



**TERMINALS 37-46 AND 48**

CHARACTERISTICS	BERTHS	
	37-46	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

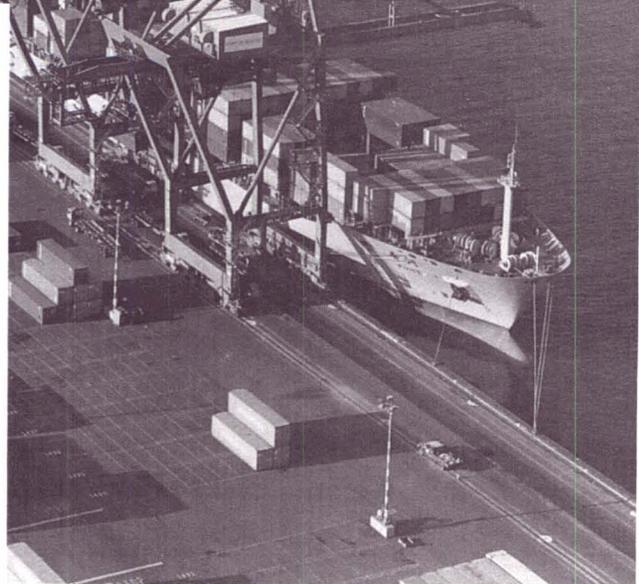
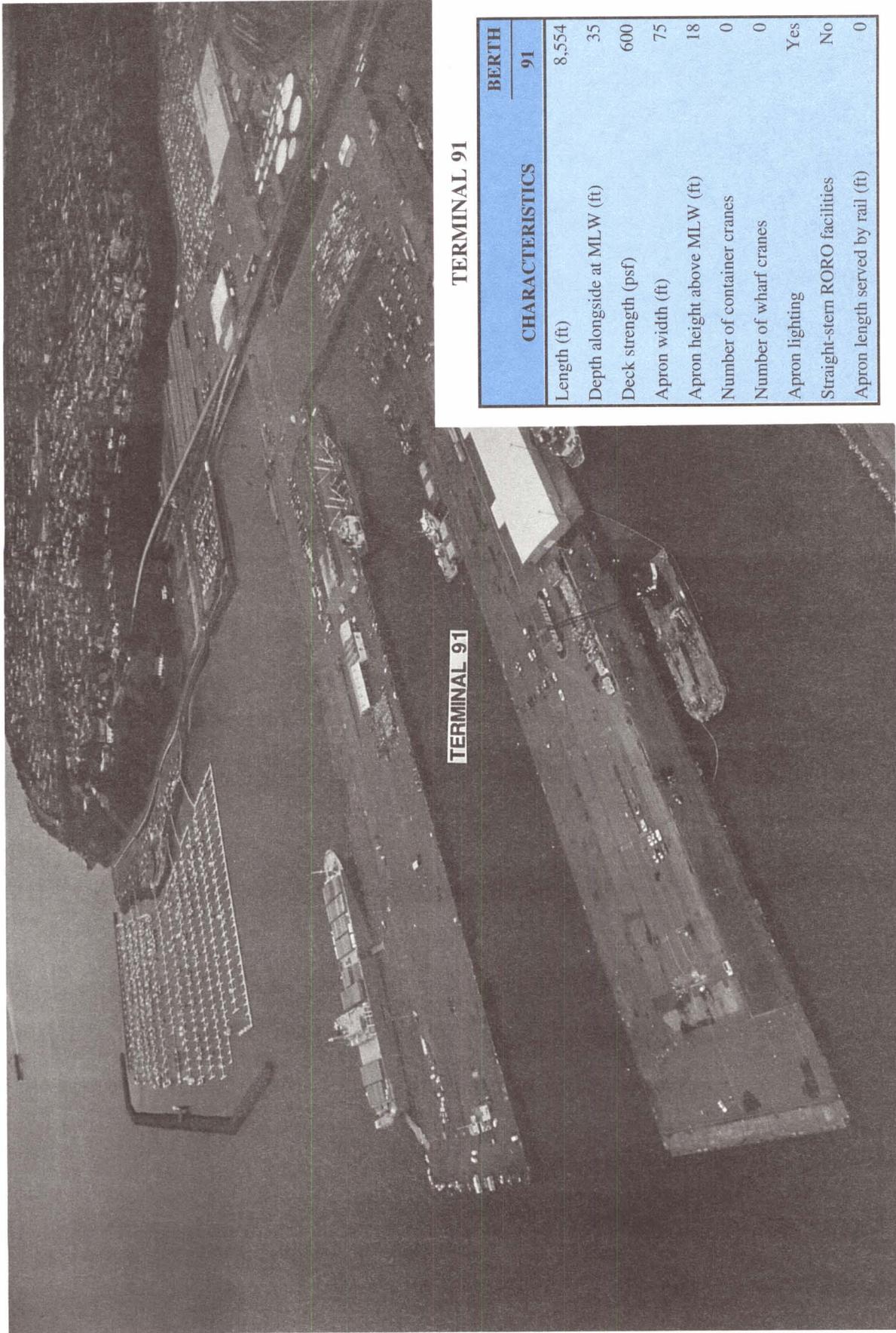


Figure 5. Berth characteristics of Terminals 37-46 and 48 (northeastward view).



**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

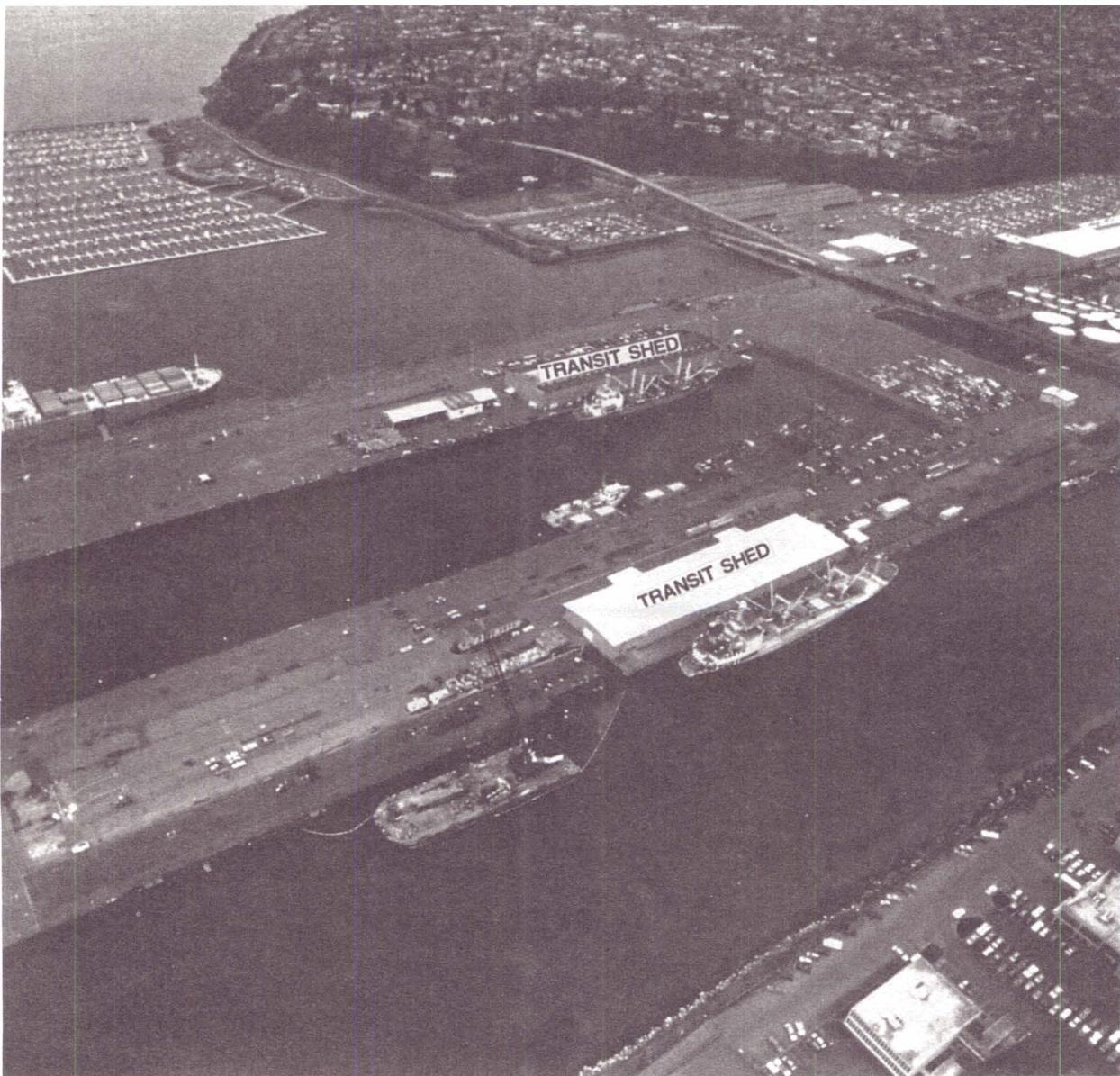
TERMINAL	OPEN STAGING ACREAGE	BERTH(S) SERVED
5	90	3
18	109	8
25	28	2
30	37	2
37	29	1
46	32	1
91	124	All
115	97	3
TOTAL 546		



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.



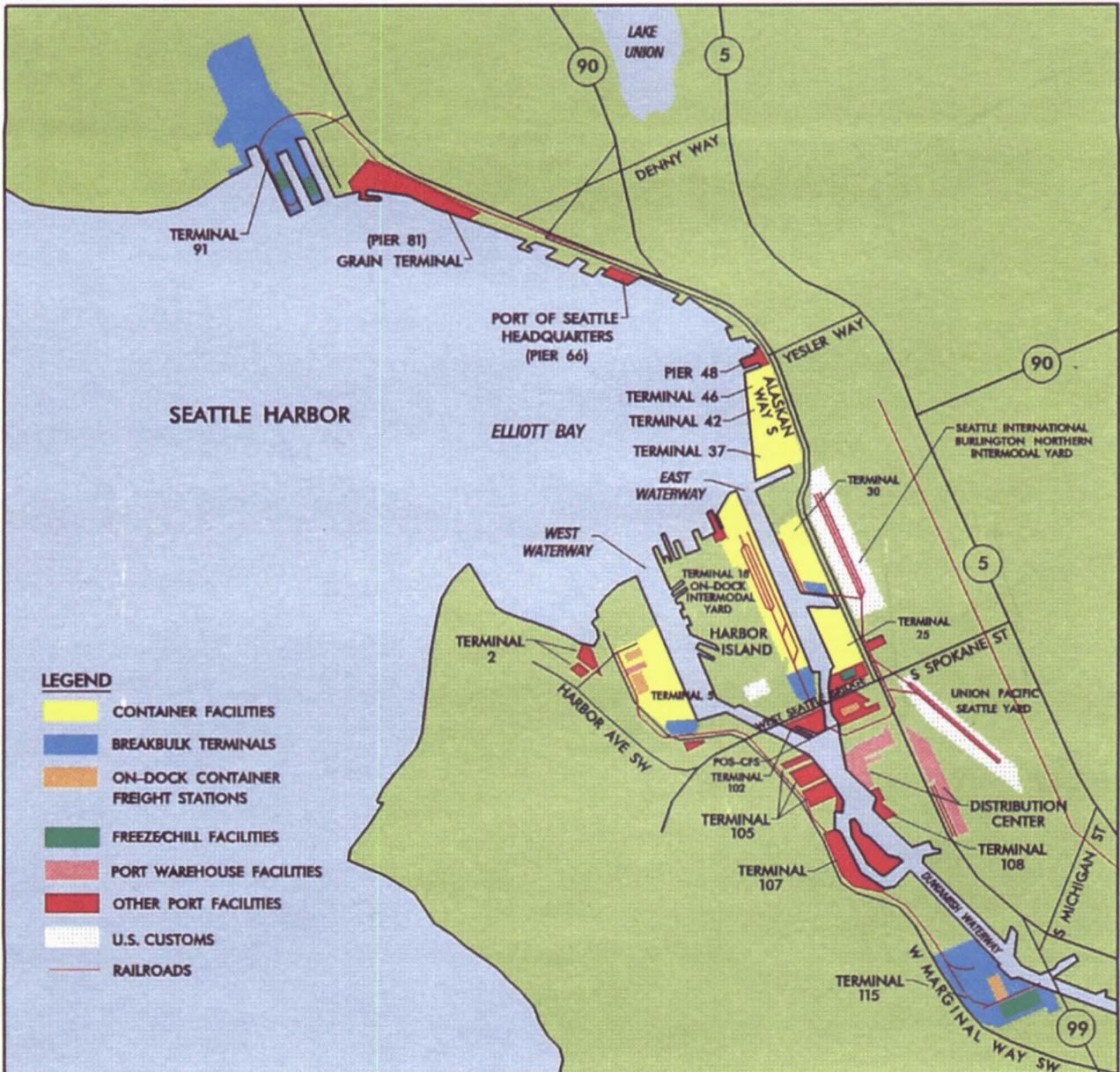
Covered Storage Facilities, Terminal 91

## 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.



## 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



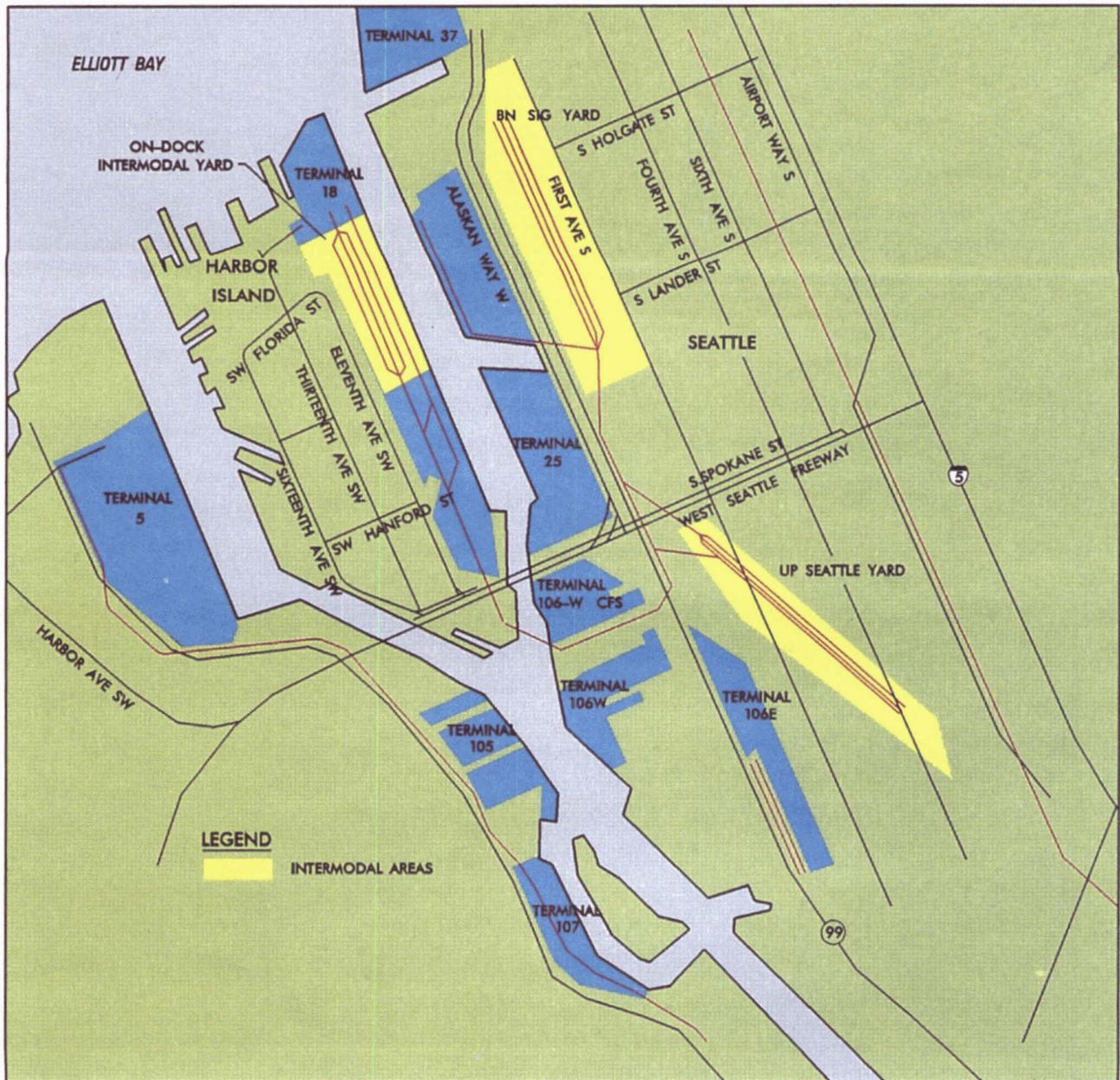
Container Top Pick



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 (piggypackers) 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))

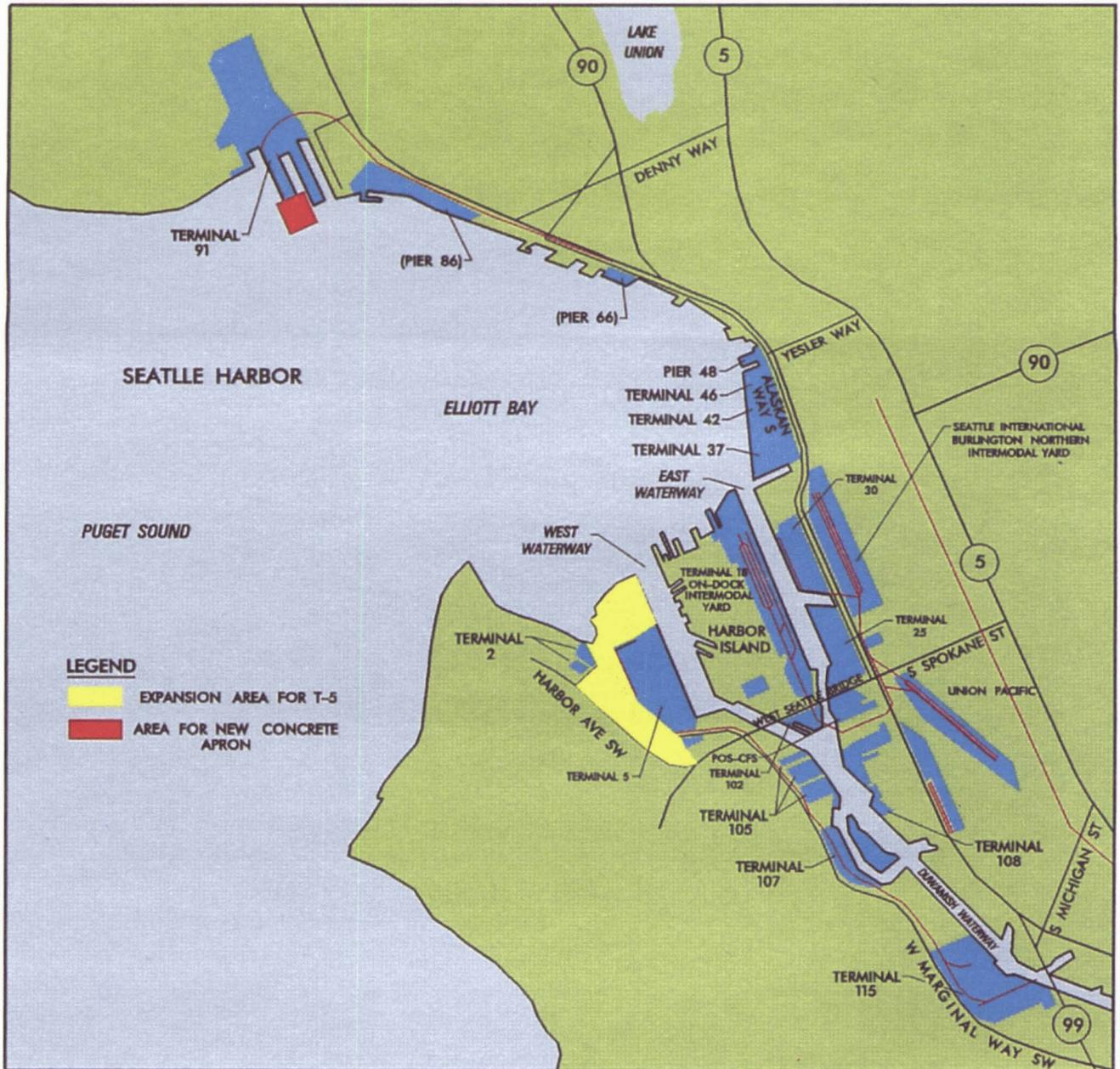
This port-owned intermodal yard is on 8 acres and can stage about 280 40-foot truck chassis. Transfer operations occur on four tracks providing about eighty-four 89-foot flatcar lengths. The IY uses 12 rough terrain container handlers for container loading operations. It can handle both TOFC and double-stacked 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.

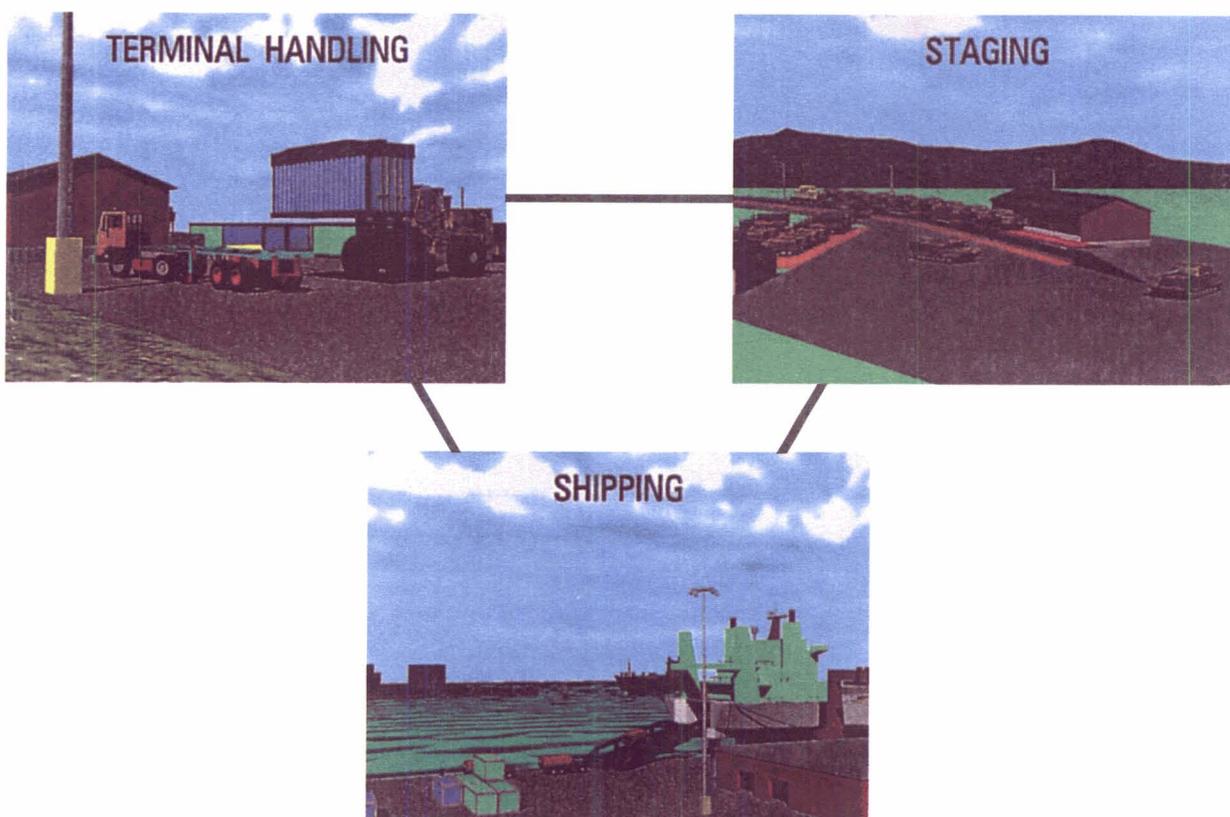


Future Development for Port of Seattle

## II. THROUGHPUT ANALYSIS

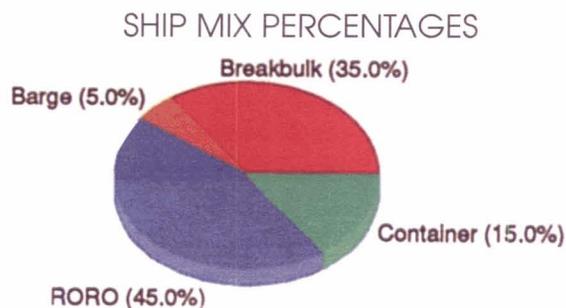
### GENERAL

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.



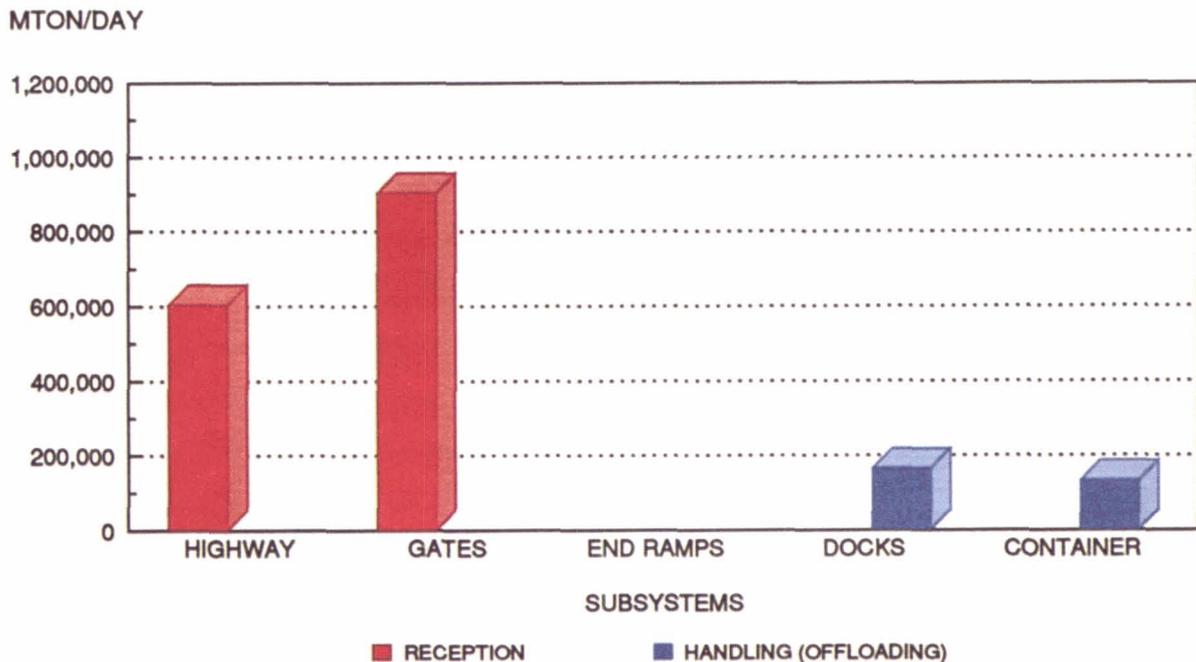
## TERMINAL RECEPTION/HANDLING

### 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.

### HIGHWAY RECEPTION/HANDLING CAPABILITY



## Rail

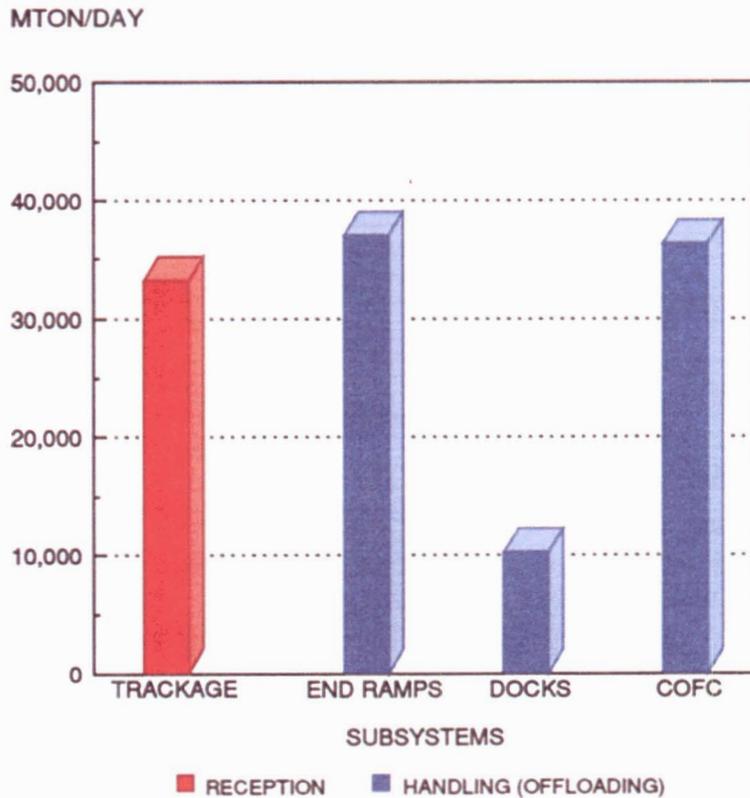
Rail reception at the Port of Seattle is very good, with two commercial carriers serving the Seattle area. No railyards are on the port; however, local railyards could store about 652 89-foot railcars. This is based on 30 percent availability of track space. The current rail service to the port varies, 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 boxcar positions available for offloading. Many of these positions are at covered storage facilities under lease. An RTCH and/or crane will offload containers.

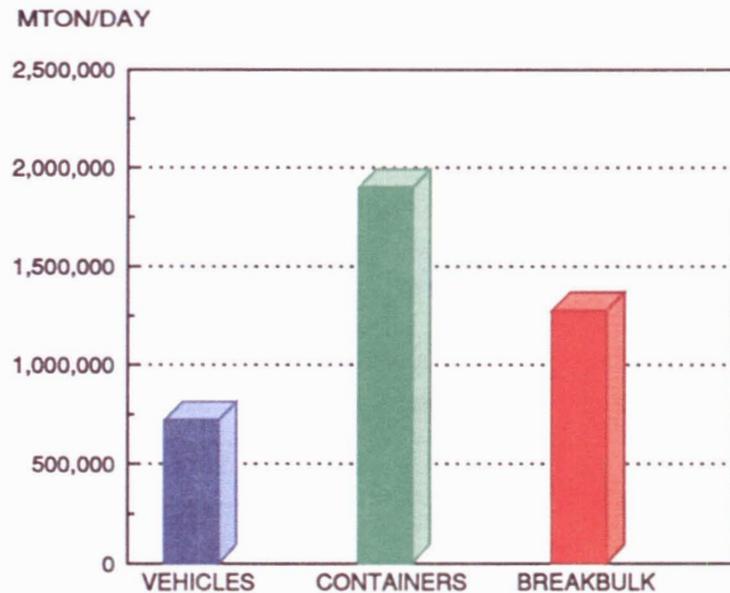
## STAGING

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.

RAIL RECEPTION/HANDLING CAPABILITY

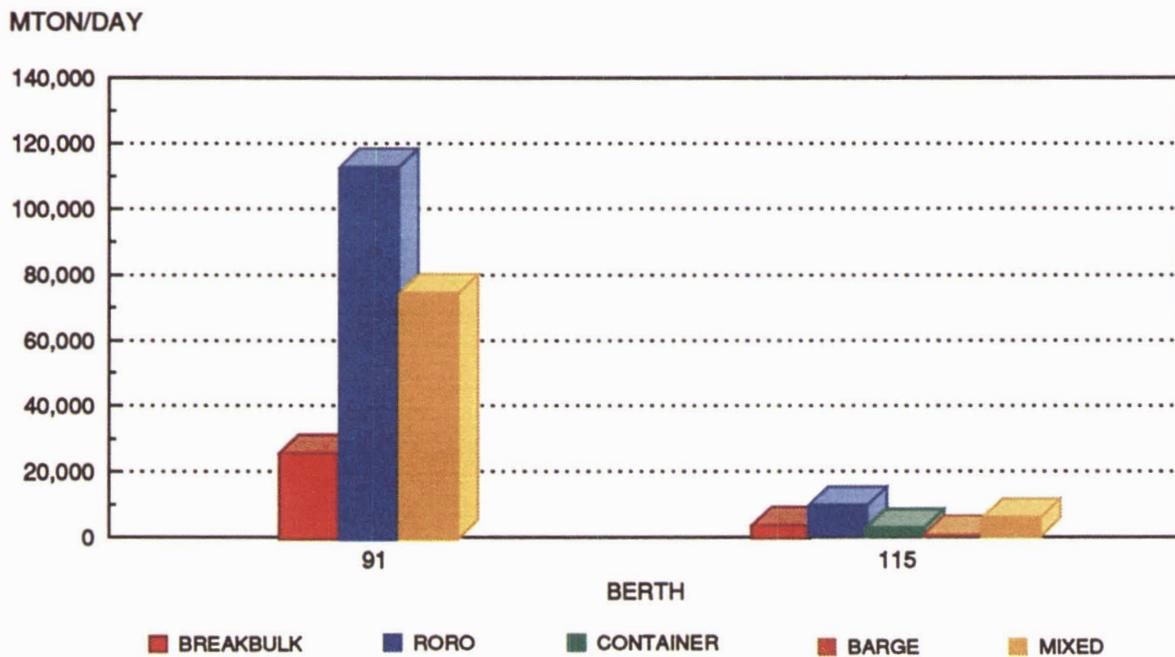
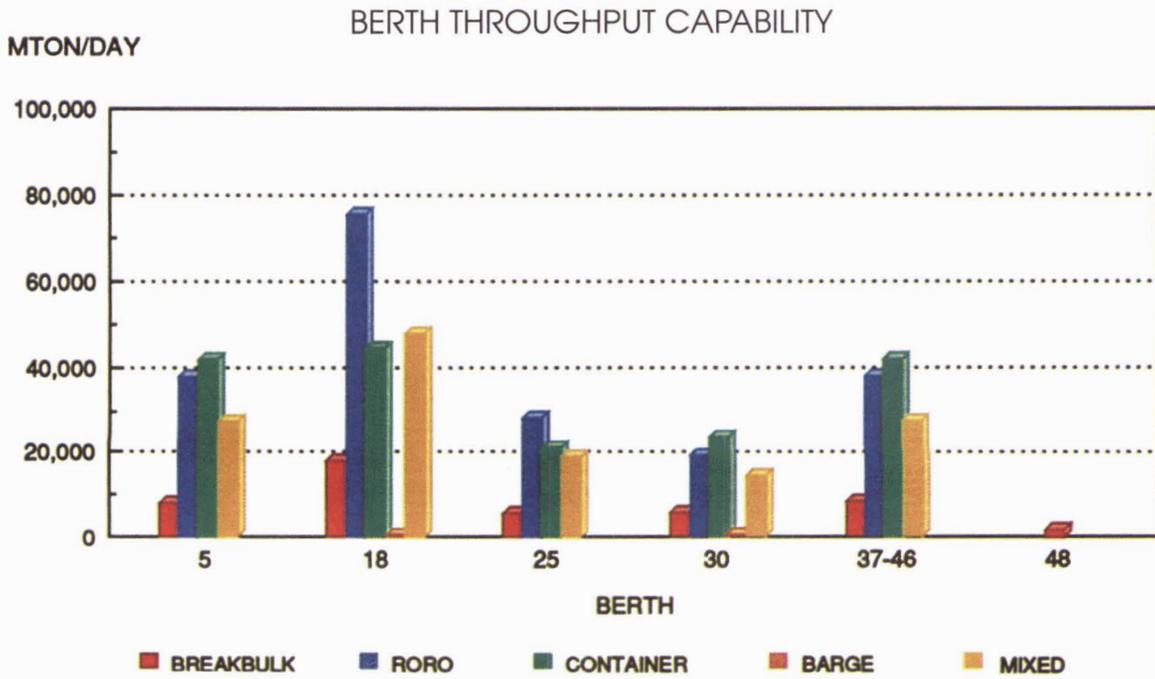


OPEN STAGING CAPABILITY



## SHIPPING

The following figures show the throughput capability per terminal in MTON per day for breakbulk, 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
<p><b>NOTES:</b>            Terminals marked with "-" are not recommended 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.</p>								

**TABLE 1**  
**SUMMARY OF SEATTLE BERTHING CAPABILITIES**

VESSEL	BERTHS									
	T5	T18A	T18B	T25	T30	T115	37-46	48A	48B	91
<b>Breakbulk</b>										
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
<b>Seatrail</b>										
GA and PR-class	4	3	6	3	3	2	4	b,c	c	14
<b>Barge</b>										
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
<b>RORO</b>										
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	ij	ij	ij	ij	ij	ij	ij	b,c	b,c	ij
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	ij	ij	ij	ij	ij	a	ij	b,c	b,c	ij
Cape H-class	3,i	2,i	4,i	2,i	2,i	a	3,i	a,b,c	a,b,c	a
<b>Container</b>										
C6-S-1w	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
<b>Combination</b>										
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 operation

Note: 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* 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.

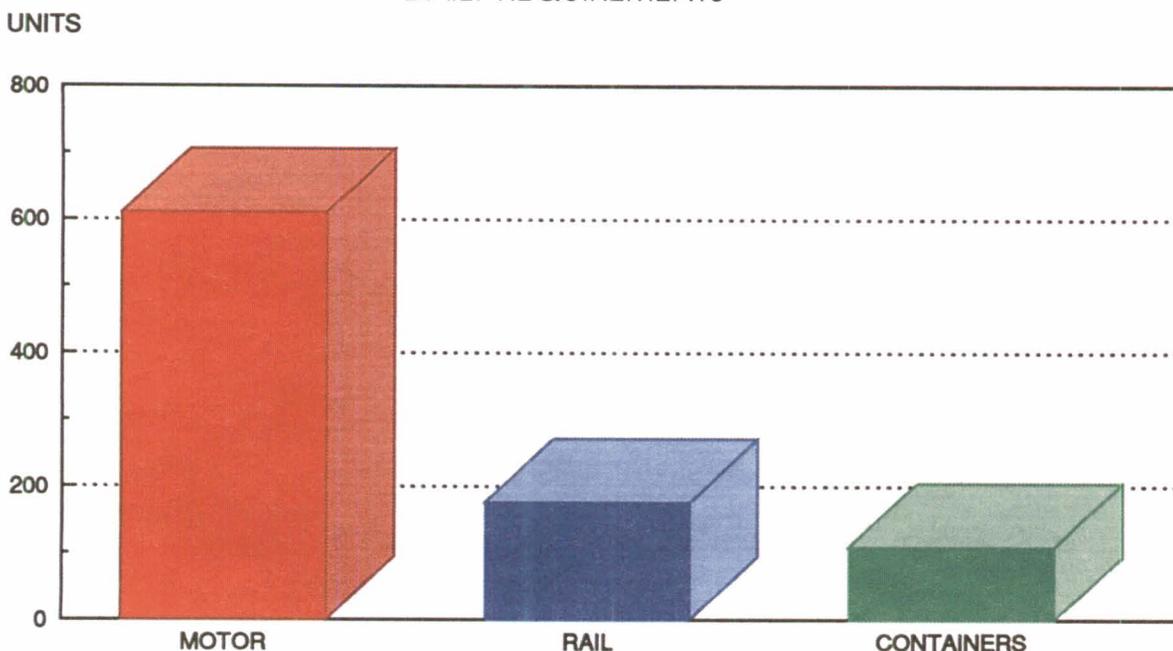
#### REQUIREMENTS

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

#### DAILY REQUIREMENTS

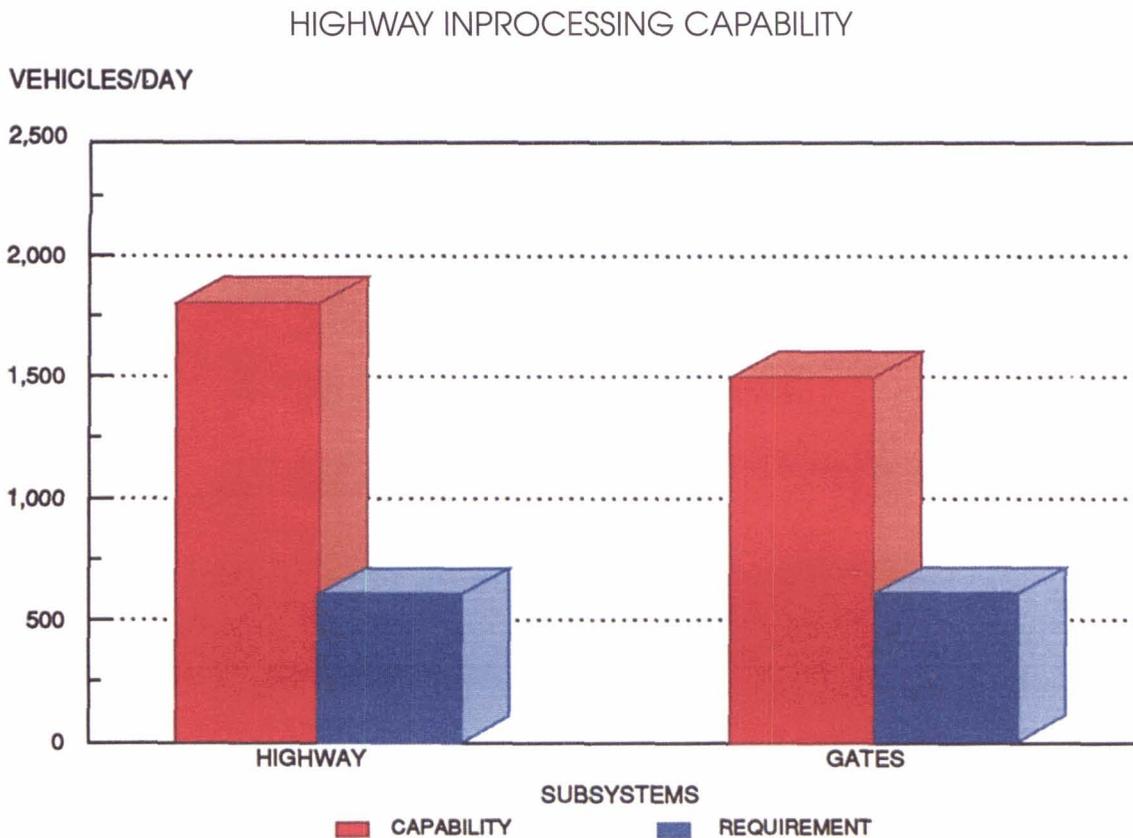


## TERMINAL HANDLING

### 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.

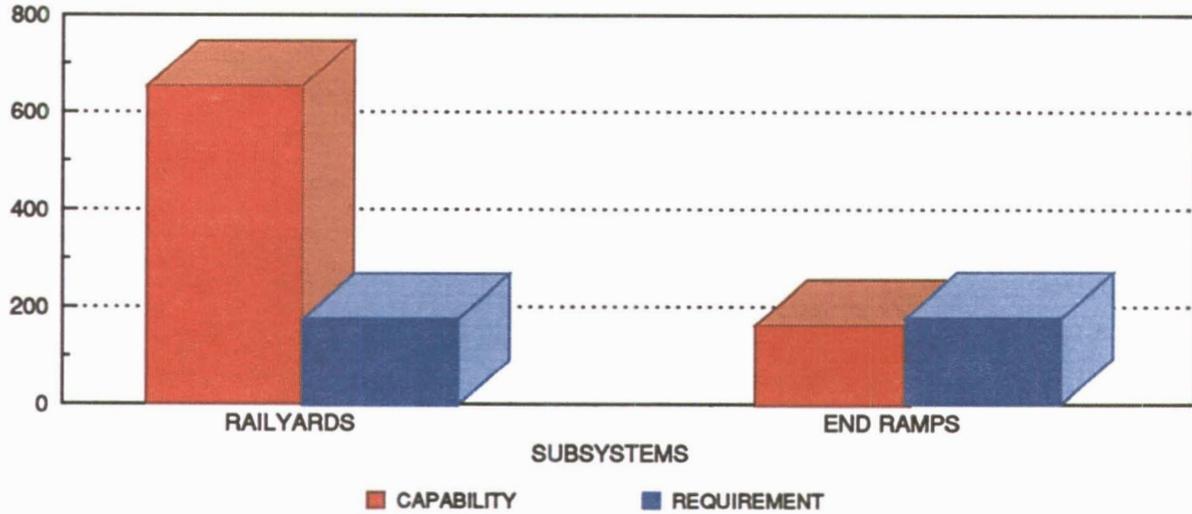


### Rail

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).

## RAIL INPROCESSING/HANDLING CAPABILITY

RAILCARS/DAY

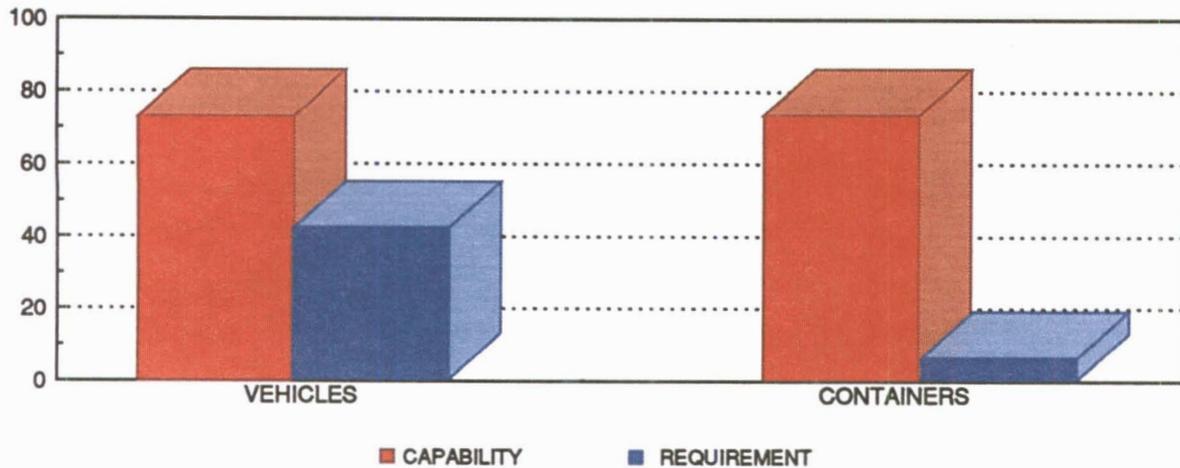


## STAGING

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.

ACRES

## OPEN STAGING CAPABILITY



## SHIPPING

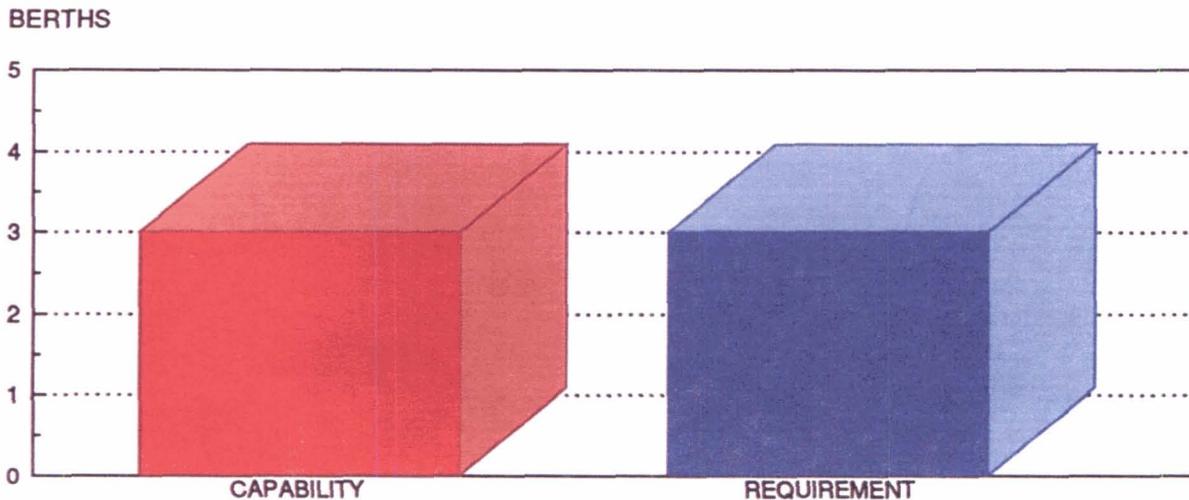
The number of ships needed to load this requirement depends on the shipping mix selected. The best ship mix would require all eight FSSs and two Cape H RORO ships.

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

LOADING CONDITION/ SAMPLE SHIP MIX	VESSEL TYPES			
	FSS (RORO/COMB)	CAPE H (RORO/COMB)	C3/C4 (BREAKBULK)	C6/C7/C8 (CONTAINER)
<i>Minimum Containerization</i>				
All FSS*	8.00	1.90		
FSS and Cape H	6.64	3.00		
All Breakbulk			37.70	
<i>Maximum Containerization</i>				
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).				
<i>Legend:</i>				
RORO - roll on/roll off				
FSS - fast sealift ship				
Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide, Aug 91.				

## FSS SHIPPING CAPABILITY



NOTE: The capability assumes the ship channel and berths have adequate depth for transport of fully loaded FSS vessels.

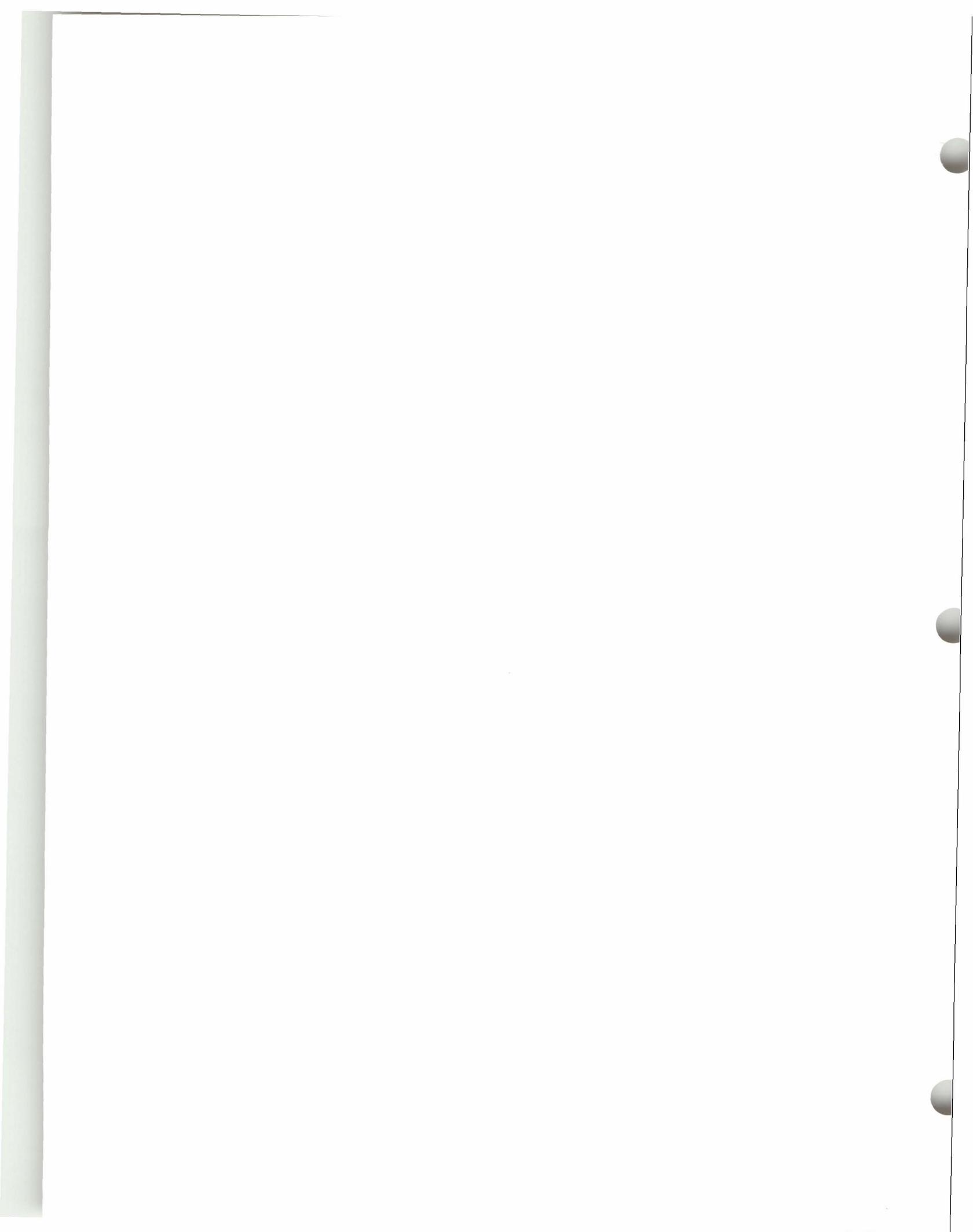
### SUMMARY

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

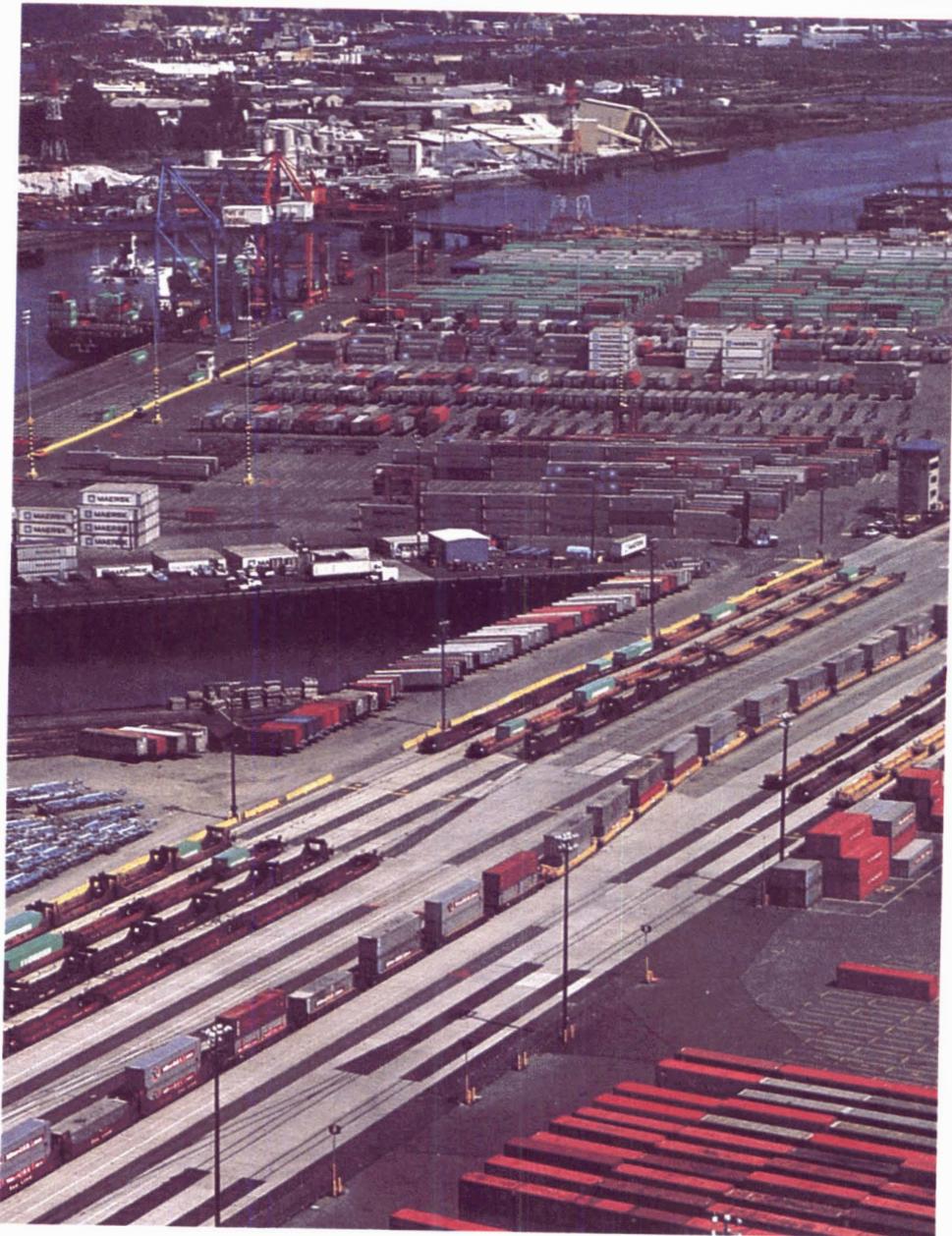
We recommend that the Port of Seattle obtain at least two heavy-duty portable end ramps to allow flexibility in offloading heavy equipment from both railcars and semitrailers. The MTMCTEA-designed end ramp is a potential solution to this recommendation.





TACUMA

# PORT OF TACOMA TACOMA, WASHINGTON



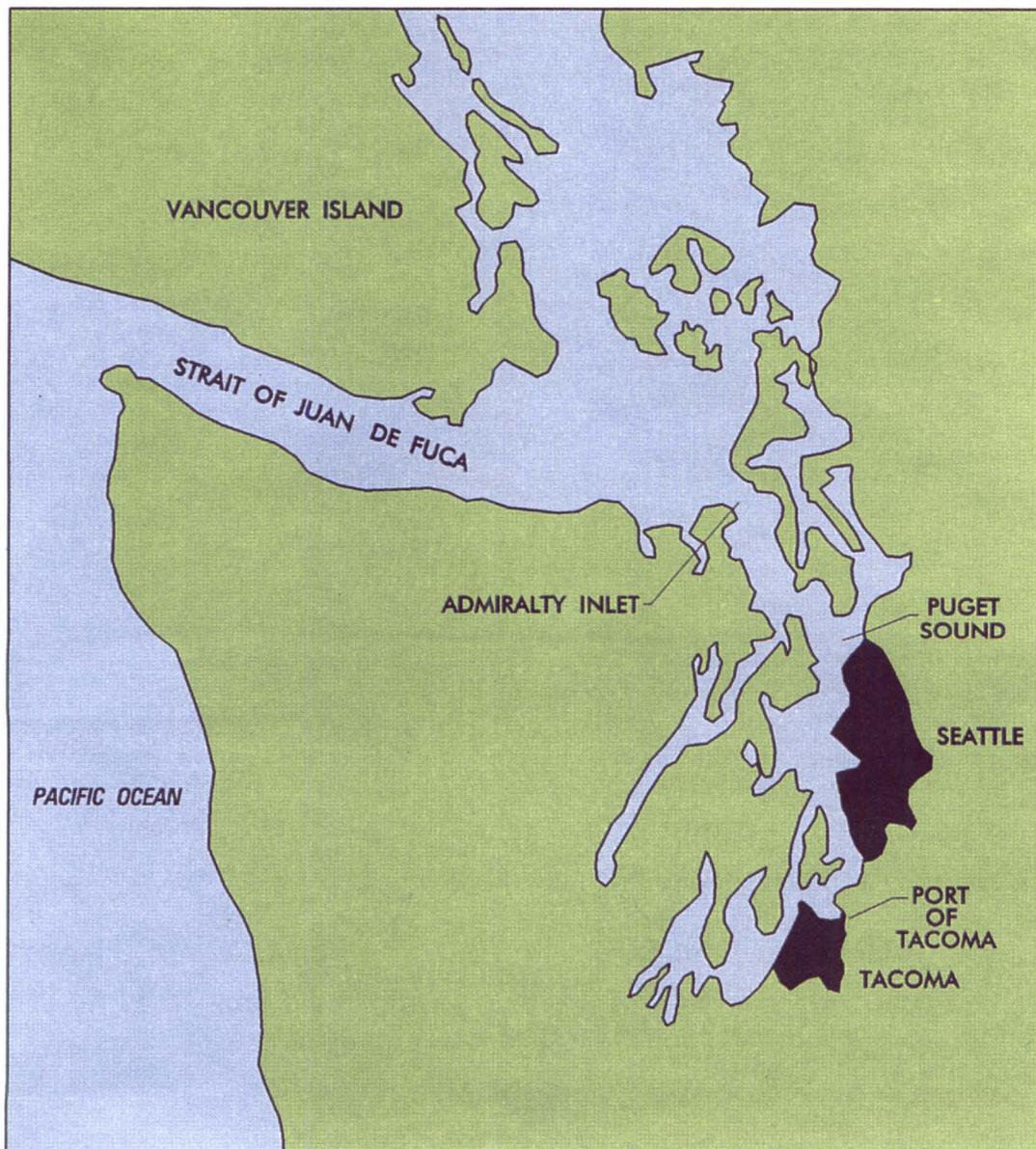


# I. GENERAL DATA

## TRANSPORTATION ACCESS

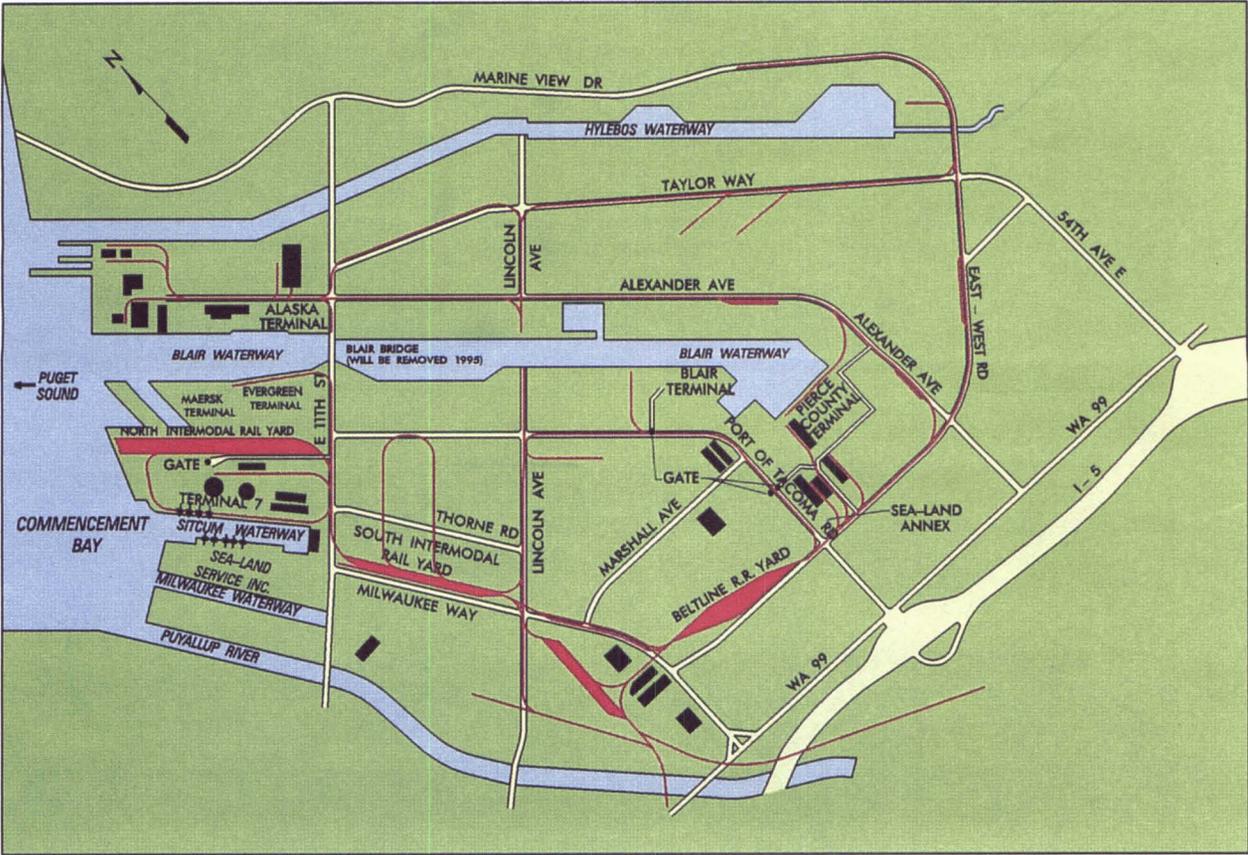
### Water

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

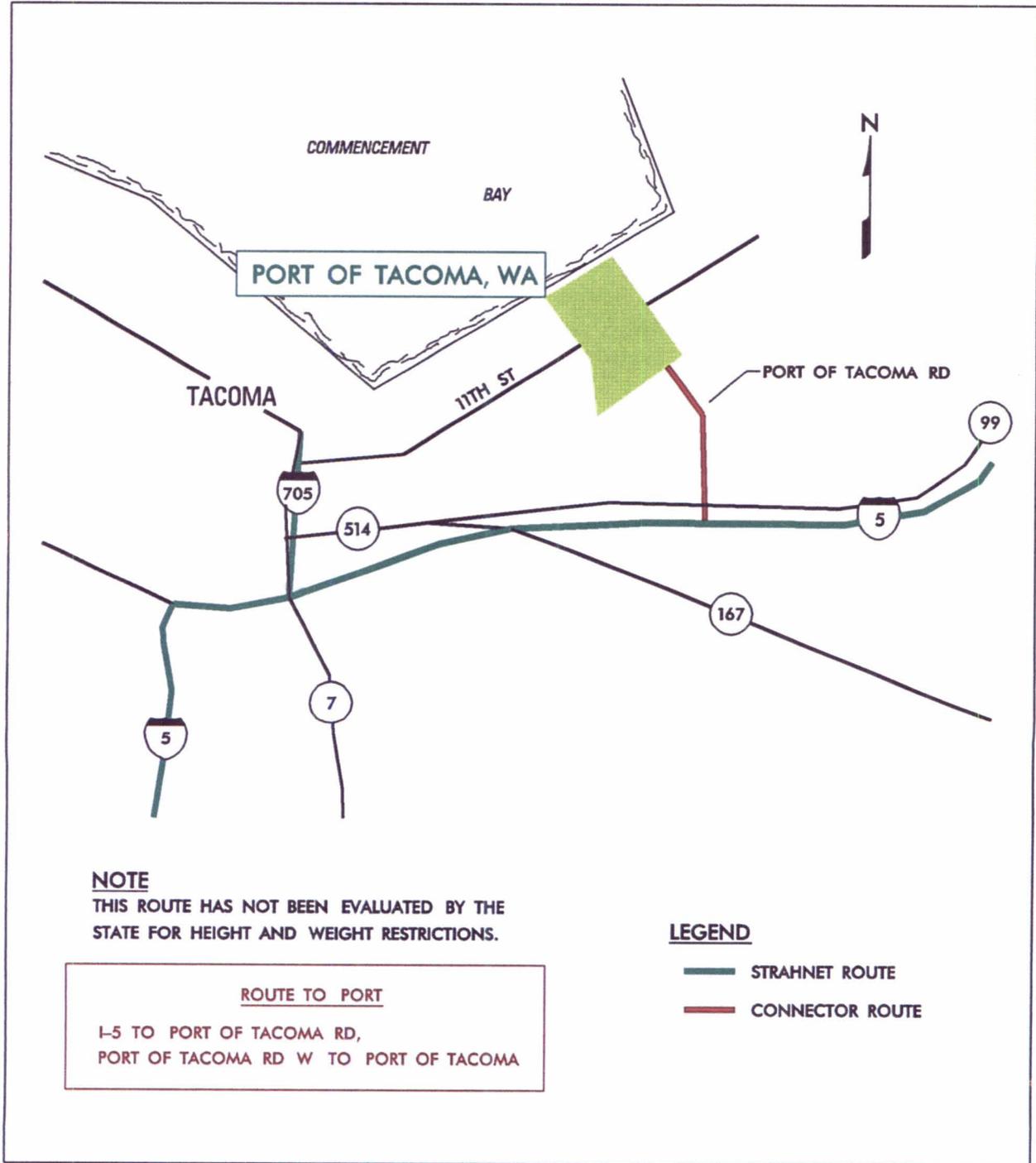
The Port of Tacoma has one bridge restriction, a 150-foot horizontal clearance, across Blair Waterway. This bridge is the 11th Street Drawbridge.



Water Access Restrictions

## Highway

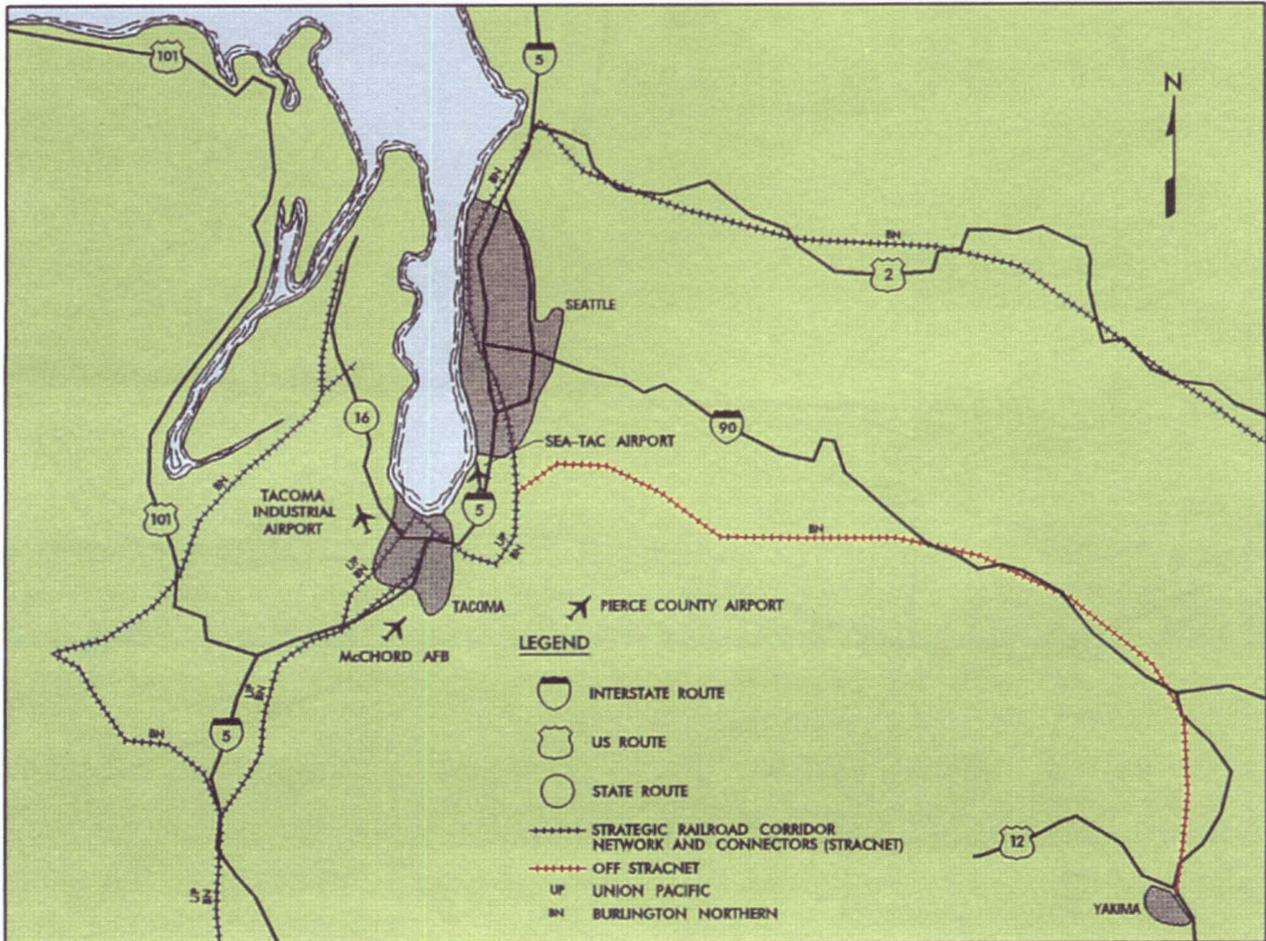
The Strategic Highway Corridor Network (STRAHNET) route to the Port of Tacoma is Interstate Route 5. The connector route is Port of Tacoma Road. Clearances are not a problem on this route. An alternate route to the port from I-5 is Interstate Route 705, connecting with 11th Street. The lowest clearance 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.

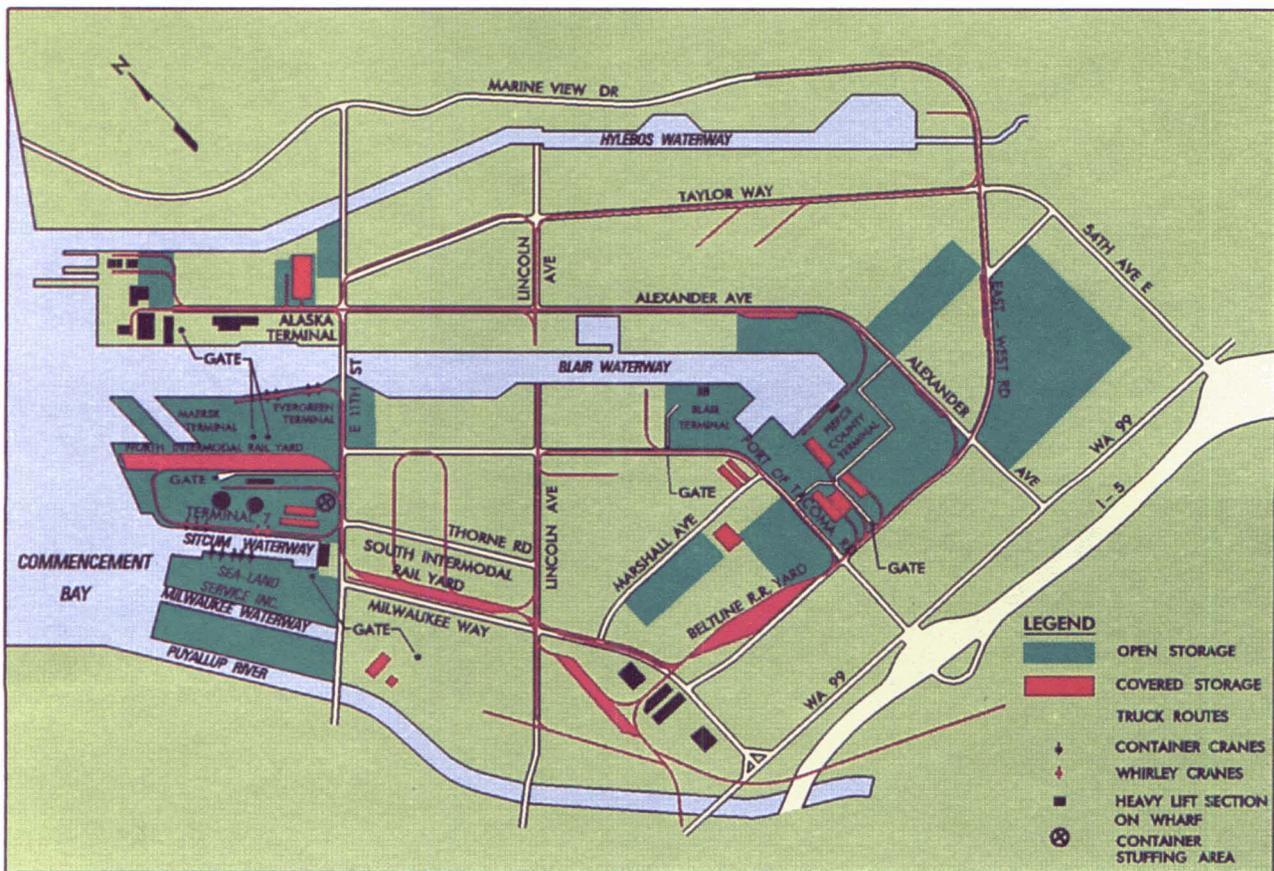
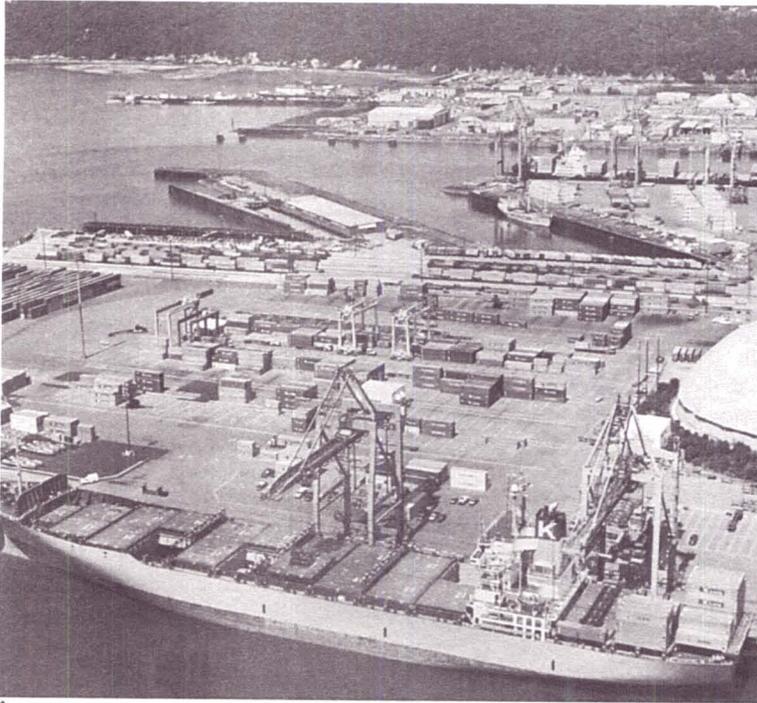


Figure 1. Land-use map for the Port of Tacoma.



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

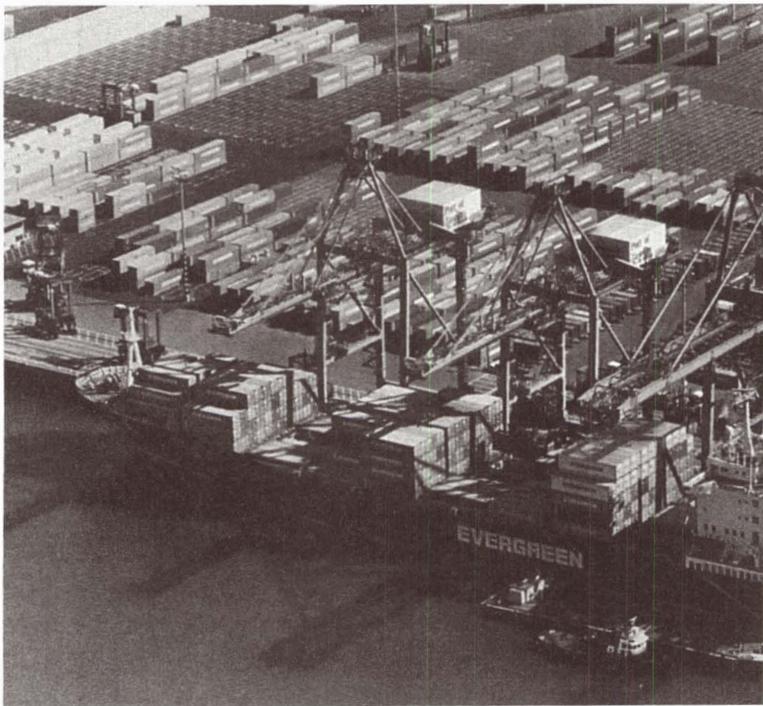
This facility is currently not in use. The Port of Tacoma plans to fill in this area.



**TERMINAL 3 - MAERSK**

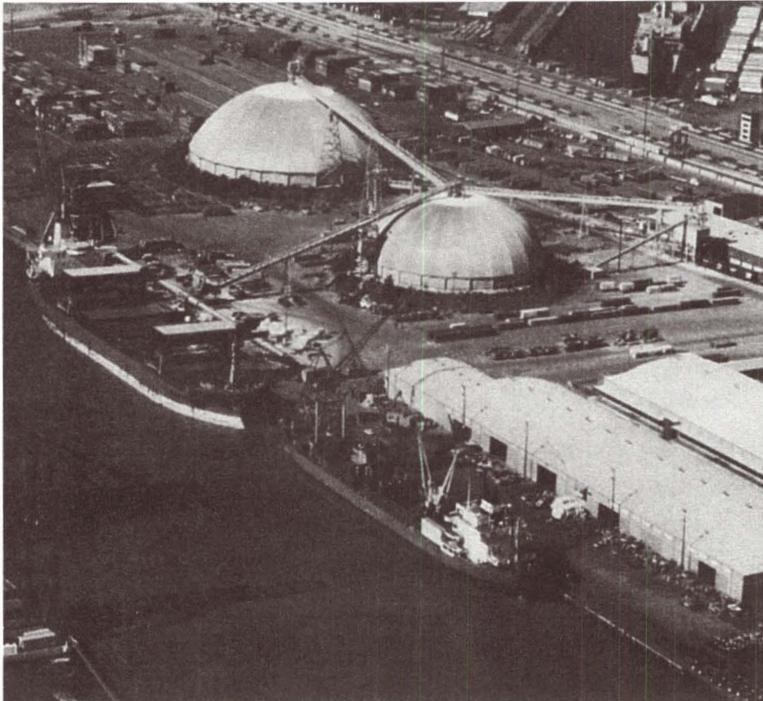
CHARACTERISTICS	BERTH
	Maersk
Length (ft)	950
Depth alongside at MLW (ft)	42
Deck strength (psf)	2,000
Apron width (ft)	Open
Apron height above MLW (ft)	18
Number of container cranes	3
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

Figure 3. Berth characteristics for Pier 2 and Maersk Terminal, Port of Tacoma.



**TERMINAL 4 - 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**

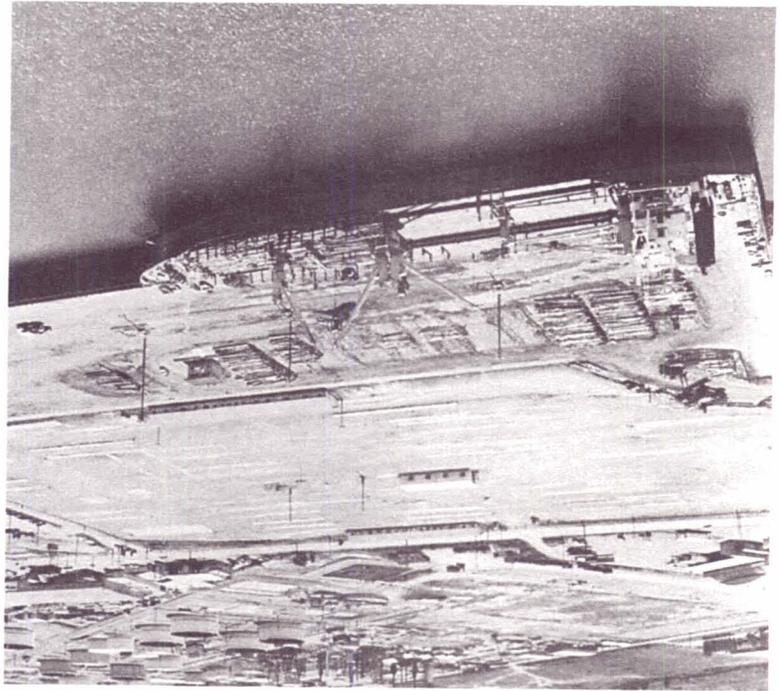
CHARACTERISTICS	BERTH
	7
Length (ft)	2,700
Depth alongside at MLW (ft)	40
Deck strength (psf)	600
Apron width (ft)	Open
Apron height above MLW (ft)	18
Number of container cranes	3
Number of wharf cranes	3
Apron lighting	Yes
Straight-stern RORO facilities	Yes
Apron length served by rail (ft)	2,700

Figure 4. Berth characteristics for Evergreen and Number 7 Terminals.

Figure 5. Berth characteristics for Alaska (Totem) and Blair Terminals.

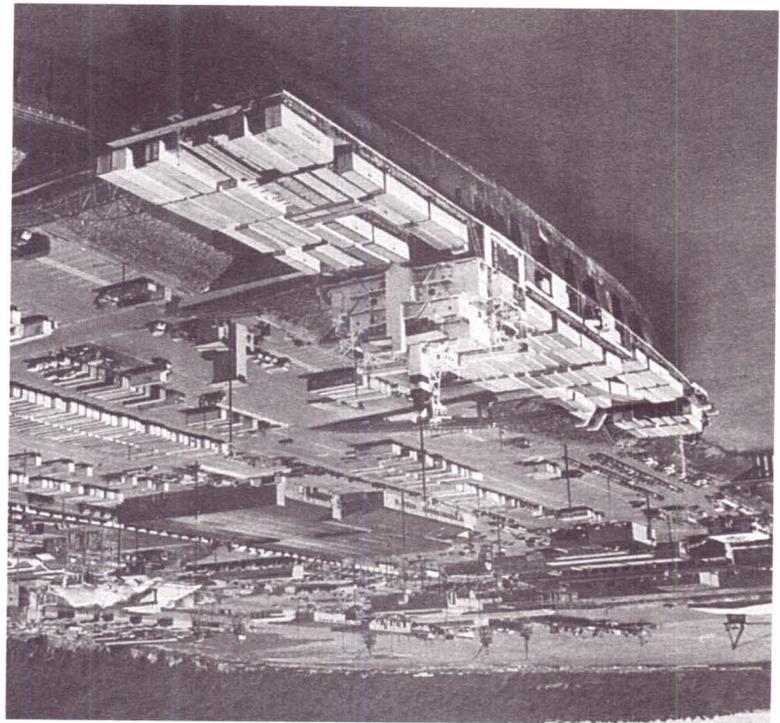
CHARACTERISTICS	
Blair	
Length (ft)	1,200
Depth alongside at MLW (ft)	35
Deck strength (psf)	1,000
Apron width (ft)	Open
Apron height above MLW (ft)	22
Number of container cranes	0
Number of wharf cranes	0
Apron lighting	Yes
Straight-stern RORO facilities	No
Apron length served by rail (ft)	0

BLAIR TERMINAL



CHARACTERISTICS	
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

TOTEM OCEAN TRAILER EXPRESS TERMINAL





### 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 characteristics 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

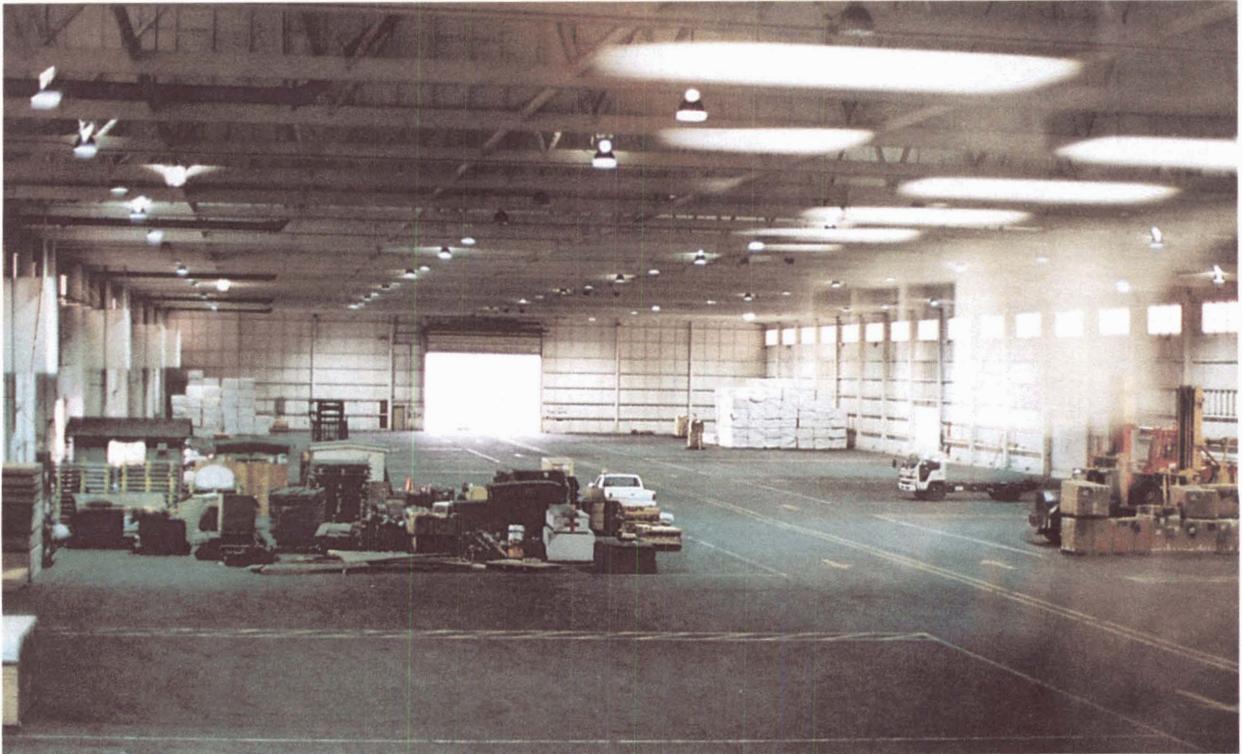
TERMINAL	OPEN STAGING ACREAGE	BERTH(S) SERVED
Maersk	40	All
Evergreen	26	All
Seven	79	All
Alaska	33	All
Sea-Land	86	All
Blair	10	All
Pierce County	147	All



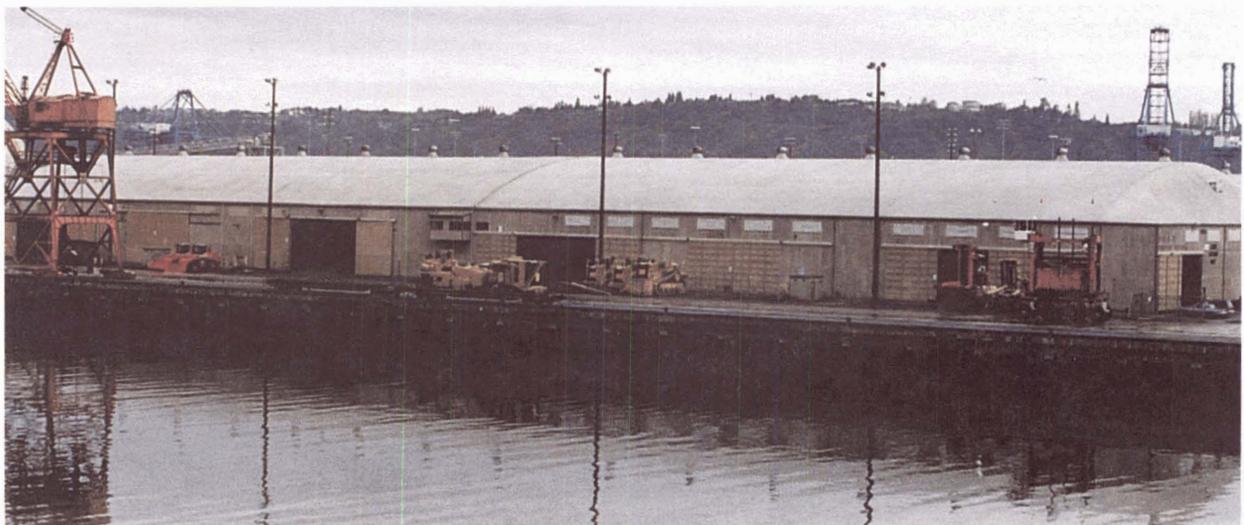
Open Staging Area at Pierce County Terminal (southeastward view)

## 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.

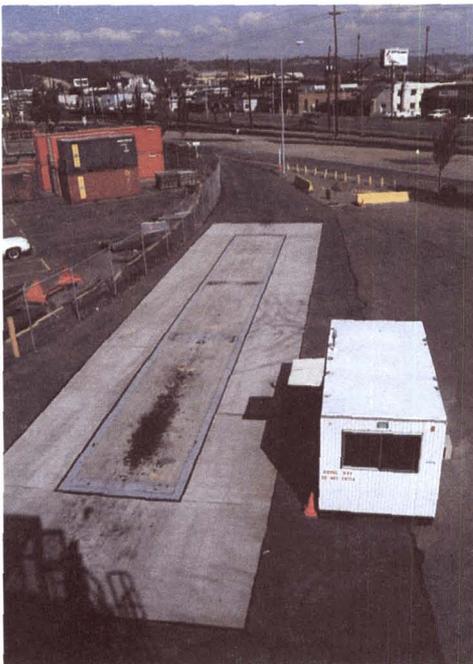
## Unloading/loading Positions

### 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



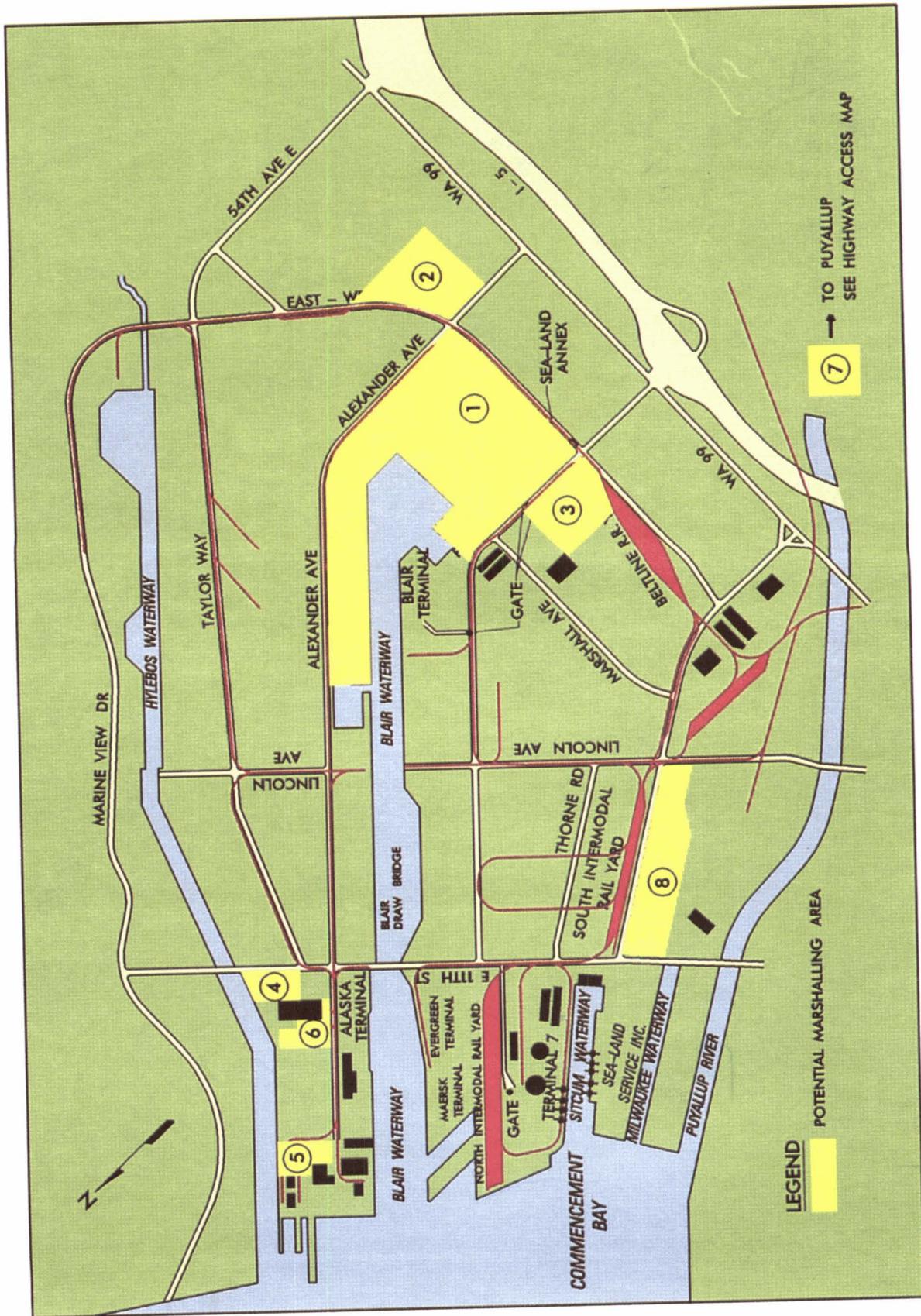
Dock Operations at Container Freight Station Behind Terminal 7 (north view)

## 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 Marshalling Areas

## 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.



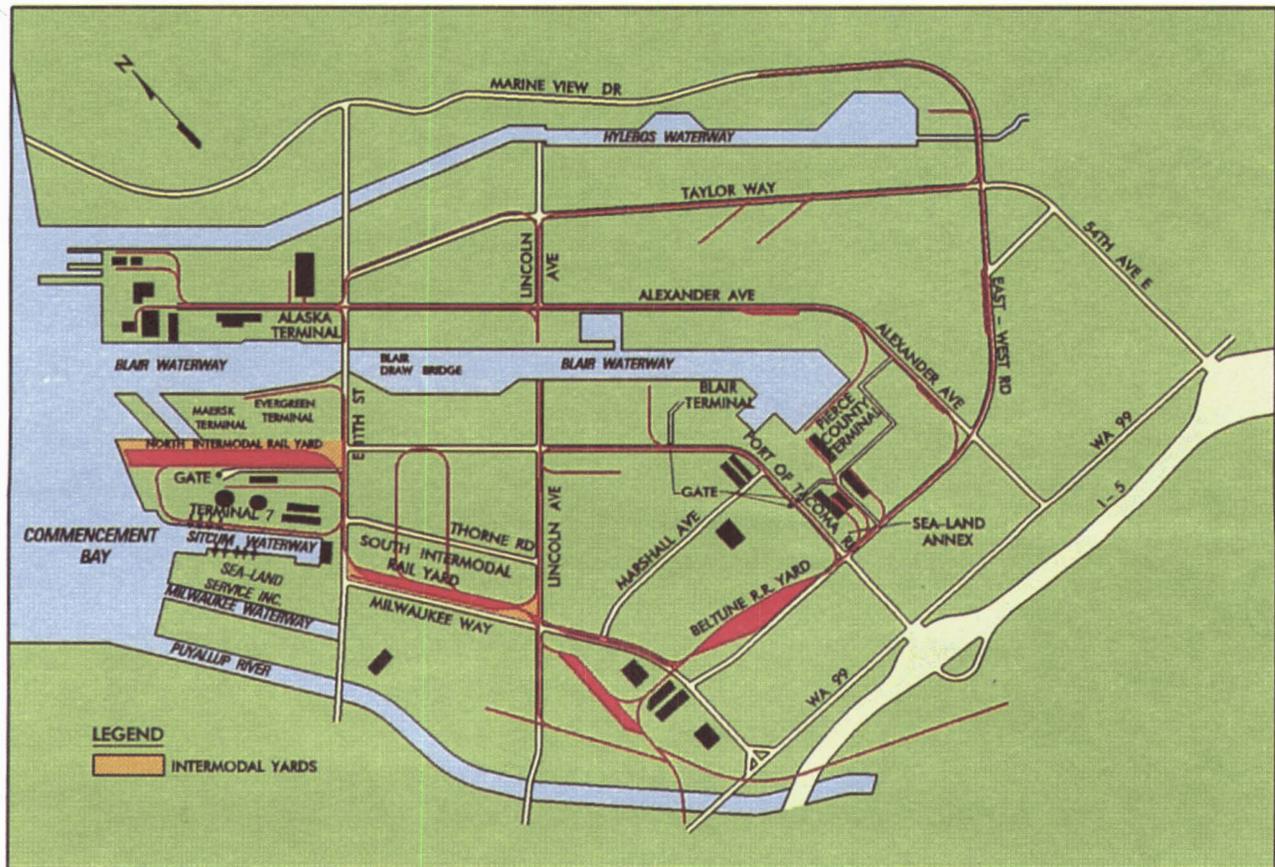
Straddle Carriers



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.



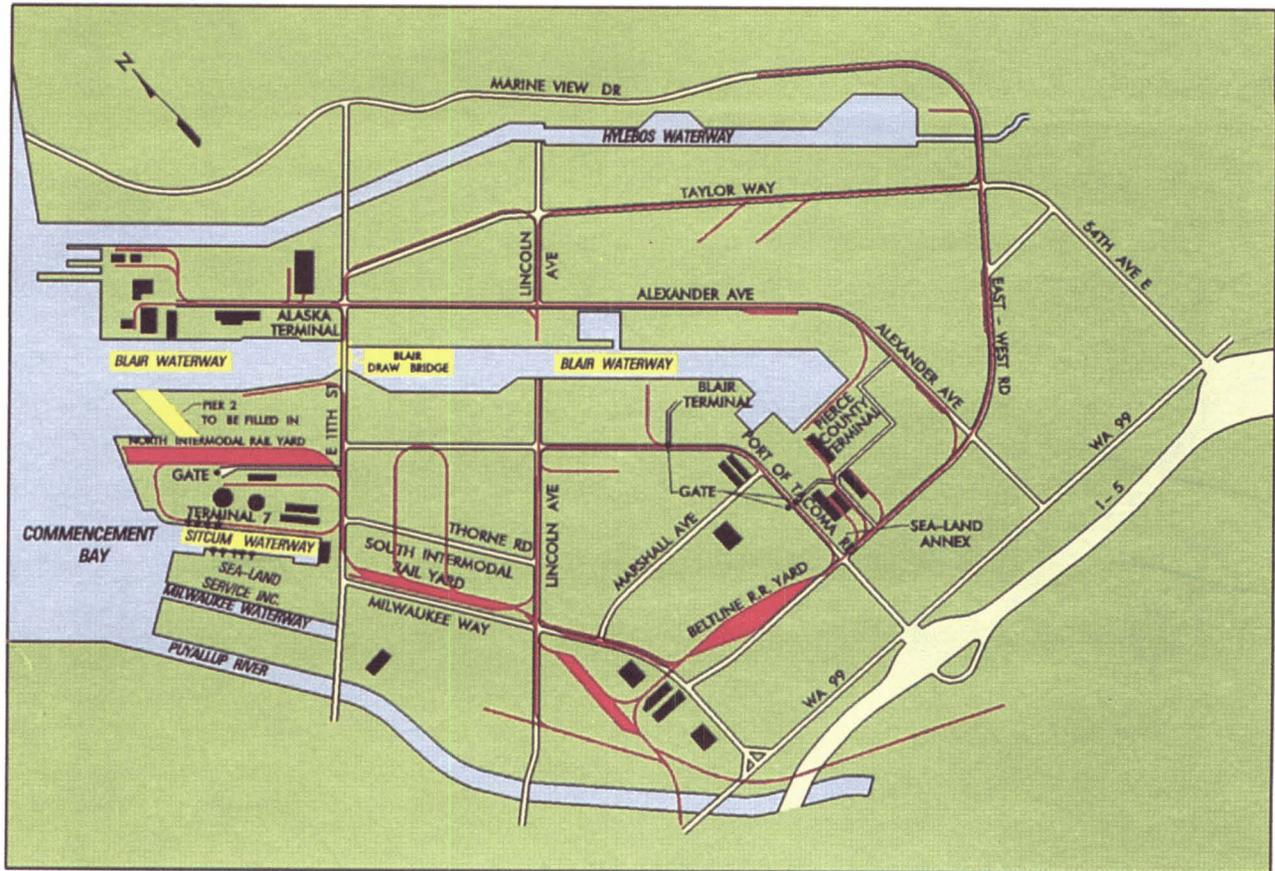
South Intermodal Railyard

## 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.

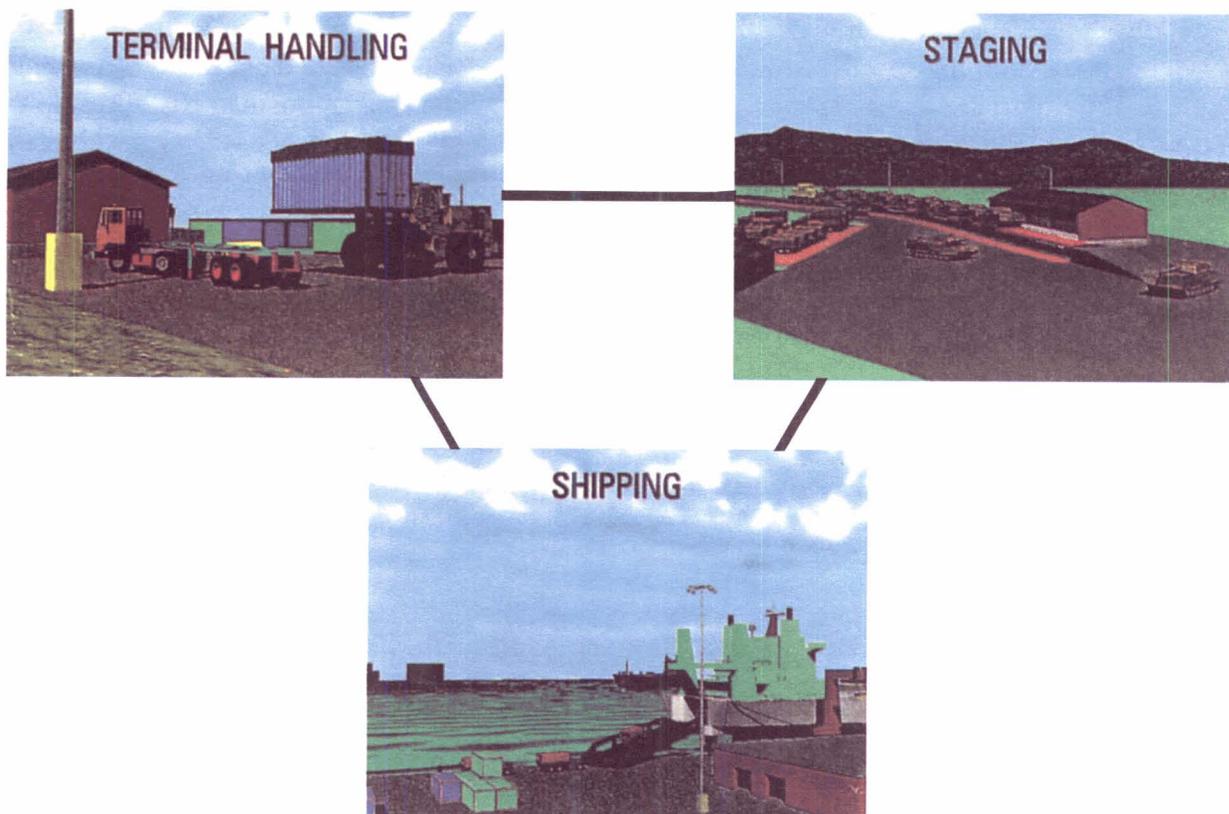


Future Development

## II. THROUGHPUT ANALYSIS

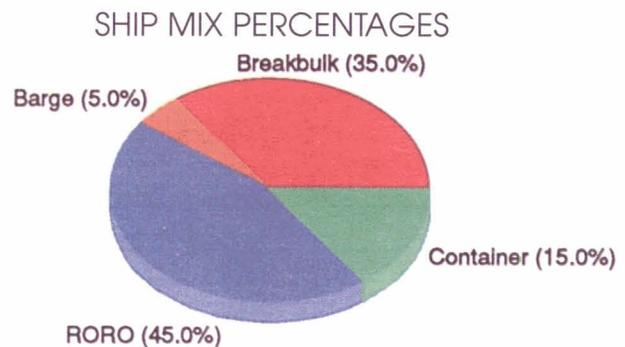
### GENERAL

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.



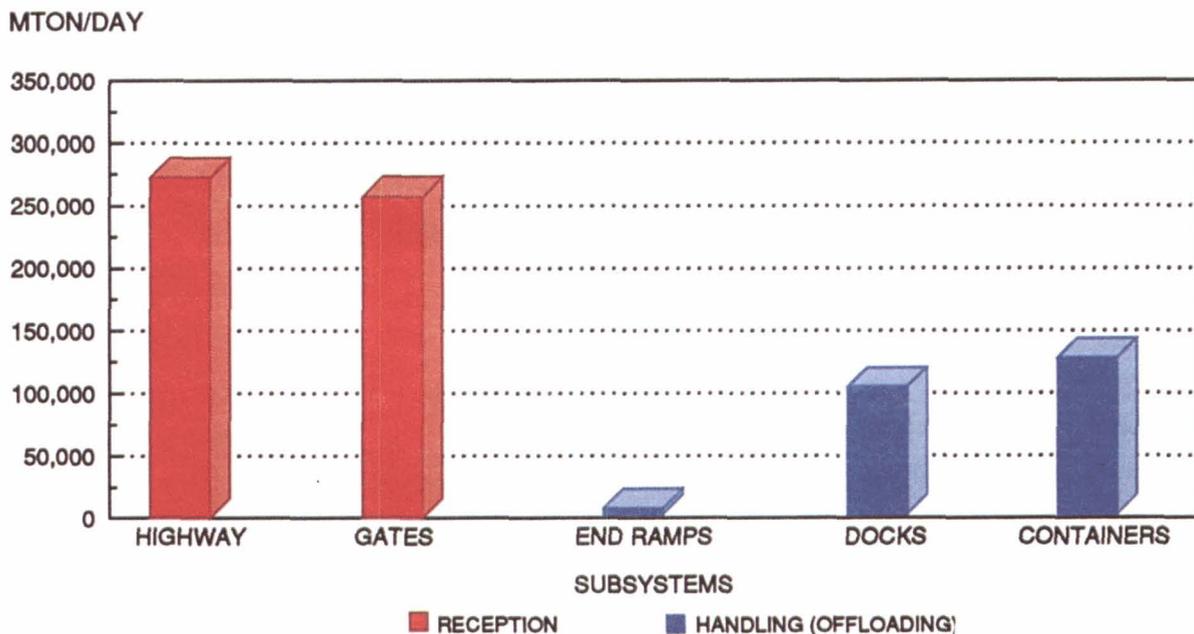
## TERMINAL RECEPTION/HANDLING

### 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.

HIGHWAY RECEPTION/HANDLING CAPABILITY

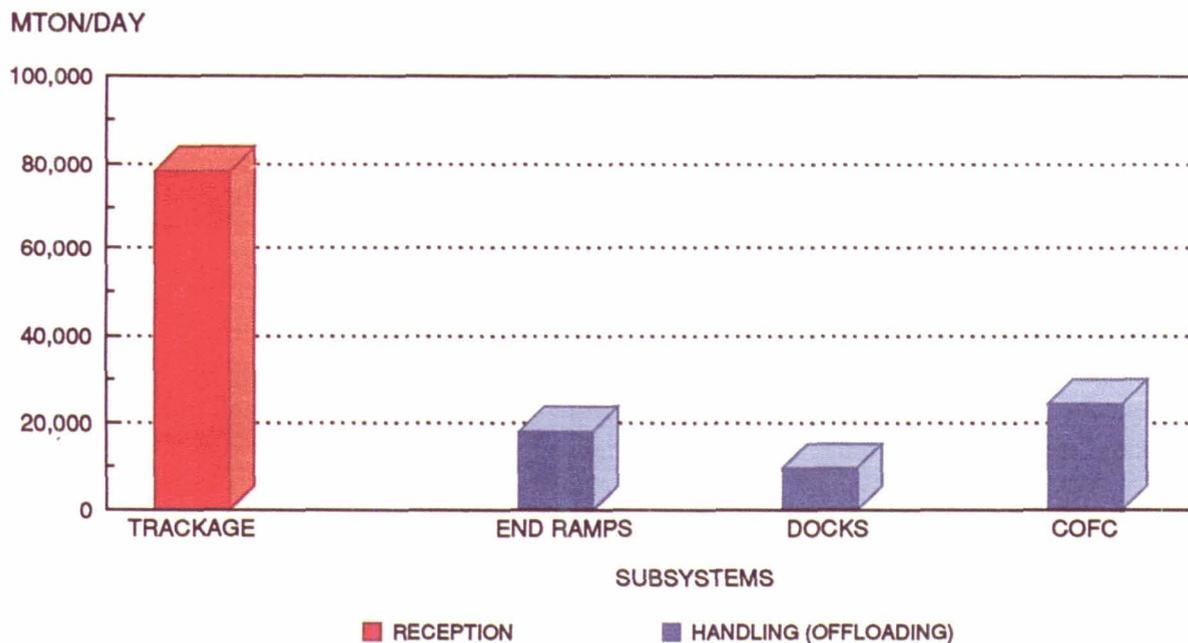


## Rail

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).

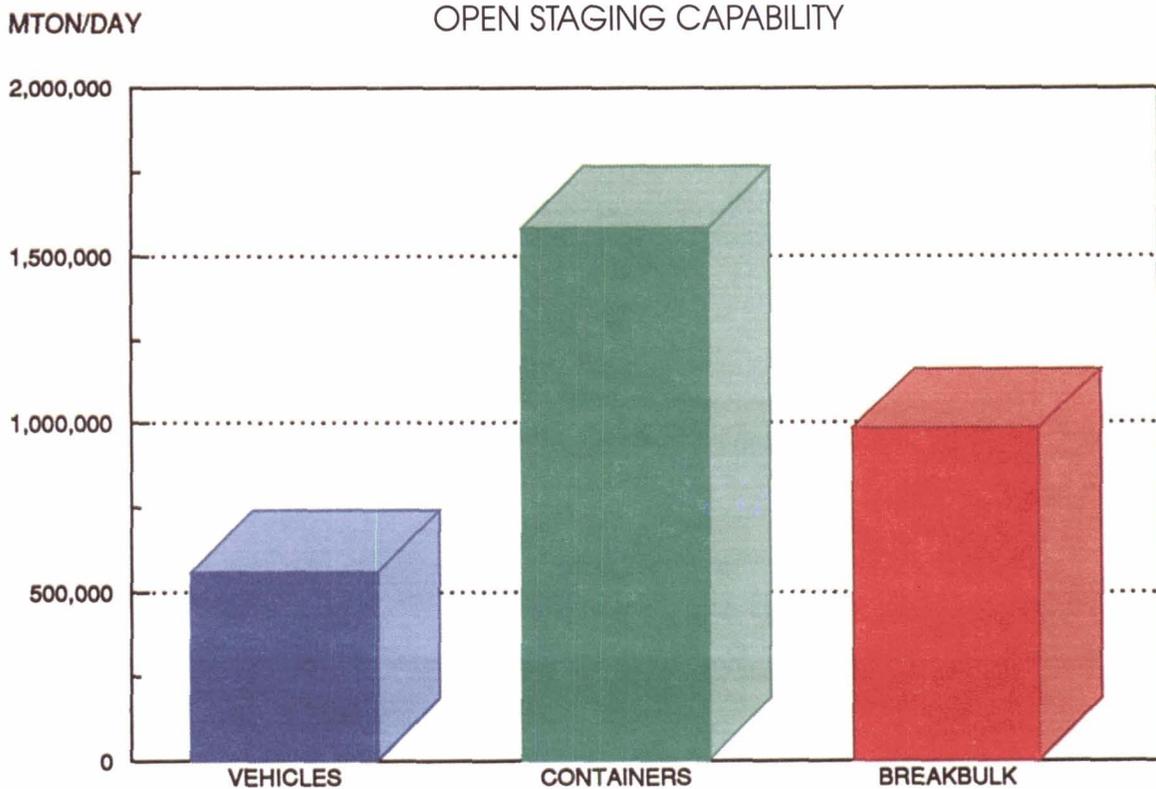
Vehicles on flatcars could offload at three locations using two portable end ramps and the fixed end ramp at the nearby BN railyard. For this study, we assumed one of the portable end ramps would be used for offloading semitrailers, leaving two end ramps for offloading railcars. Boxcars could offload at the transit sheds, where about 58 rail handling positions are available. Containers would offload at any of the container handling facilities.

RAIL RECEPTION/HANDLING CAPABILITY



## 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

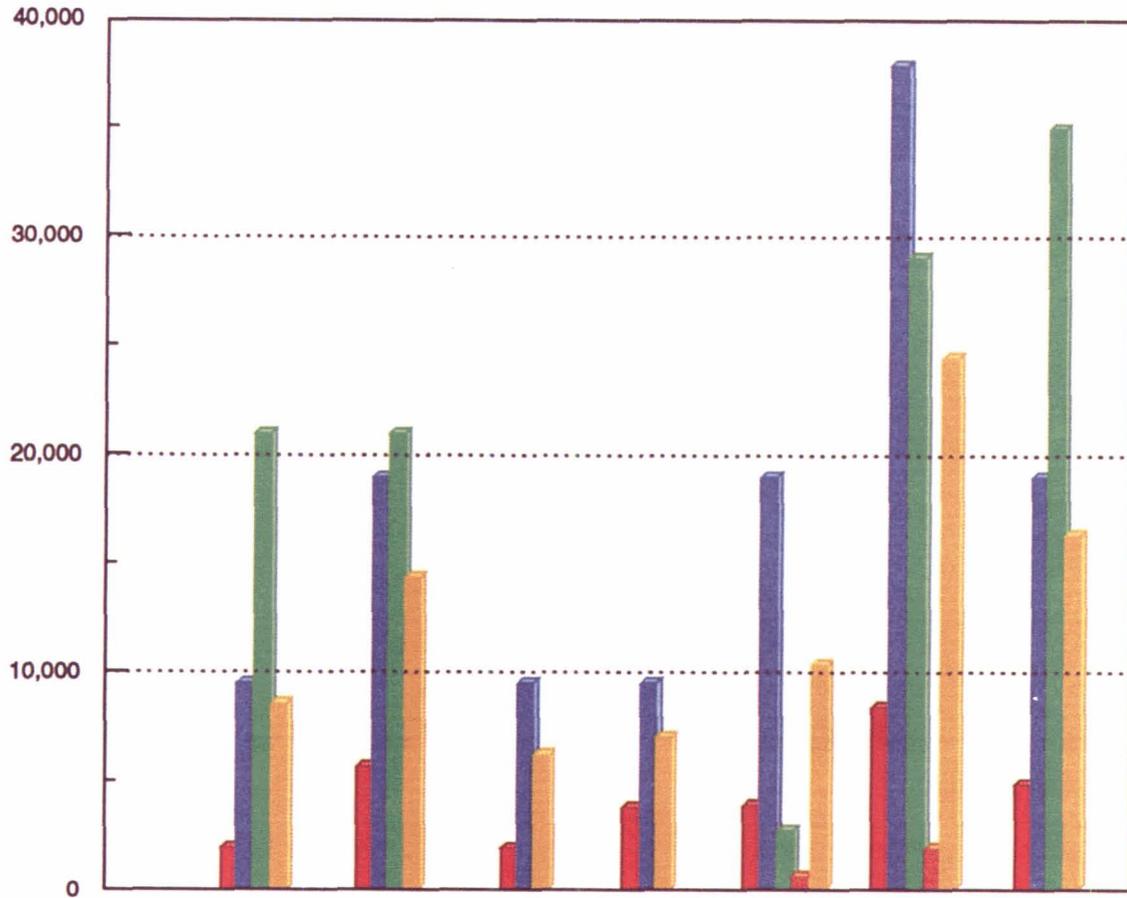
We identified the throughput capability per berth in MTON per day for breakbulk, RORO, container, and mixed vessels. Various factors, including MHE used; loading, operational, and berth usage rates; and berth/ship compatibility, provide the basis for these results.

### CONVERSION FACTORS

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

## BERTH THROUGHPUT CAPABILITY

MTON/DAY



BERTH	MAERSK	EVERGREEN	ALASKA	BLAIR	PIERCE CO.	SEVEN	SEA-LAND
BREAKBULK <span style="color: red;">■</span>	1,858	5,574	1,858	3,716	3,804	8,228	4,778
RORO <span style="color: blue;">■</span>	9,437	18,874	9,437	9,437	18,874	37,749	18,874
CONTAINER <span style="color: green;">■</span>	20,902	20,902	0	0	2,654	28,865	34,836
BARGE <span style="color: red;">■</span>	0	0	0	0	590	1,769	0
MIXED <span style="color: orange;">■</span>	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

<i>LOADING TYPE</i>	<i>TERMINALS</i>						
	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

NOTE: 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
<b>Breakbulk</b>							
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
<b>Seatrain</b>							
GA and PR-class	1	3	1	2	2	4	2
<b>Barge</b>							
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
<b>RORO</b>							
Comet	d,i,j	d,i,j	ij	d,i,j	ij	ij	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	ij	d,i,j	ij	ij	d,i,j
AmEagle/Condor	ij	ij	ij	ij	ij	ij	ij
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	ij	ij	ij	ij	ij	ij	ij
Cape H-class	g	g	g	a,g	g	3,i	2,i
<b>Container</b>							
C6-S-1w	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
<b>Combination</b>							
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		h = no shore-based ramps available					
b = inadequate apron width		i = insufficient ramp clearance at low tide					
c = inadequate berth length		j = insufficient ramp clearance at high tide					
d = no straight stern-ramp facilities		k = excessive ramp angle at low tide					
e = no container-handling equipment		m = excessive ramp angle at high tide					
f = inadequate berth depth, adequate anchorage depth		n = parallel ramp operation only					
g = inadequate channel depth		o = insufficient apron width for side-ramp operation					
Note: 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 outpost 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)

