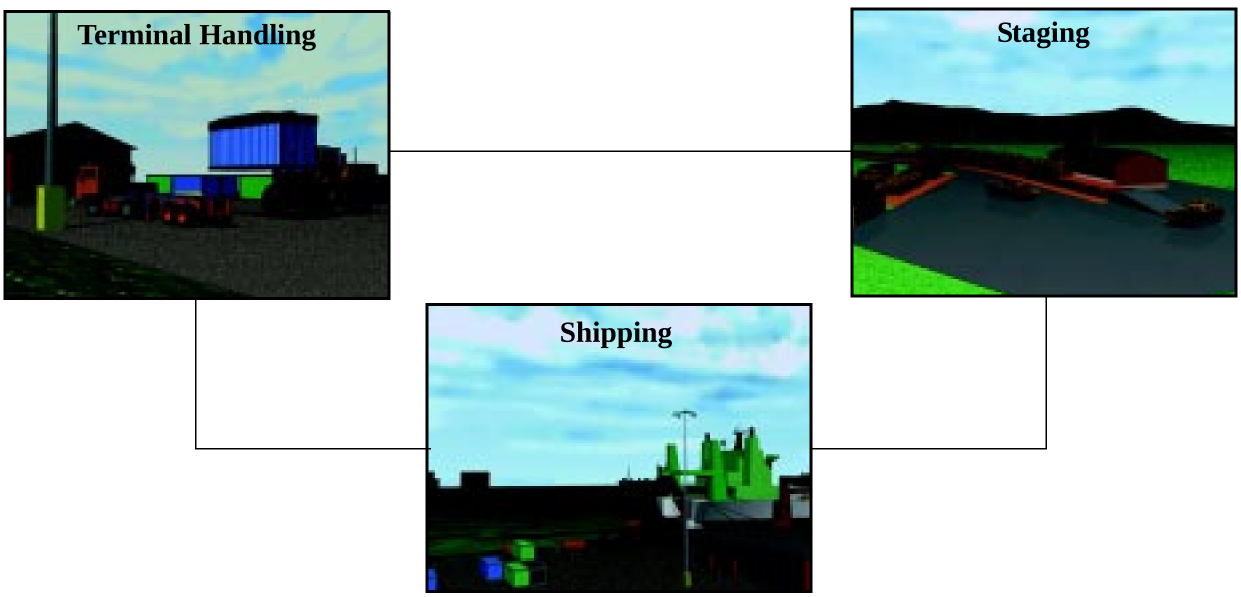
STEVEDORING

The Valdez area has a small pool of longshoremen. North Star Terminal and Stevedore Company quotes 8 registered longshoremen and up to 80 casual longshoremen.

III. THROUGHPUT ANALYSIS

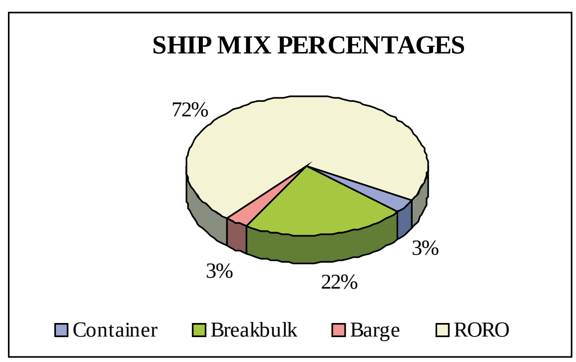
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity for the Port of Valdez. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The charts in this section show the throughput yields in STON.



Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth 90 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

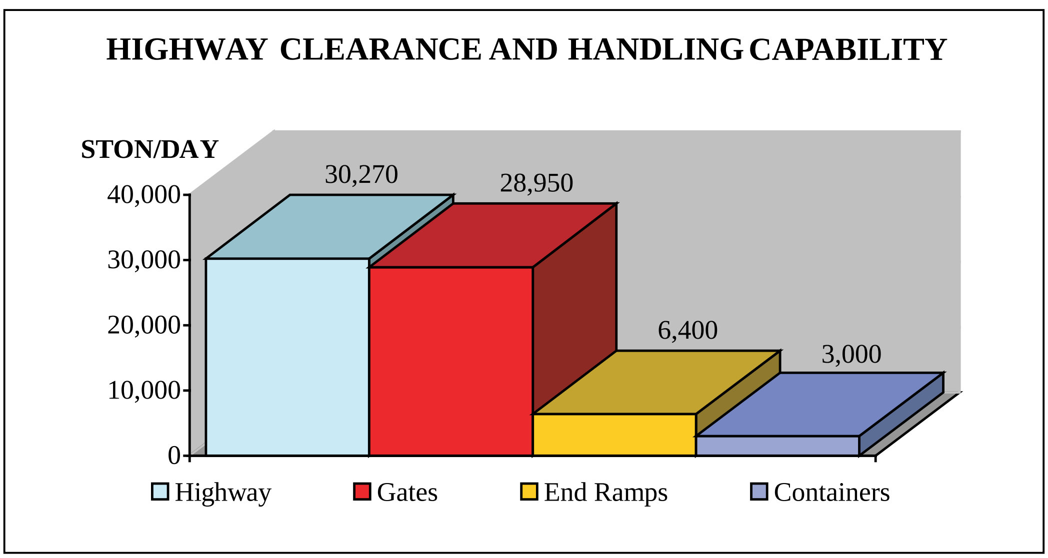
Highway

The road network accessing the port (Richardson Highway to Mineral Creek Loop Road to port access road) consists of two-lane highways. The main gate allows access to the unloading and staging areas. The road and gate going into the port can handle almost 29,000 STON of cargo per day. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or leave the port using the one lane accessing the port.

Roadable vehicles will move through the terminal gate in manageable convoys to the staging area. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. Since end ramps are not available, deploying units/military port operators must either build or acquire the necessary ramps. We assume that the using units will acquire at least two portable truck end ramps from North Star Terminal and Stevedore Company. Two end ramps with one handling position each can handle 3,200 STON of military vehicles and equipment per day.

North Star Terminal and Stevedore Company has three forklifts available with the capacity to handle containers. Assuming use of two of these forklifts, the Port of Valdez could handle 3,000 STON/day.

Maximum daily handling capability for the port is a mixed total of the three types of handling (end ramps and containers), each up to its maximum, not to exceed the daily gate limit of at least 29,000 STON.

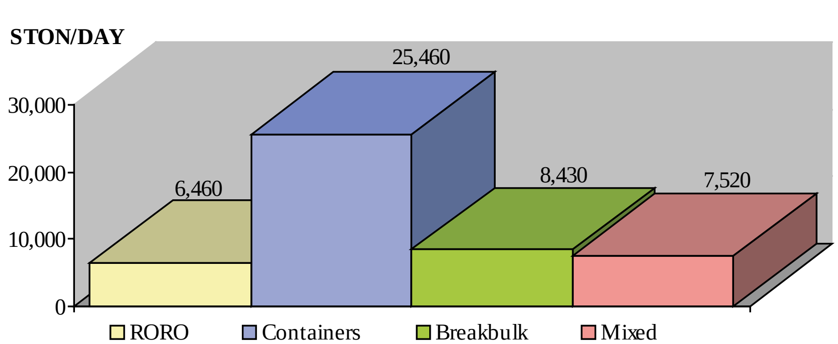


Staging

The Port of Valdez has identified 21 acres of open staging area for vehicles and/or containers.

The chart on this page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of the capability for each type cargo operation involved should be assumed.

The table shows the STON of cargo, by type, the port can handle. The dwell time used in these computations was 3 days and the open space utilization percentage was 60 percent. The container storage throughput capability is the highest with almost 25,500 STON. The ability to stack containers 3 high in the paved open storage area contributes to the high staging throughput value. The RORO storage throughput is almost 6,500 STON. The breakbulk staging throughput is about 8,400 STON.

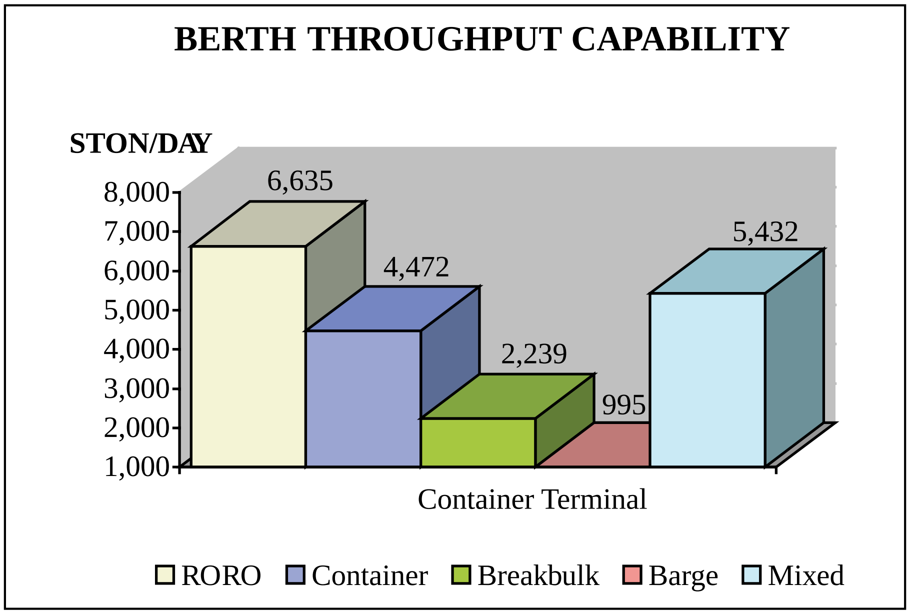


Note: Container staging area can also be used for RORO staging as needed.

Access Way to Container Staging Area

Shipping

Daily shipping subsystem totals for each terminal berth are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types. The port conducts container operations using mobile cranes. The open apron and nearby open storage area supports RORO operations. The ample wharf length (1,200 feet) and water depth (55 feet MLW) allow ships as large as the LMSR or FSS to berth at the Port of Valdez.



Container Terminal Wharf

DAILY THROUGHPUT SUMMARY	
Characteristic or Throughput	**Container Terminal**
Length (feet) (meters)	1,200 (365.8)
Depth Alongside (feet) (meters)	55 (16.8)
Breakbulk Throughput (STON) (MTON)	2,240 (5,600)
RORO Throughput (STON) (MTON)	6,640 (26,540)
RORO Square feet (EST) [1]	132,700
RORO Pieces [2]	780
Container Throughput (STON) (MTON)	4,470 (11,180)
Container Throughput (TEU) [3]	560
Barge Throughput (STON) (MTON)	1,000 (2,490)
Mixed Throughput (STON) (MTON)	5,430 (20,750)

Container Terminal at the Port of Valdez
(City of Valdez at Upper Left)

[1] Based on the 20 square foot per STON average accomplished during Operation Desert Shield/Storm.
[2] Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.
[3] Based on the 8 STON per TEU average accomplished during Operation Desert Shield/Storm.

SUMMARY

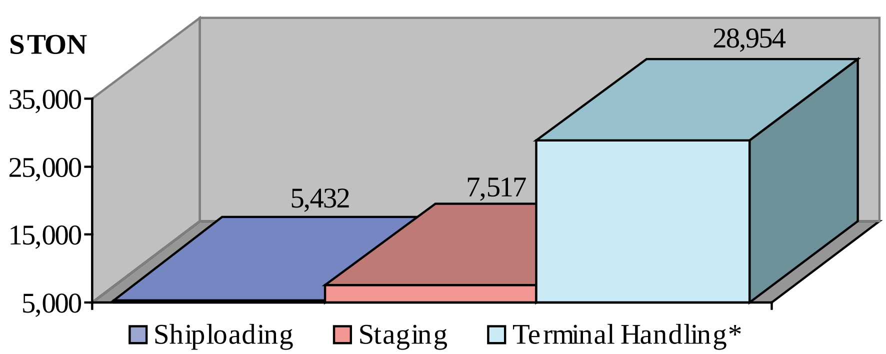
The port is multioperational with the capability to handle all types of vessels: limited container, RORO, breakbulk, and barge.

The Port of Valdez has the capability to handle military equipment for deployment or exercise. Mobile cranes, furnished by the local stevedores, can perform the lift-on/lift-off operations required for breakbulk, container, and barge shipping. Container operations will be slower due to the lower handling rates of the mobile cranes vice specialized container cranes. Due to the floating dock, the 12-foot tidal variation will not hinder RORO operations.

The port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table. The open apron and close proximity of the open storage area enhances RORO operations. To conduct loading operations on an LMSR, the port needs about 25 acres of open staging per LMSR vessel. Since the entire notional separate infantry brigade can be loaded on ¾ of an LMSR, the staging need is reduced to 16.5 acres. The amount of open staging needed for sustained loading operations on the FSS vessel is about 16 acres per vessel. The Port of Valdez has 21 acres of open storage (3 acres are paved) at the Container Terminal for military deployments. This meets the needs for both the FSS and LMSR. Additional acreage is also available at off-port sources. These additional open storage areas are located from 2 to 3 miles from the port. Proper ship loading management can help alleviate any problems that would necessitate using the off-port marshaling areas.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of about 5,430 STON.

DAILY CARGO THROUGHPUT CAPACITY



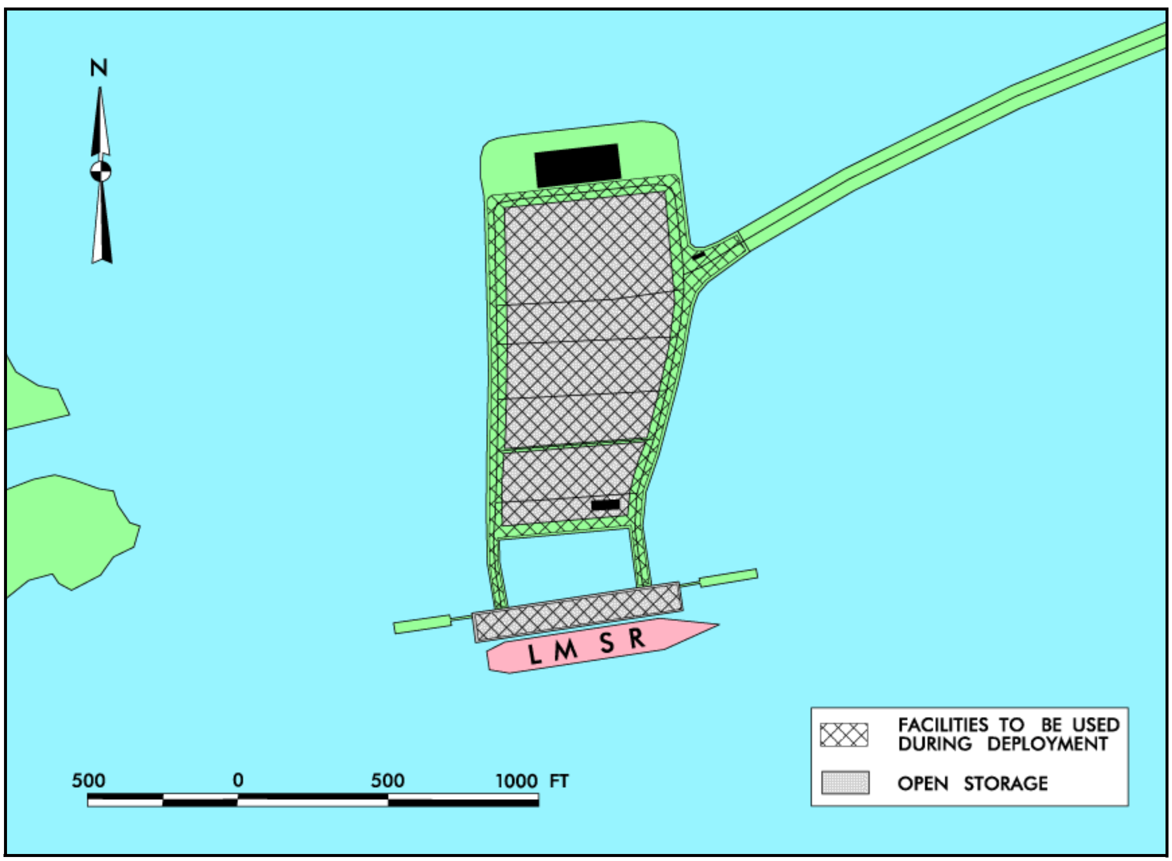
Terminal handling is the highway limit (28,954 STON).

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional separate infantry brigade using primarily LMSR vessels. We assume that the Container Terminal, to include 16.5 acres of open storage and required MHE, is available to the military for deployment. We also assume that no other military units will be competing for these facilities during the time that the brigade occupies the port. We further assume that the required assets, both transporters and people will be available to adequately load the ship and clear the port.

For this application, we assume that the deploying brigade will use the facilities identified in the graphic below during a deployment. Also, we assumed that the stevedores would provide one container handler, two mobile cranes, and various forklifts for cargo handling and shiploading for a deployment. We further assumed that two portable end ramps would be available for semitrailer offloading and that off-port marshaling areas would be available if needed.

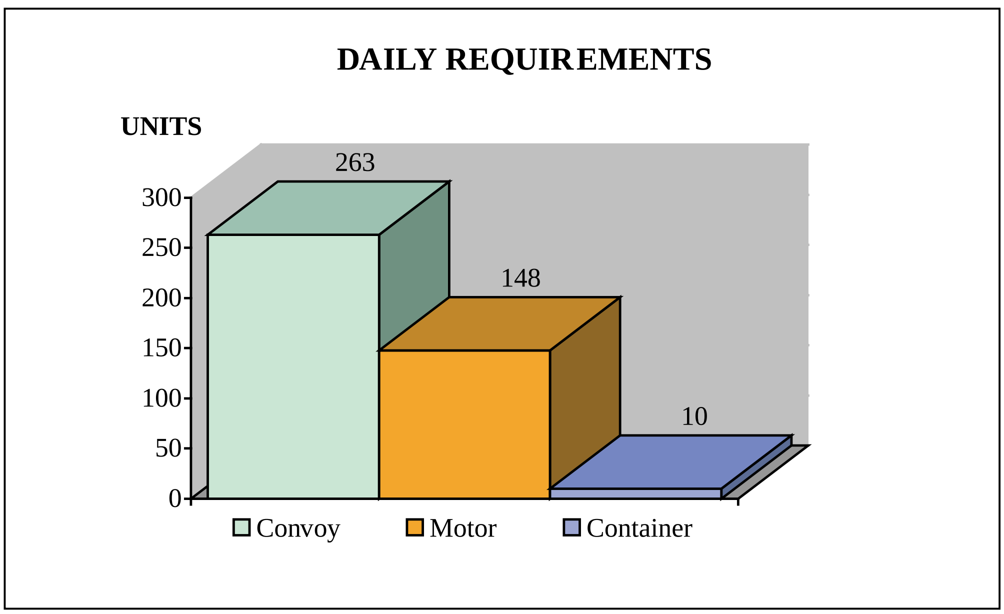


Potential Port Use During Deployment

REQUIREMENTS

To simulate a likely requirement for the Port of Valdez, we deployed a notional separate infantry brigade using 6 days for shiploading and port closure. The brigade has to move 1,577 roadable vehicles (includes 674 towed vehicles), 835 nonroadable vehicles, and 57 containers. Movement of the brigade to the port will require 886 commercial HETS/flatbeds using a convoy/motor option for transport to the port. About 10 containers would arrive daily.

TOTAL EQUIPMENT	
Volume	65,577 MTON
Weight	12,940 STON
Area	355,821 SQ FT
Vehicles	2,412
Containers	57
Note: Figures above denote current requirements.	



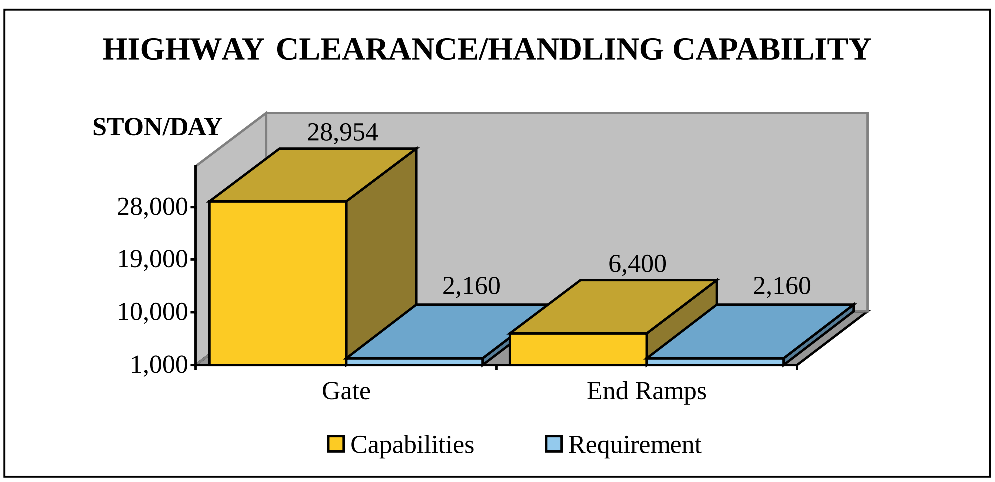
TERMINAL INPROCESSING/HANDLING

Highway

The Port of Valdez does not have rail access. Therefore, all equipment (except helicopters) will move to the port via the highway mode. The highway and gate systems leading to the port can easily handle the additional traffic generated by a deployment. For offloading wheeled and tracked vehicles from semitrailers, we assume the use of two truck end ramps at the Container Terminal in the open storage areas. Deployment mileage from Fort Wainwright to Valdez (355 miles) is comparable to the mileage to Anchorage (about 360 miles). Deployment for units from Fort Richardson, however, adds 290 miles (about 7.25 hours at 40 mph).

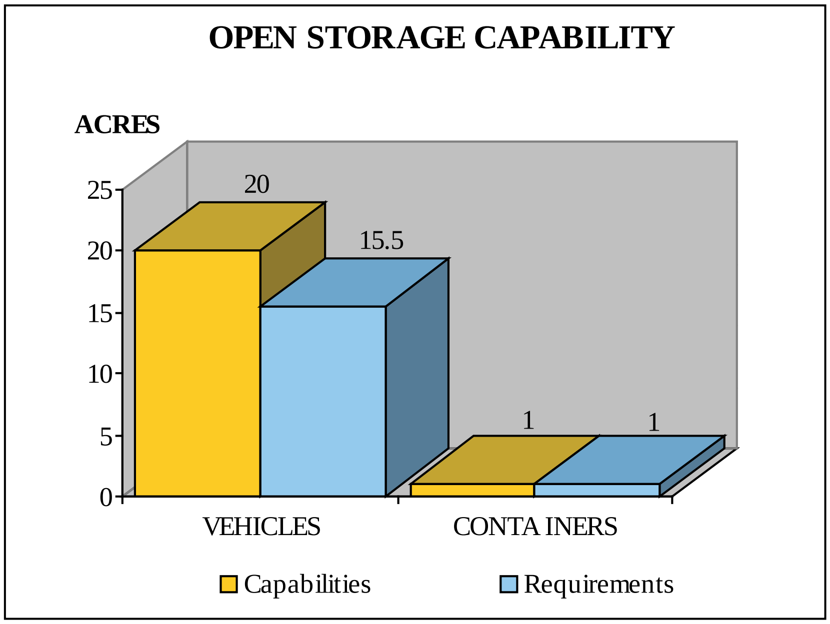
Requirements use total STON of equipment divided by six providing a daily arrival requirement by highway. Capabilities for the gate and end ramps reflect gate and end ramp daily throughputs respectively. If the entire brigade deploys through the Port of Valdez, then 886 commercial 40-foot flatbeds/HETS would be required to transport the nonroadable equipment. Commercial resources may not be able to furnish the required 886 flatbeds/ HETS for transporting the nonroadable vehicles in the brigade.

Potential Location for Truck End Ramp Operations



Open Storage

The Port of Valdez has identified about 21 acres of immediate open storage area in the Container Terminal. Of this total, 3 acres are paved. The 21 acres are enough to support the loading of an LMSR or FSS. Although 25 acres are usually needed to support sustained loading on the LMSR, the entire notional separate infantry brigade can be loaded on ¾ of a single LMSR. Therefore, 16.5 acres are needed to stage the notional separate infantry brigade for the LMSR. The FSS needs about 16 acres of open storage to conduct sustained loading operations and the 21 acres of open storage area available will meet the FSS need. Several off-port marshaling areas are available if needed to support the port staging areas. As the first ship fills up and the staging area empties there is room to stage equipment for the next FSS that will be loaded.



The 16.5-acre requirement considers the available square feet for ¾ of an LMSR times factors to allow for emergency lanes and vehicle/cargo/container access. In addition to vehicle and container acreage, space is also needed to account for maintenance, access, ramp areas, frustrated cargo, and so forth in loading any ship, including the LMSR. Since the entire notional separate infantry brigade can be loaded on ¾ of the LMSR, the normal 25-acre requirement for sustained loading operations on an LMSR is reduced to 16.5 acres. The Container Terminal (21 acres) has enough acreage to satisfy the notional separate infantry brigade need.

Shipping

Using the LMSR to transport the brigade, the Container Terminal will allow the ship to meet the 6-day loading requirement. Based on the LMSR being able to load in about 3 to 4 days, the port can meet the 6-day requirement. Berth space is adequate to allow the side and stern ramps on the LMSR to be used to load the ship. If smaller ships are used for deployment, then additional time will be required to move the brigade.

Deploying by the one LMSR requires each ramp to average about 110 STON per hour for 20 hours to deploy the brigade in 6 days. This equates to 10 vehicles per hour per ramp. Deploying by FSS requires one ship every 3 days to meet the same requirement; this equates to 20 vehicles per hour per ramp.

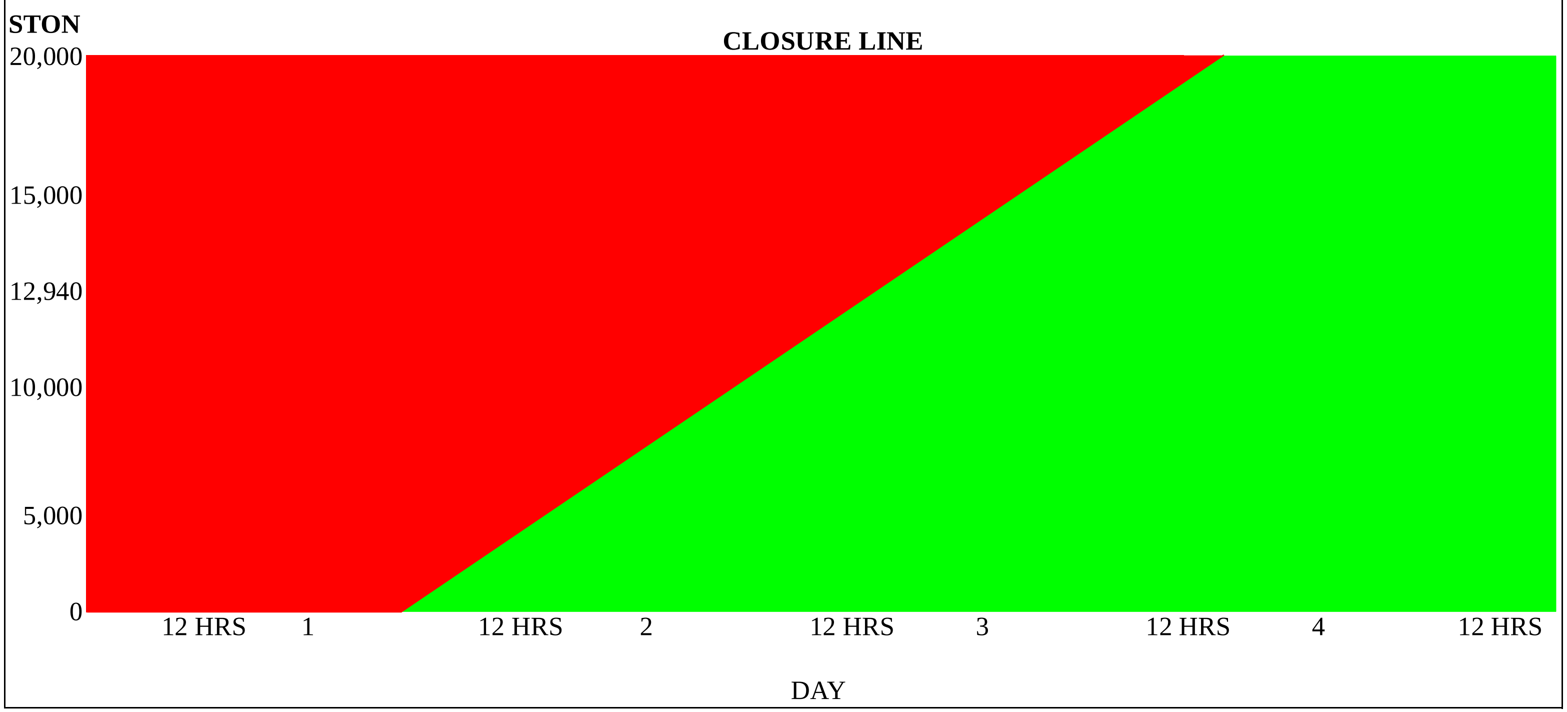
SHIP REQUIREMENTS NOTIONAL SEPARATE INFANTRY BRIGADE				
Loading Condition/ Sample Ship Mix	**FSS (RORO/ Comb)**	**LMSR (RORO/ Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	1.2			
All LMSR		.75		
All Breakbulk			3.8	
Maximum Containerization				
FSS/Container	.04			.94
LMSR/Container		.03		.94
Breakbulk/Container			.14	.94

Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

APPLICATION RESULTS

Total deployment time for the brigade was about 3-4 days with the last 2-3 of those days used for shiploading and the first 30 hours used for initial reception, staging, and ship berthing. An LMSR vessel was used to deploy the brigade. Closure results are shown in the following chart. Although the port can easily handle a separate infantry brigade within 6 days, problems may occur during peak reception of equipment during deployment. The peak day may bring as much as 8,350 STON. Based on the limiting subsystem in port throughput for Valdez (shipping subsystem – 5,432 STON/day), the peak influx of equipment may require storage in various marshaling areas until open storage is available at the port.

CLOSURE PROFILE USING SHIPLOADING SUBSYSTEMS FOR PORT OF VALDEZ



SUMMARY

The Port of Valdez can load a notional separate infantry brigade and achieve closure within 6 days using the Container Terminal and LMSR or FSS ships. The floating dock allows the Port of Valdez to operate through high and low tides. If other ships are used, additional time may be required to achieve port closure. The port must ensure that 16.5 acres of open storage are available for military use during a deployment using LMSR vessels.

Although the port can achieve closure within 6 days, peak day requirements (as much as 8,350 STON in the equipment reception and handling subsystem identified in the TEA Port Enhancement Analysis, March 1999) may exceed the shipping subsystem capability (5,432 STON per day). This means that equipment may require marshaling in various areas in and around Valdez.

MHE and end ramps are available through local stevedores. No container cranes are available at the port; therefore, loading containers aboard ships must be accomplished via mobile cranes. Mobile crane handling rates are often about ½ of specialized container cranes. Because the port does not have rail access, highway access is critical in getting equipment to the port. The number of commercial HETS/flatbeds needed to transport the nonroadable vehicles from the brigade to the port is 886. Commercial resources may not be able to furnish the required number of HETS/flatbeds to transport the brigade. Occasional avalanches occur in the Thompson Pass and Keystone Canyon areas in the late winter/early spring. While the Alaska Department of Highways can usually clear road closures in a day's time, avalanches could still cause a problem during deployment. If strategic deployment is a requirement for the Port of Valdez, then an agreement should be made with the port authority to ensure the necessary facilities are available in a contingency.

Deployment mileage from Fort Wainwright to Valdez (355 miles) is comparable to that from Fort Wainwright to Anchorage (about 360 miles). The mileage from Anchorage to Valdez is about 290 miles, which adds about 7.25 hours to the deployment time for units coming from Fort Richardson to Valdez.

MTMCTEA

PORT OF WHITTIER
ALASKA

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a site visit at the Port of Whittier in June 1999. The port is small and the two wharves that would be most desirable for military use are not considered deployment useful at this time. These wharves need repair/modification before military deployments can occur from this port. The Port of Whittier is not listed in the Port Planning Orders (PPO) issued by the Maritime Administration (MARAD). Currently, none of the Alaskan ports are listed in the PPO for deployment of a notional separate infantry brigade or any other military unit.

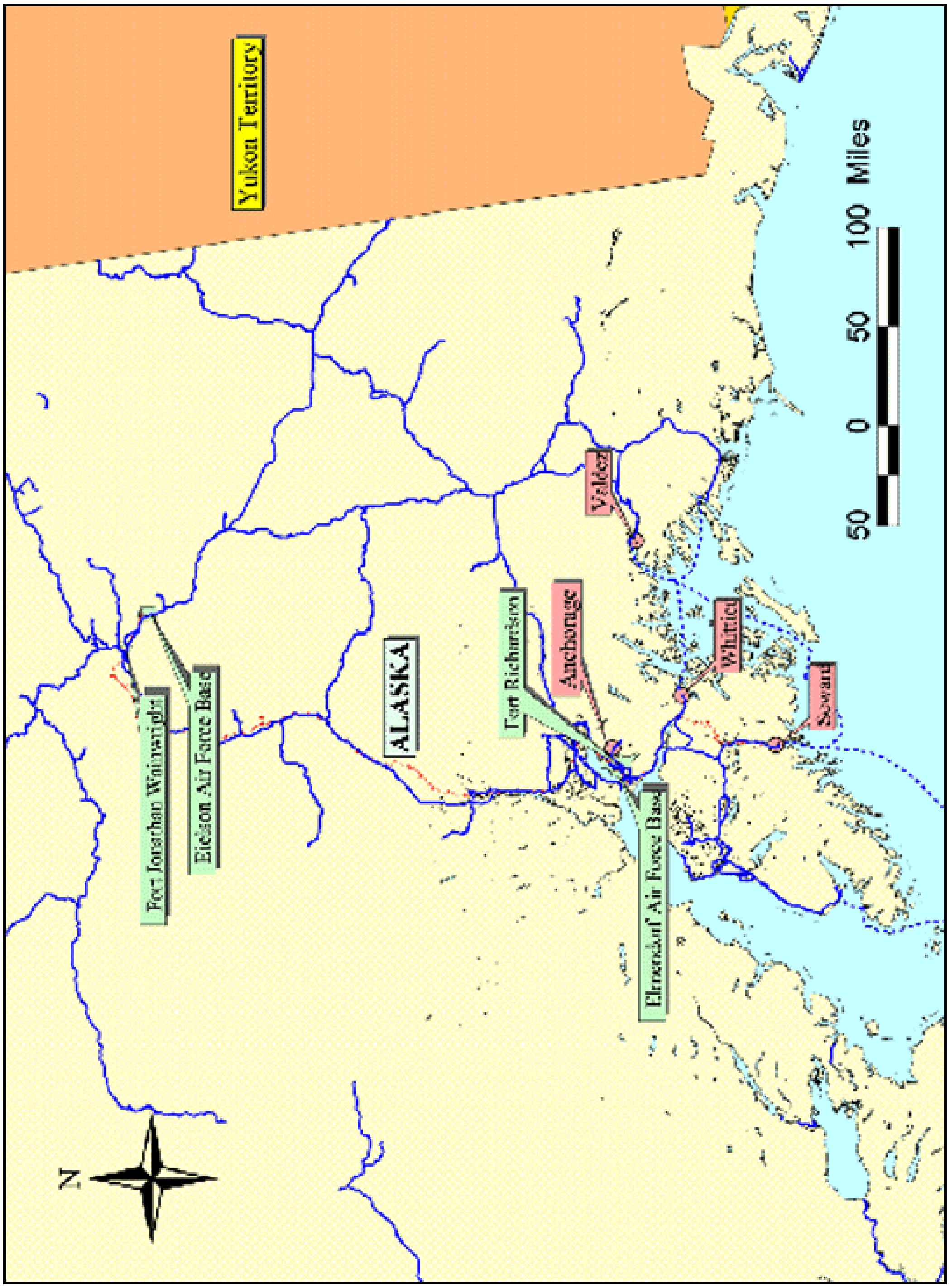
The port consists of a 1,000-foot-long marginal wharf owned by the Alaska Railroad Corporation (ARRC), the Delong Pier owned by the Department of Defense, a rail/barge facility operated by the ARRC, a ferry dock, and a few small local-use docks. The ARRC marginal wharf and Delong Pier are the two facilities that would most likely be considered for military deployment. The water depth at the ARRC varies from 23-40 feet mean low water (MLW). Also, the deck strength is only 150 pounds per square foot (psf), which negates any usefulness to the military. The DOD Delong Pier is 675 feet long and has a water depth alongside of 33 feet MLW. This pier was originally used for petroleum product transfer from vessel to storage tanks. It consists of a barge on steel pilings with concrete surface. The facilities used in fuel transfer are still fixed to the pier and would interfere with ship berthing and/or loading/offloading. Although the Delong Pier has been resurfaced, the structural integrity underneath the deck is questionable. The pier needs a thorough evaluation to determine it's structural integrity and, provided the structural integrity is adequate, modification to make it deployment useful.

Currently, Whittier does not have highway access. Construction is ongoing to make the current railroad tunnel highway capable by May 2000. Currently, the sole land access into Whittier is by rail. The ARRC runs several passenger and freight train shuttles (hauling POVs and other cargo) over the rail line from Portage to Whittier daily. Both Portage and Whittier have rail side ramps that allow easy loading of highway vehicles, including truck tractor/semitrailer combinations. A rail end ramp is also available at the Whittier railyard. Whittier does not have an airport, but does have a gravel take-off/landing strip (1,100 feet x 50 feet) that has handled small private aircraft and float planes in the past. Several firms have material handling equipment (MHE) available in the Whittier area, however, the largest mobile crane immediately available has a capacity of 50 STON. None of the docks have wharf or container cranes.

The Port of Whittier has about 10 acres of gravel-surface open staging. Other open storage areas with gravel surface are available in the Whittier area. A transit shed with covered storage area of 43,000 square feet is available at the ARRC marginal wharf. Most of this covered storage space is used by the ARRC and other private local interests.

For sustained deployment operations, 25 acres of open storage are desired per large medium size roll on/roll off (RORO) (LMSR) to support daily shiploading operations. Since the entire notional separate infantry brigade can be loaded on three-fourth of an LMSR, the open storage need is reduced to about 16.5 acres. The desired staging for a fast sealift ship (FSS) is about 16 acres per ship to support daily, sustained loading operations. The 10 acres of open storage falls short of both the LMSR and FSS requirements. Several areas exist in and around Whittier that could serve open staging needs and provide the additional open storage acreage needed to meet FSS/LMSR requirements.

As a standard application, we analyzed a notional separate infantry brigade deploying through each of the Alaskan ports using LMSR vessels. To throughput a brigade-size unit out of the Port of Whittier by FSS/LMSR, deployment requirements include a 1,000-foot ship berth with water depth alongside of 37 feet mean low water (MLW) and a wharf apron suitable (deck strength of at least 500 psf) for RORO operations. Sixteen and one-half acres of open storage for staging vehicles are desired to support loading operations for a notional separate infantry brigade on an LMSR. Covered storage is needed to support helicopter shrink-wrapping and protect palletized cargo. Some port improvements/modifications, primarily strengthening one of the wharfs for RORO operations and dredging the depth alongside to a consistent 35 feet MLW, would need to occur before the Port of Whittier can meet LMSR deployment needs. Also, other open storage areas need to be designated to complement the existing 10 acres and correct the current open storage shortfall. It is preferable for the 16.5 acres of open storage to be contiguous.


Yukon Territory
ALASKA
Fort Jonathan Wainwright
Eielson Air Force Base
Fort Richardson
Anchorage
Elmendorf Air Force Base
Valdez
Whittier
Seward
50 0 50 100 Miles
N

II. GENERAL DATA

The Port of Whittier, located on the south central Alaskan coast, is considered a potential seaport of embarkation for deploying Alaskan military units during contingencies. MTMCTEA conducted a site survey in June 1999. Information on port characteristics was obtained from port officials.

TRANSPORTATION ACCESS

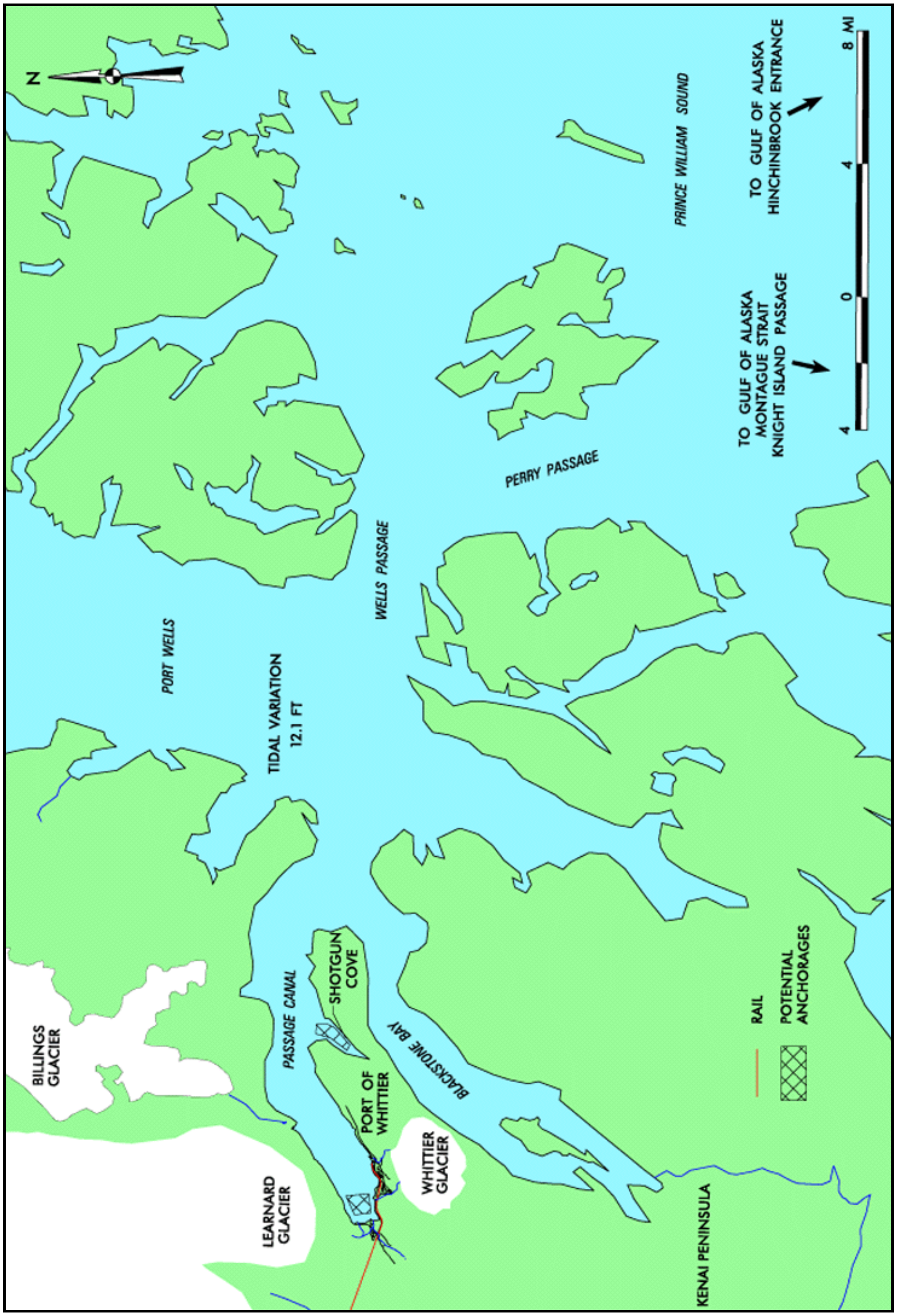
Water

The Port of Whittier (latitude 60° 47’ north, longitude 148° 40’ west, (YXDP)) is located at the northeastern corner of the Kenai Peninsula, on the southwestern shore and near the head of Passage Canal. Water access can occur via two routes from the Gulf of Alaska. The first route proceeds through the Prince William Sound via the Hinchinbrook Entrance and thence into Passage Canal via Perry Passage and Wells Passage. The other route proceeds through the following passageways into Passage Canal: Montague Strait, Knight Island Passage, Perry Passage, and Wells Passage. Channel depths are extremely deep with reported depths of at least 70 fathoms (420 feet). The water depth rapidly diminishes approaching the berth areas. Water depths alongside the major ship berths vary from 23-40 feet mean low water (MLW). No overhead clearance restrictions exist for seaport access.

Access to the port is ice-free. Passage Canal is both wide enough and deep enough to provide a natural turning basin for any ship including FSS and LMSR vessels. Due to the deep water depths, the number of anchorages are limited. Anchorage possibilities include the head of Passage Canal at 20 fathoms (120 feet) MLW and Shotgun Cove at 14-100 fathoms (84-600 feet). The tidal variation at Whittier is 12.1 feet.

All vessels calling on the Port of Whittier require pilots for navigation. Pilots are available through the Southwest Alaska Pilots Association. The number of pilots available is 12. Two tugboats and a line haul tug are in the Whittier area. The horsepower for these are 800, 2,000, and 5,000, respectively. These tugboats are provided through Crowley Marine Services, Inc.

Ship Channel Accessing the Port of Whittier



Water Access Map

Highway

Currently, Whittier does not have highway access. Construction is ongoing to make the rail tunnel highway capable. This project is discussed in the Future Development section.

Rail

The Alaska Railroad Corporation (ARRC) provides a shuttle rail service into Whittier. The rail line providing access to Whittier connects to the main rail line at Portage. Currently, six round-trip trains delivering POVs, large trucks, construction equipment, and other cargo run between Whittier and Portage daily. The ARRC states that they could provide 2 trains per day at 75-80 railcars per train for units transiting from Fort Wainwright to the port. About 250 flatcars are in the ARRC inventory and 130 of these are 53-foot flatcars. The ARRC reports that 89-foot flatcars are unavailable in Alaska.

A major classification railyard is adjacent to the Port of Whittier. This railyard can store over 450 53-foot railcars. Daily usage is currently around 20 percent. The Portage classification railyard can store about 150 railcars. This railyard is also relatively uncongested. Two tunnels exist on the rail line between Portage and Whittier. The clearances on this line meet the Association of American Railroads diagram.

Two fixed rail ramps exist at Whittier. One is an end ramp and the other is the side ramp routinely used for the current Portage/Whittier rail shuttle. The clearance between each railcar and the side ramps at Whittier and Portage is a close tolerance to allow smooth railcar access for POVs. Although the port does not have portable end ramps, the railyard has several spurs suitable for conducting rail end ramp operations using portable ramps. With adequate notification, portable end ramps could be acquired or built for military use. The ARRC and the North Star Terminal and Stevedore Company have portable ramps in the Anchorage area.

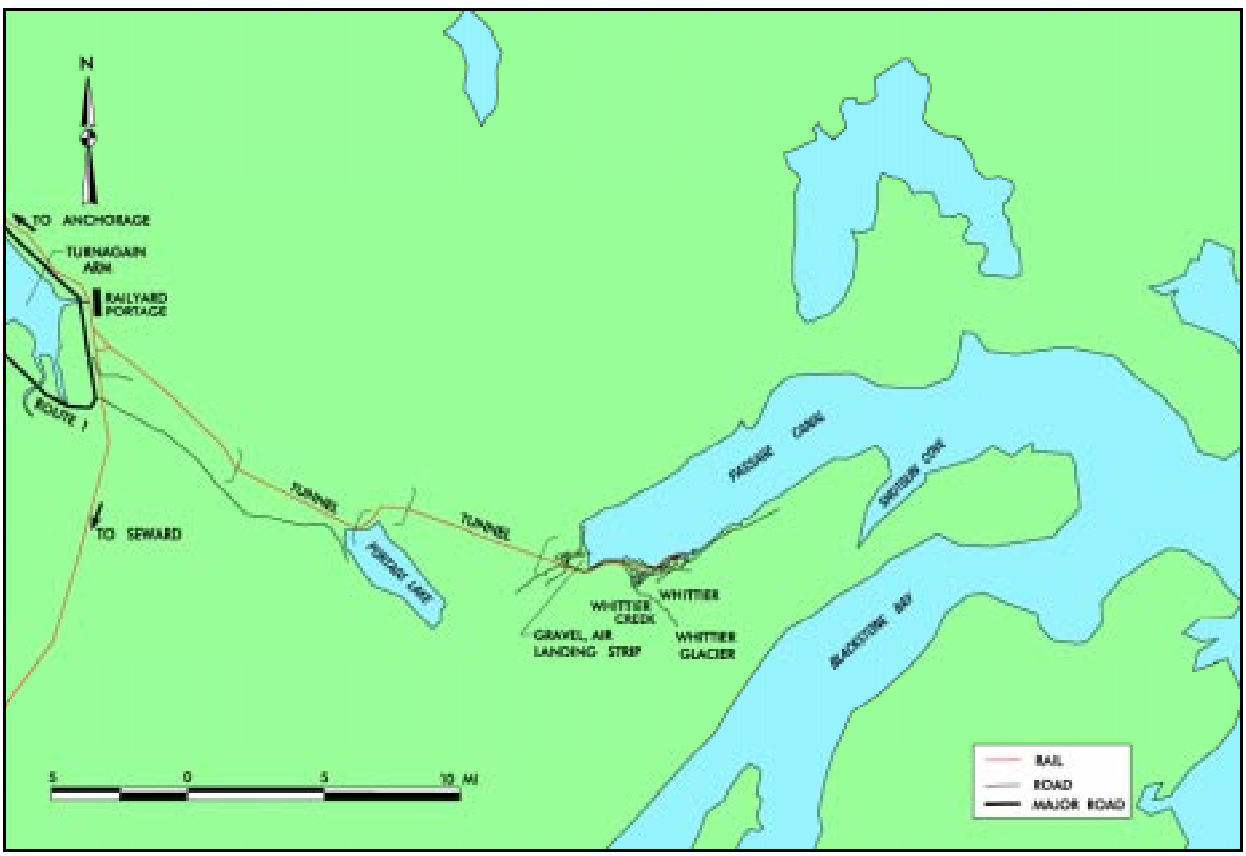
Rail Tunnel Near Portage
(Note: A truck tractor/semitrailer combination, tanker, and construction equipment on a flatbed semitrailer, are transported on this train.)

Air

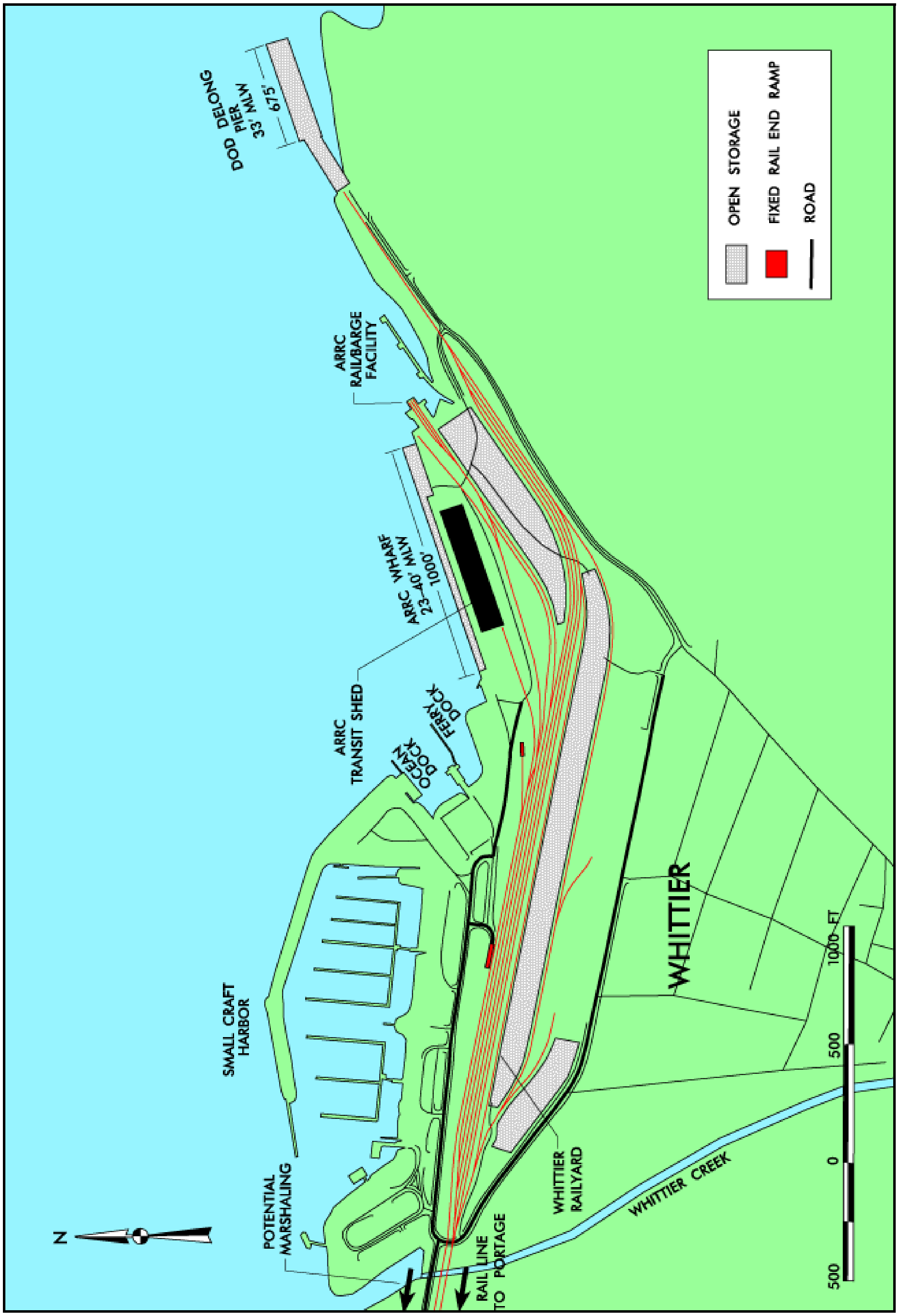
Close Tolerance Between Railcar and Side Ramp at the Port of Whittier

Whittier does not have an airport, however, a small, gravel take-off/landing strip is available at the head of Passage Canal near the rail tunnel. This landing strip measures 1,100 feet long by 50 feet wide and has been used by small private aircraft and float-planes.

According to the port authority, the best area for helicopter operations is the small gravel landing strip at the head of Passage Canal. This strip is less than a mile from the port. Other options for helicopter operations include the open storage areas by the railyard and transit shed, and the water well area adjacent to the town of Whittier. Using the open storage areas by the railyard and transit shed will further reduce the already somewhat limited open storage available for vehicles and other equipment.



Rail and Air Access Map


DOD DELONG PIER 33' MLW
675'
ARRC RAIL/BARGE FACILITY
ARRC WHARF 23-40' MLW
1000'
ARRC TRANSIT SHED
FERRY DOCK
OCEAN DOCK
SMALL CRAFT HARBOR
POTENTIAL MARSHALING
RAIL LINE TO PORTAGE
WHITTIER RAILYARD
WHITTIER CREEK
WHITTIER
OPEN STORAGE
FIXED RAIL END RAMP
ROAD
N
500
0
500
1000 FT

Land-use Map

PORT FACILITIES

Berthing

The Port of Whittier is a small port capable of light breakbulk/barge, ferry, and rail-barge operations. The port consists of a 1,000-foot-long marginal wharf owned by the Alaska Railroad Corporation (ARRC), the Delong Pier owned by the Department of Defense, a rail/barge facility operated by the ARRC, a ferry dock, and a few small local-use docks.

The ARRC marginal wharf and Delong Pier are the two facilities that would most likely be considered for military deployment. The water depth at the ARRC varies from 23-40 feet MLW. Also, the deck strength is only 150 pounds per square foot (psf), which negates any usefulness to the military. The DOD Delong Pier is 675 feet long and has a water depth alongside of 33 feet MLW. This pier was originally used for petroleum product transfer from vessel to storage tanks. It consists of a barge on steel pilings with concrete surface. The facilities used in fuel transfer are still fixed to the pier and would interfere with ship berthing and/or loading/offloading. Although the Delong Pier has been resurfaced, the structural integrity underneath the deck is questionable. The pier needs a thorough evaluation (especially underneath the surface) to determine it's structural integrity and, provided the structural integrity is adequate, modification to make it deployment useful.

The ferry dock and rail/barge facilities are specialized facilities serving special users. The ferry dock serves Alaskan cruise ships. The rail/barge slip is a facility owned by the ARRC and is used for loading railcars onto barges. A special ramp equipped with rail tracks is the facility used for loading the railcars onto the barge.

Lighting exists throughout the port. Information provided by the port authority shows 10 acres of available open staging area at the port. All of the open storage has a gravel surface. Although the ARRC marginal wharf has a transit shed, most of the storage space is used by the ARRC and local private enterprises. Any lift-on/lift-off operations are accomplished via mobile cranes; however, the largest mobile crane available in the Whittier area has a capacity of only 50 STON.

DoD Owned Delong Pier (Note the Fuel Transfer Facilities on the Pier)

BERTH CHARACTERISTICS FOR THE PORT OF WHITTIER		
Berths / Characteristics	ARRC Marginal Wharf	Delong Pier
Length feet (meters)	1,000 (304.8)	675 (205.7)
Depth alongside at MLW feet (meters)	23-40 (7.0-12.2)	33 (10.1)
Deck Strength psf (metric tons per square meter)	150 (.73)	450-500 (est.) (2.20-2.44)
Apron width feet (meters)	30 (9.1)	80 (24.4)
Apron height above MLW feet (meters)	22 (6.7)	22 (6.7)
Number of container cranes	0	0
Number of wharf cranes	0	0
Apron Lighting	Yes	Yes
Straight-stern RORO Ramp	No	No
Apron length served by rail feet (meters)	0	0

Alaska Railroad Marginal Wharf

Alaska Railroad Rail/Barge Facility

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF WHITTIER				
Vessels		Berths		
TYPE	CLASS	ARRC Marginal Wharf	Delong Pier	NOTES:
BREAKBULK	C3-S-38a	1,a,f	1,p,q	
	C4-S-58a	1,a,f	1,p,q	The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth
	C4-S-66a	1,a,f	1,p,q	
	C5-S-37e	1,a,f	1,p,q	
SEATRAIN	GA and PR	1,a,f	1,p,q	The letters in the columns to the left indicate limitations as described below.
BARGE	LASH C8-S-81b	1,a,f	a,c,f,p,q	
	LASH C9-S-81d	1,a,f	a,c,f,p,q	
	LASH Lighter	5	3,p,q	a-vessel draft limit
	SEABEE C8-S-82a	1,a,f	a,c,f,p,q	b-inadequate apron width
	SEABEE Barge	5	3,p,q	c-inadequate berth length
RORO	COMET	1,a,d,f,o,p	1,d,i,j,p,q	d-no straight stern ramp
	METEOR	1,a,d,f,o,p	1,d,i,j,p,q	e-no container handling equipment
	Cape Gnome	1,a,d,f,o,p	1,a,d,i,j,p,q	f-anchorage depth OK, berth depth inadequate
	C7-S-95A	1,a,b,f,p	a,c,p,q	g-inadequate channel depth
	Cape Taylor	1,a,b,f,p	1,i,p,q	h-no shore based ramps
	Cape Orlando	1,a,b,f,p	1,i,j,p,q	i-low tide insufficient ramp clearance
	MV Ambassador	1,a,d,f,p	1,d,p,q	j-high tide insufficient ramp clearance
	Callaghan	1,a,d,f,o,p	c,d,o,p,q	k-excessive ramp angle low tide
	Cape Lambert	1,a,b,f,p	c,p,q	m-excessive ramp angle high tide
	LMSR Class	1,a,b,f,p	a,c,p,q	n-parallel ramp operation ONLY
	FSS	1,a,b,f,p	a,c,p,q	o-insufficient apron width for side ramp
	Cape E-Class	1,a,b,f,p	1,i,j,p,q	p-inadequate/questionable deck strength
	Cape D-Class	1,a,b,f,p	c,p,q	q-interference from fuel transfer facilities
	Cape H	1,a,b,f,p	a,c,p,q	Ramp clearance and angle based on maximum vessel draft
RORO	Cape Texas	1,a,b,f,p	1,i,j,p,q	
	Cape R	1,a,b,d,f,o,p	1,d,p,q	♦ May Prevent Operation
	Cape I-class	1,a,b,f,p	c,p,q	
	Cape Victory	1,a,b,f,p	1,i,j,p,q	♦ May Limit Operation
CONTAINER	C6-M-147a	1,a,b,e,f,p	1,e,p,q	
	C7-S-69c	1,a,b,e,f,p	1,e,p,q	
	C7-S-68c	1,a,b,e,f,p	c,e,p,q	
	C8-S-85c	1,a,b,e,f,p	c,e,p,q	
	C9-M-132b	1,a,b,e,f,p	a,c,e,p,q	
	C9-M-F141a	1,a,b,e,f,p	a,c,e,p,q	
TACS	C6-S-1qd	1,a,b,f,p	1,p,q	
	C5-S-MA73c	1,a,b,f,p	1,p,q	
	C6-S-MA60d	1,a,b,f,p	1,p,q	
MPS	C7-S-133a	1,a,b,f,p	c,p,q	
	Maersk	1,a,b,f,p	c,p,q	
	AmSea	1,a,b,f,p	1,p,q	

Open Staging

According to information provided by the port authority, the Port of Whittier has 10 acres of open storage available at the port. All of this open storage has a gravel surface. The wharves are directly accessible from the open storage area. Other open storage is available in the town of Whittier and at the head of Passage Canal near the tank farm. In general, the surface material is gravel. The port states that helicopter operations can occur at the open storage areas beside the railyard and transit shed (10 acres) and the water well open area adjacent to the town. Using the open areas beside the railyard and transit shed for helicopter operations will reduce the limited storage area (10 acres) available for vehicles. Also, these open storage areas have a gravel/dirt surface and are not ideal from a safety standpoint for landing helicopters.

Open Storage Area at the Port of Whittier (portion nearest the transit shed)

Open Storage Area at the Port of Whittier (portion next to railyard)

Covered Staging

A transit shed exists on the ARRC marginal wharf. This shed has 43,000 square feet of covered storage. Most of this space is currently used by the ARRC and other private local enterprises for storage. The port would need ample notice to advise these private users to remove their property so that space is available for military use.

Alaska Railroad Marginal Wharf with Transit Shed

UNLOADING/LOADING POSITIONS

Ramps and Docks

Fixed Rail End Ramp at the Port of Whittier

The Port of Whittier has two fixed rail ramps for offloading railcars. Two fixed rail ramps exist at Whittier. One is an end ramp and the other is the side ramp routinely used for the current Portage/Whittier rail shuttle. The length of straight track serving the end ramp is 200 feet. The length of straight track serving the shuttle ramp is 1,400 feet. The clearance between each railcar and the side ramps at Whittier and Portage is a close tolerance to allow smooth railcar access for POVs. Although the port does not have portable end ramps, the railyard has several spurs suitable for conducting rail end ramp operations using portable ramps. Six spurs at the railyard have a straight track length of 2,000 feet. With adequate notification, portable end ramps could be acquired or built for military use. The ARRC and the North Star Terminal and Stevedore Company have portable ramps in the Anchorage area. No van or boxcar docks are available at the port.

Whittier Railyard (Whittier - Portage shuttle train at far left)

Marshaling Areas

As stated in the Open Storage section, other open storage areas exist in the town of Whittier and at the head of Passage Canal. These are the best areas that could serve as marshaling areas. All of these potential marshaling areas have a gravel or unimproved surface.

Materials Handling Equipment (MHE)

Several local construction companies can furnish equipment for port operations. The companies in the immediate area are Dojer Limited, Crowley Marine Services, R. C. Dock, and Passage Canal Marine. Typical available equipment is listed in the table below.

MATERIALS HANDLING EQUIPMENT		
MHE Type	**Capacity STON (tonne)**	**Quantity**
Boom Truck Crane	50 (45.4)	1
Truck Crane	20 (18.1)	2
Truck Crane	10 (9.1)	2
Forklift	30 (27.2)	2
Clark Forklift	15 (13.6)	1
Clark Forklift	3 (2.7)	2
Baker Forklift	2 (1.8)	1
Yale Electric Forklift	2.5 (2.3)	1
John Deere Loader 644C	--	1
Ottawa Yard Tractors	--	3
Truck Tractor/Semitrailer Combination	50/40 (45.4/36.3)	1
Sicard Snowblaster	--	1
Grader	--	1
Fuel Truck	--	3
Dump Truck with Plow	--	1
Flatbed	--	3

FUTURE DEVELOPMENT


Anton Anderson Railroad Tunnel at Whittier

The Port of Whittier port authority lists three future development projects. The first project is to complete modification of the 2.6 mile Anton Anderson Railroad Tunnel to allow highway access into Whittier. The result will be a tunnel shared by the ARRC and highway traffic. A computerized traffic control system will regulate both highway and rail traffic. Currently, the rail traffic will have the priority. The second project is the transfer of the DOD owned Delong Pier to the State of Alaska. No timetable was given for this transfer. The last project is the commercial development of the port to attract cruise ships and tourists into the Port of Whittier. This will be an ongoing development.

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

Due to its remote location, the Port of Whittier routinely handles explosives/hazardous materials. The port has been approved to handle two boxcar loads of hazardous materials/explosives. The Canadian National Railroad routinely has brought in explosives in the past. Other hazardous materials that have been handled in the past are LPG, sodium hydroxide, ammonium nitrate, and ethylene glycol.

NET EXPLOSIVE	
Class/Division	**NEW (lbs)**
1.1	190,000
(18) 1.2	500,000
(12) 1.2	500,000
(08) 1.2	No Limit
(04) 1.2	No Limit
1.3	1,000,000
1.4	No Limit
12 containers	500,000

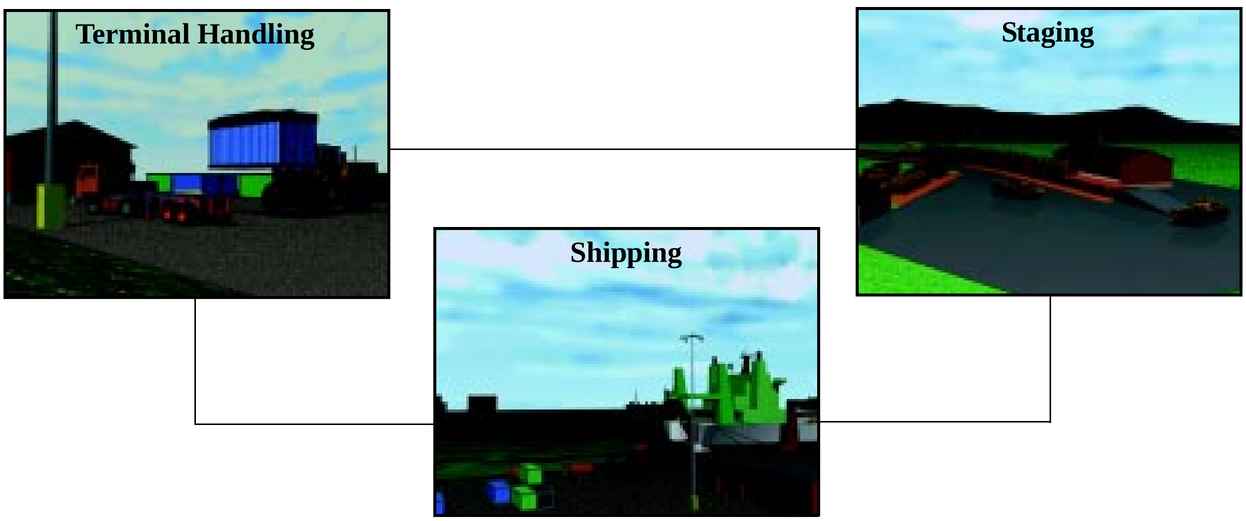
STEVEDORING

The North Star Terminal and Stevedore Company provides the stevedoring services for the Port of Whittier. Information provided by the North Star Terminal and Stevedore Company states that longshoremen are on call from the Port of Seward. Seward has 15 registered longshoremen and 30 casual longshoremen. This could pose a problem if the longshoremen are needed at the Port of Seward. North Star Terminal and Stevedore Company also has longshoremen at the Ports of Homer and Anchorage as well as Seward.

III. THROUGHPUT ANALYSIS AND APPLICATION

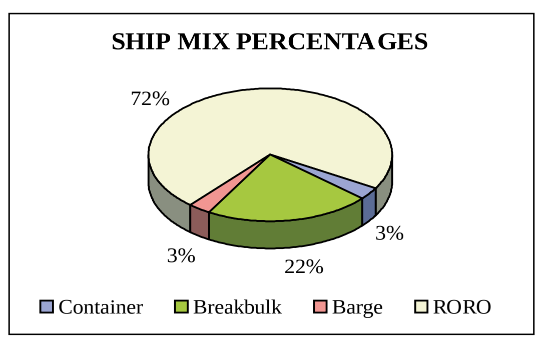
GENERAL

Because none of the ship berths are considered deployment useful at this time, the Port of Whittier does not have a deployment useful throughput. We estimated a throughput for Whittier based on the completion of improvements/modifications to the ARRC marginal wharf and Delong Pier. The port throughput was estimated using the Port Operational Performance Simulator (POPS) computer model. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and MTON per day. The numbers in this section show the throughput yields in STON.



Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth 90 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



RESULTS

Assuming the ARRC marginal wharf and Delong Pier are made deployment useful, the estimated mixed throughput for the Port of Whittier is 6,765 STON per day. This estimate assumes that the only MHE used for shiploading is that which is available in the Whittier area. This means that shiploading is restricted to breakbulk/barge and RORO operations only. Large mobile cranes with a capacity of at least 100 STON must be brought in to perform container operations unless lift-on can occur using ship cranes or the containers are rolled on using a container chassis.

Our estimate also assumes the use of 16.5 acres of open storage. Using the 10 acres provided in the port information, the staging throughput becomes the limiting subsystem and the overall port throughput is reduced from 6,765 STON to 3,970 STON per day.

Rail reception for the port is not a problem and total reception will improve with a highway access capability into Whittier.

Because the Port of Whittier is not considered to be deployment useful, no unit equipment will move through the port. Therefore, the port would be restricted to occasional shipments of light breakbulk cargo. Because of it's ability to throughput hazardous materials (hazmat)/explosives, the Port of Whittier could also move occasional shipments of hazmat.

APPENDIX

BERTH EVALUATION METHODOLOGY

GENERAL

This appendix provides a technique for accomplishing a comparative analysis of individual berths. The first step is to evaluate the individual berths within a port to determine their potential for breakbulk, RORO, container, and barge vessel operations.

INDIVIDUAL BERTH EVALUATION

For the individual berth evaluation, a comparison is made of the characteristics of each berth and the list of ideal factors required to support the different ship mixes. Tables 1 through 4 give the ideal factors for breakbulk, barge, RORO, and container ship mix operations. As the tables show, points are awarded for each factor. These are then used to compare the potential for each factor. These are then used to compare the potential of each berth to support the four ship mixes. A ranking of individual berths is established for each type of ship-mix operation, based on a comparison of the total points accumulated by each berth.

The berth receiving the highest accumulation of points is assigned a value of 1, and the remaining berths are ranking accordingly.

Return Index

TABLE 1

IDEAL BREAKBULK BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Transit Shed**	
Quay or marginal	10	Available	15
Pier	7	None	0
Berth Length (ft)		**Deck Strength (lb per sq ft)**	
Greater than 750	20	Greater than 800	10
700 to 750	18	600 to 800	9
600 to 699	16	400 to 599	5
500 to 599	10	Less than 400	2
Less than 500			
Water Depth (ft) MLW		**Ship Service Facilities**	
Greater than 35.0	20	Power, water, and telephone	6
32.0 to 35.0	18	Power and water	5
30.0 to 31.9	16	Water only	4
28.0 to 29.9	14	None	0
Less than 28.0	12		
Apron Width (ft)		**Cranes**	
20.0 or greater	15	Wharf	10
Less than 20.0	5	Heavy-lift mobile (≥100 STON)	9
		Mobile	5
		None	0
Apron Tracks		**Conditional Age**	
2	10	New	10
1	7	10 years old	8
None	0	20 years old	4
		30 years or older	1

TABLE 2

IDEAL BARGE BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Transit Shed**	
Quay or marginal	10	Available	10
Pier	7	None	5
Water Depth (ft) MLW		**Anchorages**	
Greater than 20.0	10	Protected	10
15.0 to 20.0	9	Partially protected	6
10.0 to 14.0	8	Unprotected	2
Less than 10	0	Unavailable	0
Apron Width (ft)		**Tug Availability of 650 hp or Greater**	
Greater than 60.0	10	More than 4	10
40.0 to 60.0	9	3 - 4	**9**
30.0 to 39.9	7	1 - 2	7
20.0 to 29.9	5	None	0
Less than 20.0	1		
Apron Tracks		**Barge Fleeting (Number of Barges)**	
2	10	40 or more	10
1	7	25	8
None	0	10	4
		None	0
Deck Strength (lb per sq ft)		**Conditional Age**	
Greater than 800	10	New	10
600 to 800	9	10 years old	8
400 to 599	5	20 years old	4
Less than 400	2	30 years or older	1
Cranes			
Wharf	10		
Heavy-lift mobile	9		
Mobile	7		
None	0		

TABLE 3
IDEAL RORO BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Apron Tracks**	
Quay or marginal	10	2	10
Pier	5	1	7
		None	0
Berth Length (ft)		**Deck Strength (lb per sq ft)**	
Greater than 1,000	20	Greater than 800	10
900 to 1,000	18	600 to 800	9
800 to 899	16	400 to 599	5
700 to 799	10	Less than 400	2
600 to 699	6		
Less than 600	2		
Water Depth (ft) MLW		**Ship Service Facilities**	
Greater than 35.0	20	Power, water, and telephone	6
32.0 to 35.0	18	Power and water	5
30.0 to 31.9	16	Water only	4
28.0 to 29.9	14	None	0
Less than 28.0	12		
Apron Width (ft)		**Vehicle Access**	
Greater than 60.0	20	Uncongested	10
40.0 to 60.0	15	Congested	5
30.0 to 39.9	5		
Less than 30.0	0		
RORO Ramp Operation		**Conditional Age**	
Side, slewed, straight	10	New	10
Side, slewed stern	6	10 years old	8
Slewed stern	4	20 years old	4
Starboard, slewed stern	2	30 years or older	1
None	0		
Tidal Range (ft)			
0 to 3.9	10		
4.0 to 7.9	8		
8.0 to 11.9	6		
12.0 to 16.0	4		
Greater than 16.0	0		

TABLE 4
IDEAL CONTAINER BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Deck Strength (lb per sq ft)**	
Quay or marginal	10	Greater than 1,000	10
Pier	5	800 to 999	8
		600 to 799	5
		400 to 599	3
		Less than 400	1
Berth Length (ft)		**Ship Service Facilities**	
Greater than 1,000	20	Power, water, and telephone	6
900 to 1,000	18	Power and water	5
800 to 899	16	Water only	4
700 to 799	10	None	0
600 to 699	6		
Less than 600			
Water Depth (ft) MLW		**Container Cranes**	
Greater than 40.0	20	Specialized container crane	20
35.0 to 40.0	18	Mobile gantry	16
32.0 to 34.9	16	Mobile crane (200-ton)	12
30.0 to 29.9	10	Mobile crane (100-ton)	8
Less than 28.0	6	None	0
Apron Width (ft)		**Container Handling Equipment**	
Greater than 60.0	10	Straddle cranes	10
40.0 to 60.0	9	Straddle trucks	9
30.0 to 39.9	5	Front/side-loading forklifts	8
20.0 TO 29.9	2	Mobile cranes	5
Less than 20.0	1	None	0
Apron Tracks		**Conditional Age**	
2	10	New	10
1	7	10 years old	8
0	0	20 years old	4
		30 years or older	1
Consolidated Shed			
Available	10		
None	0		

PORT OF ALMIRANTE
PANAMA

I. General Data
II. Conclusions
Return to Index

I. GENERAL DATA

Almirante is administered by the Panama National Port Authority (Autoridad Portuario Nacional). Almirante's principal business is the shipment of bananas. The United Brands Company (Chiquita) originally constructed the port and later transferred it to the Government. They operate the port under lease and ship several vessel loads of bananas through it each week. Very little cargo of other types moves through Almirante.

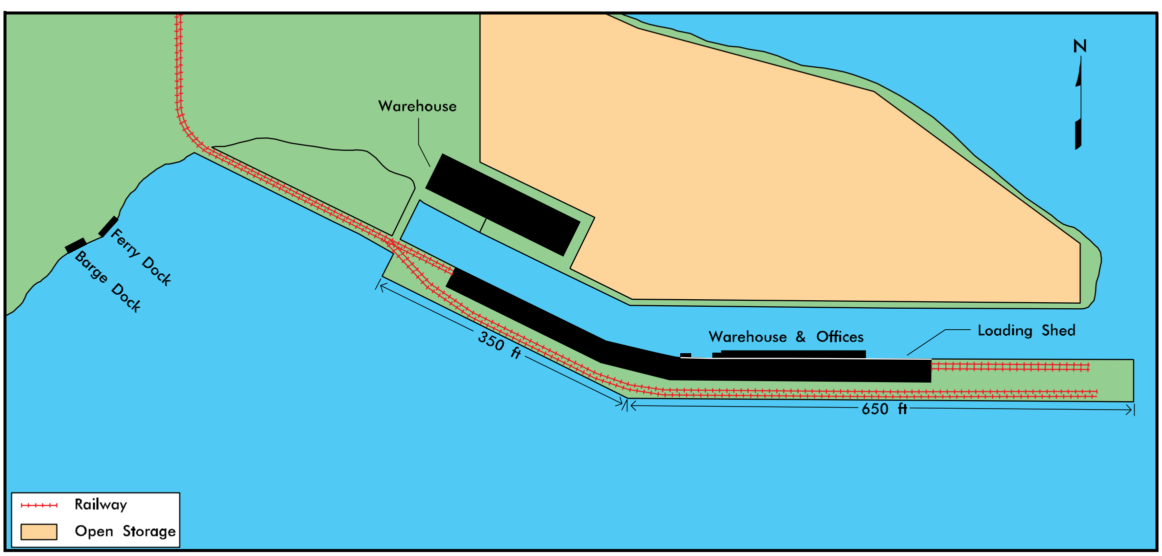
TRANSPORTATION ACCESS

Water

The Port of Almirante (latitude 09° 18' north, longitude 82° 23' west) is located on Bocas Del Toro Bay, on the Northeast end of Panama's Atlantic Coast. The access channel is 13 miles long and has a minimum depth of about 30 feet at mean low water (MLW).   The channel is about 328 feet wide. There are no vertical obstructions that restrict access to the channel or harbor. Pilotage is mandatory for all vessels entering the port.

Tides in the port area are minimal and range only about 1 foot.

Anchorage is available within the port area for vessels awaiting berthing. The maximum depth is about 50 feet. Other anchorage areas within the Bay of Almirante are available up to a maximum depth of about 90 feet.



Site Plan

Highway

The Port of Almirante is not served by any of Panama's major highways. The Bocas Del Toro region is very remote. A ferry service connects the town of Almirante with Chiriqui Grande, which is linked by regional highways to the rest of the country. The area is quite mountainous and surrounded by jungle and forest. The local road net connects the port with the region's banana plantations and small towns and villages.

Highway connecting Almirante with nearest town.

Rail

The Port of Almirante is served by a dedicated narrow gauge (36 inches) railway. This railway connects the outlying banana plantations with the port and is used to move fruit to the port for shipment. The railroad is also the only means to move large cargo (for example, wheeled vehicles, and so forth) onto or off of the large vessel berths. These are not connected to the shore by road.

Railway at Port of Almirante

The railroad has 17 locomotives ranging in size from 32 tons (12 each) to 50 tons (3 each) and 65 tons (2 each). These move trains made up of the company's flatcars, special made cars, 40 feet long by 8 feet wide that move fruit from the plantations to the port.

PORT FACILITIES

Berthing

The Port of Almirante has one marginal pier and two small docks. The docks support ferry and barge berthing. The pier supports banana vessels loading fruit at the port. The barge dock was recently used to support a military deployment for Exercise Fuertes Caminos.

Port authorities at Almirante stated there are no restrictions on vessels calling on the port as to length and beam, provided the maximum draft does not exceed 30 feet. This draft limitation, when combined with the limited access to the pier, will prevent most military cargo vessels from berthing at Almirante.

Berthing at Port of Almirante

BERTH CHARACTERISTICS FOR PORT OF ALMIRANTE

Characteristics	Banana Pier[1]	Cargo Pier	Ferry Dock	Barge Dock
Length (ft)	650	350	150	50
Depth alongside at MLW (ft)	25	25	6	4
Deck strength (psf)	400	400	400	400
Apron width (Ft)[2]	95	95	60	30
Apron height above MLW (ft)	10	10	6	6
Number of container cranes	0	0	0	0
Number of wharf cranes	0	0	0	0
Apron lighting	Yes	Yes	No	No
Straight-stern RORO Ramp[3]	No	No	No	No
Apron length served by rail (ft)	650	350	NA	NA

[1] All cargo loaded or discharged at either the Banana Pier or the Cargo Pier **MUST** be transported to or from the berth by rail.

[2] The two berths on the pier have a total width of 95 feet. The first 25 feet of this is open, the remaining 70 feet is convered by a shed roof.

[3] The two docks do not have RORO ramps. However, both facilities can support stern to berthing of RORO vessels or barges, provided the depth is suitable.

Barge Dock at Almirante

Staging

Open Staging - The Port of Almirante has only about 1.5 acres of open staging available for use. This area is located behind the Banana Pier. Most of the available area is unpaved and grassy.

Open Staging Area at Almiranta

Covered Staging - Almirante has no covered staging area for general cargo.

Rail

A narrow gauge railroad moves fruit from the banana plantations to the pier. The railway connects to the pier via a single line trestle bridge. This line is the only access to the pier for anything larger than a forklift or foot traffic.

Highway

Almirante is linked to the remainder of Panama by ferry to Chiriqui Grande and further by a regional road system that passes through very mountainous jungle to connect with the Inter-American Highway.

Unloading/loading Positions

Ramps and Docks - Almirante has no ramps or docks that could support truck loading or unloading. If these were required, portable ramps could be brought in or fabricated.

MARSHALING AREAS

No marshaling areas support the port directly.

MATERIALS HANDLING EQUIPMENT (MHE)

Other than two 4,000-pound forklifts, Almirante has no MHE.

FUTURE DEVELOPMENT

Port management stated they had limited plans for future development due to the specialized nature of the terminal.

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

Almirante has no experience with hazardous or dangerous cargo.

II. CONCLUSIONS

The Port of Almirante is not capable of supporting most US Military Cargo transhipment operations. Because of the limited capability of Almirante, no throughput analysis is presented for the port. The piers are not recommended for use to support military cargo operations because of the limited access. Although breakbulk vessels could berth at the piers, all cargo would have to move from the berth to shore by the narrow gauge rail. Also, any vessel working Almirante must be self-sustaining. No shore based equipment is available to support anything other than fruit loading.

Ferry Dock at Almirante

The ferry dock is not normally available for use for other than scheduled ferry callings. It could support a small RORO or barge, berthed stern to. The depth at this facility as well as at the barge dock will limit the capability to shallow draft vessels.

PORT OF BALBOA
PANAMA

I. GENERAL DATA

Balboa is the second largest of the Panama National Port Authority (NPA) (Autoridad Portuario Nacional) operated ports. The port handles a wide variety of vessels and cargos.

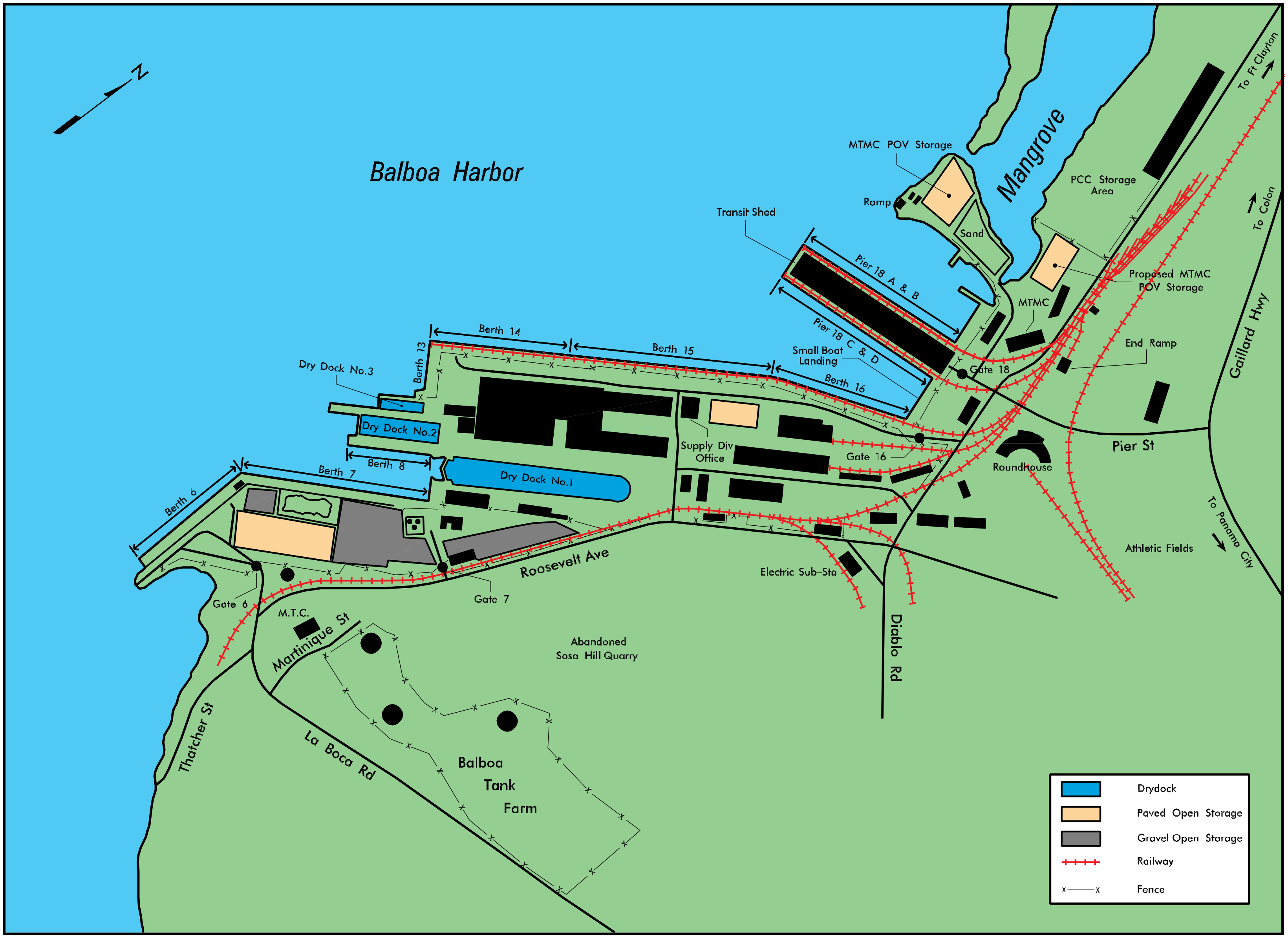
TRANSPORTATION ACCESS

Water

The Port of Balboa (latitude 08° 57' north, longitude 79° 34' west) is at the Pacific Ocean entrance to the Panama Canal, on the east side of the entrance channel in a small harbor protected from the open sea. The port harbor is accessed directly from the Panama Canal. The access channel has a minimum depth of about 36 feet, mean low water (MLW) and is 302 feet wide. The Panama Canal Commission dredges maintain the channel depths and the NPA maintains the port harbor. The most recent harbor maintenance dredging occurred in 1992.

Two way traffic in the channel is open to all vessels except those that exceed 90 feet of beam. The Bridge of the Americas, formerly known as the Thatcher Ferry Bridge, spans the Pacific entrance to the Canal, and has a clearance of 201 feet, at mean high water (MHW), and 220 feet MLW. Vessels can access the port 24 hours a day, although pilots are mandatory for vessels exceeding 150 gross registered tons (GRT). Night berthing is permitted.

Balboa Harbor



N
Balboa Harbor
Mangrove
MTMC POV Storage
Ramp
Sand
Transit Shed
Pier 18 A & B
Pier 18 C & D
Small Boat Landing
PCC Storage Area
Proposed MTMC POV Storage
MTMC
End Ramp
Gate 18
To Ft Clayton
To Colon
Gaillard Hwy
Berth 13
Berth 14
Berth 15
Berth 16
Dry Dock No.3
Dry Dock No.2
Dry Dock No.1
Berth 8
Berth 7
Berth 6
Supply Div Office
Gate 16
Roundhouse
Pier St
To Panama City
Athletic Fields
Electric Sub-Sta
Diablo Rd
Roosevelt Ave
Gate 7
Gate 6
M.T.C.
Martinique St
Abandoned Sosa Hill Quarry
Thatcher St
La Boca Rd
Balboa Tank Farm
Drydock
Paved Open Storage
Gravel Open Storage
Railway
Fence

Site Plan

Tides in the port area range from 8 to 18 feet. Access to the port is restricted to deep draft vessels exceeding 38.5 feet draft between 2.5 hours before and 2 hours after high water.

Anchorage areas located in the Bay of Panama accommodate a large number of vessels. These are generally over very good holding ground and separate areas are designated for vessels with explosive cargos.

Highway

The Port Terminal of Balboa is located in the former Panama Canal Zone town of the same name. Today, Balboa is a subdivision of Panama City. The terminal has four gates that connect the berthing areas to the greater highway system. They are Gates 6 and 7, serving Pier 6 and 7 areas (Gate 7 is normally closed); Gate 16 (outbound) and Gate 18 (inbound) that serves the berth areas 14 through 16. Gate 18 also provides inbound and outbound traffic for the Pier 18 area.

Gates 6 and 7 connect to Roosevelt Avenue, a two-lane paved road that further connects to Diable Road. Gates 16 and 18 connect via Pier Street, two-lanes, paved, to Diablo Road. Diablo Road links the terminal with the Gaillard Highway. The Gaillard Highway is the major highway in the old Canal Zone area and links the Pacific and Atlantic sides.

Port of Balboa, Gate 18

Diablo Road, south of the terminal, becomes Balboa Street and intersects with Amador Avenue. Amador Avenue links the port with the Inter-American Highway and the Bridge of the Americas.

A growing Panamanian nationalism is leading to name changes for many of the old Canal Zone's streets and avenues. It is possible that some of the access roads mentioned above will undergo name changes in the future.

Rail

The Panama National Railroad connects the port to the railway system. However, due to the poor condition of the line, first reported on by MTMCTEA in Report SE 86-3a-27 (app H), military authorities in the USSOUTHCOM have prohibited use of the line in support of military operations. Therefore, rail capability for the Port of Balboa is not analyzed.

PORT FACILITIES

Berthing

The Port of Balboa has eight berthing areas of varying length totaling 6,933 feet. These range in length from 470 feet to 1,146 feet long. Depth alongside the berths at MLW ranges between 30 to 36 feet. Only berths at Pier 18 have covered adjacent staging or storage areas. Warehouse 18 is a transit shed that provides about 159,000 square feet of covered area.

Port Balboa, Berth 14-15

All of the other berths are reasonably open, with aprons ranging in size from 30 feet to more than 110 feet.

The berths at Balboa can support all types of cargo operations. Although the great tidal ranges between 13 and 18 feet, it impedes RORO operations because of severe ramp angles, especially at low tide.

The berth at Pier 15 is the most capable and desirable for supporting military port operations. This is the only berth with sufficient length, depth alongside, and open apron area adjacent that can accommodate vessels like the FSS and LMSR. While these large vessels may berth at some of the other piers, accommodations at those sites do not offer the same operational capability as Pier 15.

BERTHS								
CHARACTERISTICS	**Berth 6**	**Berth 7**	**Berth 8**	**Berth 14**	**Berth 15**	**Berth 16**	**Pier 18a-b**	**Pier 18c-d**
Length (ft)	742	1,058	470	775	1,146	742	1,000	1,000
Depth alongside at MLW (ft)	30	36	36	33	36	33	33	36
Deck strength (psf)	750	750	750	750	750	750	750	750
Apron width (ft)	60	40	30	60	Open	60	20	20
Apron height above MLW (ft)	24	24	24	24	24	24	24	24
Number of container cranes	0	0	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No	No	No	No	No	No
Apron length served by rail (ft)	NA	NA	NA	NA	NA	NA	NA	NA

PORT OF BALBOA
SUMMARY OF BERTHING CAPABILITIES

VESSELS		BERTHS								
TYPE	**CLASS**	**BERTH 6**	**BERTH 7**	**BERTH 8**	**BERTH 14**	**BERTH 15**	**BERTH 16**	**PIER 18A-B**	**PIER 18C-D**	
BREAKBULK	C3-S-38a	1	2	c	1	2	1	1	1	**NOTES:**
	C4-S-58a	1,a	1	c	1	1	1	1	1	a-vessel draft limit
	C4-S-66a	1,a	1	c	1	2	1	1	1	b-inadequate apron width
	C5-S-37e	1	1	c	1	1	1	1	1	c-inadequate berth length
SEATRAIN	GA and PR	1	1	c	1	1	1	1	1	d-no straight-stern ramp
BARGE	LASH C8-S-81b	a,c,f	1	c	a,c,f	1	a,c,f	1,a,f	1	e-no container handling equipment
	LASH C9-S-81d	a,c,f,g	1,a,f,g	a,c,f,g	a,c,f,g	1,a,f,g	a,c,f,g	1,a,f,g	1,a,f,g	f-anchorage depth OK, berth depth
	LASH Lighter	3	5	2	3	5	3	5	5	inadequate
	SEABEE C8-S-82a	a,c,f,g	1,a,f,g	a,c,f,g	a,c,f,g	1,a,f,g	a,c,f,g	1,a,f,g	1,a,f,g	g-inadequate channel depth
	SEABEE Barge	3	5	2	3	5	3	5	5	h-no shore based ramps
RORO	COMET	1,d,o	2,d,o	c,d,o	1,d,o	2,d,i	1,d,o	1,d,o	1,d,o	i-low tide insufficient ramp clearance
	METEOR	1,d,o	1,d,o	c,d,o	1,d,o	2,d,i	1,d,o	1,d,o	1,d,o	j-high tide insufficient ramp clearance
	Cape Gnome	1,a,d,o	1,d,o	c,d,o	1,a,d,o	1,d,i,j	1,a,d,o	1,a,d,o	1,d,o	m-excessive ramp angle high tide
	C7-S-95A	1,a	1,b	b,c	1,a	1,i	1,a	1,a,b	1,b	n-parallel ramp operation ONLY
	Cape Taylor	1,i	1b	b,c	1,i	1,i	1,i	1,b	1,b	o-insufficient apron width for side ramp
	Cape Orlando	1,d	1,d	c,d	1,d	1,i	1,i	1,b	1,b	
	MV Ambassador	1,d	1,d	c,d	1,d	2,d	1,d	1,d	1,d	Ramp clearance and angle based on
	Callaghan	1,d,o	1,d,o	c,d,o	1,d,o	,d,i	1,d,o	1,d,o	1,d,o	maximum vessel draft
	Cpae Lambert	1,a	1,b	b,c	1,i,j	1,i,j	1,i,j	1,b	1,b	
	LMSR Class	a,b,c	1,b	b,c	a,b,c	1	a,b,c	1,a,b	1,b	
	FSS	a,c,g	1,a,b,g	a,b,c,g	a,c,g	1,a,g	a,c,g	1,a,b,g	1,a,b,g	
	Cape E-Class	1,a	,b	b,c	1,i,j	1,i,j	1,i,j	1,b	1,b	**May Prevent Operation**
	Cape D-Class	1,a	1,b	b,c	1,i	1,i	1,i,,j	1,b	1,b	
	Cape H	a,c	1,b	b,c	1,a	1,i	a,c	1a,b	1,b	**May Limit Operation**

PORT OF BALBOA
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS								
TYPE	CLASS	BERTH 6	BERTH 7	BERTH 8	BERTH 14	BERTH 15	BERTH 16	PIER 18A-B	PIER 18C-D	
RORO	Cape Texas	1,a,d,	1,b,d	b,c,d,o	1,d	1,i	1,i	1,b	1,b	**NOTES:**
	Cape R	1,a,d	1,b,d	b,c,d,o	1,d	1,d	1,d	1,b,d,o	1,b,d,o	a-vessel draft limit
	Cape I-class	1,a	1,b	b,c	1,i	1,i,j	1,i,j	1,b	1,b	b-inadequate apron width
	Cape Victory	1,i	1,b	b,c	1,i	1,i	1,i	1,b	1,b	c-inadequate berth length
CONTAINER	C6-M-147a	1,e	1,b,e	b,c,e	1,e	1,e	1,b,e	1,b,e	1,e	d-no straight-stern ramp
	C7-S-69c	1,a,e	1,b,e	b,c,e	1,e	1,e	1,b,e	1,b,e	1,e	e-no container handling equipment
	C7-S-68c	1,a,e	1,b,e	b,c,e	1,e	1,e	1,b,e	1,b,e	1,e	f-anchorage depth OK, berth depth
	C8-S-85c	a,c,e	1,b,e	b,c,e	c,e	1,e	1,b,e	1,b,e	c,e	inadequate
	C9-M-132b	a,c,e	1,b,e	b,c,e	c,e	1,e	1,a,b,e	1,b,e	c,e	g-inadequate channel depth
	C9-M-F141a	a,c,e,g	1,a,c,e,g	a,b,c,e,g	a,c,e,g	1,a,e,g	1,a,b,e,g	1,a,b,e,g	a,c,e,g	h-no shore based ramps
TACS	C6-S-1qd	1,a	1,b	b,c	1	1	1,b	1,b	1	i-low tide insufficient ramp clearance
	C5-S-MA73c	1,a	1,b	b,c	1	1	1,b	1,b	1	j-high tide insufficient ramp clearance
	C6-S-MA60d	1,a	1,b	b,c	1	1	1,b	1,b	1	m-excessive ramp angle high tide
MPS	C7-S-133a	a,c	1,b	b,c	c	1	1,b	1,b	c	n-parallel ramp operation ONLY
	Maersk	a,c	1,b	b,c	1	1	1,b	1,b	c	o-insufficient apron width for side ramp
	AmSea	1,a	1,b	b,c	1	1	1,b	1,b	1	
										Ramp clearance and angle based on
										maximum vessel draft
										May Prevent Operation
										May Limit Operation

Staging

Open Staging - The Port of Balboa has 10 acres or less of open staging available for use. This area is distributed throughout the port area, with much of the available staging area, about 2 acres, adjacent to the berths at Piers 15 and 16. The port normally uses this area to store containers moving across the container berth at Pier 15.

Open Staging

MTMC Warehouse

Covered Staging - The large transit shed and warehouse at Pier 18 is the primary covered staging location within the port area. This building offers about 159,000 square feet of covered staging area. Although normally supporting the berths at Pier 18, this building also supports the other berths in the port with covered staging.

Another building, the MTMC Port Command operations facility, offers several thousand square feet of covered staging space. This building currently supports the 1322d MPC by providing an operating area for shipping and receiving privately owned vehicles and small amounts of military cargo.

Rail

Although linked to the Panama National Railroad, this analysis does not address the capability of the port's railway connections. As previously discussed, the railroad's maintenance condition makes it unusable for supporting military deployment requirements.

Highway

Highway access to the terminal is excellent. Although heavily trafficked, the Gaillard Highway, the principal Trans Isthmian route through the former Canal Zone, connects with all of the roads and streets accessing the port.

Unloading/loading Positions

Ramps and Docks - The only end ramps and docks in the Port of Balboa are located at the MTMC warehouse. This area's docks could support loading and unloading of as many as six trucks with cargo moving across the dock into the warehouse and out to staging or marshaling areas. The end ramp, at the north end of the building is the only one available in the port. No portable ramps are available, nor are there cranes for lifting cargo on or off trucks. Port operators indicate that cranes for this purpose can be rented or leased from local suppliers.

MARSHALING AREAS

No marshaling areas support the port directly. However, Albrook AFB (within 1 mile) and Fort Clayton (about 3 miles away) can provide marshaling locations capable of supporting large military deployments.

MATERIALS HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity (STON)	Quantity	Wharf Assignment
Container Cranes		None	
Wharf Cranes		None	
Rail-Mounted Gantry Cranes		None	
Rubber Tired Transtainers		None	
Container Handler/Stacker	40	2	Primarily Piers 15 and 16
Mobile Cranes	17	1	Terminal Area
Forklifts	4 15 30	13 2 1	Terminal Area Terminal Area Terminal Area
NOTE: The table above represents equipment owned by the port. Port operators indicate that they lease or rent other equipment as required from local suppliers. The list is not "all inclusive" as actual totals may change.			

FUTURE DEVELOPMENT

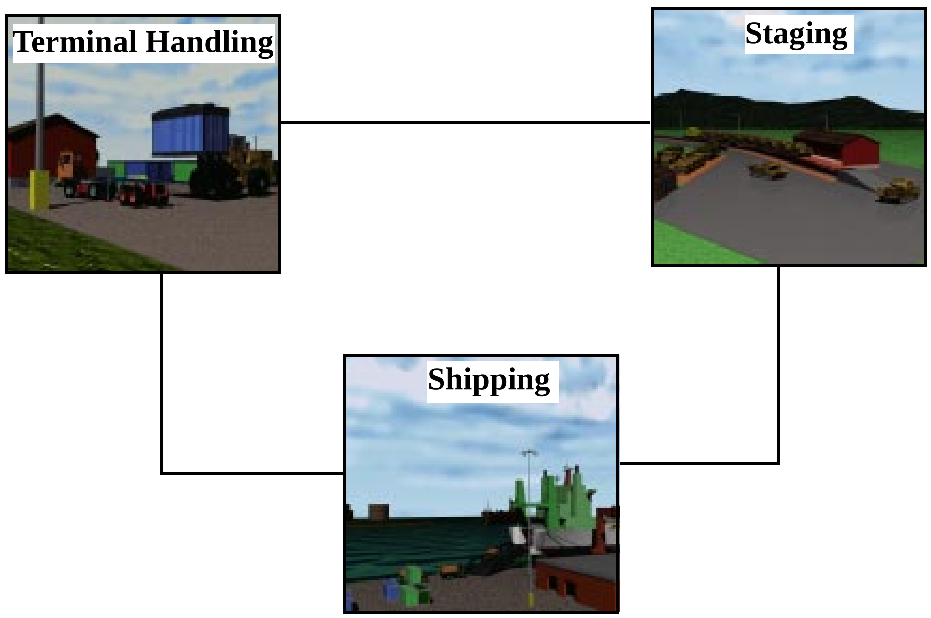
Port management stated that they plan to continue developing the areas at Piers 14, 15, and 16 into container berths. They plan to acquire three container cranes for this area and demolish the buildings that surround the future container wharves. They provided no information about schedules and indicated that because of possible privatization of the port, these plans may change.

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

Only very limited hazardous cargo operations are permitted at Balboa. The port's proximity to large civilian population centers prevent the port from consideration for explosive ammunition operations.

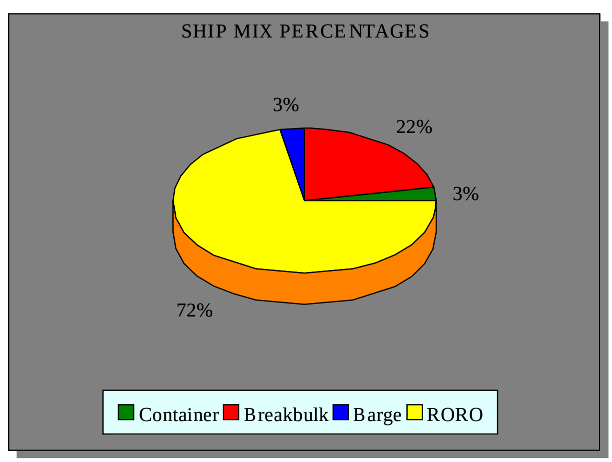
II. THROUGHPUT ANALYSIS GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Balboa. The POPS model uses a weak link analysis to determine the least capable of the three primary transportation subsystems, shiploading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of short tons (STON) and measurement tons (MTON) per day. The charts in this section show the throughput yields in STON. Approximate MTON yields can be computed by multiplying the STON amount by 3.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 60 percent of the port's facilities will support military deployments. Also, because of the port's size, we assume that the berths will have a ship alongside 70 percent of the time. The ship mix is determined by statistics collected during Operations Desert Shield and Desert Storm. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL CLEARANCE AND HANDLING

Highway

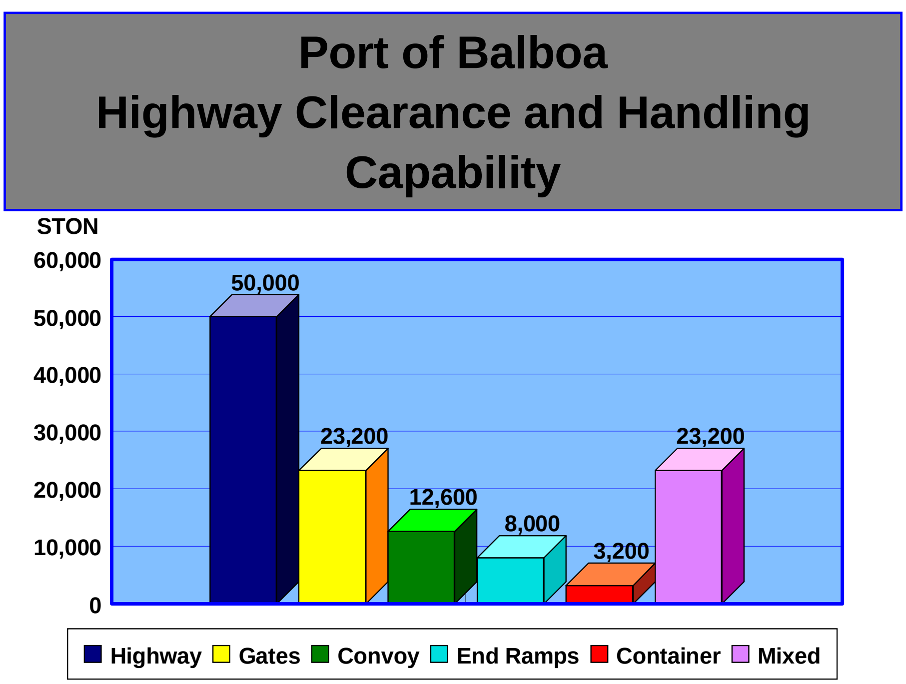
The port is connected to the highway net by four gates and several roads and streets that all connect or provide access to the Gaillard Highway.

The routes into and out of the port complex can handle over 50,000 STON of equipment and supplies daily. The four gate processing systems can handle more than 23,000 STON of cargo per day.

Roadable vehicles will move through the terminal gates in manageable convoys from staging areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a self-loading capability, will use the truck docks and end ramp located at the MTMC Terminal. No other loading sites are available in the port. These locations will handle about 8,000 STON of military cargo per day.

The port has two reach-stacker 40-ton container handlers and one 30-ton forklift/container handler. If we assume 50 percent availability for container chassis operations, the port can handle about 3,200 STON of containers daily (about 400 boxes). This assumes a conservative 267 moves per handler per day.

Maximum daily handling capability for the port is a mixed total of the three types of handling, each up to its maximum, not to exceed the daily gate limit of 23,200 STON.

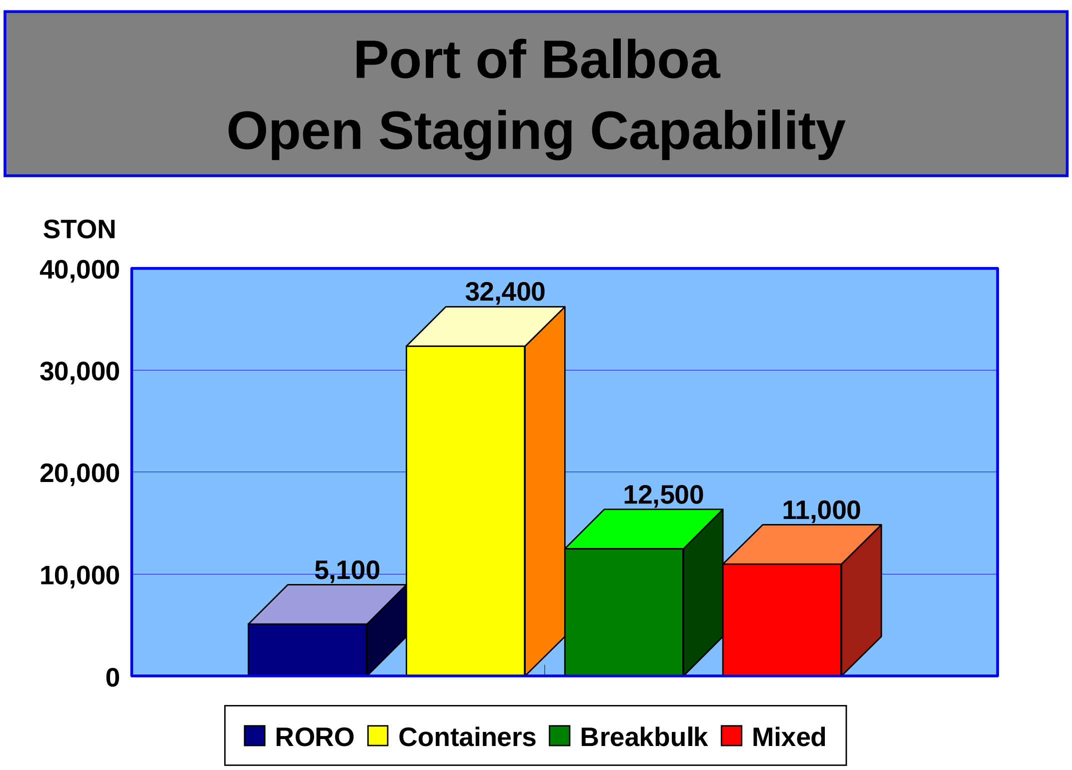


Staging

The port has less than 10 acres of suitable open staging area. This is distributed throughout the terminal area, with a significant portion adjacent to the berths at Piers 15 and 16. Availability of the staging area will vary with work at the port. Port operators assured the survey team that space can be availabale fairly quickly to support military operations. Nevertheless, under normal operational expectations, staging availability will limit operations. The availability of usable open staging space is the least capable subsystem at the port.

The port has about 149,000 square feet of covered storage space (Pier 18 Warehouse). Like the open area, much of this is subject to contain some of the breakbulk cargo moving through the port. However, covered space availability will not limit throughput at the port. About 7,750 STON of breakbulk cargo can be staged in the covered area.

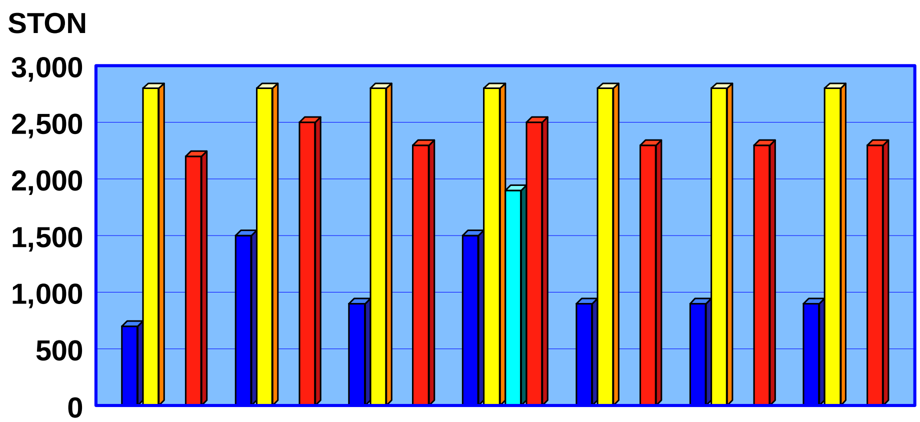
The chart shows the use of the distributed storage and staging space in the port by demonstrating the amounts by type of cargo that can be stored. This analysis assumed a usable space availability of 70 percent of the total area.



Shipping

Daily shipping subsystem totals for the terminals berths are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types. Assumptions and parameter values used to calculate these are shown in the appendix.

Port of Balboa
Berth Throughput Capability



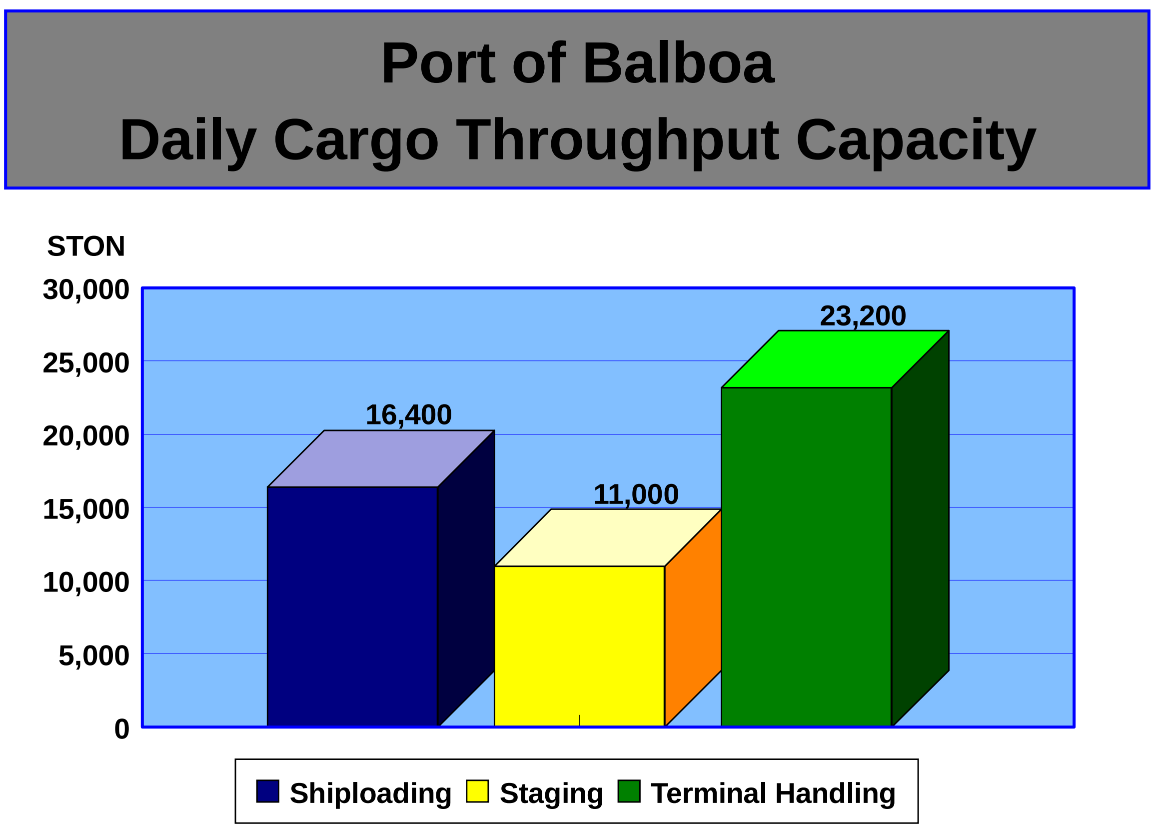
	Berth	Berth 7	Berth 14	Berth 15	Berth 16	Pier 18a-b	Pier 18c-d
Breakbulk/Barge	700	1,500	900	1,500	900	900	900
RORO	2,800	2,800	2,800	2,800	2,800	2,800	2,800
Container	0	0	0	1,900	0	0	0
Mixed	2,200	2,500	2,300	2,500	2,300	2,300	2,300

III. CONCLUSIONS

The Port of Balboa is fully capable of supporting US Military cargo transshipment operations. Although the tidal range limits RORO operations somewhat, the port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table.

Of the transportation subsystems analyzed, the least capable is the staging subsystem. Because of limited space in the port, this system is limited to a mixed throughput capability of 11,000 STON. The analysis used a 3 day dwell time for cargo for staging use. If operators can reduce dwell time to 1 day, then the port's maximum daily throughput would increase to the shipping maximum of 16,400 STON.

Commercial operations taking place concurrently in the port will limit actual daily throughput, sustainable overtime, by an appropriate percentage of the terminal's overall capability.



PORT OF BALBOA
THROUGHPUT SUMMARY
PER DAY CAPABILITY

	BERTH 6	**BERTH 7**	**BERTH 14**	**BERTH 15**	**BERTH 16**	**BERTH 18AB**	**BERTH 18CD**
Length (feet)	742	1,058	775	1,146	742	1,000	1,000
Depth Alongside (feet)	30	36	33	36	33	33	36
Breakbulk Throughput (STON)	700	1,500	900	1,500	900	900	900
RORO Throughput (STON)	2,800	2,800	2,800	2,800	2,800	2,800	2,800
RORO Square Ft (EST)	56,000	56,000	56,000	56,000	56,000	56,000	56,000
RORO Pieces [1]	330	330	330	330	330	330	330
Container Throughput (STON)	0	0	0	1,900	0	0	0
Container Throughput (TEU)	0	0	0	220	0	0	0
Mixed Throughput (STON)	2,200	2,500	2,300	2,500	2,300	2,300	2,300

[1] Based on the 170 square foot per piece average accomplished during Operation Desert Shield and Desert Storm.

PORT OF COCO SOLO
PANAMA

I. General Data
II. Conclusions
Return to Index

I. GENERAL DATA

The Port of Coco Solo is near the Atlantic Ocean entrance to the Panama Canal, on the northeastern shore of Manzanillo Bay, south of Coco Solo Point, at 9^{o} 22’ north latitude and 79^{o} 53’ west longitude. The port is 2.4 kilometers (1.5 miles) east-northeast of the center of Colon and consists of one long finger pier, two small finger piers, and one deteriorated wharf. The facilities provide 1,518 linear meters (4,980 linear feet) of berthing space. The maximum depth of 8 meters (26 feet) mean low water (MLW) severely restricts the types of vessels that may call at the port. No US flag vessels (other than barges) can call here when fully loaded. Some breakbulk ships, less than fully loaded, could be accommodated.

Some cargo vessels (mainly small coastal freighters and fishing vessels) call at the port. The port handles mainly breakbulk and general cargo, although it has the capability to handle a small number of containers (using mobile cranes or ship’s cranes), and starboard slewed-stern-ramp RORO vessels can also be accommodated subject to draft limitations. Cargo operations can be conducted 24 hours per day, and night berthing is permissible.

The port was originally part of the US controlled Coco Solo Naval Station; however, since 1979, the Authoridad Porturaria Nacional (National Port Authority) has been charged with the administration, operation, planning, and coordination of port activities.

TRANSPORTATION ACCESS

Water Access and Harbor Characteristics

Vessels in the Atlantic Ocean destined for the Port of Coco Solo should head for the approach point (9^{o} 26’ 53" north longitude and 79^{o} 55’ 17" west latitude), about 5.6 kilometers (3.5 miles) north of the entrance to Limon Bay. The entrance to Mazanillo Bay is at the east side of Limon Bay and is bordered on the north by a breakwater and on the south by the city of Colon. Channel depths along the entry route vary from 14 meters (46 feet) to 13 meters (42.6 feet) at MLW. The depth alongside Pier 1 ranges from 7.9 meters (26 feet) to 9.1 meters (30 feet) at MLW; however, the draft alongside the rest of the piers is no greater than 4 meters (13 feet) MLW. Average tidal variation is about 1 foot. The port is well protected from waves and swells and no vertical restrictions exist along the approach route or within the harbor.

Highway Access

One terminal gate, referred to as Main Gate, provides access to the port. This gate provides access to all four piers. Another gate, Gate 4, is used only for pedestrian traffic, although it could be opened for vehicular traffic, if required. The Main Gate is manned 24 hours per day.

The Trans-Isthmian Highway (also known as Boyd-Roosevelt Highway) is the main supply route (MSR) serving the port. It originates in Panama City, where it intersects with the Inter-American Highway, and leads north-northwest to Colon, about 80 kilometers (50 miles). The MSR is a bituminous-surfaced roadway, 6 meters wide (20 feet wide), with graveled shoulders.

As theTrans-Isthmian Highway approaches Colon in a westerly direction, it forms a four-leg, signal-controlled intersection with Randolph Road. The access route to the port is north on Randolph Road to Fulton Road, 3.9 kilometers (2.4 miles), and then southwest on Fulton Road until it reaches the dead end, less than 0.5 kilometer (0.3 mile). Turning right, heading north of Johnston Avenue (about four blocks), will lead to the Main Gate.

Railroad Access

The Port of Coco Solo is not served by rail.

Airports

The Nuevo France Airfield, operated by the Direcion de Aeronautica Civil (DAC), is 1.9 kilometers (1.2 miles) southeast of the port.

PORT FACILITIES

Berthing

Berthing at the port includes 1,518 meters (4,980 linear feet) of wharfage. This wharfage provides 10 berths for small, shallow-draft vessels. The beths are designated Piers 1 (south and west), 2, 3, and 4 (which is deteriorated beyond use).

BERTH CHARACTERISTICS FOR COCO SOLO

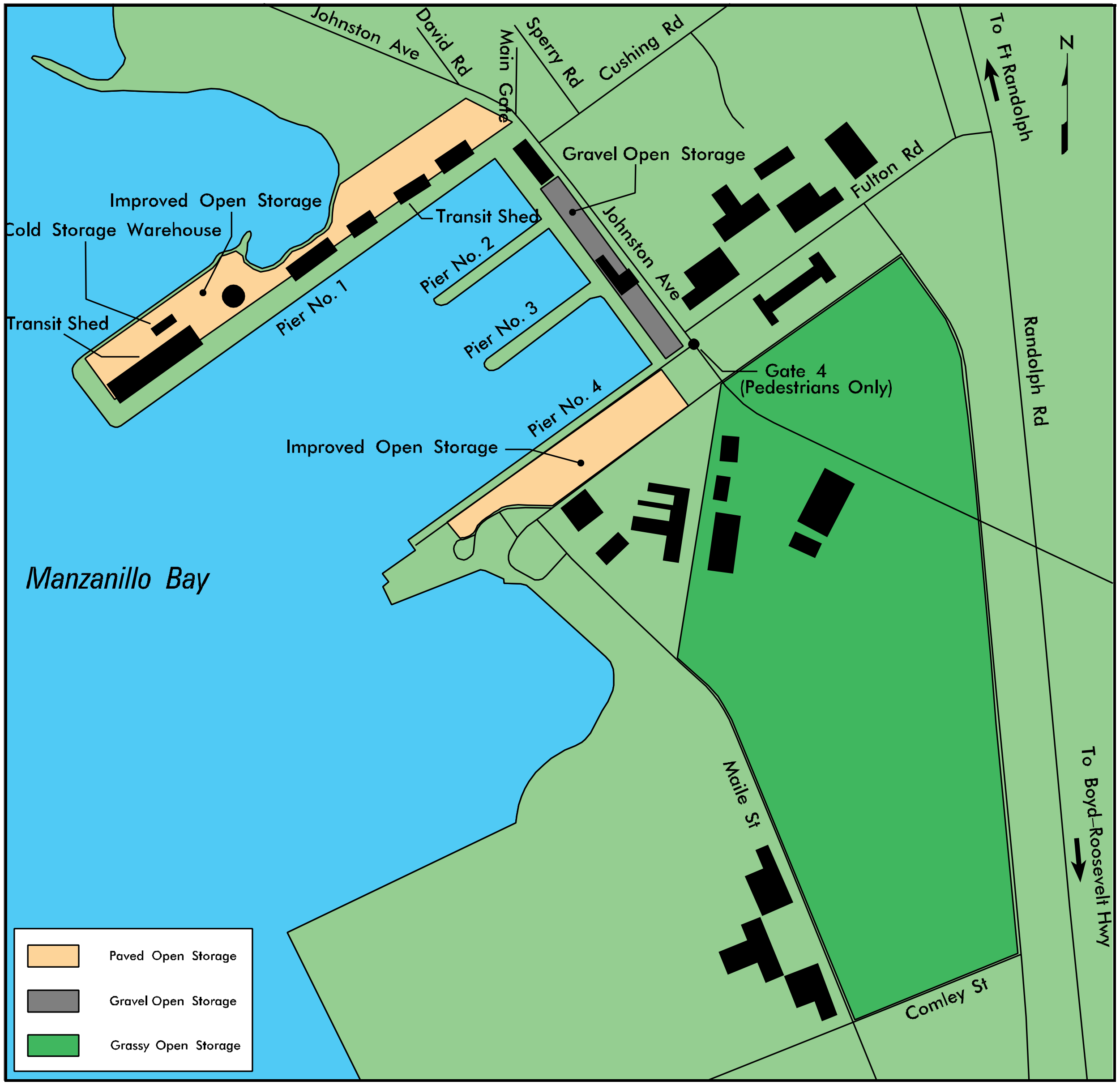
	BERTHS			
Characteristics	**Pier 1S**	**Pier 1 W**	**Pier 2**	**Pier 3**
Length (ft)	1,665	285	480	480
Depth alongside at MLW (ft)	26	30	13	13
Deck strength (psf)	400	400	250	250
Apron width (ft)	33	16	31	31
Apron height above MLW (ft)	11	11	11	11
Number of container cranes	0	0	0	0
Number of wharf cranes	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	No	No	No
Apron length served by rail (ft)	0	0	0	0

Pier 1, a finger pier, can accommodate ships at three berths on its south side and at one on its west side. The north side of the pier cannot handle vessels, because of obstructions in the water alongside. Since Pier 1 has the greatest depth alongside (26 feet MLW), it is the pier most frequently used by small cargo vessels. Three transit sheds are along the length of the pier, and the pier is well suited for breakbulk vessel or barge operations. The pier can accommodate small, self-sustaining vessels and non-self-sustaining vessels using mobile cranes to handle cargo.

Piers 2 and 3, small finger piers, can berth vessels on their north and south sides. Because of their shallow alongside depths (13 feet MLW), the piers are used mainly by fishing boats. The only cargo operations that could be conducted here are limited barge operations, which would require using mobile cranes to load and discharge cargo.

Pier 4, a marginal wharf, can handle only small vessels. Its alongside depth is 4 meters (13 feet) MLW, so this pier is used mainly by fishing boats. This wharf is in extremely poor condition and is not recommended for use, in fact, the southern end has already collapsed and fallen into the water.

All piers are lighted for night operations, and electricity and water are available on Pier 1.


Johnston Ave
David Rd
Main Gate
Sperry Rd
Cushing Rd
To Ft Randolph
N
Gravel Open Storage
Fulton Rd
Improved Open Storage
Cold Storage Warehouse
Transit Shed
Pier No. 2
Johnston Ave
Pier No. 1
Transit Shed
Pier No. 3
Randolph Rd
Gate 4
(Pedestrians Only)
Pier No. 4
Improved Open Storage
Manzanillo Bay
Maile St
To Boyd–Roosevelt Hwy
Comley St
Paved Open Storage
Gravel Open Storage
Grassy Open Storage

Site Map

Port of Coco Solo

Staging

Open Staging - An estimated 31,000 square meters (333,500 square feet) of open staging serve Piers 1 through 4; however, this will soon change with the construction of a new container terminal. See future development section for more information.

Covered Staging - Three privately owned transit sheds on Pier 1 provide about 4,240 square meters (45,600 square feet) of covered storage. All three buildings are in poor condition. These facilities will no longer be available once the Evergreen Corporation begins construction of the new container terminal.

Highway

Main Gate provides truck access to the port. The roadways leading to this gate pass through an abandon residential area and passage is somewhat difficult.

Most truck-loading operations are conducted near the transit sheds located on Pier 1. An abandoned, unusable cold storage warehouse, is on the north side of Pier 1, and has truck-level docks along each side of the building that can still be used. They are the only truck-level docks in the port complex. Coco Solo has no portable truck ramps.

MARSHALING AREAS

About 39,900 square meters (43,000 square feet) of open staging is available three blocks southeast of the port, in the grass fields, surrounding the abandoned Cristobal High School.

MATERIALS HANDLING EQUIPMENT (MHE)

The National Port Authority (Autoridad Portuaria Nacional) owns only one forklift. All other MHE must be provided by the shipper or procured from local sources.

SECURITY

The entire port complex is surrounded by a 10-foot barrier consisting of an 8-foot chain link fence topped by three strands of barbed wire. This fence is not lighted. Access to the port complex is controlled by armed guards at the Main Gate. Guards also periodically patrol the port complex.

SUPPORT SERVICES

Pilotage

Although not required for most of the vessels entering the Port of Coco Solo, pilotage is compulsory for vessels larger than 150 gross-registered tons. The Panama Canal Commission (PCC) employs 240 pilots, who assist vessels transiting the canal or entering the ports in the canal area. On the Atlantic Ocean side of the canal, the PCC operates 13 pilot boats. Pilot service is available 24 hours per day, and night berthing at the port is permissible.

Harbor Craft

Two commercially operated tugboats, each rated at 2,400 horsepower are based in the Port of Cristobal and are available for berthing or barge operations at the Port of Coco Solo. The PCC also operates a number of tugs to assist vessels in passing through the locks; however, these tugs are unavailable for normal port operations.

FUTURE DEVELOPMENTS

The Evergreen Corporation has plans to fund the demolition of Piers 1 and 2 and replace them with a new wharf. After construction, Evergreen will operate the new facilities as a modern container terminal much the same as Manzanillo International Terminal, 1 mile away. This new container terminal will accommodate deep draft vessels with about 12 meters (40 feet) of water alongside. The berth is planned to be 612 meters long (2,008 feet long) with an open apron and staging for container transfer operations. Estimated completion date for this new terminal is mid-1998.

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

Only very limited hazardous cargo operations are permitted at Coco Solo. The port's proximity to large civilian population centers prevent the port from performing explosive ammunition operations.

II. CONCLUSIONS

PORT OPERATIONS

The Port of Coco Solo is not capable of supporting US Military cargo transshipment operations. The port cannot accommodate US flag RORO, container, or breakbulk vessels, when fully loaded, because of insufficient depths within the port.

Pier 1, however, is well suited for breakbulk operations involving some less than fully loaded breakbulk ships. Pier 1 has three transit sheds along its apron for general cargo.

LASH and SEABEE barges could be discharged at any of the berths in this port. However, the mother ship would have to be moored at anchorage D, in Limon Bay, and tugs would be required to transport the barges to and from piers 2.2 kilometers (1.4 miles) away. Mobile cranes for discharging the barges would have to be procured from local sources because the port has none.

FUTURE OPERATIONS

The Port of Coco Solo will soon be unavailable for any military operation, while the Evergreen Corporation moves forward with its plans to construct a new modern container terminal. The new facilities will replace the existing Piers 1 and 2 with a new wharf. This new container terminal will accommodate deep draft vessels with about 12 meters (40 feet) of water alongside, and a 612 meters long (2,008 feet long) berth with an open apron for container transfer operations.

SAFETY CONSIDERATIONS

The Port of Coco Solo is surrounded by populated and developed areas. Many of these areas fall within the 940-meter (3,150-foot) quantity-distance arc established for the net explosive weight (NEW) carried on a LASH barge loaded with ammunition. Based on these considerations, ammunition barges should not be discharged at the Port of Coco Solo.

PORT OF CRISTOBAL
PANAMA

I. General Data
II. Throughput Analysis
III. Conclusion
Return to Index

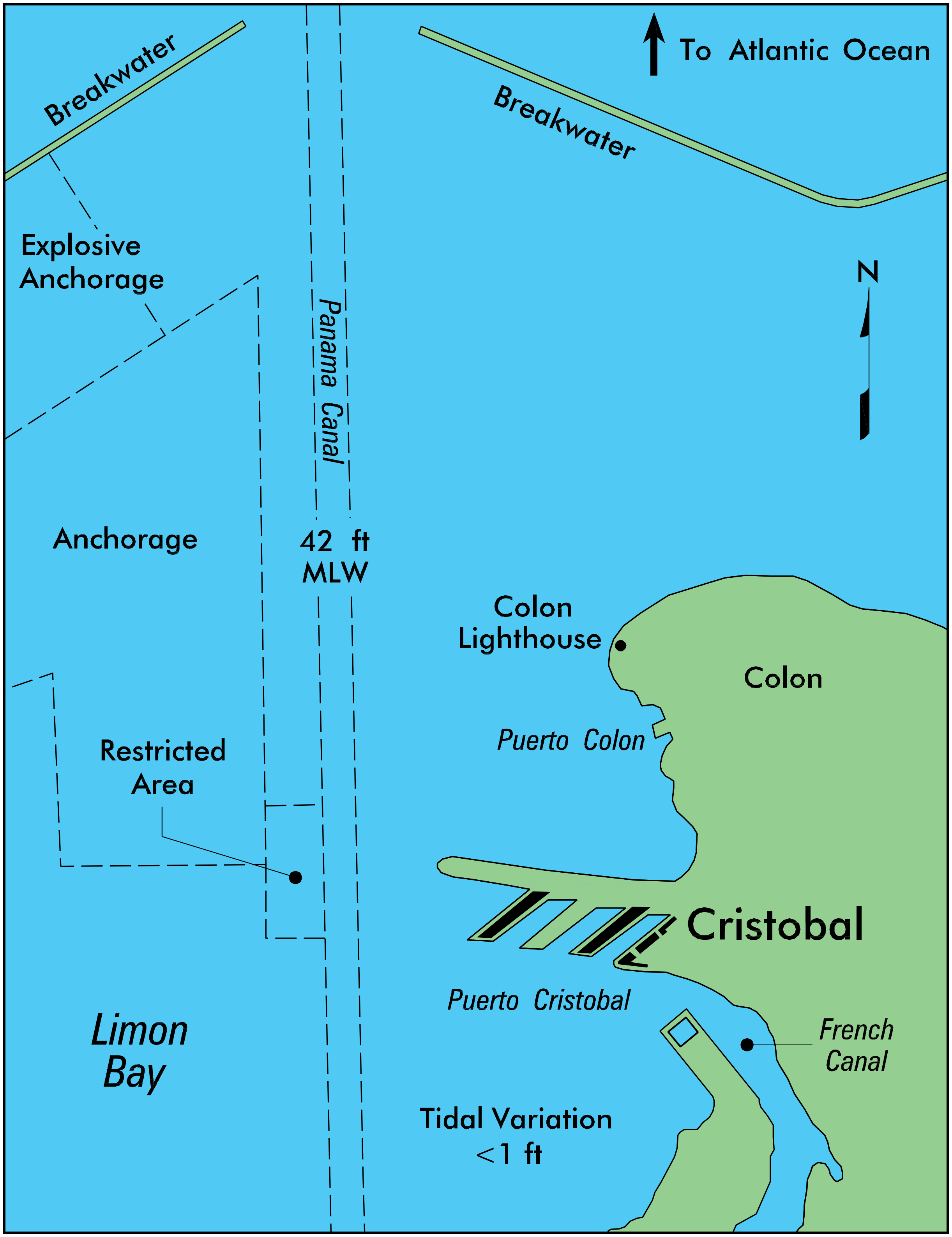
I. GENERAL DATA

Cristobal is the largest and busiest of the Panama National Port Authority (Autoridad Portuario Nacional) operated ports. The port handles a wide variety of vessels and cargos, and is the only NPA operated port with a significant container capability. Cristobal was constructed between 1914 and 1919 by the Panama Canal Company. They operated the port as part of the US administered Canal Zone until 1979.

TRANSPORTATION ACCESS

Water

The Port of Cristobal (Latitude 09° 21' North, Long. 79° 55' West) is at the Atlantic Ocean entrance to the Panama Canal. The port is on Limon Bay, just off the east side of the canal entrance channel, adjacent to the city of Colon. Cristobal Harbor, a small breakwater protected harbor shelters the port from the open sea. The port harbor is accessed directly from the Panama Canal. The access channel has a minimum depth of about 42 feet, mean low water (MLW) and is 302 feet wide. The Panama Canal Commision dredges maintain the channel depths, the National Port Authority maintains the port harbor. There are no vertical obstructions that restrict access to the channel or harbor. Vessels can access the port 24 hours a day, although pilots are mandatory for vessels exceeding 150 GRT. Night berthing is permitted.



Cristobal Access Channel

Tides in the port area range from 9 to 12 inches. The mean high water interval is about 5 hours and 45 minutes.

Anchorage areas located in the Carribean Sea at the entrance to the Canal offer accomodation to a large number of vessels. Other anchorages within the breakwaters provide additional holding area. These are generally over very good holding ground and separate areas are designated for vessels with explosive cargos.

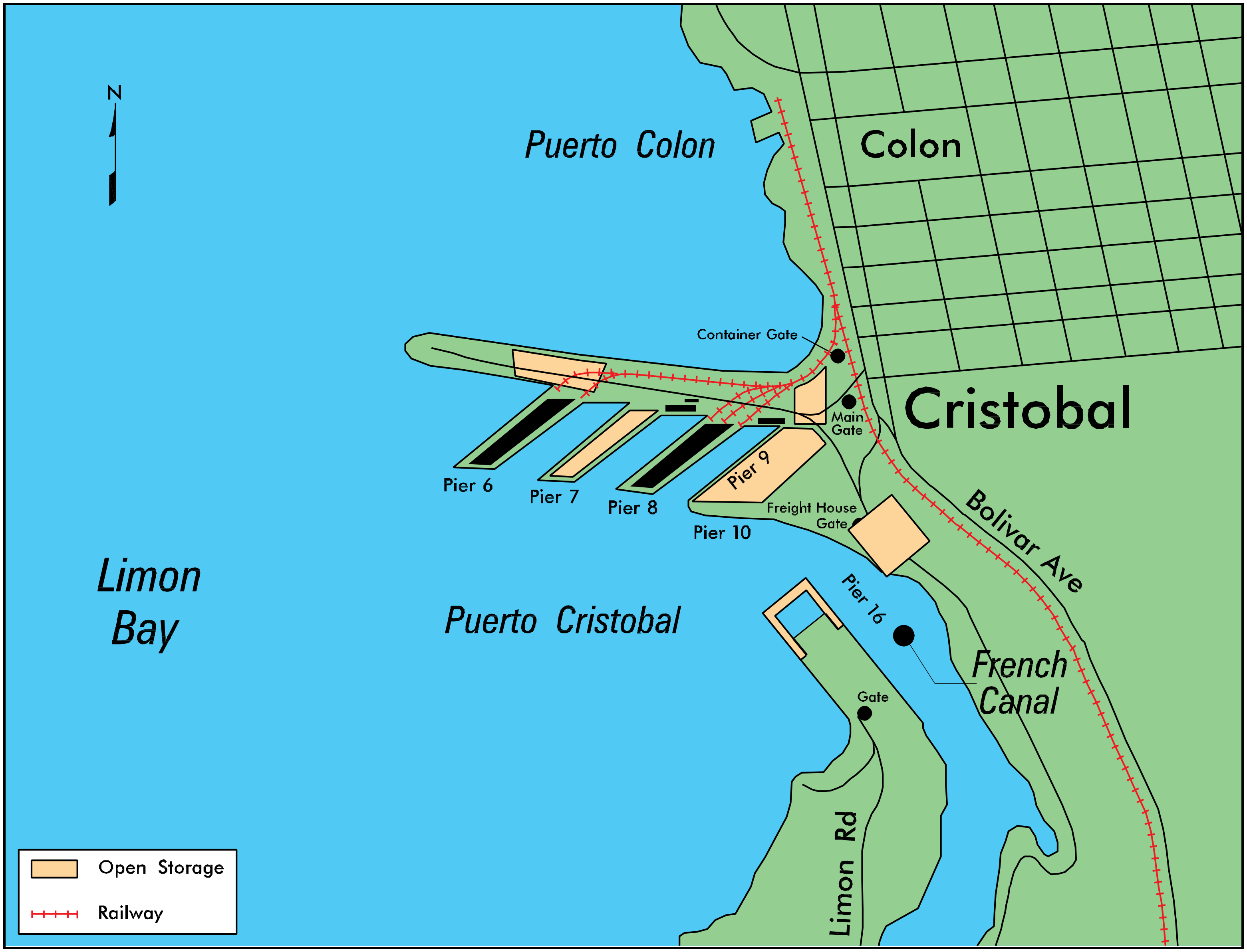
Highway

The Port Terminal of Cristobal is located in the town of Colon. Vehicular traffic at the port is handled by four terminal gates. These are known as: the Main Gate; the Container Gate; the Freight House Gate; and the Pier 16 Gate. The Main Gate provides access to all terminal areas except Pier 16. All four gates are manned around the clock.

The three gates into the main terminal area connect via Bolivar Avenue/Highway with the street network in Colon (13th Street to Terminal Street for the Main Gate, same route, but south on Market off Terminal Street to the Container Gate, and similarly except turn east off of Market on to Tobago Street for the Freight House Gate). The Pier 16 Gate is accessed by via Randolf Road to Limon Road. Bolivar Highway connects with the Trans-Isthmian Highway.

The Trans-Isthmian Highway is the principal route connecting Cristobal and Colon to the rest of the nation. The highway, formerly known as the Boyd-Roosevelt Highway, runs north-south, roughly paralleling the former Canal Zone, between Panama City on the Pacific side and Colon on the Atlantic side.

Container Gate



Site Map for Port of Cristobal

A growing Panamanian nationalism is leading to name changes for many of the old Canal Zone's streets and avenues. Its possible that some of the access roads mentioned above will likewise undergo name changes in the future.

Rail

The Panama National Railroad connects the port to the railway system. However, due to the poor condition of the line, first reported on by MTMCTEA in Report SE 86-3a-27 (app H), military authorities in the USSOUTHCOM have directed that the line not be used to support military operations. Therefore, rail capability for the Port of Cristobal is not analyzed.

PORT FACILITIES

Berthing

The Port of Cristobal has 14 berthing areas of varying length totaling 10,846 feet in overall length. Berths are designated: Piers 6AB, 6CD, 6E, 7AB, 7CD, 7E, 8AB, 8CD, 8E, 9AB, 10, 16AB, 16 CD and 16E. These range in length from 230 feet (Pier 6E) to 1,070 feet (Pier 16AB) long. Most of the berths are on finger piers (Piers 6, 7, 8, and 16). Piers 9 and 10 are marginal wharves.

Depth alongside the berths at MLW is 42 feet. The berths are open except for those at Piers 6 and 8. These piers are of traditional breakbulk construction type with narrow aprons and large transit sheds. The berths at Cristobal can support all types of cargo operations.

The berth at Pier 9 is the most capable and desireable for supporting military port operations. This is the only berth with sufficient length, water depth, open apron, and staging area that can accomodate vessels like the FSS and LMSR. While these large vessels may berth at some of the other piers, accomodations at those sites don't offer the same operational capability as Pier 9. This is also the port's primary container berth, and is served by two 40-ton gantry cranes. The Pier 16 berths are the next best.

Berth 9

The four "E" designated berths, the ends of the piers, and Pier 10 have too short a length to offer accomodation to anything other than barges or small coaster type vessels.

BERTH CHARACTERISTICS FOR PORT OF CRISTOBAL

	BERTHS									
CHARACTERISTICS	**Pier 6AB**	**Pier 6CD**	**Pier 7AB**	**Pier 7CD**	**Pier 8AB**	**Pier 8CD**	**Pier 9**	**Pier 10**	**Pier 16AB**	**Pier 16CD**
Length (ft)	1,030	1,030	977	1,000	990	1,010	1,068	423	1,070	1,070
Depth alongside at MLW (ft)	42	42	42	42	42	42	42	42	42	42
Deck Strength (psf)	750	750	750	750	750	750	1,000	1,000	750	750
Apron width (ft)	22	22	26	26	25	25	Open	Open	75	80
Apron height above MLW (ft)	13.17	13.17	13.17	13.17	10.33	10.33	10.33	10.5	10.67	10.67
Number of container cranes	0	0	0	0	0	0	2	0	0	0
Number of wharf cranes	0	0	0	0	0	0	2	0	0	0
Apron Lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No	No	No	No	No	No	No	No
Apron length served by rail (ft)	No	1,030	977	No	990	1,010	No	No	No	No

Piers 6,7,8,and 16 all have a berth on the end of the pier. These berths are designated “E” berths. All “E” berths are too short to accomodate all but the smallest of vessels and barges. Berth 10 is likewise too short for berthing These berths are not included in the Berthing Capabilities summary tables that follow.

Berths 6, 7, and 8

Berth 16

PORT OF CRISTOBAL
SUMMARY OF BERTHING CAPABILITIES

VESSELL		BERTHS							
TYPE	**CLASS**	**PIER 6AB**	**PIER 6CD**	**PIER 7AB**	**PIER 7CD**	**PIER 8AB**	**PIER 8CD**	**PIER 9**	
BREAKBULK	C3-S-38a	1	1	1	1	1	1	2	**NOTES:**
	C4-S-58a	1	1	1	1	1	1	1	a-vessel draft limit
	C4-S-66a	1	1	1	1	1	1	1	b-inadequate apron width
	C5-S-37e	1	1	1	1	1	1	1	c-inadequate berth length
									d-no straight stern ramp
SEATRAIN	GA and PR	1	1	1	1	1	1	1	e-no container handling equipment
									f-anchorage depth OK, berth depth
BARGE	LASH C8-S-81b	1	1	1	1	1	1	1	inadequate
	LASH C9-S-81d	1	1	1	1	1	1	1	g-inadequate channel depth
	LASH Lighter	5	5	4	5	4	5	5	h-no shore based ramps
	SEABEE C8-S-82a	1	1	1	1	1	1	1	i-low tide insufficient ramp clearance
	SEABEE Barge	5	5	4	5	4	5	5	j-high tide insufficient ramp clearance
									m-excessive ramp angle high tide
RORO	COMET	1,d,o	1,d,o	1,d,o	1d,o	1d,o	1,d,o	2,d,i,j	n-parallel ramp operation ONLY
	METEOR	1,d,o	1,d,o	1,d,o	1d,o	1d,o	1,d,o	1,d,i,j	o-insufficient apron width for side ramp
	Cape Gnome	1,d,o	1,d,o	1,d,o	1d,o	1d,o	1,d,o	1,d,i,j	
	C7-S-95A	1,b	1,b	1,b	1,b	1,b	1,b	1	
	Cape Taylor	1,b	1,b	1,b	1,b	1,b	1,b	1	
	Cape Orlando	1,b	1,b	1,b	1,b	1,b	1,b	1,i,j	
	MV Ambassador	1,d	1,d	1,d	1,b	1,b	1,b	1,d	Ramp clearance and angle based on
	Callaghan	1,d,o	1,d,o	1,d,o	1,d,o	1,d,o	1,d,o	1,d,i	maximum vessel draft
	Cpae Lambert	1,b	1,b	1,b	1,b	1,b	1,b	1,i,j	
	LMSR Class	1,b	1,b	1,b	1,b	1,b	1,b	1	
	FSS	1,b	1,b	1,b	1,b	1,b	1,b	1	
	Cape E-Class	1,b	1,b	1,b	1,b	1,b	1,b	1,i,j	**May Prevent Operation**
	Cape D-Class	1,b	1,b	1,b	1,b	1,b	1,b	1,i,j	
	Cape H	1,b	1,b	1,b	1,b	1,b	1,b	1	**May Limit Operation**

PORT OF CRISTOBAL
SUMMARY OF BERTHING CAPABILITIES - cont'd

VESSELS		BERTHS							
TYPE	**CLASS**	**PIER 6AB**	**PIER 6CD**	**PIER 7AB**	**PIER 7CD**	**PIER 8AB**	**PIER 8CD**	**PIER 9**	**NOTES:**
RORO	Cape Texas	1,b	1,b	1,b	1,	1,b	1,	1,i,j	a-vessel draft limit
	Cape R	1,b,d,o	1,b,d,o	1,b,d,o	1,b,d,o	1,b,d,o	1,b,d,o	1,d	b-inadequate apron width
	Cape I-class	1,b	1,b	1,b	1,b	1,b	1,b	1,i,j	c-inadequate berth length
	Cape Victory	1,b	1,b	1,b	1,b	1,b	1,b	1,i,j	d-no straight stern ramp
									e-no container handling equipment
CONTAINER	C6-M-147a	1,b,e	1,b,e	1,b,e	1,b,e	1,b,e	1,b,e	1	f-anchorage depth OK, berth depth
	C7-S-69c	1,b,e	1,b,e	1,b,e	1,b,e	1,b,e	1,b,e	1	inadequate
	C7-S-68c	1,b,e	1,b,e	1,b,e	1,b,e	1,b,e	1,b,e	1	g-inadequate channel depth
	C8-S-85c	1,b,e	1,b,e	1,b,e	1,b,e	1,b,e	1,b,e	1	h-no shore based ramps
	C9-M-132b	1,b,e	1,b,e	1,b,e	1,b,e	1,b,e	1,b,e	1	i-low tide insufficient ramp clearance
	C9-M-F141a	1,b,e	1,b,e	1,b,e	1,b,e	1,b,e	1,b,e	1	j-high tide insufficient ramp clearance
									k-excessive ramp angle low tide
TACS	C6-S-1qd	1,b	1,b	1,b	1,b	1,b	1,b	1	m-excessive ramp angle high tide
	C5-S-MA73c	1,b	1,b	1,b	1,b	1,b	1,b	1	n-parallel ramp operation ONLY
	C6-S-MA60d	1,b	1,b	1,b	1,b	1,b	1,b	1	o-insufficient apron width for side ramp
MPS	C7-S-133a	1,b	1,b	1,b	1,b	1,b	1,b	1	
	Maersk	1,b	1,b	1,b	1,b	1,b	1,b	1	
	AmSea	1,b	1,b	1,b	1,b	1,b	1,b	1	Ramp clearance based on
									maximum vessel draft

NOTE: Vessels showing a berthing limitation due to no available straight stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight stern

May Prevent Operation

May Limit Operation

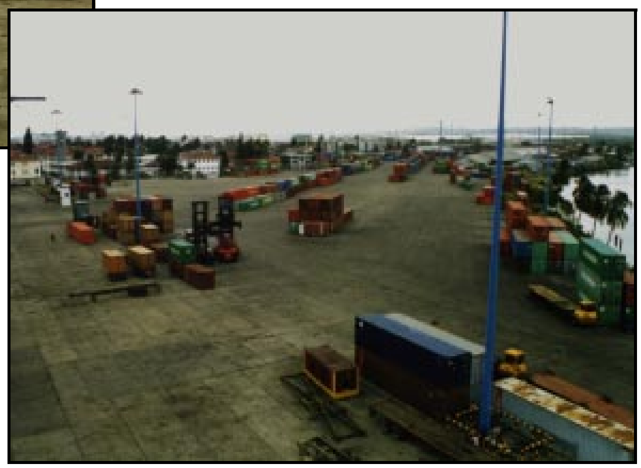
PORT OF CRISTOBAL
SUMMARY OF BERTHING CAPABILITIES - cont'd

VESSELS		BERTHS		
TYPE	**CLASS**	**PIER 16AB**	**PIER 16CD**	
BREAKBULK	C3-S-38a	2	2	**NOTES:**
	C4-S-58a	1	1	a-vessel draft limit
	C4-S-66a	1	1	b-inadequate apron width
	C5-S-37e	1	1	c-inadequate berth length
				d-no straight stern ramp
SEATRAIN	GA and PR	1	1	e-no container handling equipment
				f-anchorage depth OK, berth depth
BARGE	LASH C8-S-81b	1	1	inadequate
	LASH C9-S-81d	1	1	g-inadequate channel depth
	LASH Lighter	5	5	h-no shore based ramps
	SEABEE C8-S-82a	1	1	i-low tide insufficient ramp clearance
	SEABEE Barge	5	5	j-high tide insufficient ramp clearance
				m-excessive ramp angle high tide
RORO	COMET	2d,i,j	2d,i,j	n-parallel ramp operation ONLY
	METEOR	1d,o	1d,o	o-insufficient apron width for side ramp
	Cape Gnome	1d,i,j	1d,i,j	
	C7-S-95A	1	1	
	Cape Taylor	1	1	
	Cape Orlando	1i,j	1i,j	
	MV Ambassador	1d	1d	Ramp clearance and angle based on
	Callaghan	1d,o	1d,o	maximum vessel draft
	Cpae Lambert	1i,j	1i,j	
	LMSR Class	1	1	
	FSS	1	1	**May Prevent Operation**
	Cape E-Class	1i,j	1i,j	**May Limit Operation**
	Cape D-Class	1i,j	1i,j	
	Cape H	1	1	
	Cape Texas	1i,j	1i,j	
	Cape R	1d	1d	
	Cape I-class	1i,j	1i,j	
	Cape Victory	1i	1i	
CONTAINER	C6-M-147a	1e	1e	
	C7-S-69c	1e	1e	
	C7-S-68c	1e	1e	
	C8-S-85c	1e	1e	
	C9-M-132b	1e	1e	
	C9-M-F141a	1e	1e	
TACS	C6-S-1qd	1	1	
	C5-S-MA73c	1	1	
	C6-S-MA60d	1	1	
MPS	C7-S-133a	1	1	
	Maersk	1	1	
	AmSea	1	1	

Staging

Open Staging - The Port of Cristobal has about 23 acres of open staging available for use. This area is distributed throughout the port area, with three areas making up the most. These areas are all paved and well lighted. Most of the space, about 18 acres, is adjacent to and supports the Pier 9 and 10 area with container storage.

Pier 7 - Open Staging



Open Staging - Pier 9 and 10

Covered Staging - Cristobal is well served by covered storage areas. Large transit sheds and warehouses at Piers 6 and 8 are the primary covered staging locations within the port area. These buildings provide about 150,255 and 148,770 SQFT of covered staging area respectively in support of the berths at the two piers.. Another building, the Freighthouse, provides an additional 65,768 SQFT. This building supports the rest of the terminal with covered staging.

Covered Staging

Rail

Although linked to the Panama National Railroad, this analysis doesn't address the capability of the port's railway connections. The railroad's maintenance condition as previously discussed makes it unusable for supporting military deployment requirements.

Highway

Highway access to the terminal's four gates is via the congested city streets of Colon. The city streets connect with the Trans-isthmian Highway via the Bolivar Highway/Avenue.

Unloading/loading Positions

Ramps And Docks \- The only truck docks in the Port of Cristobal are located at the Freight-house. This area's docks could support loading and unloading of as many as 44 trucks. There are no permanent (there is one light duty portable) truck loading/unloading end ramps in the terminal. A 30-STON Mobile crane and several high capacity forklifts and container handlers could support lift on/off of cargo arriving or departing by flatbed truck.

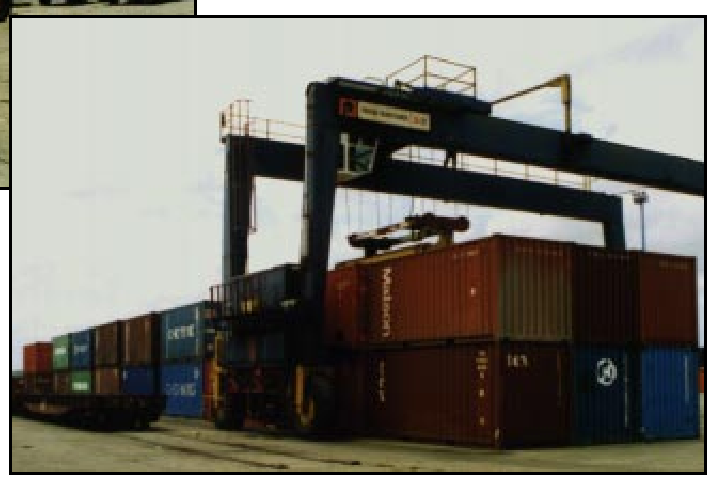
MARSHALING AREAS

No marshaling areas support the port directly.

MATERIALS HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity (STON)	Quantity	Wharf Assignment
Container Cranes	40	2	Pier 9
Wharf Cranes		None	
Rail-Mounted Gantry Cranes		None	
Rubber Tired Transtainers	30	2	Piers 9 and 10
Container Handler/Stacker	40+ 30	4 2	Piers 9 and 10
Mobile Cranes	30	1	Terminal Area
Forklifts	2-4 8 10 16	24 1 1 1	Terminal Area Terminal Area Terminal Area Terminal Area
NOTE: The table above represents equipment owned by the port. Port operators indicate that they lease or rent other equipment as required from local suppliers. The list is not "all inclusive" as actual totals may change.			

Container Handler



Transtainer

FUTURE DEVELOPMENT

Port management stated that they had limited plans for future development due to the possibility of the terminal operation becoming privatized in the future.

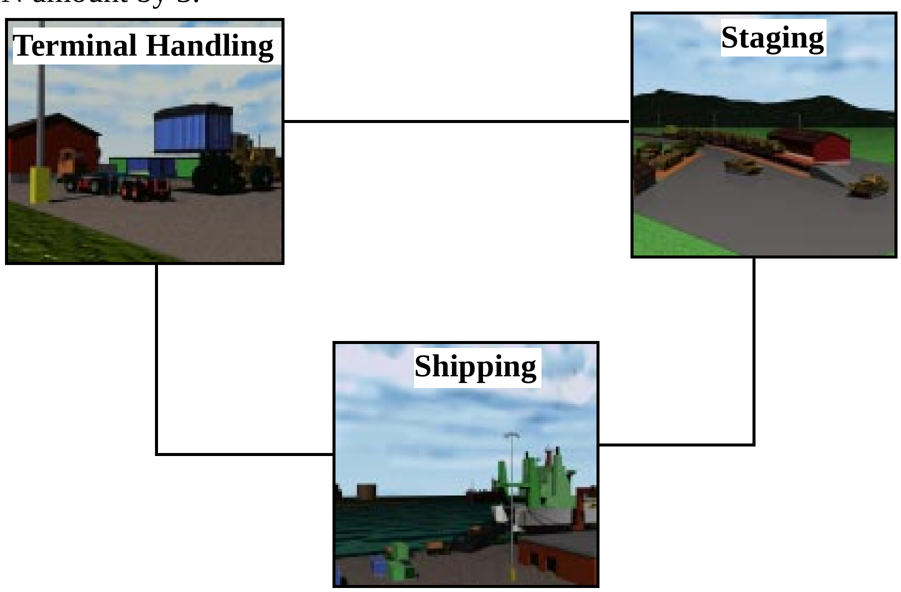
EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

Only very limited hazardous cargo operations are permitted at Cristobal. The port’s proximity to large civilian population centers prevent the port from consideration for explosive ammunition operations.

II. THROUGHPUT ANALYSIS

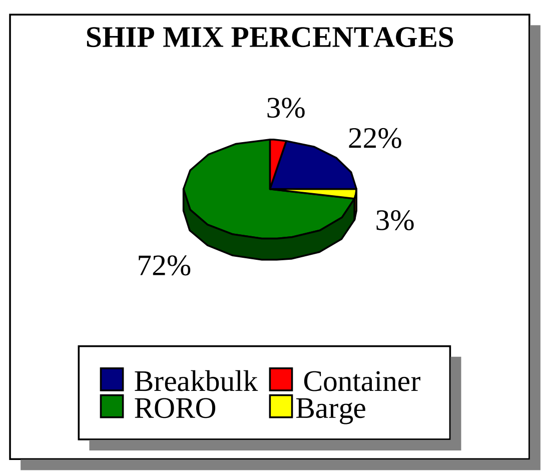
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Cristobal. The POPS model uses a weak link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of short tons (STON) and measurement tons (MTON) per day. The charts in this section show the throughput yields in STONs. Approximate MTON yields can be computed by multiplying the STON amount by 3.



Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 80 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occured during Operations Desert Shield and Desert Storm. Thes data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

Highway

The port is connected to the highway network by four gates and several streets/roads that all connect or provide access to the Trans-Isthmian Highway.

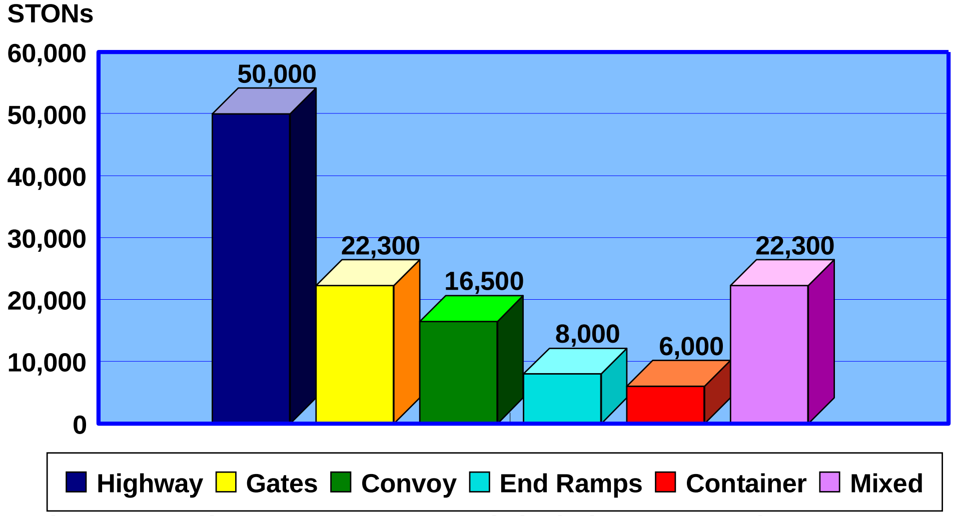
The routes into and out of the port complex can handle well over 100,000 STON of equipment and supplies daily. The four gate processing systems can handle more than 34,250 STONs of cargo per day.

Roadable vehicles will move through the terminal gates in manageable convoys from staging areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a self loading capability, will use the truck docks at the Freighthouse and end ramps either fabricated or procured locally. There is one lightweight mobile end ramp available in the terminal. No other loading sites are available in the port. These locations can handle about 11,200 STON (8,000 STON at the main terminal and 3,200 STON at the Pier 16 area) of military cargo per day.

The port has 4 reach stacker 40-ton container handlers and 2 30-ton container handlers. If we assume 50 percent availability for container chassis operations, the port can handle about 6,000 STON of containers daily (about 750 boxes). This assumes a conservative 250 moves per handler per day.

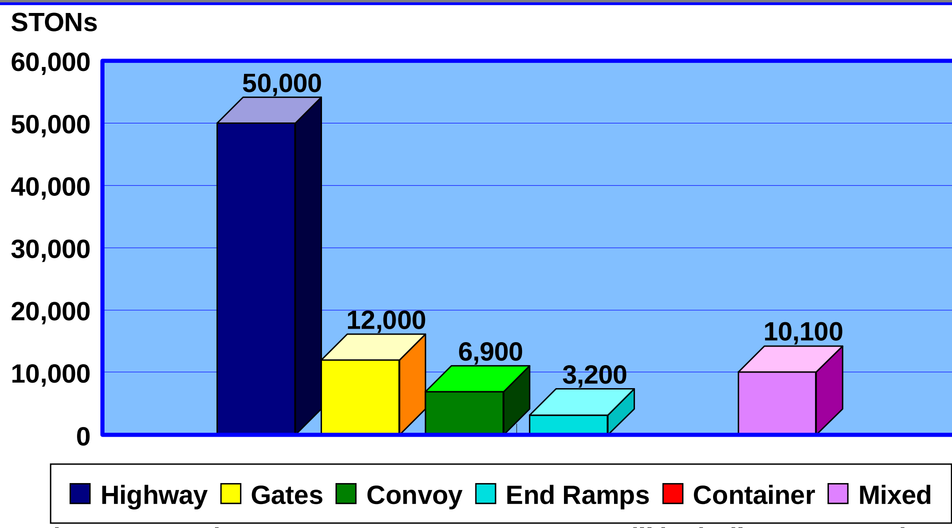
Maximum daily handling capability for the port is a mixed total of 32,300 STONs.

Port of Cristobal
Highway Clearance and Handling Capability



End ramp capacity assumes 5 ramps will be built or procured.

Port of Cristobal
Highway Clearance and Handling Capability for Pier 16



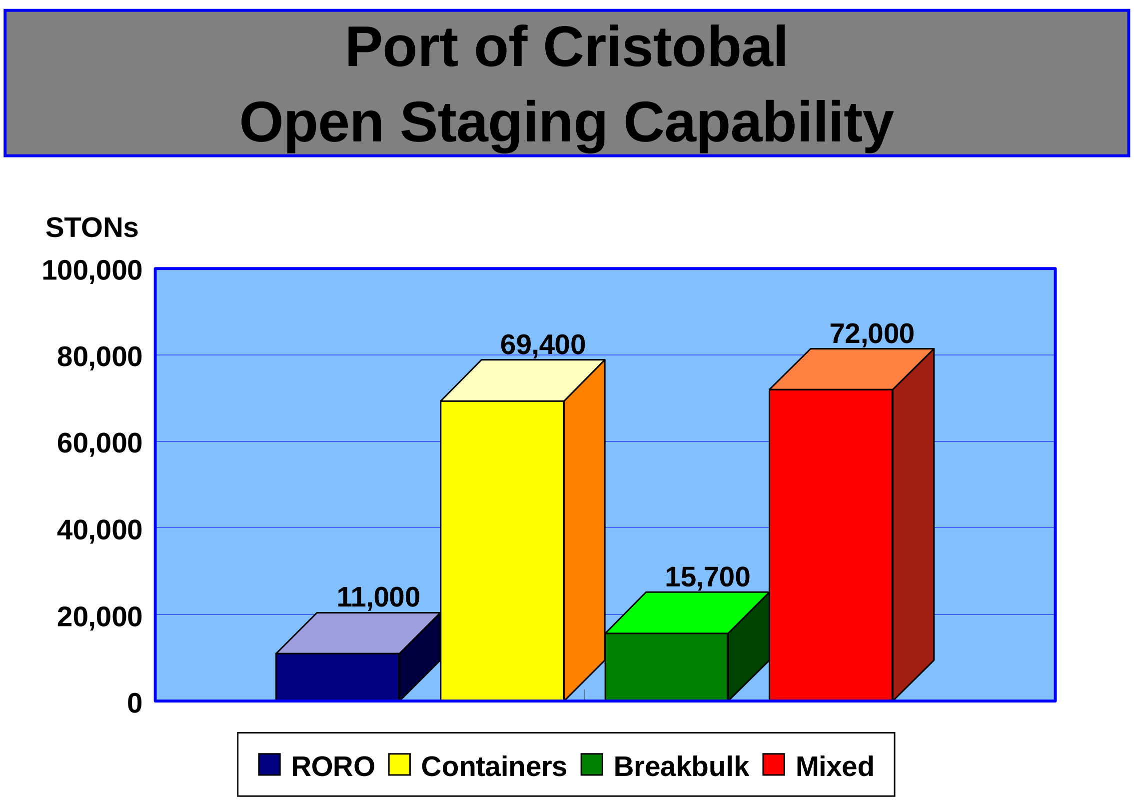
End ramp capacity assumes 2 temporary ramps will be built or procured.

Staging

The port has about 23 acres of suitable open staging area. This is distributed throughout the terminal area, with a significant portion located adjacent to the berths at Piers 9 and 10. The port can stage about 72,000 STON of mixed cargo. Availability of the staging area will vary with work at the port. Port operators assured the survey team that space can be freed up to support military operations fairly quickly. Nevertheless, under normal operational expectations, staging availability could limit operations.

The port has about 365,000 square feet of covered storage space. Like the open area, much of this is subject to storing breakbulk cargo moving through the port. However, covered space availability will not limit throughput at the port. About 12,000 STON of breakbulk cargo can be staged in the covered area.

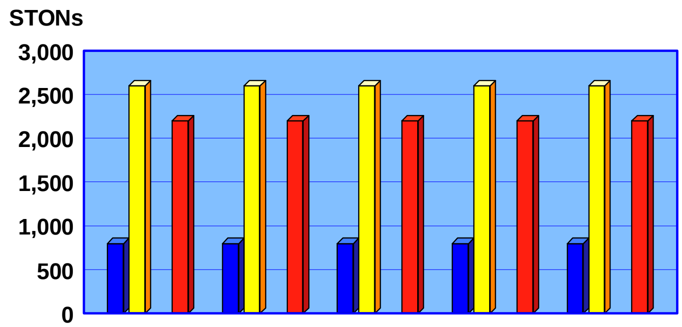
The chart shows the use of the distributed storage and staging space in the port by demonstrating the amounts by type of the cargo that can be stored there. This analysis assumed a usable space availability of 70 percent of the total area.



Shipping

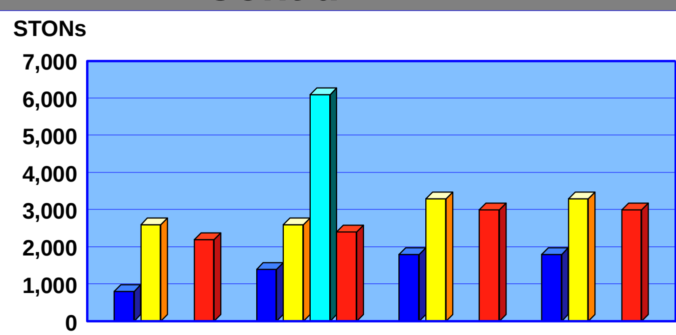
Daily shipping subsystem totals for the terminals berths are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types. Assumptions and parameter values used to calculate these are shown in appendix.

Port of Cristobal
Berth Throughput Capability



	Pier 6AB	Pier 6 CD	Pier 7AB	Pier 7CD	Pier 8AB
Breakbulk/Barge	800	800	800	800	800
RORO	2,600	2,600	2,600	2,600	2,600
Container	0	0	0	0	0
Mixed	2,200	2,200	2,200	2,200	2,200

Port of Cristobal
Berth Throughput Capability
Cont'd

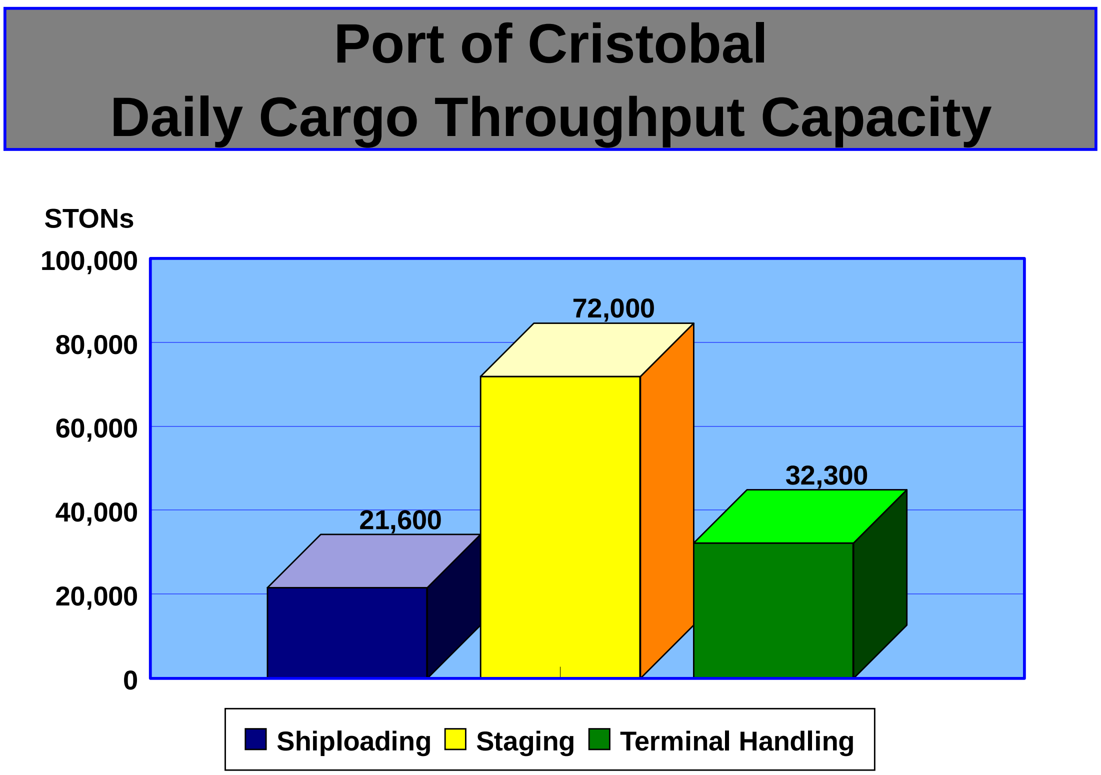


	Pier 8CD	Pier 9	Pier 16AB	Pier 16CD
Breakbulk/Barge	800	1,400	1,800	1,800
RORO	2,600	2,600	3,300	3,300
Container	0	6,100	0	0
Mixed	2,200	2,400	3,000	3,000

III. CONCLUSIONS

The Port of Cristobal is fully capable of supporting US Military cargo transshipment operations. The port can accomodate vessels as lage as the LMSR and FSS as shown in the Berthing Characteristics Table.

Of the transportation subsystems analyzed, the least capable is the shiploading subsystem. The port system has a mixed throughput capability of 21,600 STON.



Commercial operations taking place concurrently in the port will limit actual daily throughput, sustainable over time, by an appropriate percentage of the terminal's overall capability.

PORT OF CRISTOBAL
THROUGHPUT SUMMARY
PER DAY CAPABILITY

	PIER 6AB	PIER 6CD	PIER 7AB	PIER 7CD	PIER 8AB	PIER 8CD	PIER 9	PIER 16AB	PIER 16CD
Length (feet)	1,030	1,030	977	1,000	990	1,010	1,068	1,070	1,070
Depth Alongside feet)	42	42	42	42	42	42	42	42	42
Breakbulk Throughput (STON)	800	800	800	800	800	800	1,400	1,800	1,800
RORO Throughput (STON)	2,600	2,600	2,600	2,600	2,600	2,600	2,600	3,300	3,300
RORO Square Ft (EST)	52,000	52,000	52,000	52,000	52,000	52,000	52,000	66,000	66,000
RORO Pieces [1]	306	306	306	306	306	306	306	388	388
Container Throughput (STON)	0	0	0	0	0	0	6,100	0	0
Container Throughput (TEU)	0	0	0	0	0	0	700	0	0
Mixed Throughput (STON)	2,200	2,200	2,200	2,200	2,200	2,200	2,400	3,000	3,000

[1] Based on the 170 square foot per piece average accomplished during Operation Desert Shield and Desert Storm.

PORT OF LAS MINAS

I. General Data
II. Conclusions
Return to Index

I. GENERAL DATA

LOCATION AND GENERAL USE

The Port of Las Minas lies on the east side of the entrance channel to the Panama Canal on the North Coast at 9° 24' north latitude and 79° 49' west longitude, about 11 kilometers (3.4 miles) south of the entrance to Limon Bay.

Las Minas is mainly an oil port, specialized in importing crude oil and exporting refined products. It is operated by Panama Refineries, Incorporated, and administered by the National Port Authority. Aside from the tanker berths, which are not suitable for loading military equipment, there is a small quay for handling general cargo.

Las Minas General Cargo Berth

The general cargo quay is an open wharf-type design and is 91.44 meters long (300 feet long). It is used solely for berthing barges and small RORO vessels carrying dry cargo and containers on trailers. Crowley currently uses the facility to berth barges once a week and small vessels several times a month for their container and trailer transfer service.

TRANSPORTATION ACCESS

Water Access

Vessels in the Atlantic Ocean destined for Las Minas should head for the approach point near Bouy Number 1 (9° 25' 30" north latitude and 79° 40' 35" west longitude). The port is about 8 kilometers (5 miles) to the west of Cristobal and is identifiable by the silver tanks colored petroleum tanks on the shore and the ships anchored off the port. The entrance channel, with a minimum depth of 12.2 meters (40 feet) at mean low water (MLW), has a width that varies from 300 meters (984 feet) at its widest part, to 100 meters (328 feet) at its narrowest part. Tidal variation in this port is about 1 foot, so there are no restrictions for entry or leaving relating to the tides.

Las Minas Water Access and Site Map

Highway Access

The Trans-Isthmian Highway (also known as the Boyd-Roosevelt Highway) is the main supply route (MSR) serving the Port of Las Minas. It originates in Panama City, where it intersects the Inter-American Highway, and leads north-northwest to Colon, about 80 kilometers (50 miles). The MSR is a bituminous-surfaces roadway, 6 meters (20 feet) wide, with graveled shoulders.

The access route to Las Minas is north of the MSR about 16 kilometers (10 miles) south of the City of Colon. From the Trans-Isthmian Highway the access road leads directly into the Panama Refineries' tanker berths and general cargo quay, which are about 1 kilometer (0.6 mile) from the highway.

The access road, a paved, two-lane road connects with the main clearance routes, and provides truck access to the port.

Access road to general cargo berth

Railroad Access

There is no rail access to the Port of Las Minas.

Airports

The Nuevo France Airfield, operated by the *Direcion de Aeronautica Civil (DAC)*, is the closest airport, about 16 kilometers (10 miles) southeast of Las Minas.

PORT FACILITIES

Berthing

The general cargo quay at Las Minas is 91.4 meters (300 feet) and can accommodate ships up to about 152 meters long (500 feet long) using a mediterranean mooring system. The depth along side this berth is 7 meters (23 feet) (MLW). Apron height above MLW is about 2.2 meters (7 feet). The apron work area is 18.3 meters wide (60 feet wide). The quay is constructed of reinforced concrete and is an open wharf-type design. No special shore services are available, telephone is available at the Port Authority Office. Lighting is available to support 24-hour operations.

Apron and Working Area

General Cargo Berth

BERTH CHARACTERISTICS FOR LAS MINAS

Characteristics	**Las Minas**
Length (ft)	300
Depth alongside at MLW (ft)	23
Deck strength (psf)	600
Apron width (ft)	60
Apron height above MLW (ft)	7
Number of container cranes	0
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	No

Staging

Open Staging - South of the general cargo quay is a 200 meter by 300 meter (656 feet by 984 feet) gravel and earth staging area for containers on chassis. Using a container on chassis handling system about 70 twenty - foot - equivalent units (TEUs) can be staged per acre. Therefore, about 1,037 TEUs can be accommodated in this 60,000 square meter (656,504 square feet) staging area.

Open Staging

Covered Storage - A small container freight station with two bay doors and about 465 square meters (5,000 square feet) of storage are available.

Container Freight Station

Unloading And Loading Positions

Ramps And Docks - The container freight station has one truck ramp and about eight truck loading positions along the loading dock.

Truck Ramps and Loadng Docks

MATERIALS HANDLING EQUIPMENT

There is one top-pick container handler that supports the Crowley container transshipment operation.

Container Handler

SUPPORT SERVICES

Pilotage and Tugs

Pilotage is compulsory for all vessels entering the port and is provided by the Pilots of the Marine Department of the Panama Refinery. Vessels must await the Pilot beyond Bouy #1. Pilot service is available 24 hours per day. Panama Refineries have four tugs available to also provide this service to those vessels which may require it.

SECURITY

The port complex is surrounded by a 10-foot barrier consisting of an 8-foot chain link fence topped by three strands of barbed wire. This fence is not lighted, but access can be controlled at the gates.

FUTURE DEVELOPMENTS

No future developments are presently planned for Las Minas.

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

Ammunition operations are prohibited at the Port of Las Minas because of the close proximity to the oil refinery and the nearby populated areas.

II. CONCLUSIONS

BARGE AND BREAKBULK OPERATIONS

The Port of Las Minas is primarily an oil port, specialized in importing crude oil and exporting refined petroleum products. Aside from the tanker berths, which are not suitable for loading military equipment, there is a small general cargo quay. This quay can handle barges and can only accommodate small breakbulk vessels, because of draft limitations. Ship's cranes discharge the cargo onto the apron or transfer the cargo directly to clearance vehicles. The port has a small container freight station and a limited amount of open staging.

LASH AND SEABEE OPERATIONS

LASH and SEABEE barges can conceivably be discharged at the Las Minas general cargo quay; however, a mobile crane would have to be placed on the apron to discharge cargo from the barges. A floating crane could also be used to transfer cargo from barge to truck.

CONTAINER OPERATIONS

The general cargo quay can accommodate small RORO vessels carrying containers, but ship's gear must be used to discharge the boxes. For future operations Manzanillo International Terminal is much better suited for transshipment of military cargo (that is, wheeled vehicles and containers).

MANZANILLO INTERNATIONAL TERMINAL
PANAMA

I. General Data
II. Throughput Analysis
III. Conclusion
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I. GENERAL DATA

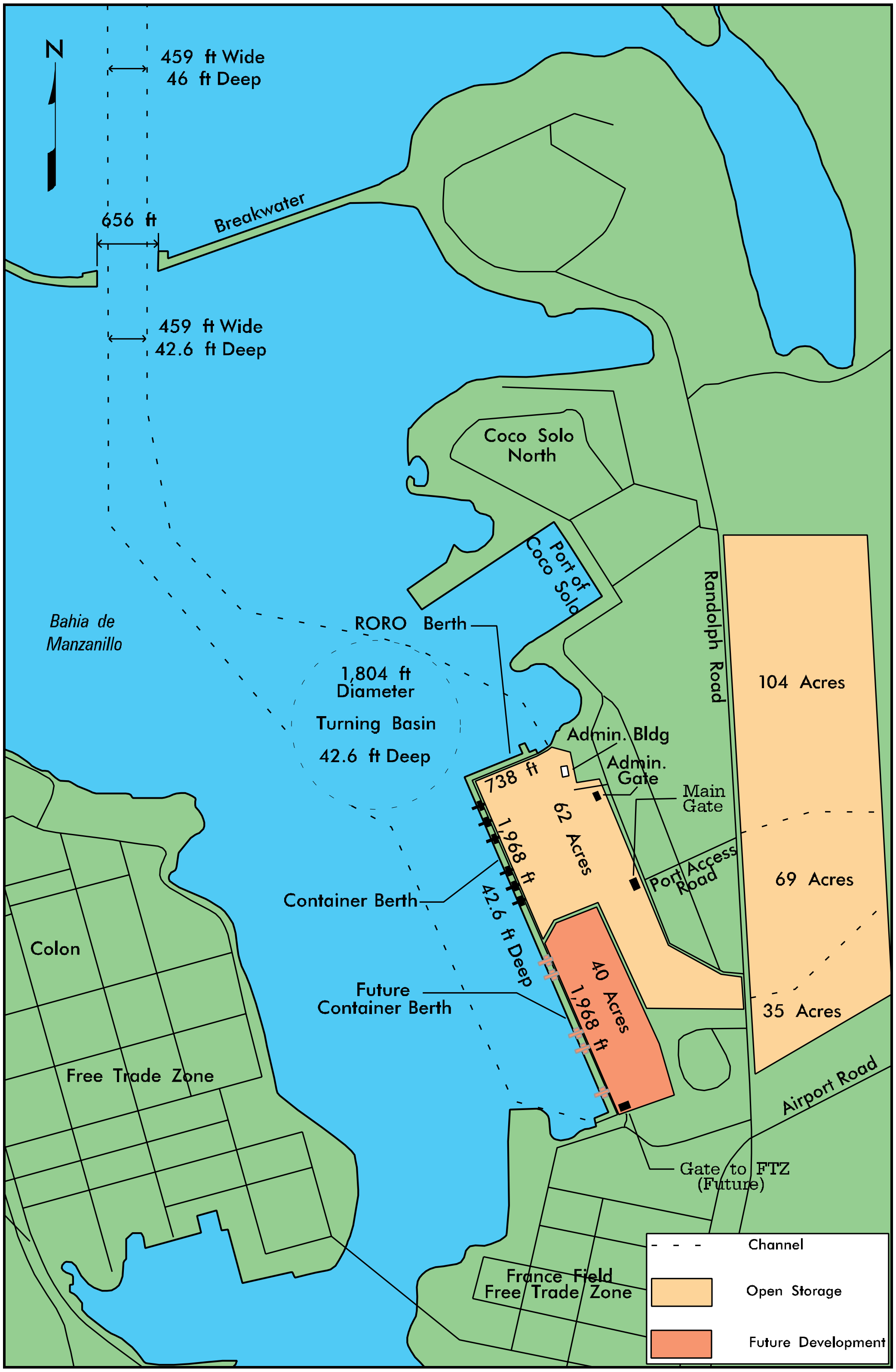
The Manzanillo International Terminal (MIT) is near the Atlantic Ocean entrance to the Panama Canal, on the northeastern shore of Manzanillo Bay, south of the Port of Coco Solo, at 9° 22' north latitude and 79° 53' west longitude. The port is 2.4 kilometers (1.5 miles) east-northeast of the center of Colon.   The terminal consists of two container berths, a RORO berth, and two small berths for tugs and barges. Berths 1, 3, and 4 provide over 825 linear meters (2,706 linear feet) of militarily useful berthing space.

The terminal is a 50-50 partnership between Panama-based Motores Internacionales, Incorporated, and Stevedoring Services of America's Panamanian affiliate, SSA-Panama, Incorporated. The terminal handles mainly large container vessels with about 60 percent of their business dedicated to transshipment operations. An average of 10 containerships call at the port each week. Cargo operations can be conducted 24 hours a day, and night berthing is permissible.

TRANSPORTATION

Water Access

Vessels in the Atlantic Ocean destined for the Manzanillo International Terminal should head for the Sea Buoy "A" at 9° 24" north latitude and 79° 53" west longitude, about 1.2 nautical miles north of the entrance to Manzanillo Bay. The entrance channel, with a minimum depth of 14 meters (46 feet) mean low water (MLW) and a width 200 meters (656 feet) at the breakwater, leads south and passes between the east breakwater of the Canal and Margarita Island breakwater and enters Manzanillo Bay. From there the harbor channel is 140 meters wide (459 feet wide) to the terminal. The terminal's turning basin is 550 meters (1,804 feet) with a draft of 13 meters (42.6 feet).   The terminal is well protected from waves and swells, and no vertical restrictions exist along the approach route or within the harbor. The average tidal range in the port area is about 1 foot.



Vicinity Map of Manzanillo

Highway Access

The Trans-Isthmian Highway is the main supply route (MSR) serving the Manzanillo International Terminal. It originates in Panama City, where it intersects the Inter-American Highway, and leads north-northwest to Colon, about 80 kilometers (50 miles). The MSR is a bituminous-surfaced road, 6 meters wide (20 feet wide), with graveled shoulders, in fair condition.

Manzanillo Main Gate

Where the MSR approaches Colon going west, it forms a four-leg, signal-controlled intersection with Randolph Road. The access road to MIT is north on Randolph Road, 1.6 kilometers (1 mile), and then west onto Port Access Road until reaching the Main Gate, less than 1 kilometer (0.6 miles). The Main Gate has five inbound and five outbound lanes, and two truck scales. Also, there is a two lane administrative gate providing access to the terminal.

Rail Access

There is no rail service to the Manzanillo International Terminal.

Air Access

The Nuevo France Airfield, operated by the Direcion de Aeronautica Civil (DAC), is 1.2 kilometer (0.8 miles) southeast of Manzanillo International Terminal. It has a control tower and two concrete-surfaced runways - one is 1,830 meters (6,000 feet) and the other is 1,525 meters long (5,000 feet long). Both runways are 45.8 meters wide (150 feet wide) and can accommodate up to C-130 aircraft.

PORT FACILITIES

Berthing

The Manzanillo International Terminal is a newly constructed, modern container port. Berthing at the terminal consists of four berths, totaling 880 meters (2,886 feet). Berth 1 is 33 meters long (110 feet long) and suitable for limited barge operations. Berth 2 is 22 meters long (70 feet long) and used to berth local tugs. Berth 3 is 225 meters long (738 feet long), it includes a RORO ramp, and ideally suited for RORO and breakbulk operations. Berth 4 is 600 meters long (1,968 feet long), fitted with six rail mounted container cranes, and is primarily used for servicing container vessels. Berth 4 can also support RORO and breakbulk operations.

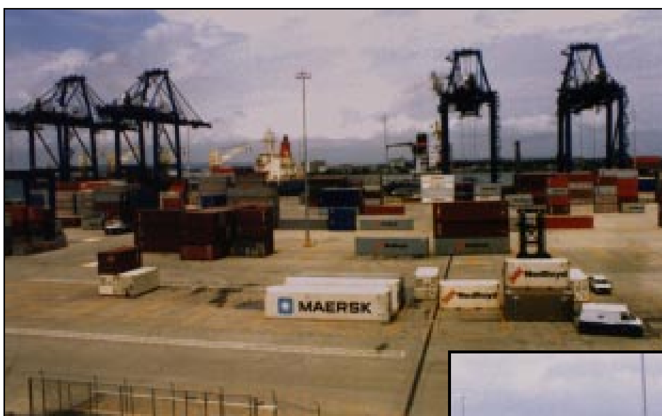
Berth 4 is the obvious choice for supporting military port operations. This is the only berth with sufficient length, depth alongside, and open apron area adjacent that can accommodate vessels like the FSS and LMSR. While Berth 3 can support smaller RORO vessels, it does not offer the same operational capability as Berth 4.

Berth 3 with RORO Ramp

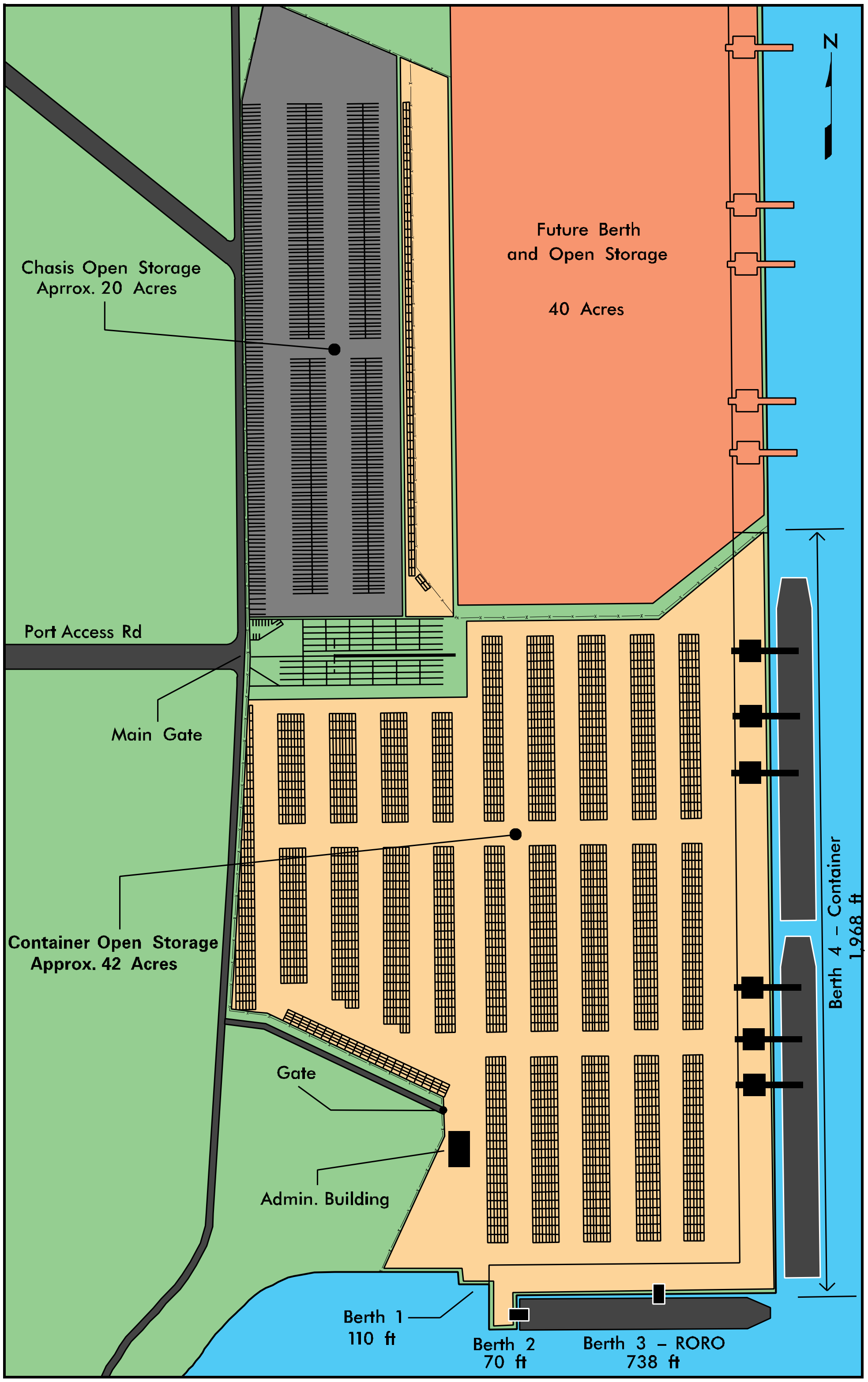
Berth 4, Container Ships

BERTH CHARACTERISTICS FOR
MANZANILLO INTERNATIONAL TERMINAL

	BERTHS			
Characteristics	**Berth 1**	**Berth 2**	**Berth 3**	**Berth 4**
Length (ft)	110	70	738	1,968
Depth alongside at MLE (ft)	46	46	46	46
Deck strength (psf)	1,000	1,000	1,000	1,000
Apron width (ft)	100	80	Open	Open
Apron height above MLW (ft)	10	10	10	10
Number of container cranes	0	0	0	6
Number of wharf cranes	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	No	Yes	Yes
Apron length served by rail (ft)	0	0	0	0



Container Cranes and Transtainer at Manzanillo


N
Future Berth
and Open Storage
40 Acres
Chasis Open Storage
Aprrox. 20 Acres
Port Access Rd
Main Gate
Container Open Storage
Approx. 42 Acres
Berth 4 – Container
1,968 ft
Gate
Admin. Building
Berth 1
110 ft
Berth 2
70 ft
Berth 3 – RORO
738 ft

Site Map

SUMMARY OF BERTHING CAPABILITIES
FOR MANZANILLO INTERNATIONAL TERMINAL

TYPE	VESSEL CLASS	Berth 1	Berth 3	Berth 4	
BREAKBULK	C3-S-38a	c	1	3	**NOTES:**
	C4-S-58a	c	1	3	a-vessel draft limit
	C4-S-66a	c	1	3	b-inadequate apron width
	C5-S-37e	c	1	3	c-inadequate berth length
					d-no straight-stern ramp
SEATRAIN	GA and PR - class	c	1	3	e-no container handling equipment
					f-anchorage depth OK, berth depth
BARGE	LASH C8-S-81b	c	c	2	inadequate
	LASH C9-S-81d	c	c	2	g-inadequate channel depth
	LASH Lighter	c	3	9	h-no shore based ramps
	SEABEE C8-S-82a	c	c	2	i-low tide insufficient ramp clearance
	SEABEE Barge	c	3	9	j-high tide insufficient ramp clearance
					k-excessive ramp angle low tide
RORO	COMET	c	1, i, j	3, d, i, j	m-excessive ramp angle high tide
	METEOR	c	1, i, j	3, d, i, j	n-parallel ramp operation ONLY
	Cape Gnome	c	1, i, j	3, d, i, j	o-insufficient apron width for side ramp
	C7-S-95a	c	1	2	
	Cape Taylor	c	1	2	Ramp clearance and angle based on
	Cape Orlando	c	1, i, j	2, i, j	maximum vessel draft
	MV Ambassador	c	1, m	3, d	
	Callaghan	c	1	2, d	**May Prevent Operation**
	Cape Lambert	c	1, i, j	2, i, j	
	LMSR - class	c	c	2	**May Limit Operation**
	FSS	c	c	2	
	Cape E	c	1, i, j	2, i, j	a-vessel draft limit
	Cape D	c	1, i, j	2, i, j	b-inadequate apron width
	Cape H	c	c	2	c-inadequate berth length
	Cape Texas	c	1, i, j	2, i, j	d-no straight-stern ramp
	Cape R	c	1, i, j	2, i, j	e-no container handling equipment
	Cape I				f-anchorage depth OK, berth depth
	Cape Victory				inadequate
					g-inadequate channel depth
CONTAINER	C6-M-147a	c, e	1, e	2	h-no shore based ramps
	C7-S-69c	c, e	1, e	2	i-low tide insufficient ramp clearance
	C7-S-68c	c, e	1, e	2	j-high tide insufficient ramp clearance
	C8-S-85c	c, e	c, e	2	k-excessive ramp angle low tide
	C9-M-132b	c, e	c, e	2	m-excessive ramp angle high tide
	C9-M-F141a	c, e	c, e	2	n-parallel ramp operation ONLY
					o-insufficient apron width for side ramp
TACS	C6-S-1qd	c	1	2	
	C5-S-MA73c	c	1	3	Ramp clearance and angle based on
	C6-S-MA60d	c	1	2	maximum vessel draft
MPS	C7-S-133a	c	c	2	**May Prevent Operation**
	Maersk	c	c	2	
	AmSea	c	1	2	**May Limit Operation**

Staging

Open Staging **-** Manzanillo International Terminal has about 62 acres of open staging available for use. This area is distributed throughout the terminal, with much of the available staging area adjacent to Berths 3 and 4. The terminal uses most of this area to store containers, to support the container transfer operations along Berth 4.

Open Staging

Covered Storage **-** There are no transit sheds or covered storage facilities at MIT. However, the terminal has future plans to construct a container freight station.

Unloading/loading Positions

Ramps and Docks **-** The terminal has no fixed or portable truck end ramps. Deploying units must use either the terminals container handlers, transtainers, or forklifts to offload trucks, flatbeds, and MILVANs.

MARSHALING AREAS

Manzanillo International Terminal has about 208 acres of unimproved open area directly adjacent to the terminal. This area can provide a marshaling area capable of supporting large military deployments.

MATERIALS HANDLING EQUIPMENT (MHE)

TYPE OF EQUIPMENT	QUANTITY	CAPACITY
Container Cranes (Hyundai-Paceco)	4	50 STON
Container Cranes (Star-Paceco)	2	40 STON
Transtainer (rubber tired)	6	40 STON
Top-Pick Container Handlers (Taylor)	12	40 STON
Side-Pick Container Handlers (Taylor)	7	7.5 STON
Yard Chassis (40-ft)	36	35 STON
Yard Tractors	44	35 STON
Forklifts	10	5-30 STON

Transtainer

Container Handlers

SUPPORT SERVICES

Maintenance and Repair: Manzanillo International Terminal is fully capable of handling any and all types of maintenance and repair and container equipment maintenance requirements. Pre-tripping and steam cleaning are several of the services that are also available.

SECURITY

MIT has contracted with Grupo de Sequridad de Las Americas (GSA), an internationally respected and recognized private security firm to provide terminal and vessel security 24 hours per day.

GSA maintains a close relationship with the US Customs Service and Panamanian authorities who have visited MIT to provide a facility security audit and to assist GSA in personnel training.

Security Guards on Duty at Manzanillo

The terminal has a 10-foot-high perimeter fence and employs over 100 security guards, (14 guards per shift) plus a 4-man vessel boarding team. MIT will meet or exceed all aspects of the Super Carrier Initiative Standards established by the US Customs Service.

FUTURE DEVELOPMENT

The owners of Manzanillo International Terminal plan to construct another 600 meter (1,968 feet) container berth with container cranes, as their business increases. This container berth will have a 16-hectare (40 acre) container yard. Future plans also include a container freight station, an additional RORO berth, and a direct access road to the Colon Free Trade Zone.

Future Development Site

Future Development Site

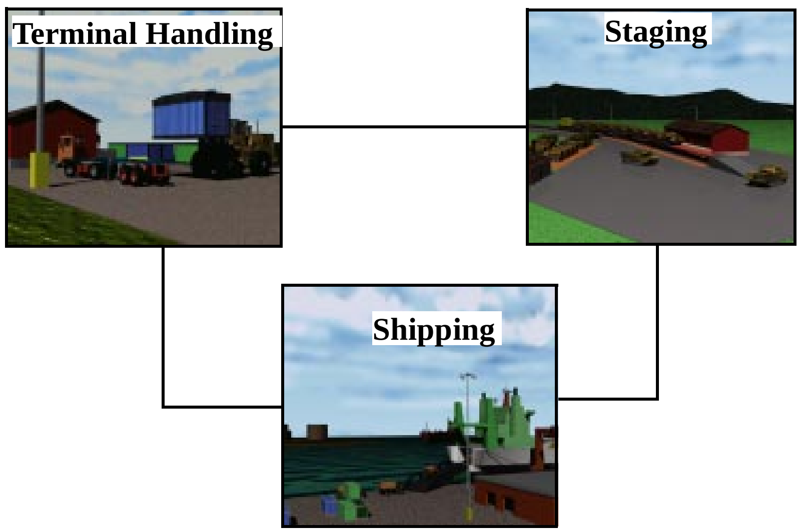
EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

Limited hazardous cargo operations are permitted at Manzanillo International Terminal on a case-by-case basis. The port's proximity to a large civilian population center (City of Colon) prevent the terminal from being considered for explosive ammunition handling operations.

II. THROUGHPUT ANALYSIS

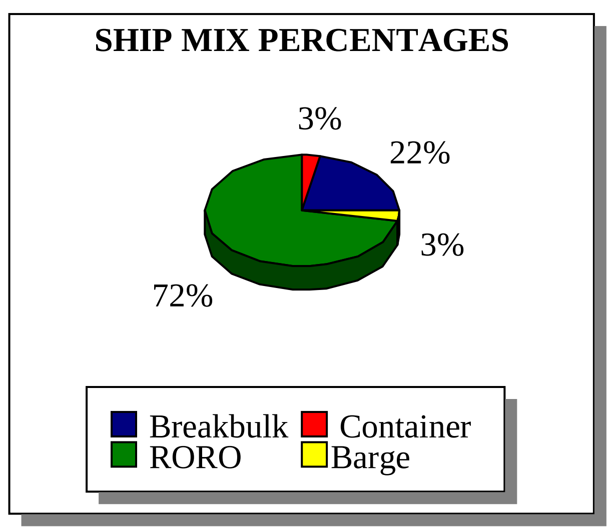
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of Manzanillo International Terminal. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal processing and handling. The least capable subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for each subsystem in terms of short tons (STON) and measurement tons (MTON) per day. The charts in this section show the throughput yields in STON. Approximate MTON yields can be computed by multiplying the STON amount by 3.



Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 80 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operation Desert Shield and Desert Storm. This data helped us develop a mix of vessels most likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployments.



TERMINAL CLEARANCE AND HANDLING

Highway

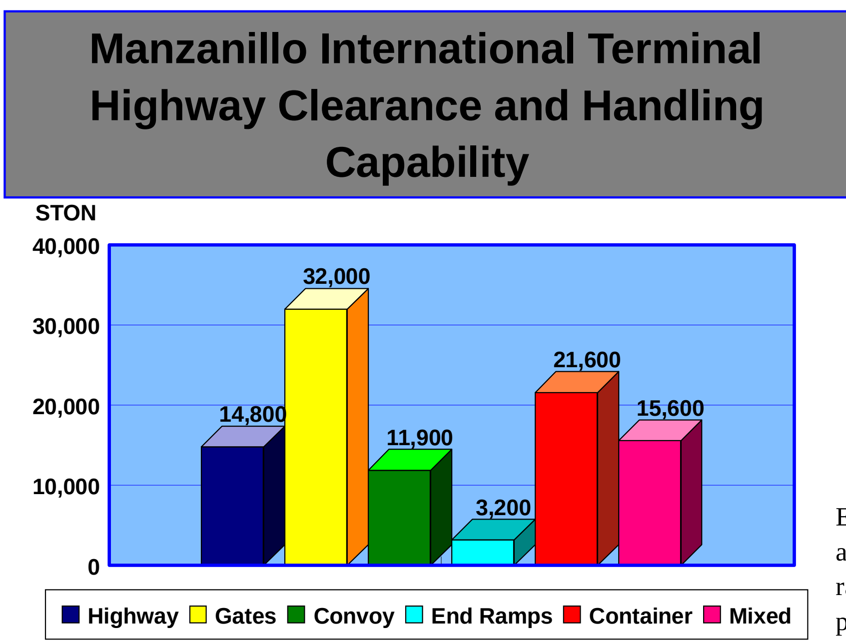
Randolp Road, a two-lane highway provides access from the City of Colon to the commercial port facilities of Manzanillo International Terminal. The road network into and out of the commercial port complex can handle at least 14,800 STON of vehicles, equipment, and supplies per day. The gate processing system can handle more than 31,900 STON of cargo per day.

Terminal Clearance

Roadable vehicles will move through the terminal gates in manageable convoys from staging areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a means of unloading, must use portable ramps. The terminal has no truck docks. We assume that deploying units will build or acquire two portable ramps for flatbed truck and semitrailer offloading operations. These ramps will handle at least 3,200 STON of military vehicles and equipment per day.

For handling loaded containers the terminal has 12 top-picks, and 6 transtainers scattered throughout the terminal. If we assume that 50 percent of all container handlers are available for use during container transfer operations, the terminal can handle about 21,600 STON of containers per day (about 2,700 TEUs). This assumes a conservative 15 lifts per hour or 300 moves per handler per day.

Maximum daily capability for the terminal is a mixed total of 15,600 STON based on various types of cargo handling, each up to its maximum.



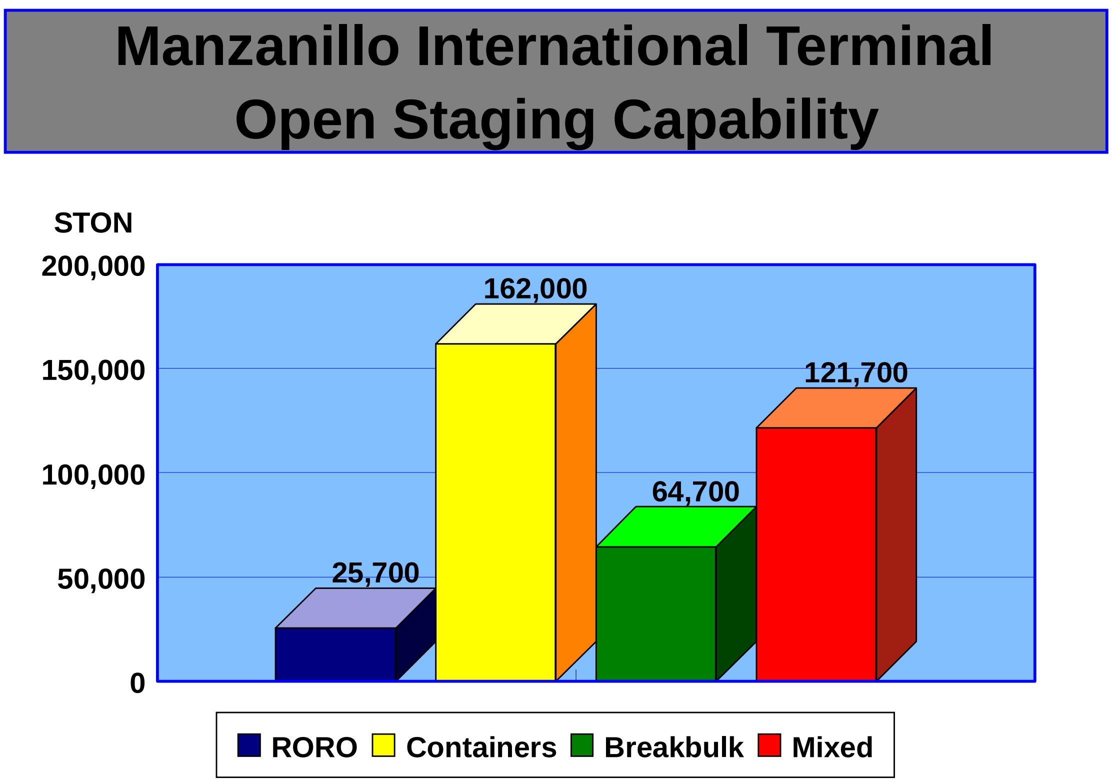
End ramp capacity assumes 2 portable ramps will be built or procured.

Staging

Manzanillo International Terminal has 62 acres of open staging hardstand that could support military operations. Plus an additional 208 acres of unimproved marshaling. The terminal has no transit shed for covered storage. Deploying units would have to negotiate with the terminal operator to use these facilities.

The port has the ability to perform operations on RORO, container, and breakbulk vessels. The cargo mix throughput is based on the assumed vessel type percentages.

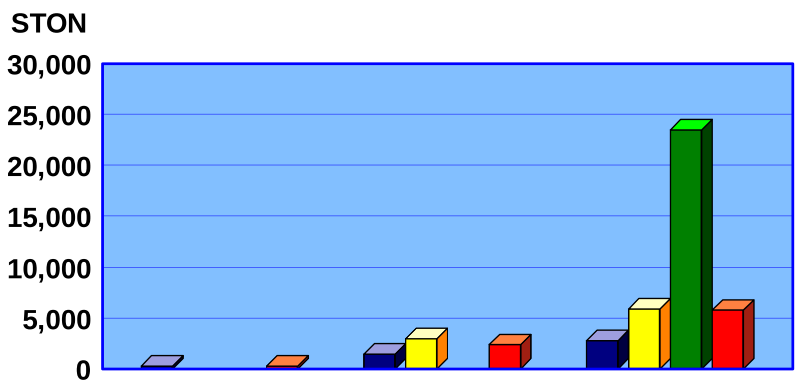
The chart shown on this page provides the cargo open staging capability for each vessel type. This analysis assumes a usable space availability of 70 percent of the total area. If a combination ship is expected, then a portion of each involved capability should be assumed.



Shipping

Daily shipping subsystem totals for terminal throughputs at each berth are shown below. They are based on various factors, including: MHE used, type of loading, operational procedures, berth usages rates, and berthing capabilities for various vessel types. Assumptions and parameter values used in this study are shown in appendix.

Manzanillo International Terminal Berth Throughput Capability



	Berth 1	Berth 3	Berth 4
Breakbulk/Barge	300	1,500	2,800
RORO	0	3,000	5,900
Container	0	0	23,500
Mixed	300	2,400	5,800

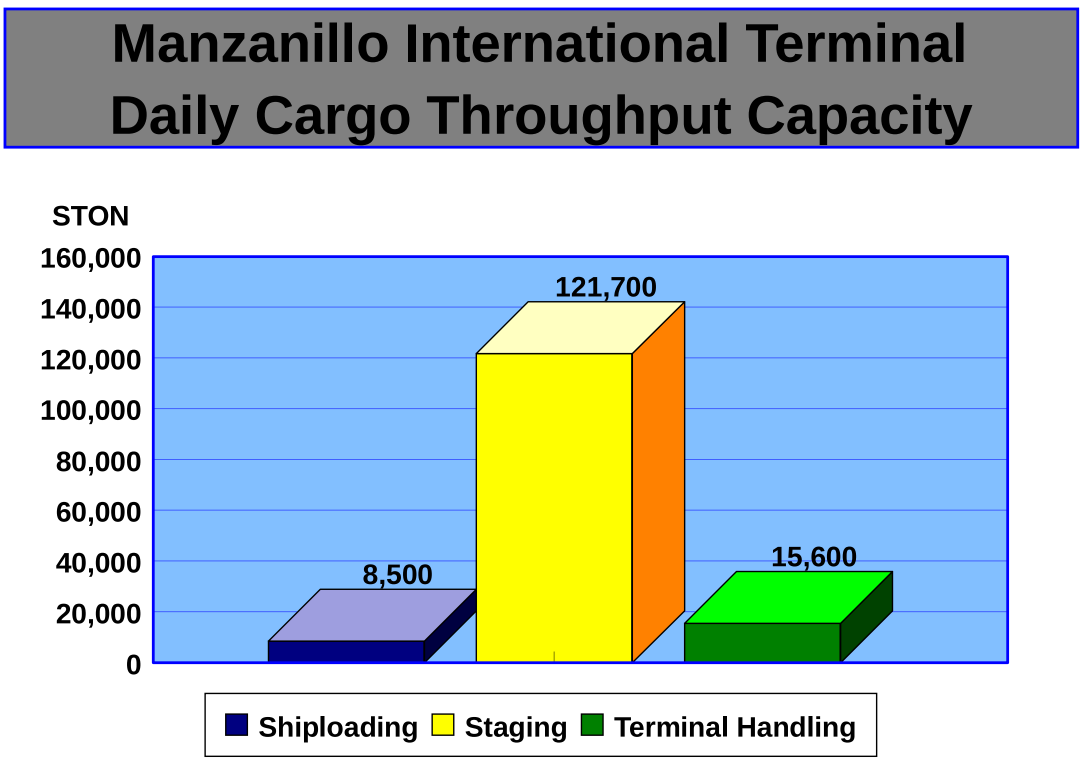
CONVERSION FACTORS	
Breakbulk	0.4 STON per MTON
RORO	0.25 STON per MTON
Containers	0.4 STON per MTON

III. CONCLUSIONS

Manzanillo International Terminal is fully capable of supporting US Military cargo transshipment operations. Berth 4 is the preferred berth for military operations, and can accommodate vessels as large as the Large Medium Speed Roll-On/Roll-Off (LMSR) and Fast Sealift Ship (FSS) as shown in the Berthing Characteristics Table.

Berth 3 offers flexible accommodations for vessels of all cargo types that are less than 700 feet in length.

Of the transportation subsystems analyzed, and based on the most likely ship mix, the least capable is the ship loading subsystem of about 8,500 STON per day.



Commercial operations taking place concurrently in the terminal will limit actual daily throughput, sustainable over time, by an appropriate percentage of the terminal's overall capability.

MANZANILLO INTERNATIONAL TERMINAL
THROUGHPUT SUMMARY
PER DAY CAPABILITY

	BERTH 1	BERTH 2	BERTH 3	BERTH 4
Length (feet)	110	70	738	1,968
Depth Alongside (feet)	46	46	46	46
Breakbulk Throughput (STON)	300	0	1,500	2,800
RORO Throughput (STON)	0	0	3,000	5,900
RORO Square Ft (EST)	0	0	59,000	118,000
RORO Pieces [1]	0	0	347	694
Container Throughput (STON)	0	0	0	23,500
Container Throughput (TEU)	0	0	0	2,700
Mixed Throughput (STON)	300	0	2,400	5,800

[1] Based on the 170 square foot per piece average accomplished during Operation Desert Shield and Desert Storm.

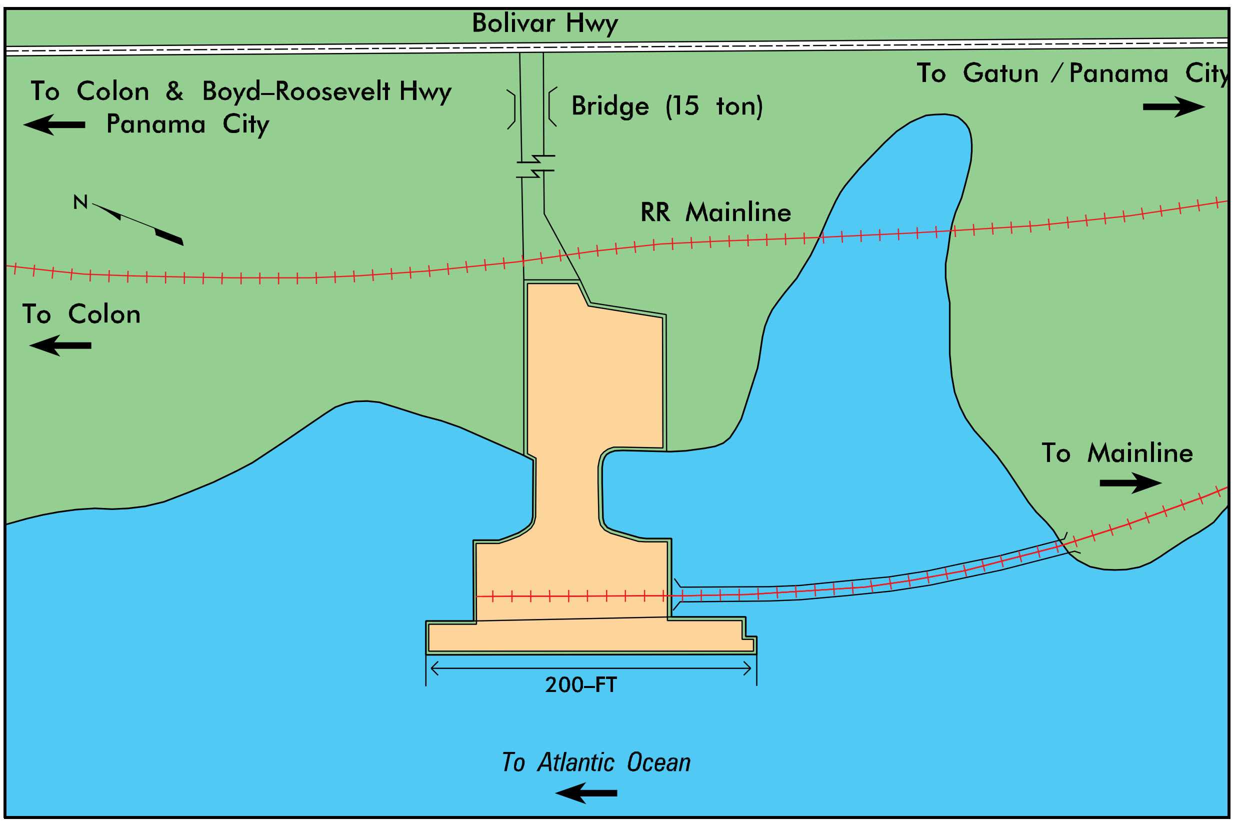
PORT OF MINDI DOCK
PANAMA

I. General Data
II. Conclusions
Return to Index

I. GENERAL DATA

LOCATION AND GENERAL USE

Mindi Dock lies on the east side of the entrance channel to the Panama Canal at 9°18' north latitude and 79° 55' west longitude, about 9.5 kilometers (5.9 miles) south of the entrance of Limon Bay. The dock is an open wharf-type design and is 200 feet long. It is used solely for berthing vessels carrying commercial and military explosives and is the only port facility in Panama that is regularly used to handle this type of cargo. The wharf has a net explosive weight (NEW) restriction of 60,000 pounds, which is currently waiverable to 120,000 pounds. The maximum vessel length is restricted to 300 feet.



Site Map

According to the Panama Canal Treaty, Mindi Dock is under the control of the Panama Canal Commission until the year 2000. The dock has no lighting available, therefore, operations are restricted to daylight hours.

TRANSPORTATION

Water Access

Vessels in the Atlantic Ocean destined for Mindi Dock should head for the approach point (9^{o} 26' north longitude and 79^{o} 55' 17" west latitude), about 5.6 kilometers (3.5 miles) north of the entrance to Limon Bay. The entrance channel, with a minimum depth of 12.8 meters (42 feet) MLW and a width of 152.5 meters (500 feet), leads south from there, passing between the heads of the Cristobal breakwaters, and enters Limon Bay. Mindi Dock is 9.5 kilometers (5.9 miles) south of the breakwaters on the east side of the Panama Canal entrance channel.

Aerial Photo of Mindi Dock

Highway

The Trans-Isthmian Highway (also known as the Boyd-Roosevelt Highway) is the main supply route (MSR) serving Mindi Dock. It originates in Panama City, where it intersects the Inter-American Highway, and leads north-northwest to Colon, about 80 kilometers (50 miles). The MSR is a bituminous-surface roadway, 6 meters (20 feet) wide, with graveled shoulders. Portions of the road can only handle axle loads no greater than 9 metric tons.

As the Trans-Isthmian Highway approaches Colon in a westerly direction, it forms a four-left signal controlled intersection with Randolph Road. The access route to Mindi Dock is south and then curving west on Randolph Road to Diversion Road, 0.9 kilometers (0.55 mile); south on Diversion Road to Bolivar Highway, 1.3 kilometers (0.8 mile); south on Bolivar Highway to Mindi Dock Access Road, 2.5 kilometers (1.6 miles); and then a right turn onto and westward on Mindi Dock Access Road to Mindi Dock, 1.5 kilometers (0.95 mile).

Access Road and Bridge

Although there is no controlled access to Mindi Dock, there is a bridge along the access road constructed of steel and timber decking. While posted with a 15 STON load limit, a structural analysis conducted in November 1996 by the USAEHSC found that the bridge has a capacity of 20 STON and can be increased to 25 tons if speed is reduced to 5 MPH.

Mindi Dock Road, an unpaved, gravel-surface, two-lane road that connects with the main clearance routes, provides truck access to the port. Traffic on the main clearance routes is rarely congested.

Railroad Access

Mindi Dock is not currently served by rail, because the existing rail line has been severed.

Rail Access

Airports

The Nuevo France Airfield, operated by the Direcion de Aeronautica Civil (DAC), is 8 kilometers (5 miles) northeast of Mindi Dock.

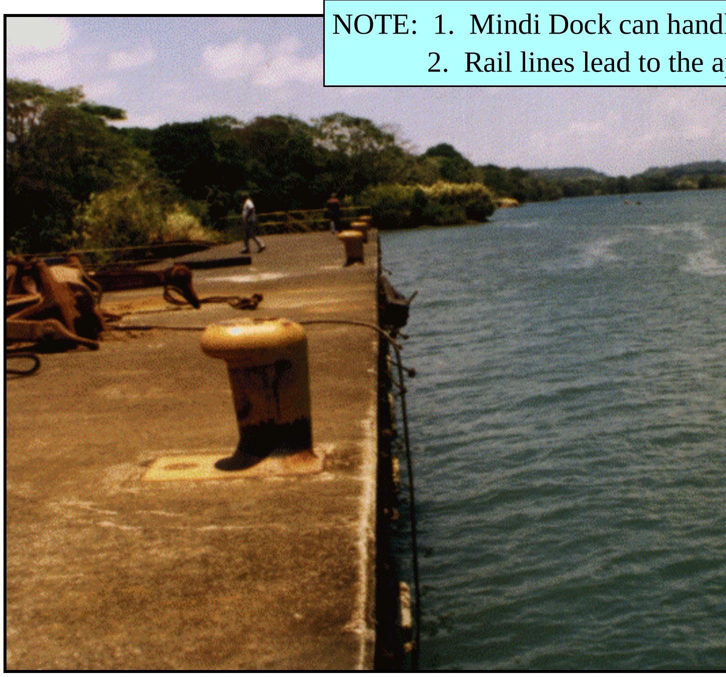
MINDI DOCK FACILITY

Berthing

The berth at Mindi Dock is 61 meters (200 feet) and can accommodate ships up to 91.5 meters long (300 feet long). The dock is constructed of reinforced concrete and is an open wharf-type design. The apron is 5.5 meters wide (18 feet wide) and 1.2 meters (4 feet) above the adjoining paved area. The dock has no materials handling equipment (MHE), nor is it served by electricity, water, telephone, or fuel.

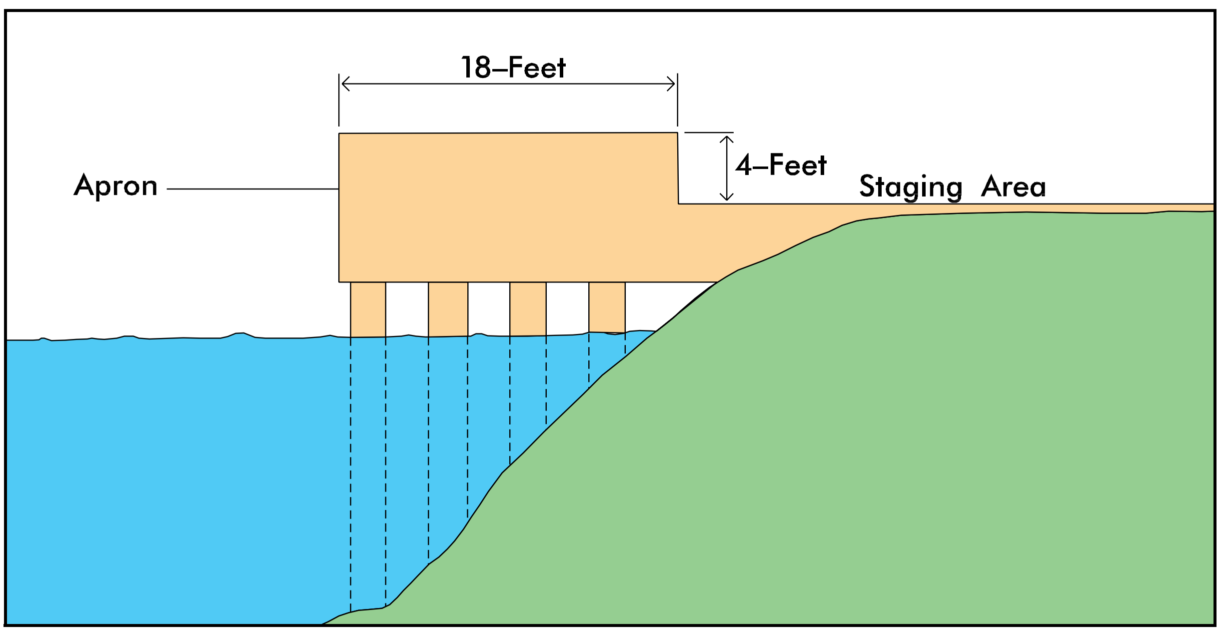
BERTH CHARACTERISTICS FOR MINDI DOCK

Characteristics	Mindi Dock
Length (ft)	200
Depth alongside at MLW (ft)	26
Deck strength (psf)	400
Apron width (ft)	18
Apron height above MLW (ft)	15
Number of container cranes	0
Number of wharf cranes	0
Apron lighting	No
Straight-stern RORO facilities	No
Apron length served by rail (ft)	Yes
NOTE: 1. Mindi Dock can handle ships up to 300 feet long. 2. Rail lines lead to the apron, but they have been severed.	



Mindi Dock Berth Face

Mindi Dock



Profile view of Mindi Dock

SUMMARY OF BERTHING CAPABILITIES
PORT OF MINDI DOCK

TYPE	VESSEL CLASS	BERTH	
BREAKBULK	C3-S-38a	a, b, c	**NOTES:**
	C4-S-58a	a, b, c	a-vessel draft limit
	C4-S-66a	a, b, c	b-inadequate apron width
	C5-S-37e	a, b, c	c-inadequate berth length
			d-no straight-stern ramp
SEATRAIN	GA and PR - class	a, b, c	e-no container handling equipment
			f-anchorage depth OK, berth depth inadequate
BARGE	LASH C8-S-81b	a, c, f	g-inadequate channel depth
	LASH C9-S-81d	a, c, f	h-no shore based ramps
	LASH Lighter	1, b	i-low tide insufficient ramp clearance
	SEABEE C8-S-82a	a, c, f	j-high tide insufficient ramp clearance
	SEABEE Barge	1, b	k-excessive ramp angle low tide
			m-excessive ramp angle high tide
RORO	COMET	a, b, c, d, o	n-parallel ramp operation ONLY
	METEOR	a, b, c, d, o	o-insufficient apron width for side ramp
	Cape Gnome	a, b, c, d, o	
	C7-S-95a	a, b, c	
	Cape Taylor	a, b, c	Ramp clearance and angle based on maximum vessel draft
	Cape Orlando	a, b, c	
	MV Ambassador	b, c, d	
	Callaghan	a, b, c, d, o	**May Prevent Operation**
	Cape Lambert	a, b, c	
	LMSR - class	a, b, c	**May Limit Operation**
	FSS	a, b, c	
	Cape E	a, b, c	a-vessel draft limit
	Cape D	a, b, c	b-inadequate apron width
	Cape H	a, b, c	c-inadequate berth length
	Cape Texas	a, b, c	d-no straight-stern ramp
	Cape R	a, b, c, d, o	e-no container handling equipment
	Cape I	a, b, c	f-anchorage depth OK, berth depth inadequate
	Cape Victory	a, b, c	g-inadequate channel depth
			h-no shore based ramps
CONTAINER	C6-M-147a	b, c, e	i-low tide insufficient ramp clearance
	C7-S-69c	a, b, c, e	j-high tide insufficient ramp clearance
	C7-S-68c	a, b, c, e	k-excessive ramp angle low tide
	C8-S-85c	a, b, c, e	m-excessive ramp angle high tide
	C9-M-132b	a, b, c, e	n-parallel ramp operation ONLY
	C9-M-F141a	a, b, c, e	o-insufficient apron width for side ramp
TACS	C6-S-1qd	a, b, c	
	C5-S-MA73c	a, b, c	Ramp clearance and angle based on maximum vessel draft
	C6-S-MA60d	a, b, c	
MPS	C7-S-133a	a, b, c	**May Prevent Operation**
	Maersk	a, b, c	
	AmSea	a, b, c	**May Limit Operation**

Staging

Open Staging - Next to the dock is 1,609 square meters (17,300 square feet) of paved staging.

Staging

Covered Staging - No covered staging is near Mindi Dock.

Unloading/loading Positions

Ramps and Docks - Mindi Dock has no truck ramps. Forklifts or mobile cranes for placing cargo onto trucks or flatbed trailers must be provided by the shipper.

MATERIALS HANDLING EQUIPMENT

The shipper must provide all MHE at Mindi Dock.

SUPPORT SERVICES

Pilotage - Pilotage is compulsory for vessels larger than 150 gross-registered tons. The Panama Canal Commission (PCC) employs 240 pilots, who assist vessels transiting the canal or entering the ports in the canal area. On the Atlantic Ocean side of the canal, the PCC operates 13 pilot boats. Pilot service is available 24 hours per day; however, since Mindi Dock is not lighted, berthing operations are limited to daytime hours.

HARBOR CRAFT

Several commercially operated tugboats, each rated at 2,400 horse-power, are based in the Port of Cristobal and are available for berthing or barge operations at Mindi Dock. the PCC also operates several tugs to assist vessels in passing through the locks; however, these tugs are unavailable for normal port operations.

SECURITY

No security services are available at Mindi Dock.

FUTURE DEVELOPMENTS

No future developments are presently planned for Mindi Dock.

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

Because no populated areas are near Mindi Dock, the dock is well suited for ammunition operations involving small breakbulk vessels. The pier has a NEW restriction of 60,000 pounds, which is currently waiverable to 120,000 pounds.

II. CONCLUSIONS

BARGE AND BREAKBULK OPERATIONS

Mindi Dock was designed expressly for barge and breakbulk operations; however, it can only accommodate small breakbulk vessels, because of draft limitations. Ship's crane discharge the cargo onto the apron, and mobile cranes or forklifts (not organic to the port) transfer the cargo from the apron to clearance vehicles. If spanner plates are available, trucks can be backed up to the apron, which is about truck-bed high, and forklifts can be driven directly onto the truck/trailer bed. The port has no covered storage and only a limited amount of open staging.

LASH AND SEABEE OPERATIONS

LASH and SEABEE barges can conceivably be discharged at Mindi Dock; however, a mobile crane would have to be placed on the apron to discharge cargo from the barges. A mobile crane with a boom long enough to reach from the paved area over the berth apron to the barge would be required. Another option is to use a floating crane to transfer cargo from barge to truck.

If the MHE problems can be overcome, the mother ship would be moored at the explosives anchorage within Limon Bay, and tugs would be required to transport the barges to and from the dock, which is 7.8 kilometers (4.8 miles) away. Two 2,400-horsepower tugs, based in the Port of Cristobal, could be used for this purpose.

NAVAL STATION PANAMA CANAL

I. General Data
II. Throughput Analysis
III. Conclusion
Return to Index

I. GENERAL DATA

Naval Station Panama Canal, formerly known as US Naval Station, Rodman, is hereafter referred to as Naval Station. The mission of the Naval Station is to exercise command and area coordination of naval shore activities; provide support for the operating forces of the Navy and other activities, as may be required; monitor security assistance matters; represent the US Navy in Latin America; and support authorities charged with defense of the Panama Canal. The Naval Station is on the west shore of Balboa Bay, on the Pacific entrance to the Panama Canal. The station contains 100 hectares (247 acres) of land, much of which was originally tidal marsh. The Panama Canal borders the east side of the Naval Station, and the Inter-American Highway forms its southwest boundary, and the area north of the Station is a tidal marsh. The Port of Balboa is across the Panama Canal from Naval Station.

The Naval Station has three finger piers, which are used for fleet support activity of US naval vessels, and occassionally, the navies of other friendly foreign countries. The average vessel traffic is estimated at over 200 ships per year. Piers 1 and 2 were turned over to Panamanian control in September 1996. In July 1997, the US Navy will cease operating at the Naval Station.

TRANSPORTATION ACCESS

Water Access

The Naval Station is at the Pacific Ocean entrance to the Panama Canal, on the western shore of the Canal, at 8^{o} 58’ north latitude, and 79^{o} 34’ west longitude. The Naval Station is accessed directly from the Panama Canal. The Canal access channel has a minimum depth of about 36 feet at mean low water (MLW), and is about 302 feet wide. The Panama Canal Commission maintains the channel depth, and the most recent dredging occurred in 1992.

Two way traffic in the channel is open to all vessels except those that exceed 90 feet in beam. The Bridge of the Americas, formerly known as the Thatcher Ferry Bridge, spans the Pacific entrance to the Canal, and has an overhead clearance of 61.3 meters (201 feet) and 66.8 meters (219 feet) at MLW. Vessels can acces the port 24 hours a day, although pilots are mandatory for vessel exceeding 150 gross-registered tons. Night berthing is permitted.

The average tidal variation ranges from 2.44 to 5.49 meters (8 to 18 feet). Access to the Naval Stations is not generally restrictive, except to vessels with drafts of 11.74 meters (38.5 feet) or more, these vessels are not handled 2.5 hours before or 2 hours after low water.

Anchorages located in the Bay of Panama offer good holding ground to many vessels, including vessels with explosive cargos.

Highway Access

Gate 2 provides direct access to the Naval Station from the Inter-American Highway. Vehicles can enter the Naval Station through three gates, although normally only Gate 2, Main Gate, and Gate 3 are used. Truck traffic use the Main Gate. Gate 3 provides direct access to the housing area. Traffic exiting Gate 3 follows Bruja Road south to the Inter-American Highway, 0.3 kilometer (0.2 mile).

Gate 1 is normally closed; however, when the staging area near the gate is being used, the gate could be opened and manned. All of the gates have one inbound and one outbound lane.

Gate 2 - Main Gate adjacent to the Inter-American Highway

Gate 1 - Adjacent to the Inter-American Highway

Railroad Access

The Naval Station has no railroad access. The closest tracks are in Balboa, across the Panama Canal.

Airports

Howard Air Force Base (AFB) is the closest airfield to the Naval Station. The gates to both of these installations are off the Inter-American Highway and only 1 kilometer (0.62 miles) apart.

Aerial Photo of Howard Air Force Base

Both Tocumen International and Marcos A. Gelabert International Airports are east of the Panama Canal, on the other side of the Bridge of the Americas.

NAVAL STATION PORT FACILITIES

Berthing

Berthing at the Naval Station consists of three finger piers - piers 1 through 3. Each pier provides two 214 meter long (704-foot long) berths. Soundings taken in May 1995, indicate the drafts at these piers ranged between 7.6 and 12.2 meters (25 and 40 feet).

BERTH CHARACTERISTICS FOR THE NAVAL STATION

	BERTHS		
Characteristics	**Pier 1**	**Pier 2**	**Pier 3**
Length (ft)	704	704	704
Depth alongside at MLW (ft)	40	35	25
Deck strength (psf)	500	400	250
Apron width (ft)	50	40	40
Apron height above MLW (ft)	25	25	25
Number of container cranes	0	0	0
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No
Apron length served by rail (ft)	0	0	0

Pier 1 - Naval Station Panal Canal

Pier 1 was constructed in 1937 and rebuilt in 1976. It is constructed on steel beams and girders encased in concrete and supported on concrete-filled caissons. Pier 1 is used for fleet support operations, including bunkering.

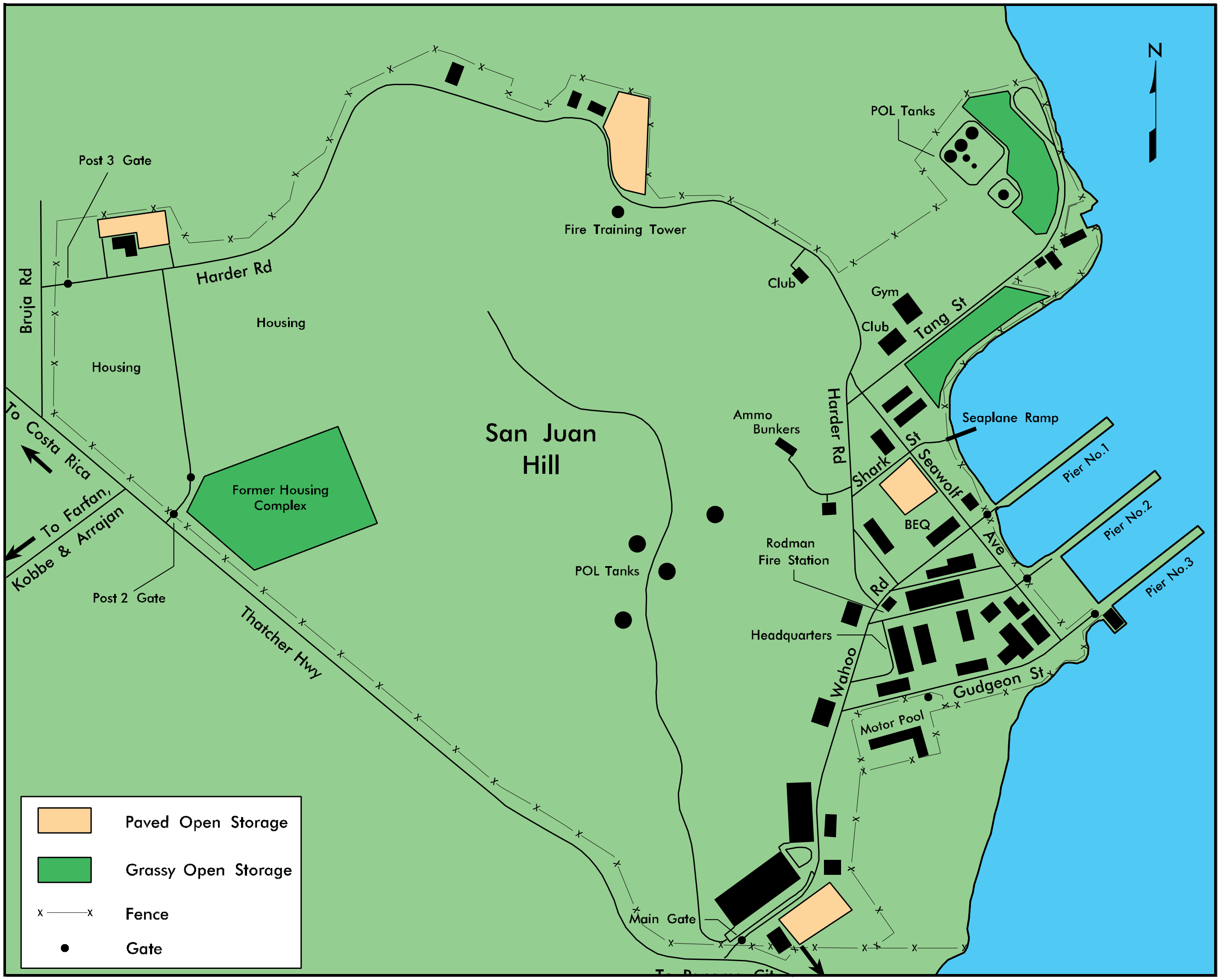
Pier 2, constructed in 1942, is also constructed of concrete-encased steel and is supported on caissons. The pier is used mainly for bunkering and for receiving petroleum products from tankers.

Pier 3 is used only to tie up lighterage and small vessels.

Each pier has high-mast lighting for night operations. Freshwater and telephone service are available on all piers. Only Pier 2 has electrical service and Pier 3 has no Petroleum, Oil and Lubricants (POL) bunkering capability.

Pier 2 - Naval Station Panal Canal

***Pier 3 - Naval Station Panal Cana*l**



Naval Station Site Map

Aerial View of Naval Station

SUMMARY OF BERTHING CAPABILITIES

TYPE	VESSEL CLASS	Pier 1	Pier 2	Pier 3	
BREAKBULK	C3-S-38a	2	2	a	NOTES:
	C4-S-58a	2	2	a	a-vessel draft limit
	C4-S-66a	2	2	a	b-inadequate apron width
	C5-S-37e	2	2	a	c-inadequate berth length
					d-no straight-stern ramp
SEATRAIN	GA and PR - class	2	2	a	e-no container handling equipment
					f-anchorage depth OK, berth depth
BARGE	LASH C8-S-81b	c	c	a, c, f	inadequate
	LASH C9-S-81d	c, g	a, c, f, g	a, c, f, g	g-inadequate channel depth
	LASH Lighter	6	6	6	h-no shore based ramps
	SEABEE C8-S-82a	c, g	a, c, f, g	a, c, f, g	i-low tide insufficient ramp clearance
	SEABEE Barge	6	6	6	j-high tide insufficient ramp clearance
					k-excessive ramp angle low tide
RORO	COMET	2, d, o	2, d, o	a, d, o	m-excessive ramp angle high tide
	METEOR	2, d, o	2, d, o	a, d, o	n-parallel ramp operation ONLY
	Cape Gnome	2, d, o	2, d, o	a, d, o	o-insufficient apron width for side ramp
	C7-S-95a	b, c	b, c	a, b, c	
	Cape Taylor	2, b	2, b	a, b	Ramp clearance and angle based on
	Cape Orlando	2, b	2, b	a, b	maximum vessel draft
	MV Ambassador	2, d	2, d	d	
	Callaghan	2, d, o	2, d, o	a, d, o	**May Prevent Operation**
	Cape Lambert	2, b	2, b	a, b	
	LMSR - class	b, c	b, c	a, b, c	**May Limit Operation**
	FSS	b, c, g	a, b, c, g	a ,b, c, g	
	Cape E	2, b	2, b	a, b	a-vessel draft limit
	Cape D	2, b	2, b	a, b	b-inadequate apron width
	Cape H	b, c	a, b, c	a, b, c	c-inadequate berth length
	Cape Texas	2, b	2, b	a, b	d-no straight-stern ramp
	Cape R	2, d	2, b, d	a, b, d	e-no container handling equipment
	Cape I	2, b	2, b	a, b	f-anchorage depth OK, berth depth
	Cape Victory	2, b	2, b	a, b	inadequate
					g-inadequate channel depth
CONTAINER	C6-M-147a	b, e	b, e	a, b, e	h-no shore based ramps
	C7-S-69c	b, e	b, e	a, b, e	i-low tide insufficient ramp clearance
	C7-S-68c	b, e	b, e	a, b, e	j-high tide insufficient ramp clearance
	C8-S-85c	b, c, e	b, c, e	a, b, c, e	k-excessive ramp angle low tide
	C9-M-132b	b, c, e	b, c, e	a, b, c, e	m-excessive ramp angle high tide
	C9-M-F141a	b,c, e,g	a, b, c,e, g	a, b, c, e, g	n-parallel ramp operation ONLY
					o-insufficient apron width for side ramp
TACS	C6-S-1qd	2, b	2, b	a, b	
	C5-S-MA73c	2, b	2, b	a, b	Ramp clearance and angle based on
	C6-S-MA60d	2, b	2, b	a, b	maximum vessel draft
MPS	C7-S-133a	b, c	b, c	a, b, c	**May Prevent Operation**
	Maersk	b, c	b, c	a, b, c	
	AmSea	2, b	2, b	a, b	**May Limit Operation**

Staging

Open Staging - The open staging areas are small and scattered throughout the station. Two large areas located near the POL tanks are not paved. The athletic field , located north of pier 1, has been used as a helicopter landing area. The former housing complex is a large grassy area, interspersed by roads, located some distance from the piers (adjacent to Gate 2). Much of this area is obstructed by elevated concrete house foundations, so its staging capability is restricted. Another paved area near Gate 1 is also a short distance from the piers.

OPEN STAGING AT THE NAVAL STATION

Location	Area (sq ft)	Surface	Berth Use	Lighting	Observed
Near Gate 1	72,000	Paved	All Piers	No	None
West of Pier 1	40,000	Paved	All Piers	No	None
North of Pier 1	120,000	Grass	All Piers	No	Athletic Field
Near POL tanks	140,000	Grass	All Piers	No	None
Near fire training tower	80,000	Paved	All Piers	No	None
Ne ar Gate 3	60,000	Paved	All Piers	No	Parking
Former housing complex	210,000	Grass	All Piers	No	None

Covered Staging - The port has three buildings that are normally used for covered storage. Building 58 is used for storing refrigerated items with 4,600 square feet of space. Building 5 is a supply warehouse with 37,000 square feet of storage, and Building 2 is the main warehouse for general cargo with over 8,000 square feet of storage area. Of these, only Building 2 is expected to be available to support temporary transshipment staging requirements. Building 2 also has docks along each side that could be used for loading general cargo by truck.

Unloading/ Loading Positions

Ramps and Docks - The Naval Station has no fixed end ramps. However, two 8-STON portable steel ramps are available for loading trucks. Deploying units can also use the stations container handlers, mobile cranes, or limited number of forklifts to offload trucks, flatbeds, and MILVANs.

Building 2, the general cargo warehouse, has the only truck-level side-loading docks available at the station. The building has loading docks on each side. To avoid double handling of cargo, cargo could be transferred directly from ships or barges on berth at Piers 1 and 2 to flatbeds. However, narrow aprons would restrict the flow of cargo and would not allow the efficient use of full-size trucks.

Building 2 - Main Warehouse (south dock)

Building 2 - Main Warehouse (north dock)

MARSHALING AREAS

The Naval Station could use off-site marshaling areas located at Howard AFB to support large military deployments.

MATERIALS HANDLING EQUIPMENT

The materials handling equipment (MHE) currently available at the Naval Station is summarized in the table. The forklifts and mobile cranes could be used to support the transshipment of cargo at the port. The port has no heavy-lift equipment, but two heavy-lift floating cranes available in Balboa Harbor could support heavy-lift breakbulk or RORO discharge operations.

MATERIALS HANDLING EQUIPMENT

TYPE OF EQUIPMENT	QUANTITY	CAPACITY
Mobile Crane	1	35 STON
Mobile Crane	1	50 STON
Container Handler	1	20 STON
Container Handler	1	40 STON
Forklifts, gas	7	2 STON
Forklifts, gas	1	3 STON
Trailers, stake, 28-ft	2	12 STON
Truck, lowbed, 20-ft	1	25 STON
Truck, stake, 18-ft	4	5 STON
Truck, 12-ft	2	2 STON
Truck, van, 12-ft	2	2 STON

POL STORAGE

The piers at the Naval Station are connected by a series of five pipelines to the Arraijan Tank Farm. The tank farm, which stores five grades of bulk fuel, is on the south side of the Inter-American Highway, 2 miles west of Naval Station. The site consists of rolling hills with thick jungle vegetation and open grassy areas. The pipelines run underground, parallel, and south of the Inter-American Highway.

Naval Station also has a tank farm, Gatun Tank Farm, on the Atlantic end of the Panama Canal. This farm stores three grades of bulk fuel - JP5, diesel, and F-76 ship fuel. Three underground pipelines connect the tank farm with pier 16 at the Port of Cristobal.

RAIL OPERATIONS

The Station has no railroad access, so rail transshipments are not possible. The closest tracks are across the Bridge of the Americas, on the east side of the Panama Canal, in Balboa.

SECURITY

The stations is surrounded by a 10-foot perimeter fence consisting of an 8-foot chain link fence topped with barbed wire. The perimeter of the installation is not lighted. US Marine Corps guards control the open gates and patrol the Naval Station.

SUPPORT SERVICES

***Pilotage* -** Pilotage is compulsory for vessels larger than 150 gross-registered tons. The Panama Canal Commission (PCC) employs 240 pilots, who assist vessels entering the ports in the canal area or transiting the canal. The PCC operates about 20 pilot boats. Pilot service is available 24 hours per day, and night berthing is permissible.

***Harbor Craft* -** Two commercially operated berthing tugboats, each rated at 2,400 horsepower, are available for berthing operations in Balboa Harbor. The PCC also operates about 17 tugs to assist vessels through the locks, but these tugs are not available for normal port operations.

FUTURE DEVELOPMENTS

No US developments are planned at the Naval Station. Piers 1 and 2 have been turned over to Panamanian control as of September 1996. The US Navy will terminate its operations at the Naval Station in July 1997. Pier 3 may see continued use as a POL pier but future Panamanian developments are unclear due to the privatization of many port facilities.

EXLOSIVE AND HAZARDOUS CARGO OPERATIONS

Explosives are handled in two primary locations at the Naval Station - the storage area and Pier 2. The storage area is on the east slope of San Juan Hill, in the center of the installation. Here, small arms and pyrotechnics are stored in two small magazines. The explosives quantity-distance arcs originating from these magazines do not result in safety problems.

At Pier 2, the authorized limit for explosives is only 100 pounds of Class 1.1 ammunition. The associated quantity-distance arc of only 204 meters (670 feet) is based on the proximity of the bachelors enlisted quarters.

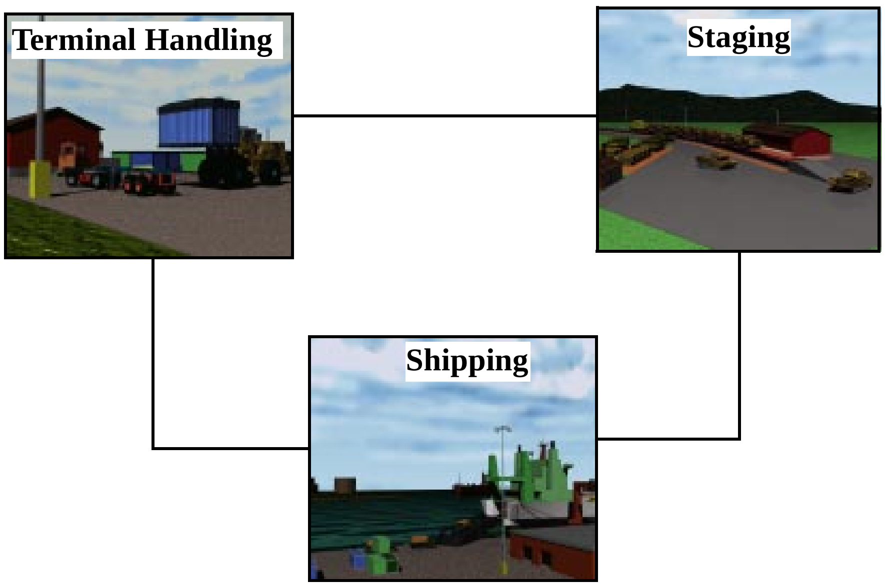
The 2,743-meter (9,000-foot) quantity-distance arc established for the net explosive weight (NEW) carried on a notional containership encompasses many activities. Within this arc are the Panama Canal, the Port of Balboa, a major POL tank farm, the Bridge of the Americas, activities on the Naval Station, and commercial and residential areas. Based on these considerations, ammunition vessels should not be discharged at the Naval Station.

The quantity-distance arc established for a LASH barge loading position (two LASH barges) is 960 meters (3,150 feet). If a single barge position were established on either pier 1 or 2, its arc would encompass much of the Naval Station southeast of San Juan Hill, the Panama Canal, and about 40 percent of the Port of Balboa.

II. THROUGHPUT ANALYSIS

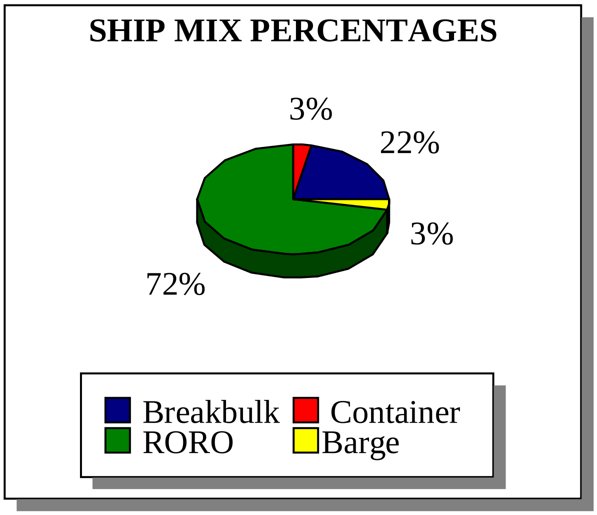
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Naval Station Panama Canal. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal processing and handling. The least capable subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for each subsystem in terms of short tons (STON) and measurement tons (MTON) per day. The charts in this section show the throughput yields in STON. Approximate MTON yields can be computed by multiplying the STON by 3.



Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 80 percent of the time. In developing the throughput scenario, we used statisical data developed from analysis of deployments that occured during Operation Desert Shield and Desert Storm. This data helped us develop a mix of vessels most likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployments.



TERMINAL CLEARANCE AND HANDLING

Highway

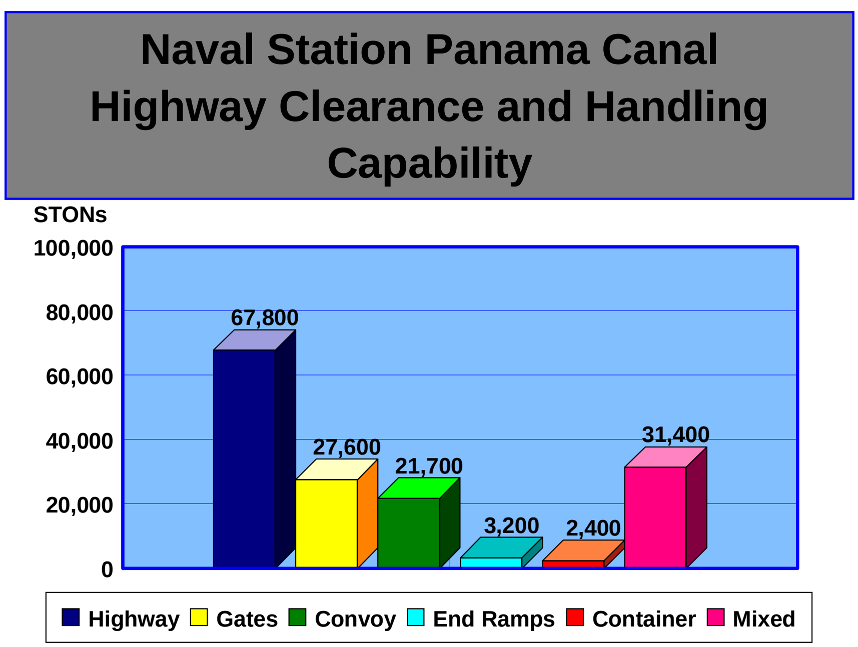
The Inter-American Highway, a two-lane roadway provides access from Panama City to the Naval Station. The road network into and out of the Naval Station facilities can handle over 67,000 STON of vehicles, equipment, and supplies per day. The gate processing system can handle more than 27,000 STON of cargo per day.

Terminal Clearance

Roadable vehicles will move through the Naval Station gates in manageable convoys from staging areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a means of unloading, must use portable ramps. We assume that deploying units will build or acquire two portable ramps for flatbed truck and semitrailer offloading operations. These ramps will handle at least 3,200 STON of military vehicles and equipment per day.

For handling loaded containers the Naval Station has two top-pick container handlers. If we assume that 50 percent of all container handlers are available for use during container transfer operations, the Naval Station can handle about 2,400 STON of container per day (about 300 TEUs). This assumes a conservative 15 lifts per hour or 300 moves per handler per day.

Maximum daily capability for the Naval Station is a mixed total of 31,400 STON based on various types of cargo handling, each up to its maximum.



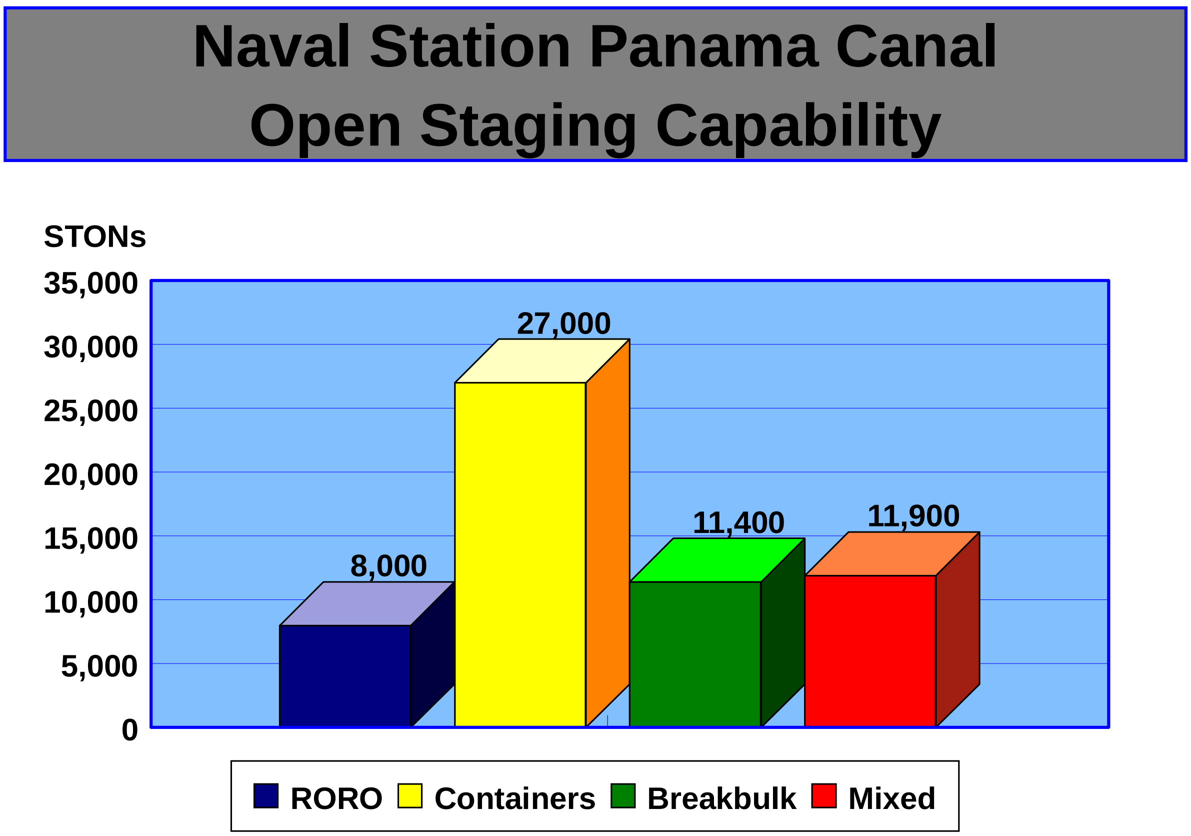
End ramp capacity assumes 2 portable ramps will be built or procured.

STAGING

Naval Station Panama Canal has over 16 acres of open staging (paved and grass) that could support military operations, plus additional acreage at Howard AFB for marshaling. The Naval Station has no transit shed for covered storage, but has access to a general cargo warehouse with over 8,000 square feet of storage. Deploying units would have to negotiate with the Naval Station operator to use these facilities.

The Station has the ability to perform limited operations on RORO, container, and breakbulk vessels. The cargo mix depends on the assumed vessel mixed percentages.

The chart shown on this page provides the cargo open staging capability for each vessel type. This analysis assumes a usable space availability of 70 percent of the total area. If a combination ship is expected, then a portion of each involved capability should be assumed.

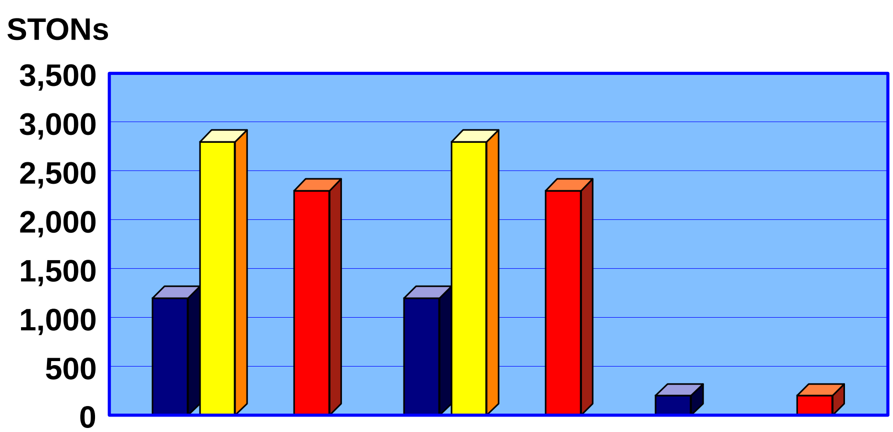


SHIPPING

Daily shipping subsystem totals for Naval Station throughputs at each pier are shown below. They are based on various factors, including: MHE used, type of loading, operational procedures, berth usages rates, and berthing capabilities for various vessel types. Assumptions and parameter values used in this study are shown in the appendix.

CONVERSION FACTORS	
Breakbulk	0.4 STON per MTON
RORO	0.25 STON per MTON
Containers	0.4 STON per MTON

Naval Station Panama Canal
Berth Throughput Capability



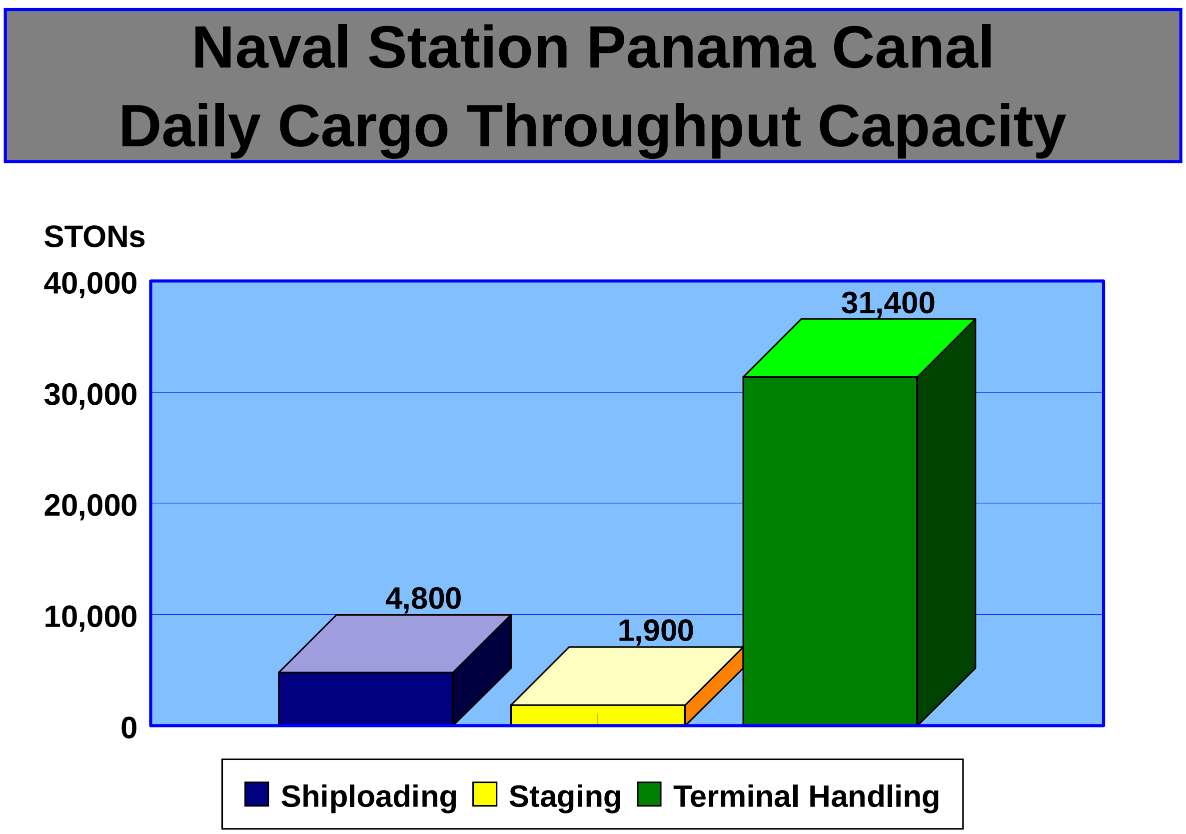
	Pier 1	Pier 2	Pier 3
Breakbulk/Barge	1,200	1,200	200
RORO	2,800	2,800	0
Container	0	0	0
Mixed	2,300	2,300	200

III. CONCLUSIONS

The Naval Station can provide only limited support for US Military cargo transshipment operations. Piers 1 and 2 are the preferred berths for military operations, they can accommodate break-bulk, small RORO, and combination containerships, as well as barge operations. None of the piers can support the Large Medium Speed Roll-On/Roll-Off (LMSR) Ship or Fast Sealift Ship (FSS) as shown in the Berthing Characteristics Table.

Pier 3 is best suited for small shallow-draft vessels, landing craft, and barges.

Of the transportation subsystems analyzed, and based on the most likely ship mix expected, the least capable subsystem is the ship loading with the ability to transfer about 4,800 STONs of cargo per day.



Other shipping operations taking place concurrently in the Naval Station will limit actual daily throughput, sustainable over time, by an appropriate percentage of the port's overall capability.

Breakbulk Operations

Piers 1 and 2 are both suitable for breakbulk operations. However, their strengths cannot support the live load of a heavy-lift mobile crane plus the cargo load of unit equipment; therefore, breakbulk operations should be restricted to general cargo. This type of cargo is normally discharged using ship's cranes. Although heavy-lift floating cranes could be used to handle unit equipment, the deck strengths of the piers would still restrict heavy-tracked vehicles from being discharged. Building 2 can be used to store general cargo items.

LASH and SEABEE Operations

Piers 1 and 2 are suitable for barge discharge operations. Smaller crane sizes can be used for barge operations than for breakbulk operations since boom reaches are less. However, because of the strengths of Piers 1 and 2, the crane size is restricted and only general cargo should be handled. The narrow aprons and the deck area required for mobile cranes would hinder access from the pier and, thus, restrict discharge operations to one side of the piers. Barge vessels could be berthed next to one of the piers and barges discharged from the vessel into the water. Pier 3 could be used as a temporary barge marshaling area.

RORO Operations

Because of the narrow aprons, none of the piers are suitable for RORO operations. The apron widths of 15.2 meters (50 feet) and 122 meters (40 feet) for Piers 1 and 2, respectively, are too narrow for RORO side-ramp discharge. Either of the berths at Pier 1 could support slewed-stern ramp RORO discharge, but only one berth could be used at a time. Installation officials reported that the piers have not been used for RORO operations. Like the Port of Balboa, tidal variations at the Naval Station would restrict operations to 3 or 4 hours per day.

Container Operations

Narrow aprons, low deck strength, and no container cranes all combine to restrict container operations at Naval Station. A self-sustaining containership could be berthed at Pier 1, and containers could be discharged onto 20-foot chassis. Since the deck strengths cannot support a heavy-lift mobile crane, heavy-lift floating cranes would be required to discharge non-self-sustaining containerships.

POL Tanker Operations

Piers 1 and 2 are routinely used for bunkering vessels and for receiving petroleum products from tankers. These piers each have a POL pumping rate of between 2,500 and 3,000 barrels per hour. The piers can accommodate small to medium-size vessels. POL products are pumped from these berths to the Arraijan Tank Farm. A series of pipelines run between the piers and the tank farm, carrying MOGAS, diesel, JP-4, JP-5, and F-76 bunker fuels.

NAVAL STATION PANAMA CANAL
THROUGHPUT SUMMARY DAILY CAPABILITY

	PIER 1	PIER 2	PIER 3
Length (feet)	740	740	740
Depth Alongside (feet)	40	35	25
Breakbulk Throughput (STON)	1,200	1,200	200
RORO Throughput (STON)	2,800	2,800	0
RORO Square Feet (Est)	55,000	55,000	0
RORO Pieces [1]	325	325	0
Container Throughput (STON)	0	0	0
Container Throughput (TEU)	0	0	0
Mixed Throughput (STON)	2,300	2,300	200

[1] Based on the 170 square foot per piece averge accomplished during Operation Desert Shield and Desert Storm.

PORT OF VACAMONTE
PANAMA

I. General Data
II. Throughput Analysis
III. Conclusions
Return to Index

I. GENERAL DATA

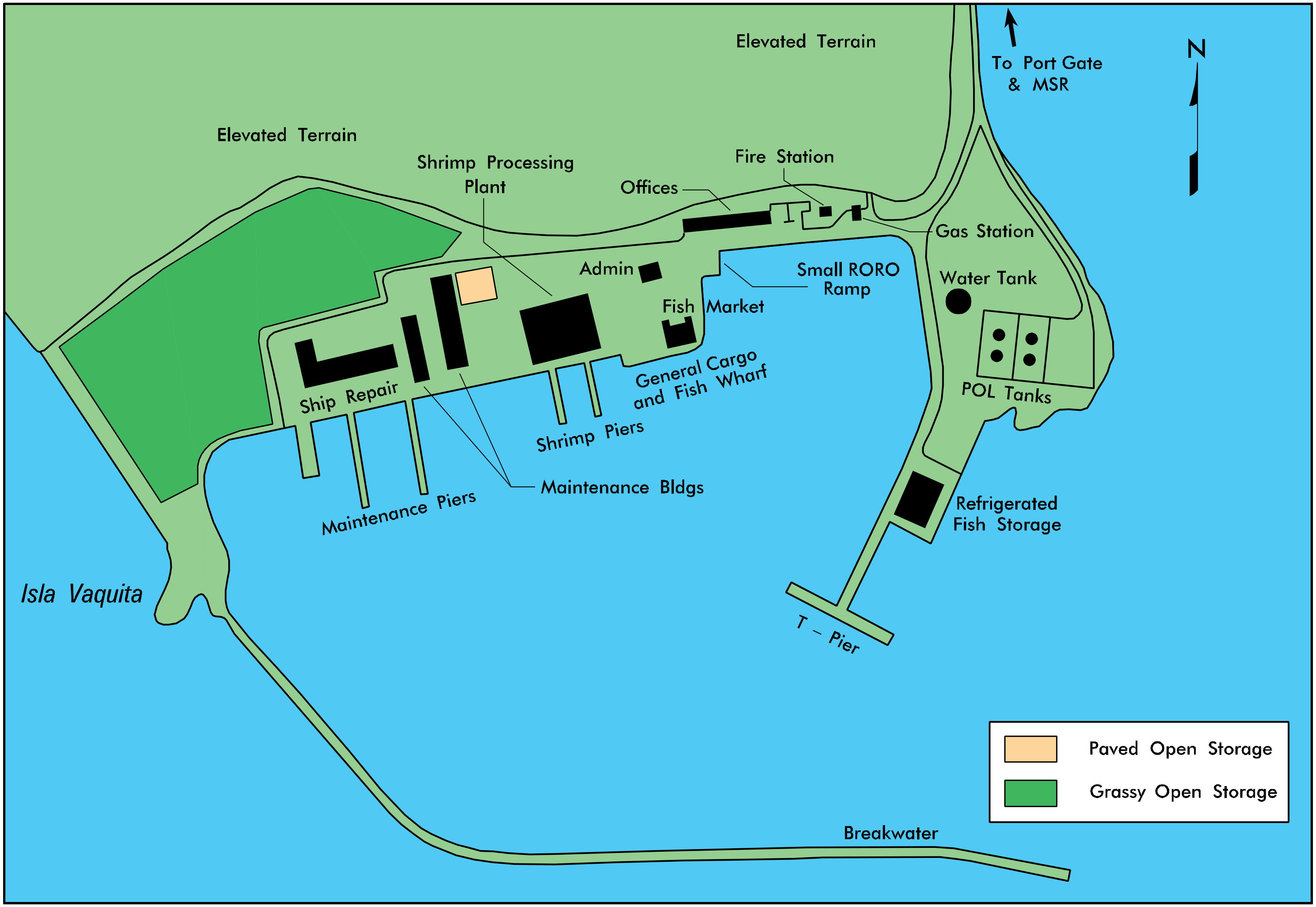
Vacamonte is operated by the Panama National Port Authority (Autoridad Portuario Nacional). The port is primarily a fishing terminal, but handles some general cargo. Vacamonte was constructed in 1979 as a special purpose port for Panama's fishing industry.

TRANSPORTATION ACCESS

Water

The Port of Vacamonte (Latitude 08^{o} 51' North, Longitude 79^{o} 40' West) is located approximately 10 miles west of the Pacific entrance to the Panama Canal on Vacamonte Point. A small breakwater protected harbor shelters the port from the open sea and Chornera Bay. The access channel has a minimum depth of about 19.7 feet, mean low water (MLW) and is 262 feet wide. The National Port Authority maintains depth in the port harbor. The harbor is dredged on a four year cycle. The most recent maintenance dredging occurred in 1994. There are no vertical obstructions that restrict access to the channel or harbor. Vessels can access the port 24 hours a day, although pilots are mandatory for vessels exceeding 150 Gross Registered Tons (GRT). Night berthing is permitted.

Entrance to Vacamonte Piers



Site Map for Port of Vacamonte

Tides in the port area are about the same as for Balboa, and range from 10 to 14 feet.

A number of anchorage areas either adjacent to the port, about 1.5 miles out, or in the Bay of Panama offer accommodation to a large number of vessels. These are generally over very good holding ground.

Highway

The Port of Vacamonte is located about 10 miles west of the Panama Canal, along the Inter-American Highway. Vehicular traffic at the port is handled by one gate. The gate is about 2 miles from the highway along the port access road, and is manned around the clock. The pier area is about 1 mile from the gate.

Gate at Port of Vacamonte

Rail

The Port of Vacamonte has no access to rail.

PORT FACILITIES

Berthing

The Port of Vacamonte has 5 piers and a marginal wharf, providing a total of about 2,250 feet of berthing. However, as most of this is special purpose fishing berth and small boat repair, only the berths at the International (or “T” pier) are considered in this analysis. Even this facility offers limited accommodation for military use. The International Pier has three usable berths ranging from 200 feet, the East and West Berths, to 459 feet for the South Berth.

Port authorities at Vacamonte stated that the largest ship that can call the port, berthed alongside the International South Berth, is about 476 feet long, but that normally vessels not exceeding 328 feet in length were the largest worked on that berth. This length limitation will prevent most military cargo vessels from berthing at Vacamonte.

T - Pier at
Port of Vacamont

BERTH CHARACTERISTICS FOR PORT OF VACAMONTE

	BERTHS[1]							
CHARACTERISTICS	**INTL SOUTH**	**INTL EAST**	**INTL WEST**	**SVC PIER EAST**	**SVC PIER WEST**	**SHRIMP PIER EAST**	**SHRIMP PIER WEST**	**FISH WHARF**
Length (ft)	459	200	200	360	360	197	197	300
Depth alongside at MLW (ft)	29	26	26	13	13	13	13	13
Deck Strength (psf)	400	400	400	300	300	300	300	400
Apron width (ft)	41	41	41	21	21	18	18	18
Apron height above MLW (ft)	24	24	24	24	24	24	24	24
Number of container cranes	0	0	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	4[2]	4[2]	0
Apron Lighting	YES	YES	YES	YES	YES	YES	YES	YES
Straight-stern RORO Ramp	NO	NO	NO	NO	NO	NO	NO	NO
Apron length served by rail (ft)	NA	NA	NA	NA	NA	NA	NA	NA

1 Only the berths on the International Pier are considered even marginally suitable for military vessel operations. Otherberths are shown for information purposes only.

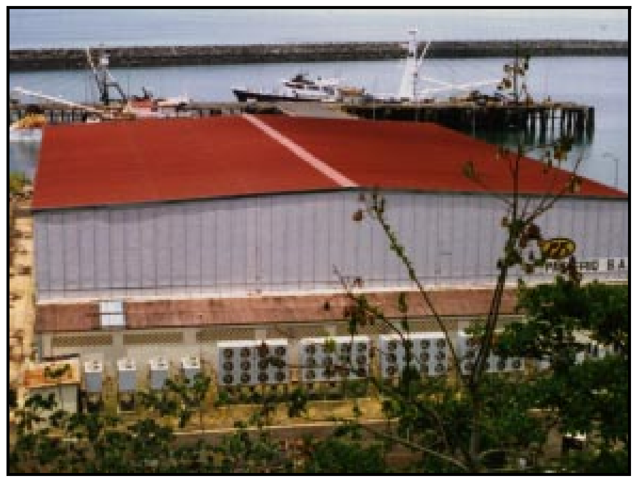
2 Wharf cranes shown on the Shrimp Piers are specialized equipment for unloading seafood, and are not suitable for other purposes.

Staging

Open Staging **-** The Port of Vacamonte has about 10 acres of open staging available for use. This area is distributed throughout the port area, with most of the area located behind the ship repair facility. Most of the available area is unpaved grassy area.

Open Staging Area

Covered Staging **-** Vacamonte has no covered staging area for general cargo. There is a refrigerated warehouse/storage building that provides storage for about 3,000 tons of frozen or chilled fish products.



Covered Staging Area

Rail

Vacamonte is not served by rail.

Highway

Highway access to the terminal is via the port access road that connects to the Inter-American Highway. Although busy, the access is not congested.

Unloading/loading Positions

Ramps And Docks - Vacamonte has no ramps or docks that could support truck loading or unloading. If these were required, portable ramps could be brought in or fabricated.

MARSHALING AREAS

No marshaling areas support the port directly. Howard Air Force Base is the closest area that might provide marshaling support to Vacamonte. Howard is about 8.5 miles away.

MATERIALS HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity (STON)	Quantity	Wharf Assignment
Wheeled Mobile Crane	15	2	International Wharf
Forklift	10	2	Port Area
Forklift	4	6	Port Area
NOTE: The table above represents equipment owned by the port. Port operators indicate that they lease or rent other equipment as required from local suppliers. The list is not "all inclusive" as actual totals may change.			

Materials Handling Equipment

FUTURE DEVELOPMENT

Port management stated that they had limited plans for future development due to the specialized nature of the terminal. They would like to expand the ports work to include more general cargo and possibly develop a grain or container berth within about 5 years. They would also like to develop some of the port's real estate, about 250 acres of undeveloped land, into commercial or industrial use.

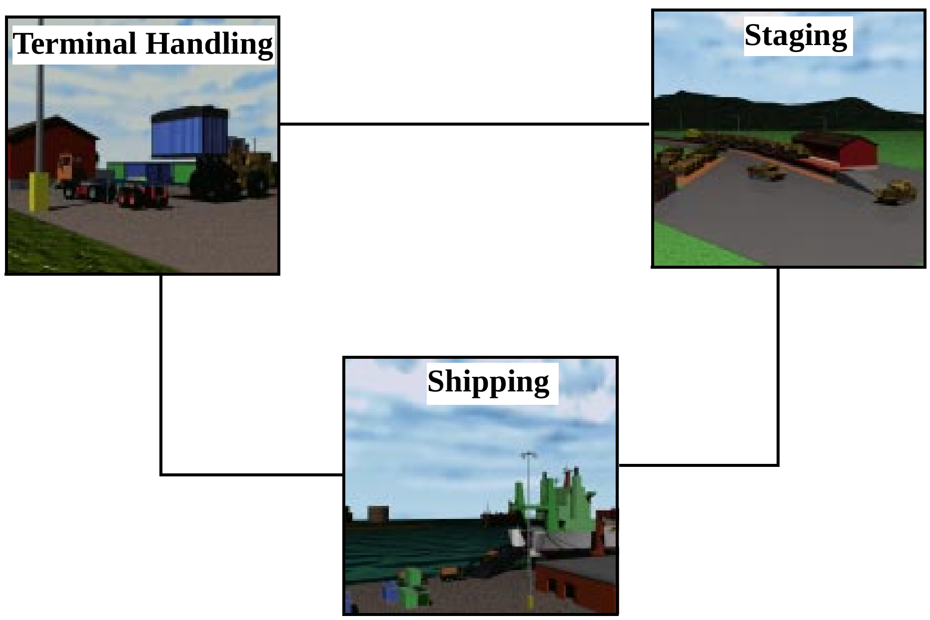
EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

Vacamonte has no experience with hazardous or dangerous cargo. However, of the ports on the Pacific side of Panama, Vacamonte is the best suited for these types of operations. The port is well distant from large civilian populations and only a small number of personnel are generally at work within the port.

II. THROUGHPUT ANALYSIS

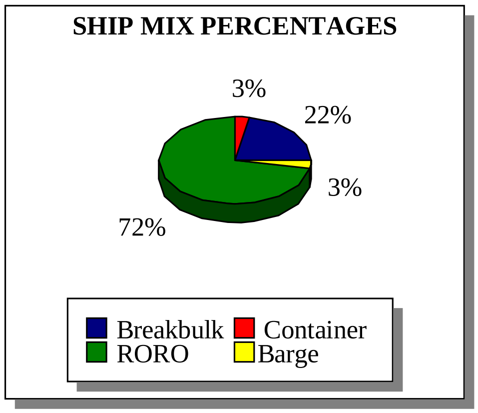
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Vacamonte. The POPS model uses a weak link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of short tons (STON) and measurement tons (MTON) per day. The charts in this section show the throughput yields in STONs. Approximate MTON yields can be computed by multiplying the STON amount by 3.



Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 80 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

Highway

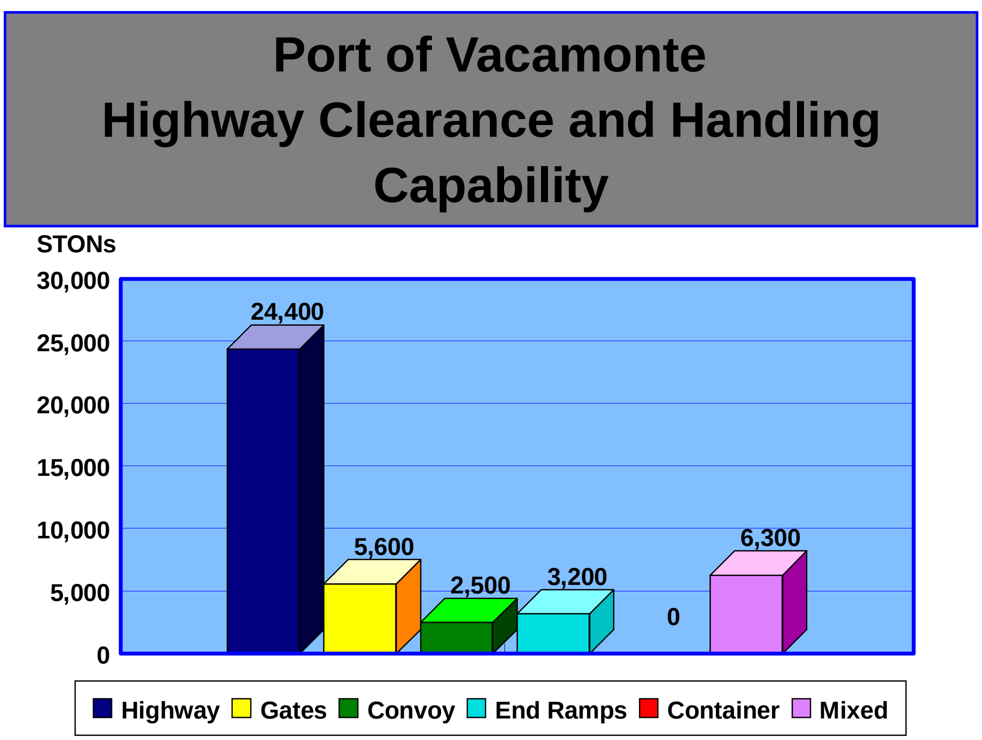
The port is connected to the highway net by a gate and an access road that connects with the Trans-Isthmian Highway.

The route into and out of the port can handle about 24,350 STONs of equipment and supplies daily. The gate processing system can handle more than 5,600 STONs of cargo per day.

Roadable vehicles will move through the terminal gates in manageable convoys from staging areas designated for these moves. About 2,500 STONs of vehicles could arrive each day in convoy.

Vehicles on commercial or military flatbed trailers, not equipped with a self loading capability must use a portable end ramp. No end ramps are available in the port. If required, these must be procured or fabricated. This analysis assumes two such ramps that could handle about 3,200 STONs of cargo daily.

Maximum daily handling capability for the port is a mixed total of the three types of handling, each up to its maximum, not to exceed the daily gate limit of 5,600 STON.

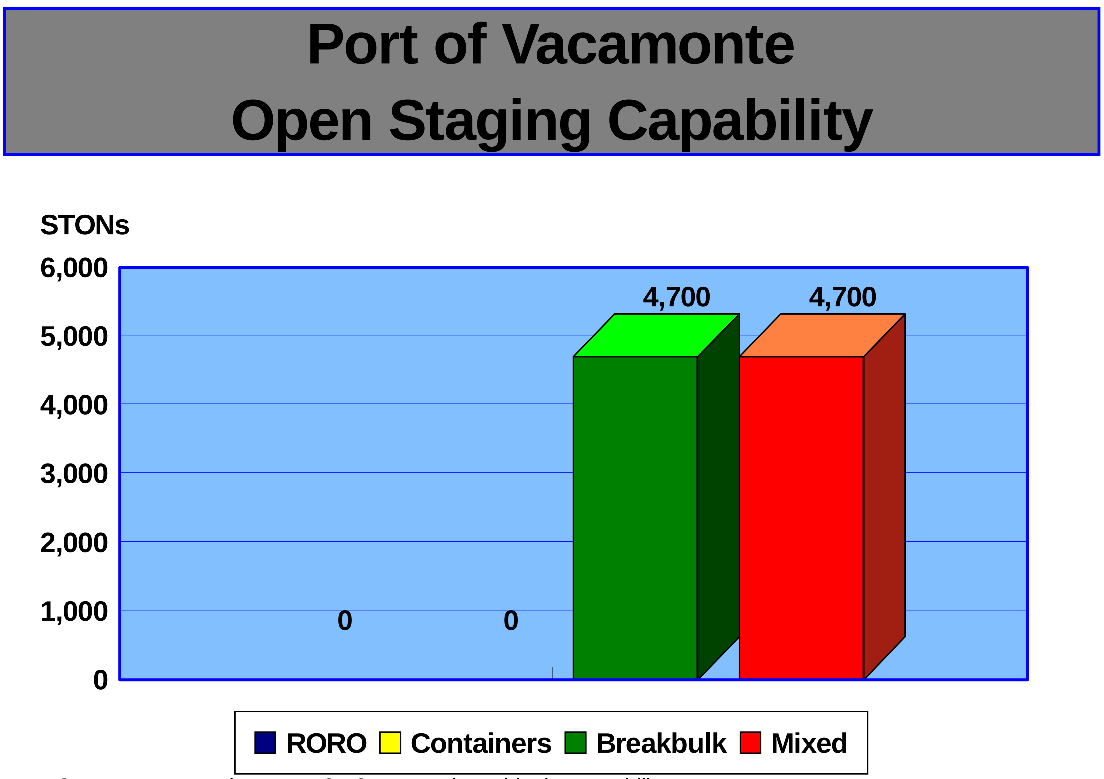


Staging

The port has about 10 acres of suitable open staging area. Availability of the staging area will vary with work at the port, but is usually good.

The port has no covered storage space suitable for general cargo. About 4,700 STON of break-bulk cargo can be staged at the port.

The chart shows the use of the distributed storage and staging space in the port by demonstrating the amounts by type of the cargo that can be stored there. This analysis assumed a usable space availability of 70 percent of the total area.

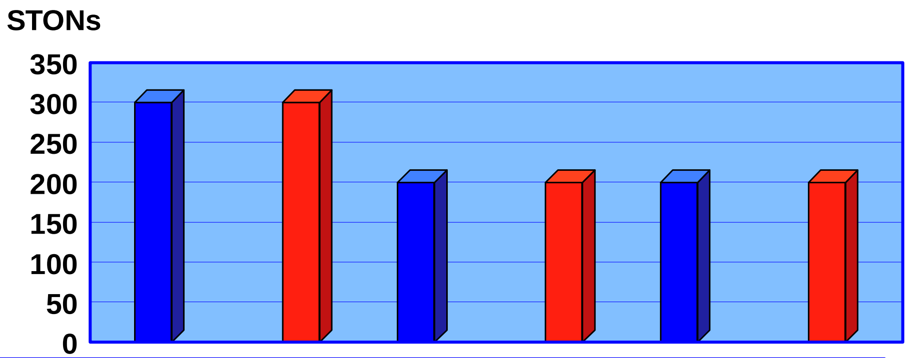


NOTE: Vacamonte has no RORO or container shipping capability

Shipping

Daily shipping subsystem totals for the terminals berths are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types. Assumptions and parameter values used to calculate these are shown in appendix.

Port of Vacamonte
Berth Throughput Capability



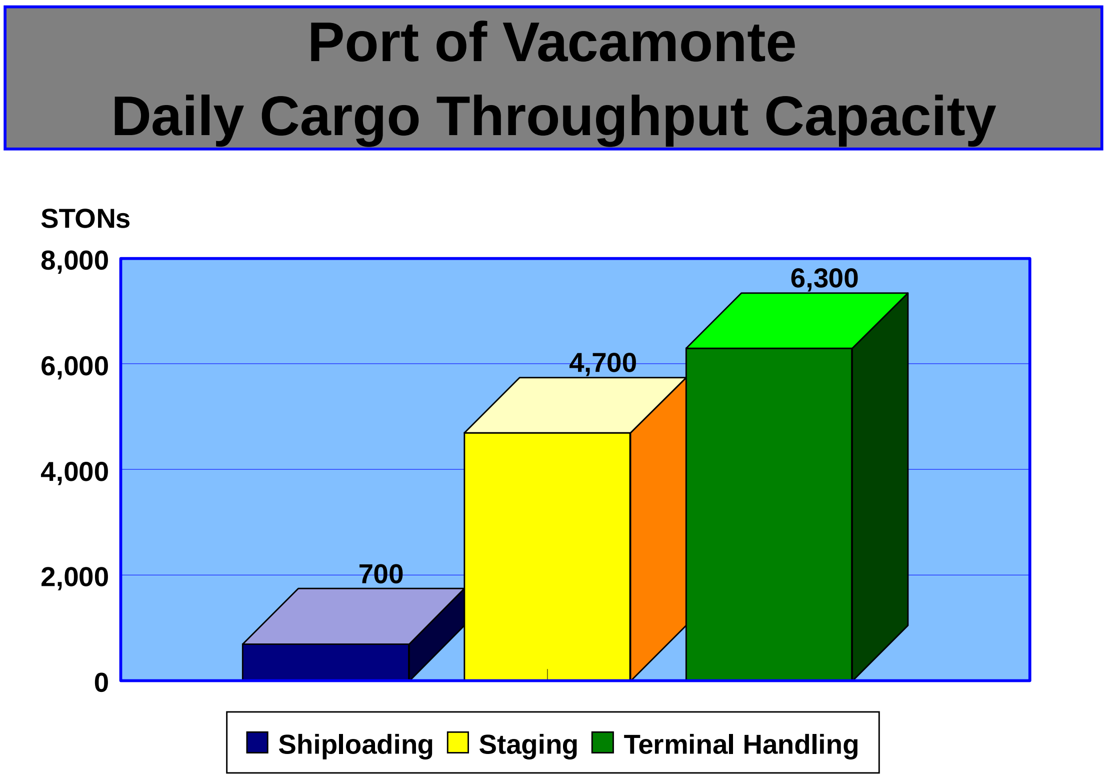
	Intl South	Intl East	Intl West
Breakbulk/Barge	300	200	200
RORO	0	0	0
Container	0	0	0
Mixed	300	200	200

NOTE: Throughput based on Barge loading only.
The port could berth small breakbulk vessels not normally used to deploy military cargo. Not recommended for RORO.

III. CONCLUSIONS

The Port of Vacamonte is not capable of supporting most US Military cargo transshipment operations.

Of the transportation subsystems analyzed, the least capable is the shipping subsystem. Because of limited vessel loading or unloading capability in the port this system is limited to a mixed throughput capability of about 700 STONs of breakbulk/barge cargo. Using small coaster type breakbulk vessels or barges, Vacamonte is an ideal candidate for hazardous cargo operations such as ammunition.



Commercial operations taking place concurrently in the port could limit actual daily throughput, sustainable over time, by an appropriate percentage of the terminal's overall capability.

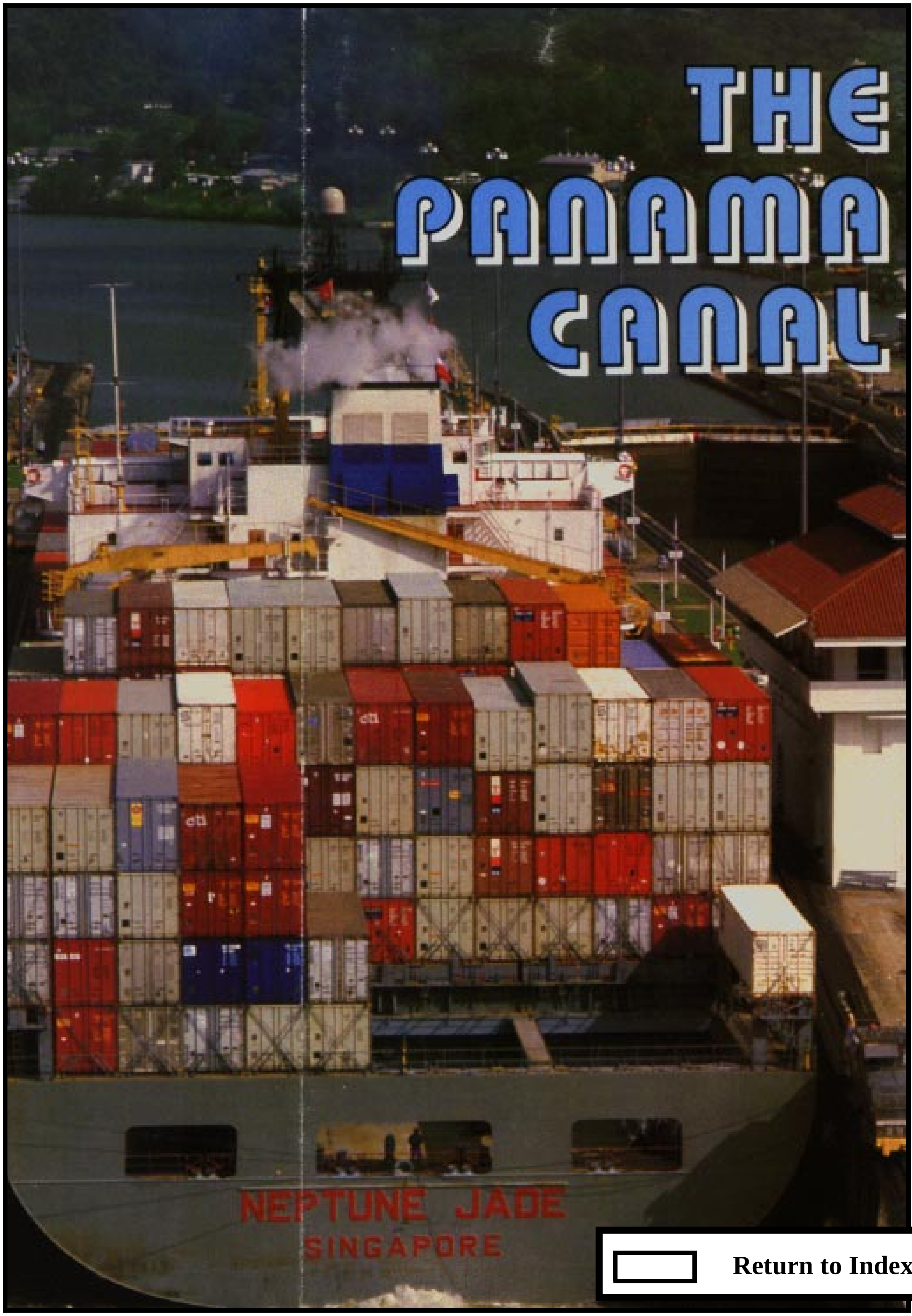
PORT OF VACAMONTE
THROUGHPUT SUMMARY
PER DAY CAPABILITY

	INTL SOUTH	**INTL EAST**	**INTL WEST**
Length (feet)	459	200	200
Depth Alongside (feet)	29	26	26
Breakbulk Throughput (STON)	300	200	200
RORO Throughput (STON)	0	0	0
RORO Square Ft (EST)	0	0	0
RORO Pieces [1]	0	0	0
Container Throughput (STON)	0	0	0
Container Throughput (TEU)	0	0	0
Mixed Throughput (STON)[2]	300	200	200

[1] Based on the 170 square foot per piece average accomplished during Operation Desert Shield and Desert Storm.

[2] Throughput for Vacamonte is based solely on barge capability. The port has minimal berthing for other types of cargo vessel. The port is not recommended for RORO due to International Pier configuration and great tidal range.

GENERAL
TRANSPORTATION SYSTEMS



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II. TRANSPORTATION SYSTEMS

GENERAL

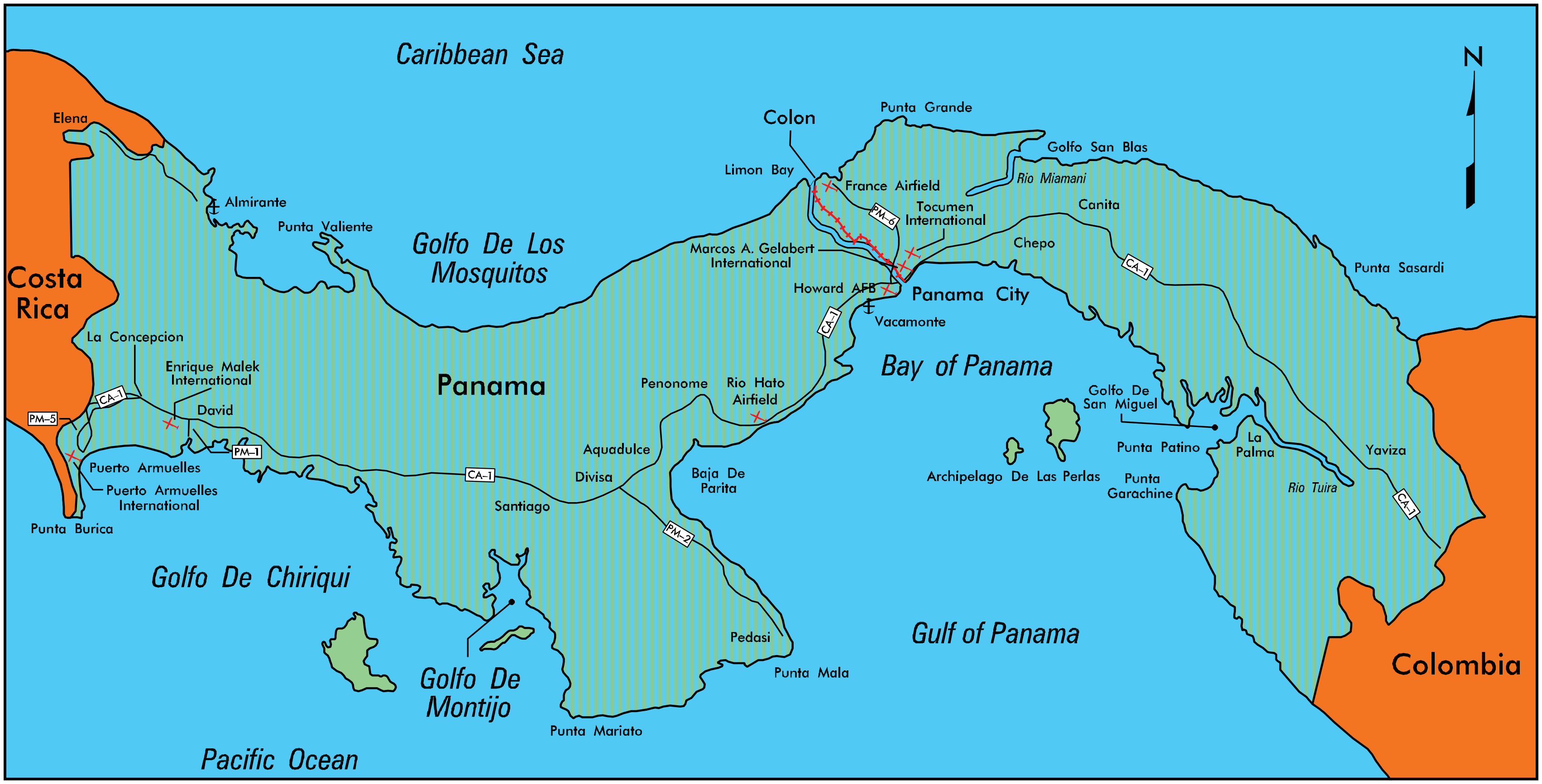
The Republic of Panama is about the size of South Carolina. It covers 74,400 square kilometers (28,750 square miles). The country is situated between Costa Rica, to the northwest, and Columbia, to the southeast. Panama City, Colon, and David are the major urban areas in Panama. Elsewhere in Panama, towns are extremely small, widely scattered, and sparsely developed. Most towns are local agricultural centers or coastal fishing ports. The entire Darien area, in eastern Panama, is sparsely populated and undeveloped.

Panama City, located near the Pacific coast entrance to the Panama Canal, is the largest urban area in Panama. It is the center of National government, commerce, industry, transportation, and military functions. The Port of Balboa, located next to Panama City in the former Canal Zone, is the Pacific terminus of the Panama Canal. It contains the administrative headquarters of the Panama Canal Commission.

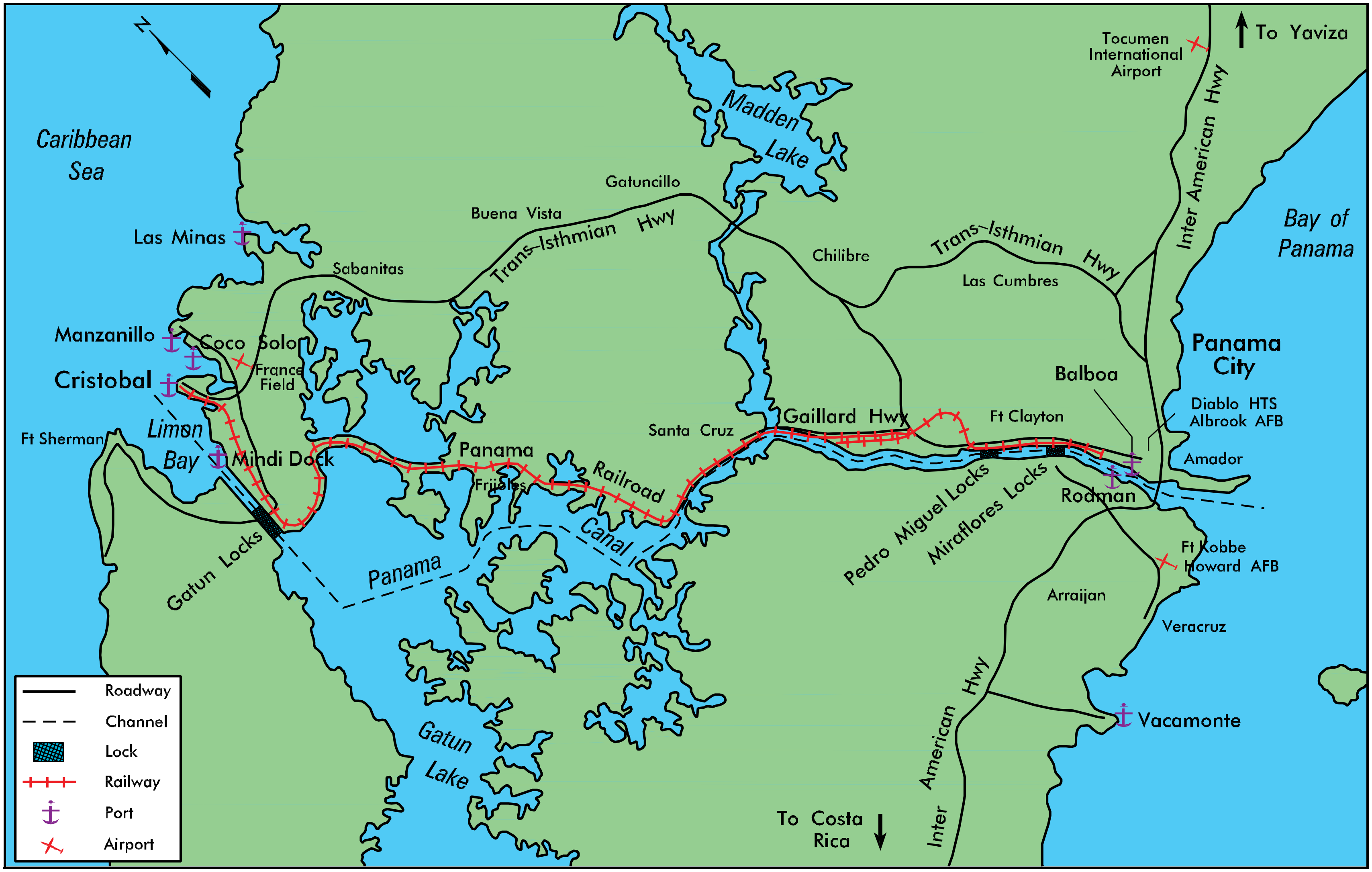
Colon, located on the Atlantic coast entrance to the Panama Canal, is the second largest urban area in Panama. The Port of Cristobal, located in Colon, is the major port in Panama. It handles most of the imported freight.

David is the third largest urban area in Panama. It serves as a regional transportation center because of its location on the segment of the Inter-American Highway and connects Panama City with Costa Rica.

Geographically, Panama has two well-defined areas: the Atlantic watershed, covered by tropical rain forest, and the Pacific watershed, which has a distinct dry season. Panama has a year-round tropical climate. The dry season runs from January through April and the rainy season from May through December. Rains are heaviest from September to November.



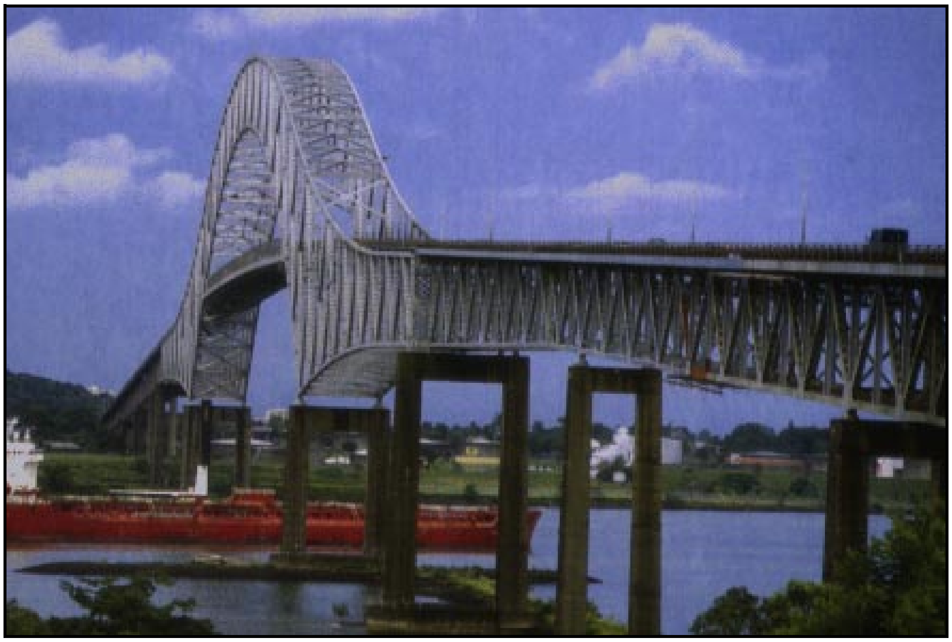
Panama Site Map



Former Panama Canal Zone Map

HIGHWAYS

The country has two main highways: the Inter-American, which extends east-west along the southern coast, and the Trans-Isthmian Highway (also known as the Boyd-Roosevelt Highway), which connects Panama City with Colon. Both highways are paved and in fair to good condition. The Trans-Isthmian Highway is the only roadway that crosses the isthmus between the Atlantic and Pacific Oceans. The Inter-American Highway connects Panama City with Costa Rica, to the west, and the town of Chepo, Panama, to the east.



Bridge of the Americans along the Inter-American Highway

Highway distances and travel times separating various cities in Panama are summarized in the following table. The route numbers in the table correspond to those shown on the previous country map.

HIGHWAY DISTANCES AND TRAVEL TIMES

Route Number	Origin	Destination	Surface	Kilometers	Miles	Travel Time
CA-1	Costa Rica	Chepo	Paved	555	345	8.6 hr
CA-1	Chepo	Yaviza	Unpaved	224	139	3.5 hr
PM-1	David	Padregal	Paved	7	4	0.2 hr
PM-2	Padasc	Divisa	Paved	105	65	1.6 hr
PM-3	Ft Clayton	Balboa	Paved	5	3	0.2 hr
PM-5	Junc CA-1	Puerto Armuelles	Paved	28	17	0.7 hr
PM-6	Junc CA-1	Colon	Paved	76	47	1.9 hr
PM-7	Manzanillo	Junc PM-6	Paved	1.6	1	0.1 hr
* Travel time based on average speeds of 64.4 kilometers per hour (40 mph).						

RAILROADS

Panama has three unconnected, single-track rail systems. The main system is a 47.3-mile, broad-gauge 1524-millimeter (60-inch) railroad track that connects Panama City, on the Pacific coast, with Colon, on the Atlantic coast.

The Ferrocorril de Panama (Panama National Railway) currently operates two freight trains to and from Colon and Panama City each weekday. Normally, a train consists of seven to ten flatcars hauling container freight.

Panama National Railcars carrying containers to the Port of Cristobal

The track has a maximum authorized speed of 64.4 kilometers per hour (40 miles per hour). With numerous stops at various locations - that is, station areas, yard limits, and track work locations where the speed limit is reduced - the schedule running time between the Port of Cristobal and the Port of Balboa is about 2 hours.

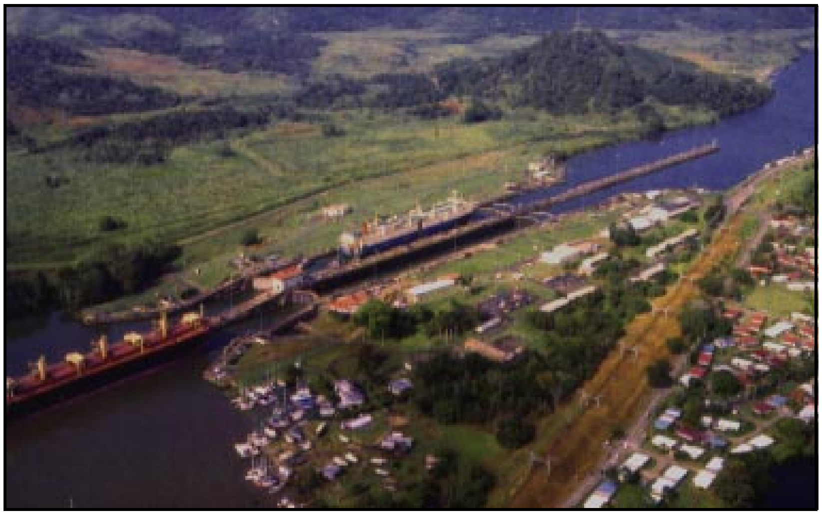
A study conducted by MTMCTEA (MTMC Report SE 86-3a-27, *Panama National Railroad Safety Study*, dated May 1986), found the Panama National Railroad to be in poor condition, with numerous defects evident throughout the system. Study results at that time were about $6 million dollars to restore the track network to safe operating conditions. Today conservative estimates to upgrade the rail network to safe operating conditions are around $60 million dollars. Based on its hazardous condition, the railroad is not recommended as a means of transporting military cargo or personnel.

INLAND WATERWAYS

The major inland waterway in the country is the Panama Canal, which extends across the Isthmus of Panama, connecting the Atlantic and Pacific Oceans. Except for the Panama Canal, inland waterways in the country are suitable for only limited navigation. Although waterways serve as the main form of transport to and from many sparsely populated areas, they are of little commercial or military value. The waterways are natural streams and are undeveloped for navigational purposes. Transit generally is limited to shallow-draft vessels carrying local products and passengers. Low tides in estuaries, low stream levels during the dry season, and debris are the major cause of waterway interruptions.

The canal is operated and administered by the Panama Canal Commission, a US agency with a nine-member board. Panama is gradually assuming control of the canal until the year 2000, when the canal will become an entirely Panamanian operation. An 82.7 kilometer (51.4 mile), lock-and-lake-type waterway, the Panama Canal is an artery for ships of all nations. It is favorably situated to work centers of commerce and sources of raw materials and, thus, is an important link in the Atlantic-Pacific trade routes. The canal affords ships on these routes substantial advantages in reduced sailing distance, time, and operating expense.

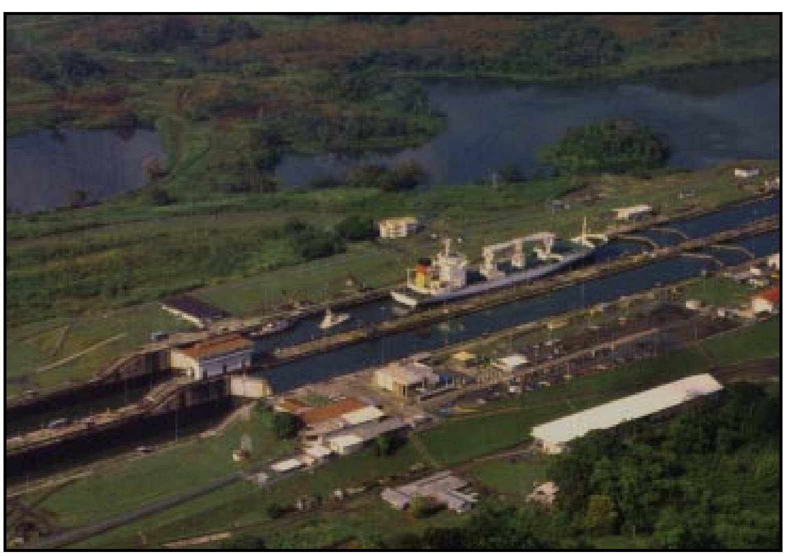
The Panama Canal crosses the narrow central portion of the Isthmus of Panama. Low, rounded hills and steep slopes between the eastern and western mountain chains comprise the continental divide. This area, 16 kilometers (9.9 miles) wide, centered on the axis of the canal, and extending 4.8 kilometers (3 miles) beyond the mean low water (MLW) marks on each coast of the Isthmus, was originally designated as the Canal Zone. (This designation was eliminated in the 1977 United States/Panamanian Treaty.) The original boundaries were extended to include all of Gatun and Madden Lakes and a portion of Chagres River, connecting the two lakes. The city of Colon is at the Caribbean entrance to the canal, and the Port of Balboa is at the Pacific entrance.



San Pedro Miguel Locks

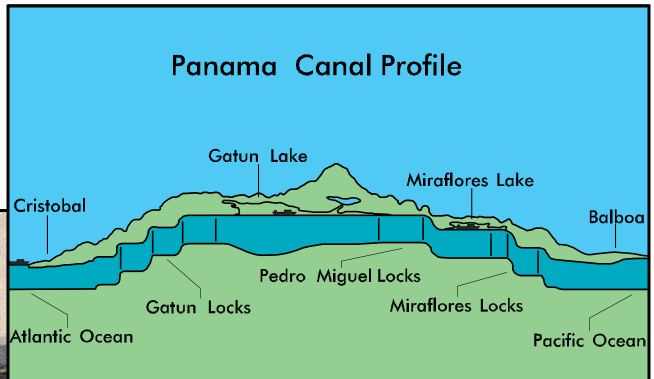
Vessels transiting the canal from the Atlantic to the Pacific follow the dredged channel to the Gatun Locks, which will raise vessels 26 meters (85 feet). Once out of the locks, ships cross Gatun Lake via a channel to Gaillard Cut and transit the continental divide. At the Pacific end of the cut, they pass through the Pedro Miguel Locks and are lowered 9.5 meters (31 feet) before entering the Miraflores Lake. Vessels, after navigating the lake, enter the Miraflores Locks and are lowered about 16.5 meters (54 feet) to the level of the Pacific Ocean and the channel leading to the Pacific approaches of the canal.

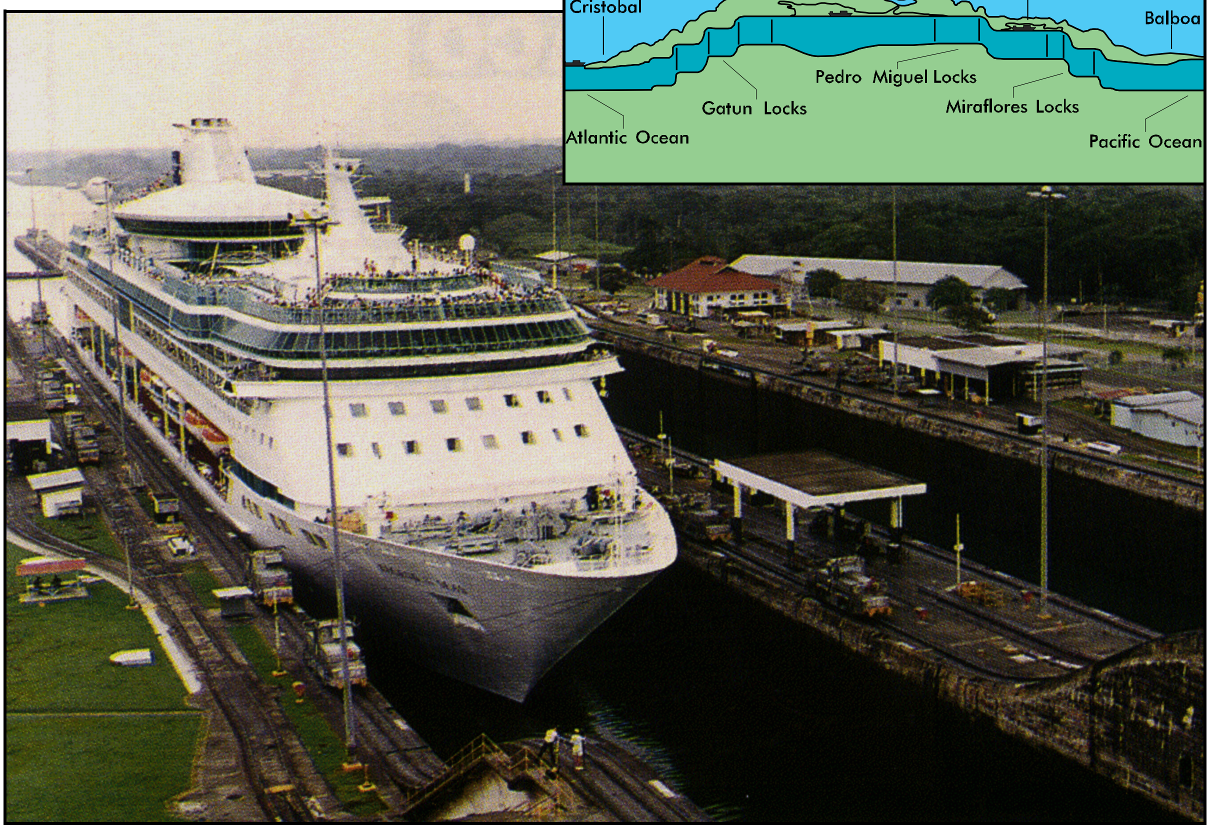
Gaillard Cut



Miraflores Locks

The lock chambers are all built in double flights to permit passage of two vessels at the same time. These chambers are 33.5 meters wide (110 feet wide) and 304.8 meters long (1,000 feet long). Minimum channel depths are 11.58 meters (38 feet) . The maximum safe dimensions for vessels in transit are 274.5 meters (900 feet) in length, 32.5 meters (107 feet) in beam, and 11.27 meters (37 feet) in draft 12.19 meters [(40 feet) in the May to December rainy season]. These dimensions include most commercial vessels except the super tankers and very large ore carriers. They also include all US Navy vessels except the large aircraft carriers.





Panama Canal Lock Chambers

Vessels are towed through the locks by electric-powered locomotives called mules. The pilot, rather than the captain, controls the ship as it transits the canal. Transit takes about 8 to 12 hours.

An average of 40 vessels transit the canal each day.

AIRPORTS

Six airfields in Panama can support C-130 aircraft at maximum gross takeoff weight. Of these airfields, Tocumen International Airport and Howard Air Force Base (AFB), near Panama City, and Enrique Malek International, near David, can support sustained military use. The remaining three airfields - Nuevo France Airfield, near Colon; Marcos A, Gelabert International, near Panama City; and Rio Hato Airfield, some distance southwest of Panama City - lack adequate service facilities. Both Tocumen International Airport and Howard AFB can accommodate the C-141 and C-5 military transport aircraft.

Howard Air Force Base Airfield

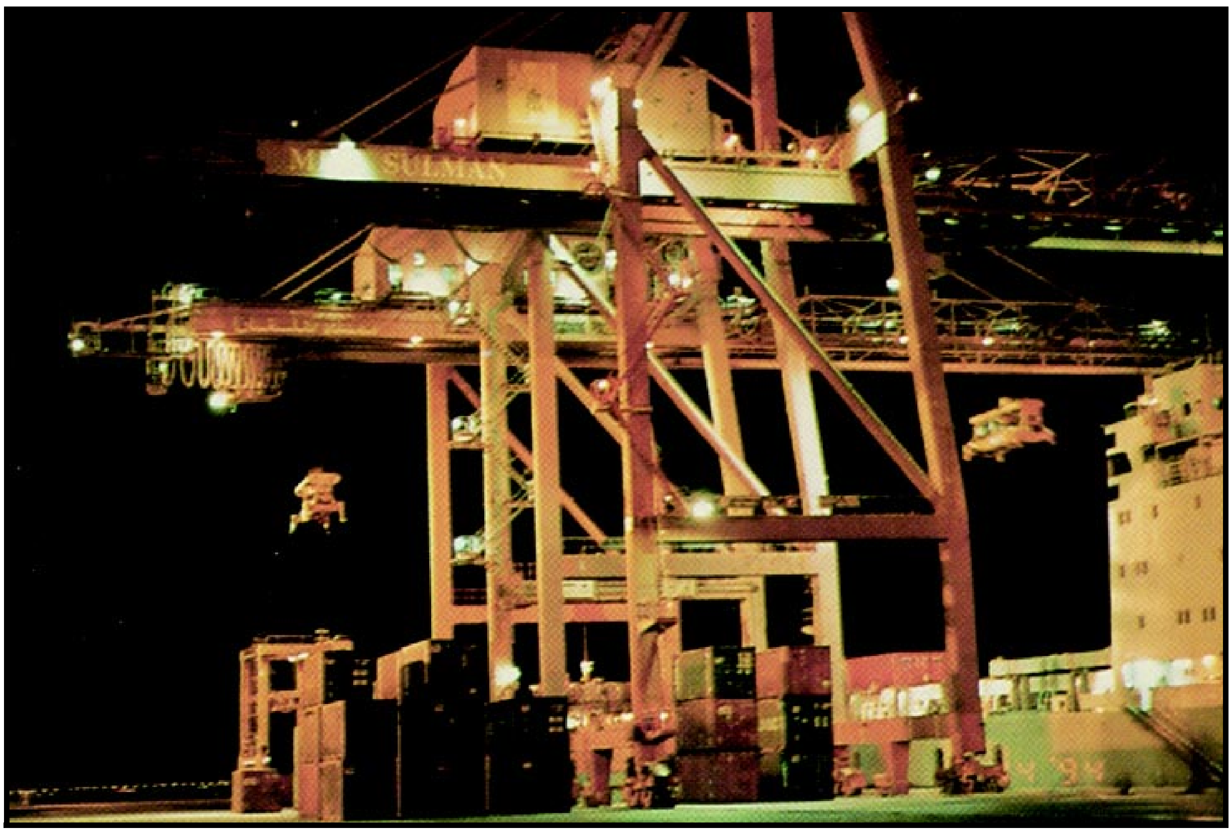
SEAPORTS

The three major seaports in Panama are the Ports of Cristobal and Balboa, and the Manzanillo International Terminal. The Ports of Cristobal and Balboa are administered by the Autoridad Portuario Nacional (National Port Authority), and Manzanillo is a new privately owned container terminal. The Port of Cristobal, and Manzanillo International Terminal are on the Atlantic coast, while the Port of Balboa is on the Pacific coast. Numerous smaller ports have been developed in Panama, including Coco Solo, Mindi Dock, Almirante, Vacamonte, and Naval Station Panama Canal, which are described later in this study. The Ports of Coco Solo, Manzanillo, and Mindi Dock are near the City of Colon, and the Port of Vacamonte and the Naval Station Panama Canal are southwest of Panama City.

PIPELINES

The old Trans-Isthmian Pipeline allowed a variety of fuels to be transferred from coast to coast without the need for a tanker to transit the canal. However, the pipeline was severed and capped near Gamboa, Panama, during the late 1970's, when the canal channel was widened and deepened. About 800 feet of each of the four pipe systems were removed. There are no plans to reconnect this pipeline.

PORT OF MINA SULMAN
BAHRAIN



I. EXECUTIVE SUMMARY

GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Mina Sulman, Bahrain, based on site visits in early June 1997 and February 1999. The port can accommodate vessels as large as FSS and LMSR, but not fully loaded due to the marginal wharf berth depths of 35 feet at mean low water (MLW). Traversing the 32-foot deep MLW channel may require the high tide.

The Port of Mina Sulman typically handles general cargo and containers along its 3,940-foot contiguous wharf, with four container cranes. The port's narrow 2,460-foot finger pier routinely supports U.S. Navy vessels for light repairs and crew rest and relaxation. The berths along the finger pier are only 29 feet deep at MLW. Tidal variation at the port is 8 feet.

The port is located in a fairly well-developed area on the northeast coast of Bahrain, adjacent to the U.S. Navy Base. Connector routes and the main highway are in very good condition, but planners should expect congestion immediately outside the port. Military convoys would traverse the causeway to Saudi Arabia. The country of Bahrain has no railroads.

THROUGHPUT

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of 15,000 short tons (STON) per day. The RORO capability is 18,000 STON per day.

APPLICATION

We find the port capable of handling a notional heavy armored cavalry regiment in 3.5 days. Our analysis uses four Cape D class vessels calling at the port. These vessels have no restrictions at the berths, but must wait for high tide to traverse the 32-foot deep MLW channel. The unit requires 10.5 acres of paved open staging area. This is only 10 percent of the total 103 acres at the port.

II. GENERAL DATA

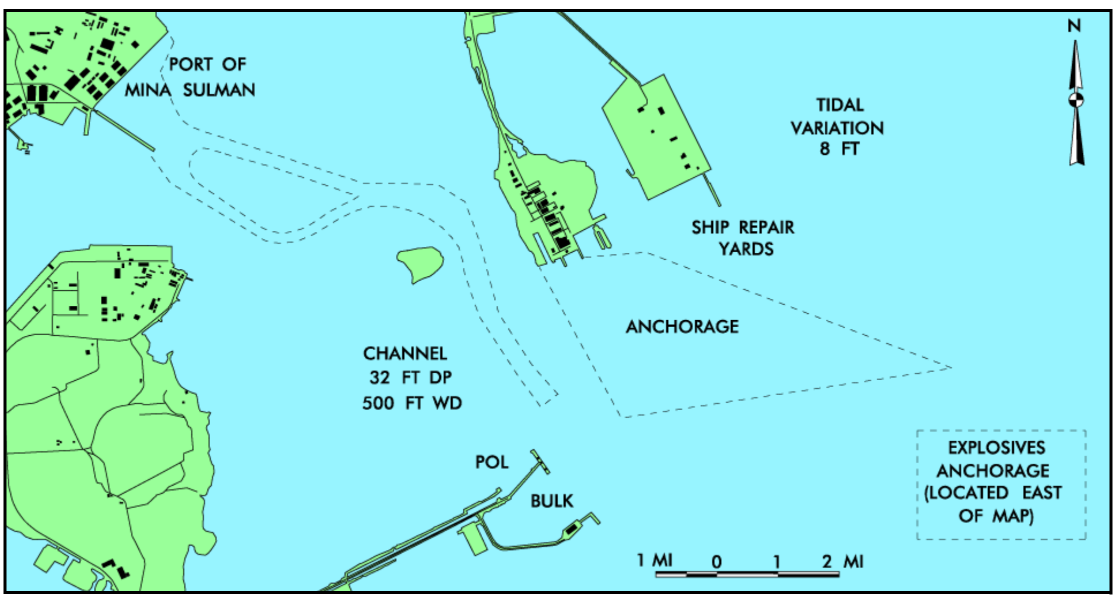
The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Mina Sulman, Bahrain, with support from the 831st U.S. Army Transportation Battalion, Southwest Asia. The major source of data was the Mina Sulman Port Authority by way of the Administrative Support Unit, Southwest Asia Support Operations. We obtained a cursory visit of the port on 2 June 1997.

TRANSPORTATION ACCESS

Water

The port is in the northeast region of Bahrain, at 26° 13’ N Latitude, and 50° 36’ E Longitude, adjacent to the U.S. Navy Base, Bahrain (Administrative Support Unit, Southwest Asia). The port consists of a marginal wharf, with four container cranes, and a 2,460-foot finger pier. The finger pier is typically used for berthing U.S. Navy vessels on liberty or awaiting light repair and supplies.

There are no overhead restrictions for vessels entering the port. While navigating the channel to the port, vessels pass two ship repair yards, a deep water petroleum, oils and lubricants pier, and a bulk facility for handling aluminum ore materials. These facilities are not useful for processing military vehicles and equipment. However, they can provide tugboats and materials handling equipment (MHE). Tidal variation at the port is 8 feet.



Water Access to the Port of Mina Sulman

Vessels up to 984 feet (300 meters) long may enter the port subject to tidal conditions. Pilots are compulsory and available at any time, and usually board vessels about 1.5 miles from the port. Four tugs are available at the port: two with 800 horsepower and two with 1,600.

Two anchorages lie in the open water at the entrance to the channel. The southern anchorage is designated for explosives.

Highway

The port gate is on Sulman Highway and has two lanes in each direction. Vehicles proceed from the port westward on Sulman Highway, which changes to Causeway Approach Road, then changes to King Fahad Causeway. This Causeway links the country of Bahrain to Saudi Arabia. During good traffic conditions, and without a border inspection, vehicles can reach the Saudi Arabian border in 30 minutes. No unusual clearance problems exist on roads leading from the port.

Air

The closest airport is Bahrain International Airport, which is 5.6 miles (9 kilometers), directly north of the port, via the Shaikh Hamad Causeway to the city of Muharraq. The runway is 10,000 feet long, and regularly handles the largest commercial jets.

The nearest military airfield is owned by the Bahrain Air Force, but shares with the U.S. military. This airfield is about 35 miles (56 kilometers) from the Port of Mina Sulman in southeast Bahrain. It has a runway about 12,000 feet long.

Rail

There is no rail in the country of Bahrain and no plans to develop any.

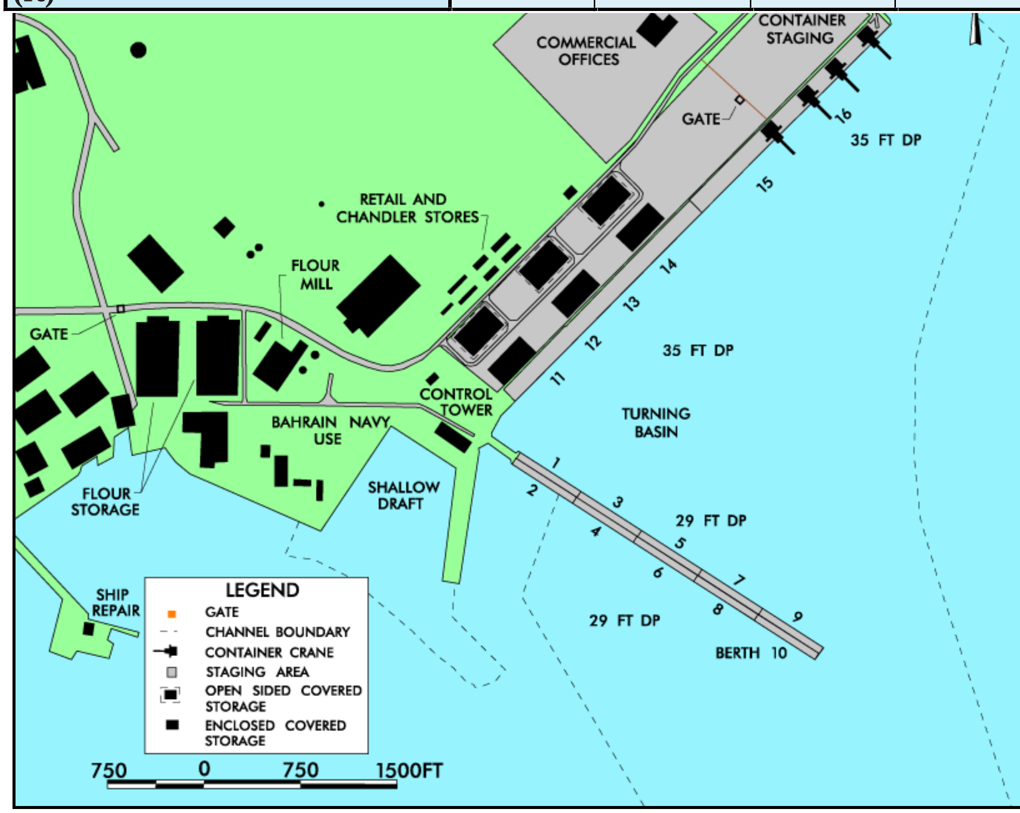
Highway and Air Access to the Port of Mina Sulman

PORT FACILITIES

Berthing

About half of the cargo handled by the Port of Mina Sulman is containerized. Most of the cargo, containerized or not, is import cargo for the country of Bahrain or for transit to Saudi Arabia.

CHARACTERISTICS OF THE PORT OF MINA SULMAN				
Characteristics	Berths			
	Berths 1-9 Odd	Berths 2-10 Even	Berths 11-14	Berths 15-16
Length (ft)	2,460	2,460	1,968	1,968
Depth alongside at MLW (ft)	29	29	35	35
Deck strength (psf)	400	400	600	600
Apron width (ft)	54	54	80	OPEN
Apron height above MLW (ft)	10	10	10	10
Number of container cranes	0	0	0	4
Number of wharf cranes	0	0	0	0
Apron lighting	YES	YES	YES	YES
Straight-stern RORO facilities	NO	NO	NO	NO
Apron length served by rail (ft)	0	0	0	0



Land-Use Map of the Port of Mina Sulman

BERTHING CAPABILITIES OF PORT OF MINA SULMAN

Vessel	Berths			
	1-9 odd	2-10 even	11-14	15-16
Breakbulk				
C3-S-38a	4	4	3	3
C4-S-58a	4,a	4,a	3	3
C4-S-66a	4,a,g	4,a,g	3,g	3,g
C5-S-37e	3,a	3,a	3	3
Seatrain				
GA and PR-class	4	4	3	3
Barge				
LASH C8-S-81b	2,a,g	2,a,g	2,g	2,g
LASH C9-S-81d	2,a,g	2,a,g	2,a,g	2,a,g
LASH lighter	12	12	9	9
SEABEE C8-S-82a	2,a,g	2,a,g	2,a,g	2,a,g
SEABEE barge	12	12	9	9
RORO				
Comet	4,d,o	4,d,o	3,d,i	3,d,i
Meteor	4,d,o	4,d,o	3,d,i	3,d,i
Cape Gnome	3,a,d,o,g	3,a,d,o,g	3,d,g,i,j	3,d,g,i,j
C7-S-95a	3,a,b,g	3,a,b,g	2,g	2,g
Cape Taylor	3,b	3,b	2	2
Cape Orlando	3,a,b	3,a,b	2,i	2,i
MV Ambassador	4,d	4,d	3,d	3,d
Callaghan	3,d,o	3,d,o	2,d,o	2,d
Cape Lambert	3,a,b	3,a,b	2,i	2,i
LMSR-class	2,a,b,g	2,a,b,g	2,g	2,g
FSS	2,a,b,g	2,a,b,g	2,a,g	2,a,g
Cape E-class	3,a,b	3,a,b	2,i,j	2,i,j
Cape D-class	3,a,b,g	3,a,b,g	2,g	2,g
Cape H-class	3,a,b,g	3,a,b,g	2,a,g	2,a,g
Cape Texas	3,b	3,b	2,i	2,i
Cape R-class	3,a,d,g	3,a,d,g	2,d,g	2,d,g
Cape I-class	3,a,b	3,a,b	2,i	2,i
Cape Victory	3,b	3,b	2,i	2,I
Container				
C6-M-147a	3,b,e	3,b,e	2,e	2
C7-S-69c	3,a,b,e	3,a,b,e	2,e	2
C7-S-68c	3,a,b,e	3,a,b,e	2,e	2
C8-S-85c	2,a,b,e,g	2,a,b,e,g	2,e,g	2,g
C9-M-132b	2,a,b,e,g	2,a,b,e,g	2,e,g	2,g
C9-M-F141a	2,a,b,e,g	2,a,b,e,g	2,a,e,g	2,a,g
C6-S-1qd (TACS)	3,a,b	3,a,b	2	2
C5-S-MA73c (TACS)	3,a,b	3,a,b	3	3
C6-S-MA60d (TACS)	3,a,b	3,a,b	2	2
Combination				
C7-S-133a	2,a,b,g	2,a,b,g	2,g	2,g
Maersk	3,a,b,g	3,a,b,g	2,g	2,g
AmSea	3,a,b	3,a,b	2	2

Notes:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

- a - vessel draft limited
- b - apron too narrow
- c - berth too short
- d - no straight-stern ramp
- e - no CNTNR cranes
- f - anchorage OK, berth too shallow
- g - shallow channel
- h - no special ramps
- i - tide too low for ramp clearance
- j - tide too high for ramp clearance
- k - ramp angle too steep at low tide
- m - ramp angle too steep at high tide
- n - parallel ramp operation ONLY
- o - apron too narrow for side ramp

Ramp clearance and angle based on maximum vessel draft.

♦ May Prevent Operation

♦ May Limit Operation

Open Storage

The Port of Mina Sulman has a total of 103 acres (4,500,000 square meters) of paved open staging available for military operations. Sixty acres support container staging at Berth 15-16.

The port has no experience handling helicopters. The area most suitable to handle helicopters is inland of Berth 14, west of the entrance to the container terminal. The inland sheds have open sides, but could easily be sealed to support shrink-wrap operations. Another option is to conduct shrink-wrapping on the adjacent Navy base.

Westward View of Container Staging at the Container Terminal (Berth 15-16) of the Port of Mina Sulman

Because of the port's vulnerable location, plans should call for the vehicles to dwell at the port as little as possible. Military vehicles and equipment should stage outside of the port, if possible.

Covered Storage

The Port of Mina Sulman has 18 sheds and warehouses totaling 1,290,000 square feet (120,000 square meters) of covered storage area. None of these sheds are refrigerated. As mentioned above, the sheds inland of Berths 11 through 14 are open-sided; and none have truck docks.

Container Stuffing at Open-sided Warehouse

Highway

The Port of Mina Sulman has one gate, which is on Sulman Highway. Containers pass through a checkpoint as they enter the container terminal at Berth 15-16.

Gate to the Port of Mina Sulman

The roads within the port are uncongested and in good condition. Vehicles can move around the port without restrictions on height or weight. Though not posted, speed limits in the port are 9 miles per hour (15 kilometers per hour).

The port has no truck scales.

Unloading/Loading Positions

The port has no ramps or docks for truck operations. The military should bring or build ramps to load trucks and trailers that do not have integral ramps.

Offsite Storage Area

The Navy base (Administrative Support Unit, Southwest Asia) is well-developed and cannot provide more than 5 acres of offsite marshaling area to support military operations. Aside from the Navy base, much of the land outside the port is flat and undeveloped. However, the area is rapidly being developed with hotels and apartment buildings. At present, there are 10 to 15 undeveloped areas that have a few acres each.

Another possibility for offsite marshaling is the southern part of the island, about 20 miles away. The Bahrain Air Force Base is in the southeast of the island, as are a few other little-known military bases. These military bases can provide support for nearby marshaling in the undeveloped areas.

MATERIALS HANDLING EQUIPMENT			
MHE Type	Capacity (STON)	Quantity	Owner
Mobile Crane	80	1	Port
Mobile Crane	40	3	Port
Mobile Crane	25	1	Port
Straddle Carrier	30	12	Port
Container Forklift	42	1	Port
Container Forklift	35	2	Port
Container Forklift	30	32	Port
Container Forklift	14	6	Port
Forklift	3	23	Port

The port owns several mobile cranes and forklifts. Stevedore and rental companies in Bahrain own other MHE. If necessary, rental equipment can easily come from Saudi Arabia.

Straddle Carrier

AMMUNITION

The Port of Mina Sulman has handled ammunition during contingencies such as the Dessert Shield/Desert Storm; however, there is still no published net explosive weight (NEW) rating. With port authority's approval, ammunition handling is possible, but discouraged. A designated explosive anchorage is provided on the water access map. It has no published NEW rating.

PETROLEUM, OILS AND LUBRICANTS (POL)

The water access map shows the POL terminal south of the Port of Mina Sulman, on the way out to open water. This facility exports oils directly from the Bahrain refineries.

FUTURE DEVELOPMENT

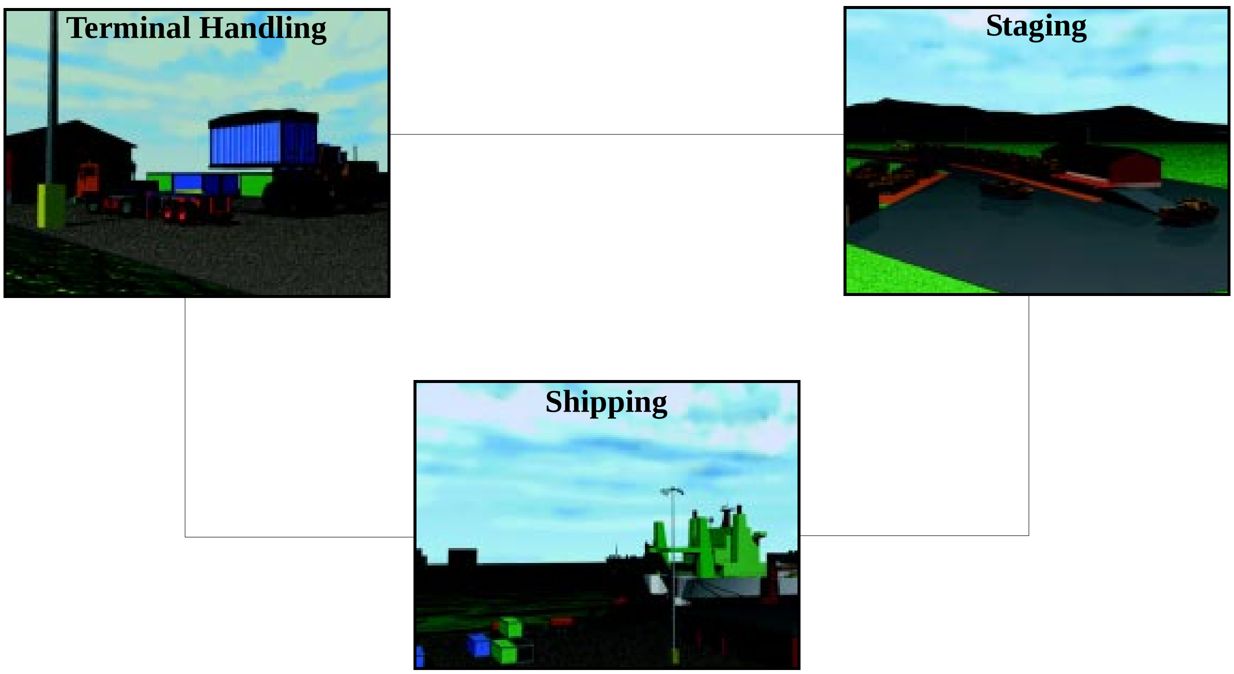
The immediate plans at the Port of Mina Sulman are to dredge the channel and berths at the finger pier to accommodate aircraft carriers. These vessels require 40 feet of water.

Although there are no further plans to improve the facilities at the port, the Navy base expects to develop land closer to the port. This will add about 50 acres to the base.

III. THROUGHPUT ANALYSIS

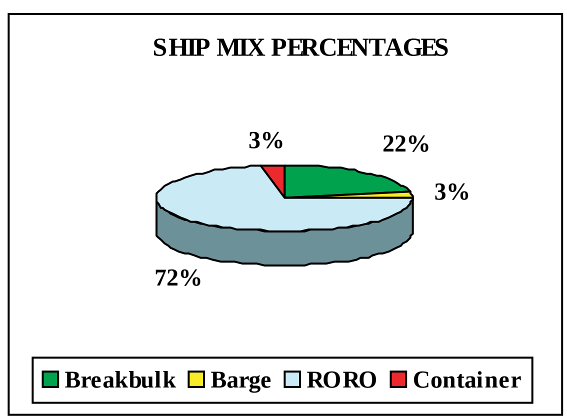
GENERAL

This section evaluates the throughput capability of the Port of Mina Sulman using the port operational performance simulator computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging/hardstand marshaling, and terminal processing/handling - in STON per day.



Terminal Throughput Subsystems

This analysis assumes 70 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using a 70 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future operations.



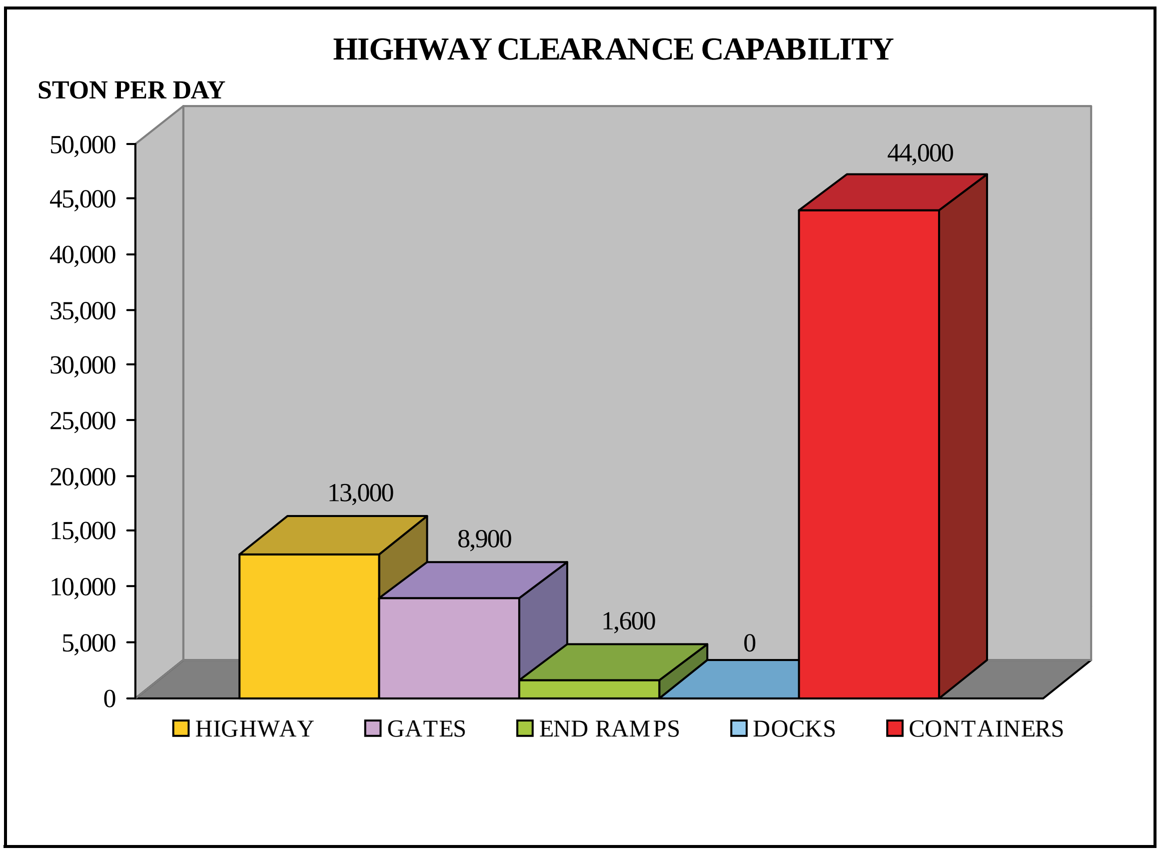
RECEPTION/HANDLING

Highway

The road leading vehicles from the port can handle 13,000 STON (53,000 MTON) of military equipment per day. The gate restricts the throughput of the port to only 8,900 STON (34,00 MTON) per day.

Roadable vehicles in convoys will proceed directly to the marshaling areas. Vehicles on commercial or military flatbed trailers without integral ramps must be handled at portable end ramps brought or built by the military port operator. Each such ramp can support 1,600 STON (4,800 MTON) per day.

There are no truck docks at the port. The port does, however, have 12 straddle carriers that can support 44,000 STON (111,000 MTON) of containers per day.



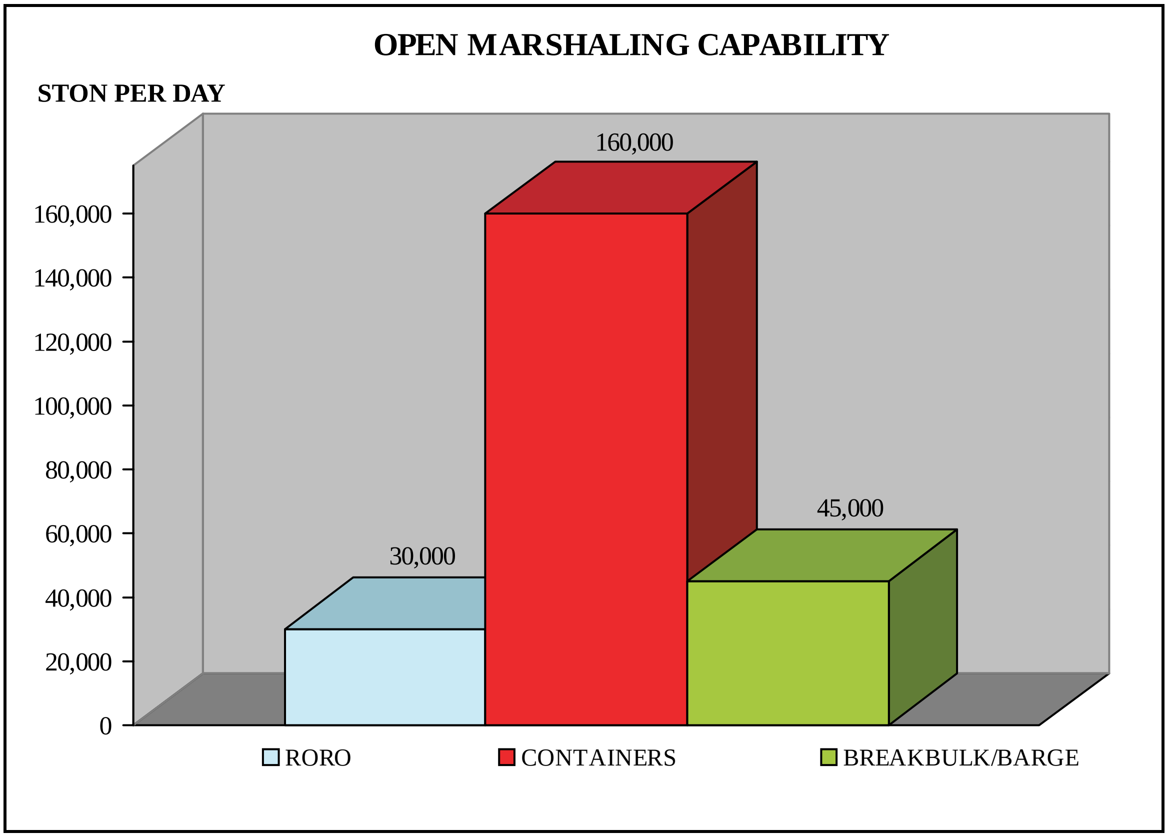
Rail

There is no rail in the country of Bahrain.

Open Storage

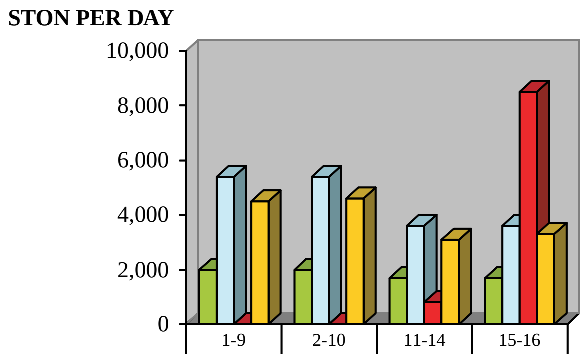
The port has a total of about 103 acres (4,500,000 square meters) of paved open storage.

The Port of Mina Sulman has 18 sheds and warehouses. These sheds and warehouses combined total about 1,290,000 square feet (120,000 square meters) of covered storage area. The sheds have no refrigeration or truck docks.



Shipping

BERTH THROUGHPUT CAPABILITY



	1-9	2-10	11-14	15-16
BREAKBULK/BARGE	2,000	2,000	1,700	1,700
RORO	5,400	5,400	3,600	3,600
CONTAINERS	0	0	810	8,500
MIXED	4,500	4,600	3,100	3,300

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility.

CONVERSION FAC TORS	
Breakbulk:	.4 STON per MTON
RORO:	.25 STON per MTON
Containers:	.4 STON per MTON

THROUGHPUT SUMMARY FOR THE PORT OF MINA SULMAN

BERTH	LENGTH (feet) (meters)	DEPTH (feet) (meters)	BB (STON) (MTON)	RORO (STON) (MTON)	RORO SQ FT (EST)	RORO PIECES	CNTNR (STON) (MTON) (TEU)	MIXED (STON) (MTON)
1-9	2,460 750	29 8.8	2,000 4,900	5,400 22,000	108,000 635	540	0	4,500 17,000
2-10	2,460 750	29 8.8	2,000 4,900	5,400 22,000	108,000 635	540	0	4,600 17,700
11-14	1,968 600	35 10.6	1,700 4,300	3,600 14,000	72,000 420	423	810 2,000 100	3,100 12,000
15-16	1,968 600	35 10.6	1,700 4,300	3,600 14,000	72,000 420	423	8,500 21,000 1,100	3,300 12,000

BERTH PREFERENCE RANKING			
	LOADING STYLE		
Berths	**Breakbulk**	**RORO**	**CNTNR**
1-9 Odd	3	3	-
2-10 Even	3	3	-
11-14	2	2	-
15-16	1	1	1

NOTE: Berths marked with a "-" are not recommended for these operations.

The type of ship preferred at each berth is based on an evaluation of various characteristics at each berth using a point system (see app). Each berth is rated by its characteristics, for its capability to support various ship-loading and discharging operations. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The berth with the highest points is the first preferred berth for that specific loading style, and is therefore rated 1. In general, no one berth is ideal for all military operations. The best berth depends on the type of ship loaded.

The container berth (Berth 15-16) is the best berth at the Port of Mina Sulman, regardless of what ship is planned. This is because the berth has four container cranes, open apron, and deep water. Berth 11-14 is the next preferred, with the finger pier being the least desirable for loading military vehicles and equipment.

Large Vessel Operations

The berths on the finger pier are the least useful for military operations. Their aprons are too narrow and weak for practical application. The berths are also too shallow to fully load large vessels. Of the remaining berths, Berth 15-16 is preferred because of its container cranes and open apron. Allowing a slight overlap into Berth 14, the military can load two large LMSR or FSS-sized vessels at Berth 15-16.

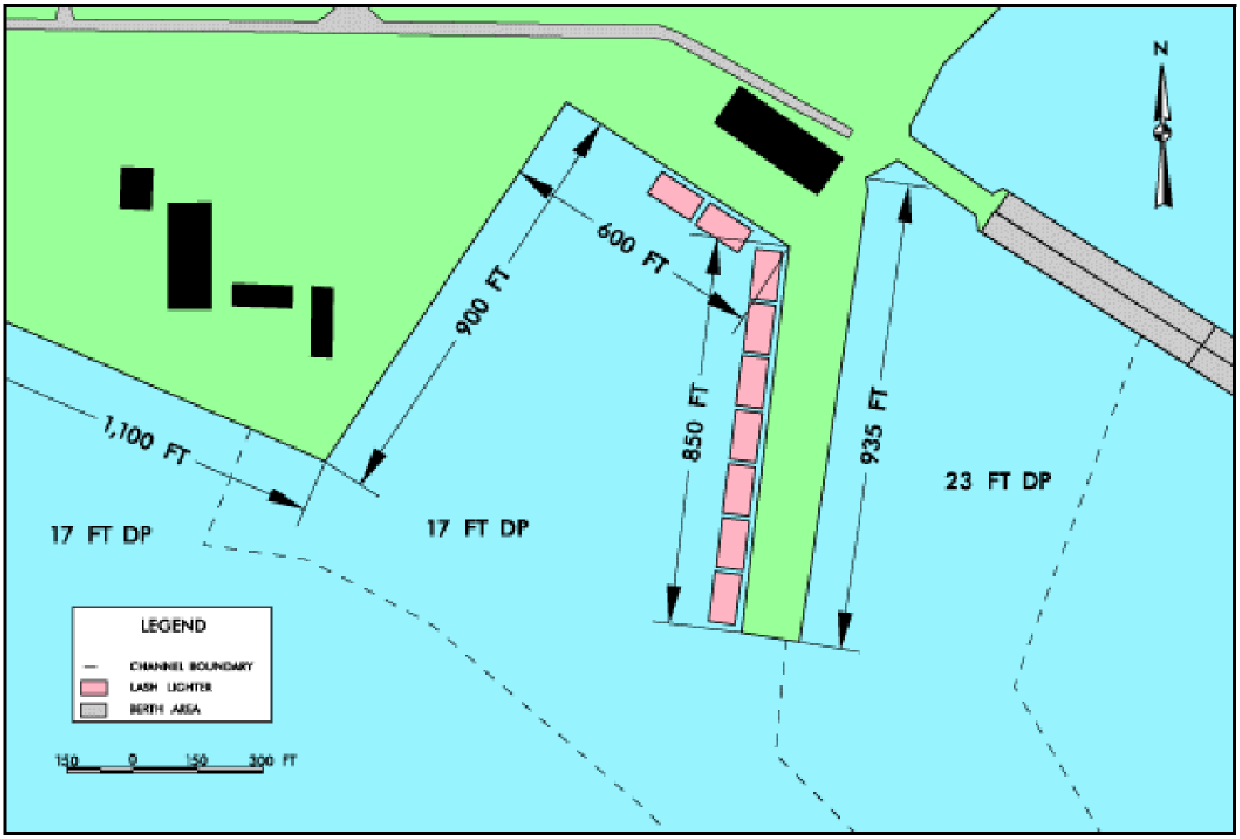
Barge Operations

Some of the berths not mentioned in this analysis might be used to support barge operations. To the west of the finger pier are berths for harbor vessels, small cargo vessels, and offshore supply and service vessels. These berths total about 4,000 feet (1,200 meters) and are 17 to 23 feet (5.2 to 7 meters) deep. They can only support military operations with barges. A few key issues for planning purposes are:

- Each mobile crane could handle 331 STON or 829 MTON per day, assuming 20 productive work hours, and a 90 percent berth utilization factor.

- SEABEE barges are 175 feet long. Typical LASH lighters are 115 foot long. A crane operating every other barge or lighter provides sufficient working space.

Assuming the 1,100-foot length of apron is available, the military could marshal nine 115-foot LASH lighters, or six 175-foot SEABEE barges. Assuming five mobile cranes are operating (one crane for every other LASH lighter), the barge operations along this side of the pier could support loading or unloading 1,600 STON or 4,100 MTON per day.

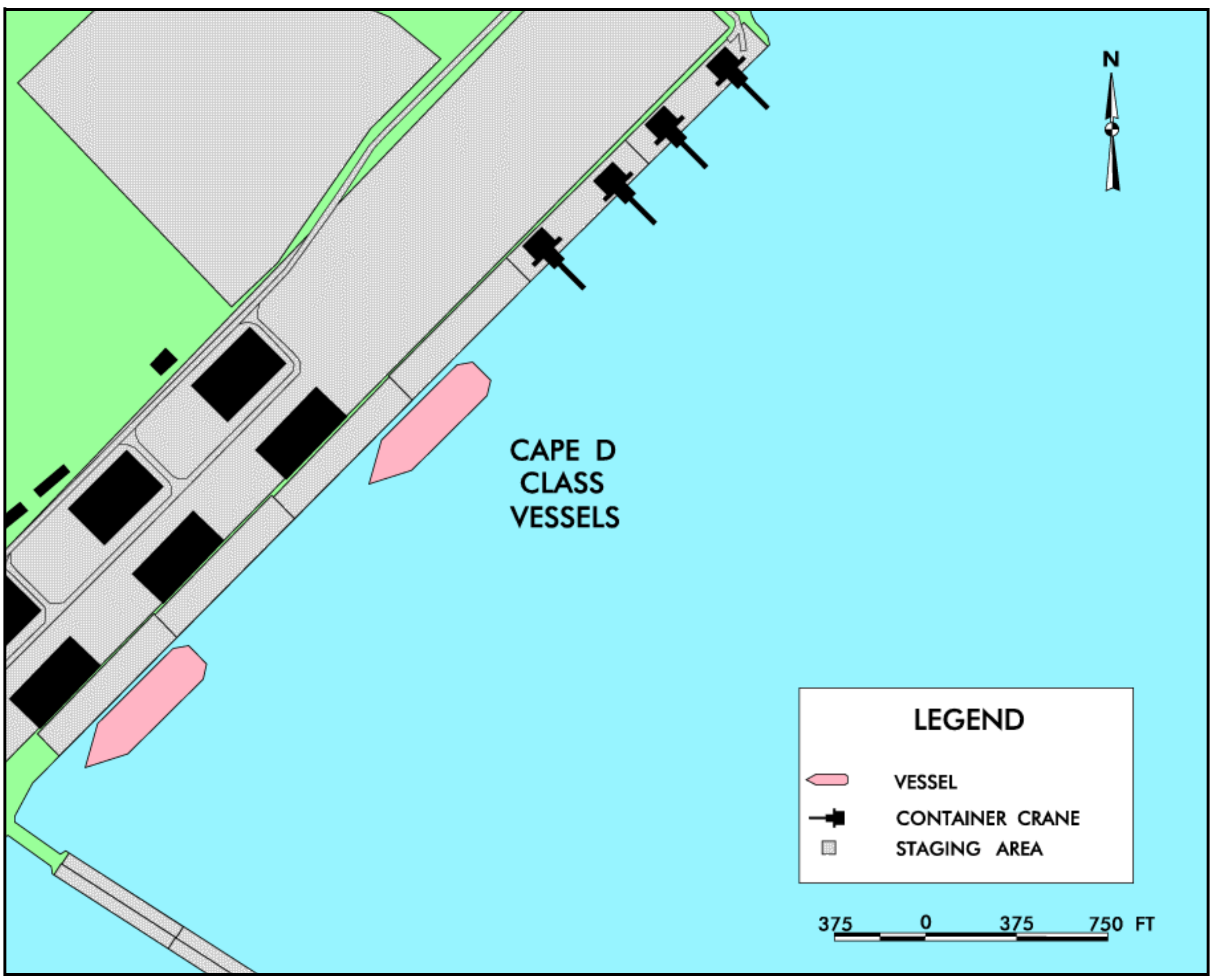


Potential Barge Loading Area in the Port of Mina Sulman

IV. APPLICATION

This section evaluates the port's throughput capability for supporting a notional heavy armored cavalry regiment. Because of the shallow drafts at the Port of Mina Sulman (29 to 35 feet MLW), this study evaluates the operation using vessels of the Cape D class, such as the ***Cape Douglas***. These vessels have a maximum draft of 33 feet, (9.8 meters), a lightship draft of 13 feet, 6 inches (4.1 meters), and an overall length of 681 feet (207 meters). They can berth without restrictions at Berths 11-16.

The facilities used depend on decisions made by the Director General of Ports. The finger pier (Berths 1-10) is too narrow and weak to support operations with heavy armored equipment. In addition, the finger pier is likely to be occupied by Navy combatant vessels during times of contingency. The U.S. military will likely be told to berth vessels beginning at Berth 11 and berthing additional vessels toward Berth 16.



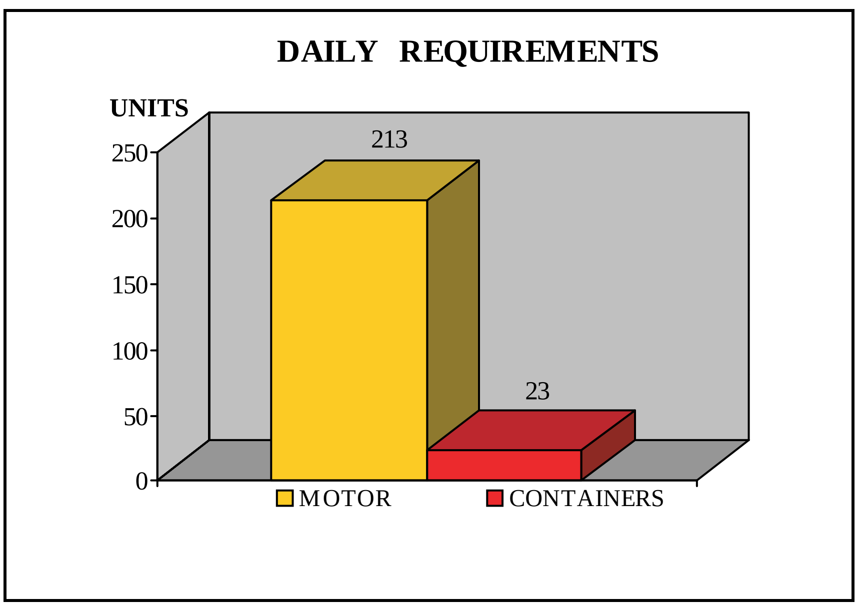
Facilities to Support U.S. Military Operations

REQUIREMENTS

For purposes of this analysis, we assume the requirement for the Port of Mina Sulman is to support a notional heavy armored cavalry regiment. Since the theater will likely be on the Saudi Arabian Peninsula, we will assume the regiment will cross the King Fahad Causeway from the island of Bahrain. Planners should ensure the weight of the vehicles and equipment is within the limits of all bridges traversed.

We assume the port must process the regiment in only 6 days of offloading and port clearance. The regiment would have 888 (148 per day) self-propelled vehicles towing 561 (94 per day) trailers, with 137 (23 per day) 40-foot semitrailers and 389 (65 per day) HETS lifts pass through the gate in the 6 days time. For traffic analysis, this equates to about 213 vehicles (some with trailers or semitrailers) passing through the gate and eventually crossing the causeway to Saudi Arabia.

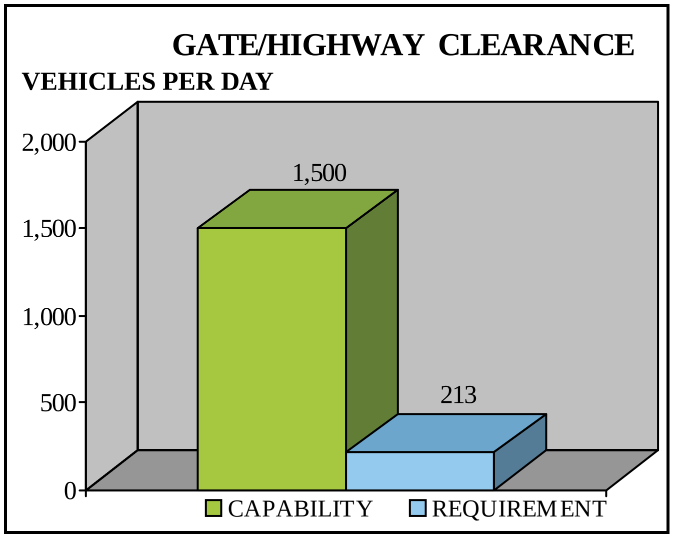
HEAVY ARMORED CAVALRY REGIMENT		
Total Equipment		Required Daily Throughput
Volume	84,440 MTON	14,073 MTON
Weight	31,267 STON	5,211 STON
Area	433,658 SQ FT	72,276 SQ FT
Vehicles*	2,138	356
Containers	140	23
*Includes trailers, tracked vehicles, aircraft, and other nonroadable vehicles		



TERMINAL OUTPROCESSING/HANDLING

Highway

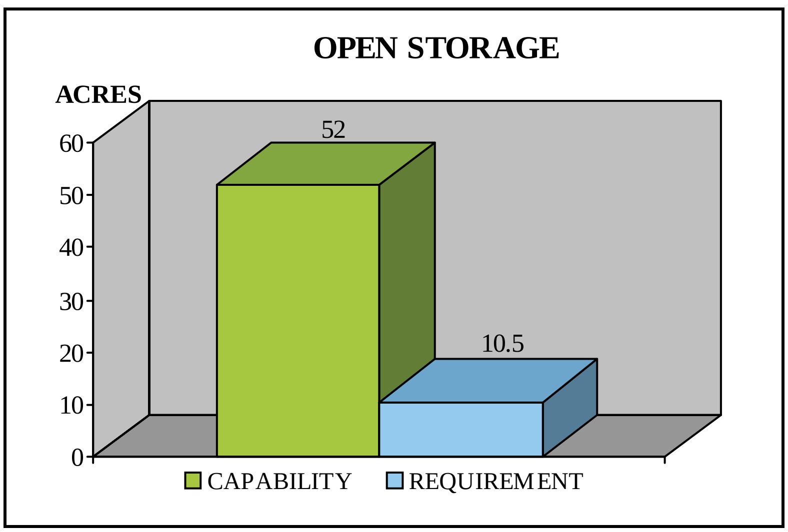
Only one gate allows military vehicles and equipment to access the highway infrastructure. One lane of this gate can accommodate 1,500 military vehicles per day. This is sufficient to meet the requirement.



Assuming a constant flow of vehicles departing the port, the daily clearance requirement is under 220 vehicles. The Manama road network can support the requirement to receive the heavy armored cavalry regiment in 6 days.

Open Storage

The port has a total of 103 acres of paved open storage. We assume half of this will be available for U.S. military operations.



Marshaling the entire regiment of equipment (433,658 square feet) requires 25 acres. We assume the maximum amount in the port at any time is about 2-1/2 days (42 percent) of the required port throughput. This requires the port to provide 10.5 acres of paved open area to support the operation. The port can easily meet the requirement.

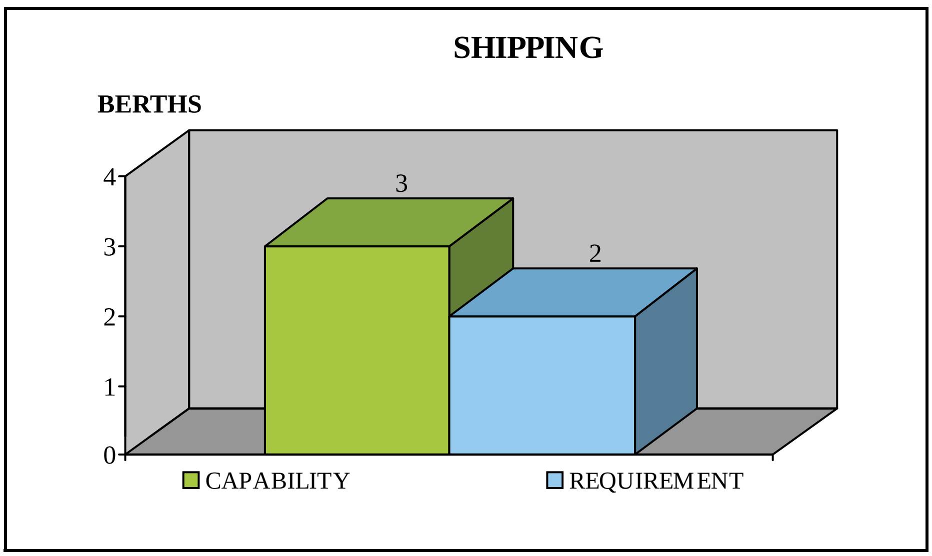
Shipping

A heavy armored cavalry regiment has 433,658 square feet of vehicles and equipment. The deck space on the Cape D class vessels is 180,868 square feet. In addition to this space for rolling stock, the vessels can also carry 554 TEUs of containers on the weather deck.

Desert Shield's records indicate an average stow factor of only 60 percent for these vessels. Although one Desert Shield sailing proved an 85 percent stow factor is possible, this analysis will conservatively use the 60 percent stow factor.

Each of the Cape D class vessels can carry 108,500 square feet of cargo, assuming the 60 percent stow factor discussed above. At this rate, the regiment would require four of these vessels. Unloading RORO vessels this size can be done in less than 2 days. To meet the 6-day requirement, the port can berth two of these vessels simultaneously throughout most of the 6-day operation. Two 2-vessel operating cycles are required to process the entire regiment, with these partially loaded vessels.

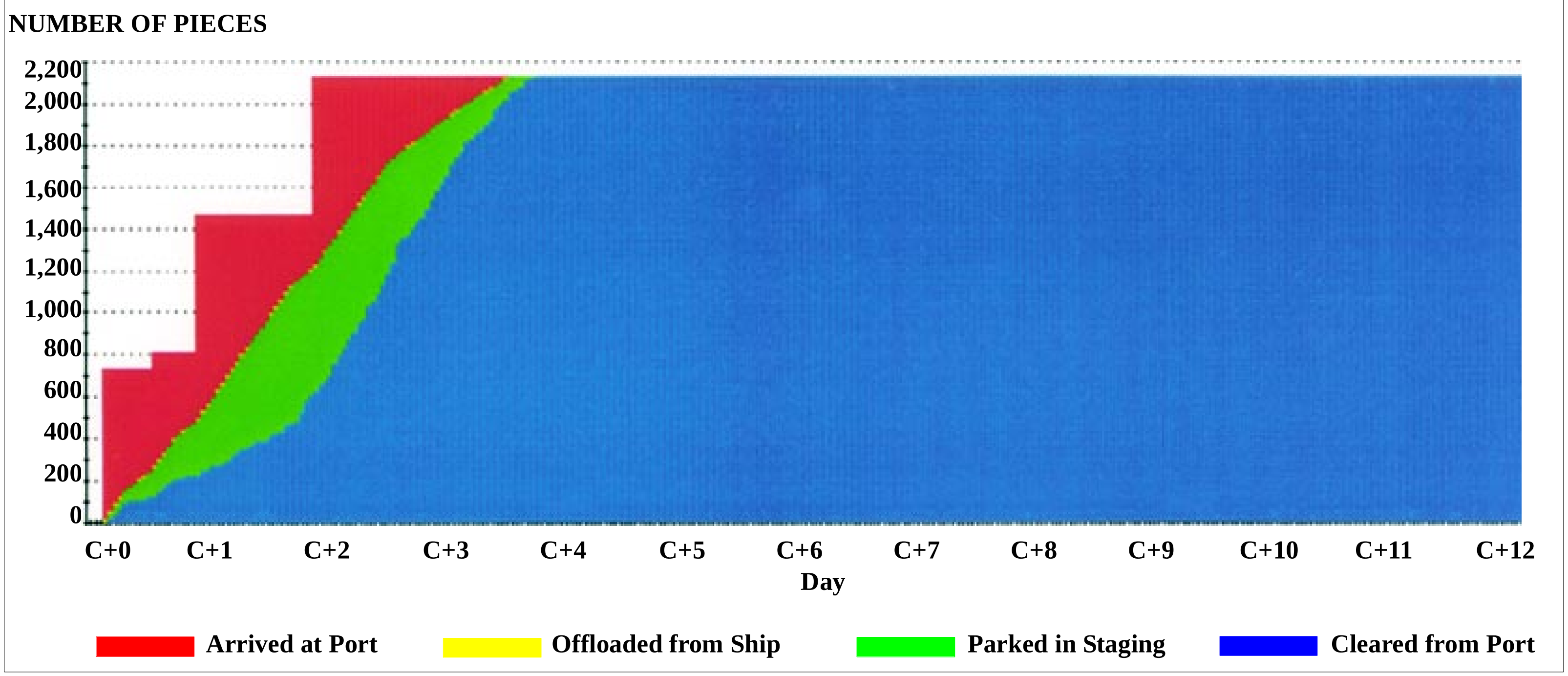
Three Cape D class vessels can berth and operate at the port simultaneously. Berthing requirements call for two 2-vessel operating cycles. The map earlier in this section provides the berthing configuration.



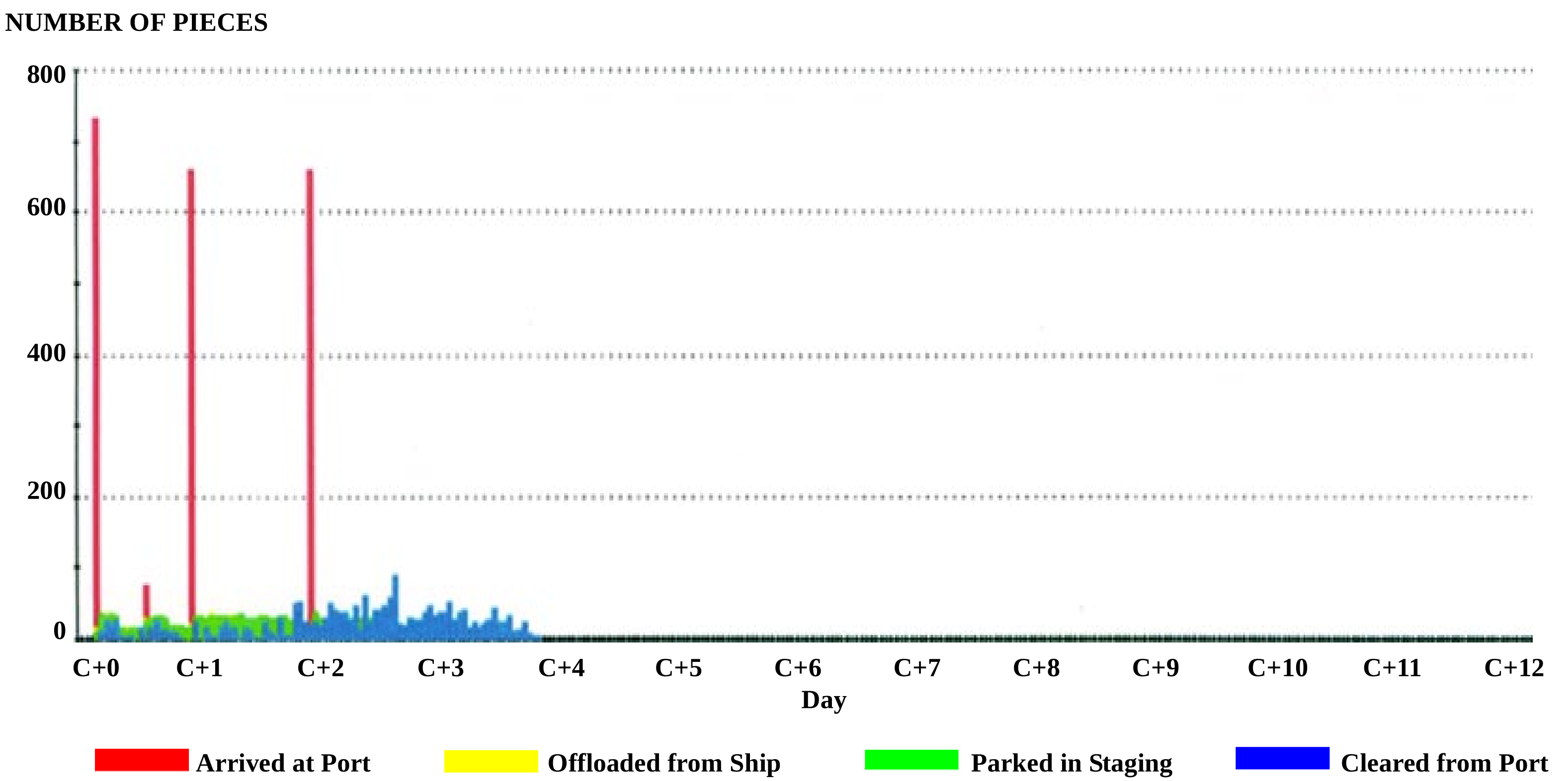
SIMULATION RESULTS

To evaluate the port's deployment capability, we used the port simulation (PORTSIM) model to flow unit equipment in the task force through the port. PORTSIM is a time-stepped, discrete event, stochastic simulation of port operations during a force deployment. The PORTSIM simulation is dynamically modeled for visual monitoring and quick identification of problems and allows the analyst to determine port closure/clearance times. Total deployment time for the regiment is about 3.5 days. Cape D ships were used to deploy the regiment. Actual throughput and closure results are shown in the graphs on the following pages.

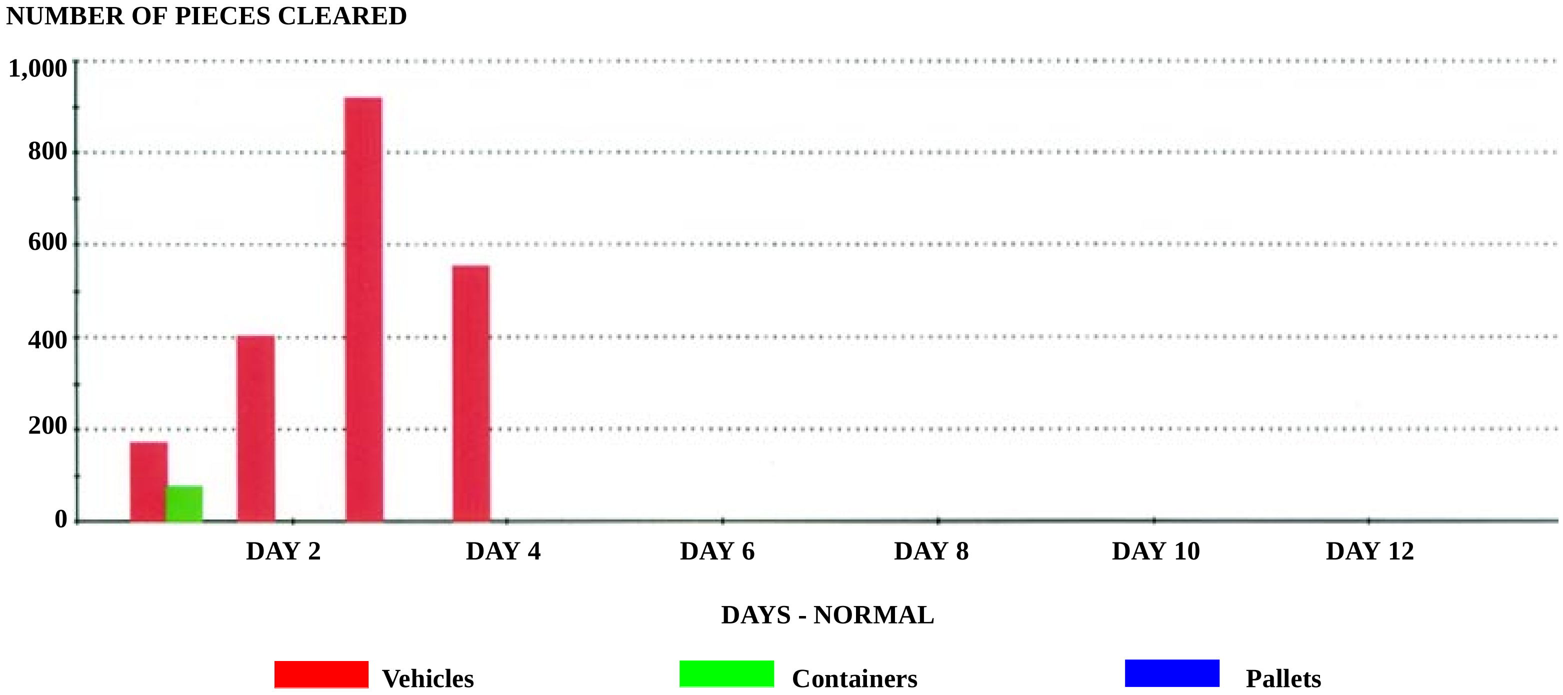
CUMULATIVE CLEARANCE PROFILE FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT FOR THE PORT OF MINA SULMAN



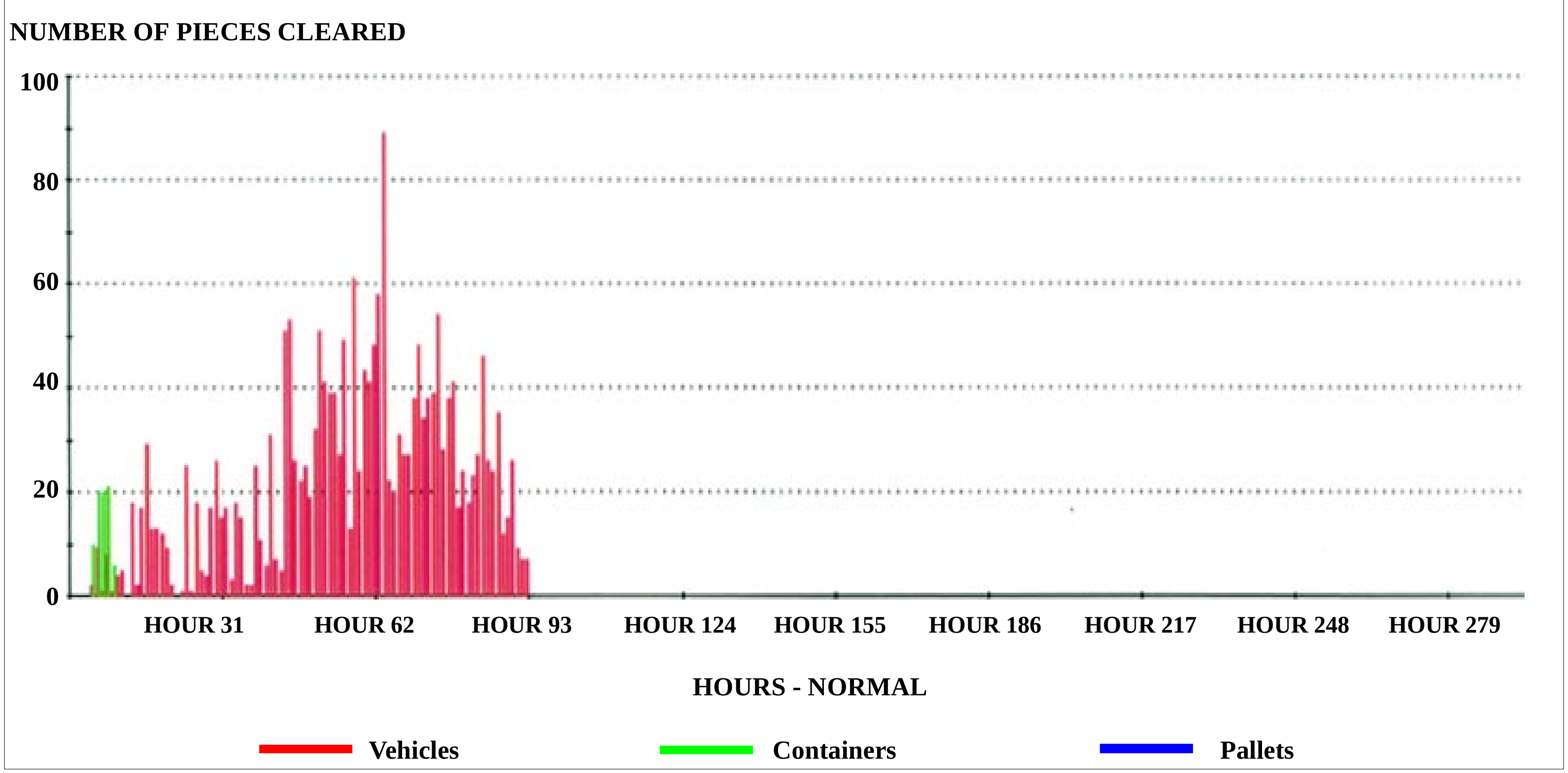
DAILY CLEARANCE PROFILE FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT FOR THE PORT OF MINA SULMAN



DAILY THROUGHPUT FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT FOR THE PORT OF MINA SULMAN



HOURLY THROUGHPUT FOR NOTIONAL HEAVY ARMORED CAVALRY REGIMENT FOR THE PORT OF MINA SULMAN



SUMMARY

The Port of Mina Sulman can receive a notional heavy armored cavalry regiment in about 3.5 days. Vehicles must convoy through the city of Manama and across the causeway to Saudi Arabia. Open staging is adequate to support deployment of the brigade.

There are no rail facilities that can support military operations. Highway access is adequate, but congested.

RECOMMENDATION

We recommend the Port of Mina Sulman be considered to support a regiment/brigade sized unit. Care must be taken, however, that the bridges and causeways can support the equipment.

PORT OF SHUAIBA
KUWAIT

I. EXECUTIVE SUMMARY

GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Shuaiba, Kuwait, based on site visits in late May 1997 and March 1999. The port can accommodate vessels as large as the LMSR or FSS classes and can support military operations.

The Port of Shuaiba is the second largest port in Kuwait, in terms of annual business. Being newer than the Port of Shuwaikh, it can accommodate deep-draft containerships. It consists of a deep water basin roughly 2,900 feet by 2,100 feet with three container cranes and two wharf cranes. Tidal variation is 9.8 feet. Berths range in depth from 34.5 feet to 45.9 feet at mean low water (MLW) and all aprons are open. Two container freight stations provide covered storage. The inland corners of the basin provide support for straight-stern RORO operations.

The port is in the southern part of Kuwait in a generally undeveloped area with growing industrial facilities. Connector routes and the main highway are in very good condition. There are no railroads in Kuwait.

THROUGHPUT

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of 21,000 short tons (STON) per day. The RORO capability is 25,000 STON per day.

APPLICATION

We find the port capable of handling a notional armored division in 8 days using three repetitions of two LMSR vessels. The port has enough wharf space to simultaneously berth eight fully loaded LMSR or FSS vessels. If deployment operations use two repetitions of three LMSR vessels, then the port can handle a notional armored division in 6 days. Only 35.7 acres of paved open staging is required to support the unit, for a two-LMSR operation. Fifty-four acres are required for a three-LMSR operation. Two six-lane highways connect the port to the interstate system and can easily handle the additional traffic.

II. GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Shuaiba, Kuwait, with support from the 831st U.S. Army Transportation Battalion, Southwest Asia, Kuwait Detachment. The major source of data was the Shuaiba Port Authority. We visited the port on 27 May 1997 and interviewed port personnel.

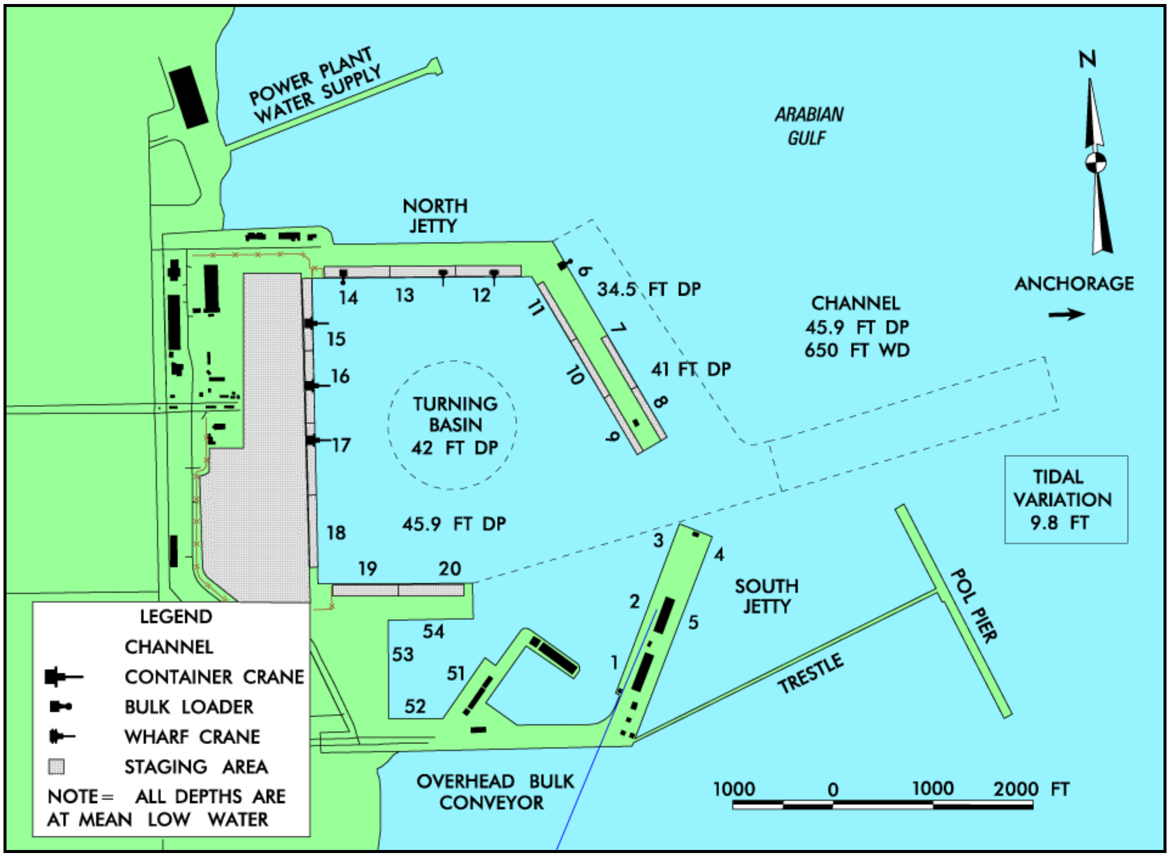
TRANSPORTATION ACCESS

Water

The Port of Shuaiba is about 28 miles (45 kilometers) south of Kuwait City. Although the port handles less cargo than the port of Shuwaikh, it can accommodate larger vessels, with drafts up to 44.9 feet at MLW (13.71 meters), at any tidal condition. It is located at 29° 02’ N Latitude, and 48° 10’ E Longitude. The port was originally built to serve the region’s industrial base, mainly oil refining, cement and fertilizer manufacturing, and fish processing. Some berths are unsuitable to support military operations because of their shallow water and congestion of conveyor belts.

The port has a very short entrance channel, being situated on the edge of open water. The gate between the breakwaters is 650 feet (200 meters) wide and 45.9 feet (14.0 meters) deep. Tidal variation is 9.8 feet (3.0 meters). Pilots and tugs are required for ships entering the harbor. Six pilots are capable of handling large vessels into the Port of Shuwaikh or the Port of Shuaiba. Three tugs are available with firefighting equipment. These tugs have 4,000; 3,600; and 3,200 horsepower, respectively. Additional tugs are available from the Ports of Doha (Kuwait) and Shuwaikh, with horsepowers up to 5,000.

Ships may anchor between 2.5 and 4.5 miles to the east of the port, in a designated rectangular area. The water in this anchorage exceeds 50 feet. Anchorage is prohibited in a much larger area to the north of the port, near the petroleum, oils and lubricants loading facilities, and the underwater pipeline. The port has no bridge restrictions.



Water Access to the Port of Shuaiba

Highway

The main driveway of the port exits through the main gate onto Route 8. Route 8 connects with Route 40, the major north-south highway, after about 5 miles. Route 40 continues northward toward the Kuwait City beltway rings, Camp Doha, and the Iraqi border.

Route 8 is four lanes and uncongested. Route 40 is six lanes divided with speed limits often at 75 miles per hour (mph) (120 kilometers per hour). Most of the route toward Kuwait City has open desert land on both sides of Route 40.

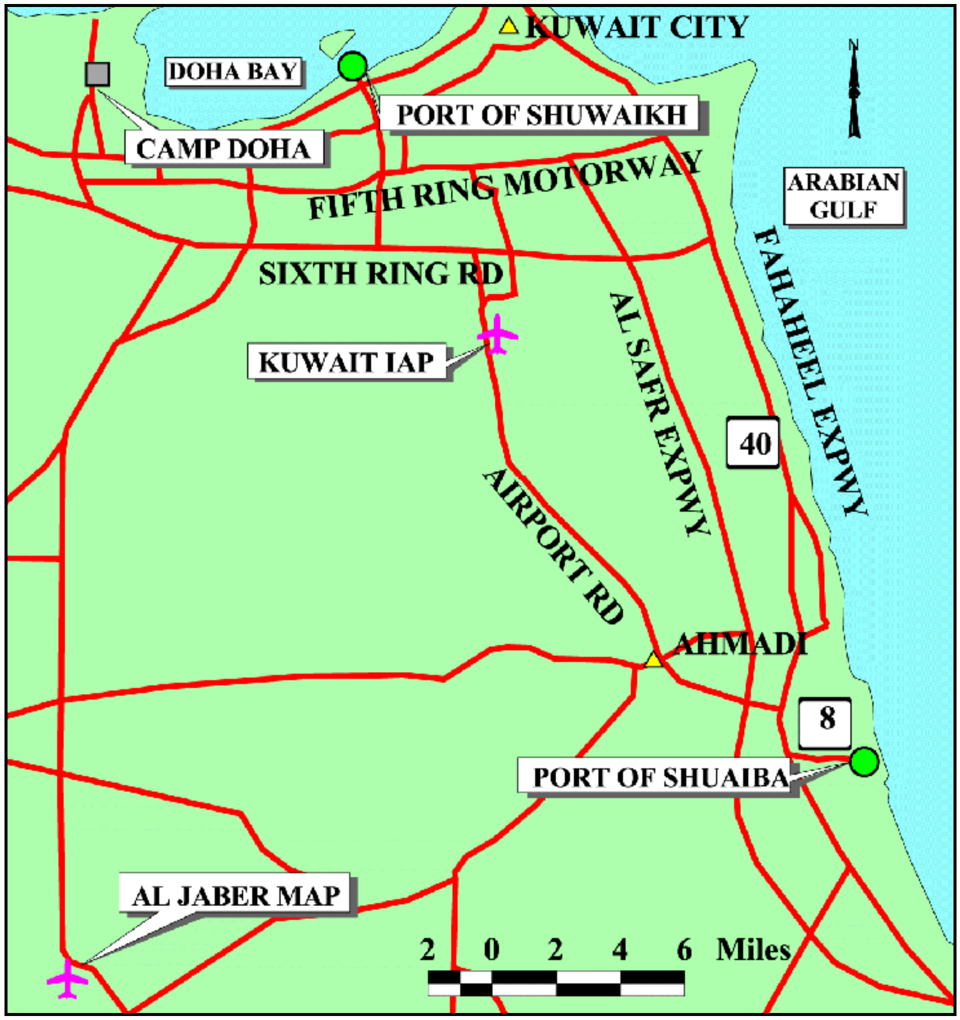
Two other gates near the south end of the port provide access to Route 40 by Route 30. These gates are usually secured. When open, each allows two lanes of vehicles to exit the port.

No unusual clearance or congestion problems exist on roads leading from the port. Overhead restrictions on roads near the Port of Shuaiba are usually 16.4 feet (5.0 meters) high. Streets are in very good condition and uncongested.

Air

The closest airport to the Port of Shuaiba is Kuwait International Airport, about 24 miles (38 kilometers) to the north of the port. The airport has four runways, each at least 10,000 feet (3,280 meters) long. The eastern runways are shared with the Kuwait Air Force.

The country of Kuwait has two additional Air Force bases. Ali Al Salem Air Force Base is about 90 miles (70 kilometers) west of Kuwait City. Al Jaber Air Force Base is west of the Port of Shuaiba.



Highway and Air Access to the Port of Shuaiba

Rail

No rail is in the country of Kuwait and no plans for rail development.

PORT FACILITIES

Berthing

The Port of Shuaiba is the second largest port in Kuwait, in terms of annual business. Being newer than the Port of Shuwaikh, however, it can accommodate deep-draft containerships.

BERTHS USAGE	
Berth(s)	**Typical Cargo**
6	sulfur conveyor
7-8	general cargo, clinker and iron ore
9-13	general cargo
14	petcoke conveyor
15-17	containers
18	RORO
19-20	RORO

The south jetty of the port is congested with bulkloading conveyor belts for fertilizer produced in the factory inland of the port. The water on the outer side of this jetty is only 24 feet (7.5 meters) deep. For these reasons, we do not further analyze Berths 1-5.

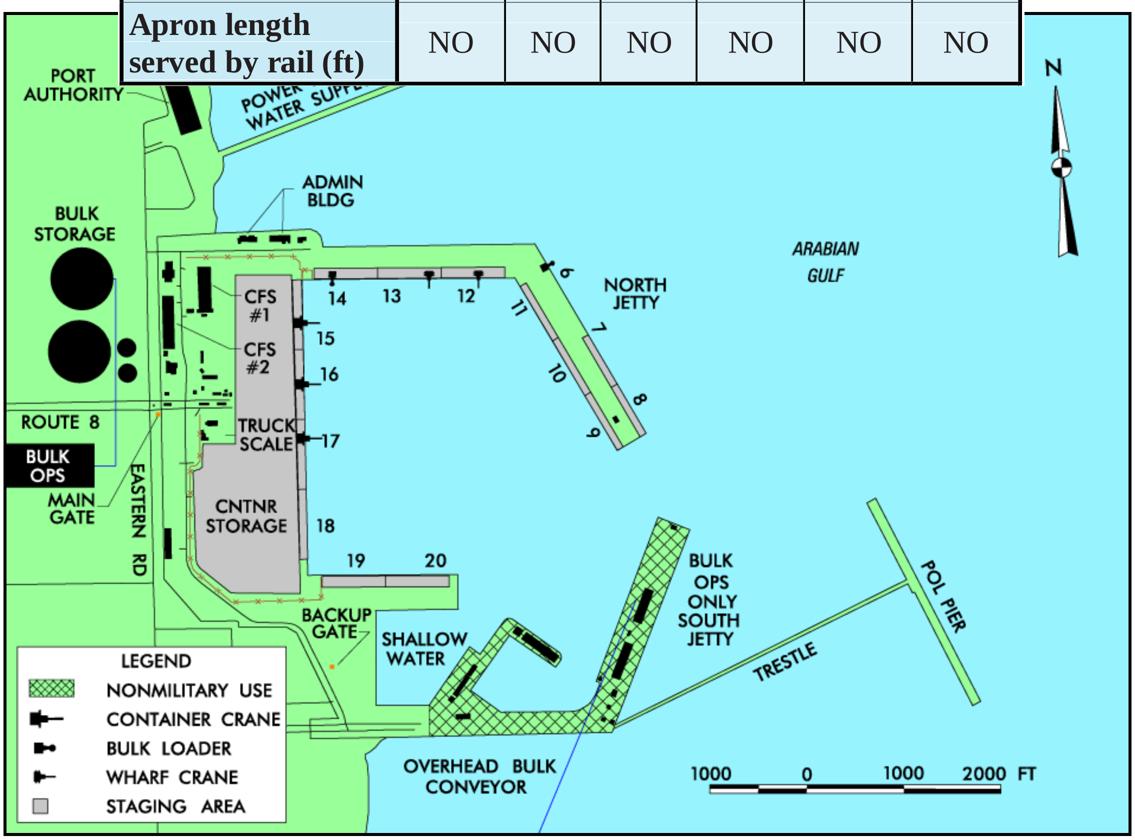
The southern portion of the port has two shallow basins. One is used for tugs, barges, and floating cranes. The other supports a fishing fleet and personal watercraft. These basins can only support the military with barge loading operations. This analysis addresses barge operations further in this report.

Except for the outer berths on the north jetty (Berths 6-8), all berths in this analysis are 45.9 feet (14 meters) deep at MLW. Berths 6-8 are only 34 to 41 feet (10.5 to 12.5 meters) deep.

The port has four positions for straight-stern RORO ramps. These are at Berths 14, 15, 18, and 19.

Berth 15 and 16 Container Cranes at Port of Shuaiba (westward view)

CHARACTERISTICS OF THE PORT OF SHUAIBA						
Characteristics	**Berth(s)**					
	6	**7-8**	**9-11**	**12-14**	**15-18**	**19-20**
Length (ft)	846	1,312	1,968	2,067	2,888	1,476
Depth at MLW (ft)	34.5	41	45.9	45.9	45.9	45.9
Deck strength (psf)	921	921	921	921	921	921
Apron width (ft)	60	70	70	OPEN	OPEN	OPEN
Apron height above MLW (ft)	12	12	12	12	12	12
Number of container cranes	0	0	0	0	3	0
Number of wharf cranes	0	0	0	2	0	0
Apron lighting	YES	YES	YES	YES	YES	YES
Straight-stern RORO facilities	NO	NO	NO	NO	NO	NO
Apron length served by rail (ft)	NO	NO	NO	NO	NO	NO



Land-Use Map of the Port of Shuaiba

BERTHING CAPABILITIES OF PORT OF SHUAIBA

Vessel	Berth(s) 6	7-8	9-11	12-14	15-18	19-20
Breakbulk						
C3 - S - 38a	1	2	3	3	5	2
C4 - S - 58a	1	2	3	3	4	2
C4 - S - 66a	1	2	3	3	5	2
C5 - S - 37e	1	2	3	3	4	2
Seatrain						
GA and PR - class	1	2	3	3	4	2
Barge						
LASH C8 - S - 81b	1,a,f	1	2	2	3	1
LASH C9 - S - 81d	a,c,f	1	2	2	3	1
LASH lighter	4	6	9	10	14	7
SEABEE C8 - S - 82a	a,c,f	1	2	2	3	1
SEABEE barge	4	6	9	10	14	7
RORO						
Comet	1,d,o	2,d,o	3,d,o	3,i	5,i	2,i
Meteor	1,d,o	2,d,o	3,d,o	3,i	5,i	2,i
Cape Gnome	1,d,o	2,d,i,j	3,d,i,j	3,i,j	4,i,j	2,i,j
C7 - S - 95a	1	1	2	2	3	1
Cape Taylor	1	1	2	3	4	2
Cape Orlando	1,i	1,i	2,i	3,i	4,i	2,i
MV Ambassador	1,d	2,d	3,d	3,m	5,m	2,m
Callaghan	1,d,o	1,d,o	2,d,o	2,i,m	4,i,m	2,i,m
Cape Lambert	1,i	1,i	2,i	2,i	4,i	2,i
LMSR - class	a,b,c	1,b	2,b	2	2	1
FSS	a,c	1	2	2	2	1
Cape E - class	1,i,j	1,i,j	2,i,j	3,i,j	4,i,j	2,i,j
Cape D - class	1,i	1,i	2,i	2,i	4,i	2,i
Cape H - class	1,a	1	2	2	3	1
Cape Texas	1,i	1,i	2,i	3,i	4,i	2,i
Cape R - class	1,d	1,d	2,d	3,i	4,i	2,i
Cape I - class	1,i	1,i	2,i	2,i	4,i	2,i
Cape Victory	1,i	1,i	2,i	3,i	4,i	2,i
Container						
C6 – M - 147a	1,e	1,e	2,e	3,e	4	2,e
C7 - S - 69c	1,e	1,e	2,e	3,e	4	2,e
C7 - S - 68c	1,e	1,e	2,e	2,e	3	2,e
C8 - S - 85c	1,e	1,e	2,e	2,e	3	1,e
C9 - M - 132b	a,c,e	1,e	2,e	2,e	3	1,e
C9 - M - F141a	a,c,e	1,e	2,e	2,e	2	1,e
C6 - S - 1qd (TACS)	1	1	2	2	4	2
C5 - S - MA73c (TACS)	1	2	3	3	4	2
C6 - S - MA60d (TACS)	1	1	2	2	4	2
Combination						
C7 - S - 133a	1	1	2	2	3	1
Maersk	1	1	2	2	3	1
AmSea	1	1	2	2	4	2

Notes:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitation as described below.

a - vessel draft limited
b - apron too narrow
c - berth too short
d - no straight-stern ramp
e - no CNTNR cranes
f - anchorage OK, berth too shallow
g - shallow channel
h - no special ramps
i - tide too low for ramp clearance
j - tide too high for ramp clearance
k - ramp angle too steep at low tide
m - ramp angle too steep at high tide
n - parallel ramp operation ONLY
o - apron too narrow for side ramp

Ramp clearance and angle based on maximum vessel draft.

♦ May Prevent Operation

♦ May Limit Operation

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this capability.

Open Storage

The Port of Shuaiba has about 76 acres (300,000 square meters) of paved open staging available for military operations. Nearly all of this is in the container staging area inland of Berths 15-18. An additional 24 acres (97,000 square meters) is available just outside the port.

The military has performed helicopter operations at the end of the northern jetty, near Berths 8 and 9. The sheds or the container freight station near Berths 15 and 16 could support helicopter assembly or reduction and shrink-wrap operations.

Container Staging at Berths 15 and 16 at Port of Shuaiba (northward view)

Covered Storage

The Port of Shuaiba has two container freight stations, each with 81,000 square feet (7,500 square meters) of fully enclosed storage.

Highway

The Port of Shuaiba has three gates. The main gate is at the intersection of Route 8 and Eastern Road. The two backup gates are inland of the shallow basin. Each gate can provide two lanes of traffic for clearing the port. Immediately inside the gate at Route 8 is a truck scale. Roads inside the port are in very good condition, free of congestion, and have no restrictions on weight or height. Speed limits are 9 mph (15 kilometers per hour).

Unloading/Loading Positions

The port has a small opensided covered storage building inland of Berth 18 that can support loading three to four trucks using forklifts. These docks are not strong enough to support tracked vehicles.

There are no permanent or portable ramps capable of supporting truck-loading operations. The military should bring or build ramps to load trucks and trailers that do not have integral ramps. Camp Doha has a few sets of semiportable ramps used to wash vehicle undersides. These might be hauled to the port.

Offsite Storage Area

The surrounding area near the Port of Shuaiba is generally undeveloped. Offsite marshaling is readily available in undeveloped, unlighted, and poorly drained areas. The military port operator should obtain permission from local police before using this land. Al Jaber Military Airport is west of the Port of Shuaiba, and might support offsite marshaling if necessary.

MATERIALS HANDLING EQUIPMENT (MHE)			
MHE Type	**Capacity (STON)**	**Quantity**	**Owner**
Straddle Carriers	36	9	Private
Straddle Carriers	34	2	Private
Container Handler	32-36	3	Private
Container Handler	8	5	Private
Forklift	13	3	Private

All portable MHE at the Port of Shuaiba is owned by one of the local stevedore companies. For planning purposes, the list above indicates what equipment can be assumed available for use at the port.

AMMUNITION

The Port of Shuaiba is prepared to handle explosives. Ships approaching the port must declare quantities and categories they are carrying. Ammunition is handled with permission from the Ministry of Defense. Usually, the U.S. Army has handled containerized ammunition with RORO vessels, direct from truck to ship. The Ministry of Defense might not allow ammunition on loose pallets.

PETROLEUM, OILS AND LUBRICANTS

The port has a dolphin pier extended off the southern jetty for large oil tankers. The steel trestle supports pipelines from the refineries just south of the port. This T-pier can berth four vessels, each 1,000 feet (331 meters) long, with drafts of 40 feet (12.1 meters) MLW. Each berth is supplied with two 20-inch fuel lines and five 16-inch supply lines for naphtha. All lines reduce to 12 inches at the loading arms.

A mile north and south of the port are offshore loading platforms that allow loading of ultra-large crude carriers. Also to the north is a single point mooring station. Vessels may arrange for low volumes of bunkering fuel by barge at any berth of the port.

FUTURE DEVELOPMENT

Aside from dredging Berths 6-8 deeper to allow largers ships, the Port Authority has no plans to further expand the Port of Shuaiba. This dredging might extend to the shore, adding a berth to the north of Berth 12-14. Very little damage remains that was caused by the retreating Iraqi soldiers. Before the Iraqi invasion, the port had four container cranes. The retreating Iraqis destroyed one. The port has no plans to replace it.

Future plans may, however, convert Berths 19-20 to bulk operations. The Port Authority hopes to install conveyor equipment, which will reduce the military usefulness of the port.

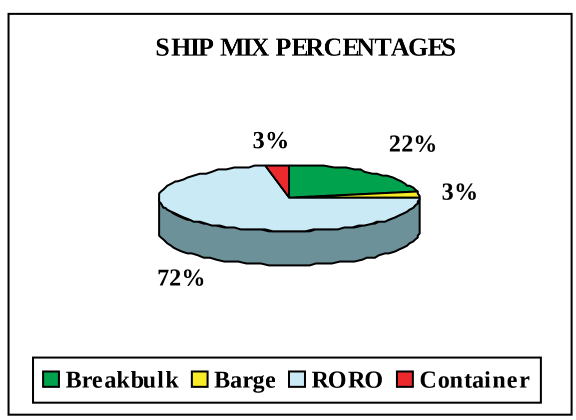
III. THROUGHPUT ANALYSIS

GENERAL

This section evaluates the throughput capability of the Port of Shuaiba using the port operational performance simulator computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging/hardstand marshaling, and terminal processing/handling - in STON per day.

Terminal Throughput Subsystems

This analysis assumes 70 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using a 70 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future operations.



RECEPTION/HANDLING

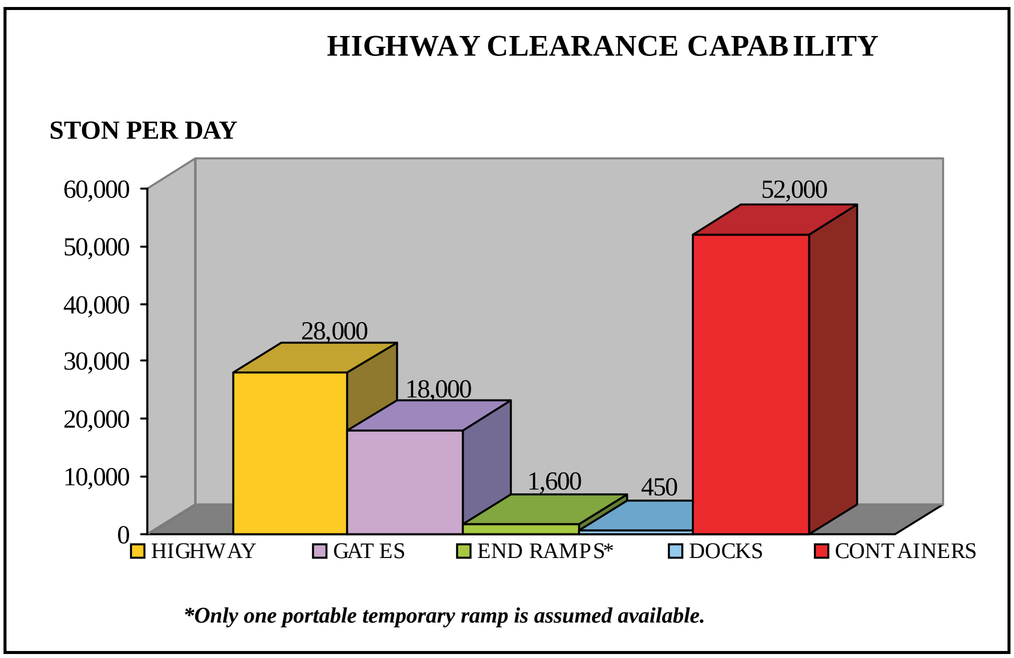
Highway

The Port of Shuaiba has three gates that lead to two main access routes to the main highway, Route 40. The gates can handle 27,000 STON (108,000 MTON) of equipment and supplies per day. The throughput assumes two lanes are used at each gate. Each vehicle is assumed to take 1 minute for processing at the gate. This daily throughput is considered a minimum value. If vehicles are preprocessed and precleared, the gate throughput can be significantly higher. Both connector routes can support 28,000 STON (106,000 MTON) per day.

Roadable vehicles in convoys will process directly to the offport marshaling areas. Vehicles on commercial or military flatbed trailers without integral ramps will operate at portable end ramps brought or built by the military port operator. Each such ramp can support 1,600 STON (4,800 MTON) per day.

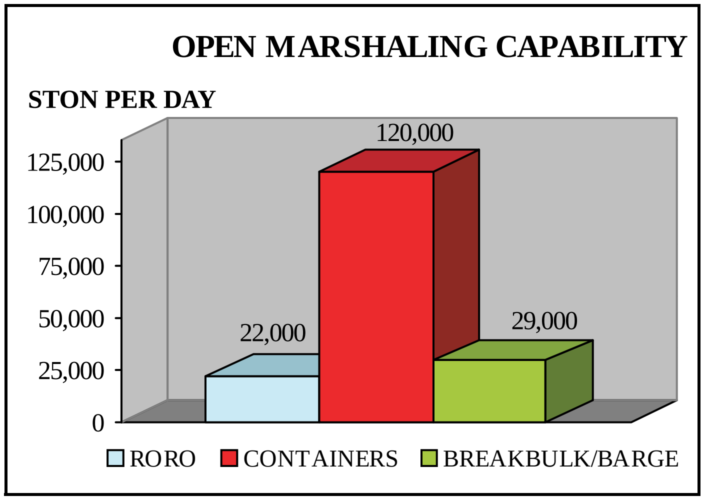
One opensided shed has a truck dock. Two trucks can operate along this side of the shed.

The port also has 11 straddle carriers and 3 container handlers that can handle full containers. Each of these machines can support 3,700 STON (9,250 MTON) of containers per day. These machines combined can handle 52,000 STON (130,000 MTON) of containers per day.



Open Storage

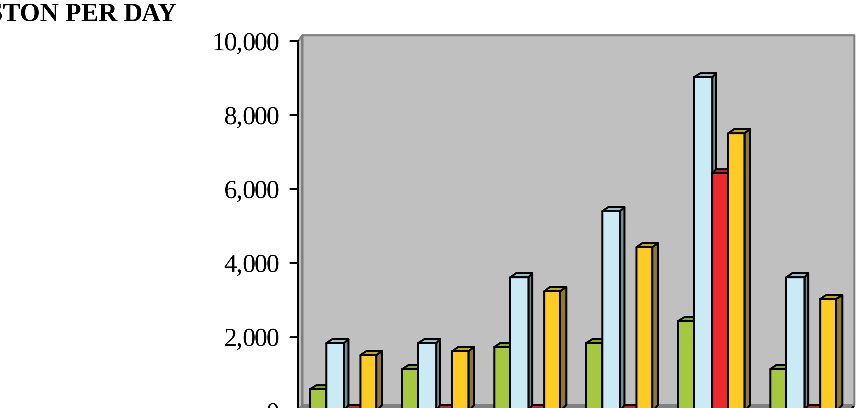
The Port of Shuabia has about 76 acres (300,000 square meters) of paved open staging available for military operations. An additional 24 acres (97,000 square meters) is available just outside the port. Each open acre provides the capability to stage 290 STON per day of RORO cargo, or 1,600 STON per day of container cargo, or 380 STON per day of breakbulk cargo.



Shipping

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility. Although these values provide the shipping rates, few ships can be loaded to their maximum draft.

CONVERSION FACTORS	
Breakbulk:	.4 STON per MTON
RORO:	.25 STON per MTON
Containers:	.4 STON per MTON



	6	7-8	9-11	12-14	15-18	19-20
BREAKBULK/BARGE	570	1,100	1,700	1,800	2,400	1,100
RORO	1,800	1,800	3,600	5,400	9,000	3,600
CONTAINERS	0	0	0	0	6,400	0
MIXED	1,500	1,600	3,200	4,400	7,500	3,000

THROUGHPUT SUMMARY FOR THE PORT OF SHUAIBA								
BERTH(S)	LENGTH (feet) (meters)	DEPTH (feet) (meters)	BB (STON) (MTON)	RORO (STON) (MTON)	RORO SQ FT (EST)	RORO PIECES	CNTNR (STON) (MTON) (TEU)	MIXED (STON) (MTON)
6	846 258	34.5 11	570 1,425	1,800 7,200	36,000	211	0 0 0	1,500 5,900
7-8	1,312 400	41 12	1,100 2,800	1,800 7,200	36,000	211	0 0 0	1,600 6,200
9-11	1,968 600	45.9 14	1,700 4,300	3,600 14,400	72,000	423	0 0 0	3,200 12,000
12-14	2,067 630	45.9 14	1,800 4,400	5,400 22,000	108,000	634	0 0 0	4,400 17,000
15-18	2,888 880	45.9 14	2,400 6,100	9,000 36,000	180,000	1,057	6,400 16,000 800	7,500 29,000
19-20	1,476 450	45.9 14	1,100 2,800	3,600 14,400	72,000	423	0 0 0	3,000 12,000

The type of ship preferred at each berth is based on an evaluation of various characteristics at each berth using a point system (see app). Each berth is rated by its characteristics, for its capability to support various ship-loading and discharging operations. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The berth with the highest points from this evaluation will be the number one berth in the Berth Preference Ranking table. Each loading style is evaluated separately because no one berth is ideal for all military operations. The best berth depends on the type of ship loaded.

BERTH PREFERENCE RANKING			
Berth(s)	Loading Style		
	Breakbulk	RORO	Container
6	6	6	-
7-8	2	4	-
9-11	2	4	-
12-14	2	1	-
15-18	1	1	1
19-20	2	1	-
NOTE: Berths marked with a "-" are not recommended for these operations.			

Berth 15-18 is ranked the best berth overall because of its container cranes, and straight-stern ramps.

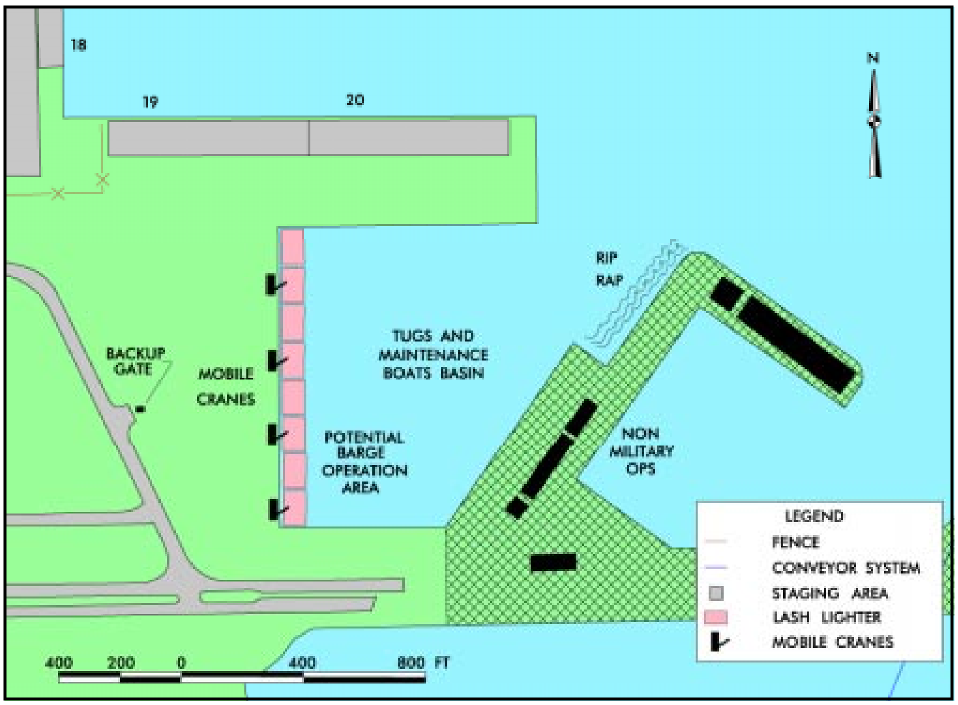
Barge Operations

To allow deep draft commercial operations wherever possible, barge operations should occur in the shallow basin used for tugs and maintenance craft in the south section of the port. A few key issues for planning purposes are:

- Each mobile crane can handle 331 STON or 829 MTON per day, assuming 20 productive work hours, and 90 percent berth utilization factor.

- SEABEE barges are 175 feet long. Typical LASH lighters are 115 feet long. A crane operating every other barge or lighter provides sufficient working space.

The inland quay of this basin is about 1,000 feet long, and can support handling eight LASH lighters. Assuming four mobile cranes are operating (one crane for every other LASH lighter), the barge operations along the inland quay of the shallow basin could handle 1,300 STON (3,300 MTON) of military cargo per day.



Potential Barge Operations Areas in the Port of Shuaiba

Large Vessel Operations

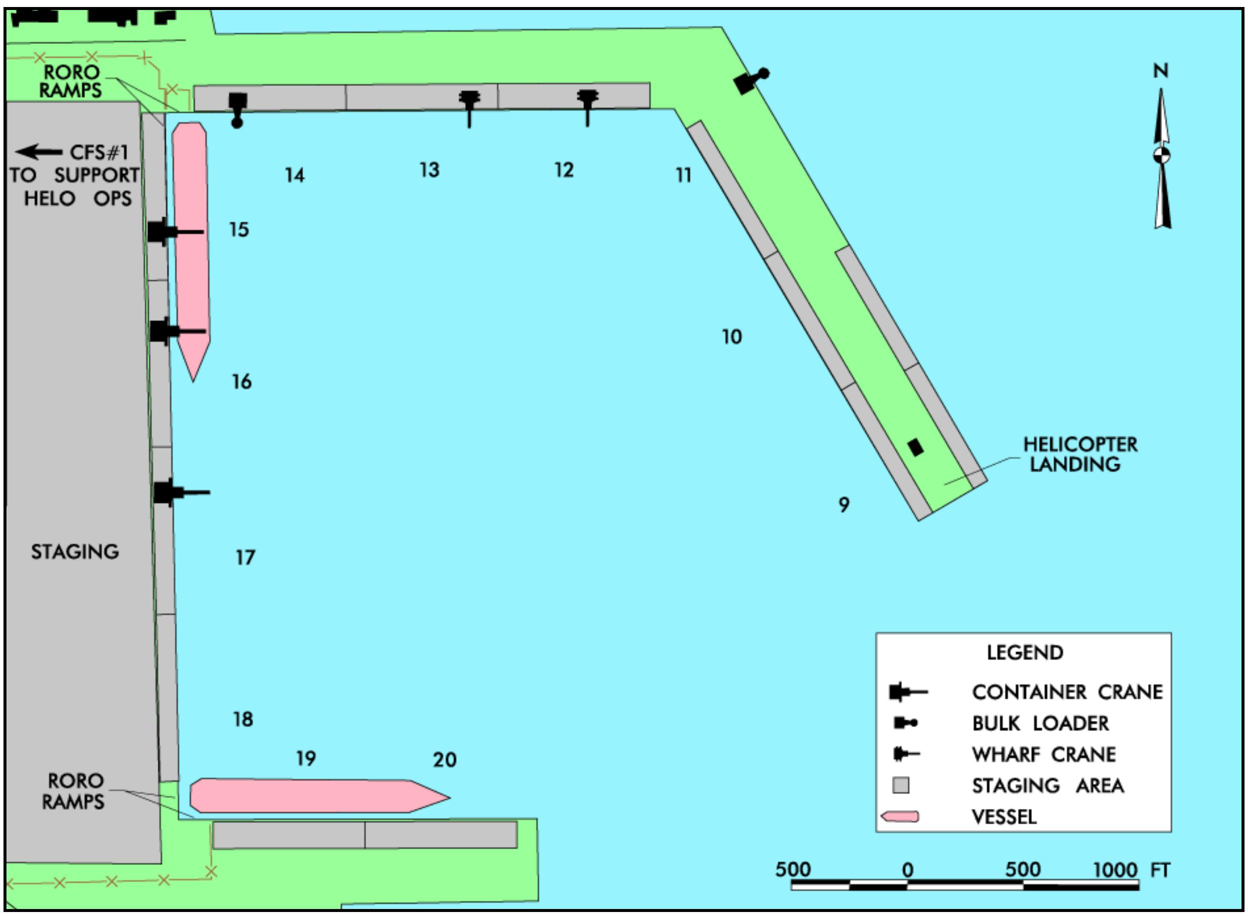
The Port of Shuaiba has enough wharfage with deep water to support berthing nine FSS or LMSR vessels. One such vessel at Berth 6 could extend into Berth 7. This one FSS should have the least draft of the nine. The water at Berth 6 will only permit the FSS or LMSR to load to a draft of 34 feet.

The number of large vessels that can be handled is restricted by the amount of paved open staging at the port. Typically, 16 acres are required to conduct sustained loading operations on an FSS, and 25 acres for an LMSR. Discharging vehicles off vessels requires less staging and depends on how fast the equipment can be cleared from the port.

IV. APPLICATION

This section evaluates the port's capability for receiving a notional armored division. Since the water in the Port of Shuaiba is deep, this study evaluates the reception using vessels of the LMSR category; specifically the NASSCO New Construction design. These vessels have a design draft of 35 feet (10.7 meters), and an overall length of 950 feet (290 meters). So far, there is very little data from exercises to suggest a reasonable stow factor for these vessels. Our analysis will assume a 65 percent stow factor.

The facilities used depend on decisions made by the Shuaiba Port Authority. This analysis assumes the U.S. military will be able to berth wherever necessary to support the operation. Although we assume the U.S. military will have their choice of facilities, every effort should be made to allow commercial operations to continue.

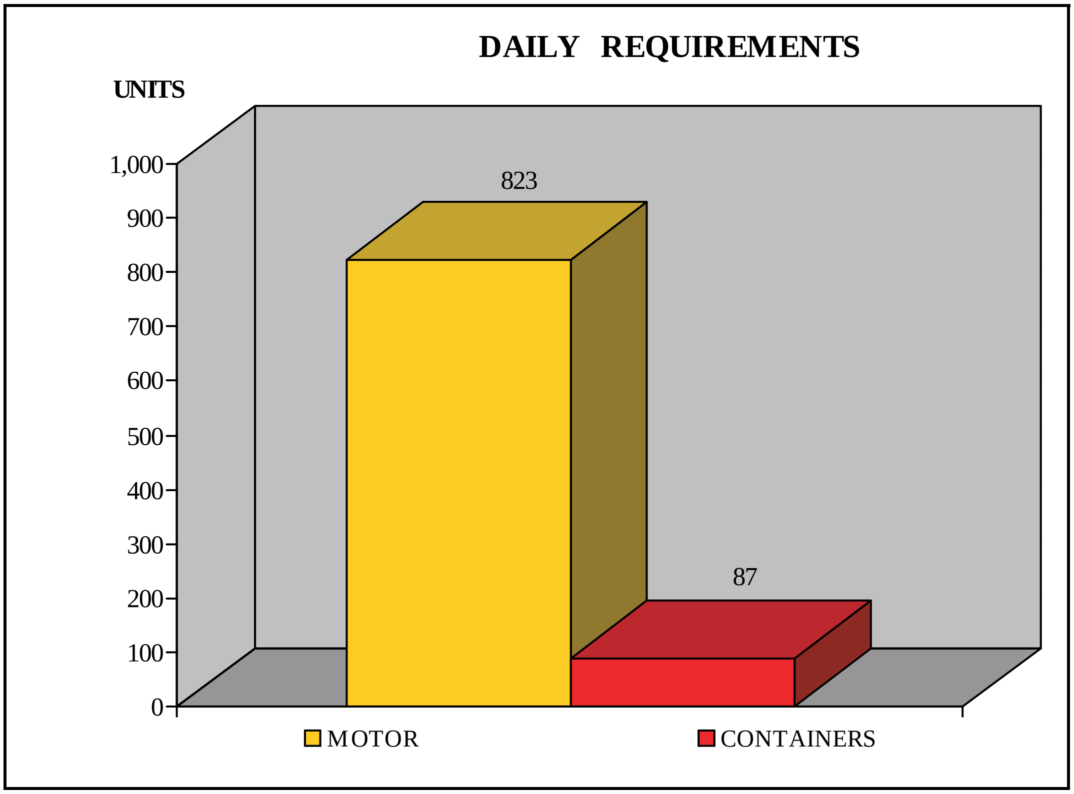


Facilities to Support U.S. Military Operations

REQUIREMENTS

For purposes of this analysis, the likely requirement for the Port of Shuaiba is to receive a notional armored division. We assume the port must handle the division in only 6 days of offloading and port clearance. About 3,752 (625 per day) self-propelled vehicles towing 2,386 (398 per day) trailers, along with 367 (61 per day) 40-foot semi-trailers and 1,189 (198 per day) HETS would pass through the gate in the 6 days time. For traffic analysis, this equates to about 823 vehicles (some with trailers or semitrailers) passing through the gates.

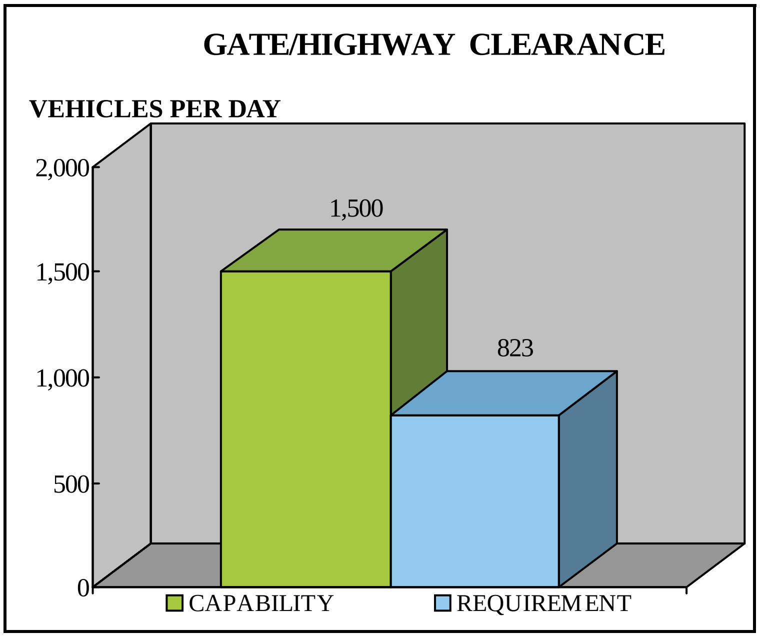
ARMORED DIVISION		
Total Equipment		Required Daily Throughput
Volume	287,175 MTON	47,862 MTON
Weight	101,342 STON	16,890 STON
Area	1,484,636 SQ FT	247,439 SQ FT
Vehicles*	8,125	1,354
Containers	522	87
*Includes trailers, tracked vehicles, aircraft, and other nonroadable vehicles.		



TERMINAL OUTPROCESSNG/HANDLING

Highway

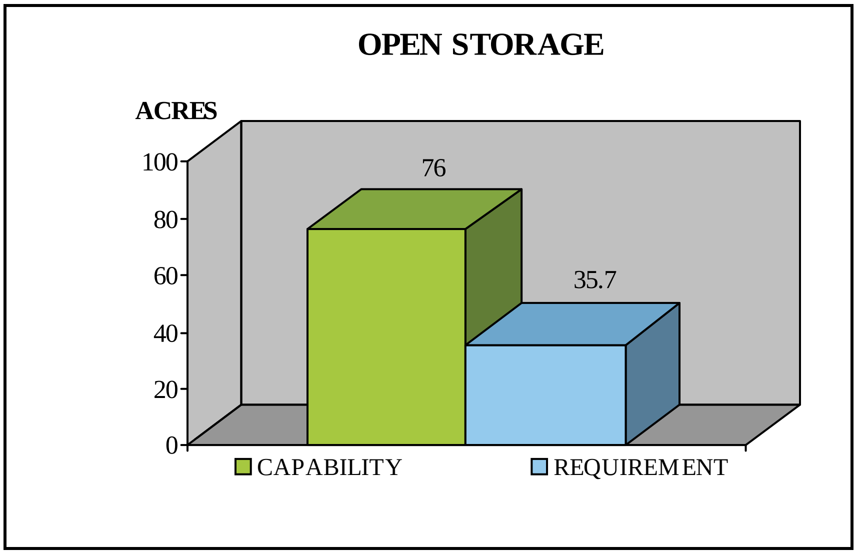
One of the two backup gates would likely support military operations. Each gate can clear a minimum of 1,500 military vehicles per day. This is sufficient to meet the requirement.



Assuming a constant flow of vehicles departing the port, the daily clearance requirement is under 900 vehicles. The Shuaiba road network can easily support the requirement to receive the armored division in 6 days.

Open Storage

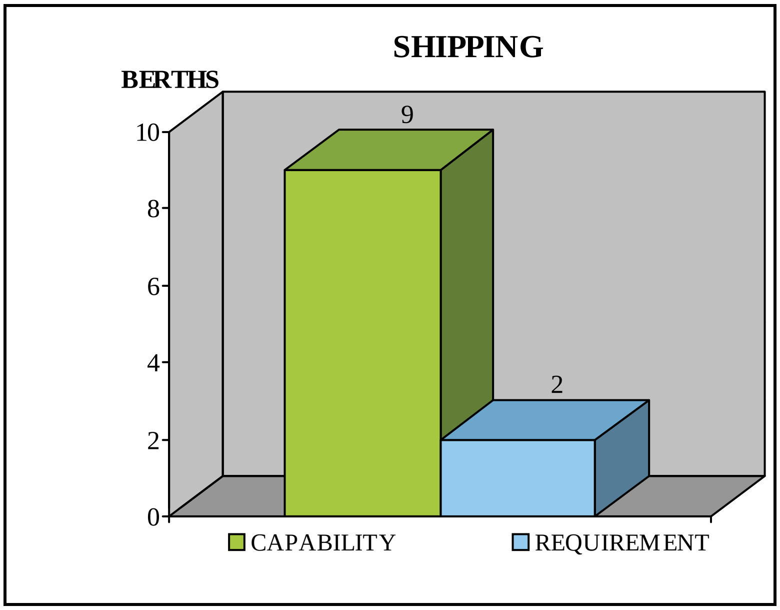
The Port of Shuaiba has a total of 76 acres (300,000 square meters) of paved open staging. Marshaling the entire division of equipment (1,484,636 square feet) requires 85 acres. We assume the maximum amount in the port at any time is about 2-1/2 days (42 percent) of the required port throughput. This requires the port to provide 35.7 acres of paved open area to support the operation. The port can easily meet the requirement.



Shipping

An armored division has 1,484,636 square feet of vehicles and equipment. The deck space on the NASSCO New Construction design is 393,268 square feet.

Each of the NASSCO New Construction design vessels can carry 256,000 square feet of cargo, assuming the 65 percent stow factor discussed earlier. At this rate, the division would require just under six of these vessels. Unloading RORO vessels this size can be done in less than 2 days. To meet the 6-day requirement, the port will have to berth three of these vessels simultaneously throughout the entire 6-day reception. Two three-vessel operating cycles are required to receive the entire division with these partially loaded vessels.



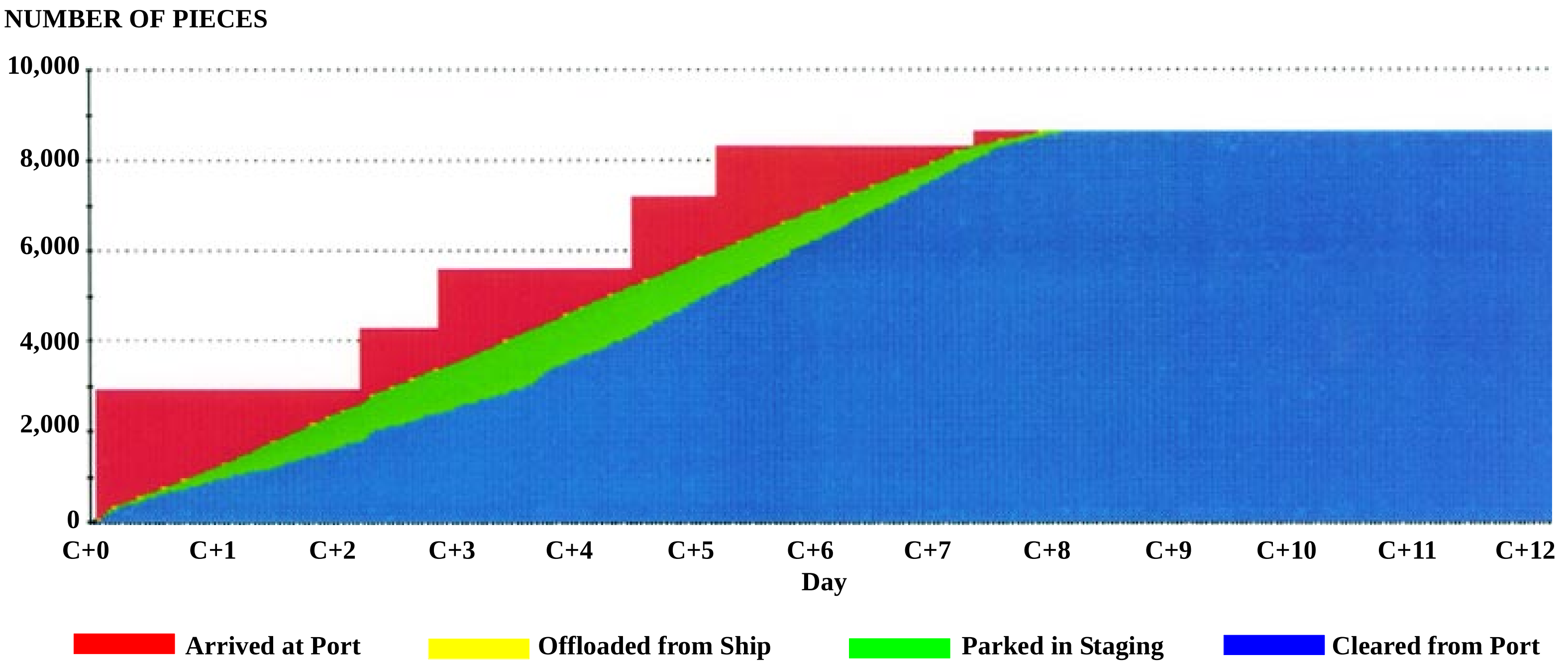
The Port of Shuaiba has enough wharf space with deep water to support berthing nine LMSR vessels. This is sufficient to meet the requirement.

The facilities map earlier in this section provides the berthing configuration.

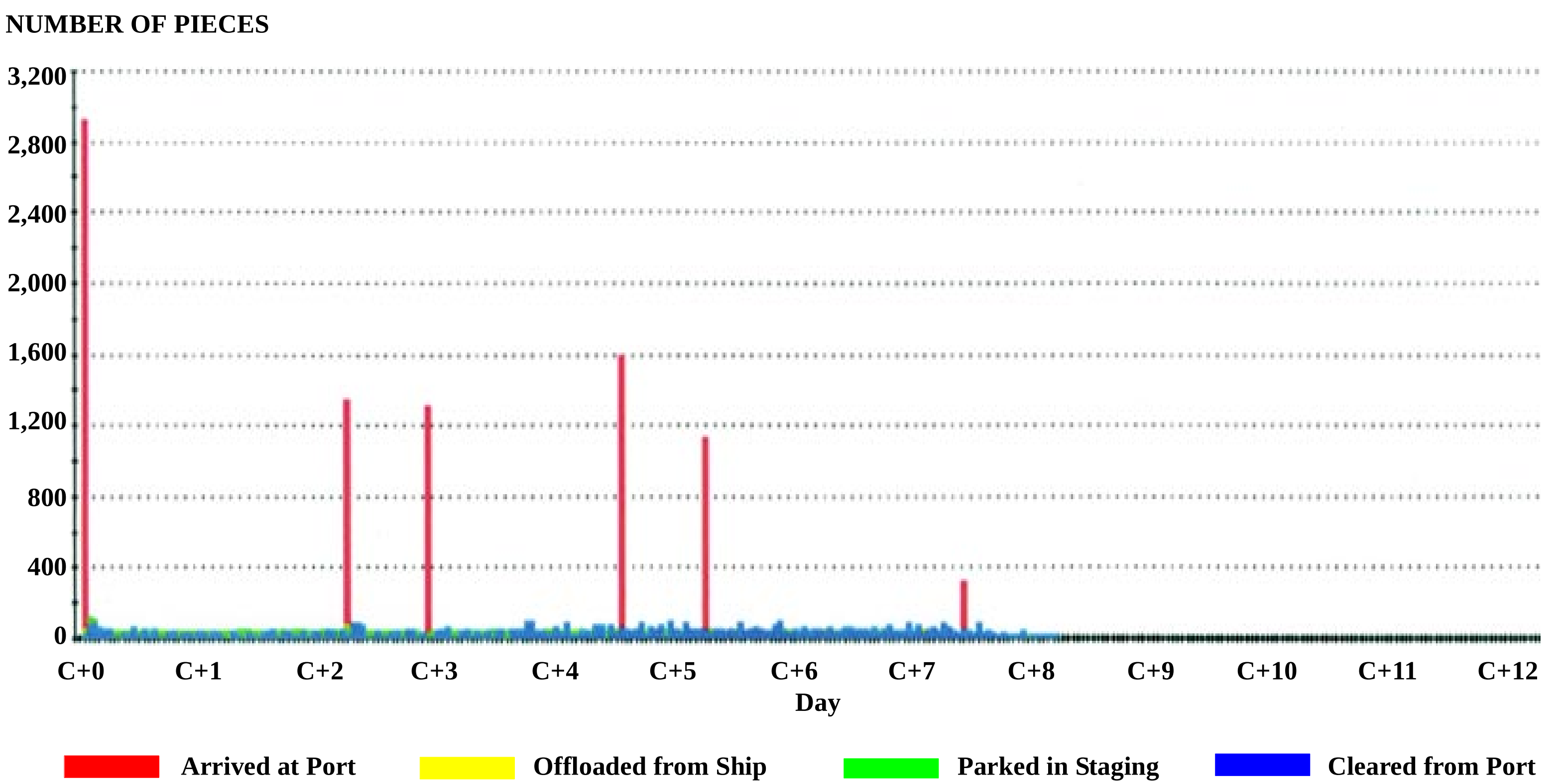
SIMULATION RESULTS

To evaluate the port's deployment capability, we used the port simulation (PORTSIM) model to flow unit equipment in the task force through the port. PORTSIM is a time-stepped, discrete event, stochastic simulation of port operations during a force deployment. The PORTSIM simulation is dynamically modeled for visual monitoring and quick identification of problems and allows the analyst to determine port closure/clearance times. Total deployment time for the division is about 8 days if three repetitions of two LMSR vessels are used. The port can deploy the division in 6 days if two repetitions of three LMSR vessels are used. LMSR vessels were used for this simulation. Actual throughput and closure results are shown in the graphs on the following pages.

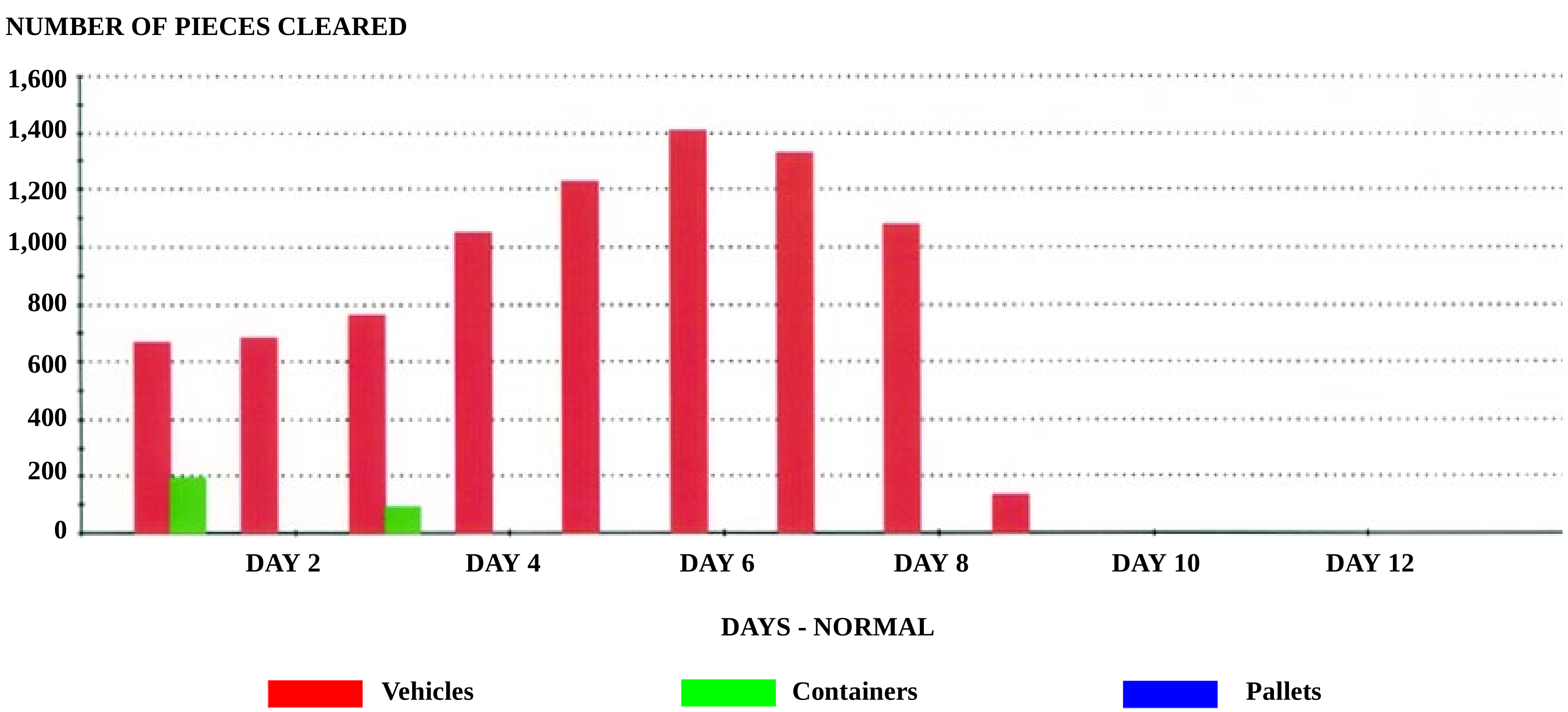
CUMULATIVE CLEARANCE PROFILE FOR NOTIONAL HEAVY ARMORED DIVISION
FOR THE PORT OF SHUAIBA
(Three Repetitions of Two LMSR)



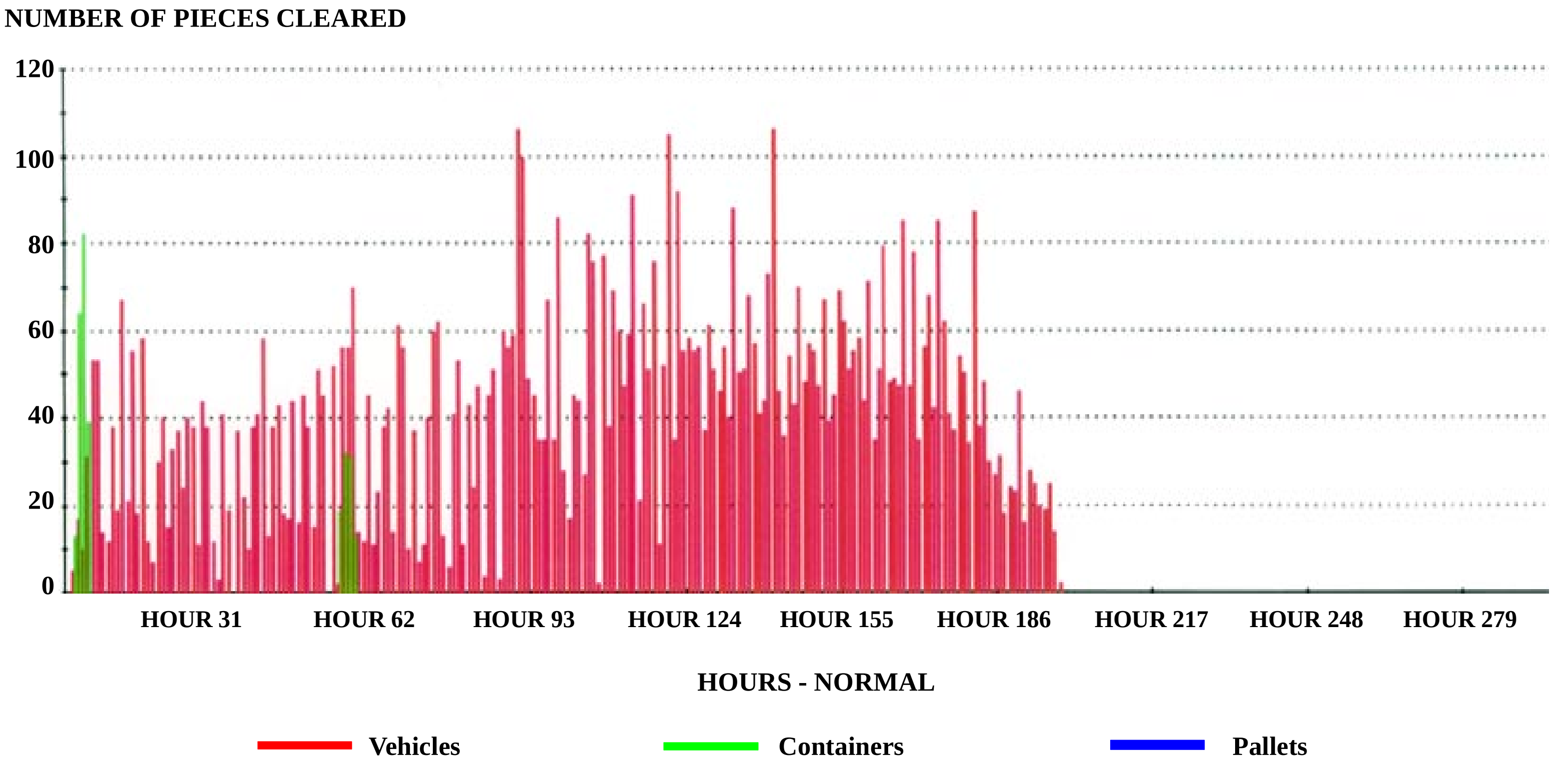
DAILY CLEARANCE PROFILE FOR NOTIONAL HEAVY ARMORED DIVISION FOR THE PORT OF SHUAIBA (Three Repetitions of Two LMSR)



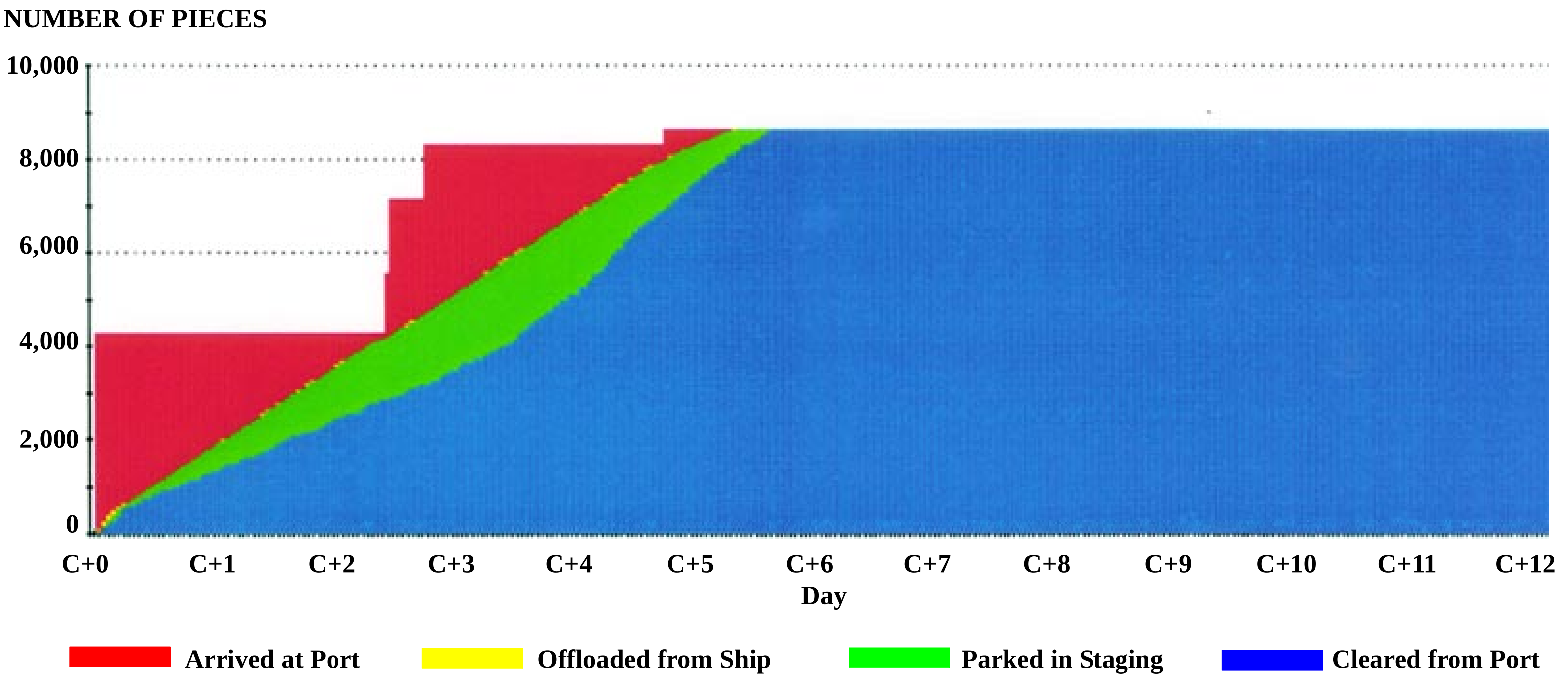
DAILY THROUGHPUT FOR NOTIONAL HEAVY ARMORED DIVISION FOR THE PORT OF SHUAIBA (Three Repetitions of Two LMSR)



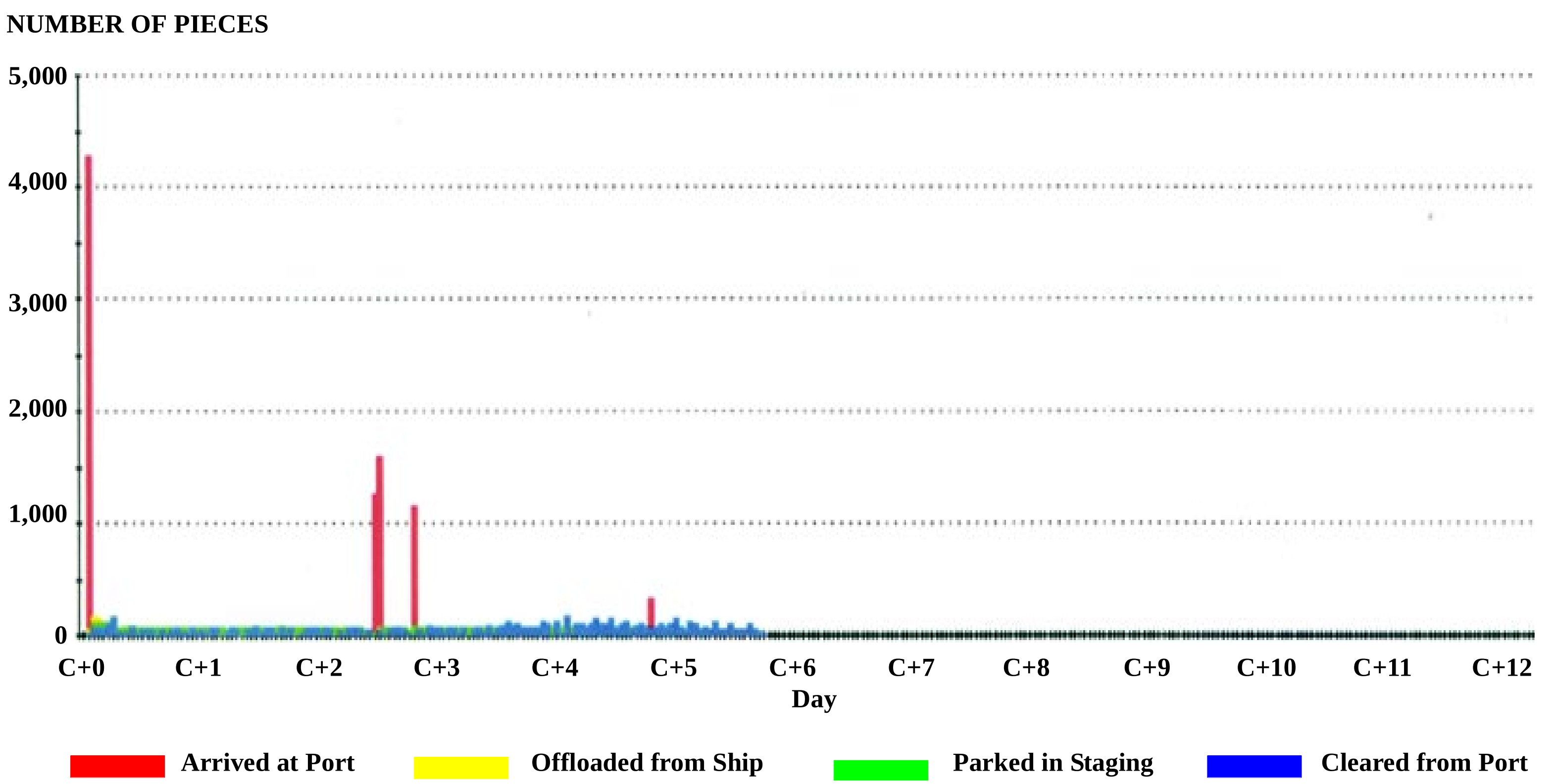
HOURLY THROUGHPUT FOR NOTIONAL HEAVY ARMORED DIVISION
FOR THE PORT OF SHUAIBA
(Three Repetitions of Two LMSR)



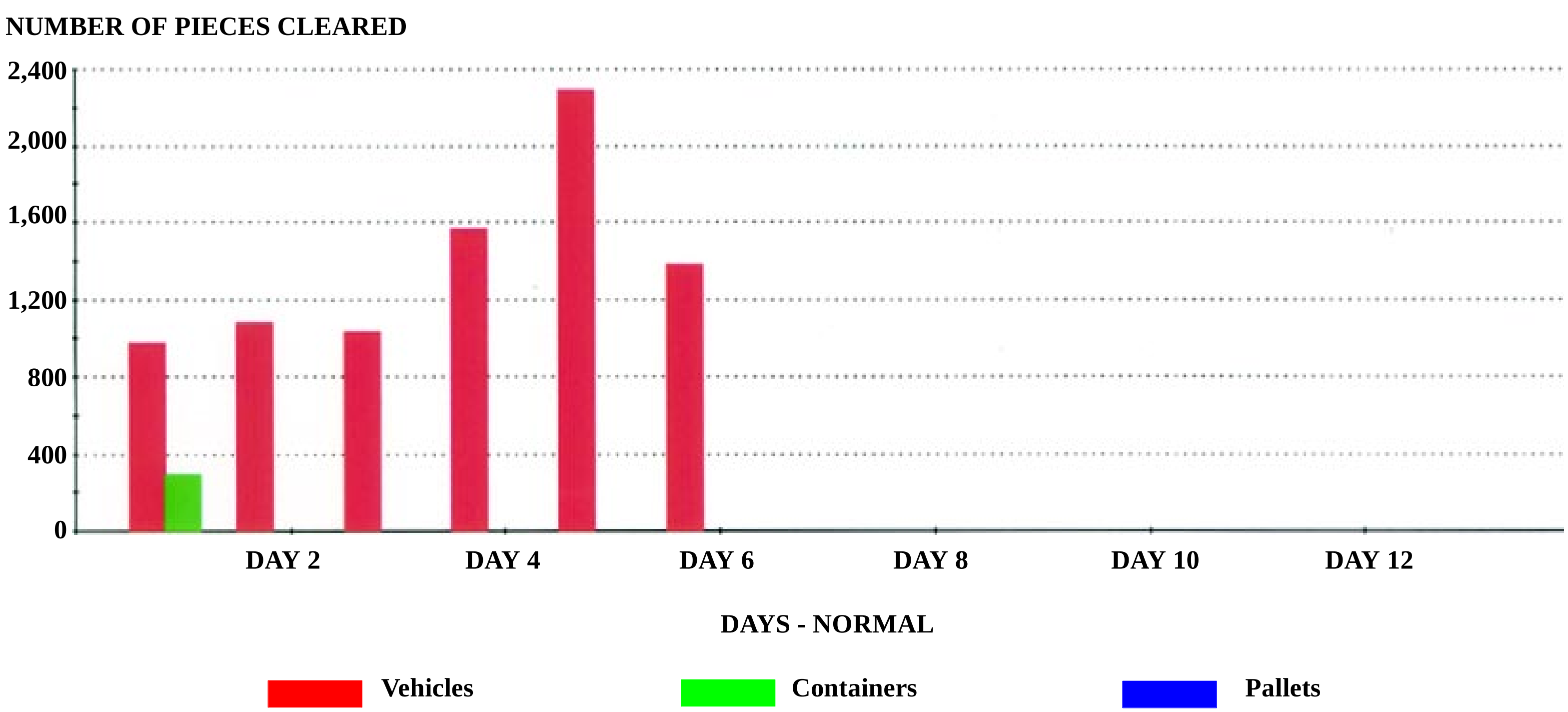
CUMULATIVE CLEARANCE PROFILE FOR NOTIONAL HEAVY ARMORED DIVISION FOR THE PORT OF SHUAIBA
(Two Repetitions of Three LMSR)



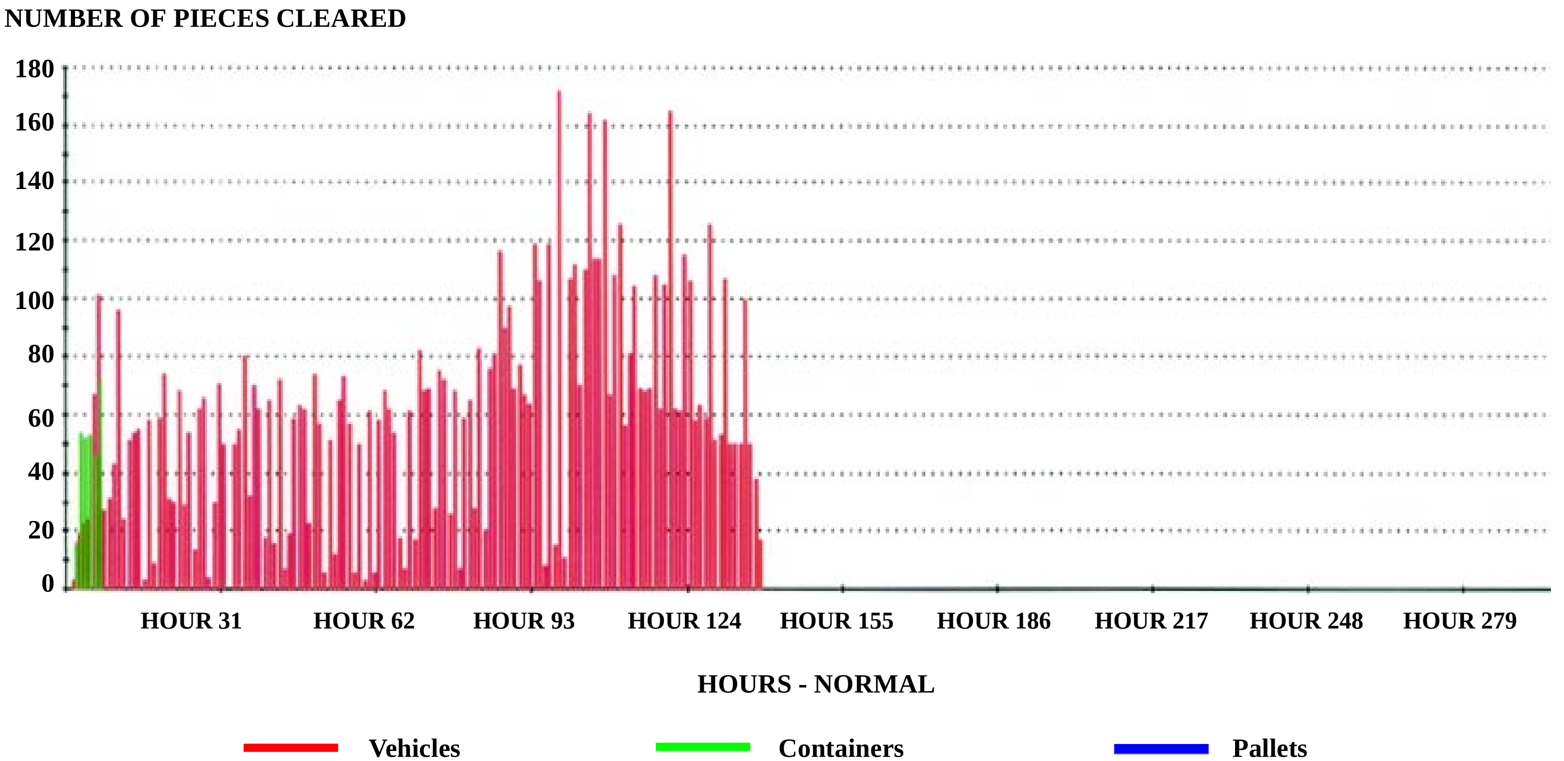
DAILY CLEARANCE PROFILE FOR NOTIONAL HEAVY ARMORED DIVISION FOR THE PORT OF SHUAIBA
(Two Repetitions of Three LMSR)



DAILY THROUGHPUT FOR NOTIONAL HEAVY ARMORED DIVISION
FOR THE PORT OF SHUAIBA
(Two Repetitions of Three LMSR)



HOURLY THROUGHPUT FOR NOTIONAL HEAVY ARMORED DIVISION
FOR THE PORT OF SHUAIBA
(Two Repetitions of Three LMSR)



SUMMARY

There are no rail facilities that can support military operations. Vehicles and equipment must convoy from the port. The port can accommodate LMSR vessels. The Port of Shuaiba can receive and process a notional armored division in 6 days, provided two repetitions of three LMSR ships are used. If three repetitions of two LMSRs are used, the division can clear in about 8 days. Using two repetitions of three LMSR vessels, the vast majority of the available open staging (76 acres) will be occupied (54 acres). Using three repetitions of two LMSR vessels, 35.7 acres will be occupied. The Shuaiba Highway Network (two 6-lane highways leaving the port) can easily handle the armored division.

RECOMMENDATION

We recommend the Port of Shuaiba be considered to handle division-sized units using LMSR vessels.

PORT OF SHUWAIKH
KUWAIT
(Updated February 2000)

I. EXECUTIVE SUMMARY

GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Shuwaikh, Kuwait, based on site visits in May 1997 and March 1999. Updated information on the channel accessing the port was provided by the 831st Transportation Battalion in December 1999. Silting has occurred in the ship channel, thereby reducing allowable ship draft. Because the channel depth varies from 20.66 feet (6.2 meters) at low tide to 23.94 feet (7.3 meters) at high tide, only small vessels such as lighterage, barges, and coastal vessels local to that area can likely access the port. Therefore, we do not consider the Port of Shuwaikh to be deployment useful unless equipment is transloaded to smaller vessels that can access the port. No dredging is planned for the ship channel due to mercury in the sediment caused by a local desalinization plant.

The port handles the most general cargo in Kuwait. It has 13,304 feet of wharf, but some berths are unsuitable to support military operations. Many of the berths have transit sheds with narrow aprons. Five berths can support straight-stern RORO ramp operations for small RORO vessels found in the SWA area. Several other berths can support slewed-stern ramps for small RORO vessels in the SWA area. Also available are two concrete landing craft ramps that can support logistics over the shore (LOTS) operations. The port has eight cranes, including two container cranes, and two container-capable 35-ton mobile cranes. All major berths are 32.8 feet (10 meters) deep at mean low water, but the controlling factor for ship berthing is the ship channel. Tidal variation at the port is about 4 feet (1.2 meters).

The port is in the center of the city of Kuwait. Connector routes and the main highway are in very good condition, but planners should expect congestion immediately around the port. Kuwait has no railroads. The port has a total of 121 open paved acres for hardstand marshaling.

II. GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Shuwaikh, Kuwait, with support from the 831st U.S. Army Transportation Battalion, Southwest Asia, Kuwait Detachment. The major source of data was the Shuaiba Port Authority. We visited the port in 1997 and 1999, interviewing port personnel. The 831st U.S. Army Transportation Battalion provided updated information on the ship channel in December 1999.

TRANSPORTATION ACCESS

Water

The Port of Shuwaikh is considered the main commercial port in Kuwait. It is located at 47^{o} 21' N Latitude and 47^{o} 56' E Longitude. It has a total land area of 790 acres and 296 acres of water. Fourteen of the berths (Berths 1-14) have depths of at least 32 feet (10 meters) at mean low water (MLW). The port has a total of 13,304 feet (4,055 meters) of wharf, although some of the berths are unsuitable to support military operations.

The vessel traffic to and from the port passes through a 5 mile (8 kilometer) navigation channel dredged inside Kuwait Bay. Shuwaikh is a tidal port with shallow draft and, therefore, entry of deep drafted ships is not feasible. The channel depth is restricted to 20.66 feet (6.2 meters) at low tide and 23.94 feet (7.3 meters) at high tide. Therefore, only shallow-draft vessels, such as lighterage, barges, and vessels local to that area can safely transit the channel. The latest information shows that the channel will not be dredged because of mercury in the sediment caused by a desalinization plant.

Tidal variation is about 4 feet (1.2 meters). Pilots and tugs are required for ships entering the harbor. There are six pilots capable of handling large vessels entering the Ports of Shuwaikh or Shuaiba. The Port of Shuwaikh has two 3,000-horsepower tugboats. Additional tugs are available from the Ports of Doha (Kuwait) and Shuaiba.

Ships may anchor 5 miles from the port, at the end of the ship channel. The anchorage depths are at least 32.8 feet (10 meters) at MLW.

Highway

The main driveway of the port exits onto Ghazali Street toward the Fifth Ring Motorway. The Fifth Ring Motorway leads west to Camp Doha and also leads to Jahra Road, which continues toward Iraq.

The roads between the Port of Shuwaikh and the Fifth Ring Motorway have four lanes and are generally uncongested. The highways from Fifth Ring Motorway onward have six lanes.

No unusual clearance or congestion problems exist on roads leading from the port. Overhead restrictions on roads near the Port of Shuwaikh are usually 16.4 feet (5.0 meters) high. Streets are in very good condition and uncongested. However, the urban streets are poorly marked. Speed limits on the main highways are usually 50 miles per hour (mph) (80 kilometers per hour). Highways often have four or six divided lanes.

Air

The closest airport to the Port of Shuwaikh is Kuwait International Airport, about 9 miles (15 kilometers) south of the port. The airport has four runways, each at least 10,000 feet (3,280 meters) long. The eastern runways are shared with the Kuwait Air Force. The country of Kuwait has two additional Air Force bases. Ali Al Salem Air Force Base is about 45 miles (70 kilometers) west of the port. Al Jaber Air Force Base is about 55 miles (90 kilometers) south of the port (not shown on map).

Rail

Kuwait has no rail nor any plans to develop rail transport.

PORT FACILITIES

Berthing

The Port of Shuwaikh is the largest port in Kuwait. Because of its age, however, it does not accommodate deep-draft containerships, RORO ships, or breakbulk ships.

In the center of the port's entrance are several dolphins to support barge operations. Along the south edge of the port (Berths 1-8) are general cargo and bulk facilities with transit sheds. Berths along the west side are suitable for small, shallow-draft RORO vessels. Berths along the north are only 22 feet (6.7 meters) deep and are used to support livestock and refrigerated cargo. These northern berths are, therefore, unsuitable to support military operations, except for barges.

The port has two landing ship, tank ramps. These are discussed later in this analysis.

Open Storage

The Port of Shuwaikh has 121 acres (497,000 square meters) of paved open staging available for military operations. Almost half of this open area is in the new container staging yard, built on reclaimed land northwest of the port.

Although helicopter operations have been conducted in the southeast portion of the port (near Berths 3 and 4), we recommend trucking the shrink-wrapped helicopters to Camp Doha for assembly.

Covered Storage

The Port of Shuwaikh has 27 cargo sheds with a total storage of about 2 million square feet (200,000 square meters). Some of these sheds are opensided.

Highway

The Port of Shuwaikh has several gates. The Main Gate is on Gambol Abel Nassau Street, inland of Berth 4. Gate 5 has the only truck scale at the port.

The roads within the port are uncongested and in good condition. Vehicles move around the port without restrictions on height or weight. Though not posted, speed limits in the port are 9 mph (15 kilometers per hour).

Unloading/Loading Positions

Only the refrigerated shed near the shipyard has truck docks. This shed will not be used to support military operations.

There are no permanent or portable ramps. The military should bring or build ramps to offload trucks and trailers that do not have integral ramps. Camp Doha has a few sets of semiportable ramps used to wash vehicle undersides.

Offsite Storage Area

Kuwait City is highly developed. Offsite marshaling would have to be about 10 miles away, outside the city. Military planners should consider marshaling vehicles in the large open area south of Amusement City, between the port and Camp Doha. This area has about 50 acres of unimproved but level ground. It is about 15 miles to the west.

Except for the two Gottwald portable container cranes to complement the rail-mounted cranes at Berth 12-13, all portable MHE is owned by one of the three local stevedore companies or a local equipment rental company. The MHE at the port varies as these companies buy and sell MHE and older equipment is retired and replaced. For planning purposes, the list above indicates what equipment can be assumed to be available for use at the port.

The existing 2- and 3-ton rail-mounted cranes along Berths 2–5 are unreliable. This analysis assumes none will operate.

AMMUNITION

The Port of Shuwaikh has experience handling hazardous material by barges, with the mother ship berthed at the mid-harbor dolphins. Explosives and ammunition can be handled the same way, with permission from the Ministry of Defense. We suggest such barge operations occur at Berths 2 and 3 if available. Barge loading operations may also occur at the shallow berths between Berths 15 and 17. These short piers can only support barge operations.

PETROLEUM, OILS AND LUBRICANTS (POL)

The Port of Shuwaikh has no facilities for bulk-loading POL materials. Vessels may arrange for low volumes of bunkering fuel by barge.

LOGISTICS OVER THE SHORE (LOTS) OPERATIONS

The Port of Shuwaikh has two concrete ramps that can support landing craft operations. One is about 60 feet wide at the end of the pier with Berths 9 and 10. The other is at least 150 feet wide, inland of Berth 1. This large ramp is used to support light ship repair, with a slip cut for lifting small craft into a repair building. The Marine Corps exercise their LOTS operations annually on this wide concrete ramp. Due to the shallow draft in the ship channel, the military will most likely perform LOTS and/or barge operations if military operations occur at this port.

The coast of Kuwait has several sandy beach areas suitable for LOTS operations.

FUTURE DEVELOPMENT

The Port Authority has no plans to develop the Port of Shuwaikh. Private contractors, however, are developing surrounding areas to support container staging and handling. Very little damage remains that was caused by the retreating Iraqi soldiers. The only damage remaining that we observed was the missing fenders in the short and shallow berths at the north end of the port. As the Iraqis retreated, the occupying soldiers drained and ignited a large tank of flammable fluid into the harbor. The wood and rubber fenders were burned beyond use. Inspections indicated the supporting piles were not severely damaged. The latest information from the 831st U.S. Army Transportation Battalion indicates that the ship channel will not be dredged due to mercury in the sediment caused by a desalinization plant. As such, this port will be limited to berthing small vessels with water draft of less than 24 feet.

PORT OF SALALAH (RAYSUT)
OMAN

I. EXECUTIVE SUMMARY

GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Salalah, formerly the Port of Raysut, Oman, based on a site visit in May 1997. The port can accommodate vessels as large as the ***American Eagle*** class fully loaded, and the Cape D class partially loaded. It cannot support larger vessels due to the depth at mean low water (MLW).

The port consists of a 1,700-foot contiguous wharf with one container crane and four wharf cranes. This wharf can support any type of shipping, provided the 30-foot maximum draft is not exceeded. Other berths are shallower and might support barge operations. Tidal variation is typically 6.5 feet, but can reach as high as 13 feet during the summer. The port has three transit sheds and one container freight station.

The port is in an undeveloped area in southwest Oman with nearby mountains. Connector routes and the main highway are in very good condition. The country of Oman has no railroads. Future expansion has begun to develop a major container terminal at the port.

THROUGHPUT

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of 4,100 short tons (STON) per day. The RORO capability is 4,600 STON per day.

APPLICATION

We find the port capable of handling a notional armored brigade in 6 days. Three repetitions of two Cape D class vessels can support the unit, provided the vessel drafts are limited to 30 feet. The Desert Storm/Desert Shield average stow factor of 60 percent for these vessels would be sufficient. Only 15 acres of paved open staging is required to support the unit. This is 31 percent of the total 48 acres of paved open staging area available at the port.

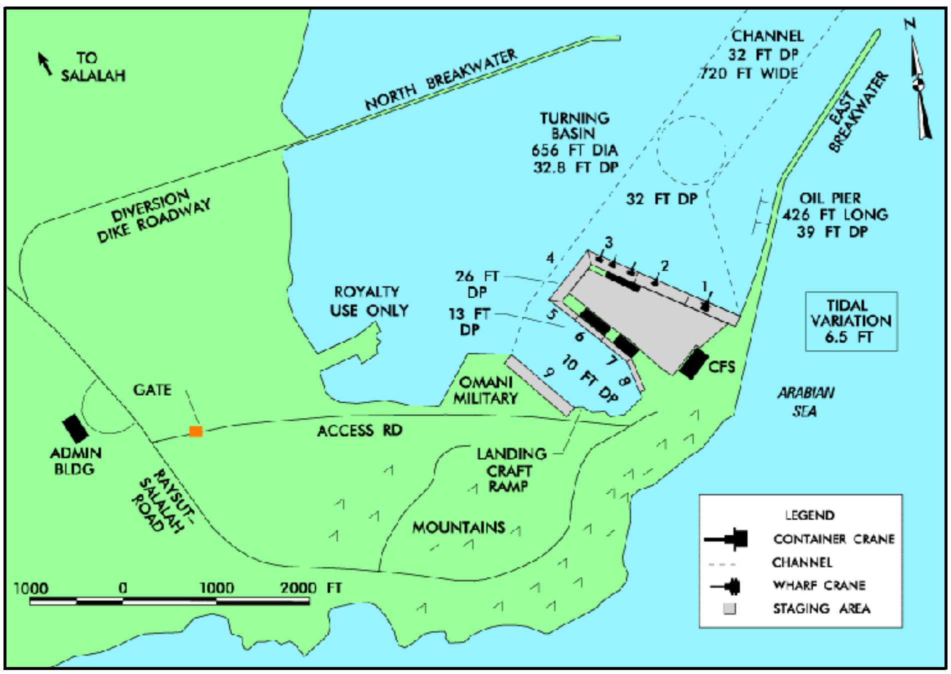
II. GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Salalah, Oman, with support from the 831st U.S. Army Transportation Battalion, Southwest Asia, and the Executive Coordinating Agency in Oman. The major source of data was the Salalah Port Authority. We visited the port on 25 May 1997 and interviewed port personnel.

TRANSPORTATION ACCESS

Water

The Port of Salalah is in the southwest region of Oman, at 16^{o} 56’ N Latitude, and 54^{o} 012’E Longitude. The port is sometimes referred to as the Port of Salalah, because of the nearby city of Salalah. The Port of Salalah is a small but growing port with four deep water berths. Additional berths include shallower berths for coastal and military vessels, a marina for fishing vessels, and a pier for the royal family’s pleasure craft. A single petroleum, oils and lubricants (POL) dolphin pier is on the east breakwater.



Water Access to the Port of Salalah

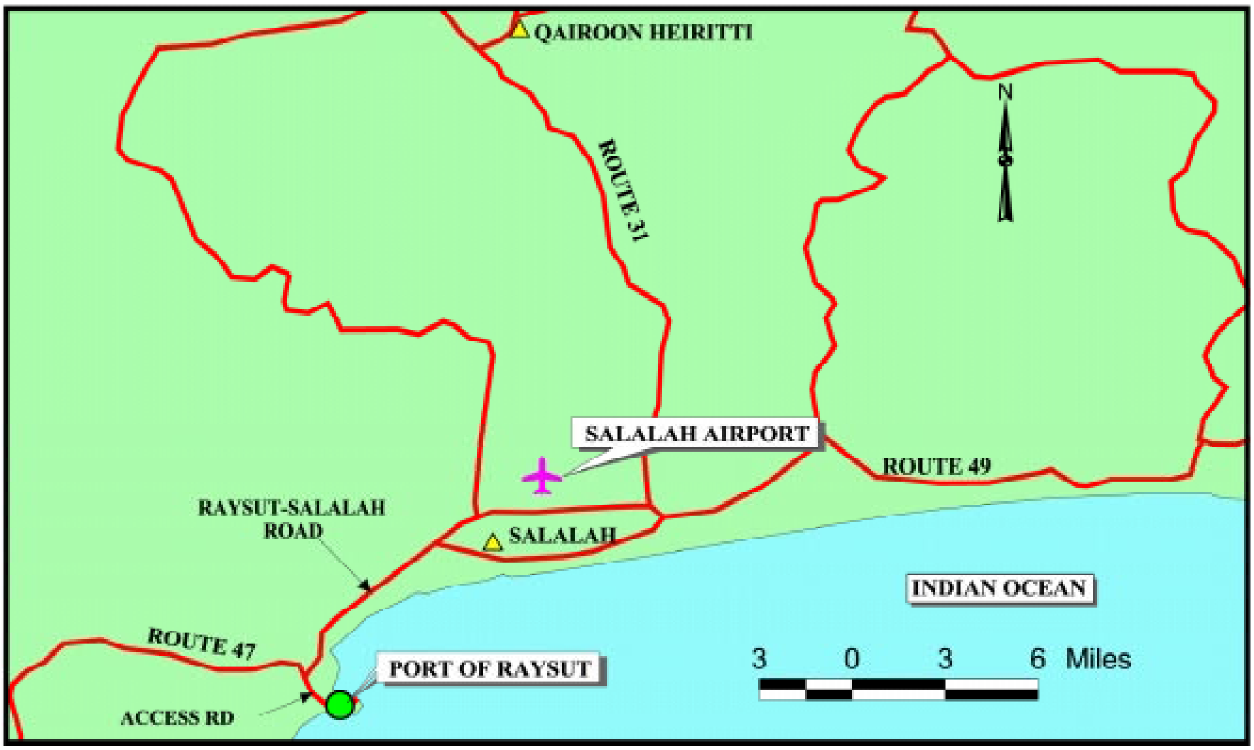
The harbor is protected on both sides by breakwaters. Tidal variation is 6.5 feet (2 meters) but can be as high as 13 feet (4.0 meters) during monsoon season, which is from June to August.

Pilots are compulsory and available at any time, and usually board vessels about 1.5 miles (2.4 kilometers) east of the light at the outboard end of the east breakwater. The pilots’ vessel is green with a white superstructure. Four tugs are available with 240; 440; 1,700; and 2,250 horsepower, respectively.

A square shaped anchorage is 2 miles east of the port. Depths in this anchorage are at least 65 feet (20 meters).

Highway

Access Road leads from the port gate to the junction of Routes 49, also known as Salalah-Salalah Road, and 47. These routes lead east and west, respectively. Following Route 49 to the east, vehicles can continue onto Route 31 northward into the mountainous interior. During monsoon season, these mountainous roads are sometimes foggy and slippery from moisture. Many sections have 30 miles-per-hour speed limits (50 kilometers per hour) or less. The roads immediately outside the port are two lanes. Route 49 is four lanes while passing through Salalah. No unusual clearance or congestion problems exist on roads leading from the port.



Highway and Air Access to the Port of Salalah

Air

The closest airport is Salalah International Airport, about 15 miles (25 kilometers) to the northeast of the port, just north of the city of Salalah. Although the airport is capable of handling international traffic, passengers often enter the country through the Seeb Airport in Muscat, roughly a 2-hour flight from Salalah.

Rail

The country of Oman has no rail. The mountainous terrain of the interior would make rail development very expensive.

PORT FACILITIES

Berthing

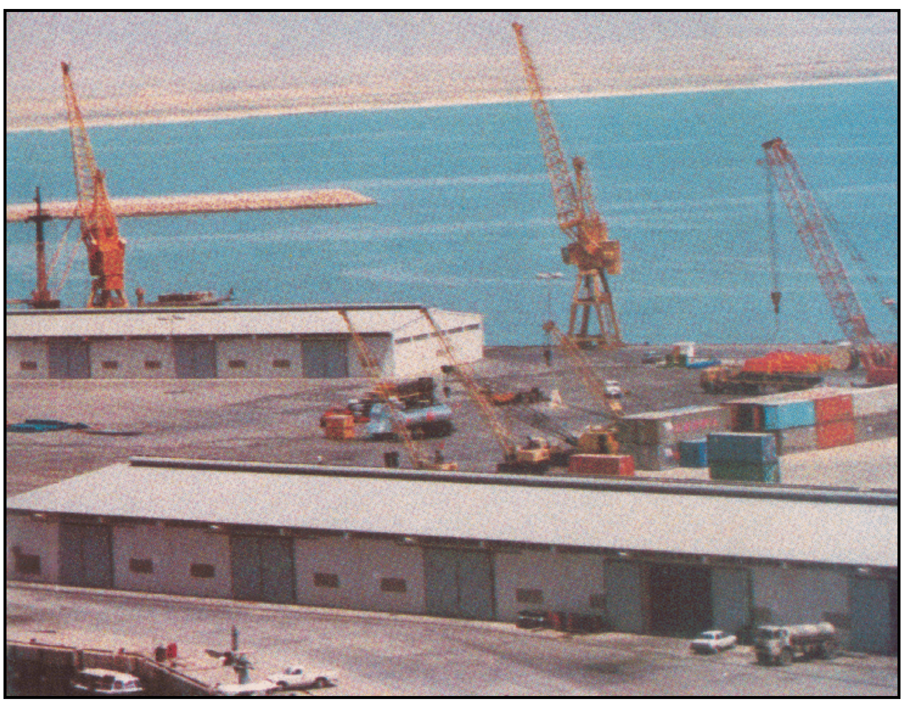
The Port of Salalah is small, but equipped to accommodate the largest post-panamax container vessels. It is nearly surrounded by mountains.

The central area of the port is used by the Omani military, and has less than 10 feet (3 meters) of water at MLW. The jetty at the west end of the port is reserved for the royal family's pleasure craft, and has only 6 feet (2 meters) of water at MLW. These berths cannot support deployments of U.S. military cargo, and are, therefore, not being considered in this analysis. Only the deep draft berths at the east end of the port are militarily useful.

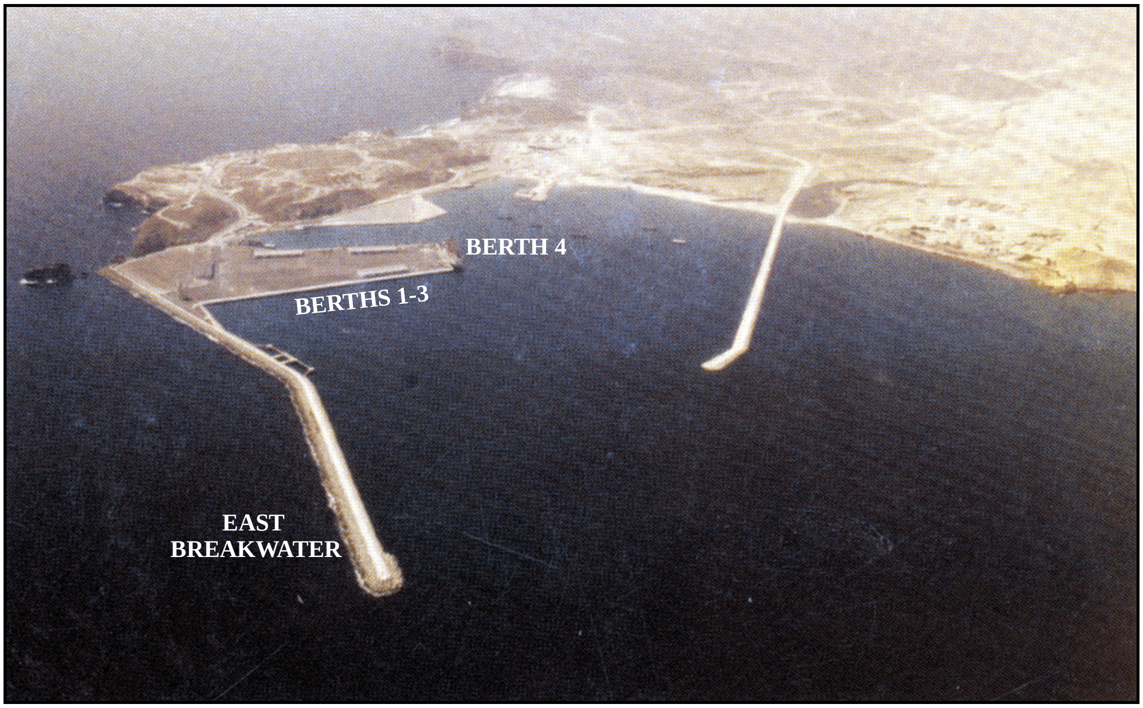
A dolphin pier for POL operations extends from the east breakwater. A small LST ramp lies at the inland end of Berth 9.

CHARACTERISTICS OF THE PORT OF SALALAH

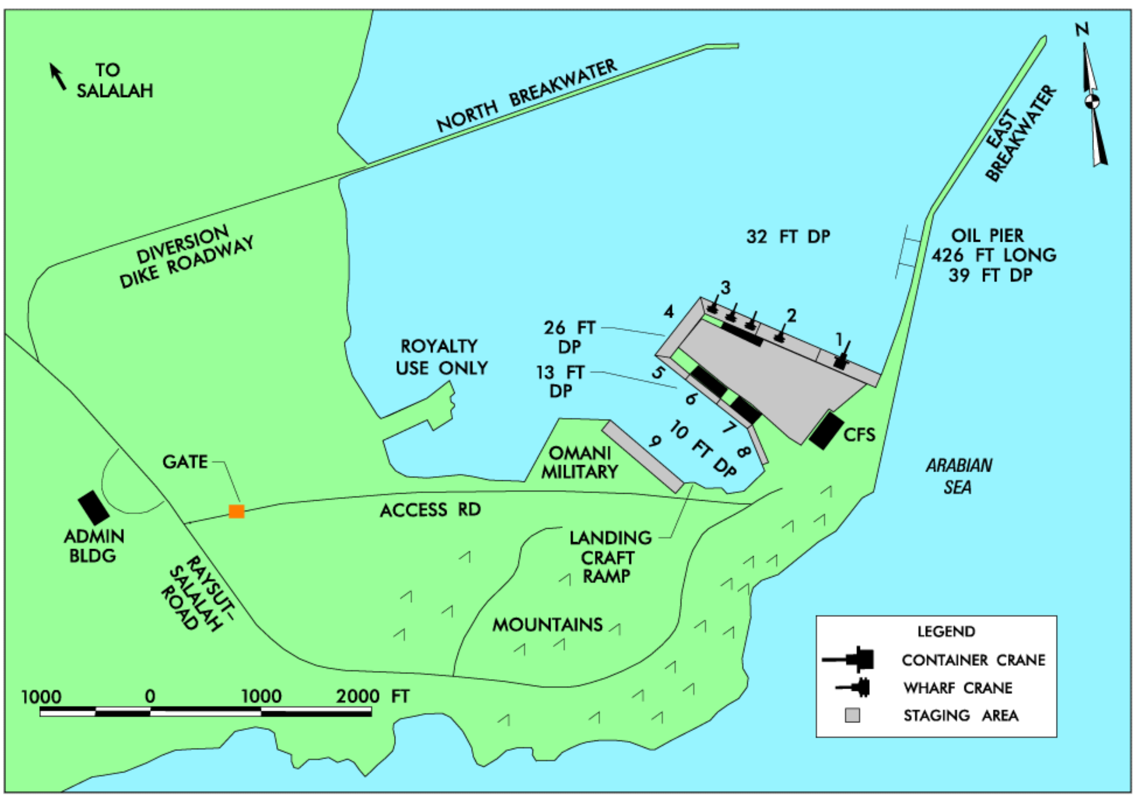
Characteristics	Berth(s)			
	1	2	3	4
Length (ft)	567	567	567	656
Depth alongside at MLW (ft)	32	32	32	26
Deck strength (psf)	500	500	500	500
Apron width (ft)	OPEN	OPEN	OPEN	OPEN
Apron height above MLW (ft)	10	10	10	10
Number of container cranes	1	0	0	0
Number of wharf cranes	0	2	2	0
Apron lighting	YES	YES	YES	YES
Straight-stern RORO facilities	NO	NO	NO	NO
Apron length served by rail (ft)	NO	NO	NO	NO



Open Staging and Cranes at Berth 2



Aerial View of Berth 3 of the Port of Salalah (southwestward view)



Land-Use Map of the Port of Salalah

BERTHING CAPABILITIES OF PORT OF SALALAH

Vessel	Berth(s) 1-3	Berth(s) 4
Breakbulk		
C3 - S - 38a	3	1,a
C4 - S - 58a	2	1,a
C4 - S - 66a	3,a	1,a
C5 - S - 37e	2	1,a
Seatrain		
GA and PR - class	2	1,a
Barge		
LASH C8 - S - 81b	2,a,f,g	a,c,f,g
LASH C9 - S - 81d	1,a,f,g	a,c,f,g
LASH lighter	8	3
SEABEE C8 - S - 82a	1,a,f,g	a,c,f,g
SEABEE barge	8	3
RORO		
Comet	3,d,i	1,a,d,i
Meteor	3,d,i	1,a,d,i
Cape Gnome	2,a,d,i,j	1,a,d,i,j
C7 - S - 95a	2,a	a,c
Cape Taylor	2	1,a
Cape Orlando	2,i	1,a
MV Ambassador	3,d	1,d
Callaghan	2,d	a,c,d
Cape Lambert	2,i,j	a,c
LMSR - class	1,a,g	a,c,g
FSS	1,a,g	a,c,g
Cape E - class	2,i,j	1,a
Cape D - class	2,a	a,c
Cape H - class	2,a,g	a,c,g
Cape Texas	2,i	1,a
Cape R - class	2,a,d	1,a,d
Cape I - class	2,i	a,c
Cape Victory	2,i	1,a
Container		
C6 – M – 147a	2	c,e
C7 – S – 69c	2	a,c,e
C7 – S – 68c	2	a,c,e
C8 – S – 85c	1,a	a,c,e
C9 - M - 132b	1,a,g	a,c,e,g
C9 - M - F141a	1,a,g	a,c,e,g
C6 - S - 1qd (TACS)	2	a,c
C5 - S - MA73c (TACS)	2	1,a
C6 - S - MA60d (TACS)	2	a,c
Combination		
C7 - S - 133a	2,a	a,c
Maersk	2,a	a,c
AmSea	2	a,c

Notes:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a - vessel draft limited
b - apron too narrow
c - berth too short
d - no straight - stern ramp
e - no CNTNR cranes
f - anchorage OK, berth too shallow
g - shallow channel
h - no special ramps
i - tide too low for ramp clearance
j - tide too high for ramp clearance
k - ramp angle too steep at low tide
m - ramp angle too steep at high tide
n - parallel ramp operation ONLY
o - apron too narrow for side ramp

Ramp clearance and angle based on maximum vessel draft.

♦ May Prevent Operation

♦ May Limit Operation

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

Open Storage

The Port of Salalah has 48 acres (200,000 square meters) of paved open staging available for military operations. Much of the open area is brick-paved and can only support 500 pounds per square foot.

The port has no experience handling helicopters. The area most suitable to land helicopters is along Berth 4. Either of the two nearby transit sheds could support helicopter shrink-wrap operations for redeployment.

Open Storage Area at Berths 1 and 2 of the Port of Salalah (northward view)

Covered Storage

The port has four single-level transit sheds. Each shed provides 32,000 square feet of covered storage. None of these sheds is refrigerated or has truck docks.

Transit Sheds at Berths 2 through 4 at the Port of Salalah (northward view)

Highway

The port has one gate. It is on Access Road, which branches off of Salalah Road. The gate has a small guard shack between two 15-foot lanes.

The roads within the port are uncongested and in good condition. Vehicles can move around the port without restrictions on height or weight. Though not posted, speed limits are 9 miles-per-hour (15 kilometers per hour). The port has no truck scales.

Unloading/Loading Positions

The port has no ramps or docks for truck operations. The military should bring or build ramps to handle trucks and trailers that do not have integral ramps.

Offsite Storage Area

The port is almost completely surrounded by mountains. Because of this, offsite marshaling would have to be at least a mile inland from the port where the land is fairly flat. There is little commercial development outside the port. Drainage is inadequate during monsoon season.

Open Area Along Roads Leading to the Port of Salalah

MATERIALS HANDLING EQUIPMENT (MHE)			
MHE Type	Capacity (STON)	Quantity	Owner
Mobile Crane	12–58	9	Port
Mobile Crane	150	1	Port
Forklift	35	1	Port
Forklift	3 - 10	20	Port

The port owns several mobile cranes and forklifts. Other MHE is owned by stevedore and rental companies in Salalah.

AMMUNITION

The Port of Salalah has no experience handling ammunition. With Port Authority approval, ammunition handling is possible. The anchorage has not been rated for net explosive weight.

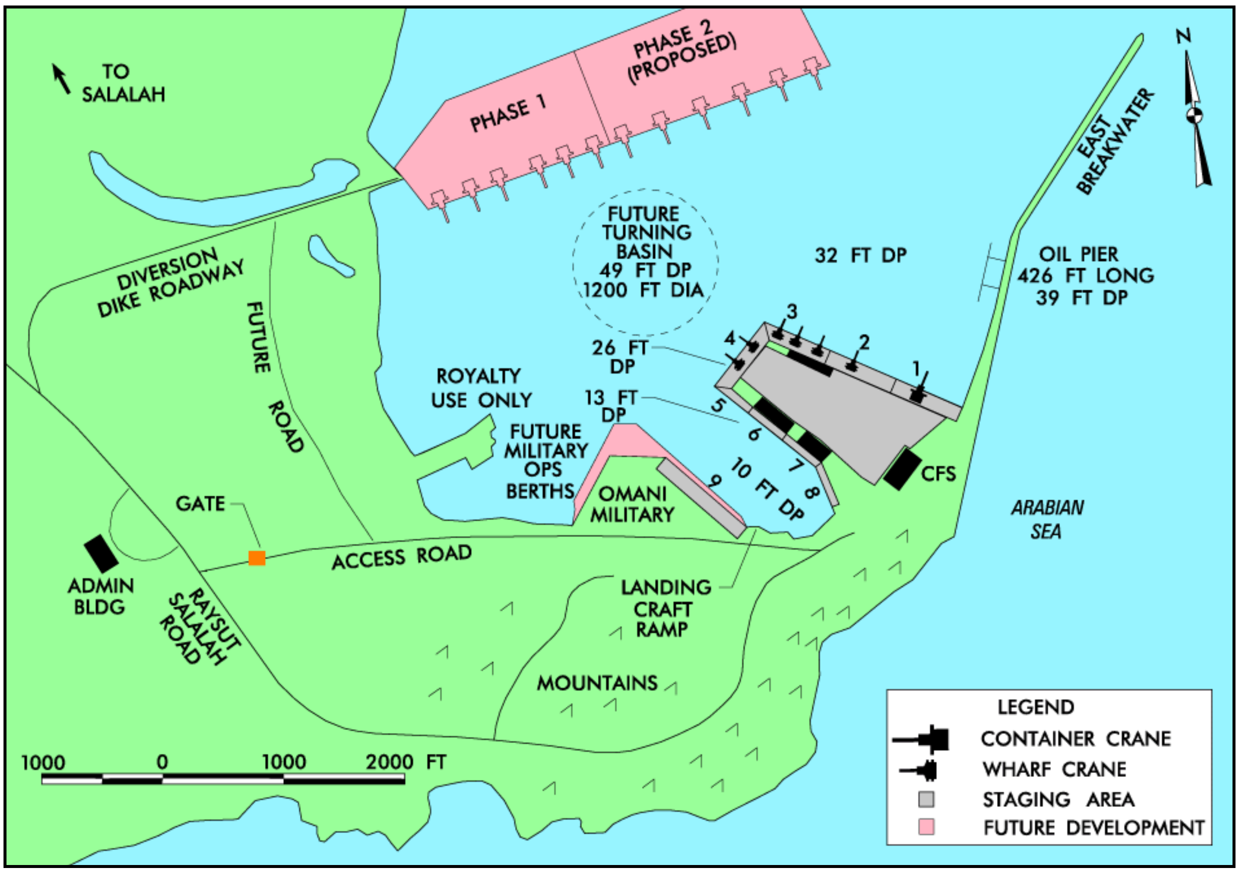
PETROLEUM, OILS AND LUBRICANTS (POL)

The land-use map shows the POL pier on the east breakwater. This berth can accommodate tankers with up to 39-foot drafts. Pipelines lead to tanks inland, at the foot of the mountains.

FUTURE DEVELOPMENT

Construction is well underway to develop container berths along the north breakwater. Four cranes will be operational by early 1999, with 55-ton capacity and post-panamax reach. Two more cranes are planned. Sealand will operate these cranes along 1,968 feet of apron, with at least 40 feet deep water at MLW. If container business continues to grow, the terminal may expand in length to 4,200 feet and in width 2,100 feet, with berths on both sides.

Plans also call for a new passenger ship terminal, expansion of the Omani military terminal at Berth 9, and a dry bulk terminal, among others.

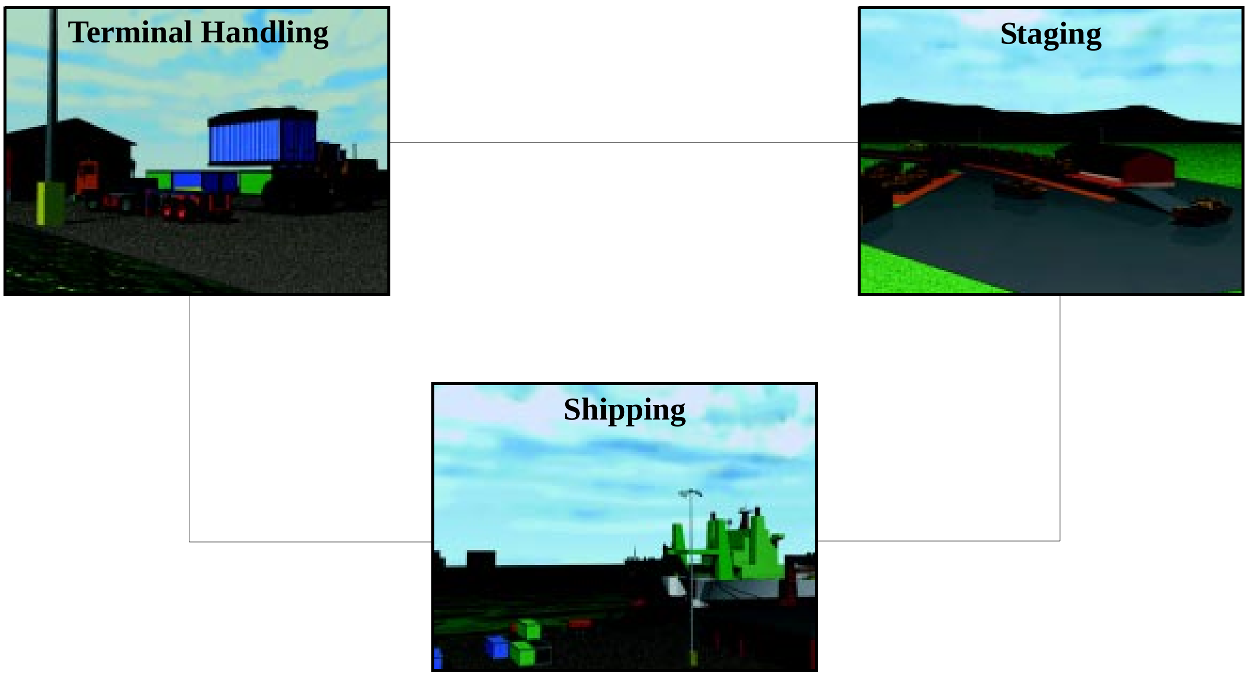


Future Development at Port of Salalah

III. THROUGHPUT ANALYSIS

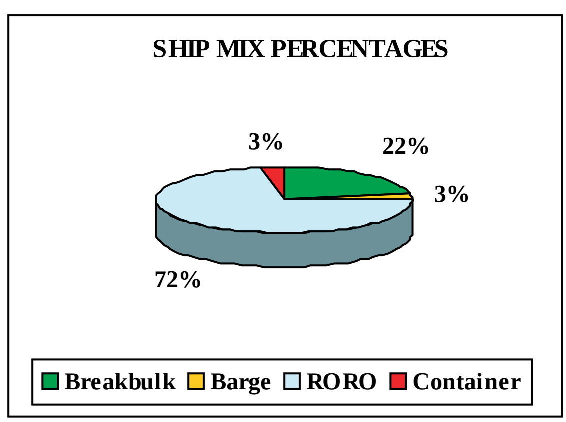
GENERAL

This section evaluates the throughput capability of the Port of Salalah using the port operational performance simulator computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging/hardstand marshaling, and terminal processing/handling - in STON per day.



Terminal Throughput Subsystems

This analysis assumes 70 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using a 70 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



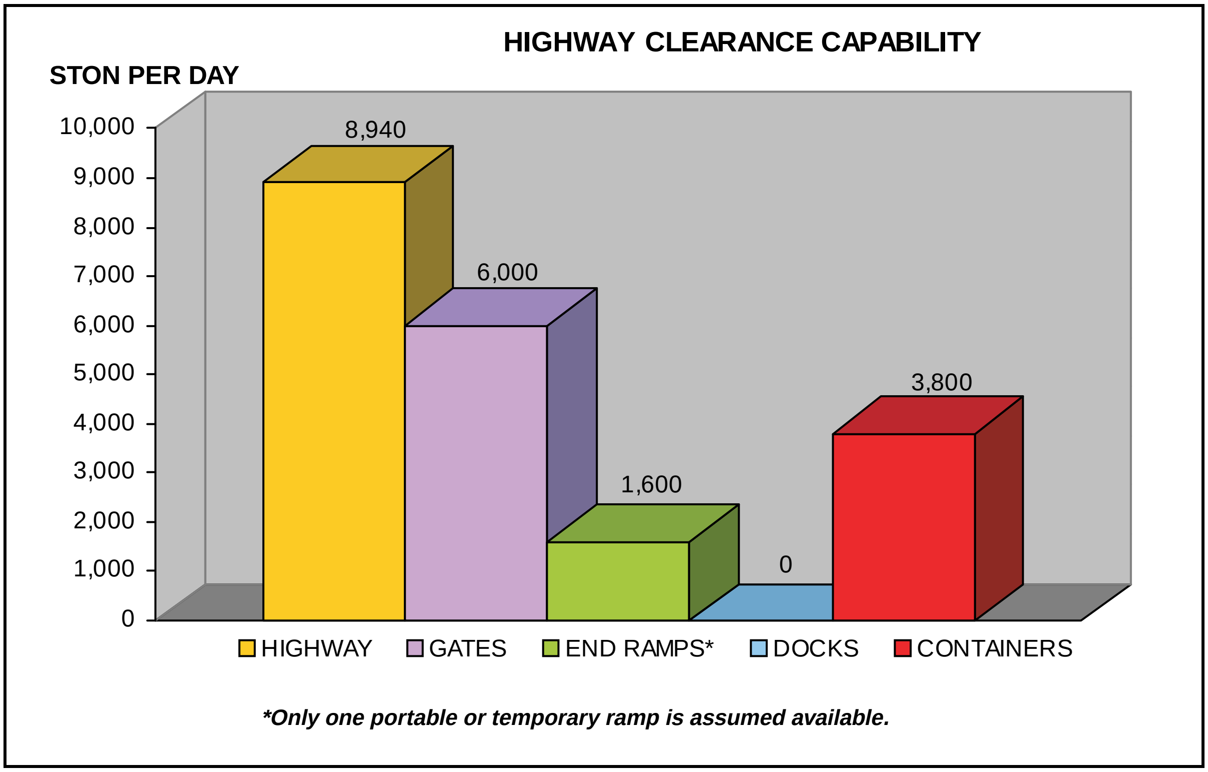
RECEPTION /HANDLING

Highway

The most restrictive highway link to or from the port is the two-lane, two-way Access Road. The road network in and out of the port, including the gate processing of vehicles, could handle about 6,036 STON (32,988 MTON) of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the off-port marshaling areas. Vehicles on commercial or military flatbed trailers without integral ramps will load at portable end ramps brought or built by the military port operator. Each such ramp can support 1,600 STON (4,800 MTON) per day. This analysis assumes the military operation will only involve one portable truck end ramp.

The port has no truck docks. It does, however, have one container handler. This single container handler can support 3,785 STON (9,462 MTON) of containers per day.

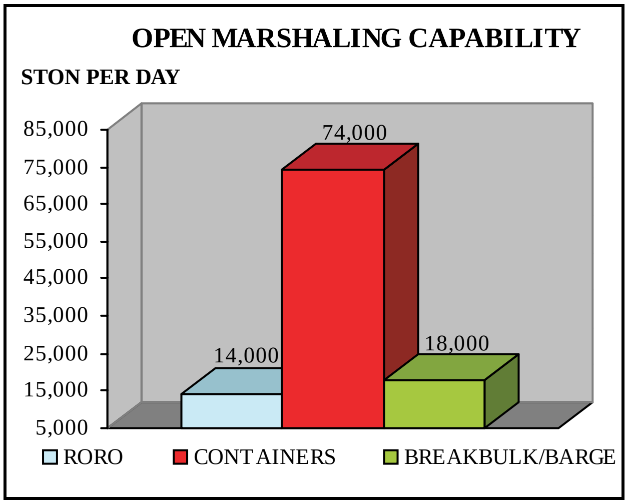


Rail

The country of Oman has no rails. The mountainous terrain of the interior would make rail development very expensive.

Open Storage

The port has a total of about 48 acres (200,000 square meters) of paved open storage. This acreage provides the marshaling capabilities in the graph to the right. If all the area is used for RORO cargo, the throughput would be 14,000 STON per day. Each open acre provides the capability to stage 290 STON per day of RORO cargo, or 1,600 STON per day of container cargo, or 380 STON per day of breakbulk cargo.

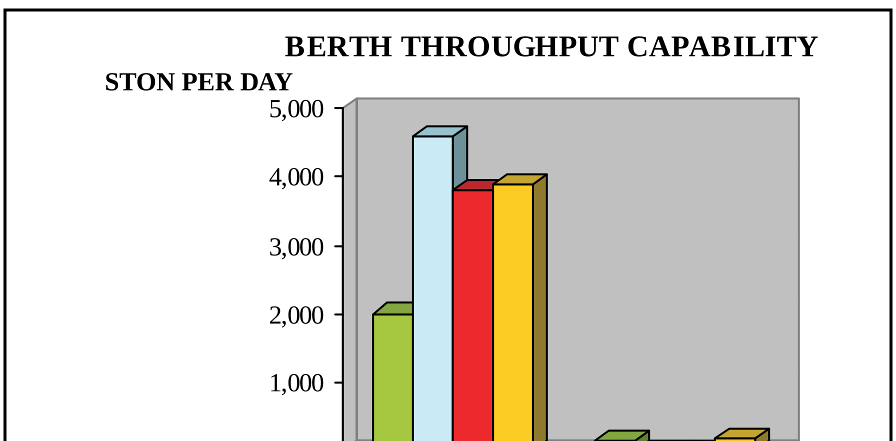


The Port of Salalah has four single-level transit sheds. Each shed provides 32,000 square feet (3,000 square meters) of covered storage. None of these sheds are refrigerated or have truck docks.

Shipping

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility. Although these values provide the shipping rates, few ships can be loaded to their maximum draft. The 26-foot depth, short length (656 feet), and lack of cranes restrict Berth 4 to very low capability.

CONVERSION FACTORS	
Breakbulk:	.4 STON per MTON
RORO:	.25 STON per MTON
Containers:	.4 STON per MTON



	1-3	4
BREAKBULK/BARGE	2000	140
RORO	4600	0
CONTAINERS	3800	0
MIXED	3900	180

THROUGHPUT SUMMARY FOR THE PORT OF RAYSUT								
BERTH(S)	LENGTH (feet) (meters)	DEPTH (feet) (meters)	BB (STON) (MTON)	RORO (STON) (MTON)	RORO SQ FT (EST)	RORO PIECES	CNTNR (STON) (MTON) (TEU)	MIXED (STON) (MTON)
1-3	1,701 518	32 9.7	2,000 5,100	4,600 18,000	92,000	540	3,800 9,500 470	3,900 15,000
4	656 200	26 7.9	140 350	0	0	0	0	180 440

BERTH PREFERENCE RANKING

The military port operator should negotiate for use of Berth 1-3 due to its deeper water, longer length, and availability of cranes. Berth 4 has essentially no military usefulness because of its water depth and length.

Berth 1-3 is the preferred berth for all modes of shipping. Berth 4 has no cranes, is shallower than Berth 1-3, and is too short for most ocean going vessels.

Barge Operations

Some of the berths otherwise not mentioned in this analysis might be used to support barge operations. For example, Berths 5 through 8 are long enough to handle six SEABEE barges, or nine LASH lighters. The water depth is only 13 feet along these berths, making them unsuitable for military operations other than barges. A few key issues for planning purposes are:

- Each mobile crane can handle 829 MTON or 331 STON per day, assuming 20 productive work hours, and 90 percent berth utilization factor.

- SEABEE barges are 175 feet long. Typical LASH lighters are 115 feet long. A crane operating every other barge or lighter provides sufficient working space.

Assuming five mobile cranes are operating, (one crane for every other LASH lighter) the barge operations along Berths 5 through 8 could support loading or unloading 1,600 STON or 4,100 MTON per day.

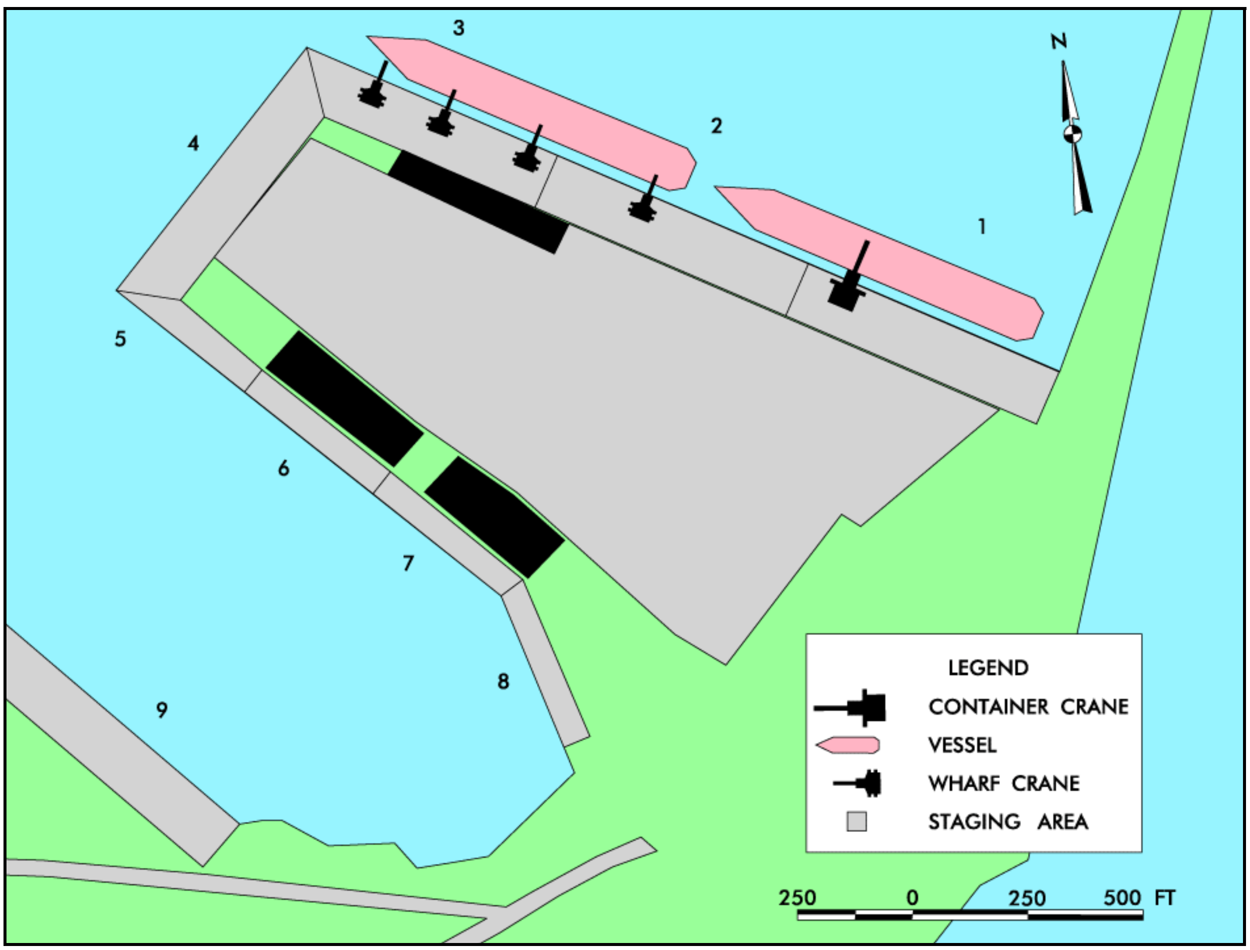
Large Vessel Operations

The shallow depth of Berth 1-3 would require large vessels to enter the port with drafts 4 to 6 feet shallower than fully loaded. The optimal vessel for the Port of Salalah is the ***American Eagle*** class, such as the ***American Falcon*** or the ***American Condor***. Fully loaded, these vessels only draw 30 feet of water and could operate unrestricted at Berth 1-3. Cape D vessels can also operate at Berth 1-3, provided typical reduced stow factors occur to reduce the draft below their maximum of 33 feet.

IV. APPLICATION

This section evaluates the port's throughput capability for processing a notional armored brigade. Because of the shallow drafts at the Port of Salalah (26 to 32 feet MLW), this study evaluates the operation using vessels of the Cape D class, such as the ***Cape Douglas***. Although these vessels have a maximum draft of 33 feet (9.8 meters), we assume the vessels will arrive with shallow enough draft to berth at high tide. These vessels typically load only to 60 percent stow factor. The density of the military equipment at this stow factor typically produces drafts of 20 to 22 feet on these vessels. The vessels have a lightship draft of only 13 feet, 6 inches (4.1 meters), and an overall length of 681 feet (207 meters).

The facilities used depend on decisions made by the Omani Ministry of Communications, by way of the Salalah Port Authority. Because the port regularly supports the Omani Navy and Coast Guard, the U.S. military can only assume to have access to the 25 acres of open staging area near Berths 1-3. Berths 1-3 is the only choice to berth two Cape D vessels.

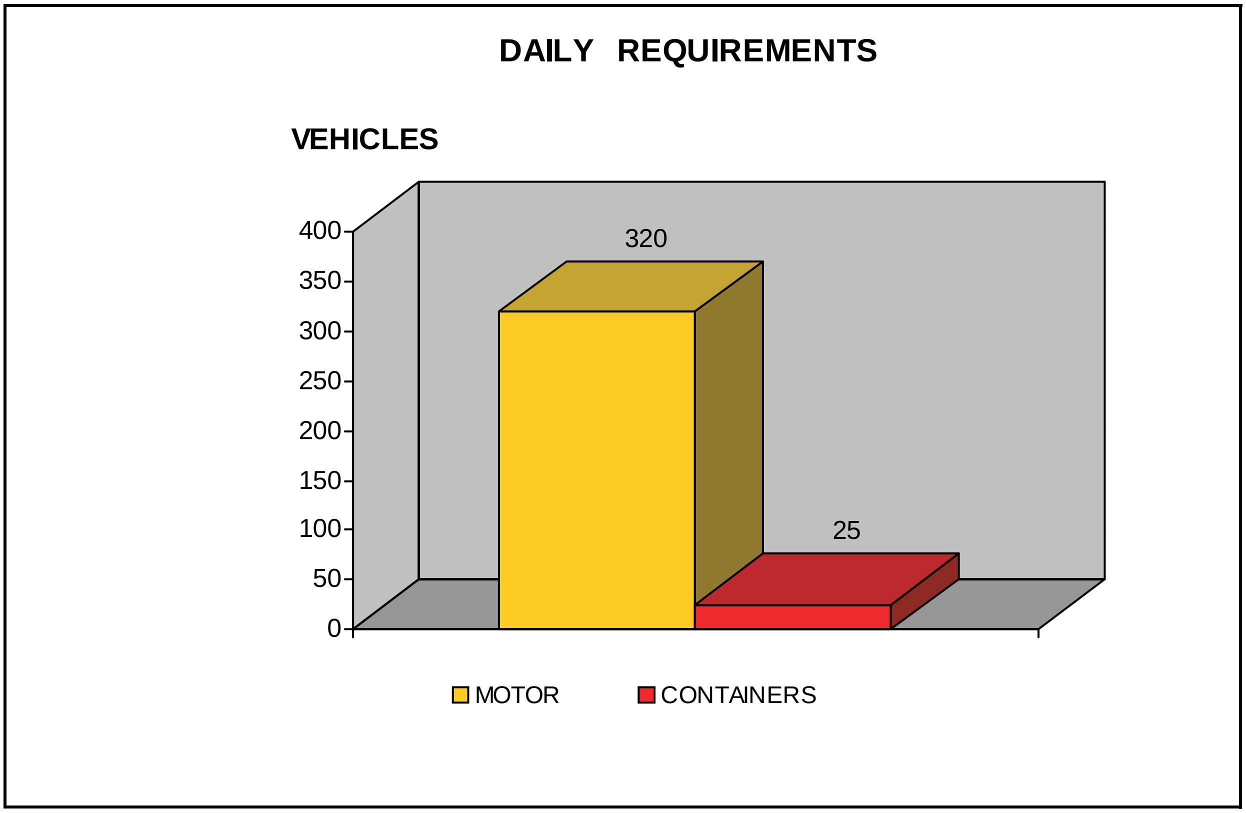


Facilities to Support U.S. Military Operations

REQUIREMENTS

ARMORED BRIGADE		
	Total Equipment	**Required Daily Throughput**
Volume	95,800 MTON	16,000 MTON
Weight	31,703 STON	5,300 STON
Area	642,645 SQ FT	107,100 SQ FT
Vehicles*	2,823	460
Containers	150	25
*Includes trailers		

For purposes of this analysis, the likely requirement for the Port of Salalah is to process a notional armored brigade. We assume the port must process the brigade in only 6 days of offloading and port clearance. The brigade has to move about 2,820 vehicles and 150 containers. As described earlier in this analysis, there is no rail access. Using a motor/convoy option, about 1,260 (210 per day) roadable vehicles transport 820 (140 per day) trailers. Also, about 230 40-foot flatbeds (40 per day) and 410 HETS (70 per day) would transport nonroadable equipment. For traffic analysis, this equates to about 320 vehicles (some with trailers or semitralers) passing through the gate. About 25 containers would arrive daily.

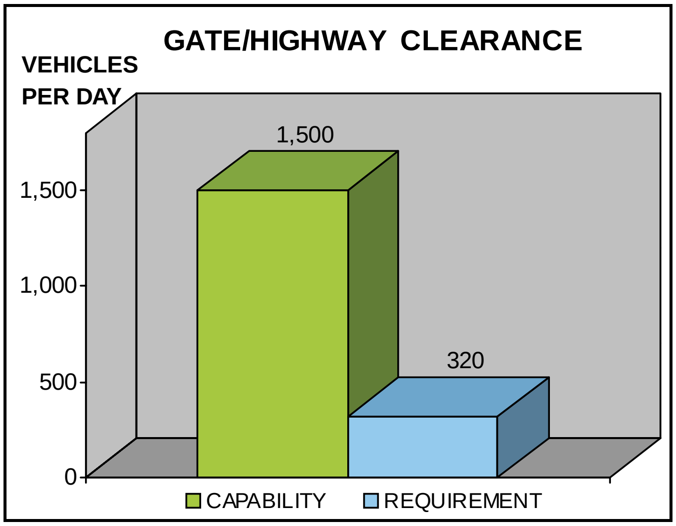


TERMINAL OUTPROCESSING/HANDLING

Highway

There is only one gate that allows military vehicles and equipment to access the causeway and the highway infrastructure. One lane can accommodate 1,500 military vehicles per day. This is sufficient to meet the requirement.

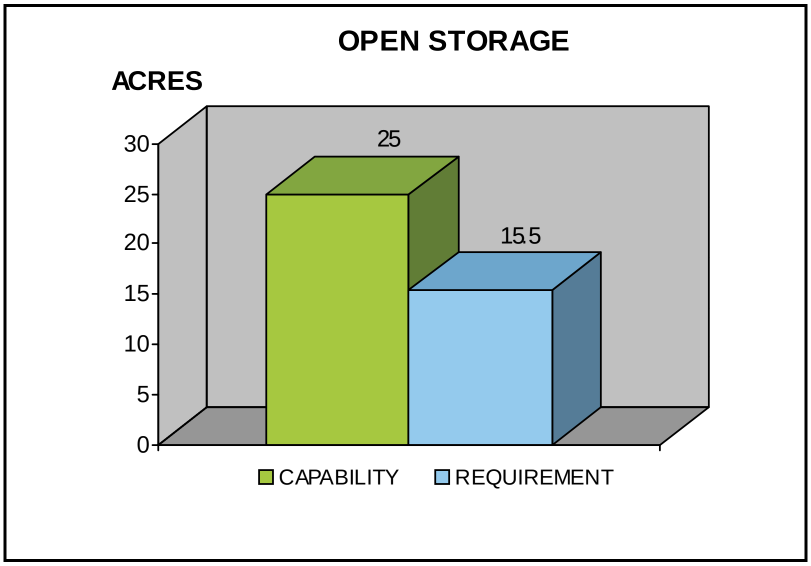
Assuming a constant flow of vehicles out the gate of the port, the daily clearance requirement is under 400 vehicles. The Salalah road network can easily support the requirement to handle the armored brigade in 6 days.



Open Storage

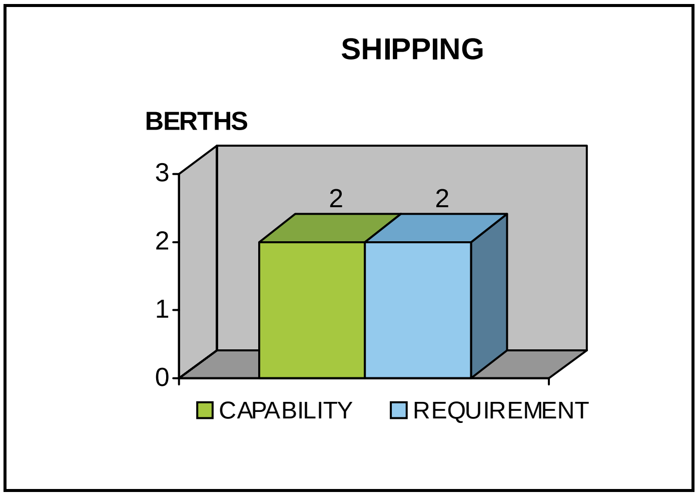
Although the Port of Salalah has a total of 48 acres of paved open storage, we assume only the 25 acres near Berths 1-4 will be available for U.S. military operations.

Marshaling the entire brigade of equipment (642,645 square feet) requires 37 acres. We assume the maximum amount in the port at any time is about 2-1/2 days (42 percent) of the required port throughput. This requires the port to provide 15.5 acres of paved open area to support the deployment. The port can easily meet the requirement.



Shipping

An armored brigade has 642,645 square feet of vehicles and equipment. The deck space on the Cape D class vessels is 180,868 square feet. In addition to this space for rolling stock, the vessels can also carry 554 TEUs of containers on the weather deck.



Desert Shield records indicate an average stow factor of only 60 percent for these vessels. Although one Desert Shield sailing proved an 85 percent stow factor is possible, the records of 11 sailings provide an average stow factor of 60 percent. Loading the vessels with only 60 percent stow factor ensures the vessels will not exceed maximum draft of the port.

Each of the Cape D class vessels can carry 108,500 square feet of cargo, assuming the 60 percent stow factor discussed above. At this rate, the deployment of the brigade would require six of these vessels. Unloading RORO vessels this size can be done in less than 2 days. To meet the 6-day requirement, the port will have to berth two of these vessels simultaneously throughout the 6-day deployment. Three two-vessel operating cycles are required to deploy the entire brigade, with these partially loaded vessels.

Two Cape D class vessels can berth and operate at the port simultaneously. The facilities map earlier in this section provides the berthing configuration.

SUMMARY

The Port of Salalah can process a notional armored brigade in 6 days. The only concern in the process is the shallow draft of the berths. Because of the shallow draft (32 feet MLW), large vessels with drafts from 35 to 37 feet have to arrive at the port with less than full loads, and possibly at high tide. Therefore, plans should call for vessels with shallow drafts, such as ***American Eagle*** class fully loaded or the ***Cape D*** class partially loaded at 30-foot drafts, to operate at the port with MLW of 32 feet.

RECOMMENDATION

We recommend the Port of Salalah be considered to process brigade-sized units. Plans should call for shallow draft ships, such as the ***American Eagle*** and ***Cape D*** classes.

PORT OF DOHA
QATAR

I. EXECUTIVE SUMMARY

GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Doha, Qatar, based on a site visit in May 1997. The port can accommodate vessels as large as the ***American Eagle*** and can support military operations. It cannot support larger vessels due to the depth at mean low water (MLW).

The Port of Doha handles the most general cargo in Qatar. It consists of a 2,986-foot wide T-shaped pier that handles general cargo operations, as well as containers using a 100-ton Gottwald mobile crane. Tidal variation at the port is 4 feet. Berths range in depth from 23 to 29 feet at MLW. Vessels up to 597 feet long may enter the port, subject to tidal conditions. Several berths have transit sheds, but RORO operations are possible in the open areas.

The port is located in the center of the highly developed city of Doha. Connector routes and the main highway are in very good condition. There are no railroads in the country of Qatar.

THROUGHPUT

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of 5,870 short tons (STON) per day. The RORO capability of the port is 6,200 STON per day.

APPLICATION

We find the port capable of handling a notional armored brigade in 6 days. Our analysis assumes the simultaneous processing of two vessels of the ***American Eagle*** class every 2 days. The depth of the port cannot support LMSR nor FSS operations. Only 15 acres of paved open staging is required to support the unit. This is only 20 percent of the total paved staging area of the port and is likely to be available on short notice.

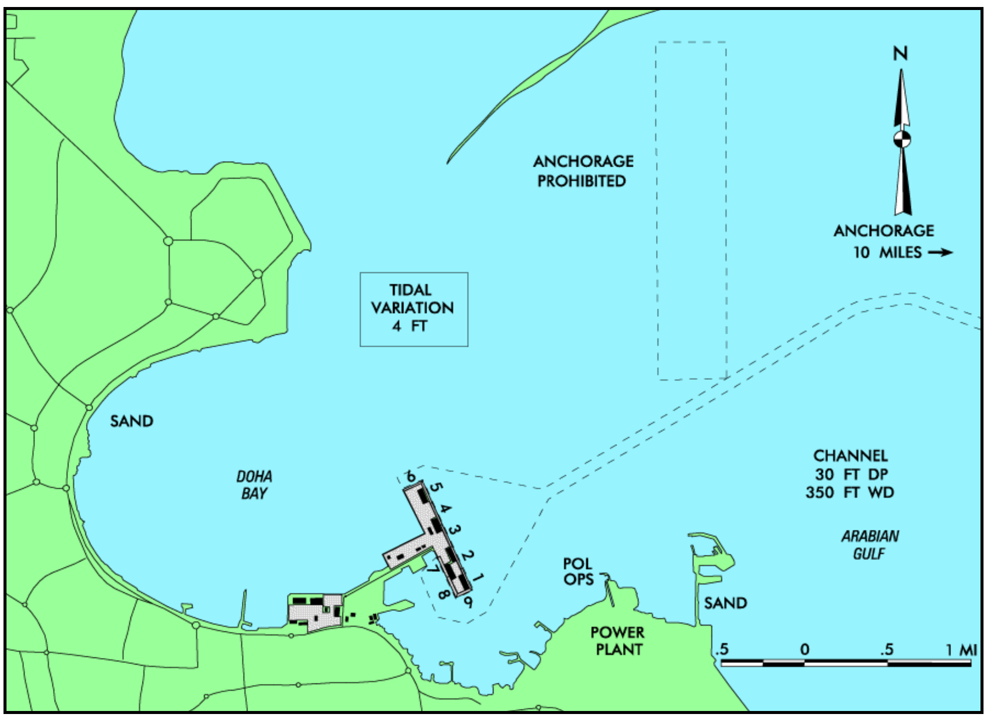
II. GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Doha, Qatar, based on a site visit on 17 May 1997. We had support from the 831st U.S. Army Transportation Battalion, Qatar Detachment. The site visit included an interview with the Doha Port Authority.

TRANSPORTATION ACCESS

Water

The Port of Doha handles the most general cargo in Qatar. It is located at 25°17' N Latitude and 051°35.8' E Longitude. In addition to containers, typical commodities that pass through the port are iron ore, wheat, foodstuffs, and livestock. The port consists of a 2,986-foot (910-meter) wide T-shaped pier and a few basins for small vessels. These shallow basins of the port are not useful for military operations, except for barge operations. The deep water T-head supports general cargo operations, as well as containers using a 100-ton Gottwald mobile crane.



Water Access to the Port of Doha

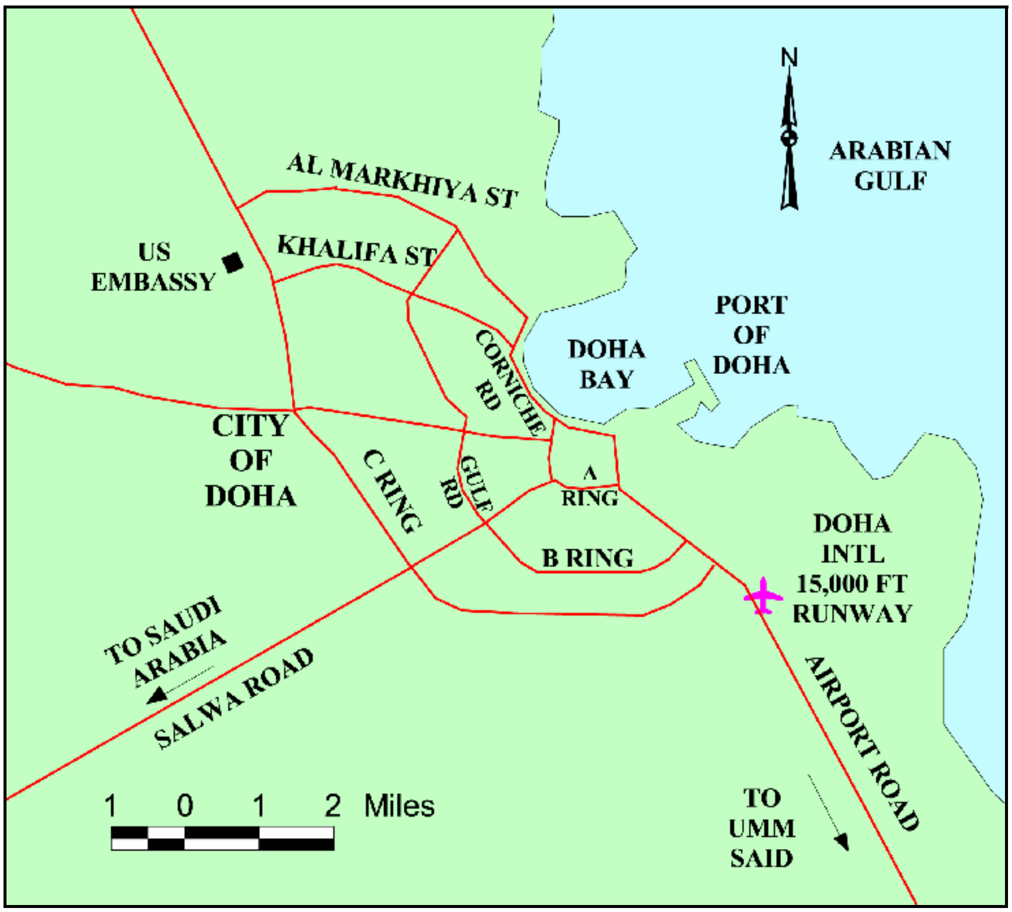
There are no overhead restrictions for vessels entering the port. Tidal variation at the Port of Doha is 4 feet (1.2 meters).

Vessels up to 597 feet (182 meters) long may enter the port subject to tidal conditions. Pilots are compulsory and available at any time. There are four tugs available directly at the port: two with 1,800 horsepower and two with 2,500 horsepower.

The anchorage lies in the open water near the entrance to the approach channel, about 10 miles east of the port. The water in this area is 30 feet deep.

Highway

The port gate is on Corniche Road, the main road along the water. Corniche Road is developed to support the tourist business of Doha. It has two lanes in each direction. Vehicles progress from the port eastward or westward on Corniche Road.



Highway and Air Access to the Port of Doha

Air

The Doha International Airport is about 3 miles (4.8 kilometers) southeast of the port. The longest runway is 15,000 feet long (one of the longest in the world) and 150 feet wide. It is capable of handling C5 aircraft.

Rail

There is no rail in the country of Qatar, nor plans to develop a rail infrastructure.

PORT FACILITIES

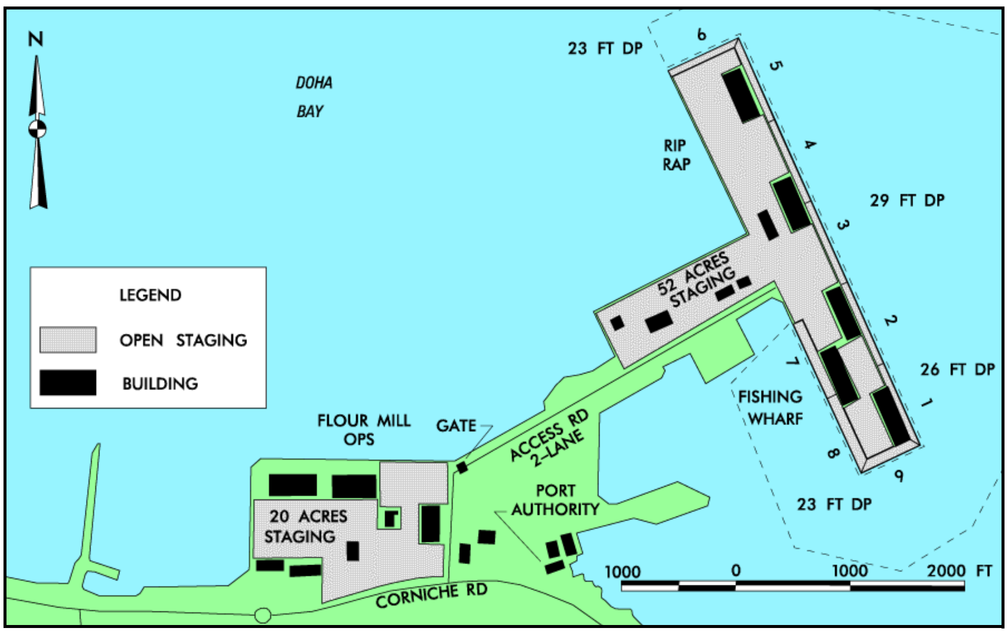
Berthing

The Port of Doha is a small multicargo facility, in the highly congested downtown area. About 5,800 feet of wharf surrounds the large T-head pier and could support military operations. One 100-ton semi-mobile crane and two straddle carriers support container operations. Other cargoes are handled by smaller mobile cranes or by ships' gear.

CHARACTERISTICS OF THE PORT OF DOHA					
Characteristics	Berth(s)				
	1	2-5	6	7-8	9
Length (ft)	597	2,388	705	1,410	705
Depth alongside at MLW (ft)	26	29	23	23	23
Deck strength (psf)	600	600	600	600	600
Apron width (ft)	OPEN	OPEN	OPEN	OPEN	OPEN
Apron height above MLW (ft)	10	10	10	10	10
Number of container cranes	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0
Apron lighting	YES	YES	YES	YES	YES
Straight-stern RORO facilities	NO	NO	NO	NO	NO
Apron length served by rail (ft)	NO	NO	NO	NO	NO

The deepest berths at the port are only 29 feet (8.8 meters) deep at MLW. This greatly restricts military operations, especially those involving the large FSS and LMSR class vessels.

The inland areas of the port are limited to handle bulk flour cargo only. About half-way out to the general cargo berths is a shallow basin for tugs and pleasure craft.



Land-Use Map of the Port of Doha

BERTHING CAPABILITIES OF PORT OF DOHA

Vessel	Berth(s) 1	2-5	6	7-8	9
Breakbulk					
C3 - S - 38a	1,a	4	1,a	2,a	1,a
C4 - S - 58a	1,a,g	4,a,g	1,a,g	2,a,g	1,a,g
C4 - S - 66a	1,a,g	4,a,g	1,a,g	2,a,g	1,a,g
C5 - S - 37e	1,a,g	3,a,g	1,a,g	2,a,g	1,a,g
Seatrain					
GA and PR - class	1,a	4	1,a	2,a	1,a
Barge					
LASH C8 - S - 81b	a,c,f,g	2,a,f,g	a,c,f,g	1,a,f,g	a,c,f,g
LASH C9 - S - 81d	a,c,f,g	2,a,f,g	a,c,f,g	1,a,f,g	a,c,f,g
LASH lighter	2	11	3	7	3
SEABEE C8 - S - 82a	a,c,f,g	2,a,f,g	a,c,f,g	1,a,f,g	a,c,f,g
SEABEE barge	2	11	3	7	3
RORO					
Comet	1,a,d,i	4,d,i	1,a,d,i	2,a,d,i	1,a,d,i
Meteor	1,a,d,i	4,d,i	1,a,d,i	2,a,d,i	1,a,d,i
Cape Gnome	0	0	0	0	0
C7 - S - 95a	a,c,g	3,a,g	a,c,g	1,a,g	a,c,g
Cape Taylor	a,c	3	1,a	2,a	1,a
Cape Orlando	a,c,g	3,a,g	1,a,g	2,a,g	1,a,g
MV Ambassador	1,d	4,d	1,d	2,d	1,d
Callaghan	a,c,d	3,d	1,a,d	1,a,d	1,a,d
Cape Lambert	a,c,g	3,a,g	1,a,g	1,a,g	1,a,g
LMSR - class	a,c,g	2,a,g	a,c,g	1,a,g	a,c,g
FSS	a,c,g	2,a,g	a,c,g	1,a,g	a,c,g
Cape E - class	a,c,g	3,a,g	1,a,g	2,a,g	1,a,g
Cape D - class	a,c,g	3,a,g	1,a,g	1,a,g	1,a,g
Cape H - class	a,c,g	3,a,g	a,c,g	1,a,g	a,c,g
Cape Texas	a,c	3,i	1,a	2,a	1,a
Cape R - class	a,c,d,g	3,a,d,g	1,a,d,g	2,a,d,g	1,a,d,g
Cape I - class	a,c,g	3,a,g	1,a,g	1,a,g	1,a,g
Cape Victory	a,c	3,i	1,a	2,a	1,a
Container					
C6 – M - 147a	c,e	3,e	1,a,e	2,a,e	1,a,e
C7 - S - 69c	a,c,e,g	3,a,e,g	1,a,e,g	2,a,e,g	1,a,e,g
C7 – S - 68c	a,c,e,g	3,a,e,g	1,a,e,g	1,a,e,g	1,a,e,g
C8 - S - 85c	a,c,e,g	2,a,e,g	a,c,e,g	1,a,e,g	a,c,e,g
C9 - M - 132b	a,c,e,g	2,a,e,g	a,c,e,g	1,a,e,g	a,c,e,g
C9 - M - F141a	a,c,e,g	2,a,e,g	a,c,e,g	1,a,e,g	a,c,e,g
C6 - S - 1qd (TACS)	a,c,g	3,a,g	1,a,g	2,a,g	1,a,g
C5 - S - MA73c (TACS)	a,c,g	3,a,g	1,a,g	2,a,g	1,a,g
C6 - S - MA60d (TACS)	a,c,g	3,a,g	1,a,g	2,a,g	1,a,g
Combination					
C7 - S - 133a	a,c,g	2,a,g	a,c,g	1,a,g	a,c,g
Maersk	a,c,g	3,a,g	a,c,g	1,a,g	a,c,g
AmSea	a,c,g	3,a,g	1,a,g	2,a,g	1,a,g

Notes:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitation as described below.

a - vessel draft limited
b - apron too narrow
c - berth too short
d - no straight-stern ramp
e - no CNTNR cranes
f - anchorage OK, berth too shallow
g - shallow channel
h - no special ramps
i - tide too low for ramp clearance
j - tide too high for ramp clearance
k - ramp angle too steep at low tide
m - ramp angle too steep at high tide
n - parallel ramp operation ONLY
o - apron too narrow for side ramp

Ramp clearance and angle based on maximum vessel draft.

♦ May Prevent Operation

♦ May Limit Operation

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

Open Storage

The Port of Doha has 72 acres (290,000 square meters) of paved open staging that can support military operations. Much of the open area is concrete-block paved and can support 600 pounds per square foot.

The port has no experience handling helicopters. The area most suitable to land helicopters is the southwest edge inland of Berth 5. This area will not likely have tall ships berthed to restrict helicopter landing. The nearby transit shed could support helicopter shrink-wrap and assembly operations.

Open Storage Area Inland of Berth 3 (southeast view)

Covered Storage

The Port of Doha has five single-level transit sheds. Each transit shed provides 63,000 square feet (5,900 square meters) of covered storage area. None of these sheds are refrigerated and none have truck docks.

Highway

The Port of Doha has only one gate that leads to the general cargo area. It is located along the main driveway into the port, Access Road. The gate has a 15-foot lane in each direction. After passing this gate, vehicles turn left or right onto Corniche Road, to access the main highway infrastructure.

The roads within the port are uncongested and in good condition. Vehicles can move around the port without restrictions on height or weight. Though not posted, speed limits in the port are all 9 miles per hour (15 kilometers per hour). The port has no truck scales.

Driveway into the Port of Doha (northeast view)

Unloading/Loading Positions

The port has no ramps or docks for truck operations. The military should bring or build ramps to handle trucks and trailers that do not have integral ramps.

Offsite Storage Area

The port is located in the center of the downtown area of the city. The surrounding area is highly developed for commercial and tourist operations. Offsite storage and staging areas would have to be at least 10 miles away, likely in undeveloped land outside the city of Doha. Much of the land in undeveloped areas of Qatar is flat with poor drainage.

MATERIALS HANDLING EQUIPMENT (MHE)			
MHE Type	**Capacity (STON)**	**Quantity**	**Owner**
Mobile Crane	70	2	Port
Mobile Crane	40	4	Port
Mobile Crane	30	3	Port
Mobile Crane	20	3	Port
Mobile Crane	100	1	Port
Straddle Carrier	35	2	Port
Container Handler	35	1	Port
Trailer	-	122	Port
Tractor	-	65	Rental
Forklift	35	1	Port
Forklift	3 - 10	20	Port

The port owns several mobile cranes and forklifts. Other MHE is owned by stevedore and rental companies in the Doha area. The availability of rental MHE depends on the level of construction at any given time.

AMMUNITION

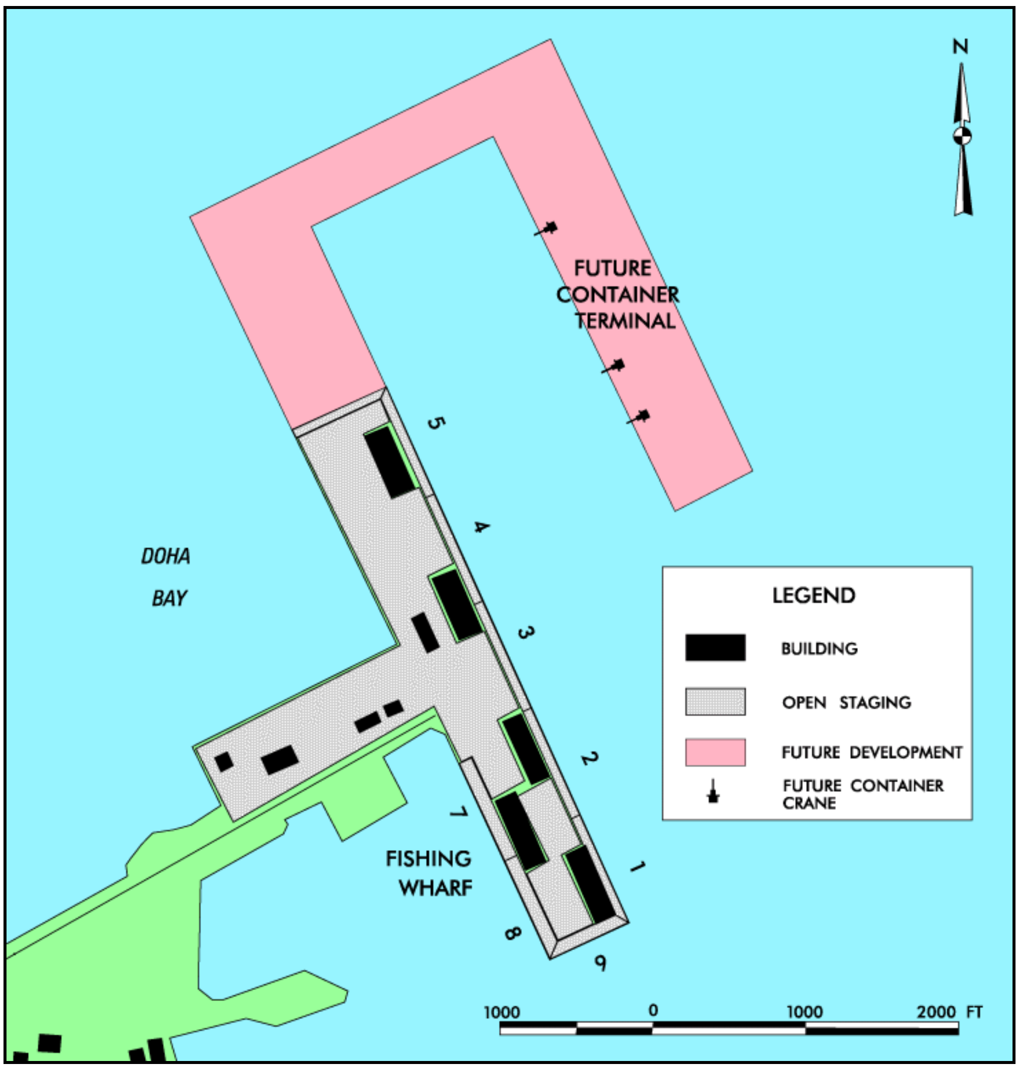
The Port of Doha has no experience handling ammunition. It is highly unlikely that the Port Authority will approve of ammunition handling, since the Doha area is densely populated. There is no anchorage designated for handling explosives.

PETROLEUM, OILS AND LUBRICANTS (POL)

The Qatar General Petroleum Company has a wharf in the south of the bay used by offshore supply tankers and small product tankers. This T-head pier is near the power plant about a mile southeast of the general cargo facilities of this report.

FUTURE DEVELOPMENT

Plans call to extend the existing T-head pier to the north, and increase the depths of the existing berths and channel to accommodate ships with at least 36-foot drafts. Funding for this expansion has not yet been approved. Building more bulk flour facilities is of higher priority.



Future Development at the Port of Doha

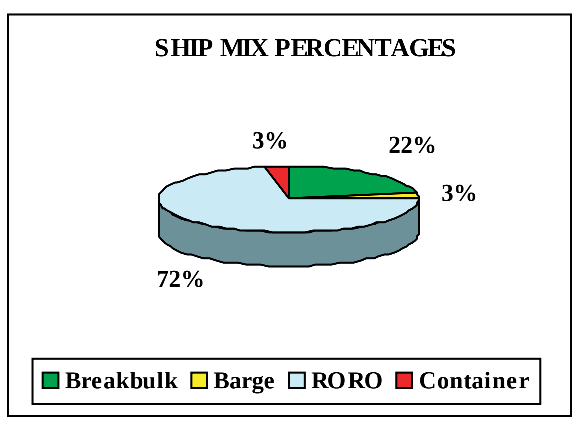
III. THROUGHPUT ANALYSIS

GENERAL

This section evaluates the throughput capability of the Port of Doha using the port operational performance simulator computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging/hardstand marshaling, and terminal processing/handling - in STON per day.

Terminal Throughput Subsystems

This analysis assumes 70 percent of the militarily useful port facilities can be made available at any one time. For this reason, we ran all port analyses using a 70 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future operations.



RECEPTION/HANDLING

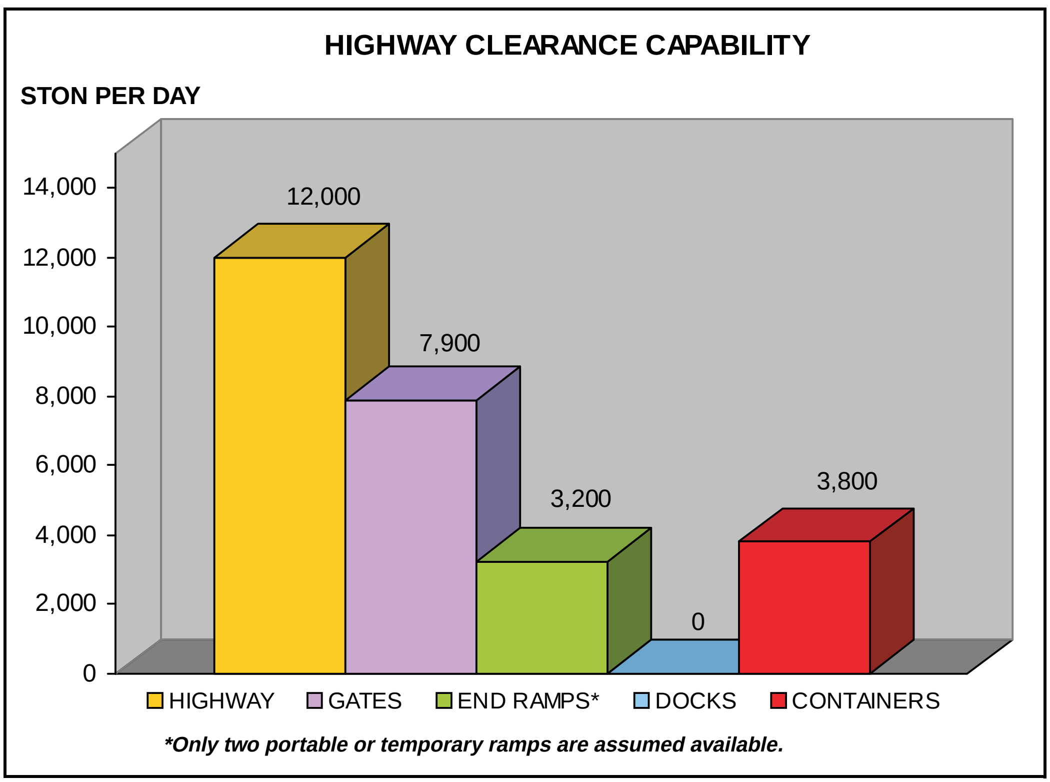
Highway

The driveway leaving the port and the gate can only support a single lane of military vehicles and equipment at a time. The gate restricts the single lane to about 7,900 STON (27,000 MTON) of equipment and supplies per day. This throughput assumes each vehicle requires a minute for processing at the gate, and is very conservative. If vehicles are preprocessed before passing the gate, the throughput is much higher.

Once vehicles pass the gate, the throughput of the port driveway leaving the port is 12,000 STON (41,000 MTON) per day.

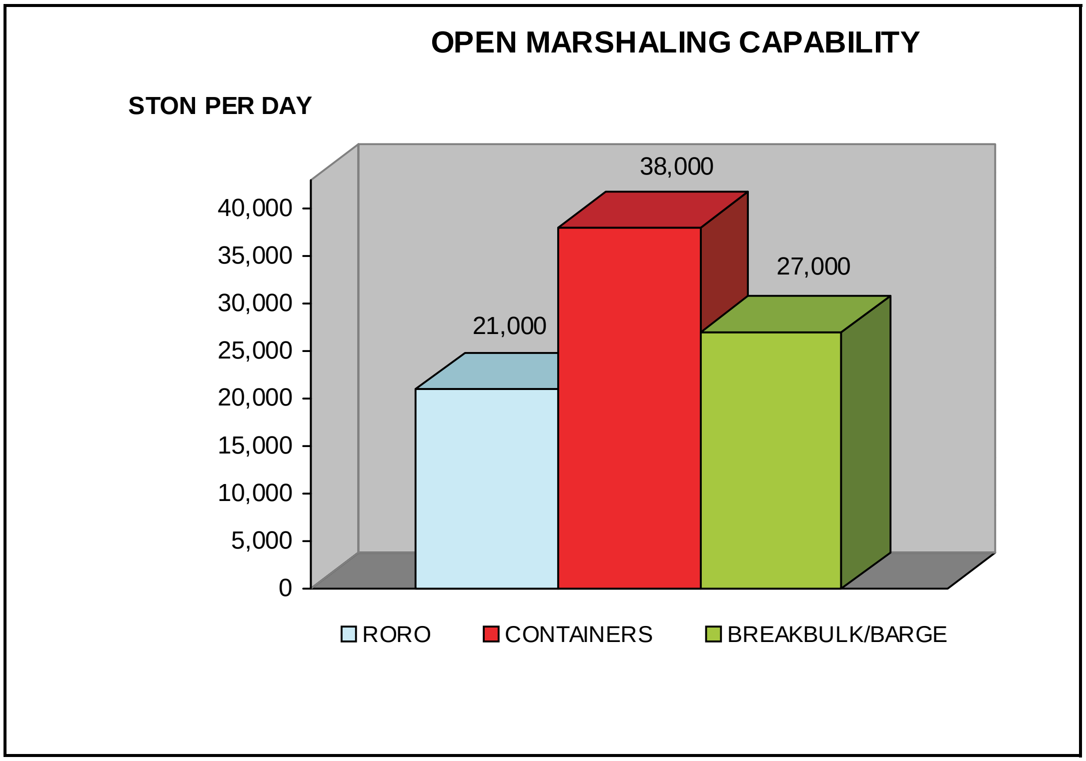
Roadable vehicles in convoys will process directly to the off-port marshaling areas. Vehicles to be loaded onto commercial or military flatbed trailers without integral ramps will load at portable end ramps brought or built by the military port operator. Each such ramp can support 1,600 STON (4,800 MTON) per day. We assume two such ramps will be made available. This analysis assumes the military operation will involve two portable truck end ramps.

The port has no truck docks. It does, however, have one container handler that can support 3,800 STON (9,000 MTON) of containers per day.



Open Storage

The port has a total of about 72 acres (290,000 square meters) of paved open staging available for military operations. This acreage provides the marshaling capabilities in the graph below. If all the area is used for RORO cargo, the throughput would be 21,000 STON per day. Each open acre provides the capability to stage 290 STON per day of RORO cargo, or 1,600 STON per day of container cargo, or 380 STON per day of breakbulk cargo.

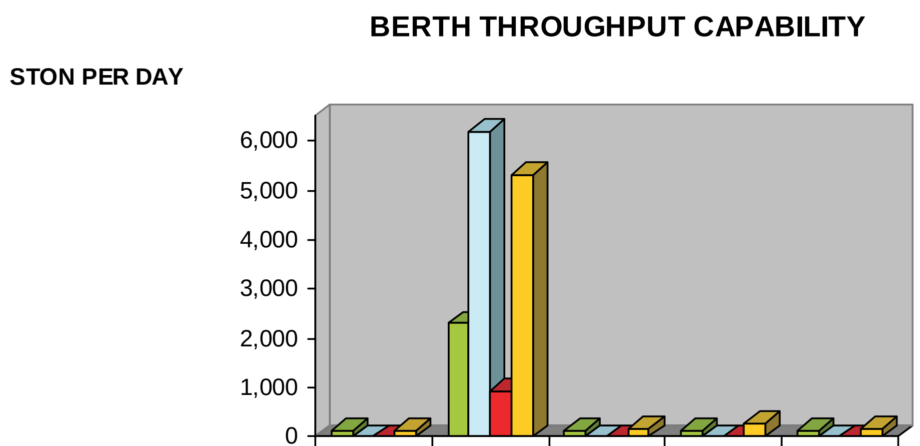


Shipping

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility. Although these values provide the shipping rates, the 23- to 29-foot water depth restricts the draft of many vessels. Only the shallow draft vessels can be loaded to their maximum draft.

CONVERSION FACTORS	
Breakbulk:	.4 STON per MTON
RORO:	.25 STON per MTON
Containers:	.4 STON per MTON

We assumed that only the 100-ton semimobile crane would be used for container operations, as is typically the case. This crane can typically load 25 containers per hour, or about 500 per day, depending on operator skill and other factors. Additional mobile cranes equipped to handle containers will increase the container throughput. Again, only the shallow draft container vessels can reach their maximum draft.



	1	2-5	6	7-8	9
BREAKBULK/BARGE	120	2,300	120	120	120
RORO	0	6,200	0	0	0
CONTAINERS	0	930	0	0	0
MIXED	130	5,300	180	280	180

THROUGHPUT SUMMARY FOR THE PORT OF DOHA								
BERTH(S)	LENGTH (feet) (meters)	DEPTH (feet) (meters)	BB (STON) (MTON)	RORO (STON) (MTON)	RORO SQ FT (EST)	RORO PIECES	CNTNR (STON) (MTON) (TEU)	MIXED (STON) (MTON)
1	597 182	26 7.9	120 310	0	0	0	0	130 330
2-5	2,388 728	29 8.8	2,300 5,600	6,200 25,000	124,000	620	930 2,300 120	5,100 20,000
6	705 215	23 7.0	120 310	0	0	0	0	180 460
7-8	1,410 430	23 7.0	120 310	0	0	0	0	280 700
9	705 215	23 7.0	120 310	0	0	0	0	180 460

BERTH PREFERENCE RANKING

The military port operator should negotiate for use of Berth 2-5 due to its water depth (29 feet MLW), length (2,388 feet), and transit sheds. Berths 6 and 9 on the ends of the T-head pier can only support military operations that involve shallow and short vessels.

Shallow Breakbulk Vessel at Berth 3 (northward view)

Barge Operations

Some of the berths otherwise unmentioned in this analysis might be used to support barge operations. For example, the shallow boat harbor, normally used for fishing boats and tugs, can support eight LASH lighters. The water depth is only 12 feet along these berths, making them unsuitable for military operations other than barges. A few key issues for planning purposes are:

- Each mobile crane can handle 331 STON or 829 MTON per day, assuming 20 productive work hours, and 90 percent berth utilization factor.

- SEABEE barges are 175 feet long. Typical LASH lighters are 115 feet long. A crane operating every other barge or lighter provides sufficient working space.

Assuming four mobile cranes are operating, (one crane for every other LASH lighter) the barge operations along the fishing boat berths could support loading or unloading 1,300 STON or 3,300 MTON per day.

Large Vessel Operations

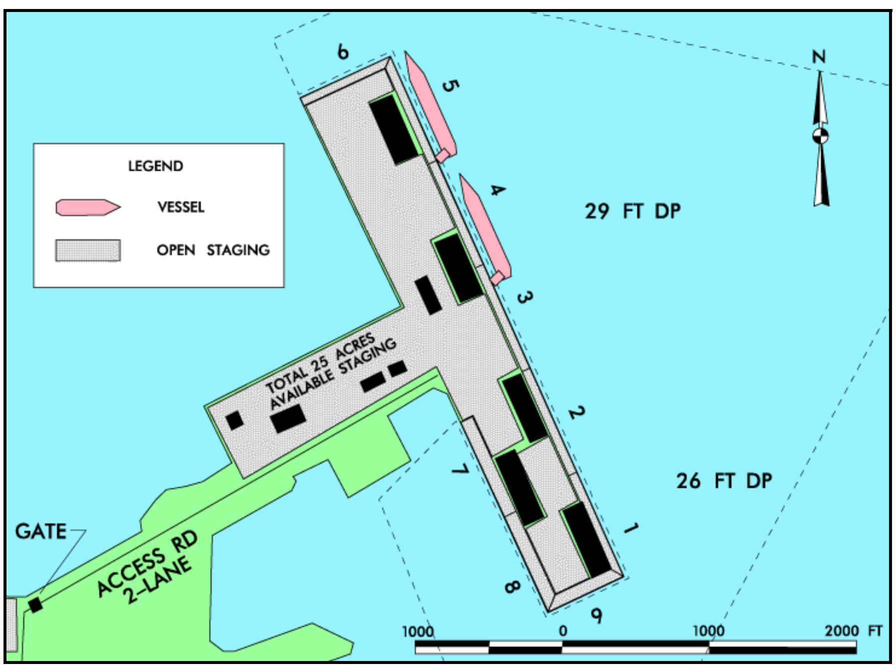
The berth and channel depths are insufficient for any vessel considered in our analysis to operate fully loaded. Allowing 2 feet of clearance below the keel, vessels calling on the Port of Doha should have drafts no greater than 27 feet (8.2 meters). The vessel with the least restriction is the ***Cape Taylor***. Even this vessel violates the 2-foot margin safety rule, with a maximum draft of 28 feet.

The shallow depth of berths would require large vessels, such as FSSs and LMSRs, to enter the port with drafts roughly 6 feet shallower than fully loaded. The optimal vessel for the Port of Doha is the ***American Eagle*** class, such as the ***American Falcon***, or the ***American Condor***. Fully loaded, these vessels only draw 30 feet of water. With proper planning, these vessels could arrive at the port with cargo loads well enough below maximum draft to operate at the port. Analysis of this vessel's draft is in the Application section of this report. Cape D vessels can also operate at these shallow berths, provided typical reduced stow factors occur to reduce the draft below their maximum of 33 feet.

IV. APPLICATION

This section evaluates the port's throughput capability for deploying a notional armored brigade. Because of the shallow drafts at the Port of Doha (23 to 29 feet MLW), this study evaluates the operation using ***American Eagle*** class vessels, such as the ***American Falcon***, or the ***American Condor***. These vessels only draw 30.25 feet of water when fully loaded, and have 183,000 square feet of deck area. In addition to this space for rolling stock, the vessels can also carry 252 TEUs of containers. Using the stability manual for the ***American Eagle***, the vessel can transport 10,400 STON of military cargo without exceeding the 27 foot maximum allowable draft. The pressure of notional armored equipment is about .0683 STON per square foot of cargo (shadow) area on the deck. This allows the ***American Eagle*** class vessels to be loaded with a stow factor of 83 percent (we assume no cargo is containerized). The stow factor will most likely be less, considering the average stow factor for the eight sailings during Desert Shield and Desert Storm for these vessels was only 62 percent. The highest stow factor during these operations was 80 percent. The ***American Eagle*** class vessels should have no problem at the Port of Doha.

Cape D vessels can also operate at any berth in the port, provided plans and stow factors are used to reduce the draft below their maximum of 33 feet to 27 feet.



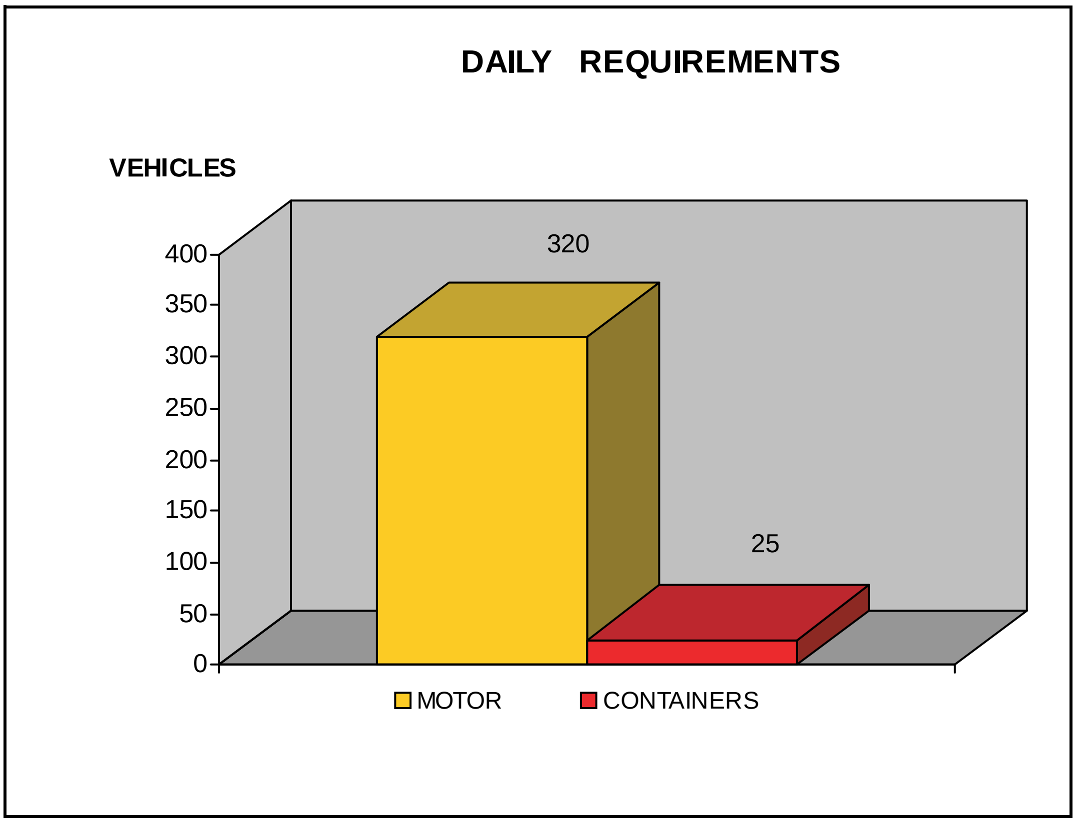
Facilities to Support U.S. Military Operations

The facilities used depend on decisions made by the Doha Port Authority. U.S. military can only assume to have access to about 25 acres of open staging in small pieces at various locations within the port, enough wharfage to berth two ***American Eagle*** class vessels at the same time.

REQUIREMENTS

For purposes of this analysis, the likely requirement for the Port of Doha is to process a notional armored brigade. We assume the port must process the brigade in only 6 days of offloading and port clearance. The brigade has to move about 2,820 vehicles and 150 containers. As described earlier in this analysis, there is no access by rail to the Port of Doha. Using a motor/convoy option, about 1,260 (210 per day) roadable vehicles would drive out the gates towing 820 (140 per day) trailers. Also, about 230 40-foot flatbeds (40 per day) and 410 HETS (70 per day) would transport nonroadable equipment. For traffic analysis, this equates to about 320 vehicles (some with trailers or semitrailers) passing through the gate.

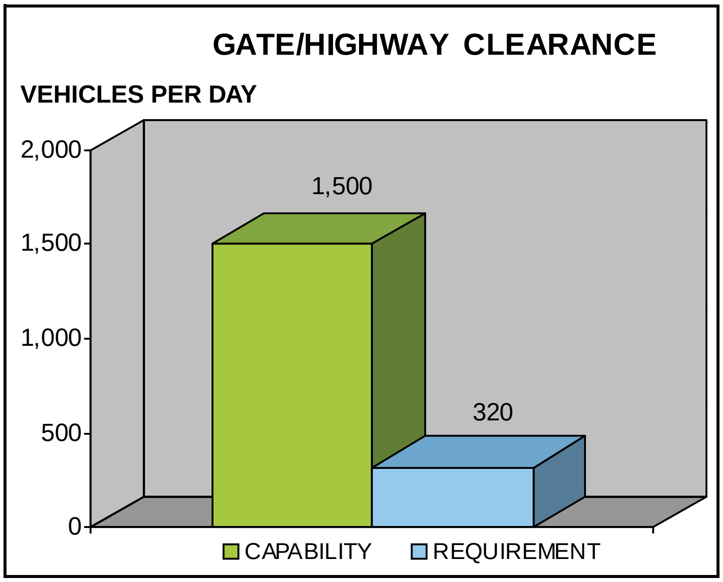
ARMORED BRIGADE		
	Total Equipment	Required Daily Throughput
Volume	95,800 MTON	16,000 MTON
Weight	31,703 STON	5,300 STON
Area	642,645 SQ FT	107,100 SQ FT
Vehicles*	2,823	460
Containers	150	25
*Includes trailers		



TERMINAL OUTPROCESSING/HANDLING

Highway

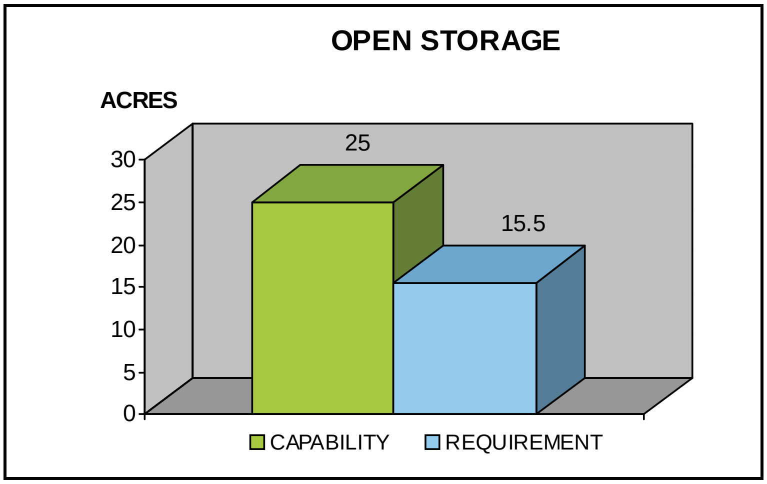
There is only one gate that allows military vehicles and equipment to access the causeway and the highway infrastructure. One lane of this gate can accommodate 1,500 military vehicles per day. This is sufficient to meet the requirement.



Assuming a constant flow of vehicles out the port gate, the daily clearance requirement is under 400 vehicles, including trailers and drayed containers. The Doha road network can easily support the requirement to handle the armored brigade in 6 days.

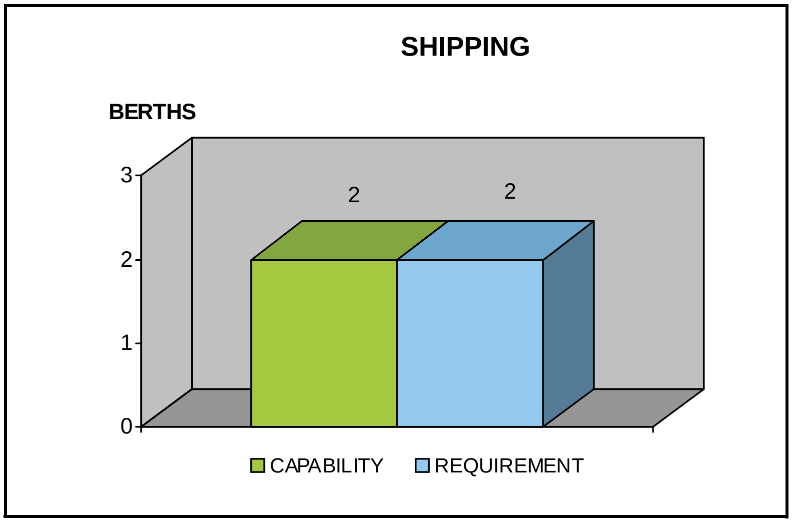
Open Storage

The Port of Doha has 72 acres (290,000 square meters) of paved open staging. Much of this area is congested with bulk flour operations, containers, and other cargoes. Only about 25 acres can be made available on short notice.



Marshaling the entire brigade of equipment (642,645 square feet) requires 37 acres. We assume the maximum amount in the port at any time is about 2-1/2 days (42 percent) of the required port throughput. This requires the port to provide 15.5 acres of paved open area to support the operation. The port can meet the requirement.

Shipping



An armored brigade has 642,645 square feet of vehicles and equipment. Assuming six ***American Eagle*** class vessels will process the brigade, each vessel would carry an average of 107,000 square feet of military cargo. Assuming no cargo is containerized, this provides a 58 percent stow factor. This is well below the stow factor we calculated earlier to ensure the vessel could operate at the port. Unloading these medium-sized RORO vessels can be accomplished in only 1 day. To be on the safe side, we assume each will require 2 days. This requires two ***American Eagle*** class vessels to unload simultaneously. Three two-vessel operating cycles are required to process the entire brigade, with these partially loaded vessels.

Two ***American Eagle*** class vessels can berth and operate at the port simultaneously. These vessels only require 1,500 feet of the 2,995 feet available at Berths 1-5. The facilities map earlier in this section provides the berthing configuration.

SUMMARY

The Port of Doha can process a notional armored brigade in 6 days. Because of the shallow draft (23 to 29 feet MLW), large vessels with maximum drafts from 30 to 37 feet have to arrive at the port with less than full loads, and possibly at high tide. Therefore, plans should call for partially loaded vessels with shallow drafts, such as ***American Eagle*** class with 30.25-foot maximum draft, to operate at the Port of Doha.

RECOMMENDATION

We recommend the Port of Doha be considered to process brigade-sized units. To support military equipment, we recommend partially loaded shallow draft ships, such as the ***American Eagle*** class. These vessels can to be loaded with a stow factor of 83 percent, and still not exceed the port's maximum allowable draft. Shiploading during Desert Shield/Desert Storm never exceeded an 83 percent stow factor.

PORT OF MESSAI'EED (UMM SAID)
QATAR

I. EXECUTIVE SUMMARY

GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Messai'eed, formerly the Port of Umm Said, Qatar, based on a site visit in May 1997. The port can accommodate vessels as large as the ***American Eagle*** and can support military operations. It cannot support larger vessels due to the berth depths at mean low water (MLW).

The Port of Messai'eed typically handles bulk and general cargo. It consists of two straight quays, totaling 4,700-foot of berthing, with 32 feet deep berths at MLW. One quay has three wharf cranes and an open apron that can support RORO operations. The other quay is close to the 40-acre staging area and has a transit shed. Tidal variation at the port is 8 feet.

The port is on undeveloped desert land, with plenty of offsite staging area. Connector routes and the main highway are in very good condition. The country of Qatar has no railroads.

THROUGHPUT

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of 8,700 short tons (STON) per day. The RORO capability is 10,400 STON per day.

APPLICATION

We find the port capable of handling a notional armored brigade in 6 days. Our analysis assumes the use of two simultaneous vessel operations using ***American Eagle*** class vessels. The depth of the port cannot support fully-loaded LMSR nor FSS vessels. The 40 acres of paved staging area is sufficient to meet the requirement.

II. GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Messai'eed, Qatar, based on a site visit on 24 May 1997. We had support from the 831st U.S. Army Transportation Battalion, Qatar Detachment. The site visit included an interview with the Messai'eed Port Authority.

TRANSPORTATION ACCESS

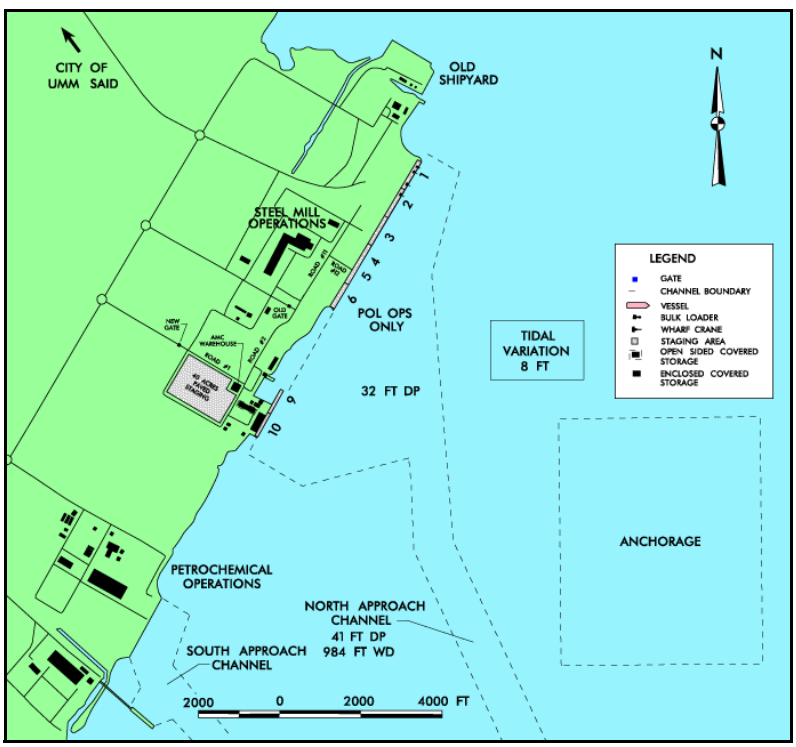
Water

The Port of Messai'eed is in the southeast region of Qatar, at 24^{o} 54' N Latitude, and 51^{o} 035' E Longitude about 30 miles (50 kilometers) south of Doha, Qatar. Sometimes the port is referred to as the Port of Mesaieed or Musayid. Typical ships that call at the port carry petroleum, oils and lubricants (POL), bulk steel production materials, and breakbulk cargoes.

The Armed Forces Depot, or "FY90" for the year it was funded, is about 45 miles (85 kilometers) northwest of the port.

The north approach channel is 41 feet (12.5 meters) deep at MLW and about 984 feet (300 meters) wide. The southern approach channel accesses bulk Berths 18 and 19, which are not available for military operations. Tidal range is 8 feet (2.44 meters).

Pilots are stationed nearby at the port and are compulsory and available at any time. Four tugs are available at the port of Doha; two with 1,800 horsepower and two with 2,500 horsepower. After the hour of sunset, all operations cease, including pilotage unless absolutely necessary.

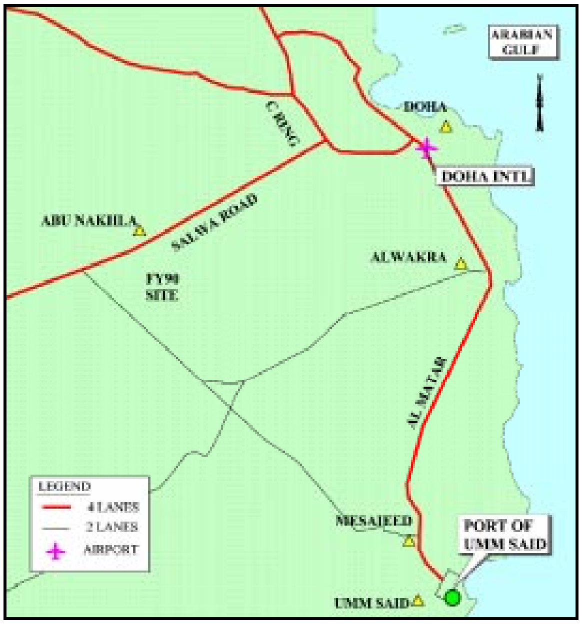


Water Access to the Port of Messai'eed

Highway

The Port of Messai'eed has two gates. The access roads from these gates lead to Al Matar Road, which leads to the highway infrastructure.

No unusual clearance or congestion problems exist on roads leading from the port. Overhead restrictions on roads near the port are usually 16.4 feet (5.0 meters) high. Streets are in very good condition and uncongested.



Highway and Air Access to the Port of Messai'eed

Air

The closest airport to the port is Doha International Airport, about 24 miles (45 kilometers) to the north. The longest runway at Doha International is 15,000 feet (4,570 meters) long and 150 feet (46 meters) wide. The runway is one of the longest in the world and can easily handle C5 aircraft.

The Udaid Air Facility is under construction near the port. When finished, it will be capable of landing the U.S. Space Shuttle if needed.

Rail

The country of Qatar has no rail and no plans for rail development.

PORT FACILITIES

Berthing

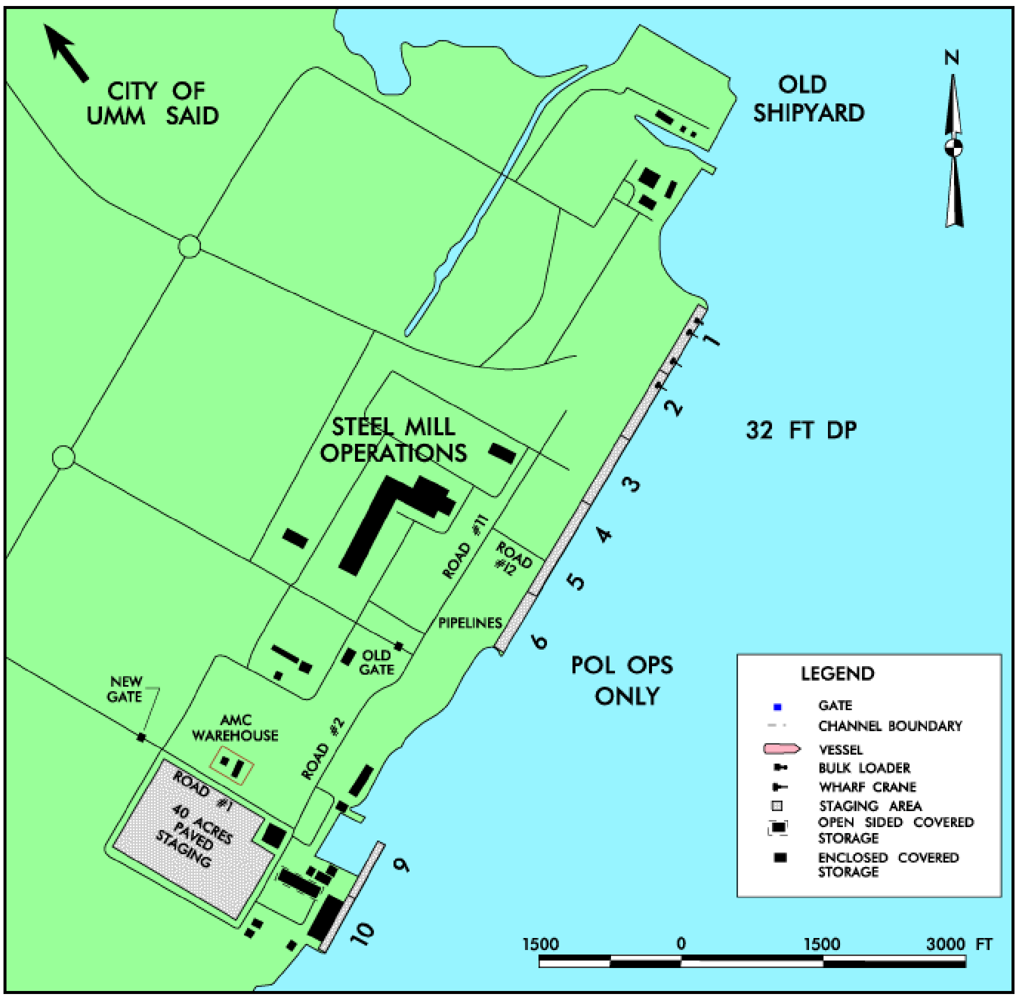
Berth 6 is strictly for POL operations, with four POL loading arms. The apron has several pipelines that prevent military operations. For this reason Berth 6 will not be considered further in the report.

BERTHING USAGE	
Berth(s)	**Equipment and Typical Cargo**
1-3	1 bulk unloader and 3 bulk cranes for raw steel producing material
4-5	General cargo, RORO
6	4 oil loading arms for POL operations
9-10	General cargo
18-19	Private petrochemical products

Berth 9-10 is very useful for military operations. The transit shed may restrict side ramp RORO operations, but the 40-acre paved staging area and the AMC Warehouse are very close.

Berth 18-19 can only support private petrochemical products operations and is not suitable nor available to support military operations. For this reason Berth 18-19 will not be considered further in the report.

CHARACTERISTICS OF THE PORT OF MESSAI'EED			
Characteristics	Berths		
	1-3	4-5	9-10
Length (ft)	2,400	1000	1,300
Depth at MLW (ft)	32	32	32
Deck strength (psf)	700	700	700
Apron width (ft)	100	118	70
Apron height above MLW (ft)	11	11	11
Number of container cranes	0	0	0
Number of wharf cranes	3	0	0
Apron lighting	NO	YES	YES
Straight-stern RORO facilities	NO	NO	NO
Apron length served by rail (ft)	NO	NO	NO



Land-Use Map

BERTHING CAPABILITIES OF PORT OF MESSAI'EED

Vessel	Berths 1-3	Berths 4-5	Berths 9-10
Breakbulk			
C3 - S - 38a	4	1	2
C4 - S - 58a	4	1	2
C4 - S - 66a	4,a	1,a	2,a
C5 - S - 37e	3	1	2
Sectarian			
GA and PR - class	4	1	2
Barge			
LASH C8 - S - 81b	2,a,f	1,a,f	1,a,f
LASH C9 - S - 81d	2,a,f	1,a,f	1,a,f
LASH lighter	12	5	6
SEABEE C8 - S - 82a	2,a,f	1,a,f	1,a,f
SEABEE barge	12	5	6
RORO			
Comet	4,d,I	1,d,I	1,d,o
Meteor	4,d,I	1,d,I	2,d,o
Cape Gnome	3,a,d,I,j	1,a,d,I,j	2,a,d,I,j
C7 - S - 95a	3,a	1,a	1,a
Cape Taylor	3	1	1
Cape Orlando	3,I	1,I	1,I
MV Ambassador	4,d	1,d	2,d
Callaghan	3,d,I	1,d,I	1,d,o
Cape Lambert	3,I,j	1,I,j	1,I,j
LMSR - class	2,a	1,a	1,a,b
FSS	2,a	1,a	1,a
Cape E - class	3,I,j	1,I,j	1,I,j
Cape D - class	3,a	1,a	1,a
Cape H - class	3,a	1,a	1,a
Cape Texas	3,I	1,I	1,I
Cape R - class	3,a,d	1,a,d	1,a,d
Cape I - class	3,I	1,I	1,I
Cape Victory	3,I	1,I	1,I
Container			
C6 - M - 147a	3,e	1,e	1,e
C7 - S - 69c	3,e	1,e	1,e
C7 - S - 68c	3,e	1,e	1,e
C8 - S - 85c	2,a,e	1,a,e	1,a,e
C9 - M - 132b	2,a,e	1,a,e	1,a,e
C9 - M - F141a	2,a,e	1,a,e	1,a,e
C6 - S - 1qd (TACS)	3	1	1
C5 - S - MA73c (TACS)	3	1	2
C6 - S - MA60d (TACS)	3	1	1
Combination			
C7 - S - 133a	2,a	1,a	1,a
Maersk	3,a	1,a	1,a
AmSea	3	1	1

Notes:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitation as described below.

a - vessel draft limited
b - apron too narrow
c - berth too short
d - no straight-stern ramp
e - no CNTNR cranes
f - anchorage OK, berth too shallow
g - shallow channel
h - no special ramps
i - tide too low for ramp clearance
j - tide too high for ramp clearance
k - ramp angle too steep at low tide
m - ramp angle too steep at high tide
n - parallel ramp operation ONLY
o - apron too narrow for side ramp

Ramp clearance and angle based on maximum vessel draft.

♦ May Prevent Operation

♦ May Limit Operation

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

Open Storage

The Port of Messai'eed has only 40 acres (160,000 square meters) of concrete paved open staging. This is located inland of Berth 9-10. It is rarely filled with cargo and would likely support military operations on short notice.

The military has not performed helicopter operations at the port. The best place for helicopter operations would be in the 40 acre paved area mentioned above. The covered storage buildings at Berth 9-10 could support shrink-wrap and assembly operations.

Covered Storage

The port has one transit shed with about 85,000 square feet (7,900 square meters) of floor space, directly inland of Berth 9-10. Farther inland is an open-sided covered storage facility with about 63,000 square feet (5,800 square meters).

Inside of the AMC Warehouse

Inland of the small craft harbor at Berth 9 is a moth-balled vehicle maintenance center with several machines, vehicle lifts, and ramps. The AMC Warehouse also has six 300 square foot offices on the second floor, and medical and shower facilities. The large maintenance area has about 15,000 square feet (1,400 square meters) of floor space. Other small rooms are available and one small warehouse building within the fenced perimeter of the complex.

AMC Warehouse Facility

Highway

The Port of Messai'eed has two gates. The new gate is inland of Berth 9-10 and the 40 acre paved staging area. The old gate is close to Berth 6. Each gate is on a four-lane, two-way street. Usually the guard processes only one lane of vehicles, but two lanes of convoy equipment could enter or exit through either gate if necessary. Roads inside the port are in very good condition and free of congestion. Speed limits are 9 miles per hour (15 kilometers per hour). There are no restrictions on weight or height within the port. The port has no truck scales.

Unloading/Loading Positions

The covered storage areas do not have truck docks. There are no permanent or portable ramps capable of supporting truck operations. The military should bring or build ramps to handle trucks and trailers that do not have integral ramps.

Offsite Storage Area

The surrounding area near the port is generally undeveloped. Offsite marshaling is readily available in undeveloped, unlighted, and poorly drained areas. The military port operator should obtain permission from local police before using this land.

MATERIALS HANDLING EQUIPMENT (MHE)

All MHE is owned by local stevedore companies. The largest stevedore company is Qatar National Navigation and Transport (QNN&T), which usually has six small forklifts operating in the transit shed. When needed, QNN&T can deliver ten 5-ton cranes on very short notice. Larger equipment must come from rental firms and stevedore companies in Doha. At their Doha facilities, QNN&T has 11 cranes with 30 to 100 ton capacities, and more than a hundred tractors and trailers.

MATERIALS HANDLING EQUIPMENT			
MHE Type	**Capacity (STON)**	**Quantity**	**Location**
Forklift	2-4	6	Port
Mobile Cranes	5	10	City of Umm Said
Mobile Cranes	30-100	11	Doha
Tractor/ Trailers	8	100	Doha

AMMUNITION

The Port of Messai'eed has no experience handling explosives. Handling ammunition might be allowed with advance permission from the Ministry of Defense.

PETROLEUM, OILS AND LUBRICANTS

Within and near the port are several POL and petroleum product handling facilities. Berth 6 at the port is only useful for POL operations. The apron has several pipelines that prevent military operations. This berth has four POL loading arms along the quay.

Berth 18-19, just a half mile southwest of Berth 9-10, routinely handles petrochemical products such as polyethylene, ethylene, and bulk sulfur. Ships can berth here with draft of 40 feet.

Two single point mooring (SPM) points for oil operations and a T-head pier for liquefied natural gas are about 3 miles south of Berth 9-10. The largest underwater pipeline to the northern SPM is 36 inches in diameter. The water at this facility is 64 feet deep. The southern of the two SPMs has a 24-inch underwater pipeline and can handle vessels of 42-foot draft.

FUTURE DEVELOPMENT

The Port Authority has no plans to expand the Port of Messai'eed further. If business increases, however, the port will likely develop farther northeast, adding berths to Berth 1-3. The old shipyard would be developed to support port operations.

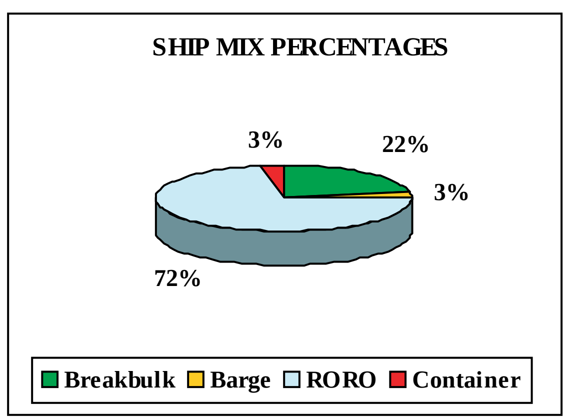
III. THROUGHPUT ANALYSIS

GENERAL

This section evaluates the throughput capability of the Port of Messai’eed using the port operational performance simulator computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging/hardstand marshaling, and terminal processing/handling - in STON per day.

Terminal Throughput Subsystems

This analysis assumes 70 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using a 70 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future operations.

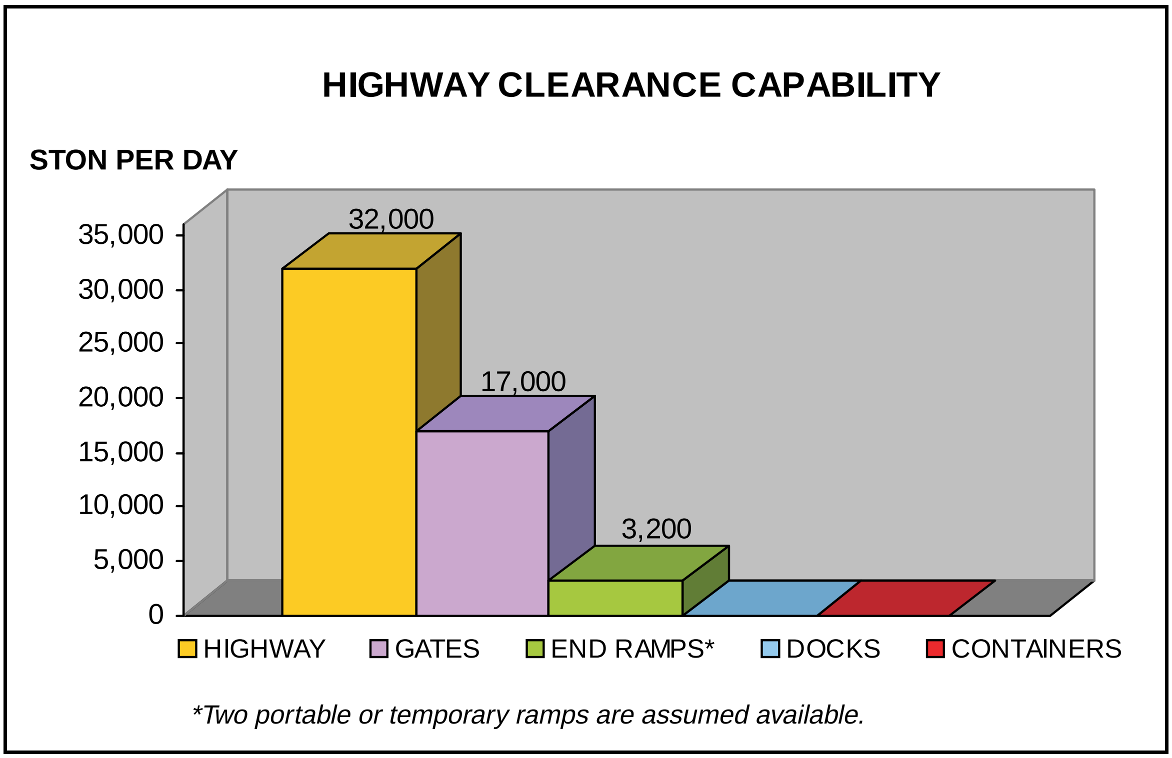


RECEPTION /HANDLING

Highway

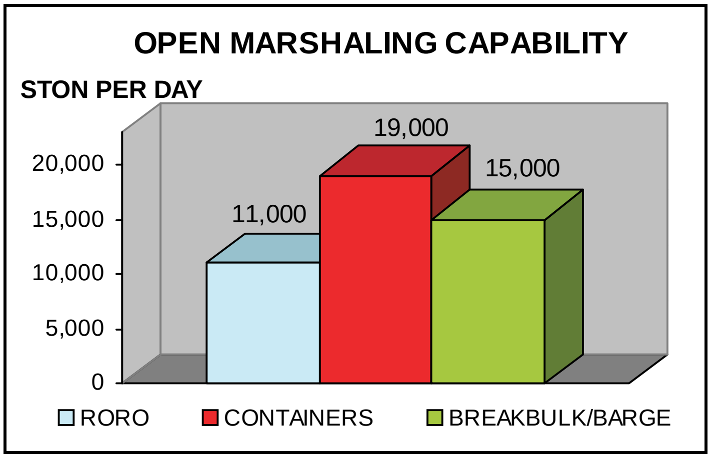
The Port of Messai'eed has two gates, each with a separate route to the main highway. The two gates together can handle 17,000 STON (68,000 MTON) of equipment and supplies per day. This gate throughput assumes two lanes are used at each gate. Each vehicle is assumed to take 1 minute for processing at the gate. This daily throughput is considered a minimum value. If vehicles are preprocessed and precleared, the gate throughput can be significantly higher. The main highway leaving the port can support 32,000 STON (127,000 MTON) per day.

Roadable vehicles in convoys will process directly to the off-port marshaling areas. Vehicles to be loaded onto commercial or military flatbed trailers without integral ramps will load at portable end ramps brought or built by the military port operator. Each such ramp can support 1,600 STON (4,800 MTON) per day. There are no truck docks or container equipment at the port.



Open Storage

The Port of Messai'eed only has 40 acres (160,000 square meters) of paved open staging available for military operations. This acreage provides the marshaling capabilities in the graph at right. If all the area were used for RORO cargo, the throughput would be 11,000 STON per day.

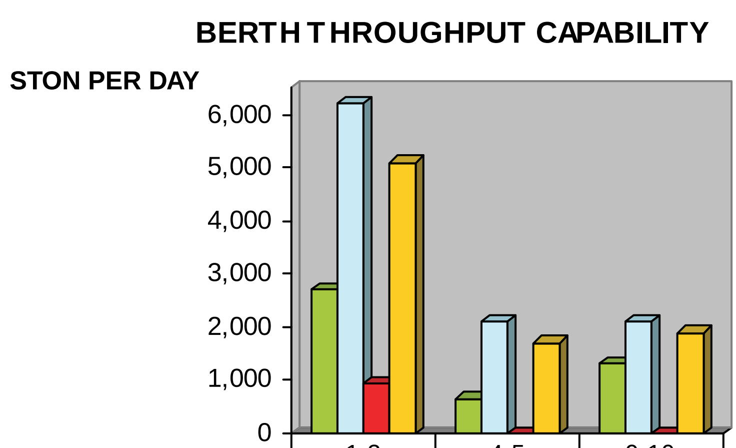


An additional undeveloped area is available outside the port. Each open acre provides the capability to stage 290 STON per day of RORO cargo, or 1,600 STON per day of container cargo, or 380 STON per day of breakbulk cargo. The area surrounding the port is generally undeveloped, unlighted land with poor drainage during the rare rains.

CONVERSION FACTORS	
Breakbulk:	.4 STON per MTON
RORO:	.25 STON per MTON
Containers:	.4 STON per MTON

Shipping

Throughputs for each berth are shown at right. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility. Although these values provide the shipping rates, few ships can be loaded to their maximum draft.



	1-3	4-5	9-10
BREAKBULK/BARGE	2,700	650	1,300
RORO	6,200	2,100	2,100
CONTAINERS	930	0	0
MIXED	5,100	1,700	1,900

THROUGHPUT SUMMARY FOR THE PORT OF MESSAI'EED								
BERTH	LENGTH (feet) (meters)	DEPTH (feet) (meters)	BB (STON) (MTON)	RORO (STON) (MTON)	RORO SQ FT (EST)	RORO PIECES	CNTNR (STON) (MTON) (TEU)	MIXED (STON) (MTON)
1-3	2,400 731	32 9.7	2,700 6,700	6,200 25,000	124,000	730	930 2,300 110	5,100 19,000
4-6	1,000 305	32 9.7	650 1,600	2,100 8,200	42,000	240	0	1,700 6,700
9-10	1,300 396	32 9.7	1,300 3,200	2,100 8,200	42,000	424	0	1,900 7,100

BERTH PREFERENCE RANKING			
Berth	**Loading Style**		
	Breakbulk	**RORO**	**Container**
1-3	2	1	1
4-6	2	1	-
9-10	1	3	-

NOTE: Berths marked with a "-" are not recommended for these operations.

The type of ship preferred at each berth is based on an evaluation of various characteristics at each berth using a point system (see app). Each berth is rated by its characteristics, for its capability to support various shiploading and discharging operations. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The berth with the highest points is the first preferred berth for that specific loading style and is, therefore, rated one. In general, no one berth is ideal for all military operations. The best berth depends on the type of ship loaded.

Berth 1-3 is ranked the best berth overall because of its wharf cranes and wide apron. Military operations would more likely occur at Berth 4-6, however, because it is more likely to be available.

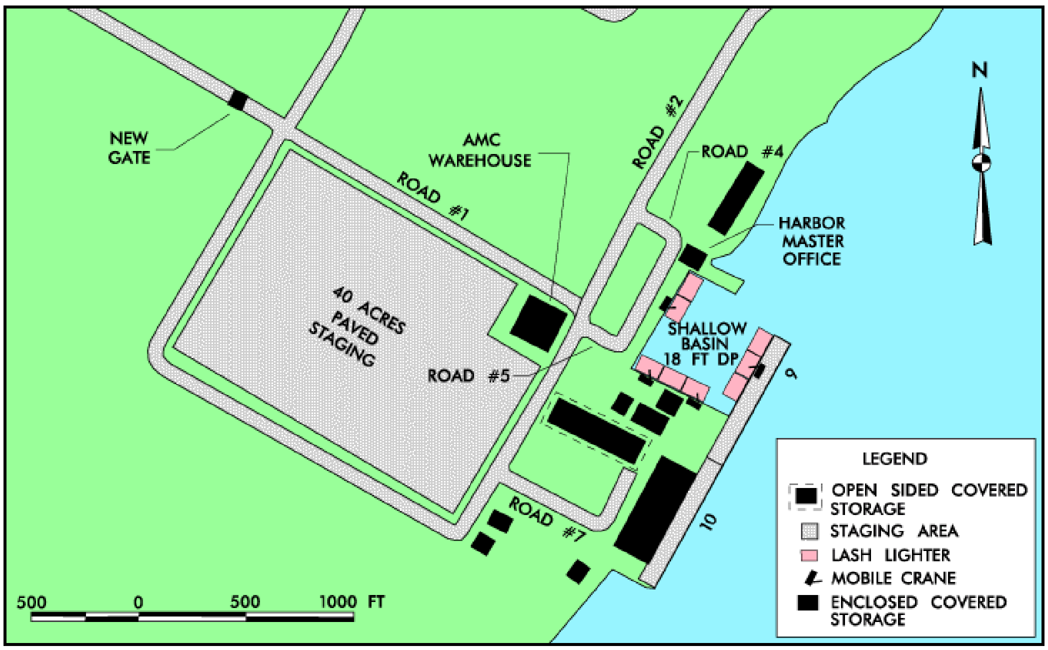
Barge Operations

To allow deep draft commercial operations wherever possible, barge operations should occur in the shallow basin used for tugs and maintenance craft inland of Berth 9. For example, this shallow basin is about 520 feet long and 460 feet wide. About eight barges could be staged for loading at the same time, if half of the perimeter supported barge operations.

- Each mobile crane can handle 331 STON or 829 MTON per day, assuming 20 productive work hours, and 90 percent berth utilization factor.

- SEABEE barges are 175 feet long. Typical LASH lighters are 115 feet long. A crane operating every other barge or lighter provides sufficient working space.

With every other barge having a crane operating, these barge loading positions can handle 1,300 STON or 3,300 MTON of military cargo per day.



Potential Barge Operations at the Port of Messai'eed

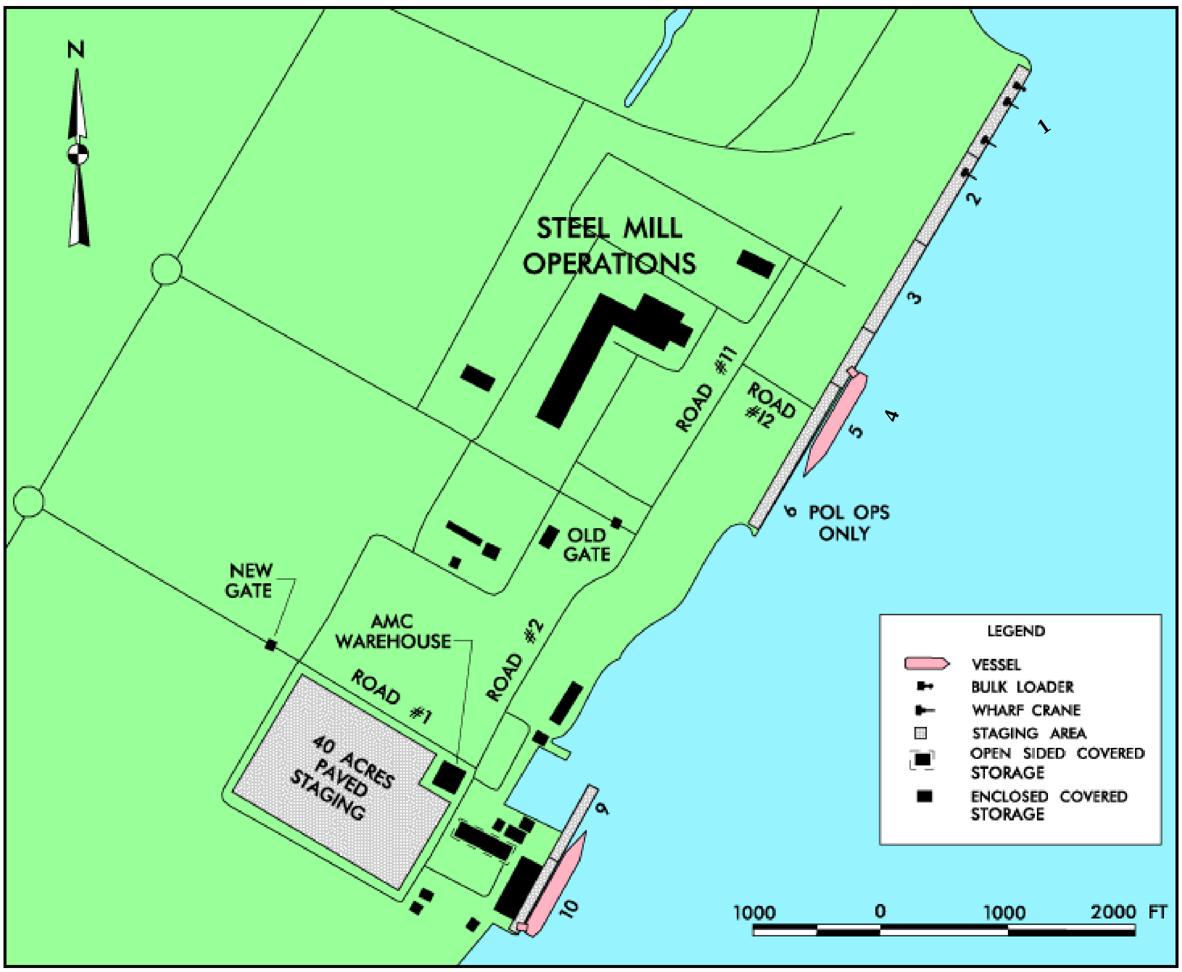
Large Vessel Operations

The shallow depth of berths would require large vessels to enter the port with drafts 4 to 6 feet shallower than fully loaded. The optimal vessel for the Port of Messai'eed is the ***American Eagle*** class, such as the ***American Falcon***, or the ***American Condor***. Fully loaded, these vessels only draw 30 feet of water and could operate unrestricted at any of the berths in this report. Cape D vessels can also operate at these shallow berths, provided typical reduced stow factors occur to reduce the draft below their maximum of 33 feet to 30 feet.

IV. APPLICATION

This section evaluates the port's throughput capability for processing a notional armored brigade. Because of the shallow drafts at the Port of Messai'eed (32 feet MLW), this study evaluates the operation using vessels of the ***American Eagle*** class, such as the ***American Falcon***, or the ***American Condor***. Fully loaded these vessels only draw 30 feet of water and could operate unrestricted. Cape D vessels can also operate at any berth in the port, provided typical reduced stow factors occur to reduce the draft below their maximum of 30 - 33 feet.

The facilities used depend on decisions made by the Messai'eed Port Authority. Because Berth 1-3 are regularly used for steel production, the U.S. military can only assume they will be given access to Berth 4-6 and Berth 9-10. The 40 paved acres and the AMC Warehouse facility can also be assumed available.

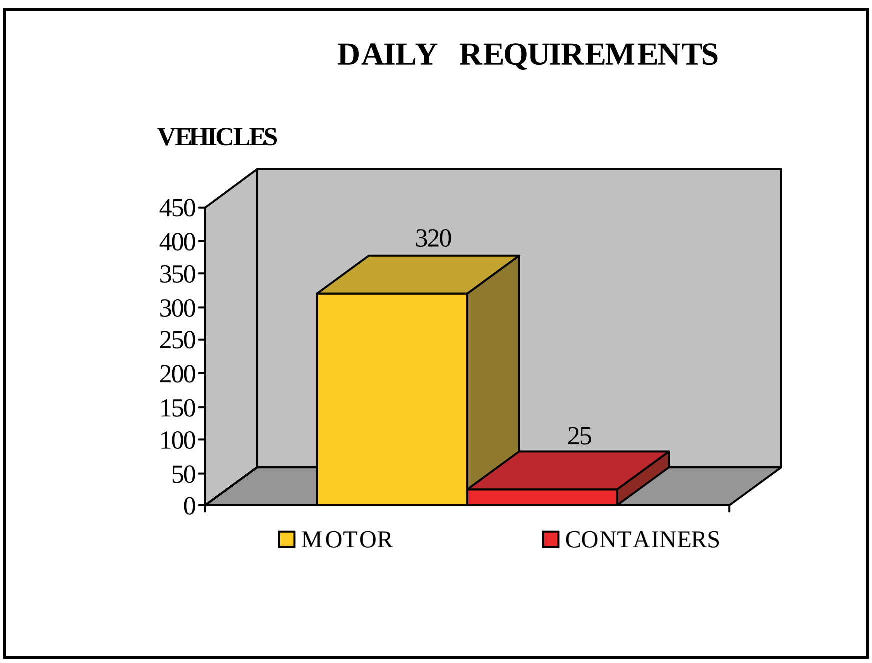


Facilities to Support U.S. Military Operations

REQUIREMENTS

ARMORED BRIGADE		
Total Equipment		Required Daily Throughput
Volume	95,800 MTON	16,000 MTON
Weight	31,703 STON	5,300 STON
Area	642,645 SQ FT	107,100 SQ FT
Vehicles*	2,823	460
Containers	150	25
*Includes trailers		

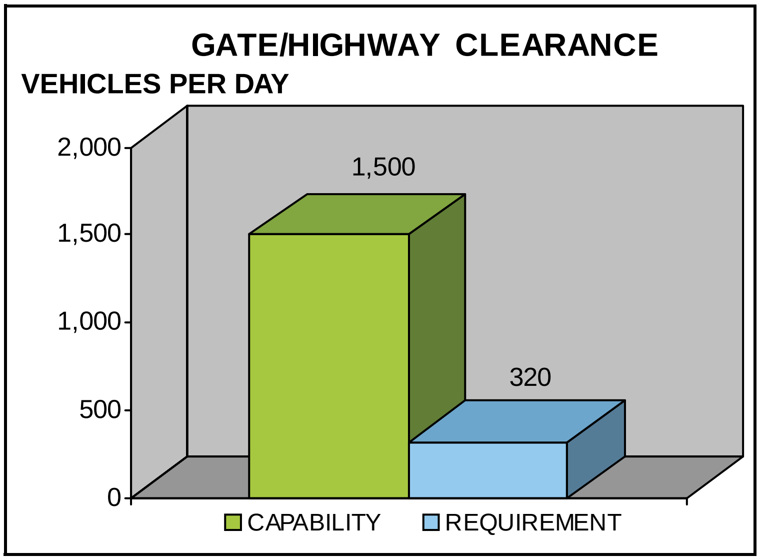
For purposes of this analysis, the likely requirement for the Port of Messai'eed is to process a notional armored brigade. We assume the port must process the brigade in only 6 days of offloading and port clearance. The brigade has to move about 2,820 vehicles and 150 containers. As described earlier in this analysis, there is no rail access to the Port of Messai'eed. Using a motor/convoy option, about 1,260 (210 per day) roadable vehicles would drive out the gates towing 820 (140 per day) trailers. Also, about 230 40-foot flatbeds (40 per day) and 410 HETS (70 per day) would transport nonroadable equipment. For traffic analysis, this equates to about 320 vehicles (some with trailers or semitrailers) passing through the gate. About 25 containers would arrive daily.



TERMINAL OUTPROCESSING/HANDLING

Highway

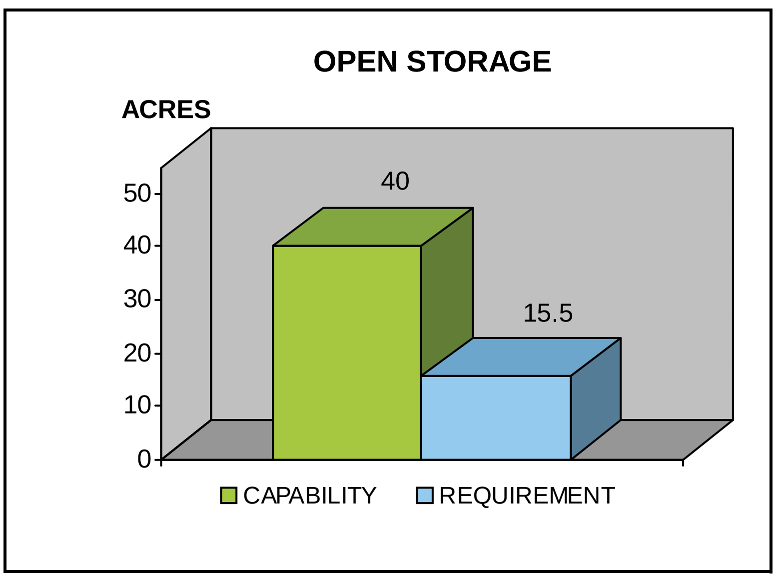
There are two gates into the port, but the Port Authority will likely request the military use only the southern "new" gate. One lane of this gate can accommodate 1,500 military vehicles per day. This is sufficient to meet the requirement.



Assuming a constant flow of vehicles out the gate of the port, the daily clearance requirement is under 400 vehicles. The road network can easily support the requirement to handle the armored brigade in 6 days.

Open Storage

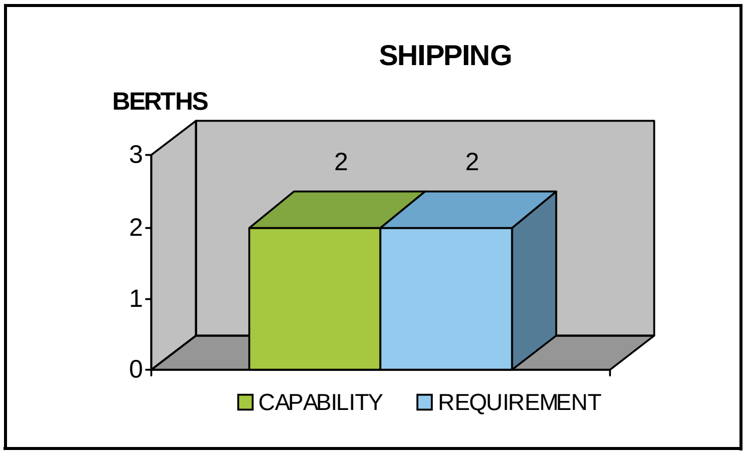
We assume the entire 40 acres inland of Berth 10 will be available for U.S. military operations.



Marshaling the entire brigade of equipment (642,645 square feet) requires 37 acres. We assume the maximum amount in the port at any time is about 2-1/2 days (42 percent) of the required port throughput. This requires the port to provide 15.5 acres of paved open area to support the operation. The port can easily meet the requirement.

Shipping

An armored brigade has 642,645 square feet of vehicles and equipment. The deck space on the ***American Eagle*** class vessels is 183,000 square feet. In addition to this space for rolling stock, the vessels can also carry 252 TEUs of containers.



The average stow factor for the eight sailings during Desert Shield and Desert Storm for these vessels was 62 percent. Each of the ***American Eagle*** class vessels can carry 110,000 square feet of cargo, assuming this 62 percent stow factor. At this rate, the operation of the brigade would require six of these vessels. Unloading RORO vessels this size can be done in less than 2 days. To meet the 6-day requirement, the port will have to berth two of these vessels simultaneously throughout the 6-day operation. Three two-vessel operating cycles are required to process the entire brigade, with these partially loaded vessels.

Two ***American Eagle*** class vessels can berth and operate at the port simultaneously. The map earlier in this section provides a suggested berthing configuration.

SUMMARY

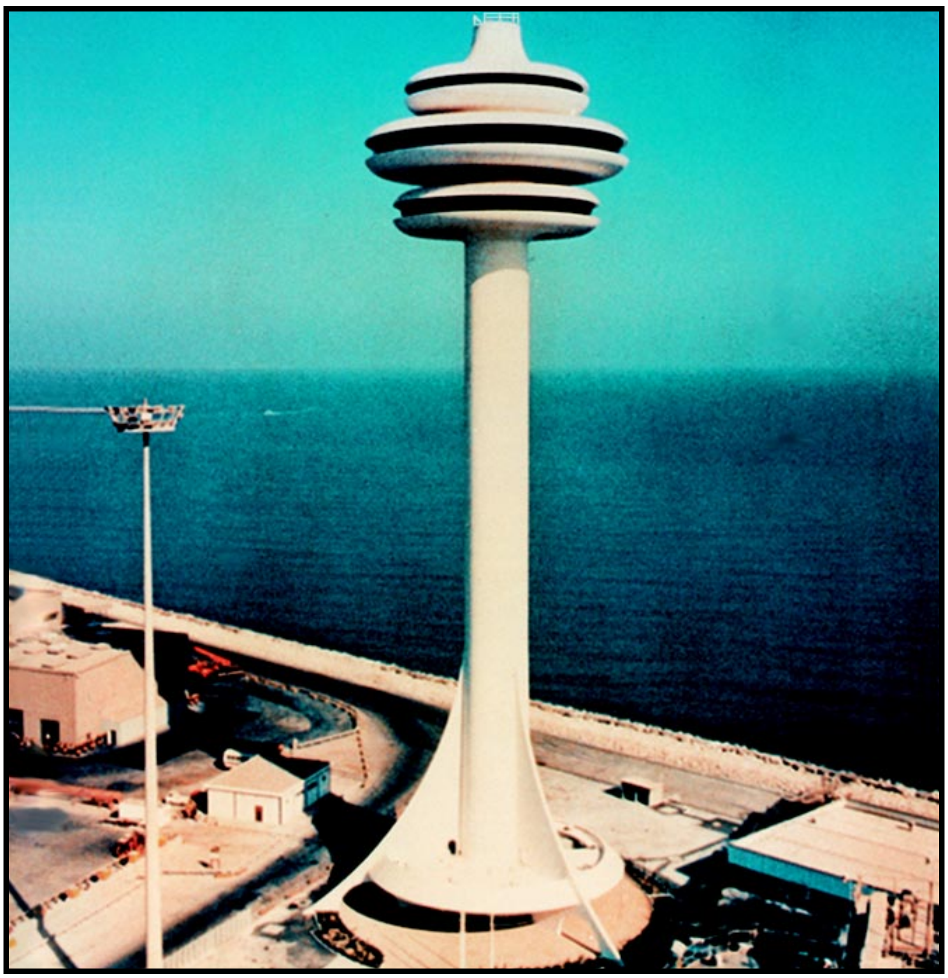
The Port of Messai'eed can process a notional armored brigade in 6 days. The only concern in the process is the shallow draft of the berths. Because of the shallow draft (32 feet MLW), large vessels with drafts from 35 to 37 feet have to arrive at the port with less than full loads, and possibly at high tide. Therefore, plans should call for vessels with shallow drafts, such as ***American Eagle*** class, with 30-foot drafts, to operate at the Port of Messai'eed.

The port has no rail facilities or container cranes.

RECOMMENDATION

We recommend the Port of Messai'eed be considered to process brigade-sized units. Plans should call for shallow draft ships, such as the ***American Eagle*** class.

PORT OF AD DAMMAM
SAUDI ARABIA



I. EXECUTIVE SUMMARY

GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Ad Dammam, Saudi Arabia, based on site visits in May 1997 and February 1999. The port can accommodate vessels as large as the LMSR or FSS classes and can support military operations.

The Port of Ad Dammam is Saudi Arabia's largest port in the Arabian Gulf. It consists of three wide piers that total nearly 4 miles of militarily useful wharf. The container terminal has eight container cranes. The West Pier is equipped to handle explosives and hazardous materials. Tidal variation is 4 feet and berths range in depth from 31 to 43 feet at mean low water (MLW). Several berths have transit sheds, but RORO operations are possible in the open areas and at three straight-stern ramps.

The port is located on reclaimed land near the causeway to the country of Bahrain, roughly centered on the east coast of Saudi Arabia. The entrance roadway to the mainland and the connector routes to the highway are in very good condition. The port has railroad access, but railcars can only go as far as Riyadh, in central Saudi Arabia. This railroad is not useful for supporting military operations.

THROUGHPUT

The port has a mixed throughput capability of 32,400 short tons (STON) per day and RORO capability of 35,600 STON per day.

APPLICATION

We find the port capable of handling a notional armored division in about 6.5 days using LMSR vessels and about 7 days using FSS vessels. Our analysis assumes two repetitions of three LMSR vessels and three repetitions of three FSS vessels, although the port can simultaneously berth seven fully-loaded LMSR or FSS vessels. Only 35.7 acres of paved open area is required to support the division. The port has 501 acres of paved open areas, 14 times more than the requirement. The average amount of open storage used on a daily basis is about 40 percent (approximately 200 acres). Most of the storage area in daily usage is at the container terminal (along Berths 23-29).

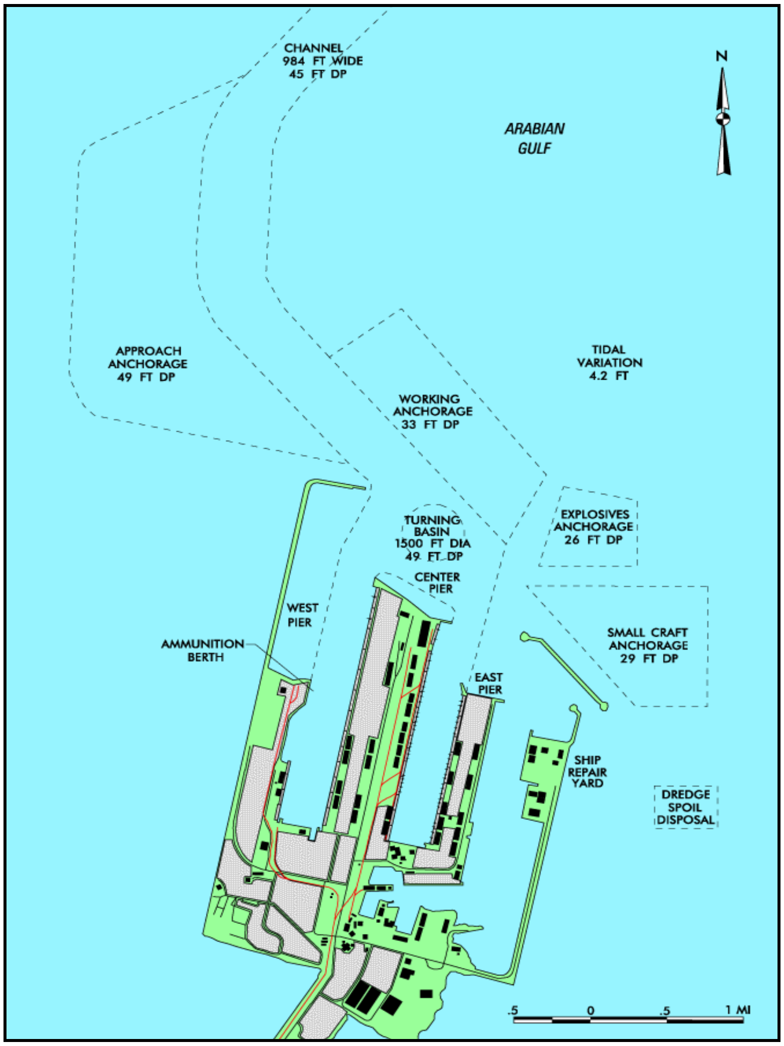
II. GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Ad Dammam, Saudi Arabia, with support from the 831st U.S. Army Transportation Battalion. The major source of data was the Ad Dammam Port Authority. We visited the port on 21 May 1997, and again in February 1999. The 831st U.S. Army Transportation Battalion, Saudi Arabia Detachment, interviewed port personnel and forwarded the data to us.

TRANSPORTATION ACCESS

Water

The Port of Ad Dammam is on an artificial fork-shaped peninsula centered on the east coast of Saudi Arabia. It is Saudi Arabia's largest port in the Arabian Gulf, located 27 miles north of Bahrain, at 26° 30' N Latitude and 50° 12' E Longitude. The port has several terminals to handle a wide variety of cargoes. Four berths handle containers; other berths handle bulk cement, grain, cold stores, and edible oils. A facility of special interest to the military is the ammunition and explosives berth. Only those facilities that are militarily useful are considered in this analysis.



Water Access Map

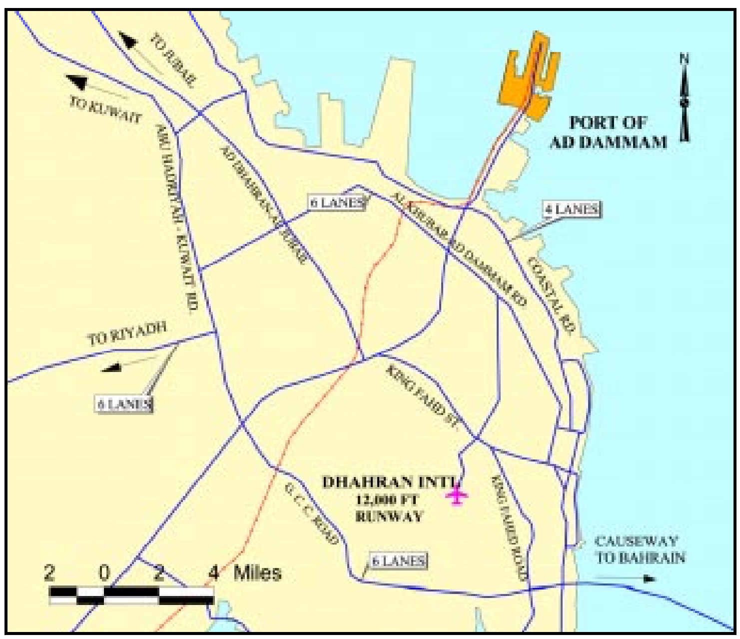
One of the three deep anchorages is designated for explosives, with a depth of only 26.2 feet MLW (8 meters). The other anchorages are 32.8 to 49.2 feet (10 to 15 meters) deep MLW.

Pilotage and tugs are required for berthing and undocking. The port has 10 tugs ranging from 460 to 4,600 horsepower. The tidal range is 4.25 feet (1.32 meters). No overhead restrictions from the gulf into the harbor. The approach channel is at least 984 feet (300 meters) wide, and 45.9 feet (14 meters) deep MLW.

Highway

All piers and berths connect to six-lane Spine Road inside the port. Spine Road connects to King Abdul Aziz Sea Port Road on the causeway for 3.5 miles to the mainland. Speed limits along the causeway are 50 miles per hour (mph) (80 kilometers per hour). Trucks and military vehicles leaving the Port of Ad Dammam can access various superhighways inland of the port. Speed limits once off the entrance roadway, are generally 62 mph (100 kilometers per hour). Roads are in excellent condition but are congested at peak times, especially at the crossroads inland of the causeway. Major highways leading north from the port are the Abu Hadriyah-Kuwait Highway and Dhahran-Jubail Highway.

No unusual clearance or congestion problems exist on roads leading from the port. Overhead restrictions on roads near the Port of Ad Dammam are usually 18 feet (5.5 meters) high. Streets are in very good condition and generally uncongested.



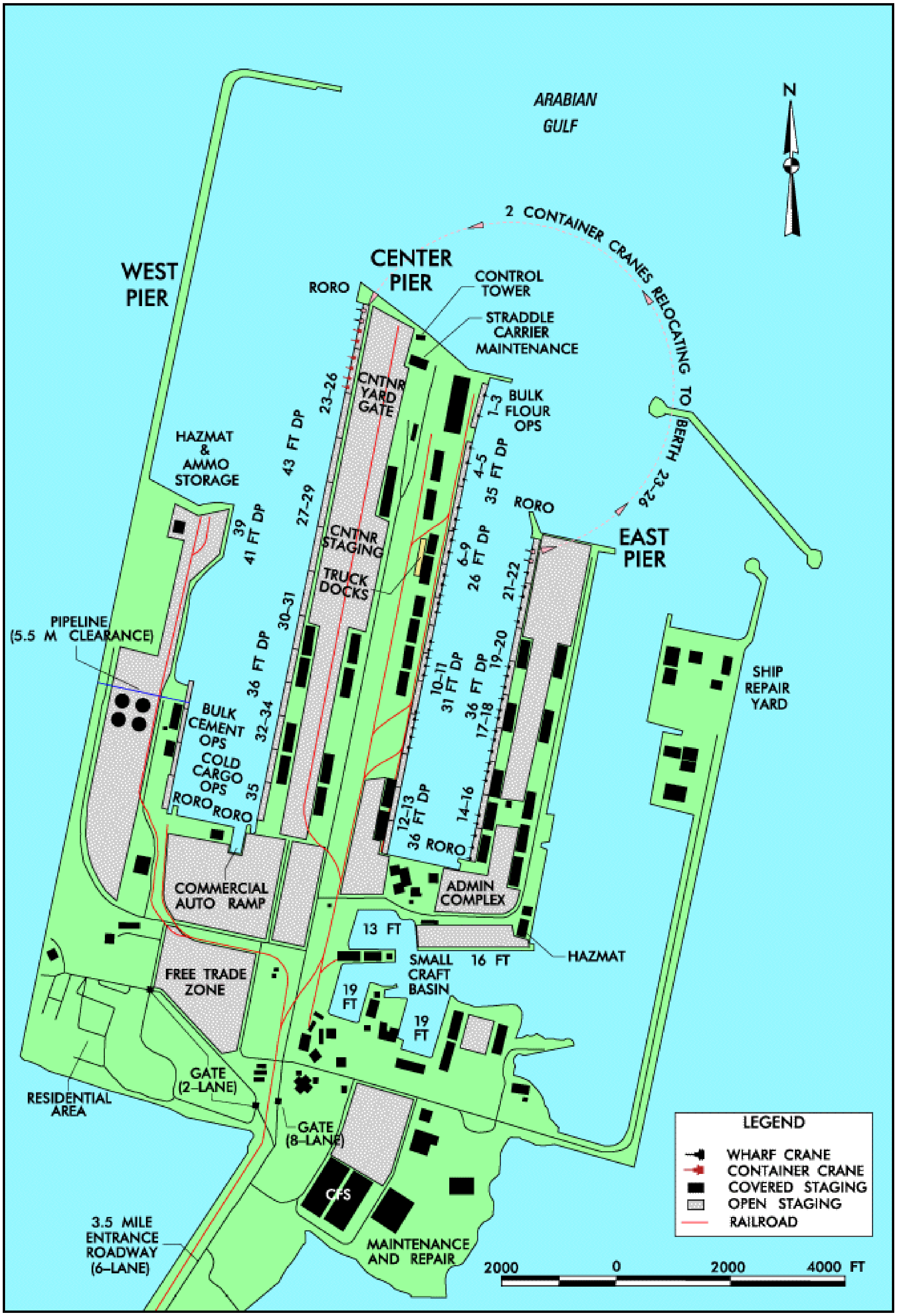
Highway, Rail, and Air Access Map

Air

The closest airport is Dhahran International, also known as Az Zahran, and King Abdul Aziz Airbase, about 10 miles (16 kilometers) south of the Port of Ad Dammam. Dhahran International has a runway 12,467 feet long and 197 feet wide and is capable of handling C-5 aircraft.

Rail

The port has rail facilities that connect to the nation's rail system, which is operated by the Saudi Railways Organization. This rail system only transports cargo and passengers between the Port of Ad Dammam and Riyadh, the capital city of Saudi Arabia, with a few cities along the way. Containerized ammunition is sometimes transported along this route. The rail system is too slow, too short, and in the wrong direction to support military vehicles and equipment.



Land-Use Map of the Port of Ad Dammam

PORT FACILITIES

Berthing

BERTH USAGE	
Berth	**Typical Cargo**
1-3	Bulk grain and flour
4-13	General cargo
14-20	General cargo
21-22	Multipurpose
23-26	Containers
27-34	General cargo
35	Cold stores
36-37	Unallocated
38	Bulk cement
39	Explosives

The Port of Ad Dammam and the entrance roadway are made entirely on reclaimed land. Berths 4-34 and Berth 39 have potential to support military operations. They have depths of 25.6 to 44 feet (7.8 to 13.4 meters) MLW. The port harbour master indicated a general clearance requirement of 1 meter for ships calling on the port. Ship draft should also allow for tidal variation and ship squat.

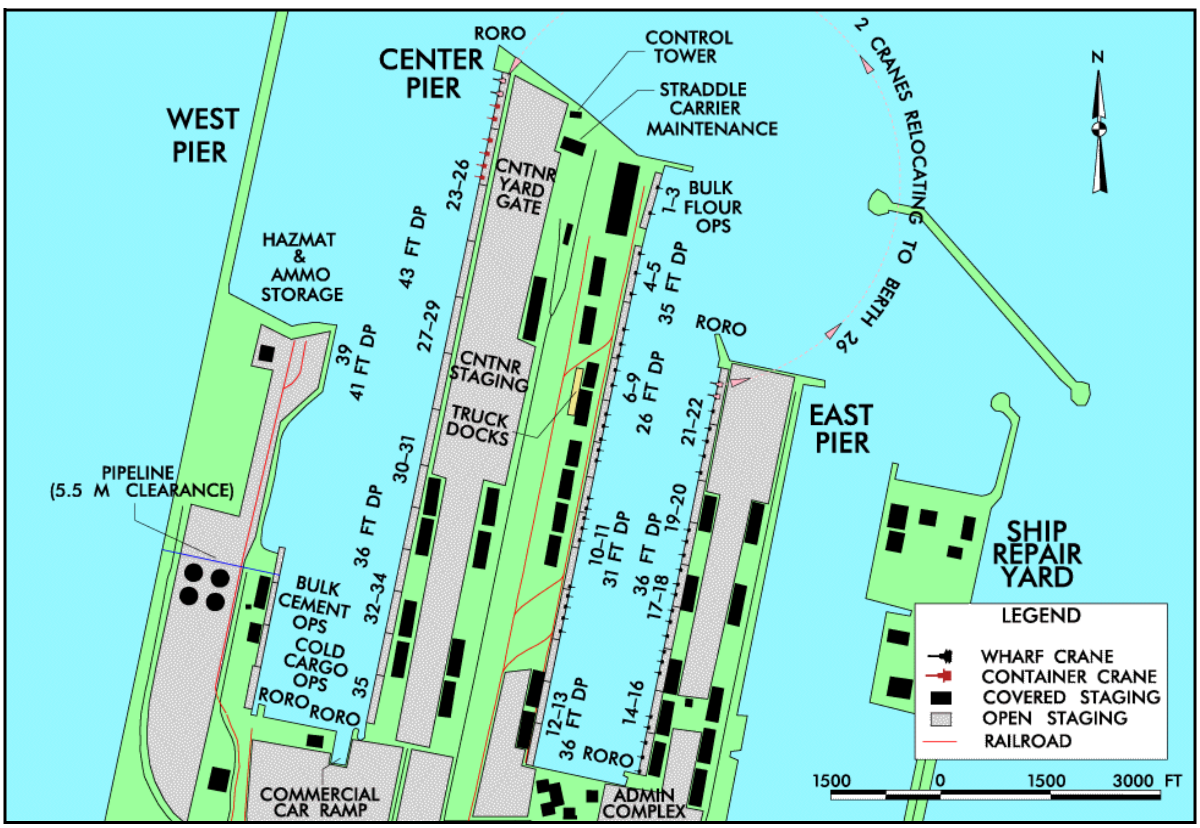
To the far east of the port lies a shipyard with two floating dry docks. At the southern edge, near the road to the mainland, are three small vessel slips with depths no greater than 20 feet (6 meters) MLW. Unless the port is extremely busy, the military will not consider these for barge operations because of their remote location from the ship channel.

The port has defense batteries at the far east and west breakwaters. Security is extremely high.

The port has four locations suitable to support straight-stern RORO operations at Berths 14, 22, 23, 35, and 36. All berths can support slewed-stern ramp operations.

Container Terminal (southward view)

CHARACTERISTICS OF THE PORT OF AD DAMMAM													
Characteristics	**Berths**												
	23-26	27-29	30-31	32-34	39	4-5	6-9	10-11	12-13	14-16	17-18	19-20	21-22
Length (ft)	3,148	2,214	1,181	1,772	623	1,180	2,063	1,295	1,180	1,770	1,180	1,180	1,574
Depth at MLW (ft)	43	43	43	36	41	35	26	31	36	36	36	36	43
Deck strength (psf)	750	750	750	750	750	750	750	750	750	750	750	750	750
Apron width (ft)	OPEN	OPEN	OPEN	OPEN	OPEN	98	98	OPEN	98	OPEN	OPEN	OPEN	OPEN
Apron height above MLW (ft)	13	13	13	13	13	13	13	13	13	13	13	13	13
Number of container cranes	6	0	0	0	0	0	0	0	0	0	0	0	2
Number of wharf cranes	0	0	0	0	0	6	10	6	6	12	8	8	0
Apron lighting	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Straight-stern RORO facilities	YES	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO	YES
Apron length served by rail (ft)	0	0	0	0	623	1,180	2,063	1,295	1,180	0	0	0	0



Land-Use Map

BERTHING CAPABILITIES OF THE PORT OF AD DAMMAM

Vessel	Berths							
	4-5	6-9	10-11	12-13	14-16	17-18	19-20	21-22
Breakbulk								
C3 - S - 38a	2	3,a	2	2	3	2	2	3
C4 - S - 58a	1	3,a	2	1	2	1	1	2
C4 - S - 66a	2	3,a	2,a	2	3	2	2	2
C5 - S - 37e	1	3,a	2	1	2	1	1	2
Seatrain								
GA and PR - class	2	3,a	2	2	3	2	2	2
Barge								
LASH C8 - S - 81b	1	2,a,f	1,a,f	1	2	1	1	1
LASH C9 - S - 81d	1,a,f	2,a,f	1,a,f	1,a,f	1,a,f	1,a,f	1,a,f	1
LASH lighter	5	10	6	5	8	5	5	7
SEABEE C8 - S - 82a	1,a,f	2,a,f	1,a,f	1,a,f	1,a,f	1,a,f	1,a,f	1
SEABEE barge	5	10	6	5	8	5	5	7
RORO								
Comet	2,d,i,j	3,a,d,i,j	2,d,i,j	2,d,i,j	3,i,j	2,d,i,j	2,d,i,j	3,i,j
Meteor	2,d,i,j	3,a,d,i,j	2,d,i,j	2,d,i,j	3,i,j	2,d,i,j	2,d,i,j	2,i,j
Cape Gnome	1,d,i,j	3,a,d,i,j	2,a,d,i,j	1,d,i,j	2,i,j	1,d,i,j	1,d,i,j	2,i,j
C7 - S - 95a	1	2,a	1,a	1	2	1	1	2
Cape Taylor	1	3,a	1	1	2	1	1	2
Cape Orlando	1,i,j	3,a	1,i,j	1,i,j	2,i,j	1,i,j	1,i,j	2,i,j
MV Ambassador	2,d	3,d	2,d	2,d	3,m	2,d	2,d	2,m
Callaghan	1,d,i	2,a,d,i	1,d,i	1,d,i	2,i	1,d,i	1,d,i	2,i
Cape Lambert	1,i,j	2,a	1,i,j	1,i,j	2,i,j	1,i,j	1,i,j	2,i,j
LMSR - class	1	2,a	1,a	1	1	1	1	1
FSS	1,a	2,a	1,a	1,a	1,a	1,a	1,a	1
Cape E - class	1,i,j	3,a	1,a	1,i,j	2,i,j	1,i,j	1,i,j	2,i,j
Cape D - class	1,i,j	2,a	1,a	1,i,j	2,i,j	1,i,j	1,i,j	2,i,j
Cape H - class	1,a	2,a	1,a	1	2	1	1	2
Cape Texas	1,i,j	3,a	1,i,j	1,i,j	2,i,j	1,i,j	1,i,j	2,i,j
Cape R - class	1,d	3,a,d	1,a,d	1,d	2,i	1,d	1,d	2,i
Cape I - class	1,i,j	2,a	1,a	1,i,j	2,i,j	1,i,j	1,i,j	2,i,j
Cape Victory	1,i	3,a	1,i	1,i	2,i	1,i	1,i	2,i
Container								
C6 – M – 147a	1,e	3,e	1,e	1,e	2,e	1,e	1,e	2
C7 – S - 69c	1,e	2,a,e	1,e	1,e	2,e	1,e	1,e	2
C7 - S - 68c	1,e	2,a,e	1,a,e	1,e	2,e	1,e	1,e	2
C8 - S - 85c	1,e	2,a,e	1,a,e	1,e	2,e	1,e	1,e	1
C9 - M – 132b	1,e	2,a,e	1,a,e	1,e	1,e	1,e	1,e	1
C9 - M - F141a	1,a,e	2,a,e	1,a,e	1,a,e	1,a,e	1,a,e	1,a,e	1
C6 - S - 1qd (TACS)	1	2,a	1	1	2	1	1	2
C5 - S – MA73c (TACS)	1	3,a	2	1	2	1	1	2
C6 - S – MA60d (TACS)	1	2,a	1,a	1	2	1	1	2
Combination								
C7 - S – 133a	1	2,a	1,a	1	2	1	1	1
Maersk	1	2,a	1,a	1	2	1	1	2
AmSea	1	2,a	1,a	1	2	1	1	2

Notes:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitation as described below.

- a - vessel draft limited
- b - apron too narrow
- c - berth too short
- d - no straight-stern ramp
- e - no CNTNR cranes
- f - anchorage OK, berth too shallow
- g - shallow channel
- h - no special ramps
- i - tide too low for ramp clearance
- j - tide too high for ramp clearance
- k - ramp angle too steep at low tide
- m - ramp angle too steep at high tide
- n - parallel ramp operation ONLY
- o - apron too narrow for side ramp

Ramp clearance and angle based on maximum vessel draft.

♦ May Prevent Operation

♦ May Limit Operation

BERTHING CAPABILITIES OF THE PORT OF AD DAMMAM - cont

Vessel	Berths				
	23-26	27-29	30-31	32-34	39
Breakbulk					
C3 - S - 38a	6	4	2	3	1
C4 - S - 58a	5	3	1	2	1
C4 - S - 66a	5	3	2	3	1
C5 - S - 37e	5	3	1	2	1
Seatrain					
GA and PR - class	5	3	2	3	1
Barge					
LASH C8 - S - 81b	3	2	1	2	c
LASH C9 - S - 81d	3	2	1	1,a,f	c
LASH lighter	15	11	5	8	3
SEABEE C8 - S - 82a	3	2	1	1,a,f	c
SEABEE barge	15	11	5	8	3
RORO					
Comet	6,i,j	4,d,i,j	2,d,i,j	3,d,i,j	1,d,i,j
Meteor	5,i,j	3,d,i,j	2,d,i,j	3,d,i,j	1,d,i,j
Cape Gnome	5,i,j	3,d,i,j	1,d,i,j	2,d,i,j	1,d,i,j
C7 - S - 95a	4	2	1	2	c
Cape Taylor	4	3	1	2	c
Cape Orlando	4,i,j	3,i,j	1,i,j	2,i,j	c
MV Ambassador	5,m	3,d	2,d	3,d	1,d
Callaghan	4,i	3,d	1,d,i	2,d,i	c,d,i
Cape Lambert	4,i,j	3,i,j	1,i,j	2,i,j	c
LMSR - class	3	2	1	1	c
FSS	3	2	1	1,a	c
Cape E - class	4,i,j	3,i,j	1,i,j	2,i,j	c
Cape D - class	4,i,j	3,i,j	1,i,j	2,i,j	c
Cape H - class	4	2	1	2	c
Cape Texas	4,i,j	3,i,j	1,i,j	2,i,j	c
Cape R - class	4,i	3,d	1,d	2,d	c,d
Cape I - class	4,i,j	3,i,j	1,i,j	2,i,j	c
Cape Victory	4,i	3,i	1,i	2,i	c
Container					
C7 - S - 147a	4	3,e	1,e	2,e	c,e
C7 - S - 69c	4	3,e	1,e	2,e	c,e
C - S - 68c	4	3,e	1,e	2,e	c,e
C - S - 85c	3	2,e	1,e	2,e	c,e
C9 - M - 132b	3	2,e	1,e	1,e	c,e
C9 - M - F141a	3	2,e	1,e	1,a,e	c,e
C6 - S - 1qd (TACS)	4	3	1	2	c
C5 - S - MA73c (TACS)	4	3	1	2	1
C6 - S - MA60d (TACS)	4	3	1	2	c
Combination					
C7 - S - 133a	3	2	1	2	c
Maersk	4	2	1	2	c
AmSea	4	3	1	2	c

Notes:

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n - parallel ramp operation ONLY
o - apron too narrow for side ramp

Ramp clearance and angle based on maximum vessel draft.

♦ May Prevent Operation

♦ May Limit Operation

Open Storage

The Port of Ad Dammam has about 501 acres (2 million square meters) of paved open staging. Some of this area is in the reclaimed land along the causeway. The container staging area near Berths 23 to 27 has 102 acres (413,000 square meters). The container staging area is heavily used.

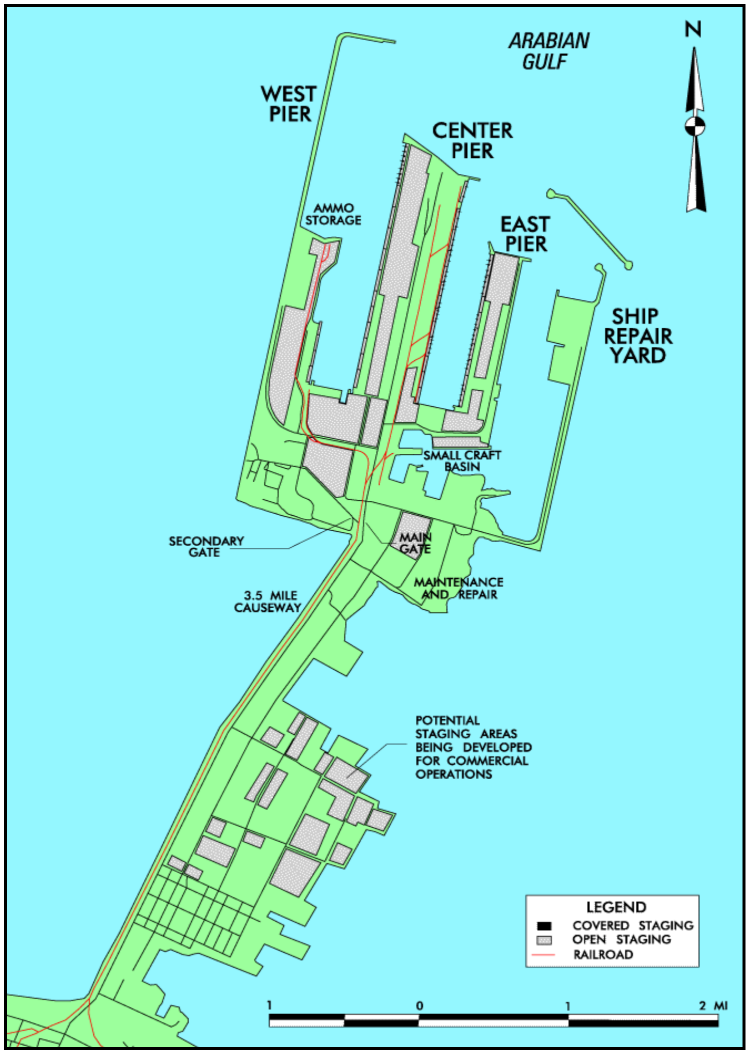
The military has performed helicopter operations in open areas on the East Pier (Berth 14-22). The nearby transit sheds can support shrink-wrapping and assembling operations. Open areas on the Center Pier (Berths 1-13 and 23-35) can also support helicopter operations.

Container Staging at Container Terminal at Port of Ad Dammam (eastward view)

Covered Storage

The port has 28 transit sheds, which average 57,000 square feet (5,300 square meters). Half of them are open-sided, but can be enclosed with tarps to protect against the wind. The sheds are usually full from day-to-day.

The port also has one container freight station with two sheds just inland of the port. Each of the sheds has 200,000 square feet of floor space (18,400 square meters).



Open Area Along Causeway

Highway

The Port of Ad Dammam has two gates; one with eight lanes, four in each direction; the other gate has two lanes, one in each direction. These gates are at the north end of the 3.5 mile causeway. Roads inside the port are generally free of congestion. Speed limits are 9 mph (15 kilometers per hour). All the roads within the port are in very good condition and have no restrictions on weight or height, except for the West Pier. An overhead pipeline restricts the vertical clearance to 18 feet (5.5 meters) on the road accessing the ammo storage area. The port's roads were resurfaced in Spring 1999.

Unloading/Loading Positions

The sheds along Berths 6-9 on the east edge of Center Pier have truck docks on their inland side. These are suitable for offloading and loading semitrailers, but do not have the strength and clearances to support heavy (tracked) vehicles. If these sheds and enough forklifts are available, about 12 van semitrailers can operate simultaneously.

There are no permanent or portable ramps capable of supporting truck operations. The military should bring or build ramps to handle trucks and trailers that do not have integral ramps.

Offsite Storage Area

Once off the entrance roadway, the surrounding area near the Port of Ad Dammam is generally undeveloped. Offsite marshaling is readily available in undeveloped, unlighted, and poorly drained areas. The military port operator should obtain permission from local police before using this land.

MATERIALS HANDLING EQUIPMENT (MHE)

The table below provides portable MHE at the Port of Ad Dammam that is owned by the Port Authority. Additional MHE is owned by local companies. The availability of privately-owned equipment varies with local industrial uses. Future privatization will likely bring more privately owned MHE to the port. For planning purposes, the list below indicates what equipment can be assumed available for use at the port.

MATERIALS HANDLING EQUIPMENT			
Location	MHE Type	Capacity (TONNES)	Quantity
Container Berth 23-26	Straddle carriers (Peiner)[1]	30	21
	Straddle carriers (TCM)[1]	40	2
	Straddle carriers (IPS)[2]	35-40	15
	Terminal Tractors (Sisu)	25	17
	Chassis and Mafis	40-60	36
	Forklifts (Hyster, Komatsu, Fantuzzi)	2.5-32	62
Multipurpose Berth 14-20	Forklifts	3-32	28
	Transtainers	35	3[3]
	Terminal Tractors (Sisu)	25	4
	Mafio trailers	40	4
Berths 4-13	Mobile cranes	5-20	4
	Terminal Tractor/Trailers	-	4
Entire Port	Floating crane	200	1

[1]These straddle carriers can stack containers two high.
[2]These straddle carriers can stack containers three high.
[3]Transtainers are not in the best operational condition.

AMMUNITION

The Port of Ad Dammam is prepared to handle explosives and hazardous materials. Ships approaching the port must declare quantities and categories they are carrying. A special anchorage for ammunition is about a half mile out to sea from the East Pier (Berths 14-22). With very few exceptions, ammunition is handled at the special ammunition pier at the far west end of the port (Berth 39). This facility provides very good security and safety. At times of contingency the anti-aircraft battery inland of the quay is manned.

Ammunition offloaded from ships or barges may be placed directly onto railcars on the apron tracks. About 120 feet of railcars can later switch to an ammunition storage bunker for safety. In addition to the railcar storage bunker, another 120-foot ammunition storage bunker at Berth 39 can safely store trucks or trailers of ammunition or explosive cargo. Containerized ammunition is the preferred method of shipment, however, palletized ammunition may also be handled. Berth 39 has no rail-mounted cranes; therefore, self-sustaining vessels, the floating crane, or mobile cranes must be used.

PETROLEUM, OILS AND LUBRICANTS (POL)

The port has no facilities for handling tankers, except for an edible oil terminal at Berth 38 (Nabati). Ships may obtain bunker fuel from barges alongside at berth or at anchorage.

The nearest POL facility, the Port of Ras Tanura, is about 45 miles north of the Port of Ad Dammam. The Port of Ras Tanura is a major bulk crude petroleum port and can accommodate ultra-large crude carriers with drafts up to 53 feet (16.3 meters) at any tidal condition. Several tanker vessels of different sizes can operate at the Port of Ras Tanura simultaneously.

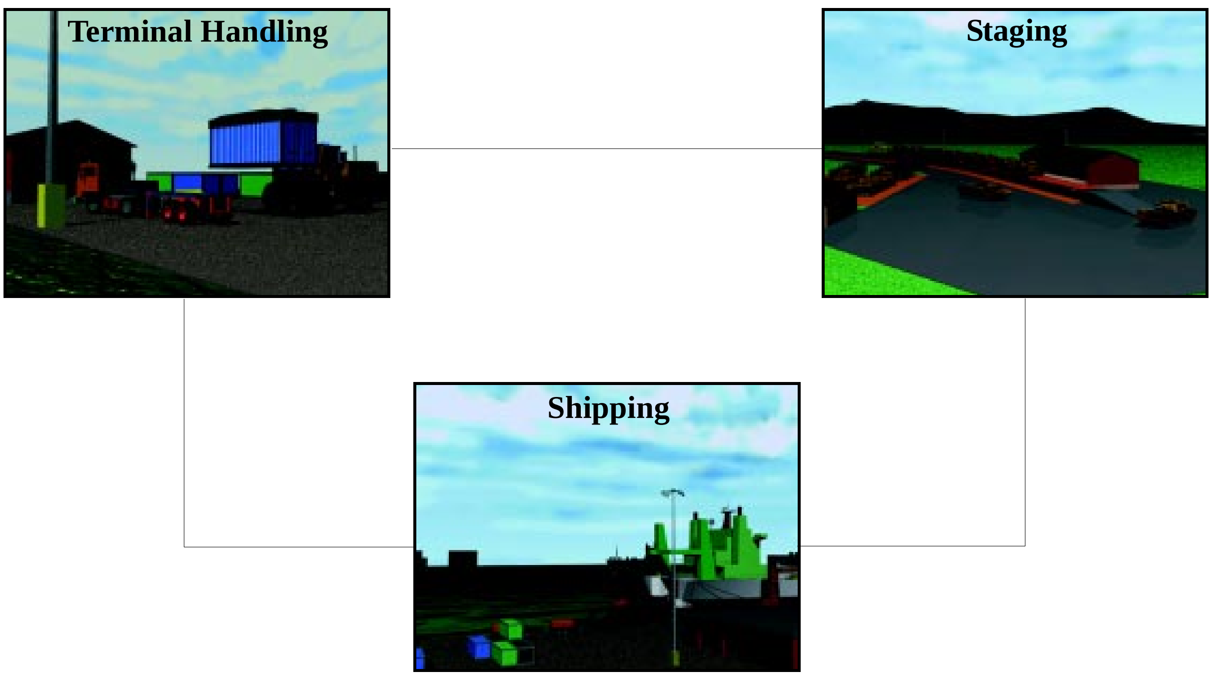
FUTURE DEVELOPMENT

The level of business at the Port of Ad Dammam does not justify further expansion. If cargo throughput levels approach the capability of the port, the West Pier could be extended north another 8,000 to 10,000 feet. The port is moving in the direction of privatization. The port authority is establishing a free-trade zone and will allow leasing of the berths in the future.

III. THROUGHPUT ANALYSIS

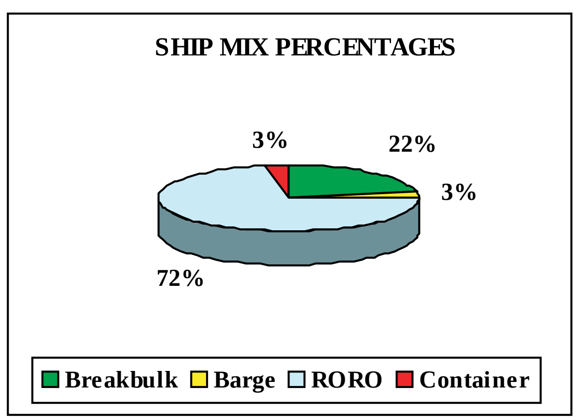
GENERAL

This section evaluates the throughput capability of the Port of Ad Dammam using the port operational performance simulator computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging/ hardstand marshaling, and terminal processing/handling - in STON per day.



Terminal Throughput Subsystems

This analysis assumes 60 percent of the militarily useful port facilities can be made available at any one time, based on current usage. For this reason, we ran all port analyses using a 60 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future operations.



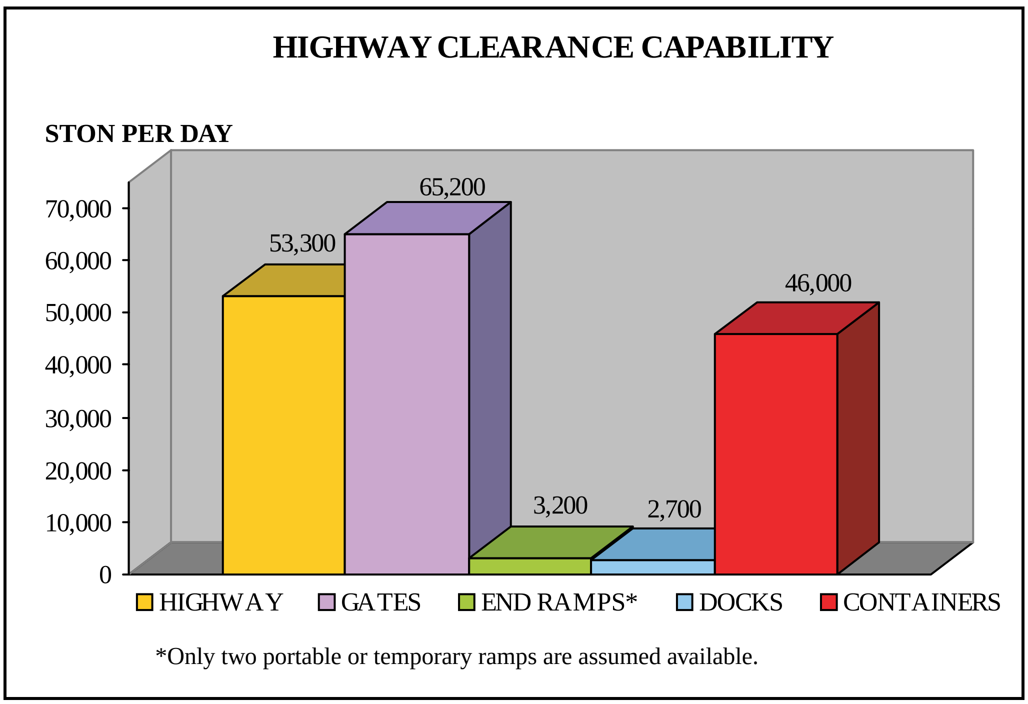
RECEPTION/HANDLING

Highway

The Port of Ad Dammam has two gates and one route to the main highway network. These gates can handle 65,200 STON (289,800 MTON) of equipment and supplies per day. Each vehicle is assumed to take 0.2 minutes for processing at the gate. King Abdul Aziz Sea Port Road can support 53,300 STON (237,000 MTON) per day.

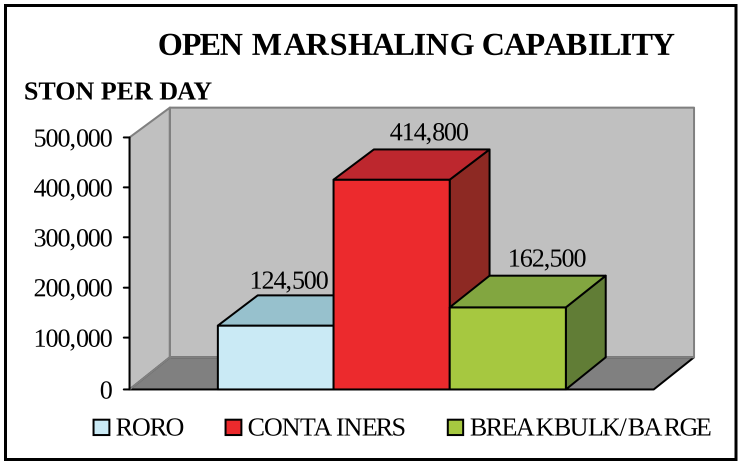
Roadable vehicles in convoys will process directly to the off-port marshaling areas. Vehicles to be loaded onto commercial or military flatbed trailers without integral ramps will load at portable end ramps brought or built by the military port operator. Each such ramp can support 1,600 STON (4,800 MTON) per day. We assume two such ramps will be made available.

At least 12 van semitrailers can operate simultaneously at truck docks along Berths 6-9. These 12 dock operations can support about 2,700 STON (6,750 MTON) per day.



Open Storage

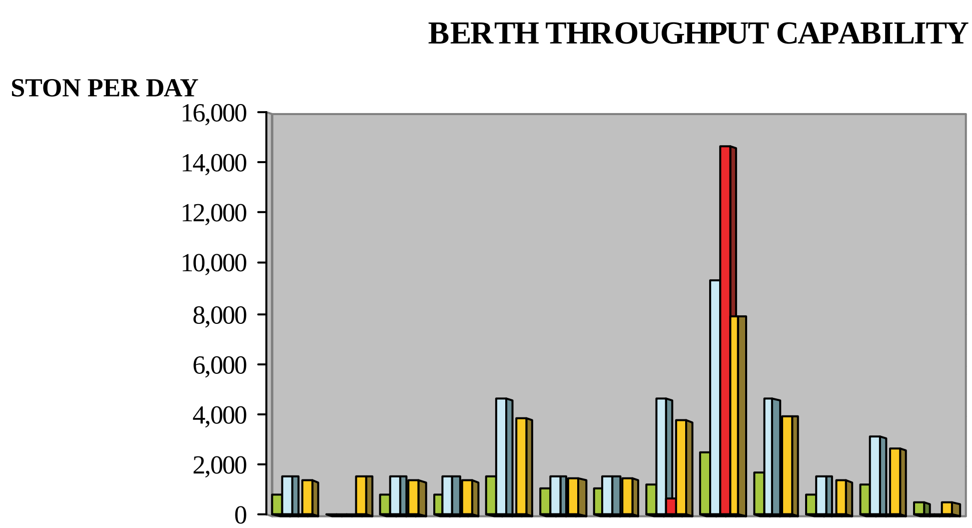
The Port of Ad Dammam has about 501 acres (2 million square meters) of paved open staging available for military operations. Each open acre provides the capability to stage 290 STON per day of RORO cargo, or 1,600 STON per day of container cargo, or 380 STON per day of breakbulk cargo.



Shipping

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility.

CONVERSION FACTORS	
Breakbulk:	.4 STON per MTON
RORO:	.25 STON per MTON
Containers:	.4 STON per MTON



	4-5	6-9	10-11	12-13	14-16	17-18	19-20	21-22	23-26	27-29	30-31	32-34	39
BREAKBULK/BARGE	840	0	840	840	1,530	1,020	1,020	1,250	2,510	1,670	840	1,250	490
RORO	1,550	0	1,550	1,550	4,640	1,550	1,550	4,640	9,290	4,640	1,550	3,100	0
CONTAINERS	0	0	0	0	0	0	0	700	14,620	0	0	0	0
MIXED	1,350	1,550	1,370	1,360	3,850	1,420	1,420	3,750	7,920	3,950	1,380	2,620	490

THROUGHPUT SUMMARY FOR THE PORT OF AD DAMMAM								
BERTH(S)	LENGTH (feet) (meters)	DEPTH (feet) (meters)	BB (STON) (MTON)	RORO (STON) (MTON)	RORO SQ FT (EST)	RORO PIECES	CNTNR (STON) (MTON) (TEU)	MIXED (STON) (MTON)
4-5	3,148 258	35 11	840 2,090	1,550 6,190	30,960	182	0	1,350 5,090
6-9	2,063 629	26 8	0	0	0	0	0	1,550 3,870
10-11	1,295 395	31 9	840 2,090	1,550 6,190	30,960	182	0	1,370 5,140
12-13	1,180 360	36 11	840 2,090	1,550 6,190	30,960	182	0	1,360 5,130
14-16	1,770 539	36 11	1,530 3,830	4,640 18,580	92,880	546	0	3,850 14,800
17-18	1,180 360	36 11	1,020 2,550	1,550 6,190	30,960	182	0	1,420 5,270
19-20	1,180 360	36 11	1,020 2,550	1,550 6,190	30,960	182	0	1,420 5,270
21-22	1,574 480	43 13	1,250 3,140	4,640 18,580	92,880	546	700 (1,740) 87	3,750 14,560
23-26	3,148 959	43 13	2,510 6,270	9,290 37,160	185,780	1,092	14,620 36,560 1,828	7,920 30,130
27-29	2,214 675	43 13	1,670 4,180	4,640 18,580	92,880	546	0	3,950 15,210
30-31	1,181 360	43 13	840 2,090	1,550 6,190	30,960	182	0	1,380 5,230
32-34	1,772 540	43 13	1,250 3,140	3,100 12,390	61,920	364	0	2,620 10,000
39	623 190	41 12	490 1,220	0	0	0	0	490 1,220

BERTH PREFERENCE RANKING			
Berth(s)	**Loading Style**		
	Breakbulk	**RORO**	**Container**
4-5	5	2	-
6-9	2	12	-
10-11	6	6	-
12-13	7	1	-
14-16	1	3	-
17-18	3	7	-
19-20	3	7	-
21-22	9	3	2
23-26	8	3	1
27-19	11	7	-
30-31	10	7	-
32-34	11	7	-
39	11	13	-

NOTE: Berths marked with a "-" are not recommended for these operations.

The type of ship preferred at each berth is based on an evaluation of various characteristics at each berth using a point system (see app). Each berth is rated by its capability to support various ship-loading and discharging operations. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The berth with the highest points is the first preferred for that specific loading style and is, therefore, rated one. In general, no one berth is ideal for all military operations. The best berth depends on the type of ship loaded.

Berth 14-16 is the best berth if a breakbulk ship is planned. This berth has 12 wharf cranes, deep water, and a transit shed. If a RORO ship is planned, Berth 12-13 is preferred. Although this berth does not have a RORO ramp, it was rated highly because of the apron track and deep water. The best berth for container operations is Berth 23-26 because of its container cranes.

Barge Operations

The East Small Craft Harbor, located south of the East Pier, is 12 to 15 feet deep and could support barge operations. However, this area is difficult to secure and is distant from the deep water berths and anchorages where the barge-carrying vessel might berth. The distance to shuttle barges to and from this harbor would reduce the overall operations.

The ammunition pier can certainly support barge operations, but is restricted by the port authority to handle ammunition exclusively.

Operation Turbo CADS in October 1997 involved barge operations at the container terminal, Berth 23-26. Barges were loaded near the RORO ramp at the end of the pier. The barge-carrying vessel was berthed just south of the barge operations. The port authority allowed the U.S. military to use about 1,500 feet of the quay. This allowed four barges at pierside simultaneously. The mobile crane used did not have the reach to access the second, third, and fourth row of barges. Future plans for barge operations should call for more wharf space, if allowed by the port authority, to handle more barges at pierside or else a larger crane that can reach several rows of barges. Severe weather can seriously hinder barge operations.

Each mobile crane can handle 331 STON (829 MTON) per day, assuming 20 productive work hours, and 90 percent berth utilization factor. With every other barge having a crane operating, 10 barge positions can handle 1,600 STON (4,100 MTON) of military cargo per day.

Large Vessel Operations

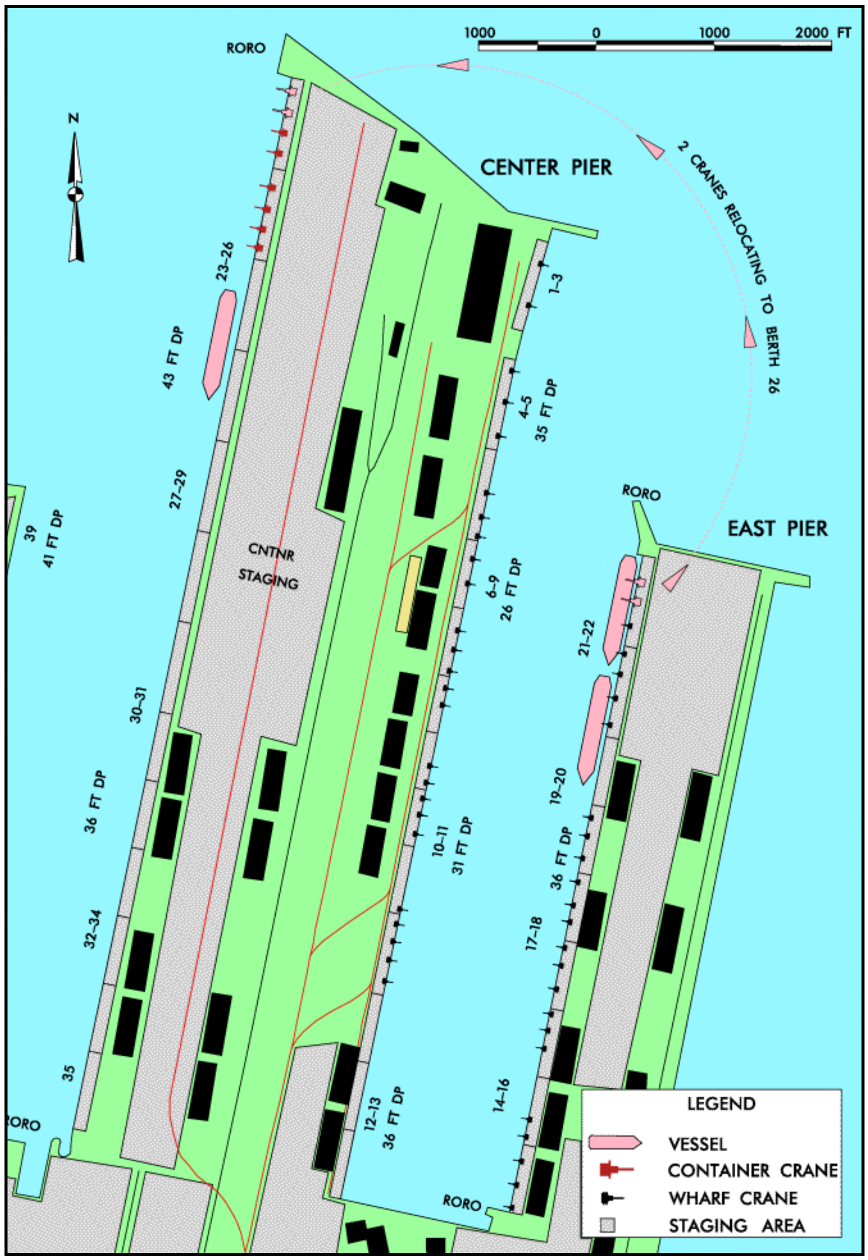
The Port of Ad Dammam can berth seven FSS or LMSR vessels, with no restrictions on draft, at Berths 21-31. As shown on the berthing capabilities table, six additional large vessels can berth at Berths 4-5, and 10-20, provided their drafts do not exceed 35 or 36 feet. In nearly all cases, cargo loads will not exceed these limits. Proper planning can ensure these vessels do not exceed these drafts. The port can berth 13 large vessels.

The number of large vessels that can be handled is restricted by the amount of paved open staging at the port. Typically, 16 acres are required to conduct sustained loading operations on an FSS, and 25 acres for an LMSR. Discharging vehicles off vessels requires less staging, and depends on how fast the equipment can be cleared from the port. It is reasonable to assume enough staging (the port has 501 acres) will be available for several simultaneous ship discharging operations.

IV. APPLICATION

This section evaluates the port's throughput capability for receiving a notional armored division. Since the water in the Port of Ad Dammam is deep, this study evaluates the reception using vessels of the LMSR category; specifically the NASSCO New Construction design. These vessels have a design draft of 35 feet (10.7 meters), and an overall length of 950 feet (290 meters). So far, there is very little data from exercises to suggest a reasonable stow factor for these vessels. Our analysis will assume a 65 percent stow factor.

The facilities used depend on decisions made by the Ad Dammam Port Authority. Although the container berths have the best lifting equipment at the port, we assume that not all of the container facilities are available. This analysis assumes the U.S. military will use the facilities along the East Pier (19-20 and 21-22) and Center Pier (23-24). These facilities are suitable for LMSR and FSS operations.

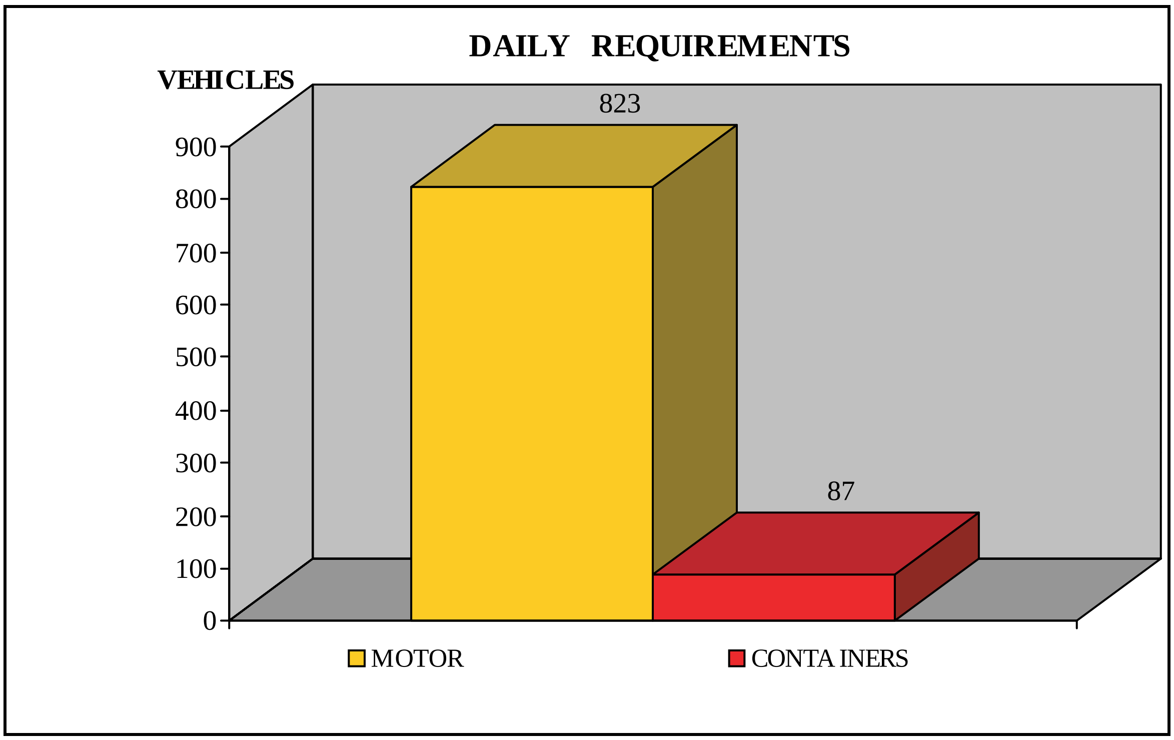


Facilities to Support U.S. Military Operations

REQUIREMENTS

For purposes of this analysis, the likely requirement for the Port of Ad Dammam is to receive a notional armored division. We assume the port must process the division in only 6 days of offloading and port clearance. Although the port has access by rail, it will not likely be used. To process the division by road, about 3,752 (625 per day) self-propelled vehicles towing 2,386 (398 per day) trailers, along with 367 (61 per day) forty-foot semitrailers and 1,189 (198 per day) HETS would pass through the gates in the 6 days time. For traffic analysis, this equates to about 823 vehicles (some with trailers or semitrailers) passing through the gates and eventually proceeding to an inland destination.

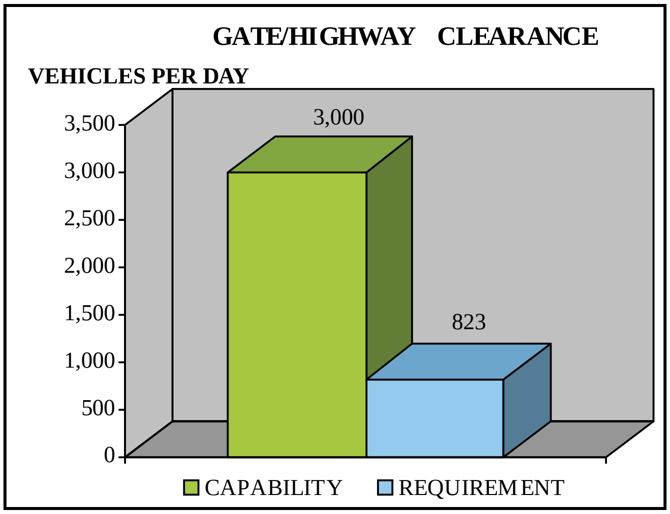
ARMORED DIVISION		
Total Equipment		Required Daily Throughput
Volume	287,175 MTON	47,862 MTON
Weight	101,342 STON	16,890 STON
Area	1,484,636 SQ FT	247,439 SQ FT
Vehicles*	8,125	1,354
Containers	522	87
*Includes trailers		



TERMINAL OUTPROCESSING/HANDLING

Highway

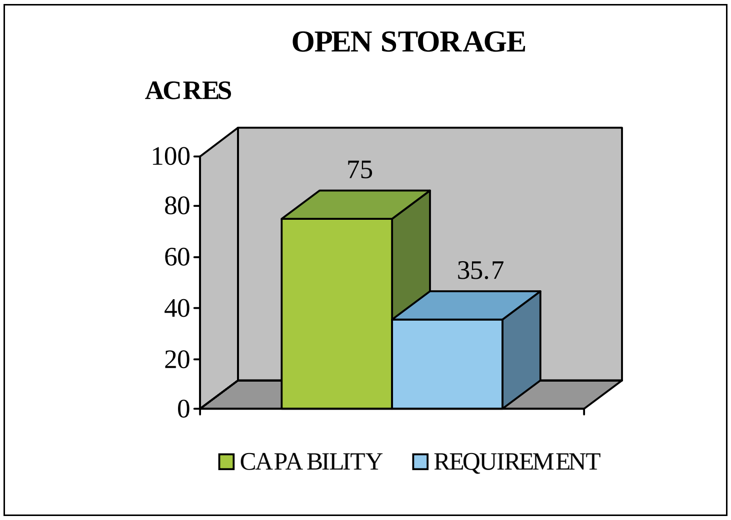
The port has two gates that allow military vehicles and equipment to access the causeway and the highway infrastructure. Two lanes of one of these gates can accommodate 3,000 military vehicles per day. This is sufficient to meet the requirement.



Assuming a constant flow of vehicles out the gates of the port, the daily clearance requirement is under 900 vehicles. The Ad Dammam road network can easily support the requirement to handle the armored division in 6 days.

Open Storage

The Port of Ad Dammam has a total of 501 acres (2 million square meters) of paved open staging. About 75 acres are in open areas on the East Pier.



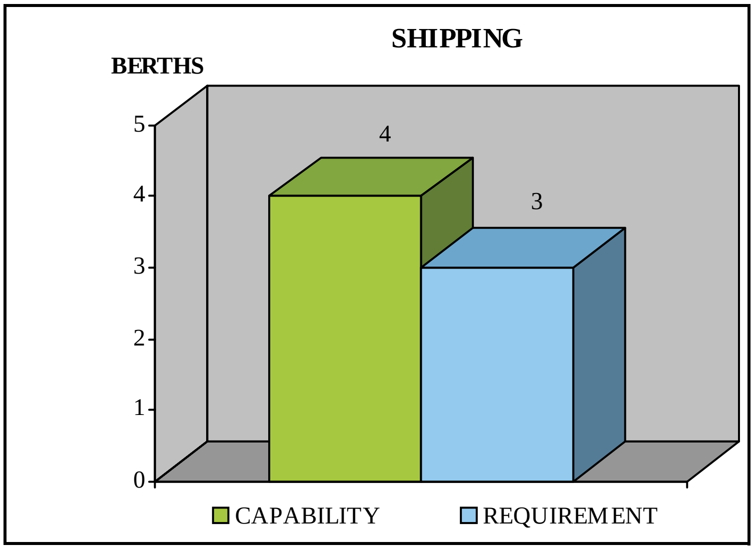
Marshaling the entire division of equipment (1,484,636 square feet) requires 85 acres. We assume the maximum amount in the port at any time is about 2-1/2 days (42 percent) of the required port throughput. This requires the port to provide 35.7 acres of paved open area to support the operation. The port can easily meet the requirement.

Shipping

An armored division has 1,484,636 square feet of vehicles and equipment. The deck space on the NASSCO New Construction design is 393,268 square feet.

Each of the NASSCO New Construction design vessels can carry 256,000 square feet of cargo, assuming the 65 percent stow factor discussed previously. At this rate, the division would require just under six of these vessels. Unloading RORO vessels this size can be done in about 2 days. To meet the 6-day requirement, the port can berth three of these vessels simultaneously throughout the entire 6-day reception.

The East Pier of the Port of Ad Dammam alone has enough wharf with deep water to support berthing at least four LMSR vessels. This is sufficient to meet the requirement.

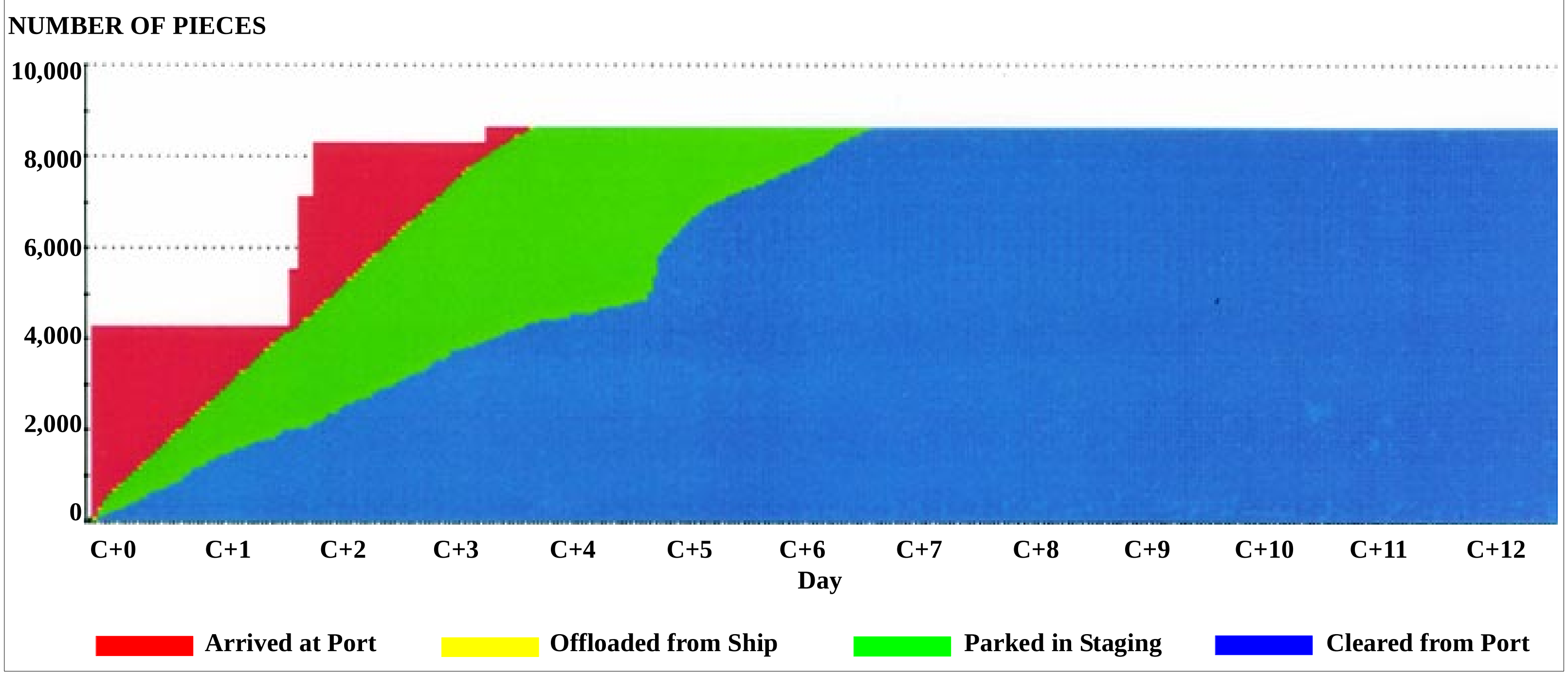


The map in this section provides the berthing configuration.

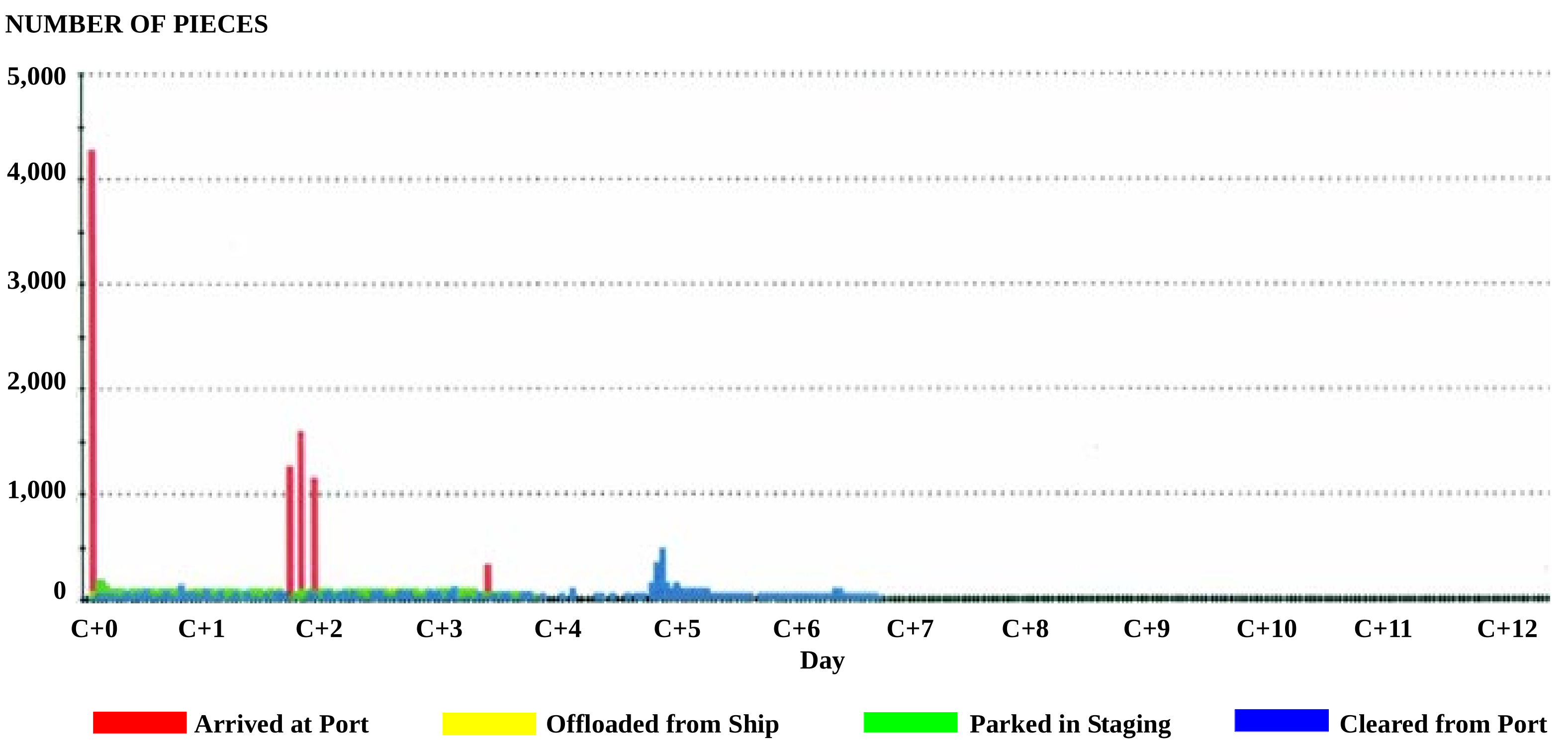
SIMULATION RESULTS

Total deployment time for the division is about 6.5 days using LMSR vessels and 7 days using FSS ships. Actual throughput and closure results are shown in the graphs on the following pages.

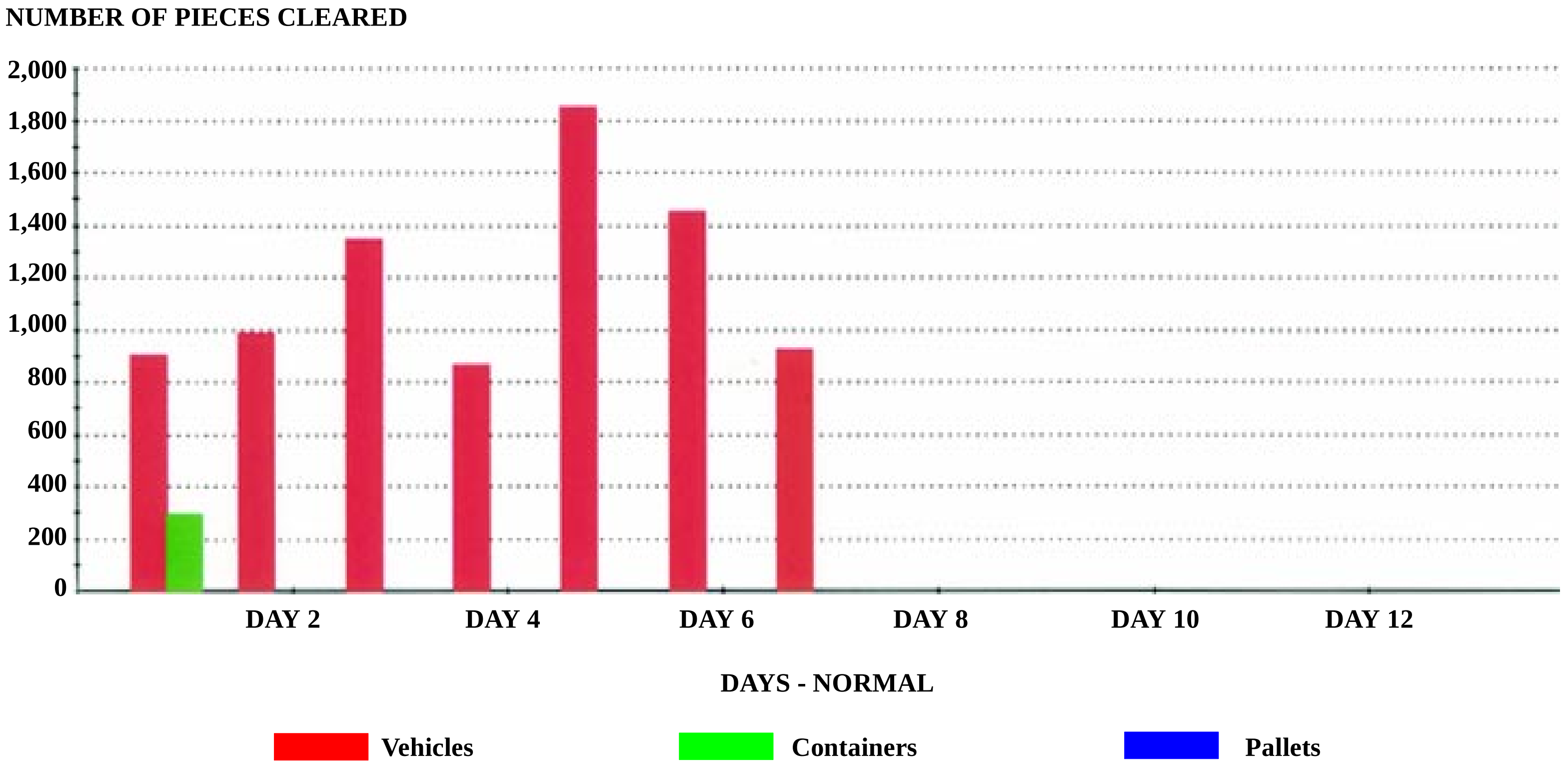
CUMULATIVE CLEARANCE PROFILE FOR NOTIONAL HEAVY ARMORED DIVISION FOR THE PORT OF AD DAMMAM (USING LMSR VESSELS)



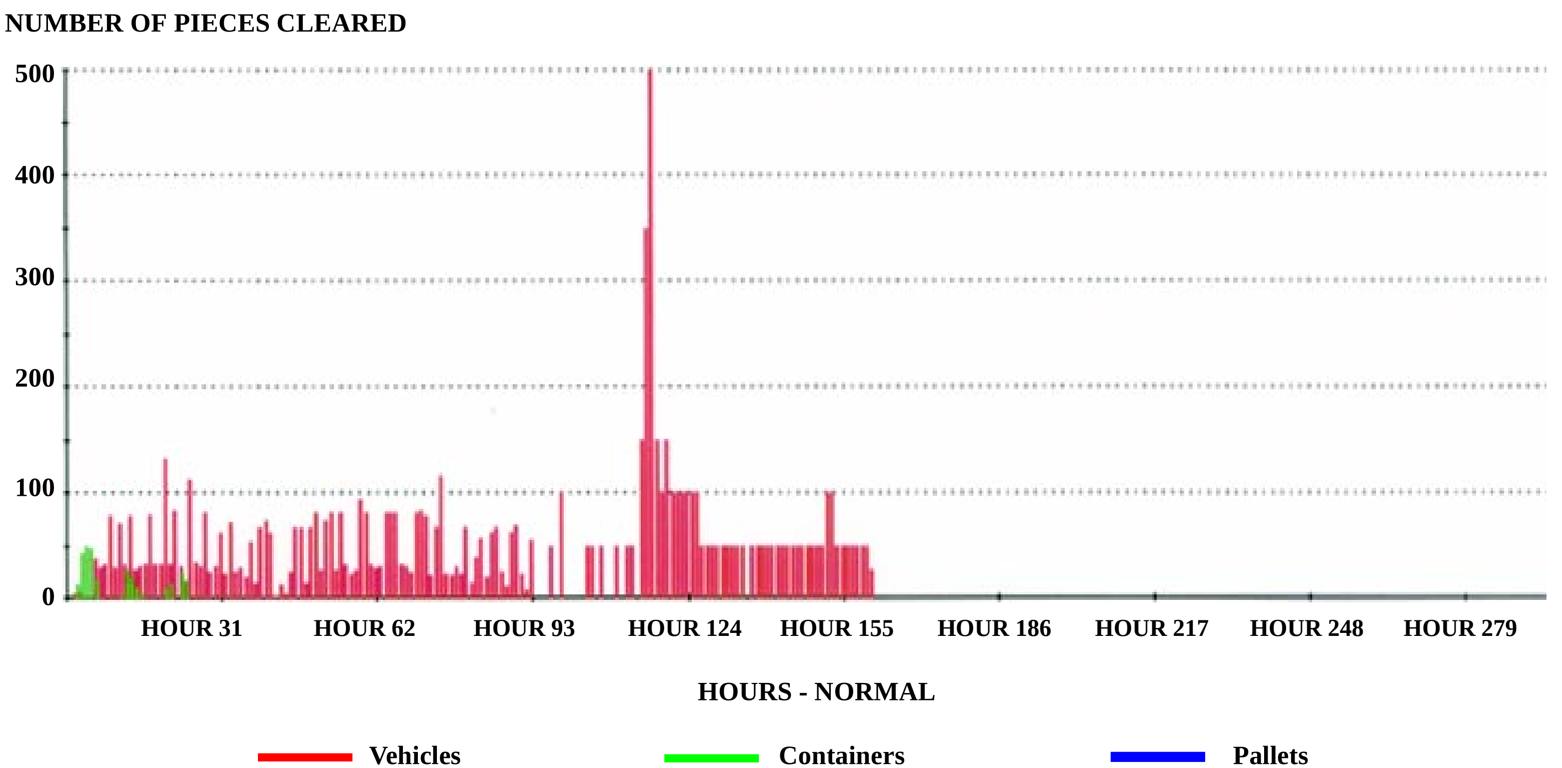
DAILY CLEARANCE PROFILE FOR NOTIONAL HEAVY ARMORED DIVISION FOR THE PORT OF AD DAMMAM (USING LMSR VESSELS)



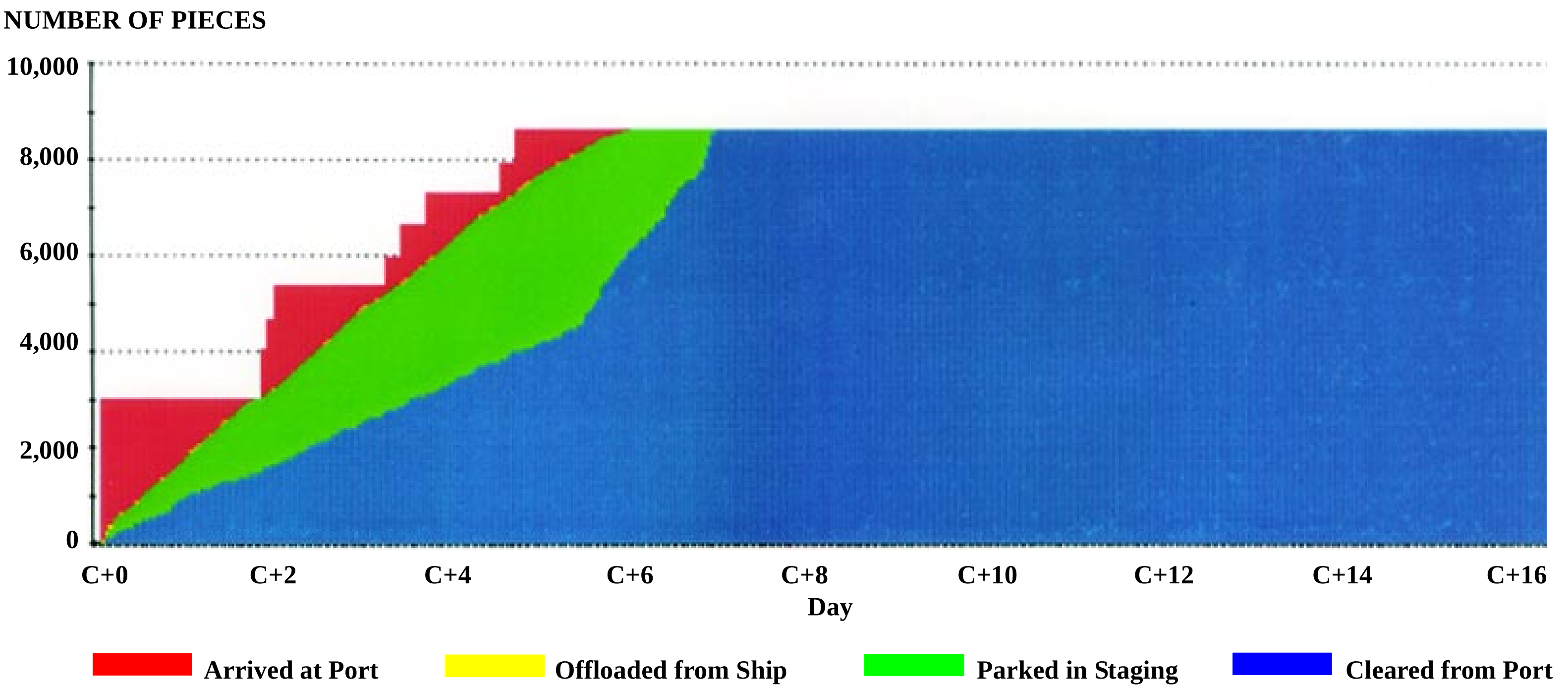
DAILY THROUGHPUT FOR NOTIONAL HEAVY ARMORED DIVISION FOR THE PORT OF AD DAMMAM (USING LMSR VESSELS)



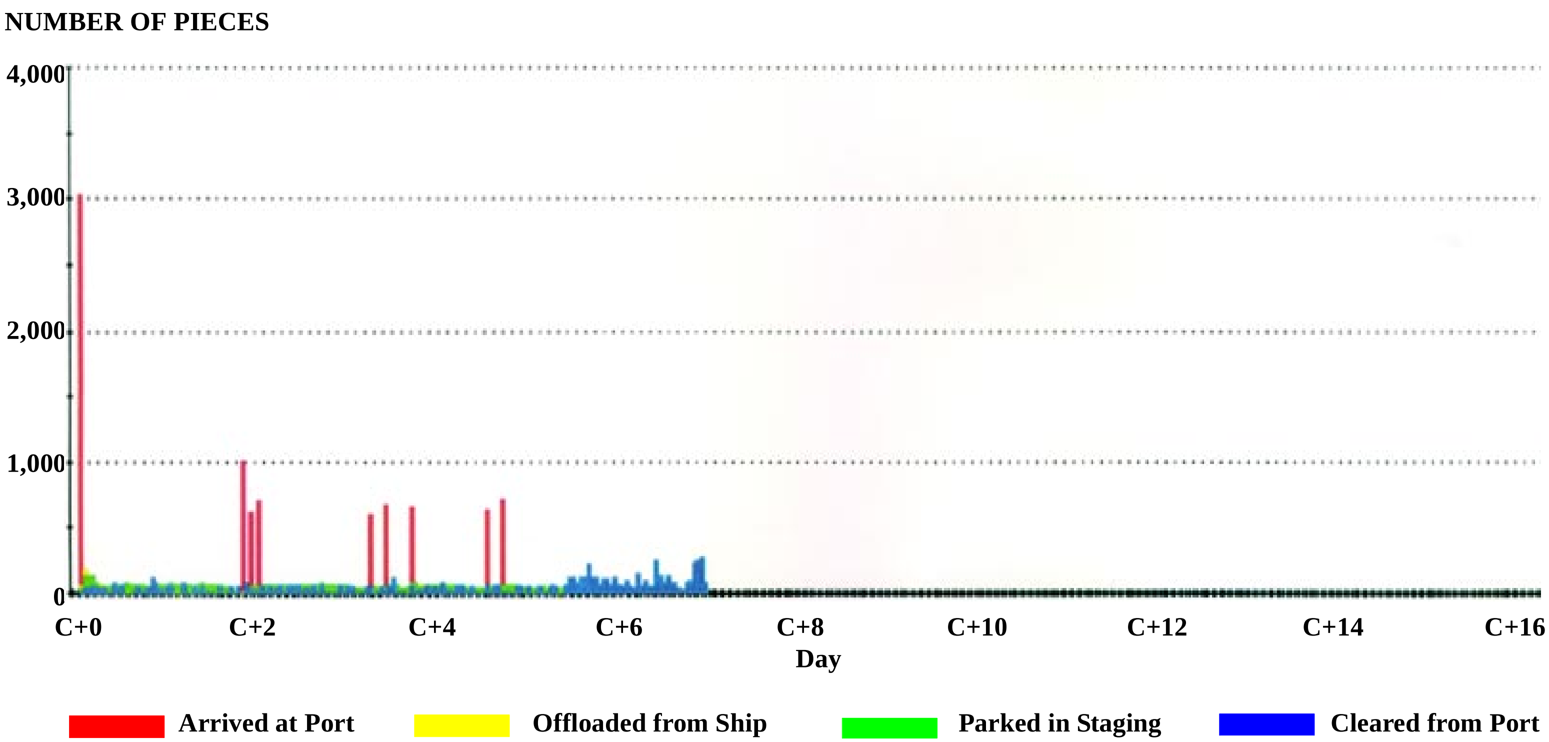
HOURLY THROUGHPUT FOR NOTIONAL HEAVY ARMORED DIVISION FOR THE PORT OF AD DAMMAM (USING LMSR VESSELS)



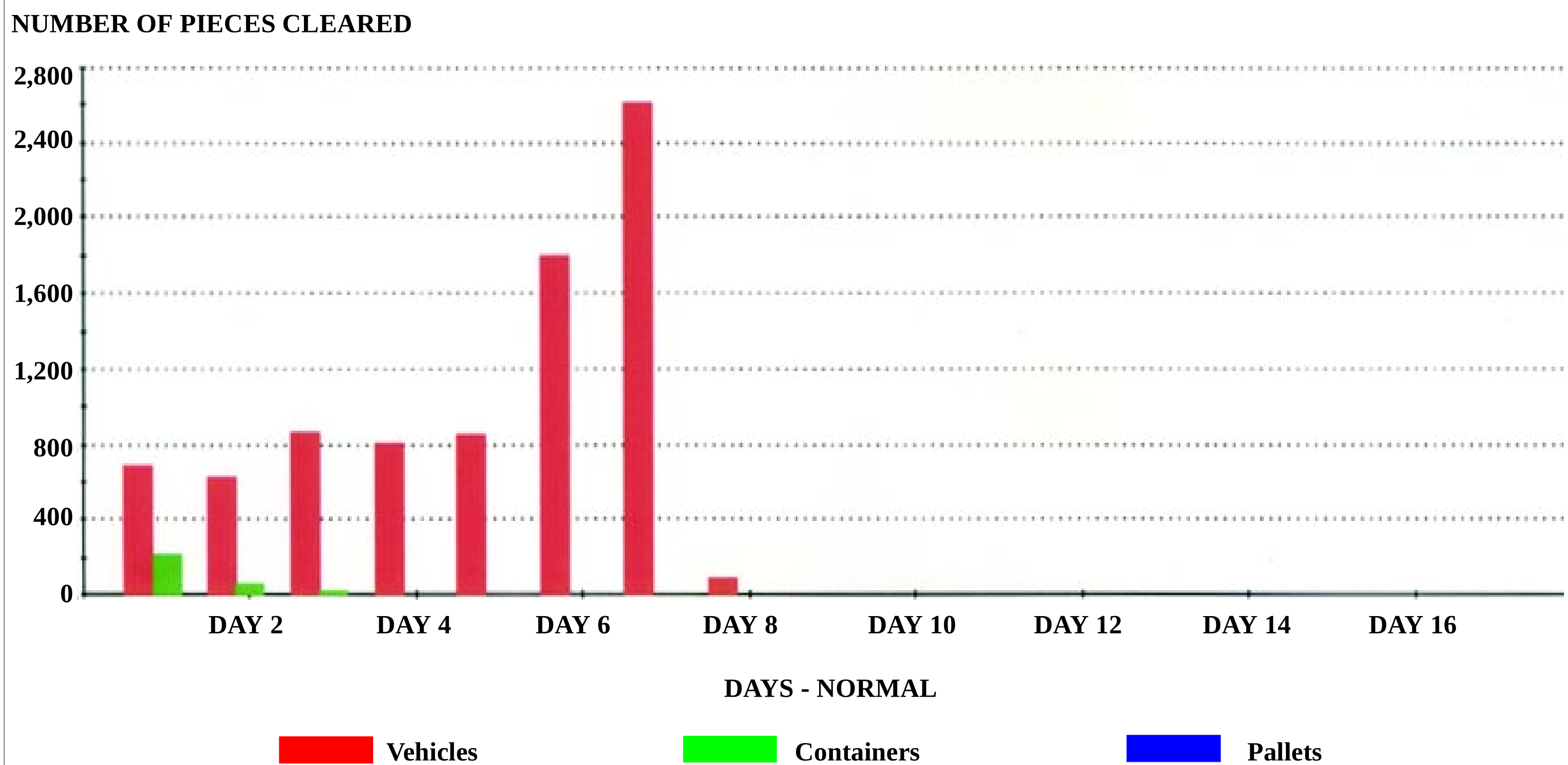
CUMULATIVE CLEARANCE PROFILE FOR NOTIONAL HEAVY ARMORED DIVISION FOR THE PORT OF AD DAMMAM (USING FSS VESSELS)



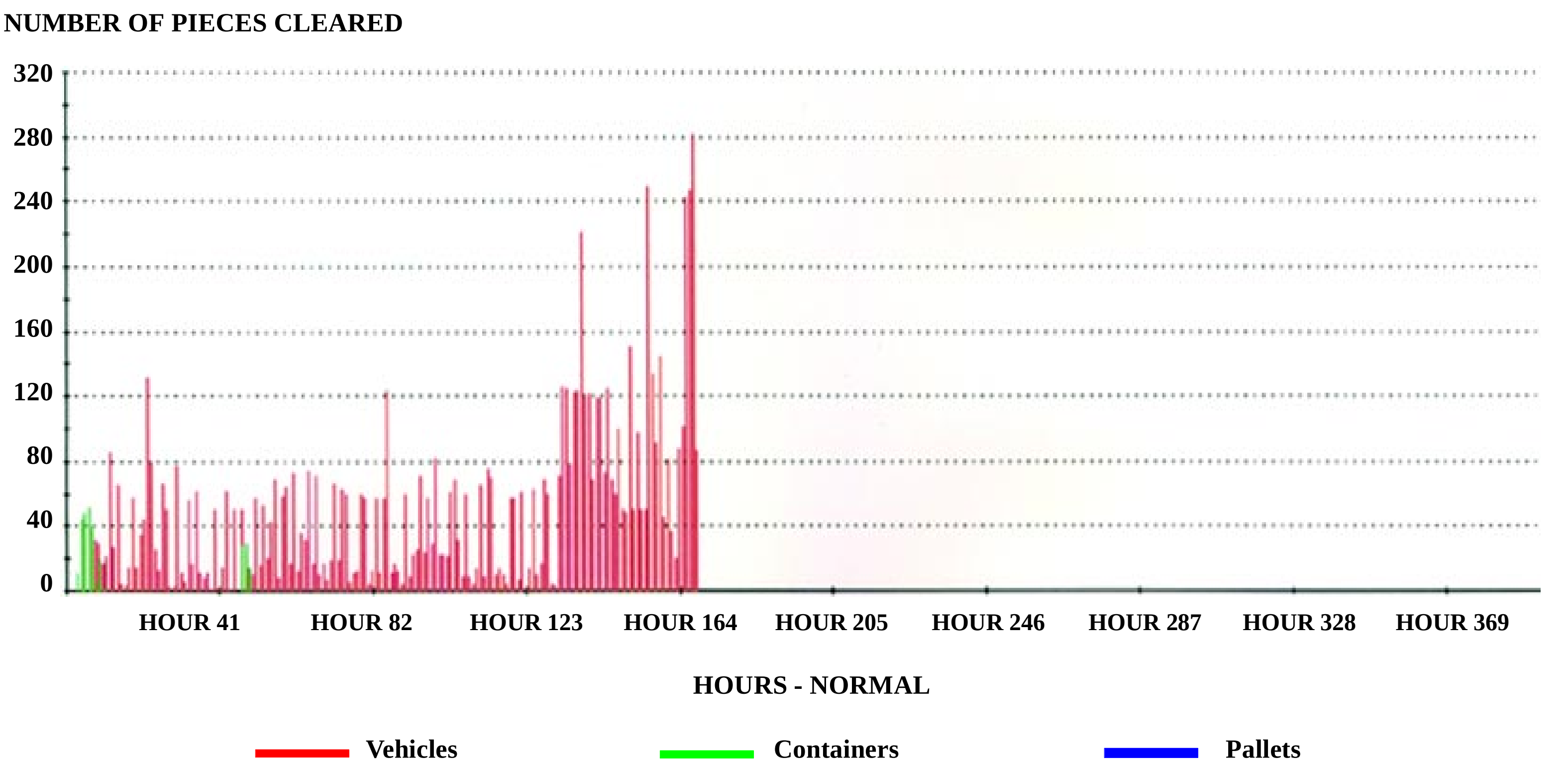
DAILY CLEARANCE PROFILE FOR NOTIONAL HEAVY ARMORED DIVISION FOR THE PORT OF AD DAMMAM (USING FSS VESSELS)



DAILY THROUGHPUT FOR NOTIONAL HEAVY ARMORED DIVISION FOR THE PORT OF AD DAMMAM (USING FSS VESSELS)



HOURLY THROUGHPUT FOR NOTIONAL HEAVY ARMORED DIVISION FOR THE PORT OF AD DAMMAM (USING FSS VESSELS)



SUMMARY

The Port of Ad Dammam is a very capable port with the ability to throughput an army heavy armored division in 6.5 days using LMSR vessels and 7 days using FSS vessels. The port has several deep-water draft berths capable of berthing LMSR or FSS vessels. RORO, breakbulk, container, and barge operations are all feasible at this port. The port has 501 acres of open storage, which far exceeds deployment requirements. About 40 percent of this total is used on a daily basis (mostly in the container terminal). Because of future privatization and the establishment of a free-trade zone, some of the current open storage will become unavailable except through negotiation with the owners of these storage areas. Rail facilities will not likely be used to process U.S. military vehicles and equipment because of the rail destination. Major roadways and superhighways accessing the port are six-laned and in good condition to support convoys for clearing the port.

RECOMMENDATION

We recommend the Port of Ad Dammam be considered to process division-sized units using LMSR vessels.

PORT OF JUBAIL (JUBAYL)
SAUDI ARABIA

I. EXECUTIVE SUMMARY

GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency (MTMCTEA) conducted a capability analysis of the Port of Jubail, Saudi Arabia, in March 1999. The port is fully capable of functioning as a strategic sea port of debarkation (SPOD) for contingencies in the Southwest Asia (SWA) region. This port can throughput a division-size unit and can support the berthing of LMSR and FSS ships.

The port consists of 1 terminal with 16 berths. Total wharf length is 12,464 feet and the water depth alongside varies from 39 – 45 feet lowest astronomical tide (LAT). The channel depth for water access into the Port of Jubail is 45 feet (LAT) making this port FSS and LMSR accessible. Breakbulk, RORO, container, and barge operations are all feasible. The apron height above the water line is about 16 feet and the tidal variation is about 12 feet. This means that the RORO ramp angle is approaching the upper limits for performing RORO operations when the water level is at low tide.

The port has excellent highway access, with four gates and several six-lane highways connecting it to the Dhahran-Jubail six-lane superhighway. The Abu Hadriyah six-lane superhighway, which connects Bahrain to Kuwait, is also readily accessible to the port. The nearest airport is Dhahran International Airport located about 1 hour south of Jubail near Ad Dammam. This airport can handle C-5 aircraft. The port does not have rail access.

Available materials handling equipment (MHE) include two container cranes at Berths 15 and 16, three transtainers in the container terminal, seven mobile cranes (including a 220 short ton (STON) floating crane), and three container handlers. The port does not have any end ramps. The port also has eight tugs supporting the commercial and industrial ports with capabilities varying from 1,500 – 2,500 HP. Six senior pilots serve the port. Other facilities include a container freight station with available area of 92,570 square feet and a straight-stern ramp offloading capability at Berth 16.

The port has ample open storage. Within the customs area, the port has 111 acres of paved open storage and another 222 acres of paved open storage outside the customs area. The port conducts very little business and at least 95 percent of the total open storage is available on a daily basis. The port also has almost 936,500 square feet of covered storage in transit sheds along the wharf.

THROUGHPUT

The shiploading subsystem is the least capable of the three transportation subsystems analyzed. The port has a mixed throughput capability of over 44,500 STON per day. A notional armored division has 101,350 STON of vehicles and equipment. Computer simulations show that the port is capable of clearing a notional armored division in about 5 days using LMSR vessels at three berths. Simulations also show the port clearing the notional armored division in 6 days using FSS ships at three berths. Using more ship berths will allow clearance in less than 6 days if desired.

APPLICATION

For a practical application, we analyzed a notional armored division deploying to the port on LMSR or FSS ships using Berths 9 and 10, 13 and 14, and 15 and 16. Deploying a notional armored division in 6 days requires 16,900 STON of vehicles and equipment (that includes 90 containers) per day to be loaded. When the six LMSRs or eight FSS plus three Cape H vessels deliver equipment to the port on schedule, the port can meet port clearance requirements. Smaller ships will require additional time and/or berths.

The division will require about 13 acres of staging to offload and clear an LMSR through the port in 2 days, for a total of 39 acres per day for three LMSR berths. This means that the port has more than enough paved open staging immediately within the customs area to support the offloading of four LMSR vessels simultaneously. The FSS requires about 10 acres of open staging per ship off-loading, for a total of 30 acres per day. The port has a total of 333 acres of paved open staging. Since the port is largely unused, most of this open staging is available on a day-to-day basis.

The Port of Jubail has the capability to handle explosives and dangerous cargoes such as ammunition. Facilities are available to handle fires and other emergencies. Available equipment include two fire-fighting boats and fire fighting and rescue vehicles.

II. GENERAL DATA

The Port of Jubail has been especially constructed to provide service and facilities necessary for infrastructure within the Jubail Industrial Area. The location was selected for ease in export of products from the Industrial Complex, but the port remains largely unused. A team from the Military Traffic Management Command (MTMC) conducted a site survey on 9 March 1999. Information was obtained from the 831st Transportation Battalion in Bahrain and Port Officials.

TRANSPORTATION ACCESS

Water

The port (LWEV) (27° 01' N latitude and 49° 40' E longitude) is on the east central coast of Saudi Arabia on the Arabian Gulf, about 56 miles northwest of Ad Dammam. A channel with water depth of 45 feet (14 meters) lowest astronomical tide (LAT) accesses the port and allows vessels as large as the LMSR and FSS to call on the port. Because the port is on open water, no overhead restrictions exist for vessels calling on the port. Vessels can turn in the open water, away from Berths 9 and 10 near the entrance to the port. An anchorage also exists in the inner and outer harbor. This anchorage has a water draft of 45 feet (14 meters).

All vessels entering the port require pilots. The port authority reports that six senior pilots and eight tugs are available. The eight tugs are split between the commercial and industrial port facilities. Tidal variation range is about 7.5 – 12.5 feet (2.3 – 3.8 meters).

Highway

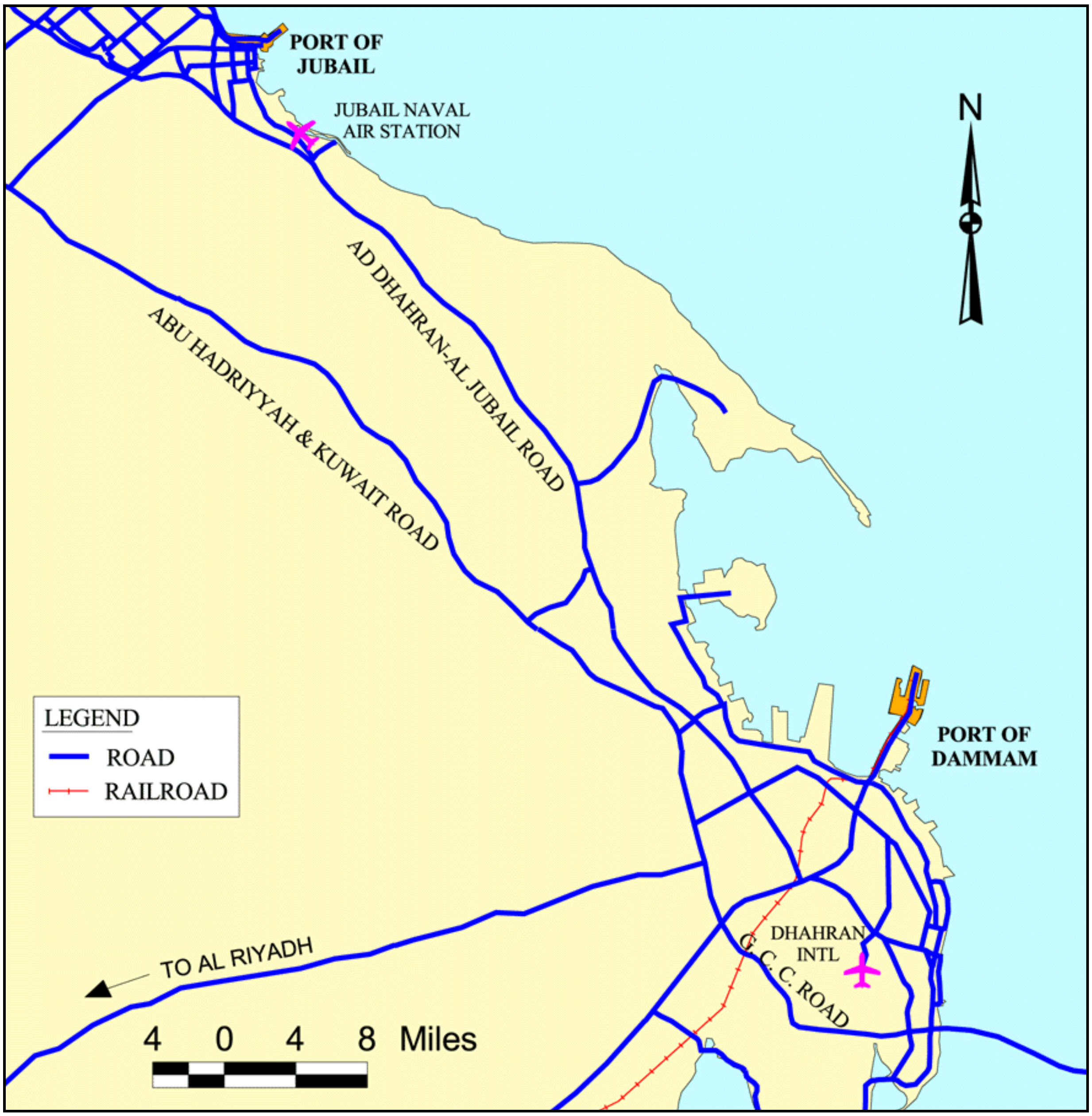
The Port of Jubail has excellent highway access, with four gates for accessing the port and several six-lane roads connect the port to Saudi Arabian superhighways. Two superhighways access the Jubail area. Closest to the port is the Dhahran-Jubail Road, a six-lane superhighway that provides a bypass around the City of Jubail while providing exits to access the city and port. The second superhighway is the Abu Hadriyah-Kuwait Road, which is a six-lane road running between the King Fahd Causeway accessing Bahrain to the south and Kuwait to the north. Northbound traffic going to Kuwait can access the Abu Hadriyah-Kuwait Road west of the Dhahran-Jubail Road. Southbound and Westbound traffic can take the Dhahran-Jubail Road south to Ad Dammam. Westbound traffic would then access the six-lane Dhahran-Al Riyadh Road superhighway. Roads on the port are in excellent condition and are either four-laned or six-laned.

Air

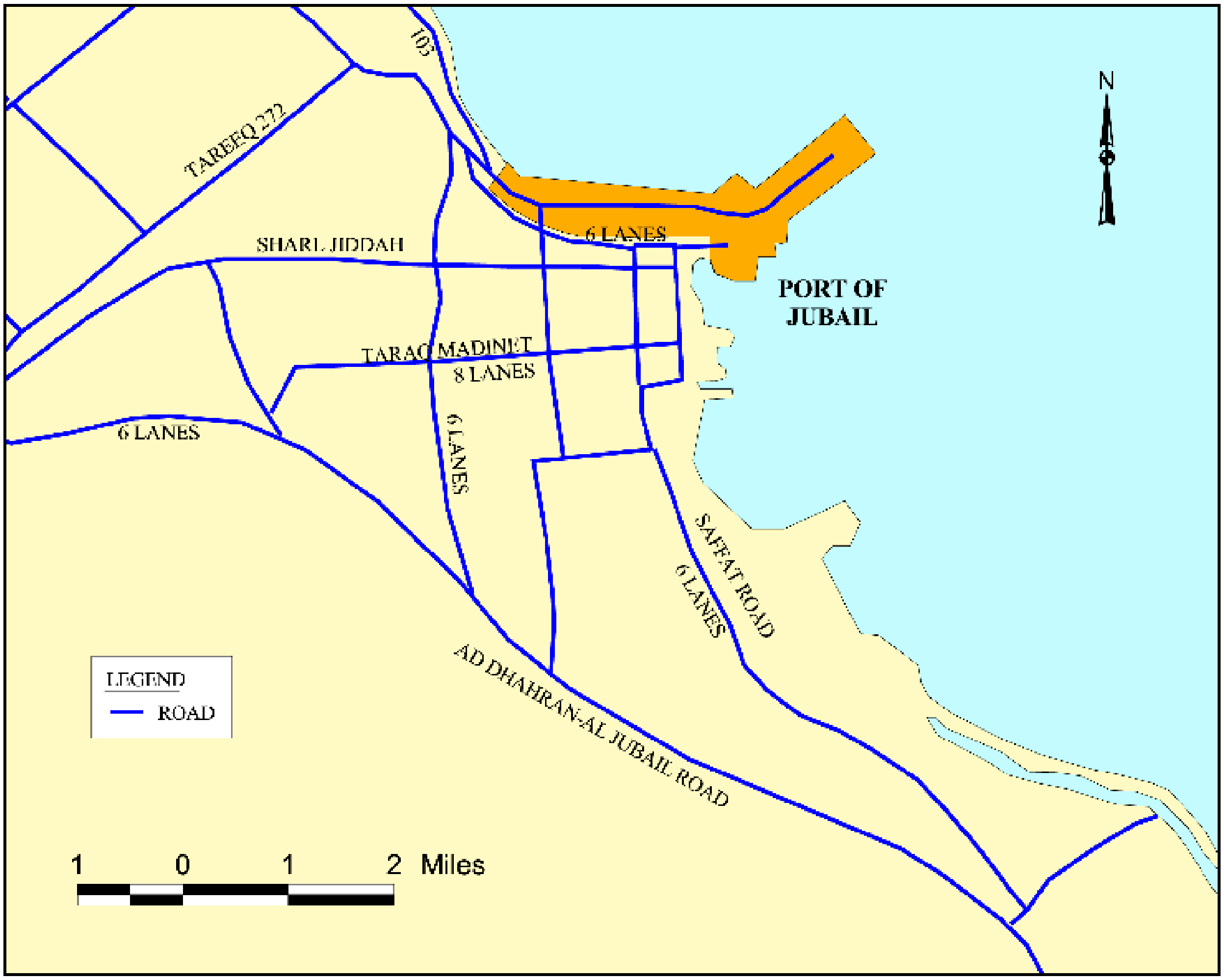
The nearest airport to the Port is Dhahran International Airport. This facility is south of Ad Dammam near the King Fahd Causeway to Bahrain. The distance to the airport is about 65-70 miles south of Jubail. This airport has a runway 12,467 feet long and 197 feet wide and can handle C-5 aircraft. In the future, another airport will be available northwest of Ad Dammam. No information is available on this airport at this time. Another option is the Jubail Naval Air Station about 2-3 miles south of the port. This facility can also handle C-130 aircraft.

Rail

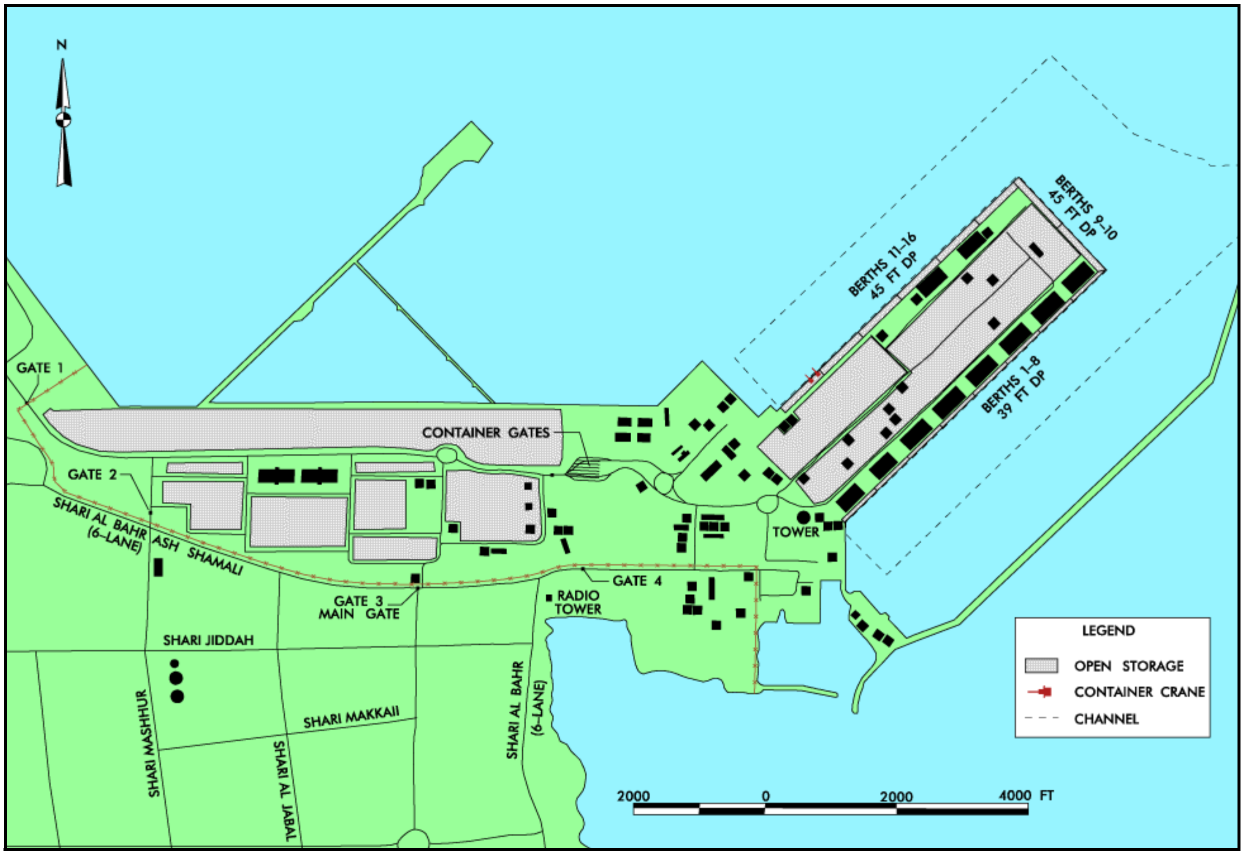
Currently, the Port of Jubail does not have rail access. Distant future plans may have a spur going to this area, but no information is available at this time.



Highway and Air Access Map to the Port of Jubail



Vicinity Map of the Port of Jubail



Land-Use Map of the Port of Jubail

PORT FACILITIES

Berthing

The Port of Jubail is on reclaimed land. All 16 berths can support military operations. Water depths vary from 39 feet (12 meters) for Berths 1-8 to 45 feet (14 meters) alongside Berths 9-16. Berths 1 and 2 are generally reserved for the floating crane and visiting ships; Berths 3-10 and 13-14 are general cargo berths; Berths 11-12 are generally used for discharging bulk grains; and Berths 15 and 16 are used for container and RORO operations. Some of the general cargo berths are equipped with wharf cranes; however, these cranes have a capacity of 6 metric tons (6.6 STON), and are not considered to be military useful. Bulk cranes are on Berths 11 and 12. Transit sheds are along Berths 1-8 and 11-14. These sheds can accommodate general breakbulk cargo, but are far enough from the edge of the apron that they do not obstruct RORO operations. The apron height is 16 feet above LAT and approaches the maximum for conducting RORO operations. Other berth information is provided in the table below.

CHARACTERISTICS OF THE PORT OF AL JUBAIL

Characteristics	Berths			
	1-8	9-10	11-14	15-16
Length (ft) (m)	5,576 (1,700)	1,968 (600)	3,280 (1,000)	1,640 (500)
Depth at LAT (ft) (m)	39 (12)	45 (14)	45 (14)	45 (14)
Deck Strength (psf) (tonne/sq m)	614 (3)	614 (3)	614 (3)	614 (3)
Apron width (ft) (m)	Open	Open	Open	Open
Apron height above LAT (ft) (m)	16 (5)	16 (5)	16 (5)	16 (5)
Number of Container Cranes	0	0	0	2
Number of Wharf Cranes (military useful)	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	Yes
Apron length served by rail (ft)	0	0	0	0

SUMMARY OF BERTHING CAPABILITIES FOR THE PORT OF AL JUBAIL						
Vessels		**Berths**				
TYPE	**CLASS**	**1-8**	**9-10**	**11-14**	**15-16**	
BREAKBULK	C3-S-38a	10	3	6	3	**NOTES:**
	C4-S-58a	9	3	5	2	
	C4-S-66a	9	3	5	2	The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.
	C5-S-37e	9	3	5	2	
SEATRAIN	GA and PR	9	3	5	2	
BARGE	LASH C8-S-81b	6	2	3	1	
	LASH C9-S-81d	6	2	3	1	The letters in the columns to the left indicate limitation as described below.
	LASH Lighter	27	9	16	8	
	SEABEE C8-S-82a	6	2	3	1	
	SEABEE Barge	27	9	16	8	
RORO	COMET	10,d,i	3,d,i	6,d,i	3,i	a-vessel draft limit
	METEOR	9,d,i	3,d,i	5,d,i	2,i	b-inadequate apron width
	Cape Gnome	8,d,i,j	3,d,i,j	5,d,i,j	2,i,j	c-inadequate berth length
	C7-S-95A	7,i	2,i	4,i	2,i	d-no straight stern ramp
	Cape Taylor	8,i	2,i	4,i	2,i	e-no container handling equipment
	Cape Orlando	8,i	2,i	4,i	2,i	f-anchorage depth OK, berth depth inadequate
	MV Ambassador	9,d	3,d	5,d	2,m	g-inadequate channel depth
	Callaghan	7,d,i	2,d,i	4,d,i	2,i	h-no shore based ramps
	Cape Lambert	7,i,j	2,i,j	4,i,j	2,i,j	i-low tide insufficient ramp clearance
	LMSR Class	5	2	3	1	j-high tide insufficient ramp clearance
	FSS	5	2	3	1	
	Cape E-Class	8,i,j	2,i,j	4,i,j	2,i,j	k-excessive ramp angle low tide
	Cape D-Class	7,i	2,i	4,i	2,i	m-excessive ramp angle high tide
	Cape H	7,i	2,i	4,i	2,i	n-parallel ramp operation ONLY
RORO	Cape Texas	8,i	2,i	4,i	2,i	o-insufficient apron width for side ramp
	Cape R	8,d	2,d	4,d	2,i	Ramp clearance and angle based on maximum vessel draft
	Cape I-class	7,i	2,i	4,i	2,i	
	Cape Victory	8,i	2,i	4,i	2,i	
CONTAINER	C6-M-147a	8,e	2,e	4,e	2	♦ May Prevent Operation
	C7-S-69c	8,e	2,e	4,e	2	
	C7-S-68c	7,e	2,e	4,e	2	
	C8-S-85c	6,e	2,e	3,e	1	♦ May Limit Operation
	C9-M-132b	6,e	2,e	3,e	1	
	C9-M-F141a	5,e	2,e	3,e	1	
TACS	C6-S-1qd	8	2	4	2	
	C5-S-MA73c	8	3	5	2	
	C6-S-MA60d	8	2	4	2	
MPS	C7-S-133a	6	2	3	1	
	Maersk	7	2	4	2	
	AmSea	7	2	4	2	

STAGING

Open Staging

The Port of Jubail has about 333 acres of paved open storage, 111 acres is inside the customs area. The rest is still inside the port, but outside the customs area. The staging is distributed throughout the port. Only about five percent of this open storage is used on a daily basis. Clearing the port will not be a problem during a contingency. Most of the open storage areas are compatible with helicopter operations; however, the best option is to use the open storage areas inland of the berth transit sheds.

Open Staging at the Port of Jubail

Covered Storage

The port has 10 transit sheds with a total of 936,468 square feet (87,000 square meters) of storage space. These sheds are located on Berths 1-8 and 12 and 13. The port also has a container freight station with 92,570 square feet (8,600 square meters) of open storage. Other covered storage includes a dangerous goods storage facility with 19,375 square feet (1,800 square meters) of storage.

Highway

The port has a total of four gates. The number of lanes at each gate are as follows: Gate 1, 2 in/2 out; Gate 2, 3 in/3 out; Gate 3 (main gate), 2 in/2 out; and Gate 4, 2 in/2 out. Roads inside the port are free of congestion. All the roads within the port are in good condition and have no restrictions on weight or height.

Main Gate to the Port of Jubail

UNLOADING/LOADING POSITIONS

Ramps and Docks

The port does not have any end ramps and truck docks at the transit sheds are surface level only.

Off-Port Marshaling Areas

The 222 acres of paved open storage area outside the customs area are ideal for off-port staging. This storage area is generally unused on a day-to-day basis.

MATERIALS HANDLING EQUIPMENT (MHE)		
MHE Type	**Capacity STON (tonne)**	**Quantity**
Container Cranes	44 (40)	2
Transtainers	33.6 (30.5)	3
Container Handlers	38.5 (35)	3
Floating Crane	220 (200)	1
Mobile Cranes	60 (55)	3
Mobile Cranes	30 (36)	3
Note: The table represents equipment owned by the port. Port operators indicate that other equipment is available from local stevedores.		

Floating Crane at the Port of Jubail

AMMUNITION HANDLING FACILITIES

The port is capable of handling ammunition; however, these type of operations must be coordinated and approved by appropriate Saudi Arabian safety offices and the port authority.

PETROLEUM, OILS AND LUBRICANTS (POL)

Bunker fuel oil, marine diesel, and marine gas oil are available.

FUTURE DEVELOPMENT

Because of limited use of the port, the port authority does not plan any future development at this time. The completion of the new airport, just north of Ad Dammam will provide a commercial airport closer to the Port of Jubail instead of the current Dhahran International. No information is available regarding the completion date for this airport.

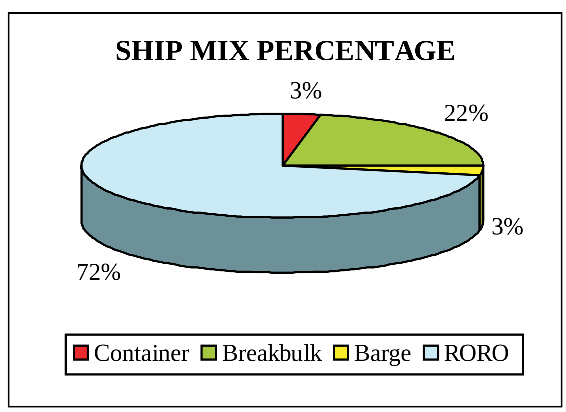
III. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Al Jubail. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal reception/handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and measurement tons (MTON) per day. The charts in this section show the throughput yields in STON.

Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 70 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

Highway

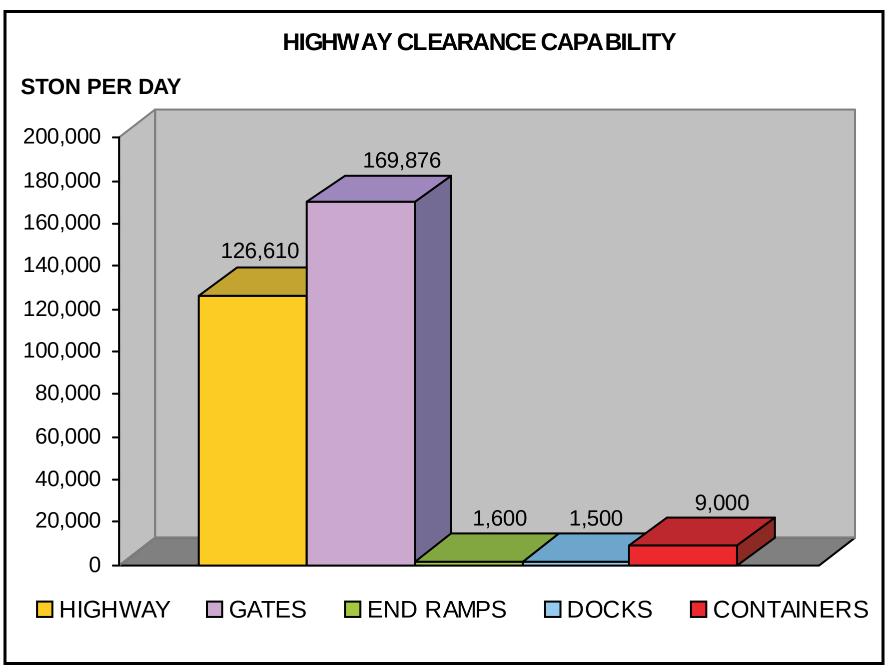
The Shari Al Bahr Ash Shamali, which connects to Route 103, and the Shari Jiddah, which eventually connects to the Dhahran-Al Jubail superhighway, are the major roadways connecting the port to the superhighways. Both of these roads are six-lane highways. Four gates provide access to the port. The major port roadways are six-laned. The two major highways can handle over 126,600 STON of cargo per day. The gates can handle almost 170,000 STON of cargo per day. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or exit the port on each lane of the highway.

Roadable vehicles will either process to an off-port marshaling area or to hardstand marshaling areas within the port, but outside the customs area. Vehicles requiring transport on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps within the terminal. If not available, deploying units/military port operator must either build or acquire the necessary ramps. For this study, we assumed one truck end ramp would be constructed for loading operations. This ramp can handle 1,600 STON of military vehicles and equipment per day.

The port has 10 transit sheds on Berths 1-8 and 12-13. All truck docks are surface level only. Each transit shed has about four loading positions on the inland side of the sheds. These docks can load/unload almost 1,500 STON of shipped material per day.

The Port of Jubail has three transtainers and three container handlers available. The port can handle at least 9,000 STON of containerized equipment and supplies per day.

Maximum daily handling capability for the port is a mixed total of the three types of handling (docks, end ramps, and containers), each up to its maximum, not to exceed the daily highway clearance capability of 126,600 STON.



Staging

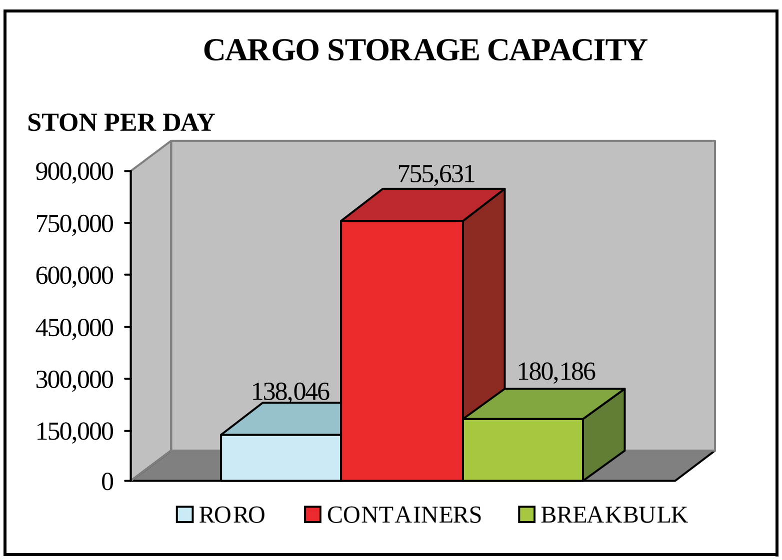
The port has 333 acres of paved open staging area. Virtually all of this area is available on a daily basis. Therefore, we assumed a facility use factor of 100 percent.

The port lists 936,468 square feet of covered storage space. About 18,700 STON of breakbulk cargo can be staged in the covered area per day.

The chart on this page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of each involved capability should be assumed. Based on the daily throughput capability for both mixed shipping and mixed staging, the port has the capability to store almost 6.5 days of cargo for shiploading.

The chart below shows the STON of cargo, by type, the port can expect to handle. The container storage throughput capability is the highest with over 755,600 STON per day. This equates to well over 94,000 twenty-foot equivalent units (TEU). The RORO storage throughput is over 138,000 STON. This equates to over 63 acres of storage space or about 16,240 pieces of equipment. The breakbulk staging throughput is about 180,200 STON per day.

Container Gantry Cranes at the Port of Jubail



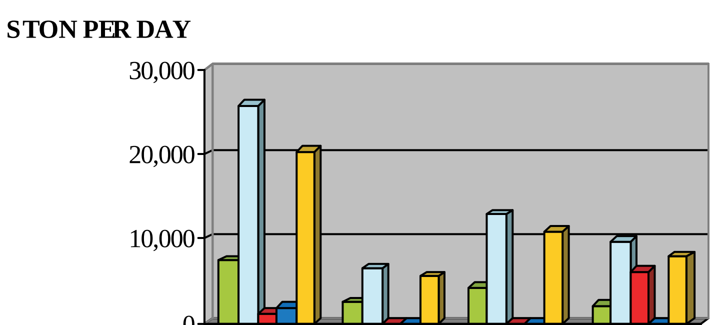
Shipping

Daily shipping subsystem totals for the terminal berths are catalogued in the chart below. They are based on various factors including MHE availability, loading, operational and berth usage; and berthing capabilities for various vessel types.

Any of the 16 ship berths can be used for RORO operations. When using Berths 11 and 12, ensure the bulk cranes are out of the way and the wharf is free of bulk cargo. Berths 1-8 and 12 and 13 have immediate access to transit sheds. All berths have immediate access to ample paved open storage.

Berths 11-16 at the Port of Jubail
(Container Cranes at Berths 15-16 are in the Background)

BERTH THROUGHPUT FOR PORT OF JUBAIL (JUBAYL)



	1-8	9-10	11-14	15-16
BREAKBULK	7,354	2,477	4,219	2,128
RORO	25,805	6,451	12,902	9,676
CONTAINER	1,160	0	0	6,096
BARGE	1,806	0	0	0
MIXED	20,285	5,520	10,869	7,853

DAILY THROUG HPUT SUMMARY				
Berth	**1-8**	**9-10**	**11-14**	**15-16**
Length (ft) **(m)**	5,576 (1,700)	1,968 (600)	3,280 (1,000)	1,640 (500)
Depth Alongside (ft) **(m)**	39 (12)	45 (14)	45 (14)	45 (14)
Breakbulk Throughput (STON) **(MTON)**	7,350 (18,390)	2,480 (6,190)	4,220 (10,550)	2,130 (5,320)
RORO Throughput (STON) **(MTON)**	25,800 (103,220)	6,450 (25,800)	12,900 (51,610)	9,680 (38,710)
RORO Square Feet [1]	516,000	129,000	258,000	193,600
RORO Pieces[2]	3,035	759	1,518	1,139
Container Throughput (STON) **(MTON)**	1,160 (2,900)	0	0	6,100 (15,240)
Container Throughput (TEU)	145	0	0	762
Barge Throughput (STON) **(MTON)**	1,810 (4,520)	0	0	0
Mixed Throughput (STON) **(MTON)**	20,290 (75,580)	5,520 (21,210)	10,870 (42,000)	7,850 (30,410)

[1] Based on the 20 square foot-per-STON average accomplished during Operation Desert Shield/Storm.
[2] Based on the 170 square foot-per-piece average accomplished during Operation Desert Shield/Storm.

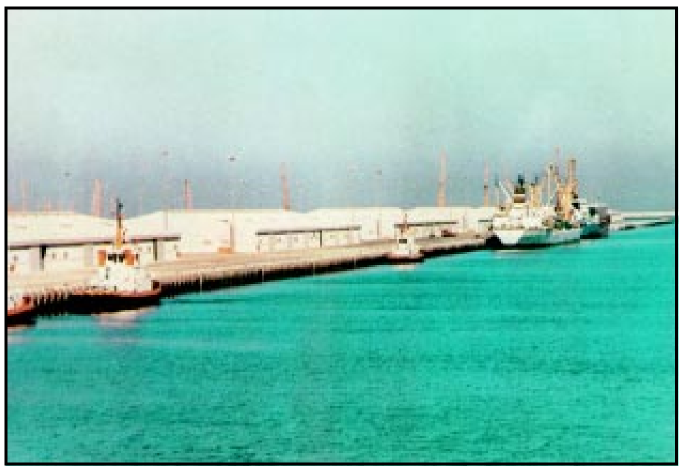
SUMMARY

The port is multioperational with the capability to handle all types of vessels: container, RORO, breakbulk, and barges.

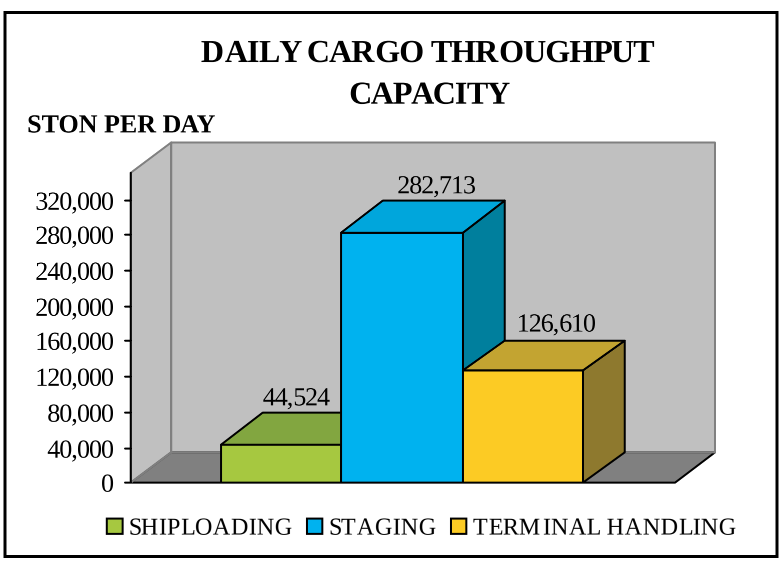
The Port of Al Jubail is fully capable of supporting U.S. Military deployment operations. Most shiploading must occur using mobile cranes and/or ship cranes. The port has a large 220 STON floating crane and 6 mobile cranes (3 @ 60 STON and 3 @ 39 STON) to support lift off operations. Any other mobile cranes needed for lift off operations must come from local stevedores. The port can conduct container operations using the two container cranes for offloading ships and the three container gantries and three container handlers for container handling.

The port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of at least 44,500 STON.



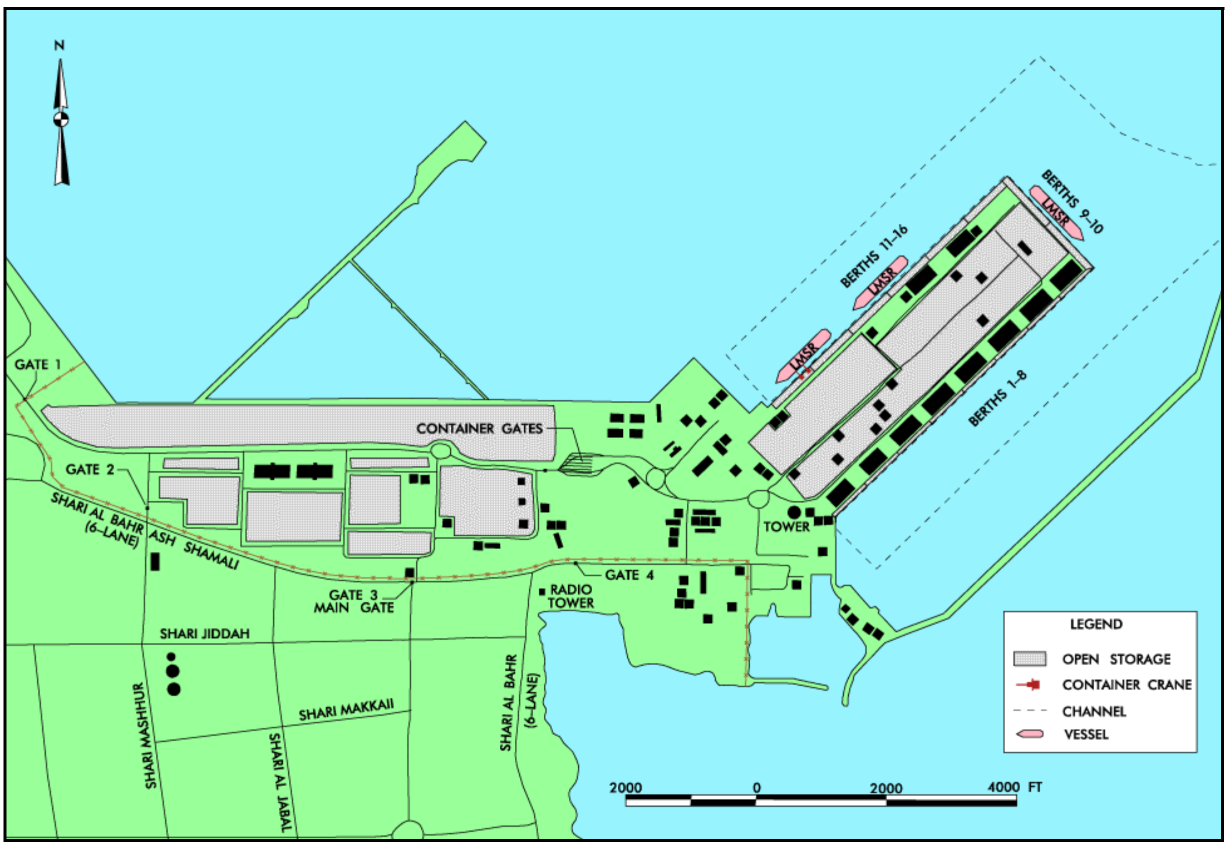
Berths 1-8 at the Port of Jubail



IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored division using primarily LMSR vessels. We also address the capability for the port to handle a deployment via FSS ships. We assume that no other military units will be competing for these facilities during the time that the armored division occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately load the ship and clear the port. Berths 9-10, 13-14, and 15-16 are used for this analysis.



Potential Port Use During Deployment at the Port of Jubail

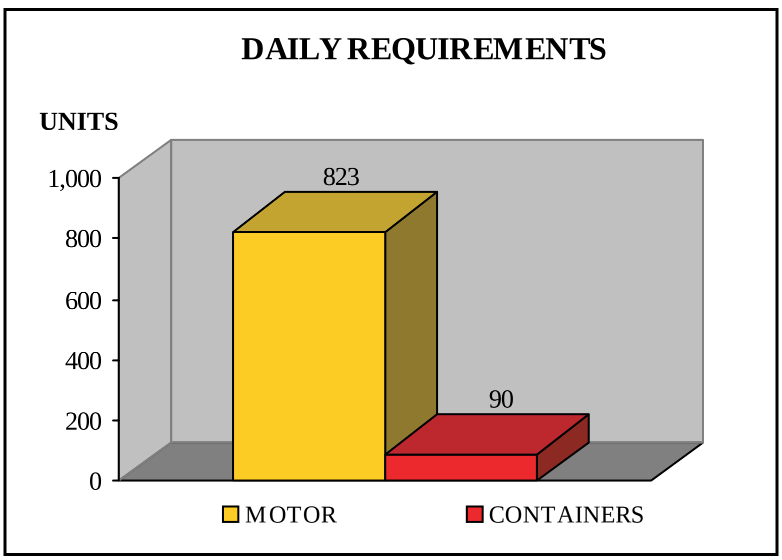
REQUIREMENTS

To simulate a likely requirement for the Port of Al Jubail, we deployed a notional armored division, using 6 days for ship offloading and port clearance. The division has to move about 8,125 vehicles and 520 containers. Movement of the division through the port will require 367 40-foot flatbeds and 1,189 HETs using a convoy/motor option for transport to the port. These numbers equate to 823 vehicles (some towing trailers or semitrailers) per day passing through the gates and proceeding inland. About 90 containers would arrive daily.

TOTAL EQUIPMENT	
Volume	287,175 MTON
Weight	101,350 STON
Area	1,484,650 SQ FT
Vehicles	8,125*
Containers	520

*Includes towed, tracked, aircraft, and other nonroadable equipment.

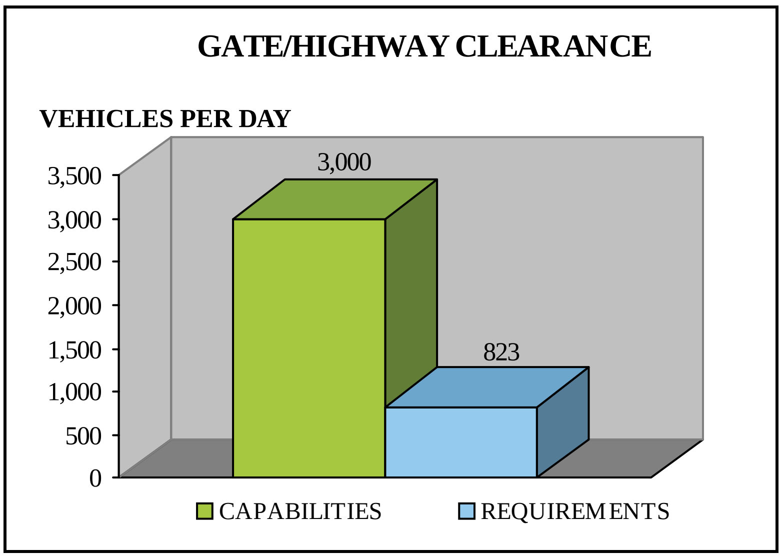
Note: *MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997*



TERMINAL INPROCESSING/HANDLING

Highway

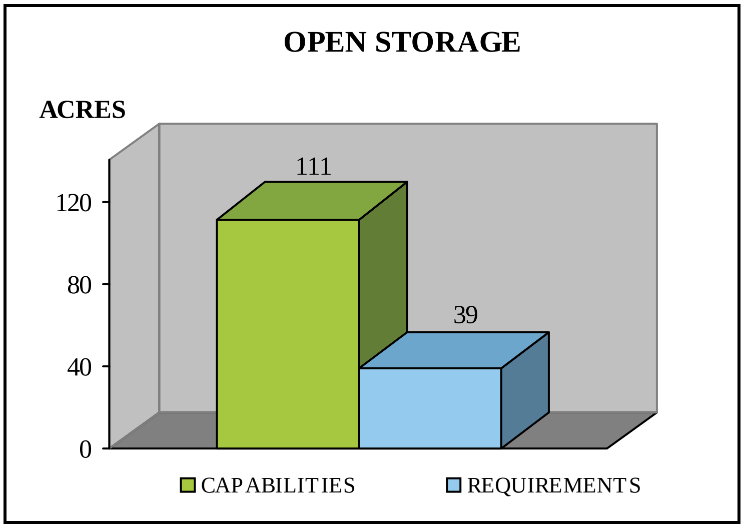
The port has two gates that allow military vehicles and equipment to access major roadways in the Jubail area. Two lanes of one of these gates can accommodate 3,000 military vehicles per day, which is more than sufficient to meet the requirement. Assuming a constant flow rate of vehicles out of the gates of the port, the daily clearance requirement is under 900 vehicles. The Jubail network can easily support the requirement to clear the armored division in 6 days.

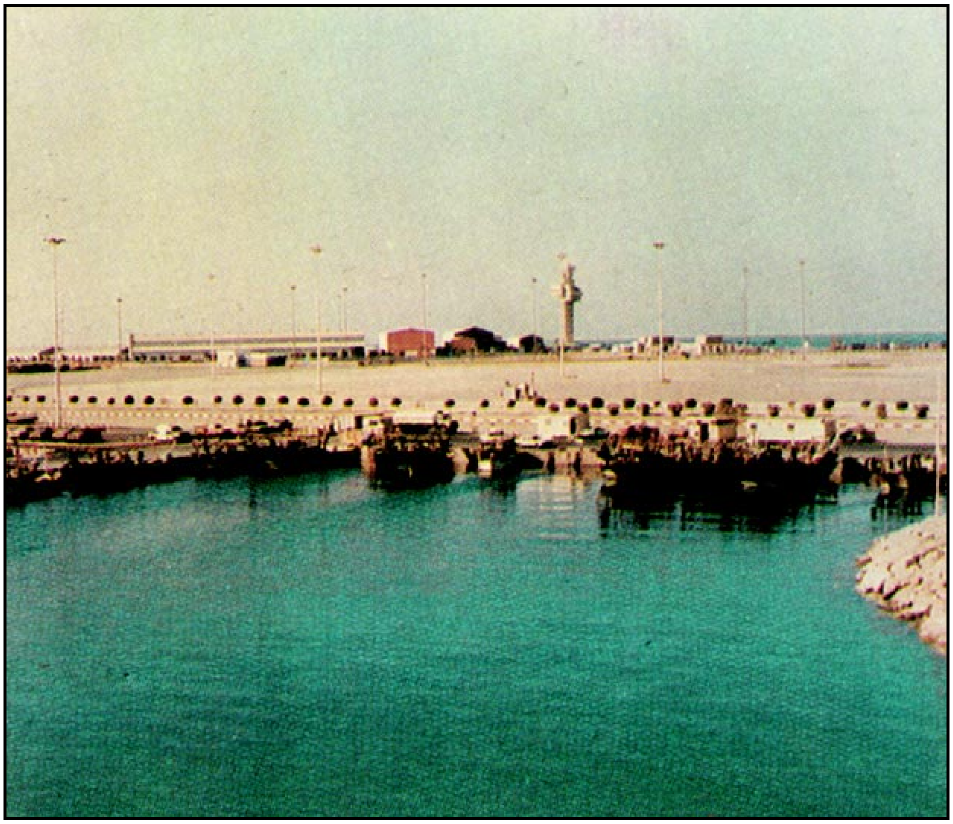


Open Storage

The Port of Jubail has 333 acres of paved open storage. Virtually all of this paved open storage is available from day-to-day. Marshaling the entire division of equipment (1,484,636 square feet) requires 85 acres (factor of 2.5 to account for access to equipment, emergency lanes, maintenance areas, and so forth). Assuming that it takes 2 days to offload and clear an LMSR load of equipment, a single LMSR (sustained operations) would require about 13 acres of paved open storage per day. This assumes that the flow off of the ship into the staging area and through the gate is constant and consistent. For a 3-LMSR simultaneous offloading operation, the open storage requirement is about 39 acres. For a 3-LMSR simultaneous loading operation, the open storage requirement is 75 acres (25 acres per LMSR and includes areas for maintenance, access, and so forth). In either case, the paved open storage in the customs area alone (over 111 acres) is enough to handle the requirement.

A single FSS requires about 10 acres of paved open storage per day. A three-FSS simultaneous offloading operation requires about 30 acres. A three-FSS simultaneous loading operation requires about 48 acres (16 acres per ship) of open storage and is generally less stringent than LMSR operations.





Paved Open Storage at the Port of Jubail

Shipping

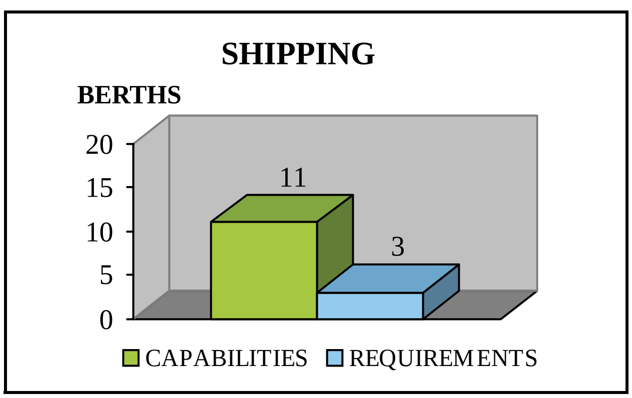
Based on the NASSCO New Construction design LMSR ships, a division requires slightly less than six ships to transport a division. Unloading RORO vessels this size can be done in less than 2 days.

Using the LMSRs to transport the division, the three berths (9-10, 13-14, and 15-16) can easily meet the 6-day offloading requirement. Based on each LMSR being able to conservatively off-load in about 2 to 3 days, the six required LMSRs can be offloaded in 4 to 6 days. Berth space is adequate to allow the side and stern ramps on the LMSRs to be used to offload equipment. If smaller ships are used to deploy the division, then additional time or berths will be required to off-load. A scenario using all FSS vessels plus three Cape H vessels will put the offloading capability at about 6 days.

SHIP REQUIREMENTS
NOTIONAL ARMORED DIVISION

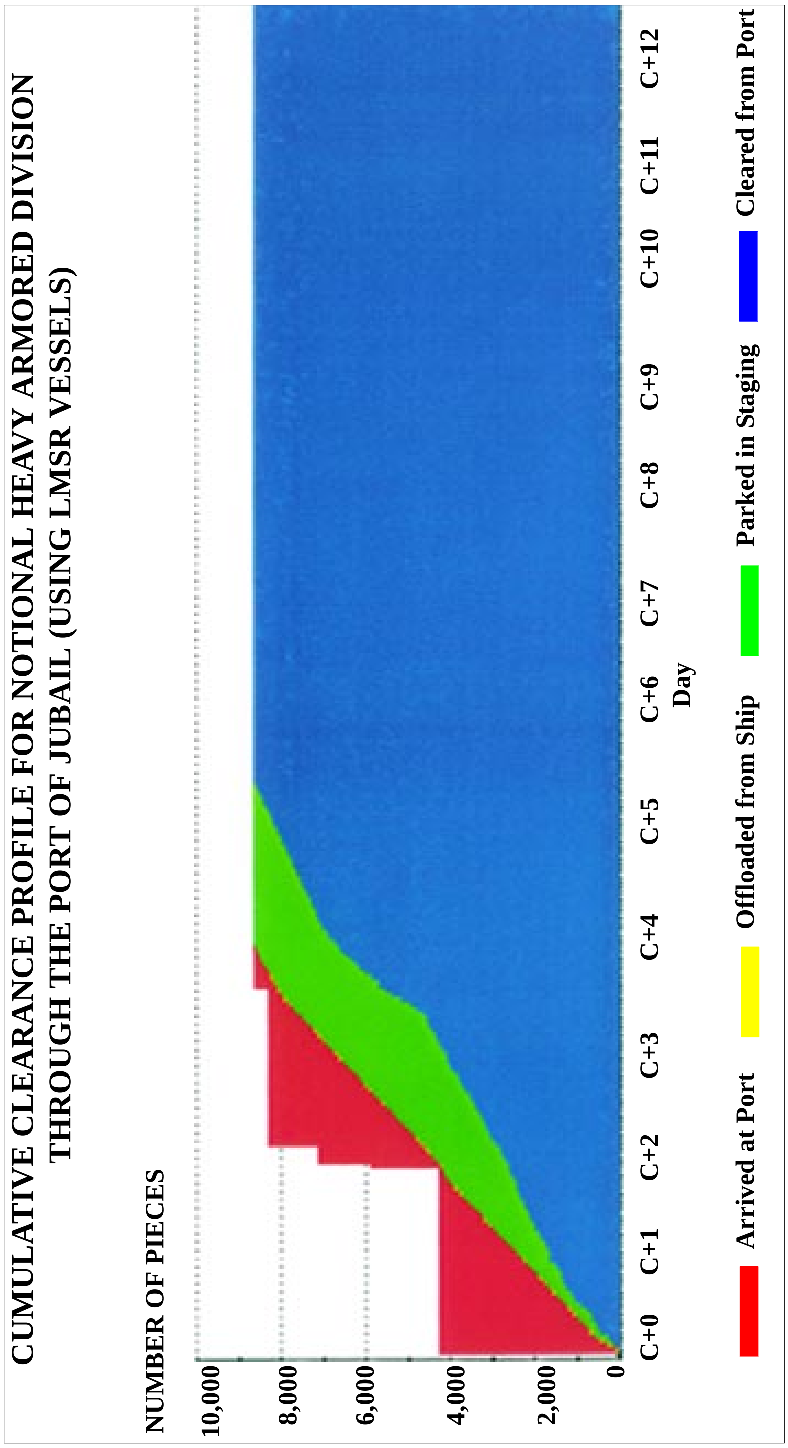
Loading Condition/ Sample Ship Mix	FSS (RORO/ Comb)	LMSR (RORO/ Comb)	C3/C4 (Breakbulk or Containers)	C6/C7/C8 (Container)
Minimum Containerization				
All FSS	9.6			
All LMSR		5.9		
All Breakbulk			29.8	
Maximum Containerization				
FSS/Container	2.9			4.9
LMSR/Container		1.8		4.9
Breakbulk/Container			9.0	4.9

Legend:
RORO – roll-on/roll-off
FSS – fast sealift ship
LMSR – large medium speed roll-on/roll-off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

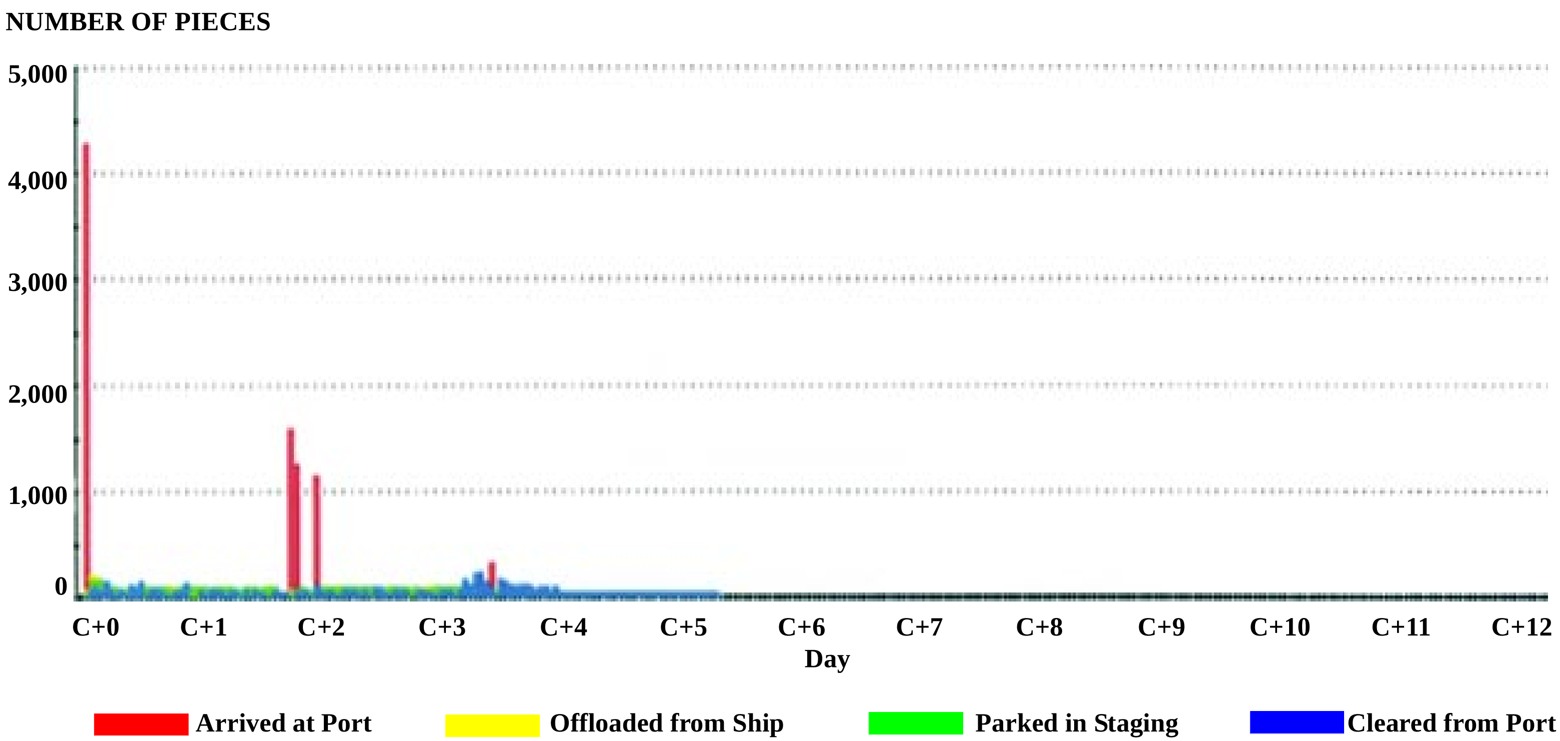


SIMULATION RESULTS

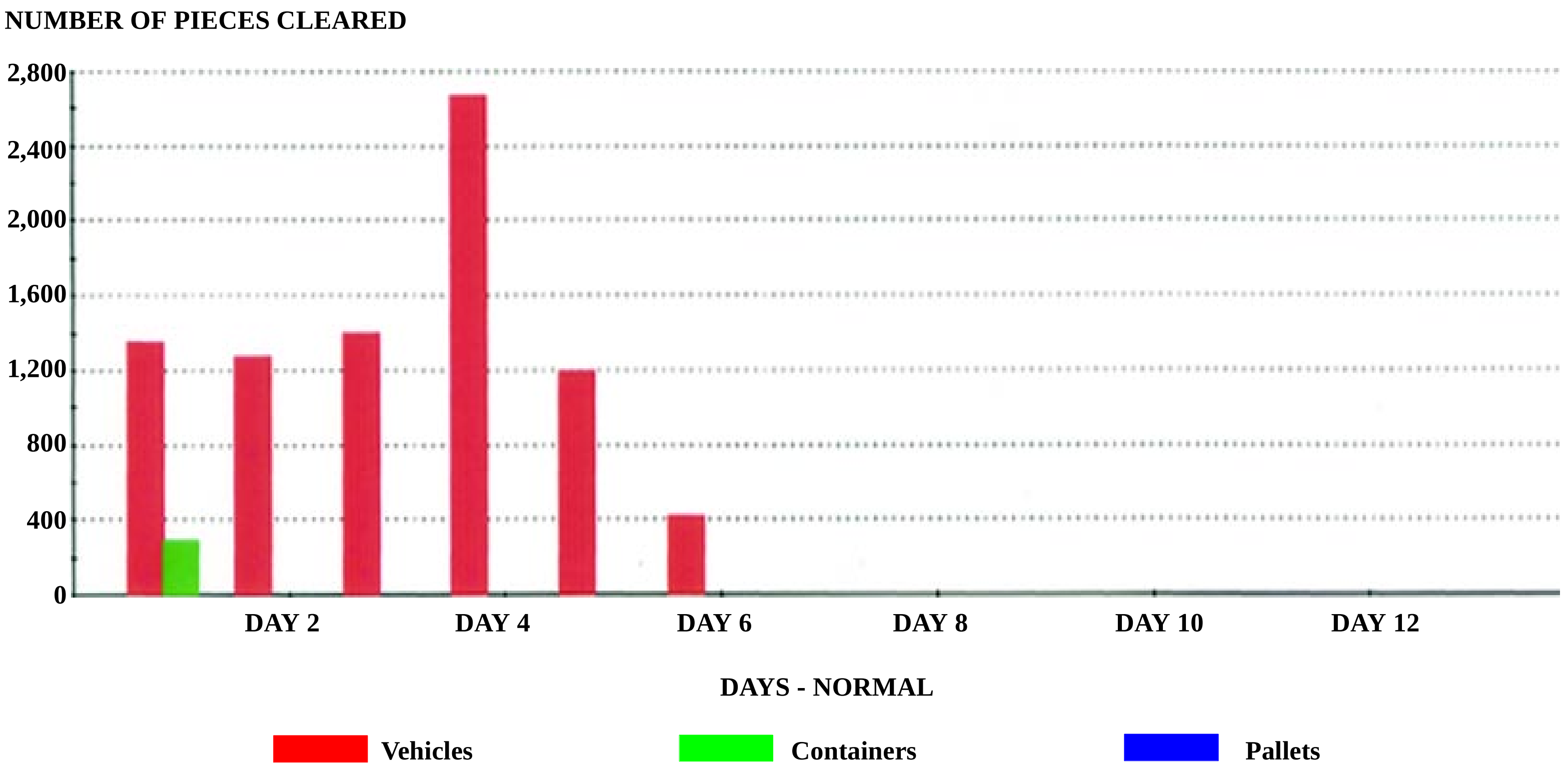
Total deployment time for the division is about 5 days, using LMSR vessels. Total deployment time for the division using FSS vessels is about 6 days. Actual throughput and closure results are shown in the following graphs.



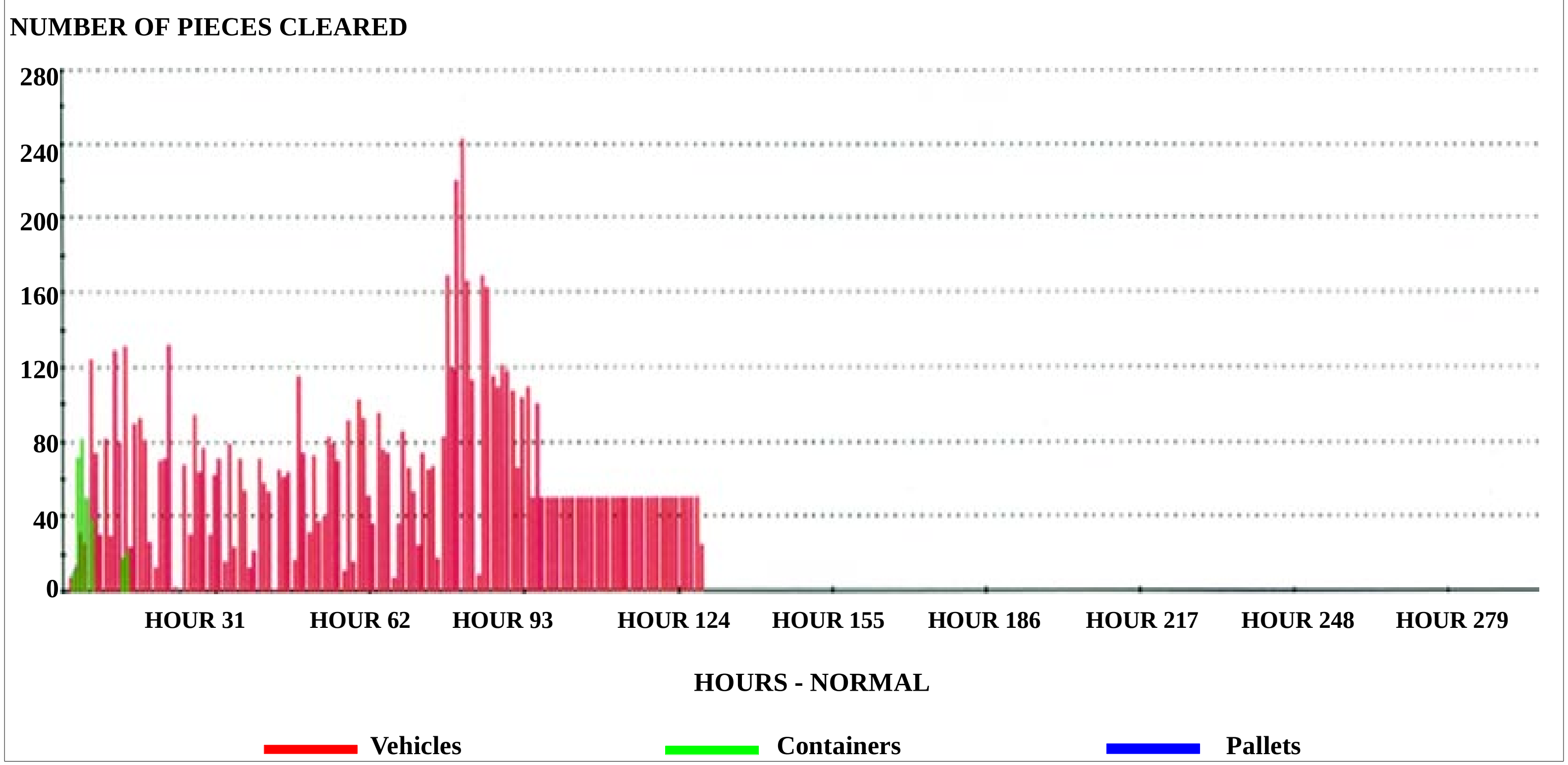
DAILY CLEARANCE PROFILE FOR NOTIONAL HEAVY ARMORED DIVISION THROUGH THE PORT OF JUBAIL (USING LMSR VESSELS)



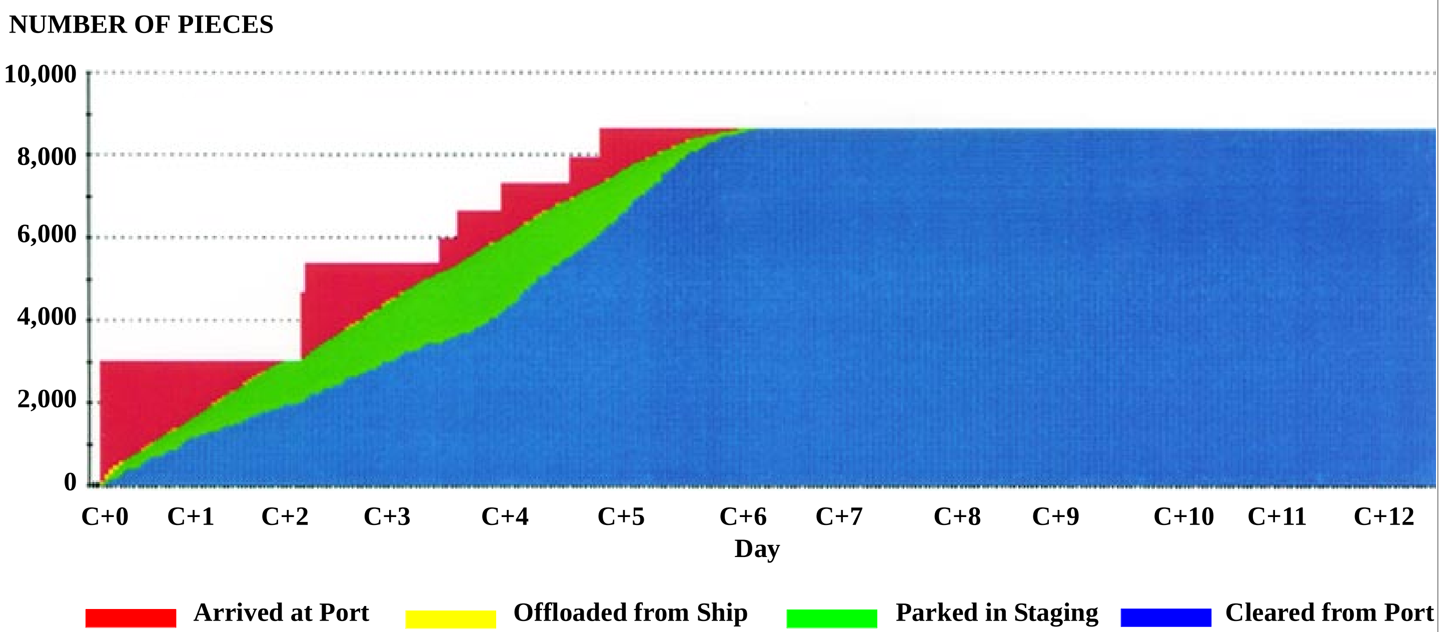
DAILY THROUGHPUT FOR NOTIONAL HEAVY ARMORED DIVISION AT THE PORT OF JUBAIL (USING LMSR VESSELS)



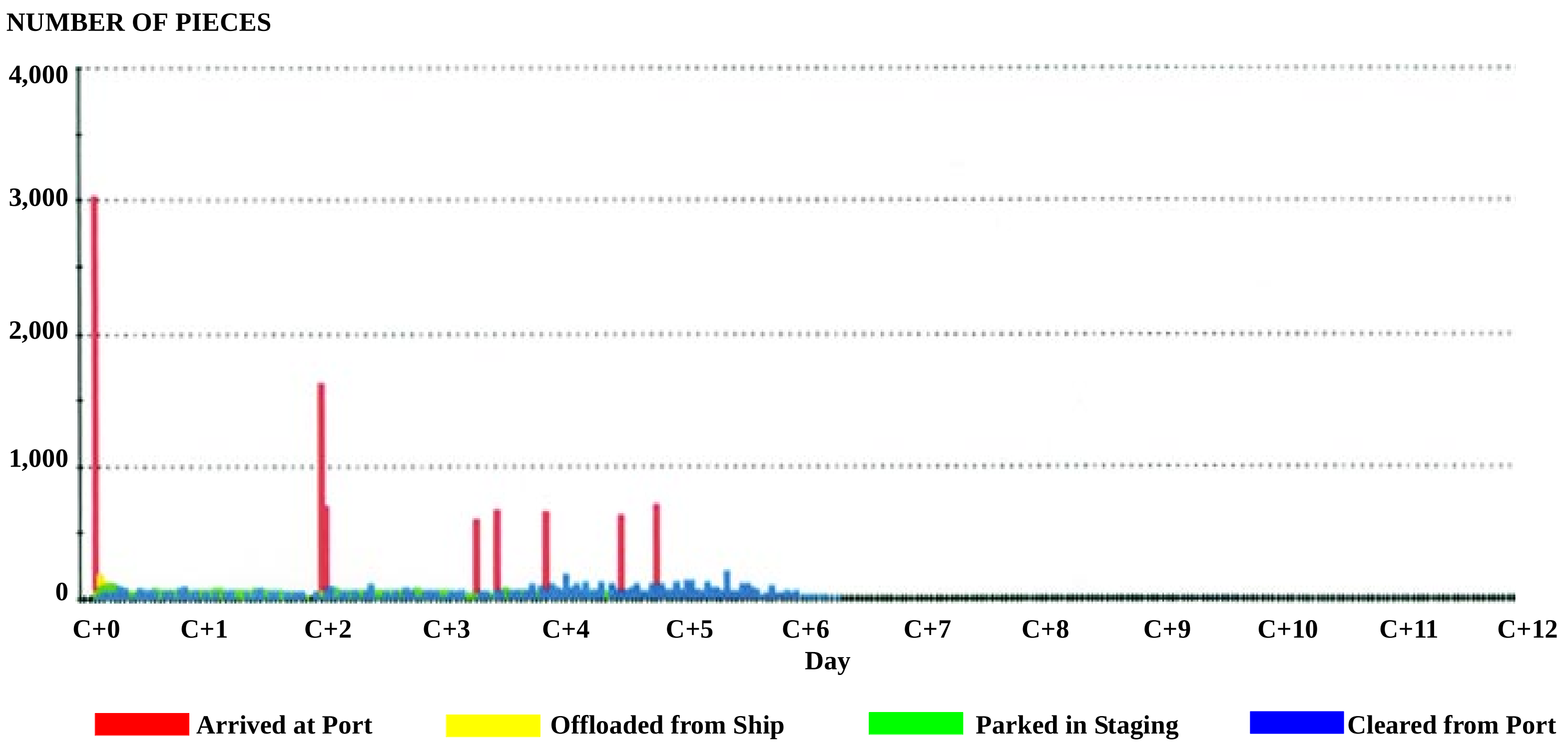
HOURLY THROUGHPUT FOR HEAVY ARMORED DIVISION THROUGH THE PORT OF JUBAIL (USING LMSR VESSELS)



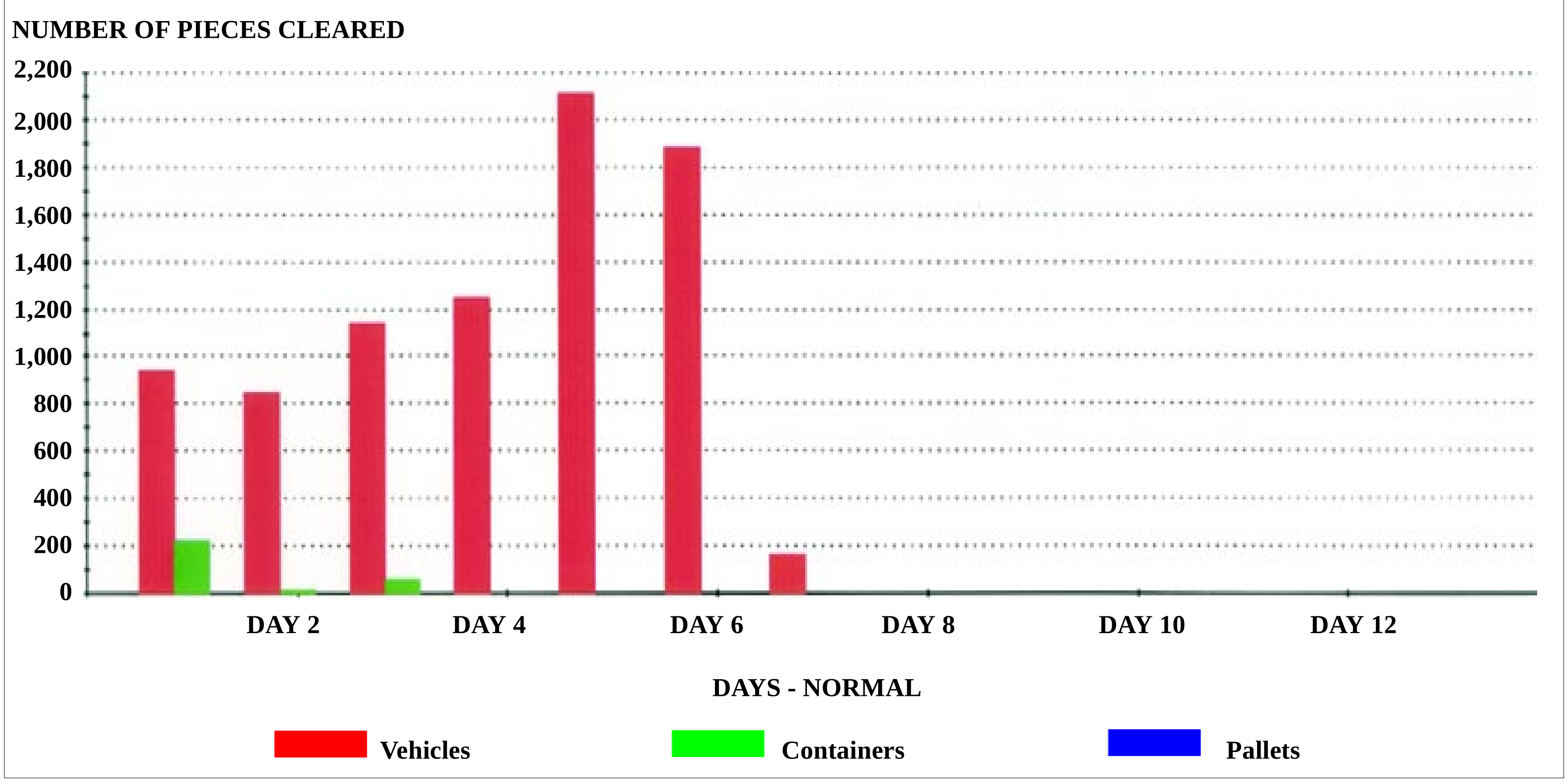
CUMULATIVE CLEARANCE PROFILE FOR NOTIONAL HEAVY ARMORED DIVISION THROUGH THE PORT OF JUBAIL (USING FSS VESSELS)



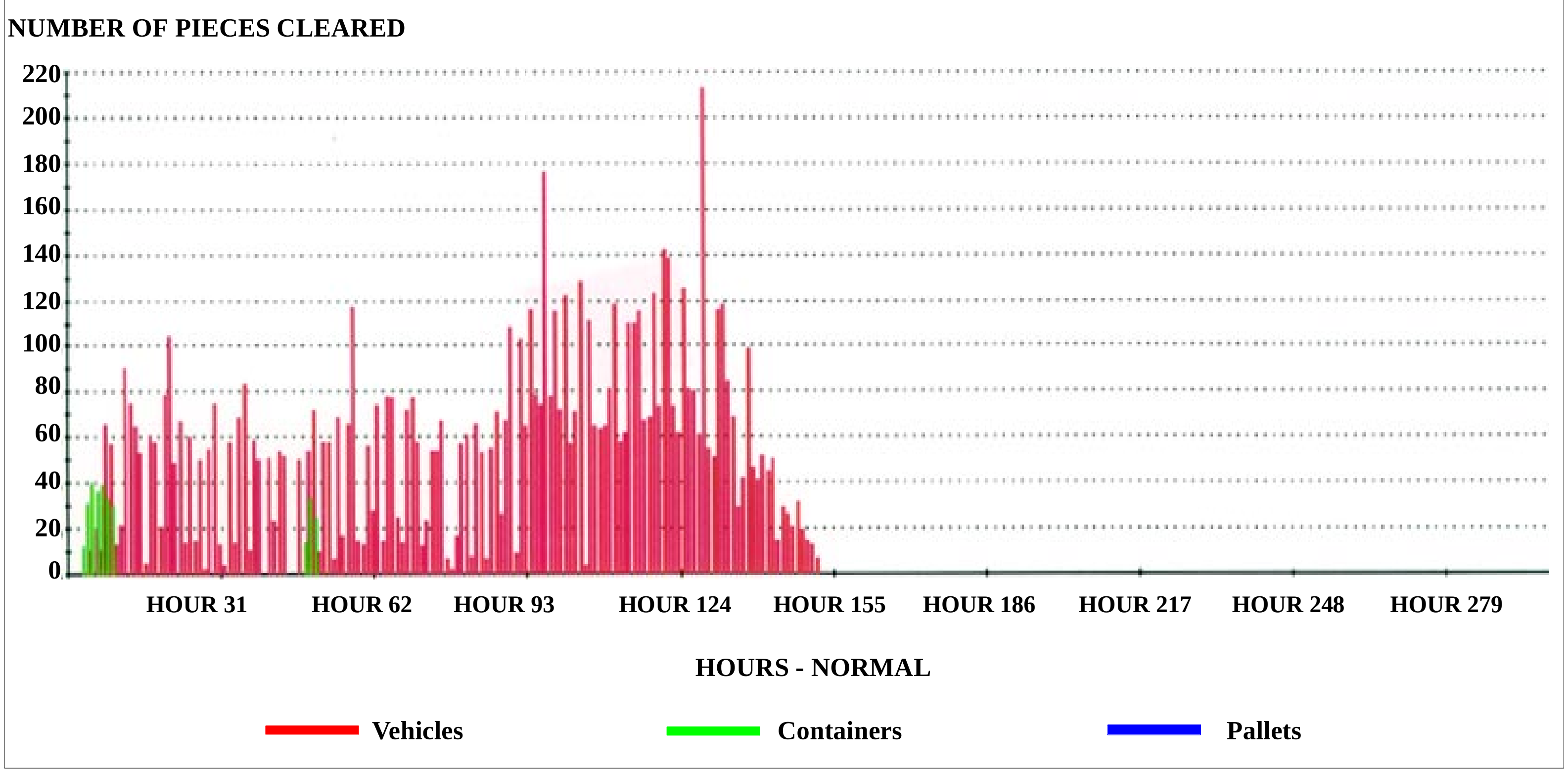
DAILY CLEARANCE PROFILE FOR NOTIONAL HEAVY ARMORED DIVISION THROUGH THE PORT OF JUBAIL (USING FSS VESSELS)



DAILY THROUGHPUT FOR NOTIONAL HEAVY ARMORED DIVISION AT THE PORT OF JUBAIL (USING FSS VESSELS)



HOURLY THROUGHPUT FOR HEAVY ARMORED DIVISION THROUGH THE PORT OF JUBAIL (USING FSS VESSELS)



SUMMARY

The Port of Al Jubail can offload and clear a notional armored division within 5 days using three berths in the port and six LMSR ships. Using eight FSS and three Cape H ships, port clearance can be achieved in roughly 6 days. The difference in closure times between the LMSR and FSS scenarios is due to the additional berthing times for five extra ships. Using additional ship berths can place closure times well within the 6-day requirement. If other ships are used, additional berths may be required to meet deployment requirements.

The port is viable for supporting deployment of a notional armored division. The lack of mobile cranes may contribute to delays in meeting deployment requirements for a notional armored division if local stevedores cannot supplement the MHE already available at the port.

Berths 1-8 at the Port of Jubail

PORT OF JEBEL ALI
UNITED ARAB EMIRATES

I. EXECUTIVE SUMMARY

GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Jebel Ali, United Arab Emirates (UAE), based on a site visit in December 1997. The port can accommodate vessels as large as the LMSR and FSS class vessels, and can support military operations.

The Port of Jebel Ali is a large multicargo and industrial facility in an otherwise undeveloped section of the UAE, about 23 miles southwest of Dubai. Although the port includes berths that are only suitable for bulk, POL, or shipbuilding operations, this report includes analysis of some 26,000 feet of militarily useful wharfage. The only rail-mounted cranes at the port are the 14 container cranes located at the container terminal, Berth 14-17. Seven berths can accommodate straight-stern ramp RORO vessels. The tidal variation is 3.7 feet. Berths range in depth from 37.7 to 45.9 feet at mean low water (MLW), with the deeper berths along the outer slip. This outer slip allows large FSS sized vessels to turn. Several berths have transit sheds.

Connector routes and the main highway are in very good condition. The country of UAE has no railroads.

THROUGHPUT

The port has a mixed throughput capability of 63,000 short tons (STON) per day. The RORO is 74,000 STON per day.

APPLICATION

The port is capable of handling a notional armored division in 6 days. Our analysis assumes three repetitions of two LMSR vessels, although the port can simultaneously berth seven fully loaded LMSR or FSS vessels. Only 35.7 acres of paved open area is required to support the division. The port has 170 paved open acres, 120 of which are at the container terminal, Berth 14-17.

II. GENERAL DATA

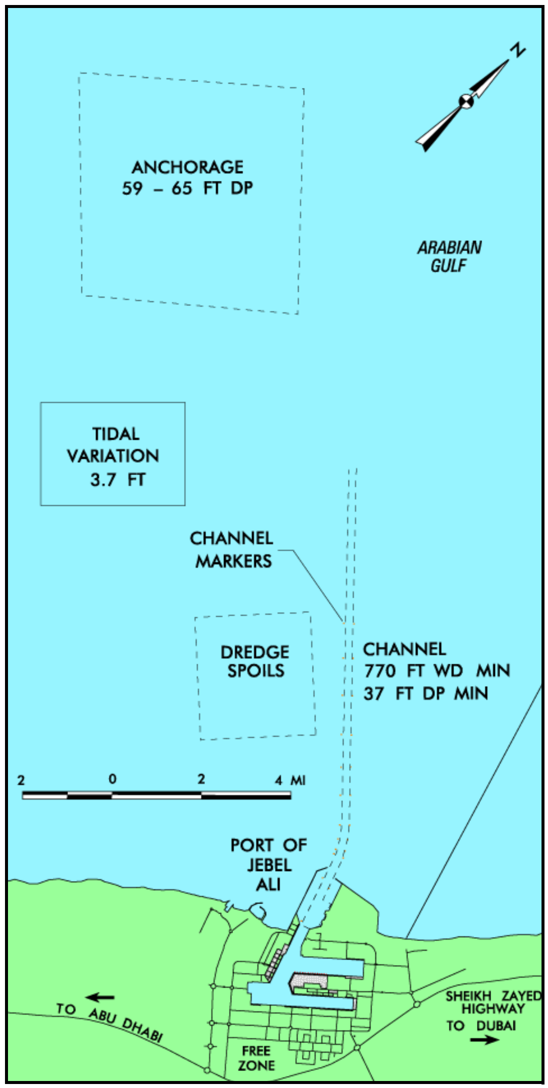
The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Jebel Ali, United Arab Emirates (UAE), based on a site visit on 8 December, 1997. We had support from the 831st U.S. Army Transportation Battalion, Southwest Asia and the U.S. Defense Attaché Office, UAE, Port Liaison Element. The visit included an interview with the Dubai/Jebel Ali Port Authority.

TRANSPORTATION ACCESS

Water

The Port of Jebel Ali (also known as Mina Jabal Ali) is a large multicargo and industrial facility in an otherwise undeveloped section of UAE. It is located at 24°59' N Latitude and 055°03' E Longitude about 23 miles (37 kilometers) southwest of Dubai. It is the world's largest reclaimed land harbor. The land immediately inland of the aprons of the port is the Jebel Ali free zone. This land is rapidly developing with private shipping, manufacturing, and service companies.

The port is about 9.2 miles (15 kilometers) from open water. The anchorage (outside the channel) is sandstone bottomed, and does not provide good holding. Channel depths begin at 49 feet (15 meters) with a width of 910 feet (280 meters). The most restrictive portion is 770 feet (235 meters) wide. As ships near the inner harbor, the channel becomes shallower with a depth of only 37 feet (11.5 meters).



Water Access to the Port of Jebel Ali

Pilotage is required with one of the nine pilots available. The port has three port-owned tug boats; two with 2,300 horsepower and bollard pulls of 30 tons, and one with 3,100 horsepower and 40 tons pull. Extra mooring boats and tugs can be made available with notice. The tidal variation is 3.7 feet (1.1 meters).

Highway

No unusual clearance or congestion problems exist on roads leading away from the berths to the main gate of the free zone. This gate routes vehicles onto the port access road, which connects to Sheikh Zayed Highway. This eight-lane highway directs traffic northeast to Dubai and southwest to Saudi Arabia. The speed limit is 75 miles per hour (120 kilometers per hour) except in urban areas. Overhead obstructions are 16.4 feet (5 meters) high. No congestion is on any of these roads. However, the traffic will likely increase as more businesses develop in the free zone and the surrounding area.

Highway and Air Access to the Port of Jebel Ali

Air

The Dubai International Airport is about 22 miles (35 kilometers) northeast of the port, on the east side of Dubai. The longest runway at this airport is 11,000 feet long and 150 feet wide. It is capable of handling C5A aircraft. The airport is one of the busiest in the world, with some 70 airlines, 300 daily flights, and 100 destinations.

Rail

The country of UAE has no rail, nor plans to develop a rail infrastructure.

PORT FACILITIES

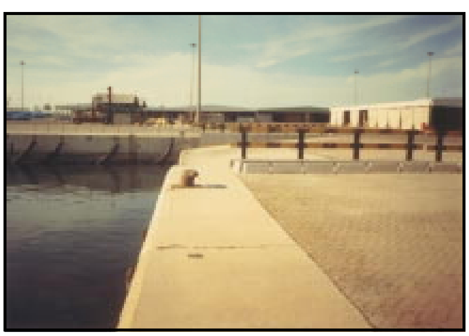
Berthing

Container Cranes at Berth 14-17 (eastward view)

The Port of Jebel Ali includes more than 9 miles (15 kilometers) of berthing space. Many berths are not yet operational for cargo loading. These are typically used to lay berth vessels such as U.S. aircraft carriers that routinely call at the unfinished Berth 12 for light repairs and crew R and R.

In addition to the port's extensive container terminal, the port also supports tankers at its various POL facilities, straight-stern RORO vessels, refrigerated cargo, and breakbulk ships.

TYPICAL BERTH USAGE		
Quay	**Berth(s)**	**Equipment and Typical Cargo**
1	1-4	Bulk alumina and grain
	5	Bulk sugar
	6-7	Repair and lay berth
2	8-9	POL, Tankers
3	10-11	General cargo
	12-13	Aircraft carrier
	14-17	Containers, 14 cranes
4A	18-19	Lay berth
4B	20-21	Lay berth
5	22-26	Repair and lay berth
	27-28	Navy stores from shed
	29-30	Breakbulk from shed
	31-32	Refrigerated cargo
	33	Breakbulk from shed, straight-stern RORO
6	34	POV RORO ops
7	35-42	Repair and lay berth
	43	Vegetable oil
	44-49	
	50	POL, Tankers
	51-54	Repair and lay berth
8	55-57	Ship repair yard
9	58-60	Repair and lay berth
10	61	Repair and lay berth
10	62-66	Breakbulk from sheds
West	67-	Tug boats, tower
East	-	Shallow lay berth
Tankers	TB1&3	POL, Tankers



RORO Ramp at Berth 33 (northwestward view)

Aerial View of the Port of Jebel Ali (Photo circa 1996)

BERTH CHARACTERISTICS															
Characteristics	**Berths**														
	6-7	**10-11**	**12-13**	**14-17**	**18-19**	**20-21**	**22-26**	**27-28**	**29-30**	**33**	**35-42**	**44-49**	**51-54**	**58-59**	**62-66**
Length (ft)	2,060	2,100	2,100	4,000	1,400	1,400	2.400	1,200	1,200	1,000	3,000	1,800	1,200	1,500	3,000
Depth at MLW (ft)	45.9	45.9	45.9	45.9	37.7	37.7	37.7	37.7	37.7	37.7	37.7	37.7	37.7	37.7	37.7
Deck strength (psf)	DIRT	750	DIRT	1,000	1,000	1,000	DIRT	630	630	630	DIRT	DIRT	DIRT	DIRT	750
Apron width (ft)	OPEN	50	OPEN	OPEN	OPEN	OPEN	100	75	60	60	OPEN	OPEN	60	OPEN	60
Apron height above MLW (ft)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Number of container cranes	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apron lighting	NO	YES	NO	YES	YES	NO	NO	YES	YES	YES	NO	NO	NO	NO	YES
Straight-stern RORO facilities	YES	YES	NO	NO	NO	NO	NO	NO	NO	YES	YES	NO	YES	NO	NO
Apron length served by rail (ft)	0	0	0	0	0	0	NO	NO	NO	NO	NO	NO	NO	0	0

Land-Use Map of the Port of Jebel Ali

BERTHING CAPABILITIES OF PORT OF JEBEL ALI NORTH BERTHS

Vessel	Berth(s)							
	6-7	10-11	12-13	14-17	18-19	20-21	58-59	62-66
Breakbulk								
C3 - S - 38a	3	4	4	7	2	2	2	5
C4 - S - 58a	3	3	3	6	2	2	2	5
C4 - S - 66a	3	3	3	7	2	2	2	5
C5 - S - 37e	3	3	3	6	2	2	2	4
Seatrain								
GA and PR - class	3	3	3	6	2	2	2	5
Barge								
LASH C8 - S – 81b	2	2	2	4	1	1	1	3
LASH C9 - S – 81d	2	2	2	4	1,a,f	1,a,f	1,a,f	3,a,f
LASH lighter	10	10	10	20	7	7	7	15
SEABEE C8 - S - 82a	2	2	2	4	1,a,f	1,a,f	1,a,f	3,a,f
SEABEE barge	10	10	10	20	7	7	7	15
RORO								
Comet	3,i,j	4,i,j	4,d,i,j	7,d,i,j	2,d,i,j	2,d,i,j	2,d,i,j	5,d,o
Meteor	3,i,j	3,i,j	3,d,i,j	7,d,i,j	2,d,i,j	2,d,i,j	2,d,i,j	5,d,o
Cape Gnome	3,i,j	3,i,j	3,d,i,j	6,d,i,j	2,d,i,j	2,d,i,j	2,d,i,j	4,d,o
C7 - S - 95a	2	2,b	2	5	1	1	1	3
Cape Taylor	3	3,b	3	6	2	2	3	4
Cape Orlando	3,i,j	3,b	3,i,j	6,i,j	2,i,j	2,i,j	2,i,j	4,i,j
MV Ambassador	3,m	3,m	3,d	7,d	2,d	2,d	2,d	5,d
Callaghan	2	2	2,d	5,d	1,d	1,d	2,d	4,d,o
Cape Lambert	2,i,j	2,b	2,i,j	5,i,j	1,i,j	1,i,j	2,i,j	4,i,j
LMSR - class	2	2,b	2	4	1	1	1	3,b
FSS	2	2,b	2	4	1	1	1	3
Cape E - class	3,i,j	3,b	3,i,j	5,i,j	2,i,j	2,i,j	2,I,j	4,i,j
Cape D - class	2,i,j	2,b	2,i,j	5,i,j	1,i,j	1,i,j	2,I,j	4,i,j
Cape H - class	2	2,b	2	5	1	1	1	3
Cape Texas	3,i,j	3,b	3,i,j	6,i,j	2,i,j	2,i,j	2,I,j	4,i,j
Cape R - class	3	3	3,d	5,d	2,d	2,d	2,d	4,d
Cape I - class	2,i,j	2,b	2,i,j	5,i,j	1,i,j	1,i,j	2,I,j	4,i,j
Cape Victory	3,i	3,b	3,i	6,i	2,i	2,i	2,i	4,i
Container								
C6 - M - 147a	3,e	3,b,e	3,e	5	2,e	2,e	4,e	6,e
C7 - S - 69c	2,e	3,b,e	3,e	5	2,e	2,e	4,e	6,e
C7 - S - 68c	2,e	2,b,e	2,e	5	1,e	1,e	4,e	6,e
C8 - S - 85c	2,e	2,b,e	2,e	4	1,e	1,e	3,e	5,e
C9 - M - 132b	2,e	2,b,e	2,e	4	1,e	1,e	3,e	5,e
C9 - M - F141a	2,e	3,b	2,e	4	1,a,e	1,a,e	3,a,e	4,a,e
C6 - S - 1qd (TACS)	2	3,b	3	5	2	1	4	6
C5 - S - MA73c (TACS)	3	3,b	3	6	2	1	4	7
C6 - S - MA60d (TACS)	2	3,b	3	5	2	2	4	6
Combination								
C7 - S - 133a	2	2,b	2	4	1	1	3	5
Maersk	2	2,b	2	5	1	1	3	5
AmSea	2	3,b	3	5	2	2	4	6

Notes:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitation as described below.

a - vessel draft limited
b - apron too narrow
c - berth too short
d - no straight - stern ramp
e - no CNTNR cranes
f - anchorage OK, berth too shallow
g - shallow channel
h - no special ramps
i - tide too low for ramp clearance
j - tide too high for ramp clearance
k - ramp angle too steep at low tide
m - ramp angle too steep at high tide
n - parallel ramp operation ONLY
o - apron too narrow for side ramp

Ramp clearance and angle based on maximum vessel draft.

♦ May Prevent Operation

♦ May Limit Operation

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

BERTHING CAPABILITIES OF PORT OF JEBEL ALI NORTH BERTHS - cont

Vessel	Berth(s)						
	22-26	27-28	29-30	33	35-42	44-49	51-54
Breakbulk							
C3 - S - 38a	4	2	2	1	5	3	2
C4 - S - 58a	4	2	2	1	5	3	2
C4 - S - 66a	4	2	2	1	5	3	2
C5 - S - 37e	3	1	1	1	4	2	1
Seatrain							
GA and PR - class	4	2	2	1	5	3	2
Barge							
LASH C8 - S – 81b	2	1	1	1	3	2	1
LASH C9 - S – 81d	2,a,f	1,a,f	1,a,f	1,a,f	3,a,f	1,a,f	1,a,f
LASH lighter	12	6	6	5	15	9	6
SEABEE C8 - S - 82a	2,a,f	1,a,f	1,a,f	1,a,f	3,a,f	1,a,f	1,a,f
SEABEE barge	12	6	6	5	15	9	6
RORO							
Comet	4,d,i,j	2,d,i,j	2,d,o	1,i,j	5,i,j	3,d,i,j	2,i,j
Meteor	4,d,i,j	2,d,o	2,d,o	1,i,j	5,i,j	3,d,i,j	2,i,j
Cape Gnome	3,d,i,j	1,d,i,j	1,d,o	1,i,j	4,i,j	2,d,i,j	1,i,j
C7 - S - 95a	3	1	1	1	3	2	1
Cape Taylor	3	1	1	1	4	2	1
Cape Orlando	3,i,j	1,i,j	1,i,j	1,i,j	4,i,j	2,i,j	i,i,j
MV Ambassador	4,d	2,d	2,d	1,m	5,m	3,d	2,m
Callaghan	3,d	1,d,o	1,d,o	1	4	2,d	1
Cape Lambert	3,i,j	1,i,j	1,i,j	1,i,j	4,i,j	2,i,j	1,i,j
LMSR - class	2	1	1,b	1,b	3	1	1,b
FSS	2	1	1	1	3	1	1
Cape E - class	3,i,j	1,i,j	1,i,j	1,i,j	4,1,j	2,i,j	1,i,j
Cape D - class	3,i,j	1,i,j	1,i,j	1,i,j	4,1,j	2,i,j	1,i,j
Cape H - class	3	1	1	1	3	2	1
Cape Texas	3,i,j	1,i,j	1,i,j	1,i,j	4,i,j	2,i,j	1,i,j
Cape R - class	3,d	1,d	1,d	1	4	2,d	1
Cape I - class	3,i,j	1,i,j	1,i,j	1,i,j	4,i,j	2,i,j	1,i,j
Cape Victory	3,i	1,i	1,i	1,i	4,i	2,i	1,i
Container							
C6 - M - 147a	3,e	1,e	1,e	1,e	4,e	2,e	1,e
C7 - S - 69c	3,e	1,e	1,e	1,e	4,e	2,e	1,e
C7 - S - 68c	3,e	1,e	1,e	1,e	4,e	2,e	1,e
C8 - S - 85c	2,e	1,e	1,e	1,e	3,e	2,e	1,e
C9 - M - 132b	2,e	1,e	1,e	1,e	3,e	2,e	1,e
C9 - M - F141a	2,a,e	1,a,e	1,a,e	1,a,e	3,a,e	1,a,e	1,a,e
C6 - S - 1qd (TACS)	3	1	1	1	4	2	1
C5 - S - MA73c (TACS)	3	1	1	1	4	2	1
C6 - S - MA60d (TACS)	3	1	1	1	4	2	1
Combination							
C7 - S - 133a	2	1	1	1	3	2	1
Maersk	3	1	1	1	3	2	1
AmSea	3	1	1	1	4	2	1

Notes:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitation as described below.

a - vessel draft limited
b - apron too narrow
c - berth too short
d - no straight - stern ramp
e - no CNTNR cranes
f - anchorage OK, berth too shallow
g - shallow channel
h - no special ramps
i - tide too low for ramp clearance
j - tide too high for ramp clearance
k - ramp angle too steep at low tide
m - ramp angle too steep at high tide
n - parallel ramp operation ONLY
o - apron too narrow for side ramp

Ramp clearance and angle based on maximum vessel draft.

♦ May Prevent Operation

♦ May Limit Operation

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

Open Storage

Container Storage Area at Berth 14-17 (northwestward view)

Altogether, nearly 25,000 acres are reserved to support businesses in the free trade zone around the loading areas at the port. For planning purposes, the port has about 170 acres of paved open area. Nearly all of this (123 acres) is at the container terminal, Berth 14-17. Besides this paved area, the port has about 100 acres of undeveloped land that can also support military operations.

POV Staging Inland of Berth 34 (northwestward view)

More than 1,100 companies from 70 countries operating in the free zone are attracted by the tax exemption and foreign ownership allowances. The concrete aprons, have strengths of 1,000 pounds per square foot (5.5 metric tons per square meter) along the northern quays, and about 630 pounds per square foot (3.1 metric tons per square meter) along the southern (inner) quays. The high-load pavement extends at least 80 feet (25 meters) inland of the water.

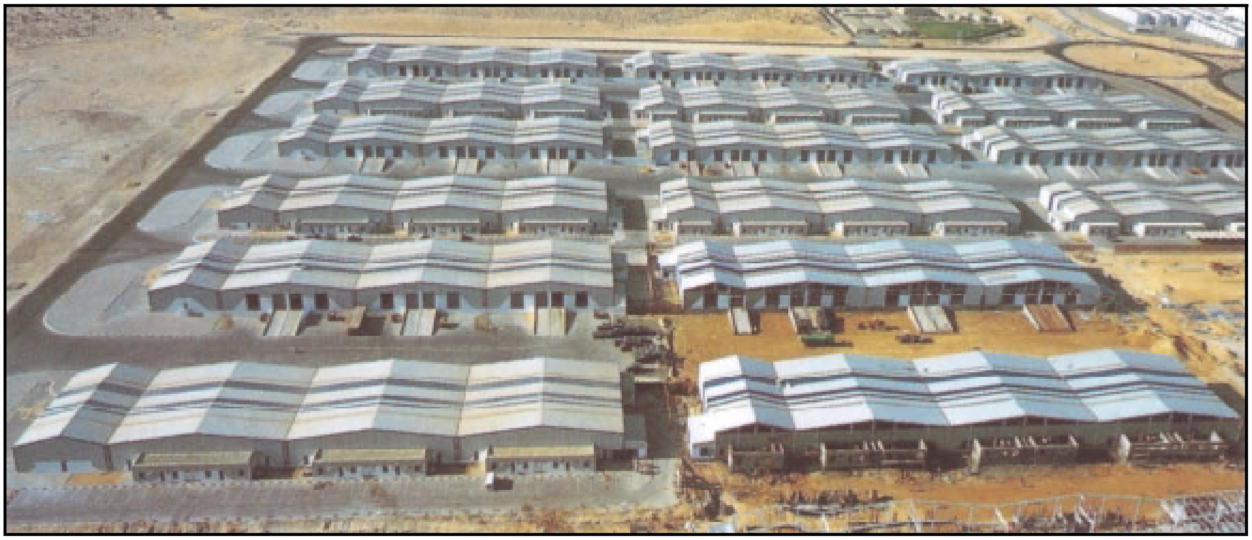
Inland of the developed free zone industries, the area surrounding the port is generally undeveloped desert land. If additional open area is required for staging, offsite areas can easily be made available.

The port has a small commercial heliport inland of Berth 57, in the Dubai Petroleum Company area. It has no experience supporting the military. The area most suitable to land military helicopters is along Berth 22-26. This area will likely be available since it is not developed to support commercial shipping. Tractors can tow the helicopters to and from the container freight station (CFS) or Shed 27 for shrink-wrapping and reduction operations.

Covered Storage

The area surrounding the free zone has over a thousand buildings of various sizes. Buildings are continually under construction. Many buildings are used for manufacturing, administration, or cold storage purposes. These cannot support military operations. Militarily useful covered storage facilities are listed in the table to the right. Other smaller warehouses are scattered throughout the free zone area. The availability of these varies from month-to-month. The CFSs and several of the Dutch barns have truck docks.

MILITARILY U SEFUL COVERED STAGIN G		
Nearest Berth	**Building Name**	**Area (SQ FT)**
15	CFS	116,000
Various	Dutch Barns	9 @ 77,000
27, 29, 33, 62, 64, 65, 66	Transit Sheds	7 @77,000



Aerial View of Dutch Barn Warehouses Inland of Berth 54 (southwestward view)

Dutch Barn Warehouses Inland of Berth 54 (westward view)

Transit Sheds at Berths 61-66 (southward view)

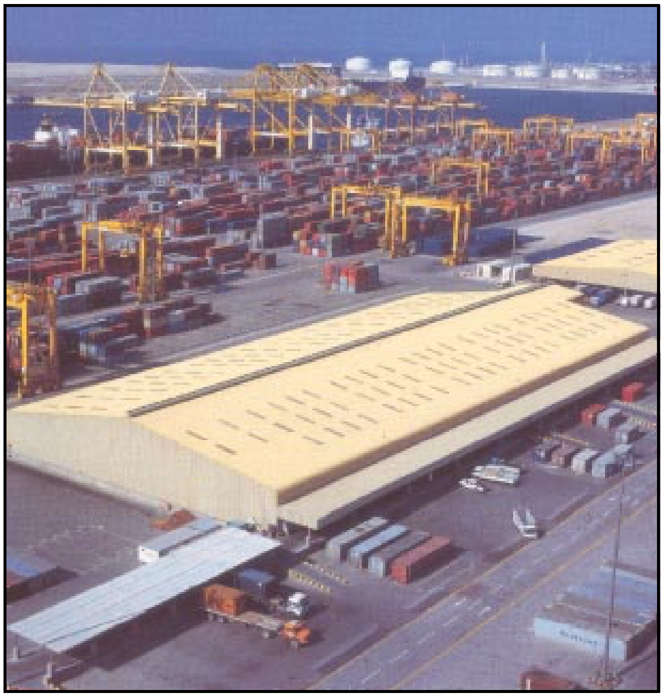
Highway

Although most of the streets within the port are numbered, vehicles usually find their way around the free zone and shiploading areas of the port by the numbered roundabouts. Most roads are four lanes and uncongested. Vehicles can move around the port without restrictions on height or weight. Five gates surround the free zone. The Main Gate is near Roundabout 5, on the northeast side of the free zone. It has three entrance lanes and four exit lanes. The Main Gate has one truck scale; the container terminal has two more scales and another two are near Roundabout 4, in the Star Energy facility.

Main Gate to the Port of Jebel Ali (northwestward view)

The four smaller gates have a guard shack in the center of the street. Each of these small gates could support one lane of convoy vehicles and equipment departing the free zone.

Gate to the Container Terminal, Berth 14-17 (northwest view)



CFS at Container Terminal (northward view)

Unloading/loading Positions

The CFS at the container terminal has dock space for about 25 trucks along one side. Each of the Dutch barn buildings has at least two truck docks at one end. The port has no ramps for truck operations, therefore, the military should bring or build ramps to handle vehicles unless the trucks and trailers have integral ramps.

Offsite Storage Area

Inland of the developed free zone industries, the area surrounding the port is generally undeveloped desert land. If additional open area is required for staging, offsite areas can easily be made available.

Offsite Marshaling (northward view)

MATERIALS HANDLING EQUIPMENT (MHE)

With all the industries in the free zone surrounding the shiploading areas, there is a tremendous variety of MHE. Unfortunately the availability varies from month-to-month. For planning purposes, the table at right shows equipment that is usually available. In addition to the MHE nearby, equipment can easily be transported from Dubai if necessary.

MATERIAL HANDLING EQUIPMENT			
MHE Type	**Capacity (STON)**	**Quantity**	**Location**
Forklifts	1-35	107	Various
Barge crane	800	1	McDermott
Barge cranes	100-300	2	Various
Container forklift	10	10	Berth 14-17
Transtainers	40-45	34	Berth 14-17
Toploaders	40	13	Berth 14-17
Mobile cranes	80-100	2	-
Mobile cranes	20-50	2	-
Chassis	-	87	Berth 14-17

CONTAINER CRANES AT BERTH 14-17				
Manufacturer	**Quantity**	**Capacity (STON)**	**Reach**	**Lifts per hour**
Deer Park	1	88	Panamax	37-38
Rajani	2	50	Post Panamax	35
Nelcon double trolly	2	50	Post Panamax	45
Mitsubishi	3	49	Panamax	30
Matsui	2	50	Post Panamax	40
Nelcon single trolly	2	50	Post Panamax	35
Hatchi	2	40	Panamax	25

AMMUNITION

The Inchcape Shipping Services has handled ammunition at the port. They were required to load the explosives directly onto trucks that immediately left the port.

With Port Authority approval, ammunition handling is possible. The anchorage has not been rated for net explosive weight.

PETROLEUM, OILS AND LUBRICANTS (POL)

The land-use map shows the POL facilities. Several berths support tanker operations. Star Energy leases Berth 8-9 for tanker operations.

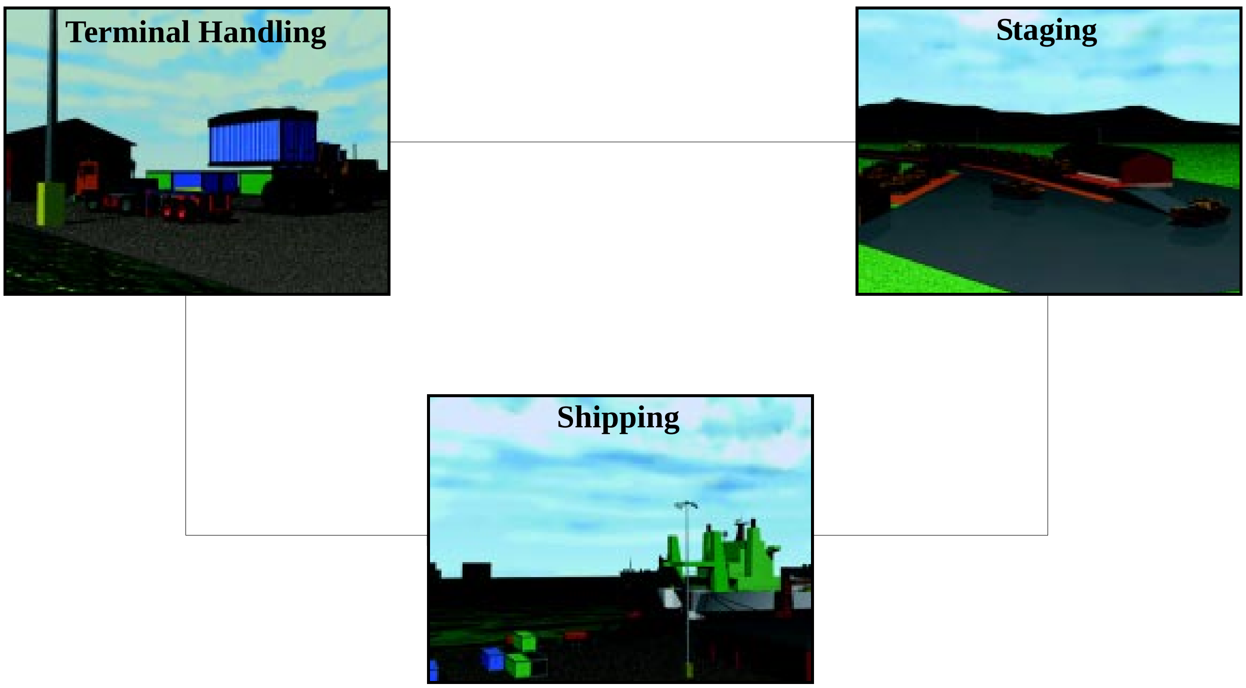
FUTURE DEVELOPMENT

The port may likely loose some shipping business to the Port of Raysut, Oman, after Raysut's expansion is complete. For this reason, there are no plans to dredge and fill land any further. The port does, however, expect to build another transit shed at Berth 25. Buildings and paved staging areas are continually being built within the free zone, as more businesses develop.

III. THROUGHPUT ANALYSIS

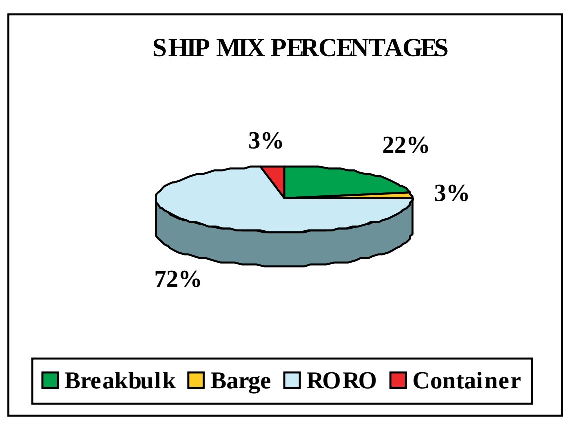
GENERAL

This section evaluates the throughput capability of the Port of Jebel Ali using the port operational performance simulator computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping/ship unloading, staging/hard-stand marshaling, and terminal processing/handling - in STON per day.



Terminal Throughput Subsystems

This analysis assumes 70 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using a 70 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



RECEPTION/HANDLING

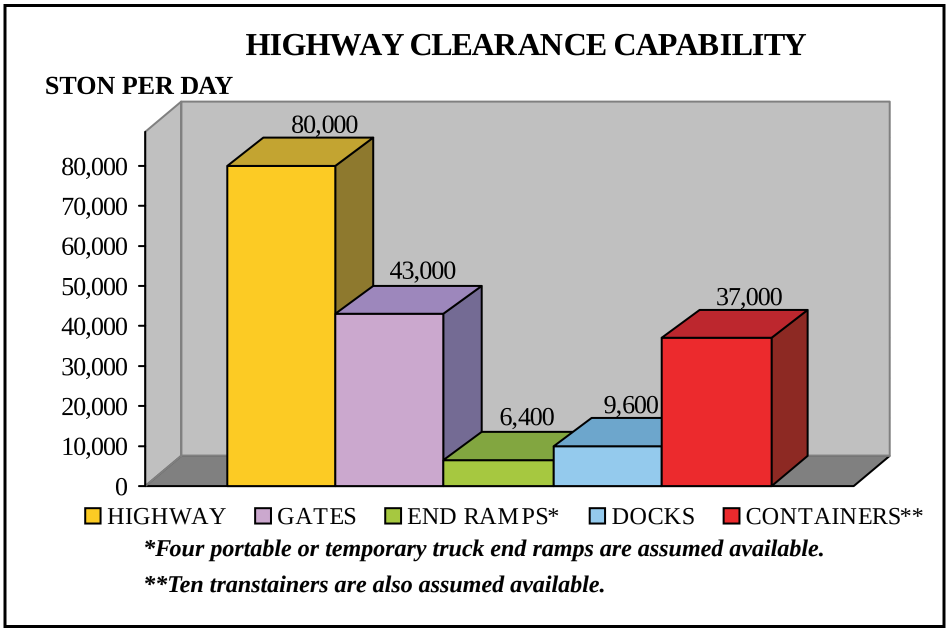
Highway

The most restrictive highway link to or from the port is the eight lane, two-way Sheikh Zayed Highway to Dubai and to Abu Dhabi. Typically all truck traffic enters and exits through the free zone Main Gate, near Roundabout 5. This gate can accommodate military vehicles through three lanes, and still maintain commercial operations with the fourth lane that exits the free zone. Under extreme conditions, the three entering lanes could be reversed. Four other small gates around the developed free zone area are only open to POVs with passes, and emergency vehicles. Altogether the port has five gates and several routes that lead vehicles to the highway. The road network in and out of the port, including the gate processing of vehicles, could handle about 43,000 STON (150,000 MTON) of equipment and supplies per day.

No permanent or portable truck ramps are at the port. Vehicles to be hauled by commercial or military flatbed trailers without integral ramps will load at portable end ramps. Each such ramp must support 1,600 STON (4,800 MTON) per day. Roadable vehicles in convoys will process directly to the off-port marshaling areas.

The CFS in the container terminal can accommodate about 25 truck dock operations simultaneously. Other covered storage buildings scattered around the shiploading and free zone areas have about 18 additional truck docks. Each truck dock can handle about 224 STON (560 MTON) per day.

This analysis also assumes 10 transtainers will be available to support chassis operations. Each of these transtainers can support 3,700 STON (9,300 MTON) of containers per day.

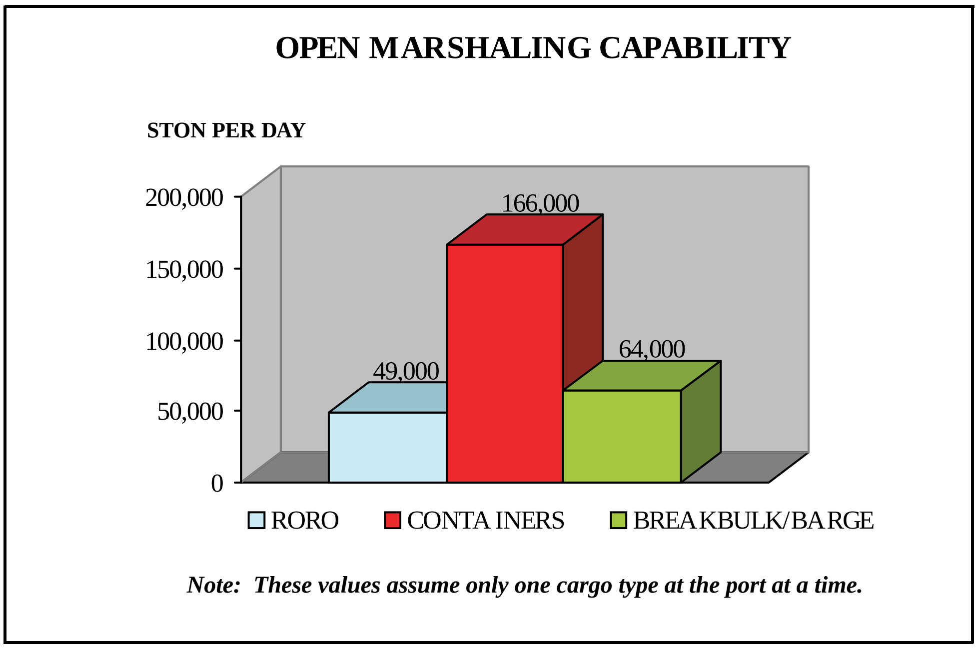


Rail

The country of UAE has no rail and no plans for development.

Open Storage

The port has about 170 acres of paved open area. Of this area, about 123 acres is at the container terminal, Berth 14-17. In addition to this paved area, the port has about 100 acres of undeveloped land that can also support military operations. The 170 paved acres provide the marshaling capabilities in the graph below. If all this area were used for RORO cargo, the throughput would be 49,000 STON per day.

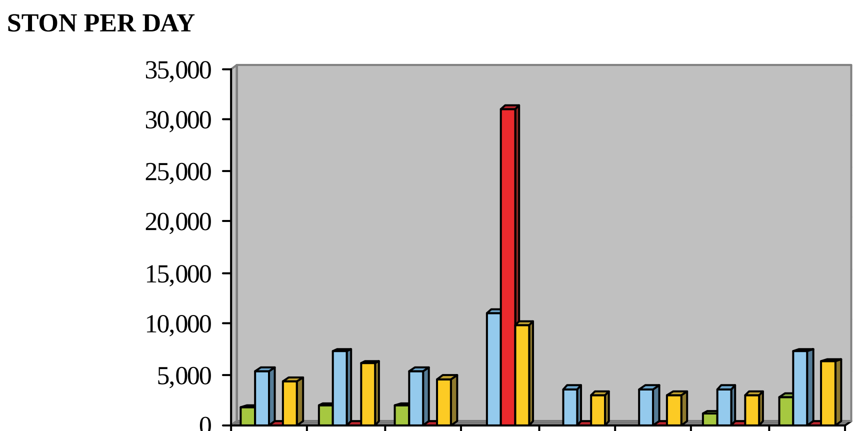


Shipping

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility.

CONVERSION FACTORS	
Breakbulk:	.4 STON per MTON
RORO:	.25 STON per MTON
Containers:	.4 STON per MTON

BERTH THROUGHPUT CAPABILITY



	6-7	10-11	12-13	14-17	18-19	20-21	58-59	62-66
BREAKBULK/BARGE	1,700	1,900	1,900	3,400	1,100	1,100	1,100	2,800
RORO	5,400	7,200	5,400	11,000	3,600	3,600	3,600	7,200
CONTAINERS	0	0	0	31,000	0	0	0	0
MIXED	4,400	6,000	4,600	9,800	2,900	2,900	3,000	6,200

Note: There is not a significant amount of mobile equipment to consider handling containers at berths other than Berths 14-17.

THROUGHPUT SUMMARY FOR THE PORT OF JEBEL ALI								
BERTH(S)	**LENGTH (feet) (meters)**	**DEPTH (feet) (meters)**	**BB (STON) (MTON)**	**RORO (STON) (MTON)**	**RORO SQ FT (EST)**	**RORO PIECES**	**CNTNR (STON) (MTON) (TEU)**	**MIXED (STON) (MTON)**
6-7	2,060 628	45.9 13.7	1,700 4,300	5,400 22,000	108,000	640	0 0 0	4,500 18,000
10-11	2,100 640	45.9 13.7	1,900 4,900	7,200 29,000	144,000	850	0 0 0	6,000 23,000
12-13	2,100 640	45.9 13.7	1,900 4,900	5,400 22,000	108,000	640	0 0 0	4,600 18,000
14-17	4,000 1,219	45.9 13.7	3,400 8,500	11,000 43,000	220,000	1,300	31,000 79,000 3,900	9,800 37,000
18-19	1,400 427	37.7 11.5	1,100 2,800	3,600 14,000	72,000	420	0 0 0	3,000 11,000
20-21	1,400 427	37.7 11.5	1,100 2,800	3,600 14,000	72,000	420	0 0 0	3,000 11,000
58-59	1,500 357	37.7 11.5	1,100 2,800	3,600 14,000	72,000	420	0 0 0	3,000 12,000
62-66	4,500 1,370	37.7 11.5	2,800 7,100	7,200 29,000	144,000	850	0 0 0	6,200 24,000
22-26	2,400 731	37.7 11.5	2,300 5,700	5,400 22,000	108,000	640	0 0 0	4,700 18,000
27-28	1,200 366	37.7 11.5	1,100 2,800	1,800 7,200	36,000	210	0 0 0	1,600 6,200
29-30	1,200 366	37.7 11.5	1,100 2,800	1,800 7,200	36,000	210	0 0 0	1,600 6,200
33	1,000 305	37.7 11.5	570 1,400	1,800 7,200	36,000	210	0 0 0	1,500 5,900
35-42	3,000 914	37.7 11.5	2,800 7,100	9,000 36,000	180,000	1,100	0 0 0	7,600 29,000
44-49	1,800 549	37.7 11.5	1,700 4,300	3,600 14,000	72,000	420	0 0 0	3,100 12,000
51-54	1,200 366	37.7 11.5	1,100 2,800	3,600 14,000	72,0000	4200	0 0 0	3,000 12,000

BERTH PREFERENCE RANKING			
Berth(s)	Shipping Style		
	Breakbulk	RORO	CNTNR
6-7	9	5	-
10-11	6	5	-
12-13	9	9	-
14-17	1	1	1
18-19	6	1	-
20-21	6	1	-
58-59	9	9	-
62-66	2	9	-
22-16	9	9	-
27-28	2	1	-
29-30	2	9	-
33	2	5	-
35-42	9	5	-
44-49	9	15	-
51-54	9	14	-
NOTE: Berths marked with a “-” are not recommended for these operations.			

The military port operator should negotiate for use of Berth 14-17 because of its deep water, open paved apron, and container cranes.

Because of the ongoing container operations, Berth 14-17 will likley be unavailable to support military operations. Although Berth 27-28 is less desirable for handling military vehicles and equipent, it may be the best berth available. It has a regular U.S. Navy presence and is suitable for supporting RORO or breakbulk cargo. Planners should be aware that large vessels are difficult to turn at Berth 27-28 because of the narrow slip.

If large vessels are planned for the operation, planners should prepare to use Berth 12-13. This berth also has a regular U.S. Navy presence, but is undeveloped, and has no transit shed.

Barge Operations

The port does not support barge operations. If military vehicles and equipment are to be shipped by barge, large vessels might be displaced to accommodate the barge operations. A few key issues for planning purposes are:

- Each mobile crane can handle 829 MTON or 331 STON per day, assuming 20 productive work hours, and 90 percent berth utilization factor.

- SEABEE barges are 175 feet long. Typical LASH lighters are 115 feet long. A crane operating every other barge or lighter provides sufficient working space.

Assuming five mobile cranes are operating, (one crane for every other LASH lighter) the barge operations along Berth 27-28 could support loading or unloading 4,100 MTON or 1,600 STON per day.

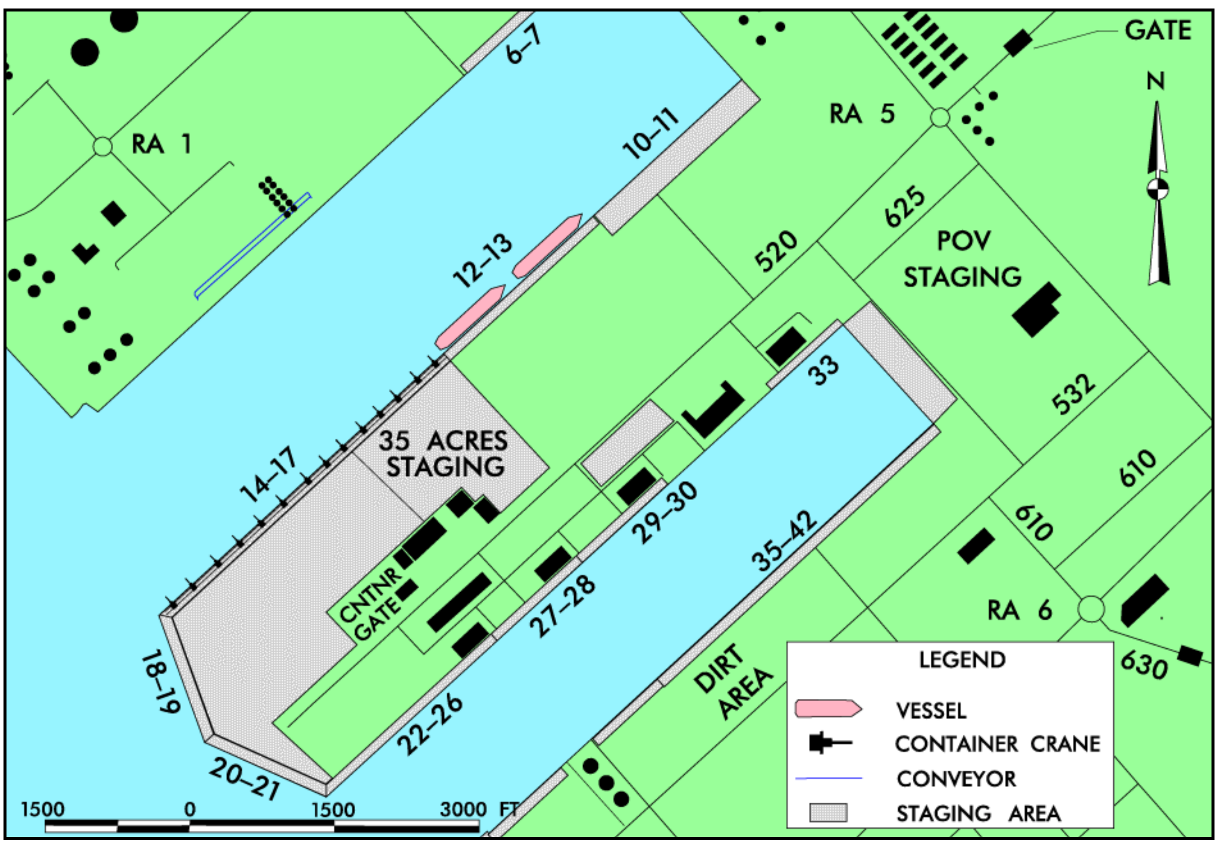
Large Vessel Operations

Berths 6-17 can support berthing seven FSS or LMSR vessels, with no restrictions on draft. Such large vessels at these berths may turn within the outer slip. Turning vessels this long in the inner slip is very difficult. For this reason, large vessel operations at the inner slip berths are not recommended.

IV. APPLICATION

This section evaluates the port's throughput capability for receiving a notional armored division. Since the water in the Port of Jebel Ali is deep, this study evaluates the reception using vessels of the LMSR category; specifically the NASSCO New Construction designs. These vessels have a maximum draft of 34 feet (10.4 meters), and an overall length of 950 feet (290 meters). So far, there is very little data from exercises to suggest a reasonable stow factor for these vessels. Our analysis will assume a 65 percent stow factor.

The facilities used depend on decisions made by the Dubai/Jebel Ali Port Authority. This analysis assumes the U.S. military will be able to berth where U.S. Navy vessels often berth for light repairs, crew rest and relaxation, and resupply. These are Berth 12-13, where the aircraft carriers berth, and Berth 27-28, where smaller Navy vessels berth for resupply.

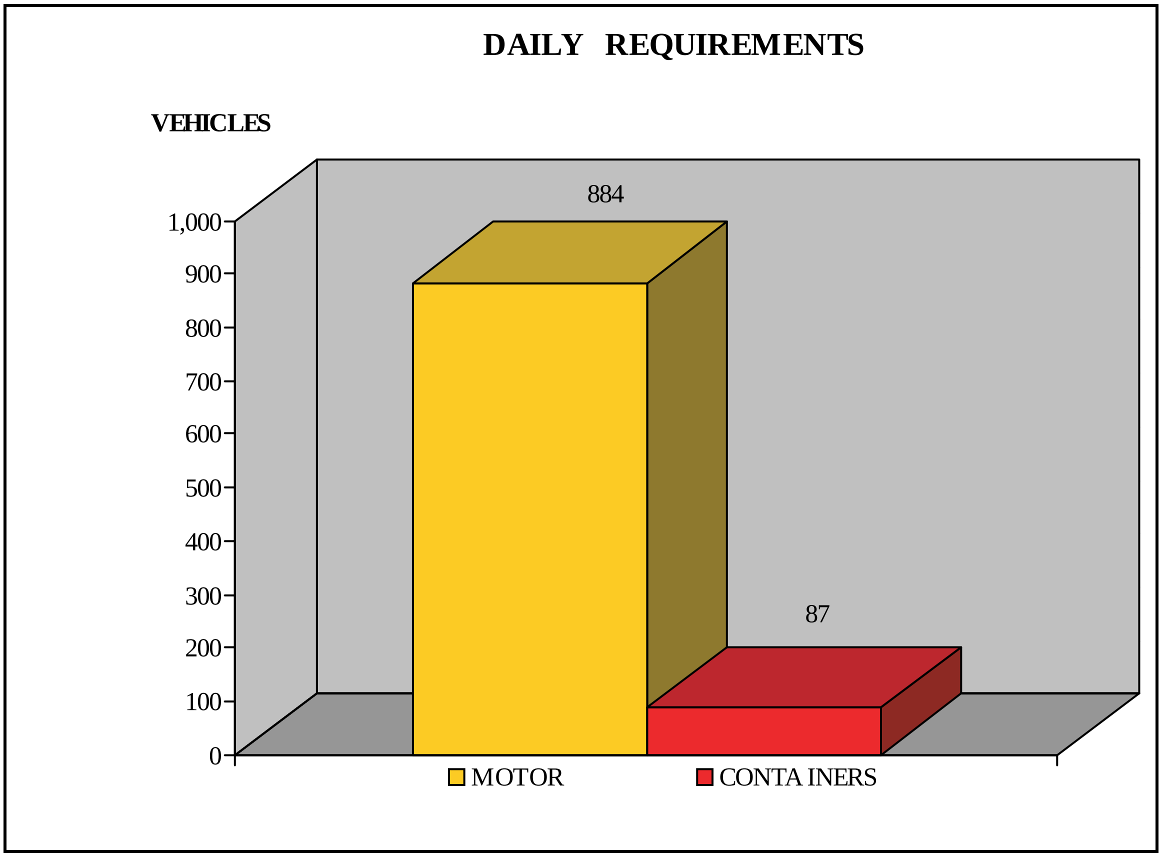


Facilities to Support U.S. Military Operations

REQUIREMENTS

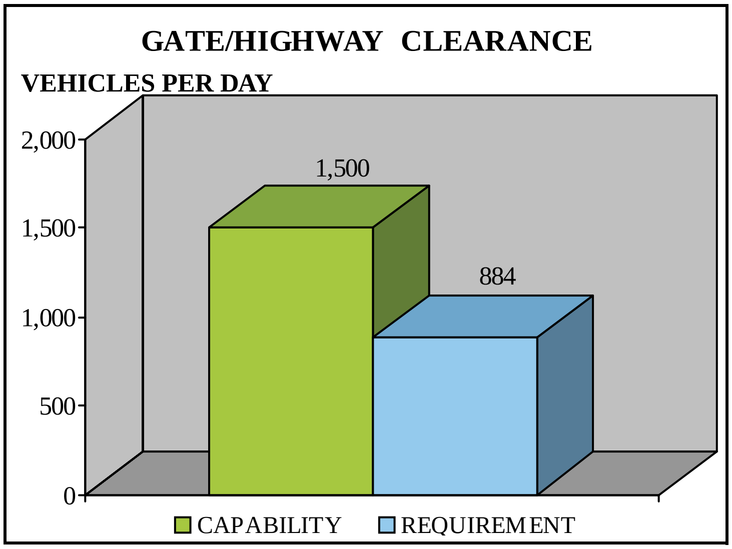
ARMORED DIVISION		
Total Equipment		Required Daily Throughput
Volume	287,175 MTON	47,862 MTON
Weight	101,342 STON	16,890 STON
Area	1,484,636 SQ FT	247,439 SQ FT
Vehicles*	8,125	1,354
Containers	522	87
*Includes trailers		

For purposes of this analysis, the likely requirement for the Port of Jebel Ali is to receive a notional armored division. We assume the port must offload and clear the division in only 6 days. To move the division by road, about 3,752 (625 per day) self-propelled vehicles towing 2,386 (398 per day) trailers, along with 367 (61 per day) forty-foot semitrailers and 1,189 (198 per day) HETs would pass through the gate in the 6 days time. For traffic analysis, this equates to about 884 vehicles (some with trailers or semitrailers) passing through the gate and eventually entering Saudi Arabia.



TERMINAL OUTPROCESSING/HANDLING

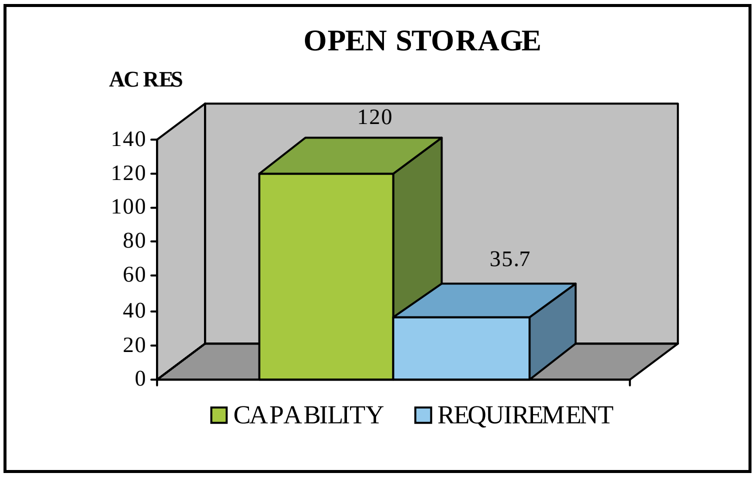
Highway



The gate likely to support the military vehicles and equipment depends on the berths used for the operation. The Main Gate will likely be used; assuming the ship operations occur at Berths 12-13 and 27-28. Although the vehicles will likely convoy westward into Saudi Arabia, the Main Gate is well equipped to handle the traffic, and is not far out of the way. If, however, the ship operations occur at berths along the west side of the port, then Gate 3 or 4 may be more practical. Even these small POV security gates can be arranged to allow one lane of convoy vehicles to depart the port. One lane through one of these small gates can accommodate 1,500 vehicles per day under controlled clearance procedures. This is sufficient to meet the requirement.

Assuming a constant flow of vehicles departing the port, the daily clearance requirement is under 900 vehicles. The Jebel Ali road network toward Abu Dhabi and further into Saudi Arabia can support the requirement to handle the armored division in 6 days.

Open Storage



The Port of Jebel Ali is continually adding more pavement into the undeveloped areas. At present there is roughly 170 acres of paved open area. 120 acres of this is at the container terminal, Berth 14-17. Marshaling the entire division of equipment (1,484,636 square feet) requires 85 acres. We assume the maximum amount of cargo in the port at any time is about 2-1/2 days (42 percent) of the required port throughput. This requires the port to provide 35.7 acres of paved open area to support the deployment. The port can easily meet the requirement.

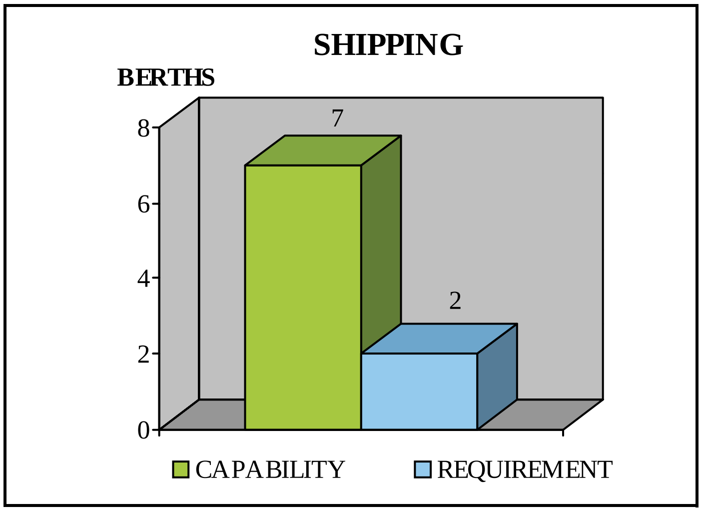
Shipping

An armored division has 1,484,636 square feet of vehicles and equipment. The deck space on the NASSCO New Construction design is 393,268 square feet.

Each of the NASSCO New Construction design vessels can carry 256,000 square feet of cargo, assuming the 65 percent stow factor discussed above. At this rate, the deployment of the division would require fewer than six of these vessels. Unloading RORO vessels this size can be done in less than 2 days. To meet the 6-day requirement, the port will have to berth two of these vessels simultaneously throughout the entire 6-day reception. Three two-vessel operating cycles are required to receive the entire division with these partially loaded vessels.

Two LMSR vessels could berth at Berth 12-13, and easily turn in the outer slip. This one location alone is sufficient to meet the requirement. Berth 27-28 is better suited for smaller vessels.

The Application Map earlier in this report provides the berthing configuration.



SUMMARY

The country of UAE has no rail facilities. Vehicles and equipment must convoy from the port. The Port of Jebel Ali can deploy a notional armored division in 6 days.

The port can accommodate LMSR or FSS vessels. Turning such large vessels is difficult in the inner slip. Sufficient paved open area and extensive undeveloped areas are near the port.

RECOMMENDATION

We recommend the Port of Jebel Ali be considered to deploy division-sized units using LMSR vessels. To stage vehicles and equipment on pavement, we recommend negotiating for the use of 35.7 acres, which is about 30 percent of paved area at the container terminal, Berth 14-17. This would provide staging for about 2-1/2 days worth of offloading equipment from the vessels. The free zone can also provide undeveloped area to support the operation.

PORT OF RASHID
UNITED ARAB EMIRATES

I. EXECUTIVE SUMMARY

GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Rashid, United Arab Emirates (UAE), based on a site visit in December 1997. The port can accommodate vessels as large as the LMSR and FSS class vessels, and can support military operations.

The Port of Rashid is a large multicargo facility in the highly developed city of Dubai. The only rail-mounted cranes at the port are the nine container cranes. Two berths can support straight-stern ramp RORO vessels. The tidal variation is 6.5 feet. Berths range in depth from 30.5 to 42.6 feet at mean low water (MLW). Several berths have transit sheds.

Connector routes and the main highway are in very good condition. The country of UAE has no railroads.

THROUGHPUT

The port has a mixed throughput capability of 42,000 short tons (STON) per day. The RORO capability is 52,000 STON per day.

APPLICATION

We find the port capable of handling a notional armored division in 6 days. Our analysis assumes three repetitions of two LMSR vessels, although the port can simultaneously berth seven fully-loaded LMSR or FSS vessels. Only 35.7 acres of paved open area is required to support the division. This required area is only 42 percent of the container staging area.

II. GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the port of Rashid, United Arab Emirates (UAE), based on a site visit on 9 December 1997. We had support from the 831st U.S. Army Transportation Battalion, Southwest Asia, and the U.S. Defense Attaché Office, UAE, Port Liaison Element. The site visit included an interview with the Dubai/Jebel Ali Port Authority.

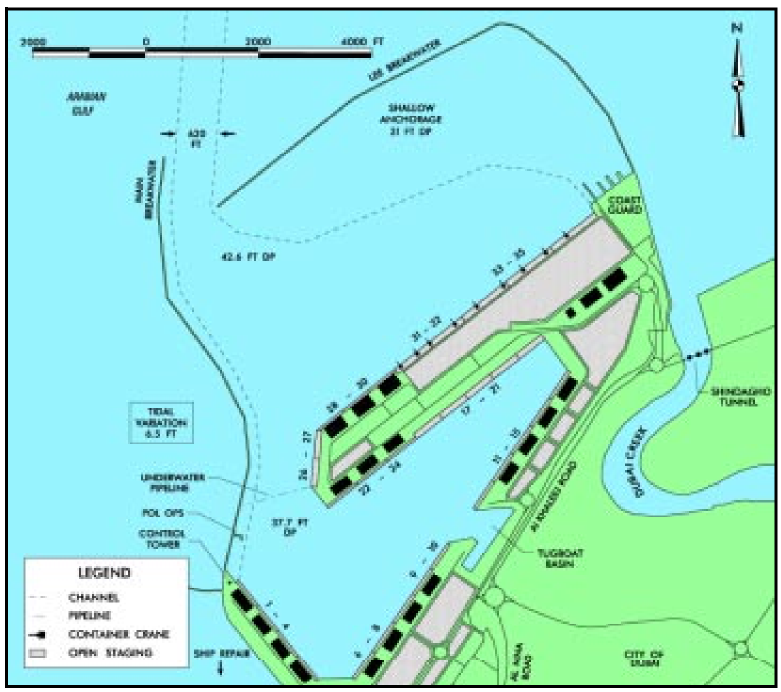
TRANSPORTATION ACCESS

Water

The Port of Rashid is in the northeast region of UAE, in a highly developed area of the city of Dubai. Its control tower is at 25^{o} 15’ 33” N Latitude, and 55^{o} 16’ 09” E Longitude. The port is sometimes referred to as the Port of Dubai, or the Port of Ad Dubayy, and supports several types of cargoes.

The port is 4 miles (6 kilometers) from open water, with no approach channel. The narrowest restriction for vessels is at the breakwaters, which are spaced 620 feet (190 meters), with a depth of 42.6 feet (13 meters) MLW. Tidal variation is 6.5 feet (2 meters).

Pilots are compulsory and are available 24 hours per day. Vessels are required to wait 2.3 miles from the port for the pilot to arrive and board. The port has three tugboats, each with 2,450 horsepower, and 28 STON bollard pull. Usually, two tugs work each vessel that enters or exits the port.



Water Access to the Port of Rashid

Ships that require more than 31 feet of water to anchor must remain in open water until berthing space is available at the port. The holding ground is very poor. It is recommended that ships use more chain than usual. Occasionally the winds from the northwest direction are very strong and most often occur in November to March.

A single petroleum, oils and lubricants (POL) jetty is on the main breakwater, north of the control tower. An underwater pipeline lies in a trench between the main breakwater and Berth 27. The depth of water over this pipeline is 37.7 feet (11.5 meters).

Highway

No unusual clearance or congestion problems exist on roads leading from the berths to the Main Gate. Vehicles depart the Main Gate at the roundabout on Khalid Irn Al Waleed Road. Vehicles continue to Trade Center Road, which turns into Sheikh Zayed Road. Shiekh Zayed Road leads the vehicles to the Port of Jebel Ali, Abu Dhabi, and further to Saudi Arabia. The speed limit on this highway is 75 miles per hour (120 kilometers per hour) except in urban areas. Overhead obstructions are 16.4 feet (5 meters) high. All these routes are in very good condition. None of these roads has congestion; however, the traffic will likely increase as more businesses develop in the Jebel Ali Free Zone and the surrounding area.

Shiekh Zayed Road, at West Edge of Dubai

Air

The Dubai International Airport is in the northeast part of the city, only 15 minutes drive from the port. The longest runway at this airport is 11,000 feet long and 150 feet wide. It is capable of handling C5A aircraft. The airport is one of the busiest in the world, with some 70 airlines, 300 daily flights, and 100 destinations.

Rail

The Emerates of UAE have no rail, nor plans to develop a rail infrastructure.

Highway and Air Access to the Port of Rashid

PORT FACILITIES

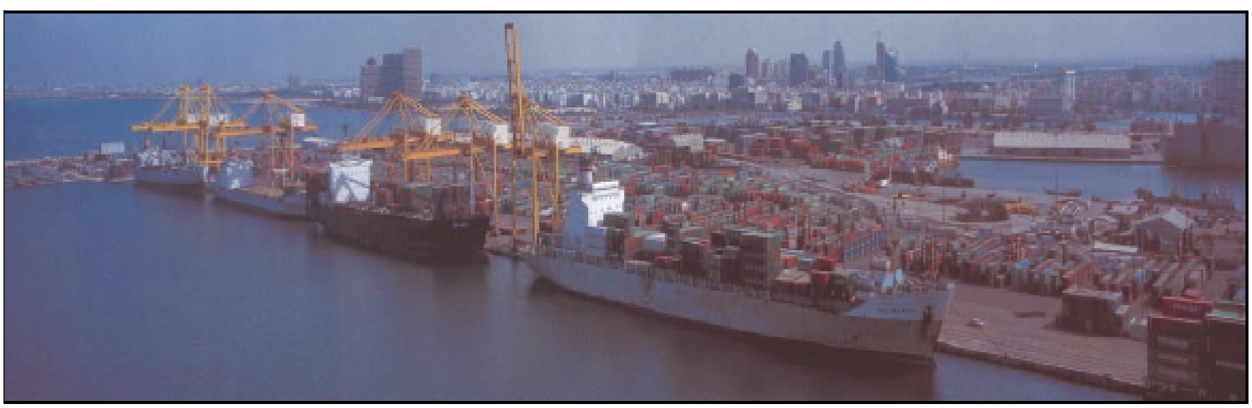
Berthing

The Port of Rashid includes nearly 4 miles (6.3 kilometers) of berthing space, and can handle a wide variety of cargoes. Its computerized cargo tracking system is among the best in the world. The port is surrounded by the highly developed city of Dubai, with no room for expansion or off-site marshaling within 5 miles of the port.

Berths 15 and 17 each have RORO ramps. The RORO ramp at Berth 35 does not have the deck strength to support military vehicles. All aprons are 11 feet (3.3 meters) above MLW. Water depths range from 30.5 to 42.6 feet at MLW. Tanker operations occur at the dolphin pier just north of the control tower, along the main breakwater.

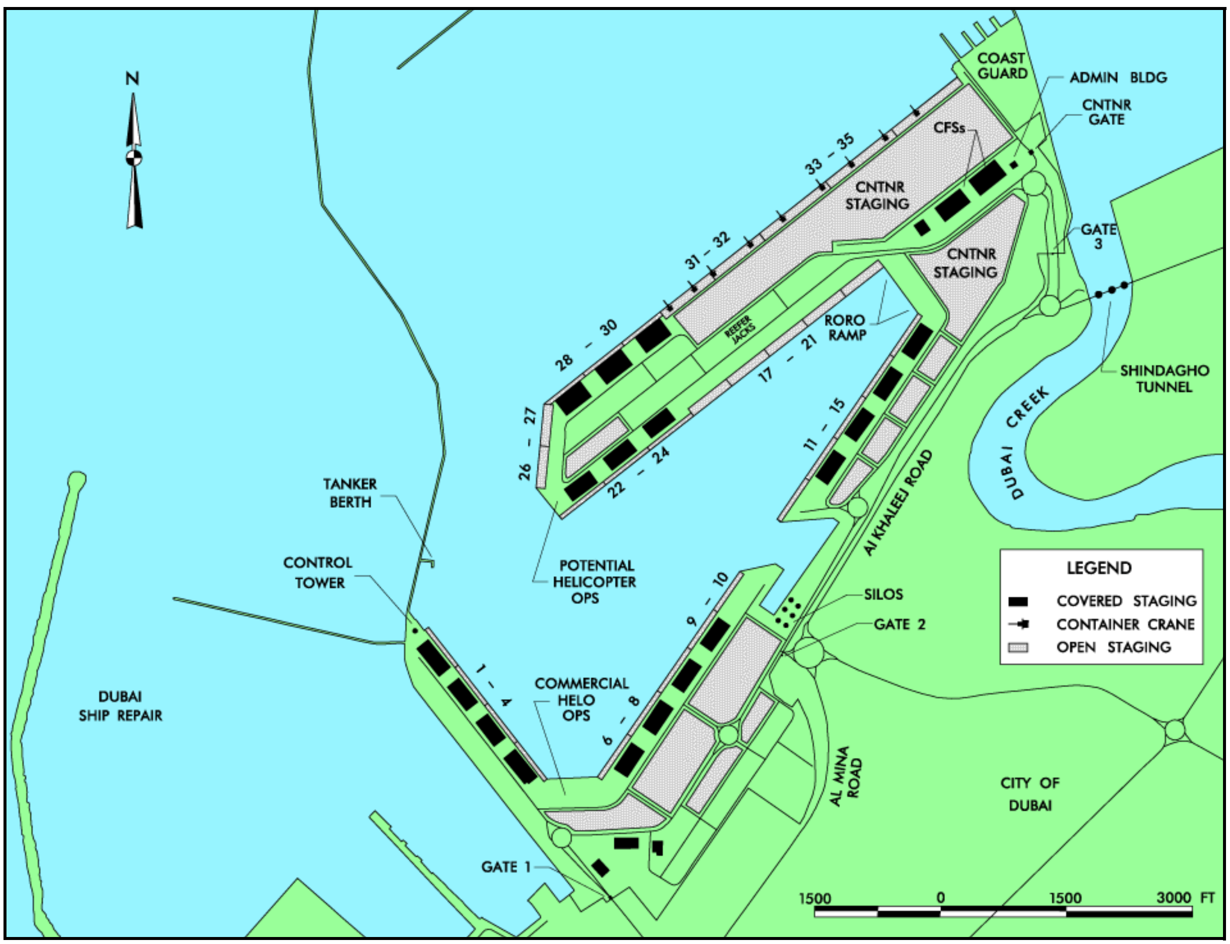
RORO Ramp at Berth 17

Port of Rashid



Berths 31-35 (Southward View)

CHARACTERISTICS OF THE PORT OF RASHID										
Characteristics	**Berths**									
	1-4	**6-8**	**9-10**	**11-15**	**17-21**	**22-24**	**26-27**	**28-30**	**31-32**	**33-35**
Length (ft)	2,302	1,882	1,101	2,822	2,884	1,998	1,004	1,770	1,508	3,009
Depth t MLW (ft)	30.5	30.5	35.4	30.5	37.7	37.7	37.7	37.7	37.7	42.6
Deck strength (psf)	600	600	600	600	600	600	600	600	600	600
Apron width (ft)	50	60	60	60	OPEN	50	OPEN	50	OPEN	OPEN
Apron height above MLW (ft)	11	11	11	11	11	11	11	11	11	11
Container cranes	0	0	0	0	0	0	0	0	4	5
Wharf cranes	0	0	0	0	0	0	0	0	0	0
Apron lighting	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Straight-stern RORO facilities	NO	NO	NO	YES	YES	NO	NO	NO	NO	NO
Rail (ft)	0	0	0	0	0	0	0	0	0	0



Land-Use Map of the Port of Rashid

BERTHING CAPABILITIES OF PORT OF RASHID

Vessel	Berths 1-4	6-8	9-10	11-15	17-21	22-24	26-27	28-30	31-32	33-35
Breakbulk										
C3 - S - 38a	4	3	2	5	5	3	1	3	2	5
C4 - S - 58a	3,a	3,a	1	4,a	4	3	1	2	2	5
C4 - S - 66a	4,a	3,a	1	4,a	5	3	1	3	2	5
C5 - S - 37e	3	3	1	4	4	3	1	2	2	4
Seatrain										
GA and PR - class	3	3	1	4	4	4	1	3	2	5
Barge										
LASH C8 - S – 81b	2,a,f	2,a,f	1	3,a,f	3	2	1	2	1	3
LASH C9 - S – 81d	2,a,f	2,a,f	1,a,f	3,a,f	3,a,f	2,a,f	1,a,f	1,a,f	1,a,f	3
LASH lighter	11	9	5	14	14	9	5	8	7	15
SEABEE C8 - S - 82a	2,a,f	2,a,f	1,a,f	3,a,f	3,a,f	2,a,f	1,a,f	1,a,f	1,a,f	3
SEABEE barge	11	9	5	14	14	9	5	8	7	15
RORO										
Comet	4,d,o	3,d,o	2,d,o	5,i,j	5,i,j	3,d,o	1,d,i,j	3,d,o	2,d,i,j	5,d,i,j
Meteor	4,d,o	3,d,o	1,d,o	4,i,j	5,i,j	3,d,o	1,d,i,j	3,d,o	2,d,i,j	5,d,i,j
Cape Gnome	3,a,d,o	3,a,d,o	1,d,o	4,a	4,i,j	3,d,o	1,d,i,j	2,d,o	2,d,i,j	4,d,i,j
C7 - S - 95a	3,a,b	2,a	1	3,a	3	2,b	1	2,b	1	3
Cape Taylor	3,b	2	1	4	4	3,b	1	2,b	2	4
Cape Orlando	3,b	2,i,j	1,i,j	4,i,j	4,i,j	3,b	1,i,j	2,b	2,i,j	4,i,j
MV Ambassador	4,d	3,d	1,d	5,m	5,m	3,d	1,d	3,d	2,d	5,d
Callaghan	3,d,o	2,d,o	1,d,o	3,i	4,i	2,d,o	1,d,i	2,d,o	2,d,i	4,d,i
Cape Lambert	3,a,b	2,a	1,i,j	3,a	4,i,j	2,b	1,i,j	2,b	2,d,i	4,d,i
LMSR - class	2,a,b	1,a,b	1,b	2,a,b	2	2,b	1	1,b	1	3
FSS	2,a,b	1,a	1,a	2,a	2	2,b	1	1,b	1	3
Cape E - class	3,a,b	2,a	1,i,j	4,a	4,i,j	2,b	1,i,j	2,b	2,i,j	4,i,j
Cape D - class	3,a,b	2,a	1,i,j	3,a	4,i,j	2,b	1,i,j	2,b	2,i,j	4,i,j
Cape H - class	2,a,b	2,a	1,a	3,a	3	2,b	1	2,b	1	3
Cape Texas	3,b	2,i,j	1,i,j	4,i,j	4,i,j	3,b	1,i,j	2,b	2,i,j	4,i,j
Cape R - class	3,a,d	2,a,d	1,d	4,a	4	2,d	1,d	2,d	2,d	4,d
Cape I - class	3,a,b	2,a	1,i,j	3,a	4,i,j	2,b	1,i,j	2,b	2,i,j	4,i,j
Cape Victory	3,b	3,i	1,i	4,i	4,i	3,b	1,i	2,b	2,i	4,i
Container										
C6 - M - 147a	3,b,e	2,e	1,e	4,e	4,e	2,b,e	1,e	2,b,e	2	4
C7 - S - 69c	3,a,b,e	2,a,e	1,e	4,a,e	4,e	2,b,e	1,e	2,b,e	2	4
C7 - S - 68c	3,a,b,e	2,a,e	1,e	3,a,e	3,e	2,b,e	1,e	2,b,e	2	4
C8 - S - 85c	2,a,b,e	2,a,e	1,e	3,a,e	3,e	2,b,e	1,e	2,b,e	1	3
C9 - M - 132b	2,a,b,e	2,a,e	1,e	3,a,e	3,e	2,b,e	1,e	1,b,e	1	3
C9 - M - F141a	2,a,b,e	1,a,e	1,a,e	2,a,e	2,a,e	2,a,b,e	1,a,e	1,a,b,e	1,a	3
C6 - S - 1qd (TACS)	3,a,b	2,a	1	4,a	4	2,b	1	2,b	2	4
C5 - S - MA73c (TACS)	3,a,b	2,a	1	4,a	4	3,b	1	2,b	2	4
C6 - S - MA60d (TACS)	3,a,b	2,a	1	4,a	4	2,b	1	2,b	2	4
Combination										
C7 - S - 133a	2,a,b	2,a	1	3,a	3	2,b	1	2,b	1	3
Maersk	2,a,b	2,a	1	3,a	3	2,b	1	2,b	1	3
AmSea	3,a,b	2,a	2	4,a	4	2,b	1	2,b	2	4

Notes:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitation as described below.

a - vessel draft limited
b - apron too narrow
c - berth too short
d - no straight-stern ramp
e - no CNTNR cranes
f - anchorage OK, berth too shallow
g - shallow channel
h - no special ramps
i - tide too low for ramp clearance
j - tide too high for ramp clearance
k - ramp angle too steep at low tide
m - ramp angle too steep at high tide
n - parallel ramp operation ONLY
o - apron too narrow for side ramp

Ramp clearance and angle based on maximum vessel draft.

♦ May Prevent Operation

♦ May Limit Operation

Note: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a “med moor” operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

Open Storage

The Port of Rashid has 136 acres of paved open staging area. Most of this area, 84 acres, are at the container terminal, Berths 31-35. The remaining 52 acres are scattered in several areas around the port. Several small areas are inland of Berths 6-15. Much of the open area is brick-paved, and can only support 600 pounds per square foot.

The port has no experience handling military helicopters. If helicopter operations are necessary, we recommend landing between Berths 4 and 6, or at Berth 26. These short berths will not likely support shipping, but are near sheds that could support helicopter shrink-wrap and reduction operations.

Aerial View of Port of Rashid, Berths 33 and 34 (southeastward view)

Covered Storage

The Port of Rashid has 20 sheds that have 77,000 square feet (7,200 square meters) of covered storage area each. Altogether these buildings provide 1,500,000 square feet (140,000 square meters) of covered storage space. Several of the sheds have container freight station (CFS) capability to consolidate, stuff, and unstuff containers.

COVERED STORAGE			
Type	**Size each (SQ FT)**	**Quantity**	**Total (SQ FT)**
Sheds	77,000	12	920,000
CFSs	80,000	8	640,000
		Total:	1,600,000

Port Roadways

The Port of Rashid has three gates. The northern most gate (Gate 3) is the primary gate for container traffic, and has three lanes heading in each direction. Gates 1 and 2 have only one lane each way. These small gates are typically used for administrative and maintenance vehicles.

The roads within the port are uncongested and in good condition. Vehicles can move around the port without restrictions on height or weight. Though not posted, speed limits are 9 miles per hour (15 kilometers per hour). The port has one semiportable truck scale inland of Berth 6. It can weight up to 66 STON.

Gate 3

Unloading/Loading Positions

The port has no truck ramps. In emergency situations, the truck docks can be used to support flatbed truck and trailer operations. The military should bring or build ramps to handle vehicles unless the trucks and trailers have integral ramps.

All the sheds have at least a few truck docks on their inland side. Several have truck docks along the entire length. We estimate the port could handle 200 van semitrailers at once, provided enough forklifts are brought in to support the operations.

Offsite Storage Area

The port is almost completely surrounded by commercial and residential buildings. Because of this, offsite marshaling would have to be at least 5 miles from the port. We recommend offsite marshaling occur south of Dubai, on the way toward the Port of Jebel Ali. Much of the land along Shiekh Zayed highway is undeveloped desert.

Truck Docks Near Berth 24 (northeastward view)

MATERIALS HANDLING EQUIPMENT (MHE)		
MHE Type	Capacity (STON)	Quantity
Straddle Carriers	-	27
Chassis Tractors	-	58
RORO Tractors	-	11
Mafio Trailers	-	20
Top Loaders	-	2
Empty Handlers	-	11
Mobile Crane	10–25	4
Floating Crane	200	1
Forklift	35	2
Forklift	2-30	60

Local stevedore and rental companies own all MHE. The adjacent shipyard owns the floating crane and several other pieces of equipment.

Straddle Carriers, and Hustler with Mafio Trailer

AMMUNITION

The Port of Rashid has no experience handling ammunition. It is highly unlikely that the Dubai Port Authority would approve of ammunition handling, even if the cargo dwell at the port were minimized. The surrounding area is too densely populated. The anchorage has not been rated for net explosive weight (NEW).

PETROLEUM, OILS AND LUBRICANTS

Within the Port of Rashid, the Port Rashid Oil Jetty (PROJ) is situated on the main breakwater, about 830 feet north of the control tower, with water that is 37 feet deep at MLW. This jetty is operated by Shell Oil Company and can routinely handle tankers up to 44,000 STON, and 750 feet (230 meters) long. Longer vessels may berth with permission from the harbormaster. The jetty is protected by plastic covered fenders, and remotely controlled fire monitors.

Bunkering is available at all berths by barges that relay fuel from the PROJ.

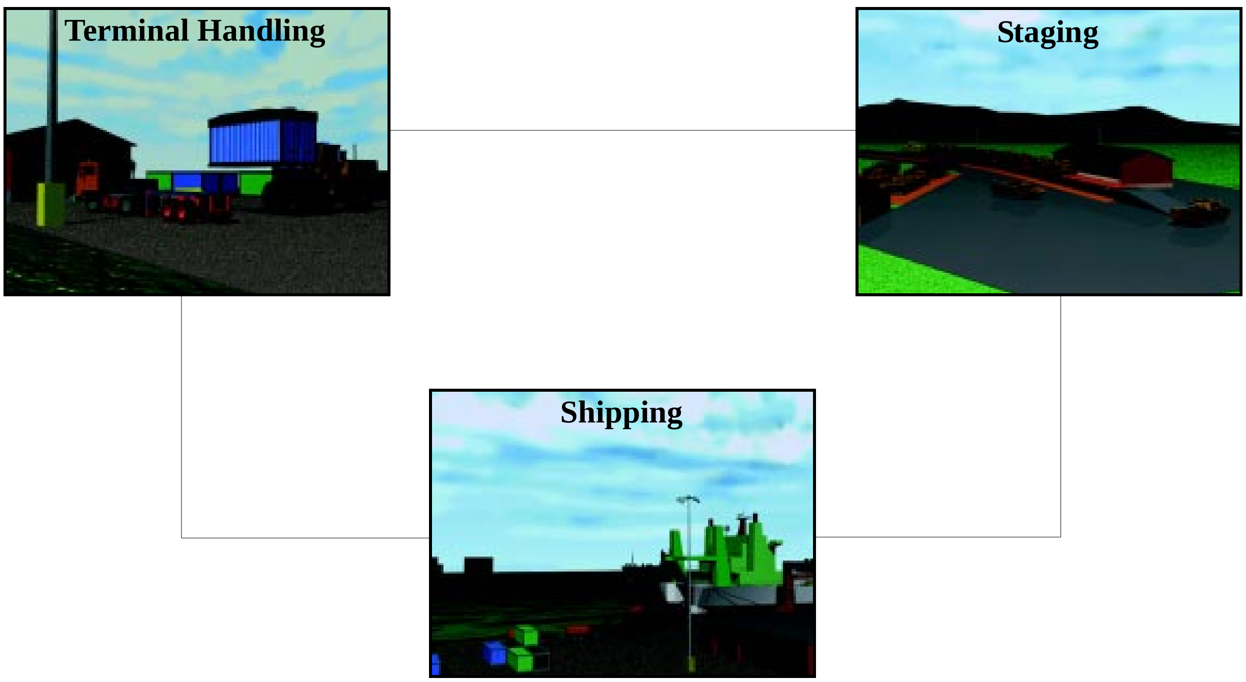
FUTURE DEVELOPMENT

The Dubai Port Authority does not expect to develop the Port of Rashid further. Being located within the congestion of the city, it cannot expand. The Ports Authority wants to route all funds for future development to the Port of Jebel Ali, which still has undeveloped land to support new businesses.

III. THROUGHPUT ANALYSIS

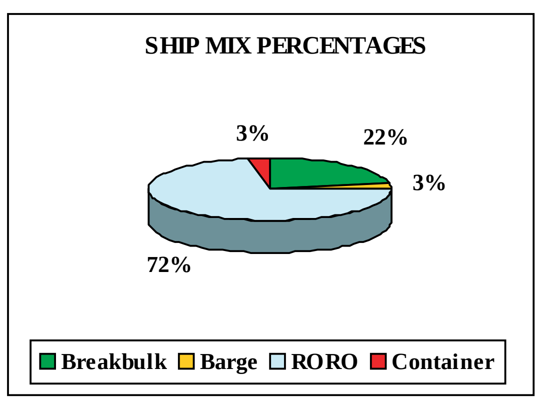
GENERAL

This section evaluates the throughput capability of the Port of Rashid using the port operational performance simulator computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging/hardstand marshaling, and terminal processing/handling - in STON per day.



Terminal Throughput Subsystems

This analysis assumes 70 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using a 70 percent facility-use factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future operations.



RECEPTION /HANDLING

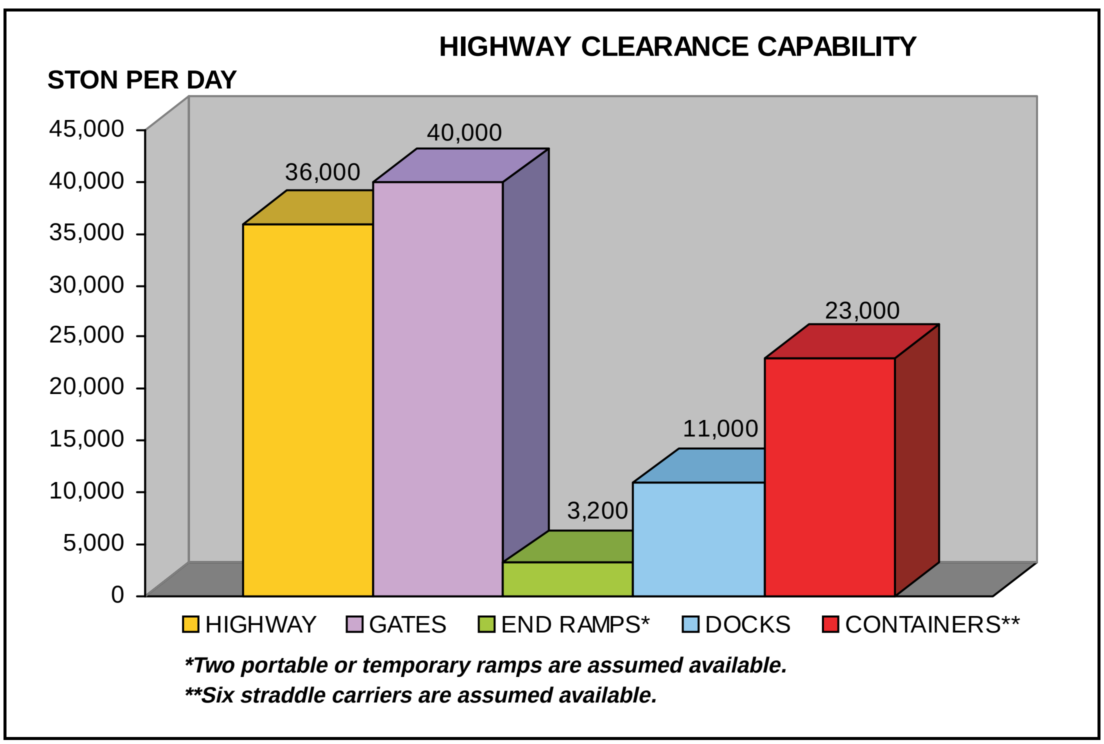
Highway

LANES FOR MILITARY TRAFFIC	
Gate 1	1
Gate 2	1
Gate 3	2

The most restrictive highway link to or from the port is the connector routes to the highway. Although vehicles may depart the port from all three gates, only two routes, Khalid Irn Al Waleed and Al Adhid Roads forward the equipment to the main highway. With the commercial traffic in the city of Dubai, the military should not expect to have more than two lanes available for convoying vehicles and equipment. The road network in and out of the port, including the gate processing of vehicles, could handle about 24,000 STON (66,000 MTON) of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the off-port marshaling areas. The port has no ramps for truck operations. The military should bring or build ramps to offload trucks and trailers that do not have integral ramps. Each such ramp can support 1,600 STON (4,800 MTON) per day. Our analysis assumes the military port operator will bring or build two portable or temporary ramps.

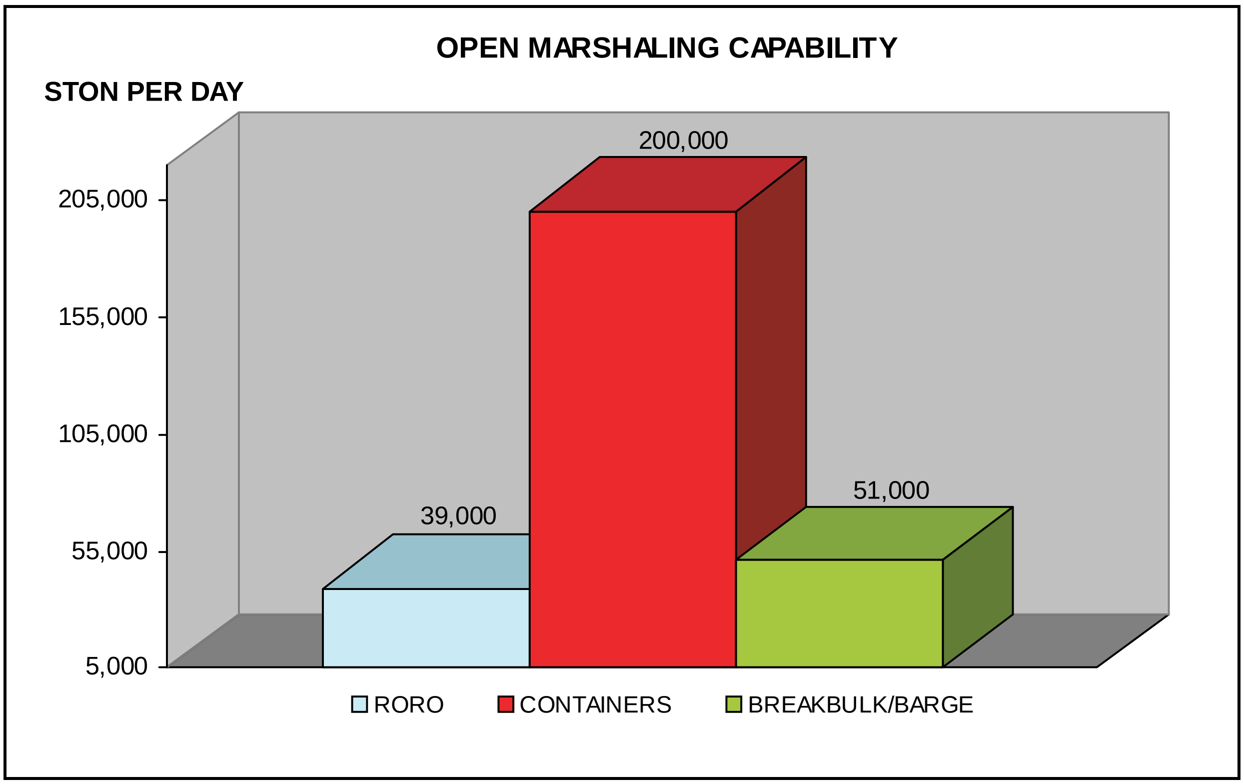
All the sheds have a few truck docks, several with docks their entire length. The port does, however, have 27 straddle carriers. Each carrier can handle 3,785 STON (9,462 MTON) of containers per day. Our analysis assumes six straddle carriers and 50 truck docks will be available.



Open Storage

The port has a total of about 136 acres of paved open staging area. Most of which, 84 acres, is at the container terminal, Berths 31-35. The 136 paved acres provide the marshaling capabilities in the graph below. If all this area is used for RORO cargo, the throughput will be 39,000 STON per day.

The Port of Rashid has 20 sheds that have 77,000 square feet of covered storage area each. Altogether these buildings provide 1,500,000 square feet of covered storage space.

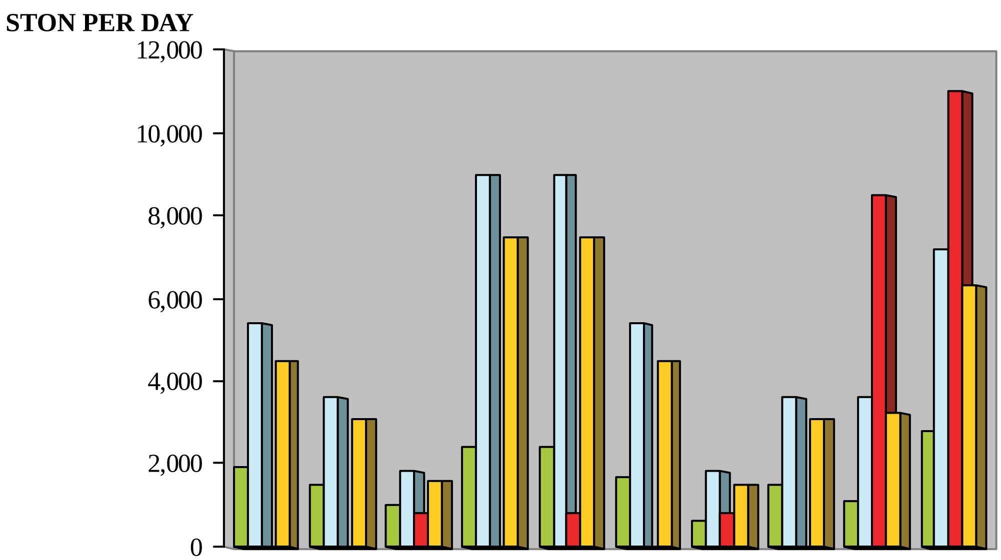


Shipping

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading/unloading, operational, and berth usage rates as well as berth/ship compatibility.

CONVERSION FACTORS	
Breakbulk:	.4 STON per MTON
RORO:	.25 STON per MTON
Containers:	.4 STON per MTON

BERTH THROUGHPUT CAPABILITY



	1-4	6-8	9-10	11-15	17-21	22-24	26-27	28-30	31-32	33-35
BREAKBULK/BARGE	1,900	1,500	1,000	2,400	2,400	1,700	600	1,500	1,100	2,800
RORO	5,400	3,600	1,800	9,000	9,000	5,400	1,800	3,600	3,600	7,200
CONTAINERS	0	0	810	0	810	0	810	0	8,500	11,000
MIXED	4,500	3,100	1,600	7,500	7,500	4,500	1,500	3,100	3,200	6,300

Note: There is only enough mobile equipment to handle containers at one of the three berths: Berths 9-10, 17-21, and 26-27.

THROUGHPUT SUMMARY FOR THE PORT OF RASHID								
BERTHS	LENGTH (feet) (meters)	DEPTH (feet) (meters)	BB (STON) (MTON)	RORO (STON) (MTON)	RORO SQ FT (EST)	RORO PIECES	CNTNR (STON) (MTON) (TEU)	MIXED (STON) (MTON)
1–4	2,302 702	30.5 9.3	1,900 4,900	5,400 22,000	108,000	630	0 0 0	4,500 17,000
6–8	1,882 574	30.5 9.3	1,500 3,700	3,600 14,000	72,000	420	0 0 0	3,100 12,000
9–10	1,101 336	35.4 10.8	1,000 2,500	1,800 7,200	62,000	360	810 2,000 100	1,600 6,000
11–15	2,822 860	30.5 9.3	2,400 6,100	9,000 36,000	180,000	1,000	0 0 0	7,500 29,000
17–21	2,884 879	37.7 11.5	2,400 6,100	9,000 36,000	180,000	1,000	810 2,000 100	7,500 28,000
22–24	1,998 609	37.7 11.5	1,700 4,200	5,400 22,000	108,000	430	0 0 0	4,400 18,000
26–27	1,004 306	37.7 11.5	600 1,500	1,800 7,200	36,000	210	810 2,000 100	1,500 5,700
28–30	1,770 539	37.7 11.5	1,500 3,700	3,600 14,000	72,000	420	0 0 0	3,100 12,000
31–32	1,508 460	37.7 11.5	1,100 2,800	3,600 14,000	72,000	420	8,500 21,000 1,100	3,200 12,000
33–35	3,009 917	42.6 13	2,800 7,000	7,200 29,000	144,000	840	11,000 27,000 1,300	6,300 24,000

The preferred berth depends on what vessels are planned to support the military operations. If a RORO vessel is planned, Berth 17-21 is preferred because of its deep water, open apron, and RORO ramp.

If vessels other than RORO ships are expected to support the operation, the two container berths are preferred. Berth 33-35 is the better of the two because of its length and extra crane.

BERTH PREFERENCE RANKING			
Berths	**Shipping Style**		
	Breakbulk	**RORO**	**CNTNR**
1-4	3	10	-
6-8	3	5	-
9-10	8	6	-
11-15	3	6	-
17-21	8	1	-
22-24	3	6	-
26-27	8	2	-
28-30	3	6	-
31-32	2	2	2
33-35	1	3	1
NOTE: Berths marked with a "-" are not recommended for these operations.			

Barge Operations

Barges are available if needed, but are not routinely handled. Tugboats have difficulty maneuvering barges in and out of the tugboat basin between Berths 10 and 11. If military vehicles and equipment are to be shipped by barge, vessels might be displaced to allow easy access for the barge operations. A few key issues for planning purposes are:

- Each mobile crane can handle 331 MTON or 829 STON per day, assuming 20 productive work hours, and 90 percent berth utilization factor.

- SEABEE barges are 175 feet long. Typical LASH lighters are 115 feet long. A crane operating every other barge or lighter provides sufficient working space.

Assuming nine mobile cranes are operating, (one crane for every other LASH lighter) the barge operations along Berth 1-4 could support loading or unloading 3,000 STON or 7,500 MTON per day.

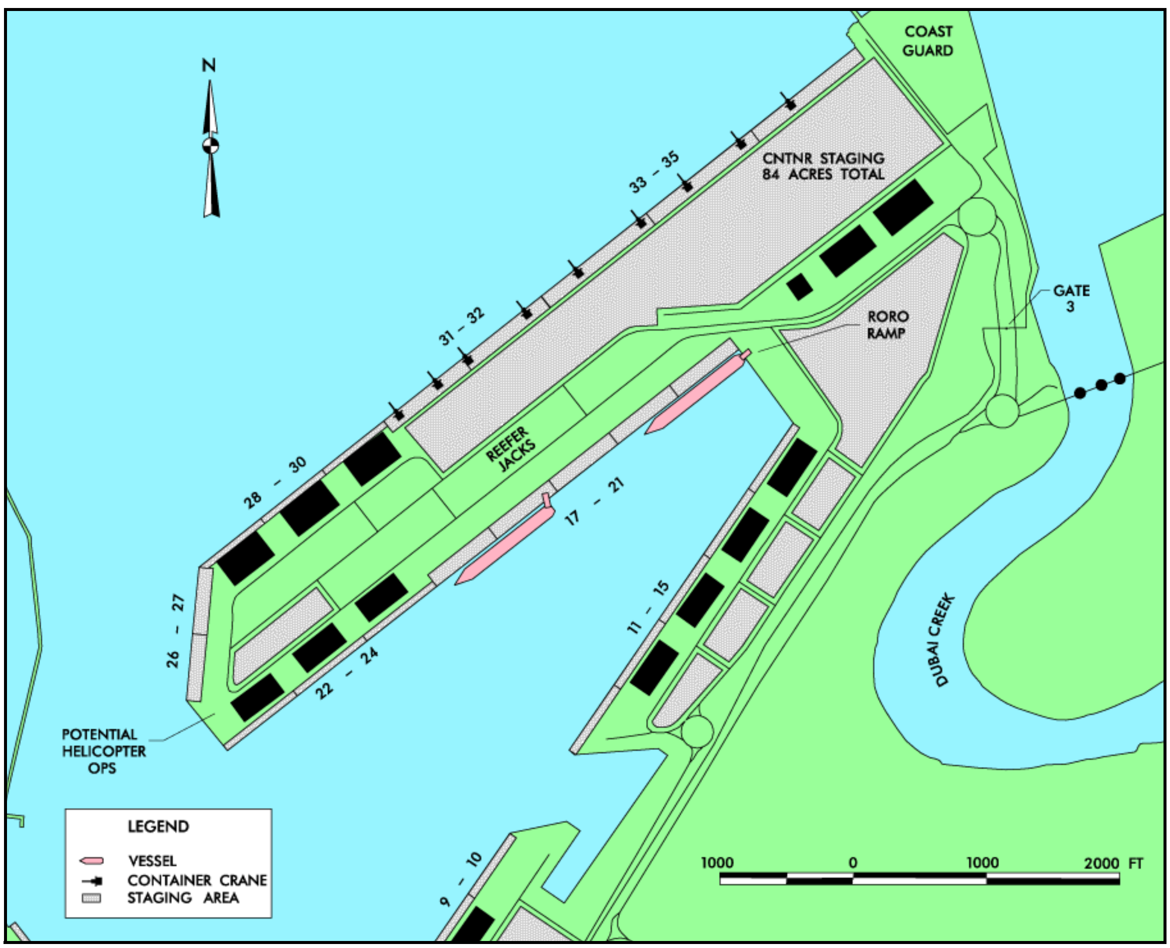
Large Vessel Operations

Berths 17-21, 26-27, and 31-35 can accommodate a total of seven FSS or LMSR vessels without restrictions on draft. Three additional large vessels may operate at Berths 9-10, 22-24, and 28-30. Vessels at Berths 22-24 and 28-30, however, require special positioning to accommodate the ramps. An FSS or LMSR vessel at Berth 9-10 would have to enter the port with a draft 2 feet shallower than fully loaded.

IV. APPLICATION

This section evaluates the port's throughput capability for receiving a notional armored division. Since the water in the Port of Rashid is deep, this study evaluates the reception using vessels of the LMSR category; specifically the NASSCO New Construction design. These vessels have a maximum draft of 34 feet (10.4 meters), and an overall length of 950 feet (290 meters). So far, very little exercise data is available to suggest a reasonable stow factor for these vessels. Our analysis will assume a 65 percent stow factor.

The facilities used depend on decisions made by the Dubai Ports Authority. Although the container berths have the best lifting equipment at the port, we assume the container berths will not be available. This analysis assumes the U.S. military will use Berth 17-21. This berth can support LMSR operations, and is adjacent to the container staging area. If necessary, one of the transit sheds along Berth 22-24 might be available to support helicopter shrink-wrapping and reduction/ assembly operations.

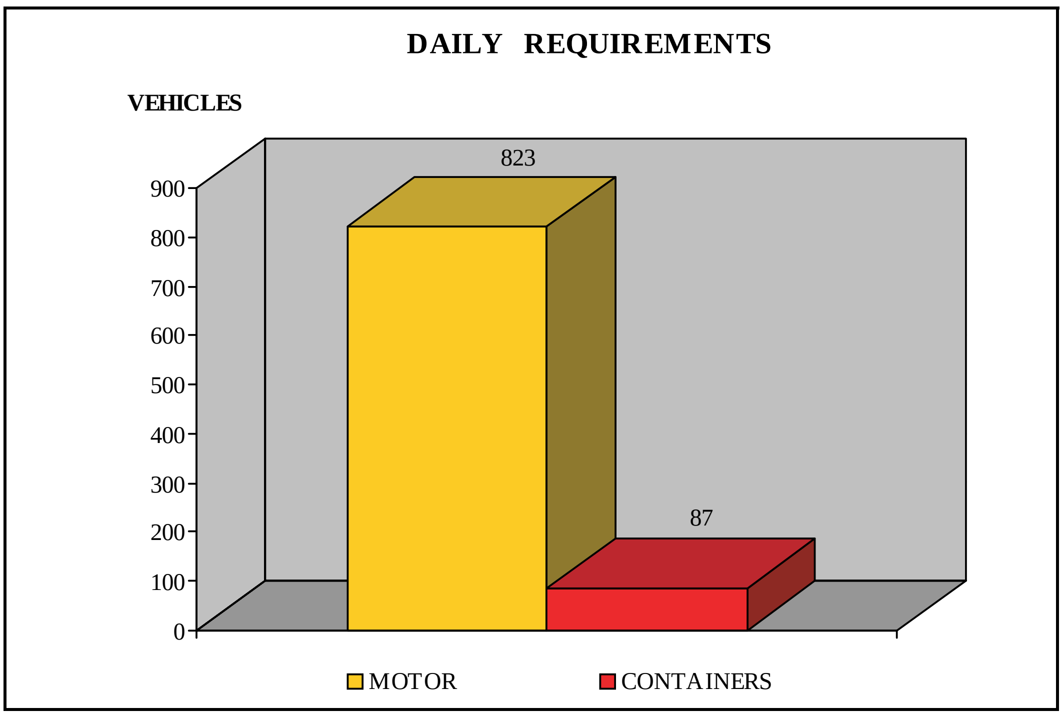


Facilities to Support U.S. Military Operations

REQUIREMENTS

ARMORED DIVISION		
	Total Equipment	Required Daily Throughput
Volume	287,175 MTON	47,862 MTON
Weight	101,342 STON	16,890 STON
Area	1,484,636 SQ FT	247,439 SQ FT
Vehicles*	8,125	1,354
Containers	522	87
*Includes trailers		

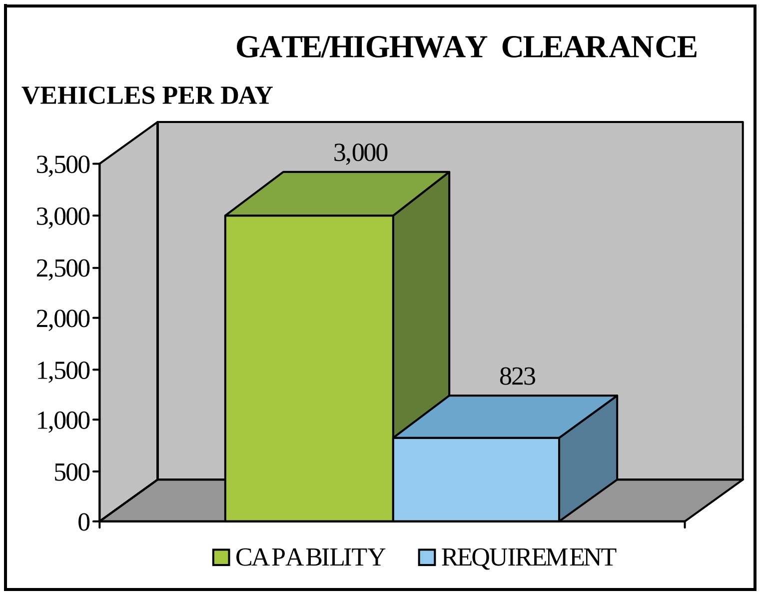
For purposes of this analysis, the likely requirement for the Port of Rashid is to receive a notional armored division. We assume the port must process the division in only 6 days of offloading and port clearance. The country of UAE has no rail. To process the division by road, about 3,752 (625 per day) self-propelled vehicles towing 2,386 (398 per day) trailers, along with 367 (61 per day) forty-foot semitrailers and 1,189 (198 per day) HETS would pass through the gate in the 6 days time. For traffic analysis, this equates to about 823 vehicles (some with trailers or semitrailers) passing through the gate and convoying to Saudi Arabia.



TERMINAL OUTPROCESSING/HANDLING

Highway

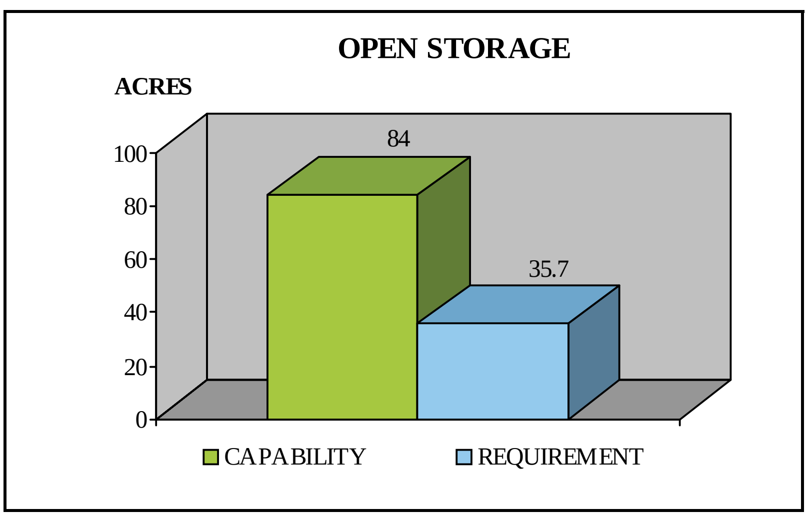
Of the three gates to the port, Gate 3 is the most convenient for operations at Berth 17-21. It has three entrances and exit lanes. Two can accommodate 3,000 military vehicles per day, which is sufficient to meet the requirement.



Assuming a constant flow of vehicles departing the port, the daily clearance requirement is under 900 vehicles. The Dubai road network can easily support the requirement to handle the armored division in 6 days.

Open Storage

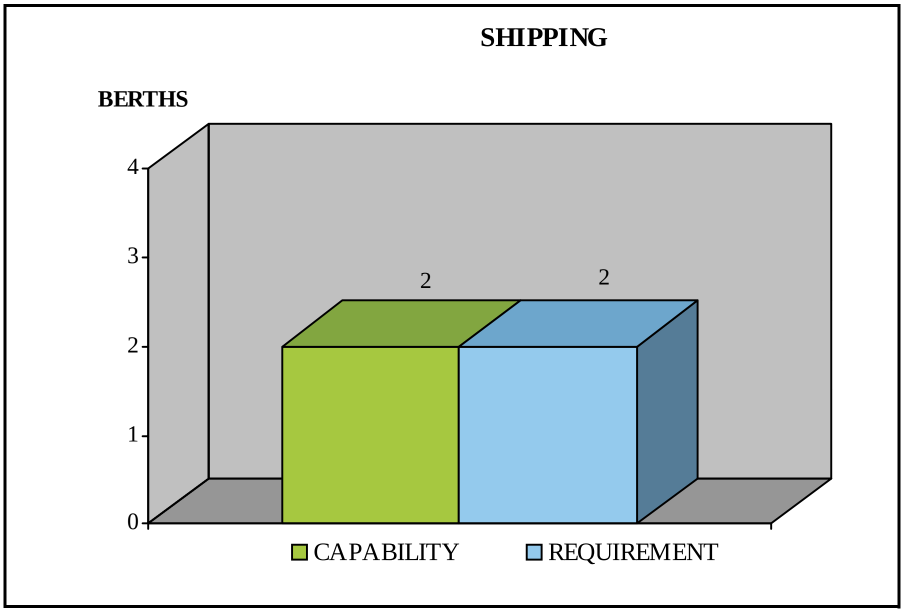
The Port of Rashid has 136 acres of paved open staging area. Most of this area, 84 acres, are at or near the container terminal, Berths 31-35. We assume this adjacent container staging area will support the military operation.



Marshaling the entire division of equipment (1,484,636 square feet) requires 85 acres. We assume the maximum amount in the port at any time is about 2-1/2 days (42 percent) of the required port throughput. This requires the port to provide 35.7 acres of paved open area to support the operation. The port can easily meet the requirement. This requirement is only 42 percent of the staging at the container terminal, Berths 31-35.

SHIPPING

An armored division has 1,484,636 square feet of vehicles and equipment. The deck space on the NASSCO New Construction design is 393,268 square feet.



Each of the NASSCO New Construction design vessels can carry 256,000 square feet of cargo, assuming the 65 percent stow factor discussed above. At this rate, the operation of the division would require just fewer than six of these vessels. Unloading RORO vessels this size can be done in less than 2 days. To meet the 6-day requirement, the port will have to berth two of these vessels simultaneously throughout the entire 6-day reception. Three two-vessel operating cycles are required to receive the entire division with these partially loaded vessels.

Berth 17-21 can support berthing two fully loaded LMSR vessels. This is sufficient to meet the requirement.

The application map earlier in this section provides the berthing configuration.

SUMMARY

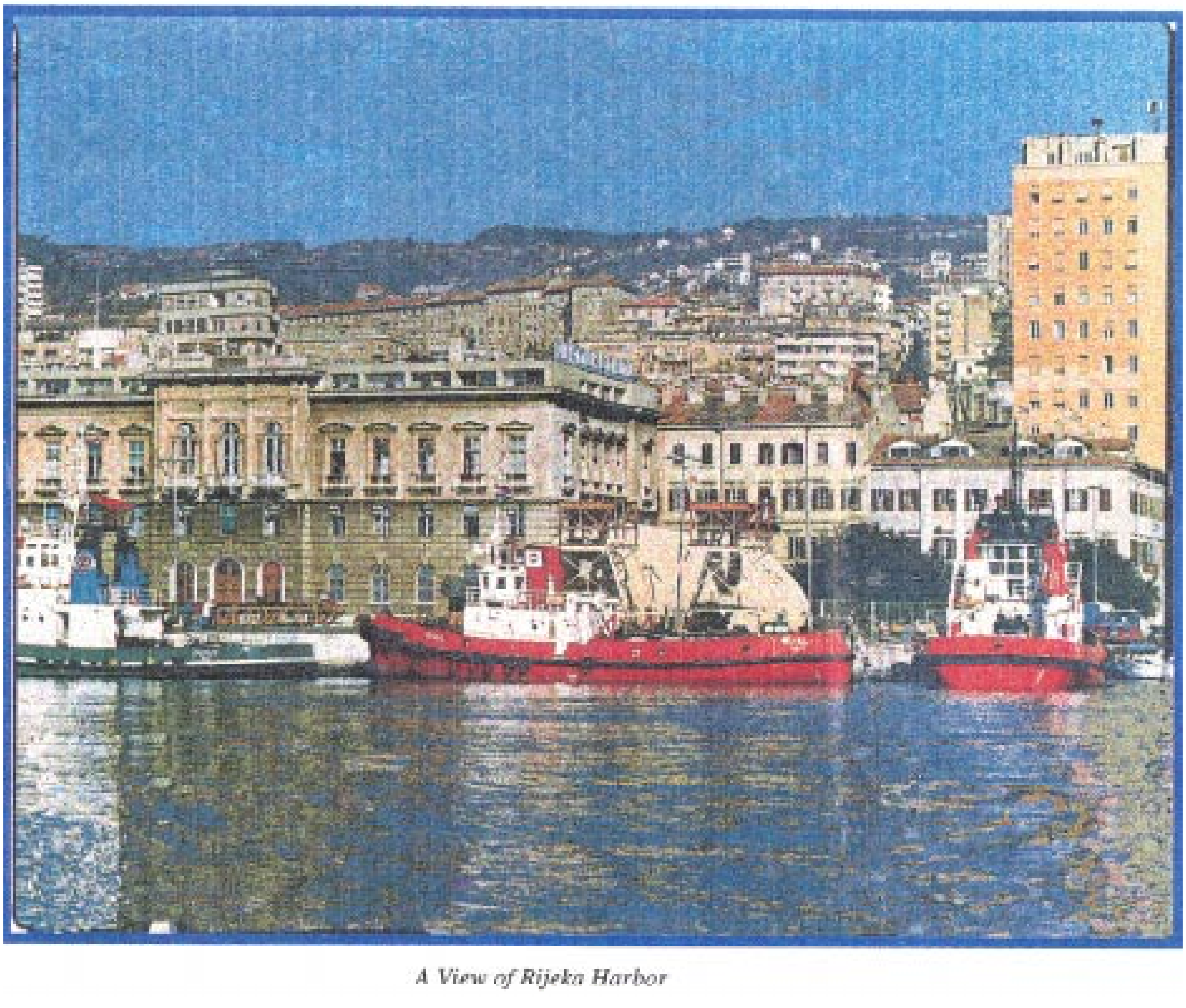
The country of UAE has no rail facilities. Vehicles and equipment must convoy away from the port. The Port of Rashid can process a notional armored division in 6 days.

The port can accommodate LMSR and FSS vessels.

RECOMMENDATION

We recommend the Port of Rashid be considered to deploy division-sized units using LMSR vessels.

PORT OF RIJEKA
CROATIA



A View of Rijeka Harbor

EXECUTIVE SUMMARY

The Port of Rijeka, Croatia is fully capable of supporting military cargo operations. It is the only Croatian port with specialized container cranes and berths. The port can accommodate the largest of U. S. Military Sealift Command vessels, including Fast Sealift Ships (FSS**), up to a berth draft limit of 34.5 feet'**[1].

Port operators at Rijeka identified four berths as capable of providing support to military operations. The most capable berth is the East-West Berth at the Container Terminal. The other berths are the North-South Berth at the Container Terminal, the Becko Quay, and the East Side of the De Francecshiev Pier. Collectively, these four berths can support a daily mixed cargo throughput of about **16,500 STON or 64,400 MTON**. This daily figure is determined by applying an expected ship mix to the overall capabilities of each berth. Total daily throughput estimates by cargo mode are: **Breakbulk..3,500 STON or 8,750 MTON, RORO....17,700 STON or 70,800 MTON (limited by staging to about 12,600 STON or 32,000 MTON, and Container...5,650 STON or 14,500 MTON.**

Over time, military sustainment cargo operations can expect to throughput **about 5,000 STON or 15,000 MTON** per day using the recommended berths. Other ongoing commercial operations in the port and limitations in recycling trucks will prevent some of the port's capability from being dedicated to military support. **About 4,000 STON or 12,000 MTON** per day via rail and about **1,000 STON or 3,000 MTON** per day by truck seem reasonable throughput estimates.

If vessels loaded with unit equipment discharge at the port, then daily throughput capability will increase as a result of self deploying vehicles moving inland from the port in convoys up to the daily limit shown above.

Highway and rail connections from the Port of Rijeka inland to Zagred were open and passable when the survey team visited the port. Other links are not considered in this report.

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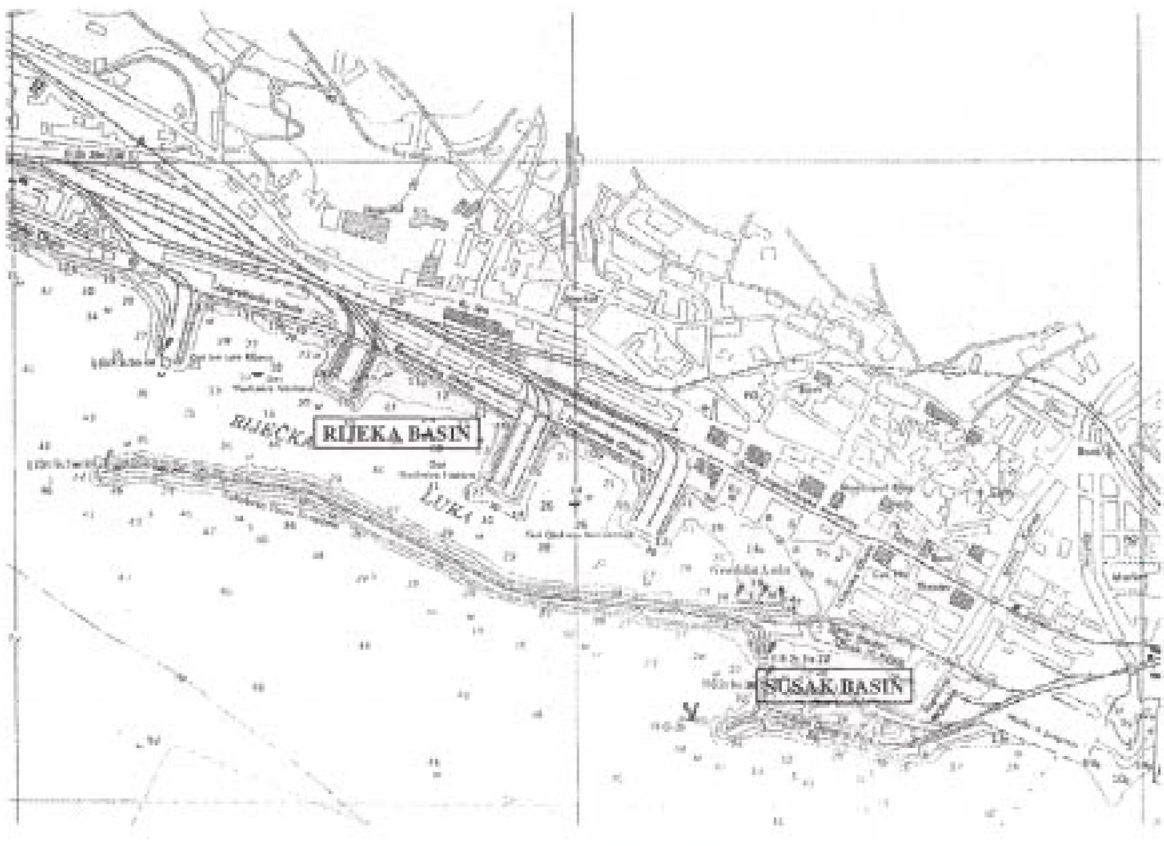
[1] Berth East-West at the Container Terminal (970 feet long) has 36 feet depth alongside except for the Easternmost 184 feet, which has 34.5 feet depth.

I. GENERAL DATA

TRANSPORTATION ACCESS

WATER

The Port of Rijeka (Lat. 45º 19' North, Long. 014º 26 East) is located on the Kvarner Bay on the North West Adriatic coast of the Republic of Croatia. The port is in a sheltered harbor. The port is divided into two basins, the Rijeka Port Basin and the Susak Port Basin. The entrance to the Rijeka Port Basin from the bay is 270 meters wide, while the enclosed portion of the Susak Basin is 45 meters wide. Both basins are protected by breakwaters, but the container terminal, although considered as Susak Basin, is approached directly from the bay.

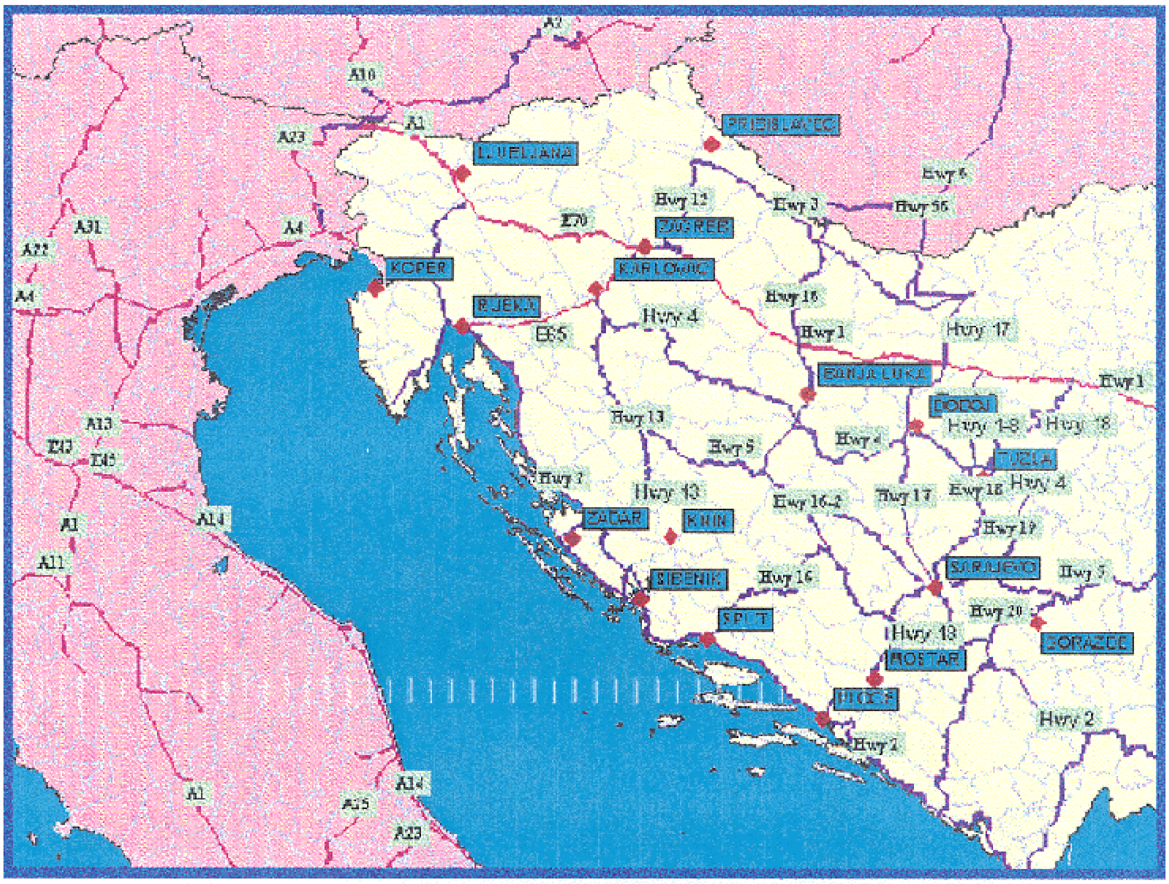


Water Access Map of Rijeka

HIGHWAY

Rijeka is located on the west side of the Dinaric Alps mountain range. These mountains effectively separate the coastal region from the rest of the country. Three highway routes connect the town to the rest of Croatia and other European destinations.[2]

The most important of these is the European E65/Croatian Highway 12, a major east-west highway in Croatia. This route connects Rijeka to the national capital, Zagreb, and the eastern portions of the country.



Highway Map of Rijeka Region

The other routes connect the port to the southern region of Croatia, and to the north with Slovenia and central Europe, Croatian Highway 2, North and South. All routes are rather mountainous, and offer significant accessibility problems in winter as a result of snow and ice. During the survey visit to the port, the trip from Zagreb to Rijeka, a distance of only 110 miles took more than 5 hours by car due to snow conditions. The town of Rijeka is built paralleling the port, so most of the roads and streets in the town either access the port directly or connect with another that does. The principle street along the port frontage is Riva Boulevard.

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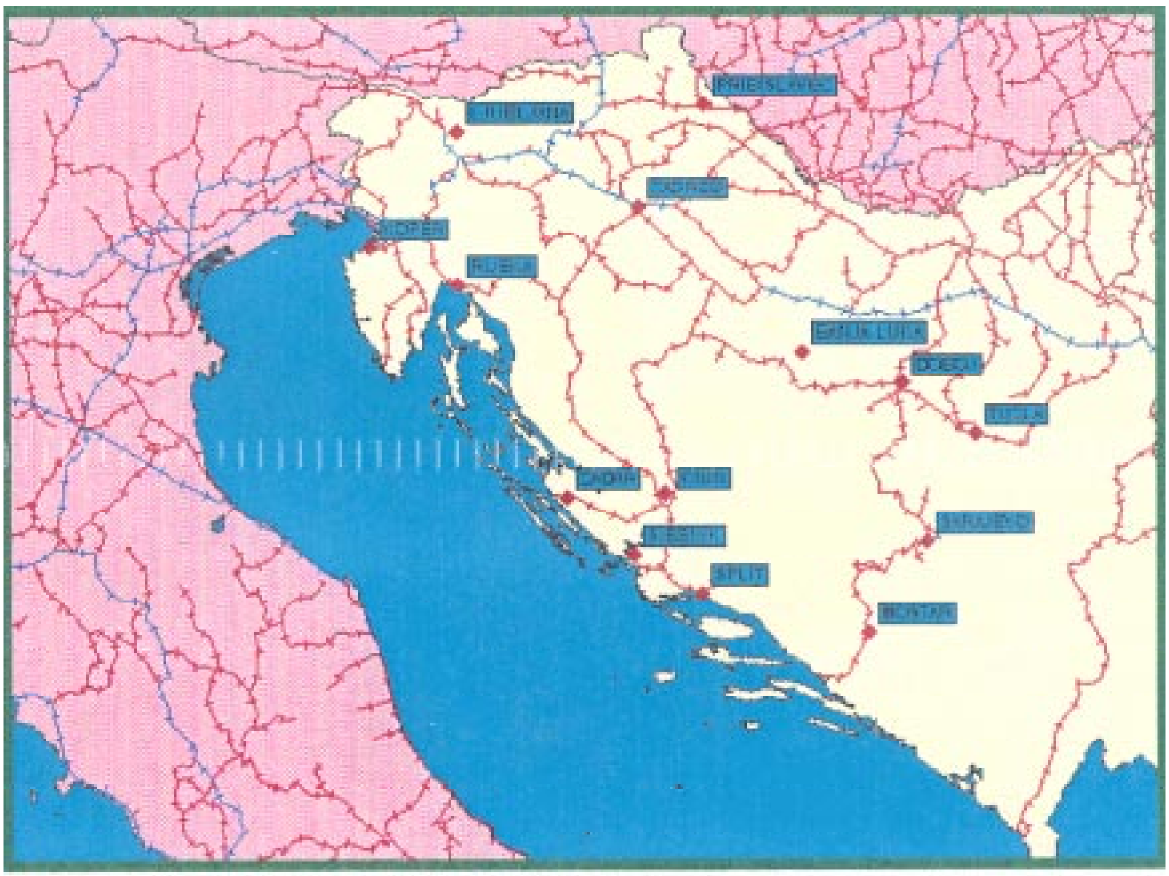
[2] Highway infrastructure between Rijeka and Zagreb, as well as routes to Slovenia and Central Europe are open and passable. Links to the Eastern Regions of Croatia and to Bosnia are not addressed in this report and may not be open or passable.

AIR

The town of Rijeka is not served by an operating commercial airport. There is a small general aviation airfield, formerly used by the Yugoslavian Air Force, about 5 miles northeast of the town. Currently, locals use this facility as an auto racing track. Light aircraft as well as helicopters could possibly use this facility with the approval of local authorities.

RAIL

The Port of Rijeka is served by the Croatian National Railway's east-west and north-south railway lines. These lines link the port to Zagreb (east-west) and the European Railway Network via Ljubljana, Slovenia.[3]



Railway Map of Rijeka Region.

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[3] Port authorities informed the survey team that the rail line to Zagreb is open and passable. This report does not address lines beyond Zagreb into Bosnia.

Most Croatian railroads are single line with adequate passing points along each route to ensure flow. According to port operating authorities, rail cargo on these lines must meet the requirements the “Normal” profile of the Berne International Railway Clearance Diagram (Appendix C). One tunnel restricts the line between Rijeka and Zagreb. The tunnel clearance prohibits large outsized equipment like M1 Abrams tanks from moving over the line. The Croatian railway doesn't have any of the eight axle rail cars typically used to transport heavy tanks over European railways.

Most containers moving through the port move via rail (COFC).

PORT FACILITIES

BERTHING

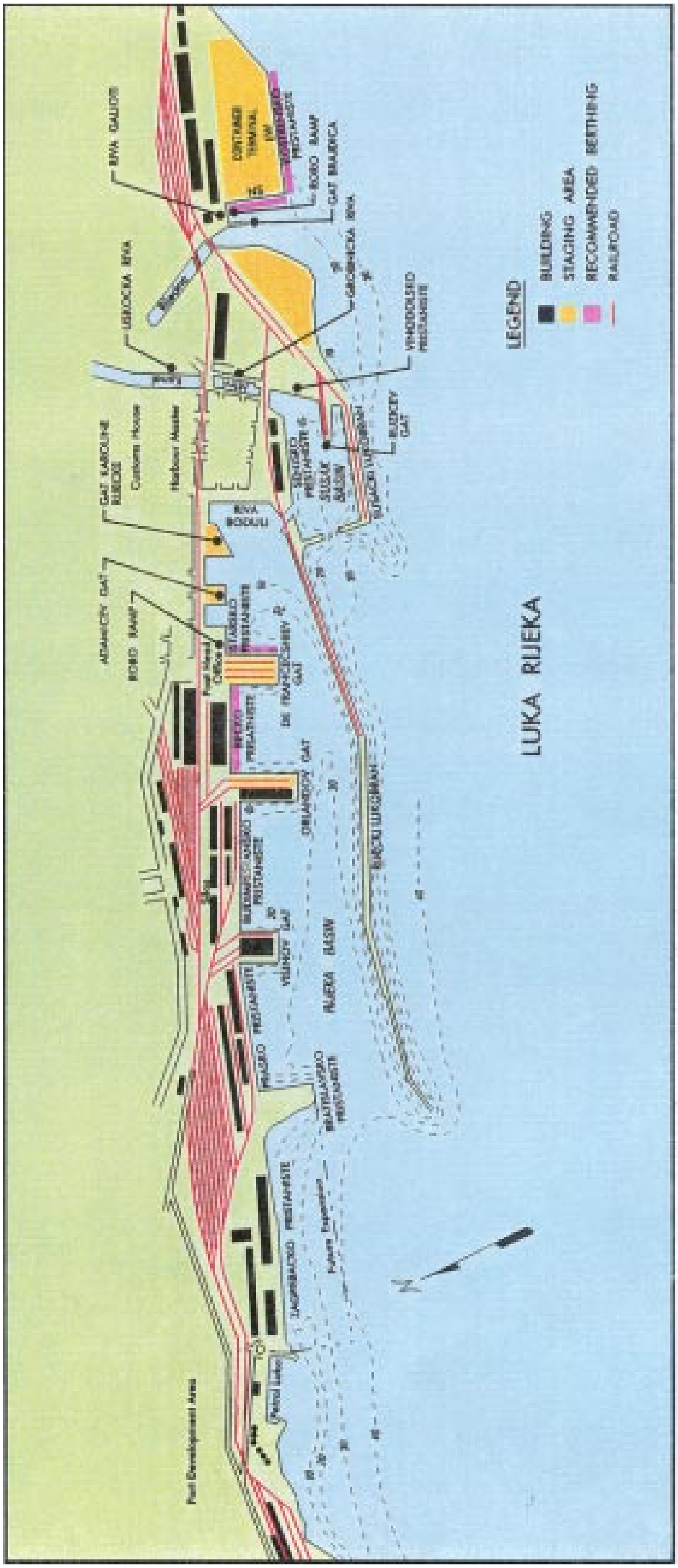
Four piers and six quays (see Site Plan) provide about 22 berths of varying lengths and depths at the port. Most of these have insufficient depth alongside to support military operations with standard Military Sealift Command vessels. Three areas though, offer berths with suitable length and depth to provide the support that military operations will require. The best of these is the container terminal, on the Susak Basin, or East side of the port. This terminal has two berths, one of about 970 feet in length with about 34.5 feet minimum depth alongside. (This berth has about 787 feet length with about 36 feet depth alongside, the easternmost 184 feet of the berth is 34.5 feet deep.) The other berth is about 535 feet long with over 39 feet depth alongside. This berth is served by a fixed stern RORO ramp about 200 feet wide. Port authorities indicate that straight stern ramp RORO vessels perhaps as long as 820 feet can berth there with over hang by the bow of the ship as great as 300 feet. Both of these berths are served by 40 ton container gantry cranes.

The other areas are the Becko Quay (formerly Ljubljanska Quay), and the De Francecshiev Piet (formerly Kersovani Pier), with the adjacent Istarsko Quay. The Becko Quay is about 807 feet long with about 29.5 feet depth alongside. The De Francecshiev Pier area offers a berth length of 492 feet with a depth alongside of about 24.5 feet. The berth also has a RORO ramp that can accommodate straight stern RORO vessels as long as 558 feet long (with about 70 feet of overhang by the bow. The Istarsko Quay also has a RORO ramp that can accommodate straight stem ramped vessels, but only in a Mediterranean Mooring position. The length of a vessel here has the same limitations as at the De Francecshiev Pier.

Since gaining its independence from the former Yugoslavia, Croatia has changed the names (of many public places to reflect a nationalist sentiment. In this regard, the port has changed the names of most of the berths at Rijeka. Many of the maps and charts available show only the old names of the port facilities. The following charts show the old name, followed by the new one.

OLD NAME	NEW NAME	OLD NAME	NEW NAME
Splitska Quay	Zagrebacka Quay	Imaj Pier	Adamcev Pier
I L Ribara Pier	Bratislavsko Pier	29.XI Pier	Karoline Rijecke Pier
Zagrebacka Quay	Prasko Quay	Tracanska Quay	Riva Boduli
V L Gortan Pier	Visinov Pier	Rujna Quay	Senjsko Quay
Beogradska Quay	Budimpestansko Quay	Supilova Quay	Vinodolsko Quay
V L Nazor Pier	Orlandov Pier	Barcic Pier	Ruzicev Pier
Ljubljanska Quay	Becko Quay	Container Terminal	Kostrensko Quay
Kersovanija Pier	De Francecshiev Pier		
Istarska Quay	Istarsko Quay		

All of the recommended berths are served by apron rail except the Container Terminal berths, which have rail access to the rear of the berth area.



Site Plan of Port of Rijeka

PORT OF RIJEKA
BERTH CHARACTERISTICS

	BERTHS[4]				
Characteristics	**Becko**	**De Fran East**	**DeFran RORO[5]**	**Cont. NS**	**Cont. EW**
Length (ft)	807	492	558	535[6]	970
Depth alongside at MLW (ft)	30	25	38	39	36[7]
Deck Strength (psf)	600	600	NA	800	800
Apron width (ft)	65	OPEN	NA	OPEN	OPEN
Apron height above MLW (ft)	13	13	13	13	13
Number of container cranes	0	0	NA	1	1
Number of wharf cranes	3	1	NA	0	0
Apron Lighting	YES	YES	YES	YES	YES
Straight-stern RORO facilities	YES	YES	YES	YES	NO
Apron length served by rail (ft)	807	492	NA	0	0

[4] These are the preferred berths at the Port of Rijeka. Other berths are either inadequate as a result of insufficient depth alongside, too short, or because of specialized cargo being worked there. Characteristics or remaining berths are catalogued in the Crisis Action Port Study of the same port, Rijeka.
[5] This is not a separate berth, but the De Francecshiev East berth used for a Mediterranean Moored RORO vessel. Vessel extends beyond berth limit. The Med Moor RORO Berth at the Istarsko Quay is identical to this berth.
[6] Stern ramped RORO vessels moored here can extend beyond the berth limit. Maximum vessel length up to 820 feet for this berth, on a case-by-case basis.
[7] Berth has 36 feet depth alongside except for the Easternmost 184 feet which is 34.5 feet deep.

PORT OF RIJEKA
SUMMARY OF BERTHING CAPABILITIES

VESSELS		BERTHS					
TYPE	CLASS	Becko	De Fran East	De Fran RORO	Cont. NS	Cont. EW	
BREAK	C3-S-38a	1	a	0	1	1	NOTES:
BULK	C4-S-58a	a	a,c	0	c	1	a-vessel draft limit
	C4-S-66a	a	a,c	0	c	1	b-inadequate apron width
	C5-S-37e	1	a,c	0	c	1	c-inadequate berth length
BARGE	LASH C8-S-81b	0	0	0	c	1	d-no straight stern ramp
	LASH C9-S-81d	a,c	a,c	0	c	a	e-no container handling equipment
	LASH Lighter	4	2	0	2	4	f-anchorage depth OK, berth depth
	SEABEE C8-S-82a	a,c	a,c	0	c	a	inadequate
	SEABEE Barge	4	2	0	2	4	g-inadequate channel depth
RORO	Jolly Smeraldo	a	a,c	a,c	c	a	h-no shore based ramps
	Isola Delle Perle	i,j	c,d	i,j	c,i,j	1,d	i-low tide insufficient ramp clearance
	Galini	i,j	i,j	i,j	i,j	i,j	j-high tide insufficient ramp clearance
	Arcade Falcon	i,j	i,j	i,j	i,j	i,j	k-excessive ramp angle low tide
	Golfo Dei Fiori	1,i	1	1	1,i	2,d	m-excessive ramp angle high tide
	Ani	i,j	i,j	i,j	i,j	i,j	n-parallel ramp operation ONLY
	MV Goya	i,j	1	1	i,j	3,d	o-insufficient apron width for side ramp
	Cape I-class	a	a,c	c	c	i,j	
	Cape Victory	1,i	a,c	c	c	1,i	
	COMET	i,j	a,c,d	i,j	i,j	d,i,j	Ramp clearance and angle based on
	METEOR	i,j	a,c,d	i,j	c,i,j	d,i,j	maximum vessel draft
	Cape Gnome	a,i,j	a,c,d	c,i,j	c,i,j	d,i,j	
	C7-S-66a	a	a,c	c	c	1	+ May Prevent Operation
	Cape Taylor	1	a,c	c	c	1	
	Cape Orlando	i,j	a,c	c	c	i,j	+ May Limit Operation
	MV Ambassador	1,m	c	1,m	1,m	d	
	Callaghan	1,i	a,c,d	c,i	c,i	1,d,i	
	Cape Lambert	a	a,c	c	c	i,j	
	FSS	a,c	a,c	c	c	1,a	
	Cape R	a,i	a,c,	c,i	c,i	1,d,i	
	Cape E	a	a,c	c	c	i,j	
	Cape D	a	a,c	c	c	i,j	
	Cape H	a	a,c	c	c	i,j	
	Cape Texas	i,j	a,c	c	c	i,j	
CONT.	C6-M-147a	1,e	a,c,e	c,e	c	1	
	C7-S-69c	a,e	a,c,e	c,e	c	1	
	C7-S-68c	a,e	a,c,e	c,e	c	1	
	C8-S-85c	a,c,e	a,c,e	c,e	c	1	
	C9-M-132b	a,c,e	a,c,e	c,e	c	1	
	C9-M-F141a	a,c,e	a,c,e	c,e	c	a	
AUX	C6-S-1qd	a	a,c	c	c	1	
CRANE	C5-S-MA73c	a	a,c	c	c	1	
	C6-S-MA60d	a	a,c	c	c	1	
MPS	C7-S-133a	a,c	a,c	c	c	1	
	Meerak	a	a,c	c	c	1	
	AmSea	a	a,c	c	c	1	

NOTE: Vessels showing a berthing limitation due to no available straight stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight stern ramp. Not all berths will provide this facility.

STAGING

OPEN STAGING

The port of Rijeka has about 56.5 acres of open staging available for use. This area is spread throughout the port, with much of the available area, about 20 acres, adjacent to the, container terminal.

COVERED STAGING

The port has a number of storage sheds, totaling 855,000 sq. ft., located throughout its operating area. Three large storage buildings support the container terminal area. These buildings provide about 290,000 sq. ft. of storage space there.

RAIL

The port is well served by the railroad. Almost all of the berths are served directly by rail, with rail lines extending along most berth aprons. Only the Container Terminal berths are without apron tracks, but these berths have rail loading tracks just inland from the wharf edge. The port area has three rail interchange yards in the immediate vicinity. One of these is behind the container terminal, and the other two are in the rear of the Budimpestansko and Prasko-Zagrebacko Quay areas. These yards collectively appear capable of storing more than 300 railcars.

Many of the containers moving through the port enter and leave as COFC over the port's rail connections.

HIGHWAY

Many of the town's streets access the port directly. Most of these are extremely congested. Convoys entering or leaving the port will require police escort through the town center to or from the main highway.

UNLOADING/LOADING POSITIONS

RAMPS

The Port of Rijeka has a fixed rail loading/unloading ramp. The ramp is in the rear of the Container Terminal. The ramp is a **side** loading ramp, 110 centimeters above the rail height, with direct access (unlike end ramps that permit "circus" style loading or unloading) for about 15 European standard rail flatcars (60 feet long).

DOCKS

No docks exist for truck loading at the port. If required, portable or temporary loading docks/ramps will have to be procured or constructed. Likewise, there are no docks/platforms for loading boxcars at the port of Rijeka.

MARSHALING AREAS

No marshaling areas exist near the port. The only areas that could support marshaling requirements are the open staging areas around the piers and quays. The most useful open staging area, about 870,000 square feet, is in the vicinity of the Container Terminal.

MATERIALS HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity (STON)	Quantity	Wharf Assignment
Container Cranes	48	1	Container NS
	48	1	Container EW
Transtainer	32	4	Container Terminal
Wharf Cranes	32	1	De Franceeshiev Pier
	3	1	De Franceeshiev Pier
	5	3	Orlandov Pier
	3	7	Becko Quay
	3	4	Prasko Quay
	6	2	Prasko Quay
	5	4	Rijeka Breakwater
Floating Crane	350	1	Port Area
Container Stacker	40	2	Container Terminal
Container Handler Fork Type	40	4	Container Terminal
	100	1	Port Area
Forklifts	Various	Many	Port Area

EXPLOSIVE AND DANGEROUS CARGO OPERATIONS

Port authorities informed the survey team that loading/unloading of explosive or other dangerous cargo is permitted with prior arrangement. Cargoes of this nature must be either first off or last on and loaded directly to or from transport. Onward movement must be coordinated with local and national police agencies. No limit has been set for Net Explosive Quantity (NEQ) or Net Explosive Weight (NEW) of explosives. Each shipment will be processed on a case-by-case basis. Shipments must comply with International Maritime Organization, which regulates carriage of dangerous goods aboard ship, and US Code regulations for movement of dangerous goods.

POL OPERATIONS

There are three areas under the control of the Rijeka Port Authority for handling POL tankers. At Bakar there are two tanker berths accommodating vessels up to 80,000 DWT, and one berth for tankers up to 40,000 DWT. At the Urinj Oil Refinery there is a berth for tankers up to 200,000 DWT. Another facility, the Omisalj Oil Terminal, has two berths for tankers up to 350,000 DWT.

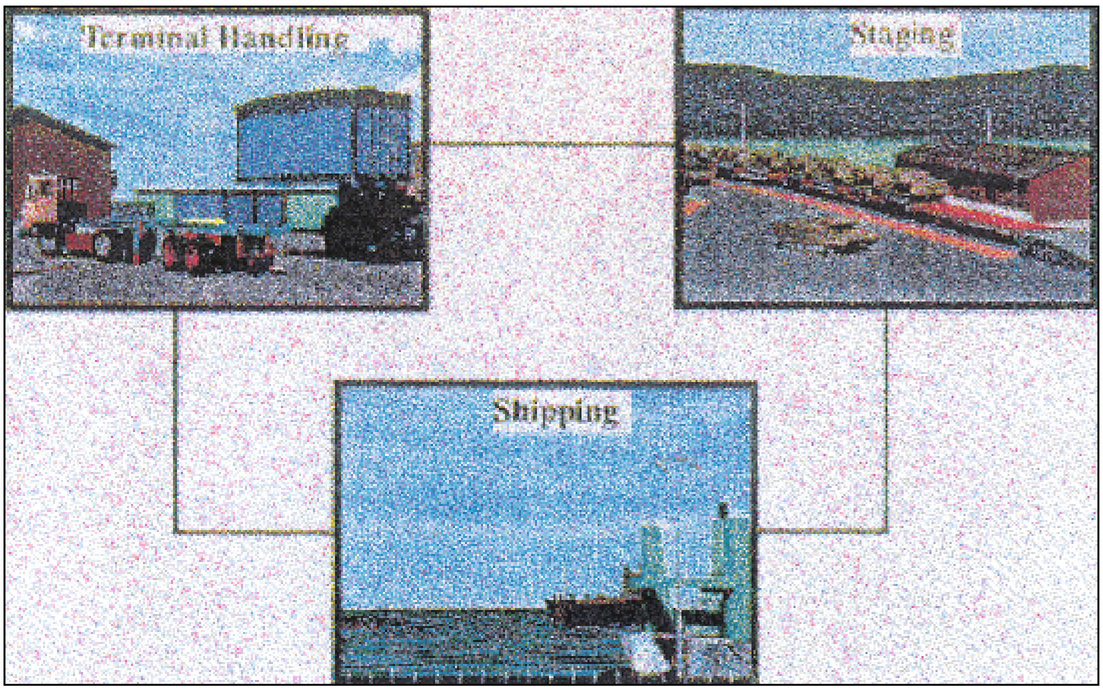
Port representatives told the survey team that arrangements for receiving, storing, and distributing POL products in bulk are possible from one of the areas. They indicated that the refinery produces gasoline and jet fuel in several grades. Storage would be accommodated in one of two ways. The first alternative was for mixed storage in tanks holding general products, with the facility operator certifying the content of distributed products. The other was for accommodating our products in another tank holding them exclusively. The decision would be based upon our needs and desires.

Distribution of POL bulk products throughout the country is accomplished by rail and commercial truck tankers. Our contacts saw no problems securing sufficient distribution means for POL.

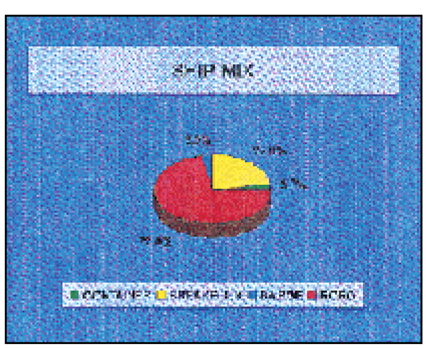
II. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Rijeka. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading, staging, and terminal handling. The weakest subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of short tons (STON) and measurement (MTON) tons per day.



Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected sites 80 percent of the time. In developing the throughput scenario, we took statistical data from Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

HIGHWAY

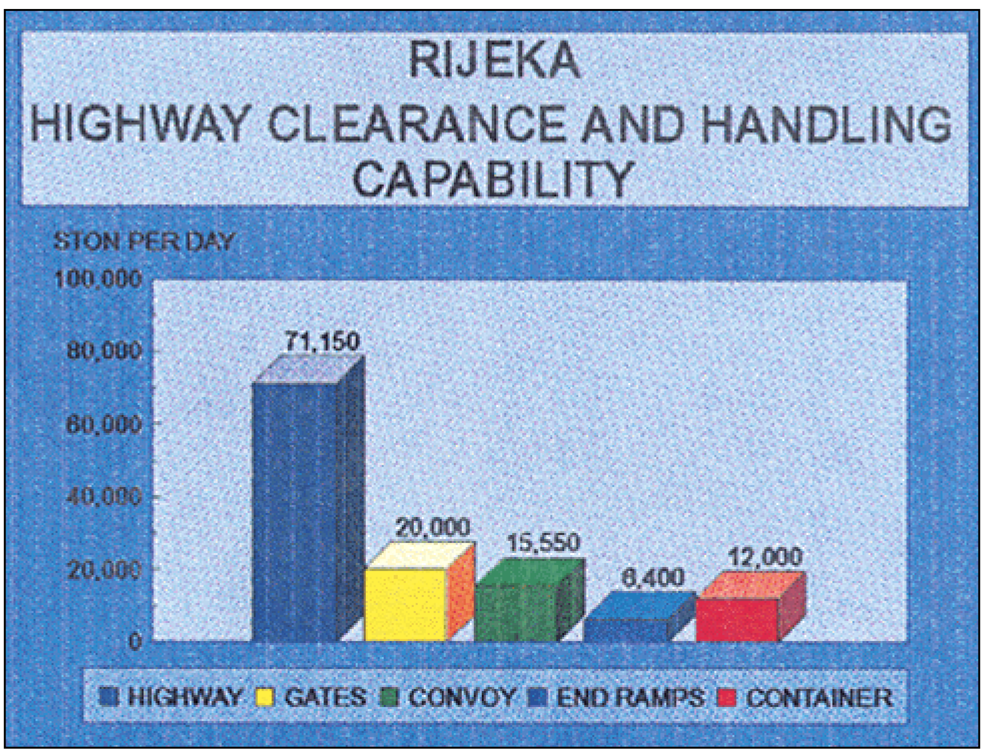
The port is connected to the Main Supply Route, E-65/Highway 12, by two fairly congested city streets. The routes into and out of the port complex, including the two gate processing systems can handle over 20,000 STON of equipment and supplies daily.

Roadable vehicles will move directly through the terminal gates in manageable convoys from staging/marshaling areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a self loading capability, will depend on portable ramps. No ramps exist in the port so they must be constructed or otherwise procured locally. The POPS analysis assumes two ramps at each of the major support sites, the Container Terminal and Becko Quay areas. These ramps will handle about 6,400 STON of military cargo per day.

The port has no truck docks.

The port has 4 transtainers (wheeled) in the Container Terminal, as well as two reach stacker and four forklift type of container handlers. Assuming half of this equipment is available to support container chassis operations, the port could handle over 12,000 STON per day. This assumes a conservative 300 moves per day.

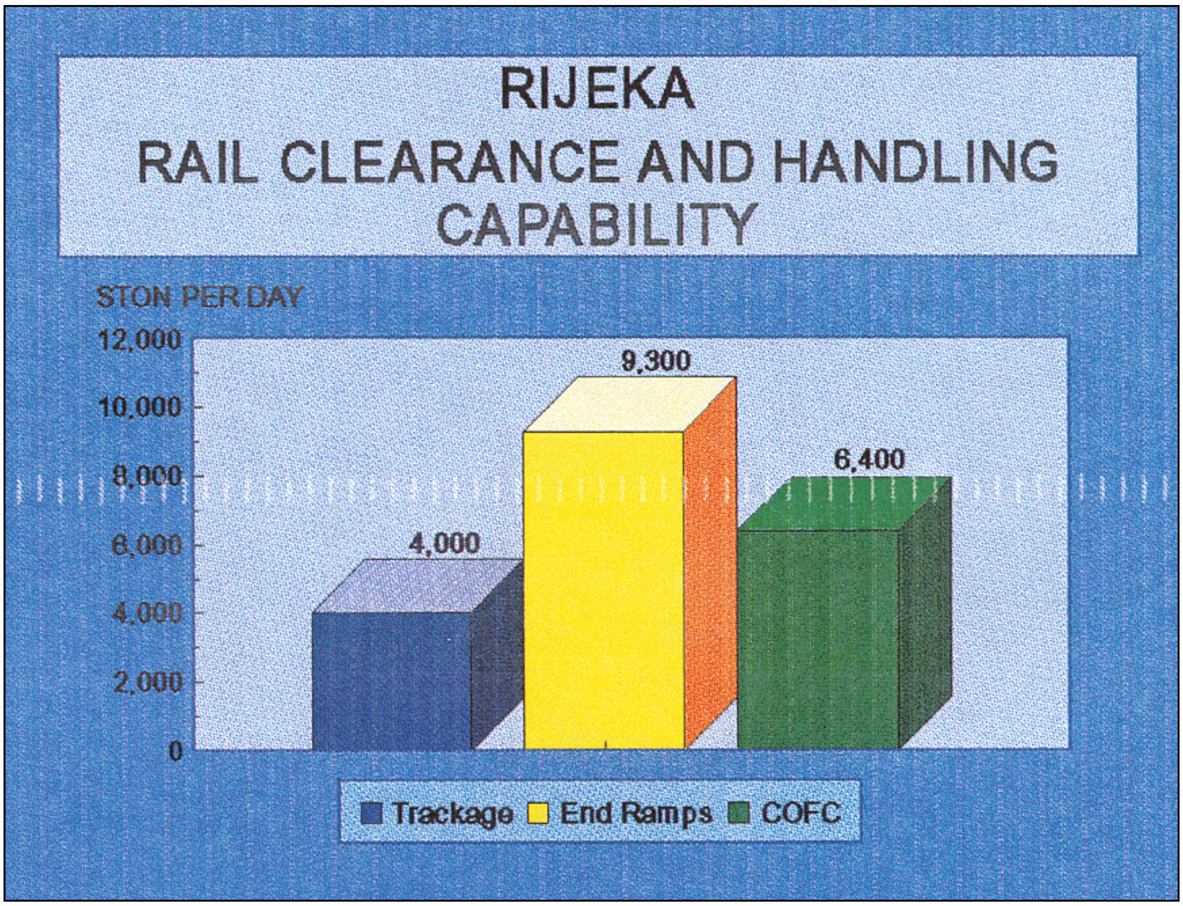
Maximum daily handling capability for the port is a mixed total of the three types of handling, each up to its maximum, not to exceed the highway limit of 20,000 STON.



RAIL

The Croatian National Railway can move at least 4 trains per day of about 20 cars each from the port in support of military operations. This trackage limit is about 4,000 STON. Vehicles loading to flatcars can load directly via the side ramp located in the Container Terminal. This ramp supports about 15 flatcars per shunt. The port doesn't have other ramps, whether end or side, for loading to railcars. If required, operators could construct an end ramp that could be sited at any of several locations throughout the port.

Given the existing ramp and container handling equipment, the port can easily support the 80 railcars a day the railway will likely provide for military trains. More than the four, 20 car trains may become possible through coordination with railway and port officials.

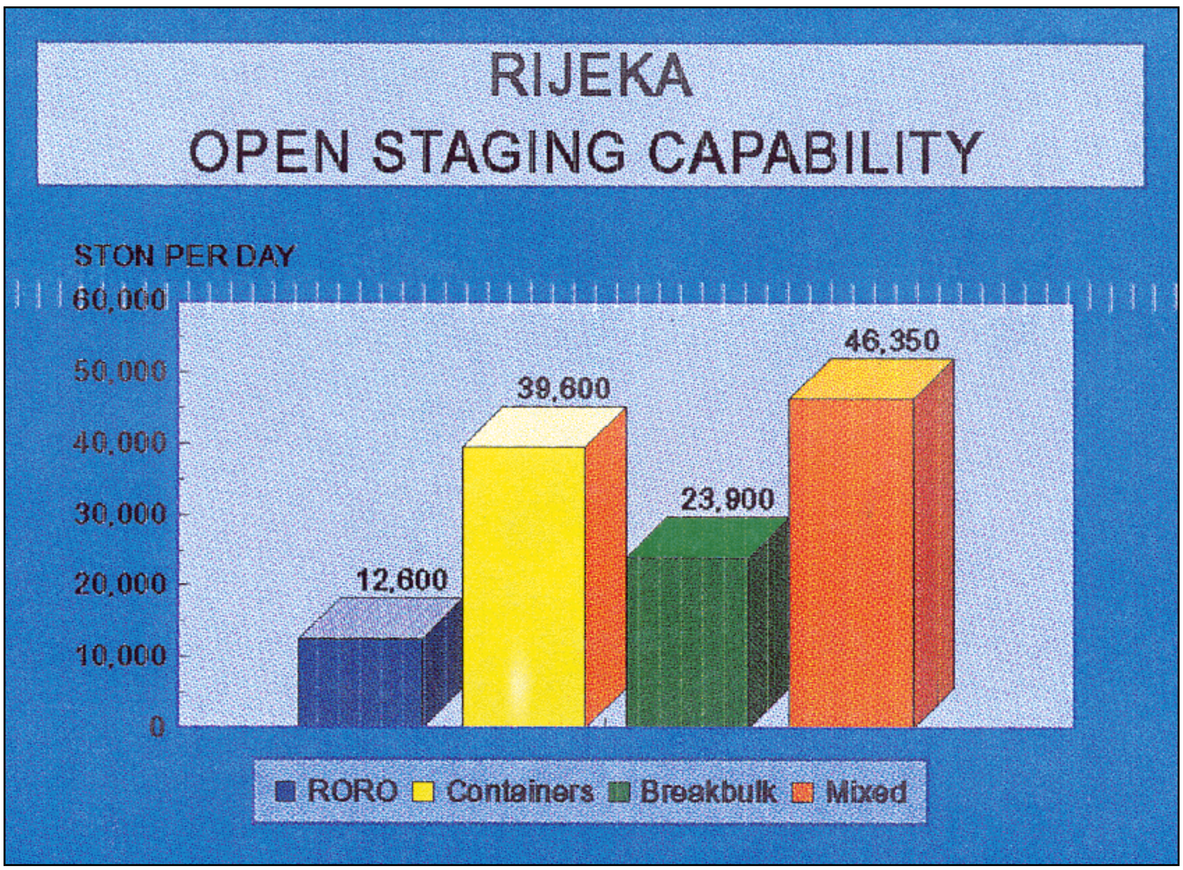


STAGING

The port has about 56.5 acres of suitable staging area (paved) distributed throughout its working area. The largest single block of this, about 20 acres is located adjacent to the container berths. Availability of the areas varies constantly. There are usually a number of containers stacked at the container terminal. Port operators assured the survey team that they will make sufficient, suitable area available to support military operations.

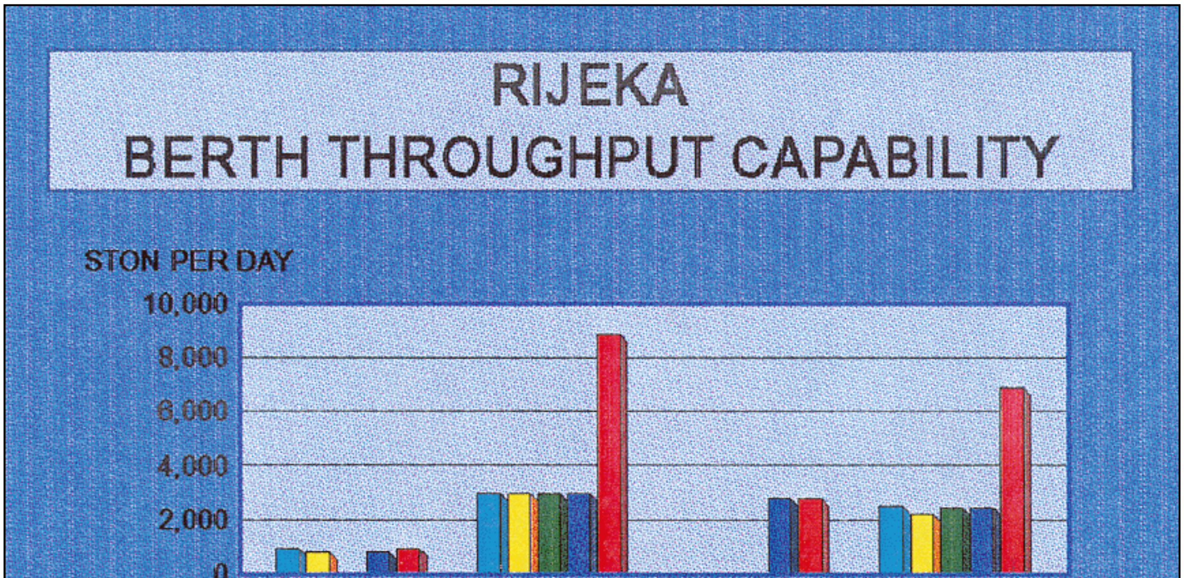
The port also has about 855,000 square feet of covered storage space. Like the open area, much of this is usually in use, storing cargoes moving through the port. However, covered space will be made available as required by military deployment operations.

The chart shows the available storage space in the areas of the recommended berths, and the various cargo amounts by type that can be stored there. The analysis assumed that about 13.5 acres of open staging area would support military operations. The analysis considered about 400,000 square feet of the available covered space.



SHIPPING

Throughput totals for the recommended berths appear in the chart below. They are based on various factors including MHE availability; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. Assumptions and parameter values used for the POPS analysis are shown in appendix AI.

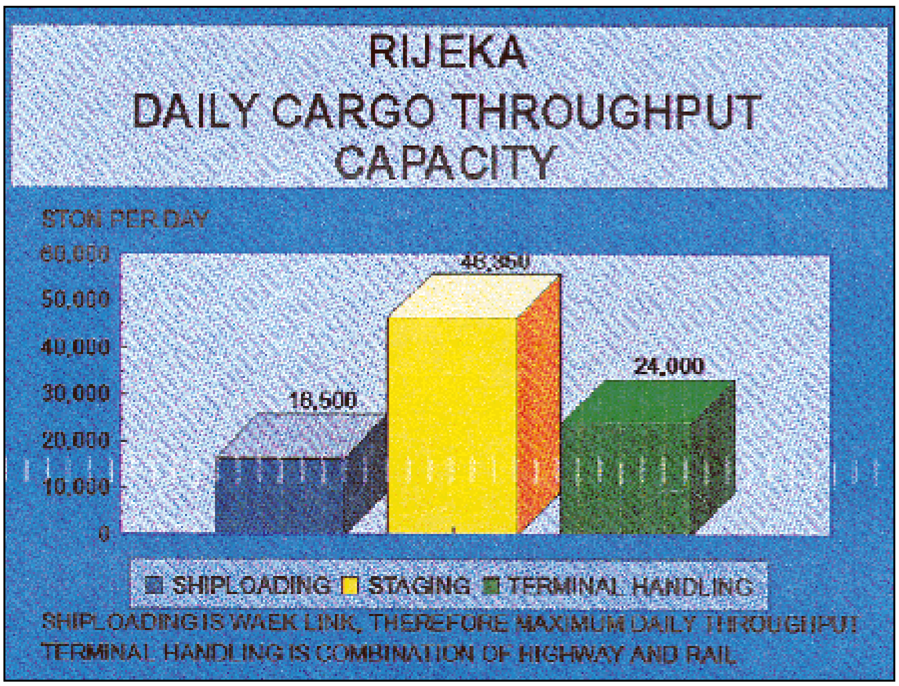


	Breakbulk/Barge	RORO	Container	Mixed
BECKO	950	2,950	0	2,500
DE FRAN E	800	2,950	0	2,200
DE FRAN RO	0	2,950	0	2,450
CONT NS	800	2,950	2,800	2,450
CONT EW	950	8,850	2,800	6,900
	3,500	20,650	5,600	16,500

II. CONCLUSIONS

The Port of Rijeka is fully capable of supporting US Military Cargo Transshipment Operations. The port is a fairly modern (container terminal) facility capable of accommodating vessels as large as the Fast Sealift Ship, **up to the draft limits shown** in the Berthing Characteristics Table.

Of the transportations subsystems analyzed, the least capable is the ship loading/unloading subsystem. Vessel loading/unloading is limited to about **16,500 STON** per day of mixed cargo types. The other subsystems have greater capabilities than this, although the **RORO** staging capability is limited to about **12,600 STON**. This is for the four berths identified by port authorities as being the most likely sites to support military operations.



Actual daily throughput, sustainable over the long term, will be further limited by other commercial operations taking place concurrently in the port. The most likely scenario, given past experience in ports of this type, is for the daily rail throughput to be about equal to the track capacity for military trains shown on the chart, about **4,000 STON** per day, and highway throughput to be limited by the available trucks and the cycle times of same. As much as **1,000 STON** per day with trucks is reasonable. The sum of these capabilities is **about 5,000 STON** per day.

If the port is used to receive unit equipment, then self deploying convoys can increase the throughput estimates up to the daily shipping subsystem capacity.

APPENDIX A

THROUGHPUT PARAMETERS

BREAKBULK RATES		
Ship Operational Rates	**STON/Hr**	**MTON/Hr**
Ship Crane	15.0	37.5
Dockside Cranes	20.0	50.0
Barge	20.0	50.0
RORO Rates	200.0	800.0
Container Lift Rates	21.0 Lifts/Hr Container Crane	8.0 Lifts/Hr Wharf Crane
Berth Utilization Factor = 0.8		

SHIP MIX PERCENTAGES	%
Breakbulk	22
Barge	3
RORO	72
Container	3

MINIMUM MOBILE CRANE SIZE	STON
Breakbulk	40.0
Barge	20.0
Container	100.0

SHIP CARGO MIX			
	Breakbulk	**RORO**	**Container**
Roadable Vehicles	43%	90%	
Nonroadable Vehicles	7%	10%	
Container	15%		100%
Noncontainer	35%		

APPENDIX A

THROUGHPUT PARAMETERS - *cont*

STAGING DATA	
Staging Dwell Time	2 Day
Space Utilization Factor	
Open	70%
Covered	65%
Facility User Factor	100%

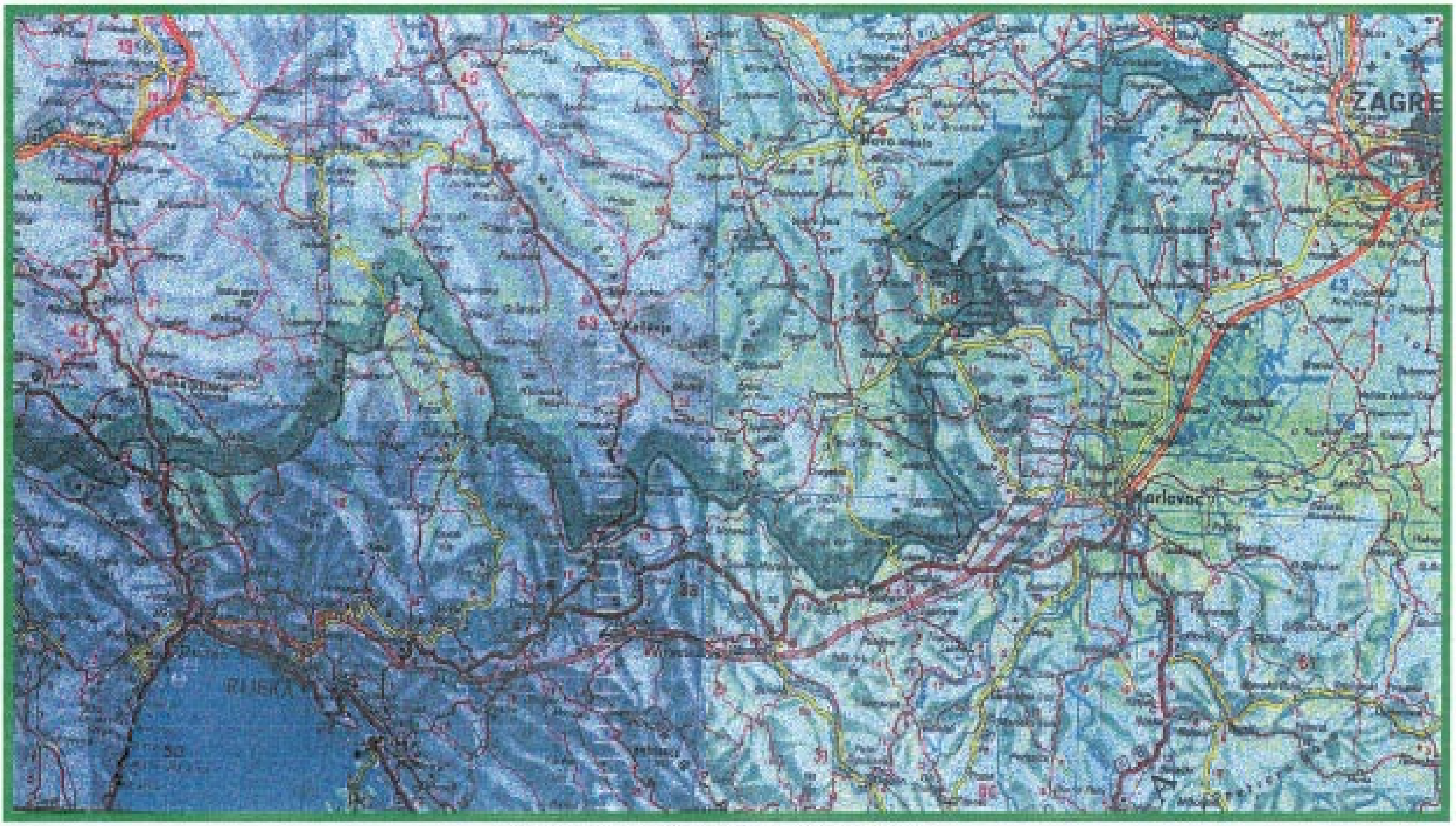
Stacking Height	Feet
Open - General	20
Covered	10
Open Vehicle	7.6

Motor Vehicle Parameters	STON	MTON
Convoy	5	30
Flatbed	20.0	60
Van	16	40
Chassis	16.0	40.0
Railcar Parameters	**STON**	**MTON**
Flatcar	50	150
Boxcar	30.0	75.0
COFC	24	60
Container (TEU) Capacity	8.0	20.0

Trucking Handling Rates	Trucks/Hr
End Ramps	4
Van Docks	1
Railcar Handling Rates	**Railcars/Hr**
End Ramps	6.0
Boxcar Docks	.3
Length of Flatcars	60 feet
Productive Work Hours	20 hours

Mode Mix	%	%
Roadable Veh: Convoy/Flatcar	90	10
Nonroadable Veh: HETs/Flatcars	10	90
General Cargo: Van/Box Flatbed/Flatcar	 50 35	 0 15
Container: Chassis/COFC	75	25

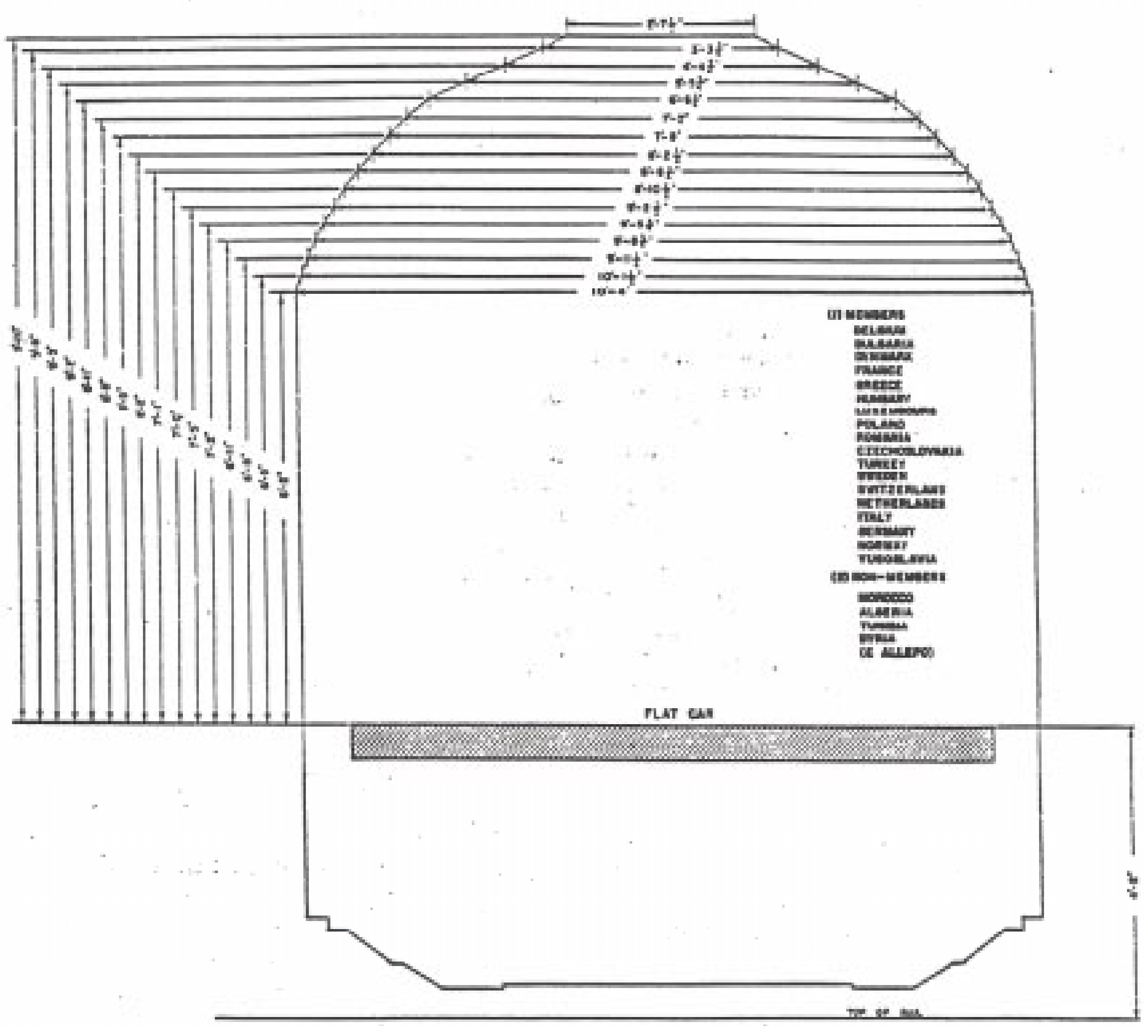
APPENDIX B



ROADMAP: Zagreb to Rijeka, Croatia

APPENDIX C

BERNE INTERNATIONAL
(CLEARANCE DIAGRAM)



ITEM LENGTH 32' 10"

PORT OF ANTWERP
BELGIUM

Footnote states source of graphic[1]

1. ***Antwerp Monograph of a world port***, Hinterland 166E, 2nd Quarter 1995, page 23

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Antwerp in May 1998. The Port of Antwerp is fully capable of supporting U.S. military cargo transshipment operations, and can accommodate vessels as large as the LMSR.

The port is made up of at least 35 terminals. Noord Natie Terminals N.V., the current contractor for the U.S. military, has berths in seven terminals: Noordzeeterminal, Delwaidedok, Churchill-dok, 5e Havendok, 6e Havendok, Hansadok, Europaterminal, and Car Terminal, with a total berth length of 23,240 feet.

The 15.7-foot tidal range will limit roll-on/roll-off (RORO) operations on the river. Noordzee and Europa container terminals are located on the river. However, the berths within the locks are not affected by the tides and can perform all RORO, container, breakbulk, and barge operations.

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The berths analyzed in the port have a mixed throughput capability of at least 81,650 STON per day.

We recommend the U.S. military use Delwaidedok for an actual deployment. For the application section, we analyzed the deployment of a notional armored division from Europe on LMSR ships using the Delwaidedok Berths. When the six LMSRs are available for loading and three berths are used, the division can be loaded in 6 days. Smaller ships will require additional time or berths in the Delwaidedok Terminal.

The division will require about 25 acres of staging per LMSR. Loading three ships at a time for deployment from a port will require a total of 75 acres per day. The FSS, loading five ships at a time, requires about 16 acres per ship for deployment, for a total 80 acres per day. The port has 1,930 acres of open storage; Noord Natie N. V. controls 940 acres with about 198 acres in the Del-waidedok area. Delwaidedok open staging is about 2.5 times the requirement.

The notional armored division will require 490 railcars per day, for a deployment by rail. The port currently has 24 trains per day with 21 railcars per train going to Delwaidedok, for a total of 504 railcars per day. The port has the capacity to handle at least 4,000 railcars per day, and can meet the rail requirement.

II. GENERAL DATA

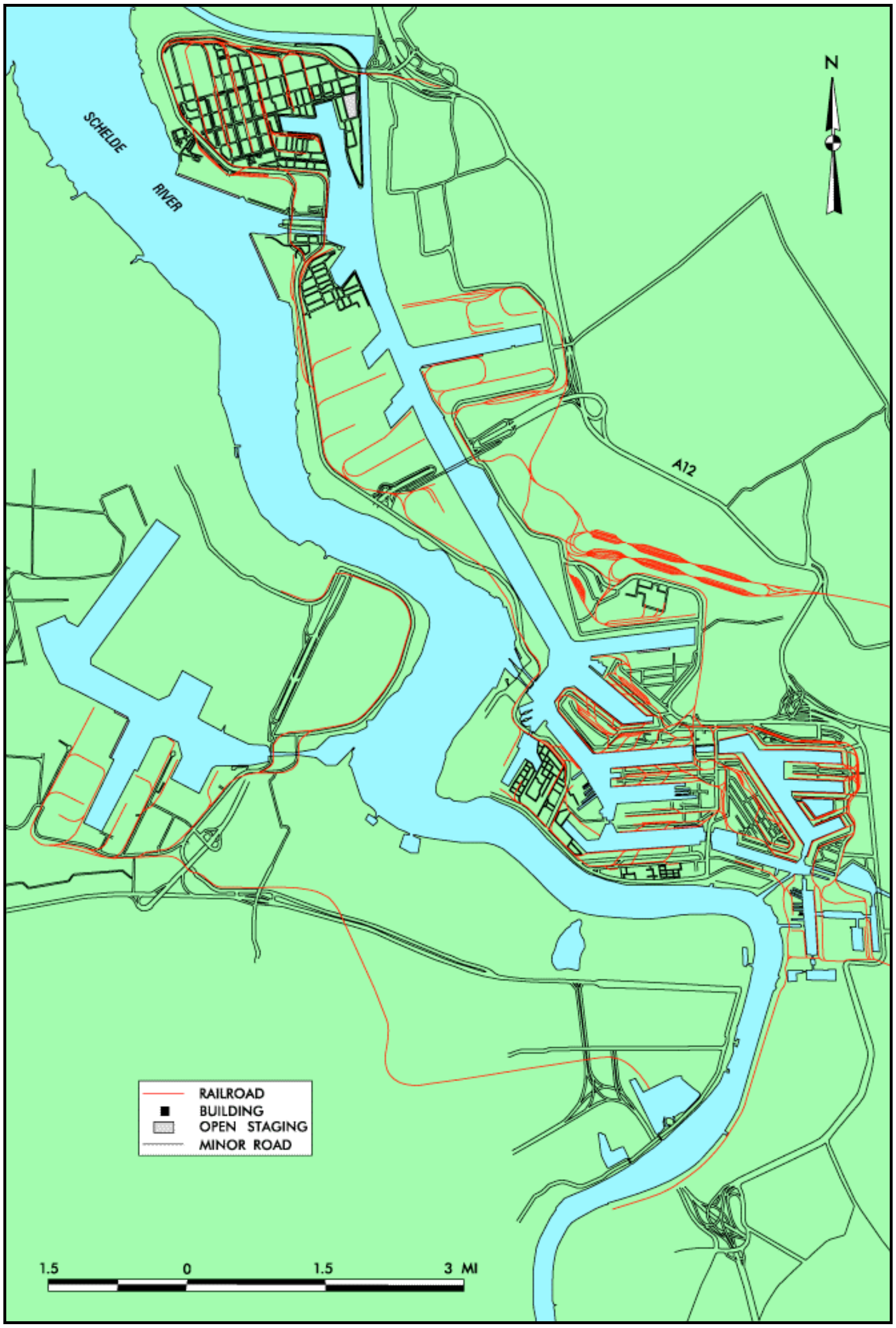
The Military Traffic Management Command Transportation Engineering Agency (MTMCTEA) conducted a capability analysis of the Port of Antwerp11-15 May 1998. Antwerp is a public-owned, contractor-operated port capable of handling RORO, container, and breakbulk ships and barges. Information was obtained from the 838th Transportation Battalion, Rotterdam, Netherlands, port officials and operators.

TRANSPORTATION ACCESS

Water

The Port of Antwerp (latitude 51°14’north, longitude 4°28’east, (ALRF - GEO location code) time zone GMT +1) is 75km from the North Sea on the Schelde River. At high water (HW) under normal weather conditions, vessels with a draft up to 49 feet may enter the port. The river has a mean low water (MLW) level of 40 feet. This depth is maintained by dredging. The tide within the Schelde River is up to 15.7 feet (4.8 meters). Pilotage is required from Vlissingen, Netherlands, to the Port of Antwerp.

Anchorage for the Port of Antwerp is in the area of the A1 Buoy, and for smaller vessels around the MSB Buoy. There is also anchorage in the Vlissingen Roads area. Anchorage on the river is limited.


N
SCHELDE
RIVER
A12
RAILROAD
BUILDING
OPEN STAGING
MINOR ROAD
1.5
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Site Plan

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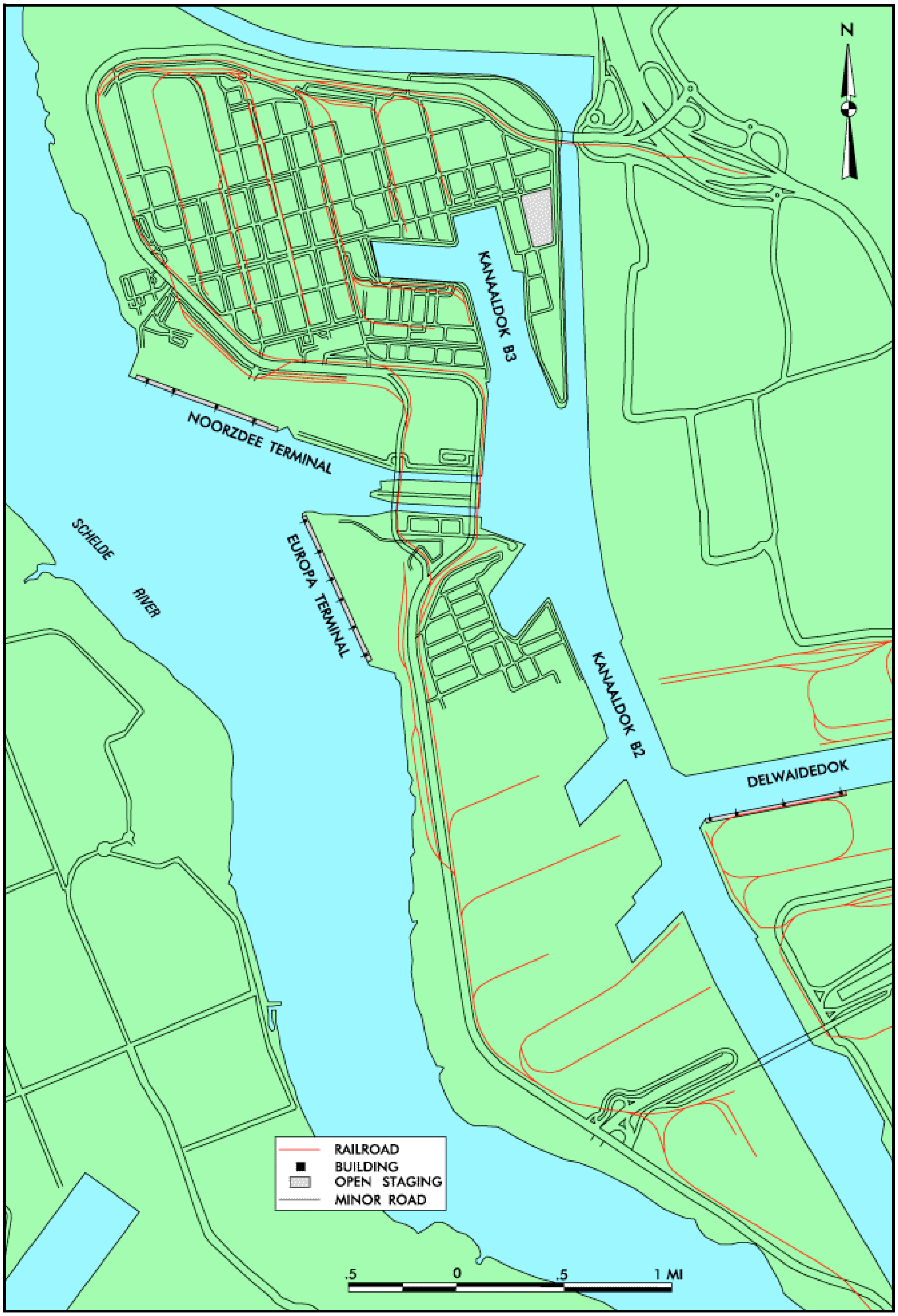
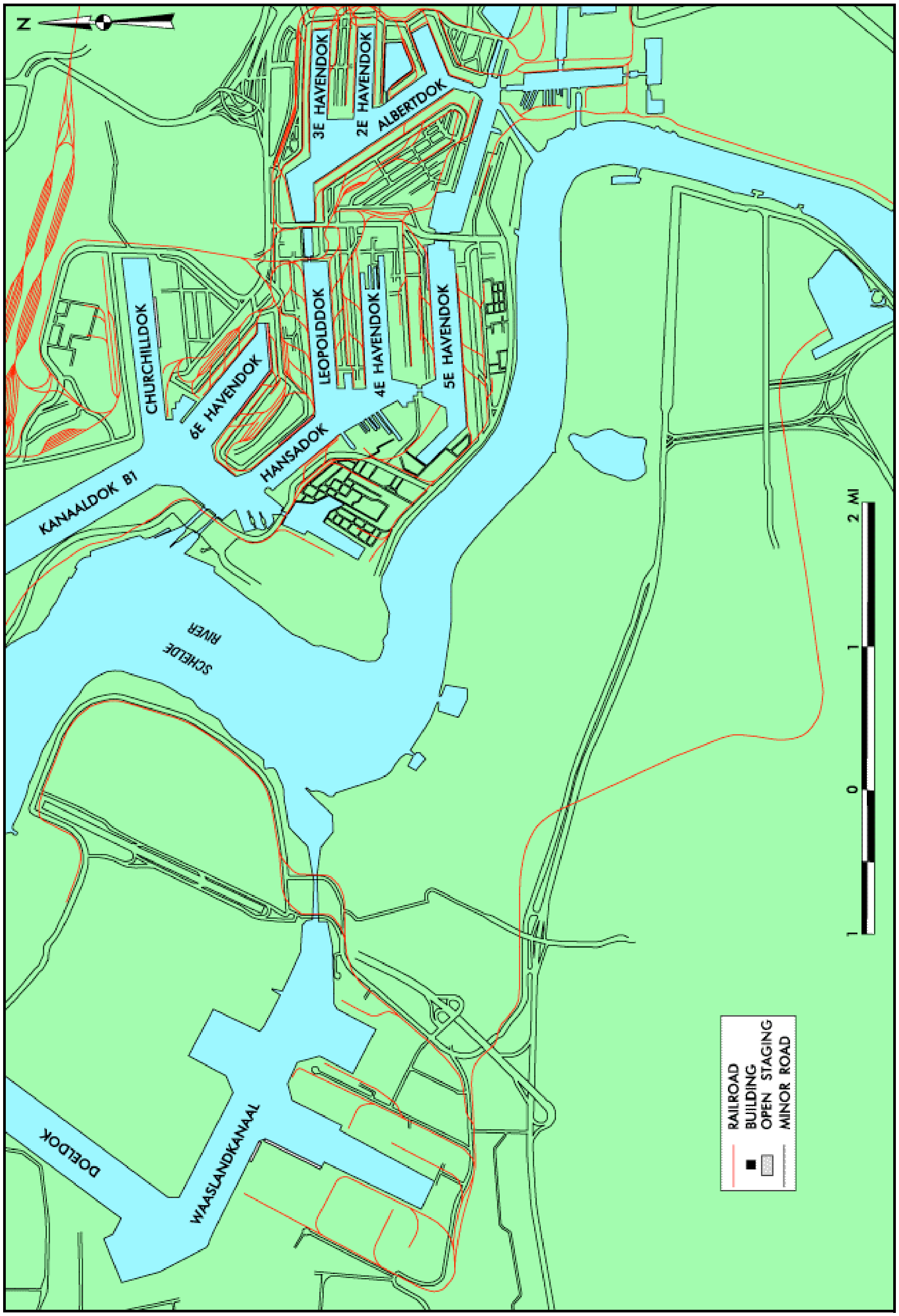


Site Plan (north view)



Site Plan (south view)

The Schelde River connects directly with the Schelde-Rijn Kanaal and indirectly with other rivers and canals in Europe to form an effective inland water network. Barge transport can be used to move items too large for easy transport by highway and rail modes. For nonmilitary moves, about 60 percent of cargo arrives in the port by barge

Map of Inland Water Network

Highway

Highway access to the port is good. It is a short drive from the Autobahn to the quays. Each terminal has its own gate speeding up the process of leaving the quays and getting on the highway network. About 20 percent of nonmilitary cargo arrives in the port by highway.

Rail

A dedicated rail line serves the Port of Antwerp. The Belgian Rail (NMBS) has a large exchange yard, Vormingstation Antwerpen-Noord, located on the port. Each terminal has rail lines. Loads leaving the port may be inspected by the railroad inspectors to make sure they are secured for rail transport and do not exceed the approved clearance for transport.

In 1994, 735,560 loaded railcars either arrived at or departed from the port. Every day in 1995, about 140 loaded trains left the port and 110 trains loaded with goods arrived in the port.

Current rail service within the port can support up to--

12 trains per day, with 21 railcars each, going to Churchilldok quay; and

24 trains per day, with 21 railcars, going to Delwaidedok quay. Rail service to the other quays in the port is not known.

The closest railyard, Vormingsstation Antwerpen-Noord, is east of the port, just north of Churchilldok quay. This railyard has the capacity to store about 4,000 railcars. The railroad provides engines to transfer railcars from this railyard to the port. About 20 percent of nonmilitary cargo arrives in the port by rail.

Air

The nearest airfield, Antwerp's Luchthaven Deurne Airport, 40 kilometers from the port, is served by regular airlines. Brussels International is 30 minutes down the motorway from Antwerp with direct international flights offered by major airlines.

PORT FACILITIES

Berthing

The Port of Antwerp is a multicargo port capable of breakbulk, RORO, container, and barge operations. Antwerp is the second largest port in Europe, biggest in Belgium, and one of the largest in the world. In 1995, over half of Antwerp's general cargo trade was carried in containers. The port has many berths capable of supporting military operations. The table on page 15 shows the terminals/quays in Antwerp.

Currently, the U.S. Army has a contract with Noord Natie N.V. Company to provide the U.S. military berths and services. These berths will be evaluated in this analysis. Noord Natie has facilities in Noordzeeterminal, Delwaidedok, Churchilldok, 6e Havendok, Hansadok, 5e Havendok, Europaterminal, and Car Terminal. Noordzeeterminal and Europaterminal are on the river, Car Terminal is in the Waaslandkanaal inside lock controlled water depth, and the other terminals are in the Schelde-Rijnverbinding Kanaal with a controlled water depth. Noordzeeterminal is typically used for container transport. Delwaidedok and 5th Harbor Dock are typically used for containers, general cargo, and RORO. The Car Terminal is typically used for RORO. Churchilldok is typically used for sugar, general cargo, and RORO. The 6e Havendok is typically used for fruit, general cargo, and RORO. Hansadok is typically used for fruit, general cargo, and containers. Berths that will be available for U.S. military operations are presented in the table in two pages.

PORT OF ANTWERP BERTHS					
Berth Name	**Signpost***	**Water Depth (feet)**	**Water Depth (meters)**	**Berth Length (feet)**	**Berth Length (meters)**
Noordzeeterminal	901- 915	48	14.6	3,688	1,125
Kanaaldok B3	701- 775	50	15.25	8,170	2,490
Europaterminal	851- 869	NA	NA	NA	NA
	621- 667	NA	NA	NA	NA
Marshalldok	423- 441	39	12	11,990	3,656
Industriedok	373- 395	39	12	5,380	1,640
Waaslandkanaal	1101-1754	59	18	8,790	2,680
Doeldok	1700-1754	59	18	3,940	1,200
Noordelijk Insteekdok	1600-1616	59	18	NA	NA
Vrasenedok	1201-1243	59	18	14,440	4,400
Zuidelijk Insteekdok	1113-1135	59	18	NA	NA
Delwaidedok	700- 762	55	16.75	15,290	4,660
Schuildok	526- 536	NA	NA	NA	NA
Churchilldok	402- 498	50	15.25	16,520	5,036
6e Havendok	300- 352	50	15.25	12,420	3,785
Graandok	354- 400	20.5-33.5	6.25-10.25	3,980	1,213
Hansadok	405- 421 232- 250	39 -50	12 -15.25	17,200	5,243
Leopolddoc	206- 230	39	12	12,560	3,827
4e Havendok	241- 285	39 -43.5	12 -13.25	7,710	2,350
5e Havendok	303- 321 345- 367	39	12	14,750	4,495
Oosterweelbrug	127- 135, 188- 198	NA	NA	NA	NA
3e Havendok	158- 186	38 -49	11.65-14.9	6,920	2,110
2e Havendok	130- 152	35	10.7	5,510	1,680
Albertdok	100- 128	31 -39	9.5 -12	16,810	5,124
Wachtdok	75- 87	NA	NA	NA	NA
Amerikadok	48- 54 91- 99	24.5-47.9	7.5 -14.6	7,730	2,355
Straatsburgdok		NA	NA	NA	NA
Asiadok	28- 31	NA	NA	NA	NA
Houtdok	25- 27 38- 40	NA	NA	NA	NA
Kempischdok	33- 37	NA	NA	NA	NA
Kattendijkdok	14- 23 42- 45	NA	NA	NA	NA
Willemdok	3- 8	NA	NA	NA	NA
Bonapartedok	1- 2	NA	NA	NA	NA
Kanaaldok B1	500- 540	55	16.75	10,990	3,249
Kanaaldok B2	600- 620	55	16.75	2,625	800

**The number is within or close to the berth. The port uses a numbering designation as well as a name designation.*
NA – Not available.

BERTH CHARACTERISTICS FOR PORT OF ANTWERP NOORD NATIE N.V.								
Characteristics	**Berths**							
	Noordzee-terminal	**Delwaidedok**	**Churchilldok**	**6e Havendok**	**Hansadok**	**5e Havendok**	**Europa - terminal**	**Car Terminal**
Berth	901-915	700-714	414-418	316-326	234-238	317-321	855-869	1233-1249
Length feet (meters)	3,688 (1,125)	3,510 (1,070)	1,837 (560)	3,937 (1,200)	1,640 (500)	1,640 (500)	3,872 (1,180)	3,117 (950)
Depth alongside at MLW feet (meters)	48 (14.6)	50 (15.2)	42 (12.8)	38 (11.6)	38 (11.6)	35 (10.7)	50 (15.2)	48 (14.6)
Deck Strength psi	500	500	500	500	500	500	500	500
Apron width feet (meters)	1,640 (500)	2,460 (750)	1,312 (400)	574 (175)	720 (220)	360 (110)	1,640 (500)	3,281 1,000)
Apron height above MLW feet (meters)	29.5 (9)	8 (2.44)	8 (2.44)	8 (2.44)	8 (2.44)	8 (2.44)	27.9 (8.5)	8 (2.44)
Number of container cranes	4	4	0	0	0	0	6	0
Number of wharf cranes	0	6	2	9	4	6	0	0
Apron Lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No	Yes	No	Yes	Yes	Yes
Apron length served by rail feet (meters)	None	3,510 (1,070)	1,837 (560)	3,937 (1,200)	1,640 (500)	1,640 (500)	None	None

PORT OF ANTWERP
SUMMARY OF NOORD NATIE N.V. BERTHING CAPABILITIES

Vessels		Berths			
Type	**Class**	**Noordzee-terminal**	**Delwaide-dok**	**Churchill-dok**	**6e Havendok**
BREAKBULK	C3-S-38a	7	6	3	3
	C4-S-58a	6	5	3	2
	C4-S-66a	6	6	3	2
	C5-S-37e	5	5	2	2
SEATRAIN	GA and PR	6	6	3	2
BARGE	LASH C8-S-81b	4	4	2	1
	LASH C9-S-81d	4	3	2	1
	LASH Lighter	18	17	9	8
	SEABEE C8-S-82a	4	3	2	2,a,f
	SEABEE Barge	18	17	9	8
RORO	COMET	7,d,i,j	6,d,i,j	3,d,i,j	3,d,i,j
	METEOR	6,d,i,j	6,d,i,j	3,d,i,j	2,d,i,j
	Cape Gnome	5,d,i,j	5,d,i,j	2,d,i,j	2,d,i,j
	C7-S-95A	4,i	4	2	2
	Cape Taylor	5,i	5	2	2
	Cape Orlando	5,i,j	5,i,j	2,i,j	2,i,j
	MV Ambassador	6,d	6,d	3,d	2,d
	Callaghan	5,d,i,j	4,d	2,d	2,d
	Cape Lambert	5,i,j	4,i,j	2,i,j	2,i,j
	LMSR Class	3,i	3	1	1
	FSS	3	3	1	1
	Cape E-Class	5,i,j	5,i,j	2,i,j	2,i,j
	Cape D-Class	5,i,j	4,i,j	2,i,j	2,i,j
	Cape H	4,i	4	2	2
	Cape Texas	5,i,j	5,i,j	2,i,j	2,i,j
	Cape R	5,d	5,d	2,d	2,d
	Cape I-class	5,i,j	4,i,j	2,i,j	2,i,j
	Cape Victory	5,i,j	5	2	2
CONTAINER	C6-M-147a	5	5	2,e	2
	C7-S-69c	5	5	2,e	2
	C7-S-68c	5	4	2,e	2
	C8-S-85c	4	4	2,e	1
	C9-M-132b	4	3	2,e	1
	C9-M-F141a	3	3	1,e	1
TACS	C6-S-1qd	5	5	2	2
	C5-S-MA73c	5	5	2	2
	C6-S-MA60d	5	5	2	2
MPS	C7-S-133a	4	4	2	1
	Maersk	4	4	2	2
	AmSea	5	5	2	2

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

PORT OF ANTWERP SUMMARY OF NOORD NATIE N.V. BERTHING CAPABILITIES - cont						
Vessels		Berths				
Type	Class	Hansdok	5e Havendok	Europa-terminal	Car Terminal	NOTES:
BREAKBULK	C3-S-38a	3	3	7	6	The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.
	C4-S-58a	2	2	6	5	
	C4-S-66a	2	2	6	5	
	C5-S-37e	2	2	6	5	The letters in the columns to the left indicate limitations as described below.
SEATRAIN	GA and PR	2	2	6	5	
BARGE	LASH C8-S-81b	1	1	4	3	a-vessel draft limit
	LASH C9-S-81d	1	1,a,f	4	3	b-inadequate apron width
	LASH Lighter	8	8	19	15	c-inadequate berth length
	SEABEE C8-S-82a	1,a,f	1,a,f	4	3	d-no straight stern ramp
	SEABEE Barge	8	8	19	15	e-no container handling equipment
RORO	COMET	3,d,i,j	3,i,j	7,i,j	5,i,j	f-anchorage depth OK, berth depth inadequate
	METEOR	2,d,i,j	2,i,j	6,i,j	5,i,j	g-inadequate channel depth
	Cape Gnome	2,d,i,j	2,i,j	6,i,j	4,i,j	h-no shore based ramps
	C7-S-95A	2	2	5,i	4	i-low tide insufficient ramp clearance
	Cape Taylor	2	2	5,i	4	j-high tide insufficient ramp clearance
	Cape Orlando	2,i,j	2,i,j	5,i,j	4,i,j	k-excessive ramp angle low tide
	MV Ambassador	2,d	2,k,m	6,i	4,k,m	m-excessive ramp angle high tide
	Callaghan	2,d	2	5,i,j	4	n-parallel ramp operation ONLY
	Cape Lambert	2,i,j	2,i,j	5,i,j	4,i,j	o-insufficient apron width for side ramp
	LMSR Class	1	1	3,i	3	
	FSS	1	1,a	3	3	Ramp clearance and angle based on maximum vessel draft
	Cape E-Class	2,i,j	2,i,j	5,i,j	4,i,j	
	Cape D-Class	2,i,j	2,i,j	5,i,j	4,i,j	
	Cape H	2	2,a	4,i	4	♦ May Prevent Operation
	Cape Texas	2,i,j	2,i,j	5,i,j	4,i,j	♦ May Limit Operation
	Cape R	2,d	2	5,i,j	4	
	Cape I-class	2,i,j	2,i,j	5,i,j	4,i,j	
	Cape Victory	2	2	5,i,j	4	
CONTAINER	C6-M-147a	2	2	5	4,e	
	C7-S-69c	2	2	5	4,e	
	C7-S-68c	2	2	5	4,e	
	C8-S-85c	1	1	4	3,e	
	C9-M-132b	1	1	4	3,e	
	C9-M-F141a	1	1,a	3	3,e	
TACS	C6-S-1qd	2	2	5	4	
	C5-S-MA73c	2	2	6	4	
	C6-S-MA60d	2	2	5	4	
MPS	C7-S-133a	1	1	4	3	
	Maersk	2	2	4	3	
	AmSea	2	2	5	4	

STAGING

Open Staging

The port currently covers an area of 9,080 acres. It has 1,930 acres of open storage and ample open staging. The terminals operated by Noord Natie N.V. Antwerp have about 940 acres of open storage. This area is distributed in the eight areas where they have quays. Noordzeeterminal has 136 acres of open staging. Delwaidedok has 198 acres, Churchilldok has 52 acres, 6e Havendok has 59 acres, Hansadok has 84 acres, 5e Havendok has 16 acres, Europaterminal has 148 acres, and Car terminal has 247 acres.

Helicopter operations could occur in any terminals, but preferably in Delwaidedok. Churchilldok has a limited landing area and will interfere with traffic flow.

Delwaidedok


Noordzeeterminal

Open Staging Areas Normally Used by U.S. Army

Covered Staging

The port has a total of 45,208,800 square feet of warehouse space; most is for specialized cargo. The port has ample covered storage for general cargo and container stuffing/unstuffing operations. Storage facilities are located near each of the berths. There are 710,420 square feet located on the Churchilldok quay; 343,590 square feet located in the Delwaidedok; and 26,910 square feet in the car terminal. Covered storage capacity is not known for the Europaterminal, 5e and 6e Havendok, and Hansadok terminals.

UNLOADING/LOADING POSITIONS

Ramps and Docks

There are no end ramps and docks in the port. Portable ramps can be built if needed. The boxcars in Europe are different than the ones in the U.S. The sides of the boxcar will slide to the other end opening half of the boxcar for loading with forklifts from the ground. When one end is loaded the side can slide to the other end to complete the loading. When loading is finished the sides are closed and ready for transport.

Marshaling Areas

Plenty of open storage is available in the port allowing part of it to be used as a marshaling area. All staging and marshaling should take place in the terminal in which the ship is being loaded or unloaded. The U.S. military may have to arrange for use of open storage as a marshaling yard with the stevedoring company ahead of time.

MATERIALS HANDLING EQUIPMENT (MHE)			
Wharf Assignment	**Type of Equipment**	**Capacity (STON)**	**Quantity**
Noordzeeterminal	Straddle carriers	40	22
	Reach stacker	41	4
	Forklifts	18	4
	Transtainer	40	1
	Tugmaster		2
Delwaidedok	Straddle carriers	40	22
	Reach stacker	40	1
	Forklifts	18	7
	Forklifts	25	2
	Forklifts	29	3
	Forklifts	4.5-16	25
	Tugmaster		4
	Tractors		2
Churchilldok	Reach stacker	41	1
	Forklifts	3.5-28	13
	Tractors		2
	Tugmaster		2
6e Havendok	Reach stacker	41	1
	Forklifts	3.5-28	40
	Tugmaster		6
	Tractor		1
Hansadok	Reach stacker	41	1
	Forklifts	3.5-28	40
	Tugmaster		2
5e Havendok	Reach stacker	36	1
	Forklifts	3.5-8	10
	Forklifts	16	2
Europaterminal	Straddle carriers	40	40
	Forklifts	18	6
	Tugmaster		6
	Reach stacker	40	2
Car terminal	Tugmaster		4
	Forklifts		Several
Port of Antwerp	Floating Crane	800	1
NOTE: The table above represents equipment owned by the port. Port operators indicate that they lease or rent other equipment as required from local suppliers. The list is not "all inclusive" as actual totals may change.			

FUTURE DEVELOPMENT

The port is continuing to upgrade to keep up with technology and to improve efficiency in port operations and to ensure equipment is up-to-date. Information on the port can be found on the Internet at http://www.portofantwerp.be.

EXPLOSIVE and HAZARDOUS CARGO OPERATIONS

These types of operations are not permitted in this port. Explosive and hazardous cargo operations for the U.S. military are performed in the Port of Nordenham, Germany. Vlissingen, Netherlands, has performed ammunition operations on a case-by-case basis.

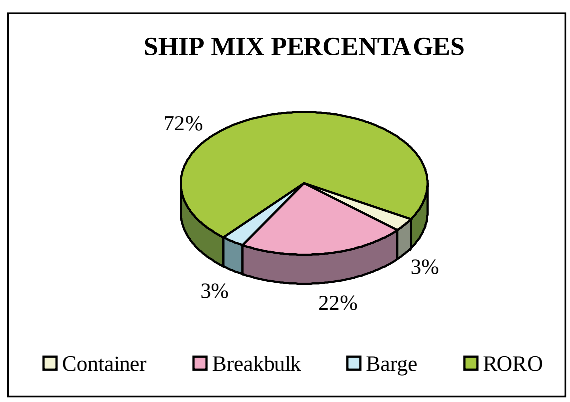
III. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Antwerp. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of short tons (STON) and measurement tons (MTON) per day. The charts in this section show the throughput yields in STON. Approximate MTON yields can be computed by multiplying the STON amount by three.

Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 70 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

Highway

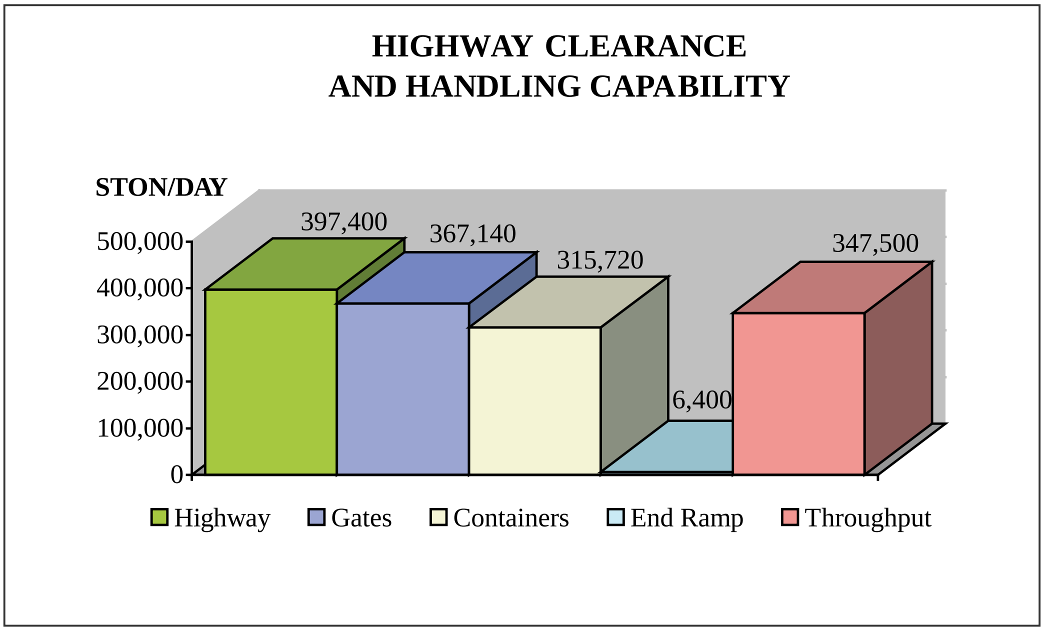
The highways in the port connect to Autosnelwegs A1, A12, A13, and A14 for highway transport throughout Europe. Most terminals have their own gate(s) allowing access from the highway network directly to the terminal. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or leave each terminal on each lane of the highway. Delwaidedok has four inbound and three outbound lanes. Noordzeeterminal has five lanes in each direction. Europaterminal has eight inbound and four outbound lanes. The car terminal has one lane in each direction. Information is not available on the other terminals.

Roadable vehicles will move through the terminal gates in manageable convoys from staging areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. If not available, deploying units/military port operators must either build or acquire the necessary ramps. For this study, we assumed four portable ramps would be built and used for loading operations. These ramps can handle 6,400 STON of military vehicles and equipment per day.

The Port of Antwerp has 84 straddle carriers available. By using these for loading semitrailers, the port can handle at least 313,850 STON of containerized equipment and supplies per day.

Maximum daily handling capability for the port is a mixed total of the three types of handling (docks, end ramps, and containers), each up to its maximum, not to exceed the daily throughput limit of at least 347,500 STON.

HIGHWAY CLEARANCE AND HANDLING CAPABILITY (STON)					
	Highway	**Gate**	**Container**	**End Ramp***	**Mixed**
Noordzeeterminal	65,190	40,240	82,800		40,240
Delwaidedok	75,860	78,240	82,800	1,600	75,860
Churchilldok	37,930	42,140	30		37,930
5e Havendok	37,590	41,760	90		37,590
6e Havendok	37,930	42,140	70	1,600	37,930
Hansadok	37,930	42,140	70		37,930
Europaterminal	65,190	40,240	149,850	1,600	40,240
Car Terminal	39,780	40,240	0	1,600	39,780
TOTAL	**397,400**	**367,140**	**315,710**	**6,400**	**347,500**
***Assumes 4 end ramps will be built and used for loading semitrailers.**					



Rail

Rail reception in the port is good, with the NMBS providing rail service directly to the port. "Nearly every quay has between two and five tracks and all the warehouses, sheds, and industrial establishments are easily accessible for the train." (Hinterland Antwerp Driemaandelijks Tijdschrift Quarterly Review 3rd Quarter 1995 Afgiftekantoor: Antwerpen X). The railroad is in the process of upgrading and increasing service to the port to handle increased traffic. One improvement is a second rail access to the port. Currently, rail service to Noord Natie can support up to twenty-four 21-railcar trains per day to Delwaidedok and twelve 21-railcar trains per day to Churchilldok. These trains can handle at least 34,550 STON per day.

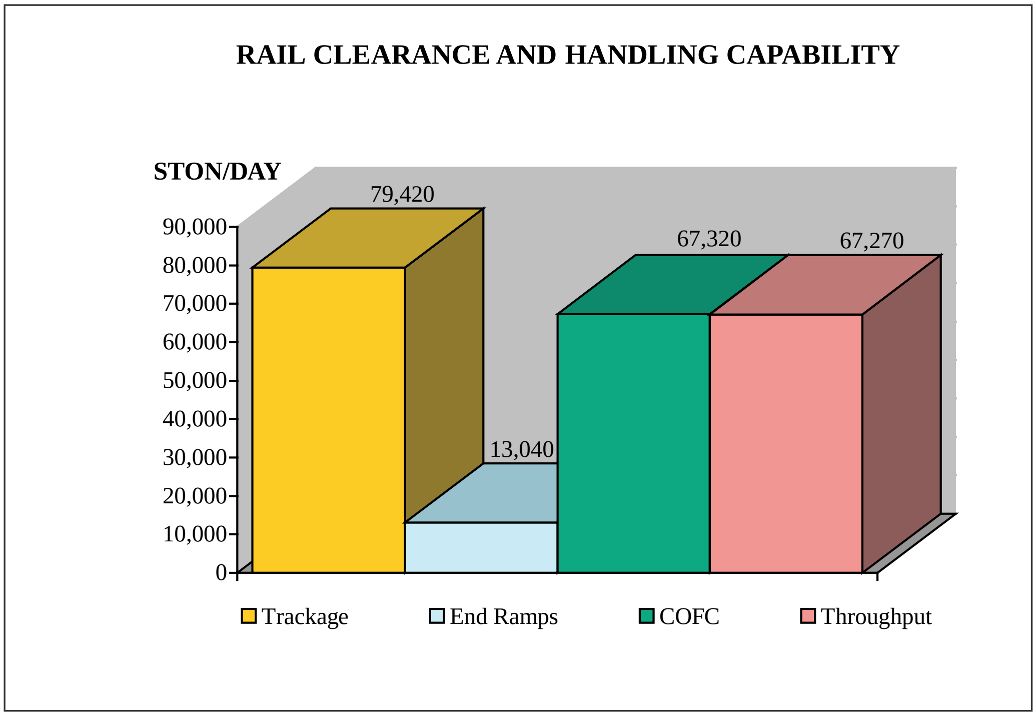
For this study, we assumed four portable rail end ramps would be built and used for unloading operations. The end ramps can handle at least 13,040 STON per day.

Based on using the 12 transtainers, reach stackers, and forklifts, the port can offload at least 67,254 STON of containerized equipment and supplies from railcars per day.

RAILCAR CLEARANCE AND HANDLING CAPABILITY (STON)

	Track	End Ramp*	COFC	Throughput
Noordzeeterminal	21,000	3,260	18,680	21,000
Delwaidedok	24,900	3,260	15,000	18,260
Churchilldok	12,520	3,260	3,750	7,010
5e Havendok**	0	0	0	0
6e Havendok**	0	0	0	0
Hansadok**	0	0	0	0
Europaterminal	21,000	3,260	29,890	21,000
Car Terminal**	0	0	0	0
TOTAL	**79,420**	**13,040**	**67,320**	**67,270**

Assumes there will be 4 portable end ramps built and used for loading railcars.
*****Information was not available on the rail facilities at these berths.***



Staging

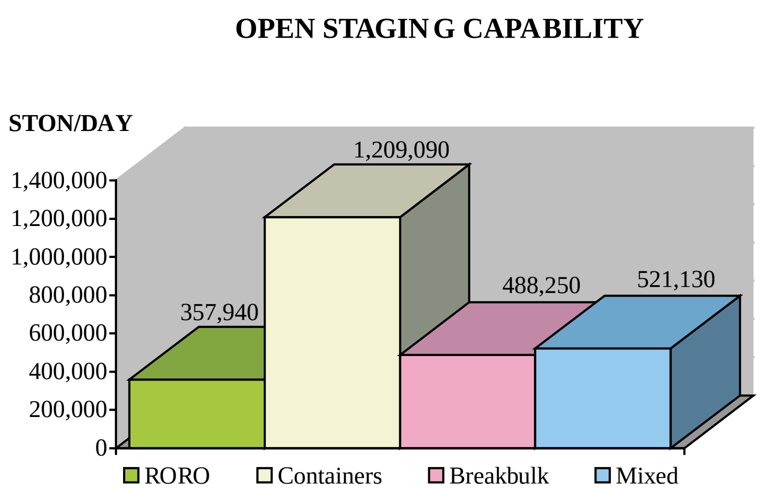
The port has about 1,930 acres of suitable open staging area. Noord Natie N.V. Antwerp has about 940 acres of open staging area in the terminals they work. This is distributed throughout the terminal area. Availability of the staging area will vary with work at the port. Nevertheless, under normal operational expectations, staging availability will not limit operations. For purposes of this analysis we assumed a usable space availability of 100 percent of the total area

The port has about 45,208,800 square feet of covered storage space. Noord Natie N.V. Antwerp has 1,080,920 square feet of covered storage in three of the terminal areas. Like the open area, much of this is subject to contain some of the breakbulk cargo moving through the port. However, covered space availability will not limit throughput at the port. About 21,070 STON of breakbulk cargo can be staged in the covered area.

The chart on the next page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of each involved capability should be assumed.

The table shows the STON of cargo, by type the port can expect to handle. The container storage capacity is the highest with 1,209,090 STON. This equates to 151,140 twenty-foot equivalent units (TEU) and with the ability to stack the containers three high 1 acre can store 325 containers. The containers will use 465 acres. The RORO storage available is 357,940 STON. This equates to 7,158,800 square feet of storage space or about 42,110 RORO pieces. The breakbulk capacity is for 488,250 STON.

OPEN STAGING CAPABILITY (STON)				
	Breakbulk	**RORO**	**Container**	**Mixed**
Amazonehaven 8180 (SEALAND)	86,420	66,210	418,170	81,710
Amazonehaven 8200 (DELTA)	86,420	66,210	418,170	81,710
Kade 1	6,670	5,110	25,840	6,110
Kade 2	7,650	5,860	29,600	5,860
Kade 3	12,370	9,480	47,900	11,330
Beatrixhaven 2720	13,640	10,450	105,600	14,120
Beatrixhaven 2730	13,640	10,450	105,600	14,120
RST	26,700	20,450	103,330	24,440
Pier I	6,670	5,110	25,830	6,110
Pier II 2188	3,340	2,560	12,920	3,060
Pier II 2195	3,340	2,560	12,920	3,060
TOTAL	**266,860**	**204,450**	**1,305,880**	**251,620**



Note: Container staging area can also be used for RORO staging as needed.

Shipping

Daily shipping subsystem totals for the terminal berths are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types.

The in-lock berths are the best choice for performing RORO operations, since the river has a tidal variation of 15.7 feet and the locks maintain a constant water depth in the impounded area. The Car Terminal has no cranes and should be used by self-supporting ships or for RORO operations. The container terminals, Noordzeeterminal, Delwaidedok, and Europaterminal are designed for container operations and are the obvious choice for container operations. All container terminals are close together making it quicker to transfer containers from ocean going ships to river/canal barges and vice versa. See the barge section below.

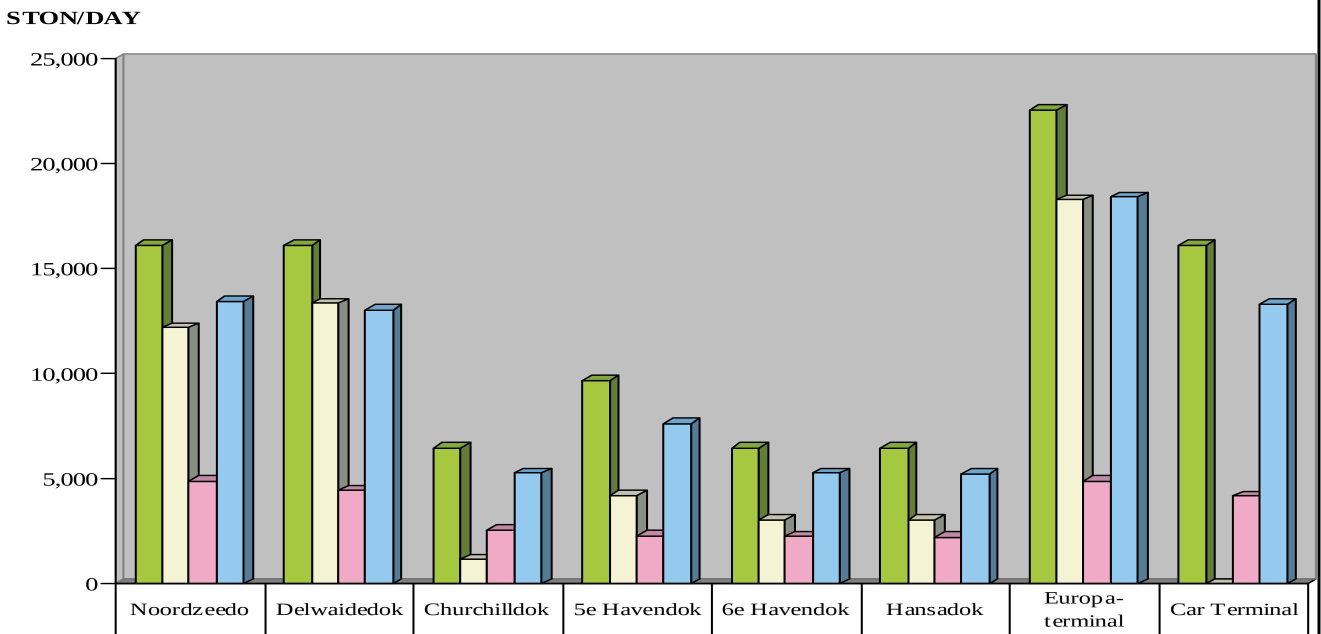
Barge

The extensive river and canal network makes it possible to use river barges to move cargo within Europe. Oversized and overweight items can be transported by barge without permits and route restrictions encountered on highways and railroads. Barges do have restrictions, which include canal depth and width, overpass heights, and locks limits.

Three general types of barges are used in canals and rivers in Europe: breakbulk, RORO, and container. These barges are handled in a similar manner as the larger vessels of the same type and the barges may be self-propelled or towed.

Antwerp is in the delta of the Schelde, Meuse, and Rhine Rivers giving the port an excellent link to Belgium and European Waterway system. The Schelde-Rhine canal has reduced the route to the Rhine and Moselle areas. The Rhine-Main-Danube canal allows barges to sail from Antwerp to the Black Sea. The Rhine-Rhone canal is scheduled to be completed in 2010 allowing traffic to flow between the North Sea and Mediterranean.

BERTH THROUGHPUT CAPABILITY



	Noordzeedo	Delwaidedok	Churchilldok	5e Havendok	6e Havendok	Hansadok	Europa-terminal	Car Terminal
RORO	16,130	16,130	6,450	9,680	6,450	6,450	22,580	16,130
Container	12,190	13,350	1,160	4,210	3,050	3,050	18,290	0
Breakbulk	4,880	4,450	2,550	2,280	2,250	2,210	4,880	4,180
Mixed	13,450	13,050	5,260	7,630	5,260	5,240	18,430	13,330

DAILY THROUGHPUT SUMMARY FOR PORT OF ANTWERP									
BERTH	**LENGTH (feet)**	**DEPTH ALONGSIDE (feet)**	**BREAKBULK THROUGHPUT (STON)**	**RORO THROUGHPUT (STON)**	**RORO SQUARE FT[1] (EST)**	**RORO PIECES[2]**	**CONTAINER THROUGHPUT (STON)**	**CONTAINER THROUGHPUT[3] (TEU)**	**MIXED THROUGHPUT (STON)**
Noordzeeterminal	3,688	48	4,880	16,130	322,600	1,900	12,190	1,520	13,450
Delwaidedok	3,510	50	4,450	16,130	322,600	1,900	13,350	1,670	13,050
Churchilldok	1,837	42	2,550	6,450	129,000	760	1,160	140	5,260
5e Havendok	1,640	35	2,280	9,680	193,600	1,140	4,210	530	7,630
6e Havendok	3,937	38	2,250	6,450	129,000	760	3,050	380	5,260
Hansadok	1,640	38	2,210	6,450	129,000	760	3,050	380	5,240
Europaterminal	3,870	50	4,880	22,580	451,600	2,660	18,290	2,290	18,430
Car Terminal	3,117	45	4,180	16,130	322,600	1,900	0	0	13,330
TOTAL	**23,239**	**35-50**	**27,680**	**100,000**	**2,000,000**	**11,780**	**55,300**	**6,910**	**81,650**

[1]Based on the 20 square foot per STON average accomplished during Operation Desert Shield/Storm.
[2]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.
[3]Based on the 8 STON per TEU average accomplished during Operation Desert Shield/Storm.

SUMMARY

The port is multioperational with the capability to handle all types of vessels: container, RORO, breakbulk, and barges.

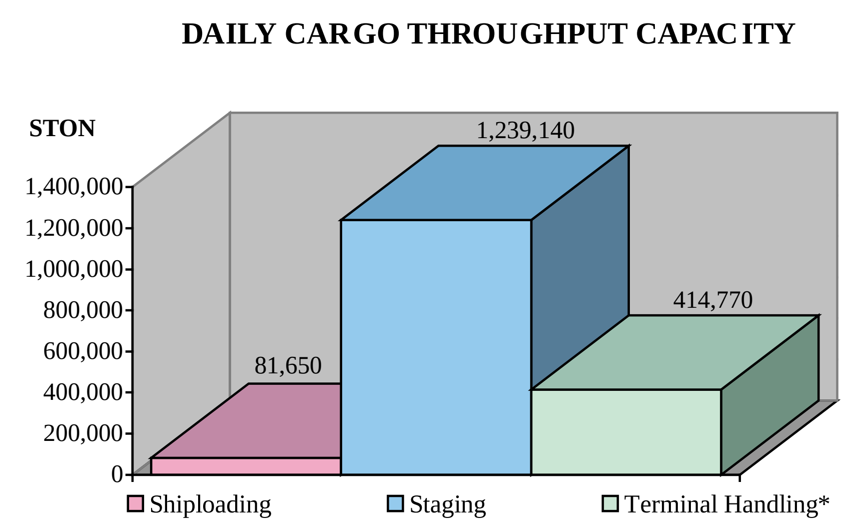
The Port of Antwerp is fully capable of supporting U.S. military cargo transshipment operations. The tidal range of 15.7 feet on the river limits RORO operations; however, there is no tidal limit in the lock. The port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of at least 81,650 STON.

The inland water network makes barge transport an effective shipping method. The port connects to this network and provides a third alternative for moving items inland.

Commercial operations taking place concurrently in the port will limit actual daily throughput, sustainable overtime, by an appropriate percentage of the terminal's overall capability.

Based on current berth usage, the U.S. military may want to use Delwaidedok for normal transport thought this port. Delwaidedok is used for container, RORO, and general cargo transport. With its four gantry cranes and six mobile cranes all types of operations can be performed in these berths.



**Terminal handling is the sum of the highway (347,500 STON) and rail (67,270 STON) limits.*

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored division using primarily LMSR or FSS vessels. We also assume that no other military units will be competing for these facilities during the time that the armored division occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately load the ship and clear the port. The berths in the Delwaidedok Terminal are used for this analysis.

Potential Port Use During Deployment[2]

REQUIREMENTS

The likely requirement for the Port of Antwerp would be to deploy a notional armored division in 6 days of ship loading. The division has to move about 8,125 vehicles and 520 containers. An all rail movement of the division to the port will require about 3,400 railcars, composed of 2,800 medium duty European railcars (RS) and 620 heavy-duty European railcars (SAMMS).

For this application, we assumed a total rail deployment.

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2. ***A guided tour of the city of Antwerp and its harbour***, published jointly by: Royal Belgain Geographical Society (S.R.B.G.), Publitra, div. of the Port of Antwerp Promotion Association (ASSIPORT)

TOTAL EQUIPMENT	
Volume	287,175 MTON
Weight	101,350 STON
Area	1,484,650 SQ FT
Vehicles	8,125
Containers	520
Note: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997	

TERMINAL INPROCESSING/HANDLING

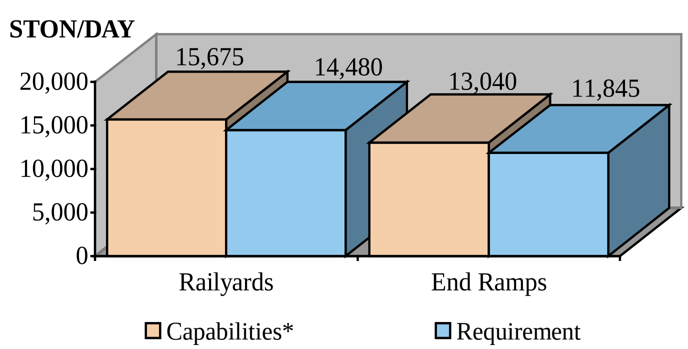
Rail

The NMBS's railyard, Vormingsstation Antwerp-Noord, serves the Port of Antwerp. The Vormingsstation is north of Churchilldok, with the capacity to handle 4,000 railcars a day. The Belgian Rail provides engines to transfer railcars from this railyard to the port. Current rail service is up to 24 trains per day with 21 railcars per train, or 504 railcars per day, going to Delwaidedok berths.

The rail requirement is 3,400 railcars. Based on the current rail capability in the berth area, it will require 7 days to get the armored division into the terminal. No railcars should be scheduled to arrive the last 2 days of the ship loading to ensure there are no conflicts with offloading the railcars and loading the ships.

Three apron tracks are available for loading/unloading railcars close to the berths. Portable ramps could be built or provided and placed at the end of these tracks. The three ramps are adequate to off load the equipment in the same amount of time it can arrive in the terminal.

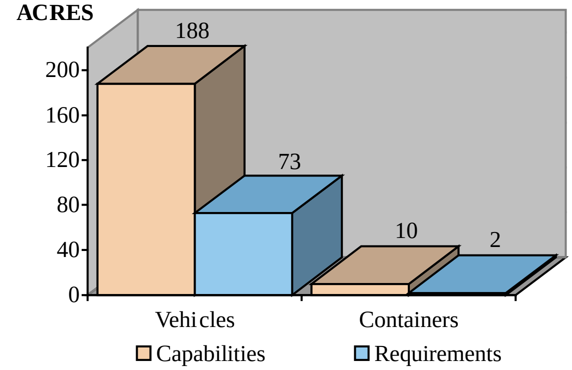
RAIL CLEARANCE/HANDLING CAPABILITY



**Based on MTMCTEA Reference 97-700-5 2,635 STON are loaded in the 520 containers. Assumes three portable ramps can be placed in the terminal for offloading the railcars. To load three LMSRs at the same time would require equipment to be stowed in the berth area prior to the ships arriving in the port if a total rail shipment is used.*

Open Storage

The Delwaidedok has 198 acres of open storage area. Limiting the open storage area used to the Delwaidedok berths will not cause a problem for a deploying force. The staging area requirement for each LMSR is 25 acres. Loading three ships at once will require a total of 75 acres for vehicle and container storage.



Note: Delwaidedok would be capable of staging equipment to loading three LMSRs at the same time.

Shipping

Berth space is adequate to allow the side and stern ramps on the LMSRs to be used to load the ships. Within the locks, tidal variation should not cause any problems. If smaller ships are used to deploy the division, then additional time or berths will be required to move the division.

SHIP REQUIREMENTS NOTIONAL ARMORED DIVISION				
Loading Condition/ Sample Ship Mix	**FSS (RORO/ Comb)**	**LMSR (RORO/ Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	9.6			
All LMSR		5.9		
All Breakbulk			29.8	
Maximum Containerization				
FSS/Container	2.9			4.9
LMSR/Container		1.8		4.9
Breakbulk/Container			9.0	4.9

Legend:
RORO – roll on/roll off --Total cargo space 162,667 sq. ft – utilized 122,000 sq. ft.
FSS – fast sealift ship --Total cargo space 199,824 sq. ft – utilized 149,868 sq. ft.
LMSR – large medium speed roll on/roll off --Total cargo space 324,000 sq. ft – utilized 243,000 sq. ft.
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

Deploying by LMSR requires six ships. Based on preliminary LMSR loading results, we estimate the LMSRs will load about 400 STON per hour. Each LMSR will require an average 42.22 hours to load. The number of days required to load the ship is determined by the hours of work per day (20) and factors for sustainment and nighttime operations. We get the equivalent of 18.43 hours per day. Based on a loading time of 42.22 hours and 18.43 hours per day productive time it will require an average of 2.29 days to load each LMSR. To meet the 6-day loading requirement will require loading three LMSRs at a time. The first three ships should arrive in time to start loading on the fourth day of railcar arrival and the last three ships arrive in the port as the first three depart. This requires a total of 9 days use of staging in the berth area, with last 6 of these days used to load the ships.

Deploying by FSS requires 10 ships. Based on FSS loading time of 250 STON per hour. Each FSS will require an average 40.5 hours to load. The number of days required to load the ship is determined by the hours of work per day (20) and factors for sustainment and nighttime operations. We get the equivalent of 18.43 hours per day. Based on a loading time of 40.5 hours and 18.43 hours per day productive time it will require 2.19 days to load the FSS. Noord Natie N.V. Company has berthing for three FSS at a time in Delwaidedok. Without two additional berths the unit cannot meet the 6-day ship-loading requirement.

SUMMARY

The Port of Antwerp can load a notional armored division within 6 days using three berths in the port and six LMSR ships. If FSS ships are used, two additional berths may be required to load a total of 10 FSS ships to meet the 6-day requirement.

The Port of Antwerp is a viable port for supporting deployment of a notional armored division provided three berths (Delwaidedok) are available for U.S. military deployments.

PORT OF BREMERHAVEN
GERMANY

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency (MTMCTEA) conducted a capability analysis of the Port of Bremerhaven in December 1997. The port is fully capable of supporting U.S. military cargo transshipment operations, and can accommodate vessels as large as the LMSR.

The port is made up of eight terminals: container (Stromkaje I, II, and III), RORO (Nordhafen), RORO/fruit (Kaiserhafen I), RORO (Kaiserhafen II and III), general cargo/breakbulk (Columbuskaje) with a total berth length of 24,100 feet.

The 12-foot tidal range will limit RORO operations on the river, since there are no floating RORO ramps available. The breakbulk and container terminals are located on the river. However, the berths within the locks are not affected by the tides and can support all RORO, container, breakbulk, and barge operations.

The shiploading is the least capable of the transportation subsystems analyzed. The port has a mixed throughput capability of at least 87,160 short tons (STON) per day. A notional armored division has 101,350 STON of vehicles and equipment.

The U.S. military will most likely use both sides of Nordhafen for an actual deployment. For this application, we analyzed a notional armored division deploying from Europe on LMSR ships using the Nordhafen berths. Deploying the unit using LMSR ships and two berths will require about 8 days. Deploying a notional armored division in 6 days will require three berths. Using FSS ships will require five berths to deploy the unit in 6 days or it will require additional time.

The division will require about 25 acres of staging per LMSR for deployment from a port, for a total of 50 acres per day to support loading two ships simultaneously. The FSS requires about 16 acres per ship for deployment, for a total of 22 acres per day to support loading two ships simultaneously. The port has 660 acres with about 120 acres in the Nordhafen berth area. Nordhafen available staging is over two times the requirement.

The notional armored division will require 570 railcars per day, for a deployment by rail. The port currently has 5 trains per day with 23 railcars per train going into the berths in the locks, for a total of 115 railcars per day. The rail requirement exceeds that of Nordhafen; however, the port has the capacity to handle 1,150 railcars per day, and can meet the rail requirement using other rail capability in the port.

II. GENERAL DATA

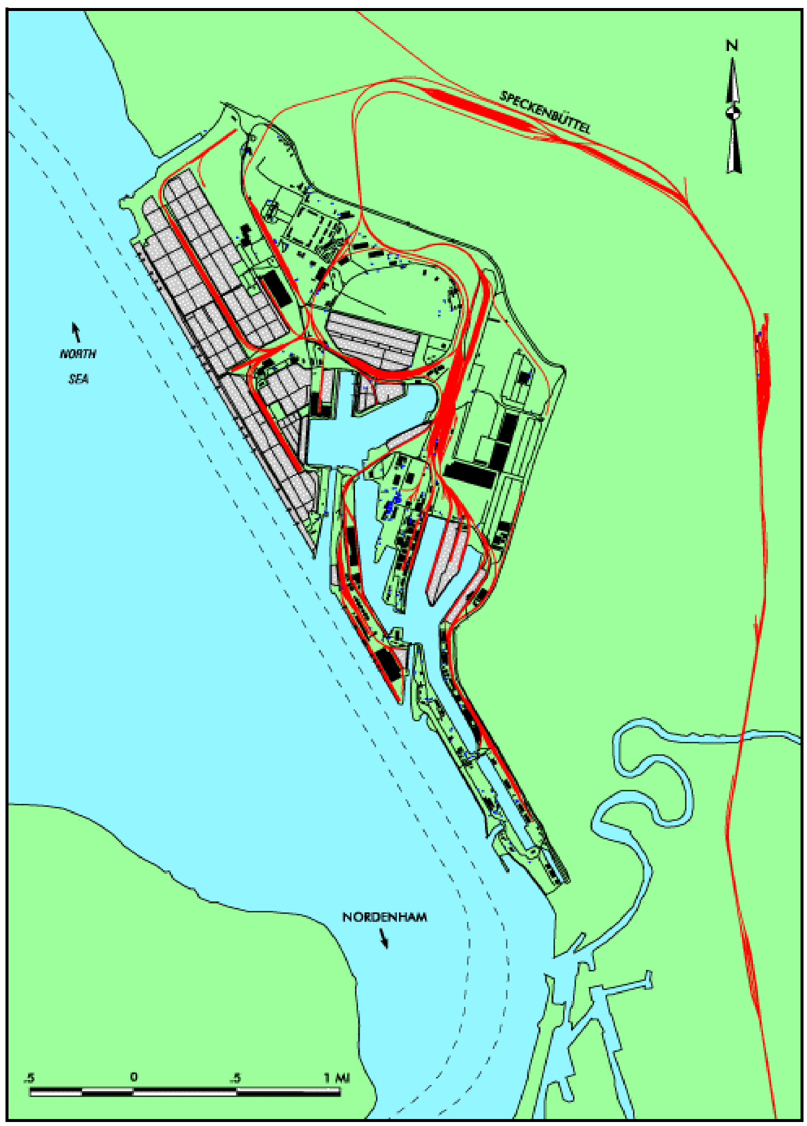
Bremerhaven, is a port used by the U.S. military for shipping military vehicles and equipment to and from Northern Europe. A team from MTMCTEA conducted a site survey between 1 and 4 December 1997. Information was obtained from the 950th U.S. Transportation Company, Bremerhaven, Germany, and port officials.

TRANSPORTATION ACCESS

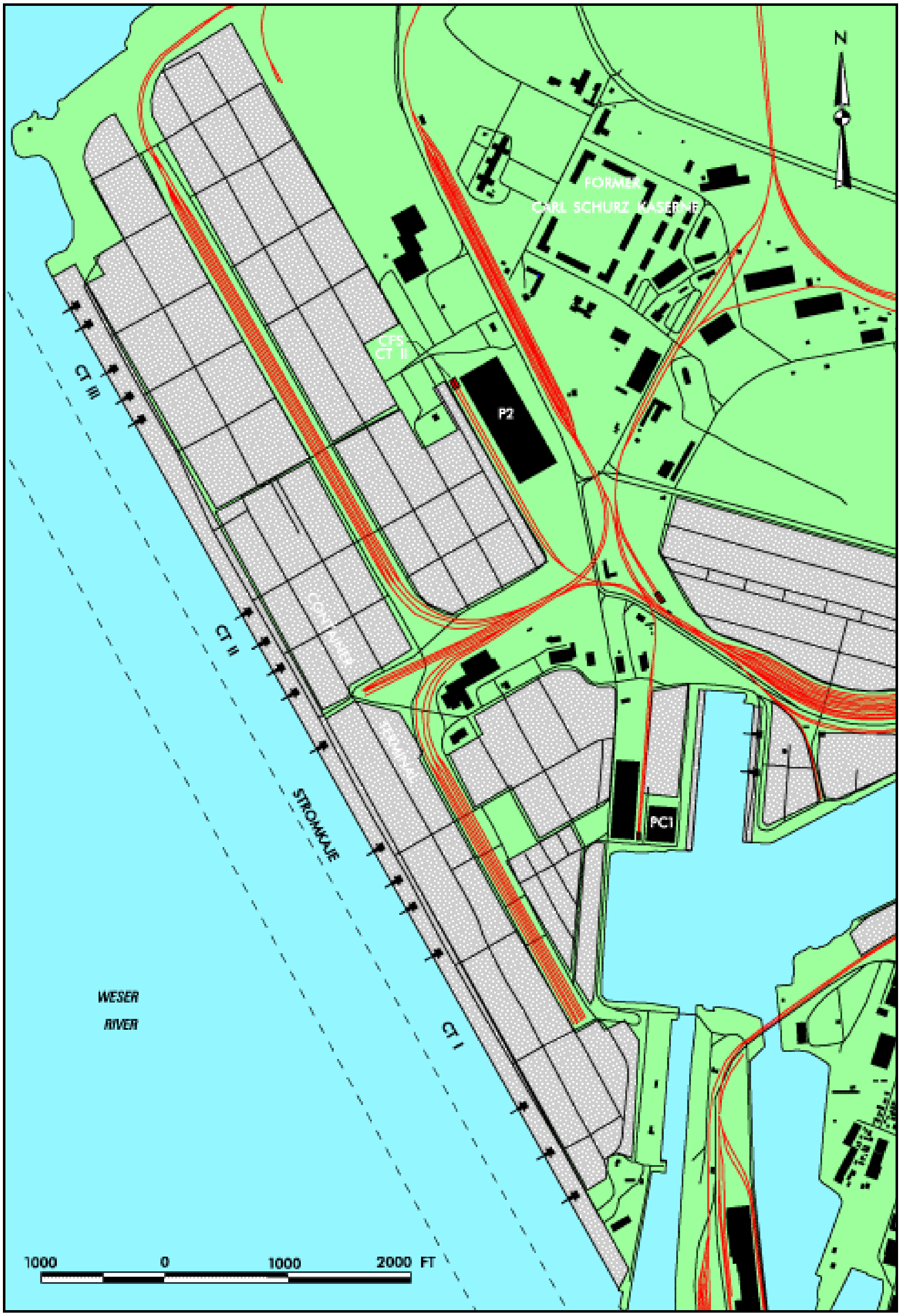
Water

The port (latitude 53° 33’ north, longitude 08° 35” east, (CHCY) time zone GMT +1) is in north-western Germany, on the Weser River 35 nautical miles from the North Sea. The river channel has a minimum depth of 47 feet 6 inches.

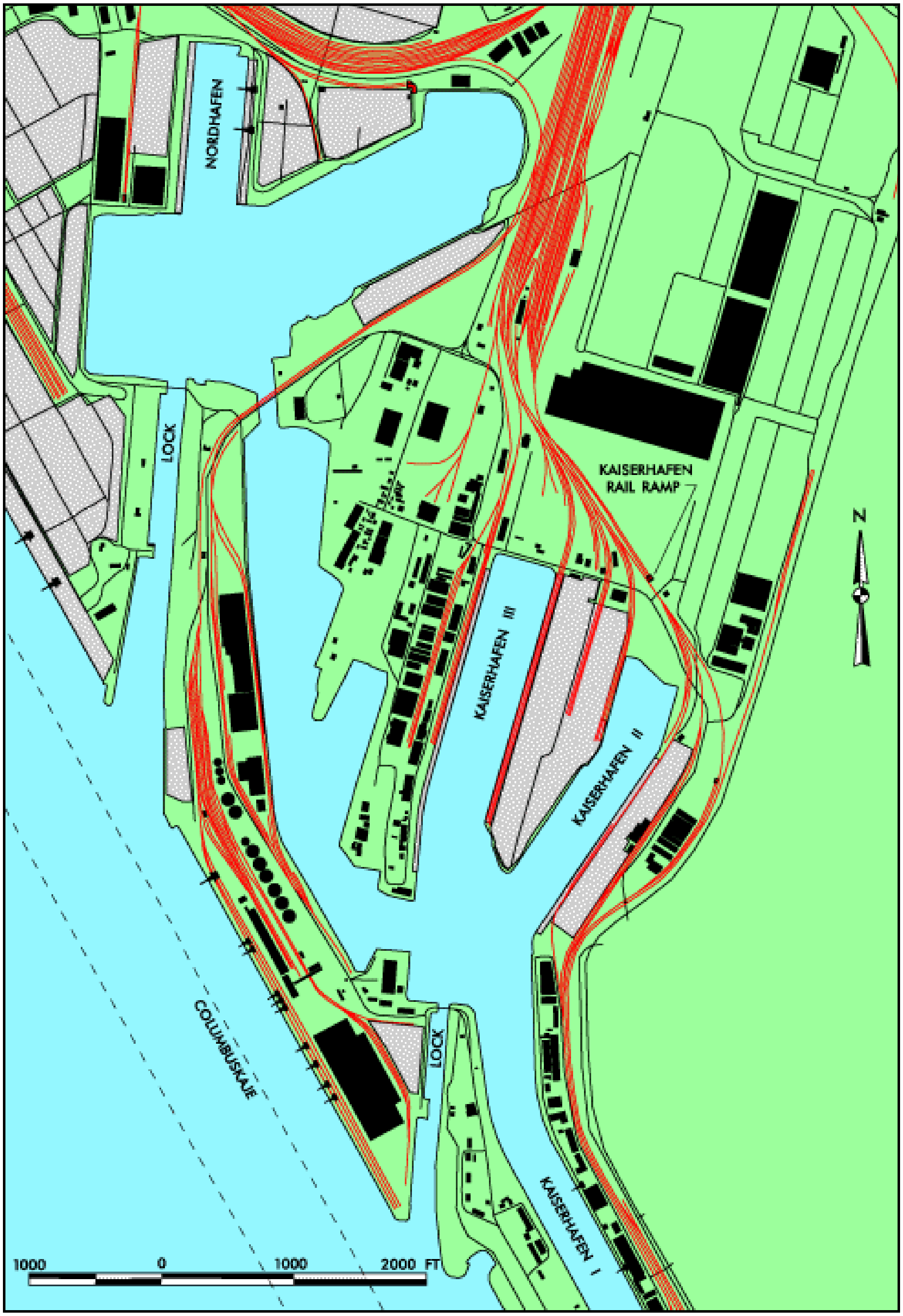
The ship channel is 1,310 feet wide from the North Sea to Robbennordsteert and 980 feet wide from Robbennordsteert to Bremerhaven. All vessels approaching and entering the Weser River and port require pilots. No vertical obstructions restrict access to the river, channel, or harbor. Several anchorages are in the port area for vessels waiting for berthing.



Channel Graphic of the Port of Bremerhaven

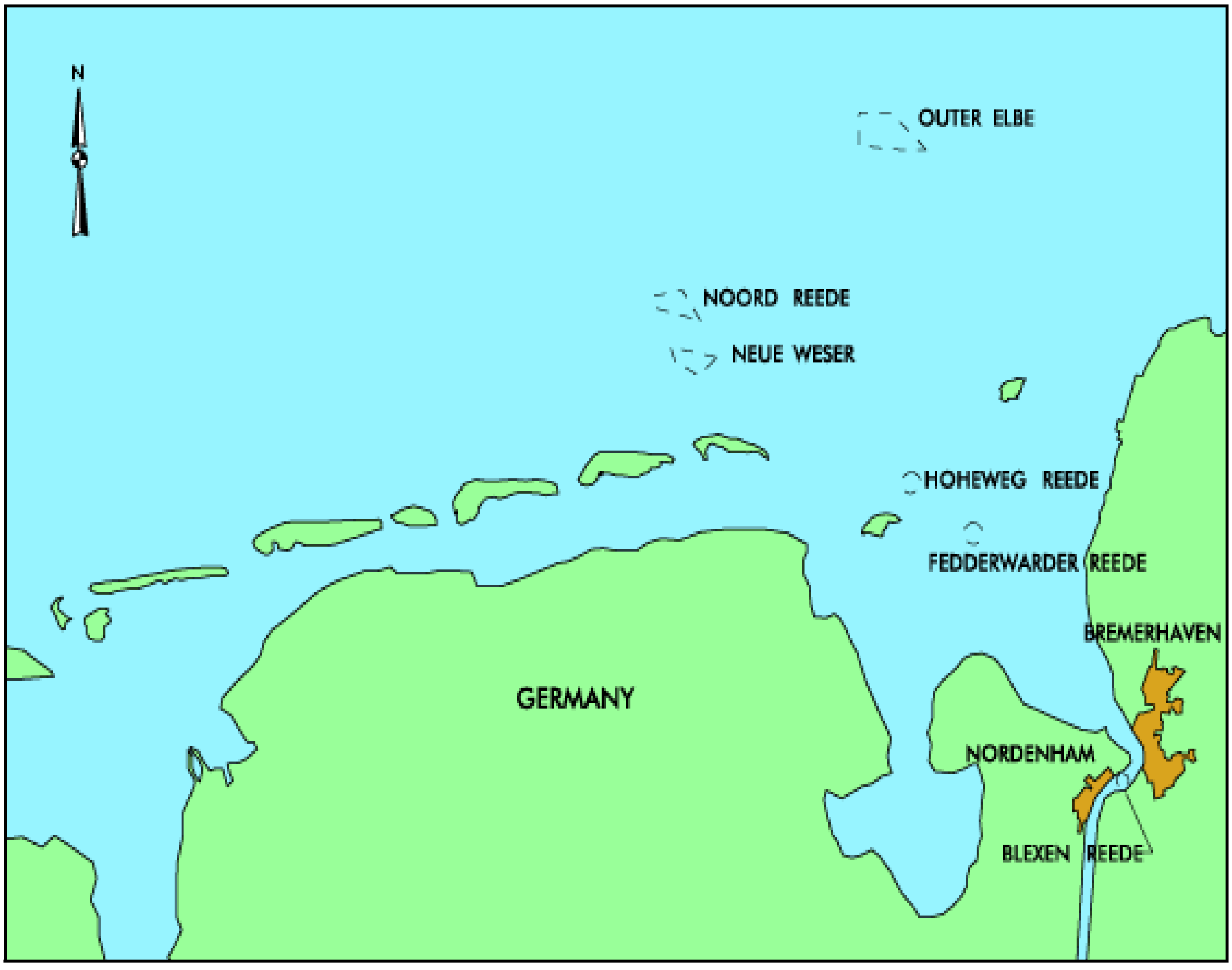


Channel Graphic (north view)



Channel Graphic (south view)

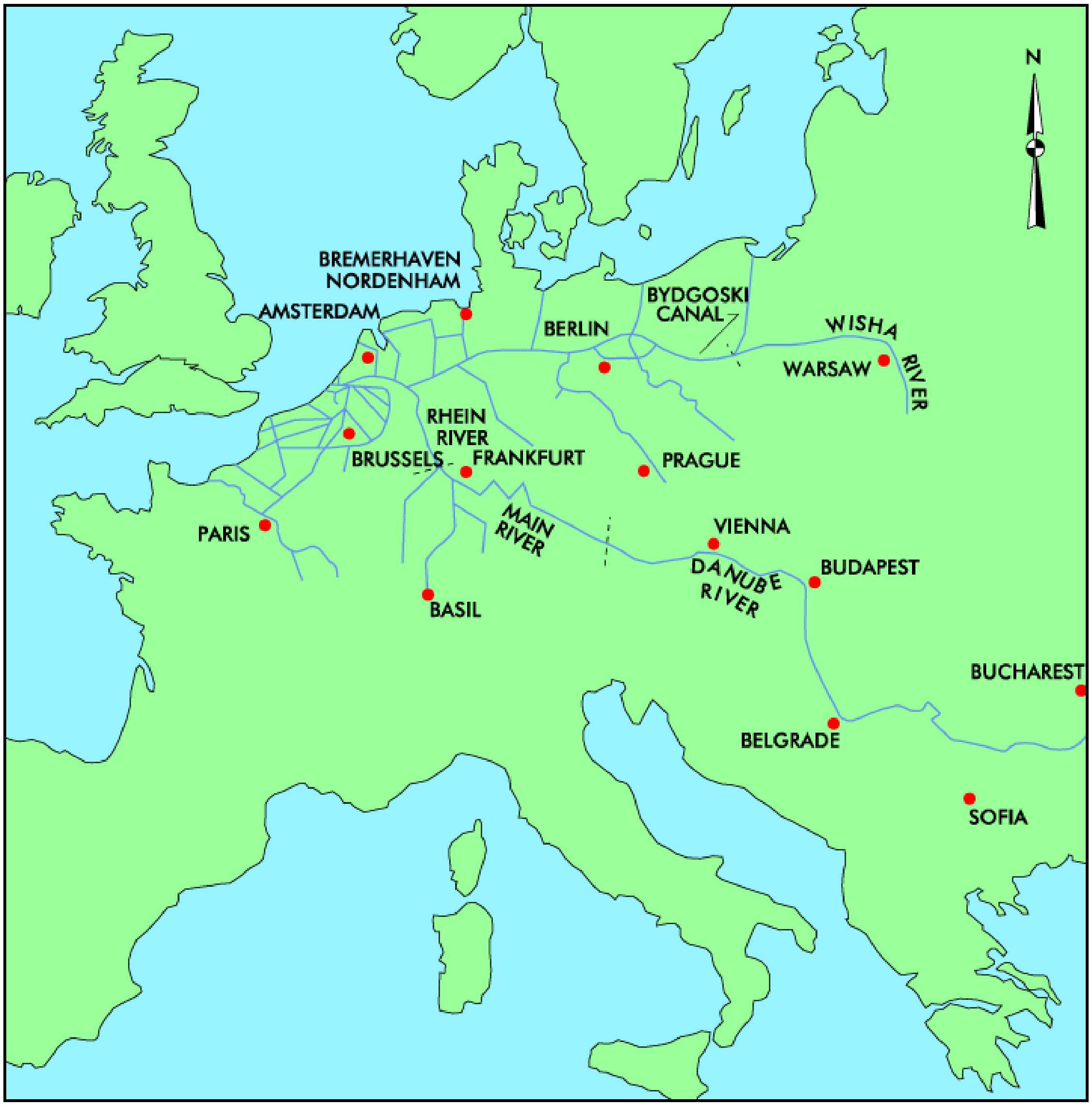
The Blexen Reede anchorage is 19.5-39 feet deep and is 3 miles south of Columbuskaje Quay. The anchorage is restricted to ships up to 390 feet in length and in-stream operations are possible. The Fedderwarder Reede anchorage is 32 feet deep and is 11 miles northwest of the container terminal. This anchorage is specifically for tankers and explosives, with no explosive limits, and in-stream operations are possible. The Hoheweg Reede anchorage is 45-59 feet deep and is 17 miles northwest of the container terminal. It has no navigational restrictions, and in-stream operations are possible. The Neue Weser Reede anchorage is 52 feet deep and is 30 miles northwest of the container terminal. It has no navigational restrictions, no explosive limits, and in-stream operations are possible. The Noord Reede anchorage is 49–59 feet deep and is 31 miles northwest of the container terminal. It has no navigational restrictions, no explosive limits, and in-stream operations are possible.



Anchorage at the Port of Bremerhaven

Tides at Bremerhaven, within the river, range up to 12 feet. Within the impounded area the tides do not affect water level. For short periods of time, during high tide, the water level inside and outside the locks is the same height. Therefore, it is possible for vessels to enter and exit the harbor without opening and closing the locks. Opening both locks at the same time is not normally done to maintain a constant water level within the locks.

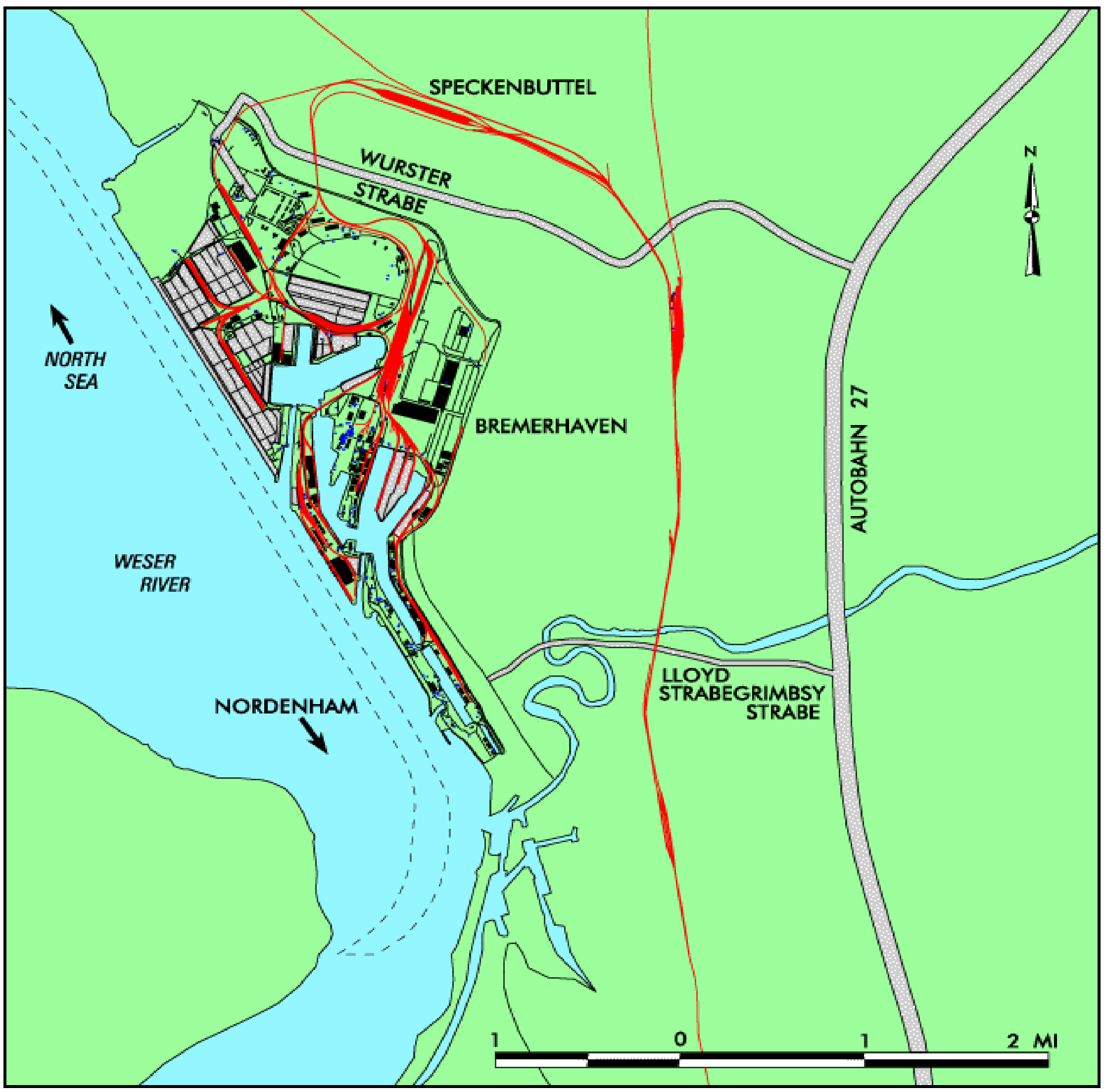
The Weser River connects with the other rivers and canals in Germany to form an effective inland water network. This makes it possible to use barges as a practical method to transport items. Barge transport can be used to move items too large for easy transport by highway and rail modes. For nonmilitary moves, about five percent (none for military) of cargo arrives in the port by barge.



Map of Inland Water Network

Highway

Highway access to the port is good. There are two roads connecting the Port of Bremerhaven to Autobahn 27, Wurster Straβe, from the North Gate, and Lloyd Straβe/Grimbsy Straβe, from the South Gate. The distance from the port's North Gate to Autobahn 27 on Wurster Straβe is 4 miles. The distance from the port's South Gate to Autobahn 27 on the expressway, Lloyd Straβe/ Grimbsy Straβe is 2 miles. These roads are not limited to port access; they also carry traffic moving through Bremerhaven. Both roads reduce to two lanes as they approach the port. In addition, there is a gate from the port near the entrance to the container terminal directly into the former U.S. Army Base. Inside the port, there is another gate to get into the container terminal. About 35 percent of nonmilitary cargo (30 percent military) arrives in the port by highway.



Road Map of the Port of Bremerhaven

North Gate to the Port of Bremerhaven

South Gate Leaving the Port of Bremerhaven

Back Gate to the Port of Bremerhaven

Container Gate to the Port of Bremerhaven

Rail

A dedicated rail line serves the Port of Bremerhaven. All loads leaving the port are inspected by the railroad inspectors to ensure they are secured to the required limits and do not exceed the approved clearance for transport.

All of the berths have at least two apron tracks. The apron tracks on the westside of Nordhafen can be equipped with mobile end ramps. Rail ramps are nearby for loading/unloading railcars close to each of the berths. The ramps served by the two parallel tracks are--

1. PC1, Nordhafen, with 1,150 feet of straight track,

2. Kaiserhafen Car Terminal with 1,150 feet of straight track,

3. CFS, CT2, with 1,150 feet of straight track, and

4. Ziomak, Carl Schurz Kaserne, with 490 feet of straight track.

All of these tracks provide access from the berth areas to the Deutsche Bahn AG railyard and mainlines. Current rail service to the port can support up to--

1. Thirty trains per day, with 30 railcars each, going to the container terminal;

2. Five trains per day, with 23 railcars, going to berths inside the locks; and

3. One train per day, with 35 railcars, going to ST/fruit terminal for fruit.

The closest Deutsche Bahn AG railyard, Bremerhaven Speckenbüttel, is north of the port. This railyard has 81 miles of track for storage. The Deutsche Bahn AG Railroad provides engines to transfer railcars from this railyard to the port. About 60 percent of nonmilitary cargo (70 percent military) arrives in the port by rail.

Air

Bremerhaven has several airfields in the area. North of Bremerhaven, 18.5 miles, is a German Navy Airfield, Nordholz (EDCN--GEO location code). This airfield has one runway 8,000 feet long and 148 feet wide. It can and has handled C-5 aircraft. The nearest civilian commercial airport is south of Bremerhaven in Bremen (EDDW). The runway is 6,673 feet long and 148 feet wide. Other German military airports in the area capable of handling a C-5 include--

1. Ahlhorn (EDNA), GAF, one runway 6,893 feet long and 148 feet wide,

2. Wunstorf (EDNW), GAF, one runway 7,600 feet long and 148 feet wide.

Helicopter operations could take place in the container and Nordhafen terminals. It has no fixed location. When needed, sufficient space can be prepared in advance.

PORT FACILITIES

Berthing

The Port of Bremerhaven is a multicargo port capable of breakbulk, roll-on/roll-off (RORO), container, and barge operations. The port has many berths capable of supporting military operations. We divided the port into two terminals for this analysis. The first terminal is located on the river and consists of the container berth, Stromkaje, and the general cargo berth, Columbuskaje. The second terminal, normally used to transport fruit and cars, is located within the locks and consists of the Kaiserhafen I, II, III, and Nordhafen berths.

Stromkaje is 9,450 feet long with a depth along side the berth at mean low water (MLW) of 46 feet and an apron height above MLW of 31 feet. Columbuskaje is 3,380 feet long with a depth along side the berth at MLW of 38 feet and an apron height of 31 feet.

Within the locks, the water level is maintained at a constant level with the apron 8 feet above the water level. Nordhafen, east side is 1,080 feet long and the west side is 1,310 feet long. Kaiserhafen I, west side is 1,950 feet long. We would not use the east side of this berth. Kaiserhafen II, south side is 2,230 feet long. We would not use the north side of this berth. Kaiserhafen III, south side is 1,970 feet long and the north side is 2,625 feet long.

BERTH CHARACTERISTICS FOR QUAYS ON THE RIVER

Characteristics	Berths			
	Stromkaje CT I	Stromkaje CT II	Stromkaje CT III	Columbuskaje
Length feet (meters)	5,200 (1,600)	1,950 (600)	2,300 (700)	3,400 (1,050)
Depth alongside at MLW feet (meters)	45.9 (14)	45.9 (14)	46.6 (14.5)	38 (11.75)
Deck strength psi (metric tons per square meter)	720 (3.5)	720 (3.5)	720 (3.5)	720 (3.5)
Apron width feet (meters)	660-980 (200-300)	660-980 (200-300)	660-980 (200-300)	82 (25)
Apron height above MLW feet (meters)	30.9 (9.4)	30.9 (9.4)	30.9 (9.4)	30.9 (9.4)
Number of container cranes	9	4	4	0
Number of wharf cranes	0	0	0	10
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	No	No	No	Yes
Apron length served by rail feet (meters)	5,200 (1,600)	1,950 (600)	2,300 (700)	3,400 (1,050)

BERTH CHARACTERISTICS FOR QUAYS IN THE LOCKS						
CHARACTERISTICS	Berths					
	Nordhafen East	Nordhafen West	Kaiserhafen I West	Kaiserhafen II South	Kaiserhafen III South	Kaiserhafen III North
Length feet (meters)	1,100 (330)	1,300 (400)	1,950 (590)	2,300 (680) North not used	2,000 (600)	2,600 (800)
Depth alongside at MLW feet (meters)	39 (12)	39 (12)	36 (11)	36 (11)	36 (11)	36 (11)
Deck Strength psi (metric tons per square meters)	410 (2)	410 (2)	410 (2)	410 (2)	410 (2)	410 (2)
Apron width feet (meters)	660 (200)	660 (200)	OPEN	330 (100)	330 (100)	330 (100)
Apron height range feet (meters)	6.5-7.5 (2.0-2.3)	6.5-7.5 (2.0-2.3)	6.5-7.5 (2.0-2.3)	6.5-7.5 (2.0-2.3)	6.5-7.5 (2.0-2.3)	6.5-7.5 (2.0-2.3)
Number of container cranes	2	0	0	0	0	0
Number of wharf cranes	0	0	2	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	Yes	Yes	No	No	No	No
Apron length served by rail feet (meters)	1,100 (330)	1,310 (400)	1,950 (590)	2,200 (680)	2,000 (600)	2,600 (800)

SUMMARY OF BERTHING CAPABILITIES FOR QUAYS ON THE RIVER

Vessels		Berths			
Type	**Class**	**Stronkaje CT I**	**Stronkaje CT II**	**Stronkaje CT III**	**Columb-Uskaje**
BREAK-BULK	C3-S-38a	10	3	4	6
	C4-S-58a	8	3	3	5
	C4-S-66a	9	3	4	5
	C5-S-37e	8	3	3	5
SEATRAIN	GA and PR	8	3	3	5
BARGE	LASH C8-S-81b	6	2	2	3
	LASH C9-S-81d	5	2	2	3
	LASH Lighter	26	9	11	3
	SEABEE C8-S-82a	5	2	2	3,a
	SEABEE Barge	26	9	11	16
RORO	COMET	9,d,i,j	3,d,i,j	4,d,i,j	6,i,j
	METEOR	9,d,i,j	3,d,i,j	4,d,i,j	5,i,j
	Cape Gnome	8,d,i,j	3,d,i,j	3,d,i,j	5,i,j
	C7-S-95A	6,i,j	2,i,j	3,i,j	4,i,j
	Cape Taylor	7,i,j	2,i,j	3,i,j	5,i,j
	Cape Orlando	7,i,j	2,i,j	3,i,j	5,i,j
	MV Ambassador	9d	3,d	4,d	6,i,j
	Callaghan	7,d,i,j	2,d,i,j	3,d,i,j	4,i,j
	Cape Lambert	7,i,j	2,i,j	3,i,j	4,i,j
	LMSR Class	5,i	1,i	2,i	3,i
	FSS	5	2	2	3
	Cape E-Class	7,i,j	2,i,j	3,i,j	4,i,j
	Cape D-Class	7,i,j	2,i,j	3,i,j	4,i,j
	Cape H	6,i,j	2,i,j	2,i,j	4,i,j
RORO	Cape Texas	7,i,j	2,i,j	3,i,j	5,i,j
	Cape R	7,d	2,d	3,d	5,i,j
	Cape I-class	7,i,j	2,i,j	3,i,j	4,i,j
	Cape Victory	7,i,j	2,i,j	3,i,j	5,i,j
CONTAINER	C6-M-147a	7	2	3	4,e
	C7-S-69c	7	2	3	4,e
	C7-S-68c	7	2	3	4,e
	C8-S-85c	6	2	2	3,e
	C9-M-132b	5	2	2	3,e
	C9-M-F141a	5	2	2	3,e
TACS	C6-S-1qd	7	2	3	4
	C5-S-MA73c	8	3	3	5
	C6-S-MA60d	7	2	3	4
MPS	C7-S-133a	6	2	2	3
	Maersk	6	2	2	4
	AmSea	7	2	3	4

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a - vessel draft limit
b - inadequate apron width
c - inadequate berth length
d - no straight stern ramp
e - no container handling equipment
f - anchorage depth OK, berth depth inadequate
g - inadequate channel depth
h - no shore based ramps
i - low tide insufficient ramp clearance
j - high tide insufficient ramp clearance
k - excessive ramp angle low tide
m - excessive ramp angle high tide
n - parallel ramp operation ONLY
o – insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

SUMMARY OF BERTHING CAPABILITIES FOR QUAYS ON THE RIVER

Vessels		Berths			
Type	**Class**	**Stronkaje Ct I**	**Stronkaje Ct II**	**Stronkaje Ct III**	**Columb-Uskaje**
BREAK-BULK	C3-S-38a	10	3	4	6
	C4-S-58a	8	3	3	5
	C4-S-66a	9	3	4	5
	C5-S-37e	8	3	3	5
SEATRAIN	GA and PR	8	3	3	5
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	LASH Lighter	26	9	11	3
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RORO	COMET	9,d,i,j	3,d,i,j	4,d,i,j	6,i,j
	METEOR	9,d,i,j	3,d,i,j	4,d,i,j	5,i,j
	Cape Gnome	8,d,i,j	3,d,i,j	3,d,i,j	5,i,j
	C7-S-95A	6,i,j	2,i,j	3,i,j	4,i,j
	Cape Taylor	7,i,j	2,i,j	3,i,j	5,i,j
	Cape Orlando	7,i,j	2,i,j	3,i,j	5,i,j
	MV Ambassador	9d	3,d	4,d	6,i,j
	Callaghan	7,d,i,j	2,d,i,j	3,d,i,j	4,i,j
	Cape Lambert	7,i,j	2,i,j	3,i,j	4,i,j
	LMSR Class	5,i	1,i	2,i	3,i
	FSS	5	2	2	3
	Cape E-Class	7,i,j	2,i,j	3,i,j	4,i,j
	Cape D-Class	7,i,j	2,i,j	3,i,j	4,i,j
	Cape H	6,i,j	2,i,j	2,i,j	4,i,j
RORO	Cape Texas	7,i,j	2,i,j	3,i,j	5,i,j
	Cape R	7,d	2,d	3,d	5,i,j
	Cape I-class	7,i,j	2,i,j	3,i,j	4,i,j
	Cape Victory	7,i,j	2,i,j	3,i,j	5,i,j
CONTAINER	C6-M-147a	7	2	3	4,e
	C7-S-69c	7	2	3	4,e
	C7-S-68c	7	2	3	4,e
	C8-S-85c	6	2	2	3,e
	C9-M-132b	5	2	2	3,e
	C9-M-F141a	5	2	2	3,e
TACS	C6-S-1qd	7	2	3	4
	C5-S-MA73c	8	3	3	5
	C6-S-MA60d	7	2	3	4
MPS	C7-S-133a	6	2	2	3
	Maersk	6	2	2	4
	AmSea	7	2	3	4

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Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

STAGING

Open Staging

The Port of Bremerhaven has about 660 acres of open storage. The staging is distributed throughout the port area, most of which is adjacent to the berths. The port has sufficient open staging to allow helicopter operations.

Open Staging Area at the Port of Bremerhaven

Covered Staging

The port has ample covered storage available for general cargo and container stuffing/unstuffing operations. Storage facilities are located near each of the berths. The largest facility is 355,212 square feet and is on the Columbuskaje pier. The next largest building, P2, is 322,920 square feet and is in the container terminal behind the CT II berths and has an area for secured storage. The F/G facility is 193,752 square feet and is in the fruit terminal. The last storage facility, PC1, next to the Nordhafen berths has 182,988 square feet. The port has a cold storage capability of 86,112 square feet.

Covered Staging (looking west)

UNLOADING/LOADING POSITIONS

Ramps and Docks

Ramps and docks are located throughout the port in the storage facilities. The Columbuskaje pier storage building has 10 truck and 20 railcar loading/unloading positions. The container terminal storage facility, P2, has 20 truck and 10 railcar loading/unloading positions. Fruit terminal storage facility, F/G, has 12 truck and 2 platform-level railcar loading/unloading positions. The Nordhafen storage facility, PC1, has 10 truck and 15 railcar loading/unloading positions. The container cold storage facility has 12 truck loading/unloading positions.

Marshaling Areas

The port may allow the U.S. military to use part of the open storage area as a marshaling yard. The Port Authority allows up to 40 days unlimited storage for volume moves. The specific areas include the container terminal and the Nordhafen berth area. The former U.S. Army Base, Carl Schurz Kaserne, has about 15 acres of gravel storage and about 3 acres of paved area. A direct gate leads from the port to the former U.S. Army base. This gate is located behind the container terminal near the Nordhafen berth area.

MATERIALS HANDLING EQUIPMENT (MHE)			
Type of Equipment	**Capacity (STON)**	**Quantity**	**Wharf Assignment**
Container cranes	40–75	19	17 Stromkaje, 2 Nordhafen
Container cranes	32	1	Columbuskaje
Wharf cranes	8	9	Columbuskaje
Straddle carriers	40	68	
Forklifts	1.5–37.5	110	
Floating cranes	100	1	
Floating cranes	500–600	2	
NOTE: The table above represents equipment owned by the port. Port operators indicate that they lease or rent other equipment as required from local suppliers. The list is not "all inclusive" as actual totals may change.			

FUTURE DEVELOPMENT

The length of the Stromkaje Container Terminal III (CT III), has just been increased by 2,300 feet. It has 47 feet MLW water depth next to the pier. The operating and storage area of 198 acres is basically finished. The six-dock rail tracks were extended to CT III allowing for unit trains with a length from 1,968 to 4,265 feet each in CT III.

Because of projected container traffic growth, further expansion of the container terminal, designated as CT IIIa, is already in the planning phase. The latest information can be obtained from the Ports of Bremen home page on the Internet, www.bremen-ports.de/.

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

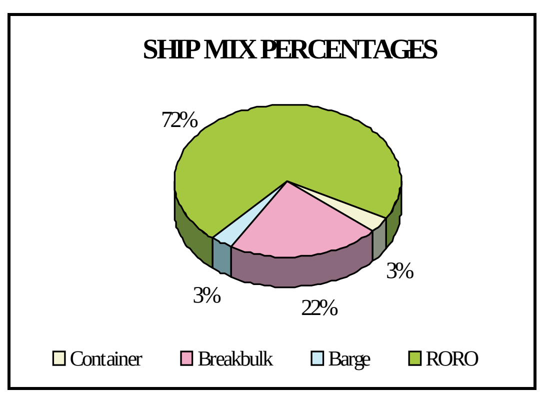
The U.S. Army does not use this port for explosive ammunition operations. Explosive and hazardous cargo operations for the U.S. military are performed at the Port of Nordenham, 4 miles south of the Port of Bremerhaven. During contingency operations (and as actually done during Desert Shield/Desert Storm), the local port authorities allow the handling of explosives under certain conditions.

III. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Bremerhaven. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, shiploading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and measurement tons (MTON) per day. The charts in this section show the throughput yields in STON. Approximate MTON yields were computed by multiplying the STON amount by three.

Terminal Throughput Subsystems



Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 70 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.

TERMINAL CLEARANCE AND HANDLING

Highway

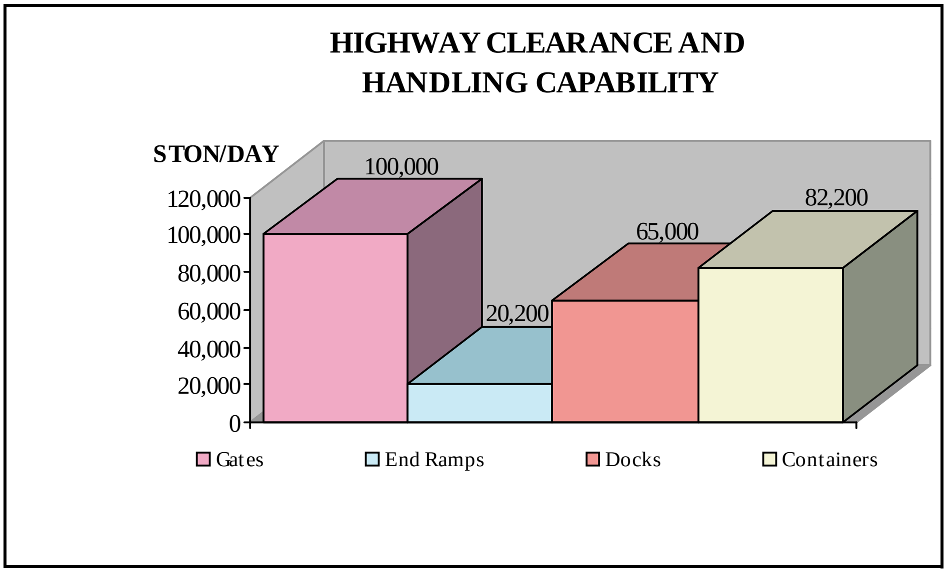
The port is connected to the highway net by two gates and roads that provide access to Autobahn 27. The two gate processing systems can handle at least 80,000 STON of cargo per day. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or leave the port on each lane of the highway. The back gate to the former U.S. Army base is not normally used for traffic to the port and the gate to the container terminal is used for access to the container terminal only.

Roadable vehicles will move through the terminal gates in manageable convoys from staging areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. If ramps are not available, deploying units/military port operators must either build or acquire the necessary ramps. For this study, we assumed 10 portable ramps would be used for loading operations. These ramps can handle 20,200 STON of military vehicles and equipment per day.

The port has 64 handling positions to load/unload supplies in van semitrailers. These positions can load/unload at least 65,000 STON of shipped material per day.

The Port of Bremerhaven has 68 straddle carriers available. By using 22 of these for loading semitrailers, the port can handle at least 82,200 STON of containerized equipment and supplies per day.

Maximum daily handling capability for the port is a mixed total of the three types of handling (docks, end ramps, and containers), each up to its maximum, not to exceed the daily gate limit of at least 80,000 STON.



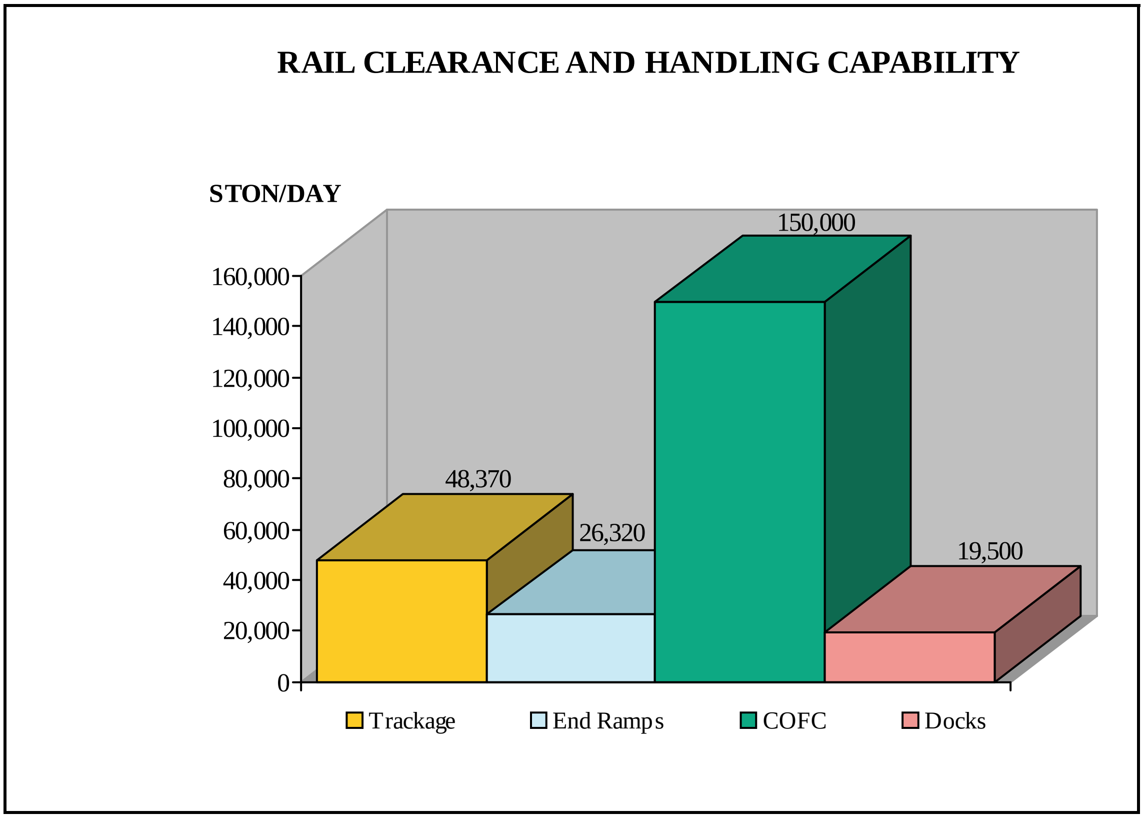
Rail

Rail reception is good, with the German National Railroad (Deutsche Bahn AG) providing rail service directly to the port. Current rail service can support up to thirty 30-railcar trains per day to the container terminal, five 23-railcar trains per day to the lock terminals, and one 35-railcar train to ST/fruit terminal. These trains can handle at least 48,370 STON per day.

Vehicles on flatcars will offload in the port on the four fixed rail end ramps, each serving double tracks. The end ramps can handle at least 26,320 STON per day.

Boxcars will load/offload at the storage buildings. The port has 47 rail handling positions available for loading/unloading boxcars. These docks can handle at least 19,500 STON per day.

Based on using the 46 straddle carriers not used for highway, the port can offload at least 150,000 STON of containerized equipment and supplies from railcars per day.



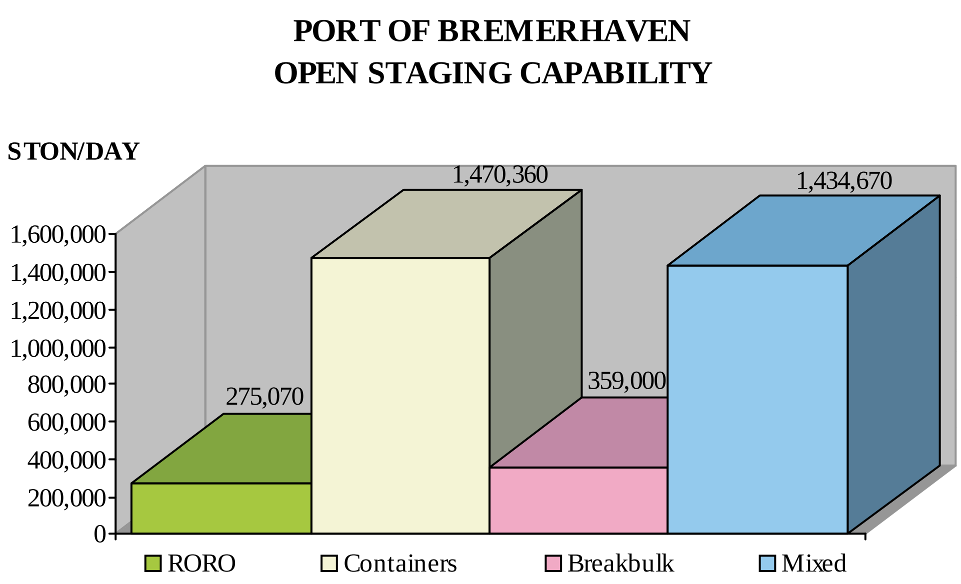
Staging

The port has about 660 acres of suitable open staging area, which is distributed throughout the terminal area. Availability of the staging area will vary with work at the port. However, under normal operational expectations, staging availability will not limit operations. For purposes of this analysis we assumed a usable space availability of 100 percent of the total area.

The port has about 1,053,000 square feet of covered storage space. Like the open area, much of this is subject to contain some of the breakbulk cargo moving through the port. However, covered space availability will not limit throughput at the port. About 21,100 STON of breakbulk cargo can be staged in the covered area.

The chart on this page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of each involved capability should be assumed. Based on the daily throughput capability, the port has the capability to store about 18 days of cargo for shiploading.

The table shows the STON of cargo, by type, the port can expect to handle. The container storage requirement is the highest with 1,470,360 STON. This equates to 183,740 twenty-foot equivalent units (TEU) and with the ability to stack the containers three-high. One acre can store 325 containers. The RORO storage available is 275,070 STON. This equates to about 34,065 RORO pieces. The breakbulk requirement is for 359,000 STON.



Note: Container staging area can also be used for RORO staging as needed.

Shipping

Daily shipping subsystem totals for the terminal berths are catalogued in the chart on the next page. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types.

The in-lock berths are the best choice for performing RORO operations, since the river has a tidal variation of 12 feet and the locks maintain a constant water depth. The Kaiserhafen berths and Nordhafen West have no cranes and should be used by self-supporting ships or for RORO operations. The container terminal is designed for container operations and is the obvious choice.

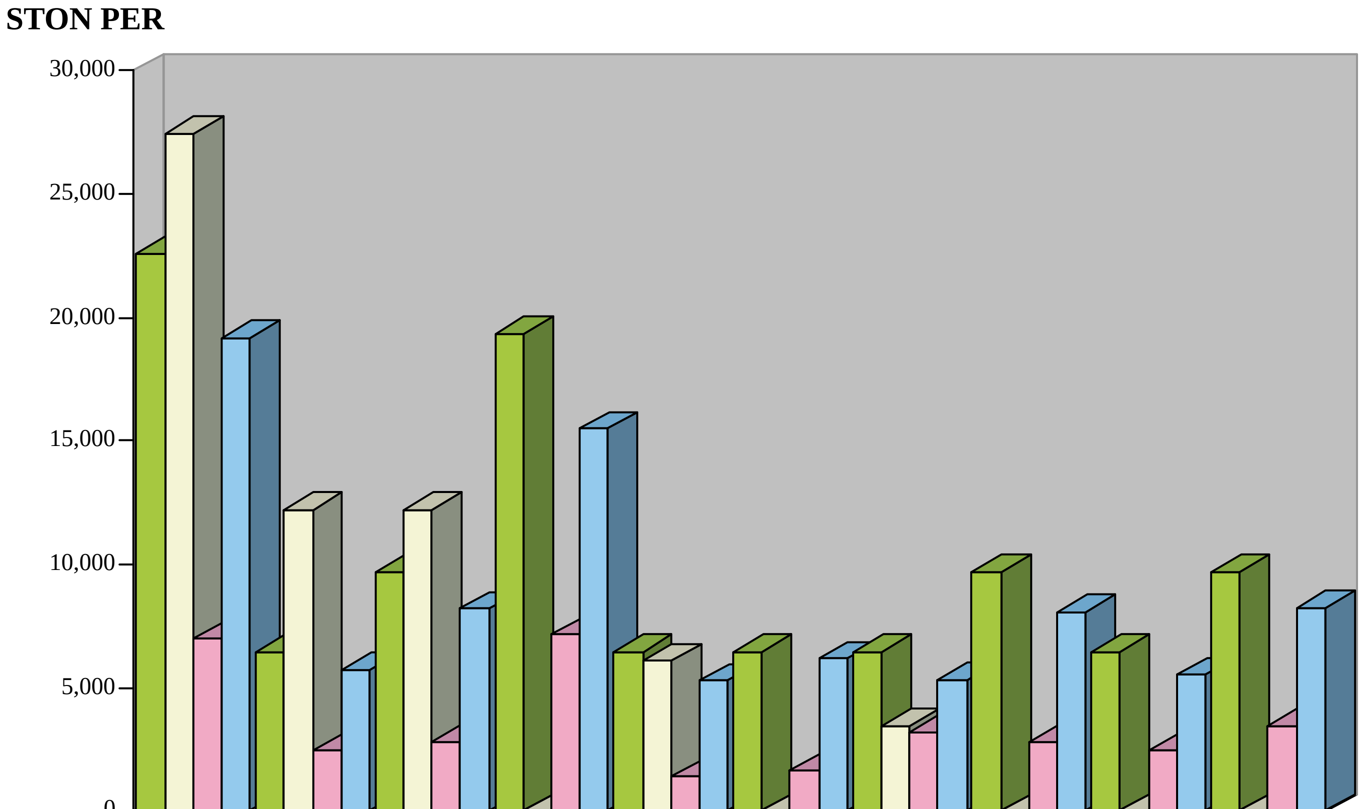
Based on current practices, the U.S. military uses the Nordhafen berths for normal transport through this port. With its two container cranes, all types of operations can be performed in these berths. The west side of Nordhafen berth has the easiest access to the P2 storage building and one of the double width rail ramps. The berth on the west side should be used by RORO vessels or self-supporting ships since it does not have cranes.

Barge

The extensive river and canal network makes it possible to use river barges to move cargo within Germany. Oversized and overweight items can be transported by barge without permits and route restrictions encountered on highways and railroads. Barges do have restrictions, which include canal depth and width, overpass heights, and locks limits.

Three general types of barges are used in canals and rivers in Europe; breakbulk, RORO, and container. These barges are handled in a similar manner as the larger vessels of the same type and the barges may be self-propelled or towed.

PORT OF BREMERHAVEN
BERTH THROUGHPUT CAPABILITY



	Stromkaje CT I	Stromkaje CT II	Stromkaje CT III	Columbuskaje	Nordhafen East	Nordhafen West	Kaiserhafen I West	Kaiserhafen II South	Kaiserhafen III South	Kaiserhafen III North
RORO	22,590	6,450	9,680	19,350	6,450	6,450	6,450	9,680	6,450	9,680
Container	27,430	12,190	12,190	0	6,100	0	3,480	0	0	0
Breakbulk	6,970	2,440	2,790	7,150	1,390	1,630	3,210	2,790	2,440	3,480
Mixed	19,190	5,720	8,190	15,480	5,290	6,180	5,310	8,060	5,510	8,230

DAILY THROUGH PUT SUMMARY FOR THE PORT OF BREMERHAVEN

BERTH	LENGTH (feet)	DEPTH ALONGSIDE (feet)	BREAKBULK THROUGHPUT (STON)	RORO THROUGHPUT (STON)	RORO SQUARE FT[1] (EST)	RORO PIECES[2]	CONTAINER THROUGHPUT (STON)	CONTAINER THROUGHPUT[3] (TEU)	MIXED THROUGHPUT (STON)
Stromkaje CT I	5,200	46	6,970	22,580	451,600	2,660	27,430	3,430	19,190
Stromkaje CT II	1,950	46	2,440	6,450	129,000	760	12,190	1,520	5,720
Stromkaje CT III	2,300	46	2,790	9,680	193,600	1,140	12,190	1,520	8,190
Columbuskaje	3,380	38	7,150[4]	19,350	387,000	2,280	0	0	15,480
Nordhafen East	1,080	39	1,390	6,450	129,000	760	6,100	760	5,290
Nordhafen West	1,310	39	1,630	6,450	129,000	760	0	0	6,180
Kaiserhafen I West	1,950	36	3,210[5]	6,450	129,000	760	3,480	440	5,310
Kaiserhafen II South	2,230	36	2,790	9,680	193,600	1,140	0	0	8,060
Kaiserhafen III South	1,970	36	2,440	6,450	129,000	760	0	0	5,510
Kaiserhafen III North	2,620	36	3,480	9,680	193,600	1,140	0	0	8,230
TOTAL	**23,990**		**34,290**	**103,220**	**2,064,400**	**12,160**	**61,390**	**7,670**	**87,160**

[1]Based on the 20 square foot per STON average accomplished during Operation Desert Shield/Storm.
[2]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.
[3]Based on the 8 STON per TEU average accomplished during Operation Desert Shield/Storm.
[4]Includes 1,800 STON of LASH and SEABEE barge throughput capacity.
[5]Includes 550 STON of LASH and SEABEE barge throughput capacity.

SUMMARY

The port is multioperational with the capability to handle all types of vessels; container, RORO, breakbulk, and barges.

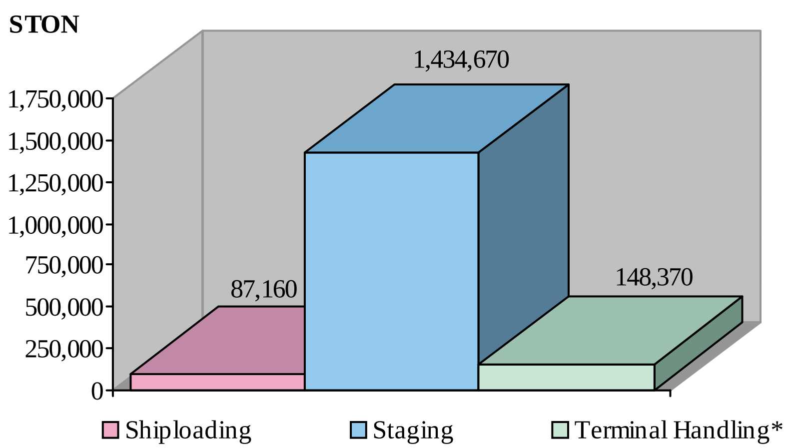
The Port of Bremerhaven is fully capable of supporting U.S. military cargo transshipment operations. The tidal range on the river limits RORO operations; however, the locks have no tidal limits. The port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of at least 87,160 STON.

The inland water network makes barge transport an effective shipping method. The port connects to this network and provides a third alternative for moving items inland.

Commercial operations taking place concurrently in the port will limit actual daily throughput, sustainable over time, by an appropriate percentage of the terminal's overall capability.

DAILY CARGO THROUGHPUT CAPABILITY



Terminal handling is the sum of the highway (100,000 STON) and rail (48,370 STON) limits.

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored division using primarily LMSR or FSS vessels. We also assume that no other military units will be competing for these facilities during the time that the armored division occupies the port. We further assume that the required assets, both transporters and people will be available to adequately load the ship and clear the port. The berths in the Nordhafen Terminal are used for this analysis.

Potential Port Use During Deployment

REQUIREMENTS

TOTAL EQUIPMENT	
Volume	287,175 MTON
Weight	101,350 STON
Area	1,484,650 SQ FT
Vehicles	8,125
Containers	520
Note: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997	

To simulate a likely requirement for the Port of Bremerhaven, we deployed a notional armored division, using two berths to load the ships in the minimum amount of time. This is based on our normal use of the two berths in Nordhafen. The division has to move about 8,125 vehicles and 520 containers. Movement of the division to the port will require about 3,400 railcars, 2,800 medium duty European railcars, and 620 heavy-duty European railcars, using an all rail option for transport to the port.

For this application, we assumed a total rail deployment. Historically, deployments to the port have been about 30 percent arriving by highway. However, more recent deployment such as to Bosnia, highway deployment has approached zero percent.

TERMINAL INPROCESSING/HANDLING

Rail

The Deutsche Bahn AG railyard, Bremerhaven Speckenbüttel, serves the Port of Bremerhaven and the former U.S. Army Base, Carl Schurz Kaserne. Speckenbüttel is north of the port, with 81 miles of track. The Deutsche Bahn AG Railroad provides engines to transfer railcars from this railyard to the port.

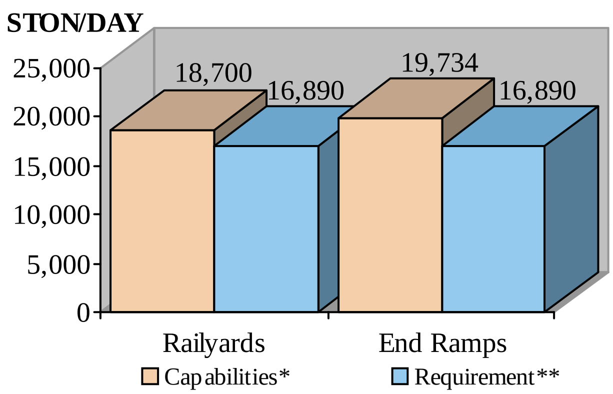
Three rail ramps are available for loading/unloading railcars close to the berths and on the former U.S. Army base. Each ramps is served by two parallel tracks. The ramps are--

1. PC1, Nordhafen, with 1,150 feet of straight track, and
2. CFS, CT2, with 1,150 feet of straight track, and
3. Ziomak, Carl Schurz Kaserne, with 490 feet of straight track.

These tracks provide access from the Deutsche Bahn AG railyard and mainline to the berth areas. Current rail service to the container terminal is up to 30 trains per day, 30 railcars per train, or 900 railcars per day. Current rail service to the berths inside the locks is up to 5 trains per day, with 23 railcars per train, or 115 railcars. There is no regular rail service to the former U.S. Army base. The apron tracks on the west side of Nordhafen can be equipped with mobile end ramps.

We assumed part of the rail service going to the container terminal and the former U.S. Army Base, Carl Schurz Kaserne would be used to meet the rail requirement. Bringing the equipment in by trains in 6 days will require 570 railcars per day, or about 16,890 STON per day. No railcars should be scheduled to arrive the last 2 days of the ship loading to ensure there are no conflicts with offloading the railcars and loading the ships.

RAIL CLEARANCE/HANDLING CAPABILITY

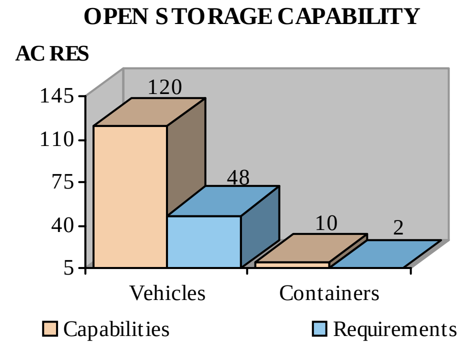


***Assumes railcars and trains for the container terminal, mobile ramps in Nordhafen, and the former U.S. Army Base, Carl Schurz Kaserne are available for use.**
****Based on the requirement for 3,400 railcars and the rail service to the Nordhafen berth area is 115 railcars, it would take 30 days to move all the railcars to these end ramps only. This is not practical.**

Rail End Ramp Locations

Open Storage

The port has plenty of open storage area. Limiting the open storage area used to the former U.S. Army Base, Carl Schurz Kaserne, and to the area around the Nordhafen berths will not cause a problem for a deploying force. The staging area requirement for each LMSR is 25 acres. Loading two ships simultaneously will require a total of 50 acres for vehicle and container storage.



Note: Includes 18 acres on Carl Schurz Kaserne, former U.S. Army Base, and 3 acres on Nordhafen, for U.S. Army pre-emptive use.

Shipping

Berth space is adequate to allow the side and stern ramps on the LMSRs to be used to load the ships. Within the locks, tidal variation should not cause any problems. If smaller ships are used to deploy the division, then additional time or berths will be required to move the division.

SHIP REQUIREMENTS NOTIONAL ARMORED DIVISION				
Loading Condition/ Sample Ship Mix	**FSS (RORO/Comb)**	**LMSR (RORO/Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	9.6			
All LMSR		5.9		
All Breakbulk			29.8	
Maximum Containerization				
FSS/Container	2.9			4.9
LMSR/Container		1.8		4.9
Breakbulk/Container			9.0	4.9

Legend:
RORO – roll-on/roll-off
FSS – fast sealift ship
LMSR – large medium speed roll-on/roll-off

Deploying by LMSR requires six ships. Based on preliminary LMSR loading results, we estimate the LMSRs will load about 400 STON per hour. Each LMSR will require an average 42.22 hours to load. The number of days required to load the ship is determined by the hours of work per day (20) and factors for sustainment and nightime operations we get the equivalent of 18.43 hours per day. Based on a loading time of 42.22 hours and 18.43 hours per day productive time it will require an average of 2.29 days to load each LMSR. The first two ships should arrive and be ready to start loading on the third day of railcar arrival, the next two ships should arrive in the port as the first two depart, and the last two ships should arrive in the port as the second two depart. This will require 6.87 days of loading; this does not include docking/undocking and ship preparation. To load the ships in 6 days requires loading three LMSRs at a time. This will require an additional berth besides the two in Nordhafen. This results in about an 8-day use of staging in the berth area, with the last 6 days used to load the ships.

Deploying by FSS requires 10 ships based on FSS loading time of 250 STON per hour. Each FSS will require an average 40.5 hours to load. The number of days required to load the ship is determined by the hours of work per day (20) and factors for sustainment and nighttime operations we get the equivalent of 18.43 hours per day. Based on a loading time of 40.5 hours and 18.43 hours per day productive time, it will require 2.19 days to load the FSS. To load two ships at a time requries 10.95 days of shiploading; this does not include docking/undocking and ship preparation. Five berths would be required to meet the 6-day requirement.

SUMMARY

The Port of Bremerhaven can load and clear a notional armored division in about 8 days using two berths and six LMSR ships. The port can load a notional armored division within 6 days using three berths and six LMSR ships. If other ships are used, additional berths or additional time will be required to deploy the division.

This is a viable port for supporting deployment of a notional armored division provided two berths (Nordhafen east and west sides) are available for U.S. military deployments. Additional berths in the locks with RORO capability will be required to meet a 6-day deployment requirement.

Currently, about 94 percent of the unit will arrive by rail. This requires more rail assets than are normally used by the berths in the locks. Since it does not exceed the port's rail capacity, the military port operator and port officials should be able to find a working solution that is acceptable to both parties.

PORT OF NORDENHAM
GERMANY

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Nordenham in December 1997. Nordenham is a public operated, privately owned port capable of handling roll-on/roll-off (RORO), container, bulk, and breakbulk ships and barges.

The port has a 2,330-foot-long wharf that makes up the North and South Piers, and can accommodate two vessels as large as the FSS and LMSR. It is one of the few ports in Northern Europe designated for the transshipment of ammunition. The port also has some capability of supporting U.S. military cargo shipment operations. It can load or unload a mixed throughput of at least 3,080 short tons (STON) per day. It would take about 9 days to load a notional armored brigade.

The Port of Nordenham connects with the inland waterway network, making barge transport an effective shipping method. Rail and barge are the normal methods of shipping to and from this port. The river, however, limits the effectiveness of highway transport to and from the port. The port is on the west side of the river, limiting movement to the east and most of Europe. Highway traffic has to cross the river in Bremen.

The 13-foot tidal range limits normal RORO operations at the port. Nordenham performs RORO operations by driving vehicles onto pontoon barges and then lifting the vehicles to the apron or railcar.

The port has four wharf cranes (three 24 STON and one 72 STON) and no container cranes. It has 22 acres of open staging.

The port is certified for transshipment of ammunition and explosives. The limit is 3 million pounds net explosive weight (NEW) for normal operations. For contingency operations, the limit is doubled to 6 million pounds NEW. Each breakbulk or container ship can be loaded/unloaded in about 2-1/2 days. The time required to load/unload the ship would be the limiting factor in the time required to move the explosives into the port.

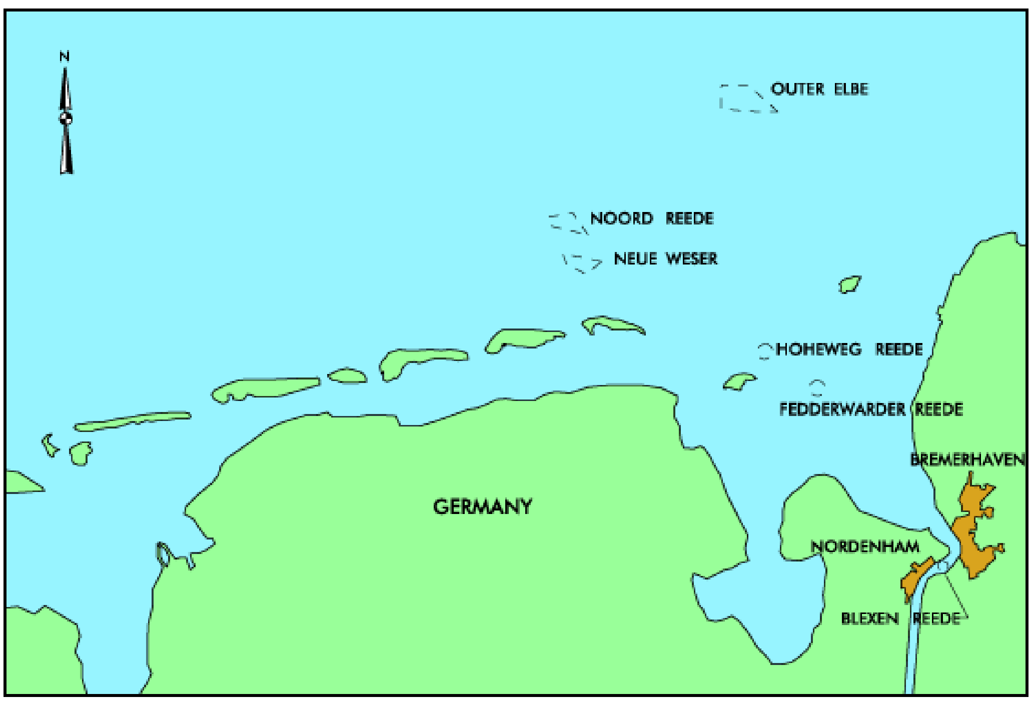
II. GENERAL DATA

Nordenham is a modern, multipurpose, privately owned port, operated as a public port. MIDGARD AG and Co. KG owns the port. A team from the Military Traffic Management Command Transportation Engineering Agency conducted a site survey 1-4 December 1997. Information was obtained from the 950th U.S. Army Transportation Company, Bremerhaven, Germany, and port officials.

TRANSPORTATION ACCESS

Water

The Port of Nordenham (latitude 53° 29' north, longitude 08° 29" east, (SAYM) time zone GMT +1) is on the Weser River about 4 nautical miles south of Bremerhaven and 39 nautical miles from the North Sea. The river channel has a minimum depth of 47 feet 6 inches at mean low water (MLW). The river channel is 1,300 feet wide from the North Sea to Robbennordsteert and 980 feet from Robbennordsteert to Bremerhaven. No vertical obstructions restrict access to the river, channel, or port. Pilotage is required for all vessels approaching and entering the Weser River and port. Tides within the river, at Nordenham, range about 13 feet. Several anchorages are in the port area for vessels waiting to berth.



Channel Graphic at the Port of Nordenham

The Blexen Reede anchorage is 19.5-39 feet deep and located 1 mile north of Nordenham. The anchorage is restricted to ships up to 390 feet in length and in-stream operations are possible. The Fedderwarder Reede anchorage is 32 feet deep and 15 miles north of Nordenham. This Fedderwarder Reede anchorage is specifically for tankers and explosives. It has no explosive limits, and in-stream operations are possible. The Hoheweg Reede anchorage is 45-59 feet deep and 21 miles north of Nordenham. There are no navigational restrictions, and in-stream operations are possible. The Neue Weser Reede anchorage is 52 feet deep and 34 miles north of Nordenham. There are no navigational restrictions or explosive limits, and in-stream operations are possible. The Nord Reede anchorage is 49–59 feet deep and 35 miles north of Nordenham. There are no navigational restrictions or explosive limits, and in-stream operations are possible.

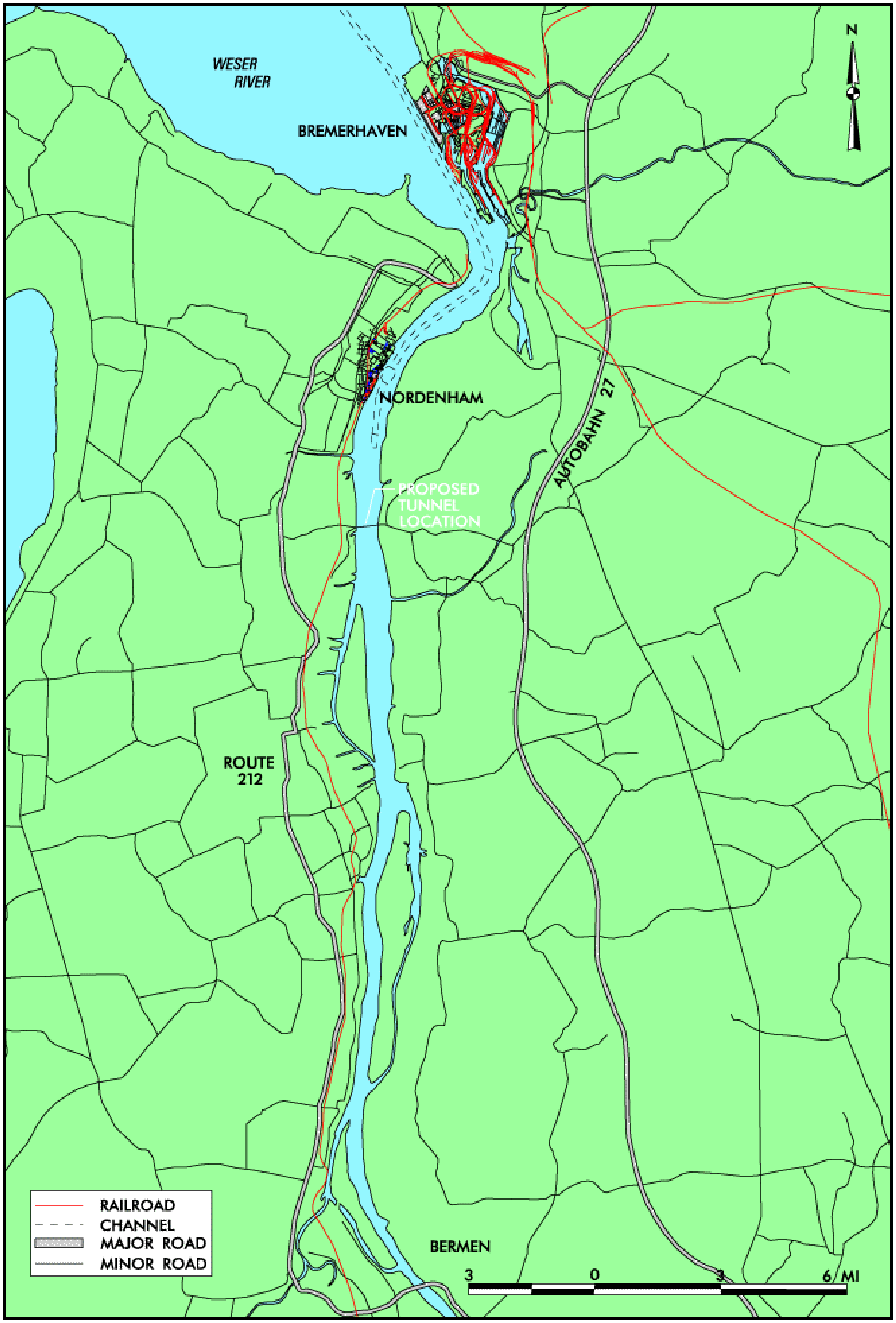
The Weser River connects with the other rivers and canals in Germany to form an effective inland water network. Barge transport can be used to move items too large for unrestricted highway and rail transport. For nonmilitary cargo, 60 percent bulk and 30 percent general cargo (zero military) goes into the port by barge.

Map of Inland Water Network at the Port of Nordenham

Highway

The Port of Nordenham is served by one road that connects to Autobahn 27. It is 35 miles from the Autobahn, through Bremen, across the Weser River, and then north to Nordenham. Highway access to the port is one lane in both directions with two gates. A ferry crosses the river 5 miles south of Nordenham. However, it is not an effective method of moving large numbers of vehicles. There is also a ferry north of Nordenham that connects to Bremerhaven. This is a 30-minute trip. Plans are to build a tunnel crossing 5 miles south of Nordenham with construction projected from 1998 to 2002. Just outside the port, the highway goes under the railroad track and large vehicles may cause a bottleneck, slowing highway movement into/out of the port. Ten percent bulk and 40 percent general nonmilitary cargo and two percent military cargo goes to the port by highway.

Main Gate to the Port of Nordenham



Highway Map of the Port of Nordenham

Highway and Rail Underpass

Rail

The Port of Nordenham has a dedicated rail line connected to the German National Railroad, Deutsche Bundesbahn AG station outside the port. Within the port is a storage area for 50 railcars. The station can store 200 railcars. The North Pier has five quayside tracks and the South Pier has three. It also has a portable rail end ramp with a 71.65 STON capacity that can be used where needed. Thirty percent of nonmilitary cargo and 98 percent of military goes to the port by rail.

PORT FACILITIES

Berthing

The port has four berthing areas. The Oil Pier is the southern most pier, which is 560 feet long; the South Pier is next and is 1,165 feet long; then the North Pier, which is 1,165 feet long. The northern most pier is the Grain Pier, which is 620 feet long. Midgard, the port operator, is converting the Grain Pier to a RORO Pier with a floating end ramp. Technical plans have been completed. MIDGARD expects to start construction work at the end of 1999.

Depth alongside the berths at MLW is 44 feet. The berths can support all types of cargo operations, but RORO operations are difficult because of the apron height and the tidal range. The apron height is 20 feet above MLW and the tidal range is 13 feet. RORO operations directly onto the pier are limited to 3 hours before and after high tide. At other times the ramp angle is too steep for normal RORO operations; however, modified RORO operations are possible. The procedure for loading/unloading RORO vessels at Nordenham is to drive the vehicles onto pontoon barges, then lift them onto the apron or directly onto railcars.

Berthing at the Port of Nordenham

STAGING

Open Staging

The Port of Nordenham has about 22 acres of open staging available for use. This space is distributed throughout the port area, with much of the available staging area adjacent to the North and South Piers. About 10 acres of open storage are within the reach of the cranes. Of this area, the port will provide about 3 acres of storage without charge. The space provided to the U.S. Army without charge is outside the crane reach.

Open Staging Area

Covered Staging

Three buildings have a total of 134,550 square feet of covered storage; two buildings have 26,910 square feet each, and one building has 80,730 square feet. The two small storage buildings are within crane reach allowing items to be moved from the storage building directly to the ship and return. Each storage building has an overhead traveling crane with a 35.3 STON capacity.

Covered Staging at the Port of Nordenham

BERTH CHARACTERISTICS FOR PORT OF NORDENHAM		
	Berths	
Characteristics	**South**	**North**
Length feet (meters)	1165 (355)	1165 (355)
Depth alongside at MLW feet (meters)	44 (13.4)	44 (13.4)
Deck strength pounds per square feet (metric tons per square meter)	819.2 (4)	819.2 (4)
Apron width feet (meters)	OPEN	OPEN
Apron height above MLW feet (meters)	20.8 (6.35)	20.8 (6.35)
Number of container cranes	0	0
Number of wharf cranes (gantry) 24 STON, (22 metric tons)	2	1
Number of wharf cranes (luffing jib) 72 STON, (65 metric tons)	1	0
Apron lighting	YES	YES
Straight-stern RORO Ramp	NO	NO
Apron length served by rail feet (meters)	1165 (355)	1165 (355)

PORT OF NORDENHAM SUMMARY OF BERTHING CAPABILITIES

Vessels		Berths	
Type	**Class**	**South**	**North**
Breakbulk	C3-S-38a	2	2
	C4-S-58a	1	1
	C4-S-66a	2	2
	C5-S-37e	1	1
Seatrain	GA and PR	1	1
Barge	LASH C8-S-81b	1	1
	LASH C9-S-81d	1,g	1,g
	LASH Lighter	5	5
	SEABEE C8-S-82a	1,g	1,g
	SEABEE Barge	5	5
RORO	COMET	2,d,i,j	2,d,i,j
	METEOR	2,d,i,j	2,d,i,j
	Cape Gnome	1,d,i,j	1,d,i,j
	C7-S-95A	1,i	1,i
	Cape Taylor	1,i	1,i
	Cape Orlando	1,i,j	1,i,j
	MV Ambassador	2,d	2,d
	Callaghan	1,d,i	1,d,i
	Cape Lambert	1,i,j	1,i,j
	LMSR Class	1	1
	FSS	1	1
	Cape E-Class	1,i,j	1,i,j
	Cape D-Class	1,i,j	1,i,j
	Cape H	1,i	1,i
RORO	Cape Texas	1,i,j	1,i,j
	Cape R	1,d	1,d
	Cape I-class	1,i,j	1,i,j
	Cape Victory	1i	1i
CONTAINER	C6-M-147a	1e	1,e
	C7-S-69c	1,e	1,e
	C7-S-68c	1,e	1,e
	C8-S-85c	1,e	1,e
	C9-M-132b	1,e	1,e
	C9-M-F141a	1,e,g	1,e,g
TACS	C6-S-1qd	1	1
	C5-S-MA73c	1	1
	C6-S-MA60d	1	1
MPS	C7-S-133a	1	1
	Maersk	1	1
	AmSea	1	1

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a - vessel draft limit
b - inadequate apron width
c - inadequate berth length
d - no straight stern ramp
e - no container handling equipment
f - anchorage depth OK, berth depth inadequate
g - inadequate channel depth
h - no shore based ramps
i - low tide insufficient ramp clearance
j - high tide insufficient ramp clearance
k - excessive ramp angle low tide
m - excessive ramp angle high tide
n - parallel ramp operation ONLY
o – insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ May Prevent Operation

♦ May Limit Operation

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

Highway

The highway to the port is two lanes and has a height restriction of 13 feet 9 inches due to a rail overpass just outside the port. The 35-mile route to the Autobahn requires passing through Nordenham and Bremen and crossing the Weser River. Plans are underway to build a tunnel crossing 5 miles south of Nordenham, in the area of the current ferry crossing.

Rail

The North Pier has five quayside tracks and the South Pier has three. The Port of Nordenham has 28,000 feet of track capable of storing about 50 railcars. The track connects directly to the Deutsche Bahn AG railroad with a Deutsche Bahn AG railyard just outside the port that can store about 200 railcars.

UNLOADING/LOADING POSITIONS

Ramps and Docks

The port can load/unload 17 trucks and 6 railcars at a time at the three storage buildings. The South and North storage facilities have three and six ramps, respectively. The West storage building has eight ramps/loading docks. The South Shed has two railcar loading/unloading positions that have surface-level track, the North Shed has one, and the West Shed has three.

Marshaling Areas

No marshaling areas support the port directly.

MATERIALS HANDLING EQUIPMENT (MHE)		
Type of Equipment	**Capacity (STON)**	**Quantity**
Locomotives	600 HP	3
Rail-Mounted Gantry Cranes	22	3
Rail-Mounted Jib Cranes	71	1
Forklifts	17 to 30	6
Forklifts	3 to 9	20
NOTE: This table represents equipment owned by the port. Port operators indicate that they lease or rent other equipment as required from local suppliers. There are two floating cranes of 110 and 606 STON capacity in the area if needed. The list is not "all inclusive" as actual totals may change.		

FUTURE DEVELOPMENT

The port is replacing the northern most pier, the Grain Pier, with a floating RORO ramp. This would allow the port to be more readily used for RORO operations. The port authorities have completed the technical plans. MIDGARD expects to begin construction work at the end of 1999.

The German Government plans to build a highway tunnel crossing 5 miles below Nordenham, near the current ferry crossing, with a road connecting to Autobahn 27. This tunnel will be about 25 miles north of Bremen and will reduce the distance to the Autobahn by about 11 miles. The construction started in 1998 and is scheduled to be finished in the year 2002. Oversized and hazardous loads may be restricted from transport through the tunnel.

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

A Memorandum for The Director of the Army Staff, which expires in the year 2000 gives the U.S. military authority to use the Port of Nordenham for transporting ammunition in Northern Europe. Port operations are limited to one ocean-going vessel and two coastal vessels containing not more than 3 million pounds NEW. Contingency operations are limited to 6 million pounds NEW with no more than two ocean-going vessels and two coastal vessels. The waiver renewal/extension process will start no later than July 1999.

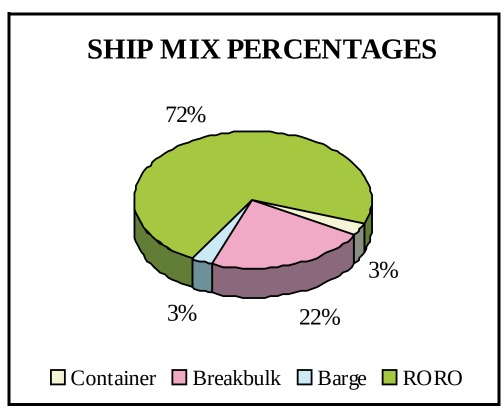
III. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Nordenham. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, shiploading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and measurement tons (MTON) per day. The charts in this section show the throughput yields in STON. Approximate MTON yields can be computed by multiplying the STON amount by three.

Terminal Throughput Subsystems

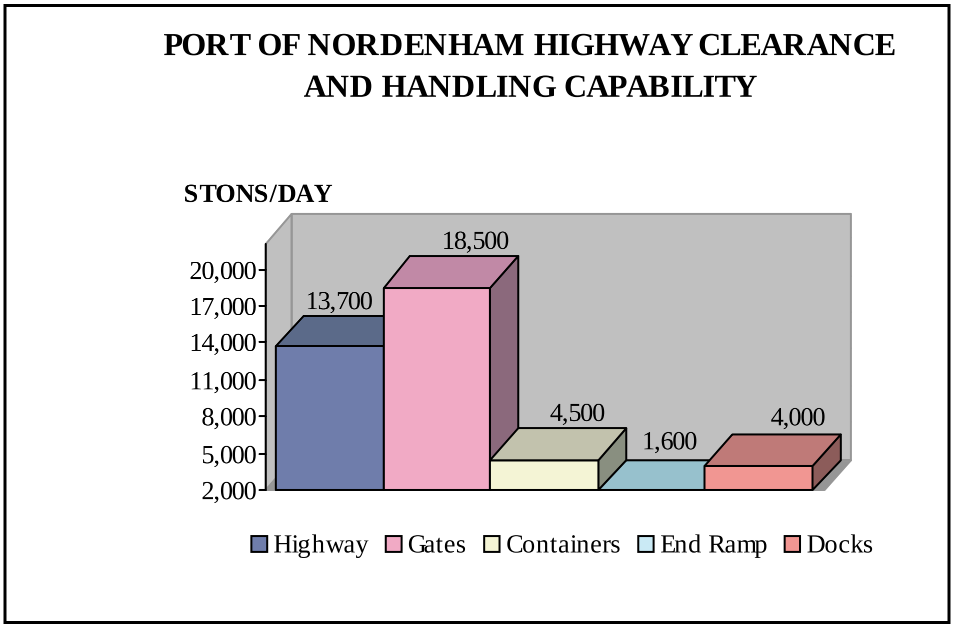
Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 70 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

Highway

The port is connected to the highway by two gates and one two-lane highway. The road entering and exiting the port complex can handle at least 13,700 STON of equipment and supplies daily. The two gates combined can handle at least 18,500 STON of cargo per day in each direction.



Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or exit the port on the two-lane highway.

Roadable vehicles will move through the terminal gates in manageable convoys from staging areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. If not available, deploying units/military port operator must either build or acquire the necessary ramps. For this study we assumed one portable ramp would be used for loading operations. This ramp can handle 1,600 STON of military vehicles and equipment per day.

The port has 17 handling positions to load/unload supplies in van semitrailers. These docks can load/unload at least 4,000 STON of material per day.

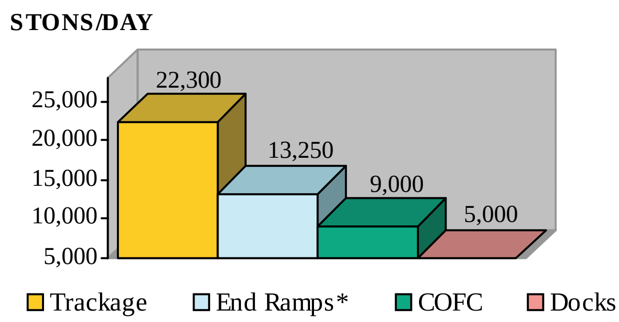
The Port of Nordenham has six forklifts that can handle available containers. By using three of these for loading, the port can handle at least 4,500 STON of containerized equipment and supplies per day.

Rail

Rail reception in the port is good, with the German National Railroad providing rail service directly to the port. The port can store 50 railcars and the Deutsche Bahn AG rail station just outside the port can store 200 additional railcars. Currently, rail service to the port can support up to

10 trains per day with 45 railcars per train. These railcars should handle at least 22,300 STON per day. The port has three locomotives for moving railcars. This allows items to be loaded, by crane, directly on/off railcars and ships when RORO operations are not practical.

RAIL RECEPTION/HANDLING CAPABILITY



Assumes two portable end ramps and lifting directly from railcars to barges for RORO operations.

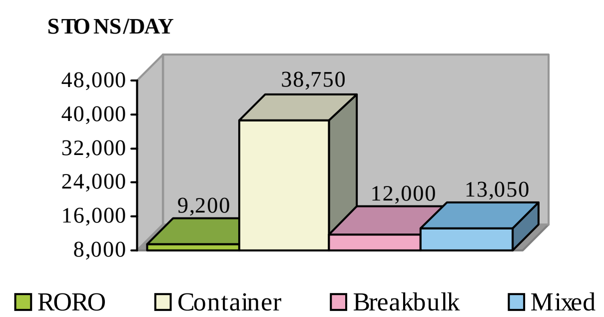
Vehicles on flatcars could be unloaded at the port at a portable end ramp. Several areas are available that could be used to unload the railcars with at least 1,300 feet of straight track. Building or providing two portable rail end ramps can decrease the time required to load/unload railcars. Nordenham also loads directly from the railcars to the ship, which will increase the rail reception/handling capability. By using the Port of Nordenham's method for unloading/loading vehicles from railcars onto barges for RORO operations and assuming two portable rail ramps are available, the port should handle at least 13,250 STON of military vehicles per day.

Boxcars could be loaded/offloaded at the three storage buildings. The port has six rail handling positions available for loading/unloading boxcars. These positions should handle at least 5,000 STON of materials and supplies per day.

Staging

The port has about 22 acres of suitable open staging area. This is distributed throughout the terminal area. Availability of the staging area will vary according to work at the port. Port operators assured the survey team that space could be freed up fairly quickly to support military operations.

PORT OF NORDENHAM
OPEN STAGING CAPABILITY

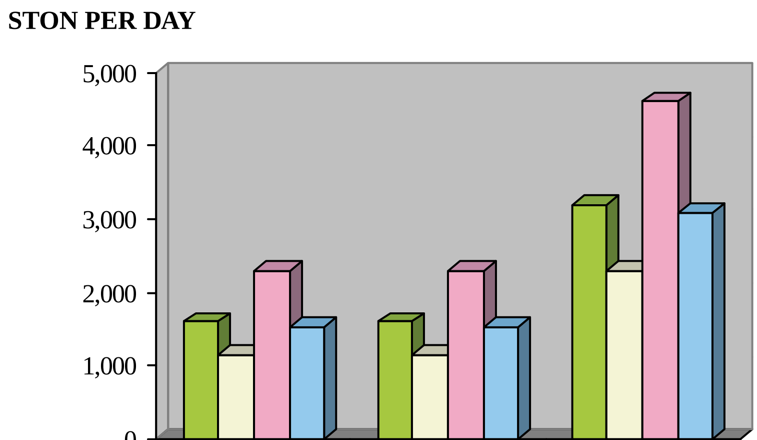


The port has about 134,550 square feet of covered storage space. Like the open area, much of this is subject to contain some of the breakbulk cargo moving through the port. About 2,700 STON of breakbulk cargo can be staged in the covered area.

Shipping

Daily shipping subsystem totals for the berths are cataloged in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types. Shipping is the least capable subsystem in the port.

PORT OF NORDENHAM
BERTH THROUGHPUT CAPABILITY



	South Berth	North Berth	Total
RORO**	1,600	1,600	3,200
Container	1,150	1,150	2,300
Breakbulk*	2,300	2,300	4,600
Mixed**	1,540	1,540	3,080

This includes 1,600 STON of LASH and SEABEE barge throughput capacity.

*****Assumes only 10 hours per day for RORO operations. Results will be higher using the port's RORO procedure.***

Barge

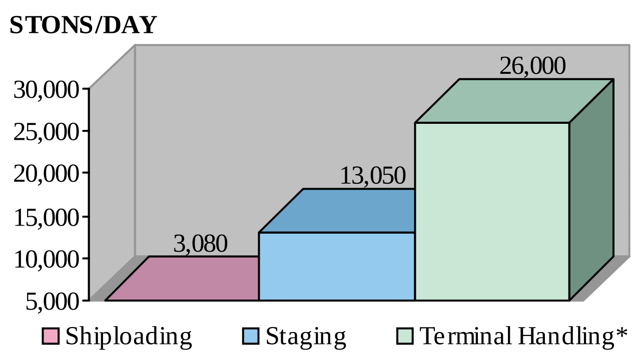
The extensive river and canal network makes it possible to use river barges to move cargo within Europe. Oversized and overweight items can be transported by barge without permits and route restrictions encountered on highways and railroads. Barges do have restrictions, which include canal depth and width, overpass heights, and having to travel through locks.

There are three general types of barges used in canals and rivers in Europe: breakbulk, RORO, and container. These barges are handled in a similar manner as the larger vessels of the same type. These barges may be self-propelled or towed.

DAILY THROUGHPUT SUMMARY FOR THE PORT OF NORDENHAM			
Berth	**North**	**South**	**Total**
Length (feet)	1165	1165	2330
Depth alongside (feet)	44	44	44
Breakbulk throughput (STON)[1]	2,300	2,300	4,600
RORO throughput (STON)	1,600	1,600	3,200
RORO square feet (Est)	32,000	32,000	64,000
RORO pieces[2]	190	190	380
Container throughput (STON)	1,150	1,150	2,300
Container throughput (TEU)	145	145	290
Mixed throughput (STON)	1,540	1,540	3,080

[1] Includes 1,600 STON of LASH and SEABEE barge throughput capacity.
[2] Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Desert Storm.

PORT OF NORDENHAM DAILY CARGO THROUGHPUT CAPABILITY



Terminal handling is the sum of the Highway (13,700 STON) and Rail (22,300 STON) limits.

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

The containership, with 500 containers, will take 2-3 days to load or unload based on using two floating cranes, each with the capability to load/offload 100 containers per day. The staging area can handle about 3,300 containers. It will take one container handler about 14 hours per day to load/unload 80 ammunition containers on railcars. The port can normally handle 450 railcars per day; therefore, the 500 containers in 3 days should not be a problem.

The breakbulk ship, with 3 million pound NEW is about 6,550 MTON (2,620 STON), will take 2-3 days to unload. The staging area can handle 25,850 MTON (8,400 STON) per day. The port can load about 5,000 STON per day in boxcars.

IV. DEPLOYMENTS

The Port of Nordenham has a history of supporting U.S. military deployments. During a recent exercise, **ADVENTURE EXPRESS**, February 1997, the port was used to deploy 213 pieces of rolling stock and containers. The units consisted of Allied Command Europe Mobile Force Land, the 6th Aviation Brigade, the 5th of the 2nd Air Defense Artillery Battalion Battery, and the 1/125th Field Artillery Battalion. The equipment arrived in the port by rail and was lifted from the berth onto pontoon barges and then driven onto the ships. Two RORO ships, with stern door ramps, ***MV Arroyofrio Dos*** and ***MV Cap Afrique***, were loaded at the port. The ***MV Arroyofrio Dos*** was loaded 1 February 1997 between 0600 and 2100 hours. The ***MV Cap Afrique*** was loaded 2 February 1997 between 1800 and 2200 hours. Loading resumed on 3 February1997 at 0600 and completed at 1300 hours.

V. CONCLUSIONS

The Port of Nordenham is multioperational with the capability to handle all types of vessels; container, RORO, breakbulk, and barges.

The port is fully capable of supporting U.S. military cargo transshipment operations. Although the tidal range limits normal RORO operations, the port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table. The port also has developed an effective way to handle RORO operations even though it has a large tidal variation of 13 feet. This entails driving equipment from the ship onto a pontoon barge, and then lifted onto the apron or waiting railcar.

The port most likely will be used for ammunition transportation since it is one of the few ports designated for the transshipment of ammunition.

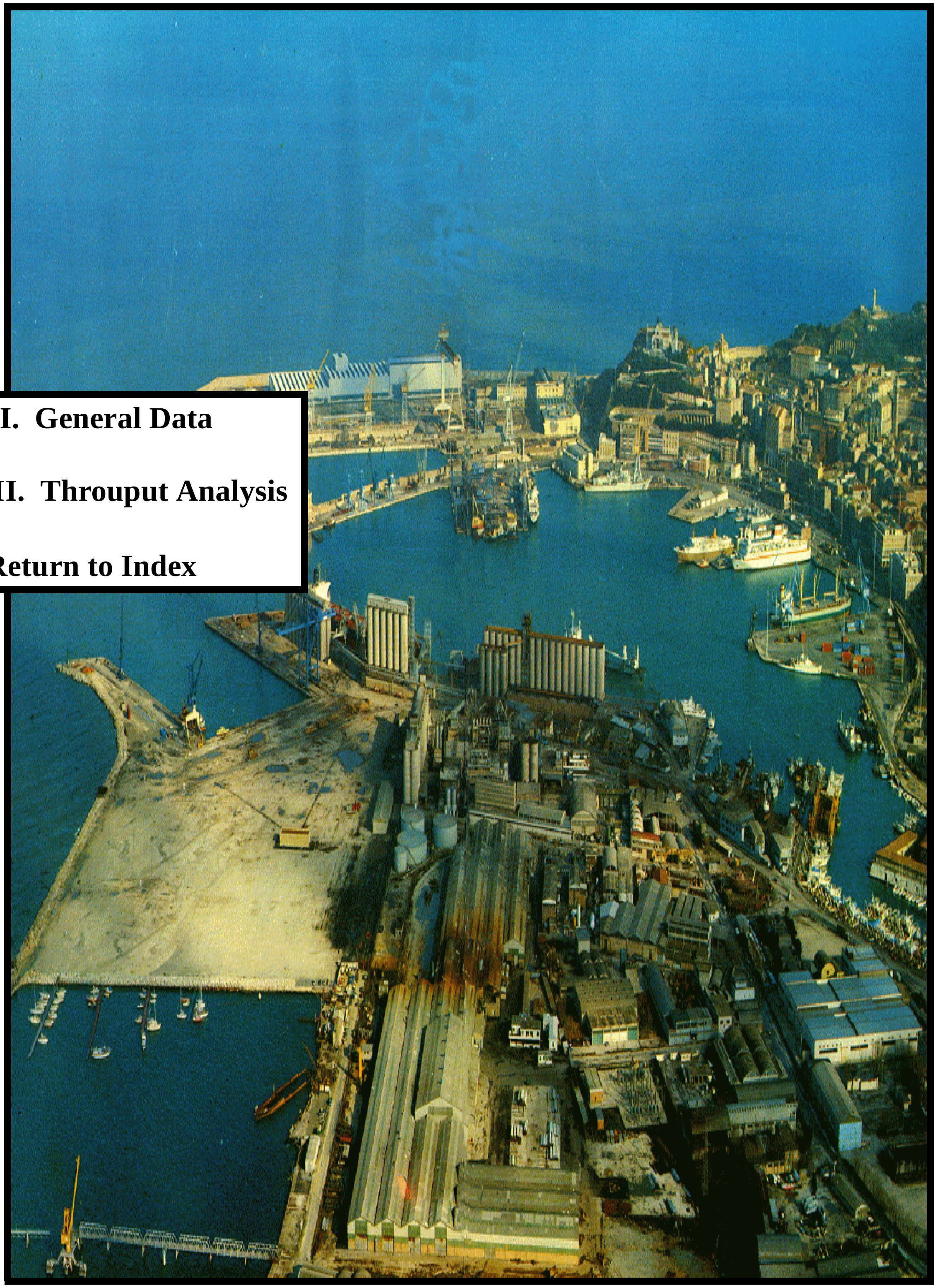
The inland water network makes barge transport an effective shipping method. The port connects to this network and provides a third alternative for moving cargo inland.

Normal transport to and from this port will be by rail and barge for loading or unloading ships. Highway transport to and from this port would not be as efficient because of the river crossings and limited highway network going to the port.

Of the transportation subsystems analyzed, the least capable is the shipping subsystem. Because of limited shipping in the port, this system is limited to a mixed throughput capability of 3,080 STON using the North and South Piers and the Desert Shield/Desert Storm ship mix.

Commercial operations taking place concurrently in the port will limit actual daily throughput, sustainable over time, by an appropriate percentage of the terminal’s overall capability.

PORT OF ANCONA, ITALY

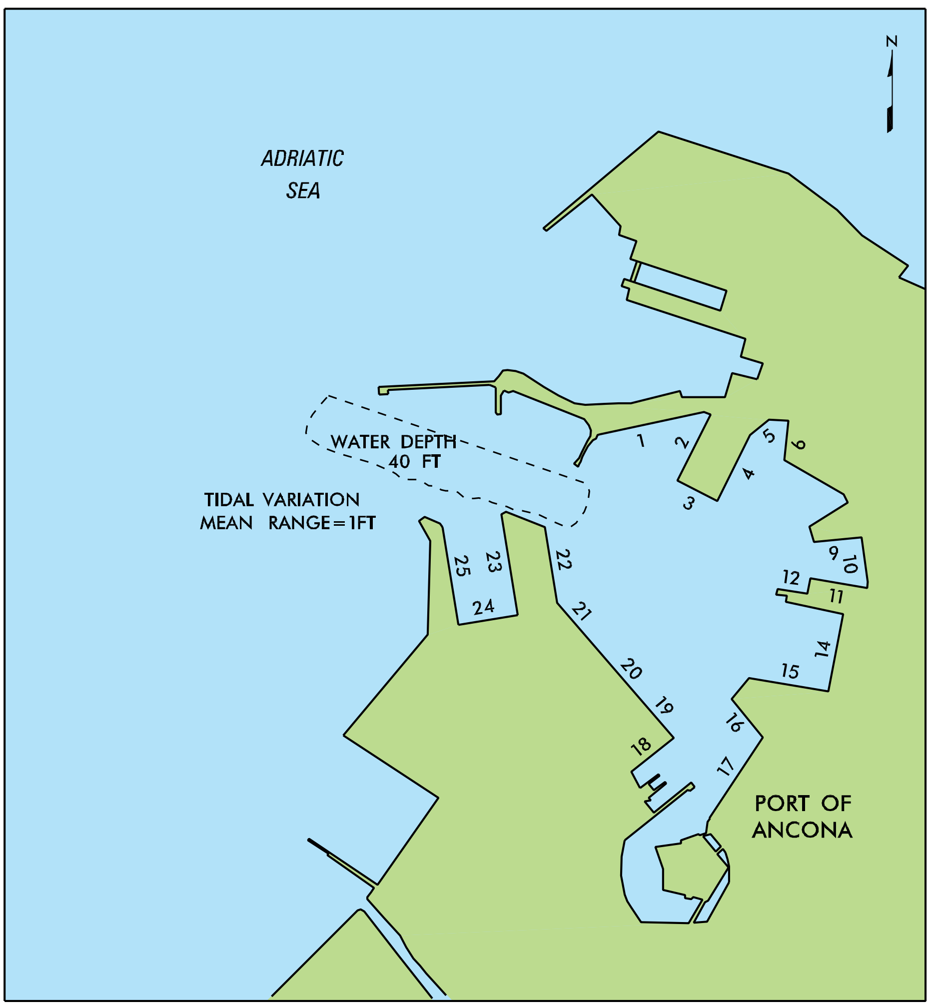


I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Ancona (43° 37' 12" north latitude and 13° 30' 36" east longitude) is on the east coast of Italy along the Adriatic Sea. The port consists of multicargo piers and wharves with a specialization in commercial passenger ferry operations to Greece, Slovenia, Croatia, Turkey, and various Middle East countries. Located in a natural harbor, the port has direct access to the Adriatic Sea. The port has no vertical or overhead restrictions on ships entering the harbor. Deep draft anchorages (32-65 feet) are located near the port and turning basins are adequate inside the port. The channel depth to the port is about 39 feet.



Water Access Map

Highway

Ancona is situated on a steep rocky slope along the Adriatic coastline. The city follows the contour of the coast forming the shape of an amphitheater. All roads leading to the port go through the city, which has heavy traffic congestion. Autostrada A14, an interstate-type highway, runs northwest/southeast along the Adriatic Coast. Ancona Nord and Sud exits lead to Route 16 going toward the city. The Via della Ricostruzione leads from Route 16 into the city. These routes have no unusual clearance (vertical and lateral) or weight restrictions.

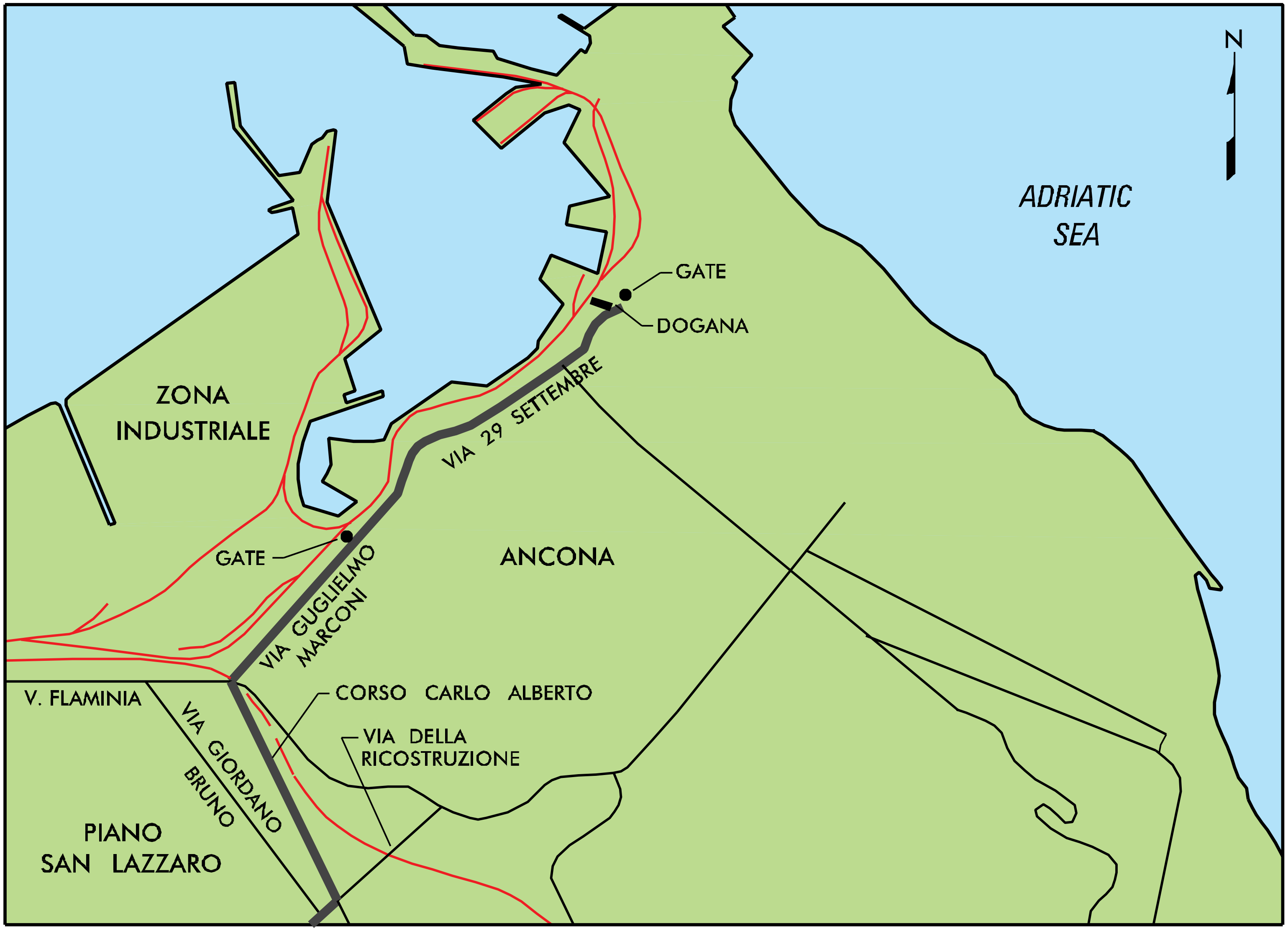
Air

Falconara Airport, a military and civilian airport, is about 6 miles northwest of the port. It has one runway with a usable length of 2,795 meters (almost 9,170 feet) and a width of 45 meters (almost 150 feet).

Rail

A major rail line extends northwest/southeast along the Adriatic Coast through Ancona. Another rail line extends from the main line at Falconara westward toward Fabriano. Rail lines extend from the main line at the Ancona rail station to the port. No unusual clearance restrictions exist on the rail lines accessing the port. Rail activity at the port is light.

Transportation Access



Vicinity Map

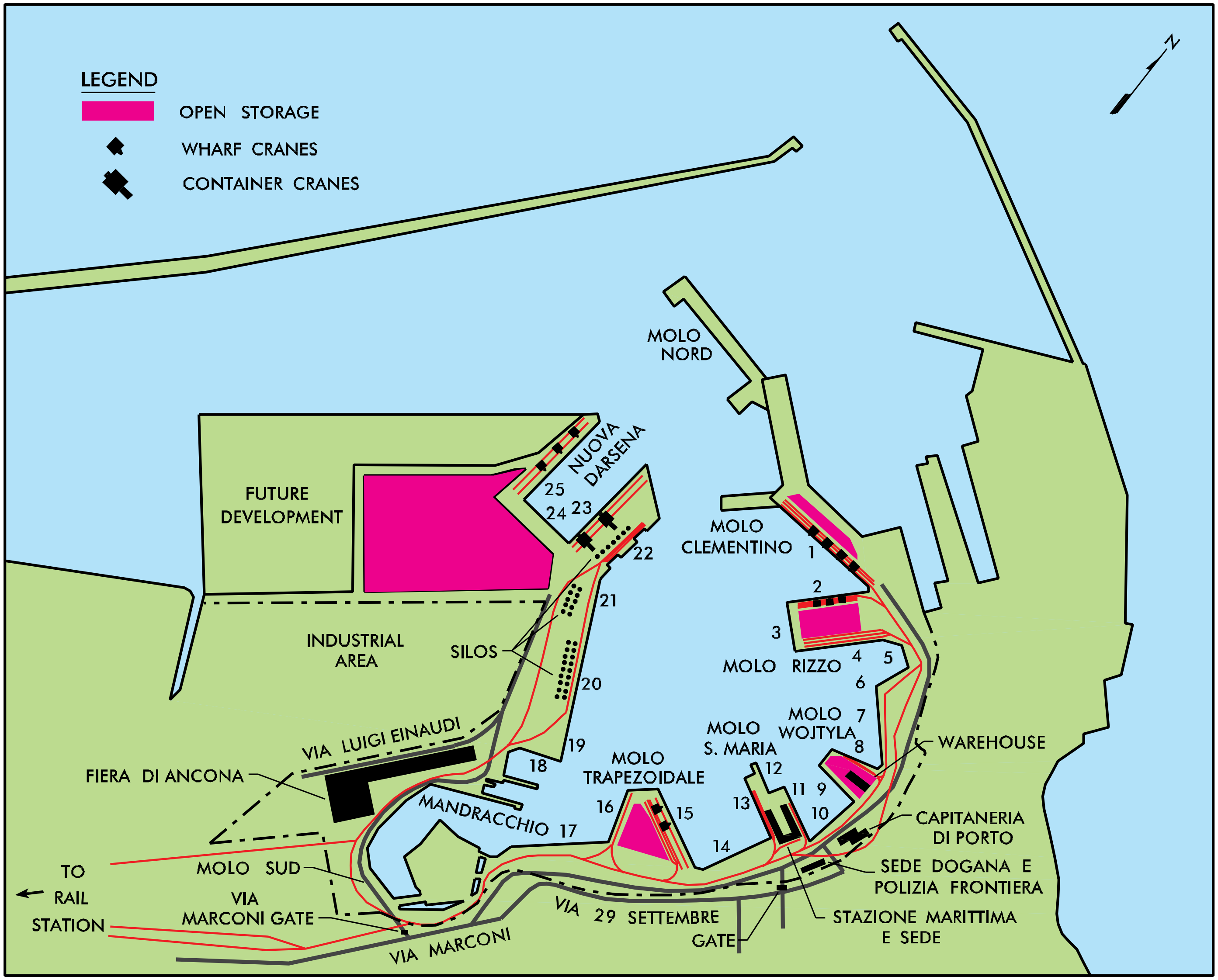
PORT FACILITIES

Berthing

Ancona is a multicargo port with emphasis in commercial ferry operations. The Nuova Darsena container terminal (berths 23-25) is the newest and most versatile of all port wharves and piers. It has the largest open staging area and is the terminal most desirable for military operations. Other piers and wharves with open staging nearby are Molo Clementino (berth 1), Molo Rizzo (berths 2-4), Molo Wojtyla (berths 8 and 9), and Molo Trapezoidale (berths 15 and 16).

Molo Rizzo (berths 3 and 4) is the pier most likely to be offered for military operations. Berths 8-16 are primarily passenger ferry berths. Berth 7 is for ship repair and finishing. Berths 19-22 are bulk terminals used for loading/discharging of cereals. Berth depths range from 22-34 feet throughout the port. Lighting exists throughout the port, but is inadequate for military night operations. Deploying units must use portable lighting to ensure adequate safety and efficiency during loading/unloading operations at night.

Aerial View of the Port of Ancona



LEGEND
OPEN STORAGE
WHARF CRANES
CONTAINER CRANES
N
MOLO NORD
NUOVA DARSENA
FUTURE DEVELOPMENT
MOLO CLEMENTINO
INDUSTRIAL AREA
SILOS
MOLO RIZZO
MOLO WOJTYLA
MOLO S. MARIA
WAREHOUSE
VIA LUIGI EINAUDI
FIERA DI ANCONA
MOLO TRAPEZOIDALE
MANDRACCHIO
CAPITANERIA DI PORTO
MOLO SUD
SEDE DOGANA E POLIZIA FRONTIERA
TO RAIL STATION
VIA MARCONI GATE
VIA 29 SETTEMBRE
STAZIONE MARITTIMA E SEDE
GATE
VIA MARCONI
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Land-Use Map

PORT OF ANCONA

BERTH CHARACTERISTICS

	Berths								
CHARACTERISTICS	1 Molo Clementino	2 Molo Rizzo	3 Molo Rizzo	4 Molo Rizzo	6 San Primiano	8 Molo Wojtyla	9 Molo Wojtyla	10 Calata Sauro	11 Molo Santa Maria
Length (ft)	866	623	383	656	318	400	406	426	482
Depth alongside at MLW (ft)	29	28	31	30	24	22	25	24	25
Deck strength (psf)	600	600	600	600	600	600	600	600	600
Apron width (ft)	open	open	open	open	open	open	open	open	65
Apron height above MLW (ft)	5	5	5	5	5	5	5	5	5
Number of container cranes	0	0	0	0	0	0	0	0	0
Number of wharf cranes	4	3	0	0	0	0	0	0	0
Apron lighting	yes	yes	yes	yes	yes	yes	yes	yes	yes
Straight-stern RORO facilities	no	no	no	no	no	no	yes	yes	no
Apron length served by rail (ft)	866	623	0	656	0	400	0	0	482

1 Molo Clementino

4 Molo Rizzo

11-13 Molo S. Maria

PORT OF ANCONA

BERTH CHARACTERISTICS - cont

	Berths								
CHARACTERISTICS	13 Molo Santa Maria	14 Calata Repubblica	15 Nuova Molo Trapezoidale	16 Nuova Molo Trapezoidale	17 Calata Da Chio	22 Molo Sud	23 Nuova Darsena	24 Nuova Darsena	25 Nuova Darsena
Length (ft)	511	656	702	393	820	656	859	492	849
Depth alongside at MLW (ft)	26	28	28	26	23	29	32	34	34
Deck Strength (psf)	600	600	600	600	600	600	600	600	600
Apron width (ft)	open	open	open	open	open	open	open	open	open
Apron height above MLW (ft)	5	5	5	5	5	5	5	5	5
Number of container cranes	0	0	0	0	0	0	2	0	0
Number of wharf cranes	0	0	2	0	0	0	0	0	3
Apron lighting	yes	yes	yes	yes	yes	yes	yes	yes	yes
Straight-stern RORO facilities	yes	yes	no	no	yes	no	no	yes	no
Apron length served by rail (ft)	511	0	702	393	0	656	0	0	0

15 Molo Trapezoidale

23 Nuova Darsena

25 Nuova Darsena

PORT OF ANCONA

SUMMARY OF BERTHING CAPABILITIES

VESSELS		BERTHS									
TYPE	CLASS	1 MClem	2 MRizz	3 MRizz	4 MRizz	6 SPrim	8 MWojt	9 MWojt	10 CSau	11 MSMa	
BREAKBULK	C3-S-38a	1	1	c	1	a,c	a,c	a,c	a,c	a,c	**NOTES:**
	C4-S-58a	a	a	c	a	a,c	a,c	a,c	a,c	a,c	a-vessel draft limit
	C4-S-66a	a	a	a,c	a	a,c	a,c	a,c	a,c	a,c	b-inadequate apron width
	C5-S-37e	a	a	c	1	a,c	a,c	a,c	a,c	a,c	c-inadequate berth length
SEATRAIN	GA and PR	1	1	c	1	a,c	a,c	a,c	a,c	a,c	d-no straight stern ramp
BARGE	LASH C8-S-81b	a,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	e-no container handling equipment
	LASH C9-S-81d	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	f-anchorage depth OK, berth depth
	LASH Lighter	4	3	1	3	1	2	2	2	2	inadequate
	SEABEE C8-S-82a	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	g-inadequate channel depth
	SEABEE Barge	4	3	1	3	1	2	2	2	2	h-no shore based ramps
RORO	Jolly Smeraldo	a	a,c	a,c	a	a,c	a,c	a,c	a,c	a,c	i-low tide insufficient ramp clearance
	Isola Delle Perle	1,d	1,d	c,d	1,d	c,d	a,c,d	c	c	c,d	j-high tide insufficient ramp clearance
	Galini	1	1	c	1	c	c	c	c	1	k-excessive ramp angle low tide
	Arcade Falcon	1,i	1,i	c	1,i	c	a,c	c	c	1,i	m-excessive ramp angle high tide
	Golfo Dei Fiori	2,d	1,d	c,d	1,d	c,d	1,d	1,m	1,m	1,d	n-parallel ramp operation ONLY
	Ani	i,j	i,j	i,j	i,j	i,j	i,j	i,j	i,j	i,j	o-insufficient apron width for side ramp
	MV Goya	2,d	2,d	1,d	2,d	1,d	1,d	1	1	1,d	
	Cape I-class	a	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	
	Cape Victory	1	c	c	1	a,c	a,c	a,c	a,c	a,c	Ramp clearance and angle based
	COMET	1,d	1,d	c,d	1,d	a,c,d	a,c,d	a,c	a,c	a,c,d,o	on maximum vessel draft
	METEOR	1,d	a,d	c,d	1,d	a,c,d	a,c,d	a,c	a,c	a,c,d,o	
	Cape Gnome	a,d	a,d	a,c,d	a,d	a,c,d	a,c,d	a,c,i,j	a,c,i,j	a,c,d	♦ **May Prevent Operation**
	C7-S-95a	a	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	
	Cape Taylor	1	c	c	1	a,c	a,c	a,c	a,c	a,c	♦ **May Limit Operation**
	Cape Orlando	a	a,c	c	1	a,c	a,c	a,c	a,c	a,c	

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF ANCONA
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS									
TYPE	**CLASS**	**1 MClem**	**2 MRizz**	**3 MRizz**	**4 MRizz**	**6 SPrim**	**8 MWojt**	**9 MWojt**	**10 CSau**	**11 MSMa**	
	MV Ambassador	d	d	c,d	d	c,d	c,d	c,k,m	c,k,m	c,d	a-vessel draft limit
	Callaghan	1,d	c,d	c,d	c,d	a,c,d	a,c,d	a,c	a,c	a,c,d,o	b-inadequate apron width
	Cape Lambert	a	a,c	c	a,c	a,c	a,c	a,c	a,c	a,c	c-inadequate berth length
	FSS	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	d-no straight stern ramp
	Cape R	a,d	a,c,d	a,c,d	a,d	a,c,d	a,c,d	a,c	a,c	a,c,d	e-no container handling equipment
	Cape E	a	a,c	a,c	a	a,c	a,c	a,c	a,c	a,c	f-anchorage depth OK, berth depth
	Cape D	a	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	inadequate
	Cape H	a	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	g-inadequate channel depth
	Cape Texas	1	c	c	1	a,c	a,c	a,c	a,c	a,c	h-no shore based ramps
CONTAINER	C6-M-147a	1,e	c,e	c,e	c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	i-low tide insufficient ramp clearance
	C7-S-69c	a,e	a,c,e	c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	j-high tide insufficient ramp clearance
	C7-S-68c	a,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	k-excessive ramp angle low tide
	C8-S-85c	a,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	m-excessive ramp angle high tide
	C9-M-132b	a,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	n-parallel ramp operation ONLY
	C9-M-F141a	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	o-insufficient apron width for side ramp
AUXILIARY CRANE	C6-S-1qd	a	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	Ramp clearance and angle based on maximum vessel draft
	C5-S-MA73c	a	a	c	a	a,c	a,c	a,c	a,c	a,c	
	C6-S-MA60d	a	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	
MPS	C7-S-133a	a	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	♦ **May Prevent Operation**
	Maersk	a	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	
	AmSea	a	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	♦ **May Limit Operation**

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF ANCONA

SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS									
TYPE	CLASS	13 MSMa	14 CdRe	15 NMTr	16 NMTR	17 CdaCh	22 MSud	23 NDar	24 NDar	25 NDar	
BREAKBULK	C3-S-38a	a	1	1	a,c	a	1	1	1	1	**NOTES:**
	C4-S-58a	a,c	a	a	a,c	a	a	1	c	1	a-vessel draft limit
	C4-S-66a	a,c	a	a	a,c	a	a	a	c	1	b-inadequate apron width
	C5-S-37e	a,c	a	a	a,c	a	a	1	c	1	c-inadequate berth length
SEATRAIN	GA and PR	a,c	1	1	a,c	a	1	1	c	1	d-no straight stern ramp
BARGE	LASH C8-S-81b	a,c,f	a,c,f	a,c,f	a,c,f	a,f	a,c,f	a,f	a,c,f	a,f	e-no container handling equipment
	LASH C9-S-81d	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	f-anchorage depth OK, berth depth
	LASH Lighter	2	3	3	1	4	3	4	2	4	inadequate
	SEABEE C8-S-82a	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	g-inadequate channel depth
	SEABEE Barge	2	3	3	1	4	3	4	2	4	h-no shore based ramps
RORO	Jolly Smeraldo	a,c	a	a	a,c	a	a	a	a,c	a	i-low tide insufficient ramp clear-ance
	Isola Delle Perle	c	1	1,d	c,d	1	1,d	1,d	c	1,d	j-high tide insufficient ramp clear-ance
	Galini	1	1	1	c	1	1	1	1	1	k-excessive ramp angle low tide
	Arcade Falcon	1,i	1,i	1,i	c	1,i	1,i	1,i	1,i	1,i	m-excessive ramp angle high tide
	Golfo Dei Fiori	1,m	1,m	1,d	1,d	1,m	1,d	2,d	1,m	2,d	n-parallel ramp operation ONLY
	Ani	i,j	i,j	i,j	i,j	i,j	i,j	i,j	i,j	i,j	o-insufficient apron width for side ramp
	MV Goya	1	2	2,d	1,d	2	2,d	2,d	1	2,d	
	Cape I-class	a,c	a,c	a	a,c	a	a,c	1	c	1	
	Cape Victory	a,c	1	1	a,c	a	1	1	c	1	Ramp clearance and angle based
	COMET	a	1	1,d	a,c,d	a	1,d	1,d	c	1,d	on maximum vessel draft
	METEOR	a,c	a	a,d	a,c,d	a	1,d	1,d	c	1,d	
	Cape Gnome	a,c,i,j	a,i,j	a,d	a,c,d	a,i,j	a,d	a,d	c,i,j	d,i,j	♦ **May Prevent Operation**
	C7-S-95a	a,c	a,c	a,c	a,c	a	a,c	a	c	1	
	Cape Taylor	a,c	1	1	a,c	a	1	1	c	1	♦ **May Limit Operation**
	Cape Orlando	a,c	a	a	a,c	a	a	1	c	1	

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF ANCONA

SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS									
TYPE	**CLASS**	**13 MSMa**	**14 CdRe**	**15 NMTr**	**16 NMTR**	**17 CdaCh**	**22 MSud**	**23 NDar**	**24 NDar**	**25 NDar**	
	MV Ambassador	c,k,m	k,m	d	c,d	k,m	d	d	c,k,m	d	a-vessel draft limit
	Callaghan	a,c	c	1,d	a,c,d	a	c,d	1,d	c	1,d	b-inadequate apron width
	Cape Lambert	a,c	a,c	a	a,c	a	a,c	i,j	c	i,j	c-inadequate berth length
	FSS	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	d-no straight stern ramp
	Cape R	a,c	a	a,d	a,c,d	a	a,d	a,d	c	d,k,m	e-no container handling equipment
	Cape E	a,c	a	a	a,c	a	a	i,j	c	i,j	f-anchorage depth OK, berth depth
	Cape D	a,c	a,c	a	a,c	a	a,c	a	c	1	inadequate
	Cape H	a,c	a,c	a,c	a,c	a	a,c	a	a,c	a	g-inadequate channel depth
	Cape Texas	a,c	1	1	a,c	a	1	1	c	1	h-no shore based ramps
CONTAINER	C6-M-147a	c,e	c,e	1,e	c,e	a,e	c,e	1	c,e	1,e	i-low tide insufficient ramp clearance
	C7-S-69c	a,c,e	a,c,e	a,e	a,c,e	a,e	a,c,e	1	c,e	1,e	j-high tide insufficient ramp clearance
	C7-S-68c	a,c,e	a,c,e	a,e	a,c,e	a,e	a,c,e	1	c,e	1,e	k-excessive ramp angle low tide
	C8-S-85c	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a	c,e	1,e	m-excessive ramp angle high tide
	C9-M-132b	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c	a,c,e	a,c,e	n-parallel ramp operation ONLY
	C9-M-F141a	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c	a,c,e	a,c,e	o-insufficient apron width for side ramp
AUXILIARY CRANE	C6-S-1qd	a,c	a,c	a	a,c	a	a,c	a	c	1	Ramp clearance and angle based on maximum vessel draft
	C5-S-MA73c	a,c	a	a	a,c	a	a	1	c	1	
	C6-S-MA60d	a,c	a,c	a	a,c	a	a,c	1	c	1	
MPS	C7-S-133a	a,c	a,c	a,c	a,c	a,c	a,c	a	c	1	♦ **May Prevent Operation**
	Maersk	a,c	a,c	a,c	a,c	a	a,c	a	c	1	
	AmSea	a,c	a,c	a	a,c	a	a,c	1	c	1	♦ **May Limit Operation**

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

Staging

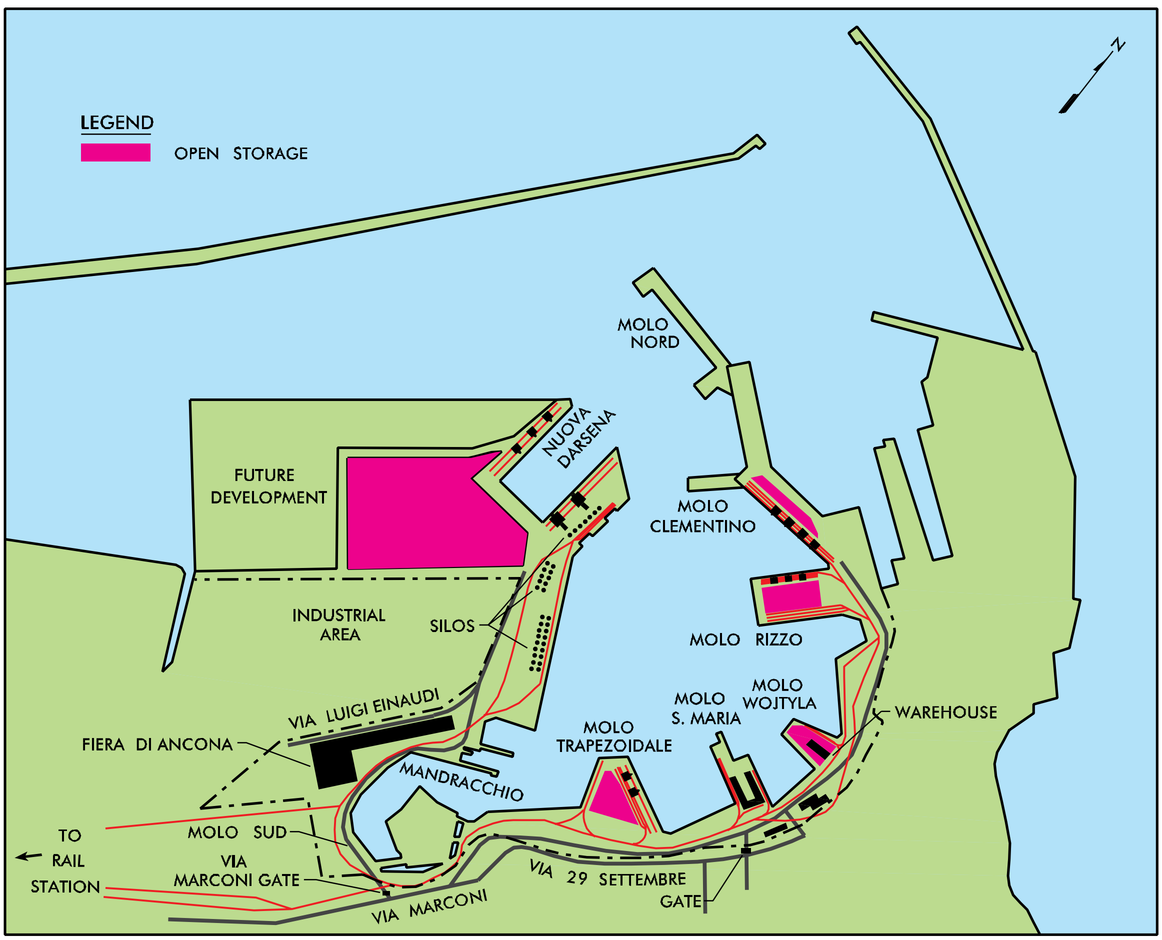
Open Staging

The Port of Ancona has about 16 acres of open storage available. Most of this open staging (over 10 acres) is at the Nuova Darsena Terminal.

The port does not have any designated areas for helicopter operations. The Molo Wojtyla has an area that is available for helicopter landing /takeoff in emergencies. A helicopter landing/take-off area, used for medical purposes, is also available in the city of Ancona. Neither of these areas are adequate for helicopter operations.

Covered Staging

The Port of Ancona does not have any covered staging available for military use.



Open Staging

Rail

Rail lines extend from the rail station in Ancona to the port. Apron tracks are on berths 1 (Molo Clementino), 2 and 4 (Molo Rizzo), 8 (Molo Wojtyla), 11 and 13 (Molo Santa Maria), 15 and 16 (Molo Trapezoidale), and 22 (Molo Sud). Berth 15 has four rail spurs. Berths 1, 2, 4, and 22 have three apron tracks each. Berths 8 and 13 each have two rail spurs and berths 11 and 16 each have one spur. A railcar storage yard is located near the Ancona rail station. The rail lines leading from the main lines to the port have no unusual height or side clearance restrictions.

Highway

Roads leading into the port are two-laned (one lane for each direction). Via della Ricostruzione, Corso Carlo Alberto, Via Giordano Bruno, Via Guglielmo Marconi, and Via 29 Settembre are the major streets connecting the port to the main highways (A-14 and Route 16). The port has two main gates that allow access to the wharf areas (Via Marconi and Dogana gates). Another gate is available in case of an emergency. One lane is allocated for each direction at the gates. Inside the port, three major roadways (Molo Sud, Via Luigi Einaudi, and Via Marconi) lead to the wharf areas. There are no unusual height or weight restrictions leading into the port from the main road networks. Truck scales are available near the Nuova Darsena/Molo Sud Terminal areas.

Via Marconi Gate

UNLOADING/LOADING POSITIONS

Ramps

The Port of Ancona does not have any fixed or portable rail or truck ramps. Deploying units must supply portable ramps for offloading railcars and semitrailers not equipped with a means for offloading wheeled/tracked vehicles. The best locations for rail end ramp operations are berths 1, 4, 15, and 22.

Docks

No docks exist for truck or boxcar loading/offloading.

MARSHALING AREAS

The only area available for marshaling is the container open staging area near the Nuova Darsena Terminal. This area has more than 10 acres of open storage available. No nearby marshaling areas exist outside the port.

Potential Marshaling Area near Nuova Darsena Terminal

MATERIAL HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity (STON)	Quantity	Wharf Assignment
Container Cranes	42	2	23
Wharf Cranes	11	2	1
Wharf Cranes	8.8	2	1
Wharf Cranes (Bridge Type)	8.8	2	2
Wharf Cranes (Bridge Type)	13.2	1	2
Mobile Crane	5.5	2	3
Mobile Crane	5.5	3	4
Wharf Cranes	11	2	15
Wharf Cranes	22	3	25
Mobile Crane	19.8	1	22-25
Forklift w/20' spreader	29.7	1	----
Forklift w/40' spreader	29.7	1	----
Forklift w/spreader	44	1	----

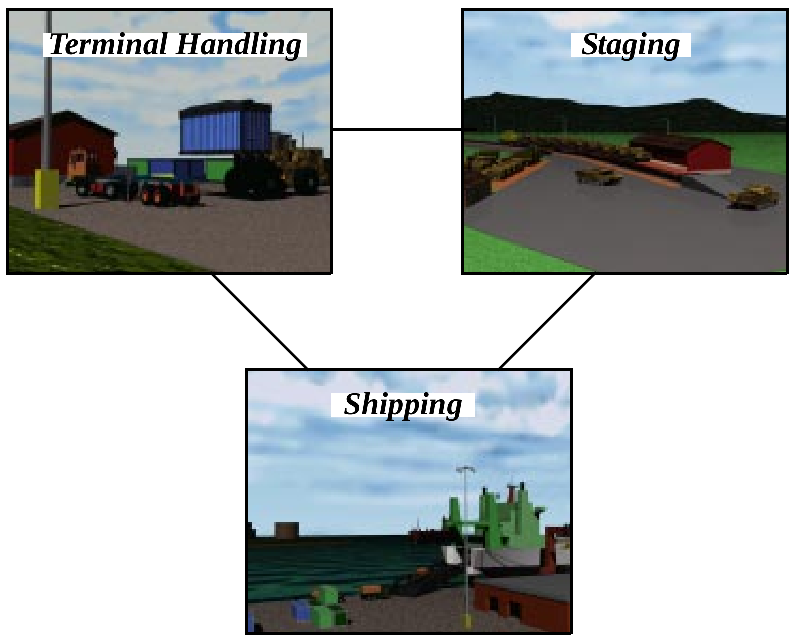
FUTURE DEVELOPMENT

The only planned future development of the Port of Ancona is a highway that directly connects the port to the major highways. No timetable for completion has been established.

II. THROUGHPUT ANALYSIS

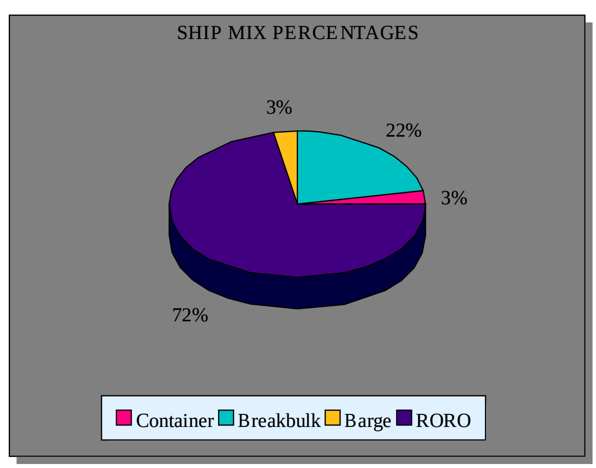
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Ancona. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of short tons (STON) per day.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 80 percent of the port facilities will support military deployments. Also, due to the size of the port, we assume that the berths will have ships 80 percent of the time. The ship mix is determined by Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL CLEARANCE/HANDLING

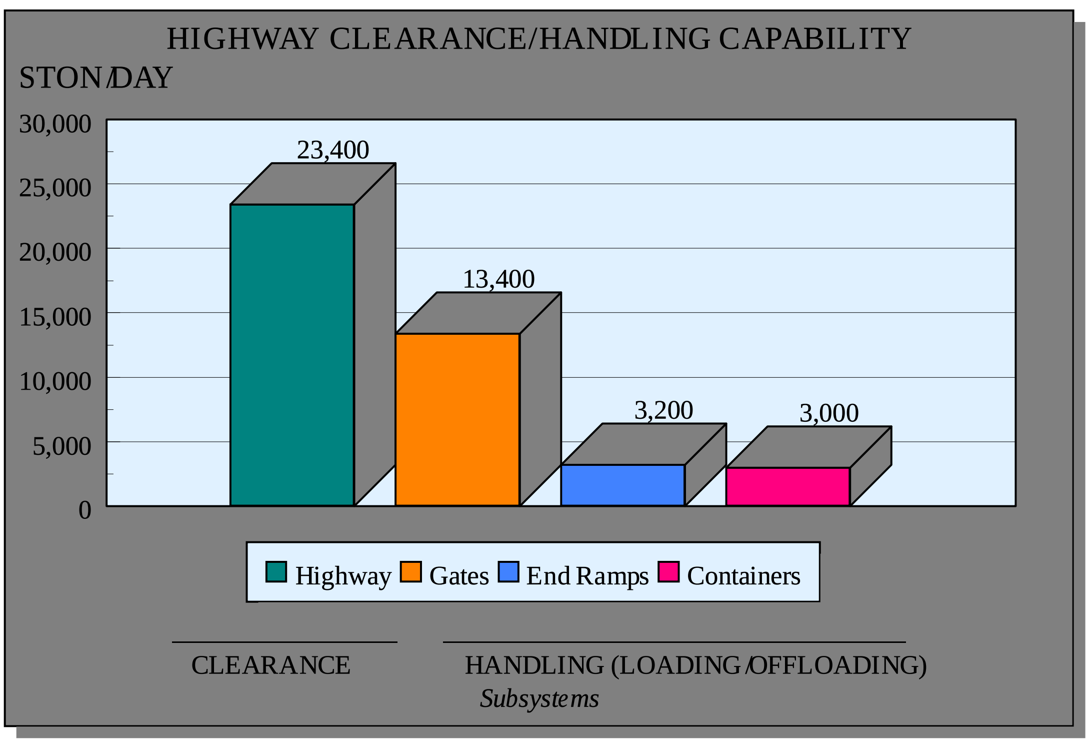
Highway

Via della Ricostruzione, Corso Carlo Alberto, Via Giordano Bruno, Via Guglielmo Marconi, and Via 29 Settembre are the major streets connecting the port to the main highways (A14 and Route 6). The road network in/out of the port, including the gate processing of vehicles, can handle more than 13,400 STON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. We assume that deploying units will build or acquire two portable ramps for flatbed truck and semitrailer operations. These ramps will handle at least 3,200 STON of military vehicles and equipment per daily.

The port has no truck docks.

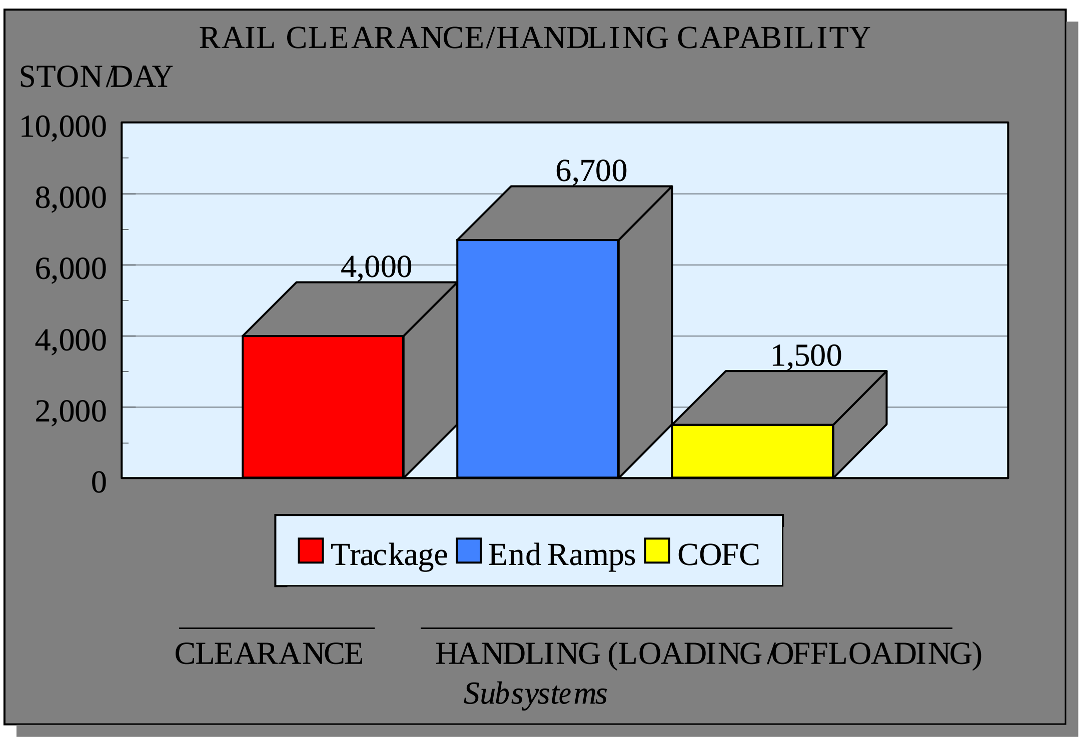
The port has three container handlers available for container operations. Based on the availability of two of these to perform operations in the open staging area in the Nuova Darsena Terminal, the handling capability for containers is about 3,000 STON per day.



Rail

The Ferrovia dello Stato (FS) could move a maximum of 8 trains of 25 railcars each day if necessary. Vehicles on flatcars must use portable ramps for loading/offloading operations. The port does not have fixed or portable ramps. We assume the deploying units would build or acquire at least two portable end ramps to use on available spurs having 1,000 feet of tangential track. The port has several locations to conduct loading/offloading operations using end ramps. The best locations along wharf areas to load/offload are berths 1 Molo Clementino, 4 Molo Rizzo, 15 Molo Trapezoidale, and 22 Molo Sud. Because of limited work space, the end ramp should not be placed in areas where shiploading operations are in progress. Assuming two portable end ramps are used for loading/offloading railcars (60-foot railcars), the port would handle about 133 railcars daily (4 interchanges in a 20-hour period).

We assume that one container handler will be used to support container-on-flatcar (COFC) operations. These operations will likely occur in the container yard near the Nuova Darsena Terminal.



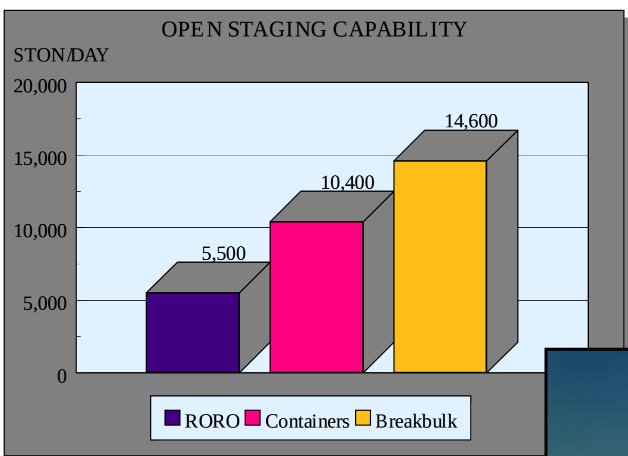
Staging

The port has about 16 acres of paved open staging (over 10 acres at the Nuova Darsena Terminal) that could support military operations. It does not have any covered storage available for military use.

The port can perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned.

The chart below provides the cargo open staging capability for each vessel type. If a combination ship is expected, then a portion of each involved capability should be assumed.

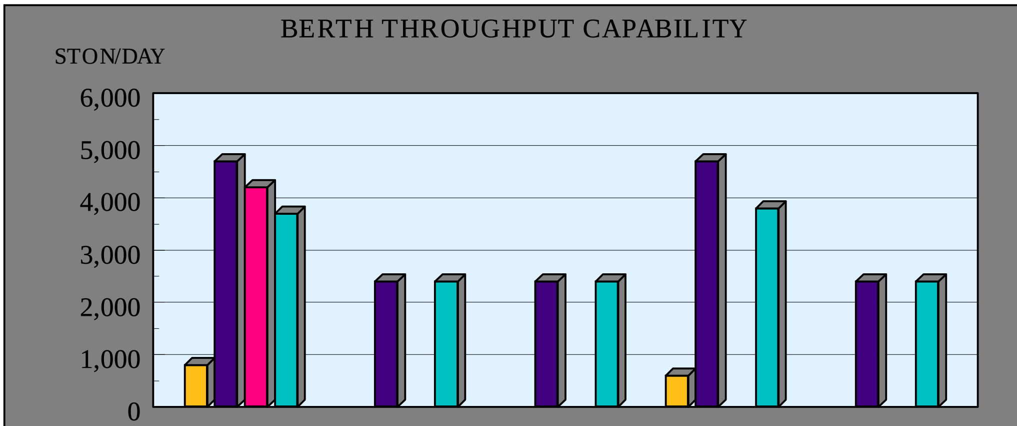
Based on the shipping subsystem throughput, about 105 acres of open storage are needed (about 16 acres are available) to stage the daily throughput capability. The 105-acre requirement consists of 78 acres needed to stage RORO cargo and 27 acres to stage containers. The RORO acreage includes areas for frustrated cargo, working areas, areas around ramps and gates, lanes and access to vehicles, and other factors. The container acreage is based on the chassis system for container storage (70 TEU per acre). This means that the Port of Ancona has a severe shortfall in available open staging to accommodate daily throughput capabilities.



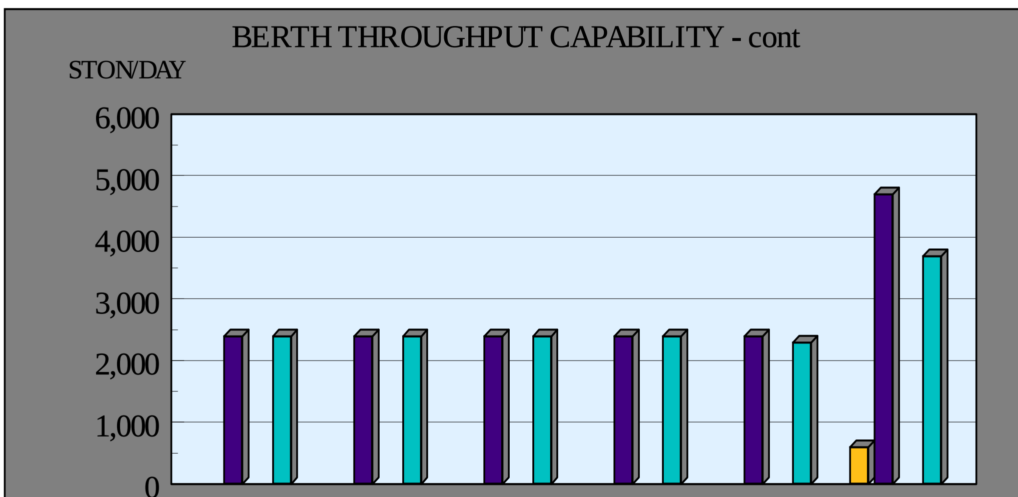
Open Staging Nuova Darsena Terminal

Shipping

Throughputs for each berth are shown below. They are based on various factors including MHE used; loading, operational, berth usage rates; and berthing capabilities for various vessel types. Assumptions used in this study are in the appendix.

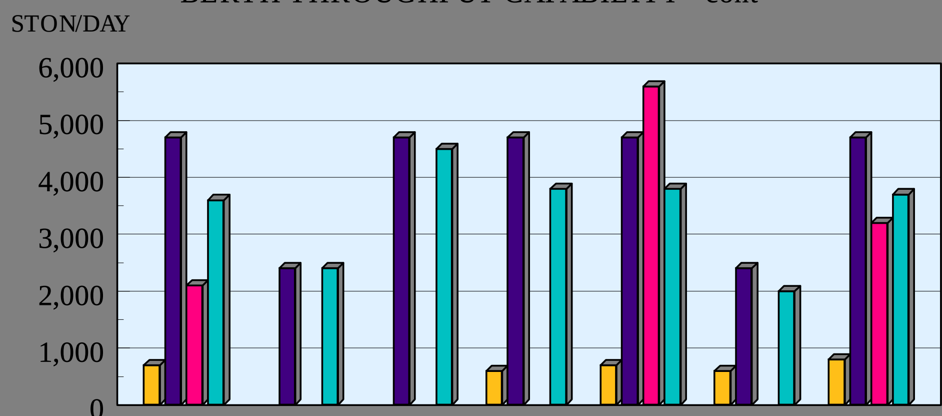


	1 MClem	2 MRizz	3 MRizz	4 MRizz	6 S Prim
Breakbulk	800			600	
RORO	4,700	2,400	2,400	4,700	2,400
Containers	4,200				
Mixed	3,700	2,400	2,400	3,800	2,400



	8 MWojt	9 MWojt	10 CSau	11 MSMa	13 MSMa	14 CdRe
Breakbulk						600
RORO	2,400	2,400	2,400	2,400	2,400	4,700
Containers						
Mixed	2,400	2,400	2,400	2,400	2,300	3,700

BERTH THROUGHPUT CAPABILITY - cont



	15 M29S	16 M29S	17 M29S	22 MSud	23 NDar	24 NDar	25 NDar
Breakbulk	700			600	700	600	800
RORO	4,700	2,400	4,700	4,700	4,700	2,400	4,700
Containers	2,100				5,600		3,200
Mixed	3,600	2,400	4,500	3,800	3,800	2,000	3,700

CONVERSION FACTORS

Breakbulk: .4 STON per MTON
RORO: .25 STON Per MTON
Containers: .4 STON per MTON

THROUGHPUT SUMMARY PER DAY FOR PORT OF ANCONA

BERTH	LENGTH (feet)	DEPTH ALONGSIDE (feet)	BREAKBULK THROUGHPUT (STON)	RORO THROUGHPUT (STON)	RORO SQUARE FT (EST)	RORO PIECES [1]	CONTAINER THROUGHPUT (STON)	CONTAINER THROUGHPUT (TEU)	BARGE THROUGHPUT (STON)	MIXED THROUGHPUT (STON)
1 Molo Clementino	886	29	800	4,700	94,380	555	4,200	531	900	3,700
2 Molo Rizzo	623	28	0	2,400	47,200	278	0	0	0	2,400
3 Molo Rizzo	383	31	0	2,400	47,180	278	0	0	0	2,400
4 Molo Rizzo	656	30	600	4,700	94,380	555	0	0	0	3,800
6 San Primiano	318	24	0	2,400	47,180	278	0	0	0	2,400
8 Molo Wojtyla	400	22	0	2,400	47,180	278	0	0	0	2,400
9 Molo Wojtyla	406	25	0	2,400	47,180	278	0	0	0	2,400
10 Calata Sauro	426	24	0	2,400	47,180	278	0	0	0	2,400
11 Molo Santa Maria	482	25	0	2,400	47,180	278	0	0	0	2,400
13 Molo Santa Maria	511	26	0	2,400	47,180	278	0	0	200	2,300
14 Calata Repubblica	656	28	600	4,700	94,380	555	0	0	200	3,700
15 Nuovo Molo Trapezoidale	702	28	700	4,700	94,380	555	2,100	265	200	3,600
16 Nuovo Molo Trapezoidale	393	26	0	2,400	47,180	278	0	0	0	2,400
17 Calata Da Chio	820	23	0	4,700	94,380	555	0	0	200	4,500
22 Molo Sud	656	29	600	4,700	94,380	555	0	0	0	3,800
23 Nuova Darsena	859	32	700	4,700	94,380	555	5,600	697	0	3,800
24 Nuova Darsena	492	34	600	2,400	47,180	278	0	0	0	2,000
25 Nuova Darsena	849	34	800	4,700	94,380	555	3,200	398	200	3,700

[1]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

We base the type of ship preferred at each berth on the methodology described in the appendix. The evaluation is a snapshot view of the current physical characteristics of the berths and MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suited for loading or unloading operations. In general, no one berth is ideal for all military operations. The best berth depends on the type of ship loaded.

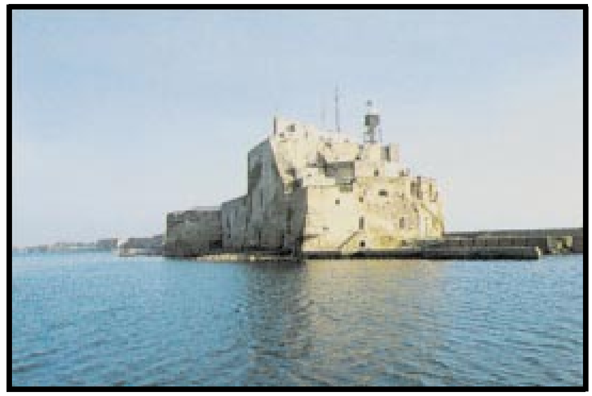
Because of their all around capability and available open staging, we recommend the Nuova Darsena Terminal as the most desirable for military port operations. Because of the available wharf cranes and rail access, the next choice is Molo Clementino.

BERTH PREFERENCE SELECTION

LOADING TYPE	**BERTHS**								
	1 MClem	**2 MRizz**	**3 MRizz**	**4 MRizz**	**6 SPrim**	**8 MWojt**	**9 MWojt**	**10 CSau**	**11 MSMa**
BREAKBULK	4	-	-	7	-	-	-	-	-
RORO	5	9	17	8	16	11	18	13	14
CONTAINER	3	-	-	-	-	-	-	-	-
NOTE: Berths marked with a "-" are not recommended for these operations.									

LOADING TYPE	**BERTHS**								
	13 MSMA	**14 CdRe**	**15 NMTr**	**16 NMTr**	**17 CdaCh**	**22 MSud**	**23 NDar**	**24 NDar**	**25 NDar**
BREAKBULK	-	8	6	-	-	3	1	5	1
RORO	11	10	7	14	6	3	1	3	1
CONTAINER	-	-	4	-	-	-	1	-	2
NOTE: Berths marked with a "-" are not recommended for these operations.									

PORT OF BRINDISI, ITALY



I. General Data

II. Throuput Analysis

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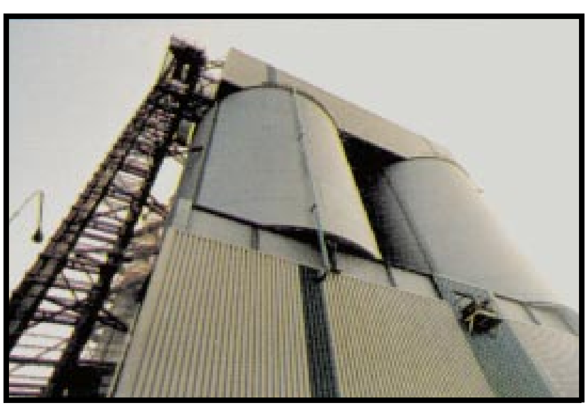


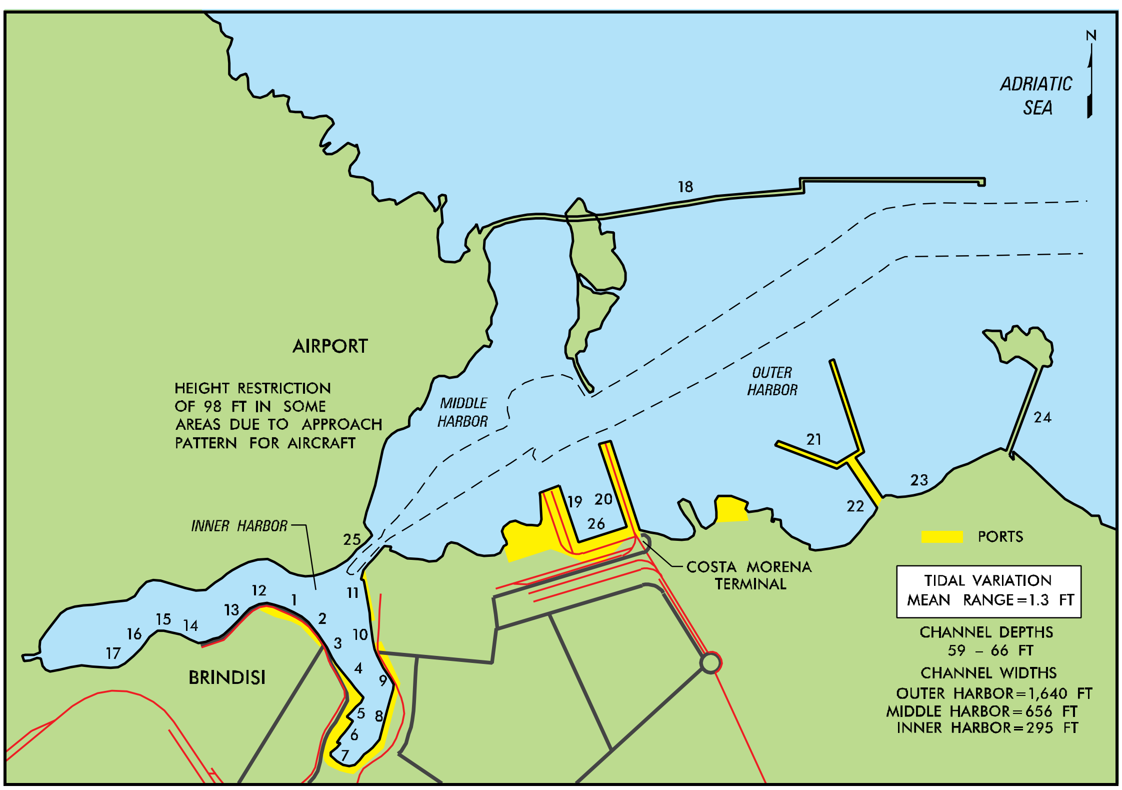
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Brindisi (40° 39’ 00" north latitude and 17° 58’ 00" east longitude) is on the southeast coast of Italy (on the heel of the boot) along the Adriatic Sea. The port has three harbors; outer, middle, and inner. The outer harbor berths are mostly for tankers importing oil and other petroleum products. The middle harbor is for the Costa Morena Terminal, a modern facility compatible with container and RORO operations. The inner harbor is for the old port and is in the congested downtown area of Brindisi. The wharves in the old port primarily support commercial ferry operations between Italy, Greece, and Albania.

The port has direct water access from the Adriatic Sea. The only vertical or overhead restriction on ships entering the port is a 98-foot height restriction near the Brindisi Airport to ensure a safe approach zone for landing aircraft. The rest of the port does not have any vertical or overhead restrictions. Deep draft anchorages are located near the port and turning basins are adequate inside the port.



Water Access

Highway

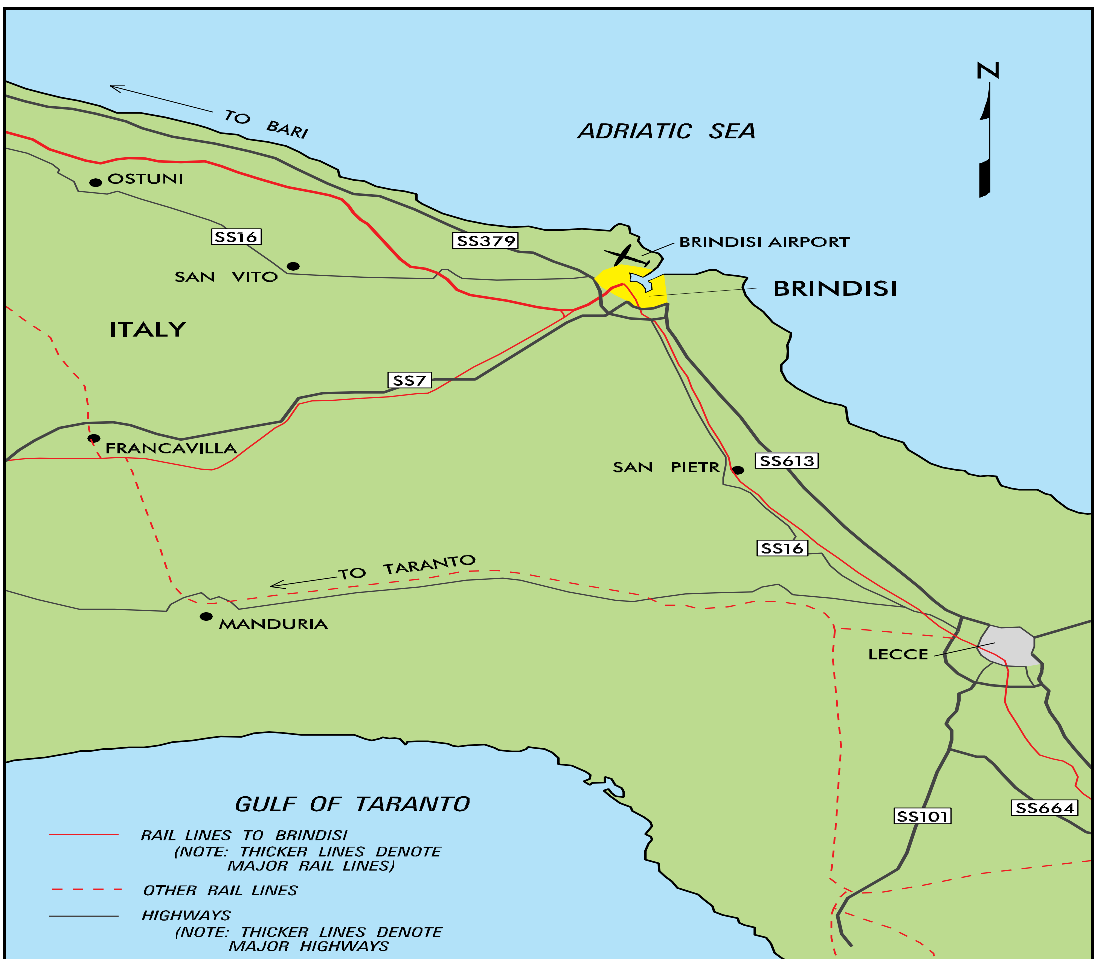
Brindisi is a large city with heavy traffic congestion in its downtown area. Highways to wharves in the inner harbor go through the congested commercial center of town. The Costa Morena Terminal has direct access to SS 379 and SS 16 via Costa Morena Extension. This extension bypasses the heavily congested downtown area.

Air

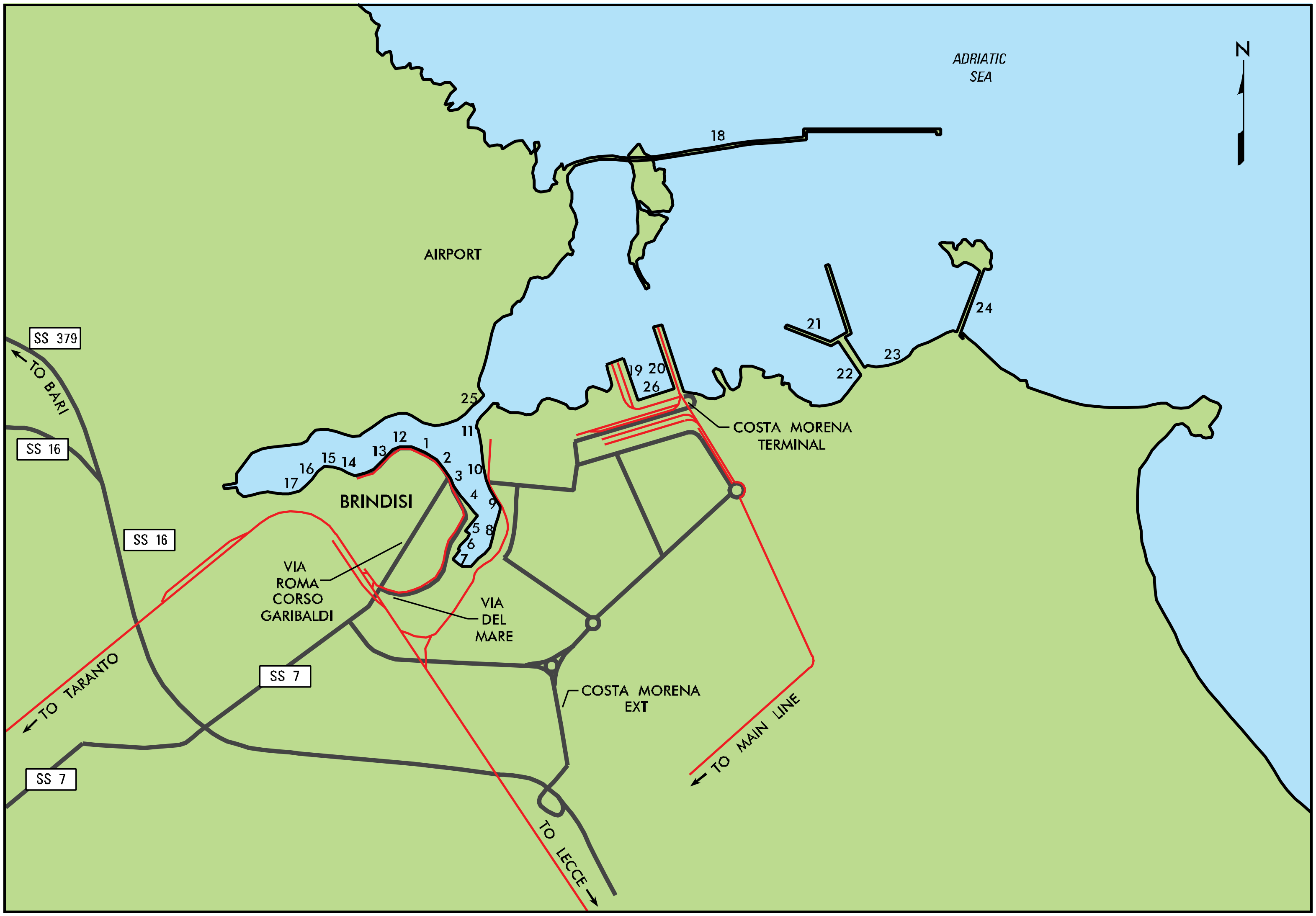
Brindisi has an airport northwest of the middle harbor. The airport has two runways, the longest being 3,000 meters (9,840 feet), and is capable of landing large cargo planes.

Rail

A major rail line extends northwestward from Brindisi to Bari. Another key rail line extends westward to Taranto. Rail access and facilities at the port are good and extend to both the middle and inner harbor areas. No unusual clearance restrictions exist on the rail lines accessing the port. Rail activity at the port is light.



Transportation Access Map



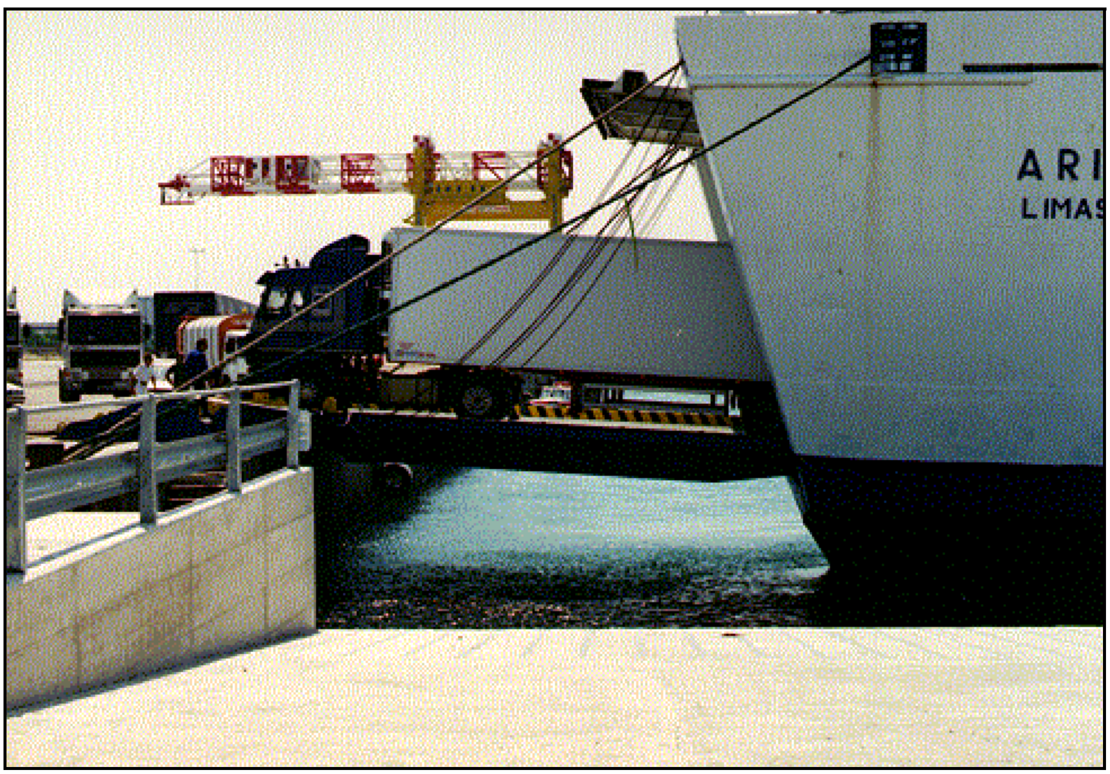
Vicinity Map

PORT FACILITIES

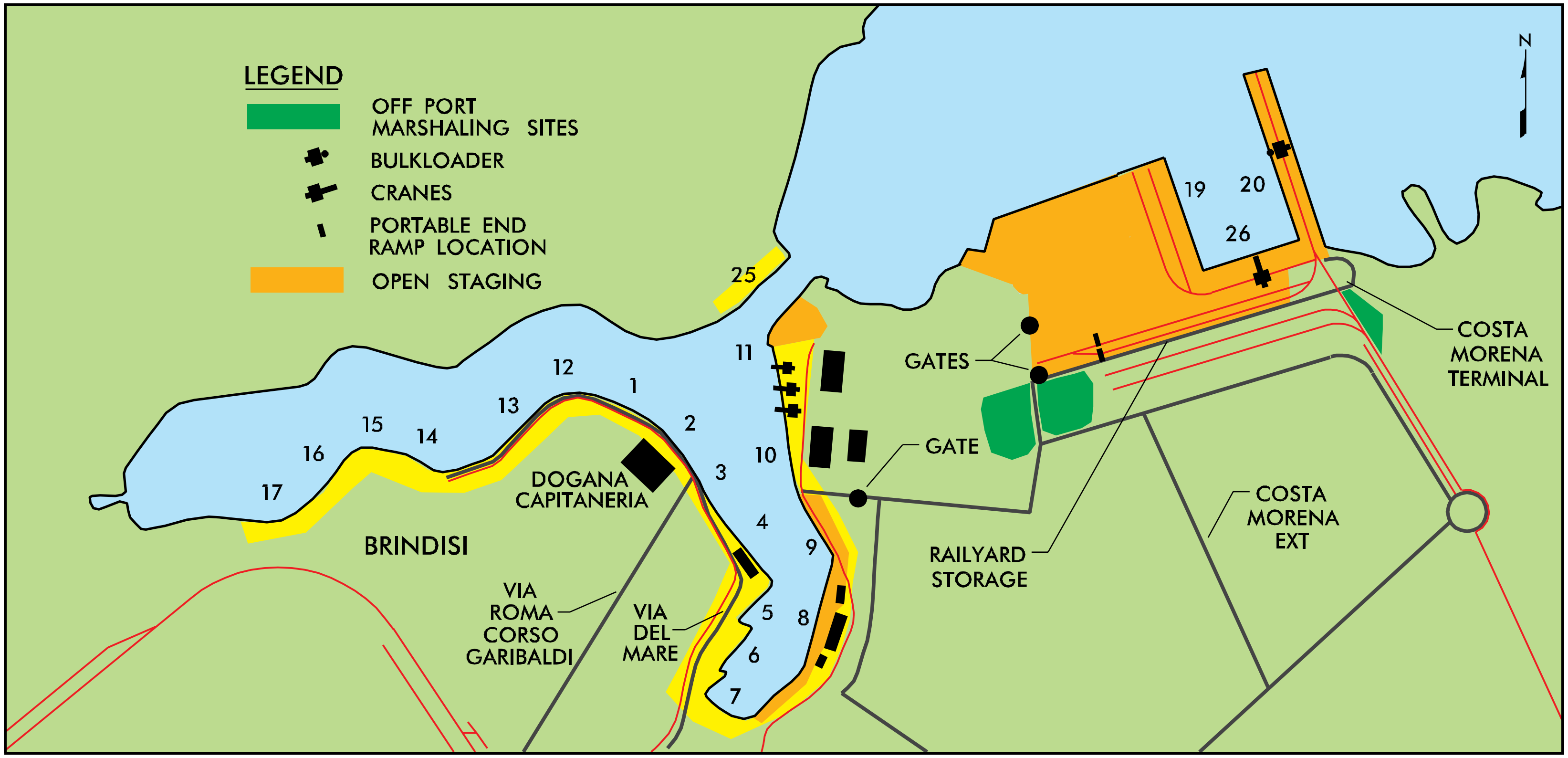
Berthing

Brindisi is a multicargo port with a specialization in commercial ferry operations. The Costa Morena Terminal is the most versatile of all the terminals and the most desirable for military operations. It is capable of breakbulk, RORO, container, and barge operations. The inner harbor wharves are used mostly for commercial ferry operations and some breakbulk operations. Also, the Italian Navy has facilities on both sides (Seno di Ponente and Seno di Levante) of the inner harbor.

Military operations will most likely take place at the Costa Morena Terminal and the wharves on the east side of the Seno di Levante in the inner harbor. Other wharves are available in the inner harbor, but will not likely be available for military operations because of the commercial ferry and Italian Navy operations. Also, the heavy traffic to the inner harbor makes the use of these wharves impractical. The availability of lighting varies throughout the port. Lighting is poor at some piers and staging areas. In these areas, night operations will require additional portable lighting.



Passenger Ferry Operations at Costa Morena Terminal


LEGEND
OFF PORT MARSHALING SITES
BULKLOADER
CRANES
PORTABLE END RAMP LOCATION
OPEN STAGING
N
BRINDISI
DOGANA CAPITANERIA
VIA ROMA CORSO GARIBALDI
VIA DEL MARE
GATES
GATE
RAILYARD STORAGE
COSTA MORENA TERMINAL
COSTA MORENA EXT
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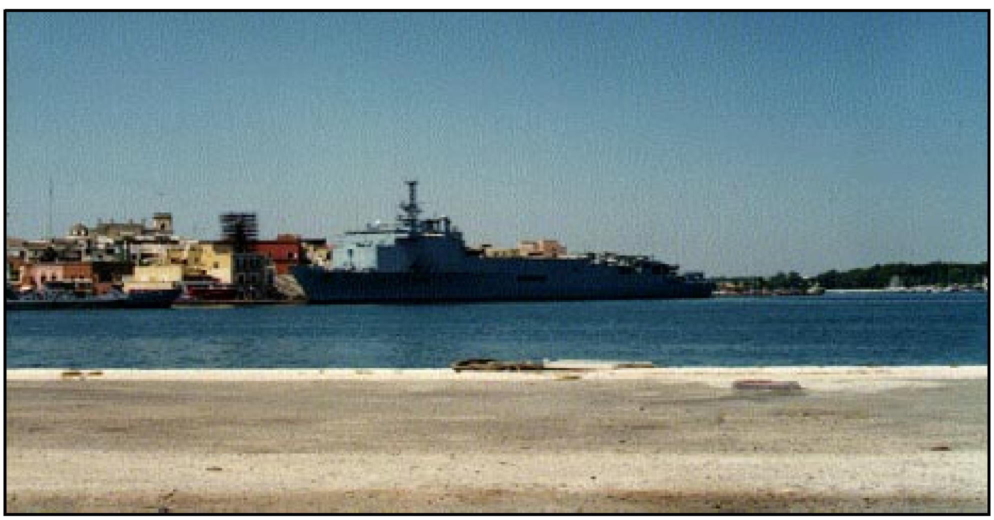
Land-Use Map

BERTH CHARACTERISTICS FOR PORT OF BRINDISI

	Berths					
CHARACTERISTICS	1 Centrale	2,3,&4*	5 Traghetto Nuova Rampa	5 Traghetto Vecchia Rampa	6 Banchina di Levante	8 Feltrinelli
Length (ft)	1,043	1,705	524	524	459	728
Depth alongside at MLW (ft)	29	29	19	19	19	24
Deck strength (psf)	600	600	600	600	600	600
Apron width (ft)	30	30	78	78	open	86
Apron height above MLW (ft)	3	4	3	5	5	6
Number of container cranes	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	Yes	Yes	No	No
Apron length served by rail (ft)	1,043	1,705	524	524	459	0
NOTE: Berth 2 is the Banchina della Dogana Wharf; Berth 3 is the Stazione Marittima Wharf; and Berth 4 is the Banchina Carbonifera Wharf.						



Inner Harbor, Port of Brindisi

PORT OF BRINDISI
BERTH CHARACTERISTICS - cont

	Berths					
CHARACTERISTICS	9 PFra	10 Mont	11 SAp	19 NSCM	20 DCM	26 RCM
Length (ft)	1,328	747	295	1,213	1,640	984
Depth alongside at MLW (ft)	24	27	24	45	45	45
Deck strength (psf)	600	600	600	800	800	800
Apron width (ft)	78	open	open	open	open	open
Apron height above MLW (ft)	6	4	5	10	10	10
Number of container cranes	0	0	0	0	0	1
Number of wharf cranes	3	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	No	Yes	No	Yes	Yes
Apron length served by rail (ft)	0	0	0	0	1,640	984

Port of Brindisi Costa Morena Terminal

PORT OF BRINDISI
SUMMARY OF BERTHING CAPABILITIES

VESSELS		BERTHS									
TYPE	**CLASS**	**1 Cent**	**2,3,&4**	**5 NTra**	**5 VTra**	**6 Leva**	**8 Felt**	**9 PFRa**	**10 Mont**	**11 SAp**	
BREAKBULK	C3-S-38a	2	3	a	a	a,c	a	a	a	a,c	**NOTES:**
	C4-S-58a	a	a	a,c	a,c	a,c	a	a	a	a,c	a-vessel draft limit
	C4-S-66a	a	a	a,c	a,c	a,c	a	a	a	a,c	b-inadequate apron width
	C5-S-37e	a	a	a,c	a,c	a,c	a	a	a	a,c	c-inadequate berth length
SEATRAIN	GA and PR	1	2	a,c	a,c	a,c	a	a	1	a,c	d-no straight stern ramp
BARGE	LASH C8-S-81b	a,f	a,f	a,c,f	a,c,f	a,c,f	a,c,f	a,f	a,c,f	a,c,f	e-no container handling equipment
	LASH C9-S-81d	a	a	a,c	a,c	a,c	a,c	a	a,c	a,c	f-anchorage depth OK, berth depth
	LASH Lighter	5	8	2	2	2	3	6	3	1	inadequate
	SEABEE C8-S-82a	a	a	a,c	a,c	a,c	a,c	a	a,c	a,c	g-inadequate channel depth
	SEABEE Barge	5	8	2	2	2	3	6	3	1	h-no shore based ramps
RORO	Jolly Smeraldo	a,b	a,b	a,c	a,c	a,c	a	a	a	a,c	i-low tide insufficient ramp clearance
	Isola Delle Perle	d,o	d,o	a,c	a,c	a,c,d	1,d	2	1,d	c	j-high tide insufficient ramp clearance
	Galini	2	3	a	a	a,c	1	2	1	c	k-excessive ramp angle low tide
	Arcade Falcon	2	3	a	a	a	i,j	i,j	1	c	m-excessive ramp angle high tide
	Golfo Dei Fiori	d,o	d,o	1,m	1,m	1,d	1,d	3,m	1,d	c,m	n-parallel ramp operation ONLY
	Ani	3	5,i	i,j	i,j	i,j	i,j	i,j	2,i	c	o-insufficient apron width for side ramp
	MV Goya	d,o	d,o	1	1	1,d	2,d	4	2,d	1	
	Cape I-class	a,b	a,b	a,c	a,c	a,c	a	a	a	a,c	
	Cape Victory	b	b	a,c	a,c	a,c	a	a	a	a,c	Ramp clearance and angle based on maximum vessel draft
	COMET	d,o	d,o	a	a	a,c,d	a,d	a	1,d	a,c	
	METEOR	d,o	d,o	a,c	a,c	a,c,d	a,d	a	a,d	a,c	
	Cape Gnome	a,d,o	a,d,o	a,c,i,j	a,c,i,j	a,c,d	a,d	a,i,j	a,d	a,c,i,j	♦ **May Prevent Operation**
	C7-S-95a	a,b	a,b	a,c	a,c	a,c	a,c	a	a	a,c	
	Cape Taylor	b	b	a,c	a,c	a,c	a	a	a	a,c	♦ **May Limit Operation**
	Cape Orlando	a,b	a,b	a,c	a,c	a,c	a	a	a	a,c	

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF BRINDISI
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS									
TYPE	**CLASS**	**1 Cent**	**2,3,&4**	**5 NTra**	**5 VTra**	**6 Leva**	**8 Felt**	**9 PFra**	**10 Mont**	**11 SAp**	**NOTES:**
	MV Ambassador	d	d	a,c,k,m	a,c,k,m	a,c,d	d	k,m	d	c,k,m	a-vessel draft limit
	Callaghan	d,o	d,o	a,c	a,c	a,c,d	a,d,o	a	1,d	a,c	b-inadequate apron width
	Cape Lambert	a,b	a,b	a,c	a,c	a,c	a	a	a	a,c	c-inadequate berth length
	FSS	a,b	a,b	a,c	a,c	a,c	a,c	a	a,c	a,c	d-no straight stern ramp
	Cape R	a,b,d,o	a,b,d,o	a,c	a,c	a,c,d	a,d	a	a,d	a,c	e-no container handling equipment
	Cape E	a,b	a,b	a,c	a,c	a,c	a	a	a	a,c	f-anchorage depth OK, berth depth
	Cape D	a,b	a,b	a,c	a,c	a,c	a	a	a	a,c	inadequate
	Cape H	a,b	a,b	a,c	a,c	a,c	a,c	a	a,c	a,c	g-inadequate channel depth
	Cape Texas	b	b	a,c	a,c	a,c	a	a	a	a,c	h-no shore based ramps
CONTAINER	C6-M-147a	b,e	b,e	a,c,e	a,c,e	a,c,e	a,e	a,e	1,e	a,c,e	i-low tide insufficient ramp clearance
	C7-S-69c	a,b,e	a,b,e	a,c,e	a,c,e	a,c,e	a,e	a,e	a,e	a,c,e	j-high tide insufficient ramp clearance
	C7-S-68c	a,b,e	a,b,e	a,c,e	a,c,e	a,c,e	a,e	a,e	a,e	a,c,e	k-excessive ramp angle low tide
	C8-S-85c	a,b,e	a,b,e	a,c,e	a,c,e	a,c,e	a,c,e	a,e	a,c,e	a,c,e	m-excessive ramp angle high tide
	C9-M-132b	a,b,e	a,b,e	a,c,e	a,c,e	a,c,e	a,c,e	a,e	a,c,e	a,c,e	n-parallel ramp operation ONLY
	C9-M-F141a	a,b,e	a,b,e	a,c,e	a,c,e	a,c,e	a,c,e	a,e	a,c,e	a,c,e	o-insufficient apron width for side ramp
AUXILIARY CRANE	C6-S-1qd	a,b	a,b	a,c	a,c	a,c	a	a	a	a,c	Ramp clearance and angle based on maximum vessel draft
	C5-S-MA73c	a,b	a,b	a,c	a,c	a,c	a	a	a	a,c	
	C6-S-MA60d	a,b	a,b	a,c	a,c	a,c	a	a	a	a,c	
MPS	C7-S-133a	a,b	a,b	a,c	a,c	a,c	a,c	a	a,c	a,c	♦ **May Prevent Operation**
	Maersk	a,b	a,b	a,c	a,c	a,c	a,c	a	a,c	a,c	
	AmSea	a,b	a,b	a,c	a,c	a,c	a	a	a	a,c	♦ **May Limit Operation**

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PORT OF BRINDISI
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		19 NSCM	20 DCM	26 RCM	
BREAKBULK	C3-S-38a	2	3	1	**NOTES:**
	C4-S-58a	2	2	1	a-vessel draft limit
	C4-S-66a	2	2	1	b-inadequate apron width
	C5-S-37e	1	2	1	c-inadequate berth length
SEATRAIN	GA and PR	2	2	1	d-no straight stern ramp
BARGE	LASH C8-S-81b	1	1	1	e-no container handling equipment
	LASH C9-S-81d	1	1	1	f-anchorage depth OK, berth depth
	LASH Lighter	6	8	4	inadequate
	SEABEE C8-S-82a	1	1	1	g-inadequate channel depth
	SEABEE Barge	6	8	4	h-no shore based ramps
RORO	Jolly Smeraldo	i,j	i,j	i,j	i-low tide insufficient ramp clearance
	Isola Delle Perle	2,d	i,j	i,j	j-high tide insufficient ramp clearance
	Galini	i,j	i,j	i,j	k-excessive ramp angle low tide
	Arcade Falcon	i,j	i,j	i,j	m-excessive ramp angle high tide
	Golfo Dei Fiori	2,d	3	2	n-parallel ramp operation ONLY
	Ani	i,j	i,j	i,j	o-insufficient apron width for side ramp
	MV Goya	3,d	i,j	i,j	
	Cape I-class	i,j	i,j	i,j	
	Cape Victory	1,i	2,i	i,j	Ramp clearance and angle based on maximum vessel draft
	COMET	d,i,j	i,j	i,j	
	METEOR	d,i,j	i,j	i,j	
	Cape Gnome	d,i,j	i,j	i,j	♦ **May Prevent Operation**
	C7-S-95a	1	2	1	
	Cape Taylor	1	2	1	♦ **May Limit Operation**
	Cape Orlando	i,j	i,j	i,j	

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF BRINDISI
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		19 NSCM	20 DCM	26 RCM	
	MV Ambassador	d	2,m	1,m	**NOTES**
	Callaghan	1,d	2	1	a-vessel draft limit
	Cape Lambert	i,j	i,j	i,j	b-inadequate apron width
	FSS	a	a	a	c-inadequate berth length
	Cape R	1,d	2	1	d-no straight stern ramp
	Cape E	i,j	i,j	i,j	e-no container handling equipment
	Cape D	i,j	i,j	i,j	f-anchorage depth OK, berth depth
	Cape H	1	2	1	inadequate
	Cape Texas	i,j	i,j	i,j	g-inadequate channel depth
CONTAINER	C6-M-147a	1,e	2,e	1	h-no shore based ramps
	C7-S-69c	1,e	2,e	1	i-low tide insufficient ramp clearance
	C7-S-68c	1,e	2,e	1	j-high tide insufficient ramp clearance
	C8-S-85c	1,e	1,e	1	k-excessive ramp angle low tide
	C9-M-132b	1,e	1,e	1	m-excessive ramp angle high tide
	C9-M-F141a	a,e	a,e	a	n-parallel ramp operation ONLY
AUXILIARY CRANE	C6S-1qd	1	2	1	o-insufficient apron width for side ramp
	C5-S-MA73c	1	2	1	Ramp clearance and angle based on maximum vessel draft
	C6-S-MA60d	1	2	1	
MPS	C7-S-133a	1	1	1	♦ **May Prevent Operation**
	Maersk	1	2	1	
	AmSea	1	2	1	♦ **May Limit Operation**

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

STAGING

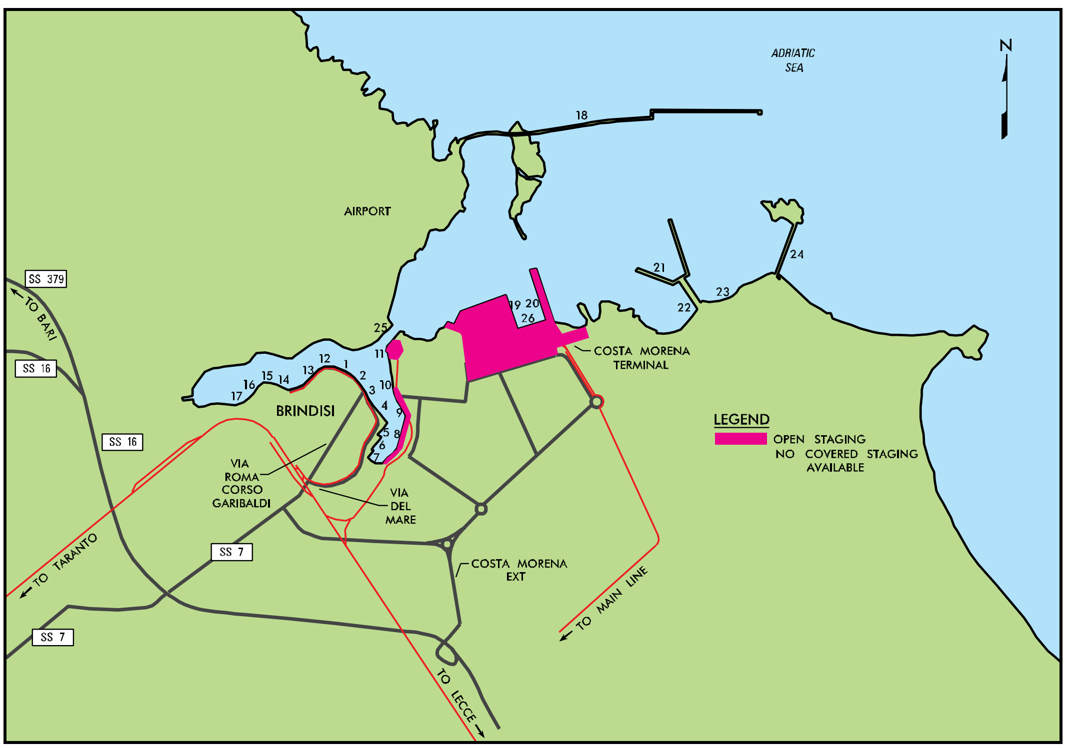
Open Staging

The Port of Brindisi has about 64 acres of open storage available. The vast majority of this is in and around the Costa Morena Terminal.

The port does not have any designated areas for helicopter operations. However, potential sites are the open staging areas at and near the Costa Morena Terminal. Temporary shelters will be needed to support shrink-wrapping activities.

Covered Staging

The port has no covered staging available for military use.



Open Staging

Rail

Rail lines extend from the main lines to the Costa Morena Terminal and the wharves on the west side of the Seno di Levante, inner harbor. Spurs and sidings extend into the staging area at the Costa Morena Terminal and additional spurs run directly alongside the Diga di Costa Morena and Riva di Costa Morena Piers. Apron tracks are on 20 Diga di Costa Morena, 26 Riva di Costa Morena, 4 Carbonifera, 3 Stazione Marittima, 2 Dogana, and 1 Centrale. These berths have one apron track each. The Costa Morena Terminal has a small rail storage area that can hold about 200 railcars. A rail marshaling yard for call forwarding of trains is about 2 miles from the port. The rail lines leading from the main lines to the port have no unusual height or side clearance restrictions.

Highway

Roads leading into the wharf areas are two-laned (one lane for each direction). The Costa Morena terminal is accessible by the Costa Morena extension, a direct connection with the major roadways that bypasses the congested downtown area. The Costa Morena Terminal and inner harbor have gates leading to the wharf areas. One lane is allocated for each direction. There are no height or weight limits leading out of the port to the main networks. Truck scales are available at the port near the Levante wharf and at the Costa Morena Terminal.

UNLOADING/LOADING POSITIONS

Ramps

The Port of Brindisi has one fixed side ramp for rail offloading next to the Costa Morena Terminal. This ramp has at least 1,050 feet of tangential track. Other than this ramp, no others exist for rail or truck offloading operations at the port. However, the Costa Morena Terminal has some locations that can support portable rail and truck end ramp operations. A port spokes-person has indicated that portable end ramps can be obtained locally for these operations.

Side Ramp at Costa Morena Terminal

Docks

No docks exist for truck or boxcar loading/offloading.

MARSHALING AREAS

About one million square feet (almost 23 acres) of paved open storage is just outside the Costa Morena Terminal. Other than this area, no other suitable marshaling areas exist near the port.

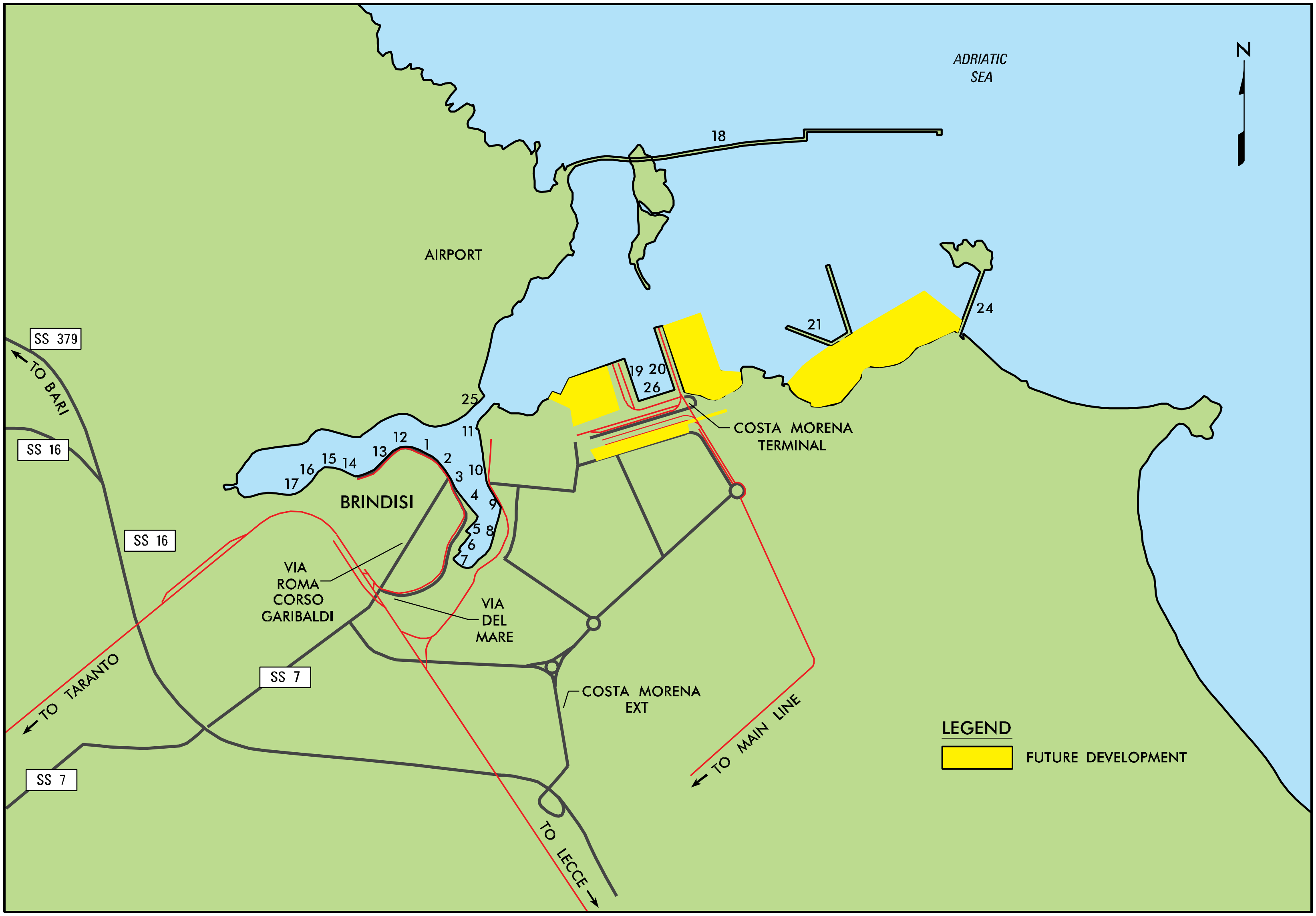
MATERIALS HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity (STON)	Quantity
Container Cranes	300	1
Wharf Cranes	3, 6, & 6.5	3
Heavy Lift Mobile Crane	551	1
Heavy Lift Mobile Crane	77	1
Mobile Crane	11	1
Mobile Crane	4.4	1
Electric Crane	3.3	1

FUTURE DEVELOPMENT

The most significant future development for the Port of Brindisi will be the expansion of the Costa Morena Terminal by the port authority. The Testata Nuovo Sporgente wharf, which is next to the Nuovo Sporgente wharf, will expand from 492 feet to 1640 feet. Also, the Diga di Costa Morena wharf will expand toward the east. No timetables have been established for completion of these wharves. The tanker berths in the outer harbor will also be improved, however, these berths are not considered deployment useful.

Future Development at Costa Morena Terminal

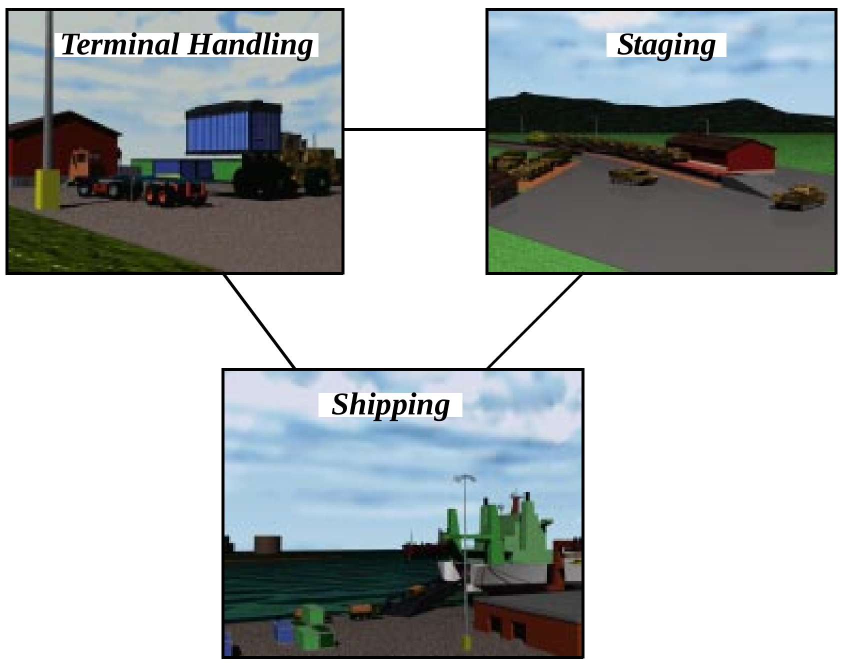


Future Development

II. THROUGHPUT ANALYSIS

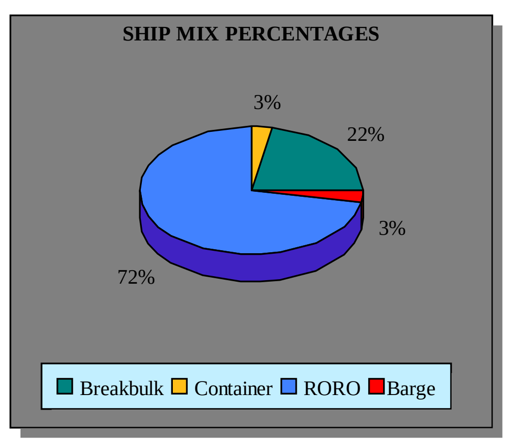
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Brindisi. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of short tons (STON) per day.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 80 percent of the port facilities will support military deployments. Also, based on the size of the port, we assume that the berths will have ships 80 percent of the time. The ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL CLEARANCE/HANDLING

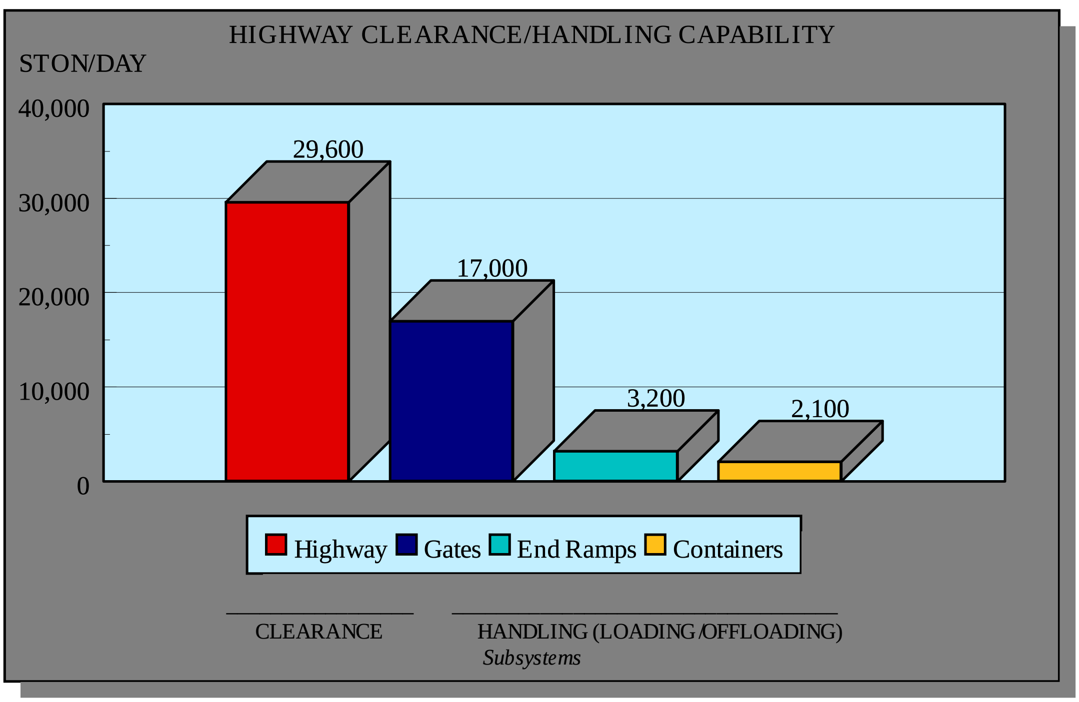
Highway

The Costa Morena Extension, Via del Mare, and Via Roma Corso Garibaldi are the roadways connecting the port to the main highways (SS 379 and SS 16). The road network in and out of the port, including the gate processing of vehicles, can handle at least 17,000 STON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. We assume that deploying units will build or acquire two portable ramps for flatbed truck and semitrailer operations. These two ramps will handle at least 3,200 STON of military vehicles and equipment per day.

The port has no truck docks.

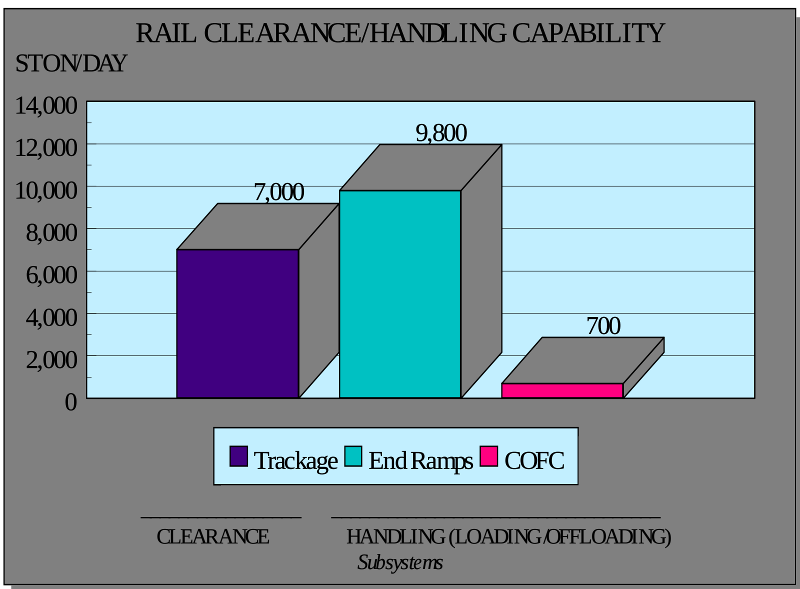
The Port of Brindisi has commercial container handlers available for use in container operations. These machines will likely perform operations in the staging area in the Costa Morena Terminal and handle about 2,100 STON per day, based on 75 percent of the container vessel discharge going by highway.

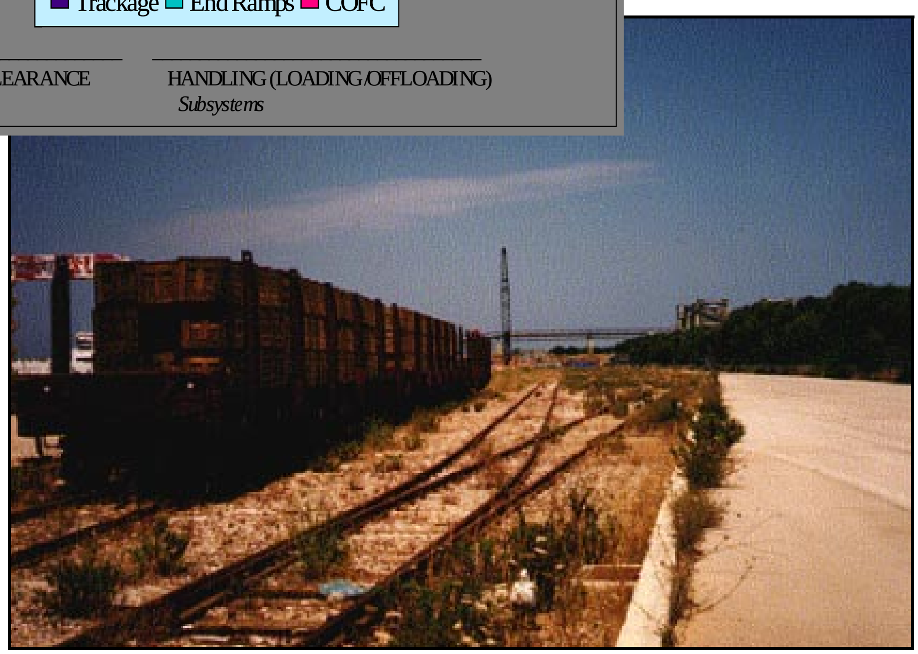


Rail

The Ferrovia dello Stato (FS) could move a maximum of 8 trains of 25 railcars each day if necessary. Vehicles on flatcars can offload at the fixed side ramp near the Costa Morena Terminal. Portable end ramps would also be used to support offloading operations. We assume the deploying units would build or acquire at least two portable end ramps to use on available spurs having 1,000 feet of tangential track. Assuming two portable end ramps and the fixed side ramp are used for loading/offloading railcars (60-foot railcars), the port would handle about 200 railcars daily (4 interchanges in a 20-hour period). Other rail spurs are available on port for use with portable end ramps if needed.

We assume that commercial container handlers will be used to support container-on-flatcar (COFC) operations. These operations will likely occur at the Costa Morena Terminal.





Costa Morena Rail Storage Yard

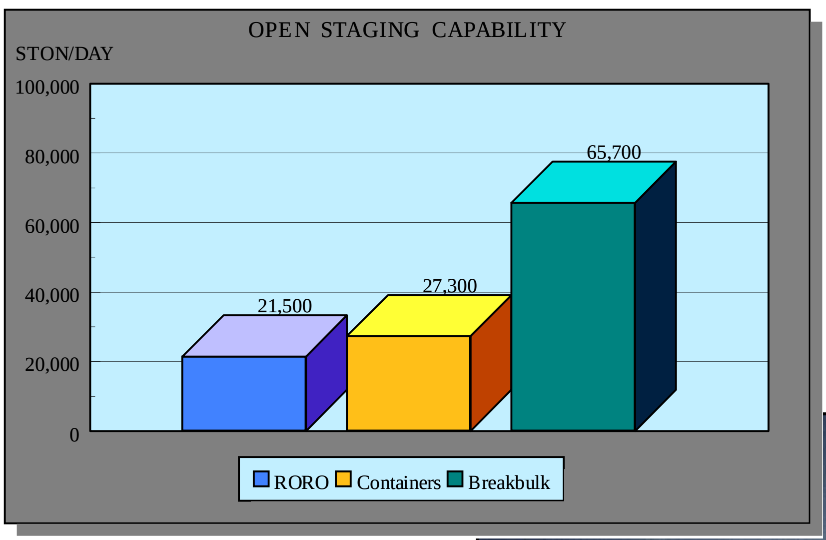
Staging

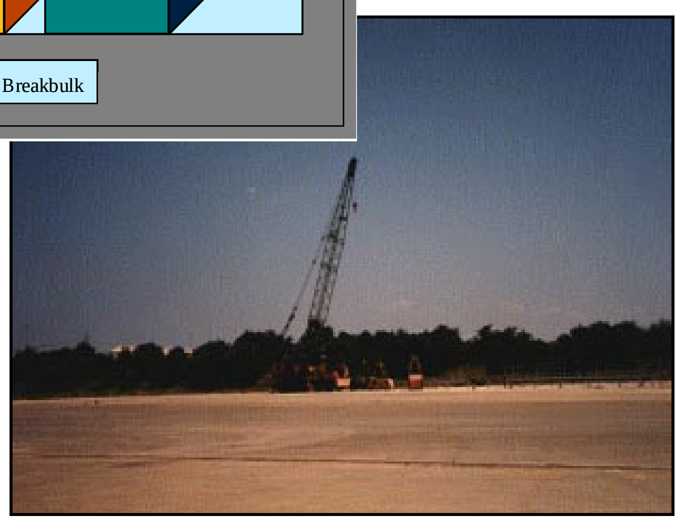
The port has about 64 acres of paved open staging (61 acres at Costa Morena) that could support military operations. It does not have any covered storage available for military use.

The port can perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned.

The chart below provides the cargo open staging capability for each vessel type. If a combination ship is expected, then a portion of each involved capability should be assumed.

Based on the shipping subsystem throughput, about 90 acres of open storage are needed (64 acres are available) to stage the daily throughput capability for the Port of Brindisi. Of the 100-acre requirement, 84 acres are needed to stage RORO and 5 acres to stage containers. The RORO acreage includes areas for frustrated cargo, working areas, areas around ramps and gates, lanes and access to vehicles, and other factors. The container acreage is based on the chassis system for container storage (70 TEUs per acre). This means that the port has a shortfall in open staging to accommodate daily throughput capabilities.

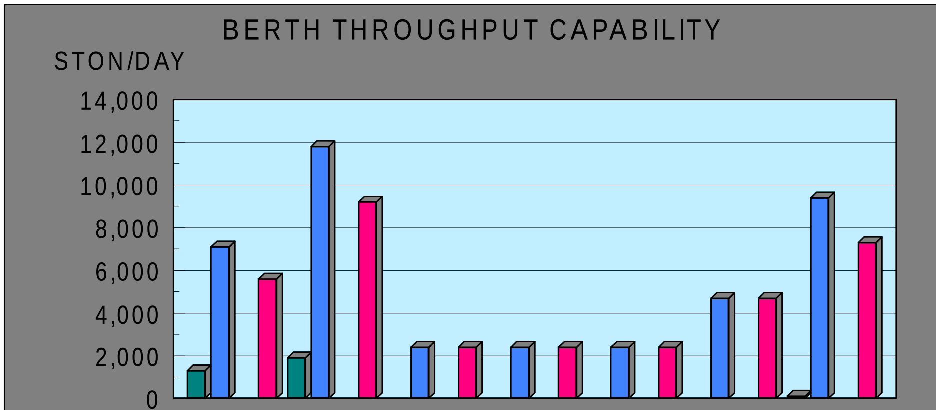




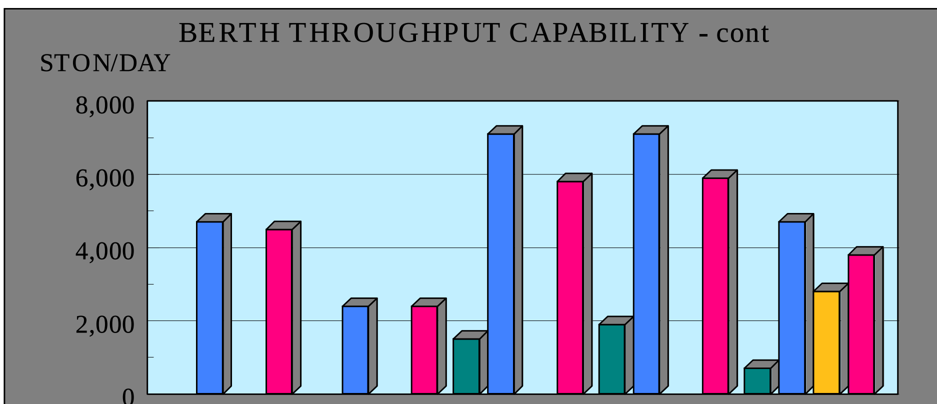
Open Staging at Costa Morena Terminal

Shipping

Throughputs for each berth are shown below. They are based on various factors, including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. Assumptions used in this study are in the appendix.



	1 Cent.	2,3&4	5NTra	5VTra	6Leva	8Felt	9PFra
Breakbulk	1,300	1,900					100
RORO	7,100	11,800	2,400	2,400	2,400	4,700	9,400
Container							
Mixed	5,600	9,200	2,400	2,400	2,400	4,700	7,300



	10 Mont	11 SAP	19 NSCM	20 DCM	26 RCM
Breakbulk			1,500	1,900	700
RORO	4,700	2,400	7,100	7,100	4,700
Container					2,800
Mixed	4,500	2,400	5,800	5,900	3,800

CONVERSION FACTORS

Breakbulk:	.4 STON per MTON
RORO:	.25 STON Per MTON
Containers:	.4 STON per MTON

THROUGHPUT SUMMARY PER DAY FOR PORT OF BRINDISI

BERTH	LENGTH (feet)	DEPTH ALONGSIDE (feet)	BREAKBULK THROUGHPUT (STON)	RORO THROUGHPUT (STON)	RORO SQUARE FT (EST)	RORO PIECES[1]	CONTAINER THROUGHPUT (STON)	CONTAINER THROUGHPUT (TEU)	BARGE THROUGHPUT (STON)	MIXED THROUGHPUT (STON)
1 Centrale	1,043	29	1,300	7,100	141,600	830	0	0	500	5,600
2, 3, &4	1,705	29	1,900	11,800	235,900	1,390	0	0	200	9,200
5 NTraghetto	524	19	0	2,400	47,200	280	0	0	0	2,400
5 VTraghetto	524	19	0	2,400	47,200	280	0	0	0	2,400
6 Levante	459	19	0	2,400	47,200	280	0	0	0	2,400
8 Feltrinelli	728	24	0	4,700	94,400	560	0	0	0	4,700
9 Punto Franco	1,328	24	100	9,400	188,700	1,110	0	0	0	7,300
10 Montecatini	747	27	0	4,700	94,200	560	0	0	200	4,500
11 S. Apollinare	295	24	0	2,400	47,200	280	0	0	0	2,400
19 NSporgente Costa Morena	1,213	45	1,500	7,100	141,560	830	0	0	0	5,800
20 Diga di Costa Morena	1,640	45	1,900	7,100	141,600	830	0	0	0	5,900
26 Riva di Costa Morena	984	45	700	4,700	94,400	560	2,800	348	0	3,800

[1]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

We base the type of ship preferred at each berth on the methodology described in the appendix. The evaluation is a snapshot view of the current physical characteristics of the berths and MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better it is suited for loading or unloading operations. In general, no one berth is ideal for all military operations. The best berth depends on the type of ship loaded.

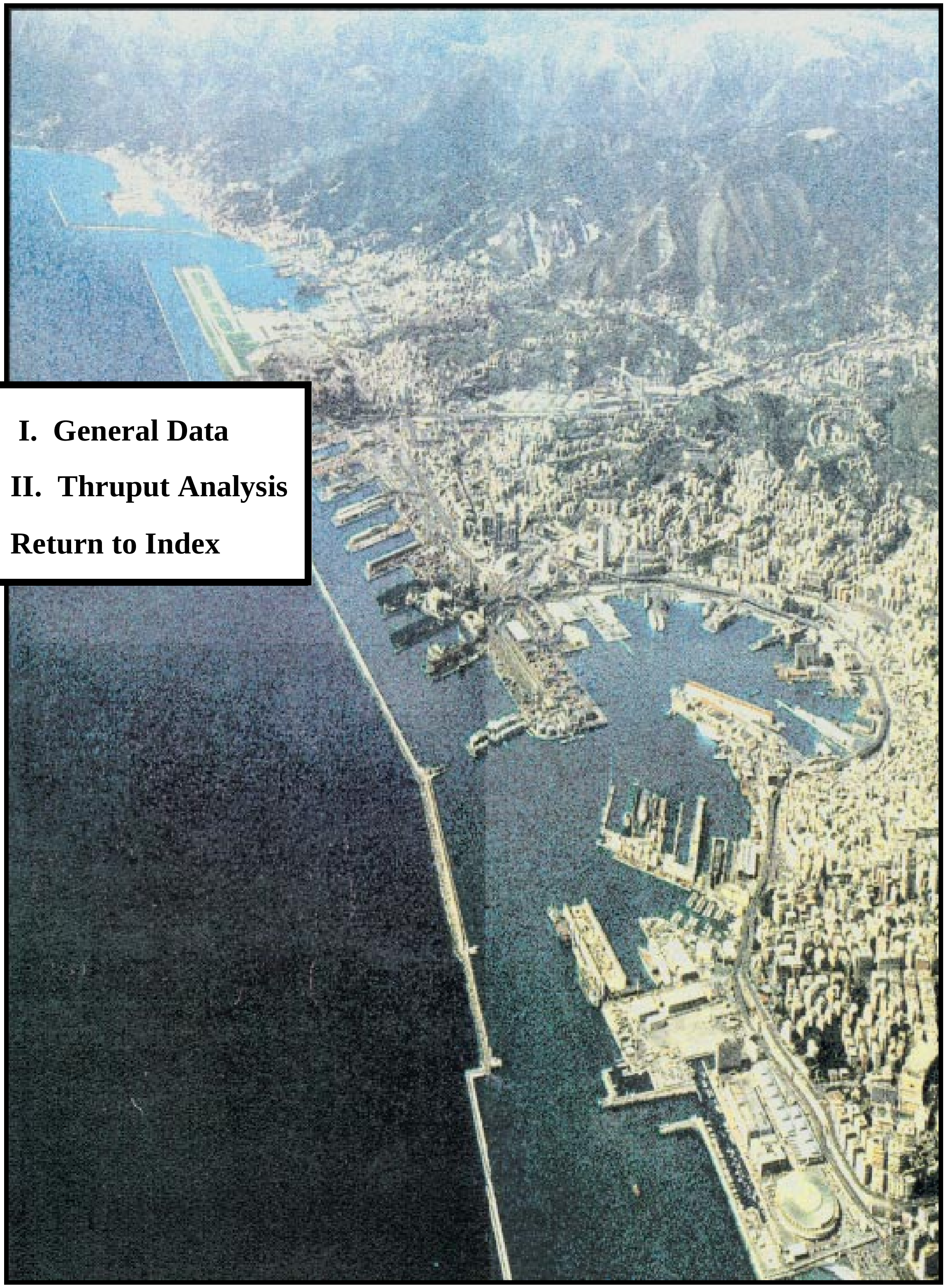
Because of their all around capability, excellent highway access, and available open staging, we recommend the berth on the Costa Morena Terminal as the most desirable for port operations. Because of the congested highway access, limited open staging, and commercial ferry operations; the berths on the west side of the Seno Levante are the least desirable for port operations.

BERTH PREFERENCE FOR PORT OF BRINDISI

LOADING TYPE	BERTHS					
	20 DIGA di COSTA MORENA	26 RIVA di COSTA MORENA	19 NUOVO SPORGENTE di COSTA MORENA	11 S. APOLLINARE	10 BANCHINA MONTECATINI	9 PUNTO FRANCO
BREAKBULK	1	1	3	-	-	-
RORO	1	2	3	9	5	4
CONTAINER	2	1	3	-	4	-
NOTE: Berths marked with a "-" are not recommended for these operations.						

LOADING TYPE	BERTHS					
	8 FELTRINELLI	6 BANCHINA di LEVANTE	5 TRAGHETTO NUOVA RAMPA	5 TRAGHETTO VECCHIA RAMPA	2, 3, & 4	1 CENTRALE
BREAKBULK	-	-	-	-	4	4
RORO	6	12	10	10	7	7
CONTAINER	-	-	-	-	-	-
NOTE: Berths marked with a "-" are not recommended for these operations.						

PORT OF GENOVA, ITALY



I. General Data

II. Thruput Analysis

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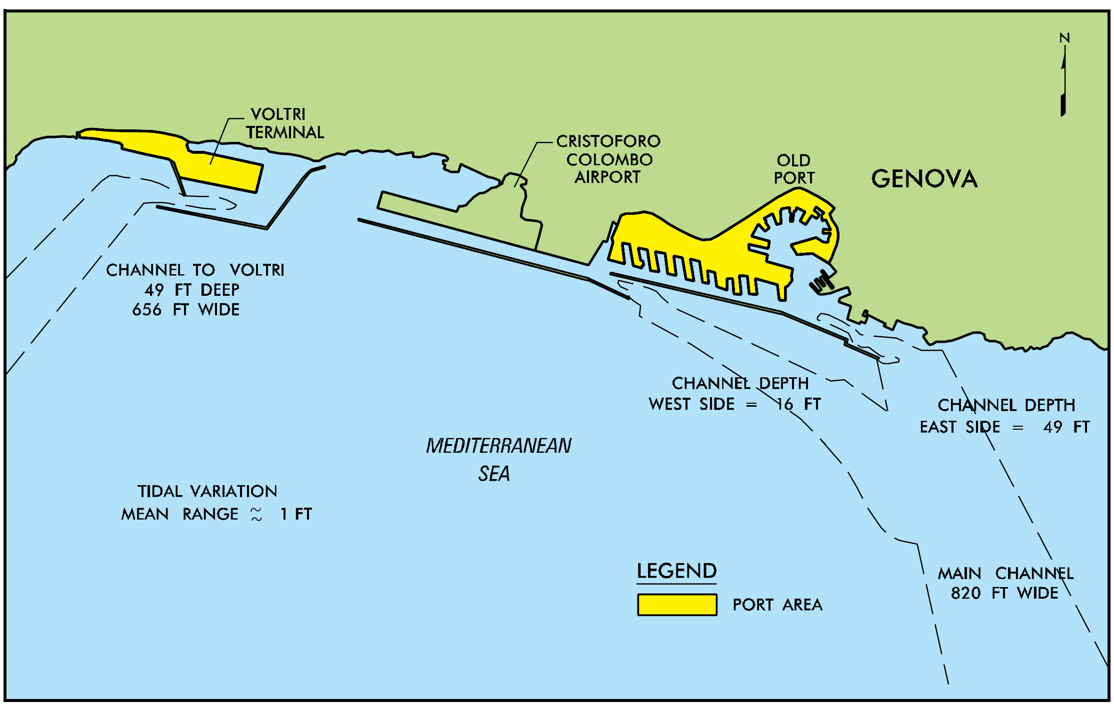
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Genova (44.24° north latitude and 8.54° east longitude) is a major port on the Italian northwest coast along the Mediterranean Sea. The port consists of multicargo piers and wharves and has ample capability to perform a wide variety of cargo operations. The Port of Genova is the largest container port on the Mediterranean and is a major gateway in the trade route to southern Europe. Located in a natural harbor, the port has direct access to the Mediterranean Sea. The main port has two channels (East and West channels) providing an approach to the wharf areas. These channels have water depths of 49 and 16 feet, respectively. The East channel does not have any vertical or overhead clearance restrictions. The West channel, used by smaller vessels, has an overhead clearance restriction to allow for aircraft approaching Cristoforo Colombo Airport. A separate channel provides an approach to the Voltri Terminal. This channel has a depth of 49 feet and has no vertical or overhead restrictions. Deep draft anchorages (70 plus feet) are located near the port and turning basins are adequate inside the port.



Water Access Map

Highway

Genova is situated on a steep slope along the Mediterranean coastline. The city follows the contour of the coast and all roads leading to the port go through the city. Three major autostradas (interstate type highways) intersect at Genova (A7, A10, and A12). Another autostrada (A26) intersects A10 at Voltri. A10 and A12 run along the Mediterranean coastline. A7 and A26 are north/south routes that extend northward from Genova to Milano and Alessandria, respectively. These four major roadways plus the large city of Genova cause heavy traffic congestion going into/out of the port.

Voltri can be accessed from A10. Major roads connecting the main port to the autostrada are Autostrada Genova-Valle del Po, Via A Cantore, Lungomare Minolli Canepa, and Strada Sopraelevata. These routes have no unusual clearance (vertical and lateral) or weight restrictions.

Air

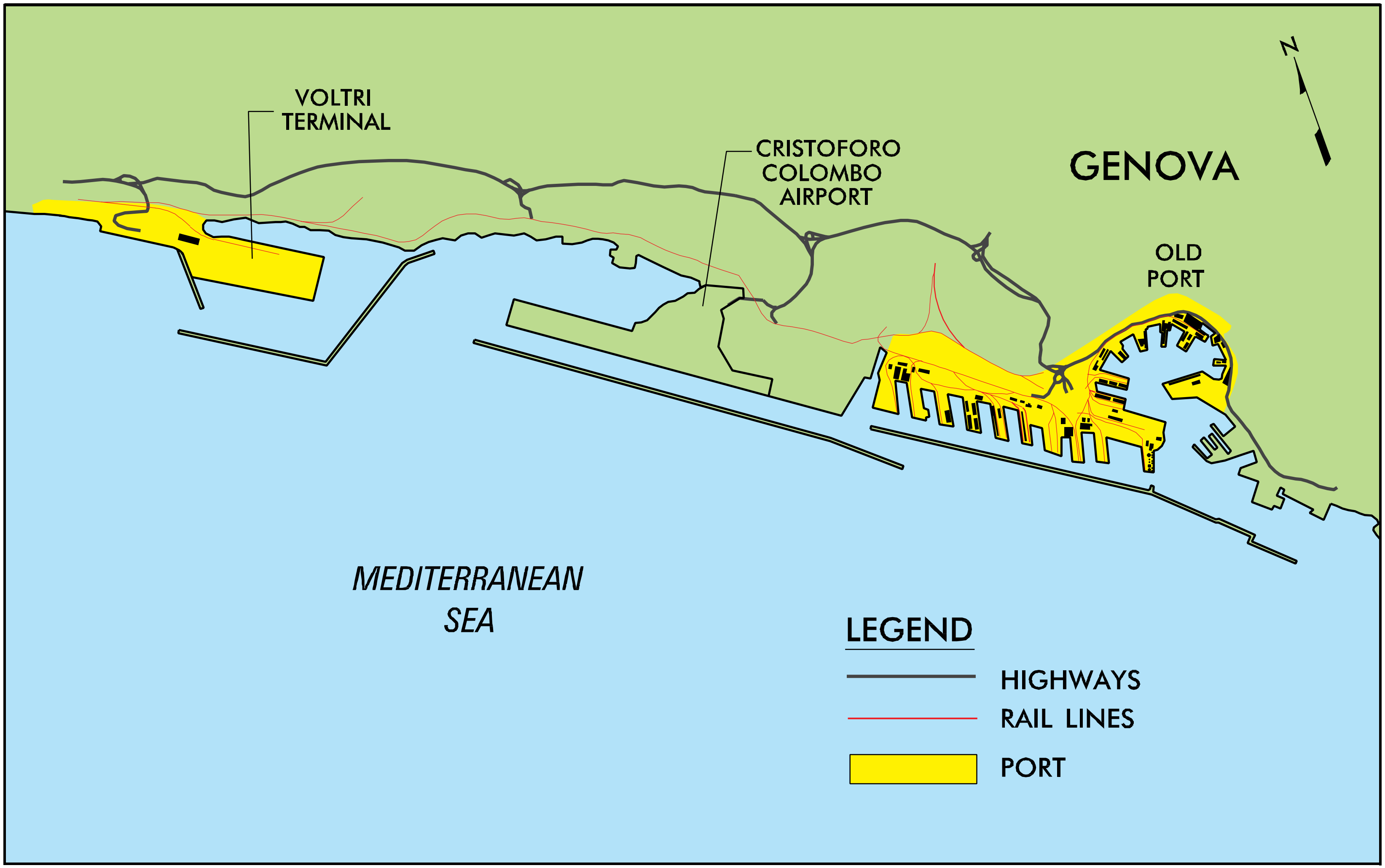
Cristoforo Colombo Airport, a commercial international airport, is directly between the main port area and the Voltri Terminal. It has two runways with a length of 3,050 meters (10,000 feet).

Location of Cristoforo Colombo Airport

Rail

The Port of Genova has access to major rail lines. One major rail line runs along the Mediterranean coastline passing through Genova. Another major rail line extends north from Genova and branches toward the cities of Alessandria and Milano. Rail spurs extend from the main lines into the port. No unusual clearance restrictions exist on the rail lines accessing the port. The Planning Board for European Inland Surface Transport Rail Circulation Maps - Envelope A and B shows rail cargo must meet envelope A (defined in Standardization Agreement (STANAG) 2832) to ensure unrestricted rail transport to the port. Rail activity at the port ranges from moderate to heavy.

Transportation Access Map of Port of Genova



Vicinity Map of Port of Genova

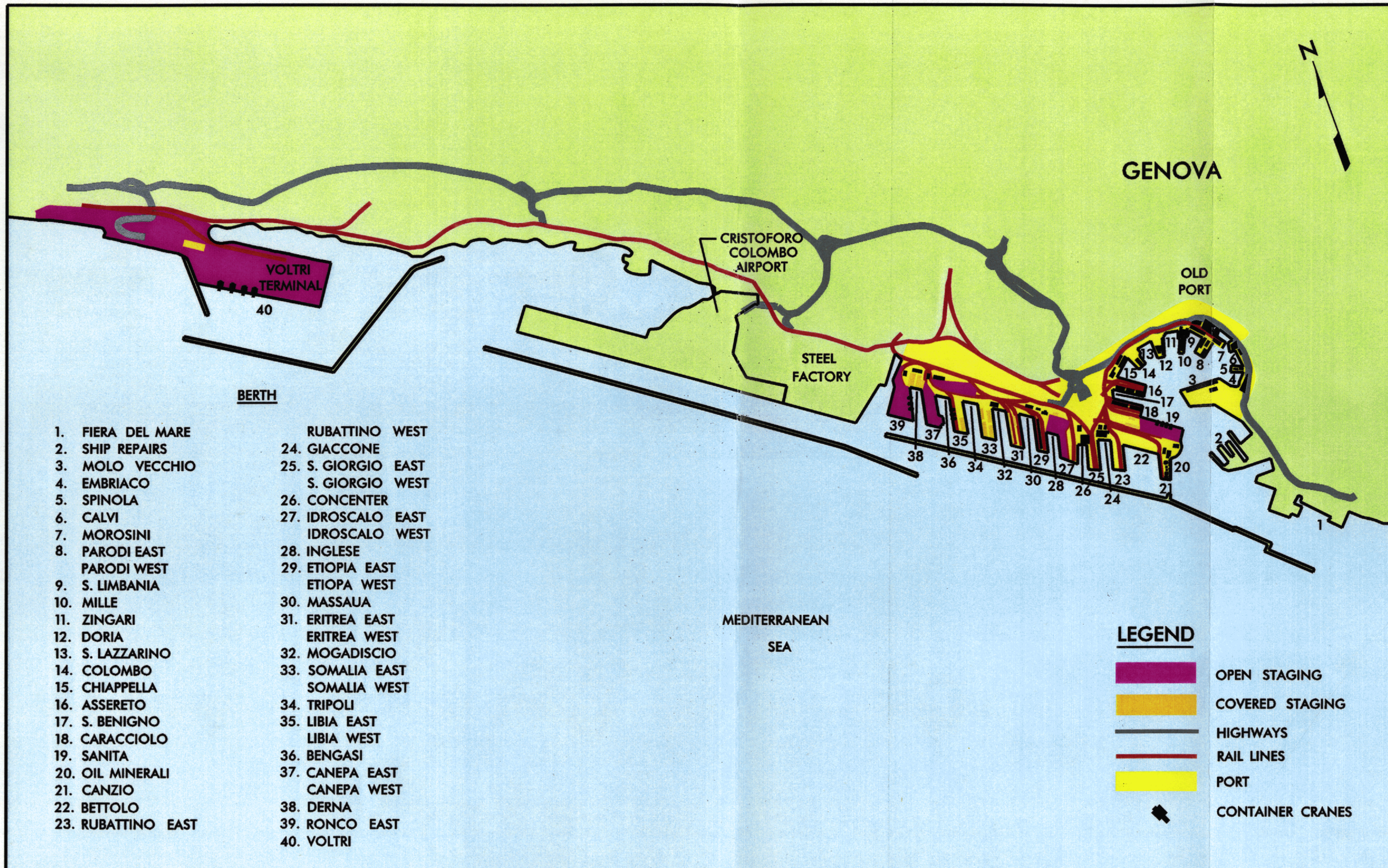
PORT FACILITIES

Berthing

Genova is a major multicargo port capable of a wide variety of cargo operations. This port is also the largest container port on the Mediterranean Sea. The Voltri Terminal appears to be the terminal with the most potential for military operations. It is the newest terminal in the port and is primarily designed for intermodal operations. This terminal has a deep water draft, rail access, and has the best highway access of all the terminals. It also has the largest staging area of all terminals (98.8 acres). Other piers and wharves of note are the Calata Alla Sanita Container Terminal, Ponte Ronco, Ponte Canepa, and the Genova Terminal. The Genova Terminal (Ponte Eritrea) is the terminal most likely to be offered for military operations.

In addition to the piers and wharves previously mentioned, other terminals are available. However, many of these are specific-use terminals not readily adaptable to military operations such as bulk terminals that handle raw natural resources. Due to current use, some piers may not be readily available in a contingency. For example, the Ponte de Mille, Calata Zingari, Ponte Doria, Calata S. Lazzarino, Ponte Colombo, Calata Chiapella, Ponte Assereto, Calata S. Benigno, and Ponte Caracciolo piers are RORO piers specifically used for commercial ferry, cruise, and RORO operations. These piers are generally not available during the summer season. Light vehicles may use these piers in RORO operations during other seasons. Berth depths throughout the port vary from 19-49 feet. Lighting exists throughout the port.

Commercial Ferry and Cruise Operations of Port of Genova



Port of Genova - Land-use Map

PORT OF GENOVA

BERTH CHARACTERISTICS

	Berths					
CHARACTERISTICS	**40 Voltri**	**39 Ronco East**	**38 Derna**	**37 Canepa West**	**36 Bengasi**	**35 Libia West**
Length (ft)	4,592	1,344	524	1,180	528	1,315
Depth alongside at MLW (ft)	49	36	29	32	29	32
Deck Strength (psf)	800	600	600	600	600	600
Apron width (ft)	Open	Open	82	Open	Open	Open
Apron height above MLW (ft)	10	10	10	10	10	10
Number of container cranes	4	3	0	0	0	3
Number of wharf cranes	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	Yes	No	Yes	No
Apron length served by rail (ft)	0	1,344	0	1,180	0	1,315

Voltri Terminal of Port of Genova

Piers at Port of Genova

PORT OF GENOVA

BERTH CHARACTERISTICS - cont

	Berths						
CHARACTERISTICS	**35 Libia East**	**34 Tripoli**	**33 Somalia West**	**33 Somalia East**	**32 Mogadiscio**	**31 Eritrea West**	**31 Eritrea East**
Length (ft)	1,295	528	1,315	1,279	514	1,305	1,295
Depth alongside at MLW (ft)	29	19	29	29	36	32	29
Deck Strength (psf)	600	600	600	600	600	600	600
Apron width (ft)	Open	Open	Open	Open	Open	33	Open
Apron height above MLW (ft)	10	10	10	10	10	10	10
Number of container cranes	0	0	0	0	0	0	0
Number of wharf cranes	4	0	6	7	0	4	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	Yes	No	No	Yes	No	No
Apron length served by rail (ft)	1,295	528	657	639	0	0	1,295

Piers at Port of Genova

PORT OF GENOVA

BERTH CHARACTERISTICS - cont

	Berths						
CHARACTERISTICS	**30 Massaua**	**29 Etiopia West**	**29 Etiopia East**	**28 Inglese**	**25 S. Giorgio East**	**22 Bettolo**	**19 Sanita**
Length (ft)	514	1,308	803	524	1,279	1,397	1,705
Depth alongside at MLW (ft)	26	29	19	19	32	29	45
Deck Strength (psf)	600	600	600	600	600	600	600
Apron width (ft)	Open	82	Open	Open	Open	Open	Open
Apron height above MLW (ft)	10	10	10	10	10	10	10
Number of container cranes	0	0	0	0	0	0	4
Number of wharf cranes	0	4	0	0	2	3	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	No	No	Yes	No	Yes	Yes
Apron length served by rail (ft)	0	1,308	0	0	1,279	0	0

Etiopia East

S. Giorgio East

Sanita Container Terminal (on left) and Bettolo (on right)

PORT OF GENOVA

BERTH CHARACTERISTICS - cont

Berths							
CHARACTERISTICS	**18 Caracciolo Berth 1**	**18 Caracciolo Berth 2**	**16 Assereto Berth 1**	**16 Assereto Berth 2**	**16 Assereto Berth 3**	**16 Assereto Berth 4**	**16 Assereto Berth 5**
Length (ft)	485	728	1,189	164	287	287	164
Depth alongside at MLW (ft)	19	19	19	19	19	19	19
Deck Strength (psf)	600	600	600	600	600	600	600
Apron width (ft)	35	35	40	40	60	60	Open
Apron height above MLW (ft)	10	10	10	10	10	10	10
Number of container cranes	0	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	No	No	Yes	No	No	Yes
Apron length served by rail (ft)	0	728	0	0	0	0	0

Berths							
CHARACTERISTICS	**16 Assereto Berth 6**	**15 Chiapella**	**14 Colombo Berth 1**	**14 Colombo Berth 2**	**14 Colombo Berth 3**	**14 Colombo Berth 4**	**13 S. Lazzarino**
Length (ft)	1,148	803	574	369	328	369	369
Depth alongside at MLW (ft)	19	26	19	19	19	19	19
Deck Strength (psf)	600	600	600	600	600	600	600
Apron width (ft)	Open	Open	Open	41	41	30	Open
Apron height above MLW (ft)	10	10	10	10	10	10	10
Number of container cranes	0	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	Yes	No	Yes	Yes	Yes	Yes
Apron length served by rail (ft)	1,148	0	0	0	0	0	0

PORT OF GENOVA

BERTH CHARACTERISTICS - cont

Berths						
CHARACTERISTICS	**12 Doria West**	**12 Doria East**	**10 Ponte dei Mille 1**	**10 Ponte dei Mille 2**	**10 Ponte dei Mille 3**	**8 Parodi East**
Length (ft)	764	780	328	410	533	557
Depth alongside at MLW (ft)	26	26	22	22	22	22
Deck Strength (psf)	600	600	600	600	600	600
Apron width (ft)	Open	30	30	Open	Open	40
Apron height above MLW (ft)	10	10	10	10	10	10
Number of container cranes	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	Yes	No	No	No	No
Apron length served by rail (ft)	0	0	0	0	0	0

Cruise and Ferry Terminals

PORT OF GENOVA

THROUGHPUT SUMMARY PER DAY

BERTH	LENGTH (feet)	DEPTH ALONGSIDE (feet)	BREAKBULK THROUGHPUT (STON)	RORO THROUGHPUT (STON)	RORO SQUARE FT (EST)	RORO PIECES[1]	CONTAINER THROUGHPUT (STON)	CONTAINER THROUGHPUT (TEU)	MIXED THROUGHPUT (STON)
40 Voltri	4,592	49	4,600	31,000	619,320	3,644	9,750	1,219	24,350
39 Ronco East	1,344	36	1,350	8,250	165,160	972	7,300	914	6,650
38 Derna	524	29	600	2,050	41,280	243	0	0	1,750
37 Canepa West	1,180	32	1,200	6,200	123,860	729	0	0	5,000
36 Bengasi	528	29	600	2,050	41,280	243	0	0	1,750
35 Libia West	1,315	32	1,350	8,250	165,160	972	7,300	914	6,650
35 Libia East	1,295	29	1,300	8,250	165,160	972	3,700	464	6,550
34 Tripoli	528	19	0	2,050	41,280	243	0	0	2,050
33 Somalia West	1,315	29	1,350	8,250	165,160	972	5,550	697	6,600
33 Somalia East	1,279	29	1,400	8,250	165,160	972	6,500	813	6,650
32 Mogadiscio	514	36	600	2,050	41,280	243	0	0	1,750
31 Eritrea West	1,305	32	1,500	0	0	0	3,700	464	1,750
31 Eritrea East	1,295	29	1,200	8,250	165,160	972	0	0	6,600
30 Massaua	514	26	0	2,050	41,280	243	0	0	2,050
29 Etiopia West	1,308	29	1,300	8,250	165,160	972	3,700	464	6,550
29 Etiopia East	803	19	0	4,150	82,580	486	0	0	4,150
28 Inglese	524	19	0	2,050	41,280	243	0	0	2,050
25 S. Giorgio East	1,279	32	1,400	8,250	165,160	972	1,850	232	6,500
22 Bettolo	1,397	29	1,250	6,200	123,860	729	2,800	348	5,000
19 Sanita	1,705	45	1,750	8,250	165,160	972	9,750	1,219	6,800
18 Caracciolo 1	485	19	0	2,050	41,280	243	0	0	2,050
18 Caracciolo 2	728	19	0	4,150	82,600	486	0	0	4,150

[1]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

PORT OF GENOVA

THROUGHPUT SUMMARY PER DAY - cont

BERTH	LENGTH (feet)	DEPTH ALONGSIDE (feet)	BREAKBULK THROUGHPUT (STON)	RORO THROUGHPUT (STON)	RORO SQUARE FT (EST)	RORO PIECES[1]	CONTAINER THROUGHPUT (STON)	CONTAINER THROUGHPUT (TEU)	MIXED THROUGHPUT (STON)
16 Assereto Berth 1	1,189	19	0	6,200	123,860	729	0	0	6,200
16 Assereto Berth 3	287	19	0	2,050	41,280	243	0	0	2,050
16 Assereto Berth 4	287	19	0	2,050	41,280	243	0	0	2,050
16 Assereto Berth 6	1,148	19	0	6,200	123,860	729	0	0	6,200
15 Chiapella	803	26	0	2,050	41,280	243	0	0	2,050
14 Colombo Berth 1	574	19	0	2,050	41,280	243	0	0	2,050
12 Doria West	764	26	0	2,050	41,280	243	0	0	2,050
12 Doria East	780	26	0	2,050	41,280	243	0	0	2,050
10 Ponte dei Mille 2	410	22	0	2,050	41,280	243	0	0	2,050
10 Ponte dei Mille 3	533	22	0	2,050	41,280	243	0	0	2,050
8 Parodi East	557	22	0	2,050	41,280	243	0	0	2,050

[1]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

PORT OF GENOVA

SUMMARY OF BERTHING CAPABILITIES

VESSELS		BERTHS									
TYPE	CLASS	40 Voltri	39 Ronco E	38 Derna	37 Can W	36 Beng	35 Lib W	35 Lib E	34 Trip	33 Som W	
BREAKBULK	C3-S-38a	8	2	1	2	1	2	2	a	2	**NOTES:**
	C4-S-58a	7	2	a,c	1	a,c	2	a	a,c	a	a-vessel draft limit
	C4-S-66a	8	2	a,c	a	a,c	a	a	a,c	a	b-inadequate apron width
	C5-S-37e	7	2	a,c	1	a,c	2	a	a,c	a	c-inadequate berth length
SEATRAIN	GA and PR	7	2	c	2	c	2	2	a,c	2	d-no straight stern ramp
BARGE	LASH C8-S-81b	5	1	a,c,f	a,f	a,c,f	a,f	a,f	a,c,f	a,f	e-no container handling equipment
	LASH C9-S-81d	5	a	a,c	a	a,c	a	a	a,c	a	f-anchorage depth OK, berth depth
	LASH Lighter	22	6	2	5	2	6	6	2	6	inadequate
	SEABEE C8-S-82a	5	a	a,c	a	a,c	a	a	a,c	a	g-inadequate channel depth
	SEABEE Barge	22	6	2	5	2	6	6	2	6	h-no shore based ramps
RORO	Jolly Smeraldo	i,j	a	a,c	a	a,c	a	a	a,c	a	i-low tide insufficient ramp clearance
	Isola Delle Perle	7,d	2,d	c,i,j	2,d	c,i,j	2,d	2,d	a,c,i,j	2,d	j-high tide insufficient ramp clearance
	Galini	i,j	i,j	i,j	i,j	i,j	i,j	i,j	a	i,j	k-excessive ramp angle low tide
	Arcade Falcon	i,j	i,j	i,j	i,j	i,j	i,j	i,j	a	i,j	m-excessive ramp angle high tide
	Golfo Dei Fiori	11,d	3,d	1	2,d	1	3,d	3,d	1	3,d	n-parallel ramp operation ONLY
	Ani	i,j	i,j	i,j	i,j	i,j	i,j	i,j	i,j	i,j	o-insufficient apron width for side ramp
	MV Goya	15,d	4,d	i,j	3,d	i,j	4,d	4,d	i,j	4,d	
	Cape I-class	i,j	i,j	a,c	i,j	a,c	i,j	a	a,c	a	
	Cape Victory	6,i	2,i	c	1,i	c	2,i	1,i	a,c	2,i	Ramp clearance and angle based
	COMET	d,i,j	d,i,j	i,j	d,i,j	i,j	d,i,j	d,i,j	a,i,j	d,i,j	on maximum vessel draft
	METEOR	d,i,j	d,i,j	c,i,j	d,i,j	c,i,j	d,i,j	d,i,j	a,c,i,j	d,i,j	
	Cape Gnome	d,i,j	d,i,j	a,c,i,j	a,d	a,c,i,j	a,d	a,d	a,c,i,j	a,d	♦ **May Prevent Operation**
	C7-S-95a	6	1	a,c	a	a,c	a	a	a,c	a	
	Cape Taylor	6	2	c	1	c	1	1	a,c	1	♦ **May Limit Operation**
	Cape Orlando	i,j	i,j	a,c	i,j	a,c	i,j	a	a,c	a	

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PORT OF GENOVA

SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS									
TYPE	**CLASS**	**40 Voltri**	**39 Ronco E**	**38 Derna**	**37 Can W**	**36 Beng**	**35 Lib W**	**35 Lib E**	**34 Trip**	**33 Som W**	**NOTES:**
	MV Ambassador	d	d	c,m	d	c,m	d	d	a,c,m	d	a-vessel draft limit
	Callaghan	6,d	1,d	c	1,d	c	1,d	1,d	a,c	1,d	b-inadequate apron width
	Cape Lambert	i,j	i,j	a,c	i,j	a,c	i,j	a	a,c	a	c-inadequate berth length
	FSS	a	a	a,c	a	a,c	a	a	a,c	a	d-no straight stern ramp
	Cape R	6,d	1,d	a,c	a,d	a,c	a,d	a,d	a,c	a,d	e-no container handling equipment
	Cape E	i,j	i,j	a,c	i,j	a,c	i,j	a	a,c	a	f-anchorage depth OK, berth depth
	Cape D	i,j	i,j	a,c	a	a,c	a	a	a,c	a	inadequate
	Cape H	5	1	a,c	a	a,c	a	a	a,c	a	g-inadequate channel depth
	Cape Texas	i,j	i,j	c	i,j	c	i,j	i,j	a,c	i,j	h-no shore based ramps
CONTAINER	C6-M-147a	6	1	c,e	1,e	c,e	1	1,e	a,c,e	1,e	i-low tide insufficient ramp clearance
	C7-S-69c	6	1	a,c,e	1,e	a,c,e	1	a,e	a,c,e	a,e	j-high tide insufficient ramp clearance
	C7-S-68c	6	1	a,c,e	1,e	a,c,e	1	a,e	a,c,e	a,e	k-excessive ramp angle low tide
	C8-S-85c	5	1	a,c,e	a,e	a,c,e	a	a,e	a,c,e	a,e	m-excessive ramp angle high tide
	C9-M-132b	5	1	a,c,e	a,e	a,c,e	a	a,e	a,c,e	a,e	n-parallel ramp operation ONLY
	C9-M-F141a	a	a	a,c,e	a,e	a,c,e	a	a,e	a,c,e	a,e	o-insufficient apron width for side ramp
AUXILIARY CRANE	C6-S-1qd	6	1	a,c	a	a,c	a	a	a,c	a	Ramp clearance and angle based on maximum vessel draft
	C5-S-MA73c	7	2	a,c	1	a,c	2	a	a,c	a	
	C6-S-MA60d	6	1	a,c	1	a,c	1	a	a,c	a	
MPS	C7-S-133a	5	1	a,c	a	a,c	a	a	a,c	a	♦ **May Prevent Operation**
	Maersk	5	1	a,c	a	a,c	a	a	a,c	a	
	AmSea	6	1	a,c	1	a,c	1	a	a,c	a	♦ **May Limit Operation**

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PORT OF GENOVA
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS									
TYPE	CLASS	33 Som E	32 Moga	31 Eri W	31 Eri E	30 Mass	29 Eti W	29 Eti E	28 Ing	25 S. Gio E	
BREAKBULK	C3-S-38a	2	1	2	2	a	2	a	a	2	**NOTES:**
	C4-S-58a	a	c	2	a	a,c	a	a	a,c	2	a-vessel draft limit
	C4-S-66a	a	c	a	a	a,c	a	a	a,c	a	b-inadequate apron width
	C5-S-37e	a	c	2	a	a,c	a	a	a,c	2	c-inadequate berth length
SEATRAIN	GA and PR	2	c	2	2	a,c	2	a	a,c	2	d-no straight stern ramp
BARGE	LASH C8-S-81b	a,f	c	a,f	a,f	a,c,f	a,f	a,c,f	a,c,f	a,f	e-no container handling equipment
	LASH C9-S-81d	a	a,c	a	a	a,c	a	a,c	a,c	a	f-anchorage depth OK, berth depth
	LASH Lighter	6	2	6	6	2	6	4	2	6	inadequate
	SEABEE C8-S-82a	a	a,c	a	a	a,c	a	a,c	a,c	a	g-inadequate channel depth
	SEABEE Barge	6	2	6	6	2	6	4	2	6	h-no shore based ramps
RORO	Jolly Smeraldo	a	a,c	a,b	a	a,c	a	a	a,c	a	i-low tide insufficient ramp clearance
	Isola Delle Perle	2,d	c,i,j	d,o	2,d	c,i,j	2,d	a,d	a,c,i,j	2,d	j-high tide insufficient ramp clearance
	Galini	i,j	i,j	i,j	i,j	i,j	i,j	a	a	i,j	k-excessive ramp angle low tide
	Arcade Falcon	i,j	i,j	i,j	i,j	i,j	i,j	a	a	i,j	m-excessive ramp angle high tide
	Golfo Dei Fiori	3,d	1	d,o	3,d	1	3,d	1,d	1	3,d	n-parallel ramp operation ONLY
	Ani	i,j	i,j	i,j	i,j	i,j	i,j	i,j	i,j	i,j	o-insufficient apron width for side ramp
	MV Goya	4,d	i,j	d,o	4,d	i,j	4,d	2,d	i,j	4,d	
	Cape I-class	a	c	b	a	a,c	a	a	a,c	i,j	
	Cape Victory	1,i	c	b	1,i	a,c	1,i	a	a,c	1,i	Ramp clearance and angle based
	COMET	d,i,j	i,j	d,o	d,i,j	a,i,j	d,i,j	a,d	a,i,j	d,i,j	on maximum vessel draft
	METEOR	d,i,j	c,i,j	d,o	d,i,j	a,c,i,j	d,i,j	a,d	a,c,i,j	d,i,j	
	Cape Gnome	a,d	c,i,j	a,d,o	a,d	a,c,i,j	a,d	a,d	a,c,i,j	a,d	♦ **May Prevent Operation**
	C7-S-95a	a	c	a,b	a	a,c	a	a	a,c	a	
	Cape Taylor	1	c	b	1	a,c	1	a	a,c	1	♦ **May Limit Operation**
	Cape Orlando	a	c	b	a	a,c	a	a	a,c	i,j	

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PORT OF GENOVA
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS									
TYPE	**CLASS**	**33 Som E**	**32 Moga**	**31 Eri W**	**31 Eri E**	**30 Mass**	**29 Eti W**	**29 Eti E**	**28 Ing**	**25 S. Gio E**	**NOTES:**
	MV Ambassador	d	c,m	d	d	c,m	d	a,d	a,c,m	d	a-vessel draft limit
	Callaghan	1,d	c	d,o	1,d	a,c	d,o	a,d	a,c	1,d	b-inadequate apron width
	Cape Lambert	a	c	b	a	a,c	a	a	a,c	i,j	c-inadequate berth length
	FSS	a	a,c	a,b	a	a,c	a	a,c	a,c	a	d-no straight stern ramp
	Cape R	a,d	c	a,b,d,o	a,d	a,c	a,d	a,d	a,c	a,d	e-no container handling equipment
	Cape E	a	c	b	a	a,c	a	a	a,c	i,j	f-anchorage depth OK, berth depth
	Cape D	a	c	a,b	a	a,c	a	a	a,c	a	inadequate
	Cape H	a	c	a,b	a	a,c	a	a	a,c	a	g-inadequate channel depth
	Cape Texas	i,j	c	b	i,j	a,c	i,j	a	a,c	i,j	h-no shore based ramps
CONTAINER	C6-M-147a	1,e	c,e	b,e	1,e	c,e	1,e	a,e	a,c,e	1,e	i-low tide insufficient ramp clearance
	C7-S-69c	a,e	c,e	b,e	a,e	a,c,e	a,e	a,e	a,c,e	1,e	j-high tide insufficient ramp clearance
	C7-S-68c	a,e	c,e	b,e	a,e	a,c,e	a,e	a,e	a,c,e	1,e	k-excessive ramp angle low tide
	C8-S-85c	a,e	c,e	a,b,e	a,e	a,c,e	a,e	a,c,e	a,c,e	a,e	m-excessive ramp angle high tide
	C9-M-132b	a,e	c,e	a,b,e	a,e	a,c,e	a,e	a,c,e	a,c,e	a,e	n-parallel ramp operation ONLY
	C9-M-F141a	a,e	a,c,e	a,b,e	a,e	a,c,e	a,e	a,c,e	a,c,e	a,e	o-insufficient apron width for side ramp
AUXILIARY CRANE	C6-S-1qd	a	c	a,b	a	a,c	a	a	a,c	a	Ramp clearance and angle based on maximum vessel draft
	C5-S-MA73c	a	c	b	a	a,c	a	a	a,c	2	
	C6-S-MA60d	a	c	b	a	a,c	a	a	a,c	1	
MPS	C7-S-133a	a	c	a,b	a	a,c	a	a,c	a,c	a	♦ **May Prevent Operation**
	Maersk	a	c	a,b	a	a,c	a	a	a,c	a	
	AmSea	a	c	b	a	a,c	a	a	a,c	1	♦ **May Limit Operation**

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PORT OF GENOVA

SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		**BERTHS**									
TYPE	**CLASS**	**22 Bett**	**19 Sani**	**18 Cara 1**	**18 Cara 2**	**16 Asse 1**	**16 Asse 2**	**16 Asse 3**	**16 Asse 4**	**16 Asse 5**	
BREAKBULK	C3-S-38a	2	3	a,c	a	a	a,c	a,c	a,c	a,c	**NOTES:**
	C4-S-58a	a	2	a,c	a	a	a,c	a,c	a,c	a,c	a-vessel draft limit
	C4-S-66a	a	3	a,c	a	a	a,c	a,c	a,c	a,c	b-inadequate apron width
	C5-S-37e	a	2	a,c	a	a	a,c	a,c	a,c	a,c	c-inadequate berth length
SEATRAIN	GA and PR	2	2	a,c	a	a	a,c	a,c	a,c	a,c	d-no straight stern ramp
BARGE	LASH C8-S-81b	a,f	2	a,c,f	a,c,f	a,f	a,c,f	a,c,f	a,c,f	a,c,f	e-no container handling equipment
	LASH C9-S-81d	a	1	a,c	a,c	a	a,c	a,c	a,c	a,c	f-anchorage depth OK, berth depth
	LASH Lighter	6	8	2	3	5	c	1	1	c	inadequate
	SEABEE C8-S-82a	a	1	a,c	a,c	a	a,c	a,c	a,c	a,c	g-inadequate channel depth
	SEABEE Barge	6	8	2	3	5	c	1	1	c	h-no shore based ramps
RORO	Jolly Smeraldo	a	i,j	a,b,c	a,b	a,b	a,b,c	a,c	a,c	a,c	i-low tide insufficient ramp clearance
	Isola Delle Perle	i,j	i,j	a,c,i,j	a,d	a,d	a,c,i,j	a,c,d	a,c,d	a,c,i,j	j-high tide insufficient ramp clearance
	Galini	i,j	i,j	a	a	a	a,c	a,c	a,c	a,c	k-excessive ramp angle low tide
	Arcade Falcon	i,j	i,j	a	a	a	a,c	a,c	a,c	a,c	m-excessive ramp angle high tide
	Golfo Dei Fiori	3	4	1	1,d	2,d	c	c,d	c,d	c	n-parallel ramp operation ONLY
	Ani	i,j	i,j	i,j	i,j	i,j	c	c	c	c	o-insufficient apron width for side ramp
	MV Goya	i,j	i,j	i,j	2,d	3,d	c,i,j	1,d	1,d	c,i,j	
	Cape I-class	a	i,j	a,b,c	a,b	a,b	a,b,c	a,c	a,c	a,c	
	Cape Victory	2,i	2,i	a,b,c	a,b	a,b	a,b,c	a,c	a,c	a,c	Ramp clearance and angle based
	COMET	i,j	i,j	a,c,i,j	a,d,o	a,d,o	a,c,i,j	a,c,d,o	a,c,d,o	a,c,i,j	on maximum vessel draft
	METEOR	i,j	i,j	a,c,i,j	a,d,o	a,d,o	a,c,i,j	a,c,d,o	a,c,d,o	a,c,i,j	
	Cape Gnome	a,i,j	i,j	a,c,i,j	a,d,o	a,d,o	a,c,i,j	a,c,d,o	a,c,d,o	a,c,i,j	♦ **May Prevent Operation**
	C7-S-95a	a	2	a,b,c	a,b,c	a,b	a,b,c	a,c	a,c	a,c	
	Cape Taylor	2	2	a,b,c	a,b	a,b	a,b,c	a,c	a,c	a,c	♦ **May Limit Operation**
	Cape Orlando	a	i,j	a,b,c	a,b	a,b	a,b,c	a,c	a,c	a,c	

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PORT OF GENOVA

SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS									
TYPE	**CLASS**	**22 Bett**	**19 Sani**	**18 Cara 1**	**18 Cara 2**	**16 Asse 1**	**16 Asse 2**	**16 Asse 3**	**16 Asse 4**	**16 Asse 5**	**NOTES:**
	MV Ambassador	2,m	3,m	a,c,m	a,d	a,d	a,c,m	a,c,d	a,c,d	a,c,m	a-vessel draft limit
	Callaghan	1	2	a,c	a,d,o	a,d,o	a,c	a,c,d,o	a,c,d,o	a,c	b-inadequate apron width
	Cape Lambert	a	i,j	a,b,c	a,b	a,b	a,b,c	a,c	a,c	a,c	c-inadequate berth length
	FSS	a	a	a,b,c	a,b,c	a,b	a,b,c	a,c	a,c	a,c	d-no straight stern ramp
	Cape R	a	2	a,b,c	a,b,d,o	a,b,d,o	a,b,c	a,c,d	a,c,d	a,c	e-no container handling equipment
	Cape E	a	i,j	a,b,c	a,b	a,b	a,b,c	a,c	a,c	a,c	f-anchorage depth OK, berth depth
	Cape D	a	i,j	a,b,c	a,b	a,b	a,b,c	a,c	a,c	a,c	inadequate
	Cape H	a	2	a,b,c	a,b,c	a,b	a,b,c	a,c	a,c	a,c	g-inadequate channel depth
	Cape Texas	i,j	i,j	a,b,c	a,b	a,b	a,b,c	a,c	a,c	a,c	h-no shore based ramps
CONTAINER	C6-M-147a	2,e	2	a,b,c,e	a,b,e	a,b,e	a,b,c,e	a,c,e	a,c,e	a,c,e	i-low tide insufficient ramp clearance
	C7-S-69c	a,e	2	a,b,c,e	a,b,e	a,b,e	a,b,c,e	a,c,e	a,c,e	a,c,e	j-high tide insufficient ramp clearance
	C7-S-68c	a,e	2	a,b,c,e	a,b,e	a,b,e	a,b,c,e	a,c,e	a,c,e	a,c,e	k-excessive ramp angle low tide
	C8-S-85c	a,e	1	a,b,c,e	a,b,c,e	a,b,e	a,b,c,e	a,c,e	a,c,e	a,c,e	m-excessive ramp angle high tide
	C9-M-132b	a,e	1	a,b,c,e	a,b,c,e	a,b,e	a,b,c,e	a,c,e	a,c,e	a,c,e	n-parallel ramp operation ONLY
	C9-M-F141a	a,e	a	a,b,c,e	a,b,c,e	a,b,e	a,b,c,e	a,c,e	a,c,e	a,c,e	o-insufficient apron width for side ramp
AUXILIARY CRANE	C6-S-1qd	a	2	a,b,c	a,b	a,b	a,b,c	a,c	a,c	a,c	Ramp clearance and angle based on maximum vessel draft
	C5-S-MA73c	a	2	a,b,c	a,b	a,b	a,b,c	a,c	a,c	a,c	
	C6-S-MA60d	a	2	a,b,c	a,b	a,b	a,b,c	a,c	a,c	a,c	
MPS	C7-S-133a	a	2	a,b,c	a,b,c	a,b	a,b,c	a,c	a,c	a,c	♦ **May Prevent Operation**
	Maersk	a	2	a,b,c	a,b,c	a,b	a,b,c	a,c	a,c	a,c	
	AmSea	a	2	a,b,c	a,b	a,b	a,b,c	a,c	a,c	a,c	♦ **May Limit Operation**

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PORT OF GENOVA
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS									
TYPE	**CLASS**	**16 Asse 6**	**15 Chia**	**14 Colo 1**	**14 Colo 2**	**14 Colo 3**	**14 Colo 4**	**13 S. Laz**	**12 Dori W**	**12 Dori E**	
BREAKBULK	C3-S-38a	a	a	a	a,c	a,c	a,c	a,c	a	a	**NOTES:**
	C4-S-58a	a	a	a	a,c	a,c	a,c	a,c	a	a	a-vessel draft limit
	C4-S-66a	a	a	a	a,c	a,c	a,c	a,c	a	a	b-inadequate apron width
	C5-S-37e	a	a	a,c	a,c	a,c	a,c	a,c	a	a	c-inadequate berth length
SEATRAIN	GA and PR	a	a	a	a,c	a,c	a,c	a,c	a	a	d-no straight stern ramp
BARGE	LASH C8-S-81b	a,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	e-no container handling equipment
	LASH C9-S-81d	a	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	f-anchorage depth OK, berth depth
	LASH Lighter	5	4	2	1	1	1	1	3	3	inadequate
	SEABEE C8-S-82a	a	a,c	a,c	a,c	a,c	a,c	a,c	a,c	a,c	g-inadequate channel depth
	SEABEE Barge	5	4	2	1	1	1	1	3	3	h-no shore based ramps
RORO	Jolly Smeraldo	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	i-low tide insufficient ramp clearance
	Isola Delle Perle	a,d	i,j	a,d	a,c,i,j	a,c,i,j	a,c,i,j	a,c,i,j	i,j	i,j	j-high tide insufficient ramp clearance
	Galini	a	i,j	a	a,c	a,c	a,c	a,c	i,j	i,j	k-excessive ramp angle low tide
	Arcade Falcon	a	i,j	a	a,c	a,c	a,c	a,c	i,j	i,j	m-excessive ramp angle high tide
	Golfo Dei Fiori	2,d	1	1,d	c	c	c	c	1	1	n-parallel ramp operation ONLY
	Ani	i,j	i,j	i,j	i,j	i,j	i,j	i,j	i,j	i,j	o-insufficient apron width for side ramp
	MV Goya	3,d	i,j	1,d	i,j	i,j	i,j	i,j	i,j	i,j	
	Cape I-class	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	
	Cape Victory	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	Ramp clearance and angle based on maximum vessel draft
	COMET	a,d	a,i,j	a,d	a,c,i,j	a,c,i,j	a,c,i,j	a,c,i,j	a,i,j	a,i,j	
	METEOR	a,d	a,i,j	a,d	a,c,i,j	a,c,i,j	a,c,i,j	a,c,i,j	a,i,j	a,i,j	
	Cape Gnome	a,d	a,i,j	a,c,d	a,c,i,j	a,c,i,j	a,c,i,j	a,c,i,j	a,i,j	a,i,j	♦ **May Prevent Operation**
	C7-S-95a	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	
	Cape Taylor	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	♦ **May Limit Operation**
	Cape Orlando	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF GENOVA

SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS									
TYPE	**CLASS**	**16 Asse 6**	**15 Chia**	**14 Colo 1**	**14 Colo 2**	**14 Colo 3**	**14 Colo 4**	**13 S. Laz**	**12 Dori W**	**12 Dori E**	**NOTES**
	MV Ambassador	a,d	1,m	a,d	a,c,m	a,c,m	a,c,m	a,c,m	1,m	1,m	a-vessel draft limit
	Callaghan	a,d	a	a,c,d	a,c	a,c	a,c	a,c	a	a	b-inadequate apron width
	Cape Lambert	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	c-inadequate berth length
	FSS	a	a,c	a,c	a,b,c	a,b,c	a,b,c	a,c	a,c	a,b,c	d-no straight stern ramp
	Cape R	a,d	a	a,c,d	a,b,c	a,b,c	a,b,c	a,c	a	a,b	e-no container handling equipment
	Cape E	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	f-anchorage depth OK, berth depth
	Cape D	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	inadequate
	Cape H	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	g-inadequate channel depth
	Cape Texas	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	h-no shore based ramps
CONTAINER	C6-M-147a	a,e	1,e	a,c,e	a,b,c,e	a,b,c,e	a,b,c,e	a,c,e	1,e	b,e	i-low tide insufficient ramp clearance
	C7-S-69c	a,e	a,e	a,c,e	a,b,c,e	a,b,c,e	a,b,c,e	a,c,e	a,e	a,b,e	j-high tide insufficient ramp clearance
	C7-S-68c	a,e	a,e	a,c,e	a,b,c,e	a,b,c,e	a,b,c,e	a,c,e	a,e	a,b,e	k-excessive ramp angle low tide
	C8-S-85c	a,e	a,c,e	a,c,e	a,b,c,e	a,b,c,e	a,b,c,e	a,c,e	a,c,e	a,b,c,e	m-excessive ramp angle high tide
	C9-M-132b	a,e	a,c,e	a,c,e	a,b,c,e	a,b,c,e	a,b,c,e	a,c,e	a,c,e	a,b,c,e	n-parallel ramp operation ONLY
	C9-M-F141a	a,e	a,c,e	a,c,e	a,b,c,e	a,b,c,e	a,b,c,e	a,c,e	a,c,e	a,b,c,e	o-insufficient apron width for side ramp
AUXILIARY CRANE	C6-S-1qd	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	Ramp clearance and angle based on maximum vessel draft
	C5-S-MA73c	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	
	C6-S-MA60d	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	
MPS	C7-S-133a	a	a,c	a,c	a,b,c	a,b,c	a,b,c	a,c	a,c	a,b,c	♦ **May Prevent Operation**
	Maersk	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	
	AmSea	a	a	a,c	a,b,c	a,b,c	a,b,c	a,c	a	a,b	♦ **May Limit Operation**

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PORT OF GENOVA

SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS				
TYPE	**CLASS**	**10 PMil 1**	**10 PMil 2**	**10 PMil 3**	**8 Paro E**	
BREAKBULK	C3-S-38a	a,c	a,c	a	a	**NOTES:**
	C4-S-58a	a,c	a,c	a,c	a,c	a-vessel draft limit
	C4-S-66a	a,c	a,c	a,c	a	b-inadequate apron width
	C5-S-37e	a,c	a,c	a,c	a,c	c-inadequate berth length
SEATRAIN	GA and PR	a,c	a,c	a,c	a,c	d-no straight stern ramp
BARGE	LASH C8-S-81b	a,c,f	a,c,f	a,c,f	a,c,f	e-no container handling equipment
	LASH C9-S-81d	a,c	a,c	a,c	a,c	f-anchorage depth OK, berth depth
	LASH Lighter	1	2	2	2	inadequate
	SEABEE C8-S-82a	a,c	a,c	a,c	a,c	g-inadequate channel depth
	SEABEE Barge	1	2	2	2	h-no shore based ramps
RORO	Jolly Smeraldo	a,b,c	a,c	a,c	a,b,c	i-low tide insufficient ramp clearance
	Isola Delle Perle	a,c,d,o	a,c,d	a,c,d	a,d	j-high tide insufficient ramp clearance
	Galini	c	c	i,j	i,j	k-excessive ramp angle low tide
	Arcade Falcon	a,c	a,c	a	a	m-excessive ramp angle high tide
	Golfo Dei Fiori	c,d,o	1,d	1,d	1,d	n-parallel ramp operation ONLY
	Ani	i,j	i,j	i,j	i,j	o-insufficient apron width for side ramp
	MV Goya	d,o	1,d	1,d	1,d	
	Cape I-class	a,b,c	a,c	a,c	a,b,c	
	Cape Victory	a,b,c	a,c	a,c	a,b,c	Ramp clearance and angle based on maximum vessel draft
	COMET	a,c,d,o	a,c,d	a,d	a,d,o	
	METEOR	a,c,d,o	a,c,d	a,c,d	a,d,o	
	Cape Gnome	a,c,d,o	a,c,d	a,c,d	a,c,d,o	♦ **May Prevent Operation**
	C7-S-95a	a,b,c	a,c	a,c	a,b,c	
	Cape Taylor	a,b,c	a,c	a,c	a,b,c	♦ **May Limit Operation**
	Cape Orlando	a,b,c	a,c	a,c	a,b,c	

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF GENOVA

SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS				
TYPE	CLASS	10 PMil 1	10 PMil 2	10 PMil 3	8 Paro E	NOTES
	MV Ambassador	c,d,o	c,d	c,d	d	a-vessel draft limit
	Callaghan	a,c,d,o	a,c,d	a,c,d	a,c,d,o	b-inadequate apron width
	Cape Lambert	a,b,c	a,c	a,c	a,b,c	c-inadequate berth length
	FSS	a,b,c	a,c	a,c	a,b,c	d-no straight stern ramp
	Cape R	a,b,c,d,o	a,c,d	a,c,d	a,b,c,d,o	e-no container handling equipment
	Cape E	a,b,c	a,c	a,c	a,b,c	f-anchorage depth OK, berth depth
	Cape D	a,b,c	a,c	a,c	a,b,c	inadequate
	Cape H	a,b,c	a,c	a,c	a,b,c	g-inadequate channel depth
	Cape Texas	a,b,c	a,c	a,c	a,b,c	h-no shore based ramps
CONTAINER	C6-M-147a	a,b,c,e	a,c,e	a,c,e	a,b,c,e	i-low tide insufficient ramp clearance
	C7-S-69c	a,b,c,e	a,c,e	a,c,e	a,b,c,e	j-high tide insufficient ramp clearance
	C7-S-68c	a,b,c,e	a,c,e	a,c,e	a,b,c,e	k-excessive ramp angle low tide
	C8-S-85c	a,b,c,e	a,c,e	a,c,e	a,b,c,e	m-excessive ramp angle high tide
	C9-M-132b	a,b,c,e	a,c,e	a,c,e	a,b,c,e	n-parallel ramp operation ONLY
	C9-M-F141a	a,b,c,e	a,c,e	a,c,e	a,b,c,e	o-insufficient apron width for side ramp
AUXILIARY CRANE	C6-S-1qd	a,b,c	a,c	a,c	a,b,c	Ramp clearance and angle based on maximum vessel draft
	C5-S-MA73c	a,b,c	a,c	a,c	a,b,c	
	C6-S-MA60d	a,b,c	a,c	a,c	a,b,c	
MPS	C7-S-133a	a,b,c	a,c	a,c	a,b,c	♦ **May Prevent Operation**
	Maersk	a,b,c	a,c	a,c	a,b,c	
	AmSea	a,b,c	a,c	a,c	a,b,c	♦ **May Limit Operation**

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STAGING

Open Staging

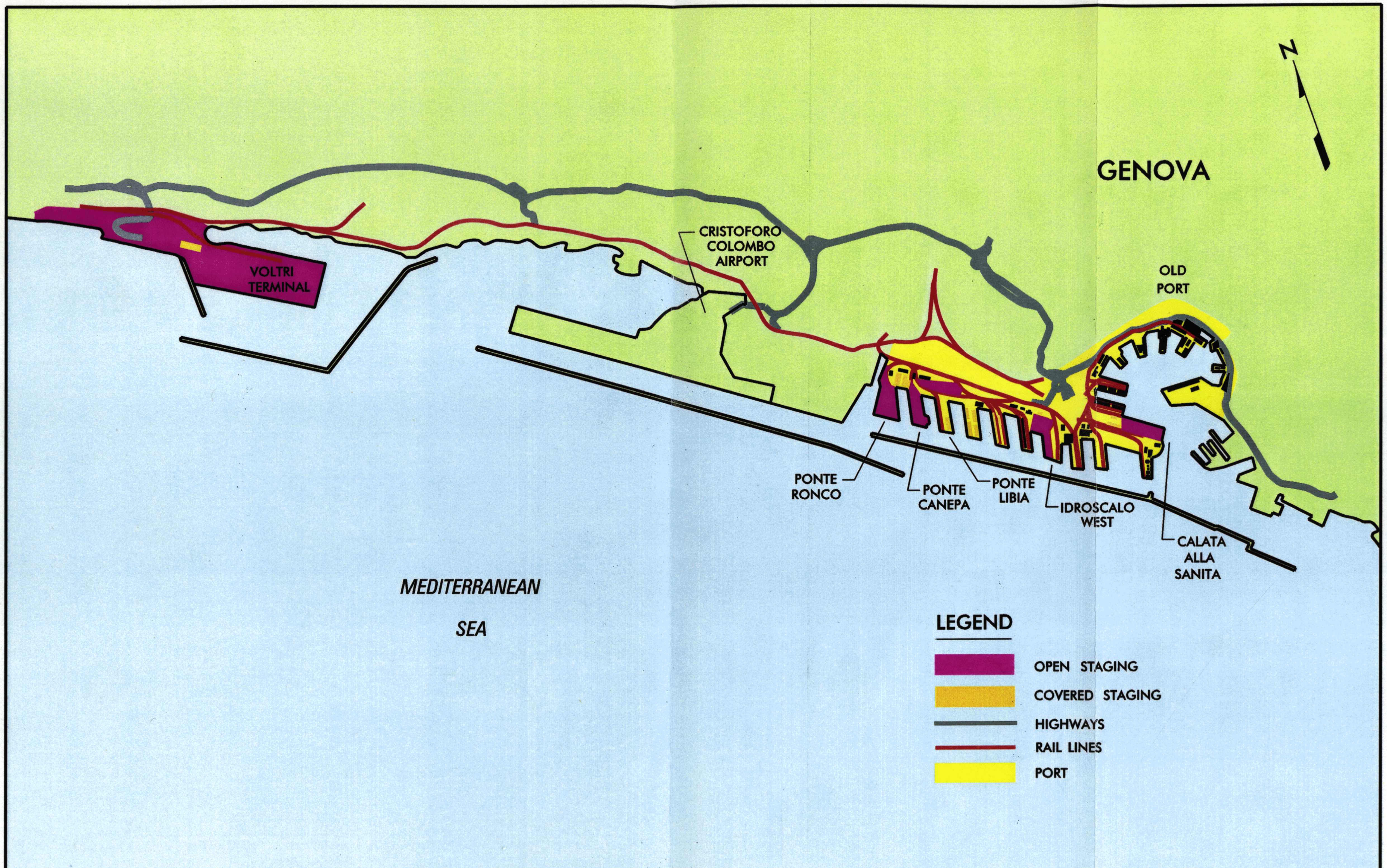
The Port of Genova has about 205 acres of open storage available at the deployment-useful wharves. Almost half of this amount is at the Voltri Terminal (98.8 acres). Other areas with significant available open staging are Ponte Ronco, Ponte Canepa, Ponte Libia, and Calata Alla Sanita Container Terminal. Other open staging is available in other terminals if needed. The Port of Genova is completely privatized, renting out to private operators. Deploying units must negotiate with the terminal operators to obtain use of this open storage. In general, many of the terminals have limited or no open staging available (particularly true in the old port area). Also, open staging areas at berths handling bulk materials can be taken up by raw natural resources such as coal.

The port authority states that small helicopters can land on the area at the end of the Ponte de Mille pier. This option could be used in emergencies. Another option for helicopter operations is Cristoforo Colombo Airport.

Covered Staging

The Port of Genova has 1,216,870 square feet available at the deployment-useful wharves. Other covered staging is available in other terminals if needed. Since the Port of Genova is privatized, deploying units must negotiate with the terminal operators to obtain use of this covered storage.

Helicopter Landing Area, Ponte dei Mille (Port of Genova)



Open and Covered Storage

Rail

Rail lines extend from the main lines in Genova to the port. Of the berths analyzed, apron tracks are on Ponte Assereto, Ponte Caracciolo, Ponte S. Giorgio East, Ponte Etiopia West, Ponte Eritrea East, Ponte Somalia East and West, Calata Tripoli, Ponte Libia East and West, Ponte Canepa West, and Ponte Ronco East. Three spurs are on Ponte Ronco. Double tracks are on the Genova Terminal, Canepa West, Ponte Libia and Ponte Somalia. A rail storage yard is in the Voltri Terminal and is mainly used for intermodal operations. This railyard can hold more than 160 railcars. Another intermodal railyard is in the Calata Alla Sanita Container Terminal. It can hold approximately 180 railcars.

Highway

Roads leading to the port are four-laned (two lanes for each direction). Major roads connecting the main port to the autostrada are Autostrada Genova-Valle del Po, Via A Cantore, Lungomare Minolli Canepa, and Strada Sopraelevata. Five gates allow access into the port. They are located at Voltri Terminal, near Ponte Ronco, near Genova Terminal, near Calata Alla Sanita Container Terminal, and near Ponte Assereto. There are no unusual height or weight restrictions leading into the port from the main road networks. Truck scales are available near the Ponte Ronco, Calata Giaccone, and Oil Minerali piers.

Gate to Calata Alla Sanita Container Terminal at Port of Genova

UNLOADING/LOADING POSITIONS

Ramps

The Port of Genova has portable rail end ramps at the Voltri railyard and Genova Terminal. Other portable ramps (some lightweight) are also available through the various terminal operators.

End Ramp and Rail Storage Yard, Voltri Terminal

Rail End Ramp, Genova Terminal

Docks

No docks exist for truck or boxcar loading/offloading.

MARSHALING AREAS

A private secure open storage area exists about 12 miles north of the port. Other than this area, no other known storage areas exist outside the port. The open storage areas at the Voltri Terminal, Ponte Ronco, Ponte Canepa, and Ponte Libia could be used for marshaling if needed.

MATERIAL HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity (STON)	Quantity	Wharf Assignment
Container Cranes	50	4	Voltri
Container Cranes	35	4	Sanita
Container Cranes	35	3	Ronco East
Container Cranes	35	3	Libia West
Transtainers	45	2	Voltri
Transtainers	35	7	Sanita
Transtainers	35	8	Ponte Ronco
Transtainers	35	2	Libia West
Wharf Cranes	--	3	Bettolo
Wharf Cranes	--	2	S. Giorgio East
Wharf Cranes	--	4	Etiopia West
Wharf Cranes	--	4	Eritrea West
Wharf Cranes	--	13	Ponte Somalia
Wharf Cranes	--	4	Libia East
Straddle Carriers	--	22	Libia East
Mobile Cranes	Up to 63 tons	more than 300	--
Semi-mobile Cranes	Up to 45 tons	80	--
Forklifts	various	350	--

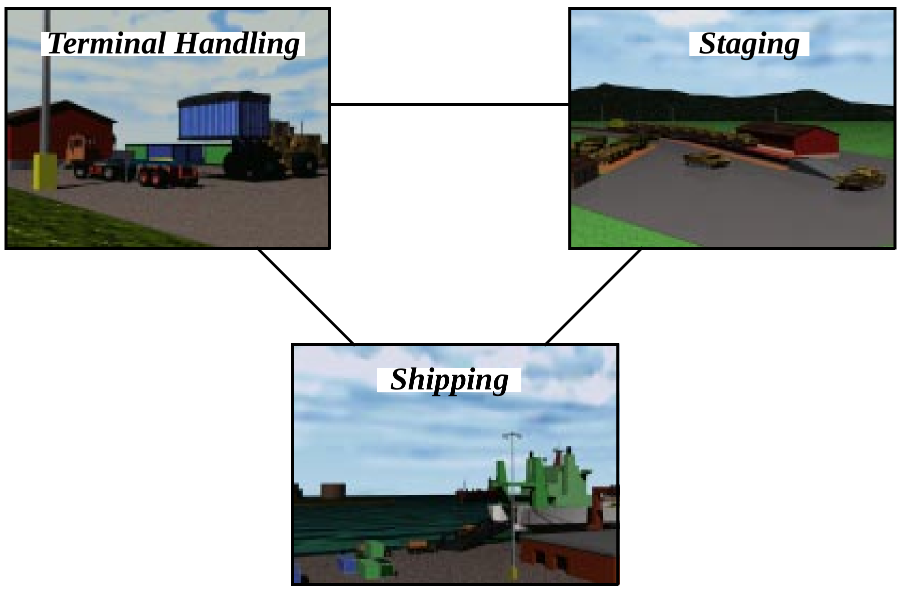
FUTURE DEVELOPMENT

The only future development planned for the Port of Genova is to upgrade and improve existing facilities.

II. THROUGHPUT ANALYSIS

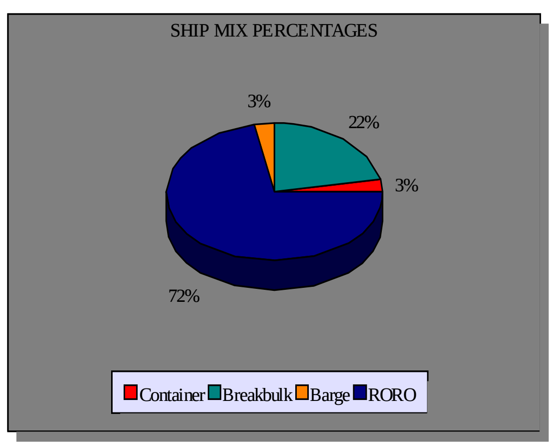
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Genova. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of short tons (STON) per day.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 70 percent of the port facilities will support military deployments. Also, due to the size of the port, we assume that the berths will have ships 80 percent of the time. The ship mix is determined by Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL CLEARANCE/HANDLING

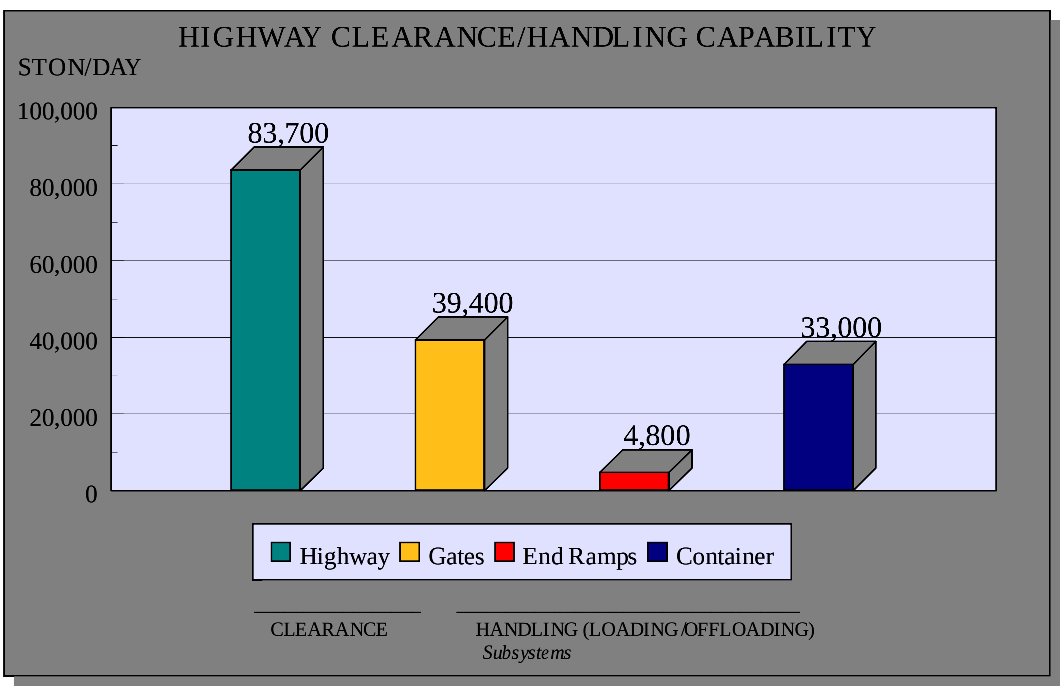
Highway

Major roads connecting the main port to the autostrada are Autostrada Genova-Valle del Po, Via A Cantore, Lungomare Minolli Canepa, and Strada Sopraelevata. The road network into/out of the port, including the gate and processing of vehicles, can handle almost 39,400 STON of equipment and supplies per day.

Roadable vehicles in convoys will process into the port directly to staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. We assume that deploying units will build or acquire three portable ramps for flatbed truck and semitrailer operations. Portable ramps (some are lightweight) are also available through terminal operators. These ramps will handle 4,800 STON of military vehicles and equipment per day.

The port has no truck docks.

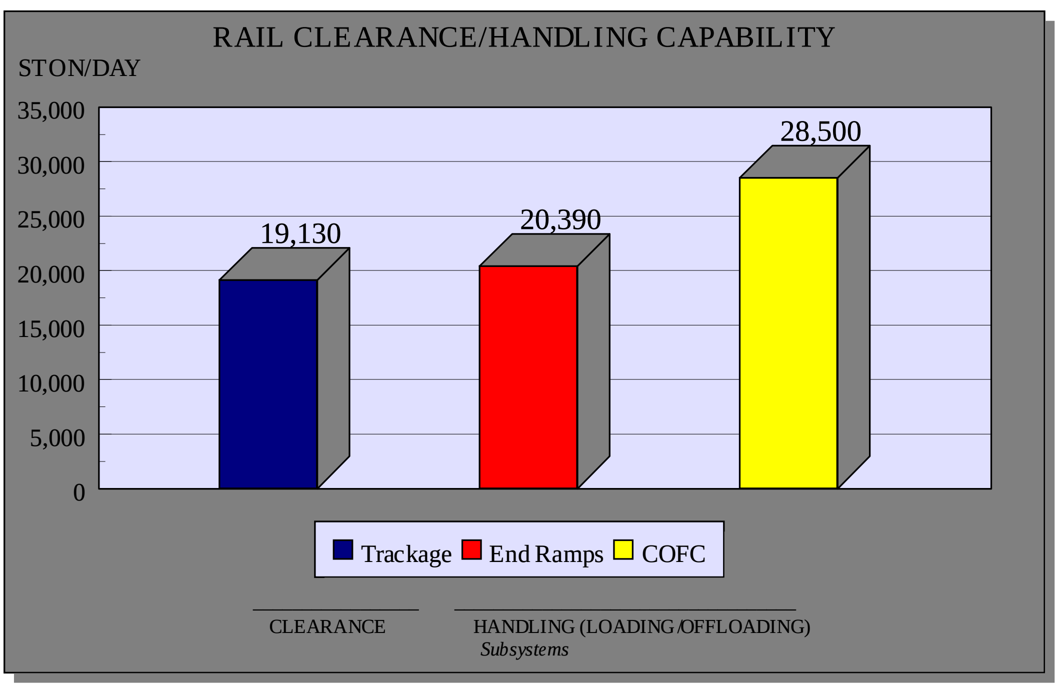
The Port of Genova has 22 straddle carriers and other MHE available for use in container operations. Using the straddle carriers alone for container operations, the port can handle about 33,000 STON per day.



Rail

The Ferrovia dello Stato (FS) could move a maximum of 8 trains of 25 railcars each day if necessary. Vehicles on flatcars can use the portable ramps at the Voltri and Genova Terminals for loading/offloading operations. Portable ramps can also be obtained through the terminal operators if needed. We assume the deploying units would build or acquire three portable end ramps to supplement the ramps in the Voltri and Genova Terminals. The port has several locations with rail spurs having a range of 1,000 to 1,900 feet of tangential track to conduct loading/offloading operations using end ramps. The best locations in the port are the railyard at the Voltri Terminal, Ponte Ronco, Ponte Libia, Ponte Canepa, Genova Terminal, and Calata Alla Sanita railyard. Because of limited work space, end ramps should not be placed in areas where other operations are taking place. Using a total of 6 end ramps (3 constructed or acquired by deploying units), for loading/offloading railcars (60-foot railcars), the port would handle 576 railcars daily (4 interchanges in a 20-hour period).

The port has 19 transtainers and other MHE available for COFC operations in the container terminals. Using the transtainers alone, the port can handle 28,500 STON per day.



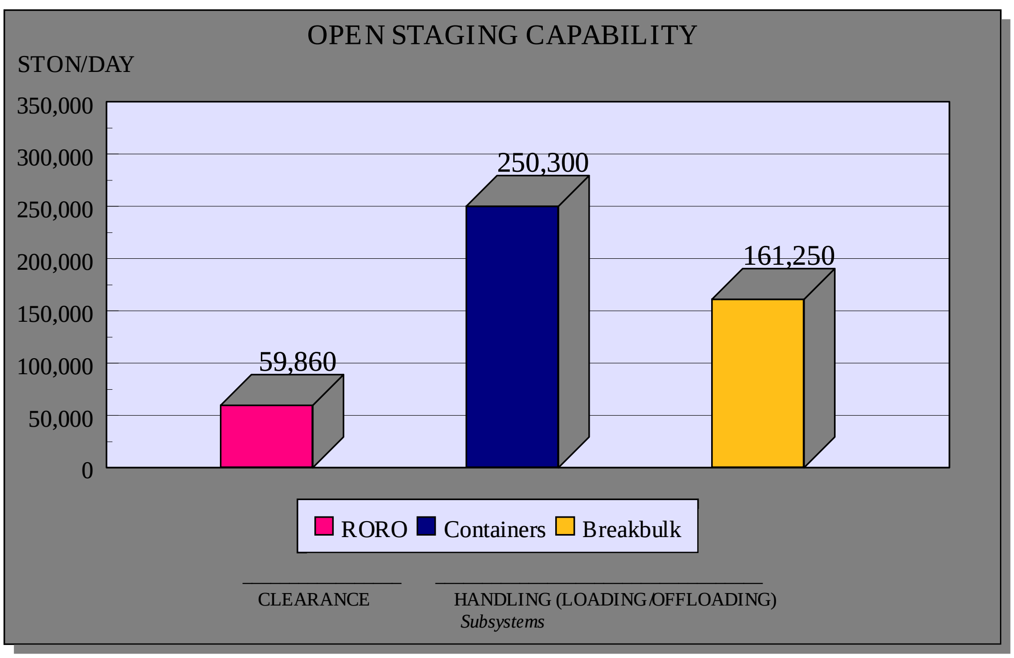
Staging

The port has 205 acres of paved open staging (98.8 acres at Voltri Terminal) that could support military operations at the deployment-useful berths. The port also has 1,216,870 square feet of covered storage available at these same berths. Deploying units must negotiate with terminal operators for use of any storage areas at the Port of Genova.

The port has the ability to perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned.

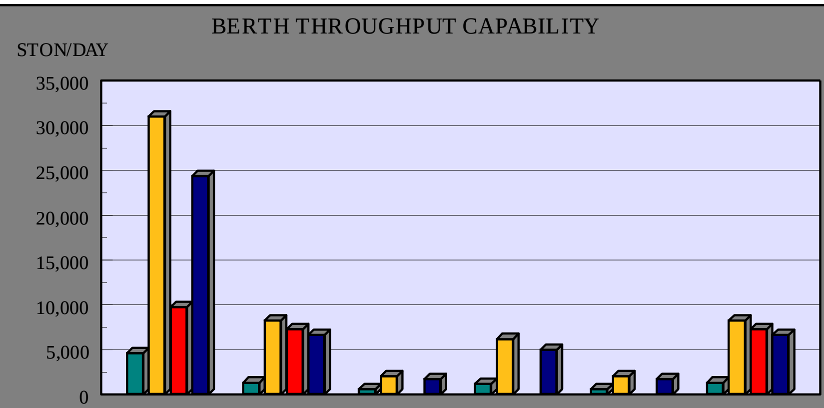
The chart shown on this page provides the cargo open staging capability for each vessel type. If a combination ship is expected, then a portion of each involved capability should be assumed.

Based on the shipping subsystem throughput, about 283 acres of open storage are needed (371 acres are available in the entire port; 205 acres are available at the deployment-useful berths) to stage the daily throughput capability for the deployment-useful berths in the Port of Genova. The 283-acre requirement consists of 216 acres needed to stage RORO cargo and 67 acres to stage containers. The RORO acreage includes areas for frustrated cargo, working areas, areas around ramps and gates, lanes and access to vehicles, and other factors. The container acreage is based on the straddle carrier system for the Voltri Terminal (168 TEU per acre), yard gantry crane system for the Calata Alla Sanita, Libia West, and Ronco East Terminals (325 TEU per acre), and chassis system for all other terminals with container throughput (70 TEU per acre). Because deploying units cannot likely obtain the use of the available open storage in the entire port, open storage shortfalls are likely to develop for accommodating daily throughput capabilities.

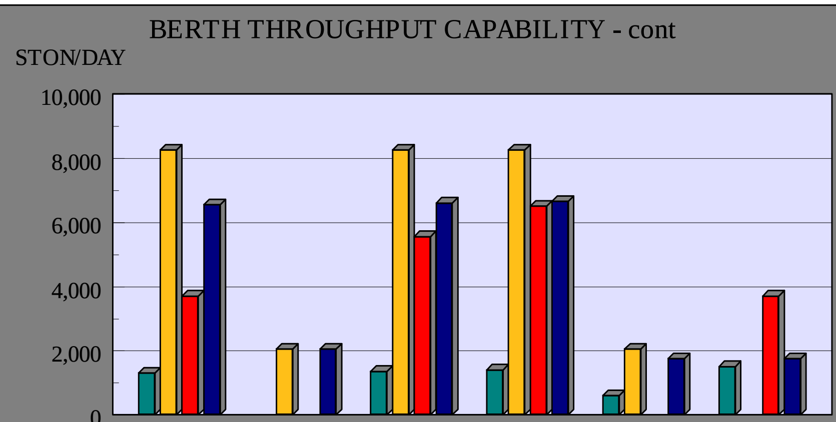


Shipping

Throughputs for each deployment-useful berth are shown below. They are based on various factors including MHE used, loading, operational, berth usage rates, and berthing capabilities for various vessel types. Assumptions used in this study are in the appendix.



	40 Voltri	39 Ronco E	38 Dern	37 Can W	36 Beng	35 Lib W
Breakbulk	4,600	1,350	600	1,200	600	1,350
RORO	31,000	8,250	2,050	6,200	2,050	8,250
Container	9,750	7,300				7,300
Mixed	24,350	6,650	1,750	5,000	1,750	6,650

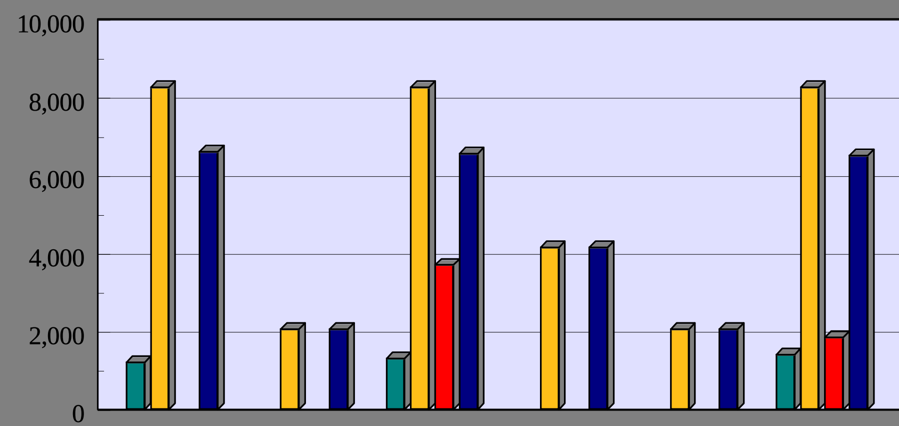


	35 Lib E	34 Trip	33 Som W	33 Som E	32 Moga	31 Eri W
Breakbulk	1,300		1,350	1,400	600	1,500
RORO	8,250	2,050	8,250	8,250	2,050	
Container	3,700		5,550	6,500		3,700
Mixed	6,550	2,050	6,600	6,650	1,750	1,750

CONVERSION FACTORS

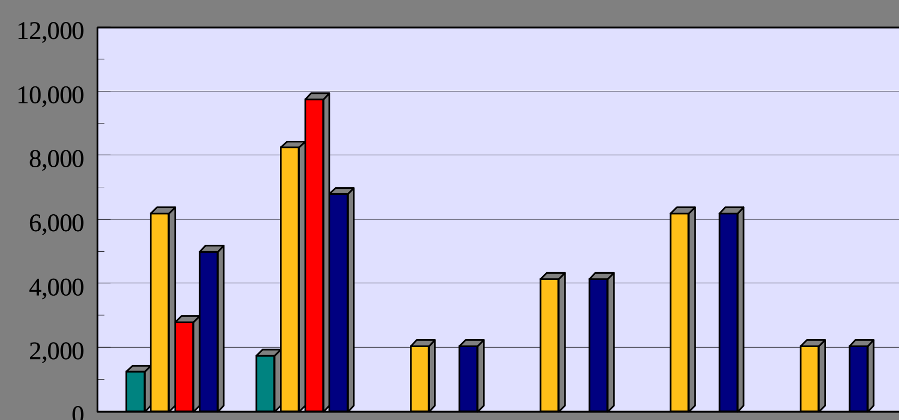
Breakbulk:	.4 STON per MTON
RORO:	.25 STON Per MTON
Containers:	.4 STON per MTON

BERTH THROUGHPUT CAPABILITY - cont



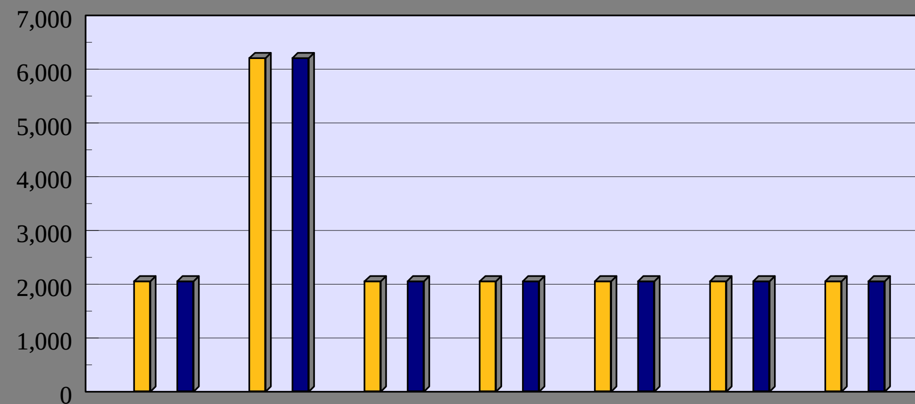
	31 Eri E	30 Mass	29 Eti W	29 Eti E	28 Ing	25 S Gio E
Breakbulk	1,200		1,300			1,400
RORO	8,250	2,050	8,250	4,150	2,050	8,250
Container			3,700			1,850
Mixed	6,600	2,050	6,550	4,150	2,050	6,500

BERTH THROUGHPUT CAPABILITY - cont



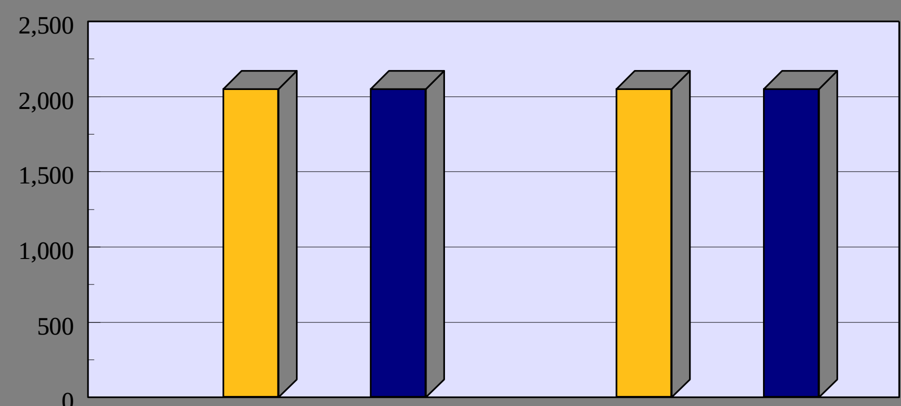
	22 Bett	19 Sani	18 Cara E	18 Cara N	16 Asse S1	16 Asse S3
Breakbulk	1,250	1,750				
RORO	6,200	8,250	2,050	4,150	6,200	2,050
Container	2,800	9,750				
Mixed	5,000	6,800	2,050	4,150	6,200	2,050

BERTH THROUGHPUT CAPABILITY - cont



	16 Asse N4	16 Asse N5	15 Chia	14 Colo	12 Dor W	12 Dor F	10 PMill 2
Breakbulk	0	0	0	0	0	0	0
RORO	2,050	6,200	2,050	2,050	2,050	2,050	2,050
Container	0	0	0	0	0	0	0
Mixed	2,050	6,200	2,050	2,050	2,050	2,050	2,050

BERTH THROUGHPUT CAPABILITY - cont



	10 PMil 3	8 Paro E
Breakbulk	0	0
RORO	2,050	2,050
Container	0	0
Mixed	2,050	2,050

We base the type of ship preferred at each berth on the methodology described in the appendix. The evaluation is a snapshot view of the current physical characteristics of the berths and MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suited for the loading or unloading operation. In general, no one berth is ideal for all military operations. The best berth depends on the type of ship loaded. In an effort to provide a simpler chart, we have eliminated those berths that did not rank in the top 13 for any of the shipping operations.

Because of its all around capability, available open staging, and highway access, we recommend the Voltri Terminal as the most desirable for military port operations. The next choices are the Calata Sanita Container Terminal, Ponte Ronco and Ponte Libia, and Genova Terminal in that order.

BERTH PREFERENCE SELECTION

LOADING TYPE	BERTHS								
	40 Voltri	39 Ronco E	37 Can W	35 Lib W	35 Lib E	33 Som W	33 Som E	31 Eri W	31 Eri E
BREAKBULK	2	6	7	7	1	5	2	10	4
RORO	1	2	4	4	7	11	11	-	8
CONTAINER	1	3	-	4	6	7	7	11	-
NOTE: Berths marked with a "-" are not recommended for these operations.									

LOADING TYPE	BERTHS				
	29 Eti W	25 S Gio E	22 Bett	19 Sani	15 Chia
BREAKBULK	7	12	13	10	-
RORO	10	6	13	3	8
CONTAINER	10	5	9	2	-
NOTE: Berths marked with a "-" are not recommended for these operations.					

PORT OF LA SPEZIA, ITALY

I. General Data

II. Thruput Analysis

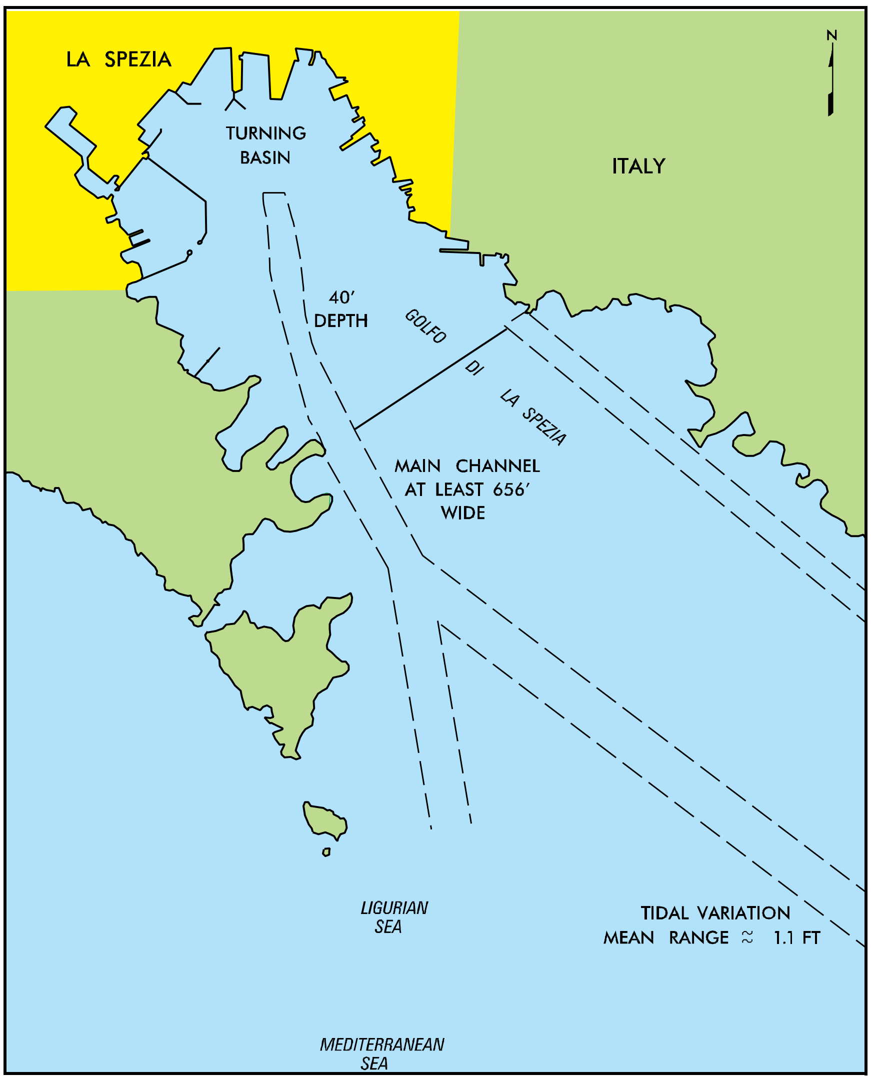
Return to Index

I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of La Spezia (44° 07' north latitude and 9° 50' east longitude) is on the northwest coast of Italy along the Ligurian Sea. The port has multicargo piers and wharves and specializes in container operations. Located in a natural harbor, the port has direct access to the Ligurian Sea. The port has no vertical or overhead restrictions on ships entering the harbor. Deep draft protected anchorages (39-42 feet) are available near the port and turning basins are adequate inside the port. The channel depth to the port is about 40 feet for the channel at the west end of the port. The channel on the east side of the port is mainly used by pleasure craft.



Water Access

Highway

La Spezia is situated at the base of the mountains next to the Ligurian Sea and has only three main highway routes leading into/out of the city. Autostrada A-12, an interstate type highway, runs northwest/southeast along the Mediterranean Sea. The La Spezia exit onto the A-15 extension leads into the city. City streets leading into the port are Via G. Carducci, Via Palmaria, Viale San Bartolomeo, and Corso Italia. These routes have no unusual clearance (vertical and lateral) or weight restrictions. Highway tunnels have a general height limitation of 4 meters in Italy.

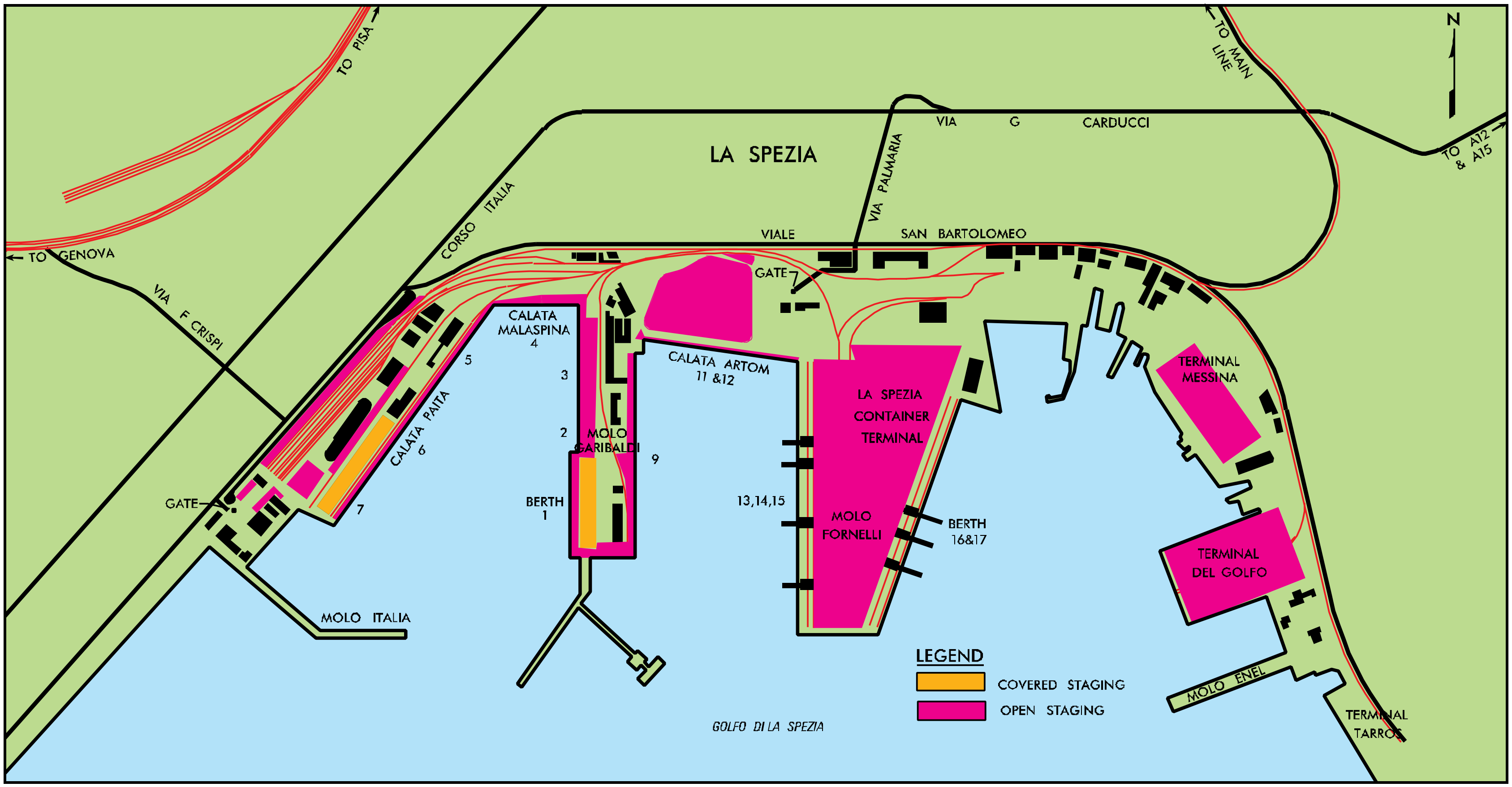
Air

The two nearest airports are at Pisa (military and commercial airport about 47 miles southeast of the port) and Genova (about 68 miles northwest of the port). The airport at Pisa has two runways with a length of 9,840 feet. The airport at Genova has one 9,840-foot runway.

Rail

A major rail line extends northwest/southeast along the Italian west coast through La Spezia. Another line extends northward toward Parma from a point just east of La Spezia. Rail lines extend from the main line into the port. Rail tunnels are north and east of La Spezia leading through the mountains. Rail cargo must meet envelope B, defined in NATO Standardization Agreement 2832, to ensure tunnel clearances are met to access the port. Due to container operations, rail activity at the port is heavy.

Transportation Access



Vicinity Map

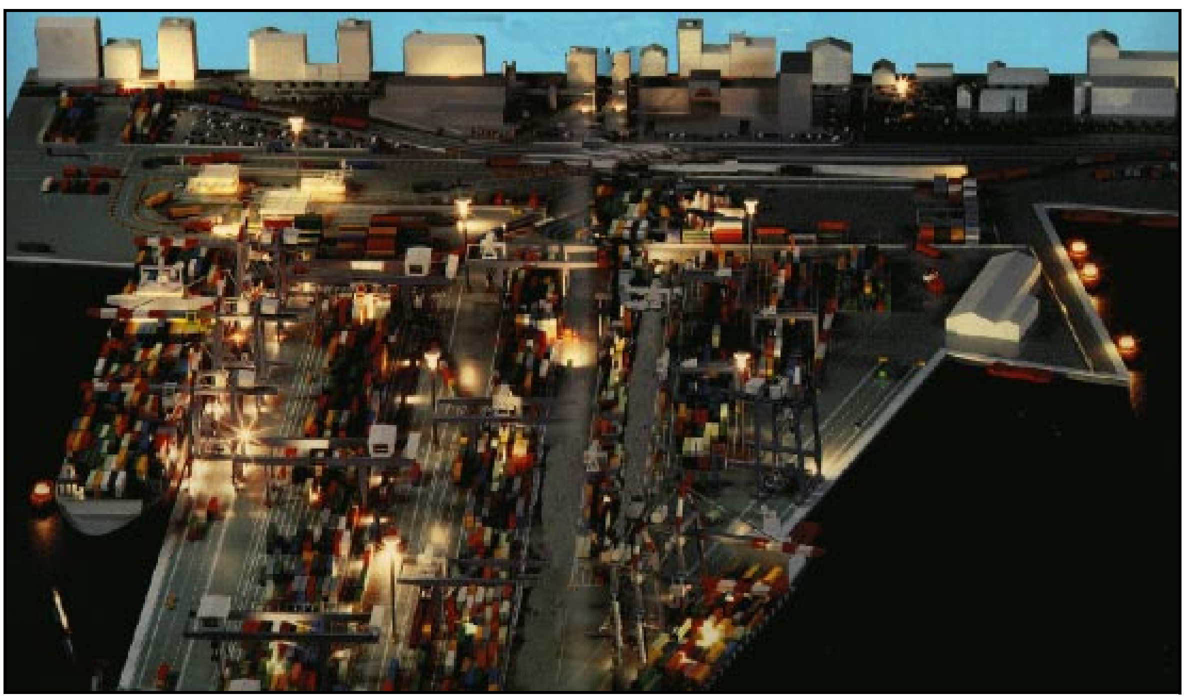
PORT FACILITIES

Berthing

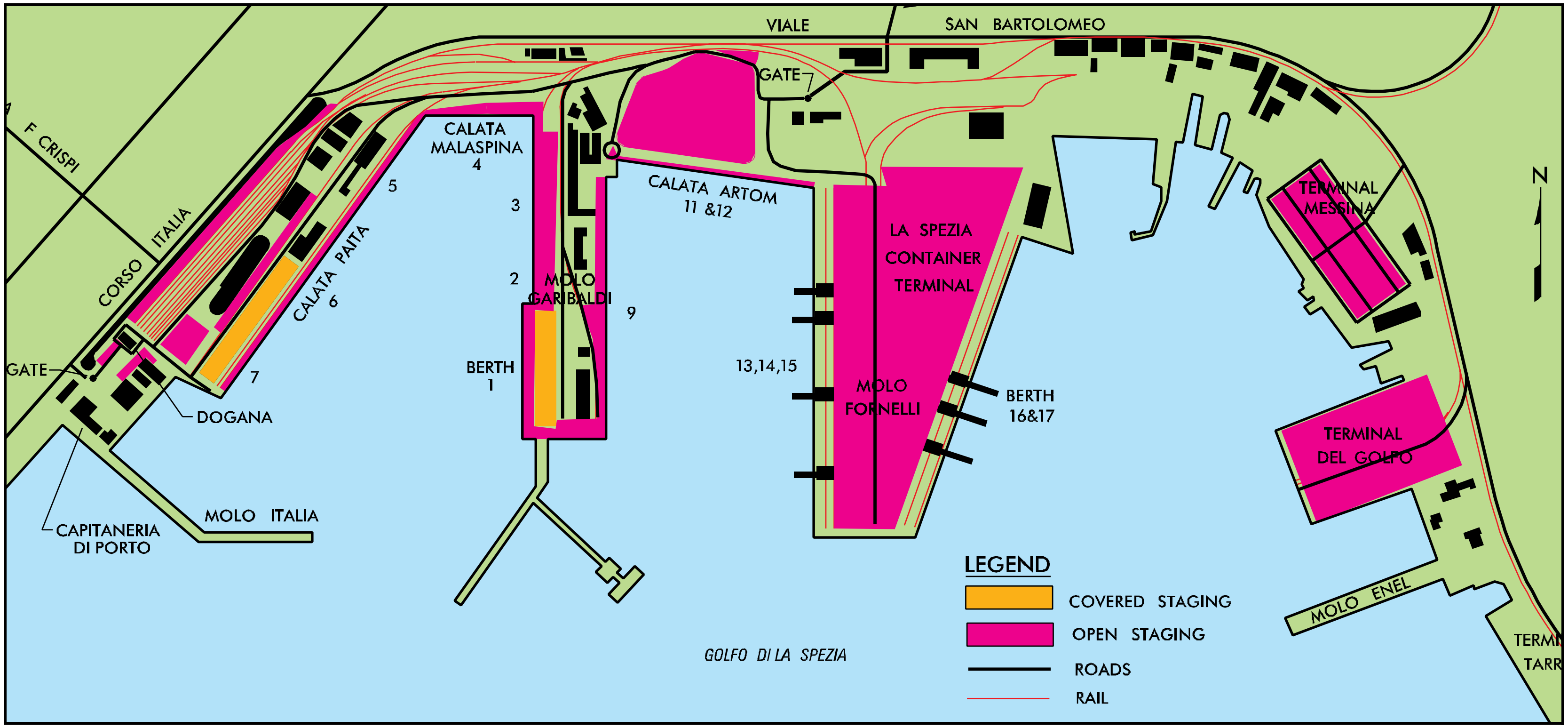
La Spezia is a multicargo port with emphasis on containers. The La Spezia Container Terminal on Molo Fornelli is the most important terminal in the port. It has the largest open staging area of all wharves and piers and is the most desirable for military port operations. The La Spezia Container Terminal is also the busiest terminal in the Port of La Spezia. Facility use at this terminal is estimated to be at least 80 percent. This means the percent availability of this facility may be low during deployment.

The Messina Terminal and Terminal del Golfo are privately owned container terminals. Like the La Spezia Container Terminal, percent availability of these facilities may be low during deployment. Other wharves with potential for military deployment include berth 9 on Molo Garibaldi and the Calata Paita wharf. These berths are general cargo berths. Berth depths range from 16 to 46 feet. Lighting exists throughout the port.

Molo Italia, near the Capitaneria di Porto, has a draft of 16 feet and is not considered in this study. The Italian Navy has a base including port facilities west of the port. The maximum draft of the military port is 26 feet. The military port does not have rail access and is not considered in this study.



La Spezia Container Terminal Molo Fornelli (Model)


VIALE
SAN BARTOLOMEO
F CRISPI
CORSO ITALIA
GATE
CALATA MALASPINA
4
5
3
2
CALATA PAITA
6
7
MOLO GARIBALDI
9
CALATA ARTOM
11 &12
LA SPEZIA
CONTAINER
TERMINAL
13,14,15
MOLO
FORNELLI
BERTH
16&17
TERMINAL
MESSINA
TERMINAL
DEL GOLFO
N
GATE
DOGANA
BERTH
1
CAPITANERIA
DI PORTO
MOLO ITALIA
MOLO ENEL
GOLFO DI LA SPEZIA
LEGEND
COVERED STAGING
OPEN STAGING
ROADS
RAIL

Land-Use Map

BERTH CHARACTERISTICS

	Berths					
CHARACTERISTICS	1 Molo Garibaldi	2-3 Molo Garibaldi	9 Molo Garibaldi	4 Calata Malaspina	5-7 Calata Paita	11-12 Calata Artom
Length (ft)	679	984	1,148	656	1,755	1,003
Depth alongside at MLW (ft)	25	21	36	16	36	30
Deck Strength (psf)	600	600	600	600	600	600
Apron width (ft)	65	Open	Open	33	Open	Open
Apron height above MLW (ft)	9	9	9	9	9	9
Number of container cranes	0	0	0	0	0	0
Number of wharf cranes	1	1	2	1	2	4
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	Yes	Yes	No	Yes
Apron length served by rail (ft)	679	984	951	656	1,755	0

1. ***Molo Garibaldi***

2-3 Molo Garibaldi

11-12 Calata Artom

BERTH CHARACTERISTICS - cont

Berths							
CHARACTERISTICS	13-15 Molo Fornelli	17-18 Molo Fornelli	16 Molo Fornelli	Terminal Messina	Terminal del Golfo East	Terminal del Golfo West	Terminal del Golfo Head
Length (ft)	1,705	1,531	528	328	524	492	196
Depth alongside at MLW (ft)	42	46	32	36	32	26	26
Deck Strength (psf)	800	800	800	800	800	800	800
Apron width (ft)	Open	Open	Open	Open	Open	Open	Open
Apron height above MLW (ft)	9	9	9	9	9	9	9
Number of container cranes	4	3	0	0	1	0	0
Number of wharf cranes	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	Yes	No	Yes	No	No	Yes
Apron length served by rail (ft)	1,705	1,531	0	0	524	492	0

Terminal Messina

17-18 Molo Fornelli

13-15 Molo Fornelli

PORT OF LA SPEZIA
SUMMARY OF BERTHING CAPABILITIES

VESSELS		BERTHS						
TYPE	**CLASS**	**1 MGari**	**2-3 MGari**	**9 MGari**	**4 CalMal**	**5-7 CalPai**	**11-12 CalArt**	
BREAKBULK	C3-S-38a	a	a	2	a	3	1	**NOTES:**
	C4-S-58a	a	a	1	a	2	a	a-vessel draft limit
	C4-S-66a	a	a	2	a	3	a	b-inadequate apron width
	C5-S-37e	a	a	1	a	2	1	c-inadequate berth length
SEATRAIN	GA and PR	a	a	1	a	3	1	d-no straight stern ramp
BARGE	LASH C8-S-81b	a,c,f	a,f	1	a,c,f	2	a,f	e-no container handling equipment
	LASH C9-S-81d	a,c	a	a	a,c	a	a	f-anchorage depth OK, berth depth
	LASH Lighter	3	4	5	3	8	5	inadequate
	SEABEE C8-S-82a	a,c	a	a	a,c	a	a	g-inadequate channel depth
	SEABEE Barge	3	4	5	3	8	5	h-no shore based ramps
RORO	Jolly Smeraldo	a	a	a	a,b	a	a	i-low tide insufficient ramp clearance
	Isola Delle Perle	1,d	a,d	i,j	a,i,j	3,d	i,j	j-high tide insufficient ramp clearance
	Galini	i,j	i,j	i,j	a	i,j	i,j	k-excessive ramp angle low tide
	Arcade Falcon	i,j	a	i,j	a	i,j	i,j	m-excessive ramp angle high tide
	Golfo Dei Fiori	1,d	2,d	2	a	4,d	2	n-parallel ramp operation ONLY
	Ani	i,j	i,j	i,j	i,j	i,j	i,j	o-insufficient apron width for side ramp
	MV Goya	2,d	3,d	i,j	i,j	5,d	i,j	
	Cape I-class	a,c	a	i,j	a,b,c	i,j	a	
	Cape Victory	a	a	1	a,b	2	1	Ramp clearance and angle based on maximum vessel draft
	COMET	a,d,o	a,d	i,j	a,i,j	d,i,j	i,j	
	METEOR	a,d,o	a,d	i,j	a,i,j	d,i,j	i,j	
	Cape Gnome	a,d	a,d	i,j	a,i,j	d,i,j	a,i,j	♦ **May Prevent Operation**
	C7-S-95a	a,c	a	1	a,b,c	2	a	
	Cape Taylor	a	a	1	a,b	2	1	♦ **May Limit Operation**
	Cape Orlando	a	a	i,j	a,b	i,j	i,j	

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF LA SPEZIA
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS						
TYPE	**CLASS**	**1 MGari**	**2-3 MGari**	**9 MGari**	**4 CalMal**	**5-7 CalPai**	**11-12 CalArt**	**NOTES**
	MV Ambassador	d	d	k,m	a,k,m	d	k,m	a-vessel draft limit
	Callaghan	a,c,d,o	a,d	1	a,c	2,d	1	b-inadequate apron width
	Cape Lambert	a,c	a	i,j	a,b,c	i,j	a	c-inadequate berth length
	FSS	a,c	a	a	a,b,c	a	a	d-no straight stern ramp
	Cape R	a,d	a,d	1	a,b	2,d	a	e-no container handling equipment
	Cape E	a	a	i,j	a,b	i,j	a	f-anchorage depth OK, berth depth
	Cape D	a,c	a	i,j	a,b,c	i,j	a	inadequate
	Cape H	a,c	a	1	a,b,c	2	a	g-inadequate channel depth
	Cape Texas	a	a	i,j	a,b	i,j	i,j	h-no shore based ramps
CONTAINER	C6-M-147a	a,e	a,e	1,e	a,b,c,e	2,e	1,e	i-low tide insufficient ramp clearance
	C7-S-69c	a,e	a,e	1,e	a,b,c,e	2,e	a,e	j-high tide insufficient ramp clearance
	C7-S-68c	a,c,e	a,e	1,e	a,b,c,e	2,e	a,e	k-excessive ramp angle low tide
	C8-S-85c	a,c,e	a,e	1,e	a,b,c,e	2,e	a,e	m-excessive ramp angle high tide
	C9-M-132b	a,c,e	a,e	1,e	a,b,c,e	1,e	a,e	n-parallel ramp operation ONLY
	C9-M-F141a	a,c,e	a,e	a,e	a,b,c,e	a,e	a,e	o-insufficient apron width for side ramp
AUXILIARY CRANE	C6-S-1qd	a	a	1	a,b,c	2	a	Ramp clearance and angle based on maximum vessel draft
	C5-S-MA73c	a	a	1	a,b	2	a	
	C6-S-MA60d	a	a	1	a,b,c	2	a	
MPS	C7-S-133a	a,c	a	1	a,b,c	2	a	♦ **May Prevent Operation**
	Maersk	a,c	a	1	a,b,c	2	a	
	AmSea	a	a	1	a,b,c	2	a	♦ **May Limit Operation**

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF LA SPEZIA
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS							
TYPE	CLASS	13-15 MForn	17-18 MForn	16 MForn	Term Mess	T.del GolfoE	T.del GolfoW	T.del GolfoH	
BREAKBULK	C3-S-38a	3	2	1	c	1	a	a,c	**NOTES:**
	C4-S-58a	2	2	c	c	c	a,c	a,c	a-vessel draft limit
	C4-S-66a	3	2	a,c	c	a,c	a,c	a,c	b-inadequate apron width
	C5-S-37e	2	2	c	c	c	a,c	a,c	c-inadequate berth length
SEATRAIN	GA and PR	2	2	c	c	c	a,c	a,c	d-no straight stern ramp
BARGE	LASH C8-S-81b	2	1	a,c,f	c	a,c,f	a,c,f	a,c,f	e-no container handling equipment
	LASH C9-S-81d	1	1	a,c	a,c	a,c	a,c	a,c	f-anchorage depth OK, berth depth
	LASH Lighter	8	7	2	1	2	2	1	inadequate
	SEABEE C8-S-82a	1	1	a,c	a,c	a,c	a,c	a,c	g-inadequate channel depth
	SEABEE Barge	8	7	2	1	2	2	1	h-no shore based ramps
RORO	Jolly Smeraldo	i,j	i,j	a,c	a,c	a,c	a,c	a,c	i-low tide insufficient ramp clearance
	Isola Delle Perle	2,d	i,j	c,d	c,i,j	c,d	c,d	c,i,j	j-high tide insufficient ramp clearance
	Galini	i,j	i,j	i,j	c	i,j	i,j	c	k-excessive ramp angle low tide
	Arcade Falcon	i,j	i,j	i,j	c	i,j	i,j	c	m-excessive ramp angle high tide
	Golfo Dei Fiori	4,d	3	1,d	c	1,d	1,d	c	n-parallel ramp operation ONLY
	Ani	i,j	i,j	i,j	i,j	i,j	i,j	c	o-insufficient apron width for side ramp
	MV Goya	5,d	i,j	1,d	i,j	1,d	1,d	c,i,j	
	Cape I-class	i,j	i,j	c	c	c	a,c	a,c	
	Cape Victory	2	2	c	c	c	a,c	a,c	Ramp clearance and angle based on maximum
	COMET	d,i,j	i,j	d,i,j	c,i,j	d,i,j	a,c,d	a,c,i,j	vessel draft
	METEOR	d,i,j	i,j	c,d	c,i,j	c,d	a,c,d	a,c,i,j	
	Cape Gnome	d,i,j	i,j	a,c,d	c,i,j	a,c,d	a,c,d	a,c,i,j	♦ **May Prevent Operation**
	C7-S-95a	2	2	a,c	c	a,c	a,c	a,c	
	Cape Taylor	2	2	c	c	c	a,c	a,c	♦ **May Limit Operation**
	Cape Orlando	i,j	i,j	c	c	c	a,c	a,c	

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF LA SPEZIA
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS							
TYPE	**CLASS**	**13-15 MForn**	**17-18 MForn**	**16 MForn**	**Term Mess**	**T.del GolfoE**	**T.del GolfoW**	**T.del GolfoH**	**NOTES**
	MV Ambassador	d	k,m	c,d	c,k,m	c,d	c,d	c,k,m	a-vessel draft limit
	Callaghan	2,d	2	c,d	c	c,d	a,c,d	a,c	b-inadequate apron width
	Cape Lambert	i,j	i,j	c	c	c	a,c	a,c	c-inadequate berth length
	FSS	a	a	a,c	a,c	a,c	a,c	a,c	d-no straight stern ramp
	Cape R	2,d	2	a,c,d	c	a,c,d	a,c,d	a,c	e-no container handling equipment
	Cape E	i,j	i,j	c	c	c	a,c	a,c	f-anchorage depth OK, berth depth
	Cape D	i,j	i,j	a,c	c	a,c	a,c	a,c	inadequate
	Cape H	2	1	a,c	c	a,c	a,c	a,c	g-inadequate channel depth
	Cape Texas	i,j	i,j	c	c	c	a,c	a,c	h-no shore based ramps
CONTAINER	C6-M-147a	2	2	c,e	c,e	c	c,e	c,e	i-low tide insufficient ramp clearance
	C7-S-69c	2	2	c,e	c,e	c	a,c,e	a,c,e	j-high tide insufficient ramp clearance
	C7-S-68c	2	2	c,e	c,e	c	a,c,e	a,c,e	k-excessive ramp angle low tide
	C8-S-85c	1	1	a,c,e	c,e	a,c	a,c,e	a,c,e	m-excessive ramp angle high tide
	C9-M-132b	1	1	a,c,e	c,e	a,c	a,c,e	a,c,e	n-parallel ramp operation ONLY
	C9-M-F141a	a	a	a,c,e	a,c,e	a,c	a,c,e	a,c,e	o-insufficient apron width for side ramp
AUXILIARY CRANE	C6-S-1qd	2	2	a,c	c	a,c	a,c	a,c	Ramp clearance and angle based on maximum vessel draft
	C5-S-MA73c	2	2	c	c	c	a,c	a,c	
	C6-S-MA60d	2	2	c	c	c	a,c	a,c	
MPS	C7-S-133a	2	1	a,c	c	a,c	a,c	a,c	♦ **May Prevent Operation**
	Maersk	2	1	a,c	c	a,c	a,c	a,c	
	AmSea	2	2	c	c	c	a,c	a,c	♦ **May Limit Operation**

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

STAGING

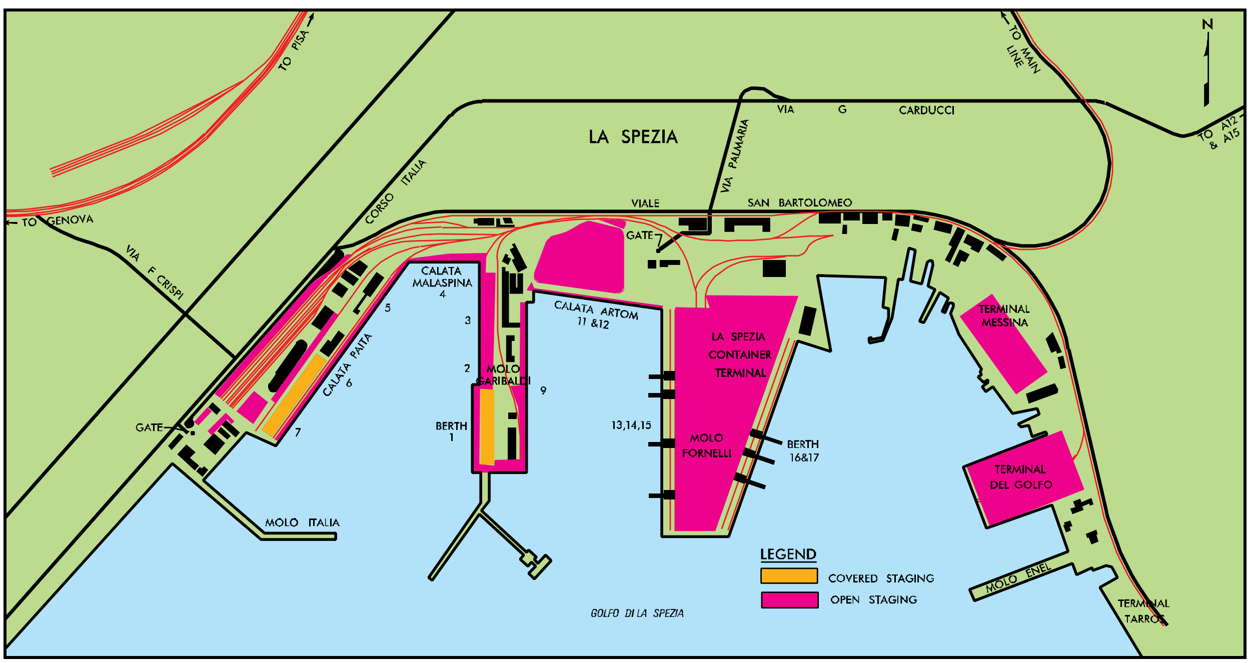
Open Staging

The Port of La Spezia has about 96 acres of open staging available. Most of this storage area (55.7 acres) is in the Molo Fornelli and Messina Terminal container yards.

The commercial port does not have any areas designated for helicopter operations. The nearest area with potential for helicopter operations is the military port.

Covered Staging

The port has about 230,350 square feet of covered storage at the Port of La Spezia, however, all of it is privately owned. Deploying units must negotiate with the facility owner(s) for storing equipment in the port's warehouses and transit sheds. Percent availability to deploying units can vary considerably. The available covered storage includes a container freight station in Terminal Messina with a storage area of 86,112 square feet.



Open Staging

RAIL

Rail lines extend from the main line into the port. Apron tracks are on Calata Paita, Calata Malaspina, Molo Garibaldi, Molo Fornelli, and Terminal del Golfo. Calata Paita has three rail spurs. Calata Malaspina, both sides of Molo Garibaldi, Molo Fornelli, and Terminal del Golfo have two spurs each. The port has two railcar storage areas capable of storing at least 200 railcars. One is behind the Calata Paita wharf next to the Corso Italia. The other is behind the Calata Malaspina wharf next to Viale San Bartolomeo. The rail lines leading from the main lines to the port have no unusual height or side clearance restrictions. Rail cargo must meet envelope B, defined in STANAG 2832, to ensure tunnel clearances are met. The port uses its own container train to transport COFCs throughout the port.

HIGHWAY

Roads leading into the port are four-laned (two lanes for each direction). Via G. Carducci, Via Palmaria, Viale San Bartolomeo, and Corso Italia are the major streets connecting the port to the A-15 Extension. The port has two gates that allow access to the wharf areas. One is near the Capitaneria di Porto (behind the Calata Paita wharf) and allows access to Corso Italia. The other is the Container Gate allowing access to Molo Fornelli and other wharves from Viale San Bartolomeo. There are no unusual height or weight restrictions leading into the port from the main road networks. Arriving container trains, however, block the highway access gate to the Container Terminal on Molo Fornelli. Two truck scales are located at the container terminal. In general, the height limitation for highways in Italy is 4 meters.

Gate to La Spezia Container Terminal

UNLOADING/LOADING POSITIONS

Ramps

The Port of La Spezia does not have any fixed or portable rail or truck end ramps. Deploying units must either supply portable end ramps or obtain them through the terminal operators for offloading railcars and semitrailers not equipped with a means for offloading wheeled/tracked vehicles. The best locations for rail end ramp operations are the two rail storage yards in port.

Rail Storage Yard off Corso Italia

Docks

No docks exist for truck or boxcar loading/offloading.

MARSHALING AREAS

No marshaling areas exist near the port. The only areas that could be used for marshaling are the open storage areas at the wharves. The open storage area near the Calata Artom wharf appears to have the most potential for marshaling operations.

MATERIAL HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity (STON)	Quantity	Wharf Assignment
Container Cranes	48 48 46	4 3 1	Molo Fornelli 13-15 Molo Fornelli 17-18 Terminal Del Golfo
Wharf Cranes	38 27 22 13 8 6 6 6 3	2 2 2 2 2 2 2 9 2	Calata Paita Calata Artom Calata Artom Molo Garibaldi Molo Garibaldi Calata Paita Calata Malaspina Molo Garibaldi Calata Malaspina
Rail-Mounted Gantry Cranes	49	9	Molo Fornelli
Rubber-Tired Gantry Cranes	44	3	Molo Fornelli
Mobile Crane	110	1	----
Floating Cranes	99 74 33 27	2 1 1 1	---- Molo Fornelli Italian Navy Port ----
Forklifts	Up to 38 Up to 38 27 13 Up to 13 2	26 5 3 6 20 4	Terminal Messina Terminal del Golfo Terminal del Golfo Terminal del Golfo Terminal Messina Terminal del Golfo

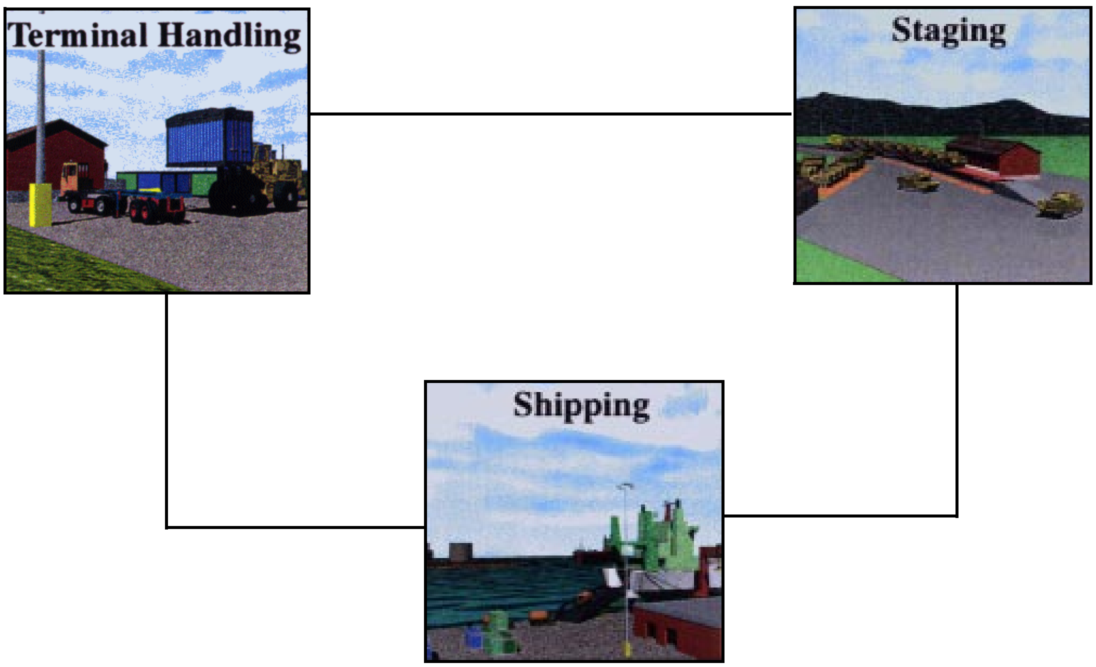
FUTURE DEVELOPMENT

The Port of La Spezia has two planned improvements. An underground connector route that directly connects the port to the autostrada and bypasses the city is currently under construction. Also, the port plans to construct a new pier similar to the container terminal. No timetables have been set for completion of these projects.

II. THROUGHPUT ANALYSIS

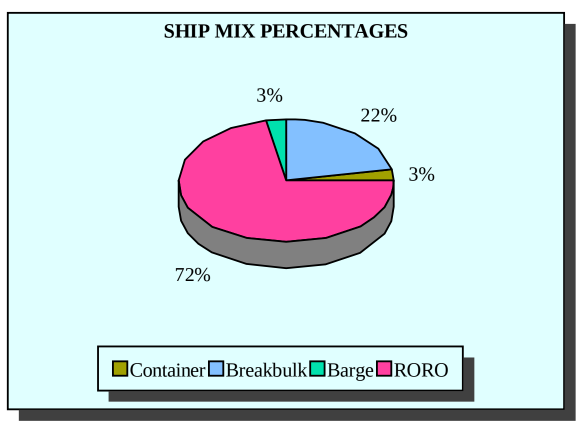
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of La Spezia. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling-in terms of short tons (STONS) per day.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 60 percent of the port facilities will support military deployments. Also, due to the size of the port, we assume that the berths will have ships 70 percent of the time. The ship mix is determined by Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL CLEARANCE/HANDLING

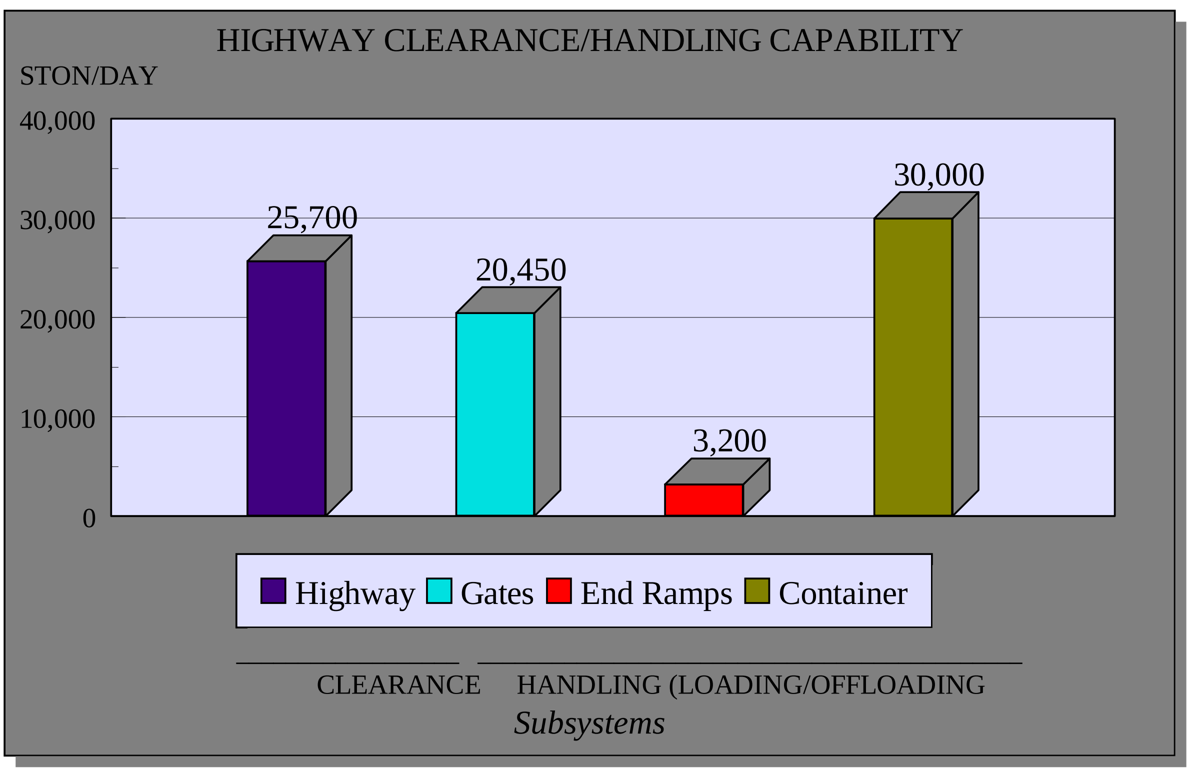
Highway

Via G. Carducci, Via Palmaria, Viale San Bartolomeo, and Corso Italia are the major streets connecting the port to the A-15 Extension. The road network into/out of the port, including the gate processing of vehicles, can handle over 20,450 STON of equipment and supplies per day.

Roadable vehicles in convoys will process into the port directly to staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. We assume that deploying units will build or acquire two portable ramps for flatbed truck and semitrailer operations. These ramps will handle at least 3,200 STON of military vehicles and equipment per day.

The port has no truck docks.

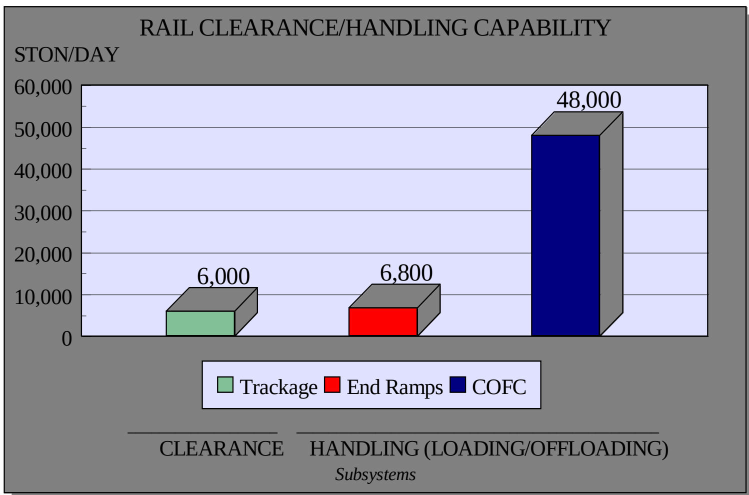
The Port of La Spezia has nine rail mounted gantry cranes, three wheeled gantry cranes, and numerous forklift trucks scattered throughout the three container terminals (Molo Fornelli, Terminal Messina, and Terminal del Golfo). Assuming one-third of all container handling capable forklifts are used in container operations, the port could handle 30,000 STON per day.



Rail

The Ferrovia dello Stato (FS) could move a maximum of 8 trains of 25 railcars each day if necessary. Vehicles on flatcars must use portable ramps for loading/offloading operations. The port does not have fixed or portable ramps to use for loading/offloading operations. We assume the deploying units would build or acquire at least two portable end ramps to use on available spurs having at least 1,000 feet of tangential track. The port has several locations to conduct loading/offloading operations using end ramps. The best locations are the two rail storage yards located on the west side of the port. Assuming two portable end ramps are used for loading/offloading railcars (60-foot railcars), the port would handle about 133 railcars daily (4 interchanges in 20-hour period).

The port has ample capability to handle container-on-flatcar (COFC) operations. These operations will likely occur at the three container terminals.



Access for COFC Operations on Molo Fornelli

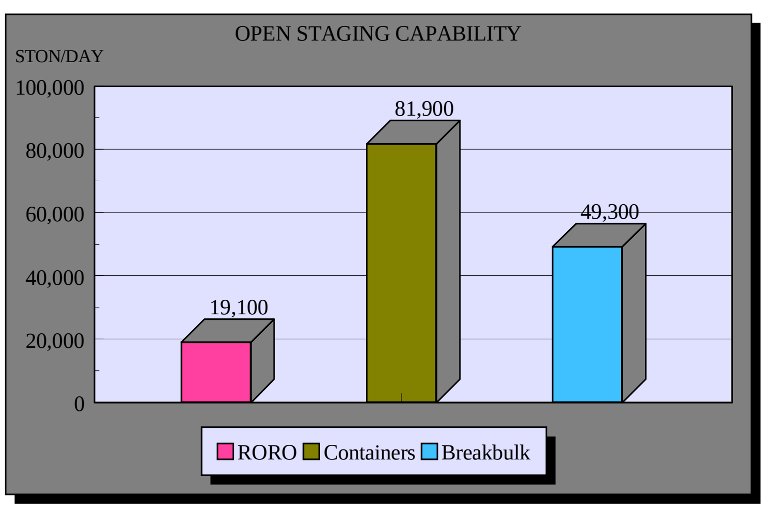
Staging

The port has about 96 acres of paved open staging scattered throughout the port that could support military operations. Most of the open staging (about 80 acres) is in the three container terminals. Since the Port of La Spezia has heavy container traffic, percent availability of open staging at the container terminals can vary dramatically and can be as low as 30 percent. The port also has over 144,200 square feet of covered staging. Because ports in Italy are converting from publicly owned terminals to private ownership, all covered storage in La Spezia is privately owned. Deploying units must negotiate with the terminal operators to obtain covered storage.

The port has the ability to perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned.

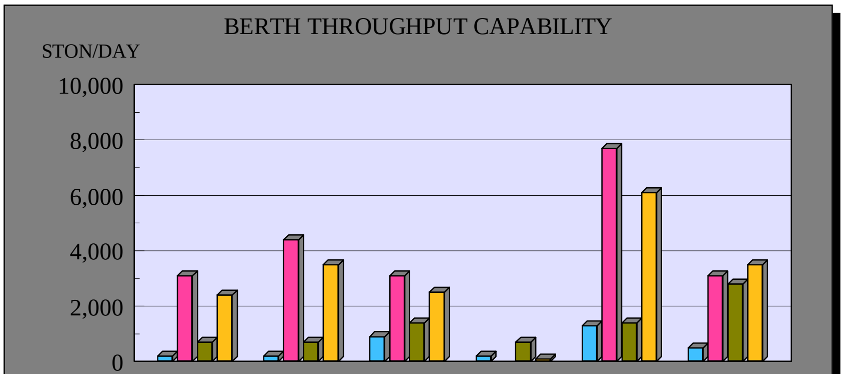
The chart shown on this page provides the cargo open staging capability for each vessel type. If a combination ship is expected, then a portion of each involved capability should be assumed.

Based on the shipping subsystem throughput, about 71 acres of open storage are needed (about 96 acres are available) to stage the daily throughput capability for the Port of La Spezia. The 71-acre requirement consists of 51 acres needed to stage RORO cargo and 20 acres to stage containers. The RORO acreage includes areas for frustrated cargo, working areas, areas around ramps and gates, lanes and access to vehicles, and other factors. The container acreage is based on the container handling method that will most likely occur at a particular terminal. The chassis system for container storage (70 TEUs per acre) is used for general cargo terminals. For specialized container terminals, either the yard gantry (325 TEUs per acre) or front-end top pick (240 TEUs per acre) container storage factors are used. The Port of La Spezia has the open storage needed to accommodate daily throughput provided these areas are available to deploying units. A shortfall in open storage will be experienced if less than 75 percent of the available open storage areas are available to deploying units.

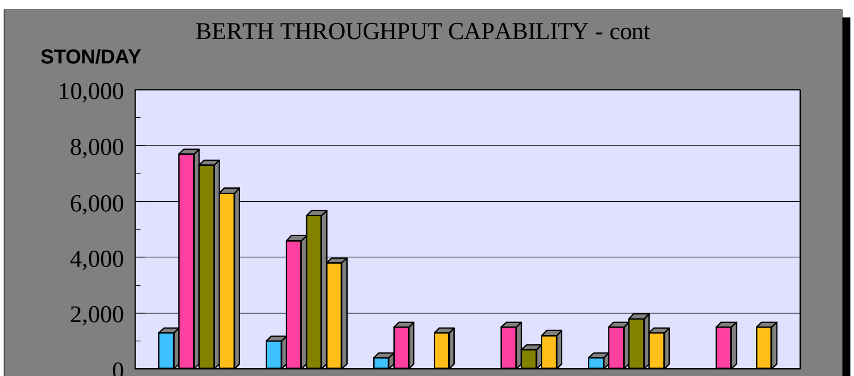


Shipping

Throughputs for each berth are shown below. They are based on various factors including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. Assumptions used in this study are in the appendix.



	1 M Gari	2-3 M Gari	9 M Gari	4 Cal Mal	5-7 Cal Pai	11-12 Cal Art
Breakbulk	200	200	900	200	1,300	500
RORO	3,100	4,400	3,100	0	7,700	3,100
Container	700	700	1,400	700	1,400	2,800
Mixed	2,400	3,500	2,500	100	6,100	3,500



	13-15 M Forn	17-18 M Forn	16 M Forn	Term Mess	Tdel Golfo E	Tdel Golfo W
Breakbulk	1,300	1,000	400	0	400	0
RORO	7,700	4,600	1,500	1,500	1,500	1,500
Container	7,300	5,500	0	700	1,800	0
Mixed	6,300	3,800	1,300	1,200	1,300	1,500

CONVERSION FACTORS

Breakbulk:	.4 STON per MTON
RORO:	.25 STON per MTON
Containers:	.4 STON per MTON

THROUGHPUT SUMMARY FOR PORT OF LA SPEZIA PER DAY

BERTH	LENGTH (feet)	DEPTH ALONGSIDE (feet)	BREAKBULK THROUGHPUT (STON)	RORO THROUGHPUT (STON)	RORO SQUARE FT (EST)	RORO PIECES[1]	CONTAINER THROUGHPUT (STON)	CONTAINER THROUGHPUT (TEU)	MIXED THROUGHPUT (STON)
1 Molo Garibaldi	679	25	200	3,100	61,940	365	700	87	2,400
2-3 Molo Garibaldi	984	21	200	4,400	92,900	547	700	87	3,500
9 Molo Garibaldi	1,148	36	900	3,100	61,940	365	1,400	174	2,500
4 Calata Malaspina	656	16	200	0	0	0	700	87	100
5-7 Calata Paita	1,755	36	1,300	7,700	154,820	911	1,400	174	6,100
11-12 Calata Artom	1,003	30	500	3,100	61,940	365	2,800	348	2,500
13-15 Molo Fornelli	1,705	42	1,300	7,700	154,820	911	7,300	914	6,300
17-18 Molo Fornelli	1,531	46	1,000	4,600	92,900	547	5,500	686	3,800
16 Molo Fornelli	528	32	400	1,500	30,960	183	0	0	1,300
Terminal Messina	328	36	0	1,500	30,960	183	700	87	1,200
Terminal del Golfo East	524	32	400	1,500	30,960	183	1,800	229	1,300
Terminal del Golfo West	492	26	0	1,500	30,960	183	0	0	1,500

[1]Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

We base the type of ship preferred at each berth on the methodology described in the appendix. The evaluation is a snapshot view of the current physical characteristics of the berths and MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suited for the loading or unloading operation. In general, no one berth is ideal for all military operations. The best berth depends on the type of ship loaded.

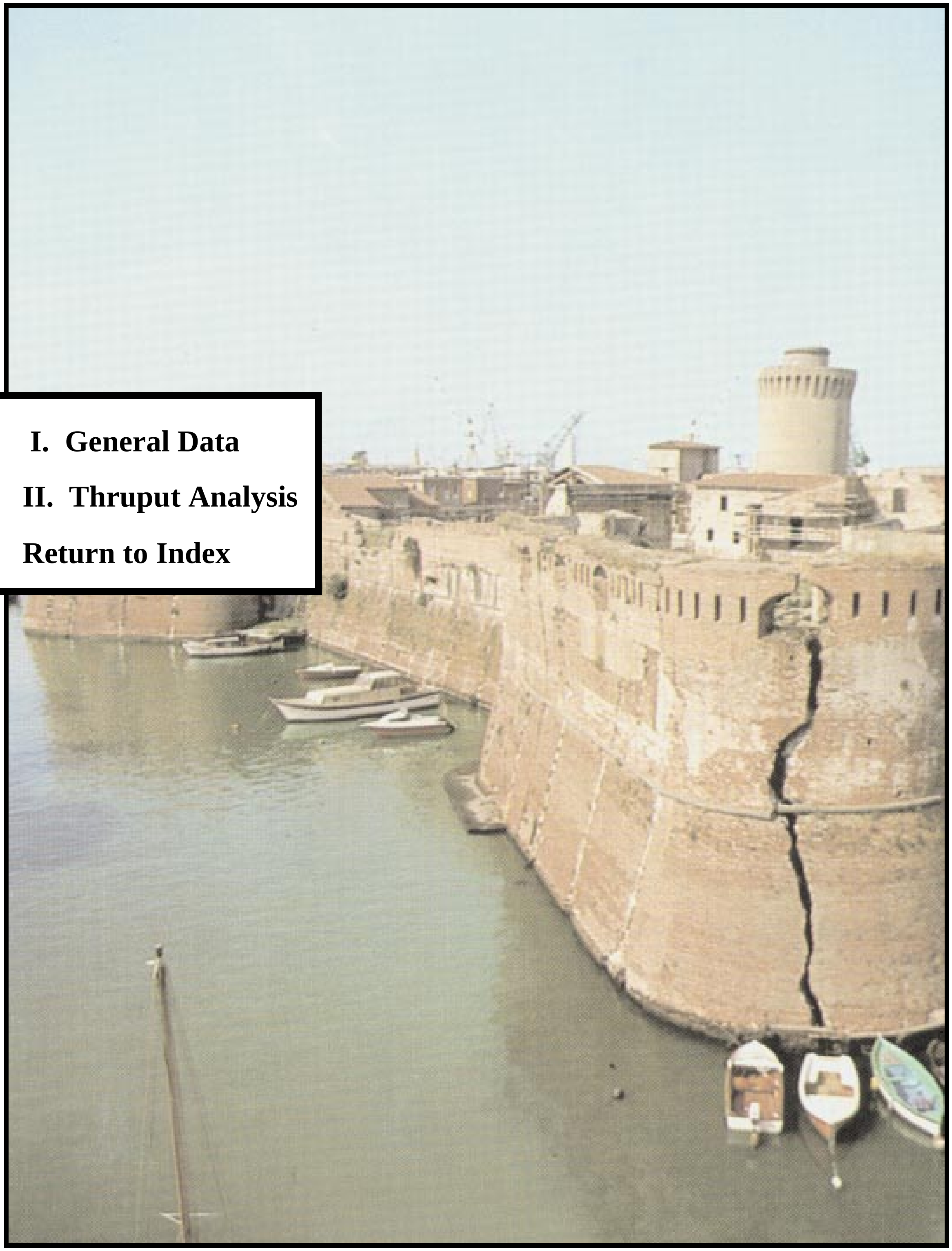
Because of their deep-water draft for handling various types of ships (including RORO and container), open staging, and tremendous container handling capability, we recommend the wharves on the Molo Fornelli as the most desirable for military port operations. The Port of La Spezia has potential for resupply operations.

BERTH PREFERENCE SELECTION

LOADING TYPE	BERTHS					
	1 M Gari	2-3 M Gari	9 M Gari	4 Cal Mal	5-7 Cal Pai	11-12 Cal Art
BREAKBULK	7	5	1	6	2	10
RORO	11	9	4	-	3	6
CONTAINER	9	8	5	9	4	6
NOTE: Berths marked with a "-" are not recommended for these operations.						

LOADING TYPE	BERTHS					
	13-15 MForn	17-18 M Forn	16 M Forn	Term Mess	T. del Golfo E	T. del Golfo W
BREAKBULK	3	3	8	-	9	-
RORO	1	1	5	8	6	10
CONTAINER	1	1	-	7	3	-
NOTE: Berths marked with a "-" are not recommended for these operations.						

PORT OF LIVORNO, ITALY



I. General Data

II. Thruput Analysis

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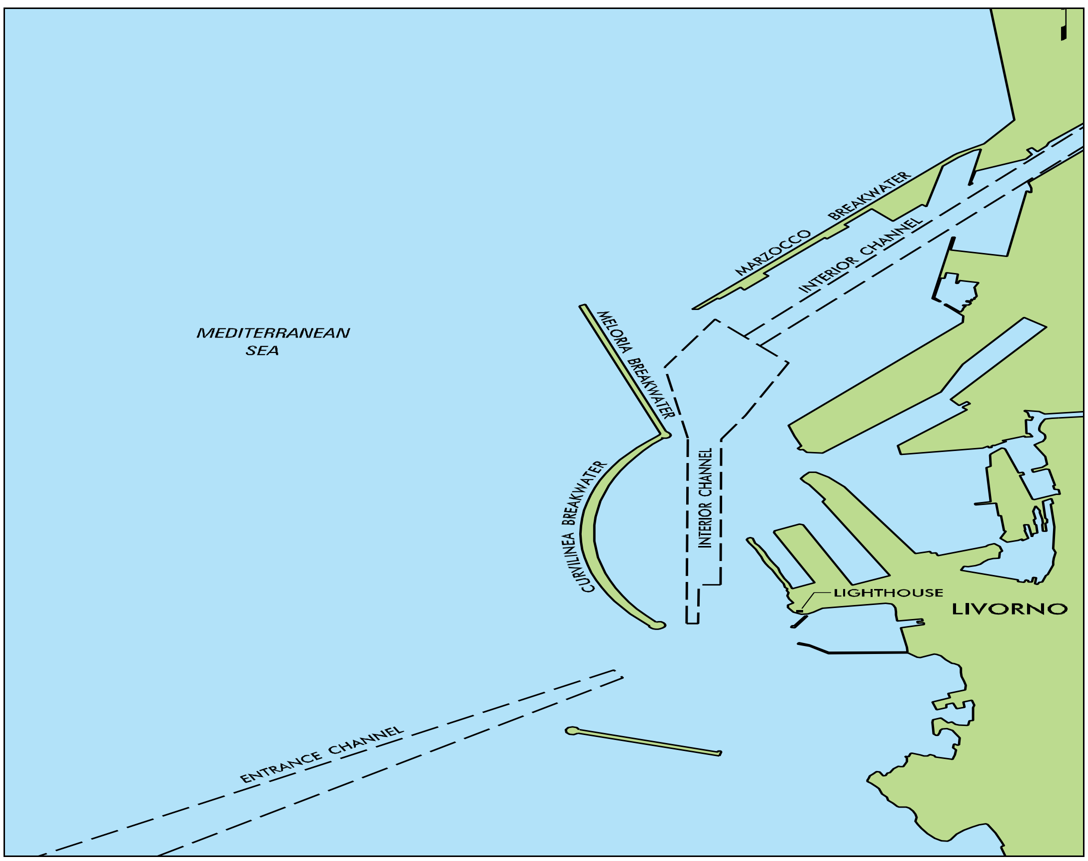
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Livorno (43° 33’ 04” north latitude and 10° 18’ 02” east longitude) is on the northwest coast of Italy about 200 miles northwest of Rome, and 9 miles southwest of Pisa. Livorno fronts both the Tyrrhenian and Ligurian Seas, accessing the central Mediterranean Sea. The port is a deep draft harbor protected by a series of breakwaters and quays. Vessels enter Livorno from both the North and South entrances. The North entrance, located between the Marzocco and Meloria breakwaters, is 1,082 feet wide, with a draft of 20 feet. The South entrance, bounded by the Curvilinear breakwater and the shoal in front of the lighthouse, is 984 feet wide, with a draft of 39 feet. There are no vertical or overhead restrictions on vessels entering the port. Vessels will, however, encounter crosscurrents of varying speed and direction as they approach the harbor. Vessels must take care when aligning for entry into the port.

Livorno is an old port, it dates from as early as the thirteenth century. It was the principal port of the Florentine Republic and during the reign of the Medici. Today the port is an important modern multimodal facility that moves passengers and cargo throughout the region and the world.



Water Access Map

Highway

Highway access to the port of is very good. Three major highways connect the port to the National Network: Autostrada A12, the major north-south super highway along the Mediterranean coast; Strada Statale (National Road) SS1 (Aurelia, the old north-south highway); and the new Livorno Port-Florence Highway that connects the port directly with the other links and with the eastern regions of the country. The A12 also links the port with the northeast by connecting to the A11 at Pisa, some 15 miles to the north.

Air

The nearest airport to Livorno is in Pisa, about 9 miles away. The Pisa Airport consists of a main runway, parallel taxiway, and three operations loops. The runway is 9,816 feet long and 148 feet wide. The airport is suitable for most aircraft including wide-bodied, up to a maximum weight limit of 840,000 pounds.

Rail

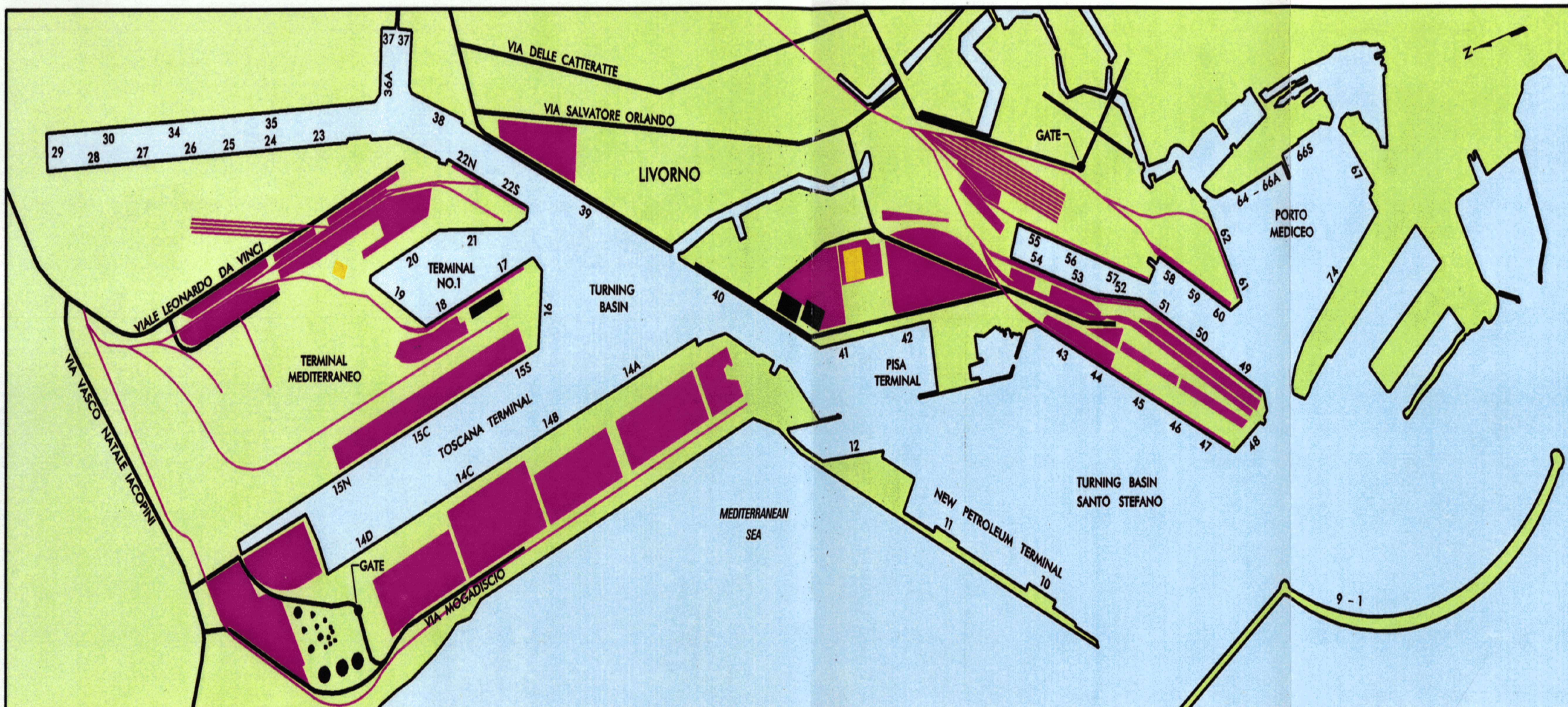
The Port of Livorno is served by the west coast's north-south railway line, the Livorno/Florence/Torino/Rome line. This line links Livorno to the rest of Italy, and ultimately, all of Europe. The port connects to the main line via its own station at Livorno Calambrone. Like the other west coast ports, the line connecting Livorno is restricted by numerous tunnels. Rail cargo on most of these lines must meet the requirements of Envelope B, as defined in NATO STANAG 2832.

Highway and Rail Access Map

PORT FACILITIES

Berthing

Livorno is classified as a "first-class port," or a commercial port of national interest. Livorno is a multimodal port specializing in containers and vehicles. The port is divided into 12 major terminal areas, with 65 numbered berthing locations. Most of these berths are privately owned and operated, and are used for specialized purposes. Most are not available to support military operations.



Port of Livorno - Land-use Map

Of those available, the Tuscany Docks Terminal (Darsa Toscana), berths 14A-D, is the most capable and desirable for support of military port operations. United States Fast Sealift Ships (FSS) have berthed there in the past. These types of vessels can also berth at several other locations, including the Deep Sounding Quay (Alto Fondale), berths 43-47, at drafts up to the berth limits.

Silting is a major problem throughout the port. Dredging, although recognized as an ongoing concern, is not accomplished at most of the port's terminals as regularly as the situation calls for. In 1993, depth alongside the Tuscany Terminal berths was about 39.5 feet. Today, the depth is reported to be between 30 feet at berth 14D, and 35 feet at berths 14A-B. Drafts this shallow can limit berthing of large, deep draft U.S. vessels like the FSS. Port authorities indicate that maintenance dredging is planned for the Tuscany Docks Terminal, but are unable to provide a schedule for the work.

Tuscany Docks Terminal

BERTH CHARACTERISTICS FOR PORT OF LIVORNO

	Berths							
CHARACTERISTICS	**14A-D[1]**	**16[2]**	**17-18[3]**	**20[4]**	**24[5]**	**43-47[6]**	**49-51[7]**	**53-54[8]**
Length (ft)	3,311	690	1,312	875	1,351	2,505	1,485	980
Depth alongside at MLW (ft)	35[9]	35	29	29	28	35	30	25
Deck Strength (psf)	800	800	800	800	800	800	800	800
Apron width (ft)	Open	Open	Open	Open	Open	50	Open	Open
Apron height above MLW (ft)	7	7	7	7	7	7	7	7
Number of container cranes	6	0	0	0	3	2	0	0
Number of wharf cranes	0	0	0	2	0	9	0	2
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Apron length served by rail (ft)	3,311	690	1,312	875	0	2,505	1,485	980

[1] **Tuscany Docks Terminal**

[2] **Terminal No. 1**

[3] **Terminal No. 1. Assab Quay**

[4] **Terminal No. 1. Addis Adeba Quay**

[5] **Sintermar Terminal (privately owned)**

[6] **Deep Sounding Quay**

[7] **Orlando Quay**

[8] **Pisa Quay**

[9] **Berth 14D, inner most 984 feet, has only 30 feet depth alongside until maintenance dredging is completed. Once complete, all berths should have 39.5 feet of depth.**

PORT OF LIVORNO
SUMMARY OF BERTHING CAPABILITIES

VESSELS		BERTHS								
TYPE	**CLASS**	**14A-D**	**16**	**17-18**	**20**	**24**	**43-47**	**49-51**	**53-54**	
BREAKBULK	C3-S-38a	6	1	2	1	2	4	2	a	**NOTES:**
	C4-S-58a	5	1	a	a	4	a	a	a	a-vessel draft limit
	C4-S-66a	5	1	a	a	4	4	a	a	b-inadequate apron width
	C5-S-37e	5	1	a	a	4	4	2	a	c-inadequate berth length
SEATRAIN	GA and PR	5	1	2	1	2	4	2	a	d-no straight stern ramp
BARGE	LASH C8-S-81b	3	c	a,f	a,f	a,f	2	a,f	a,f	e-no container handling equipment
	LASH C9-S-81d	a	a,c	a	a,c	a	a	a	a	f-anchorage depth OK, berth depth
	LASH Lighter	16	3	6	4	6	12	7	4	inadequate
	SEABEE C8-S-82a	a	a,c	a	a,c	a	a	a	a	g-inadequate channel depth
	SEABEE Barge	16	3	6	4	6	12	7	4	h-no shore based ramps
RORO	Jolly Smeraldo	a	a	a	a	a	a,b	a	a	i-low tide insufficient ramp clearance
	Isola Delle Perle	5,i	1,i	2,i	1,i	2,i	4,i	2,d	1,i	j-high tide insufficient ramp clearance
	Galini	6	1	2	1	2	5	3	2	k-excessive ramp angle low tide
	Arcade Falcon	i,j	i,j	i,j	i,j	i,j	i,j	i,j	i,j	m-excessive ramp angle high tide
	Golfo Dei Fiori	7	1	3	2	3	6	3,d	2	n-parallel ramp operation ONLY
	Ani	i,j	i,j	i,j	i,j	i,j	i,j	i,j	i,j	o-insufficient apron width for side ramp
	MV Goya	10	2	4	2	4	6	4,d	3	
	Cape I-class	4,i	1,i	a	a	a	b	a	a	
	Cape Victory	5	1	1	1	2	b	2	a	Ramp clearance and angle based on maximum vessel draft
	COMET	6,i	1,i	2,i	1,i	2,i	4,i	2,d,i	a,i	
	METEOR	5,i	1,i	2,i	1,i	a,i	4,i	2,d,i	a,i	
	Cape Gnome	i,j	i,j	2,i	1,i	a,i,j	i,j	a,d	a,i,j	♦ **May Prevent Operation**
	Cape Taylor	5	1	1	1	2	b	2	a	
	Cape Orlando	5,i	1,i	a	a	a	b	2	a	♦ **May Limit Operation**

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF LIVORNO
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS								
TYPE	**CLASS**	**14A-D**	**16**	**17-18**	**20**	**24**	**43-47**	**49-51**	**53-54**	**NOTES**
	MV Ambassador	k,m	k,m	k,m	k,m	k,m	k,m	k,m	k,m	a-vessel draft limit
	Callaghan	4	c	1	1	1	3	2,d	a	b-inadequate apron width
	Cape Lambert	i,j	i,j	a	a	1	b	a	a	c-inadequate berth length
	FSS	3, a	a,c	1,a	a,c	a	2,a,b	1,a	1,a	d-no straight stern ramp
	Cape R	4	1	a	a	a	3	a,d	a	e-no container handling equipment
	Cape E	i,j	i,j	a	a,c	a	b	a	a	f-anchorage depth OK, berth depth
	Cape D	4,i	1,i	a	a	a	b	a	a	inadequate
	Cape H	a	a,c	a	a	a	a,c	a	a	g-inadequate channel depth
	Cape Texas	5,i	1,i	1,i	1,i	2,i	b	2,i	a	h-no shore based ramps
CONTAINER	C6-M-147a	4	1,e	1,e	1,e	1	b	2,e	a,e	i-low tide insufficient ramp clearance
	C7-S-69c	4	1,e	a,e	a,e	a	b	a,e	a,e	j-high tide insufficient ramp clearance
	C7-S-68c	4	c,e	a,e	a,e	a	b	a,e	a,e	k-excessive ramp angle low tide
	C8-S-85c	3	c,e	a,e	a,e	a	b	a,e	a,e	m-excessive ramp angle high tide
	C9-M-132b	3	c,e	a,e	a,e	a	b	a,e	a,e	n-parallel ramp operation ONLY
	C9-M-F141a	a	a,c,e	a,e	a,c,e	a	a,b	a,e	a,e	o-insufficient apron width for side ramp
AUXILIARY CRANE	C6-S-1qd	4	1	a	a	a	b	a	a	Ramp clearance and angle based on maximum vessel draft
	C5-S-MA73c	5	1	a	a	a	b	a	a	
	C6-S-MA60d	4	1	a	a	a	b	a	a	
MPS	C7-S-133a	3	c	a	a	a	b	a	a	♦ **May Prevent Operation**
	Maersk	4	c	a	a	a	b	a	a	
	AmSea	4	1	a	a	a	b	a	a	♦ **May Limit Operation**

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

STAGING

Open Staging

The Port of Livorno has more than 100 acres of open staging area available. Much of this, about 45 acres, directly supports the Tuscany Docks Terminal.

Although the port does not have a specific location for supporting helicopter operations, the Tuscany Docks Terminal offers the best possibility for these type of operations. Another area offering support for helicopters is the U. S. Army facility at Camp Darby, about 2 miles away by road. On one mission during Operation Desert Shield, 100 helicopters landed and were prepared for ocean shipment at the Tuscany Docks Terminal.

Covered Staging

The port has about 415,000 square feet of covered storage. The warehouses and storage buildings providing this space are spread throughout the port's terminal areas. Most are privately owned and operated. Availability of these areas to support military operations will require arrangement with the building operators. Nearby Camp Darby is an alternative site for covered storage. The depot area has over 480,000 square feet of covered storage. (The depot likewise has more than 16 acres of open area that might support military deployment operations.)

Open Staging

Open Staging

Rail

One rail line connects the port's internal railway system with the Calambrone Railway Station for the terminals on the north end of the port and the Old Port Railway Station for those terminals on the south end. All terminals are rail served, including berth apron rail tracks at most of the terminals. The railway network within the port has about 72 kilometers of track, most of which supports intermodal rail operations. Several rail classification yards also support operations at the port. The Tuscany Docks Terminal has three loading or offloading spurs adjacent to the staging areas. Trains entering the Tuscany Terminal area must pass over a swinging rail bridge that crosses the Navicelli Canal. (The Navacelli Canal connects the port to the Tombolo Docks at Camp Darby, an area used to support ammunition shipping there.) Several locations throughout the port offer access for portable end ramps that can support "circus" style rail loading and unloading.

Calambrone Railway Station at Livorno

Highway

Highway access to most of the port's newer terminals is very good. An Autostrada extension, the Livorno Port-Florence Highway, connects the Tuscany Docks Terminal and other terminals on the Port's north side to the National Superhighway system. Access to the older terminal areas is adequate most of the time, but extremely congested at normal commuting hours. Most roads leading to these older terminals pass through congested city streets. The port's terminals are connected by a number of internal roads, which are poorly marked and are often very congested.

The port is served by two main gates. The Tuscany Dock Terminal Gate off the Via Massaua, connects that terminal and other northern terminals to the highway system. This route passes over the Calambrone Bridge crossing the Navicelli Canal. The older terminals are accessed by the gate on Via Del Porticolo. Once inside these gates, the port's terminals are accessed by individual entrances from the internal roadway system. There are no unusual height or weight restrictions leading into the port from the main highway network.

Gate into Tuscany Docks Terminal

UNLOADING/LOADING POSITIONS

Ramps

Although the Port of Livorno does not have any fixed rail or truck ramps, there are several portable rail and truck ramps available for use. Several locations throughout the port offer adequate sites for employing these ramps. The Tuscany Docks Terminal has three rail spurs adjacent to the staging area that are the best location for ramp usage. Likewise, portable truck ramps can be used in the dock's staging area.

Rail Loading and Unloading Spurs at Tuscany Docks Terminal

Docks

No docks exist for truck or boxcar loading or unloading at the port.

MARSHALING AREAS

No marshaling areas exist immediately adjacent to the port. The closest areas usable for this purpose are located at Camp Darby and the Depot. Together, these areas offer more than 30 acres that could serve as marshaling areas to support military operations. If needed, some of the area within the Tuscany Docks Terminal could also support marshaling requirements.

MATERIAL HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity (STON)	Quantity	Wharf Assignment
Container Cranes	45 45 45	6 2 3	Tuscany Docks Terminal Deep Sounding Quay Sintermar Terminal
Wharf Cranes	4 8-16 12 8-16 6 8-16	5 4 1 3 1 2	Deep Sounding Quay Deep Sounding Quay Orlando Terminal Carrara Terminal Sgarallino Terminal Addis Abeba Terminal
Rail-Mounted Gantry Cranes	45	3	Tuscany Docks Terminal
Rubber-Tired Transtainers	40+	8	Port Area
Container Handler/Stacker	40	23	Port Area
Mobile Cranes	63 40 36	1 1 1	Port Area Port Area Port Area
Forklifts	Up to 35	210	Port Area

NOTE: The table above represents equipment owned by the port as well as private companies operating within the port. The list is not “all inclusive” as actual totals may change.

Typical MHE Available at Livorno

HAZARDOUS CARGO

The Port of Livorno does not permit movement of ammunition or explosive cargo through the port. Permission from the Port Captain for this type of movement must be requested as far in advance as possible. Approval ***may*** be granted on a case-by-case basis.

FUTURE DEVELOPMENT

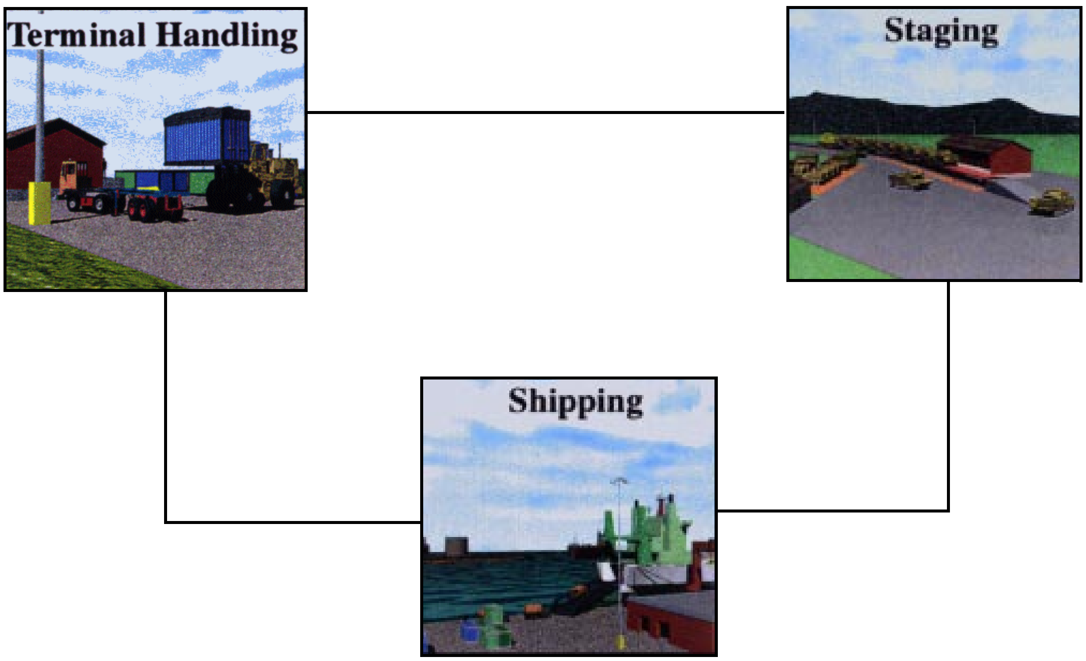
The Port of Livorno authorities indicate that foremost of developmental plans for the port is deepening of the Tuscany Docks Berths to 44 feet. While this is planned "soon," a timetable for the work is not available.

Tuscany Docks

THROUGHPUT ANALYSIS

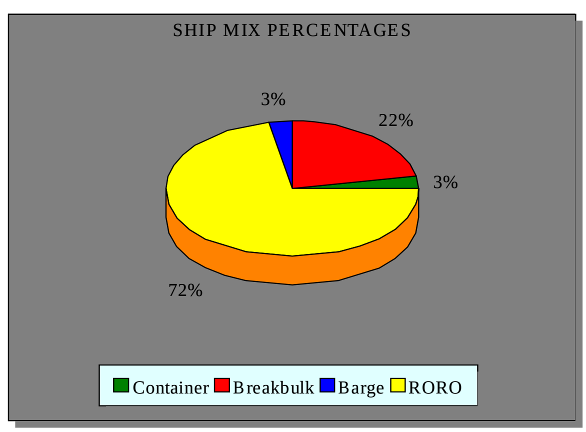
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capability of the Port of Livorno. The POPS model performs a weak-link analysis in which each of three subsystems is analyzed separately and then compared to find the least capable. The weakest subsystem determines the maximum throughput capability of the port. The model yields throughput capability values for each of the subsystems - terminal handling/ processing, staging, and ship loading/unloading - in terms of short tons (STON) and measurement tons (MTON) per day.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 60 percent of the port's facilities will support military deployments. Also, because of the port's size, we assume that the berths will have a ship alongside 70 percent of the time. The ship mix is determined by statistics collected during Operations Desert Shield and Desert Storm. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL CLEARANCE/HANDLING

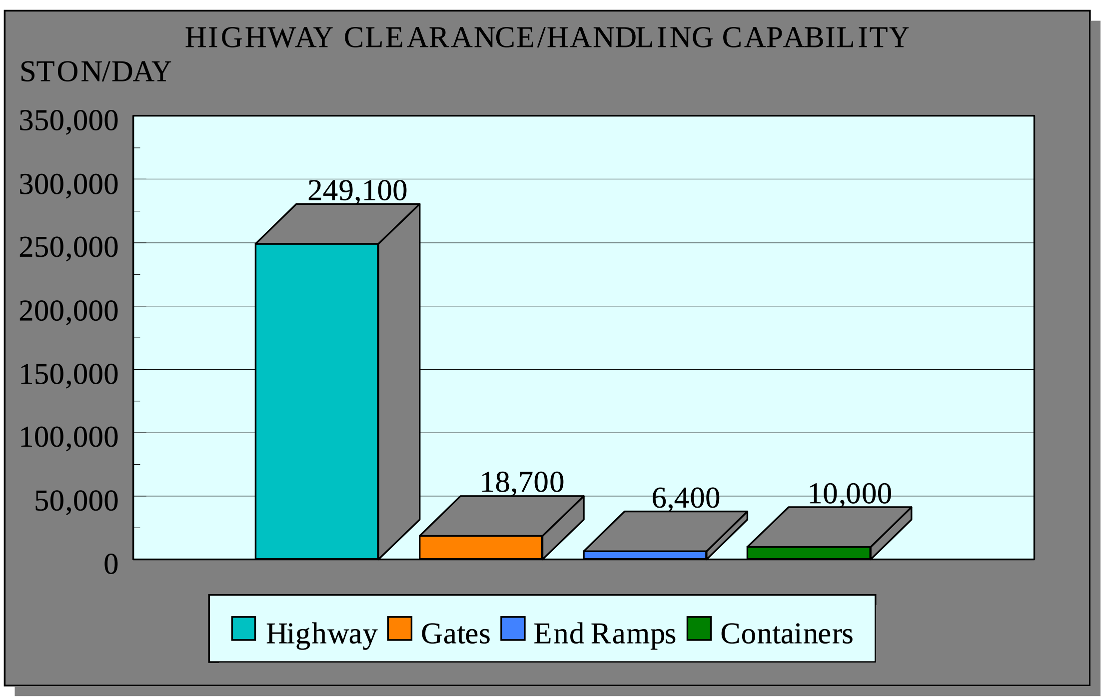
Highway

The new Livorno Port-Florence Highway is the principle highway connecting the port's northside terminals by way of Viale Leonardo Da Vinci and Via Vasco Natale Iacopini to the national highway network. On the southside, several roads connect the port's older terminals to the highway system. These roads include Via Del Porticolo, Via Delle Catteratte, and Via Salvatore Orlando. The road network in and out of the port can handle about 250,000 STON of equipment a day. The two gates can process about 18,700 STON of cargo daily.

Roadable vehicles will process directly to or from staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading or unloading, must depend on portable ramps. We assume that deploying forces will build or acquire at least two more of these for servicing these types of vehicles. Four of these ramps can handle at least 6,400 STON of military vehicles and equipment per day.

The port has no truck docks.

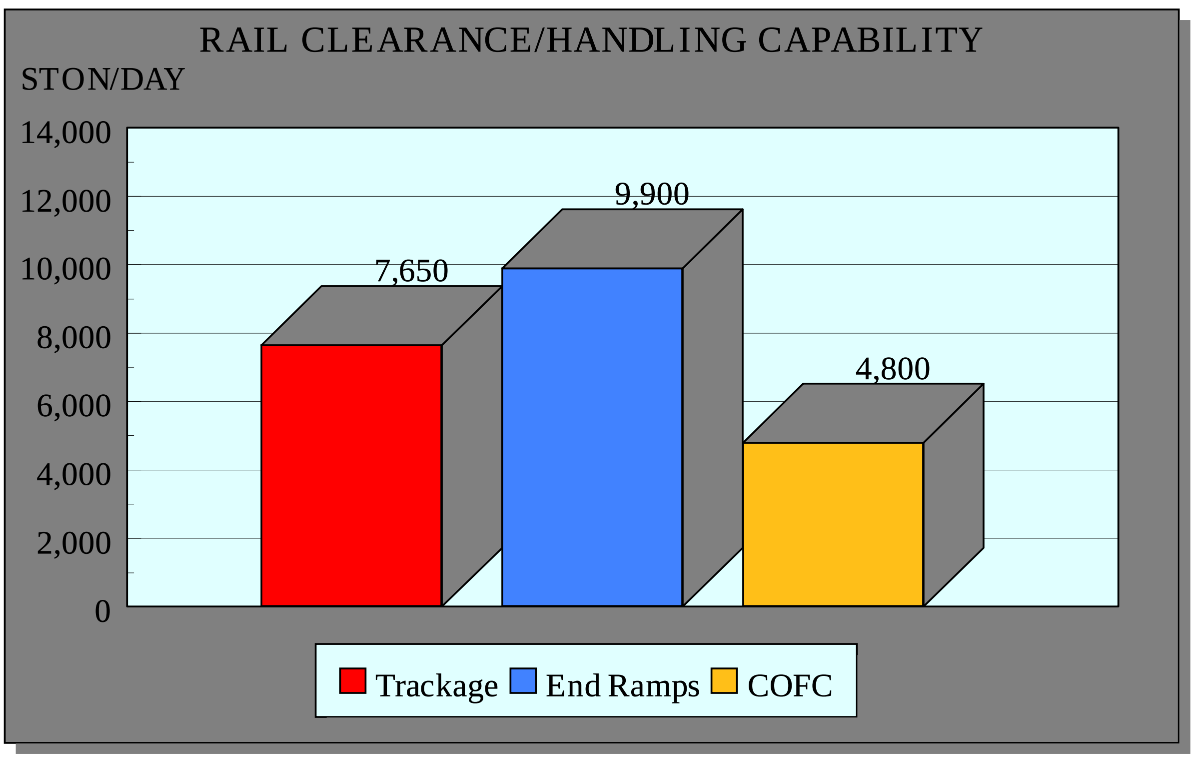
The Port of Livorno has 3 rail-mounted gantry cranes, 8 wheeled transtainers, and 23 container handler/stackers. Most of this equipment supports container operations in the Tuscany Docks Terminal, but the mobile equipment can move throughout the port area as required. Assuming one-third of this equipment is available to support container operations, the port could easily handle over 10,000 STON per day.



Rail

The Italian State Railroad (FS) could support military operations with at least seven trains per day. These trains will consist of about 25 cars each. These trains provide a daily trackage capability of about 7,650 STON. Vehicles on flatcars must use portable ramps for "circus" style loading or unloading. We assume deploying forces would build or acquire at least three portable end ramps to support their operations. The best location to place the ramps is at the three loading spurs adjacent to the staging area in the Tuscany Docks Terminal. There are several other locations within the port where operators can place ramps. Three end ramps, supporting 16-17 sixty-foot railcars per interchange, will provide a daily loading or unloading capability of about 9,900 STON, based on four interchanges per 20-hour day.

Assuming a conservative 200 lifts per day, the 3 rail-mounted transtainers at the Tuscany Docks could load at least 4,800 STON of containers on flatcars (COFC) per day.

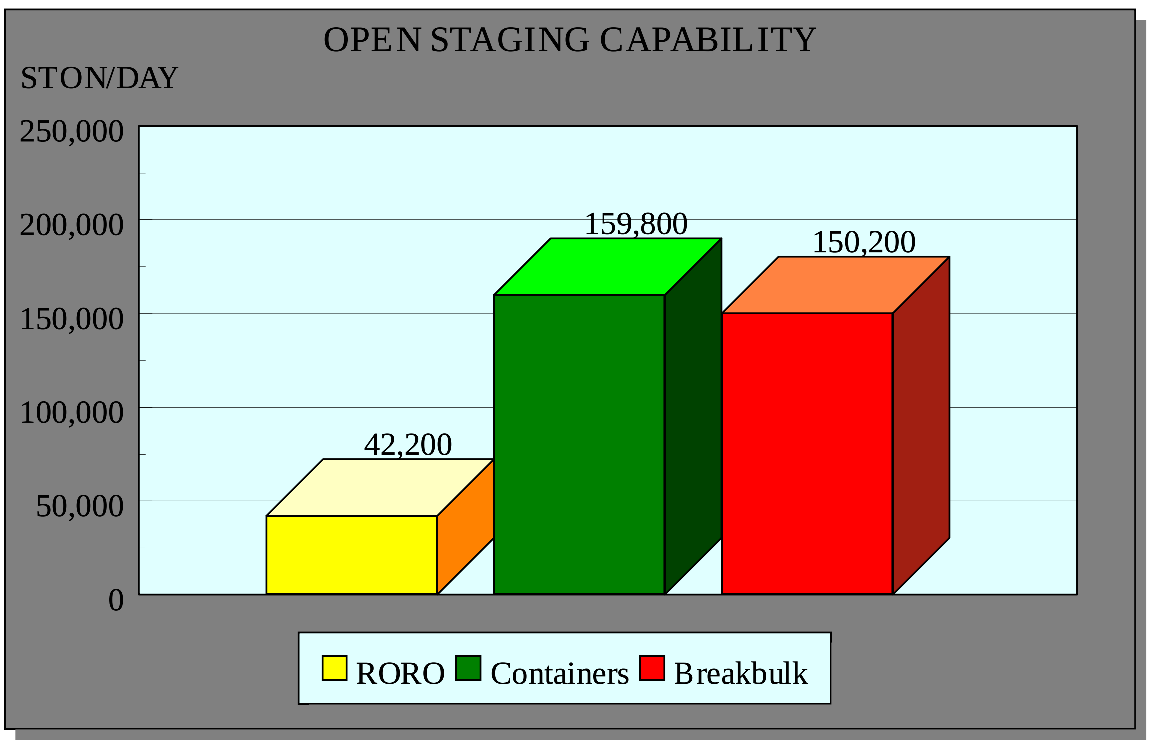


Staging

The port has about 101 acres of paved open staging areas scattered throughout the terminal areas. About one-half of the overall area is adjacent to the Tuscany Docks Terminal. Like most commercial ports, the Port of Livorno is a busy enterprise. Available staging areas will depend on the amount of commercial traffic at any given time. A high range of 60 percent to as little as 30 percent of the overall area will most likely offer support to military operations at the port.

There is very little public covered staging at the port. Most warehouses and other storage buildings are privately owned and operated. Access to these areas will likely depend on separate contractual arrangements with owner operators.

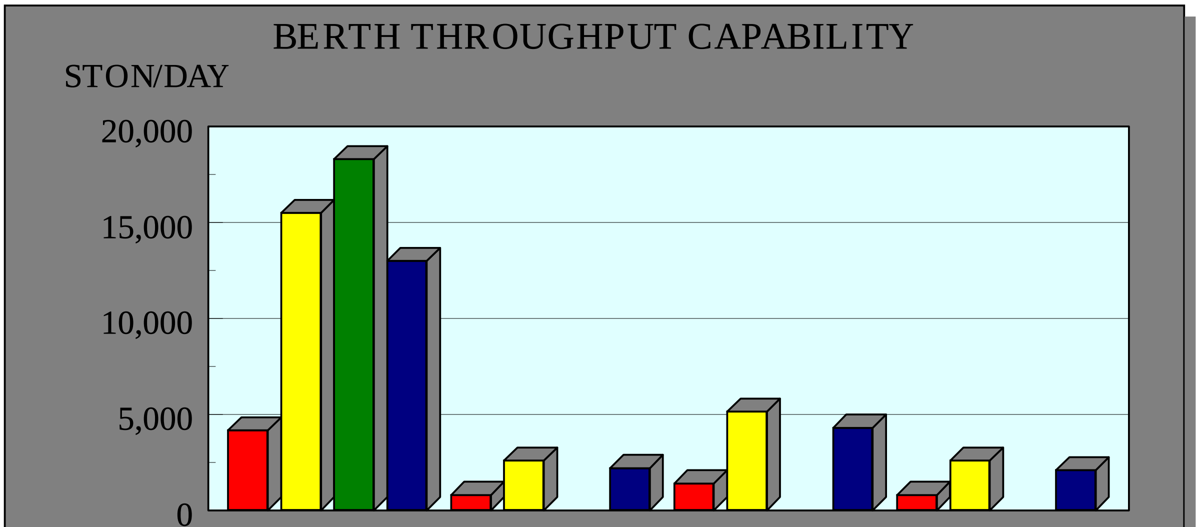
The port supports all modes of cargo operations, offering accommodations to RORO, container, and breakbulk vessels. Our analysis considered the staging requirements of all modes of cargo and applied these to the staging areas. The chart below illustrates staging distribution for each cargo type. Where combination ships are expected, then a portion of each staging mode should be distributed accordingly.



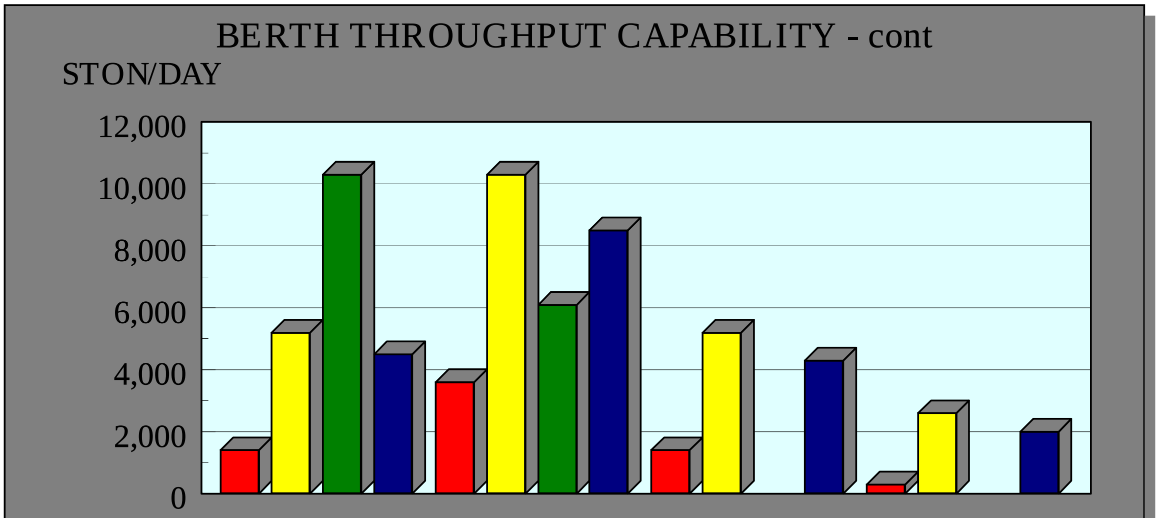
Shipping

The following charts show throughputs for shiploading at the berths. Each mode shown depicts the maximum capability per day for that type of cargo on that berth. Mixed number is attained by applying the ship mix to the overall port. We made other assumptions to support our analysis, these include: MHE availability; loading, operational, and berth usage rates; and berth capabilities for various vessel types. A complete list of assumptions used in the analysis are in the appendix.

The following table shows conversion factors applicable throughout the analysis.



	Berth 14A-D	Berth 16	Berth 17-18	Berth 20
Breakbulk	4,160	800	1,400	800
RORO	15,500	2,600	5,150	2,600
Container	18,300	0	0	0
Mixed	13,000	2,200	4,300	2,100



	Berth 24	Berth 43-47	Berth 49-51	Berth 53-54
Breakbulk	1,400	3,600	1,400	300
RORO	5,200	10,300	5,200	2,600
Container	10,300	6,100	0	0
Mixed	4,500	8,500	4,300	2,000

CONVERSION FACTORS	
Breakbulk	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON

DAILY THROUGHPUT SUMMARY FOR PORT OF LIVORNO

BERTH	LENGTH (FEET)	DEPTH ALONGSIDE (FEET)	BREAKBULK THROUGHPUT (STON)	RORO THROUGHPUT (STON)	RORO SQUARE FEET (EST)	RORO (PIECES)[10]	CONTAINER THROUGHPUT (STON)	CONTAINER THROUGHPUT (TEU)	MIXED THROUGHPUT (STON)
14A-C	3,311	35[11]	4,200	15,500	309,640	1,821	18,300	2,286	13,000
16	690	35	800	2,600	51,600	304	0	0	2,200
17-18	1,312	29	1,400	5,200	103,200	607	0	0	4,300
20	875	29	800	2,600	51,600	304	0	0	2,100
24	1,351	28	1,400	5,200	103,200	607	10,300	1,288	4,500
43-47	2,505	35	3,600	10,300	206,420	1,214	6,100	762	8,500
49-51	1,485	30	1,400	5,200	103,200	607	0	0	4,300
53-54	980	25	300	2,600	51,600	304	0	0	2,000
TOTAL[12]			14,000	49,000	980,460	5,768	34,700	4,336	40,800

[10] Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

[11] Berth 14D has only 30 feet depth alongside until completion of maintenance dredging. Once complete, all of the berths (14A-D) will have 39.5 feet depth alongside.

[12] Port total throughput by mode. Mixed total computed by applying shipmix.

BERTH PREFERENCE SELECTION

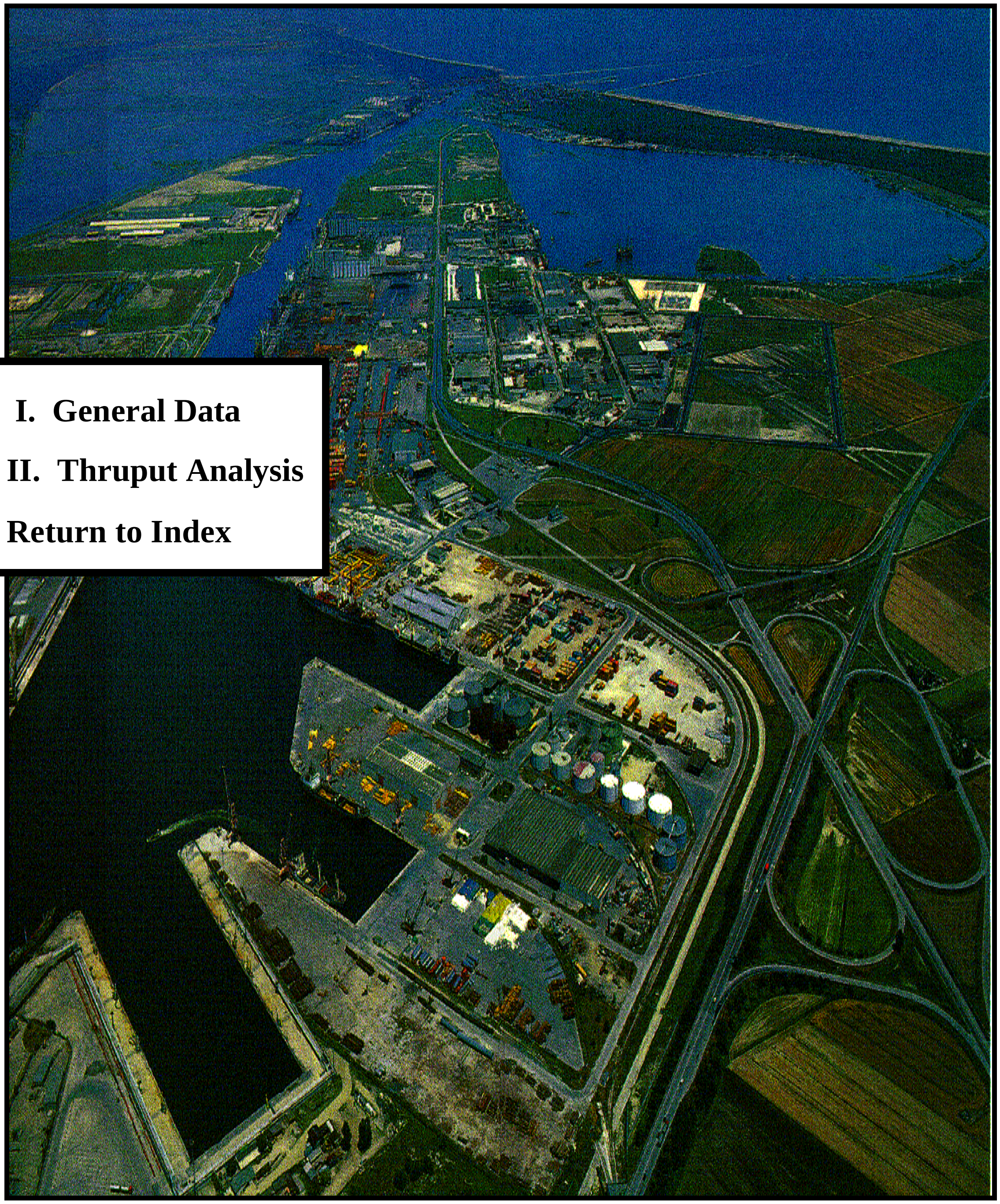
We base the type of ship preferred at each berth on the methodology described in the appendix. The evaluation is a snapshot view of the current physical characteristics of the berths and available MHE. The evaluation gives no consideration for enhancements, such as equipment, not now available to support operations at the berths. The lower the number for a berth, the better the berth is suited to support the loading or unloading operation rated. In general, no one berth is ideal for all types of cargo operations. The best berth depends on the vessel type worked.

In the Port of Livorno, because of various factors, for example, depth alongside, open staging availability, and container handling capability, etc.so forth, the most capable and recommended berths are berths 14A-C at the Tuscany Docks Terminal. These are the most desirable for military operations.

BERTH EVALUATION SELECTION

LOADING TYPE	BERTHS							
	14A-C	16	17-18	20	24	43-47	49-51	53-54
BREAKBULK	1	6	3	7	3	2	3	8
RORO	1	6	3	6	3	2	3	6
CONTAINER	1	-	-	-	2	3	-	-
NOTE: Berths marked with a "-" are not recommended for these operations.								

PORT OF RAVENNA, ITALY



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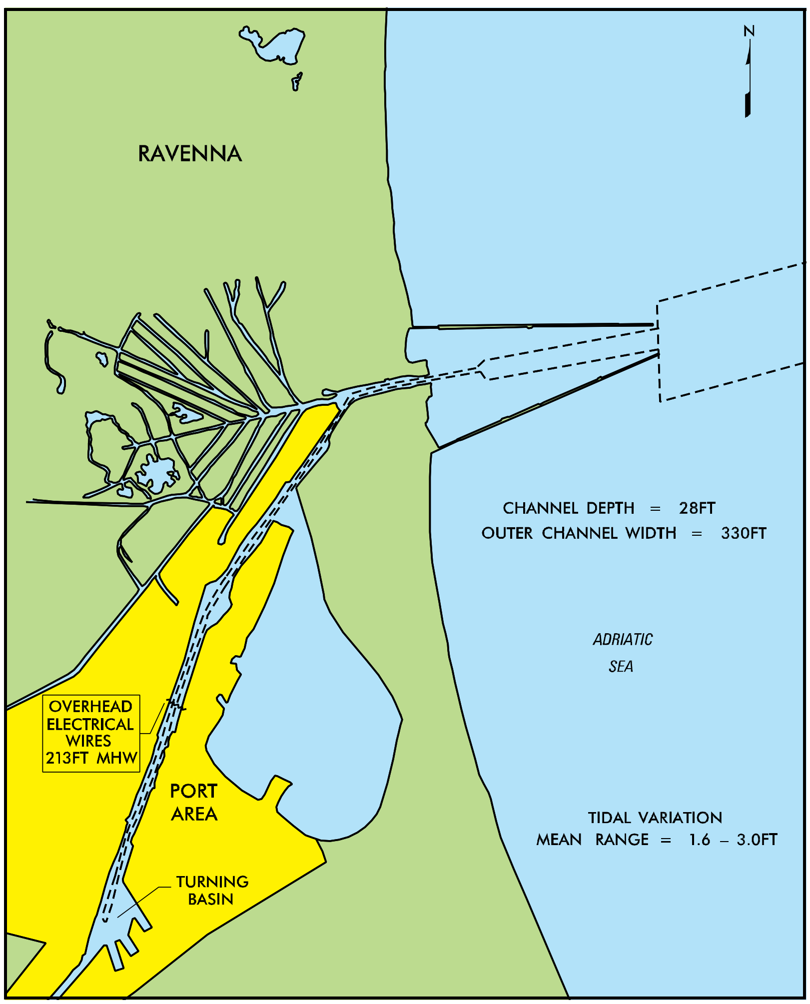
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Ravenna (44º 29.5' north latitude and 12º 17' east longitude) is on the northeast coast of Italy along the Adriatic Sea. Consisting of multicargo piers and wharves, the port is easily capable of a wide variety of shipping operations. Located on a canal accessing the Adriatic Sea, the port has only one vertical or overhead restriction. Overhead electrical wires (213 feet mean high water (MHW)) cross the canal between the New and Setramar Terminals. Deep draft anchorages are located 6 and 11 miles from the port (drafts of 32.8 feet and 65.6 feet, respectively). A 1,148-foot diameter ship turning basin is located next to the San Vitale Docks (part of Sapir Terminal). Maximum ship dimensions allowed to use this basin are 833-885 feet in length, 114 feet wide, and 28 feet in draft. The channel depth into the port is about 28 feet.



Water Access Map

Highway

Located along the Candiano Canal, the Port of Ravenna has direct highway access to Autostrada A14 via SS67. A14, an interstate-type highway, runs northwest/southeast along the Adriatic Coast. Routes Autostrada A14 dir. and SS71 lead from A14 to route SS16, the road connecting to SS67. These routes have no unusual clearance (vertical and lateral) or weight restrictions.

Air

Two airports are near the seaport. A military airport (NATO) is at Cervia (12 miles southeast of the port). The nearest commercial airport is at Forli (18 miles west of the port) these airports have one runway each. Both runways are about 10,000 feet in length.

Rail

Branch rail lines extend from the main line that runs northwest/southeast along the Adriatic Coast to the city of Ravenna. Rail lines extend from these branch lines to the port. No unusual clearance restrictions exist on the rail lines accessing the port. Rail activity at the port is moderate.

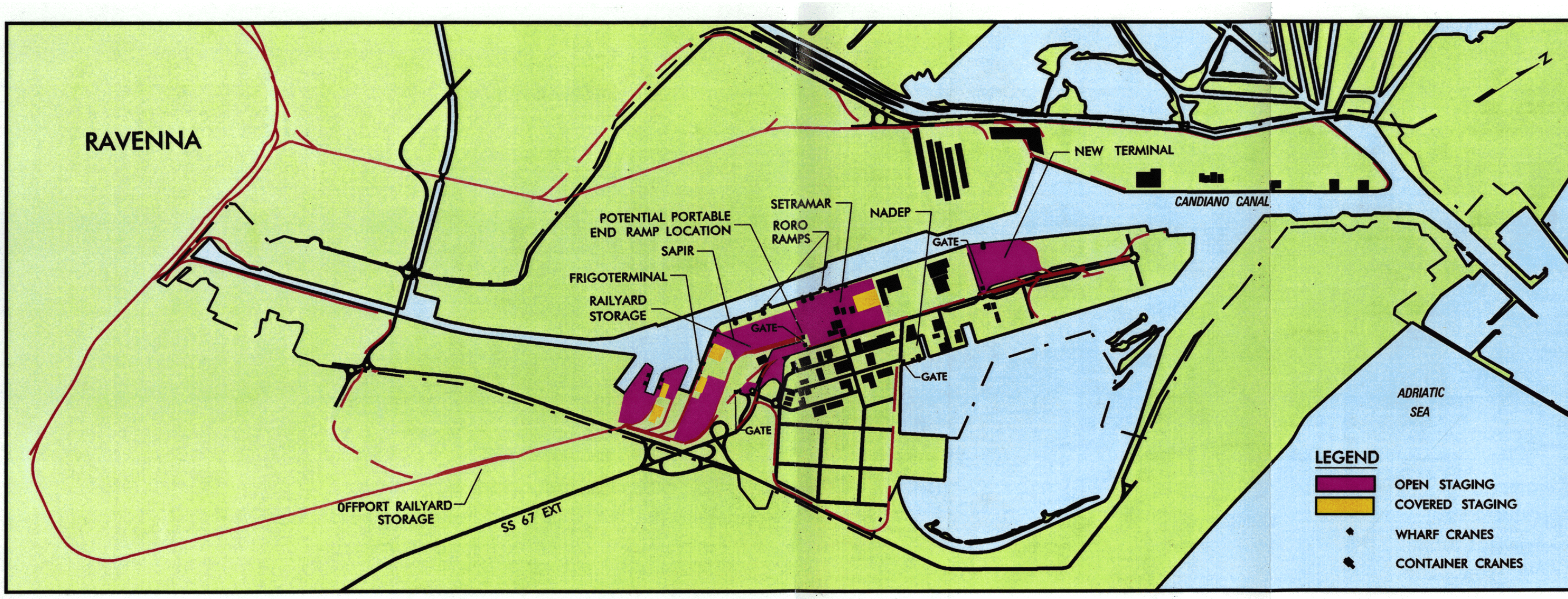
Transportation Access Map

PORT FACILITIES

Berthing

The port is administered by the Port Authority and the Ravenna Chamber of Commerce, but leased to private owners much like the Port of Oakland, California. Since all of the port is privately owned, deploying units must negotiate with terminal operators for use of the terminals. The New, Setramar, Sapir (to include the Frigoterminal), and Nadep Terminals are versatile and the most desirable for military operations. They are modern facilities having ample wharf and container cranes for offloading ships, large staging areas, materials handling equipment (MHE) for material handling, and easy access to the main highway. The Sapir Terminal has rail access. Other terminals are available, however, they are generally specific-use terminals that may not be readily adaptable to military deployments. Lighting exists throughout the port.

Port of Ravenna



Port of Ravenna - Land-use Map

BERTH CHARACTERISTICS

	Berths					
CHARACTERISTICS	New	Nadep	Setramar	Sapir 1	Sapir 2 plus Frigoterminal	Sapir 3
Length (ft)	984	1,312	2,017	2,188	1,860	328
Depth alongside at MLW (ft)	30	23	30	30	30	30
Deck Strength (psf)	800	800	800	800	800	800
Apron width (ft)	Open	Open	Open	Open	Open	Open
Apron height above MLW (ft)	6	6	6	6	6	6
Number of container cranes	1	1	2	3	0	0
Number of wharf cranes	0	1	3	0	4	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	Yes	Yes	Yes	No	Yes
Apron length served by rail (ft)	0	0	0	0	1,860	0

New Terminal

Setramar

Sapir 1

BERTH CHARACTERISTICS

	Berths				
CHARACTERISTICS	**Sapir 4**	**Sapir 5**	**Sapir 6**	**Sapir 7**	**Sapir 8**
Length (ft)	600	548	548	328	656
Depth alongside at MLW (ft)	30	30	30	30	30
Deck Strength (psf)	800	800	800	800	800
Apron width (ft)	Open	Open	Open	Open	Open
Apron height above MLW (ft)	6	6	6	6	6
Number of container cranes	0	0	0	0	0
Number of wharf cranes	0	0	2	0	2
Apron lighting	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	Yes	No
Apron length served by rail (ft)	600	0	548	0	656

Sapir 2 Plus Frigoterminal

Sapir 4

Sapir 8

PORT OF RAVENNA
SUMMARY OF BERTHING CAPABILITIES

VESSELS		BERTHS						
TYPE	CLASS	New	Nadep	Setramar	Sapir 1	Sapir 2 & Frigo	Sapir 3	
BREAKBULK	C3-S-38a	1	a	3	4	3	c	**NOTES:**
	C4-S-58a	a,g	a,g	a,g	a,g	a,g	a,c,g	a-vessel draft limit
	C4-S-66a	a,g	a,g	a,g	a,g	a,g	a,c,g	b-inadequate apron width
	C5-S-37e	g	a,g	g	g	g	c,g	c-inadequate berth length
SEATRAIN	GA and PR	1	a	3	3	3	c	d-no straight stern ramp
BARGE	LASH C8-S-81b	a,f,g	a,f,g	a,f,g	a,f,g	a,f,g	a,c,f,g	e-no container handling equipment
	LASH C9-S-81d	a,g	a,g	a,g	a,g	a,g	a,c,g	f-anchorage depth OK, berth depth
	LASH Lighter	4	6	10	10	9	1	inadequate
	SEABEE C8-S-82a	a,g	a,g	a,g	a,g	a,g	a,c,g	g-inadequate channel depth
	SEABEE Barge	4	6	10	10	9	1	h-no shore based ramps
RORO	Jolly Smeraldo	a,g	a,g	a,g	a,g	a,g	a,c,g	i-low tide insufficient ramp clearance
	Isola Delle Perle	1,d	2	3	3	3,d	c	j-high tide insufficient ramp clearance
	Galini	2	2	4	4	3	c	k-excessive ramp angle low tide
	Arcade Falcon	i,j	i,j	i,j	i,j	i,j	c	m-excessive ramp angle high tide
	Golfo Dei Fiori	2,d	3,m	4,m	5,m	4,d	c,m	n-parallel ramp operation ONLY
	Ani	i,j	i,j	i,j	i,j	i,j	i,j	o-insufficient apron width for side ramp
	MV Goya	3,d	4	6	7	6,d	1	
	Cape I-class	a,g	a,g	a,g	a,g	a,g	a,c,g	
	Cape Victory	1	a	3	3	2	c	Ramp clearance and angle based on maximum vessel draft
	COMET	1,d	a	3	4	3,d	c	
	METEOR	g,d	a,g	g	g	g,d	c,g	
	Cape Gnome	a,g,d	a,g,i,j	a,g,i,j	a,g,i,j	a,g,d	a,c,g,i,j	♦ **May Prevent Operation**
	C7-S-95a	a,g	a,g	a,g	a,g	a,g	a,c,g	
	Cape Taylor	1	a	3	3	2	c	♦ **May Limit Operation**
	Cape Orlando	g	a,g	g	g	g	c,g	

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF RAVENNA
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS						
TYPE	CLASS	New	Nadep	Setramar	Sapir 1	Sapir 2 & Frigo	Sapir 3	NOTES
	MV Ambassador	d	k,m	k,m	k,m	d	c,k,m	a-vessel draft limit
	Callaghan	1,d	a	2	3	2,d	c	b-inadequate apron width
	Cape Lambert	a,g	a,g	a,g	a,g	a,g	a,c,g	c-inadequate berth length
	FSS	a,g	a,g	a,g	a,g	a,g	a,c,g	d-no straight stern ramp
	Cape R	a,g,d	a,g	a,g	a,g	a,g,d	a,c,g	e-no container handling equipment
	Cape E	a,g	a,g	a,g	a,g	a,g	a,c,g	f-anchorage depth OK, berth depth
	Cape D	a,g	a,g	a,g	a,g	a,g	a,c,g	inadequate
	Cape H	a,g	a,g	a,g	a,g	a,g	a,c,g	g-inadequate channel depth
	Cape Texas	1	a	3	3	2	c	h-no shore based ramps
CONTAINER	C6-M-147a	1	a	2	3	2,e	c,e	i-low tide insufficient ramp clearance
	C7-S-69c	a,g	a,g	a,g	a,g	a,e,g	a,c,e,g	j-high tide insufficient ramp clearance
	C7-S-68c	a,g	a,g	a,g	a,g	a,e,g	a,c,e,g	k-excessive ramp angle low tide
	C8-S-85c	a,g	a,g	a,g	a,g	a,e,g	a,c,e,g	m-excessive ramp angle high tide
	C9-M-132b	a,g	a,g	a,g	a,g	a,e,g	a,c,e,g	n-parallel ramp operation ONLY
	C9-M-F141a	a,g	a,g	a,g	a,g	a,e,g	a,c,e,g	o-insufficient apron width for side ramp
AUXILIARY CRANE	C6-S-1qd	a,g	a,g	a,g	a,g	a,g	a,c,g	Ramp clearance and angle based on maximum vessel draft
	C5-S-MA73c	a,g	a,g	a,g	a,g	a,g	a,c,g	
	C6-S-MA60d	a,g	a,g	a,g	a,g	a,g	a,c,g	
MPS	C7-S-133a	a,g	a,g	a,g	a,g	a,g	a,c,g	♦ **May Prevent Operation**
	Maersk	a,g	a,g	a,g	a,g	a,g	a,c,g	
	AmSea	a,g	a,g	a,g	a,g	a,g	a,c,g	♦ **May Limit Operation**

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF RAVENNA
SUMMARY OF BERTHING CAPABILITIES

VESSELS		BERTHS					
TYPE	**CLASS**	**Sapir 4**	**Sapir 5**	**Sapir 6**	**Sapir 7**	**Sapir 8**	
BREAKBULK	C3-S-38a	1	1	1	c	1	**NOTES:**
	C4-S-58a	a,g	a,c,g	a,c,g	a,c,g	a,g	a-vessel draft limit
	C4-S-66a	a,g	a,g	a,g	a,c,g	a,g	b-inadequate apron width
	C5-S-37e	g	c,g	c,g	c,g	g	c-inadequate berth length
SEATRAIN	GA and PR	1	c	c	c	1	d-no straight stern ramp
BARGE	LASH C8-S-81b	a,c,f,g	a,c,f,g	a,c,f,g	a,c,f,g	a,c,f,g	e-no container handling equipment
	LASH C9-S-81d	a,c,g	a,c,g	a,c,g	a,c,g	a,c,g	f-anchorage depth OK, berth depth
	LASH Lighter	3	2	2	1	3	inadequate
	SEABEE C8-S-82a	a,c,g	a,c,g	a,c,g	a,c,g	a,c,g	g-inadequate channel depth
	SEABEE Barge	3	2	2	1	3	h-no shore based ramps
RORO	Jolly Smeraldo	a,c,g	a,c,g	a,c,g	a,c,g	a,g	i-low tide insufficient ramp clearance
	Isola Delle Perle	1,d	c,d	c,d	c	1,d	j-high tide insufficient ramp clearance
	Galini	1	1	1	c	1	k-excessive ramp angle low tide
	Arcade Falcon	i,j	i,j	i,j	c	i,j	m-excessive ramp angle high tide
	Golfo Dei Fiori	1,d	1,d	1,d	c,m	1,d	n-parallel ramp operation ONLY
	Ani	i,j	i,j	i,j	i,j	i,j	o-insufficient apron width for side ramp
	MV Goya	1,d	1,d	1,d	1	2,d	
	Cape I-class	a,c,g	a,c,g	a,c,g	a,c,g	a,c,g	
	Cape Victory	c	c	c	c	1	Ramp clearance and angle based on
	COMET	1,d	1,d	1,d	c	1,d	maximum vessel draft
	METEOR	g,d	g,d	g,d	c,g	g,d	
	Cape Gnome	a,c,g,d	a,c,g,d	a,c,g,d	a,c,g,i,j	a,g,d	♦ **May Prevent Operation**
	C7-S-95a	a,c,g	a,c,g	a,c,g	a,c,g	a,c,g	
	Cape Taylor	c	c	c	c	1	♦ **May Limit Operation**
	Cape Orlando	c,g	c,g	c,g	c,g	g	

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

PORT OF RAVENNA
SUMMARY OF BERTHING CAPABILITIES - cont

VESSELS		BERTHS					
TYPE	**CLASS**	**Sapir 4**	**Sapir 5**	**Sapir 6**	**Sapir 7**	**Sapir 8**	**NOTES**
	MV Ambassador	d	d	d	c,k,m	d	a-vessel draft limit
	Callaghan	c,d	c,d	c,d	c	c,d	b-inadequate apron width
	Cape Lambert	a,c,g	a,c,g	a,c,g	a,c,g	a,c,g	c-inadequate berth length
	FSS	a,c,g	a,c,g	a,c,g	a,c,g	a,c,g	d-no straight stern ramp
	Cape R	a,c,g,d	a,c,g,d	a,c,g,d	a,c,g	a,g,d	e-no container handling equipment
	Cape E	a,c,g	a,c,g	a,c,g	a,c,g	a,g	f-anchorage depth OK, berth depth
	Cape D	a,c,g	a,c,g	a,c,g	a,c,g	a,c,g	inadequate
	Cape H	a,c,g	a,c,g	a,c,g	a,c,g	a,c,g	g-inadequate channel depth
	Cape Texas	c	c	c	c	1	h-no shore based ramps
CONTAINER	C6-M-147a	c,e	c,e	c,e	c,e	c,e	i-low tide insufficient ramp clearance
	C7-S-69c	a,c,e,g	a,c,e,g	a,c,e,g	a,c,e,g	a,c,e,g	j-high tide insufficient ramp clearance
	C7-S-68c	a,c,e,g	a,c,e,g	a,c,e,g	a,c,e,g	a,c,e,g	k-excessive ramp angle low tide
	C8-S-85c	a,c,e,g	a,c,e,g	a,c,e,g	a,c,e,g	a,c,e,g	m-excessive ramp angle high tide
	C9-M-132b	a,c,e,g	a,c,e,g	a,c,e,g	a,c,e,g	a,c,e,g	n-parallel ramp operation ONLY
	C9-M-F141a	a,c,e,g	a,c,e,g	a,c,e,g	a,c,e,g	a,c,e,g	o-insufficient apron width for side ramp
AUXILIARY CRANE	C6-S-1qd	a,c,g	a,c,g	a,c,g	a,c,g	a,c,g	Ramp clearance and angle based on maximum vessel draft
	C5-S-MA73c	a,c,g	a,c,g	a,c,g	a,c,g	a,g	
	C6-S-MA60d	a,c,g	a,c,g	a,c,g	a,c,g	a,c,g	
MPS	C7-S-133a	a,c,g	a,c,g	a,c,g	a,c,g	a,c,g	♦ **May Prevent Operation**
	Maersk	a,c,g	a,c,g	a,c,g	a,c,g	a,c,g	
	AmSea	a,c,g	a,c,g	a,c,g	a,c,g	a,c,g	♦ **May Limit Operation**

NOTE: Vessels showing a berthing limitation due to no available straight-stern ramp may still be able to work at some of the berths by performing a "med moor" operation. This involves backing into the face of the marginal wharf and using the wharf face as a straight-stern ramp. Not all berths will provide this facility.

STAGING

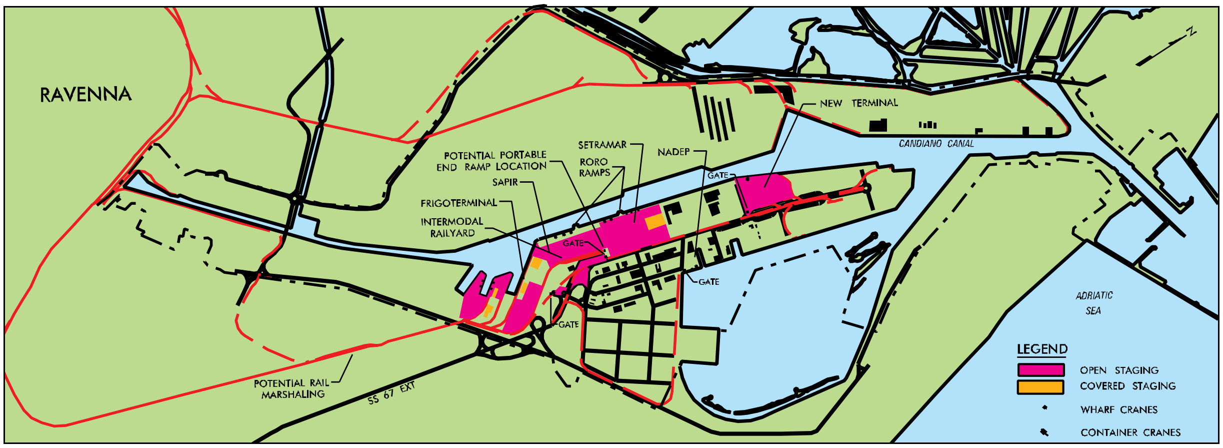
Open Staging

The Port of Ravenna has over 250 acres of open storage available at the New, Setramar, Sapir, and Nadep terminals. Other open staging is available in other terminals if needed.

The port has several areas capable of helicopter operations. All of the terminals named above have enough open space available to conduct helicopter operations.

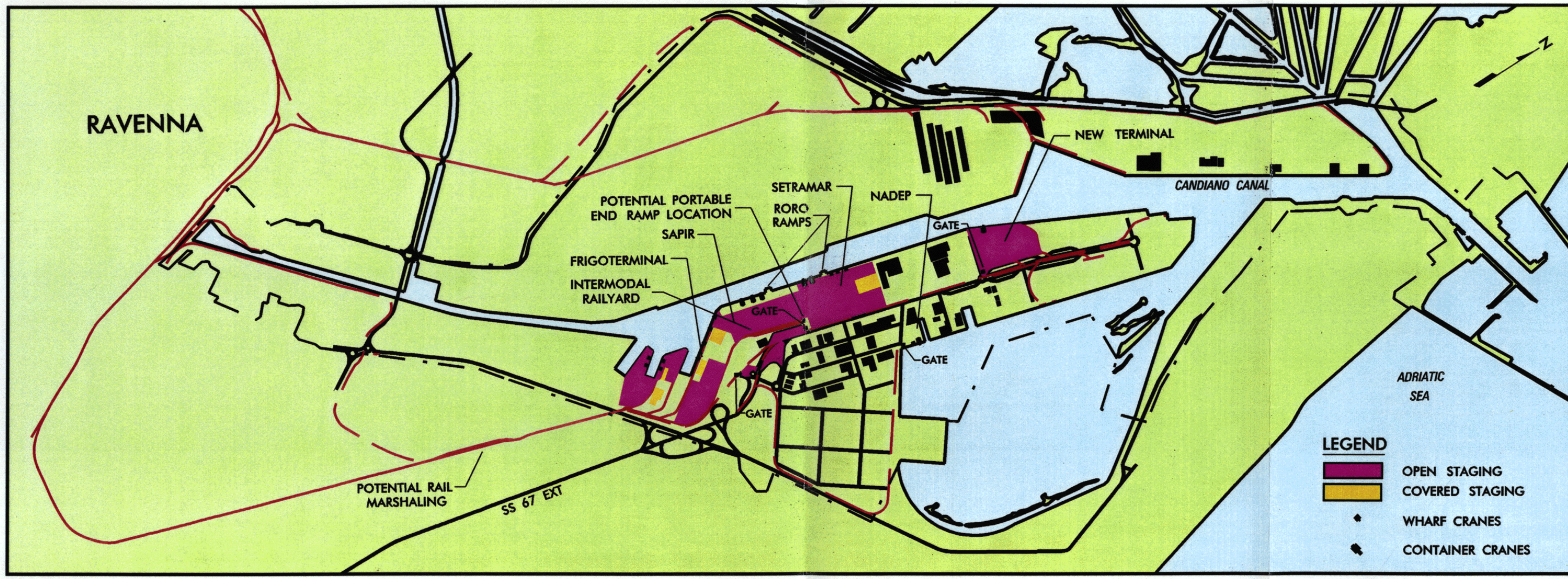
Covered Staging

The Port of Ravenna has more than 268,000 square feet of covered staging among the Setramar and Sapir Terminals combined. Other open staging is available in other terminals if needed. Since all of the port is leased out to private ownership, deploying units must negotiate with the terminal operators for use of this covered storage.



Open Staging

See next page for Open Staging Enlargement



Open Staging

Rail

Rail lines extend from the branch rail lines near the rail station in Ravenna into the port. Apron tracks are on the wharf and piers of the Sapir Terminal. Dual rail spurs are on the Sapir 2 (to include the Frigoterminal), Sapir 4, Sapir 6, and Sapir 8 wharves. A small railcar storage yard is located on the Sapir Terminal and is mainly used for intermodal operations. Another railcar storage yard exists just outside the port (west of the port) and has potential to be a railcar marshaling yard.

Highway

The SS67 Extension into the port is four-laned (two lanes for each direction). Each terminal has its own gate. One lane is allocated for each direction at each of the gates. There are no unusual height or weight restrictions leading into the port from the main road networks. Truck scales are available at each terminal.

Sapir Terminal Gate

New Terminal Truck Scale

UNLOADING/LOADING POSITIONS

Ramps

The Port of Ravenna does not have any fixed or portable rail or truck ramps in the port. Deploying units must supply portable ramps for offloading railcars and semitrailers not equipped with a means for offloading wheeled/tracked vehicles. The port has several locations for rail end ramp operations. These include the intermodal yard, and apron tracks all within the Sapir Terminal. Another potential location is the railcar marshaling yard just west of the port. This railyard, however, is not a secure area.

Rail Marshaling Yard

Docks

No docks exist for truck or boxcar loading/offloading.

MARSHALING AREAS

The port has plenty of open staging areas that could be used for marshaling operations. More than 250 acres of open storage are available at the New, Setramar, Sapir, and Nadep Terminals. More open storage is available at other terminals if needed. The railyard outside the port could be used for marshaling railcars.

MATERIAL HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity (STON)	Quantity	Wharf Assignment
Container Cranes	44 33 33 33	3 2 1 1	Sapir Setramar New Nadep
Wharf Cranes	33 33 33	8 3 1	Sapir Setramar Nadep
Yard Gantry Cranes	44	4	Sapir
Mobile Cranes	various	numerous	----
Forklifts	various	numerous	----

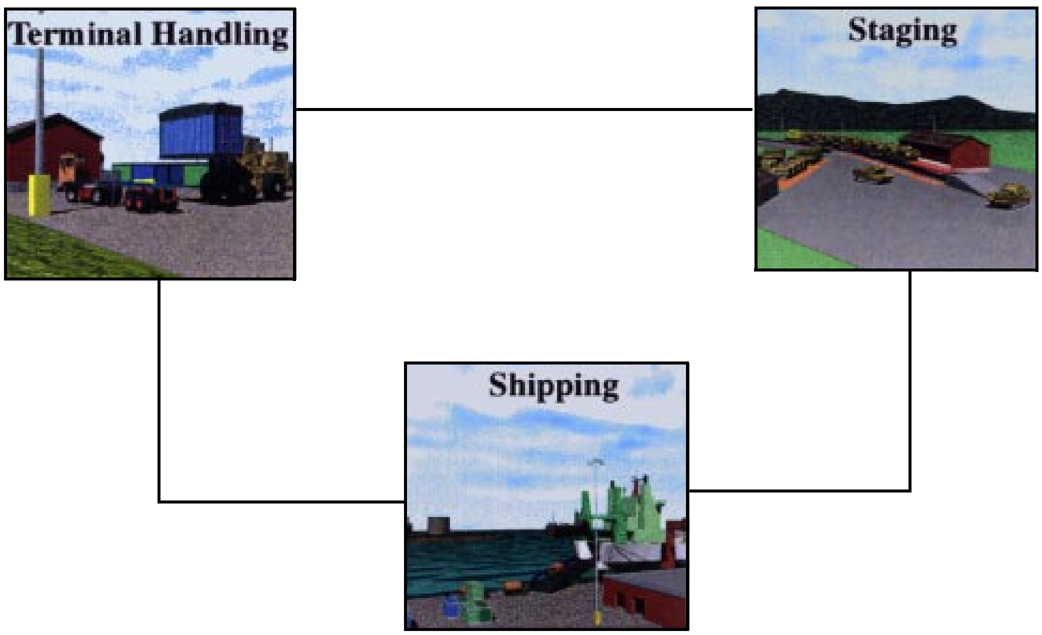
FUTURE DEVELOPMENT

The only planned future development for the Port of Ravenna is to deepen the canal accessing the port and add more terminals. No timetables or specifics are available regarding these two actions.

II. THROUGHPUT ANALYSIS

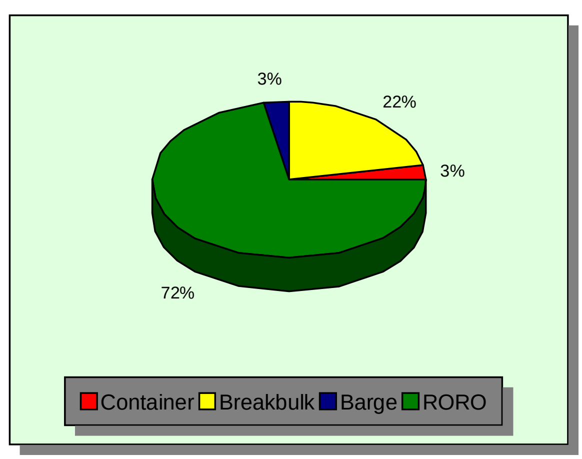
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Ravenna. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/ handling - in terms of short tons (STON) per day.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 80 percent of the port facilities will support military deployments. Also, due to the size of the port, we assume that the berths will have ships 80 percent of the time. The ship mix is determined by Desert Shield and Desert Storm statistics. We weighed the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL CLEARANCE/HANDLING

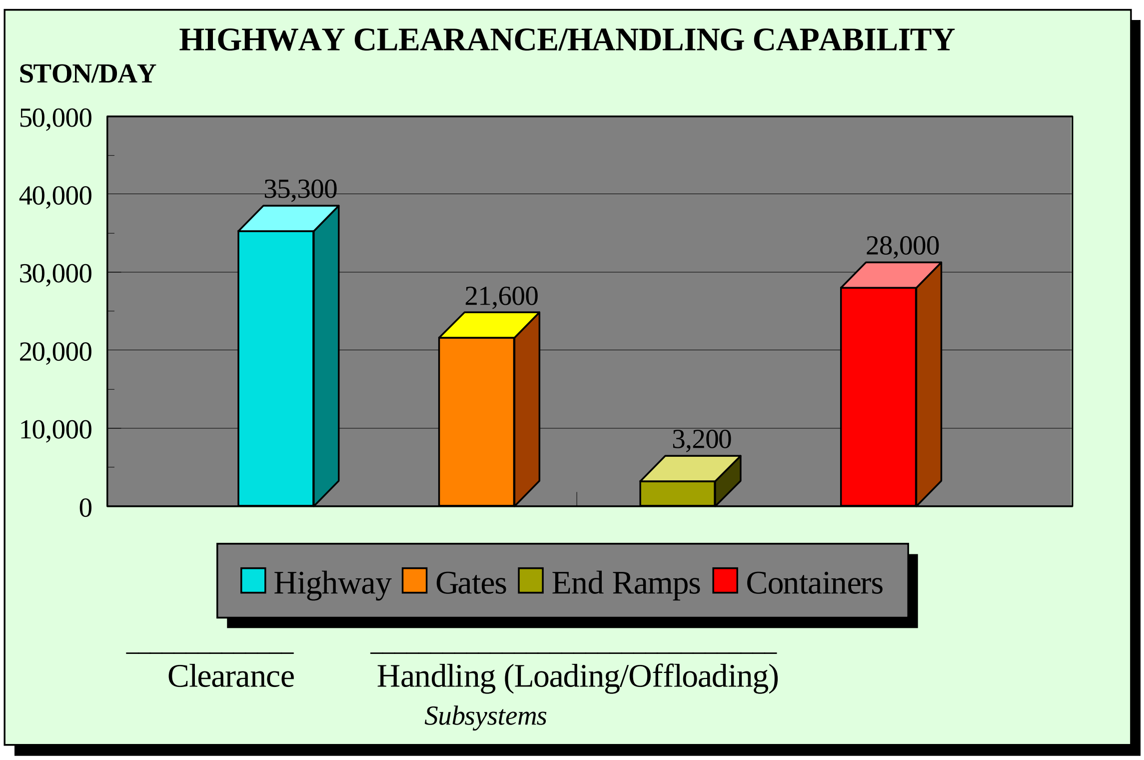
Highway

The SS67 Extension is the major roadway connecting the port to the autostrada. The road network into/out of the port, including the gate processing of vehicles, can handle almost 21,600 STON of equipment and supplies per day.

Roadable vehicles will process into the port directly to staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. We assume that deploying units will build or acquire two portable ramps for flatbed truck and semi-trailer operations. These ramps will handle at least 3,200 STON of military vehicles and equipment per day.

The port has no truck docks.

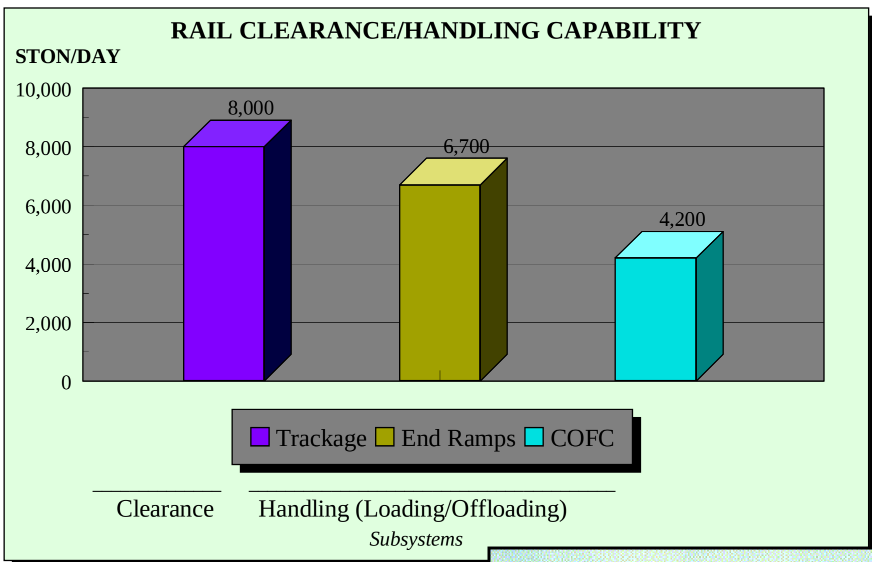
The Port of Ravenna has numerous container handling equipment including gantry cranes, mobile cranes, and forklift trucks. Container operations can occur in the Sapir, Setramar, New, and Nadep Terminals. Based on 75 percent of the container vessel discharge in the Sapir Terminal and 100 percent of the container vessel discharge for the other terminals going by highway, the port can handle over 28,000 STON per day.



Rail

The Ferrovia dello Stato (FS) could move a maximum of 8 trains of 25 railcars each day if necessary. Vehicles on flatcars must use portable ramps for loading/offloading operations. The port does not have fixed or portable ramps to use for loading/offloading operations. We assume the deploying units would build or acquire at least two portable end ramps to use on available spurs having 1,000 feet of tangential track. The port has several locations to conduct loading/offloading operations using end ramps. The best locations are the intermodal yard and apron tracks in the Sapir Terminal. The rail-yard outside the port is another option for end ramp operations. Assuming two portable end ramps are used for loading/offloading railcars (60-foot railcars), the port would handle about 133 railcars daily (4 interchanges in 20-hour period).

We assume that rail-mounted gantry cranes, mobile cranes, and forklifts will perform the COFC operations. These operations will occur in the Sapir Terminal. Based on 25 percent of the container vessel discharge for the Sapir Terminal going by rail, the port can handle over 4,200 STON per day.



Rail-Mounted Gantry Crane, Sapir Terminal

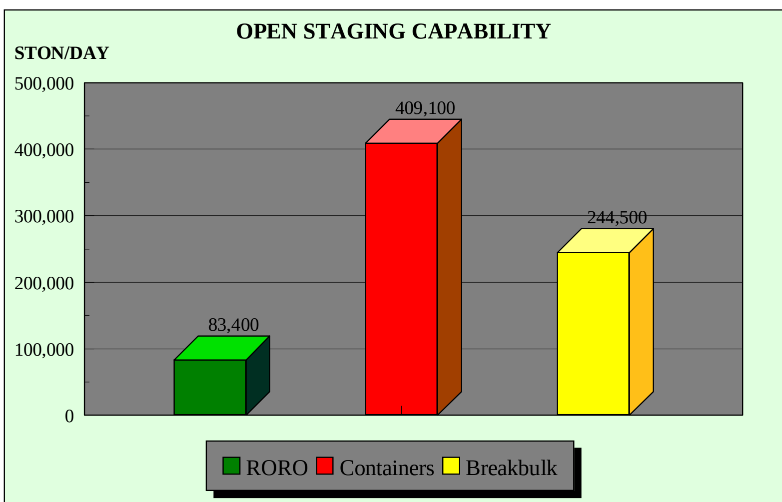
Staging

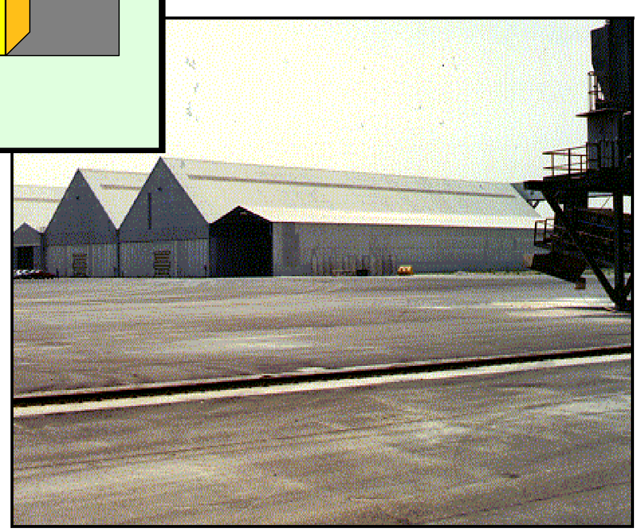
The port has over 250 acres of paved open staging at the Sapir, Setramar, New, and Nadep Terminals (over 128 acres at the Sapir Terminal) that could support military operations. The port also has over 268,000 square feet of covered storage at the Sapir and Setramar Terminals. Deploying units must negotiate with terminal operators for access to all port facilities.

The port has the ability to perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned.

The chart on this page provides the cargo open staging capability for each vessel type. If a combination ship is expected, then a portion of each involved capability should be assumed.

Based on the shipping subsystem throughput, about 111 acres of open storage are needed to stage the daily throughput capability for the Port of Ravenna. The open storage available in the Sapir Terminal (about 128 acres) alone has the potential to stage the daily throughput for the Sapir, Setramar, New, and Nadep Terminals. The 111-acre requirement consists of 98 acres needed to stage RORO cargo and 13 acres to stage containers. The RORO acreage includes areas for frustrated cargo, working areas, areas around ramps and gates, lanes and access to vehicles, and other factors. The container acreage is based on the yard gantry system for container storage (325 TEUs per acre).

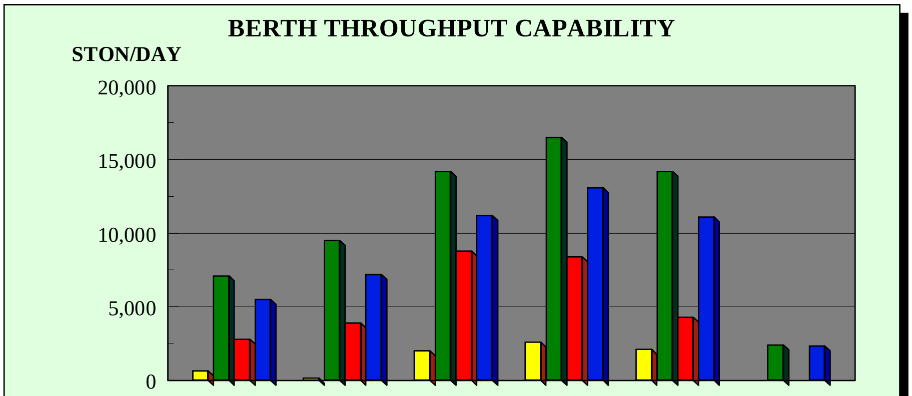




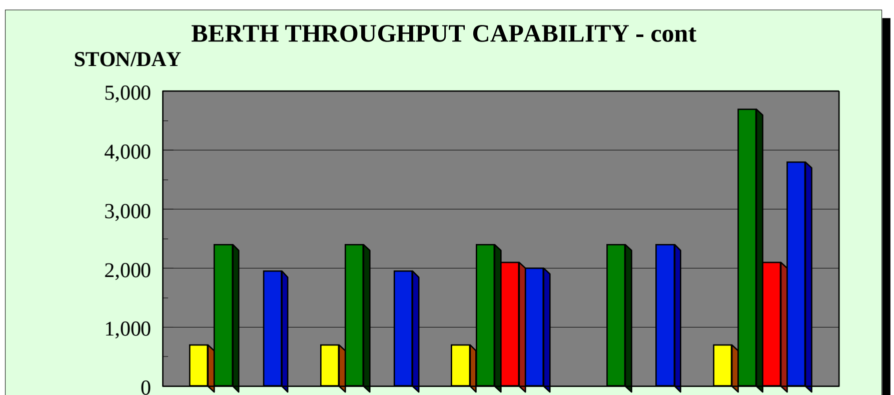
Open Staging at New Terminal

Shipping

Throughputs for each berth are shown below. They are based on various factors including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. Assumptions used in this study are in the appendix.



	New	Nadep	SETRA	Sap 1	S2&F	Sap 3
Breakbulk	650	150	2,000	2,600	2,100	0
RORO	7,100	9,500	14,200	16,500	14,200	2,400
Container	2,800	3,900	8,800	8,400	4,300	0
Mixed	5,500	7,200	11,200	13,100	11,100	2,350



	Sap 4	Sap 5	Sap 6	Sap 7	Sap 8
Breakbulk	700	700	700	0	700
RORO	2,400	2,400	2,400	2,400	4,700
Container	0	0	2,100	0	2,100
Mixed	1,950	1,950	2,000	2,400	3,800

CONVERSION FACTORS	
BREAKBULK	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON

THROUGHPUT SUMMARY FOR PORT OF RAVENNA PER DAY

BERTH	LENGTH (feet)	DEPTH ALONGSIDE (feet)	BREAKBULK THROUGHPUT (STON)	RORO THROUGHPUT (STON)	RORO SQUARE FT (EST)	RORO PIECES [1]	CONTAINER THROUGHPUT (STON)	CONTAINER THROUGHPUT (TEU)	MIXED THROUGHPUT (STON)
New	984	30	650	7,100	141,560	833	2,800	348	5,500
Nadep	1,312	23	150	9,400	188,740	1,111	3,800	481	7,200
Setramar	2,017	30	2,000	14,200	283,120	1,666	8,800	1,095	11,200
Sapir 1	2,188	30	2,500	16,500	330,300	1,943	8,400	1,045	13,100
Sapir 2 plus Frigoterminal	1,860	30	2,100	14,200	283,120	1,666	4,200	531	11,100
Sapir 3	328	30	0	2,400	47,180	278	0	0	2,350
Sapir 4	600	30	600	2,400	47,180	278	0	0	1,950
Sapir 5	548	30	600	2,400	47,180	278	0	0	1,950
Sapir 6	548	30	700	2,400	47,180	278	2,100	265	2,000
Sapir 7	328	30	0	2,400	47,180	278	0	0	2,400
Sapir 8	656	30	700	4,700	94,380	556	2,100	265	3,700

[1] Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

We base the type of ship preferred at each berth on the methodology described in the appendix. The evaluation is a snapshot view of the current physical characteristics of the berths and MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suited for the loading or unloading operation. In general, no one berth is ideal for all military operations. The best berth depends on the type of ship loaded.

Because of their all around capability, we recommend the container wharf and adjacent wharf including the Frigoterminal (Sapir 1 and 2 plus Frigoterminal) for military port operations. The Setramar Terminal is a good alternative for RORO and container operations due to the availability of container cranes and a RORO ramp. A good alternative for breakbulk operations is the pier (San Vitale docks) in the Sapir Terminal (Sapir 6). This pier has wharf cranes, a transit shed, and ample staging.

LOADING TYPE	**BERTHS**					
	New	**Nadep**	**Setramar**	**Sapir 1**	**Sapir 2 plus Frigoterminal**	**Sapir 3**
BREAKBULK	6	8	6	3	1	-
RORO	5	4	3	1	2	9
CONTAINER	4	5	3	1	2	-
NOTE: Berths marked with a "-" are not recommended for these operations.						

LOADING TYPE	**BERTHS**				
	Sapir 4	**Sapir 5**	**Sapir 6**	**Sapir 7**	**Sapir 8**
BREAKBULK	5	9	6	-	4
RORO	6	11	8	9	6
CONTAINER	-	-	6	-	7
NOTE: Berths marked with a "-" are not recommended for these operations.					

Intermodal Operations at Sapir Terminal

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THROUGHPUT PARAMETERS

BREAKBULK RATES		
SHIP OPERATIONAL RATES	STON/HR	MTON/HR
Ship Crane	15.0	37.5
Dockside Cranes	20.0	50.0
Barge	20.0	50.0
RORO Rates	200.0	800.0
Container Lift Rates	21.0 Lifts/Hr Container Crane	8.0 Lifts/Hr Wharf Crane
Berth Utilization Factor = 0.8		

Ship Mix Percentages	%
BreakBulk	22.0
Barge	3.0
RORO	72.0
Container	3.0

Minimum Mobile-Crane Size	STON
Breakbulk	40.0
Barge	20.0
Container	100.0

Ship Cargo Mix			
	Breakbulk	RORO	Container
Roadable Vehicles	43%	90%	
Nonroadable Vehicles	7%	10%	
Container	15%		100%
Noncontainer	35%		

Staging Data:	
Staging Dwell Time	3 Days
Space Utilization Factor	
Open	60%
Covered	60%
Facility User Factor	80%

Stacking Height	Feet
Open - General	32
Covered	10
Open - Vehicle	7.6

Motor Vehicle Parameters	STON	MTON
Convoy	3.5	17.0
Flatbed	20.0	60.0
Van	16.0	40.0
Chassis	16.0	40.0
Railcar Parameters	STON	MTON
Flatcar	50.0	150.0
Boxcar	30.0	75.0
COFC	24.0	60.0
Container (TEU) Capacity	8.0	20.0

Truck Handling Rates	Trucks/Hr
End Ramps	4.0
Van Docks	1.0
Railcar Handling Rates	Railcars/Hr
End Ramps	4.0
Boxcar Docks	0.3
Length of Flatcars	60 Feet
Productive Work Hours	20 Hours

Mode Mix	%	%
Roadable Veh: Convoy/Flatcar	90	10
Nonroadable Veh: HETs/Flatcars	10	90
General Cargo:		
Van/Box	35	15
Flatbed/Flatcar	35	15
Container:		
Chassis/COFC	75	25

APPENDIX

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IDEAL BREAKBULK BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Transit Shed**	
Quay or marginal	10	Available	15
Pier	7	None	0
Berth Length (ft)		**Deck Strength (lb per ft^2)**	
Greater than 750	20	Greater than 800	10
700 to 750	18	600 to 800	9
600 to 699	16	400 to 599	5
500 to 599	10	Less than 400	2
Less than 500	5		
Water Depth (ft) MLW		**Ship Service Facilities**	
Greater than 35.0	20	Power, water, and telephone	6
32.0 to 35.0	18	Power and water	5
30.0 to 31.9	16	Water only	4
28.0 to 29.9	14	None	0
Less than 28.0	12		
Apron Width (ft)		**Cranes**	
20.0 or greater	15	Wharf	10
Less than 20.0	5	Heavy-lift mobile(≥100 STON)	9
		Mobile	5
		None	0
Apron Tracks		**Conditional Age**	
2	10	New	10
1	7	10 years old	8
None	0	20 years old	4
		30 years or older	1
Vehicle Access		**Staging Access**	
Uncongested	10	At least 435,600 sq ft (10 acres) (large RORO)	10
Moderated Congestion	5	At least 173,345 sq ft (4 acres) (small RORO)	7
Congested	0	At least 114,692 sq ft (2.6 acres) (small Breakbulk)	5
		Over 100,000 sq ft (2.3 acres)	4
		10,001-100,000 sq ft (.2-2.3 acres)	3
		0-10,000 sq ft (0-.2 acres)	1

IDEAL RORO BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Apron Tracks**	
Quay or marginal	10	2	10
Pier	5	1	7
		None	0
Berth Length (ft)		**Deck Strength (lb per ft^2)**	
Greater than 1,000	20	Greater than 800	10
900 to 1,000	18	600 to 800	9
800 to 899	16	400 to 599	5
700 to 799	10	Less than 400	2
600 to 699	4		
Less than 600	2		
Water Depth (ft) MLW		**Ship Service Facilities**	
Greater than 35.0	20	Power, water, and telephone	6
32.0 to 35.0	18	Power and water	5
30.0 to 31.9	16	Water only	4
28.0 to 29.9	14	None	0
Less than 28.0	12		
Apron Width (ft)		**Vehicle Access**	
Greater than 60.0	20	Uncongested	10
40.0 to 60.0	15	Moderate Congestion	5
30.0 to 39.9	5	Congested	0
Less than 30.0	0		
RORO Ramp Operation		**Conditional Age**	
Side, slewed, straight	10	New	10
Side, slewed-stern	6	10 years old	8
Slewed-stern	4	20 years old	4
Starboard-slewed-stern	2	30 years or older	1
None	0		
Tidal Range (ft)		**Staging Access**	
0 to 3.9	10	At least 435,600 sq ft (10 acres) (large RORO)	10
4.0 to 7.9	8		
8.0 to 11.9	6	At least 173,345 sq ft (4 acres) (small RORO)	7
12.0 to 16.0	4		
Greater than 16.0	0	At least 114,692 sq ft (2.6 acres) (small Breakbulk)	5
		Over 100,000 sq ft (2.3 acres)	4
		10,001-100,000 sq ft (.2-2.3 acres)	3
		0-10,000 sq ft (0-.2 acres)	1

IDEAL CONTAINER BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Deck Strength (lb per ft^2)**	
Quay or marginal	10	Greater than 1,000	10
Pier	5	800 to 999	8
		600 to 799	5
		400 to 599	3
		Less than 400	1
Berth Length (ft)		**Ship Service Facilities**	
Greater than 1,000	20	Power, water, and telephone	6
900 to 1,000	18	Power and water	5
800 to 899	16	Water only	4
700 to 799	10	None	0
600 to 699	8		
Less than 600	2		
Water Depth (ft) MLW		**Container Cranes**	
Greater than 40.0	20	Specialized container crane	20
35.0 to 40.0	18	Mobile gantry	16
32.0 to 34.9	16	Mobile crane (200-ton)	12
30.0 to 31.9	10	Mobile crane (100-ton)	8
28 to 29.9	8		
Less than 28.0	6	None	0
Apron Width (ft)		**Container Handling Equipment**	
Greater than 60.0	10	Straddle cranes	10
40.0 to 60.0	9	Straddle trucks	9
30.0 to 39.9	5	Front/side-loading forklifts	8
20.0 to 29.9	2	Mobile cranes	5
Less than 20.0	1	None	0
Apron Tracks		**Conditional Age**	
2	10	New	10
1	7	10 years old	8
None	0	20 years old	4
		30 years or older	1
Consolidated Shed		**Staging Access**	
Available	10	At least 435,600 sq ft (10 acres) (large RORO)	10
None	0		
		At least 173,345 sq ft (4 acres) (small RORO)	7
Vehicle Access			
Uncongested	10	At least 114,692 sq ft (2.6 acres) (small Breakbulk)	5
Moderated Congestion	5		
Congested	0	Over 100,000 sq ft (2.3 acres)	3
		10,001-100,000 sq ft (.2-2.3 acres)	3
		0-10,000 sq ft (0-.2 acres)	1

PORT OF ROTTERDAM
NETHERLANDS

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Rotterdam in May 1998. The Port of Rotterdam is fully capable of supporting U.S. military cargo transshipment operations and can accommodate vessels as large as the large medium speed RORO (LMSR). The port has up to a 6-foot tidal range.

Six areas in the port were evaluated for use by the U.S. military: Beerkanaal, Calandkanaal, Nieuwe Waterweg, Botlek Terminal, Eemhaven Terminal, and Waalhaven Terminal. These areas exceed the U.S. military requirements. Areas not evaluated include petroleum, chemical, and bulk berths, berths on the north side of the river, berths having a draft of less than 27 feet mean low water (MLW), and berths on the river beyond Koningshaven (Noorder Eiland (Island)).

The shiploading subsystem is the least capable of the transportation subsystems analyzed. The berths analyzed in the port have a mixed throughput capability of at least 97,535 short ton (STON) per day.

We used three berths in three different terminals to analyze the capability for U.S. military deployment. For this application, we used a berth in Botlek Terminal, in Eemhaven, and in Waalhaven to analyze a notional armored division deploying from Europe on LMSR ships. Deploying a notional armored division in 6 days requires 16,900 STON of vehicles and equipment (that includes 520 total containers) per day to be loaded. Smaller ships will require additional time or berths.

The division will require about 25 acres of staging per LMSR for deployment from a port, for a total of 75 acres per day. The fast sealift ships (FSS) requires about 16 acres per ship for deployment. The terminals controlled by C. Steinweg Handelsveem B.V. Stevedoring Facility Rotterdam, the current U.S. Army contractor, controls 310 acres with about 75 acres in the Botlek Terminal, 140 acres in Eemhaven area, and 50 acres in Waalhaven.

The notional armored division will require 3,400 railcars for a deployment by rail. The port currently has 63 trains per day with 21 railcars per train going into the berths, for a total of 1,323 railcars per day. The port has the capacity to handle 3,400 railcars in less than 3 days, and can meet the rail requirement.

II. GENERAL DATA

Rotterdam, Netherlands, is a port used by the U.S. military for shipping military vehicles and equipment to and from northern Europe. The port is public owned, contractor operated, and capable of handling RORO, container, and breakbulk ships and barges. A team from Military Traffic Management Command Transportation Engineering Agency (MTMCTEA) conducted a site survey from 11 to 15 May 1998. Information was obtained from the 838th U. S. Transportation Battalion, Rotterdam, Netherlands, port officials and operators.

TRANSPORTATION ACCESS

Water

The Port of Rotterdam (latitude 51° 55’ north, longitude 04° 30” east, (UNAP - GEO location code) time zone GMT +1) is in southwest Netherlands, on the mouth of the Maas River. Rotterdam is the largest port in Europe. Tides in the river range up to 6 feet. Vessels entering and leaving the port require pilotage.

After leaving the North Sea, there are two main waterways: the Nieuwe Waterweg to the north and the Calandkanaal to the south. The Nieuwe Waterweg from the North Sea to the entrance of Botlek Terminal has a minimum depth of 45.5 feet (13.86 meters) at MLW. The Nieuwe Waterweg from Botlek Terminal to the Waalhaven Terminal has a minimum depth of 42 feet (12.86 meters) at MLW. The Nieuwe Maas from the Waalhaven Terminal to the Rijnhaven Terminal has a minimum depth of 32.8 feet (10.01 meters) at MLW. The Nieuwe Maas from the Rijnhaven Terminal to the Koningshaven Terminal has a minimum depth of 22.5 feet (6.86 meters) at MLW. The Calandkanaal from the North Sea to Beerkanaal has a minimum depth of 75.5 feet (23.01 meters) at MLW. The Calandkanaal from Beerkanaal to 7e Petroleumhaven has a minimum depth of 72.2 feet (22.01 meters) at MLW. The Calandkanaal from 7e Petroleumhaven to Brittanniehaven has a minimum depth of 39.4 feet (12.01 meters) at MLW.

The Calandkanaal connects to Beerkanaal Terminal, Dintelhaven, Brittanniehaven, and Seinehaven. The Nieuwe Waterweg connects to Botlek Terminal, Geulhaven, Madroelhaven, Eemhaven Terminal, Werkhaven, Heysehaven, Dokhaven, Sleepboothaven, Waalhaven Terminal, Kortenoordsehaven, Robbenoordsehaven, St. Janshaven, Maashaven, Katendrechtsehaven, Rijnhaven, Koningshaven, Spoorweghaven, Binnenhaven, and Entrepothaven.

Five anchorage areas are available. In-stream operations are possible after coordination with the port authorities (see recommendations for each anchorage). Explosives require a waiver from the Dutch Government and USAREUR. Class 1 (except 1.4) has such a small quantity allowed it may not be feasible.

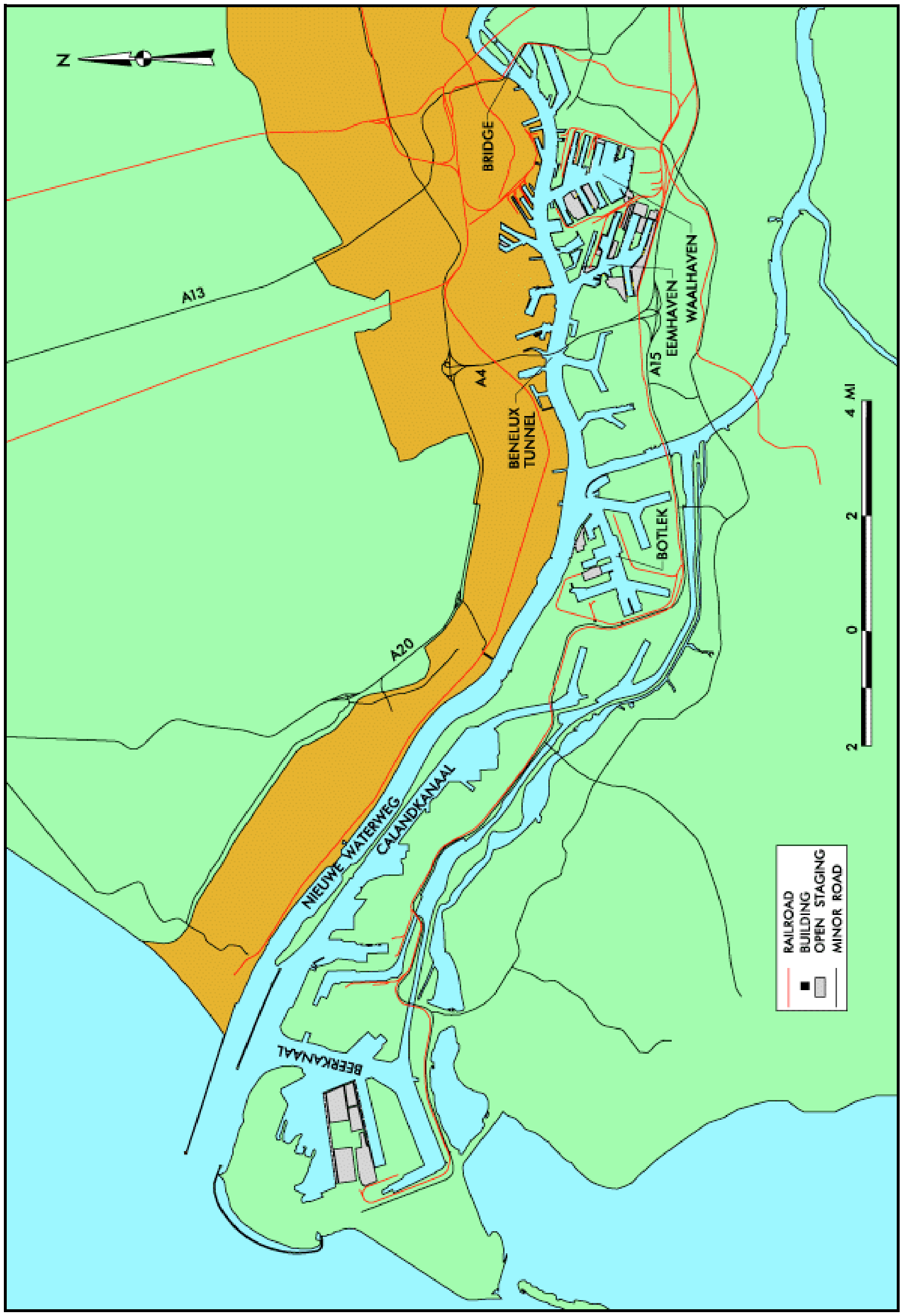
1. Long-term anchorage for deep draft vessels (57 feet (17.37 meters) or more) is north of North Hinder Junction. In-stream operations are not recommended due to the tidal current, a sea state of three or greater.

2. Short-term anchorage is for deep draft vessels (57 feet (17.37 meters) or more). In-stream operations are not recommended since large crude oil tankers and other bulk carriers waiting to enter the harbor use this anchorage.

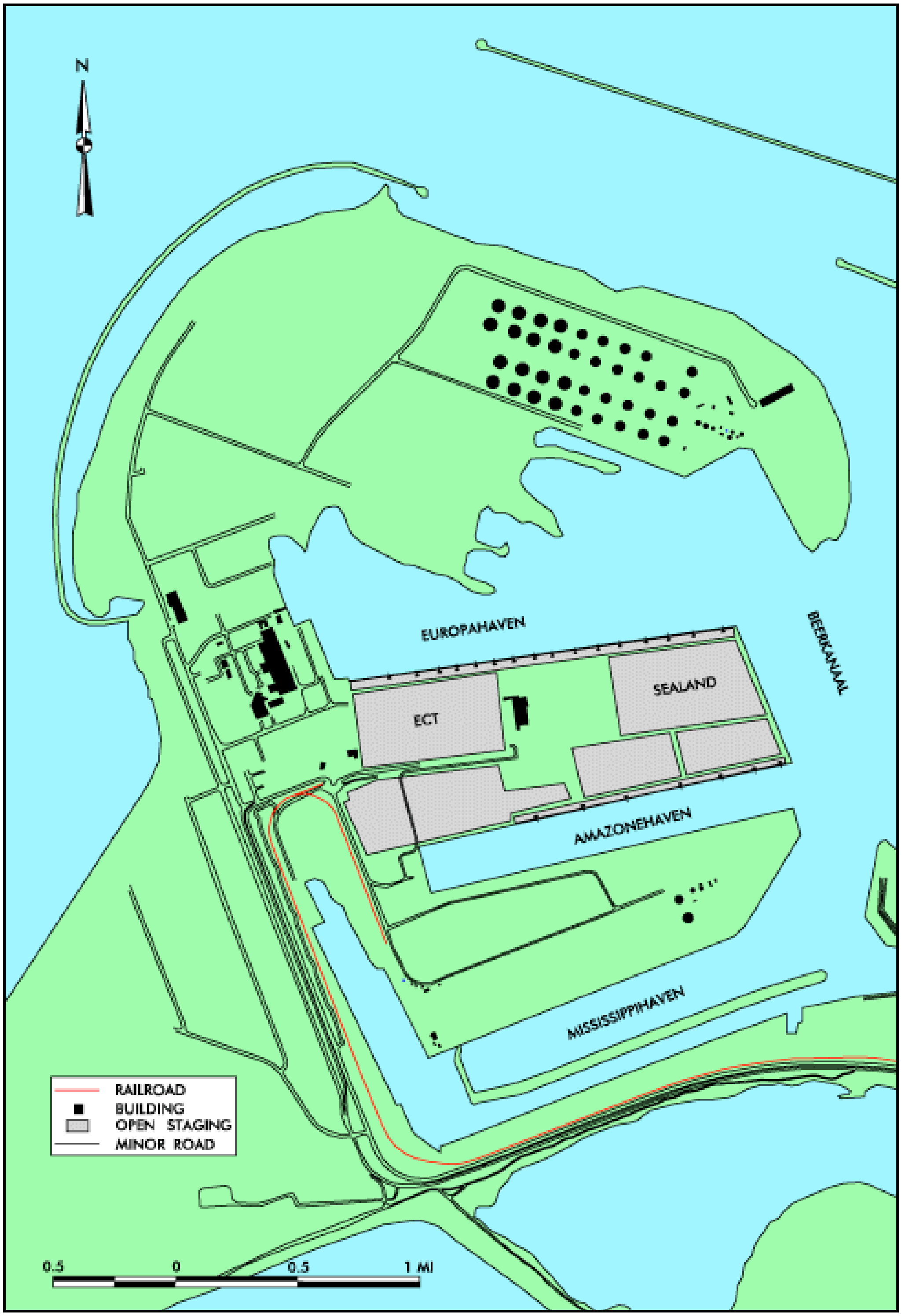
3. Maas Outer is for vessels with a maximum draft of 57 feet (17.37 meters). In-stream operations require good coordination since this is a heavily traveled anchorage.

4. Maas West has a maximum draft of 40 feet (12.2 meters) on the north end and 29.9 feet (9.10 meters) on the south end. In-stream operations require good coordination since this is a heavily traveled anchorage.

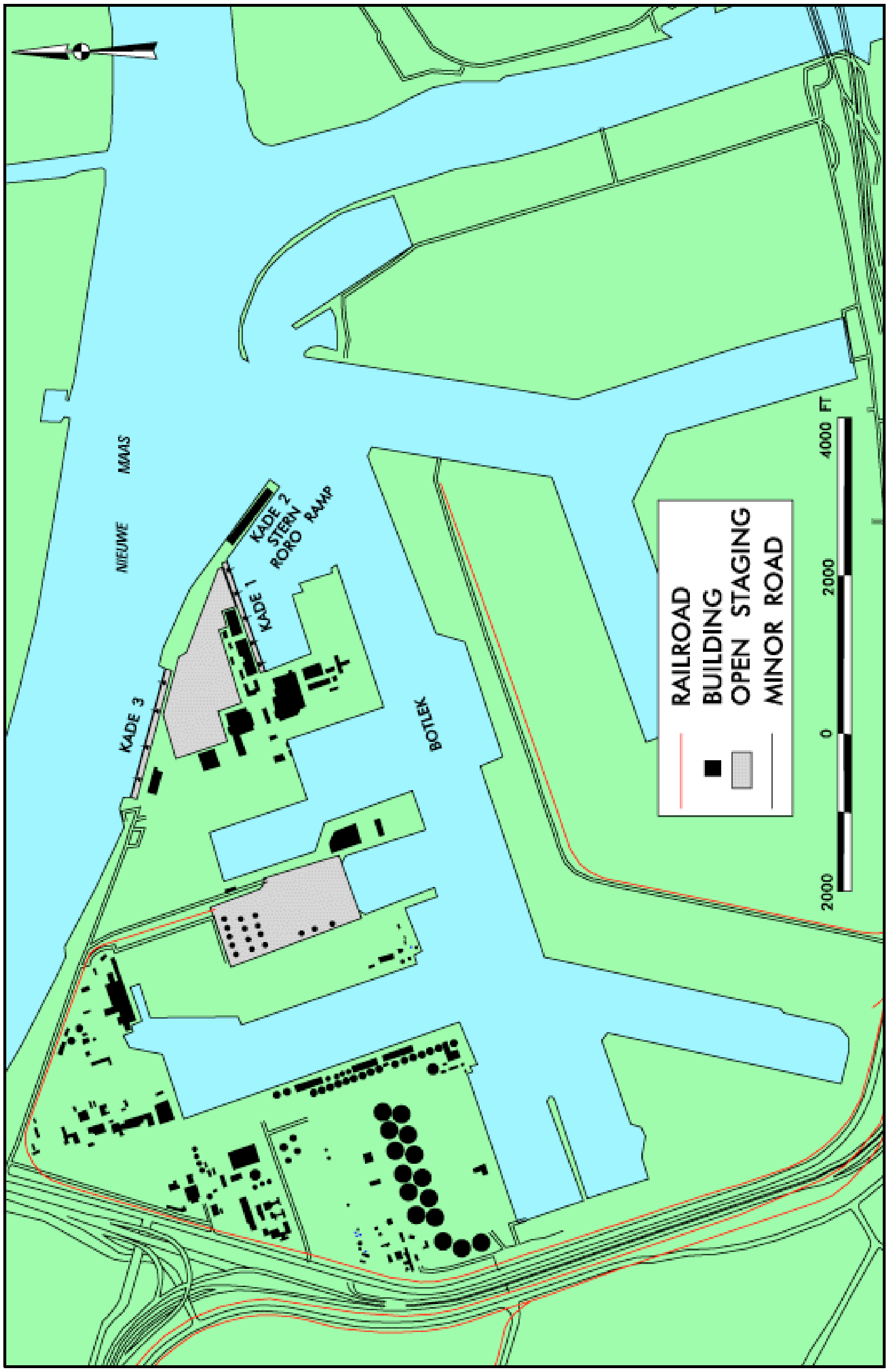
5. Maas Noord maximum draft of 45 feet (13.70 meters). In-stream operations require good coordination since this is a heavily traveled anchorage.


N
BRIDGE
A13
A4
BENELUX TUNNEL
EEMHAVEN
WAALHAVEN
A15
BOTLEK
A20
NIEUWE WATERWEG
CALANDKANAAL
BEERKANAAL
4 MI
2
0
2
RAILROAD
BUILDING
OPEN STAGING
MINOR ROAD

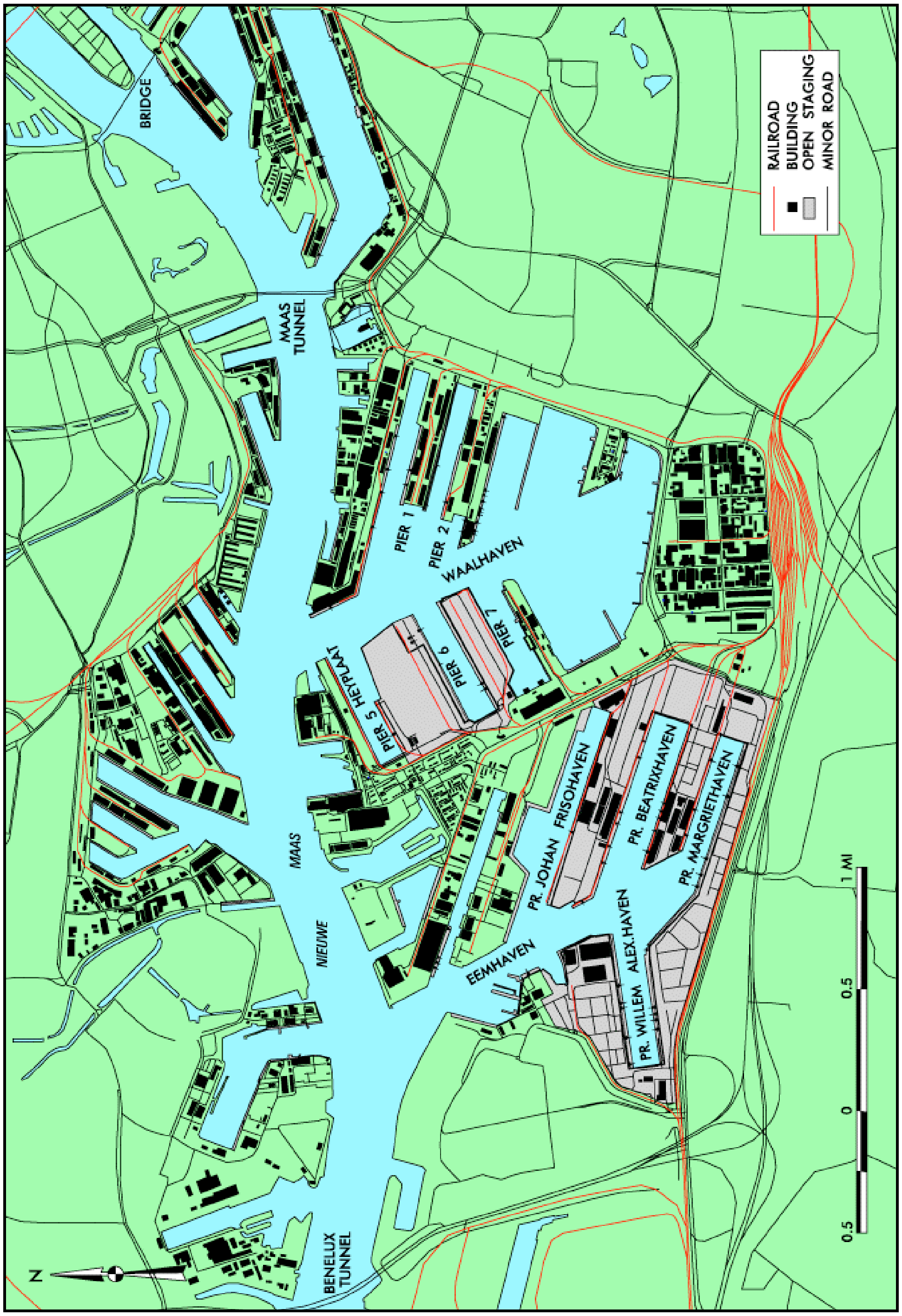
Site Plan



Map of Europoort



Map of Botlek Terminal



Map of Eemhaven and Waalhaven

The Maas River connects with the other rivers and canals in Europe to form an effective inland water network. Barge transport can be used to move items too large for unrestricted transport by highway and rail modes. For nonmilitary moves about 80 percent of cargo arrives in the port by barge. No U.S. military equipment arrives in the port by barge.

Map of Inland Wate Network

Highway

Highway access to the port is good. Highway A15 runs through the port area with exits and entrances near the berths. Highways A4, A29, and A16 connect to Highway A15. Other major highways in the area include A13 and A20. Most berths are only a short drive from A15. To limit entering/departing delays at the port, most berths have their own gate. The only traffic on these local roads is going to the berths or companies in the port area. About 15 percent of nonmilitary cargo arrives in the port by highway.

Rail

A dedicated rail line serves the port. Most berths have tracks directly on the berths. Loads leaving the port may be inspected by the railroad inspectors to make sure they are secured for rail transport and do not exceed the approved clearance. There is a maximum of 21 railcars, each up to 59 feet (18 meters) long, or 1,875 tons (1,700 metric tons) per train limit.

The closest railyard, Kijhoek, is east of the port and currently handles 20 trains per day with 27 railcars per train. South of the Waalhaven Terminal is another switching yard, Waalhaven Southside. The railroad provides engines to transfer railcars from this railyard to the port. About five percent of nonmilitary cargo arrives in the port by rail.

Botlek Terminal has two tracks; each is 820 feet (250 meters) long for loading and unloading cargo, with the capability to store 30 railcars. Rail service to the terminal is four trains per 8-hour shift.

Eemhaven Terminal has four tracks, two 1,475 feet (450 meters) long and two 1,640 feet (500 meters) long, with the capability to store 120 railcars. Rail service to the terminal is eight trains per 8-hour shift.

Waalhaven Terminal has two tracks on Pier 1, each 2,300 feet (700 meters) long, with the capability to store 60 railcars. Pier 2 has three tracks, each is 985 feet (300 meters) long, with the capability to store 60 railcars. Rail service to Pier 1 is six trains per 8-hour shift and rail service to Pier 2 is four trains per 8-hour shift.

Air

Rotterdam has two civilian airports in the area. The Rotterdam Airport has one runway 7,220 feet (2,200 meters) long. The International Airport in Amsterdam has four runways and is 40 miles (65 kilometers) from the port. Soesterberg is a military airport and is 40 miles (65 kilometers) from the port. Eindhaven is a joint military/commercial airport and is 70 miles (110 kilometers) from the port.

PORT FACILITIES

Berthing

The Port of Rotterdam is a multicargo port capable of breakbulk, bulk, roll-on/roll-off (RORO), container, and barge operations. Currently, about 74 percent of Rotterdam's general cargo is containerized. The port has six terminal areas and many berths capable of supporting military operations. The first area is the closest to the North Sea, Beerkanaal, next area Calandkanaal, Botlek Terminal, Eemhaven Terminal, Waalhaven Terminal, and finally berths on the Niewe Waterweg.

Currently, the U.S. Army has a contract with C. Steinweg Handelsveem B.V. Stevedoring Company to provide the U.S. military berths and services. These berths will be evaluated in this analysis. Steinweg has facilities in Botlek, Eemhaven, and Waalhaven Terminals, and a barge berth in Seinehaven. The U.S. military will likely use the Botlek Terminal Kades 1, 2, and 3. Kades 1 and 3 are multipurpose and can be used for all types of cargo - breakbulk, RORO, and container. Kade 2 is a fixed-stern RORO ramp with a pier for securing the vessel while loading and unloading. RORO vessels with a slewable rear ramp can use Kade 1. This ramp is next to the Kade 2 RORO ramp. This area is more open and less congested, which will result in fewer delays because of other vehicles. C. Steinweg Handelsveem B.V. has two berths in Eemhaven - Beatrixhaven and RST. Beatrixhaven is a multipurpose quay with three stern RORO ramps. The two on the north side have a draft deep enough for ships. The end pier ramp has only a 13-foot draft, suitable only for RORO barges. RST Beatrixhaven berth is used for full-time container operations, specifically for local ships. Seinhaven is a shallow draft berth specializing in special handling and storage of chemicals. Steinweg operates two piers in Waalhaven Terminal - Piers 1 and 2. These piers can be used for breakbulk and container operations. The main purpose of the Waalhaven Terminal is warehousing.

Berths that will be available for U.S. military operations are presented in the tables on the following pages. The port has many berths not analyzed in this study because of lack of information. The list of berths is given in the appendix.

BERTH CHARACTERISTICS FOR BEERKANAAL		
Characteristics	Berths	
	Europahaven	
Quay Signpost number	8180 (SeaLand)	8200 (Delta)
Length feet (meters)	3,200 970	5,400 1,650
Depth alongside at MLW feet (meters)	42.5 13.01	42.5 13.01
Deck Strength psi (metric tons per square meter)	600 2.9	600 2.9
Apron width feet (meters)	Open	Open
Apron height above MLW feet (meters)	Not Available	Not Available
Number of container cranes	8	6
Number of wharf cranes	None	None
Apron Lighting	Yes	Yes
Straight-stern RORO Ramp	No	No
Apron length served by rail feet (meters)	None	None

BERTH CHARACTERISTICS FOR C. STEINWEG HANDELSVEEM BV STEVEDORING COMPANY

Characteristics	Berths									
	Botlek*			Eemhaven			Seinehaven	Waalhaven		
	Kade 1	Kade 2	Kade 3	Beatrixhaven		RST	Barge	Pier 1	Pier 2	
Quay Signpost number	4570	4575	4590	2720	2730	2750	5111	2175	2188	2195
Length feet (meters)	1,300 400	**	1,650 500	1,950 600	1,300 400	4,600 1,400	1,500 450	3,300 1,000	650 200	1,650 500
Depth alongside at MLW feet (meters)	36 11.01	27.4 8.36	42.7 13.01	32.8 10.01	32.8 10.01	36 10.96	20.2 6.16	32.8 10.01	29.6 9.01	32.8 10.01
Deck Strength psi (metric tons per square meters)	11.4 8	11.4 8	11.4 8	11.4 8	11.4 8	11.4 8		11.4 8	11.4 8	11.4 8
Apron width feet (meters)	Open	10 3	Open	Open	Open	Open	Open	Open	Ope n	Open
Apron height range feet (meters)	13.1 4	13.1 4	13.1 4	9.8 3	9.8 3	9.8 3		11.8 3.6	11.8 3.6	11.8 3.6
Number of container cranes* **	No	No	No	No	No	4-40	No	No	No	No
Number of wharf cranes* **	5-40	No	4-40	4-36	6-36	No	4-30	7-40	7-65	2-65
Apron Lighting	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO Ramp	No	Yes-1	No	Yes-2	Yes-1	No	No	No	No	No
Apron length served by rail feet (meters)	****	No	****	1,950 600	1,300 400	4,600 1,400	No	3,300 1,000	650 200	1,650 500

***Botlek Terminal is the preferred location for U.S. military operations.**
****The berth is available to secure the vessel for RORO operations from the stern ramp. No other operations can be performed at this berth due to narrow apron width.**
*****The crane capacity is given in STON.**
******The Stevedoring company plans to install two 500-meter rail lines from Kade 3 to the ramp at Kades 1 & 2.**

SUMMARY OF BERTHING CAPABILITIES FOR BEERKANAAL QUAY S

Vessels		Berths	
Type	Class	8180 (Sealand)	8200 (Delta)
BREAKBULK	C3-S-38a	6	10
	C4-S-58a	5	9
	C4-S-66a	5	9
	C5-S-37e	5	8
SEATRAIN	GA and PR	5	9
BARGE	LASH C8-S-81b	3	6
	LASH C9-S-81d	3	5
	LASH Lighter	16	27
	SEABEE C8-S-82a	3	5
	SEABEE Barge	16	27
RORO	COMET	6,d,i,j	10,d,i,j
	METEOR	5,d,i,j	9,d,i,j
	Cape Gnome	5,d,i,j	8,d,i,j
	C7-S-95A	4,i	7,i
	Cape Taylor	4,i	8,i
	Cape Orlando	4,i,j	8,i,j
	MV Ambassador	5,d	9,d
	Callaghan	4,d,i,j	7,d,i,j
	Cape Lambert	4,i,j	7,i,j
	LMSR Class	3	5
	FSS	3	5
	Cape E-Class	4,i,j	7,i,j
	Cape D-Class	4,i,j	7,i,j
	Cape H	4,i	6,i
RORO	Cape Texas	4,i,j	8,i,j
	Cape R	4,d	8,d
	Cape I-class	4,i,j	7,i,j
	Cape Victory	4,i,j	8,i,j
CONTAINER	C6-M-147a	4	7
	C7-S-69c	4	7
	C7-S-68c	4	7
	C8-S-85c	3	6
	C9-M-132b	3	6
	C9-M-F141a	3	5
TACS	C6-S-1qd	4	7
	C5-S-MA73c	5	8
	C6-S-MA60d	4	7
MPS	C7-S-133a	3	6
	Maersk	4	6
	AmSea	4	7

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight-stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF C. STEINWEG HANDELSVEEM B.V. STEVEDORING COMPANY BERTHING CAPABILITIES FOR BOTLEK TERMINAL QUAYS

Vessels		Berths		
Type	**Class**	**Kade 1**	**Kade 2**	**Kade 3**
BREAKBULK	C3-S-38a	2	0	3
	C4-S-58a	2	0	2
	C4-S-66a	2	0	2
	C5-S-37e	2	0	2
SEATRAIN	GA and PR	2	0	2
BARGE	LASH C8-S-81b	1	0	1
	LASH C9-S-81d	1,a,f	0	1
	LASH Lighter	6	0	8
	SEABEE C8-S-82a	1,a,f	0	1
	SEABEE Barge	6	0	8
RORO	COMET	2,d,i,j	1,i	3,d,i,j
	METEOR	2,d,i,j	1,a,b	2,d,i,j
	Cape Gnome	2,d,i,j	1,a,b	2,d,i,j
	C7-S-95A	1	1,a,b	2
	Cape Taylor	1	1,a,b	2
	Cape Orlando	1,i,j	1,a,b	2,i,j
	MV Ambassador	2,d	1,b	2,d
	Callaghan	1,d,i	1,b	2,d,i
	Cape Lambert	1,i,j	1,a,b	2,i,j
	LMSR Class	1	1,a,b	1
	FSS	1,a	1,a,b	1
	Cape E-Class	1,i,j	1,a,b	2,i,j
	Cape D-Class	1,i,j	1,a,b	2,i,j
	Cape H	1	1,a,b	2
	Cape Texas	1,i,j	1,a,b	2,i,j
	Cape R	1,d	1,a,b	2,d
	Cape I-class	1,i,j	1,a,b	2,i,j
	Cape Victory	1,i	1,a,b	2,i
CONTAINER	C6-M-147a	1	0	2
	C7-S-69c	1	0	2
	C7-S-68c	1	0	2
	C8-S-85c	1	0	1
	C9-M-132b	1	0	1
	C9-M-F141a	1,a	0	1
TACS	C6-S-1qd	1	0	2
	C5-S-MA73c	2	0	2
	C6-S-MA60d	1	0	2
MPS	C7-S-133a	1	0	1
	Maersk	1	0	2
	AmSea	1	0	2

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight-stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF C. STEINWEG HANDELSVEEM B.V. STEVEDORING COMPANY BERTHING CAPABILITIES FOR EEMHAVEN TERMINAL QUAYS

Vessels		Berths		
Type	Class	Pr Beatrixhaven		RST
		2720	2730	2750
BREAKBULK	C3-S-38a	3	2	8
	C4-S-58a	3	2	7
	C4-S-66a	3,a	2,a	8
	C5-S-37e	3	2	7
SEATRAIN	GA and PR	3	2	7
BARGE	LASH C8-S-81b	2,a,f	1,a,f	5
	LASH C9-S-81d	2,a,f	1,a,f	5,a,f
	LASH Lighter	9	6	23
	SEABEE C8-S-82a	2,a,f	1,a,f	5,a,f
	SEABEE Barge	9	6	23
RORO	COMET	3,i	2,i	8,d,i
	METEOR	3,i	2,i	8,d,i
	Cape Gnome	3,a	2,a	7,d,i,j
	C7-S-95A	2,a	1,a	6
	Cape Taylor	2	1	6
	Cape Orlando	2,i	1,i	6,i
	MV Ambassador	3,m	2,m	8,d
	Callaghan	2	1	6,d
	Cape Lambert	2,i,j	1,i,j	6,i,j
	LMSR Class	1,a	1,a	4
	FSS	2,a	1,a	4,a
	Cape E-Class	2,i,j	1,i,j	6,i,j
	Cape D-Class	2,a	1,a	6,i
	Cape H	2,a	1,a	5
	Cape Texas	2,i	1,i	6,i
	Cape R	2,a	1,a	6,d
	Cape I-class	2,i	1,i	6,i
	Cape Victory	2,i	1,i	7,i
CONTAINER	C6-M-147a	2	1	6
	C7-S-69c	2	1	6
	C7-S-68c	2	1	6
	C8-S-85c	2,a	1,a	5
	C9-M-132b	2,a	1,a	5
	C9-M-F141a	2,a	1,a	4,a
TACS	C6-S-1qd	2	1	6
	C5-S-MA73c	3	2	7
	C6-S-MA60d	2	1	6
MPS	C7-S-133a	2,a	1,a	5
	Maersk	2,a	1,a	5
	AmSea	2	1	6

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight-stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp

Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

SUMMARY OF C. STEINWEG HANDELSVEEM B.V. STEVEDORING COMPANY BERTHING CAPABILITIES FOR WAALHAVEN TERMINAL QUAYS					
Vessels		Berths			
Type	Class	Pier 1	Pier 2	Pier 2	
		2175	2188	2195	
BREAKBULK	C3-S-38a	6	1	3	NOTES:
	C4-S-58a	5	1,a	2	The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.
	C4-S-66a	5,a	1,a	2,a	
	C5-S-37e	5	1,a	2	
SEATRAIN	GA and PR	5	1	2	The letters in the columns to the left indicate limitations as described below.
BARGE	LASH C8-S-81b	3,a,f	a,c,f	1,a,f	
	LASH C9-S-81d	3,a,f	a,c,f	1,a,f	
	LASH Lighter	16	3	8	
	SEABEE C8-S-82a	3,a,f	a,c,f	1,a,f	a-vessel draft limit
	SEABEE Barge	16	3	8	b-inadequate apron width
RORO	COMET	6,d,i	1,d,i	3,d,i	c-inadequate berth length
	METEOR	5,d,i	1,d,i	2,d,i	d-no straight-stern ramp
	Cape Gnome	5,a,d,i,j	1,a,d,i,j	2,a,d,i,j	e-no container handling equipment
	C7-S-95A	4,a	a,c	2,a	f-anchorage depth OK, berth depth inadequate
	Cape Taylor	5	1	2	g-inadequate channel depth
	Cape Orlando	5,i	1,a	2,i	h-no shore based ramps
	MV Ambassador	5,d	1,d	2,d	i-low tide insufficient ramp clearance
	Callaghan	4,d,i	c,d,i	2,d,i	j-high tide insufficient ramp clearance
	Cape Lambert	4,i,j	a,c	2,i,j	k-excessive ramp angle low tide
	LMSR Class	3,a	a,c	1,a	m-excessive ramp angle high tide
	FSS	3,a	a,c	1,a	n-parallel ramp operation ONLY
	Cape E-Class	4,i,j	a,c	2,i,j	o-insufficient apron width for side ramp
	Cape D-Class	4,a	a,c	2,a	
	Cape H	4,a	a,c	2,a	Ramp clearance and angle based on maximum vessel draft
	Cape Texas	5,i	1,i	2,i	
	Cape R	4,a,d	1,a,d	2,a,d	♦ May Prevent Operation
	Cape I-class	4,i,j	a,c	2,i,j	
	Cape Victory	5,i	1,i	2,i	♦ May Limit Operation
CONTAINER	C6-M-147a	4	c	2	
	C7-S-69c	4	a,c	2	
	C7-S-68c	4	a,c	2	
	C8-S-85c	3,a	a,c	1,a	
	C9-M-132b	3,a	a,c	1,a	
	C9-M-F141a	3,a	a,c	1,a	
TACS	C6-S-1qd	4	a,c	2	
	C5-S-MA73c	5	1,a	2	
	C6-S-MA60d	4	a,c	2	
MPS	C7-S-133a	3,a	a,c	1,a	
	Maersk	4,a	a,c	2,a	
	AmSea	1	a,c	2	

STAGING

Open Staging

The port has ample open staging area. The terminals controlled by C. Steinweg Handelsveem B.V. have about 310 acres of open storage. This is distributed in the four terminals where they have quays. Botlek has 75 acres of staging area; Eemhaven has 140 acres; Seinhaven has 45 acres; and Waalhaven has 50 acres.

Helicopter operations can be carried out in the three terminal areas. Botlek has limited landing area. Outside staging of helicopters will limit vehicle staging. Eemhaven has adequate space without interfering with other operations and warehouses capable of handling helicopters. Waalhaven operations will be limited to Pier 2 with adequate warehouse space for storage; however, there is limited landing area.

Open and Covered Staging Area in Botlek

Covered Staging

The port has ample covered storage for general cargo and container stuffing/unstuffing operations. Storage facilities are located near each of the berths. The terminals controlled by C. Steinweg Handelsveem B.V. have about 83 acres of covered storage. This is distributed in the four terminals where they have quays. Botlek has 17 acres of covered storage; Eemhaven has 16 acres; Seinehaven 25 acres; and Waalhaven 25 acres.

Open and Covered Staging Area
Beatrixhaven, Eemhaven

Open and Covered Staging Area Pier II Waalhaven

UNLOADING/LOADING POSITIONS

Ramps and Docks

There are no fixed end ramps and docks in the port area controlled by the contractor the U.S. Army is currently using. There are portable loading end ramps, in addition portable loading end ramps can be made with materials in the port. This should not cause any problems loading and deploying through this port. It may have some impact on breakbulk operations.

Marshaling Areas

The port and/or the stevedore company may allow the U.S. military to use part of the open storage area as a marshaling yard.

MATERIALS HANDLING EQUIPMENT (MHE)			
C. Steinweg Handelsveem B.V. Stevedoring Company - Available Rolling Material			
Terminal/Dock	**Type of Equipment**	**Capacity (tons)**	**Quantity**
Pier II	Reach Stacker	41	1
	Container Truck	29	1
	Tugmaster		1
	Forklift	2.7	7
	Forklift	4	7
	Forklift	7.25	1
	Forklift electric	2.7	1
	Forklift electric	7.25	1
Beatrixhaven	Container Truck	29	1
	Container Truck	41	1
	Tugmaster		1
	Forklift	2.7	2
	Forklift	4.1	4
	Forklift	7.25	2
Botlek	Reach Stacker	41	2
	Container Truck	25	1
	Tugmaster		7
	Forklift	2.7	3
	Forklift	3.6	10
	Forklift	4.5	20
	Forklift	6.3	3
Material of Beatrixhaven and Botlek are interchangeable.			

DELTA MATERIALS HANDLING EQUIPMENT (MHE)			
Terminal/Dock	**Type of Equipment**	**Capacity (tons)**	**Quantity**
E.C.T. and	Straddle carriers	38.6	69
SeaLand	Container lift trucks	13/17.6/44	20
	Rail loading cranes		2

FUTURE DEVELOPMENT

This port is the largest in Europe and is constantly being upgraded, expanded, and modified to stay the premier port in the world.

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

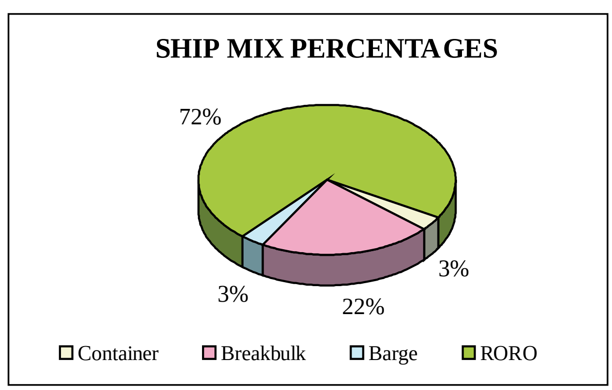
The U.S. Army does not use this port for explosive ammunition operations. Explosive and hazardous cargo operations for the U.S. military are performed in the Port of Nordenham, Germany. Vlissingen, Netherlands, performs ammunition operations on a case-by-case basis.

III. THROUGHPUT ANALYSIS

GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Rotterdam. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of short tons (STON) and measurement tons (MTON) per day. The charts in this section show the throughput yields in STON. Approximate MTON yields can be computed by multiplying the STON amount by three.

Terminal Throughput Subsystems



Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 70 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.

TERMINAL CLEARANCE AND HANDLING

Highway

Each of the terminals is connected to the highway network with roads that provide direct access to and from Autobahn 15. Based on standard traffic engineering practice, at least 1,500 vehicles per day should be able to enter or leave the port on each lane of the highway.

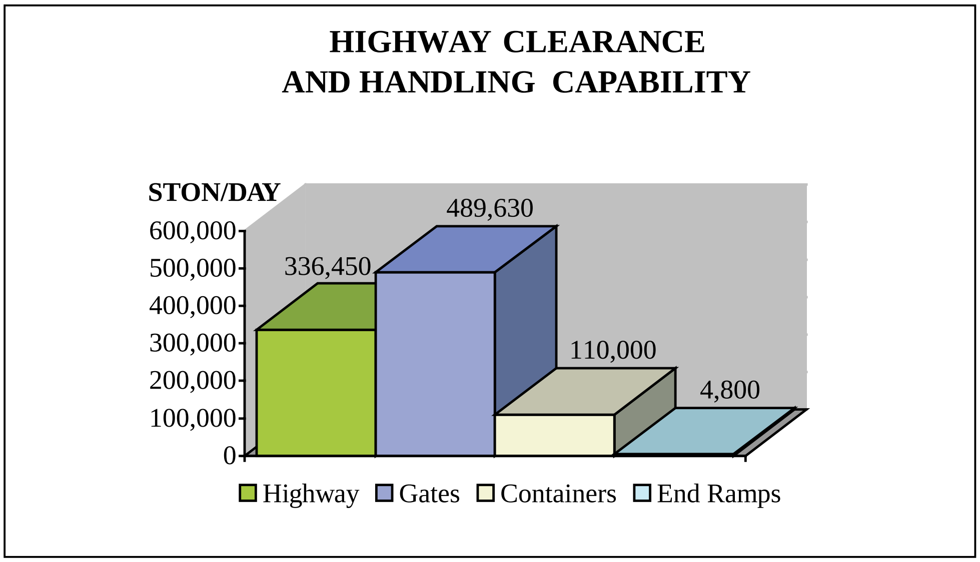
Roadable vehicles will move through the terminal gates in manageable convoys from staging areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a means for unloading vehicles, must use portable ramps. If not available, deploying units/military port operators must either build or acquire the necessary ramps. For this study, we assumed three portable ramps would be used for loading operations. These ramps can handle 4,800 STON of military vehicles and equipment per day.

The Port of Rotterdam has 69 straddle carriers available in the Delta Container Terminal. By using these for unloading semitrailers, the port can handle at least 107,800 STON of containerized equipment and supplies per day.

Maximum daily handling capability for the port is a mixed total of the three types of handling (docks, end ramps, and containers), each up to its maximum, not to exceed the daily gate limits of at least 202,060 STON.

HIGHWAY CLEARANCE AND HANDLING CAPABILITY (STON)					
	Highway	**Gate**	**Container**	**End Ramps**	**Total**
Delta	60,550	165,000	107,800	0	60,550
Botlek	67,650	41,750	220	1,600	41,750
Eemhaven	68,100	42,030	540	1,600	42,030
Waalhaven	79,600	75,850	900	1,600	57,730
TOTAL*	**336,450**	**489,630**	**110,000**	**4,800**	**202,060**

Assumes three portable end ramps will be built to load the lowboy semitrailers.

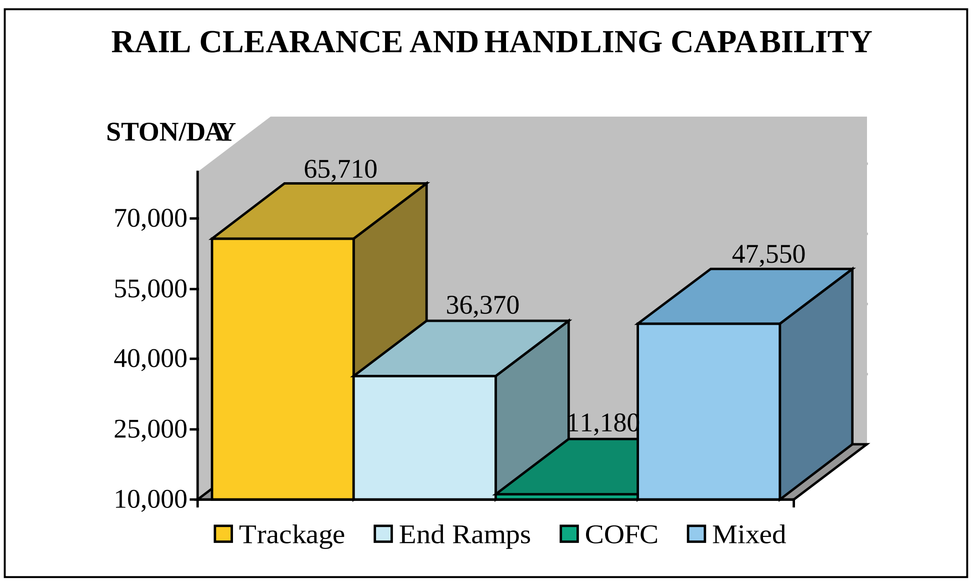


Rail

Rail reception in the port is good, with the Dutch Railroad providing rail service directly to the port. Current rail service is shown in the table below. These trains can handle a mixed load of at least 47,550 STON per day.

CURRENT RAIL SERVICE CAPACITY				
	Trains/Day	**Railcars/Train**	**Track Length***	**Railcar Storage**
Delta Terminal	NA**	NA	NA	NA
Botlek Terminal	9	21	2 tracks 820 ft (250m)	30
Eemhaven	24	21	2 tracks 1,475 ft (450m) 2 tracks 1,650 ft (500m)	120
Waalhaven Pier 1	18	21	2 tracks 2,300 ft (700m)	60
Waalhaven Pier 2	12	21	3 tracks 980 ft (300m)	60
Assumes we build an end ramp for each track.** *****NA-Not available				

RAILCAR CLEARANCE AND HANDLING CAPABILITY (STON)				
	Track	**End Ramp**	**COFC**	**Mixed**
Delta Terminal	NA	NA	6,200	6,200
Botlek Terminal	9,450	6,400	3,000	9,400
Eemhaven	25,060	13,400	180	13,580
Waalhaven	31,200	16,570	1,800	18,370
TOTAL	**65,710**	**36,370**	**11,180**	**47,550**



Staging

The port has ample open staging area. The terminals controlled by C. Steinweg Handelsveem B.V. have about 310 acres of open storage. This is distributed in the four terminals where they have quays. Botlek has 75 acres of staging area; Eemhaven 140 acres; Seinehaven 45 acres; and Waalhaven 50 acres. For purposes of this analysis we assumed a usable space availability of 70 percent of the total area.

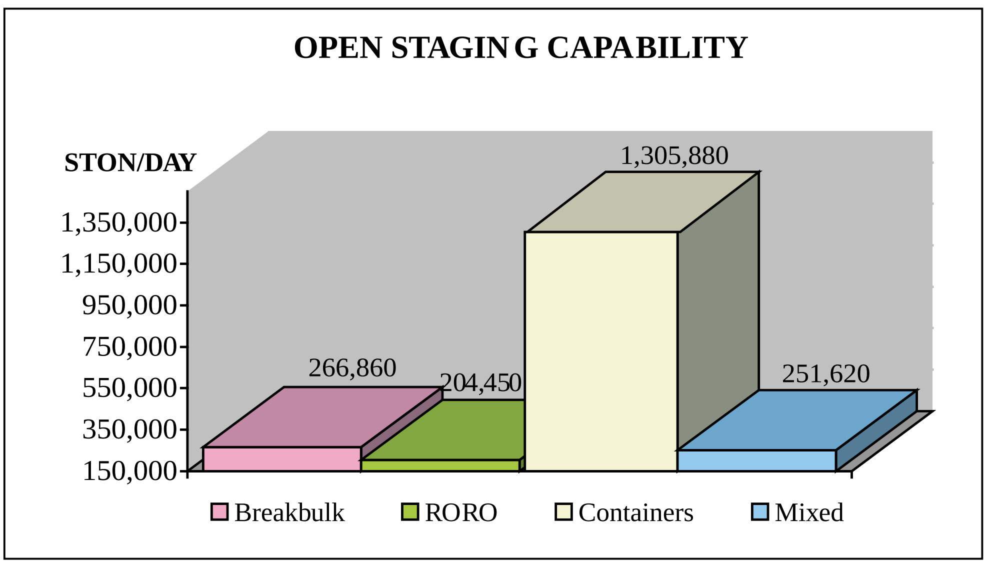
Delta terminal has a total area of 212 hectares (520 acres).

The port has about 83 acres, 3,615,450 square feet, of covered storage space. Like the open area, much of this is subject to contain some of the breakbulk cargo moving through the port. However, covered space availability will not limit throughput at the port. About 50,300 STON of breakbulk cargo can be staged in the covered area.

The table on the next page shows the STON of cargo, by type, the port can expect to handle. The container storage requirement is the highest with 1,305,880 STON. This equates to 163,230 twenty-foot equivalent units (TEU) and with the ability to stack the containers three-high, 1 acre can store 325 containers. The containers will require 502 acres. The available RORO storage is 204,450 STON. This equates to 4,089,000 square feet of storage space or about 24,050 RORO pieces. The breakbulk capability is for 266,860 STON.

The chart on the next page provides the cargo open storage capacity for each vessel type. If a combination ship is expected, then a portion of each involved capability should be assumed.

OPEN STAGING CAPABILITY (STON)				
	Breakbulk	**RORO**	**Container**	**Mixed**
Amazonehaven 8180 (SEALAND)	86,420	66,210	418,170	81,710
Amazonehaven 8200 (DELTA)	86,420	66,210	418,170	81,710
Kade 1	6,670	5,110	25,840	6,110
Kade 2	7,650	5,860	29,600	5,860
Kade 3	12,370	9,480	47,900	11,330
Beatrixhaven 2720	13,640	10,450	105,600	14,120
Beatrixhaven 2730	13,640	10,450	105,600	14,120
RST	26,700	20,450	103,330	24,440
Pier I	6,670	5,110	25,830	6,110
Pier II 2188	3,340	2,560	12,920	3,060
Pier II 2195	3,340	2,560	12,920	3,060
TOTAL	**266,860**	**204,450**	**1,305,880**	**251,620**



Shipping

Daily shipping subsystem totals for the terminal berths are compiled in the chart on the next page. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types.

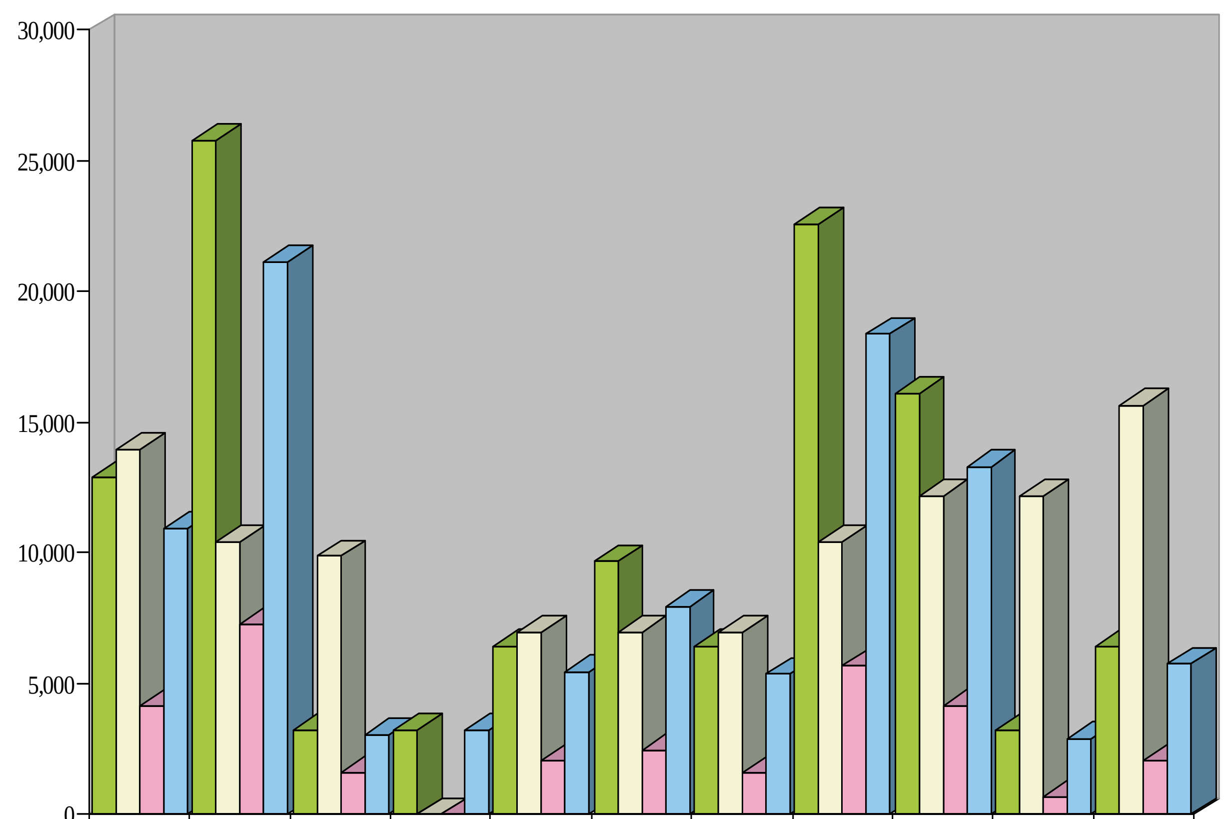
Based on the current use of the port, C. Steinweg Handelsveem B.V. will probably use one berth in three of the four terminals where they have quays - Botlek, Eemhaven, and Waalhaven. Seine-haven is used for barge operations and would not be used for loading ships. For purposes of this analysis we assumed a usable space availability of 70 percent of the total

Barge

The extensive river and canal network makes it possible to use river barges to move cargo within Europe. Oversized and overweight items can be transported by barge without permits and route restrictions encountered on highways and railroads. Barges do have restrictions that include canal depth and width, overpass heights, and locks limits.

Three general types of barges are used in canals and rivers in Europe - breakbulk, RORO, and container. These barges are handled in a similar manner as the larger vessels of the same type and the barges may be self-propelled or towed.

PORT OF ROTTERDAM
BERTH THROUGHPUT CAPABILITY



	Sealand	Delta	Kade 1	Kade 2	Kade 3	Beatrixhaven 2720	Beatrixhaven 2730	RST	Pier I	Pier II 2188	Pier II 2195
RORO	12,900	25,800	3,225	3,225	6,450	9,675	6,450	22,580	16,130	3,225	6,450
Container	13,930	10,450	9,865	0	6,960	6,960	6,960	10,450	12,190	12,190	15,670
Breakbulk	4,180	7,315	1,625	0	2,090	2,440	1,625	5,690	4,180	700	2,090
Mixed	10,960	21,135	3,070	3,225	5,480	7,950	5,370	18,370	13,295	2,930	5,750

DAILY THROUGHPUT SUMMARY									
BERTH	**LENGTH (feet)**	**DEPTH ALONGSIDE (feet)**	**BREAKBULK THROUGHPUT (STON)**	**RORO THROUGHPUT (STON)**	**RORO SQUARE FT[1] (EST)**	**RORO PIECES[2]**	**CONTAINER THROUGHPUT (STON)**	**CONTAINER THROUGHPUT[3] (TEU)**	**MIXED THROUGHPUT (STON)**
(SeaLand)	3,200	42	4,180	12,900	258,000	1,520	13,930	1,740	10,960
(Delta)	5,400	42	7,315	25,800	516,000	3,035	10,450	1,310	21,135
Kade 1	1,300	36	1,625	3,225	64,500	380	9,865	1,230	3,070
Kade 2	1,000	27	0	3,225	64,500	380	0	0	3,225
Kade 3	1,650	42	2,090	6,450	129,000	760	6,960	870	5,480
Beatrixhaven 2720	1,950	32	2,440	9,675	193,500	1,140	6,960	870	7,950
Beatrixhaven 2730	1,300	32	1,625	6,450	129,000	760	6,960	870	5,370
RST	4,600	36	5,690	22,580	451,600	2,660	10,450	1,310	18,370
Pier I	3,300	32	4,180	16,130	322,600	1,900	12,190	1,520	13,295
Pier II 2188	650	29	700	3,225	64,500	380	12,190	1,520	2,930
Pier II 2195	1,650	32	2,090	6,450	129,000	760	15,670	1,960	5,750
TOTAL[4]	**26,000**	**27-42**	**31,935**	**116,110**	**2,322,200**	**13,675**	**105,625**	**13,200**	**97,535**

[1]Based on the 20 square foot per STON average accomplished during Operation Deserts Shield/Storm.

[2]Based on the 170 square foot per piece average accomplished during Operation Deserts Shield/Storm.

[3]Based on the 8 STON per TEU average accomplished during Operation Deserts Shield/Storm.

[4]Barge terminal not analyzed.

SUMMARY

The port is multioperational with the capability to handle all types of vessels - container, RORO, breakbulk, and barges.

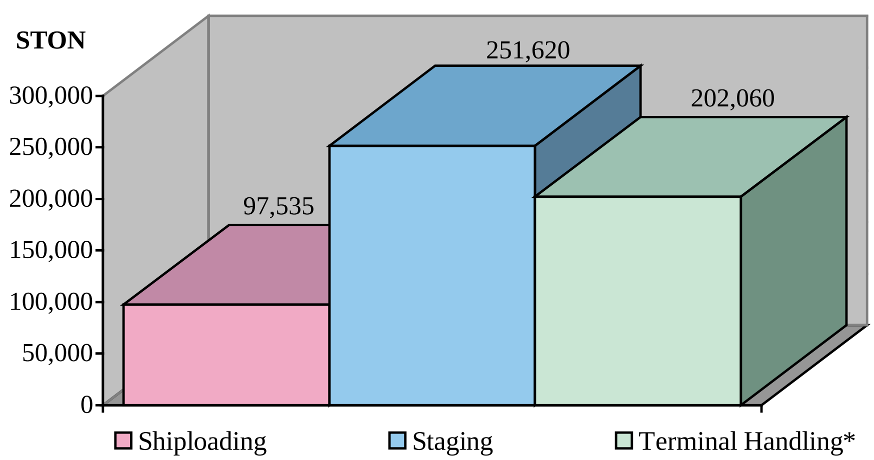
The Port of Rotterdam is fully capable of supporting U.S. military cargo transshipment operations. The tidal range of up to 6 feet will not limit RORO operations. The port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table.

Of the transportation subsystems analyzed, the least capable is the shiploading. The port has a mixed throughput capability of at least 97,535 STON.

The inland water network makes barge transport an effective shipping method. The port connects to this network and provides a third alternative for moving items inland.

Commercial operations taking place concurrently in the port will limit actual daily throughput, sustainable overtime, by an appropriate percentage of the terminal's overall capability. Based on port usage, three berths in three different terminals may be required to move a division in a short period of time.

DAILY CARGO THROUGHPUT CAPACITY



**Terminal handling is the sum of the highway (202,060 STON) and rail (47,550 STON) limits.*

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored division using primarily LMSR or FSS vessels. We also assume that no other military units will be competing for these facilities during the time that the armored division occupies the port. We further assume that the required assets, both transporters and people will be available to adequately load the ship and clear the port. For this application, we will use a berth in Botlek (Kade 1), Eemhaven (Beatrixhaven), and Waalhaven (Pier 1).

Potential Port Use During Deployment at Pier II Waalhaven

REQUIREMENTS

TOTAL EQ UIPMENT	
Volume	287,175 MTON
Weight	101,350 STON
Area	1,484,650 SQ FT
Vehicles	8,125
Containers	520
Note: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997.	

To simulate a likely requirement for the Port of Rotterdam, we deployed a notional armored division, using three berths to load the ships in the minimum amount of time. This is based on the use of three berths in three terminals. The division has to move about 8,125 vehicles and 520 containers. Movement of the division to the port will require about 3,400 railcars, 2,800 medium duty European railcars (RS) and 620 heavy-duty European railcars (SAMMS), using an all rail option for transport to the port.

For this application, we assumed a total rail deployment.

BERTHS

Botlek Terminal has two berths that are FSS and LMSR capable. Eemhaven has six, maybe seven berths that are FSS and LMSR capable. Waalhaven has six berths that are FSS and LMSR capable.

TERMINAL INPROCESSING/HANDLING

Rail

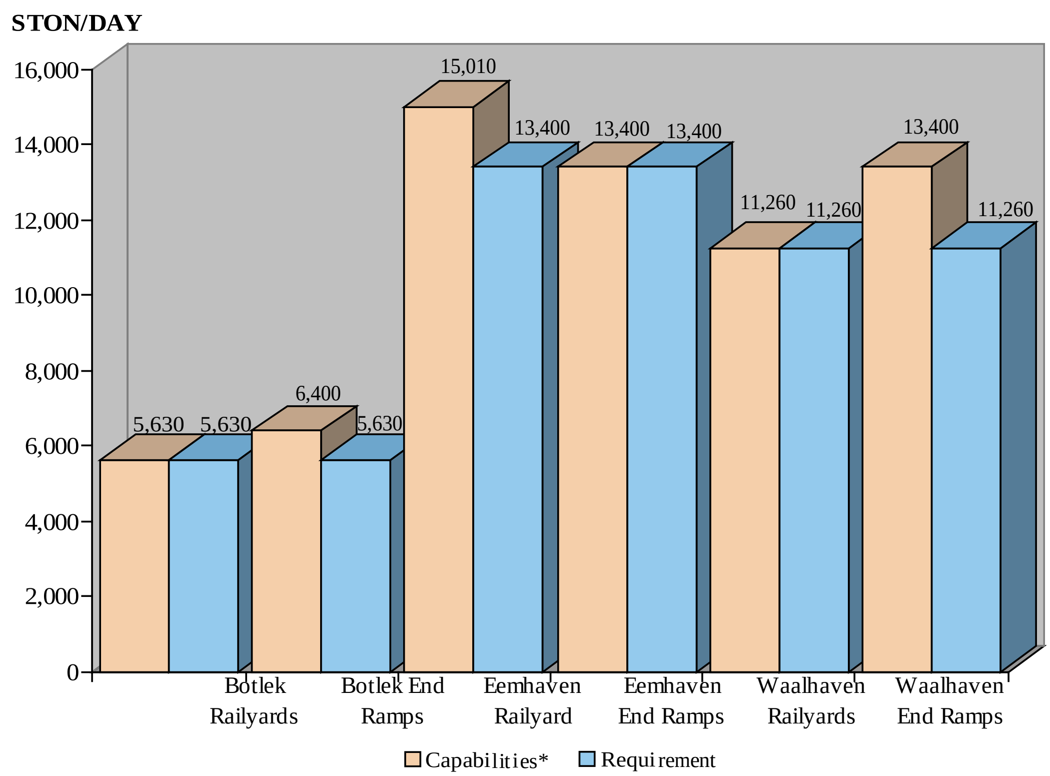
The Dutch Rail provides engines to transfer railcars to the port. Current rail capability is up to 9 trains per day, with 21 railcars per train or 189 railcars per day, going to Botlek Terminal; up to 24 trains per day, with 21 railcars per train or 504 railcars per day, going to Eemhaven; and up to 18 trains per day, with 21 railcars per train or 378 railcars per day, going to Waalhaven, Pier 1.

The rail requirement is 3,400 railcars, or 1,133 railcars per berth assuming a third of the division will deploy from each of the berths. Based on current rail capability to each of the terminals and no other requirements on the terminal rail assets, Botlek will require 6 days, Eemhaven will require 2 ½ days, and Waalhaven will require 3 days to get a third of the armored division into each of the terminals and unload the railcars. No railcars should be scheduled to arrive the last 2 days of the shiploading to ensure there are no conflicts with offloading the railcars and loading the ships.

Botlek has two apron tracks available for loading/unloading railcars close to Kade 1. Eemhaven has four apron tracks available for loading/unloading railcars close to Beatrixhaven. Waalhaven, has two apron tracks available for loading/unloading railcars close to Pier 1. Portable ramps could be placed at the end of these tracks. Other alternatives include staging equipment ahead of time or using other methods to get the equipment to the berths.

Rail and end ramp capacities are the limiting factors in deploying the division. By using the total rail capacity in the terminals, Botlek would require 18 days for unit arrival and offload from the railcars, Eemhaven would require 8 days for arrival and offload, and Waalhaven would require a little over 6 days for arrival and offload.

RAIL CLEARANCE/HANDLING CAPABILITY

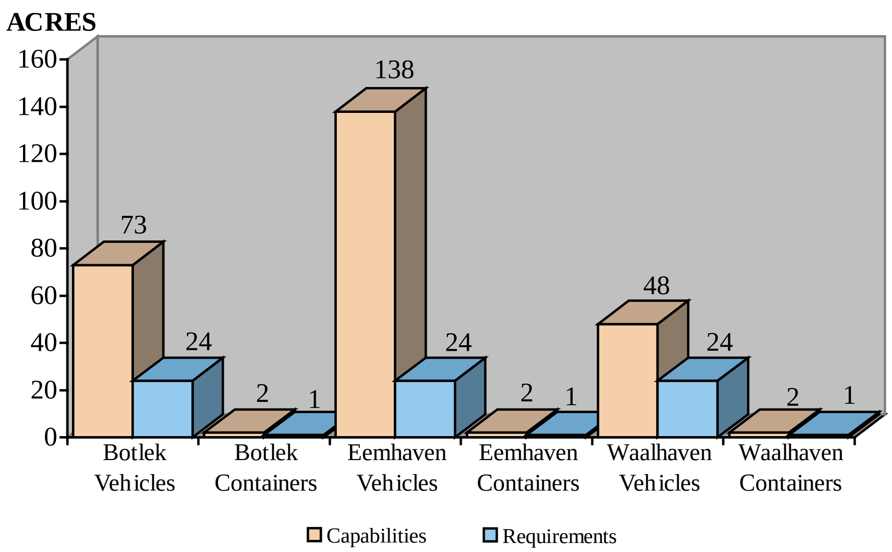


Assumes eight portable ramps can be placed in the terminals for offloading the railcars. To load three LMSRs at the same time would require equipment to be stowed in the berth area prior to the ships arriving in the port if a total rail shipment is used. Based on MTMCTEA Reference 97-700-5, 2,635 STON are loaded in the 520 containers

Open Storage

Botlek Terminal has 75 acres of open storage area, Eemhaven has 140 acres, and Waalhaven has 50 acres. Limiting the open storage area used to 25 acres, the requirement for an LMSR, in each of the terminals should not cause a problem for a deploying force. Botlek and Eemhaven Terminals have enough open storage for three LMSRs. Waalhaven has enough open storage for two LMSRs.

OPEN STORAGE CAPABILITY



Note: The terminals should be capable of staging equipment to loading three LMSRs at the same

Shipping

Berth space is adequate to allow the side and stern ramps on the LMSRs to be used to load the ships. If smaller ships are used to deploy the division, then additional time or berths will be required to move the division.

SHIP REQUIREMENTS FOR A NOTIONAL ARMORED DIVISION				
Loading Condition/ Sample Ship Mix	**FSS (RORO/ Comb)**	**LMSR (RORO/ Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	9.6			
All LMSR		5.9		
All Breakbulk			29.8	
Maximum Containerization				
FSS/Container	2.9			4.9
LMSR/Container		1.8		4.9
Breakbulk/Container			9.0	4.9

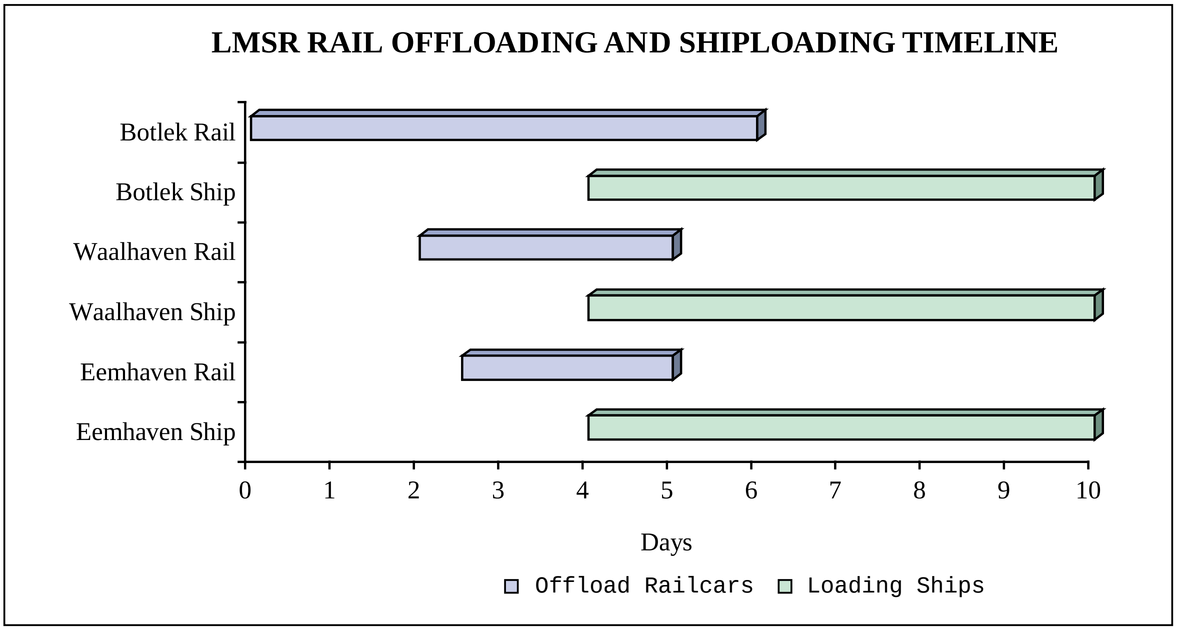
Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997.

Deploying by LMSR requires six ships. Based on preliminary LMSR loading results, we estimate the LMSRs will load about 400 STON per hour. Each LMSR will require an average 42.22 hours to load. The number of days required to load a ship is determined by the hours worked per day (20) and factors for sustainment and nighttime operations. This results in an equivalent of 18.43 hours per day. Based on a loading time of 42.22 hours and 18.43 hours per day productive time, it will require an average of 2.29 days to load each LMSR.

It will require 6 days to get a third of the division into Botlek Terminal by rail, 3 days to get a third of the division into Waalhaven, and 2 1/2 days to get a third of the division into Eemhaven. The arrival of the railcars with equipment to the berths should be staggered to minimize the time equipment is in the terminal. The arrival of railcars in Waalhaven and Eemhaven should start on day two of railcar arrival in Botlek. The first three LMSRs will arrive at the berths and start loading on day four of railcar arrival in Botlek Terminal. The timeline is shown on the next page.

The efficient outloading of a divsion will require optional coordination of equipment arriving by rail and staging and loading the equipment on ships.

The first LMSR should arrive in Botlek Terminal and start loading after 4 days of railcar arrival and unloading. The first LMSR should arrive in Eemhaven and start loading after 2 days of railcar arrival and unloading. And the first LMSR should arrive in Waalhaven and start loading after 3 days of railcar arrival and unloading. The last three ships will arrive after the first three have departed. This will require 4.58 days of loading; this does not include docking/undocking and ship preparation. To dock/undock and load the ships requires about 6 days, loading three LMSRs at the same time. This results in using about 10 days for staging in the Botlek area, with the last 6 of these days used to load the ships.



Deploying by FSS requires 10 ships. Based on an FSS loading time of 250 STON per hour, each FSS will require an average 40.5 hours to load. The number of days required to load the ship is determined by the hours worked per day (20) and factors for sustainment and nighttime operations. This results in an equivalent of 18.43 hours per day. Based on a loading time of 40.5 hours and 18.43 hours per day productive time, it will require 2.19 days to load the FSS. To load three ships at a time requires 6.57 days of shiploading; this does not include docking/undocking and ship preparation. Five berths would be required to meet the 6-day requirement.

SUMMARY

Botlek, Eemhaven, and Waalhaven Terminals at the Port of Rotterdam can load a notional armored division within 6 days using three berths and six LMSR ships. If other ships are used, additional berths or time will be required to deploy the division.

This is a viable port for supporting deployment of a notional armored division provided three berths are available for U.S. military deployments using LMSRs or five berths are available using FSS.

If only one terminal could be used to deploy the division and there were a 6-day shiploading limit, then Eemhaven Terminal would have to be used, using RST and Beatrixhaven berths. Botlek Terminal has two berths and will require 18 days of railcar arrival and unloading.

APPENDIX

PORT OF ROTTERDAM BERTHS AND TERMINALS

Note: Limited information is available on all berths.

The berths on the north side of the river were not evaluated in this analysis. The development on the north side of the river is being converted from industry, shipping, and storage terminals to business and residential. Port growth is ongoing on the south side of the river.

BERTHS ON THE NORTH SIDE OF THE RIVER			
Berth Name	**Signpost***	**Water Depth (meters)**	**Water Depth (feet)**
Berghaven			
Buitenhaven	700		
HydroAgrihaven/ Windmill Holland		2.16-3.96	7-13
Ijselhaven	265	6.01-10.26	19.5
Keilehaven	300	3.01-4.61	10-15
Koningin Wilhelminahaven	640	6.06	20
Koushaven	255	3.01	10
Lekhaven	280	6.01-10.01	19.5-33
Leuvehaven	175	3.01	10
Merwehaven	360	7.01-10.01	3-33
Parkhaven	200	4.01-7.01	13-23
Schiehaven	235	8.51	28
Schiemond	245	3.01	10
Spuihaven	510		
St. Jorishaven/ St. Jobshaven	220	6.01-8.01	19.5-26
Veerhaven	185	4.01	13
Vijfsluizerhaven	590		
Vlaardingen			
Vliethaven	343		
Voorhaven	410		
Vulkaanhaven/ Vulcaanhaven	610	12.06	39.5
Wilhelminahaven	530	7.96-8.96	26-29
Wiltonhaven	560	9.01	29.5
Quay signpost number. The number is within or close to the berth. The port uses a numbering designation as well as a name designation.			

Bulk berths were not included in the analysis.

BULK BERTHS			
Berth Name	**Signpost***	**Water Depth (meters)**	**Water Depth (feet)**
Dintelhaven	6200	3.01-5.01	10-16
Dokhaven/ Droogdok	2600	6.51-10.01	21-33
Elbehaven	5850	5.01-14.01	16-46
Europort	5860	7.01-11.01	23-36
Grote Piers N&Z	4220	4.01-13.01	13-42.5
Mississippihaven	8000	21.01-22.36	69-73
St Laurenshaven	4400	4.01-13.86	13-45.5
Quay signpost number. The number is within or close to the berth. The port uses a numbering designation as well as a name designation.			

Additional berths not evaluated in this analysis include petroleum berths.

PETROLEUM BERTHS			
Berth Name	**Signpost***	**Water Depth (meters)**	**Water Depth (feet)**
Beneluxhaven	5800	7.01-21.01	23-69
Donauhaven	5610	6.01	19.5
Torontohaven	4530	6.01-13.01	19.5-42.5
1e Petroleumhaven	3220	4.01-11.86	13-39
2e Petroleumhaven	3100	4.01-11.36	13-37
3e Petroleumhaven	4100	4.01-12.01	13-39.4
4e Petroleumhaven	5720	2.51-15.86	8-52
5e Petroleumhaven	5650	10.01-21.01	33-69
6e Petroleumhaven	6410	12.01-21.61	69-71
7e Petroleumhaven	5530	4.01-23.01	13-75.5
8e Petroleumhaven	8490	23.01-23.36	39.5-76.5
Quay signpost number. The number is within or close to the berth. The port uses a numbering designation as well as a name designation.			

Chemical berths were not evaluated and include.

CHEMICAL BERTHS			
Berth Name	**Signpost***	**Water Depth (meters)**	**Water Depth (feet)**
Chemiehaven	4200	7.36-12.01	24.1-39.4
Waalhaven Nz	2150	6.01-12.01	19.7 39.4
Weserhaven	5625	5.01	16.4
Quay signpost number. The number is within or close to the berth. The port uses a numbering designation as well as a name designation.			

Other terminals beyond the bridge crossing the river at Koningshaven were not listed or evaluated.

Berths with draft less than 30 feet were not included in this analysis.

BERTHS WITH DRAFTS LESS THAN 27 FEET (8.25 METERS)			
Berth Name	**Signpost***	**Water Depth (meters)**	**Water Depth (feet)**
1e Eemhaven	2680	4.01	13
Barendrechtsehaven	2125	2.01	6.5
Binnenhaven	1180	4.61	15
Brandblus Pier (Pier GEB)/ Kolenpier	2500	4.01	13
Dommelhaven	5830	3.01-4.01	10-13
Entrepothaven	1175	4.61	15
Geulhaven	4020	3.01-4.01	10-13
Hartelhaven	7200	4.86	16
Konignshaven	1170	6.86	22.5
Kortenoordsehaven	2130	4.01	13
Londenhaven	5200	4.01	13
Madroelhaven	2910	6.01	19.5
Neckarhaven	6010	4.51	14.5
Niehuis & v.d. Berg	2820	6.01	19.5
Pier 3	2210	3.01	10
Pier 4	2225	6.01	20
Pier 8	2520	5.51	18
Pr Christinahaven	2815	3.01	10
Robbenoordsehaven	2130	4.01	13
Scheurhaven	5400	5.51	18
Seinehaven	5110	4.01-6.11	13-20
Sleepboothaven	2585	3.36	11
Spoorweghaven	1240	4.61	15
St Janshaven	2110	3.01	10
Vliegassteiger	8210	6.51	21
Werkhaven	2640	3.01	10
Quay signpost number. The number is within or close to the berth. The port uses a numbering designation as well as a name designation.			

These tables show additional berths and their characteristics that the U.S. military could use in the future.

BERTH CHARACTERISTICS FOR CALANDKANAAL				
	Berths			
Characteristics	Brittanniehaven		Hartelhaven*	
Quay Signpost number	5210	5230	7200	7220
Length feet (meters)	3,300 1,000	4,250 1,300	9,600 1,100	2,300 700
Depth alongside at MLW feet (meters)	33-39 10.01-12.01	33-39 10.01-12.01	16-17.5 4.86-5.36	16-17.5 4.86-5.36
Deck Strength psi (metric tons per square meter)				
Apron width feet (meters)	Open	Open	Open	Open
Apron height above MLW feet (meters)				
Number of container cranes				
Number of wharf cranes				
Apron Lighting				
Straight-stern RORO Ramp		Yes	No	No
Apron length served by rail feet (meters)				
Hartelhaven is a multipurpose barge terminal.				

BERTH CHARACTERISTICS FOR NIEUWE WATERWAY				
	Berths			
Characteristics	Heysehaven	Katendrechtse	Maashaven	Rijnhaven
Quay Signpost number	2620	1295	1360	1260
Length feet (meters)				
Depth alongside at MLW feet (meters)				
Deck Strength psi (metric tons per square meter)				
Apron width feet (meters)				
Apron height above MLW feet (meters)				
Number of container cranes				
Number of wharf cranes				
Apron Lighting				
Straight-stern RORO Ramp				
Apron length served by rail feet (meters)				

BERTH CHARACTERISTICS FOR BOTLEK	
Berths*	
Characteristics	2e Werkhaven
Quay Signpost number	4550
Length feet (meters)	
Depth alongside at MLW feet (meters)	29.5 9.01
Deck Strength psi (metric tons per square meter)	
Apron width feet (meters)	
Apron height above MLW feet (meters)	
Number of container cranes	
Number of wharf cranes	
Apron Lighting	
Straight-stern RORO Ramp	
Apron length served by rail feet (meters)	
**Steinweg uses Kades 1, 2, and 3.*	

BERTH CHARACTERISTICS FOR BEERKANAAL		
Berths		
Characteristics	Amazonehaven	
Quay Signpost number	8030	8160
Length feet (meters)	2,600 800	2,600 800
Depth alongside at MLW feet (meters)	69 21.01	69 21.01
Deck Strength psi (metric tons per square meter)	600 2.9	600 2.9
Apron width feet (meters)	Open	Open
Apron height above MLW feet (meters)		
Number of container cranes	None	6
Number of wharf cranes	None	None
Apron Lighting	Yes	Yes
Straight-stern RORO Ramp	No	No
Apron length served by rail feet (meters)	None	None

BERTH CHARACTERISTICS FOR EEMHAVEN								
	Berths							
Characteristics	Pr Johan Frisohaven		Pr Beatrixhaven		Pr Margriethaven		Pr Willem Alexanderhaven	
Quay Signpost number	2680	2700	2720	2740	2760	2780	2795	2800
Length feet (meters)	3,950 1,200	3,250 1,600	4,600 1,400	3,950 1,200	3,300 1,000	2,600 800	2,300 700	3,300 1,000
Depth alongside at MLW feet (meters)	10-17.5 3.01-5.36	10-19.5 3.01-6.01	33 10.01	33-36 10.01-11.01	33 10.01	33-36 10.01-11.01	32 9.82	39 12.01
Deck Strength psi (metric tons per square meter)								
Apron width feet (meters)								
Apron height above MLW feet (meters)								
Number of container cranes								
Number of wharf cranes								
Apron Lighting								
Straight-stern RORO Ramp				Yes		Yes		
Apron length served by rail feet (meters)								

BERTH CHARACTERISTICS FOR WAALHAVEN

Berths								
Characteristics	**Pier 1**	**Pier 2**		**Pier 5**	**Pier 6**	**Pier 7**		**Heyplaat**
Quay Signpost number	2160	2180	2200	2570	2550	2530	2540	2580
Length feet (meters)	2,600 800	2,950 900	2,600 800	2,450 750	2,600 800	2,600 800	2,600 800	2,600 800
Depth alongside at MLW feet (meters)	29.5-33 9.01-10.01	10-29.5 3.01-9.01	33 10.01	36 11.01	10-44 3.01-13.51	10-13 3.01-4.01	37-42 11.36-12.86	19.5-31 6.01-9.51
Deck Strength psi (metric tons per square meters)								
Apron width feet (meters)								
Apron height range feet (meters)								
Number of container cranes								
Number of wharf cranes								
Apron Lighting								
Straight-stern RORO Ramp								
Apron length served by rail feet (meters)								

PORT OF VLISSINGEN-OOST (FLUSHING EAST)
NETHERLANDS

I. EXECUTIVE SUMMARY

The Military Traffic Management Command Transportation Engineering Agency conducted a capability analysis of the Port of Vlissingen 11-15 May 1998. Vlissingen is a public-owned, contractor-operated port fully capable of handling roll-on/roll-off (RORO), container, and break-bulk ships and barges.

The port has a 2,985-foot-long general-purpose quay, Quarleshaven, and a floating RORO ramp that makes up the Sloehaven Terminal, and can accommodate vessels as large as the fast sealift ships (FSS) and large medium speed RORO (LMSR). The port has the capability of supporting U.S. military cargo shipment operations. It can load or offload a mixed throughput of at least 20,920 short ton (STON) a day.

The Port of Vlissingen connects with the inland waterway network, making barge transport an effective shipping method. Rail and barge are the normal methods of shipping to and from this port. Rail and highway access to the port is good. It is a 5 minute drive from Autobahn 58 to the port. A railyard in the port speeds up rail operations.

The 12-foot tidal range may limit RORO operations in the port.

Quarleshaven has two container cranes and four mobile cranes, with 125 acres of open staging. An FSS requires about 16 acres per day of staging to load/offload the ship and a LMSR requires about 25 acres per day of staging for continuous operation.

Vlissingen is a viable port for supporting deployments of a notional armored brigade provided one berth, Quarleshaven, is available for U.S. military deployments. A notional armored brigade has a total of 27,970 STON of vehicles and equipment and could be loaded on 1.4 LMSRs in about 4 days. The brigade will require use of the port for about 6 days. The first 4 for rail arrival and offloading and the last 4 for ship loading. Rail operations and ship loading overlaps during the 2 middle days.

The U.S. military has used this port for transshipping ammunition. Waivers are issued for a one-time use and obtained on a case by case basis. The Dutch Ministry of Defense has approved the port for transshipping ammunition, up to 220 STON net explosive weight (NEW) (49 to 176 containers) depending on ammunition class and berth.

II. GENERAL DATA

The Military Traffic Management Command Transportation Engineering Agency (MTMCTEA) conducted a capability analysis of the Port of Vlissingen 11-15 May 1998. Vlissingen is a public-owned, contractor-operated port capable of handling RORO, container, and breakbulk ships and barges. Vlissingen is also known as Flushing. The port we are evaluating is Vlissingen-Oost (Flushing East) and will be referred to as Vlissingen in this report. The port is east of the town of Vlissingen.

TRANSPORTATION ACCESS

Water

The Port of Vlissingen (latitude 51° 27' north, longitude 03° 36'east, (YALL - GEO location code) time zone GMT+1) is on the north bank of the Westerschelde (Western Scheldt) River. The port is situated in the deep water area of the Scheldt River. The harbor is a tidal basin. The entrance to the harbor is 1,150 feet (350 meters) wide. The main channel in the port is dredged to 41 feet (12.5 meters) below lowest low water spring (LLWS). Mean low water (MLW) is 9 inches (.23 meters) above LLWS. The tide range is up to 12 feet (3.6 meters). There are no vertical obstructions that restrict access to the river, harbor, or port. Pilotage is required for all vessels approaching and entering the port. The berths water depths and berths lengths are shown in the table below.

Berth Name	Water Depth, MLW (feet)	Water Depth, MLW (meters)	Berth Length (feet)	Berth Length (meters)
Sloehaven	43.5	13.3	NA	NA
Quarleshaven	43.5	13.3	2,985	910
Floating RORO Ramp	43.5	13.3	NA	NA
Westhofhaven	34.5	10.5	985	300
Bijleveldhaven	34.5	10.5	5,350	1,600
Van Cittershaven	NA	NA	NA	NA
Port Scaldia	47.5	14.5	1,970	600
Kaloothaven	54	16.5	3,710	1,130
NA – Not available				

Vlissingen has designated anchorage areas. Vlissingen roads offers safe anchorage positions with sandy bottoms. Ships can anchor south of Koopmanshaven (the western harbor of Vlissingen (original port)) at least .75 miles from the northern coast. The depths vary from 33 feet (10 meters) to 85 feet (26 meters).

A58
N254
N
BIJEVELDHAVEN
WESTHOFHAVEN
QUARLESHAVEN
SLOEHAVEN
PORT SCALDIA
V. CITTERSHAVEN
KALOOTHAVEN
WESTERN
SCHELDT
RIVER
RAILROAD
BUILDING
OPEN STAGING
MINOR ROAD
0.5
0
0.5
1 MI

Site Map

The Scheldt River connects with the other rivers and canals in the Netherlands and Europe to form an effective inland water network. This makes it possible to use barges as a suitable method to transport items. Barge transport can be used to move items too large for easy highway and rail transport.

Map of Inland Water Network

For nonmilitary cargo, 20 percent is transported by barge to and from the port. The U.S. military does not use this port often; however, during the Ardent Ground Exercise, 50 percent of the 120 vehicles traveled by barge.

Highway

Highway access to the port is good. Autobahn 58 is a 5 minute drive from the port. A four-lane road connects the Autobahn to the port. For nonmilitary equipment, 40 percent is transported by highway to and from the port. The U.S. military did not use highway transport during the last exercise.

Gate to the Port of Vlissingen

Rail

The Port of Vlissingen has a dedicated rail line connected to the Dutch National Railroad. A rail switching yard is located in the port. The quay that may be used by the U.S. Army has two quay-side tracks. It also has a portable rail end ramp that can be used where it is needed.

For nonmilitary cargo, 40 percent is transported by rail to and from the port. The U.S. military transports 50 percent of the vehicles by rail.

PORT FACILITIES

Berthing

Quarleshaven, an extension of the Sloehaven Terminal, is used for multipurpose cargo. The quay length, for container, RORO, and conventional cargo, is 2,985 feet (910 meters) with along side depths of up to 43.6 feet (13.3 meters). There is a RORO ramp at the end of the quay farthest from the river. In addition to this ramp there is a floating RORO ramp capable of handling three RORO vessels at a time. One vessel on this ramp would have to be secured to the ramp by aft of the ship (med moore--shown on the next page).

The tidal range is 12 feet (3.6 meters). RORO operations directly onto the pier may be limited, because the ramp angle may be too steep for normal RORO operations. The floating RORO ramp will not have these restrictions. The other terminals in this port were not evaluated in this analysis.

STAGING

Open Staging

The port harbor and industrial area covers 5,440 acres (2,200 hectares). One hundred twenty five acres of land is available for open storage in the area of the berth the U.S. military will use. The area within the reach of the container cranes is open and available for use (shown below).

Covered Staging

There are 14 storage buildings in the Quarleshaven Berth area. The buildings are outside of the reach of the quay side cranes. There is a total of 2,583,360 square feet of covered storage in these buildings (shown below).

Quarleshaven Berthing Area

BERTH CHARACTERISTICS FOR PORT OF VLISSINGEN		
Berths		
Characteristics	**Quarleshaven**	**RORO**
Length feet (meters)	2,985 910	
Depth alongside at MLW feet (meters)	43.6 13.3	43.6 13.3
Deck strength pounds per square feet (metric tons per square meter)	600 2.9	600 2.9
Apron width feet (meters)	1,044 320	Open
Apron height above MLW feet (meters)	23.75 7.25	
Number of container cranes	2	None
Number of wharf cranes STON	6 13-110	None
Apron Lighting	Yes	Yes
Straight-stern RORO Ramp	Yes	3
Apron length served by rail feet (meters)	1,310 400	None

PORT OF VLISSINGEN SUMMARY OF BERTHING CAPABILITIES			
Vessels		Berths	
Type	Class	Quarleshaven	RORO*
BREAKBULK	C3-S-38a	5	0
	C4-S-58a	5	0
	C4-S-66a	5	0
	C5-S-37e	4	0
SEATRAIN	GA and PR	5	0
BARGE	LASH C8-S-81b	3	0
	LASH C9-S-81d	3	0
	LASH Lighter	14	0
	SEABEE C8-S-82a	3	0
	SEABEE Barge	14	0
RORO	COMET	5,i,j	3,b
	METEOR	5,i,j	3,b
	Cape Gnome	4,i,j	3,b
	C7-S-95A	3,i	3,b
	Cape Taylor	4,i	3,b
	Cape Orlando	4,i,j	3,b
	MV Ambassador	5,i	3,b
	Callaghan	4,i,j	3,b
	Cape Lambert	4,i,j	3,b
	LMSR Class	3	3,b
	FSS	3	0,b
	Cape E-Class	4,i,j	3,b
	Cape D-Class	4,i,j	3,b
	Cape H	3,i	3,b
RORO	Cape Texas	4,i,j	3,b
	Cape R	4,i,j	3,b
	Cape I-class	4,i,j	3,b
	Cape Victory	4,i,j	3,b
CONTAINER	C6-M-147a	4	0
	C7-S-69c	4	0
	C7-S-68c	4	0
	C8-S-85c	3	0
	C9-M-132b	3	0
	C9-M-F141a	3	0
TACS	C6-S-1qd	4	0
	C5-S-MA73c	4	0
	C6-S-MA60d	4	0
MPS	C7-S-133a	3	0
	Maersk	3	0
	AmSea	4	0

NOTES:

The numbers in the columns to the left indicate the quantity of vessels that might operate at the berth.

The letters in the columns to the left indicate limitations as described below.

a-vessel draft limit
b-inadequate apron width
c-inadequate berth length
d-no straight stern ramp
e-no container handling equipment
f-anchorage depth OK, berth depth inadequate
g-inadequate channel depth
h-no shore based ramps
i-low tide insufficient ramp clearance
j-high tide insufficient ramp clearance
k-excessive ramp angle low tide
m-excessive ramp angle high tide
n-parallel ramp operation ONLY
o-insufficient apron width for side ramp
Ramp clearance and angle based on maximum vessel draft

♦ **May Prevent Operation**

♦ **May Limit Operation**

This is a floating RORO ramp that can accommodate three vessels at a time. One vessel will be med moored to the RORO ramp.

Highway

Highway access to the port is good. The highway going to the port has four lanes. There is a 5 minute drive from the port to Autobahn 58. Rotterdam is about 60 miles from the port, the Germany border 120 miles, and the Belgium border 30 miles.

Rail

Quarleshaven has two quayside tracks that are 1,300 feet long each. There are also two tracks in the area of the floating RORO ramp that are 1,480 feet long each. The track connects directly to the railroad with a railyard just inside the port.

OFFLOADING/LOADING POSITIONS

Ramps and Docks

The port has one portable rail loading end ramp and more can be built if required. There are no fixed truck and boxcar ramps or docks. If any are needed they will have to be provided by the military port operators or they will have to make the stevedoring company aware of the requirement and get the company to rent or build them.

Marshaling Areas

The port has an open field directly behind the Quarleshaven quay that could be used as a marshaling area. This 2,691,000 square foot area can be used for staging and marshaling if required.

MATERIALS HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity (STON)	Quantity
Mobile Cranes	13	1
Mobile Cranes	28	1
Mobile Cranes	33	2
Mobile Cranes	50	1
Mobile Cranes	110	1
Forklifts	44	8
Forklifts	13	10
Forklifts	18	12
Forklifts	20	1
Forklifts	24	1
Forklifts	28	1
Straddle Carriers		6

NOTE: The table above represents equipment owned by the port. Port operators may be able to lease or rent other equipment as required from local suppliers. The list is not "all inclusive" as actual totals may change.

FUTURE DEVELOPMENT

The port is expanding the Port Scaldia quay. The expansion will handle breakbulk, vehicles, and unitized cargo. When complete, Port Scaldia will have 250 acres (100 hectares) of land and 7,545 feet (2,300 meters) of quay with a water depth of 41 feet (12.5 meters) LLWS on the north side and 47.6 feet (14.5 meters) LLWS on the south side. Construction is scheduled for completion around the year 2000. The port is also considering converting the grass area behind Quarleshaven quay into hard stand.

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

The U.S. military has used the port for transshipping ammunition. The waivers are issued for one-time use and are obtained on a case-by-case basis. Normally, explosive and hazardous cargo operations for the U.S. military are performed in the Port of Nordenham, Germany.

AMMO RESTRICTIONS FOR H.V. VLISSINGEN QUARLESHAVEN*

	Quay	Net Explosive Weight (NEW), STON	NEW, kilograms
Ammo Class 1.1	Location A	11	10,000
	Location B	44	40,000
	Location C	132	120,000
Ammo Class 1.2/1.3/1.4	Location A	110	100,000
	Location B	132	120,000
	Location C	220	200,000

Location A is the third of Quarleshaven quay closest to the port entrance.
Location B is the center third of Quarleshaven quay.
Location C is the third of Quarleshaven furthest from the port entrance including the floating RORO ramp.

Source: Dutch Ministry of Defense (DMOD), Mil Commission for Dangerous Goods letter dated, 17 Sep 97, these restrictions are applicable until 17 Sep 99.

Note:

1. When Gas/LPG discharge/loading operations are taking place at the Gas Terminal all ammunition operations have to be stopped, hatches closed, and vessels leave the berth and find a place outside Sloehaven. Operations handling only class 1.4 are exempt from above limitations.

2. Martien Burger, H.V. Vlissingen, stated that the draft, berth, and handling RORO/LOLO are not technical problems for the stevedore.

3. Harbormaster:

a. LPG/Gas operations are limited to one per month and could be negotiated.

b. Restriction of 120,000kg NEW at location C is still applicable, but could be subject to alterations based on availability of actual vessel characteristics, detailed quantity of ammunition classes, NEW and related cargo. This NEW data is evaluated between harbormaster and DMOD Mil Commission for dangerous goods for possible alterations or increases to meet this shipment's NEW.

c. Although direct transshipment from rail to vessel (or via quay) is the normal process, temporary staging of rail cargo for a maximum of 48 hours on the quay, while guarded, will be granted by the Harbormaster (no shed storage).

d. A request with detailed information is required to start the process in accordance with DMOD Dangerous Goods regulations for final approval.

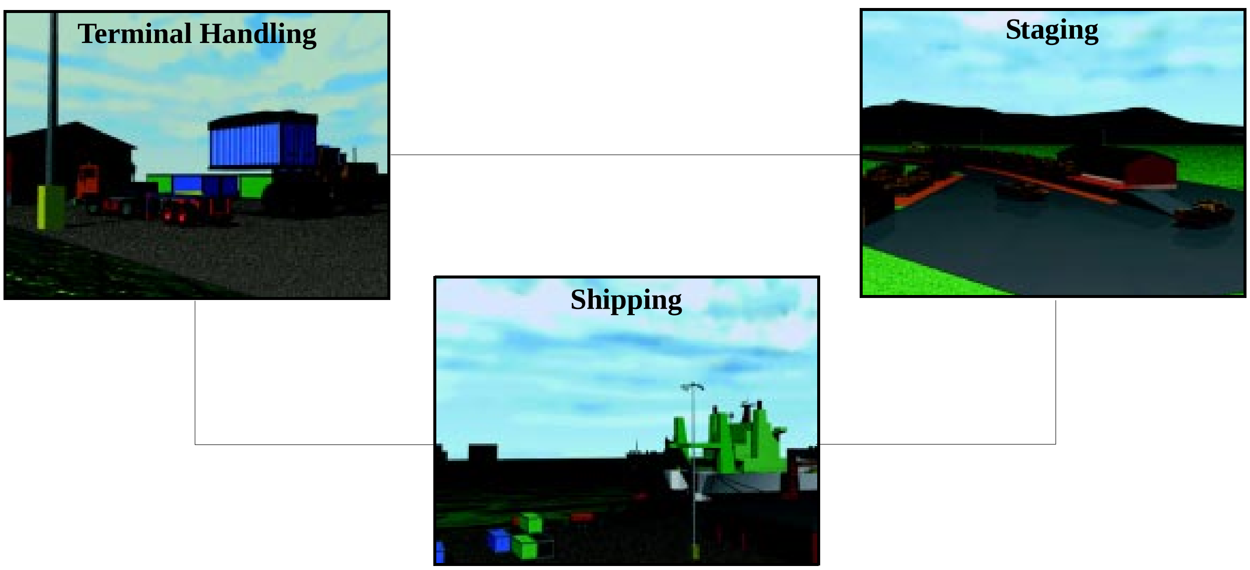
4. On 3 Mar 99, Harbormaster provided the 598th Terminal Group a Dutch written version clarifying that "current law of dangerous goods is not applicable to international transport of dangerous goods on transportation assets owned by or in custody and responsibility of the forces or of the forces of an allied country."

5. A copy of paragraph 4 was hand-carried to the 598th Terminal Group (Safety Director) for evaluation and clarification. Best recommendation is still to apply paragraph 1 on the previous page, until 598th Safety Director provides the proper guidelines.

III. THROUGHPUT ANALYSIS

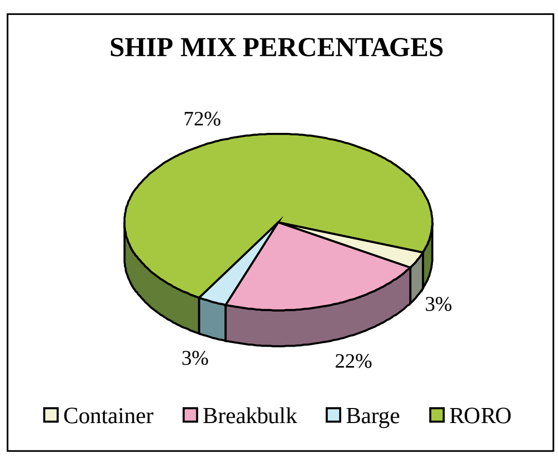
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of the Port of Vlissingen. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or off-loading, staging, and terminal handling. The least capable subsystem defines the maximum throughput capability for the port. The model yields throughput capability values for each subsystem in terms of STON and measurement tons (MTON) per day. The charts in this section show the throughput yields in STON. Approximate MTON yields can be computed by multiplying the STON amount by three.



Terminal Throughtput Subysystems

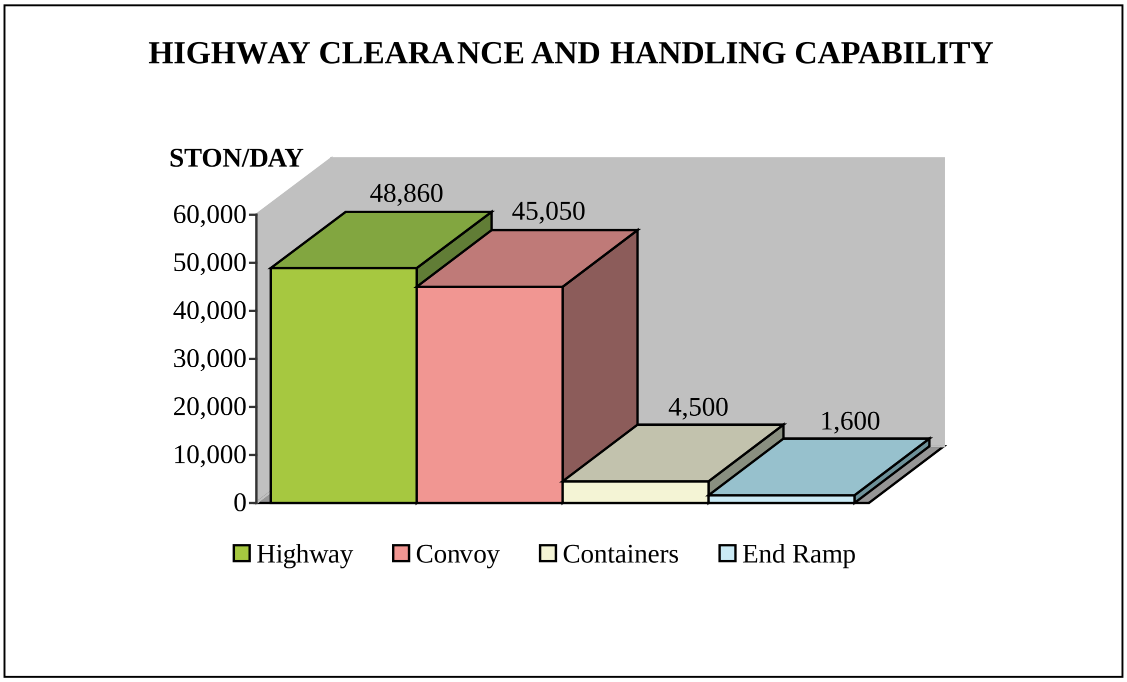
Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 70 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operations Desert Shield and Desert Storm. These data helped us develop a mix of vessels likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployment.



TERMINAL CLEARANCE AND HANDLING

Highway

The port is connected to the Autobahn by two gates and a four-lane highway. Based on standard traffic engineering practice, at least 1,500 vehicles per day per lane should be able to enter or leave the port on the four-lane highway with two lanes going in each direction. The road into and out of the port complex is capable of handling at least 48,860 STON of equipment and supplies daily in each direction. The U.S. military port operators should work with the port officials to ensure processing at the gate does not delay the movement.



Roadable vehicles will move through the terminal gates in manageable convoys from staging areas designated for these moves. Military convoys could be 45,050 STON. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. If not available, deploying units/military port operator must either build or acquire the necessary ramps. For this study we assumed one portable ramp would be used for loading operations. This ramp can handle 1,600 STON of military vehicles and equipment per day. The port has no handling positions to load/offload supplies in van semitrailers.

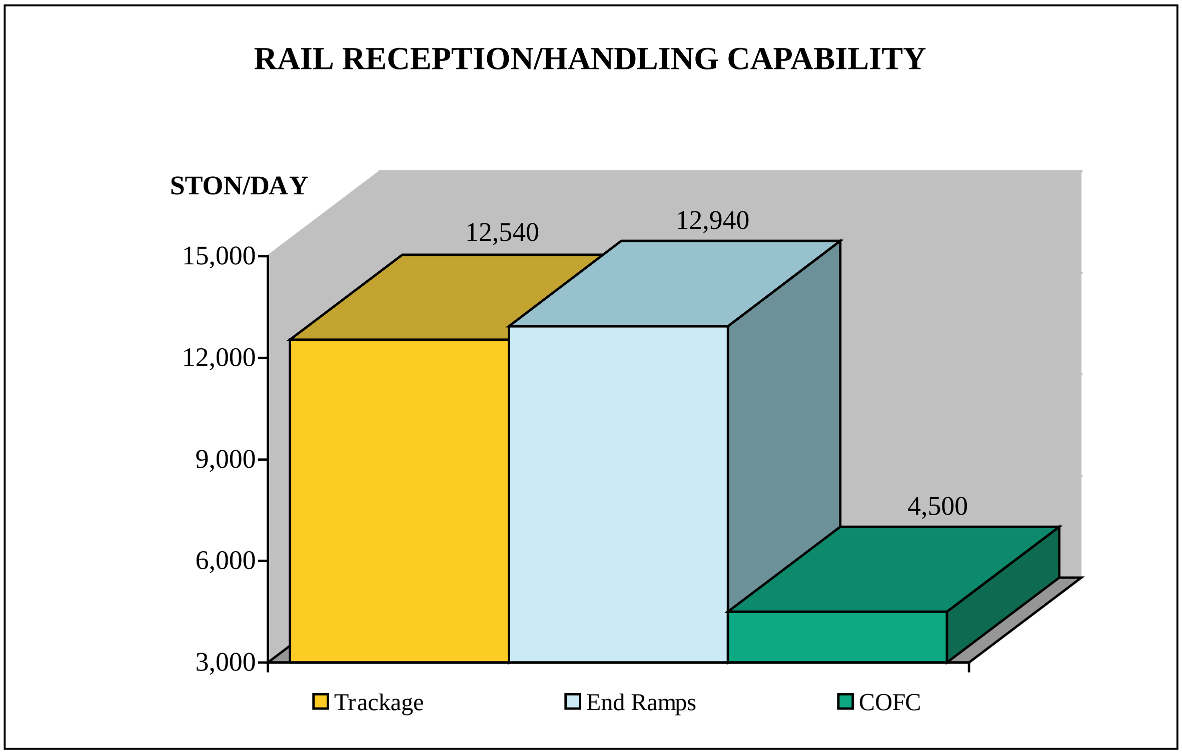
The Port of Vlissingen has six straddle carriers that can handle containers available in the port. By using three of these for loading, the port is capable of handling at least 4,500 STON of containerized equipment and supplies per day.

Rail

Rail reception in the port is good, with the Dutch National Railroad providing rail service directly to the port. The port can store a total of 90 railcars at Quarleshaven quay and the floating RORO dock. The Nieuwdorp Railyard just outside the port can store 450 additional railcars. Currently, rail service to the port can support up to 12 trains per day with 21 railcars per train. These railcars are capable of handling at least 12,540 STON per day.

Vehicles on flatcars could be offloaded in the port at portable end ramps. The port owns one portable end ramp suitable for offload-ing tanks. Four tracks are available that could be used to offload the railcars with at least 1,300 feet of straight track for two tracks and 1,480 feet of straight track for the other two tracks. Building or providing three additional portable rail end ramps, for a total of four end ramps, can decrease the time required to load/offload railcars. The port should handle at least 12,940 STON of military vehicles per day using four portable end ramps. This makes the railcar capacity the limiting factor for rail transport. If the three additional rail ramps are not built, the ability to offload the railcars becomes the limiting factor and it will take four times as long to off load the railcars. The port has no rail handling positions available for loading/offloading boxcars.

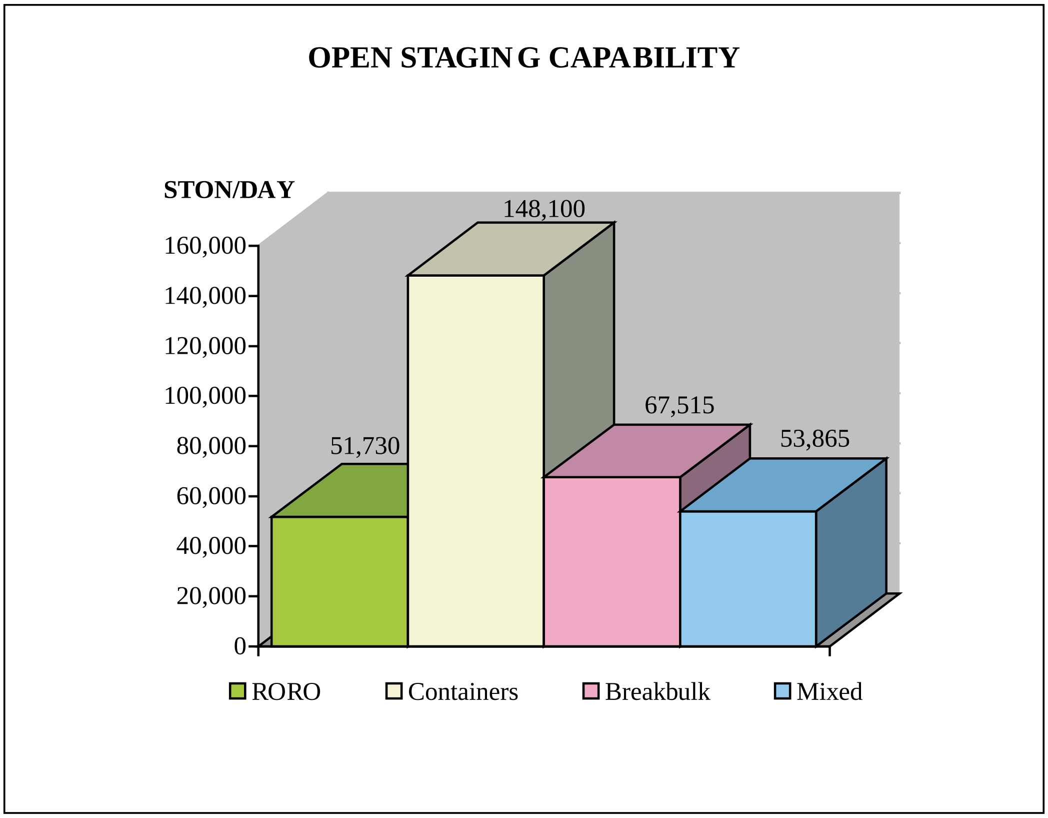
Based on using the three straddle carriers not used for highway, the port is capable of loading/offloading at least 4,500 STON of containerized equipment and supplies from railcars per day.



Staging

The port has about 125 acres of suitable open staging area in the Quarleshaven Terminal area. Availability of the staging area will vary with work at the port. Port operators assured the survey team that space could be freed up fairly quickly to support military operations. Sixty acres is a grassed lot between the road and covered storage.

The port has about 2,583,360 square feet of covered storage space. Like the open area, much of this is subject to contain some of the breakbulk cargo moving through the port. About 51,670 STON of breakbulk cargo can be staged in the covered area.

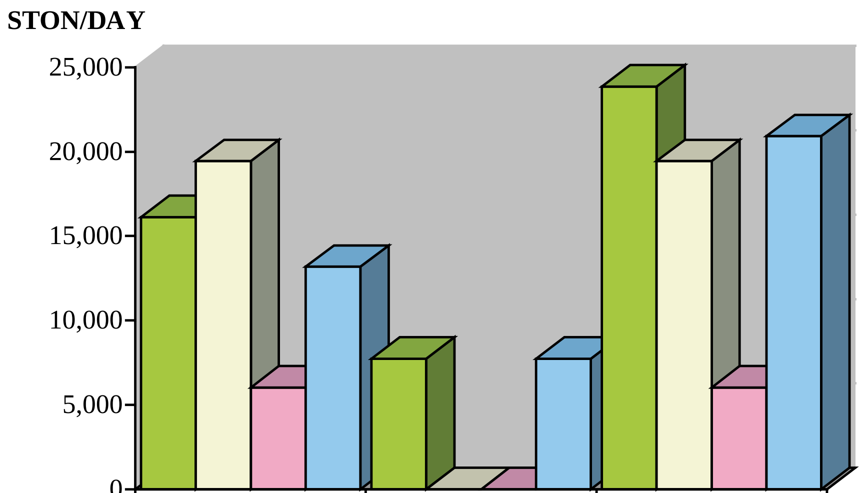


Shipping

Daily shipping subsystem totals for the berths are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types. Shipping is the least capable subsystem in the port.

Although the floating RORO ramp is capable of supporting LMSR, it may not be practical to load/offload these vessels to the floating RORO ramp since it would not be possible to use the side ramps on the ships. This would increase the loading/unloading time.

BERTH THROUGHPUT CAPABILITY



	Quay	RORO	Total
RORO	16,130	7,740	23,870
Container	19,450	0	19,450
Breakbulk	6,030	0	6,030
Mixed	13,180	7,740	20,920

	Quay	**RORO***	**Total**
RORO	16,130	7,740	23,870
Container	19,450	0	19,450
Breakbulk**	6,030	0	6,030
Mixed	13,180	7,740	20,920

Floating RORO Ramp.
****Includes 1,810 STON of Seabee and Lash barge capability.***

Barge

The extensive river and canal network makes it possible to use river barges to move cargo within Europe. Oversized and overweight items can be transported by barge without permits and route restrictions encountered on highways and railroads. Barges do have restrictions, which include canal depth and width, overpass heights, and having to travel through locks.

Three general types of barges are used in canals and rivers in Europe: breakbulk, RORO, and container. These barges are handled in a similar manner as the larger vessels of the same type. These barges may be self-propelled or towed.

EXPLOSIVE AND HAZARDOUS CARGO OPERATIONS

AMMO RESTRICTIONS FOR H.V. VLISSINGEN QUARLESHAVEN*			
	Quay	**NEW pounds**	**NEW kilograms**
Ammo Class 1.1	Location A	11	10,000
	Location B	44	40,000
	Location C	132	120,000
Ammo Class 1.2/1.3/1.4	Location A	110	100,000
	Location B	132	120,000
	Location C	220	200,000
Location A is the third of Quarleshaven quay closest to the port entrance. Location B is the center third of Quarleshaven quay. Location C is the third of Quarleshaven furthest from the port entrance including the floating RORO ramp.			
***Source: Dutch Ministry of Defense (DMOD), Mil Commission for Dangerous Goods Letter dated, 17 Sep 1997, these restrictions are applicable until 17 Sep 1999.**			

A containership with 500 containers or a small breakbulk ship is capable of transporting three million pound NEW limit. The number of containers/pallets the port can handle depends on the ammunition density. Currently, about one third of the ammunition containers (Mil Vans) have a NEW of 9,160 pounds and about two thirds have a NEW of 2,500 pounds, across all ammunition classes.

AMMO CONTAINERS, BASED ON AMMO DENSITY	
NEW, STON	**Range – number of containers**
11	2 – 9
44	10 – 35
132	29 – 106
110	24 – 88
132	29 – 106
220	49 – 176

The amount of ammunition DMOD allows in the port, in the table on the previous page, will not approach the limits of the throughput or shipping capability. The port is capable of handling 19,450 STON of containers or 6,030 STON of breakbulk cargo per day.

SUMMARY

The port is multioperational with the capability to handle all types of vessels: container, RORO, breakbulk, and barges.

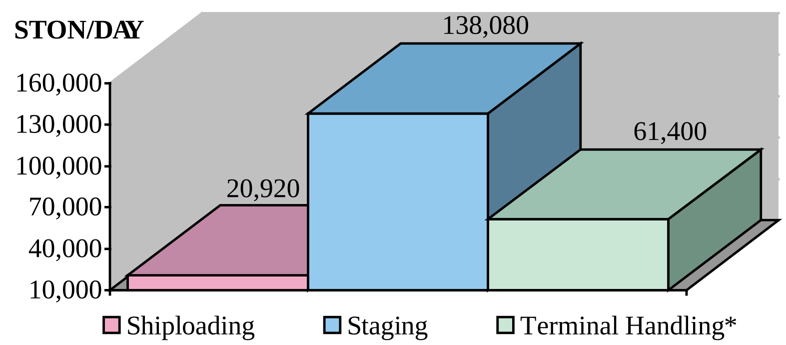
The Port of Vlissingen is fully capable of supporting U.S. military cargo transshipment operations. It can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table.

Of the transportation subsystems analyzed, the least capable is the shiploading. The military useful berths in the port have a mixed throughput capability of at least 20,920 STON.

The inland water network makes barge transport an effective shipping method. The port connects to this network and provides a third alternative for moving items inland.

Commercial operations taking place concurrently in the port will limit actual daily throughput, sustainable overtime, by an appropriate percentage of the terminal's overall capability.

DAILY CARGO THROUGHPUT CAPABILITY

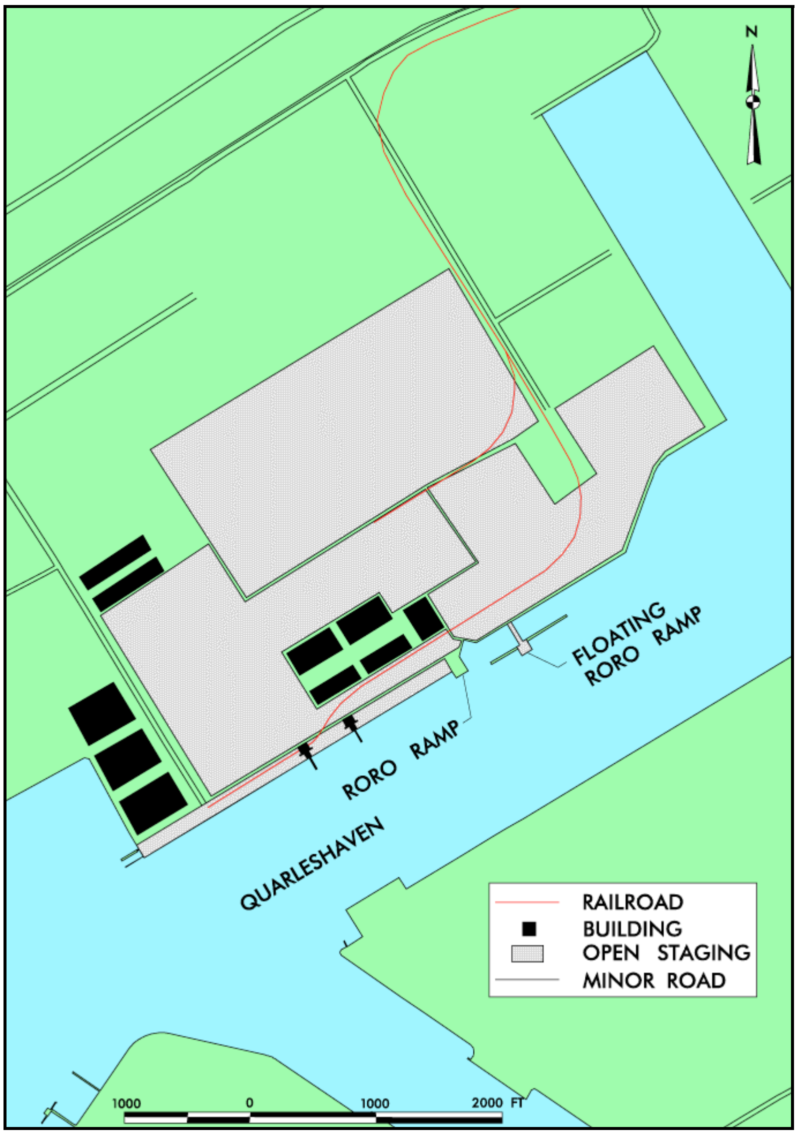


Terminal handling is the sum of the highway (48,860 STON) and rail (12,530 STON) limits.

IV. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored brigade using primarily LMSR and FSS vessels. We also assume that no other military units will be competing for these facilities during the time that the armored brigade occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately load the ship and clear the port. The berths in the Quarleshaven Terminal are used for this analysis.



Potential Use During Deployment

REQUIREMENTS

A likely requirement for the Port of Vlissingen would be to deploy a notional armored brigade in about 4 days of ship loading (two ships one at a time using the same berth). The brigade has to move about 1,820 vehicles and 94 containers. Movement of the brigade to the port will require about 880 railcars, 565 medium duty European railcars and 215 heavy-duty European railcars, using an all rail option for transport to the port. About 24 containers would arrive daily.

For this application, we assumed a total rail deployment. The U.S. military does not use this port often. During the Ardent Ground Exercise, 50 percent of the 120 vehicles traveled by barge and the rest by rail.

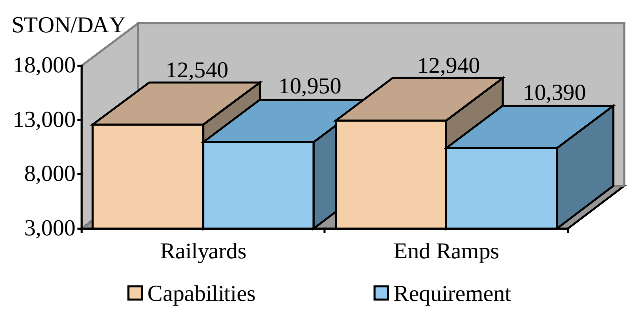
TOTAL EQUIPMENT	
Volume	81,600 MTON
Weight	27,970 STON
Area	373,910 SQ FT
Vehicles	1,820
Containers	94
Note: MTMCTEA REFERENCE 97-700-5, Deployment Planning Guide, July 1997	

TERMINAL INPROCESSING/HANDLING

Rail

The Dutch railyard, Nieuwdorp, serves the Port of Vlissingen. Nieuwdorp is east of the port, with 5.4 miles of track. The Dutch railroad provides engines to transfer railcars from this railyard to the port. These tracks provide access from the Dutch railyard and main line to the berth areas. Current rail service is up to 12 trains per day, with 21 railcars per train, 252 railcars per day, going to Quarleshaven berths. The brigade requires about 880 railcars. At 252 railcars per day, it will take 3 1/2 to 4 days to get the railcars to the berths.

RAIL CLEARANCE/HANDLING CAPABILITY

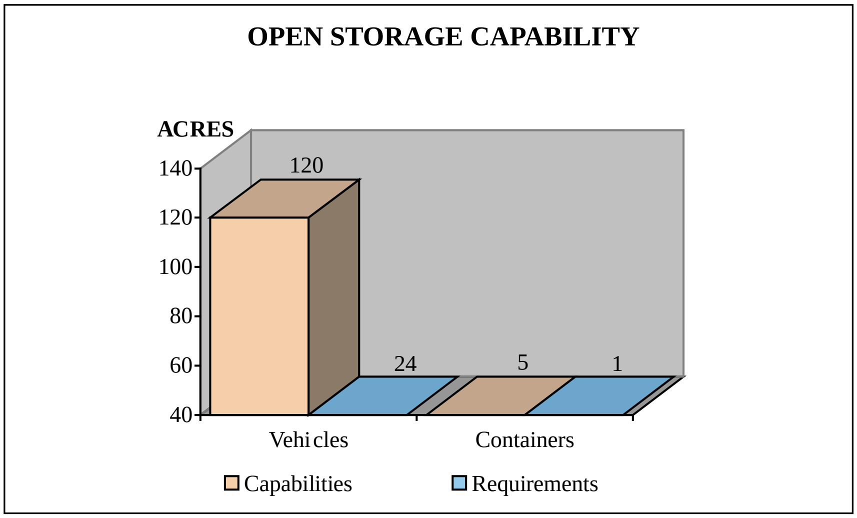


*Assumes four portable ramps can be in place in the terminal for offloading the railcars. The berth requires 4 days for the railcars to arrive and not exceed the rail capacity. Based on MTMCTEA Reference 97-700-5 560 STON are loaded in 94 containers. The containers arrive in the port on the railcars.

One rail ramp is available for loading/unloading railcars close to the berth and we assume three others will be built.

OPEN STORAGE

The port has plenty of open storage area. Limiting the open storage around the Quarleshaven berths will not cause a problem for a deploying force. The staging area requirement for sustained single LMSR loading operations is about 25 acres for vehicle and container storage.



SHIPPING

Berth space is adequate to allow the side and stern ramps on the LMSR to be used to load the ship. If smaller ships are used to deploy the brigade, then additional time or berths will be required to move the brigade.

SHIP REQUIREMENTS NOTIONAL ARMORED BRIGADE				
Loading Condition/ Sample Ship Mix	**FSS (RORO/ Comb)**	**LMSR (RORO/ Comb)**	**C3/C4 (Breakbulk or Containers)**	**C6/C7/C8 (Container)**
Minimum Containerization				
All FSS	2.3			
All LMSR		1.4		
All Breakbulk			7.0	
Maximum Containerization				
FSS/Container	0.8			0.9
LMSR/Container		0.5		0.9
Breakbulk/Container			2.5	0.9

Legend:
RORO – roll on/roll off
FSS – fast sealift ship
LMSR – large medium speed roll on/roll off
Source: MTMCTEA Reference 97-700-5, Deployment Planning Guide, July 1997

Deploying by LMSR requires two ships. Based on preliminary LMSR loading results, we estimate the LMSRs will load about 400 STON per hour. Each LMSR will require an average 34.81 hours to load. The number of days required to load the ship is determined by the hours of work per day (20) and factors for sustainment and nighttime operations. Applying these factors, we get the equivalent of 18.43 hours per day. Based on a loading time of 34.81 hours and 18.43 hours per day productive time it will require an average of 1.89 days to load each LMSR. To meet the 4-day loading requirement will require loading one LMSR at a time. The first ships should arrive no earlier than the third day of railcar arrival and begin loading and the last ship arrives in the port as the first ship departs. This requires a total of 6 days use of staging in the berth area, with last 4 of these days used to load the ships. Berthing at Quarleshaven will allow up to three LMSR vessels to dock at a time. It would be possible to load both vessels at the same time in 2 days starting after the railcars have arrived. To prevent lost time for docking and undocking, arrangements should be made to dock the second ship in another berth while the first one is finishing loading.

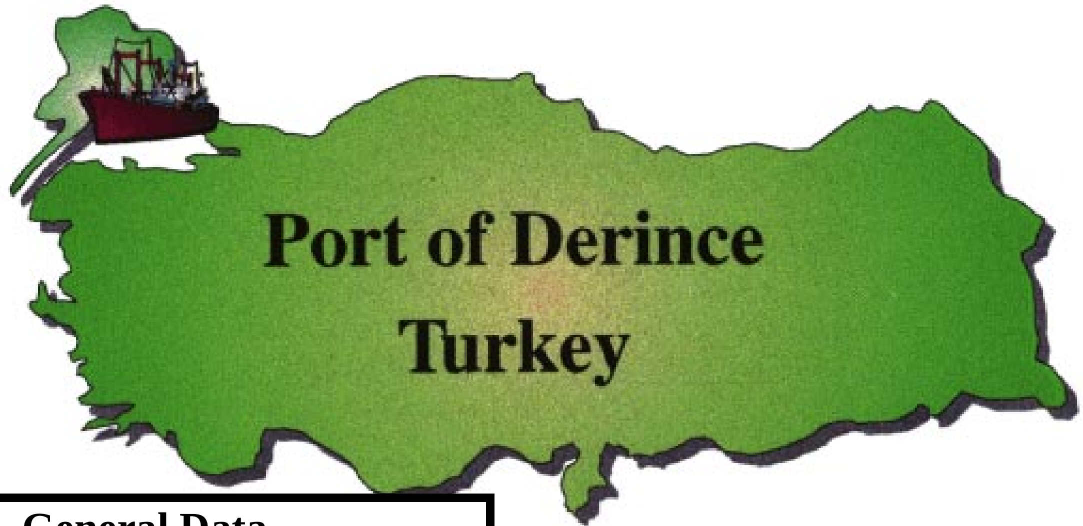
Deploying by FSS requires three ships based on FSS loading time of 250 STON per hour. Each FSS will require an average 37.14 hours to load. The number of days required to load the ship is determined by the hours of work per day (20) and factors for sustainment and nighttime operations. Applying these factors, we get the equivalent of 18.43 hours per day. Based on a loading time of 37.14 hours and 18.43 hours per day productive time, it will require 2.01 days to load the FSS. Quarleshaven has berthing for three FSS at a time in the berth. This requires a total of 6 days use of staging in the berth area, and the first two vessels arriving on day three and the last on arriving on day four.

SUMMARY

The Port of Vlissingen can load a notional armored brigade in about 4 days using only one berth in the port and two LMSR vessels. If other ships are used, additional berths may be required to load the vessels in 4 days.

The Port of Vlissingen is a viable port for supporting deployment of a notional armored brigade provided one berth (Quarleshaven) is available for U.S. military deployments.

June 94



I. General Data

II. Throughput Analysis

Throughput Summary

Return to Index

I. GENERAL DATA

TRANSPORTATION ACCESS

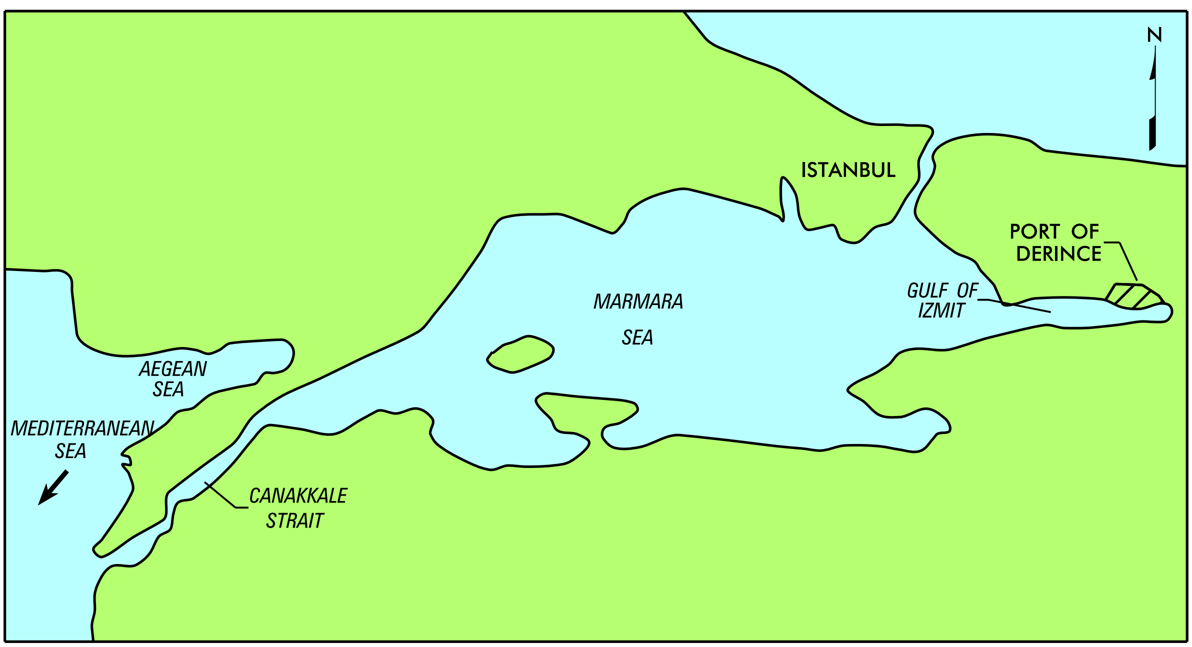
WATER

The Port of Derince is on the northwest side of Turkey just southeast of Istanbul. The port is at 40^o44'44" N Latitude and 29^o50'00" E Longitude on the northern shore of the Gulf of Izmit Approaching channels have no vertical or overhead restrictions. The channel entering the port is more than 50 feet at mean low water (MLW). Water depth at the ship berths ranges from 32.8 to 49.2 feet MLW. Pilotage is required for berthing and unberthing. Pilots are available 24 hours a day.

Water access to the port is more difficult than that of Izmir, Iskenderun, and Mersin. For ships to get to the Port of Derince, they must first pass through the Canakkale Strait and the Gulf of Izmit. Neither of these passages are exceptionally narrow, but the ships must slow down in several areas.

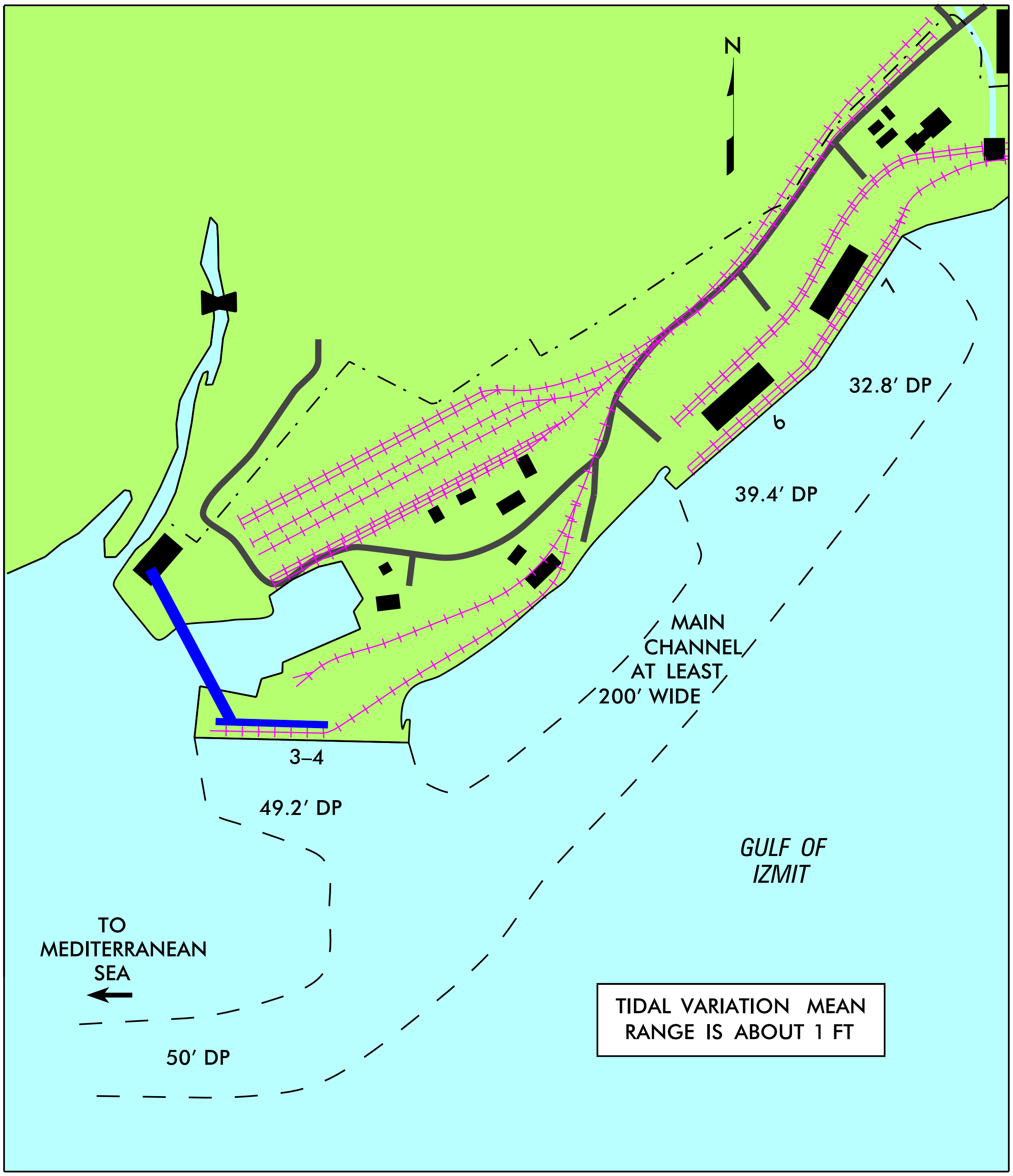
Anchorage is forbidden near the port. Waiting anchorage is at Izmit, 4 miles east of the port. Just west of the port is an explosives anchorage used occasionally to handle Turkish ammunition. This explosives anchorage includes a few shipwrecks.

Ships may turn in the channel just outside the port.



Water Access Through the Marmara Sea

Within the Gulf of Izmit, the water is relatively calm. The port has no breakwaters to obstruct entering. Ships may turn in the channel.



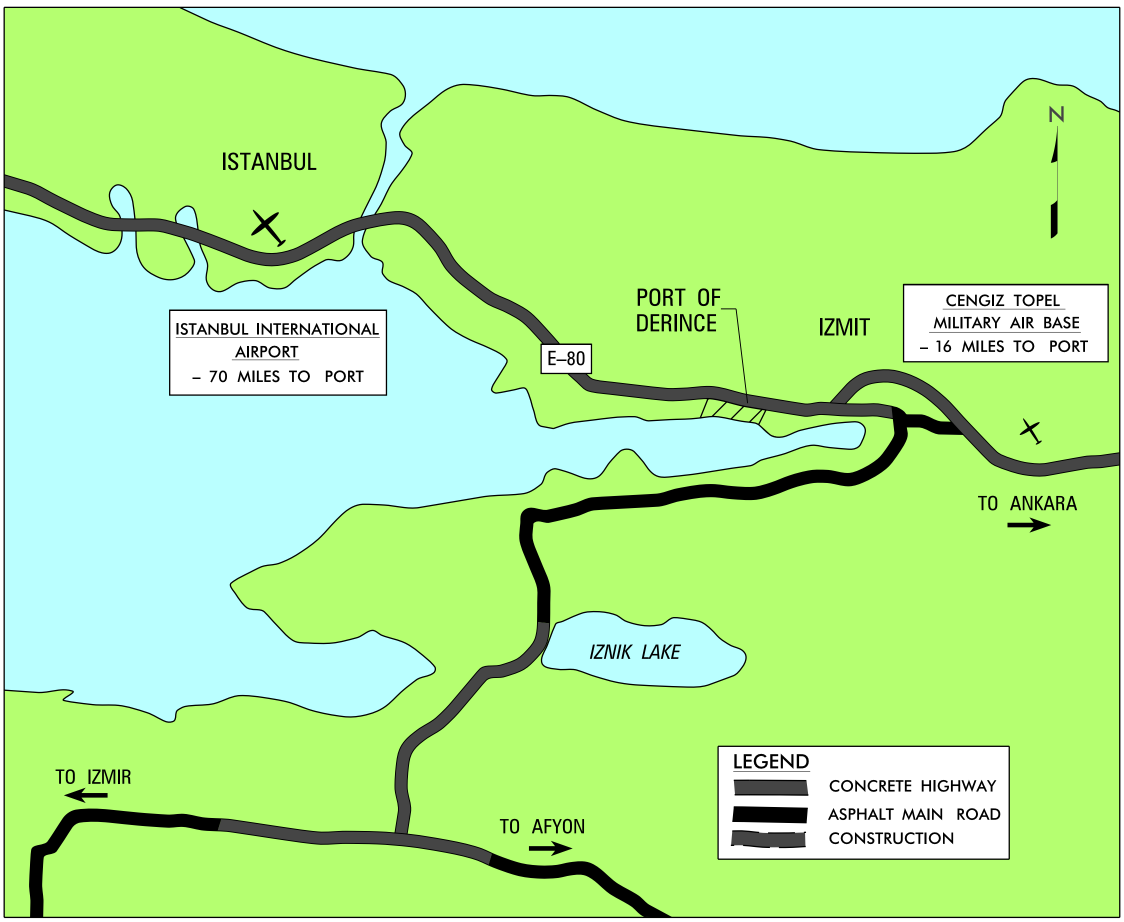
Water Access

HIGHWAY

Derince is a small city. Although traffic is light, delays occur because of narrow roads. The port is connected with the State railways and highways network.

The port has only one highway gate, with one lane in each direction. The gate is located off the Istanbul-Izmit Highway, E-80. E-80 is primarily a two-lane road, with intermittent four-lane sections along urban areas.

The port has no bridges, ramps, or overhangs that cause height restrictions for cargo on trucks or trailers. All paved areas within the port are hard surfaced and capable of withstanding heavy vehicular traffic. There are no height or weight limits leading out of the port to the main networks.



Highway and Air Access

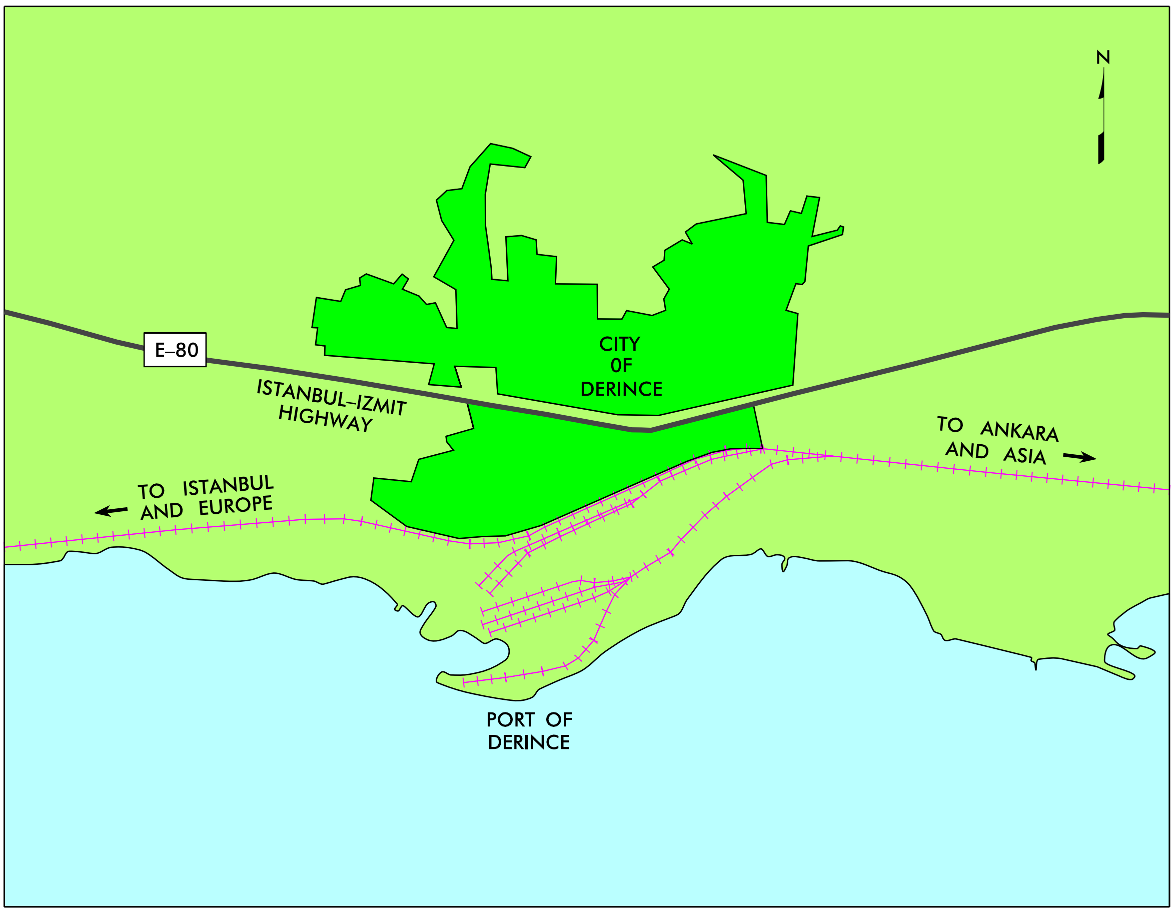
AIR

The Largest airport near the Port of Derince is in Istanbul. This airport handles most of Turkey's international traffic to and from Europe.

RAIL

The Turkish State Railways (TCDD) owns and operates the rail line accessing the Port of Derince. On the average, five trains access the port each day. These trains average 30 railcars in length. Rail access and facilities in the Derince area are very good. A rail ferry crosses the Bosphorus to Istanbul and provides easy access to Europe. The route into central Turkey, on the other hand, winds around mountains. These mountains will delay trains on their way to eastern Turkey or Middle East countries by at least 2 days.

The port's rail storage yard can hold about 200 railcars. A TCDD railyard just outside the port can hold an additional 400 railcars.



Rail Access

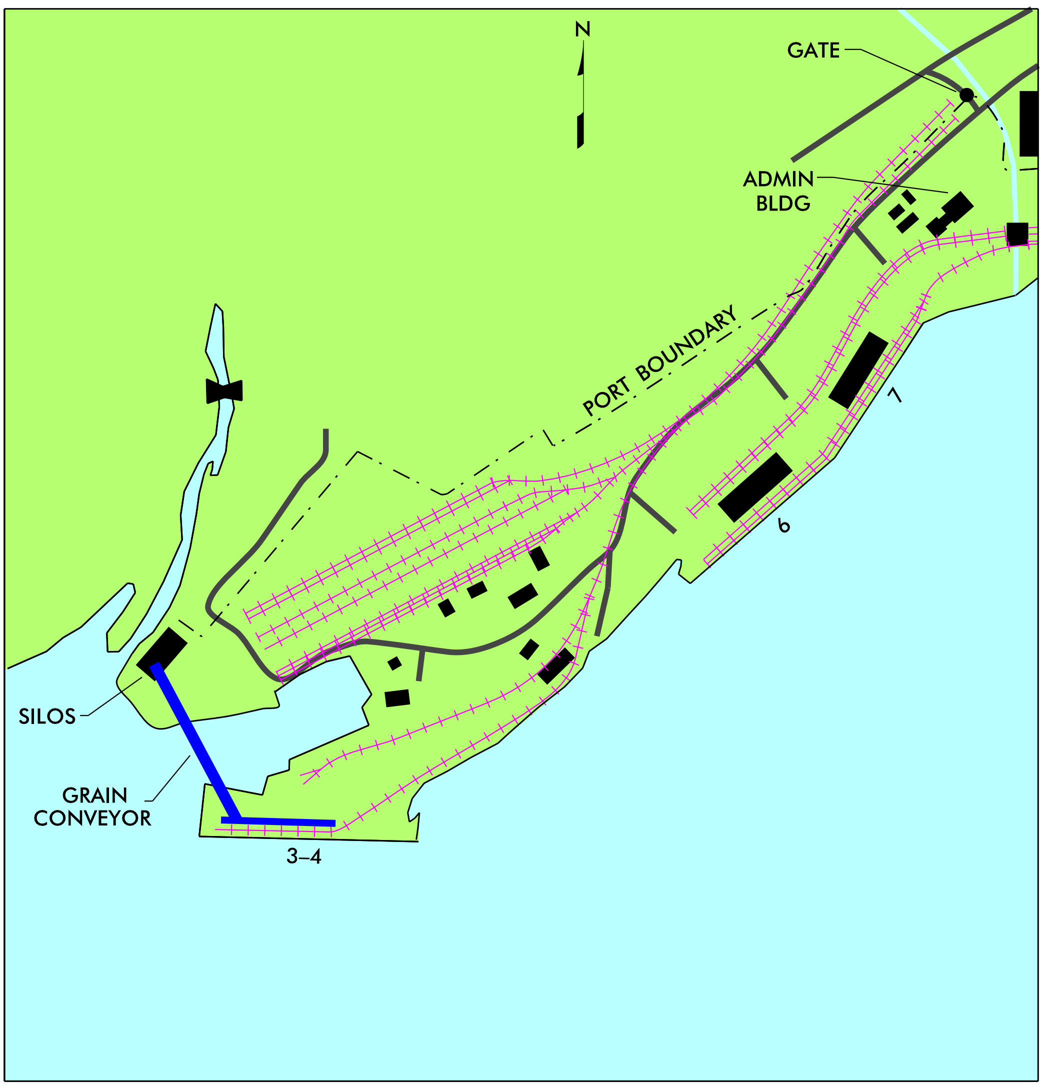
PORT FACILITIES

BERTHING

Derince is primarily a dry bulk and breakbulk terminal. However, the port also supports a regular roll on/roll off (RORO) service to and from Romania and handles containers.

All of the berths at the Port of Derince are well lighted for night operations.

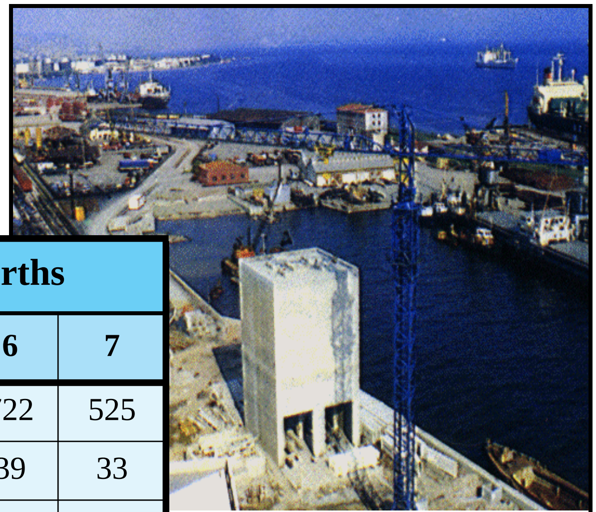
The three wharves in this report range from 525 feet to 1,312 feet in length. The port includes other shallower and shorter berths that are incapable of supporting military deployments, unless the deployments involve loading barges. All aprons are 6.6 feet above the water at MLW and at least 50 feet wide.



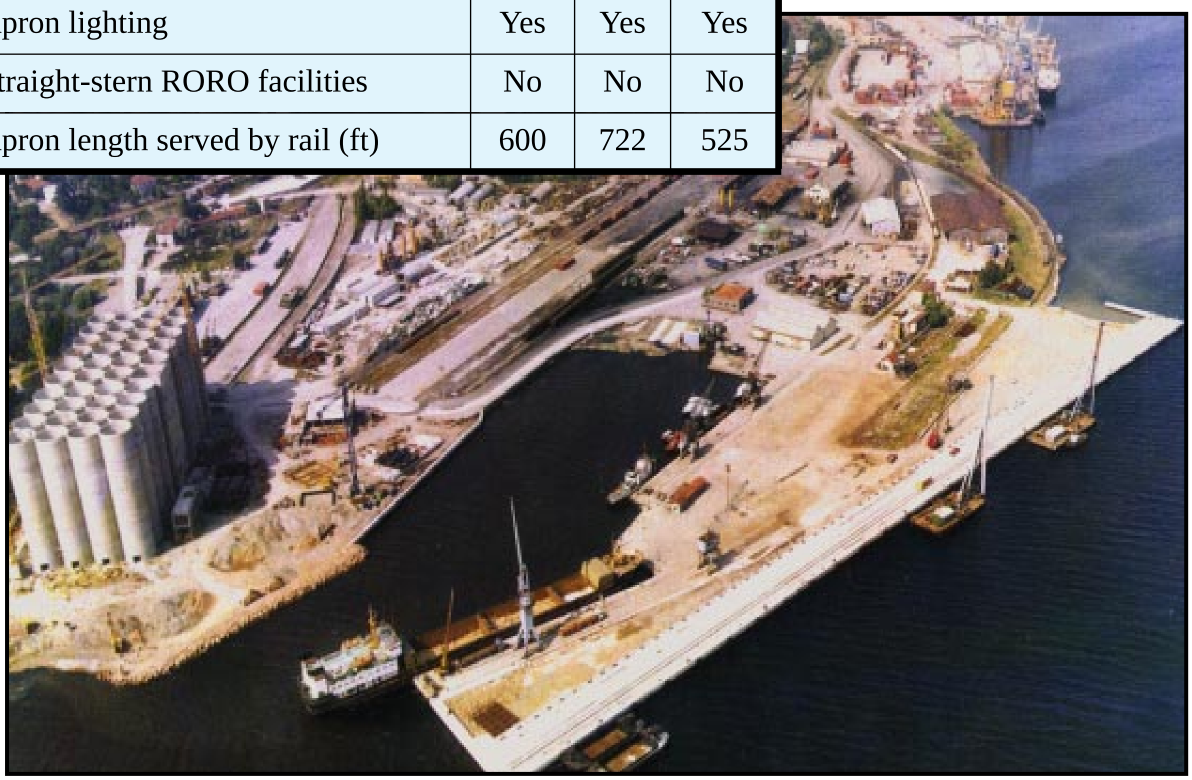
Land-Use Map

Berthing Characteristics

Characteristics	Berths		
	3-4	6	7
Length (ft)	1,312	722	525
Depth alongside at MLW (ft)	49	39	33
Deck Strength (psf)	614	614	614
Apron width (ft)	Open	50	50
Apron height above MLW (ft)	7	7	7
Number of container cranes	0	0	0
Number of wharf cranes	0	5	5
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No
Apron length served by rail (ft)	600	722	525



Eastward View



Port of Derince, Eastward View
(Note: Photo taken prior to conveyor system installation.)

STAGING

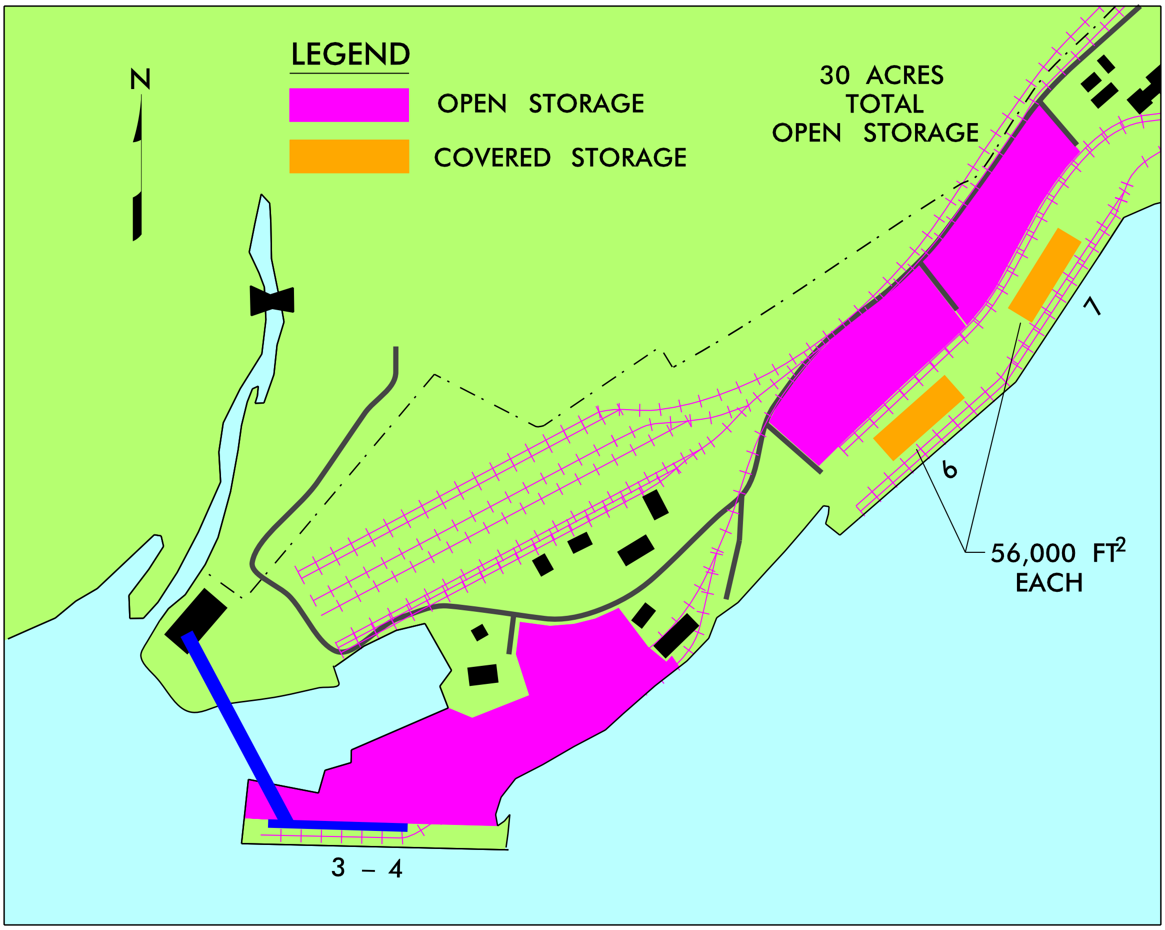
Open Staging

The Port of Derince has about 30 acres of paved open staging area. Usually logs or containers cover about a third of the area.

We do not recommend helicopter operations at the port. Silos, sheds, and conveyors make helicopter landing very difficult. The only place where helicopters might land without obstruction is the undeveloped area between berths 3-4 and 6. In addition, the military requires temporary shelters to support shrink wrapping. The port's railroad tracks also hinder towing the helicopters to loading areas.

Covered Storage

Two transit sheds and a warehouse have a total of 113,000 square feet of covered storage. The sheds serve berths 6 and 7.



Staging Areas

RAIL

Railyards on the port have the capacity to store about 200 railcars. Less than half a mile outside the port is a railyard capable of holding about 400 railcars. All the berths in this report have apron tracks. Berths 6 and 7 have two apron tracks each.

HIGHWAY

Only one gate is available to allow trucks in and out of the port. One lane is allocated for each direction. Occasionally trucks stage along the roads leading to the port.

The port has three truck scales that can weigh up to 80 tons.

UNLOADING/LOADING POSITIONS

Ramps

There are no ramps at the Port of Derince for truck operations. However, the port does have a rail ramp with 984 feet of tangential track. Its location prevents shiploading at berth 6. Several additional locations can support portable rail end ramp operations that would not obstruct any shiploading.

Docks

No docks exist for truck or boxcar loading.

Typical Boxcar Loading

MARSHALING AREAS

All of the open storage areas on the port are required to support staging of commercial and military cargo. There is no room for vehicles to marshal within the port. Also, the city of Derince has no areas nearby to marshal vehicles.

MATERIAL HANDLING EQUIPMENT (MHE)

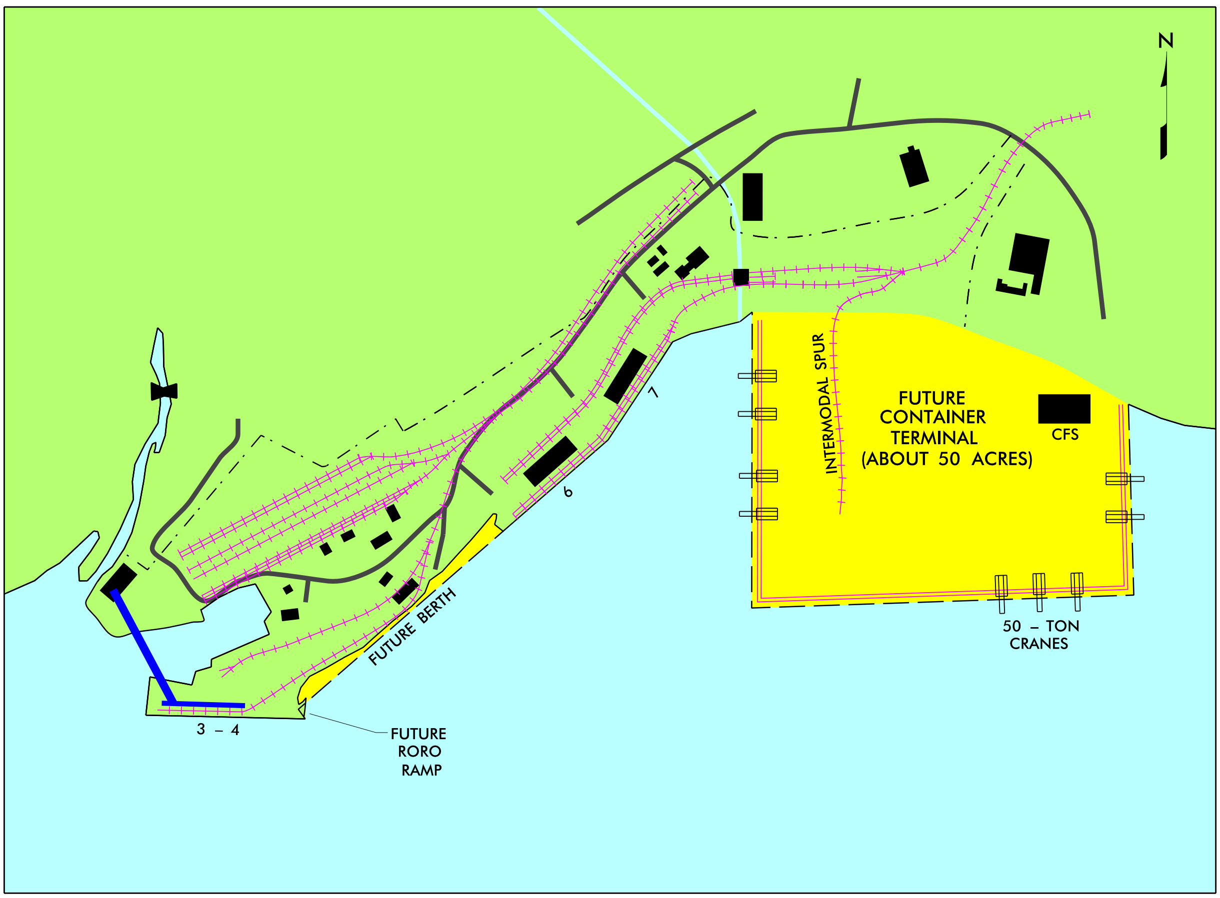
TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY
Wharf Cranes	20	9
Wharf Crane	35	1
Mobile Cranes	5-25	12
Crawler Cranes	6-30	3
Reach Stacker	40	1

Wharf Cranes at Berths 6 and 7

FUTURE DEVELOPMENT

The port is developing the area east of berth 7 to handle containers. This area will be roughly 50 acres, and have the capability to store 150,000 containers. Nine 50-ton container cranes will load ships on three sides of the terminal. Because of the high cost of land, 17 transtainers will stack containers. Water depths will likely be 49 feet MLW. The terminal is expected to be operational in 1997.

Another improvement will be the development of the quay between berths 3-4 and 6. This new berth will include a RORO ramp at the west end near berth 3-4, and about five more acres of pavement, including some new land fill. This project has already begun, and is expected to be operational in late 1995 or early 1996.

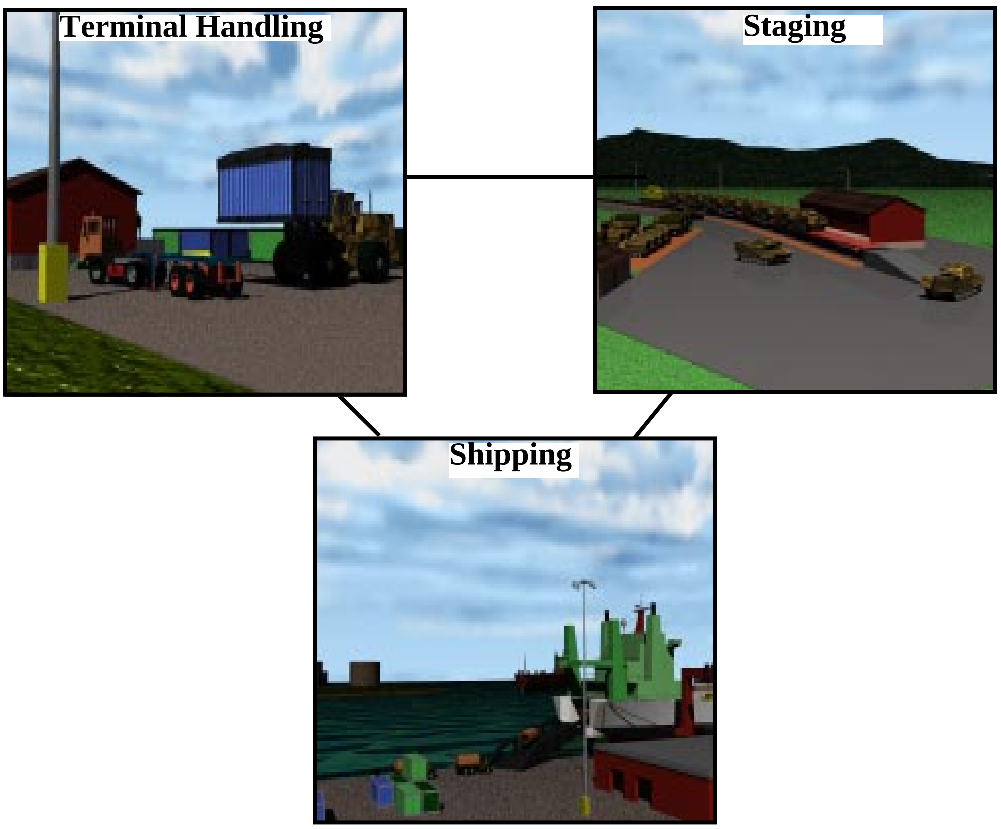


Future Development

II. THROUGHPUT ANALYSIS

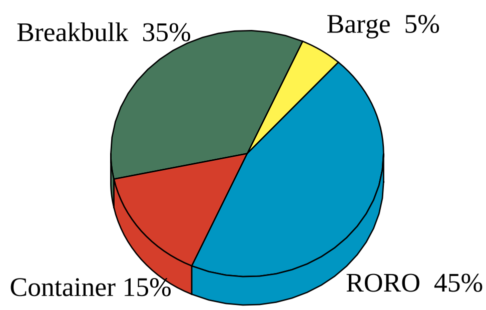
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Derince. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



The analysis assumes that 70 percent of the port facilities will support military deployments, and that the berths will have ships 95 percent of the time. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.

SHIP MIX PERCENTAGES



TERMINAL CLEARANCE/HANDLING

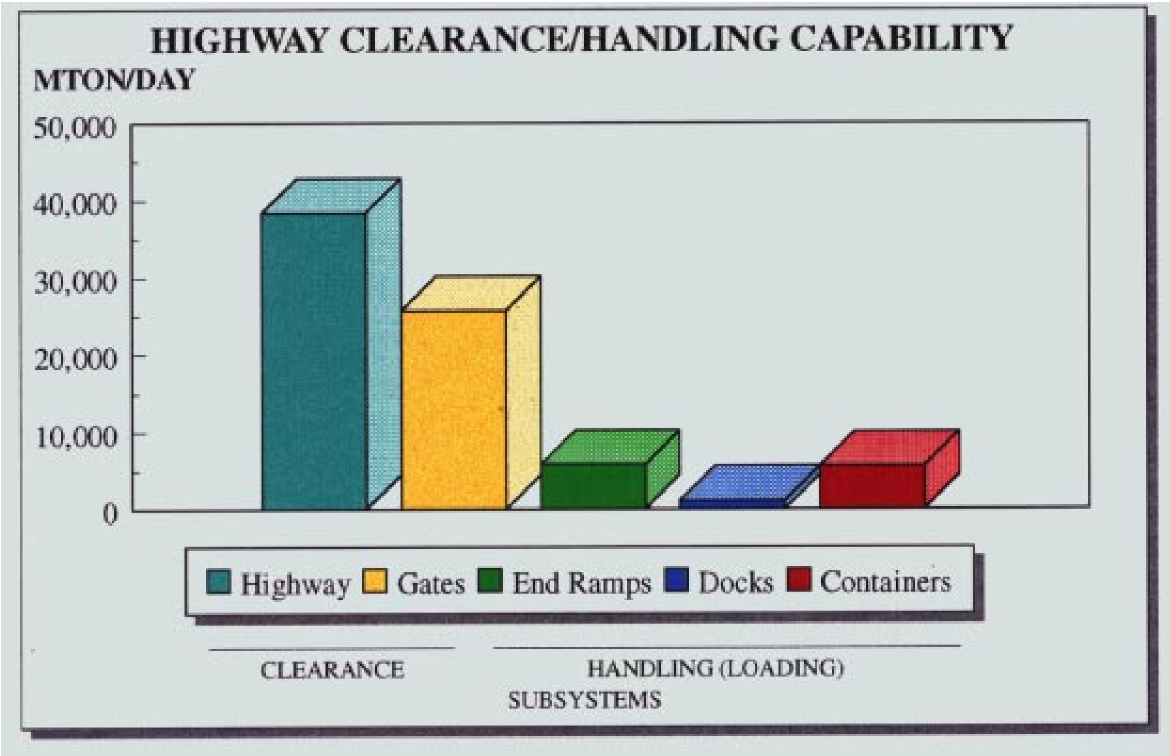
HIGHWAY

E-80 is the main highway that leads away from the Port of Derince in an east or west direction. The road network out of the port, including the gate processing of vehicles, could only handle 25,700 MTON of equipment and supplies per day. The limiting factor is the single gate with one lane exiting the port.

Roadable vehicles in convoys will process out of the port directly from the staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. We assume that troops will build or acquire two portable ramps for flatbed truck and semitrailer operations. These ramps will handle about 5,800 MTON of military vehicles and equipment per day.

The port has no truck docks, and will therefore use ramps to stuff vans. Approximately eight van semitrailers can load simultaneously at various locations throughout the port. The most practical location is the open area inland of berths 6 and 7. With a .60 factor to account for delays resulting from the ramps, these loading operations could load about 1,130 MTON per day into vans or semitrailers.

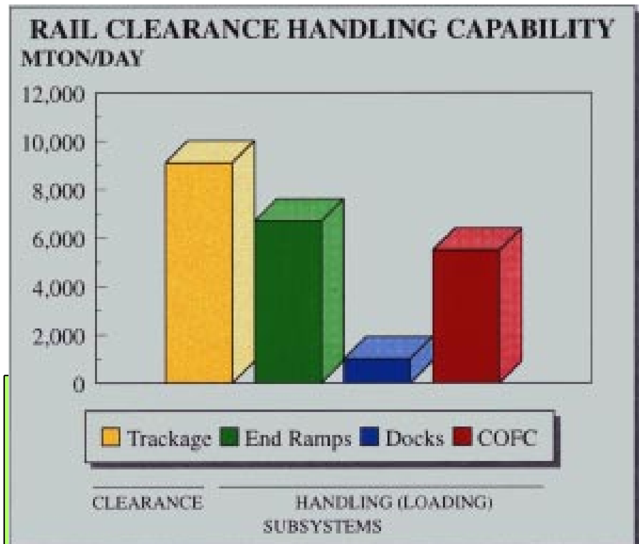
The Port of Derince has 15 mobile or crawler cranes and a reach stacker available for use. These machines can perform chassis operations in the open area inland of berths 6 and 7.



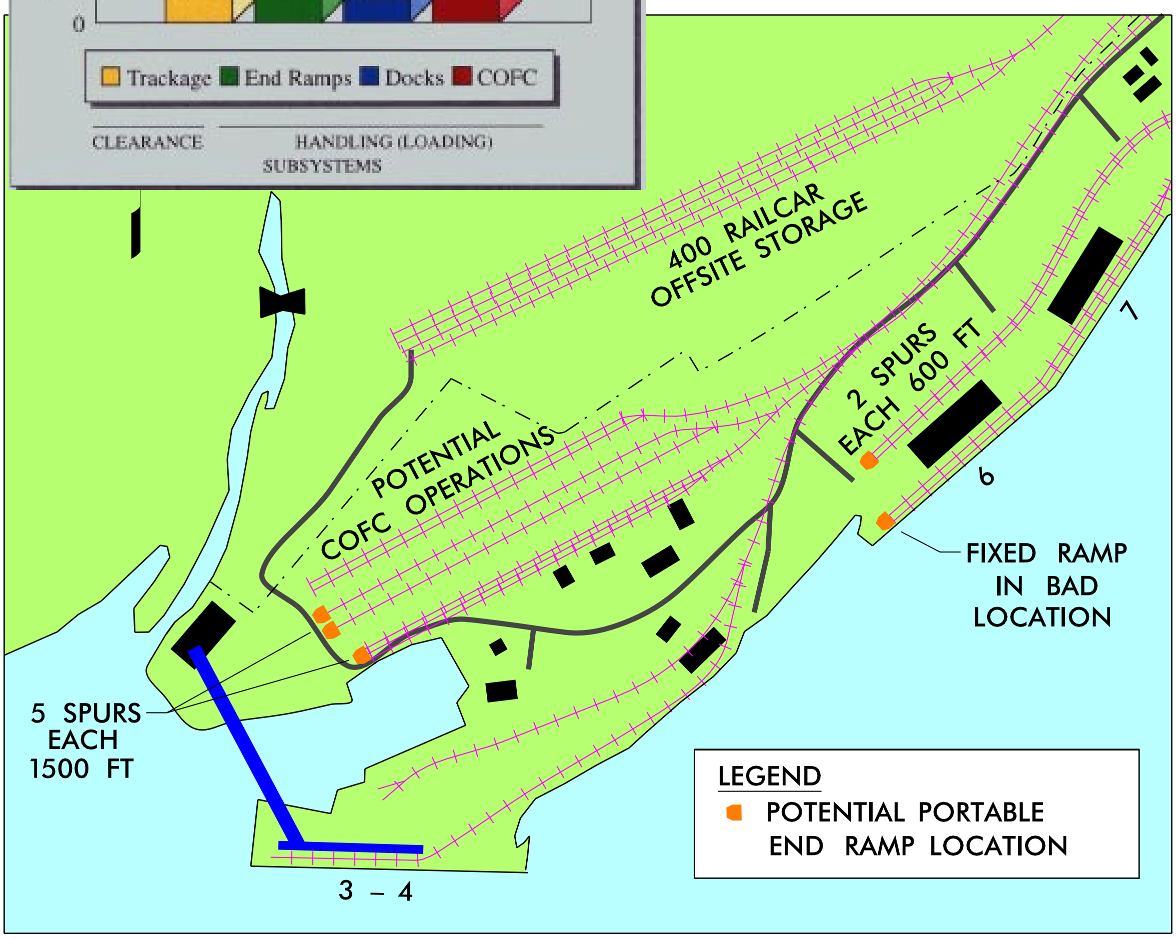
RAIL

The TCDD could remove 5 trains of 30 railcars each day if necessary. Vehicles on flatcars would require portable end ramps to load. We assume the troops would build or acquire at least one portable end ramp, with 1,000 feet of tangential track. Because of its location, the port's fixed end ramp would not likely be available. The map below shows several locations for portable ramps.

Since the port has no boxcar handling docks, forklifts would access the boxcars with portable ramps. Because of this, we used a 60 percent facility-use factor.



We assume that at least one crane will be used to support container-on-flatcar (COFC) operations. These operations will likely occur at the far west end of the port, near the silos.

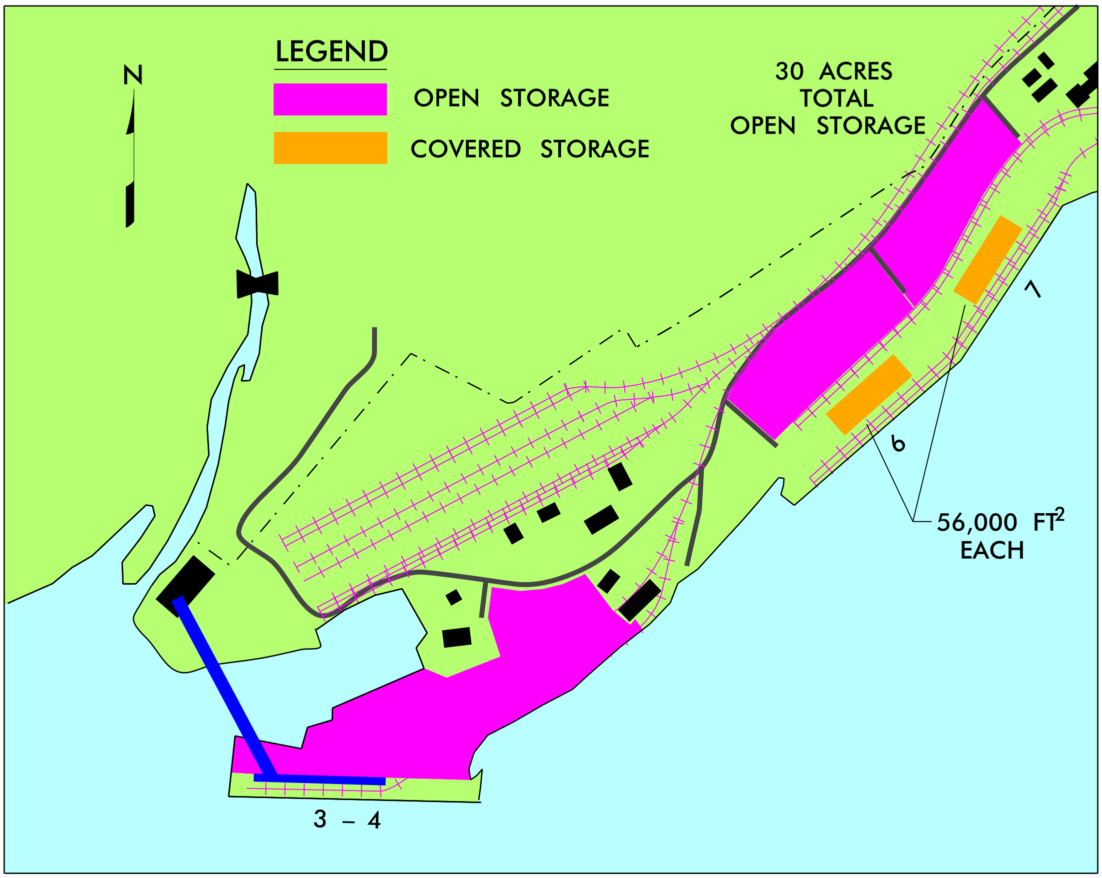


Port Rail Facilities

STAGING

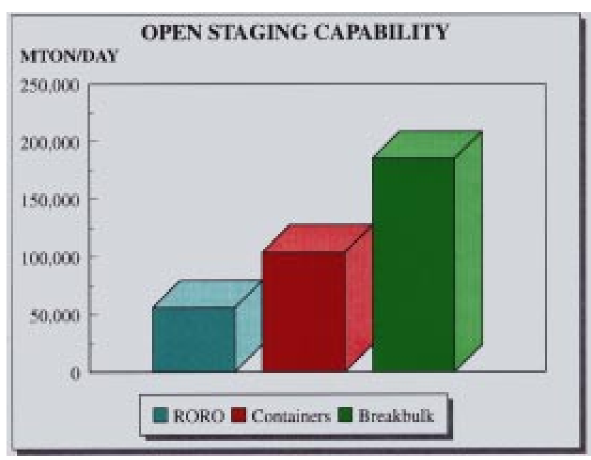
The port has about 30 acres of paved open staging that could support military operations. About half of the open area is regularly used for cargo storage such as logs and containers.

Two transit sheds and a warehouse have a total of 113,000 square feet of covered storage. The sheds serve berths 6 and 7.



The port can perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned.

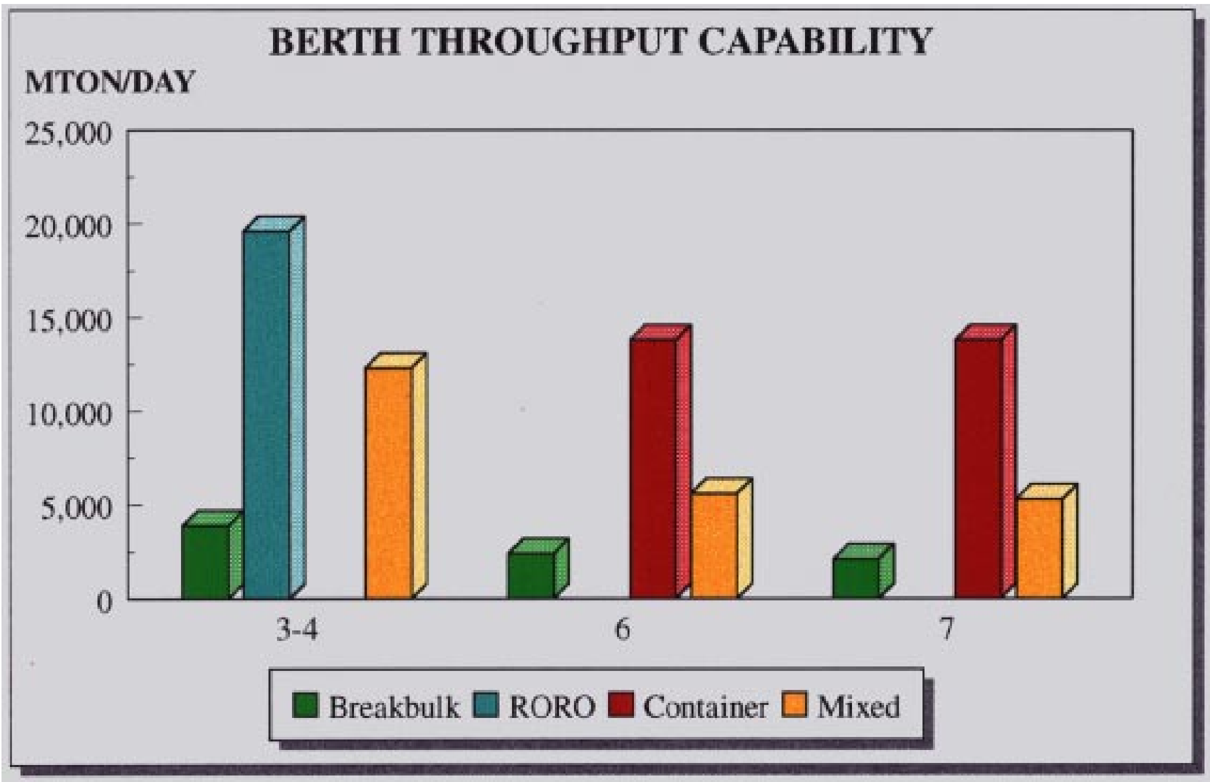
The chart on the right provides the staging capability for the cargo for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.



SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types.

For comparison, figure that an FSS carries about 28,500 MTON of equipment. The chart below indicates that unloading an FSS (primarily RORO) would require about 2 days at the Port of Derince.



CONVERSION FACTORS

Breakbulk:	.4	STON per MTON
RORO:	.25	STON per MTON
Containers:	.4	STON per MTON

We base the type of ship preferred at each berth on the methodology described in the appendix. The evaluation is a snapshot view of the current physical characteristics of the berths and MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suited for the loading or unloading operation.

Berths 3-4 can support FSS and LMSR operations. A FSS would likely berth toward the east end, with port-side to pier. This would allow for perpendicular side ramp operations unobstructed by the conveyor system colums. Stern ramp operations with a LMSR are unrestriced.

No one berth is ideal for all military operations. The best berth depends on the type of ship loaded.

PREFERENCE BERTH SELECTION

LOADING TYPE	BERTHS		
	3-4	6	7
Breakbulk	3	1	2
RORO	1	-	-
Container	-	1	-

Note: Berths marked with a "-" are not recommended for these operations.

SUMMARY OF BERTHING CAPABILITIES OF DERINCE

Vessel	Berths		
	3-4	6	7
Breakbulk			
C3-S-33a	2	1	1
C3-S-37c	2	1	1
C3-S-37d	2	1	1
C3-S-38a	2	1	1
C4-S-1a	2	1	c
C4-S-1qb and 1u	2	1	c
C4-S-58a	2	1	c
C4-S-65a	2	1	c
C4-S-66a	2	1	a,c
C4-S-69b	2	1	c
Seatrain			
GA and PR-class	2	1	c
Barge			
LASH C8-S-81b	1	c	a,c,f
LASH C9-S-81d	1	c	a,c
LASH lighter	9	5	3
SEABEE C8-S-82a	1	c	a,c
SEABEE barge	6	3	2
RORO			
Comet	2,d,i	d,o	d,o
C7-S-95a/Maine-class	1	b,c	a,b,c
Ponce-class	h	b,h	b,c,h
Great Land-class	h	b,c,h	b,c,h
Cygnus/Pilot-class	1	b	b,c
Meteor	d,i,j	d,o	c,d,o
AmEagle/Condor	1,i	b	b,c
MV Ambassador	d	d	c,d
FSS-class	1	b,c	a,b,c
Cape D-class	1,i	b	a,b,c
Cape H-class	1	b,c	a,b,c
LMSR	l	b,c	a,b,c
Container			
C6-S-1w	1,e	1,e	c,e
C7-S-68e	1,e	1,e	c,e
C8-S-85c	1,e	c,e	a,c,e
Combination			
C5-S-78a	2,e	1,e	a,c,e
C5-S-37e	2,e	1,e	c,e

a = maximum draft limited to berth depth
b = inadequate apron width
c = inadequate berth length
d = no straight stern-ramp facilities
e = no container-handling equipment
f = inadequate berth depth, adequate anchorage depth
g = inadequate channel depth
h = no short-based ramps available
i = insufficient ramp clearance at low tide
j = insufficient ramp clearance at high tide
k = excessive ramp angle at low tide
m = excessive ramp angle at high tide
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

Note: Ramp clearance and ramp angle based on maximum vessel draft.


Port of Iskenderun
Turkey

I. GENERAL DATA

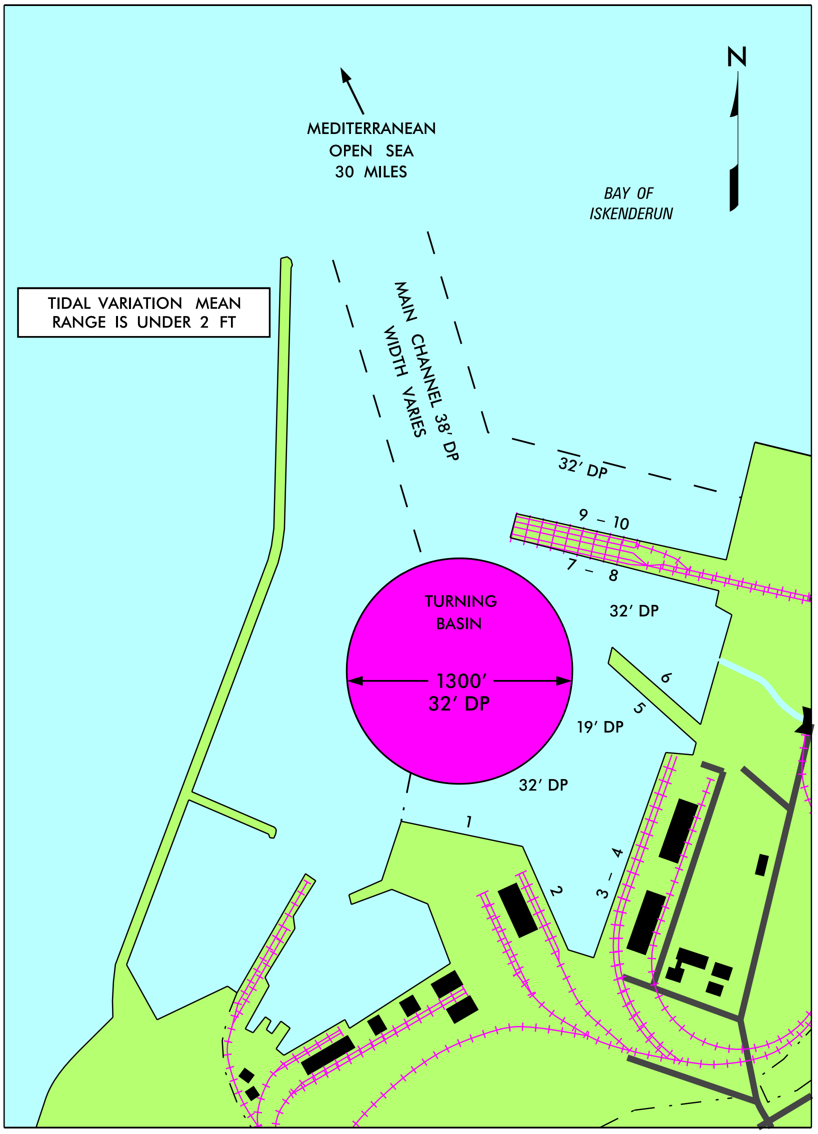
TRANSPORTATION ACCESS

WATER

The Port of Iskenderun is on the south coast of Turkey, near the coast of Syria. The port is at 36.38 North Latitude and 36.10 East Longitude, on the eastern shore of the Bay of Iskenderun, (northeastern corner of the Mediterranean Sea), about 30 miles from the open sea.

The approaching channels to the port have no vertical or horizontal restrictions. The channel entering the port is 38 feet at mean low water (MLW).

The water depth for the ship berths ranges from 19.6 to 36 feet. Pilotage is required for berthing and undocking. English speaking pilots are available 24 hours a day. Surrounding beaches are primarily rocky and unsuitable for any logistics-over-the-shore (LOTS) operations. Tidal ranges are less than 2 feet. A 5-million square-foot explosives anchorage is available 1.5 milesnorthwestoftheport.



Water Access

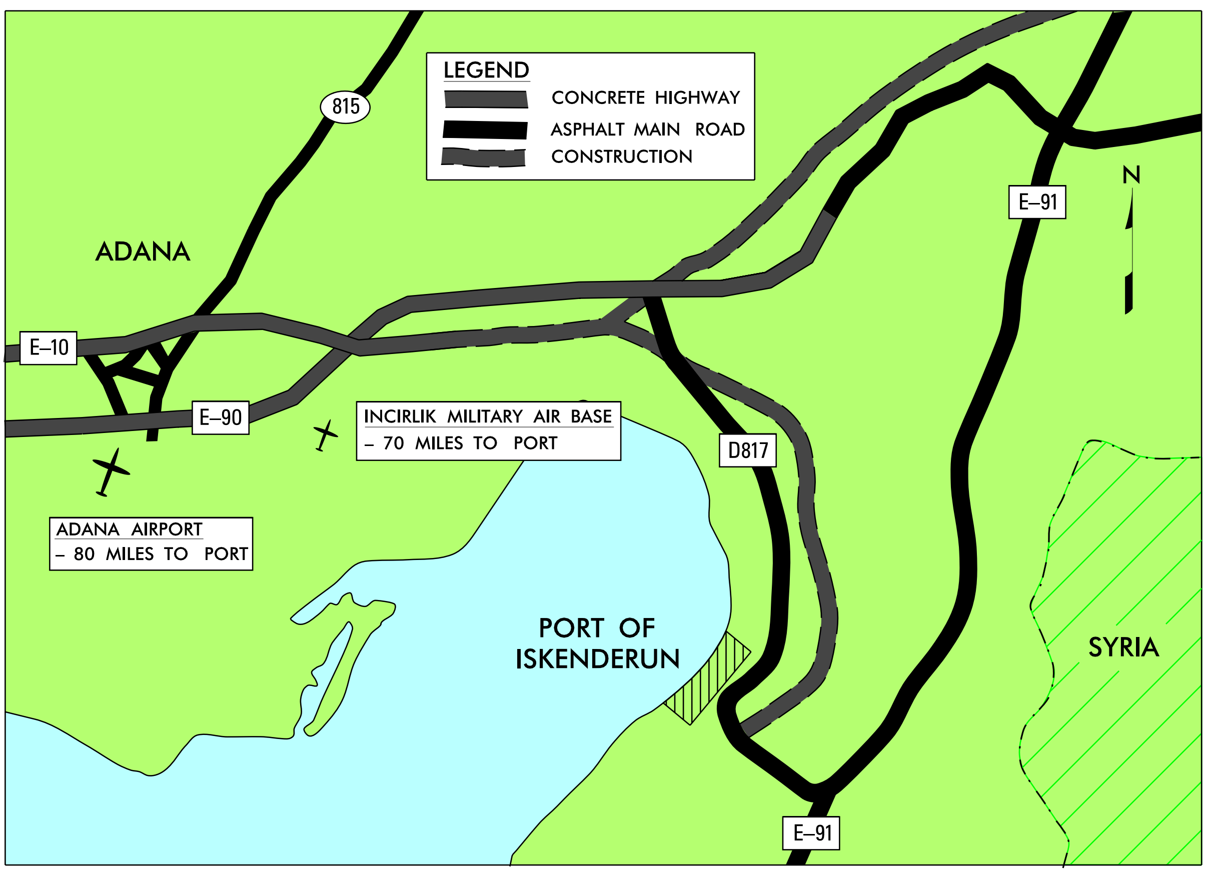
HIGHWAY

A network of highways serve the Port of Iskenderun. The port has access to Routes E-90 and E-91, via D817. Routes E-90 and E-91 can sustain heavy traffic, but D817 is usually congested. The distance between the Port of Iskenderun and Adana is about 85 miles. The first 35 miles on D817 is a two-lane road, the last 50 miles is a four-lane highway. Highways leading to other directions are less developed.

Three highway gates provide access to the port, but only two are routinely used for trucks. The third gate is usually limited to administrative vehicles.

AIR

The largest airport nearby is in Adana, about 80 miles from the port. This airport routinely handles small- and medium-sized passenger jets. The Turkish military owns and operates Incirlik Air Field, about 70 miles to the northwest.

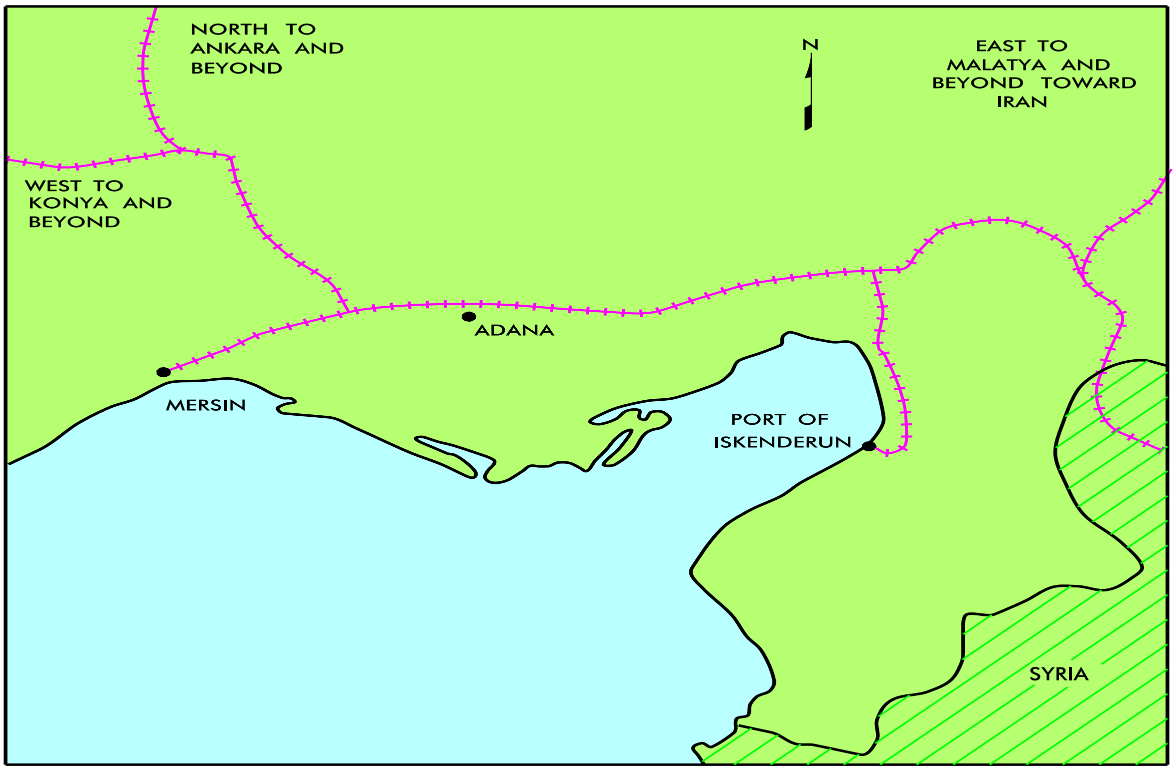


Highway and Airport Access

RAIL

The Turkish State Railways (TCDD) owns and operates the rail line accessing the Port of Iskenderun. Turkish flatcars tend to be shorter than those in CONUS.

Iskenderun is at the southern end of the Turkish National Railroad network.



Rail Access

PORT FACILITIES

BERTHING

The Port of Iskenderun is a multicargo terminal consisting of seven wharves. All seven berths are well lighted for night operations. Individual wharves range from 450 to 1,200 feet long. All aprons are at least 100 feet wide and 8 feet above MLW.

Land-use Map

Berthing Characteristics

Characteristics	Berths						
	1	2	3-4	5	6	7-8	9-10
Length (ft)	557	557	1,160	450	450	1,200	1,200
Depth alongside at MLW (ft)	32	32	32	19	19	32	32
Deck Strength (psf)	614	614	614	614	614	614	614
Apron width (ft)	Open	100	100	50	50	100	100
Apron height above MLW (ft)	8	8	8	8	8	8	8
Number of container cranes	0	0	0	0	0	0	0
Number of wharf cranes	2	3	6	0	0	3	3
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	Yes	No	No	Yes	Yes
Apron length served by rail (ft)	0	500	1,160	0	0	656	656

Berths 7-10 Looking West

Berths 3-4 Looking North

STAGING

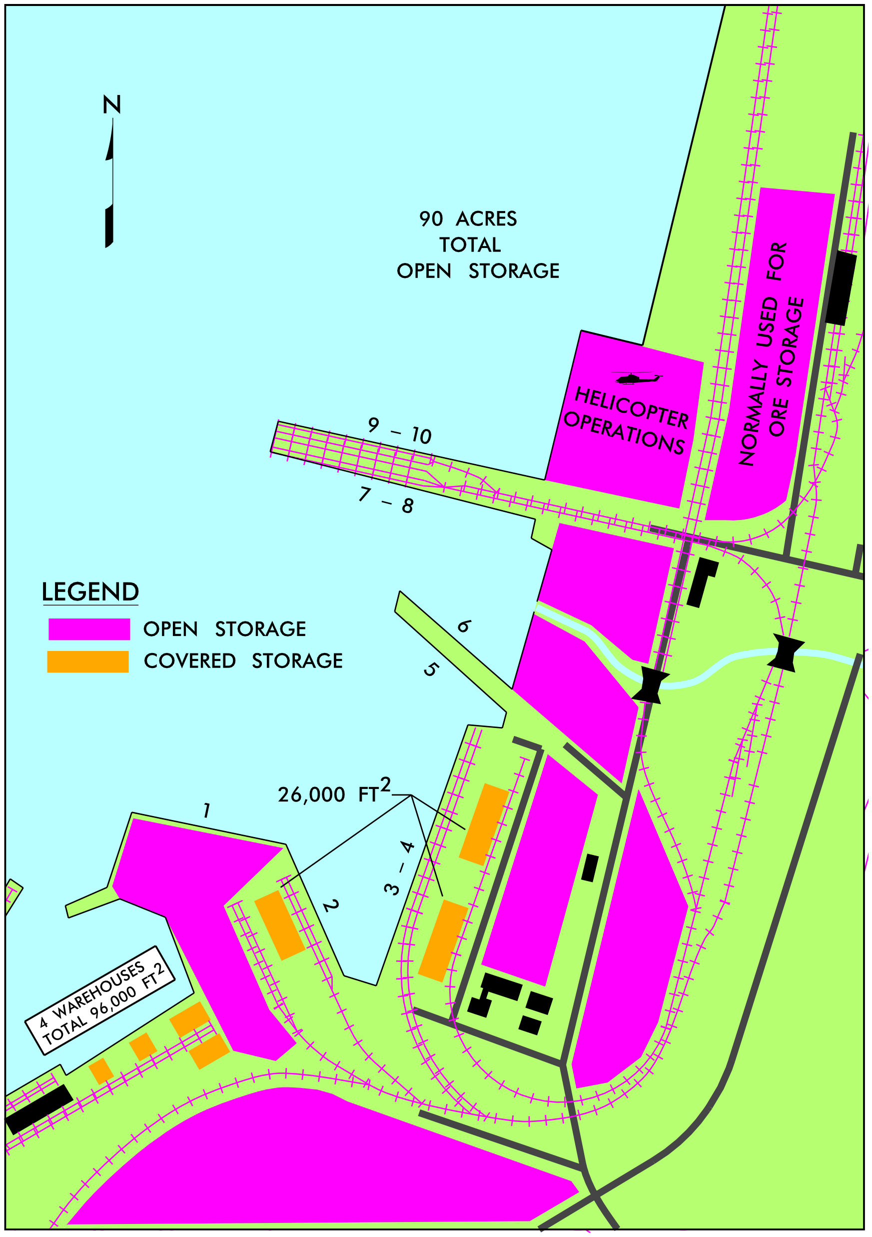
Open Staging

The port has about 90 acres of paved open storage area, including the working areas at the wharves.

Helicopter operations could be performed just north of berth 9-10. Temporary shelters are required to support shrink wrapping.

Covered Staging

Three transit sheds total 78,000 square feet. Four inland warehouses at the south end of the port provide an additional 96,000 square feet of covered storage.



Staging Areas

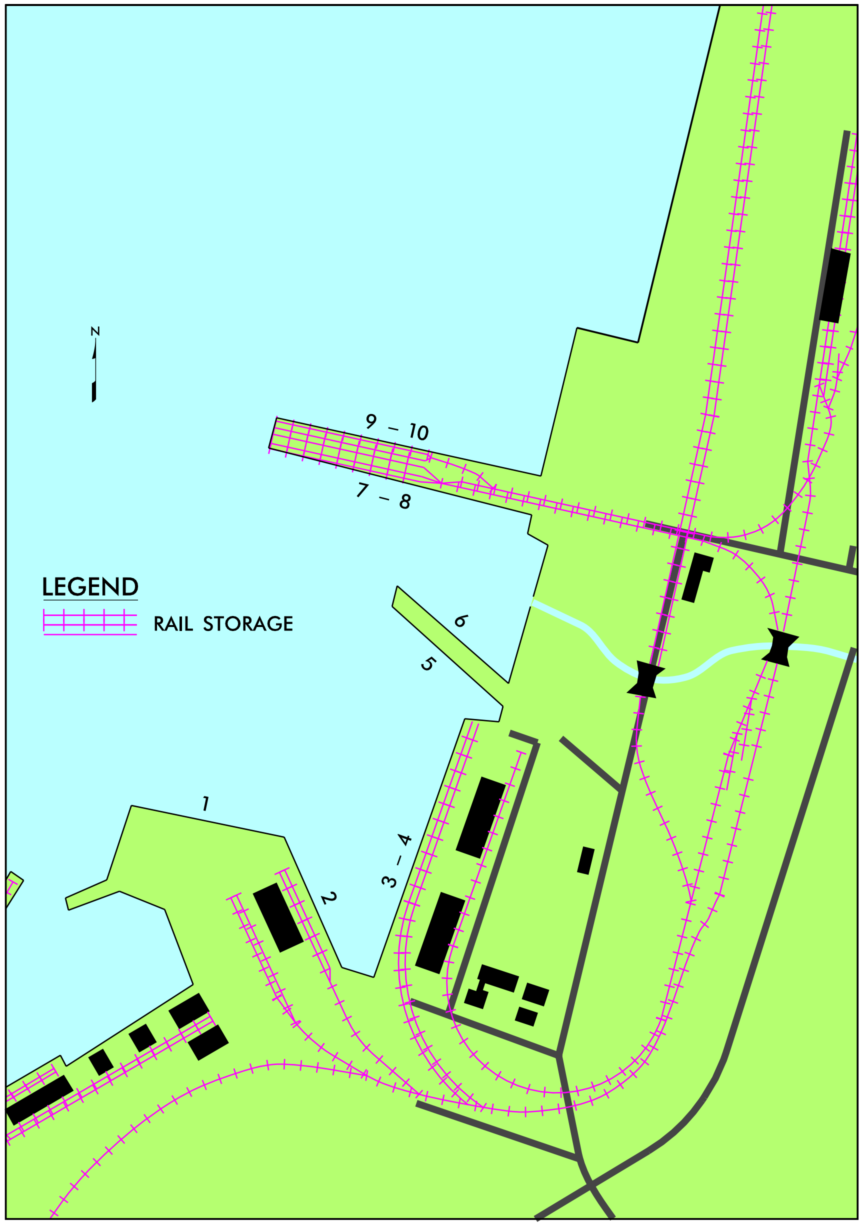
RAIL

Railyards on the port can store about 50 railcars. The overall length of trackage within the port is more than 10 miles.

All berths have two apron tracks except berths 1, 5, and 6, which have no apron tracks.

HIGHWAY

Noncargo carrying vehicles may enter and exit the port via the Administrative Gate. Two other gates allow loaded trucks to enter and exit. These two truck gates usually allow traffic in only one direction. Trucks with or without cargo occasionally stage along D817, outside of the port.



Rail and Highway Facilities

UNLOADING /LOADING POSITIONS

Ramps

Two truck loading ramps and one rail ramp are at the north end of the port. Another ramp at the south end of the port supports rail and truck operations.

North-end Truck Ramp

Docks

The ramp at the south end of the port can also support boxcar operations. None of the sheds have truck or boxcar docks.

MARSHALING AREAS

All of the open storage areas on the port are required to support staging of commercial and military cargo.

MATERIAL HANDLING EQUIPMENT (MHE)

TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY
Bridge Cranes (for railcar operations only)	8-20	4
Mobile Cranes	3-35	18
Floating Crane	90	1
Shore Cranes	3-25	17
Container Handler	10	1
Container Handler	35	1
Forklifts	2-5	35

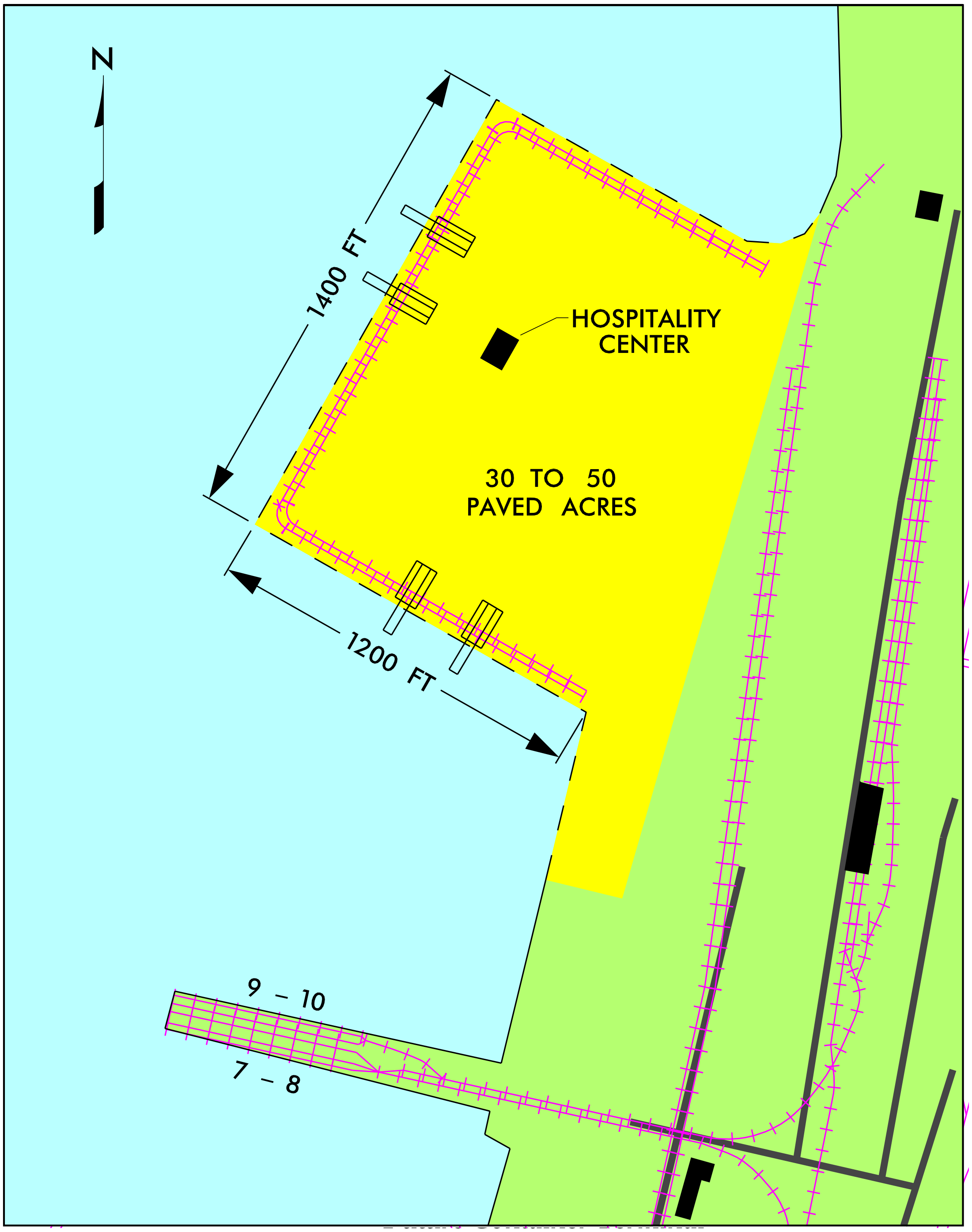
Wharf Cranes

Container Handler

Floating Crane

FUTURE DEVELOPMENT

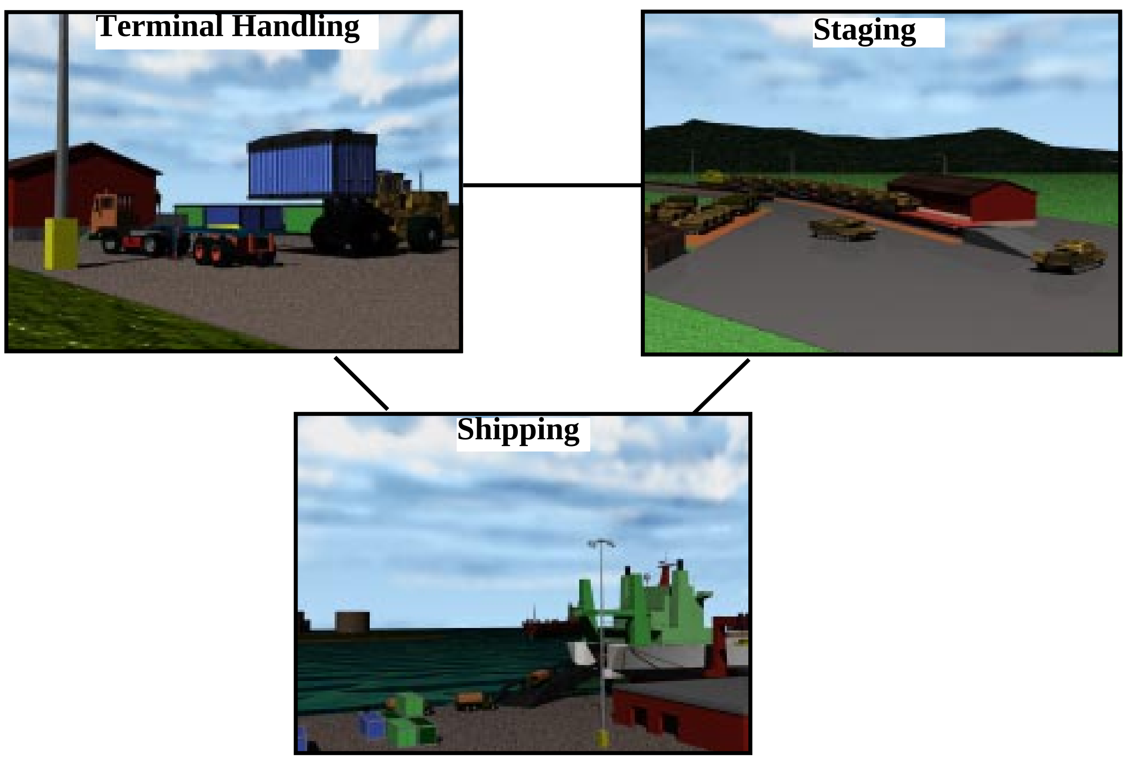
The port hopes to develop a 30- to 50-acre container facility at its north end. There is no schedule for completion. This expansion project will not receive Government funds until after the completion of the South East Anatolia Project (GAP). See appendix for details of the GAP Development.



II. THROUGHPUT ANALYSIS

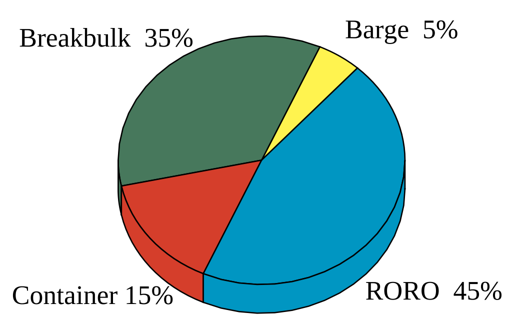
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Iskenderun. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



The analysis assumes that 70 percent of the port facilities will support military deployments. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.

SHIP MIX PERCENTAGES



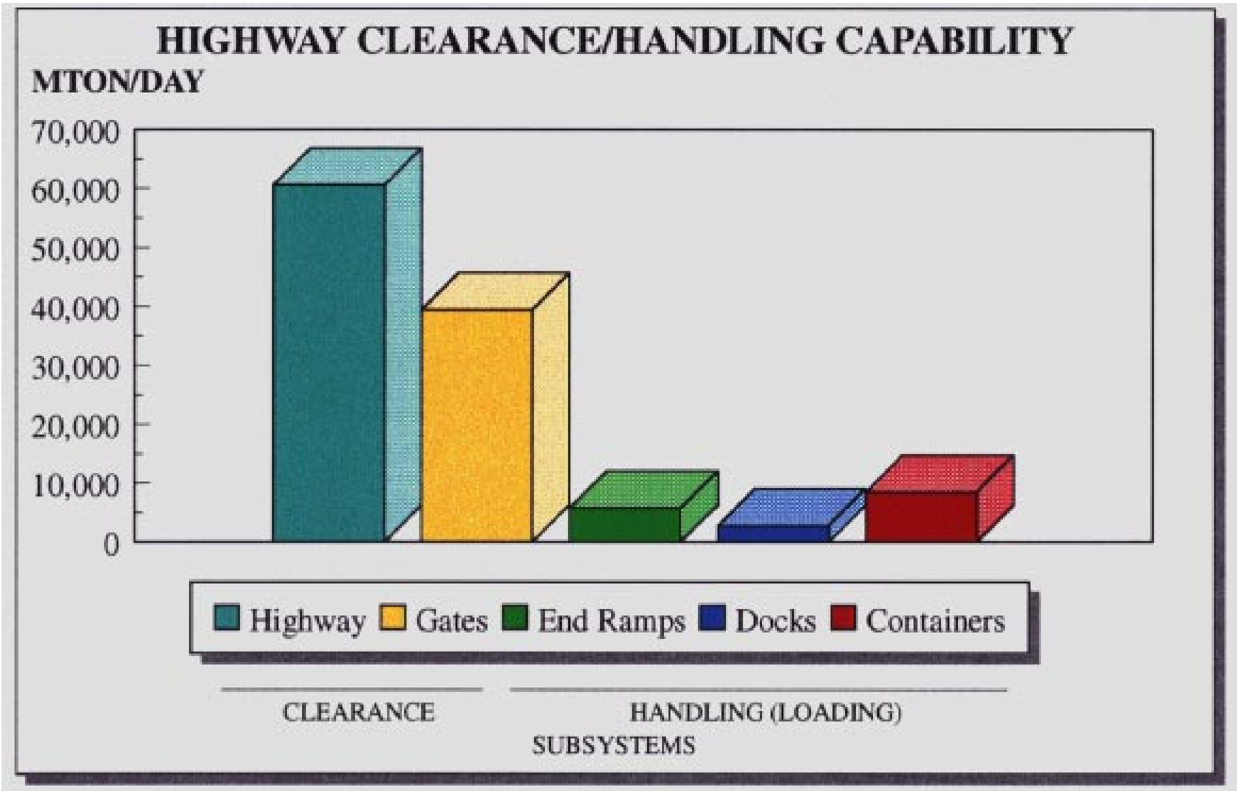
TERMINAL CLEARANCE/HANDLING

HIGHWAY

E-90 and E-91 are the main highways that lead away from the Port of Iskenderun. The port has three gates, but only two are used for cargo traffic. The road network out of the port, including the gate processing of the vehicles, could handle more than 39,000 MTON of equipment and supplies per day.

Roadable vehicles in convoys will process out of the port directly from the staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, can load at the stationary truck ramps at the rate of about 5,700 MTON of equipment per day.

Approximately 20 van semitrailers can load simultaneously at various locations throughout the port. With a .60 factor to account for delays resulting from ramps, these 20 loading operations could load about 2,800 MTON per day. Docks that are isolated from sheds are not considered in this analysis. The transit time limits remote dock usage to special cargos.



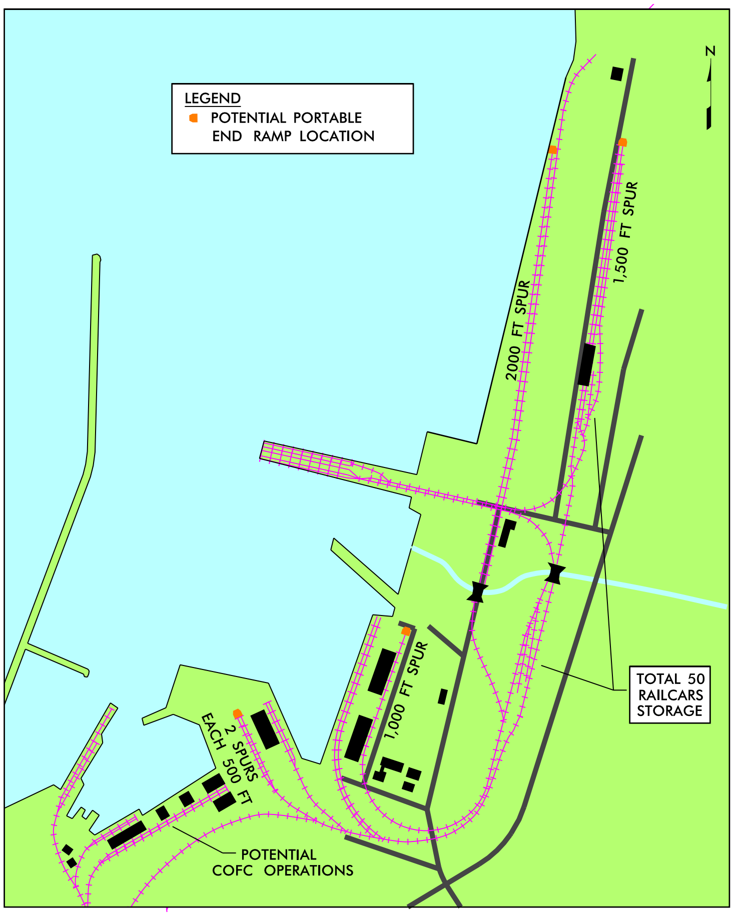
RAIL

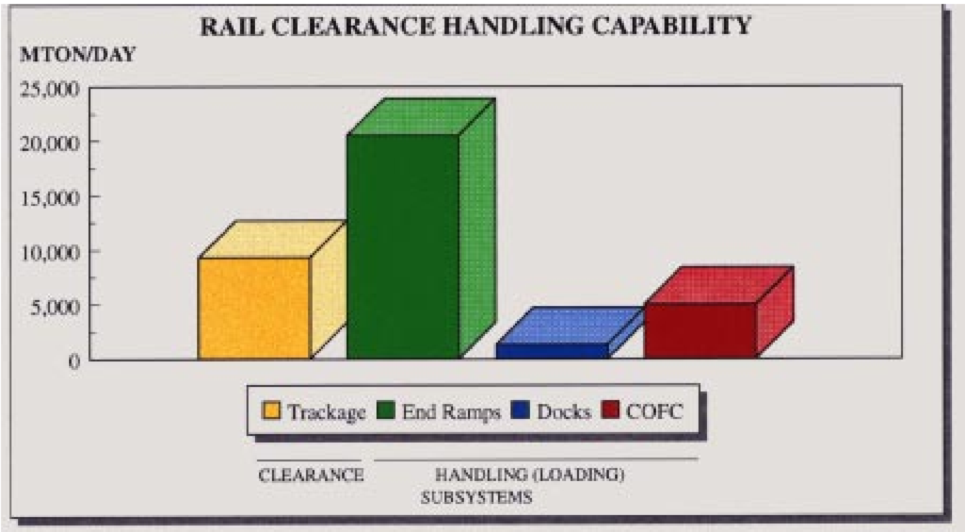
Rail clearance at the port is very good. TCDD could remove 4 trains of 35 railcars each day if necessary.

Railyards within the port could store about 50 railcars. There are no railyards outside the port that could support military operations.

Vehicles on flatcars would require portable end ramps to load. The troops would need to bring, rent, or build these ramps. Equipment or supplies in boxcars, like van semitrailers, would require ramps for loading. Since the port has no boxcar handling docks, forklifts would access the boxcars with portable ramps. Because of this, we used a 60 percent facility-use factor.

Although not specifically set up for container-on-flatcar operations, railroad tracks at the south end of the port could support loading containers with mobile cranes.

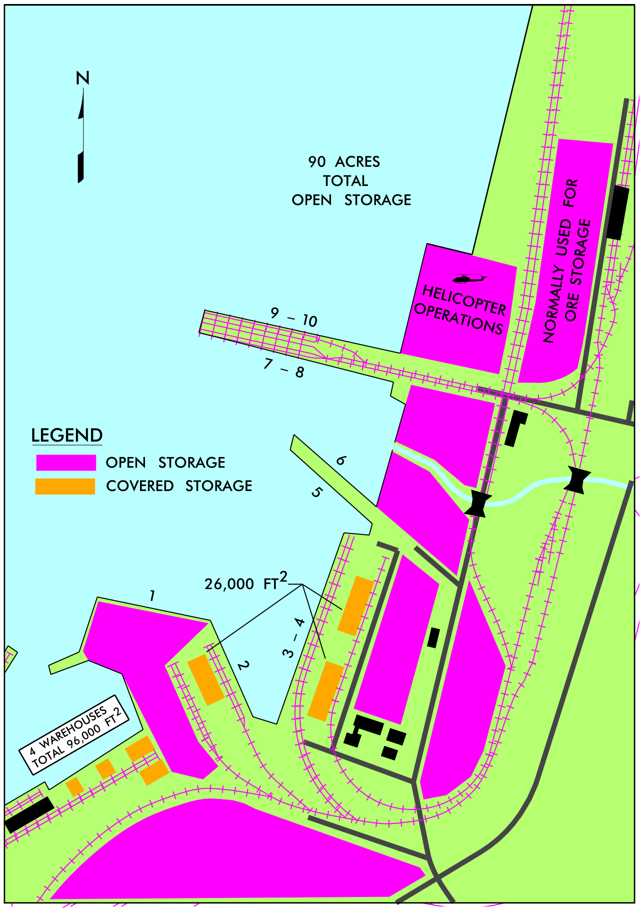


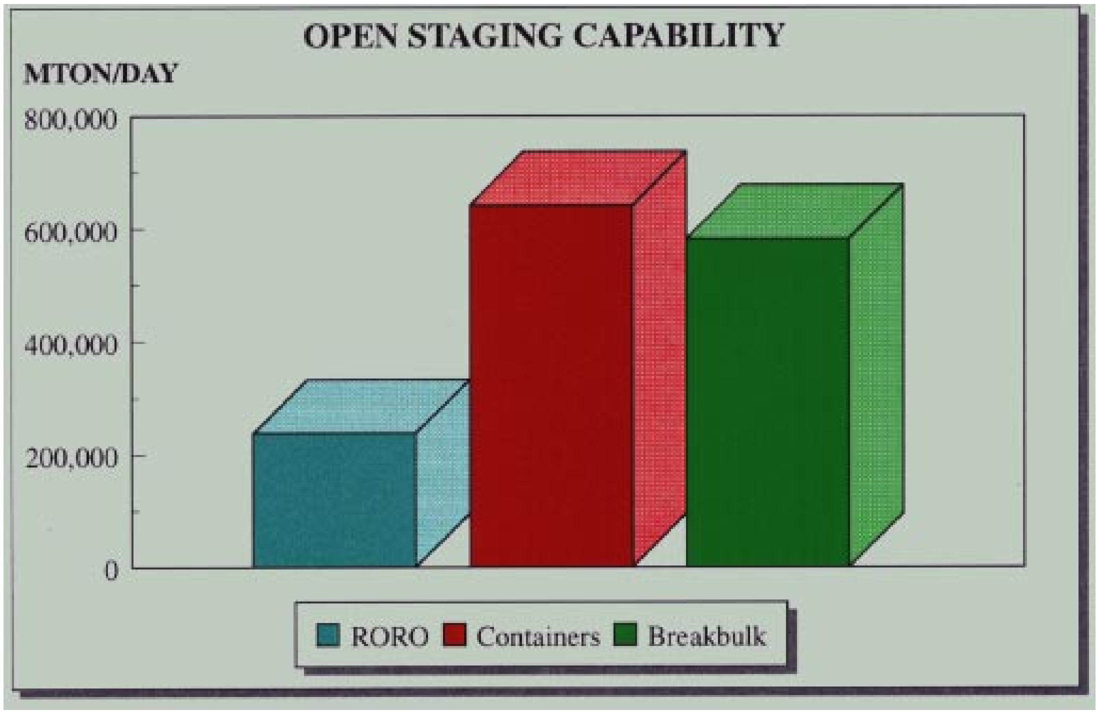


The port has about 90 acres of paved open staging that could support military operations.

The port can perform operations on RORO, container, or breakbulk ships The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a container ship is planned. The chart below provides thestaging capability for the cargo for each of these vessel types. If a combination ship is expected then a portion of each involved capability should be assumed.

Together, the sheds and warehouses total about 175,000 square feet of covered storage.

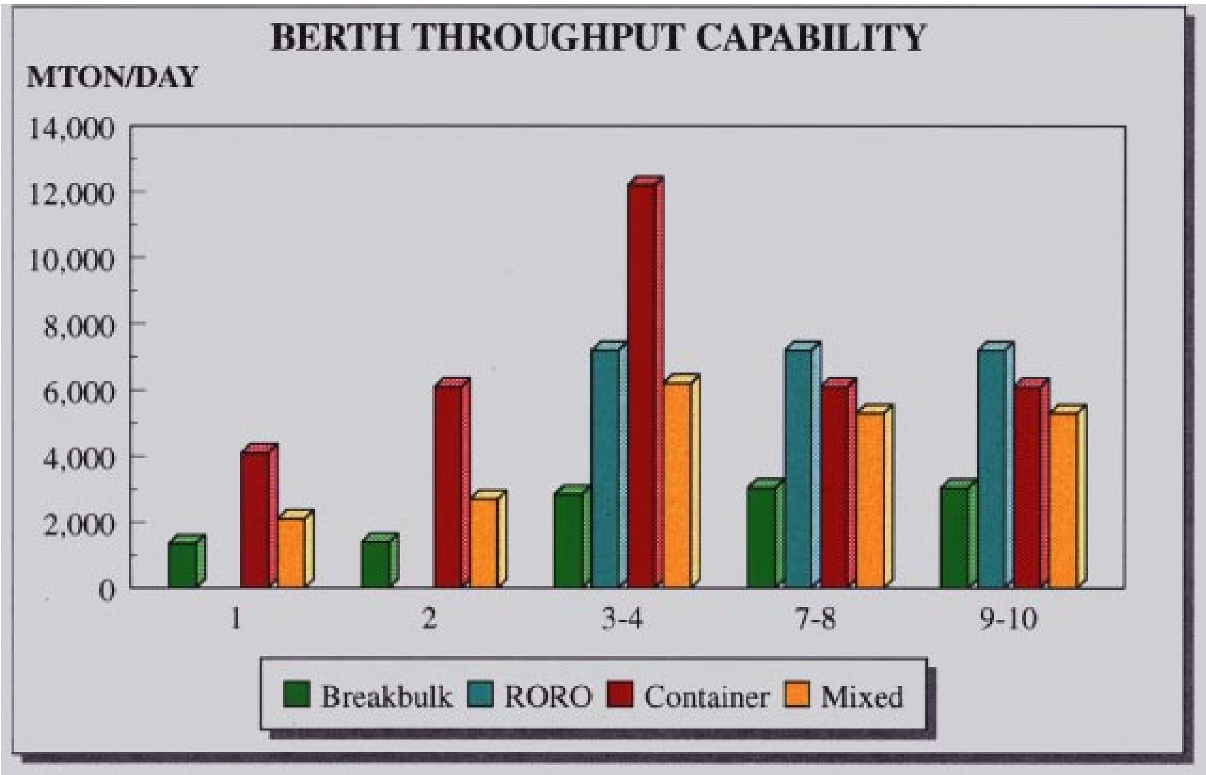




SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. Berths 5 and 6 are too shallow for any ship to berth. For this reason they have no throughput.

For comparison, figure that an FSS carries about 28,500 MTON of equipment. The chart below indicates that unloading an FSS (primarily RORO) would require about 4 days.



CONVERSION FACTORS		
Breakbulk:	.4	STON per MTON
RORO:	.25	STON per MTON
Containers:	.4	STON per MTON

The type of ship preferred at each berth is based on the methodology described in the appendix. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suited for the loading or unloading operation.

LOADING TYPE	**BERTHS**						
	1	**2**	**3-4**	**5**	**6**	**7-8**	**9-10**
Breakbulk	5	2	1	6	7	3	4
RORO	-	-	1	-	-	2	3
Container	-	-	1	-	-	2	3
Note: Berths marked with a "-" are not recommended for these operations.							

Berth 3-4 is the first choice for all three types of shiploading. The next best choice would be berth 7-8.

SUMMARY OF BERTHING CAPABILITIES OF ISKENDERUN

Vessel	Berths						
	1	2	3-4	5	6	7-8	9-10
Breakbulk							
C3-S-33a	1	1	2	a,c	a,c	2	2
C3-S-37c	1	1	2	a,c	a,c	2	2
C3-S-37d	1	1	2	a,c	a,c	2	2
C3-S-38a	1	1	2	a,c	a,c	2	2
C4-S-1a	c	c	1	a,c	a,c	2	2
C4-S-1qb and 1u	c	c	1	a,c	a,c	2	2
C4-S-58a	c	c	1	a,c	a,c	2	2
C4-S-65a	c	c	1	a,c	a,c	2	2
C4-S-66a	1,a	1,a	2,a	a,c	a,c	2,a	2,a
C4-S-69b	c	c	1	a,c	a,c	1	1
Seatrain							
GA and PR-class	c	c	1	a,c	a,c	2	2
Barge							
LASH C8-S-81b	a,c,f	a,c,f	1,a,f	a,c,f	a,c,f	1,a,f	1,a,f
LASH C9-S-81d	a,c,f	a,c,f	1,a,f	a,c,f	a,c,f	1,a,f	1,a,f
LASH lighter	3	3	8	3	3	8	8
SEABEE C8-S-82a	a,c,f	a,c,f	1,a,f	a,c,f	a,c,f	1,a,f	1,a,f
SEABEE barge	2	2	5	2	2	6	6
RORO							
Comet	1,d,i,j	1,d,i,j	2,i,j	a,c,d,o	a,c,d,o	2,i,j	2,i,j
C7-S-95a/Maine-class	a,c	a,c	1,a	a,b,c	a,b,c	1,a	1,a
Ponce-class	c,h	c,h	1,h	a,b,c,h	a,b,c,h	1,h	1,h
Great Land-class	c,h	c,h	1,h	a,b,c,h	a,b,c,h	1,h	1,h
Cygnus/Pilot-class	c	c	1	a,b,c	a,b,c	1	1
Meteor	1,d,i,j	1,d,i,j	2,i,j	a,c,d,o	a,c,d,o	2,i,j	2,i,j
AmEagle/Condor	c	c	l,i,j	a,b,c	a,b,c	1,i,j	l,i,j
MV Ambassador	1,d	1,d	2,k,m	a,b,c	a,b,c	2,k,m	2,k,m
FSS-class	a,c	a,c	1,a	a,b,c	a,b,c	1,a	1,a
Cape D-class	a,c	a,c	1,a	a,b,c	a,b,c	1,a	1,a
Cape H-class	a,c	a,c	1,a	a,b,c	a,b,c	1,a	1,a
LMSR	a,c.	a,c	l,a	a,b,c	a,b,c	1,a	1,a
Container							
C6-S-1w	c,e	c,e	1,e	a,c,e	a,c,e	1,e	1,e
C7-S-68e	c,e	c,e	1,e	a,c,e	a,c,e	1,e	1,e
C8-S-85c	a,c,e	a,c,e	1,a,e	a,c,e	a,c,e	1,a,e	1,a,e
Combination							
C5-S-78a	a,c,e	a,c,e	1,a,e	a,c,e	a,c,e	1,a,e	1.a,e
C5-S-37e	c,e	c,e	1,e	a,c,e	a,c,e	1,e	1,e

1 or 2 = number of ships that can berth
a = maximum draft limited to berth depth
b = inadequate apron width
c = inadequate berth length
d = no straight stern-ramp facilities
e = no container-handling equipment
f = inadequate berth depth, adequate anchorage depth
g = inadequate channel depth
h = no short-based ramps available
i = insufficient ramp clearance at low tide
j = insufficient ramp clearance at high tide
k = excessive ramp angle at low tide
m = excessive ramp angle at high tide
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

Note: Ramp clearance and ramp angle based on maximum vessel draft.

June 94

I. General Data

II. Throughput Analysis

Throughput Summary

Return to Index

I. GENERAL DATA

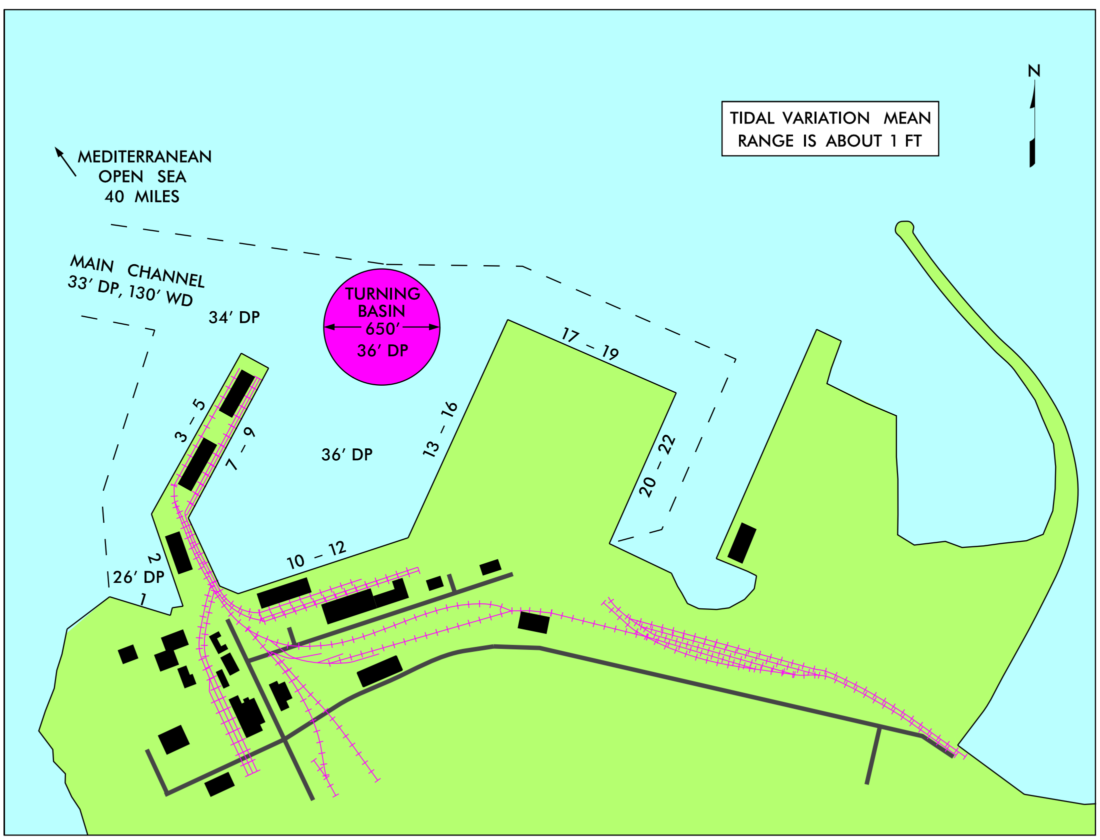
TRANSPORTATION ACCESS

WATER

The Port of Izmir is on the south coast of Turkey, on the Aegean Sea. The port is at 38°25'00" N Latitude and 27°04'30" E Longitude in the northeastern corner of the Mediterranean Sea, about 40 miles from open water. Approaching channels have no vertical or overhead restrictions. The channel entering the port is 33 feet at mean low water (MLW). Water depth for the ship berths ranges from 23 to 36 feet. Pilotage is required for berthing and unberthing. Pilots are available 24 hours a day.

The port has several nearby beaches that can be used for logistics-over-the-shore (LOTS) operations, if necessary. They are generally pebbly, accessible, and minimally affected by tides. The gradients vary, but most permit small boat landing.

A mud-bottomed anchorage is about 3 miles to the west of the port and is never congested.



Water Access

HIGHWAY

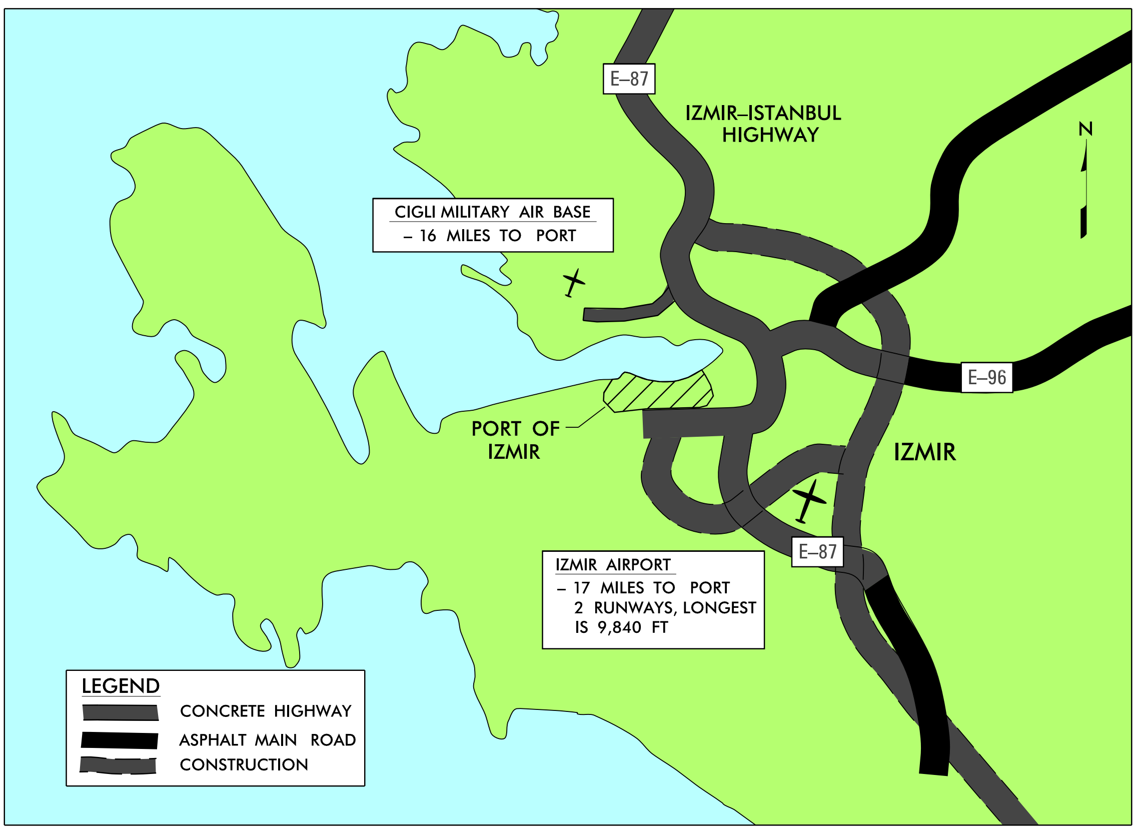
The port is connected with State railways and highways network. Most streets in the port area, except for major roads in and out of Izmir, are narrow and congested. Traffic is heavy most of the day.

The port has only one highway gate, with one lane in each direction. The gate is located off E-87. E-87 is in excellent condition and is four lanes northward to Aliaga. Further north than Aliaga, it is two lanes all the way to Canakkale. At this point a car ferry must be used to cross the Dardanelles to Europe.

Leading east from the port to Afyon, E-96 consists of good two-lane roads. From Afyon to Konya and Konya to Adana the road is a good two-laned hard-surfaced road. This portion of road is very mountainous with steep inclines for approximately 27 miles.

South of Izmir along E-87, the road begins with four lanes. After the first 15 miles, it narrows to two lanes.

The port has no bridges, ramps, or overhangs that cause height restrictions. All paved areas within the port are hard surfaced and capable of withstanding heavy vehicular traffic. There are no height or weight restrictions leading out of the port to the main networks.



Highway and Air Access

AIR

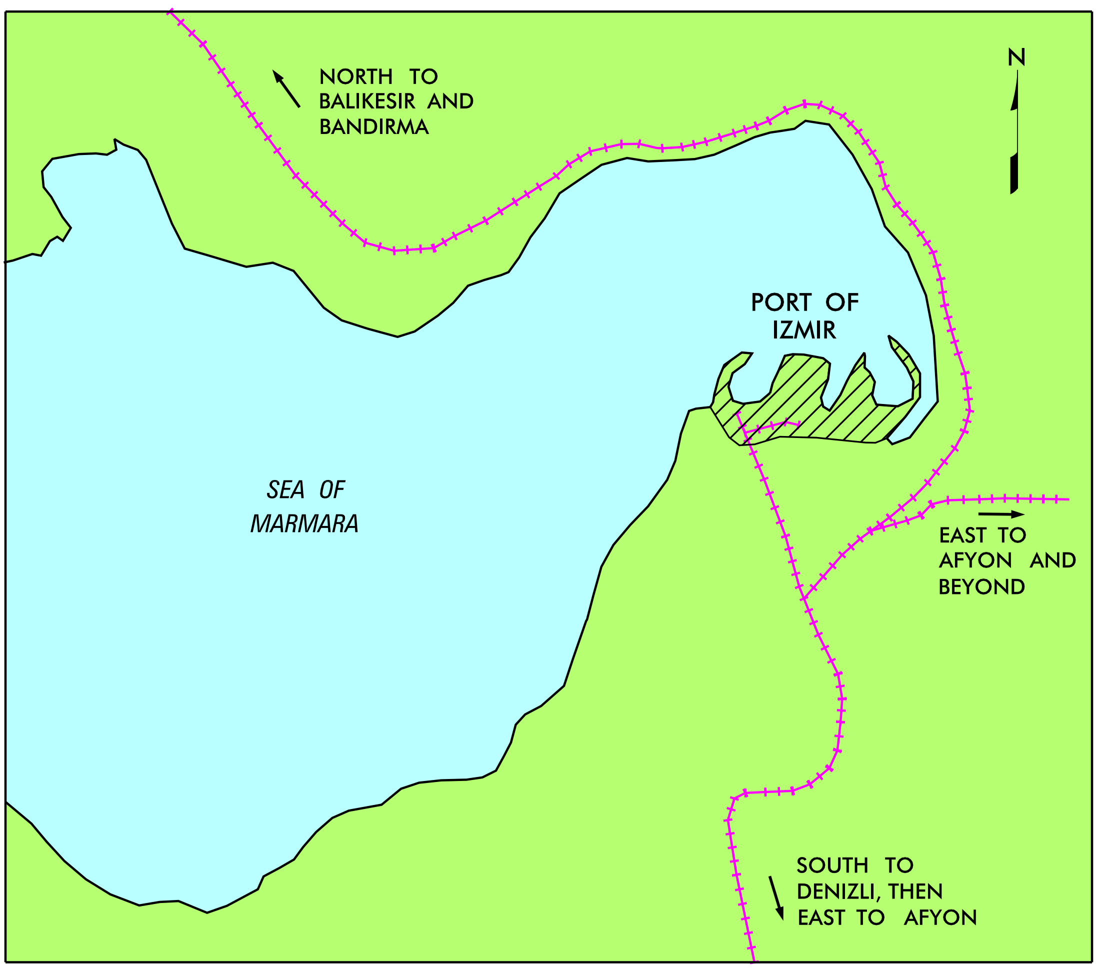
The Menderes Airport is about 16 miles southeast of the port. This airport routinely handles small- and medium-sized passenger jets. It has two runways. The longest is 9,800 feet.

The Turkish military owns and operates Cigli Military Air Field, about 16 miles north of the port. It has two runways and the longest is more than 10,000 feet.

RAIL

The Turkish State Railways (TCDD) owns and operates the rail line accessing the Port of Izmir. On the average, 10 trains access the port each day. These trains average 30 railcars in length. TCDD could deliver or remove fifteen 30-railcar trains per day if necessary.

The port rail storage yard can hold about 50 railcars. A TCDD railyard just south of the port can hold about 500 railcars. An unusual facility at this offsite railyard is the indoor handling yard.



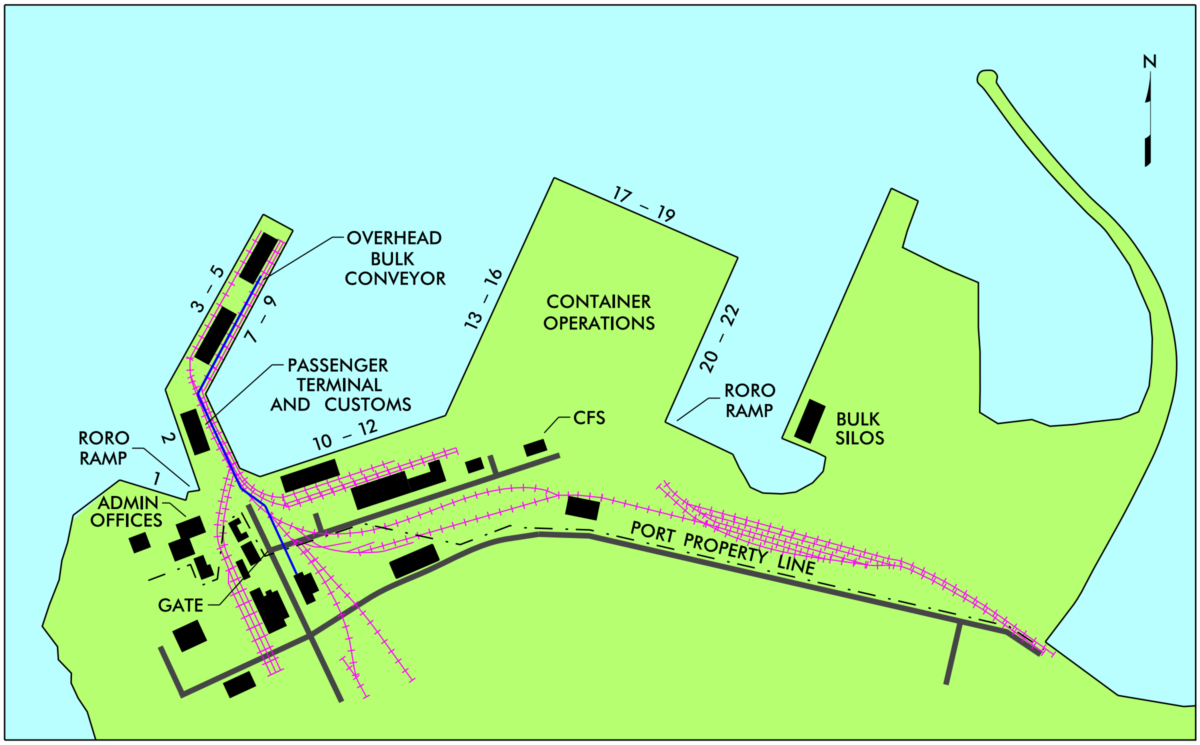
Rail Access

PORT FACILITIES

BERTHING

Izmir is a multicargo port, with a container terminal, bulk conveyors, and silos. All of the berths at the Port of Izmir have good apron lighting for night operations. The bulk equipment supports agricultural products brought in by trains. Individual wharves range from 460 to 1,970 feet long. All aprons are at least 50 feet wide and 8 feet above the water at MLW. The chart on the following page shows a list of berth characteristics.

Berth 2



Land-Use Map

Berthing Characteristics

Characteristics	Berths							
	1	2	3-5	7-9	10-12	13-16	17-19	20-22
Length (ft)	460	623	1,378	1,220	1,142	1,970	1,476	1,194
Depth alongside at MLW (ft)	26	35	35	35	23	36	36	36
Deck strength (psf)	614	614	614	614	614	614	614	614
Apron width (ft)	Open	50	60	60	Open	Open	Open	Open
Apron height above MLW (ft)	8	8	8	8	8	8	8	8
Number of container cranes	0	0	0	0	0	2	2	0
Number of wharf cranes	0	0	3	3	3	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	Yes	No	No	No	No	No	Yes
Apron length served by rail (ft)	0	0	1,000	1,100	0	0	0	0

Northeastward View

STAGING

Open Staging

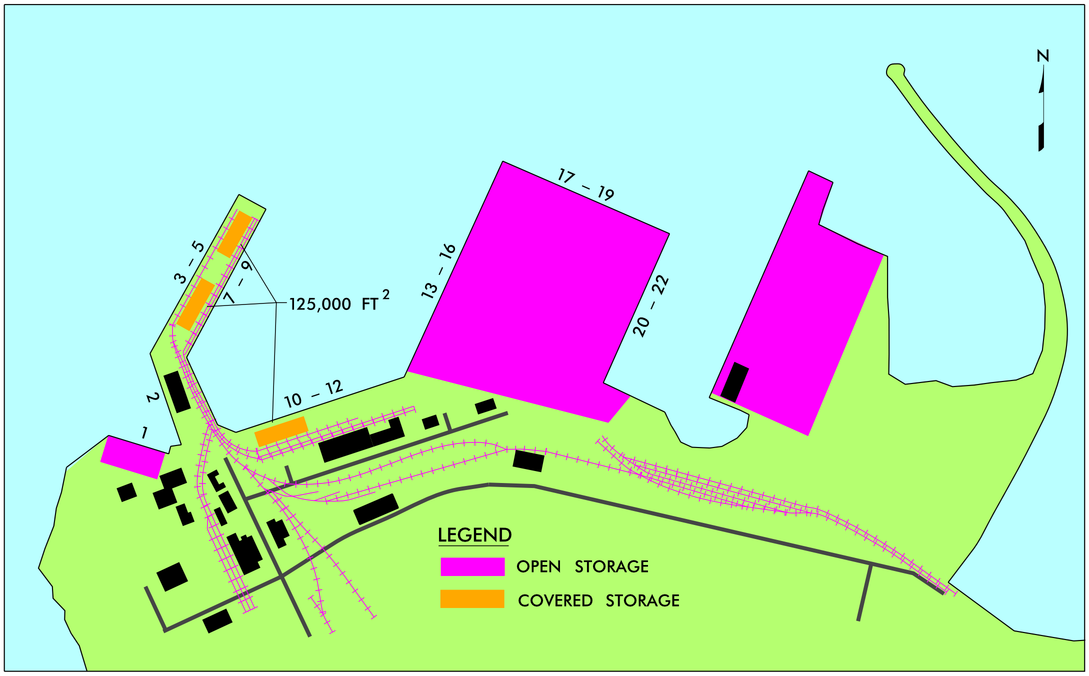
The Port of Izmir has about 53 acres of paved open staging area. Thirty-three acres is at the container terminal, berths 13-22. Another large area is at the east end of the port, where the port is expanding. Not all of this new land is paved.

Helicopter operations could be performed at berth 1. Temporary shelters are required to support reduction and shrink-wrapping operations.

Covered Storage

Three transit sheds and a small hazardous material warehouse total about 254,000 square feet of covered storage. The sheds serve berths 3-5, 7-9, and 10-12.

Open Staging at Berth 13-16



Staging Areas

RAIL

Railyards on the port have the capacity to store about 50 railcars. Just outside of the port is additional space to store 500 railcars.

Only berths 3-5 and 7-9 at the west end of the port have apron tracks.

Rail Storage

HIGHWAY

There is only one gate to allow trucks in and out of the port. One lane is allocated for each direction. Occasionally, trucks stage along the roads leading to the port.

The port has two truck scales that can weigh up to 80 tons.

UNLOADING /LOADING POSITIONS

Ramps

The port has no ramps for truck or railcar unloading. However, the port does have several locations that can support portable ramp operations. In this analysis we assume the deploying troops can build or acquire two ramps for truck operations and three ramps for railcar operations.

Docks

There are no docks for truck or boxcar loading.

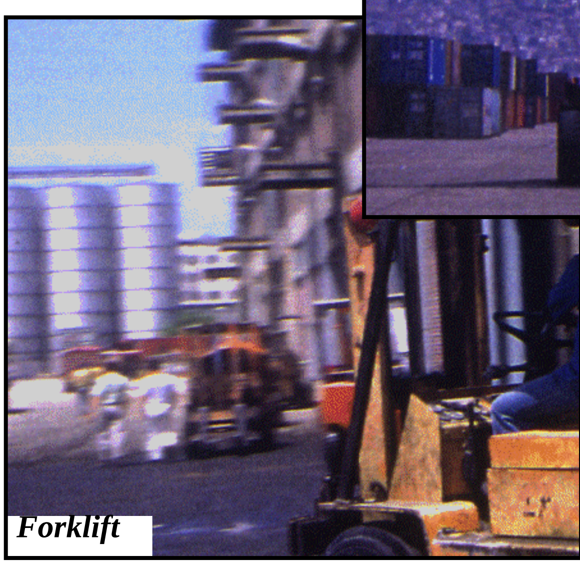
MARSHALING AREAS

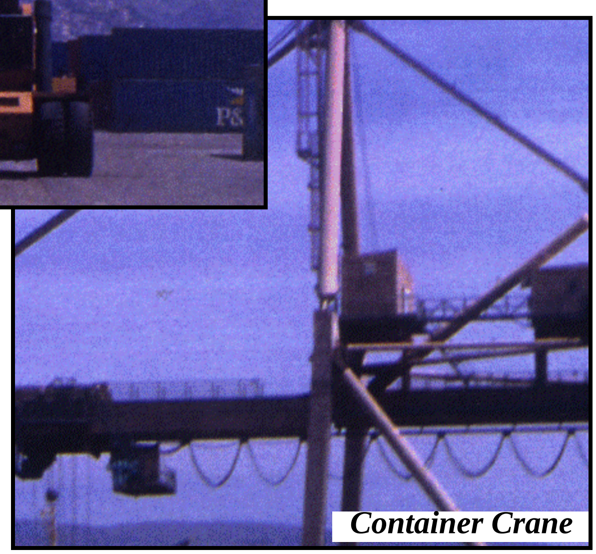
All of the open storage areas on the port are required to support staging of commercial and military cargo. The port has no additional room for vehicles to marshal. The city of Izmir is very highly developed, but has no areas nearby that might be used to marshal vehicles.

MATERIAL HANDLING EQUIPMENT (MHE)

TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY
Container Cranes	40	4
Wharf Cranes	3-15	9
Floating Crane	100	1
Mobile Cranes	6-30	14
Transtainers	35	7
Container Handlers	40-42	16


Container Handler

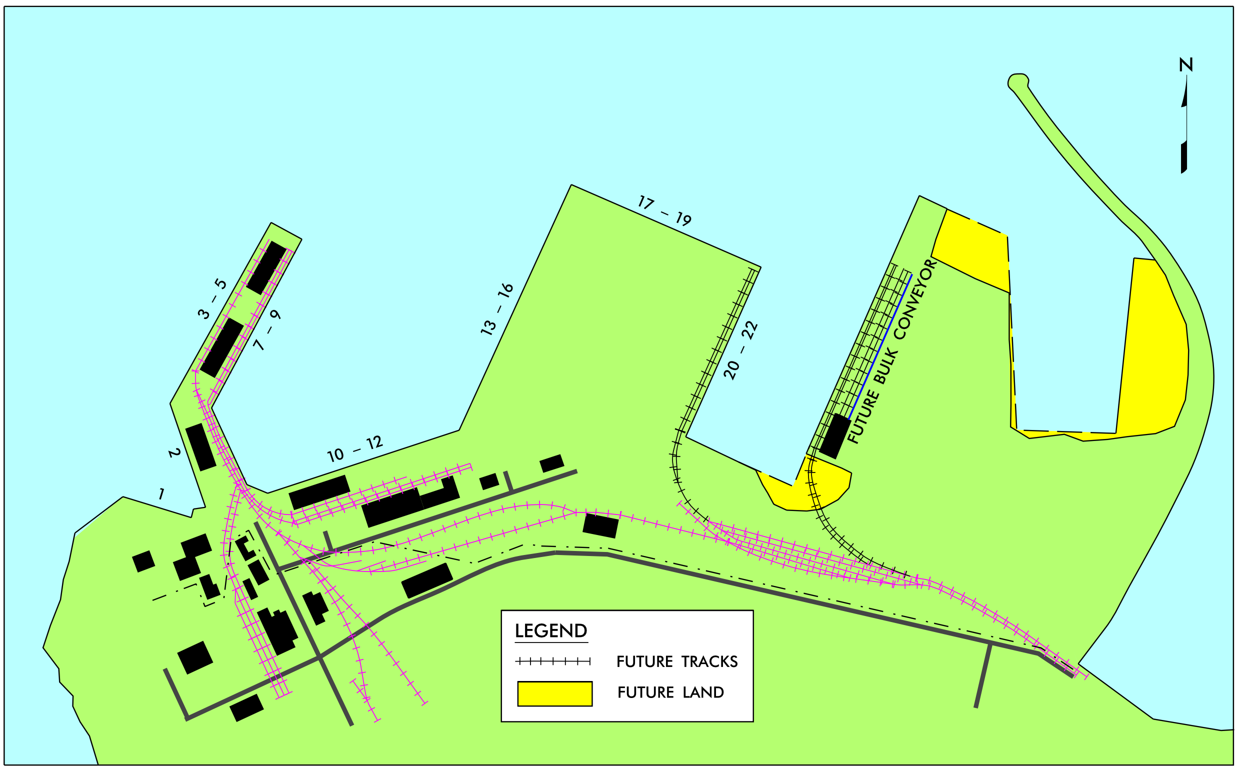

Forklift


Container Crane

FUTURE DEVELOPMENT

The port will continue to fill the east end of the port and add a bulk conveyor to improve shiploading from the existing silos. Dual apron tracks will also be added at berth 20-22. This expansion project, like most others for Turkish ports, will not receive further funding until after the completion of the South East Anatolia Project (GAP).

Highway access will improve. Construction has already begun on an overpass that will relieve some of the congestion in the immediate area.

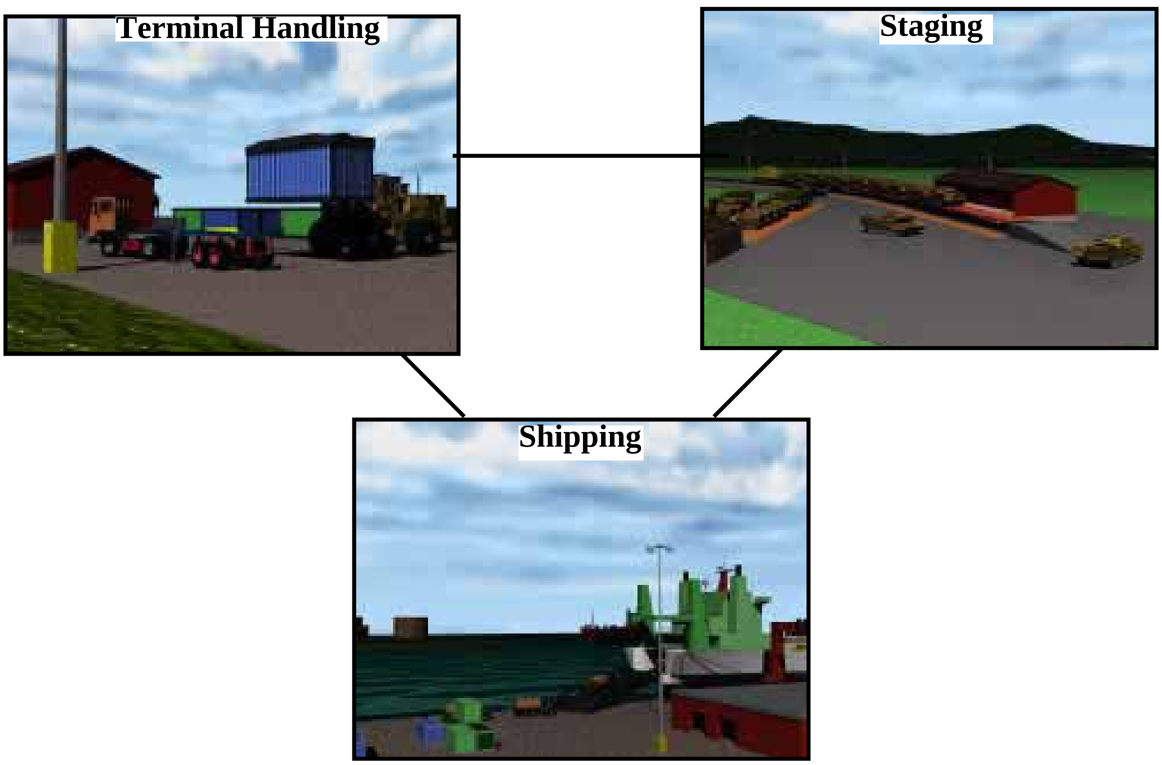


Future Development

II. THROUGHPUT ANALYSIS

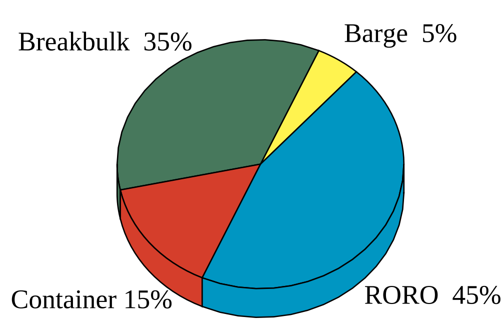
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Izmir. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



The analysis assumes that 70 percent of the port facilities will support military deployments. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.

SHIP MIX PERCENTAGES



TERMINAL CLEARANCE/HANDLING

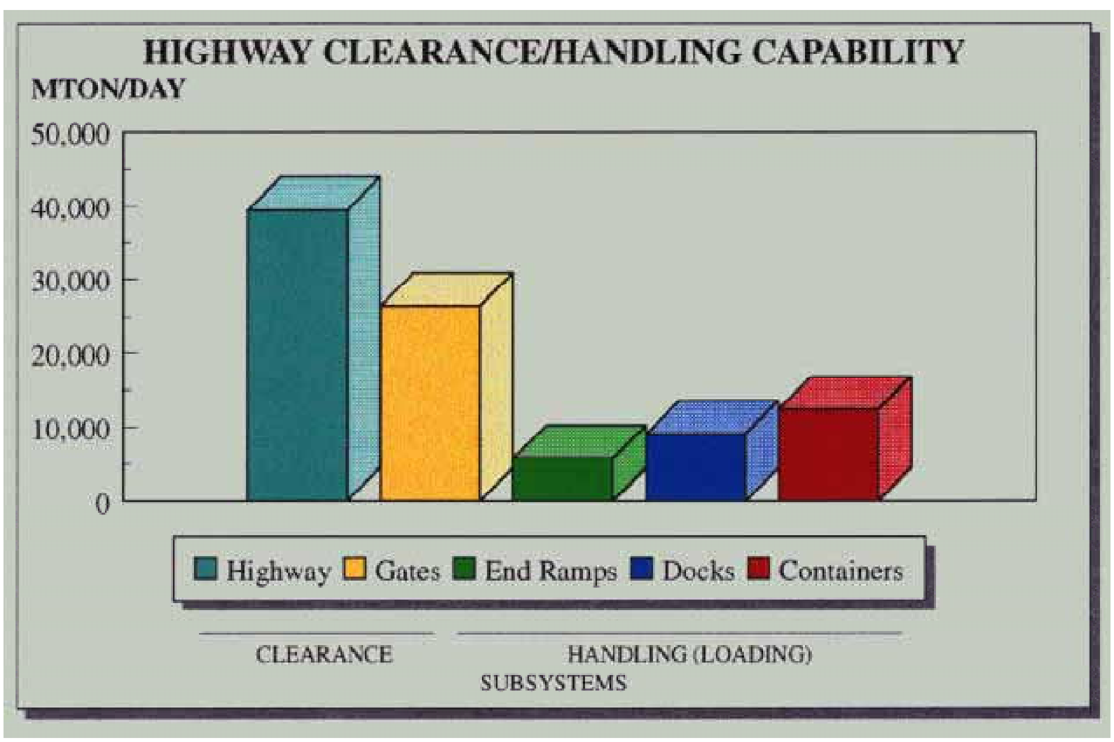
HIGHWAY

E-87 and E-96 are the main highways that lead away from the Port of Izmir. The road network out of the port, including the gate processing of the vehicles, could handle only 26,400 MTON of equipment and supplies per day. The limiting factor is the single gate leading out of the port.

Roadable vehicles in convoys will process out of the port directly from the staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. We assume that troops will build or acquire two portable ramps for flatbed truck and semitrailer operations. These ramps could handle about 5,800 MTON of military vehicles and equipment per day.

The port has no truck docks, and will therefore use ramps to stuff vans. Approximately 20 van semitrailers can load simultaneously at various locations throughout the port. With a .60 factor to account for delays resulting from the ramps, these 20 van semitrailers could load about 9,100 MTON per day.

The Port of Izmir has 16 container handlers available for use. We assume that two of these will be used to support chassis operations. These operations will likely occur at the inland end of the container terminal, berths 13-22.



RAIL

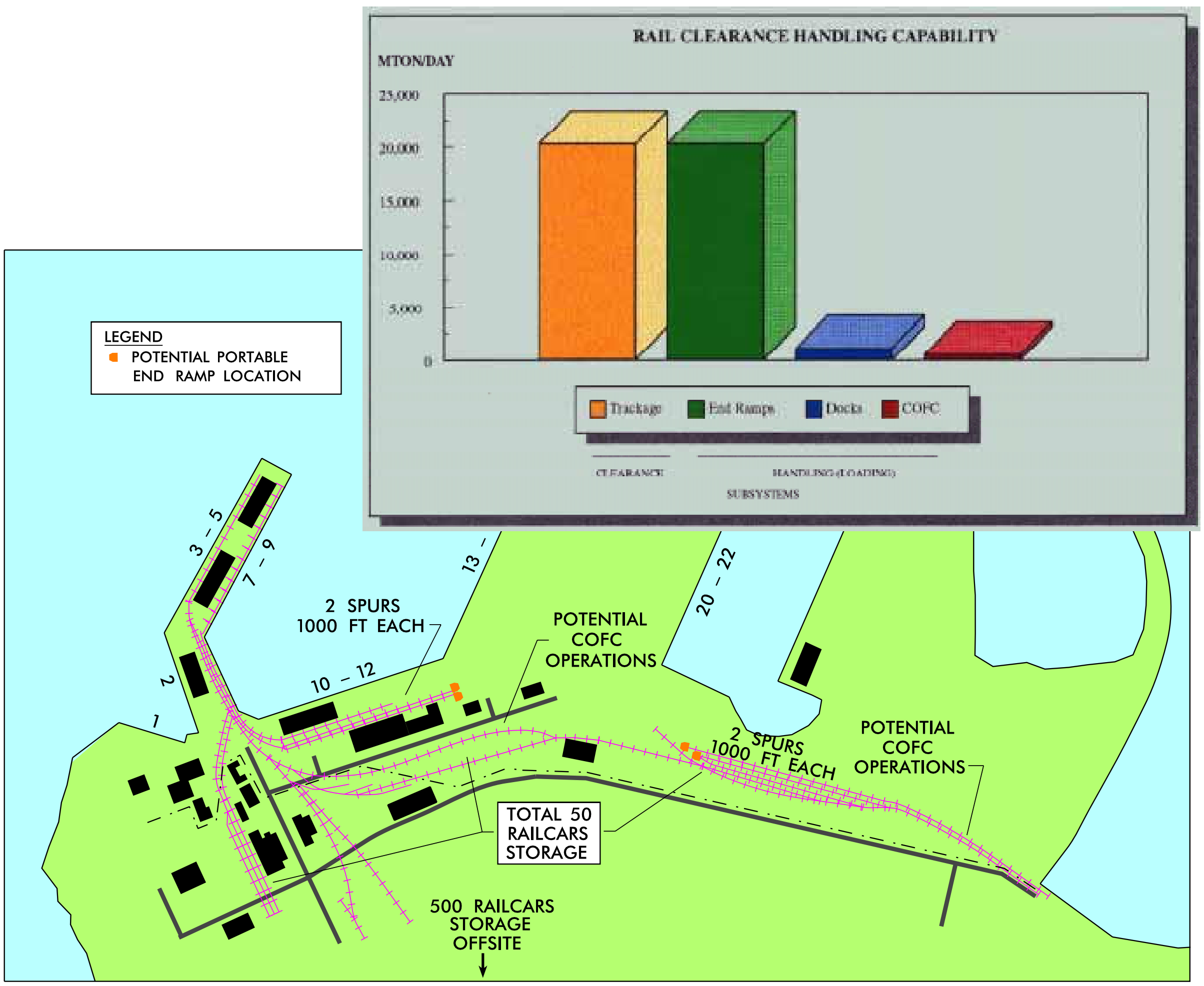
Rail clearance at the port is very good. The TCDD could remove 15 trains of 30 railcars each day if necessary.

The 500-railcar facility just outside the port includes a conveyor system to transfer agricultural bulk materials to berth 7-9.

Vehicles on flatcars would require portable end ramps to load. We assume the troops would build or acquire three portable end ramps would be built or acquired.

Equipment or supplies in boxcars, like van semitrailers, would require ramps for loading. Since the port has no boxcar handling docks, forklifts would access the boxcars with portable ramps. Because of this, we used a 60 percent facility-use factor.

The Port of Izmir has 16 container handlers available for use. We assume that five of these will be used to support container-on-flatcar (COFC) operations.

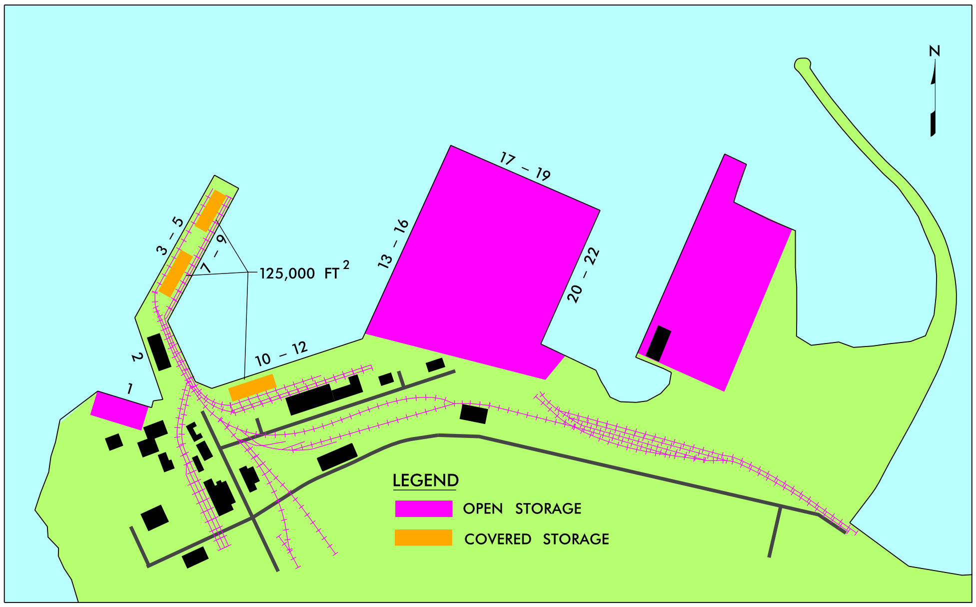


Rail Facilities

STAGING

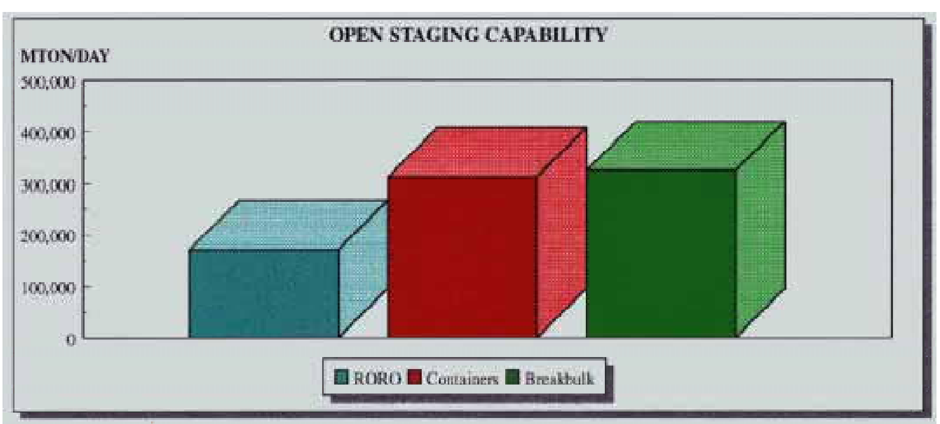
The port has about 53 acres of paved open staging that could support military operations. Most of the acreage is regularly used for containers.

Together, the three sheds and the hazardous material warehouse total about 254,000 square feet of covered storage. The building along the wharf at berth 2 supports passenger services and cannot be used for covered storage.



Staging Areas

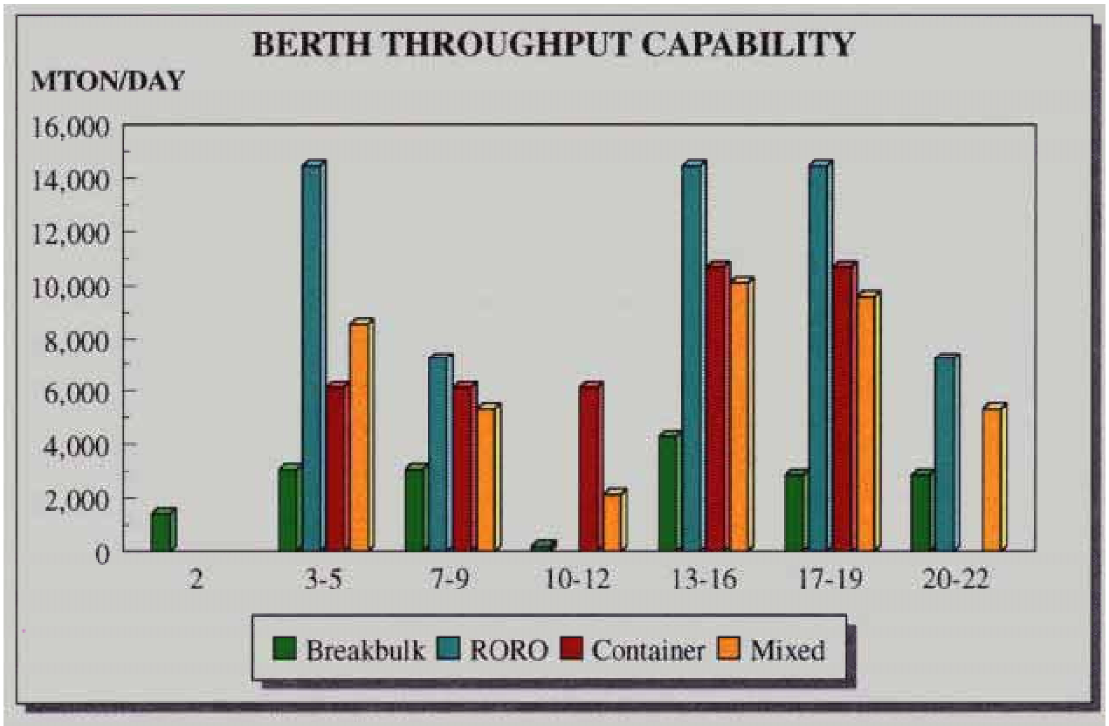
The port can perform operations on roll on/roll off (RORO), container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned. The chart below provides the staging capability for the cargo for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.



SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. Berth 1 is too short for any ship to berth. It can only be used for barge loading. For this reason we did not consider it for throughput.

FSSs cannot operate at the port because of the shallow channel and small turning basin.



CONVERSION FACTORS

Breakbulk:	.4	STON per MTON
RORO:	.25	STON per MTON
Containers:	.4	STON per MTON

The type of ship preferred at each berth is based on the methodology described in the appendix. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better it is suited for loading or unloading operations.

Although berth 2 has a RORO ramp, our analysis shows it cannot support the RORO ships most often used by the military. The length and apron height are too low.

LOADING TYPE	BERTHS						
	2	**3-5**	**7-9**	**10-12**	**13-16**	**17-19**	**20-22**
Breakbulk	7	2	1	3	4	4	6
RORO	-	5	4	-	2	2	1
Container	-	-	-	1	2	-	-
Note: Berths marked with a "-" are not recommended for these operations.							

No one berth is ideal for all military operations. The best berth depends on the type of ship to be loaded.

SUMMARY OF BERTHING CAPABILITIES OF IZMIR

Vessel	Berths						
	2	3-5	7-9	10-12	13-16	17-19	20-22
Breakbulk							
C3-S-33a	1	2	2	a	3	2	2
C3-S-37c	1	2	2	a	3	2	2
C3-S-37d	1	2	2	a	3	2	2
C3-S-38a	1	2	2	a	3	2	2
C4-S-1a	1	2	2	a	3	2	2
C4-S-1qb and 1u	1	2	2	a	3	2	2
C4-S-58a	1	2	2	a	3	2	2
C4-S-65a	1	2	2	a	3	2	2
C4-S-66a	1	2	2	a	3	2	2
C4-S-69b	1	2	2	a	3	2	1
Seatrain							
GA and PR-class	1	2	2	a	3	2	2
Barge							
LASH C8-S-81b	a,c,f	a,f	a,f	a,f	2	1	1
LASH C9-S-81d	a,c	a	a	a	a	a	a
LASH lighter	4	9	8	8	14	10	8
SEABEE C8-S-82a	a,c	a	a	a	a	a	a
SEABEE barge	3	6	6	5	9	7	5
RORO							
Comet	i,j	d,o	d,o	a,d	d,i,j	d,i,j	i,j
C7-S-95a/Maine-class	b,c	1	1	a	2	1	1
Ponce-class	b,c,h	b,h	b,h	a,h	h	h	h
Great Land-class	b,c,h	b,h	b,h	a,h	h	h	h
Cygnus/Pilot-class	b,c	2	1	a	2	2	1
Meteor	i,j	d,o	d,o	a,d	d,i,j	d,i,j	i,j
AmEagle/Condor	b,c	i,j	i,j	a	i,j	i,j	i,j
MV Ambassador	k,m	d	d	d	d	d	k,m
FSS-class	a,c,g	n,g	n,g	a,g	g	g	g
Cape D-class	b,c	i,j	i,j	a	i,j	i,j	i,j
Cape H-class	a,b,c,g	a,g	a,g	a,g	g	1	1
LMSR	a,c,g	n,g	n,g	a,g	g	g	g
Container							
C6-S-1w	c,e	2,e	1,e	a,e	2	2	1,e
C7-S-68e	c,e	1,e	1,e	a,e	2	2	1,e
C8-S-85c	c,e	1,e	1,e	a,e	2	1	1,e
Combination							
C5-S-78a	1,e	2,e	1,e	a,e	3	2	1,e
C5-S-37e	1,e	2,e	1,e	a,e	3	2	1,e

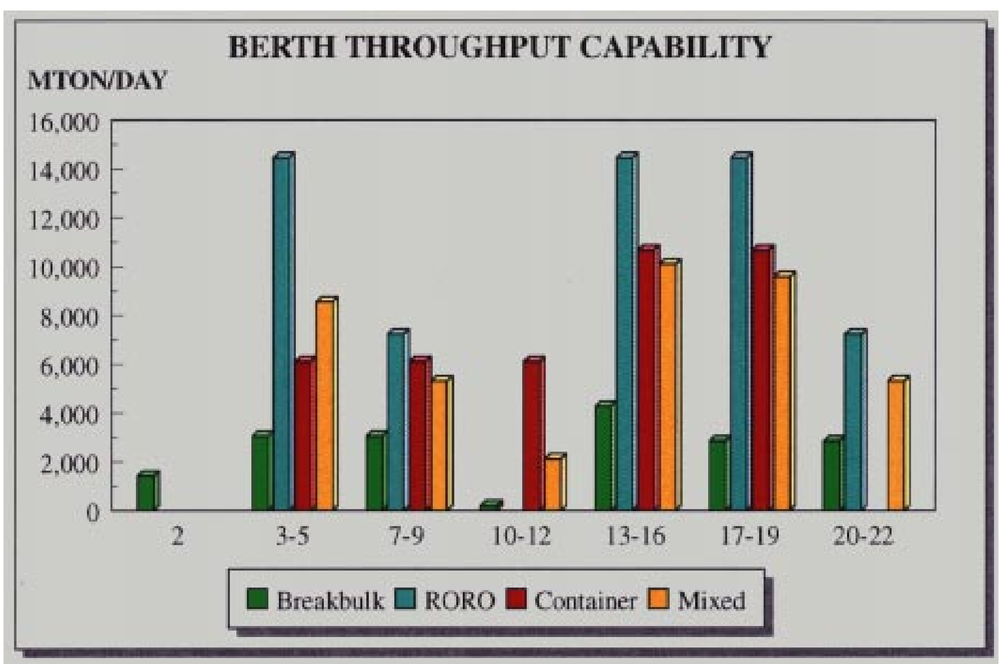
a = maximum draft limited to berth depth
b = inadequate apron width
c = inadequate berth length
d = no straight stern-ramp facilities
e = no container-handling equipment
f = inadequate berth depth, adequate anchorage depth
g = inadequate channel depth
h = no shore-based ramps available
i = insufficient ramp clearance at low tide
j = insufficient ramp clearance at high tide
k = excessive ramp angle at low tide
m = excessive ramp angle at high tide
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

Note: Ramp clearance and ramp angle based on maximum vessel draft.

PORT OF IZMIR

The port is a multicargo facility. The west end (berths 1-12) handles breakbulk, passenger and light RORO ships. The east end (berths 13-16 and 17-19) is a modern container facility with four container cranes. The port has a total of 53 acres of open staging. Most of the staging is at the container facility. The port has storage for 50 railcars, but has no fixed or portable rail end ramps. The estimated mixed throughput is 44,000 MTON per day.

Characteristics	Berths							
	1	2	3-5	7-9	10-12	13-16	17-19	20-22
Length (ft)	460	623	1,378	1,220	1,142	1,970	1,476	1,194
Depth alongside at MLW (ft)	26	35	35	35	23	36	36	36
Deck strength (psf)	614	614	614	614	614	614	614	614
Apron width (ft)	Open	50	60	60	Open	Open	Open	Open
Apron height above MLW (ft)	8	8	8	8	8	8	8	8
Number of container cranes	0	0	0	0	0	2	2	0
Number of wharf cranes	0	0	3	3	3	0	0	0



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I. General Data

II. Throughput Analysis

Throughput Summary

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I. GENERAL DATA

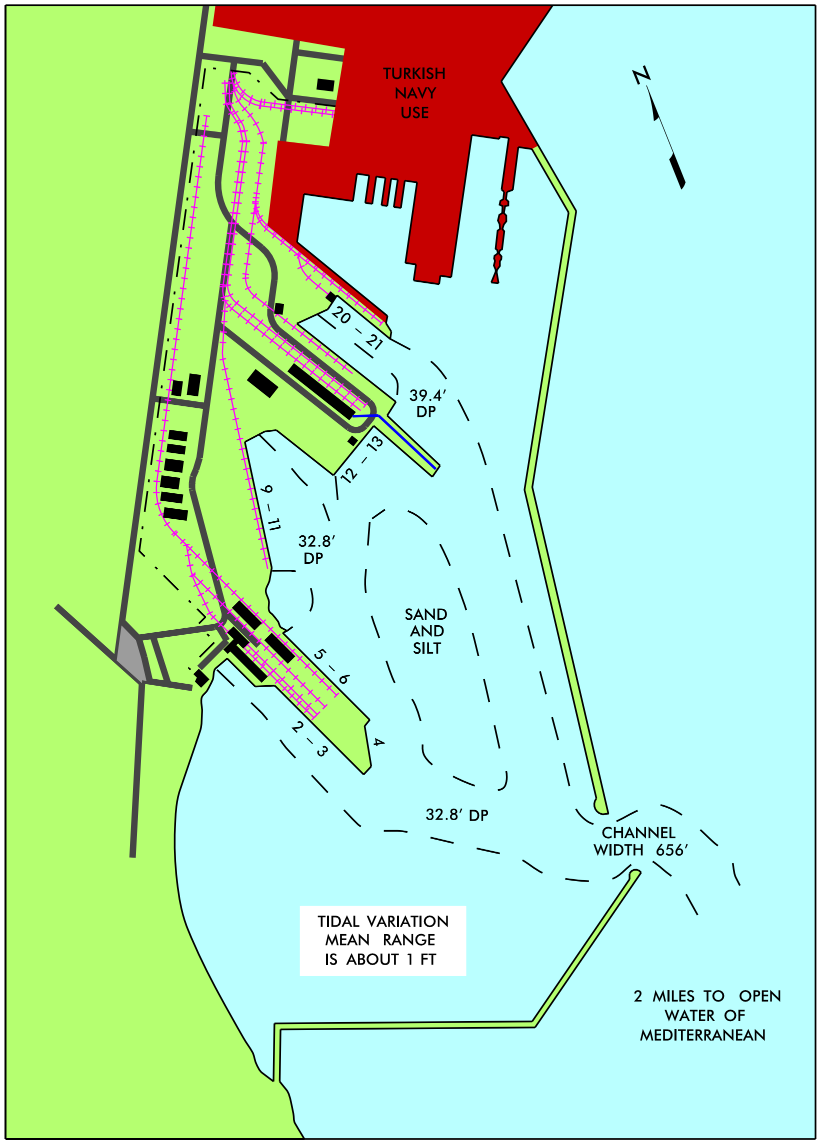
TRANSPORTATION ACCESS

WATER

The Port of Mersin is on the south coast of Turkey, 42 miles west of Adana. The port is at 36°46'20" N Latitude and 34°39'00" E Longitude, on the eastern part of the Mediterranean Sea.

Approaching channels have no restrictions. The entrance channel to the port is 33 feet deep at mean low water (MLW) and 656 feet wide. Large ships must turn in the open water outside the port. They then enter the port between two breakwaters. There are no nighttime restrictions for entry, however, ships with drafts exceeding 29.5 feet may not enter the port during the winter months. Pilotage is required for berthing and undocking. A pilot is available 24 hours a day. Tidal range is about 1 foot. An explosives anchorage is available less than a mile south of the port.

The water depths for the berths in this analysis range from 32.8 to 47.6 feet.



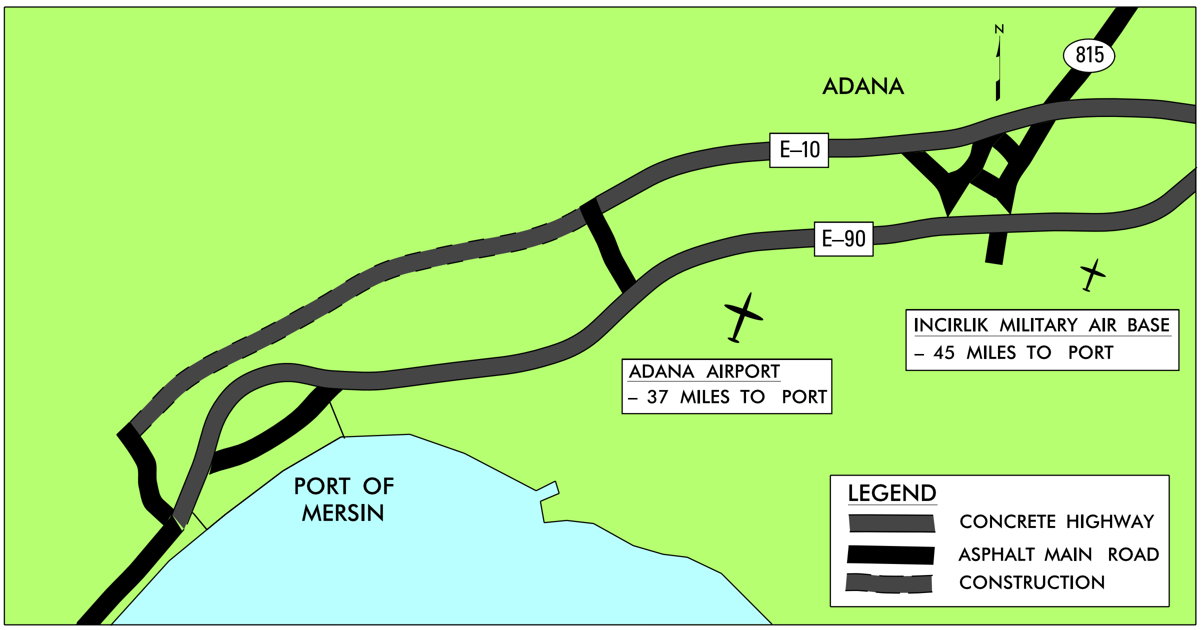
Water Access

HIGHWAY

Mersin is a large city in Turkey. The roads leading out of the port are narrow and are usually congested. Military convoys should plan to leave the port very early or very late in the day to avoid congestion. The port is connected with the State railways and highways network.

The port has four gates for cargo-carrying trucks. Each gate has one lane in each direction. The roads outside the gates lead directly to Highway E-90 (also called Devet Karayolu, or the Adana Highway). E-90 is primarily a concrete four-lane road from the port eastward toward the Middle East countries. Westward and northward, the highways are typically two lanes. The Syrian border is about 150 miles from the port, by highway.

The port has no bridges, ramps, or overhangs that cause height restrictions for cargo on trucks or trailers. All paved areas within the port are hard surfaced and capable of withstanding heavy vehicular traffic. There are no height or weight limits leading out of the port to the main networks.



Air and Highway Access

AIR

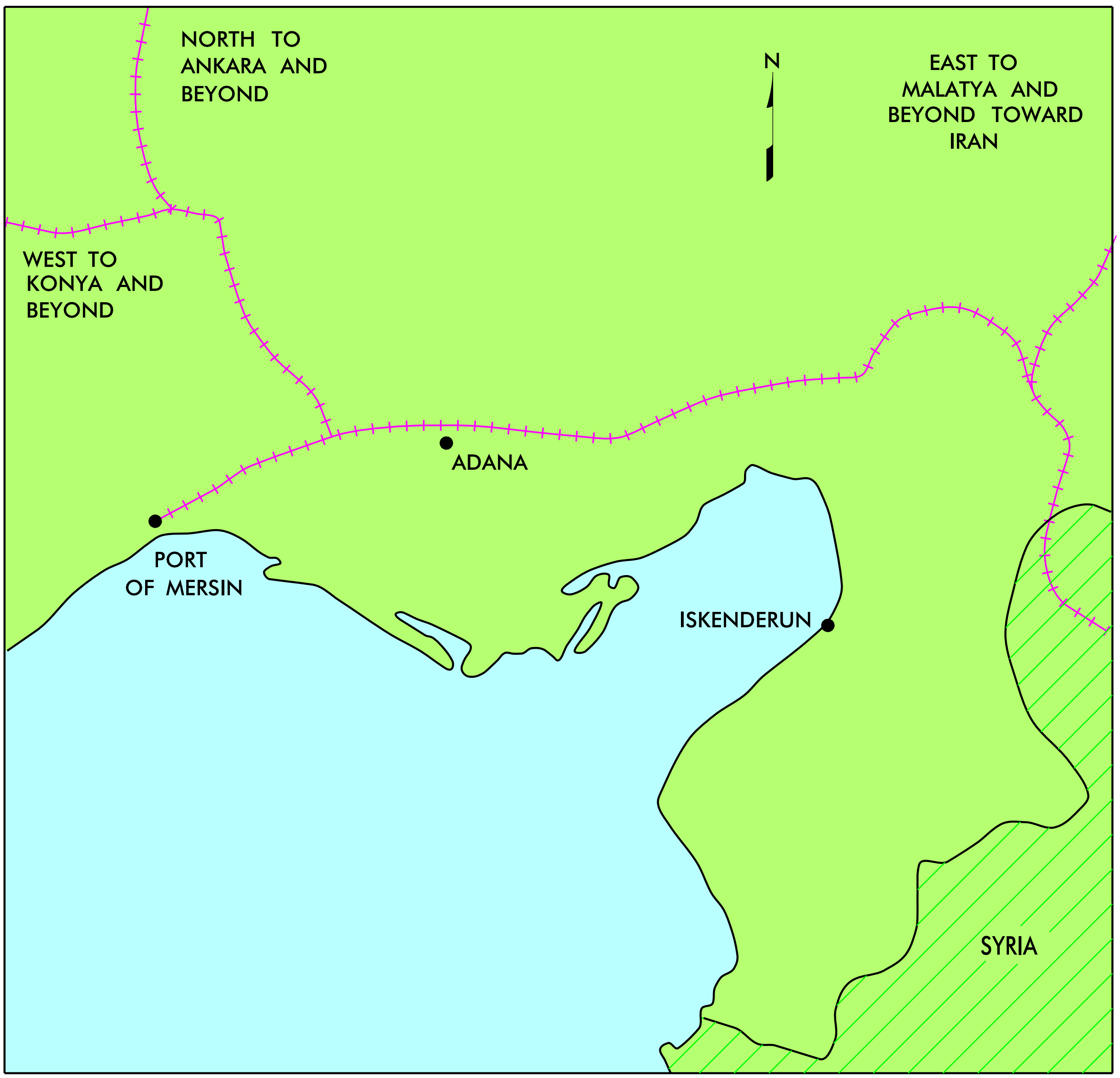
The largest airport near the Port of Mersin is in Adana about 37 miles away. It has only one runway, which can handle small- and medium-sized passenger jets. The airport handles domestic flights to Ankara, Istanbul, and Northern Cyprus.

The nearest military airfield is Incirlik Air Force Base, which is about 45 miles to the east, near Adana. This airfield is owned and operated by the Turkish military.

RAIL

The Turkish State Railways (TCDD) owns and operates the rail line accessing the Port of Mersin. The rail access and facilities at the port are extremely poor. On the average, only three trains access the port each day. These trains average 30 railcars in length. The rail line leads to the east, toward the Middle East countries.

The port's rail storage yard can hold only 20 railcars. There are no additional railyards outside the port that are available for military operations.



Rail Access

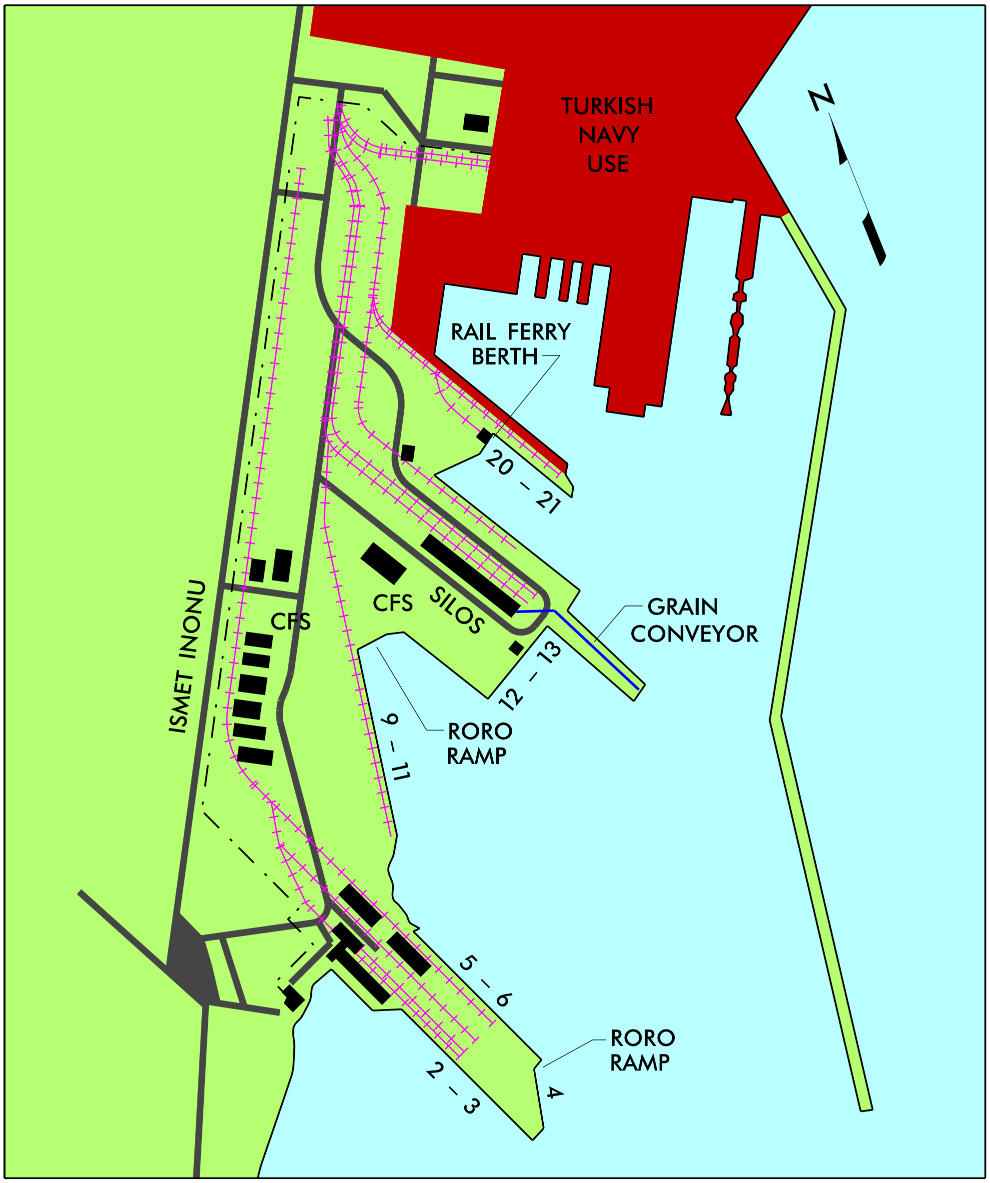
PORT FACILITIES

BERTHING

Mersin is a multicargo port with a free-trade-zone. It has several container cranes, container freight stations (CFS), transtainers, bulk conveyors, liquid bulk pipelines and hoses, and a regular ferry route for passengers and vehicles to and from Northern Cyprus.

All of the berths are well lighted for night operations.

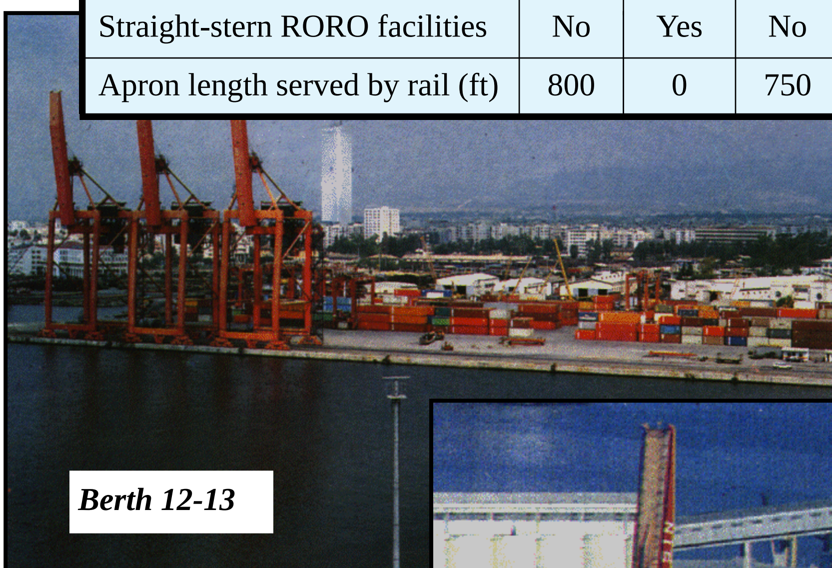
The wharves in this report range from 574 to 1,312 feet in length. The port includes other shallower and shorter berths that are incapable of supporting military deployments, unless they involve barge operations. The aprons are only 6.6 feet above MLW. They are at least 50 feet wide.



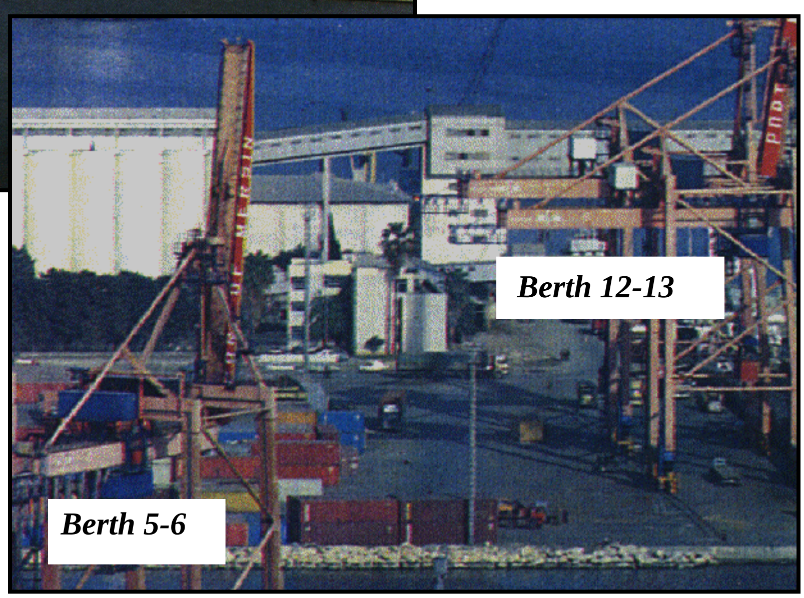
Land-Use Map

Berthing Characteristics

Characteristics	Berths					
	2-3	4	5-6	9-11	12-13	20-21
Length (ft)	902	574	902	1,312	1,016	870
Depth alongside at MLW (ft)	33	33	33	33	33	39
Deck strength (psf)	614	614	614	614	614	614
Apron width (ft)	Open	Open	Open	Open	Open	50
Apron height above MLW (ft)	7	7	7	7	7	7
Number of container cranes	0	0	0	3	2	0
Number of wharf cranes	4	1	6	2	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	Yes	No	Yes	No	No
Apron length served by rail (ft)	800	0	750	900	0	0



Berth 12-13



Berth 12-13

Berth 5-6

STAGING

Open Staging

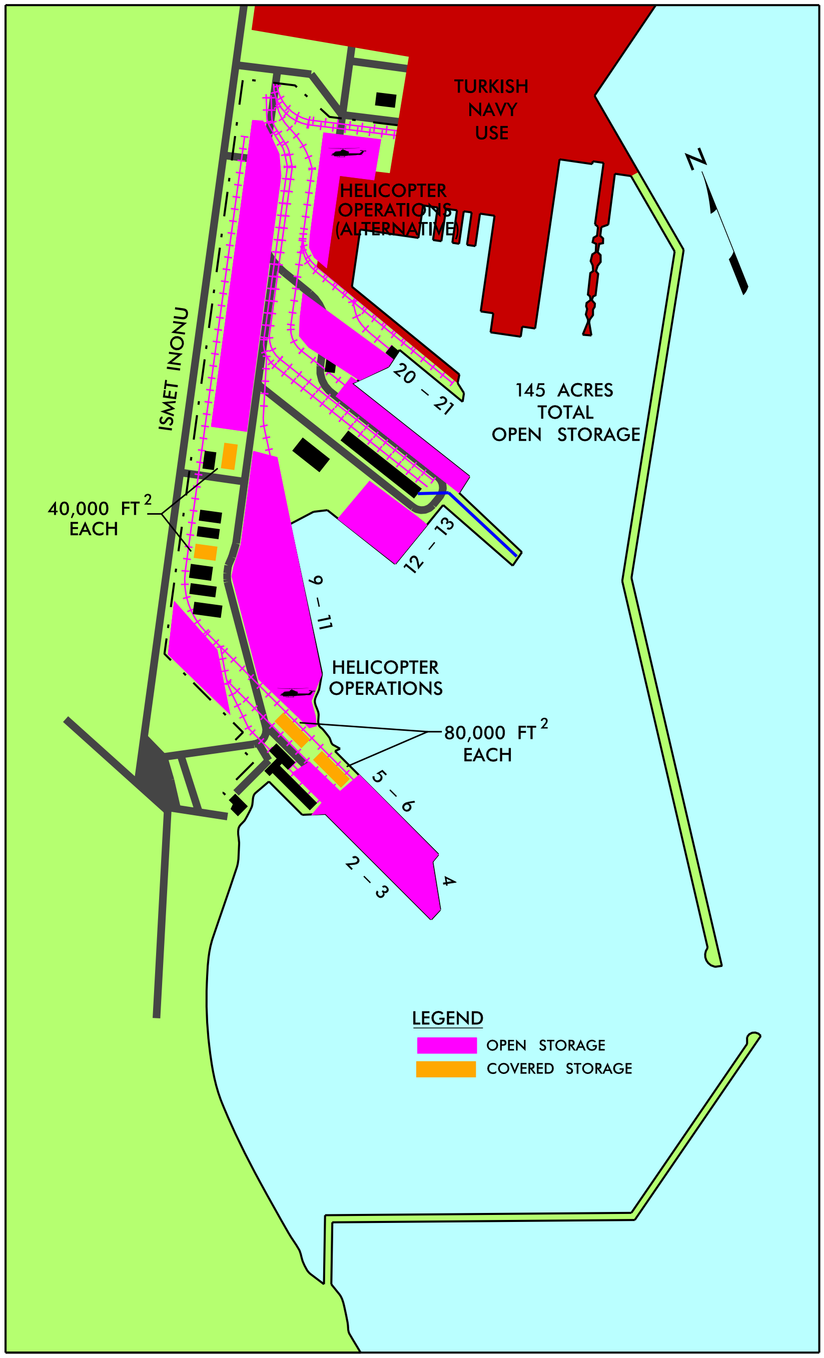
The Port of Mersin has about 145 acres of paved open staging area. Usually about a quarter of the open storage is covered with containers.

Helicopter operations are possible along the unfinished berth 8. Temporary shelters would be required to support reduction and shrink wrapping. After berth 8 is completed, the area will be used for shiploading, and may not be available for helicopter operations.

An alternate area for helicopter operations is the container storage yard near the Turkish Navy boundary at the north end of the port. Landing is hindered by lighting poles. The port's railroad tracks hinder towing the helicopters to loading areas.

Covered Storage

Six transit sheds total about 240,000 square feet of covered storage. The sheds serve the berths at the south end of the port, especially berth 5-6.



Staging Areas

RAIL

Any more than 20 railcars stored at the port would obstruct switching and handling. A passenger terminal is near the port, but the deploying units cannot assume it will be available for military operations. No other offsite railyards are available.

The port has a rail ferry berth at the inland end of berth 20-21. Once a bridging system is designed and built to adapt the berth with a ferry, regular delivery is possible to as many as seven other ports. The Port of Mersin hopes to establish a regular route with a port in Romania.

HIGHWAY

Discharging trucks from the port may leave through the port's four gates. Trucks may take different gates and routes to distribute the load on the congested connectors.

The port has five truck scales, but only one can weight up to 90 tons.

UNLOADING/LOADING POSITIONS

Ramps

The Port of Mersin has no truck or rail end ramps. To rail deploy from the port, the units will need to build or acquire portable end ramps. Several locations can support offloading with portable end ramps, without disrupting shiploading operations.

Docks

There are no docks for truck or boxcar loading.

Gate inland of Berth 11

MARSHALING AREAS

All of the open storage areas on the port are required to support staging of commercial and military cargo. There is no room for vehicles to marshal within the port. The city of Mersin is highly developed on the edge of the Taurus mountains. There are no areas nearby that might be used to marshal vehicles.

MATERIAL HANDLING EQUIPMENT (MHE)

TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY
Wharf Cranes	3-5	12
Wharf Cranes	35-40	5
Mobile Cranes	3-25	18
Floating Crane	60	1
Reach Stackers	40	2
Mobile Container Crane	40	1
Container Cranes	40	5
Transtainers	36	13
Container Forklifts	10-42	6

Container Crane

Transtainer

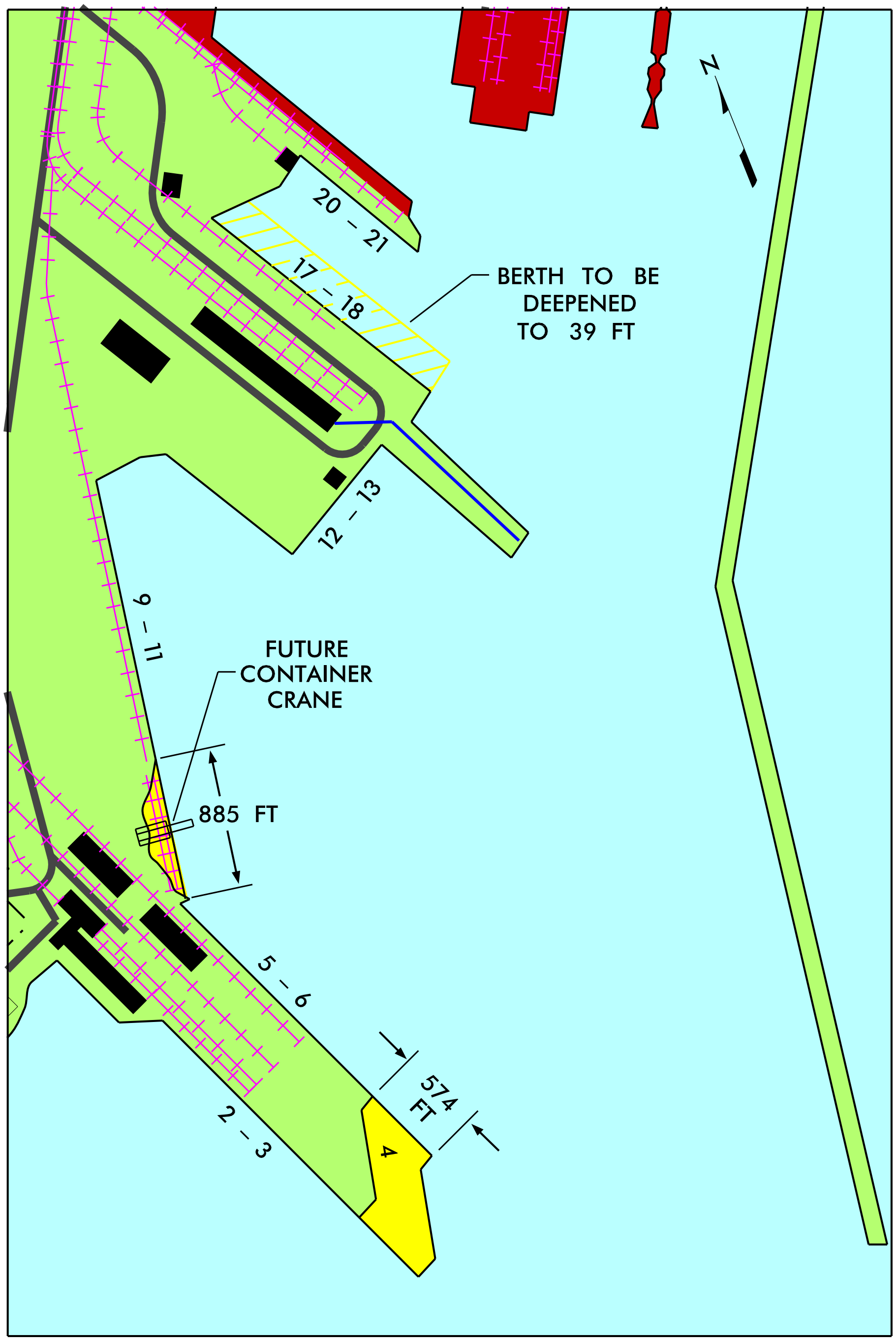
FUTURE DEVELOPMENT

The port has already begun the development of berth 8. The apron is mostly filled and can be used for staging. Ships cannot berth alongside until dredging is complete. The port expects the berth to be operational in 1995. This will add about 885 contiguous feet to berth 9-11. The port also expects to add at least one additional container crane to work ships along the quay.

The new bulkhead can support a draft of 45 feet. It is unlikely the port will dredge so deep in the near future.

The port also hopes to extend the pier at berths 2 through 6 another 474 feet to allow longer ships to berth alongside.

Another tentative plan is to dredge berth 17-19 to 39 feet deep. At present, the water is only 20 feet deep. For this reason we did not consider this berth for military operations.



Future Development

II. THROUGHPUT ANALYSIS

GENERAL

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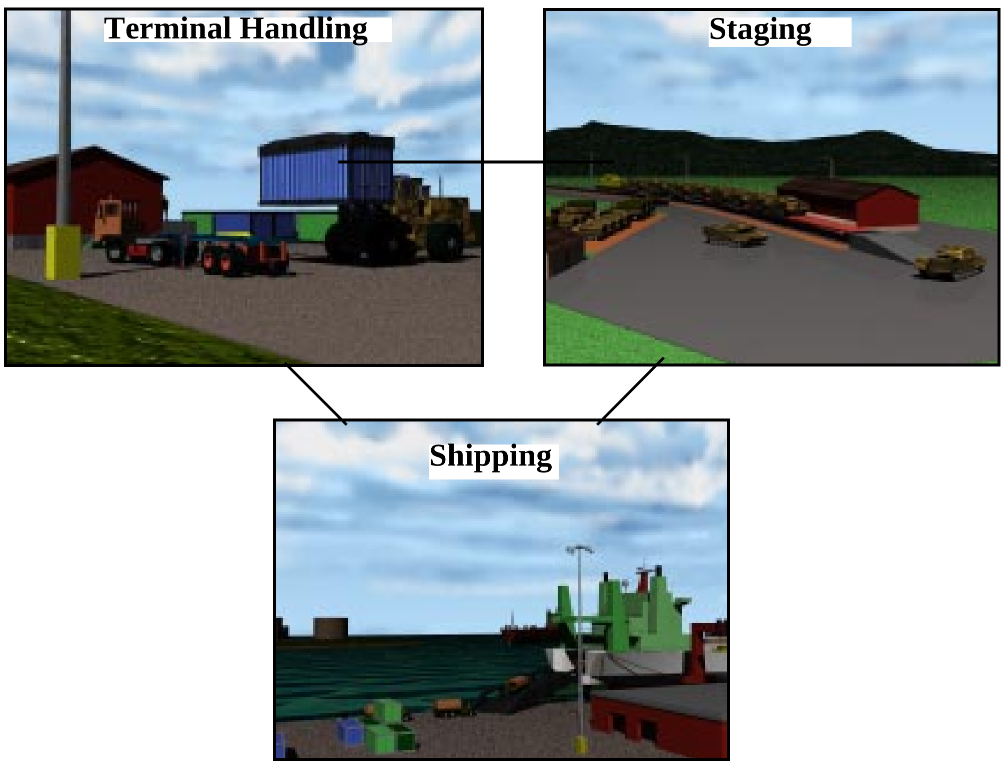

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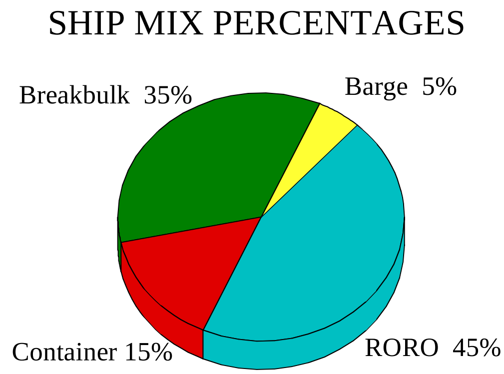


TERMINAL CLEARANCE/HANDLING

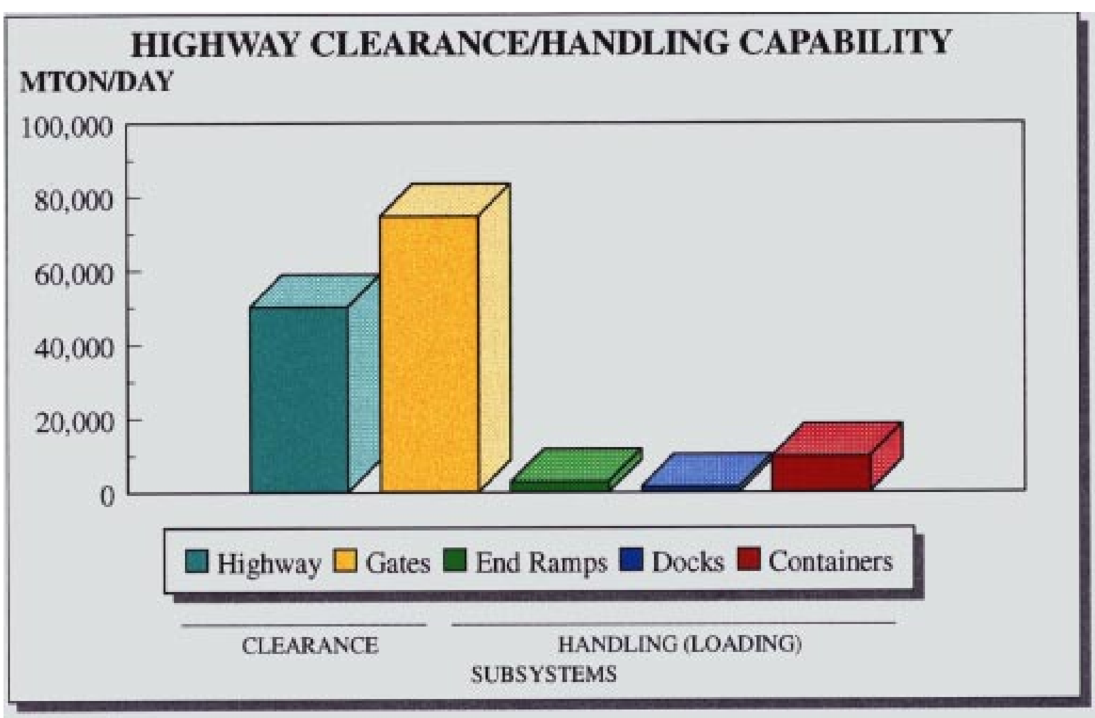
HIGHWAY

E-90 is the main highway that leads away from the Port of Mersin in an east or west direction. The road network out of the port, including the gate processing of the vehicles, could handle only 50,000 MTON of equipment and supplies per day. The limiting factor is the highway leading out of the port, assuming all four gates and connectors can be used to the highway.

Roadable vehicles in convoys will process out of the port directly from the staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. We assume that troops will build or acquire two portable ramps for flatbed truck and semitrailer operations. These ramps will handle about 2,800 MTON of military vehicles and equipment per day.

The port has no truck docks, and will therefore use ramps to stuff vans. Approximately eight van semitrailers can load simultaneously at various locations throughout the port. The most practical location is the open area inland of berth 9-11, near the CFS and sheds. With a .60 factor to account for delays resulting from the ramps, these loading operations could load about 1,100 MTON into vans or semitrailers.

The Port of Mersin has several machines capable of performing chassis operations, to include mobile cranes, reach stackers, and container forklifts. We assume two machines will be available to perform container offloading operations. These machines can perform chassis operations in the open area inland of berth 9-11, along with the van loading.



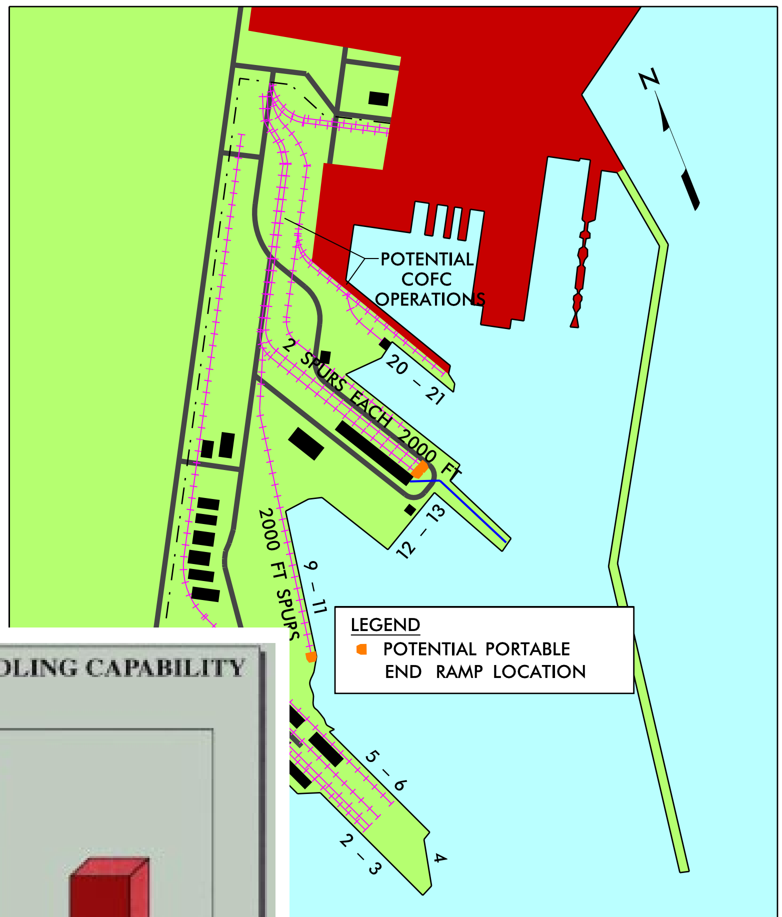
RAIL

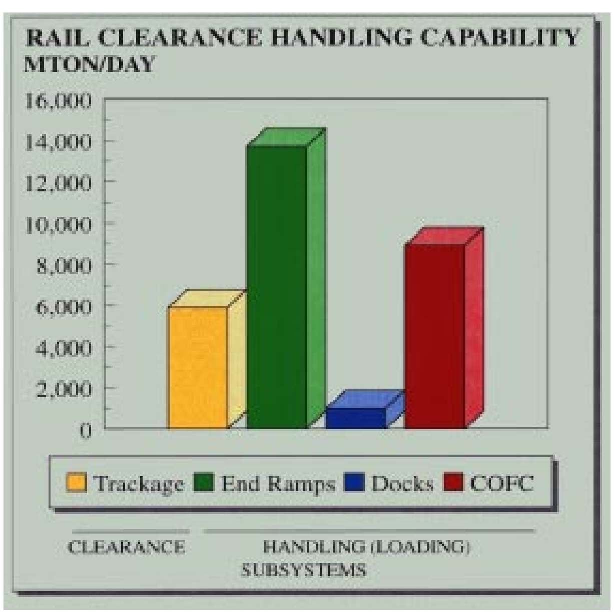
The TCDD could remove only 3 trains of 30 railcars each day if necessary. Because of this limited capability, we recommend deployment troops consider road deploying from the port.

Vehicles on flatcars would require portable end ramps to load. We assume the troops would build or acquire two portable end ramps, with 1,600 feet of tangential track at each.

Since the port has no boxcar handling docks, forklifts would access the boxcars with portable ramps. Because of this, we used a 60 percent facility-use factor.

The port has several machines capable of handling containers. We assume that at least two reach stackers or container handlers will be available to support COFC operations. These operations will likely occur at the north end of the port, away from the end ramp and shiploading operations.





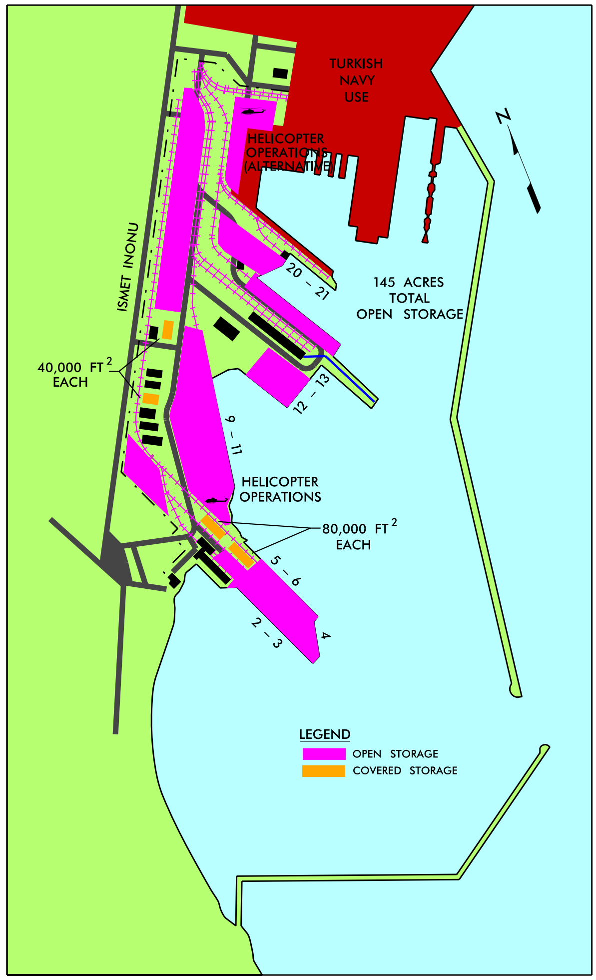
Port Rail Facilities

STAGING

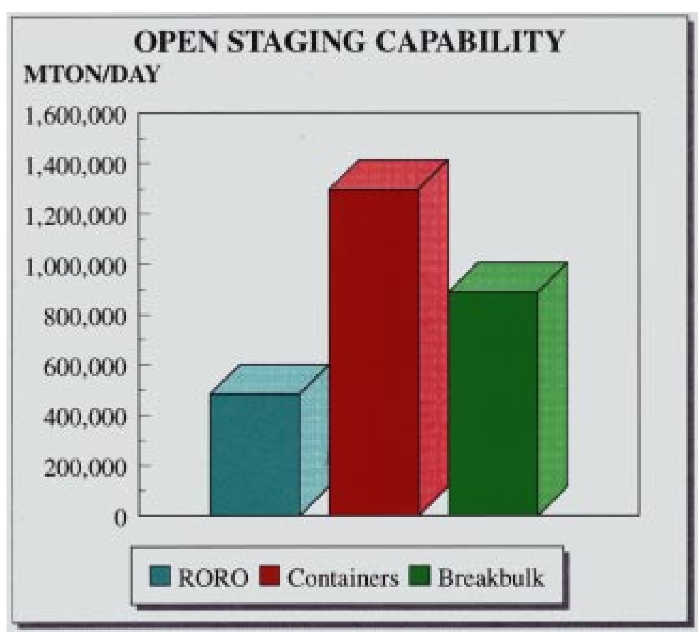
The Port of Mersin has about 145 acres of paved open staging area that could be used to support military operations. Usually about a quarter of the open storage is covered with containers.

Six transit sheds have a total of about 245,000 square feet of covered storage. Two additional CFS have another 112,000 square feet. The sheds serve the berths at the south end of the port.

The port can perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned.



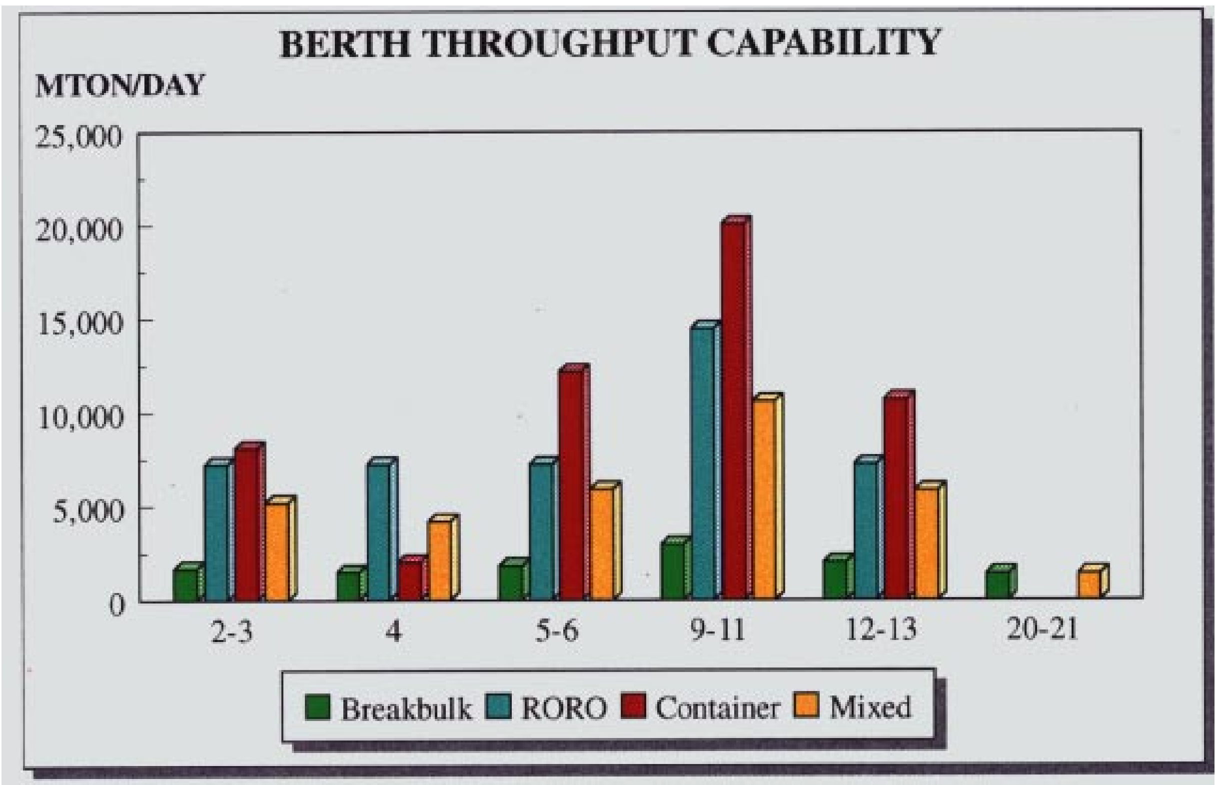
The chart at right provides the staging capability for the cargo for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.



SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types.

For comparison, figure that an FSS carries about 28,500 MTON of equipment. The chart below indicates that unloading an FSS (primarily RORO) would require about 4 days at the Port of Mersin.



CONVERSION FACTORS

Breakbulk:	.4	STON per MTON
RORO:	.25	STON per MTON
Containers:	.4	STON per MTON

The type of ship preferred at each berth is based on the methodology described in the appendix. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better it is suited for loading or unloading operations.

LOADING TYPE	**BERTHS**					
	2-3	**4**	**5-6**	**9-11**	**12-13**	**20-21**
Breakbulk	3	6	1	2	4	5
RORO	2	-	3	1	3	-
Container	-	-	-	1	2	-
Note: Berths marked with a "-" are not recommended for these operations.						

Although the port routinely operates light RORO ships such as ferries, the ships that typically carry military cargo require greater draft and apron height than the berths have at the Port of Mersin. Only the ***Cynus/Pilot*** class vessels can offload military cargo without restrictions. These ships can only berth at berths 2-3, 5-6, 9-11, and 12-13. ***American Eagle*** class vessels have operated at the port of Mersin with less than their maximum draft.

An FSS would have to enter the port very light, because of the shallow berths and channel. An FSS would also require a tall shoring ramp (3 to 5 feet) to decrease the ramp angle because of the low apron. For these reasons, we do not recommend the Port of Mersin for FSS operations.

No one berth is ideal for all military operations. The best berth depends on the type of ship to be loaded. Berth 9-11 is probably the best berth for the ships that carry military cargo.

SUMMARY OF BERTHING CAPABILITIES OF MERSIN

Vessel	Berths					
	2-3	4	5-6	9-11	12-13	20-21
Breakbulk						
C3-S-33a	1	1	1	2	2	1
C3-S-37c	1	1	1	2	1	1
C3-S-37d	1	1	1	2	1	1
C3-S-38a	1	1	1	2	1	1
C4-S-1a	1	1	1	2	1	1
C4-S-1qb and 1u	1	1	1	2	1	1
C4-S-58a	1	1	1	2	1	1
C4-S-65a	1	1	1	2	1	1
C4-S-66a	a	a	a	a	a	1
C4-S-69b	1	c	1	2	1	1
Seatrain						
GA and PR-class	1	1	1	2	1	1
Barge						
LASH C8-S-81b	a,f,g	a,c,f,g	a,f,g	a,f,g	a,f,g	g
LASH C9-S-81d	a,g	a,c,g	a,g	a,g	a,g	c,g
LASH lighter	6	4	6	9	7	6
SEABEE C8-S-82a	a,g	a,c,g	a,g	a,g	a,g	c,g
SEABEE barge	4	2	4	6	5	4
RORO						
Comet	1,d,i	1,i	1,d,i	2,i	1,d,i	d,o
C7-S-95a/Maine-class	a,g	a,c,g	a,g	a,g	a,g	b,g
Ponce-class	h	c,h	h	h	h	b,h
Great Land-class	h	c,h	h	h	h	b,h
Cygnus/Pilot-class	1	c	1	1	1	b
Meteor	d,i,j	i,j	d,i,j	i,j	d,i,j	d,o
AmEagle/Condor	1,i	c	1,i	1,i	1,i	b
MV Ambassador	d	k,m	d	k,m	d	d
FSS-class	a,c,g	a,c,g	a,c,g	a,g	a,g	b,c,g
Cape D-class	a	a,c	a	a	a	b
Cape H-class	a,g	a,c,g	a,g	a,g	a,g	b,g
LMSR	a,c,g	a,c,g	a,c,g	a,g	a,g	b,c,g
Container						
C6-S-1w	1,e	c,e	1,e	1	1	1,e
C7-S-68e	1,e	c,e	1,e	1	1	1,e
C8-S-85c	a,e	a,c,e	a,e	a	a	1,e
Combination						
C5-S-78a	a,e,g	a,c,e,g	a,e,g	a,g	a,g	e,g
C5-S-37e	1,e	c,e	1,e	2	1	1,e

a = maximum draft limited to berth depth
b = inadequate apron width
c = inadequate berth length
d = no straight stern-ramp facilities
e = no container-handling equipment
f = inadequate berth depth, adequate anchorage depth
g = inadequate channel depth
h = no shore-based ramps available
i = insufficient ramp clearance at low tide
j = insufficient ramp clearance at high tide
k = excessive ramp angle at low tide
m = excessive ramp angle at high tide
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

Note: Ramp clearance and ramp angle based on maximum vessel draft.

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Throughput Summary

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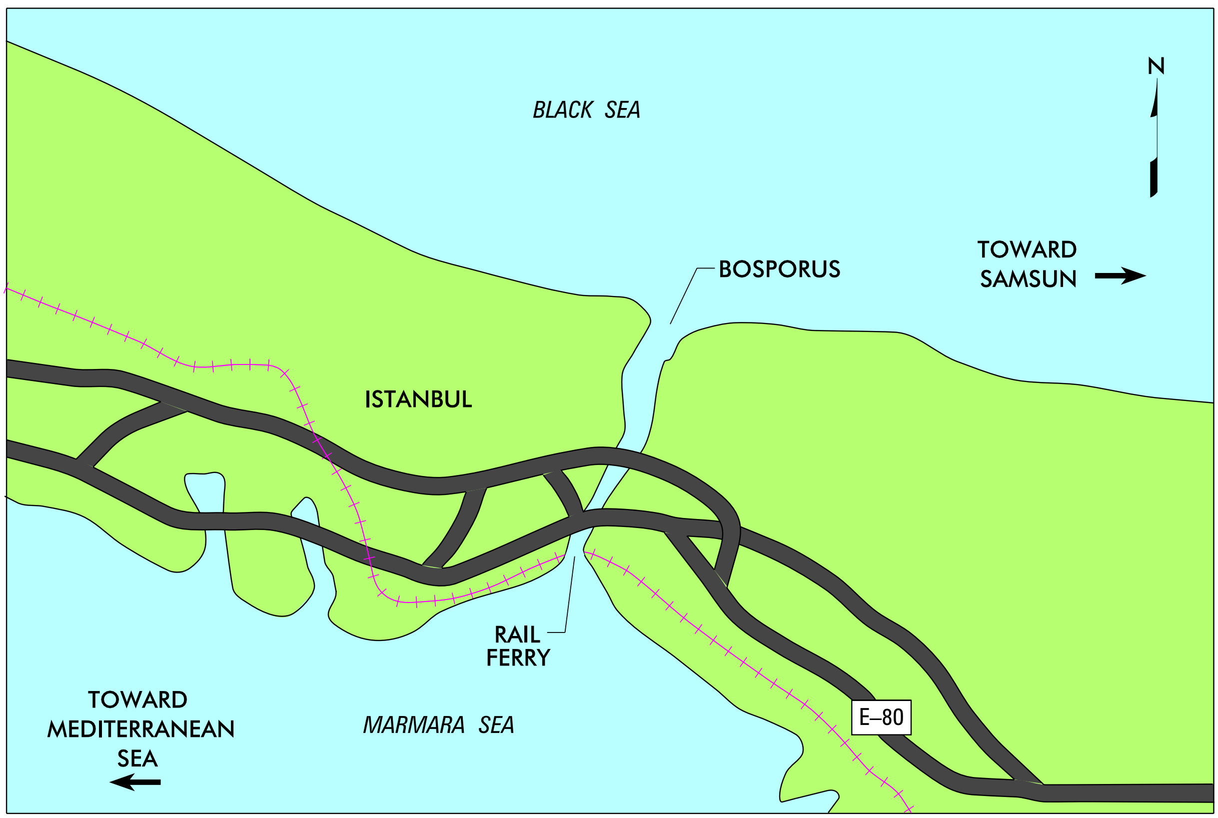
I. GENERAL DATA

TRANSPORTATION ACCESS

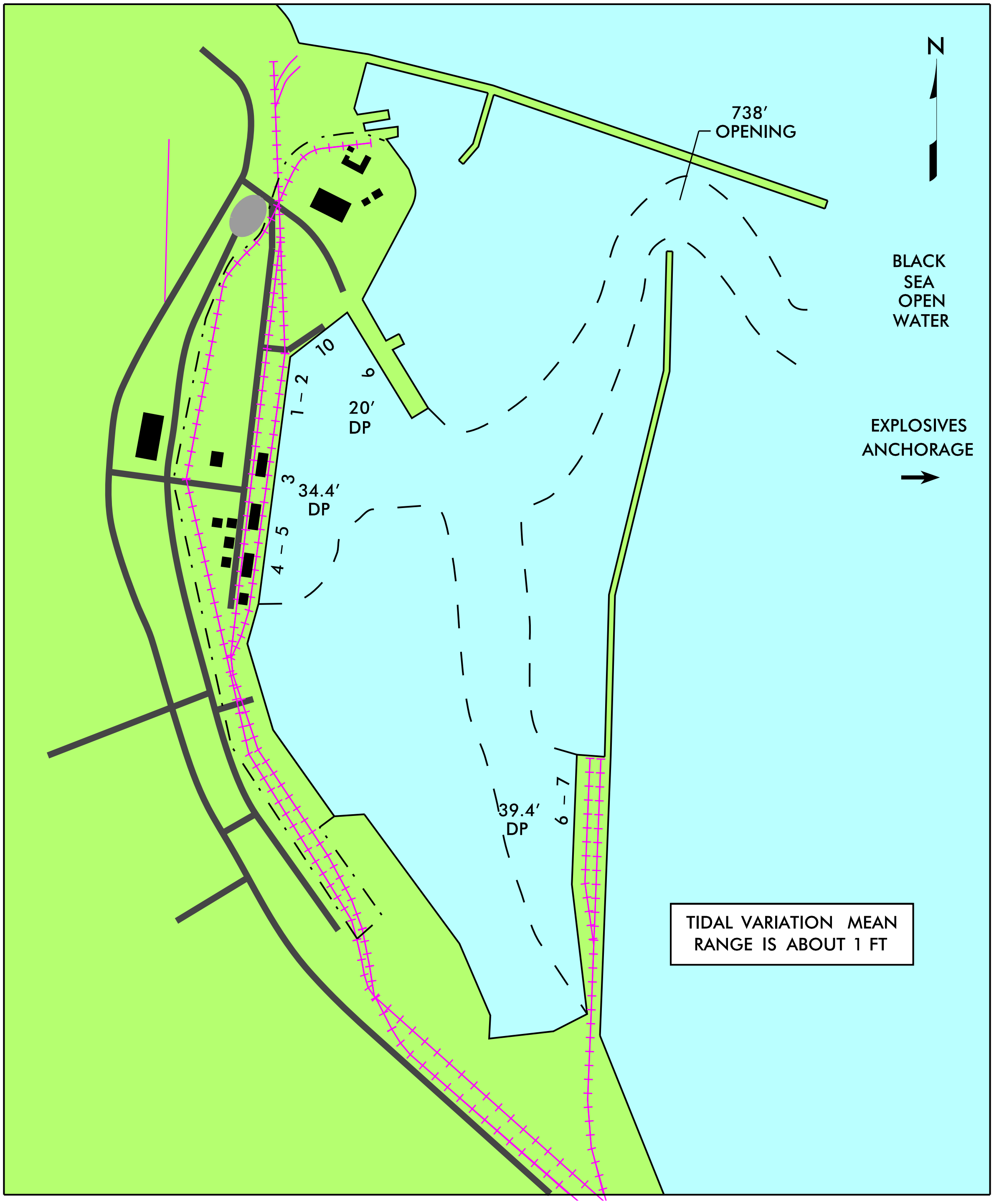
WATER

The Port of Samsun is on the northern coast of Turkey, on the Black Sea. The port is at $41^{o}18'00''$ N Latitude and $36^{o}22'00''$ E Longitude on the southern coast of the Black Sea. Approaching channels have no vertical or overhead restrictions. Cargo ships entering from the Sea of Marmara to the Black Sea, through the straights of Dardarlles and Bosporus cross under bridges and power lines that are about 210 feet above sea level. The channel entering the port is 39 feet at mean low water (MLW).



Passage Through the Bosporus

The water depth for the ship berths ranges from 20 to 35 feet. The port is protected by two breakwaters, 5,182 and 10,273 feet long. The width at the port entrance is 738 feet. Pilotage is required for berthing and undocking. Pilots are available 24 hours a day. An explosives anchorage is also nearby.



Water Access

HIGHWAY

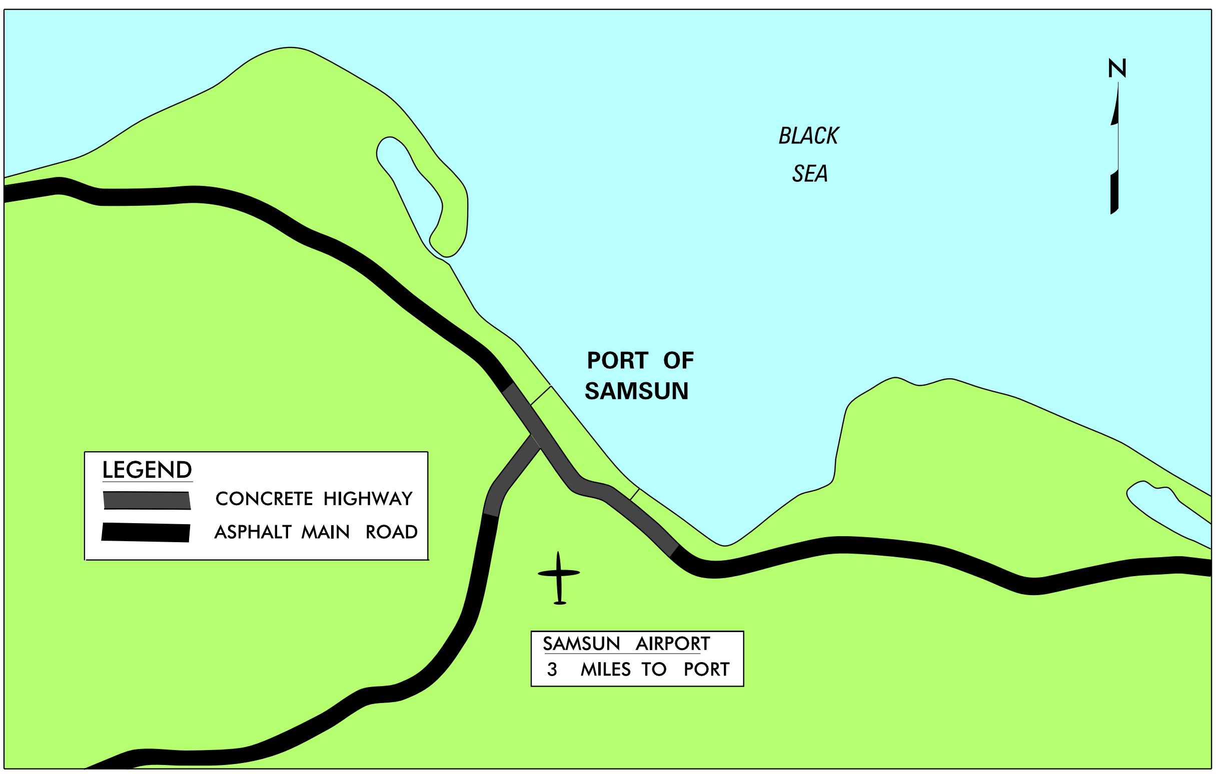
The port is connected with State railways and highways network. Most streets in the port area, except for major roads in and out of Samsun, are narrow and congested. Traffic is heavy most of the day.

The port has only one highway gate, with one lane in each direction. The gate is located off the Black Sea Coastal Highway, which is in excellent condition and is four lanes for the first mile, then it narrows to two lanes northwest to Sinop. It also has two lane access southwest toward Ankara, where it becomes four lanes at the E-88 merge. East of Samsun, along the Black Sea Coastal Highway, the road begins with four lanes. After the first 6 miles, the road narrows to two lanes.

The port has no bridges, ramps, or overhangs that cause height restrictions. All paved areas within the port are hard surfaced and capable of withstanding heavy vehicular traffic. There are no height or weight limits coming out of the port to the main networks.

AIR

The Samsun Airport is about 3 miles southeast of the port. This airport routinely handles small- and medium-sized passenger jets. It has one runway, which is 6,560 feet long.



Air and Highway Access

RAIL

The Turkish State Railways (TCDD) owns and operates the rail line accessing the Port of Samsun. On the average, three trains access the port each day. These trains average 30 railcars in length. TCDD could deliver or remove fifteen 30-railcar trains per day if necessary.

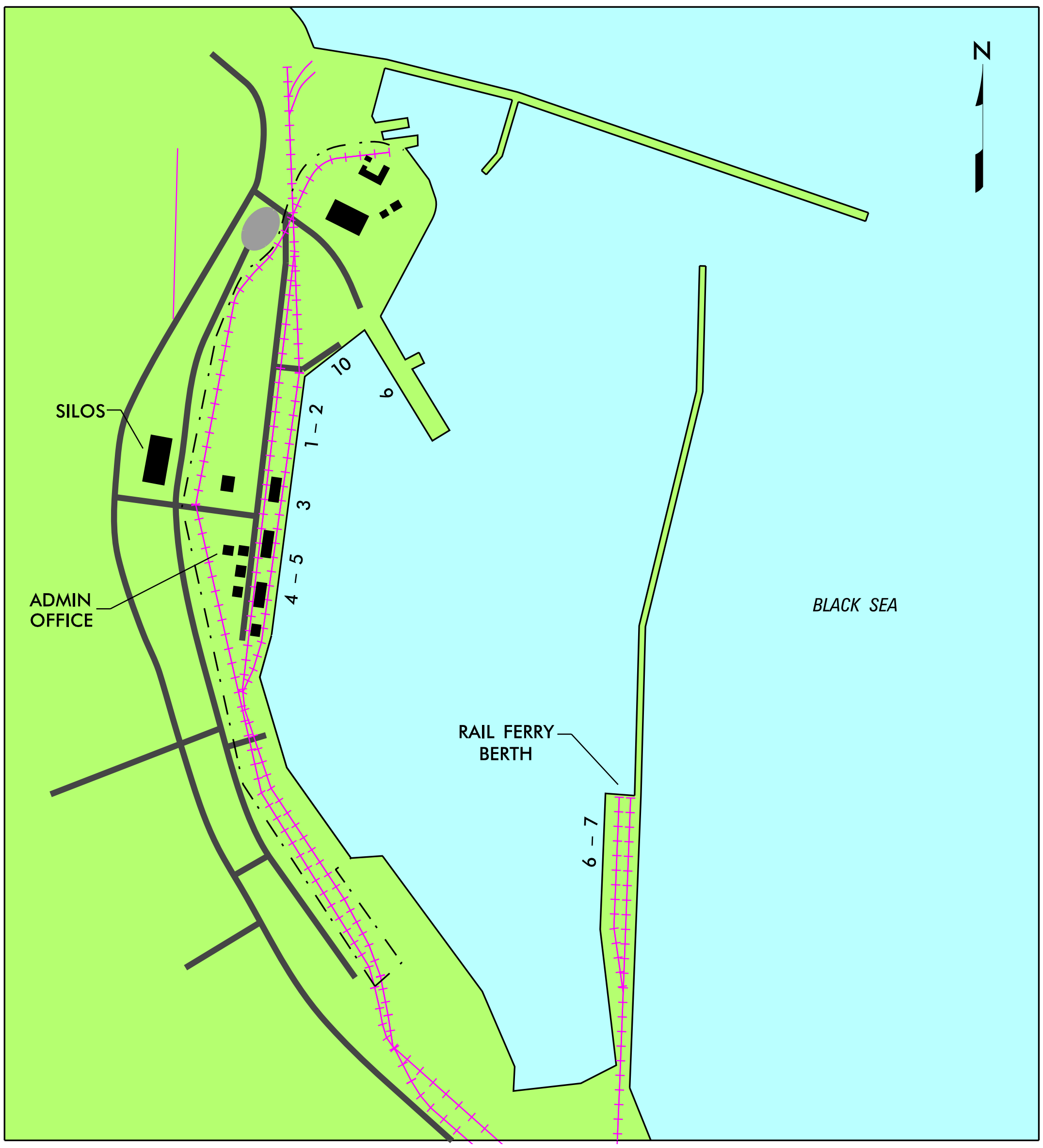
The port has a ship-to-shore bridge system to serve the rail-maritime-highway combined transport from North European countries to Iran, Iraq, and other Middle East countries. The system and the yard behind have been designed according to the mixed ferry boats carrying rail and road vehicles.

Rail Access

PORT FACILITIES

BERTHING

Samsun is a multicargo port, with a container terminal and bulk conveyors and silos. All of the berths at the port are well lighted for night operations. The bulk equipment supports agricultural products brought in by trains. Individual wharves range from 492 to 1,312 feet long. All aprons are at least 50 feet wide and 7 feet above MLW. The chart on the following page shows a list of berth characteristics.



Land-Use Map

Berthing Characteristics

Characteristics	Berths					
	1-2	3	4-5	6-7	9	10
Length (ft)	1,069	492	984	1,312	1,312	590
Depth alongside at MLW (ft)	34	34	34	39	21	20
Deck strength (psf)	614	614	614	614	614	614
Apron width (ft)	75	50	50	50	50	50
Apron height above MLW (ft)	7	7	7	7	7	7
Number of container cranes	0	0	0	0	0	0
Number of wharf cranes	4	3	4	3	2	3
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No	Yes	No
Apron length served by rail (ft)	1,069	492	984	1,312	0	590

Berths 1-5, seen from Berth 9

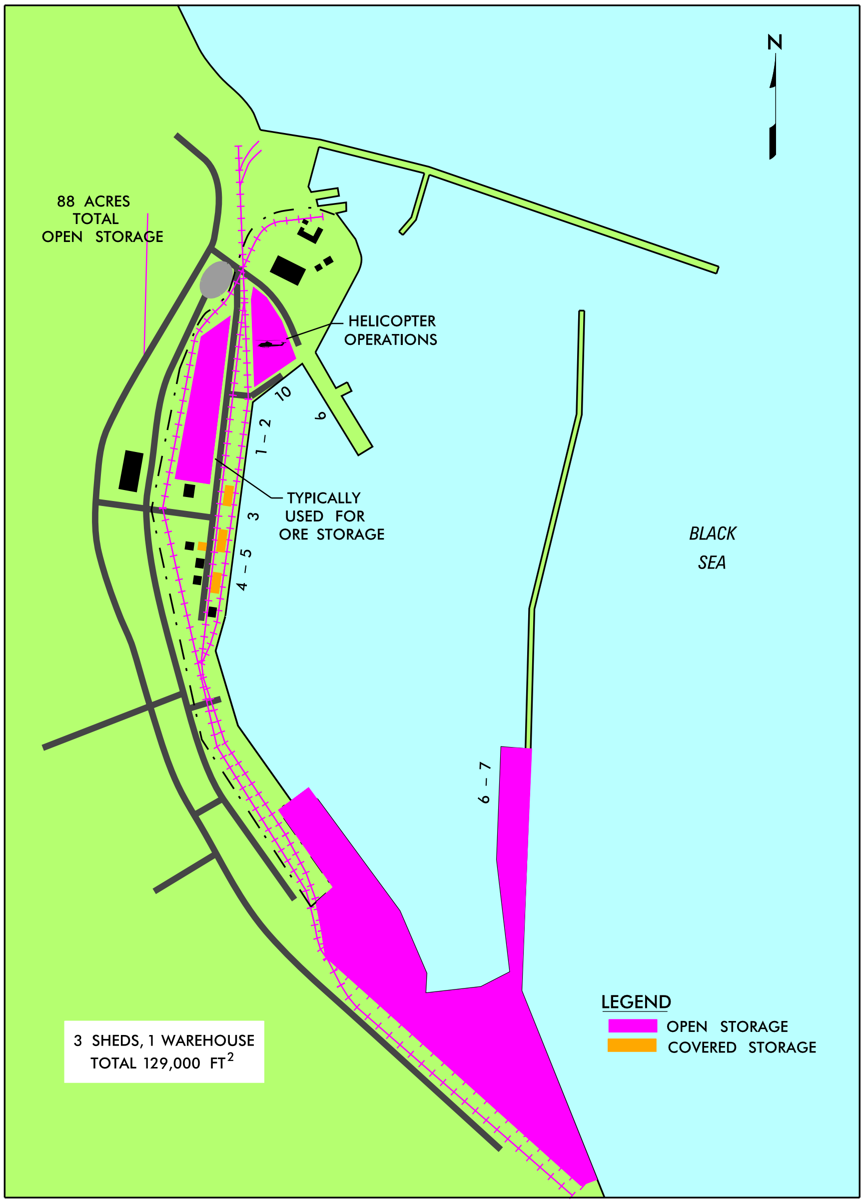
STAGING

Open Staging

The Port of Samsun has about 88 acres of paved open staging area. Berths 1-5 are generally used for bulk cargo and containers. Helicopter operations can be performed at berth 10. Temporary shelters are required to support reduction and shrink-wrapping operation.

Covered Storage

Three transit sheds and a warehouse have a total of about 129,000 square feet of covered storage. The sheds serve berths 1-5. There is also a passenger lounge that can be used as a reception point for incoming personnel.



Covered and Open Staging Areas

RAIL

The port operates a rail ferry to transport railcars between the Turkish rail network and North European countries. A small railyard stores railcars waiting to board the ferry.

Railyards on the port that can store about 200 railcars. Outside of the port is a railyard with additional capacity to store 200 railcars.

Rail lines go out to the rail ferry terminal.

Rail Ferry

Rail Storage

HIGHWAY

There is only one gate to allow trucks in and out of the port. One lane is allocated for each direction. Occasionally trucks stage along the roads leading to the port. The lane widths are 3.5 meters (12 feet).

The port has three truck scales can weigh up to 100 tons. Another 80-ton capacity weighbridge will be in service soon.

UNLOADING /LOADING POSITIONS

Ramps

No ramps are available at the Port of Samsun for truck or railcar unloading operations. However, the port has several locations that can support portable ramp operations (see map in Throughput section). In this analysis we assume the deploying troops can build or acquire two ramps for truck operations and three ramps for railcar operations.

Docks

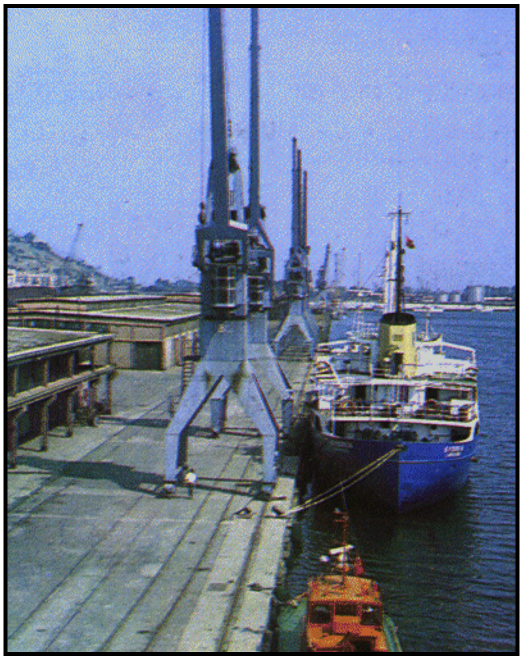
There are no docks for truck or boxcar loading.

Truck Operation

MARSHALING AREAS

Commercial and military cargoes require all of the open storage areas on the port. There is no room for vehicles to marshal on or near the port.

MATERIAL HANDLING EQUIPMENT (MHE)



Wharf Cranes at Berths 1-5

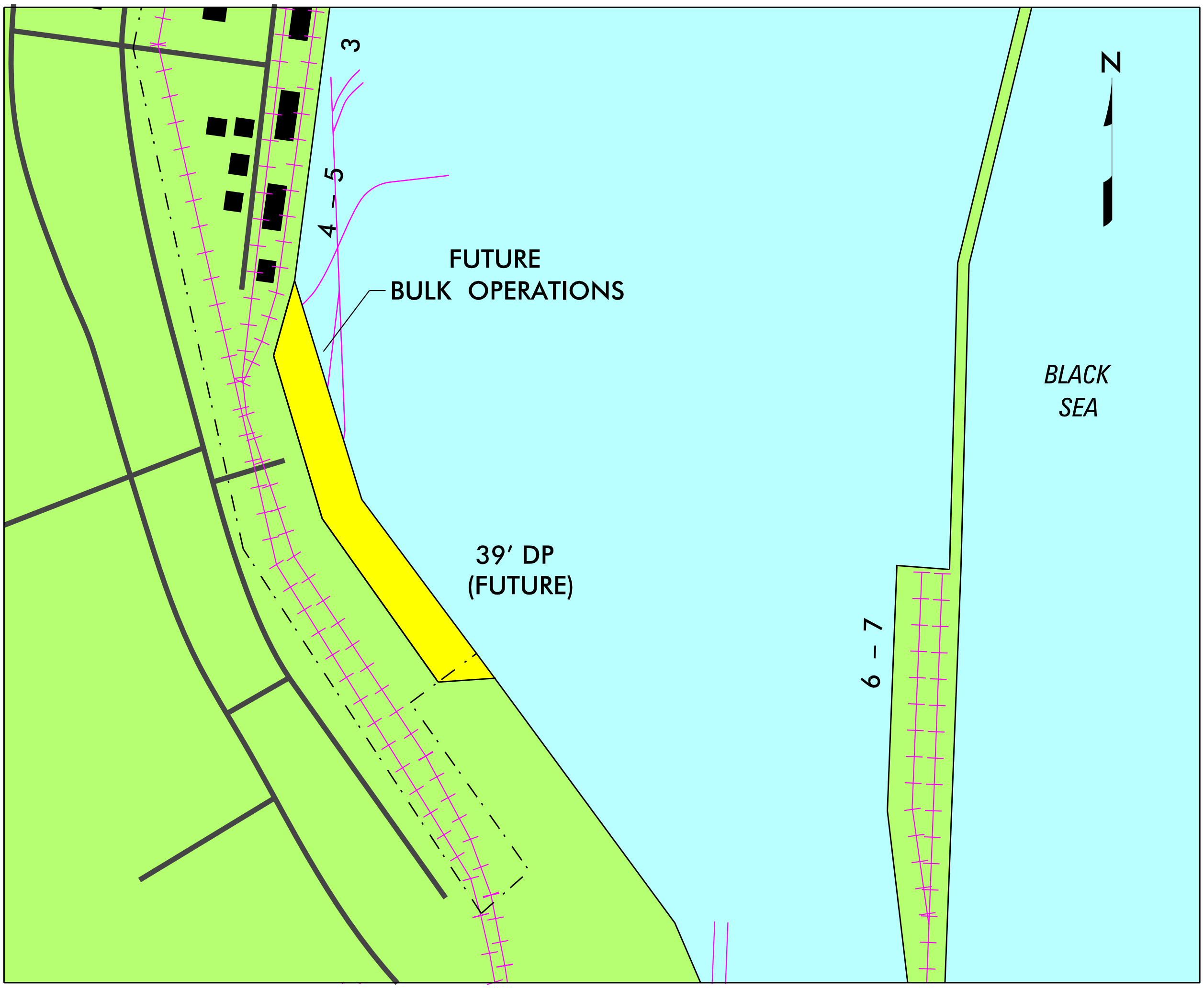
TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY
Wharf Cranes	3-35	17
Mobile Cranes	5-25	8

Mobile crane used for container handling operations.

FUTURE DEVELOPMENT

The port is adding a new bulk cargo quay, currently under construction, with a length of 1,640 feet and a depth of 39 feet.

A rail RORO ship is planned for use between Samsun and Constanza, Romania. Currently, the port uses a truck RORO ship.

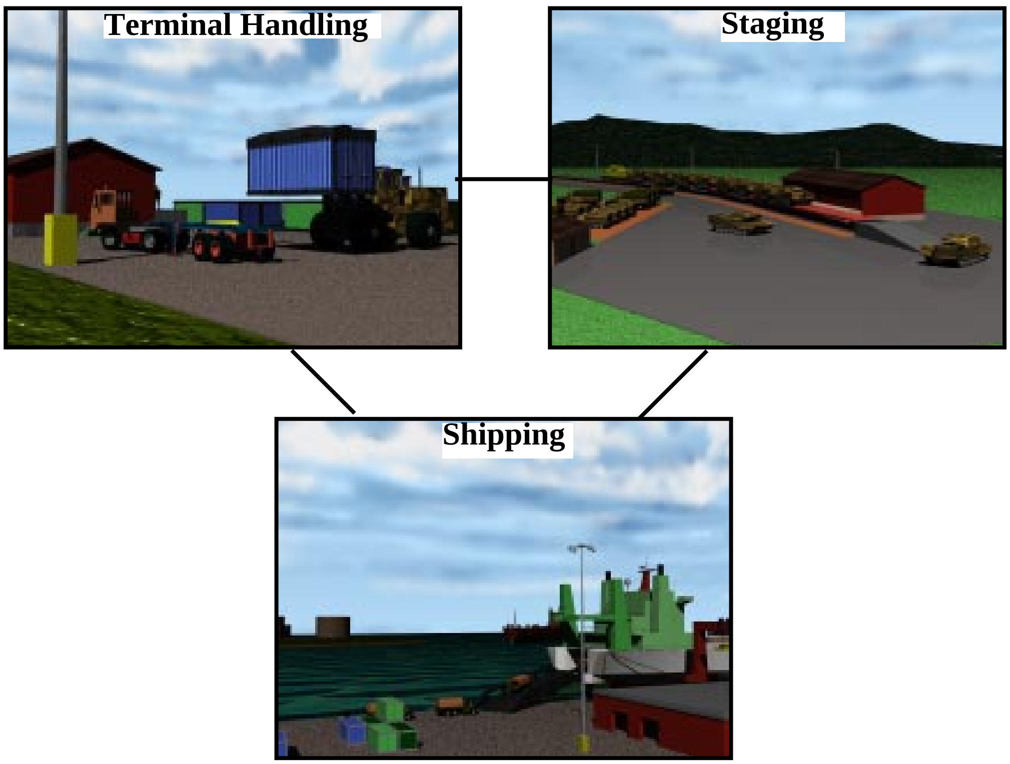


Future Development

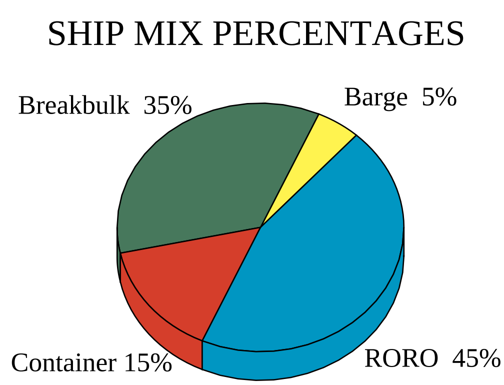
II. THROUGHPUT ANALYSIS

GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Samsun. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



The analysis assumes that 70 percent of the port facilities will support military deployments and that the berths will have ships 95 percent of the time. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL CLEARANCE/HANDLING

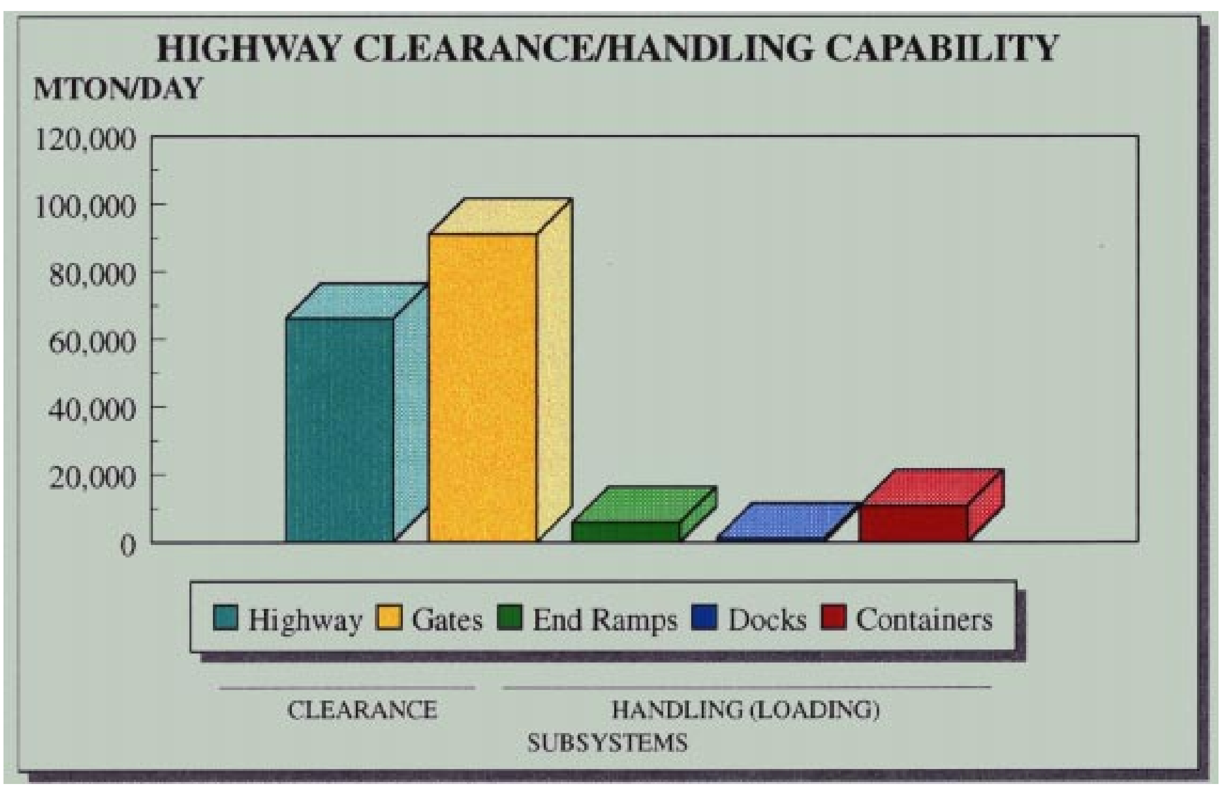
HIGHWAY

The Black Sea coastal highway is the only access leading away from the Port of Samsun. The road network out of the port, including the gate processing of the vehicles, could handle about 42,900 MTON of equipment and supplies per day. The limiting factor is the single gate leading out of the port.

Roadable vehicles in convoys will process out of the port directly from the staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. We assume that troops will build or acquire two portable ramps for flatbed truck and semitrailer operations. These ramps could handle about 5,800 MTON of military vehicles and equipment per day.

The port has no truck docks, and will therefore use ramps to stuff vans. Approximately eight van semitrailers can load simultaneously at various locations throughout the port. With a .60 factor to account for delays resulting from the ramps, these eight loading operations could load about 1,100 MTON per day.

The Port of Samsun has no container handlers available for use. Container on flatcar operations require mobile cranes.



RAIL

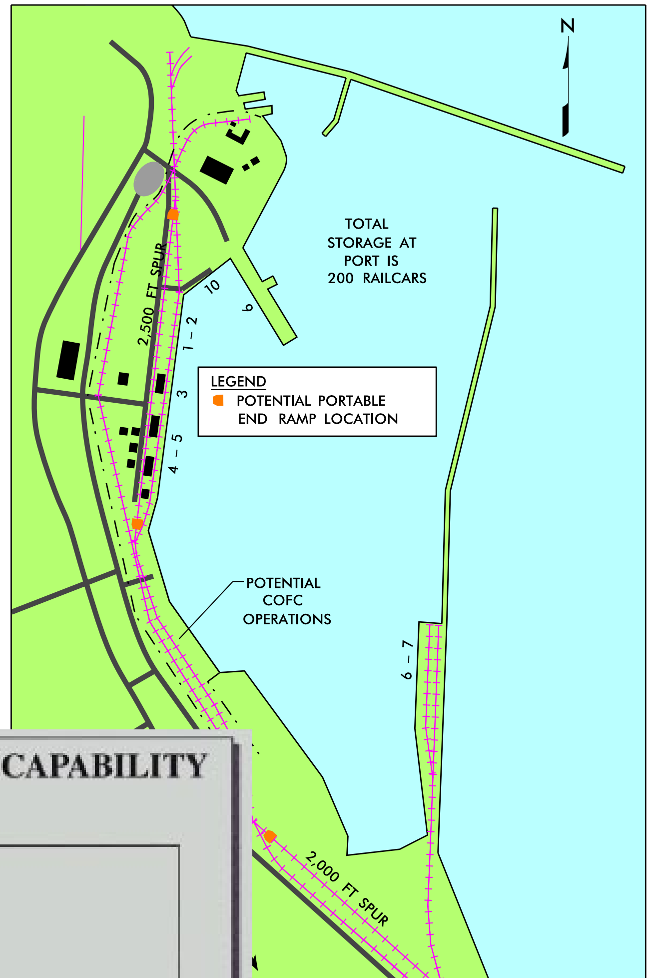
Rail clearance at the port is very good. The TCDD could remove 3 trains of 30 railcars each day if necessary.

Railyards within the port could store about 200 railcars. Outside the port is a railyard that can store 200 railcars. It is generally used for storing and handling agricultural shipments.

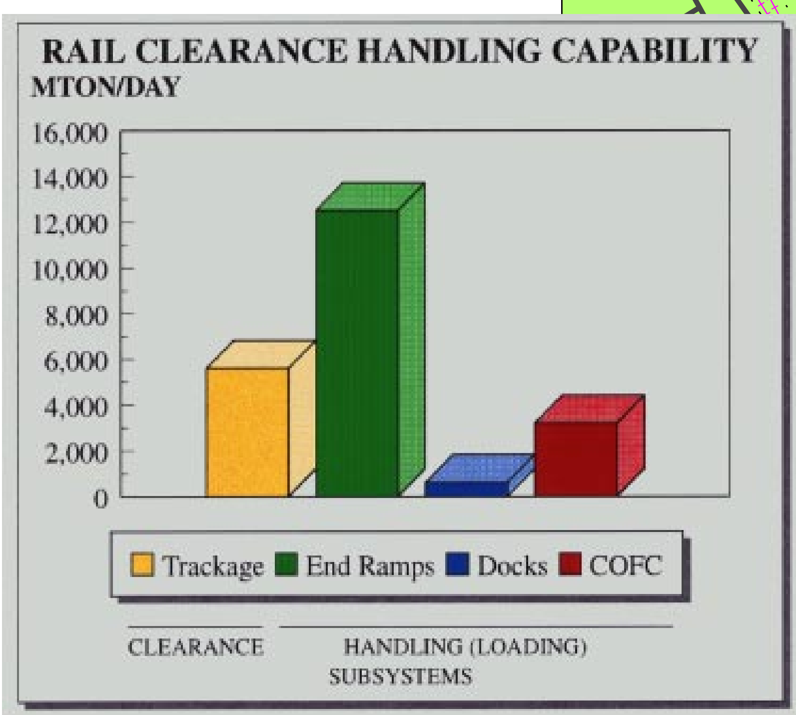
Vehicles on flatcars would require portable end ramps to load. We assume the troop would build or acquire two portable end ramps. Suggested locations for the ramps are shown in the map to the righ

Equipment or supplies in boxcars, like van semitrailers, would require ramps for loading. Since the port has no boxcar handling docks, forklifts would access the boxcars with portable ramps. Because of this, we used a 60 percent facility-use factor.

The Port of Samsun has n container handlers available for use. Container-on-flatcar (COFC) operations require mobile cranes.



Port Rail Facilities

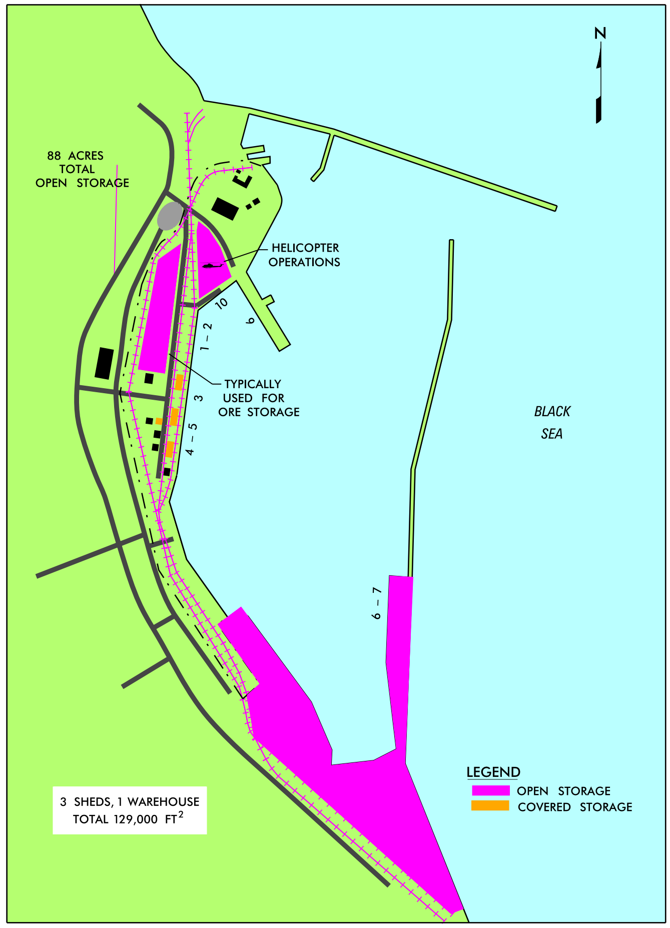


STAGING

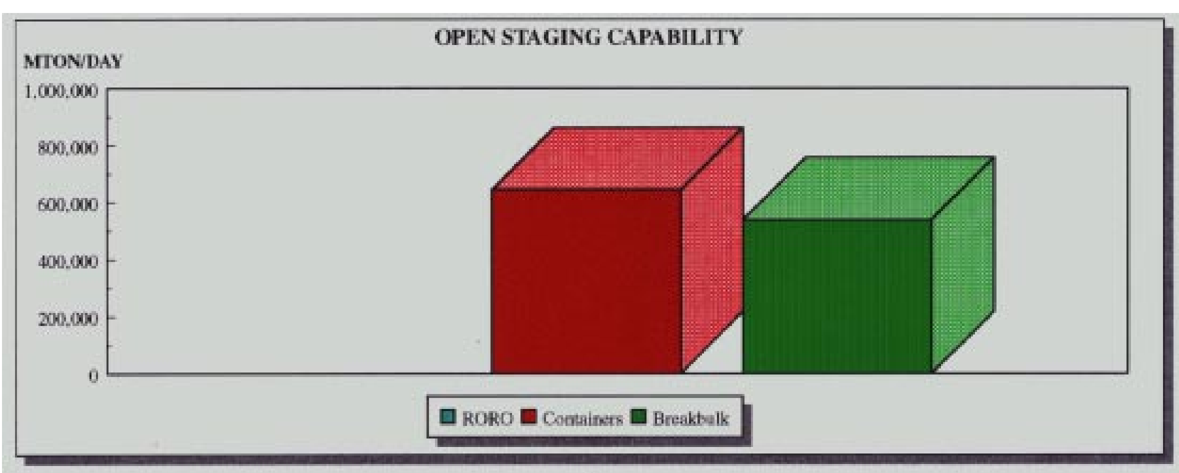
The port has about 88 acres of paved open staging that could support military operations. Most of the acreage is regularly used for containers.

Together, the three sheds and the four warehouses have about 129,300 square feet of covered storage. The building along the wharf at berth 5 supports passenger services and cannot be used for covered storage.

The port can perform operations on container or breakbulk ships. Although European ferries have berthed at the port, these ships are not normally used to move military cargo. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned. The chart below provides the staging capability for the cargo for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.

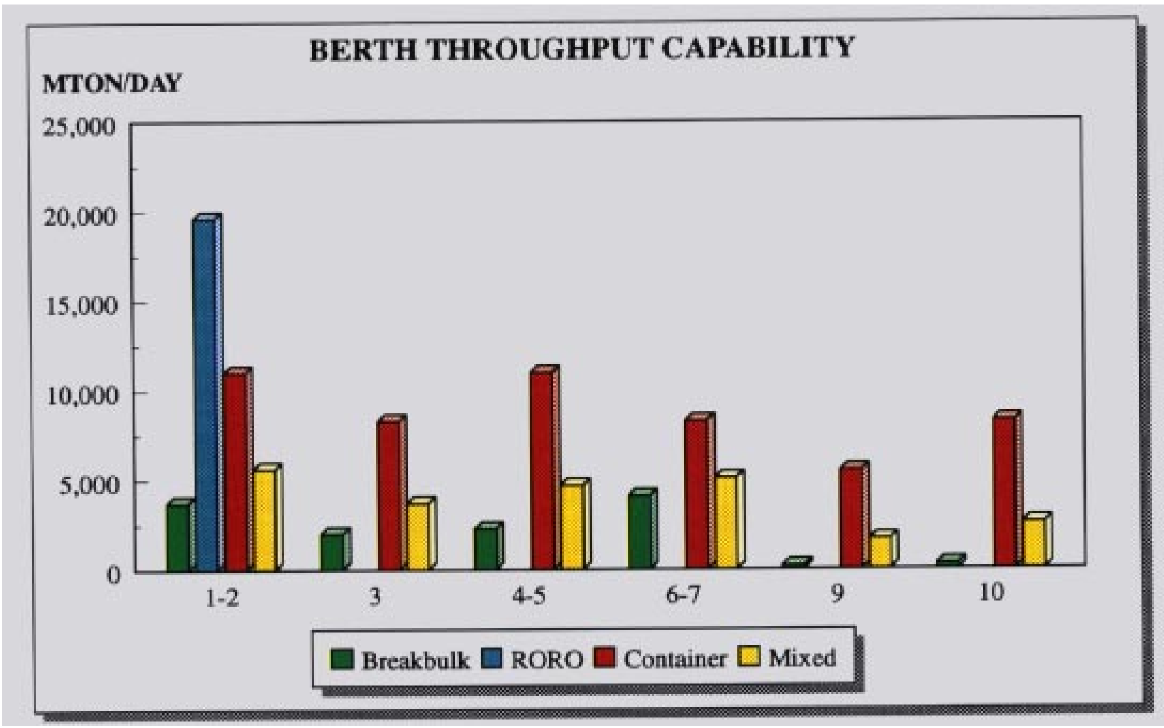


Covered and Open Staging Areas



SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. Berths 9 and 10 are too short for any ship to berth. They can only be used for barge loading. For this reason we did not consider them for throughput.



CONVERSION FACTORS

Breakbulk:	.4	STON per MTON
RORO:	.25	STON per MTON
Containers:	.4	STON per MTON

The type of ship preferred at each berth is based on the methodology described in the appendix. The evaluation is a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better it is suited for loading or unloading operations.

Cygnus/Pilot class and ***American Eagle*** class RORO vessels can unload at berths 3-5 provided the stern ramp is placed between sheds. Berth 1-2 can support FSS and LMSR operations.

LOADING TYPE	**BERTHS**					
	1-2	**3**	**4-5**	**6-7**	**9**	**10**
Breakbulk	2	-	2	1	-	-
RORO	1	-	2	2	-	-
Container	2	4	3	1	-	-
Note: Berths marked with a "-" are not recommended for these operations.						

No one berth is ideal for all military operations. The best berth depends on the type of ship to be loaded.

SUMMARY OF BERTHING CAPABILITIES OF SAMSUN

Vessel	Berths					
	1-2	3	4-5	6-7	9	10
Breakbulk						
C3-S-33a	2	1	1	2	a	a
C3-S-37c	2	c	1	2	a	a
C3-S-37d	2	c	1	2	a	a
C3-S-38a	2	1	1	2	a	a
C4-S-1a	1	c	1	2	a	a
C4-S-1qb and 1u	1	c	1	2	a	a
C4-S-58a	1	c	1	2	a	a
C4-S-65aa,b	1	c	1	2	a	a
C4-S-66a	1	c	1	2	a	a
C4-S-69b	1	c	1	2	a	a
Seatrain						
GA and PR-class	1	c	1	2	a	a
Barge						
LASH C8-S-81b	a,f	a,c,f	a,f	1	a,f	a,c,f
LASH C9-S-81d	a,g	a,c,g	a,g	g	a,g	a,c,g
LASH lighter	7	3	7	9	9	4
SEABEE C-S-82a	a,g	a,c,g	a,g	g	a,g	a,c,g
SEABEE barge	5	2	4	6	6	2
RORO						
Comet	2,d,i	c,d,o	d,o	d,o	a,i	a,d,o
C7-S-95a/Maine-class	i	b,c	b	b	a,b	a,b,c
Ponce-class	b,h	b,c,h	b,h	b,h	a,b,h	a,b,c,h
Great Land-class	b,h	b,c,h	b,h	b,h	a,b,h	a,b,c,h
Cygnus/Pilot-class	l	b,c	b	b	a,b	a,b,c
Meteor	d,o	c,d,o	d,o	d,o	a,i,j	a,d,o
AmEagle/Condor	l,i	b,c	b	b	a,b	a,b,c
MV Ambassador	d	c,d	d	d	k,m	a,d
FSS-class	l,n	b,c	b	b	a,b	a,b,c
Cape D-class	1,i	b,c	b	b	a,b	a,b,c
Cape H-class	a	a,b,c	a,b	b	a,b	a,b,c
LMSR	1	b,c	b	b	a,b	a,b,c
Container						
C6-S-1w	1,e	c,e	1,e	1,e	a,e	a,c,e
C7-S-68e	1,e	c,e	1,e	1,e	a,e	a,c,e
C8-S-85c	1.e	c,e	1,e	1,e	a,e	a,c,e
Combination						
C5-S-78a	1,e	c,e	1,e	2,e	a,e	a,c,e
C5-S-37e	1,e	c,e	1,e	2,e	a,e	a,c,e

a = maximum draft limited to berth depth
b = inadequate apron width
c = inadequate berth length
d = no straight stern-ramp facilities
e = no container-handling equipment
f = inadequate berth depth, adequate anchorage depth
g = inadequate channel depth
h = no shore-based ramps available
i = insufficient ramp clearance at low tide
j = insufficient ramp clearance at high tide
k = excessive ramp angle at low tide
m = excessive ramp angle at high tide
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

Note: Ramp clearance and ramp angle based on maximum vessel draft.

I. General Data

II. Throughput Analysis

Throughput Summary

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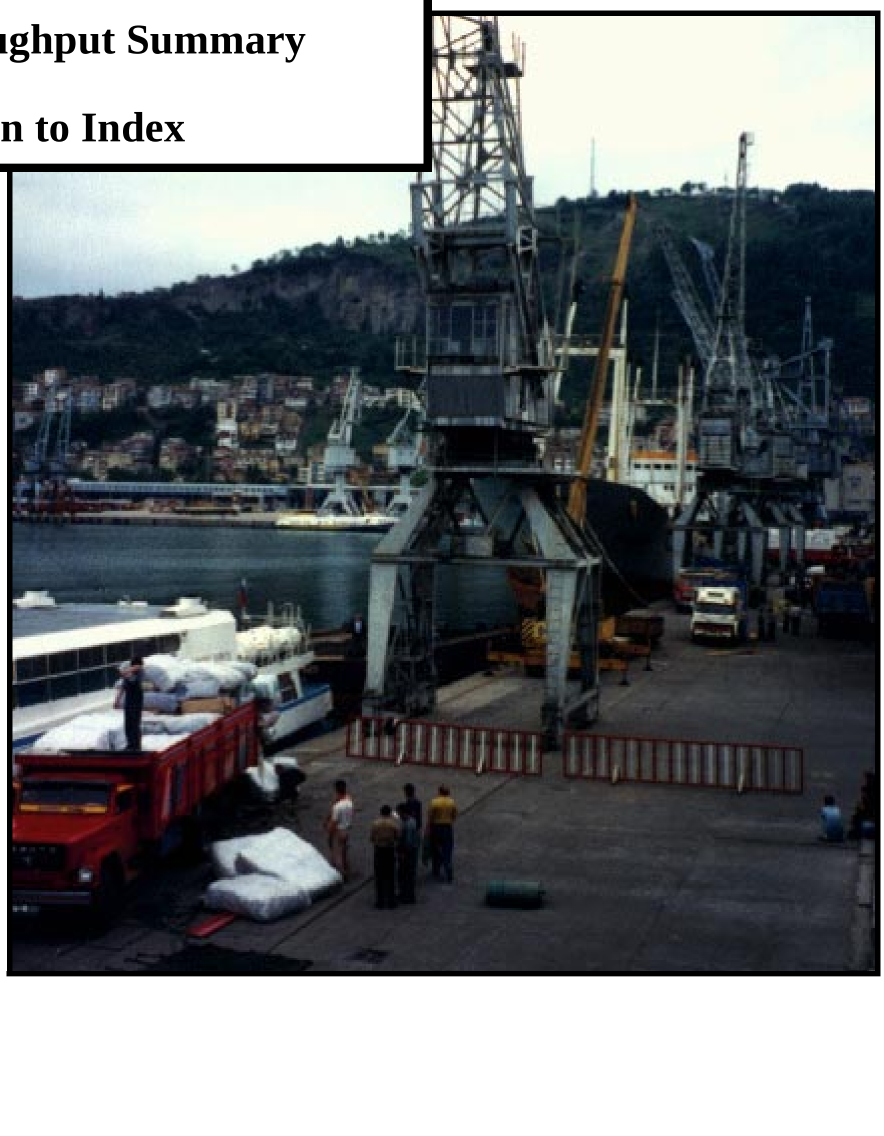


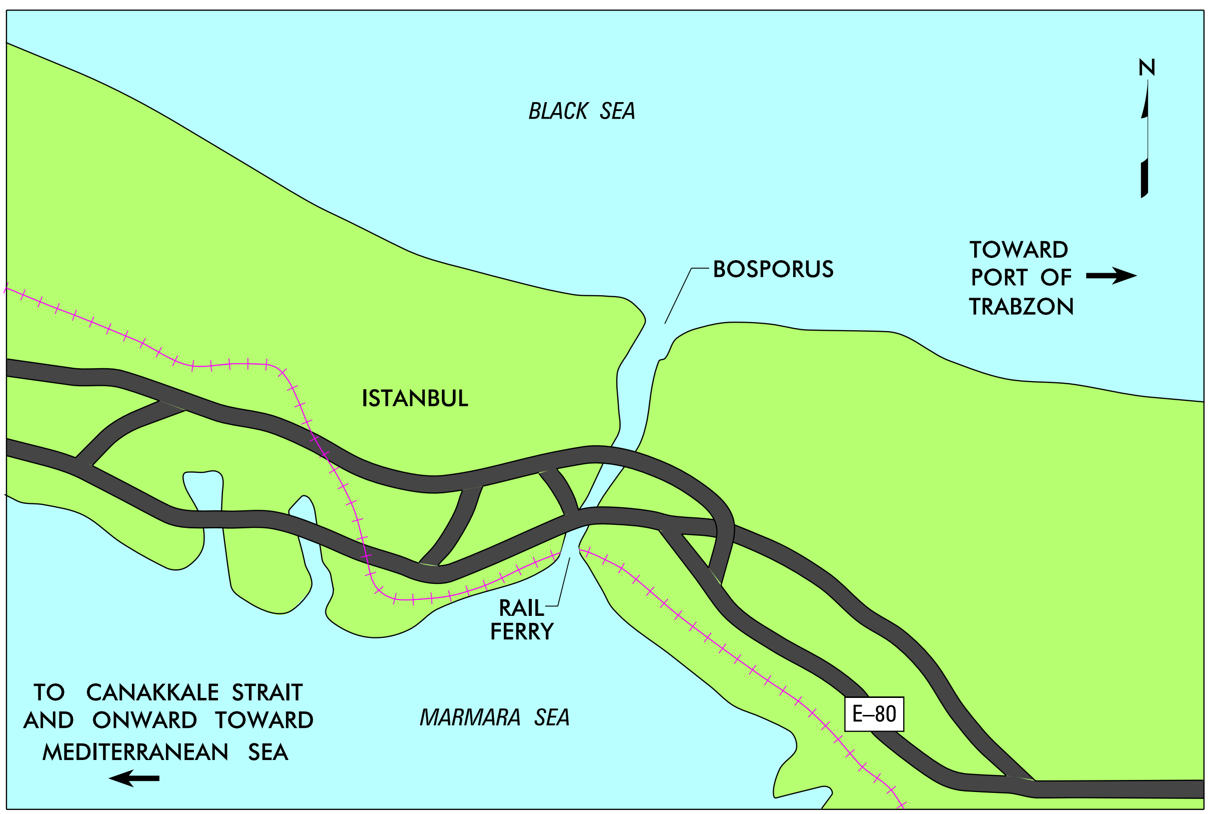
I. GENERAL DATA

TRANSPORTATION ACCESS

WATER

The Port of Trabzon is on the northeast of Turkey, on the Black Sea coast. The port is at 41^{o}00’15" N Latitude and 39^{o}48’07" E Longitude. Of the six Turkish ports in this report, the Port of Trabzon is the only one that is not under the control of the Turkish State Railways office. It is one of the few Turkish ports operated by the Turkish Maritime Organization. It has no rail facilities. The channel entering the port is only 31.1 feet deep at mean low water (MLW). Water depths at the ship berths range from 29.5 to 36 feet MLW. Pilotage is required for berthing and undocking. Pilots are available 24 hours a day.

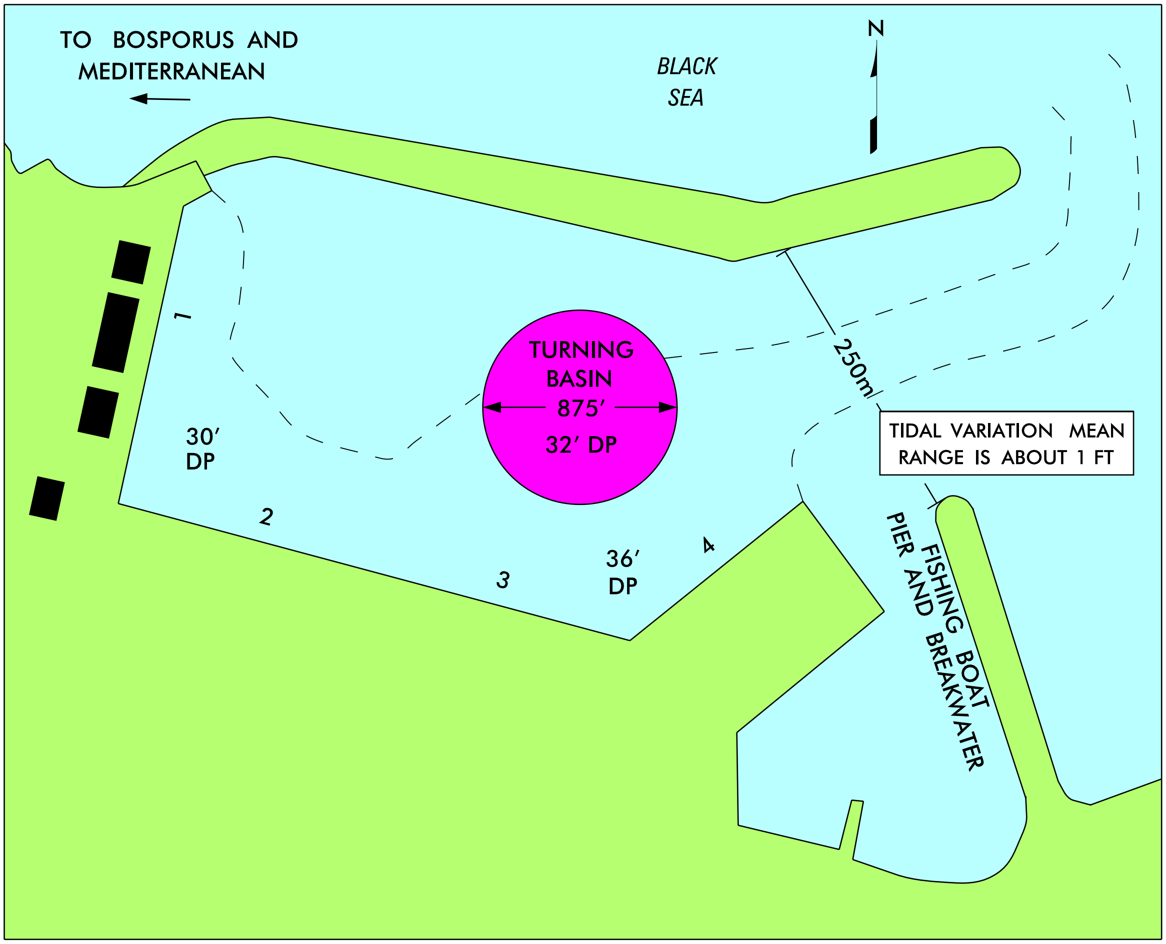
Water access to the port is more difficult than that of Izmir, Iskenderun, and Mersin. For ships to get to the Port of Trabzon, they must first pass Dardarelles through the Marmara Sea and the Bosporus as they pass Istanbul. Ships pass under two bridges, but none cause any restriction.



Ships pass through the Bosporus

Anchorage is in the Outer Harbor just outside the breakwater.

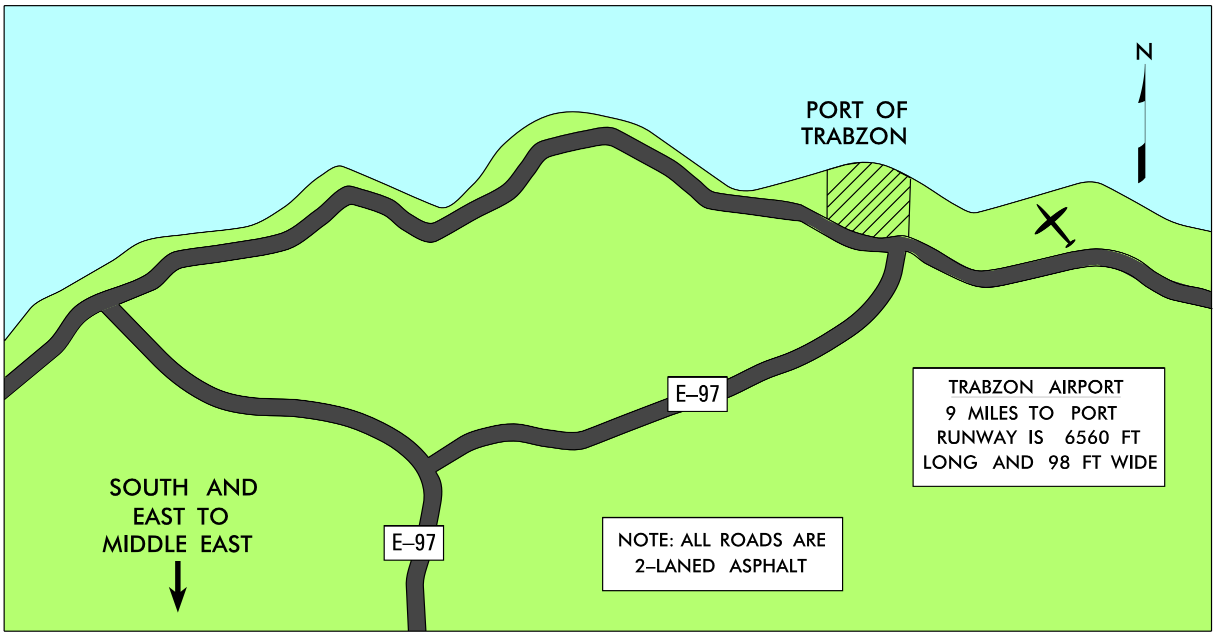
Ships that are less than 820 feet long can turn within the port. Longer ships must turn in the Outer Harbor.



Water Access

HIGHWAY

The port has only one highway gate, with one inbound and one outbound lane. The gate is located off the Black Sea Shoreline Road and the Iran Transit Road. The Black Sea Shoreline Road is primarily a two-lane road that runs along the north coast of Turkey. Often traffic has the edge of mountains to the inland side and a steep cliff on the Black Sea side, with no guard rails.



Highway and Air Access

AIR

The Trabzon Airport is about 9 miles east of the port. Its only runway is 6,560 feet long and 98 feet wide. Most traffic is domestic, but charter flights frequently fly international travelers.

RAIL

There is no rail accessing the Port of Trabzon. The port hopes to eventually have a rail route along the coast of the Black Sea, into the former Soviet Union State of Georgia, and southward into the Middle East countries.

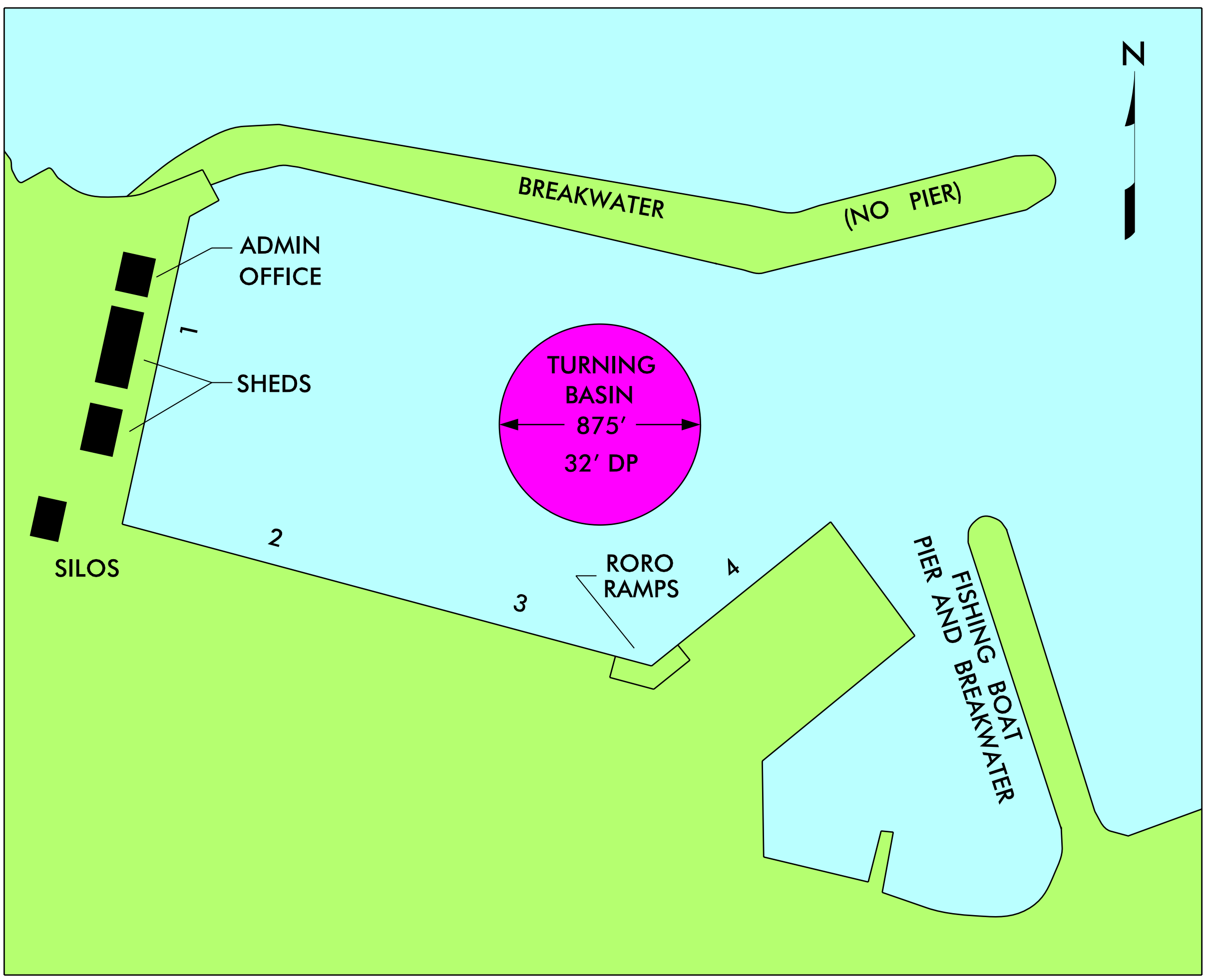
PORT FACILITIES

BERTHING

Trabzon is a 35-year-old multicargo port. It supports a daily passenger and roll on/roll off (RORO) ferry to Georgia, and occasionally handles containers with its wharf or mobile cranes.

All of the berths at the Port of Trabzon are well lighted for night operations.

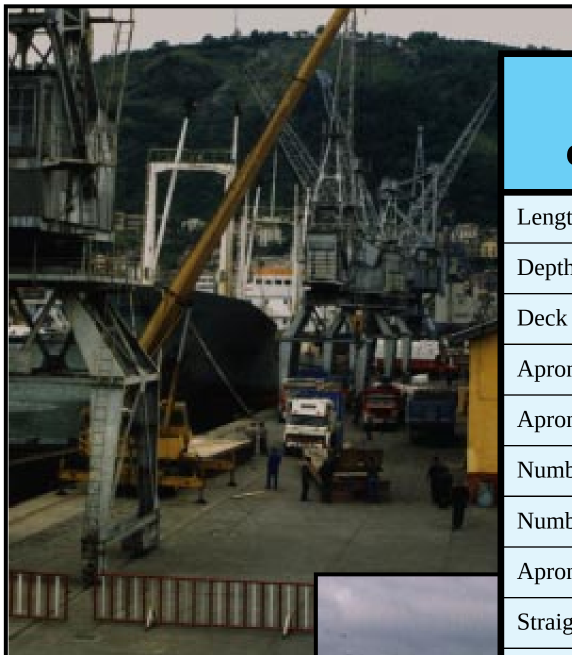
The three wharves in this report range from 951 to 1,902 feet in length. The port includes a very narrow pier with shallow water on both sides, on the east end. These shallow berths are only used for fishing boats, and are of no interest to military operations. The berths in this analysis are at least 40 feet wide. The aprons are only 6.23 feet above the water at MLW.



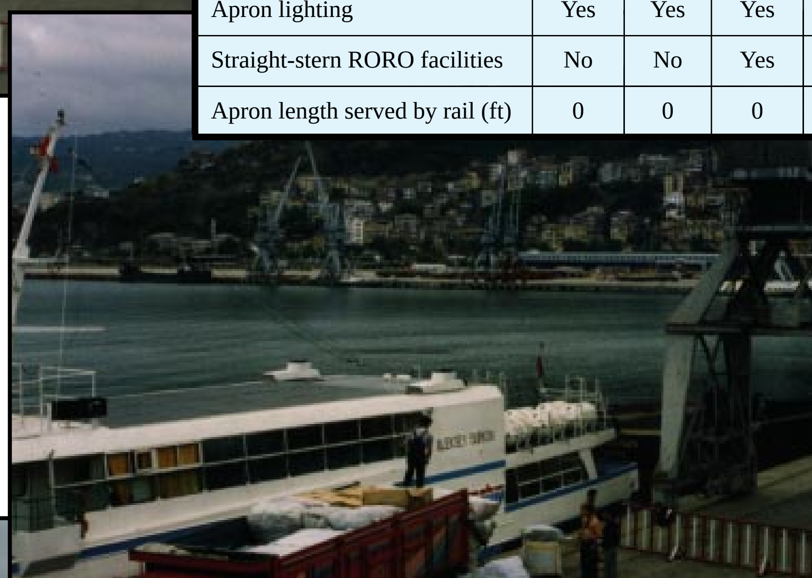
Land-use Map

Berthing Characteristics

Characteristics	Berths			
	1	2	3	4
Length (ft)	1,312	984	918	951
Depth alongside at MLW (ft)	30	30	30	36
Deck strength (psf)	614	614	614	614
Apron width (ft)	40	Open	Open	Open
Apron height above MLW (ft)	6	6	6	6
Number of container cranes	0	0	0	0
Number of wharf cranes	3	2	2	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	Yes	Yes
Apron length served by rail (ft)	0	0	0	0



Narrow Apron at Berth 1



Berth 2-3 seen from Berth 1

RORO Ramps seen from Berth 3

STAGING

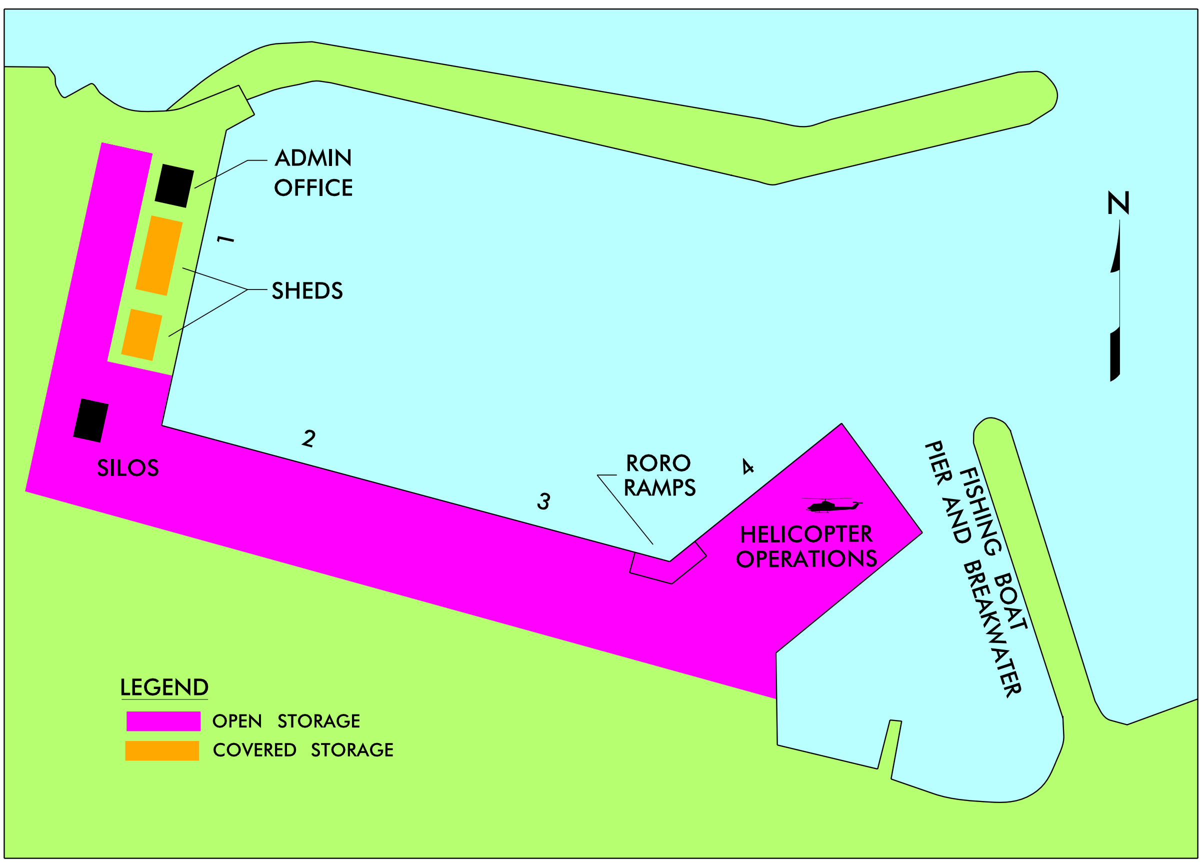
Open Staging

The Port of Trabzon has about 74 acres of paved open staging area. Most of it is available at any given time. Since the trade embargo resulting from the Desert Storm/Desert Shield War, traffic through the port has been very slow.

Helicopter operations may take place on the apron to the southeast of berth 4. The apron has three lighting poles that might hinder helicopter landing and departing. For redeployment, we recommend towing the helicopters into the sheds, after the rotor blades have been removed. These sheds can support further reduction and shrink wrapping. This arrangement is very efficient if the redeployment shiploading is done near the sheds, at berth 1.

Covered Storage

Two transit sheds have a total of 33,000 square feet of covered storage. Both sheds serve berth 1.



Staging Areas

RAIL

There is no rail access or facilities at the Port of Trabzon.

HIGHWAY

There is only one gate to allow trucks in and out of the port. One 12-foot lane is allocated for each direction.

The port has no bridges, ramps, or overhangs that cause height restrictions for cargo on trucks or trailers. All paved areas within the port are hard surfaced and capable of withstanding heavy vehicular traffic. There are no height or weight limits leading to the main highway networks.

The port has two truck scales.

UNLOADING /LOADING POSITIONS

Ramps

There are no ramps at the Port of Trabzon for truck operations. We recommend deploying troops build or acquire portable truck end ramps for these operations.

Docks

There are no docks for van or semitrailer loading. Portable ramps must be used for the forklifts to enter and exit the vans.

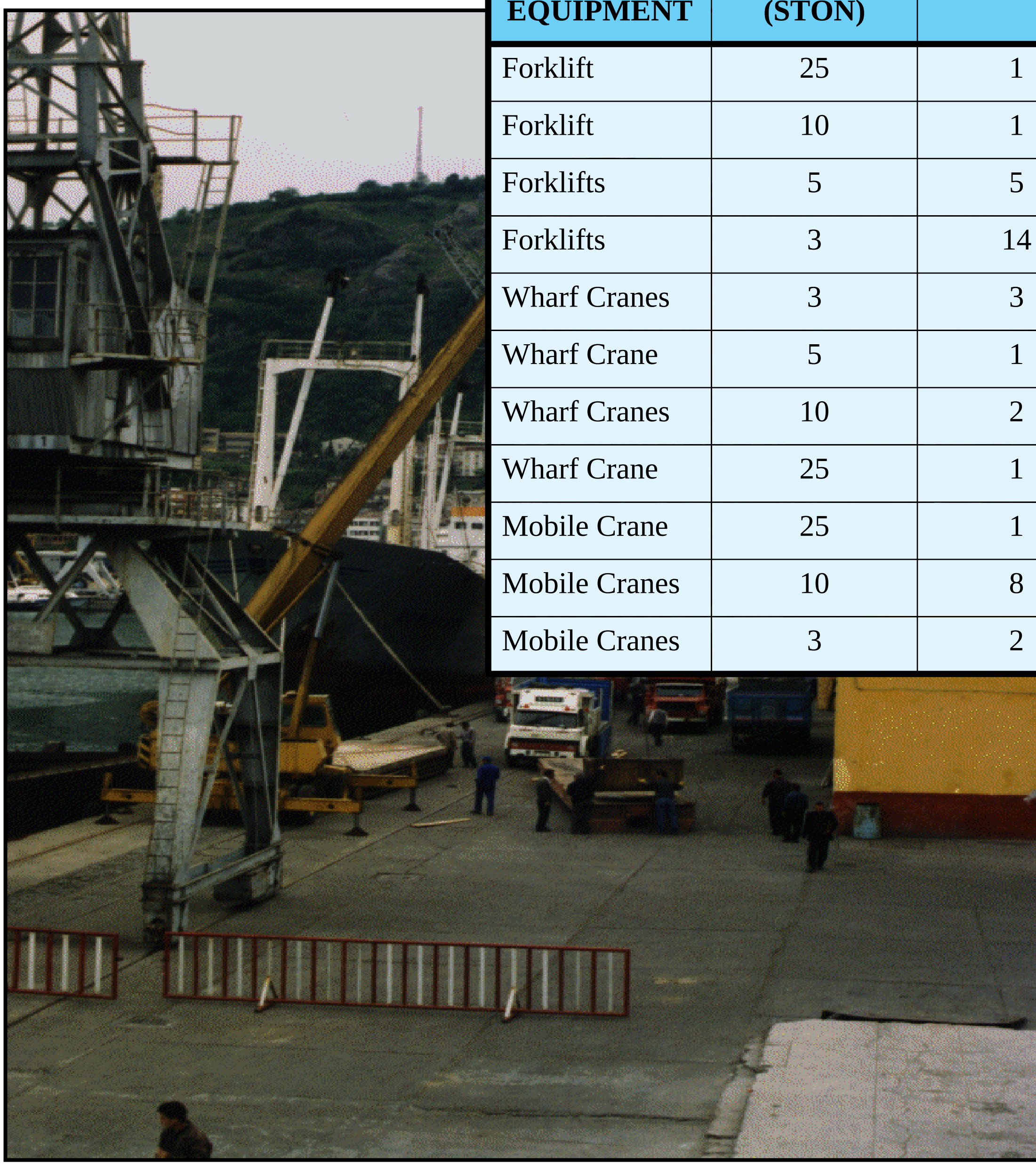
Truck Operations Inland of Berth 1

MARSHALING AREAS

All of the open storage areas on the port are required to support staging of commercial and military cargo. There is no room for vehicles to marshal in or near the port. The city of Trabzon is highly developed, and mountains begin within a mile inland of the port.

MATERIAL HANDLING EQUIPMENT (MHE)

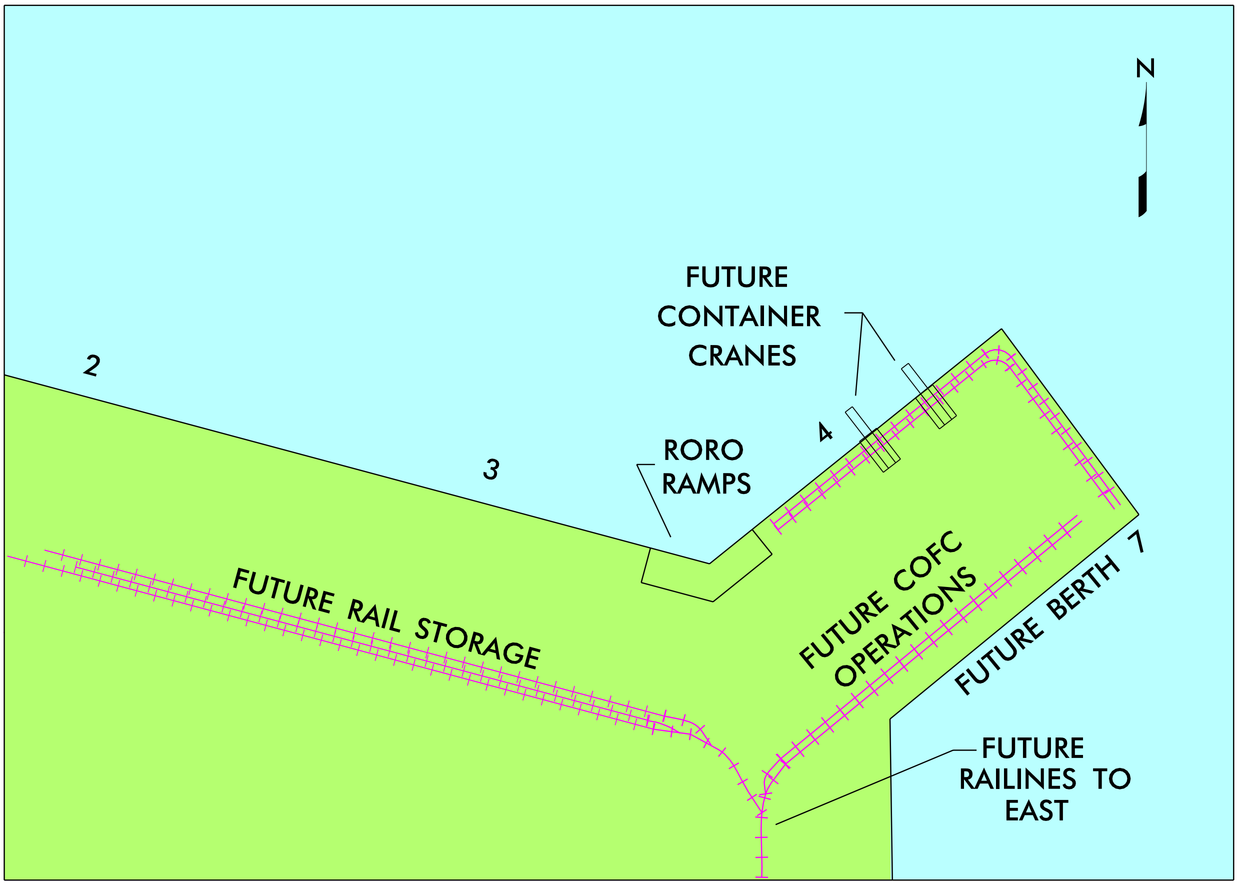
TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY
Forklift	25	1
Forklift	10	1
Forklifts	5	5
Forklifts	3	14
Wharf Cranes	3	3
Wharf Crane	5	1
Wharf Cranes	10	2
Wharf Crane	25	1
Mobile Crane	25	1
Mobile Cranes	10	8
Mobile Cranes	3	2



Wharf Cranes and a Mobile Crane at Berth 1

FUTURE DEVELOPMENT

The port plans to lease two 45- or 50-ton container cranes to install at berth 4. Container handlers will assist with chassis operations. Plans are to provide rail access into the port, and along the Black Sea coast into Georgia and southward to the Middle East countries. The port hopes to have double stack container trains access the port within 5 years.

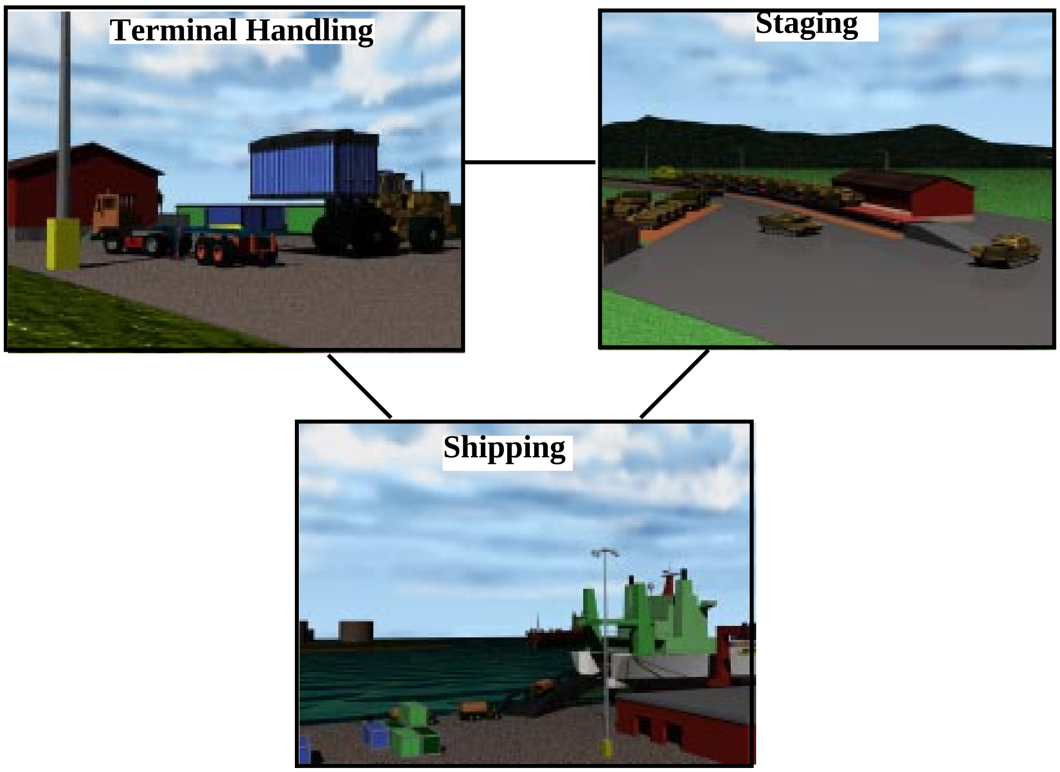


Future Development

II. THROUGHPUT ANALYSIS

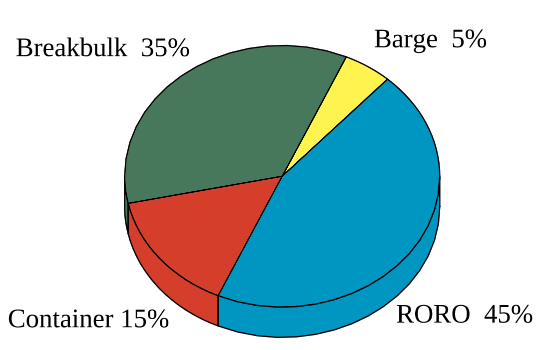
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Trabzon. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of measurement tons (MTON) per day.



The analysis assumes that 70 percent of the port facilities will support military deployments, and that the berths will have ships 95 percent of the time. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.

SHIP MIX PERCENTAGES



TERMINAL CLEARANCE/HANDLING

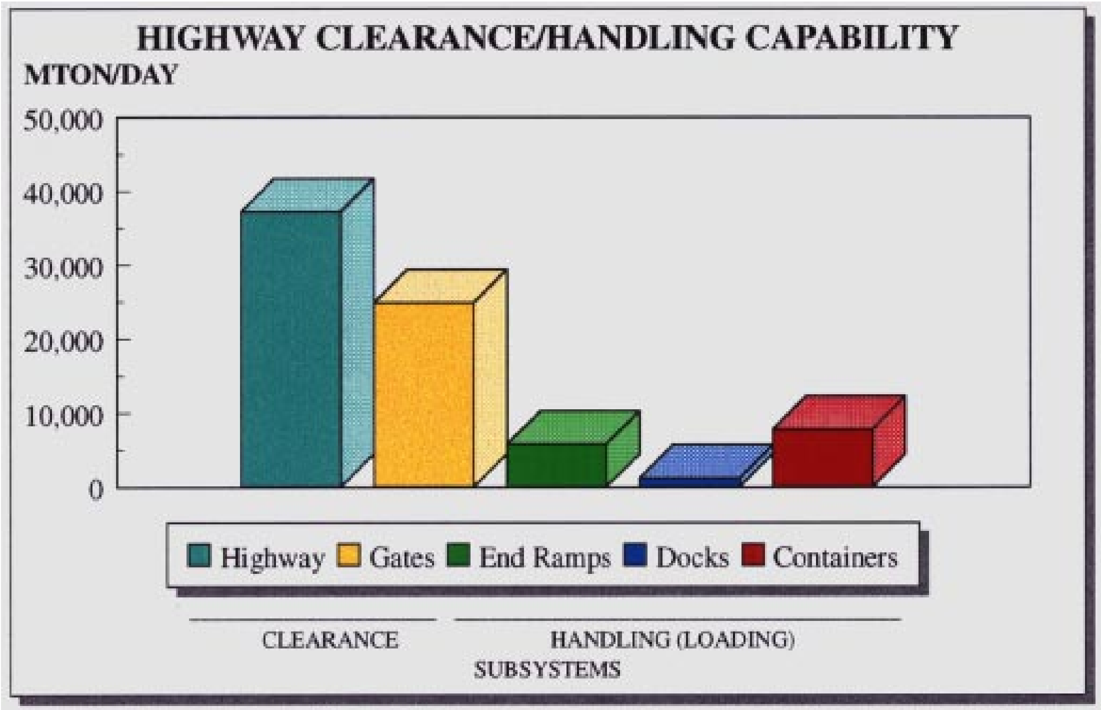
HIGHWAY

The Black Sea Shoreline Road is the main highway that leads away from the Port of Trabzon. The road network out of the port, including the gate processing of the vehicles, could handle only 25,000 MTON of equipment and supplies per day. The limiting factor is the single gate with one lane leading out of the port. This gate forms a bottleneck when military cargo tries to leave the port along with the commercial cargo.

Roadable vehicles in convoys will process out of the port directly from the staging areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps to load. We assume that troops will build or acquire two portable ramps for flatbed truck and semitrailer operations. These ramps will handle about 5,800 MTON of military vehicles and equipment per day.

The port has no truck docks, and will therefore require ramps to stuff vans. About six van semitrailers can load or unload simultaneously at the port. The most practical location is the open area inland of berth 1, behind the sheds. With a .60 factor to account for delays resulting from the ramps, these loading operations could load about 1,200 MTON per day into vans or semitrailers.

The Port of Trabzon has nine mobile cranes available for chassis operations. These machines can operate in the open area inland of berth 1, or inland at the end of berth 4. Our analysis assumes the military will bring a Rough Terrain Container Handler (RTCH) or equivalent machine for handling containers.



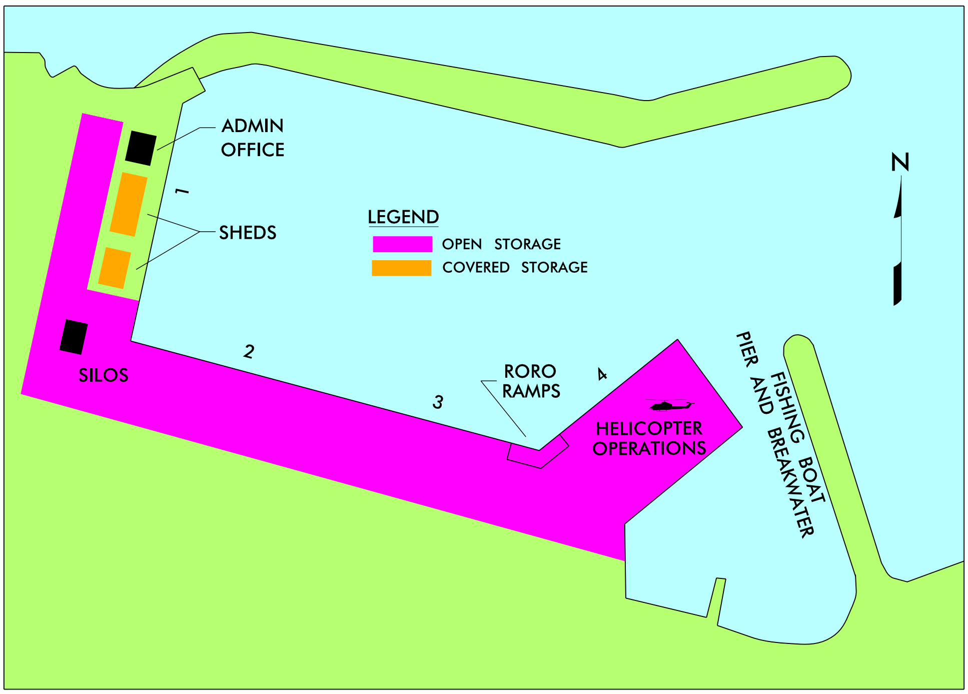
RAIL

The port has no rail access or rail facilities.

STAGING

The Port of Trabzon has about 74 acres of paved open staging area. Most of the staging is available at any given time.

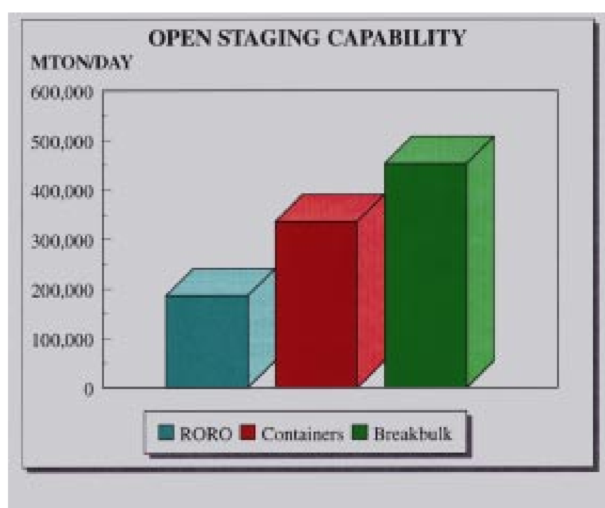
Two transit sheds have a total of 33,000 square feet of covered storage. Both sheds serve berth 1.



Staging Area

The port can perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned.

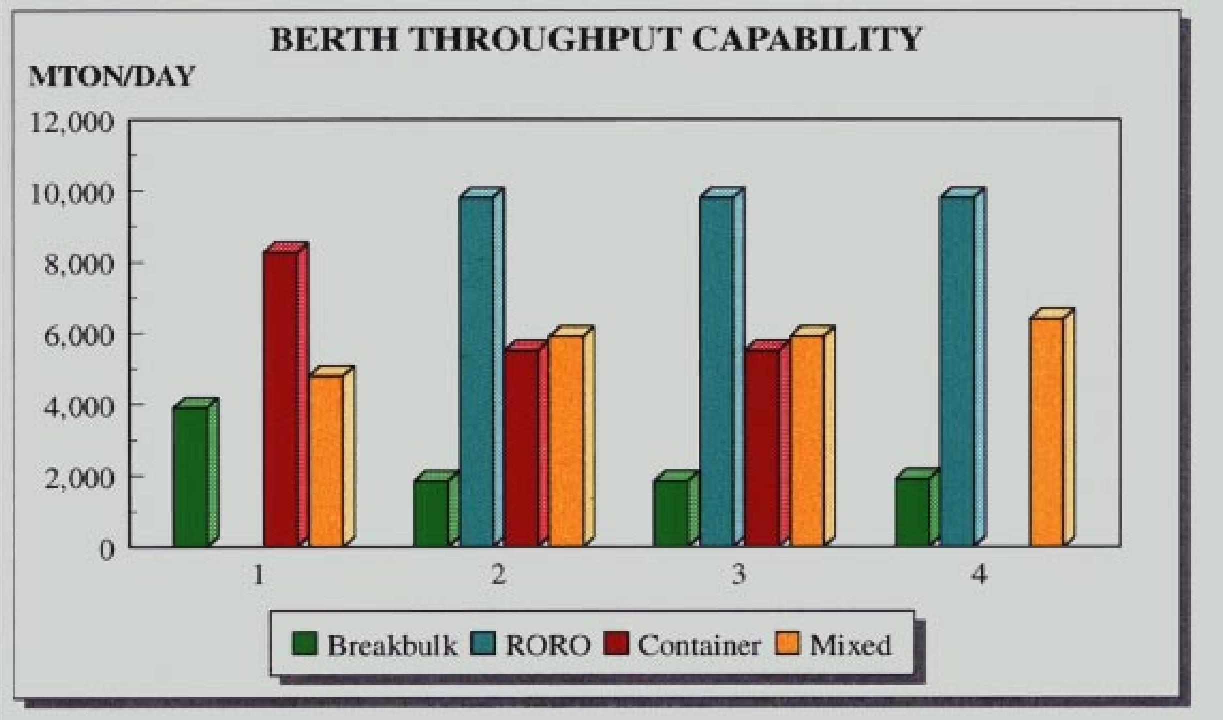
The chart at right provides the staging capability for the cargo for each of these vessel types. If a combination ship is expected, then a portion of each involved capability should be assumed.



SHIPPING

Throughputs for each berth are shown below. They are based on various factors, including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types.

FSSs cannot operate at the port because of the shallow channel.



CONVERSION FACTORS

Breakbulk:	.4	STON per MTON
RORO:	.25	STON per MTON
Containers:	.4	STON per MTON

The type of ship preferred at each berth is based on the methodology described in the appendix. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation at right gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better it is suited for loading or unloading operations.

LOADING TYPE	**BERTHS**			
	1	**2**	**3**	**4**
Breakbulk	1	2	3	4
RORO	-	3	2	1
Container	-	2	1	-

Note: Berths marked with a "-" are not recommended for these operations.

No one berth is ideal for all military operations. The best berth depends on the type of ship to be loaded.

SUMMARY OF BERTHING CAPABILITIES OF TRABZON

Vessel	Berths			
	1	2	3	4
Breakbulk				
C3-S-33a	a	a	a	1
C3-S-37c	a,g	a,g	a,g	g
C3-S-37d	a	a	a	1
C3-S-38a	2	1	1	1
C4-S-1a	a	a	a	1
C4-S-1qb and 1u	a,g	a,g	a,g	g
C4-S-58a	a	a	a	1
C4-S-65a	a	a	a	1
C4-S-66a	a,g	a,g	a,g	g
C4-S-69b	a,g	a,g	a,g	g
Seatrain				
GA and PR-class	2	1	1	1
Barge				
LASH C8-S-81b	a,f,g	a,f,g	a,f,g	g
LASH C9-S-81d	a,g	a,g	a,g	a,g
LASH lighter	9	7	6	6
SEABEE C8-S-82a	a,g	a,g	a,g	a,g
SEABEE barge	6	4	4	4
RORO				
Comet	d,o	1,d,i	1,i	1,i
C7-S-95a/Maine-class	a,b,g	a,g	a,g	g
Ponce-class	b,h	h	h	h
Great Land-class	b,h	h	h	h
Cygnus/Pilot-class	b	1	1	1
Meteor	d,o	d,i,j	i,j	i,j
AmEagle/Condor	a,b	a	a	1,i
MV Ambassador	d	d	k,m	k,m
FSS-class	a,b,g	a,g	a,c,g	g
Cape D-class	a,b,g	a,g	a,g	g
Cape H-class	a,b,g	a,g	a,g	g
LMSR	a,b,g	a,g	a,c,g	g
Container				
C6-S-1w	1,e	1,e	1,e	1,e
C7-S-68e	a,e,g	a,e,g	a,e,g	e,g
C8-S-85c	a,e,g	a,e,g	a,e,g	e,g
Combination				
C5-S-78a	a,e,g	a,e,g	a,e,g	e,g
C5-S-37e	a,e	a,e	a,e	1,e

a = maximum draft limited to berth depth
b = inadequate apron width
c = inadequate berth length
d = no straight stern-ramp facilities
e = no container-handling equipment
f = inadequate berth depth, adequate anchorage depth
g = inadequate channel depth
h = no shore-based ramps available
i = insufficient ramp clearance at low tide
j = insufficient ramp clearance at high tide
k = excessive ramp angle at low tide
m = excessive ramp angle at high tide
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

Note: Ramp clearance and ramp angle based on maximum vessel draft.

THROUGHPUT PARAMETERS

SHIP OPERATIONAL RATES	STON/HR	MTON/HR
Breakbulk Rates		
Ship Crane	15.0	37.5
Dockside Cranes	20.0	50.0
Barge	20.0	50.0
RORO Rates	200.0	800.0
Container Lift Rates	21.0 Lifts/Hr Container Crane	8.0 Lifts/Hr Wharf Crane
Berth Utilization Factor= 0.7 NOTE: Derince, Samsun and Trabzon used .95 instead of .7		

Ship Mix Percentages	%
BreakBulk	35.0
Barge	5.0
RORO	45.0
Container	15.0

Minimum Mobile-Crane Size	STON
Breakbulk	40.0
Barge	20.0
Container	100.0

Ship Cargo Mix			
	Breakbulk	RORO	Container
Roadable Vehicles	43%	90%	
Nonroadable Vehicles	7%	10%	
Container	15%		100%
Noncontainer	35%		

Staging Data:	
Staging Dwell Time	1 Day
Space Utilization Factor	
Open	60%
Covered	60%
Facility User Factor	70%

Stacking Height	Feet
Open - General	24
Covered	10
Open - Vehicle	7.6

Motor Vehicle Parameters	STON	MTON
Convoy	3.5	17.0
Flatbed	16.0	48.0
Van	12.8	32.0
Chassis	16.0	40.0
Railcar Parameters	STON	MTON
Flatcar	33.0	100.0
Boxcar	30.0	75.0
COFC	16.0	40.0
Container (TEU) Capacity	8.0	20.0

Truck Handling Rates	Trucks/Hr
End Ramps	3.0
Van Docks	0.8
Railcar Handling Rates	Railcars/Hr
End Ramps	4.0
Boxcar Docks	0.2
Length of Flatcars	50 Feet
Productive Work Hours	20 Hours

Mode Mix	%	%
Roadable Veh: Convoy/Flatcar	90	10
Nonroadable Veh: HETs/Flatcars	10	90
General Cargo:		
Van/Box	35	15
Flatbed/Flatcar	35	15
Container:		
Chassis/COFC	75	25

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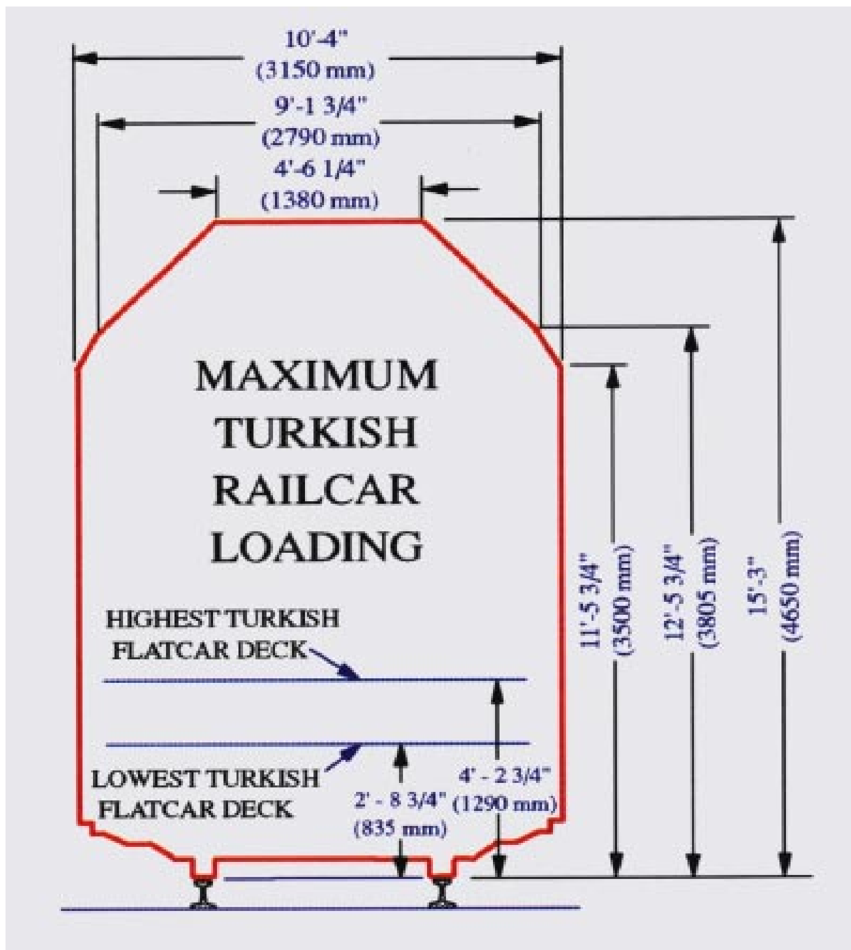
APPENDIX

SOUTHEAST ANATOLIA PROJECT (GAP)

The southeast Anatolia Project (abbreviated from Turkish as GAP) is one of the largest development projects in Turkey. The backbone of the project is a series of dams. The work will then turn to irrigation tunnels and pipelines to route water from reservoirs to farming areas. Roads are being built to support this construction. The resulting increase in bulk agricultural products will then justify the expansion of Turkey's railroads, roadways, and seaports. The ports of Iskenderun and Mersin will likely see the largest increase in agricultural shipping.

RAIL INFRASTRUCTURE

With the exception of the country's northeast region, the Turkish State Railways (TCDD) provides rail access throughout Turkey. It is the only rail company in Turkey, and owns and operates most of Turkey's ports. The Port of Trabzon is the only port in this report that has no rail access.



July 96

PORT OF KUNSAN

I. General Data
II. Throughput Analysis
III. Application
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I. GENERAL DATA

TRANSPORTATION ACCESS

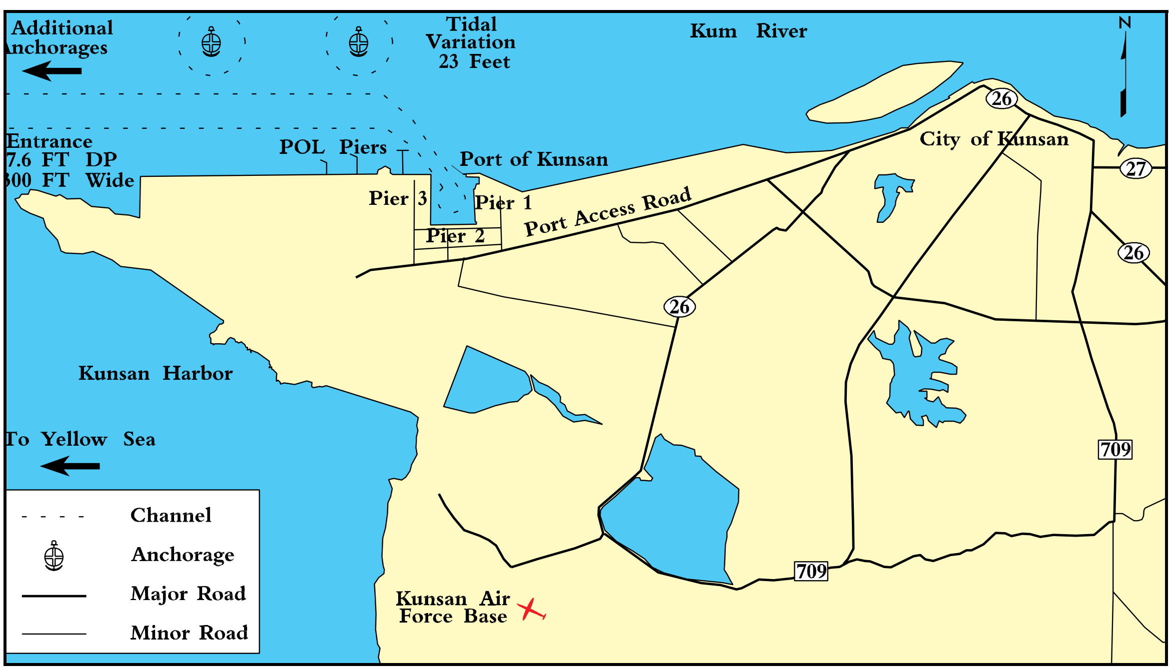
Water

The Port of Kunsan is a multicargo port. The typical cargo is lumber, cement, and bulk raw glass. The port also has the capability to handle containers and RORO vessels. It is on the west coast of Korea, 9 miles (14.5 kilometers) up the Kum River from the Yellow Sea. It is less than 30 minutes drive north from Kunsan Air Force Base. The port is at 35^{o} 58' 20" north latitude and 126^{o} 37' 20" east longitude.

The ship channel has no overhead restrictions entering the port. The channel depth is 47.6 feet (14.5 meters) deep at mean low water (MLW) and 1,300 feet wide (45.7 meters). Tide permitting, ships may turn within the harbor. Tidal variation is about 23 feet.

There are four anchorages outside the port. All have sand or mud bottoms, and are at least 32.5 feet (8.5 meters) deep at MLW.

Ships arrive during high tide and daylight hours with compulsory pilotage. Four pilots are available with 24 hours notice.



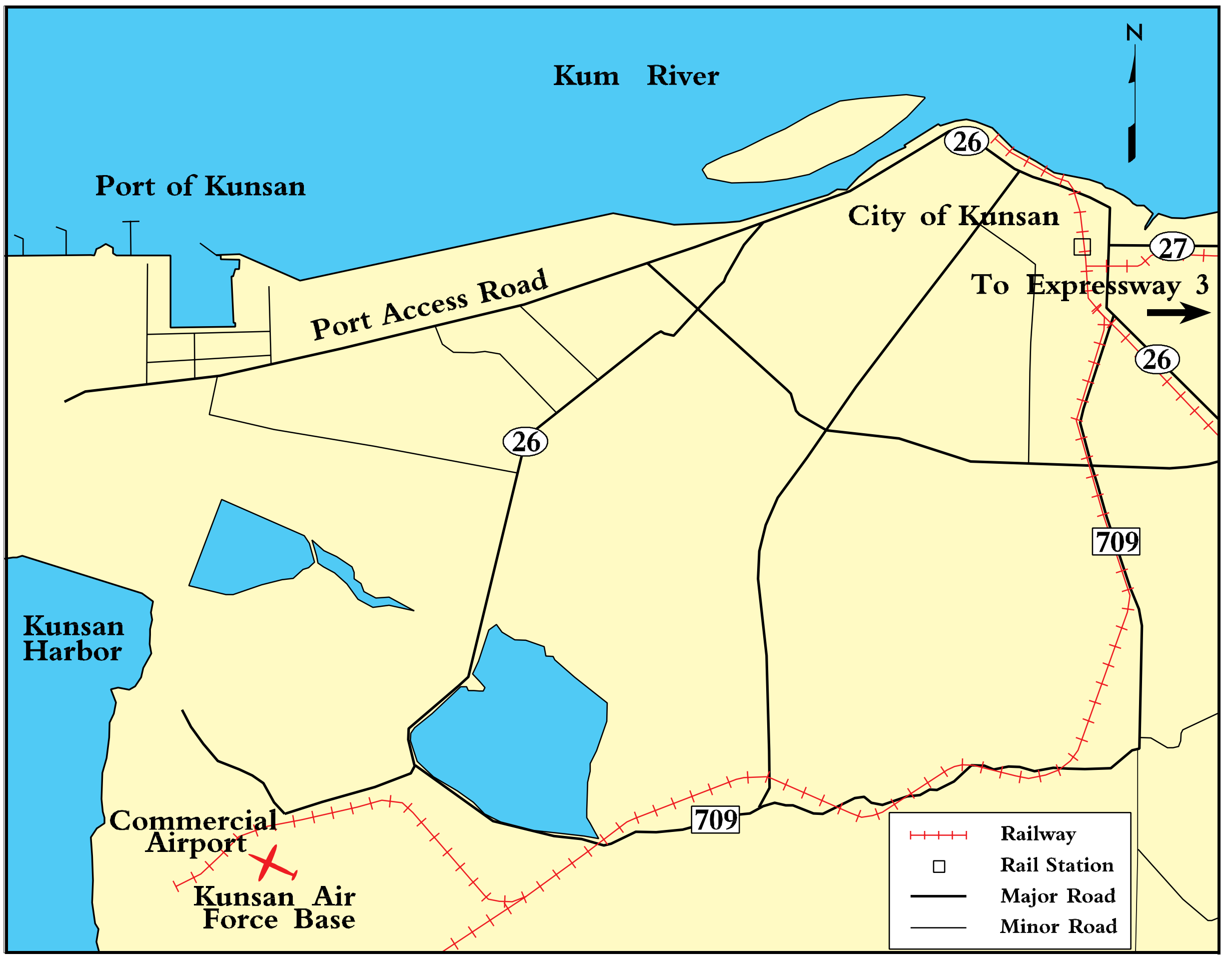
Water Access to Port of Kunsan

Highway

The roads near the Port of Kunsan are four-laned with 40 kilometer/hour speed limits. During the MTMCTEA site visit, the access roads were not congested; however, access to the port was poorly labeled. Vehicles leave the port via the Port Access Road to Route 26. Route 26 leads to Kunsan Air Force Base to the southwest or connects with Route 27, which leads eastward to Expressway 3, the main north-south artery in western Korea.

Air

Kunsan Air Force Base is less than 30 minutes drive south of the port. Its 9,000-foot C-5-capable runway is shared by the adjacent commercial airport. A parallel 5,400-foot emergency runway is also available.



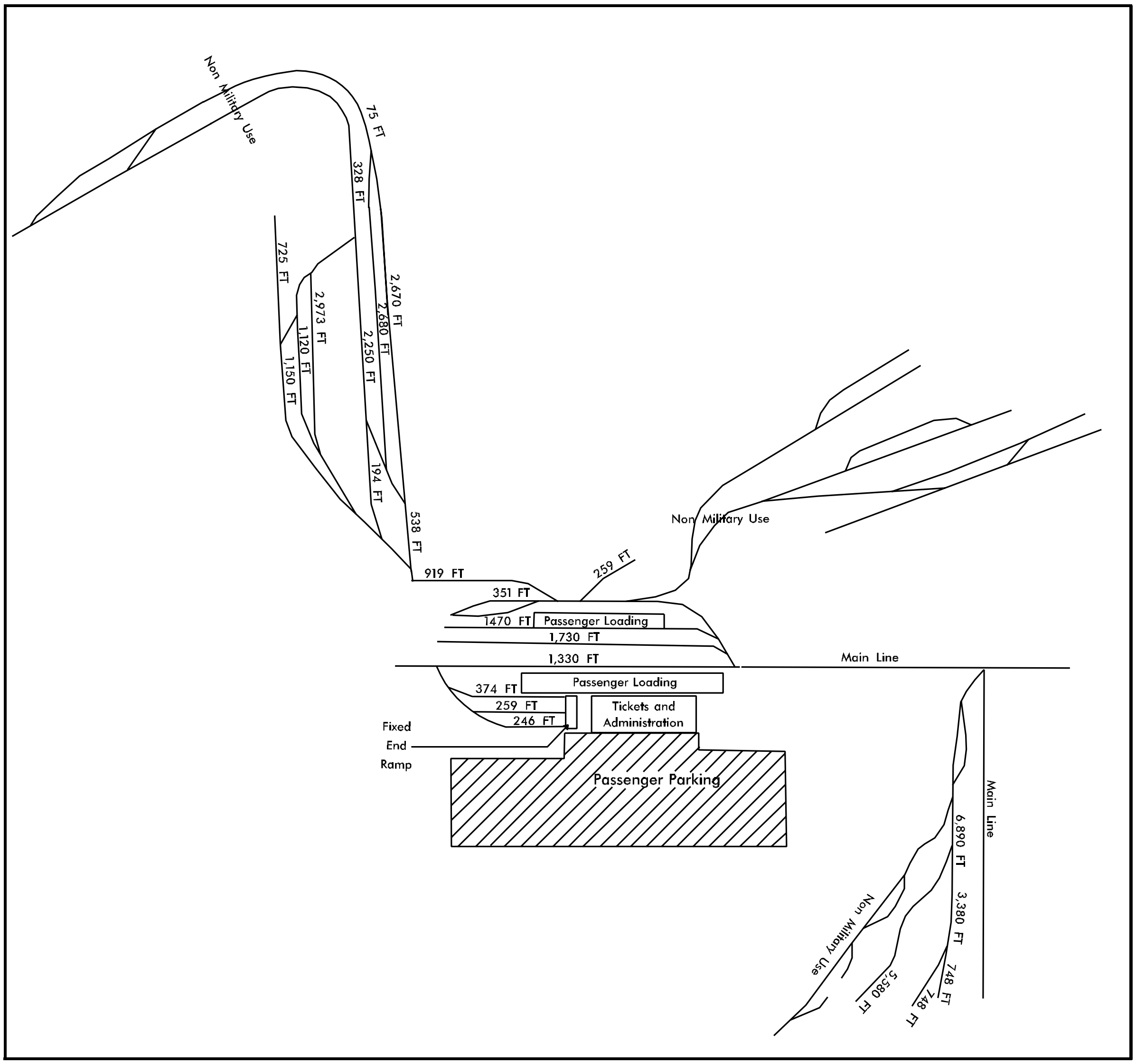
Highway, Rail, and Air Access to the Port of Kunsan

Rail

All railroad tracks within Korea are owned and operated by the Korean National Railroads. There is no direct rail access to the port, but the Kunsan Rail Station can easily support offloading operations. This 17-track station is about 7 miles from the port. It can hold 491 railcars total. Storing only 336 allows space for routine passenger operations. Altogether the rail station covers 30 acres (124,000 square meters) of land, including the tracks, buildings, and parking lot. Nine trains arrive each day. The longest spur can hold 32 railcars.

An adjacent undeveloped 1.8 acre (7,500 square meters) area can be used to stage vehicles. The station hopes to handle containers in this area in the future. The rail station has one fixed end ramp in need of clearing and repair, that can offload seven railcars. The military will have to bring or build portable or temporary end ramps for use at any of several spurs.

There are no rail restrictions for height or weight at the station.



Kunsan Rail Station (not to scale)

PORT FACILITIES

Berthing

The Port of Kunsan generally consists of a 1,700 feet (528 meters) square slip with small vessel floating pontoon piers at the north east, and POL piers and storage tanks to the west. The port also has an adjustable RORO ramp, though it needs minor repair. The three wharves in this report (Piers 1, 2 and 3) are all 26 feet (8 meters) deep MLW, with 6.6 feet (2 meters) apron heights and 614 PSF deck strength.

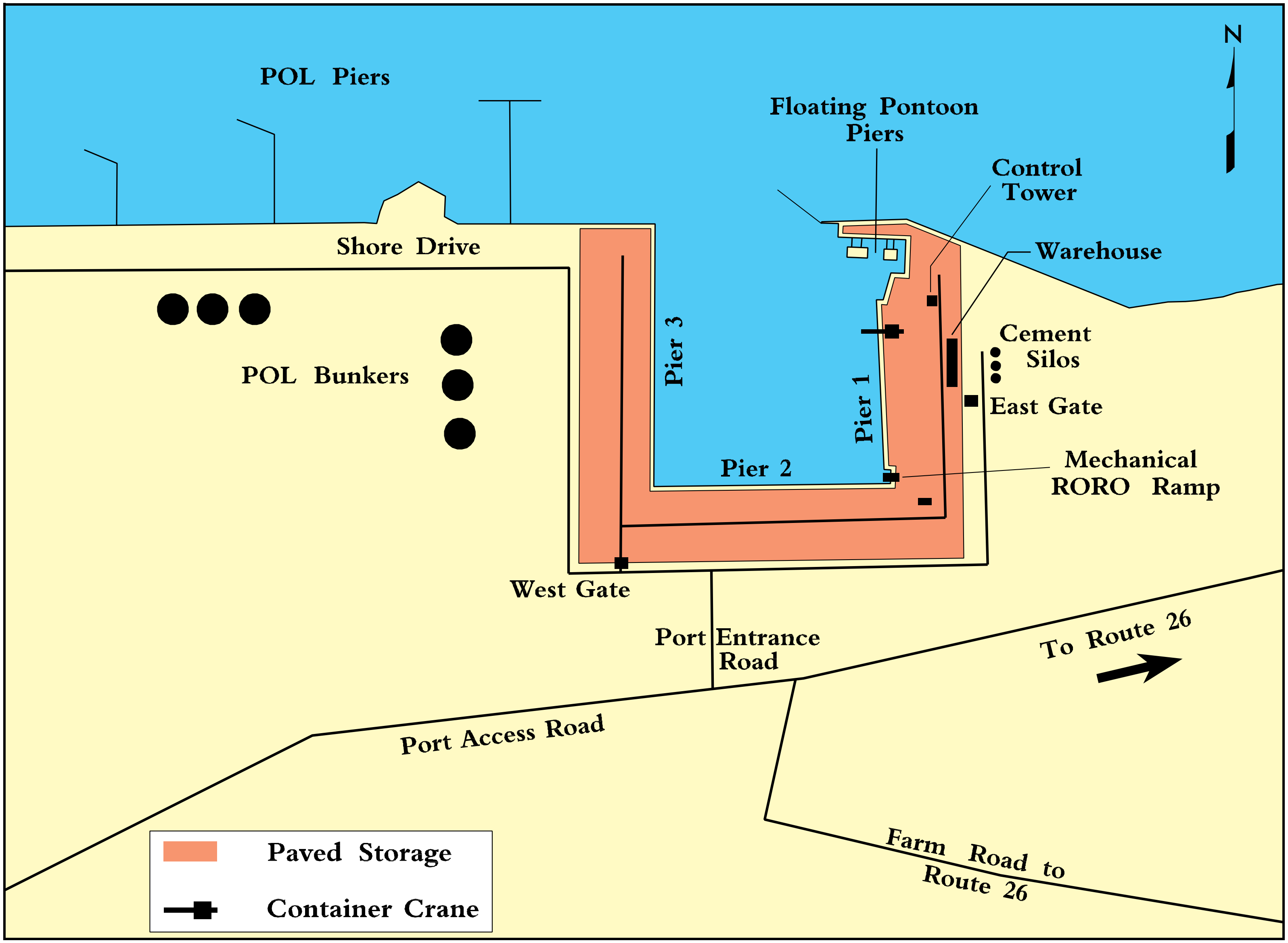
The port has one 33 STON container crane set for 20-foot containers. It can quickly be modified for 40-foot containers or breakbulk operations, but only averages 12 lifts per hour. Typical cargos that import through the port are lumber, cement, grain, and raw bulk glass. These cargos typically occupy 75 percent of the open and covered storage areas.

Adjustable RORO Ramp

Open Area Near Berth 1

BERTHING CHARACTERISTICS
OF THE PORT OF KUNSAN

Characteristics	Berths		
	Pier 1	Pier 2	Pier 3
Length, ft (m)	1,722 (525)	1,807 (551)	2,100 (640)
Depth alongside at MLW, ft (m)	26 (8)	26 (8)	26 (8)
Deck strength, psf (met. tons/sq m)	614 (3)	614 (3)	614 (3)
Apron width, ft (m) (useful)	98 (30)	98 (30)	98 (30)
Apron height above MLW, ft (m)	6.5 (2)	6.5 (2)	6.5 (2)
Number of container cranes	1	0	0
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	Yes	Yes
Apron length served by rail, ft (m)	0	0	0



Land-Use Map for Port of Kusan

SUMMARY OF BERTHING CAPABILITIES FOR KUNSAN			
VESSEL	**BERTHS**		
	Pier 1	Pier 2	Pier 3
Breakbulk			
C3-S-38a	a	a	a
C4-S-58a	a	a	a
C4-S-66a	a	a	a
C5-S-37e		a	a
Seatrain			
GA and PR-class	a	a	a
Barge			
LASH C8-S-81b	a,f	a,f	a,f
LASH C9-S-81d	a	a	a
LASH lighter	8	9	10
SEABEE C8-S-82a	a	a	a
SEABEE barge	8	9	10
RORO			
Comet	a,i,m	a,i,m	a,i,m
Meteor	a,i,m	a,i,m	a,i,m
Cape Gnome	a,i,m	a,i,m	a,i,m
C7-S-95a	a	a	a
Cape Taylor	a	a	a
Cape Orlando	a	a	a
MV Ambassador	k,m	k,m	k,m
Callaghan	a,m	a,m	a,m
Cape Lambert	a	a	a
FSS-Class	a	a	a
Cape E-class	a	a	a
Cape D-class	a	a	a
Cape H-class	a	a	a
Cape R-class	a,m	a,m	a,m
Cape Texas	a	a	a
Container			
C6-M-147a	2	2,e	3,e
C7-S-69c	a	a,e	a,e
C7-S-68c	a	a,e	a,e
C8-S-85c	a	a,e	a,e
C9-M-132b	a	a,e	a,e
C9-M-F141a	a	a,e	a,e
Combination			
C6-S-1qd	a	a	a
C5-S-MA73c	a	a	a
C6-S-MA60d	a	a	a

•May Limit Operation •May Prevent Operation

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst.

Open Storage

The port has 128 acres of paved open storage. The biggest areas are inland of Piers 1 and 3. During the MTMCTEA site visit, most open storage area was covered with import cargo. The 98 feet (30 meters) nearest the water is generally concrete, with asphalt paving further inland. The only lighting is along the water. These lights illuminate some of the inland area.

Nearest Pier	Open Storage Area		
	Acres	Square Feet	Square Meters
Pier 1	55.3	2,410,000	224,000
Pier 2	17	741,000	68,900
Pier 3	55.3	2,410,000	224,000
TOTAL	128	5,560,000	517,000
Note: 90 percent of open storage is routinely used for import cargo			

Lumber in Open Storage

Cement and Glass Bulk in Open Storage

Covered Storage

The only warehouse at the port that might provide support for military operations is privately owned, inland of Pier 1, to the east of the slip. It is about 52,000 square feet (4,800 square meters), but has no rail or truck docks. It is usually filled with import cargo.

Highway

There are two gates to the Port of Kunsan, both have guard shacks. The West Gate is more modern. Each gate has two lanes in each direction.

Although the port has a conveyor belt to an offsite cement storage facility, there are no overhead restrictions that would restrict cargo on trucks or trailers. There are no height or weight restrictions leading out of the port to the main networks. The port has no truck scales. Roads within the port are generally 25 feet wide.

West Gate to Port of Kunsan

East Gate to Port of Kunsan

UNLOADING/LOADING POSITIONS

The port has no ramps or docks for truck operations. The military should build or bring ramps for offloading trucks and trailers that do not have integral ramps.

The nearby rail station has one fixed ramp. Further details of this facility are in the Rail Access section earlier in this report.

OFFSITE STORAGE AREAS

All of the open storage areas within the port are necessary to support staging and marshaling of commercial and/or military cargo. There is no additional room for vehicles to marshal within the port. Military vehicles would have to marshal on farmland or undeveloped land outside of the city.

MATERIALS HANDLING EQUIPMENT (MHE)

Several mobile cranes are available from stevedoring companies in Kunsan. The nearby Air Force Base has a variety of construction equipment available.

Mobile Cranes Owned by Local Stevedoring Companies

TYPE OF EQUIPMENT	CAPACITY		QUANTITY
	LTON	STON	
Mobile Cranes	140	154	1
	10-20	11-22	5
	25-50	27-55	10
	75	82	1
Floating Crane	30	33	1

Mobile Crane Rigged for 20-foot Containers

Floating Crane

Local Mobile Cranes

AMMUNITION HANDLING

The Port of Kunsan has no experience in handling ammunition. Ammunition handling is possible with permission from the Korea Ministry of Maritime Affairs and Fisheries (MMAF). There is little risk to nearby population.

PETROLEUM, OIL, AND LUBRICATION (POL)

Three finger piers for 4,000 dead weight ton tankers are directly west of the port. One of these routinely provides fuel to Kunsan Air Force Base. The fuel is trucked to the base. The other two piers are for private industry. One of these connects to the TransKorea Pipeline. Typically, each pier can take 400 to 500 kiloliters per hour of fuel from ships. Each pier can discharge fuel to the ships at about 100 kiloliters per hour.

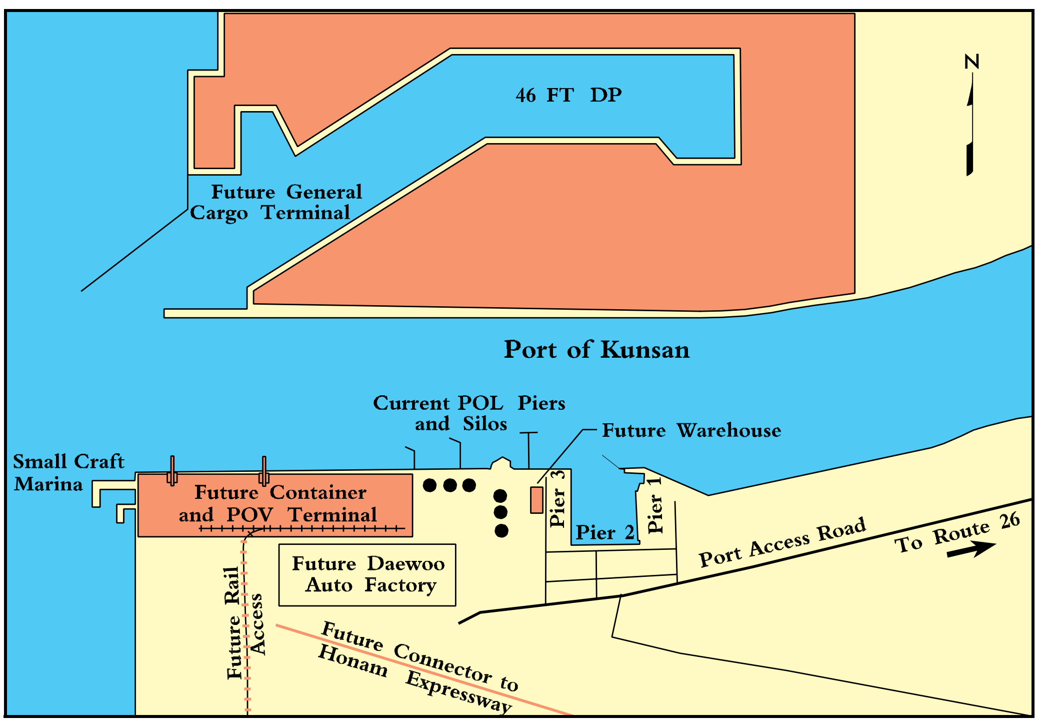
Except for the silo of fuel for Kunsan Air Force Base, all the POL silos are privately owned. All four silos combined store a total of 400,000 barrels of bunker C fuel, diesel, or gasoline.

FUTURE DEVELOPMENT

The Port of Kunsan hopes to fill westward to develop another 4,000 feet of container and export POV berths. Daewoo Motor Company expects to ship cars from this site. There is already a major Daewoo plant in the city.

The long-term plans include a new slip north of the Kum River. This new terminal will have 46 feet draft (14 meters) MLW.

The new Honam Expressway is expected to be complete in 1998. This will improve access for 37 miles (60 kilometers) to the east.



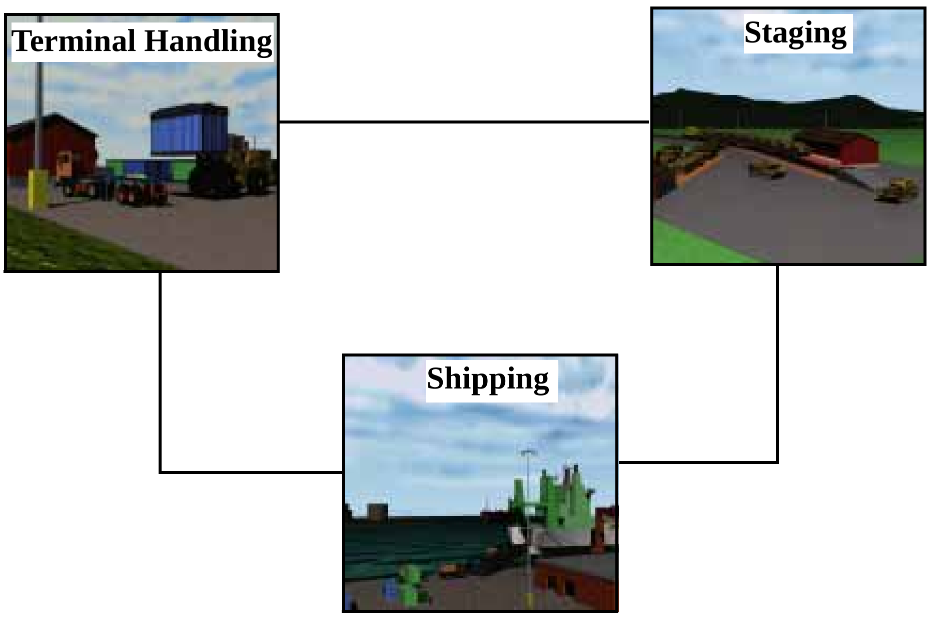
Future Development Map

The port also expects to build another warehouse similar to the existing one. The new warehouse will likely be inland of Pier 3.

II. THROUGHPUT ANALYSIS

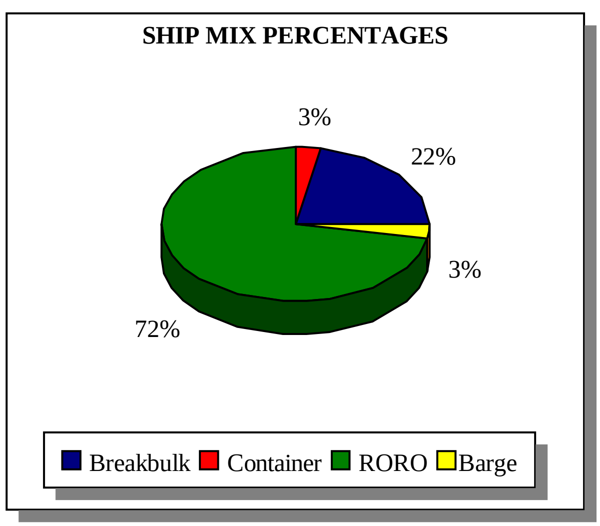
GENERAL

This section evaluates the throughput capability of the Port of Kunsan using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, hardstand marshaling, and terminal processing/handling - in short tons (STON) per day.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 80 percent of the port facilities will support military deployments. Also, due to the size of the port, we assumed a berth utilization factor of 80 percent. The ship mix is determined by Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



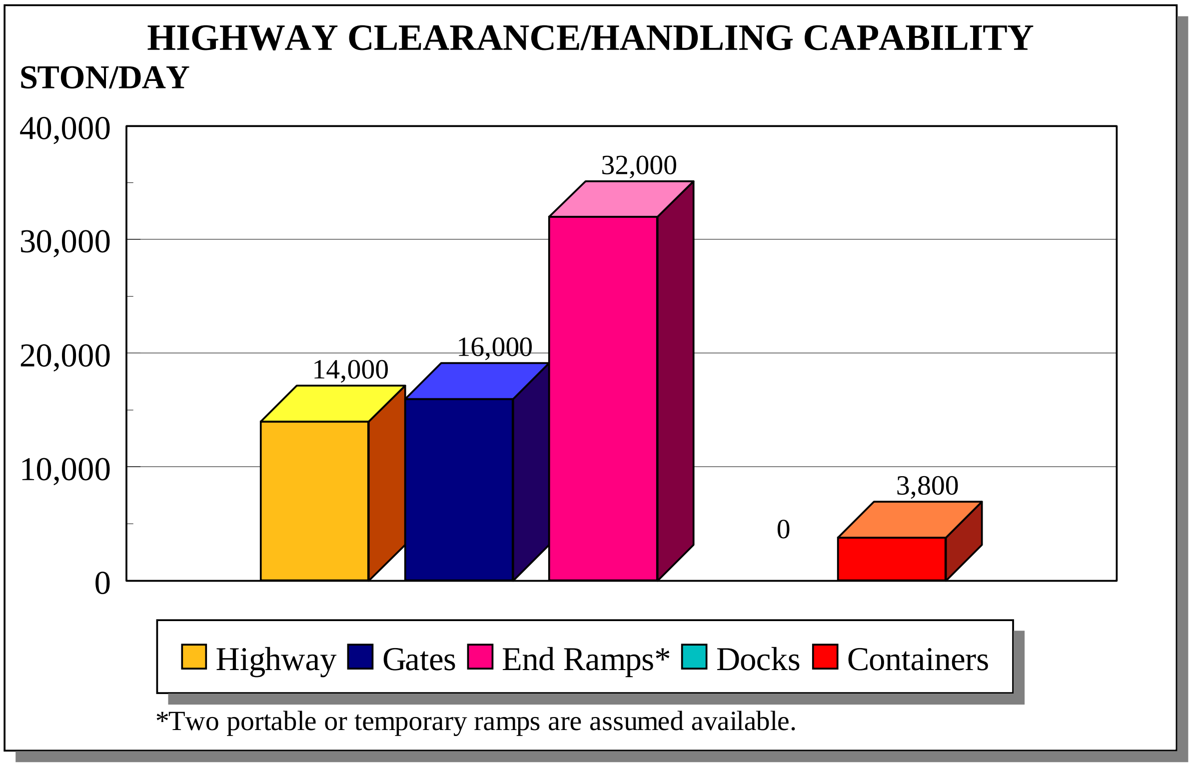
RECEPTION/HANDLING

Highway

The most restrictive link in highway access to or from the port is the port access road leading to the gates of the port. The road network in and out of the terminals, including the gate processing of vehicles, could handle about 14,000 STON (52,000 MTON) of equipment and supplies per day.

Roadable vehicles will process directly to the open storage areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at permanent and portable end ramps.

The port has no truck docks nor container handlers.



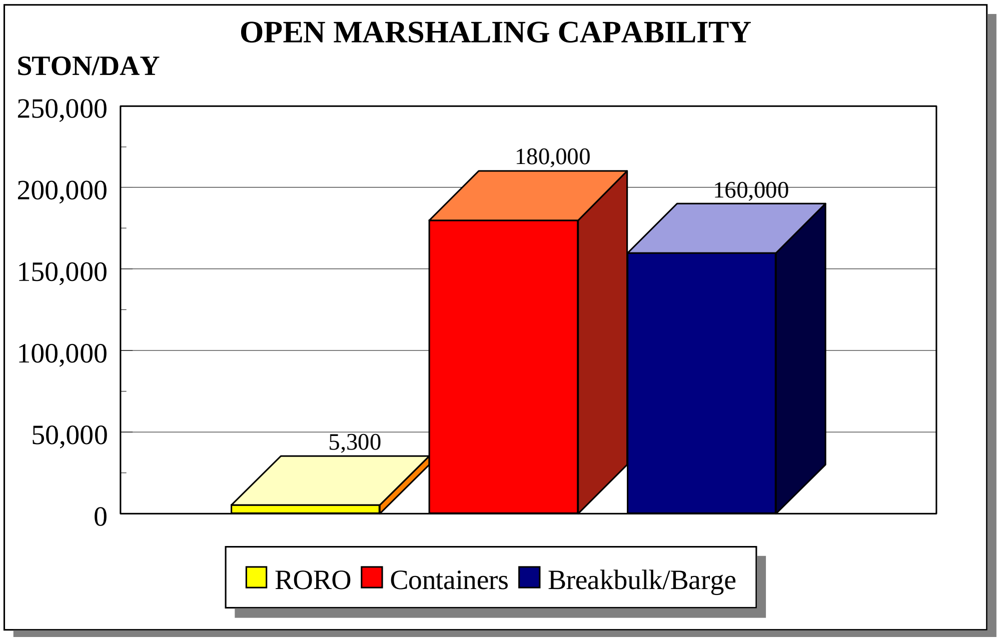
*Two portable or temporary ramps are assumed available.

Rail

The port has no rail reception capability.

OPEN STORAGE

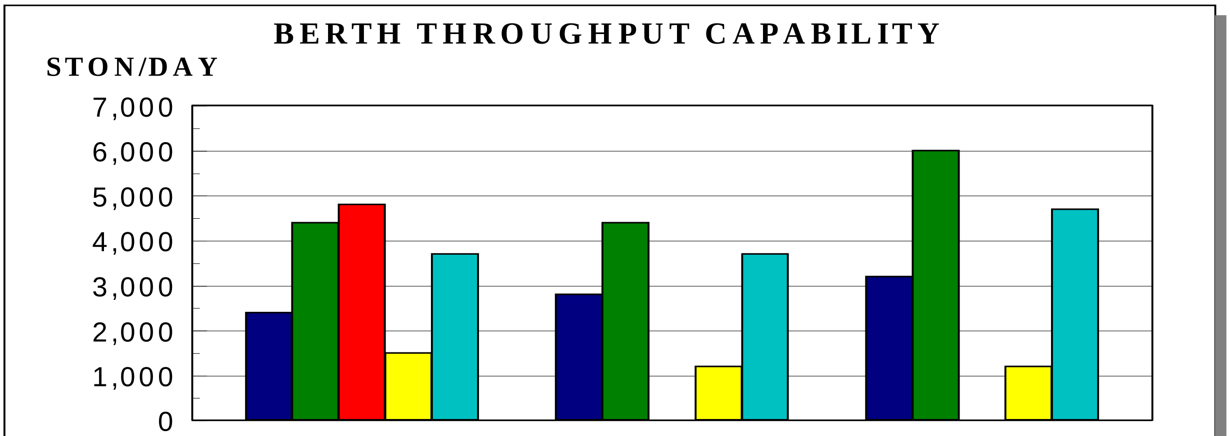
The port has about 128 acres (518,000 square meters) of paved open storage and 52,000 square feet (4,830 square meters) of covered storage.



Warehouse Inland of Pier 1

SHIPPING

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility. Although these values provide the shipping rates, few ships can be loaded to their maximum draft. The water depth at the berths is relatively shallow.



	PIER 1	PIER 2	PIER 3
Breakbulk	2,400	2,800	3,200
RORO	4,400	4,400	6,000
Containers	4,800	0	0
Barge	1,500	1,200	1,200
Mixed	3,700	3,700	4,700

CONVERSION FACTORS

Breakbulk or Barge	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON

Of the three berths in this report, Pier 1 is preferred for all military operations. It has the container crane, large open area, and nearby warehouse. The only ships that might warrant military operations at Pier 3 instead of Pier 1 are straight-stern-ramp RORO vessels. These ships could use the adjustable RORO ramp.

The next best berth would be Pier 3 because of its length. Pier 2 is the least desirable because of the low open storage nearby.

Because of the shallow water and high tidal variation, FSS and LMSR operations are not recommended at this port.

THROUGHPUT SUMMARY FOR PORT OF KUNSAN PER DAY

BERTH	LENGTH (feet) (meters)	DEPTH (feet) (meters)	BB (STON) (MTON)	RORO (STON) (MTON)	RORO SQ FT (EST)	RORO PIECES	CNTNR (STON) (MTON) (TEU)	BARGE (STON) (MTON)	MIXED (STON) (MTON)
Pier 1	1,722 525	26 8	2,400 6,000	8,800 35,000	176,000	1,040	4,800 12,000 600	1,500 3,700	7,100 27,000
Pier 2	1,807 551	26 8	2,800 7,000	8,800 35,000	176,000	1,040	0	1,200 2,900	7,200 28,000
Pier 3	2,100 640	26 8	3,200 8,000	12,000 47,000	240,000	1,400	0	1,100 2,900	9,500 37,000
Note: Number of RORO pieces is based on 170 square foot per piece accomplished during Desert Shield/Storm.									

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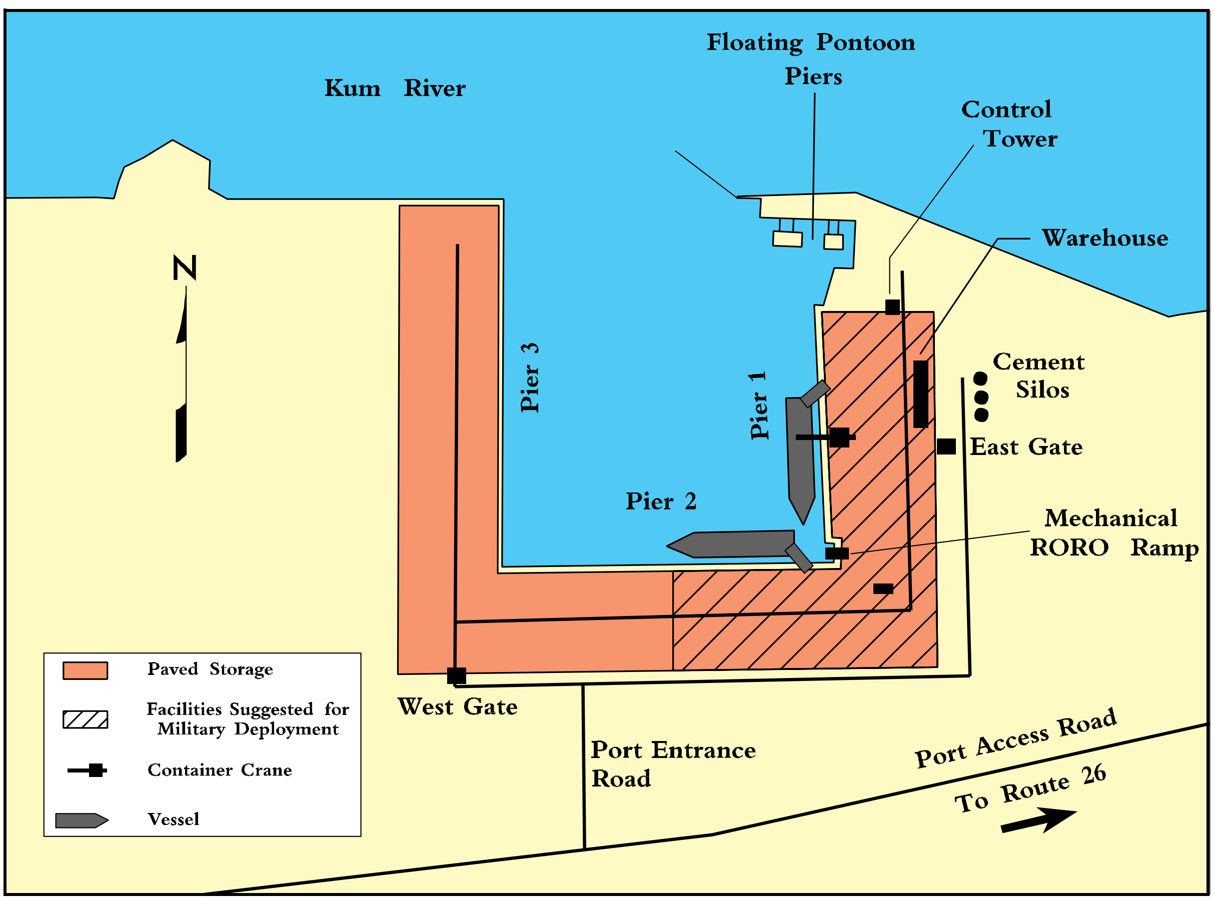
III. APPLICATION

This section evaluates the port's throughput capability for deploying a notional armored brigade. Because of the shallow draft at the Port of Kunsan (26 feet), this study evaluates the deployment using vessels of the 2nd LT John P. Bobo (MPS-AMSEA) class, such as the 1st LT Daldomero Lopez. Although these vessels have a maximum draft of 32 feet, 1 inch, (9.8 meters) we assume the vessels will arrive with shallow enough draft to berth at the port during high tide. The vessels have a lightship draft of only 14 feet, 4 inches (4.4 meters).

Currently, the facility use depends on decisions made by the Korean Ministry of Defense and MMAF. Because of the Korean commitment to the defense of their country, and considering current facility use of the port, we assume all of the port and the nearby Kunsan Rail Station will be made available for military use. We also assume that no other military units (US or Republic of Korea) will be competing for port assets, both transporters and people will be available to adequately offload the ship and clear the port. The Port of Kunsan has a mechanical RORO ramp in need of repair. Since the 2nd LT John P. Bobo class vessels have semi-slewing stern ramps, our analysis does not consider the port's mechanical RORO ramp.



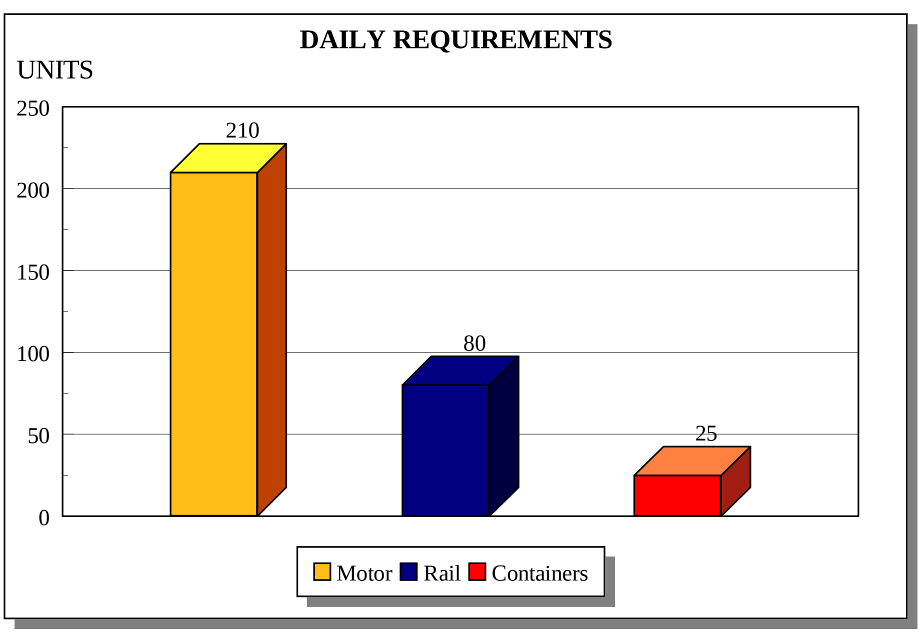
Potential Port Use During Deployment

REQUIREMENTS

The likely requirement for the Port of Kunsan would be to deploy a notional armored brigade to support the overflow of deployment operations at larger ports. We assume the port must deploy the brigade in only six days of offloading and port clearance. The brigade has to move about 2,820 vehicles and 150 containers. Although Kunsan is far north in Korea, and rail deployments are unlikely, we will analyze the deployment using the rail/convoy option. Because vehicles will have to road march to the Kunsan Rail Station, the gates of the port and the local roadways through the city of Kunsan will have to handle the entire brigade. About 1,260 (210 per day) roadable vehicles would pass the rail station and continue to the theater towing 833 (138 per day) trailers. The remaining vehicles would load onto about 80 railcars at the Kunsan Rail Station. About 25 containers would arrive per day.

ARMORED BRIGADE

Total Equipment		Required Daily Throughput
Volume	95,800 MTON	16,000 MTON
Weight	31,703 STON	5,300 STON
Area	642,645 SQ FT	107,100 SQ FT
Vehicles	2,823	460
Containers	150	25

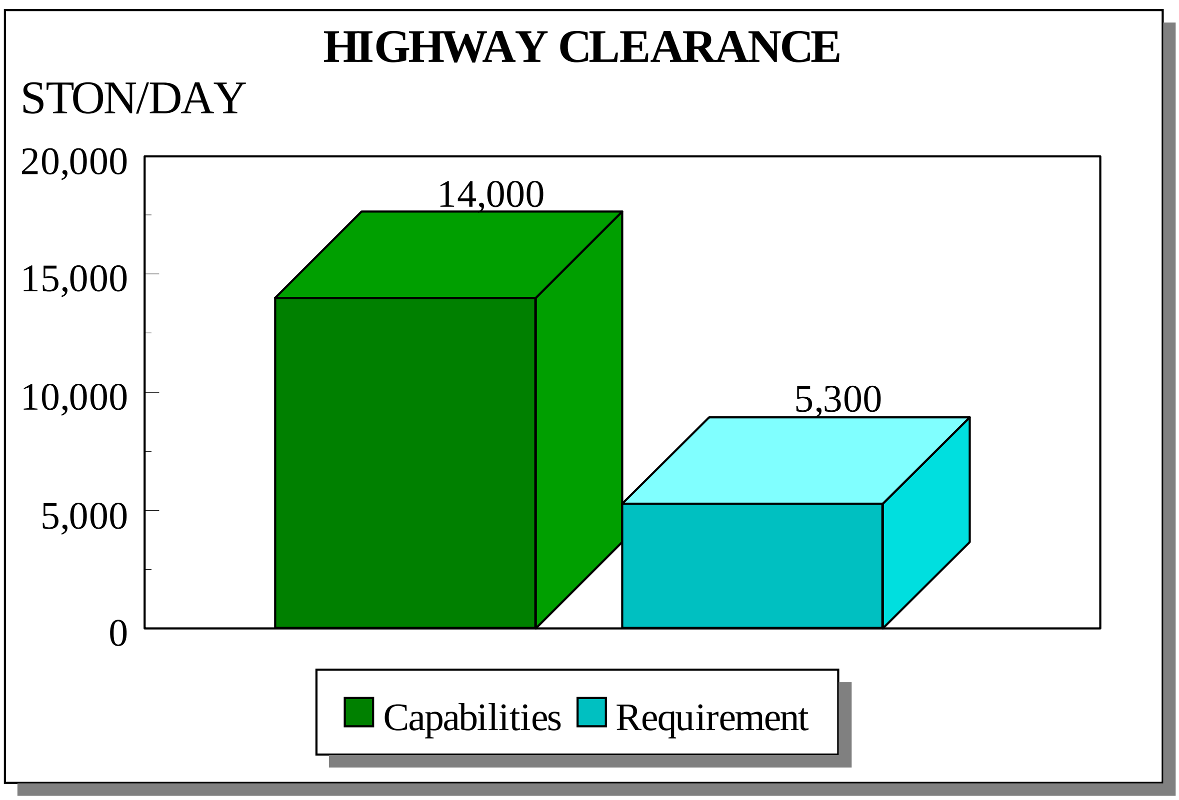


TERMINAL INPROCESSING/HANDLING

Highway

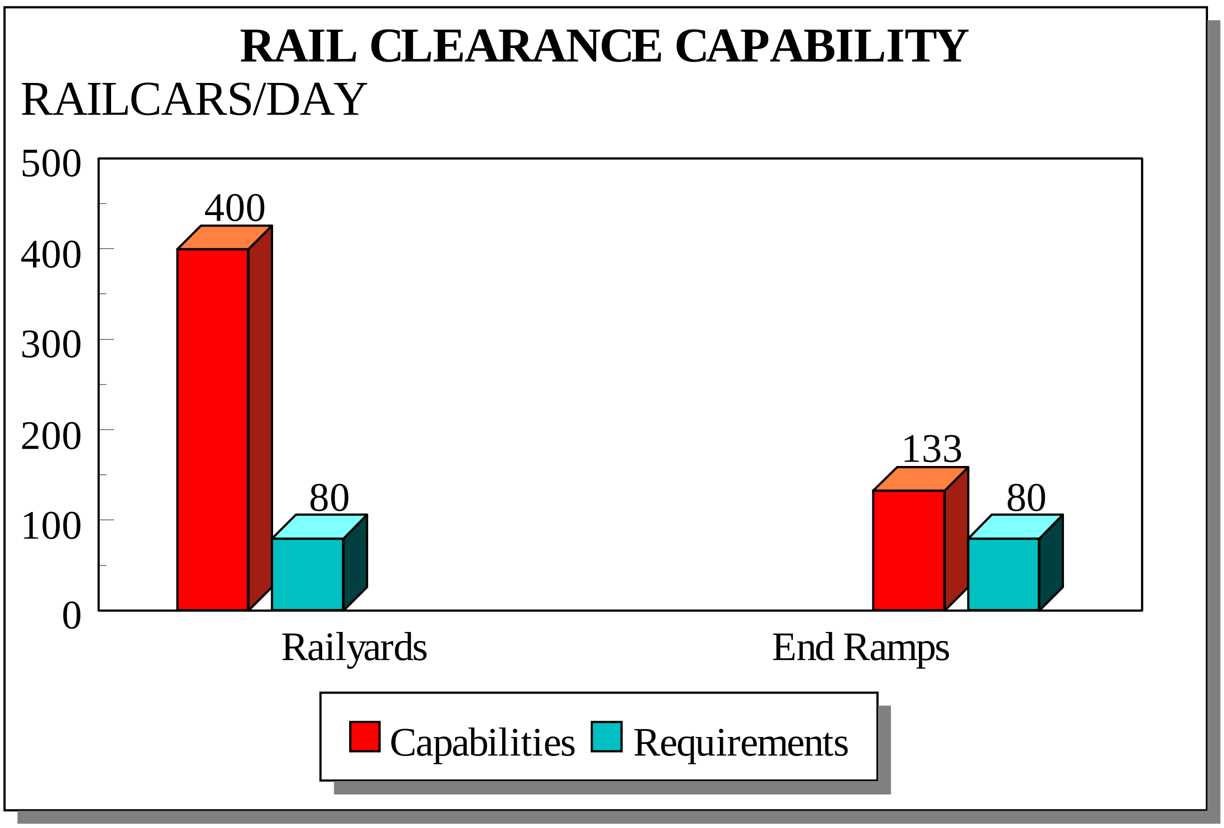
Because there is no direct rail access to the port, all vehicles will have to convoy along Port Access Road. To avoid congestion of the city, the road-deployed vehicles should take the farm roads to join south-bound Route 26 to continue to the main arteries of the Korean highway infrastructure. Those vehicles to continue further deployment by rail will follow Port Access Road to east-bound Route 26 to the Kunsan Rail Station at the intersection of Route 26 and Route 27. This rail station is about seven miles from the port. The routes are shown on the Highway Access map earlier in this analysis.

Assuming a constant flow of vehicles out the gates of the port and at least along Port Access Road to the farm roads, the daily clearance requirement is 5,300 STON. The Port Access Road can easily support the requirement to deploy the armored brigade in six days.



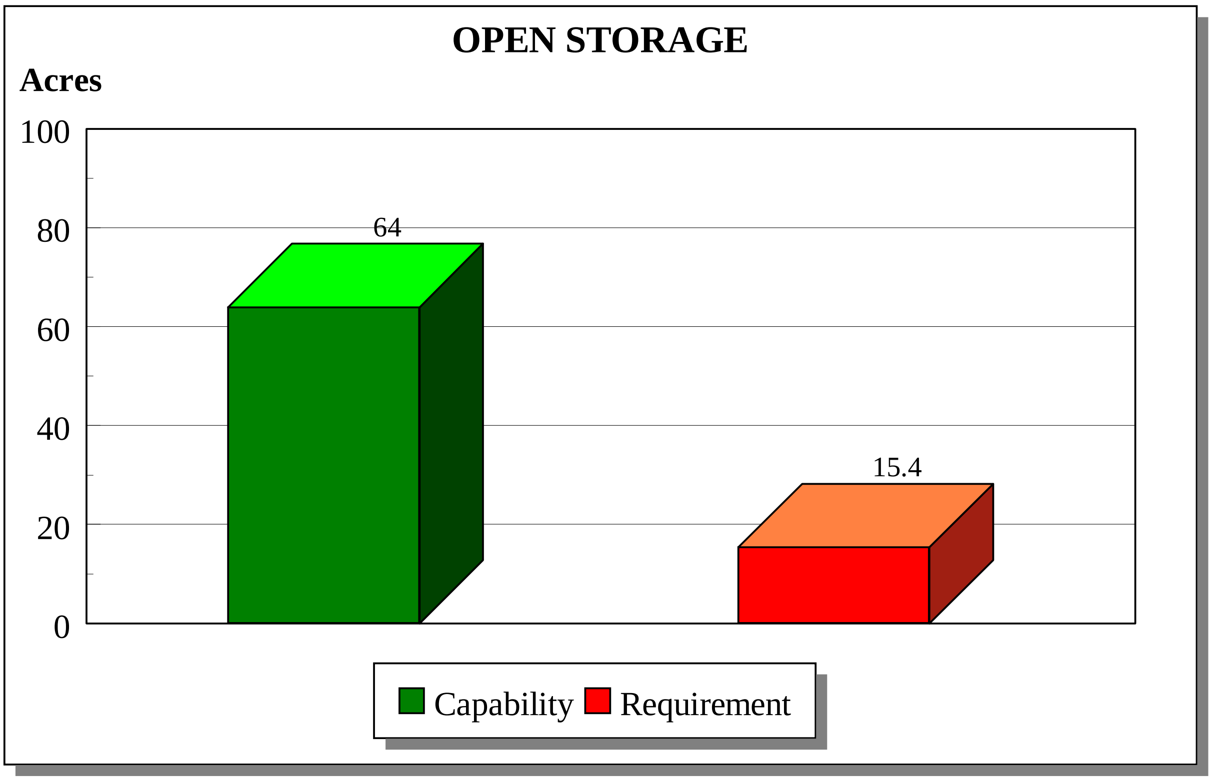
__Rail__

The Kunsan Rail Station primarily supports passenger traffic. Fortunately it is very well configured to support railcar-loading operations. The rail station characteristics are provided earlier in this analysis. Using the fixed rail end ramp and portable ramps at locations shown below and assuming two switching cycles per day at each ramp, the rail station can load and deploy 133 railcars per day. This exceeds the requirement.



Open Storage

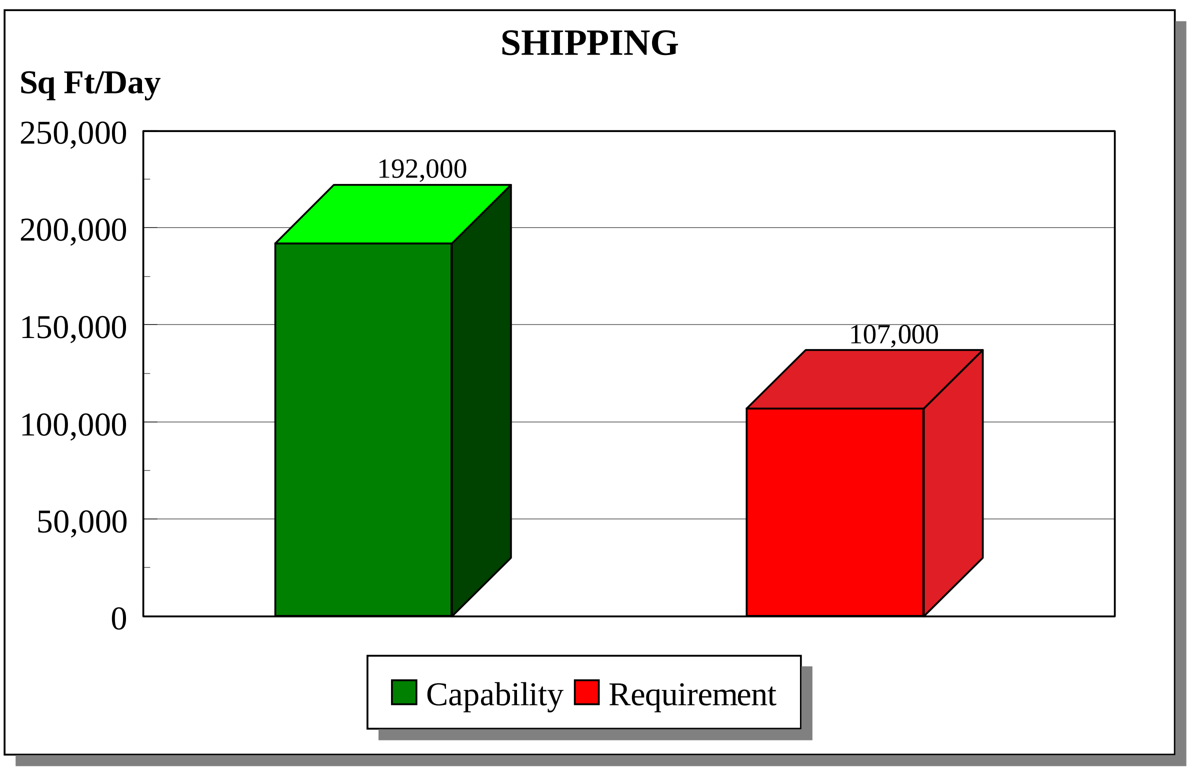
The port has 128 acres (528,000 square meters) of paved open storage area. We assume the equipment will marshal in open areas away from the aprons. Marshaling the entire brigade of equipment (642,645 square feet) requires 37 acres. We assume the maximum amount in the port at any time is about one and a half days of the required port throughput. This requires the port to provide 15.4 acres of paved open area to support the deployment. The port can easily meet the requirement.

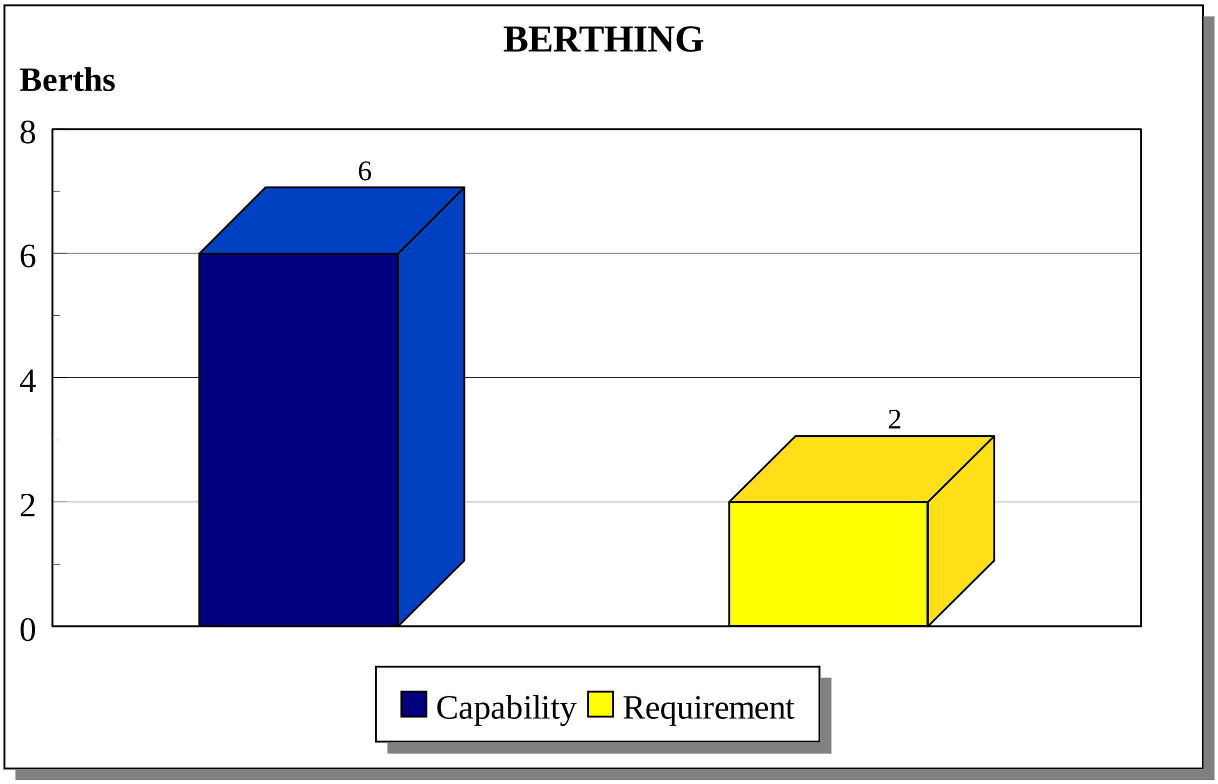


Shipping

An armored brigade has 642,645 square feet of vehicles and equipment. The deck space on the 2nd LT John P. Bobo (MPS-AMSEA) class vessels is 256,566 square feet, not including the container cells, which can carry an additional 546 TEUs. Assuming a 75 percent stow factor, each of these vessels can carry 192,242 square feet of vehicles and equipment. At this rate, the deployment of the brigade would require only 3.3 of these vessels, if each were fully loaded. Since the water depth at the port can not accommodate fully loaded 2nd LT John P. Bobo (MPS-AMSEA) class vessels, we assume 2.7 additional vessels are required for the deployment. Unloading RORO vessels this size can be done in under two days. To meet the six day requirement, the port will have to berth two of these vessels simultaneously. Three two-vessel operating cycles are required to deploy the entire brigade, with these partially loaded vessels.

This analysis assumes the vessels arrive at the port at high tide, with less than full loads. The port can berth six of these vessels. This exceeds the requirement to berth two simultaneously.





SUMMARY

The Port of Kunsan can deploy a notional armored brigade in six days. The only concern in the deployment process is the shallow draft of the berths. Because of the shallow draft (26 feet MLW), large vessels will have to arrive at the port with less than full loads, and at possibly at high tide. Even if additional ships are required to limit the drafts, the port can deploy the brigade in the required time.

The highway and rail access to the port are sufficient to meet the requirement, and the port has sufficient open staging area.

RECOMMENDATION

We recommend the Port of Kunsan be considered to deploy brigade-sized units. Plans should call for small ships, or additional large ships to limit the maximum draft at time of arrival to no more than 24 feet.

July 96

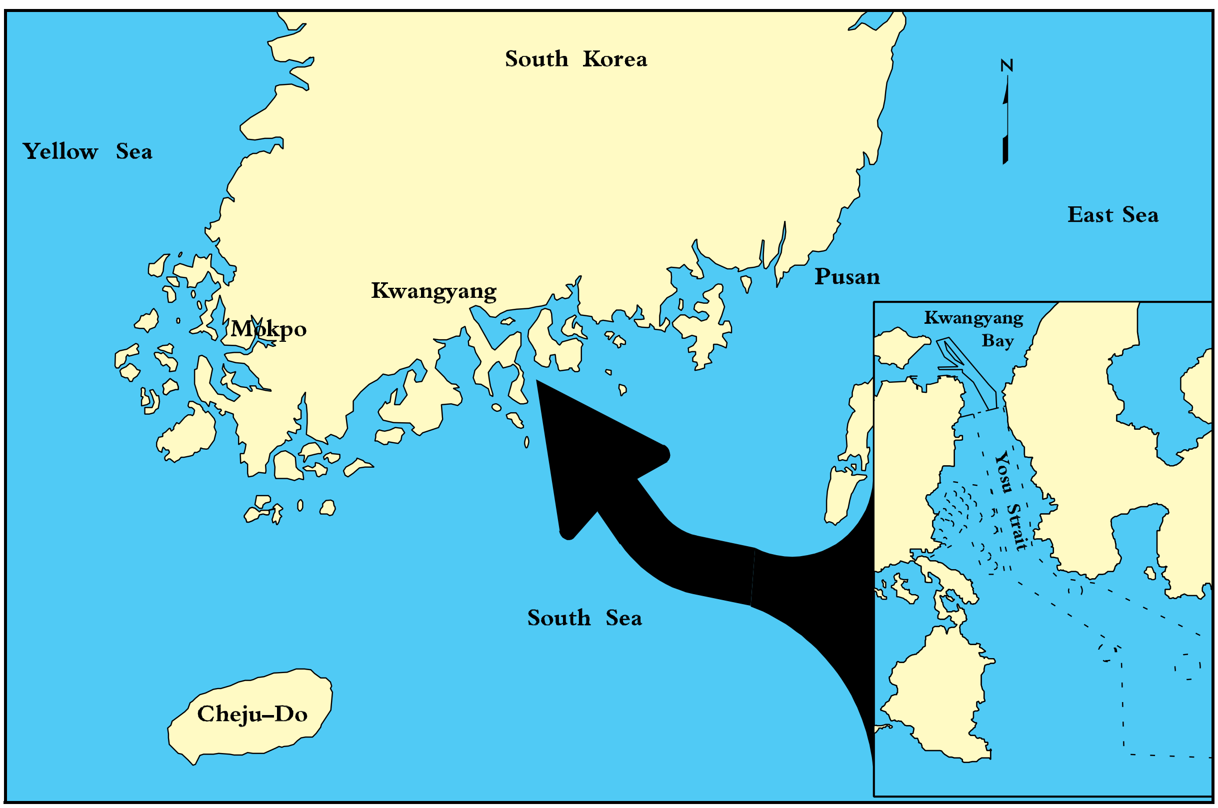
PORT OF KWANGYANG

I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Kwangyang is 34° 50' 2" north latitude and 127° 46' 32" east longitude on the south central coast of Korea about 100 miles (160 kilometers) west of Pusan and 105 miles (170 kilometers) east of Mokpo. The GeoCode for Kwangyang is MMGG. The Pohang Iron and Steel Company (POSCO) owns and operates the port. Located on an island on Kwangyang Bay, the port has no vertical (overhead) restrictions for access to open water. The Yosu Strait connects the Port of Kwangyang to the South Sea (NamHae). The channel depth into the Port of Kwangyang is about 65 feet (19.8 meters) and can handle any ship. This channel is 14 miles long (22.5 meters) and has a minimum width of 984 feet (300 meters). Deep water anchorages are near the port, pilotage is compulsory. The turning basin near the wharf area can accommodate 100,000 deadweight (DWT) ton ships (1,050-foot-long ships).



Water Access

Highway

Two highways provide access to the POSCO Island at Kwangyang. One route crosses the Kumho Bridge from POSCO Island to the mainland and the other crosses the Taeinn Bridge from POSCO Island to Taeinn Island. If traveling inland from the port and using the Kumho Bridge, take Route 840 to Route 861, follow Route 861 north and access Expressway 6 using the Okgo interchange. The other route exits POSCO Island via the Taeinn Bridge to Taeinn Island. From here, take Route 29 north, cross the Grand Taeinn Bridge, and continue northward to Expressway 6. The Chinwol Access provides the access to Expressway 6. A third route (not yet given a route number) heads eastward off of Taeinn Island across the Sumchin Bridge and thence northeastward to Expressway 6 (Hadong Interchange). All routes accessing POSCO Island intersect a two-lane access road that goes around the west side of POSCO Island and ends at the Export Wharf terminal. The International Road Federation chart lists Korean highway legal limits as 3.8 meters for height and 2.5 meters for width. The highway legal limit for a single axle load is 10 metric tons. The graphic on the next page shows highway access.

Rail

The Port of Kwangyang has indirect rail access. Rail operations are limited to the railyard (38 spurs) at Taegum Rail Station on the northwest side of the island. A single track rail bridge connects POSCO Island to the mainland. This line connects to the main line (Kyongjonson Line) near the city of Kwangyang, west of the port. Due to the location of the railyard away from the port, deploying units must convoy equipment from the port to the railyard. The graphic on the next page shows rail access.

Air

The nearest military airfields are located at Kwangju (62 miles (100 kilometers) northwest of Kwangyang), and Sachon (37 miles (60 kilometers) east of Kwangyang). These airfields can handle C-5 aircraft. A small commercial airport is located at Yosu (28 miles (45 kilometers) southwest of Kwangyang). This airport can handle small commercial aircraft only.

Air Access

Highway and Rail Access Map

PORT FACILITIES

Berthing

The Port of Kwangyang falls under the Yosu District Ministry of Maritime Affairs and Fisheries (MMAF). POSCO, a huge manufacturer of raw steel products with a headquarters in the Port of Pohang, Korea, owns and operates the Port of Kwangyang.

The Port of Kwangyang currently consists of four wharves: Import Wharf, Export Wharf, Container Wharf, and Management Wharf. The Import Wharf is used for importing raw materials, such as coal, needed for the manufacturing of bulk steel products. This wharf is used specifically for importing bulk cargo and is not militarily useful.

The Export Wharf is used for exporting bulk steel products and has potential for military operations. This wharf consists of four berths all in a straight line totaling almost 6,500 feet (about 1,980 meters). Berth water depths range from 23-46 feet (7-14 meters). The graphic on the following page is a layout of the port facilities. Over 4,000 feet (1,220 meters) of this wharf has a water depth of at least 36 feet (11 meters) alongside at mean low water (MLW).

The Container Wharf is under construction and only one berth has been completed. Although ships could berth here, the supporting infrastructure, such as paved marshaling area and rail access, is not developed. Also, no cranes have been installed at the Container Wharf. A total of four berths should be operational in 1997.

The Management Wharf is used for administrative purposes and is not useful to the military.

In general, the Port of Kwangyang is suitable for breakbulk, RORO, container, and barge operations. Lighting exists throughout the port.

Export Wharf at Kwangyang

KNR Rail Line
Single Track Rail Bridge
Taegum Rail Station
Side Ramp
38 Spur Rail Yard
To Kumho Bridge
29
Taeinn Bridge
Taeinn Island
POSCO
Container Wharf (Future Development)
Management Wharf
Covered Storage
Open Storage
Port Authority Administration Building
Gate
EXPORT WHARF
POL Hookup
Bulk Cranes
IMPORT WHARF
Open Storage
Tidal Basin

Land-Use Map

CHARACTERISTICS OF THE PORT OF KWANGYANG

Characteristics	Berths				
	Export 1	Export 2	Export 3	Export 4	Container
Length, ft (m)	2,361 720	787 240	2,427 740	918 280	4,362 1,330
Depth alongside at MLW, ft (m)	39 12	36 11	23 7	46 14	46 14
Deck strength, psf (met. ton/sq m)	614 3	614 3	614 3	614 3	614 3
Apron width, ft (m)	Open	Open	Open	Open	Open
Apron height above MLW, ft (m)	10 3	10 3	10 3	10 3	10 3
Number of container cranes	0	0	0	0	1
Number of wharf cranes	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	Yes	Yes	Yes	Yes
Apron length served by rail, ft (m)	0	0	0	0	0

Export Wharf 2

SUMMARY OF BERTHING CAPABILITIES for KWANGYANG					
VESSEL	BERTHS				
	EXPORT 1	EXPORT 2	EXPORT 3	EXPORT 4	CONTAINER
Breakbulk					
C3-S-38a	4	1	a	1	8
C4-S-58a	3	1	a	1	7
C4-S-66a	4	1	a	1	7
C5-S-37e	3	1	a	1	7
Seatrain					
GA and PR-class	4	1	a	1	7
Barge					
LASH C8-S-81b	2	(1)	a,f	1	5
LASH C9-S-81d	2	a,c	a	1	4
LASH lighter	16	5	17	6	21
SEABEE C8-S-82a	2	a,c	a	1	4
SEABEE barge	11	3	12	4	21
RORO					
Comet	i,m	i,m	a,i,m	i,m	8,d,i,m
Meteor	4,i	1,i	a,i	1,i	7,d,i,m
Cape Gnome	3,1	1,i	a,i	1,i	6,d,i
C7-S-95a	3	1	a	1	5
Cape Taylor	3	1	a	1	6
Cape Orlando	3,i	1,i	a	1,i	6,i
MV Ambassador	4,m	1,m	4,m	1,m	7,d
Callaghan	3,m	1,m	a,m	1,m	6,d,m
Cape Lambert	i,m	i,m	a	i,m	6,i,m
FSS-Class	2	(1)	a	(1)	4
Cape E-class	3,i	1,i	a	1,i	6,i
Cape D-class	3,i	1,i	a	1,i	6,i
Cape H-class	3	1	a	1	5
Cape R-class	3,m	1,m	a,m	1,m	6,d,m
Cape Texas	3,i	1,i	a	1,i	6,i
Container					
C6-M-147a	3,e	1,e	a,e	1,e	6
C7-S-69c	3,e	1,e	a,e	1,e	6
C7-S-68c	3,e	1,e	a,e	1,e	6
C8-S-85c	2,e	c,e	a,e	1,e	5
C9-M-132b	2,e	c,e	a,e	1,e	4
C9-M-F141a	2,e	a,c,e	a,e	(1),e	4
Combination					
C6-S-1qd	3	1	a	1	6
C5-S-MA73c	3	1	a	1	6
C6-S-MA60d	3	1	a	1	6

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft

( ) indicates vessels assigned by analyst

Open Storage

The Port of Kwangyang has 56 acres (226,860 square meters) of developed open storage at the Export and Management Wharves. Another 11.3 acres (45,777 square meters) of open storage will be available at the Container Wharf. One berth is complete at this wharf and another three will be complete in July 1997.

The open storage at the Export Wharf is in a dynamic state of change. Much of this area will be converted to covered storage within 1 year and will be used to protect the bulk steel from rusting. We believe that some of the Container Wharf open storage will be complete and available to ease the open storage-to-covered storage conversion at the Export Wharf. Current open storage use is about 20 percent. The Export Wharf appears to have the most potential for helicopter operations. After the Export Wharf open storage is converted to covered storage, the Container Wharf will have the most potential for helicopter operations. Deploying units should contact the MMAF and POSCO to make arrangements for such operations.

Covered Storage

The Port of Kwangyang has 81,430 square feet (7,573 square meters) of covered storage at the Export (Berth 3) Wharf. Current facility use is estimated at 20 percent.

Open Storage

Covered Storage

Rail

The wharf areas do not have rail access. This means rail operations are limited to the railyard at Taegum Rail Station. This railyard has 38 spurs and is capable of storing a maximum of 900 railcars (790 railcars on a daily basis). A fixed side ramp is located along one spur that has 492 feet (150 meters) of straight track. A small switching locomotive is available at this railyard. It has the ability to move a maximum of 15 loaded railcars at one time. For rail transport, deploying units must convoy equipment from the wharf area to the Taegum Rail Station (2-3 miles, 3.2-4.8 kilometers).

Highway

The Taeinn and Kumho Bridges provide the highway access to POSCO Island. All routes accessing POSCO Island intersect a two-lane access road that goes around the west side of the island and ends at the Export Wharf terminal. Road clearance under the railroad bridge is 4 meters. Another route (a six-lane road) leads directly through the POSCO facilities to the Export Wharf. The gate leading to the Export Wharf has two lanes, one for each direction. A portable truck scale is available at the wharf gate.

Taeinn Bridge

Kumho Bridge

Wharf Gate

Ramps

The only available ramp at the Port of Kwangyang is the fixed side ramp at Taegum Rail Station. Deploying units should make arrangements for portable ramps for offloading railcars and semi-trailers through the 1317th Medium Port Command. The Taegum station railyard has several spurs with potential for end-ramp operations.

Taegum Railyard

Fixed Side Ramp

Docks

No docks exist for truck or boxcar loading/offloading.

OFF-PORT MARSHALING AREAS

No specific off-port marshaling areas were identified by port officials. However, the area surrounding the port is open and off-port marshaling areas should be available throughout POSCO Island.

MATERIALS HANDLING EQUIPMENT (MHE)

The Export Pier has 10 container-type cranes; however, these cranes have been rigged to handle bulk steel for export shipments. The Port Authority has stated that these cranes would take extensive re-rigging to perform other operations such as breakbulk or container. Kwangyang does not have any mobile cranes inherent to the port. Local stevedoring companies would provide these cranes and deploying units would need to ensure arrangements have been made to get the necessary MHE.

AMMUNITION HANDLING FACILITIES

The Port of Kwangyang has no experience in handling ammunition. However, its location away from heavily populated areas and storage facilities provide a potential for ammunition operations. Any plans for conducting such operations must be coordinated with the Korean Ministry of Defense and MMAF well in advance.

PETROLEUM, OIL, AND LUBRICATION (POL)

POL facilities are available at the Port of Kwangyang. The port has 10 storage bunkers. They are allotted as follows: three 30,000-barrel tanks for Bunker C fuel; two 10,000-barrel tanks for diesel fuel; one 10,000-barrel tank for Bunker C fuel; one 5,000-barrel tank for diesel fuel; one 5,000-barrel tank for Bunker A fuel; one 5,000-barrel tank for Bunker C fuel; and one 2,000-barrel tank for Bunker A fuel. Four pipelines connect the ships to the storage tanks. Two are 10-inch hoseline connections for Bunker C fuel with a flow rate of 400 kiloliters per hour. The other two are 6-inch hoseline connections, one for Bunker A and one for diesel, with a flow rate of 200 kiloliters per hour.

POL Facilities

INTERMODAL FACILITIES

An intermodal capability is part of the future development for the Kwangyang Port. When complete, the Container Wharf will be over 19,000 feet (5,800 meters) long. A rail spur will connect this wharf to the main line at Hwangkil Rail Station. Four berths are due to be completed by July 1997. Currently, the nearest intermodal facilities are at Pusan.

FUTURE DEVELOPMENT

The Port of Kwangyang has ambitious plans concerning future development. In addition to the Container Wharf mentioned in the Intermodal Facilities, a car-carrier wharf will be built southwest of the Container Wharf. This wharf will be a RORO facility used for the export of Korean cars to foreign countries. Because this is a long-term project, no timetable has been established for completing this wharf.

Much of the open storage area at the Export Wharf will be converted to covered storage within the year. The reason for this is to establish protective temporary storage for the bulk steel products to be exported. The covered storage will prevent the bulk steel products from rusting.

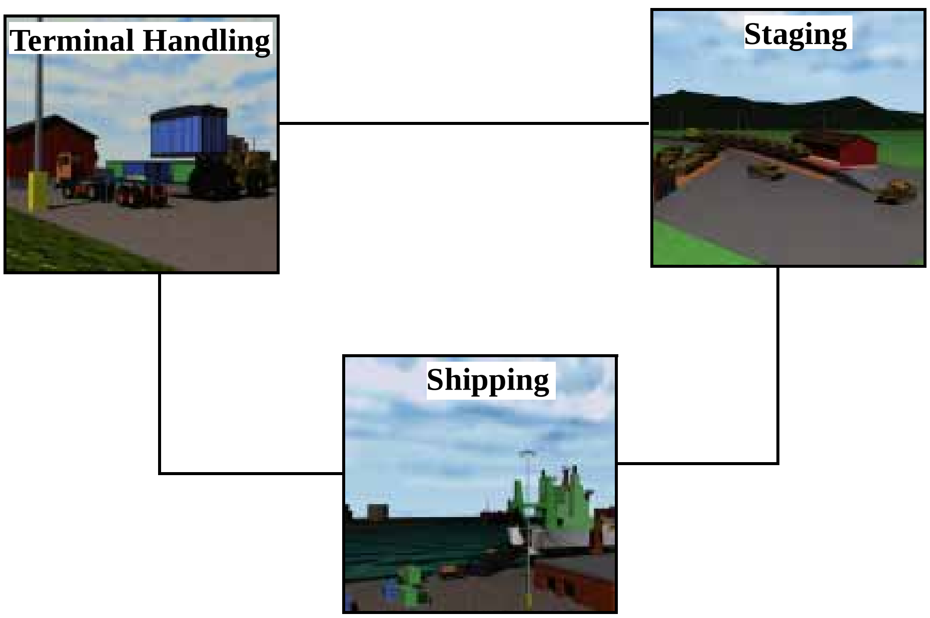
Another project is to extend the length of the Export Wharf. No information was available that would show the length of the wharf after completion.

Future Development

II. THROUGHPUT ANALYSIS

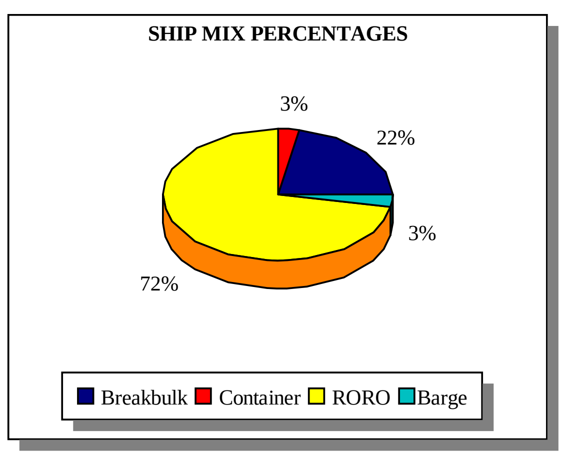
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Kwangyang. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, hardstand marshaling, and terminal processing/handling - in terms of short tons (STON) per day. This study assumes that two floating cranes and four 100-STON mobile cranes will be available for offloading ships at the Port of Kwangyang. Further, this study assumes that one container crane will be installed for container operations at the container wharf by July 1997.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 80 percent of the port facilities will support military deployments. Also, due to the size of the port, we assumed a berth utilization factor of 80 percent. The ship mix is determined by Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo DWT and expectations for future deployments.



TERMINAL RECEPTION/HANDLING

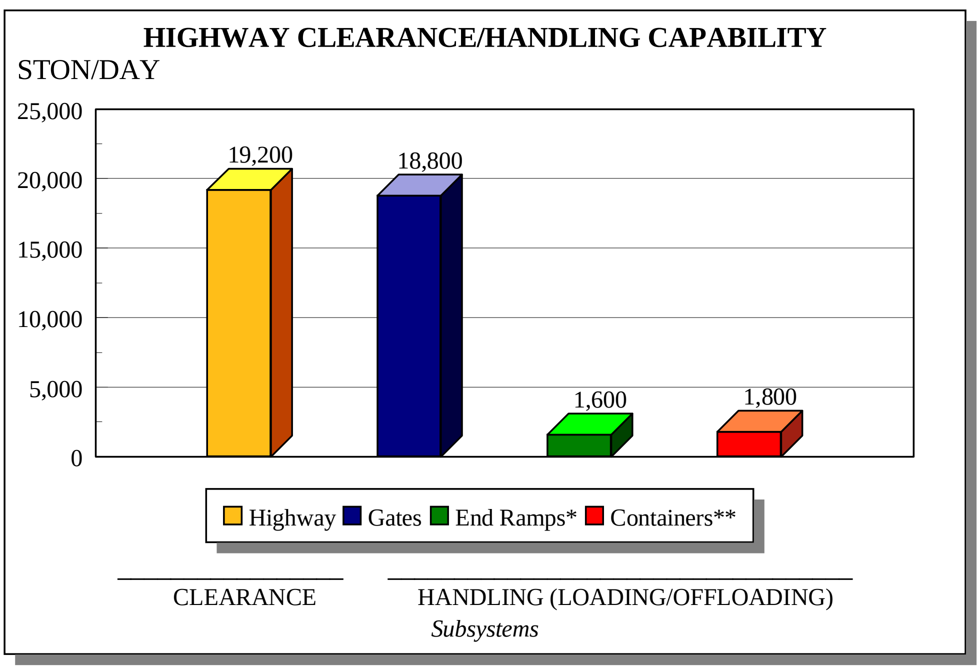
Highway

The port access road around the west end of the island is the major roadway connecting the port to the roads going inland (Routes 29, 840, and so forth). This road, including the gate, is a two-lane facility. This road network into and out of the port, including the gate processing of vehicles, can handle about 10,200 STON (40,200 MTON) of equipment and supplies per day. A six-lane roadway appears to go from the north end of the island straight through the POSCO facilities to the terminal gate. If the military has access to this during a deployment the highway throughput will increase to 18,800 STON (74,600 MTON).

Roadable vehicles will process from the port directly to off-port marshaling areas. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. Since no fixed or portable truck ramps are available at the port, we assume that the military port operator will acquire a portable end ramp to support loading flatbed trucks and semitrailers. This ramp could handle 1,600 STON (4,800 MTON) per day.

The port has no truck docks.

The Port of Kwangyang is scheduled to have four container berths available by July 1997. Assuming these berths will have one container handler to support container loading operations, the port can handle almost 1,800 STON (4,400 MTON) per day. This capability assumes that 75 percent of the containers will go by highway from the port.

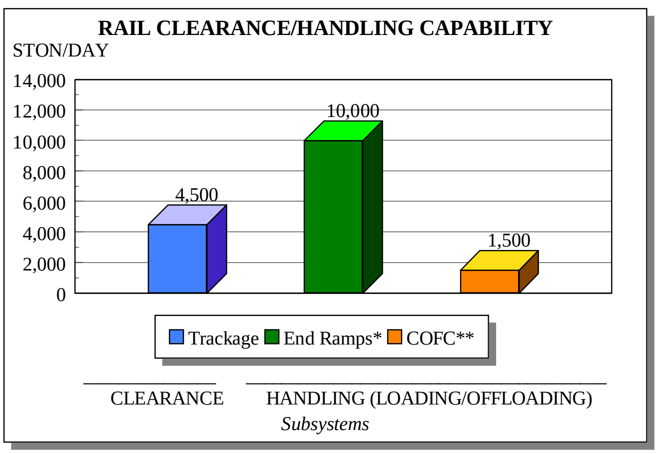


*Based on acquiring one portable end ramp.
**Based on acquiring one item of container handling equipment

Rail

A spokesperson at the Taegum Rail Station stated that the current workload is 6 trains per day at 15 railcars per train. A small switching locomotive, having the capability to move a maximum of 15 loaded railcars at one time, is a constraint here. In general, rail lines in Korea are designed to handle 22 railcar trains. The single track rail bridge is also a constraint and will limit the number of trains that can cross to POSCO Island each day. A fixed side ramp is available at Taegum Rail Station. The length of straight track along the spur with fixed side ramp is 492 feet (150 meters). We assume that the military port operator can acquire two other portable end ramps to supplement the fixed side ramp. The Taegum Station railyard has numerous spurs with straight track length of at least 1,500 feet (457 meters) each that could accommodate these portable ramps. The three ramps could easily handle 90 railcars daily. If a more capable locomotive is available, the ramps can handle about 105 railcars daily. (This estimate assumes 6 trains per day with 4 of the trains (22 railcars per train) going to the portable end ramps and two trains (9 railcars for each train) going to the fixed side ramp).

We assume that at least one CHE will perform container-on-flatcar (COFC) operations. This CHE could handle 1,500 STON (3,750 MTON) per day.



*Based on acquiring two portable end ramps to supplement the fixed side ramp.

**Based on acquiring one CHE.

Single Track Railroad Bridge

OPEN STORAGE

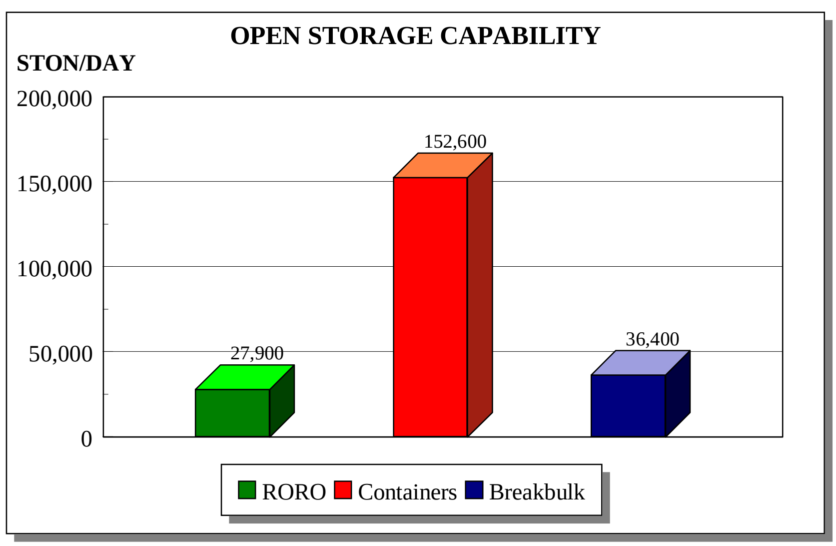
The port has about 56 acres (almost 226,900 square meters) of developed open storage that can be used for hardstand marshaling. It also has 81,430 square feet (7,565 square meters) of covered storage at Berth 3 of the Export Wharf.

The port currently has the ability to perform operations on RORO, barge, or breakbulk ships. A container capability is in the future. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned.

The chart on this page provides the cargo open storage capability for each vessel type. If a combination ship is expected, then a portion of each involved capability should be assumed.

Based on the shipping subsystem throughput for RORO and container operations (see Throughput Summary Table), 60 acres (243,100 square meters) of open storage are estimated to marshal the daily RORO throughput capability for the Port of Kwangyang (includes development of four berths at the container terminal). Nine acres of open storage are needed to store containers. The RORO acreage considers the estimated square feet for RORO throughput (Throughput Summary Table) and includes a factor to account for areas to store frustrated cargo, working areas, areas around ramps and gates, lanes and access to vehicles, and other factors. The container acreage is based on the container throughput in TEUs (Throughput Summary Table) and uses the yard gantry crane system for storage (325 TEUs per acre). This estimate does not take into consideration that equipment would clear the port shortly after offloading. Including the acreage to be developed at the Container Wharf, the port will have about 67 acres. This should be enough to store the daily throughput capability for the Port of Kwangyang, especially since some equipment may leave the port shortly after offloading.

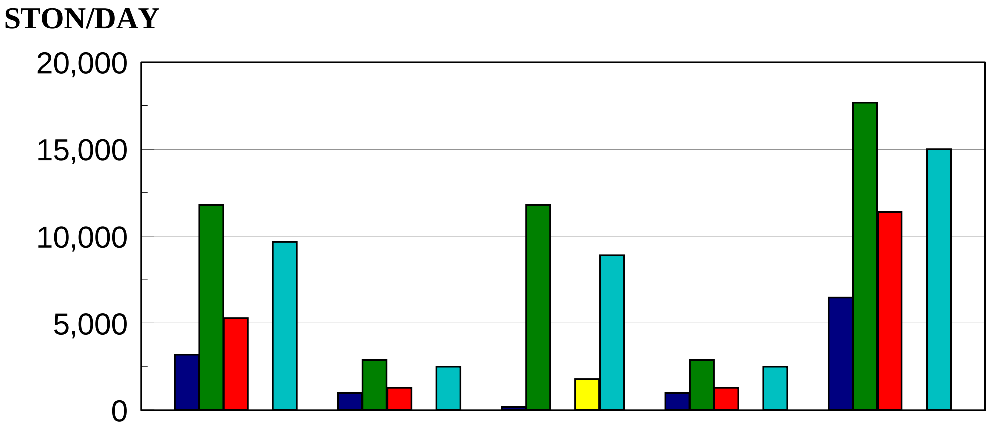
Based on the shipping subsystem, current port conditions (without container wharf) require about 38 acres of open storage to marshal the daily RORO throughput capability. Twenty-one acres are needed to store containers. The container requirement is based on the chassis system for storing containers (70 TEUs per acre). The 56 acres currently available should be sufficient in handling open storage requirements. Again, a significant portion of the equipment should clear the port immediately upon offloading from the ship.



SHIPPING

Throughputs for each berth are shown below. They are based on various factors including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. Assumptions used in this study are in the appendix.

BERTH THROUGHPUT CAPABILITY



	EXPORT 1	EXPORT 2	EXPORT 3	EXPORT 4	CONTAINER
Breakbulk	3,200	1,000	200	1,000	6,500
RORO	11,800	2,900	11,800	2,900	17,700
Containers	5,300	1,300	0	1,300	11,400
Barge	0	0	1,800	0	0
Mixed	9,700	2,500	8,900	2,500	15,000

CONVERSION FACTORS

Breakbulk: .4 STON per MTON
RORO: .25 STON per MTON
Containers: .4 STON per MTON

Export Wharf

THROUGHPUT SUMMARY FOR PORT OF KWANGYANG PER DAY

PORT/ BERTH	LENGTH (feet) (meters)	DEPTH ALONGSIDE (feet) (meters)	BREAKBULK THROUGHPUT (STON) (MTON)	RORO THROUGHPUT (STON) (MTON)	RORO SQUARE FT (EST)	RORO PIECES	CONTAINER THROUGHPUT (STON) (MTON) (TEU)	BARGE THROUGHPUT (STON) (MTON)	MIXED THROUGHPUT (STON) (MTON)
EXPORT-1	2,361 720	39 12	3,200 8,100	11,800 47,200	236,000	1,390	5,300 13,300 660	0	9,700 38,000
EXPORT-2	787 240	36 11	1,000 2,400	2,900 11,800	59,000	350	1,300 3,300 410	0	2,500 9,600
EXPORT-3	2,427 740	23 7	200 400	11,800 47,200	236,000	1,390	0	1,800 4,400	8,900 35,300
EXPORT-4	918 280	46 14	1,000 2,400	2,900 11,800	59,000	350	1,300 3,300 410	0	2,500 9,600
CONTAINER	4,362 1,330	46 14	6,500 16,400	17,700 70,800	354,000	2,080	11,400 28,600 1,430	0	15,000 57,100

Note: RORO pieces based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

We base the type of ship preferred at each berth on the methodology described in the appendix. The evaluation is a snapshot view of the current physical characteristics of the berths and MHE available. The berths are rated according to rank. The lower the number for a berth, the better the berth is suited for the loading or offloading operation. For example, Export 1 is ranked better than Export 3 at conducting RORO and container operations. In general, no one berth is ideal for all military operations. The best berth depends on the type of ship loaded.

Because of direct rail access and new state-of-the-art facilities, the new Container Wharf is the obvious choice for all types of operations. Of the existing facilities, Export 1 is the choice for all-around operations.

LOADING TYPE	**BERTHS**				
	Export 1	**Export 2**	**Export 3**	**Export 4**	**Container**
Breakbulk	2	2	-	2	1
RORO	2	4	5	3	1
Container	2	4	-	2	1
Barge	2	2	2	2	1
Note: Berths marked with a "-" are not recommended for these operations.					

III. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional airborne division using primarily FSS vessels. Currently, facility use depends on decisions made by the Korean Ministry of Defense and MMAF. Because of the Korean commitment to defense of their country and considering current facility use at Kwangyang (about 20 percent), we assume that all of the Export Wharf and associated staging areas are available for military use. We also assume that no other military units (US or Republic of Korea) will be competing for port assets and facilities during the time that the airborne division occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately offload the ship and clear the port. Since it is not fully developed, we are not considering use of the Container Wharf at this time.

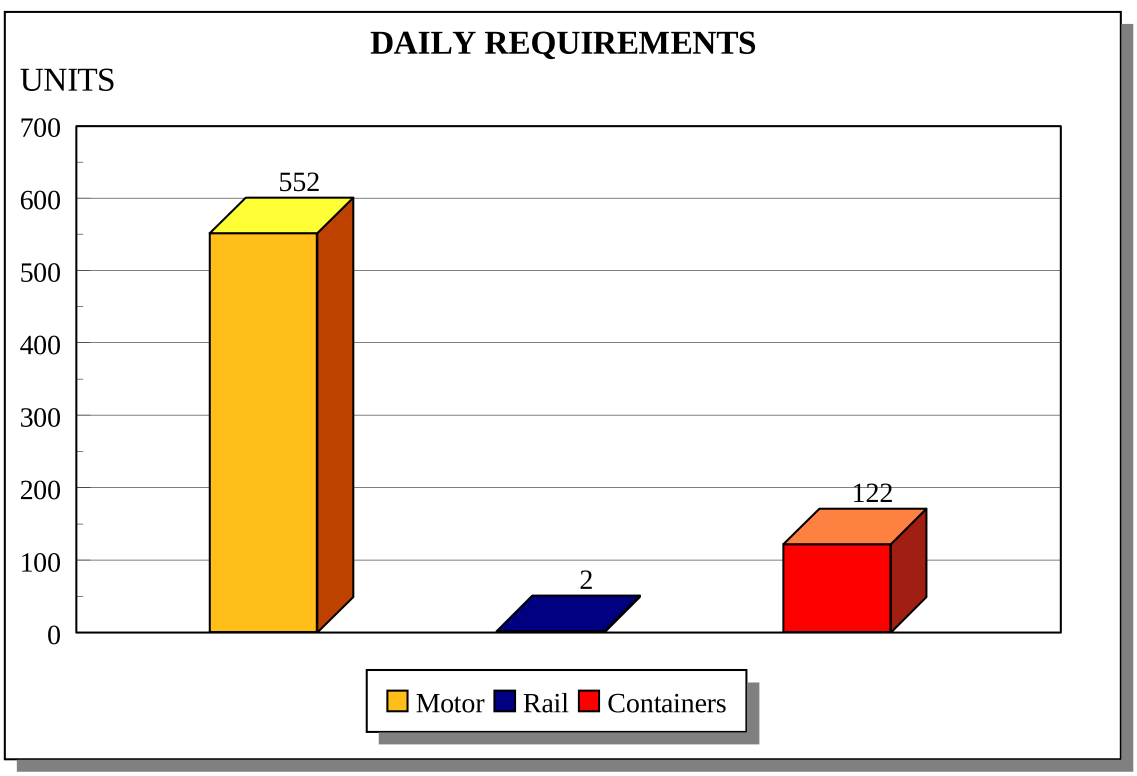
Potential Port Use During Deployment

REQUIREMENTS

The likely requirement for the Port of Kwangyang would be to deploy a notional airborne division in 5 days of ship offloading and port clearance. The division has to move 4,714 vehicles and 609 containers. Movement of this division from the port will require only seven railcars using the convoy/rail option. Under this option, 2,760 (552 per day) roadable vehicles would be driven through the gate, towing 1,176 (236 per day) trailers. About 122 containers would arrive daily.

AIRBORNE DIVISION

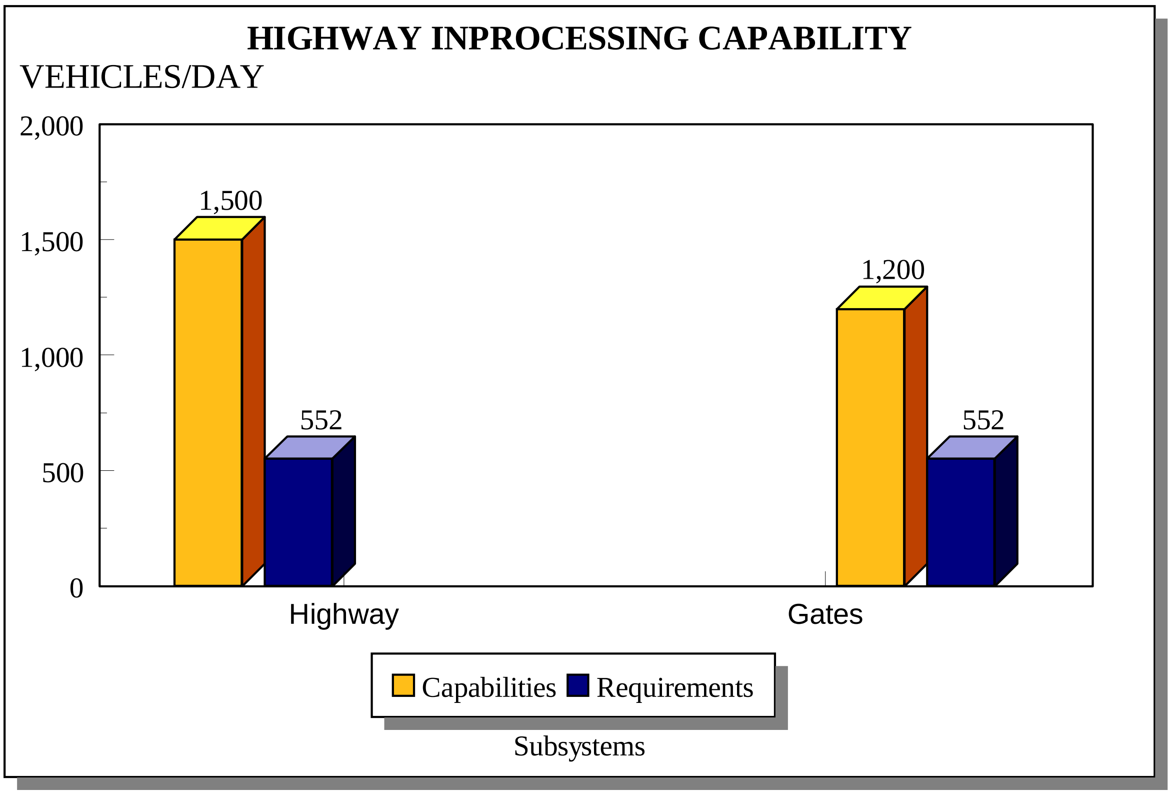
Total Equipment	
Volume	119,900 MTON
Weight	26,900 STON
Area	773,650 SQ FT
Vehicles	4,911
Containers	609



TERMINAL INPROCESSING/HANDLING

Highway

The port access road is the connector between the port and the two roadways leaving the island. The access road and gate processing subsystems can handle more than 1,500 and 1,200 additional vehicles per day, respectively. A six-lane road appears to go through the POSCO facilities from the north end of the island straight to the wharf. If needed, deploying units could pursue using this additional roadway through the Korean Ministry of Defense and the MMAF. Portable scales are available at the wharf gate.



Rail

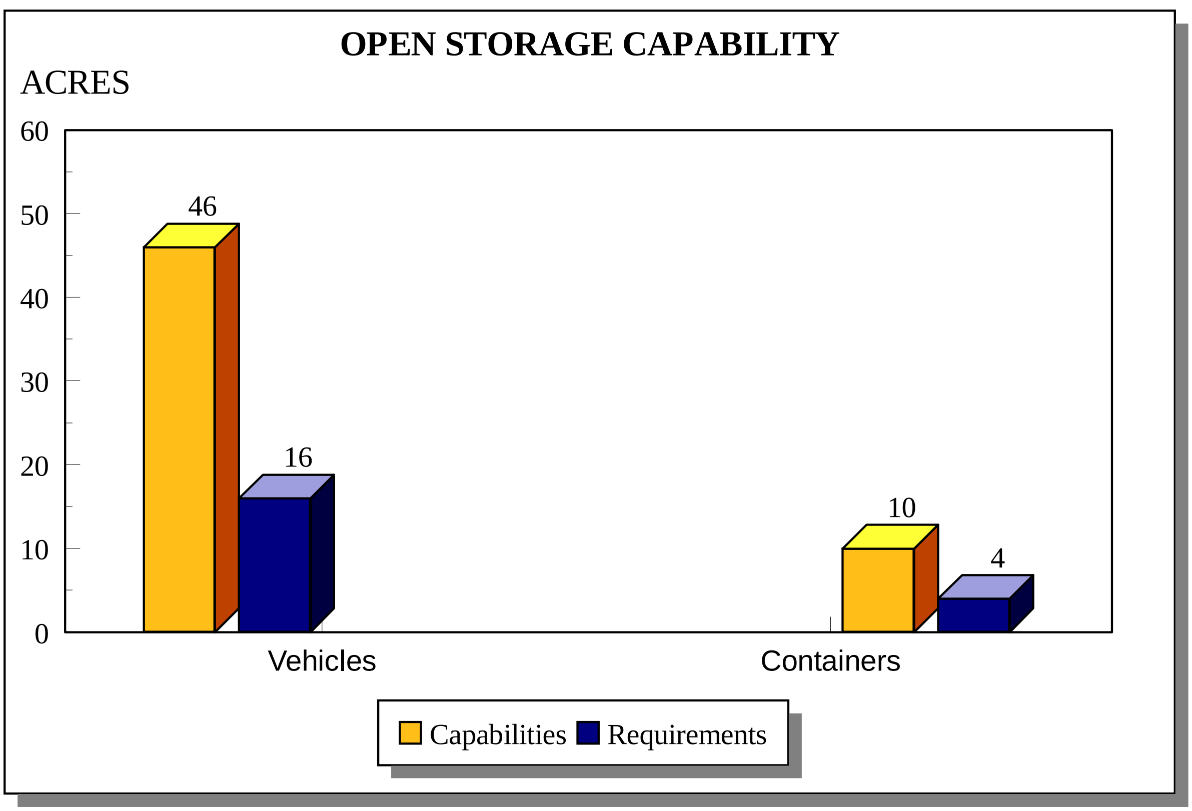
The Korean National Railroad (KNR) serves Taegum Rail Station on the northwest side of the island (about 2-3 miles northwest of the port). A spokesperson at the rail station has stated that the current rail service is six trains per day. The number of railcars per train is 15. Seven railcars are needed to move a notional Airborne Division. The facilities at the rail station can easily accommodate loading and moving the seven railcars within the time requirements.

OPEN STORAGE

Based on the MTMCTEA Deployment Planning Guide (MTMCTEA Reference 94-700-5), this analysis assumes that a little over four FSS-sized ships will deploy a notional Airborne Division. This division must deploy through the port in 5 days. Because of this, the storage requirement is to support two sustained offloading operations.

Although an FSS load of cargo can be offloaded on as little as 8 acres of hardstand marshaling, we determined 10 acres (40,510 square meters) are required for sustained offloading operations. The 10-acre per FSS requirement is dependent upon port clearing capabilities and the availability of off-port marshaling areas. The highway and rail portions of this application show that port clearance should not be a problem. If needed, off-port marshaling areas should be available within the POSCO facilities to supplement the port in open storage. Of the 10 acres, about 2 acres are required for marshaling the 152 containers per FSS. About 20 acres are required to support the simultaneous offloading of two FSS ships. The Port of Kwangyang currently has 56 acres at the Export Wharf. This should be enough to handle hardstand marshaling requirements. The acreage requirement could increase to 32 acres (16 acres per ship) if conditions do not allow for adequate port clearance or off-port marshaling of equipment.

Available covered storage is 81,430 square feet (7,565 square meters) at the Export Wharf.



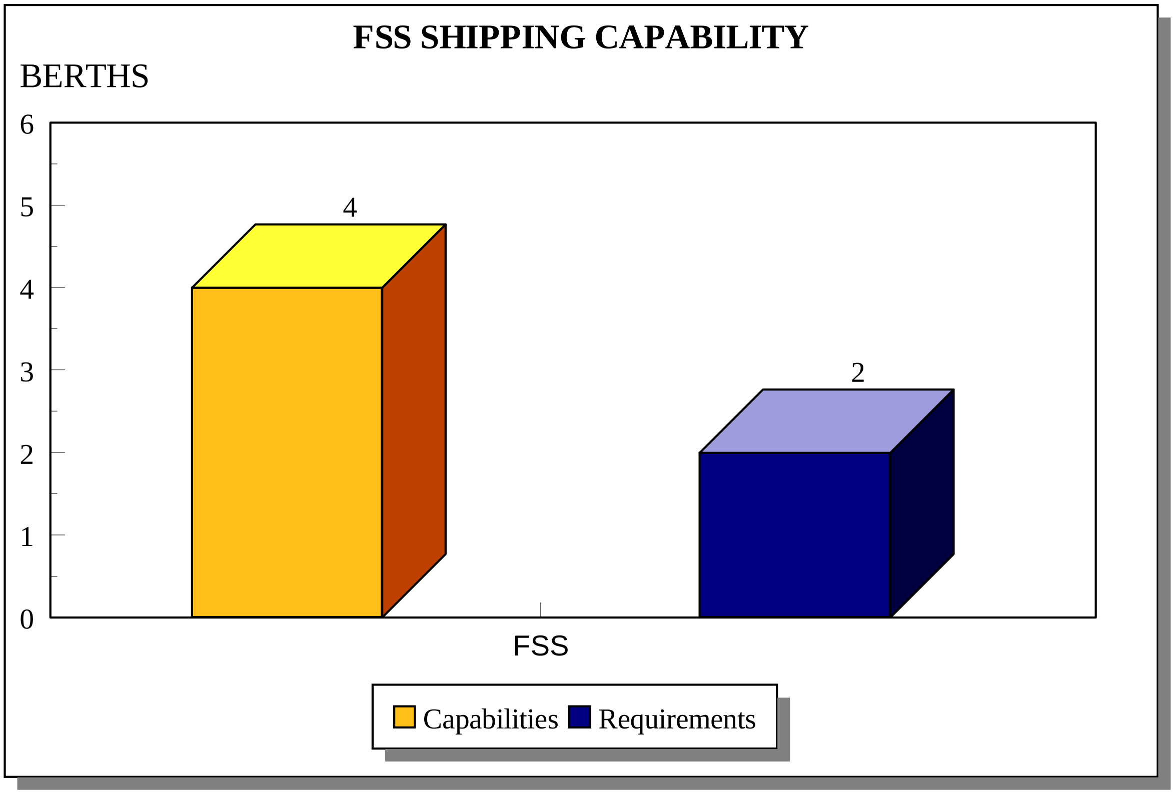
Although this analysis assumes that only FSS-sized ships can deploy a notional Airborne Division, the table below provides ship quantities needed to move this division using minimum containerization. The number of ships required depends on the shipping mix selected. The best ship mix would consist of four FSS and one small RORO or three LMSR.

The port could berth and offload a maximum of four FSS vessels at one time depending on port clearance capabilities and availability of off-port marshaling areas. If adequate hardstand marshaling is not available within the POSCO facilities to handle equipment leaving the port area immediately after offloading and/or port clearance, then the port will likely be limited to a maximum of three FSS vessels at one time.

UNIT MOVEMENT REQUIREMENTS
AIRBORNE DIVISION

Loading Condition/ Sample Ship Mix	FSS (RORO/ Comb)	LMSR (RORO/ Comb)	Notional RORO (RORO/ Comb)	C3/C4 (Breakbulk or Container)	C6/C7/C8 (Container)
Minimum Containerization					
All FSS	4.3				
All LMSR		2.8			
Notional RORO			5.1		
All Breakbulk				15.6	
Maximum Containerization					
FSS/Container	.41				3.4
LMSR/Container		.25			3.4
RORO/Container			.5		3.4
Breakbulk/Container				1.3	3.4

Legend:
RORO - roll on/roll off
FSS - fast sealift ship
Source: MTMCTEA Reference 94-700-5, Deployment Planning Guide, Sep 94.



SUMMARY

The Port of Kwangyang can offload and clear a notional Airborne Division within 5 days.

RECOMMENDATION

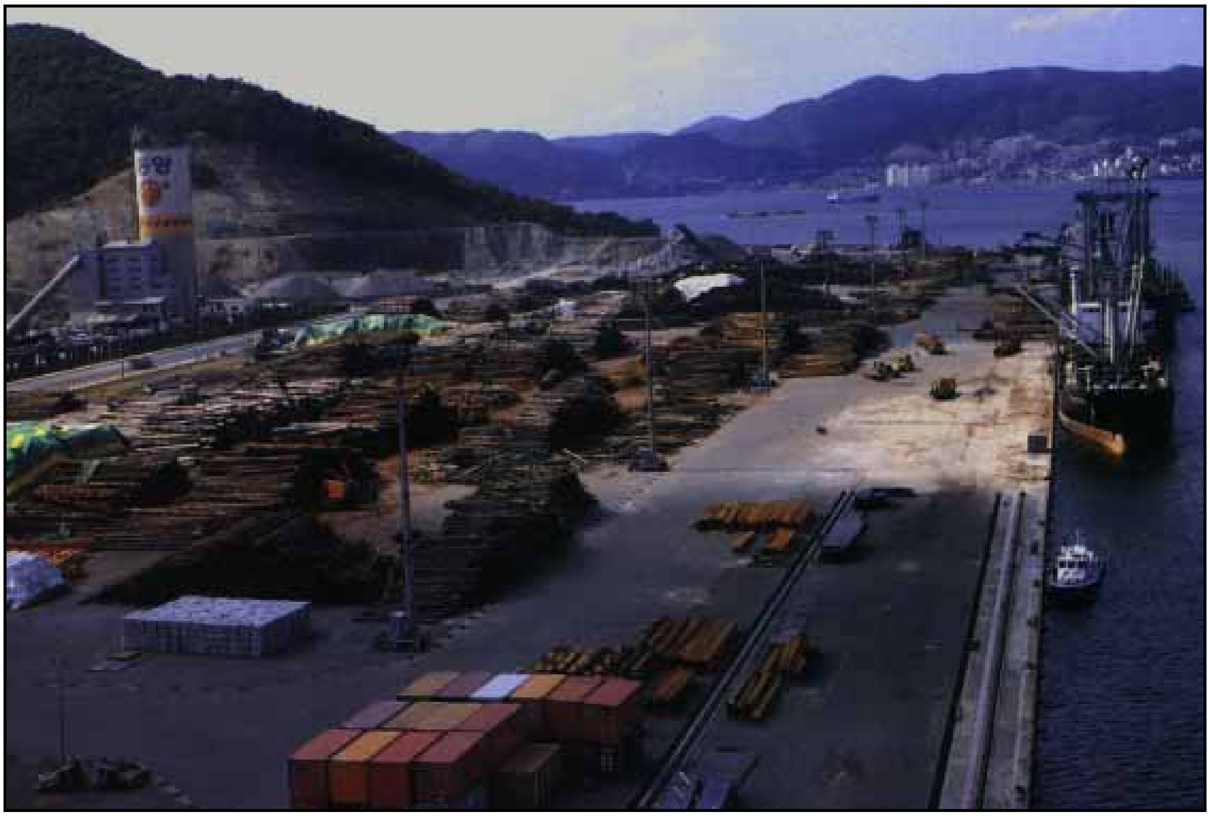
The Port of Kwangyang is a viable port for supporting deployment of a notional Airborne Division. The identification of off-port marshaling areas will become extremely important as much of the current available open storage at the Export Wharf will be converted to covered storage.

Efforts should be made to stay abreast of development of the Container Wharf. As the open storage areas at the Export Wharf are converted to covered storage, ships may need to be diverted to the Container Wharf. The development of open storage areas at the Container Wharf should ease the conversion of open storage to covered storage at the Export Wharf and will likely increase the number of FSS ships that the port can handle.

Arrangements should be made for self-deployable vehicles to use the six-lane roadway going through the POSCO facilities rather than use the two-lane access road going around the west end of the island.

July 96

PORT OF MASAN



I. General Data

II. Throughput Analysis

III. Application

Return to Index

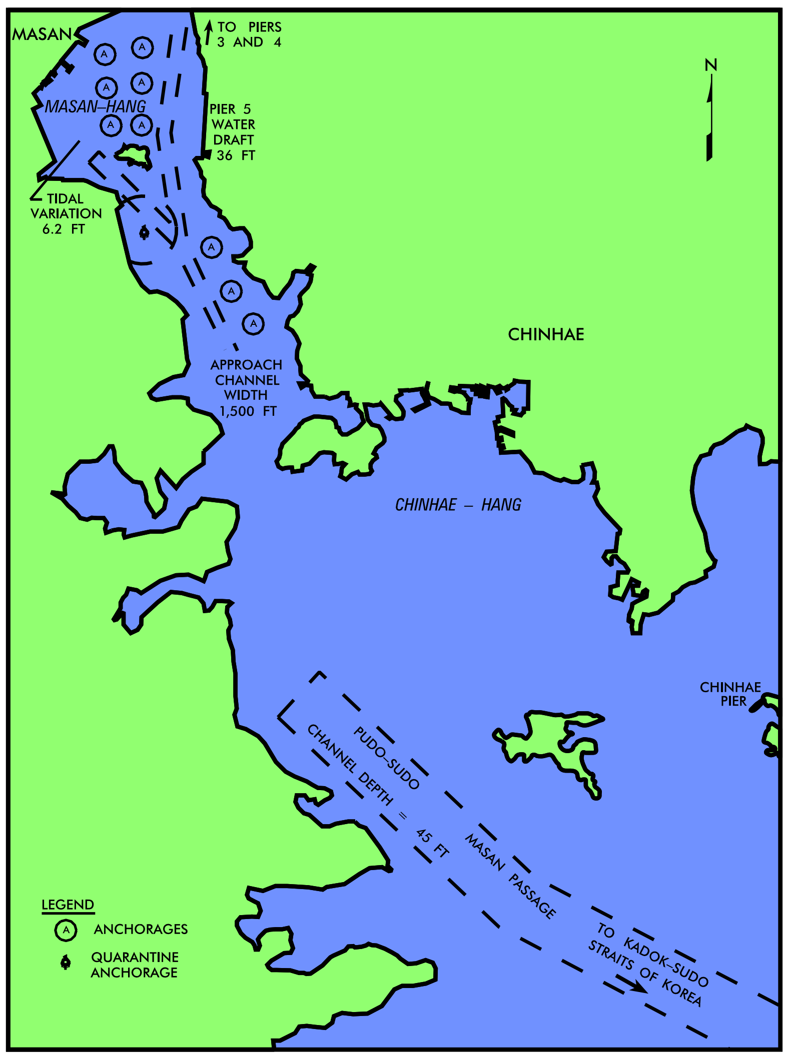
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Masan (35^{o} 11’ N; 128^{o} 34’ E) is a major port on the south coast of South Korea about 28 miles (45 kilometers) west of Pusan. The GeoCode for Masan is PKVP. Masan Bay, a bay well-protected by hills and islands, provides a natural harbor for the port and is considered a typhoon shelter. Ships calling on the Port of Masan can access Masan Bay from the Straits of Korea by using the Kadok Channel (Kadok-sudo) and Pudo Channel (Pudo-sudo). Having a deep-water draft, the Port of Masan can handle ships with water drafts up to 36 feet (11 meters). The tidal variation at the port is 6.2 feet (1.9 meters).

The channel depth of the Kadok and Pudo Channels is about 45 feet (13.9 meters). The Masan harbor (Masan Hang) is susceptible to silting during the rainy season. Dredging occurs on an intermittent basis to maintain channel depths in the Masan harbor. The approach channels are 1,500 feet wide (457 meters) and pilotage is compulsory. Several anchorages are in the Masan harbor. The maximum draft of the deepest anchorage is 42 feet (13 meters). The harbor has one turning basin with a 2,300 foot diameter (700-meter) and draft of 34 feet (10.5 meters). Ships exceeding the turning basin maximum draft must turn in the approach channel outside Masan harbor. No vertical or overhead restrictions exist in the approach to Masan, however, local fisheries place their nets in the ship channel. Sometimes these fishing nets are stretched across the entire width of the channel.



Water Access

Highway

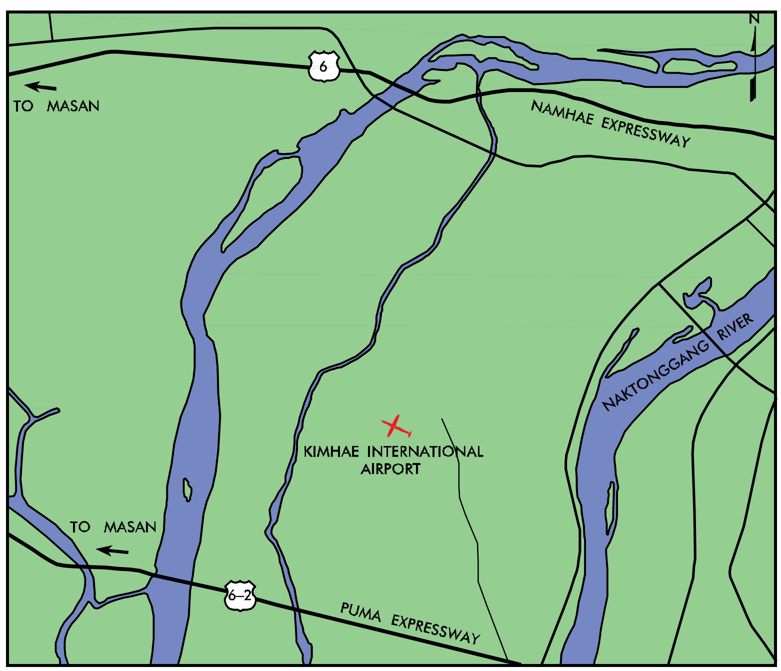
The Namhae Expressway (Expressway 6) is the major highway providing access to the Masan area. This highway, an east-west route near the southern coast of South Korea, can provide highway access to Pusan in the east and Kwangju in the west. Expressway 7 intersects Expressway 6 four miles (6.4 kilometers) west of Masan and leads north to Taegu. To reach these expressways, take the port access roads from the wharf areas to Route 2. Follow Route 2 northwest to the Samhoro. If traveling north or west, take route 5 off of Samhoro and access Expressway 6 at the Somasan Interchange. If traveling east, take route 14 off of the Samhoro and access Expressway 6 at the Tongmasan Interchange. Taking Route 2 southeast from the wharf access roads will lead to the port city of Chinhae. The Access Map on the following page provides a graphic of the highway network in and around Masan.

Rail

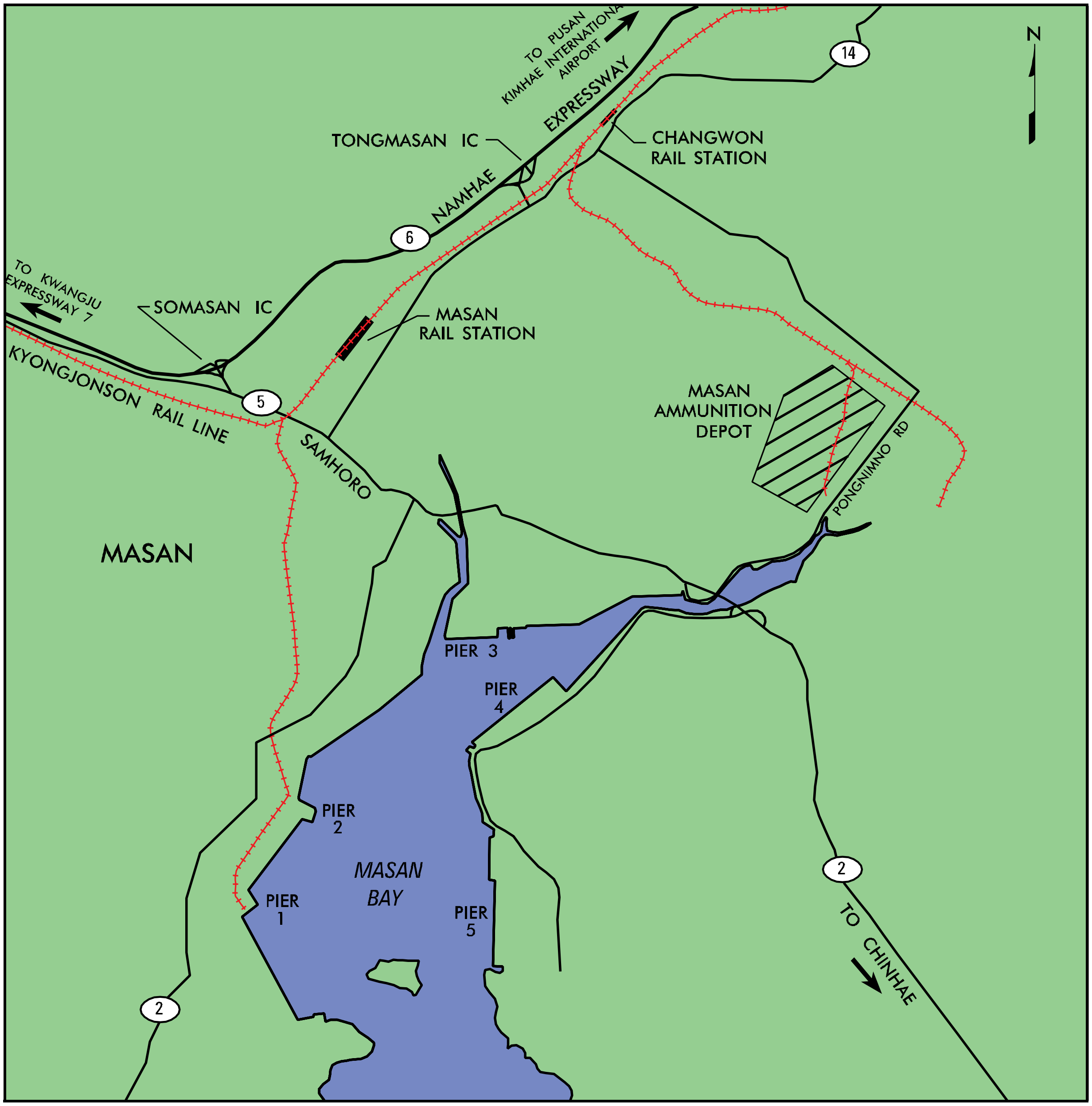
The Kyongjonson rail line provides rail access to the city of Masan. A rail spur leads to Pier 1 from the main line. Although the Port of Masan has rail access, vehicles and equipment would have to convoy to Pier 1 from Piers 3, 4, and 5 (deployment useful berths) to achieve rail transport. Convoys must travel through the most congested portion of the city from the military useful wharves to access Pier 1. More likely, deploying units will convoy to the rail spurs at Masan Ammunition Depot located 5 miles (8 kilometers) east of Pier 4, Port of Masan. The rail spurs at Masan Ammunition Depot access the Chinhaeson rail line. The Chinhaeson rail line intersects the Kyongjonson rail line near the Changwon rail station. The rail spurs at the ammunition depot can accommodate 69 railcars or store 54 railcars. The Pongnimno is the road that provides access to the ammunition depot from Piers 3, 4, and 5. The Access Map on the following page provides a graphic of the rail network in and around Masan.

Air

Kimhae International Airport, located on an island in the Naktong River delta in northwestern Pusan, is the nearest airport to Masan. This airport is about 25 miles (40 kilometers) east of Masan. Expressway 6 provides the highway access from Masan to the airport. This airport has one runway jointly used by commercial and military aircraft. The runway is 9,000 feet long (2,743 meters) by 150 feet wide (45 meters) and can handle C-5 aircraft.



Kimhae International Airport, Pusan



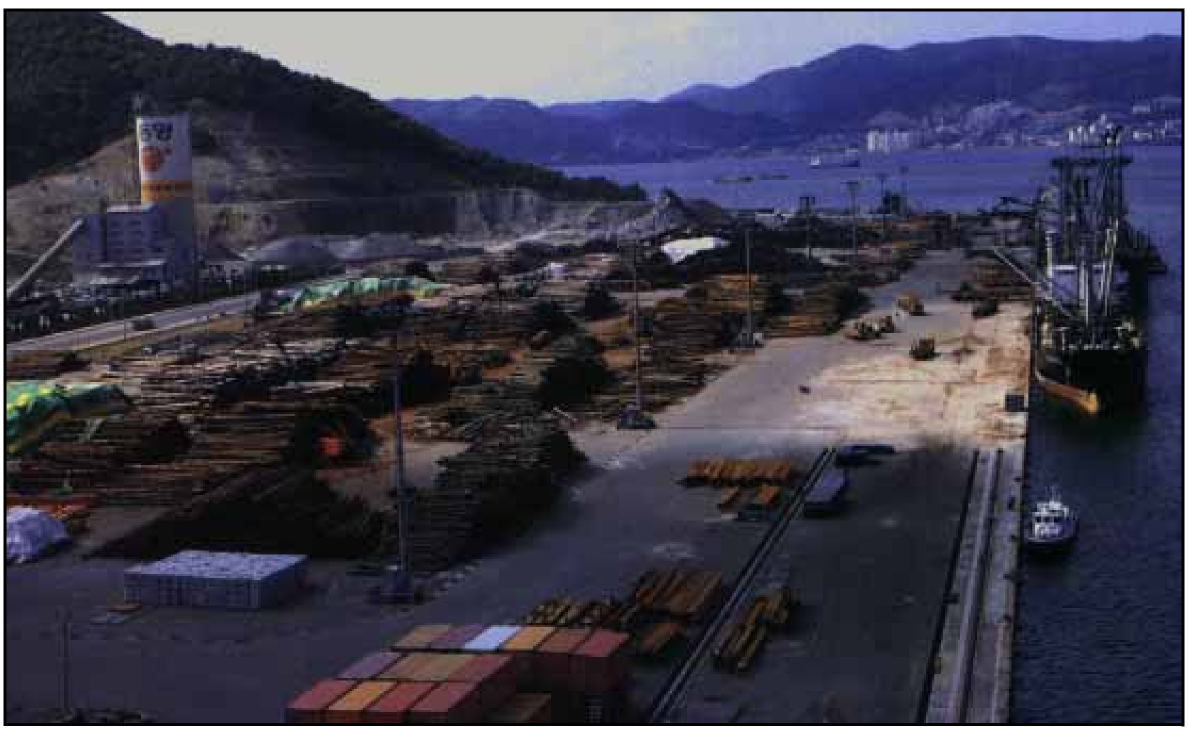
Highway and Rail Access Map

PORT FACILITIES

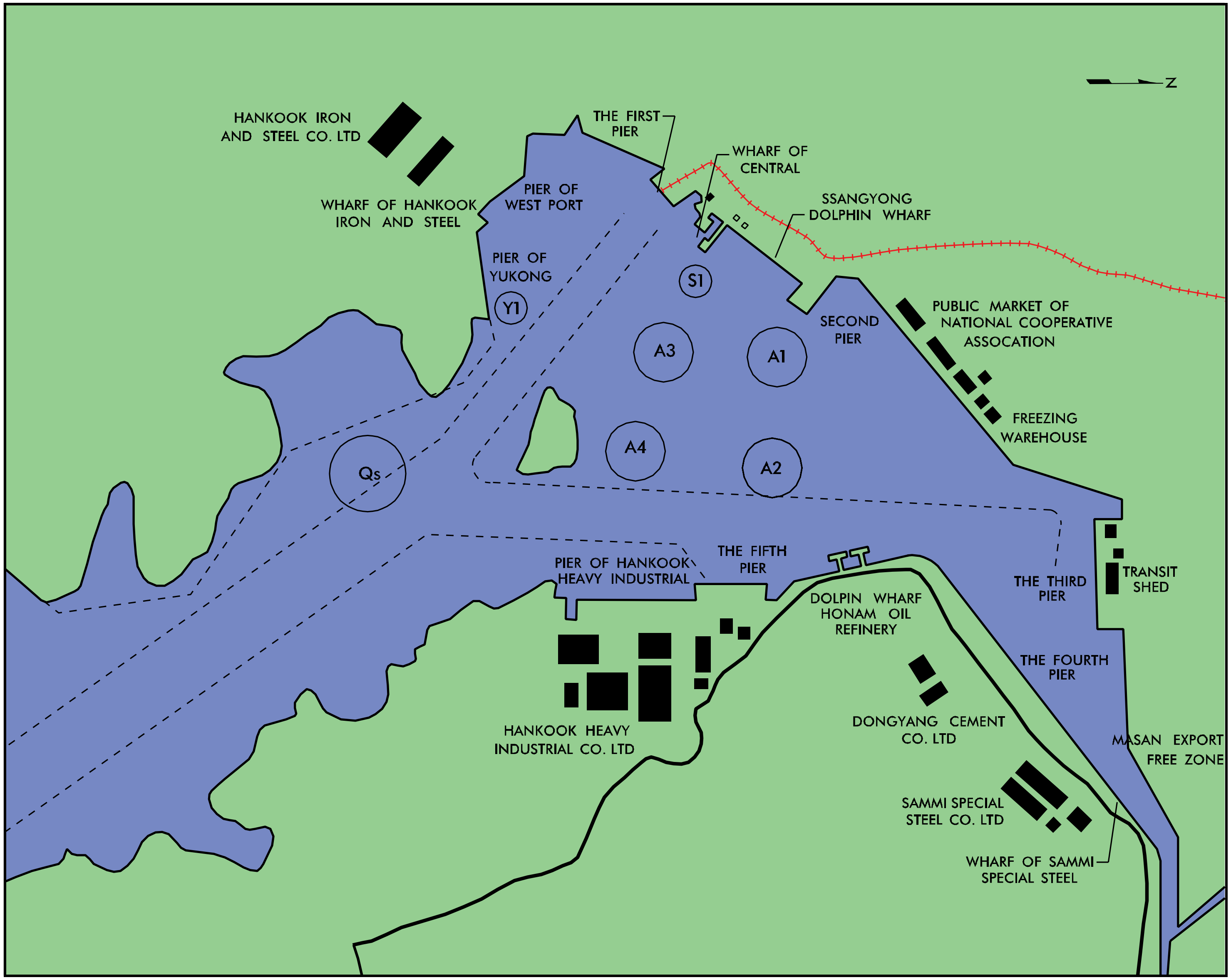
Berthing

The Port of Masan is a multicargo port capable of breakbulk, RORO, container, and barge operations. This port has experienced recent rapid development due to its establishment as the first free trade zone in the country. The Port of Masan falls under the Masan District Ministry of Maritime Affairs and Fisheries (MMAF). Because of their deep-water draft, available open storage, and location away from the most congested portion of Masan; Piers 3, 4, and 5 are the most desirable wharves for military operations.

Pier 3 is a general cargo wharf with transit shed and small open storage area. Pier 4 is the largest wharf at the Port of Masan. It is a general cargo wharf with large open storage area and is equipped with a 40-metric ton wharf crane. This crane is used to handle containers as well as general cargo. Pier 5 is the newest wharf at the Port of Masan and is also used for general cargo. Part of this wharf is still under development. Piers 4 and 5 are best suited for RORO operations. Lighting is available for night operations. None of these wharves have rail access. Piers 3 and 5 do not have wharf or container cranes. All three wharves have open storage available.



Pier 4


HANKOOK IRON AND STEEL CO. LTD
THE FIRST PIER
WHARF OF CENTRAL
SSANGYONG DOLPHIN WHARF
PIER OF WEST PORT
WHARF OF HANKOOK IRON AND STEEL
PIER OF YUKONG
Y1
S1
A3
A1
SECOND PIER
PUBLIC MARKET OF NATIONAL COOPERATIVE ASSOCATION
FREEZING WAREHOUSE
A4
A2
Qs
THE FIFTH PIER
PIER OF HANKOOK HEAVY INDUSTRIAL
THE THIRD PIER
TRANSIT SHED
DOLPIN WHARF HONAM OIL REFINERY
THE FOURTH PIER
HANKOOK HEAVY INDUSTRIAL CO. LTD
DONGYANG CEMENT CO. LTD
MASAN EXPORT FREE ZONE
SAMMI SPECIAL STEEL CO. LTD
WHARF OF SAMMI SPECIAL STEEL
N

Land-Use Map

CHARACTERISTICS OF THE PORT OF MASAN

Characteristics	Berths		
	Pier 3	**Pier 4**	**Pier 5**
Length, ft (m)	1,377 (420)	3,444 (1,050)	1,377 (420)
Depth alongside at MLW, ft (m)	30 (9.1)	33 (10)	36 (11)
Deck Strength, psf (met. ton/sq m)	600 (3)	600 (3)	600 (3)
Apron width, ft (m)	65 (19.8)	Open	Open
Apron height above MLW, ft (m)	6 (1.8)	6 (1.8)	6 (1.8)
Number of container cranes	0	0	0
Number of wharf cranes	0	1	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No
Apron length served by rail, ft (m)	0	0	0

Pier 5

SUMMARY OF BERTHING CAPABILITIES FOR MASAN

VESSEL	BERTHS		
	Pier 3	Pier 4	Pier 5
Breakbulk			
C3-S-38a	2	6	2
C4-S-58a	2,a	5	2
C4-S-66a	2,a	6	2
C5-S-37e	2	5	2
Seatrain			
GA and PR-class	2	5	2
Barge			
LASH C8-S-81b	1,a,f	4,a,f	1
LASH C9-S-81d	1,a,f,g	3,a,f,g	1,a,f,g
LASH lighter	6	17	6
SEABEE C8-S-82a	1,a,f,g	3,a,f,g	1,a,f,g
SEABEE barge	6	17	6
RORO			
Comet	2,d,o	6,d	2,d
Meteor	2,d,o	6,d	2,d
Cape Gnome	2,a,d,i	5,a,d,i	2,d,i
C7-S-95a	1,a	4,a	1
Cape Taylor	2	5	2
Cape Orlando	2	5	2
MV Ambassador	2,d	6,d	2,d
Callaghan	1,d,o	4,d	1,d
Cape Lambert	1,a	4,i	1,i
FSS-Class	1,a,g	3,a,g	1,a,g
Cape E-class	2,a	5,i,j	2,i,j
Cape D-class	1,a	4	1
Cape H-class	1,a	4,a	1
Cape R-class	2,a,d	5,d	2,d
Cape Texas	2	5	2
Container			
C6-M-147a	2,e	5,e	2,e
C7-S-69c	1,a,e	4,e	1,e
C7-S-68c	1,a,e	4,e	1,e
C8-S-85c	1,a,e	4,e	1,e
C9-M-132b	1,a,e	3,a,e	1,e
C9-M-F141a	1,a,e,g	3,a,e,g	1,a,e,g
Combination			
C6-S-1qd	1,a	4	1
C5-S-MA73c	2,a	5	2
C6-S-MA60d	1,a	4	1

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft

( ) indicates vessels assigned by analyst

Open Storage

The Port of Masan has 82 acres (332,567 square meters) of paved open storage at the military useful wharves (Piers 3, 4, and 5). The terminal-by-terminal breakdown for this open storage is in the table below. Much of this open storage is used on a daily basis for the temporary storage of raw materials such as logs. The only location suitable for helicopter operations is Pier 5.

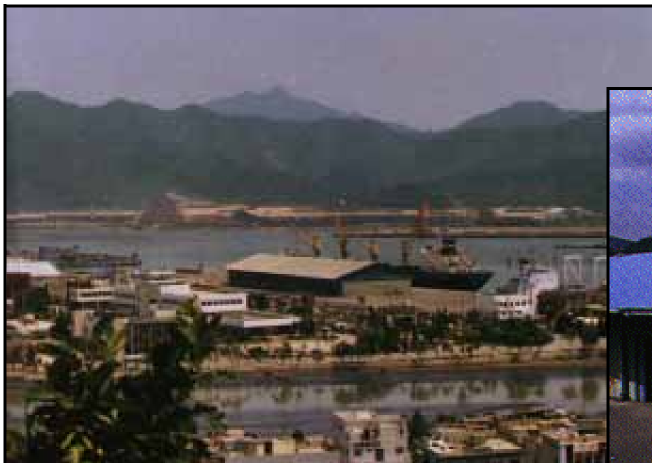
Port of Masan Open Storage Breakdown

Wharf/Pier	Acreage (square meters)
3	11 (44,680)
4	32 (131,538)
5	38 (156,000)

Open Storage Pier 4, Masan

Covered Storage

The Port of Masan has one transit shed on Pier 3 with an estimated storage area of 42,625 square feet (3,960 square meters). No other covered storage facilities are available at the military useful wharves.



Transit Shed at Pier 3

Rail

Convoys must travel through the most congested portions of Masan to reach the rail spurs on Piers 1, 2, and central. Convoys will most likely deploy to the nearby Masan Ammunition Depot. The rail spurs there can accommodate 69 railcars and store 54 railcars. No unusual clearance restrictions exist on the rail lines accessing the ammunition depot. All rail cargo must meet the clearance envelope for Korean rail transport. The 1317th Medium Port Command will likely need to furnish a portable steel end ramp for loading/offloading railcars.

Highway

In the port area, Route 2 is the major road providing access to the port access roads from the Samhoro. This road is a four-lane road and it experiences heavy congestion. Each terminal has its own gate. The access roads through the gates are four-laned (two for each direction). No unusual clearances exist on these roads. The International Road Federation Chart lists highway legal limits as 3.8 meters (12.5 feet) for height, 2.5 meters (8.2 feet) for width, and 10 metric tons (11 tons) for a single axle loading in South Korea. Truck scales are at Piers 4 and 5.

Ramps

The Port of Masan does not have any fixed or portable end ramps. Deploying units should make arrangements through the military port operator to ensure end ramps are available for loading/off-loading operations for railcars and semitrailers. One alternative is to transport a couple of the portable steel end ramps that are available at Pier 8, 1317th Medium Port Command, in Pusan. Pier 8 is about 35 miles (56 kilometers) from the Port of Masan.

Portable Steel End Ramps at Pier 8, Pusan

Docks

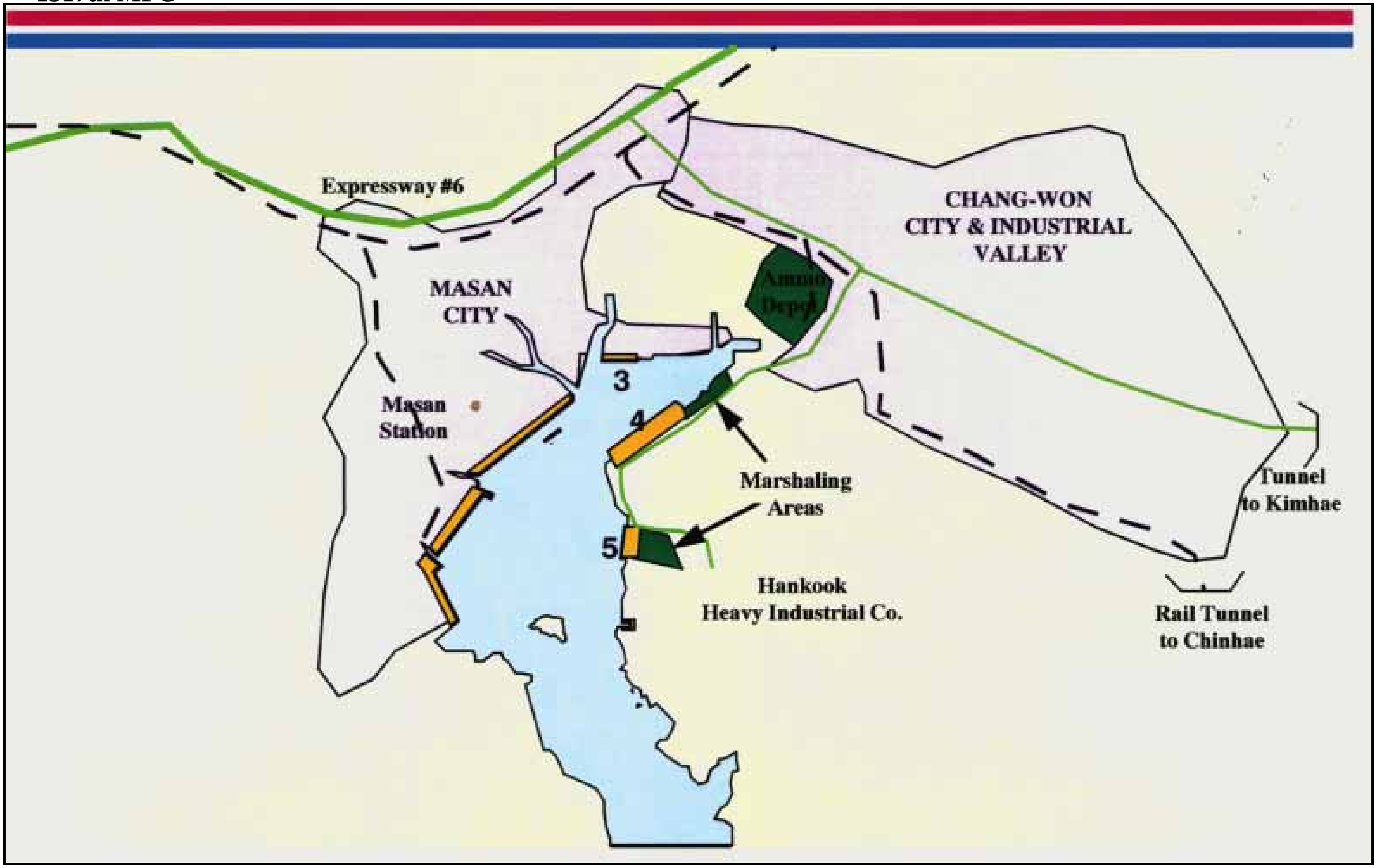
The transit shed at Pier 3 has two truck dock positions available for loading/offloading truck vans. This shed does not have any rail dock positions for loading/offloading boxcars.

OFF-PORT MARSHALING AREAS

The city of Masan has several areas that could be used for off-port marshaling. The best locations are the landfill area between the Hankook Heavy Industrial Company and Pier 5 and the area on the east side of Pier 4, across from the Sammi Special Steel Company. The area between Hankook and Pier 5 is estimated to be about 19 acres (78,000 square meters). The area on the east side of Pier 4 is about 27.5 acres (112,000 square meters). Other potential marshaling areas include several industries in the Changwon Valley (east of the Masan Ammunition Depot) that have helicopter pads, new automobile staging parking lots and/or vehicles test tracks. Although less desirable because general cargo and ammunition operations would occur simultaneously, the Masan Ammunition Depot (5 miles east of Pier 4) is another alternative for marshaling. A map of the marshaling areas is on the following page.

PORT OF MASAN
Off-Port Marshaling Areas

Compliments of 1317th MPC



Off-Port Marshaling Areas

MATERIALS HANDLING EQUIPMENT

Type of Equipment	Capacity STON (met. tons)	Quantity	Wharf Assignment	Owner
Wharf Crane	44 (40)	1	Pier 4	Port of Masan
Mobile Crane	165 (150)	2	None	Hyup Sin Co. Dong Bang Co.
Mobile Crane	132 (120)	1	None	Sae Bang Co.
Mobile Crane	110 (100)	2	None	Korean Express Co. Sae Hwa Tongun Co.
Mobile Crane	99 (90)	1	None	Sae Bang Co.
Mobile Crane	77 (70)	1	None	Dong Bang Co.
Mobile Crane	66 (60)	1	None	Korean Express Co.
Mobile Crane	55 (50)	1	None	Korean Express Co.
Mobile Crane	22 (20)	2	None	Hyup Sin Co. Dong Bang Co.

The table above reflects equipment immediately available at the port. If other MHE are needed, deploying units/the port operator should make the necessary arrangements through the MMAF and Korean Ministry of Defense.

AMMUNITION HANDLING FACILITIES

The Port of Masan has no experience in handling ammunition. Any plans for conducting such operations must be coordinated with the Korean Ministry of Defense and MMAF well in advance. Because of the nearby ammunition depot and the location of Piers 4 and 5 away from highly populated areas, the Port of Masan is desirable for ammunition operations. The Ammunition Depot has limited MHE available for handling cargo. Available are: 7 - forklifts, 13 - 2.5-ton trucks, 6 - 9-ton trucks, 4 - 2.9-ton cherry pickers, 2 - 5-ton wreckers, 2 - 2.5-ton cranes and 2 - fire trucks. The railhead Net Explosive Weight (NEW) at the depot is 150,000 lb (1.1 Hazard Class, Mass Detonating) and 250,000 lb (1.2 Hazard Class, Non-Mass Detonating, Fragment Producing).

PETROLEUM, OIL, AND LUBRICATION (POL)

Exclusive POL terminals are available at the Port of Masan. These facilities are owned by Yukong Co. Ltd. and Honam Oil Co. Ltd. These facilities are located on the west side of Masan Bay near the West Pier and Pier 4, respectively. Both facilities are shown in the pictures below.

Yukong Pier

Dolphin Wharf Honam Oil Refinery

INTERMODAL FACILITIES

The Port of Masan has a limited container handling capability at Pier 4. The 44-ton (40-metric ton) level luffing crane (wharf crane) performs the container handling operations.

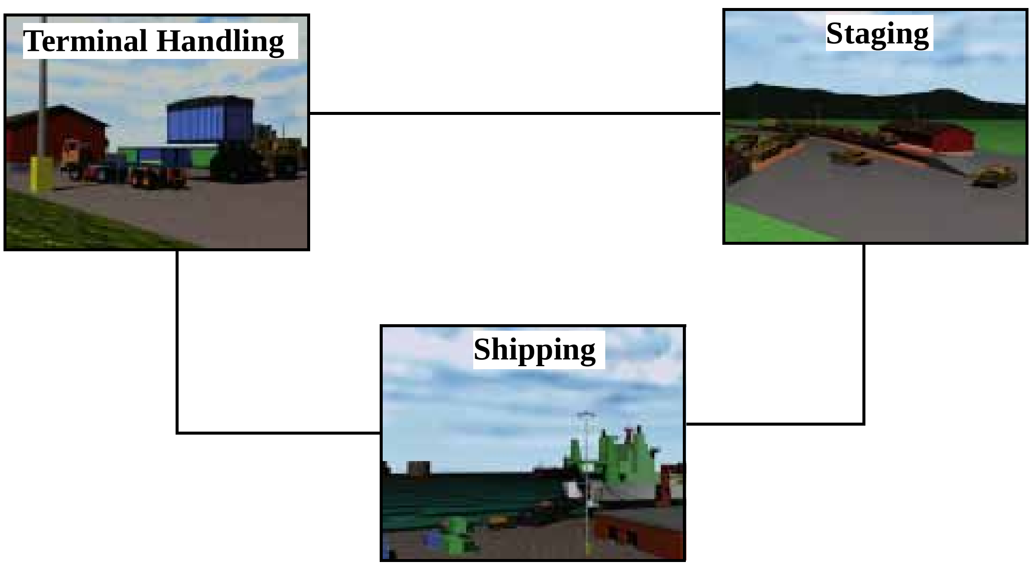
FUTURE DEVELOPMENT

The Port of Masan is currently extending Pier 5. This extension is 1,380 feet long (421 meters) and will have a water depth of 36 feet (11 meters) at Mean Low Water (MLW). The estimated completion date for this project is December 1998.

II. THROUGHPUT ANALYSIS

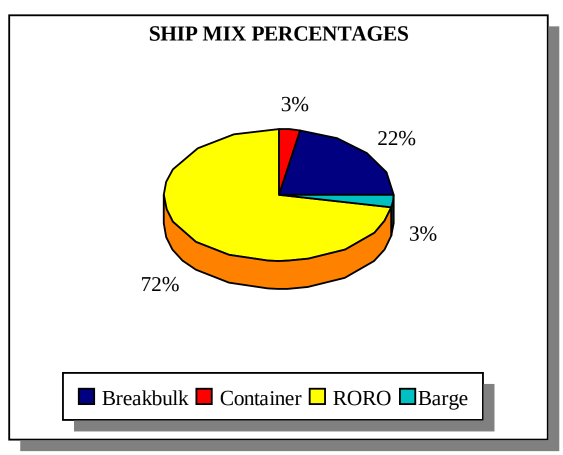
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Masan. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, hardstand marshaling, and terminal processing/handling - in terms of short tons (STON) per day.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 80 percent of the port facilities will support military deployments. Also, due to the size of the port, we assumed a berth utilization factor of 90 percent. The ship mix is determined by Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo DWT and expectations for future deployments.



TERMINAL RECEPTION/HANDLING

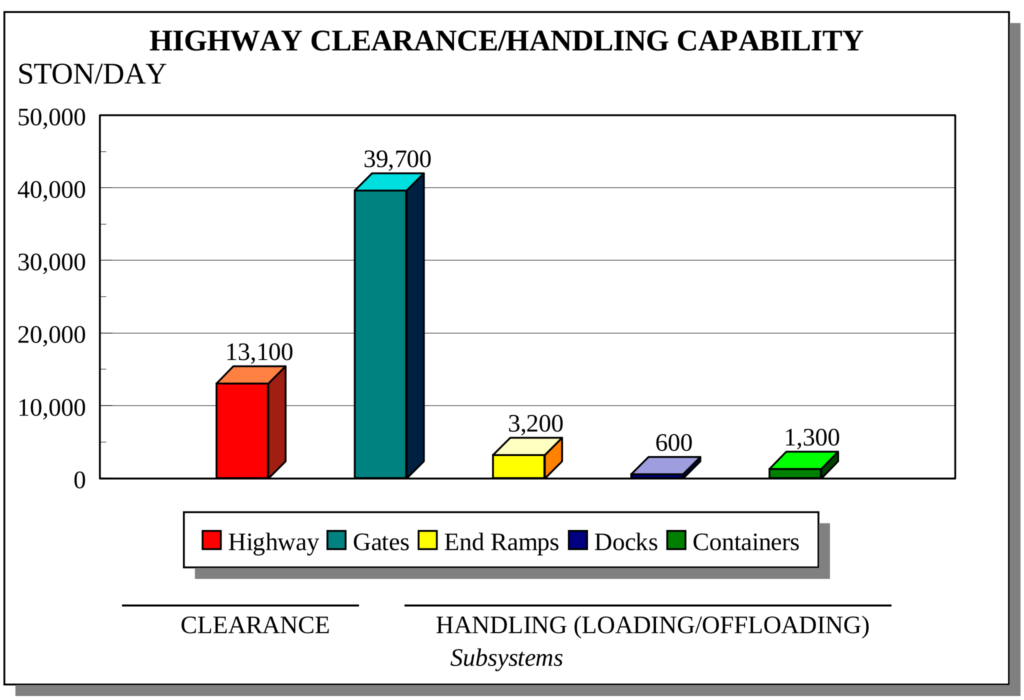
Highway

The major roadway clearing the port to the expressway is Route 2. The access roads, including the gates, connecting the port to the expressway can handle about 13,100 STON of equipment and supplies per day. As can be seen from the bar chart below, the congested Masan roadways are more of a weak link in the system rather than the gates to the terminals.

Roadable vehicles will either process to an off-port marshaling area or to hardstand marshaling areas within the port. Vehicles requiring transport on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps within the terminal. We assume that the 1317th Medium Port Command can provide two portable end ramps (one for operations on Pier 4 and the other for Pier 5). These ramps can handle at least 3,200 STON of military vehicles and equipment per day.

The port has two handling positions to load/offload supplies in van semitrailers. These docks can load/offload about 600 STON of van semitrailer-shipped materials per day.

Other than the wharf crane at Pier 4, the Port of Masan does not have any specialized container handling equipment available at the port. Deploying units must use a mobile crane for container handling operations. Assuming one crane is used for container handling at a rate of 8 lifts/hour, this crane could handle about 1,300 STON of containerized general cargo equipment and supplies per day. If the commodity is containerized ammunition, the crane could handle about 2,200 STON per day. Because the port of Masan has no experience in handling ammunition, such operations must be approved by the MMAF and Korean Ministry of Defense. **NEW requirements will seriously diminish throughput capabilities.**

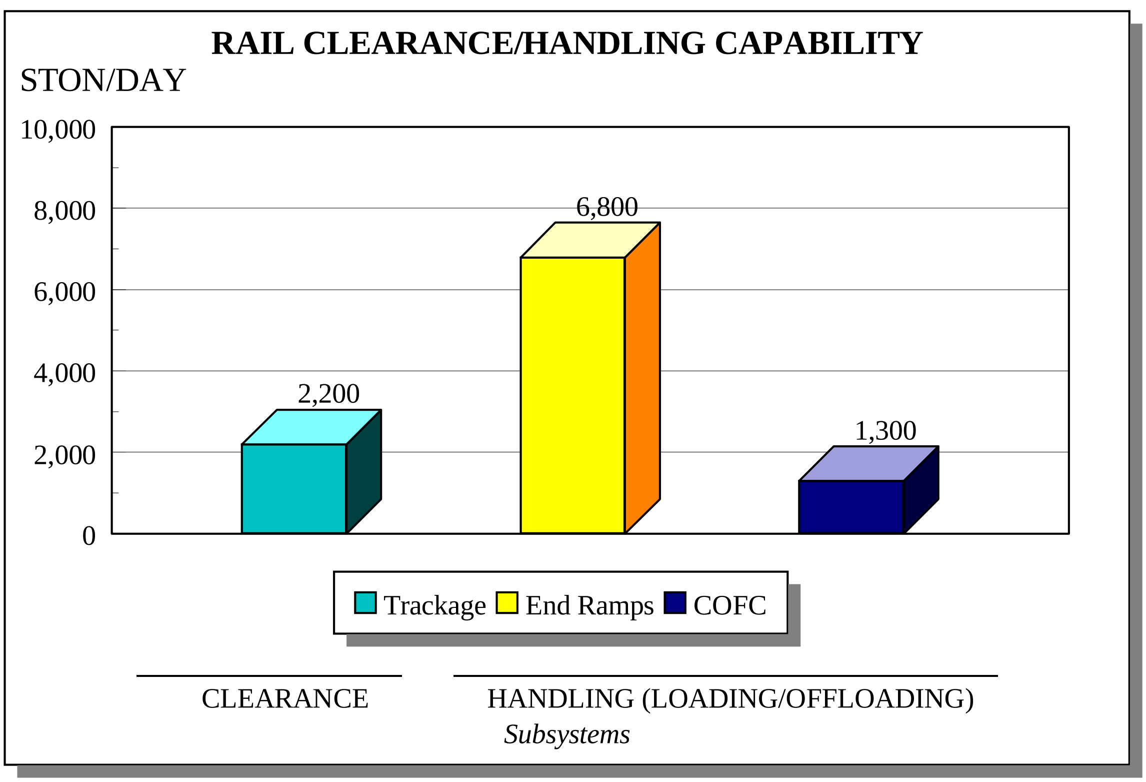


Rail

The Korean National Railroad (KNR) provides rail service on the Chinhaeson rail line. Current service is assumed to be two 22-railcar trains per day. The four rail spurs at Masan Ammunition Depot can accommodate 69 railcars. Railcar storage is 54 railcars. We assume 100 percent of this total could be made available on a daily basis.

Vehicles on flatcars must use portable ramps for loading/off-loading operations. We assume that the 1317th Medium Port Command will provide the needed end ramps to perform rail operations. Assuming the 1317th Medium Port Command provides two rail end ramps and spurs CT3A and CT4A are used in end ramp operations, the Masan Ammunition Depot could handle 82 railcars per day. This estimate is based on two cycles of trains per day at each of the loading spurs. Spurs CT3A and CT4A can accommodate 19 and 22 railcars, respectively. Daily rail throughput using end ramps is about 6,800 STON.

Piers 3, 4, and 5 do not have rail access. The Port of Masan uses the wharf crane on Pier 4 to conduct container operations. Therefore, COFC operations would require a ship to berth at Pier 4, the wharf crane would off-load containers onto a truck chassis, and the truck chassis would haul the containers to the Masan Ammunition Depot for transfer onto COFC railcars. We assume a mobile crane is available for transferring containers to COFC railcars. This crane could load 1,300 STON of containerized general cargo per day. If the commodity is containerized ammunition, the crane would handle 2,200 STON per day. The railhead NEW requirement is 150,000 lb (1.1 Hazard Class, Mass Detonating) and 250,000 lb (1.2 Hazard Class, Non-Mass Detonating, Fragment Producing). **NEW requirements will likely diminish throughput capabilities.**



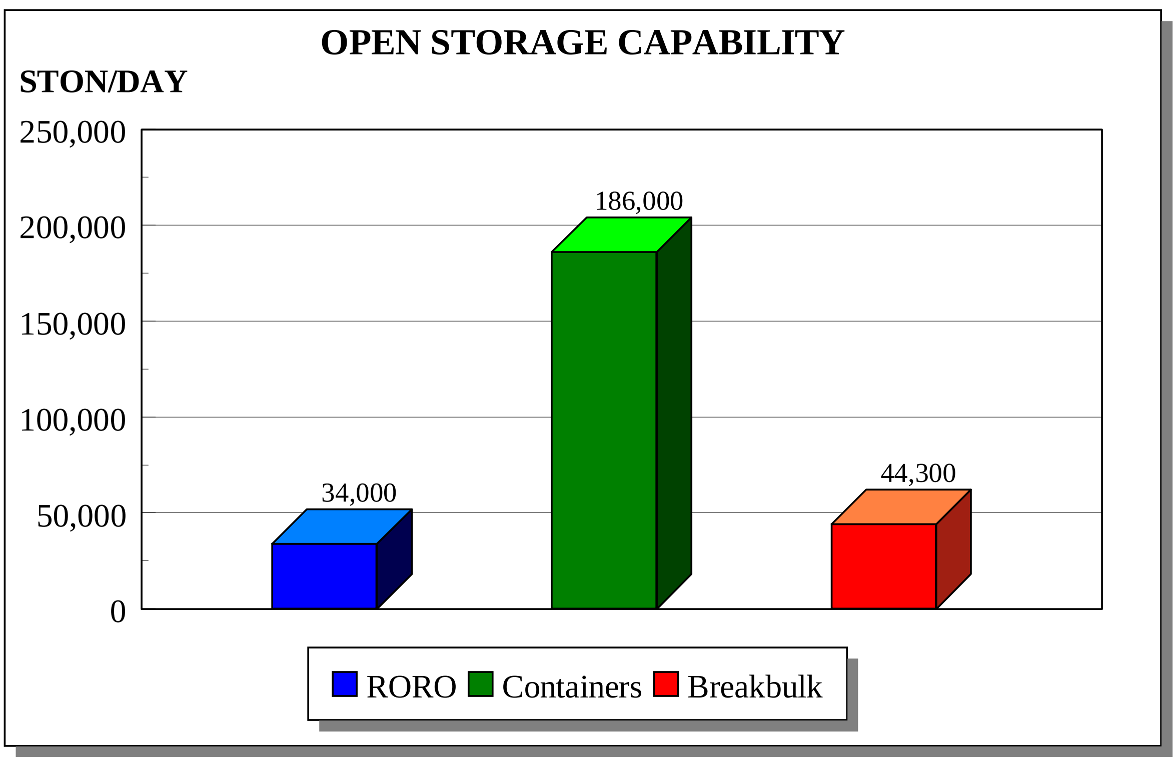
OPEN STORAGE

The port has 81 acres (332,218 square meters) of open storage available at Piers 3, 4, and 5. The port has the ability to perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned.

The chart on this page provides the cargo open storage capability for each vessel type. If a combination ship is expected, then a portion of each involved capability should be assumed.

Based on the shipping subsystem throughput for RORO and container operations (see Throughput Summary Table), 34 acres (49,290 square meters) of open storage are estimated to marshal the daily RORO throughput capability for the Port of Masan. Four acres of open storage are needed to store containers. The RORO acreage considers the estimated square feet for RORO throughput (Throughput Summary Table) and includes a factor to account for areas needed to store frustrated cargo, working areas, areas around ramps and gates, lanes and access to vehicles, and other factors. This estimate does not take into consideration the equipment that would leave the port immediately after loading.

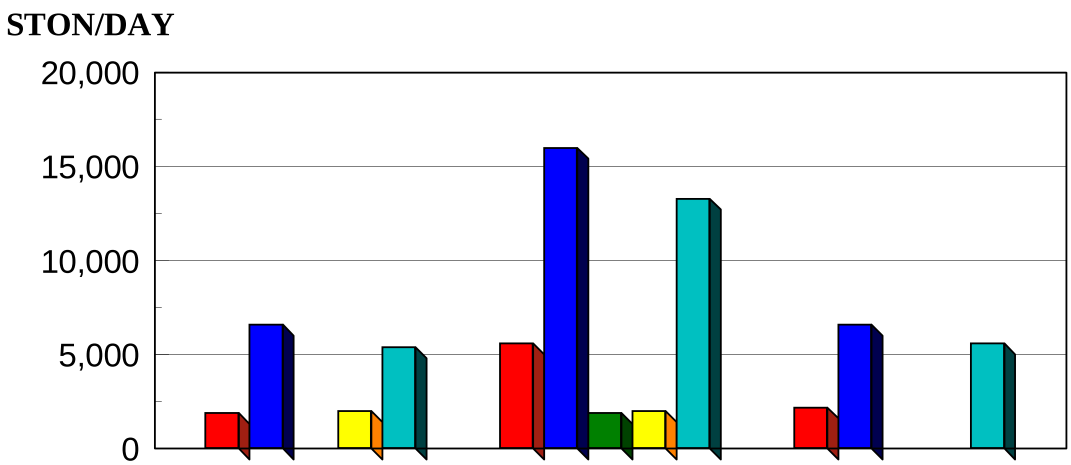
The container acreage is based on the container throughput in TEUs (Throughput Summary Table) and uses the chassis system for storage (70 TEUs per acre). The port has 81 acres of total open storage and should be able to handle the daily throughput capability, especially since some equipment may leave the port shortly after offloading.



SHIPPING

Throughputs for each berth are shown below. They are based on various factors including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. Assumptions used in this study are in the appendix.

BERTH THROUGHPUT CAPABILITY



	Pier 3	Pier 4	Pier 5
Breakbulk	1,900	5,600	2,200
RORO	6,600	16,000	6,600
Containers	0	1,900	0
Barge	2,000	2,000	0
Mixed	5,400	13,300	5,600

CONVERSION FACTORS

Breakbulk: .4 STON per MTON
RORO: .25 STON per MTON
Containers: .4 STON per MTON

THROUGHPUT SUMMARY FOR PORT OF MASAN PER DAY

PORT/ BERTH	LENGTH feet (meters)	DEPTH ALONGSIDE feet (meters)	BREAKBULK THROUGHPUT STON (MTON)	RORO THROUGHPUT STON (MTON)	RORO SQUARE FT (EST)	RORO PIECES	CONTAINER THROUGHPUT STON (MTON) (TEU)	BARGE THROUGHPUT STON (MTON)	MIXED THROUGHPUT STON (MTON)
Pier 3	1,377 (420)	30 (9.1)	1,900 (4,900)	6,600 (26,500)	132,000	777	0	2,000 (5,000)	5,400 (21,000)
Pier 4	3,444 (1,050)	33 (10)	5,600 (13,900)	16,600 (66,400)	332,000	1,953	1,900 (7,700) 240	2,000 (5,000)	13,300 (51,200)
Pier 5	1,377 (420)	36 (11)	2,200 (5,600)	6,600 (26,500)	132,000	777	0	0	5,600 (21,600)

NOTE: RORO pieces based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

We base the type of ship preferred at each berth on the methodology described in the appendix. The evaluation is a snapshot view of the current physical characteristics of the berths and MHE available. The berths are rated according to rank. The lower the number for a berth, the better the berth is suited for the loading or offloading operation. For example, Pier 4 is ranked the best at conducting container operations. In general, no one berth is ideal for all military operations. The best berth depends on the type of ship loaded.

Pier 3 is ranked the best at breakbulk and barge operations because of the available transit shed. Because of its deepwater draft, Pier 5 is the choice for RORO operations. Pier 4 is the choice for container operations because of the wharf crane.

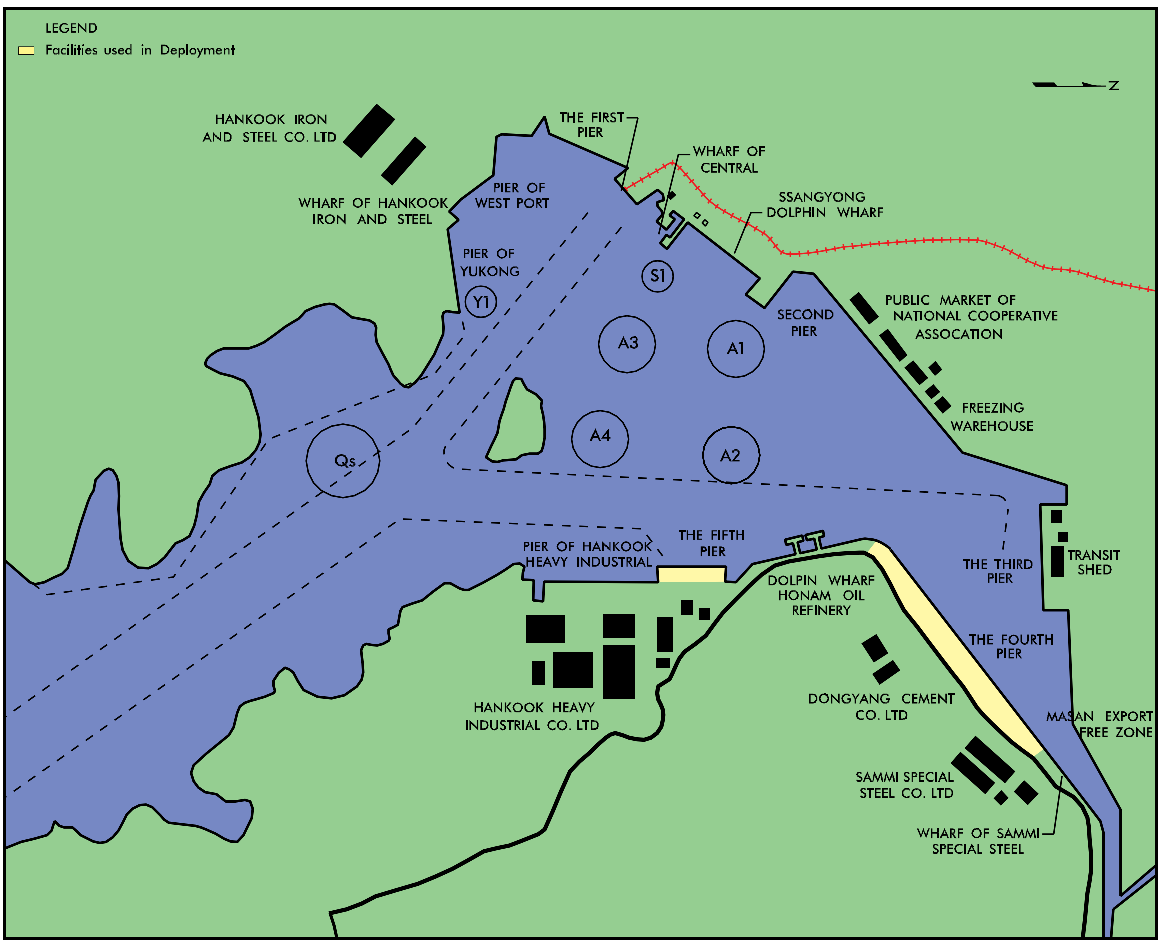
LOADING TYPE	**BERTHS**		
	Pier 3	**Pier 4**	**Pier 5**
Breakbulk	1	3	2
RORO	3	2	1
Container	3	1	2
Barge	1	2	3
NOTE: Berths marked with a "-" are not recommended for these operations.			

Pier 4 Wharf Crane

III. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored brigade using primarily FSS vessels. Currently, facility use depends on decisions made by the Korean Ministry of Defense and MMAF. Because of the Korean commitment to defense of their country and considering current facility use of Masan, we assume that 50 percent of Piers 4 and 5 would be available for military use. We further assume that the open storage areas outside the port (identified in the off-port marshaling section) and the Masan Ammunition Depot will be available for off-port marshaling. We also assume that no other military units (US or Republic of Korea) will be competing for these facilities during the time that the armored brigade occupies the port and that the required assets (transporters and people) will be available to clear the port.



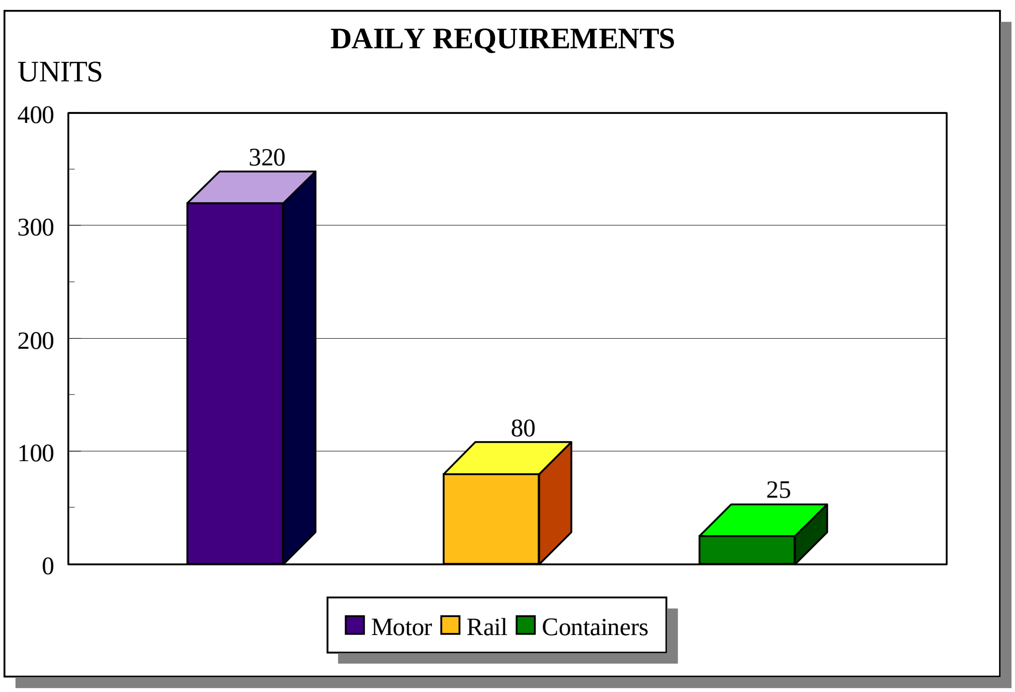
Potential port use during deployment.

REQUIREMENTS

The likely requirement for the Port of Masan would be to deploy a notional armored brigade in 6 days of ship offloading and port clearance. The brigade has to move about 2,820 vehicles and 150 containers. Movement of the brigade from the port inland will require about 475 (80 per day) rail-cars using the convoy/rail option. Under this option, about 1,270 (210 per day) roadable vehicles would drive out the gates towing 830 (140 per day) trailers. About 25 containers would arrive daily. Because the military useful piers at the Port of Masan have indirect rail access, a notional armored brigade must convoy to the nearest railhead (Masan Ammunition Depot) to achieve rail transport. This means about 230 40-foot flatbeds (40 per day) and 410 heavy equipment transporters (HET) (70 per day) would transport non-roadable equipment to the railhead.

ARMORED BRIGADE

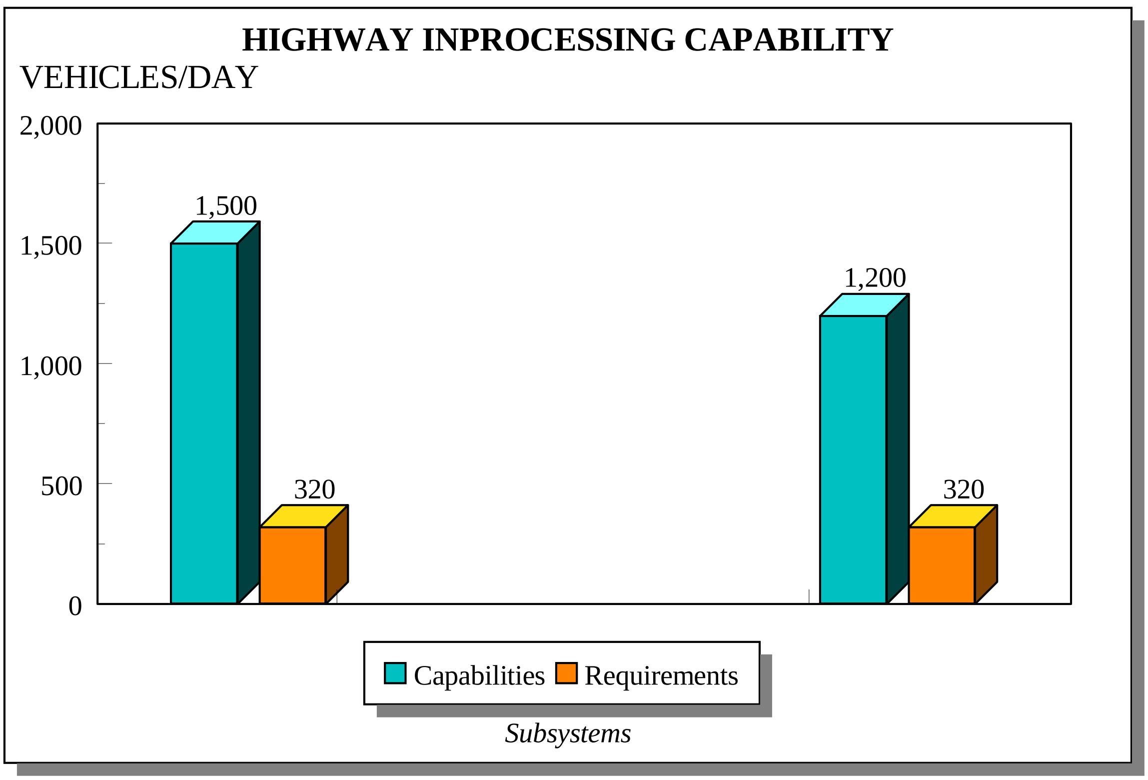
Total Equipment	
Volume	95,800 MTON
Weight	31,700 STON
Area	642,650 SQ FT
Vehicles	2,823
Containers	150



TERMINAL INPROCESSING/HANDLING

Highway

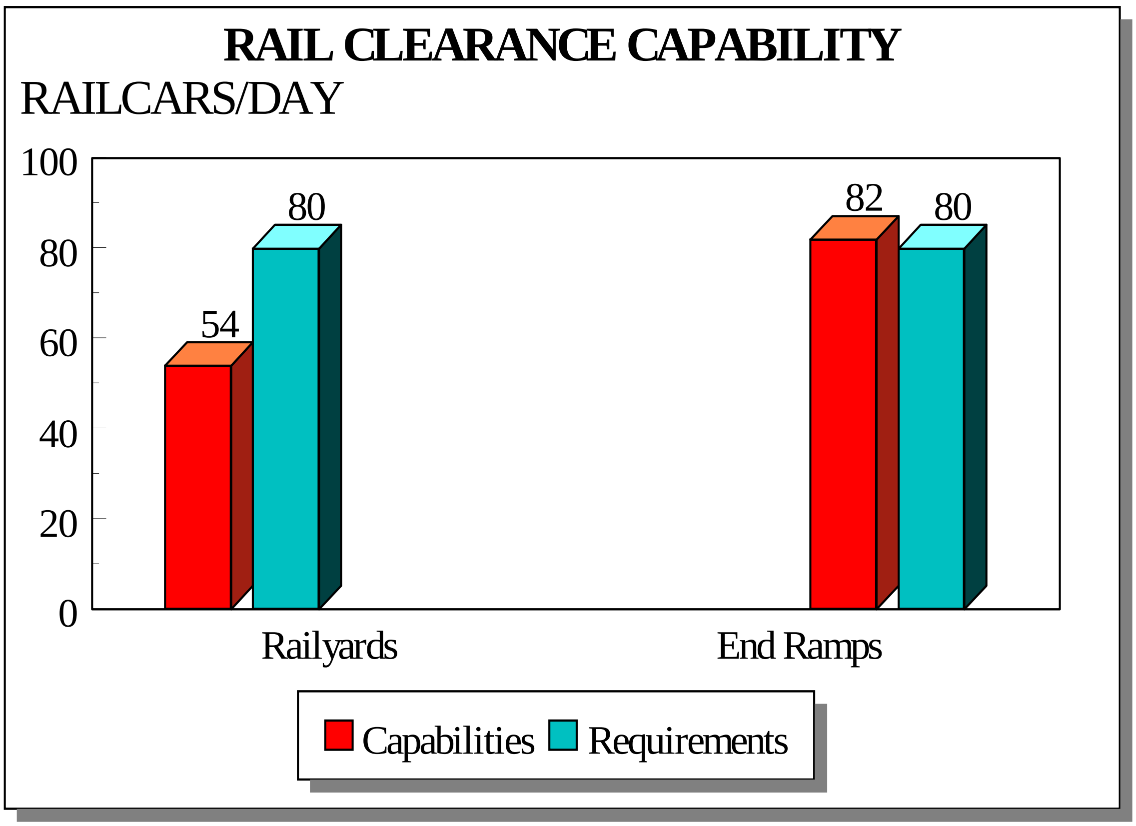
The major access roads out of the port are Route 2, Samhoro, and Routes 5 and 14. All access roads into the wharf areas are four-lane roads. Each terminal has its own gate. The access roads and gate processing subsystems can handle more than 1,500 and 1,200 additional vehicles per day, respectively.



Rail

Piers 3, 4, and 5 at the Port of Masan do not have direct rail access. The nearest rail access is at the Masan Ammunition Depot, 5 miles east of Pier 4. Rail service to this facility is assumed to be two 22-railcar trains per day. The four rail spurs can accommodate 69 railcars or store 54 railcars. The breakdown for the four spurs is as follows: spur CT1A - accommodate 14 railcars, store 11 railcars; spur CT2A - accommodate 14 railcars, store 11 railcars; spur CT3A - accommodate 19 railcars, store 15 railcars; and spur CT4A - accommodate 22 railcars, store 17 railcars.

We assume spurs CT3A and CT4A will be used for end ramp operations. Assuming two trains per day on each spur, the two end ramps could load 82 railcars per day.

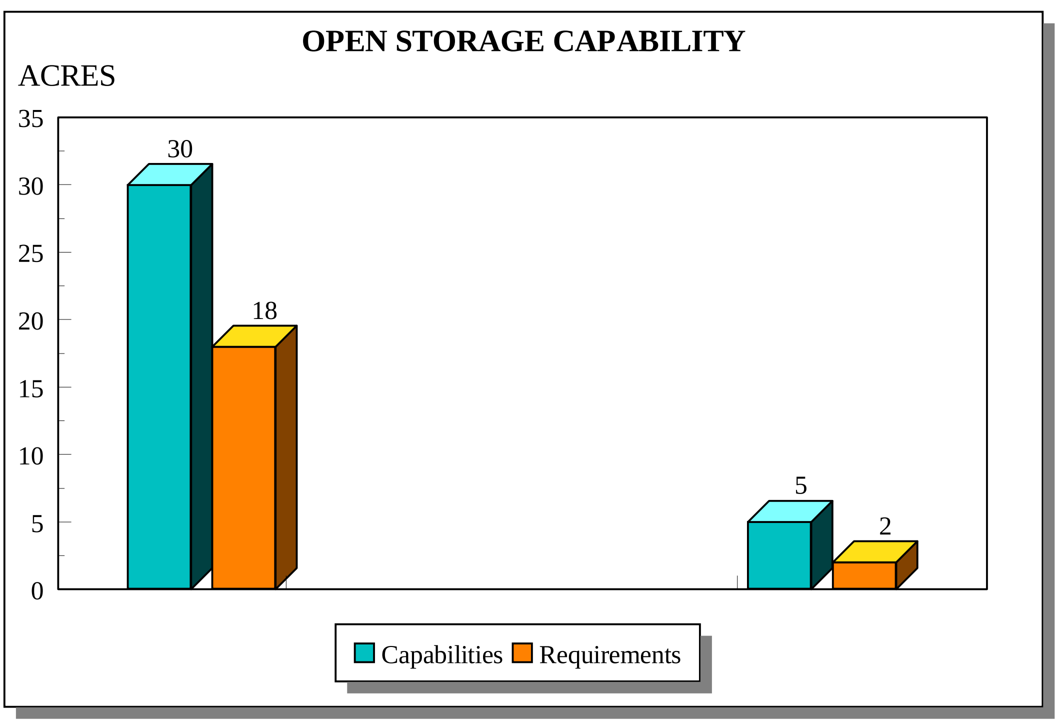


OPEN STORAGE

Using the MTMCTEA Deployment Planning Guide (MTMCTEA Reference 94-700-5), this analysis assumes that a little over 3 FSS-ships will deploy a notional Armored Brigade. This brigade must deploy through the port in 6 days. Because of this, the storage requirement is to support one sustained offloading operation.

Although an FSS load of cargo can be offloaded on as little as 8 acres of hardstand marshaling, we determined 10 acres (40,510 sq m) are required for sustained offloading operations. The 10-acre per FSS requirement is dependent upon port clearing capabilities and the availability of off-port marshaling areas. The highway and rail portions of this application show that port clearance should not be a problem. Off-port marshaling areas are available near both Piers 4 and 5 (see Off-port Marshaling). Of the 10 acres, less than 1 acre is required for the marshaling of 50 containers per FSS. We assume that Piers 4 and 5 can berth one FSS apiece. Because the water draft of Pier 4 is about 33 feet, an FSS will berth there at less than full load. About 20 acres are required to support the simultaneous offloading of two FSS ships. Using 50 percent of the available area at Piers 4 and 5, the Port of Masan would have about 35 acres (16 acres for Pier 4 and 19 acres for Pier 5) of open storage for two FSS ships offloading simultaneously. This should be enough to handle hardstand marshaling requirements.

Piers 4 and 5 do not have any covered storage facilities available. Pier 3 has a transit shed. Assuming 50 percent of this shed is available for military use, deploying units would have access to about 21,300 square feet (2,000 square meters).



SHIPPING

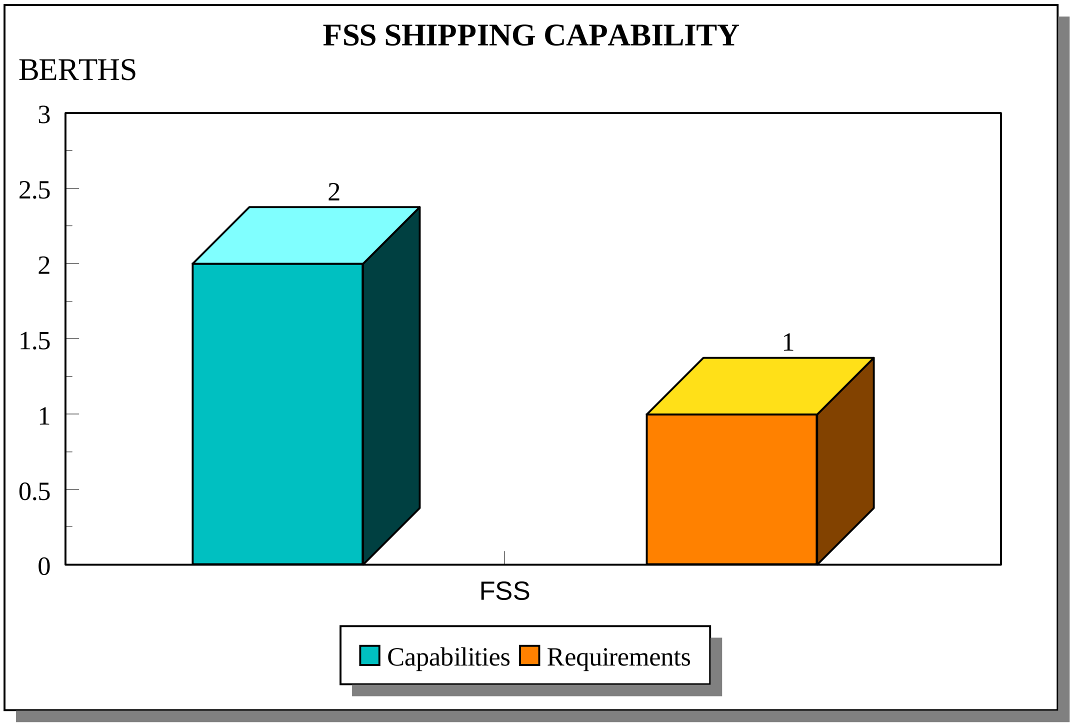
Although this analysis assumes that only FSS-sized ships can deploy an armored brigade, the table below provides ship quantities needed to move this division using minimum containerization. The number of ships required depends on the shipping mix selected. The best ship mix would consist of 3 FSS and 1 LMSR or 3 LMSR.

Using 50 percent of Piers 4 and 5, the port could easily berth 2 FSS vessels at one time. Note that FSS docking at Pier 4 must berth at less than full load. The maximum draft of an FSS vessel is slightly less than 37 feet.

UNIT MOVEMENT REQUIREMENTS
ARMORED BRIGADE

Loading Condition/ Sample Ship Mix	FSS (RORO/ Comb)	LMSR (RORO/ Comb)	Notional RORO (RORO/ Comb)	C3/C4 (Breakbulk or Container)	C6/C7/C8 (Container)
Minimum Containerization					
All FSS	2.67	.43			
All LMSR		2.07			
Notional RORO			4.10		
All Breakbulk				10.43	
Maximum Containerization					
FSS/Container	1.33				1.57
LMSR/Container		.83			1.57
RORO/Container			1.63		1.57
Breakbulk/Container				4.17	1.57

Legend:
RORO - roll on/roll off
FSS - fast sealift ship
Source: MTMCTEA Reference 94-700-5, Deployment Planning Guide, Sep 94



Note: FSS docking at Pier 4 will berth at less than full load.

SUMMARY

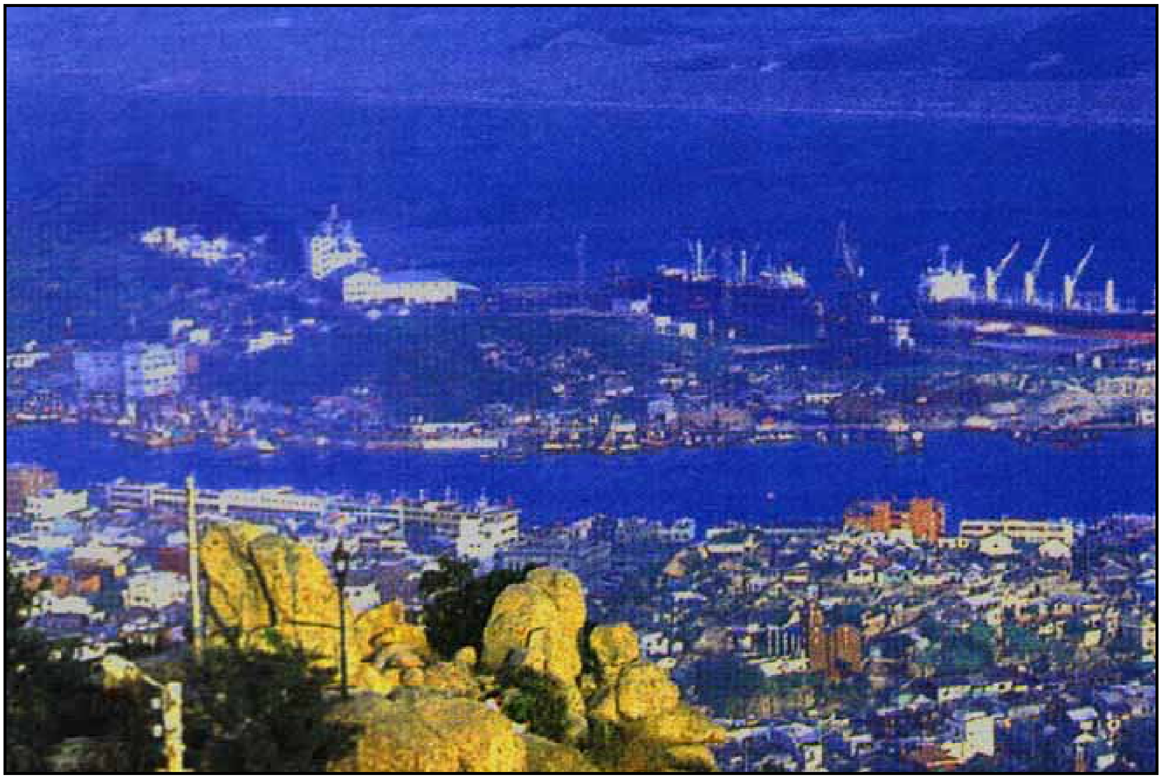
The Port of Masan can offload and clear a notional Armored Brigade from the port area within 6 days. Problems may occur in rail clearance capabilities at Masan Ammunition Depot. This facility can store a maximum of 54 railcars per day. Eighty railcars per day are needed to move an armored brigade. Also, equipment must convoy about 5 miles from the port to the depot for rail transport.

RECOMMENDATION

The Port of Masan is a viable port for supporting deployment of a notional Armored Division provided 50 percent of Piers 4 and 5 are available for US military deployments. Efforts should be made to coordinate with the Korean Ministry of Defense and Port of Masan MMAF to arrange for use of these facilities during a contingency. Also, efforts should be made to improve rail access to the deployment useful piers (Piers 3, 4, and 5) for efficient rail deployment.

July 96

PORT OF MOKPO



I. General Data

II. Throughput Analysis

III. Application

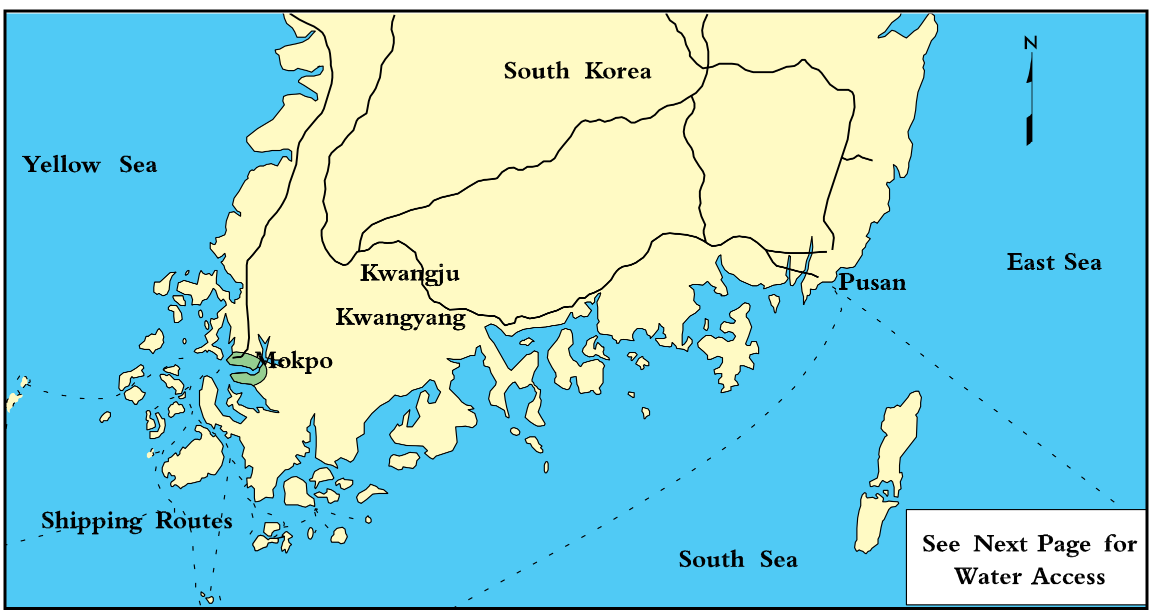
Return to Index

I. GENERAL DATA

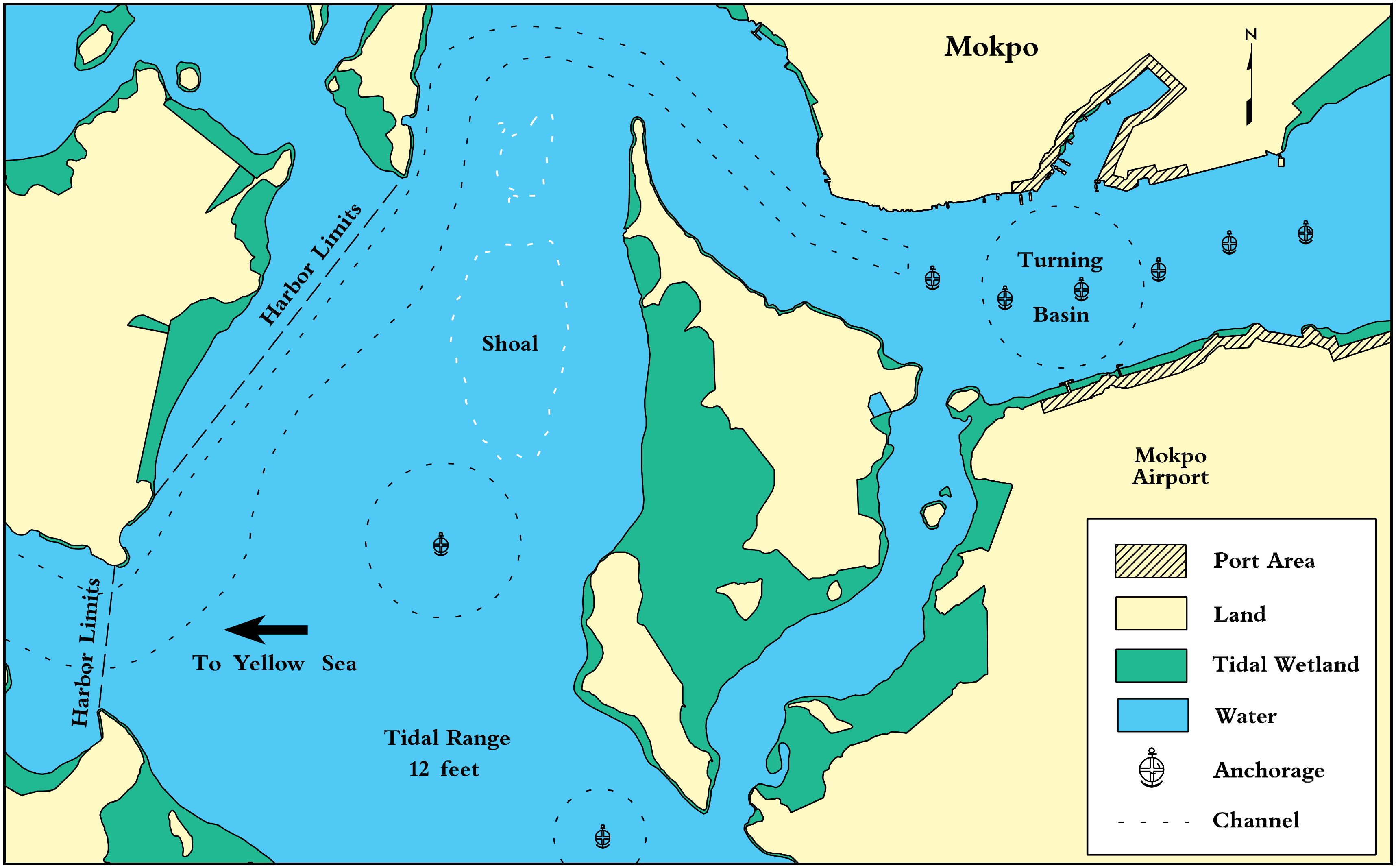
TRANSPORTATION ACCESS

The Port of Mokpo (34^{o} 37' north latitude and 126^{o} 23' east longitude) is on the southwest coast of South Korea about 45 miles (73 kilometers) southwest of Kwangju and 105 miles (170 kilometers) west of Kwangyang. The GeoCode for Mokpo is QNPW. A protected harbor and relatively mild tidal variation of 12 feet (3.6 meters), as opposed to a range of 20-30 feet on much of the Korean west coast, make Mokpo an important Korean west coast seaport. The main port operations at Mokpo are the import of logs, coal, and fish.

The ship channel into Mokpo varies from 29.5 to 49 feet (9-15 meters) in depth and is almost 2,000 feet wide (600 meters) at its narrowest point. Pilotage is not compulsory; however, strong tidal currents and sharp changes of direction in the ship channel present a ship navigation challenge. The tidal flow reaches 4 knots at flood and ebb. Currently, the only vertical or overhead clearance restriction exists near the Mokpo airport to ensure a safe landing and take off zone for aircraft. Although this restriction does not significantly affect the approach to the port, it will become more significant in the future as the port expands to property nearer to the airport. The area adjacent to the main wharf at Mokpo serves as a suitable turning basin for ships. The depth of water in this area is 42 feet (13 meters) and has a turning diameter of 5,900 feet (1800 meters). Several anchorages are available with a maximum water depth of 105 feet (32 meters) out in the open water. Lesser anchorages are also available in the ship channel. The ship holding ground varies from mud and sand to rock.



General Location of Mokpo, Korea



Water Access to Port of Mokpo

Highway

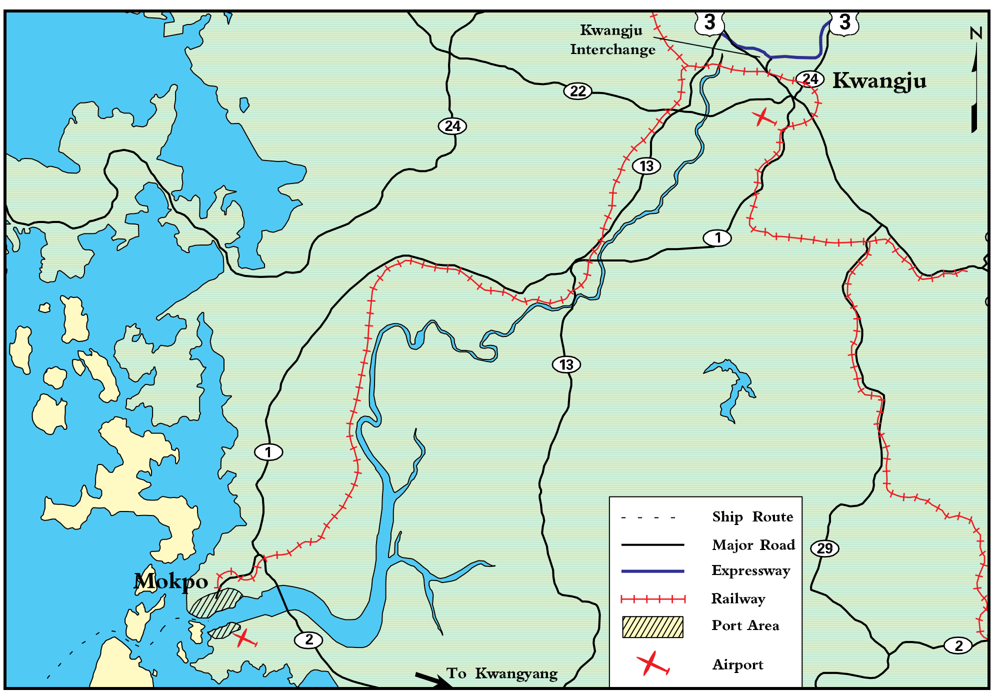
The major highways leading from Mokpo to the expressways are Route 1 going north to Kwangju and Route 2 going east toward Kwangyang. If going north, take the port access road to Industrial Road (g sanno). Industrial Road will lead to Route 1, follow Route 1 north to Kwangju. The Kwangju Interchange provides the access to Expressway 3. If going east, Route 2 will break off from Route 1 on the northeast side of the city and lead to Expressway 6. The Sunchon Interchange provides the access to Expressway 6.

Rail

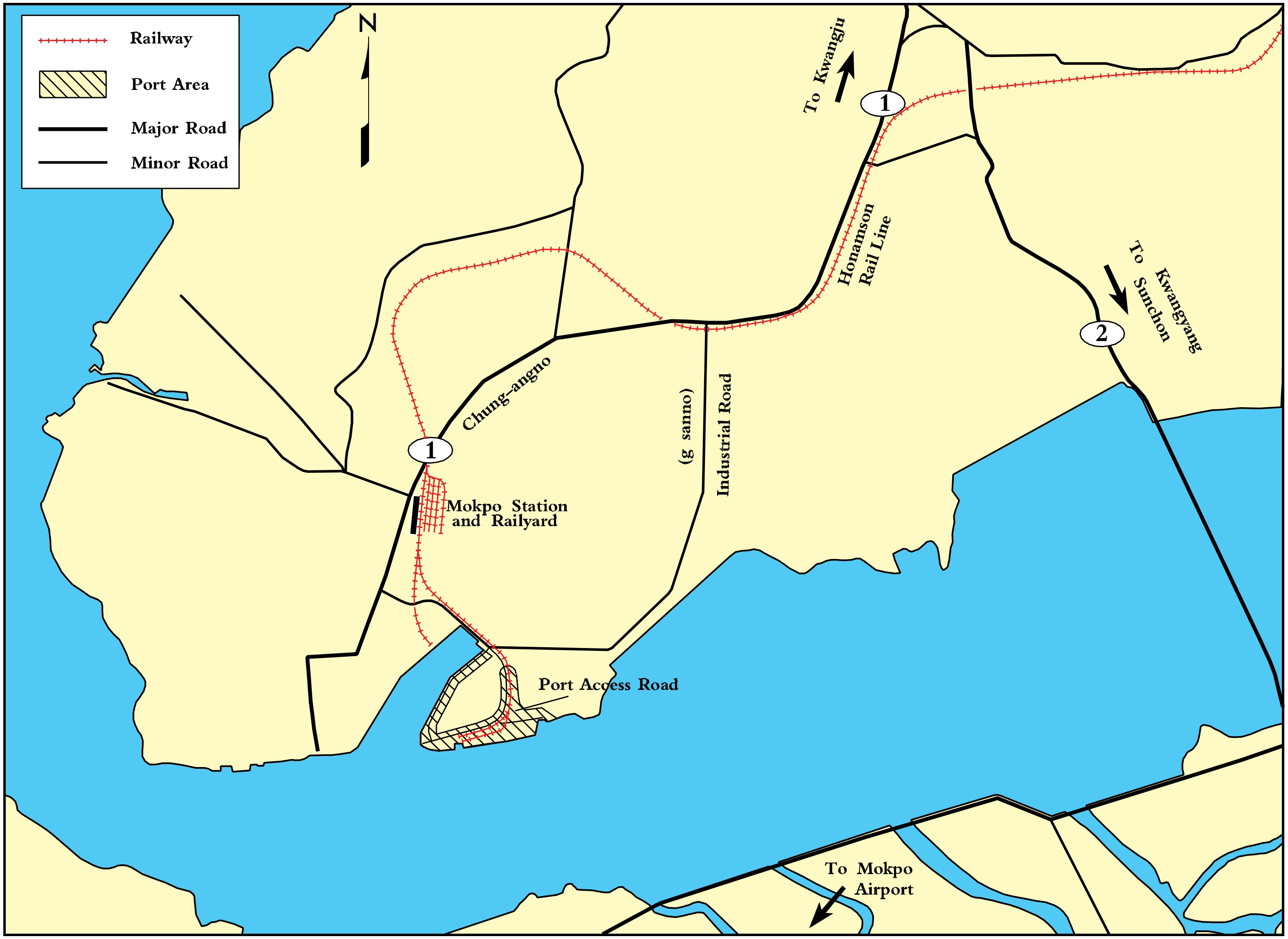
A main rail line (Honamson Rail Line) leads from Mokpo (rail station) to Kwangju. This rail line has no unusual clearance restrictions. Cargo dimensions must be within the Korean rail envelope to achieve unrestricted rail transport. A rail spur leads from the Mokpo rail station to the port. This spur is 1.7 miles long (2.8 kilometers) and runs directly alongside buildings in a business section of town. Clearance restrictions require rail cargo to be no more than 6 feet (1.8 meters) high and 8 feet wide (2.4 meters) to prevent fouling buildings and signs. This track is in use and supports the import of coal. A speed restriction ranges from 3 to 6 miles per hour (5-10 kilometers/hours) on this spur.

Air

The city of Mokpo has an airport on the other side of the ship channel from the port. This airport is located off Route 2. It has one runway about 5,900 feet long (1,800 meters) and can handle C-130 military aircraft and B-737 commercial aircraft. The nearest military airport is Kwangju Air Base, about 3 miles (5 kilometers) west of Kwangju. This facility has one runway 9,300 feet long (2,834 meters) by 150 feet wide (45 meters) and can handle C-5 aircraft.



Highway, Rail, and Air Access to Mokpo (see next page for access to port)



Highway, Rail, and Air Access to Port of Mokpo

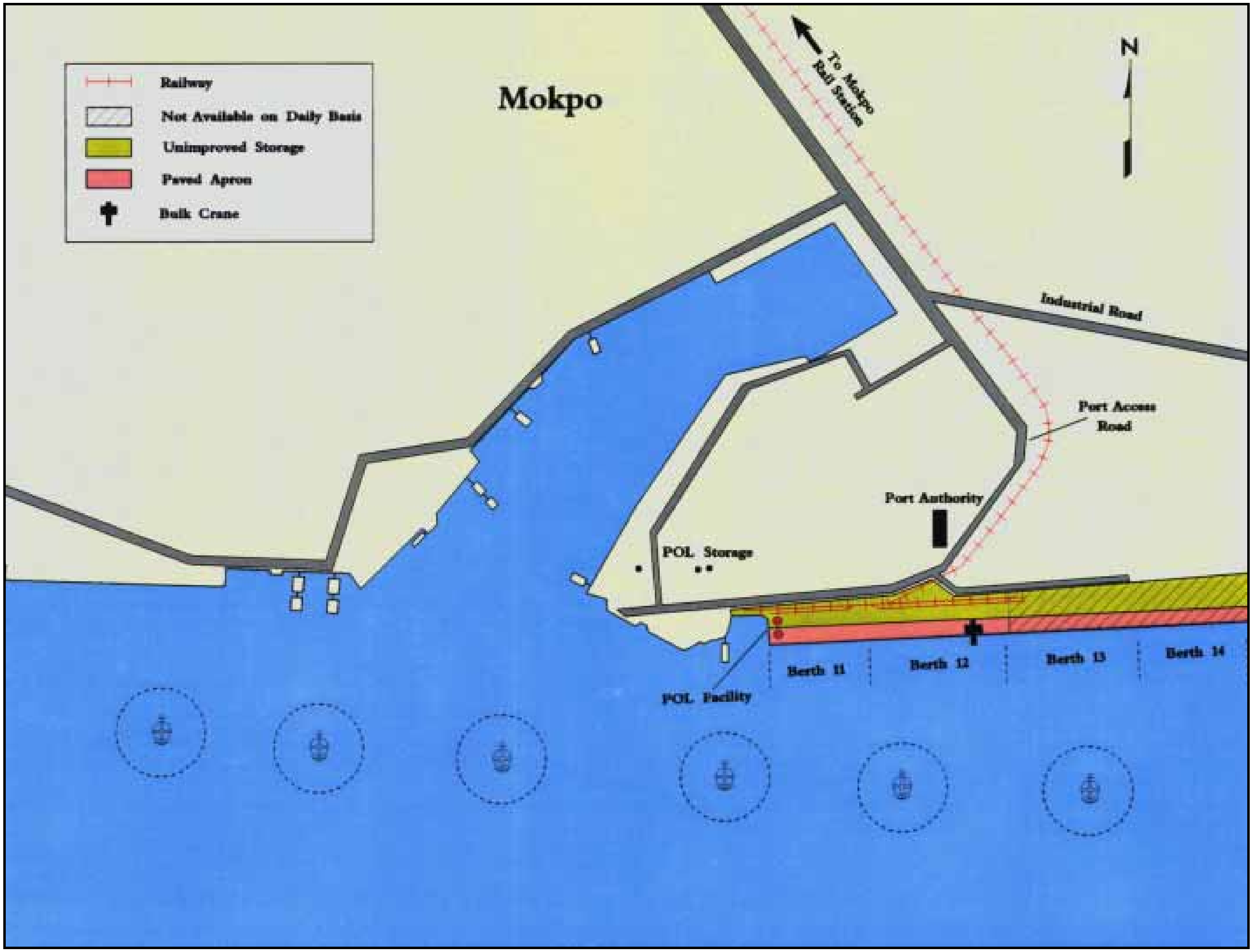
PORT FACILITIES

Berthing

The Port of Mokpo is capable of breakbulk, RORO, and barge operations and specializes in the import of bulk materials such as coal and logs. Fishing and passenger ferries are other significant industries operating at the port. Currently, the port does not have a capability in container operations and has one public wharf (Pier 1) that has potential for military use. Other wharves are available, however, all are privately owned and/or has specific use. The public wharf (Berths 11, 12-13, and 14) is about 2,600 feet long (792 meters) and has a water depth alongside, ranging from 29 to 49 feet deep (9-15 meters). This wharf is open and has a wharf crane that is used for handling bulk materials. The apron support consists of concrete piling and the storage area is landfill--both are concrete capped. The wharf has a solid rubber fendering system. Lighting exists for night operations.

Fendering System

Passenger Ferries


Railway
Not Available on Daily Basis
Unimproved Storage
Paved Apron
Bulk Crane
Mokpo
To Mokpo Rail Station
N
Industrial Road
Port Access Road
Port Authority
POL Storage
POL Facility
Berth 11
Berth 12
Berth 13
Berth 14

Land-Use Map

CHARACTERISTICS OF PORT OF MOKPO

Characteristics	Berths		
	11	12-13	14
Length, ft (m)	551 (168)	1,607 (490)	442 (135)
Depth alongside at MLW, ft (m)	29 (9)	49 (15)	32 (10)
Deck strength, psf (met. ton/sq m)	614 (3)	614 (3)	614 (3)
Apron width, ft (m)	Open	65 (20)	65 (20)
Apron height above MLW, ft (m)	7 (2)	7 (2)	7 (2)
Number of container cranes	0	0	0
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No
Apron length served by rail, ft (m)	0	0	0

Wharf

SUMMARY OF BERTHING CAPABILITIES FOR MOKPO

VESSEL	BERTHS		
	11	12-13	14
Breakbulk			
C3-S-38a	1	3	c
C4-S-58a	a,c	2	c
C4-S-66a	a	2	a,c
C5-S-37e	a,c	2	c
Seatrain			
GA and PR-class	c	2	c
Barge			
LASH C8-S-81b	a,c,f	1	a,c,f
LASH C9-S-81d	a,c	1	a,c,f
LASH lighter	2	8	2
SEABEE C8-S-82a	a,c	1	a,c
SEABEE barge	2	8	2
RORO			
Comet	d,i,m	d,o	c,d,o
Meteor	d,i,m	d,o	c,d,o
Cape Gnome	a,c,d	d,i,m	a,c,d
C7-S-95a	a,c	2	a,c
Cape Taylor	c	2	c
Cape Orlando	a,c	2,i	c
MV Ambassador	d	d	c,d
Callaghan	c,d	d,o	c,d,o
Cape Lambert	a,c	2,i,m	c
FSS-Class	a,c	1	a,c
Cape E-class	a,c	2,i	c
Cape D-class	a,c	2,i	a,c
Cape H-class	a,c	2	a,c
Cape R-class	a,c,d	d,k,m	a,c,d
Cape Texas	c	2,i	c
Container			
C6-M-147a	c,e	2,e	c,e
C7-S-69c	a,c,e	2,e	c,e
C7-S-68c	a,c,e	2,e	c,e
C8-S-85c	a,c,e	1,e	a,c,e
C9-M-132b	a,c,e	1,e	a,c,e
C9-M-F141a	a,c,e	a,e	a,c,e
Combination			
C6-S-1qd	a,c	2	a,c
C5-S-MA73c	a,c	2	c
C6-S-MA60d	a,c	2	c

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

Open Storage

The Port of Mokpo has eight open storage areas totaling about 16 acres (63,800 square meters). However, six of the eight are filled routinely with bulk materials. The two open storage areas available on a daily basis provide a little over 3 acres of paved open storage. No other significant open storage areas exist at the port. Due to its location near the downtown area, no significant open storage areas exist immediately outside the port. Estimated use of the two available open storage areas is less than 20 percent. A Republic of Korea (ROK) Navy base is near the public wharf and has potential for helicopter operations. Another option for helicopter operations is at a military base about 12 miles (20 kilometers) north of Mokpo.

Covered Storage

No covered storage exists at the port.

Open Storage Areas

Rail

A rail spur runs alongside a business district from the rail station in Mokpo to the port. No tracks are on the apron. However, a small rail yard (three spurs) is next to the wall providing security to the wharf area and is just inland of the wharf apron. These spurs provide temporary storage for railcars being loaded with coal. Current rail activity at the port is three trains per day at nine railcars per train. Clearance restrictions limit cargo to a height of 6 feet (1.8 meters) and width of 8 feet (2.4 meters) for trains going to or from the port area. A railyard (total of 18 tracks) is at the Mokpo train station and can store a maximum of 213 railcars. At 30 percent use, this railyard could still store 149 railcars on a daily basis without interrupting rail service. The length of the longest spur is about 1,100 feet long (336 meters). The Korean National Railroad (KNR) performs the switching operations in the railyard at the rail station. Neither the port nor the rail station have any fixed or portable end ramps.

Highway

Routes 1 and 2 are two-lane highways leading into Mokpo. These routes are undergoing some construction for conversion to four-lane highways. Also, a future expressway going northward along the west coast will link Mokpo to the Seoul/Inchon metropolitan areas. Industrial Road going through Mokpo is a congested four-lane highway. The access road into the port is two-laned and the gate to the public wharf is also two-laned (one for each direction). No unusual clearance restrictions exist on these roads. The International Federation Chart lists highway legal limits as 3.8 meters (12.5 feet) for height, 2.5 meters (8.2 feet) for width, and 10 metric tons (11 tons) for a single axle for South Korea. The port has portable truck scales at the gate.

Rail Clearance Restrictions

Highway Congestion, Industrial Road

Ramps

No fixed or portable end-or side-ramps exist at the port. Deploying units should arrange for portable end ramps through the 1317th Medium Port Command (MPC) for loading/offloading of railcars and/or semitrailers. The best place to conduct loading operations is the railyard at the Mokpo rail station. Several spurs at this railyard have potential for end ramp operations. The station master indicated that deploying units would most likely use spurs two and three for loading operations. These two spurs can hold nine and eight railcars, respectively. Loading operations can also occur at the port; however, only small cargo can be loaded there to meet rail clearance restrictions between the port and the rail station. Rail cargo must not be higher than 6 feet (1.82 meters) and no wider than 8 feet (2.44 meters).

Mokpo Railyard

Port Rail Spurs

Docks

No docks exist for truck or boxcar loading/offloading.

OFF-PORT MARSHALING AREAS

No specific off-port marshaling areas were identified by port officials. The best storage areas are next to the wharves (about 30 meters from the wharf) along the wall securing the port. Another possibility is the military base 12 miles (20 kilometers) north of Mokpo.

MATERIALS HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity STON (metric tons)	Quantity	Wharf Assignment	Owner
Bulk Crane	14 (13)	1	12	Port
Mobile Cranes	22-27 (20-25)	5	---	local stevedoring company
Forklifts	11 (10)	3	---	local stevedoring company
Forklifts	5.5 (5)	2	---	local stevedoring company

AMMUNITION HANDLING FACILITIES

The port has no experience in handling ammunition. Any plans for conducting such operations must be coordinated with the Korean Ministry of Defense and Ministry of Maritime Affairs and Fisheries (MMAF) well in advance.

PETROLEUM, OIL, AND LUBRICATION (POL)

The Port of Mokpo has POL facilities and also acts as a distribution hub for transport of POL to smaller Korean ports. Two pipelines can carry POL from ships docked at the public wharf to nine storage bunkers. These bunkers have a capacity of 1,000 kiloliters each (9,000 kiloliters total) and are used to store gasoline and diesel fuel. From here, truck-tankers transport the fuel inland from the port or tanker vessels transport POL to other ports. The flow-rate from ship to bunker is 200 kiloliters/hour. The flow-rate from bunker to ship is 80 kiloliters per hour.

POL Facilities at Port of Mokpo (storage tanks in background)

INTERMODAL FACILITIES

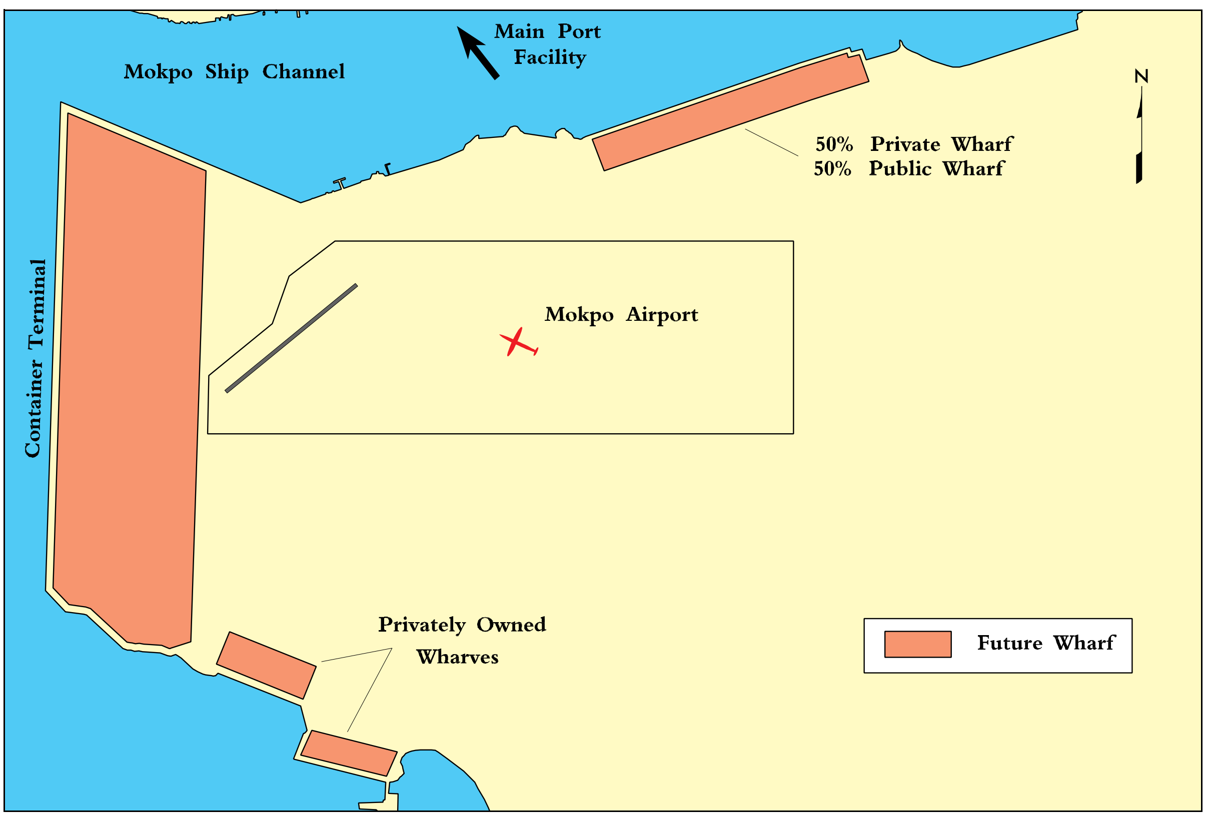
The port does not have any intermodal facilities.

FUTURE DEVELOPMENT

The port has ambitious future development plans. Two wharves are currently under construction and are due to be completed by the end of next year. These wharves are located on the narrow peninsula on the other side of the Mokpo ship channel. One pier will be an exclusive-use only, and the other will be split between exclusive and public use.

For long-term development, the port plans to construct a container terminal consisting of 22 berths on the point of the peninsula on the other side of the Mokpo ship channel. Because of the location directly in the flight path of aircraft landing and taking off from the Mokpo airport, container cranes will require a low profile. Project completion is not due until well after the year 2000.

For highway transport, an expressway will be constructed along the Korean west coast linking Mokpo to the Seoul and Inchon metropolitan areas. Completion of the expressway is not expected until the year 2004.

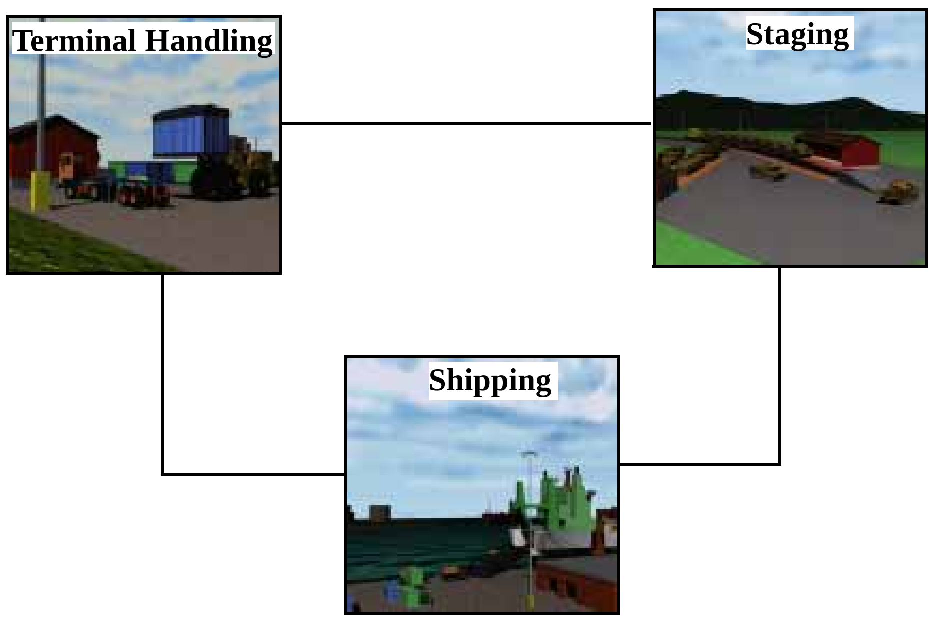


Future Devlopment, Port of Mokpo

II. THROUGHPUT ANALYSIS

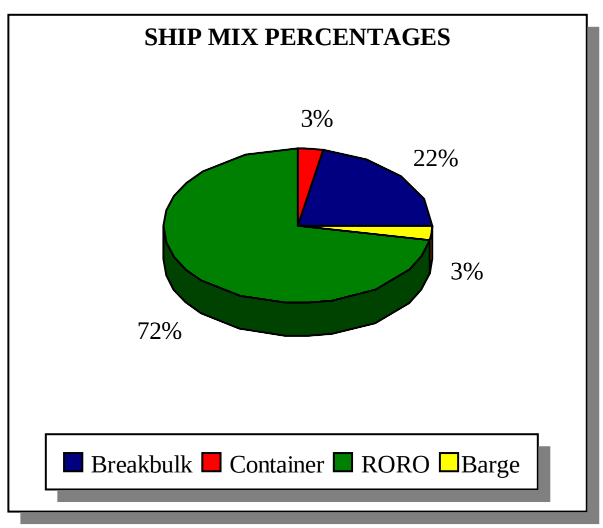
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Mokpo. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, hardstand marshaling, and terminal processing/handling - in terms of short tons (STON) per day.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 80 percent of the port facilities will support military deployments. Also, due to the size of the port, we assumed a berth utilization factor of 80 percent. The ship mix is determined by Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL RECEPTION/HANDLING

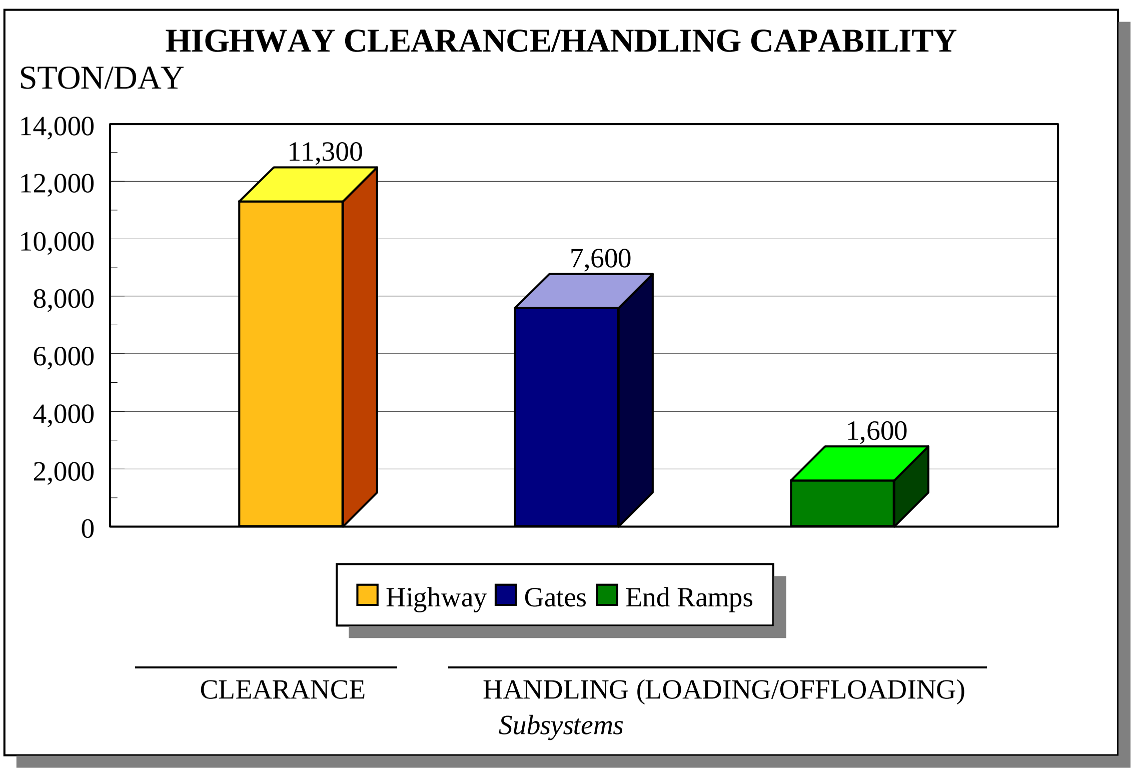
Highway

The access road, including the gate, connecting the port to Industrial Road is a two-lane facility. The road network in and out of the port, including the gate processing of vehicles, can handle about 7,600 STON (29,400 MTON) of equipment and supplies per day.

Roadable vehicles will likely process from the wharf area directly to the open storage area adjacent to the wharf or travel to an inland off-port marshaling area such as the military base north of Mokpo. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. Since no fixed or portable truck ramps are available at the port, we assume that the military port operator will make arrangements to acquire a portable end ramp to support loading flatbed trucks and semitrailers. This ramp could handle 1,600 STON (4,800 MTON) per day.

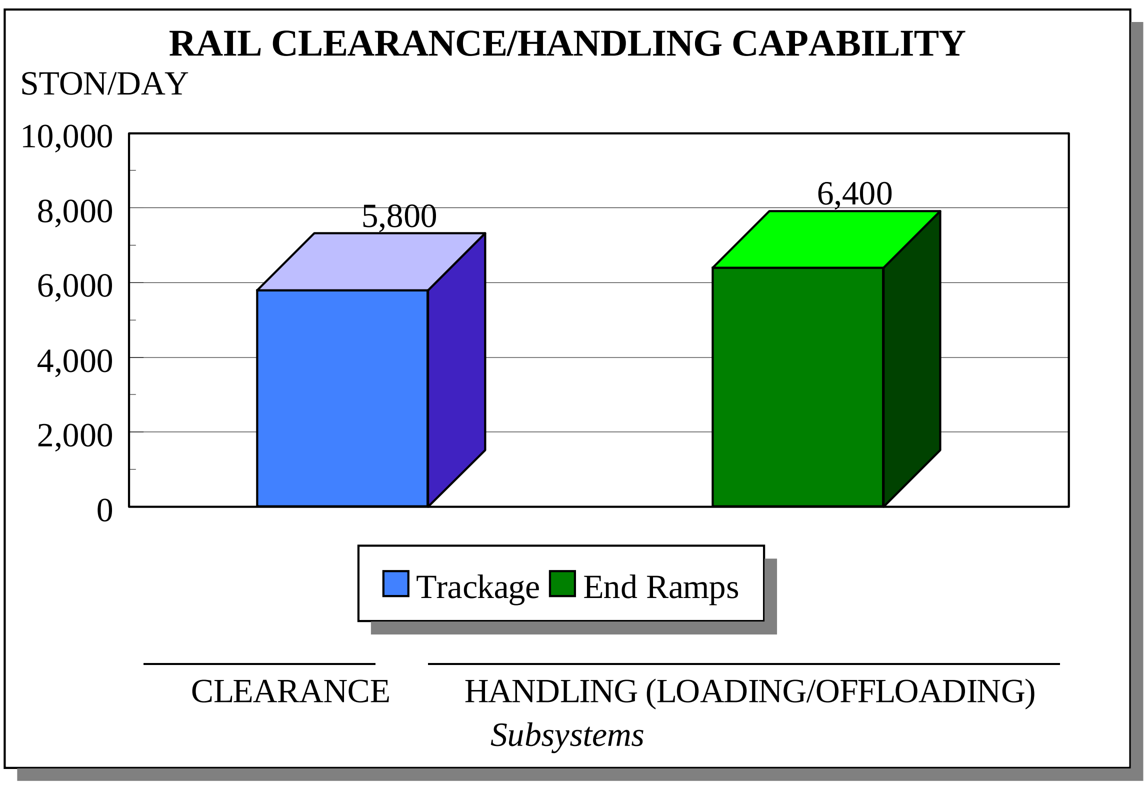
The port has no truck docks.

The port does not have a container capability.



Rail

Both the port authority and station master at the Mokpo Rail Station state that the current workload going to the port is three trains per day at nine railcars per train. The station master indicated that spurs two and three are the most likely tracks that would be used for railcar loading at the railyard next to the Mokpo Rail Station. These spurs can handle nine and eight railcars, respectively. The railyard at the train station has a total of 18 tracks. Assuming deploying units would have access to another spur, this railyard could likely handle four trains per day. In general, trains in Korea are limited to 22 railcars per train to fit sidings accommodating passing trains. The KNR would perform switching operations at the Mokpo Train Station. We assume that the military port operator would make arrangements for use of two portable end ramps at Mokpo. One ramp could be placed at a spur in the port and the other would go to spur two at the railyard. However, because only small cargo can be loaded at the spurs in the port to meet rail clearances between the port and railyard, we assume all end ramp operations will occur at the railyard. Using spurs two and three, these two ramps could handle almost 70 railcars per day. Currently, the port does not conduct container operations.

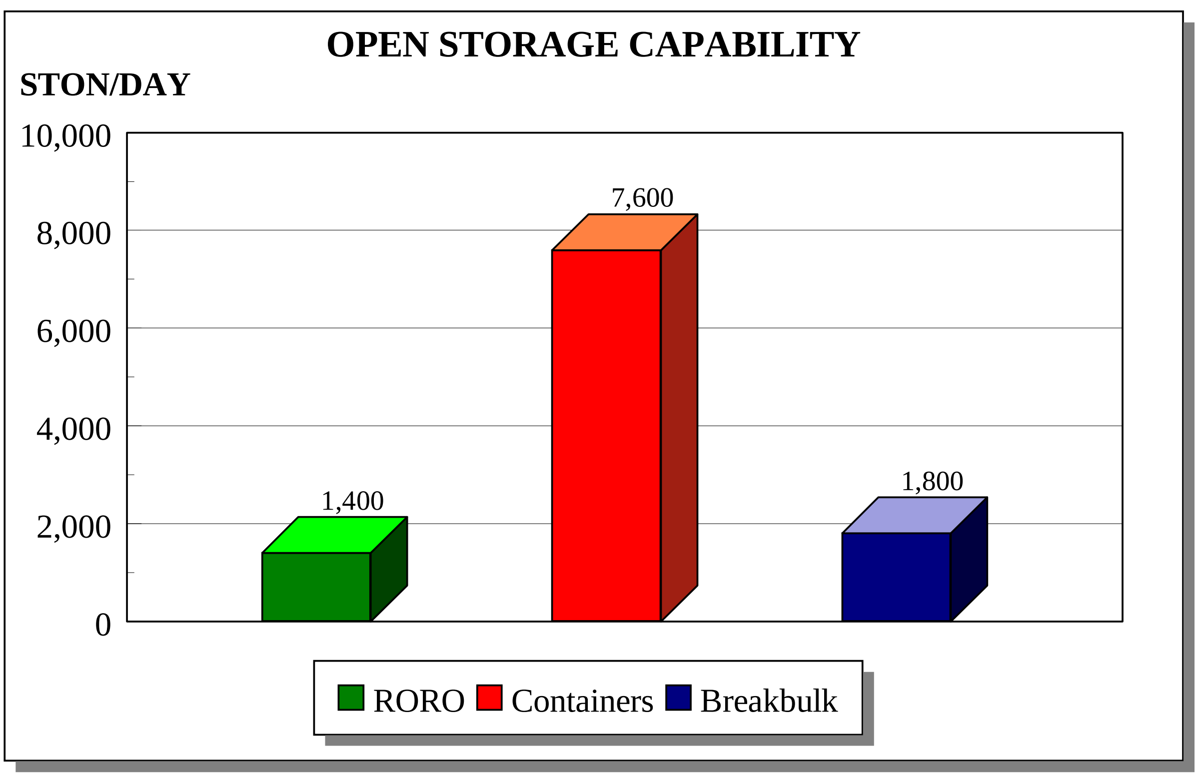


OPEN STORAGE

The port has about 3 acres (13,510 square meters) of open storage available on a daily basis. This storage area is located at Berths 11 and 12 and can be used for marshaling. Not all of this area is paved. The port currently has the ability to perform breakbulk, RORO, or barge operations. A container capability is in the future. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned.

The chart below provides the cargo open storage capability for each vessel type. If a combination ship is expected, then a portion of each involved capability should be assumed.

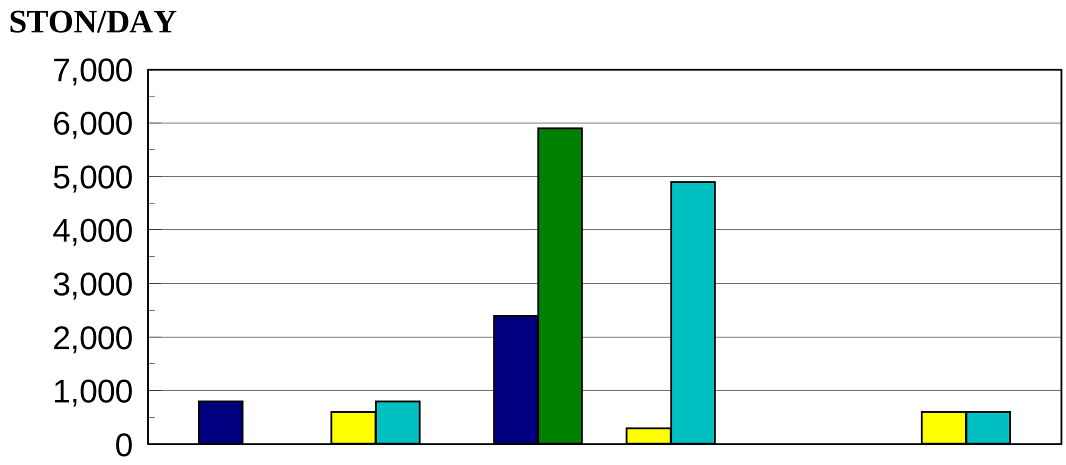
Based on the shipping subsystem throughput for RORO operations (see Throughput Summary Table), about 7.5 acres (30,140 square meters) of open storage will be needed to marshal the daily throughput capability for the Port of Mokpo. Because the Port of Mokpo does not have a container throughput capability, all of this area would be dedicated to vehicles and palletized cargo. The RORO acreage considers the estimated square feet for RORO throughput (Throughput Summary Table) and includes a factor to account for areas needed to store frustrated cargo, working areas, areas around ramps and gates, lanes and access to vehicles, and other factors. This estimate does not take into consideration the equipment that would leave the port immediately after off-loading. The port will have a shortfall of open storage capability unless enough vehicles can immediately leave the port and marshal inland at areas such as the military base north of the city.



SHIPPING

Throughputs for each berth are shown below. They are based on various factors including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. Assumptions used in this study are in the appendix.

BERTH THROUGHPUT CAPABILITY



	BERTH 11	BERTHS 12-13	BERTH 14
Breakbulk	800	2,400	0
RORO	0	5,900	0
Containers	0	0	0
Barge	600	300	600
Mixed	800	4,900	600

CONVERSION FACTORS	
Breakbulk	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON

THROUGHPUT SUMMARY FOR PORT OF MOKPO PER DAY

PORT/ BERTH	LENGTH (feet) (meters)	DEPTH ALONGSIDE (feet) (meters)	BREAKBULK THROUGHPUT (STON) (MTON)	RORO THROUGHPUT (STON) (MTON)	RORO SQUARE FT (EST)	RORO PIECES	CONTAINER THROUGHPUT (STON) (MTON) (TEU)	BARGE THROUGHPUT (STON) (MTON)	MIXED THROUGHPUT (STON) (MTON)
11	551 168	29 9	800 2,000	0	0	0	0	600 1,500	800 1,900
12-13	1,607 490	49 15	2,400 6,000	5,900 23,600	118,000	690	0	300 700	4,900 18,900
14	442 135	32 10	0	0	0	0	0	600 1,500	600 1,500

Note: RORO pieces based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

We base the type of ship preferred at each berth on the methodology described in the appendix. The evaluation is a snapshot view of the current physical characteristics of the berths and MHE available. The berths are rated according to rank. The lower number for a berth, the better the berth is suited for the loading or offloading operation. For example, Berths 12-13 are ranked better than the other berths for conducting RORO operations. In general, no one berth is ideal for all military operations. The best berth depends on the type of ship loaded.

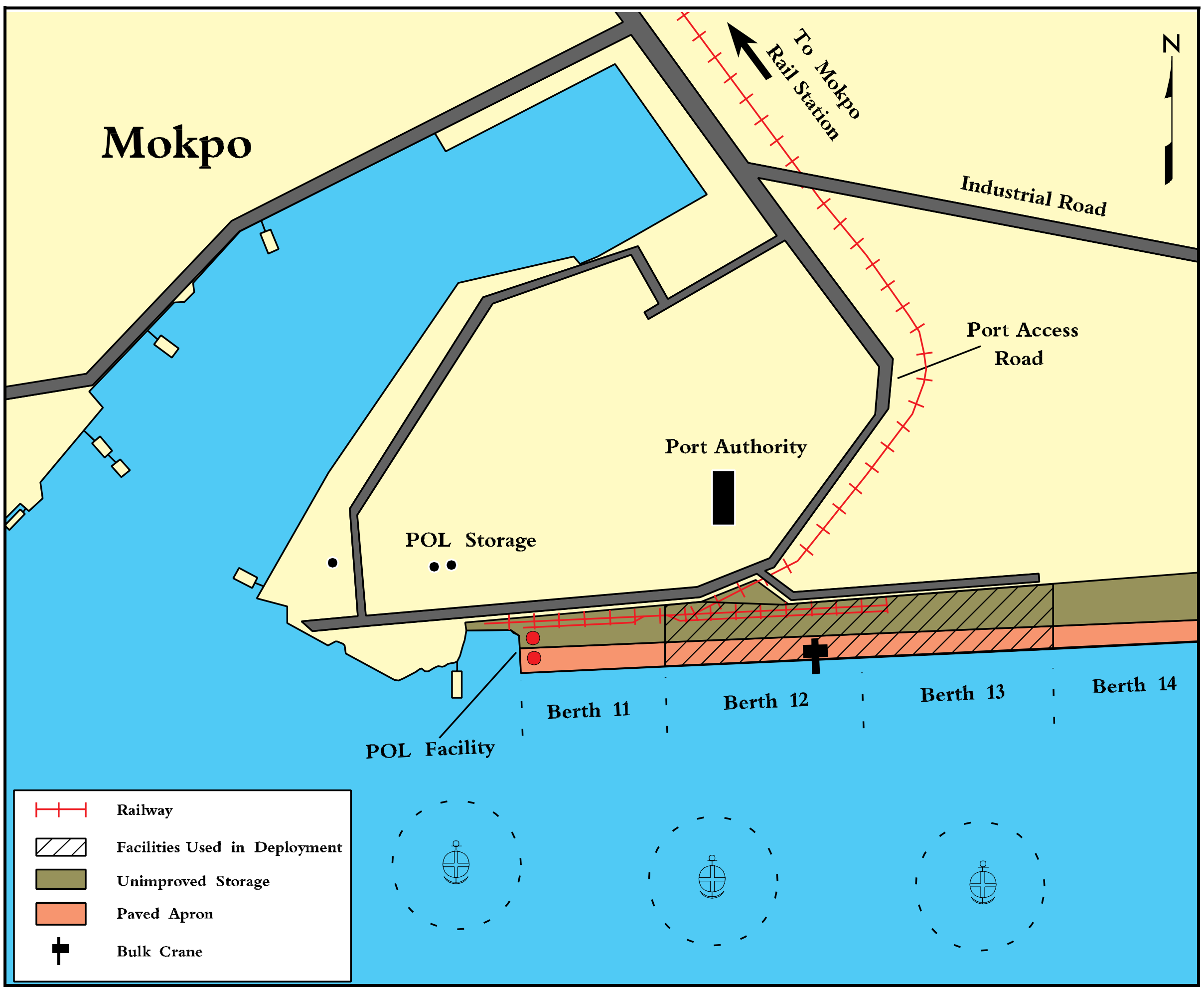
Because of its deep water draft, Berths 12-13 are the obvious choice for all types of operations.

LOADING TYPE	**BERTHS**		
	11	**12-13**	**14**
Breakbulk	2	1	--
RORO	--	1	--
Container	--	--	--
Barge	1	1	1
Note: Berths marked with a “-” are not recommended for these operations.			

III. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored brigade. Because the large tidal variation seriously affects the channel draft, this study evaluates deployment using 2nd LT John P. Bobo - class RORO vessels. The 2nd LT John P. Bobo ship is a small RORO ship with maximum draft of about 32 feet (9.8 meters) and total deck space of 256,566 square feet (23, 861 square meters). Facility use depends on decisions made by the Korean Ministery of Defense and MMAF. Because of the Korean commitment to defense of their country and considering current facility use at Mokpo, we assume berth 12-13 and associated storage areas are available for military use. We also assume that no other military units (US or Republic of Korea) will be competing for port assets and facilities during the time that the armored brigade occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately offload the ship and clear the port.



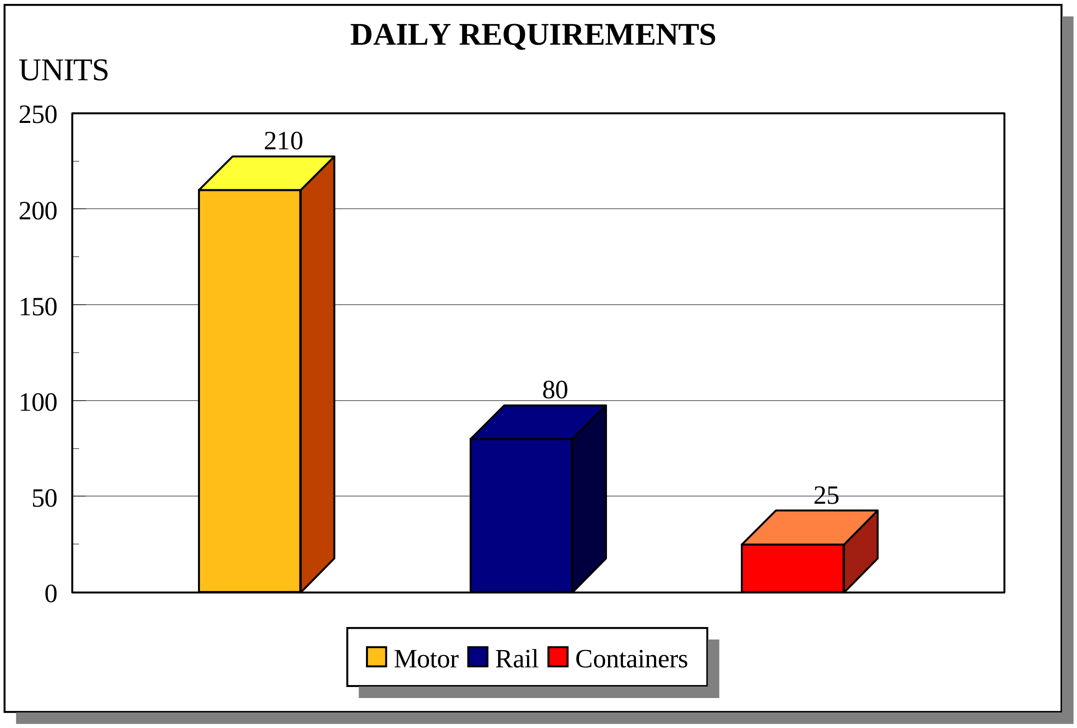
Potential Port Use During Deployment

REQUIREMENTS

The likely requirement for the Port of Mokpo would be to deploy a notional armored brigade to support the overflow of deployment operations at larger ports. We assume the port must throughput the Armored Brigade in 6 days of shiploading and port clearance. The brigade has to move about 2,820 vehicles and 150 containers. Movement of the brigade from the port inland will require about 475 railcars (80 per day) using the convoy/rail option. Under this option, about 1,270 (210 per day) roadable vehicles would drive out the gates towing 830 (140 per day) trailers. About 25 containers would arrive daily.

ARMORED BRIGADE

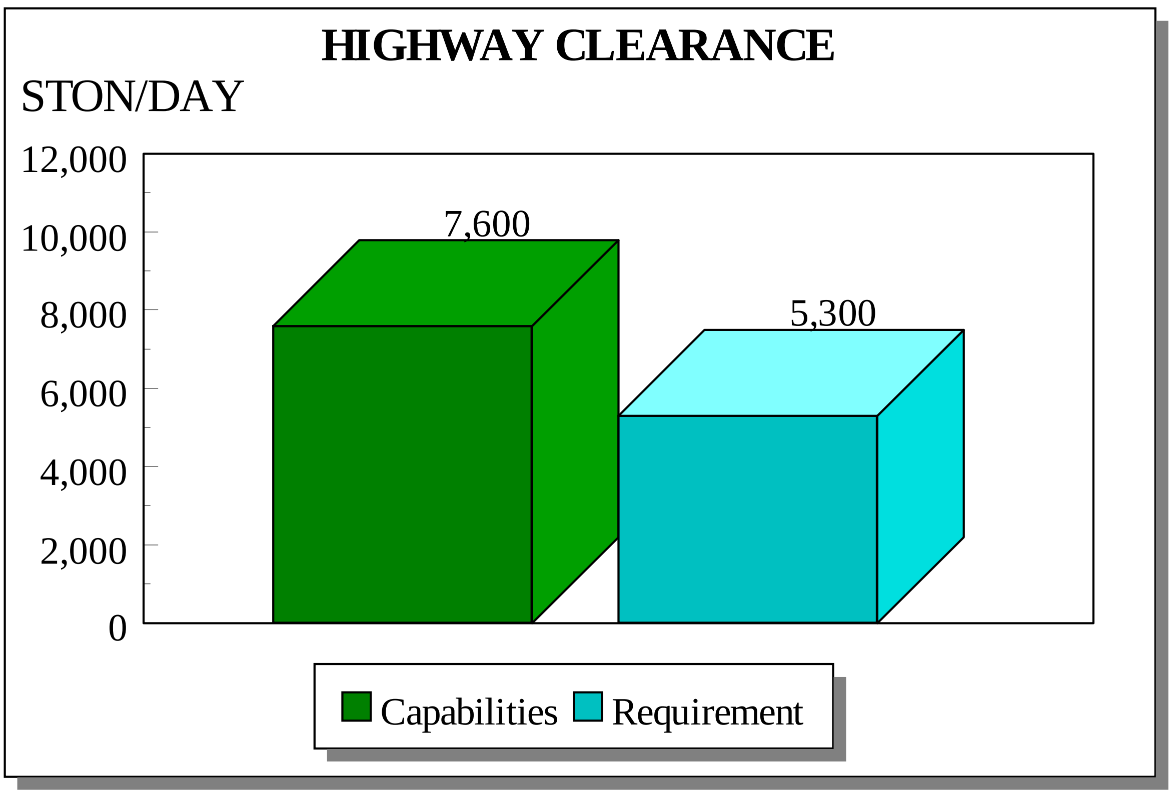
Total Equipment		Required Daily Throughput
Volume	95,800 MTON	16,000 MTON
Weight	31,703 STON	5,300 STON
Area	642,645 SQ FT	107,100 SQ FT
Vehicles	2,823	460
Containers	150	25



TERMINAL INPROCESSING/HANDLING

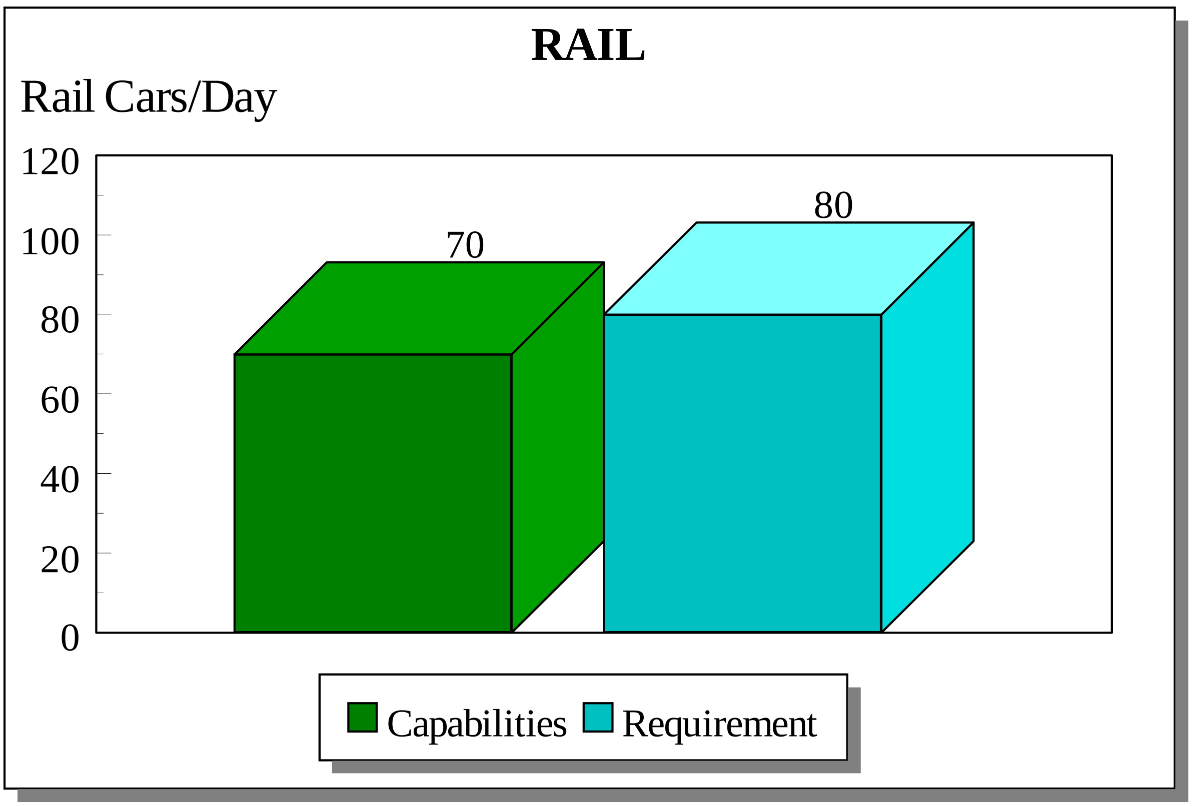
Highway

Industrial Road, a two-lane road, is the major highway connecting the port to the main routes exiting Mokpo. This highway, including gate to the wharf areas, can handle about 7,600 STON of equipment and supplies per day. The rail line between Mokpo rail station and the port has restrictive rail clearances. Because of this, we assume all equipment and cargo, including that requiring rail transport, would leave the port area by highway. Assuming a constant flow of equipment out the gate, the daily clearance requirement is 5,300 STON. Based on the highway throughput, the Mokpo highway network can handle an armored brigade within 5 days.



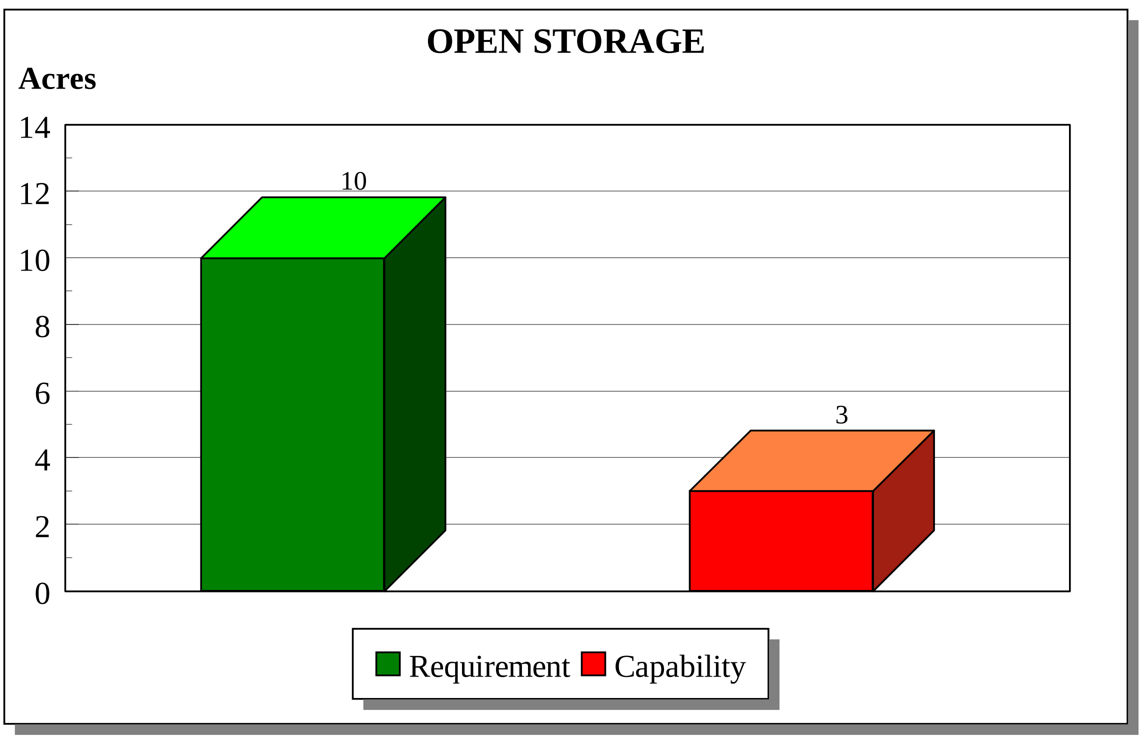
Rail

The railyard at the Mokpo train station can store 149 railcars on a daily basis without disrupting rail service. End ramp operations will likely occur on spurs two and three. These spurs can handle nine and eight railcars, respectively. Although the current rail service is three trains per day, we assume this railyard is capable of four trains per day. Based on this assumption, the two end ramps could load 70 railcars per day. This means an armored brigade would require 7 days to load out.



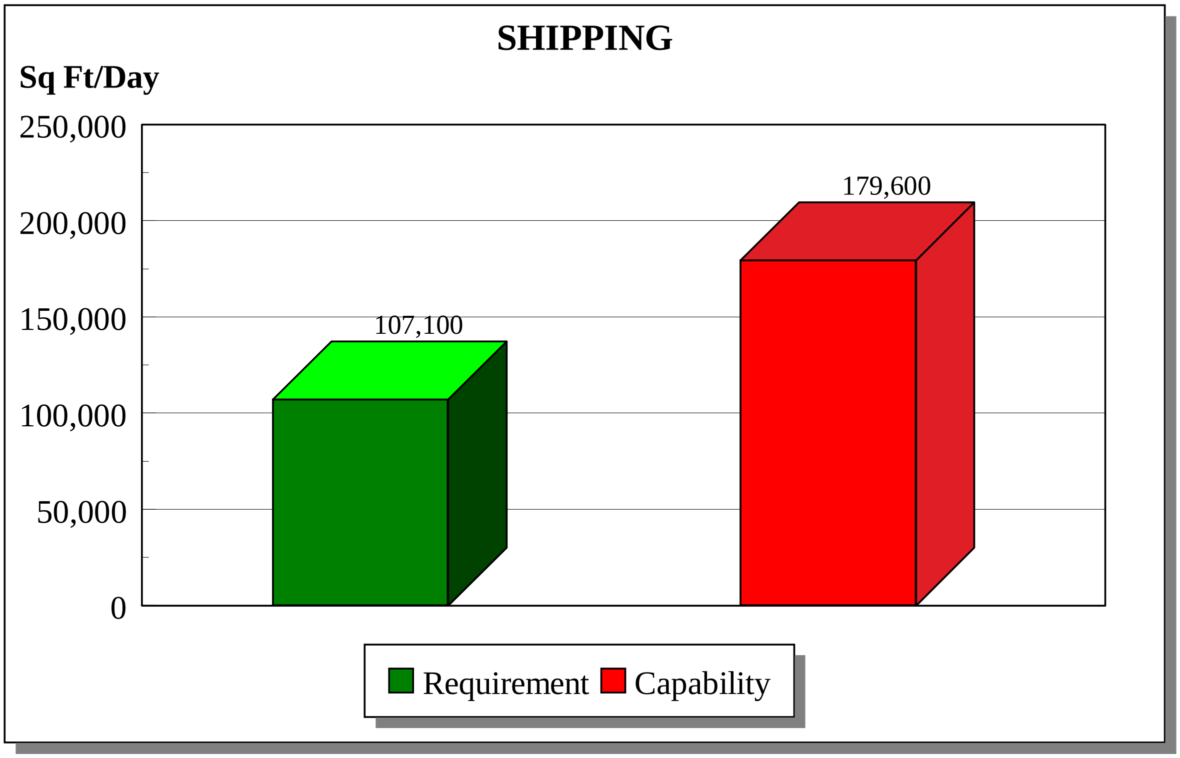
OPEN STORAGE

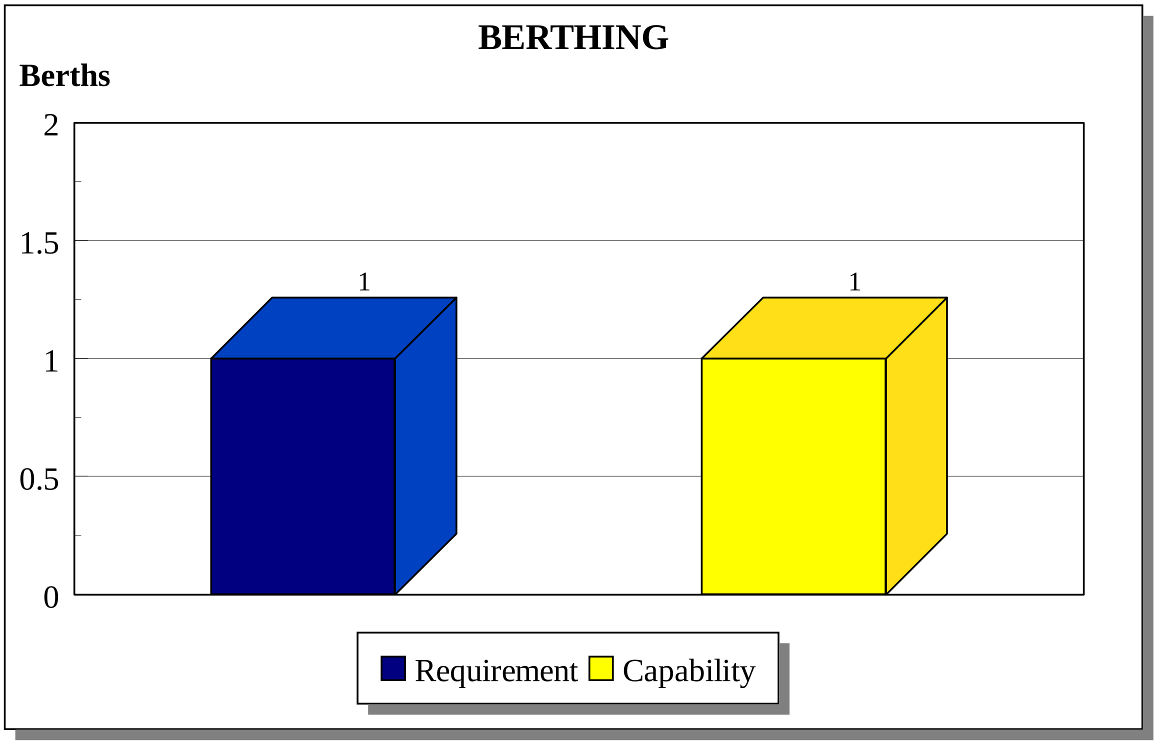
The nearest off-port marshaling area to the Port of Mokpo is 12 miles away (military base) through the city of Mokpo. Because of this, we assume that all equipment offloaded at the port must be marshaled in the port's open storage areas. The 2nd LT John P. Bobo - class RORO ship has a total deck space of 256,566 square feet. Assuming a 70 percent stow factor, this ship can carry about 179,600 square feet of cargo. Assuming a small RORO ship can offload in one day, the port open storage areas must accommodate the entire shipload of cargo each day. To account for additional space needed for working areas, lanes and access to vehicles, areas around gates and ramps, and frustrated cargo, the daily required working area is about 449,000 square feet or 10.3 acres). The port has eight open storage areas totaling 16 acres, however, only 3 acres are available on a daily basis. To meet open storage requirements, the port must keep 10.3 acres clear on a daily basis to handle a shipload of equipment per day. This study assumes that equipment and cargo will remain at the port for one day.



SHIPPING

An armored brigade has 642,645 square feet of equipment. If the 2nd LT John P. Bobo - class RORO vessel can transport a maximum of 179,600 square feet of cargo (includes 70 percent stow factor), about four of these ships are needed to move an armored brigade. Assuming the port can offload and clear one shipload of equipment per day, an armored brigade could be offloaded in four days.





SUMMARY

The Port of Mokpo can throughput an armored brigade in 7 days. The rail subsystem is the weak link in the port clearance process. Equipment requiring rail transport must convoy through Mokpo to the rail station because rail line clearances are minimal on the spur connecting the port to the rail station. The two rail spurs most likely to support end ramps, together can hold only 17 railcars. The access into the railyard at the rail station is one-laned and open storage is minimal.

If rail transport is not required, the port can throughput an armored brigade in 5 days. To accomplish this, the Port of Mokpo must ensure at least 10 acres of open storage are available for marshaling. We assume that equipment and cargo will remain at the port for one day.

RECOMMENDATION

The Port of Mokpo has potential as an overflow port when problems or delays occur at the larger ports. Due to the lack of open storage and the difficulty in access to rail transport, the port should be limited to occasional shiploads.

July 96

PORT OF MUKHO

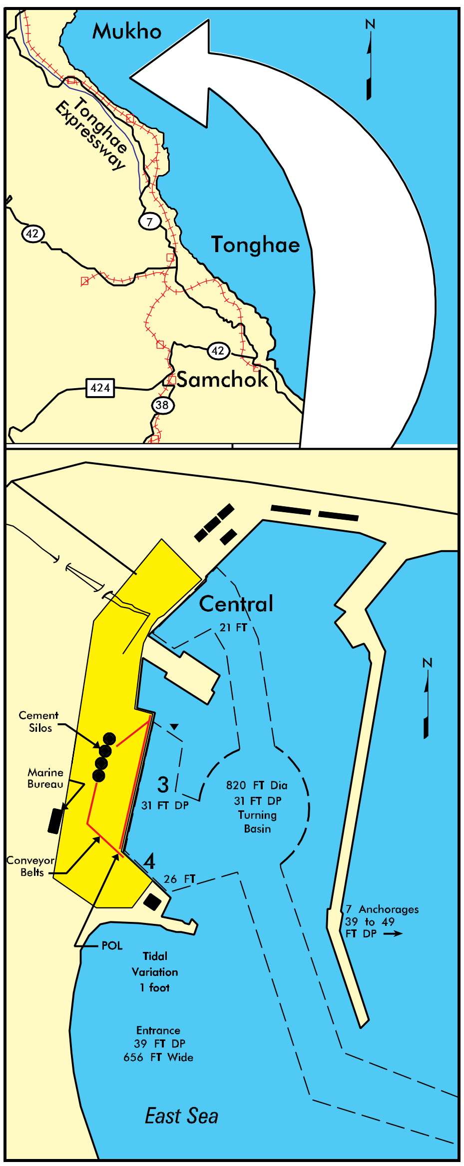
I. General Data
II. Throughput Analysis
III. Application
Return to Index

I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Mukho is primarily a passenger and cement port. The GeoCode for Mukhojin Ni is RBXH. It was originally developed for coal operations, but there is no longer a demand for coal. Conveyor belts obstruct most of the aprons. It is on the northeast side of Korea on the East Sea, between Tonghae and Okkye. The port is 37^{o} 35’ 00” north latitude and 129^{o} 07’ 00” east longitude.



The entrance into the harbor is only 39 feet deep (12 meters) Mean Low Water (MLW) and about 656 feet wide (200 meters) between the breakwaters. There are no overhead restrictions. There is a 820-foot diameter turning basin within the breakwaters. This basin is about 31 feet deep (9.5 meters) MLW. Tidal variation is about 1 foot.

Seven anchorages are outside the breakwaters of the port. Typical anchorage depths range from 39 to 49 feet deep (12 to 15 meters) deep with a few areas 65 feet deep (20 meters). All anchorages are sand or mud bottomed.

Berthing and undocking of ships requires pilotage, and is only allowed during daylight hours. There are two or three pilots in the area, but only one tug boat. The maximum ships routinely allowed to enter the inner harbor are 590 feet long (180 meters) and 27.9 (8.5 meters) draft.

Water Access to Port of Mukho

Highway

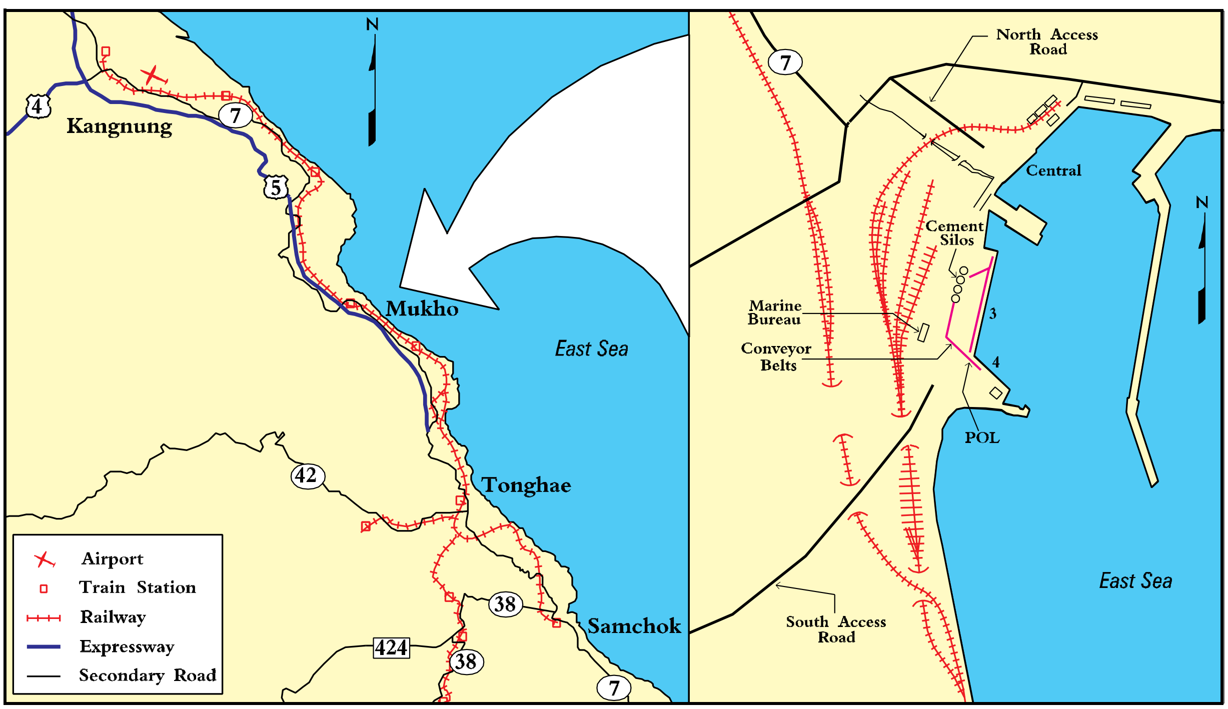
Roads in Mukho are only two lanes wide but not generally congested. Highway access into the main gate of the port (at the south end) requires crossing a bridge that passes over one of the port's railyard. This bridge does not restrict weight. Another highway access to the port is by the south port access road. This road connects to Route 7 which extends north or south to join the Tonghae Expressway.

Air

The nearest airport is in Kangnung, about a 45-minute drive to the northwest. It has two runways 9,000 feet long. One runway is 150 feet wide and routinely handles A300 passenger jets to Seoul. The other runway is 98 feet wide, C-5 capable, and is used by the adjacent ROK airbase.

Rail

All railroad tracks within Korea are operated by the Korean National Railroads. The Port of Mukho has no rail facilities that are suitable for military operations, although the port has two railyards for coal storage and handling. The southern railyard is confined by bridges and buildings, and is only usable for railcar storage. The northern railyard is unused, but is configured for internal bulk coal operations.



Highway and Air Access to the Port of Mukho

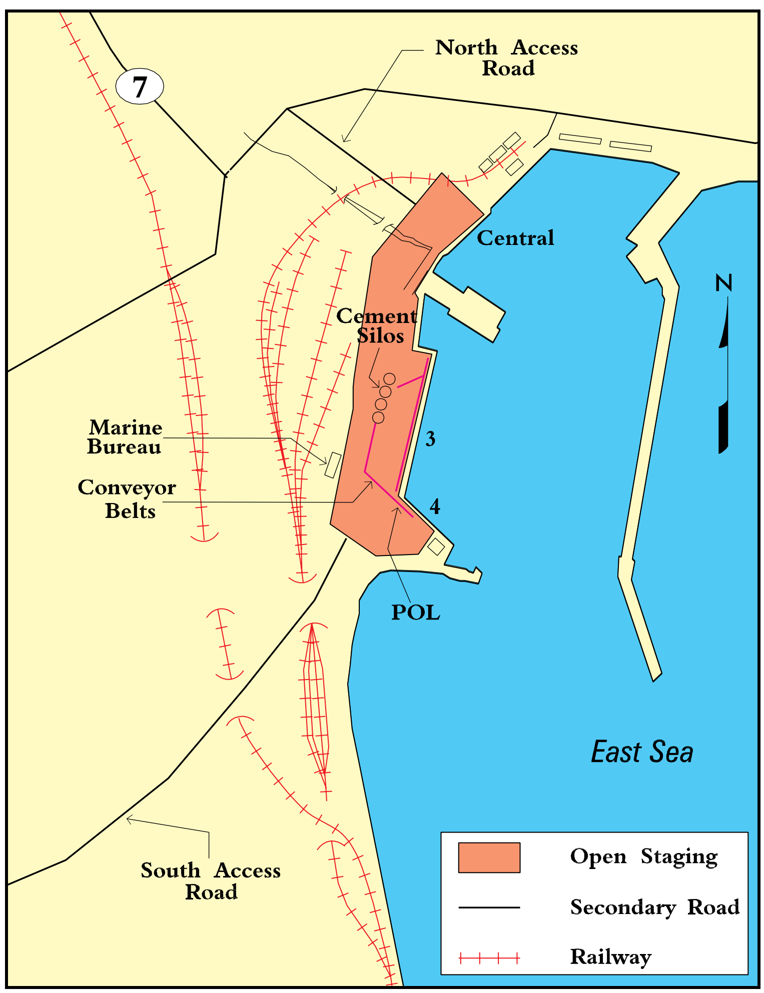
PORT FACILITIES

Berthing

Recent cargo for the port has primarily been cement. Ground level and overhead conveyors for cement operations congest the aprons of Pier 3 and the north end of Pier 4. The south end of Pier 4 supports ferry operations. POL operations are performed between Piers 3 and 4, but only for the nearby cement company. None of the piers have lighting for nighttime operations.

The wharves of this report range in depth from 21 to 30 feet (6.4 to 9.1 meters) at MLW. The longest berth (Pier 3) is 1,083 feet long. Apron heights are all 8 feet (2.4 meters) above MLW.

	BERTHS		
CHARACTERISTICS	**Central**	**3**	**4**
Length, feet (meters)	394 (120)	1,083 (330)	968 (295)
Depth alongside at MLW, feet (meters)	21 (6.4)	30 (9.1)	26 (7.9)
Deck strength, psf (metric tons/ square meter)	614 (3)	614 (3)	614 (3)
Apron width, feet (meters)	Open	45	45
Apron height above MLW, feet (meters)	8 (2.4)	8 (2.4)	8 (2.4)
Number of container cranes	0	0	0
Number of wharf cranes	0	0	0
Apron lighting	No	No	No
Straight-stern RORO facilities	No	No	No
Apron length served by rail, feet (meters)	0	0	0



Land-Use Map for Port of Mukho

SUMMARY OF BERTHING CAPABILITIES FOR MUKHO			
VESSEL	BERTHS		
	Central	3	4
Breakbulk			
C3-S-38a	a,c	2	a
C4-S-58a	a,c	a	a
C4-S-66a	a,c,g	a,g	a,g
C5-S-37e	a,c	a	a
Seatrain			
GA and PR-class	a,c	1	a
Barge			
LASH C8-S-81b	a,c,f,g	a,f,g	a,f,g
LASH C9-S-81d	a,c,g	a,g	a,g
LASH lighter	1	5	4
SEABEE C8-S-82a	a,c,g	a,g	a,g
SEABEE barge	1	5	4
RORO			
Comet	a,c,d	d,o	a,d,o
Meteor	a,c,d	d,o	a,d,o
Cape Gnome	a,c,g,d	a,g,d,o	a,g,d,o
C7-S-95a	a,c,g	a,b,g	a,b,g
Cape Taylor	a,c	b	a,b
Cape Orlando	a,c	a,b	a,b
MV Ambassador	a,c,d	d	d
Callaghan	a,c,d	d,o	a,d,o
Cape Lambert	a,c	a,b	a,b
FSS-Class	a,c,g	a,b,g	a,b,g
Cape E-class	a,c	a,b	a,b
Cape D-class	a,c,g	a,b,g	a,b,g
Cape H-class	a,c,g	a,b,g	a,b,g
Cape R-class	a,c,g,d	a,g,d,o	a,g,d,o
Cape Texas	a,c	b	a,b
Container			
C6-M-147a	a,c,e	b,e	b,e
C7-S-69c	a,c,e	a,b,e	a,b,e
C7-S-68c	a,c,e	a,b,e	a,b,e
C8-S-85c	a,c,e,g	a,b,e,g	a,b,e,g
C9-M-132b	a,c,e,g	a,b,e,g	a,b,e,g
C9-M-F141a	a,c,e,g	a,b,e,g	a,b,e,g
Combination			
C6-S-1qd	a,c,g	a,b,g	a,b,g
C5-S-MA73c	a,c	a,b	a,b
C6-S-MA60d	a,c	a,b	a,b
Landing Craft			
LSV	1	3	3
LCU-2000	2	6	5

SUMMARY OF BERTHING CAPABILITIES FOR MUKHO (Cont)			
VESSEL	BERTHS		
	Central	3	4
Maritime Preposition Ships			
C7-M-PVT028 MPS AMSEA	a,c	a	a
C7-S-133a MPS Waterman	a,c	a	a
C8-M-PVT119 MPS Maersk	a,c	a	a

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst.

Open Storage

The port has about 15 acres of open staging. None of this area has lighting for nighttime operations. The Central Pier has the largest unobstructed open area, about five acres. The remaining ten acres are evenly distributed throughout the remaining berths.

Because of the small amount of open staging area, adjacent housing, and the congestion caused by conveyors, helicopter operations are not recommended at the port. Furthermore, there is no covered staging to support shrink wrapping.

North Gate to Port of Mukho

Highway

South Gate to Port of Mukho

There are two gates into the Port of Mukho. Both are 15 to 20 feet wide. Vehicles can move around the port without restrictions on height or weight. The port only has portable truck scales. All conveyors are high enough to prevent causing height limitations. The hill in the road , between Pier 3 and Central Pier, may cause short delays for vehicles to cross.

All paved areas at the port are concrete and capable of withstanding heavy vehicular traffic. There are no height or weight restrictions leading from the port to the main networks.

UNLOADING/LOADING POSITIONS

The port has no ramps or docks for truck operations. The military should bring or build ramps to offload trucks and trailers that do not have integral ramps.

Although the port has good rail facilities for bulk cement and coal operations, they are useless for military operations. There are no ramps or docks for offloading flatcars or boxcars. Access to the port's two railyards are obstructed by buildings.

OFFSITE STORAGE AREA

The city of Mukho is very highly developed and fairly mountainous. There are no nearby offsite areas that might support offsite marshaling.

MATERIALS HANDLING EQUIPMENT (MHE)

Local Mobile Cranes

CRANE CAPACITY (STON)	QUANTITY
99	4
77	2
55	2
33	3

The Port of Mukho has no MHE. As with other nearby cities, rental MHE is typically delivered from Tonghae. This MHE is owned by local stevedoring companies. There is no MHE in the area that has the capability to load maximum weight containers onto ships.

AMMUNITION

The Port of Mukho has no experience handling ammunition. With Korea Ministry of Maritime Affairs and Fisheries (MMAF) approval, ammunition handling is possible.

PETROLEUM, OIL, AND LUBRICATION (POL)

A very small POL facility is between Piers 3 and 4. This only has the capacity to support the nearby cement plant. It does not connect to the Trans-Korea Pipeline.

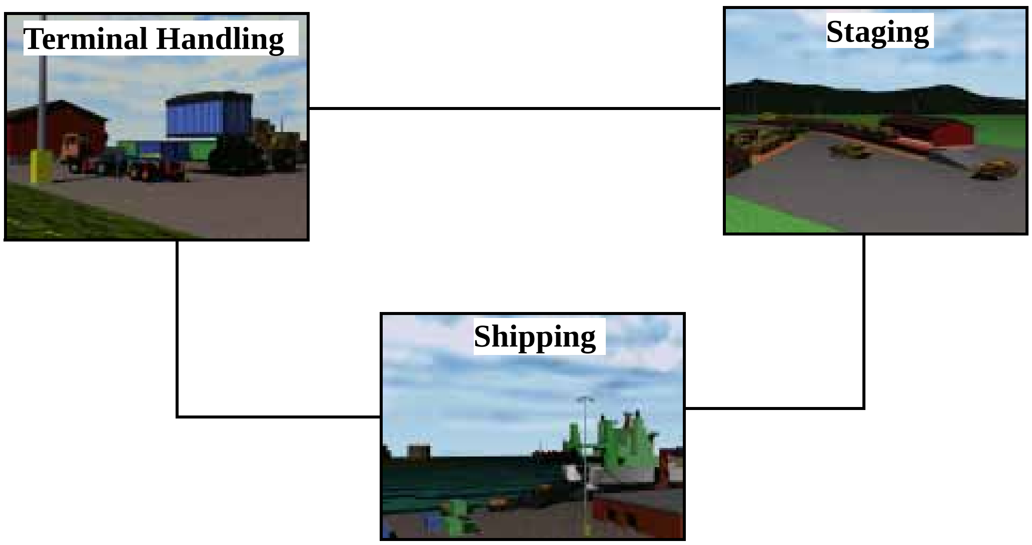
FUTURE DEVELOPMENT

The MMAF has no plans to expand or improve facilities at the Port of Mukho.

II. THROUGHPUT ANALYSIS

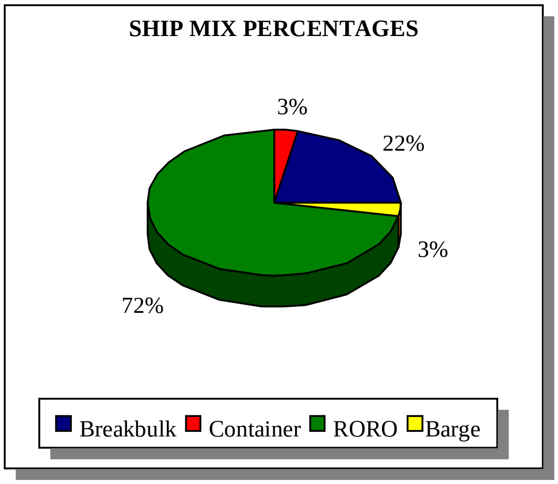
GENERAL

This section evaluates the throughput capability of the Port of Mukho using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, hardstand marshaling, and terminal processing/handling - in short tons (STON) per day.



Terminal Throughput Subsystems

This analysis assumes a maximum of 80 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using an 80 percent Facility Use Factor. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo dead weights and expectations for future deployments.



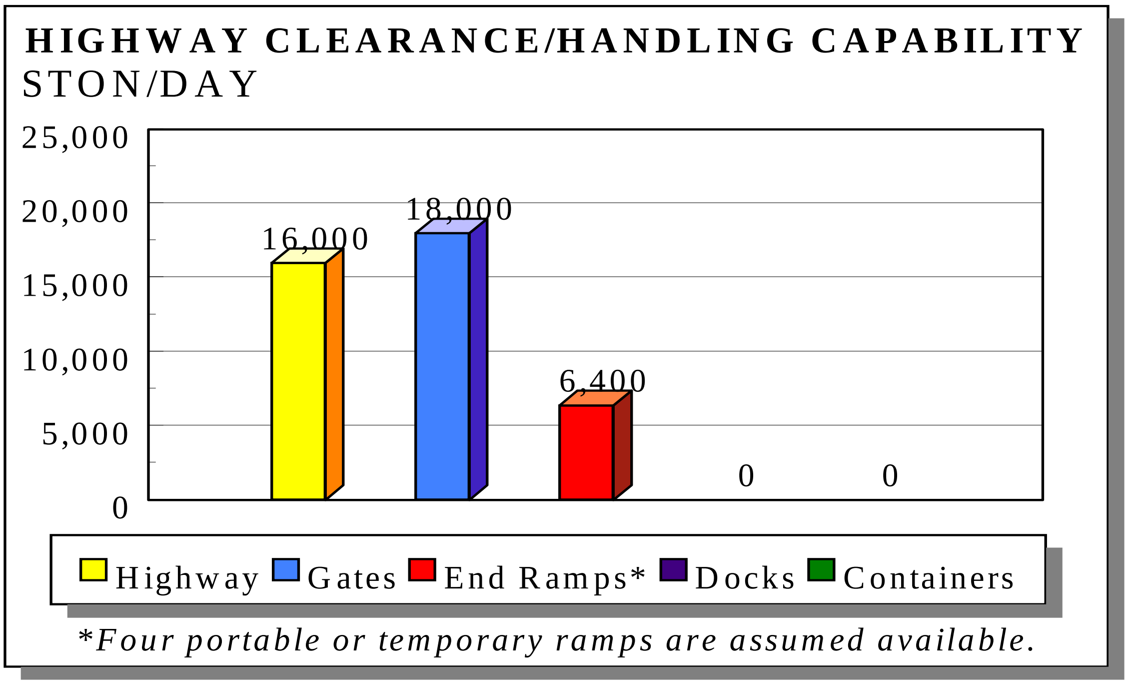
RECEPTION /HANDLING

Highway

The most restrictive highway link to or from the port are the two access roads leading to the gates of the port. The south port access road is very narrow and can be blocked by disabled vehicles. The road network in and out of the port, including the gate processing of vehicles, could handle about 16,000 STON (54,000 MTON) of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the open storage areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable end ramps brought or built by the military port operator.

There are no truck docks nor container handlers at the port.

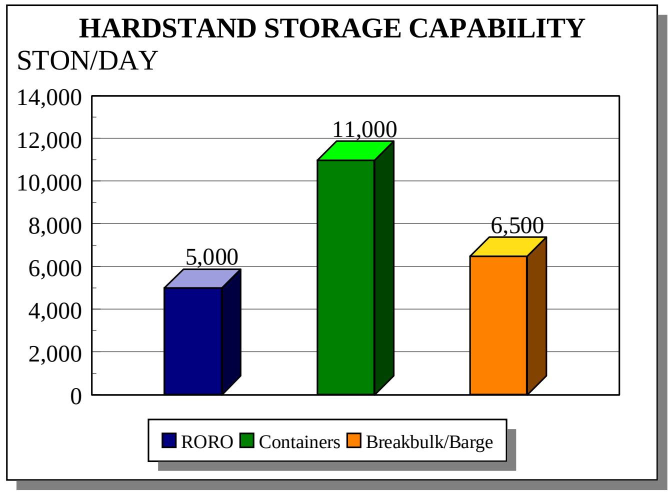


Rail

The port has no rail reception capability.

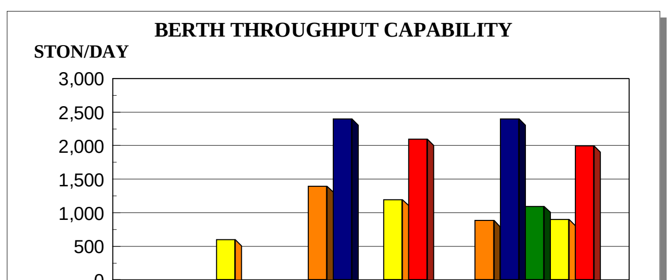
OPEN STORAGE

The port has a total of about 15 acres of paved open storage. The largest open area is inland off the Central Pier. The remaining open storage is the apron areas themselves along Piers 3 and 4. These areas are obstructed to some extent by the conveyors. There is no covered storage.



SHIPPING

Throughputs for each berth are shown at right. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ ship compatibility. Although these values provide the shipping rates, few ships can be loaded to their maximum draft.



	Central	3	4
Breakbulk	0	1,400	890
RORO	0	2,400	2,400
Containers*	0	0	1,100
Barge	600	1,200	900
Mixed	0	2,100	2,000

**This assumes the military will provide a 100-ton mobile crane.*

CONVERSION FACTORS	
Breakbulk or Barge	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON

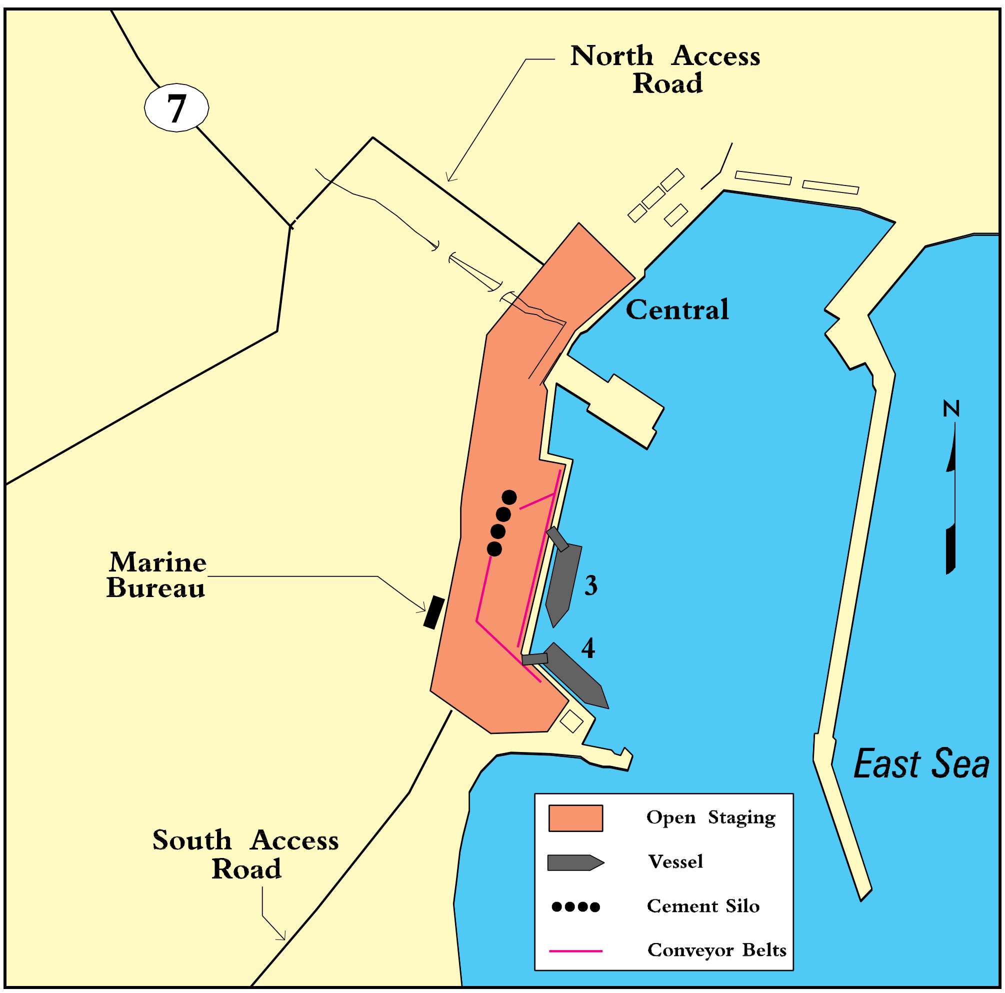
THROUGHPUT SUMMARY FOR THE PORT OF MUKHO

BERTH	LENGTH (feet) (meters)	DEPTH (feet) (meters)	BB (STON) (MTON)	RORO (STON) (MTON)	RORO SQ FT (EST)	RORO PIECES	CNTNR (STON) (MTON) (TEU)	BARGE (STON) (MTON)	MIXED (STON) (MTON)
Central	394 120	21 6.4	0	0	0	0	0	600	600
3	1,083 330	30 9.1	1,400 3,500	2,400 9,400	48,000	280	1,100 2,700 130	1,200 2,900	2,100 7,900
4	968 295	26 7.9	880 2,200	2,400 9,400	48,000	280	0	900 2,400	2,000 7,600

III. APPLICATION

This section evaluates the port's throughput capability for deploying a notional armored brigade. Because of the shallow drafts at the Port of Mukho (21 to 30 feet), this study evaluates the deployment using vessels of the 2nd LT John P. Bobo (MPS-AMSEA) class, such as the 1st LT Baldomero Lopez. Although these vessels have a maximum draft of 32 feet, 1 inch, (9.8 meters) we assume the vessels will arrive with shallow enough draft to berth. Accomplishing this may require additional vessels. The vessels have a lightship draft of only 14 feet, 4 inches (4.4 meters).

Currently, the facility use depends on decisions made by the Korean Ministry of Defense and MMAF. Because of the Korean commitment to the defense of their country, and considering current facility use of the port, we assume all of the port will be made available for military use. We also assume that no other military units (US or Republic of Korea) will be competing for port assets, both transporters and people, will be available to adequately offload the ship and clear the port.



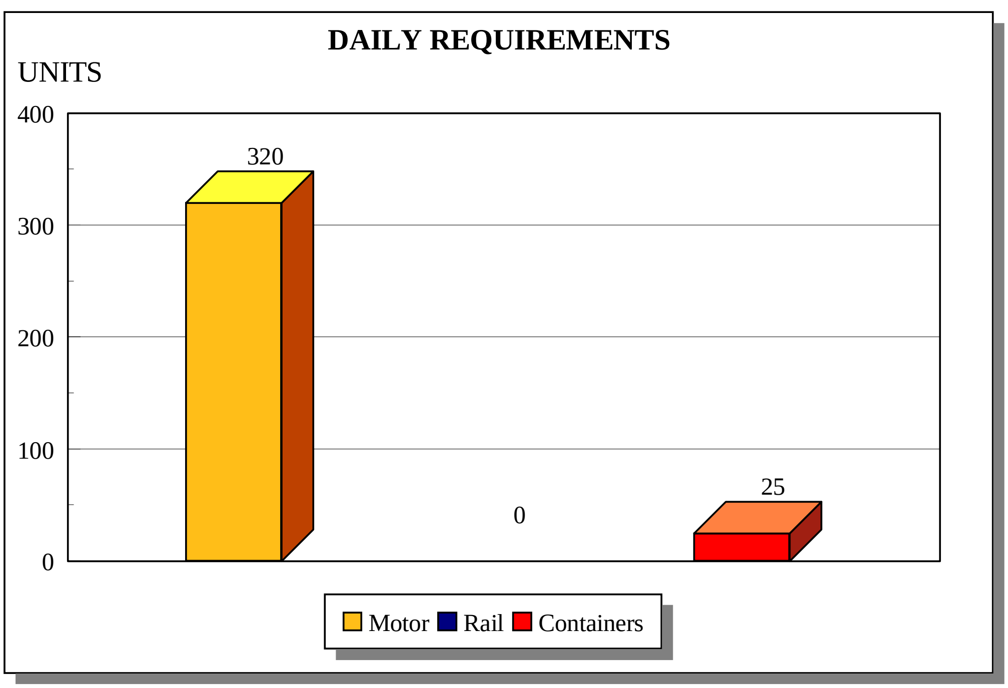
Potential Port During Deployment

REQUIREMENTS

The likely requirement for the Port of Mukho would be to deploy a notional armored brigade to support the overflow of deployment operations at larger ports. We assume the port must deploy the brigade in only six days of offloading and port clearance. The brigade has to move about 2,820 vehicles and 150 containers. As described earlier in this analysis, the rail facilities at the Port of Mukho are insufficient to support military operations. All deployment inland is by highway. Using an OCONUS motor/convoy option, about 1,260 (210 per day) roadable vehicles would drive out the gates towing 820 (140 per day) trailers. Also, about 230 forty-foot flatbeds (40 per day) and 410 Heavy Equipment Transporters (HET) (70 per day) would transport non-roadable equipment. About 25 containers would arrive daily.

ARMORED BRIGADE

Total Equipment		Required Daily Throughput
Volume	95,800 MTON	16,000 MTON
Weight	31,703 STON	5,300 STON
Area	642,645 SQ FT	107,100 SQ FT
Vehicles	2,823	460
Containers	150	25

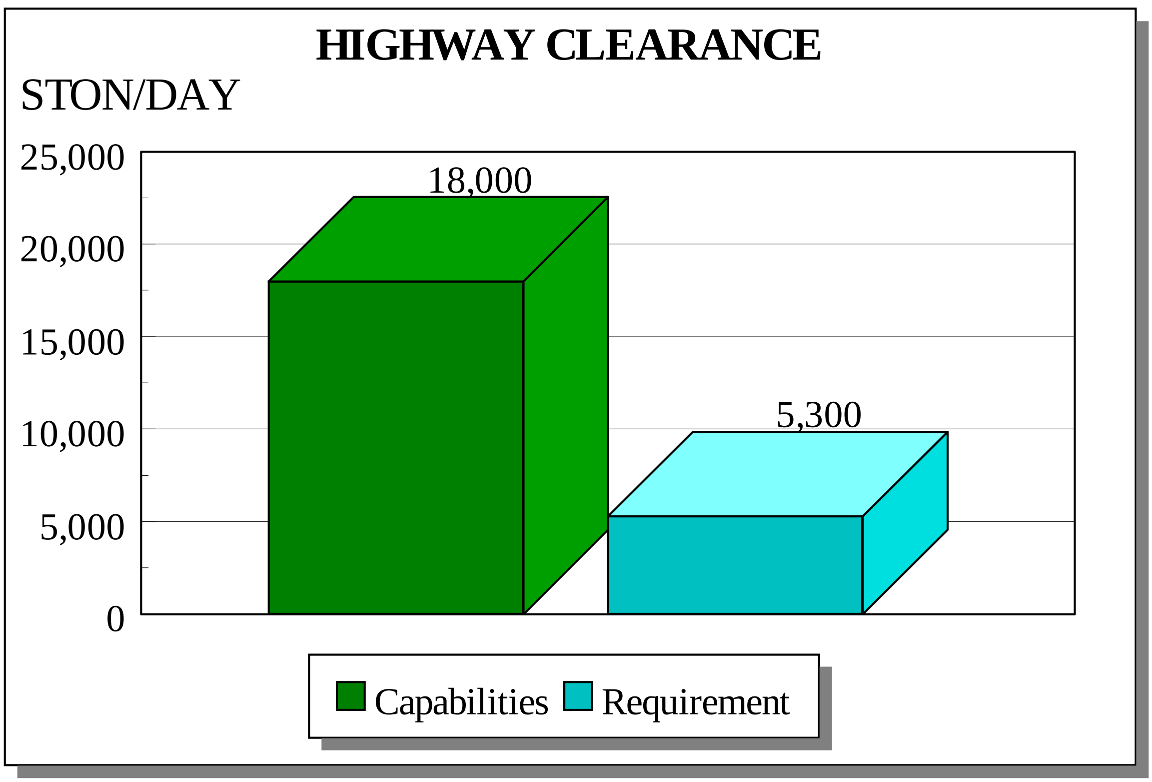


TERMINAL INPROCESSING/HANDLING

Highway

Because the military can not use the rail facilities, all vehicles will have to convoy along North Access Road to Route 7. Route 7 is a four-laned road that leads further north to the Tonghae Expressway. The Tonghae Expressway (Route 5) is four laned. The routes are shown on the Highway Access and Land-Use maps earlier in this analysis.

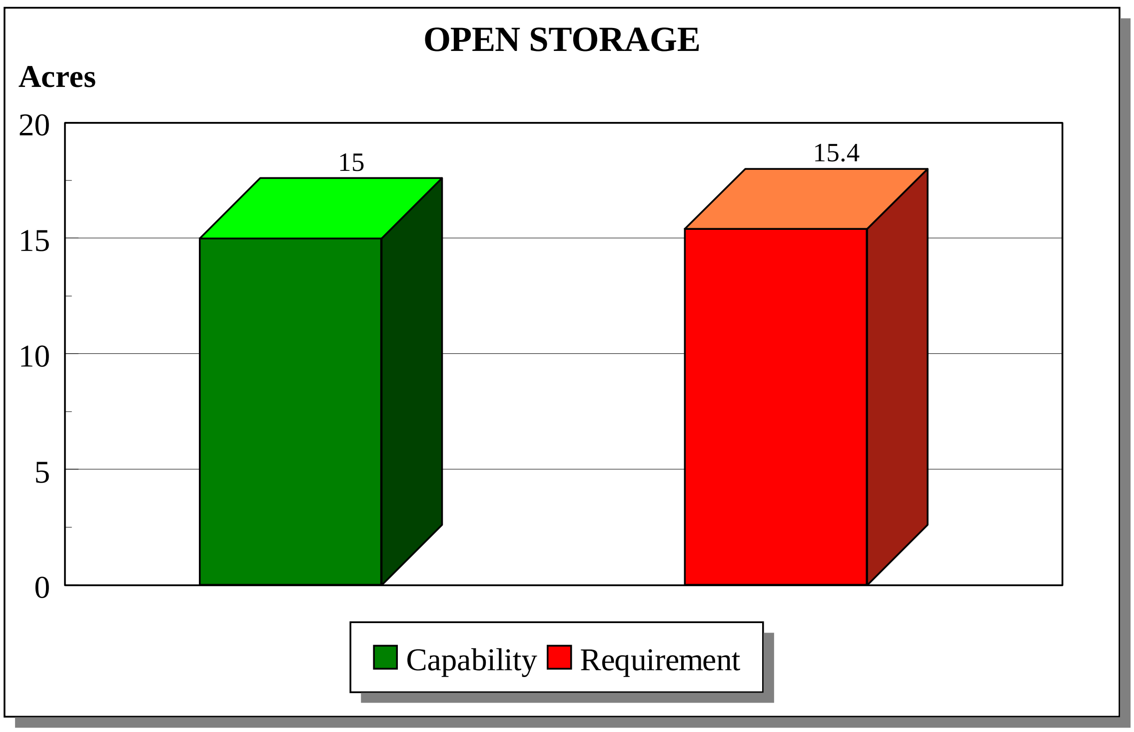
Assuming a constant flow of vehicles out the gates of the port the daily clearance requirement is 5,300 STON. The Mukho road network can easily support the requirement to deploy the armored brigade in six days.



OPEN STORAGE

The port has only 15 acres (61,000 square meters) of paved open storage area. We assume the equipment will marshal in open areas away from the aprons. There are no nearby areas that might provide additional offsite staging area.

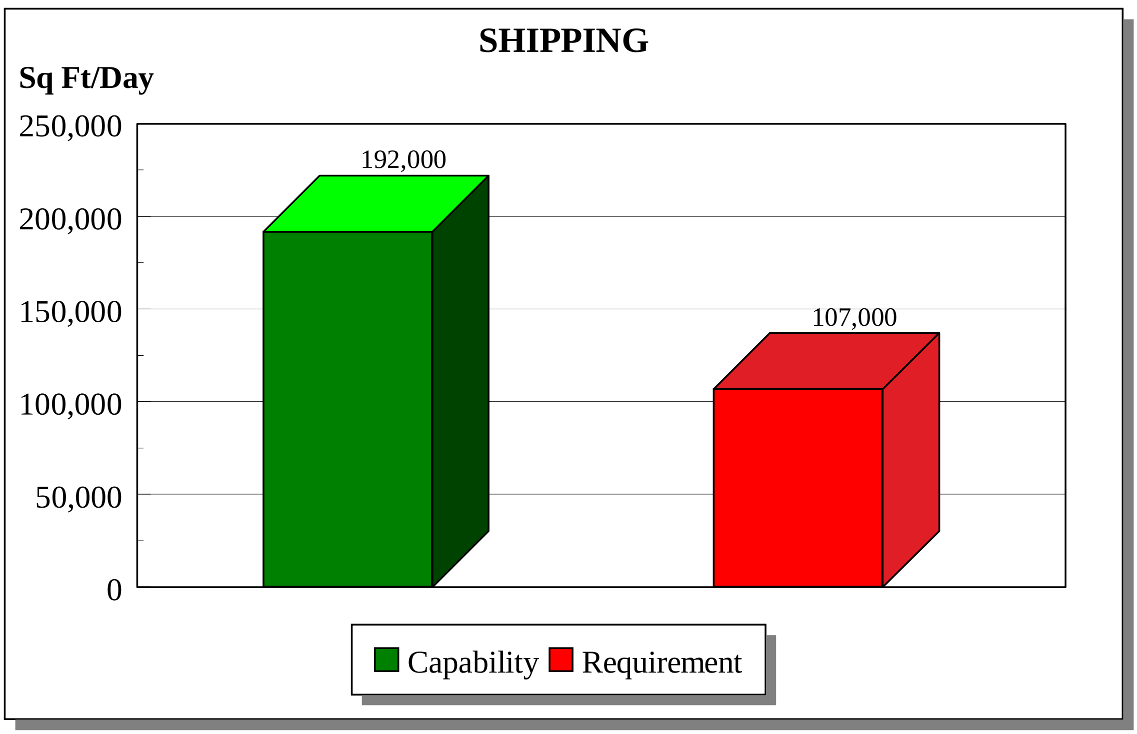
Marshaling the entire brigade of equipment (642,645 square feet) requires 37 acres. We assume the maximum amount in the port at any time is about one and a half days of the required port throughput. This requires the port to provide 15.4 acres of paved open area to support the deployment. The port can not meet the requirement.

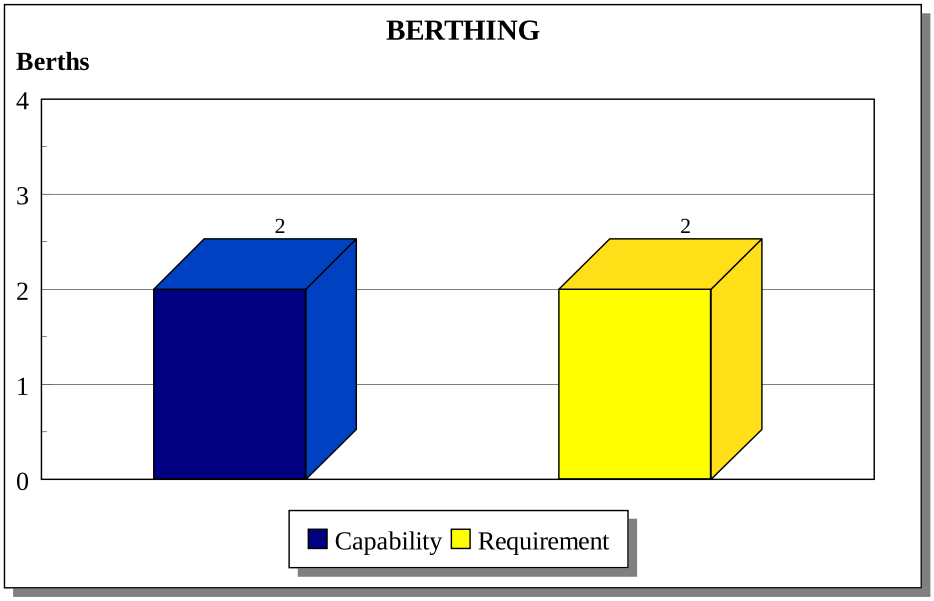


SHIPPING

An armored brigade has 642,645 square feet of vehicles and equipment. The deck space on the 2nd LT John P. Bobo (MPS-AMSEA) class vessels is 256,566 square feet, not including the container cells, which can carry an additional 546 TEUs. Assuming a 75 percent stow factor, each of these vessels can carry 192,242 square feet of vehicles and equipment. At this rate, the deployment of the brigade would require only 3.3 of these vessels, if each were fully loaded. Since the water depth at the port can not accommodate fully loaded 2nd LT John P. Bobo (MPS-AMSEA) class vessels, we assume 2.7 additional vessels are required for the deployment. Unloading RORO vessels this size can be done in under two days. To meet the six day requirement, the port will have to berth two of these vessels simultaneously. Three two-vessel operating cycles are required to deploy the entire brigade, with these partially loaded vessels.

Two 2nd LT John P. Bobo (MPS-AMSEA) class vessels can berth and operate at the port simultaneously. The map earlier in this section provides the berthing configuration.





SUMMARY

The Port of Mukho can not deploy a notional armored brigade in six days. The amount of open area is just below the required amount.

The water at the port is too shallow to berth fully loaded 2nd LT John P. Bobo (MPS-AMSEA) class vessels. If the staging problem above can be resolved, the deployment will require additional vessels to limit the draft. Two vessels will have to operate simultaneously. To accomplish this, the vessels must be berthed as shown on the earlier Application map.

The highway access to the port is sufficient to meet the requirement. There are no rail facilities that can support military operations. Vehicles and equipment must convoy away for the port.

RECOMMENDATION

We do not recommend the Port of Mukho be considered for deployment of brigade-sized units. This is for three reasons:

- The port does not quite have enough open area to support the deployment.
- The water depth is insufficient to berth fully loaded 2nd LT John P. Bobo (MPS-AMSEA) class vessels.
- The rail facilities are insufficient to support military operations.

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PORT OF OKKYE

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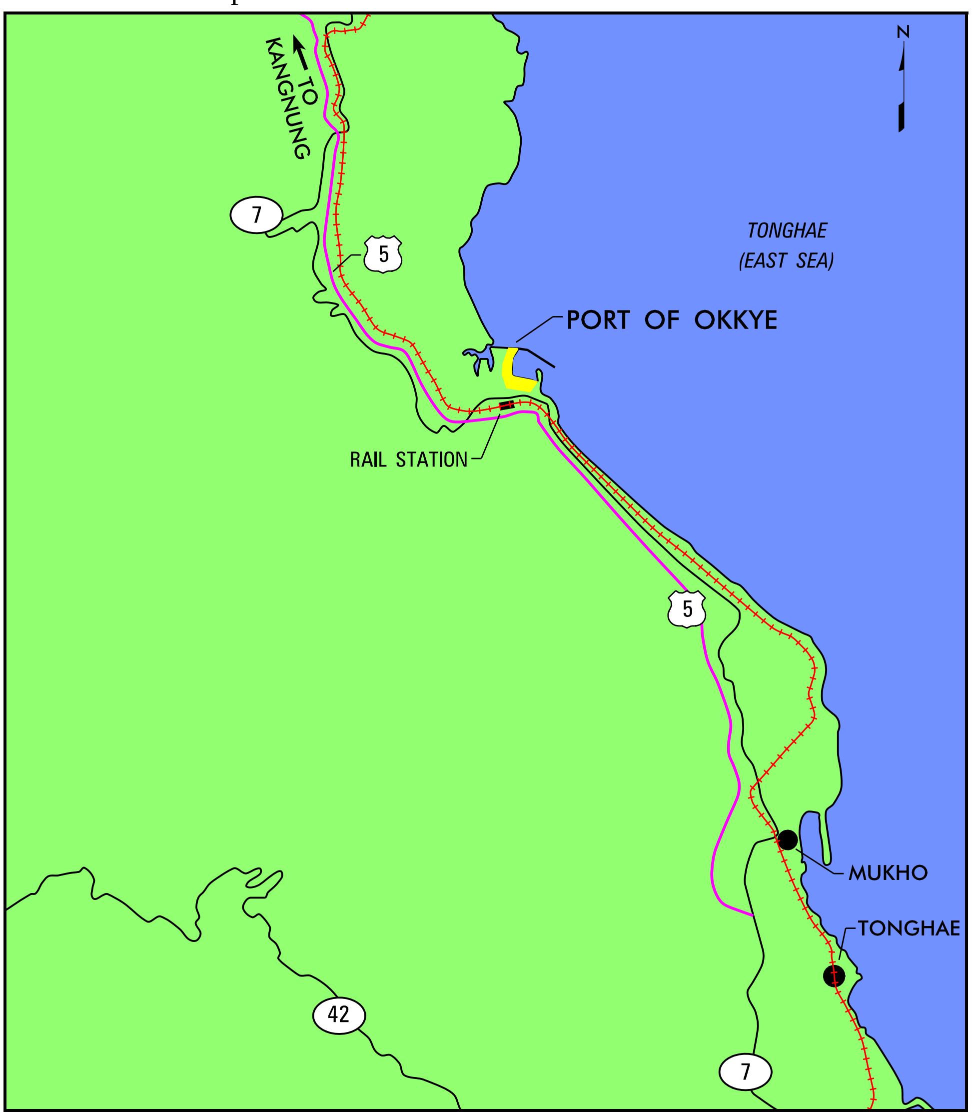
LOCATION AND ACCESS

The Port of Okkye is 37 ^{o} 37' north latitude and 129^{o} 05' 03" east longitude on the northeast coast of South Korea. The port is about 20 miles (32.7 kilometers) south of Kangnung and about 12 miles (20 kilometers) north of Tonghae and Mukho (see access map). Because the port is alongside the open sea, ships need only to negotiate the breakwaters into the harbor. Deep water anchorages over 100 feet (30 meters) in depth at mean low water (MLW) are available outside the breakwaters. The ship turning basin will accommodate ships up to 1,340 feet (410 meters) in length.

Route 7 off of Expressway 5 provides highway access to the port.

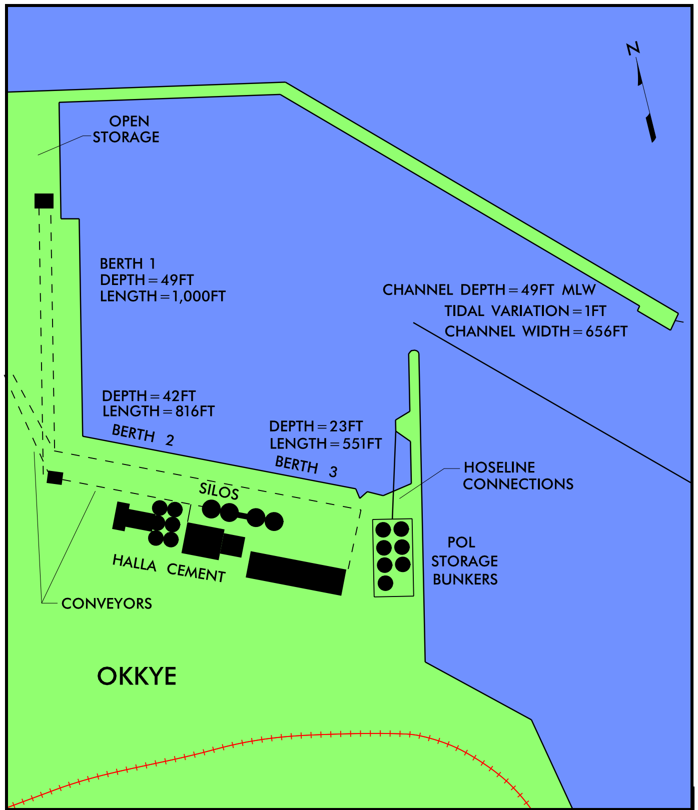
The port has indirect rail access. The Okkye rail station is about 2,300-2,600 feet (700-800 meters) from the port. No rail spurs access the port. Vehicles and cargo must convoy by highway to the rail station for rail transport.



Access Map

DESCRIPTION

The Port of Okkye is a small specialized port on the northeast coast of Korea. It has three ship berths, none of which are useful for military operations. The port was constructed by the Halla Cement Manufacturing Company for exporting/transporting cement products. This port is directly linked to the Halla cement plant, which is about 3 miles (5 kilometers) north of the port, by a conveyor belt system. Similar conveyors are along the three ship berths rendering the port as not useful for deployment operations. The Port of Okkye falls under the Tonghae District Ministry of Maritime Affairs and Fisheries (MMAF). The water depth of the channel is 49 feet (15 meters) MLW and the tidal variation is about 1-foot (.3 meters).



Land-Use Map

Berths 1, 2, and 3 have water depths of 49 feet (15 meters), 42 feet (13 meters), and 23 feet (7 meters), respectively. (See Land-Use Map for port layout.) The lengths of berths1, 2, and 3 are 1,088 feet (332 meters), 816 feet (249 meters), and 551 feet (168 meters), respectively. The channel width is over 650 feet wide (200 meters) through the breakwaters. Because the port is along the open water of the East Sea (Tonghae), no overhead or vertical restrictions exist in the approach to the port.

Berth 1

Petroleum, Oil, and Lubrication (POL) facilities are available at the port. It has 7 storage bunkers that can store 20,000 kiloliters of POL/Liquid Petroleum Gas (LPG). Hoseline connections can transfer petroleum products from the ship to the bunkers at a rate of 250 kiloliters/hour. The port does not have access to the TransKorea Pipeline. From the port, tankers are used to truck out POL products.

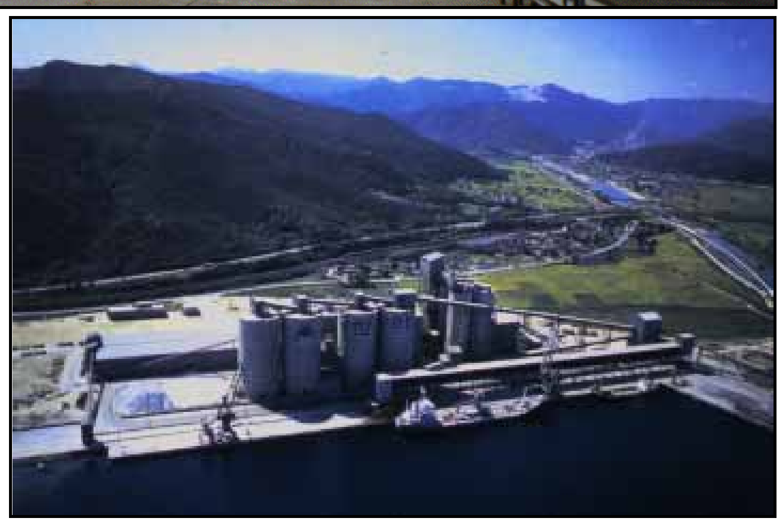
Total available open storage is about 8 acres (33,000 square meters). The port has no covered storage.

FUTURE DEVELOPMENT

Currently, the port has no plans for further development. The Halla Cement Manufacturing Company will likely continue to use the port for exporting cement products. If the conveyor system (or at least a portion) was removed from Berth 1, this port would have potential for use in military deployments. Because the port is located away from populated areas and due to the deep-water draft, the potential exists for use not only as a general cargo port but as an ammunition port. To do this, modifications are needed (removing or altering the conveyor system) to make the wharf area deployment useful for such operations. Also, such conversions need to be approved, arranged, and coordinated with the appropriate Korean officials such as the Halla Cement Manufacturing Company, MMAF, and Korean Ministry of Defense.

Assuming one breakbulk ship berths at Berth 1 and two mobile cranes unload breakbulk ammunition at a rate of 10 STON/hour, the port could throughput 400 STON (450 MTON) of ammunition per day.

Berth 1 with Open Storage Area



Halla Cement Manufacturing Company

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PORT OF POHANG

- I. General Data
- II. Throughput Analysis
- III. Application
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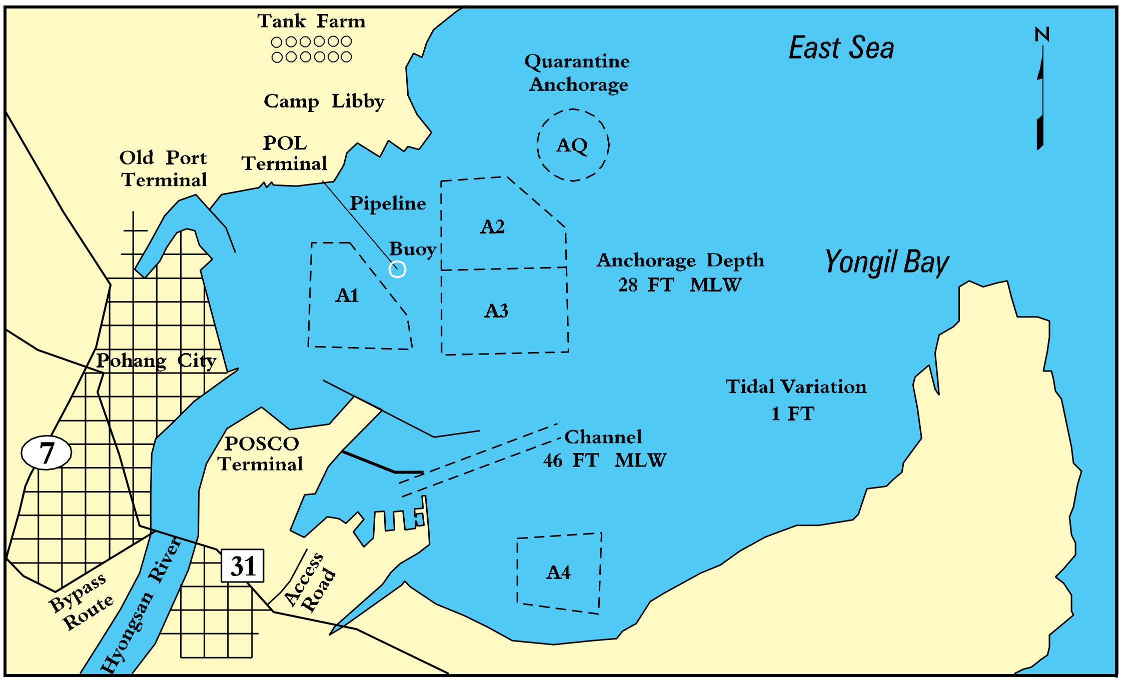
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Pohang is in a natural harbor located on the southeastern coast of the Korean peninsula, about 48 miles (77 kilometers) north of Pusan and 176 miles (283 kilometers) south of Seoul. The port lies on the southwest shore of Yongil Bay at 37° 0' 10" N Latitude, and 129° 14' 24" E Longitude, about 7.5 miles (12 kilometers) inland from the Sea of Japan.



Water Access to the Port of Pohang

The port has two terminals, Old Port Terminal, and the privately owned Pohang Steel Mill Company (POSCO) Terminal. The Old Port Terminal (to the north) has one POL and bulk berth with water depth of 24 feet (7.5 meters). All other berths at the Old Port Terminal are shallower, and generally used for fishing vessels, Korean Coast Guard operations, and ferries. For this reason, this report only analyses the capability of the POSCO Terminal, located on the southwest coast of the Yongil Bay.

The entrance into the bay is about 4 miles (6.5 kilometers) wide with channel drafts ranging from 46 to 66 feet (14 to 20 meters) MLW. The bay has four anchorage areas that can accommodate 18 vessels total. The water ranges from 28 to 78.7 feet (8.5 to 24 meters) deep MLW. The bottoms of these anchorages are predominantly mud and sand and provide good holding ground. An additional anchorage is for quarantine. It is located north of the port.

Pilotage is required for berthing and undocking. The port has six pilots and two pilot boats. The port has three tugs; each with 3,000 horsepower. The entrance to the port is about 500 feet wide, between the breakwaters, with no overhead restrictions from the Sea of Japan. Tidal variation is about 1 foot (.30 meters).

There are three designated turning basins. The largest basin is 1,800 feet (540 meters) in diameter and 39 feet (12 meters) deep MLW. This basin is located between the inner and outer breakwaters of the port. The land-use map shows these basins.

Highway

Roads leading to the Port of Pohang are all 4-laned, and very congested. No unusual clearance problems exist on these roads. The International Road Federation Chart lists highway legal highway legal limits as 12.5 feet (3.8 meters) for height, 8.2 feet (2.5 meters) for width, and 10 metric tons (11 short tons) for a single axle loading in South Korea.

Route 7 follows the east coast and leads directly into the city of Pohang from the north and south. From the north, vehicles take Route 31 from Route 7. From the south vehicles take the Bypass Route and then Route 31. Vehicles cross over the Hyongsan River between the city and the port. Several bridges cross this river. From Route 31, vehicles take Port Access Road into the port. The water access map and the land-use map show these routes.

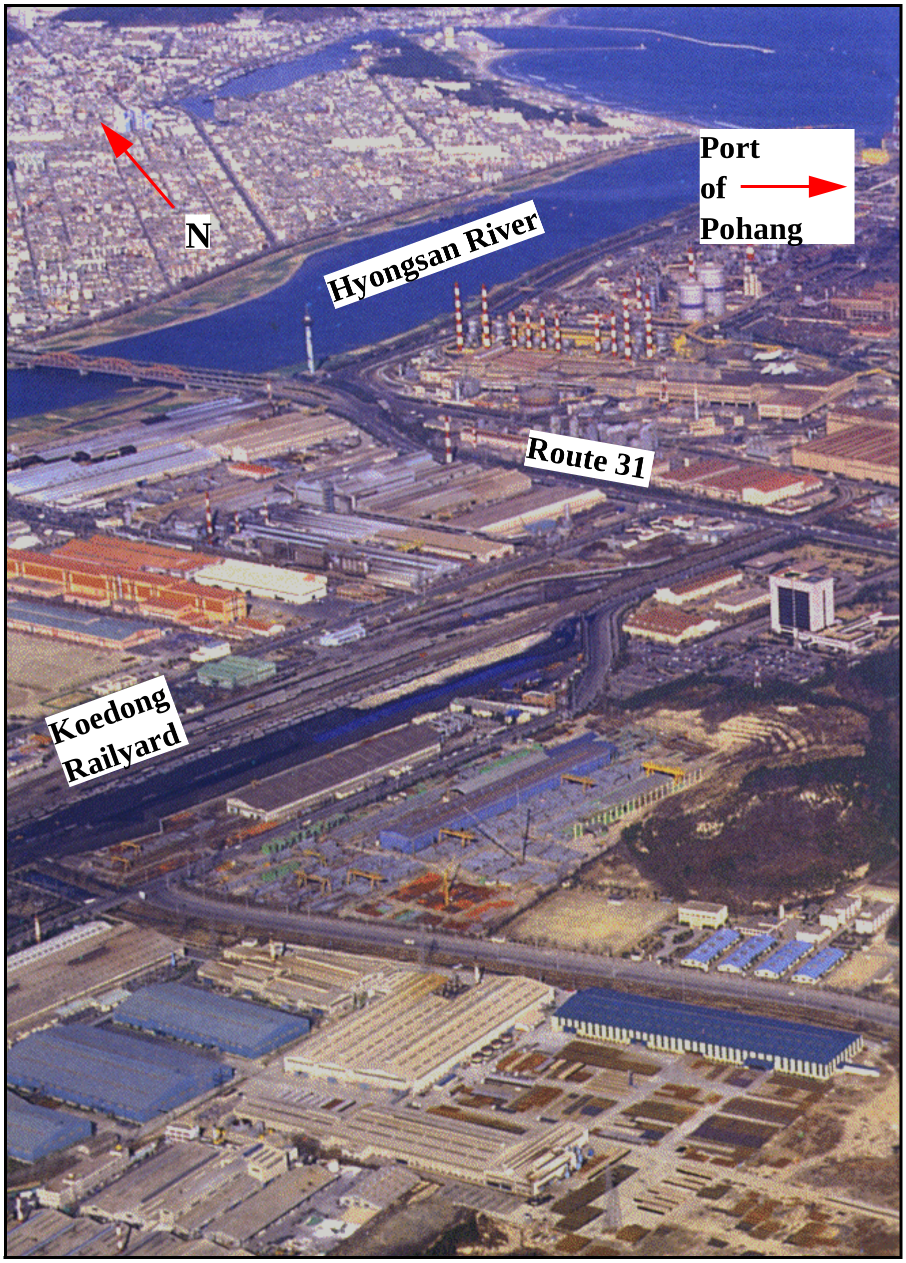
Highway, Air, and Rail Access to Port of Pohang

Air

The closest airfield is Pohang Airport, located about 1.9 miles (3 kilometers) south of the port. The asphalt runway is 7,000 feet (2,130 meters) long and 150 feet (46 meters) wide. Other airports are at Ulsan and Pusan.

Rail

All railroad tracks within Korea are operated by the Korean National Railroads. The rail infrastructure branches off in Kyongju and runs north to Pohang. The line branches off further to access the POSCO steel mill, just south of the port. This line has no unusual clearance restrictions. Cargo dimensions must be within the Korean rail envelope to achieve unrestricted rail transport. The Koedong railyard has 13 tracks and can store about 275 railcars. This railyard is only 2.5 miles (4 kilometers) southwest of the port.



Aerial View of Koedong Railyard

PORT FACILITIES

Berthing

The port of Pohang is the headquarters of the Pohang Iron and Steel Company (POSCO). It is primarily an industrial port for bulk raw ore and finished steel products.

The far west end of the port is configured for bulk raw materials such as coal and ore. There are several bulk loaders in this area. Berths 1 and 2 cannot be used for military operations. The conveyors and bulk loaders cause too much congestion.

CHARACTERISTICS OF THE PORT OF POHANG

Characteristics	CENTRAL BERTHS					
	3	4W	4E	5W	5H	5E
Length, feet	1,787	738	639	984	557	1,262
Depth alongside at MLW, feet	24	33	36	36	31	24
Deck Strength, psf	600	600	600	600	600	600
Apron width, feet	Open	Open	Open	Open	Open	Open
Apron height above MLW, feet	10	10	10	10	10	10
Number of container cranes	0	0	0	0	0	0
Number of wharf cranes	4	2	2	2	2	0
Apron lighting	No	No	No	No	No	No
Straight-stern RORO facilities	No	No	No	No	No	No
Apron length served by rail, feet	0	0	0	0	0	0

The central and east portions of the port generally handle finished steel products.

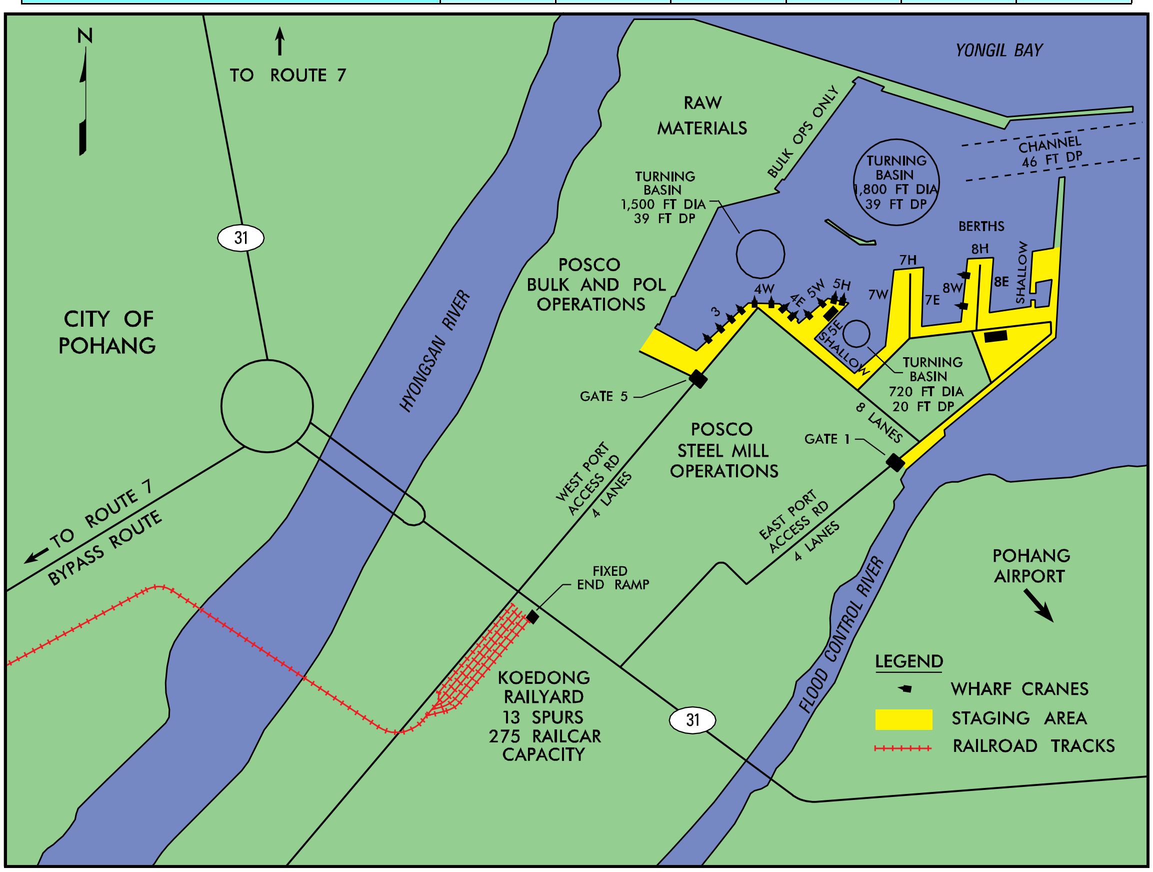
All together, these berths have 14 wharf cranes that can be rigged to handle military vehicles, containers, and equipment.

The wharves of this report range in depth from 24 feet (7.3 meters) to over 39 feet (11.9 meters) deep MLW. The longest berth (Berth 7E) is 2,545 feet (776 meters) long. Apron heights are all 10 feet (3.0 meters) above MLW.

Pier 5 of Port of Pohang
(Prior to shed construction)

CHARACTERISTICS OF THE PORT OF POHANG

CHARACTERISTICS	EAST BERTHS					
	7W	7H	7E	8W	8H	8E
Length, feet	1,056	787	2,545	1,640	656	2,543
Depth alongside at MLW, feet	39	39	39	36	36	36
Deck Strength, psf	600	600	600	600	600	600
Apron width, feet	98	98	98	98	98	98
Apron height above MLW, feet	10	10	10	10	10	10
Number of container cranes	0	0	0	0	0	0
Number of wharf cranes	0	0	0	2	0	0
Apron lighting	No	No	No	No	No	No
Straight-stern RORO facilities	No	No	No	No	No	No
Apron length served by rail, feet	0	0	0	0	0	0



Land-Use Map for Port of Pohang

Aerial View of Port of Pohang
(Northward view)

SUMMARY OF BERTHING CAPABILITIES FOR POHANG

VESSEL	BERTHS					
	3	4W	4E	5W	5H	5E
Breakbulk						
C3-S-38a	a	1	1	1	1	a
C4-S-58a	a	1	1	1	c	a
C4-S-66a	a	1	1	1	a	a
C5-S-37e	a	1	1	1	c	a
Seatrain						
GA and PR-class	a	1	1	1	c	a
Barge						
LASH C8-S-81b	a,f	a,c,f	c	1	a,c,f	a,c,f
LASH C9-S-81d	a	a,c	a,c	a	a,c	a,c
LASH lighter	8	3	3	4	2	6
SEABEE C8-S-82a	a	a,c	a,c	a	a,c	a,c
SEABEE barge	8	3	3	4	2	6
RORO						
Comet	a,d	d,i,j	d,i,j	d,i,j	d,i,j	a,d
Meteor	a,d	d,i,j	d,i,,j	d,i,j	d,i,j	a,d
Cape Gnome	a,d	a,d	d,i,j	d,i,j	a,c,d	a,d
C7-S-95a	a	a	c	1	a,c	a,c
Cape Taylor	a	1	1	1	c	a,c
Cape Orlando	a	i,j	i,j	i,j	c	a,c
MV Ambassador	d	d	d	d	d	d
Callaghan	a,d	1,d	c,d	1,d	c,d	a,c,d
Cape Lambert	a	i,j	c	(1),i,j	c	a,c
FSS-Class	a	a,c	a,c	a	a,c	a,c
Cape E-class	a	i,j	c	i,j	a,c	a,c
Cape D-class	a	i,j	c	i,j	a,c	a,c
Cape H-class	a	a,c	c	1	a,c	a,c
Cape R-class	a,d	1,d	c,d	1,d	a,c,d	a,c,d
Cape Texas	a	i,j	i,j	i,j	c	a,c
Container						
C6-M-147a	a,e	1,e	c,e	1,e	c,e	a,c,e
C7-S-69c	a,e	1,e	c,e	1,e	c,e	a,c,e
C7-S-68c	a,e	1,e	c,e	1,e	a,c,e	a,c,e
C8-S-85c	a,e	c,e	c,e	1,e	a,c,e	a,c,e
C9-M-132b	a,e	a,c,e	c,e	1,e	a,c,e	a,c,e
C9-M-F141a	a,e	a,c,e	a,c,e	a,e	a,c,e	a,c,e
Combination						
C6-S-1qd	a	1	c	1	a,c	a,c
C5-S-MA73c	a	1	1	1	c	a,c
C6-S-MA60d	a	1	c	1	a,c	a,c

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft

( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES FOR POHANG

VESSEL	BERTHS					
	7W	7H	7E	8W	8H	8E
Breakbulk						
C3-S-38a	2	1	4	3	1	4
C4-S-58a	1	1	4	2	1	4
C4-S-66a	1	1	4	2	1	4
C5-S-37e	1	1	4	2	1	3
Seatrain						
GA and PR-class	1	1	4	2	1	4
Barge						
LASH C8-S-81b	1	c	3	1	c	2
LASH C9-S-81d	a	a,c	a	a	a,c	a
LASH lighter	5	3	12	8	3	12
SEABEE C8-S-82a	a	a,c	a	a	a,c	a
SEABEE barge	5	3	12	8	3	12
RORO						
Comet	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j
Meteor	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j
Cape Gnome	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j	d,i,j
C7-S-95a	1	1	3	2	c	3
Cape Taylor	1	1	3	2	1	3
Cape Orlando	i,j	i,j	i,j	i,j	i,j	i,j
MV Ambassador	d	d	d	d	d	d
Callaghan	1,d	1,d	3,d	2,d	c,d	3,d
Cape Lambert	i,j	i,j	i,j	i,j	c	i,j
FSS-Class	(1)a	a,c	(2)a	(1)a	a,c	(2)a
Cape E-class	i,j	i,j	i,j	i,j	i,j	i,j
Cape D-class	i,j	i,j	i,j	i,j	c	i,j
Cape H-class	1	1	3	2	c	3
Cape R-class	1,d	1,d	3,d	2,d	1,d	3,d
Cape Texas	i,j	i,j	i,j	i,j	i,j	i,j
Container						
C6-M-147a	1,e	1,e	3,e	2,e	c,e	3,e
C7-S-69c	1,e	1,e	3,e	2,e	c,e	3,e
C7-S-68c	1,e	1,e	3,e	2,e	c,e	3,e
C8-S-85c	1,e	c,e	2,e	1,e	c,e	2,e
C9-M-132b	1,e	c,e	2,e	1,e	c,e	2,e
C9-M-F141a	a,e	a,c,e	a,e	a,e	a,c,e	a,e
Combination						
C6-S-1qd	1	1	3	2	c	3
C5-S-MA73c	1	1	4	2	1	3
C6-S-MA60d	1	1	3	2	c	3

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft

( ) indicates vessels assigned by analyst

Open Storage

The port has about 28 acres (115,000 square meters) of open staging that can support operations from berth 3 to berth 5E. Another 60 acres (243,000 square meters) supports the central and eastern portions of the port. Few areas have lighting for nighttime operations.

The port has no experience handling helicopters. The areas most suitable to land helicopters are the outboard ends of Piers 5, 7, and 8.

Covered Storage

The only berth with a transit shed is 5E. Unfortunately, this 80,000 square foot (7,600 square meter) shed is for breakbulk-loading finished steel products into narrow vessels under the roof extension. The Port of Kwangyang has a similar shed for loading steel. It is unlikely that this berth could support military ship loading operations. The shed is often 75 percent full of finished steel products. It may, however, support helicopter shrink wrapping.

Transit Shed at Berth 5E, covered shiploading for finished steel products

Highway

Only Gate 1 and Gate 5 enter the Port of Pohang. Other numbered gates in the area enter areas for steel operation only. Both gates entering the port are at least 15 feet wide. Vehicles can move around the port without restrictions on height or weight. Speed limits in the port are all nine miles per hour (15 kilometers per hour). The port only has portable truck scales. Although there are a few overhead conveyors, none cause restrictions within the port. All paved areas at the port are concrete and capable of withstanding heavy vehicular traffic. There are no height or weight restrictions leading from the port to the main highway networks.

Gate 5 to Port of Pohang

Unloading/Loading Positions

The port has no ramps or docks for truck operations. The adjacent steel mill building have loading docks but these can not be used for military vehicles. The military should bring or build ramps to offload trucks and trailers that do not have integral ramps.

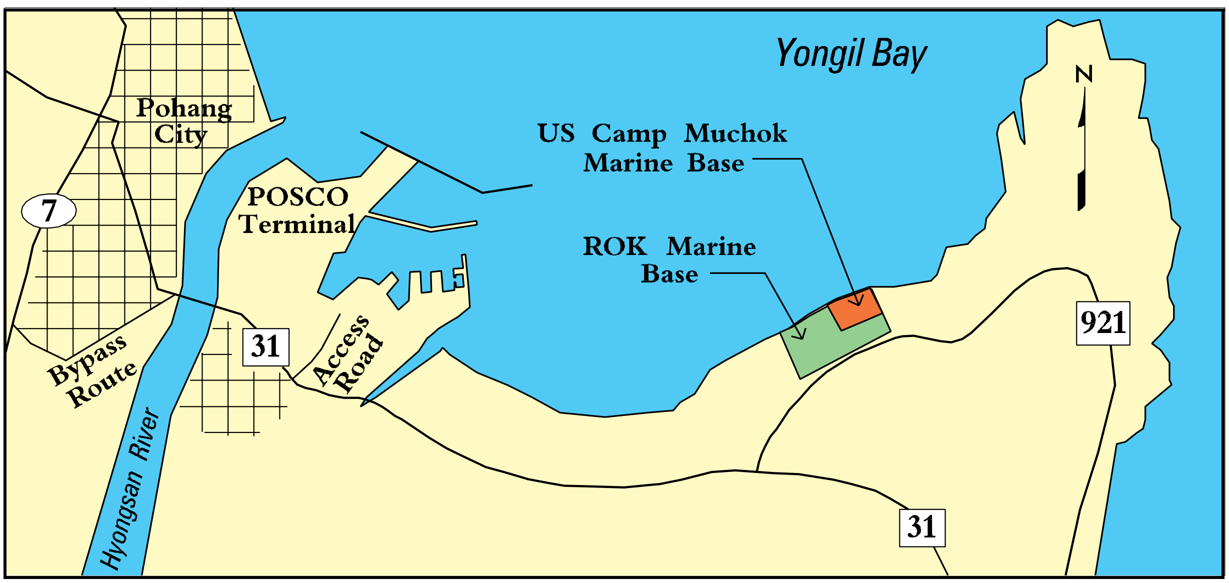
The Koedong railyard has 13 tracks and is only 1.2 miles (2 kilometers) southwest of the port. The east-most track ends at a fixed concrete rail end ramp. This ramp can support about 2,395 feet (730 meters) of offloading operations. Other spurs of equal length can support operations with portable rail end ramps. Fifteen portable ramps are located at the 1317th MPC at Pier 8 of the Port of Pusan, about 50 miles south of Pohang.

Koedong Railyard End Ramp, Port of Pohang

Offsite Storage Area

The port is completely surrounded by POSCO steel mills. The area is heavily congested with steel production and administration buildings. From the inland edge of the steel mill to the mountains, the area is highly developed with commercial and residential buildings. The only potential offsite marshaling area is the ROK Marine base adjacent to USMC Camp Muchok, about 3 miles east of the port. The ROK base can provide at least 10 acres of open marshaling area.

Although Camp Muchok supported Marine Corps activities during a Team Spirit exercise, it is too small to provide marshaling for vehicles. Camp Libby, inland of the POL terminal, is also too small for marshaling.



Potential Off-Port Marshaling for Port of Pohang

MATERIALS HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity STON	Quantity	Owner
Barge Crane	1,000	1	Port Authority
Mobile Crane	30	1	Hanjin Trans Co
Forklift	2 to 16	6	Hanjin Trans Co
Forklift	16	17	Tongbang Trans Co
Forklift	14	9	Tongbang Trans Co
Forklift	4 to 10	4	Tongbang Trans Co
Forklift	15	2	Sebang Enterprising Co
Forklift	15	4	Korea Express Co
Forklift	5 to 10	5	Korea Express Co
Forklift	5	1	Sampyo Industrial Co

The exact availability of materials handling equipment would be subject to the production level of the steel mill and would fluctuate inversely with the plant's productive rate.

Mobile Crane

Wharf Crane

Barge Crane

AMMUNITION

The Port of Pohang has no experience handling ammunition. With Korea Ministry of Maritime Affairs and Fisheries (MMAF) approval, ammunition handling is possible. The anchorages have not been rated for net explosive weight (NEW).

PETROLEUM, OIL, AND LUBRICATION (POL)

There are several POL bunkers that support steel mill operations. These are not capable of supporting military operations.

On the north side of the Yongil Bay is a POL dolphin pier with two 12-inch diameter, 1.4-mile (2,300-meter) underwater pipelines. This POL terminal supplies oil from tankers to nearby commercial and military oil tank farms. The POL supports the US Army, Southern Operations District, and ties into the Trans-Korean pipeline. Ships can tie up at either of two buoys. The deeper buoy can handle tankers with 60-foot draft. The shallower buoy, can handle vessels with 35 foot draft. Each of the buoys has two eight-inch rubber hoses for POL transfer.

The east side of Pier 8 has two pipe line connections. One pipe line is eight inches in diameter. The other is ten inches in diameter. These handle liquefied chemical products.

The Old Port Terminal has minor POL reception and storage capability. This supplies the steel mill, and is not likely to support military operations.

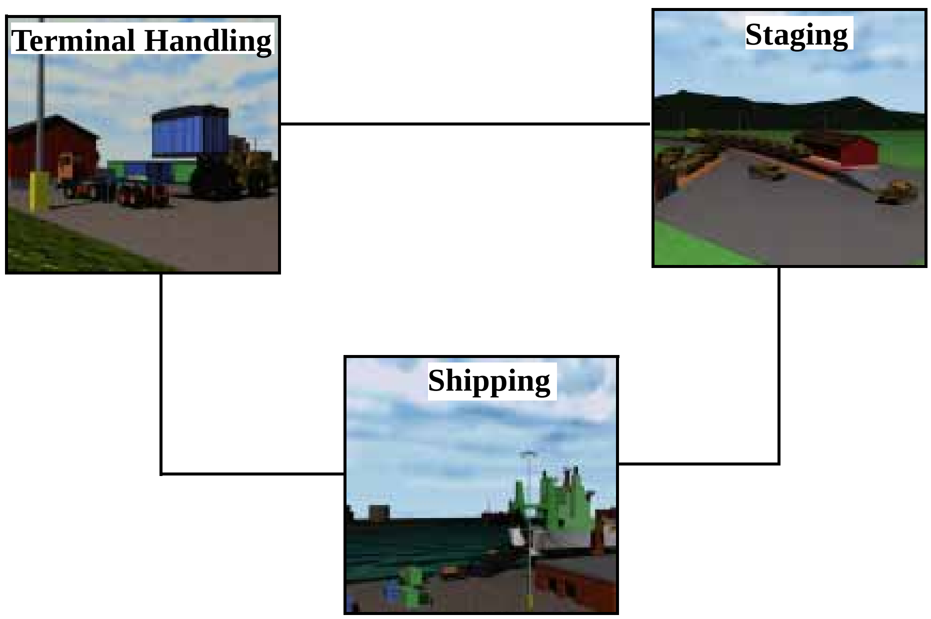
FUTURE DEVELOPMENT

The MMAF has no plans to expand or improve facilities at the Port of Pohang. On occasion the Port Authority repairs breakwaters, and dredges.

II. THROUGHPUT ANALYSIS

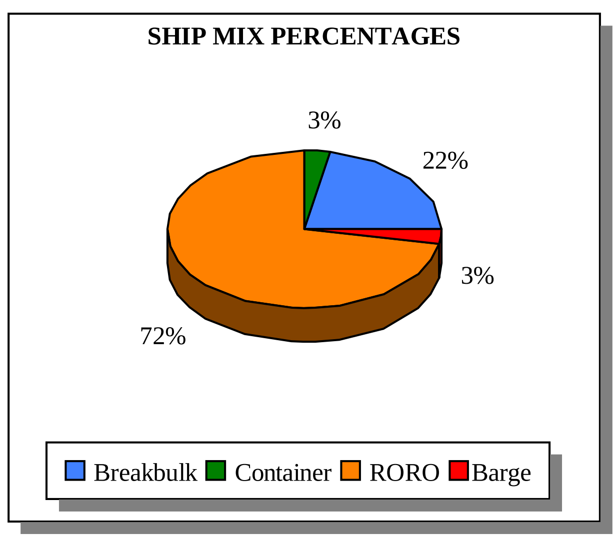
GENERAL

This section evaluates the throughput capability of the Port of Pohang using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, hardstand marshaling, and terminal processing/handling - in short tons (STON) per day.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 80 percent of the port facilities will support military deployments. Also, due to the size of the port, we assumed a berth utilization factor of 90 percent. The ship mix is determined by Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



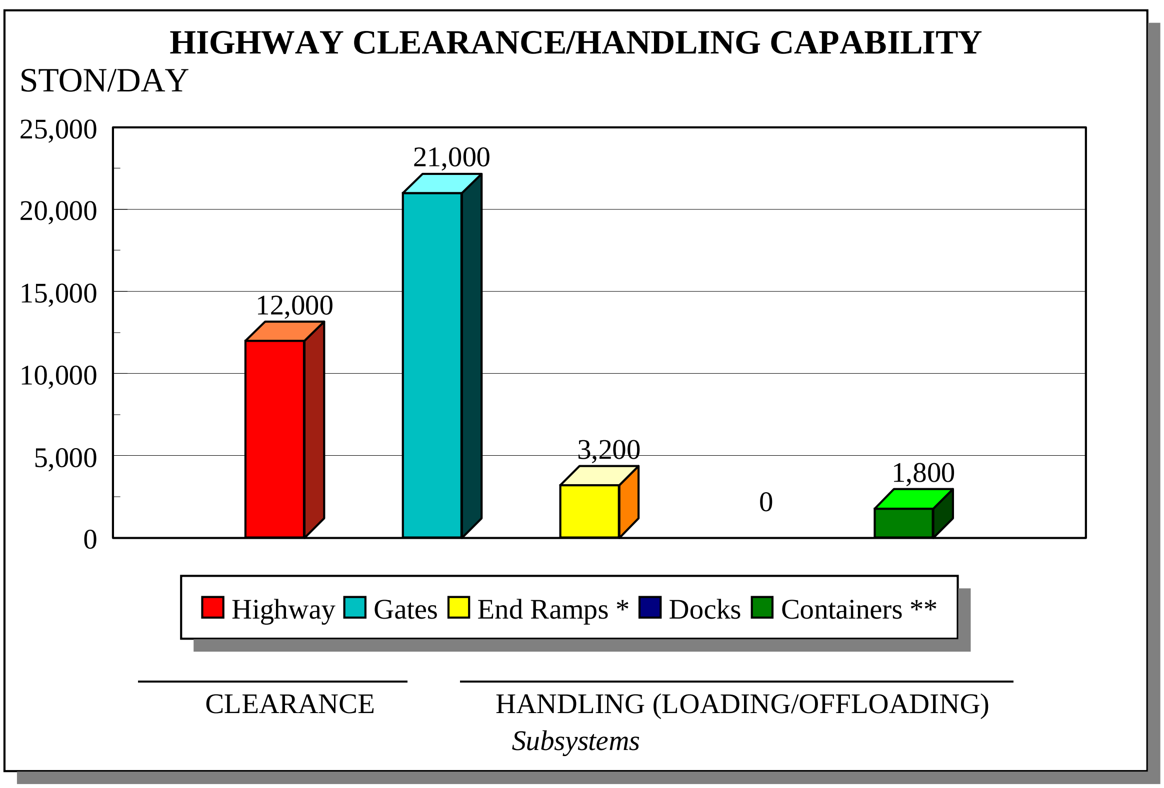
RECEPTION /HANDLING

Highway

The most restrictive highway link to or from the port are the two access roads leading to the gates of the port. The Port Access Road has four lanes. The road network in and out of the port, including the gate processing of vehicles, could handle about 12,000 STON (45,000 MTON) of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the off-port marshaling areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable end ramps brought or built by the military port operator. Two such ramps can support 3,200 STON (9,600 MTON) per day.

There are no truck docks nor container handlers at the port. Our analysis assumes the military port operator can provide one container handler to support COFC operations. This single container handler can support 1,800 STON (5,400 MTON) of containers per day.



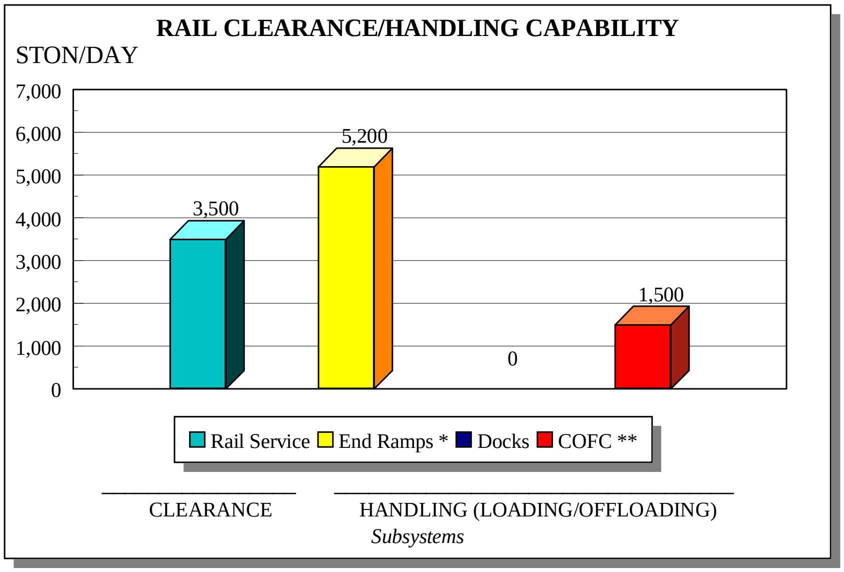
* 2 portable or temporary ramps are assumed available

** 1 container handler is assumed available

Rail

In general, rail lines in Korea are designed to handle 22 railcars per train. The Koedong railyard can easily receive four 22-railcar trains per day. Longer trains would likely disrupt traffic at crossings. This provides for about 3,500 STON (11,000 MTON) of military vehicles and equipment per day. The Koedong railyard has one fixed rail end ramp that can support about 2,400 feet (730 meters) of rail offloading operations. This analysis assumes the military port operator can provide two additional portable or temporary rail end ramp at the ends of other 2,400 foot spurs. Together these three ramps can support offloading of about 5,200 STON of military equipment and vehicles per day.

Our analysis also assumes one container handler will be available to support COFC operations, even though the port does not routinely handle containers. This single container handler can handle about 1,500 STON (3,750 MTON) of containers per day.

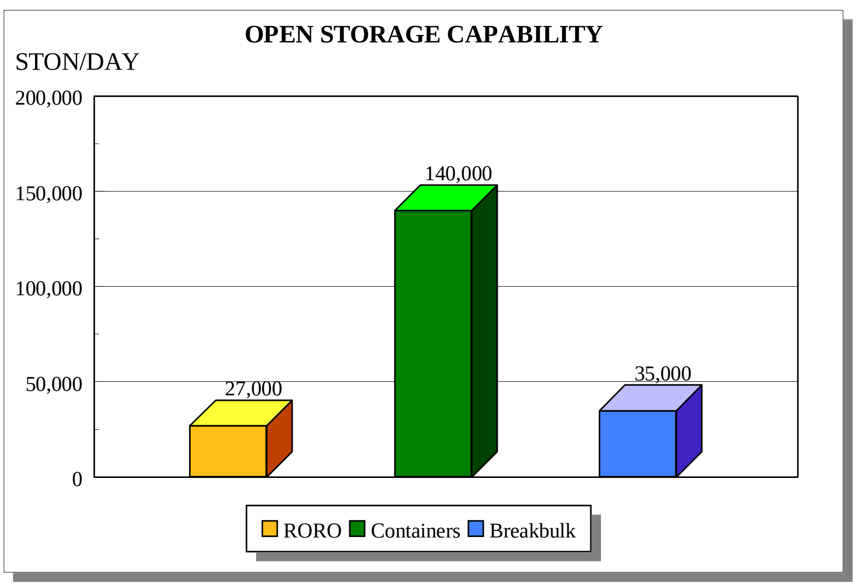


* 1 fixed and 2 portable or temporary ramps are assumed available

** 1 container handler is assumed available

Open Storage

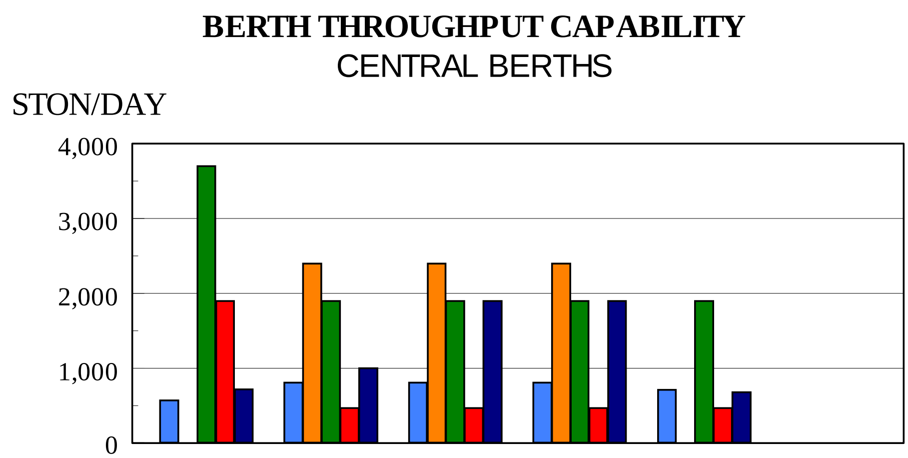
The port has a total of about 88 acres (360,000 square meters) of paved open storage. The largest open area is inland of the Central Pier. The remaining open storage is the aprons themselves along Piers 3 and 4. These areas are obstructed to some extent by the conveyors. There is no covered storage.



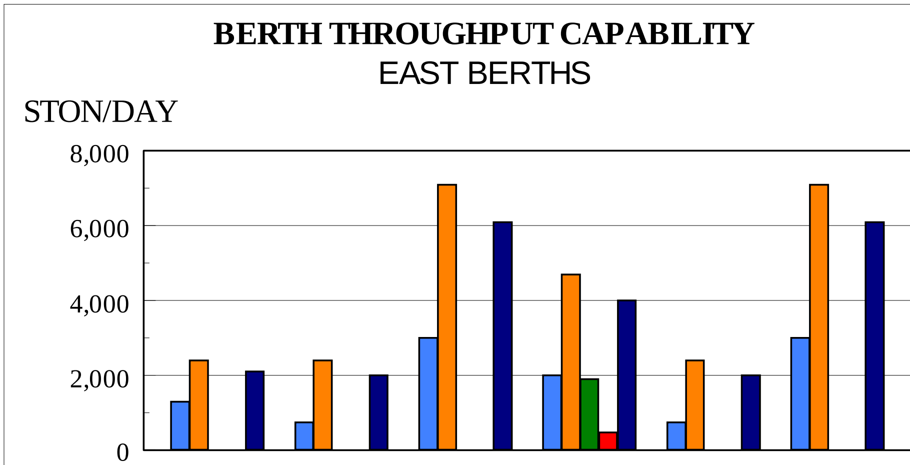
Shipping

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility. Although these values provide the shipping rates, few ships can be loaded to their maximum draft.

CONVERSION FACTORS	
Breakbulk	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON



	3	4W	4E	5W	5H	5E
Breakbulk	570	810	810	810	710	0
RORO	0	2,400	2,400	2,400	0	0
Container	3,700	1,900	1,900	1,900	1,900	0
Barge	1,900	470	470	470	470	0
Mixed	720	1,000	1,900	1,900	680	0



	7W	7H	7E	8W	8H	8E
Breakbulk	1,300	740	3,000	2,000	740	3,000
RORO	2,400	2,400	7,100	4,700	2,400	7,100
Container	0	0	0	1,900	0	0
Barge	0	0	0	470	0	0
Mixed	2,100	2,000	6,100	4,000	2,000	6,100

THROUGHPUT SUMMARY FOR PORT OF POHANG PER DAY

PORT/ BERTH	LENGTH (feet) (meters)	DEPTH ALONGSIDE (feet) (meters)	BREAKBULK THROUGHPUT (STON) (MTON)	RORO THROUGHPUT (STON) (MTON)	RORO SQUARE (FT) (EST)	RORO PIECES	CONTAINER THROUGHPUT (STON) (MTON) (TEU)	BARGE THROUGHPUT (STON) (MTON)	MIXED THROUGHPUT (STON) (MTON)
3	1,787 545	24 7.3	570 1,400	0	0	0	3,700 9,300 460	1,900 4,700	700 1,800
4W	738 225	33 10	810 2,000	2,400 9,400	48,000	282	1,900 4,600 230	470 1,200	1,900 7,500
4E	639 195	36 11	810 2,000	2,400 9,400	48,000	282	1,900 4,600 230	470 1,200	1,900 7,500
5W	984 300	36 11	810 2,000	2,400 9,400	48,000	282	1,900 4,600 230	470 1,200	1,900 7,500
5H	557 170	31 9.4	710 1,800	0	0	0	1,900 4,600 230	470 1,200	680 1,700
5E	1,262 385	24 7.3	0	0	0	0	0	0	0
7W	1,056 322	39 12	1,300 3,200	2,400 9,400	48,000	282	0	0	2,100 8,000
7H	787 240	39 12	740 1,900	2,400 9,400	48,000	282	0	0	2,000 7,700
7E	2,545 776	39 12	3,000 7,400	7,000 28,000	140,000	823	0	0	6,100 23,000
8W	1,640 500	36 11	2,000 5,000	4,700 19,000	94,000	553	1,900 4,600 230	470 1,200	4,000 15,000
8H	656 200	36 11	740 1,900	2,400 9,400	48,000	282	0	0	2,000 7,700
8E	2,543 775	36 11	3,000 7,400	7,100 28,000	142,000	835	0	0	6,100 23,000

NOTE: RORO pieces based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

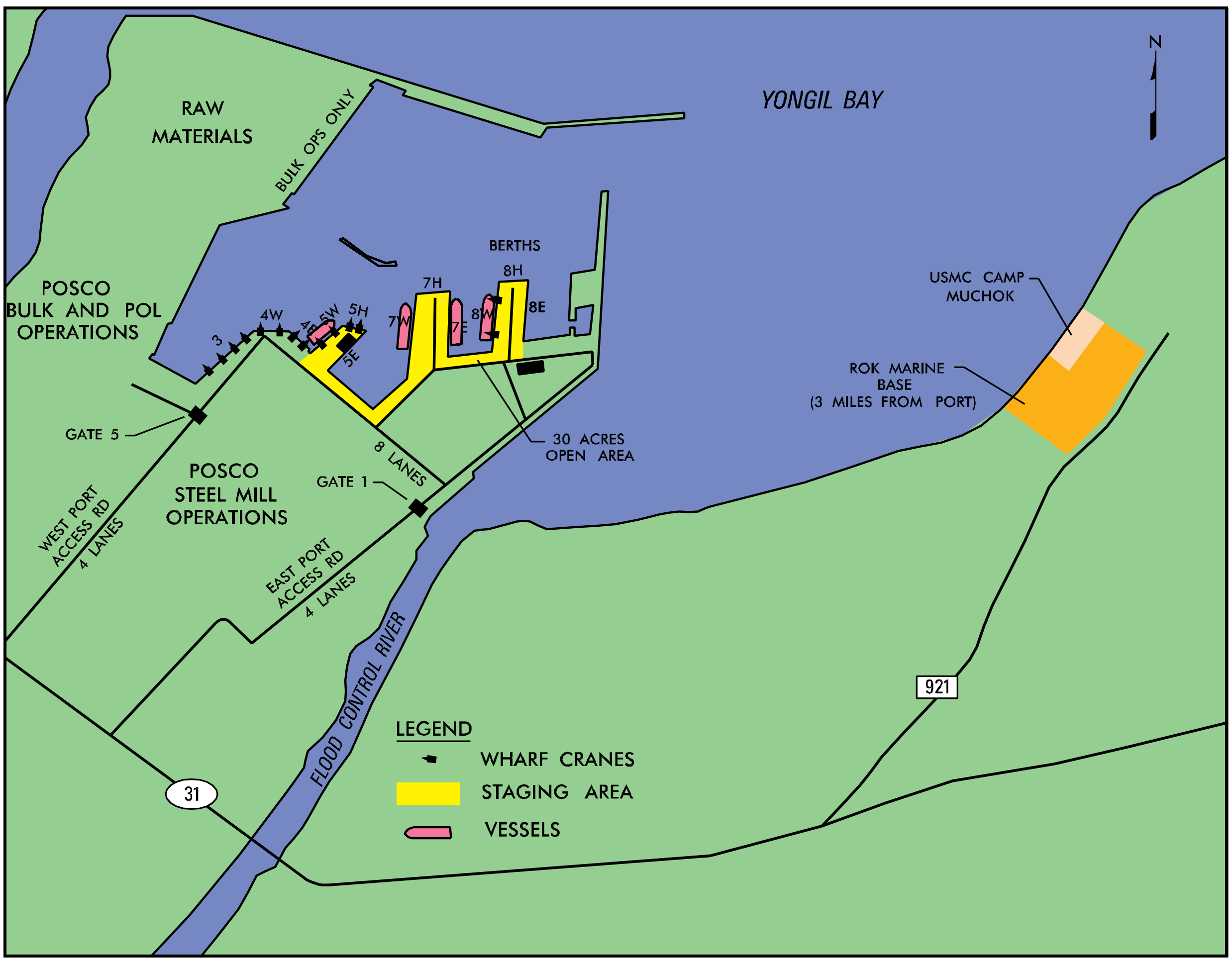
The type of ship preferred at each berth is based on the methodology described in the appendix. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for loading and unloading operations. The best berth depends on the type of ship loaded.

Because of it's length, two cranes, depth, and age, berth 8W is the best berth overall for military operations. The only exception to selecting berth 8W would be if the military conducts breakbulk or barge operations. Berth 3 would be the best for these operations because of its length and four cranes.

LOADING TYPE	**BERTHS**											
	3	**4W**	**4E**	**5W**	**5H**	**5E**	**7W**	**7H**	**7E**	**8W**	**8H**	**8E**
Breakbulk	1	4	4	3	6	12	6	6	6	2	10	10
RORO	7	10	11	5	12	8	1	6	1	1	8	1
Container	2	7	8	3	12	11	4	9	4	1	10	4
Barge	1	2	2	5	5	12	7	7	7	2	7	7
Note: Berths marked with a "-" are not recommended for these operations.												

III. APPLICATION

This section evaluates the port's throughput capability for deploying a notional armored division using primarily FSS vessels. Currently, facility use depends on decisions made by the Korean Ministry of Defense and MMAF. Because of the Korean commitment to defense of their country and considering current facility use of Pusan, we assume that 75 percent of the port facilities would be available for military use. We also assume that no other military units (US or Republic of Korea) will be competing for these facilities during the time that the armored division occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately offload the ship and clear the port.



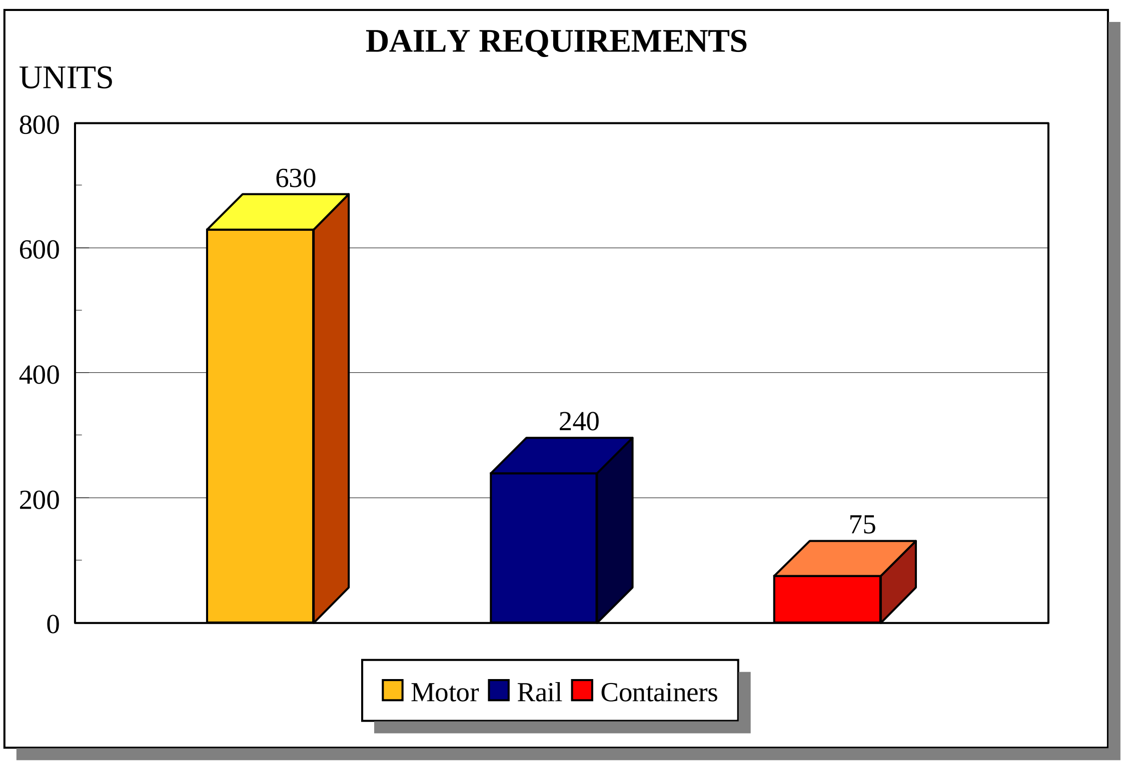
Potential Port Use During Deployment

REQUIREMENTS

The likely requirement for the Port of Pohang would be to deploy a notional armored division in 6 days of ship offloading and port clearance. The division has to move about 8,470 vehicles and 450 containers. Movement of the division from the port inland will require about 1,425 (240 per day) railcars using the convoy/rail option. Under this option, about 3,800 (630 per day) roadable vehicles would drive out the gates towing 2,500 (415 per day) trailers. About 75 containers would arrive daily.

ARMORED DIVISION

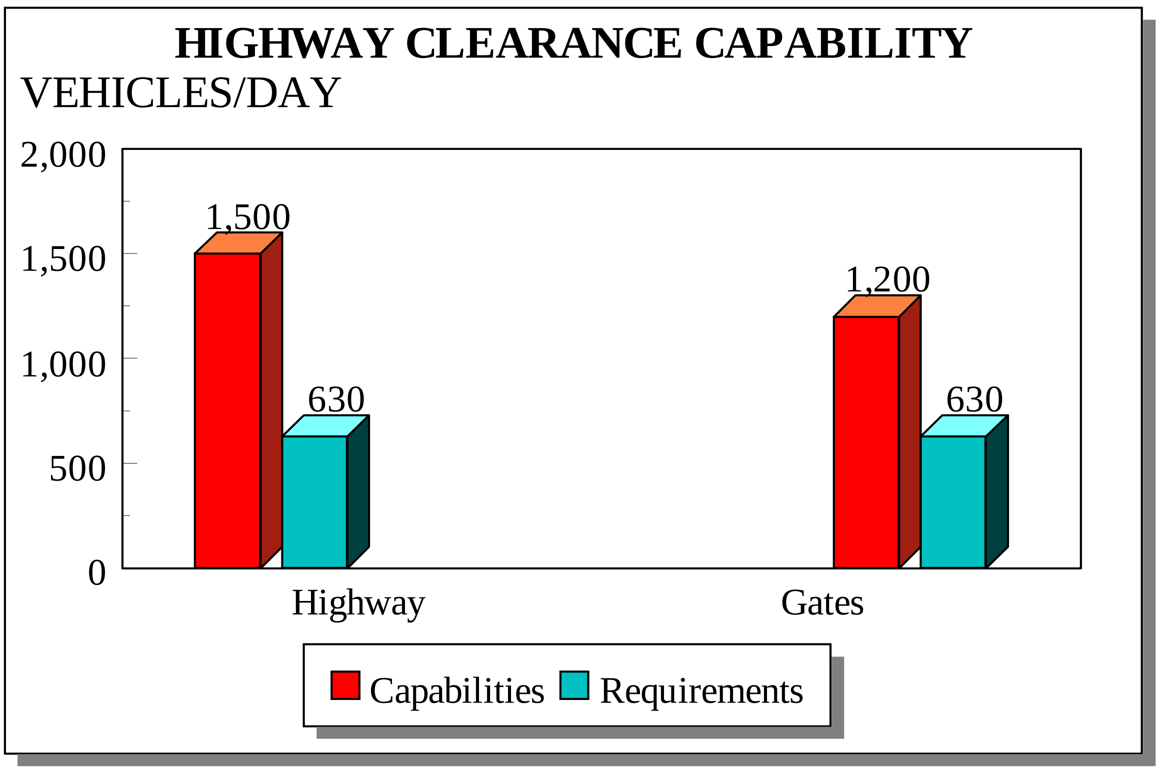
Total Equipment	
Volume	287,400 MTON
Weight	95,108 STON
Area	1,927,933 SQ FT
Vehicles	8,468
Containers	450



TERMINAL INPROCESSING/HANDLING

Highway

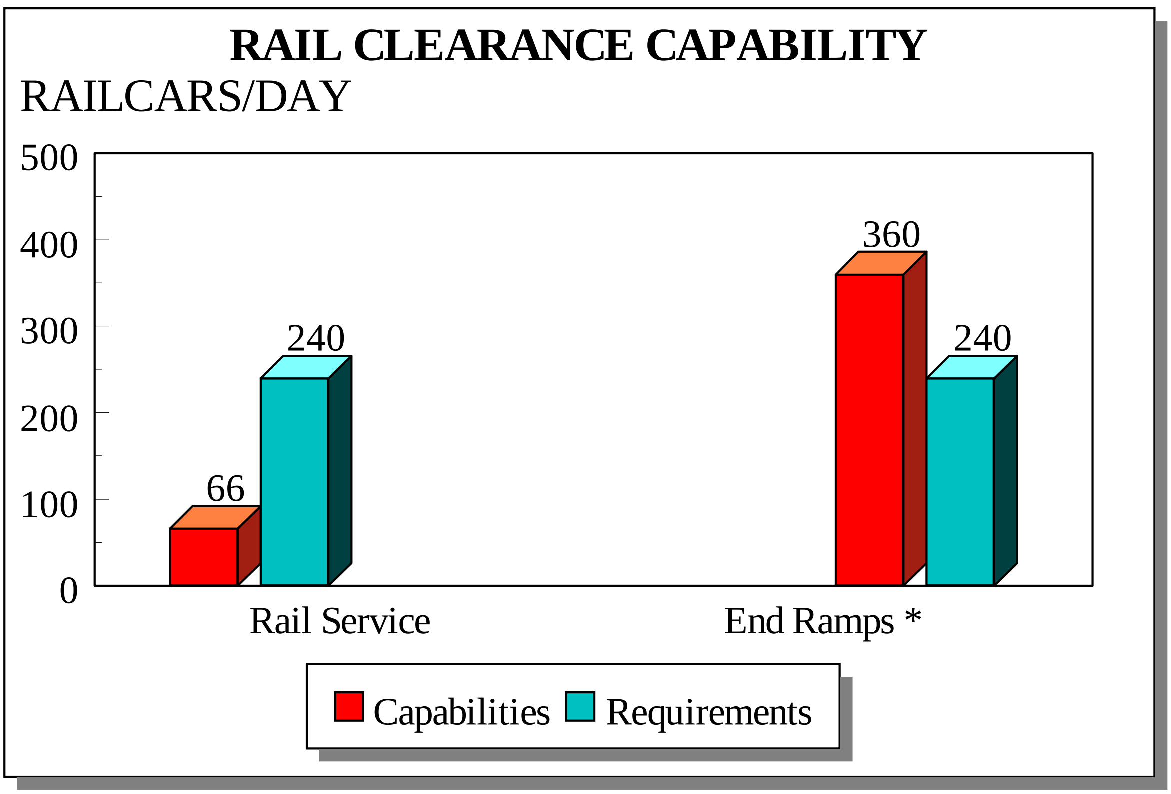
Route 7 leads to the city of Pohang. Route 31 continues into the port area, however vehicles may avoid congestion of the city by taking the Bypass Route, just south of Pohang. Route 31 connects to the West and East Port Access Roads. These roads lead to Gate 5 and Gate 1 of the port, respectively. From Route 7 to the gates, the roads are all 4- laned. The access roads and gate processing subsystems can handle more than 1,500 and 1,200 additional vehicles per day, respectively.



Rail

The Koedong railyard is located 2.5 miles (4 kilometers) southwest of the port. This railyard has the capability to hold 275 railcars. The railyard can receive four trains per day, each containing 22 railcars. Seventy-five percent of this capability is only 66 railcars. This does not meet the requirement to receive 240 railcars per day.

The Koedong railyard has 13 tracks and is only 1.2 miles (2 kilometers) southwest of the port. The east-most track ends at a fixed concrete rail end ramp. This ramp can support about 2,395 feet (730 meters) of offloading operations. Other spurs of equal length can support operations on portable rail end ramps. Fifteen portable ramps are located at the 1317th MPC at Pier 8 of the Port of Pusan, about 50 miles south of Pohang. Assuming the military port operator can provide two portable or temporary rail end ramps, three spurs of this railyard can support offloading of about 360 railcars per day, assuming four switching cycles. This meets the requirement.



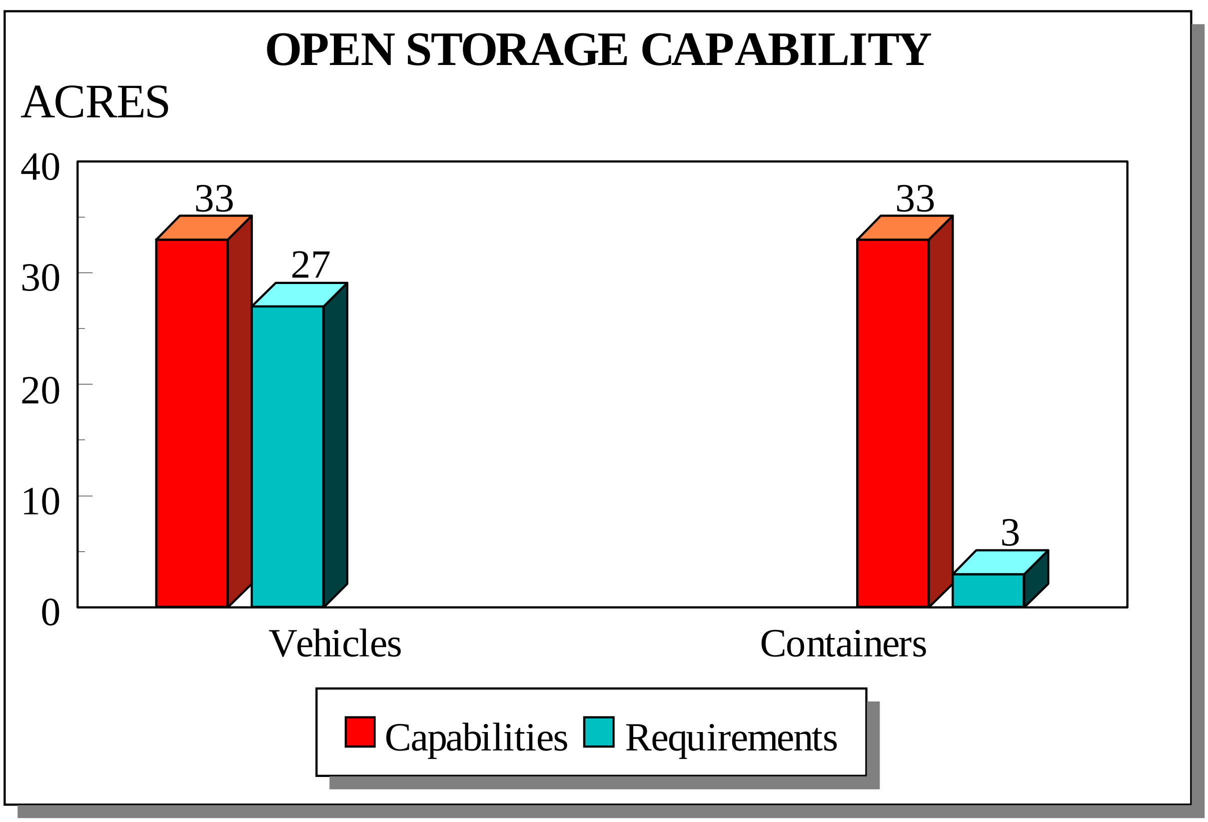
* Two portable or temporary ramps, and the concrete fixed ramp are assumed available.

OPEN STORAGE

Using the MTMCTEA Deployment Planning Guide (MTMCTEA Reference 94-700-5), this analysis assumes that a little over 9 FSS-ships will deploy a notional Armored Division. This division must deploy through the port in 6 days. Because of this, the storage requirement is to support three sustained offloading operations.

Although an FSS load of cargo can be offloaded on as little as 8 acres of hardstand marshaling, we determined 10 acres (40,510 square meters) are required for sustained offloading operations. The 10-acre per FSS requirement is dependent upon port clearing capabilities and the availability of off-port marshaling areas. Our analysis assumes the ROK Marine base adjacent to Muchok US Marine base can provide the necessary off-port marshaling for the roadable equipment. Of the 10 acres required within the port for each FSS unloading operation, less than 1 acre is required for the marshaling of 50 containers. About 30 acres are required to support the simultaneous offloading of three FSS ships.

The port has about 88 acres of paved open area. Seventy-five percent of this acreage is 66 acres. This meets the requirement.



SHIPPING

Although this analysis assumes that only FSS-sized ships can deploy a notional armored division, the table below provides ship quantities needed to move this division using minimum containerization. The number of ships required depends on the shipping mix selected. The best ship mix would consist of 8 FSS and 2 LMSR or 7 LMSR.

UNIT MOVEMENT REQUIREMENTS
ARMORED DIVISION

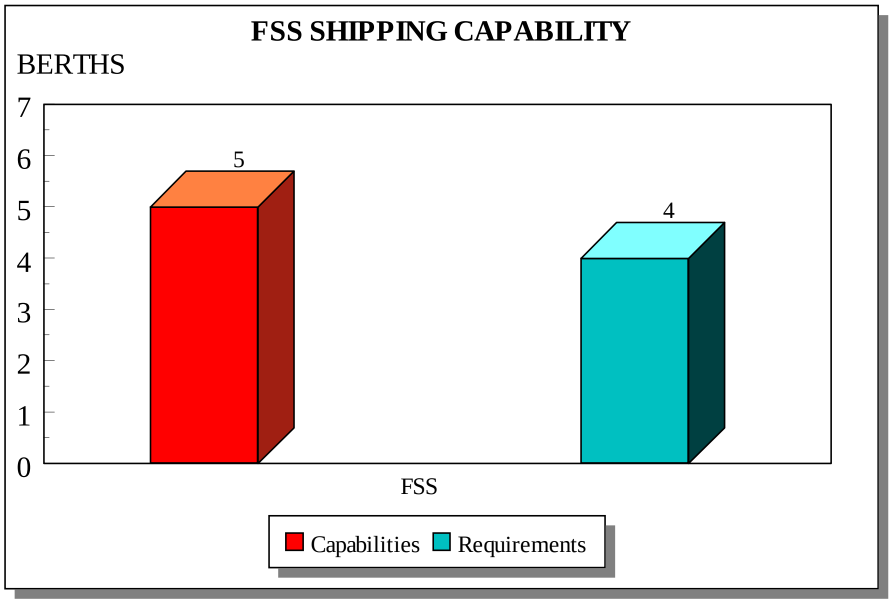
Loading Condition/ Sample Ship Mix	FSS (RORO/ Comb)	LMSR (RORO/ Comb)	Notional RORO (RORO/ Comb)	C3/C4 (Breakbulk or Container)	C6/C7/C8 (Container)
Minimum Containerization					
All FSS	8.0	1.3			
All LMSR		6.2			
Notional RORO			12.3		
All Breakbulk				31.3	
Maximum Containerization					
FSS/Container	4.0				4.7
LMSR/Container		2.5			4.7
RORO/Container			4.9		4.7
Breakbulk/Container				12.5	4.7

Legend:
RORO - roll on/roll off
FSS - fast sealift ship
Source: MTMCTEA Reference 94-700-5, Deployment Planning Guide, Sep 94.

The port could berth FSS vessels at berths 5W, 7W, 7E (two vessels), 8W, and 8E (two vessels). All together these berths can accommodate 7 FSS vessels. Seventy five percent of this capability is 5.25, which meets the requirement to berth 4 FSS vessels at once.

To prevent congestion of military operations, the FSS operations should be spread over piers 5, 7 and 8, with pier 7 having two FSS vessels, when necessary. Berths 5W, 8W and 8E do not have water depths to support fully loaded FSS or LMSR vessels. These berths should accommodate the vessels with the least draft.

LMSR operations are possible where FSS operations may occur. In general, ramps are higher on LMSR vessels than on FSS vessels. Because of the ten-foot apron heights, planners should prepare to use ramp extensions, or shore the ramp to prevent excessive ramp angles at high tide and low draft.



SUMMARY

The Port of Pohang is unable to offload and clear a notional Armored Division within 6 days. The rail service to the port is insufficient to clear enough railcars from the port.

RECOMMENDATION

The Port of Pohang is a large port that can accommodate several large vessels. The port should be considered for division-sized deployments, provided the requirements do not call for more than 66 railcars per day to be further deployed by rail from southeast Korea. Plans should also arrange for about 10 acres of off-port marshaling areas at the ROK Marine base to the east of the port. Efforts should be made to coordinate with the Korean Ministry of Defense and Port of Pusan MMAF to arrange for use of these facilities during a contingency.

July 96

PORT OF PUSAN

I. General Data

II. Throughput Analysis

III. Application

Return to Index

I. GENERAL DATA

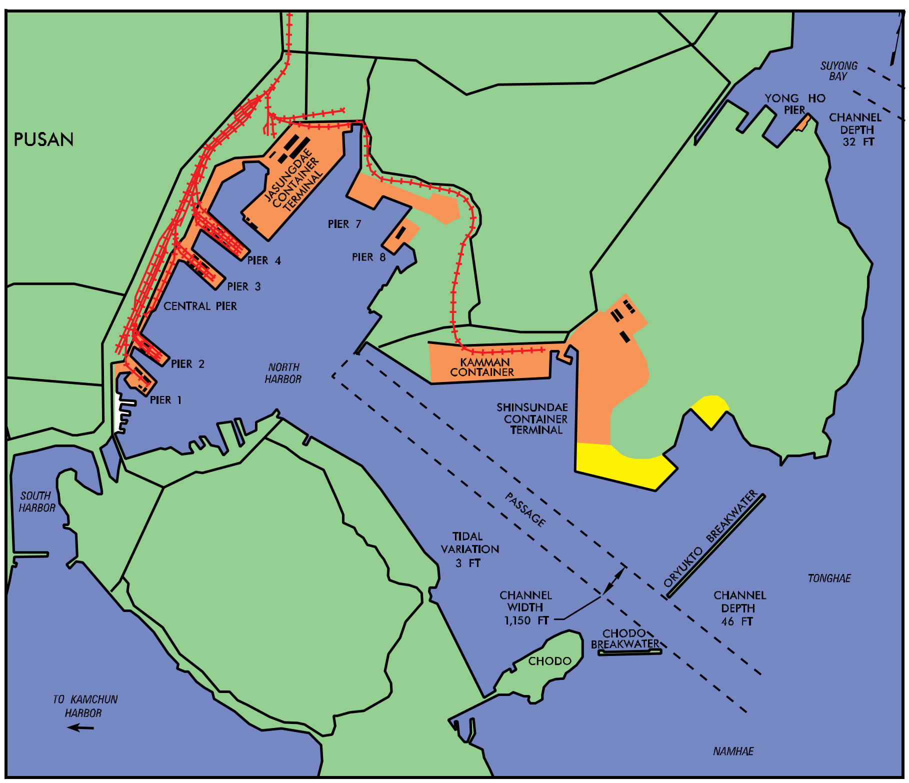
TRANSPORTATION ACCESS

Water

The Port of Pusan (35^{o} 04' 42" N; 129^{o} 01' 02" E) is on the southeast coast of South Korea about 250 miles (over 400 kilometers) southeast of Seoul and 60 miles (100 kilometers) south of Pohang. The GeoCode for Pusan is TVHX. Providing a major gateway to Asia, the Port of Pusan is the largest port in Korea and consistently ranks in the top five (currently fourth) in the world in container traffic. The mountains and islands surrounding the port provide a natural harbor. Having a deep water draft, the port can handle ships with water drafts up to about 46 feet (14 meters). The tidal variation is about 3 feet (.94 meters).

The ship channel from the confluence of the East and South Seas (Tong and Nam Hae) to the port is 46 feet deep (14 meters) and runs in between the Chodo and Oryukto Breakwaters into the main (North) harbor. The width of this channel at the breakwaters is about 1,150 feet (350 meters). Pilotage is compulsory. No vertical clearance restrictions exist between the port and open water. The main harbor serves as a turning basin for ships and is large enough to turn FSS-size vessels. Several anchorages exist around the Pusan area.

The deepest anchorage is 57 feet deep (17.5 meters). Kamchun Harbor and the wharves in Suyong Bay (secondary harbors to the main harbor) have different approaches for water access. The passage into Kamchun harbor from the open sea is 49 feet deep (15 meters) and about 590 feet wide (180 meters) between the east and west breakwaters. The wharves on Suyong Bay are in open water and the water depth is 32 feet (10 meters) going toward the pier.



Water Access

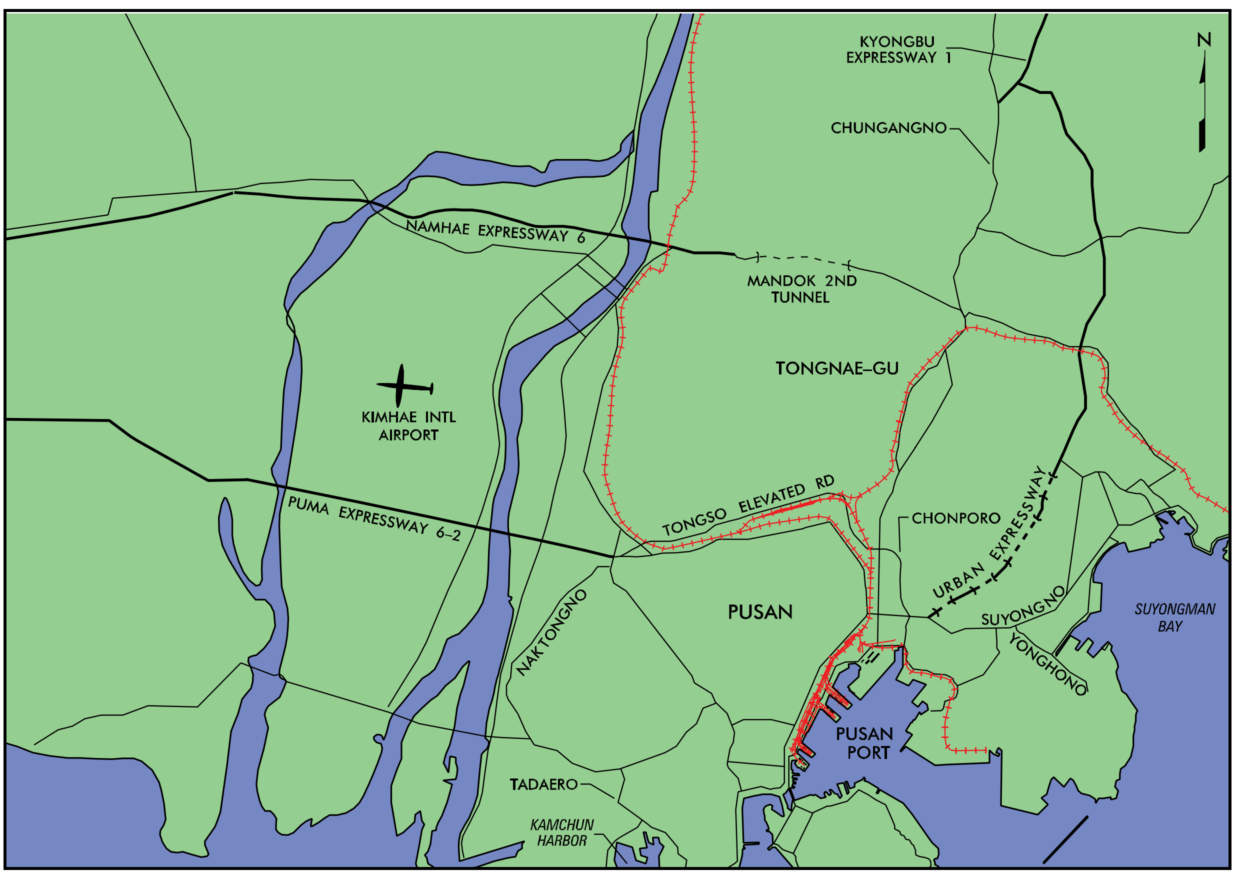
Highway

Three major highways (expressways) access the Pusan area. They are the Namhae Expressway (Expressway 6), the Puma Expressway (Expressway 6-2), and the Kyongbu Expressway (Expressway 1). From the Kyongbu Expressway, there are two major city roads into the port area. They are the Urban Expressway and Chung-angno. The major route going to the main port area from the Puma Expressway is the Tongso Elevated Road. The Namhae Expressway intersects the Chung-angno in the Tongnae area of northern Pusan east of the Mandok 2nd Tunnel.

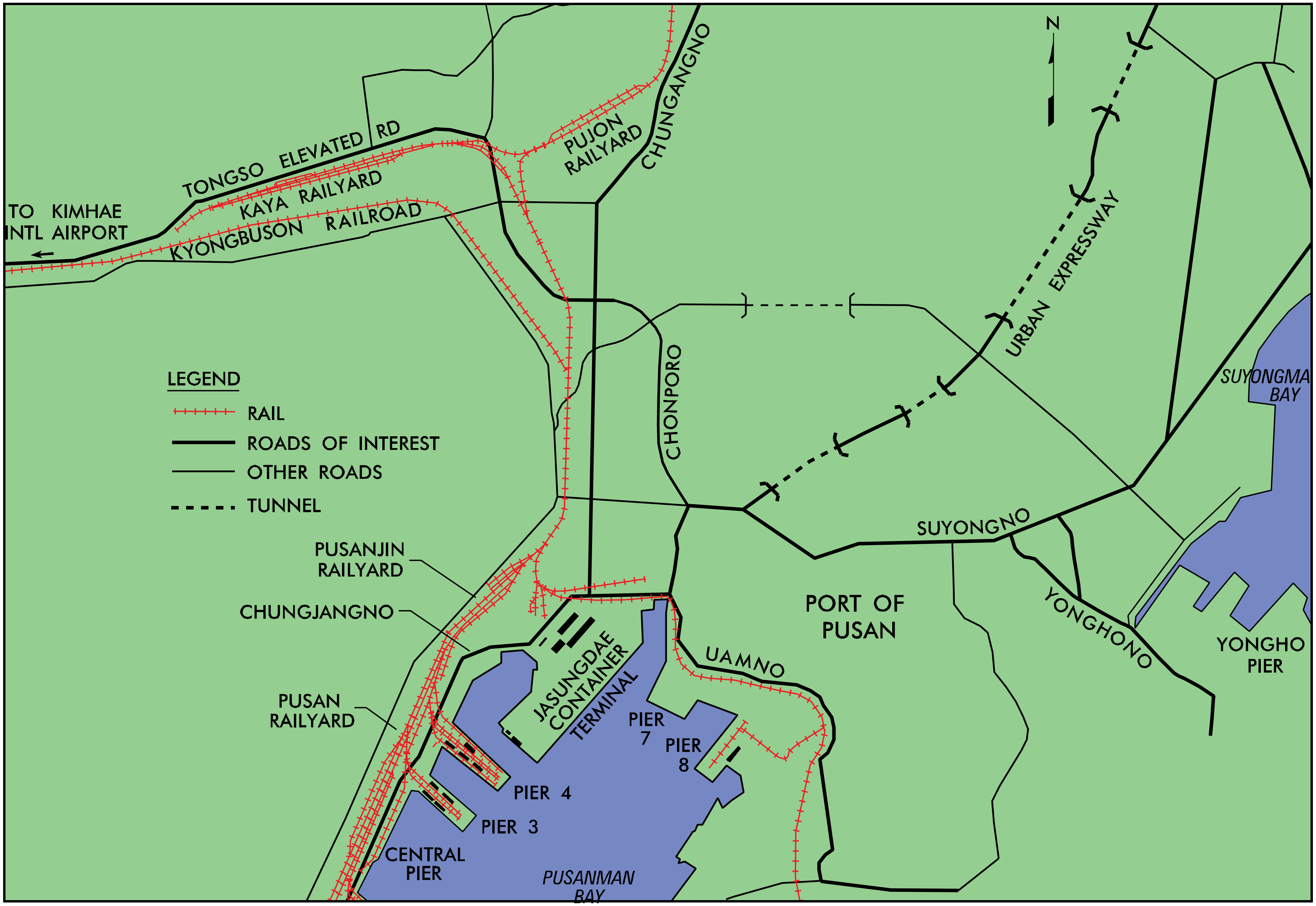
To reach the Kyongbu Expressway from the main port area, deploying units should take one of the following roadways: For the first option, take the Chonporo to the Suyongno. The Suyongno intersects with the Urban Exressway. The Urban Expressway leads to the Kyongbu Expressway going north toward Seoul. For the second option, take the Chonporo to the Chung-angno. The Chung-angno leads to the Kyongbu Expressway.

To reach the Puma Expressway, take the Chonporo to the Tongso Elevated Road. The Tongso Elevated Road leads to the Puma Expressway going west toward Masan.

The Naktongno off of the Puma Expressway and Tadaero provide the access to Kamchun Harbor. The Suyongno and Yonghono provide access to the wharves on Suyong Bay.



Highway, Rail, and Air



Highway, Rail, and Air

Rail

Two major rail lines access the Pusan area. The Tonghae NamBuson rail line extends northeastward through Ulsan to Kyongju. The KyongBuson rail line extends northwestward to Taegu. The city of Pusan has four railyards near the port. They are Pusan, Pusanjin, Kaya, and Pujon. Pusan and Pusanjin railyards are together on the west side of the Pusan harbor. Together, they can store almost 1,100 railcars on a daily basis. The Kaya railyard is along the Tongso Elevated Road. Its 6 spurs can store about 20 railcars on a daily basis. The smaller Pujon yard lies in between the Pusanjin and Kaya railyards and is just north of the Somyon Circle in Pusan. Its two spurs can store about six railcars on a daily basis.

Air

Kimhae International Airport, located on an island in the Naktong River delta, provides air access into Pusan. This airport is about 9 miles (15 km) northwest of the port in the northwestern portion of Pusan. The Puma Expressway provides the highway access to the airport. This airport has one runway jointly used by commercial and military aircraft. The runway is 9,000 feet long (2,743 meters) by 150 feet wide (45 meters) and can handle C-5 aircraft.

Pusanjin Railyard

Kaya Railyard

PORT FACILITIES

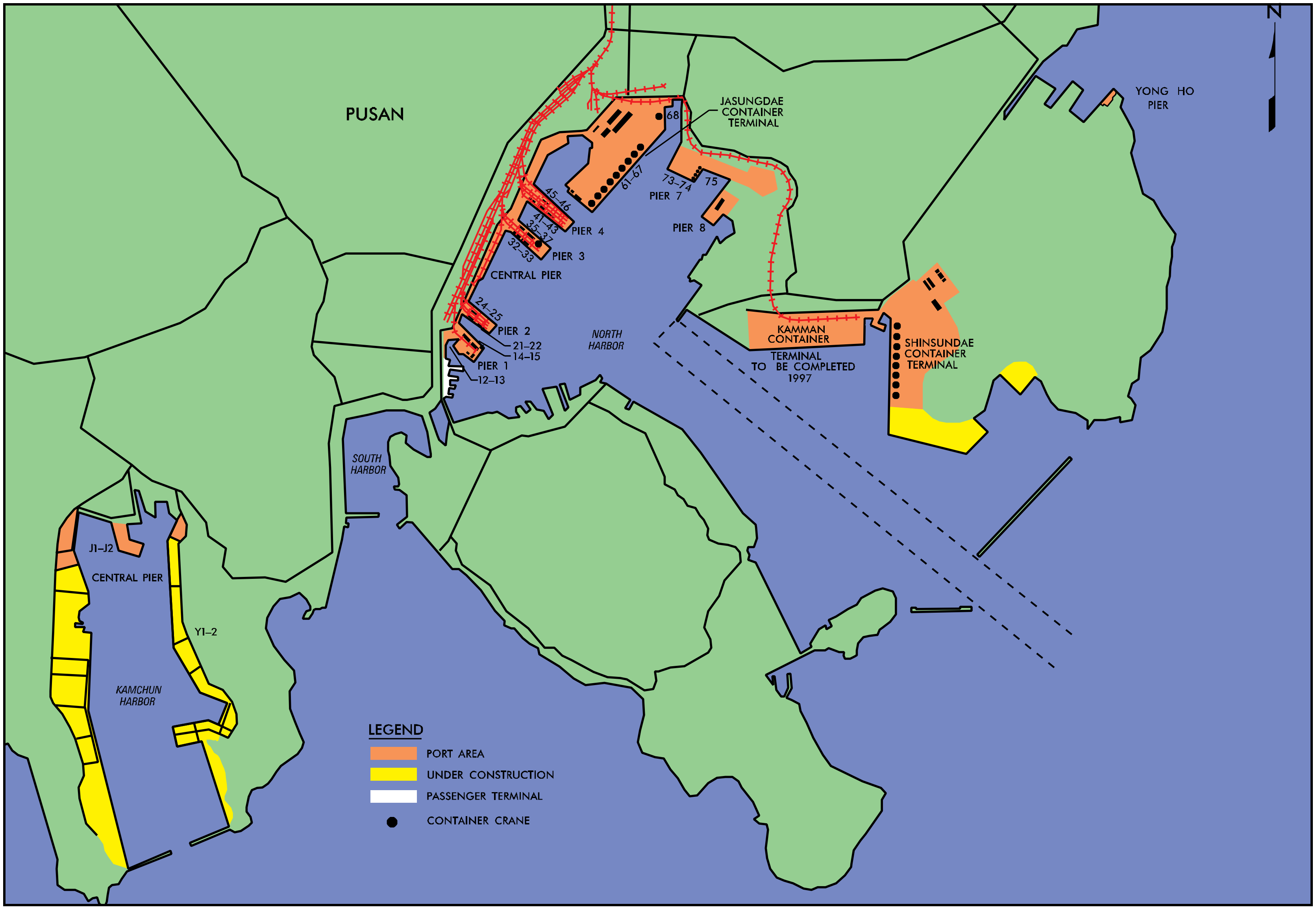
Berthing

The Port of Pusan is a multicargo port capable of breakbulk, RORO, container, and barge operations. It specializes in handling containers and is currently ranked fourth in the world in container operations. The port has many wharves and piers capable of supporting military operations. The wharves most desirable for supporting military operations are the Jasungdae Container Terminal (Piers 5 and 6) operated by the Busan Container Terminal Operation Corporation (BCTOC), Shinsundae Container Terminal operated by the Pusan East Container Terminal Company (PECT), Pier 8 operated by the Military Traffic Management Command (MTMC) 1317th Medium Port Command (MPC), and Kamman Container Terminal (projected for completion by the end of 1997). Other usable wharves and piers include Piers 1, 2 ,3, 4, central, 7, general cargo wharf at Kamchun Harbor, and Yong Ho Pier on Suyong Bay.

The Jasungdae and Shinsundae terminals are state-of-the-art container facilities with open aprons, container freight stations, 9 and 8 container cranes, respectively, paved open storage, and lighting for night operations. The Kamman facility will be similar to the Jasungdae and Shinsundae facilities when complete. Piers 2, 3, 4, and central wharf are all general cargo facilities primarily suited for breakbulk operations. All piers, except for central wharf, have transit sheds and pier 3 has one container crane. The southwestern portion of pier 1 is the international passenger ferry terminal. Pier 7 is a bulk terminal that is undergoing conversion to the Uam Container Terminal. The southeast portion of this terminal is already converted to container operations and has four container cranes. Pier 8, operated by the MTMC 1317th MPC, is best suited for RORO operations. This pier does not have any wharf or container cranes. Covered storage and end ramps are readily available at Pier 8. All wharves and piers mentioned above have rail access. Lighting is available for night operations. All current facilities have paved open storage and the Kamman facility will be paved when completed.

The facilities in Kamchun Harbor and Suyong Bay are best suited as alternative off-loading locations to the facilities in the main harbor.

Southeastern portion of Pier 7



N
PUSAN
JASUNGDAE
CONTAINER
TERMINAL
68
61–67
73–74
75
PIER 7
PIER 8
45–46
41–43
35–37
32–33
PIER 4
PIER 3
CENTRAL PIER
24–25
PIER 2
21–22
14–15
PIER 1
12–13
NORTH
HARBOR
YONG HO
PIER
KAMMAN
CONTAINER
TERMINAL
TO BE COMPLETED
1997
SHINSUNDAE
CONTAINER
TERMINAL
SOUTH
HARBOR
J1–J2
CENTRAL PIER
Y1–2
KAMCHUN
HARBOR
LEGEND
PORT AREA
UNDER CONSTRUCTION
PASSENGER TERMINAL
CONTAINER CRANE

Land-use Map

CHARACTERISTICS OF THE PORT OF PUSAN

Characteristics	Berths					
	Jasungdae 61-67	**Jasungdae 68**	**Pier 7 73-74**	**Pier 7 75**	**Pier 8**	**Shinsundae**
Length, feet (meters)	4,149 (1,265)	606 (185)	1,084 (330)	656 (200)	1,779 (542)	2,952 (900)
Depth alongside at MLW, feet (meters)	39 (11.9)	32 (9.8)	32 (9.8)	32 (9.8)	40 (12.2)	42 (12.8)
Deck Strength, psf (tonne/sq meters)	614 (3)	614 (3)	614 (3)	614 (3)	614 (3)	614 (3)
Apron width, feet (meters)	Open	Open	Open	Open	Open	Open
Apron height above MLW, feet (meters)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)
Number of container cranes	9	1	0	4	0	8
Number of wharf cranes	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No	No	No
Apron length served by rail, feet (meters)	0	0	0	0	1,779	0

CHARACTERISTICS OF PORT OF PUSAN - cont

Characteristics	Berths					
	Kamman	**Pier 1 12**	**Pier 1 13**	**Pier 1 14-15**	**Pier 2 21-22**	**Pier 2 24-25**
Length, feet (meters)	4,592 (1,400)	721 (219)	630 (192)	1,433 (437)	1,272 (388)	1,374 (419)
Depth alongside at MLW, feet (meters)	42 (12.8)	26 (7.9)	27 (8.2)	27 (8.2)	29 (8.8)	29 (8.8)
Deck Strength, psf (tonne/sq meters)	614 (3)	614 (3)	614 (3)	614 (3)	614 (3)	614 (3)
Apron width, feet (meters)	Open	Open	Open	Open	Open	Open
Apron height above MLW, feet (meters)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)
Number of container cranes	8*	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0
Straight-stern RORO facilities	No	No	No	No	No	No
Apron length served by rail, feet (meters)	0	0	0	0	1,272	1,374

* Assumes the number of container cranes installed at Kamman Container Terminal will be similar to the number at Jasungdae and Shinsundae Container Terminals.

CHARACTERISTICS OF PORT OF PUSAN - cont

Characteristics	Berths					
	Central	**Pier 3 32-33**	**Pier 3 35-37**	**Pier 4 41-43**	**Pier 4 45-46**	**Suyong Bay Yong Ho Pier**
Length, feet (meters)	2,118 (646)	1,476 (450)	1,541 (470)	2,145 (654)	1,318 (402)	688 (210)
Depth alongside at MLW, feet (meters)	29 (8.8)	29 (8.8)	29 (8.8)	29 (8.8)	29 (8.8)	32 (9.8)
Deck Strength, psf (tonne/sq meters)	614 (3)	614 (3)	614 (3)	614 (3)	614 (3)	614 (3)
Apron width, feet (meters)	Open	Open	Open	Open	Open	Open
Apron height above MLW, feet (meters)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)
Number of container cranes	0	0	1	0	0	0
Number of wharf cranes	0	0	0	0	0	0
Straight-stern RORO facilities	No	Yes	No	No	Yes	No
Apron length served by rail, feet (meters)	2,118	0	0	2,145	1,318	0

CHARACTERISTICS OF PORT OF PUSAN - cont

Characteristics	Berths	
	Kamchun Y1-2	**Kamchun J1-2**
Length, feet (meters)	1,279 (390)	984 (300)
Depth alongside at MLW, feet (meters)	32 (9.8)	27 (8.2)
Deck Strength, psf (tonne/sq meter)	614 (3)	614 (3)
Apron width, feet (meters)	Open	Open
Apron height above MLW, feet (meters)	8 (2.4)	8 (2.4)
Number of container cranes	0	0
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straight-stern RORO facilities	0	0
Apron length served by rail, feet (meters)	0	0

Pier 8

SUMMARY OF BERTHING CAPABILITIES FOR PUSAN

VESSEL	BERTHS				
	61-67 JASUNG.	68 JASUNG.	73-74 PIER 7	75 PIER 7	SHINSUNDAE
Breakbulk					
C3-S-38a	8	1	2	1	5
C4-S-58a	6	1	1	1	4
C4-S-66a	7	1,a	1,a	1,a	5
C5-S-37e	6	1	1	1	4
Seatrain					
GA and PR-class	7	1	1	1	5
Barge					
LASH C8-S-81b	4	a,c,f	1,a,f	a,c,f	3
LASH C9-S-81d	4	a,c,f	1,a,f	a,c,f	3
LASH lighter	20	3	5	3	14
SEABEE C8-S-82a	4	a,c,f	1,a,f	a,c,f	3
SEABEE barge	20	3	5	3	14
RORO					
Comet	7,d,i	1,d,i	2,d,i	1,d,i	5,d,i
Meteor	7,d,i	1,d,i	1,d,i	1,d,i	5,d,i
Cape Gnome	6,d,i,j	1,a,d,i,j	1,a,d,i,j	1,a,d,i,j	4,d,i,j
C7-S-95a	5	a,c	1,a	a,c	3
Cape Taylor	6	c	1	1	4
Cape Orlando	6,i	c	1,i	1,i	4,i
MV Ambassador	7,d	1,d	1,d	1,d	5,d
Callaghan	5,d	c,d	1,d	c,d	4,d
Cape Lambert	5,i,j	c	1,i,j	c	4,i,j
FSS-Class	4	a,c	1,a	a,c	3
Cape E-class	6,i,j	c	1,i,j	1,i,j	4,i,j
Cape D-class	5,i	a,c	1,a	a,c	4,i
Cape H-class	5	a,c	1,a	a,c	3
Cape R-class	6,d,m	a,c,d	a,d	a,d	4,d,m
Cape Texas	6,i	c	1,i	1,i	4,i
Container					
C6-M-147a	6	c,e	1,e	c	4
C7-S-69c	6	c,e	1,e	c	4
C7-S-68c	5	c,e	1,e	c	4
C8-S-85c	4	a,c,e	1,a,e	a,c	3
C9-M-132b	4	a,c,e	1,a,e	a,c	3
C9-M-F141a	4	a,c,e	1,a,e	a,c	3
Combination					
C6-S-1qd	5	a,c	1,a	a,c	4
C5-S-MA73c	6	c	1	1	4
C6-S-MA60d	6	c	1	c	4

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft

( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES FOR PUSAN

VESSEL	BERTHS				
	KAMMAN	PIER 8	12 PIER 1	13 PIER 1	14-15 PIER 1
Breakbulk					
C3-S-38a	8	3	1,a	1,a	2,a
C4-S-58a	7	2	1,a	1,a	2,a
C4-S-66a	8	3	1,a	1,a	2,a
C5-S-37e	7	2	1,a	1,a	2,a
Seatrain					
GA and PR-class	7	3	1,a	1	2
Barge					
LASH C8-S-81b	5	2	a,c,f	a,c,f	1,a,f
LASH C9-S-81d	5	1	a,c,f	a,c,f	1,a,f
LASH lighter	22	8	3	3	7
SEABEE C8-S-82a	5	1	a,c,f	a,c,f	1,a,f
SEABEE barge	22	8	3	3	7
RORO					
Comet	8,d,i	3,d,i	1,a,d,i	1,d,i	2,d,i
Meteor	8,d,i	3,d,i	1,a,d,i	1,a,d,i	2,a,d,i
Cape Gnome	7,d,i,j	2,d,i,j	1,a,d,i,j	1,a,d,i,j	2,a,d,i,j
C7-S-95a	6	2	a,c	a,c	1,a
Cape Taylor	6	2	1,a	a,c	2,a
Cape Orlando	6,i	2,i	1,a	a,c	2,a
MV Ambassador	8,d	3,d	1,d	1,d	2,d
Callaghan	6,d	2,d	1,a,d	c,d	1,d
Cape Lambert	6,i,j	2,i,j	1,a	a,c	2,a
FSS-Class	4	1	a,c	a,c	1,a
Cape E-class	6,i,j	2,i,j	1,a	a,c	2,a
Cape D-class	6,i	2,i	1,a	a,c	2,a
Cape H-class	5	2	a,c	a,c	1,a
Cape R-class	6,d,m	2,d,m	a,d	a,c,d	a,d
Cape Texas	6,i	2,i	1,a	a,c	2,a
Container					
C6-M-147a	6	2,e	1,e	c,e	2,e
C7-S-69c	6	2,e	1,a,e	a,c,e	2,a,e
C7-S-68c	6	2,e	1,a,e	a,c,e	1,a,e
C8-S-85c	5	2,e	a,c,e	a,c,e	1,a,e
C9-M-132b	5	2,e	a,c,e	a,c,e	1,a,e
C9-M-F141a	4	1,e	a,c,e	a,c,e	1,a,e
Combination					
C6-S-1qd	6	2	1,a	a,c	2,a
C5-S-MA73c	7	2	1,a	1,a	2,a
C6-S-MA60d	6	2	1,a	a,c	2,a

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft

( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES FOR PUSAN

VESSEL	BERTHS				
	21-22 PIER 2	24-25 PIER 2	CENTRAL	32-33 PIER 3	35-37 PIER 3
Breakbulk					
C3-S-38a	2	2	4	2	2
C4-S-58a	2,a	2,a	3,a	2,a	2,a
C4-S-66a	2,a	2,a	3,a	2,a	2,a
C5-S-37e	2,a	2,a	3,a	2,a	2,a
Seatrain					
GA and PR-class	2	2	3	2	2
Barge					
LASH C8-S-81b	1,a,f	1,a,f	2,a,f	1,a,f	1,a,f
LASH C9-S-81d	1,a,f	1,a,f	2,a,f	1,a,f	1,a,f
LASH lighter	6	6	10	7	7
SEABEE C8-S-82a	1,a,f	1,a,f	2,a,f	1,a,f	1,a,f
SEABEE barge	6	6	10	7	7
RORO					
Comet	2,d,i	2,d,i	4,d,i	2,i	2,d,i
Meteor	2,d,i	2,d,i	3,d,i	2,i	2,d,i
Cape Gnome	2,a,d,i,j	2,a,d,i,j	3,a,d,i,j	2,a	2,a,d,i,j
C7-S-95a	1,a	1,a	2,a	1,a	2,a
Cape Taylor	1	2	3	2	2
Cape Orlando	1,a	2,a	3,a	2,a	2,a
MV Ambassador	2,d	2,d	3,d	2,k,m	2,d
Callaghan	1,d	1,d	2,d	2	2,d
Cape Lambert	1,a	1,a	2,a	2,a	2,a
FSS-Class	1,a	1,a	2,a	1,a	1,a
Cape E-class	1,a	2,a	3,a	2,a	2,a
Cape D-class	1,a	1,a	3,a	2,a	2,a
Cape H-class	1,a	1,a	2,a	1,a	1,a
Cape R-class	a,d	a,d	a,d	a	a,d
Cape Texas	1,i	2,i	3,i	2,i	2,i
Container					
C6-M-147a	1,e	2,e	3,e	2,e	2
C7-S-69c	1,a,e	1,a,e	3,a,e	2,a,e	2,a
C7-S-68c	1,a,e	1,a,e	2,a,e	2,a,e	2,a
C8-S-85c	1,a,e	1,a,e	2,a,e	1,a,e	1,a
C9-M-132b	1,a,e	1,a,e	2,a,e	1,a,e	1,a
C9-M-F141a	1,a,e	1,a,e	2,a,e	1,a,e	1,a
Combination					
C6-S-1qd	1,a	1,a	3,a	2,a	2,a
C5-S-MA73c	2,a	2,a	3,a	2,a	2,a
C6-S-MA60d	1,a	1,a	3,a	2,a	2,a

a=vessel draft limited to berth depth
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j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft

( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES FOR PUSAN

VESSEL	BERTHS				
	41-43 PIER 4	45-46 PIER 4	YONG HO	Y1-2 KAMCHUN	J1-2 KAMCHUN
Breakbulk					
C3-S-38a	4	2	1	2	1,a
C4-S-58a	3,a	2,a	1	2	1,a
C4-S-66a	3,a	2,a	1,a,g	2,a,g	1,a,g
C5-S-37e	3,a	2,a	1	2	1,a
Seatrain					
GA and PR-class	3	2	1	2	1
Barge					
LASH C8-S-81b	2,a,f	1,a,f	a,c,f,g	1,a,f,g	1,a,f,g
LASH C9-S-81d	2,a,f	1,a,f	a,c,f,g	1,a,f,g	1,a,f,g
LASH lighter	10	6	3	6	4
SEABEE C8-S-82a	2,a,f	1,a,f	a,c,f,g	1,a,f,g	1,a,f,g
SEABEE barge	10	6	3	6	4
RORO					
Comet	4,d,i	2,i	1,d,i	2,d,i	1,d,i
Meteor	3,d,i	2,i	1,d,i	2,d,i	1,a,d,i
Cape Gnome	3,a,d,i,j	2,a	1,a,d,g,i,j	2,a,d,g,i,j	1,a,d,g,i,j
C7-S-95a	2,a	1,a	a,c,g	1,a,g	1,a,g
Cape Taylor	3	2	1	1	1,a
Cape Orlando	3,a	1,a	1,i	1,i	1,a
MV Ambassador	3,d	2,k,m	1,d	2,d	1,d
Callaghan	2,d	1	c,d	1,d	1,d
Cape Lambert	3,a	1,a	1,i,j	1,i,j	1,a
FSS-Class	2,a	1,a	a,c,g	1,a,g	1,a,g
Cape E-class	3,a	1,a	1,i,j	1,i,j	1,a
Cape D-class	3,a	1,a	1,a,g	1,a,g	1,a,g
Cape H-class	2,a	1,a	a,c,g	1,a,g	1,a,g
Cape R-class	a,d	a	a,g,d	a,g,d	a,g,d
Cape Texas	3,i	2,i	1,i	1,i	1,a
Container					
C6-M-147a	3,e	1,e	1,e	1,e	1,e
C7-S-69c	3,a,e	1,a,e	1,e	1,e	1,a,e
C7-S-68c	2,a,e	1,a,e	c,e	1,e	1,a,e
C8-S-85c	2,a,e	1,a,e	a,c,e,g	1,a,e,g	1,a,e,g
C9-M-132b	2,a,e	1,a,e	a,c,e,g	1,a,e,g	1,a,e,g
C9-M-F141a	2,a,e	1,a,e	a,c,e,g	1,a,e,g	1,a,e,g
Combination					
C6-S-1qd	3,a	1,a	1,a,g	1,a,g	1,a,g
C5-S-MA73c	3,a	2,a	1	2	1,a
C6-S-MA60d	3,a	1,a	1	1	1,a

a=vessel draft limited to berth depth
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j=insufficient ramp clearance at high tide
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m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft

( ) indicates vessels assigned by analyst

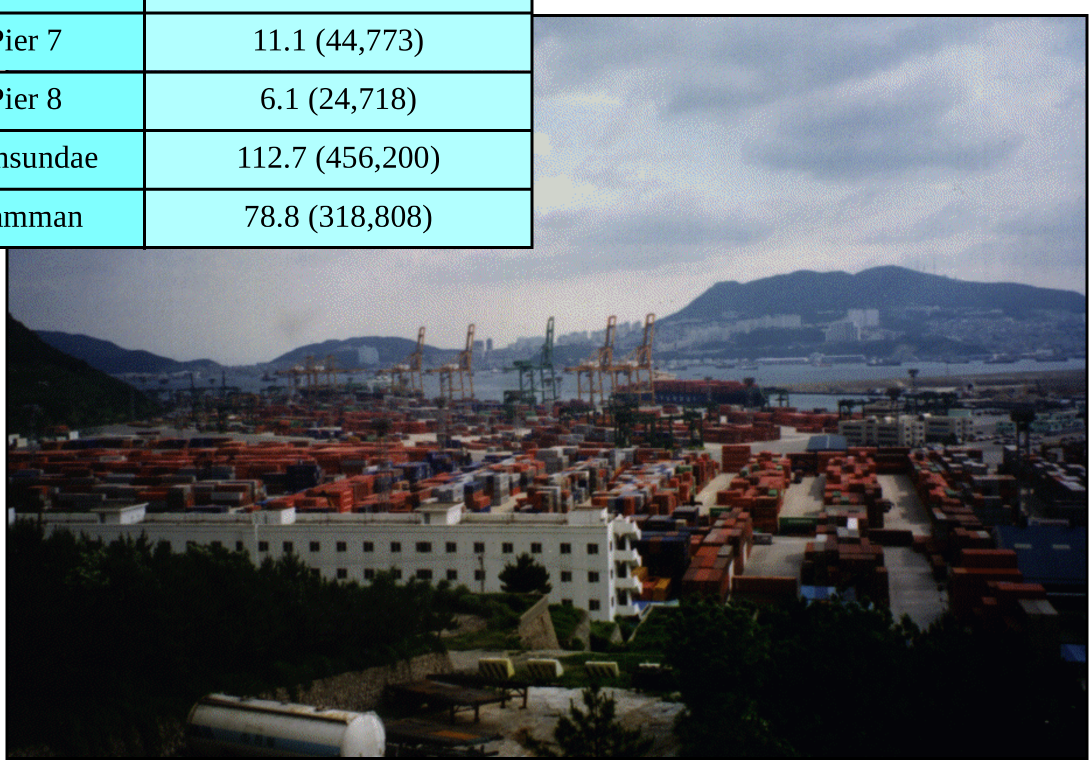
Open Storage

The Port of Pusan lists significant open storage capability for all of the wharves and piers in the main harbor. Total open storage capability at the military useful facilities within the port is about 15,090,300 square feet (1,401,900 square meters). The terminal-by-terminal breakdown for this open storage is in the table below. Excepting Pier 8 and Kamman Container Terminal, about 50 percent of the port's open storage is available on a daily basis. Currently, the Kamman Container Terminal open storage is unimproved and not used. The most likely location for helicopter operations is Pier 8. Helicopter operations could also occur in the container terminals provided areas can be appropriately cleared of containers and equipment.

Port of Pusan Open Storage Breakdown

Wharf/Pier	Acreage (square meters)
Pier 1	3.0 (12,254)
Pier 2	2.9 (11,558)
Central	3.9 (15,685)
Pier 3	6.4 (26,100)
Pier 4	12.7 (51,396)
Jasungdae	97.4 (394,312)
Pier 7	11.1 (44,773)
Pier 8	6.1 (24,718)
Shinsundae	112.7 (456,200)
Kamman	78.8 (318,808)

Open Storage Shinsundae Container Terminal



Covered Storage

The port has ample covered storage available for breakbulk general cargo and container stuffing/ unstuffing operations. Covered storage exists on Piers 1, 2, 3, 4, 8, Jasungdae, Shinsundae, and Kamman.

Total covered storage on the militarily useful terminals at the port is 1,015,470 square feet (94,344 sq m). Current covered storage usage is about 50 percent. A terminal-by-terminal breakdown is in the following table.

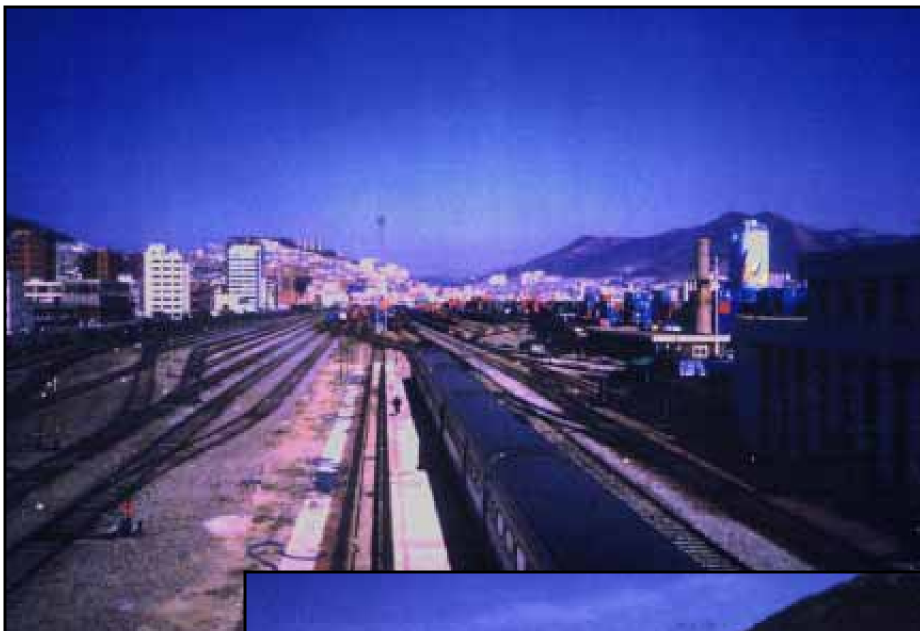
Port of Pusan Covered Storage Breakdown

Wharf/Pier	Area square feet (square meters)
Pier 1	88,114 (8,186)
Pier 2	101,504 (9,430)
Pier 3	146,390 (13,600)
Pier 4	146,390 (13,600)
Jasungdae	275,741 (25,617)
Shinsundae	107,995 (10,033)
Kamman	103,334 (9,600)
Pier 8	46,000 (4,278)

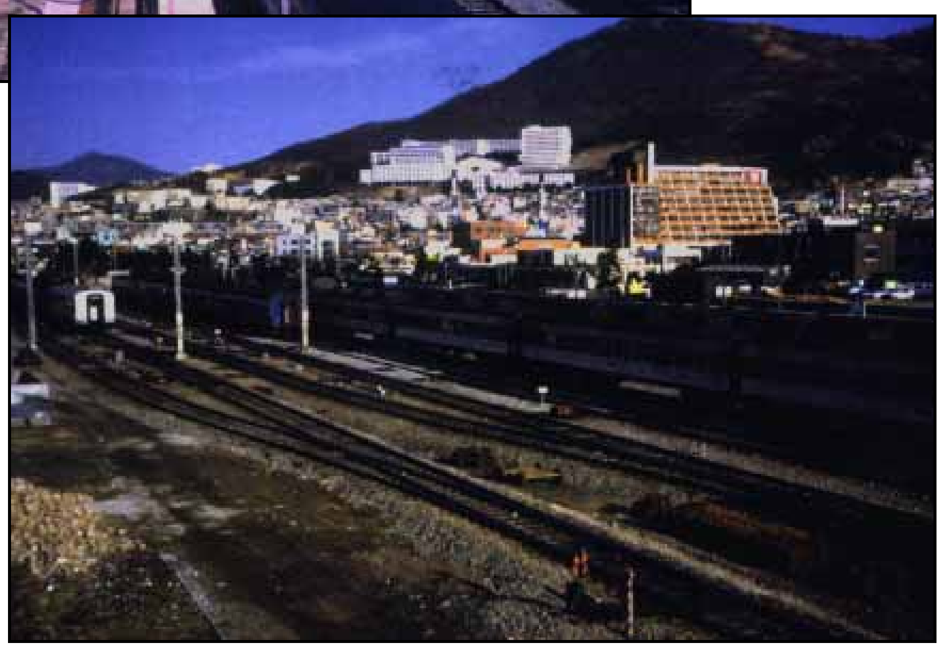
Shinsundae Container Freight Station

Rail

All of the wharves and piers in the main port area have rail access. Piers 1, 2, 3, 4, and 8 all have apron tracks although some of the spurs have the transit sheds in between the spur and the wharf. All of these spurs provide access from the wharf areas to the Pusan and Pusanjin railyards and the main lines. Current rail activity to the port is two 80-railcar trains per day out of Jasungdae and Shinsundae Container Terminals totaling 320 TEUs. No unusual clearance restrictions exist from the rail lines to the port. All rail cargo must meet the clearance envelope for Korean rail transport. The four railyards in the area, Pusan, Pusanjin, Kaya, and Pujon have a total storage capacity of about 1,120 railcars. Neither the Port of Pusan nor the rail stations have any rail end ramps. The 1317th MPC has 15 portable steel end ramps suitable for offloading tanks. In addition, they also have three portable wooden end ramps having a 75-ton capacity. Also available are two fixed end ramps on Pier 8.



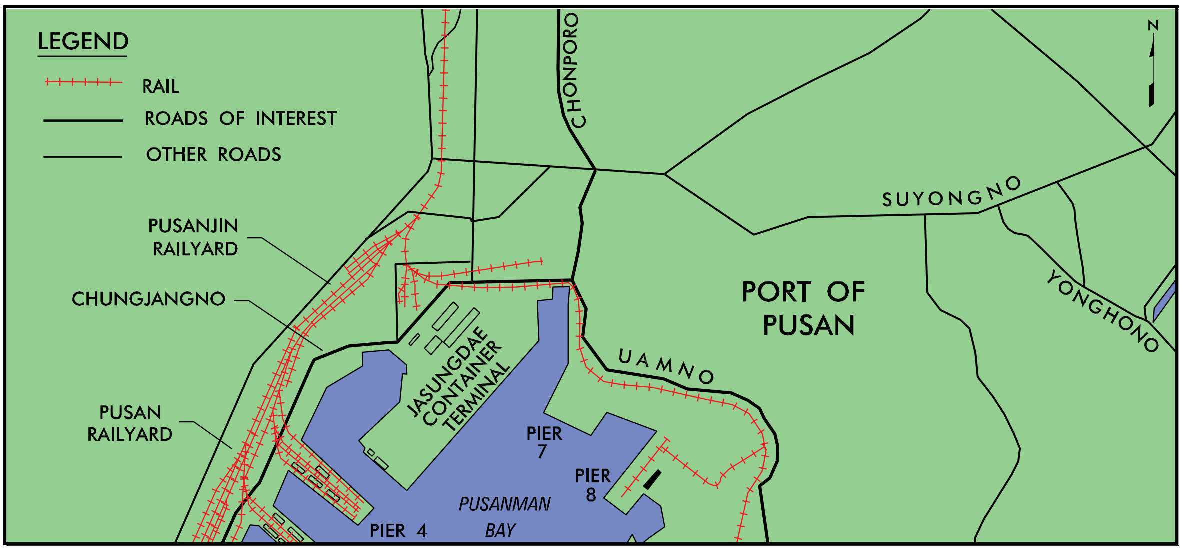
Pusan Railyard



Pujon Railyard

Highway

In the main port area, the Chungjangno and Uamno are the two roads leading to the port access roads from the Chonporo. The Chungjangno is a 10-lane highway and the Uamno is a 6-lane highway. These roads are heavily congested. Each terminal has its own gate and the access roads through the gates are two-laned (one for each direction). Access into Shinsundae is four-laned (two lanes for each direction) and access to Jasungdae is eight-laned (four for each direction). No unusual clearances exist on these roads. The International Road Federation Chart lists highway legal limits as 3.8 meters (12.5 feet) for height, 2.5 meters (8.2 feet) for width, and 10 metric tons (11 tons) for a single axle loading in South Korea. Every terminal has a truck scale near the gate.



Close-up of roads around ports

Access to Jasungdae Container Terminal

Ramps

The only ramps available at the Port of Pusan are all located at Pier 8. Fifteen portable steel end ramps are available and have the capacity to load/offload tanks. Also available are three portable wooden end ramps and two concrete fixed end ramps. The port has several locations that have potential for using portable end ramps to load railcars.

Portable Steel End Ramps at Pier 8

The spurs on the wharf apron at Pier 8, the spurs in the Jasungdae and Shinsundae Container Terminals, and the spur at Kamman Container Wharf are currently the best locations for end ramp operations. Alternative locations are the spurs at piers 1, 2, 3, 4, and the Pusanjin railyard.

Docks

Truck and Boxcar Handling Positions at the Port of Pusan

Facility	Truck Positions	Boxcar Positions
Pier 1	30	10
Pier 2	40	20
Pier 3	24	22
Pier 4	24	22
Pier 8	12	22
Total	130	96

OFF-PORT MARSHALING AREAS

The city of Pusan and its surrounding areas have several places that could be used for off-port marshaling. The following table provides a summary for off-port marshaling. The graphic after the table shows the locations of the potential marshaling areas.

Port of Pusan Potential Marshaling Areas

Name of Marshaling Area	**Acreage acres (square meters)**
K-9 Airfield	136 (550,000)
Kamman Pier	79 (318,810)
Yangsan Inland Container Depot	220 (891,000)
Kamchun Harbor	339 (1,371,000)
Kaya Rail Marshaling Yard	Not Available
Sajik Stadium	15 (61,290)
Pusan Storage Facility (PSF)	Not Available
Golf Courses	Not Available

Sajik Stadium in Pusan

Pusan Storage Facility Off-Port Marshaling (Pier 7 and Jasungdae Terminals in Background)

Off-Port Marshaling

MATERIALS HANDLING EQUIPMENT (MHE)

Type of Equipment	Capacity STON (met. tons)	Quantity	Wharf Assignment	Owner
Container Cranes	33-44 (30-40.6)	30	Jasungdae (10)[1] Shinsundae (8) Pier 3 (1) Kamman (8)[2] Pier 7 (4)	BCTOC PECT & others
Transfer Cranes	33-44 (30-40.6)	59	Jasungdae (24) Shinsundae (25) Pier 7 (10)	BCTOC PECT & others
Straddle Carriers	33 (30-30.5)	24	Jasungdae	BCTOC
Mobile Harbor Container Jib Cranes	33-44 (30-40.6)	8	---	local stevedors
Floating Crane	176 (160)	1	---	local stevedores
Mobile Crane	330 (300)	1	---	local stevedores
Mobile Crane	275 (250)	1	---	local stevedores
Mobile Crane	248 (225)	4	---	local stevedores
Mobile Crane	165 (150)	5	---	local stevedores
Mobile Crane	140 (127)	4	---	local stevedores
Mobile Crane	121 (110)	1	---	local stevedore
Mobile Crane	77-110 (70-100)	25	---	local stevedores
Mobile Crane	38-66 (35-60)	19	---	local stevedores
Mobile Crane	27-33 (25-30)	16	---	local stevedores
Mobile Crane	11-22 (10-20)	17	---	local stevedores

MATERIALS HANDLING EQUIPMENT (MHE) - cont

Type of Equipment	Capacity STON (met. tons)	Quantity	Wharf Assignment	Owner
Forklift	34-44 (31-40)	20	---	local stevedores, BCTOC, and PECT
Forklift	17-33 (16-30)	13	---	local stevedores, BCTOC, and PECT
Forklift	12-16 (11-15)	16	---	local stevedores, BCTOC, and PECT
Forklift	4.4-11 (4-10)	92	---	local stevedores, BCTOC, and PECT
Forklift	1.2-3.8 (1-3.5)	168	---	local stevedores, BCTOC, and PECT
Chassis (20-ft)	---	608	---	local stevedores, BCTOC, and PECT
Chassis (40-ft)	---	2,730	---	local stevedores, BCTOC, and PECT
Truck-tractors	---	906	---	local stevedores, BCTOC, and PECT
Trailers	---	35	---	local stevedores, BCTOC, and PECT
Spreaders	---	55	---	local stevedores, and BCTOC

[1] Two of these cranes have a 16 container row reach capability. The other two have a 13 container row reach capability.

[2] Assumes that Kamman Container Terminal will have a number of container cranes similar to Jasungdae and Shinsundae Container Terminals upon completion of facility development.

AMMUNITION HANDLING FACILITIES

The only ammunition handled by the Port of Pusan is small arms 1.4-class S and L, and fireworks. Any ammunition shipments would need to be coordinated with and approved by the Korean Ministry of Defense and the Pusan Ministry of Maritime Affairs and Fisheries (MMAF) well in advance before any deployment.

PETROLEUM, OIL, AND LUBRICATION (POL)

The only POL facilities are at the Shinsundae Container Terminal used to berth ships no greater than 5,000 deadweight tons (DWT). These facilities are strictly for city consumption.

INTERMODAL FACILITIES

The main intermodal facilities are located at the Jasungdae and Shinsundae Container Terminals. A smaller one is on Pier 7. Containers can be transported out of these facilities by either highway or rail. Future plans call for intermodal facilities at Kamman and Uam Container Terminals. The current rail activity is two 80-railcar trains per day. To avoid problems with rail traffic from passenger and other freight trains, these trains travel during the night. A new inland container depot (Yangsan Inland Container Depot) is to be built along the Naktong River delta north of Pusan and northeast of Kimhae International Airport. This depot will be a huge facility covering 220 acres (891,000 square meters).

Jasungdae Intermodal Facilities

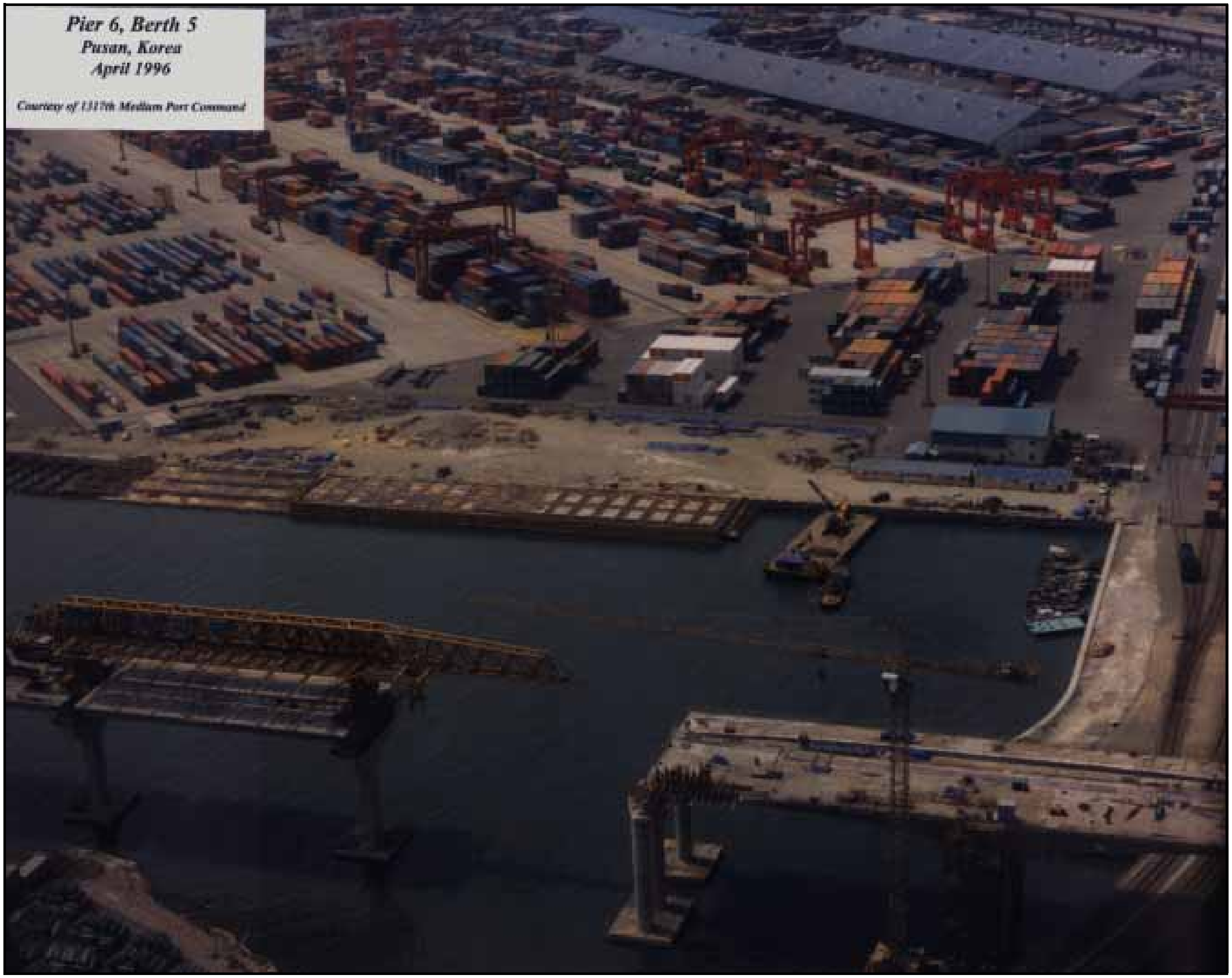
FUTURE DEVELOPMENT

The Port and city of Pusan plan many projects that will improve the capabilities of the port and supporting infrastructure. Among the most notable projects are the establishment of the Yangsan Inland Container Terminal north of the city. This facility will provide a focal point for container handling and storage in the Pusan area and ease congestion in the city and around the port.

A second project is the expansion of several terminals in the port that includes but is not limited to the Shinsundae, Jasungdae, Kamman, Uam Container Terminals, piers 3 and 4, pier 2, pier 7, and Kamchun Harbor. The Kamman Container Terminal is scheduled to begin operations in January 1998. No timetable has been noted for completion of the other terminals. New gantry cranes will be installed on Pier 7 and the back side of Jasungdae.

New highways being built in the area include the Kupo-Yangsangan Expressway, the Kwang An Daero, and the completion of the Tongso Elevated Road. The Kwang An Daero will be an expressway providing direct access to the Kamman and Shinsundae Terminal from the Kyongbu Expressway. This route will lead from near the Kamman and Shinsundae Terminals, over a portion of Suyong Bay, follow the Suyong River by K-9 Airfield and intersect the Kyongbu Expressway in the Tongnae area. The Kupo-Yangsangan Expressway will provide a more direct access from the Kyongbu Expressway to the Namhae Expressway north of the city. This expressway should provide a direct access to the Yangsan Inland Container Depot. The completion of the Tongso Elevated Road will provide a direct access for container traffic going to and from the Jasungdae, Kamman, and Shinsundae Container Terminals.

Portion of Area for Expansion of Shinsundae Terminal

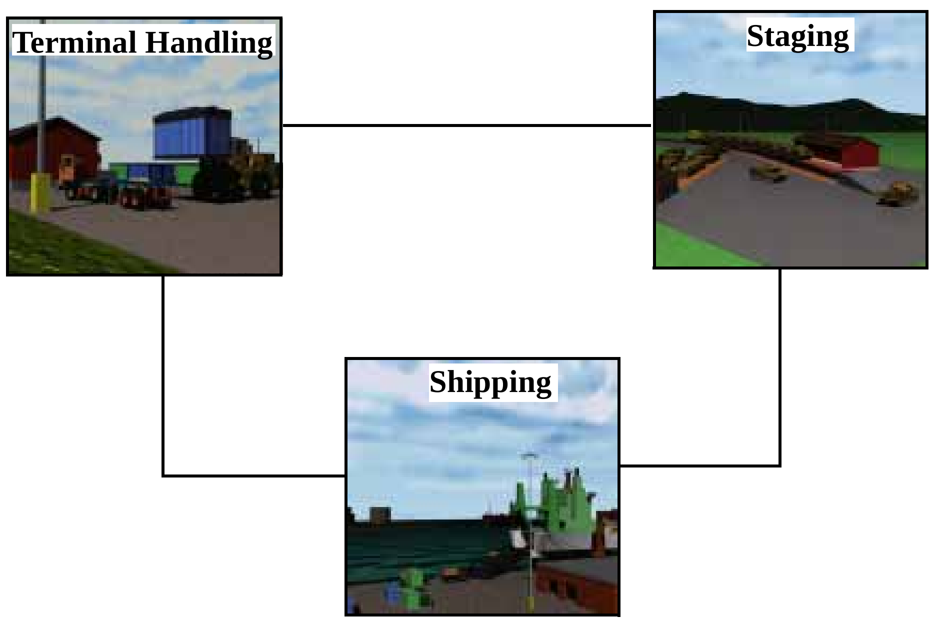


Future Development - Expressway Construction Near Jasungdae Terminal

II. THROUGHPUT ANALYSIS

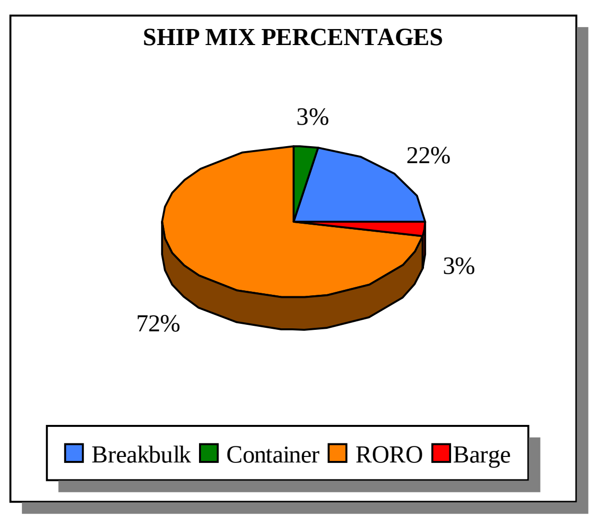
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Pusan. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, hardstand marshaling, and terminal processing/handling - in terms of short tons (STON) per day.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 80 percent of the port facilities will support military deployments. Also, due to the size of the port, we assumed a berth utilization factor of 90 percent. The ship mix is determined by Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL RECEPTION/HANDLING

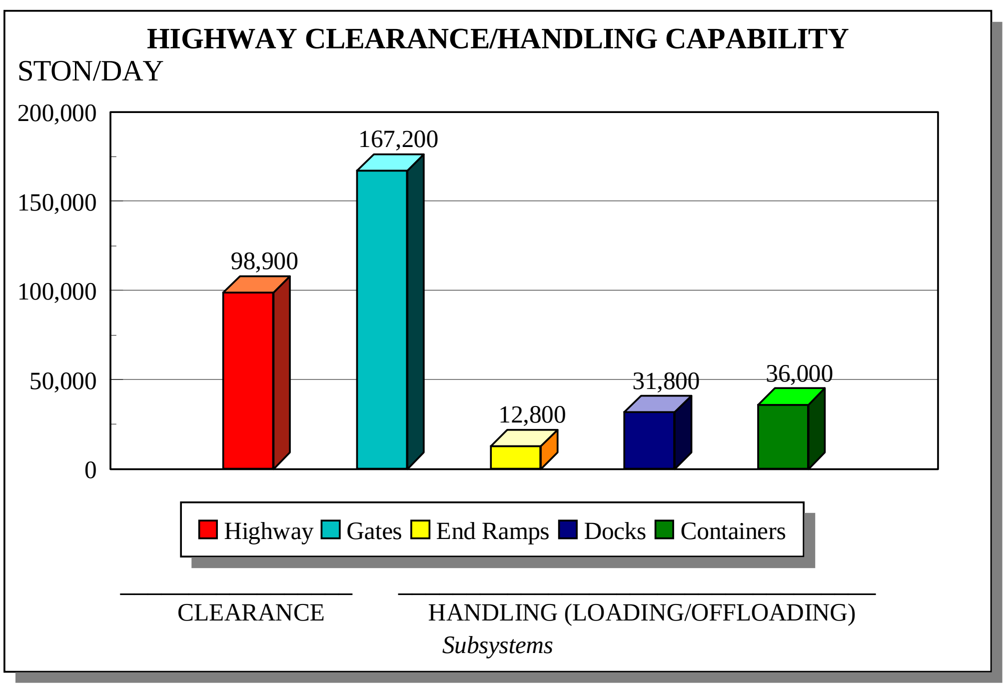
Highway

The major roadways clearing the port to the expressways are the Chungjangno and Uamno in the main harbor, the Naktongno in Kamchun harbor, and Yonghono in the Suyong Bay harbor. The access roads, including the gates, connecting the port to the expressways can handle about 98,900 STON of equipment and supplies per day. As can be seen from the bar chart below, the congested Pusan roadways are more of a weak link in the system rather than the gates to the terminals. The efforts of the city to develop improved roadways in and around Pusan, to provide direct access to the container terminals, and to provide an inland container depot may do much to relieve congestion.

Roadable vehicles will either process to an off-port marshaling area or to hardstand marshaling areas within the port. Vehicles requiring transport on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps within the terminal. We assume that the 1317th MPC can provide some of the ramps stored on Pier 8. If not available, deploying units/military port operator must either build or acquire the necessary ramps. For this study, we assumed eight portable ramps would be used for loading operations. These ramps can handle at least 12,800 STON of military vehicles and equipment per day.

The port has about 130 handling positions to load/offload supplies in van semitrailers. These docks can load/offload about 31,800 STON of van semitrailer-shipped materials per day.

The Port of Pusan has 24 straddle carriers available at the container terminals. Using these alone, the port can handle at least 36,000 STON of containerized equipment and supplies per day.

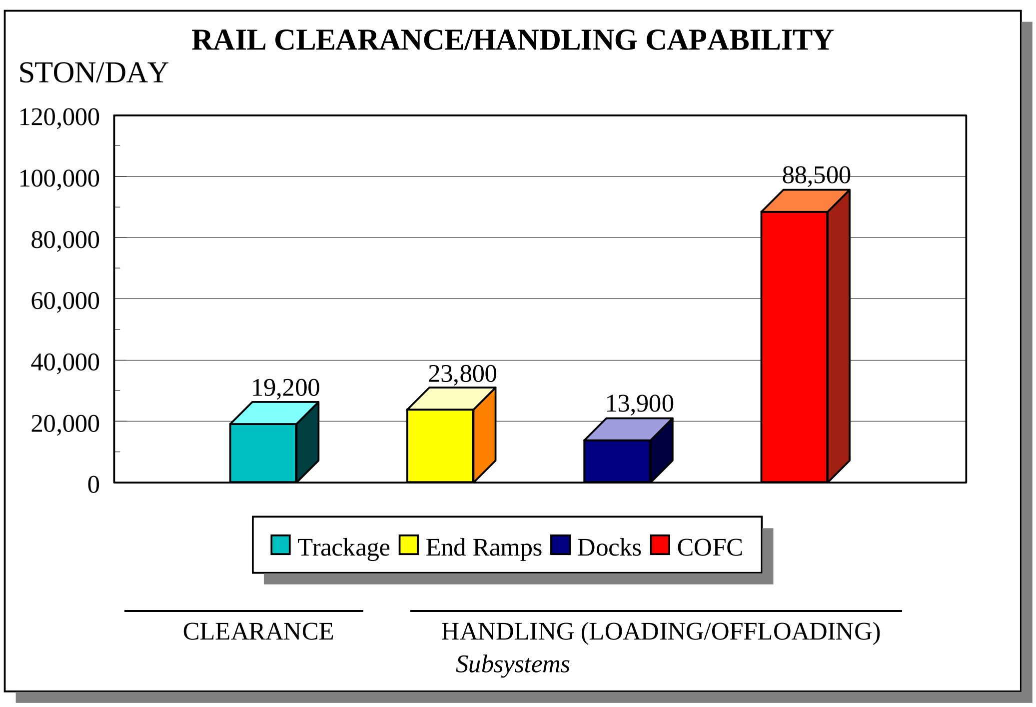


Rail

The Korean National Railroad (KNR) provides rail service to the port. Current service is two 80-railcar trains per day out of the Shinsundae and Jasungdae Container Terminals. Loading 2 containers per railcar, the port moves 320 twenty-foot equivalent units (TEU) per day. Because most Korean trains are limited to 22 railcars per train, container movements occur during the night. Loading operations can occur at the Jasungdae, Shinsundae, and Kamman Container Terminals and Piers 1, 2, 3, 4, 7, and 8. Trackage in the four railyards in the Pusan area appear able to store about 1,120 railcars. Assuming 40 percent of this total is available on a daily basis, these yards could still store about 450 railcars.

Vehicles on flatcars must use portable ramps for loading/offloading operations. We assume that the 1317th MPC will provide the needed end ramps stored at Pier 8 to perform rail operations. For this study, we assumed that seven end ramps would be used for loading railcars. Potential end ramp locations are the spurs at Pier 8, the storage spurs at the Pusan and Pusanjin railyards, the tracks leading to the Kamman and Shinsundae Container Terminals, the spurs at the Jasungdae Container Terminal, and any of the sidings at the conventional piers (Piers 1 through 4). Based on 22 railcar trains and 2 cycles during the day, the 7 ramps could load over 300 railcars per day. Daily rail throughput using end ramps is over 23,800 STON.

We assume that rail-mounted transfer cranes, mobile cranes, and forklifts will perform the COFC operations. These operations will occur at the Jasungdae, Shinsundae, Kamman, and Pier 7 terminals. Using the available 59 transfer cranes alone, the Port of Pusan can handle 88,500 STON of containerized equipment and supplies per day.



OPEN STORAGE

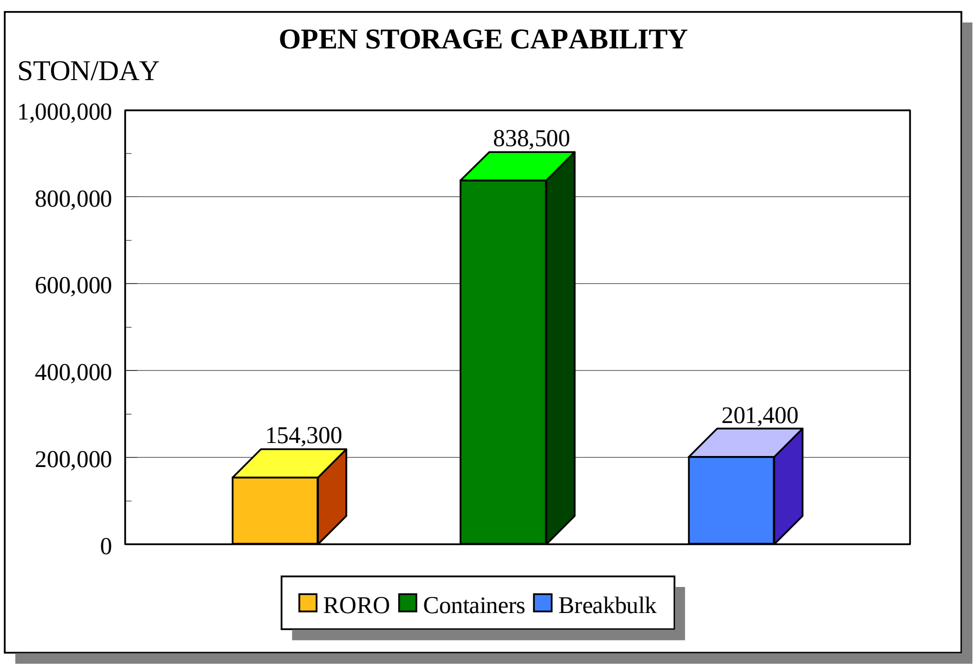
The port has almost 350 acres (1,417,900 square meters) of open storage distributed throughout the port. Another 800 acres (3,240,900 square meters) of open storage is available at various off-port marshaling sites. Total available covered storage is over 1,015,500 square feet (94,400 square meters).

The port has the ability to perform operations on RORO, container, or breakbulk ships. The cargo mix depends on the anticipated vessel type. For example, cargo will be containerized if a containership is planned.

The chart on this page provides the cargo open storage capability for each vessel type. If a combination ship is expected, then a portion of each involved capability should be assumed.

Based on the shipping subsystem throughput for RORO and container operations (see Throughput Summary Table), about 240 acres (972,260 square meters) of open storage will be needed to marshal the daily throughput capability for the Port of Pusan. The 240-acre requirement consists of 157 acres needed to store RORO cargo and 83 acres needed to store containers. The RORO acreage considers the estimated square feet for RORO throughput (Throughput Summary Table) and includes a factor to account for areas needed to store frustrated cargo, working areas, areas around ramps and gates, lanes and access to vehicles, and other factors. This estimate does not take into consideration the equipment that would leave the port immediately after offloading.

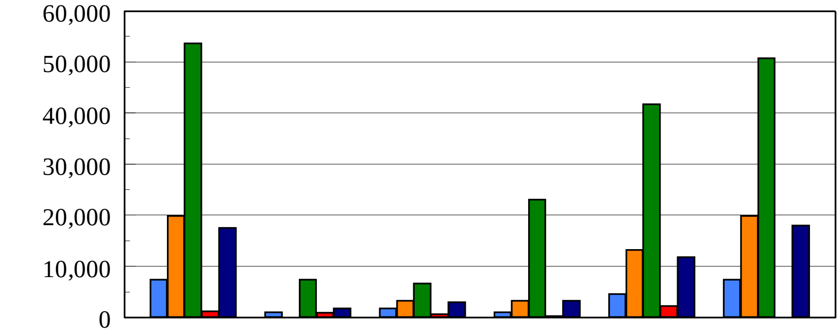
The container acreage is based on the container throughput in TEU (Throughput Summary Table) and uses the yard gantry crane system for storage (325 TEU per acre). The port has almost 350 acres of total open storage and should easily handle the 240-acre requirement (RORO equipment plus containers).



SHIPPING

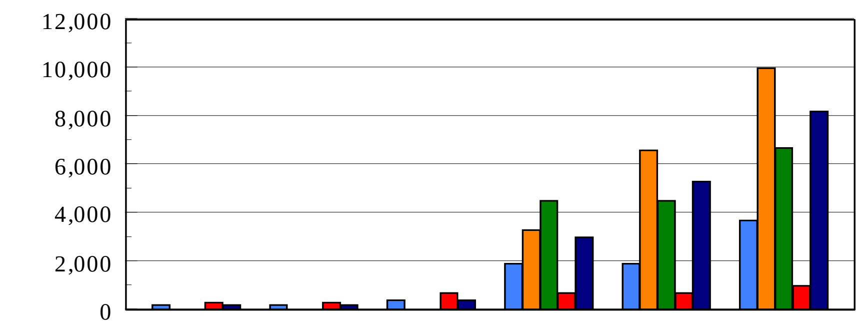
Throughputs for each berth are shown below. They are based on various factors including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. Assumptions used in this study are in the appendix.

BERTH THROUGHPUT CAPABILITY



	61-67	68	73-73	75	Shinsundae	Kamman
Breakbulk	7,400	1,100	1,800	1,100	4,600	7,500
RORO	19,900	0	3,300	3,300	13,300	19,900
Container	53,700	7,500	6,700	23,100	41,800	50,800
Barge	1,300	1,000	700	300	2,300	0
Mixed	17,600	1,800	3,000	3,300	11,900	18,000

BERTH THROUGHPUT CAPABILITY - cont

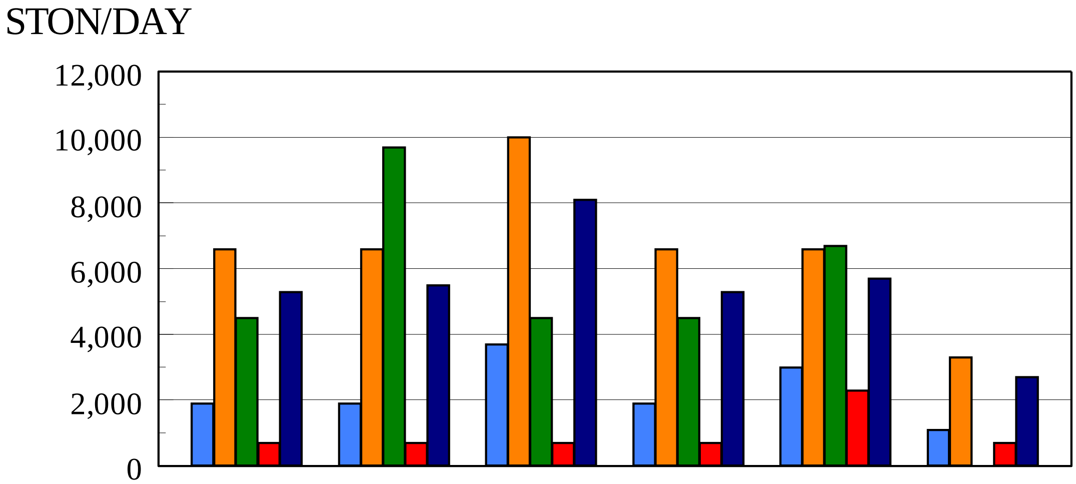


	12	13	14-15	21-22	24-25	Central
Breakbulk	200	200	400	1,900	1,900	3,700
RORO	0	0	0	3,300	6,600	10,000
Container	0	0	0	4,500	4,500	6,700
Barge	300	300	700	700	700	1,000
Mixed	200	200	400	3,000	5,300	8,200

CONVERSION FACTORS

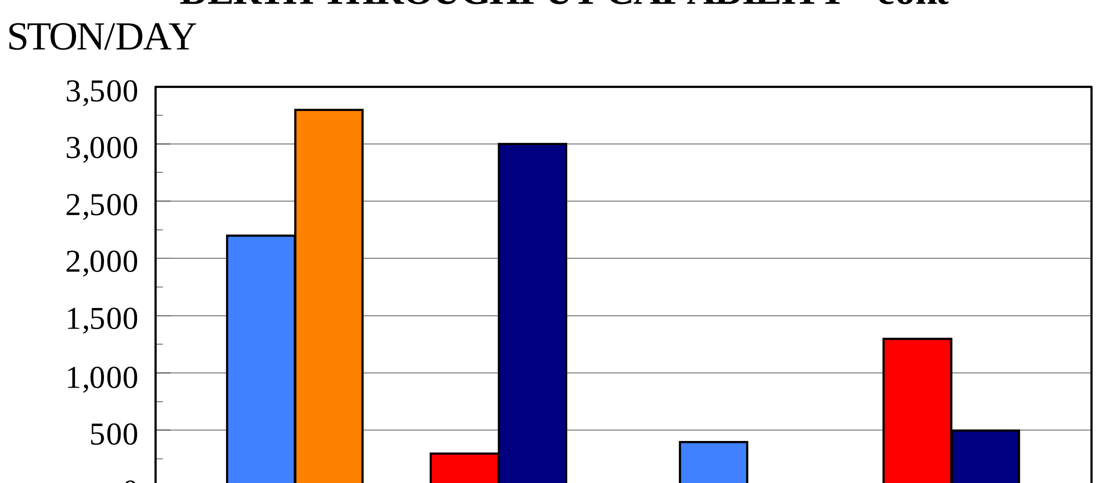
Breakbulk	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON

BERTH THROUGHPUT CAPABILITY - cont



	32-33	35-37	41-43	45-46	Pier 8	Yong Ho
Breakbulk	1,900	1,900	3,700	1,900	3,000	1,100
RORO	6,600	6,600	10,000	6,600	6,600	3,300
Container	4,500	9,700	4,500	4,500	6,700	0
Barge	700	700	700	700	2,300	700
Mixed	5,300	5,500	8,100	5,300	5,700	2,700

BERTH THROUGHPUT CAPABILITY - cont



	y1-2	j1-2
Breakbulk	2,200	400
RORO	3,300	0
Container	0	0
Barge	300	1,300
Mixed	3,000	500

THROUGHPUT SUMMARY FOR PORT OF PUSAN PER DAY

PORT/ BERTH	LENGTH feet (meters)	DEPTH ALONGSIDE feet (meters)	BREAKBULK THROUGHPUT STON (MTON)	RORO THROUGHPUT STON (MTON)	RORO SQUARE FT (EST)	RORO PIECES	CONTAINER THROUGHPUT STON (MTON) (TEU)	BARGE THROUGHPUT STON (MTON)	MIXED THROUGHPUT STON (MTON)
Jasungdae (61-67)	4,149 (1,265)	39 (11.9)	7,400 (18,400)	19,900 (79,600)	398,000	2,341	53,700 (134,400) (6,720)	1,300 (3,300)	17,600 (65,500)
Jasungdae (68)	606 (185)	32 (9.8)	1,100 (2,900)	0	0	0	7,500 (18,700) (933)	1,000 (2,500)	1,800 (4,500)
Pier 7 73-74	1,084 (330)	32 (9.8)	1,800 (4,600)	3,300 (13,300)	66,000	388	2,200 (5,600) (280)	700 (1,700)	3,000 (11,100)
Pier 7 75	656 (200)	32 (9.8)	1,100 (2,700)	3,300 (13,300)	66,000	388	23,100 (57,800) (2,890)	300 (800)	3,300 (11,900)
Pier 8	1,779 (542)	40 (12.2)	3,000 (7,600)	6,600 (26,500)	132,000	776	6,700 (16,800) (839)	2,300 (5,800)	5,700 (21,500)
Shinsundae	2,952 (900)	42 (12.8)	4,600 (11,600)	13,300 (53,100)	266,000	1,565	41,800 (104,500) (5,225)	2,300 (5,800)	11,900 (44,100)
Kamman	4,592 (1,400)	42 (12.8)	7,500 (18,700)	19,900 (79,600)	398,000	2,341	50,800 (126,900) (6,345)	0	18,000 (67,300)
Pier 1 12	721 (219)	26 (7.9)	200 (500)	0	0	0	0	300 (800)	200 (500)

NOTE: RORO pieces based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

THROUGHPUT SUMMARY FOR PORT OF PUSAN PER DAY - cont

PORT/ BERTH	LENGTH feet (meters)	DEPTH ALONGSIDE feet (meters)	BREAKBULK THROUGHPUT STON (MTON)	RORO THROUGHPUT STON (MTON)	RORO SQUARE FT (EST)	RORO PIECES	CONTAINER THROUGHPUT STON (MTON) (TEU)	BARGE THROUGHPUT STON (MTON)	MIXED THROUGHPUT STON (MTON)
Pier 1 13	630 (192)	27 (8.2)	200 (500)	0	0	0	0	300 (800)	200 (500)
Pier 1 14-15	1,433 (437)	27 (8.2)	400 (1,000)	0	0	0	0	700 (1,700)	400 (1,100)
Pier 2 21-22	1,272 (388)	29 (8.8)	1,900 (4,700)	3,300 (13,300)	66,000	388	4,500 (11,200) (560)	700 (1,700)	3,000 (11,000)
Pier 2 24-25	1,374 (419)	29 (8.8)	1,900 (4,700)	6,600 (26,500)	132,000	776	4,500 (11,200) (560)	700 (1,700)	5,300 (20,500)
Central	2,118 (646)	29 (8.8)	3,700 (9,300)	10,000 (39,800)	200,000	1,176	6,700 (16,800) (840)	1,000 (2,500)	8,200 (31,300)
Pier 3 32-33	1,476 (450)	29 (8.8)	1,900 (4,700)	6,600 (26,500)	132,000	776	4,500 (11,200) (560)	700 (1,700)	5,300 (20,500)
Pier 3 35-37	1,541 (470)	29 (8.8)	1,900 (4,700)	6,600 (26,500)	132,000	776	9,700 (24,300) (1,210)	700 (1,700)	5,500 (20,900)
Pier 4 41-43	2,145 (654)	29 (8.8)	3,700 (9,200)	10,000 (39,800)	200,000	1,176	4,500 (11,200) (560)	700 (1,700)	8,100 (31,100)
Pier 4 45-46	1,318 (402)	29 (8.8)	1,900 (4,700)	6,600 (26,500)	132,000	776	4,500 (11,200) 560	700 (1,700)	5,300 (20,500)

NOTE: RORO pieces based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

THROUGHPUT SUMMARY FOR PORT OF PUSAN PER DAY - cont

PORT/ BERTH	LENGTH feet (meters)	DEPTH ALONGSIDE feet (meters)	BREAKBULK THROUGHPUT STON (MTON)	RORO THROUGHPUT STON (MTON)	RORO SQUARE FT (EST)	RORO PIECES	CONTAINER THROUGHPUT STON (MTON) (TEU)	BARGE THROUGHPUT STON (MTON)	MIXED THROUGHPUT STON (MTON)
Suyong Bay Yong Ho	688 (210)	32 (9.8)	1,100 (2,900)	3,300 (13,300)	66,000	388	0	700 (1,700)	2,700 (10,600)
Kamchun Y1-2	1,279 (390)	32 (9.8)	2,200 (5,500)	3,300 (13,300)	66,000	388	0	300 (800)	3,000 (11,100)
Kamchun J1-2	984 (300)	27 (8.2)	400 (1,000)	0	0	0	0	1,300 (3,300)	500 (1,300)

NOTE: RORO pieces based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

Piers 3 and 4

Pier 8

Shinsundae and Kamman

We base the type of ship preferred at each berth on the methodology described in the appendix. The evaluation is a snapshot view of the current physical characteristics of the berths and MHE available. The berths are rated according to rank. The lower the number for a berth, the better the berth is suited for the loading or offloading operation. For example, Pier 8 is ranked better than the Shinsundae or Jasungdae Container Terminals at conducting RORO operations. In general, no one berth is ideal for all military operations. The best berth depends on the type of ship loaded.

Because of the rail spurs on the apron, available transit shed, deep water draft, berth length, and open apron, Pier 8 is the choice for conducting RORO, breakbulk, and barge operations. Because the Port of Pusan has specialized in container operations, the container terminals (Jasungdae, Shinsundae, Uam, and Kamman) are the obvious choice for container operations.

LOADING TYPE	**BERTHS**					
	Jasungdae 61-67	**Jasungdae 68**	**Pier 7 (Uam) 73-74**	**Pier 7 (Uam) 75**	**Shinsundae**	**Kamman**
Breakbulk	11	18	13	15	4	4
RORO	4	14	5	14	2	2
Container	3	6	5	6	1	1
Barge	4	4	4	4	2	2
Note: Berths marked with a "-" are not recommended for these operations.						

LOADING TYPE	**BERTHS**					
	Pier 8	**Pier 1 12**	**Pier 1 13**	**Pier 1 14-15**	**Pier 2 21-22**	**Pier 2 24-25**
Breakbulk	1	14	17	12	6	6
RORO	1	18	19	17	10	10
Container	4	17	--	16	10	10
Barge	1	17	17	17	11	11
Note: Berths marked with a "-" are not recommended for these operations.						

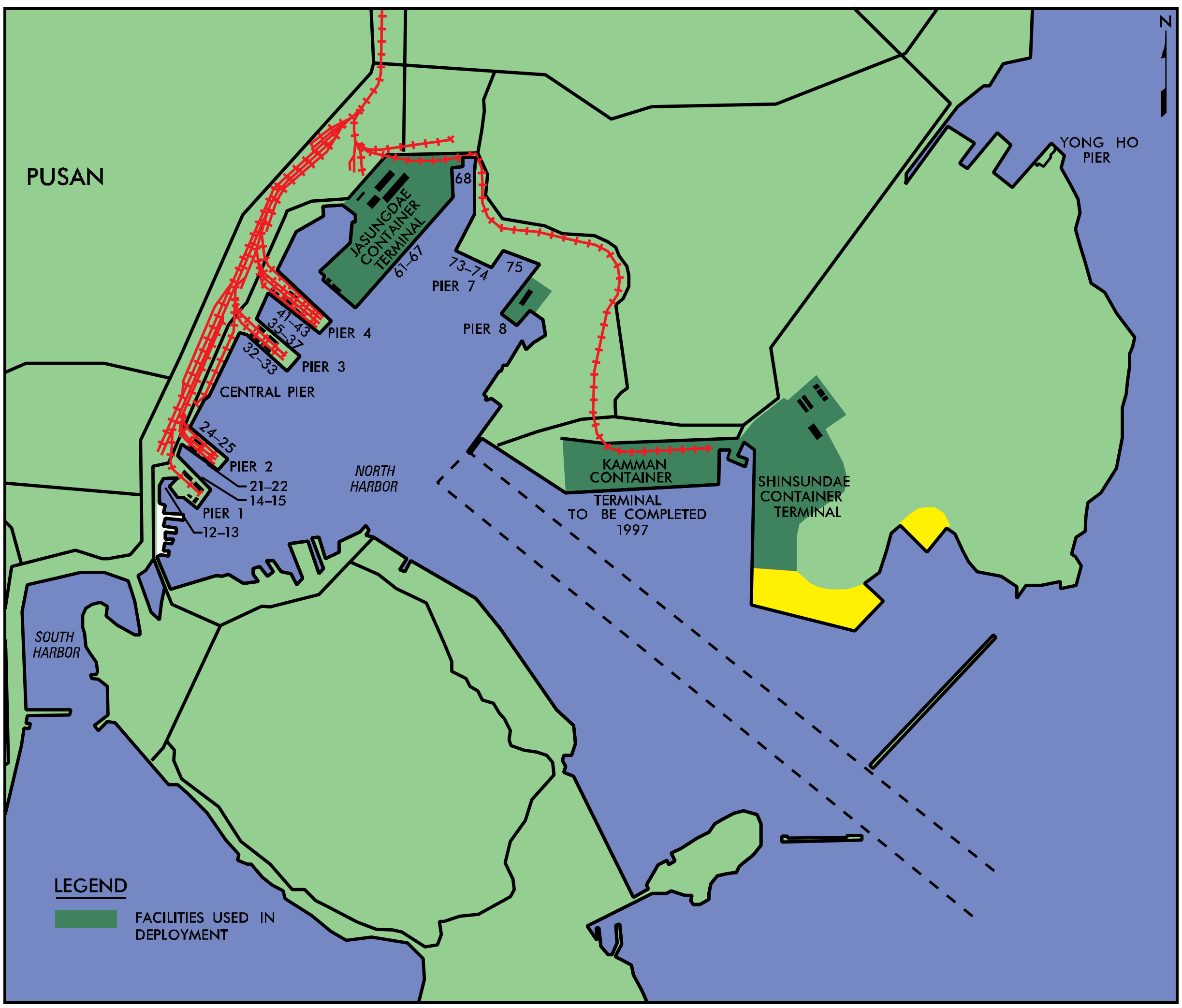
LOADING TYPE	**BERTHS**					
	Central	**Pier 3 32-33**	**Pier 3 35-37**	**Pier 4 41-43**	**Pier 4 45-46**	**Suyong Bay Yong Ho**
Breakbulk	15	8	8	2	2	20
RORO	7	12	16	9	7	18
Container	13	13	13	8	8	19
Barge	14	15	15	9	9	13
Note: Berths marked with a "-" are not recommended for these operations.						

LOADING TYPE	**BERTHS**	
	Kamchun Harbor Y1-2	**Kamchun Harbor J1-2**
Breakbulk	10	7
RORO	5	13
Container	12	17
Barge	8	8
Note: Berths marked with a "-" are not recommended for these operations		

III. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored division using primarily FSS vessels. Currently, facility use depends on decisions made by the Korean Ministry of Defense and MMAF. Because of the Korean commitment to defense of their country and considering current facility use of Pusan, we assume that 50 percent of the Jasungdae and Shinsundae Terminals would be available for military use in addition to Pier 8. Because the Kamman Container Terminal is presently under construction, we assume deploying units could use the unimproved storage area for additional marshaling if it is needed. We also assume that no other military units (US or Republic of Korea) will be competing for these facilities during the time that the armored division occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately offload the ship and clear the port.



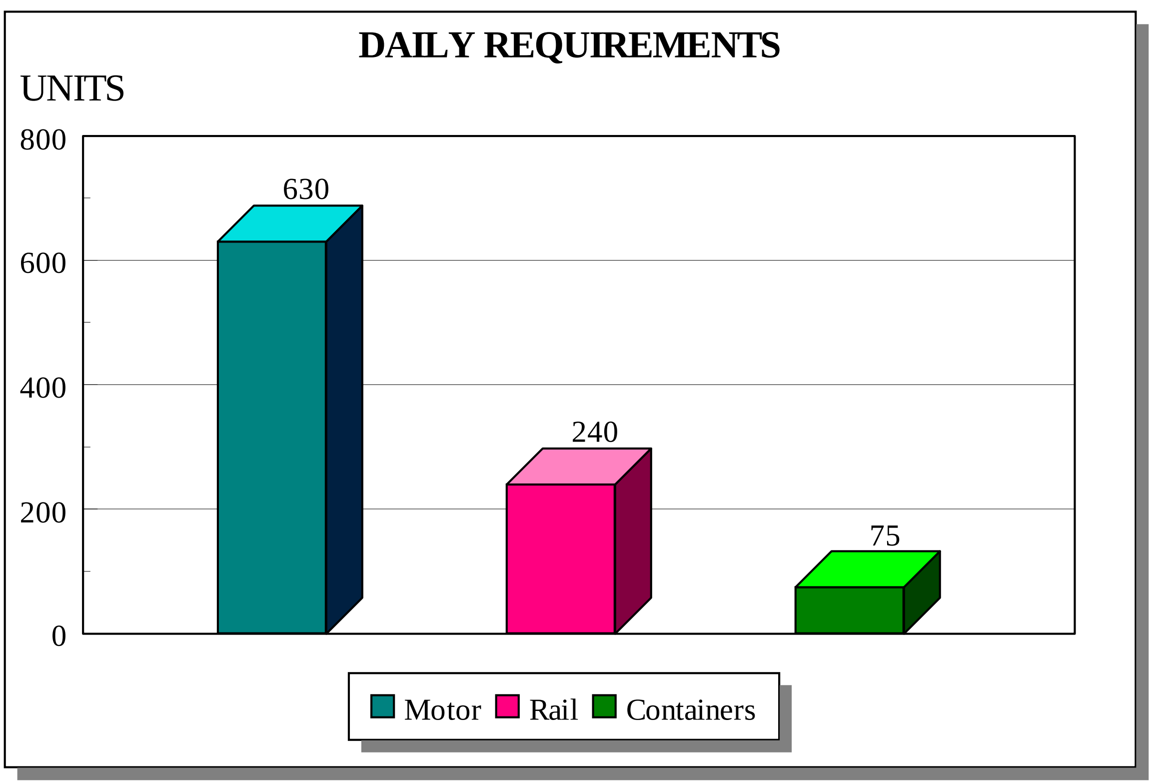
Potential Port Use During Deployment

REQUIREMENTS

The likely requirement for the Port of Pusan would be to deploy a notional armored division in 6 days of ship offloading and port clearance. The division has to move about 8,470 vehicles and 450 containers. Movement of the division from the port inland will require about 1,425 (240 per day) railcars using the convoy/rail option. Under this option, about 3,800 (630 per day) roadable vehicles would drive out the gates towing 2,500 (415 per day) trailers. About 75 containers would arrive daily.

ARMORED DIVISION

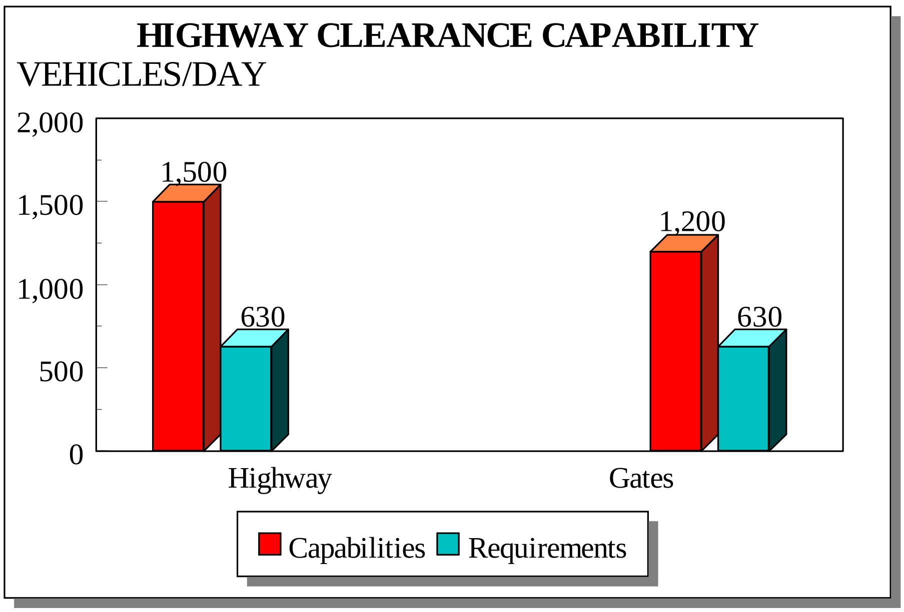
Total Equipment	
Volume	287,400 MTON
Weight	95,108 STON
Area	1,927,933 SQ FT
Vehicles	8,468
Containers	450



TERMINAL INPROCESSING/HANDLING

Highway

The major access roads to the port are the Chungjangno and Uamno. The Chungjangno is a 10-lane highway and the Uamno is a 6-lane highway. Chungjangno provides access to the Jasungdae Terminal and the Uamno provides the access to the Shinsundae, Kamman, and Pier 8 Terminals. Each terminal has its own access gate. The access roads and gate processing subsystems can handle more than 1,500 and 1,200 additional vehicles per day, respectively.

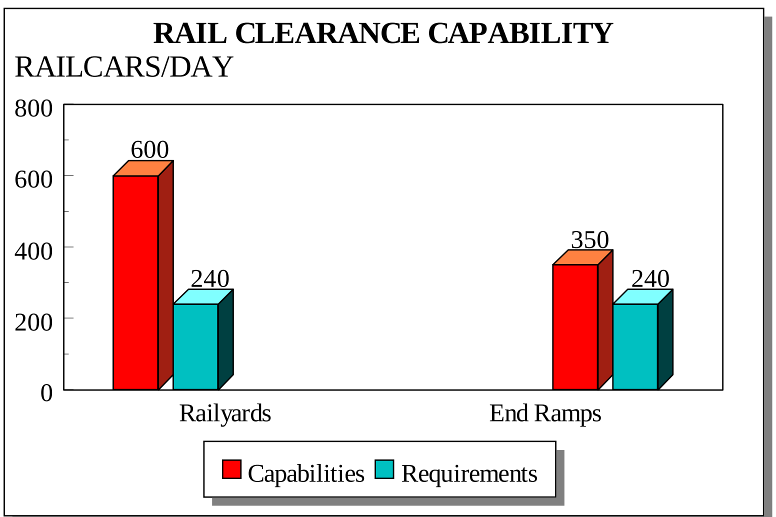


Gate at Pier 8, 1317th Medium Port Command

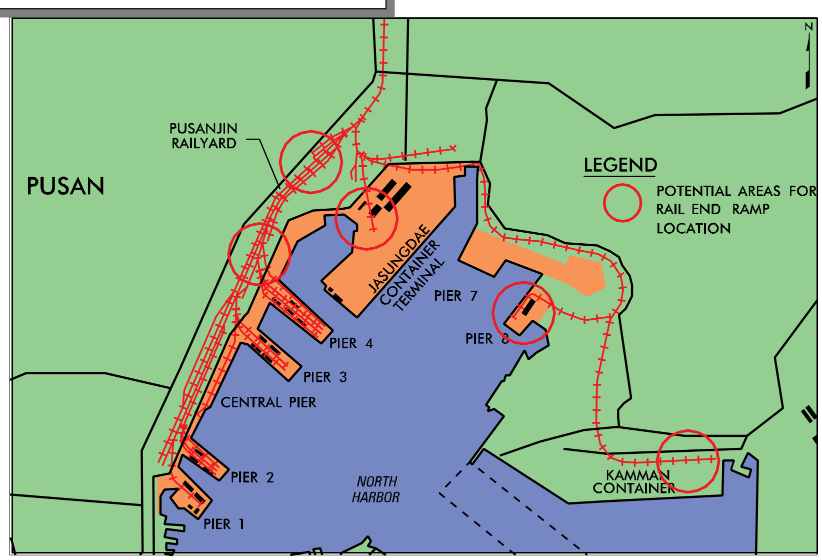
Rail

The Pusanjin railyard serves the Jasungdae, Shinsundae, Kamman, and Pier 8 Terminals. The Pusanjin railyard can store almost 800 railcars per day. Assuming an operational factor of 80 percent, this railyard could easily store 600 railcars per day. Current rail service to the Jasungdae and Shinsundae Container Terminals is two 80-railcar trains per day. These trains travel during the night to avoid causing rail traffic problems with passenger trains.

Pier 8 has 15 portable steel end ramps available for loading/offloading railcars. Several areas within the port can serve as a facility for end ramp operations. Ramp operations will likely occur at Pier 8, Jasungdae Container Terminal, and Shinsundae/Kamman Container Terminals. We assume two end ramps will be placed at Pier 8, one will be used at the Jasungdae Container Terminal, and one will be used in the Shinsundae/Kamman Container Terminal areas. These end ramps could load 88 railcars every 5 hours or about 350 railcars per day (including switching time). If needed, the Pusanjin railyard is another option for end ramp operations. Ramp operations at the Pusanjin railyard could increase the outloading capability from 350 railcars to almost 450 railcars per day.



End Ramp Loading Areas

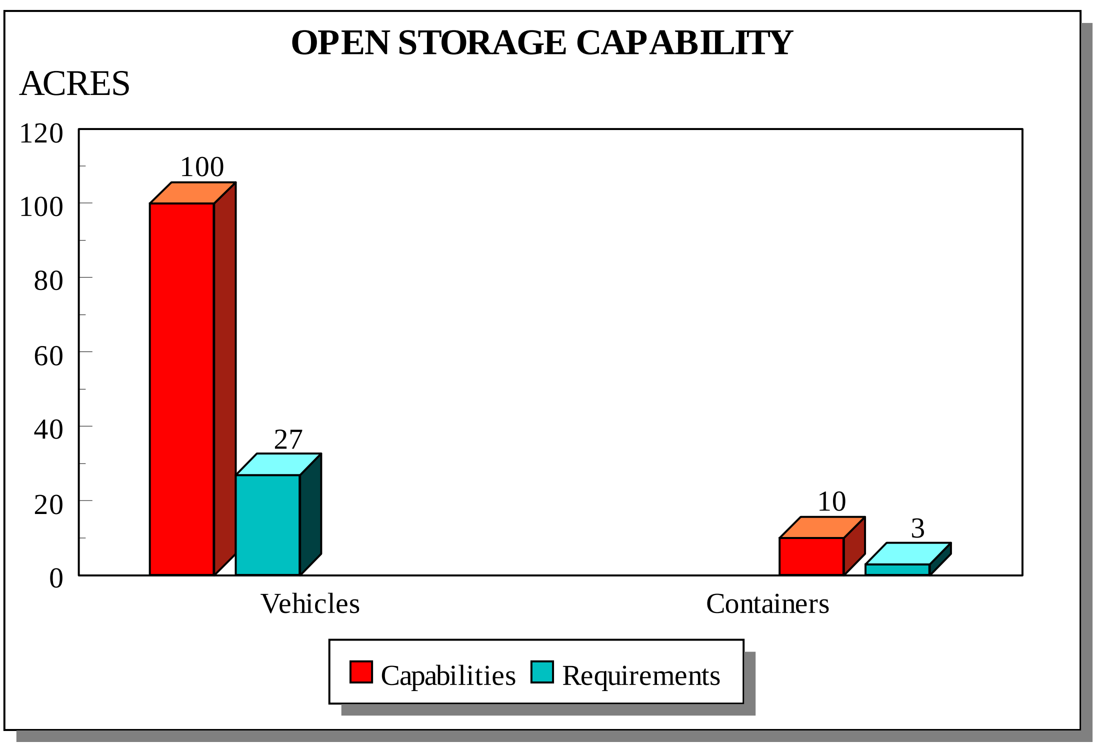


OPEN STORAGE

Using the MTMCTEA Deployment Planning Guide (MTMCTEA Reference 94-700-5), this analysis assumes that a little over nine FSS-ships will deploy a notional Armored Division. This division must deploy through the port in 6 days. Because of this, the storage requirement is to support three sustained offloading operations.

Although an FSS load of cargo can be offloaded on as little as 8 acres of hardstand marshaling, we determined 10 acres (40, 510 square meter) are required for sustained offloading operations. The 10-acre per FSS requirement depends on port clearing capabilities and the availability of off-port marshaling areas. The highway and rail portions of this application show that port clearance should not be a problem. Off-port marshaling areas should be available in several nearby areas including the Pusan Storage Facility, K-9 Airfield, and the undeveloped storage area at Kamman Container Terminal. Of the 10 acres, less than 1 acre is required for marshaling 50 containers per FSS. About 30 acres are required to support the simultaneous offloading of three FSS ships. Using 50 percent of the available area at Jasungdae and Shinsundae Container Terminals and all of Pier 8, the Port of Pusan would have over 110 acres of open storage for three FSS ships offloading simultaneously. This should be enough to handle hardstand marshaling requirements. Although Pier 8, to include the adjoining ROK Army Port Operations Group (POG) facility, has just a little over 6 acres of hardstand marshaling combined, a nearby unimproved overflow field (8 acres) can adequately supplement the Pier 8 hardstand marshaling.

Using 50 percent of the Jasungdae and Shinsundae facilities and all of Pier 8, the Port of Pusan has about 237,900 square feet (22,100 square meters) of available covered storage.



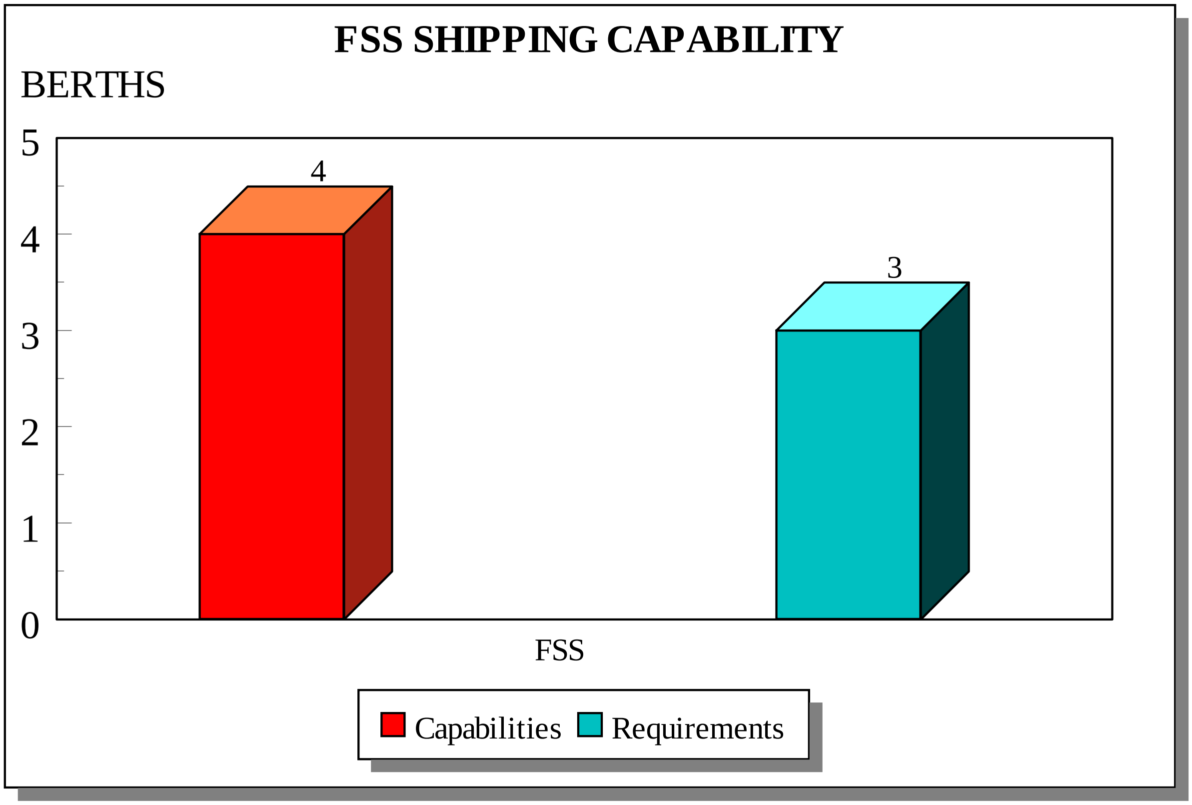
SHIPPING

Although this analysis assumes that only FSS-sized ships can deploy a notional Armored Division, the table below provides ship quantities needed to move this division using minimum containerization. The number of ships required depends on the shipping mix selected. The best ship mix would consist of eight FSS and two LMSR or seven LMSR.

Using 50 percent of the Jasungdae and Shinsundae Container Terminals and all of Pier 8, the port could easily berth four FSS vessels at one time.

UNIT MOVEMENT REQUIREMENTS
ARMORED DIVISION

Loading Condition/ Sample Ship Mix	FSS (RORO/ Comb)	LMSR (RORO/ Comb)	Notional RORO (RORO/ Comb)	C3/C4 (Breakbulk or Container)	C6/C7/C8 (Container)
Minimum Containerization					
All FSS	8.0	1.3			
All LMSR		6.2			
Notional RORO			12.3		
All Breakbulk				31.3	
Maximum Containerization					
FSS/Container	4.0				4.7
LMSR/Container		2.5			4.7
RORO/Container			4.9		4.7
Breakbulk/Container				12.5	4.7
Legend: RORO - roll on/roll off FSS - fast sealift ship Source: MTMCTEA Reference 94-700-5, Deployment Planning Guide, Sep 94					



SUMMARY

The Port of Pusan can offload and clear a notional Armored Division within 6 days.

RECOMMENDATION

The Port of Pusan is a viable port for supporting deployment of a notional Armored Division provided 50 percent of the Jasungdae and Shinsundae Container Terminals are available for US military deployments. Efforts should be made to coordinate with the Korean Ministry of Defense and Port of Pusan MMAF to arrange for use of these facilities during a contingency.

July 96

PORT OF PYONGTAEK

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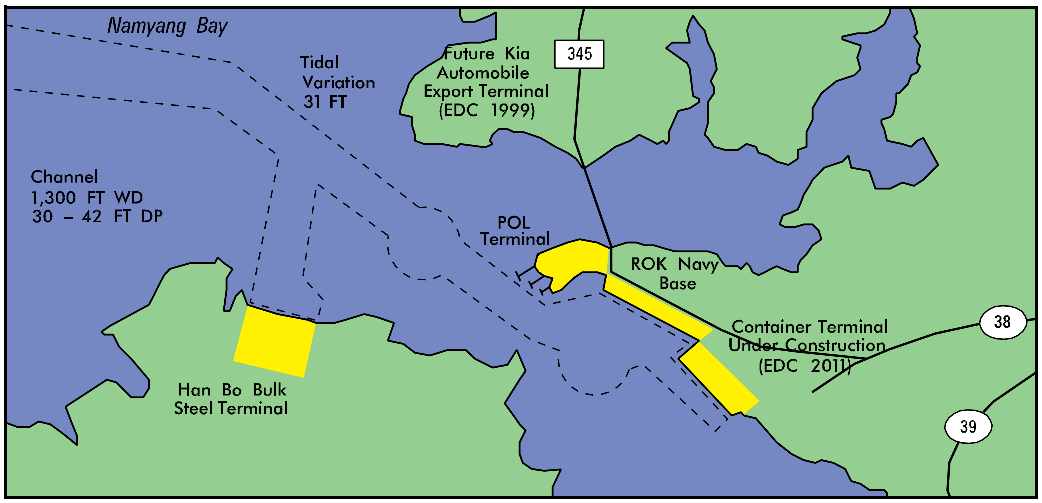
LOCATION

The Port of Pyongtaek is at 37° 01' 55" north latitude and 126° 44' 44" east longitude on the west coast of Korea, 30 miles (48 kilometers) south of Seoul. The channel entering the Port of Pyongtaek from the Yellow Sea and the Namyang Bay is about 19 miles long (30 kilometers), and about 1,300 feet wide (400 meters) at its narrowest spot. Depths along the channel range from 36 to 42 feet mean low water (MLW) (11 to 13 meters).

Tidal variation is about 31 feet. This will restrict RORO operations to only a few hours each day.



Current Facilities at Port of Pyongtaek

DESCRIPTION

The Port of Pyongtaek has several terminals, none of which are currently usable for military operations. The main terminal of the port has three dolphin piers to discharge liquid natural gas (LNG) ultra large crude carriers (ULCC) up to 64,000 dead weight tons (DWT) (about 36 feet draft) directly into a refinery.

Outboard End of the LNG Pier

This terminal is the major gateway into the country for foreign fuel, especially for consumption in the Seoul metropolitan area. Small coastal ships take on fuel at this terminal to distribute to other ports around Korea. The terminal also provides bunker B and C fuel to the nearby electric plant, and liquid petroleum gas (LPG) fuel.

Another terminal, southwest of the petroleum, oil, and lubricants (POL) terminal handles bulk materials directly into the Han Bo steel plant. The water depth is 41 feet at MLW.

None of the terminals have rail access. There are no plans for rail development. When necessary, rail operations are conducted at the Pyongtaek Rail Station about 25 miles away (40 km).

Port access roads are Routes 345 and 38.

FUTURE DEVELOPMENT

The new West Coast Expressway is under construction. This will improve highway access to the port from the north and south. From Inchon to Pyongtaek will be done by the end of 1997. From Inchon to Mokpo will be completed by 2004.

The ROK Navy base just south of the POL terminal is operational, but will not be complete before 1998.

The southward expansion has already begun. By 2011, the new container terminal will be about 13,000 feet long (4,000 meters), and 1,900 feet wide (400 meters). Assuming shipping companies continue to bring business to the Port of Pyongtaek, and the port provides three container cranes for every 1,000 feet of apron, the terminal container capability will be about 120,000 STON (110,000 metric tons, or 16,000 TEU) per day. If the entire 13,000-foot terminal is used to support RORO vessels, the terminal will provide 31,000 STON (28,000 metric tons) per day throughput. The port will add container cranes as business increases. The first crane might be installed in 1998.

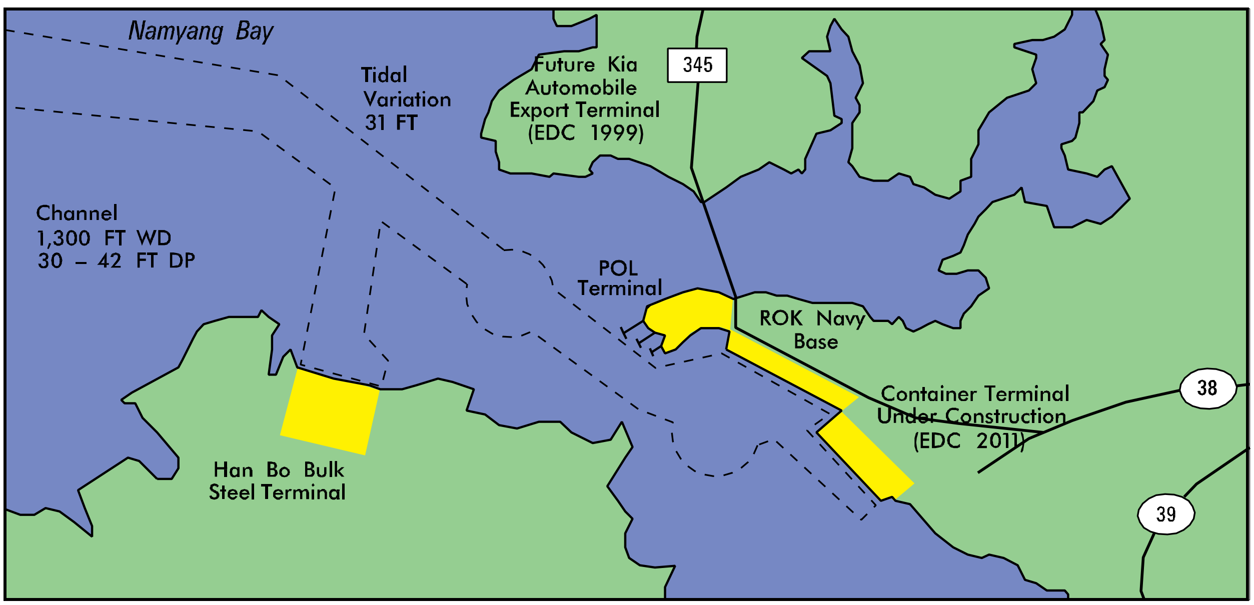
In mid-1997, at least one berth of the southward expansion will be operational with 36 feet deep water. We expect this 1,000-foot berth will be capable of LMSR and FSS operations. Throughput of this berth will likely be 2,400 STON (2,200 metric tons) per day, using RORO vessels.

Construction of Southward Container Terminal

The port plans to develop a POV handling terminal to the north of the POL terminal. The nearby Kia Motor Company expects to export cars from this future site. The terminal is expected to be about 1,640 feet long (500 m) and 36 feet deep at MLW (11 m), with a deck strength of 409 psf (two metric tons per square meter). This facility will handle two 50,000 DWT vessels simultaneously, and might support military operations. Construction of this POV terminal might begin in 1997 after the permit paperwork is complete. It will not be operational until 2000.

Adjacent to this marginal wharf, the Ministry of Maritime Affairs and Fisheries (MMAF) expects to develop an additional light duty dolphin pier for POV loading. It will not likely be strong enough for military vehicles.

The southward expansion will eventually include three slips for general cargo operations. These slips, with locks at the entrance, are not likely to be available until 2020.



Future Terminals at the Port of Pyongtaek

July 96

PORT OF SAMCHOK

I. General Data
II. Throughput Analysis
III. Application
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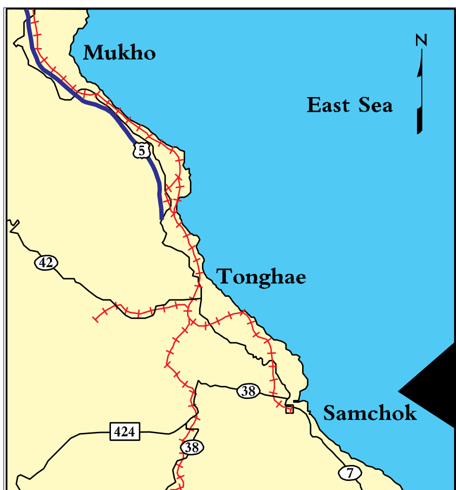
I. GENERAL DATA

TRANSPORTATION ACCESS

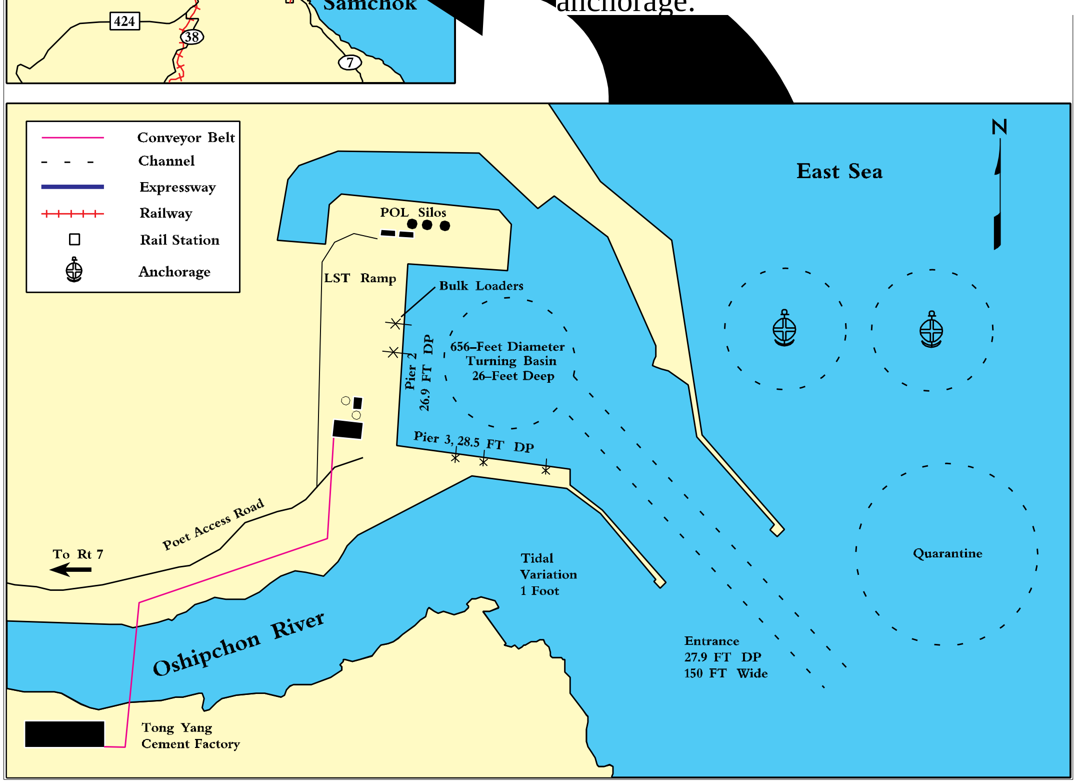
Water

The Port of Samchok is primarily a bulk cement port, owned by the nearby Tong Yang Cement Company (TYCC). It is on the northeast side of Korea on the East Sea, 88 miles north of Pohang, and 9 miles south of Mukho. The port is at 37^{o} 26' 17" north latitude and 129^{o} 31' 41" east longitude.



The ship channel has no overhead restrictions entering the port. However, the channel depth is only 27.9 feet (8.5 meters) deep at mean low water (MLW) and 150 feet (45.7 meters) wide. Large ships must turn outside the breakwaters of the port since the inner harbor turning basin has a diameter of only 656 feet. Tidal variation is about 1-foot.

Pilotage and tugs are required for berthing and undocking of foreign ships. Two pilots from the nearby port of Tonghae meet ships at the quarantine anchorage.



Water Access to Port of Samchok

Highway

Direct access to the port is via the Port Access Road. This road is only two lanes wide but has no height or weight restrictions.

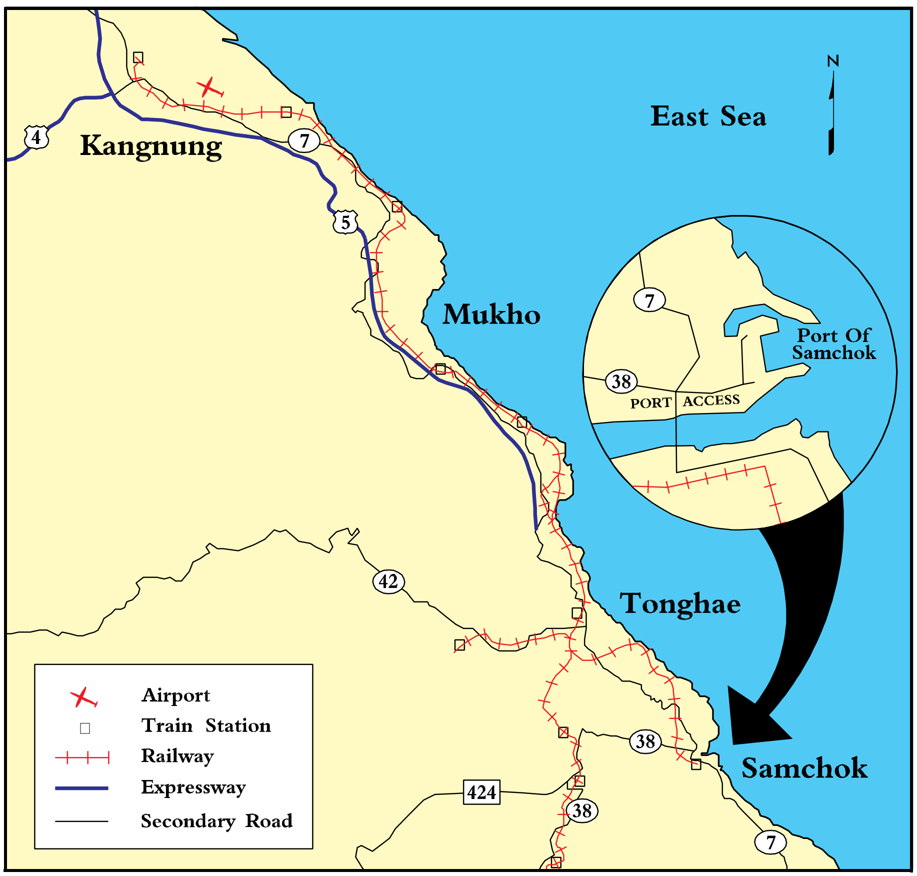
The Port Access Road connects to Route 7, which is the north-south highway and is four lanes wide. Route 7 connects with Expressway 5 to the north and Routes 42 and 424 provide access to the west.

Air

The nearest airport is in Kangnung, about 35 miles from the Port of Samchok. It has two runways 9,000 feet long. One runway is 150 feet wide and routinely handles the A300 passenger jets to Seoul and Pusan. The other runway is 98 feet wide, C-5 capable, and is used by the adjacent ROK airbase.

Rail

All railroad tracks within Korea are owned and operated by the Korean National Railroads. The rail lines at the Port of Samchok once supported a coal-burning power plant, which is now abandoned. The tracks no longer connect to the rail network. The nearby railyard (1/2 mile south) is configured for bulk cement operations only.



Highway and Air Access to Port of Samchok

PORT FACILITIES

Berthing

The slip at the north end of the port supports small fishing vessels. Pier 1 is shallow and often supports tug boats or fishing vessels waiting to enter the slip. Piers 2 and 3 are well lighted but have conveyors and bulk loaders along most or all of their lengths. The TYCC is connected to the port by a 1/2 mile-long conveyor line crossing the Oshipchon River.

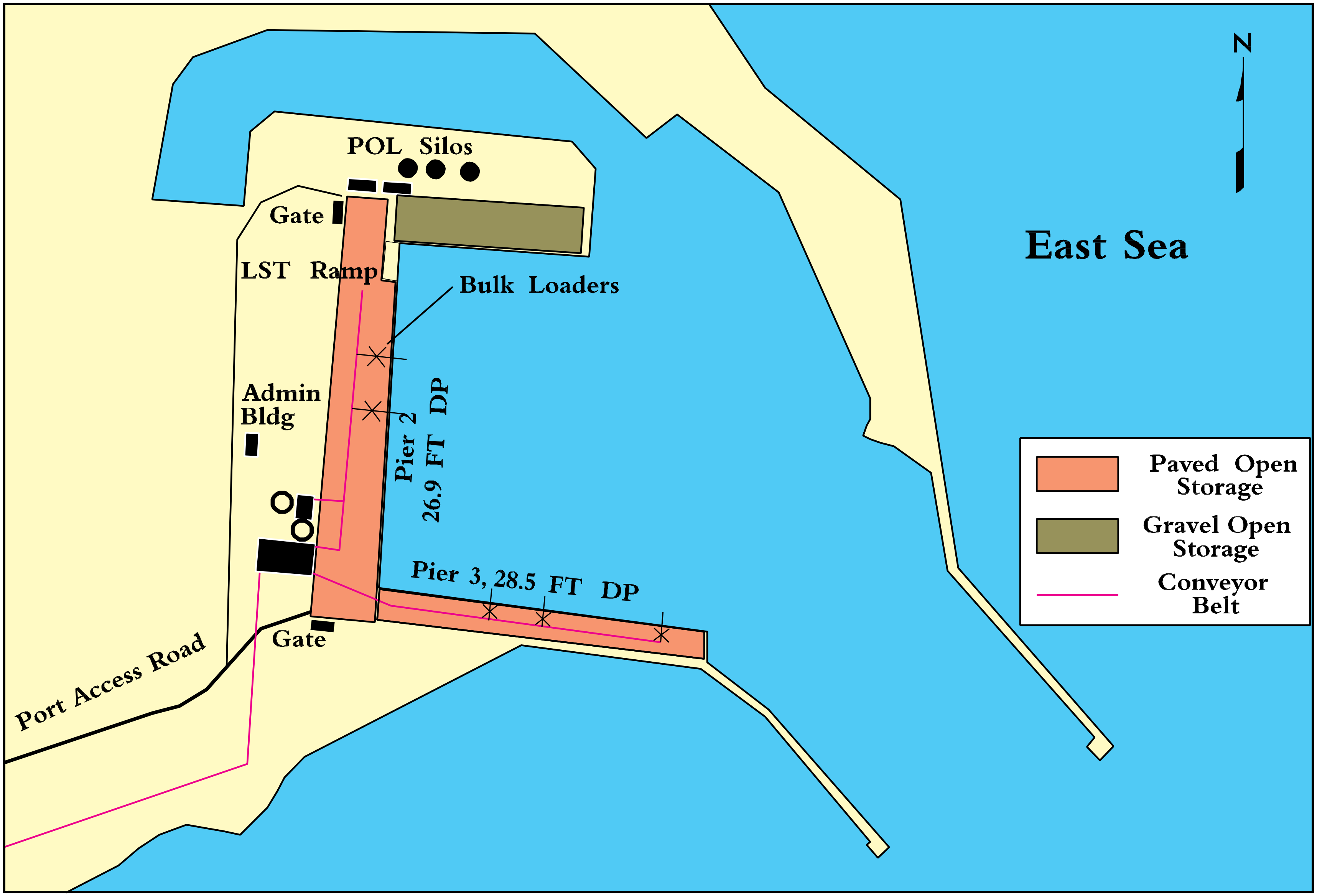
An unusual facility at the port is the 98-foot-wide LST ramp at the north end of Pier 2. It has never supported military operations.

Each of the two wharves in this report (Piers 2 and 3) is about 28 feet deep (8.5 meters) and 900 feet long (274 meters). The aprons are both 8.2 feet (2.5 m) above MLW.

LST-Capable Ramps at Port of Samchok

BERTHING CHARACTERISTICS OF THE PORT OF SAMCHOK

Characteristics	**Berths**	
	Pier 2	**Pier 3**
Length, ft (m)	912 (278)	905 (275)
Depth alongside at MLW, ft (m)	27 (8.2)	29 (8.8)
Deck strength, psf (met. tons/sq m)	372 (2)	372 (2)
Apron width, ft (m) (useful)	50 (15.2)	30 (9.1)
Apron height above MLW, ft (m)	8 (2.4)	8 (2.4)
Number of container cranes	0	0
Number of wharf cranes	0	0
Apron lighting	Yes	Yes
Straight-stern RORO facilities	Yes	Yes
Apron length served by rail, ft (m)	0	0



Land-Use Map for Port of Samchok

SUMMARY OF BERTHING CAPABILITIES FOR SAMCHOK		
VESSEL	BERTHS	
	Pier 2	Pier 3
Breakbulk		
C3-S-38a	a,g	g
C4-S-58a	a,g	a,g
C4-S-66a	a,g	a,g
C5-S-37e	a,g	a,g
Seatrain		
GA and PR-class	a	1
Barge		
LASH C8-S-81b	a,f,g	a,f,g
LASH C9-S-81d	a,g	a,g
LASH lighter	4	4
SEABEE C8-S-82a	a,g	a,g
SEABEE barge	4	4
RORO		
Comet	a,i,j	i,j
Meteor	a,g,i,j	a,g,i,j
Cape Gnome	a,g,i,j	a,g,i,j
C7-S-95a	a,b,g	a,b,g
Cape Taylor	a,b,g	b,g
Cape Orlando	a,b,g	a,b,g
MV Ambassador	k,m	k,m
Callaghan	a	1
Cape Lambert	a,b,g	a,b,g
FSS-Class	a,b,c,g	a,b,c,g
Cape E-class	a,b,g	a,b,g
Cape D-class	a,b,g	a,b,g
Cape H-class	a,b,g	a,b,g
Cape R-class	a,g	a,b,g
Cape Texas	a,b,g	b,g
Container		
C6-M-147a	b,e	b,e
C7-S-69c	a,b,e,g	a,b,e,g
C7-S-68c	a,b,e,g	a,b,e,g
C8-S-85c	a,b,e,g	a,b,e,g
C9-M-132b	a,b,e,g	a,b,e,g
C9-M-F141a	a,b,c,e,g	a,b,c,e,g
Combination		
C6-S-1qd	a,b,g	a,b,g
C5-S-MA73c	a,b,g	a,b,g
C6-S-MA60d	a,b,g	a,b,g
Landing Craft		
LSV	3	3
LCU-2000	4	4

SUMMARY OF BERTHING CAPABILITIES FOR SAMCHOCK (Cont)		
VESSEL	**BERTHS**	
	Pier 2	**Pier 3**
Maritime Preposition Ships		
C7-M-PVT028 MPS AMSEA	a,g	a,g
C7-S-133a MPS Waterman	a,g	a,g
C8-M-PVT119 MPS Maersk	a,g	a,g

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities
e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide
j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst.

Open Storage

The port has only 2 acres of paved open storage. Most of the open area is obstructed by stanchions for overhead cement conveyor belts.

Conveyor Belts at Port of Samchok

Covered Storage

There are no warehouses or transit sheds at the port.

HIGHWAY

The Port of Samchock has two gates. The small vehicle gate to the north is the only gate with a guard shack. Since the port is a privately owned facility for bulk cement, guards are rarely at either gate. The concrete roads leading to the gates are only 20 feet wide. A stalled vehicle could easily block access, if not pushed to one side.

Although the port has conveyor systems, there are no overhead restrictions that would restrict cargo on trucks or trailers. All paved areas in the port are concrete and capable of withstanding heavy vehicular traffic. There are no height or weight restrictions leading out of the port to the main networks. The port has no truck scales.

South Gate to Port of Samchok

UNLOADING/LOADING POSITIONS

The port has no ramps or docks for truck operations. The military should build or bring ramps for offloading trucks and trailers that do not have integral ramps.

OFFSITE STORAGE AREAS

All of the open storage areas within the port are necessary to support marshaling of commercial and/or military cargo. There is no additional room for vehicles to marshal within the port. The city of Samchok is highly developed and very mountainous. Military vehicles would have to marshal on undeveloped land outside of the city.

MATERIALS HANDLING EQUIPMENT (MHE)

Several mobile cranes are available from stevedoring companies in Tonghae. There is no other MHE in the Samchok area.

Mobile Cranes Owned by Local Stevedoring Companies

CAPACITY (LTON)	CAPACITY (STON)	QUANTITY
90	99	4
70	77	2
50	55	2
30	33	3

AMMUNITION HANDLING

The Port of Samchok has no experience in handling ammunition. Although the area is highly populated, ammunition handling is possible with permission from the Ministry of Maritime Affairs and Fisheries (MMAF).

PETROLEUM, OIL, AND LUBRICATION (POL)

A small POL bunker facility is at the outer end of Pier 1, for bunker C and diesel fuels. This facility supports only small fishing vessels and the nearby cement factory.

FUTURE DEVELOPMENT

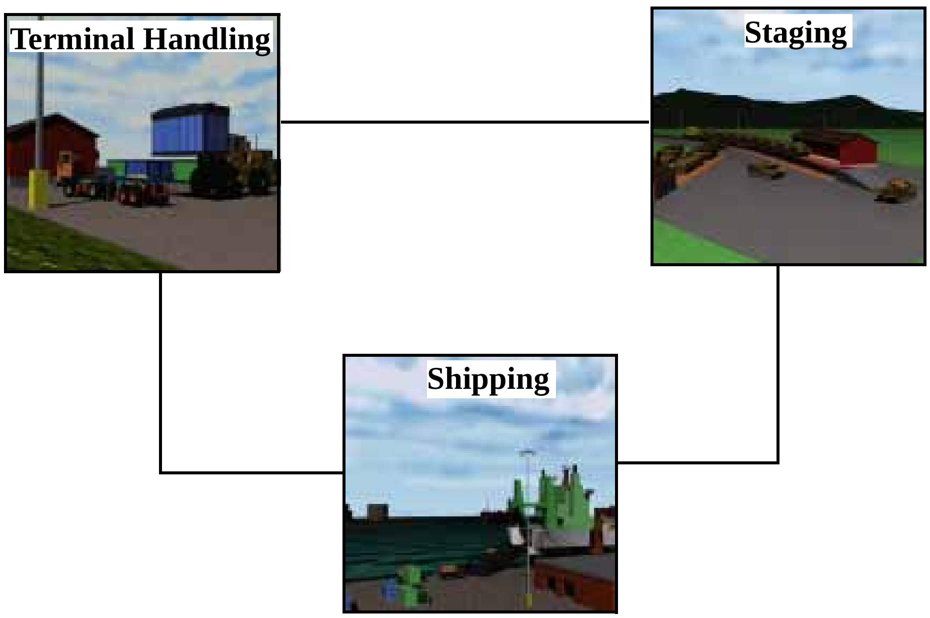
The residential land just south of the open area of Pier 2 is jointly owned by the MMAF and the TYCC. Although this area is expected to be cleared within 3 years, it will likely support additional silos and conveyor equipment. At best, about half an acre would be added for paved open storage.

The city plans to improve the highway access to the port with a new expressway along the coast. This expressway will improve access to and from the north; however, completion is not expected for another 10 years.

II. THROUGHPUT ANALYSIS

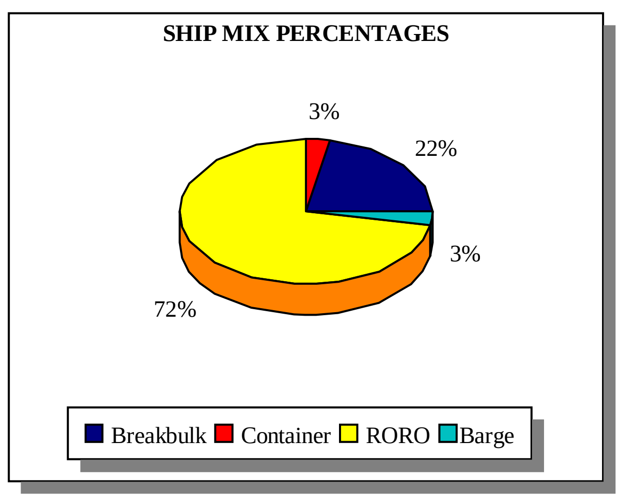
GENERAL

This section evaluates the throughput capability of the Ports of Samchok using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, hardstand marshaling, and terminal processing/handling - in short tons (STON) per day.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 80 percent of the port facilities will support military deployments. Also, due to the size of the port, we assumed a berth utilization factor of 80 percent. The ship mix is determined by Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



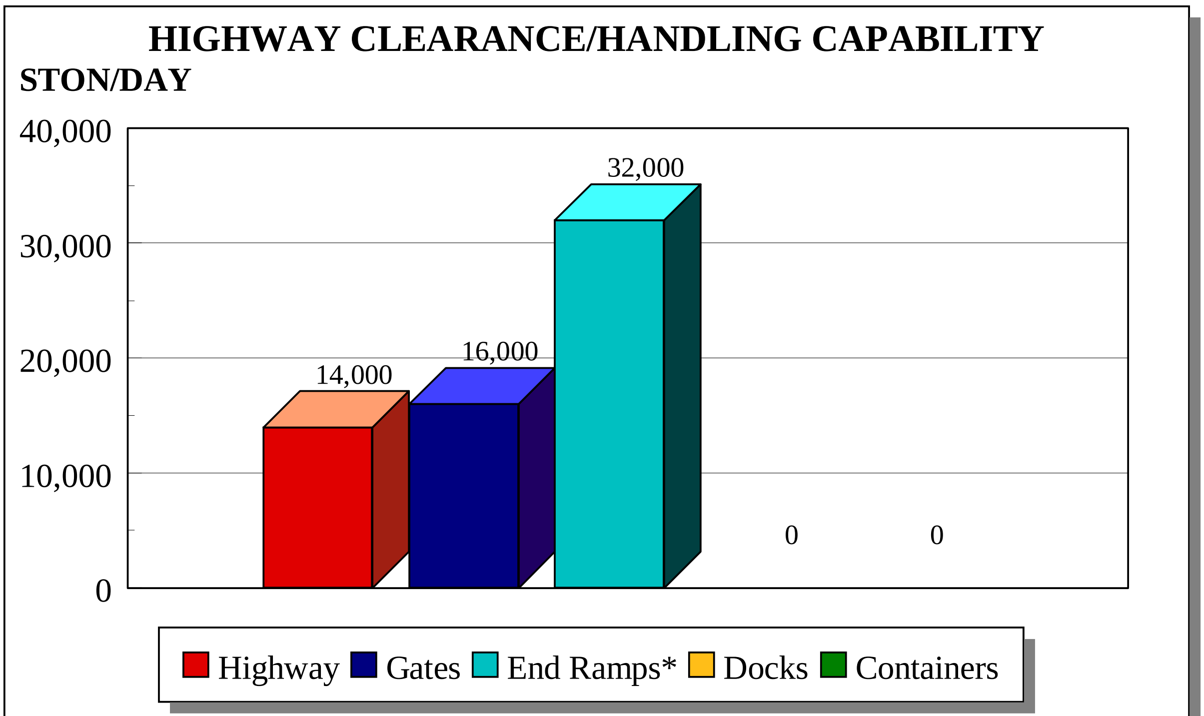
RECEPTION/HANDLING

Highway

The most restrictive link in highway access to or from the port is the port access road, leading to the gates of the port. This road is very narrow, and can be blocked by disabled vehicles. The road network in and out of the terminals, including the gate processing of vehicles, could handle about 14,000 STON (52,000 MTON) of equipment and supplies per day.

Roadable vehicles will process directly to the open storage areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at permanent and portable end ramps.

There are no truck docks or container handlers at the port.



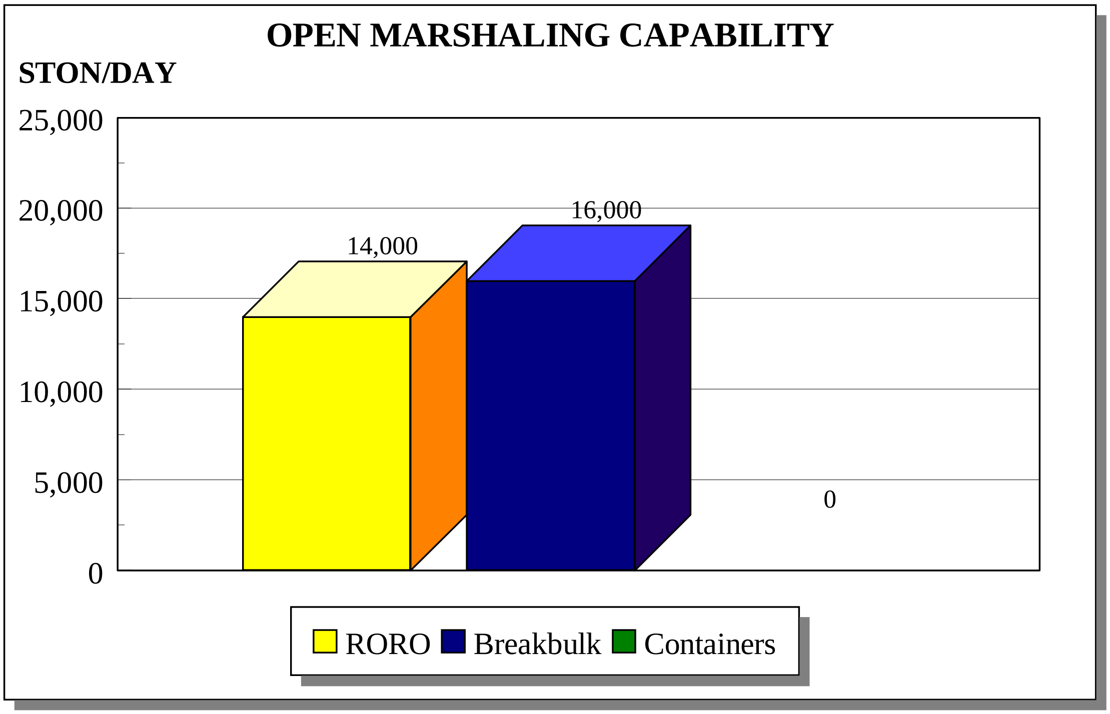
*Two portable or temporary ramps are assumed available.

Rail

The port has no rail reception capability.

HARDSTAND MARSHALING

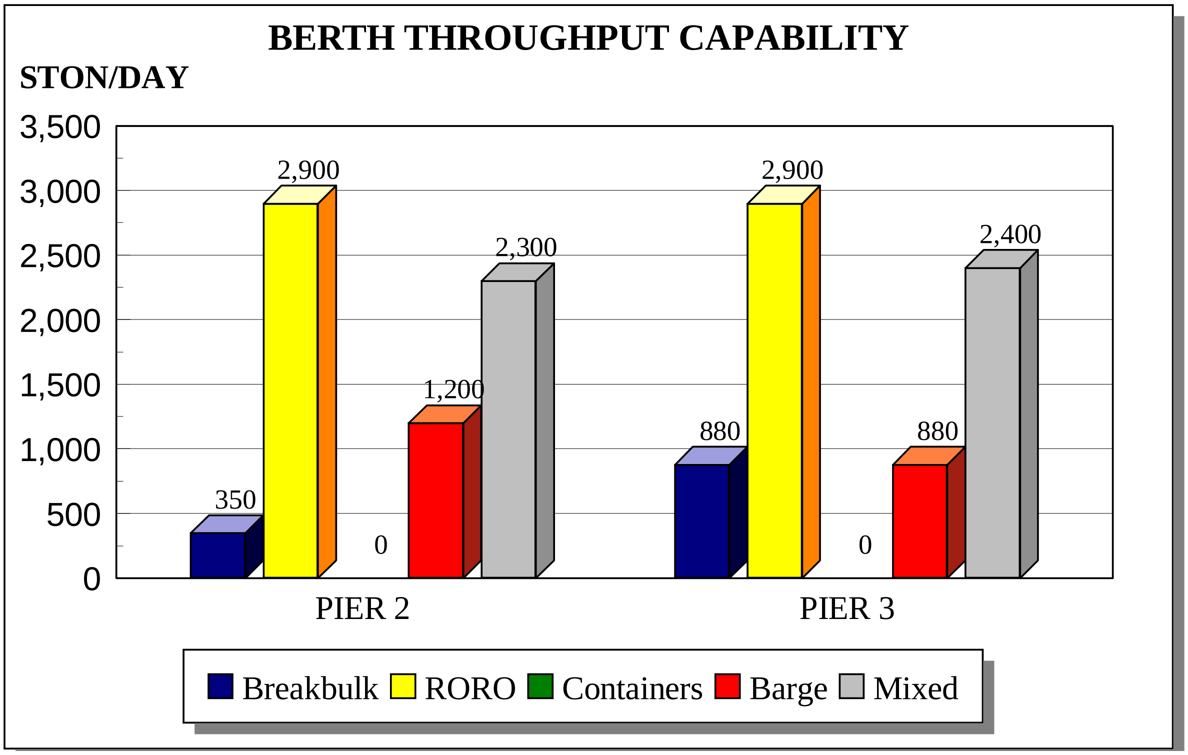
The port has about 2 acres (8,090 square meters) of paved open marshaling. There is no covered storage.



Open Area at South End of Pier 2
(northward view)

SHIPPING

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility. Although these values provide the shipping rates, few ships can be loaded to their maximum draft. The water depth at the berths is relatively shallow.



CONVERSION FACTORS	
Breakbulk or Barge	0.4 STON per MTON
RORO	.25 STON per MTON

THROUGHPUT SUMMARY FOR PORT OF SAMCHOK PER DAY

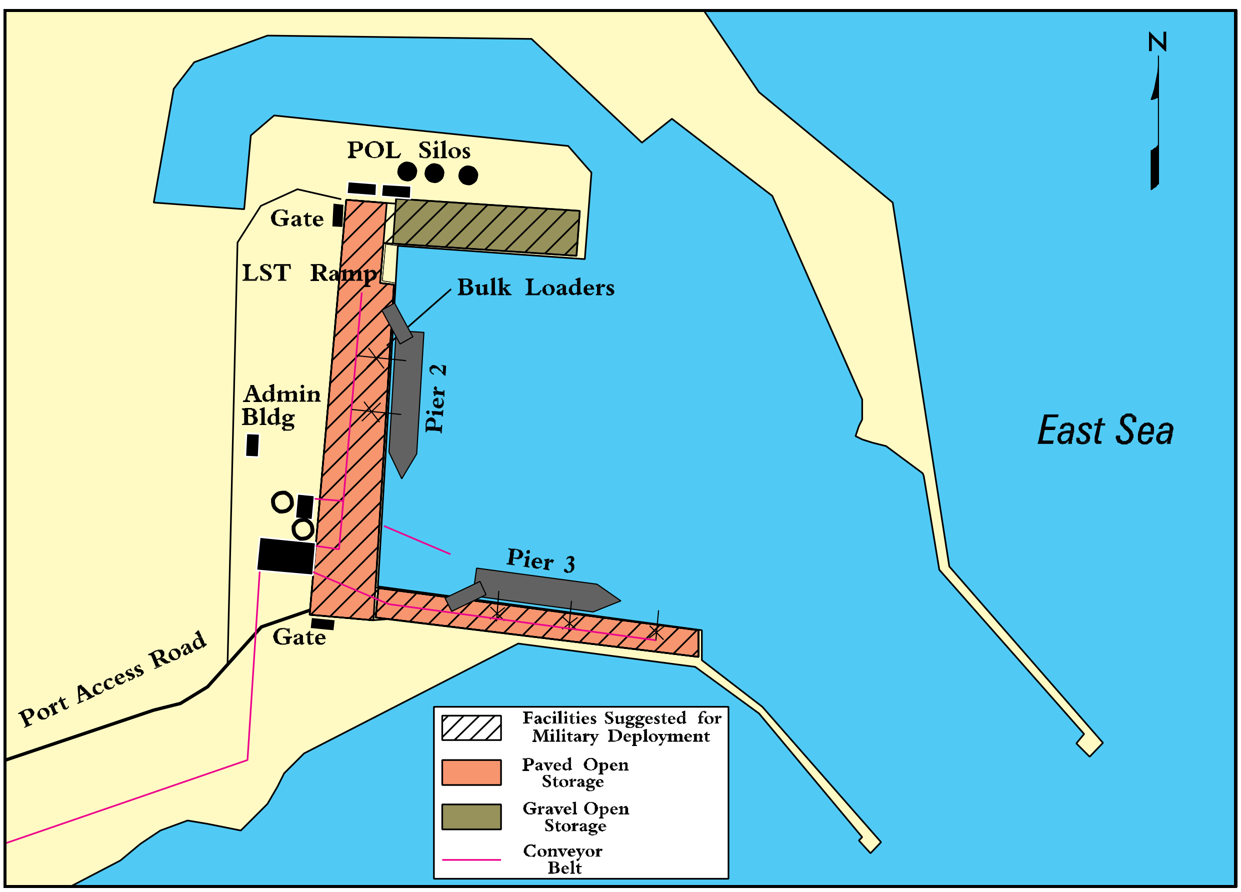
BERTH	LENGTH (feet) (meters)	DEPTH (feet) (meter)	BB (STON) (MTON)	RORO (STON) (MTON)	RORO SQ FT (EST)	RORO PIECES	CNTNR (STON) (MTON) (TEU)	BARGE (STON) (MTON)	MIXED (STON) (MTON)
Pier 2	912 278	27 8.2	350 880	2,900 12,000	58,000	340	0	1,100 2,900	2,300 9,000
Pier 3	905 275	29 8.8	880 2,200	2,900 12,000	58,000	340	0	880 2,200	2,400 9,300
Note: RORO pieces based on the 170 square foot per piece accomplished during Desert Shield/Storm.									

Of the two berths that are militarily useful at the port, Pier 2 is preferred for all operations. This is because of the wider apron, and access from both sides. Because of the shallow water and very small marshaling area, FSS and LMSR operations are not recommended at this port.

III. APPLICATION

This section evaluates the port's throughput capability for deploying a notional armored brigade. Because of the shallow drafts at the Port of Samchok (27 to 29 feet MLW), this study evaluates the deployment using vessels of the 2nd LT John P. Bobo (MPS-AMSEA) class, such as the 1st LT Daldomero Lopez. Although these vessels have a maximum draft of 32 feet, 1 inch, (9.8 meters) we assume the vessels will arrive with shallow enough draft to berth. Accomplishing this may require additional vessels. The vessels have a lightship draft of only 14 feet, 4 inches (4.4 meters).

Currently, the facility use depends on decisions made by the Korean Ministry of Defense and MMAF. Because of the Korean commitment to the defense of their country, and considering current facility use of the port, we assume all of the port will be made available for military use. We also assume that no other military units (US or Republic of Korea) will be competing for port assets, both transporters and people, will be available to adequately offload the ship and clear the port.



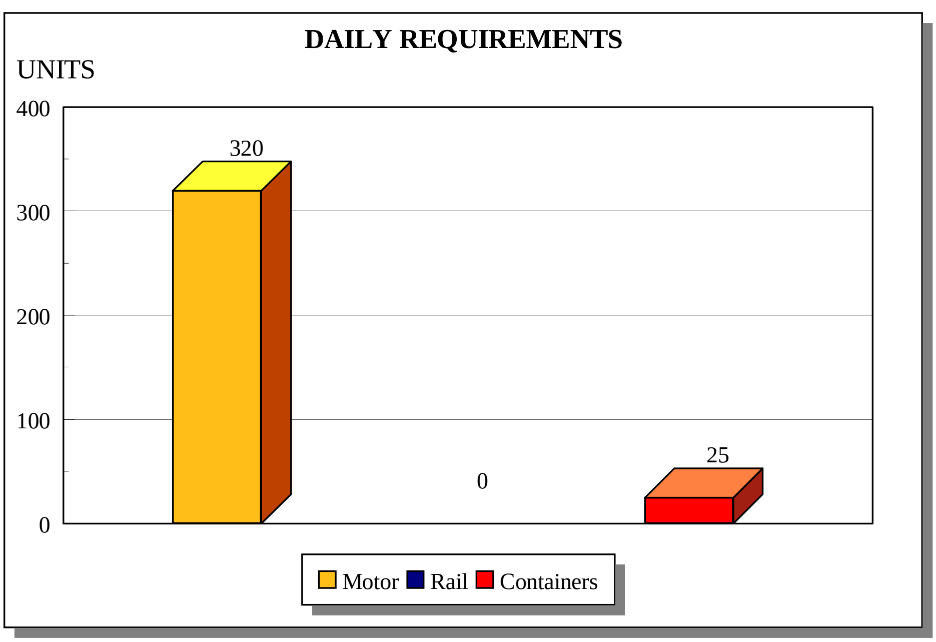
Potential Port Use During Deployment

REQUIREMENTS

The likely requirement for the Port of Samchok would be to deploy a notional armored brigade to support the overflow of deployment operations at larger ports. We assume the port must deploy the brigade in only six days of offloading and port clearance. The brigade has to move about 2,820 vehicles and 150 containers. As described earlier in this analysis, there is no direct access by rail to the Port of Samchok. The nearby rail station is only configured for bulk cement operations. Because of this, all deployment inland of the port is by highway. Using an OCONUS motor/convoy option, about 1,260 (210 per day) roadable vehicles would drive out the gates towing 820 (140 per day) trailers. Also, about 230 forty-foot flatbeds (40 per day) and 410 Heavy Equipment Transporters (HET) (70 per day) would transport non-roadable equipment. About 25 containers would arrive daily.

ARMORED BRIGADE

Total Equipment		Required Daily Throughput
Volume	95,800 MTON	16,000 MTON
Weight	31,703 STON	5,300 STON
Area	642,645 SQ FT	107,100 SQ FT
Vehicles	2,823	460
Containers	150	25

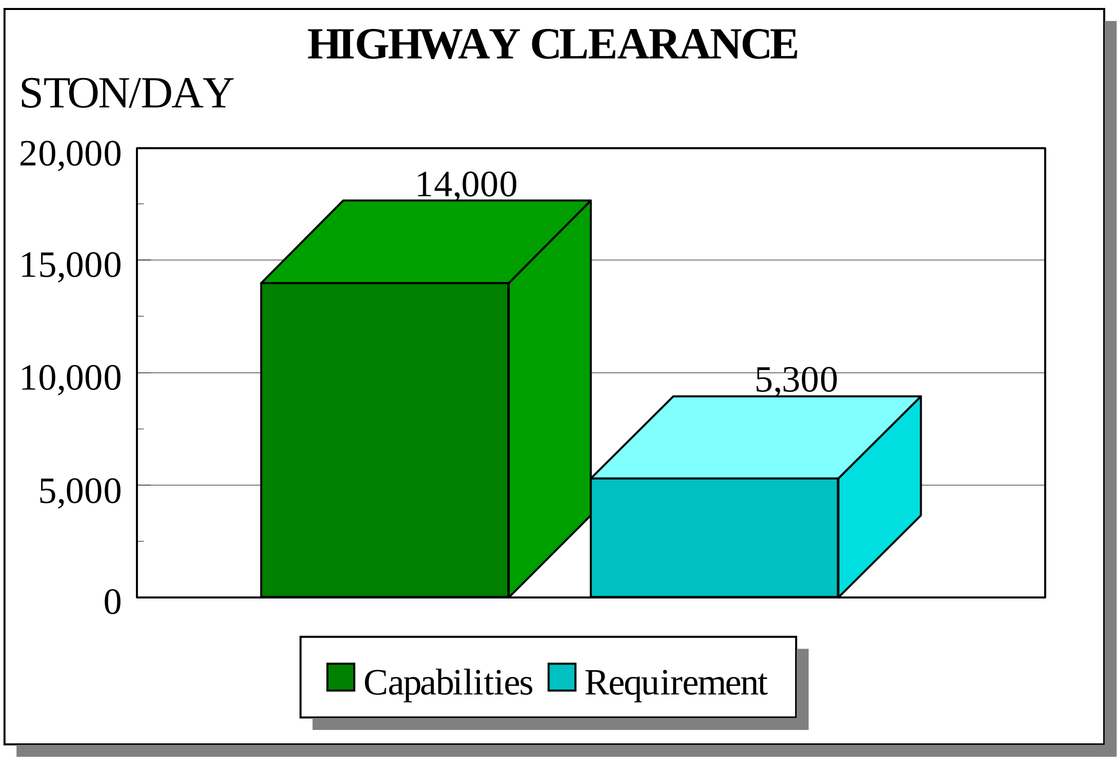


TERMINAL INPROCESSING/HANDLING

Highway

The Port Access Road is the restricting link of the highway route out of the port. This narrow road will limit highway throughput to about 14,000 STON (52,000 MTON) of military vehicles and equipment per day. All vehicles will have to convoy to Route 7 and possibly further to Route 5, (Tonghae Expressway) along North Access Road. Route 7 is a four-laned road that leads further north to the Tonghae Expressway. The Tonghae Expressway (Route 5) is four laned. The routes are shown on the Highway Access and Land-Use maps earlier in this analysis.

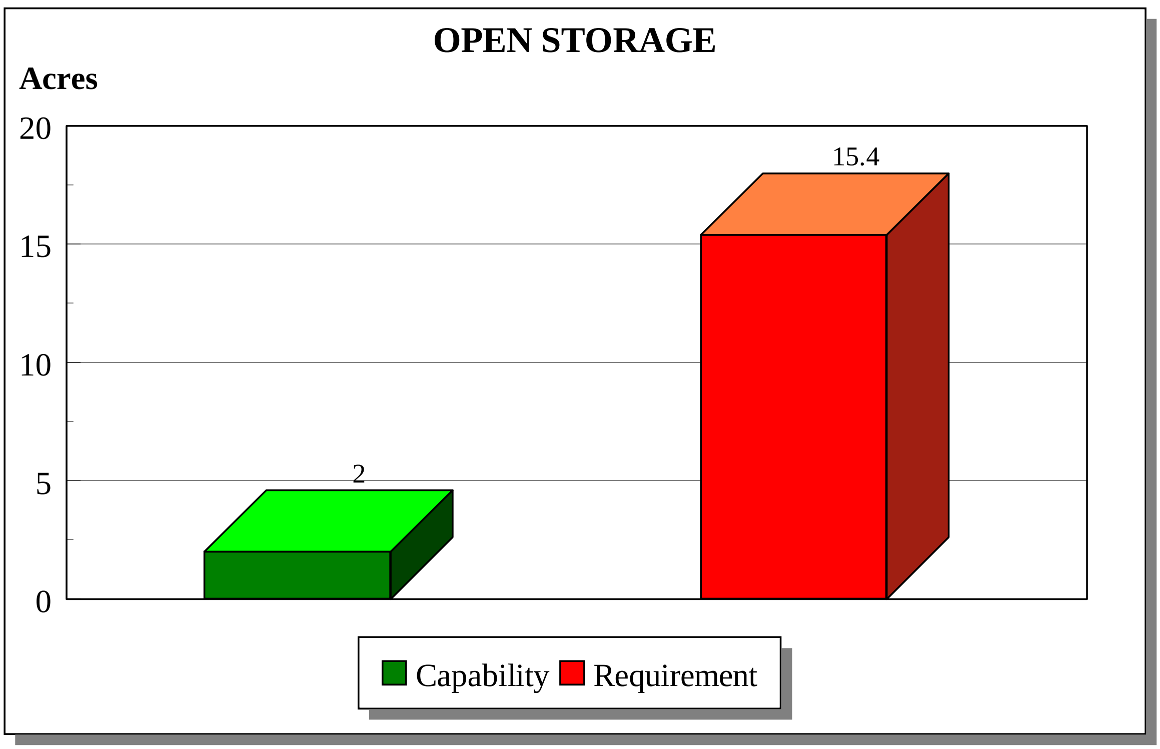
Assuming a constant flow of vehicles out the gates of the port the daily clearance requirement is 5,300 STON. The Samchok road network can easily support the requirement to deploy the armored brigade in six days.



OPEN STORAGE

The port has only 2 acres (61,000 square meters) of paved open storage area. We assume the equipment will marshal in open areas away from the aprons. There are no nearby areas that might provide additional offsite staging area.

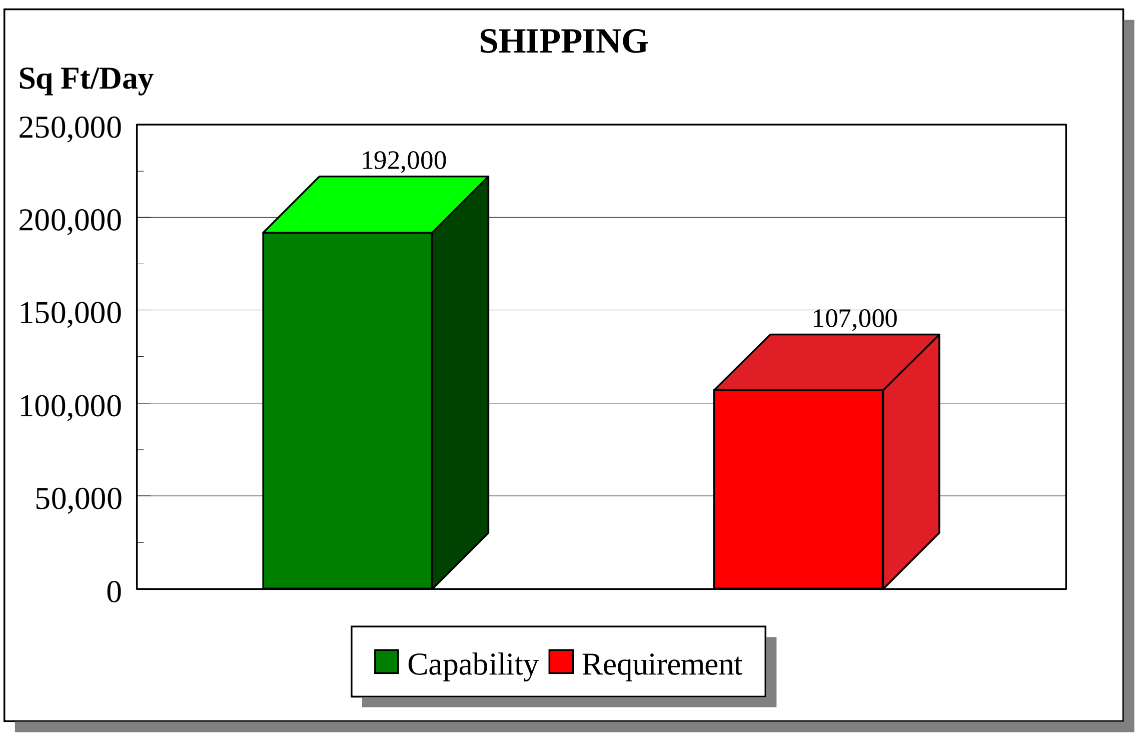
Marshaling the entire brigade of equipment (642,645 square feet) requires 37 acres. We assume the maximum amount in the port at any time is about one and a half days of the required port throughput. This requires the port to provide 15.4 acres of paved open area to support the deployment. The port can not meet the requirement.

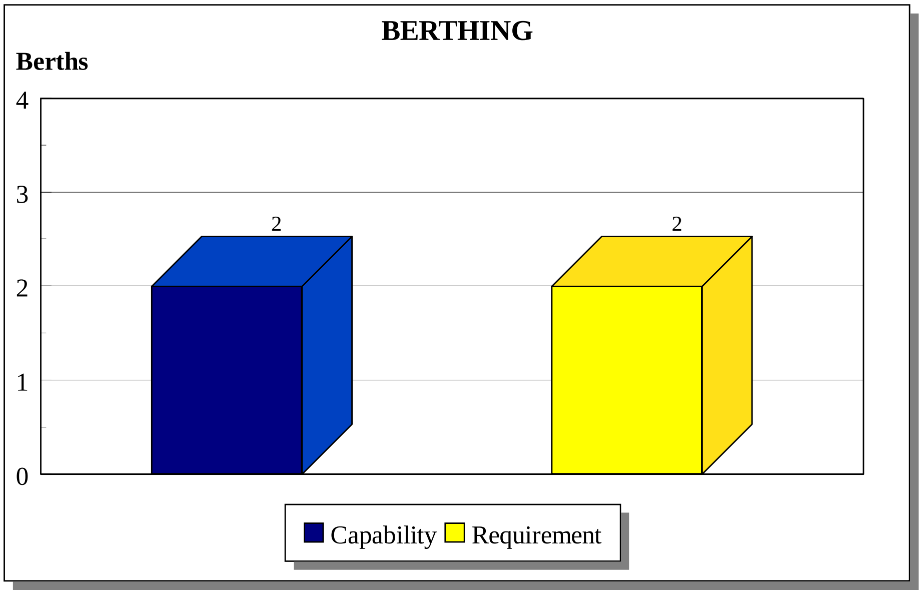


SHIPPING

An armored brigade has 642,645 square feet of vehicles and equipment. The deck space on the 2nd LT John P. Bobo (MPS-AMSEA) class vessels is 256,566 square feet, not including the container cells, which can carry an additional 546 TEUs. Assuming a 75 percent stow factor, each of these vessels can carry 192,242 square feet of vehicles and equipment. At this rate, the deployment of the brigade would require only 3.3 of these vessels, if each were fully loaded. Since the water depth at the port can not accommodate fully loaded 2nd LT John P. Bobo (MPS-AMSEA) class vessels, we assume 2.7 additional vessels are required for the deployment. Unloading RORO vessels this size can be done in under two days. To meet the six day requirement, the port will have to berth two of these vessels simultaneously. Three two-vessel operating cycles are required to deploy the entire brigade, with these partially loaded vessels.

Two 2nd LT John P. Bobo (MPS-AMSEA) class vessels can berth and operate at the port simultaneously. The Application Map earlier in this report provides the berthing configuration.





SUMMARY

The Port of Samchok can not deploy a notional armored brigade in six days. The amount of open area is far below the required amount.

The water at the port is too shallow to berth fully loaded 2nd LT John P. Bobo (MPS-AMSEA) class vessels. If the staging problem above can be resolved, the deployment will require additional vessels to limit the draft. Two vessels will have to operate simultaneously. To accomplish this, the vessels must be berthed as shown on the earlier Application map.

The highway access to the port is sufficient to meet the requirement. There are no rail facilities that can support military operations. Vehicles and equipment must convoy away for the port.

RECOMMENDATION

We do not recommend the Port of Samchok be considered for deployment of brigade-sized units. This is for three reasons:

- The port does not have enough open area to support the deployment.
- The water depth is insufficient to berth fully loaded 2nd LT John P. Bobo (MPS-AMSEA) class vessels.
- There are no rail facilities.

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PORT OF SOKCHO

I. General Data
II. Throughput Analysis
III. Application
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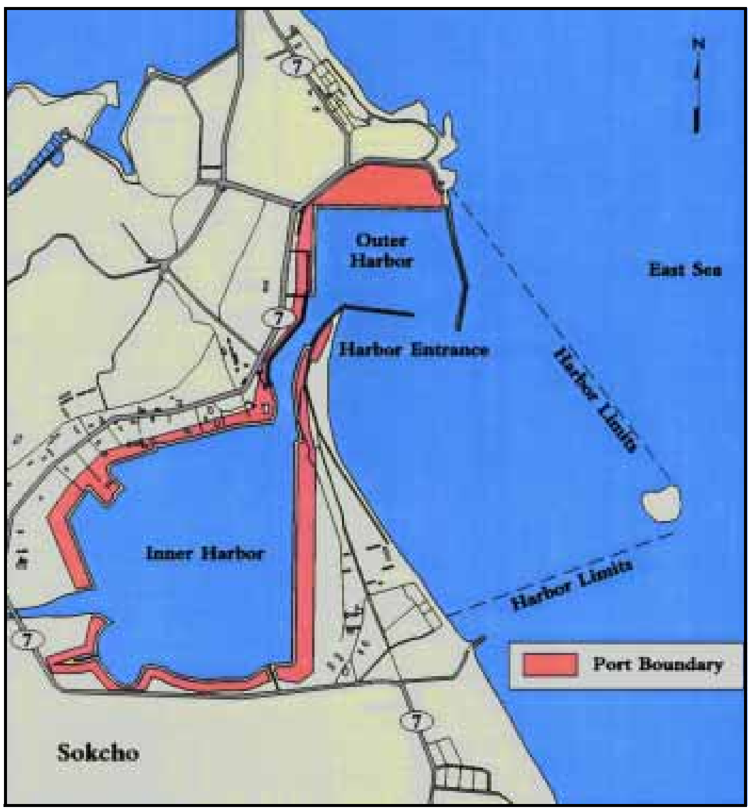
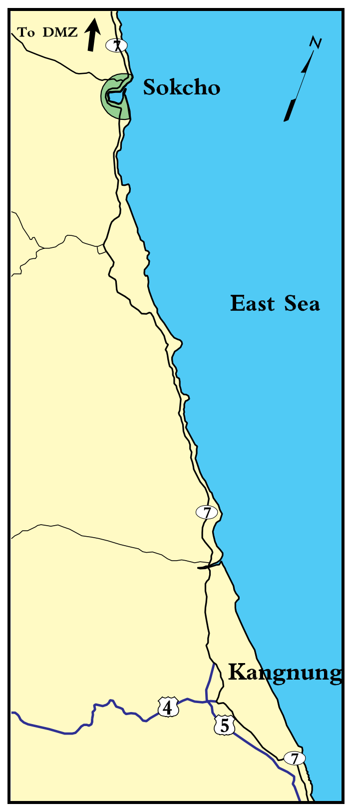
I. GENERAL DATA

TRANSPORTATION ACCESS

Water

The Port of Sokcho is 38^{o} 12’ north latitude and 128^{o} 36’ east longitude on the northeast coast of South Korea about 34 miles (54.7 kilometers) south of the demilitarized zone (DMZ). It is about 45 miles (72 kilometers) north of the city of Kangnung. The GeoCode is VWRM. This port is along the open water of the East Sea (Tonghae). A breakwater protects the harbor and the tidal variation is only 1 foot (.3 meters). The channel depth into the harbor from the open sea is about 32 feet (10 meters). The channel width through the breakwaters is about 720 feet (220 meters). Pilotage is compulsory for a ship calling on the port the first time. After the first visit, pilotage is optional. The port does not have any vertical restrictions pertaining to water access. A 984-foot (300 meter) turning basin exists in the outer harbor and can handle a maximum ship length of 650 feet (200 meters). According to Navy Standard Operating Procedures, ships do not normally turn in an area that is less than 1.5 times the ship’s length. No official anchorage has been established; however, the port authority indicates that a potential anchorage exists southeast of the harbor. The water depth for this potential anchorage is 49 feet (15 meters) and the holding ground consists of sand.





Water Access Maps

Highway

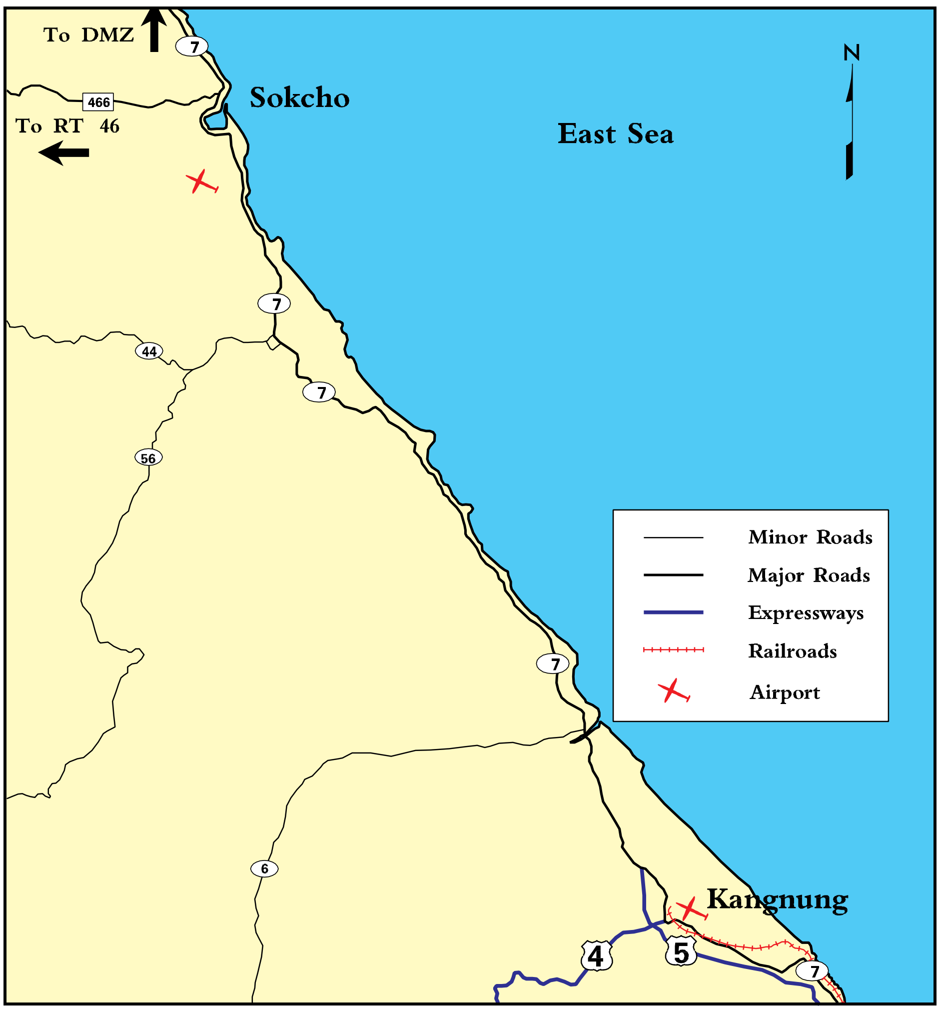
Route 7, a north-south coastal route, is the major highway route providing access to the port. The gates at the port provide direct access to this route. Currently, Route 7 is a two-lane highway; however, some of this route is under construction for conversion to a four-lane highway. Because Sokcho is guarded by rugged mountains to the west, Route 466 is the only highway going in this direction. Route 466 intersects Route 46, a northeast-southwest route, about 16 miles (25 kilometers) west of Sokcho into the mountains. Any highway deployments toward the west are likely to be slow and treacherous.

Rail

The city of Sokcho does not have rail access. The nearest rail facilities are located 45 miles south of Sokcho in the city of Kangnung.

Air

Sokcho has an airport about 9 miles (15 kilometers) south of the port. The airport has one runway 5,100 feet long by 98 feet wide. It has the ability to handle C-130 aircraft. The Republic of Korea (ROK) Air Force also uses this airfield. The airport at Kangnung, about 45 miles (72 kilometers) to the south, is the nearest facility capable of handling a C-5 aircraft. This airport has one runway measuring 9,000 feet by 150 feet.



Highway, Rail, and Air Access Map

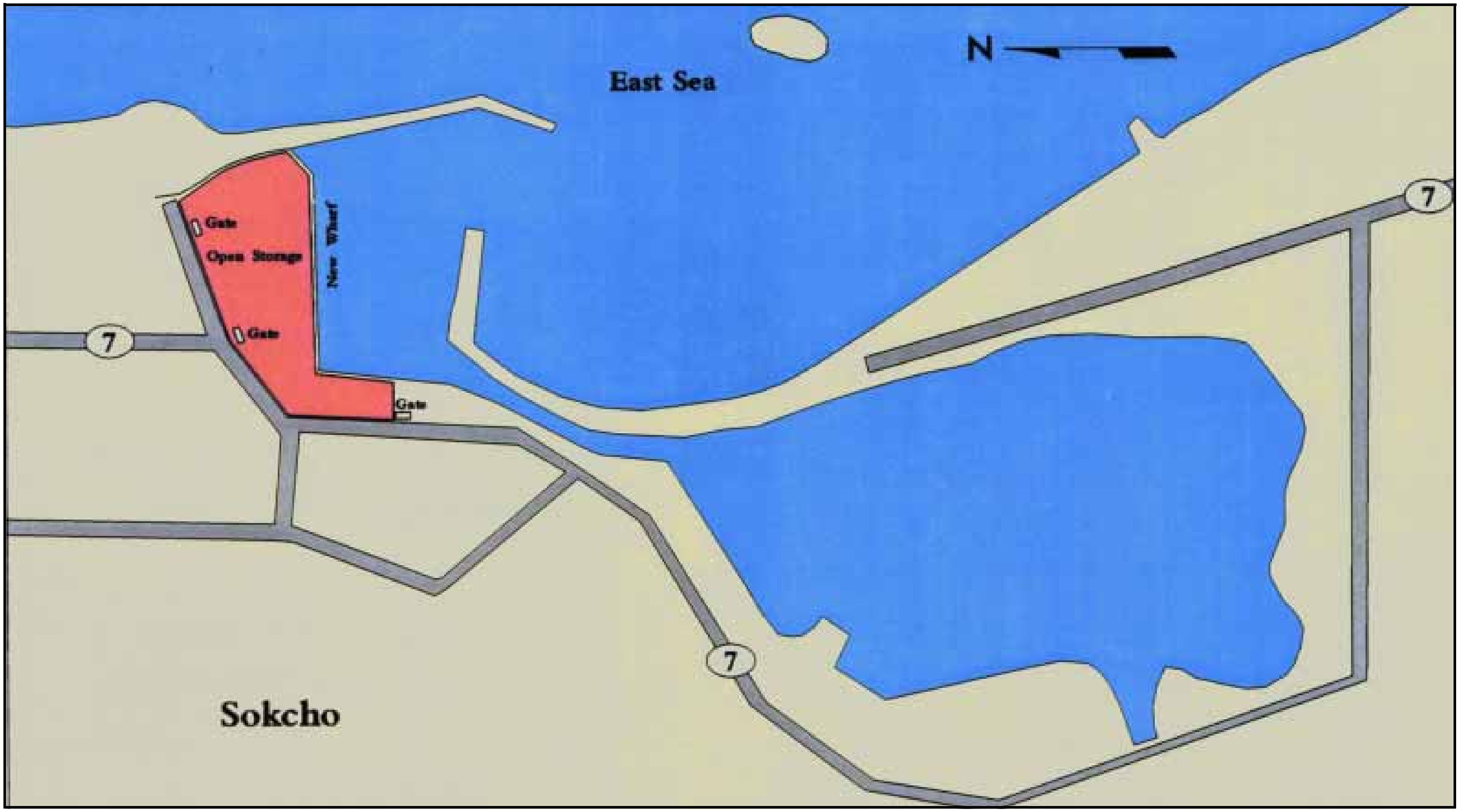
PORT FACILITIES

Berthing

The Port of Sokcho specializes as a fishing port. It consists of two harbors, outer and inner. The inner harbor has a shallow draft and is dedicated to fishing vessels. The outer harbor has two wharves, a management wharf and the new wharf. The new wharf has a water draft of 24 feet (7.5 meters) and is the most suitable wharf for military operations. Currently, the outer harbor is also being used for berthing fishing vessels, although the port authority is aggressively seeking business for general cargo. The port authority also states that the new wharf with an adjacent open storage area would be readily available for military operations if needed. The new wharf is an open wharf with no wharf or container cranes and has easy access to the main highway. The port does have lighting for night operations.

New Wharf (looking east)

Harbor Entrance to Sokcho



Land-Use Map

CHARACTERISTICS OF PORT OF SOKCHO

Characteristics	Berths
	New Wharf
Length, ft (m)	1,646 (502)
Depth alongside at MLW, ft (m)	24 (7.5)
Deck Strength, psf (met. ton/sq m)	614 (3)
Apron width, ft (m)	open
Apron height above MLW, ft (m)	8 (2.5)
Number of container cranes	0
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail, ft (m)	0

New Wharf Sokcho (looking west)

SUMMARY OF BERTHING CAPABILITIES FOR SOKCHO	
VESSEL	**BERTH**
	New Wharf
Breakbulk	
C3-S-38a	(3),a
C4-S-58a	(2),a
C4-S-66a	(2),a,g
C5-S-37e	(2),a
Seatrain	
GA and PR-class	2,a
Barge	
LASH C8-S-81b	a,f,g
LASH C9-S-81d	a,f,g
LASH lighter	8
SEABEE C8-S-82a	a,f,g
SEABEE barge	8
RORO	
Comet	a,d
Meteor	a,d
Cape Gnome	a,g,d
C7-S-95a	a,g
Cape Taylor	a
Cape Orlando	a
MV Ambassador	d
Callaghan	a,d
Cape Lambert	a
FSS-Class	a,g
Cape E-class	a
Cape D-class	a,g
Cape H-class	a,g
Cape R-class	a,g,d
Cape Texas	a
Container	
C6-M-147a	a,e
C7-S-69c	a,e
C7-S-68c	a,e
C8-S-85c	a,e,g
C9-M-132b	a,e,g
C9-M-F141a	a,e,g
Combination	
C6-S-1qd	a,g
C5-S-MA73c	a,g
C6-S-MA60d	a
Landing Craft	
LSV	5
LCU-2000	8

SUMMARY OF BERTHING CAPABILITIES FOR SOKCHO (Cont)	
VESSEL	BERTH
	New Wharf
Maritime Preposition Ships	
C7-M-PVT028 MPS AMSEA	a,g
C7-S-133a MPS Waterman	a,g
C8-M-PVT119 MPS Maersk	a,g

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operation
•May Prevent Operations

Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

Open Storage

The Port of Sokcho has about 17.5 acres (70,910 square meters) of open storage immediately adjacent to the new wharf. No other significant open storage areas are inside the port. Since the port is located in the middle of the city of Sokcho, no open storage areas exist immediately outside the port. The open storage area has immediate access to the main highway and has potential for helicopter operations.

Open Storage

Covered Storage

The port has no covered storage.

Unimproved Storage

Rail

The port has no rail access.

Highway

The port has immediate access to Route 7, the main highway running north and south along the Korean east coast. The port has a maximum of three gates providing access to Route 7, a main gate and two minor gates. No unusual clearance restrictions exist for accessing the port by highway. The main gate has two lanes (one for each direction) and the minor gates are one lane access roads. The International Road Federation chart lists Korean highway legal limits as 3.8 meters for height and 2.5 meters for width. The highway legal limit for a single axle load is 10 metric tons. The port does not have any fixed or portable truck scales.

Gate to Sokcho (view into port)

Gate to Sokcho (view out of port)

Ramps

The Port of Sokcho has no fixed or portable truck ramps in the port. Deploying units should make arrangements through the military port operator to ensure ramps are available, if needed. The 1317th Medium Port Command (MPC) in Pusan has portable ramps on their facility at Pier 8. Deploying units should contact the 1317th MPC prior to making any other arrangements.

Docks

There are no docks for cargo truck offloading.

OFF-PORT MARSHALING AREAS

The port is located in the downtown area of Sokcho. The port authority has indicated that no off-port marshaling areas exist near the port.

MATERIALS HANDLING EQUIPMENT (MHE)

The port does not have any MHE inherent to the port. Mobile cranes can be obtained through local stevedoring companies. The largest mobile cranes available are in the 100-metric ton range. Most of the cranes in the Sokcho area are in the 25-metric ton range. No experienced crane operators are in the immediate Sokcho area.

AMMUNITION HANDLING FACILITIES

The port has no experience in handling ammunition. Furthermore, because of its location in downtown Sokcho, it appears not to have any potential for ammunition handling operations.

PETROLEUM, OIL, AND LUBRICATION (POL)

Except for use by local fishing vessels, the port does not have any POL facilities.

INTERMODAL FACILITIES

The port has no intermodal facilities. As a matter of fact, there are no intermodal facilities on the northeast coast of South Korea.

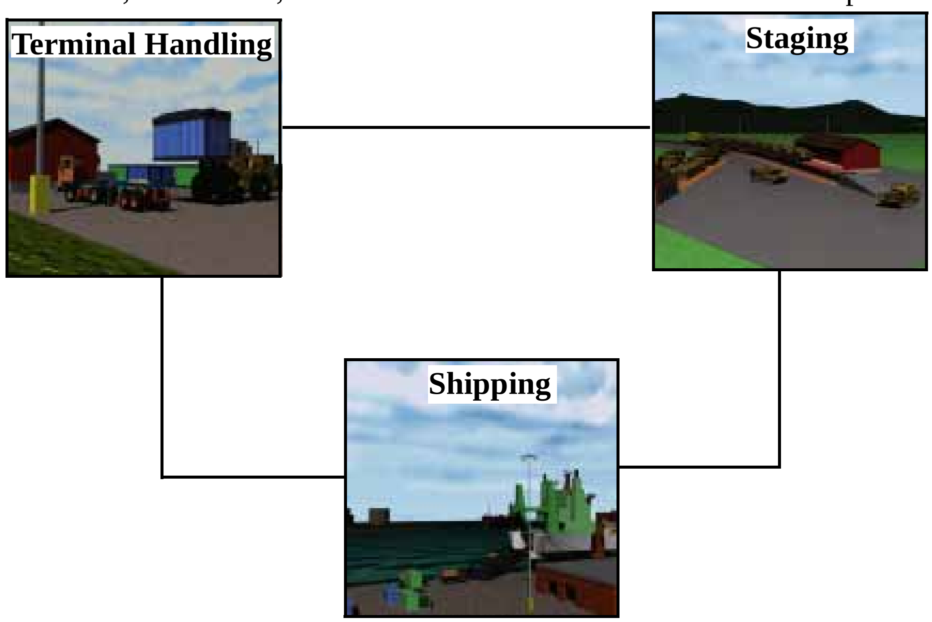
FUTURE DEVELOPMENT

Except for seeking general cargo business for the new wharf, the port has no future development plans.

II. THROUGHPUT ANALYSIS

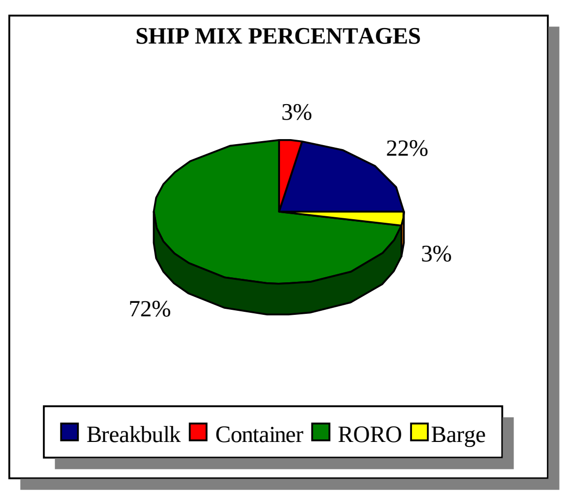
GENERAL

Based on the port operational performance simulator (POPS) computer model, we evaluated the throughput capability of the Port of Sokcho. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, hardstand marshaling, and terminal processing/handling - in terms of short tons (STON) per day. For this analysis, we assumed one 100-ton, one 40-ton, and one 25-ton crane were available for ship offloading.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that at least 80 percent of the port facilities will support military deployments. Also, due to the size of the port, we assumed a berth utilization factor of 80 percent. The ship mix is determined by Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



TERMINAL RECEPTION/HANDLING

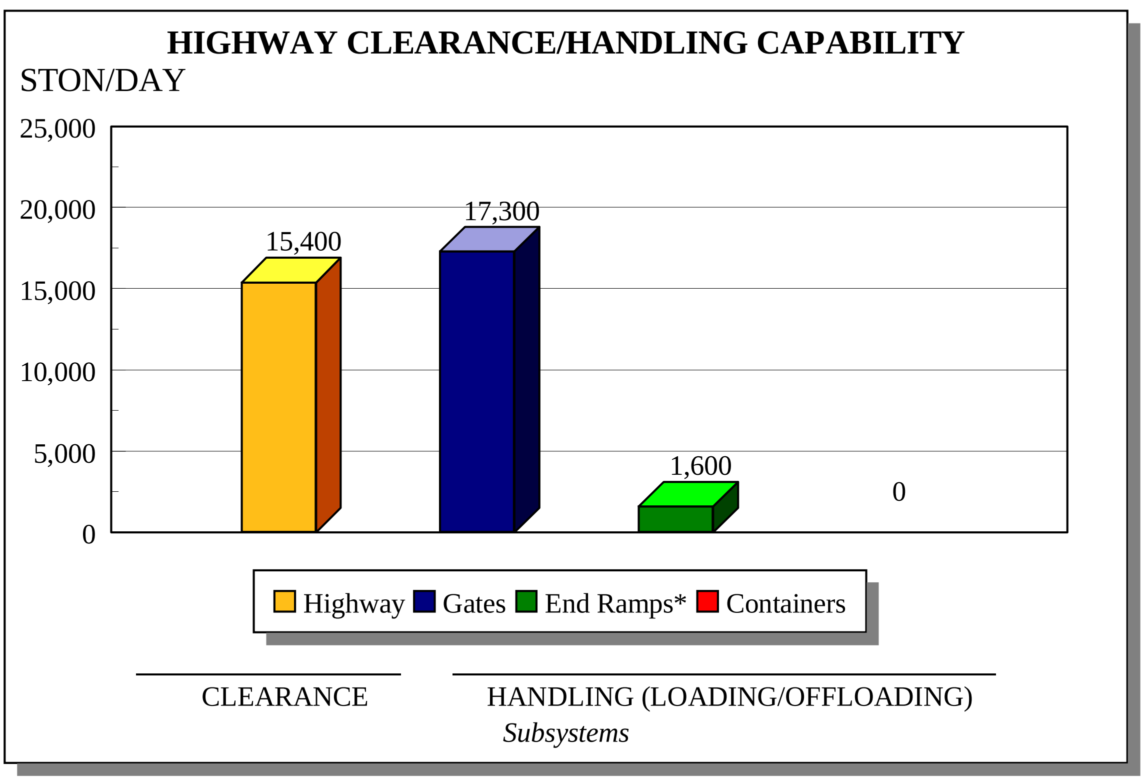
Highway

The port has direct access to Route 7. This road has four lanes going through the city of Sokcho. The main gate is two-laned (one lane for each direction) and the two minor gates are one-lane facilities. The road network in and out of the port, including the gate processing of vehicles, can handle about 15,400 STON (65,200 MTON) of equipment and supplies per day.

Roadable vehicles will process from the wharf area directly to the open storage area. Vehicles on commercial or military flatbed trailers, not equipped with a means for loading vehicles, must use portable ramps. Since no fixed or portable truck ramps are available at the port, we assume that the military port operator will acquire a portable end ramp to support loading flatbed trucks and semitrailers. This ramp could handle 1,600 STON (4,800 MTON) per day.

The port has no truck docks.

Unless appropriate mobile cranes and container handling equipment are obtained through stevedoring companies, the port has no container handling capability.



*Based on acquiring one portable end ramp.

Rail

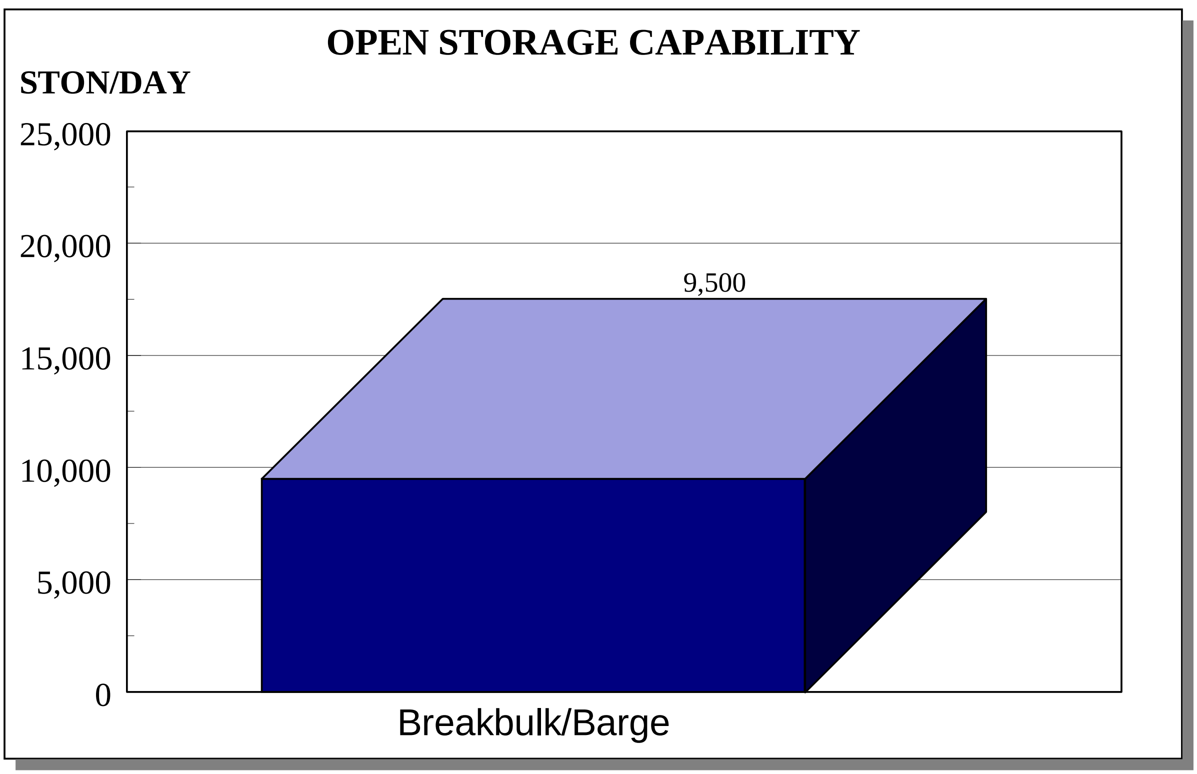
The port has no rail access.

OPEN STORAGE

The port has 17.5 acres (70,910 square meters) of open storage. Some of this area is unpaved. No covered storage is available.

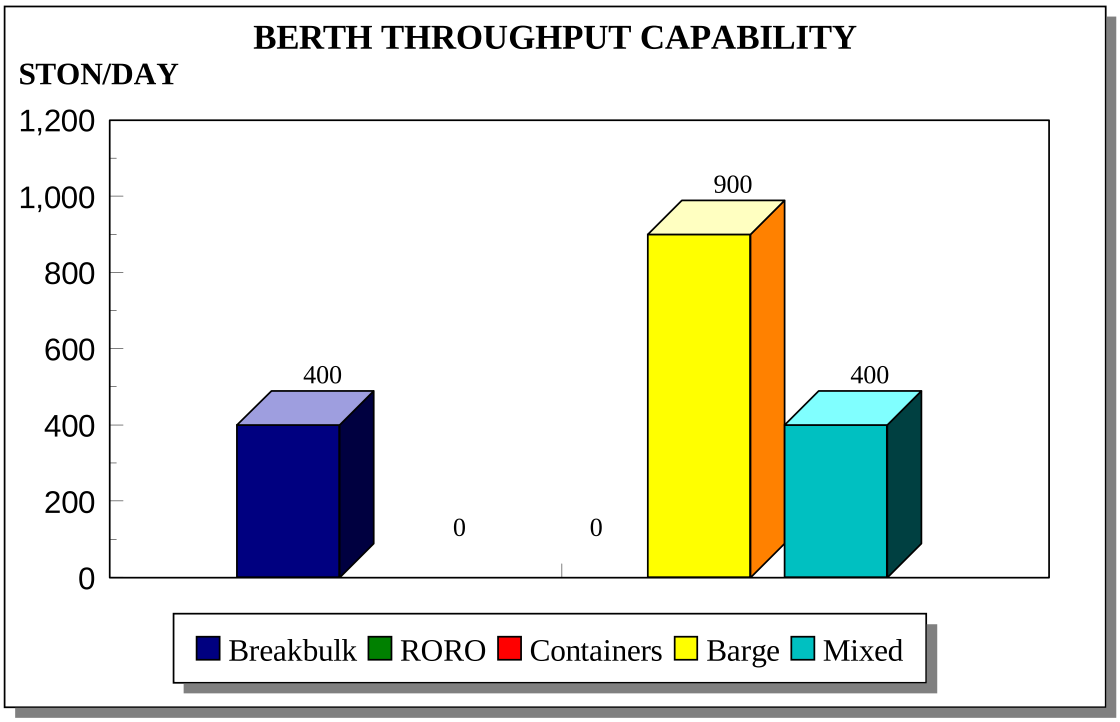
The port currently has the ability to perform breakbulk and barge operations. The cargo mix depends on the anticipated vessel type. For example, cargo will be prepared for breakbulk handling if a breakbulk ship is planned.

Based on the shipping subsystem throughput, one acre (4,051 square meters) of open storage is needed to marshal the daily throughput capability for the Port of Sokcho. Because the port has no container throughput capability, all of this area would be dedicated to vehicles and palletized cargo. The acreage includes areas for: working areas, areas around ramps and gates, lanes and access to vehicles, and other factors. The port's 17 acres can easily handle storage requirements for the port's daily throughput.



SHIPPING

Throughputs for the new wharf are based on various factors including MHE used; loading, operational, and berth usage rates; and berthing capabilities for various vessel types. The study assumptions are in the appendix.



CONVERSION FACTORS

Breakbulk: .4 STON per MTON
RORO: .25 STON per MTON
Containers: .4 STON per MTON

THROUGHPUT SUMMARY FOR PORT OF SOKCHO

BERTH	LENGTH (feet) (meters)	DEPTH ALONGSIDE (feet) (meters)	BREAKBULK THROUGHPUT (STON) (MTON)	RORO THROUGHPUT (STON) (MTON)	RORO SQUARE FT (EST)	RORO PIECES	CONTAINER THROUGHPUT (STON) (MTON) (TEU)	BARGE THROUGHPUT (STON) (MTON)	MIXED THROUGHPUT (STON) (MTON)
New Wharf	1,646 502	24 7.5	400 900	0 0	0	0	0	900 2,200	400 1,000
NOTE: RORO Pieces based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.									

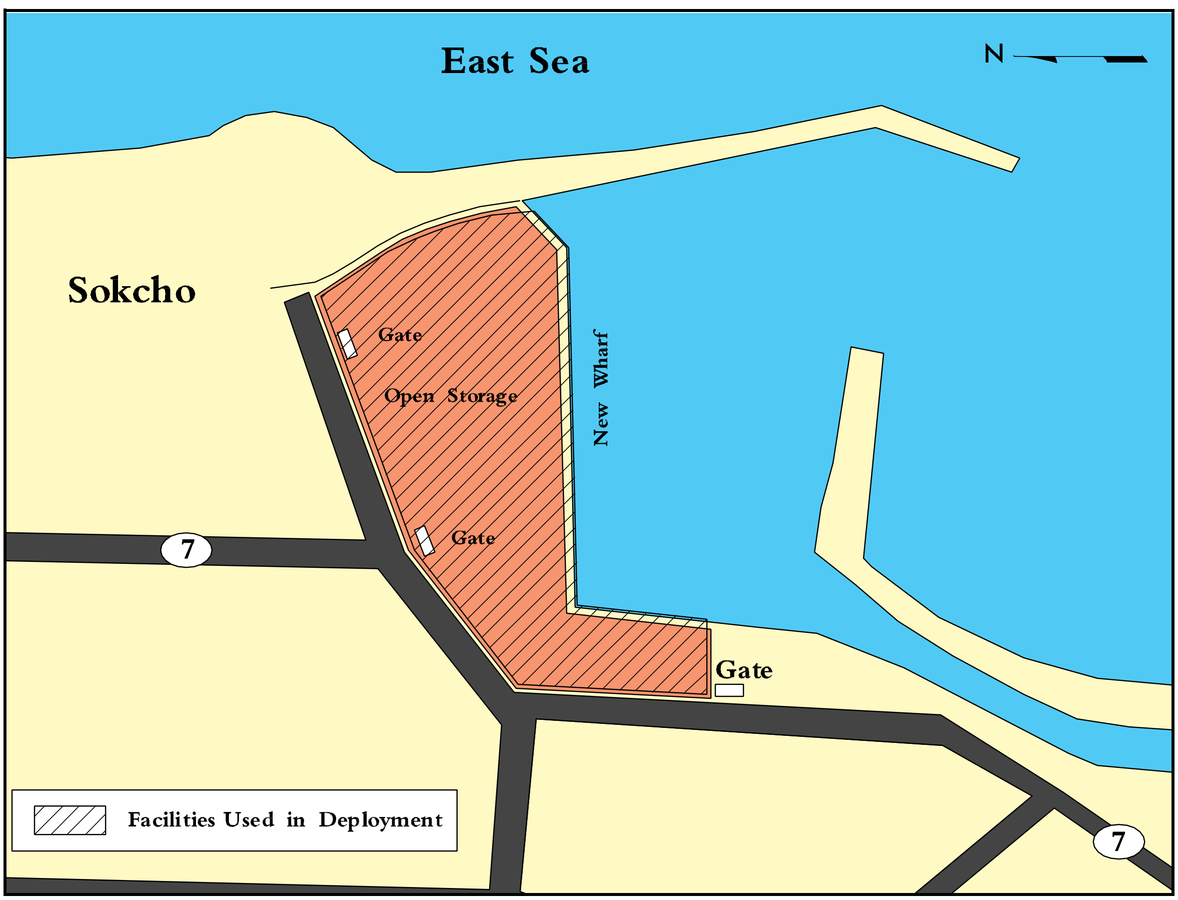
New Wharf Used by Local Fishing Boats

Rugged Mountains, West of Sokcho (limit the number of highway routes going west)

III. APPLICATION

GENERAL

This section evaluates the port's throughput capability for deploying a notional armored brigade. Because of the shallow draft of the New Wharf (24 feet) into Sokcho, this study evaluates the deployment using the Haewoo Frontier vessel, a heavy-lift ship similar to the Strong Texan. The draft of these ships is about 18 feet (5.5 meters) and the total deck space is 12,882 square feet (1,198 square meters). Currently, facility use depends on decisions made by the Korean Ministry of Defense and Ministry of Maritime Affairs and Fisheries (MMAF). Because of the Korean commitment to defense of their country and considering current facility use at Sokcho, we assume all of the New Wharf and associated storage area are available for military use. We also assume that no other military units (US or Republic of Korea) will be competing for port assets and facilities during the time that the armored brigade occupies the port. We further assume that the required assets, both transporters and people, will be available to adequately offload the ship and clear the port. The Port of Sokcho has not established that straight-stern operations are feasible here. We are assuming that the necessary adjustments can be made to make straight-stern operations feasible.



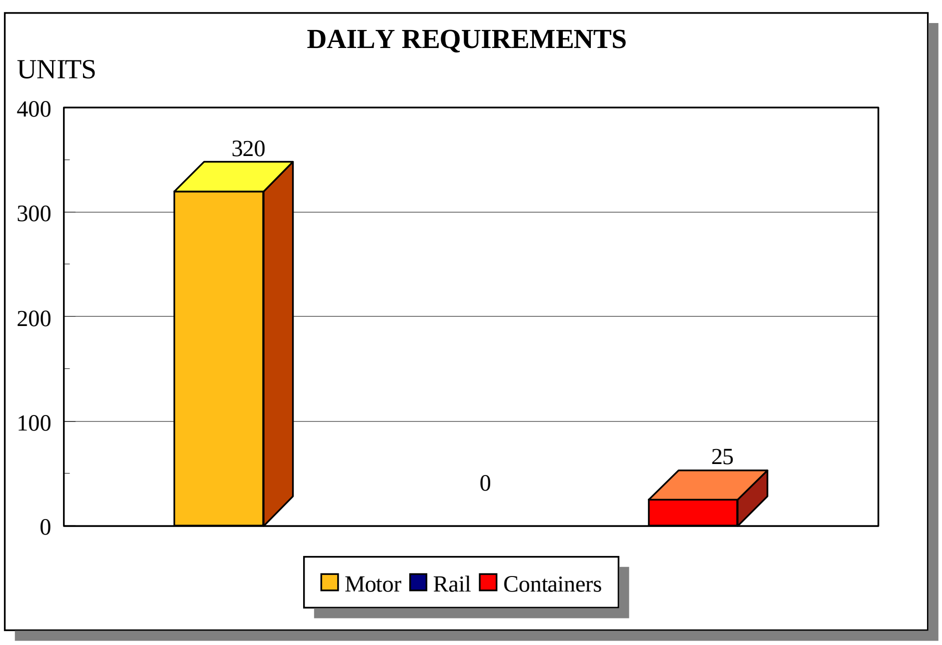
Potential Port Use During Deployment

REQUIREMENTS

The likely requirement for the Port of Sokcho would be to deploy a notional armored brigade to support the overflow of deployment operations at larger ports. We assume the port must throughput the Armored Brigade in 6 days of shiploading and port clearance. The brigade has to move about 2,820 vehicles and 150 containers. Because the Port of Sokcho has no rail access, all deployment inland is by highway. Using an OCONUS convoy/motor option, about 1,260 (210 per day) roadable vehicles would drive out the gates towing 820 (140 per day) trailers. Also, about 230 forty-foot flatbeds (40 per day) and 410 Heavy Equipment Transporters (HET) (70 per day) would transport non-roadable equipment. About 25 containers would arrive daily.

ARMORED BRIGADE

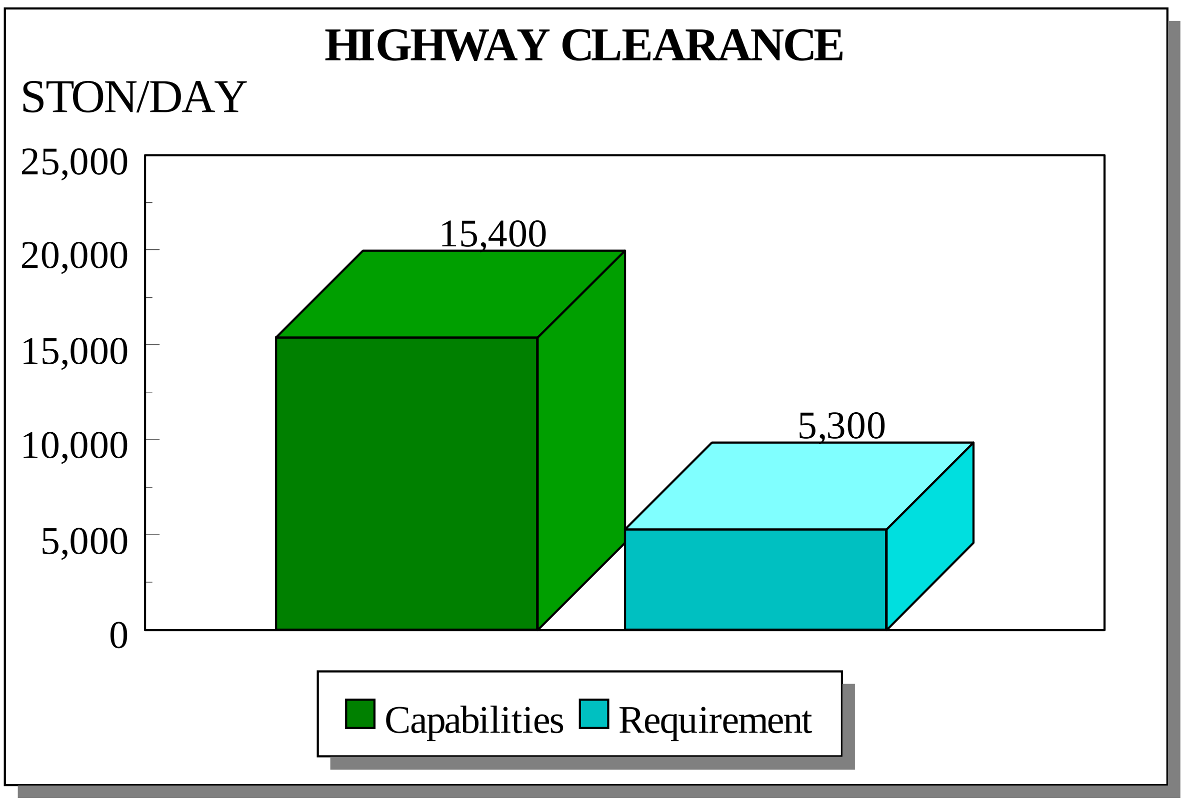
Total Equipment		Required Daily Throughput
Volume	95,800 MTON	16,000 MTON
Weight	31,703 STON	5,300 STON
Area	642,645 SQ FT	107,100 SQ FT
Vehicles	2,823	460
Containers	150	25



TERMINAL INPROCESSING/HANDLING

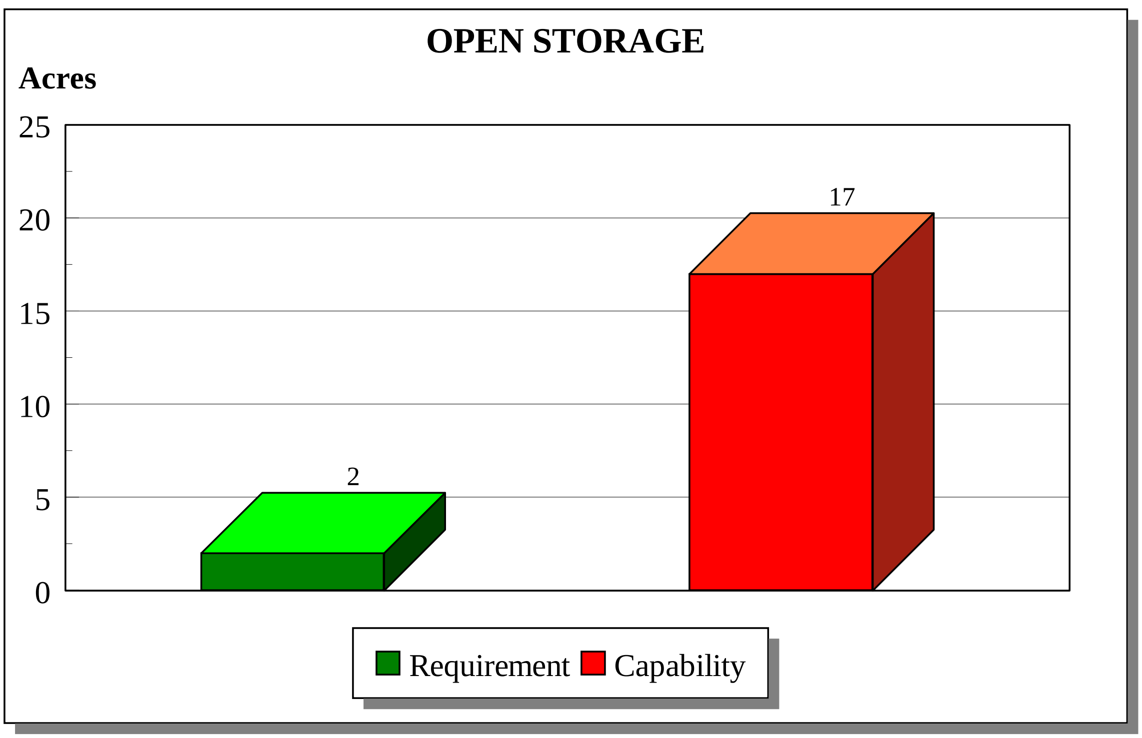
Highway

Route 7, a two-lane main highway, is the major route providing access to inland destinations. This highway, including gates to the wharf area, can handle about 15,400 STON of equipment and supplies per day. Because Sokcho does not have rail access, all port clearance for an armored brigade is by highway. Assuming a constant flow of equipment out the gates, the daily clearance requirement is 5,300 STON. The Sokcho highway network can easily handle an armored brigade in 6 days. Because rugged mountains exist west of Sokcho, most deployment will be either to the north or south.



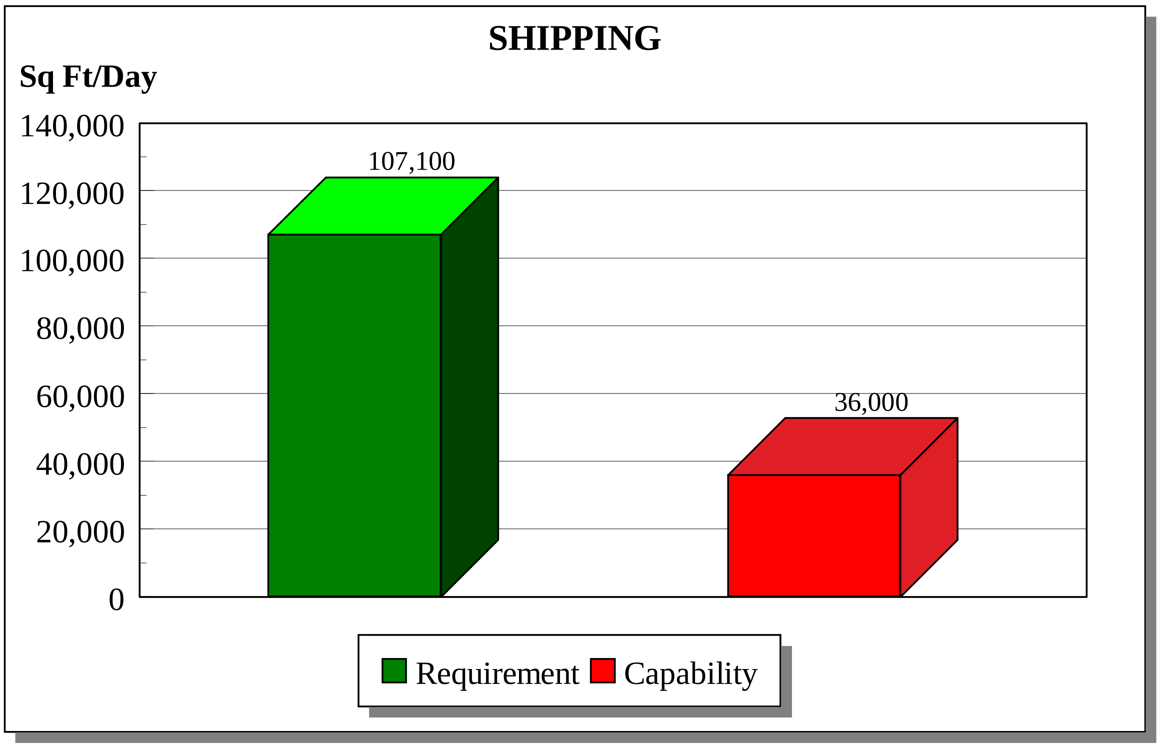
OPEN STORAGE

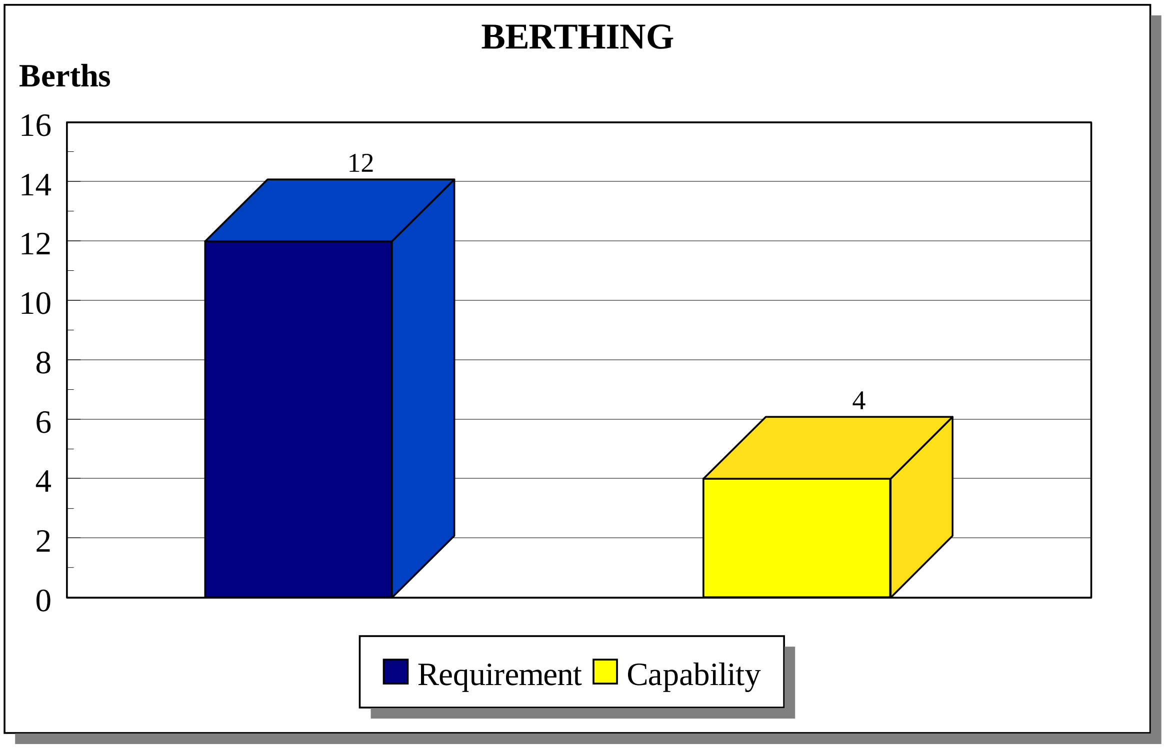
The port has 17.5 acres (70,910 square meters) of open storage. Because no off-port marshaling areas are near the port, we assume that all equipment offloaded at the port must be marshaled in the port's open storage areas. The Haewoo Frontier has 12,882 square feet of deck space. Assuming a 70 percent stow factor, this ship can carry about 9,000 square feet of cargo. Assuming four heavy lift ships can berth and offload simultaneously within one day, the open storage area must accommodate four shiploads of cargo each day. To account for additional space needed for working areas, lanes and access to vehicles, areas around gates and ramps, and frustrated cargo, the daily required working area is about 90,000 square feet or 2.1 acres. The port has 17.5 acres and can easily accommodate this daily influx of equipment. If needed, the port clearance could occur using a 3-day dwell time.



SHIPPING

An armored brigade has 642,645 square feet of equipment. If the Haewoo Frontier vessel can transport a maximum of 9,000 square feet of equipment (includes 70 percent stow factor), 71 of these vessels are needed to move an armored brigade. Assuming the port can berth and offload 4 shiploads of equipment per day, an armored brigade could be offloaded in 18 days.





SUMMARY

The Port of Sokcho can throughput an armored brigade in 18 days. The weak link in the port clearance process is the berthing capabilities. The shallow draft limits the size of the vessel calling at the port to heavy-lift ships or car ferry size vessels. We believe that operations can become cluttered if more than four vessels offload simultaneously. The open storage and highway routes appear adequate for handling the daily throughput of equipment. Port officials have not established that straight-stern operations can occur here. If adjustments can be made to accommodate straight-stern ramp offloading, we assume that the maximum number of ships that can offload simultaneously at the New Wharf is four.

RECOMMENDATION

The Port of Sokcho has potential as an overflow port when problems or delays occur at the larger ports. Due to the shallow draft at the New Wharf and the large number of vessels required to deploy an Army unit, the port should be limited to occasional shiploads.

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PORT OF TAESAN

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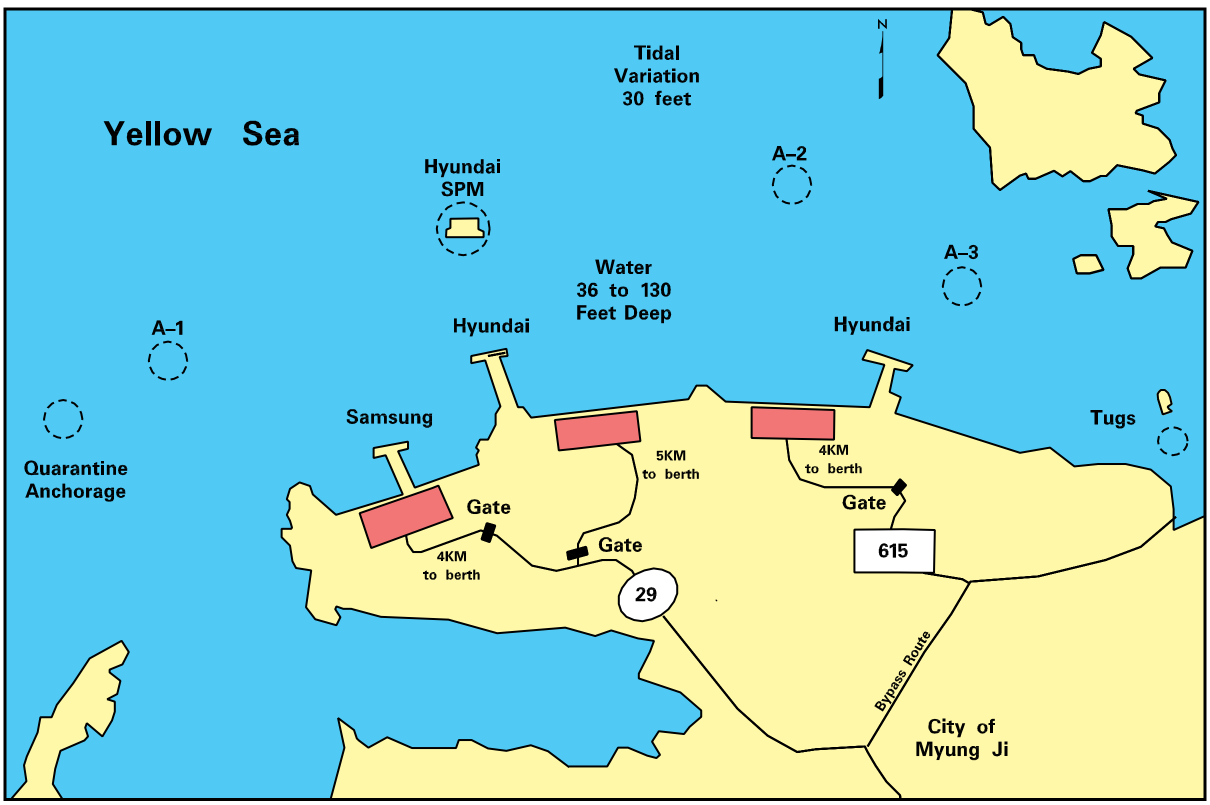
PORT OF TAESAN

LOCATION

The Port of Taesan is at 37° 01' 00" N Latitude, 126° 21' 18" E Longitude, on the west coast of Korea, 35 miles (48 kilometers) southwest of Seoul, on the Yellow Sea. It is about 25 miles west of the Port of Pyongtaek. The berths are on the open water, without breakwaters. There are three nearby anchorages, including one for quarantine.



Current POL Facilities at Port of Taesan

Tidal variation is about 30 feet (9.2 meters). This will restrict RORO operations to only a few hours each day.

DESCRIPTION

The Port of Taesan is a petroleum, lubricant and oil (POL) facility for ultra large crude carriers (ULCC). Large ships discharge fuel from foreign countries. Smaller ships load to distribute fuel around the coast of Korea. The port is not usable for deploying or receiving military equipment.

East POL Pier at Port of Taesan (northeastward view)

The Port of Taesan has three dolphin piers, each which is owned by a different oil company. Seven or eight large ships can berth simultaneously.

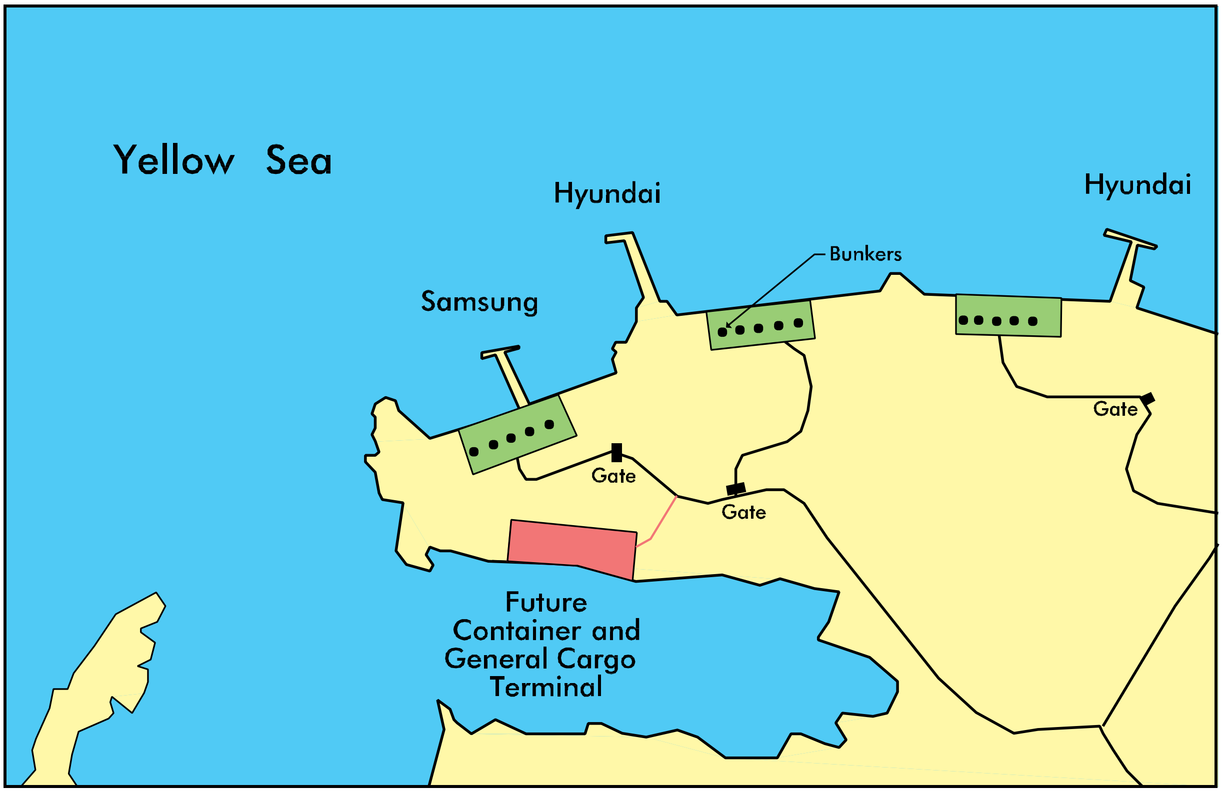
The largest ships berth at the single point mooring (SPM) berth, to discharge POL in 78 feet water (24 meters) at mean low water (MLW). This facility occasionally handles vessels as large as 100,000 dead weight tons (DWT). There is rarely ever any operations during the night. There is no connection with the Trans-Korea pipeline.

The port has no rail access. There are no plans for rail development. The major road that accesses the port is Route 29, which leads southward from the port. About 15 miles south of the port, Route 32 breaks off to the east and west.

Osan Air Force Base is about two hours in the north east direction.

FUTURE DEVELOPMENT

The Port Authority hopes to develop a container and general cargo facility on the south side of the peninsula, in naturally deep water. Construction is not expected to begin until about 2002. The terminal is expected to be about 2000 feet (600 meters long). Cranes will be added as the shipping business increases.

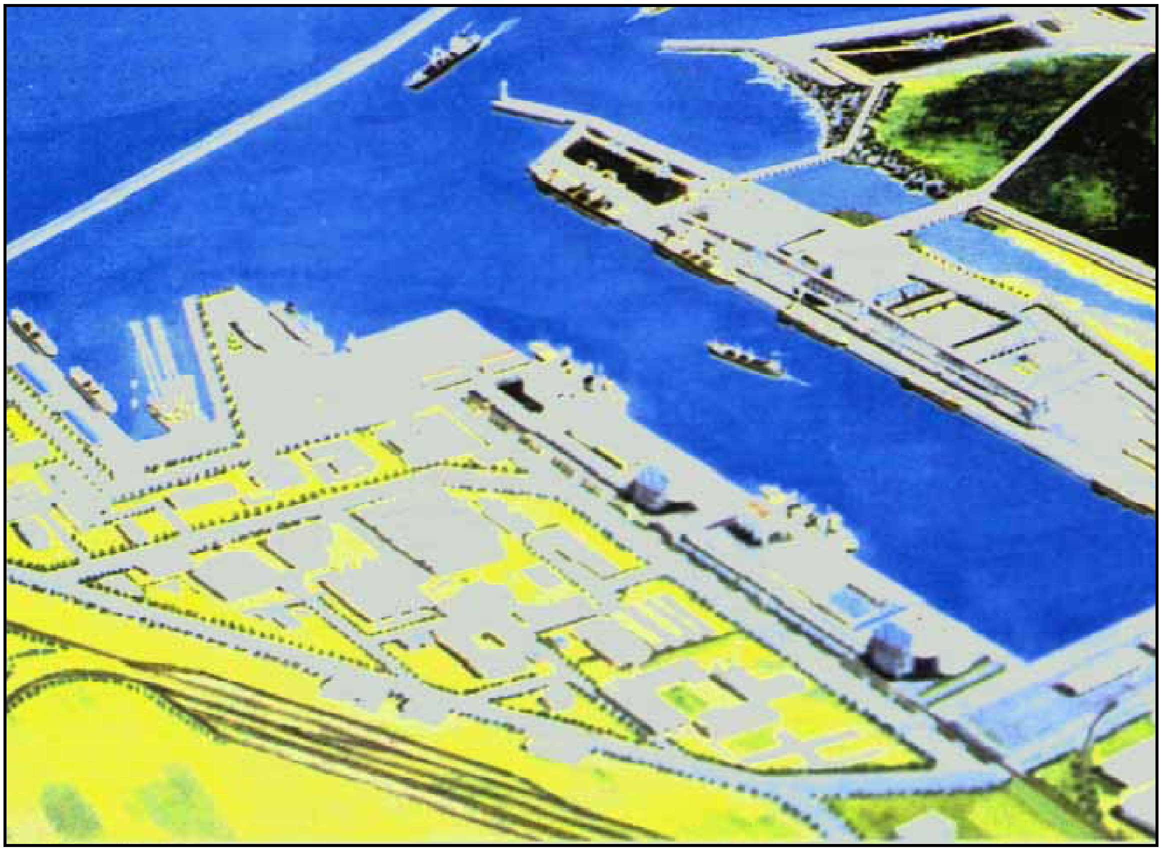


Proposed Future Container and General Cargo Terminal

The new West Coast Expressway is under construction. This will improve highway access to the port from the north and south. From Inchon to Taesan will be done by the end of 1997. From Inchon to Mokpo will be completed by 2004.

July 96

PORT OF TONGHAE



I. General Data

II. Throughput Analysis

III. Application

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I. GENERAL DATA

TRANSPORTATION ACCESS

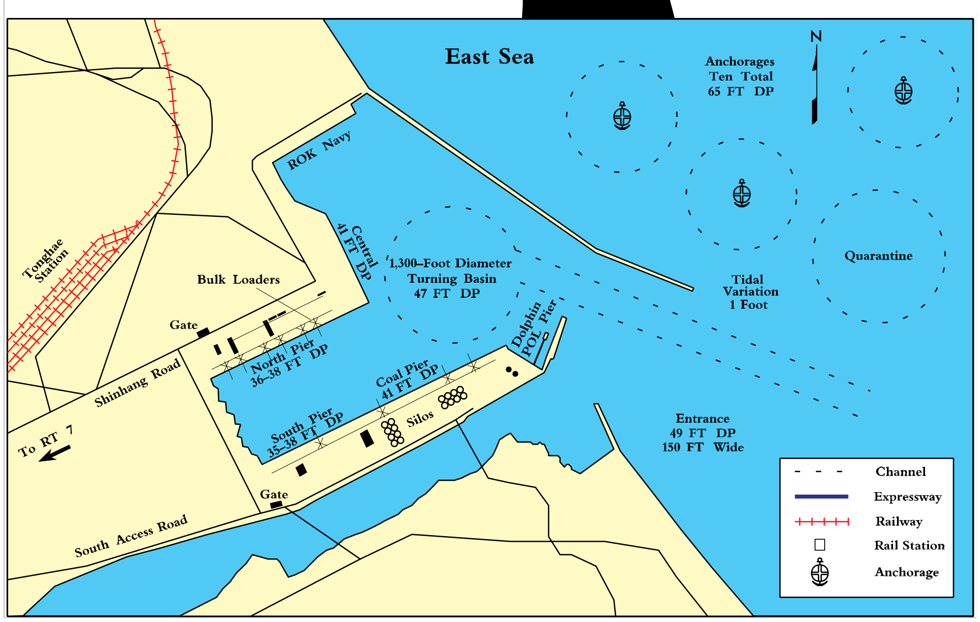
Water

The Port of Tonghae is primarily a bulk cement and coal port. It is on the northeast side of Korea on the East Sea, between Mukho and Samchok, 85 miles north of Pohang. The port is at 37^{o} 29’ 00" north latitude and 129^{o} 08’ 00" east longitude.

The ship channel has no overhead restrictions entering the port. However, the channel depth is only 49 feet (14.9 meters) deep at mean low water (MLW) and about 150 feet wide (45.7 meters) between the breakwaters. Ships may turn within the breakwaters, in the 47 feet (14.3 meters) deep MLW, 1,300-foot (396 meters) diameter turning basin. Tidal variation at the port is about 1 foot.

There are 10 anchorages just outside the breakwaters of the port. All are sand or mud bottomed, and at least 65 feet (19.8 meters) deep MLW.

Berthing and undocking of ships is permitted during daylight hours with pilotage. One of the two pilots at Tonghae will meet incoming vessels at the quarantine anchorage, just outside the breakwaters.



Water Access

Highway

Tonghae is a small city. Roads are typically four-laned and uncongested, but the access into the port is only two-laned. Highway access to the port is via Expressway 5, to Route 7. Route 7 connects to Shinhang Road, which leads to the north gate.

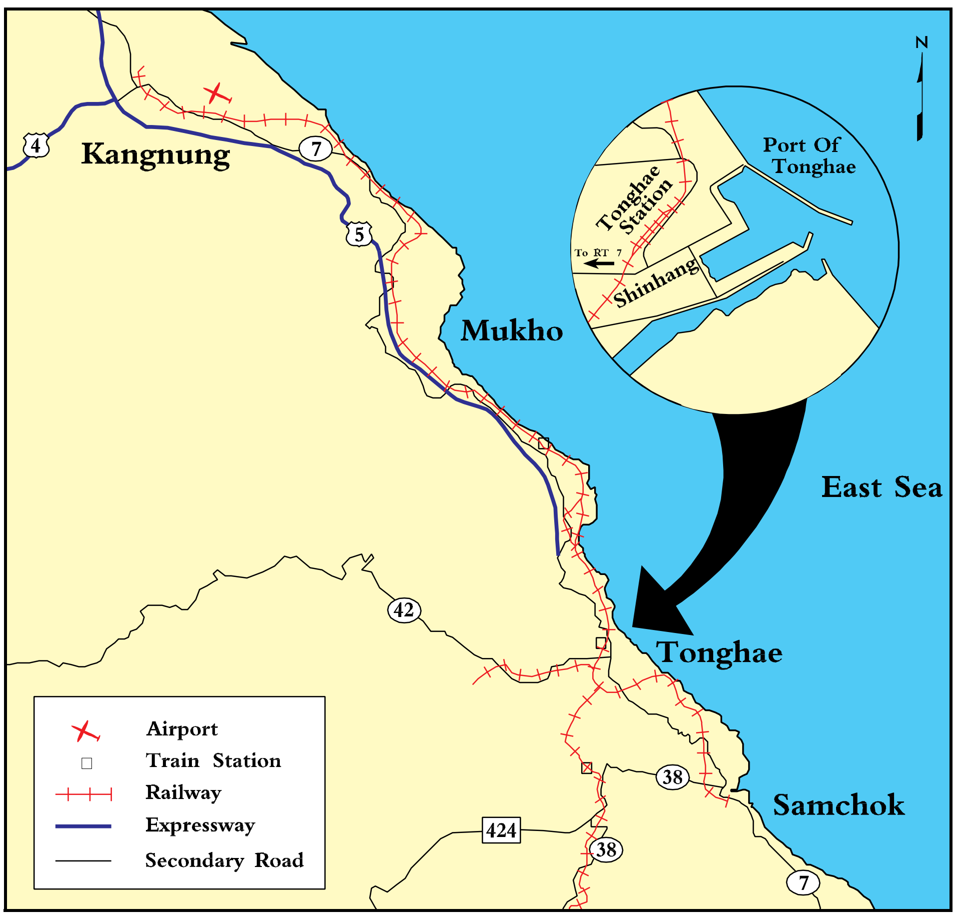
There are two gates to the port of Tonghae. Both gates are narrow and may cause delays for highway access. The concrete roads leading to the gates are very narrow. A stalled vehicle could easily block access, if not pushed to one side.

Air

The nearest airport is in Kangnung, about an hour's drive away. It has two runways 9,000 feet long. One runway is 150 feet wide and routinely handles the A300 passenger jets to Seoul and Pusan. The other runway is 98 feet wide, C-5 capable, and is used by the adjacent ROK airbase.

Rail

All railroad tracks within Korea are owned and operated by the Korean National Railroads. The Tonghae rail station is only 500 meters west of the North Pier. The rail station has no spurs sufficient to support military operations.



Highway and Air Access to Port of Tonghae

PORT FACILITIES

Berthing

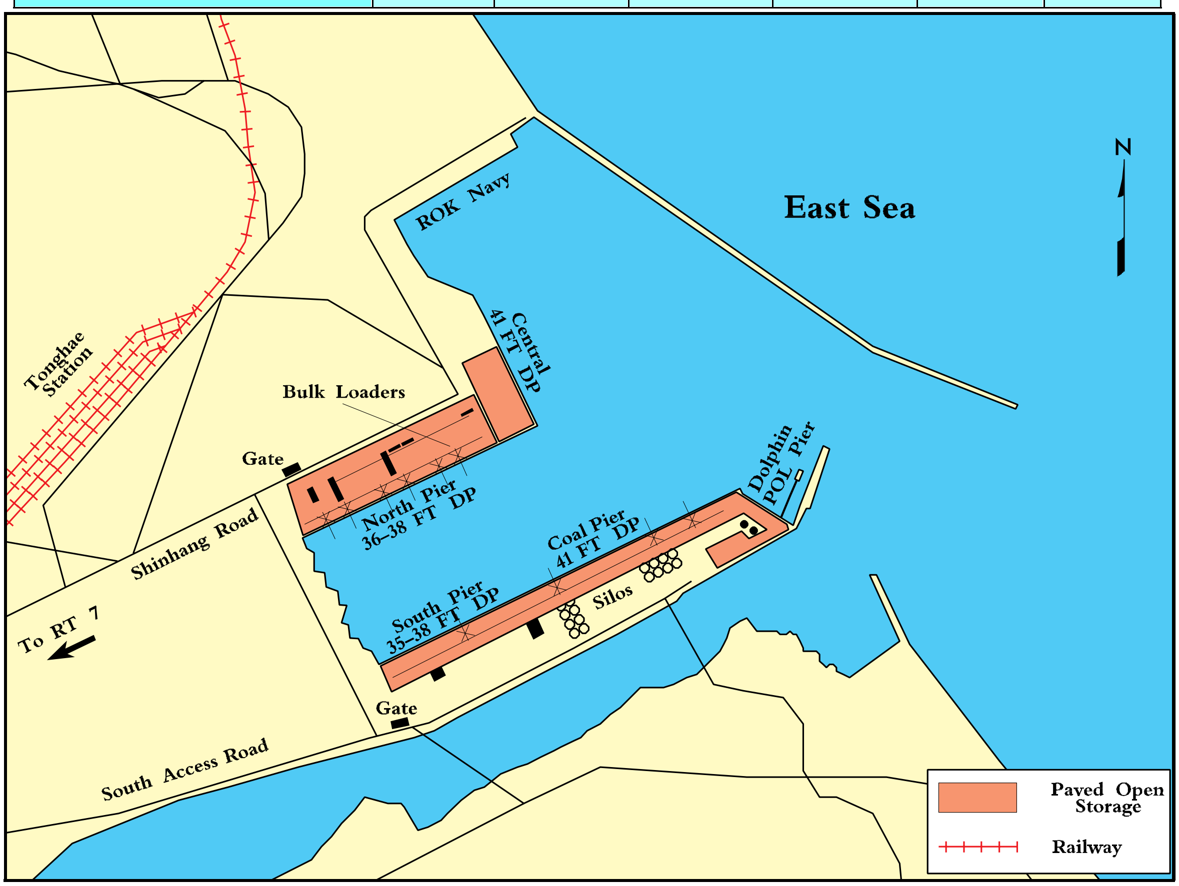
The Port of Tonghae normally handles bulk cargos of cement, coal, and occasionally limestone or dolomite. Most of the North and South piers are occupied by overhead conveyor belts and bag or bulk loading equipment. A small ROK Navy base is just north of the port, and a POL dolphin pier with nearby bunkers is at the outboard end of the South Pier.

The wharves in this report (Central, North, South and Coal Piers) range in depth from 35 to 41 feet (10.7 to 12.5) at MLW. The North and South Piers are each over 2,000 feet long (609 meters). The aprons are all 8.2 feet (2.5 meters) above MLW.

Port of Tonghae (westward view)

BERTHING CHARACTERISTICS OF THE PORT OF TONGHAE

Characteristics	Berths					
	Central	North 20-21	North 22-23	South 11-12	South 13-14	Coal
Length, ft (m)	885 (278)	1,050 (320)	1,150 (350)	1,444 (440)	968 (295)	886 (270)
Depth alongside at MLW, ft (m)	41 (12.5)	38 (11.6)	36 (11)	38 (11.6)	35 (10.7)	41 (12.5)
Deck strength, psf (met. tons/sq m)	614 (3)	614 (3)	614 (3)	614 (3)	614 (3)	614 (3)
Apron width, ft (m) (useful)	Open	45 (13.7)	45 (13.7)	45 (13.7)	45 (13.7)	45 (13.7)
Apron height above MLW, ft (m)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)	8 (2.4)
Number of container cranes	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No	No	No
Apron length served by rail, ft (m)	0	0	0	0	0	0



Land-Use Map for Port of Tonghae

SUMMARY OF BERTHING CAPABILITIES FOR TONGHAE

VESSEL	BERTHS					
	Central	North 20-21	North 22-23	South 11-12	South 13-14	Coal
Breakbulk						
C3-S-38a	1	2	2	2	1	1
C4-S-58a	1	1	1	2	1	1
C4-S-66a	1	1	2	2	1	1
C5-S-37e	1	1	1	2	1	1
Seatrain						
GA and PR-class	1	1	1	2	1	1
Barge						
LASH C8-S-81b	1	1	1	1	1	1
LASH C9-S-81d	(1),c	a	a	a	a	c
LASH lighter	4	5	5	7	4	4
SEABEE C8-S-82a	1	a	a	a	a	1
SEABEE barge	4	5	5	7	4	4
RORO						
Comet	d,i,j	d,o	d,o	d,o	d,o	d,o
Meteor	d,i,j	d,o	d,o	d,o	d,o	d,o
Cape Gnome	d,i,j	d,o	d,o	d,o	d,o	d,o
C7-S-95a	1	b	b	b	b	b
Cape Taylor	1	b	b	b	b	b
Cape Orlando	i,j	b	b	b	b	b
MV Ambassador	d	d	d	d	d	d
Callaghan	1,d	d,o	d,o	d,o	d,o	d,o
Cape Lambert	i,j	b	b	b	b	b
FSS-Class	(1) c	b	a,b	b	a,b	b,c
Cape E-class	i,j	b	b	b	b	b
Cape D-class	i,j	b	b	b	b	b
Cape H-class	l	(1)b	b	b	b	b
Cape R-class	l,d,m	d,o	d,o	d,o	d,o	d,o
Cape Texas	i,j	b	b	b	b	b
Container						
C6-M-147a	1,e	b,e	b,e	b,e	b,e	b,e
C7-S-69c	l,e	b.e	b,e	b,e	b,e	b,e
C7-S-68c	1,e	b,e	b,e	b,e	b,e	b,e
C8-S-85c	l,e	b,e	b,e	b,e	b,e	b,e
C9-M-132b	l,e	b,e	b,e	b,e	b,e	b,e
C9-M-F141a	(1) c,e	a,b,e	a,b,e	a,b,e	a,b,e	b,c,e
Combination						
C6-S-1qd	1	b	b	b	b	b
C5-S-MA73c	1	b	b	b	b	b
C6-S-MA60d	1	b	b	b	b	b

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft

( ) indicates vessels assigned by analyst

OPEN STORAGE

The port has only 10.8 acres of paved open storage. Large sections of the open areas are at the Central Pier, and inland of the Coal Pier.

Because of this small amount of open area, and the congestion caused by the conveyors, helicopter operations are not recommended at the port. The adjacent ROK Navy base can support helicopter landing.

Open Storage at Central Pier
(currently covered with bulk cement)

Conveyor Belts Cause Congestion at North and South Piers

COVERED STORAGE

There are no warehouses or transit sheds at the port.

HIGHWAY

There are two gates to the port of Tonghae. Both are about 15 feet wide and may cause delays for highway access. Vehicles can move around the port without restrictions on height or weight. The concrete roads leading to the gates are very narrow. A stalled vehicle could easily block access, if not pushed to one side. There are no truck scales at the port.

Although the port has conveyor systems, there are no overhead restrictions that would restrict cargo on trucks or trailers. All paved areas in the port are concrete and capable of withstanding heavy vehicular traffic. There are no height or weight restrictions leading to the main networks.

Gate to North Pier

Gate to South Pier

UNLOADING/LOADING POSITIONS

The port has no ramps or docks for truck operations. The military should build or bring ramps for offloading trucks and trailers that do not have integral ramps.

Presently, there is no rail operations at the Port of Tonghae. Future plans include placing at least one spur into the port.

OFFSITE OPEN STORAGE

Until the west end of the slip is extended for additional wharfage, the 10-acre undeveloped area can support offsite open storage. Another 10-acre area is along the water, about 1 mile north of the port. Both areas are uneven with poor drainage.

MATERIALS HANDLING EQUIPMENT (MHE)

Several mobile cranes are available from local stevedoring companies. None have the capacity to handle maximum weight containers. The port does not have any other MHE.

Local Mobile Cranes

CRANE CAPACITY (STON)	QUANTITY
99	4
77	2
55	2
33	3

Mobile Crane Used at Port of Tonghae

AMMUNITION

The Port of Tonghae has no experience in handling ammunition. It is doubtful the Ministry of Maritime Affairs and Fisheries (MMAF) would grant permission for ammunition handling with the POL bunkers nearby.

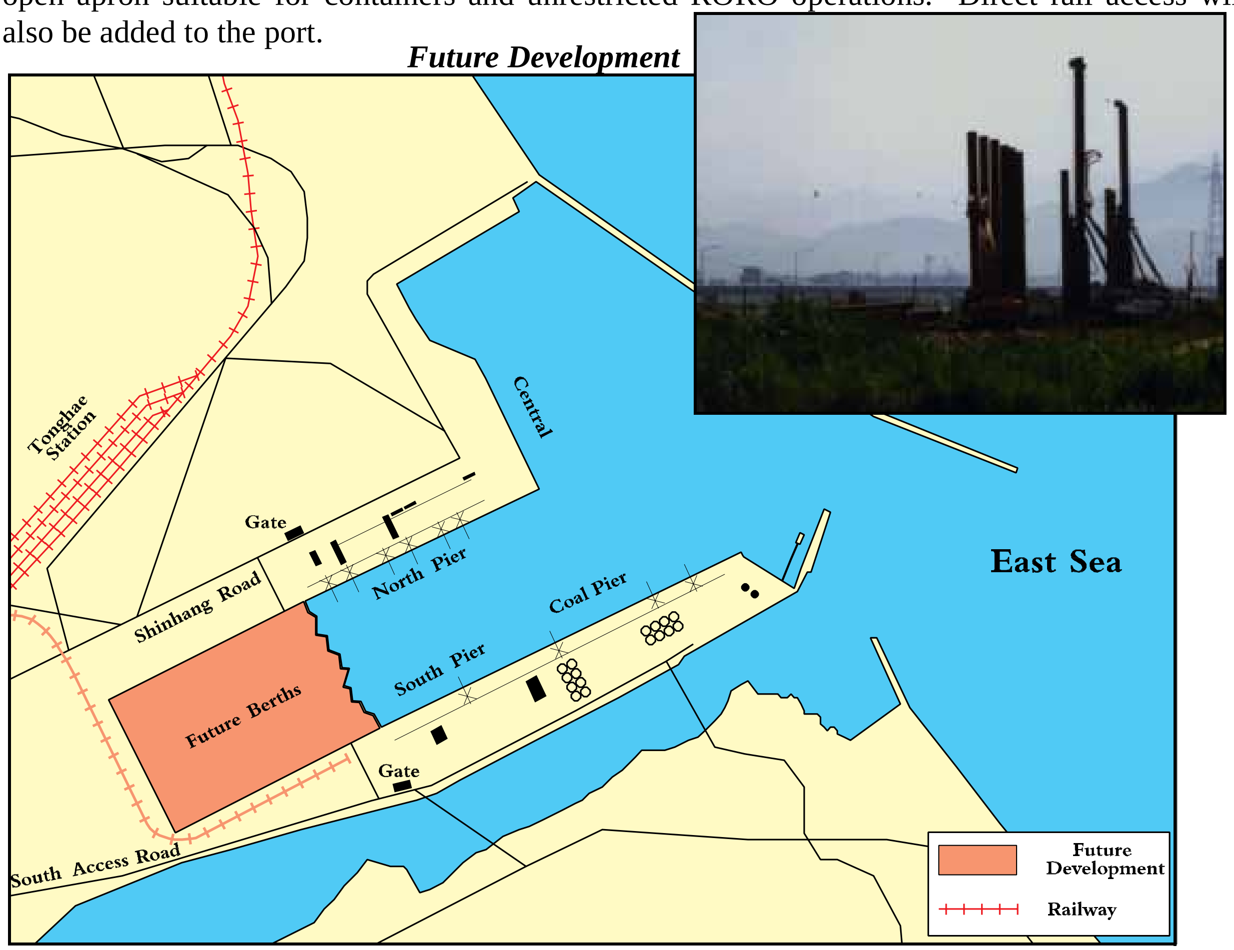
PETROLEUM, OIL, AND LUBRICATION (POL)

A small POL bunker facility is at the outboard end of the Coal Pier, for bunker C and diesel fuels. The facility does not connect to the Trans-Korea Pipeline. There are 10 POL bunkers near the Coal Pier that store 24,000 kiloliters. The pier can transfer POL at about 250 kiloliters per hour.

FUTURE DEVELOPMENT

The construction has begun to extend the North and South Piers to the west by about 1,200 feet. Conveyor lines will likely continue onto the wharfage; however, the new West Pier may have an open apron suitable for containers and unrestricted RORO operations. Direct rail access will also be added to the port.

Future Development

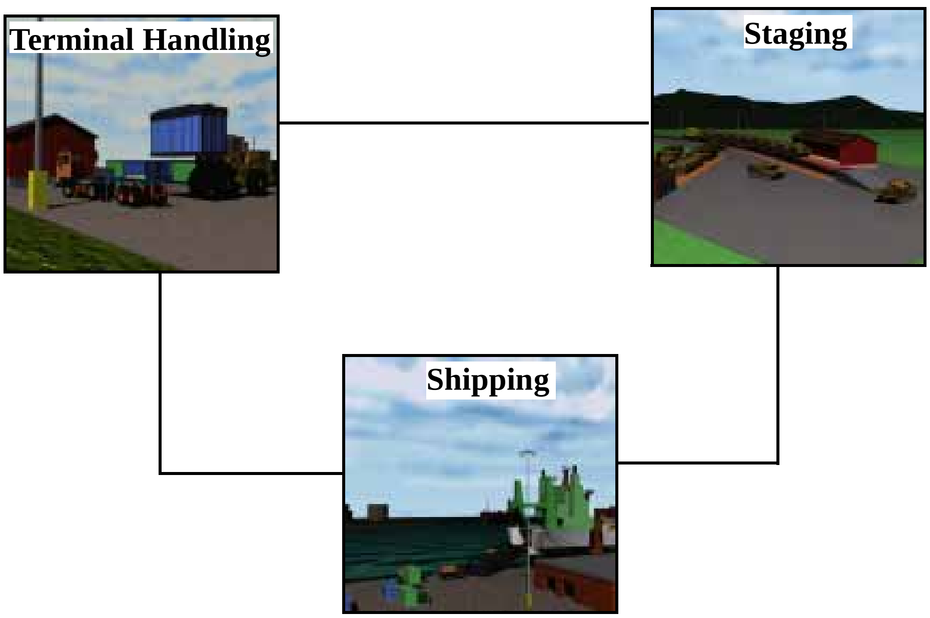


Future Expansion at Port of Tonghae

II. THROUGHPUT ANALYSIS

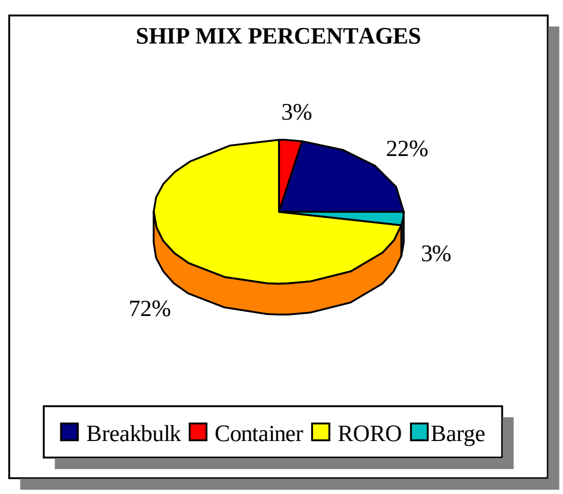
GENERAL

This section evaluates the throughput capability of the Ports of Tonghae using the port operational performance simulator (POPS) computer model. The model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, hardstand marshaling, and terminal processing/handling - in short tons (STON) per day.



Terminal Throughput Subsystems

Based on current activity level at the port, the analysis assumes that 80 percent of the port facilities will support military deployments. Also, due to the size of the port, we assumed a berth utilization factor of 80 percent. The ship mix is determined by Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



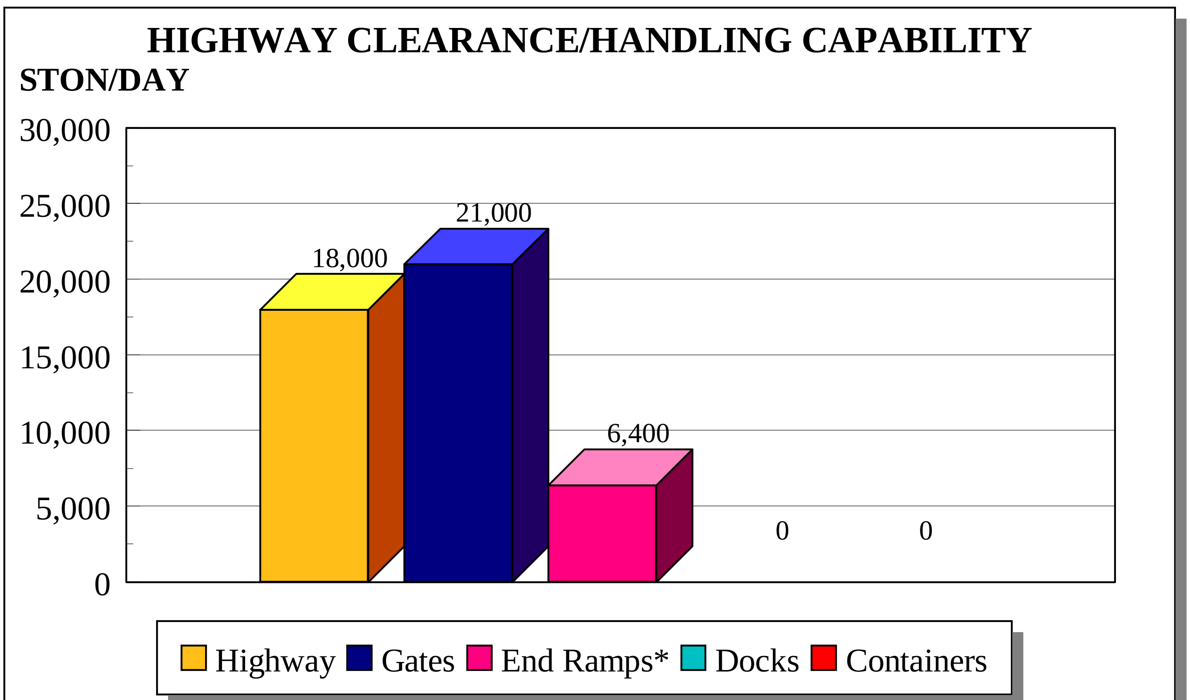
RECEPTION/HANDLING

Highway

The most restrictive highway link to or from the port is the Port Access Road leading to the gates of the port. This road is very narrow and can be blocked by disabled vehicles. The road network in and out of the terminals, including the gate processing of vehicles, could handle about 18,000 STON (63,000 MTON) of equipment and supplies per day.

Roadable vehicles in convoys will process directly to the open storage areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable end ramps brought or built by the military port operator.

There are no truck docks or container handlers at the port.



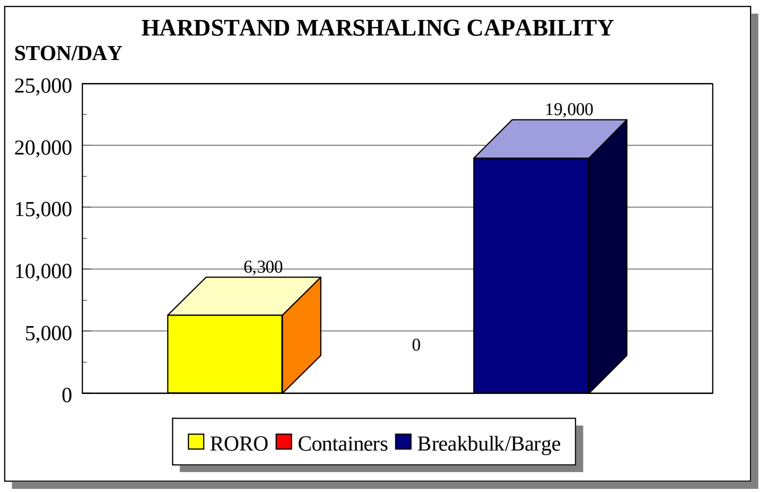
*Four portable or temporary ramps are assumed available.

Rail

The port has no rail reception capability.

Open Storage

The port has about 10 acres of paved open storage. The large sections of open storage are inland of the Coal and Central Piers. The remaining open storage is the aprons along the North and South Piers. There is no covered storage.

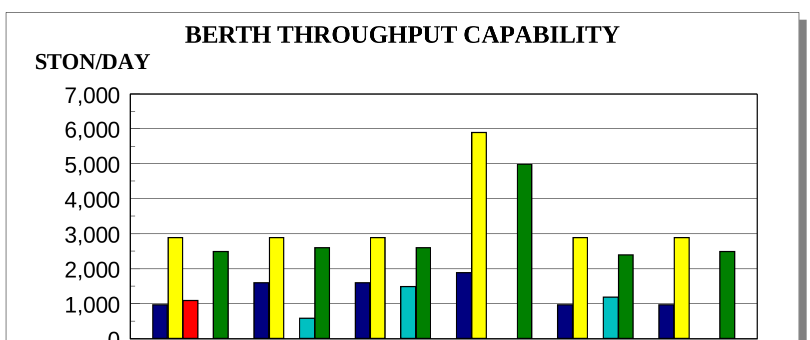


Shipping

Throughputs for each berth are shown below. They are based on various factors including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility. The appendix provides these operation factors. Although these values provide the shipping rates, few ships can be loaded to their maximum draft.

CONVERSION FACTORS

Breakbulk or Barge	.4 STON per MTON
RORO	.25 STON per MTON
Containers	.4 STON per MTON



	CENTRAL	N20-21	N22-23	S11-12	S13-14	COAL
Breakbulk	970	1,600	1,600	1,900	970	970
RORO	2,900	2,900	2,900	5,900	2,900	2,900
Containers*	1,100	0	0	0	0	0
Barge	0	590	1,500	0	1,200	0
Mixed	2,500	2,600	2,600	5,000	2,400	2,500

*This assumes the military will provide a 100-ton mobile crane.

THROUGHPUT SUMMARY FOR PORT OF TONGHAE PER DAY

BERTH	LENGTH (feet) (meters)	DEPTH (feet) (meters)	BB (STON) (MTON)	RORO (STON) (MTON)	RORO SQ FT (EST)	RORO PIECES	CNTNR (STON) (MTON) (TEU)	BARGE (STON) (MTON)	MIXED (STON) (MTON)
Central	885 278	41 12.5	2,800 7,600	890 3,600	18,000	110	1,100 2,700 130	0	2,500 9,600
North 20-21	1,050 320	38 11.6	2,800 7,700	900 3,600	18,000	110	0	590 1,500	2,600 9,700
North 22-23	1,150 350	36 11	2,800 7,800	910 3,600	18,000	110	0	1,500 3,700	2,600 9,800
South 11-12	1,444 440	38 11.6	5,600 15,000	1,800 7,100	36,000	210	0	0	5,000 19,000
South 13-14	968 295	35 10.7	2,700 7,500	880 3,500	18,000	110	0	1,200 2,900	2,400 9,400
Coal	886 270	41 12.5	2,800 7,600	890 3,600	18,000	110	0	0	2,500 9,600
Note: Number for RORO pieces is based on 170 square foot per piece accomplished during Desert Shield/Storm.									

The type of ship preferred at each berth is based on the methodology described in the appendix. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation below gives no considerations for enhancements, such as equipment. The lower the number for a berth, the better the berth is suitable for loading and unloading operations.

PREFERENCE BERTH SELECTION

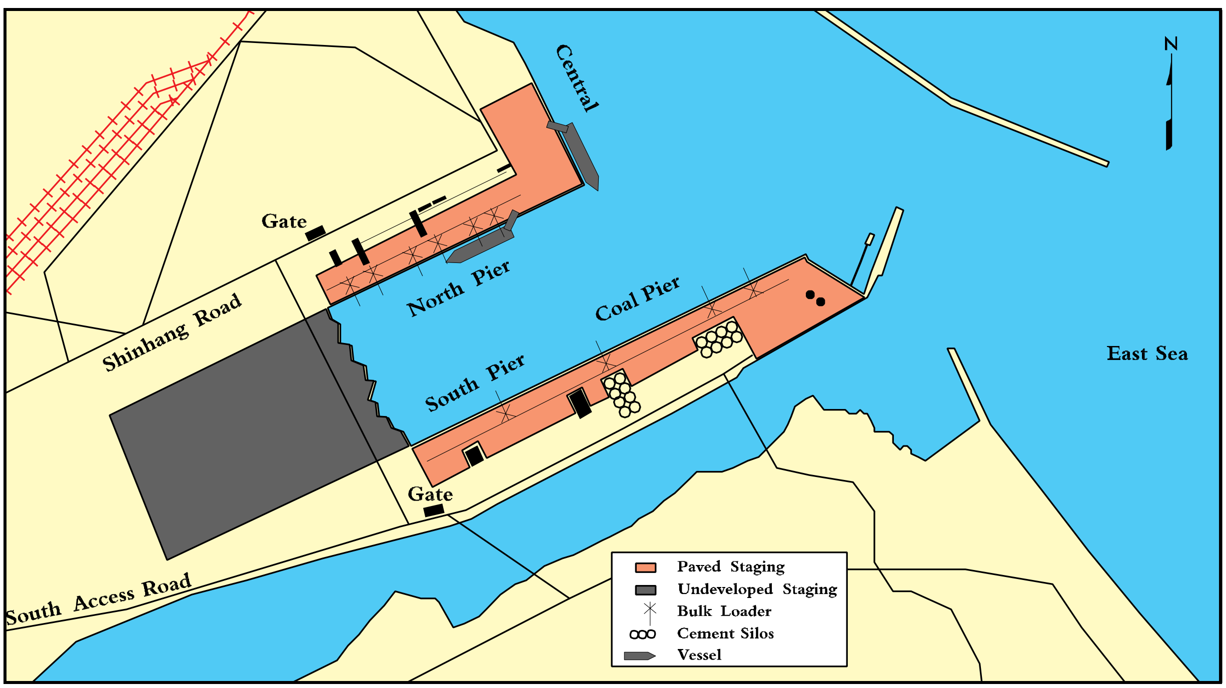
BERTH	BB	RORO	CNTNR	BARGE
Central	1	1	1	1
North 20-21	1	2	-	2
North 22-23	1	2	-	2
South 11-12	1	2	-	2
South 13-14	6	5	-	2
Coal	1	5	-	2

Overall, the Central Pier and the outboard end of the North Pier are best suited for military operations. The reason is that they both can use the open storage at the Central Pier. Although the Central Pier is short for FSS operations, an FSS could extend into the basin to conduct operations. The Coal Pier also has some open area, but it is largely obstructed by the coal conveyor and bulk loading equipment.

III. APPLICATION

This section evaluates the port's throughput capability for deploying a notional armored brigade. This analysis evaluates the deployment using vessels of the 2nd LT John P. Bobo (MPS-AMSEA) class, such as the 1st LT Daldomero Lopez. These vessels have a maximum draft of 32 feet, 1 inch, (9.8 meters), which is within the capability of the port. The semi-slewing stern ramps can operate along contiguous wharfage.

Currently, the facility use depends on decisions made by the Korean Ministry of Defense and MMAF. Because of the Korean commitment to the defense of their country, and considering current facility use of the port, we assume all of the port will be made available for military use. We also assume that no other military units (US or Republic of Korea) will be competing for port assets, both transporters and people, will be available to adequately offload the ship and clear the port.



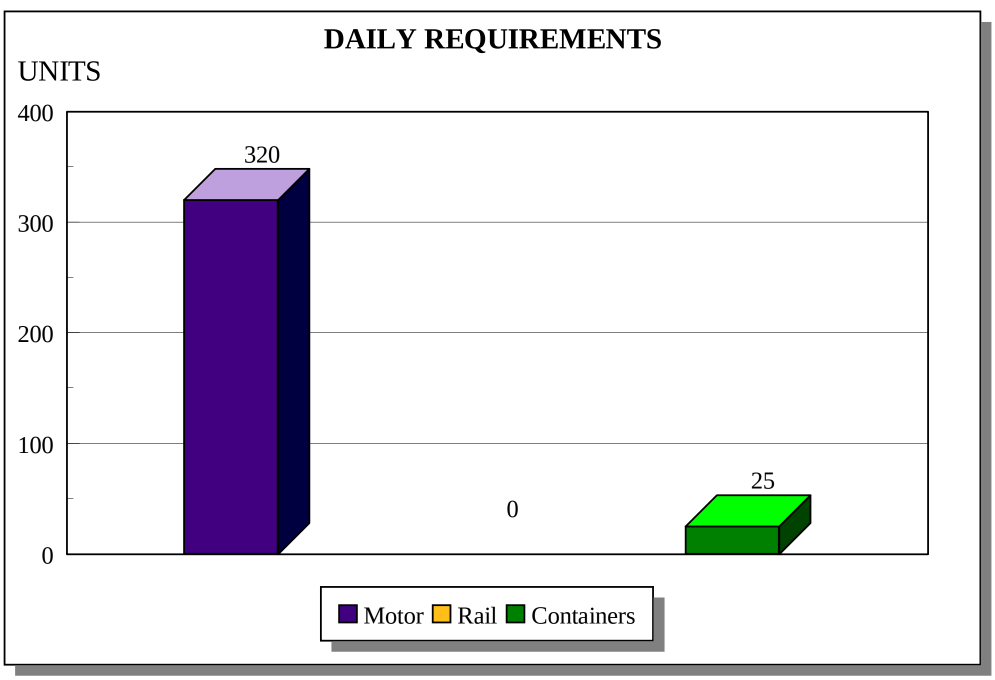
Potential Port Use During Deployment

REQUIREMENTS

The likely requirement for the Port of Tonghae would be to deploy a notional armored brigade to support the overflow of deployment operations at larger ports. We assume the port must deploy the brigade in only six days of offloading and port clearance. The brigade has to move about 2,820 vehicles and 150 containers. There are currently no rail facilities at the port, and the nearby rail station is insufficient to support military operations. All deployment inland is by highway. Using an OCONUS motor/convoy option, about 1,260 (210 per day) roadable vehicles would drive out the gates towing 820 (140 per day) trailers. Also, about 230 forty-foot flatbeds (40 per day) and 410 Heavy Equipment Transporters (HET) (70 per day) would transport non-roadable equipment. About 25 containers would arrive daily.

ARMORED BRIGADE

Total Equipment		Required Daily Throughput
Volume	95,800 MTON	16,000 MTON
Weight	31,703 STON	5,300 STON
Area	642,645 SQ FT	107,100 SQ FT
Vehicles	2,823	460
Containers	150	25

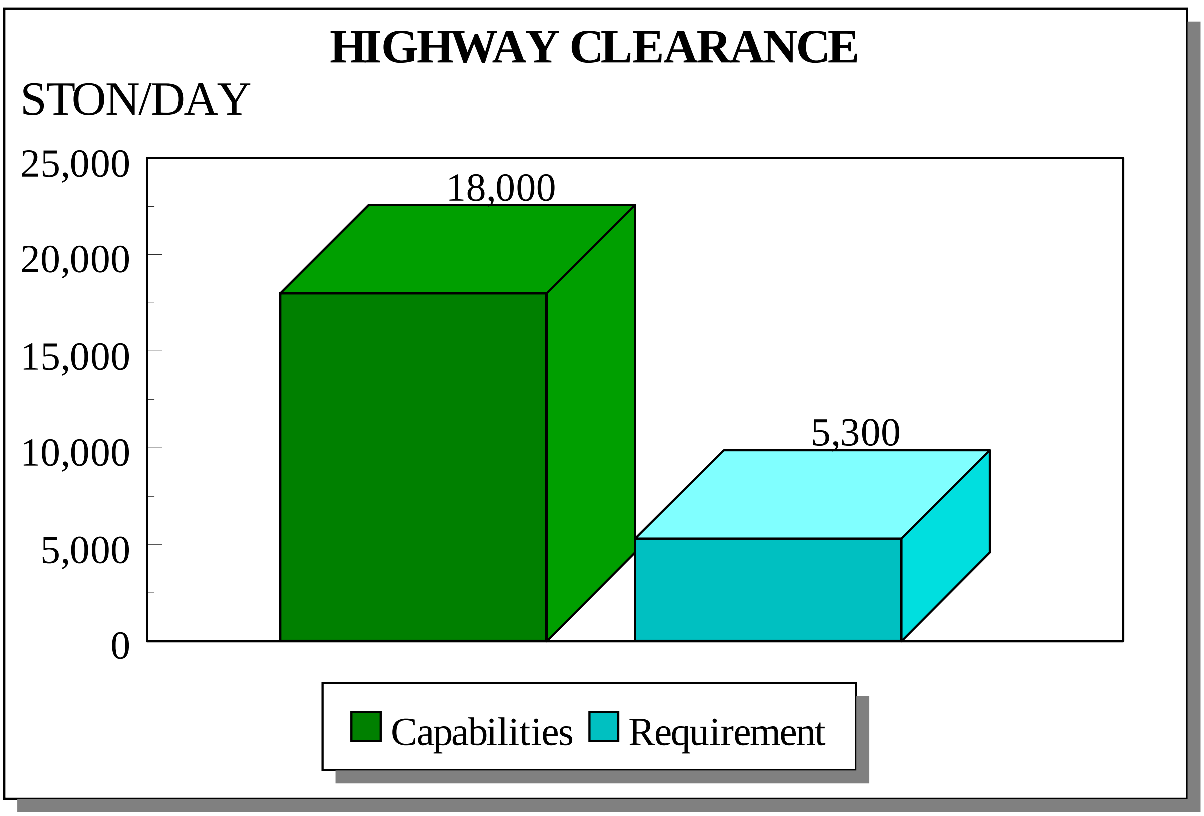


TERMINAL INPROCESSING/HANDLING

Highway

Because there is no rail access to the port, all vehicles will have to convoy along Shinhang Road to Route 7, which connects to Expressway 5 to the north. Shinhang and Route 7 are both two-laned. Shinhang might restrict traffic if a vehicle breaks down. Roads further inland of the port are four-laned. The routes are shown on the Highway Access and Land-Use maps earlier in this analysis.

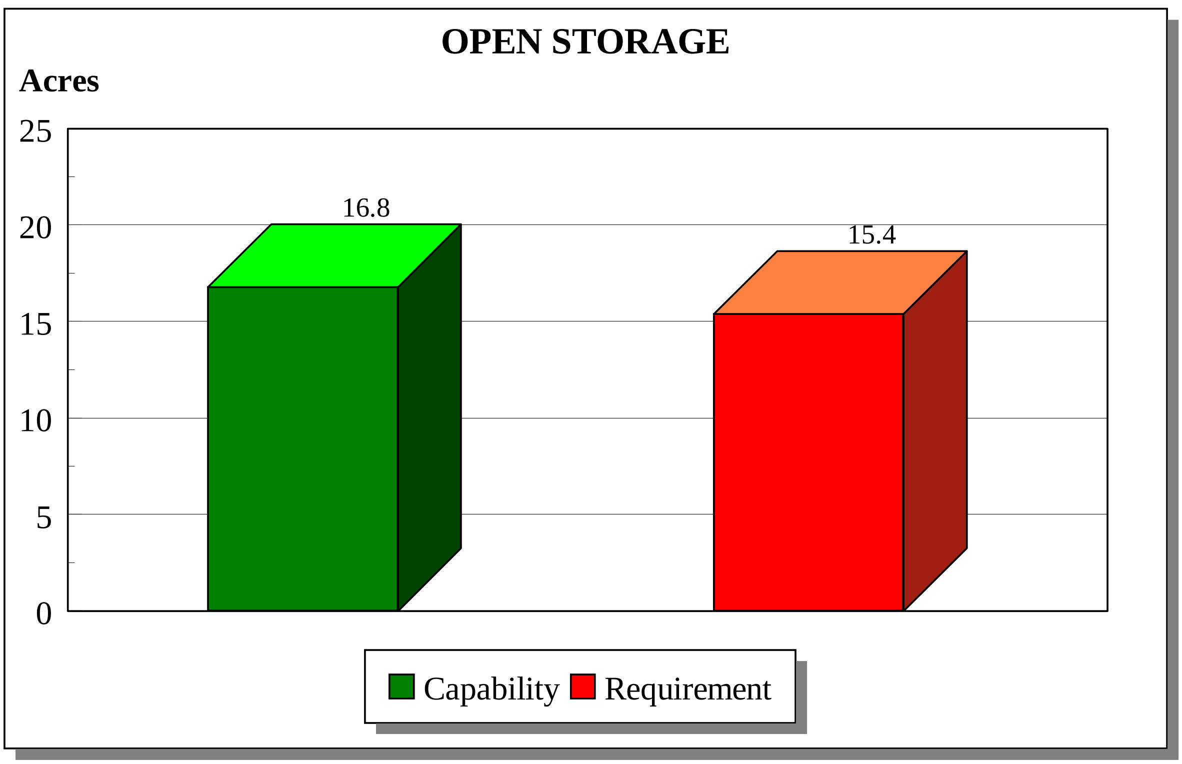
Assuming a constant flow of vehicles out the gates of the port the daily clearance requirement is 5,300 STON. The Tonghae road network can easily support the requirement to deploy the armored brigade in six days.



Open Storage

The port has only 10.8 acres (44,000 square meters) of paved open storage area. We assume the equipment will marshal in open areas away from the aprons. Some vehicles will mashal on the ten open undeveloped acres west of the port. This area is only 60 percent effective due to poor drainage. Although not considered in this analysis, the 10-acre beach-front area a mile north of the port might also support marshaling. This area is also poorly drained.

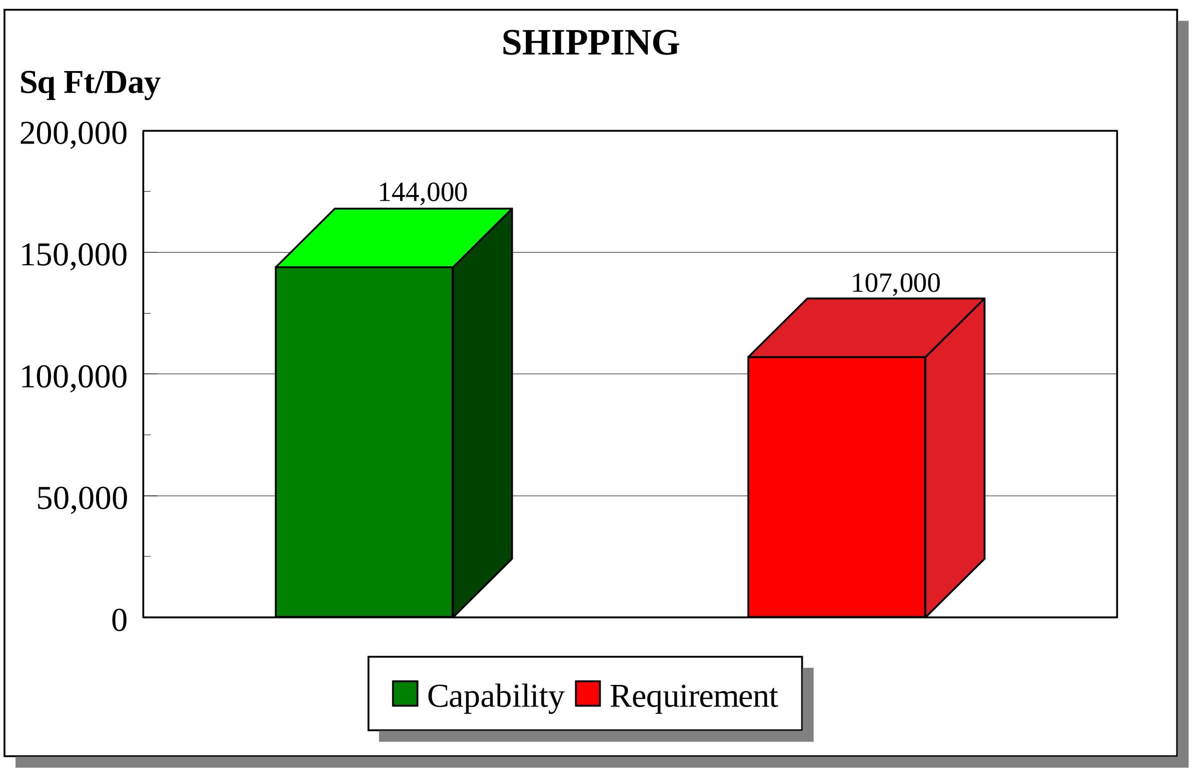
Marshaling the entire brigade of equipment (642,645 square feet) requires 37 acres. We assume the maximum amount in the port at any time is about one and a half days of the required port throughput. This requires the port to provide 15.4 acres of paved open area to support the deployment. The port can meet the requirement.

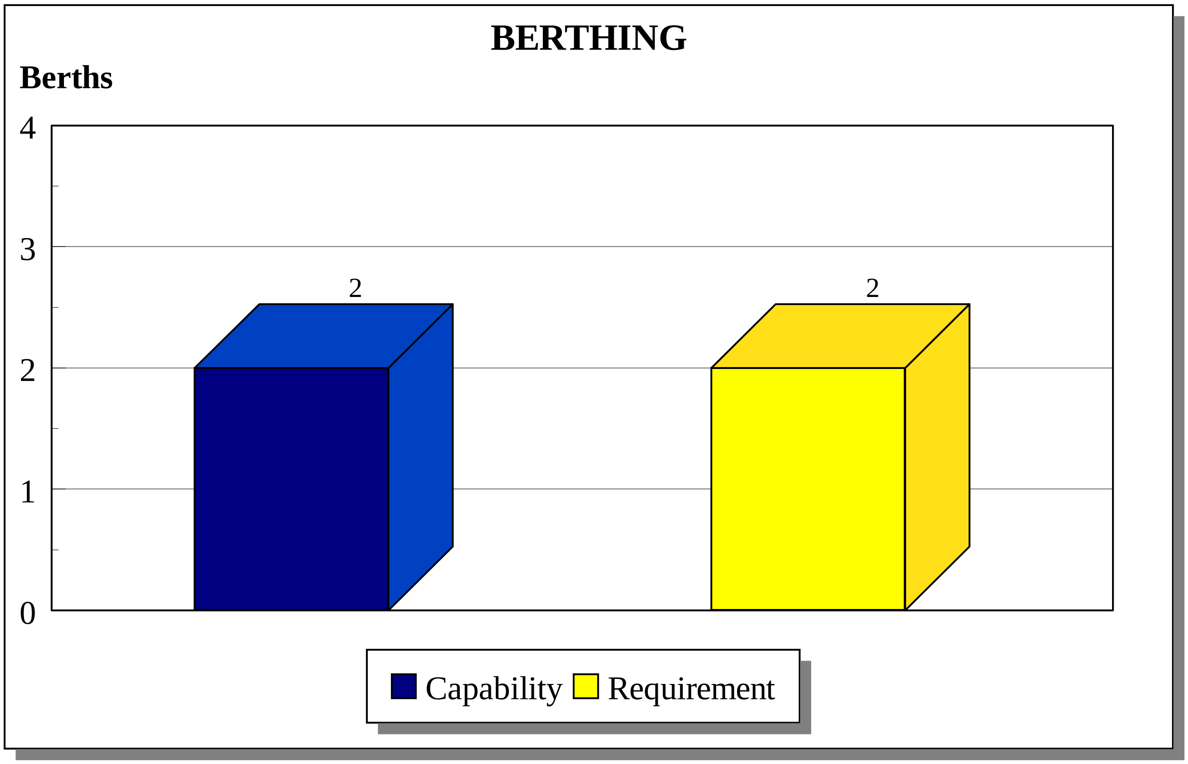


Shipping

An armored brigade has 642,645 square feet of vehicles and equipment. The deck space on the 2nd LT John P. Bobo (MPS-AMSEA) class vessels is 256,566 square feet, not including the container cells, which can carry an additional 546 TEUs. Assuming a 75 percent stow factor, each of these vessels can carry 192,242 square feet of vehicles and equipment. At this rate, the deployment of the brigade would require only 3.3 of these vessels, if each were fully loaded. Unloading RORO vessels this size can be done in under two days. To meet the six day requirement, the port will have to berth two of these vessels simultaneously for one loading cycle. The other two loading cycles will only involve one vessel. The maximum requirement for berthing is two 2nd LT John P. Bobo (MPS-AMSEA) class vessels.

Two 2nd LT John P. Bobo (MPS-AMSEA) class vessels can berth and operate at the port simultaneously. The map earlier in this section provides the berthing configuration. Because of the congestion of the ships so close together, the off-loading rate of the "extra" vessel will be reduced to about fifty percent of maximum. At most, it might require four days instead of two to off-load if fully loaded. This extra vessel, however, will not necessarily be fully loaded. Since this partially-loaded vessel can take the entire six days to off-load, the port can meet the requirement to berth two vessels simultaneously.





SUMMARY

The Port of Tonghae can deploy a notional armored brigade in six days. For two days of the deployment, two vessels will have to operate simultaneously. To accomplish this, the vessels must be berthed as shown on the earlier Application map. Including the adjacent undeveloped area, the port has adequate open area to support the deployment.

The highway access to the port is sufficient to meet the requirement. There are no rail facilities that can support military operations. Vehicles and equipment must convoy away for the port.

RECOMMENDATION

We recommend the Port of Tonghae be considered to deploy brigade-sized units, provided further deployment by rail is not required. Plans should call for the use of the outboard section of the North Berth, and the Central Berth. All the port's paved open staging and some of the undeveloped land must be made available to support the military.

July 96

SUMMARY OF PORT THROUGHPUTS

PORT	BREAKBULK THROUGHPUT STON (MTON)	RORO THROUGHPUT STON (MTON)	CONTAINER THROUGHPUT STON (MTON)	BARGE THROUGHPUT STON (MTON)	MIXED THROUGHPUT STON (MTON)
KUNSAN	8,400 (21,000)	15,000 (59,000)	4,800 (12,000)	3,900 (9,500)	12,100 (48,500)
KWANGYANG	11,900 (29,700)	47,100 (188,800)	19,300 (48,500)	1,800 (4,400)	38,600 (149,600)
MASAN	9,700 (24,400)	29,800 (119,400)	1,900 (7,700)	4,000 (10,000)	24,300 (93,800)
MOKPO	3,200 (8,000)	5,900 (23,600)	0	1,500 (3,700)	6,300 (22,300)
MUKHO	2,300 (5,700)	4,800 (19,200)	1,100 (2,700)	2,700 (6,600)	4,100 (15;900)
OKKYE	NDU[2]	NDU	NDU	NDU	NDU
POHANG	14,400 (36,000)	33,000 (132,000)	0	4,200 (10,600)	29,500 (111,300)
PUSAN (CURRENT)	40,400 (101,200)	93,700 (490,900)	224,700 (561,800)	16,700 (41,700)	91,000 (339,500)
PUSAN (PROJECTED)[1]	47,900 (119,900)	113,600 (570,500)	275,500 (688,700)	16,700 (41,700)	109,000 (406,800)
PYONGTAEK	NDU	NDU	NDU	NDU	NDU
SAMCHOK	1,200 (3,100)	5,800 (23,200)	0	2,100 (5,100)	4,700 (18,200)
SOKCHO	400 (900)	0	0	900 (2,200)	400 (1,000)
TAESAN	NDU	NDU	NDU	NDU	NDU
TONGHAE	8,100 (20,200)	20,600 (82,600)	0	3,200 (8,100)	17,600 (67,300)

[1] Includes Kamman Container Terminal

[2] NDU - Not deployment useful. These ports conduct bulk or POL operations only.

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THROUGHPUT PARAMETERS

BREAKBULK RATES		
SHIP OPERATIONAL RATES	STON/HR	MTON/HR
Ship Crane	15.0	37.5
Dockside Cranes	20.0	50.0
Barge	20.0	50.0
RORO Rates	200.0	800.0
Container Lift Rates	21.0 Lifts/Hr Container Crane	8.0 Lifts/Hr Wharf Crane
Berth Utilization Factor = 0.8		
Exceptions: Container Lift Rate 28.0 lifts/hr (Container Crane)and 12.0 lifts/hr (wharf crane) at Pusan Berth Utilization Factor = 0.9 at Masan and Pusan		

Ship Mix Percentages	%
BreakBulk	22.0
Barge	3.0
RORO	72.0
Container	3.0

Minimum Mobile-Crane Size	STON
Breakbulk	40.0
Barge	20.0
Container	100.0

Ship Cargo Mix			
	Breakbulk	RORO	Container
Roadable Vehicles	43%	90%	
Nonroadable Vehicles	7%	10%	
Container	15%		100%
Noncontainer	35%		

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Staging Data:	
Staging Dwell Time	3 Days
Space Utilization Factor	
Open	60%
Covered	60%
Facility User Factor	80%

Stacking Height	Feet
Open - General	7.5
Covered	10
Open - Vehicle	7.6

Motor Vehicle Parameters	STON	MTON
Convoy	3.5	17.0
Flatbed	20.0	60.0
Van	16.0	40.0
Chassis	16.0	40.0
Railcar Parameters	STON	MTON
Flatcar	50.0	150.0
Boxcar	30.0	75.0
COFC	24.0	60.0
Container (TEU) Capacity	8.0	20.0

Truck Handling Rates	Trucks/Hr
End Ramps	4.0
Van Docks	1.0
Railcar Handling Rates	Railcars/Hr
End Ramps	4.0
Boxcar Docks	0.3
Length of Flatcars	55 Feet
Productive Work Hours	20 Hours

Mode Mix	%	%
Roadable Veh: Convoy/Flatcar	90	10
Nonroadable Veh: HETs/Flatcars	10	90
General Cargo:		
Van/Box	35	15
Flatbed/Flatcar	35	15
Container:		
Chassis/COFC	75	25

IDEAL BREAKBULK BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Transit Shed**	
Quay or marginal	10	Available	15
Pier	7	None	0
Berth Length (ft)		**Deck Strength (lb per ft^2)**	
Greater than 750	20	Greater than 800	10
700 to 750	18	600 to 800	9
600 to 699	16	400 to 599	5
500 to 599	10	Less than 400	2
Less than 500	5		
Water Depth (ft) MLW		**Ship Service Facilities**	
Greater than 35.0	20	Power, water, and telephone	6
32.0 to 35.0	18	Power and water	5
30.0 to 31.9	16	Water only	4
28.0 to 29.9	14	None	0
Less than 28.0	12		
Apron Width (ft)		**Cranes**	
20.0 or greater	15	Wharf	10
Less than 20.0	5	Heavy-lift mobile(≥100 STON)	9
		Mobile	5
		None	0
Apron Tracks		**Conditional Age**	
2	10	New	10
1	7	10 years old	8
None	0	20 years old	4
		30 years old	1
Vehicle Access		**Staging Access**	
Uncongested	10	At least 435,600 sq ft (10 acres) (large RORO)	10
Moderated Congestion	5	At least 173,345 sq ft (4 acres) (small RORO)	7
Congested	0	At least 114,692 sq ft (2.6 acres) (small Breakbulk)	5
		Over 100,000 sq ft (2.3 acres)	4
		10,001-100,000 sq ft (.2-2.3 acres)	3
		0-10,000 sq ft (0-.2 acres)	1

IDEAL RORO BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Apron Tracks**	
Quay or marginal	10	2	10
Pier	5	1	7
		None	0
Berth Length (ft)		**Deck Strength (lb per ft^2)**	
Greater than 1,000	20	Greater than 800	10
900 to 1,000	18	600 to 800	9
800 to 899	16	400 to 599	5
700 to799	10	Less than 400	2
600 to 699	6		
Less than 600	2		
Water Depth (ft) MLW		**Ship Service Facilities**	
Greater than 35.0	20	Power, water, and telephone	6
32.0 to 35.0	18	Power and water	5
30.0 to 31.9	16	Water only	4
28.0 to 29.9	14	None	0
Less than 28.0	12		
Apron Width (ft)		**Vehicle Access**	
Greater than 60.0	20	Uncongested	10
40.0 to 60.0	15	Congested	5
30.0 to 39.9	5		
Less than 30.0	0		
RORO Ramp Operation		**Conditional Age**	
Side, slewed, straight	10	New	10
Side, slewed-stern	6	10 years old	8
Slewed-stern	4	20 years old	4
Starboard-slewed-stern	2	30 years old	1
None	0		
Tidal Range (ft)		**Staging Access**	
0 to 3.9	10	At least 435,600 sq ft (10 acres) (large RORO)	10
4.0 to 7.9	8	At least 173,345 sq ft (4 acres) (small RORO)	7
8.0 to 11.9	6	At least 114,692 sq ft (2.6 acres) (small Breakbulk)	5
12.0 to 16.0	4	Over 100,000 sq ft (2.3 acres)	4
Greater than 16.0	0	10,001-100,000 sq ft (.2-2.3 acres)	3
		0-10,000 sq ft (0-.2 acres)	1

IDEAL CONTAINER BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Deck Strength (lb per ft^2)**	
Quay or marginal	10	Greater than 1,000	10
Pier	5	800 to 999	8
		600 to 799	5
		400 to 599	3
		Less than 400	1
Berth Length (ft)		**Ship Service Facilities**	
Greater than 1,000	20	Power, water, and telephone	6
900 to 1,000	18	Power and water	5
800 to 899	16	Water only	4
700 to799	10	None	0
600 to 699	6		
Less than 600	2		
Water Depth (ft) MLW		**Container Cranes**	
Greater than 40.0	20	Specialized container crane	20
35.0 to 40.0	18	Mobile gantry	16
32.0 to 34.9	16	Mobile crane (200-ton)	12
30.0 to 31.9	10	Mobile crane (100-ton)	8
28.0 to 29.9	8	None	0
Less than 28.0	6		
Apron Width (ft)		**Container Handling Equipment**	
Greater than 60.0	10	Straddle cranes	10
40.0 to 60.0	9	Straddle trucks	9
30.0 to 39.9	5	Front/side-loading forklifts	8
20.0 TO 29.9	2	Mobile cranes	5
Less than 20.0	1	None	0
Apron Tracks		**Conditional Age**	
2	10	New	10
1	7	10 years old	8
None	0	20 years old	4
		30 years old	1
Consolidated Shed		**Staging Access**	
Available	10	At least 435,600 sq ft (10 acres) (large RORO)	10
None	0	At least 173,345 sq ft (4 acres) (small RORO)	7
Vehicle Access		At least 114,692 sq ft (2.6 acres) (small Breakbulk)	5
Uncongested	10	Over 100,000 sq ft (2.3 acres)	4
Moderated Congestion	5	10,001-100,000 sq ft (.2-2.3 acres)	3
Congested	0	0-10,000 sq ft (0-.2 acres)	1

IDEAL BARGE BERTH FACTORS

Berth Factor	Points	Berth Factor	Points
Berth Type		**Transit Shed**	
Quay or marginal	10	Available	10
Pier	7	None	5
Water Depth (ft) MLW		**Anchorages**	
Greater than 20.0	10	Protected	10
15.0 to 20.0	9	Partially protected	6
10.0 to 14.9	8	Unprotected	2
Less than 10	0	Unavailable	0
Apron Width (ft)		**Tug Availability of 650 hp or Greater**	
Greater than 60.0	10	More than 4	10
40.0 to 60.0	9	3 - 4	**9**
30.0 to 39.9	7	1 - 2	7
20.0 to 29.9	5	None	0
Less than 20.0	1		
Apron Tracks		**Barge Fleeting (Number of Barges)**	
2	10	40 or more	10
1	7	25	8
None	0	10	4
		None	0
Deck Strength (lb per ft^2)		**Conditional Age**	
Greater than 800	10	New	10
600 to 800	9	10 years old	8
400 to 599	5	20 years old	4
Less than 400	2	30 years old	1
Cranes		**Staging Access**	
Wharf	10	At least 435,600 sq ft (10 acres) (large RORO)	10
Heavy-lift mobile	9	At least 173,345 sq ft (4 acres) (small RORO)	7
Mobile	7	At least 114,692 sq ft (2.6 acres) (small Breakbulk)	5
None	0	Over 100,000 sq ft (2.3 acres)	4
		10,001-100,000 sq ft (.2-2.3 acres)	3
		0-10,000 sq ft (0-.2 acres)	1
Vehicle Access			
Uncongested	10		
Moderated Congested	5		
Congested	0		

JUNE 1999

ARMY AMMUNITION PORTS OF JAPAN (Kure Area)

HIRO AMMUNITION STORAGE AREA

AKIZUKI AMMUNITION STORAGE AREA

Ondo Bridge

I. GENERAL DATA

In June 1997, a team of Transportation Engineering Agency (TEA) analysts visited the US Army's 83d Ordnance Battalion, located at Kure, Japan.[1] The unit provides direct and general ammunition logistics support to forces throughout the 9th TAACOM area of responsibility. The battalion also provides a power projection platform for army war reserve and operational project stocks of ammunition. The ammunition stored at the 83d's facilities will be shipped out to other areas in the theater to support contingency requirements.

To accomplish these missions, the unit operates three ammunition storage areas in mainland Japan (and one in Okinawa, not addressed in this report). Two of the areas, **Hiro Ammunition Storage Area** and **Akizuki Ammunition Storage Area,** also provide facilities to transship ammunition by barge. The other site, Kawakami Ammunition Storage Area, is located well inland accessible only by highway or helicopter.

Although the battalion is headquartered at Kure, and Army watercraft that support operations are berthed there, no ordnance operations are permitted within the Kure Harbor

[1] Data used to support this analysis comes largely from on-site observation by the survey team and information provided by operations and management personnel at the facility. Other data sources used include industry and related publications.

area. Ammunition transshipment operations occur at the anchorages. The ammunition storage facilities of Hiro and Akizuki directly support ammunition operations at the anchorages. Still, the anchorages are actually referred to in the MILSTAMP as water port code UL1, Kure. This often causes confusion when operations are said to take place in either Hiro or Akizuki, when in fact they occur in Kure.

The purpose of our study was to determine the capability of each storage facility to transship cargo, and not to argue geography. Therefore, in this report, the storage facilities will be linked to the explosive anchorage that supports them.

HIRO AMMUNITION STORAGE AREA

Location And General Use

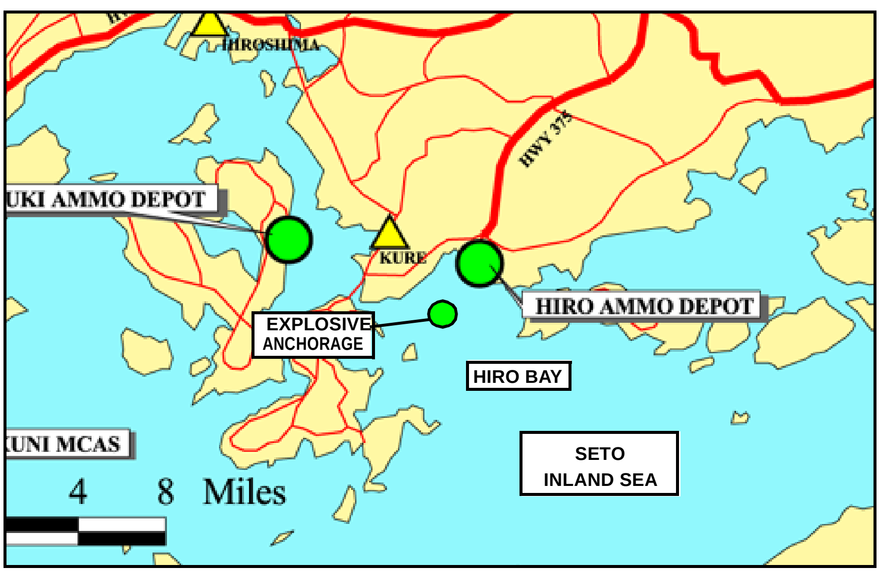
The Hiro Ammunition Storage Area (latitude 34^{o} 13’ north, longitude 132^{o} 37’ east) is located on the eastern edge of Hiro Bay on Japan’s Seto Inland Sea, about 25 miles southeast of Hiroshima. The facility has three ammunition storage structures and currently maintains about 2,500 STON of munitions on hand.

In addition to ammunition storage, there are two barge piers used to transship ammunition. The site also houses the only military container maintenance and repair operation in the theater.

TRANSPORTATION ACCESS

Water

The Port area is accessed directly from the sea. Because of the limited size and depth of the wharf areas at the Storage Area, only barges normally berth at the docks.



Water Access Map

Explosive laden vessels are worked from anchorage (34° 10' 47" north 132° 37' 05" east) and loaded or unloaded in-stream.[2] Tugs move the barges between vessel and pier.

Highway

An extension of State Road 375 is the main supply route (MSR) connecting the Hiro facility with the Japanese National Highway System and other routes in the area. This road joins the primary route 375 and State Road 185 at a junction about 1 mile north of the Storage Area. Route 375 is also the MSR that connects Hiro with the Kawakami Ammunition Storage Area, about 25 miles to the north.

These routes, like all Japanese highways are extremely congested at all times. The following chart shows estimated highway travel distances and transit times.

DISTANCE AND TIME FROM HIRO

LOCATION	MILES	TIME
AKIZUKI	27	1.5 Hours
KURE	8	0.5 Hours
KAWAKAMI	25	1.0 Hour
CAMP ZAMA	544	12 Hours
IWAKUNI	50	2.5 Hours

Highway Access Map

[2] Net Explosive Weight limit at the anchorage is 600,000 lbs, based on latest DOD waiver (signed by CG USARPAC).

The installation has two gates, a main gate that offers access to Hiro during working hours and an auxiliary gate that is normally closed. The security force mans the main gate and limits entry to authorized vehicles and personnel only.

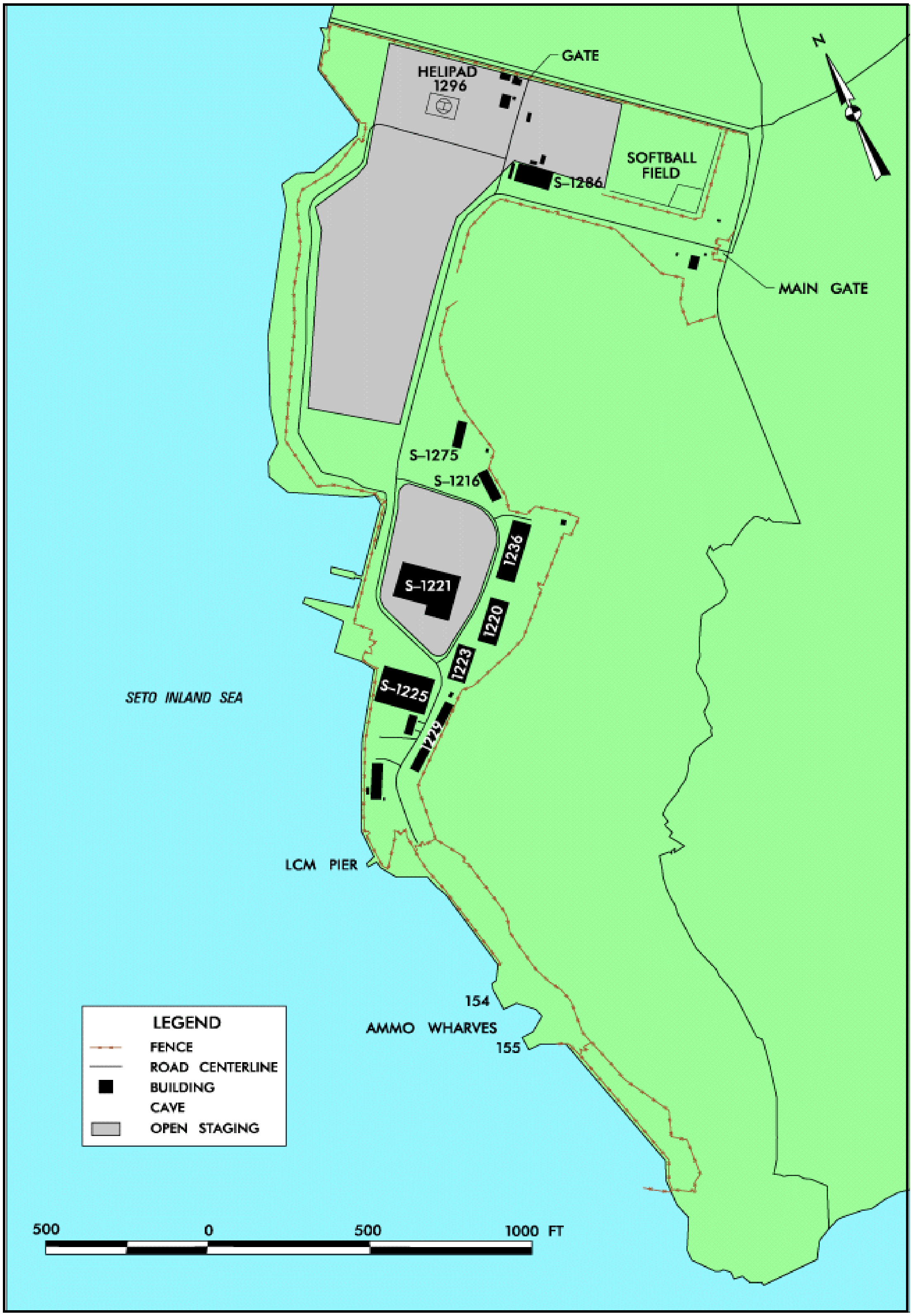
Rail

The Hiro Storage Area is not currently served by rail. In December 1989 a rail spur that connected the facility to the Japanese National railway was removed.

Air

The closest commercial airport to Hiro is the Hiroshima International Airport, about two hours away by highway. The US Marine Corps Air Station Iwakuni is about 50 miles and 2.5 hours away. Hiro does have a helipad. Small quantities of munitions can move by helicopter through the activity, although there are no plans for this type of move.

Hiro Map Model



Hiro Ammunition Storage Area

PORT FACILITIES

Berthing

Hiro has two barge docks, pier 154, which has a working face of 100 feet, and pier 155 with a working face of 50 feet. The piers are constructed of reinforced concrete and have an open wharf design. The water depth alongside the piers is between 26-30 feet. These piers are too small and the water depth too shallow for berthing deep draft commercial type vessels. Shallow draft coaster type ships and small amphibious type vessels may tie up alongside the piers. NEW limits at Hiro piers are 200,000 lbs for class 1.1, and 500,000 lbs for all other classes.

All ammunition vessels are worked at anchorage (34^{o} 10’ 37” N 132^{o} 37’ 05E). A local stevedore contractor provides barges that are shuttled between ships at anchor and pierside at Hiro.

Characteristics	Pier 154	Pier 155
Length (ft)	100	50
Depth Alongside at MLW (ft)	26	30
Deck Strength (psf)	400	800
Apron Width	Open	Open
Apron Height above MLW (ft)	10	10
Number of Container Cranes	None	None
Number of Wharf Cranes	None	None
Apron Lighting	Yes	Yes
Straight Stern Ramp	No	No
Apron Length Served by Rail	None	None

Pier 154

Pier 155

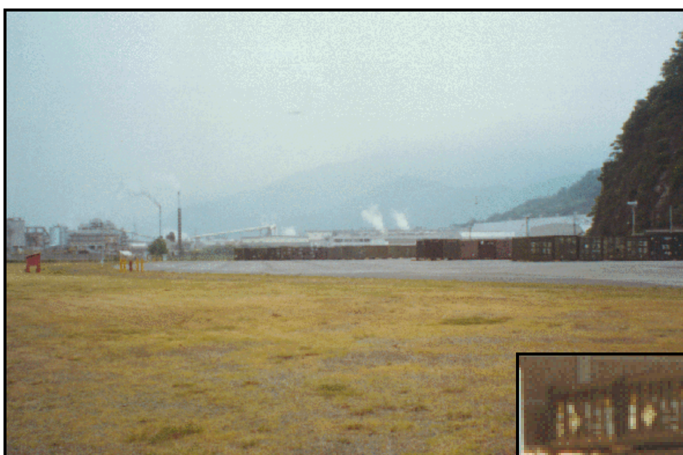
STAGING

Open Staging

The Hiro Ammunition Storage area lies at the foot of a steep forested hill. The Hiro facility has about 13 acres of open staging area, most of which is paved. Of this, the most useable is on the northeast side of the installation, adjacent to the helipad and softball field. This area offers about 8-9 paved acres for staging. The remaining acreage is distributed throughout the depot.

Covered Staging

The facility has three storage structures for ammunition. When the survey team visited Hiro, there were about 2,500 STON of munitions stored in these locations. Other than a building that houses the container repair facility (also used to store empty containers), there are no other buildings at Hiro used for covered staging. The Hiro container repair and storage facility maintains about 200 empty containers on hand. There are numerous old caves and magazines that might support covered staging. However, these are in varying states of repair and may take considerable maintenance to make them usable. Some of these facilities are awaiting removal. In any event, only licensed storage facilities can be used for ammunition storage.



Open Staging at Hiro

Covered Staging at Hiro

UNLOADING/LOADING POSITIONS

Ramps

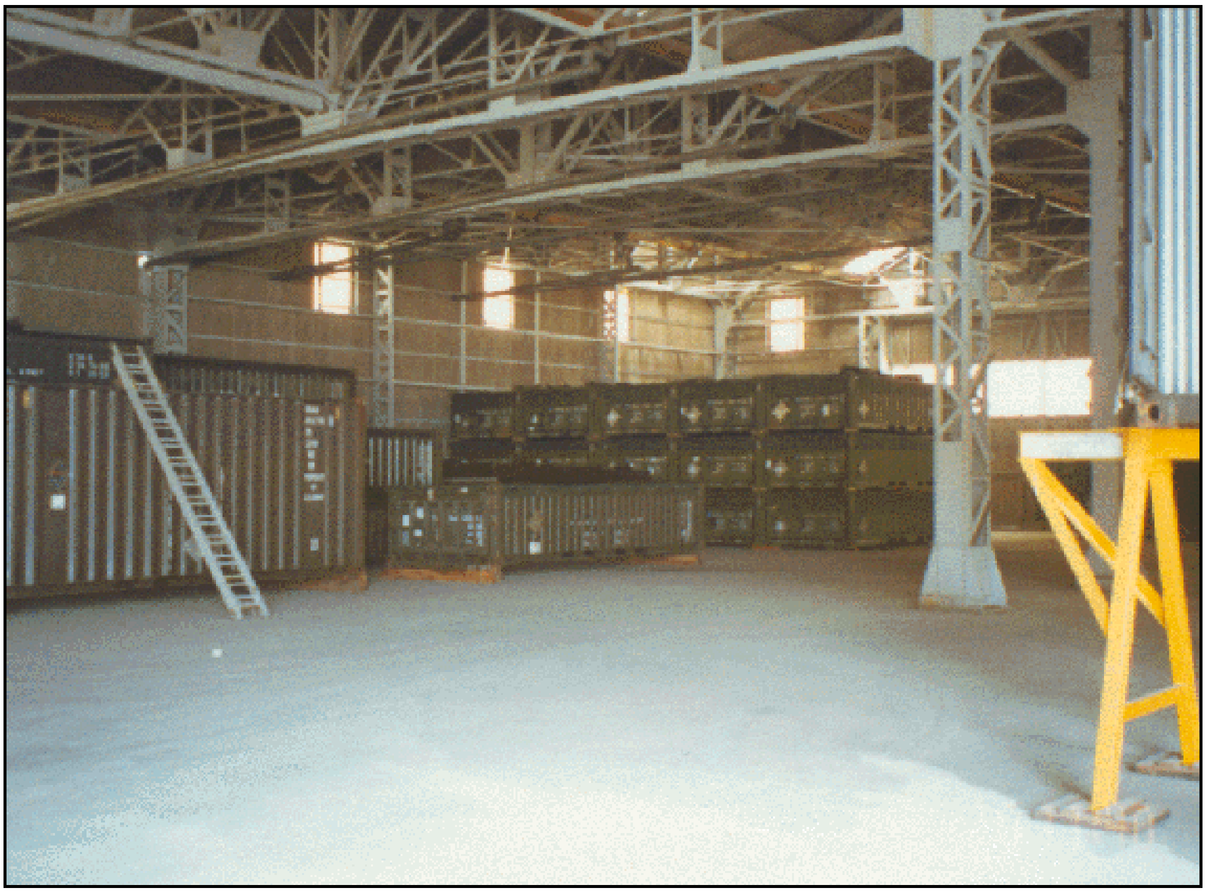
There are no end ramps available in the port. Port operators could construct a temporary ramp(s) if required. Also, the stevedore contractor could provide one if requested.

Docks

The port has no loading docks.

MARSHALING AREAS

There are no marshaling areas in the vicinity of the port.



Hiro Container Repair Facility

KURE AREA MATERIAL HANDLING EQUIPMENT (MHE)[1]

Type of Equipment	Capacity (STON)	Quantity On Hand	Quantity Due In [2]	Total Authorized
Mobile Cranes	140	0	2	2
	25	4	0	0
Container Handlers RTCC	40	1	3	4
Container Handlers Tophandler	40	0	4	4
Forklifts RT	25	0	4	4
Forklifts Diesel	7.5	2	0	1
	5	0	8	8
	2	27[3]	4	26
Forklifts Variable Reach	3	8	0	8
Forklifts Electric	2	8	0	8
	3	5	0	3

[1] This MHE supports all of the 83d Ordnance operations in Japan and may be divided between Hiro, Akizuki, and Kawakami. The stevedore contractor can also provide additional MHE as required.

[2] Items shown are due in against valid requisitions.

[3] Five of these owned by MTMC.

MHE at Hiro

AKIZUKI AMMUNITION STORAGE AREA

LOCATION AND GENERAL USE

The Akizuki Ammunition Storage Area (latitude 34^{o} 14' north, longitude 132^{o} 30' east) is located on the Island of Eta (Etashima). The island is located on the eastern edge of Hiroshima Bay on Japan's Seto Inland Sea, about 25 miles south of Hiroshima. The facility has 27 ammunition storage structures and currently maintains about 27,000 STONs of munitions on hand.

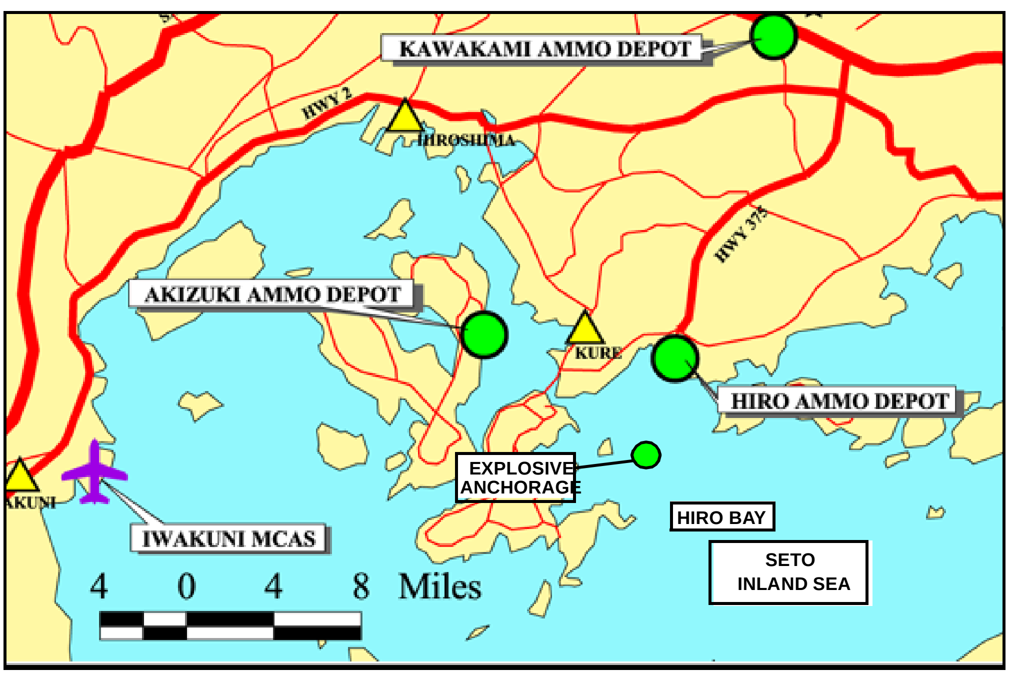
In addition to ammunition storage, Akizuki has two explosive barge berths for handling ammunition transshipments.

TRANSPORTATION ACCESS

Water

The barge berths at Akizuki are accessed directly from the sea. Because of short berth lengths and shallow water depth, only barges are normally worked at Akizuki. Small amphibious and coaster type vessels can call at the berths provided they don't exceed length and depth capability.

Large explosive laden vessels must anchor in stream at 34^{o} 13' 30" North 132^{o} 30' 30" East.



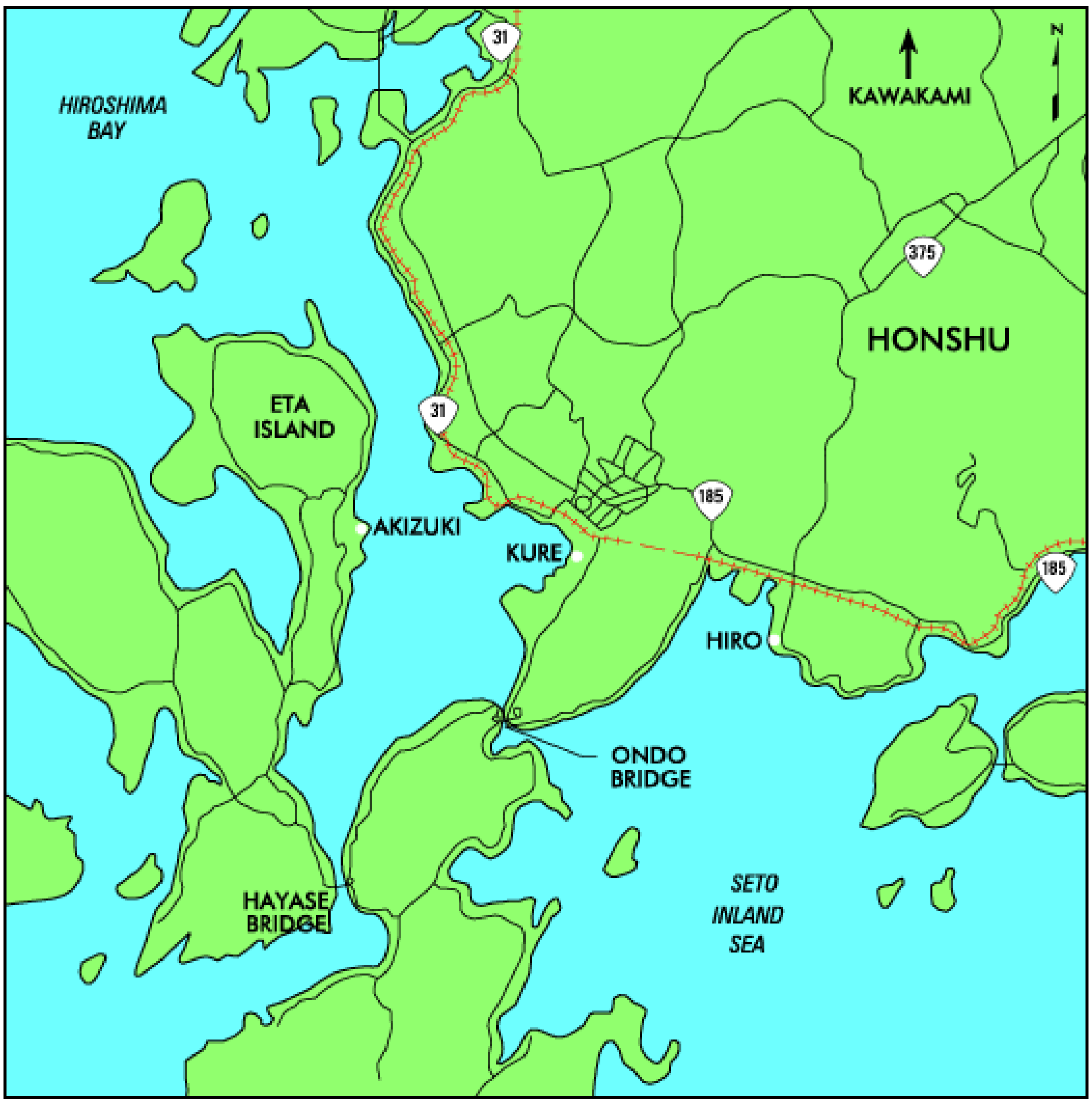
Water Access Map

Ammunition is transloaded at this anchorage from mother ships to barges. Tugs then move the barges from the ship to one of the barge berths or to two other anchorage sites (Ammunition Anchorage A, 34º 13' 55" North, 132º 30' 36" East or Ammunition Anchorage B, 34º 13' 30" North, 132º 13' 30" East).

These anchorage sites have 5,724 feet radii and have maximum Net Explosive Weight limits of 1.5 million pounds each. They serve as barge marshalling or staging areas as well as ammunition ship anchorages.

HIGHWAY

The Hiroshima Prefecture highway system connects Eta Island with the main island of Honshu. Most of this system is two lanes. Also, the route to Eta crosses two bridges, Ondo and Hayase, over which munitions laden vehicles cannot pass.



Highway Access Map

All ammunition moving to or from Akizuki must do so by barge. Like most roads in Japan, the routes connecting Eta to Honshu are very congested. Although only about 19 miles from Kure, travel time by car is about one hour. Likewise, Iwakuni Marine Corps Air Station is about 56 miles away, but takes about three hours to reach by highway.

The Akizuki facility has two gates, the Main Gate and a Back Gate. The Main Gate is manned around the clock by security personnel. The Back Gate is normally closed.

Rail

The Akizuki Storage Area is not served by rail.

Air

The closest commercial airport to Akizuki is the Hiroshima International Airport, about three hours away by highway. The US Marine Corps Air Station Iwakuni is about 56 miles and three hours away. Akizuki does have a helipad. Small quantities of munitions can move by helicopter through the activity, although there are no plans for this type of move.

Akizuki Model Map

PORT FACILITIES

Berthing

Akizuki has two ammunition barge docks, Pier 379 and 380. Characteristics of these berths are shown in the table below. The piers are constructed of reinforced concrete and have an open wharf design. According to local authorities, the depth alongside these two piers is significantly less than at the Hiro piers. The most recent soundings available indicate a working depth of only about 11.5 feet. Only barges and very shallow draft motor vessels can approach the piers. Engineers indicate that a dredging project is planned to bring the area adjacent to the piers to 26-30 feet depth alongside, although they didn't have a schedule for the project. NEW limits at Akizuki Piers is 300,000 lbs for classes other than 1.1. Class 1.1 is not stored at Akizuki.

Ammunition vessels are worked in stream with cargo transloaded to barges that are then shuttled to the piers by contractor tugs.

Characteristics	Pier 379	Pier 380
Length (ft)	66	92
Depth Alongside at MLW (ft)[1]	11.5	11.5
Deck Strength (psf)	800	800
Apron Width	Open	Open
Apron Height above MLW (ft)	14	14
Number of Container Cranes	None	None
Number of Wharf Cranes	None	None
Apron Lighting	Yes	Yes
Straight Stern Ramp	No	No
Apron Length Served by Rail	None	None

[1] Estimate based on sounding provided by Kure Facility Engineers.

Berth at Akizuki Ammunition Port

Akizuki Ammunition Storage Area

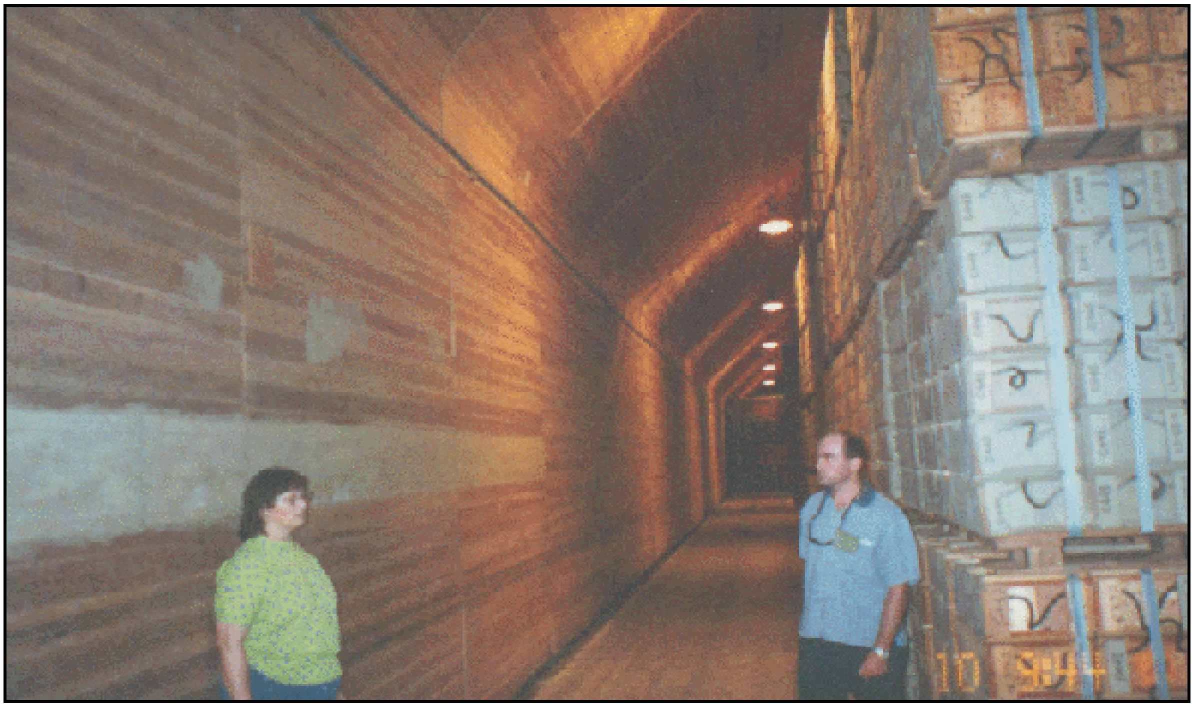
STAGING

Open Staging

The Akizuki Ammunition Storage Area is situated at the foot of a very steep mountainous area between the mountain and the sea. Its location coupled with the storage mission limits open staging to six ammunition pads that offer about 1 acre of staging and another 4-5 acres spaced throughout the facility. These lie mainly adjacent to the piers and the seafront in general. However, various net explosive weight limitations (interline or inter-magazine distance as well as inhabited building distance) may prevent use of much of this area.

Covered Staging

The facility has nineteen caves of which fourteen are currently used to store ammunition. The other five serve various storage purposes or are closed. Most of the ammunition storage caves provide about 17,000 square feet of storage. Akizuki also has fourteen warehouses or ammunition magazines. Most of these are used to store explosives. A typical warehouse provides between 2000 and 10,500 square feet of storage space. Building S-302, a general-purpose warehouse, provides about 46,000 square feet of space.



Covered Staging

UNLOADING/LOADING POSITIONS

Ramps

There are no end ramps available at the facility. Port operators could construct a temporary ramp(s) if required. Also, the stevedore contractor could provide one if requested.

Docks

The facility has no loading docks.

MARSHALING AREAS

There are no marshaling areas in the vicinity of Akizuki.

Akizuki Open Support Area

KURE AREA MATERIAL HANDLING EQUIPMENT (MHE)[1]

Type of Equipment	Capacity (STON)	Quantity On Hand	Quantity Due In [1]	Total Authorized
Mobile Cranes	140	0	2	2
	25	4	0	0
Container Handlers RTCC	40	1	3	4
Container Handlers Tophandler	40	0	4	4
Forklifts RT	25	0	4	4
Forklifts	7.5	2	0	1
	5	0	8	8
	2	27[3]	4	26
Electric Forklifts	3	5	0	3

[1] This MHE supports all of the 83d Ordnance operations in Japan and may be divided between Hiro, Akizuki, and Kawakami. The stevedore contractor can also provide additional MHE as required.

[2] Items shown are due in against valid requisitions.

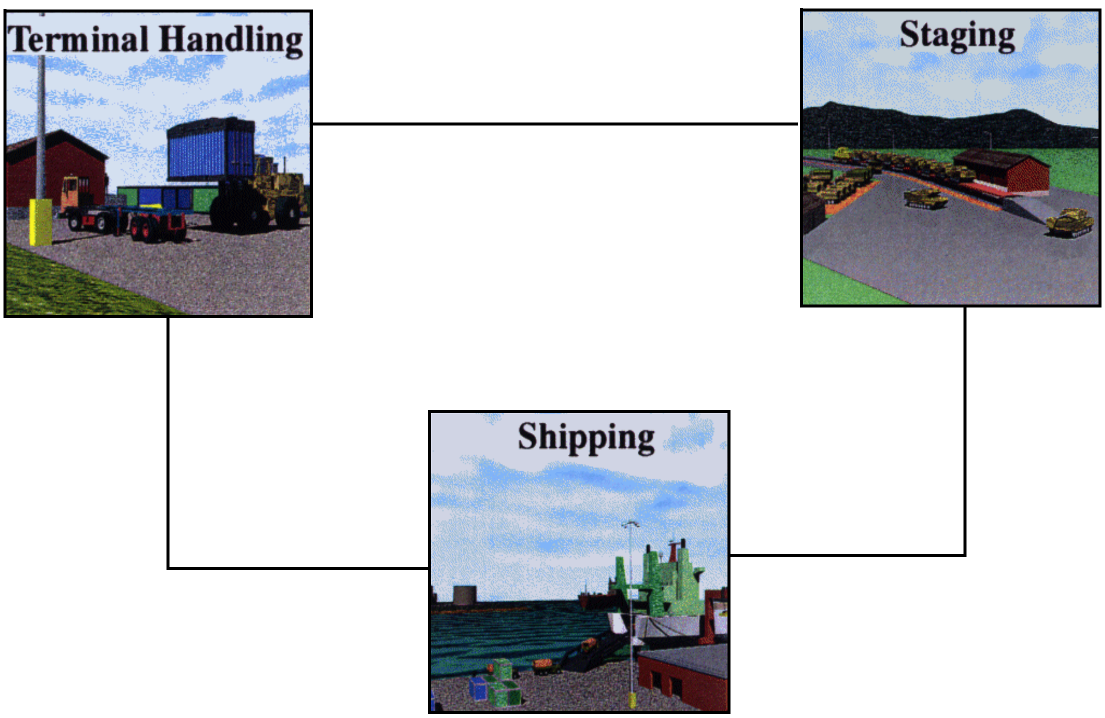
[3] Five of these owned by MTMC.

MHE at Akizuki

II. THROUGHPUT ANALYSIS

GENERAL

For the purposes of this report, cargo throughput at the studied ammunition storage areas is based on each facility's capability to transship ammunition-laden containers. The transshipment operation includes stuffing munitions into containers, staging the containers, loading the containers to barges and transferring the containers from barges to sea going vessels in stream (or the reverse of this process). Using a weak-link analytical approach to these functions will identify the least capable. The weakest subsystem determines the maximum throughput capability of the facility. The analysis yields throughput capability values for each of the subsystems - terminal handling/processing, staging, and ships loading/unloading - in terms of short tons (STON) and measurement tons (MTON) and containers (TEU) per day.



Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations.

TERMINAL HANDLING

Container Stuffing

According to operations personnel at the 83d Ordnance Bn., the Hiro and Akizuki storage facilities' stuffing teams can stuff about **16** containers per day at each facility. Additionally, teams at Kawakami Ammunition Storage area can stuff about **18-21** containers daily. [3] These Kawakami containers can then be transported to Hiro by truck. This gives the Battalion a stuffing total of about **50** containers daily. [4] Converting TEUs to STON and MTON, this equates to about **650 STON/MTON** per day.

Highway

No explosive cargo is permitted to move through Akizuki by highway. Japanese highway traffic regulations prohibit this type of movement.

Current rules also limit the movement of explosives by highway to or through Hiro and Kawakami. Only 10 trucks daily are available to move containers between these two facilities. Because highway congestion limits speed, each truck can only make about three round trips per day. This is reduced to two trips daily during winter, as Japanese law prohibits explosive laden vehicles from operation during hours of darkness [5]. These ten trucks can move the 18-21 containers loaded each day.

Terminal Handling at Akizuki Barge Pier

[3] MHE at Kawakami can only support empty containers. In order to support loaded boxes, operators must contract for MHE.

[4] Each twenty-foot equivalent unit (TEU) is estimated to contain about 13 STONs/MTONs of cargo.

[5] According to movements personnel at the 83d Ordnance Battalion.

RAIL

None of the three storage facilities is supported by railroad.

Dunnage at Hiro

Container Stuffing Lumber Shop

STAGING

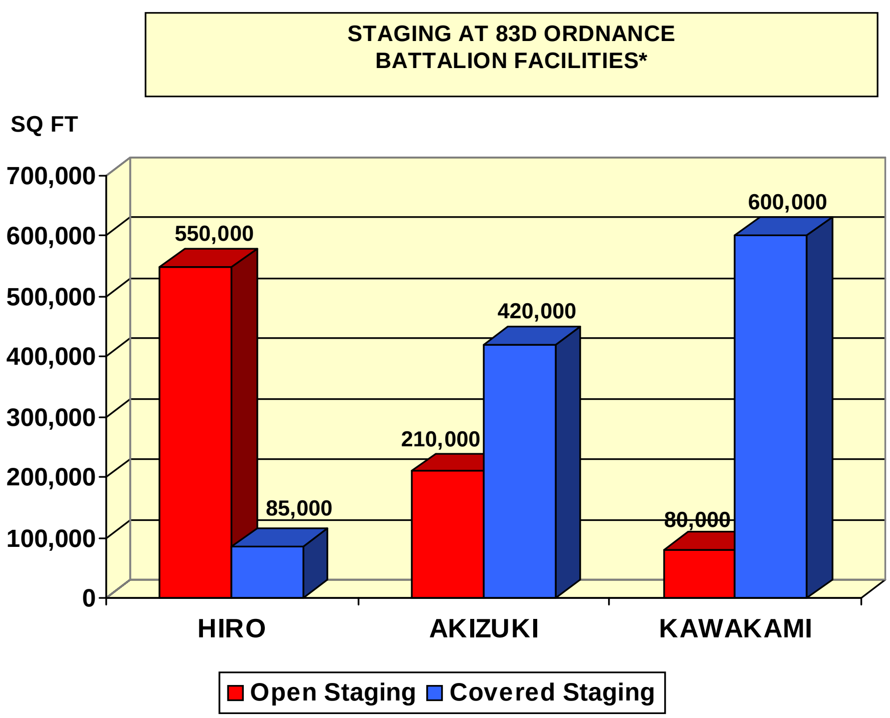
Open

Open staging available at the three storage facilities is limited. Of the three, Hiro has the most open staging area, about 13 acres or about 566,000 square feet. Most of this area is not paved, so shoring material is required to support loaded containers staged there. Using a planning estimate of 120 containers per acre for boxes staged one-high, these 13 acres can provide staging for as many as 1560 empty containers.

Akizuki has about 5 acres spread throughout the facility that can be used for open staging. This is about 220,000 square feet. There too, shoring is required to support containers staged on unpaved areas. The Akizuki facility can stage as many as 600 containers.

***NOTE:* Actual number of boxes staged at either of these facilities will depend on explosive safety factors and quantity distance considerations. Explosive safety limited staging will be less than the maximum.**

Kawakami Storage Area likewise provides open staging that will support containers. Operations personnel have identified spaces for about **200** to **400** containers, depending on explosive safety considerations.



**NOTE:* Numbers for Kawakami are estimates.*

COVERED STAGING

The Hiro Facility has only about 70,000 square feet of covered staging. Most of this is used to store ammunition and might not be available for conversion to any other use. Akizuki has about 430,000 square feet of covered staging space provided by buildings and caves. Like Hiro, much of this space normally warehouses ammunition and its use for other storage purposes is limited. The space at Kawakami, about 600,000 [6] square feet also is used for ammunition storage and its distance away from the other facilities further limits its use.

Cave Storage

Covered Storage Building

[6] Estimate

SHIPPING

Normally, ammunition-laden vessels calling the Hiro/Akizuki area anchor instream and the munitions are transferred to barges for movement to the storage areas (the reverse for outbound shipments). Although small, shallow draft vessels can come along side the ammunition piers, such operations are rare.[7]

Each of the storage areas has two barge piers. Only one pier at each facility is deemed to have sufficient deck strength to support a container capable crane. Tugs shuttle barges between the piers and the vessel(s) at anchorage. Normally, one barge is along-side the vessel while another is at the pier. MTMC's stevedoring contractor has 9 barges available to support ammunition operations.[8] Six of these are 250 long ton (LT) capacity steel flatdeck barges, which have a removable wood framework that supports the spray skirt (plastic tarp) . The other three are 200 LT BC type barges.

Depending on the barge type and container weights, between 9 and 16 containers move on each barge. Using a conservative handling rate of about 8 lifts per hour, then it takes between 68 and 120 minutes to load or unload a barge with containers.[9]

Container Loading

[7] Army watercraft and similar vessels can berth and work at the barge piers, up to depth alongside limit. The Logistics Support Vessels (LSV), the largest vessel of this type, for example can load or unload directly at the piers at about the same work rate as barges. The LSV has a payload of 50, double stacked containers, or 2,000 STONs.

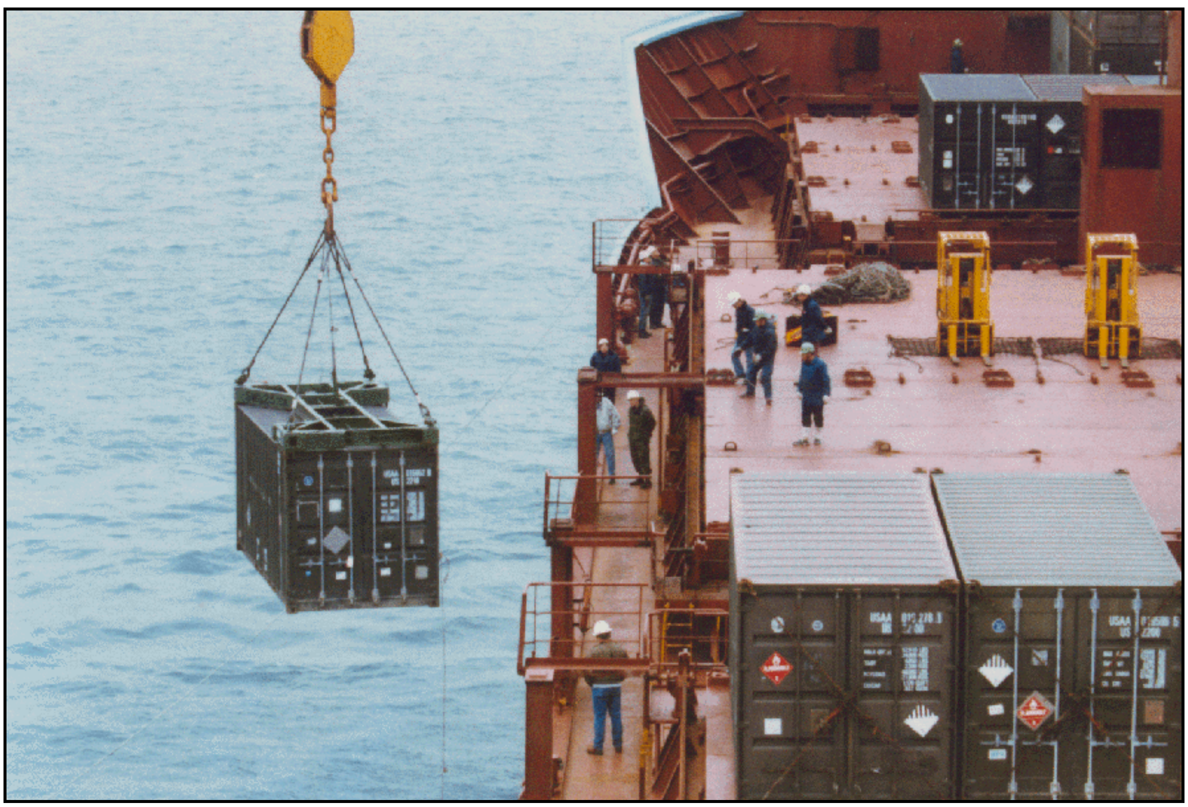
[8] These barges support both Hiro and Akizuki.

[9] Facility mobile cranes and contractor provided cranes are used to load or unload containers at the barge piers. Vessels worked at anchorage must be self-sustaining.

The contractor provides up to four longshore gangs that load or unload containers to or from the barges. Each barge shuttle requires two gangs, one at the facility and one aboard ship. Therefore, the labor force can support two shuttle operations running concurrently. These can take place, either both at one of the storage areas or divided one at each location.

Movement between pier and anchorage takes one hour or less. Assuming four barges support each operation, one alongside the vessel, one at the pier and two in route (one in-bound and one out-bound), then work can proceed throughout the day with little if any stoppage.

Contracted longshore personnel work a shift from 0830 to 1800 hours daily, or 9.5 hours. Japanese law prohibits them from transloading ammunition before sunrise or after sunset. However, blocking, bracing and tiedown of containers aboard ship may continue until completed. If the hourly lift rate of 8 boxes per hour is maintained at both the pier and the vessel, and if one hour is used for lunch, then **each two-gang team can load/unload about 68 containers or 884 STON/MTON per day.** This means that the **daily load/unload capability for two separate vessel operations (one at each facility) is about 136 containers or 1768 STON/MTON.**



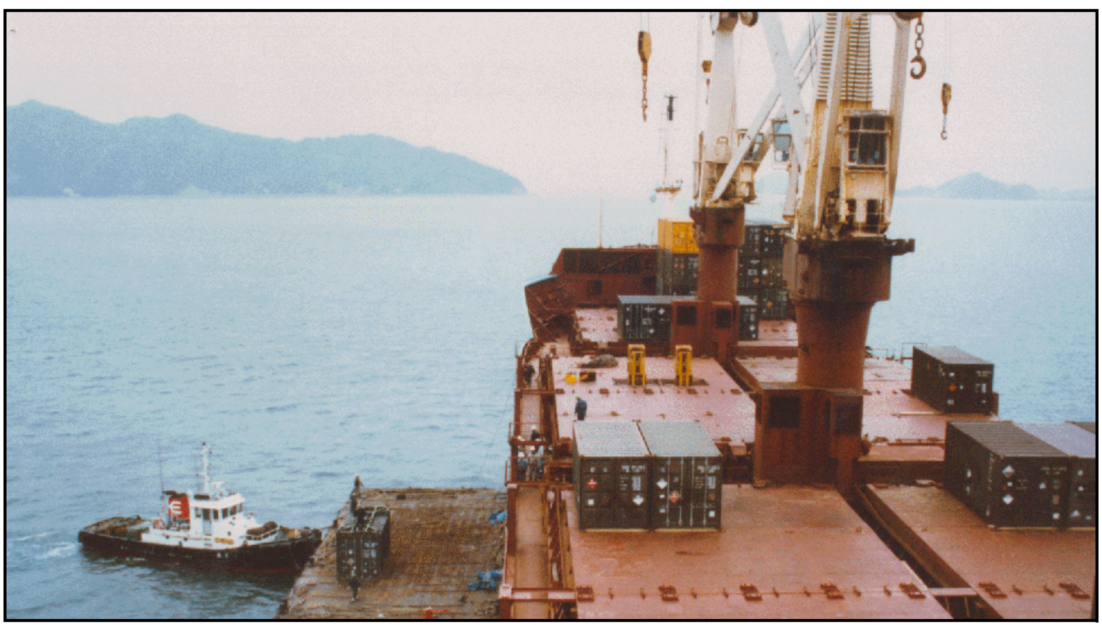
Ship Container Loading

THROUGHPUT SUMMARY

Based on the evaluation of each of the 83d Ordnance's ammunition storage facilities and the analysis of the three primary transportation subsystems, the daily container throughput capability is 50 boxes or 650 STON/MTON. This daily capability is what the organization can sustain over time. However, the storage areas have a daily loading capability of 136 boxes and staging capacity of up to 2560 containers. If the unit is allowed several days to build up an inventory of containers ready for shipment before vessel operations begin, then they can outload about 136 boxes a day (or about 1768 STON/MTON) up to the actual staged container limit.

SUBSYSTEM EVALUATION FOR CONTAINER DAILY THROUGHPUT

	HIRO	AKIZUKI	KAWAKAMI	TOTAL
STUFFING	16	16	18	50
STAGING	1,560	600	400	2,560
LOADING *	68	68	NA	136
THROUGHPUT				50
* Or Unloading				



JUNE 1999

PORT of HACHINOHE

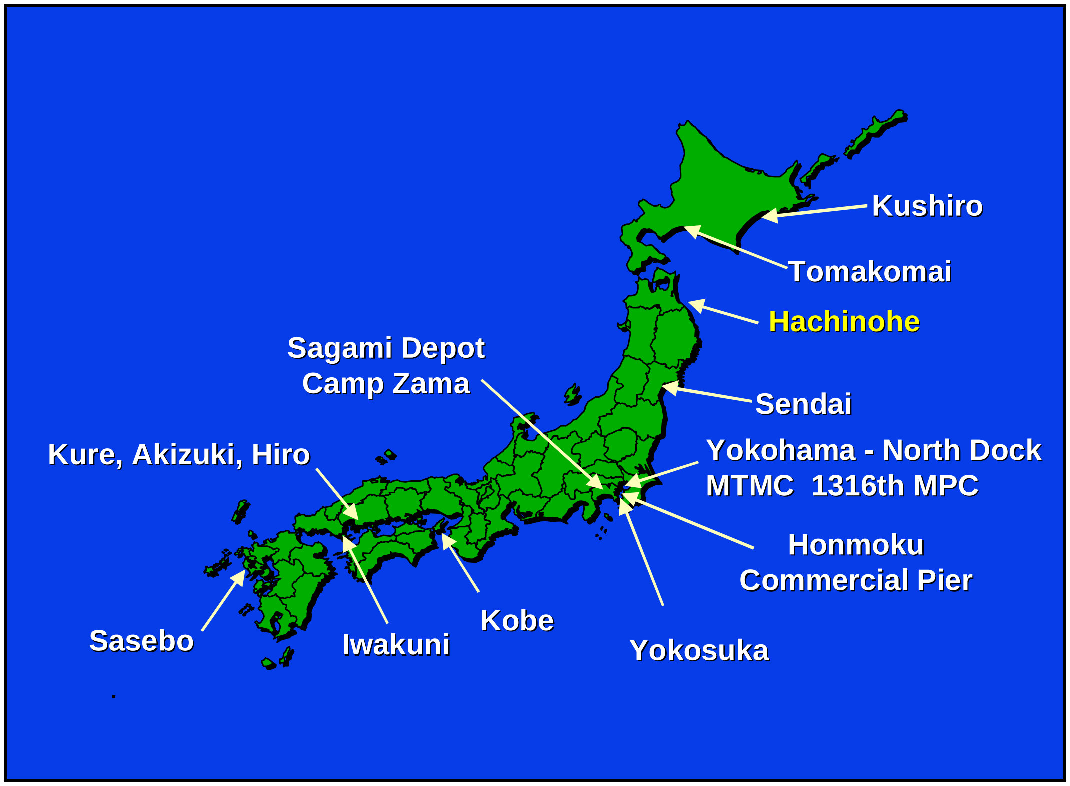
HONSHU, JAPAN

GENERAL DATA

In June 1997, a team of Transportation Engineering Agency analysts visited the Port of Hachinohe to conduct a capability analysis of the port.

LOCATION

The Port of Hachinohe is in the northern most region of Japan, on the eastern side of the island of Honshu, at Latitude 40^{o} 33.7' North and Longitude 141^{o} 33.3' East. This port opens to the Sea of Japan on the northeast coast of Japan, and is surrounded by gently rolling hills on the north, west and south, creating an ideal natural harbor. Man-made breakwaters protect the port against winds and high waves.



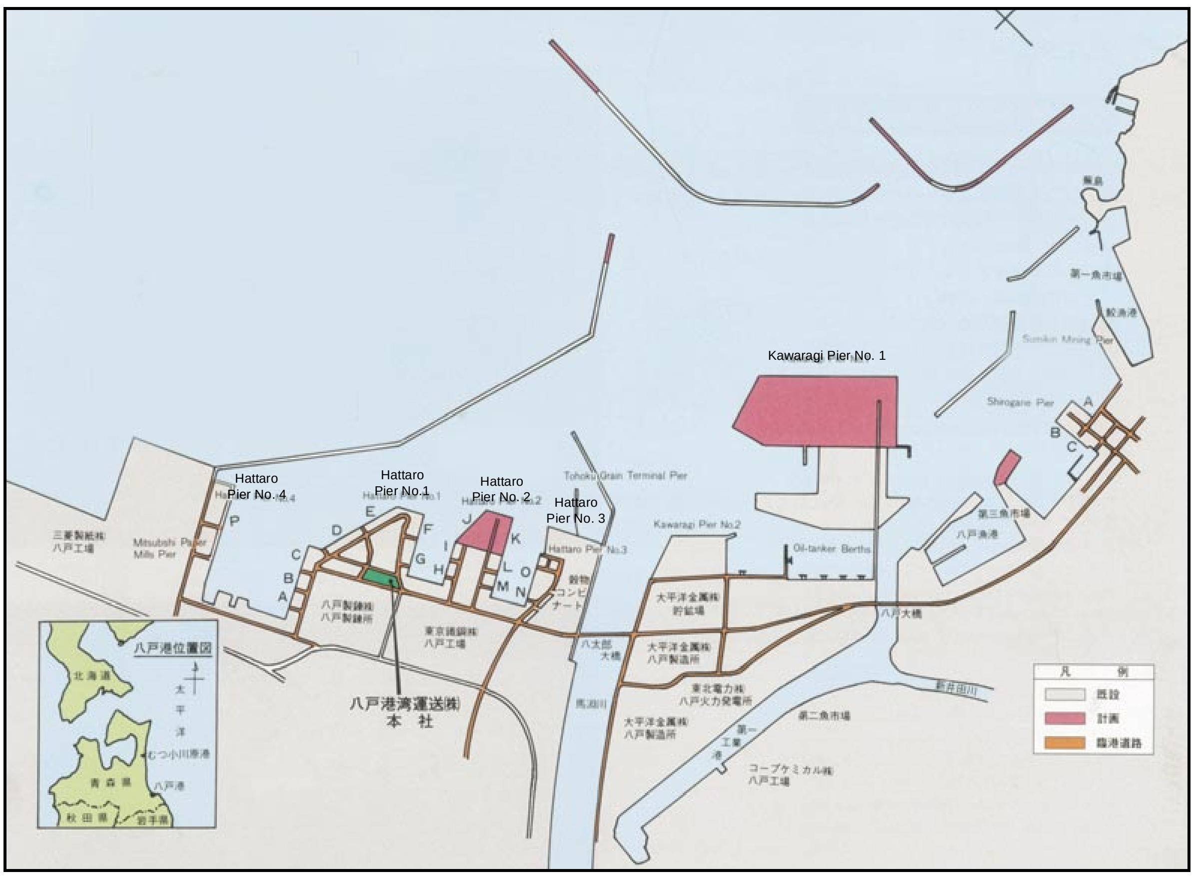
Major Ports of Japan

Hachinohe is in the Northern Tohoku region in the Aomori Prefecture, and has a population of about 245,000. This port provides industrial, fishery and distribution functions supporting the new industrial City of Hachinohe, which forms a large-scale industrial belt as the core city in the region. The port handles over thirty million tons of cargo per year, primarily raw materials for coastal factories in the industrial belt, such as non-ferrous refinery materials, paper, livestock feed and steel. Hachinohe plays an important role in the development of the local economy as an integrated port. It is about to take a great leap toward being the international distribution port in Northern Japan, with sea-lanes open to Southeast Asia, North America, and Europe.

TRANSPORTATION MODES

WATER ACCESS

Vessels destined for the Port of Hachinohe should head for the Quarantine Anchorage (pilot pick-up station) at Latitude 40° 34' North and Longitude 141° 33.5' East. A Pilot is not compulsory when entering the harbor. However, if desired the ships Agent can arrange a harbor pilot at the Master's request. Harbor Pilot will board vessels at about 1.9 miles off 322° from Samekado lighthouse. In bad weather the Pilot may wish to board in the channel. The entrance channel has a minimum depth of 42.6 feet at mean low water (MLW) and a width of 1,150 feet at its' narrowest point. The inner harbor has ample maneuvering room, with a turning basin in excess of 1,500 feet and a draft of 42 feet MLW. There are no vertical restrictions on vessels entering the harbor.



Water Access into the Port of Hachinohe

Waves: Waves in the Port of Hachinohe, under normal weather conditions, are minimally affected by wind because the distance to shore within the breakwaters is relatively short. Wind velocity and the distance to the shore generally determine wave heights. On the basis of these two factors, wave heights observed by the local weather bureau are most frequently less than 2 foot high under normal wind conditions.

Winds: Southwesterly winds generally prevail in the summer, while northerly winds blow frequently in other seasons.

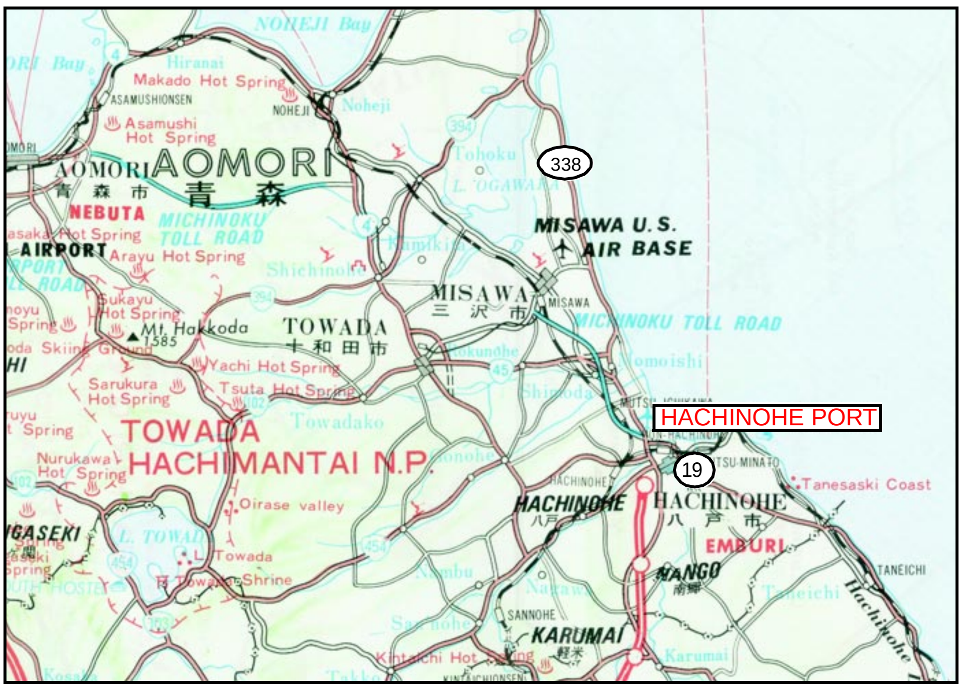
Currents: Hachinohe has a maximum current of 0.5 knots in the vicinity of the harbor entrance at rising tide. At ebb tide the current flows in the opposite direction and is faster than during flood tide, but does not hinder navigation into the port.

Tides: The minimum tide in the harbor is about 0.3 feet below MLW, the maximum tide is about 4.9 feet above MLW, with an average tidal range of about 3.5 feet above MLW.

HIGHWAY ACCESS

The Port of Hachinohe is situated to the east of the City of Hachinohe near a moderately sized metropolitan area. Located on the eastern side of the Island of Honshu, about a 40-minute drive south of Misawa Air Base. The road network is sufficient to support modern transportation requirements. Exiting Misawa Air Base from the construction gate head east along the Misawa City Road to Yokawame Intersection, then proceed south on National Route 338, and continue south until reaching Prefecture Route 19 at the Hitokawame Intersection. Then travel south on Route 19 until reaching the port access road, and proceed east on the access road to the Main Gate of the port.

The road networks to the surrounding prefectures and the inland roadways around the Port of Hachinohe are continually being improved. Many of the two-lane routes are bituminous-surfaced roadways about 20 feet wide, with concrete curb shoulders in good to excellent condition.



Highway Access Map

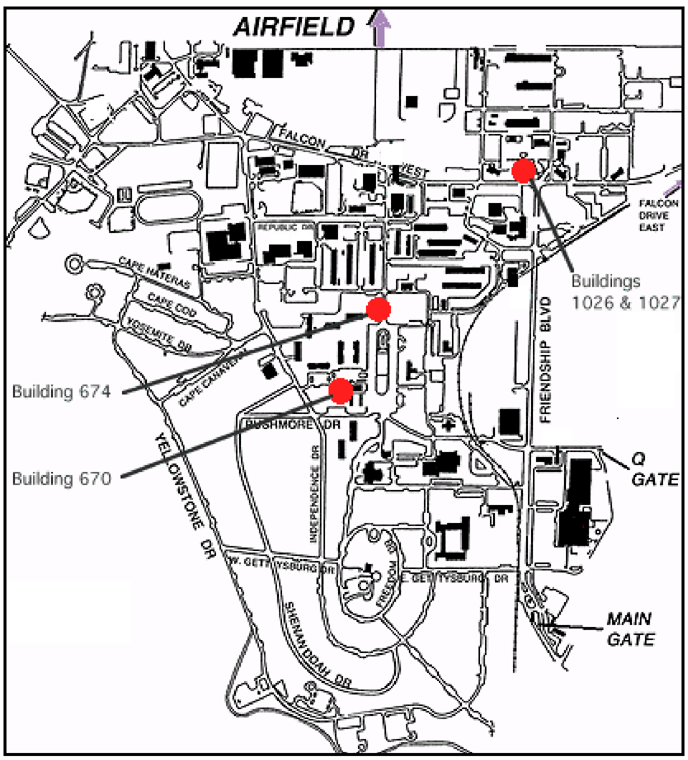
Access into the Port of Hachinohe: Access into the Port of Hachinohe is by a two-lane divided roadway in good condition. There are several gates into the port complex. The Main Gate has a single inbound and outbound lane providing access to the primary facilities. Guards control the entrances to part of the complex.

RAIL ACCESS

Japan has excellent passenger rail service throughout the Island of Honshu, and the Northern Tohoku Region. However, freight rail service is somewhat limited. There is no rail service into the Port of Hachinohe.

AIR ACCESS

Commercial Airports: Misawa Air Base is the major airport serving the area. It is a joint-use facility, providing service for both commercial and military transports. The airport provides 4 domestic flights per day between Misawa and Tokyo; 1 flight per day between Misawa and Sapporo; and 1 flight per day between Misawa and Itami. The Misawa Airport is about 25 kilometers from the Port of Hachinohe, a short 40 to 50 minute drive north of the port and City of Hachinohe.



Misawa Air Base, Japan

Military Airfields: Misawa Air Base is the closest military airfield. Runway 10/28 a concrete-surfaced runway is about 10,000-feet long and 150-feet wide. It handles both military and commercial transports such as the Boeing-737 aircraft and approved for C-5, and suitable for C-9, C-21, C-130, KC-10, KC-135, C17, and C-141 aircraft.

PORT FACILITIES

BERTHING

The Port of Hachinohe provides a diverse set of public and private wharves, designed to handle a wide range of bulk, general, and container cargo. The primary public facilities consist of five large piers (Berths A through P and Kawaragi Pier No. 1) which total over 8,000 linear feet of berthing.

In this report, we have combined some of the berths in order to handle a wider range of ship types. Berth A-B is 853 feet long and handles steel and bulk cargo. Berth C is 607 feet long and also handles bulk cargo.

Berth D-E has a combined length of 1,772 and handles bulk cargo and containers on Berth E with its container gantry crane. (Berth D-E has 42.6 feet of water alongside, and well suited for large vessels, capable of supporting breakbulk, RORO, container, and combination ships).

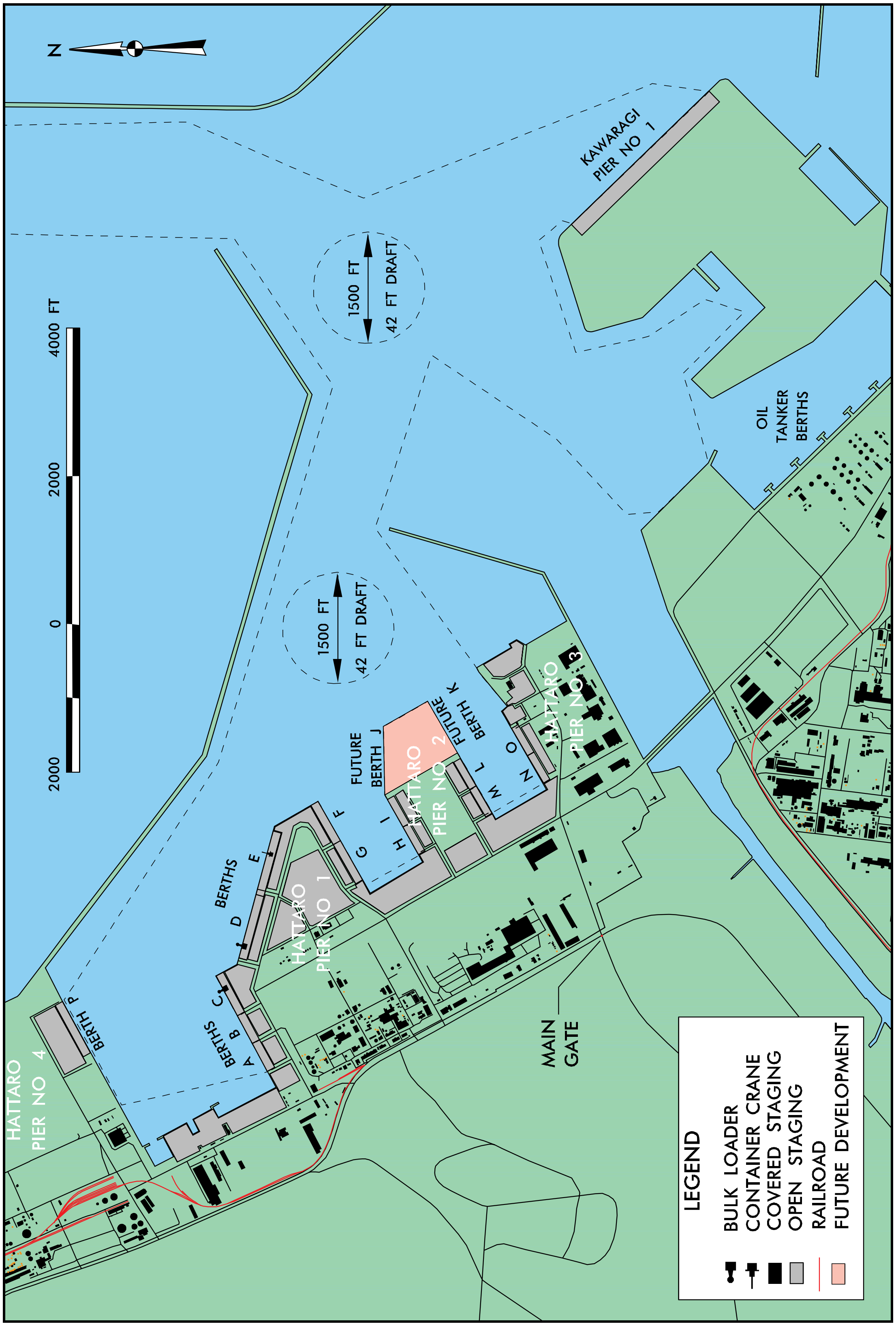
Berth F-G is 1,214 feet long and handles logs and bulk cargo. (Berth F-G has 32.8 feet of water alongside, and suitable for medium to large ships and capable of handling breakbulk, RORO, limited container operations, and combination vessels).

Berth H-I is 853 feet long and handles automobiles, bulk cargo, and steel.

BERTH CHARACTERISTICS

	BERTHS				
Characteristics	**Berth A-B**	**Berth C**	**Berth D-E**	**Berth F-G**	**Berth H-I**
Length (ft)	853	607	1,772	1,214	853
Depth alongside at MLW (ft)	24.6	32.8	42.6	32.8	24.6
Deck strength (psf)	800	800	800	800	800
Apron width (ft)	Open	Open	Open	Open	Open
Apron height above MLW (ft)	12	12	12	12	12
Number of container cranes	0	0	1	0	0
Number of wharf cranes	0	1	1	2	0
Apron lighting	No	No	No	No	No
Straight-stern RORO facilities	Yes	No	Yes	Yes	Yes
Apron length served by rail (ft)	0	0	0	0	0

The Berth Characteristics table above summarizes many of the important features of each berth. Berth D-E and Berth F-G offers the best potential for the shipment of military cargo. In the past Berth F-G supported Operation TURBO-CADS 95 with the transshipment of munitions to and from Misawa Air Base.



Site Map - Port of Hachinohe

PORT FACILITIES - CONT

Berth L-M is 853 feet long and handles steel, bulk and general cargo.

Berth N-O is 853 feet long and handles steel and bulk cargo.

Berth P is 1,280 feet long and handles automobiles, bulk cargo, and steel. (Berth P has 39.4 feet of water alongside, and well suited for medium to large ships, and capable of handling breakbulk, RORO, limited container operations, and combination vessels).

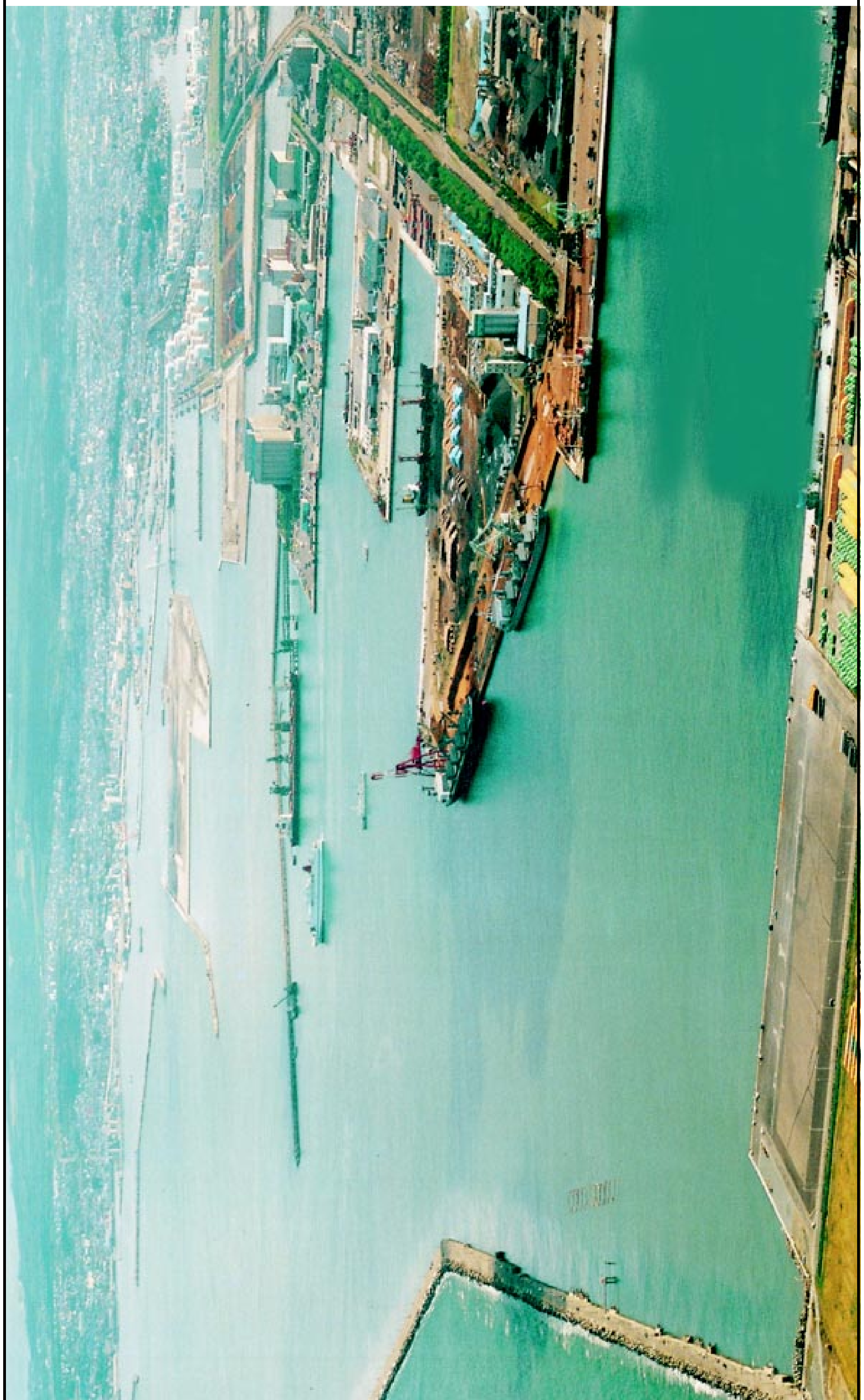
Kawaragi Pier No. 1 is 1,837 feet long and handles bulk and general cargo (Kawaragi Pier No. 1 with its 45-feet of water alongside, is suitable for large cargo vessels of all types, capable of supporting breakbulk, RORO, limited container, and combination ships).

The access causeway leading to Kawaragi Pier may limit transshipment of some military cargo. This pier is also a fairly new facility and negotiating for its use may compete heavily with commercial use.

BERTH CHARACTERISTICS - CONT

	BERTHS			
Characteristics	**Berth L-M**	**Berth N-O**	**Berth P**	**Kawaragi Pier # 1**
Length (ft)	853	853	1,280	1,837
Depth alongside at MLW (ft)	24.6	24.6	39.4	45
Deck strength (psf)	800	800	800	800
Apron width (ft)	Open	Open	Open	Open
Apron height above MLW (ft)	12	12	12	12
Number of container cranes	0	0	0	0
Number of wharf cranes	0	0	0	0
Apron lighting	No	No	No	No
Straight-stern RORO facilities	Yes	Yes	No	No
Apron length served by rail (ft)	0	0	0	0

NOTE: The Berth Characteristics shown in the two previous tables summarizes the important features of each berth. Of these facilities Berth D-E, Berth F-G, Berth P, and Kawaragi Pier No. 1 (highlighted in light red) are most likely to support future military shipments.



Port of Hachinohe

Berth D-E

Berth F-G

Berth P

Kawaragi Pier No. 1

PORT OF HACHINOHE
SUMMARY OF BERTHING CAPABILITIES

TYPE	VESSEL CLASS	D - E	F - G	P	
BREAKBULK	C3-S-38a	3	2	2	**NOTES:**
	C4-S-58a	2	2	2	a-vessel draft limit
	C4-S-66a	3	2, a	2	b-inadequate apron width
	C5-S-37e	2	1	2	c-inadequate berth length
					d-no straight stern ramp
SEATRAIN	GA & PR - class	3	2	2	e-no container handling equipment
					f-anchorage depth OK, berth depth
BARGE	LASH C8-S-81b	2	1, a, f	1	inadequate
	LASH C9-S-81d	1	1, a, f	1	g-inadequate channel depth
	LASH Lighter	8	6	6	h-no shore based ramps
	SEABEE C8-S-82a	1	1, a, f	1	i-low tide insufficient ramp clearance
	SEABEE Barge	8	6	6	j-high tide insufficient ramp clearance
					k-excessive ramp angle low tide
RORO	COMET	3, i, j	2, i, j	2,d, i, j	m-excessive ramp angle high tide
	METEOR	3, i, j	2, i, j	2,d, i, j	n-parallel ramp operation ONLY
	Cape Gnome	2, i, j	1, a	2,d, i, j	o-insufficient apron width for side ramp
	C7-S-95a	2	1, a	1	
	Cape Taylor	2	1	1	Ramp clearance and angle based on
	Cape Orlando	2, i, j	1, i, j	1, i, j	maximum vessel draft
	MV Ambassador	3, m	2, m	2, d	
	Callaghan	2, i	1, i	1, d, i	♦ **May Prevent Operation**
	Cape Lambert	2, i, j	1, i, j	1, i, j	
	LMSR - Class	1	1, a	1	♦ **May Limit Operation**
	FSS	1	1, a	1	
	Cape E	2, i, j	1, i, j	1, i, j	a-vessel draft limit
	Cape D	2, i, j	1, a	1, i, j	b-inadequate apron width
	Cape H	2	1, a	1	c-inadequate berth length
	Cape Texas	2, i, j	1, i, j	1, i, j	d-no straight stern ramp
	Cape R	2, i	1, a	1, d	e-no container handling equipment
	Cape I	2, i, j	1, i, j	1, i, j	f-anchorage depth OK, berth depth
	Cape Victory	2, i	1, i	1, i	inadequate
					g-inadequate channel depth
CONTAINER	C6-M-147a	2	1, e	1, e	h-no shore based ramps
	C7-S-69c	2	1, e	1, e	i-low tide insufficient ramp clearance
	C7-S-68c	2	1, e	1, e	j-high tide insufficient ramp clearance
	C8-S-85c	2	1, a, e	1, e	k-excessive ramp angle low tide
	C9-M-132b	1	1, a, e	1, e	m-excessive ramp angle high tide
	C9-M-F141a	1	1, a, e	1, e	n-parallel ramp operation ONLY
					o-insufficient apron width for side ramp
TACS	C6-S-1qd	2	1	1	
	C5-S-MA73c	2	1	2	Ramp clearance and angle based on
	C6-S-MA60d	2	1	1	maximum vessel draft
MPS	C7-S-133a	2	1, a	1	♦ **May Prevent Operation**
	Maersk	2	1, a	1	
	AmSea	2	1	1	♦ **May Limit Operation**

PORT OF HACHINOHE
SUMMARY OF BERTHING CAPABILITIES

TYPE	VESSEL CLASS	Kawaragi Pier No. 1	
BREAKBULK	C3-S-38a	3	NOTES:
	C4-S-58a	3	a-vessel draft limit
	C4-S-66a	3	b-inadequate apron width
	C5-S-37e	2	c-inadequate berth length
			d-no straight stern ramp
SEATRAIN	GA and PR - class	3	e-no container handling equipment
			f-anchorage depth OK, berth depth
BARGE	LASH C8-S-81b	2	inadequate
	LASH C9-S-81d	2	g-inadequate channel depth
	LASH Lighter	9	h-no shore based ramps
	SEABEE C8-S-82a	2	i-low tide insufficient ramp clearance
	SEABEE Barge	9	j-high tide insufficient ramp clearance
			k-excessive ramp angle low tide
RORO	COMET	3, d, i, j	m-excessive ramp angle high tide
	METEOR	3, d, i, j	n-parallel ramp operation ONLY
	Cape Gnome	2, d, i, j	o-insufficient apron width for side ramp
	C7-S-95a	2	
	Cape Taylor	2	Ramp clearance and angle based on
	Cape Orlando	2, i, j	maximum vessel draft
	MV Ambassador	3, d	
	Callaghan	2, d, l	♦ **May Prevent Operation**
	Cape Lambert	2, i, j	
	LMSR - Class	1	♦ **May Limit Operation**
	FSS	1	
	Cape E	2, i, j	a-vessel draft limit
	Cape D	2, i, j	b-inadequate apron width
	Cape H	2	c-inadequate berth length
	Cape Texas	2, i, j	d-no straight stern ramp
	Cape R	2, d	e-no container handling equipment
	Cape I	2, i, j	f-anchorage depth OK, berth depth
	Cape Victory	2, i	inadequate
			g-inadequate channel depth
CONTAINER	C6-M-147a	2, e	h-no shore based ramps
	C7-S-69c	2, e	i-low tide insufficient ramp clearance
	C7-S-68c	2, e	j-high tide insufficient ramp clearance
	C8-S-85c	2, e	k-excessive ramp angle low tide
	C9-M-132b	2, e	m-excessive ramp angle high tide
	C9-M-F141a	1, e	n-parallel ramp operation ONLY
			o-insufficient apron width for side ramp
TACS	C6-S-1qd	2	
	C5-S-MA73c	2	Ramp clearance and angle based on
	C6-S-MA60d	2	maximum vessel draft
MPS	C7-S-133a	2	♦ **May Prevent Operation**
	Maersk	2	
	AmSea	2	♦ **May Limit Operation**

STAGING

Open Staging

The Port of Hachinohe has over 39 acres of open staging distributed across the berths most likely to support military cargo shipments. Additional open staging is available throughout the port complex at other berths, which could stage military equipment. Most of the staging areas are concrete or asphalt surfaced, and in good condition. The port has plenty of concrete staging areas that could serve as helicopter landing pads (Berth P and Kawaragi Pier No. 1 are most suitable for this use). All of the berths have wide-open aprons that are ideal for working cargo and ship loading. See the following table for a summary of staging areas at the Port of Hachinohe.

STAGING AREAS

Port of Hachinohe	Open Staging (Acres)	Transit Sheds (Square Feet)	Container Freight Station (Square Feet)
Berth D-E	8	None	None
Berth F-G	5.5	None	None
Berth P	5.7	None	None
Kawaragi Pier No. 1	20.6	None	None

Open Staging at Berth P

Open Staging at Kawaragi Pier 1

Covered Storage

There are warehousing facilities and other buildings on Hattaro Pier No. 2, along Berth H-I and Berth L-M, however, these structures are mostly for the day-to-day commercial operations of the port. There are no transit sheds or container freight stations available to support the deployment of military cargo and equipment.

RAMPS AND DOCKS

The Port of Hachinohe has several light duty portable truck ramps which can accommodate the loading or unloading of the smaller tactical vehicles. Field expedient ramps could also be built to support loading and deployment of larger vehicles. Units could also use mobile cranes, and forklifts to offload trucks, flatbeds and MILVAN chassis.

MARSHALING AREAS

No off-site marshaling or nearby fields are available to support a military deployment.

MATERIALS HANDLING EQUIPMENT (MHE)

The following table summarizes material handling equipment available at the Port of Hachinohe. Hachinohe Kowan Unso Kaisha, Ltd. and Shinmaru Koun Company, Ltd. own and operate the terminal equipment. There are no heavy lift cranes in Hachinohe.

MATERIALS HANDLING EQUIPMENT

TYPE OF EQUIPMENT	QUANTITY	CAPACITY
Container Gantry Crane	1	30.5 STON
Container Straddle Carrier	3	35 STON
Forklift	1	4.5 STON
Forklift	1	11 STON
Mobile Tower Crane	2	15 STON
Mobile Tower Crane	2	25 STON
Bulk Cargo Unloader	2	8 STON
Bulk Cargo Unloader	1	19 STON

MAINTENANCE AND REPAIR: Minor repairs and small tank cleaning services are available.

SECURITY: A 10-foot high perimeter fence surrounds the port complex, with the ability to control access to most areas of the port.

TERMINAL LIGHTING: The existing lighting at Hachinohe is limited and may not support 24-hour ship loading operations. Portable light sets may be borrowed from Misawa Air Base to support night operations.

STEVEDORE LABOR: The local stevedores are provided by Hachinohe Kowan Unso Kaisha Ltd. Arriving vessels must report their estimated time of arrival (ETA) at least one day before the vessel's arrival on weekdays, in order to arrange gangs. Normal working hours: Weekdays: 0830 - 1630 hours. Sundays and Holidays: Gang availability is subject to negotiations.

EXPLOSIVE and HAZARDOUS CARGO OPERATIONS

Limited hazardous cargo operations are permitted at Hachinohe as necessary. However, due to the port's close proximity to a large civilian population center (City of Hachinohe) explosive ammunition handling operations must be approved on a case-by-case basis.

In the past Berth F supported Operation TURBO-CADS 95 with the transshipment of munitions to and from Misawa Air Base. During this operation Crowley Marine was responsible for the line-haul requirements. They sub-contracted this requirement to a Japanese trucking firm. At Hachinohe a waiver was in place to handle a maximum of 305,000-lbs. net explosive weight (NEW). Government of Japan public law restricts the movement of ammunition to daylight hours only.

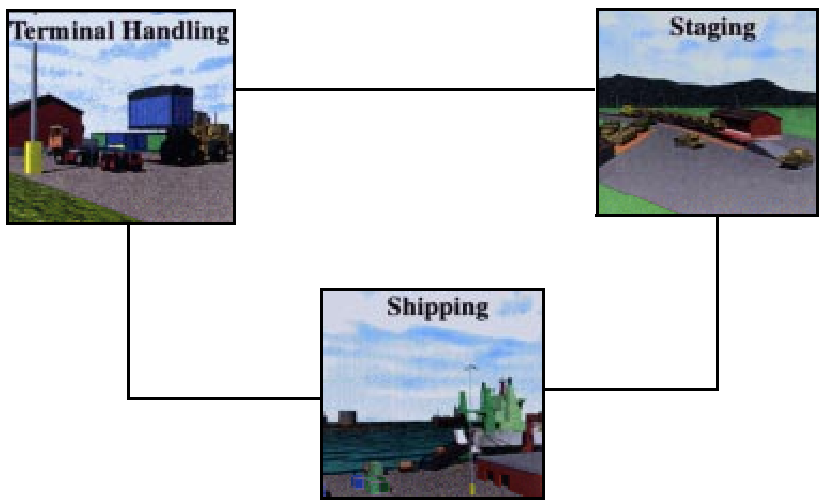
FUTURE DEVELOPMENT PROJECTS

The Port Authority has plans to increase the channel depth, extend the breakwater and construct new deep-water berths. Two future Berths J and K will be about 900 feet long each, and have a depth alongside of about 42 feet at (MLW). The expected date of completion is within 7 years.

II. THROUGHPUT ANALYSIS

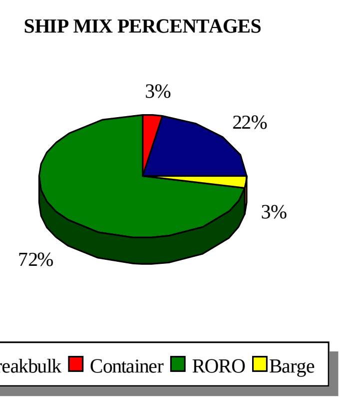
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity for the Port of Hachinohe, Japan. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal processing and handling. The least capable subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for each subsystem in terms of short tons (STON) and measurement tons (MTON) per day. The charts in this section show the throughput yields in STON. Approximate MTON yields can be computed by multiplying the STON amount by 2.5 for breakbulk and container cargo, and multiplying by 4 for RORO cargo.



Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 75 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occured during Operation Desert Shield and Desert Storm. This data helped us develop a mix of vessels most likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployments.



TERMINAL CLEARANCE AND HANDLING

HIGHWAY

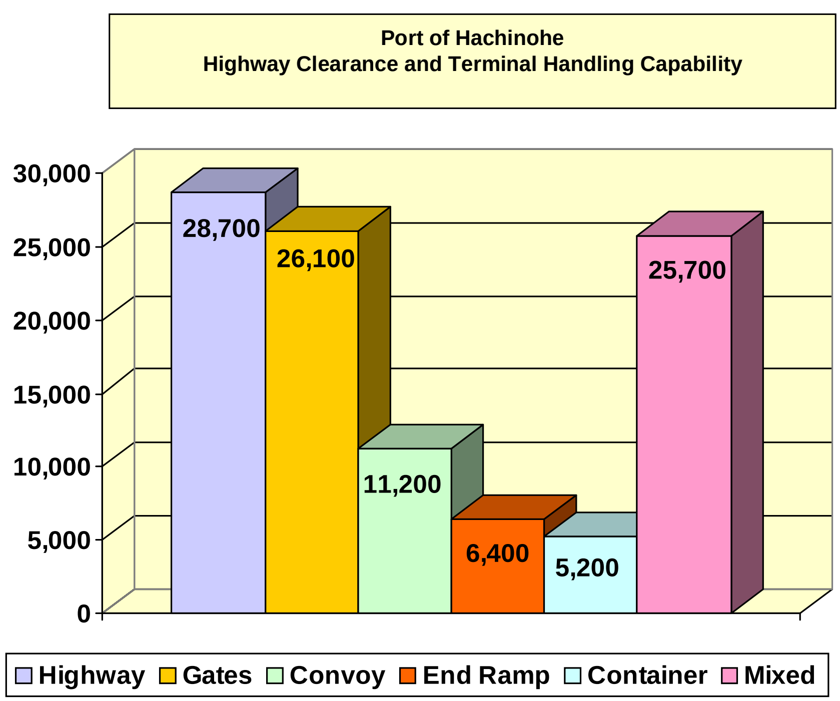
The road network into and out of the Port of Hachinohe can handle at least 28,700 STON of vehicles, equipment, and supplies per day. The gate processing system can handle more than 26,100 STON of cargo per day.

TERMINAL CLEARANCE

Roadable vehicles can move through the terminal gates in manageable convoys (11,200 STON per day) from staging areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a means of unloading, must use one of the loading positions at the port. Units can also build or acquire two portable ramps for flat-bed truck and semi-trailer offloading operations. End ramp capability will handle at least 6,400 STON of military vehicles and equipment per day.

For handling loaded containers the terminal has access to three (3) mobile cranes and two (2) container straddle carriers. If we assume that two are available for use during container transfer operations, the terminal can handle about 5,200 STON of containers per day (about 600 TEUs). This assumes a conservative 15 lifts per hour or 300 moves per handler per 20-hour day.

Maximum daily capability for the terminal is a mixed total of **25,700 STON** based on handling various cargo types, each up to its maximum.

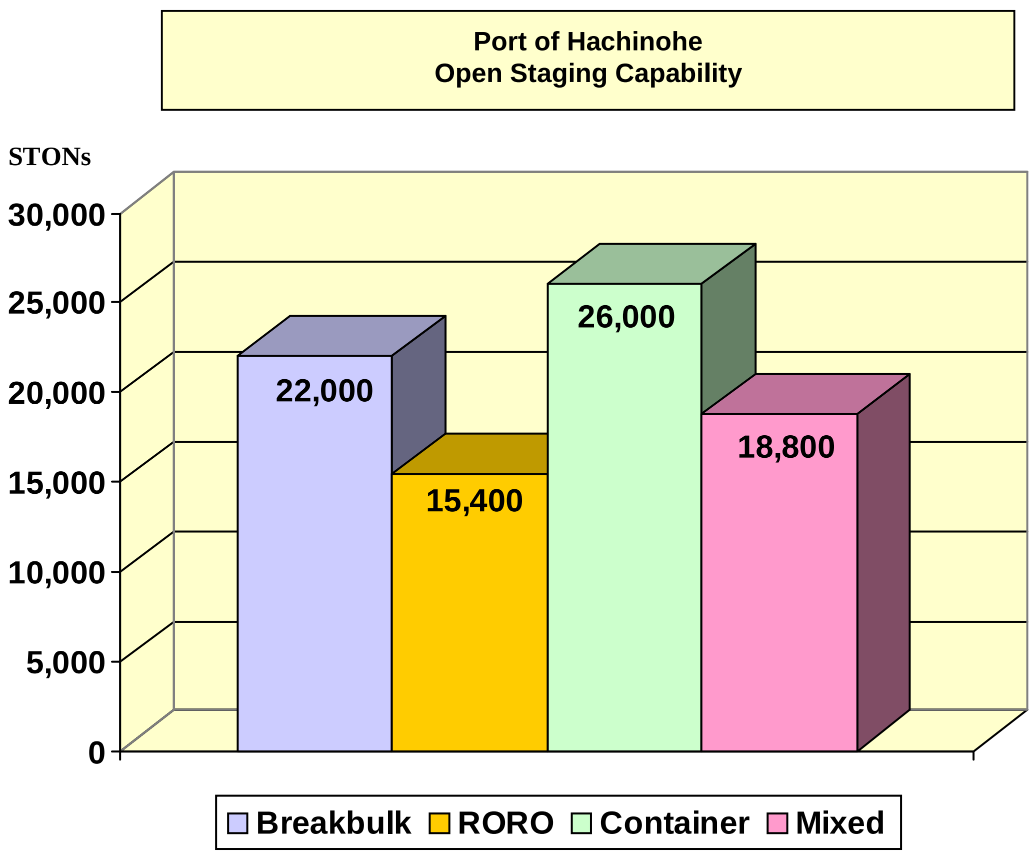


OPEN STAGING

The Port of Hachinohe has over 39 acres of open staging disbursed through out the berths most likely to support military operations. The terminal has some warehouses but no transit sheds for covered storage. Coordination with the terminal operator is necessary to use the limited warehouse facilities along Berth H-I and L-M.

The port has the ability to perform operations on RORO, container, breakbulk, and combination vessels. The cargo mix depends on the anticipated vessel type.

The following chart shows the cargo open staging capability for each cargo/vessel type. The mixed staging capability is **18,800 STON** per day, which nearly equals the ports' ship loading capability of 19,800 STON of cargo per day. This analysis assumes a usable space availability of 70 percent of the total area. If a combination ship is expected, then a portion of each involved capability should be assumed.

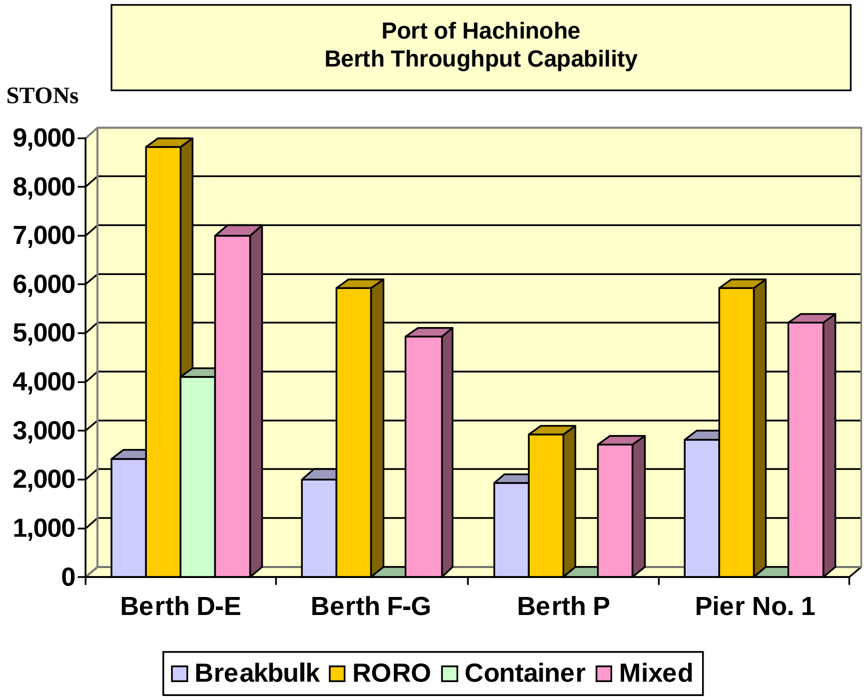


SHIPPING

Daily shipping subsystem totals for the Port of Hachinohe throughputs at each of the berths analyzed are shown below. They are based on various factors, including: material handling equipment (MHE) used, type of loading, operational procedures, berth usage rates, and berthing capabilities for various vessel types. Assumptions and parameter values used in this study are shown in the appendix.

CONVERSION FACTORS

Breakbulk	0.4 STON per MTON
RORO	0.25 STON per MTON
Containers	0.4 STON per MTON



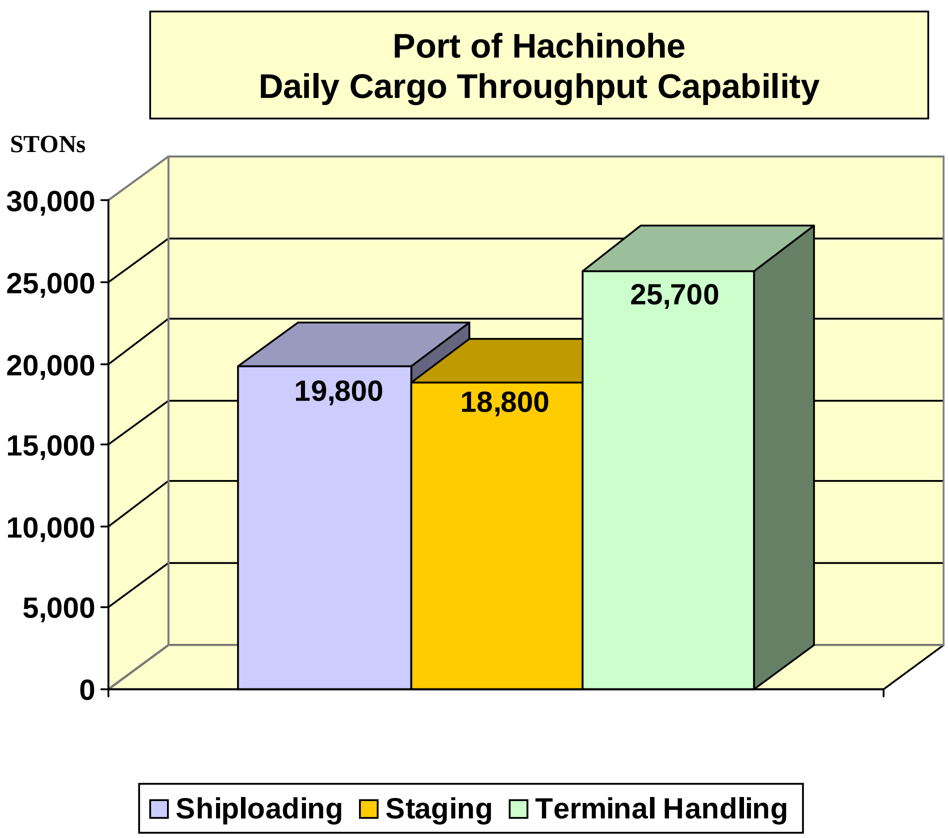
	Berth D-E	Berth F-G	Berth P	Pier No. 1
Breakbulk	2,400	2,000	1,900	2,800
RORO	8,800	5,900	2,900	5,900
Container	4,100	0	0	0
Mixed	7,000	4,900	2,700	5,200

III. CONCLUSIONS

The Port of Hachinohe is capable of supporting military cargo transshipment operations. Berths D-E, F-G, and P are the preferred berths for military operations, and can accommodate vessels as large as the Large Medium Speed Roll-On Roll-Off (LMSR) and Fast Sealift Ship (FSS) as shown in the Berthing Characteristics Table. However, the 32.8-foot draft along side Berth F-G may limit the amount of cargo a vessel can take onboard. The LMSR and FSS have a maximum draft of about 35 and 37 feet, respectively. Berth E has 42.6 feet of water alongside and is the only berth with a container gantry crane. The other berths analyzed can support limited container operations using the ports mobile cranes or ships gear.

The Kawaragi Pier No. 1 with its large open apron and staging area offers suitable accommodations for vessels of all cargo types, especially large deep draft RORO and combination vessels. However, this pier has no straight-stern ramp for RORO offloading.

Of the transportation subsystems analyzed at Hachinohe, and based on the most likely ship mix, the least capable is the staging subsystem, which is about **18,800 STON** per day.



Other operations taking place concurrently in the terminal will limit actual daily throughput, sustainable over time, by an appropriate percentage of the terminal's overall capability.

Limited hazardous cargo operations are permitted at Hachinohe. However, due to the port's close proximity to a large civilian population center (City of Hachinohe), explosive ammunition handling operations must be approved on a case-by-case basis. In the past Berth F supported Operation TURBO-CADS 95 with the transshipment of munitions to and from Misawa Air Base. The container throughput of **4,100 STON** shown below can be for either general container cargo or containerized ammunition.

PORT OF HACHINOHE
THROUGHPUT SUMMARY
DAILY CAPABILITY

	BERTH D-E	BERTH F-G	BERTH P	PIER No. 1
LENGTH (feet)	853	1,772	1,280	1,837
DEPTH ALONGSIDE (feet)	42.6	32.8	39.4	45
BREAKBULK THROUGHPUT (STON)	2,400	2,000	1,900	2,800
RORO THROUGHPUT (STON)	8,800	5,900	2,900	5,900
RORO SQUARE FEET (Estimate)	176,000	118,000	58,000	118,000
RORO PIECES [1]	1,035	694	341	694
CONTAINER THROUGHPUT (STON)	4,100	0	0	0
CONTAINER THROUGHPUT (TEU)	520	0	0	0
MIXED THROUGHPUT (STON)	7,000	4,900	5,100	5,200

[1] Based on the 170 square foot per piece average accomplished during Operation Desert Shield and Desert Storm; and using an average vehicle weight of 8.5 STON.

JUNE 1999

U.S. MARINE CORPS AIR STATION
IWAKUNI, JAPAN

I. GENERAL DATA

LOCATION AND GENERAL USE

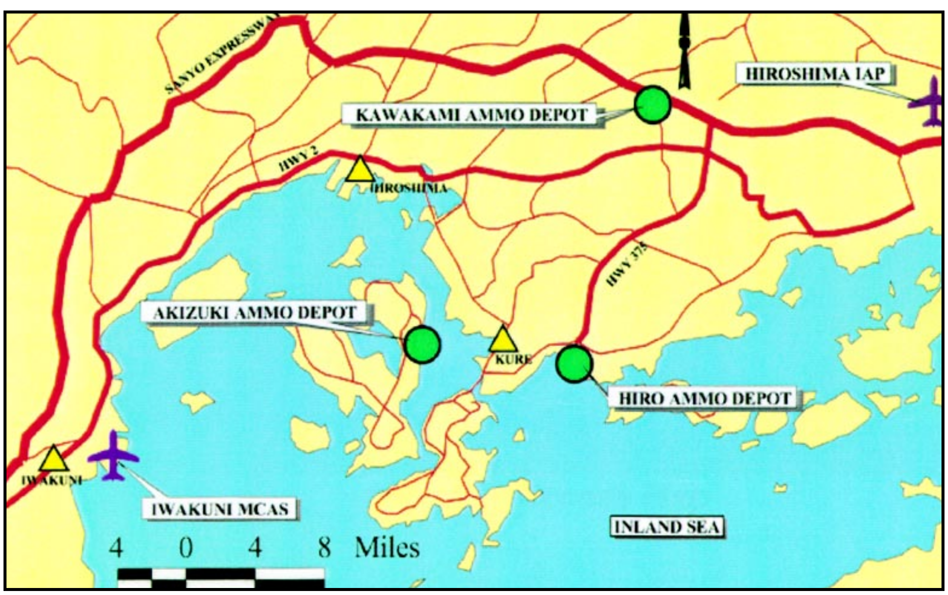
In June 1997, a survey team from the Transportation Engineering Agency (TEA) visited the U. S. Marine Corps Air Station (MCAS) Iwakuni, (latitude 34° 08’ north, longitude 132° 14’ east, approximately). The station is located on the western edge of Hiroshima Bay on Japan’s Seto Inland Sea, near the city of the same name, about 40 kilometers southwest of Hiroshima. Iwakuni is located in Yamaguchi Prefecture, on the Island of Honshu. The MCAS, Iwakuni occupies most of an island formed by the confluence of the Monzen and Imazu Rivers. The facility is the base of operations for a variety of USMC aircraft in support of the North East Asian requirements, as well as Marine Corps units in other areas of the theater. In addition to ammunition storage, Iwakuni has an explosive barge berth located near the storage area for handling ammunition transshipments.

TRANSPORTATION ACCESS

Water

The barge berth at Iwakuni is located within a man made harbor, accessed directly from the sea. Because of short berth length and relatively shallow water depth, only barges are normally worked at Iwakuni.

Water Access Map



[1] Data used to support this analysis comes largely from on-site observation by the survey team and information provided by operations and management personnel at the facility. Other data sources used include industry and related publications.

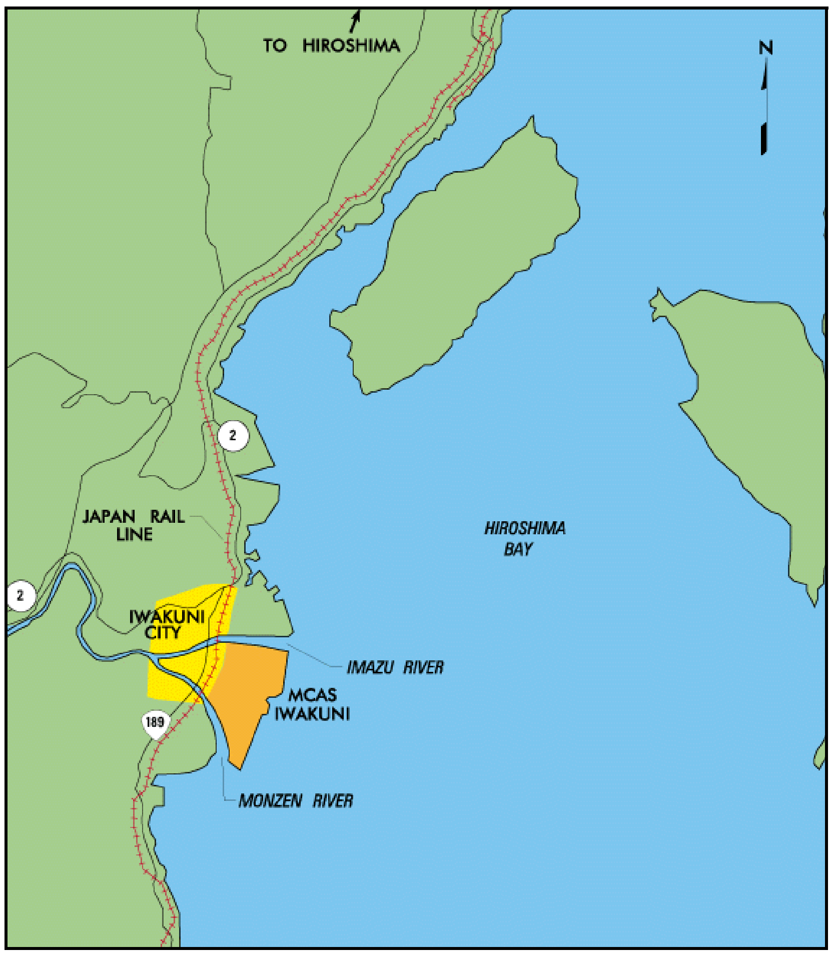
Small amphibious and coaster type vessels can call at the berth provided they do not exceed length and depth capability. Large explosive laden vessels must anchor in stream. Ammunition is transloaded at the anchorage from mother ships to barges. Tugs then move the barges from the ship to the barge berth.

Highway

The Yamaguchi Prefecture highway network connects MCAS Iwakuni with the main Honshu highway system via National Highway 2. Most of the prefecture highways and roads are two lanes. Like most roads in Japan, the routes connecting Iwakuni with the rest of the country are very congested. Although only about 31 miles from Hiroshima, travel time there by car often takes more than one hour. Likewise, Kure about 56 miles away, can take about three hours to reach by highway.

Ammunition does not normally move by highway within Japan, with the exception of very small quantities of low hazard class explosives, e.g. class 1.4. The normal method of transporting explosives between Iwakuni and the Akizuki-Hiro Storage areas is by vessel. Army watercraft based at Kure move larger amounts (as much as 36 pallets per day by LCM) of higher hazard munitions between the two locations.

The Iwakuni facility has three gates, the Main Gate and two auxiliary gates. The Main Gate is manned around the clock by Marine Corps security personnel. Security personnel likewise control the other gates when they are open.



Highway Access Map

Rail

The MCAS Iwakuni is not linked to the Japan National Railway system, although the railroad serves Iwakuni City. MCAS Iwakuni does not use rail for ammunition movements.

Air

The US Marine Corps Air Station Iwakuni has a runway capable of supporting wide body aircraft from C-5 down. The runway is 8,000 feet long and 150 feet wide. The working Maximum on Ground (MOG) is three wide body aircraft. The nearest commercial airport to Iwakuni is the Hiroshima International Airport, about three hours or more away by highway.

PORT FACILITIES

Berthing

Iwakuni has an ammunition barge dock. Characteristics of this berth are shown in the first table below. The pier is constructed of reinforced concrete and has an open wharf design. According to local authorities, the depth alongside the berth is about 20 feet. Only barges and very shallow draft motor vessels can approach the piers. A project to move the airfield at Iwakuni has been approved. As this project progresses, the area of the base's harbor or basin will be filled in.

A new harbor is part of the project (Phase 1) and when completed in 1999 (est) will significantly change Iwakuni's vessel berthing capability. ***During the construction of Phase 1, Iwakuni will not have a berth.*** The second table shows the characteristics the berths included in the construction project.

Currently, ammunition vessels are worked in stream with cargo transloaded to barges that are then shuttled to the piers by contractor tugs. This operational methodology is not likely to change when the new berths are completed due to NEW/ESQD limitations, although the new ammunition barge pier will be capable of berthing small breakbulk vessels alongside.

Present Characteristics	Barge Pier
Length (ft)	130
Depth alongside at MLW (ft)	20
Deck strength (psf)	800
Apron width (ft)	Open
Apron height above MLW (ft)	12
Number of container cranes	None
Number of wharf cranes	1[2]
Apron lighting	Yes
Straight-stern ramp	No
Apron length served by rail	None

Future Characteristics	GP Wharf	Barge Pier
Length (ft)	1,180	450
Depth alongside at MLW (ft)	50	50
Deck strength (psf)	800	800
Apron width (ft)	110	100
Apron height above MLW (ft)	14	14
Number of container cranes	None	None
Number of wharf cranes [3]	1	None
Apron lighting	Yes	Yes
Straight-stern ramp	No	No
Apron length served by rail	None	None

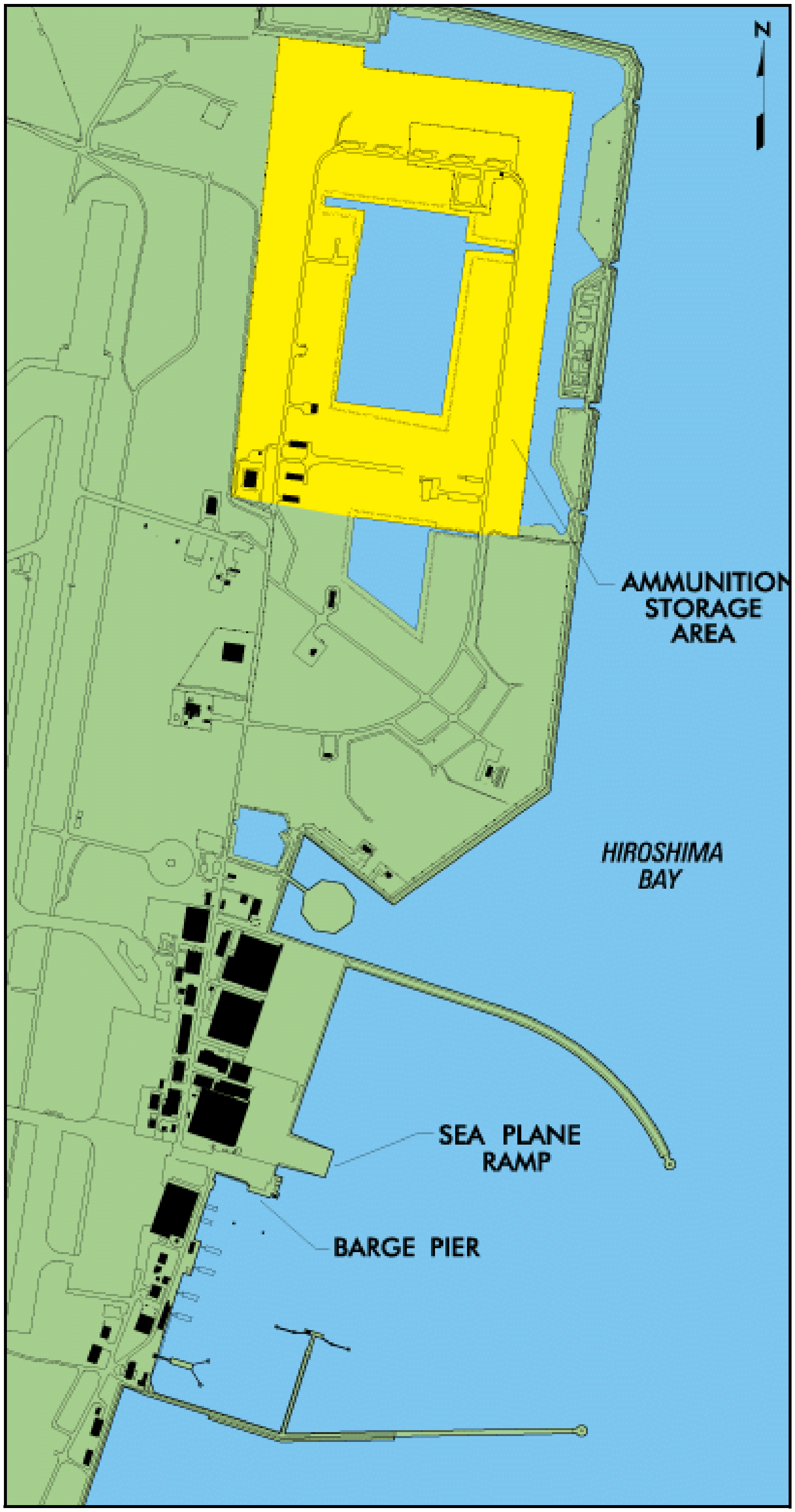
[2] Crane is present on the berth. However, it appears to be in poor mechanical conditions. It should not be considered for loading or unloading ammunition until inspected, passed, and certified for explosives handling.

[3] Plans call for a rail mounted luffing crane, capable of loading unloading containers.

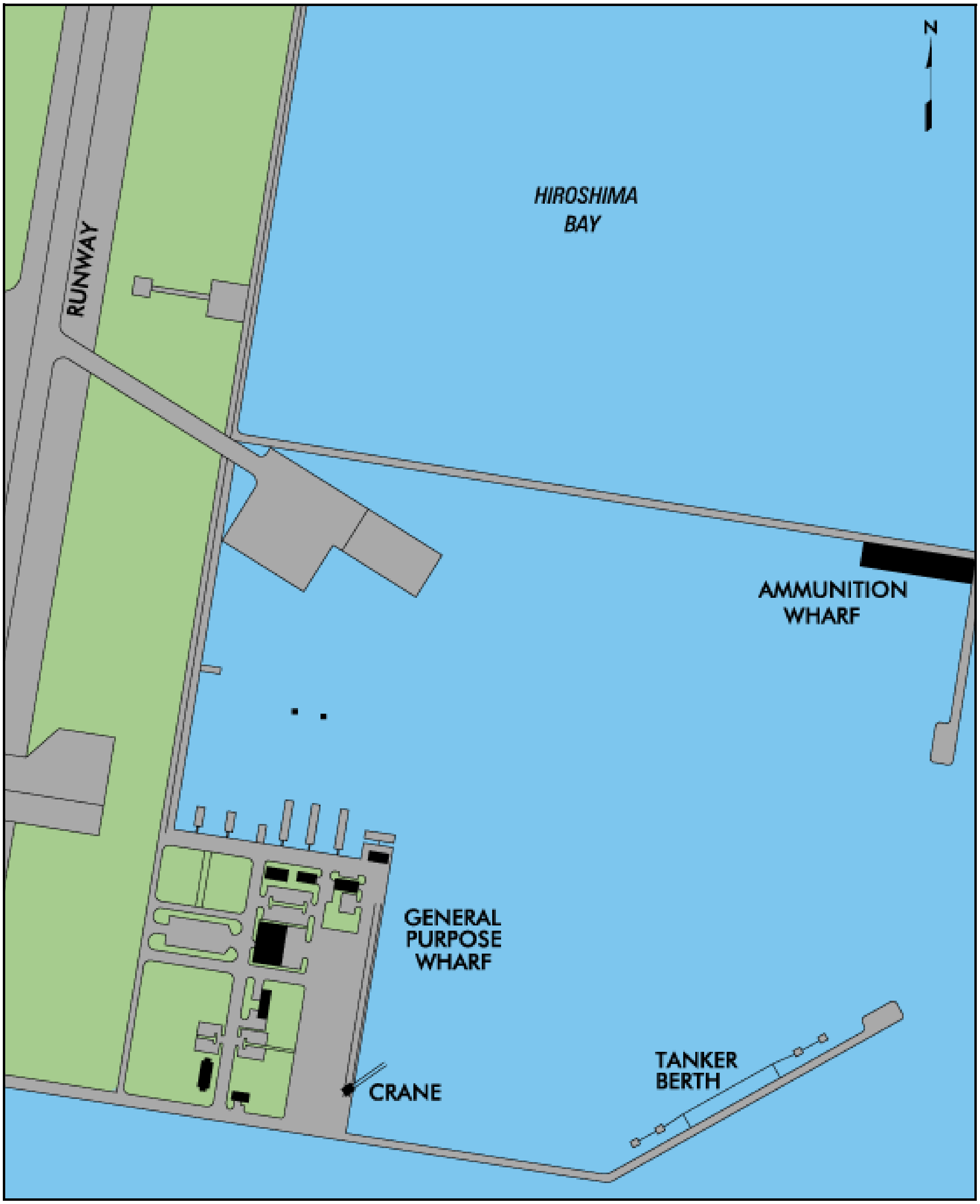
Present MCAS Iwakuni

Future MCAS Iwakuni

Barge Berth at Iwakuni



Existing facility site plan



New berth site plan

PORT COMPLEX AT IWAKUNI
SUMMARY OF BERTHING CAPABILITIES
(After completion of Construction)

VESSELS		BERTHS		
TYPE	**VESSEL CLASS**	**General Purpose Wharf**	**Ammo Whart**	
BREAKBULK	C3-S-38a	2		**NOTES**
	C-4-S-58a	1		a-vessel draft limit
	C4-S-66a	2		b-inadequate apron width
	C5-S-37e	1		c-inadequate berth length
				d-no straight stern ramp
SEATRAIN	GA & PR- Class	2		e-no container handling equipment
				f-anchorage depth OK, berth depth
BARGE	LASH C8-S-81b	1		inadequate
	LASH C9-S-81d	1		g-inadequate channel depth
	LASH Lighter	5	2	h-no shore based ramps
	SEABEE C8-S-82a	1		i - low tide insufficient ramp clearance
	SEABEE Barge	5	2	j-high tide insufficient ramp clearance
				k-excessive ramp angle low tide
RORO	COMET	2,d,i		m-excessive ramp angle high tide
	METEOR	2,d,i		n-parallel ramp operation ONLY
	Cape Gnome	1,d,i,j		o-insufficient apron width for side ramp
	C7-S-95a	1		
	Cape Taylor	1		Ramp clearance and angle based on
	Cape Orlando	1,i		maximum vessel draft
	MV Ambassador	2,d		
	Callaghan	1,d,i		**May Prevent Operation**
	Cape Lambert	1,i,j		
	LMSR - Class	1		**May Limit Operation**
	FSS	1		
	Cape E	1,i,j		
	Cape D	1,i		
	Cape H	1,i		
	Cape Texas	1,i		
	Cape R	1,d		
	Cape I	1,i		
	Cape Victory	1,i		
CONTAINER	C6-M-147a	1		
	C7-S-69c	1		
	C7-S-68c	1		
	C8-S-85c	1		
	C9-M-132b	1		
	C9-M-F141a	1		
TACS	C6-S-1qd	1		
	C5-S-MA73c	1		
	C6-S-MA60d	1		
MPS	C7-S-133a	1		
	Maersk	1		
	AmSea	1		

STAGING

Open Staging

Iwakuni Air Station has a number of large areas that can provide open staging for cargo and equipment. Immediately adjacent to the barge berth there is about 120,000 square feet of paved surface that can support open staging requirements. Much of this area supports the Japan Maritime Self-Defense Force's seaplane operations day to day and its use, as staging, must be coordinated with them.

The area adjacent to the General Purpose Berth will have about 200,000 square feet exclusively for staging when Phase 1 of the construction project is complete. The other area around the installation can support staging requirements on an exceptional basis provided flight operations are not impeded.

Covered Staging

Iwakuni has a number of magazines and igloos that provide staging and storage for ammunition and explosives. According to Ordnance officials, the construction projects will not affect these areas.

There are many warehouses and other buildings that can provide staging or storage when needed. The engineers at Iwakuni identified two warehouses that will be part of a future construction phase. These buildings will each offer about 17,600 square feet of staging. The project plan places these buildings directly behind the General Purpose Berth they will support.

Staging area

UNLOADING/LOADING POSITIONS

Ramps

There are no end ramps available in the port. MCAS operators could construct a temporary ramp(s) if required.

Docks

MCAS Iwakuni has no loading docks.

MARSHALING AREAS

There are no locations near the air station suitable for use as marshaling areas.

MATERIAL HANDLING EQUIPMENT (MHE)

TYPE OF EQUIPMENT	CAPACITY (STON)	QUANTITY ON HAND	OWNING ORGANIZATION
Mobile Cranes	50	2	Heavy Equip Sqdn
	45	1	Station Motor Pool
	25	1	Station Motor Pool
	7.5	5	Heavy Equip Sqdn
Container Handlers RTCC	25	2	Heavy Equip Sqdn
Forklifts RT	5	19	Heavy Equip Sqdn
	2	5	Heavy Equip Sqdn
Forklifts	3	2	Station ORD
Electric Forklifts	3	4	Station Ord

The table lists the equipment available from several sources that customarily support ammunition operations at Iwakuni. Ownership of the equipment is divided between the Station Ordnance Unit, the MWSS 171 Heavy Equipment Squadron, and the Station Motor Pool.

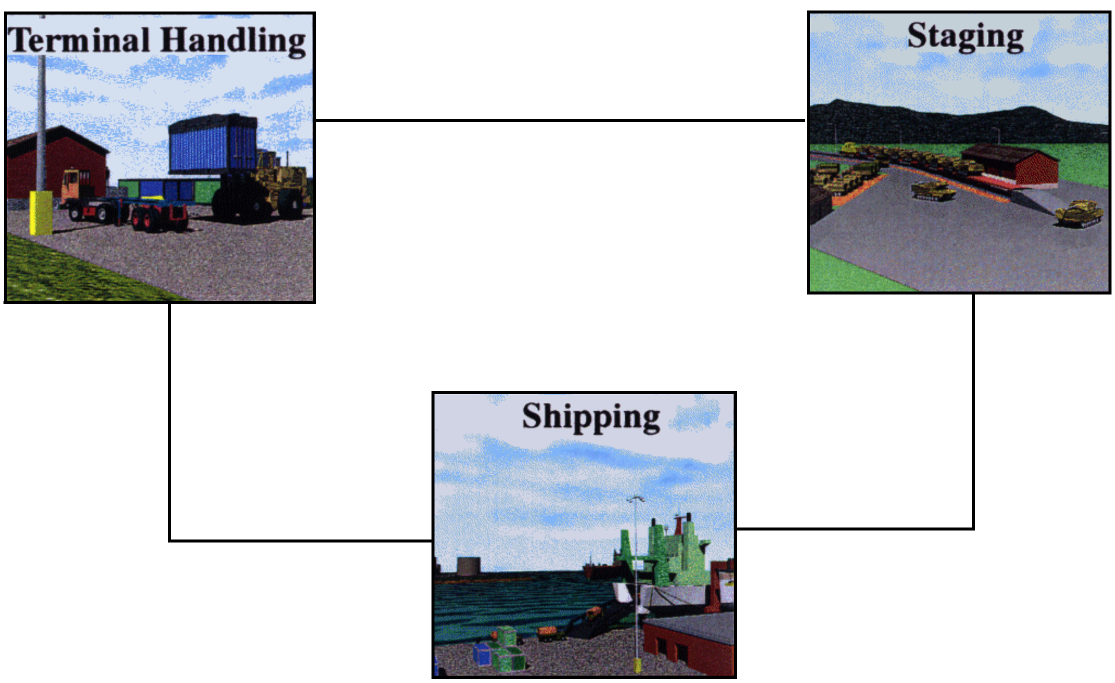
In addition to the equipment listed above, various types of trucks and trailers are available to move ammunition between the berth and storage area.

II. THROUGHPUT ANALYSIS

GENERAL

For the purposes of this report, cargo throughput at the studies Air Station is based on the facility's capability to transship ammunition and general cargo, **after** completion of the construction project's Phase 1. Because work has already begun on Phase 1, Iwakuni's barge berth will soon disappear, never to return. In late 1999, the new berths will be completed. Therefore, an analysis that projects the capability of the new facilities will better reflect the installation's capability for future operations.

To predict the future throughput capability of Iwakuni, the Port Operational Performance Simulator (POPS) computer model was used. The POPS model performs a weak-link analysis in which each of three subsystems is analyzed separately and then compared to find the least capable. The weakest subsystem determines the maximum throughput capability of the port (Iwakuni). The model yields throughput capability values for each of the subsystems - terminal handling/processing, staging, and shiploading/unloading - in terms of short tons (STON) and measurement tons (MTON) per day.



Terminal Throughput Subsystems

TERMINAL CLEARANCE AND HANDLING

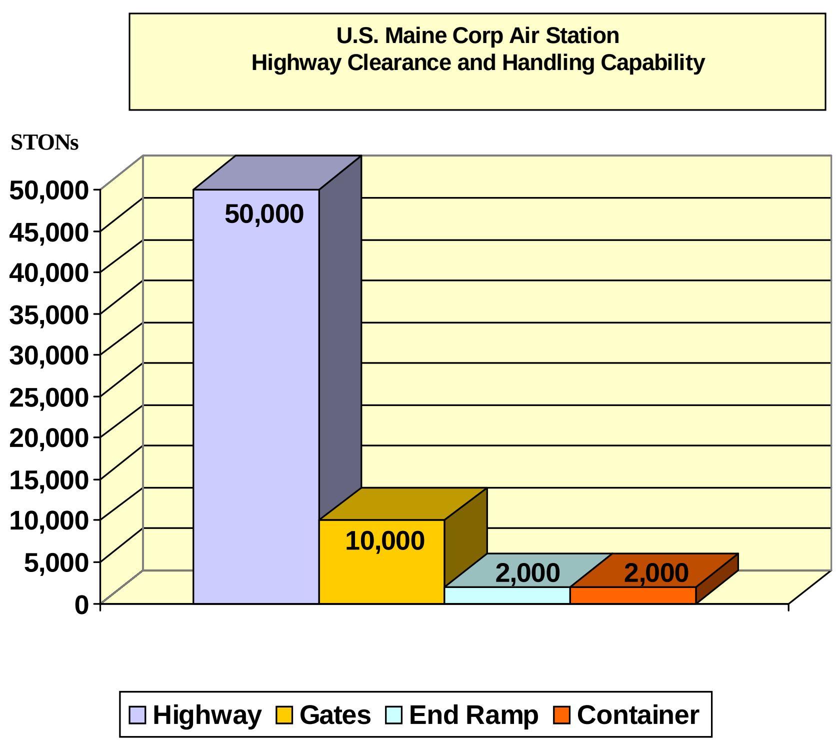
Highway

The port area at Iwakuni connects directly to the main support area of the base and to the ammunition storage area by dedicated roads. This network further connects to the Japenase National and Yamaguchi Prefecture highway systems. As many as three gates connect the base to these roads. However, only the main gate will support truck entry and exit of the base.

The routes around the port complex can handle over 50,000 STONs of equipment and supplies daily. The gate processing system can handle more than 10,000 STONs (about 40,000 MTONs) of cargo per day.

Roadable vehicles can move through the installation gates in manageable convoys from staging areas designated for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a self-loading capability, will be limited to temporary truck docks and end ramps constructed as required by MCAS personnel. No other loading sites are available in the port complex. These locations could handle as much as 2,000 STON (8,000 MTON) of military cargo per day.

The base has two rough terrain container handlers (25-ton). If we assume 50 percent availability for container chassis operations, the port can handle about 2,000 STON (8,000 MTON) of containers daily (about 250 boxes). This assumes 250 (conservative) moves per handler per day.



Rail

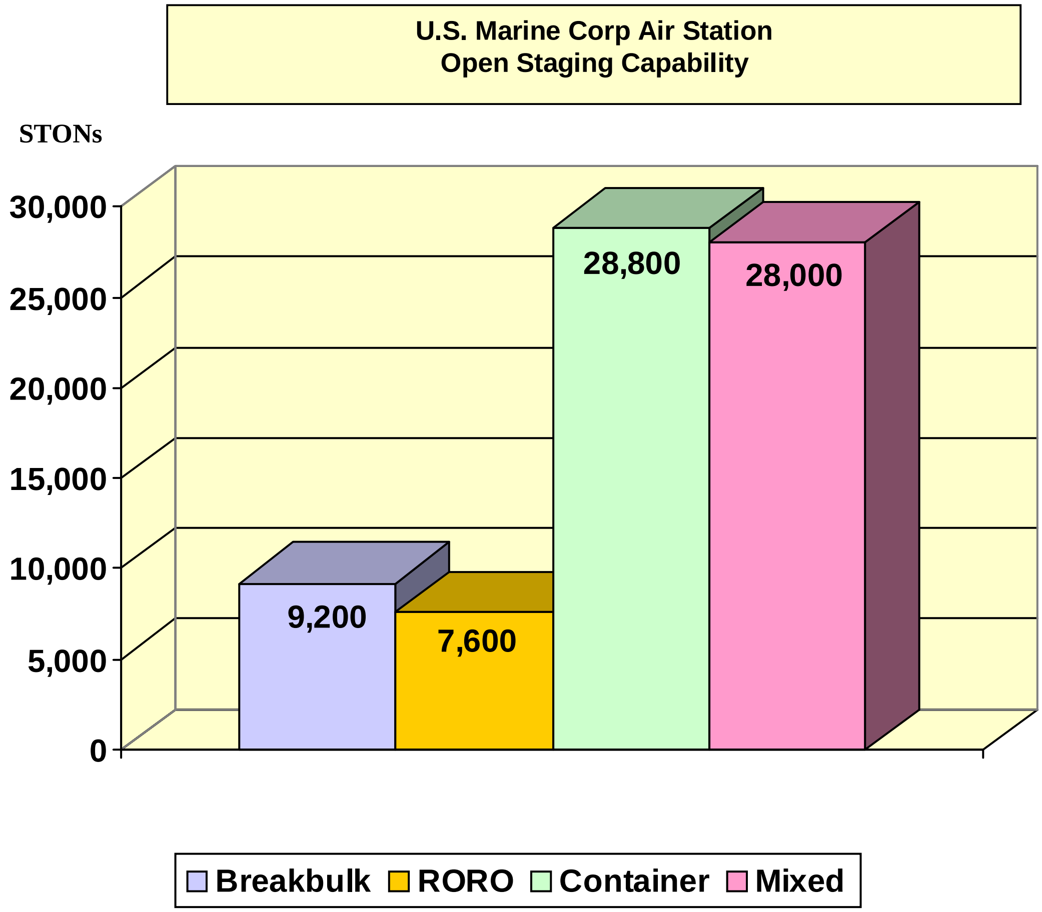
There is no direct rail service into MCAS Iwakuni, although the Japan National Railway does serve the city of Iwakuni.

STAGING

The port area has less than 5 acres of suitable open staging area. This area will support staging requirements primarily for the General Purpose Berth. This area offers staging for about 28,000 STON (70,400 MTON) of mixed cargo. The ammunition storage area will stage explosive cargoes.

The port has about 35,200 square feet of covered storage space. About 2,200 STON (8,800 MTON) of breakbulk/barge cargo can be staged in the covered area.

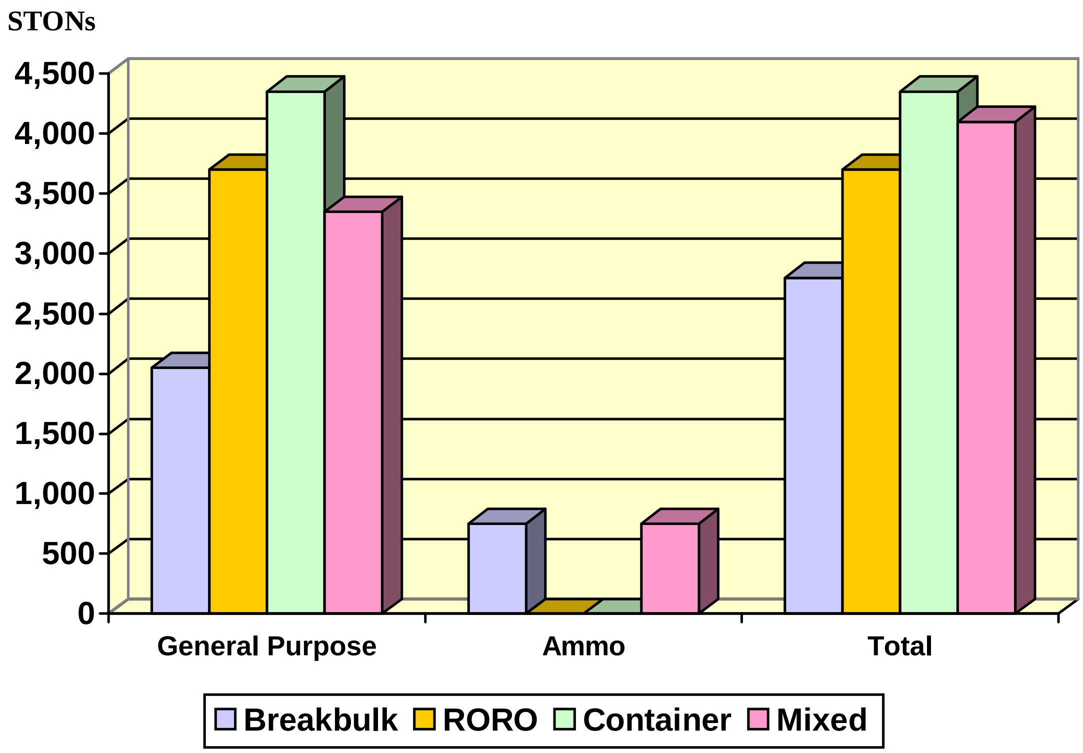
The chart shows the use of the distributed open storage and staging space in the port by demonstrating the amounts by type of the cargo that can be stored there. This analysis assumed a usable space availability of 70 percent of the total area.



SHIPPING

Daily shipping subsystem totals for the berths are catalogued in the chart below. They are based on various factors including MHE availability; loading, operational and berth usage rates; and berthing capabilities for various vessel types. Assumptions and parameter values used to calculate these are shown in appendix A.

U.S. Marine Corp Air Station
Berth Throughput Capability

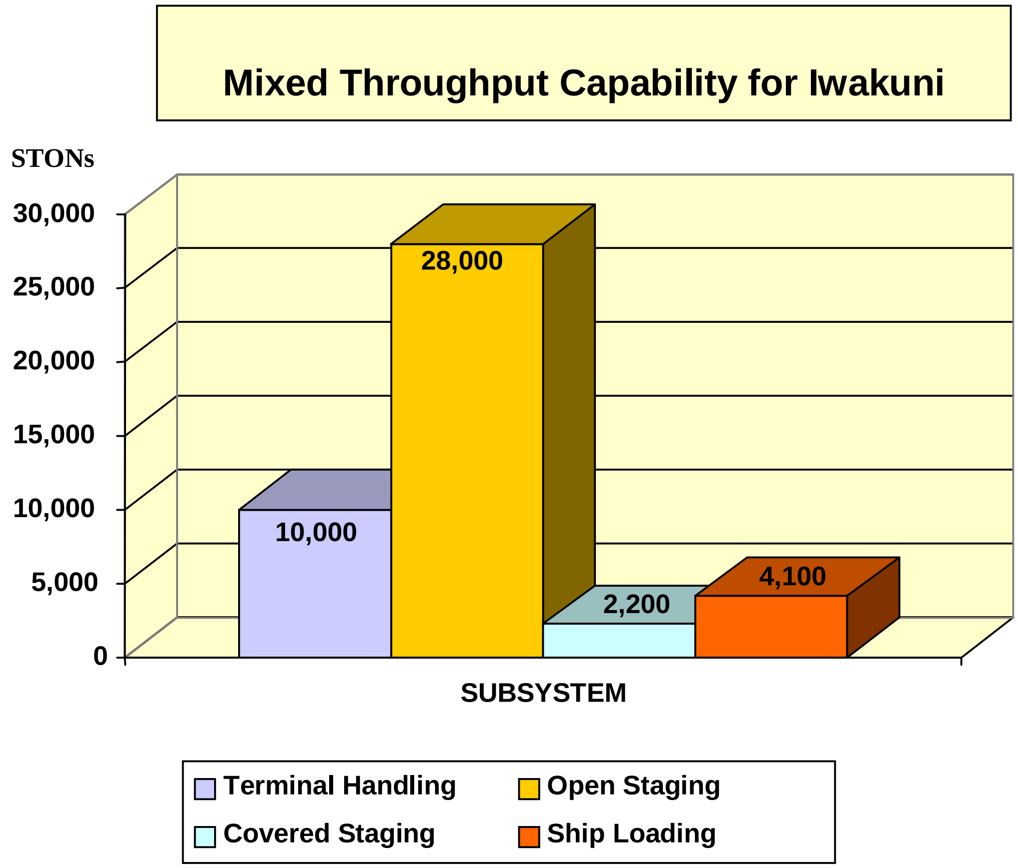


	General Purpose	Ammo	Mixed
Breakbulk	2,000	700	2,700
RORO	3,600	100	3,700
Container	4,300	100	4,400
Mixed	3,300	700	4,100

III. CONCLUSIONS

The future port berths at Iwakuni are fully capable of supporting US Military cargo transhipment operations. Although the tidal range limits RORO operations somewhat, the port can accommodate vessels as large as the LMSR and FSS as shown in the Berthing Characteristics Table.

Of the transportation susbystems analyzed, the least capable is the shiploading system[4]. This subsystem limits the cargo throughput at Iwakuni to about 4,100 STON or 16,400 MTON per day of mixed throughput.



[4] Terminal handling capability for containers is the least capable for that commodity only. Terminal handling limits daily throughput of containers to about 2,000 STON or 250 TEUs.

JUNE 1999

U.S. NAVAL BASE
PEARL HARBOR

I. GENERAL DATA

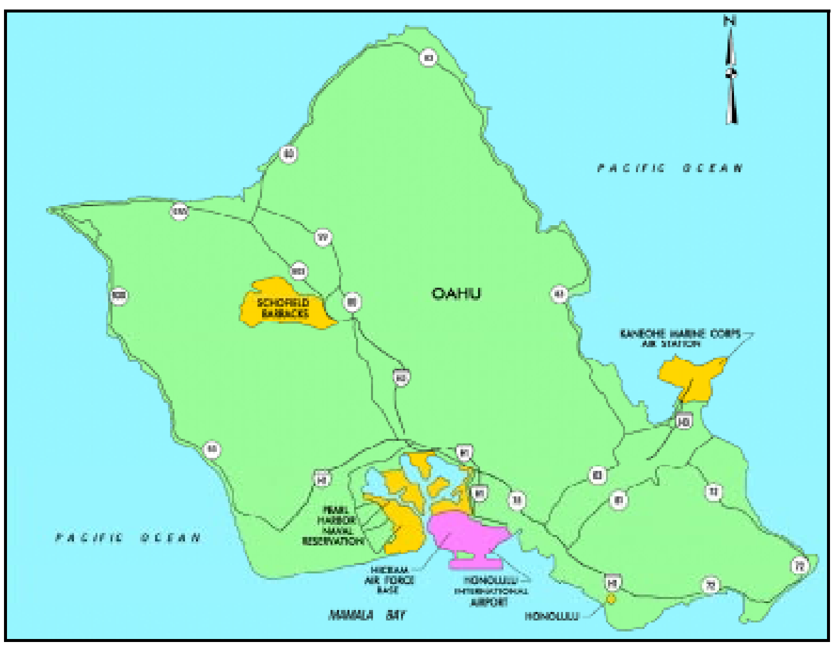
TRANSPORTATION ACCESS

Water

A survey team from the Transportation Engineering Agency (TEA) visited the U.S. Naval Base at Pearl Harbor, Hawaii in June 1997.[1] The base is located on the south side of the Island of Oahu on the Mamala Bay. The base terminal areas are divided into three major branches: East Loch, Middle Loch and West Loch. The Pearl Harbor entrance channel is maintained at a minimum depth of 40 feet (50 feet in some areas) at mean low water (MLW). Tidal range around Pearl Harbor is about three (3) feet. The channel is not less than 300 yards wide from the seabouys to Waipio Point where the West Loch Channel leaves the Main Channel. The Main Channel continues north to the vicinity of Ford Island and splits into two arms (the Main Channel/South Channel and the Ford Island/North Channel.) Two turning basins are located within the harbor. The first of these is centered at 21º 20' 35" North 157º 58' 10" West, or just North of the West Loch Channel cut-off. This turning basin is about 450 yards in diameter and can accommodate vessels up to 900 feet long. The other turning basin is located at about 21º 21' 32" North and 157º 57' 20" West, in the South fairway between Ford Island and the Kuahua Area. This basin is about 750 yards in diameter and can turn vessels up to 1200 feet long.

The Pearl Harbor Complex has two anchorage locations, a deep draft anchorage and an ammunition anchorage. These are both located in the North Channel area, north of Ford Island.

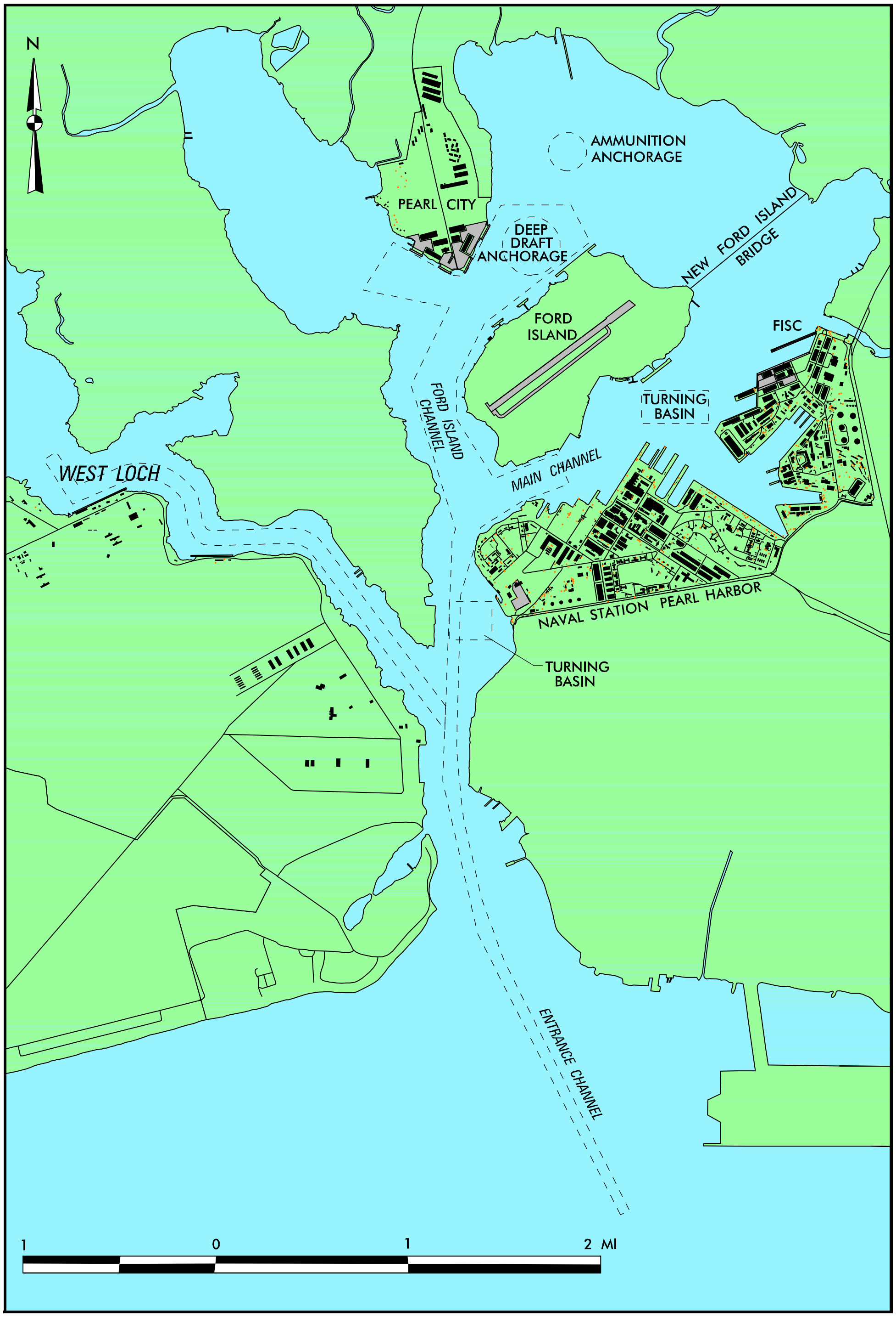
The deep draft anchorage has a depth of 42 feet at MLW. The ammunition anchorage has a depth of 35 feet MLW. No navigational restrictions affect either anchorage. Both are sited for 70,000 lbs. Net Explosive Weight (NEW).



Oahu

[1] Data used to support this analysis comes largely from on-site observation by the survey team and information provided by operations and management personnel at the facility. Other data sources used include industry and related publications.

The Ford Island Bridge (under construction during the site visit to Pearl Harbor) spans the Main Channel/South Channel, upstream of the major industrial area of Pearl Harbor. The bridge will have a floating pontoon center section that will open to provide a 650-feet-wide channel clearance with no overhead clearance restrictions. The 3,073-feet-long bridge is expected to open in mid 1998.



Pearl Harbor

Highway

The Pearl Harbor complex is within 5 miles of Honolulu, and immediately adjacent to Hickam AFB. Interstate Route H-1 and Hawaii State Road 99, the Kamehameha Highway, parallel the base boundary and connect the base's access roads to the Oahu Highway network. Highway 90, the Farrington Highway, connects the West Loch area of the base via Highway 742, the Waipio Point Access Road. Three gates, the Nimitz Gate on the Mauka Extension, the Halawa Gate and the Makalapa Gate on North Road off Highway 99, provide access to the main industrial area of the base. The Pearl City Gate accesses that area from Lehua Avenue. The gate on Iroquois Drive off North Road and Highway 760 accesses the West Loch facilities. All gates except the West Loch Gate have two entry and two exit lanes. The West Loch Gate has one lane each way.

Halawa Gate

Rail

There is no rail service on the island of Oahu.

Airports

Two airports serve the Pearl Harbor area. Hickam Air Force Base and Honolulu International Airport are located within 2-3 miles of the main base industrial area. These two facilities are located adjacent to each other and share the same runways. Both can accommodate aircraft of all sizes, including wide body planes. The Pearl Harbor complex shares a common boundary line with Hickam AFB.

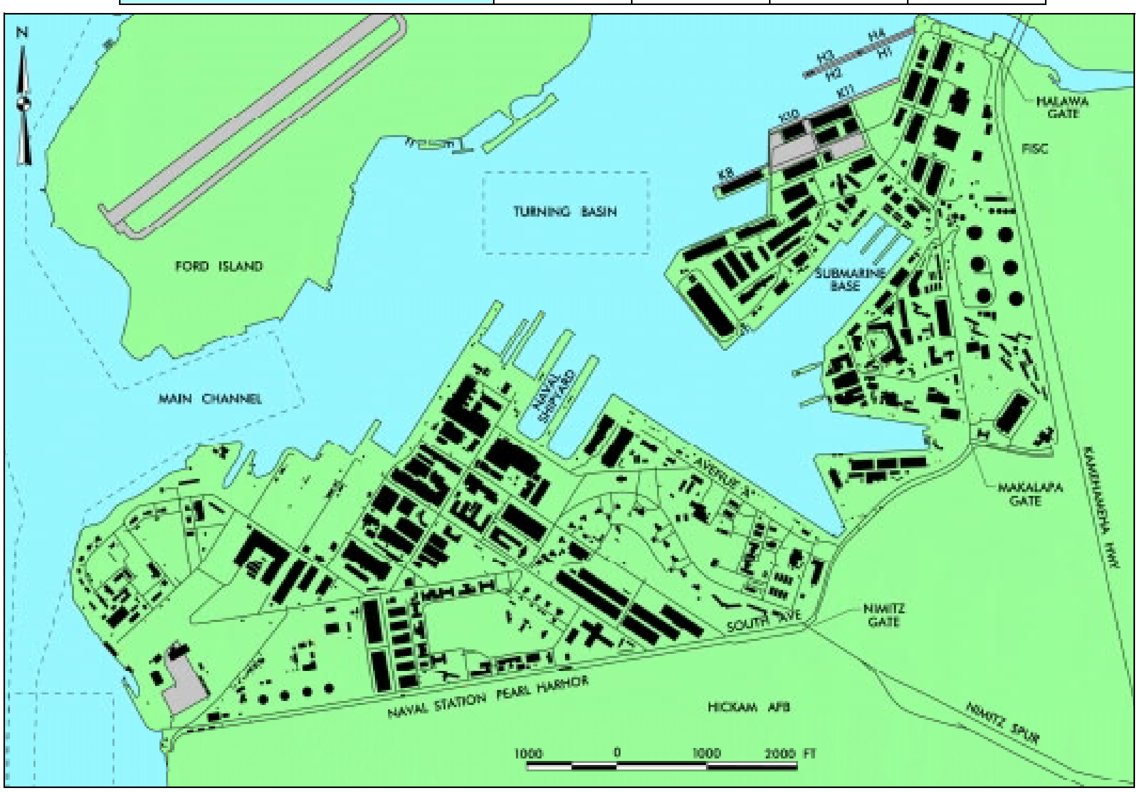
PORT FACILITIES

Berthing

The Pearl Harbor complex is divided into three major berthing areas: the main industrial area or Fleet Industrial Support Center (FISC)/Naval Station Pearl Harbor (NAVSTA PH) berths (K8, K10-11, H1-2, H2-4), the Pearl City berths (V1, V2, V3, V4) and the ammunition berths (W1-5) in the West Loch area of the base complex.

BERTHING CHARACTERISTICS OF THE FISC/NAVSTA PEARL HARBOR BERTHS

Characteristics	Berths			
	K8	**K10-11**	**H1-2**	**H3-4**
Length (ft)	667	1016	1376	1376
Depth alongside at MLW (ft)	40	40	40	40
Deck strength (psf)	750	700	600	600
Apron width (ft)	30	50	40	40
Apron height above MLW (ft)	9	9	9	9
Number of container cranes	0	0	0	0
Number of wharf cranes	0	0	0	0
Apron lighting	YES	YES	YES	YES
Straight-stern RORO facilities	NO	YES	NO	NO
Apron length served by rail (ft)	NA	NA	NA	NA



Naval Station Pearl Harbor and Fleet Industrial Support Center (FISC)

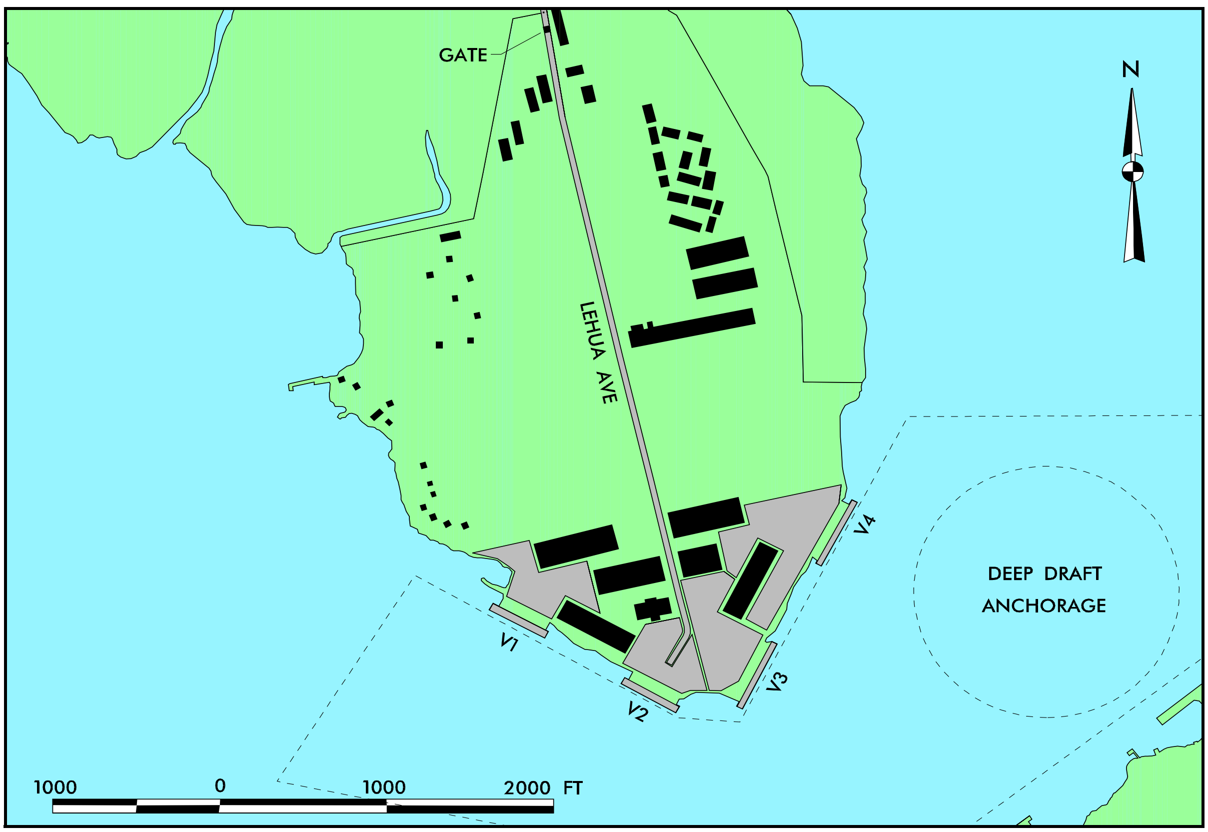
FISC Aerial Photo

BERTHING CHARACTERISTICS OF PEARL CITY BERTHS

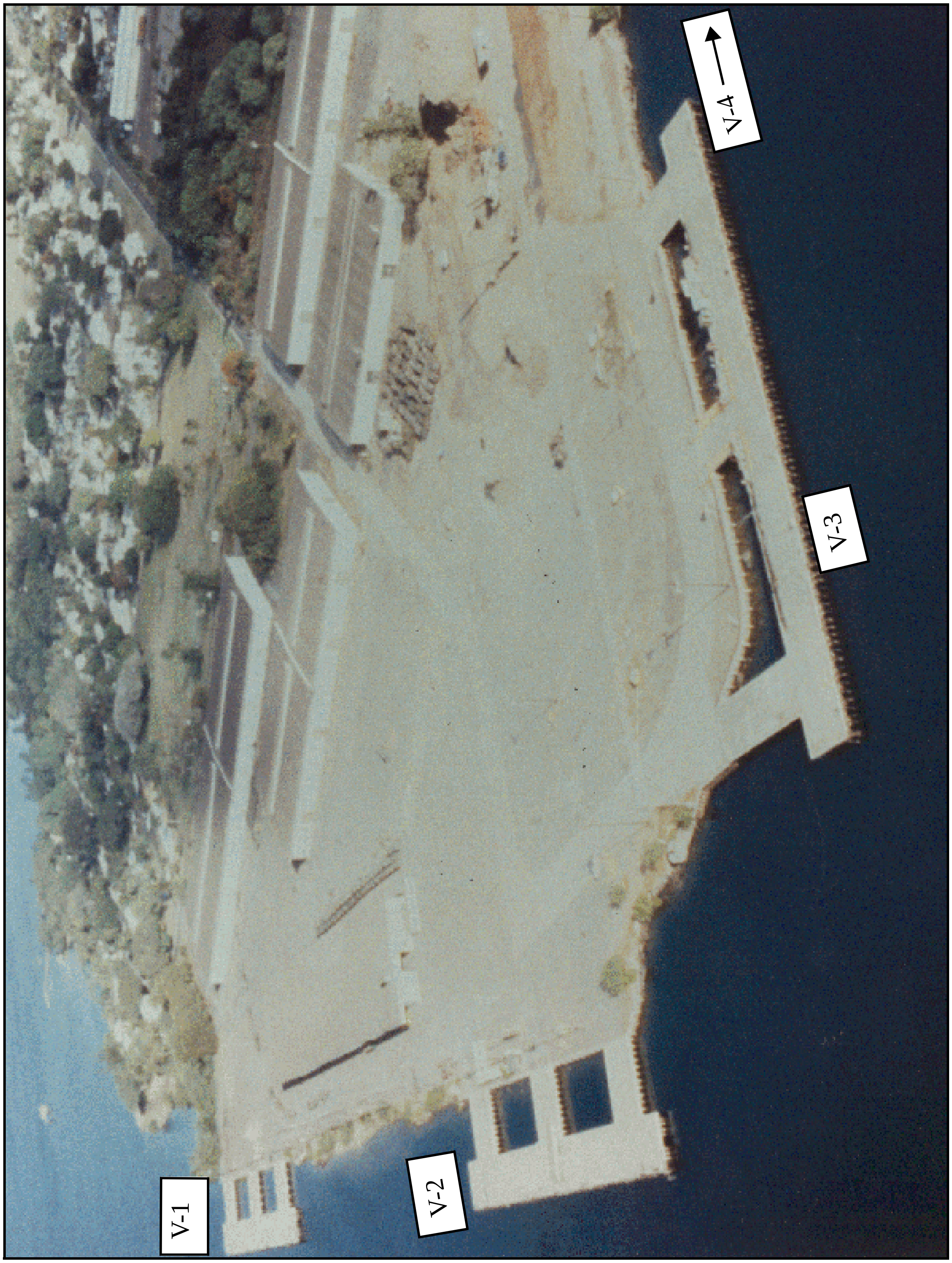
Characteristics	Berths			
	V1[1]	V2	V3[2]	V4
Length (ft)	376	376	454	454
Depth alongside at MLW (ft)	40	40	40	40
Deck strength (psf)	600	600	600	600
Apron width (ft)	40	40	40	40
Apron height above MLW (ft)	9	9	9	9
Number of container cranes	0	0	0	0
Number of wharf cranes	0	0	0	0
Apron lighting	YES	YES	YES	YES
Straight-stern RORO facilities	NO	NO	NO	NO
Apron length served by rail (ft)	NA	NA	NA	NA

[1] Pearl City berths have accomodated large RORO and FSS vessels in a berthing configuration that permits the side or stern ramp to fall on the berth although the entire length of the vessel is not alongside the pier.

[2] Berths V3 and V4 primarily support POL operations, but could support other types of vessels.



Pearl City



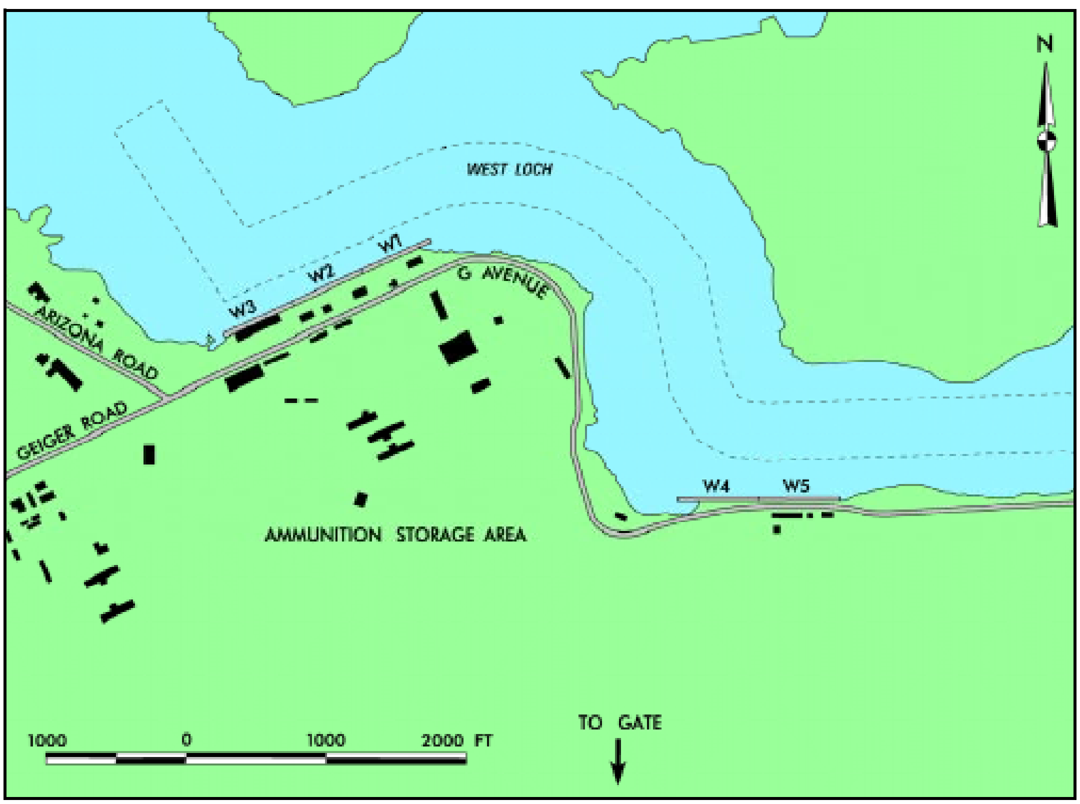
Pearl City

Fast Sealift Ship working at Pearl City - Berth V-1 and V-2

BERTHING CHARACTERISTICS OF WEST LOCH BERTHS

Characteristics	Berths*	
	W1-3	W4-5
Length (ft)	1500	1500
Depth alongside at MLW (ft)	40	40
Deck strength (psf)	700	700
Apron width (ft)	OPEN	OPEN
Apron height above MLW (ft)	9	9
Number of container cranes	0	0
Number of wharf cranes	0	0
Apron lighting	YES	YES
Straight-stern RORO facilities	NO	NO
Apron length served by rail (ft)	NA	NA

*These berths are used for loading and unloading ammunition. Base regulations limit the overall Net Explosive Weight (NEW) to 3,2500,000 LBS. Berth W5 (the Ease end of Berth W4-5) is limited to 500,000 LBS NEW; Berth W3 (the West end of Berth W1-3) is limited to 3,000,000 LBS NEW. The other berths can be utilized to the overall limit.



West Loch

STAGING

Open Staging

The main base area of the Pearl Harbor Complex has about 150,000 square feet of open staging. The Pearl City area has about 15 (660,000 square feet) acres of open storage. In the vicinity of the West Loch berths, open staging is limited to about 120,000 square feet.

Covered Staging

The FISC storage facility in the main base industrial area has about 117,000 square feet of covered space. At any given time at least half of this space could support port operations. In the Pearl City area, several buildings can support covered staging requirements. Collectively these buildings offer over 250,000 square feet of space. Observations made during the site visit found some of these buildings to be in disrepair; therefore, all of this space may not be usable. In the West Loch area there is no covered storage other than areas dedicated to ammunition storage.

Open Staging

Covered Staging

UNLOADING/LOADING POSITIONS

Ramps

None of the terminals in Pearl Harbor has a fixed end-ramp. The FISC has several portable ramps that can support offload of vans and flatbed trucks. Additionally, temporary ramps can be constructed if required.

Docks

The FISC storage facility has six dock positions for offloading flatbed trucks and vans.

FISC Work Area

MARSHALING AREAS

Several areas near the complex could possibly support marshalling requirements. Two sites offer the best possibility for use as a marshalling area. The first and largest of these is in the immediate area of the Aloha Stadium. The stadium's huge parking lot and support area might provide as much as 40 acres in which to marshal equipment. Similarly, the area around the Pearl City Terminal can provide significant marshalling space, as much as 15-20 acres. Other areas that can probably support marshalling requirements are Hickam AFB, Schofield Barracks and Wheeler Army Airfield.

PORT OF PEARL HARBOR
SUMMARY OF BERTHING CAPABILITIES

VESSELS		BERTHS										
TYPE	CLASS	K8	K10-11	H1-2	H3-4	V1*	V2	V3	V4	W1-3	W4-5	
BREAKBULK	C3-S-38a	1	1	2	2					2	1	NOTES:
	C4-S-58a	1	1	2	2					2	1	a-vessel draft limit
	C4-S-66a	1	1	2	2					2	1	b-inadequate apron width
	C5-S-37e	1	1	2	2					2	1	c-inadequate berth length
SEATRAIN	GA and PR	1	1	2	2					2	1	d-no straight stern ramp
BARGE	LASH C8-S-81b		1	1	1					1	1	e-no container handling equipment
	LASH C9-S-81d		1	1	1					1	1	f-anchorage depth OK, berth depth
	LASH Lighter	3	5	6	6	1	1	2	2	7	5	inadequate
	SEABEE C8-S-82a		1	1	1					1	1	g-inadequate channel depth
	SEABEE Barge	3	5	6	6	1	1	2	2	7	5	h-no shore based ramps
RORO	COMET	1d,o	1i	2d,o	2d,o					2d,i	1d,i	i-low tide insufficient ramp clearance
	METEOR	1d,o	1i	2d,o	2d,o					2d,i	1d,i	j-high tide insufficient ramp clearance
	Cape Gnome	1d,o	1i,j	2d,o	2d,o					2d,i,j	1d,i,j	m-excessive ramp angle high tide
	C7-S-95A		1b	1b	1b	1b		1b		1	1	n-parallel ramp operation ONLY
	Cape Taylor	1b	1b	2b	2b	1b		1b		2	1	o-insufficient apron width for side ramp
	Cape Orlando	1b	1b	2b	2b	1b		1b		2i	1i	
	MV Ambassador	1d	1k,m	2d	2d					2d	1d	Ramp clearance and angle based on
	Callaghan		1	1d,o	1d,o					2d	1d	maximum vessel draft
	Cape Lambert		1b	1b	1b	1b		1b		2i,j	1i,j	
	LMSR Class		1b	1b	1b	1b		1b		1	1	
	FSS		1b	1b	1b	1b		1b		1	1	
	Cape E-Class	1b	1b	2b	2b	1b		1b		2i,j	1i,j	♦ May Prevent Operation
	Cape D-Class		1b	1b	1b	1b		1b		2i	1i	
	Cape H		1b	1b	1b	1b		1b		1	1	♦ May Limit Operation

* Large RORO vessels have berthed at berths V1 and V3 although their length exceeds the berth length. The vessels center on the berth and lay down ramps in positions that maximize load/offload capability. In these cases, the berths immediately adjacent (V2 and V4) are used to secure the vessels and therefore, cannot accommodate other ships.

PORT OF PEARL HARBOR
SUMMARY OF BERTHING CAPABILITIES (CONT)

VESSELS		BERTHS										
TYPE	CLASS	K8	K10-11	H1-2	H3-4	V1*	V2	V3	V4	W1-3	W4-5	
RORO	Cape Texas	1b	1b	2b	2b	1b		1b		2i	1i	NOTES:
	Cape R	1b,d,o	1							2d	1d	a-vessel draft limit
	Cape I-class		1b	1b	1b	1b		1b		2i,j	1i,j	b-inadequate apron width
	Cape Victory	1b	1b	2b	2b	1b		1b		2	1	c-inadequate berth length
CONTAINER	C6-M-147a	1b,e	1b,e	2b,e	2b,e	1b,e		1b,e		2e	1e	d-no straight stern ramp
	C7-S-69c	1b,e	1b,e	1b,e	1b,e	1b,e		1b,e		2e	1e	e-no container handling equipment
	C7-S-68c		1b,e	1b,e	1b,e	1b,e		1b,e		2e	1e	f-anchorage depth OK, berth depth
	C8-S-85c		1b,e	1b,e	1b,e	1b,e		1b,e		1e	1e	inadequate
	C9-M-132b		1b,e	1b,e	1b,e	1b,e		1b,e		1e	1e	g-inadequate channel depth
	C9-M-F141a		1b,e	1b,e	1b,e	1b,e		1b,e		1e	1e	h-no shore based ramps
TACS	C6-S-1qd		1b	1b	1b	1b		1b		2	1	i-low tide insufficient ramp clearance
	C5-S-MA73c	1b	1b	2b	2b	1b		1b		2	1	j-high tide insufficient ramp clearance
	C6-S-MA60d	1b	1b	1b	1b	1b		1b		2	1	m-excessive ramp angle high tide
MPS	C7-S-133a		1b	1b	1b	1b		1b		1	1	n-parallel ramp operation ONLY
	Maersk		1b	1b	1b	1b		1b		1	1	o-insufficient apron width for side
	AmSea		1b	1b	1b	1b		1b		1	1	ramp
												Ramp clearance and angle based
												on maximum vessel draft
												♦ May Prevent Operation
												♦ May Limit Operation

* Large RORO vessels have berthed at berths V1 and V3 although their length exceeds the berth length. The vessels center on the berth and lay down ramps in positions that maximize load/offload capability. In these cases, the berths immediately adjacent (V2 and V4) are used to secure the vessels and therefore, cannot accommodate other ships.

MATERIAL HANDLING EQUIPMENT (MHE)

The table below lists the MHE at each of the terminal areas.

Equipment	Capacity (STON)	FISC	Pearl City	West Loch
Mobile Crane	70			1
Mobile Crane	45	1		
Forklift	3	5		
Forklift	2	8		
Forklift	7			4
Forklift (Elec)	5.5			3
Forklift (Elec)	3.5			2

FUTURE DEVELOPMENT

Completion of the bridge and planned development of the Ford Island area of Pearl Harbor will cause several units currently based on the Island to move to other locations. The U.S. Army Boat Company will possibly relocate to the Pearl City Area. If this relocation occurs, then the available berths and staging/marshalling area in Pearl City will change.

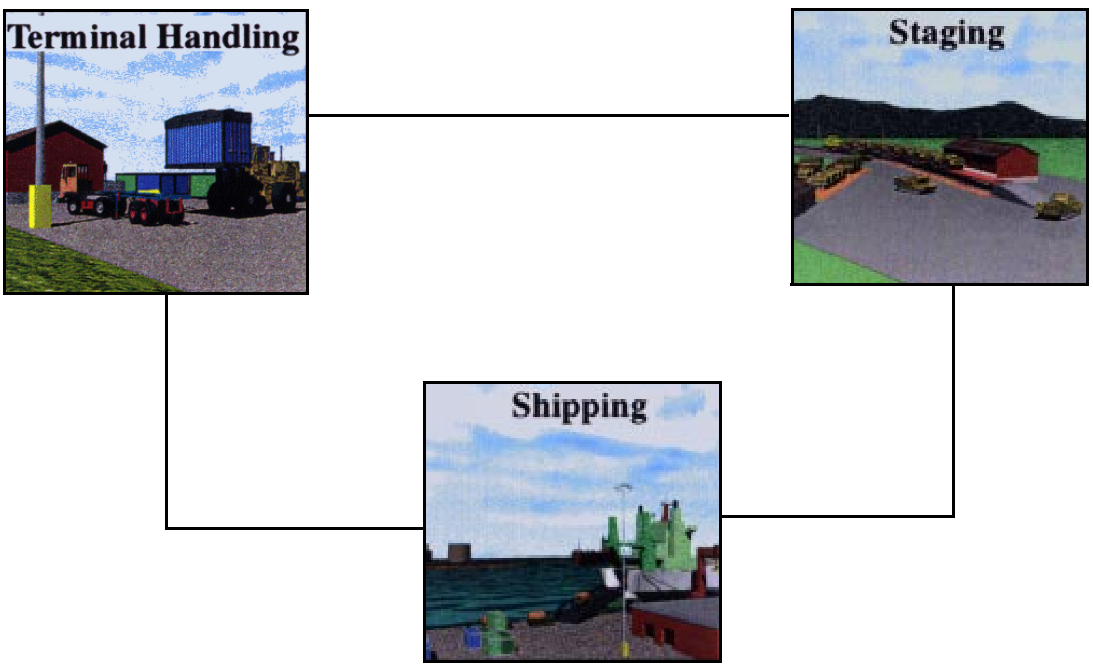
Ford Island Bridge under construction

Ford Island Bridge

II. THROUGHPUT ANALYSIS

GENERAL

This section evaluates the throughput capability of the Port of Pearl Harbor using the port operational performance simulator (POPS) computer model. The model is based on a weak link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in terms of short tons (STON) and measurement tons (MTON) per day. The charts in each subsystem section of this report show STONs. Approximate conversion to MTONs is possible by applying the factors in the chart at the end of the section. In each section some differences in the numbers may appear. These are due to rounding.



Terminal Throughput Sub-systems

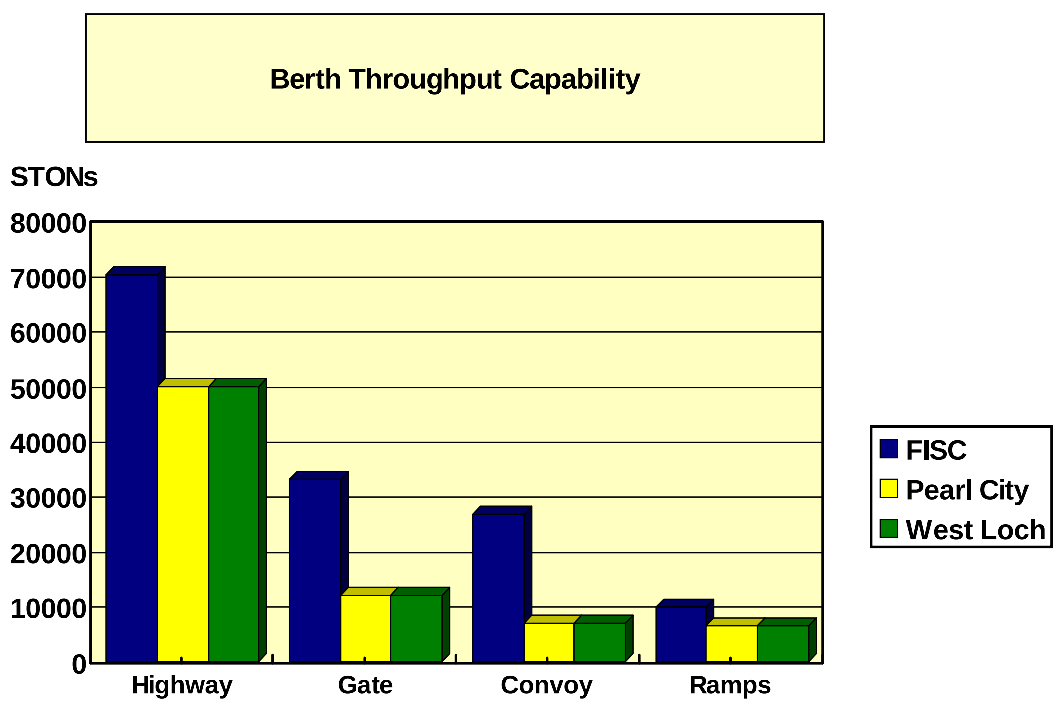
This analysis assumes a maximum of 100 percent of the port facilities can be made available at any one time. For this reason, we ran all port analyses using a 100 percent facility-use factor. In addition, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.

RECEPTION/HANDLING

The main Pearl Harbor/FISC complex is reached from Kamehameha Highway through one of three gates. The highway network accessing the area can handle at least 70,200 STON or 318,100 MTON of equipment or supplies daily. Gate capacity at the complex exceeds 33,000 STON or 150,000 MTON per day. As much as 26,800 STON or 121,000 MTON of roadable vehicles arriving in convoy can process directly to the staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at fixed docks or portable ramps. The terminal has six permanent truck docks and several portable ramps. These facilities could offload about 9,700 STON or 30,000 MTON from flatbed trailers per day.

Vehicles and unit equipment enter the Pearl City terminal area from Lehua Avenue. The access road can handle more than 50,000 STON or 225,000 MTON of cargo each day. The gate there can process about 12,000 STON or 45,000 MTON daily. Convoy capability at the terminal is at least 6,800 STON or 25,700 MTON per day. Vehicles or equipment arriving on flatbed trucks require portable ramps for unloading. The terminal area has no ramps so these must be procured elsewhere or temporary ramps constructed. Two ramps can process about 6,400 STON or 19,300 MTON of cargo daily.

The West Loch area is supported, like Pearl City, by one major access road and one gate. Highway and gate capabilities are essentially identical to Pearl City. Although this terminal is used to load and unload ammunition, unit equipment could move through the berths.

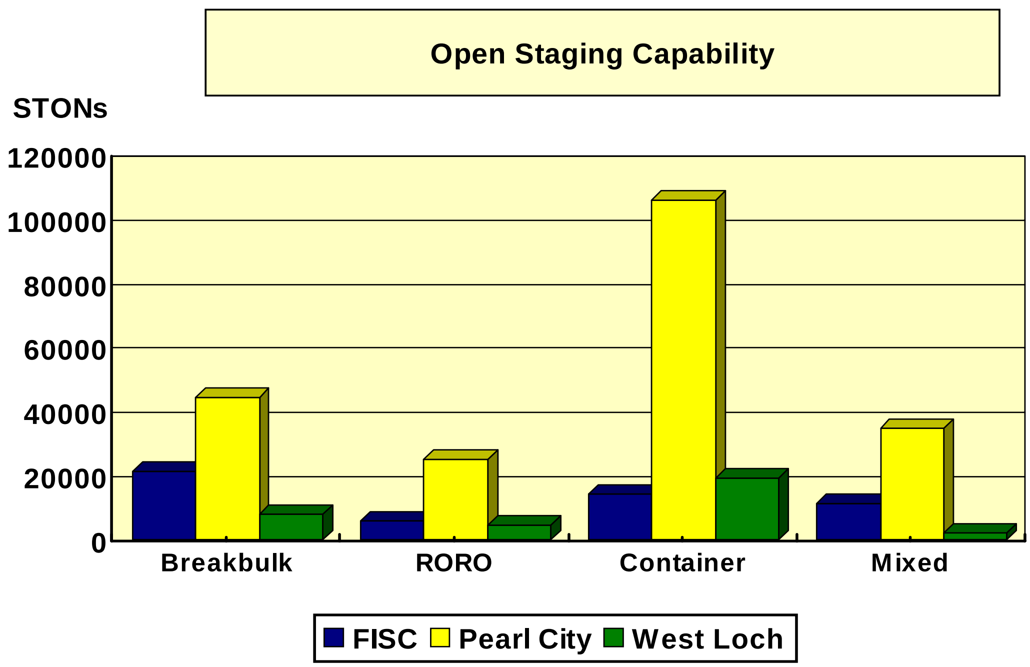


STAGING

The FISC/Main Base area at Pearl Harbor has about 150,000 SQFT (3.44 acres) of open staging area. This area provides staging for about 21,400 STON or 60,000 MTON of breakbulk cargo or 5,700 STON or 22,800 MTON of RORO cargo. The area will also stage about 1,800 TEUs, 14,400 STON, or 36,000 MTON of containers and cargo.[2] By applying the ship mix, then the area could stage a total of about 11,400 STON or 28,500 MTON of breakbulk and 4,350 STON or 17,400 MTON of RORO cargo.

The Pearl City area has about 660,000 SQFT (15.1 acres) of open staging area. This area can stage about 44,150 STON or 138,600 MTON of breakbulk cargo or 25,000 STON or 100,000 MTON of RORO cargo. The area can stage as many as 13,200 TEUs or 105,600 STON or 264,000 MTON of containers and cargo. The mixed capability for the Pearl City area is a total of breakbulk, 34,700 STON or 93,400 MTON, RORO, 19,200 STON or 76,850 MTON.

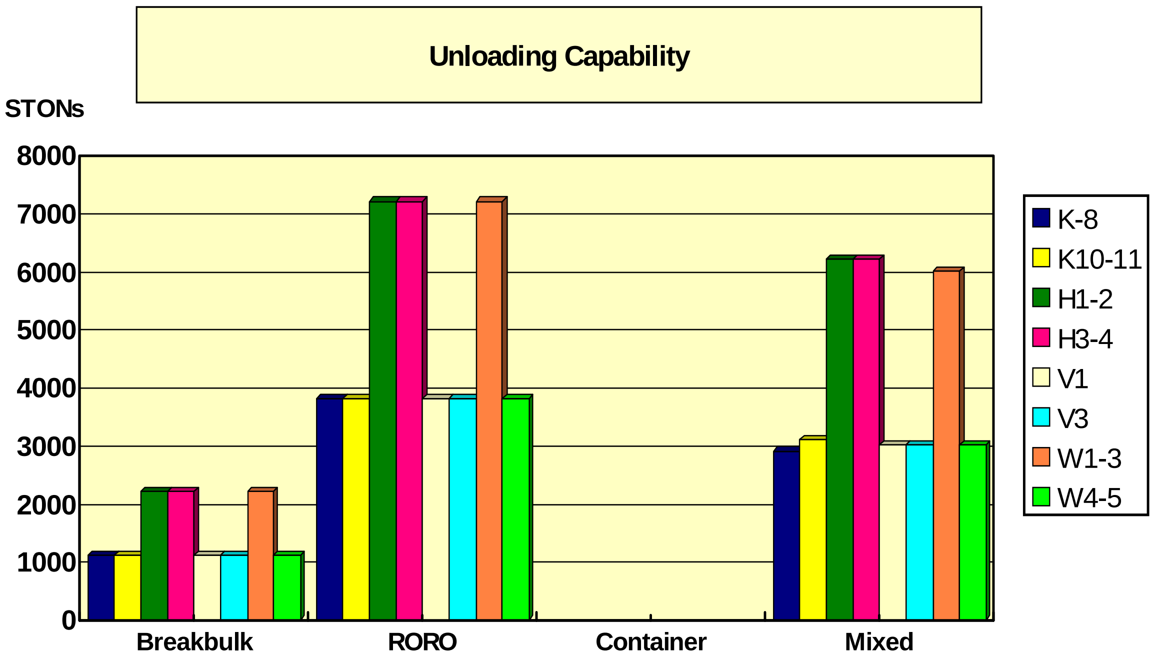
The West Loch area has about 120,000 SQFT (2.75 acres) of open staging area. This area offers staging for about 8,000 STON or 25,200 MTON of breakbulk cargo. The area can stage as much as 4,600 STON or 18, 250 MTON of RORO cargo. It could stage as many as 2,400 containers with about 19,200 STON or 48,000 MTON of cargo. The mixed staging capability for West Loch is a total of about 2,000 STON or 6,300 MTON of breakbulk cargo and about 3,400 STON or 13,700 MTON of RORO cargo.



[2] These totals are mutually exclusive, and represent individual cargo capabilities and can not be summed.

SHIPPING

The shiploading or unloading capabilities of the berths in the Pearl Harbor Complex are shown in the following table.



	K-8	K10-11	H1-2	H3-4	V1	V3	W1-3	W4-5
Breakbulk	1,100	1,100	2,200	2.200	1,100	1,100	2,200	1,100
RORO	3,800	3,800	7,200	7,200	3,800	3,800	7,200	3,800
Container								
Mixed	2,900	3,100	6,200	6,200	3,000	3,000	6,000	6,00

NOTE: Container shiploading is not considered because no container crane is available at either of the Pearl Harbor berths or terminals. If cranes are brought in, then any berth except the V1 or V3 berth can support containership operations.

III. APPLICATION

GENERAL

This section of the report will evaluate the port's throughput capability for deploying the 25th Infantry Division (Light) (-) using FSS vessels. The likely requirement for the Port of Pearl Harbor is to deploy the 25th Infantry Division (-) in six days of reception and throughput. The division, less the brigade in Alaska, is based at Schofield Barracks, within a 30-minute drive of the port over highways H-2 and H-1. The movement to the port will largely be by convoy, although some vehicles and outsize equipment may move by flatbed truck. This analysis will assume a four-day deployment for the division's equipment to the port, and a four-day vessel-loading period as shown in the chart below. [3]

DAY	1	2	3	4	5	6
MOVE TO PORT	X	X	X	X		
SHIPLOADING			X	X	X	X

TERMINAL INPROCESSING/HANDLING

HIGHWAY

Military vehicles and containers arriving by convoy or flatbed will enter one of several gates leading into the terminals. The primary highway leading from Schofield Barracks to the terminals at Pearl City and the Main FISC area is the Hawaii State Highways H-2 to H-1, then H-1 to Kamehameha Highway. Terminal entry roads have two lanes. Port Support Activity personnel will assist base security police in receiving vehicles at the terminal gate, and directing them to a processing area. Flatbeds arriving will offload at either the docks in the FISC area or at a portable or temporary end ramp as required.

Daily vehicle and equipment arrivals at the terminal are estimated [4] to be: 52 flatbeds with loaded equipment, two HETs with heavy equipment, 320 self propelled vehicles and 215 trailers. Additionally, about 69 containers per day will arrive. The total daily reception requirement is about 2750 STON of vehicles and equipment. These daily deployment rates do not exceed the capability of any of the three terminals to receive cargo.

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[3] Outload period could be compressed into as little as five days if operation is conducted at Pearl City.

[4] Estimate is based on the reduced size of the division in Hawaii, and represents about two-thirds of a light infantry division's vehicles and equipment.

SHIPPING

The current size of a Light Infantry Division requires 2.8 FSS-sized ships to deploy. The 25th Infantry Division has only two of its brigades in Hawaii. Therefore, we will assume the vessel requirement is only two FSS-sized vessels. All three terminals could load two vessels of this type concurrently.

The ASMP deployment standard requirement is to outload a division in six days. In order to meet the deployment timeline, Pearl Harbor terminal operators need to work only one vessel at a time. The Pearl Harbor berths can easily meet this requirement.[5] A six day deployment period will provide more time than required for loading two FSS-sized vessels.

NOTE: Although this analysis assumes the 25th Division will deploy using two FSS-sized ships, the number of ships required depends on the shipping mix selected. The adjacent table provides ship quantities required for various other ship types.

UNIT MOVEMENT REQUIREMENTS, LIGHT INFANTRY DIVISION *

Vessel Type	Number of Ships
All FSS	2.8
All LMSR	1.8
Notional RORO	3.5
All Breakbulk	9.1

* The numbers shown in this chart are for an entire division. The 25th Infantry Division has only two brigades on Oahu. The third brigade is in Alaska. Therefore, vessel requirements to deploy the division's Hawaii forces must be reduced by about one-third.

STAGING

Although an FSS-load of cargo can be staged and loaded on 10 acres, 16 acres are normally required for sustained loading operations. Of these 16 acres, about two acres are required for the staging of containers for each FSS.

While all three of the terminal areas can easily berth the vessel requirement for outloading the division, only the Pearl City Terminal has sufficient staging to warrant consideration as first choice for this application analysis. Neither terminal area has the necessary 20 acres of staging required for two FSSs. The Pearl City terminal area comes closest to providing the requirement, with about 15 acres. Additionally, the parking area adjacent to the Aloha Stadium could serve as an intermediate staging. Vehicles and equipment there could be called forward to either the Pearl City or FISC berths as needed without negatively affecting the loading.

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[5] Container handling equipment is not available at the Pearl Harbor Complex. Equipment for this purpose must be procured locally. The vessels can use ship's gear to load the containers.

III. SUMMARY

The Pearl Harbor Complex has adequate facilities to support the deployment of the 25th Infantry Division (-). Staging near the berths is an issue if the two vessels are loaded concurrently. The availabile area is less than capable of staging all of the division's cargo. If the deployment uses only one vessel at a time, then there is adequate staging at the Pearl City Terminal area to support the operation.

Pearl Harbor Terminal Staging Comparison

TERMINAL AREA	AVAILABLE STAGING (Acres)	1 FSS REQUIREMENT (Acres)	2 FSS REQUIREMENT (Acres)
FISC Main Base	3.44	10	20
Pearl City	15.15	10	20
West Loch	2.75	10	20

Only Pearl City has sufficient staging to adequately stage cargo to work one FSS. West Loch Terminal is included for comparison purposes only, as berths there are limited to ammunition shipment.

JUNE 1999

PORT OF SASEBO

U.S. Fleet Activities, Sasebo
Main Base
Maebata and Hario Ordnance Facilities
Akasaki, Motofune, Iorizaki, and Yokose POL Terminals

KYUSHU, JAPAN

U.S. Fleet Activities, Sasebo

I. GENERAL DATA

In June 1997, a team of Transportaiton Engineering Agency analysts visited the Port of Sasebo to conduct a capability analysis of the port.

LOCATION

The Port of Sasebo is located in southern Japan, on the western side of the Japanese island of Kyushu, at Latitude 33^{o} 10’ North and Longitude 129^{o} 43’ East. This port opens to the sea on the southwest coast of Japan, and is surrounded by rolling hills on the north, east and west, creating an ideal natural harbor protecting the port against winds and high waves.

Major Ports of Japan

Sasebo is situated in the northern part of the Nagasaki Prefecture, and with a population of 250,000 it is the second largest town in the prefecture next to Nagasaki City. This region has a long naval history, and after World War II, U.S. Fleet Activities, Sasebo was established in the summer of 1946. The Port is situated in a highly advantageous location to support the six U.S. Navy ships forward deployed to Sasebo. The USS Belleau Wood (LHA-3), USS Dubuque (LPD-8), USS Fort McHenry (LSD-43), and the USS Germantown (LSD-42) comprise part of Commander, Amphibious Squadron ELEVEN and Amphibious Group One, Sasebo. Minesweepers USS Guardian (MCM-5) and USS Patriot (MCM-7) also call Sasebo home.

TRANSPORTATION MODES

Water Access

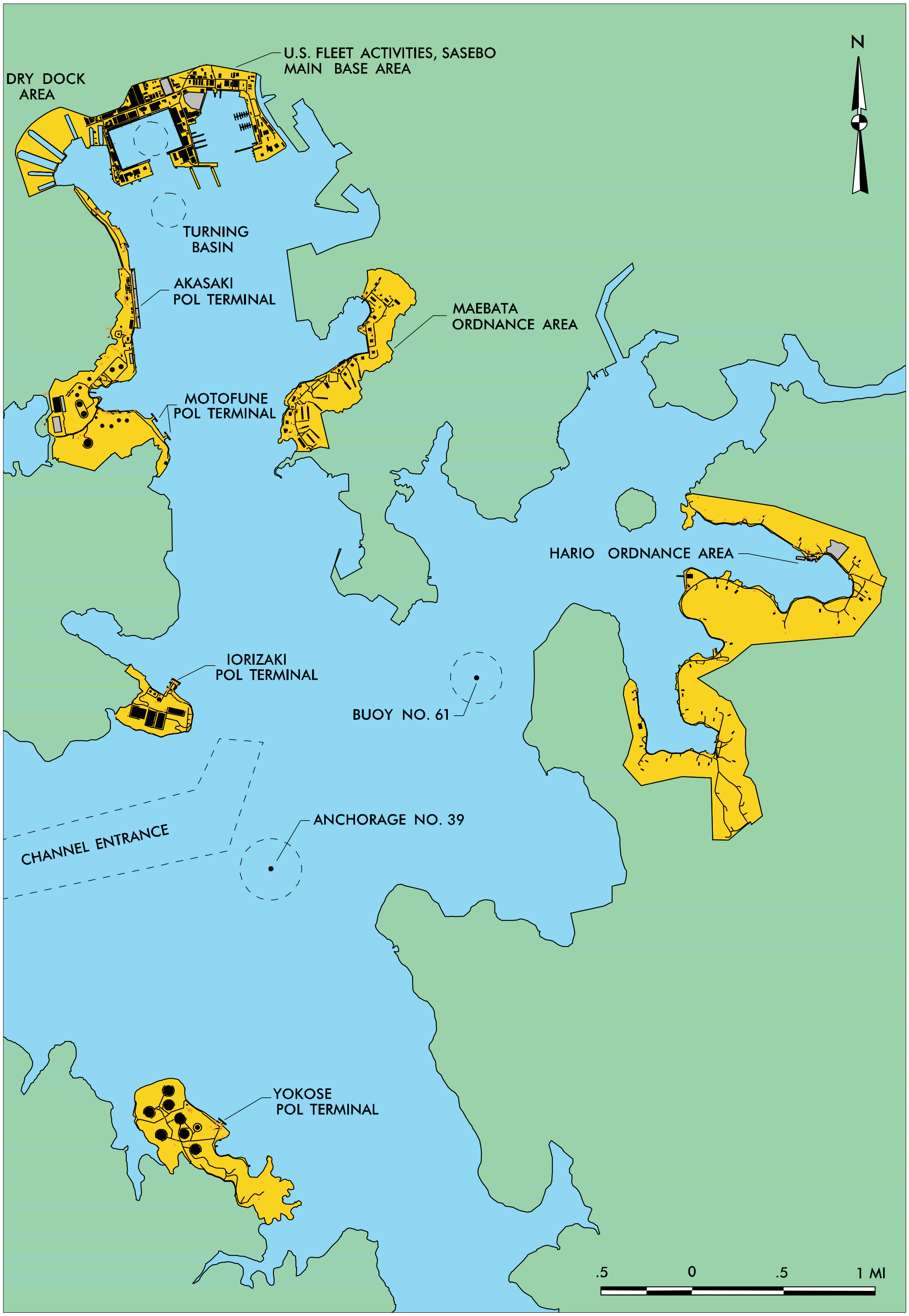
Vessels destined for the Port of Sasebo should head for the pilot station at Latitude 33° 06' North and Longitude 129° 38' East. A Pilot is compulsory when entering the harbor, and will board vessels 1.8 miles northwest of Kogosaki lighthouse. In bad weather the Pilot will board in the channel at Latitude 33° 05' 48" North and Longitude 129° 40' 24" East. The entrance channel has a minimum depth of 39 feet at mean low water (MLW) and a width of 1,800 feet at its' narrowest point. The inner harbor has ample maneuvering room, with a turning basin in excess of 1,000 feet and a draft of 34.8 feet MLW. The outer turning basis is about 1,500 feet in diameter. There are no vertical restrictions on vessels entering the harbor.

Waves: Waves in the Port of Sasebo, under normal weather conditions, are minimally affected by wind because the distance to shores is relatively short. Wind velocity and the distance to the shore generally determine wave heights. On the basis of these two factors, wave heights observed by the local weather bureau are most frequently less than 1 foot high under normal wind condition.

Winds: Southwesterly winds generally prevail in the summer, while northerly winds blow frequently in other seasons. Maximum wind velocity recorded 85.6 feet per second.

Currents: Sasebo has a maximum current of 1.5 knots (0.83 feet per second) in the vicinity of the harbor entrance at rising tide. At ebb tide the current flows in the opposite direction and is faster than during flood tide, but not so strong as to hinder navigation.

Tides: The minimum tide in the harbor is about 1.3 feet below MLW, the maximum tide is about 11.1 feet above MLW, with an average tidal range of about 8.5 feet above MLW.



Water Access and Vicinity Map

Highway Access

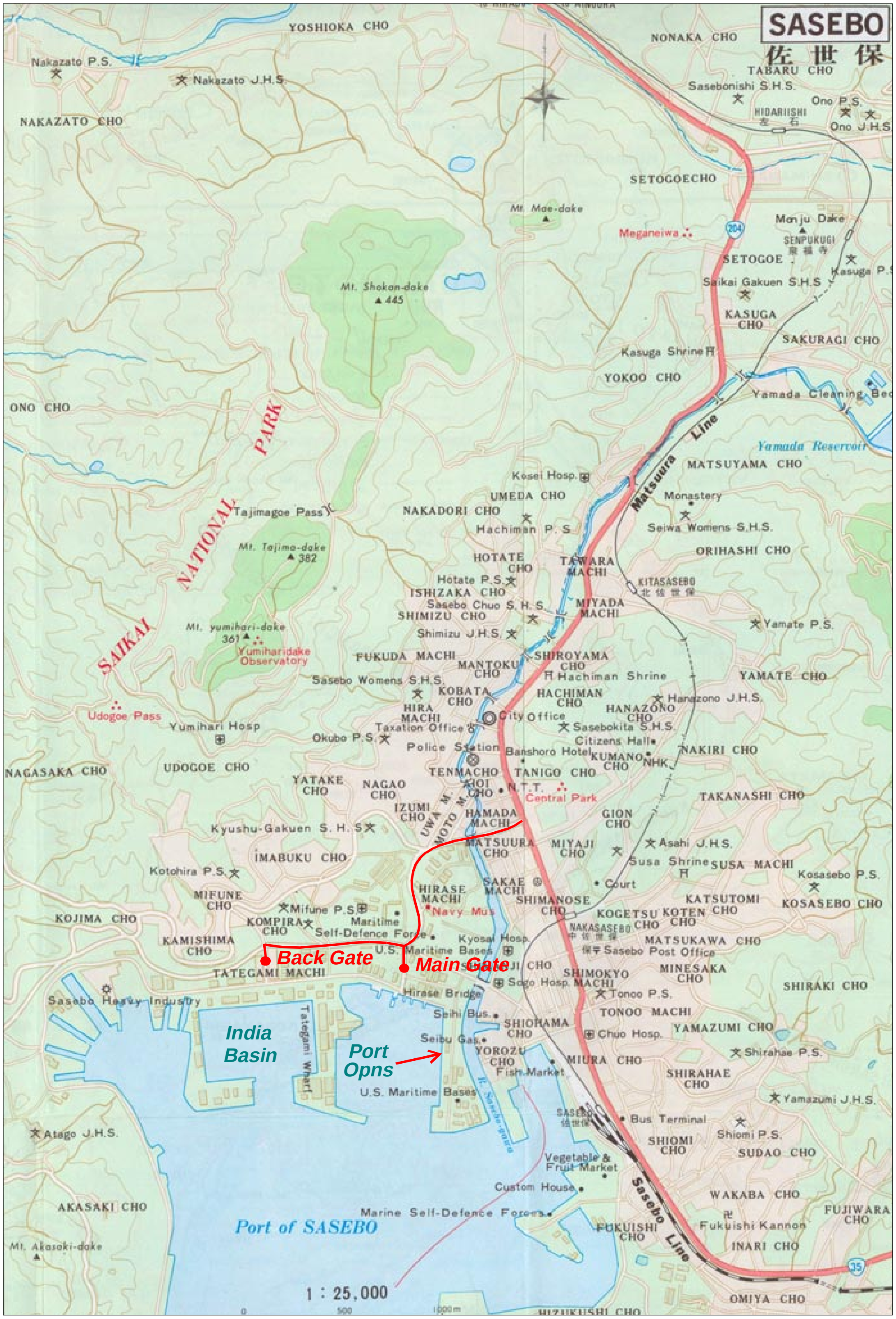
The Port of Sasebo is situated in the center of a small metropolitan area. Located on the western side of the Japanese Island of Kyushu, about one and a half hours north of Nagasaki and two hours south of Fukuoka. The road network is sufficient to support modern transport needs. National Routes 204 and 35 are functionally linked with the Nagasaki Expressway and the Kyushu Expressway to transport materials.

The road networks to the surrounding prefectures and the inland roadways around the Port of Sasebo are continually being improved. Many of the two-lane routes are bituminous-surfaced roadways about 20 feet wide, with concrete curb shoulders in excellent condition.

Main Gate to U.S. Fleet Activities, Sasebo

Access road to U.S. Fleet Activities, Sasebo

Access to U.S. Fleet Activities, Sasebo: Access to the Port of Sasebo is by a four-lane divided roadway in very good condition. The Port's Main Gate has two inbound and two outbound lanes providing access to the primary facilities at U.S. Fleet Activities, Sasebo. Although, under normal conditions only one lane in each direction are open, and manned by a guard 24-hours a day.



Highway Access Map

Access to Maebata Ordnance Depot: The access road from Maebata passes through various two-lane city streets, and provides easy access to National Route 204, 35, and links with the Nagasaki Expressway, and the Kyushu Expressway. Maebata's main entrance has one (1) inbound and one (1) outbound lane for all truck traffic. Guards man the gate 24-hours a day.

Main Entrance to Maebata Ordnance Depot

Access to Hario-Shima Ordnance Depot: The access road from Hario-Shima passes through various two-lane city streets, and provides easy access to National Route 204, 35, and links with the Nagasaki Expressway, and the Kyushu Expressway. Hario-Shima's main entrance has one (1) inbound and one (1) outbound lane for all truck processing and documentation. Guards man the gate 24-hours a day.

Main Entrance to Hario Ordnance Depot

Rail Access

Japan has excellent passenger rail service throughout the Island of Kyushu. However, there is very limited freight movement, and no rail service to the Port of Sasebo.

Air Access

Commercial Airports: The Nagasaki International Airport (primarily domestic flights) and Fukuoka International Airport are the two major commercial airports serving the area. The Nagasaki Airport is a short drive south of Sasebo, about one and a half-hours, while Fukuoka is a 2 hour drive northwest of Sasebo.

Nagasaki Airport has one runway - 7,000 feet long and 150 feet wide, and suitable for C-9, C-17, C-21, C-130, and can accommodate medium-sized aircraft, such as the B-727, B-757, AB-300, MD-80, and DC-9's.

Fukuoka International Airport has several concrete-surfaced runways - the primary runway is 11,000 feet long and about 200 feet wide, and can accommodate large wide-bodied aircraft, such as the Boeing 747, and the military's C-5, C-9, KC-10, C-17, C-21, C-130, KC-135 and C-141 aircraft. The east apron and passenger aprons are used heavily by commercial carriers, and not normally available to military. Class "C" hazardous cargo authorized per Japan Air Traffic Regulation 86 and Japan Flight Regulation 194.

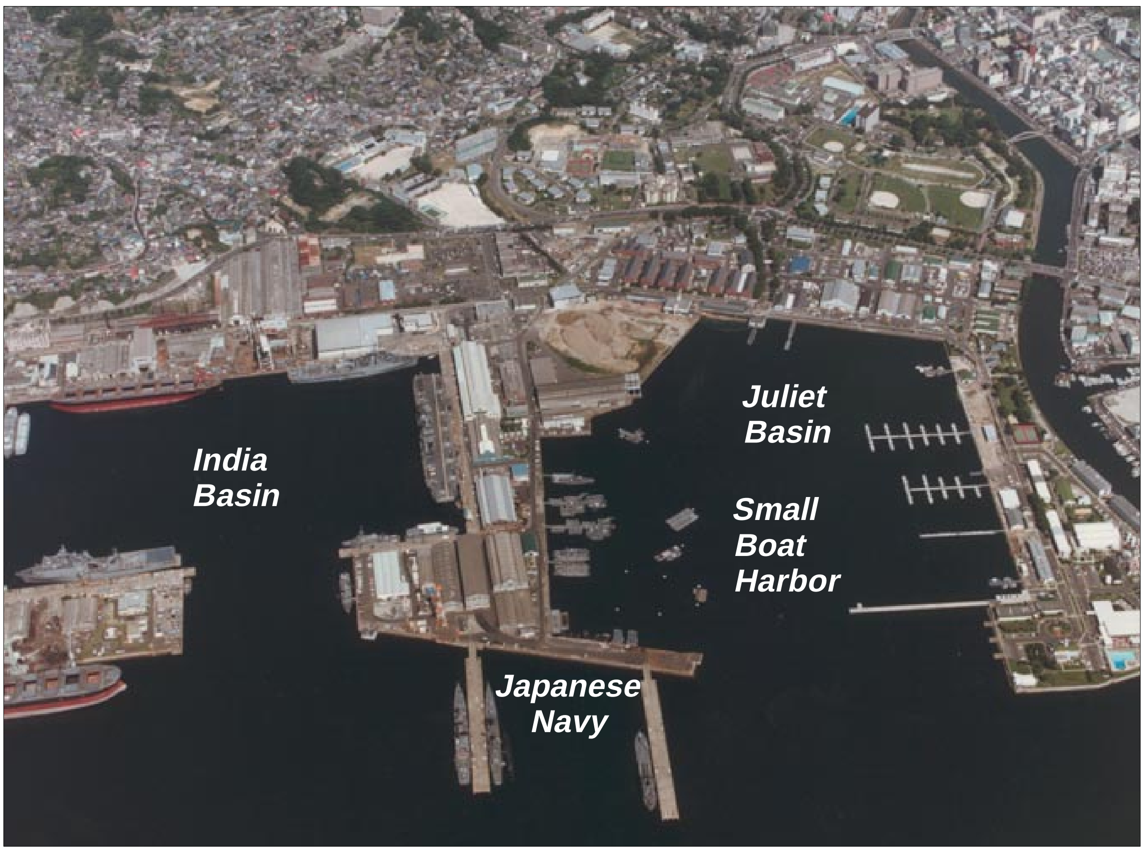
Nagasaki International Airport

Military Airfields: Iwakuni Marine Corps Air Station is the closest military airfield, about 6 hours by car. The runway is about 8,000 feet long and 150 feet wide and is suitable for C-9, C-21, C-130, KC-10, KC-135, C17, C-141 and C-5 aircraft.

PORT FACILITIES

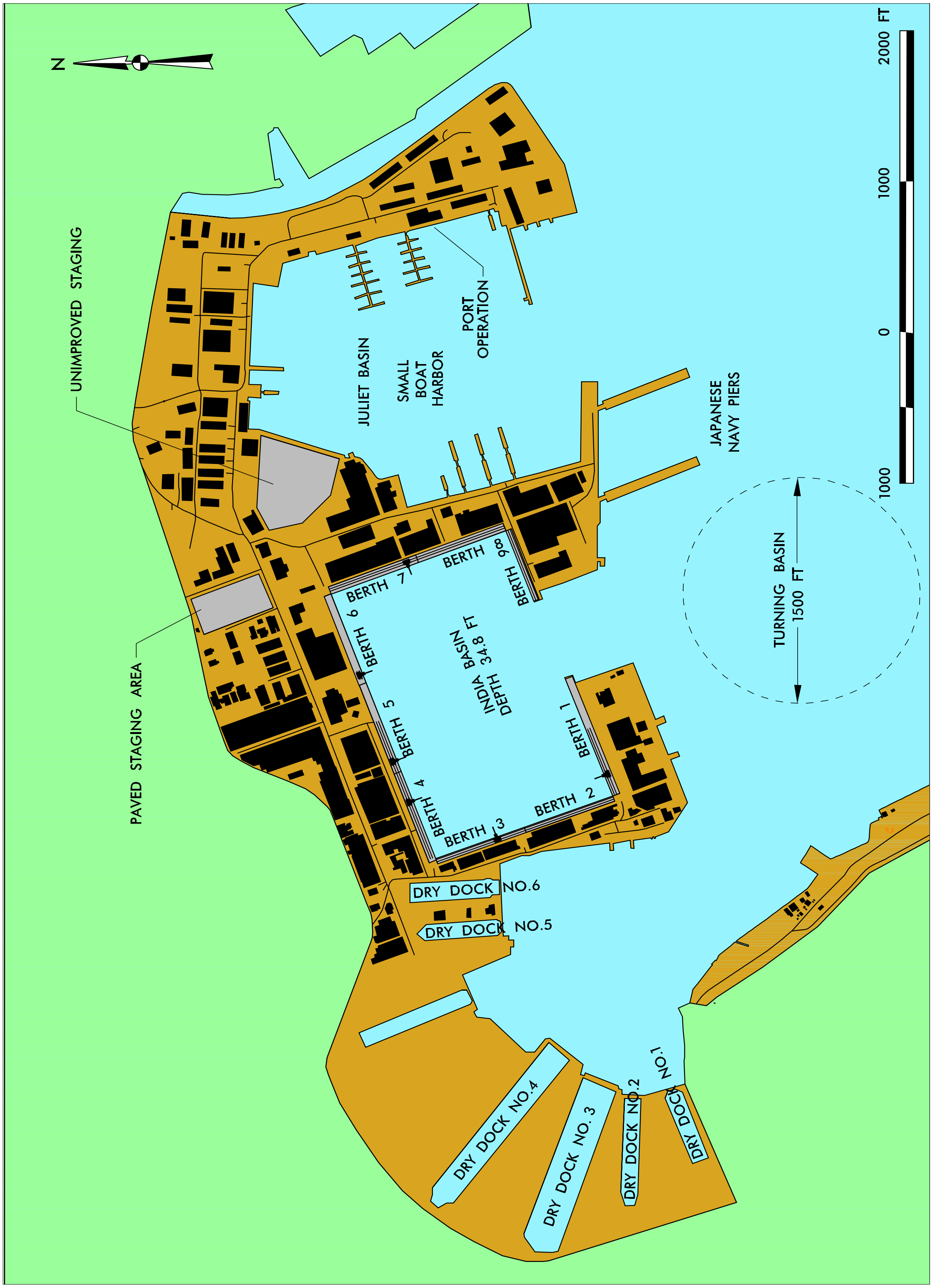
BERTHING – India Basin

U.S. Fleet Activities, Sasebo was established in 1946 after World War II. Commander, U.S. Fleet Activities, Sasebo operates the facility to support U.S. forward deployed units. This facility consists of a large small boat harbor and nine berths at ***India Basin***, which total over 5,600 linear feet of berthing. In this report, we have combined some of the berths in order to handle a wider range of ship types. Berth 1 is 833 feet long and well suited for general cargo operations. Berth 2-3 is 1,194 feet long and good for medium to large ships and capable of handling breakbulk, RORO, and combination vessels. Berth 4-6 has a combined length of 1,888 feet and is suitable for large vessels, capable of supporting limited RORO, limited container, and combination vessels. Berth 7-8 is 1,194 feet long and capable of handling medium to large vessels. Berth 9 is 499 feet long and suitable for small vessels.



U.S. Fleet Activities, Sasebo

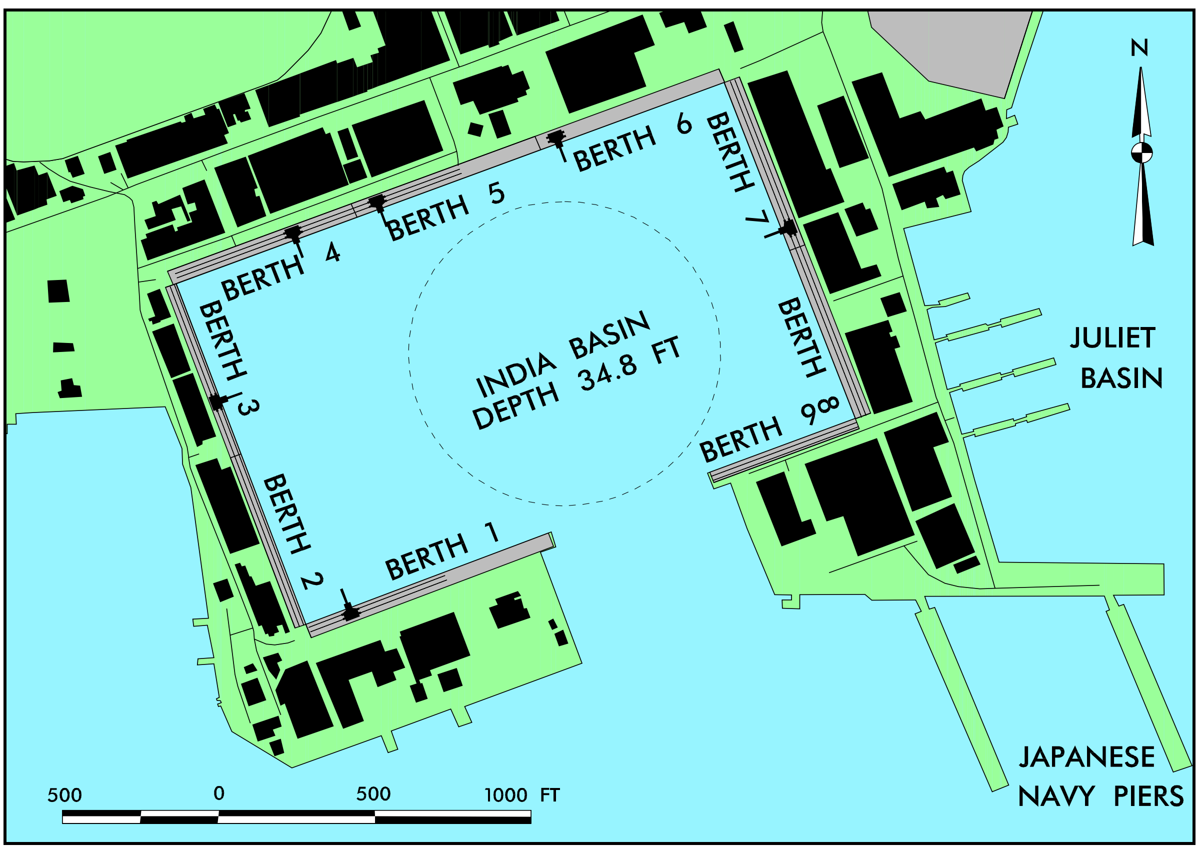
The mission of the Commander, U.S. Fleet Activities, Sasebo is to operate and maintain base facilities for the logistic support of home ported units and visiting ships in the Pacific Fleet. In addition they receive, renovate, maintain, store and issue ammunition, explosives, expendable ordinance items, weapons and technical ordinance material.



U.S. Fleet Activities, Sasebo - Site Map

BERTH CHARACTERISTICS
PORT OF SASEBO - INDIA BASIN

	BERTHS				
Characteristics	**Berth 1 USN**	**Berth 2-3 USN**	**Berth 4-6 USN**	**Berth 7-8 USN**	**Berth 9 USN**
Length (ft)	833	1,194	1,888	1,194	499
Depth alongside at MLW (ft)	34.8	34.8	34.8	34.8	34.8
Deck strength (psf)	800	800	800	800	800
Apron width (ft)	50	30	30 to 40	50	50
Apron height above MLW (ft)	14	14	14	14	14
Number of container cranes	0	0	0	0	0
Number of wharf cranes	1	1	3	1	0
Apron lighting	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	Yes	No
Apron length served by rail (ft)	0	0	0	0	0



India Basin Berth 1

India Basin Berth 2-3

India Basin Berth 4-6

India Basin Berth 7-8

India Basin Berth 9

Small boat berthing

Port Operations

Japanese Navy Pier

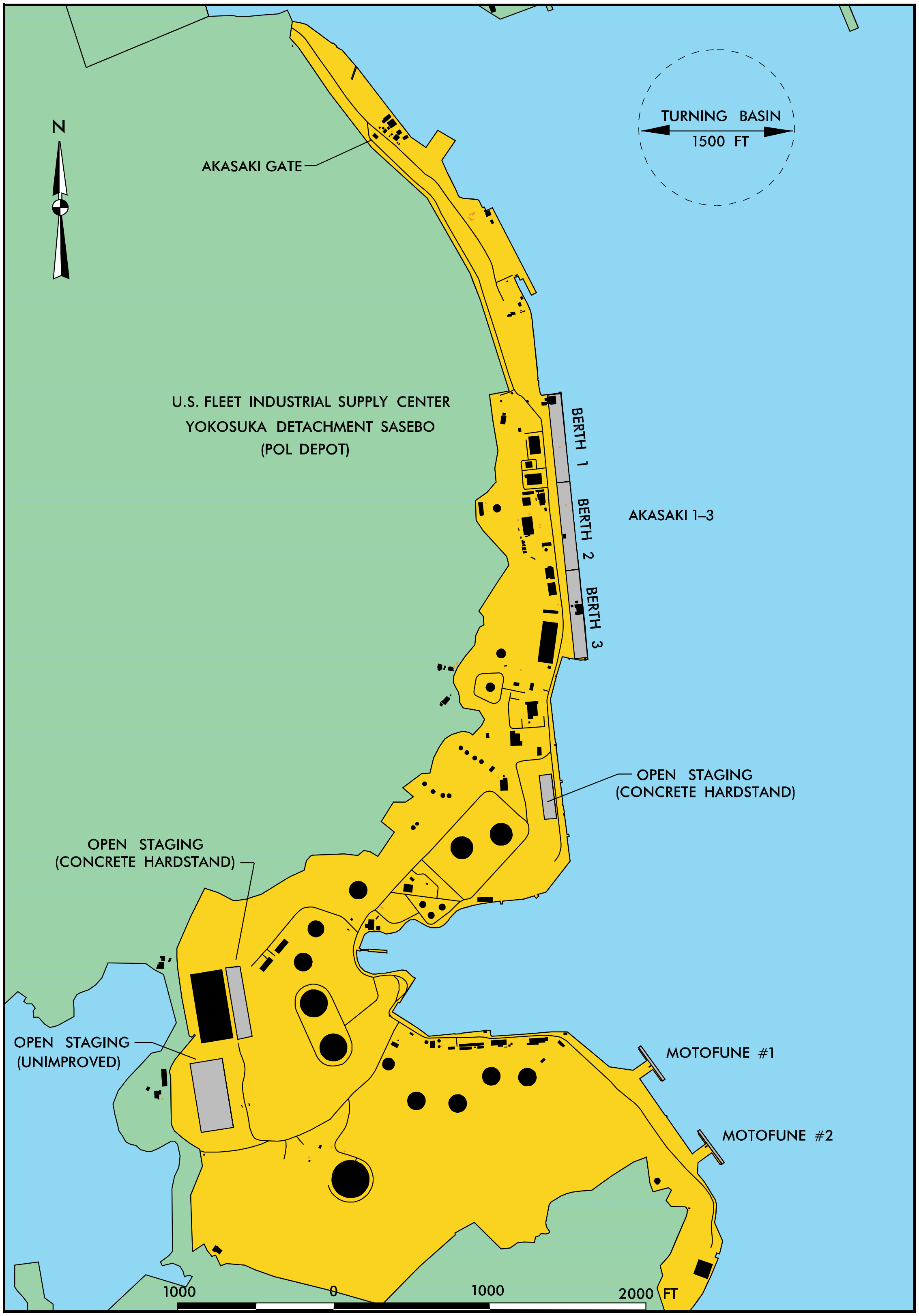
BERTHING - POL Terminals

In addition to the berths at Indian Basin, the Port of Sasebo consists of four petroleum oil and lubricant (POL) terminals. These terminals are under the control of U.S. Fleet and Industrial Supply Center, Yokosuka Detachment, Sasebo, Fuel Services Division. While, all four terminals (Akasaki, Motofune, Iorizaki, and Yokose) provide fuel for the U.S. Fleet, only Akasaki is capable of supporting large deep draft vessels. Akasaki is made up of three berths, totaling 1,699 linear feet, with an along side draft of 37 to 40 feet. Akasaki is the only POL terminal with a significant amount of working apron, and easily accessible staging, which is ideal for supporting breakbulk and Roll-on/Roll-off (RORO) operations, limited only by ship refueling priorities. Akasaki can support the new Large Medium Speed RORO.

BERTH CHARACTERISTICS

	BERTHS			
Characteristics	**Akasaki 1-3**	**Motofune 1 & 2**	**Iorizaki**	**Yokose**
Length (ft)	1699	263 & 263	266	264
Depth alongside at MLW (ft)	37 to 40	34 & 32	36	37
Deck strength (psf)	600	600	600	600
Apron width (ft)	115	25	46	27
Apron height above MLW (ft)	12	14	14	14
Number of container cranes	0	0	0	0
Number of wharf cranes	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No
Apron length served by rail (ft)	0	0	0	0

Akasaki POL Terminal



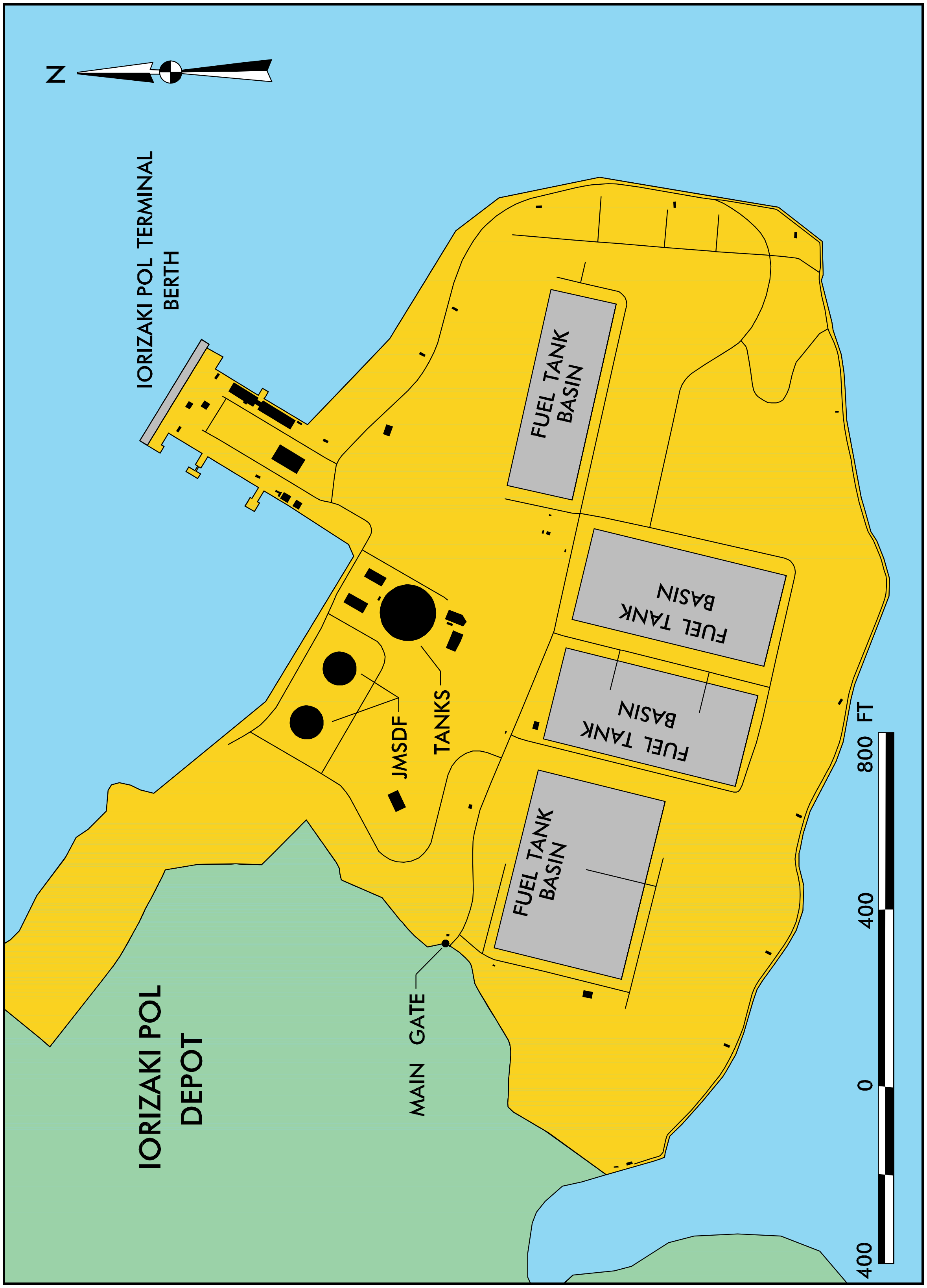
Site Map of Akasaki and Motofune

Akasaki Gate

Akasaki Access Road

Akasaki POL Terminal - Berth 1-2

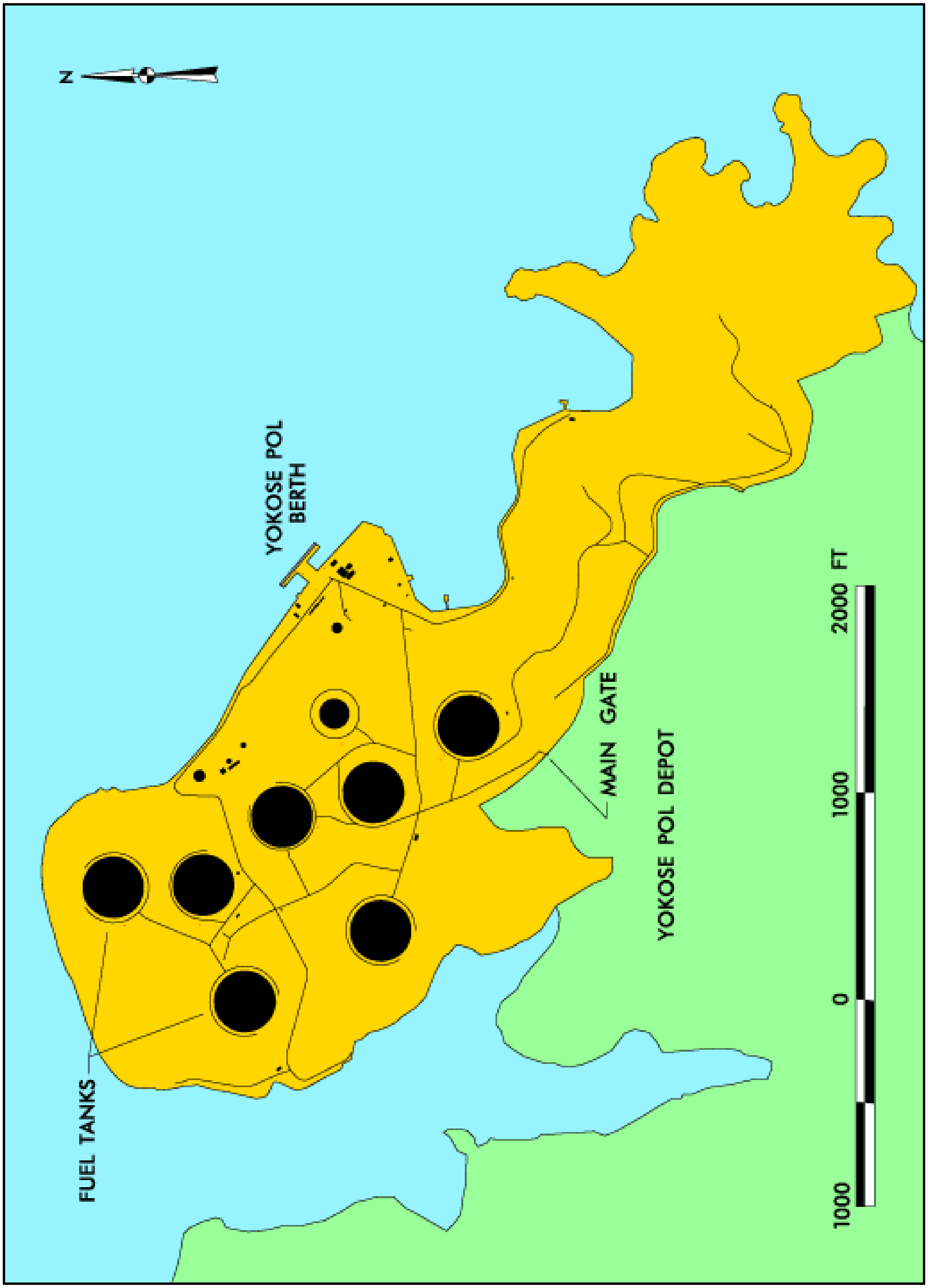
Akasaki POL Terminal - Berth 2-3



Iorizaki Site Map

Motofune POL Terminal

Iorizaki POL Terminal



Yokose Site Map

U.S. FLEET AND INDUSTRIAL SUPPLY CENTER
YOKOSUKA DETACHMENT, SASEBO,
FUEL SERVICES DIVISION

Data as of 1 NOV 96

POL TERMINAL DATA

PORT	TERMINAL	BERTH & MOORING DATA			SIZE OF LINE	NO. OF CONNECTION	DISCH. RATE		LOAD RATE		FUEL AVAILABLE AT EACH PIER
		PIER NAME	LENGTH FT	DRAFT FT			AVG.	MAX.	AVG.	MAX.	
SASEBO	AKASAKI	Akasaki #1	550	38	-	-	-	-	-	-	Under FIP: 1 Jan 97
		Akasaki #2	450	37	-	-	-	-	-	-	Under FIP: 1 Jan 97
		Akasaki #3	716	40	8”	Loading Arm 4	6.0	7.0	5.0	6.0	F-76/JP-5/MUM
		Motofune #1	263	34	8”	5	6.0	8.0	4.0	4.5	JP-5
		Motofune #2	263	32	8”	2	6.0	8.0	3.0	3.5	JP-5
	IORIZAKI	Iorizaki	266	36	8”	Loading Arm 4	5.0	6.0	4.0	5.0	F-76/JP-8
							10.0	12.0	8.0	10.0	JP-5
	YOKOSE	Yokose	264	37	8”	Loading Arm 4	10.0	12.0	8.0	10.0	F-76/JP-5

FUEL BARGE:		
YON-290	Capacity: 2.8 MB F-76 & 1.2 MB JP-5	Pumping Rate: F-76 = 36 MG (860 MB)/H JP-5 = 35 MG (830 MB)/H
YON-305	Capacity: 4.1 MB F-76	Pumping Rate: 60 MG (1.4 MB)/H
YON-285	Capacity: 8 MB Newly assigned to Sasebo from Subic. Currently OOC awaiting modification.	

Data as of 1 NOV 96

TANK STORAGE CAPACITY DATA

	PRODUCT	No. of Tanks	Tank Number	Total Qty		Pump
AKASAKI	F-76	1	A-18 AN-2 AN-9	10 MB/ 150 MB/ 7.3 MB/	428 MG 6,300 MG 307 MG	Gravity Electric x 2 Electric x 1 Tank truck loading
	JP-5	2	AN-3 AN-8 A-12	150 MB/ 7.3 MB/ 329 MB/	6,300 MG 307 MG 13,818 MG	Electric x 3 Electric x 1 Tank truck loading Electric x 3
	MUM	1	AN-1 AN-10	15 MB/ 7.3 MB/	630 MG 307 MG	Electric x 2 Electric x 1 Tank truck loading
	SLOP	9	AS-1 thru AD-5 A-24 thru A-27	34.1 MB/	1,432 MG	Diesel driven x 1
IORIZAKI	F-76	1	I-2	365 MB/	15,330 MG	Electric x 3
	JP-5	2	I-3 & I-4	725.7 MB/	30,479 MG	Electric x 3 Each
	JP-8	1	I-1	230 MB/	9,660 MG	Electric x 3
	SLOP	1	IS-2	9.4 MB/	1,432 MG	
YOKOSE	F-76	6	Y-1 thru Y-6 & US-3	2,242.5 MB/	93,786 MG	Electric x 3 Each (YS-3 = Gravity)
	JP-5	2	Y-7 & Y-8	382 MB/	16,045 MG	Electric x 3 Each
	SLOP	3	YS-2, YS-4 & YS-5	22.6 MB/	949 MG	

NOTE: 1) All electric pumps are backed up by emergency generator.

PORT FACILITIES - cont

BERTHING - Maebata And Hario-Shima Ordnance Facilities

The Japanese Imperial Navy established ordnance areas at Maebata and Hario-Shima between 1889 and 1945. After World War II, the U.S. Army occupied these areas, with the establishment of Commander Fleet Activities, Sasebo Ordnance Department in 1950. A year later the Officer-in-Charge became U.S. Naval Ordnance Facility. In 1976, COMFLEACT Sasebo merged with the Naval Ordnance Facility. Naval Ordnance Facility once again converted to COMFLEACT Sasebo Ordnance Department in July 1980.

Maebata Ordnance Facility

The land areas that make-up the Ordnance Facilities total 631 acres, 144 acres at the Maebata Ordnance Area and 487 acres at the Hario Ordnance Area.

Maebata contains 22 above ground magazines, 3 portable magazines, and 12 tunnels, equal in capacity to 100 U.S. Navy standard earth covered magazines. This facility has one explosive wharf adequate for small vessels, or ammunition transshipments using various navy landing craft and barges. The wharf is 200 feet in length and the water depth alongside is about 27 feet.

Maebata Wharf

BERTH CHARACTERISTICS
MAEBATA AND HARIO-SHIMA ORDNANCE FACILITIES

	BERTHS		
Characteristics	**Maebata Wharf**	**Hario Wharf**	**Hario Dock**
Length (ft)	200	151	248
Depth alongside at MLW (ft)	27	20	20
Deck strength (psf)	600	600	600
Apron width (ft)	50	60	75
Apron height above MLW (ft)	12	12	12
Number of container cranes	0	0	0
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No
Apron length served by rail (ft)	0	0	0

Hario Wharf

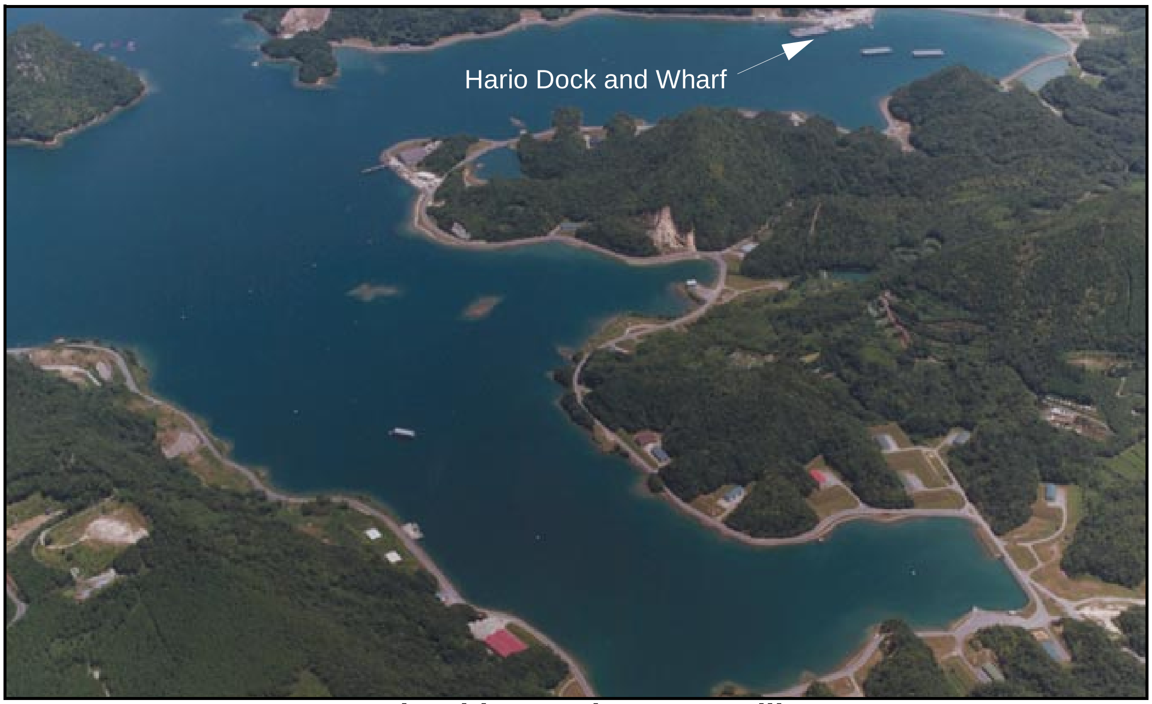
Hario Dock

Maebata Site Map

PORT FACILITIES - cont

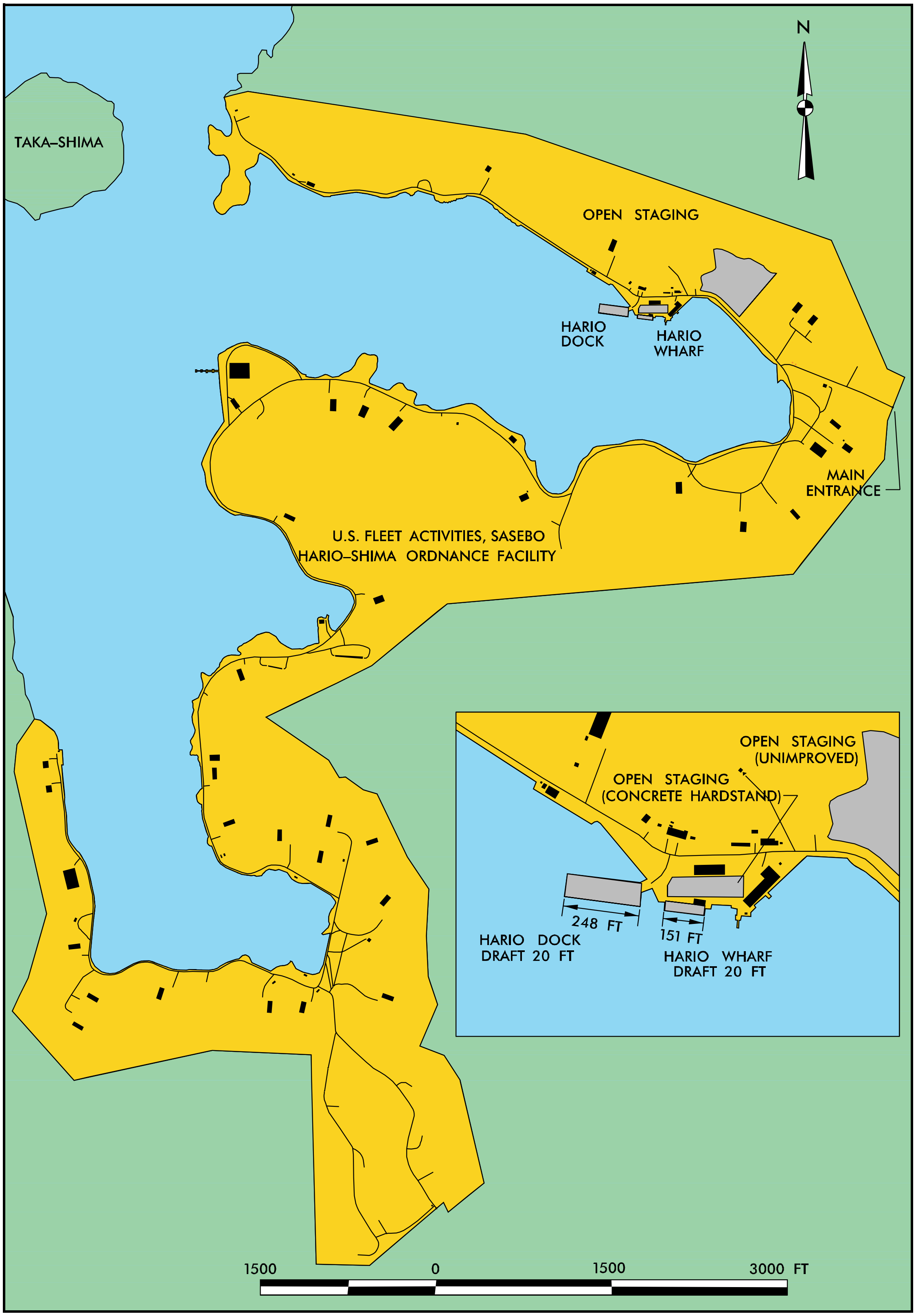
BERTHING - Hario-Shima Ordnance Facilities

Hario currently has 2 earth covered magazines, 39 above ground magazines, 3 portable magazines, 11 open revetments, and 2 open storage pads, most of which have small buildings or structures for enviornmental protection. This facility has two explosive barge berths for handling ammunition transshipments using navy landing craft and barges. The Hario barge berths are 151 feet and 248 feet in length respectively, with a water depth alongside of about 20 feet.



Hario-Shima Ordnance Facility

The Ordnance Department operates 3 ammunition/ordance renovation facilities, two at Maebata and one at Hario. The Security Department of CFAS maintains security, and an intrusion detection system (IDS) protects 11 of the magazines.



Hario Site Map

ORDNANCE DEPARTMENT MISSIONS

Here are the major mission areas performed by U.S. Fleet Activities, Sasebo, Ordnance Department.

- Receive, segregate, store and issue (RSS&I) conventional ordnance in support of the Pacific Fleet and Marine Corps.
- Provide storage for and maintain basic stock levels of USN and USMC pre-positioned War Reserve Ammunition.
- Conduct renovation of ordnance materials.
- Perform demilitarization of unserviceable ordnance. Future plans call for the construction of a small arms de-mil furnace.
- Provide support services for U.S. Army Pre-positioned ship operations.
- Provide emergency services for missile vertical launching system on-load and off-load.
- Provide missile vertical launching system weight test facility for Guam, Yokosuka, and Okinawa.
- Serve as Marine Corps inventory control point for Western Pacific Area of operations.
- House the conventional ammunition integrated management control system (CAIMS) for Japan.
- House the U.S. Marine Corps quality evaluation lab performs surveillance of ammunition as directed by Headquarters Marine Corps.

U.S. FLEET ACTIVITIES, SASEBO - INDIA BASIN
SUMMARY OF BERTHING CAPABILITIES

TYPE	VESSEL CLASS	Berth 1	Berth 2-3	Berth 4-6	
BREAKBULK	C3-S-38a	1	2	3	NOTES
	C-4-S-58a	1	2	3	a-vessel draft limit
	C4-S-66a	1	2	3	b-inadequate apron width
	C5-S-37e	1	1	3	c-inadequate berth length
					d-no straight stern ramp
SEATRAIN	GA & PR- Class	1	2	3	e-no container handling equipment
					f-anchorage depth OK, berth depth
BARGE	LASH C8-S-81b	1	1	3	inadequate
	LASH C9-S-81d	a,c,f	1,a,f	2,a,f	g-inadequate channel depth
	LASH Lighter	4	5	9	h-no shore based ramps
	SEABEE C8-S-82a	a,c,f	1,a,f	2,a,f	i - low tide insufficient ramp clearance
	SEABEE Barge	4	5	9	j-high tide insufficient ramp clearance
					k-excessive ramp angle low tide
RORO	COMET	1,d,i	2,d,o	3,d,o	m-excessive ramp angle high tide
	METEOR	1,d,o	2,d,o	3,d,o	n-parallel ramp operation ONLY
	Cape Gnome	1,d,i,j	1,d,o	3,d,o	o-insufficient apron width for side ramp
	C7-S-95a	1	1,b	2,b	
	Cape Taylor	1	1,b	2,b	Ramp clearance and angle based on
	Cape Orlando	1,i	1,b	2,b	maximum vessel draft
	MV Ambassador	1,d	2,d	3,d	
	Callaghan	1,d,o	1,d,o	2,d,o	**May Prevent Operation**
	Cape Lambert	1,i,j	1,b	2,b	
	LMSR - Class	c	1,b	1,b	**May Limit Operation**
	FSS	a,c	1,a,b	1,a,b	
	Cape E	1,i,j	1,b	2,b	a-vessel draft limit
	Cape D	1,i	1,b	2,b	b-inadequate apron width
	Cape H	1,a	1,a,b	2,a,b	c-inadequate berth length
	Cape Texas	1,i	1,b	2,b	d-no straight stern ramp
	Cape R	1,d	1,d	2,d	e-no container handling equipment
	Cape I	1,i,j	1,b	2,b	f-anchorage depth OK, berth depth
	Cape Victory	1,i	1,b	2,b	inadequate
					g-inadequate channel depth
CONTAINER	C6-M-147a	1,e	1,b,e	2,b,e	h-no shore based ramps
	C7-S-69c	1,e	1,b,e	2,b,e	i - low tide insufficient ramp clearance
	C7-S-68c	1,e	1,b,e	2,b,e	j-high tide insufficient ramp clearance
	C8-S-85c	1,e	1,b,e	2,b,e	k-excessive ramp angle low tide
	C9-M-132b	c,e	1,b,e	2,b,e	m-excessive ramp angle high tide
	C9-M-F141a	a,c,e	1,a,b,e	1,a,b,e	n-parallel ramp operation ONLY
					o-insufficient apron width for side ramp
TACS	C6-S-1qd	1	1,b	2,b	
	C5-S-MA73c	1	1,b	2,b	Ramp clearance and angle based on
	C6-S-MA60d	1	1,b	2,b	maximum vessel draft
MPS	C7-S-133a	1	1,b	2,b	**May Prevent Operation**
	Maersk	1	1,b	2,b	
	AmSea	1	1,b	2,b	**May Limit Operation**

U.S. FLEET ACTIVITIES, SASEBO - INDIA BASIN & AKASAKI
SUMMARY OF BERTHING CAPABILITIES

TYPE	VESSEL CLASS	Berth 7-8	Berth 9	Akasaki	
BREAKBULK	C3-S-38a	2	1	3	NOTES
	C-4-S-58a	2	c	2	a-vessel draft limit
	C4-S-66a	2	c	3	b-inadequate apron width
	C5-S-37e	1	c	2	c-inadequate berth length
					d-no straight stern ramp
SEATRAIN	GA & PR- Class	2	c	2	e-no container handling equipment
					f-anchorage depth OK, berth depth
BARGE	LASH C8-S-81b	1	c	2	inadequate
	LASH C9-S-81d	1,a,f	a,c,f	1	g-inadequate channel depth
	LASH Lighter	5	2	8	h-no shore based ramps
	SEABEE C8-S-82a	1,a,f	a,c,f	1	i - low tide insufficient ramp clearance
	SEABEE Barge	5	2	8	j-high tide insufficient ramp clearance
					k-excessive ramp angle low tide
RORO	COMET	2,d,o	1,d,o	3,d,i	m-excessive ramp angle high tide
	METEOR	2,d,o	c,d,o	3,d,i	n-parallel ramp operation ONLY
	Cape Gnome	1,d,o	c,d,o	2,d,i,j	o-insufficient apron width for side ramp
	C7-S-95a	1,b	b,c	2	
	Cape Taylor	1,b	b,c	2	Ramp clearance and angle based on
	Cape Orlando	1,b	b,c	2,i	maximum vessel draft
	MV Ambassador	2,d	c,d	3,d	
	Callaghan	1,d,o	c,d,o	2,d,i	**May Prevent Operation**
	Cape Lambert	1,b	b,c	2,i	
	LMSR - Class	1,b	b,c	1	**May Limit Operation**
	FSS	1,a,b	a,b,c	1	
	Cape E	1,b	b,c	2,i,j	a-vessel draft limit
	Cape D	1,b	b,c	2,i	b-inadequate apron width
	Cape H	1,a,b	a,b,c	2	c-inadequate berth length
	Cape Texas	1,b	b,c	2,i	d-no straight stern ramp
	Cape R	1,d	c,d	2,d	e-no container handling equipment
	Cape I	1,b	b,c	2,i	f-anchorage depth OK, berth depth
	Cape Victory	1,b	b,c	2,i	inadequate
					g-inadequate channel depth
CONTAINER	C6-M-147a	1,b,e	b,c,e	2,e	h-no shore based ramps
	C7-S-69c	1,b,e	b,c,e	2,e	i - low tide insufficient ramp clearance
	C7-S-68c	1,b,e	b,c,e	2,e	j-high tide insufficient ramp clearance
	C8-S-85c	1,b,e	b,c,e	1,e	k-excessive ramp angle low tide
	C9-M-132b	1,b,e	b,c,e	1,e	m-excessive ramp angle high tide
	C9-M-F141a	1,a,b,e	a,b,c,e	1,e	n-parallel ramp operation ONLY
					o-insufficient apron width for side ramp
TACS	C6-S-1qd	1,b	b,c	2	
	C5-S-MA73c	1,b	b,c	2	Ramp clearance and angle based on
	C6-S-MA60d	1,b	b,c	2	maximum vessel draft
MPS	C7-S-133a	1,b	b,c	2	**May Prevent Operation**

STAGING

Open Staging

Main Base Sasebo has about 10 acres of open staging distributed throughout the port. Most of this staging area is asphalt surfaced, and in good condition. Akasaki POL Terminal has a concrete staging area between Berths 1-3 and the helicopter-landing pad. The terminal also has a wide open apron that is ideal for working cargo and ship loading. There is also a large unimproved staging area within the POL terminal. Maebata has a small open work area adjacent to the wharf. Hario has a small open work area adjacent to its' wharf and dock; and a large unimproved field nearby. See the following table for a summary of staging areas.

STAGING AREA

U.S. Fleet Activities, Sasebo	Open Staging (acres)	Transit Sheds (sq ft)	Container Freight Station (sq ft)
Main Base	10	None	None
Akasaki	3.6	None	None
Maebata	0.25	None	None
Hario	4.8	None	None

Open Staging at Akasaki

Helicopter Pad at Akasaki

Unimproved Staging at Akasaki

Covered Storage

While there are warehouses and other buildings surrounding India Basin these structures are mostly for the day-to-day operations and administration of the port. There are no transit sheds or warehouses available to support the deployment of military cargo and equipment.

RAMPS AND DOCKS

The Port of Sasebo has several light duty portable truck ramps which can accommodate the loading or unloading of the smaller tactical vehicles. Field expedient ramps could also be built to support loading and deployment of larger vehicles. Units could also use the Navy's mobile cranes, and forklifts to offload trucks, flatbeds and MIL-VANs.

MARSHALING AREAS

It may be possible to use a small portion of Nimitz Park or other nearby fields as off-site marshaling to temporarily support a military deployment.

MATERIAL HANDLING EQUIPMENT (MHE)

The following table summarizes material handling equipment at U.S. Fleet Activities, Sasebo. The Shipyard and Government of Japan own some of the equipment.

MATERIAL HANDLING EQUIPMENT

TYPE OF EQUIPMENT	QUANTITY	CAPACITY
Top-Pick Container Handlers	2 (War Reserve)	25 STON
Mobile Cranes	2	22 STON
Mobile Cranes	1	25 STON
Mobile Cranes	2	35 STON
Mobile Cranes	1	65 STON
Mobile Cranes	1	75 STON
Wharf Cranes (India Basin Berth 1)	1 (Owned by SSK)	10 STON
Wharf Cranes (India Basin Berth 2-3)	1 (Owned by SSK)	15 STON
Wharf Cranes (India Basin Berth 4-5)	2 (Owned by SSK)	15 STON
Wharf Cranes (India Basin Berth 6)	1 (Owned by SSK)	250 STON
Wharf Cranes (India Basin Berth 7-8)	1 (Owned by GOJ)	15 STON
Floating Cranes (FAS-17 & FAS-18)	2	20 STON
Floating Cranes (FAS-3 & FAS-4)	2	30.8 STON
Floating Cranes (FAS-9 & FAS-16)	2	59 STON
Chassis & Tractors	Contractor Available	35 STON
Forklifts (electric)	1	1 STON
Forklifts (electric)	1	2.5 STON
Forklifts (gas)	7	2 STON
Forklifts (gas & diesel)	17	3 STON
Forklifts (diesel)	1	7.5 STON
Stock Picker	1	1.25 STON
Side Loader	1	3 STON
Platform Trucks	6	1-3 STON
Straddle Trucks	1	15 STON
Pallet Trucks	2\3	2-3 STON
Warehouse Cranes	3	5-10 STON
Warehouse Tow Tractors	5	2 STON
Forklifts (electric) - (At Hario)	6	2 STON
Forklifts (electric) - (At Hario)	6	3 STON
Forklifts (electric) - (At Maebata)	1	1.5 STON
Forklifts (electric) - (At Maebata)	20	2 STON
Forklifts (electric) - (At Maebata)	9	3 STON
Side Loader - (At Maebata)	2	2 STON
Side Loader - (At Maebata)	1	4 STON
Warehouse Cranes - (At Maebata)	1	2 STON
Warehouse Tractors - (At Maebata)	1	2 STON

MAINTENANCE AND REPAIR: Local contractors and SSK Ship Yard facilities are fully capable of handling any and all types of deck and engine maintenance or repairs. There are 6 dry docks available. The U.S. Navy and Japanese Maritime Self Defense Force have joint-use of Dry Dock No 2. Sasebo Heavy Industries Company, Ltd. operates Dry Dock No. 3, however, the U.S. Navy has a joint-use agreement which gives 7-day recall rights to the Navy.

Ship Yard Crane

Dry Dock No. 3 has the following characteristics: length 1,213 feet, width 230 feet, depth 49 feet, maximum ship 300,000 dead weight ton.

Dry Dock No. 1

Dry Dock No. 2

SECURITY: U.S. Fleet Activities, Sasebo, the Ordinance Facilities and POL Terminals have controlled access 24 hours per day. The terminals have a 10-foot high perimeter fence and employ security guards.

TERMINAL LIGHTING: All vessel operation areas, and warehouses have some lighting for the safety of pedestrian traffic and normal activities. However, the existing lighting at India Basin and Akasaki is not quite sufficient to support 24-hour ship loading operations. Portable light sets are available and could be used during night loading operations.

STEVEDORE LABOR: There is a maximum of 10 local stevedore gangs available. Regular employees consist of about 100 stevedores and 100 longshoremen/warehousemen. Temporary laborers number about 150 stevedores and 200 longshoremen/warehousemen. Normal working hours: Weekdays: 0830 - 1630 hours, and 1630 – 2130 hours. Sundays and Holidays: Gang availability is subject to negotiations, usually up to a maximum of 3 gangs.

FUTURE DEVELOPMENT PROJECTS

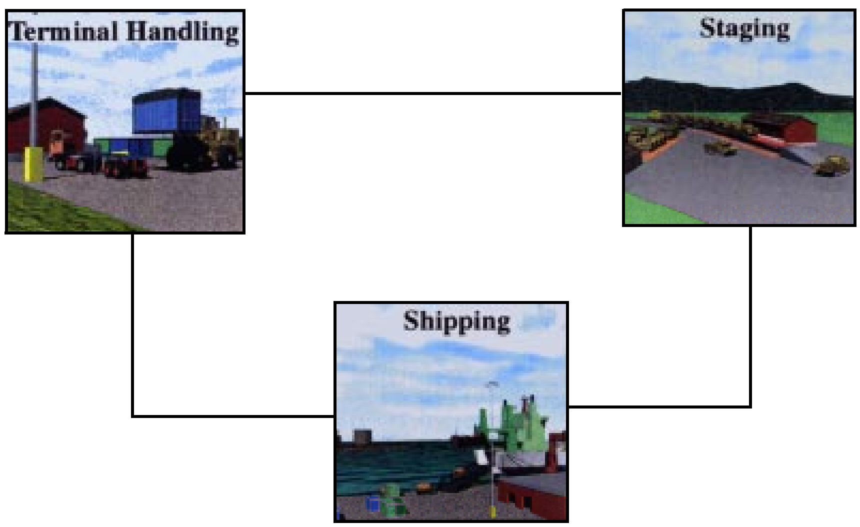
The facilities planning manager for U.S. Fleet Activities, Sasebo indicated that facility improvement projects for the base include construction of new covered storage warehousing. Scheduled construction is planned for fiscal year 2000, and could support the future deployment of military vehicles, cargo and equipment.

U.S. Fleet Activities, Sasebo has been directly involved in meetings with the City of Sasebo to draw up a plan for the release, relocation and consolidation of the Maebata Ordnance Area. The purpose is to elevate a severe problem with Explosive Safety Quantity Distance (ESQD) arcs that emanate from the Maebate Ordnance Areas, because the local civilian population has built residential housing very close to the property boundaries. These civilian residential houses are located within the Inhabited Building Distance ESQD arcs, which is the minimum distance required to provide protection against serious injuries or death after an explosion. The U.S. Government has developed a plan to consolidate all ordnance functions to the Hario Ordnance Area.

II. THROUGHPUT ANALYSIS - INDIA BASIN & AKASAKI

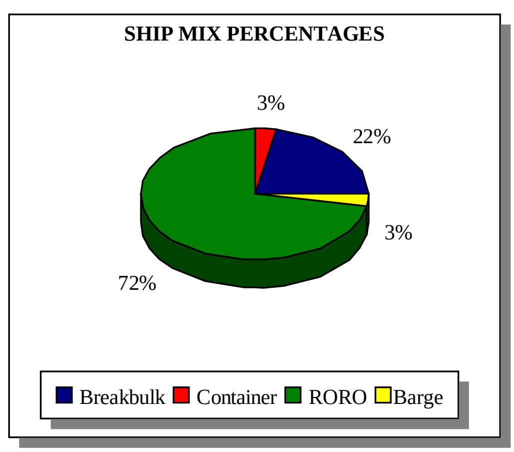
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity for U.S. Fleet Activities, Sasebo. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal processing and handling. The least capable subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for each subsystem in terms of short tons (STON) and measurement tons (MTON) per day. The charts in this section show the throughput yields in STON. Approximate MTON yields can be computed by multiplying the STON amount by 2.5 for breakbulk and container cargo, and multiplying by 4 for RORO cargo.



Terminal Throughput Subsystems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected beths 75 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operation Desert Shield and Desert Storm. This data helped us develop a mix of vessels most likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for differences in cargo and expectations for future deployments.



TERMINAL CLEARANCE AND HANDLING

HIGHWAY

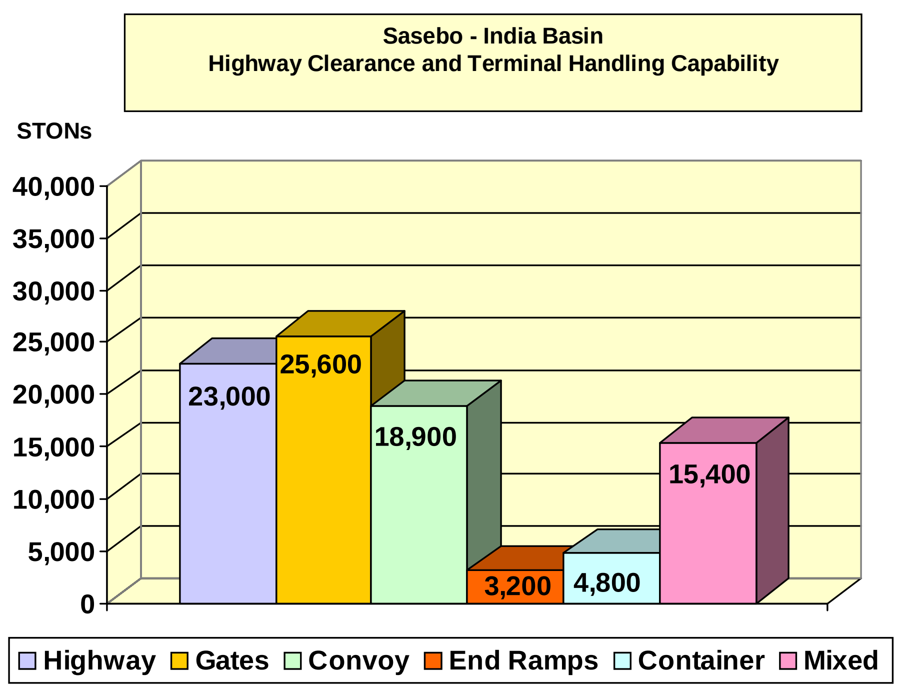
The road network into and out of U.S. Fleet Activities, Sasebo can handle at least 23,000 STON of vehicles, equipment, and supplies per day. The gate processing system can handle more than 25,600 STON of cargo per day.

TERMINAL CLEARANCE

Roadable vehicles will move through the terminal gates in manageable convoys (18,900 STON per day) from staging areas designated for these moves. Vehicles on commerical or military flatbed trailers, not equipped with a means of unloading, must use one of the loading positions at the base. Units can also build or acquire two portable ramps for flatbed truck and semi-trailer offloading operations. End ramp capability will handle at least 3,200 STON of military vehicles and equipment per day.

For handling loaded containers the terminal has access to one (1) top-pick container handler, and seven (7) mobile cranes. If we assume that two are available for use during container transfer operations, the terminal can handle about 4,800 STON of containers per day (about 600 TEUs). This assumes a conservative 15 lifts per hour or 300 moves per handler per 20-hour day.

Maximum daily capability for the terminal is a mixed total of **15,400 STON** based on handling various cargo types, each up to its maximum.

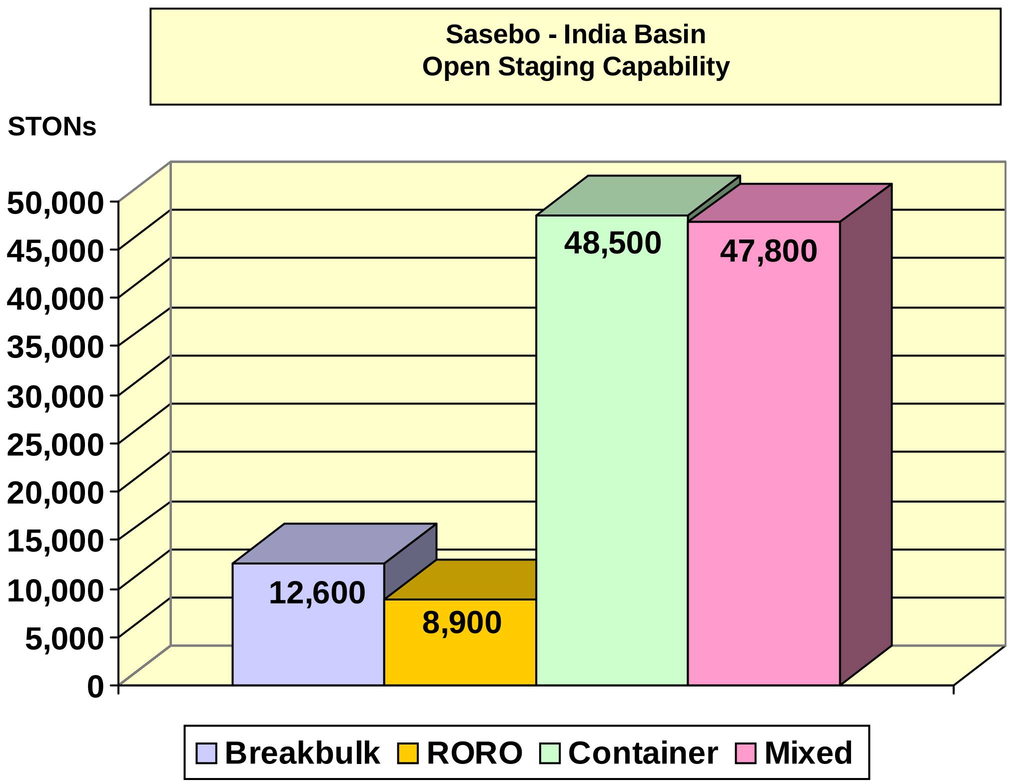


OPEN STAGING

U.S. Fleet Activities, Sasebo has over 18 acres (784,080 square feet) of open staging scattered throughout the port complex and nearby POL and ammunition terminals that could support military operations. The terminal has various warehouses but no transit sheds for covered storage. The base plans to construct some new covered storage within the next few years, deploying units would have to coordinate with the terminal operator to use these facilities when built.

The port has the ability to perform operations on RORO, container, breakbulk, and combination vessels. The cargo mix depends on the anticipated vessel type.

The following chart shows the cargo open staging capability in STONs for each cargo/vessel type, which far exceeds the Port's ship loading capability of 15,100 STON of cargo per day. This analysis assumes a usable space availability of 70 percent of the total area. If a combination ship is expected, then a portion of each involved capability should be assumed.

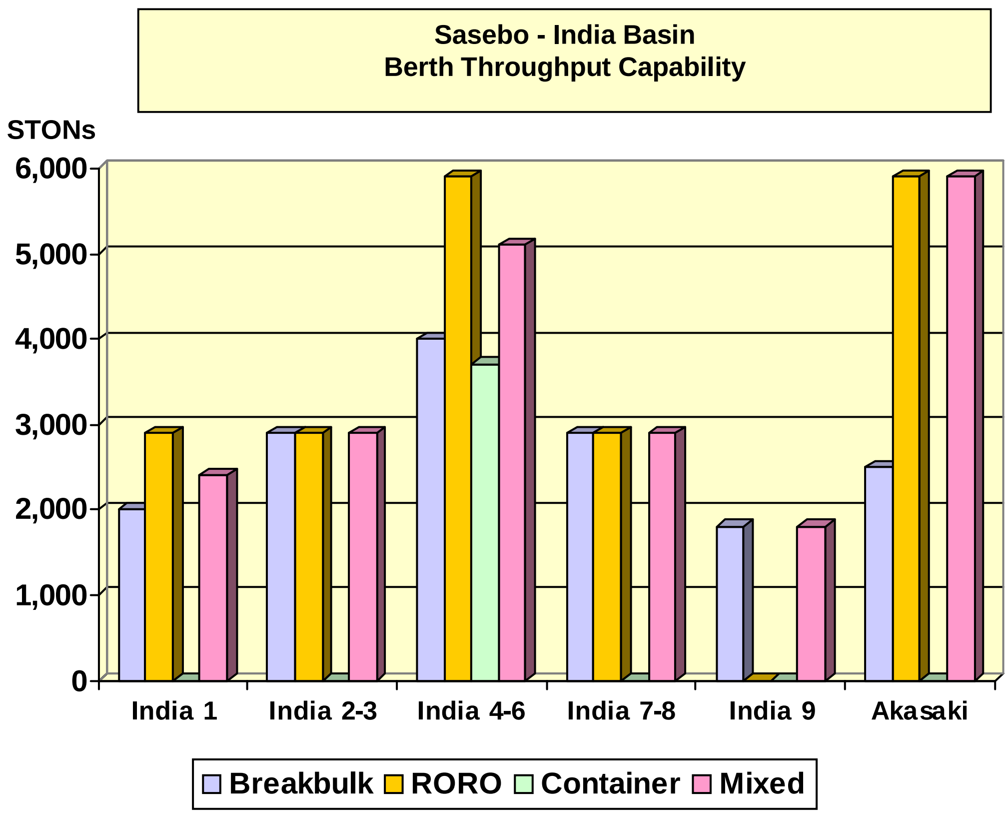


SHIPPING

Daily shipping subsystem totals for Fleet Activities, Sasebo throughputs at each of the berths analyzed are shown below. They are based on various factors, including: material handling equipment (MHE) used, type of loading, operational procedures, berth usage rates, and berthing capabilities for various vessel types. Assumptions and parameter values used in this study are shown in the appendix

CONVERSION FACTORS

Breakbulk	0.4	STON per MTON
RORO	0.25	STON per MTON
Containers	0.4	STON per MTON



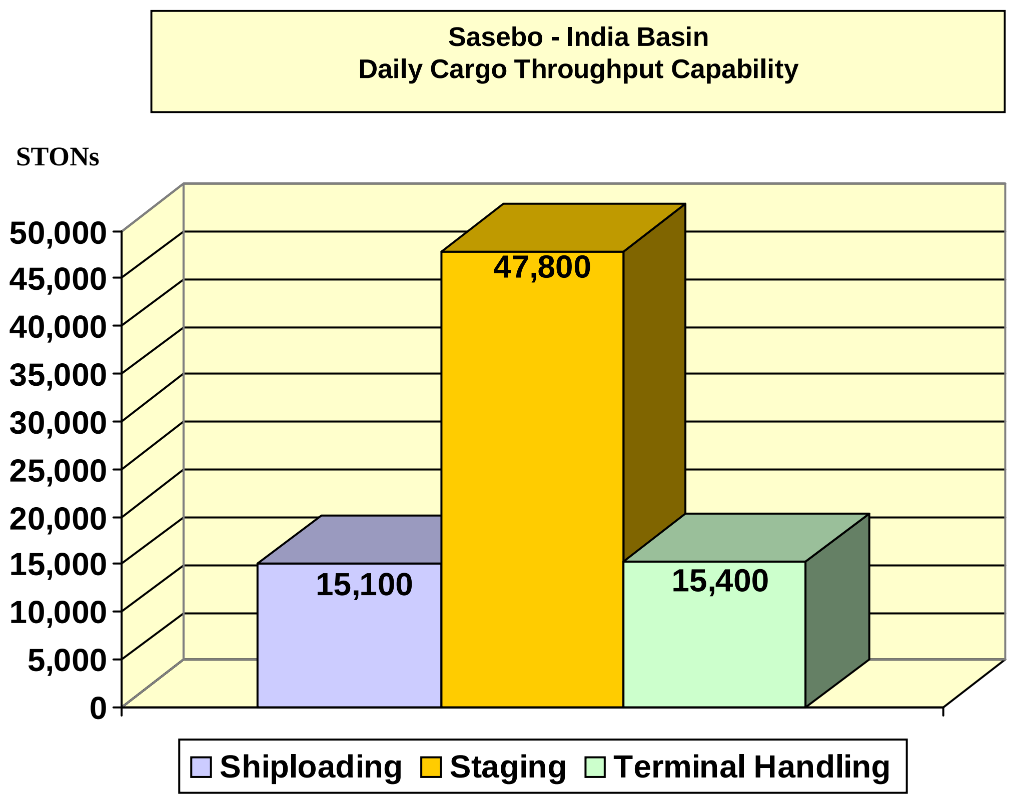
	India 1	India 2-3	India 4-6	India 7-8	India 9	Akasaki
Breakbulk	2,000	2,900	4,000	2,900	1,800	2,500
RORO	2,900	2,900	5,900	2,900	0	5,900
Container	0	0	3,700	0	0	0
Mixed	2,400	2,900	5,100	2,900	1,800	5,000

III. CONCLUSIONS - INDIA BASIN & AKASAKI

U.S. Fleet Activities, Sasebo - India Basin is capable of supporting military cargo trans-shipment operations. Berths 2-3, 4-6 and 7-8 are the preferred berths for military operations, and can accomodate vessels as large as the Large Medium Speed Roll-On-Roll-Off (LSMR) and Fast Sealift Ship (FSS) as shown in the Berthing Characteristic Table. However, the 34.8 foot draft along side these berths could limit the amount of cargo the vessels could take onboard. The LMSR and FSS have a maximum draft of about 35 and 37 fet, respectively. India Basin can handle many vessel types, but because of the narrow apron width is more suited toward handling breakbulk, combination ships, and naval combatant vessels with a draft of less than 34.8 feet.

The nearby Akasaki POL Terminal with its open apron, offers more flexible accomodations for vessels of all cargo types, especially large deep draft RORO and combination vessels. Berths 1 through 3 at Akasaki have depths alongside of 37 to 40 feet. Akasaki also has a wide work apron,and nearby open staging areas, which make it ideal for performing shiploading operations on FSS and LMSR vessels.

Of the transportation subsystems analyzed at Sasebo, and based on the most likely ship mix, the least capable is the ship loading subsystem, which is about 15,100 STON per day.



Other operations taking place concurrently in the terminal will limit actual daily throughput, sustainable over time, by an appropriate percentage of the terminal's overall capability.

U.S. FLEET ACTIVITIES, SASEBO
THROUGHPUT SUMMARY
DAILY CAPABILITY

	INDIA BASIN 1 USN Berth	INDIA BASIN 2-3 USN Berths	INDIA BASIN 4-6 USN Berths
LENGTH (feet)	833	1,194	1,888
DEPTH ALONGSIDE (feet)	34.8	34.8	34.8
BREAKBULK THROUGHPUT (STON)	2,000	2,900	4,000
RORO THROUGHPUT (STON)	2,900	2,900	5,900
RORO SQUARE FT (EST)	57,800	57,800	118,000
RORO PIECES [1]	340	340	340
CONTAINER THROUGHPUT (STON)	0	0	3,700
CONTAINER THROUGHPUT (TEU)	0	0	460
MIXED THROUGHPUT (STON)	2,400	2,900	5,100

[1] Based on the 170 square foot per pieced average accomplished during Operation Desert Shield and Desert Storm; and using an average vehicle weight of 8.5 STON.

NOTE: India Basin berths 1 through 9 are USN berths and joint use berths under a joint use agreement with the GOJ. SSK uses berths 4 and 5 as their major outfitting berths as they are located adjacent to a 250 ton crane and the SSK machine shops. India Basin berths 4 and 5 consistently have tankers berthed for repair by SSK.

U.S. FLEET ACTIVITIES, SASEBO
THROUGHPUT SUMMARY
DAILY CAPABILITY

	INDIA BASIN 7-8 USN Berth	INDIA BASIN 9 USN Berth	AKASAKI 1-3 USN Berths
LENGTH (feet)	1,194	499	1,699
DEPTH ALONGSIDE (feet)	34.8	34.8	37 to 40
BREAKBULK THROUGHPUT (STON)	2,900	1,800	2,500
RORO THROUGHPUT (STON)	2,900	0	5,900
RORO SQUARE FT (EST)	57,800	57,800	118,000
RORO PIECES [1]	340	0	694
CONTAINER THROUGHPUT (STON)	0	0	0
CONTAINER THROUGHPUT (TEU)	0	0	0
MIXED THROUGHPUT (STON)	2,900	1,800	5,000

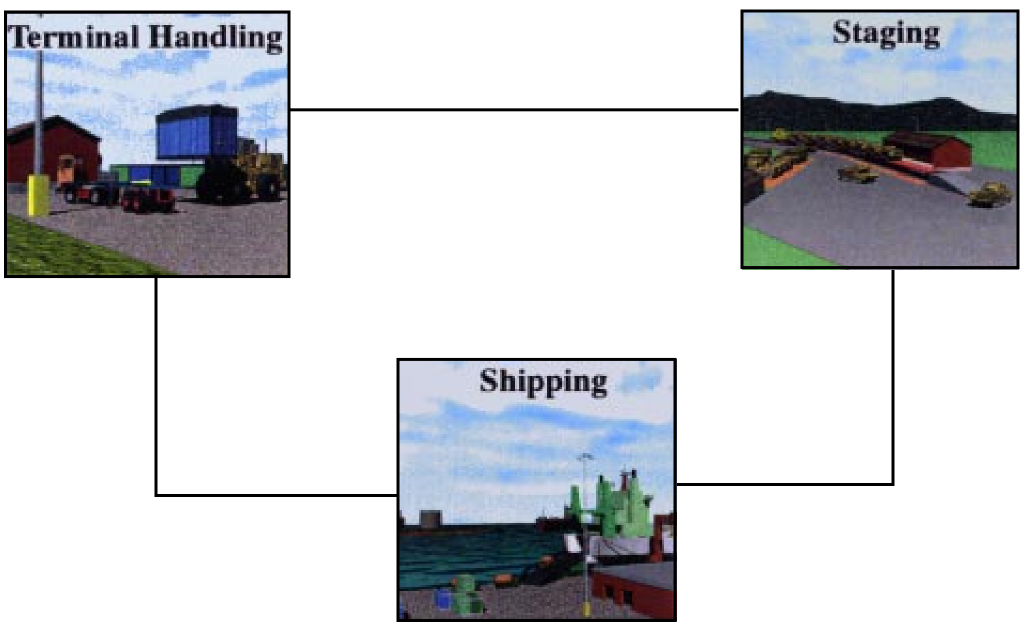
[1] Based on the 170 square foot per pieced average accomplished during Operation Desert Shield and Desert Storm; and using an average vehicle weight of 8.5 STON.

IV. THROUGHPUT ANALYSIS FOR MAEBATA AND HARIO-SHIMA ORDNANCE FACILITIES

GENERAL

EXPLOSIVE and HAZARDOUS CARGO

Limited hazardous cargo operations are permitted at India Basin as necessary. However, due to the port's close proximity to a large civilian population center (City of Sasebo) the terminal is prevented from performing explosive ammunition handling operations. All transfer of explosive ordnance is performed at the Maebata and Hario barge sites with ship transfer occurring at explosive Anchorage No. 39 and/or Buoy No. 61. Anchorage No. 39 has a swing radius of 1,530 feet, and an Explosive Safety Quantity Distance (ESQD) arc of 6,025 feet with a maximum Net Explosive Weight (NEW) limit of 1.75 million pounds. Buoy No. 61 has a swing radius of 890 feet, and an ESQD arc of 7,210 feet with a maximum NEW limit of 3.0 million pounds.



Terminal Throughput Subsystems

For the purposes of this report, cargo throughput at Maebata and Hario Ordnance Facilities is based on each location's capability to transship breakbulk ammunition. The transshipment operation includes: moving the ammunition from igloos, magazines, or open revetments to either site's barge wharf, staging the breakbulk munitions, loading the munitions onto barges and transferring the munitions from barges to sea going vessels in-stream (or the reverse of this process). Additionally, throughput projections are presented for container shipments. Currently, the Navy uses only breakbulk shipment as the mode to move munitions. However, Naval authorities have indicated an interest in the container throughput capability of the two facilities at Hario and Maebata. Using a weak-link analytical approach to these functions will identify the least capable. The weakest subsystem determines the maximum throughput capability of the facility. The analysis yields throughput capability values for each of the subsystems - terminal handling and/or processing, staging, and ship loading/unloading - in terms of short ton (STON) and measurement ton (MTON) and equivalent containers (TEUs) per day.

Maebata Ordnance Facility

TERMINAL HANDLING

CONTAINER STUFFING[1]

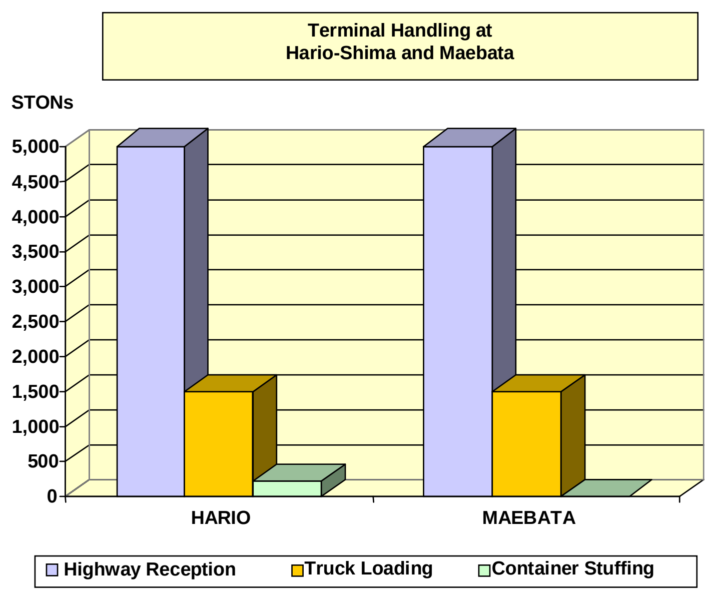
According to operations personnel at the Maebata and Hario Ordnance Facilities, stuffing teams can stuff about **16** containers per day. [2] Converting TEUs to STON and MTON, this equates to about **222 STON** or **245 MTON** per day. [3]

HIGHWAY

Limited movement of explosive cargo by highway through Sasebo or between Maebata and Hario Ordnance Facilities is permitted with advanced coordination by the military and local Japanese authorities. The Government of Japan generally only allows small quantities of minor hazardous (Class 4) munitions to move by highway, but exceptions during contingency periods may be permitted. Both facilities could receive or ship at least **200** trucks or **5,000 STON** or **5,500 MTON** of breakbulk munitions daily by highway.

TRUCK LOADING or UNLOADING

Personnel at each location could load or unload as many as **60** vehicles a day, or about **1,500 STON** or **1,650 MTON** of breakbulk munitions daily.



[1] Information on container handling included for future reference. Navy indicates they are considering container operations in the future.

[2] MHE at Maebata and Hario can only support empty containers. In order to support loaded boxes, operators must contract for container handling equipment (CHE).

[3] Each twenty-foot equivalent unit (TEU) is estimated to contain ~ 13.9 STONs/15.3 MTONs of cargo.

Most ammunition arrives and departs the two depots as breakbulk cargo using barge operations and in-stream transshipment movements to and from ammunition ships. This ammunition remains on station, stored until needed in the many ammunition storage buildings on the depots, and does not customarily move by highway.

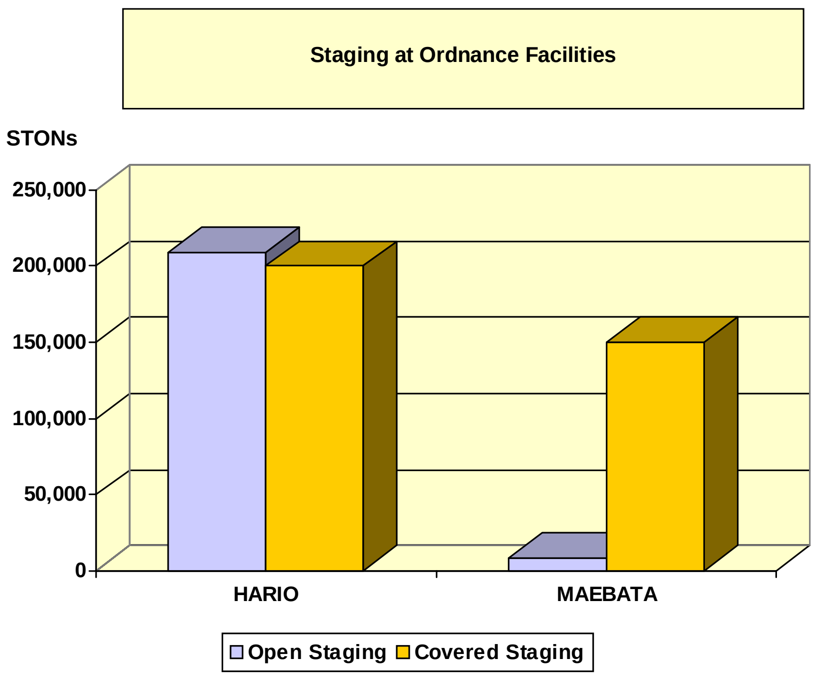
Breakbulk Ammunition Handling

STAGING

OPEN

Hario-Shima Open Staging

Open staging available at the storage facilities supporting Maebata and Hario is limited. Of the two, Hario has the most open staging area, about 4.8 acres or about 209,000 square feet. Much of this area is not paved, so shoring material is required to support loaded containers and other heavy munitions staged there. Hario can store as much as **2,070 STON** or **2,280 MTON** of breakbulk ammunition cargo in this open area. Maebata, with less than one acre of open staging area can stage about **110 STON** or **120 MTON** breakbulk cargo. Using a planning estimate of 120 containers per acre for boxes staged one-high, these 4.8 acres at Hario can provide staging for as many as **576** containers, or **8,000 STON** or **8,800 MTON**. Maebata has less than one acre that can be used for open staging. Maebata is capable of staging very few containers and probably should not be considered for this type of operation.



NOTE: Actual amount of cargo staged at either of these facilities will depend on explosive safety factors and quantity distance considerations. Explosive safety limited staging will probably be less than the maximum.

COVERED STAGING

The Maebata Facility has covered staging equivalent to about 150,000 square feet of covered staging provided by buildings and magazines. This space is normally used to store ammunition and might not be available for conversion to any other use. Hario has about 200,000 square feet of covered staging space. Like Maebata, this space normally warehouses ammunition and its use for other storage purposes is limited. [4]

Hario-Shima Covered Staging

[4] Most, if not all, of the munitions transshipped through these facilities will be stored in these buildings.

SHIPPING

Breakbulk

Normally, ammunition-laden vessels calling on the Port of Sasebo anchor instream and the munitions are transferred to barges for movement to the berths at Maebata and/or Hario (the reverse for outbound shipments). Although small, shallow draft, vessels can come alongside the ammunition berths, such operations are rare. [5]

Tugs move and shuttle barges between the berths and the ammunition vessel(s) at anchorage. Normally, one barge is alongside the vessel while another is at the ammo berth, and a third is in transit. The Fleet Activities, Sasebo has 9 barges for support of ammunition operations. [6] Six of these are 250 long ton (LT) capacity wooden well-deck barges, the other three are 200 LT BC type barges.

Assuming each vessel operation requires three barges, the two facilities can support three separate loading or unloading operations. It takes about two hours to load each barge with palletized breakbulk cargo. Each load carries about 25 STON of munitions. Assuming each barge handles two loads per day, total daily throughput for both facilities is about **450 STON** or about **500 MTON** of breakbulk munitions.

Container

If container-handling equipment (CHE) is made available (none currently available), then Hario could support two container operations. Depending on the barge type and container weights, between 9 and 16 containers move on each barge. Using a conservative handling rate of about 8 lifts per hour, then it takes between 68 and 120 minutes to load or unload a barge with containers. [7] Assuming that U.S. Fleet Activities, Sasebo personnel (both military and Japanese Nationals) work a shift from 0800 to 1800 hours daily, or 10 hours. Japanese law prohibits them from transloading ammunition before sunrise or after sunset. However, blocking, bracing and tiedown of containers aboard ship may continue until completed. If the hourly lift rate of 8 boxes per hour is maintained at both the pier and the vessel, and if one hour is used for lunch, then **each two-gang team can load/unload about 68 containers or 884 STON or 970 MTON per day.** This means that the **daily load/unload capability for two operations would be about 136 containers or 1,768 STON or 1,945 MTON.**

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[5] Army watercraft and similar vessels can berth and work at the barge sites, up to depth alongside limit. The Logistics Support Vessels (LSV), the largest vessel of this type, for example can load or unload directly at the piers at about the same work rate as barges. The LSV has a payload of 50, double stacked containers, or 2,000 STONs.

[6] These barges support both Maebata and Hario Ordnance Facilities.

[7] Facility mobile cranes and contractor provided cranes are used to load or unload containers at the barge piers. Vessels worked at Anchorage must be self-sustaining.

Breakbulk Ammunition Operations

THROUGHPUT SUMMARY

Based on the evaluation of each of the Ordnance Department's ammunition storage facilities and the analysis of the three primary transportation subsystems, the daily breakbulk throughput capability is about **450 STON** or **500 MTON.**

Daily container capability is limited to **16** boxes a day or **222 STON** or **245 MTON.** This is contingent upon container handling equipment (CHE) being made available. This is based on the daily stuffing capability.

This daily capability is what the organization can sustain over time. However, if stuffing capability is increased, then daily throughput will increase accordingly, up to the daily vessel loading maximum of about **136 boxes** a day, or about **1,768 STON or 1,945 MTON.**

U.S. FLEET ACTIVITIES, SASEBO
AMMUNITION THROUGHPUT SUMMARY
DAILY CAPABILITY

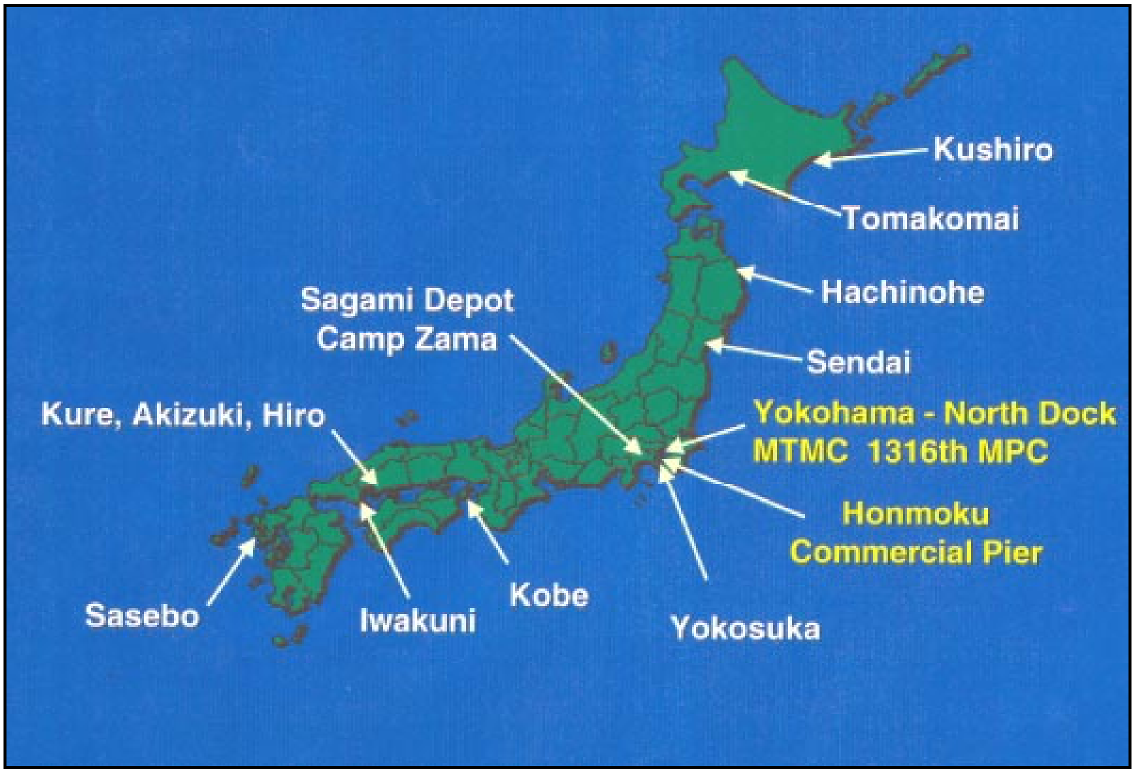
	MAEBATA WHARF USN Berth	**HARIO WHARF** USN Berth	**HARIO DOCK** USN Berth
LENGTH (feet)	200	151	248
DEPTH ALONGSIDE (feet)	27	20	20
BREAKBULK THROUGHPUT (STON & MTON)	225 STON 250 MTON	225 STON 250 MTON	
CONTAINER THROUGHPUT (STON & MTON)	111 STON 122 MTON	111 STON 122 MTON	
CONTAINER THROUGHPUT (TEU)	8	8	

PORT OF YOKOHAMA, JAPAN

I. GENERAL DATA

LOCATION

The Port of Yokohama is located in the northwest area of the Tokyo Bay, at Latitude 35^{o} 20'~28' north and Longitude 139^{o} 37'~43' west. Surrounded by moderately rolling hills on the north, west and south, this ideal natural port opens to the sea on the east coast of Japan.



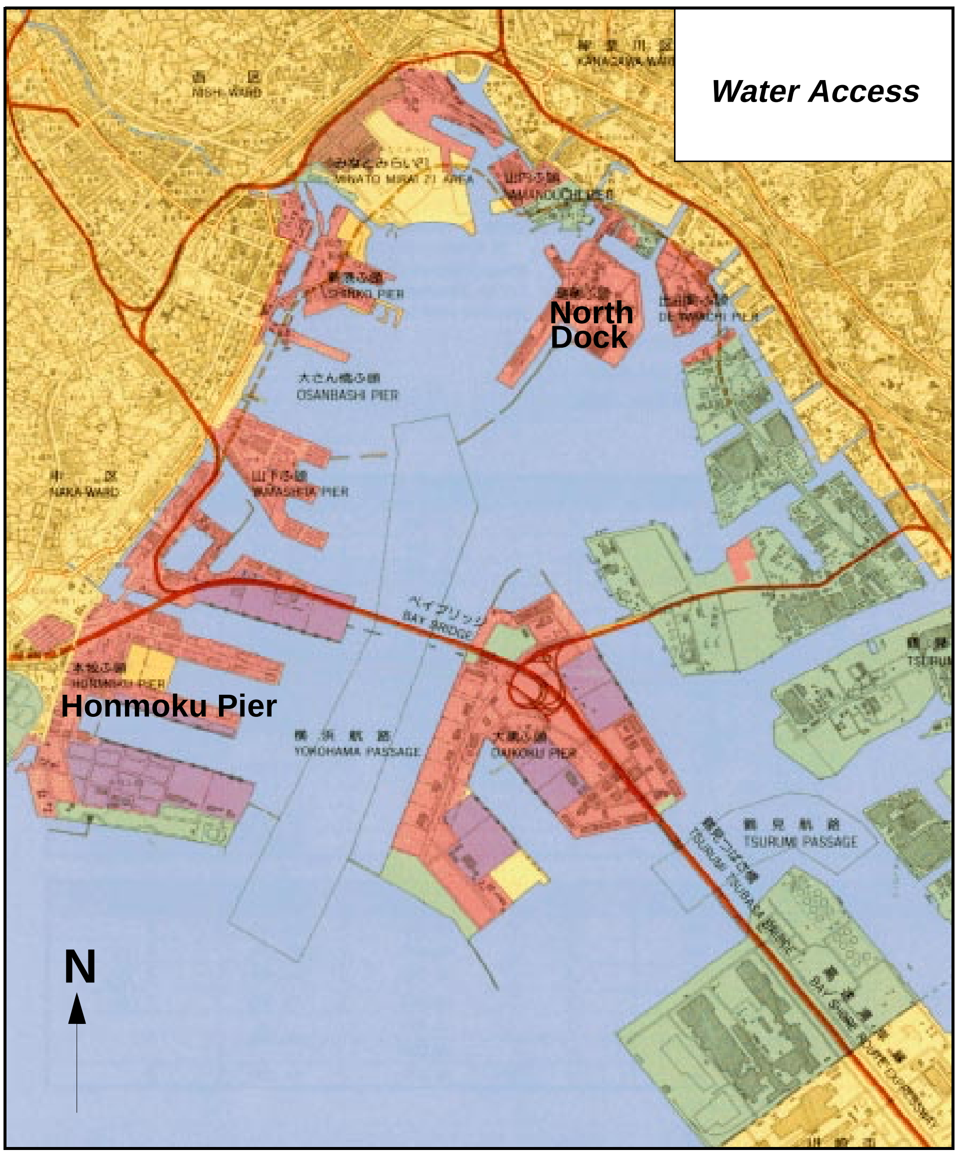
Major Ports of Japan

Breakwaters inside and outside the port protect its deep waters against winds and high waves. The Port of Yokohama lies close to Tokyo, Japan's capital. This region is the political, economic and cultural center of Japan. It is a huge consumer area, linked by a network of trunk highways to Yokohama. Situated in the coastal industrial belt that includes the Keihin Industrial Zone, Yokohama is the premier eastern port, the shortest distance from the United States, Japan's largest trade partner. Yokohama is situated in a highly advantageous location geographically, economically, and socially. It is also an international trade port. Since its opening, 138 years ago, Yokohama has made great contributions to the Japanese economy.

TRANSPORTATION MODES

Water Access

Vessels destined for the Port of Yokohama should head for the entrance to Tokyo Bay at 35° 10.24' north latitude and 139° 45.54' east longitude, located 5 miles 161° from Kannon Saki Lighthouse. Here the Bay Pilot will board the vessel from a tug. The entrance channel, "Yokohama Passage," has a depth of 39 feet at mean low water (MLW) and a width of 1,312 feet at the Yokohama Bay Bridge. The inner habor has ample maneuvering room, with a turning basin of at least 1,500 feet and a draft of 39 feet MLW. The Yokohama Bay Bridge crosses the approach channel with a vertical clearance of 180 feet at mean high water; however, this clearance poses no vertical restriction on vessels entering the harbor.



Waves: Waves in the Port of Yokohama, under normal weather conditions, are minimally affected by wind because the distance to shores is relatively short. Wave heights are generally determined by wind velocity and the distance to the shore. On the basis of these two factors, wave heights observed by the Yokohama District Weather Bureau are most frequently 1~1.6 feet high under a wind velocity of over 16 feet per second. The annual occurrence of waves higher than 1.6 feet is about 17 percent, while those exceeding 4.6 feet are rarely observed.

Wave heights under abnormal conditions such as typhoons in the last few decades, computed on the basis of average wind velocity and distance from the shore, are as follows: Typhoon Kity, 10.3 feet; Typhoon Isewan, 10.5 feet; Typhoon Catherine, 8.5 feet; Typhoon Makurazaki, 7.2 feet; Typhoon Muroto, 8.5 feet. The highest wave was 10.5 feet, during Typhoon Isewan, maximum wave height during this typhoon was 60~80 percent higher than the average height under normal weather conditions. It is therefore possible for waves 18 to 19.7 feet high to occur once every 10-20 minutes, although this wouldn't occur continuously.

The Bohso and Miura Peninsulas virtually shelter the port from high seas swells. Even when there are 32.8-feet-high swell in the Pacific, they are only 4 inches high in the harbor, which is nearly insignificant.

Currents: The current in the Port of Yokohama varies from day to day. Affected by weather conditions, the surface current is highly complex. At flowing tide, sea water comes in from the outer breakwaters at an average rate of not more than 1.6 feet per second. At ebbing tide it goes out at a much slower rate. The currents on the navigation channels outside the outer breakwaters are the swiftest of all currents inside and outside the port, but even they do not run at more than 3.3 feet per second.

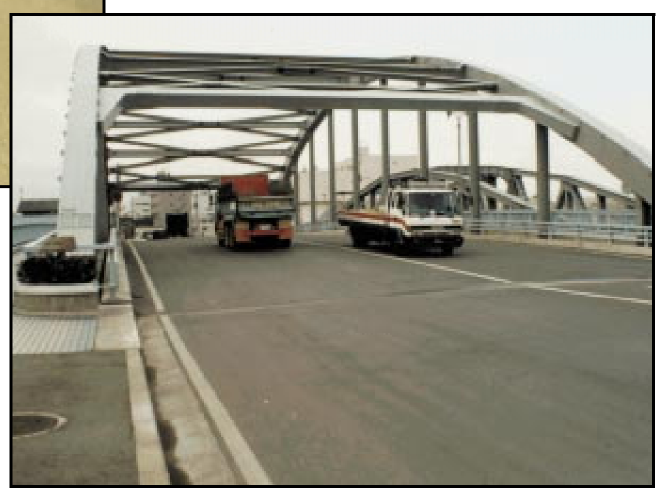
Tides: The minimum tide in the harbor is about 1.5 feet below MLW, the maximum tide is about 8.4 feet above MLW, and the average tidal range is 4 feet above MLW.

Highway Access

The Port of Yokohama is situated in the center of a huge Metropolitan area. The traffic network connecting bases with each other is sufficient to support modern needs. In addition, this network is functionally linked with expressways to transport materials to cities and towns in the surrounding area. Tokyo Bay Shore Expressway (the fourth phase) was opened to traffic in 1994. So Yokohama is connected with Tokyo by two expressways (10 lanes). As a result, access from Yokohama to each Metropolitan area became much easier.

The road networks to the surrounding districts around the Port of Yokohama and the inland roadways are continually being improved. Many of the two-lane routes are bituminous-surfaced roadways about 20 feet wide, with concrete curb shoulders in good condition.

Access Road and Main Gate to Yokohama North Dock



Access to North Dock: The access road to Yokohama North Dock is a two-lane road in very good condition. From either National Route 15, the Metropolitan Expressway, or the Yokohama-Haneda Airport Expressway, proceed south-east onto Chiwaka-Cho Street, the port access road until reaching North Dock. The Main Gate at North Dock normally has only one inbound and one outbound lane providing access to the US Army facility.

Access to Honmoku Pier, Jetty A: The access road leading from the Sea-Land terminal on Honmoku Pier, Jetty A connects to Yokohama Municipal Road No. 136, which provides access to National Highway Route 357 and two Metropolitan expressways, the Yokohama-Haneda Airport Expressway and the Tokyo Bay Shore Expressway. The Sea-Land terminal main entrance has three (3) inbound and three (3) outbound lanes for truck processing and documentation.

Main Entrance to Sea-Land

Access to Honmoku Pier, Jetty D: The access road leading from the American President Lines terminal on Honmoku Pier, Jetty D connects to Yokohama Municipal Road No. 377, which provides access to National Highway Route 357 and two Metropolitan expressways, Yokohama-Haneda Airport Expressway and the Tokyo Bay Shore Expressway. The American President Lines terminal entrance has five (5) inbound and five (5) outbound truck lanes for processing and documentation of containers.

Main Entrance to American President Lines

Highway Access Map

Rail Access

Japan has excellent passenger rail service throughout the Tokyo and Yokohama area. Even though tracks are available, there is no freight rail service to either the US Military facility at North Dock or the commercial terminals at Honmoku Pier on a regular basis.

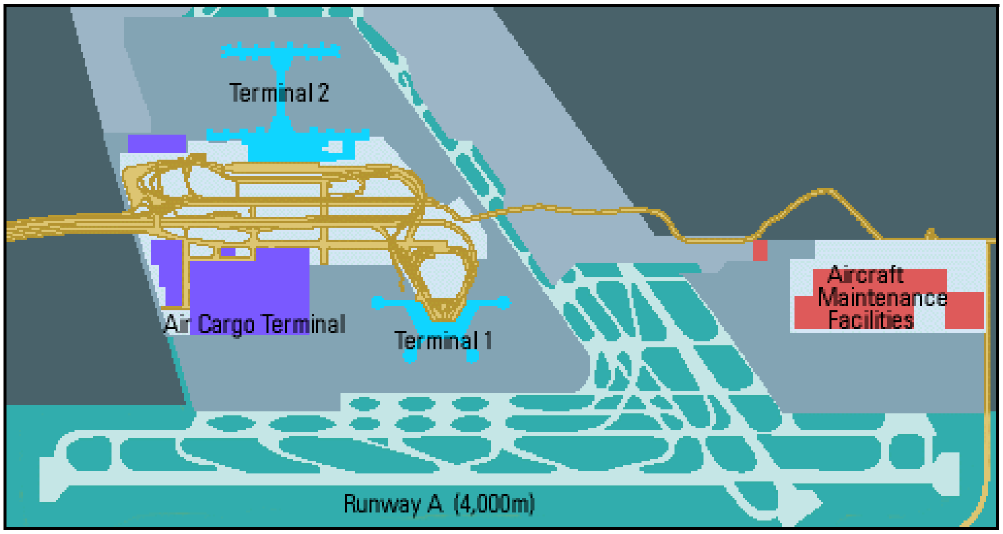
Air Access

Commercial Airports: The New Tokyo International Airport (Narita International Airport), and Haneda Airport (Domestic Airport) are the two major commercial airports serving the Tokyo Metropolitan area.

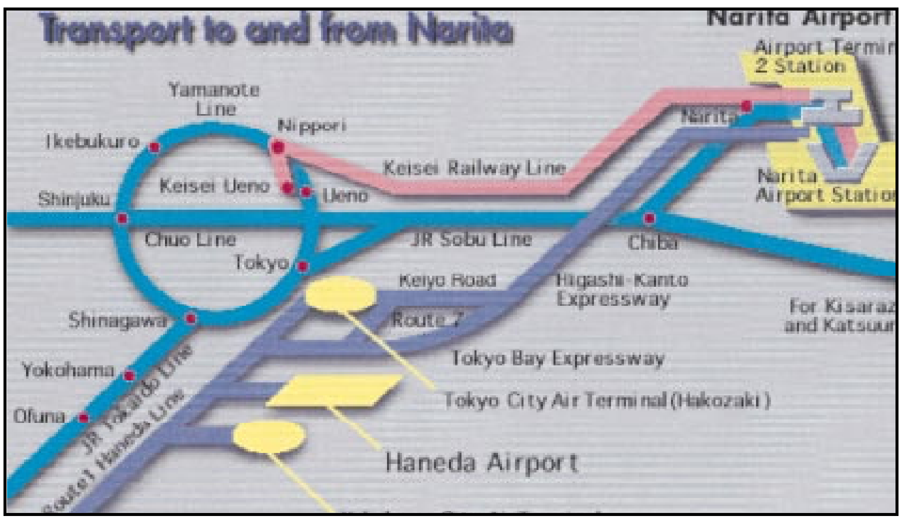
Haneda Airport has three runways - two of them are over 10,000 feet long and 200 feet wide.

Narita International Airport

Narita International Airport is 41 miles northeast of Tokyo in Narita City. It has several concrete-surfaced runways - the primary runway is 13,120 feet long and about 200 feet wide, and can accommodate large wide-bodies such as B-747 aircraft.



Layout of Narita Airport



Transportation to and from Narita Airport

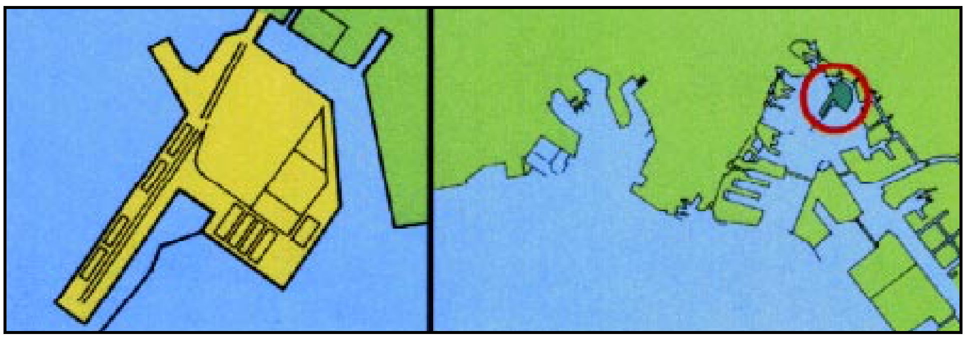
Military Airfields: Yokota Air Base and Atsugi Naval Air Facility are the two major military airfield serving the region. Yokota Air Base has a control tower and two concrete-surfaced runways. The primary runway 18/36 is about 11,000 feet long and 200 feet wide and is suitable for C-5, C-9, KC-10, C-17, C-21, C-130, KC-135, and C-141 aircraft.

Atsugi Naval Air Facility has a control tower and one concrete-surfaced runway. Runway 01/19 is 8,000 feet long and 150 feet wide, and can accommodate KC-10, C-17, and C-141 aircraft. It is suitable for C-9, C-21, C-130, and KC-135E/R aircraft, and approved as an alternate airfield for C-5 aircraft only during emergencies.

PORT FACILITIES

Berthing - Yokohama North Dock

Yokohama North Dock, also known as Mizuho Pier, was constructed between 1925 and 1945, as a land reclamation project. The Military Traffic Management Command's 836th U.S. Army Transportation Battalion operates most of the facility in support of U.S. Army missions. This facility consists of eight short berths, totaling 4,140 linear feet. In this report, we have combined the berths in order to handle a wider range of ship types. Berth A-B is 1,000 feet long and suitable for general cargo and barge operations. Berth C-D is 1,100 feet long and good for small to medium breakbulk ships. Berth E-F is 1,100 feet long and suitable for breakbulk, limited RORO and container operations. Berth G-H is 940 feet long and capable of handling small to medium size RORO or combination vessels.



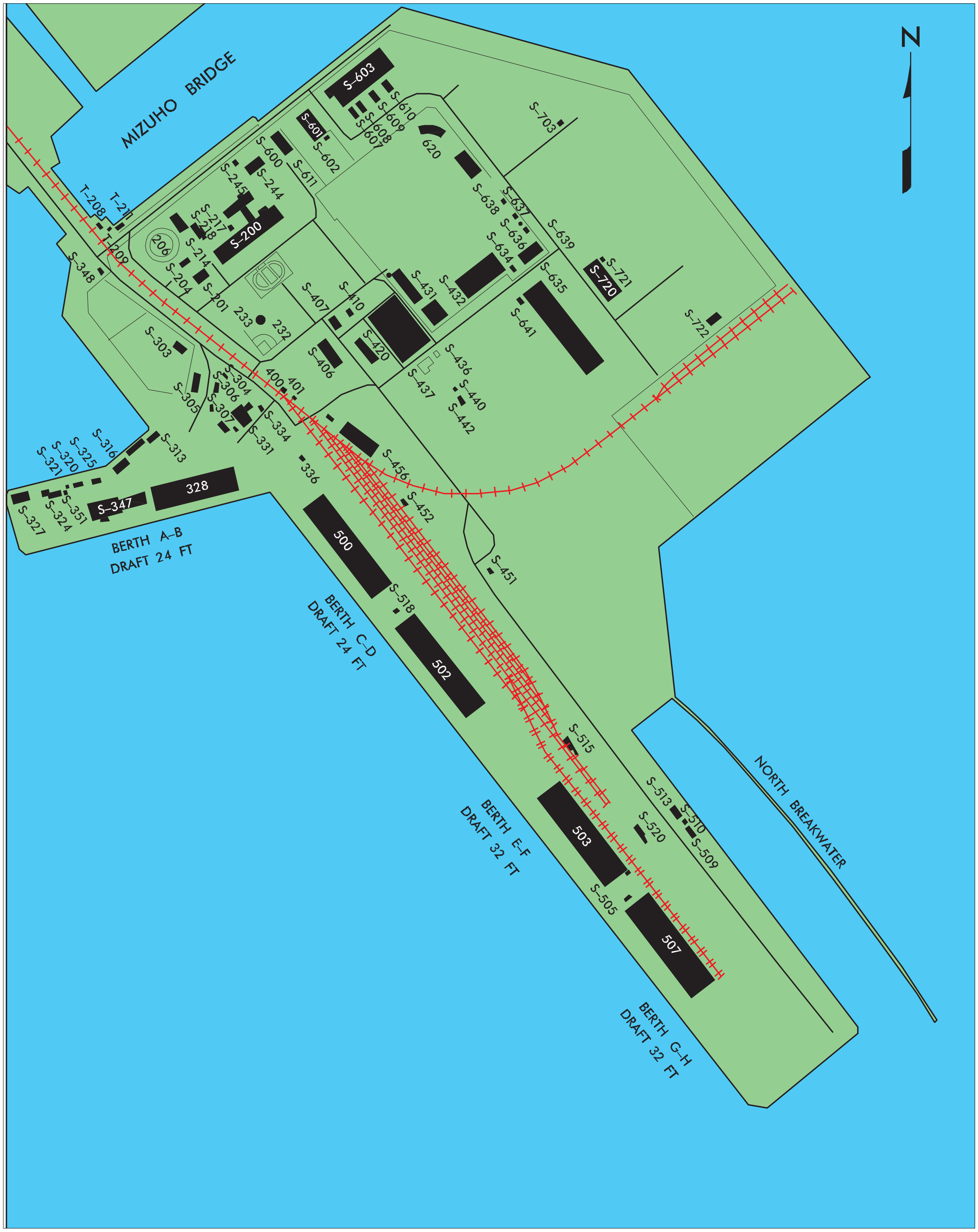
North Dock (Mizuho Pier)

BERTH CHARACTERISTICS
YOKOHAMA - NORTH DOCK

	BERTHS			
Characteristics	**Berth A-B**	**Berth C-D**	**Berth E-F**	**Berth G-H**
Length (ft)	1000	1100	1100	940
Depth alongside at MLW (ft)	24	24	32	32
Deck strength (psf)	500	500	500	500
Apron width (ft)	41 to 64	45	48 to Open	48 to Open
Apron height above MLW (ft)	11	11	11	11
Number of container cranes	0	0	0	0
Number of wharf cranes	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	Yes	No	No
Apron length served by rail (ft) *	0	0	0	0

***** Although each transit shed can be accessed by rail, the terminal has no freight rail service.

North Dock (Mizuho Pier)



North Dock Site Map

PORT FACILITIES - CONT

Berthing - Honmoku Pier, Jetty A

Honmoku Pier is the main pier of the Port of Yokohama. The reclamation work of this pier started in 1963 and was completed in 1970. It is a finger type pier which consists of Jetties A, B, C and D. There are large scale container terminals in Jetties A and D. Jetty B has berths for conventional ships. Jetty C has multipurpose berths for roll-on/roll-off (RORO) ships and semi-container ships. To handle the increasing container cargo, the water area between Jetties B and C is now being reclaimed to provide a container yard.

Jetty A consists of Berths A1-3 which supports conventional ships, Berth A4 has only 26 feet of water alongside and is used for staging Sea-Land containers, Berths A5-6 are operated by Sea-Land, and Berths A7-8 are operated by K-Line. The Sea-Land and K-Line Berths provide over 3,600 linear feet of militarily useful berthing space.

The Sea-Land terminal handles mainly large container vessels with an average of eight container ships calling at the port each week. Container operations can be conducted 24 hours a day, and night berthing is permissible.

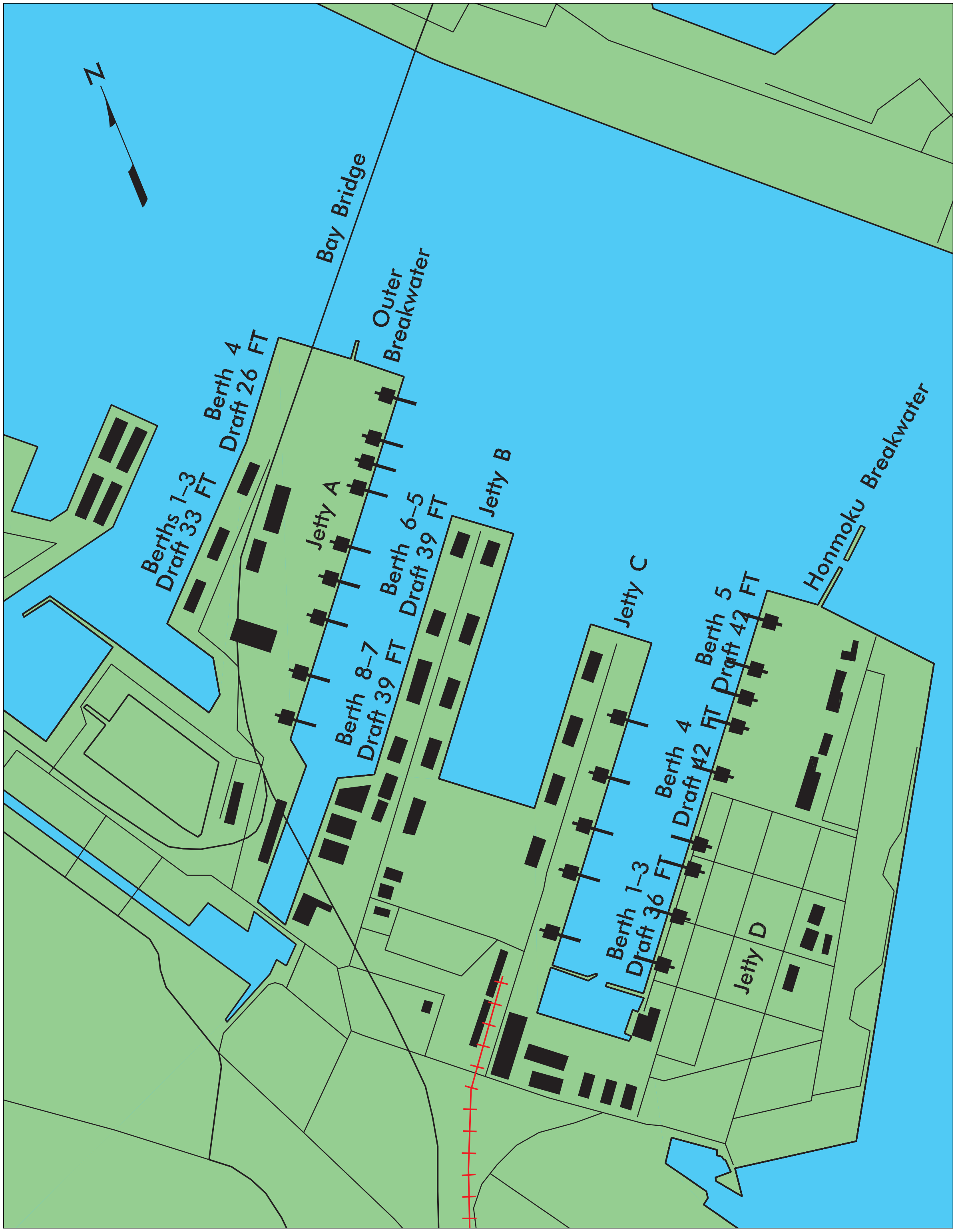
Berth A5-6 (Sea-Land terminal) and Berth A7-8 (K-Line terminal) are the obvious choices for supporting military cargo operations. They are the only berths at Jetty A with sufficient length, depth alongside, and open apron area adjacent that can accommodate vessels like the FSS and LMSR. Berth A8 also has a RORO ramp for supporting military cargo vessels.

Port of Yokohoma, Container Terminal

BERTH CHARACTERISTICS
HONMOKU PIER - JETTY A

	BERTHS			
Characteristics	**A1-3** Public Tml	**A4** Sea-Land	**A5-6** Sea-Land	**A7-8** K-Line
Length (ft)	1,968	1,148	1,968	1,640
Depth alongside at MLW (ft)	33	26	39	39
Deck strength (psf)	600	600	600	600
Apron width (ft)	65	Open	Open	Open
Apron height above MLW (ft)	12	12	12	12
Number of container cranes	0	0	5	3
Number of wharf cranes	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	Yes
Apron length served by rail (ft)	0	0	0	0

Honmoku Pier - Jetty A



Honmoku Pier

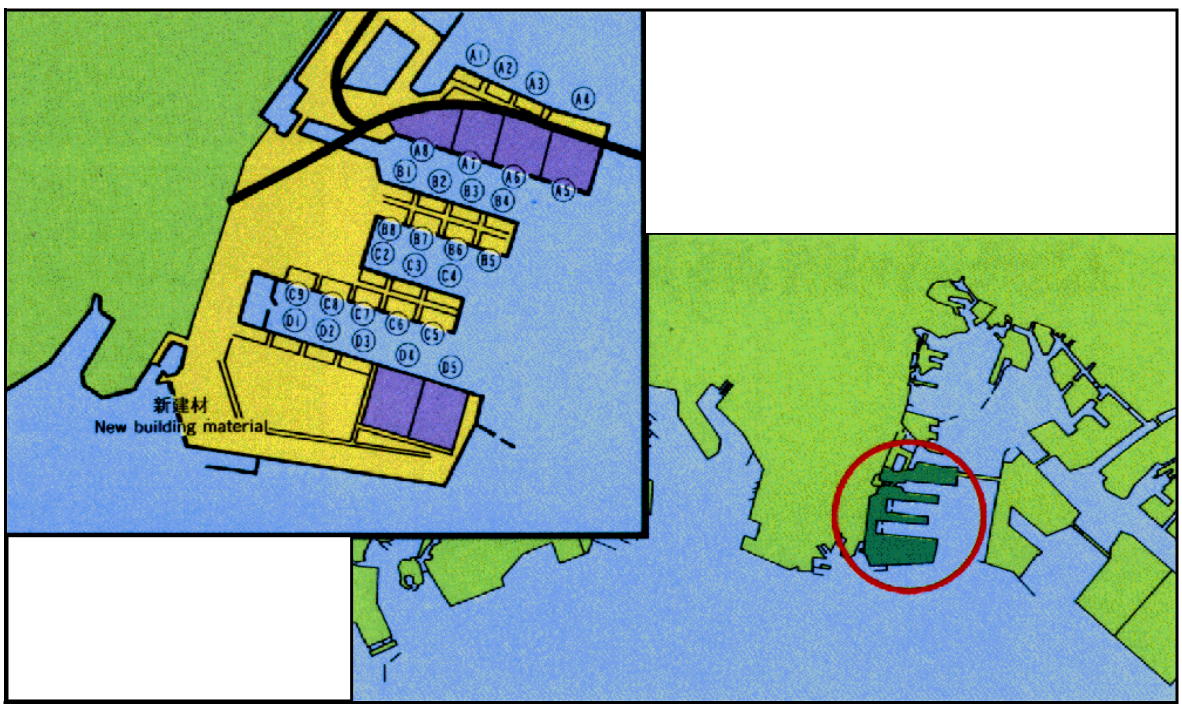
PORT FACILITIES - CONT

Berthing - Honmoku Pier, Jetty D

Honmoku Pier - Jetty D consists of three large scale container terminals. Berths D1-3 are part of the Public Terminal, Berth D4 is operated by American President Lines (APL), and Berth D5 is operated by Mitsui Osk Lines (MOL). In addition, Jetty D has berths used exclusively for building materials, as well as, the Port of Yokohama Symbol Tower and Honmoku Fishing Jetty located on the south side of the pier.

The terminal handles mainly large container vessels with an average of three to four container ships calling at the port each week. Container operations can be conducted 24 hours a day, and night berthing is permissible.

The APL and MOL Terminals are the obvious choices for supporting military cargo operations. APL was used during Desert Shield/Storm to support large shipments of military containers, such as the Navy's Mobile Hospital. Both terminals offers almost 1,000 feet of berthing, deep water, container cranes, and open apron area that are fully capable of supporting vessels like the FSS and LMSR.



Honmoku Pier

BERTH CHARACTERISTICS
HONMOKU PIER - JETTY D

	BERTHS		
Characteristics	**D1-3 Public Terminal**	**D4 APL Terminal**	**D5 MOL Terminal**
Length (ft)	2,033	984	984
Depth alongside at MLW (ft)	36	42	42
Deck strength (psf)	750	600	600
Apron width (ft)	Open	Open	Open
Apron height above MLW (ft)	12	12	12
Number of container cranes	4	3	2
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No
Apron length served by rail (ft)	0	0	0

Honmoku Pier - Jetty D

YOKOHAMA NORTH DOCK
SUMMARY OF BERTHING CAPABILITIES

TYPE	VESSEL CLASS	A-B	C-D	E-F or G-H	
BREAKBULK	C3-S-38a	1,a	2,a	2/1	NOTES
	C-4-S-58a	1,a	1,a	1	a-vessel draft limit
	C4-S-66a	1,a	1,a	1,a	b-inadequate apron width
	C5-S-37e	1,a	1,a	1	c-inadequate berth length
					d-no straight stern ramp
SEATRAIN	GA & PR- class	1,a	1,a	1	e-no container handling equipment
					f-anchorage depth OK, berth depth
BARGE	LASH C8-S-81b	1,a,f	1,a,f	1,a,f	inadequate
	LASH C9-S-81d	1,a,f	1,a,f	1,a,f	g-inadequate channel depth
	LASH Lighter	5	5	5/4	h-no shore based ramps
	SEABEE C8-S-82a	1,a,f	1,a,f	1,a,f	i - low tide insufficient ramp clearance
	SEABEE Barge	5	5	5/4	j-high tide insufficient ramp clearance
					k-excessive ramp angle low tide
RORO	COMET	1,a,d,o	2,a	2,d,i,j	m-excessive ramp angle high tide
	METEOR	1,a,d,o	1,a	1,d,i,j	n-parallel ramp operation ONLY
	Cape Gnome	1,a,d,o	1,a	1,a,d,i,j	o-insufficient apron width for side ramp
	C7-S-95a	1,a,b	1,a,b	1,a	
	Cape Taylor	1,a,b	1,a,b	1	Ramp clearance and angle based on
	Cape Orlando	1,a,b	1,a,b	1,i,j	maximum vessel draft
	MV Ambassador	1,d	1,m	1,d	
	Callaghan	1,a,d,o	1,a	1,d,i	**May Prevent Operation**
	Cape Lambert	1,a,b	1,a,b	1,i,j	
	LMSR - class	1,a,b	1,a,b	1,a	**May Limit Operation**
	FSS	1,a,b	1,a,b	1,a	
	Cape E	1,a,b	1,a,b	1,i,j	a-vessel draft limit
	Cape D	1,a,b	1,a,b	1,a	b-inadequate apron width
	Cape H	1,a,b	1,a,b	1,a	c-inadequate berth length
	Cape Texas	1,a,b	1,a,b	1,i,j	d-no straight stern ramp
	Cape R	1,a,b,d	1,a	1,a,d	e-no container handling equipment
	Cape I	1,a,b	1,a,b	1,i,j	f-anchorage depth OK, berth depth
	Cape Victory	1,a,b	1,a,b	1,i	inadequate
					g-inadequate channel depth
CONTAINER	C6-M-147a	1,a,b,e	1,a,b,e	1,e	h-no shore based ramps
	C7-S-69c	1,a,b,e	1,a,b,e	1,e	i - low tide insufficient ramp clearance
	C7-S-68c	1,a,b,e	1,a,b,e	1,e	j-high tide insufficient ramp clearance
	C8-S-85c	1,a,b,e	1,a,b,e	1,a,e	k-excessive ramp angle low tide
	C9-M-132b	1,a,b,e	1,a,b,e	1,a,e	m-excessive ramp angle high tide
	C9-M-F141a	1,a,b,e	1,a,b,e	1,a,e	n-parallel ramp operation ONLY
					o-insufficient apron width for side ramp
TACS	C6-S-1qd	1,a,b	1,a,b	1	
	C5-S-MA73c	1,a,b	1,a,b	1	Ramp clearance and angle based on
	C6-S-MA60d	1,a,b	1,a,b	1	maximum vessel draft
MPS	C7-S-133a	1,a,b	1,a,b	1,a	**May Prevent Operation**
	Maersk	1,a,b	1,a,b	1,a	
	AmSea	1,a,b	1,a,b	1	**May Limit Operation**

HONMOKU PIER - JETTY A
SUMMARY OF BERTHING CAPABILITIES

TYPE	VESSEL CLASS	A4	A5-6	A7-8	
BREAKBULK	C3-S-38a	3	3	3	**NOTES**
	C-4-S-58a	3	3	2	a-vessel draft limit
	C4-S-66a	3	3	2	b-inadequate apron width
	C5-S-37e	3	3	2	c-inadequate berth length
					d-no straight stern ramp
SEATRAIN	GA & PR- class	3	3	2	e-no container handling equipment
					f-anchorage depth OK, berth depth
BARGE	LASH C8-S-81b	2,a,f	2	1	inadequate
	LASH C9-S-81d	2,a,f	2	1	g-inadequate channel depth
	LASH Lighter	9	9	8	h-no shore based ramps
	SEABEE C8-S-82a	2,a,f	2	1	i - low tide insufficient ramp clearance
	SEABEE Barge	9	9	8	j-high tide insufficient ramp clearance
					k-excessive ramp angle low tide
RORO	COMET	3,d,i,j	3,d,i,j	3,i,j	m-excessive ramp angle high tide
	METEOR	3,d,i,j	3,d,i,j	2,i,j	n-parallel ramp operation ONLY
	Cape Gnome	3,d,i,j	3,d,i,j	2,i,j	o-insufficient apron width for side ramp
	C7-S-95a	2,a	2	2	
	Cape Taylor	2	2	2	Ramp clearance and angle based on
	Cape Orlando	2,i,j	2,i,j	2,i,j	maximum vessel draft
	MV Ambassador	3,d	3,d	2,m	
	Callaghan	2,d,i	2,d,i	2,i	**May Prevent Operation**
	Cape Lambert	2,i,j	2,i,j	2,i,j	
	LMSR - class	2,a	2	1	**May Limit Operation**
	FSS	2,a	2	1	
	Cape E	2,i,j	2,i,j	2,i,j	a-vessel draft limit
	Cape D	2,i,j	2,i,j	2,i,j	b-inadequate apron width
	Cape H	2,a	2	2	c-inadequate berth length
	Cape Texas	2,i,j	2,i,j	2,i,j	d-no straight stern ramp
	Cape R	2,d	2,d	2,i	e-no container handling equipment
	Cape I	2,i,j	2,i,j	2,i,j	f-anchorage depth OK, berth depth
	Cape Victory	2,i	2,i	2,i	inadequate
					g-inadequate channel depth
CONTAINER	C6-M-147a	2,e	2	2	h-no shore based ramps
	C7-S-69c	2,e	2	2	i - low tide insufficient ramp clearance
	C7-S-68c	2,e	2	2	j-high tide insufficient ramp clearance
	C8-S-85c	2,e	2	1	k-excessive ramp angle low tide
	C9-M-132b	2,a,e	2	1	m-excessive ramp angle high tide
	C9-M-F141a	2,a,e	2	1	n-parallel ramp operation ONLY
					o-insufficient apron width for side ramp
TACS	C6-S-1qd	2	2	2	
	C5-S-MA73c	3	3	2	Ramp clearance and angle based on
	C6-S-MA60d	2	2	2	maximum vessel draft
MPS	C7-S-133a	2	2	1	**May Prevent Operation**
	Maersk	2	2	2	
	AmSea	2	2	2	**May Limit Operation**

HONMOKU PIER - JETTY D
SUMMARY OF BERTHING CAPABILITIES

TYPE	VESSEL CLASS	D1-3	D4	D5	
BREAKBULK	C3-S-38a	3	1	1	NOTES
	C-4-S-58a	3	1	1	a-vessel draft limit
	C4-S-66a	3	1	1	b-inadequate apron width
	C5-S-37e	3	1	1	c-inadequate berth length
					d-no straight stern ramp
SEATRAIN	GA & PR- class	3	1	1	e-no container handling equipment
					f-anchorage depth OK, berth depth
BARGE	LASH C8-S-81b	2	1	1	inadequate
	LASH C9-S-81d	2,a,f	1	1	g-inadequate channel depth
	LASH Lighter	10	4	4	h-no shore based ramps
	SEABEE C8-S-82a	2,a,f	1	1	i - low tide insufficient ramp clearance
	SEABEE Barge	10	4	4	j-high tide insufficient ramp clearance
					k-excessive ramp angle low tide
RORO	COMET	3,d,i,j	1,d,i,j	1,d	m-excessive ramp angle high tide
	METEOR	3,d,i,j	1,d,i,j	1,d	n-parallel ramp operation ONLY
	Cape Gnome	3,d,i,j	1,d,i,j	1,d	o-insufficient apron width for side ramp
	C7-S-95a	2	1	1	
	Cape Taylor	3	1	1	Ramp clearance and angle based on
	Cape Orlando	3,i,j	1,i,j	1,i,j	maximum vessel draft
	MV Ambassador	3,d	1,d	1,d	
	Callaghan	2,d,i	1,d,i	1,d,i	**May Prevent Operation**
	Cape Lambert	2,i,j	1,i,j	1,i,j	
	LMSR - class	2	1	1	**May Limit Operation**
	FSS	2,a	1	1	
	Cape E	2,i,j	1,i,j	1,i,j	a-vessel draft limit
	Cape D	2,i,j	1,i,j	1,i,j	b-inadequate apron width
	Cape H	2	1	1	c-inadequate berth length
	Cape Texas	3,i,j	1,i,j	1,i,j	d-no straight stern ramp
	Cape R	3,d	1,d	1,d	e-no container handling equipment
	Cape I	2,i,j	1,i,j	1,i,j	f-anchorage depth OK, berth depth
	Cape Victory	3,i	1,i	1,i	inadequate
					g-inadequate channel depth
CONTAINER	C6-M-147a	2	1	1	h-no shore based ramps
	C7-S-69c	2	1	1	i - low tide insufficient ramp clearance
	C7-S-68c	2	1	1	j-high tide insufficient ramp clearance
	C8-S-85c	2	1	1	k-excessive ramp angle low tide
	C9-M-132b	2	1	1	m-excessive ramp angle high tide
	C9-M-F141a	2,a	1	1	n-parallel ramp operation ONLY
					o-insufficient apron width for side ramp
TACS	C6-S-1qd	2	1	1	
	C5-S-MA73c	3	1	1	Ramp clearance and angle based on
	C6-S-MA60d	2	1	1	maximum vessel draft
MPS	C7-S-133a	2	1	1	**May Prevent Operation**
	Maersk	2	1	1	
	AmSea	2	1	1	**May Limit Operation**

STAGING

Open Staging

Yokohama North Dock has about 32 acres of open staging distributed throughout the terminal. Part of this area is asphalt surfaced, but a good portion of this staging area requires improvement. Some of this open staging is apron area adjacent to Berths E and H. The terminal uses a large portion of the available staging to store containers, to support the Diego Garcia container transfer operation.

Open Staging at Berth E

Open Staging at Berth H

Covered Storage

There are four transit sheds of masonry and steel construction available at North Dock, each with a checker office inside. The first transit shed, Building 500 is adjacent to Berth C and has 44,677 square feet of floor space. Along Berth D is Building 502 which has 48,060 square feet of storage.

Beside Berth F is Building 503 which has 58,881 square feet of storage. The fourth transit shed, Building 507 has 58,852 square feet of storage, and is adjacent to Berth G. In addition, the transit sheds at Berth F and G also have security lockers of 3,796 and 2,704 square feet, respectively. See the following tables for a summary of staging at North Dock, and Honmoku Pier - Jetties A and D.

Transit Shed, Building 503

STAGING AREAS - NORTH DOCK

Terminal	Open Staging (Acres)	Covered Storage (square feet)	Security Lockers (square feet)
North Dock	40	210,470	6,500

STAGING AREAS - HONMOKU JETTY A

Honmoku Pier Jetty "A"	Open Staging (Acres)	Covered Storage (square feet)	Container Freight Station (square feet)
A1-3 (Public Tml)	0	~ 150,000	0
A5-6 (Sea-Land)	54	No Transit Sheds	64,538
A7-8 (K-Line)	40	No Transit Sheds	73,903

* Staging in the commercial port would have to be negotiated with the terminal operator.

STAGING AREAS - HONMOKU JETTY D

Honmoku Pier Jetty "D"	Open Staging (Acres)	Covered Storage (square feet)	Container Freight Station (square feet)
D1-3 (Public Tml)	86	No Transit Sheds	60,782
D-4 (APL)	26	No Transit Sheds	57,359
D-5 (MOL)	26	No Transit Sheds	35,348

* Staging in the commercial port would have to be negotiated with the terminal operator.

RAMPS AND DOCKS

North Dock has a permanent concrete truck loading dock, which can accommodate up to four trucks. The terminal has no portable truck end ramps. The terminal also has a truck holding area, 243,000 square feet, which can accommodate about 736 military vehicles. Deploying units can use leased equipment, or the terminals' ramps, mobile crane, and forklifts to offload trucks, flatbeds and MILVANs.

Honmoku Pier - Jetty A has no truck loading positions at Berths A1-3, or A5, there is one truck loading position at Berth A6, one position at Berth A7, and one position at Berth A8.

Honmoku Pier - Jetty D has two truck loading positions at Berths D1-3, one loading position at Berth D-4, and one truck loading position at Berth D-5.

MARSHALING AREAS

The terminals at both North Dock and Honmoku Pier have no off-site marshaling which could provide over flow areas capable of supporting large military deployments.

MATERIALS HANDLING EQUIPMENT (MHE)

NORTH DOCK - MHE

TYPE OF EQUIPMENT	QUANTITY	CAPACITY
Mobile Crane (wheeled)	1	80 STON
Top-Picker Container Handlers	Contractor Available	40 STON
Mobile Cranes	Contractor Available	20-150 STON
Floating Barge Cranes	Contractor Available	100-150 STON
Chassis (40-ft) & Tractors	8-13 Contractor	35 STON
Forklifts	Contractor Available	4-15 STON
Forklifts (diesel)	2	7.5 STON
Forklifts (clean-burning diesel)	6	3 STON
Forklifts (clean-burning diesel)	3	2 STON
Forklifts (electric) Located at Hiro	3	2 STON
Tow Tractors	2	2 STON

HONMOKU PIER - MHE

TYPE OF EQUIPMENT	QUANTITY	CAPACITY
Container Cranes (at Jetty A)	8	40 STON
Container Cranes (at Jetty D)	9	40 STON
Transtainer (at Sea-Land)	10	40.5 STON
Transtainer (at APL)	5	40.5 STON
Straddle Carrier (at APL)	16	40.5 STON
Top-Pick Container Handlers (at SL)	2	40 STON
Side Pick Container Handlers (at APL)	4	20 STON
Side Pick Container Handlers (at APL)	1	18 STON
Yard Chassis (45-FT) (at Sea-Land)	22	35 STON
Yard Chassis (40-FT) (at Sea-Land)	284	35 STON
Yard Chassis (20-FT) (at Sea-Land)	63	35 STON
Yard Chassis (40-FT) (at APL)	100-200 (leased)	35 STON
Yard Tractors (at Sea-Land)	4	35 STON
Yard Tractors (at APL)	16	35 STON
Forklifts (At Sea-land)	8	2.5-6 STON
Forklifts (at APL)	8	2.5-6 STON

MAINTENANCE AND REPAIR: Local contractors are fully capable of handling any and all types of maintenance and repair; including contrainer equipment maintenance requirements.

SECURITY: North Dock and Honmoku Pier have terminal and vessel security 24 hours per day. The terminals have a 10-foot high perimeter fence and employ mobile security guards.

TERMINAL LIGHTING: All vessel operation areas, staging areas, transit sheds, and warehouses have adequate lighting for normal and emergency, 24 hour, operations.

EXPLOSIVE and HAZARDOUS CARGO OPERATIONS

Limited hazardous cargo operations are permitted at Yokohama North Dock and Honmoku Pier on a case-by-case basis. However, due to the port's close proximity to a large civilian population center (City of Yokohama) the terminals are prevented from performing explosive ammunition handling operations.

FUTURE DEVELOPMENT

North Dock:

In fiscal year 1996-1999 the Government of Japan plans several facility improvement projects (FIP) to support the proposed development of the North Dock facility, which reflects the long range mission, functions, and facility requirements of the installation. Project priority is given to improvement of the pier operations and utility upgrade, and the location of similar activities in one area (i.e. sub-facility engineer, administration, morale, and welfare, etc.) These projects are to be designed and funded by the Government of Japan.

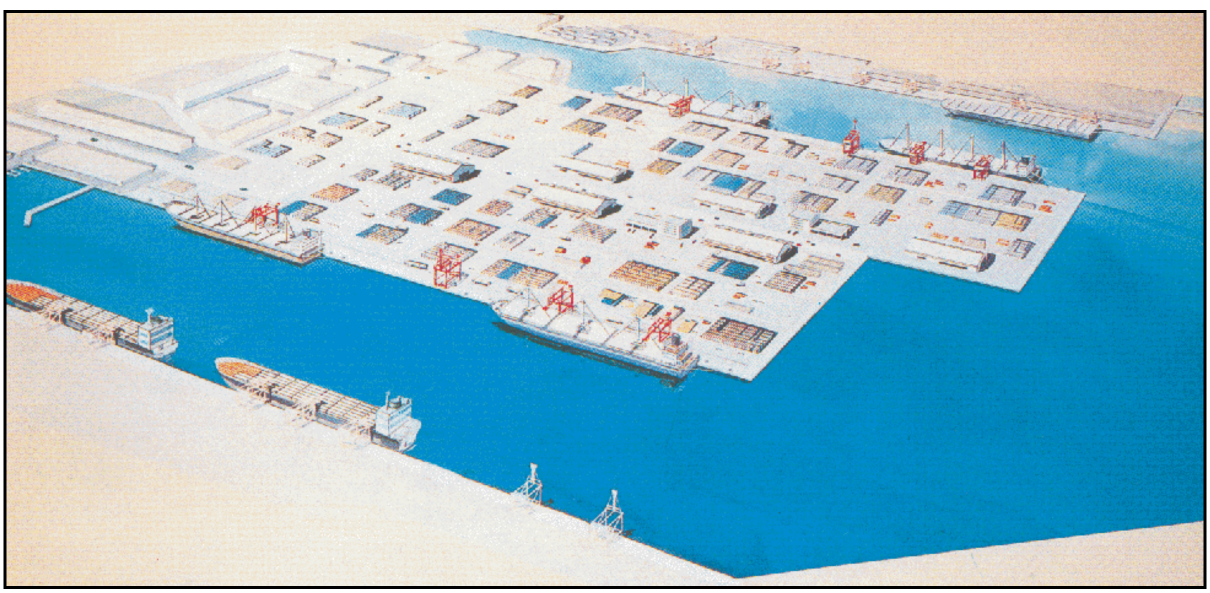
(1) The Kanagawa Milk Plant, operated by the 17th Area Support Group, will be relocated to north Dock. The GOJ will build a turn-key facility (i.e., structure and all dairy processing machinery) on U.S. government controlled land to replace the plant now located in Yokohama City.

(2) The Yokohama Cold Storage Facility and the Shinko Warehouse, formerly located at Center Pier in Yokohama City, have been returned to Japanese control; the replacement construction to be funded by the City. The Yokohama municipal government commenced construction of replacement facilities on the North Dock installation in 1995, with an estimated completion date of August 1997. The new facilities are being built on reclaimed land. When completed the structures will be used by the U.S. Navy.

(3) A tennis court and warehouse, building 720, will be relocated within North Dock, at Yokohama City expense, as part of a road construction project. U.S. Forces Japan approved, as an accommodation to the City, the construction of a below-ground road under the existing municipal road located in the northern part of the installation. The project will permit public access to a large reclamation project that the City of Yokohama plans to undertake in the future. Originally, the road was to be elevated and would have truncated the installation and taken up valuable open storage area.

Honmoku Pier:

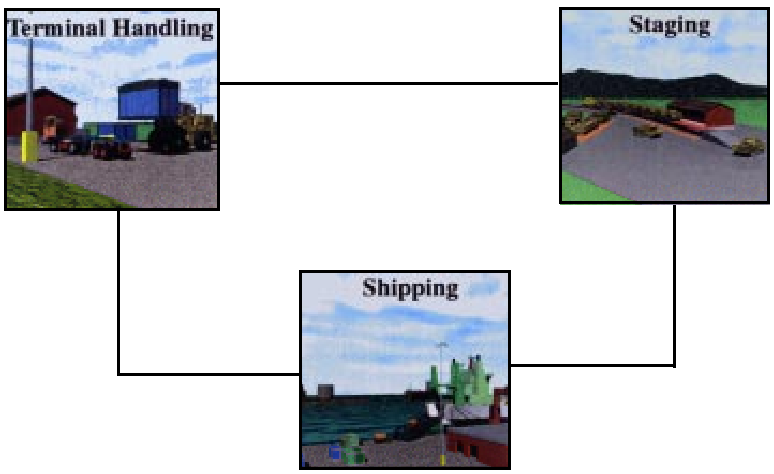
The Port and Harbor Bureau for the City of Yokohama plans to reclaim the water area between Jetties B and C of Honmoku Pier to handle the ever increasing container cargo. Completing this land reclamation project and reorganizing the existing facilities will improve the efficiency of container cargo loading and unloading operation. The container berths on Jetty D will also be improved by dredging to accommodate larger container ships.



II. THROUGHPUT ANALYSIS

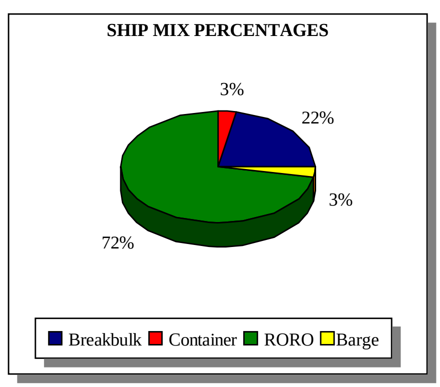
GENERAL

Based on the Port Operational Performance Simulator (POPS) computer model, we evaluated the throughput capacity of North Dock and Honmoku Pier. The POPS model uses a weak-link analysis to determine the least capable of the three primary transportation subsystems, ship loading or unloading, staging, and terminal processing and handling. The least capable subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for each subsystem in terms of short tons (STON) and measurement tons (MTON) per day. The charts in this section show the throughput yields in STONs. Approximate MTON yields can be computed by multiplying the STON amount by 2.5 for breakbulk and container cargo, and multiplying by 4 for RORO cargo.



Terminal Throughput Sub-systems

Throughput computations are based on the assumption that 100 percent of the facilities analyzed will support military operations. Similarly, we assume a vessel on berth at the selected berths 75 percent of the time. In developing the throughput scenario, we used statistical data developed from analysis of deployments that occurred during Operation Desert Shield and Desert Storm. This data helped us develop a mix of vessels most likely to support military deployment operations. We further weighted the mix percentages to adjust for differences in cargo and expectations for future deployments.



TERMINAL CLEARANCE AND HANDLING

North Dock

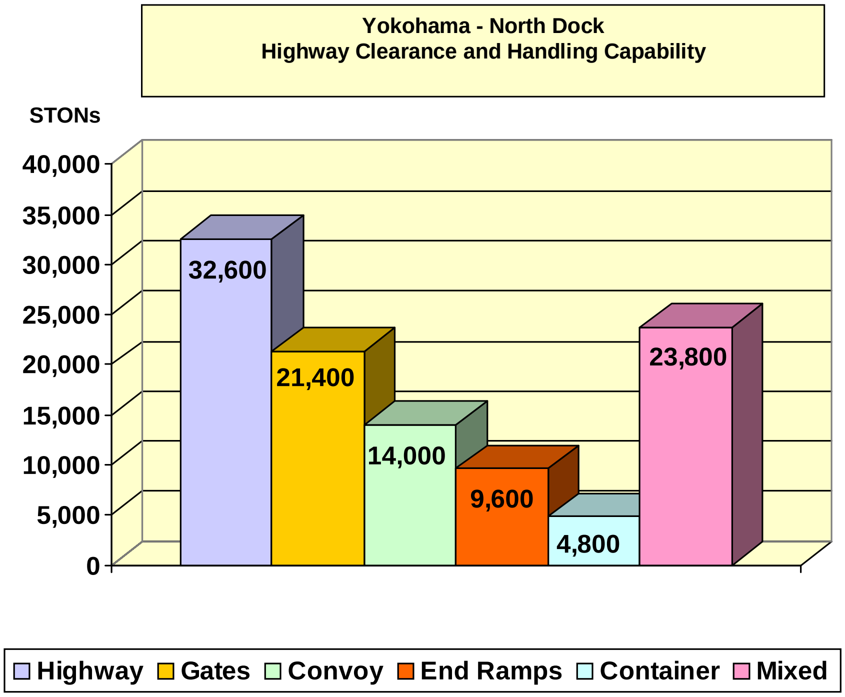
Highway

The road network into and out of the North Dock port complex can handle at least 32,600 STON of vehicles, equipment, and supplies per day. The gate processing system can handle more than 21,400 STON of cargo per day.

Terminal Clearance

Roadable vehicles will move through the terminal gates in managable convoys (14,000 STON per day) from staging areas designed for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a means of unloading, must use one of the loading positions at the platform truck dock. Deploying units can also build or acquire two portable ramps for flatbed truck and semitrailer offloading operations. End ramp capability will handle at least 9,600 STON of military vehicles and equipment per day.

For handling loaded containers the terminal has access to one (1) top-pick container handler, and one (1) mobile crane. If we assume that these are available for use during container transfer operations, the terminal can handle about 4,800 STON of container per days (about 600 TEUs). This assumes a conservative 15 lifts per hour or 300 moves per handler per day.



Maximum daily capability for the terminal is a total of 23,800 STON based on various types of cargo handling, each up to its maximum.

Honmoku Pier - Jetty A

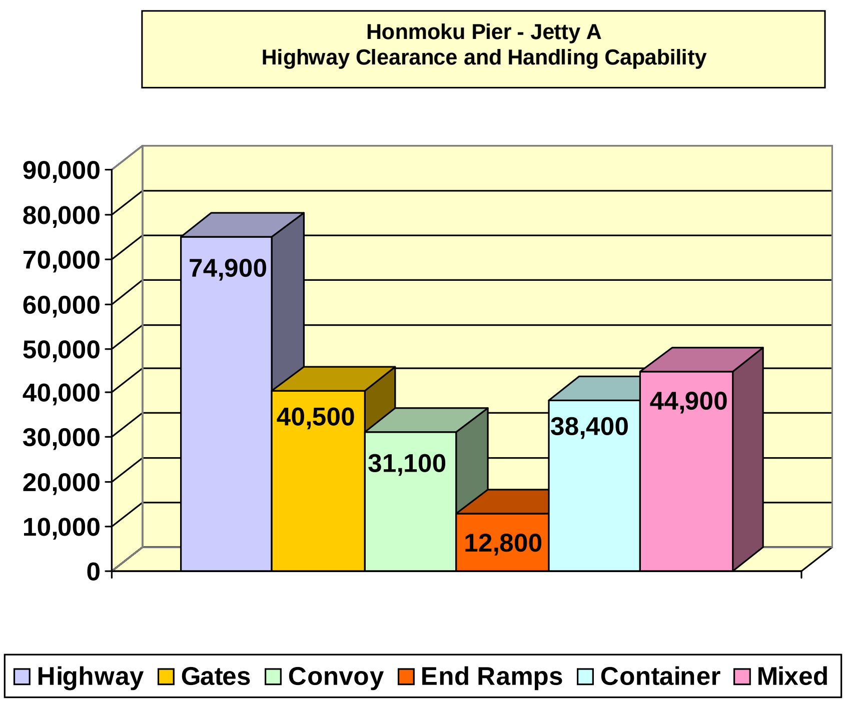
Highway

The road network into and out of the Honmoku Pier - Jetty A port complex can handle at least 74,900 STON of vehicles, equipment, and supplies per day. The gate processing system can handle more than 40,500 STON of cargo per day.

Terminal Clearance

Roadable vehicles will move through the terminal gates in managable convoys (31,100 STON per day) from staging areas designed for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a means of unloading, must use one of the loading positions at the container freight station (CFS). Deploying units can also build or acquire two portable ramps for flatbed truck and semitrailer offloading operations. End ramp capability at the CFS will handle at least 12,800 STON of military vehicles and equipment per day.

For handling loaded containers the terminal has access to at least 16 top-pick container handlers. If we assume that these are available for use during container transfer operations, the terminal can handle about 38,400 STON of container per days (about 4,800 TEUs). This assumes a conservative 15 lifts per hour or 300 moves per handler per day.



Maximum daily capability for the terminal is a total of 44,900 STON based on various types of cargo handling, each up to its maximum.

Homoku Pier - Jetty D

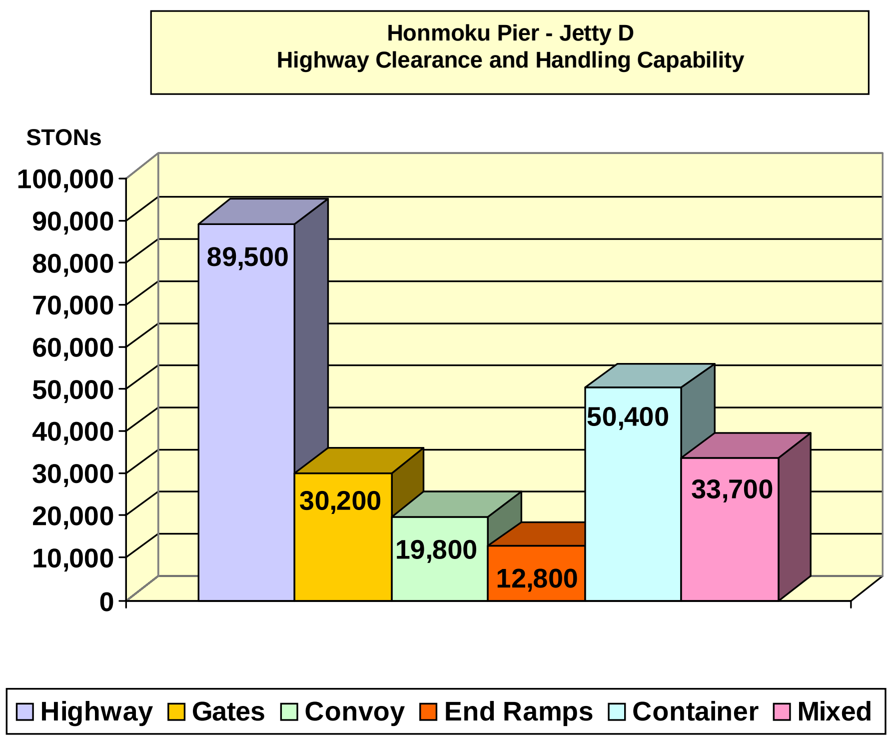
Highway

The road network into and out of the Honmoku Pier - Jetty D port complex can handle at least 89,500 STON of vehicles, equipment, and supplies per day. The gate processing system can handle more than 30,200 STON of cargo per day.

Terminal Clearance

Roadable vehicles will move through the terminal gates in managable convoys (19,800 STON per day) from staging areas designed for these moves. Vehicles on commercial or military flatbed trailers, not equipped with a means of unloading, must use one of the loading positions at the container freight station (CFS). Deploying units can also build or acquire two portable ramps for flatbed truck and semitrailer offloading operations. End ramp capability at the CFS will handle at least 12,800 STON of military vehicles and equipment per day.

For handling loaded containers the terminal has access to at least 21 top-pick container handlers. If we assume that these are available for use during container transfer operations, the terminal can handle about 50, 400 STON of container per days (about 6,300 TEUs). This assumes a conservative 15 lifts per hour or 300 moves per handler per day.



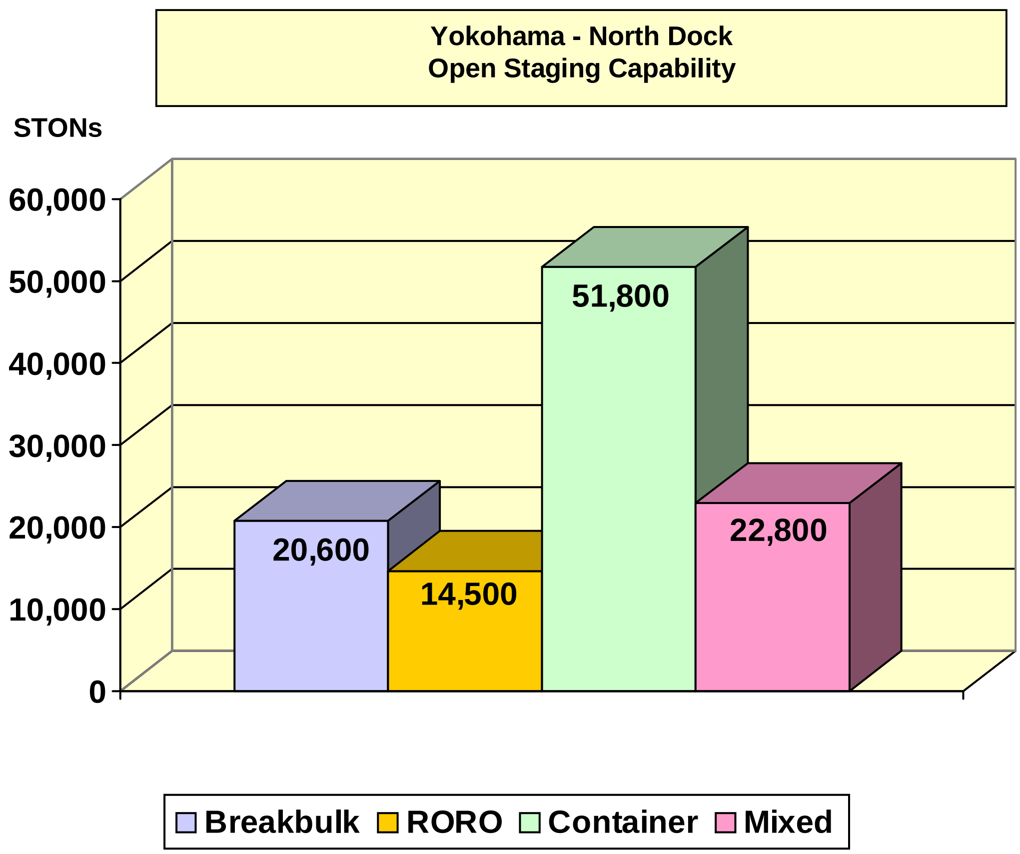
maximum daily capability for the terminal is a total of 33,700 STON based on various types of cargo handling, each up to its maximum.

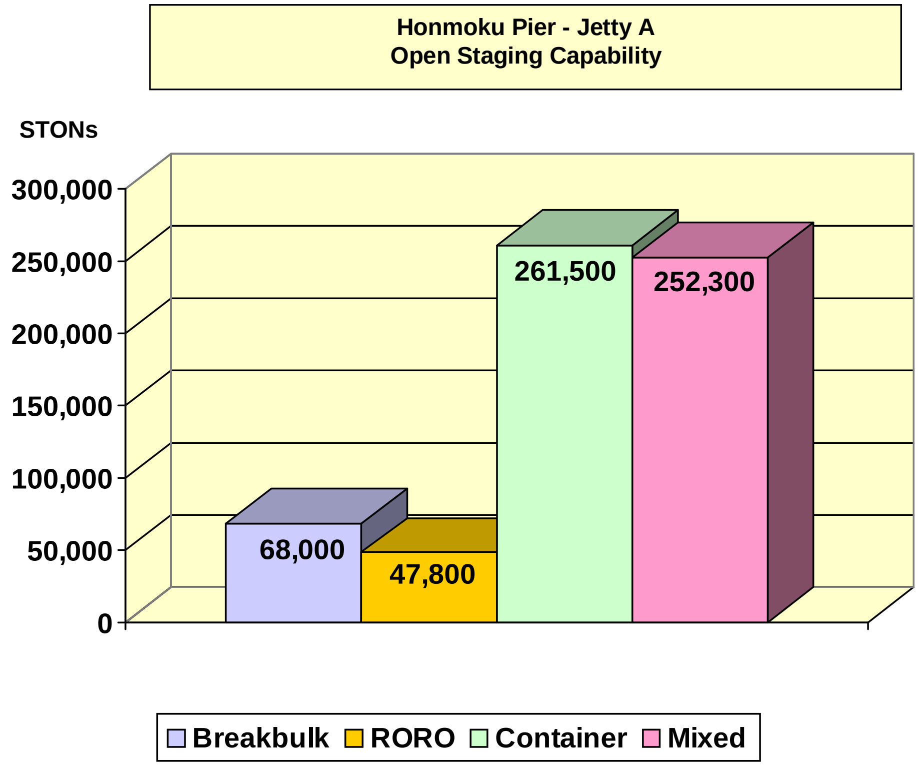
OPEN STAGING

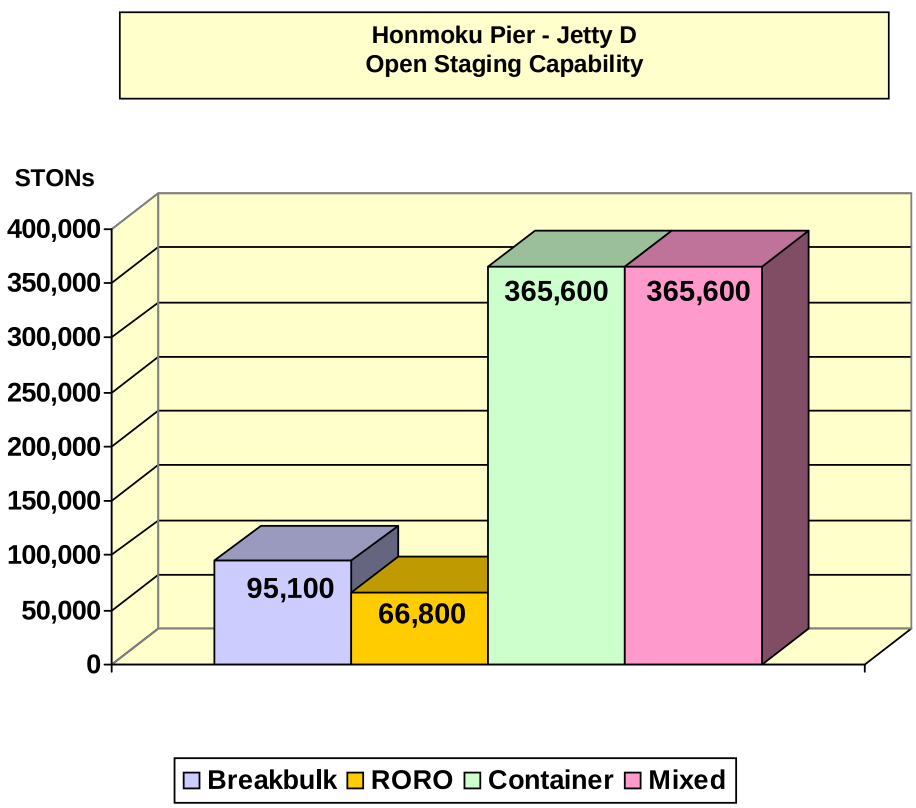
North Dock has over 40 acres of open staging that could support military deployment operations. The terminal also has four transit sheds, 210,470 square feet of covered storage. Deploying units would have to coordinate with the terminal operator to use these facilities.

The port has the ability to perform operations on RORO, container, and breakbulk vessels. The cargo mix depends on the anticipated vessel type.

The following three charts show the cargo open staging capability for each cargo/vessel type, which far exceeds the ports shiploading capability. This analysis assumes a usable space availability of 70 percent of the total area. If a combination ship is expected then a portion of each involved capability should be assumed.



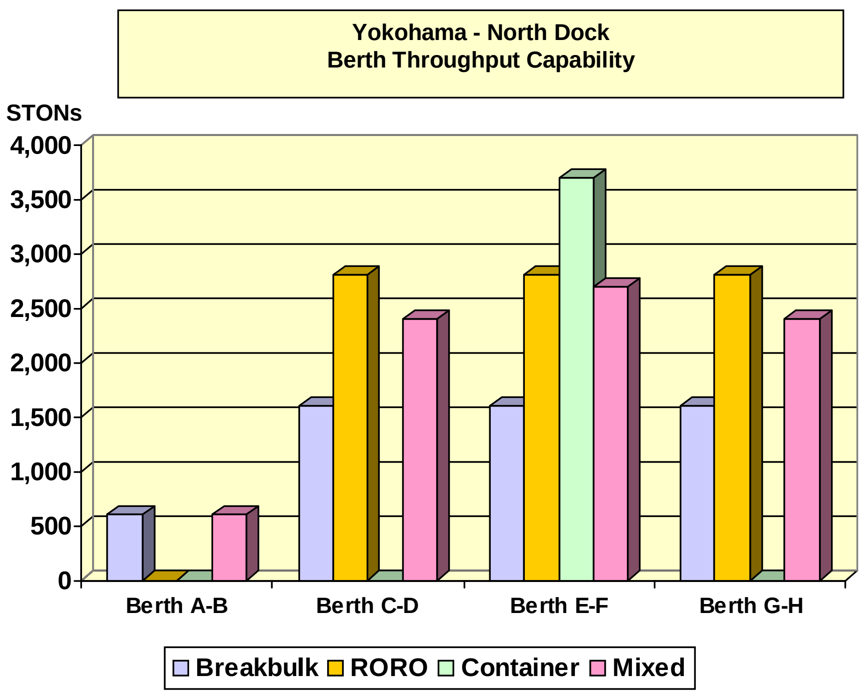

Honmoku Pier - Jetty A
Open Staging Capability
STONs
300,000
250,000
200,000
150,000
100,000
50,000
0
68,000
47,800
261,500
252,300
Breakbulk
RORO
Container
Mixed


Honmoku Pier - Jetty D
Open Staging Capability
STONs
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
95,100
66,800
365,600
365,600
Breakbulk
RORO
Container
Mixed

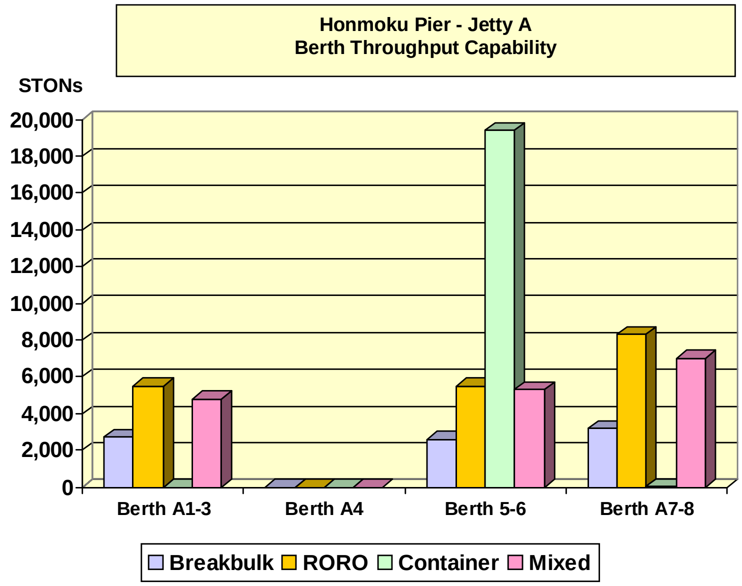
SHIPPING

Daily shipping subsystem totals for terminal throughputs at each berth are shown below. They are based on various factors, including: MHE used, type of loading, operational procedures, berth usage rates, and berthing capabilities for various vessel types. Assumptions and parameter values used in this study are shown in the appendix.

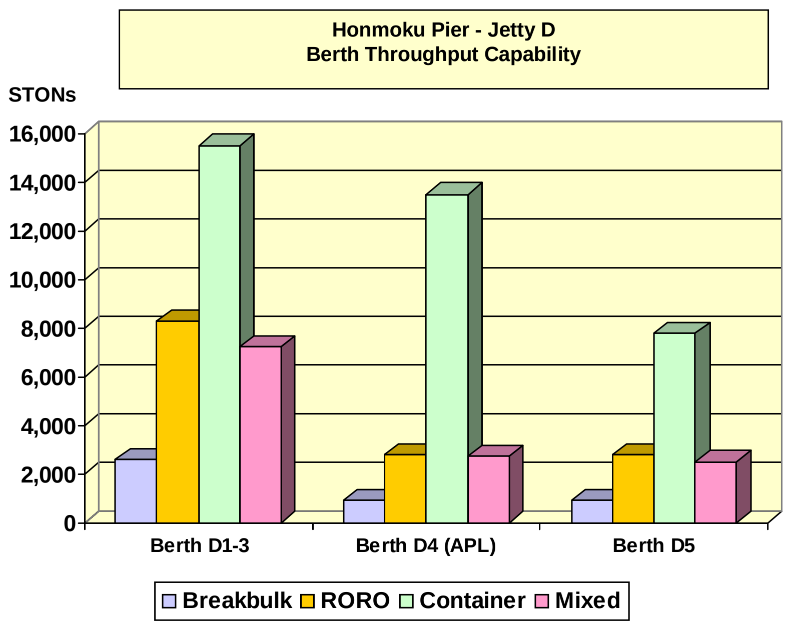
CONVERSION FACTORS	
Breakbulk	0.4 STON per MTON
RORO	0.25 STON per MTON
Containers	0.4 STON per MTON



	Berth A-B	Berth C-D	Berth E-F	Berth G-H
Breakbulk	600	1,600	1,600	1,600
RORO	0	2,800	2,800	2,800
Container	0	0	3.700	0
Mixed	600	2,400	2,700	2,400



	Berth A1-3	Berth A4	Berth A5-6	Berth A7-8
Breakbulk	2,700	0	2,600	2,200
RORO	5,500	0	5,500	8,300
Container	0	0	19,400	11,700
Mixed	4,800	0	5,300	7,000

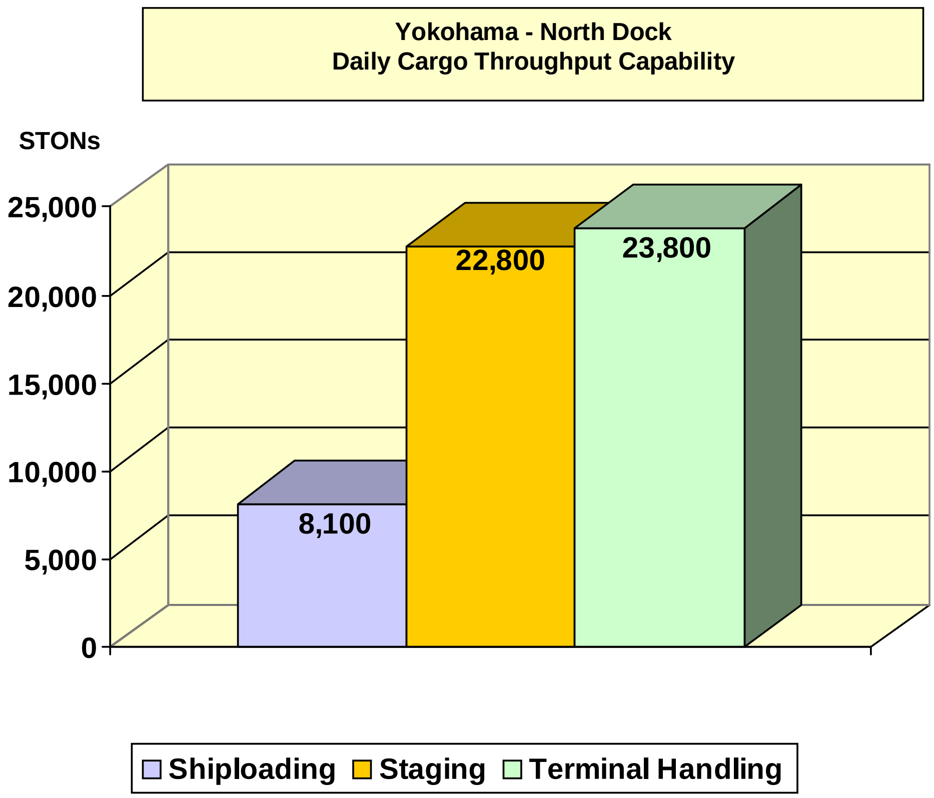


	Berth D1-3	Berth D4 (APL)	Berth D5
Breakbulk	2,600	900	900
RORO	8,300	2,800	2,800
Container	15,500	13,500	7,800
Mixed	7,200	2,700	2,500

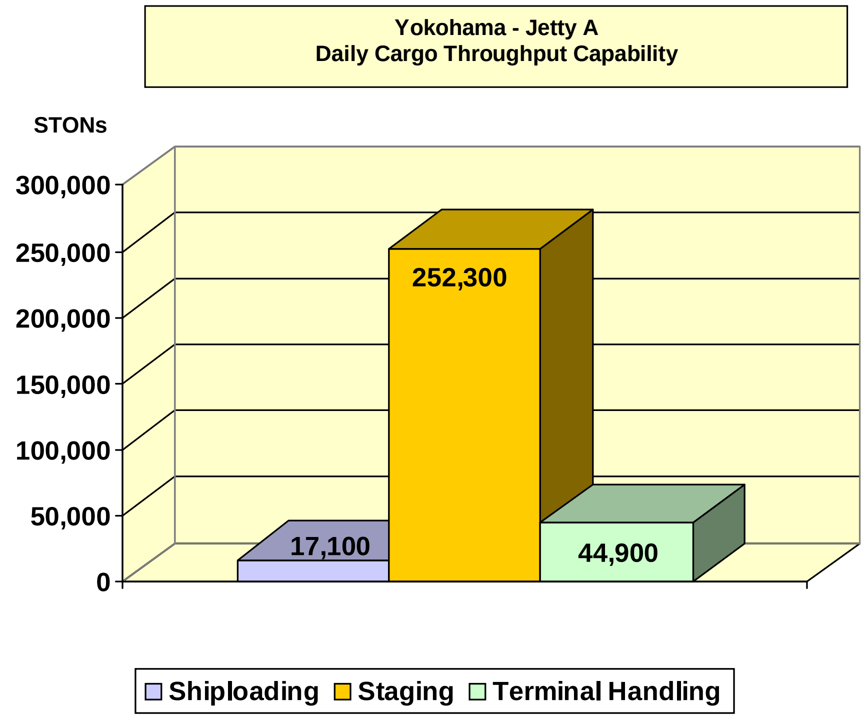
III. CONCLUSIONS

Yokohama - North Dock is capable of supporting US Military cargo transhipment operations. Berths E-F and G-H are the preferred berths for military operations, and could accommodate vessels as large as the Large Medium Speed Roll-On Roll-Off (LMSR) and Fast Sealift Ship (FSS) as shown in the Berthing Characteristics Table. However, the 32-foot draft along side these two berths would severely limit the amount of cargo the vessels could take onboard. The LMSR and FSS have a maximum draft of about 35 and 37 feet, respectively.

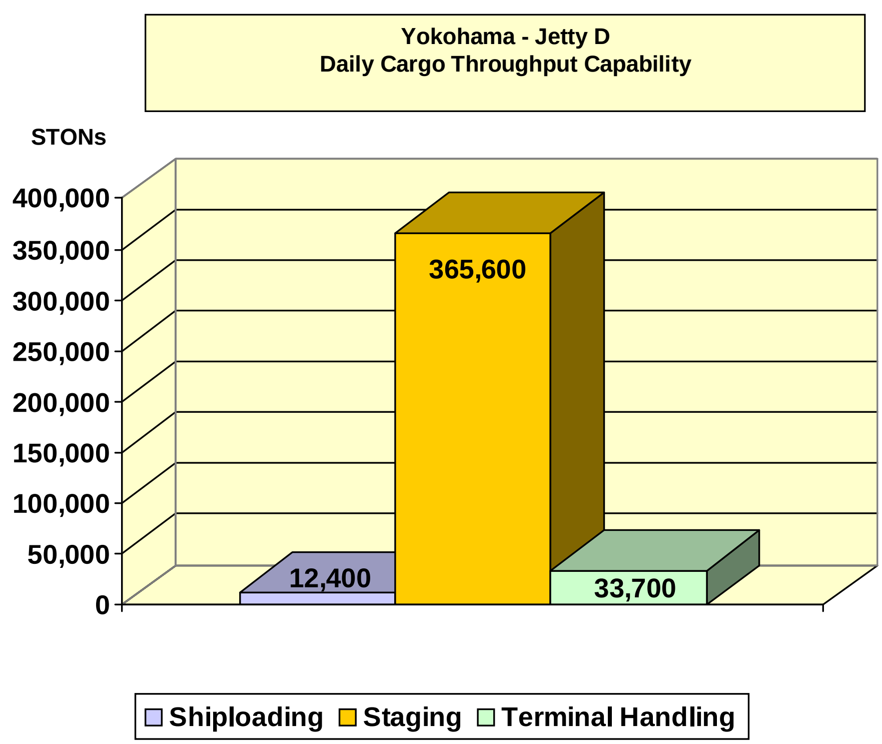
North Dock is more suited toward handling medium sized breakbulk and combination vessels with a draft of less than 32 feet. Across the harbor, Honmoku Pier (Sea-Land and American President Lines) offer more flexible accomodations for vessels of all cargo types, especially large deep draft container vessels. Berths at Sea-Land and American President Lines have depths alongside of 39 and 42 feet, respectively.



Of the transportation subsystems analyzed, and based on the most likely ship mix, the least capable is the ship loading subsystem about 8,100 STON per day. Other operations taking place concurrently in the terminal will limit actual daily throughput, sustainable over time, by an appropriate percentage of the terminal's overall capability.



Of the transportation subsystems analyzed, and based on the most likely ship mix, the least capable is the ship loading subsystem, about 17,100 STON per day at Jetty A, and about 12,400 STON per day at Jetty D.



YOKOHAMA - NORTH DOCK
THROUGHPUT SUMMARY
DAILY CAPABILITY

	BERTH A-B	BERTH C-D	BERTH E-F	BERTH G-H
LENGTH (feet)	1,000	1,100	1,100	940
DEPTH ALONGSIDE (feet)	24	24	32	32
BREAKBULK THROUGHPUT (STON)	600	1,600	1,600	1,600
RORO THROUGHPUT (STON)	0	2,800	2,800	2,800
RORO SQUARE FT (EST)	0	56,000	56,000	56,000
RORO PIECES [1]	0	330	330	330
CONTAINER THROUGHPUT (STON)	0	0	3,700	0
CONTAINER THROUGHPUT (TEU)	0	0	460	0
MIXED THROUGHPUT (STON)	600	2,400	2,700	2,400

[1] Based on the 170 square foot per piece average accomplished during Operation Desert Shield and Desert Storm; and using an average vehicle weight of 8.5 STON.

HONMOKU PIER - JETTY A
THROUGHPUT SUMMARY
DAILY CAPABILITY

	BERTH A1-3 Public Terminal	BERTH A4 Sea-Land	BERTH A5-6 Sea-Land	BERTH A7-8 K-Lines
LENGTH (feet)	1,968	1,148	1,968	1,640
DEPTH ALONGSIDE (feet)	33	26	39	39
BREAKBULK THROUGHPUT (STON)	2,700	0	2,600	2,200
RORO THROUGHPUT (STON)	5,500	0	5,500	8.300
RORO SQUARE FT (EST)	110,000	0	110,000	166,000
RORO PIECES [1]	647	0	647	976
CONTAINER THROUGHPUT (STON)	0	0	19,400	11.700
CONTAINER THROUGHPUT (TEU)	0	0	2,425	1,460
MIXED THROUGHPUT (STON)	4,800	0	5,300	7,000

[1] Based on the 170 square foot per piece average accomplished during Operation Desert Shield and Desert Storm; and using an average vehicle weight of 8.5 STON.

HONMOKU PIER - JETTY D
THROUGHPUT SUMMARY
DAILY CAPABILITY

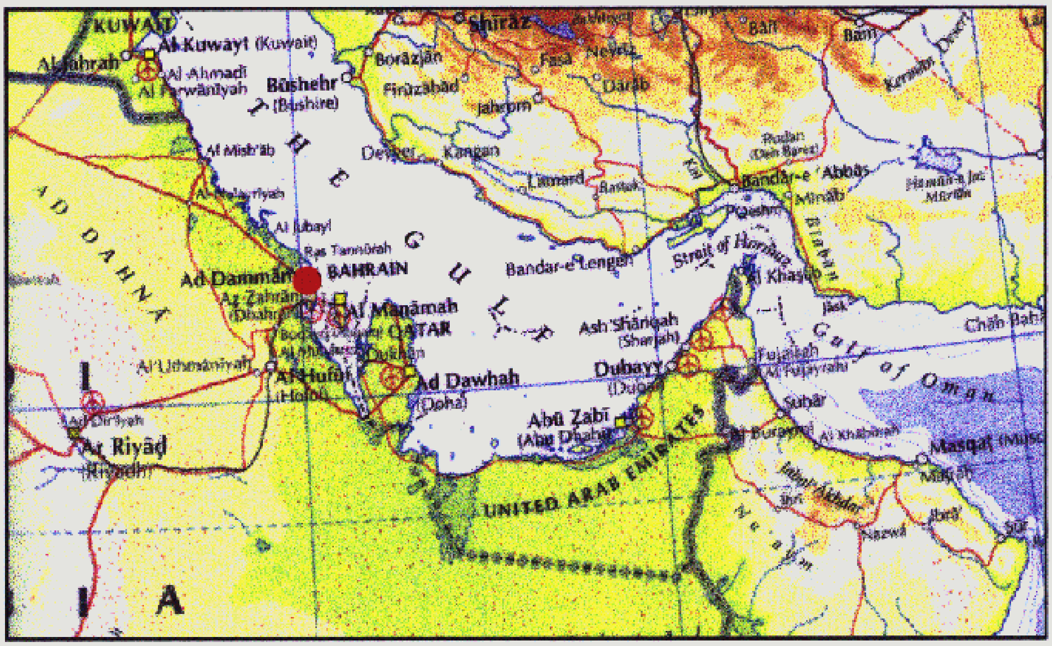
	BERTH D1-3 Public Terminal	BERTH D4 APL Terminal	BERTH D5 MOL Terminal
LENGTH (feet)	2,033	984	984
DEPTH ALONGSIDE (feet)	36	42	42
BREAKBULK THROUGHPUT (STON)	2,600	900	900
RORO THROUGHPUT (STON)	8,300	2,800	2,800
RORO SQUARE FT (EST)	166,000	56,000	56,000
RORO PIECES [1]	976	330	330
CONTAINER THROUGHPUT (STON)	15,500	13,500	7,800
CONTAINER THROUGHPUT (TEU)	1,938	1,688	975
MIXED THROUGHPUT (STON)	7,200	2,700	2,500

[1] Based on the 170 square foot per piece average accomplished during Operation Desert Shield and Desert Storm; and using an average vehicle weight of 8.5 STON.

MTMCTEA CRISIS ACTION PORT STUDY

MILITARY TRAFFIC MANAGEMENT COMMAND

MILITARY TRAFFIC MANAGEMENT COMMAND
T E A
TRANSPORTATION ENGINEERING AGENCY



BAHRAIN

A THROUGHPUT ANALYSIS
of the
PORT OF MINA SULMAN, BAHRAIN

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This crisis action port study covers the port of Mina Sulman, Bahrain (26.12N 50.37E). It was performed to support the 1311th Medium Port Command (MPC) in any port operation that may occur at Mina Sulman. Sources of information for this effort are ***Guide to Port Entry 1993/94*** and ***Fairplay World Ports Directory 1995.*** These sources are unclassified and the information used in this study is incorporated in the appendix.

In general, the port is capable of breakbulk, RORO, container, and barge types of shipping operations. The channel depth is 32 feet at mean low water (MLW), therefore, ships with a 30-foot water draft can navigate the channel (includes a 2-foot clearance). The tidal variation is listed at about 8 feet.

Mina Sulman does not have rail access.

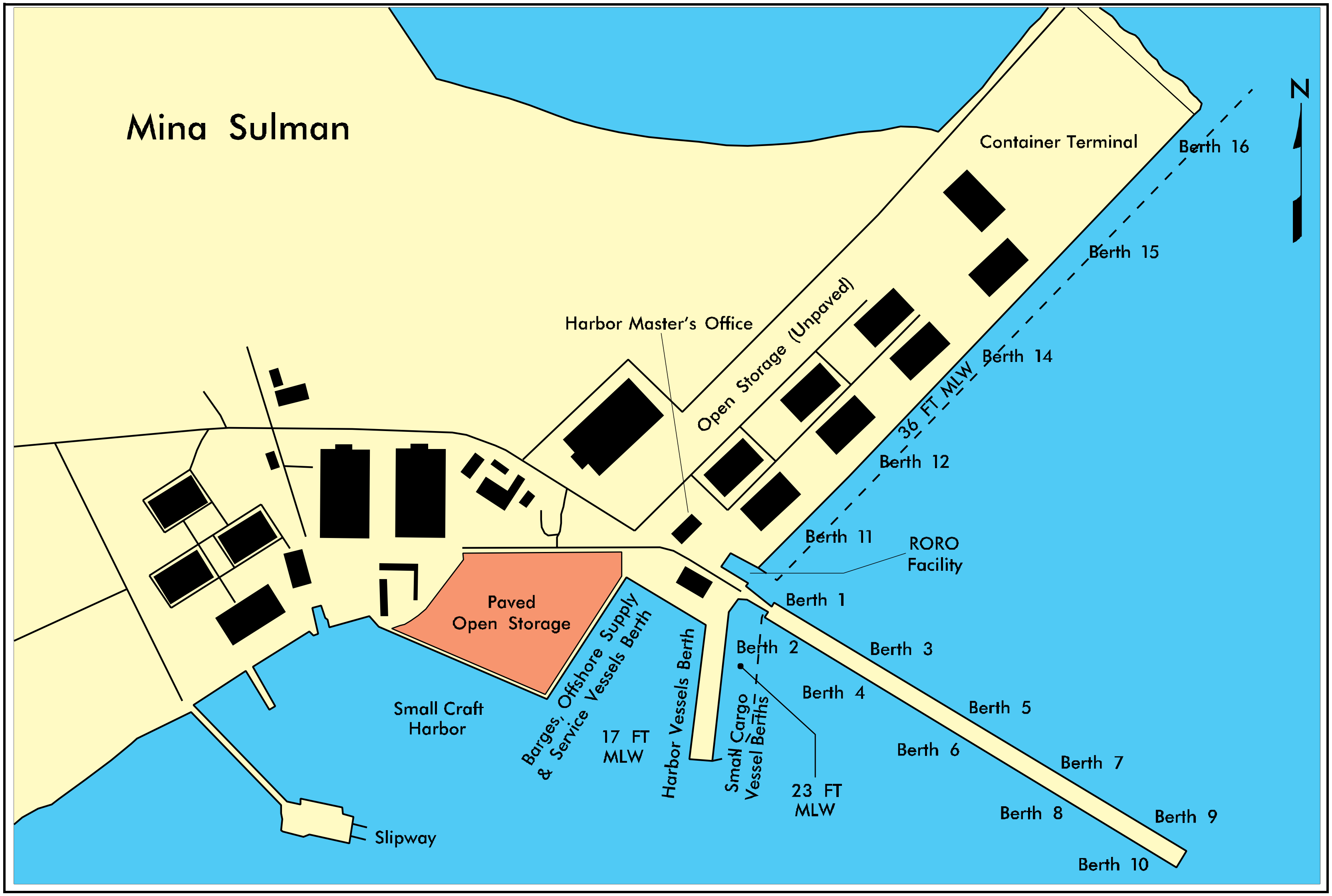
The port consists of a finger pier over 2,600 feet in length with ship berths on both sides and a quay used for general cargo and containers. Covered storage facilities consist of 14 sheds totalling 1,000,000 square feet. Mobile cranes up to 200 tons are available.

The container berths are located at berths 15 and 16. These berths have a total of four container gantry cranes.

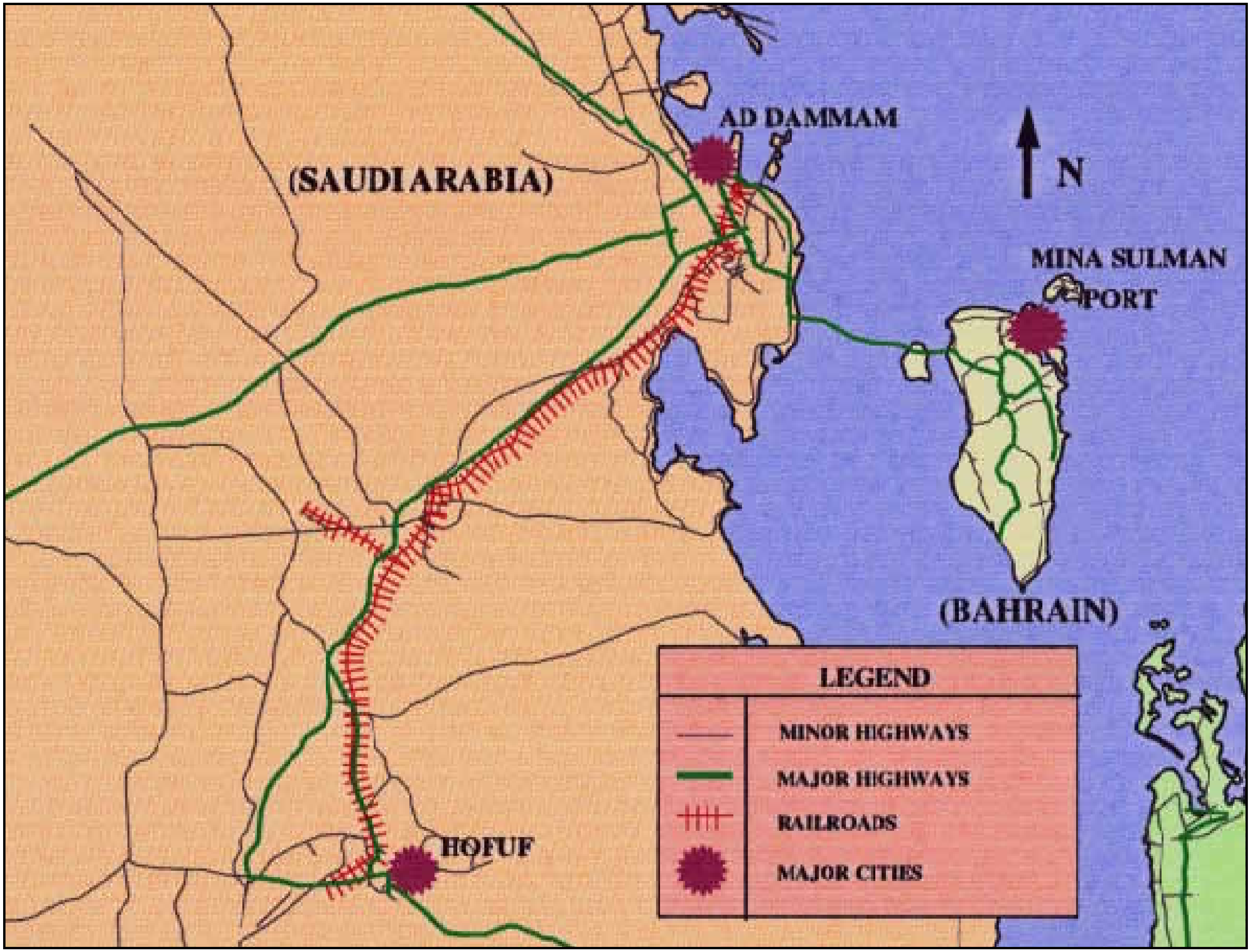
A RORO berth with an 18-foot draft is available for small landing craft.

Vessel types used in this analysis include standard vessels provided by the Military Sealift Command (MSC) to support deployment of US Forces. In performing the throughput analysis for this port, we used the following ship mix to provide the mixed throughput capability: breakbulk, 22 percent; RORO, 72 percent; container, 3 percent; barge, 3 percent. These mixes represent only a starting point, actual final mix was determined by the Port Operational Performance Simulator (POPS) program.

Port throughput is about 10,400 STON (26,100 MTON) for breakbulk operations; 25,800 STON (103,200 MTON) for RORO operations; 12,200 STON (30,500 MTON) for container operations; 800 STON (1,900 MTON) for barge operations; and 22,300 STON (84,900 MTON) for mixed shipping operations.


Mina Sulman
Container Terminal
Berth 16
Berth 15
Berth 14
36 FT MLW
Berth 12
Berth 11
RORO Facility
Harbor Master's Office
Open Storage (Unpaved)
Paved Open Storage
Berth 1
Berth 2
Berth 3
Berth 4
Berth 5
Berth 6
Berth 7
Berth 8
Berth 9
Berth 10
Barges, Offshore Supply & Service Vessels Berth
Harbor Vessels Berth
Small Cargo Vessel Berths
17 FT MLW
23 FT MLW
Small Craft Harbor
Slipway
N

Land-Use Map



Highway and Rail Access Map

THROUGHPUT SUMMARY for PORT of MINA SULMAN PER DAY

PORT/BERTH	LENGTH (feet) (meters)	DEPTH ALONGSIDE (feet) (meters)	BREAKBULK THROUGHPUT (STON) (MTON)	RORO THROUGHPUT (STON) (MTON)	RORO SQUARE FT (EST)	RORO PIECES[a]	CONTAINER THROUGHPUT (STON) (MTON)	CONTAINER THROUGHPUT (TEU)	BARGE THROUGHPUT (STON) (MTON)	MIXED THROUGHPUT (STON) (MTON)
Berths 1-9 Odd	2,460 (750)	29 (9)	2,800 (7,000)	7,700 (31,000)	154,000	906	0	0	800 (1,900)	6,400 (24,600)
Berths 2-10 Even	2,460 (750)	29 (9)	2,800 (7,000)	7,700 (31,000)	154,000	906	0	0	0	6,600 (25,300)
Berths 11-14	1,968 (600)	35 (10.9)	2,400 (6,100)	5,200 (20,600)	104,000	612	0	0	0	4,500 (17,200)
Berths 15-16	1,968 (600)	35 (10.9)	2,400 (6,100)	5,200 (20,600)	104,000	612	12,200 (30,500)	1,524	0	4,800 (17,600)

a. Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

BERTH CHARACTERISTICS FOR PORT OF MINA SULMAN, BAHRAIN

	PORT/BERTH			
Characteristics	**Berths 1-9 Odd**	**Berths 2-10 Even**	**Berths 11-14**	**Berths 15-16**
Length (ft)	2,460	2,460	1,968	1,968
Depth alongside at MLW (ft)	29	29	35	35
Deck Strength (psf)	600	600	600	600
Apron width (ft)	54	54	open	open
Apron height above MLW (ft)	10	10	10	10
Number of container cranes	0	0	0	4
Number of wharf cranes	0	0	0	0
Apron lighting	yes	yes	yes	yes
Straight-stern RORO facilities	no	no	no	no
Apron length served by rail (ft)	0	0	0	0

SUMMARY OF BERTHING CAPABILITIES for MINA SULMAN

Vessel	Berths			
	Berths 1-9 Odd	Berths 2-10 Even	Berths 11-14	Berths 15-16
Breakbulk				
C3-S-38a	4	4	3	3
C4-S-58a	4,a	4,a	3	3
C4-S-66a	4,a,g	4,a,g	3,g	3,g
C5-S-37e	3,a	3,a	3	3
Seatrain				
GA and PR-class	4	4	3	3
Barge				
LASH C8-S-81b	2,a,g	2,a,g	2,g	2,g
LASH C9-S-81d	2,a,g	2,a,g	2,a,g	2,a,g
LASH lighter	12	12	9	9
SEABEE C8-S-82a	2,a,g	2,a,g	2,a,g	2,a,g
SEABEE barge	12	12	9	9
RORO				
Comet	4,d,o	4,d,o	3,d,i	3,d,i
Meteor	4,d,o	4,d,o	3,d,i	3,d,i
Cape Gnome	3,a,d,o,g	3,a,d,o,g	3,d,g,i,j	3,d,g,i,j
C7-S-95a/Maine-class	3,a,b,g	3,a,b,g	2,g	2,g
Cape Taylor	3,b	3,b	2	2
Cape Orlando	3,a,b	3,a,b	2,i	2,i
MV Ambassador	4,d	4,d	3,d	3,d
Callaghan	3,d,o	3,d,o	2,d	2,d
Cape Lambert	3,a,b	3,a,b	2,i	2,i
FSS-class	2,a,b,g	2,a,b,g	2,a,g	2,a,g
Cape E-class	3,a,b	3,a,b	2,i,j	2,i,j
Cape D-class	3,a,b,g	3,a,b,g	2,g	2,g
Cape H-class	3,a,b,g	3,a,b,g	2,a,g	2,a,g
Cape Texas	3,b	3,b	2,i	2,i
Container				
C6-M-l47a	3,b,e	3,b,e	2,e	2
C7-S-69c	3,a,b,e	3,a,b,e	2,e	2
C7-S-68c	3,a,b,e	3,a,b,e	2,e	2
C8-S-85c	2,a,b,e,g	2,a,b,e,g	2,e,g	2,g
C9-M-132b	2,a,b,e,g	2,a,b,e,g	2,e,g	2,g
C9-M-F141a	2,a,b,e,g	2,a,b,e,g	2,a,e,g	2,a,g
Combination				
C6-S-1qd	3,a,b,g	3,a,b,g	2,g	2,g
C5-S-MA73c	3,a,b	3,a,b	3	3
C6-S-MA60d	3,a,b	3,a,b	2	2

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

ASSUMPTIONS

ASSUMPTIONS

Parameters Screen 1

Ship Operational Rates:	STON/HR	MTON/HR
Breakbulk Rates		
Ship Crane (15.0,37.5)	15.0	37.5
Dockside Cranes (20.0,50.0)	20.0	50.0
Barge (20.0,50.0)	20.0	50.0
Roro Rates (200,800)	200.0	800.0
Container Lift Rates (21,8)	21.0	8.0

Ship Mix Percentages:	%	Minimum Mobile-Crane Size:	STON
BreakBulk (35.3%)	22.0	Breakbulk (100)	40.0
Barge (10.0%)	3.0	Barge (20)	20.0
Roro (15.6%)	72.0	Container (100)	100.0
Container (39.1%)	3.0		

Berth Utilization Factor (0.9) 0.9

Parameters Screen 2

Ship Cargo Mix:

Breakbulk/Barge	%	Roro	%
Roadable Vehicles (43%)	43.0	Roadable Vehicles (85%)	90.0
Nonroadable Vehicles (7%)	7.0	Nonroadable Vehicles (15%)	10.0
Container (15%)	15.0	Container	
Noncontainer (35%)	35.0	Container (100%)	100.0

Staging Data:

Staging Dwell Time (3 Days)	3.0
Space Utilization Factor:	%
Open (70%)	60.0
Covered (65%)	60.0

Facility User Factor (100%) 80.0

ASSUMPTIONS

Parameters Screen 3

Stacking Height:	ft		ft
Open - General (7.5)	7.5	Open - Vehicle (7.6)	7.6
Covered (10.0)	10.0		

Motor Vehicle Parameters:	STON	MTON
Convoy (3.5,17)	3.5	17.0
Flatbed (20,60)	20.0	60.0
Van (16,40)	16.0	40.0
Chassis (16,40)	16.0	40.0
Railcar Parameters:		
Flatcar (50,150)	50.0	150.0
Boxcar (30,75)	30.0	75.0
COFC (24,60)	24.0	60.0
Container (TEU) Capacity (8,20)	8.0	20.0

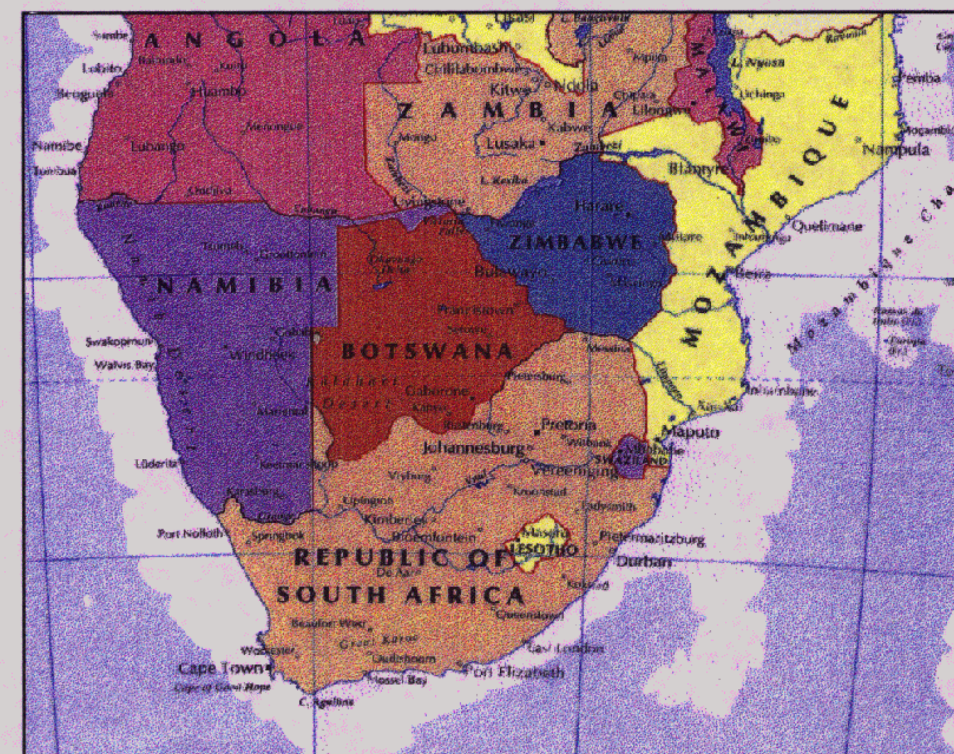
Parameters Screen 4

Truck Handling Rates:	Trucks/Hr
End Ramps (4)	4.0
Van Docks (1)	1.0
Railcar Handling Rates:	**Railcars/Hr**
End Ramps (4)	4.0
Boxcar Docks (0.33)	0.3

Length Of Flatcars(60 Ft) 60.0 Productive Work Hours(20 Hrs) 20.0

Mode Mix:	%	%
Roadable Veh: Convoy/Flatcar (100%,0%)	90.0	10.0
Nonroadable Veh: Hets/Flatcars (0%,100%)	10.0	90.0
Gen Cargo: Van/Box (25%,25%)	35.0	15.0
Flatbed/Flatcar (25%,25%)	35.0	15.0
Container: Chassis/COFC (50%,50%)	75.0	25.0

MTMCTEA CRISIS ACTION PORT STUDY



MILITARY TRAFFIC MANAGEMENT COMMAND

MILITARY TRAFFIC MANAGEMENT COMMAND
T A E
TRANSPORTATION ENGINEERING AGENCY

DURBAN

A THROUGHPUT ANALYSIS

of the

PORT OF DURBAN,

SOUTH AFRICA

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This crisis action port study covers the port of Durban, South Africa (29.53S 31.02E). It was performed to support the 1311th Medium Port Command (MPC) in any port operations that may occur at Durban. Sources of information for this effort are ***Guide to Port Entry 1993/94*** and ***Fairplay World Ports Directory 1995.*** These sources are unclassified and the information used in this study is incorporated in the appendix.

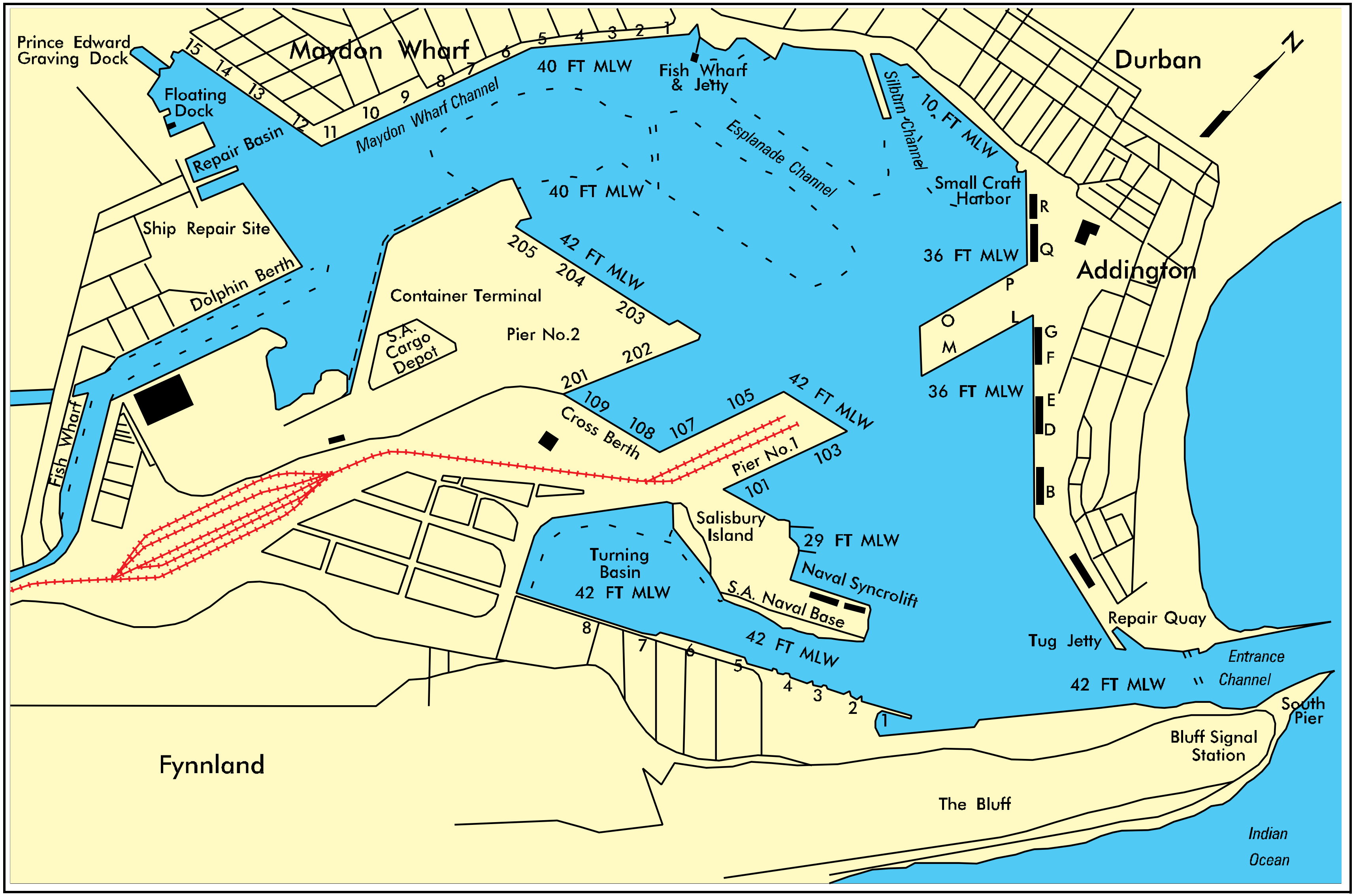
The port is easily capable of breakbulk, RORO, container, and barge types of shipping operations. The channel depth is about 39 feet at mean low water (MLW), therefore, ships with a 37-foot water draft can navigate the channel (includes a 2-foot clearance). This means that an FSS can berth at the Port of Durban at maximum draft. The tidal variation is listed at almost 6 feet.

Information shows that the port has rail access.

The port consists of various piers and quays. In general, ship berths A through R, Pier 1, and the Maydon Wharf are used for handling general cargo and bulk products. Wharves 108 through 205 are mainly used for container operations. Information shows that two floating cranes (one 220-ton and one 66-ton), one 33-ton mobile crane, and eight container cranes are available at this port. Guide to Port Entry indicates that 16 cargo sheds are available providing covered storage for about 895,000 square feet.

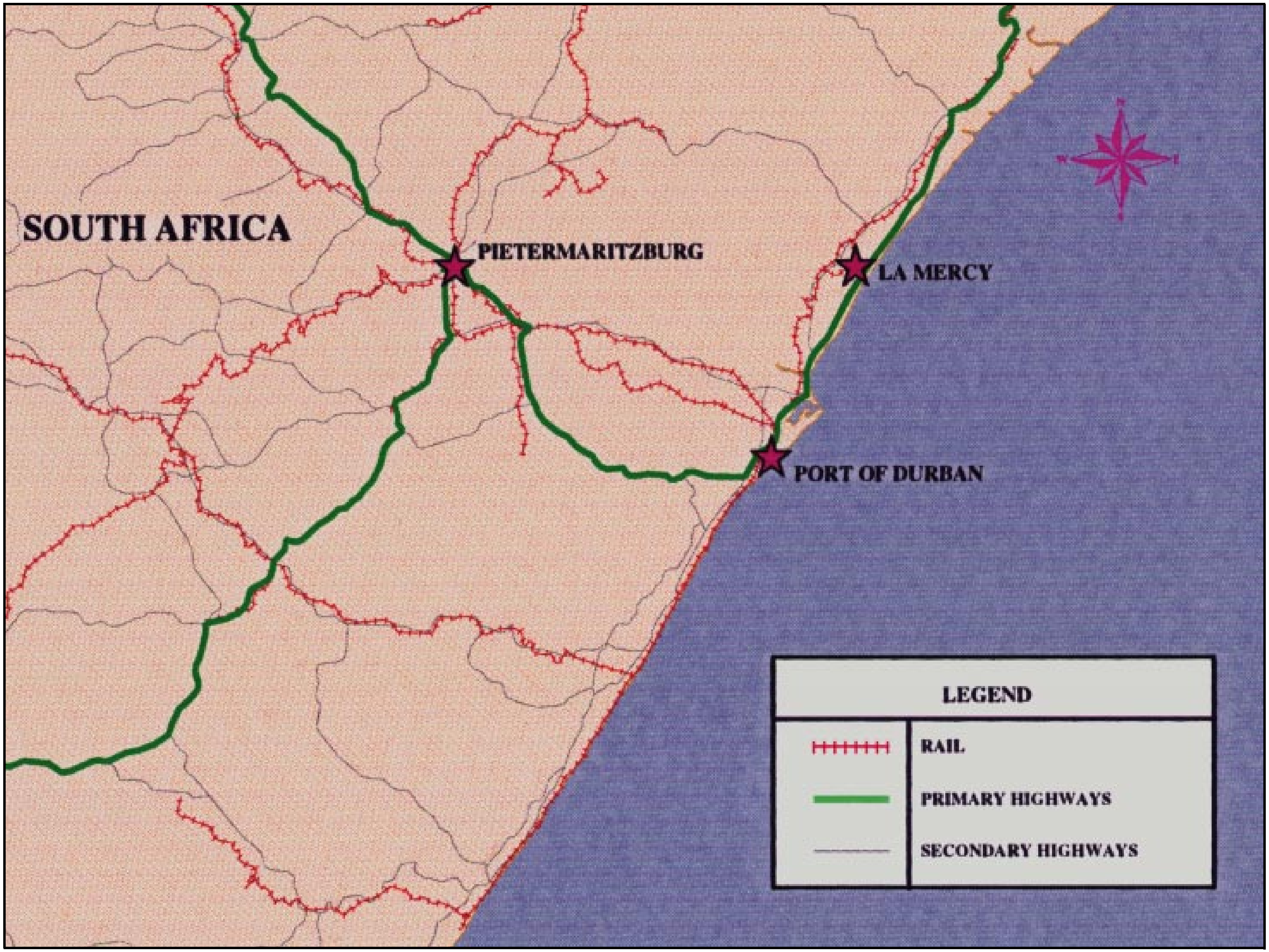
Vessel types used in this analysis include standard vessels provided by the Military Sealift Command (MSC) to support deployment of US Forces. In performing the throughput analysis for this port, we used the following ship mix to provide the mixed throughput capability: breakbulk, 22 percent; RORO, 72 percent; container, 3 percent; barge, 3 percent. These mixes represent only a starting point, actual final mix was determined by the Port Operational Performance Simulator (POPS) program.

Port throughput is about 31,800 STON (79,500 MTON) for breakbulk operations; 87,600 STON (350,300 MTON) for RORO operations; 26,300 STON (65,700 MTON) for container operations; 1,100 STON (2,700 MTON) for barge operations; and 74,500 STON (285,800 MTON) for mixed shipping operations.



Prince Edward Graving Dock
Floating Dock
Repair Basin
Maydon Wharf
Maydon Wharf Channel
40 FT MLW
Fish Wharf & Jetty
Esplanade Channel
Silburn Channel
10 FT MLW
Durban
N
Small Craft Harbor
Ship Repair Site
Dolphin Berth
Container Terminal
40 FT MLW
42 FT MLW
36 FT MLW
Addington
S.A. Cargo Depot
Pier No.2
36 FT MLW
Fish Wharf
Cross Berth
42 FT MLW
Pier No.1
Salisbury Island
29 FT MLW
Turning Basin
42 FT MLW
Naval Syncrolift
S.A. Naval Base
42 FT MLW
Repair Quay
Tug Jetty
Entrance Channel
42 FT MLW
South Pier
Bluff Signal Station
Fynnland
The Bluff
Indian Ocean

Land-Use Map



Highway and Rail Access Map

THROUGHPUT SUMMARY for PORT of DURBAN PER DAY

PORT/BERTH	LENGTH (feet) (meters)	DEPTH ALONGSIDE (feet) (meters)	BREAKBULK THROUGHPUT (STON) (MTON)	RORO THROUGHPUT (STON) (MTON)	RORO SQUARE FT (EST)	RORO PIECES[a]	CONTAINER THROUGHPUT (STON) (MTON)	CONTAINER THROUGHPUT (TEU)	BARGE THROUGHPUT (STON) (MTON)	MIXED THROUGHPUT (STON) (MTON)
Berth A	944 (288)	38 (11.6)	800 (2,100)	2,700 (10,600)	53,080	313	0	0	0	2,200 (8,600)
Berth B	1,079 (329)	34 (10.4)	1,400 (3,600)	2,700 (10,600)	53,080	313	0	0	0	2,400 (9,000)
Berth C	698 (213)	29 (8.8)	800 (1,900)	2,700 (10,600)	53,080	313	0	0	800 (2,000)	2,200 (8,400)
Berth L-M	2,000 (610)	36 (11.0)	2,500 (6,300)	8,000 (31,900)	159,240	937	0	0	0	6,700 (25,900)
Berth N	859 (262)	40 (12.2)	800 (2,100)	2,700 (10,600)	53,080	313	0	0	0	2,200 (8,600)
Berth O-P	2,033 (620)	36 (11.0)	2,500 (6,300)	8,000 (31,900)	159,240	937	0	0	0	6,700 (25,900)
Berth Q-R	1,200 (366)	36 (11.0)	1,700 (4,200)	2,700 (10,600)	53,080	313	0	0	0	2,400 (9,100)
Berth 6-7	1,305 (398)	32 (9.8)	1,700 (4,200)	2,700 (10,600)	53,080	313	0	0	0	2,400 (9,100)
Berth 10-11	1,364 (416)	32 (9.8)	1,700 (4,200)	5,300 (21,200)	106,160	625	0	0	0	4,500 (17,200)
Berth 15	698 (213)	32 (9.8)	800 (2,100)	2,700 (10,600)	53,080	313	0	0	0	2,200 (8,600)
Berth 100	905 (276)	29 (8.8)	700 (1,800)	2,700 (10,600)	53,080	313	0	0	300 (700)	2,100 (8,300)
Berth 101-103	2,220 (677)	42 (12.8)	2,900 (7,200)	8,000 (31,900)	159,240	937	0	0	0	6,800 (26,100)
Berth 104	1,151 (351)	42 (12.8)	1,400 (3,600)	2,700 (10,600)	53,080	313	0	0	0	2,400 (9,000)
Berth 105-107	2,250 (686)	42 (12.8)	2,900 (7,200)	8,000 (31,900)	159,240	937	0	0	0	6,800 (26,100)
Berth 108-109	1,787 (545)	42 (12.8)	2,100 (5,400)	8,000 (31,900)	159,240	937	4,300 (10,800)	541	0	6,500 (25,200)
Berth 200-202	2,191 (668)	42 (12.8)	2,900 (7,200)	8,000 (31,900)	159,240	937	6,300 (15,700)	783	0	6,800 (25,800)
Berth 203-205	3,001 (915)	42 (12.8)	4,200 (10,500)	10,600 (42,500)	212,320	1249	15,700 (39,200)	1,959	0	9,300 (35,100)

a. Based on the 170 square foot per piece average accomplished during Operation Desert Shield/Storm.

BERTH CHARACTERISTICS FOR PORT OF DURBAN, SOUTH AFRICA

	PORT/BERTHS						
Characteristics	**Berth A**	**Berth B**	**Berth C**	**Berth L-M**	**Berth N**	**Berth O-P**	**Berth Q-R**
Length (ft)	944	1,079	698	2,000	859	2,033	1,200
Depth alongside at MLW (ft)	38	34	29	36	40	36	36
Deck Strength (psf)	600	600	600	600	600	600	600
Apron width (ft)	Open	Open	Open	Open	Open	Open	Open
Apron height above MLW (ft)	10	10	10	10	10	10	10
Number of container cranes	0	0	0	0	0	0	0
Number of wharf cranes	0	0	1	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No	No	No	No
Apron length served by rail (ft)	0	0	0	0	0	0	0

BERTH CHARACTERISTICS FOR PORT OF DURBAN - CONT'D

	PORT/BERTHS						
Characteristics	**Berth 6-7**	**Berth 10-11**	**Berth 15**	**Berth 100**	**Berth 101-103**	**Berth 104**	**Berth 105-107**
Length (ft)	1,305	1,364	698	905	2,220	1,151	2,250
Depth alongside at MLW (ft)	32	32	32	29	42	42	42
Deck Strength (psf)	600	600	600	600	600	600	600
Apron width (ft)	Open	Open	Open	Open	Open	Open	Open
Apron height above MLW (ft)	10	10	10	10	10	10	10
Number of container cranes	0	0	0	0	0	0	0
Number of wharf cranes	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	No	No	No	No	No	No	No
Apron length served by rail (ft)	0	0	0	0	2,220	0	0

BERTH CHARACTERISTICS FOR PORT OF DURBAN - CONT'D

	PORT/BERTHS		
Characteristics	**Berth 108-109**	**Berth 200-202**	**Berth 203-205**
Length (ft)	1,787	2,191	3,001
Depth alongside at MLW (ft)	42	42	42
Deck Strength (psf)	600	600	600
Apron width (ft)	Open	Open	Open
Apron height above MLW (ft)	10	10	10
Number of container cranes	1	2	5
Number of wharf cranes	0	0	0
Apron lighting	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	No	No
Apron length served by rail (ft)	0	0	0

SUMMARY OF BERTHING CAPABILITIES for DURBAN					
VESSEL	BERTHS				
	Berth A	Berth B	Berth C	Berth L-M	Berth N
Breakbulk					
C3-S-38a	1	2	1	3	1
C4-S-58a	1	1	1,a	3	1
C4-S-66a	1	1	1,a	3	1
C5-S-37e	1	1	1,a	3	1
Seatrain					
GA and PR-class	1	1	1	3	1
Barge					
LASH C8-S-81b	1	1,a,f	a,c,f	2	1
LASH C9-S-81d	1	1,a,f	a,c,f	2,a,f	c
LASH lighter	4	5	3	10	4
SEABEE C8-S-82a	1,a,f	1,a,f	a,c,f	2,a,f	c
SEABEE barge	4	5	3	10	4
RORO					
Comet	1,d,i	2,d,i	1,d,i	3,d,i	1,d,i
Meteor	1,d,i	1,d,i	1,d,i	3,d,i	1,d,i
Cape Gnome	1,d,i,j	1,d,i,j	1,a,d,i,j	3,d,i,j	1,d,i,j
C7-S-95a	1	1	a,c	2	1
Cape Taylor	1	1	1	3	1
Cape Orlando	1,i	1,i	1,a	3,i	1,i
MV Ambassador	1,d	1,d	1,d	3,d	1,d
Callaghan	1,d	1,d	1,d	2,d	1,d
Cape Lambert	1,i,j	1,i,j	1,a	2,i,j	1,i,j
LMSR-Class	c	1,a	a,c	2,a	c
FSS	c	1,a	a,c	2,a	c
Cape E-class	1,i,j	1,i,j	1,a	2,i,j	1,i,j
Cape D-class	1,i	1,i	1,a	2,i	1,i
Cape H-class	1	1,a	a,c	2	1
Cape Texas	1,i	1,i	1,i	3,i	1,i
Cape R-class	1,d	1,d	1,a,d	2,d	1,d
Cape I-class	1,i	1,i	1,a	2,i	1,i
Cape Victory	1,i	1,i	1,i	3,i	1,i
Container					
C6-M-147a	1,e	1,e	1,e	2,e	1,e
C7-S-69c	1,e	1,e	1,a,e	2,e	1,e
C7-S-68c	1,e	1,e	a,c,e	2,e	1,e
C8-S-85c	1,e	1,e	a,c,e	2,e	1,e
C9-M-132b	1,e	1,a,e	a,c,e	2,e	c,e
C9-M-F141a	c,e	1,a,e	a,c,e	2,a,e	c,e
Combination					
C6-S-1qd	1	1	1,a	2	1
C5-S-MA73c	1	1	1,a	3	1
C6-S-MA60d	1	1	1,a	2	1

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES for DURBAN - cont'd					
VESSEL	**BERTHS**				
	Berth O-P	**Berth Q-R**	**Berth 6-7**	**Berth 10-11**	**Berth 15**
Breakbulk					
C3-S-38a	3	2	2	2	1
C4-S-58a	3	2	2	2	1
C4-S-66a	3	2	2,a	2,a	1,a
C5-S-37e	3	1	2	2	1
Seatrain					
GA and PR-class	3	2	2	2	1
Barge					
LASH C8-S-81b	2	1	1,a,f	1,a,f	a,c,f
LASH C9-S-81d	2,a,f	1,a,f	1,a,f	1,a,f	a,c,f
LASH lighter	10	6	6	6	3
SEABEE C8-S-82a	2,a,f	1,a,f	1,a,f	1,a,f	a,c,f
SEABEE barge	10	6	6	6	3
RORO					
Comet	3,d,i	2,d,i	2,d,i	2,d,i	1,d,i
Meteor	3,d,i	2,d,i	2,d,i	2,d,i	1,d,i
Cape Gnome	3,d,i,j	1,d,i,j	2,a,d,i,j	2,a,d,i,j	1,a,d,i,j
C7-S-95a	2	1	1,a	1,a	a,c
Cape Taylor	3	1	1	2	1
Cape Orlando	3,i	1,i	1,i	2,i	1,i
MV Ambassador	3,d	2,d	2,d	2,d	1,d
Callaghan	2,d	1,d	1,d	1,d	1,d
Cape Lambert	2,i,j	1,i,j	1,i,j	1,i,j	1,i,j
LMSR-Class	2	1	1,a	1,a	a,c
FSS	2,a	1,a	1,a	1,a	a,c
Cape E-class	2,i,j	1,i,j	1,i,j	2,i,j	1,i,j
Cape D-class	2,i	1,i	1,a	1,a	1,a
Cape H-class	2	1	1,a	1,a	a,c
Cape Texas	3,i	1,i	1,i	2,i	1,i
Cape R-class	3,d	1,d	1,a,d	2,a,d	1,a,d
Cape I-class	2,i	1,i	1,i	1,i	1,i
Cape Victory	3,i	1,i	1,i	2,i	1,i
Container					
C6-M-147a	2,e	1,e	1,e	1,e	1,e
C7-S-69c	2,e	1,e	1,e	1,e	1,e
C7-S-68c	2,e	1,e	1,e	1,e	c,e
C8-S-85c	2,e	1,e	1,a,e	1,a,e	a,c,e
C9-M-132b	2,e	1,e	1,a,e	1,a,e	a,c,e
C9-M-F141a	2,a,e	1,a,e	1,a,e	1,a,e	a,c,e
Combination					
C6-S-1qd	2	1	1,a	1,a	1,a
C5-S-MA73c	3	1	2	2	1
C6-S-MA60d	2	1	1	1	1

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES for DURBAN - cont'd					
VESSEL	**BERTHS**				
	Berth 100	**Berth 101-103**	**Berth 104**	**Berth 105-107**	**Berth 108-109**
Breakbulk					
C3-S-38a	1	4	2	4	3
C4-S-58a	1,a	3	1	3	2
C4-S-66a	1,a	3	2	3	3
C5-S-37e	1,a	3	1	3	2
Seatrain					
GA and PR-class	1	3	1	3	3
Barge					
LASH C8-S-81b	1,a,f	2	1	2	2
LASH C9-S-81d	1,a,f	2	1	2	1
LASH lighter	4	11	5	11	8
SEABEE C8-S-82a	1,a,f	2	1	2	1
SEABEE barge	4	11	5	11	8
RORO					
Comet	1,d,i	4,d,i	2,d,i	4,d,i	3,i
Meteor	1,d,i	3,d,i	2,d,i	3,d,i	3,i
Cape Gnome	1,a,d,i,j	3,d,i,j	1,d,i,j	3,d,i,j	2,i,j
C7-S-95a	1,a	2	1	2	2
Cape Taylor	1	3	1	3	2
Cape Orlando	1,a	3,i	1,i	3,i	2,i
MV Ambassador	1,d	3,d	2,d	4,d	3,m
Callaghan	1,d	3,d	1,d	3,d	2
Cape Lambert	1,a	3,i,j	1,i,j	3,i,j	2,i,j
LMSR-Class	a,c	2	1	2	1
FSS	a,c	2	1	2	1
Cape E-class	1,a	3,i,j	1,i,j	3,i,j	2,i,j
Cape D-class	1,a	3,i	1,i	3,i	2,i
Cape H-class	1,a	2	1	2	2
Cape Texas	1,i	3,i	1,i	3,i	2,i
Cape R-class	1,a,d	3,d	1,d	3,d	2
Cape I-class	1,a	3,i	1,i	3,i	2,i
Cape Victory	1,i	3,i	1,i	3,i	2,i
Container					
C6-M-147a	1,e	3,e	1,e	3,e	2
C7-S-69c	1,a,e	3,e	1,e	3,e	2
C7-S-68c	1,a,e	3,e	1,e	3,e	2
C8-S-85c	1,a,e	2,e	1,e	2,e	2
C9-M-132b	1,a,e	2,e	1,e	2,e	2
C9-M-F141a	a,c,e	2,e	1,e	2,e	1
Combination					
C6-S-1qd	1,a	3	1	3	2
C5-S-MA73c	1,a	3	1	3	2
C6-S-MA60d	1,a	3	1	3	2

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

e=no container-handling equipment
f=shallow berth, adequate anchorage depth
g=inadequate channel depth
h=no shore-based ramps available
i=insufficient ramp clearance at low tide

j=insufficient ramp clearance at high tide
k=excessive ramp angle at low tide
m=excessive ramp angle at high tide
n=parallel ramp operation only
o=too narrow apron for side-ramp

•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

SUMMARY OF BERTHING CAPABILITIES for DURBAN - cont'd		
VESSEL	**BERTH**	
	Berth 200-202	**Berth 203-205**
Breakbulk		
C3-S-38a	4	5
C4-S-58a	3	5
C4-S-66a	3	5
C5-S-37e	3	4
Seatrain		
GA and PR-class	3	5
Barge		
LASH C8-S-81b	2	3
LASH C9-S-81d	2	3
LASH lighter	10	15
SEABEE C8-S-82a	2	3
SEABEE barge	10	15
RORO		
Comet	4,d,i	5,d,i
Meteor	3,d,i	5,d,i
Cape Gnome	3,d,i,j	4,d,i,j
C7-S-95a	2	3
Cape Taylor	3	4
Cape Orlando	3,i	4,i
MV Ambassador	3,d	5,d
Callaghan	3,d	4,d
Cape Lambert	3,i,j	4,i,j
LMSR-class	2	3
FSS-Class	2	3
Cape E-class	3,i,j	4,i,j
Cape D-class	3,i	4,i
Cape H-class	2	3
Cape Texas	3,i	4,i
Cape R-class	3,d	4,d
Cape I-class	3,i	4,i
Cape Victory	3,i	4,i
Container		
C6-M-147a	3	4
C7-S-69c	3	4
C7-S-68c	3	4
C8-S-85c	2	3
C9-M-132b	2	3
C9-M-F141a	2	3
Combination		
C6-S-1qd	3	4
C5-S-MA73c	3	4
C6-S-MA60d	3	4

a=vessel draft limited to berth depth
b=inadequate apron width
c=inadequate berth length
d=no straight stern-ramp facilities

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•May Limit Operations
•May Prevent Operations
Notes: Ramp clearance and ramp angle based on maximum vessel draft
( ) indicates vessels assigned by analyst

ASSUMPTIONS

ASSUMPTIONS

Parameters Screen 1

Ship Operational Rates:	STON/HR	MTON/HR
Breakbulk Rates		
Ship Crane (15.0,37.5)	15.0	37.5
Dockside Cranes (20.0,50.0)	20.0	50.0
Barge (20.0,50.0)	20.0	50.0
Roro Rates (200,800)	200.0	800.0
Container Lift Rates (21,8)	21.0	8.0

Ship Mix Percentages:	%
BreakBulk (35.3%)	22.0
Barge (10.0%)	3.0
Roro (15.6%)	72.0
Container (39.1%)	3.0

Minimum Mobile-Crane Size:	STON
Breakbulk (100)	40.0
Barge (20)	20.0
Container (100)	100.0

Berth Utilization Factor (0.9) 0.9

Parameters Screen 2

Ship Cargo Mix:

Breakbulk/Barge	%
Roadable Vehicles (43%)	43.0
Nonroadable Vehicles (7%)	7.0
Container (15%)	15.0
Noncontainer (35%)	35.0

Roro	%
Roadable Vehicles (85%)	90.0
Nonroadable Vehicles (15%)	10.0
Container	
Container (100%)	100.0

Staging Data:

Staging Dwell Time (3 Days)	3.0
Space Utilization Factor:	%
Open (70%)	60.0
Covered (65%)	60.0
Facility User Factor (100%)	80.0

ASSUMPTIONS

Parameters Screen 3

Stacking Height:	ft			ft
Open - General (7.5)	7.5	Open - Vehicle (7.6)		7.6
Covered (10.0)	10.0			
Motor Vehicle Parameters:			STON	MTON
Convoy (3.5,17)			3.5	17.0
Flatbed (20,60)			20.0	60.0
Van (16,40)			16.0	40.0
Chassis (16,40)			16.0	40.0
Railcar Parameters:				
Flatcar (50,150)			50.0	150.0
Boxcar (30,75)			30.0	75.0
COFC (24,60)			24.0	60.0
Container (TEU) Capacity (8,20)			8.0	20.0

Parameters Screen 4

Truck Handling Rates:	Trucks/Hr			
End Ramps (4)	4.0			
Van Docks (1)	1.0			
Railcar Handling Rates:	Railcars/Hr			
End Ramps (4)	4.0			
Boxcar Docks (0.33)	0.3			
Length Of Flatcars(60 Ft)	60.0	Productive Work Hours(20 Hrs)		20.0
Mode Mix:			%	%
Roadable Veh: Convoy/Flatcar (100%,0%)			90.0	10.0
Nonroadable Veh: Hets/Flatcars (0%,100%)			10.0	90.0
Gen Cargo: Van/Box (25%,25%)			35.0	15.0
Flatbed/Flatcar (25%,25%)			35.0	15.0
Container: Chassis/COFC (50%,50%)			75.0	25.0