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KOREAN PORTS AND TRANSPORTATION SYSTEMS CAPABILITY STUDY

VOLUME II

THE PORTS OF KOREA

(PART I)

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has good maps of
port
main roads
→ AFs
railway.
- listing at end of best ports.
- note: problem of pop'n ☉ relative to ammo hazard.
- lack of railway
- need to rely on private yards especially for
~~ROR~~ roll on-roll off & containers.

- vol. I & III are inter & intra theater lift analysis.
- this vol is just the port data.

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EXECUTIVE SUMMARY (U)

BACKGROUND AND SCOPE

Concern over the capability of Korean seaports to support peacetime and contingency defense requirements prompted the Eighth Army, United States Forces, Korea (EUSA/USFK), to request an evaluation of Korean ports. With the approval of the Joint Deployment Agency (JDA) and Pacific Command (PACOM), the Military Traffic Management Command (MTMC) conducted an onsite evaluation of 22 Korean ports potentially suitable for military operations. This evaluation was conducted in September and October 1983.

Results of the Korean Ports and Transportation Systems Capability Study are documented in three volumes. Volumes I and III contain analyses of the intertheater and intratheater, respectively. Volume II consists of two parts. Part I, this report, provides a compendium and an analysis of the surveyed ports. Part 2 of this volume provides the throughput capabilities of each port.

The principal objectives of the port study were to:

a. Determine the adequacy of the ports to support various types of vessel discharge operations.

b. Provide an up-to-date, easily used reference of Korean port characteristics as they relate to discharging unit equipment, general resupply, and ammunition cargoes from breakbulk, roll-on/roll-off (RORO), container, and barge vessels in the US-flag and Korean-flag fleets.

c. Provide a priority listing of ports by type of operation that is best suited to meet deployment and resupply requirements.

d. Identify any suitable alternative ports and berths that could be used if some or all of the designated primary facilities were unavailable.

e. Validate port and mode clearance capabilities through analyses of vessel support systems and calculation of the resultant port throughput capability.

FINDINGS

The five ports best suited for unit equipment (UE)/general resupply and ammunition operations, in order of suitability, are:

UE/General Resupply	Ammunition
1. Pusan	1. Chinhae
2. Pohang	2. Samchonpo
3. Okpo	3. Kunsan
4. Masan	4. Pohang
5. Kunsan	5. Okpo

This rank ordering reflects a consideration of port vulnerability, operational, multiple vessel support system (VSS), and safety characteristics. A rank ordering of all surveyed ports is presented in section VII of this report.

Overall, the ports throughout Korea have excellent berthing capability for all types of vessels. However, most port terminals have neither stern-ramp RORO facilities nor truck and rail end-loading ramps for expedient transfer of heavy equipment and tracked vehicles to overland conveyances.

Many key ports have more than enough capability to handle military cargo, but no rail service to their facilities. Most rail lines terminate in the cities surrounding or at facilities near the port complexes.

Privately owned ports have some of the best facilities for berthing of and discharging military cargo from typical US-flag fleet ships. These ports are Pohang, Mipo, Yompo, Okpo, and Samchonpo.

RECOMMENDATIONS

Appropriate military and civilian authorities should implement the following recommendations immediately:

a. Use the ports designated as most suitable for military cargo operations in deployment planning consistent with local economic, political, logistical, and tactical considerations by the Korean Government and the Commander, Combined Forces Command (CFC).

b. Include stern-ramp RORO facilities in the port development projects underway at the Ports of Pusan and Masan.

c. Initiate projects to install permanent or to acquire portable end ramps for the Ports of Pusan, Pohang, Ulsan, Masan and Kusan.

d. Negotiate with appropriate Korean governmental ministries to use privately owned ports as either primary or alternative discharge sites during contingencies.

e. Initiate actions with appropriate Korean governmental ministries to provide rail spurs to key port facilities without rail access.

I. INTRODUCTION (U)

(U) GENERAL

The Military Traffic Management Command Transportation Engineering Agency (MTMCTEA), MTMC Western Area (MTMCWA), and Eighth Army (EUSA/USFK) conducted an onsite survey of 22 Korean ports in September and October 1983. The results of the Korean Ports and Transportation Systems Capability Study are documented in three volumes. Volume I addresses the intertheater portion of the analysis. Volume II consists of two parts. Part 1 of volume II, this report, provides a compendium of the surveyed ports and an analysis of the adequacy of the ports to support various types of vessel discharge operations. Part 2 of volume II provides the throughput capability of each port. Volume III provides an analysis of the capability of the Korean internal transportation network to support the throughput of cargo northward to final destinations and/or using units.

(U) BACKGROUND

The need for a reference guide on ports within Korea surfaced initially in December of 1982. At that time, the Commander of MTMC Pusan Terminal, Korea, requested MTMCWA to study all ports in Korea to determine those with the capability to discharge ammunition safely. In January 1983, a Phase I Refinement Conference on the operational plan (OPLAN) for Korea was held at the Joint Deployment Agency (JDA), MacDill Air Force Base, Florida. During this conference, shortfalls in the transportation aspects of the plan were identified. These shortfalls prompted the CINCPAC staff to request EUSA/USFK to conduct a container reception capability survey of Korean ports and upcountry terminals.

The results of this survey generated many unanswered questions about port capabilities in Korea. In March 1983, the J4 (Transportation Division), EUSA/USFK requested MTMCTEA to conduct an evaluation of 21 Korean ports. MTMCTEA accepted this task. During April to June 1983, the scope, objectives, and scheduling of the study were established. These items were briefed to the Phase II OPLAN Refinement Conferees in June 1983, and the study plan was completed. In September and October 1983, the study team conducted onsite surveys of all the requested ports.

(U) OBJECTIVES

The study objectives are to:

a. Provide an up-to-date, easily used reference of Korean port characteristics as they relate to discharging unit equipment, general resupply, and ammunition cargoes from breakbulk, roll-on/roll-off (RORO), container, and barge vessels in the US-flag and Korean-flag fleets.

b. Establish a priority listing of ports by type of operation that identifies those best suited to support deployment and resupply requirements.

c. Identify ports and berths suitable for use as alternates for the primary facilities.

d. Validate port and mode clearance capabilities through vessel support system (VSS) analyses and calculation of the resultant throughput capability of each port. (Since this information is classified "Confidential," it is presented under a separate cover as Part 2 of Volume II.)

(U) SCOPE

Initially, the study request from EUSA/USFK involved 21 ports in Korea. However, during the onsite survey, additional berth facilities were found that warranted a separate evaluation, thereby increasing the number of ports to 22. These ports are listed in table I-1 and their locations are illustrated in figure I-1.

TABLE I-1
PORTS SURVEYED

East Coast	South Coast	West Coast
Sokcho	Pusan	Inchon
Mukho	Chinhae	Changhang
Pukpyong	Masan	Kunsan
Samchok	Okpo	Mokpo
Pohang	Chungmu	
Mipo	Samchonpo	
Yompo 1/	Samil	
Ulsan	Yosu	
Onsan	Cheju 2/	

1/ This port was not identified in the initial study request; however, it was surveyed because of its potential suitability for discharging military cargo.
2/ This port is located on an island off the southern coast of Korea.

II. STRATEGIC MOBILITY (U)

(U) GENERAL

As defined in this report, strategic mobility consists of five basic elements - surface movement facilities, including ports, railroads, highways, and pipelines; airlift; sealift; pre-positioning; and traffic management of all of the foregoing elements.

These elements will be discussed briefly in this section to provide the planner with a general background on the various transportation systems available within Korea. Capabilities of these systems are provided in volume III.

Airlift, sealift, and pre-positioning are discussed in volume I and traffic management is discussed in volume III.

The data provided in these reports can be used to conduct gross and/or detailed mobility deployment planning. The reports are designed to provide planners with a uniform basis of information to maintain the continuity and uniformity required to conduct joint deployment and exercise planning.

(U) PORTS

The Korean Peninsula has about 7,992 miles of coastline with some 1,800 ports of various sizes. Only 22 of these ports are designated as first class and are open to international traffic. These first-class ports were constructed and are operated by the Korean Maritime and Port Administration (KMPA). Another 22 ports constructed by KMPA are operated and managed by local governors.

The MTMC survey included all but two of the first-class ports. The Ports of Seogwipo and Wando were not evaluated because they are totally unsuitable for large-scale military cargo discharge operations. The ports surveyed are identified in table I-1. The Ports of Mipo, Yompo, and Onsan are considered part of the Port of Ulsan, which is under the jurisdiction of the Ulsan KMPA, but were evaluated separately because of their complexity.

As mentioned previously, the ports were evaluated based on their ability to accommodate various types of vessels. Each port had to have the necessary VSS for each type of operation before it was considered capable of discharging a specific type of vessel. Six types of VSS operations were evaluated at each port - breakbulk (BVSS), container (CVSS), RORO (RVSS), lighterage or barge (LVSS), LST, and bulk POL.

The criteria for each type of VSS are as follows:

1. Breakbulk VSS

The port must have:

a. At least one berth capable of accommodating a US-flag or Korean-flag breakbulk ship.

b. Adequate open and covered storage areas for staging and storage of cargo.

c. Highway and/or rail clearance systems adequate to clear breakbulk-type cargo.

2. RORO VSS

The port must have:

a. At least one berth capable of accommodating a RORO vessel with stern, side, or slewed ramps.

b. Abundant open storage and staging/marshaling areas for rolling stock.

c. An adequate highway clearance system capable of sustaining a RORO-type operation.

3. Container VSS

The port must have:

a. At least one berth capable of accommodating a container vessel.

b. Fixed rail-mounted container cranes and supporting container equipment.

c. Large, open storage areas for containers either grounded or on chassis.

d. An adequate highway and/or rail systems capable of sustaining a container discharge and retrograde operation.

4. Barge VSS

The port must have:

a. At least one berth capable of accommodating LASH or SEABEE barges.

b. MHE available to discharge barges.

c. One tug of at least 650 horsepower and capable of towing barges.

d. An adequate anchorage for a LASH or SEABEE vessel.

e. Adequate open and covered storage areas.

f. Adequate highway and/or rail systems to clear cargo from port.

5. LST

The port must have:

a. At least one LST ramp.

b. An adequate highway system to clear vehicles and/or cargo from port.

c. An adequate marshaling area for cargo discharged by use of an LST ramp.

6. POL

The port must have:

a. A bulk POL discharge facility capable of transferring large quantities of POL from vessel to shore.

b. Adequate POL storage sites.

The type of VSS capabilities of each port surveyed are listed in table II-1. Specific details on each type of VSS operation within a port complex is discussed in sections IV through VI of this report.

(U) HIGHWAYS

Locations of roads throughout Korea have been dictated by terrain features. The major highways throughout the country are shown in figure II-1. All of the superhighways that now crisscross the country have been constructed within the last 15 years. They illustrate the nation's effort to expand and modernize its transportation network.

The three east-west superhighways traverse the north, central, and southern portions of the country, thereby linking major ports with other key urban and industrial areas. The country has three major east-west and three major north-south superhighways. Superhighway 1, which runs from Pusan north to Seoul, is the only north-south superhighway traversing the entire country. The other two superhighways (3 and 7) link the major cities of Kwangju and Masan with Taejon and Taegu, where they intersect with Superhighway 1 about halfway up the Korean Peninsula.

The most vulnerable points along these highways, indicated in volume III, include key bridges and tunnels.

(U) RAILROADS

The locations of the railroads in Korea have also been dictated largely by terrain features. The main

TABLE II-1
PORT VESSEL SUPPORT SYSTEM CAPABILITY

Port	BVSS	CVSS	RVSS	LVSS	LST	Bulk POL	Remarks
East Coast							
Sokcho	X			X			No rail access
Mukho	X		X	X			
Pukpyong	X		X	X	X		No rail access*
Samchok	X			X	X		No rail access*
Pohang	X	X	X	X	X	X	
Mipo	X		X	X			No rail access*
Yompo	X		X	X			No rail access*
Ulsan	X		X	X	X	X	No rail access*
Onsan	X		X	X		X	No rail access*
South Coast							
Pusan	X	X	X	X	X	X	
Chinhae	X		X				
Masan	X		X	X			
Okpo	X	X	X	X			No rail access
Chungmu	X						No rail access
Samchonpo	X		X	X			No rail access*
Samil	X			X		X	No rail access*
Yeosu	X			X			
Cheju	X			X	X		Island, no rail or highway access
West Coast							
Inchon	X	X	X	X	X		
Changhang	X				X		
Kunsan	X	X	X	X	X		
Mokpo	X			X	X		

*No rail access directly to port facilities; however, rail service is available at nearby locations.

east-west cross-country routes traverse the south and middle portions of the peninsula. The main north-south routes run along the east and west sides of the country, cutting across the peninsula where the terrain allows.

The Korean National Railroad (KNR) was made a separate entity from the Transportation Ministry in 1963 and has been managing the railroads since then. Korea's existing railroad network has more than 6000 kilometers (4,750 miles) of trackage. The main lines are listed in table II-2 and shown in figure II-2. At the end of 1980, the system had 2,658 railroad bridges, 424 tunnels, and 585 train stations. Currently, the major commodities carried by the KNR are anthracite (coal), cement, oil, ore, and fertilizer.

The rail network has been constructed to service national defense as well as economic needs and is, therefore, fully capable of handling military cargo. It has two height and width limitations. For trackage south of the cities of Suwon and Chechon, the maximun height of cargo or vehicles above the top of flatcars is 4600 millimeters (15.1 feet). The width is 2000 millimeters (6.6 feet) because of the cross section of tunnels. For trackage north of these cities, the corresponding height and width limitations are 4500 millimeters (14.7 feet) and 3800 millimeters (12.5 feet), respectively. This lower height limit is due to overhead electrical wires.

(U) PIPELINES

Supporting bulk petroleum operations with pipelines is beyond the scope of this report. These operations,

TABLE II-2
KOREAN NATIONAL RAILROAD STATUS

Line Number	Line Name	Line (km)	Length (mi)	Line Number	Line Name	Line (km)	Length (mi)
01	Gyeongbu	444.5	276.2	41	Bug-Jeonju	1.7	1.1
02	Jung'ang	382.7	237.8	50	Hwasun	11.1	6.9
03	Honam	259.6	161.3	51	Yeocheon	10.4	6.5
04	Jeonra	199.1	123.7	60	Yeongdong	193.6	120.3
05	Chungbug	115.0	71.5	61	Jeongseon	45.9	28.5
06	Gyeong'in	38.7	24.1	63	Samcheog	12.9	8.0
07*	Suin	46.9	29.1	65	Taebaeg	107.4	66.7
08	Janghang	143.1	88.9	68	Mugho-hang	5.9	3.7
09	Anseong	28.4	17.6	69	Bugpyeong	6.4	4.0
11	Gyeong'ui	46.0	28.6	75	Donghae-Nambu	145.8	90.6
12	Yongsan	9.4	5.8	76	Onsan	8.6	5.3
13	Gyeongweon	88.8	55.2	77	Jangsanengpo	9.2	5.7
14	Gyeongchun	87.3	54.3	78	Ulsan-hang	3.9	2.4
15	Gyo'oe	31.8	19.8	79	Goedong	5.6	3.5
16	Mang'u	4.9	3.0	81	Jinhae	22.2	13.8
19	Nampo	4.3	2.7	82	Jinsam	29.1	18.1
30	Gyeongbug	115.2	71.6	83	Daegu	34.9	21.7
31	Mun'gyeong	22.3	13.9	84	Gaya	8.3	5.2
32	Gunsan	23.1	14.4	85	Bujeon	2.2	1.4
33	Oggu	11.6	7.2	87	Uam	5.8	3.6
34	Ganggyeong	5.8	3.6	88	Gyeongjeon	315.0	195.7
35	Ga'eun	11.9	7.4				

	(km)	(mi)	(pct)
Total, all	3106.5	1,930	100.0
Total, standard-gauge	3059.4	1,901	98.5
Double tracks (all or portion of 01, 03, 05, 06, 11, & 13)	712.5	443	22.9
Electrified (all or portion of 01, 06, & 13)	98.4	61	3.2
Nonelectrified	614.1	382	19.7
Single tracks	2346.9	1,458	75.6
Electrified (all or portion of 02, 60, & 65)	319.5	198	10.3
Nonelectrified	2027.4	1,260	65.3
Total electrified tracks (double or single)	417.9	259	13.5
Total nonelectrified tracks (including narrow-gage)	2688.4	1.671	86.5
*Narrow-gage, single-track (line number 07)	46.9	29	1.5

using in-place pipelines in Korea, are briefly discussed in volume III of this report. The discussion includes the location of the Trans-Korea Pipeline (TKP) and its distribution terminals along the pipeline. Also included will be in-country storage capabilities, alternate distribution sites, and a discussion on the use of pre-positioned stocks.

(U) AIRFIELDS

Located throughout Korea is an extensive network of airfields to support passenger and general cargo requirements. These airfields are located as shown in figure II-3. Also shown in the figure is the largest type of US Air Force strategic-lift aircraft that could use each respective facility. Specific capabilities of each airfield are addressed in volume III.

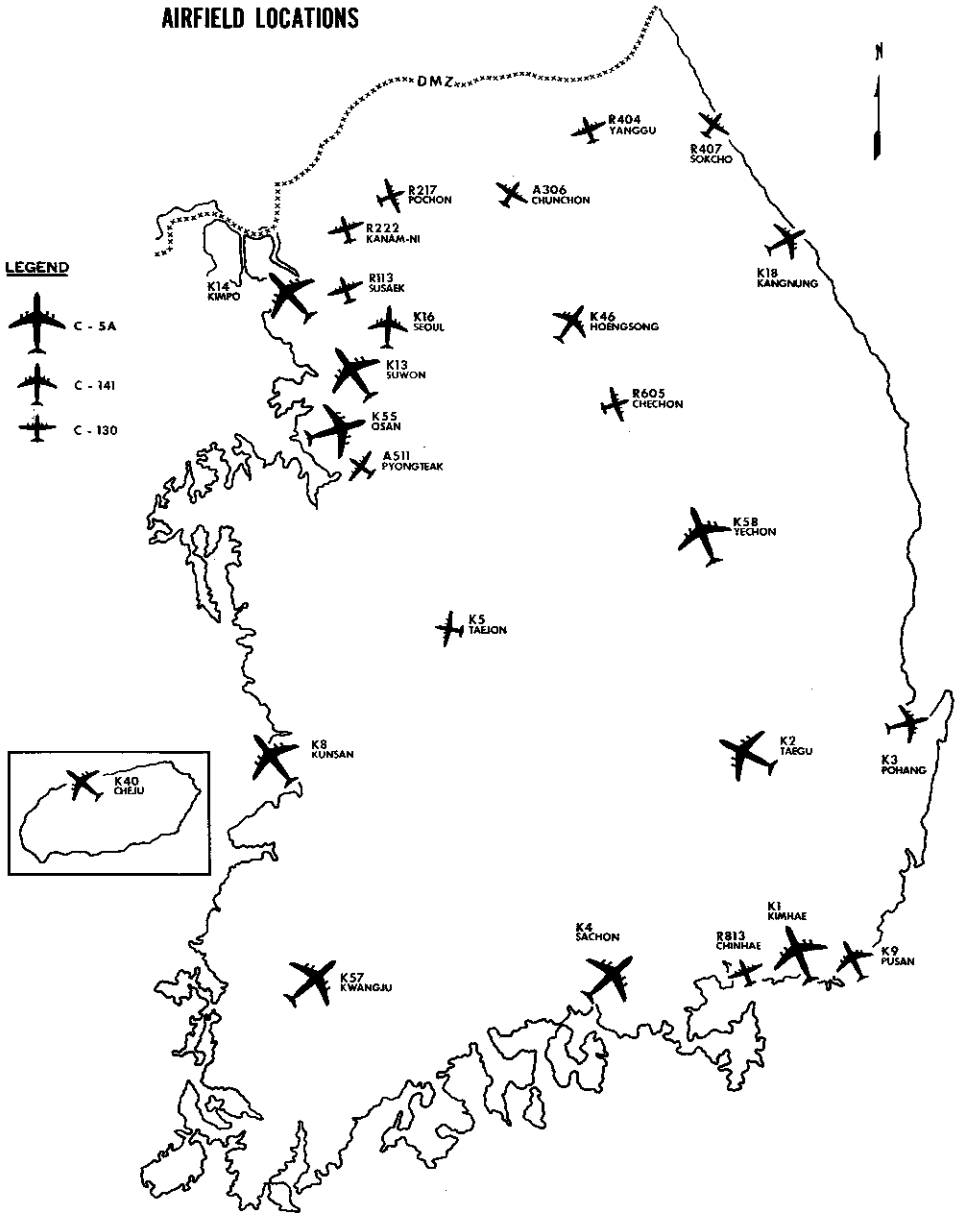


Figure II-3. Principal airfield locations.

III. METHODOLOGY (U)

(U) GENERAL

In its original tasking message, the Eighth Army requested a validation of the proposed port use and designated priorities. To accomplish this task, it was necessary to develop a detailed port assessment system using a combination of military and commercial evaluation techniques. This section outlines, in detail, the methodology for evaluating individual berths within a port, the port complex as a whole, and the port's suitability compared to other ports.

(U) PORT RANK-ORDERING SCHEME

Individual Berth Analysis

The first step of the methodology for evaluating individual berths within a port complex was an onsite survey and data collection to establish the types of VSS available at each berth. The second step involved a determination of individual berth reception capability for typical US-flag and Korean-flag ships that might call at Korean ports. These typical vessels and their respective characteristics are listed in tables III-1 and III-2. Next, ship characteristics were compared with the individual berth characteristics by a computer model. The model identified only those berths capable of receiving a particular type of vessel expediently without any extraordinary procedures or special materials handling equipment. It also indicates the number of each ship type a berth, wharf, or quay could accommodate, or lists the reasons why the berths could not accommodate a particular ship type.

TABLE III-1
SUMMARY OF SHIP CHARACTERISTICS (US-FLAG ONLY)

Vessel Type	Ship Characteristics: Length (ft)	Draft* (ft)	Speed * (knots)	Cargo Deadweight (STON)	Cargo Capacity (ft^2)
RORO					
GTS Callaghan	694	29	25	10,356	167,537
USNS Comet	499	27	18	9,055	86,478
Maine-class	684	34	23	16,920	151,348
Barge					
LASH C8-5-81B	820	41	22	39,435 MTON	56,224
SEABEE C8-5-83A	876	39	20	46,501 MTON	103,455
LASH barge	61.5	8.6	NA	490 MTON	1,757
SEABEE barge	97.6	10.7	NA	978 MTON	-
Seatrain					
Georgia-class	557	27	16.5	10,039	73,665
Puerto-class	560	27	16.5	10,337	67,997
Breakbulk					
C4 Mariner-class	564	31	20	11,004 to 11,763	65,606 to 72,959
C4-5-58a	572	31	20	9,725	61,267
C3-5-38a	492	28	18	8,744	59,839
C3-5-33a	483	29	18	9,146	54,568
Container					
C6-S-1W	661	29	20	695 (cntnrs)	164,307
C7-5-68E	701	32	22	990 (cntnrs)	183,083
C8-S-85B	669	33	23	958 (cntnrs)	168,903
RORO/Container					
C5-S-78	601	34	24	834 (cntnrs)	158,602
T-AKR (SL-7)	946	34.1	33	24,650	217,600
Breakbulk/Container					
C5-S-37E	592	30	17	30 (cntnrs)	51,592
C4-S-10	564	32	20	359 (cntnrs)	22,189

*Drafts and speeds are maximum characteristics based on loaded vessels and full speeds respectively.

With the receiving capability known, the type of vessel support systems to be evaluated at each berth was determined. Each VSS operation has ideal factors for evaluating a berth. The factors for breakbulk/RORO, container, and barge VSS operations are shown in tables III-3 through III-5, respectively. As shown in the tables, points were assessed for each factor and

TABLE III-2
SUMMARY OF SHIP CHARACTERISTICS (KOREAN-FLAG ONLY)

Vessel Type	Ship Characteristics: Length (ft)	Draft (ft)	Cargo Capacity (MTON)
Breakbulk*			
Type 1	115	10	2,000
Type 2	244	15	2,856
Type 3	252	16-17	2,677
Type 4	286	18	3,324
Type 5	286	19-20	3,839
Type 6	360	22	6,479
Type 7	419	26	11,614

*Vessel types are designated in numerical sequence for Korean-flag ships because specific vessel designations by type of class were unavailable.

used as the basis for comparing the suitability of, and for ranking, individual berths within a port complex. Berths with the highest total points will be ranked as the best within a port complex, and a rank ordering will be established for each type of VSS operation within a port complex.

The military cargo (unit equipment, general resupply, and ammunition) is unique. Therefore, to determine the suitability of a port to discharge military cargo requires an analysis of different characteristics and physical support systems. The criteria for unit equipment and general resupply are basically the same; however, when ammunition is to be discharged, safety becomes a primary criterion. Thus, ammunition discharge operations must be analyzed separately. The

TABLE III-3
IDEAL BREAKBULK/
RORO BERTH FACTORS

Berth Factor	Points		Berth Factor	Points
Berth Length (ft)			**Deck Loading (lb/ft^2)**	
750 >	20		800 >	10
700 - 750	18		600 - 800	8
600 - 700	16		500 - 600	5
500 - 600	10		500 <	1
500 <	5			
			Heavy-Lift Cranes (tons)	
Water Depth (ft) MLW				
			100 >	10
35 >	20		50 - 100	9
32 - 35	18		30 - 50	7
30 - 32	16		10 - 30	5
28 - 30	14		10 <	3
28 <	12		None	0
			Berth	
Backup Area (ft^2)				
			Quay or marginal	10
400,000 >	10		Pier	8
300,000 - 400,000	8			
200,000 - 300,000	5		**Truck Tailgate**	
100,000 - 200,000	2			
100,000 <	1		Full length of house	9
			At end of house	4
Apron Width (ft)	BB	RORO		
			Rail End Ramp	
60 >	20	20		
40 - 60	18	18	Yes	6
30 - 40	14	5	No	0
20 - 30	10	0		
20 <	2	0	**Truck Access**	
Transit Shed (ft^2, not rated for RORO)				
			Direct to superhighway	10
90,000 >	10		Direct to national highway	9
50,000 - 90,000	6		Direct to city arterial	8
50,000 <	2		Direct to city street	5
			Unsuitable for military equipment	0
Distribution Shed (ft^2, not rated for RORO)			**Ship Service Facilities**	
			Power, water, & sewer	6
30,000 >	10		Power & water	5
20,000 - 30,000	6		Water only	4
20,000 <	2			
			Conditional Age of Facility	
Apron Tracks				
			Condition of structures determines effectiveness.	
2	10		Reduces or increases effectiveness of other factors by maintenance.	
1	7			
No track	0		New	10
			10 years old	8
RORO Stern Ramp (not rated for BB)			25 years old	5
			50 years old	3
Yes	10			
No	5			

TABLE III-4
IDEAL CONTAINER BERTH FACTORS

Berth Factor	Points
Berth Length (ft)	
1,000 >	20
900 - 1,000	18
800 - 900	16
700 - 800	10
600 - 700	6
600 <	2
Water Depth (ft) MLW	
40 >	20
35 - 40	18
32 - 35	16
30 - 32	10
30 <	6
Backup Area (ft^2)	
400,000 >	20
300,000 - 400,000	16
200,000 - 300,000	10
100,000 - 200,000	4
100,000 <	2
Apron Width (ft)	
60 >	10
40 - 60	9
30 - 40	5
20 - 30	2
20 <	1
Consolidation Shed (ft^2)	
30,000 >	10
20,000 - 30,000	6
20,000 <	2
Apron Tracks	
2	10
1	7
No track	0
Materials Handling Equipment	
Stradle cranes	10
Stradle trucks	9
Front/Side loading forklifts	8
Mobile cranes	5

Berth Factor	Points
Deck Loading (lb/ft^2)	
1,000 >	10
800 - 1,000	8
600 - 800	5
500 - 600	3
500 <	1
Heavy-Lift Cranes (tons)	
300 > Mobile gantry	10
40 - Specialized cntnr crane	10
300 - Mobile crane	7
140 - Mobile crane	5
40 < Specialized cntnr crane	7
None	0
Berth	
Quay or marginal	10
Pier	5
Truck Tailgate	
Full length of house	9
At end of house	4
Rail End Ramp (Piggyback)	
Yes	6
No	0
Truck Access	
Direct to superhighway	10
Direct to national highway	9
Direct to city arterial	8
Direct to city street	5
Unsuitable for military equipment	0
Ship Service Facilities	
Power, water, & sewer	6
Power & water	5
Water only	4
Conditional Age of Facility	
Condition of structures determines effectiveness.	
Reduces or increases effectiveness of other factors by maintenance	
New	10
5 years old	8
10 years old	7
20 years old	5

port rank-ordering scheme used in evaluating the capability of Korean ports for ammunition and general cargo discharge operations is graphically shown in figure III-1.

As shown in figure III-1, the port berth ratings are the first step in the process. They are followed by an individual port assessment, based on an aggregation of port factors, to provide a single operational rating for each port. Table III-6 lists the operational factors considered during the evaluation of an individual port. Again, a point system is used to establish the relative suitability of a port from an operational standpoint. The factors listed in table III-6 are based on the primary concern of maximizing the amount of cargo cleared through a port.

The final criterion for each port is a safety analysis of an ammunition discharge operation to be conducted somewhere within the port. The critical factor is the ability of the port to meet the criteria imposed by the Department of Defense Safety Board (DODSB). These criteria restrict the areas where ammunition may be handled to those that would cause the least risk or hazard to the local population. The determinant of this hazard is the size of the affected population and the type of development within set quantity-distance (Q-D) arcs.

Q-D arcs were calculated based on three representative vessel types that could call at a Korean port. Full ammunition shiploads for each vessel type were assumed and the resultant net explosive weight (NEW) was calculated. The 1983 ammunition mix requirement provided by the military services was the basis for this calculation. The NEW figures were applied to the DOD Q-D tables to determine recommended separation requirements for inhabited buildings and public traffic routes. These distances are shown in table III-7.

For every port evaluated, berths were selected where ammunition most likely would be discharged. Then, based on the largest or most probable type of vessel that could be berthed there, a Q-D arc was assigned. Every site map of the ports evaluated shows these Q-D arcs, with radii corresponding to Q-D standards. Residential, commercial, and industrial developments and the affected population within the Q-D circles were identified and then compared to determine the relative safety hazard to the population and industry at each port. Schools, hospitals, bridges, narrow ship channels, and military installations also were identified. In addition, petroleum refineries, chemical plants, and power stations, which have the potential to compound the effects of an ammunition explosion, were identified. These and other national interest factors are included in the overall analysis of the ports. Ratings ranging from 1 to 22, with 22 being the least hazardous, were assigned to each port.

Overall Port Analysis

This step is the second phase in validating port use and designated priorities. As in the first phase, type of cargo discharge operation being conducted must be evaluated separately.

As shown in figure III-1, the overall port analysis applies weighted factors in determining the overall ammunition and general port rankings. These factors, or criteria, are each allocated a certain percentage

TABLE III-5
IDEAL BARGE BERTH FACTORS

Berth Factor	Points
Berth Length (ft)	
500 >	10
300 - 500	8
200 - 300	6
100 <	3
Water Depth (ft) MLW	
20 >	10
15 - 20	9
10 - 15	8
10 <	0
Backup Area (ft^2)	
200,000 >	10
100,000 - 200,000	8
100,000 <	5
Apron Width (ft)	
60 >	10
40 - 60	9
35 - 40	7
20 - 30	5
20 <	0
Consolidation Shed (ft^2)	
30,000 >	10
20,000 - 30,000	6
20,000 <	2
Apron Tracks	
2	10
1	7
No track	0
Anchorage Diameter (ft)	
1,000 >	10
900 - 1,000	9
800 - 900	8
700 - 800	5
700 < or in open seas	1
Age of Facility (yrs)	
New	10
5 - 10	9
10 - 20	7
20 >	5

Berth Factor	Points
Deck Loading (lb/ft^2)	
800 >	10
600 - 800	9
400 - 600	5
400 <	2
Heavy-Lift Cranes (tons)	
100 >	10
50 - 100	9
30 - 50	7
10 - 30	5
10 <	3
None	0
Berth	
Quay or marginal	10
Pier	5
Truck Tailgate	
Full length of house	9
At end of house	4
Rail End Ramp	
Yes	6
No	0
Truck Access	
Direct to superhighway	10
Direct to national highway	9
Direct to city arterial	3
Direct to city street	5
Unsuitable for military equipment	0
Tug Availability of 650 hp or greater	
4 >	10
3 - 4	9
2 - 3	8
1 - 2	5
1	3
None	0
Barge Lay Area (No. of barges)	
30 - 40	10
20 - 30	9
10 - 20	6
10 <	3

TABLE III-6
OVERALL PORT OPERATIONAL FACTORS

Port Factor	Points	Port Factor	Points
Berth Rating		Rail Access	
5 or more berths with 90 points	10	2 apron tracks	10
4 berths with 90 points	9	1 apron track	8
3 berths with 90 points	8	Track on port complex	5
2 berths with 90 points	7	No rail access	0
1 berth with 90 points	6		
2 or more berths with 80 points	5	Highway Access	
2 berths with 80 points	4	Direct to superhighway	10
1 berth with 80 points	3	Direct to national route	8
1 berth with 70 points	2	Direct to city arterial	6
No berths with 70 points	1	Direct to city street	4
Breakbulk Gantries		MHE Availability	
4 or more berths with shoreside gantries	10	Adequate to work every berth	10
3 berths with shoreside gantries	9	Adequate to work 80% of berths	8
2 berths wtih shoreside gantries	8	Adequate to work 60% of berths	6
1 berth with shoreside gantries	6	Adequate to work less than 50% of berths	5
No shoreside gantries	5		
Container Cranes 1/		Security 2/	
4 or more berths with container cranes	10	Secured complex	3
3 berths with container cranes	9	Lighting	2
2 berths with container cranes	8	Guards	2
1 berth with container crane	7	Lack of congestion	1
		Surveillance system	1

1/ Container crane is considered a bonus factor when evaluating a port complex as a whole. When rank ordering just breakbulk ports, this factor will not be included.
2/ Security factor point total for a port complex is considered the sum of all the subelements.

based on relative importance. The percentages that were allocated in the final analysis have been concurred with by representatives of EUSA/USFK and are as follows:

TABLE III-7
AMMUNITION SAFETY ANALYSIS FACTORS

Type of Ship	STON per Shipload	Pounds NEW per Ship-Load Million	Quantity-Distance* Meters	Feet	Remarks
Breakbulk (Medium)	8,200	2.7	2 200 (1 320)	7,210 (4,325)	These figures were chosen as the representative range for the various ship types.
RORO (Large)	12,100	4.0	2 500 (1 500)	8,100 (4,860)	
Container (Large)	16,700	5.5	2 800 (1 700)	9,085 (5,540)	

*The Q-D distance given first is the separation requirement from inhabited buildings. The figures in parentheses are the separation requirement for a public traffic route.

	Ammunition (pct)	Other (pct)
Port vulnerability	30	30
Operational capability	40	50
Safety	30	0
Dual VSS capability	0	20

In a mobilization situation, an important factor that influences port selection is the vulnerability of a port to interdiction by unfriendly forces. The farther away a port is from the forward edge of the battle area (FEBA), the greater are its chances of surviving an initial enemy thrust. Since all types of military cargo serve an important function, the percentage weight allocation for this factor is the same for all cargo.

The rating scheme used to determine the relative vulnerability of a port is shown in table III-8. As shown, three factors are used. The first and most important is the distance of the port from the FEBA. The second is the distance of the port from a major

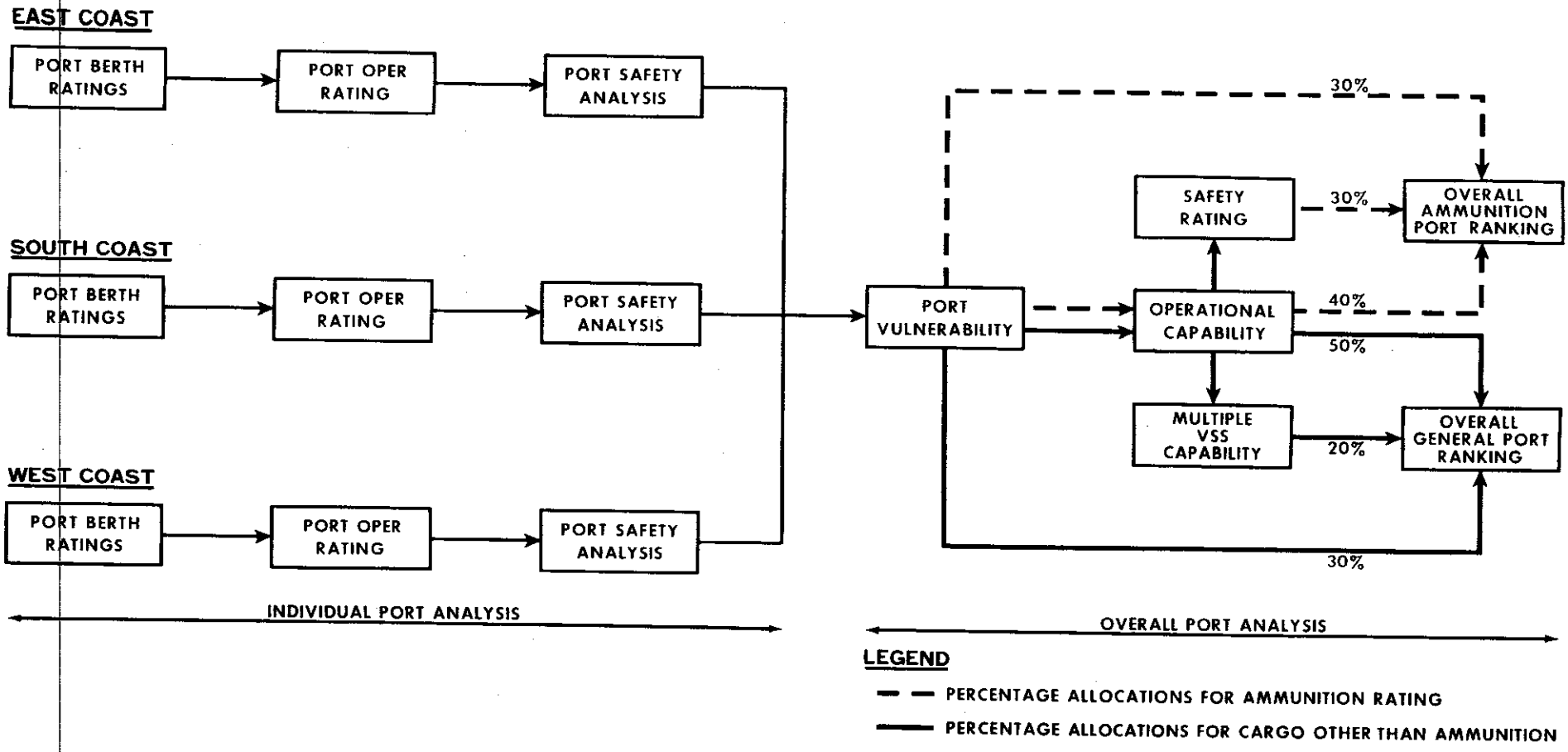


Figure III-1. Port rank-ordering scheme.

supply route (MSR), or the strategic location of the port. If a port is not located at a terminus of or along an MSR, it is usually served by a secondary roadway. These lower class roads generally have less capacity, which could limit the amount of cargo to be cleared from a port. The longer it takes to clear cargo, the more undesirable the port becomes.

TABLE III-8
PORT VULNERABILITY RATING SCHEME

Port Vulnerability Rating Factors*	
Factor	Points
Distance From FEBA (km)	
0-49	1
50-99	3
100-199	5
200-299	8
300	10
Distance From MSR (km)	
0-9	0
10-29	-1
30-49	-2
50-99	-3
100	-4
Port Mining Potential	
High	-2
Medium	-1
Low	0

*An overall rating for a port is obtained by adding points for distance from the FEBA and subtracting points for distance from MSR and enemy interdiction potential.

It is important to note that these two factors can present a tradeoff situation. For example, in order to discharge more cargo at a port located close to an MSR, it may be necessary to use a port closer to the FEBA. The rating scheme takes this into account by subtracting points for strategic location or distance from an MSR.

Finally, the potential for mining the port, either by surface craft, submarines, or aircraft, is determined based on its relative importance and location. Again, points are subtracted based on vulnerability. The results of the vulnerability analysis of the Korean ports surveyed are shown in section VII of this report.

The next step in the overall port analysis is the operational rating. These ratings are determined during the individual port analysis. At this point, the weighted percentage allocation is applied based on the type of cargo to be discharged. Here, the percentage allocations differ for ammunition and the other types of military cargo. The operational capability required to discharge ammunition is less important than for other types of military cargo because ammunition is usually easier to handle.

Ammunition is obviously more dangerous to handle than the other types of military cargo (ranging from small palletized loads to tanks weighing more than 140,000 pounds), which clearly indicates why operational capability is weighted heavier for berths or ports that would be handling cargo other than ammunition. Additionally, one of the prime considerations during wartime resupply is to maximize cargo clearance through a port. To accomplish this, a port must have

the operational capability, which is another reason this factor is given the highest weighted consideration.

Safety is given the most consideration in determining port suitability for ammunition discharge only. Safety analyses are conducted in conjunction with the individual port analysis. Overall port rank orderings are determined in Section VII, "Analysis," of this report. A 30-percent weighted allocation for safety is given in the overall ammunition port rank-ordering scheme.

Multiple VSS capability is considered as the primary factor in determining port suitability for cargo other than ammunition. Such cargo covers all classes of supply except Class V. Therefore, it is desirable for ports to have multiple means of discharging cargo, such as container systems, LST ramps, POL dolphins, RORO ramps, and other types of discharging systems. Table III-9 shows the multiple VSS rating scheme for ports handling cargo other than ammunition.

In the final analysis, port vulnerability, operational capability, and safety or multiple VSS capability are aggregated into two tables that rank orders the ports in terms of overall desirability based on the types of cargo to be cleared through a port. Section VII of this report provides the results of this procedure and establishes port priorities as tasked.

TABLE III-9
MULTIPLE VSS RATING SCHEME

Vessel Support Systems Available*	Points
Breakbulk, container, RORO, barge, LST, POL	10
Breakbulk, container, RORO, barge, LST	9
Breakbulk, container, RORO, barge	8
Breakbulk, container, barge	7
Breakbulk, container	6
Breakbulk, barge, POL	6
Breakbulk, LST	5
Breakbulk, barge	5
Breakbulk only	4
Barge only	3

*Not every possible combination is given a rating in the above listing. For unlisted combinations, multiply the number of VSS available by two to obtain points.

IV. EAST COAST PORTS (U)

(U) PORT OF SOKCHO

A. (U) General Description

1. (U) Location and General Uses. The Port of Sokcho (fig SO-1) is located on the east coast of Korea, about 32 kilometers (20 miles) from the closest point on the demilitarized zone. The port is about 160 kilometers (99 miles) east of Seoul and 277 kilometers (172 miles) north of Pusan. During the last few years, port activity has declined and the port is now only supporting the local fishing industry and handling a small volume of bulk materials such as iron ore and coal. The port is administered by the Sokcho Branch Office of the Donghae District Maritime and Port Authority, which is itself under the purview of the Korean Maritime and Port Administration.

2. (U) Harbor. The port has two harbor areas, referenced as inner harbor (Chong-cho Lake) and outer harbor. Inner harbor is naturally protected from the open waters of the Sea of Japan by a strip of land that runs in a north-south direction, forming the harbor's eastern boundary. A 175-meter (574-foot) breakwater is located on the north end of this peninsula to further protect inner harbor. Outer harbor is artificially formed by a 577-meter (1,893-foot) breakwater. The breakwater forms the eastern boundary of the harbor and provides some protection to the harbor during bad weather and rough seas. The breakwaters are concrete, covered with tetrapods for additional protection. Both breakwaters are currently being extended to provide better protection for ships in outer harbor. Neither harbor is considered a safe haven for ships during adverse weather conditions.

The access channel from the Sea of Japan to outer harbor is 150 meters (492 feet) wide and has a channel depth of 10 meters (32.8 feet). The inner harbor channel is 90 meters (292 feet) wide and has a 4-meter (13.1-foot) draft. There are no overhead clearance obstructions on either channel. The draft in inner harbor is shallow, varying from about 4 to 5 meters (13.1 to 16.4 feet) in the north end near the berths to 1 to 3 meters (3.3 to 9.8 feet) throughout the remainder of the harbor. The draft throughout outer harbor averages about 8 meters (26.2 feet). The mean tidal range in both harbors is 0.2 meter (8 inches).

Silting is not a major problem in inner harbor or outer harbor, but dredging is required periodically at the mouth of the river that empties into inner harbor. The berths and channels throughout the port are dredged as needed to maintain water depths. They were last dredged in 1981.

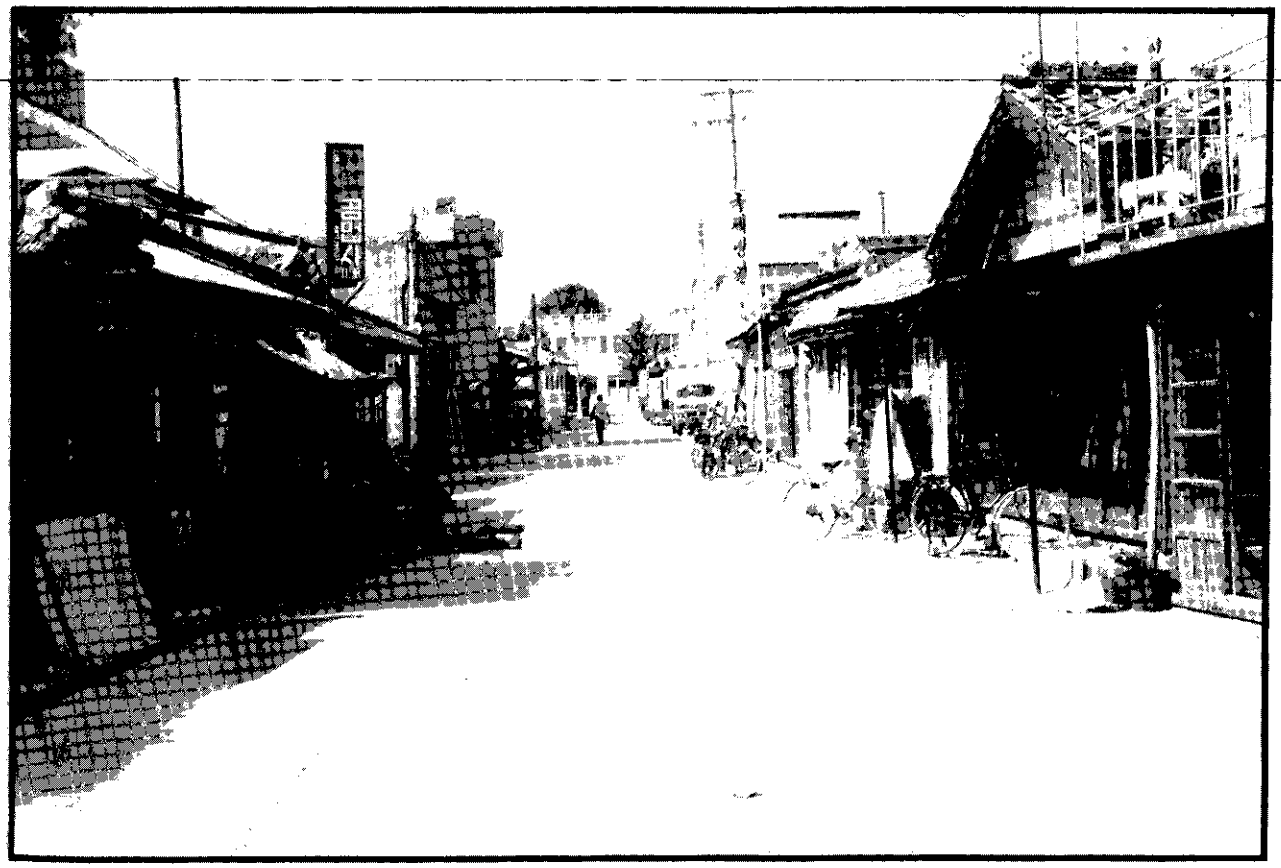
Although turning basins have not been officially designated in either harbor, adequate space is available in both harbors for turning basins with 170-meter (558-foot) diameters. The draft available in these turning basins would be 5 meters (16.4 feet) in inner harbor and 8 meters (26.2 feet) in outer harbor. Use of the outer harbor turning basin would block access to the port and would make all ship movements in the harbor channels impossible.

No anchorages are available in either of the harbors and no anchorages suitable for deep-draft ocean vessels have been designated outside the harbor limits in the Sea of Japan. However, outside the breakwaters in the Sea of Japan, anchorages could be created for deep-draft vessels. However, sea anchorages are unprotected and subject to easterly gales and sea swells.

3. (U) Highway Access. The major highway access to the town and Port of Sokcho is Korean Route 7, a two-lane rural road spanning the entire east coast of Korea. The route goes through the central business district of Sokcho. While heavy pedestrian and vehicular traffic hinders movement on that portion of the route, there is still suitable access for military unit equipment and other large truck traffic. All access roads (fig SO-2) from Korean 7 to the various berths also run through densely populated commercial and residential areas, but are too narrow and congested to permit passage of unit equipment or large supply trucks. Without improvements to highway access, the Port of Sokcho is not recommended for military operations.

4. (U) Rail Access. The city of Sokcho does not have rail access because the east coast routing of the Korean National Railroad terminates 69 kilometers (43 miles) south of Sokcho in Kangnung. Since the Kangnung Railroad Station provides the closest rail facilities to the Port of Sokcho, rail access to support military operations at the port is not adequate. The substructure for a railroad track from Kangnung to Sokcho, including a prepared track bed and piers and abutments for bridges, was constructed sometime prior to 1945 and remains in place today.

5. (U) Airports. The airport closest to the Port of Sokcho is located about 7 miles south of the port, along Korean 7. The runway is asphalt and measures 1220 meters (4,000 feet) long and 24 meters (80 feet) wide. The airport is capable of supporting only intratheater aircraft.



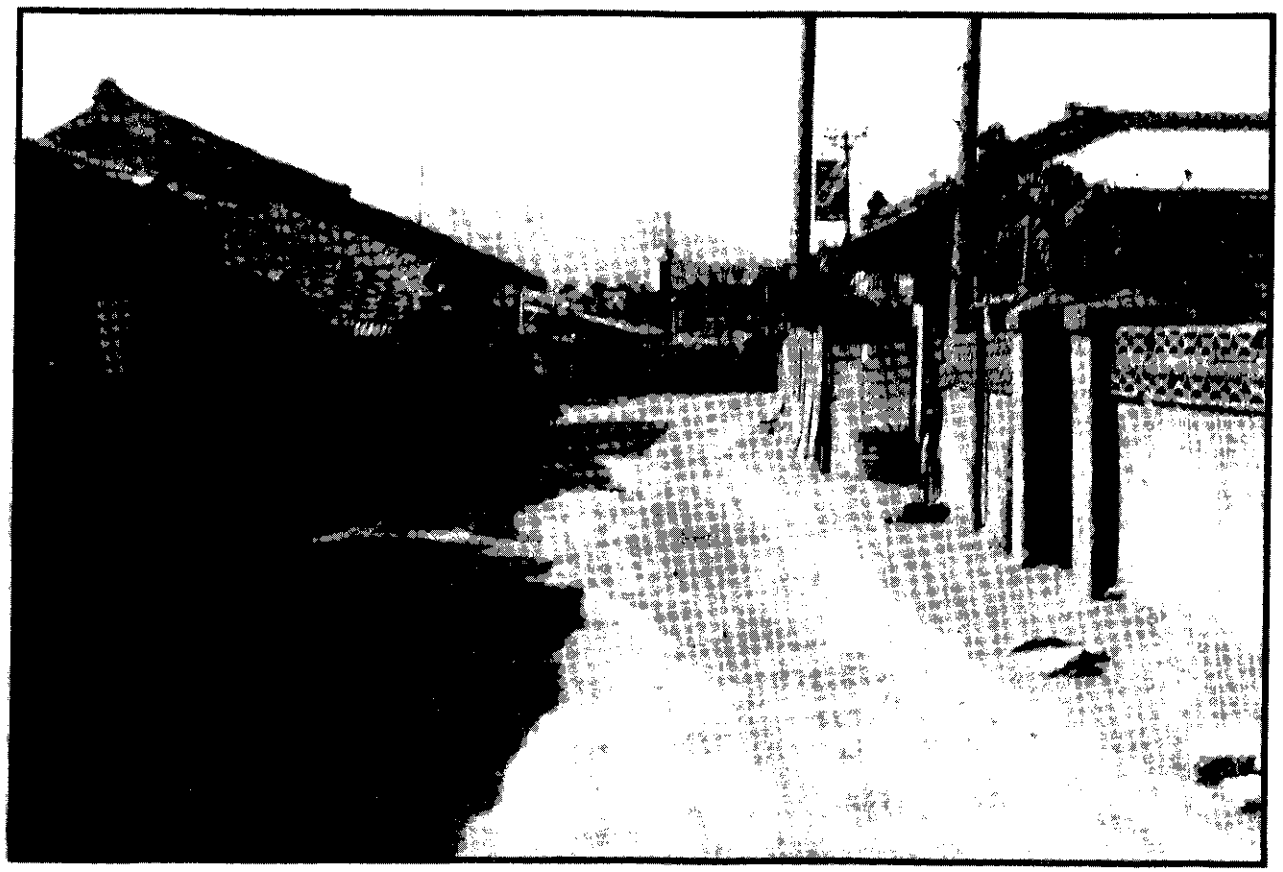


Figure SO-2. Access road between Korean Route 7 and the wharves.

B. (U) Sokcho Port Terminal

1. (U) Berthing. Berthing facilities at the Port of Sokcho are located along the northern shore and western bank of the entrance channel to inner harbor and along the northern shore of outer harbor (fig SO-3). All of the berths in inner harbor have drafts less than required to operate oceangoing vessels, while they could support lighterage operations. The new wharf being constructed in outer harbor will be deep enough to be suitable for shallow-draft Korean-flag breakbulk ships, but not adequate for large oceangoing vessels. A summary of the individual characteristics of these berths is presented in table SO-1. Ship loading at these berths under normal operating procedures is discussed below.

a. (U) RORO Operations. Drafts at all berths in the port are inadequate for the US-flag RORO ships examined in this study.

b. (U) Breakbulk Operations. Water depths at all berths in the port are inadequate for the US-flag breakbulk ships examined in this study; however, once the construction of the new wharf in outer harbor is completed, shallow-draft Korean-flag breakbulk ships will be able to berth at the port. No equipment is available at the port to perform heavy lifts, so current breakbulk operations would be limited to self-sustaining breakbulk vessels with cranes that are adequate to perform all lifts. The new wharf has a wide apron with no obstructions. The area adjacent to the apron is to be developed into paved open storage. Highway access from the wharf is restrictive but, with improvements, could be made suitable for handling military unit equipment.

c. (U) LASH Operations. The inner harbor facilities are all shallow-draft berths, but adequate for LASH barges. Water depths in inner harbor for SEABEE barges are adequate only at the west end of Lighter wharf 2 (fig SO-4). Lighter wharf 1 (fig SO-5) cannot be used because its apron width is too narrow for cargo handling operations. Barge operations could also be conducted at the new wharf in outer harbor, once construction on the wharf is completed. No lifting equipment is available at the port to support the unloading of equipment from the barges, so mobile cranes would have to be provided. The deck strength of some of the aprons in inner harbor are believed to be low, but exact figures were not available. In years past, tug service at the port was provided by the Korea Express Company. However, with the sharp decline of shipping during the last several years, the tugs have been relocated to other ports. Although tugs could be brought in from other ports, no tugs are currently available at Sokcho to support LASH operations. The LASH and SEABEE vessels could be anchored outside the harbor in the open waters, but the ability to load and unload lighters would depend on weather and sea conditions. Lighter operations at these anchorages would be possible only during good weather and calm seas.

d. (U) Container Operations. Water depths at all berths are inadequate for the US-flag container ships used in this study.

e. (U) Summary of Berth Availability. A summary of the berths available at the Port of Sokcho for different types of US-flag and Korean-flag vessels are shown in tables SO-2 and SO-3, respectively. The tables show for each type of vessel, the number each

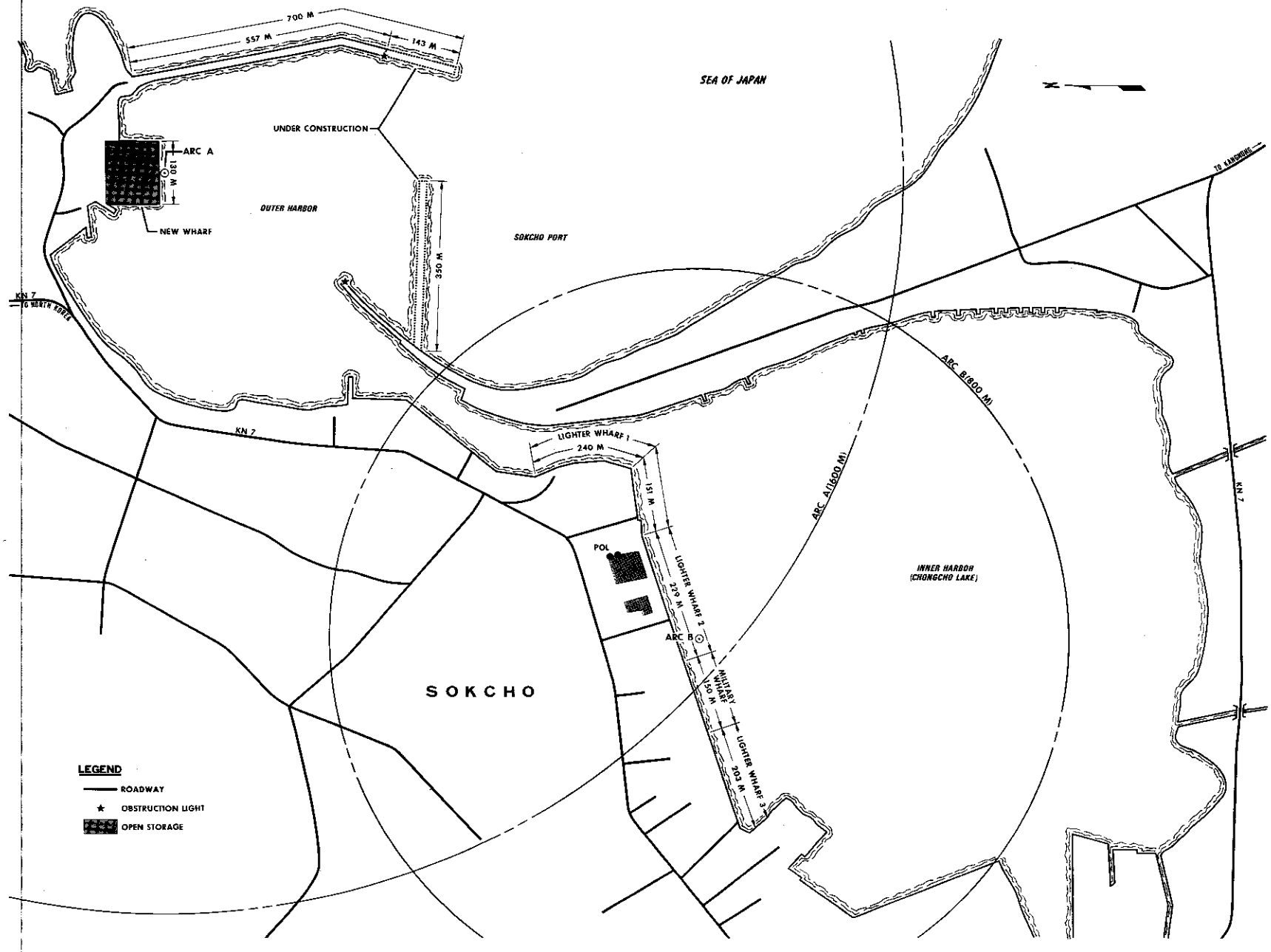


Figure SO-1. Site map.

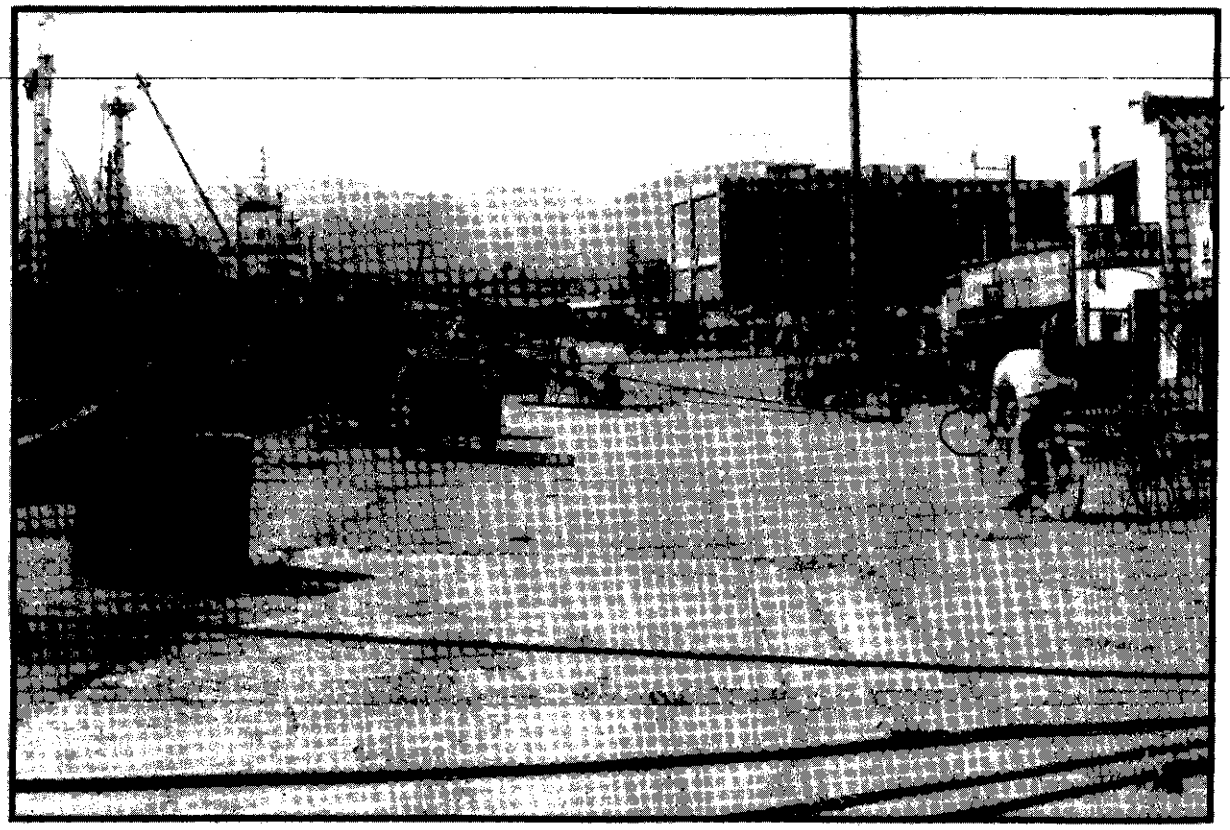
TABLE SO-1
PORT OF SOKCHO
OPERATED BY: DONGHAE DISTRICT MARITIME AND PORT AUTHORITY (SOKCHO BRANCH)

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m (ft)	Individual Berth	Berth Length m (ft)	Approximate Apron Width m (ft)	MLW m (ft)	Approximate Apron Height Above MLW m (ft)	Deck* Strength (psf)	Serviced by Rail-Mounted Crane	Railcar Access to Apron
Lighter wharf 1	1	Marginal	240 (787)	1	240 (787)	2 (7)	3.0 (9.8)	0.7 (2.3)	410	No	No
Lighter wharf 2	East, west	Marginal	430 (1,410)	East	151 (495)	15 (49)	3.0 (9.8)	1.5 (4.9)	410	No	No
				West	279 (915)	15 (49)	3.5(22.5)	1.5 (4.9)	140	No	No
Military wharf	1	Marginal	150 (492)	1	150 (492)	15 (49)	3.0 (9.8)	1.5 (4.9)	410	No	No
Lighter wharf 3	Coast Guard Cargo berth	Marginal	203 (666)	Coast Guard	108 (354)	15 (49)	3.0 (9.8)	1.2 (3.9)	410	No	No
				Cargo berth	95 (312)	15 (49)	3.0 (9.8)	1.2 (3.9)	410	No	No
New wharf	1	Marginal	130 (426)	1	130 (426)	20 (66)	7.0(23.0)	1.5 (4.9)	615	No	No

Rail-Mounted Cranes	Serving Berths	Roll-on/Roll-off Facilities	Serving Berths	Open Storage	Serving Berths	Covered Storage	Serving Berths
None	-	None	-	4 000 m^2 (1 acre)	Lighter wharf	None	-
				24 000 m^2 (6 acres)	New wharf		

berth could accommodate or the characteristics that make the berth unsuitable. As indicated in the tables, only LASH and SEABEE barges, plus the shallow-draft Korean-flag breakbulk ships can be accommodated at any of the berths serving the port.

f. (U) Safety Considerations. Although berth facilities would be available for handling ammunition by barge, several other factors must be considered. The city of Sokcho, with a population of 65,000, completely surrounds the port terminal area, crammed within 2000 meters (6,560 feet) of the berths in inner harbor and the new wharf in outer harbor. Within this same area, POL storage includes about 3,650 barrels of bunker C and diesel fuel. The main supply route, Korean 7, runs within 200 meters of the berths. Therefore, all these activities and transportation assets fall within the 2200-meter (7,216-foot) quantity-distance arc established for small breakbulk ammunition ships or barge operations.



(EAST END)

(WEST END)

Figure SO-4. Lighter wharf 2.

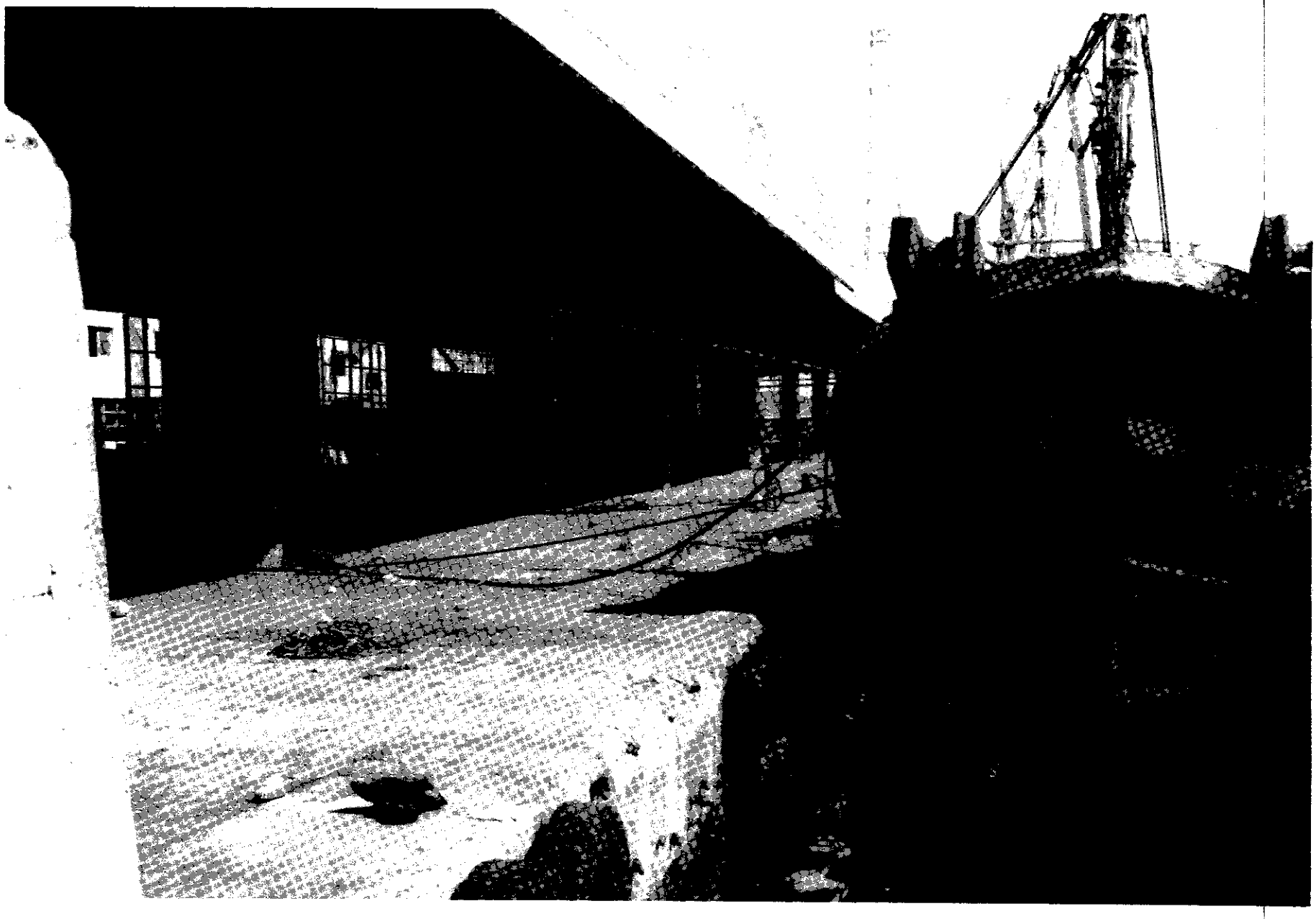


Figure SO-5. Lighter wharf 1.

TABLE SO-2
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF SOKCHO

US-Flag Ship Type	Berths						
	Lighter Wharf 1	Lighter Wharf 2 (East)	Lighter Wharf 2 (West)	Military Wharf	Lighter Wharf 3 (Coast Guard)	Lighter Wharf 3 (Cargo Berth)	New Wharf
RORO							
GTS Callaghan	a,b,d	a,b,c,d	a,b,d	a,b,c,d	a,b,c,d	a,b,c,d	a,c,d
USNS Comet	a,b,d	a,b,c,d	a,b,d	a,b,c,d	a,b,c,d	a,b,c,d	a,c,d
Maine-class	a,b	a,c	a	a,c	a,c	a,c	a,c
Breakbulk							
C4 Marine-class	a,b	a,c	a	a,c	a,c	a,c	a,c
C4-S-58a	a,b	a,c	a	a,c	a,c	a,c	a,c
C3-S-38a	a,b	a	a	a,c	a,c	a,c	a,c
C3-S-33A	a,b	a	a	a,c	a,c	a,c	a,c
Barge							
LASH C8-S-81B	a,b,c,f	a,c,f	a,f	a,c,f	a,c,f	a,c,f	a,c,f
LASH barge	b	8	14	8	5	5	6
SEABEE C8-S-82A	a,b,c,f	a,c,f	a,f	a,c,f	a,c,f	a,c,f	a,c,f
SEABEE barge	a,b	a	9	a	a	a	4
Seatrain							
Georgia-class	a,b	a,c	a	a,c	a,c	a,c	a,c
Puerto-class	a,b	a,c	a	a,c	a,c	a,c	a,c
Container							
SL-7 (Cntnr only)	a,b,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e
C6-S-1W	a,b,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e
C7-S-68E	a,b,e	a,c,e	a,e,	a,c,e	a,c,e	a,c,e	a,c,e
C8-S-85B	a,b,e	a,c,e	a,e	a,c,e	a,c,e	a,c,e	a,c,e
RORO/Container							
C5-S-78	a,b,e	a,b,c,e	a,b,e	a,b,c,e	a,b,c,e	a,b,c,e	a,c,e
T-AKR (SL-7)	a,b,c,e	a,b,c,e	a,b,c,e	a,b,c,e	a,b,c,e	a,b,c,e	a,c,e
Breakbulk/Container							
C5-S-37E	a,b,e	a,c,e	a,e	a,c,e	a,c,e	a,c,e	a,c,e
C4-S-10	a,b,e	a,c,e	a,e	a,c,e	a,c,e	a,c,e	a,c,e

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.
f - Inadequate draft from barge ship at berth; however, ship could be unloaded from anchorage.

TABLE SO-3
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF SOKCHO

Korean-Flag Ship Type	Berths						
	Lighter Wharf 1	Lighter Wharf 2 (East)	Lighter Wharf 2 (West)	Military Wharf	Lighter Wharf 3 (Coast Guard)	Lighter Wharf 3 (Cargo Berth)	New Wharf
Breakbulk							
Type 1	a	a	7	a	a	a	3
Type 2	a	a	a	a	a	a	1
Type 3	a	a	a	a	a	a	1
Type 4	a	a	a	a	a	a	1
Type 5	a	a	a	a	a	a	1
Type 6	a	a	a	a	a,b	a,b	1
Type 7	a	a	a	a	a,b	a,b	a

a - Inadequate draft at berth.
b - Inadequate berth length.

2. (U) Cargo Handling Equipment. The port does not maintain any lifting equipment or other MHE. The Korea Express Company had previously provided a small number of mobile cranes and forklifts, but with the decline in volume of general cargo imports and exports, the company has relocated all of the equipment elsewhere. While the company may be able to provide equipment to the port through its local office, no equipment is currently available.

3. (U) Storage Area

a. (U) Covered Storage. Covered and refrigerated storage is not available at the Port of Sokcho.

b. (U) Open Storage. The port terminal provides a total of 28000 square meters (7 acres) of open storage space in three separate areas. Two of

the areas, located adjacent to the west berth of Lighter wharf 2, provide combined space of about 4000 square meters (1 acre), used to stockpile iron ore and coal. The stockpiles at these areas would have to be removed and the import/export of the materials would have to be suspended before the areas could be used for marshaling activities. Because of their small size, extremely poor highway access, and the presence of nearby POL tanks, these areas are not recommended for military use.

The third storage area is located adjacent to the new wharf and provides about 24 000 square meters (6 acres) of open storage space. The area is unpaved and currently provides storage for the tetrapods that will be used in constructing extensions to the breakwaters. Highway access to the location is poor and improvements would be required to provide suitable access for military unit equipment.

c. (U) POL Storage. The port terminal itself has no POL storage tanks; but tanks are located adjacent to the port, owned and operated by local industry. The tanks contain bunker C and diesel fuel and provide a total capacity of about 3,650 barrels.

4. (U) Rail Operations. The terminal has no rail access and the closest rail facilities are located in Kangnung, about 69 kilometers (43 miles) south of the port. This great distance to the rail loading site means rail operations are not a viable means of transporting military unit equipment from this region of Korea.

5. (U) Truck Operations. The terminal has no end-loading ramps for loading nonroadable equipment onto transporters. The port also has no truck docks or portable ramps for loading general cargo into vans. If portable ramps were available, the open storage area adjacent to the new wharf could support truck-loading operations. However, since this area is unpaved, it would not be suitable during inclement weather. Highway access to this area is poor, but limited operations could be supported. Vehicle access to other areas of the port is extremely poor and not recommended for conveying military equipment.

6. (U) Security. The terminal has no perimeter barriers and does not have a security force. The wharves in inner harbor and along the entrance channel are backed by commercial and residential properties that have free access to the area. The new wharf in outer harbor also has no perimeter barrier. However, unlike the inner harbor area, an effective barrier could be placed around the new wharf and the open storage area adjacent to the wharf.

C. (U) Support Services

1. (U) Pilotage. No services are currently available. The port supports only fishing vessels and small, shallow-draft, bulk-carrier ships, which do not require pilot services.

2. (U) Harbor Craft. No harbor craft is currently available at the port. Harbor craft previously provided by the Korea Express Company was relocated from Sokcho when port activity declined and services were no longer required.

3. (U) Stevedores. The Sokcho Chapter of the National Docker's Union has a membership of 340

stevedores. More labor is available locally as needed. With the decline of shipping at the port, the stevedores have had very limited work during the last few years, handling only relatively small amounts of coal and iron ore.

D. (U) Future Developments

Work on the new wharf in outer harbor is currently being completed. The wharf structure is in place and the berth will be dredged to 7 meters (22.8 feet), early in 1984. The open storage area adjacent to the wharf still needs to be graded and paved once all tetrapods currently stored in this area are removed. (The tetrapods are being used in the construction of the breakwater extensions.) The easternmost breakwater is being extended 143 meters (469 feet) and the other breakwater is being redirected to an east-west direction and extended 350 meters (1,148 feet). Future plans include the development of several additional marginal wharves in outer harbor, but no time period has been established for completing the expansion.

E. (U) Summary

The Port of Sokcho supports the local fishing industry and handles a small volume of bulk materials, including coal and ores. Presently, the port can berth only LASH and SEABEE barges at the inner harbor wharves. However, the port is completing the construction of the new wharf in outer harbor, which will be suitable for shallow-draft Korean breakbulk vessels as well as barges. Barges must be anchored at unprotected locations in the Sea of Japan, while discharging and loading barges.

Based on the port's capabilities, individual berth rankings have been computed in tables SO-4 and SO-5 for breakbulk and barge operations at selected berths. These rankings indicate the berths that are best suited for each shipping operation and the relative suitability of other selected berths. As can be seen, the new wharf will provide the best berthing facility at the port.

The port has no rail access and the closest rail facilities are located about 69 kilometers (43 miles) away. Access roads from Korean 7 to the wharves are narrow and congested and are not recommended for use by military unit equipment. The port will have a large, open storage area adjacent to the new wharf when construction on the wharf is completed. The port has no covered storage, materials handling equipment, harbor craft, or pilot service.

Sokcho City surrounds the port terminal and has a population of 65,000 located within a 2000-meter (6,560-foot) arc of the berths and within the 2200-meter (7,216-foot) quantity-distance arc established for small breakbulk ships or cargo operations.

TABLE SO-4
INDIVIDUAL BERTH RATING (BB/RORO)*

Ideal Berth Factors	Berths New Wharf
Length	5
Alongside depth	12
Backup area	5
Apron width	20
Transit shed	0
Distribution shed	0
Apron tracks	0
Deck loading	8
Heavy-lift cranes	0
Berth type	10
Truck tailgate	0
Rail end ramp	0
Truck access	0
Ship service facilities	4
Conditional age of facility	10
RORO stern ramp	0
Total Points	74
Ranking	1

*Since there are no berths with sufficient draft for RORO vessels, the berths are rated only for breakbulk operations.

TABLE SO-5
INDIVIDUAL BERTH RATING (BARGE)

Ideal Berth Factors	Berths*		
	Lighter Wharf 2	Lighter Wharf 3	New Wharf
Length	10	10	8
Alongside depth	8	0	10
Backup area	5	0	10
Apron width	9	9	10
Consolidation shed	0	0	0
Apron tracks	0	0	0
Anchorage diameter	1	1	1
Conditional age of facility	5	5	5
Deck loading	5	5	5
Heavy-lift cranes	0	0	0
Berth type	10	10	10
Truck tailgate	0	0	0
Rail end ramp	0	0	0
Truck access	0	0	0
Tug availability	0	0	0
Barge lay area	10	10	10
Total Points	63	50	69
Ranking	2	3	1

*Lighter wharf 1 is excluded because its apron width is too narrow for cargo handling operations.

(U) PORT OF MUKHO

A. (U) General Description

1. (U) Location and General Uses. The Port of Mukho (fig MU-1) is located on the eastern seacoast of Korea, about 336 kilometers (209 miles) north of Pusan and 275 kilometers (171 miles) east of Seoul. It is the northernmost port of a group that includes the Port of Pukpyong, about 13 kilometers (8 miles) to the south, and the Port of Samchok, about 21 kilometers (13 miles) to the south. Administered by the Mukho Branch of the Donghae District Maritime and Port Authority, this industrial port supports the surrounding regional industrial complex. The principal commodities handled at the port include anthracite (coal), graphite, and cement. The cement is produced adjacent to the port by the Ssang Yong Cement Company, one of the largest cement plants in Korea. The port terminal area is situated just east of Mukho City and can be divided into four major sections. The northern and eastern sections have shallow-draft berths that support the local fishing industry. Cement is handled at the wharves located in the southwestern section of the terminal, which have the deepest drafts in the port. The Korean Coast Guard occupies one wharf in the northwestern section of the port. The remaining berths in the northwestern section are used to export coal.

2. (U) Harbor. Mukho Harbor (fig MU-2) is an artificial harbor formed by the 945-meter (3,100-foot) east breakwater and the 200-meter (656-foot) south breakwater. Since the southern end of the harbor faces directly to the Sea of Japan, the harbor is vulnerable to rough seas and waves moving toward the port from the south. Mukho Harbor has no approach channels. The entrance channel between the breakwaters enters the port from the south and is about 300 meters (984 feet) in width with water depths of about 11 meters (36 feet). There are no overhead obstructions that could block access to the harbor. To aid navigation into the harbor, a red light is positioned at the head of the east breakwater and a green light is positioned at the head of the south breakwater. A lighthouse, with a fog siren, is located south of the port. Navigational hazards to be avoided include a rocky area between the east breakwater and the anchorages, which has a clearance draft of only 7 meters (23 feet), and rocky areas southwest of the quarantine anchorage.

The harbor has a rock bottom, and average water depths vary from about 11 meters (36 feet) in the southern section of the harbor to about 3 meters (10 feet) in the northern section. The tidal range in the harbor is only about 0.15 meter (6 inches). No turning basins have been designated for the harbor, but area is available in the southern section of the port for a 300-meter (984-foot) turning basin with a minimum draft of 9.5 meters (31 feet). Area is also available in the northern section of the port for a 200-meter (656-foot) turning basin with a minimum draft of 7.5 meters (25 feet). Use of either of these areas as a turning basin would block access to and from all locations north of the areas.

The harbor has had no silting problems since the breakwaters were extended. It was entirely dredged several years ago during port construction. Although no annual dredging program exists, port authorities conduct periodic soundings to ensure that designated drafts are maintained. The area north of

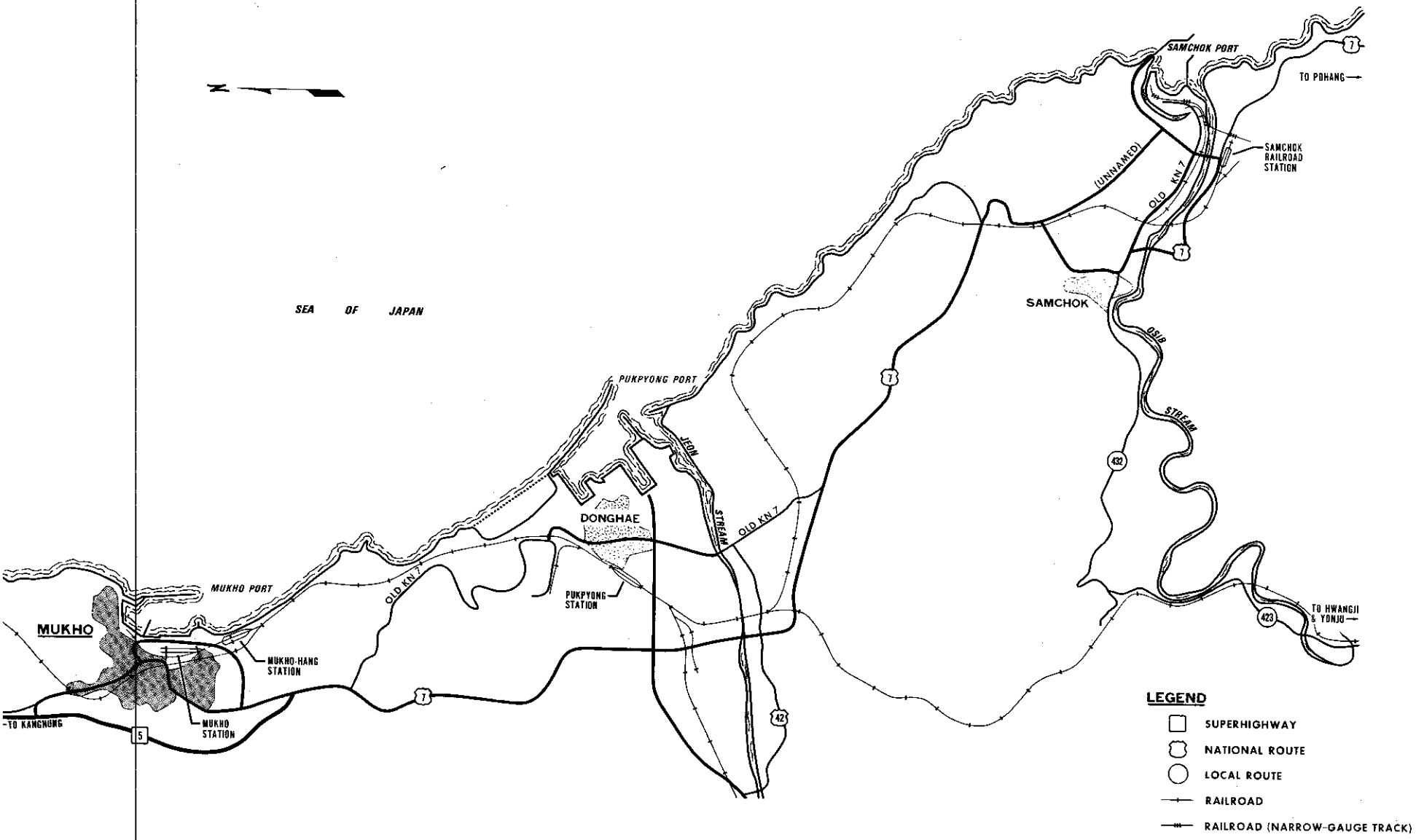


Figure MU-1. Vicinity map.

which would offer more protection to shipping operations, is located about 10 kilometers (6 miles) west of the port, in Ulsan Bay. These anchorages are described in detail under the "Port of Ulsan."

3. (U) Highway Access. Five gates (fig MI-2) provide highway access from the wharves to Local Route 981. HMD Gates 1 and 2 provide the best access from the wharves surrounding Junha Bay, while Main Gate and North Gates 1 and 2 provide the best access from the wharves surrounding Mipo Bay. Local 981 is a two-lane road that runs south to Pangojin and north to Local Route 1058. It forms the eastern segment of a road network that encircles the entire peninsula. The network also provides access to the Port of Yompo, which is located about 7 kilometers (4.4 miles) from the Port of Mipo, on the western coast of the peninsula.

Local 981 intersects Local 1058 about 2.6 kilometers (1.6 miles) north of Main Gate, then continues north along the east coast of Korea to Pohang. The access route from the port is via Local 1058, which runs northwest for 6.1 kilometers (3.8 miles) to a major intersection east of Ulsan. At this intersection, the road to the right leads north for 3.1 kilometers (1.9 miles) and intersects with Korean Route 7. The through street continues west 5 kilometers (3.1 miles) and intersects with Korean 7 in Ulsan. Korean 7, the main supply route in this region of Korea, runs north and south along the entire eastern seaboard of Korea. The access route from the port consists of all two and four-lane roads that would be suitable for military unit equipment and supply trucks. None of the access roads from the terminal have vertical clearance obstructions, so vehicle height is not a concern.

About 6 kilometers (3.7 miles) south of Ulsan, Korean 7 intersects Superhighway 8, a four-lane, limited access road. Superhighway 8 runs west about 14 kilometers (8.7 miles) and intersects Superhighway 1, a four-lane, limited access road that runs north to Seoul and south to Pusan.

4. (U) Rail Access. The port has no rail access since trackage from the Korean National Railroad does not extend to the terminal. Tracks closest to the port are at the Ulsan Railroad Station, located on the east side of Ulsan City about 13.7 kilometers (8.5 miles) west of the port. The station is on a main line of the Korean Railroad and serves mainly as a passenger terminal. It has five track sidings with a total capacity of 80 railcars, but no facilities for loading military unit equipment or general cargo. Therefore, to develop the station as a suitable railcar loading site for military operations, all support equipment such as heavy-lift cranes, portable ramps, and materials handling equipment would have to be supplied from external sources.

5. (U) Airports. A helipad area is located about 10.8 kilometers (6.7 miles) north of the terminal. Highway access to the helipad is poor. Available at the terminal is open area to accommodate helicopter operations. The closest airports are located in Pohang, about 90 kilometers (56 miles) north of the port, and in Pusan and Kimhae, about 77 kilometers (48 miles) south of the port. The concrete runway at the Pohang airport is 2134 meters (7,000 feet) long and 46 meters (150 feet) wide; it can handle only intratheater aircraft. The concrete runway at Kimhae airport is 2744 meters (9,000 feet) long and 46 meters (150 feet) wide; it is capable of supporting intertheater aircraft.

(U) PORT OF MIPO

A. (U) General Description

1. (U) Location and General Uses. The Port of Mipo (fig MI-1) is located on the eastern seacoast of Korea, on the east coast of the peninsula that juts into the Sea of Japan forming the eastern shore of Ulsan Harbor. The port is about 16.6 kilometers (10.3 miles) east of Ulsan, 80 kilometers (50 miles) north of Pusan, and 432 kilometers (268 miles) southeast of Seoul. It falls under the jurisdiction of the Ulsan District Maritime and Port Administration, but the facilities are privately owned and operated by Hyundai Heavy Industries Company, Ltd (HHI) and Hyundai Mipo Dockyard Company, Ltd (HMD). The port terminal serves a vast industrial complex that supports the activities of HHI and HMD. HHI, which occupies the northern half of the terminal, builds a variety of large oceangoing vessels and marine structures in addition to manufacturning marine engines and heavy electronic equipment. HMD occupies the southern half of the terminal and performs a variety of ship repair and rebuilding activities. HMD also has facilities at the Port of Yompo, which is located on the west coast of the same peninsula, about 7 kilometers (4.4 miles) west of the Port of Mipo.

2. (U) Harbor. The Port of Mipo, which faces the Sea of Japan, includes Mipo and Junha Bays. Mipo Bay, which is northernmost, is surrounded by wharves that support the industrial activities of HHI. Junha Bay is located to the south of Mipo Bay and is surrounded by wharves that serve HMD. The designated harbor limit is formed by a semicircle, which has a 2000-meter (6,560-foot) radius and is centered about a midpoint located on the eastern shore of the port. The average tidal range in the harbor is only about 0.3 meter (1 foot), which does not affect ship operations. The mean high water interval is 7 hours 15 minutes.

Both bays are protected by breakwaters that shelter them from the open sea. Under most climatic conditions, both bays offer adequate vessel protection although neither of them is a safe haven during extremely adverse weather. The access channel to Mipo Bay is 200 meters (656 feet) wide and 12.5 meters (41 feet) deep. The draft in the center of the bay averages about 10.5 meters (34.4 feet). Adequate space is available in the bay for a turning basin with a diameter of 500 meters (1,640 feet). The access channel has no overhead obstructions to restrict the vertical clearance of ships.

The entrance channel to Junha Bay has a width of 100 meters (328 feet) and a draft of 11.5 meters (37.7 feet). Sufficient space is available in the bay for a turning basin with a maximum diameter of 300 meters (984 feet). Most large oceangoing ships would have to be turned by pivoting the ship with one end resting against one of the wharves. The central draft in Junha Bay is about 9.5 meters (31.2 feet). There are no vertical clearance obstructions on the access channel to the bay, so vessel height would not be a factor. Neither bay has experienced a silting problem, so the port does not conduct annual dredging. The bays were last dredged during the construction of the port in 1973.

There are no designated anchorages within the harbor limit, so vessels are anchored in the open waters of the Sea of Japan. An alternative anchorage,

Train Station, 700 meters of Korean 7, and 1250 meters (4,100 feet) of the PDSK POL pipeline. Therefore, these areas fall within the 2200-meter (7,216-foot) quantity-distance arc established for barges handling ammunition. POSCO Terminal is 4200 meters (13,776 feet) south of the central business district of Pohang. The Pohang Steel Company surrounds the wharves, occupying all areas within 2000 meters (6,560 feet) of the berths. Therefore, the steel company is the major activity within the 2500-meter (8,200-foot) and the 2800-meter (9,184-foot) quantity-distance arcs that have been established for ammunition breakbulk vessels and container ships, respectively.

TABLE PO-16
INDIVIDUAL BERTH RATING (CONTAINER)

Ideal Berth Factors	Berths			
		Wharf 4		Wharf 5
	Wharf 3	West	East	West
Length	20	10	6	18
Alongside depth	16	18	18	18
Backup area	16	10	10	4
Apron width	10	10	10	10
Consolidation shed	0	0	0	0
Apron tracks	0	0	0	0
Materials handling equipment	8	8	8	8
Deck loading	8	8	8	8
Heavy-lift cranes	7	7	7	7
Berth type	10	10	10	10
Truck tailgate	0	0	0	0
Rail end ramp	0	0	0	0
Truck access	8	8	8	8
Ship service facilities	4	4	4	4
Conditional age of facility	10	10	10	10
Total Points	117	103	99	100
Ranking	1	2	4	3

Pohang Train Station, located near Old Port Terminal, has an end-loading ramp on a spur track that can handle 10 railcars at a time. The station also has a side-loading dock and storage track. Access from the port to the station is acceptable. Most of the trackage serving POSCO Terminal provides access to the manufacturing plants and would not make good railcar-loading sites. However, one track siding is available where equipment and cargo could be loaded onto flatcars using a heavy-lift crane. The Goedong railyard, located near POSCO Terminal, could also be used as a loading site if portable ramps and mobile cranes were made available.

Highway access from both terminals could be used by military unit equipment; however, access from Old Port Terminal would be slowed by narrow roads and overcrowded city streets. Access from POSCO Terminal is excellent. Korean 7 is the main supply route from both terminals. There are no truck-loading end ramps or side docks at either terminal. Truck loading could be performed in the open storage areas using a heavy-lift crane, or on the wharf aprons where items could be loaded directly from the ship to the truck. Portable ramps would still be required if forklifts are used to load general cargo into vans. Open storage area is abundant at POSCO Terminal and limited at Old Port Terminal. Pilot service is available and mandatory throughout Pohang Harbor. The port is serviced by four berthing tugs and 576 stevedores.

The berths at Old Port Terminal are located within 1000 meters (3,280 feet) of the 225,000 population of Pohang, 1300 meters (4,264 feet) of two POL tank farms, 1100 meters (3,605 feet) of the Pohang

TABLE PO-15
INDIVIDUAL BERTH RATING (BARGE)

Ideal Berth Factors	Berths							
	POSCO Terminal			Old Port Terminal				
	Hoan Wharf	Wharf 5 (East)	Wharf 6	Wharf 1	Lighterage Wharf 1	Lighterage Wharf 2	Lighterage* Wharf 3	Lighterage Wharf 4
Length	10	10	10	8	10	10	10	10
Alongside depth	9	10	9	8	8	8	8	8
Backup area	5	5	10	5	5	5	5	5
Apron width	10	10	10	10	9	9	9	5
Consolidation shed	0	0	0	2	2	0	0	2
Apron tracks	0	0	0	0	0	0	7	0
Anchorage diameter	10	10	10	10	10	10	10	10
Conditional age of facility	10	10	10	7	7	7	7	7
Deck loading	9	10	9	9	5	5	5	5
Heavy-lift cranes	9	9	9	0	0	0	0	0
Berth type	10	5	10	10	10	10	10	10
Truck tailgate	0	0	0	0	0	0	0	0
Rail end ramp	0	0	0	0	0	0	0	0
Truck access	8	8	8	5	5	5	5	5
Tug availability	9	9	9	9	9	9	9	9
Barge lay area	10	10	10	10	6	6	6	6
Total Points	109	106	114	93	86	84	91	82
Ranking	2	3	1	4	6	7	5	8

*Availability of Lighterage wharf 3 is uncertain.

Terminal has all shallow-draft berths, which are currently used by general cargo barges, local fishing vessels, ferries, and the Korean Coast Guard. These berths would only be suitable for lighterage operations. The LASH and SEABEE ships would have to be anchored in the anchorages of Pohang Harbor. POSCO Terminal has several deep-draft berths, which are suitable for large oceangoing vessels. The terminal currently supports the import of bulk raw materials and the export of products manufactured by the Pohang Steel Company. Because of the unique construction of the aprons on wharves 1 and 2, they are suitable only for bulk-loading operations. Wharves 3, 4, and 5 have several deep-draft berths, which could accommodate US-flag breakbulk and RORO vessels and container ships. Side-ramp RORO operations are possible at all berths; however, due to draft considerations, wharf 3 cannot accommodate Maine-class RORO vessels, so slewed stern-ramp RORO operations are only possible at wharves 4 and 5. The T-AKR vessel can be berthed only at wharf 5 (west). Wharf 5 (west) is also the only berth at the terminal where straight stern-ramp RORO operations are possible. Bridge-type cranes, which can be used for container or breakbulk vessels, are available at wharves 3, 4 (east and west), and 5 (head). Level-luffing cranes equipped with lifting hooks are available on wharves 3 and 5 (west). Although wharves 1 and 2 cannot be used for cargo operations, they can be used to berth LASH and SEABEE ships while barges are being loaded and discharged.

Based on these shipping capabilities of the wharves at Old Port Terminal and the POSCO Terminal, individual rankings have been computed in tables PO-14 through PO-16 for various shipping operations at selected berths. The rankings indicate the berths that are best suited for each shipping operation and the relative suitability of the other selected berths.

TABLE PO-14
INDIVIDUAL BERTH RATING (BB/RORO)

Ideal Berth Factors	Berths					
		Wharf 4		Wharf 5		
	Wharf 3	West	East	West	Head	East
Length	20	18	16	20	10	20
Alongside depth	18	20	20	20	16	12
Backup area	8	5	5	1	1	1
Apron width	20/20	20/20	20/20	20/20	20/20	20/20
Transit shed	0/NR*	0/NR	0/NR	0/NR	0/NR	0/NR
Distribution shed	0/NR	0/NR	0/NR	0/NR	0/NR	0/NR
Apron track	0	0	0	0	0	0
Deck loading	10	10	10	10	10	10
Heavy-lift cranes	3	7	7	5	7	0
Berth type	10	10	10	8	8	8
Truck tailgate	0	0	0	0	0	0
Rail end ramp	0	0	0	0	0	0
Truck access	8	8	8	8	8	8
Ship service facilities	4	4	4	4	4	4
Conditional age of facility	10	10	10	10	10	10
RORO stern ramp	NR/5	NR/5	NR/5	NR/10	NR/5	NR/5
Total Points	111/116	112/117	105/115	106/116	94/99	93/98
Ranking	2/2	1/1	3/3	4/2	5/4	6/5

*NR - Not Rated.

Both port terminals have rail access, but neither has end-loading ramps. The trackage at Old Port Terminal is serviced by warehouse docks that could be used to load boxcars with general cargo. The

Pohang District Maritime and Port Authority owns and operates two tugs rated at 2,500 horsepower and a third rated at 650 horsepower. A fourth tugboat is owned and operated by the Daeryong Tug Boat Company and is rated at 3,200 horsepower. The local stevedoring companies own and operate three small tugs which are rated at 50, 70, and 150 horsepower. These small tugs are not large enough to be used for military shipping discussed in this report. The stevedoring companies also own and operate the 24 barges shown in table PO-13.

TABLE PO-13
BARGES

Type	Size (STON)	Quantity	Total Capacity (STON)
Wooden	80	10	750
Wooden	100	6	600
Steel	200	6	1,200
Steel	300	2	600

3. (U) Stevedores. There are 576 stevedores registered in the Pohang Chapter of the National Docker's Union, which serve the Port of Pohang. Stevedore companies located in Pohang are:

a. Dongbang Forwarding Co, Ltd.
b. Dongnam Enterprises Co.
c. Global Enterprises Co, Ltd.
d. Jangyung Shipping Co.
e. Hanjin Transportation Co, Ltd.
f. Korea Express Co, Ltd.

4. (U) Supplies and Utilities. Freshwater is available at designated points along wharf 2 and can be supplied to ships at anchorages from the three water barges operating at the port. Bunker supplies are also available from three bunker supply barges operated at the port.

E. (U) Future Developments

At POSCO Terminal, a new general cargo wharf is being constructed along the north breakwater and is scheduled for completion at the end of 1984. Also, a large tract of land is being reclaimed adjacent to the east breakwater, and three 140-meter (460-foot) piers are to be constructed in this area by the end of 1984. These projects would double the current berthing facilities and greatly increase the throughput capability of the port. The entrance channel is projected to be dredged to 19 meters (62 feet) by the end of 1984.

At Old Port Terminal, a wharf 302 meters (991 feet) long is being constructed at the end of the peninsula that forms the western shore of the harbor. Two wharves, which are 112 meters (367 feet) and 190 meters (623 feet), are being constructed on the western and northern shores of the peninsula, respectively. They are scheduled for completion at the end of 1984. The large tract of land adjacent to these wharves is to be developed as an open storage area.

F. (U) Summary

The Port of Pohang consists of two port terminals, which are commonly referenced as Old Port Terminal and POSCO Terminal. Old Port

older warehouses, terminate before reaching the warehouses, in an area where there is not adequate space for end-loading operations. Highway access to these tracks is provided by an unpaved road that runs alongside. During dry weather, the road could be used as an access, but during inclement weather it would become unsuitable for vehicles.

The track running along Lighterage wharf 3, terminates close to the building, leaving inadequate space for end-ramp operations. Heavy-lift cranes could be positioned adjacent to the track and used to load railcars with material discharged from barges at Lighterage wharf 3. However, since this wharf is used exclusively by the Korean Coast Guard, its availability is uncertain.

As previously discussed in paragraph A4, rail loading could be conducted at the Pohang Train Station, where there is an end ramp that can support 10 railcars at a time. Also, there are side-loading docks and other spur tracks where railcars could be loaded if portable ramps or lifting equipment were made available. The station does not have materials handling equipment required to load boxcars. At Old Port Terminal, potential railcar loading sites are available at the warehouse adjacent to wharf 1, at the Lighterage wharf 3 spur track, and at the Pohang Train Station.

5. (U) Truck Operations. Truck access to and from Old Port Terminal is acceptable, but travel would be slowed by the narrow, overcrowded access roads. The access to Lighterage wharf 4 would be further complicated by narrow gates and the limited space available between the sheds and on the wharf aprons. The terminal has no truck docks or end-loading ramps, so portable ramps or mobile cranes would be required for truck loading. To avoid double handling, nonroadable unit equipment and general cargo could be loaded directly from the ship onto flatbed trucks. Trucks could be positioned adjacent to the barges, and the heavy-lift mobile cranes discharging the barges could load material directly onto the trucks. Portable ramps would still be required if forklifts are used to load general cargo into vans. This loading could be accomplished on the wharf aprons or in the open storage area adjacent to wharf 1.

6. (U) Security. Old Port Terminal is not well secured. The wharf areas are surrounded by fencing, but access to and from the wharves is not controlled. The terminal is located on the border of a large city, so it is surrounded by commercial and residential areas. The perimeter fencing has no lights and there are no security guards.

D. (U) Support Services

1. (U) Pilotage. Pilotage is compulsory. Five pilots and three pilot boats are available to provide service throughout the day. Pilots usually board incoming vessels at the quarantine anchorage. These pilots service both Old Port and POSCO Terminals. However, most of the shipping to Old Port Terminal is local traffic, which does not require pilot service, so the pilots predominantly serve POSCO Terminal.

2. (U) Harbor Craft. There are four berthing tugboats available for use at the Port of Pohang. The

TABLE PO-11
STORAGE FACILITIES FOR PORT OF POHANG (OLD PORT TERMINAL)

Type Storage Location/ Berths Served	Number of Storage Areas	Total Space (m^2)	Total Space (ft^2)	Storage Capacity (tons)	Current Use	Condition	Owner/Remarks
Covered Storage							
Wharf 1	2	1468	15,801	4,404	Cement	Good	KMPA
	1	205	2,207	615	Cement	Good	Korea Express Co
Lighterage wharf 1	2	345	3,713	1,035	Cement	Good	KMPA
Lighterage wharf 4	4	1472	15,844	4,416	Cement	Good	KMPA
	2	380	4,090	1,140	Cement	Good	Korea Express Co
	2	577	6,211	1,731	General Cargo	Good	Korea Association Fishery

c. (U) POL Storage. KMPA has no POL storage tanks; however, POL tanks located near the port terminal are listed in table PO-12. The US Army (PDSK) operates a large tank farm north of Pohang at Camp Libby.

4. (U) Rail Operations. Old Port Terminal has rail access provided by four standard-gauge spur tracks. Three of these tracks provide access to the warehouses at wharf 1 and the remaining track runs along Lighterage wharf 3 about 15 meters (49 feet) from the edge of the apron. None of these tracks have end-loading ramps, nor are they located so that portable ramps could be positioned for end-loading operations. The spur track adjacent to wharf 1 provides access to the side docks along the KMPA warehouse. Three railcars can be loaded simultaneously from these side docks. The other two tracks, which formerly served

TABLE PO-12
POL STORAGE FACILITIES
FOR PORT OF POHANG (OLD)

Geographic Location	Number of Tanks	Storage Capacity (BBL)	Type Fuel	Owner/Remarks
Old Port vicinity	1	5,500	Diesel	Kyongbuk POL Co
	1	1,600	Kerosene	Hanil POL Co
	1	2,600	Bunker C	Hanil and Kyongbuk POL Co
	2	2,300	Bunker A	Hanil and Kyongbuk POL Co
	2	1,000	Bunkers C&A	Hankuk Marine POL Co
	1	1,000	Diesel	Pohang Fishery Association
	1	800	Bunker C	Pohang Fishery Association

TABLE PO-10
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF POHANG (OLD PORT TERMINAL)

Korean-Flag Ship Type	Berths						
	Wharf 1	Lighterage Wharf 1	Lighterage Wharf 2	Lighterage Wharf 3	Lighterage Wharf 4 North	Lighterage Wharf 4 Center	Lighterage Wharf 4 South
Breakbulk							
Type 1	3	4	4	6	4	5	5
Type 2	a	a	a	a	a	a	a
Type 3	a	a	a	a	a	a	a
Type 4	a	a	a	a	a	a	a
Type 5	a	a	a	a	a	a	a
Type 6	a	a	a	a	a	a	a
Type 7	a,b	a	a	a	a	a	a

a - Inadequate draft at berth.
b - Inadequate berth length.

business district of Pohang. This location places all berths at the port within 1000 meters (3,280 feet) of the city, which has a population of 225,000. Two POL tank farms are located about 1300 meters (4,264 feet) and 2800 meters (9,184 feet), respectively, from the northern wharves at the port. In addition, the Pohang Train Station is located about 1100 meters (3,608 feet) from the southern wharves. Korean Route 7, the main supply route in this region of Korea, reaches to within 700 meters (2,296 feet) of the port terminal, and the PDSK POL pipeline is about 1250 meters (4,100 feet) from the northern wharves. Therefore, these activities and transportation assets fall well within the 2200-meter (7,216-foot) quantity-distance arc established for small breakbulk ships or barges handling ammunition.

2. (U) Materials Handling Equipment. Equipment is discussed in paragraph B2.

3. (U) Storage Areas

a. (U) Open Storage. Old Port Terminal has one open storage area, amounting to about 6000 square meters (1.5 acres), located by wharf 1.

b. (U) Covered Storage. Covered storage at Old Port Terminal is provided by the warehouses listed in table PO-11. The two KMPA warehouses located by wharf 1 provide the greatest storage capacities. With the exception of the small KMPA storage sheds on Lighterage wharf 4, all of the remaining warehouses are relatively small and privately owned and operated.

TABLE PO-9
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF POHANG (OLD PORT TERMINAL)

US-Flag Ship Type	Berths						
	Wharf 1	Lighterage Wharf 1	Lighterage Wharf 2	Lighterage* Wharf 3	Lighterage Wharf 4 North	Lighterage Wharf 4 Center	Lighterage Wharf 4 South
RORO							
GTS Callaghan	a,c	a,b,c	a,b,c	a,b	a,b,c	a,b,c	a,b,c
USNS Comet	a,c	a,b	a,b	a,b	a,b	a,b	a,b
Maine-class	a,c	a,c	a,c	a	a,b	a,b	a,b
Breakbulk							
C4 Mariner-class	a,c	a,c	a,c	a,c	a,c	a	a
C4-S-58a	a,c	a,c	a,c	a,c	a,c	a	a
C3-S-38a	a,c	a	a	a	a	a	a
C3-S-33a	a,c	a	a	a	a	a	a
Barge							
LASH C8-S-81B	a,c	a,c	a,c	a,c	a,c	a,c	a,c
LASH barge	6	8	8	11	8	11	11
SEABEE C8-S-82A	a,c	a,c	a,c	a,c	a,c	a,c	a,c
SEABEE barge	4	5	5	7	5	7	6
Seatrain							
Georgia-class	a,c	a,c	a,c	a	a,c	a,c	a,c
Puerto-class	a,c	a,c	a,c	a	a,c	a,c	a,c
Container							
SL-7 (Cntnr only)	a,c	a,c	a,c	a,c	a,c	a,c	a,c
C6-S-1W	a,c	a,c	a,c	a	a,c	a	a
C7-S-68E	a,c	a,c	a,c	a,c	a,c	a,c	a,c
C8-S-85B	a,c	a,c	a,c	a	a,c	a	a
RORO/Container							
C5-S-78	a,c	a,b,c	a,b,c	a,b	a,b,c	a,b	a,b
T-AKR (SL-7)	a,c	a,b,c	a,b,c	a,b,c	a,b,c	a,b,c	a,b,c
Breakbulk/Container							
C5-S-37E	a,c	a,c	a,c	a	a,c	a	a
C4-S-10	a,c	a,c	a,c	a	a,c	a	a

*Note: Berths are not expected to be available.
a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.
f - Inadequate draft for barge ship at berth; however, ship could be unloaded from anchorage.

TABLE PO-8
PORT OF POHANG (OLD PORT TERMINAL)
OPERATED BY: POHANG DISTRICT MARITIME AND PORT AUTHORITY

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m	(ft)	Individual Berth	Berth Length m	(ft)	Approximate Apron Width m	(ft)	MLW m	(ft)	Approximate Apron Height Above MLW m	(ft)	Deck * Strength psf	Services by Rail-Mounted Crane	Railcar Access to Apron
Wharf 1	1	Marginal	125	(410)	1	125	(410)	20	(66)	4.0	(13.1)	2.0	(6.6)	628	No	No
Lighterage wharf 1	1	Marginal	161	(528)	1	161	(528)	15	(49)	4.0	(13.1)	1.1	(3.6)	419	No	No
Lighterage wharf 2	1	Marginal	160	(525)	1	160	(525)	15	(49)	4.0	(13.1)	1.1	(3.6)	419	No	No
Lighterage wharf 3 (Coast Guard)	1	Marginal	212	(695)	1	212	(695)	15	(49)	3.5	(11.5)	1.0	(3.3)	419	No	No
Lighterage wharf 4	North, Center, South		583	(1,912)	North, Center, South	166 210 207	(544) (689) (679)	7 7 7	(23) (23) (23)	4.5 4.5 4.5	(14.8) (14.8) (14.8)	2.0 2.0 2.0	(6.6) (6.6) (6.6)	419 419 419	No No No	No No No

Rail-Mounted Cranes	Serving Berths	Roll-on/Roll-off Facilities	Serving Berths	Open Storage m^2	(acres)	Serving Berths	Covered Storage m^2	ft^2	Serving Berths
None	-	None	-	6000	(1.5)	Wharf 1	1673	18,008	Wharf 1
							345	3,713	Lighterage wharf 1
							2429	26,145	Lighterage wharf 4

* Estimated value.

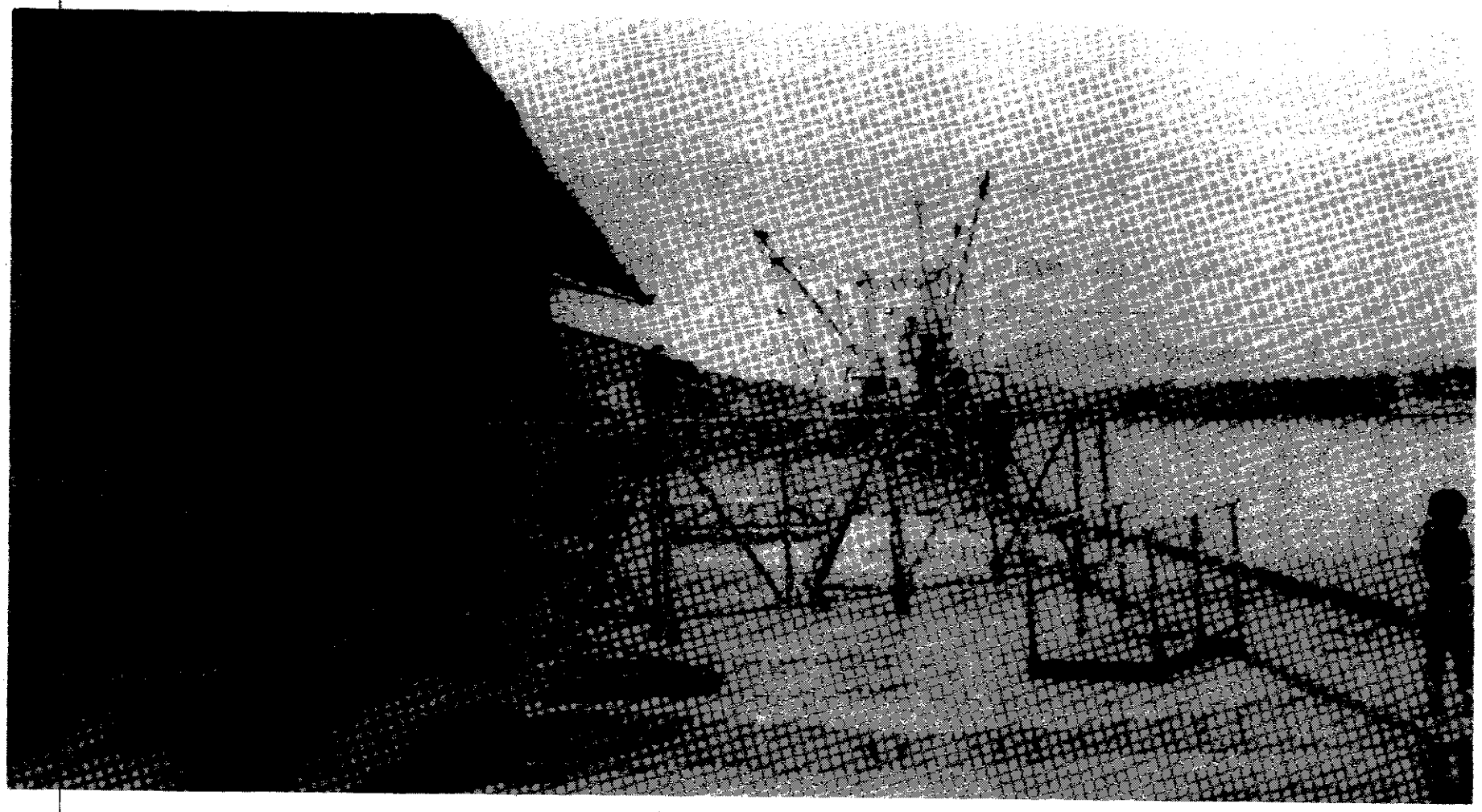


Figure PO-13. Wharf 4 (northwestward view).

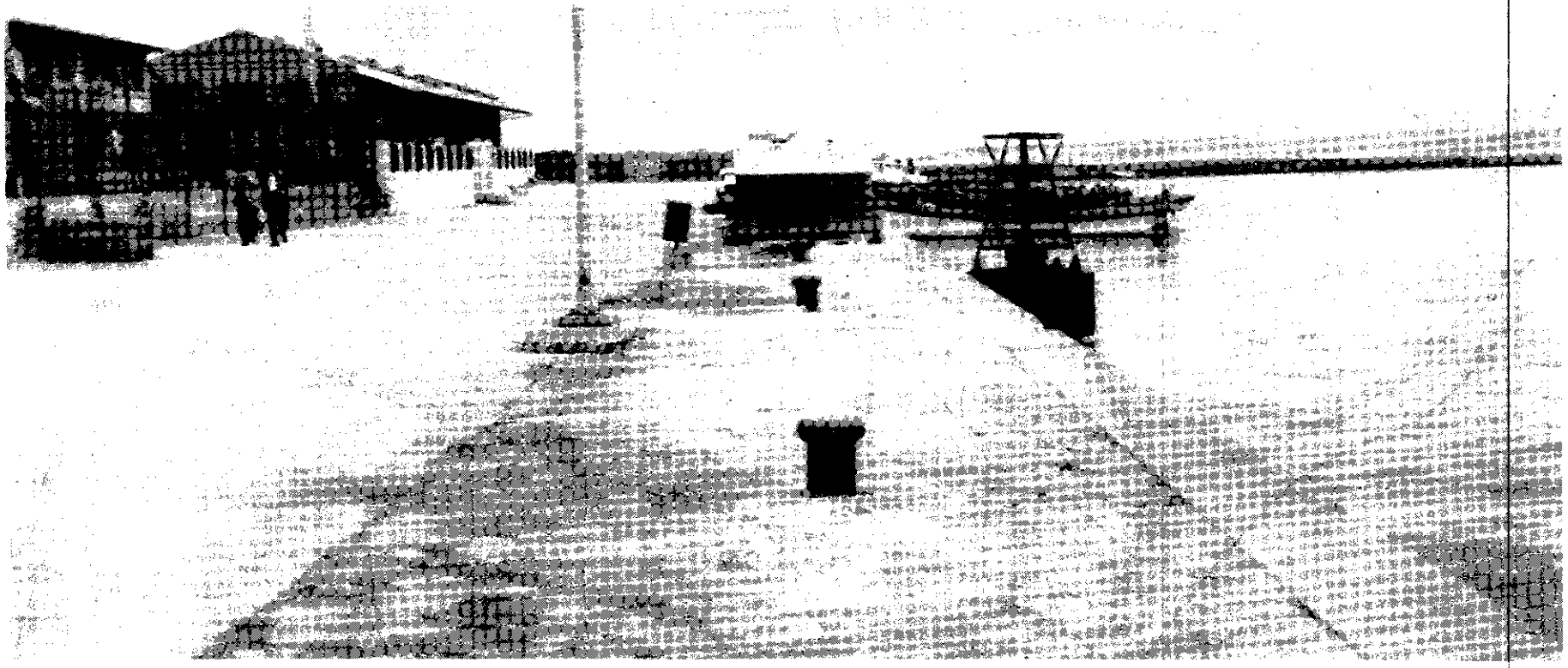


Figure PO-12. Wharf 1 (northwestward view).

d. (U) Container Operations. There are no berths at Old Port Terminal with drafts deep enough to accommodate the US-flag container ships reviewed in this study.

e. (U) Summary of Berth Availability. The berths available at Old Port Terminal for different types of US-flag and Korean-flag vessels are summarized in tables PO-9 and PO-10, respectively. Shown for each type is the number each berth could accommodate or the characteristics that make the berth unsuitable.

As shown in the tables, none of the wharves are suitable for US-flag breakbulk, RORO, or container ships. Wharf 1 and Lighterage wharves 1, 2, and 4 could be used for barge operations and could accommodate the shallowest draft (Type 1) Korean breakbulk vessels. Drafts in Old Port Harbor are too shallow for LASH and SEABEE vessels, so they must be anchored in Yongil Bay.

f. (U) Safety Considerations. Old Port Terminal is located immediately east of the central

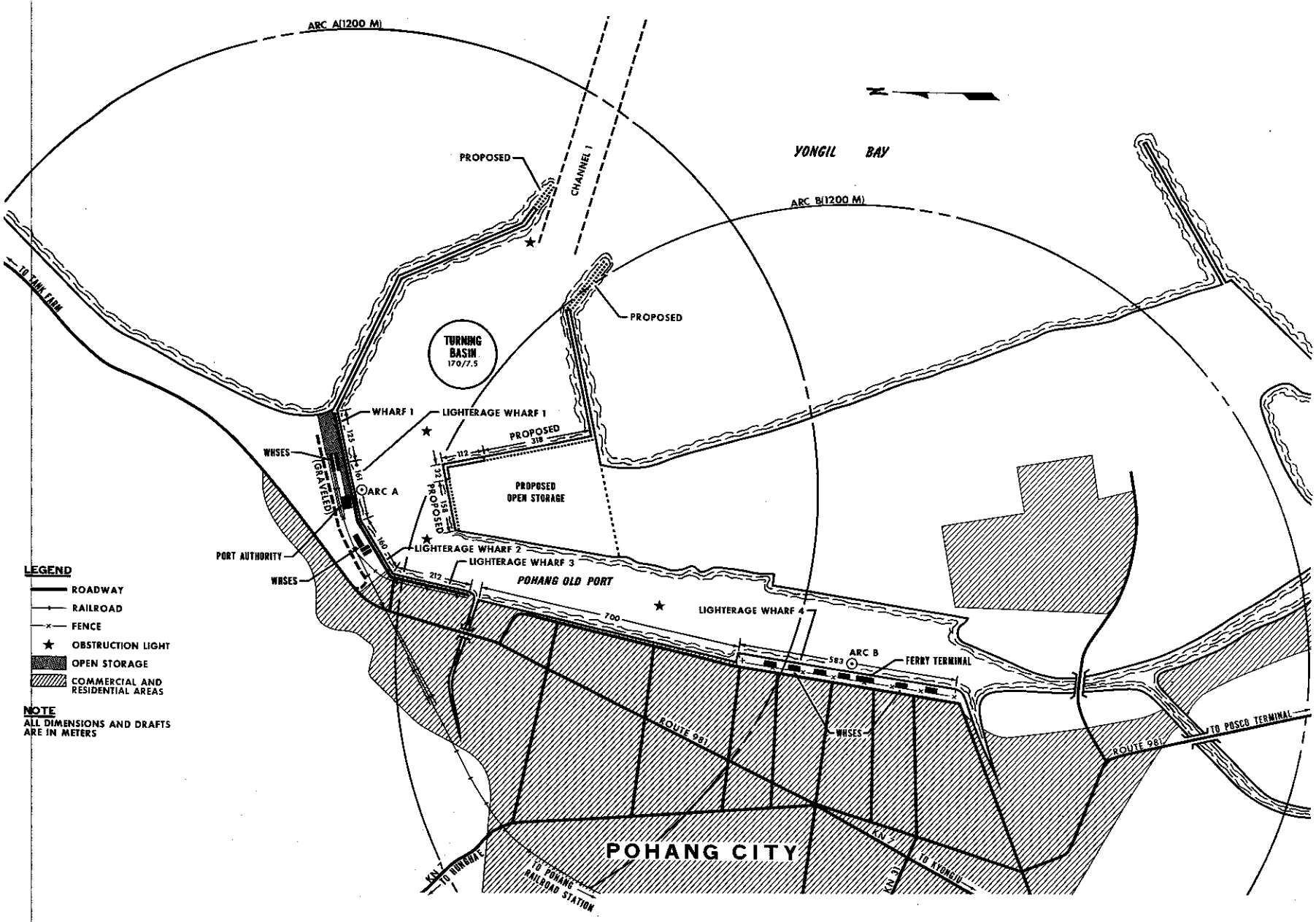


Figure PO-11. Old Port Terminal site map.

adjacent to the ships and the heavy-lift cranes would load the trucks at the same time it unloads the ship. If forklifts are used to load general cargo into van trucks, portable ramps would still be required. This loading could be accomplished on the wharf aprons or in the open storage areas adjacent to the wharves. In summary, portable ramps are needed for loading vans and, although methods exist for loading flatbed trucks, the availability of an end-loading ramp would be better.

6. (U) Security. POSCO Terminal is highly secured. The entire steel mill is surrounded by a lighted concrete wall. The POSCO plant facilities surround the wharf areas a distance of about 2000 meters (6,560 feet) from the wharves. POSCO employs a large security force and guards are posted at all access gates. These guards also patrol along the perimeter and throughout the terminal. All vehicles are stopped at the access gates and only those identified belonging to POSCO or those operated by POSCO personnel are allowed into the plant. In addition, several places within the plant have security fencing.

C. (U) Pohang Old Port Terminal

1. (U) Berthing. The wharves at Old Port Terminal (fig PO-11) consist of wharf 1 (fig PO-12) and Lighterage wharves 1, 2, 3, and 4 (fig PO-13). They all have shallow drafts and are used by local fishing vessels, general cargo lighters, ferries, and the Korean Coast Guard. The Coast Guard vessels occupy Lighterage wharf 3, so this wharf is not expected to be available for cargo operations. Additional wharves are being constructed on the north and east shores of the peninsula that forms the western shore of Old Port Harbor. These wharves are expected to be completed during 1984. The Korean Navy occupies the western shore of the peninsula opposite lighterage wharf 3 and areas farther south along the peninsula. The specific characteristics of these wharves are are summarized in table PO-8 and are analyzed to determine the ship types the port can accommodate.

a. (U) RORO Operations. There are no berths at Old Port Terminal with drafts deep enough to accommodate the US-flag RORO ships reviewed in this study.

b. (U) Breakbulk Operations. There are no berths at Old Port Terminal with drafts deep enough to accommodate the US-flag breakbulk ships reviewed in this study. Also, since only the shallowest draft Korean-flag breakbulk vessels (Type 1) can be berthed at the wharves, breakbulk operations at the terminal would be minimal.

c. (U) LASH and SEABEE Operations. LASH and SEABEE barges could be unloaded at wharf 1 and Lighterage wharves 1, 2, and 4. Mobile cranes are available that could be used to unload barges. Abundant space is available for staging barges in the harbor, but the large LASH and SEABEE vessels must be anchored outside the harbor in Yongil Bay. Since these anchorages are sheltered from sea waters, loading barges onto and discharging them from the vessels would not be a problem. The four tugboats available at Pohang Port would be required to tow the barges between the anchorages and staging areas in the harbor. So while barge operations are possible at Old Port Terminal, it is recommended that all support assets be used first at POSCO Terminal and that Old Port Terminal be used only as a backup site.

TABLE PO-7
MATERIALS HANDLING EQUIPMENT - POHANG

Owner	Capacity (STON)	Quantity	Motive Power
Hanjin Trans Co.	30	1	Diesel
	16	2	Diesel
	13	2	Diesel
	5	1	Diesel
	2	1	Diesel
Tongbang Trans Co.	16	17	Diesel
	14	9	Diesel
	10	1	Diesel
	8	1	Diesel
	4	2	Diesel
Sebang Enterprising Co.	15	2	Diesel
	2	1	Diesel
Korea Express Co.	15	4	Diesel
	10	2	Diesel
	6	1	Diesel
	5	2	Diesel
Sampyo Industrial Co.	5	1	Diesel

Wharf 3 - 29 525 square meters (7.3 acres)
Wharf 4 - 46 550 square meters (11.5 acres)
Wharf 5 - 9500 square meters (2.4 acres)
Wharf 6 - 29 500 square meters (7.3 acres)

b. (U) Covered Storage. POSCO Terminal has no covered storage.

c. (U) POL Storage. POSCO has a small number of POL tanks located throughout the plant. The POL is used only to support various activities at the steel mill.

3. (U) Rail Operations. Although POSCO Terminal has rail access, most of the trackage serves the various manufacturing plants at the mill and must be kept open for that purpose. However, one siding, located about 230 meters (754 feet) northeast of Local 981, could be a potential loading site (fig PO-2). The track is about 730 meters (2,395 feet) long, the entire length of which is adjacent to a road. Vehicles driven alongside the siding could be loaded onto railcars by a heavy-lift crane. As previously discussed in paragraph A4, if portable ramps or cranes were provided, the railyard at the Goedong Station could be used as a railcar loading site. The railyard is close to the port, and highway access from the port is excellent.

4. (U) Truck Operations. Truck access to and from POSCO Terminal is excellent and can be reached through North or South Gate. All roads on the terminal are paved and in good condition, so truck travel would not be impeded. Many of the terminal roads, such as the one leading from North Gate to the wharves, are four-lane arterials. The port has no truck docks or end-loading ramps, so portable ramps and mobile cranes would be required for truck loading. The port has a number of mobile cranes that could be used to lift nonroadable equipment onto flatbed trucks. The port also has a number of forklifts that could be used to load general cargo into vans or to lift pallets of cargo onto flatbeds. The exact availability of the materials handling equipment would be subject to the production level of the manufacturing plants and would fluctuate inversely with the plants' production rate. Trucks could be loaded in one of the paved, open storage areas adjacent to wharves 3, 4, 5, and 6. These areas are suitable for loading operations during all climatic conditions. As an alternate, nonroadable unit equipment and general cargo could be loaded directly from the ship onto flatbed trucks. Trucks could be positioned

TABLE PO-6
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF POHANG (POSCO TERMINAL)

Korean-Flag Ship Type	Berths								
			Wharf 4		Wharf 5			Wharf 6	
	Hoan Wharf	Wharf 3	West	East	West	Head	East	Lighter	Low-deck
Breakbulk									
Type 1	4	12	6	5	8	4	10	9	8
Type 2	2	5	3	2	4	2	5	4	4
Type 3	2	5	2	2	3	2	5	4	3
Type 4	1	5	2	2	3	1	4	3	3
Type 5	a	5	2	2	3	1	4	a	3
Type 6	a	4	2	1	2	1	a	a	a
Type 7	a	3	1	1	2	1	a	a	a

a - Inadequate draft at berth.

f. (U) Safety Considerations. POSCO Terminal is located about 4200 meters (13,776 feet) south of the center of the central business district of Pohang. The wharf facilities are completely surrounded by the Pohang Steel Mill Company, which occupies all area within about 2000 meters (6,560 feet) of the port. POL storage tanks are scattered throughout the terminal but not in great quantities. The quantity-distance arcs established for breakbulk vessels and container ships loaded with ammunition are 2500 meters (8,200 feet) and 2800 meters (9,184 feet), respectively. Therefore, the steel mill is the major activity within these arcs.

2. (U) Materials Handling Equipment. In addition to the mobile cranes at the port terminal, the forklifts listed in table PO-7 are also available. These forklifts would be required to load general cargo into conveyance vehicles. A total of 50 forklifts are available, 40 of which have a capacity of 10 tons or greater. The port also has access to about 121 cargo trucks and 84 trailers owned and operated by local stevedore companies.

3. (U) Storage Areas

a. (U) Open Storage. POSCO Terminal has four open storage areas totaling 115 075 square meters (28.5 acres). These areas are adjacent to wharves 3, 4, 5, and 6 and generally support shipping activities on the respective wharves. Open storage is composed of the following paved areas:

TABLE PO-5
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF POHANG (POSCO TERMINAL)

US-Flag Ship Type	Berths								
	Hoan Wharf	Wharf 3	Wharf 4		Wharf 5			Wharf 6	
			West	East	West	Head	East	Lighter	Low-deck
RORO									
GTS Callaghan	a,c,d	2,d	1,d	c	1	c,d	a,d	a,d	a,c,d
USNS Comet	a,d	2,d	1,d	1	1	1,d	a,d	a,d	a,c,d
Maine-class	a,c,d	a,d	1,d	c	1	a,c,d	a,d	a,d	a,c,d
Breakbulk									
C4 Mariner-class	a,c	2	1	1	1	c	a	a	a,c
C4-S-58a	a,c	2	1	1	1	c	a	a	a,c
C3-S-38a	a	2	1	1	2	1	a	a	a,c
C3-S-33a	a	2	1	1	2	1	a	a	a,c,
Barge									
LASH C8-S-81B	a,c,f	a,f	a,c,f	a,c,f	a,f	a,c,f	a,f	a,f	a,c,f
LASH barge	a	23	12	10	16	9	20	17	z
SEABEE C8-S-82A	a,c,f	a,f	c,f	a,c,f	a,f	a,c,f	a,f	a,f	a,c,f
SEABEE barge	5	14	7	6	10	5	12	11	z
Seatrain									
Georgia-class	a	2	1	1	1	1	a	a	a,c,
Puerto-class	a,c	2	1	1	1	c	a	a	a,c
Container									
SL-7 (Cntnr only)	a,c,e	a	c	c	1	a,c	a	a,e	a,c,e
C6-S-1W	a,c,e	2	1	c	1	c	a	a,e	a,c,e
C7-S-68E	a,c,e	a	1	c	1	a,c	a	a,e	a,c,e
C8-S-85B	a,c,e	2	1	c	1	a,c	a	a,e	a,c,e
RORO/Container									
C5-S-78	a,c,e	a	1	1	1	a,c	a	a,e	a,c,e
T-AKR (SL-7)	a,c,e	a	c	c	1	a,c	a	a,e	a,c,e
Breakbulk/Container									
C5-S-37E	a,c,e	2	1	1	1	c	a	a,e	a,c,e
C4-S-10	a,c,e	2	1	1	1	a,c	a	a,e	a,c,e

*Note: Berths are not expected to be available.
a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.
f - Inadequate draft for barge ship at berth; however, ship could be unloaded from anchorage.

maximize berthing capability, deep-draft berths should be reserved for oceangoing vessels, and barges should be unloaded from shallow-draft berths whenever possible. Therefore, Hoan wharf, wharf 5 (east), and wharf 6 would provide suitable berths for either type of barge. The terminal has access to the mobile cranes shown in table PO-4. These cranes could be positioned at the wharves to support barge operations. Based on normal circumstances, each crane would establish a loading position and would require adequate wharfage for two barges. Although wharves 1 and 2 are unsuitable for cargo operations, they provide good berths for LASH and SEABEE ships while barges are loaded or discharged. Abundant space for staging barges is available adjacent to wharf 2 near Hoan wharf and in the turning basin adjacent to wharf 5 (east) and wharf 6. Additional space is available near wharf 1 and North wharf. Four tugboats are available at the port to provide towing service.

TABLE PO-4
MOBILE CRANES

Owner	Capacity (STON)	Quantity	Motive Power
Sebang Enterprising Co.	90	1	Diesel
Hanjin Trans Co.	70	1	Diesel
	50	1	Diesel
Korea Express Co.	50	1	Diesel
	20	2	Diesel
Tongbang Trans Co.	40	3	Diesel
Sampyo Industrial Co.	25	1	Diesel

d. (U) Container Operations. Container ships could be berthed at wharf 3, wharf 4 (east and west), and wharf 5 (west). Wharf 3 does not have sufficient draft for all container ships, and ships at wharf 4 (east) would extend into the LST ramp wharfage, which would prevent straight stern-ramp RORO operations from wharf 5 (west). Although none of these wharves have container cranes, the bridge-type cranes on wharves 3 and 4 (east and west) function in a similar way and could support container operations. Additional bridge-type cranes are available at wharf 5 (head), but the length of this berth is inadequate for the container ships used in this study. The level-luffing cranes on wharves 3 and 5 (west) could also support container operations, although the unloading rates would be slower.

e. (U) Summary of Berth Availability. The berths available at POSCO Terminal for different types of US-flag and Korean-flag vessels are summarized in tables PO-5 and PO-6, respectively. Shown for each type is the number each berth could accommodate or the characteristics that make the berth unsuitable.

As shown in the tables, wharves 3, 4, and 5 provide the best berths for large oceangoing vessels. Wharf cranes are available on the wharves that can support breakbulk and container operations. Side ramp and slewed stern-ramp RORO operations are also possible at these wharves and straight stern-ramp RORO operations are possible from wharf 5 (west). Hoan wharf, wharf 5 (east), and wharf 6 provide suitable berths for barges and can accommodate the shallow-draft Korean breakbulk ships. Cargo loading/unloading is not possible at wharves 1 and 2, so these wharves are not included in the tables. However, these wharves can accommodate LASH and SEABEE vessels while barges are loaded and discharged.

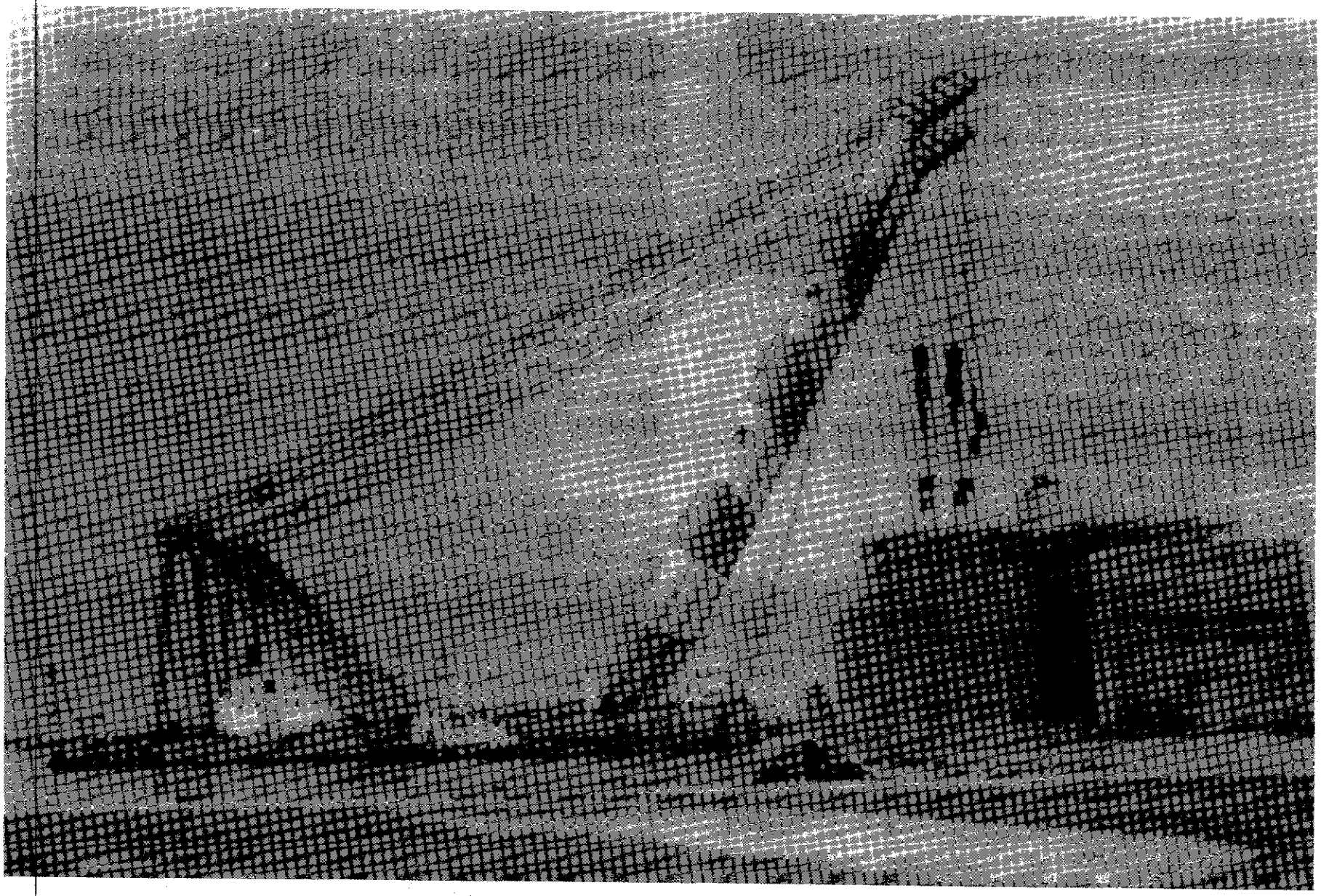


Figure PO-10. 2,000-STON floating crane.

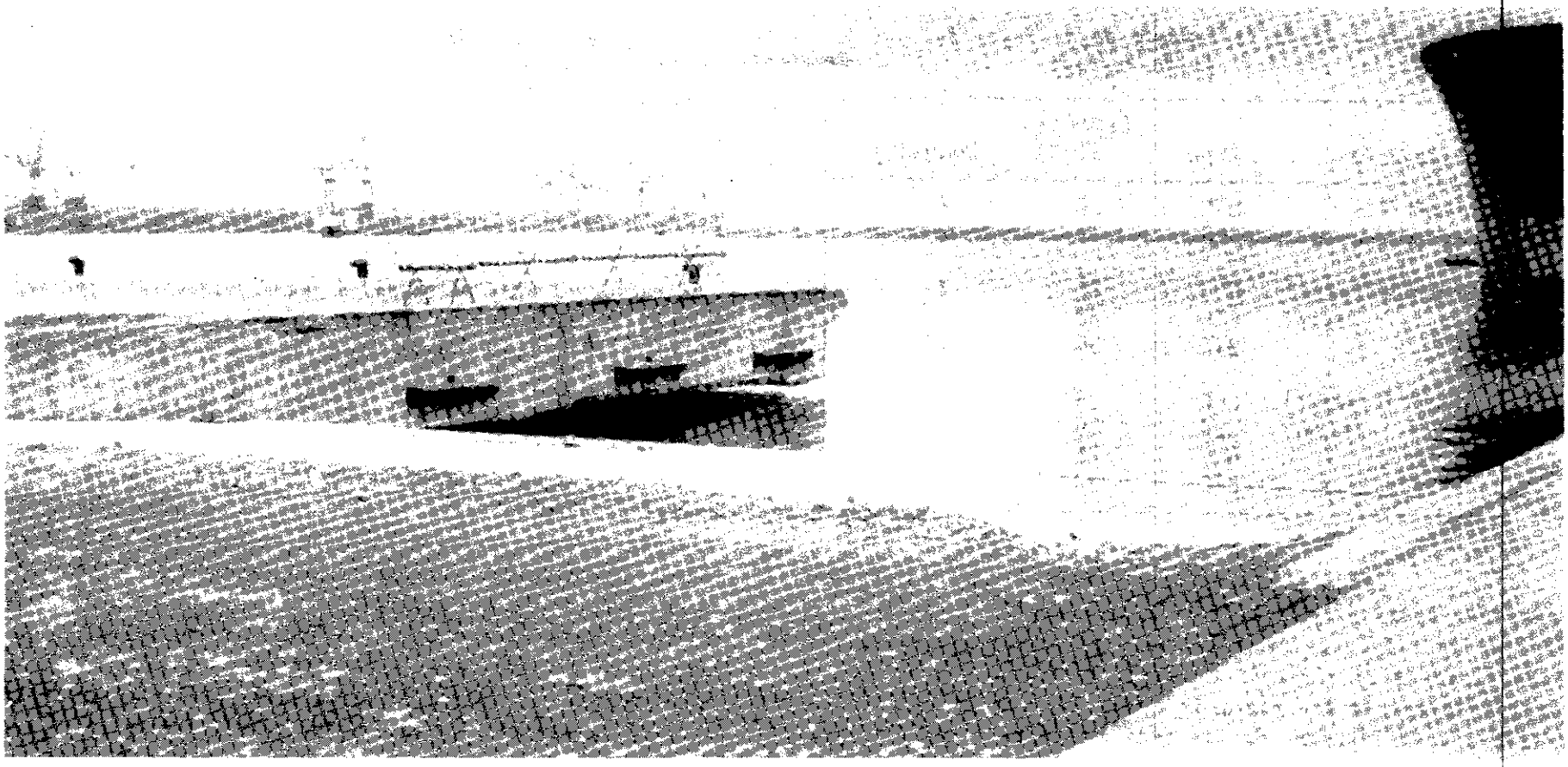


Figure PO-9. LST ramp (northward view).

lifting capacities that range between 15 and 35 STON, are available on wharves 3, 4, and 5. These cranes could be used to unload breakbulk cargo or to load cargo onto conveyance vehicles, but their capacities are not adequate for heavy lifts. Lifting capacities of the mobile cranes available at the port are also inadequate, so heavy-lift cranes must be provided at all wharves to handle heavy military equipment. Although a 2,000-STON floating crane (fig PO-10), owned by the Korean Ministry of Construction, is currently located at POSCO Terminal, its availability for shipping operations is uncertain.

c. (U) LASH and SEABEE Operations. LASH and SEABEE barges could be unloaded from Hoan wharf and wharves 3, 4, 5, and 6; however, to

TABLE PO-3
WHARF CRANES

Location	Type	Capacity (STON)	Quantity
Wharf 3	BTC	15	2
	LLC	15	2
Wharf 4 (west)	BTC	30	2
(east)	BTC	25	1
	BTC	35	1
Wharf 5 (west)	LLC	25	1
(head)	LLC	15	1
	BTC	25	1
	BTC	30	1

An LST ramp (fig PO-9), located between wharves 4 and 5, can accommodate straight stern ramps from RORO ships berthed at wharf 5 (west). This ramp is 25 meters (82 feet) wide and the shore area adjacent to the ramp is open. Hoan wharf and wharf 6 have shallow drafts that would be suitable only for barges or Korean breakbulk vessels. These wharves do not have wharf cranes. Several new wharves are being constructed in the southeastern section of the harbor. Construction on these wharves is estimated to be completed by the end of 1984. These wharves will greatly increase the berthing capacity of the harbor. Based on the above considerations, Hoan wharf and wharves 3, 4, 5, and 6 and the LST ramp are available at POSCO Terminal to potentially support military shipping. The capability of these wharves to support specific ship operations are described below.

a. (U) RORO Operations. RORO operations at POSCO Terminal are possible at wharf 3, wharf 4 (east and west), and wharf 5 (west, head); however, not all RORO ships can be berthed at each. For example, wharf 5 (head) can accommodate only smaller RORO vessels like the USNS Comet and wharf 3 cannot accommodate deep-draft RORO vessels like the T-AKR or Maine-class. Maine-class RORO vessels can be accommodated only at wharf 4 (east and west) and wharf 5 (west). At wharf 4 (east), these ships would extend into the LST ramp wharfage, which would prevent RORO straight stern-ramp operations from wharf 5 (west). Therefore, wharf 4 (east) would be available only when RORO ships not requiring straight stern-ramp facilities or other ship types were berthed at wharf 5. The T-AKR vessel can be berthed only at wharf 5 (west), where it would occupy the entire berth. The rail-mounted cranes on these wharves could be pushed aside to accommodate the ship ramps. All of these wharves have open aprons that would provide ample space for side ramp and slewed-stern ramp operations. So while POSCO Terminal has a number of berths that are suitable for RORO vessels, not all RORO ships or ramp operations are possible at each berth.

b. (U) Breakbulk Operations. Wharf 3, wharf 4 (east and west), and wharf 5 (west and head) provide a number of berths that can be used by US-flag and Korean-flag breakbulk vessels. The shallow-draft Korean breakbulk vessels can be berthed also at Hoan wharf, wharf 5 (east), and wharf 6, although Hoan wharf and wharf 6 would better serve barge operations. Rail-mounted, bridge, and level-luffing cranes with

Figure PO-8. Wharf 6 (northwestward view).

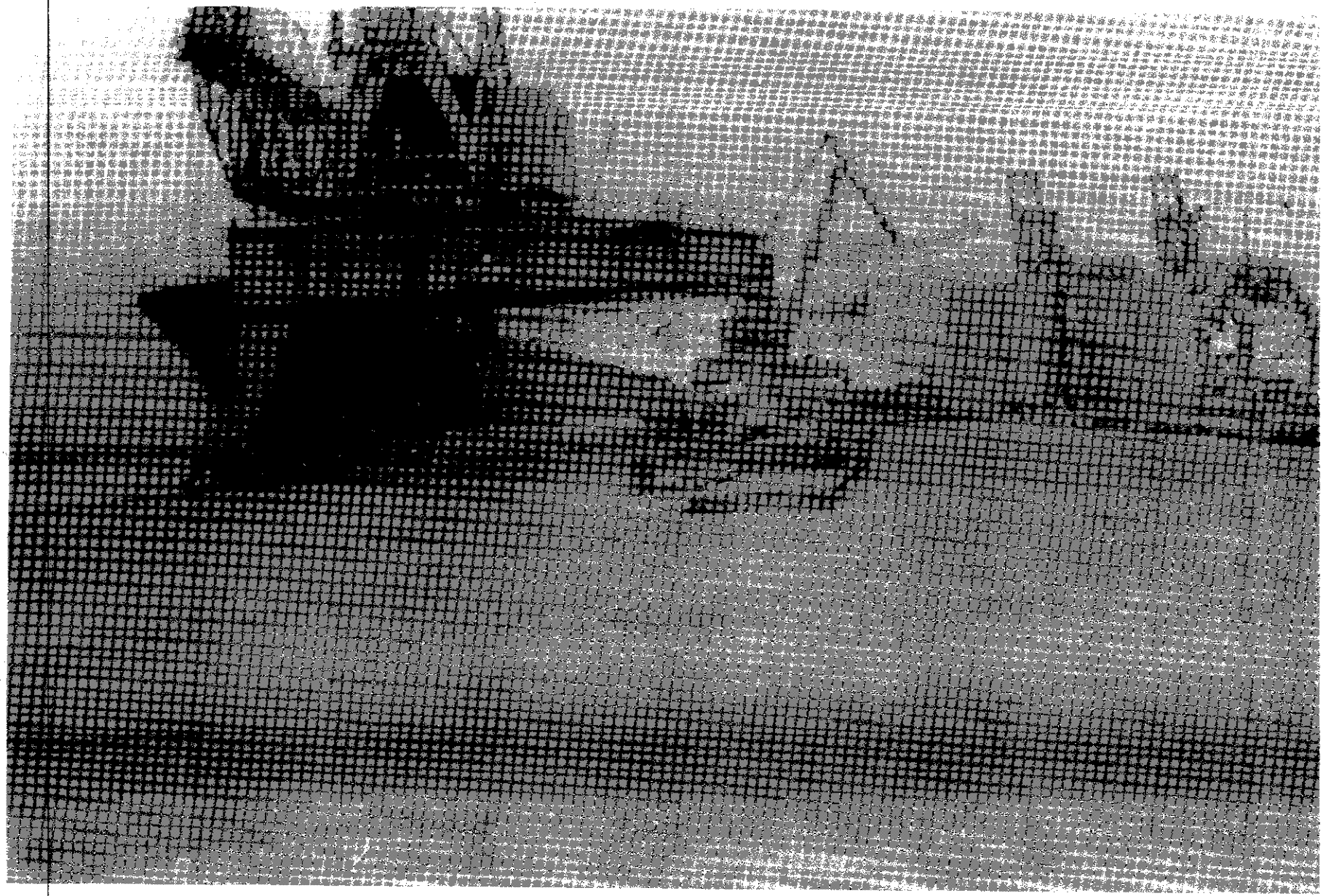
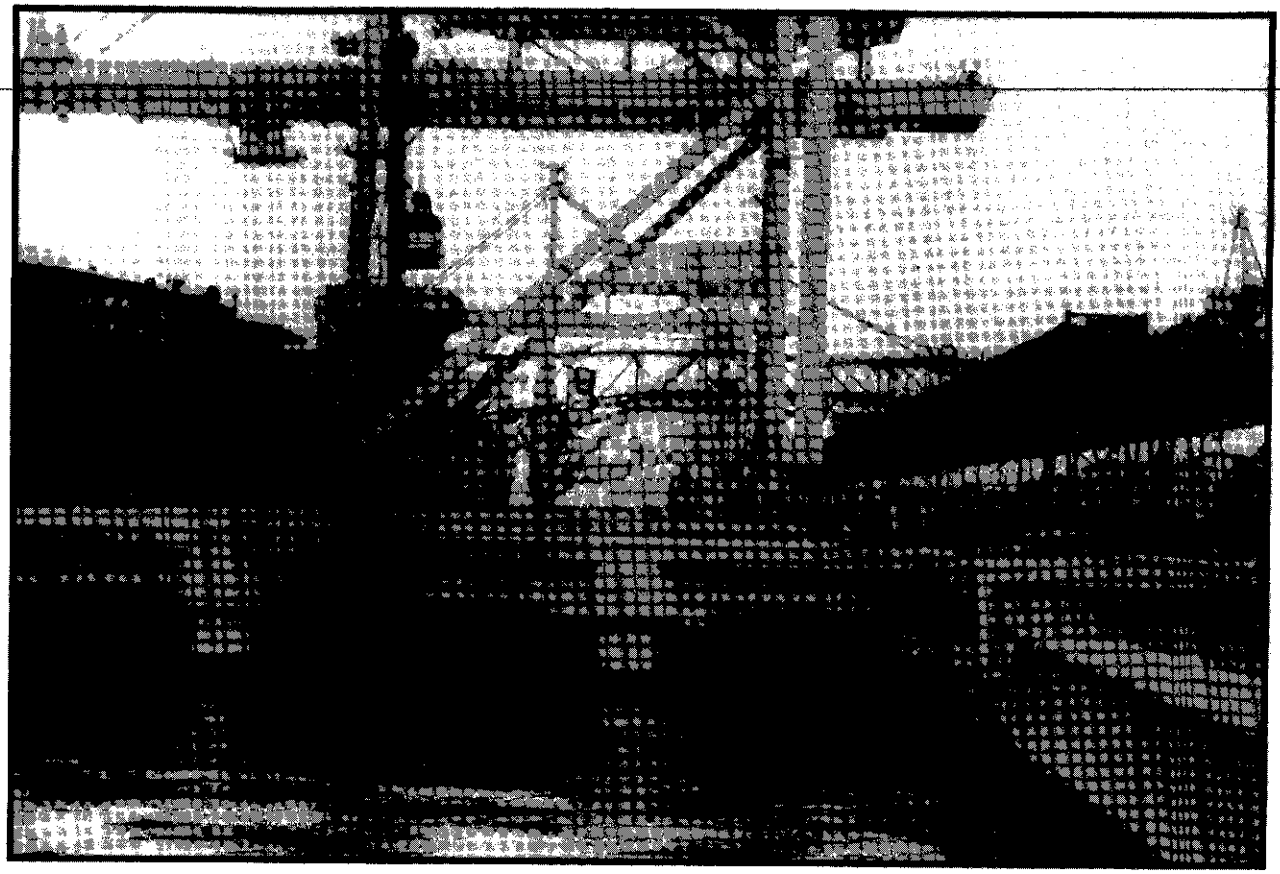


Figure PO-7. Wharf 5 (northeastward view).

Figure PO-6. Wharf 3 (northeastward view).



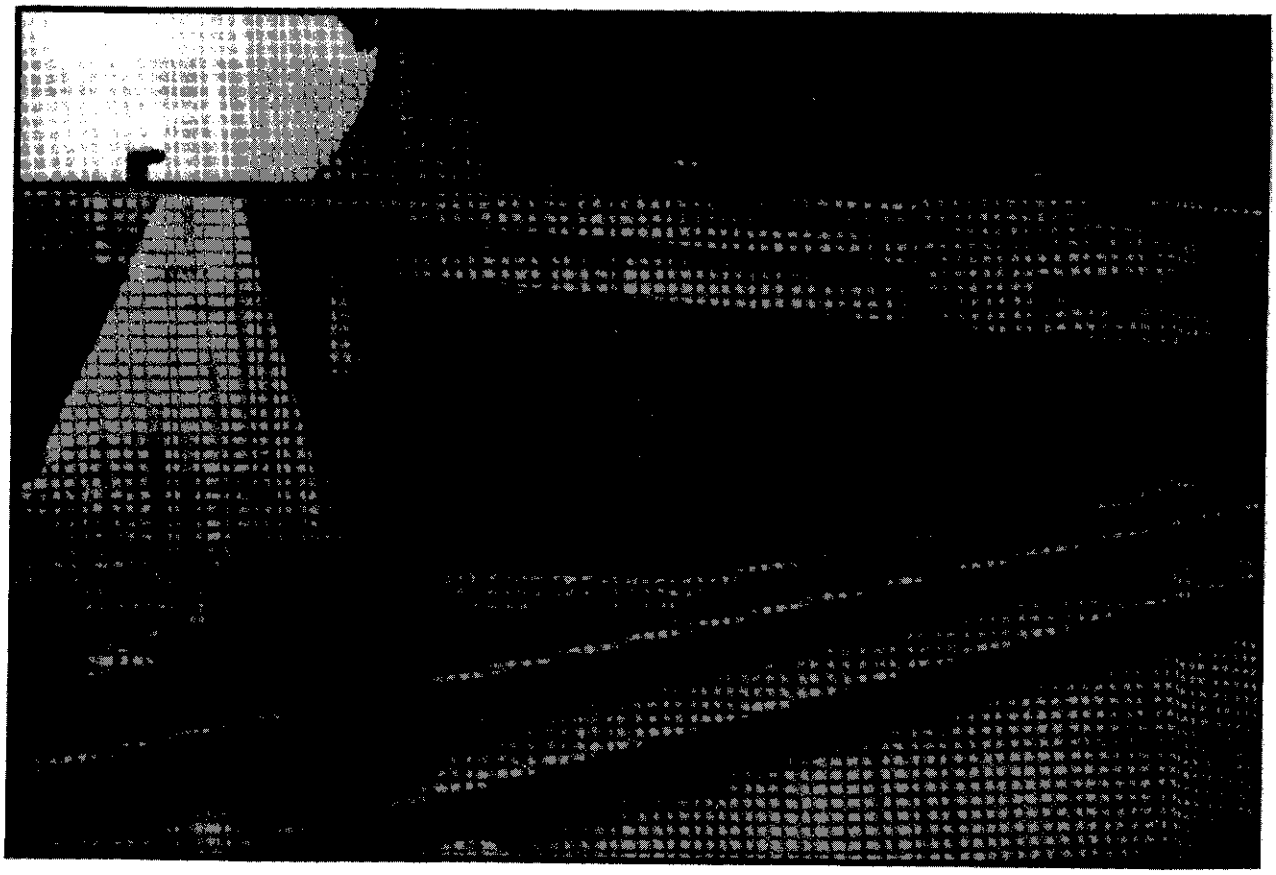


Figure PO-5. Open apron of wharf 1.

TABLE PO-2
PORT OF POHANG (POSCO TERMINAL)
OPERATED BY: POHANG DISTRICT MARITIME AND PORT AUTHORITY

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m (ft)	Individual Berth	Berth Length m (ft)	Approximate Apron Width m (ft)	MLW m (ft)	Approximate Apron Height Above MLW m (ft)	Deck [1] Strength (psf)	Services by Rail-Mounted Crane	Railcar Access to Apron
Wharf 1	1	Marginal	950 (3,116)	1	950 (3,116)	None [2]	15.0 (40.2)	3.2 (10.5)	NA [2]	No [3]	No
Wharf 2	North, Center, South	Marginal	1010 (3,313)	North,	300 (984)	None [2]	6.0 (19.7)	3.2 (10.5)	NA [2]	No [3]	No
				Center,	310 (1,017)	None [2]	12.0 (39.4)	3.2 (10.5)	NA [2]	No [3]	No
				South	400 (1,312)	None [2]	12.0 (39.4)	3.2 (10.5)	NA [2]	No [3]	No
Hoan wharf	1	Marginal	170 (558)	1	170 (558)	20 (66)	5.5 (18.0)	3.2 (10.5)	(628)	No	No
Wharf 3	1	Marginal	440 (1,443)	1	440 (1,443)	Open	10.0 (32.8)	3.2 (10.5)	(838)	Yes	No
Wharf 4	West, East	Marginal	420 (1,378)	West,	225 (738) [4]	Open	12.0 (39.4)	3.2 (10.5)	(838)	Yes	No
				East	195 (640) [4]	Open	11.0 (36.1)	3.2 (10.5)	(838)	Yes	No
Wharf 5	West,	Pier	300 (984)	West,	300 (984)	Open	11.0 (36.1)	3.2 (10.5)	(838)	Yes	No
	Head,		170 (558)	Head,	170 (558)	Open	9.5 (31.2)	3.2 (10.5)	(838)	Yes	No
	East		385 (1,263)	East	385 (1,263)	Open	7.5 (24.6)	3.2 (10.5)	(838)	No	No
Wharf 6	Lighter wharf	Marginal	381 (1,249)	Lighter wharf	330 (1,082)	Open	5.5 (18.0)	3.2 (10.5)	(628)	No	No
	Low-deck wharf			Low-deck wharf	51 (167)	Open	5.5 (18.0)	3.2 (10.5)	(628)	No	No

Rail-Mounted Cranes	Serving Berths	Roll-on/Roll-off Facilities	Serving Berths	Open Storage m^2 (acres)	Serving Berths	Covered Storage	Serving Berths
Two 15-Ton BTC [5] [6] Two 15-Ton LLC Two 30-Ton BTC	Wharf 3 Wharf 4 (west)	LST Ramp	Wharf 5 (west)	29 525 (7.3) 46 550 (11.5)	Wharf 3 Wharf 4	None	-
One 25-Ton BTC One 35-Ton BTC One 25-Ton LLC One 15-Ton LLC One 25-Ton BTC One 30-Ton BTC	Wharf 4 (east) Wharf 5 (west) Wharf 5 (head)			9 500 (2.4) 29 500 (7.3)	Wharf 5 Wharf 6		

[1] Estimated values.
[2] Open structure apron with no deck, used only to support cranes.
[3] Since these berths are not suitable for general cargo operations, the cranes serving these berths are not considered to be available.
[4] Can be increased to 220 meters (722 feet) if the ship is allowed to extend into the LST ramp area.
[5] BTC - bridge-type crane.
[6] LLC - level-luffing crane.

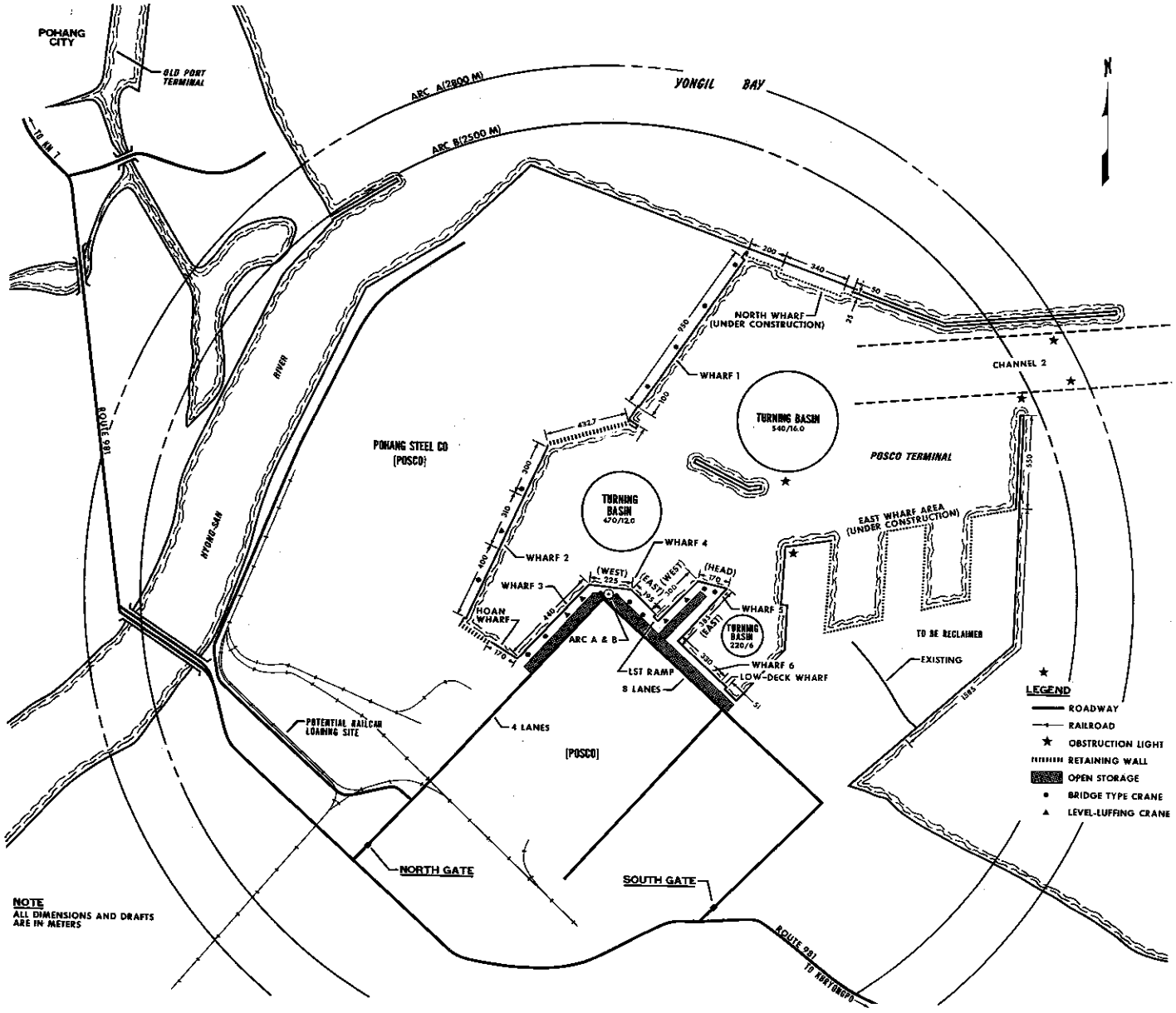


Figure PO-4. POSCO Terminal site map.

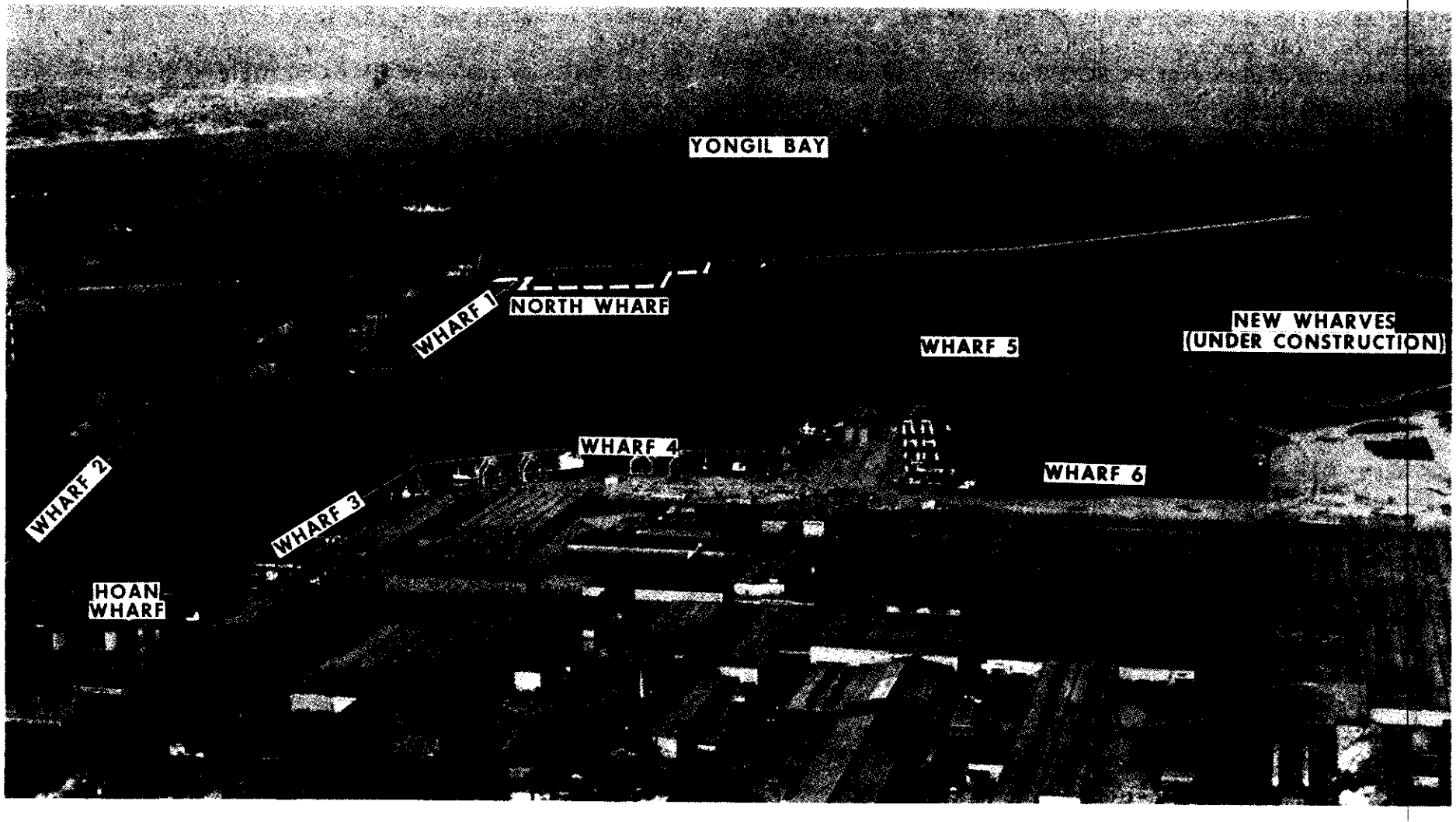


Figure PO-3. Aerial view of POSCO Terminal.

of wharf 5 at POSCO Terminal. The yard has 13 sidings that can accommodate about 275 railcars. Portable ramps or cranes would be required to load vehicles at this site since the ramps are not currently available. Although most of the rail spurs serving the manufacturing plants at POSCO Terminal are unsuitable loading sites, one potentially usable siding is available. So, there are two potential railcar loading sites for cargo and equipment handled by POSCO Terminal, although at both sites, portable ramps or cranes would have to be obtained.

5. (U) Airports. The closest airfield is Pohang Airport, located about 3 kilometers (1.9 miles) south of POSCO Terminal (fig PO-1). The asphalt runway is 2134 meters (7,000 feet) long and 46 meters (150 feet) wide. The airport is capable of supporting intratheater aircraft.

B. (U) Pohang (POSCO) Port Terminal

1. (U) Berthing. The berths at POSCO Terminal (figs PO-3 and PO-4) were developed to support the Pohang Steel Company. The berths are used mainly for import of bulk materials essential to the production of steel and the export of finished products manufactured at the mill. The current use of the wharves in support of the industrial mission of the port would be interrupted if they were used for military operations. The specific characteristics of the berths at POSCO Terminal are summarized in table PO-2. These characteristics are analyzed to determine the ship types that the port terminal can accommodate.

In general, POSCO Terminal can be divided into four distinct sections. Along the north breakwater, a new general cargo wharf, North wharf, is being constructed and is to be completed by the end of 1984. The wharf will be 340 meters (1,115 feet) in length with an apron width of 50 meters (164 feet) and a draft of 19 meters (62 feet).

Wharves 1 and 2 are located along the western shore of the harbor and are used to import bulk raw materials used in the production of steel. Both wharves have a number of rail-mounted cranes specially outfitted with clamshells and conveyance systems to handle the bulk material. The wharf aprons (fig PO-5) that support the cranes consist only of reinforced-concrete T-beams which in turn are supported by concrete piles. The aprons have no decks and serve only to support the cranes. So while all of the ships discussed in this report could be berthed at these wharves, their unique construction renders them useless for normal military cargo handling.

Hoan wharf and wharves 3 (fig PO-6), 4, 5 (fig PO-7), and 6 (fig PO-8) are located along the southwestern shore of the harbor and are used mainly for exporting products manufactured at the mill. Wharves 3, 4, and 5 have deep-draft berths that are suitable for many of the ships discussed in this report. These wharves also have a total of eight bridge-type cranes (BTC), which are similar to container cranes, and four level-luffing cranes (LLC), which are outfitted with hooks. All of the cranes are rail mounted and are able to travel along the entire length of the wharves. The quantity, type, and location of the cranes available at wharves 3, 4, and 5 are listed in table PO-3.

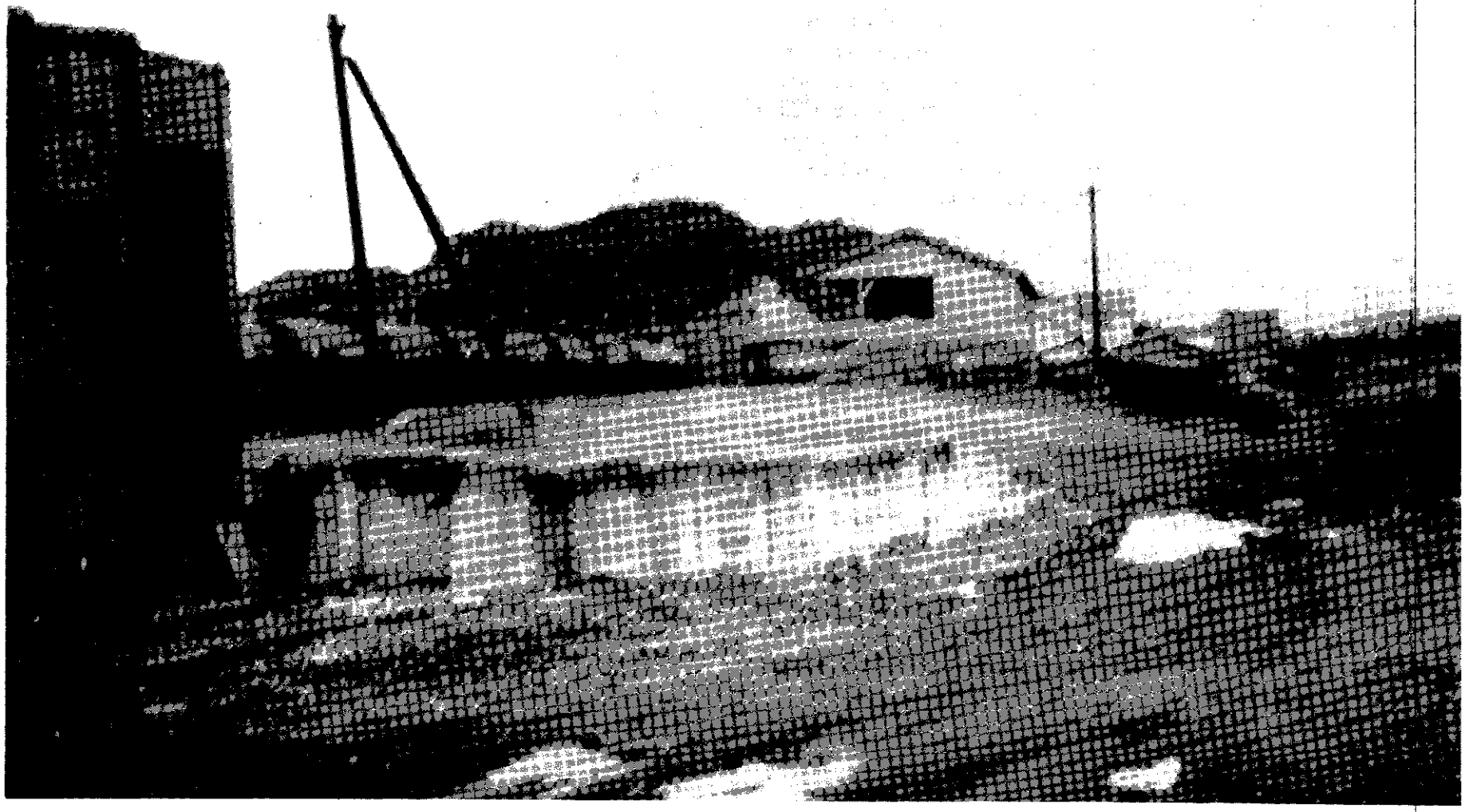


Figure PO-2. Railcar end-loading ramp at Pohang Railroad Station.

that runs north from the station to Old Port Terminal. This track terminates at Old Port Terminal, where three spur tracks branch off to provide access to various terminal facilities.

Another track separates from the Kongju-Pohang branch line and runs southeast to the Goedong railyard and on to POSCO Terminal. The Goedong railyard is located about 2 kilometers (1.2 miles) west

Since Old Port Harbor does not have a major silting problem, the port authority does not conduct annual dredging. However, soundings are taken periodically to ensure that designated drafts are maintained throughout the harbor, as well as in the entrance and inland channels. In 1983, the section of the harbor located adjacent to the new wharves was dredged to establish the design draft of the wharves.

3. (U) Highway Access. North and South Gates provide access from POSCO Terminal to Local Route 981. Between the wharves and these gates are four-lane arterial roads that would provide excellent access for military unit equipment. Local 981, a 14-meter (46-foot) -wide, four-lane road with broad shoulders, extends northward to Pohang and intersects with Korean Route 7 about 5.5 kilometers (3.4 miles) from the terminal. Korean 7 is the main supply route and runs north and south along the entire eastern seaboard of Korea. It is four lanes as it cuts through the central business district of Pohang (fig PO-1) at a width of 14 meters (48 feet). North of Pohang, Korean 7 is a 7-meter (23-foot) -wide, two-lane roadway. South of Pohang, it becomes four lanes, widening to 14.6 meters (48 feet). Therefore, the highway access from the POSCO Terminal to the main supply route is suitable for moving military equipment.

Highway access from the wharves at Old Port Terminal is provided by unnamed city streets that run west, intersecting Local 981 and Korean 7. These access roads have two narrow lanes and are generally crowded with pedestrians and commercial and domestic vehicles. Local 981 runs parallel to the wharves, approaching to within about 100 meters (328 feet) of the northern wharves and within about 300 meters (984 feet) of the southern wharf. It provides good access from the port but is generally overcrowded with local traffic. Korean 7, which has good access to the north and south of Pohang, is located about 250 meters (820 feet) west of Local 981. Highway access from Old Port Terminal is therefore considered acceptable, but travel in the port area would be slowed by narrow roads and local traffic until the main supply route was reached.

4. (U) Rail Access. A line branches from the Korean National Railroad in Kongju and runs north to Pohang. This line provides access to the Pohang Railroad Station and then continues north to Old Port Terminal and the PDSK tank farm. Pohang Station, which also serves as a passenger terminal and a low-volume freight station, handles all railcars to and from both areas. The station is located about 2.5 kilometers (1.6 miles) from Old Port Terminal, on the western edge of the central business district of Pohang. Adequate trackage is available for about 176 railcars, and railcar loading facilities include an end-loading ramp (fig PO-2), a side dock, and a general cargo warehouse.

The unpaved area surrounding the loading ramp could become unserviceable during inclement weather. The end-ramp spur track has a capacity of 10 railcars and the side dock and general cargo warehouse can handle 3 boxcars at a time. The station has no switch locomotive or materials handling equipment for loading railcars.

A double-track siding, which has a side-loading dock, is located about midway along the line

a. (U) POSCO Terminal Harbor. POSCO Terminal Harbor is enclosed by the 2050-meter (6,724-foot) north breakwater and the 2135-meter (7,003-foot) east breakwater. Breakwaters used to exist in the center of the harbor and at the eastern end of wharf 6 prior to the harbor expansion. This expansion doubled the size of the harbor, thereby allowing the large tract of land located west of wharf 1 to be reclaimed. It is also allowing the current reclaiming of the tract located between wharf 6 and the eastern breakwater. The harbor's entrance channel has a 200-meter (656-foot) width and an 18.5-meter (61-foot) draft. The average water depths vary from about 16 meters (52 feet) in the northern section to 12 meters (39 feet) in the southern section. The average tidal range is only about 0.17 meter (7 inches), which does not affect shipping. No overhead obstructions block harbor access, so ship heights are not a factor.

The harbor has three designated turning basins. The largest has a diameter of 540 meters (1,771 feet) and a draft of 16 meters (52 feet) and is located north of the center breakwater. Another large turning basin, with a diameter of 470 meters (1,542 feet) and a draft of 12 meters (39 feet), is located south of the center breakwater. The third turning basin is smaller, with a diameter of 220 meters (722 feet) and a draft of about 6 meters (20 feet), and is located adjacent to wharf 5 (east) and wharf 6.

The harbor does not have a silting problem so annual dredging is not required. Port authorities periodically conduct sounding measurements to ensure that designated drafts are maintained. Based on those soundings, areas may be dredged selectively to maintain or increase drafts. An area adjacent to wharf 3 was dredged in 1983. In 1984, the port authorities plan to dredge near the new wharf, which is being constructed along the north breakwater. They also plan to deepen the harbor's access channel.

b. (U) Old Port Harbor. Old Port Harbor is formed by the 790.5-meter (2,593-foot) north breakwater and the 488.7-meter (1,603-foot) south breakwater. Both breakwaters extend eastward into Pohang Harbor. The access channel to Old Port Harbor has a 200-meter (656-foot) width and an 8-meter (26-foot) draft. The average water depths in the harbor vary from about 7.5 meters (24.6 feet) at the southern end to about 4.5 meters (14.8 feet) at the northern end. Since the average tidal range is only about 0.17 meter (7 inches), shipping is not affected. No overhead obstructions block ship access to the harbor, so the vertical clearance of ships is not a factor. A turning basin with a diameter of 170 meters (558 feet) and a minimum draft of about 7.5 meters (24.6 feet) is located within the harbor.

The wharves at Old Port Terminal are located along the mainland shore from the channel that extends inland from the main harbor. This channel averages between 150 and 200 meters (492 to 656 feet) in width, and the operating draft is about 4.5 meters (14.8 feet). There are no vertical clearance obstructions along the channel to impede ship passage. Additional wharves are being constructed at the northern end of the peninsula, forming the western perimeter of the harbor.

TABLE PO-1
POHANG ANCHORAGE DATA

Anchorage Designation	Geographic Location	Site Characteristics: Diameter m	Diameter (ft)	Depth m	Depth (ft)	Bottom Type
Area I						
1-N-1	lat 36°01'43"N long 129°23'09"E	1000	(3,280)	9	(30)	Sand
1-N-2	lat 36°01'59"N long 129°23'32"E	1000	(3,280)	8	(26)	Sand
1-N-3	lat 36°01'11"N long 129°23'06"E	1000	(3,280)	8	(26)	Sand
1-N-4	lat 36°02'27"N long 12°23'00"E	1000	(3,280)	6	(20)	Sand
Area II						
2-N-1	lat 36°01'32"N long 129°24'25"E	1000	(3,280)	8	(26)	Mud, sand
2-N-2	lat 36°01'18"N long 129°23'57"E	1000	(3,280)	8	(26)	Mud, sand
2-N-3	lat 36°02'17"N long 129°23'59"E	1000	(3,280)	9	(30)	Mud, sand
2-N-4	lat 36°02'46"N long 129°23'45"E	1000	(3,280)	10	(33)	Mud, sand
2-N-5	lat 36°02'37"N long 129°24'52"E	1000	(3,280)	9.5	(31)	Mud, sand
Area III						
3-N-1	lat 36°02'03"N long 129°25'52"E	1000	(3,280)	18	(59)	Mud
3-N-2	lat 36°02'41"N long 129°25'35"E	1000	(3,280)	19	(62)	Mud
3-N-3	lat 36°03'14"N long 129°25'15"E	1000	(3,280)	16	(52)	Mud
3-N-4	lat 36°01'30"N long 129°25'35"E	200	(656)	15	(49)	Mud

TABLE PO-1 - cont

Anchorage Designation	Geographic Location	Site Characteristics: Diameter m	Diameter (ft)	Depth m	Depth (ft)	Bottom Type
3-N-5	lat 36°02'45"N long 129°24'58"E	200	(656)	15	(49)	Mud
3-N-6	lat 36°02'38"N long 129°24'52"E	1000	(3,280)	15.5	(51)	Mud
3-N-7	lat 36°01'16"N long 129°25'04"E	1000	(3,280)	12	(39)	Mud
3-N-8	lat 36°02'17"N long 129°25'13"E	1000	(3,280)	17	(56)	Mud
2-N-9	lat 36°03'04"N long 129°24'04"E	1000	(3,280)	13	(43)	Mud
Area IV						
3-S-1	lat 36°01'12"N long 129°26'27"E	500	(1,640)	16	(52)	Shells
3-S-2	lat 36°00'38"N long 129°26'47"E	500	(1,640)	13	(43)	Shells
3-S-3	lat 36°00'55"N	500	(1,640)	13	(43)	Shells
3-S-4	lat 36°00'24"N long 129°26'05"E	500	(1,640)	13	(43)	Shells
3-S-5	lat 36°00'39"N long 129°25'17"E	500	(1,640)	10	(33)	Shells
3-S-6	lat 36°00'08"N long 129°26'35"E	500	(1,640)	10	(33)	Shells

harbor limit at coordinates latitude 36°03'41"N - longitude 129°25'30"E. Anchorage is prohibited near the oil pipeline dolphin, which is located among the northern anchorage areas. The pipeline serves the US Army, Southern Operations District, Petroleum Distribution Systems - Korea (PDSK), supplying POL material to the nearby tank farm at Camp Libby.

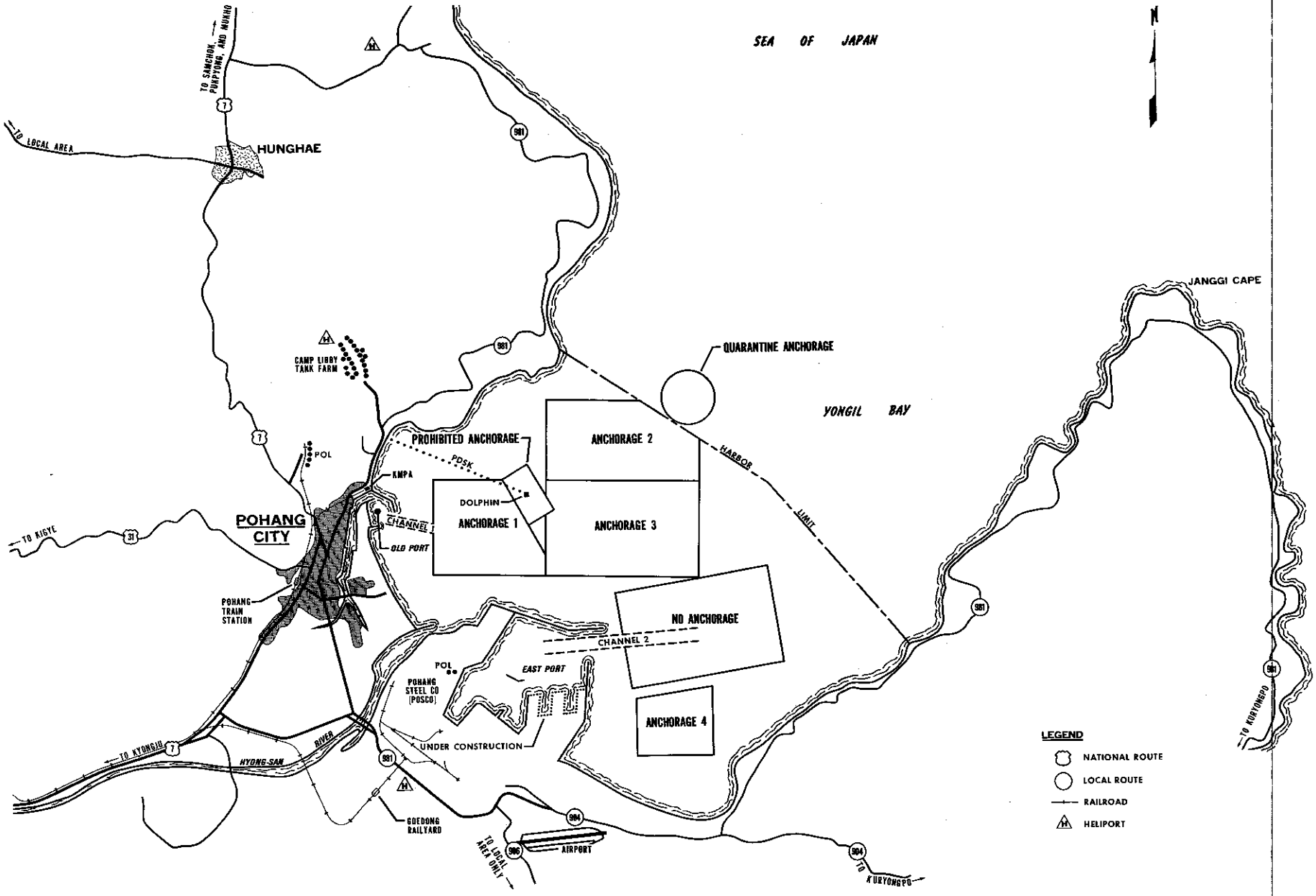


Figure PO-1. Vicinity map.

(U) PORT OF POHANG

A. (U) General Description

1. (U) Location and General Uses. The Port of Pohang (fig PO-1) is located on the eastern seacoast of Korea, about 77 kilometers (48 miles) north of Pusan and 283 kilometers (176 miles) southeast of Seoul. The port has two main inner harbor sections, commonly referred to as the Old Port Terminal and the Pohang Steel Mill Company (POSCO) Terminal. Old Port Terminal is located immediately east of Pohang City. POSCO Terminal is located about 5 kilometers (3 miles) southeast of the city. The port is under the jurisdiction of the Pohang District Maritime and Port Authority, although POSCO Terminal, opened in 1973, is owned and operated by the Pohang Steel Mill Company, the largest steel company in Korea. The steel mill completely surrounds the terminal's harbor and generates all shipping activity there. POSCO Terminal Harbor has several deep-draft berths, which are used to import various bulk materials such as coal and ore. Exports include various steel products manufactured at the mill. The raw materials are unloaded from bulk carriers at wharves located along the western shore of the harbor. The finished products manufactured by the mill are loaded onto ships at wharves located along the southern shore. POSCO Terminal is currently undergoing a major expansion that will add several new piers in the southeastern section of the harbor and a large general cargo wharf along the north breakwater. Old Port Terminal has all shallow-draft wharves, which are used by general cargo lighters, local fishing vessels, ferries, and the Korean Coast Guard.

2. (U) Harbor. The port terminals are located at the head of Yongil Bay, about 12 kilometers (7.5 miles) from the Sea of Japan. Old Port Terminal and POSCO Terminal are situated on the western and southwestern shores of the bay, respectively. The bay is naturally formed and is surrounded by the mainland on the west and south and Janggi Cape on the east. The bay is open to the north-northeast to the Sea of Japan, making it subject to gales from this direction. However, the bay is sheltered from prevailing westerly and northwesterly winds, which worsen from December through March. Pohang Harbor occupies the southwestern section of Yongil Bay. It encompasses an area of about 61.5 square kilometers (24 square miles) from the shore facilities to the outer harbor limit, a distance of about 6400 meters (4 miles), averaging about 9600 meters (6 miles) in width. The harbor entrance is about 5.6 kilometers (3.5 miles) wide, and drafts range from 14 to 20 meters (46 to 66 feet). For safe access, ships are directed away from the eastern section of the bay near Janggi Cape. The average depths throughout Pohang Harbor range from about 20 meters (66 feet) near the harbor limit to about 6 meters (20 feet) near Old Port Terminal and 12 meters (39 feet) near POSCO Terminal. The inner harbor areas at Old Port Terminal and POSCO Terminal, as well as the access channels, have been dredged deeper than these average surrounding depths.

The bay has four anchorage areas with a total of 24 deep-draft anchorages. The bottoms of these anchorages are predominantly mud and sand and provide good holding ground. The specific characteristics of these anchorages are listed in table PO-1. A quarantine anchorage is located to the north, just outside the

all these activities and transportation assets fall within the 2200-meter (7,216-foot) quantity-distance arc established for small breakbulk ammunition ships or barge operations.

TABLE SA-6
INDIVIDUAL BERTH RATING (BARGE)

Ideal Berth Factors	Berths	
	Wharf 2	Wharf 3
Length	10	10
Alongside depth	10	10
Backup area	5	5
Apron width	10	10
Consolidation shed	0	0
Apron tracks	0	0
Anchorage diameter	1	1
Conditional age of facility	8	8
Deck loading	8	8
Heavy-lift cranes	0	0
Berth type	10	10
Truck tailgate	0	0
Rail end ramp	0	0
Truck access	5	5
Tug availability	3	3
Barge lay area	10	10
Total Points	80	80
Ranking	2	1

The port has no standard-gauge rail access. A narrow-gauge track runs between wharf 1 and a local cement manufacturing plant. The Samchok Railroad Station is located near the port and could be used to load cargo and equipment if portable ramps and heavy-lift mobile cranes were made available.

Suitable highway access from the port to Korean Route 7, the main supply route in this region of Korea, is available through Main Gate. The roads on the terminal are paved, but vehicles must cross a graveled, open area to reach Main Gate from wharves 2 and 3. The terminal has no truck docks or end-loading ramps, only two 35-STON mobile cranes, and a small fleet of forklifts for truck loading. Loading operations could be performed in one of the two open storage areas available on the terminal, which provide a total of 6500 square meters (1.7 acres). The port maintains no POL storage tanks, but commercial activities surrounding the terminal do. No covered storage is available since the one warehouse on the terminal is accessible only by the narrow-gauge rail track. Pilot service is available and mandatory, and the port is serviced by one berthing tugboat and about 660 stevedores.

Wharves 2 and 3 are located about 2800 meters (9,184 feet) from the central business district of Samchok, but about 12,000 of the populace are within 2000 meters (6,560 feet) of the wharves. The area surrounding the terminal also includes a powerplant, about 350 meters (1,148 feet) from the wharves, and Korean Route 7, about 900 meters (2,952 feet) from the wharves. A small volume of POL is stored at the powerplant, wharf 1, and fishing wharf 2. Therefore,

Once this land has been reclaimed, wharf 2 and the southern berth of wharf 1 may both be extended. The port is constructing a new shallow-draft wharf, fishing wharf 3, and is planning to reconstruct fishing wharf 1. A large, open storage area is planned adjacent to the new fishing wharf. The proposed area is to be paved and will include about 11 900 square meters (3 acres); however, there are no plans to improve the access road, which is just 2.5 meters (8.2 feet) wide and unsuitable for military equipment. Commercial and residential buildings would have to be removed to allow the road to be widened.

E. (U) Summary

The Port of Samchok is an industrial port that primarily handles bulk materials, such as coal and cement, and small quantities of POL. The port also supports the local fishing industry. Highway access to wharf 1 and the fishing wharves is not adequate for military unit equipment, so only wharves 2 and 3 are available for the types of shipping discussed in this study. Both wharves have elevated conveyor systems running along their aprons, but water depths are suitable only for barges or shallow-draft Korean breakbulk vessels. However, the conveyor system leaves adequate apron width for cranes to discharge ships, and the wharves could be adapted to support cargo shipping. LASH and SEABEE vessels supporting barge operations must be anchored in the unprotected quarantine area. Based on the shipping capabilities of the wharves, individual berth rankings have been computed in tables SA-5 and SA-6 for breakbulk and barge operations, respectively.

TABLE SA-5
INDIVIDUAL BERTH RATING (BB/RORO)*

Ideal Berth Factors	Berths	
	Wharf 2	Wharf 3
Length	5	30
Alongside depth	12	12
Backup area	1	1
Apron width	20	20
Transit shed	0	0
Distribution shed	0	0
Apron tracks	0	0
Deck loading	8	8
Heavy-lift cranes	0	0
Berth type	10	10
Truck tailgate	0	0
Rail end ramp	0	0
Truck access	5	5
Ship service facilities	4	4
Conditional age of facility	8	8
RORO stern ramp	0	0
Total Points	73	88
Ranking	2	1

*Since there are no berths with sufficient draft for RORO vessels, the berths are rated only for Korean-flag breakbulk ships.

about 0.7 kilometer (0.4 mile) from the port. Highway access between the port terminal and the station is adequate for military equipment. The station has storage capacity for about 118 railcars, a side-loading dock that can handle four railcars simultaneously, and two spur tracks with a combined capacity of 22 railcars, suitable for end loading if portable ramps were made available. So while the port terminal cannot support rail operations, equipment could be trucked to Samchok Station and loaded on railcars.

5. (U) Truck Operations. Truck access to and from the port terminal is through Main Gate. Overhead utilities that cross the port access road near the gate leave a vertical clearance of about 7 meters (230 feet), which is adequate for military equipment. The terminal road is paved, but vehicles must cross a graveled, open area to reach wharves 2 and 3. The port has no truck-loading docks or end-loading ramps. Truck loading could be performed in the open areas adjacent to wharves 2 and 3; however, portable ramps would have to be provided for loading vans or for end loading flatbeds and heavy haulers. The 35-STON cranes could also be used in these areas to load some of the nonroadable vehicles onto flatbeds and heavy haulers. For breakbulk operations, ship cranes or heavy-lift mobile cranes could load nonroadable equipment directly onto trucks that are positioned on the adjacent apron.

6. (U) Security. The port terminal is located on a peninsula that is also occupied by a powerplant, Korean Electric Company, and some residential developments. A concrete wall topped with barbed wire runs in a north-south direction through the center of the peninsula and separates wharves 1, 2, and 3 from the powerplant. Another concrete wall runs perpendicular, separating wharves 2 and 3 from wharf 1 and the residential developments that are located west of wharf 1 and the LST ramp. A concrete wall also runs the length of wharf 3, forming a protective barrier along the southern perimeter of the port terminal. These perimeter barriers are not lighted. The port has a guard force of just three employees. The guards are posted 24 hours per day at Main Gate.

C. (U) Support Services

1. (U) Pilotage. Pilotage is mandatory for entrance into the Port of Samchok. Three pilots and one pilot boat are available at the port to provide service 24 hours per day. These pilots also serve the Ports of Mukho and Pukpyong. They usually board incoming vessels at the quarantine anchorage, located outside the breakwaters in the outer harbor at the Port of Mukho.

2. (U) Harbor Craft. Only one berthing tugboat, with a 1,200 horsepower rating, is available at the Port of Samchok.

3. (U) Stevedores. There are about 660 stevedores registered in the Mukho Chapter of the National Docker's Union that service the Port of Samchok as well as the Ports of Mukho and Pukpyong. Gang sizes vary according to the type of cargo, but 16 to 18 members are common for general cargo operations.

D. (U) Future Developments

The Port of Samchok is currently reclaiming land located between the LST ramp and wharves 1 and 2.

meters (6,560 feet) of the terminal, the population is about 12,000. A coal-fired powerplant is located immediately west of the terminal on the port terminal peninsula. The powerplant is about 350 meters (1,148 feet) from wharf 3 and maintains three POL storage tanks that are filled from a pipeline extending from wharf 2. Also, two smaller POL storage tanks are located adjacent to fishing wharf 2, and three tanks operated by Tongyang Cement Company are located on wharf 1. The main supply route in this region of Korea, Korean 7, passes within about 900 meters (2,952 feet) of the berths. Therefore, all these activities and transportation assets fall within the 2200-meter (7,216-foot) quantity-distance arc established for small breakbulk ammunition ships or barges.

2. (U) Materials Handling Equipment. In addition to the 35-STON mobile cranes, the port has access to the equipment shown in table SA-4. The equipment is owned by the Tongyang Cement Company.

TABLE SA-4
MATERIALS HANDLING EQUIPMENT - SAMCHOK

Equipment	Quantity	Type	Capacity (STON)
Forklifts	4	Gas	5
	1	Diesel	10
	2	Diesel	15
Trucks	1	Gas	3
	1	Gas	5
	5	Gas	10
	10	Gas	15
Locomotives	4	Gas	-
Gondola cars	98	-	2.4

3. (U) Storage Areas

a. (U) Open Storage. The port terminal has two open storage areas that could be used for marshaling military unit equipment. These areas include the 5100-square-meter (1.3-acre) graveled, open area behind the elevated conveyor system on wharf 2 and the 1400-square-meter (0.4-acre) paved, open area on wharf 3 behind the conveyor system.

b. (U) Covered Storage. The Samchok terminal has one 825-square-meter (8,876-square-foot) warehouse, located on wharf 1. The warehouse is accessible only by the narrow-gauge rail system. The warehouse has no road access as well as no value for military cargo storage.

c. (U) POL Storage. The port authority maintains no POL storage tanks. A small number of tanks, located on wharf 1 at the powerplant and the fishing wharves, store a low volume of POL.

4. (U) Rail Operations. The Port of Samchok does not have rail access, so rail movements are not possible at the port terminal. The track system at the terminal is narrow gauge and supports locomotives and railcars used to convey cement materials between wharf 1 and a local cement plant. The Samchok Railroad Station, used primarily as a passenger terminal, provides the closest rail facilities to the port. Nonroadable equipment could be trucked to the station,

TABLE SA-3
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF SAMCHOK

Korean-Flag Ship Type	Berths						
	Wharf 1		Wharf 2	Wharf 3	Fishing Wharf 1	Fishing Wharf 2	Fishing Wharf 3
	South	East					
Breakbulk							
Type 1	2	2	3	7	5	1	4
Type 2	1	b	1	3	a	a	a
Type 3	1	b	1	3	a	a	a
Type 4	b	b	1	3	a	a	a
Type 5	b	a,b	1	3	a	a	a
Type 6	a,b	a,b	a	2	a	a	a
Type 7	a,b	a,b	a,b	a	a	a	a

a - Inadequate draft at berth.
b - Inadequate berth length.

show, for each type of vessel, the number each berth could accommodate or the characteristics that make the berth unsuitable.

As shown in the tables, the wharves at Samchok Port could support only barge or breakbulk operations using Korean-flag breakbulk ships. Although the tables indicate that wharf 1 and the fishing wharves could accommodate barges and some of the shallow-draft Korean-flag breakbulk vessels, poor highway access would prevent their use. Therefore, only wharves 2 and 3 could support these activities. LASH and SEABEE vessels supporting barge loading and unloading can be anchored only in the unprotected quarantine area.

f. (U) Safety Considerations. Although the central business district of Samchok City is about 2800 meters (9,184 feet) from the port, residential and commercial areas surround the port terminal. Within 2000

TABLE SA-2
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF SAMCHOK

US-Flag Ship Type	Berths						
	Wharf 1		Wharf 2	Wharf 3	Fishing Wharf 1	Fishing Wharf 2	Fishing Wharf 3
	South	East					
RORO							
GTS Callaghan	b,c	a,b,c,d	a,c,d	a,d	a,b,c,d	a,b,c,d	a,b,c,d
USNS Comet	b,c	a,b,c,d	a,c,d	a,d	a,b,d	a,b,d	a,b,d
Maine-class	a,c	a,c	a,c	a	a,b,d	a,b,c	a,c
Breakbulk							
C4 Mariner-class	a,c	a,c	a,c	a	a	a,b,c	a,c
C4-5-58a	a,c	a,c	a,c	a	a	a,b,c	a,c
C3-5-38a	a,c	a,c	a,c	a	a	a,b,c	a,c
C3-5-33	a,c	a,c	a,c	a	a	a,b	a
Barge							
LASH C8-5-81B	a,c,f	a,c,f	a,c,f	a,f	a,c,f	a,b,c,f	a,c,f
LASH barge	4	3	6	14	10	b	8
SEABEE C8-5-82A	a,c,f	a,c,f	a,c,f	a,f	a,c,f	a,b,c,f	a,c,f
SEABEE barge	2	2	4	a	a	b	5
Seatrain							
Georgia-class	a,c	a,c	a,c	a	a	a,b,c	a,c
Puerto-class	a,c	a,c	a,c	a	a	a,b,c	a,c
Container							
SL-7 (Cntnr only)	a,c,e	a,c,e	a,c,e	a,c,e	a,c,e	a,b,c,e	a,c,e
C6-5-1W	a,c,e	a,c,e	a,c,e	a,e	a,c,e	a,b,c,e	a,c,e
C7-5-68E	a,c,e	a,c,e	a,c,e	a,e	a,c,e	a,b,c,e	a,c,e
C8-S-85B	a,c,e	a,c,e	a,c,e	a,e	a,c,e	a,b,c,e	a,c,e
RORO/Container							
C5-5-78	a,b,c	a,b,c	a,c	a	a,b	a,b,c	a,b,c
T-AKR (SL-7)	a,b,c	a,b,c	a,c	a,c	a,b,c	a,b,c	a,b,c
Breakbulk/Container							
C5-5-37E	a,c	a,c	a,c	a	a	a,b,c	a,c
C4-5-10	a,c	a,c	a,c	a	a	a,b,c	a,c

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.
f - Inadequate draft for barge ship at berth; however, ship could be unloaded from anchorage.

Therefore, based on the above considerations, wharves 2 and 3 are the only wharves available at the Samchok Port that could be used in support of military shipping. The capability of these berths to support specific ship operations are determined below.

a. (U) RORO Operations. There are no berths at the Samchok Port with drafts deep enough to accommodate the US-flag RORO ships reviewed in this study.

b. (U) Breakbulk Operations. There are no berths at Samchok Port with drafts deep enough to accommodate the US-flag breakbulk ships reviewed in this study. However, both wharves 2 and 3 have adequate drafts for many of the Korean-flag breakbulk vessels. Wharf cranes are not available at either of the berths, so mobile cranes would be required at both to perform heavy lifts.

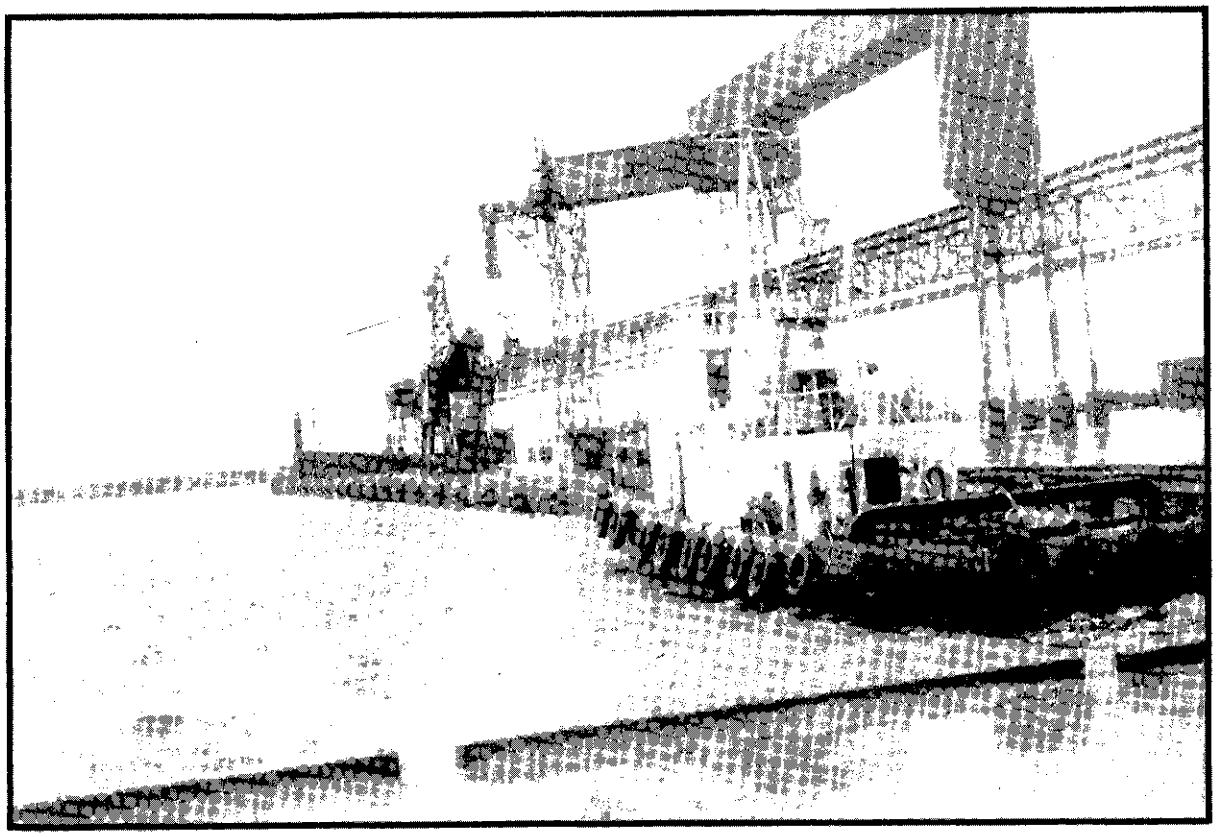
The port has access to only two 35-STON mobile cranes owned by Tongyang Cement Company, so additional cranes would be required to handle heavy lifts. On both wharves, the rail-mounted bulk loaders could be pushed aside as needed to accommodate the unloading of each hatch. The unloading operations would be forced to work around the stationary bulk loader on wharf 3. At both wharves, the elevated conveyor systems leave about 20 meters (66 feet) for cargo handling. This is adequate space for breakbulk operations and should not hamper crane operations. The rails supporting the bulk loaders do not protrude above the apron surface and would not impede vehicle or crane access to these wharves.

c. (U) LASH and SEABEE Operations. LASH and SEABEE barges could be unloaded at wharves 2 and 3.

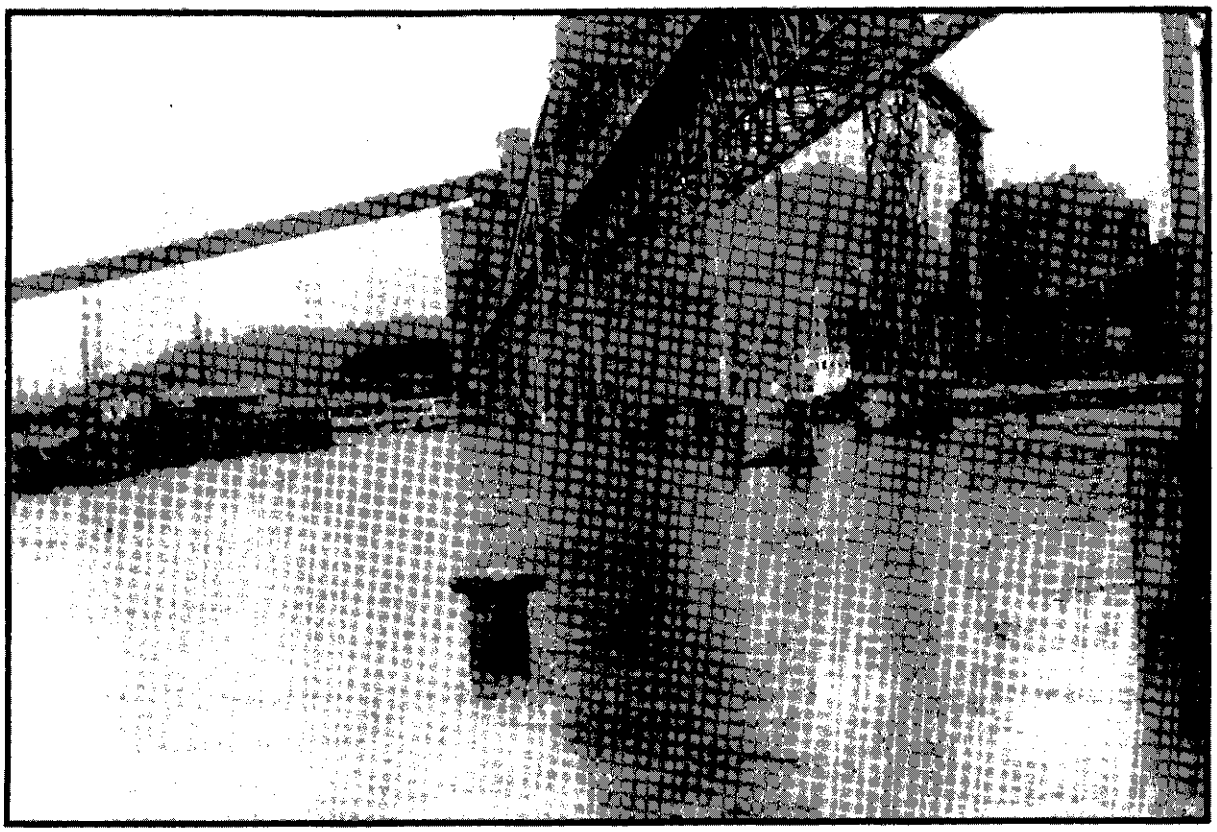
Only two 35-STON mobile cranes are available at the port to support barge operations, so additional cranes would have to be supplied to establish additional loading positions. Since the elevated conveyor systems on both wharves are 20 meters (66 feet) from the berths, adequate space is available on both wharves for crane operations. Abundant space is available for staging barges in the northern end of the harbor, just south of wharf 1 near the LST ramp. Barges stored in this area would block the LST ramp and the south berth of wharf 1, but should not interfere with vessel traffic to the fishing wharves. One tugboat is available at the port to provide towing services. LASH and SEABEE vessels must be anchored outside harbor limits in the quarantine anchorage since the draft inside the harbor is too shallow. This anchorage is also unprotected, so the ability to load and unload barges from the ships would be dependent on weather and sea conditions. Barge loading/unloading could be conducted only during fair weather and calm seas.

d. (U) Container Operations. There are no berths at the Port of Samchok with drafts deep enough to accommodate the US-flag container ships reviewed in this study.

e. (U) Summary of Berth Availability. The berths available at the Port of Samchok for different types of US-flag and Korean-flag vessels are summarized in tables SA-2 and SA-3, respectively. The tables



(EASTWARD VIEW)



(WESTWARD VIEW)

Figure SA-4. Wharf 3.

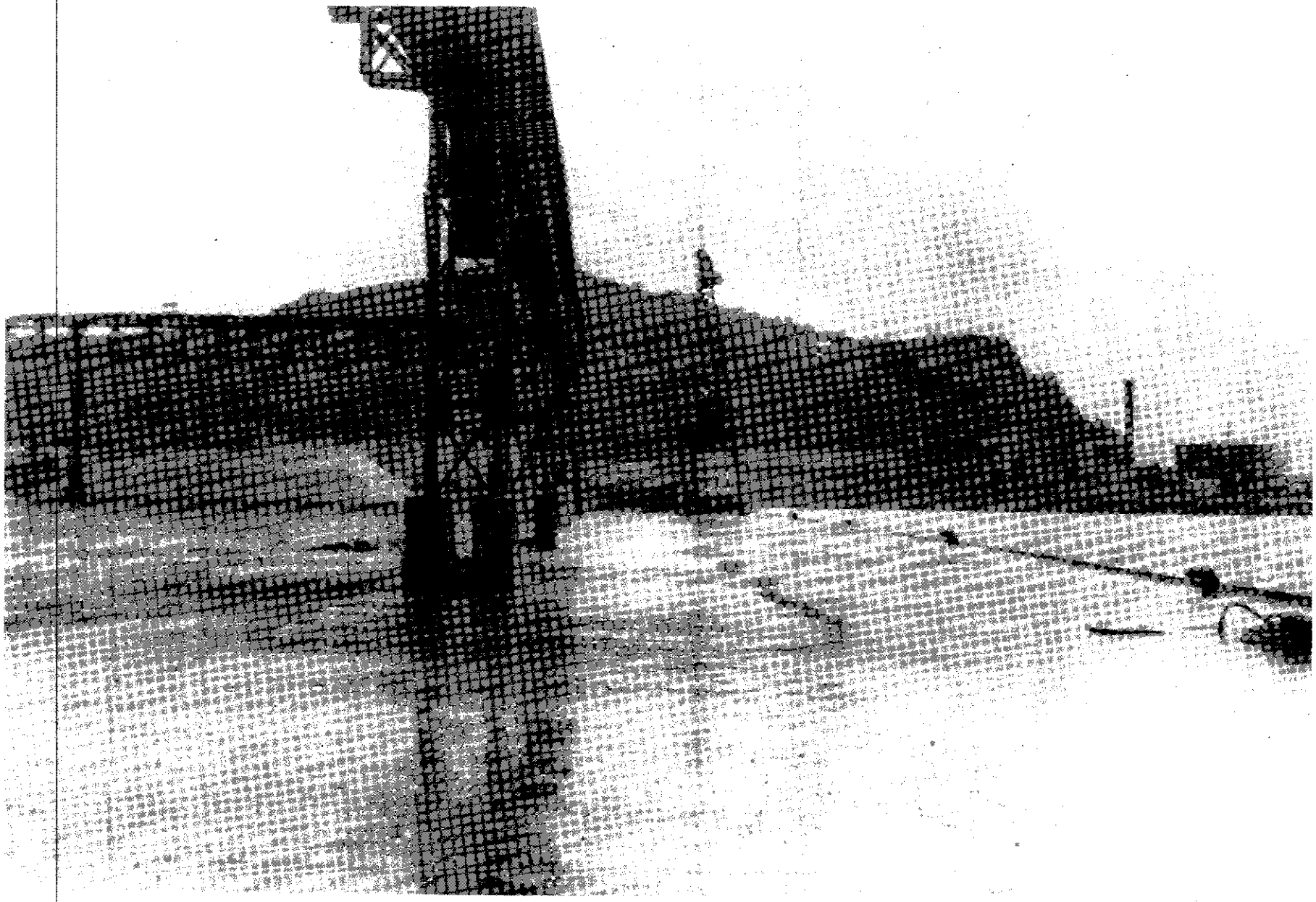


Figure SA-3. Wharf 2 (northward view).

TABLE SA-1
PORT OF SAMCHOK
OPERATED BY: DONGHAE DISTRICT MARITIME AND PORT AUTHORITY

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m (ft)	Individual Berth	Berth Length m (ft)	Approximate Apron Width m (ft)	MLW m (ft)	Approximate Apron Height Above MLW m (ft)	Deck Strength [1] psf	Serviced by Rail-Mounted Crane	Rail Access to Apron
Wharf 3	1	Marginal	271 (889)	1	271 (889)	20 (66)	7.5 (24.6)	2.0 (6.6)	628	No [2]	No
Wharf 2	1	Marginal	122 (400)	1	122 (400)	20 (66)	6.5 (21.3)	2.0 (6.6)	628	No [2]	No
Wharf 1 (south)	1	Marginal	80 (262)	1	8 (262)	15 (49)	5.5 (18.0)	2.5 (8.2)	419	No	No
Wharf 1 (east)	1	Marginal	70 (230)	1	70 (230)	15 (49)	5.5 (18.0)	2.5 (8.2)	419	No	No
Fishing wharf 1	1	Marginal	195 (640)	1	195 (640)	7 (23)	3.2 (10.5)	1.5 (4.9)	419	No	No
Fishing wharf 2	1	Marginal	155 (508)	1	155 (508)	3 (10)	3.5 (11.5)	2.0 (6.6)	419	No	No
Fishing wharf 3	1	Marginal	152 (499)	1	152 (499)	10 (33)	4.0 (13.1)	2.0 (6.6)	628	No	No

Rail-Mounted Cranes	Serving Berths	Roll-on/Roll-off Facilities	Serving Berths	Open Storage m^2	Open Storage acres	Serving Berths	Covered Storage m^2	Covered Storage ft^2	Serving Berths
None	-	LST Ramp	Wharf 1 (South)	5100	1.3	Wharf 2	825	8,876	Wharf 1
				1400	0.4	Wharf 3			

[1] Estimated values.
[2] Rail-mounted bulk loaders that are not suitable for handling general cargo.

breakbulk ships; however, the only access to and from the wharf is provided by a narrow-gauge railroad track. There are no roads to the wharf, so military equipment unloaded at either berth would have no access route. Wharves 2 (fig SA-3) and 3 (fig SA-4) are located along the western and southern shores of the harbor, respectively. Both wharves are laden with elevated conveyor systems and have rail-mounted bulk loaders running along their entire lengths. Although the drafts at these wharves are the deepest in the port, they are not sufficient to accommodate the US-flag vessels used in this study; however, the drafts are adequate to accommodate barges or shallow-draft Korean breakbulk ships.

and to other local industries. Although the track to the powerplant is the closest to the port, it provides no useful sites for loading railcars.

The Samchok Railroad Station, used primarily as a passenger terminal and a classyard for railcars serving the local industries, is located about 0.7 kilometer (0.4 mile) south of the port terminal (fig SA-1). Highway access from the port terminal to the station follows the port access road to its intersection with Old Route 7, then south on Old Route 7 across the Osib River to its intersection with Korean 7 in front of the station.

The station has about 1537 meters (5,042 feet) of sidings with a maximum storage capacity of 118 railcars. The station also has two spurs that provide about 286 meters (938 feet) of tangent track that could, with portable ramps, accommodate the end loading of about 22 railcars. About 4000 square meters (1 acre) of unpaved, open storage is available adjacent to these spurs. The station also has a covered side-loading dock adjacent to one of the spurs that could accommodate four railcars at a time. A small, open storage area, about 370 square meters (0.1 acre), is located adjacent to the dock. The station has no switch locomotives or materials handling equipment, but does have suitable highway access from the port, plus storage and side-loading capability. If portable ramps were provided, two spur tracks could be used as end-loading sites.

5. (U) Airports. The closest airport to the port terminal is located in Kangnung, about 56 kilometers (35 miles) to the north. The asphalt runway is 2622 meters (8,600 feet) long and 36.6 meters (120 feet) wide. There is no helipad at the port terminal.

B. (U) Samchok Port Terminal

1. (U) Berthing. The berths at Samchok Port (fig SA-2) were designed to support the local fishing industry and the import/export of bulk materials. They were not intended to be used for general cargo, and their use in support of military operations would interfere with the current industrial mission of the port. However, berths available at this port can accommodate some of the ship types normally used to transport military equipment. The specific characteristics of the berths at the Port of Samchok are summarized in table SA-1. These characteristics will be analyzed to determine the ship types that can be accommodated.

Based on use and location, the wharves at the Port of Samchok are divided into three major sections. The shallow-draft fishing wharves are located along the north shore and the inland extension of the harbor. Although these wharves have adequate drafts for barges, the highway access is extremely poor and not seen as suitable for military equipment. Construction of fishing wharf 3 is currently underway, and the construction of the apron at fishing wharf 1 is to be completed in 1983 or early 1984. The existing apron width at fishing wharf 2 is too narrow for cargo operations.

Wharf 1 is located at the north end of the port terminal peninsula and is used exclusively for handling cement. The wharf has two berths with adequate drafts for barges or shallow-draft Korean

the breakwaters in the Sea of Japan. Anchorage A-1, located adjacent to the east breakwater, has an operating draft of 9.4 meters (30.8 feet) and is centered at coordinates latitude 37°25'55" N - longitude 129°11'53" E. Anchorage A-2, located south of the breakwaters, is centered at coordinates latitude 37°25'38" N - longitude 129°11'52" E and has a maximum allowable draft of 8.5 meters (27.9 feet). The quarantine anchorage, with a maximum allowable draft of 12 meters (39 feet), is located outside the harbor limits, northeast of the approach channel. The exact coordinates of this anchorage were not available. These anchorages are unprotected, so barge operations would be subject to prevailing climatic and surf conditions.

3. (U) Highway Access. The unnamed port access road, a two-lane, concrete, rural roadway, extends about 0.8 kilometer (0.5 mile) from Main Gate east to its intersection with Old Route 7 (fig SA-1). At this intersection, another unnamed road extends north about 2.4 kilometers (1.5 miles) and intersects Korean Route 7. Old Route 7, to the south, is the through road. It extends about 0.2 kilometer (0.1 mile) across the Osib River, joining with Korean 7. It also winds northward about 1.6 kilometers, again joining with Korean 7. All of these routes are two-lane, paved roads and run through commercial and residential sections. Korean 7 is a two-lane rural road, serving as the main supply route in this region of Korea. It is a north-south route spanning the entire east coast of Korea. These roads are suitable access routes for military equipment.

Main Gate provides access only to wharves 2 and 3. The unnamed road that leads to the LST ramp branches to the north from the port access road just outside Main Gate. This road is about 4.5 meters (15 feet) wide and paved and could be used by military equipment. It extends between the port terminal and the electric plant and terminates near the LST ramp. It is the only road leading toward wharf 1, but it terminates before reaching the wharf, thereby making wharf 1 inaccessible.

Highway access to the fishing wharves is provided by a two-lane road adjacent to the inland extension of the harbor. The road is bordered on one side by small commercial shops and on the other by the aprons of the fishing wharves. This road narrows to about 2.5 meters (8.2 feet) in some spots and is unpaved along the east breakwater behind fishing wharves 1, 2, and 3. This route is not recommended as an access route for military equipment.

4. (U) Rail Access. The port does not have access to the Korean National Railroad. A narrow-gauge track, which supports miniature locomotives and railcars, runs from wharf 1 to a cement plant located south of the port and across the Osib River. The track system is used only to transport cement materials to wharf 1 and has no applicability for military operations.

The main-line track in this region of Korea runs north from Paeksan and terminates in Kangnung. The line is located about 6 kilometers (3.7 miles) west of the port terminal. A branch line splits off this main line in Pukpyong and runs south to Samchok, where it terminates at the Samchok Railroad Station. In Samchok, another line splits off this branch, running to the powerplant located near the port terminal

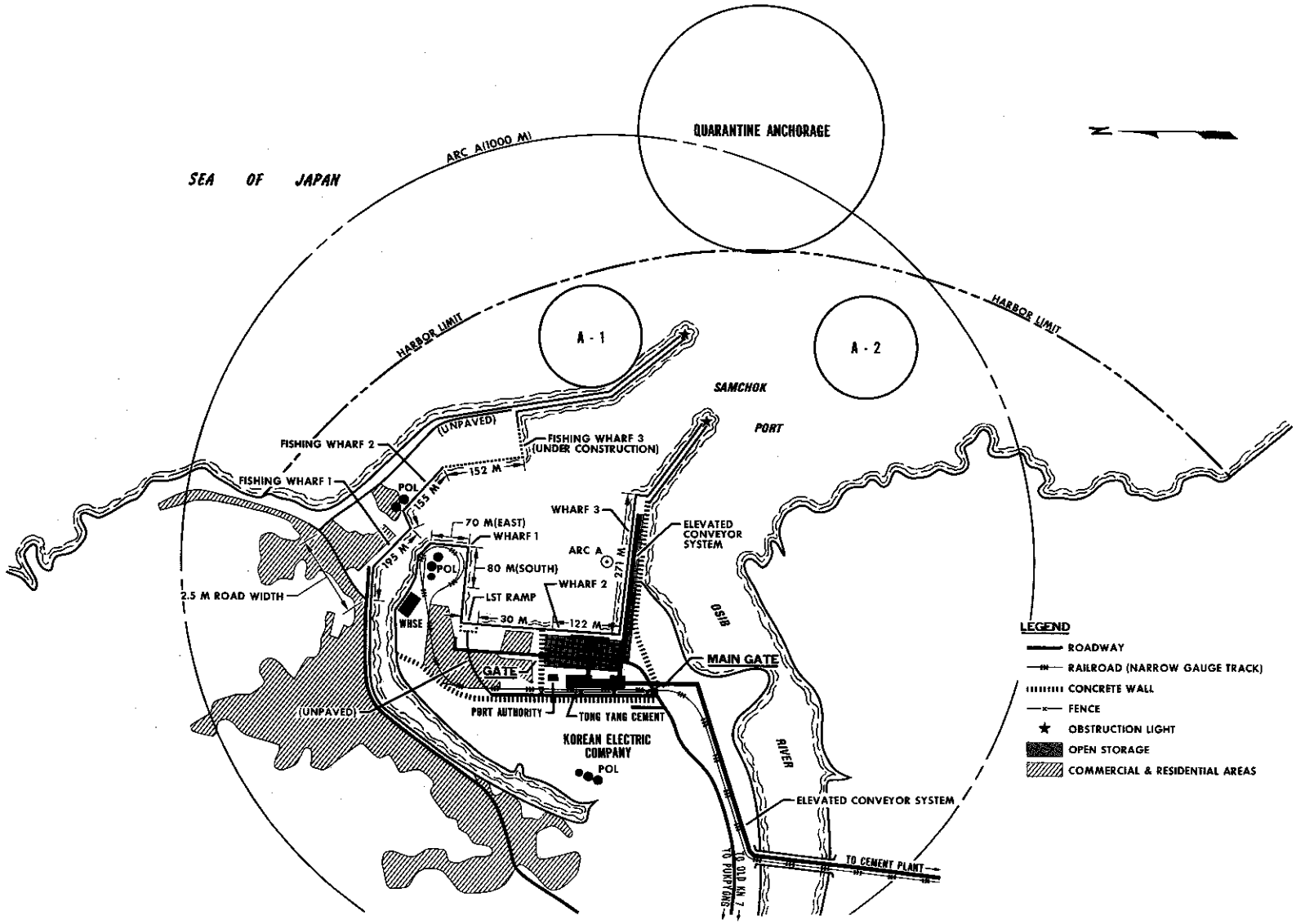


Figure SA-2. Site map.

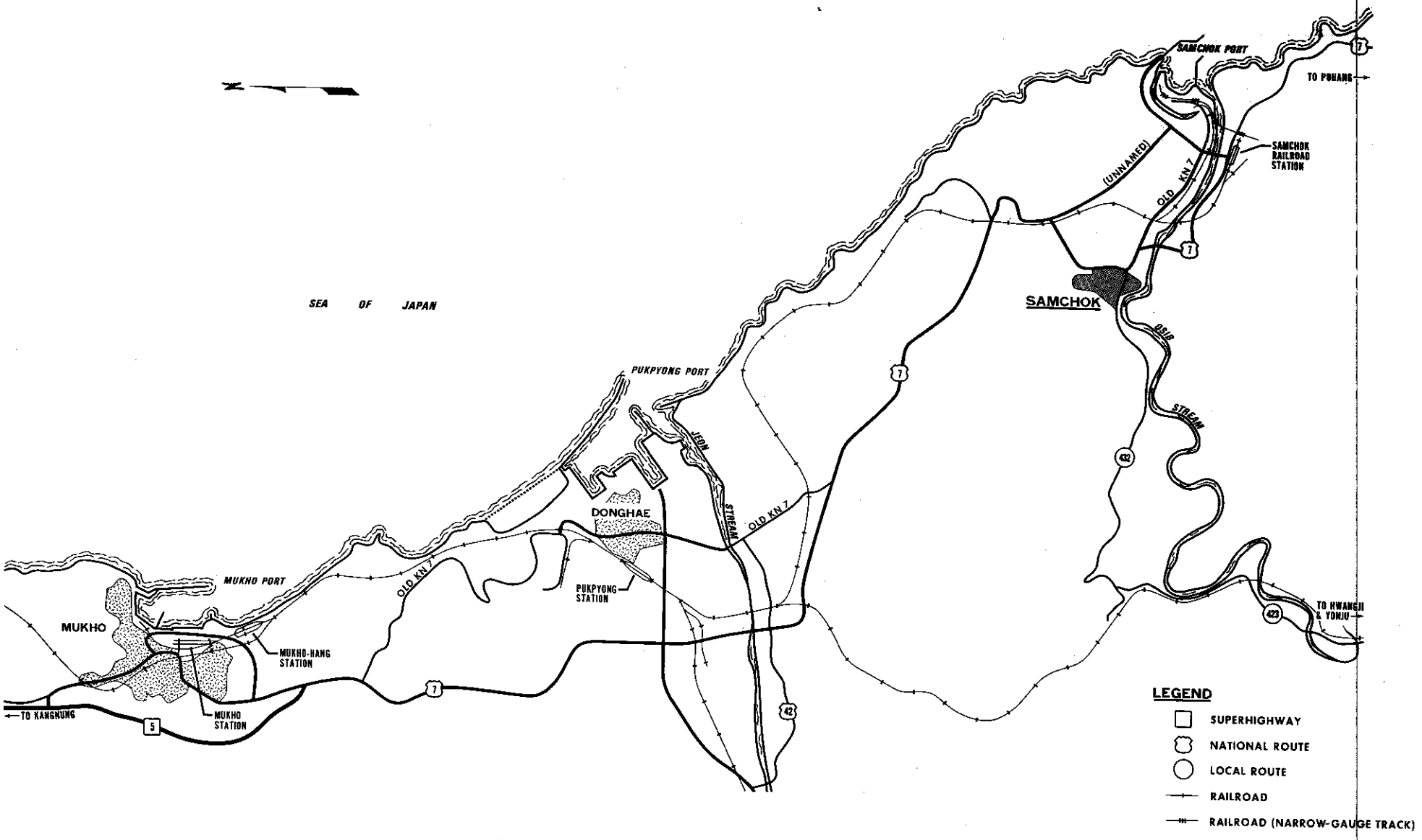


Figure SA-1. Vicinity map.

(U) PORT OF SAMCHOK

A. (U) General Description

1. (U) Location and General Uses. The Port of Samchok (fig SA-1) is located on the eastern seacoast of Korea, about 315 kilometers (196 miles) north of Pusan and 296 kilometers (184 miles) east of Seoul. The port is the southernmost in a group that includes the Port of Pukpyong, located about 8 kilometers (5 miles) to the north, and the Port of Mukho, located about 21 kilometers (13 miles) to the north. The Samchok Port is situated directly on the seacoast about 2.8 kilometers (1.7 miles) east of the central business district of the city of Samchok. The port can be divided into two major sections. The main port terminal includes wharves 1, 2, and 3. It is located on a peninsula formed on the south by the Osib River and on the remaining sides by the Samchok Harbor and an inland extension of the harbor. The other major section of the port consists of three fishing wharves, which are located on a peninsula that protrudes south from the mainland to form the eastern perimeter of the harbor.

The port supports the surrounding regional industrial complex and is administered by the Samchok Branch Office of the Donghae District Maritime and Port Authority. The principal import commodities include bulk raw materials and small quantities of POL. These products are used by the large cement manufacturing plant that is located opposite wharf 2 and extends south across the Osib River. Cement is the major export commodity.

2. (U) Harbor. The Samchok Harbor is formed by the 880-meter (2,886-foot) east breakwater and the 174-meter (571-foot) west breakwater (fig SA-2). The harbor is vulnerable to rough seas and waves moving toward the port from the south, because the southern end of the harbor opens directly to the Sea of Japan. The entrance channel approaches the harbor from the south and runs between the breakwaters at a 135-meter (443-foot) width and an 8.5-meter (28-foot) depth. To aid navigation into the harbor, a red light is positioned at the head of the east breakwater and a green light is positioned at the head of the west breakwater.

The average water depth throughout the main portion of the harbor is about 7.5 meters (24.6 feet), but lower drafts are found at the north end and along the inland extension of the harbor, which encircles the port terminal. The tidal range in the harbor is only about 0.15 meter (6 inches). No turning basins have been designated for the harbor, but area is available in the main body of the harbor for a 240-meter (787-foot) turning basin at a 7.5-meter (24.6-foot) draft. Use of this area as a turning basin would block access to and from the harbor.

The Osib River, which flows into the Sea of Japan just south of the port terminal, caused silting problems in the harbor and the entrance channel prior to the extension of the west breakwater. However, since the extension, silting from the river has been eliminated. The berths were last dredged during 1983 to maintain their designated drafts. About 17 000 cubic meters (22,220 cubic yards) of material was removed during the dredging.

Two anchorages with diameters of 200 meters (656 feet) and a quarantine anchorage with a diameter of 475 meters (1,558 feet) are located outside

TABLE PU-5
INDIVIDUAL BERTH RATING (BARGE)

Ideal Berth Factors	Berths		
	South Wharf		North Wharf
	Middle	East	East
Length	10	8	8
Alongside depth	10	10	10
Backup area	5	5	5
Apron width	10	10	10
Consolidation shed	0	0	0
Apron tracks	0	0	0
Anchorage diameter	10	10	10
Conditional age of facility	10	10	10
Deck loading	10	10	10
Heavy-lift cranes	0	0	0
Berth type	10	10	10
Truck tailgate	0	0	0
Rail end ramp	0	0	0
Truck access	9	9	9
Tug availability	8	8	8
Barge lay area	6	6	6
Total Points	98	96	96
Ranking	1	2	2

The port has no rail access, but rail facilities are available close to the port, at the Pukpyong Railroad Station. Although this station could be used as a rail-car loading site, many limitations, including the poor highway access from the port, lack of end-loading ramps and materials handling equipment, and only one side-loading dock, reduce its capability to support railcar loading operations.

Highway access from Main Gate at the port is provided by an unnamed road that runs to Korean 7, the main supply route. Highway access to the main supply route and within the port terminal is suitable for military unit equipment.

The terminal has no truck docks or end-loading ramps, only one 35-STON mobile crane, and a small fleet of forklifts to support truck-loading operations. The large open area adjacent to Central wharf will provide a suitable area for truck-loading operations, once it has been cleared of construction materials and paved. This is the only large, open storage area on the port terminal. No covered storage or POL storage is available. Pilot service is available and mandatory. The port is serviced by three berthing tugboats and about 660 stevedores.

The berths are located within 1000 meters (3,280 feet) of Donghae City, which has a population of 30,000. This population, the two large cement plants, and the Navy facilities located on the port terminal fall within the 2500-meter (8,200-foot) quantity-distance arc established for a notional breakbulk ammunition ship and the 2800-meter (9,184-foot) arc of a container ship.

TABLE PU-4
INDIVIDUAL BERTH RATING (BB/RORO)

Ideal Berth Factors	Berths				
	Coal Wharf	South Wharf		North Wharf	
		West	Middle	West	Central Wharf
Length	20	20	10	20	20
Alongside depth	20	20	14	20	20
Backup area	1	1	1	1	0 [a/]
Apron width	20/20	20/20	20/20	20/20	20/20
Transit shed	0/NR [b/]	0/NR	0/NR	0/NR	0/NR
Distribution shed	0/NR	0/NR	0/NR	0/NR	0/NR
Apron tracks	0	0	0	0	0
Deck loading	10	10	10	10	10
Heavy-lift cranes	0	0	0	0	0
Berth type	10	10	10	10	10
Truck tailgate	0	0	0	0	0
Rail end ramp	0	0	0	0	0
Truck access	9	9	9	9	9
Ship service facilities	4	4	4	4	4
Conditional age of facility	10	10	10	10	10
RORO stern ramp	NR/5	NR/5	NR/5	NR/5	NR/5
Total Points	104/109	104/109	88/93	104/109	103/108
Ranking	1/1	1/1	3/3	1/1	2/2

[a/] Large backup area will be available when construction is completed.
[b/] NR - Not rated.

C. (U) Support Services

1. (U) Pilotage. Pilotage is mandatory for entrance into the Port of Pukpyong. Three pilots and one pilot boat are available to provide service throughout the day. These pilots also serve the Ports of Mukho and Samchok and usually board incoming vessels at the quarantine anchorage located near the Port of Mukho.

2. (U) Harbor Craft. Three berthing tugboats rated at 2,500, 2,400, and 1,100 horsepower are available for use at the Port of Pukpyong.

3. (U) Stevedores. About 660 stevedores are registered in the Mukho Chapter of the National Docker's Union serving the Port of Pukpyong. These stevedores also serve the Ports of Mukho and Samchok. Gang size varies according to the type of cargo, but usually consists of 16 to 18 members for general cargo operations.

D. (U) Future Development

The port has recently completed the construction of Central wharf, where general cargo operations are planned. The large open area adjacent to the wharf is to be graded and paved, but no project dates have been set. The port plans to install an elevated conveyor system and bulk loaders on Coal wharf, but again no dates have been established. The Korean Navy, which occupies the entire north sections of the port, is constructing a drydock facility for naval vessels just south of its LST ramp. The port plans to construct a ferry terminal between the new Navy drydock and Central wharf. Future plans also include the construction of an access railroad spur track, which would enter the terminal from the west and run to Central wharf. The port has additional long-range plans to further expand the berthing facilities by reclaiming land located south of the existing port and constructing additional wharfage.

E. (U) Summary

The Port of Pukpyong is a newly constructed industrial port and primarily handles bulk materials such as cement, coal, and iron ore. The port also supports the Korean Navy, which occupies the entire north section of the port. The wharves in the southern section of the port have deep-draft berths that could accommodate any of the large oceangoing vessels used in this study, including the deep-draft barge vessels and the T-AKR. Although the wharves in the southern section of the port are designed to handle bulk materials, they could be adapted to support RORO, break-bulk, barge, or container operations. The newly constructed Central wharf, in the central section of the port terminal, is being developed as a general cargo wharf, with an open apron, and will be able to accommodate all types of ships. Based on the shipping capabilities of these wharves, individual berth rankings have been computed in tables PU-4 and PU-5 for various shipping operations at selected berths. The rankings indicate the berths that are best suited for each shipping operation and the relative suitability of the other selected berths. South wharf (west), Coal wharf, North wharf (west), and Central wharf provide good berths for large oceangoing vessels. Once the open area adjacent to Central wharf is completed, Central wharf will provide the best berths for all shipping operations at Pukpyong Port.

The sections between the bulk loader rails and the elevated conveyor systems on North and South wharves cannot be considered open storage areas, but some of the unit equipment being unloaded could be marshaled at these wharves before departing the port terminal. These areas are located along the entire length of the wharves but are only 15 meters (49 feet) wide. Since they provide the only access route from the wharves, the width of the areas would be further reduced by vehicle access lanes.

b. (U) Covered Storage. Covered storage is not available at the port terminal.

c. (U) POL Storage. The port terminal has no POL storage tanks. The closest tanks to the port are located at the Pukpyong Railroad Station and are used to store locomotive fuel.

4. (U) Rail Operations. Rail access is not available, so rail loading operations are not possible at Pukpyong Port Terminal. The rail facilities closest to the port are located at the Pukpyong Railroad Station, about 2.4 kilometers (1.5 miles) from the port. As previously mentioned under "Railroad Access," highway access from the port is extremely poor and the station has no end ramps or spur tracks that could employ portable ramps. Therefore, flatcar loading operations could be conducted at the station only if spur tracks were added, or if existing tracks were altered for end loading, or if cranes were made available to lift equipment onto railcars. The one available side-loading dock could serve as a transfer dock to support boxcar loading operations. However, no materials handling equipment is available at the station to transfer materials from trucks to boxcars.

Therefore, based on the limitations of the railroad station and the lack of rail access to the port, rail service at the Port of Pukpyong is considered to be negligible.

5. (U) Truck Operations. Truck access to and from the terminal is through Main Gate, which is the only access. All roads on the terminal are paved and in good condition, so truck travel would not be impeded. The port does not maintain any truck docks or end-loading ramps, so portable equipment or mobile cranes would be required for truck-loading operations. The port has one 35-STON mobile crane that could be used to lift nonroadable equipment onto flatbed trucks. Also, there are no large, paved, open areas where the portable ramps could be positioned. Operations could be conducted in the open area adjacent to Central wharf only during dry weather, since it has an unimproved surface.

With support facilities for loading general cargo and/or unit equipment not currently available, the truck outloading capability is negligible.

6. (U) Security. A concrete wall topped with barbed wire surrounds most of the port terminal, except the property line at the western end of North and South wharves, where it borders agricultural property and is protected with barbed wire fencing. The concrete wall is lighted and has guard towers located along its span. The port employs a guard force of 14 per shift, three shifts per day. The guards are posted at Main Gate and in the guard towers along the wall; a few patrol throughout the port.

TABLE PU-3
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF PUKPYONG

Korean-Flag Ship Type	Berths									
	South Wharf			Coal Wharf	North Wharf		Central Wharf	Korean Navy*		
	West	Middle	East		West	East		LST Ramp	Wharf 1	Wharf 2
Breakbulk										
Type 1	12	4	3	7	12	3	10	NA	3	11
Type 2	5	2	1	3	5	1	4	NA	1	5
Type 3	5	2	1	3	5	1	4	NA	1	5
Type 4	5	1	1	3	5	1	4	NA	1	4
Type 5	5	1	1	3	5	1	4	NA	1	4
Type 6	4	1	1	2	4	1	3	NA	a	a
Type 7	3	1	a	2	3	a	2	NA	a, b	a

*Note: Berths are not expected to be available.
a - Inadequate draft at berth.
b - Inadequate berth length.

3. (U) Storage Areas

a. (U) Open Storage. The port terminal has only one large open area that could be developed into an open storage area and used as a marshaling area for military equipment. The area is located adjacent to Central wharf and totals 30 000 square meters (7.4 acres). The area is only rough graded and currently is filled with construction material and large concrete tetrapods, which are being stored for future use on the breakwaters. If these materials were removed and the area graded, military unit equipment could be marshaled there during dry weather. The port plans to pave this area at some future date, but specifics have not been established. Once this section is paved, it would serve as an excellent marshaling area during wet-weather conditions. This site serves best as a marshaling area for military equipment unloaded from Central wharf, but if required, it could serve as a marshaling area for unit equipment being unloaded at the other wharves.

TABLE PU-2
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF PUKPYONG

US-Flag Ship Type	Berths									
	South Wharf			Coal	North Wharf		Central	Korean Navy *		
	West	Middle	East	Wharf	West	East	Wharf	LST Ramp	Wharf 1	Wharf 2
RORO										
GTS Callaghan	2,d	c,d	a,c,d	1,d	2,d	a,c,d	1,d	a,c	a,c,d	a,d
USNS Comet	2,d	1,d	a,c,d	1,d	2,d	a,c,d	2,d	a,c	a,c,d	a,d
Maine-class	2	a,c	a,c	1	2	a,c	1	a,c	a,c	a
Breakbulk										
C4 Mariner-class	2	a,c	a,c	1	2	a,c	2	NA	a,c	a
C4-S-58a	2	a,c	a,c	1	2	a,c	2	NA	a,c	a
C3-S-38a	2	1	a,c	1	2	a,c	2	NA	a,c	a
C3-S-33a	2	1	a,c	1	2	a,c	2	NA	a,c	a
Barge										
LASH C8-S-81B	a,f	a,c,f	a,c,f	1	a,f	a,c,f	1	NA	a,c,f	a,f
LASH barge	23	8	7	14	23	6	19	NA	5	21
SEABEE C8-S-82A	1	a,c,f	a,c,f	1	1	a,c,f	1	NA	a,c,f	a,f
SEABEE barge	14	5	4	9	14	4	12	NA	3	13
Seatrain										
Georgia-class	2	c	a,c	1	2	a,c	2	NA	a,c	a
Puerto-class	2	c	a,c	1	2	a,c	2	NA	a,c	a
Container										
SL-7 (Cntnr only)	1,e	a,c,e	a,c,	c,e	1,e	a,c,e	1,e	NA	a,c,e	a,e
C6-S-1W	2,e	c,e	a,c,e	1,e	2,e	a,c,e	1,e	NA	a,c,e	a,e
C7-S-68E	2,e	a,c,e	a,c,e	1,e	2,e	a,c,e	1,e	NA	a,c,e	a,e
C8-S-85B	2,e	a,c,e	a,c,e	1,e	2,e	a,c,e	1,e	NA	a,c,e	a,e
RORO/Container										
C5-S-78	2	a,c	a,c	1	2	a,c	2	NA	a,c	a
T-AKR (SL-7)	1	a,c	a,c	c	1	a,c	1	NA	a,c	a
Breakbulk/Container										
C5-S-37E	2	a,c	a,c	1	2	a,c	2	NA	a,c	a
C4-S-10	2	a,c	a,c	1	2	a,c	2	NA	a,c	a

*Note: Berths are not expected to be available.
a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.
f - Inadequate draft for barge ship at berth; however, ship could be unloaded from anchorage.

d. (U) Container Operations. Again, only Central wharf is intended for use as a general cargo berth, but container ships could be accommodated at North, South, and Coal wharves. The port has no container cranes. Since only one mobile crane is available, cranes would have to be brought in to handle non-self-sustaining container ships. None of the berths currently have any large, open storage areas to serve as container staging areas, and only Central wharf is likely to have such an area in the future. The open area adjacent to Central wharf is currently unsuitable for container operations. It would have to be cleared of currently stored items, graded, and preferably paved before sustained container operations could be performed. Cranes at North and South wharves would be slowed due to the proximity of the elevated conveyor systems, and both the cranes and the unloaded equipment would have to cross the raised rails that support the bulk loaders. Therefore, while container ships could be accommodated at the berths, container handling facilities and conventional container-handling equipment are not available, or are not adequate, to make container operations practical at present.

e. (U) Summary of Berth Availability. Tables PU-2 and PU-3 summarize the berths available at the Port of Pukpyong for various US-flag and Korean-flag vessels, respectively. The tables show, for each type of vessel, the number each berth could accommodate or the characteristics that make the berth unsuitable.

As shown in the tables, South wharf (west), Coal wharf, North wharf (west), and the newly constructed Central wharf provide the best berths for large oceangoing breakbulk and RORO ships, although these wharves have no stern-ramp facilities for the RORO ships and no wharf cranes for the breakbulk ships. These same wharves could accommodate container ships, but no container facilities are available at the berths. Although barges could also be handled at these wharves, to maximize the shipping capacity of the port, barges should be handled at the shallow-draft berths of South wharf (east) and North wharf (east). The large LASH ships could be berthed at the Coal wharf or Central wharf for barge loading/unloading operations. The SEABEE ships could be berthed at these wharves as well as at South wharf (west) and North wharf (west). The wharves occupied by the Korean Navy, in the northern section of the port, are not expected to be available for cargo operations.

f. (U) Safety Considerations. Located immediately adjacent to Donghae City, the port's berths are all within 1000 meters (3,280 feet) of the city, which has a population of 30,000. POL storage tanks for locomotive fuel are located at the Pukpyong Railroad Station within 1200 meters (3,936 feet) of all berths. Industry near the port includes two large cement manufacturing plants immediately adjacent to North and South wharves. Korean naval facilities, including a new drydock, are located at the north end of the port within 1000 meters (3,280 feet) of all berths. Therefore, all these activities fall within the 2500-meter (8,200-foot) quantity-distance arc established for a notional breakbulk ammunition ship and the 2800-meter (9,184-foot) arc established for a notional container ship.

2. (U) Materials Handling Equipment. In addition to the 35-STON mobile crane, the port maintains seven gas-operated, 3.5-STON forklifts, which could be used to load or unload general cargo.

stern-ramp operations from one berth onto the apron of an adjacent berth. Berths with lengths, drafts, and apron widths to accommodate a notional 213-meter (700-foot) RORO vessel are located at Central, North, South, and Coal wharves. These same berths are adequate to handle the much larger T-AKR vessel. With the exception of Central wharf, these berths are not intended to be used as RORO berths. Further, their elevated conveyor systems and rail-mounted bulk loaders would hinder operations. However, the berths could be adapted for this use if the bulk loaders were pushed aside and the ramps of the RORO ships were carefully positioned to prevent damage to the rails that support the loaders. Before Central wharf can be used, the apron and adjacent open storage area must be cleared and the draft must be dredged to its designated depth.

b. (U) Breakbulk Operations. Breakbulk operations using a notional 183-meter (600-foot) US-flag breakbulk vessel or the smaller Korean-flag vessels could be conducted at Central, North, South, and Coal wharves. As previously discussed, only Central wharf is intended for use as a general cargo berth, but the other wharves can be adapted for breakbulk use. Wharf cranes are not available at any of the berths to perform heavy lifts, so mobile or floating cranes would be required at all berths. Since the one, 35-STON mobile crane currently available at the port is not adequate for breakbulk operations, heavy-lift cranes must be provided to lift military unit equipment. On North and South wharves, the bulk loaders could be pushed aside, as needed, to accommodate the mobile cranes as they move between hatches. Ship unloading operations at these wharves may require more time than usual due to the proximity of the elevated conveyor systems, which limit the mobility of cranes. Also, depending on location of the ship, the cranes and the military equipment being unloaded may have to traverse the raised rails that support the bulk loaders. Even if these crossings were made with care so as not to damage the rail, operations would be slowed.

c. (U) LASH and SEABEE Operations. LASH and SEABEE barges could be unloaded from all available port berths; however, to maximize berthing capability, deep-draft berths should be reserved for ocean-going vessels and shallow-draft berths should be used for barges whenever possible. The east ends of both North and South wharves would provide suitable berths for either type of barge, if mobile cranes were available. The port currently has only one 35-STON mobile crane to support unloading operations. Additional cranes would have to be supplied to support unloading operations at many sites. The raised rails as well as the elevated conveyor systems would increase the time required to unload barges. Barges could be staged at the far western end of the southern section of the terminal between North and South wharves. This area provides about 20 000 square meters (5 acres) of storage space. Three tugboats are available at the port to provide towing services.

LASH and SEABEE vessels can be berthed at Central, North, South, and Coal wharves while barges are being loaded or unloaded. These vessels could also be anchored in the large turning basin during these operations, but this would block all access to and from the port. The vessels could also be anchored outside the breakwater in the open sea, but operations would be possible only during fair weather and calm seas.

The specific characteristics of the berths at the Port of Pukpyong are summarized in table PU-1. Based on these characteristics, suitable berths for various types of vessels will be analyzed.

a. (U) RORO Operations. Stern-ramp facilities are not available at the port to support straight stern-ramp RORO operations. The berth locations also are not positioned at angles, which would allow

TABLE PU-1
PORT OF PUKPYONG
OPERATED BY: DONGHAE DISTRICT MARITIME AND PORT AUTHORITY

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m (ft)	Individual Berth	Berth Length m (ft)	Approximate Apron Width m (ft)	MLW m (ft)	Approximate Apron Height Above MLW m (ft)	Deck Strength [a] psf	Serviced by Rail-Mounted Crane	Rail Access to Apron
Coal wharf	1	Marginal	270 (886)	1	270 (886)	30 (98)	13.0(42.6)	2.0(6.6)	838	No [b]	No
South wharf	West	Marginal	735 (2,411)	West	440(1,443)	30 (98)	12.0(39.4)	2.0(6.6)	838	No	No
	Middle			Middle	160 (525)	30 (98)	9.0(29.5)	2.0(6.6)	838	No [b]	No
	East			East	135 (443)	30 (98)	7.5(24.6)	2.0(6.6)	838	No [b]	No
North wharf	West	Marginal	570 (1,870)	West	440(1,443)	30 (98)	12.0(39.4)	2.0(6.6)	838	No [b]	No
	East			East	130 (426)	30 (98)	7.5(24.6)	2.0(6.6)	838	No [b]	No
Central wharf	1	Marginal	370 (1,214)	1	370(1,214)	Open [c]	14.0(45.9) [d]	2.5(8.2)	838	No	No
LST ramp [e]	1	Marginal	100 (328)	1	100 (328)	50 (164)	6.0(19.7)	.6(2.0)	628	No	No
Navy wharf 1 [e]	1	Marginal	110 (361)	1	110 (361)	50 (164)	6.0(19.7)	6.0(19.7)	628	No	No
Navy wharf 2 [e]	West,	Marginal	410 (1,345)	West	90 (295)	50 (164)	6.0(19.7)	1.5(4.9)	628	No	No
	East			East	320(1,050)	50 (164)	6.0(19.7)	2.0(6.6)	628	No	No

Rail-Mounted Cranes	Serving Berths	Roll-on/Roll-off Facilities	Serving Berths	Open Storage m^2 (acres)	Serving Berths	Covered Storage	Serving Berths
None	-	LST ramp	Navy LST ramp	30 000 (7.4)	Central wharf	None	-

[a] Estimated values.
[b] Rail-mounted bulk loaders that are not suitable for handling general cargo.
[c] Open area is littered with construction materials that must be removed before area can be used.
[d] Central wharf is newly constructed and will be dredged to this estimated draft early in 1984.
[e] Used exclusively to support Korean naval vessels.

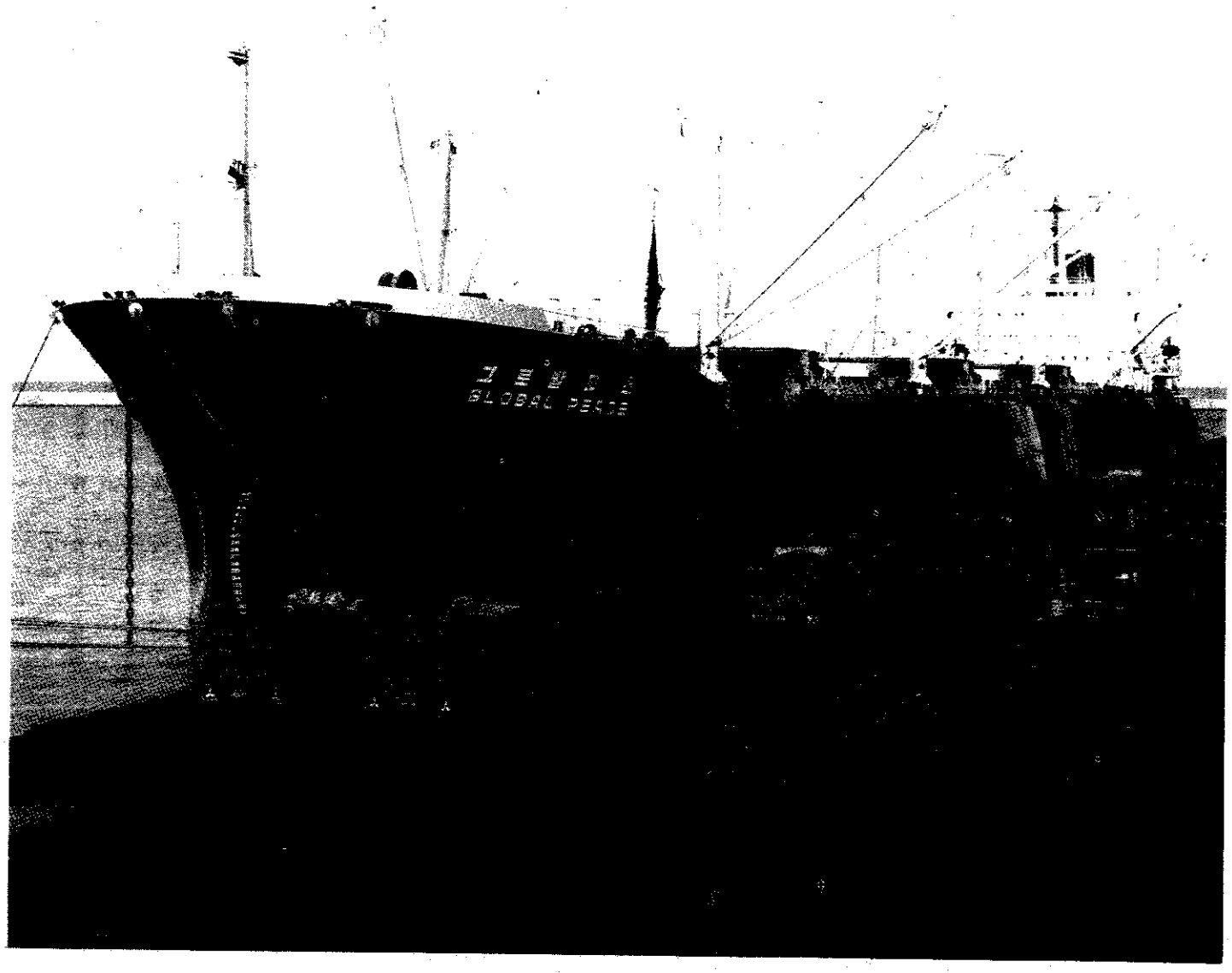


Figure PU-4. Coal wharf (eastward view).

Figure PU-3. South wharf (eastward view).

would be very slow and would interfere with the local commercial and domestic activity surrounding the station.

In addition, the station has neither end-loading ramps nor spur tracks that could be used with a portable end-loading ramp. The station maintains one diesel switching locomotive, but has no cranes or other materials handling equipment for use in loading military unit equipment. A side-loading dock with a capacity of three railcars is located adjacent to a track siding that can hold six railcars at a time. A small, unpaved open area adjacent to the dock provides only 1100 square meters (0.3 acre). So while the station could be developed into a railcar loading site, many limitations reduce its current capability for loading operations.

5. (U) Airports. The closest airfield to the port is located in Kangnung, about 48 kilometers (30 miles) north of the port. The asphalt runway measures 2622 meters (8,600 feet) long and 36.6 meters (120 feet) wide. The airport is capable of supporting only intra-theater aircraft.

B. (U) Pukpyong Port Terminal

1. (U) Berthing. With the exception of the newly constructed Central wharf, none of the wharves at Pukpyong Port Terminal (fig PU-2) were designed or intended to be used as general cargo berths. The current use of the wharves in support of the industrial mission of the port would be interrupted if they were used for military operations. The berthing can be divided, by use and geography, into three distinct areas. The berthing in the southern section of the port includes North wharf, South wharf (fig PU-3), and Coal wharf (fig PU-4). These wharves were designed to handle bulk materials such as cement, iron ore, and coal. North and South wharves have elevated conveyor systems, located about 30 meters (98 feet) from the edge of their aprons, and rail-mounted bulk loaders that run along their entire lengths. An elevated conveyor system has not yet been installed on Coal wharf, but one is planned for the future. All of the wharves in the southern section of the port have berths with lengths and drafts that are suitable for large ocean-going vessels transporting military equipment.

In the central section of the terminal, the construction of Central wharf was completed in 1983. The port plans to use this wharf for handling general cargo. At the time of the field visit, the wharf had not yet been used, and the large open area adjacent to the wharf was only rough graded and cluttered with construction materials and debris. Large concrete tetrapods, which are to be used on the face of the breakwaters, are also stored in this area and should be removed before cargo handling operations are initiated. The exact draft at the wharf is not known, but it will be dredged to 14 meters (46 feet) early in 1984.

All berthing in the northern section of the terminal is used exclusively by the Korean Navy and is not expected to be available for cargo operations. These berths all have shallow drafts and would be suitable for barges only. Just south of its LST ramp, the Navy is currently constructing a small drydock to be used exclusively as a repair facility for naval ships.

temporarily blocks access to and from the port, because the turning basin is located just inside the breakwaters exactly where the entrance channel enters the harbor. A smaller turning basin, with a diameter of 300 meters (984 feet) and a draft of 7 meters (23 feet), is located in the northern section of the harbor.

There are no anchorages inside the harbor, but three areas located outside the harbor, to the northeast of the north breakwater, have been designated as anchorages. The anchorages are in unprotected waters in the Sea of Japan, so barge operations would be impossible during rough seas. The specific depths and diameters of the anchorages have not yet been documented; however, the minimum draft is believed to be 18 meters (59 feet), and the diameters are adequate for oceangoing vessels.

The harbor does not have a silting problem, so there is no ongoing dredging program. The entire harbor was dredged during the construction of the port, and the new cargo and coal wharves were recently dredged during their construction. Soundings are taken periodically throughout the harbor to ensure that drafts are maintained. Since some silting occurs outside the harbor at the mouth of Jeon Stream, this area is monitored carefully so that silt flows will not affect drafts in the harbor or entrance channel.

3. (U) Highway Access. The highway access route from the port to the main supply route follows an unnamed road that extends about 1.6 kilometers (2.6 miles) west from Main Gate, the only gate at the port, to Korean Route 7. This rural access road is constructed of asphalt and has two traffic lanes, with no excessive grades or curvatures. The access road crosses Old Route 7 about 0.3 kilometer (0.2 mile) west of Main Gate, then continues on to Korean 7, the main supply route in this region of Korea. Korean 7 is a north-south road spanning the entire coast of Korea. Old Route 7 runs through Donghae City and connects with Korean 7 to the north and south of the city. At one time, Old Route 7 was Korean 7, but to avoid the urban traffic and clutter, it was replaced with the new Korean 7 road segment, which bypasses Donghae City. The access route has no vertical clearance obstructions and would provide a good entrance from the port for military unit equipment and supply trucks.

4. (U) Railroad Access. The port has no rail access because trackage from the Korean National Railroad does not extend to the port terminal. Tracks nearest the port are at the Pukpyong Railroad Station, about 1.5 kilometers (0.9 mile) west of the terminal, in Donghae City. The station serves as a passenger terminal and as a relay point for freight cars traveling north to the Port of Mukho and south to the industries in Samchok. The main-line track, which provides access to the station, runs north to Kangnung, where it terminates, and south to Yonju, where it connects with the Korean railroad network. Branch lines from the Pukpyong station run north to the Port of Mukho and south to Samchok. In addition to these tracks, the station has about 3247 meters (10,650 feet) of holding tracks that can accommodate about 250 railcars.

The station is located on the boundary of Donghae City and, thus, would not make a good rail loading site because highway access to the station would be extremely poor. The access route from the port extends through Donghae City and is not designed to accommodate large vehicles. Therefore, movement

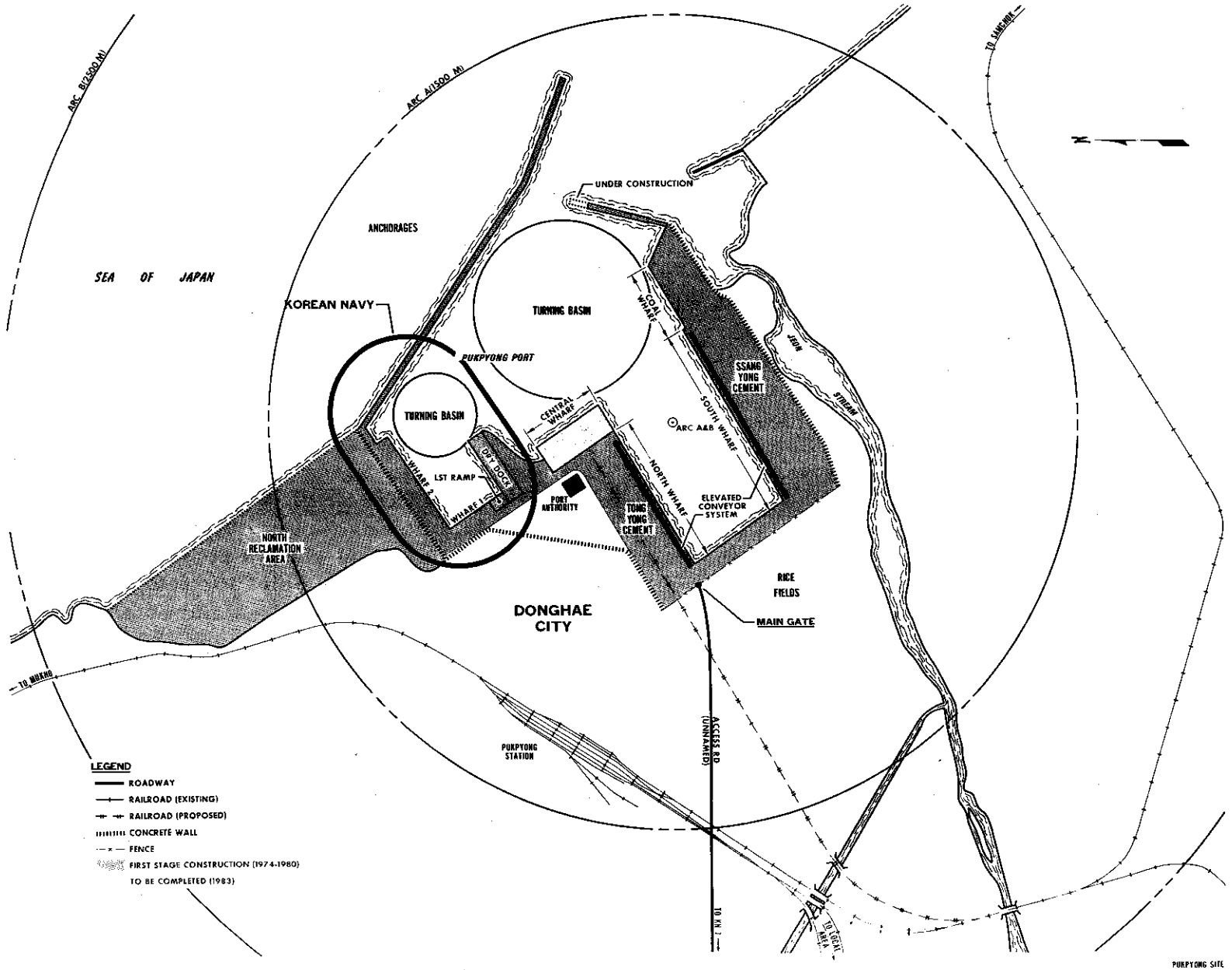


Figure PU-2. Site map.

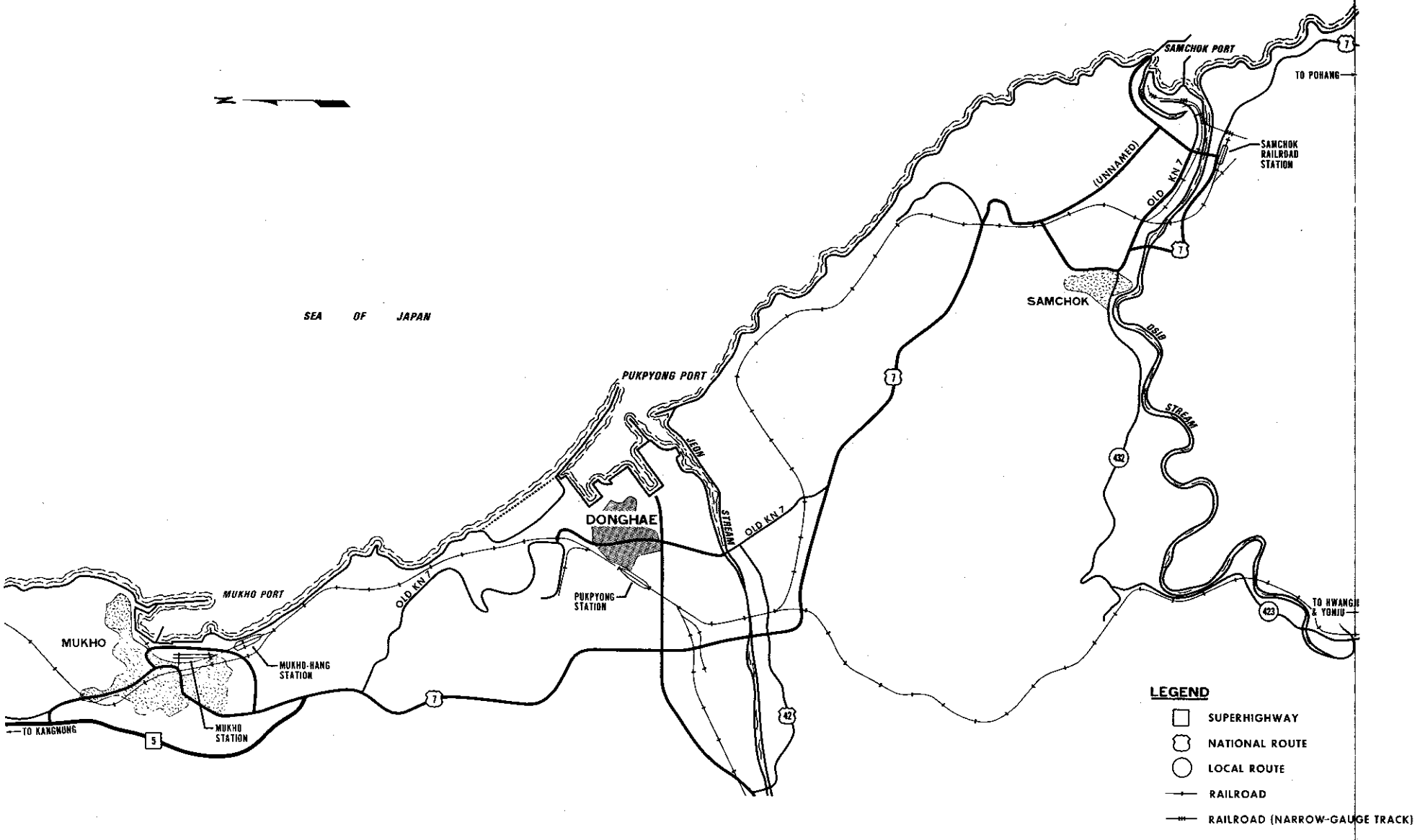


Figure PU-1. Vicinity Map.

(U) PORT OF PUKPYONG

A. (U) General

1. (U) Location and General Uses. The Port of Pukpyong (fig PU-1) is located on the eastern seacoast of Korea, about 323 kilometers (201 miles) north of Pusan and 288 kilometers (179 miles) east of Seoul. It is centrally located between the Port of Mukho, which is about 13 kilometers (8 miles) to the north, and the Port of Samchok, which is about 8 kilometers (5 miles) to the south. Pukpyong, which is administered by the Donghae District Maritime and Port Authority, was opened in 1979 to support the growing industrial complex in this region of the country. The port terminal is situated just east of the city of Donghae (previously the city of Pukpyong) and can be divided into three major sections - north, south, and central. The northern section is used exclusively by the Korean Navy, while the southern section is used to handle bulk materials such as cement, coal, and iron ore. In the central section of the terminal, another new wharf has been recently constructed and is planned for handling general cargo. Cement manufacturing plants are located adjacent to both North and South wharves, which are both located in the southern section of the port terminal. A new coal wharf to support increasing imports has been constructed recently in the southern section of the terminal as an extension to South wharf.

2. (U) Harbor. The harbor encompasses an area of about 1 000 000 square meters (247 acres) and can be divided into a northern and southern section (fig PU-2). The Pukpyong Harbor is a manmade harbor formed by the construction of the north and south breakwaters. The north breakwater, which is 1480 meters (4,855 feet) long, extends southeast from the northernmost section of the terminal, forming a protective barrier that separates the harbor from the Sea of Japan. The south breakwater is 580 meters (1,902 feet) long and extends northeast from the new coal wharf toward the north breakwater. In addition to protecting the harbor from rough seas, the south breakwater also offers protection from river currents and the flow of silt from Jeon Stream. This stream flows along the southern boundary of the terminal and empties into the Sea of Japan immediately south of the port, near the entrance to the harbor.

The northern section of the port is located directly opposite the entrance channel and is subject to sea swells and adverse wave actions. The southern section of the port lies between North and South wharves and is more protected than the northern section during bad weather. Although the southern area is safer, the harbor is not a safe haven during extremely poor weather or rough seas. The normal tidal range throughout the harbor under fair weather conditions is only 0.2 meter (8 inches).

The entrance channel approaches the harbor from the southeast and runs between the north and south breakwaters. The channel has no overhead obstructions and enters the harbor from the Sea of Japan at a width of 250 meters (820 feet) and a draft of 15 meters (49 feet). The harbor has a large turning basin with a diameter of 650 meters (2,132 feet) and a draft of 14 meters (46 feet). Use of this turning basin

If portable ramps or heavy-lift cranes were made available, railcars could be loaded from these tracks. The Mukho-Hang Railroad Station is located near the port terminal, but poor highway access and the absence of cargo handling facilities and equipment make the station an unsuitable loading site. The Mukho Railroad Station, also located near the port, is not recommended as a railcar loading site either, because of its poor highway access, the availability of only one side-loading dock, and the unavailability of end ramps, switching locomotives, and materials handling equipment. Therefore, rail operations could be accomplished best at the port terminal.

Highway access from the terminal is available through North and South Gates, but only South Gate provides military equipment with suitable access to the main supply route, Korean 7. The road network on the terminal is also suitable for military equipment. The terminal has no truck docks or end-loading ramps. It has only two 20-STON mobile cranes and a small fleet of forklifts to support truck-loading operations. Loading operations could be performed in one of the three open storage areas available on the terminal, which provide a total of 24 700 square meters (6 acres) of open area. The port has no POL storage and only two warehouses with a total of 660 square meters (7,100 square feet) of covered storage. Pilot service is available and mandatory, and the port is serviced by three berthing tugboats and about 660 stevedores.

The berths are located within 1000 meters (3,280 feet) of Mukho City, which has a population of 30,000. Also within this area are a large cement located adjacent to the terminal; a small volume of POL storage at local industries; the train station and the main-line railroad track; and the main supply routes, Korean 7 and Superhighway 5. Therefore, these activities and transportation assets fall within the 2500-meter (8,200-foot) quantity-distance arc established for a notional breakbulk ammunition ship and the 2800-meter (9,184-foot) arc of a container ship.

TABLE MU-4
INDIVIDUAL BERTH RATING (BB/RORO)

Ideal Berth Factors	Berths		
	Central Wharf	Wharf 3	Wharf 4
Length	5	20	5
Alongside depth	12	16	12
Backup area	2	1	1
Apron width	20/20	20/20	20/20
Transit shed	0/0	0/0	0/0
Distribution shed	2/0	2/0	2/0
Apron tracks	0	0	0
Deck loading	8	8	8
Heavy-lift cranes	0	0	0
Berth type	10	10	10
Truck tailgate	0	0	0
Rail end ramp	0	0	0
Truck access	9	9	9
Ship service facilities	4	4	4
Conditional age of facility	8	8	8
RORO stern ramp	0/5	0/5	0/5
Total Points	80/83	98/101	79/82
Ranking	2/2	1/1	3/3

TABLE MU-5
INDIVIDUAL BERTH RATING (BARGE)

Ideal Berth Factors	Berths		
	Central Wharf	Wharf 3	Wharf 4
Length	8	10	8
Alongside depth	10	10	10
Backup area	8	5	5
Apron width	10	10	10
Consolidation shed	2	2	2
Apron tracks	0	0	0
Anchorage diameter	1	1	1
Conditional age of facility	8	8	8
Deck loading	8	8	8
Heavy-lift cranes	0	0	0
Berth type	10	10	10
Truck tailgate	0	0	0
Rail end ramp	0	0	0
Truck access	9	9	9
Tug availability	5	5	5
Barge lay area	10	10	10
Total Points	89	88	86
Ranking	1	2	3

pilot boat are available at the port to provide pilot service throughout the day. These pilots also serve the Ports of Pukpyong and Samchok. They usually board incoming vessels at the quarantine anchorage, which is located outside the breakwaters in the outer harbor at the Port of Mukho.

2. (U) Harbor Craft. Two berthing tugboats, both rated at 1,100 horsepower, are available for use at the Port of Mukho. The port also operates one 109-STON and two 89-STON barges.

3. (U) Stevedores. About 660 stevedores are registered in the Mukho Chapter of the National Docker's Union serving the Port of Mukho. These stevedores also serve the Ports of Pukpyong and Samchok. Gang size varies according to the type of cargo, but usually consists of 16 to 18 members for general cargo operations. The local stevedore companies in Mukho are:

a. (U) Daesung Transportation Company, Ltd.

b. (U) Hongikhoe Forwarding Company (bulk handlers).

c. (U) Korea Express Company, Ltd.

d. (U) Tong Yang Sangun Company, Ltd.

4. (U) Supplies and Utilities. Freshwater is available at water points along wharf 3 and Central wharf and can be provided to ships at anchorage by the two water barges operating at the port. Bunker supplies are also available from two bunker supply barges operated at the port. Port officials should be notified of needed supplies prior to ship arrival at the port to ensure a timely delivery.

D. (U) Future Developments

The port has no developments planned for the immediate future.

E. (U) Summary

The Port of Mukho is an industrial port that handles mainly bulk materials such as coal, graphite, and cement. The port also supports the local fishing industry and provides berthing for the Korean Coast Guard. Only wharf 3 has deep-draft berths that could accommodate the US-flag breakbulk vessels and some of the shallow-draft RORO vessels and container ships. Wharf 4 and Central wharf are suitable for barges and the shallow-draft Korean breakbulk ships. Although wharves 3 and 4 have elevated conveyor systems and are designed to handle bulk materials, they could be adapted to support cargo shipping operations. None of the wharves have drafts adequate for LASH and SEABEE vessels. Based on these shipping capabilities of the wharves, individual berth rankings have been computed in tables MU-4 and MU-5 for various shipping operations at selected berths. The rankings indicate the berths that are best suited for each shipping operation and the relative suitability of the other selected berths.

The port rail access is provided by two track spurs that have one side-loading dock but no end ramps.

mobile cranes were provided to load the railcars, military equipment could be transported by railroad from the port terminal. A switch locomotive from the Mukho-Hang Railroad Station performs all railcar switching operations at the port terminal. Additional spur tracks serve the cement manufacturing plant, which is located just west of the port terminal. Many of the tracks are elevated and others have extremely poor access and are used for alternate purposes, so they are not suitable for military operations and do not increase the rail outloading capacity of the port. As discussed previously, rail loading operations would not be possible from the Mukho-Hang Railroad Station and are not recommended from the Mukho Railroad Station. Therefore, the spur tracks on the port terminal provide the best railcar loading site and could be used if portable end ramps or cranes were made available for loading operations.

5. (U) Truck Operations. Truck access to and from the port terminal can be gained through North or South Gate; however, since highway access from North Gate to the main supply route is extremely poor, only truck access via South Gate is recommended. All roads on the terminal are paved and in good condition, so truck travel would not be impeded. The port has no truck docks or end-loading ramps, so portable ramps and mobile cranes would be required for truck-loading operations. The port has two 20-STON mobile cranes that could be used to lift nonroadable equipment onto flatbed trucks. Truck-loading operations using portable ramps or cranes could be conducted in one of the open storage areas adjacent to wharves 3 and 4 or in the area adjacent to Central wharf. Since these areas are paved, loading operations would be possible during all climatic conditions. As an alternative for break-bulk or barge shipping operations, the cranes used to unload the vessels could be used to load nonroadable unit equipment and general cargo directly onto a truck positioned alongside the ship. Although this would be possible, it would increase the time required to unload the ship because of the extra time required to make the exact placement. Therefore, unless trucks are loaded directly from the ship, the current truck outloading capability is limited to the lifting capacities of the two mobile cranes. However, if portable ramps or heavy-lift cranes were made available, suitable areas are available to conduct truck-loading operations.

6. (U) Security. A perimeter barrier separates the port terminal from a residential development on its southern border, the Ssang Yong Cement Plant on its southwestern border, and a commercial area on its northwestern and northern borders. A concrete wall, which is topped with barbed wire, surrounds much of the port terminal from the Ferry Terminal north to wharf 2. Fencing is used along the southwest border of the terminal to provide separation from the Ssang Yong Cement Plant. There are no lights or guard posts along the perimeter of the port terminal. Guard posts are located at North and South Gates, and the port has a small guard force that employs three guards per shift and operates three shifts per day. The guards are posted at North and South Gates and periodically patrol throughout the port terminal.

C. (U) Support Services

1. (U) Pilotage. Pilotage is mandatory for entrance into the Port of Mukho. Three pilots and one

terminal, but two pipelines run from wharf 3 to Mukho-Hang Railroad Station. Large industries near the port include one of the largest cement manufacturing plants in Korea, which is operated by Ssang Yong Cement Company and located on the western border of the port terminal. Also, both of the train stations and the main-line railroad track fall within a 1000-meter (3,280-foot) arc surrounding the berths. The main supply routes in this part of Korea, Superhighway 5 and Korean 7, are within 500 meters (4,920 feet) of the berths. Therefore, all these activities and transportation assets fall well within the 2500-meter (8,200-foot) quantity-distance arc established for a notional break-bulk ammunition ship and the 2800-meter (9,184-foot) arc established for a notional container ship.

2. (U) Materials Handling Equipment. In addition to the two 20-STON mobile cranes, the port maintains two 5-STON and one 3-STON diesel-powered forklifts, which could be used to load or unload conveyance vehicles with general cargo. The port also operates 78 cargo trucks with capacities ranging between 6.5 and 13.0 STON and one 40-STON trailer.

3. (U) Storage Areas

a. (U) Open Storage. The port terminal has three open storage areas with a total of 24 700 square meters (6 acres). The largest storage area, which covers about 13 000 square meters (3 acres), is located behind Central wharf and wharf 2 and is used to stockpile coal. Also, two railroad spur tracks run through the area. The area is paved and would make a good marshaling area if the coal stockpiles were removed. The other open storage areas, covering 7500 square meters (1.9 acres) and 4200 square meters (1 acre) are adjacent to wharves 3 and 4. These areas are actually two sections of one large, open storage area. The area is completely paved and has good access to South Gate. It is only slightly encumbered by the column supports of the elevated conveyor system. This area would be an excellent marshaling site for unit equipment unloaded at wharves 3 and 4.

b. (U) Covered Storage. The only covered storage on the port terminal is the two warehouses adjacent to the open storage area near Central wharf and wharf 2. These warehouses are owned and operated by KMPA; each warehouse provides about 300 square meters (3,550 square feet), for a combined total of 660 square meters (7,100 square feet).

c. (U) POL Storage. The port terminal has no POL storage tanks. A small number of storage tanks serve the industries that surround the port, and two tanks are located at the Mukho-Hang Railroad Station.

4. (U) Rail Operations. The port terminal rail access is provided by two standard-gauge spur tracks, which are located in the open storage area adjacent to Central wharf and wharf 2. The tracks run generally parallel to the wharves about 60 meters (197 feet) west of the berths. Both tracks are 150 meters (492 feet) long and terminate in an open area with no end ramps. The tracks are used by coal cars and are completely surrounded by stockpiles of coal. A side-loading dock, which can accommodate two railcars at a time, is located adjacent to one of the tracks. These spur tracks could each accommodate about 11 railcars at a time. Therefore, if portable end ramps or suitable

TABLE MU-3
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF MUKHO

Korean-Flag Ship Type	Berths								
	Ferry Terminal	Wharf 4	Wharf 3	Lighter Wharf	Central Wharf	Wharf 2 (Coast Guard)	Fishing Wharf 1	Fishing Wharf 2	Fishing Wharf 3
Breakbulk									
Type 1	b	3	9	a	3	5	a	a,b	7
Type 2	b	1	4	a	1	a	a	a,b	a
Type 3	b	1	4	a	1	a	a	a,b	a
Type 4	a,b	1	3	a	1	a	a	a,b	a
Type 5	a,b	1	3	a	1	a	a	a,b	a
Type 6	a,b	1	3	a	1	a	a	a,b	a
Type 7	a,b	1	2	a,b	a	a	a	a,b	a

a - Inadequate draft at berth.
b - Inadequate berth length.

As shown in the tables, wharf 3 provides the best berths for large oceangoing breakbulk and RORO ships; however, it has no stern-ramp facilities for RORO ships and no wharf cranes for breakbulk ships. The shallow-draft breakbulk Korean vessels can be berthed at wharves 3 and 4 and Central wharf. Wharf 3 can also accommodate shallow-draft container ships, but no container facilities are available at the berths. If wharf 3 were reserved for deep-draft vessels, then wharf 4 and Central wharf would provide the most suitable berths for barge operations. Large LASH and SEABEE vessels cannot be berthed at any of the wharves and must be anchored in unprotected anchorages.

f. (U) Safety Considerations. The location of the port, immediately adjacent to Mukho City, places all berths at the port within 1000 meters (3,280 feet) of the city, which has a population of 30,000. POL storage tanks for local industries and for locomotive fuel also lie within a 1000-meter (3,280-foot) arc of the berths. No storage tanks are located on the port

TABLE MU-2
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF MUKHO

US-Flag Ship Type	Berths								
	Ferry Terminal	Wharf 4	Wharf 3	Lighter Wharf	Central Wharf	Wharf 2 (Coast Guard)	Fishing Wharf 1	Fishing Wharf 2	Fishing Wharf 3
RORO									
GTS Callaghan	a,c,d	a,c,d	1,d	a,c,d	a,c,d	a,c,d	a,b,d	a,b,c,d	a,d
USNS Comet	a,c,d	a,c,d	1,d	a,c,d	a,c,d	a,d	a,b,d	a,b,d	a,d
Maine-class	a,c	a,c	a	a,c	a,c	a,c	a	a,b,c	a
Breakbulk									
C4 Mariner-class	a,c	a,c	1	a,c	a,c	a	a	a,b,c	a
C4-5-58a	a,c	a,c	1	a,c	a,c	a	a	a,b,c	a
C3-5-38a	a,c	a,c	2	a,c	a,c	a	a	a,b	a
C3-5-33a	a,c	a,c	2	a,c	a,c	a	a	a,b	a
Barge									
LASH C8-5-81B	a,c,f	a,c,f	a,f	a,c,f	a,c,f	a,c,f	a,f	a,b,c,f	a,c,f
LASH barge	1	7	17	a	7	9	a	b	13
SEABEE C8-5-82A	a,c,f	a,c,f	a,f	a,c,f	a,c,f	a,c,f	a,f	a,b,c,f	a,c,f
SEABEE barge	1	4	11	a	4	6	a	a,b	8
Seatrain									
Georgia-class	a,c	a,c	1	a,c	a,c	a	a	a,b	a
Puerto-class	a,c	a,c	1	a,c	a,c	a	a	a,b,c	a
Container									
SL-7 (Cntnr only)	a,c,e	a,c,e	a,e	a,c,e	a,c,e	a,c,e	a,e	a,b,c,e	a,c,e
C6-5-1W	a,c,e	a,c,e	1,e	a,c,e	a,c,e	a,c,e	a,e	a,b,c,e	a,e
C7-5-68E	a,c,e	a,c,e	a,e	a,c,e	a,c,e	a,c,e	a,e	a,b,c,e	a,e
C8-S-85B	a,c,e	a,c,e	a,e	a,c,e	a,c,e	a,c,e	a,e	a,b,c,e	a,e
RORO/Container									
C5-5-78	a,c	a,c	a	a,c	a,c	a,c	a,b	a,b,c	a
T-AKR (SL-7)	a,c	a,c	a	a,b,c	a,c	a,c	a,b	a,b,c	a,c
Breakbulk/Container									
C5-5-37E	a,c	a,c	1	a,c	a,c	a,c	a	a,b,c,	a
C4-5-10	a,c	a,c	a	a,c	a,c	a	a	a,b,c	a

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.
f - Inadequate draft for barge ship at berth; however, ship could be unloaded from anchorage.

STON diesel mobile cranes currently available at the port are not adequate for breakbulk operations, heavy-lift cranes must be provided to lift military unit equipment. On wharves 3 and 4, the rail-mounted bulk loaders could be pushed aside, as needed, to accommodate the mobile cranes as they move between hatches. The cranes would be forced to work around the stationary bulk loaders and the proximity of the elevated conveyor systems would limit the operating space available for crane operations. The rails supporting the rail-mounted bulk loaders would not interfere with vehicle or crane access along the wharves since they do not raise above the apron surface. Central wharf is not hindered with bulk-material handling systems or other obstructions, so normal ship unloading operations are possible.

c. (U) LASH and SEABEE Operations. LASH and SEABEE barges could be unloaded from Central wharf and wharves 3 and 4. To maximize berthing capability, deep-draft berths should be reserved for oceangoing vessels, and barges should be unloaded from shallow-draft berths whenever possible. Therefore, if mobile cranes were available, Central wharf and wharf 4 would provide suitable berths for either type of barge. The port has only two 20-STON mobile cranes that could be used to support barge unloading operations. Additional heavy-lift cranes would have to be supplied. The elevated conveyor system and the bulk loaders at wharf 4 would complicate operations and increase the time required to unload the barges. Abundant space for staging the barges is available in the northern end of the harbor and along the east breakwater near fishing wharf 3. Two tugboats are available at the port to provide towing services. LASH and SEABEE vessels can be anchored only at the anchorages located outside the breakwaters in the open water of the Sea of Japan. Since these anchorages are unprotected, the ability to load and unload barges from the ships would depend on weather and sea conditions. These operations could only be conducted during fair weather and calm seas.

d. (U) Container Operations. At Mukho Port, only wharf 3 has adequate draft for container ships. Wharf 3 could accommodate fully loaded shallow-draft container ships or partially loaded deep-draft vessels. The wharf has no container cranes, and the mobile cranes that would have to be brought in to handle non-self-sustaining container ships would have to operate around the bulk loaders. Crane operations would be slowed by the proximity of the elevated conveyor system, and access to and from the wharf for container transport vehicles would be constrained by the support columns of the conveyor system. The large open area adjacent to wharves 3 and 4 is paved and could be used as a container staging area. Although some container ships could be accommodated at wharf 3, and although a large container staging area is available, container handling equipment is not available, and the bulk-loading system would complicate crane operations and vehicle access to and from the wharf.

e. (U) Summary of Berth Availability. A summary of the berths available at the Port of Mukho for different types of US-flag and Korean-flag vessels are shown in tables MU-2 and MU-3, respectively. The tables show, for each type of vessel, the number each berth could accommodate or the characteristics that make the berth unsuitable.

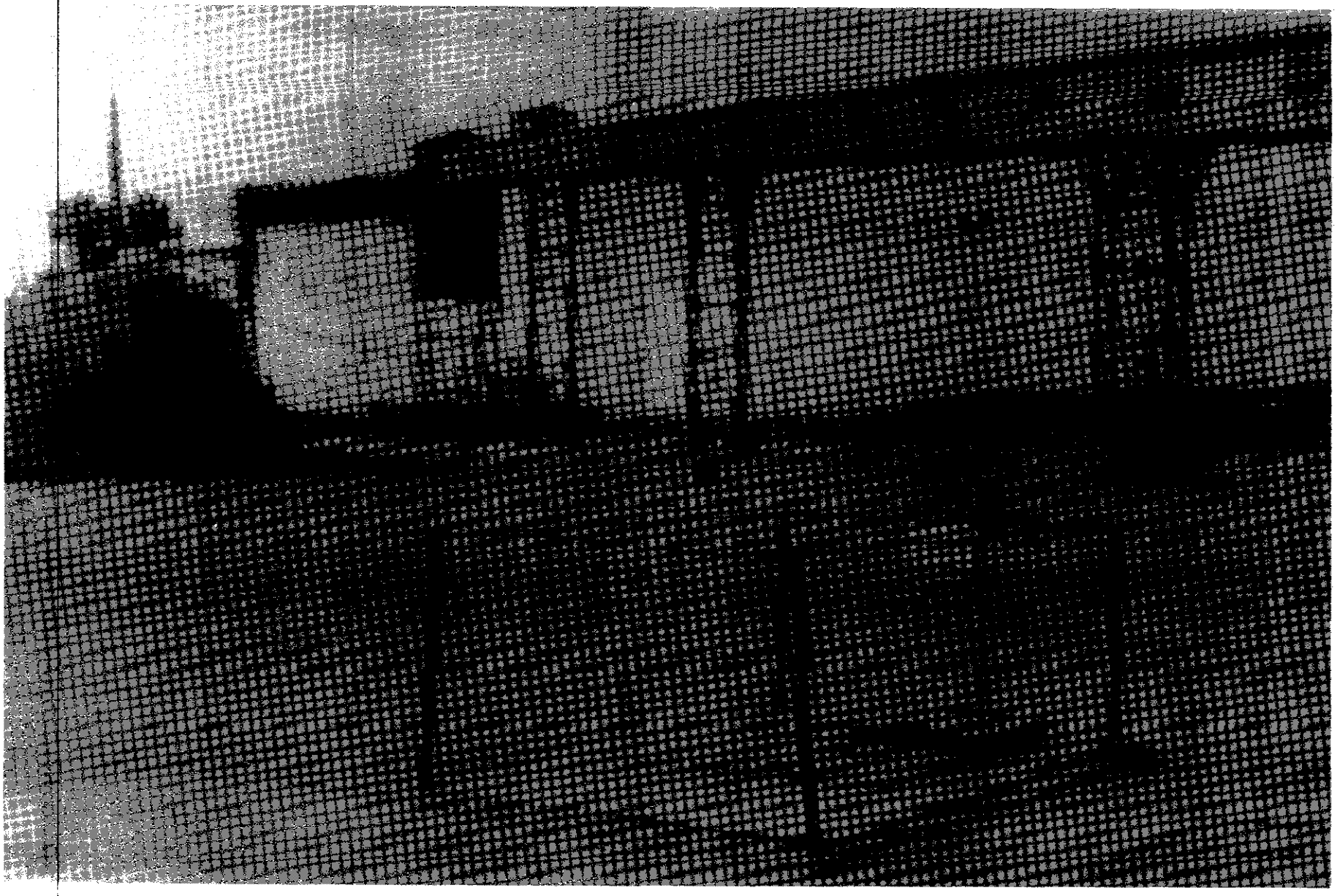
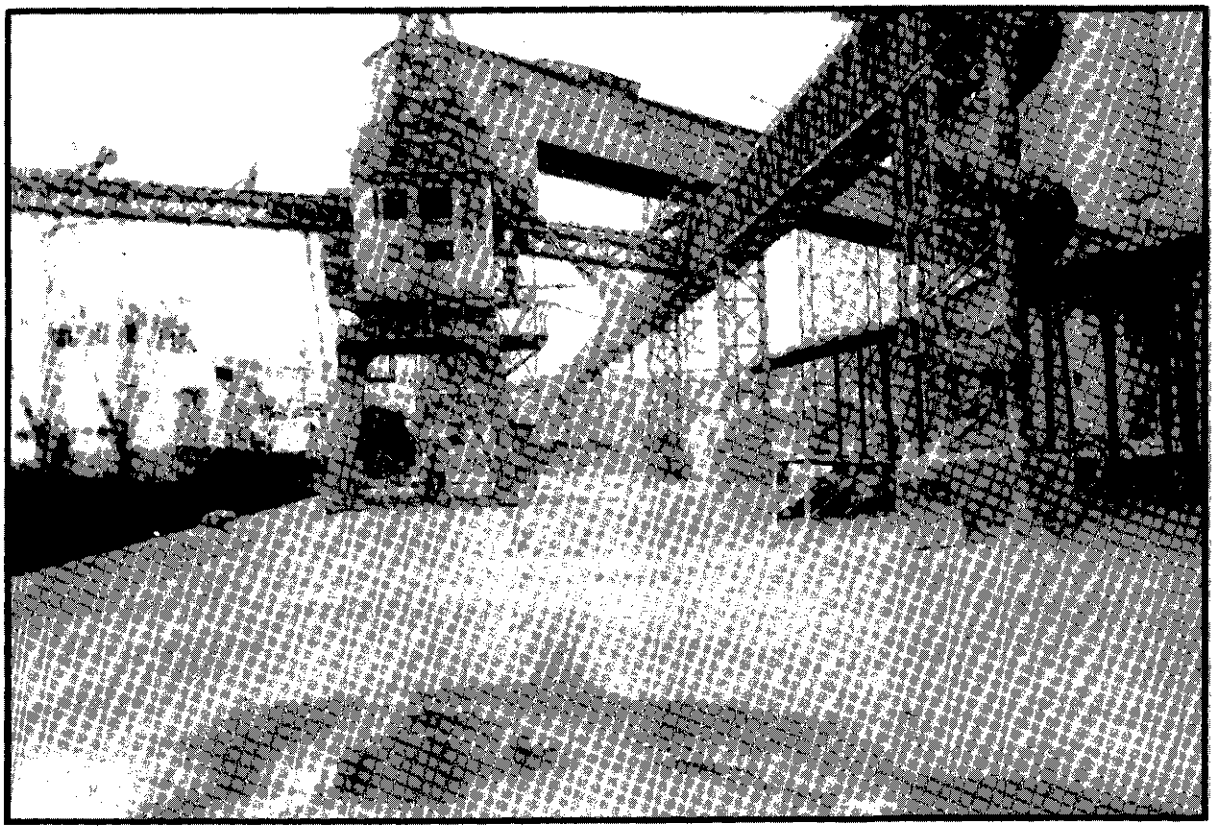
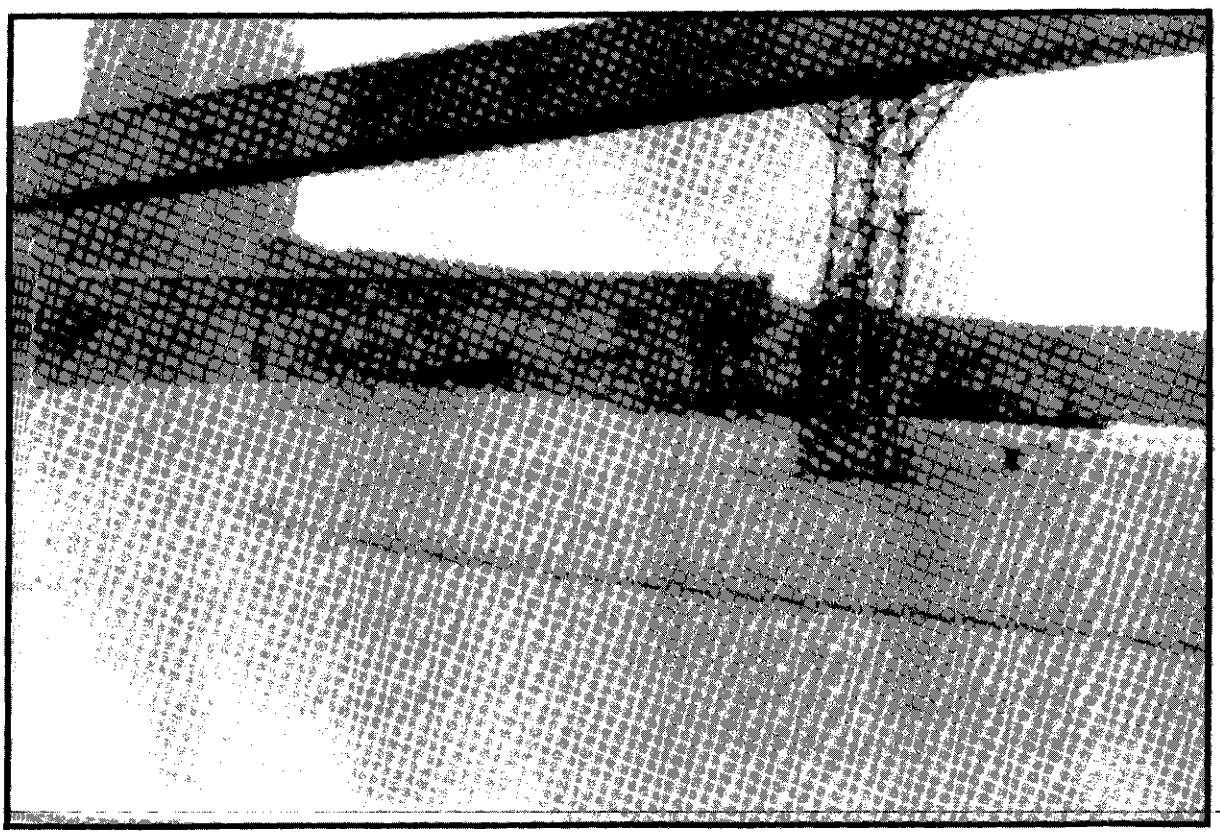


Figure MU-6. Wharf 4 (southeastward view).



(SOUTHWARD VIEW)



(NORTHWARD VIEW)

Figure MU-5. Wharf 3.

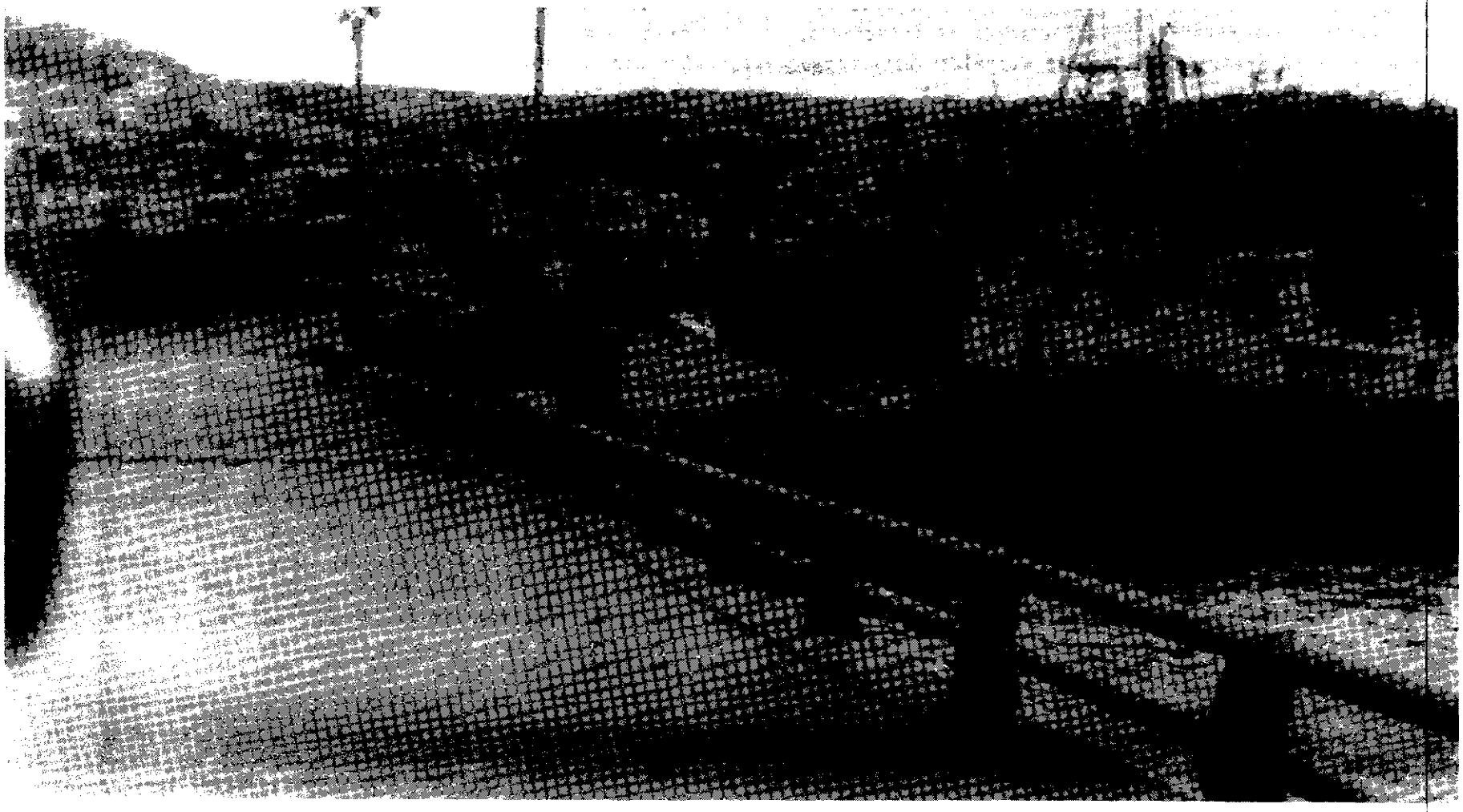


Figure MU-4. Central wharf (northward view).

The wharves along the western shore of the harbor are divided by the coal pier, which is a specially designed conveyor system that consists of several belt conveyors on top of a support structure. The pier has no apron area and is suitable only for bulk loading of coal.

Wharf 2 and Central wharf (fig MU-4) are located north of the coal pier. Wharf 2 is used exclusively by the Korean Coast Guard and is not expected to be available for cargo operations. Central wharf is used to handle coal barges and is backed by an open storage area where coal is stockpiled. The draft at Central wharf is adequate for barge vessels and some of the shallow-draft Korean breakbulk vessels.

The wharves south of the coal pier are Lighter wharf, wharves 3 and 4, and the Ferry Terminal. The draft at Lighter wharf is too shallow for barges and the Ferry Terminal wharf is too short to support barge operations, so only wharves 3 and 4 are available for general cargo operations.

Although wharves 3 (fig MU-5) and 4 (fig MU-6) could support general cargo, their drafts will restrict the ship types that could use their berths. Also, both of these wharves are equipped with rail-mounted elevated conveyor structures and stationary bulk loaders that handle bulk cement materials. The elevated conveyor system moves the cement from silos, which are located immediately east of the port terminal, to the bulk loaders along wharves 3 and 4. These structures would adversely affect cargo handling operations on either wharf.

Based on the above considerations, Central wharf and wharves 3 and 4 are the only ones available at Mukho Port that could be used in support of military shipping operations. The capability of these berths to support specific ship operations will be determined below.

a. (U) RORO Operations. Wharf 3 is the only wharf at the Port of Mukho with adequate draft for some large oceangoing RORO vessels. The draft is too shallow for a fully loaded Maine-class vessel and the T-AKR vessel. The apron (width) along the northern end of wharf 3 is extremely encumbered with the bulk-loading equipment, so RORO side-ramp operations are recommended only for the south end of the wharf. The rail-mounted bulk loaders on the south end of wharf 3 could be pushed aside and, if needed, the ship's side ramps could be positioned between the support columns of the elevated conveyor system. The port has no stern-ramp facilities, and none of the berths are suitably positioned to allow stern-ramp operations. Therefore, RORO operations at the Port of Mukho would be limited to side-ramp operations at the south end of wharf 3. Consequently, RORO ships must be discharged one at a time in the port.

b. (U) Breakbulk Operations. Breakbulk operations could be conducted at Central wharf and wharves 3 and 4. All of the wharves have drafts that are deep enough for the Korean breakbulk vessels; however, only wharf 3 has drafts suitable for US-flag breakbulk vessels. Cranes are not available at any of the berths, so mobile cranes would be required at all berths to perform heavy lifts. Since the two ~~20~~—

TABLE MU-1
PORT OF MUKHO
OPERATED BY: DONGHAE DISTRICT MARITIME AND PORT AUTHORITY

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m (ft)	Individual Berth	Berth Length m (ft)	Approximate Apron Width m (ft)	MLW m (ft)	Approximate Apron Height Above MLW m (ft)	Deck Strength psf	Serviced by Rail-Mounted Crane	Railcar Access to Apron
Ferry terminal	1	Marginal	30 (98)	1	30 (98)	20 (66)	5.0(16.4)	2.0(6.6)	628	No	No
Wharf 4	1	Marginal	140 (459)	1	140 (459)	30 [b/] (98)	8.0(26.2)	2.0(6.6)	628	No [c/]	No
Wharf 3	South	Marginal	330 (1,082)	North	165 (541)	15 [b/] (49)	9.5(31.2)	2.0(6.6)	628	No [c/]	No
	North			South	165 (541)	20 [b/] (66)	9.5(31.2)	2.0(6.6)	628	No [c/]	No
					120 (394)	15 (49)	2.0 (6.6)	2.0(6.6)	628	No	No
Lighter wharf	1	Marginal	120 (394)	1							
Coal conveyor	1	Conveyor structure	NA [d/]	1	NA	NA	NA	NA	NA	NA	NA
Central wharf	1	Marginal	133 (436)	1	133 (436)	25 (82)	7.5(24.6)	2.0(6.6)	628	No	No
Wharf 2 (Coast Guard)	1	Marginal	180 (590)	1	180 (590)	20 (66)	4.0(13.1)	2.0(6.6)	628	No	No
Fishing wharf 1	1	Marginal	71 (889)	1	290 (951)	10 (33)	2.5 (8.2)	2.5(8.2)	419	No	No
Fishing wharf 2	1	Marginal	170 (558)	1	170 (558)	3 (10)	3.0 (9.8)	2.0(6.6)	419	No	No
Fishing wharf 3	1	Marginal	246 (807)	1	246 (807)	40 (131)	3.5(11.5)	1.8(5.9)	419	No	No

Rail-Mounted Cranes	Serving Berths	Roll-on/Roll-off Facilities	Serving Berths	Open Storage	Serving Berths	Covered Storage	Serving Berths
None	-	None	-	13 000 m^2 (3 acres)	Central wharf	Two warehouses - 660 m^2 (7,100 ft^2)	Central wharf
				7 500 m^2 (2 acres)	Wharf 3		
				4 200 m^2 (1 acre)	Wharf 4		

[a/] Estimated values.
[b/] Aprons are open, but widths are limited by overhead conveyor systems.
[c/] Rail-mounted bulk loaders that are not suitable for handling general cargo.
[d/] NA - not applicable, conveyor structure used only for loading coal ships.

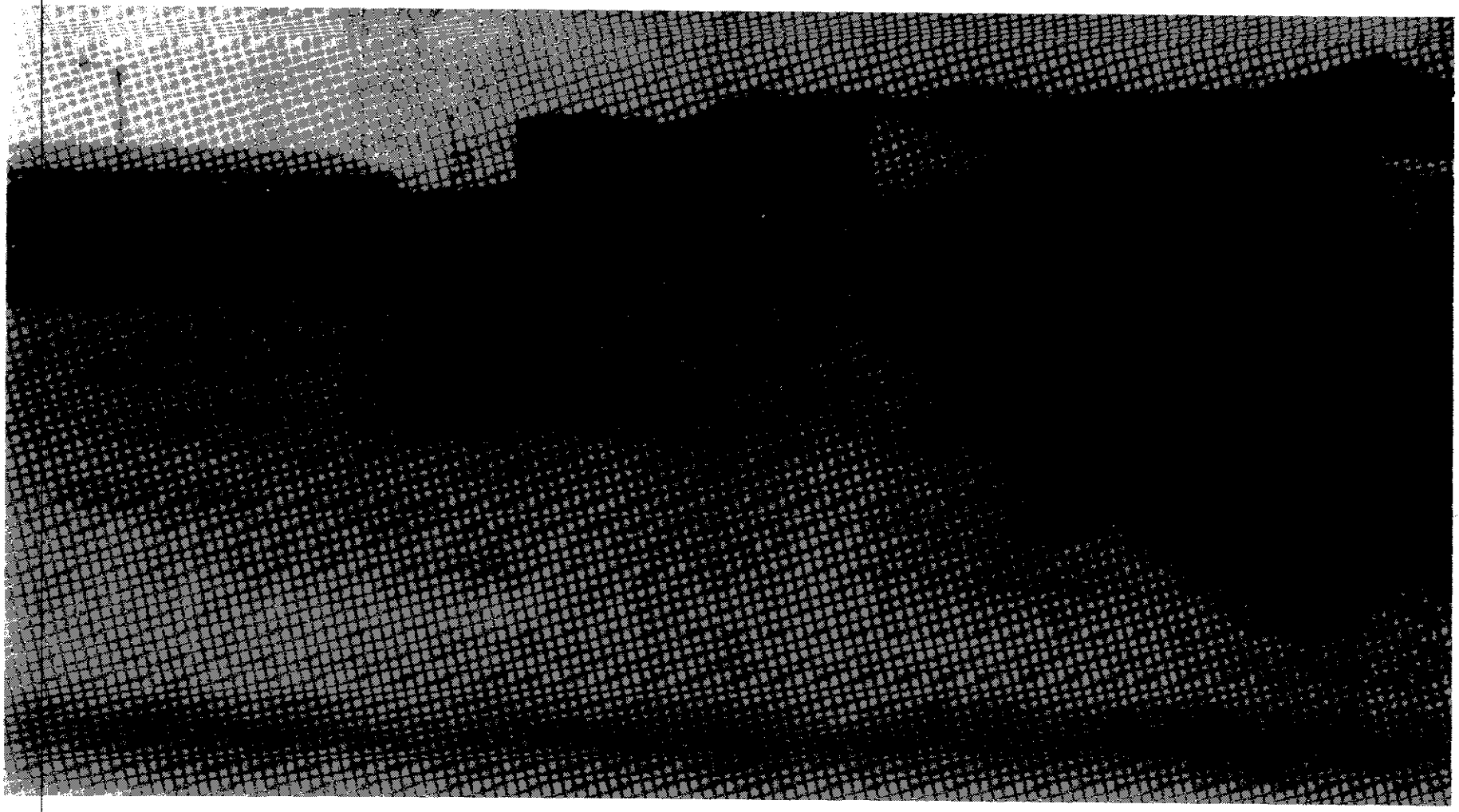


Figure MU-3. Side-loading dock at Mukho Railroad Station.

2249 meters (7,377 feet) of siding track that can hold a maximum of 173 railcars. It also has a main-line track, which must be kept clear for through trains. However, the extremely poor highway access, which is provided by a one-lane road with deteriorating pavement and an excessively steep grade, makes the station inaccessible to military unit equipment. In addition, the station has no cargo handling facilities or equipment. One switch locomotive operates at the station and handles all rail traffic to and from the port terminal.

The Mukho Railroad Station, also located near the port and in the central business district of Mukho, is used mainly as a passenger station and as a loading point for small quantities of agricultural products. The station is on the main-line track that runs north from Mukho to Kangnung. It has about 793 meters (2,601 feet) of siding track that can handle a maximum of 61 railcars. Not included in this trackage is the main-line track, which must be kept clear for through trains. Highway access from the port terminal to the station is along city streets that are adequate for military unit equipment, but extremely congested with urban vehicular and pedestrian traffic. The station has no switching locomotive or materials handling equipment. One covered, side-loading dock (fig MU-3) is available at the station and can accommodate three boxcars at a time. The dock has one opening in its rear side for van loading operations and is surrounded by a hard-packed soil area that provides about 1500 square meters (6.4 acres) for truck maneuvering at the dock. The station has no end-loading ramps and no spur tracks that could be expediently adapted with portable ramps to end-loading sites.

5. (U) Airports. There is no helipad at the port; however, if required, areas exist for helicopter operations. The closest airport to the port terminal is located in Kangnung, about 35 kilometers (22 miles) to the north. The runway is asphalt and is 2622 meters (8,600 feet) long and 36.6 meters (120 feet) wide. The airport is capable of supporting only intratheater aircraft.

B. (U) Mukho Port Terminal

1. (U) Berthing. The berths at Mukho Port (fig MU-2) were designed to support the local fishing industry and the import/export of bulk materials such as coal and cement. These berths were not intended to be used as general cargo berths. Further, their use in support of military operations would interfere with the current industrial mission of the port. However, there are berths available at this port that can accommodate some of the ship types that may be used to transport military equipment. The specific characteristics of the berths at the Port of Mukho are summarized in table MU-1. These characteristics will be analyzed to determine which ship types the port can accommodate. Wharves in Mukho Harbor are located along the northern, eastern, and western shores of the harbor. The wharves along the northern and eastern shores have shallow-draft berths that are used by fishing vessels. These wharves include fishing wharf 1 on the northern shore and fishing wharves 2 and 3 along the east breakwater. The highway access to all three wharves is extremely poor, so these wharves are not recommended for barge operations. Even if the highway access were improved, the draft at fishing wharf 1 is too shallow for barges and the apron width at fishing wharf 2 is too narrow to support unloading operations.

the coal pier must be dredged about every 3 years to remove silt that accumulates from a village runoff.

Seven anchorages with a 500-meter (1,640-foot) diameter and a quarantine anchorage with a 1000-meter (3,280-foot) diameter are located in the outer harbor, about 1200 meters (3,936 feet) east of the east breakwater. These anchorages are located in the open water of the Sea of Japan. While their general locations are known, the exact coordinates of their centers are not. The average draft of these anchorages varies between 13 and 20 meters (43 and 66 feet), which is adequate for all ship types considered in this study. Occasionally at the anchorages, easterly gales cause sudden heavy swells that are dangerous to and unstabilizing for anchored vessels. Strict caution must be exercised at all times, but especially from December through March. Dense fog of short duration frequently occurs from mid-May to mid-July, but visibility is seldom less than 450 meters (1,476 feet).

3. (U) Highway Access. Two gates, North and South, provide access to wharf 2 on the north and the Ferry Terminal on the south. Fishing wharves 1, 2, and 3 are accessible only via narrow (5-meter (16-foot) or less), two-lane city streets, which are congested with local vehicular and pedestrian traffic. These streets, many of which are unpaved, are unsuitable for the passage of military unit equipment.

Highway access via North Gate is provided by two-lane Korean 7, which runs through the central business district of Mukho City. This segment of Korean 7 is extremely congested with commercial and domestic vehicular traffic and pedestrians and is not recommended for use by military unit equipment.

Access through South Gate is provided by an unnamed road that intersects Korean 7, one of the main supply routes in this region of Korea. From this intersection, Korean 7 extends north and south along the entire eastern seaboard of Korea. It intersects with Superhighway 5 (Donghae Expressway) about 0.8 kilometer (0.5 mile) south of this intersection and Superhighway 4 about 35 kilometers (22 miles) north, in Kangnung. Superhighway 5 runs only between Mukho and Kangnung, where it also intersects with Superhighway 4. The unnamed access road is a four-lane concrete roadway from the port to a distance of 0.3 kilometer (0.2 mile), then it narrows to two lanes and remains as such until its intersection with Korean 7, a distance of 1.1 kilometer (0.7 mile). The four-lane section of this road slopes downward, with a grade of about 7 percent. Korean 7 is a rural, two-lane asphalt road, and Superhighways 4 and 5 are four-lane limited access routes. Therefore, all vehicular access to the port terminal should be through South Gate, which would provide military unit equipment with good highway access to the main supply routes.

4. (U) Rail Access. A main-line track of the Korean National Railroad runs north from Paeksan through Mukho to Kangnung, where it terminates, about 35 kilometers (22 miles) north of Mukho. A line branches from the main line in Pukpyong and rejoins it in Mukho. The Mukho-Hang Railroad Station, which handles all cars entering and exiting the port, is located on this branch line just south of the port terminal. Track spurs from the station provide access to Mukho port terminal and to the Ssang Yong Cement Company. The Mukho-Hang Station could be used as a classification yard or storage area for empty or loaded railcars supporting port operations. The station has about

B. (U) Mipo Port Terminal

1. (U) Berthing. The quays at Mipo Port (figs MI-2 and MI-3) support the shipbuilding and repair operations of two large commercial companies. The quays are located along the perimeters of Mipo and Junha Bays and are surrounded by a large industrial complex. Their current use, in support of the industrial mission of the port, would be interrupted if they were used for military operations. In Mipo Bay, quays 1, 3, 4, 5, and 7 have deep-draft berths suitable for some of the large US-flag vessels used in this study. Quay 1 has the greatest draft and therefore is most capable of accommodating vessels. Quays 2 and 11, in Junha Bay, also have deep-draft berths that are suitable for some oceangoing vessels. The remaining berths are best suited for the shallow-draft Korean-flag breakbulk vessels or barge operations.

The specific characteristics of the berths surrounding Mipo and Junha Bays are summarized in tables MI-1 and MI-2, respectively. These characteristics are analyzed to determine which ship types the port terminal can accommodate. As shown in the table, rail-mounted quay cranes are available at all of the quays, except for quays 5 and 7, in Mipo Bay, and quay 13, in Junha Bay.

Besides the marginal quays, Mipo has seven drydocks, which are listed in table MI-3. These drydocks could be flooded to provide additional berthing facilities. However, since their availability is uncertain, the docks are not included in this study as berthing sites.

a. (U) RORO Operations. Quays 1, 3, 4, 5, and 7 can support side-ramp RORO operations, although the draft at quay 7 is only adequate for the Comet. Slewed stern-ramp RORO operations from Maine-class vessels are possible only at quay 1, the only place where the draft is adequate. Quay 1 is also the only place where the draft requirement of T-AKR vessels can be met; this quay is long enough to accommodate three of these vessels at once. The only potential berth for straight stern-ramp RORO operations is at quay 5, where stern ramps could be positioned on the breakwater structure at the east end of the quay. In Junha Bay, quays 11 and 2 are the only ones that could support side-ramp RORO operations. None of the berths have adequate draft for the Maine-class vessel, which uses a slewed stern ramp to discharge. Quay 11 can only support the shallow-draft RORO vessels like the Comet. Straight stern-ramp RORO operations are not possible at any of the quays in Junha Bay.

b. (U) Breakbulk Operations. In Mipo Bay, US-flag breakbulk vessels can be berthed at quays 1, 4, 5, 7, and 3, although only the shallow-draft vessels can be accommodated at quays 4 and 7. A number of vessels could be accommodated at the other quays. The shallow-draft Korean-flag breakbulk vessels could be berthed at all of the quays in Mipo Bay. A total of 10 rail-mounted jib cranes with lifting capacities that range from 15 to 30 STON are available on quays 1, 4, 6, 8, 9, and 3. These cranes could be used to unload breakbulk cargo, but their capacities are inadequate for heavy lifts. The shipyard also has a number of heavy-lift mobile cranes, which are listed in table MI-4. The availability of this equipment for breakbulk discharge operations is uncertain and would depend on the

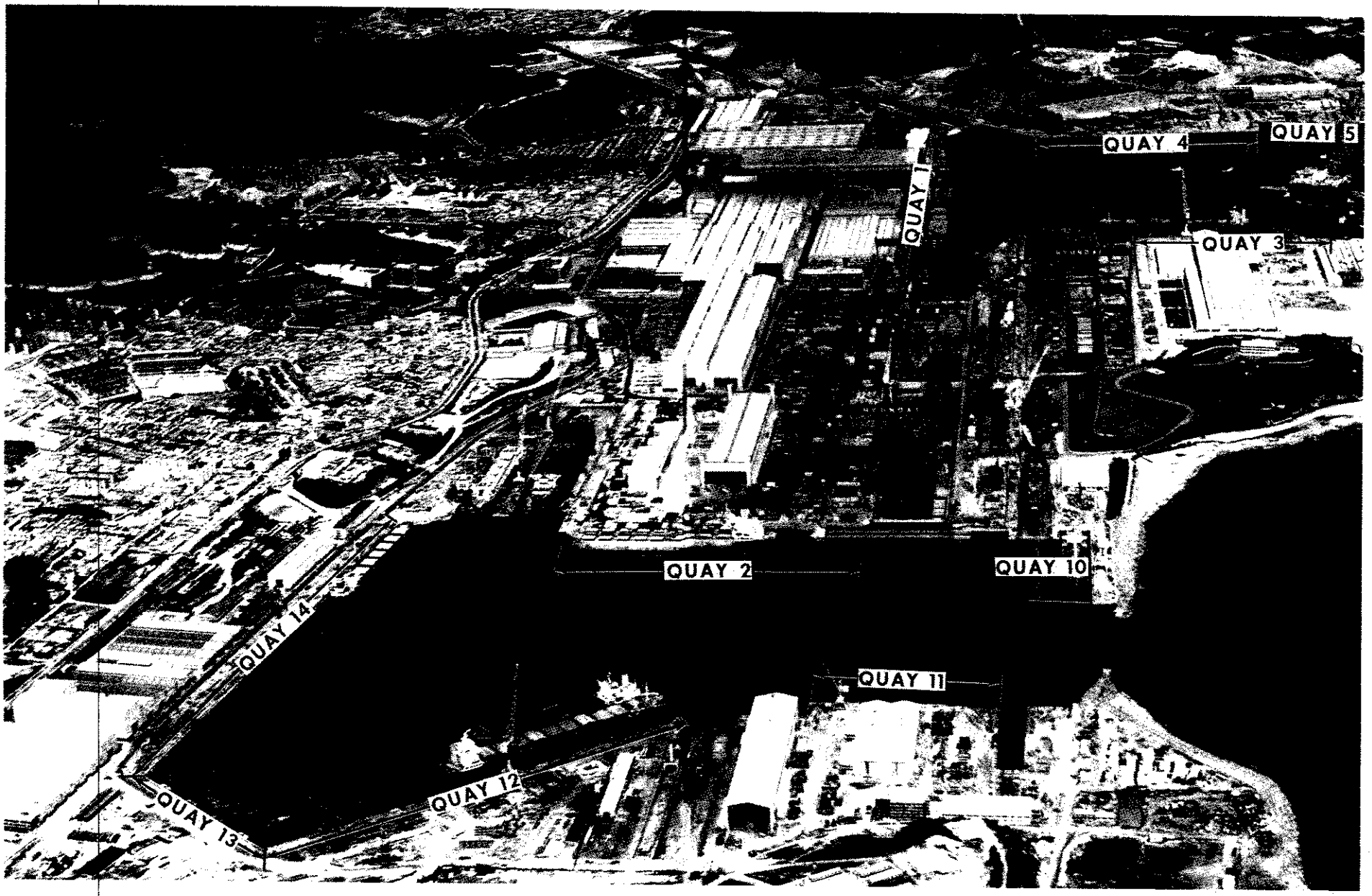


Figure MI-3. Aerial view of Mipo Port.

TABLE MI-1
PORT OF MIPO (MIPO BAY)
OPERATED BY: ULSAN DISTRICT MARITIME AND PORT ADMINISTRATION

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m (ft)	Individual Berth	Berth Length m (ft)	Approximate Apron Width m (ft)	MLW m (ft)	Approximate Apron Height Above MLW m (ft)	Deck* Strength psf	Services by Rail-Mounted Crane	Railcar Access to Apron
Quay 1	North, Center, South	Marginal	1000 (3,280)	North, Center, South	333 (1,092) 334 (1,096) 333 (1,092)	50 (164) 50 (164) 50 (164)	10.5 (34.4) 10.5 (34.4) 10.5 (34.4)	2.5 (8.2) 2.5 (8.2) 2.5 (8.2)	838 838 838	Yes Yes Yes	No No No
Quay 4	East, West	Marginal	400 (1,312)	East, West	200 (656) 200 (656)	Open Open	9.0 (29.5) 9.0 (29.5)	2.5 (8.2) 2.5 (8.2)	838 838	Yes Yes	No No
Quay 5	East, West	Marginal	310 (1,016)	East, West	155 (508) 155 (508)	Open Open	10.0 (32.8) 10.0 (32.8)	2.5 (8.2) 2.5 (8.2)	838 838	No No	No No
Quay 6		Marginal	190 (623)		190 (623)	20 (66)	8.0 (26.2)	2.5 (8.2)	838	Yes	No
Quay 7		Pier	200 (656)		200 (656)	20 (66)	9.0 (29.5)	2.5 (8.2)	838	No	No
Quay 8		Pier	210 (689)		210 (689)	20 (66)	8.0 (26.2)	2.5 (8.2)	838	Yes	No
Quay 9		Marginal	180 (590)		180 (590)	20 (66)	8.0 (26.2)	2.5 (8.2)	838	Yes	No
Quay 3		Marginal	300 (984)		300 (984)	Open	10.0 (32.8)	2.5 (8.2)	838	Yes	No

Rail-Mounted Cranes	Serving Berths	Roll-on/Roll-off Facilities	Serving Berths	Open Storage m^2	Open Storage acres	Serving Berths	Covered Storage	Serving Berths
15-STON, two 20-STON, two 30-STON	Quay 1	None	-	140 000	34.6	Quay 5	None	-
30-STON	Quay 4			60 000	14.8	Quay 4		
20-STON	Quay 6			120 000	29.6	Quay 1		
30-STON	Quay 8							
20-STON	Quay 9							
30-STON	Quay 3							

*Estimated values.

TABLE MI-2
PORT OF MIPO (JUNHA BAY)
OPERATED BY: ULSAN DISTRICT MARITIME AND PORT ADMINISTRATION

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m	(ft)	Individual Berth	Berth Length m	(ft)	Approximate Apron Width m	(ft)	MLW m	(ft)	Approximate Apron Height Above MLW m	(ft)	Deck* Strength psf	Services by Rail-Mounted Crane	Railcar Access to Apron
Quay 10		Marginal	120	(394)		120	(394)	20	(66)	9.5	(3.1)	2.5	(8.2)	838	Yes	No
Quay 11		Marginal	200	(656)		200	(656)	30	(98)	9.0	(29.5)	2.5	(8.2)	838	Yes	No
Quay 12	East, West	Marginal	430	(1,410)	East, West	215 155	(705) (705)	Open Open		7.0 7.0	(23.0) (23.0)	2.5 2.5	(8.2) (8.2)	838 838	No No	No No
Quay 13		Marginal	200	(656)		200	(656)			6.0	(19.7)	2.5	(8.2)	838	Yes	No
Quay 14	North, Center, South	Marginal	600	(1,968)	North, Center, South	200 200 200	(656) (656) (656)	50 50 50	(164) (164) (164)	8.0 8.0 8.0	(26.2) (26.2) (26.2)	2.5 2.5 2.5	(8.2) (8.2) (8.2)	838 838 838	Yes Yes Yes	No No No
Quay 2	East, West	Marginal	350	(1,148)	East, West	175 175	(574) (574)	Open Open		9.5 9.5	(31.2) (31.2)	2.5 2.5	(8.2) (8.2)	838 838	Yes Yes	No No

Rail-Mounted Cranes	Serving Berths	Roll-on/Roll-off Facilities	Serving Berths	Open Storage m^2	acres	Serving Berths	Covered Storage	Serving Berths
20-STON	Quay 10	None	-	80 000	19.8	Quay 2	None	-
30-STON	Quay 11							
30-STON	Quay 12			30 000	7.5	Quay 11		
two 30-STON	Quay 14			60 000	14.8	Quay 12		
30-STON	Quay 2			60 000	14.8	Quay 13		

*Estimated values.

TABLE MI-3
DRYDOCK FACILITIES

Dock Number	Length m	Length (ft)	Width m	Width (ft)	Depth m	Depth (ft)	Draft m	Draft (ft)	Lifting Equipment
1	400	(1,312)	80	(262)	12.7	41.7	10	(32.8)	450-STON 30-STON
2	500	(1,640)	80	(262)	12.7	41.7	10	(32.8)	450-STON, 30-STON
3	660	(2,165)	92	(302)	13.2	43.3	10	(32.8)	Two 450-STON, 150-STON, 80-STON, 30-STON
4	380	(1,246)	65	(213)	12.7	41.7	10	(32.8)	15-STON, 30-STON
5	262	(859)	65	(213)	12.0	39.4	10	(32.8)	Same as Dock 4
6	260	(853)	43	(141)	12.0	39.4	9	(29.5)	30-STON
7(encl)	170	(558)	25	(82)	12.0	39.4	9	(29.5)	None

alternate activities and lifting needs at the shipyards. However, based on the assumption that these cranes would be available, the shipyard has 13 cranes with capacities of 100 STON or greater that could be used to discharge breakbulk vessels.

In Junha Bay, US-flag breakbulk vessels could be berthed at quays 2 and 11, although only the shallowest vessels could be berthed at quay 11. Most of the Korean-flag breakbulk vessels could be berthed at all of the quays; however, vessel types 6 and 7, which are larger, could not be accommodated at all quays. A total of six rail-mounted quay cranes, with lifting capacities of 20 or 30 STON, are located on quays 2, 10, 11, 12, and 14. These cranes would be suitable for discharging breakbulk ships, although their capacities would not be adequate to lift heavier unit equipment such as tanks.

TABLE MI-4
MOBILE CRANES

Type	Capacity (STON)	Quantity
Track-mounted	150	1
	140	1
	110	3
	100	5
	80	1
	70	3
	60	1
Wheel-mounted	200	1
	140	1
	115	1
	75	5

c. (U) LASH and SEABEE Operations. LASH and SEABEE barges could be unloaded from all available berths; however, to maximize the port's capacity, deep-draft berths should be reserved for oceangoing vessels, and barges should be discharged at shallow-draft berths whenever possible. Therefore, in Mipo Bay, quays 6, 8, and 9 would provide suitable berths for either type of barge. In Junha Bay, quays 10, 12, 13, and 14 would provide additional berths for barges. The combined quays in both bays are adequate for 100 LASH or 63 SEABEE lighters. Except for quay 13, rail-mounted quay cranes with lifting capacities of 20 or 30 STON are available on all quays. Each of these cranes could be used to establish a loading position that would provide adequate quayage for two additional lighters. The port also maintains 23 mobile cranes having capacities of 60 STON or greater that may be available to discharge barges. An additional

unloading position would be established by each mobile crane and would also provide adequate quayage for two lighters. Lighter storage would best be accomplished adjacent to one of the quays recommended for their operation. This would only slightly reduce the quayage available for barge discharge while providing a convenient and secure staging area. The port has two tugboats that could provide towing service. LASH and SEABEE vessels can be anchored only at the anchorages in Ulsan Harbor. Although these anchorages are sometimes subjected to rough seas from the south, they are sufficiently sheltered so that barge operations should be possible most of the time.

d. (U) Container Operations. None of the quays at Mipo Port were designed or intended to be used as berths for container ships. However, quays 1, 3, 4, and 5 in Mipo Bay and quay 2 in Junha Bay could accommodate container ships. Except for quay 1, the drafts at the quays are restrictive for some of the vessels reviewed in this study. The port does not have any container cranes; however, if the mobile cranes at the port were available, a total of 22 have capacities adequate to handle containers. In addition, on all quays, except quay 5, are quay cranes that could be equipped with the proper lifting gear and used to discharge container ships. Although the port has abundant open storage space that could be used for staging containers, current use of these areas would have to be suspended to make the space available. The mobile cranes could be used in the storage areas to load and unload containers from truck chassis. Containers could be driven to the storage site and temporarily stored, or they could directly exit the port on the same chassis. So, while no quays at the terminal are designed for container operations, container ships could be accommodated at selected berths.

e. (U) Summary of Berth Availability. The berths available for different types of US-flag and Korean-flag vessels are summarized, respectively, in tables MI-5 and MI-6 for Mipo Bay and in tables MI-7 and MI-8 for Junha Bay. The tables show, for each type of vessel, the number each berth could accommodate or the characteristics that make the berth unsuitable.

As shown in the tables, quays 1, 3, 4, 5, and 7 in Mipo Bay and quays 2 and 11 in Junha Bay provide the best berths for large oceangoing vessels. Quay cranes are available on most of the quays and could support breakbulk and container operations. Side-ramp RORO operations are possible at all of these quays; but, because of the draft limitations of the quays, slewed stern-ramp RORO operations from Maine-class vessels are possible only at quay 1. Straight stern-ramp RORO operations may be possible from quay 5. The T-AKR vessel can be berthed only at quay 1, which can accommodate three of the vessels. Quays 6, 8, and 9 in Mipo Bay and quays 10, 12, 13, and 14 in Junha Bay provide suitable berths for barges and can also accommodate the shallow-draft Korean-flag breakbulk vessels. The LASH and SEABEE vessels cannot be accommodated in either bay and must be anchored in Ulsan Bay while barges are being loaded or discharged.

f. (U) Safety Considerations. Mipo Port is located adjacent to Chonha City, which has a population of about 35,000 within 2000 meters of the quays. The quay facilities in both Mipo and Junha Bays are completely surrounded by industrial complexes that support the shipbuilding and repair activities of Hyundai Heavy

TABLE MI-5
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF MIPO (MIPO BAY)

US-Flag Ship Type	Berths							
	Quay 1	Quay 4	Quay 5	Quay 6	Quay 7	Quay 8	Quay 9	Quay 3
RORO								
GTS Callaghan	4	1	1	a,c	c	a,c	a,c	1
USNS Comet	6	2	2	a	1	a	a	1
Maine-class	4	a	a	a,c	a,c	a	a,c	a
Breakbulk								
C4 Mariner-class	5	a	1	a	a	a	a	1
C4-5-58a	5	a	1	a	a	a	a	1
C3-5-38a	6	2	2	a	1	a	a	2
C3-5-33a	6	2	2	a	1	a	a	2
Barge								
LASH C8-5-81B	a	a	a	a,c	a,c	a,c	a,c	a
LASH barge	53	21	16	10	10	11	9	16
SEABEE C8-5-82A	a	a	a	a,c	a,c	a,c	a,c	a
SEABEE barge	33	13	10	6	6	7	6	10
Seatrain								
Georgia-class	5	2	1	a	1	a	a	1
Puerto-class	5	2	1	a	1	a	a	1
Container								
C6-5-1W	4	1	1	a,c	c	a	a,c	1
C7-5-68E	4	a	1	a,c	a,c	a,c	a,c	1
C8-S-85B	4	a	a	a,c	a,c	a	a,c	a
RORO/Container								
C5-5-78	5	a	a	a	a	a	a,c	a
T-AKR (SL-7)	3	a	a	a,c	a,c	a,c	a,c	a
Breakbulk/Container								
C5-5-37E	5	a	1	a	a	a	a,c	1
C4-5-10	5	a	1	a	a	a	a	1

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container-handling equipment.
f - Inadequate draft for barge ship at berth; however, ship could be unloaded from anchorage.

TABLE MI-6
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF MIPO (MIPO BAY)

Korean-Flag Ship Type	Berths							
	Quay 1	Quay 4	Quay 5	Quay 6	Quay 7	Quay 8	Quay 9	Quay 3
Breakbulk								
Type 1	28	11	8	5	5	5	5	8
Type 2	13	5	4	2	2	2	2	4
Type 3	13	5	4	2	2	2	2	3
Type 4	11	4	3	2	2	2	2	3
Type 5	11	4	3	2	2	2	2	3
Type 6	9	3	2	1	1	1	1	2
Type 7	7	3	2	1	1	1	1	2

TABLE MI-7
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF MIPO (JUNHA BAY)

US-Flag Ship Type	Berths					
	Quay 10	Quay 11	Quay 12	Quay 13	Quay 14	Quay 2
RORO						
GTS Callaghan	c	c	a	a,c	a	1
USNS Comet	c	1	a	a	a	2
Maine-class	a,c	a,c	a	a,c	a	a
Breakbulk						
C4 Mariner-class	c	a	a	a	a	2
C4-5-58a	c	a	a	a	a	2
C3-5-38a	c	1	a	a	a	2
C3-5-33a	c	1	a	a	a	2
Barge						
LASH C8-5-81B	a,c	a,c	a	a,c	a	a
LASH barge	6	10	22	10	32	18
SEABEE C8-5-82A	a,c	a,c	a	a,c	a	a
SEABEE barge	4	6	14	6	20	11
Seatrain						
Georgia-class	c	1	a	a	a	2
Puerto-class	c	1	a	a	a	2
Container						
C6-5-1W	c	c	a	a,c	a	1
C7-5-68E	a,c	a,c	a	a,c	a	a
C8-5-85B	a,c	a,c	a	a,c	a	a
RORO/Container						
C5-5-78	a,c	a	a	a	a	a
T-AKR (SL-7)	a,c	a,c	a	a,c	a	a
Breakbulk/Container						
C5-5-37E	c	a	a	a	a	1
C4-5-10	a,c	a	a	a	a	a

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length..
d - No stern-ramp facilities.
e - No container-handling equipment.
f - Inadequate draft for barge ship at berth; however, ship could be unloaded from anchorage.

TABLE MI-8
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF MIPO (JUNHA BAY)

Korean-Flag Ship Type	Berths					
	Quay 10	Quay 11	Quay 12	Quay 13	Quay 14	Quay 2
Breakbulk						
Type 1	3	5	12	5	17	9
Type 2	1	2	5	2	8	4
Type 3	1	2	5	2	7	4
Type 4	1	2	4	2	6	4
Type 5	1	2	4	2	6	4
Type 6	1	1	3	a	5	3
Type 7	6	1	a	a	4	2

a - Inadequate draft at berth.

Industries (HHI) and Hyundai Mipo Dockyard (HMD), respectively. The industrial complex occupies all area within about 500 meters (1,640 feet) of the quays. POL storage tanks are scattered throughout the complex, but not in great quantities. Therefore, the population of Chonha, as well as the facilities of HHI and HMD, falls well within the 2500-meter (8,200-foot) quantity-distance arc established for breakbulk ammunition ships and the 2800-meter (9,184-foot) arc established for container ships.

2. (U) Materials Handling Equipment. Besides the 23 mobile cranes owned and operated by Hyundai, the port has 45 forklifts - five 15-STON, fifteen 10-STON, fifteen 7-STON, and ten 5-STON. Their availability for cargo handling operations is uncertain and would be subject to the needs of the ongoing industrial mission at the port.

3. (U) Storage Areas

a. (U) Open Storage. The port has a total of 550 000 square meters (135.9 acres) of open storage space located throughout the shipyard adjacent to the quays. This storage currently supports the industrial missions of HHI and HMD operations, which would have to be suspended before the area could be used for military unit equipment staging. The area would also have to be cleared. There is good highway access but none for rail. The location, size, and surface condition of these areas are shown in table MI-9.

TABLE MI-9
OPEN STORAGE

Location	Size m^2	Size Acres	Surface
Adjacent to quay 5	140 000	34.6	Concrete
Adjacent to quay 4	60 000	14.8	Concrete
West of drydock 1	60 000	14.8	Concrete
West of drydock 2	40 000	9.9	Concrete
East of drydock 4	40 000	9.9	Concrete
North of drydock 4	60 000	14.8	Concrete
Adjacent to quay 11	30 000	7.5	Concrete
Adjacent to quay 12	60 000	14.8	Concrete
Adjacent to quay 13	60 000	14.8	Concrete
Total	550 000	135.9	

b. (U) Covered Storage. The port has no transit sheds on the quays, or buildings dedicated as warehouses. Port officials indicated that 10 buildings, with 700 000 square meters (7,531,339 square feet) of floor space, could be made available for covered storage, but that the current shipbuilding and repair activities performed within would have to be suspended. Since these buildings all support various industrial processes, their availability is uncertain. Further details on these buildings and a breakdown of their total and individual areas were not available.

c. (U) POL Storage. The port has a small unspecified quantity of POL storage, which is used to meet the port's industrial needs.

4. (U) Rail Operations. Rail loading operations are not possible at Mipo Port because of no rail access. The rail facilities closest to the port are located at the Ulsan Railroad Station, on the east side of Ulsan City. As discussed under "Rail Access," the station has no end ramps, but portable ramps or mobile cranes could be used to load flatcars. The station has no cranes or other materials handling equipment, so this equipment would have to be provided from external sources. The station has a side-loading dock, so boxcars could be loaded if forklifts are made available. The station has five sidings that could handle a maximum of 80 railcars.

5. (U) Truck Operations. The road network at the port terminal and the highway access between the terminal and the main supply route are suitable for military unit equipment. The port has no truck docks or end-loading ramps, so portable equipment or mobile cranes would be required for truck-loading operations. The port has 23 mobile cranes that may be available to lift nonroadable equipment onto flatbed trucks. The terminal also has several large, open storage areas adjacent to the wharves and at other remote areas where trucks could be loaded. Cranes discharging breakbulk vessels and barges could load the equipment directly onto trucks positioned on the quay aprons

adjacent to the ship. This procedure would prevent the equipment from being handled twice. However, cargo to be loaded into vans would be transported to an open area where portable ramps and forklifts would be required to load the cargo into vans. The port has 45 forklifts, of which 25 have capacities suitable for loading trucks. These forklifts may be available, but the port does not have the portable ramps required for loading trucks. However, if required, the shipyard has ample resources to manufacture any number of suitable ramps.

6. (U) Security. The port is surrounded by a lighted concrete wall, which runs along Local 981 and separates the port from the residential and commercial developments of Chonha. To the north and south, the terminal is bordered by mountainous terrain. The port maintains an adequate security force and guards are posted throughout the day at all access gates. All vehicles are stopped and the drivers are questioned before access to the terminal is permitted. Patrols are also conducted throughout the terminal.

C. (U) Support Services

1. (U) Pilotage. Pilotage is mandatory for entrance into the Port of Mipo. Four pilots and one pilot boat are available to provide service throughout the day. These pilots also serve the Ports of Ulsan, Onsan, and Yompo and usually board at the quarantine anchorage located in the lower section of Ulsan Bay. Two additional pilots are expected to be hired in 1984.

2. (U) Harbor Craft. Two berthing tugboats, both rated at 2,000 horsepower, are available for use at Mipo Port.

3. (U) Stevedores. About 770 stevedores are registered with the Ulsan Branch of the National Docker's Union. These stevedores, which also serve the Ports of Ulsan, Onsan, and Yompo, would be available for cargo operations at the Port of Mipo. Gang size varies according to the type of cargo, but the stevedores are divided into 35 groups, with 22 stevedores per group. Each group consists of two teams of 11 stevedores. Stevedore companies located in Ulsan are:

a. Daewon Express Company, Ltd.

b. Dongbang Forwarding Company, Ltd.

c. Global Enterprises Company, Ltd.

d. Korea Express Company, Ltd.

e. A-Nam Transportation Company, Ltd.

f. Hyopsin Heavylift Company, Ltd.

g. Sambo Transportation Company, Ltd.

D. (U) Future Development

The port has no development planned for the immediate future.

E. (U) Summary

The Port of Mipo is an industrial port, which supports the ship repair and rebuilding activities of Hyundai Heavy Industries and Hyundai Mipo Dockyard. Quays 1, 3, 4, 5, and 7 in Mipo Bay and quays 2 and

11 in Junha Bay provide the best berths for large ocean-going vessels; however, the drafts of some of the quays are restrictive for certain US-flag vessels reviewed in this study. Quays 6, 8, and 9 in Mipo Bay and quays 10, 12, 13, and 14 in Junha Bay provide suitable berths for barge operations and can also accommodate many of the Korean shallow-draft breakbulk vessels. None of the quays are designed for container operations, but the deep-draft berths could accommodate container ships. Rail-mounted quay cranes with capacities between 15 and 30 STON are available on all quays, except quays 5 and 7 in Mipo Bay and quay 13 in Junha Bay. These cranes could support discharge operations, but their capacities are inadequate for heavy lifts. Side-ramp RORO operations are possible at all of the deep-draft berths, but draft for Maine-class vessels, which are discharged using slewed stern ramps, is adequate only at quay 1. Straight stern-ramp RORO operations may be possible from quay 5 in Mipo Bay. Quay 1 is long enough to handle three T-AKR vessels. None of the quays can accommodate LASH or SEABEE vessels. Based on the shipping capabilities of these quays, individual berth rankings have been computed in tables MI-10 and MI-11 for various shipping operations at selected berths. The rankings indicate the berths that are best suited for each shipping operation and the relative suitability of the other selected berths.

The port has no rail access, but rail facilities are available close to the port, at the Ulsan Railroad Station. If support equipment were provided, this station could be developed as a low-volume railcar loading site; however, at present, the station has no end-loading ramps or materials handling equipment to support railcar loading operations.

Highway access from the terminal to the main supply route, Korean 7, is suitable for military unit equipment. Terminal roads leading from the five access gates are in excellent condition and provide suitable access to the quays. The terminal has no truck docks or end-loading ramps, but 23 mobile cranes, which may be available at the port, could be used to load flatbed trucks. The port also has 25 forklifts with capacities suitable for loading trucks. Since truck docks are not available, portable ramps would be required if forklifts are used to load vans.

The terminal has a total of 550 000 square meters (135.9 acres) of open storage space, but no POL storage or warehouses for covered storage. Port officials indicated that 700 000 square meters (7,531,339 square feet) of building space, currently used to support industrial activities, could be used for covered storage if the current activities in the buildings were suspended. Pilot service is available and mandatory, and the port is serviced by two tugboats and about 770 stevedores. The stevedores also serve the Ports of Ulsan, Onsan, and Yompo.

The port is located on the eastern shore of a mountainous peninsula adjacent to Chonha City. The city and port are surrounded by mountains and isolated from the other activities on the peninsula. The population of the city is 35,000; it lies within 2000 meters (6,560 feet) of the quays. The HHI and HMD shipbuilding and repair facilities occupy all of the area within 500 meters (1,640 feet) of the quays. Therefore, these activities and the population of Chonha lie within the 2500-meter (8,200-foot) quantity-distance arc established for a notional breakbulk ammunition ship and the 2800-meter (9,184-foot) arc established for a notional container ship.

TABLE MI-10
INDIVIDUAL BERTH RATING (BB/RORO)

Ideal Berth Factors	Berths								
	Mipo Bay							Junha Bay	
	Quay 1								
	North	Center	South	Quay 3	Quay 4	Quay 5	Quay 7	Quay 2	Quay 11
Length	20	20	20	20	20	20	16	20	16
Alongside depth	18	18	18	18	14	18	14	16	14
Backup area	10	10	10	0	10	10	0	10	8
Apron width	20/20	20/20	20/20	20/20	20/20	20/20	20/20	20/20	20/20
Transit shed	O/NR	O/NR	O/NR	O/NR	O/NR	O/NR	O/NR	O/NR	O/NR
Distribution shed	O/NR	O/NR	O/NR	O/NR	O/NR	O/NR	O/NR	O/NR	O/NR
Apron tracks	0	0	0	0	0	0	0	0	0
Deck loading	10	10	10	10	10	10	10	10	10
Heavy-lift cranes	7	7	7	7	7	0	0	7	7
Berth type	10	10	10	10	10	10	8	10	10
Truck tailgate	0	0	0	0	0	0	0	0	0
Rail end ramp	0	0	0	0	0	0	0	0	0
Truck access	5	5	5	5	5	5	5	5	5
Ship service facilities	5	5	5	5	5	5	5	5	5
Conditional age of facility	10	10	10	10	10	10	10	10	10
RORO stern ramp	NR/5	NR/5	NR/5	NR/5	NR/5	NR/5	NR/5	NR/5	NR/5
Total Points	115/120	115/120	115/120	105/110	111/116	108/113	88/93	113/118	105/110
Ranking	1/1	1/1	1/1	5/5	3/3	4/4	6/6	2/2	5/5

NR- Not Rated

TABLE MI-11
INDIVIDUAL BERTH RATING (BARGE)

Ideal Berth Factors	Berths						
	Mipo Bay			Junha Bay			
	Quay 6	Quay 8	Quay 9	Quay 10	Quay 12	Quay 13	Quay 14
Length	10	10	10	8	10	10	10
Alongside depth	10	10	10	10	10	9	10
Backup area	0	0	0	0	10	10	0
Apron width	10	10	10	10	10	10	10
Consolidation shed	0	0	0	0	0	0	0
Apron tracks	0	0	0	0	0	0	0
Anchorage diameter	10	10	10	10	10	10	10
Conditional age of facility	10	10	10	10	10	10	10
Deck loading	10	10	10	10	10	10	10
Heavy-lift cranes	5	7	5	5	7	0	7
Berth type	5	5	5	5	10	10	10
Truck tailgate	0	0	0	0	0	0	0
Rail end ramp	0	0	0	0	0	0	0
Truck access	5	5	5	5	5	5	5
Tug availability	5	5	5	5	5	5	5
Barge lay area	10	10	10	10	10	10	10
Total Points	90	92	90	88	107	99	97
Ranking	5	4	5	6	1	2	3

(U) PORT OF YOMPO

A. (U) General Description

1. (U) Location and General Uses. The Port of Yompo (fig YO-1) is located on the eastern seacoast of Korea, about 14 kilometers (8.7 miles) east of Ulsan. This port, situated on the west coast of the peninsula that forms the east shore of Ulsan Harbor, is about 77 kilometers (48 miles) north of Pusan and 429 kilometers (267 miles) southeast of Seoul. The port is under the jurisdiction of the Ulsan District Maritime and Port Administration, but its facilities are privately owned and operated by Hyundai Mipo Dockyard Company, Ltd (HMD), and the Inchon Steel Mill. HMD was formed as a joint venture between Hyundai Shipbuilding and Heavy Industrial Company, Ltd, which is the largest shipbuilder in Korea, and Kawasaki Heavy Industrial, Ltd (KHI) of Japan. The HMD facilities in Yompo were constructed to supplement the HMD facilities at the Port of Mipo. The HMD facilities in the Port of Mipo, which comprise half of the port, are described under "Port of Mipo." Many of the ship repair and rebuilding activities previously accomplished at the Mipo facilities are now performed at the Yompo facilities. Activities at the Inchon Steel Mill include the assembly of large marine structures, such as offshore oil platforms, and the construction of other large steel structures. HMD uses wharves 1, 2, and 3 and the Middle East wharf, and the Inchon Steel Mill uses wharves 4 and 5 (fig YO-2). The steel mill will also occupy the new wharf, wharf 6, when completed.

2. (U) Harbor. The Yompo terminal is located on the eastern shore of Ulsan Bay, which is described in detail under "Port of Ulsan."

3. (U) Highway Access. HMD has two gates, Main and South, which provide vehicle access from the terminal to an unnamed port access road. The access road was being graded during the field visit and construction of this two-lane road was scheduled to be completed by the end of 1983. Adequate right-of-way is available for a four-lane road, which is planned for sometime in the future. When completed, this road will become part of a road network that will encircle the entire peninsula, thereby permitting easy access from the Port of Yompo to the Port of Mipo, located on the east coast of this peninsula.

The unnamed access road intersects Local Route 1058 about 2.6 kilometers (1.6 miles) north of Main Gate or 4.1 kilometers (2.6 miles) north of South Gate. Local 1058, which consists of two- and four-lane sections, runs northwest 6.1 kilometers (3.8 miles) to a major intersection located east of Ulsan. At that intersection, the road to the right leads north 3.1 kilometers (1.9 miles) and intersects with Korean Route 7. The through street continues west 5 kilometers (3.1 miles) and intersects with Korean 7 in Ulsan. Korean 7, the main supply route in this region of Korea, runs north and south along the entire eastern seaboard of Korea. The access roads to Korean 7 are suitable for military unit equipment and supply trucks. None of the access roads from the terminal have vertical clearance obstructions, so vehicle height is not a concern. About 6 kilometers (3.7 miles) south of Ulsan, Korean 7 intersects Superhighway 8, a four-lane limited access highway. Superhighway 8 runs west about 14 kilometers (8.7 miles) and intersects Superhighway 1, a four-lane limited access highway that runs north to Seoul and south to Pusan.

4. (U) Rail Access. Trackage from the Korean National Railroad does not extend to the port terminal, so the port has no rail access. The trackage nearest the port is at the Ulsan Railroad Station, which is located on the east side of Ulsan City, about 13.7 kilometers (8.5 miles) west of the port. The station, located on a main line of the Korean Railroad, serves as a passenger terminal. The station has five sidings that have a maximum capacity of 80 railcars, but no facilities that could be used to load military unit equipment or general cargo. Thus, all support equipment such as heavy-lift cranes, portable ramps, and materials handling equipment would have to be supplied from external sources.

5. (U) Airports. A helipad area is located about 10.8 kilometers (6.7 miles) north of the terminal. Highway access to the helipad is poor. Open area is also available at the terminal to accommodate helicopter operations. The closest airports are located in Pohang, about 90 kilometers (56 miles) north of the port, and in Pusan, 77 kilometers (948 miles) south of the port. Pohang Airport has a concrete runway that is 2134 meters (7,000 feet) long and 46 meters (150 feet) wide. The airport is capable of supporting intertheater aircraft. Pusan Airport has an asphalt runway that is 2012 meters (6,600 feet) long and 46 meters (150 feet) wide. The runway is capable of supporting only intratheater aircraft.

B. (U) Yompo Port Terminal

1. (U) Berthing. The wharves at Yompo Port Terminal (fig YO-2) are owned and operated by two large industries, Hyundai Mipo Drydock Company and Inchon Steel Mill. HMD uses wharves 1, 2, and 3 and the Middle East wharf (fig YO-3) to support ship repair and rebuilding activities, and the steel mill, which constructs large marine structures, uses wharves 4 and 5. The steel mill will be using the new wharf, wharf 6, once construction is completed. The current use of the wharves, which is to support the industrial mission of the port, would be interrupted if the wharves were used for military operations.

Wharves 1, 2, 3 (north and center), and 4 (south) have relatively shallow draft berths and cannot accommodate the large oceangoing US-flag vessels. However, the wharves could be used by the shallow-draft Korean-flag breakbulk vessels or for barge operations. Wharves 3 (south), 4 (north), and 5 (west, center, and east) and the Middle East wharf can all accommodate a variety of deep-draft vessels.

The specific characteristics of the berths at Yompo terminal are summarized in table YO-1. These characteristics are analyzed to determine which types of ships the port terminal can accommodate. The wharves have a total of nine wharf cranes equipped with hooks that could assist in discharging ships. All but one of the cranes are rail mounted. The location, type, and quantity of the wharf cranes available at the port are listed in table YO-2. The jib cranes have a maximum reach of 70 meters (230 feet).

Besides the marginal wharves, Yompo has four drydocks, which are outlined in table YO-3. Although these docks could be flooded to provide additional berthing facilities, they were not included in this study because their availability is uncertain.

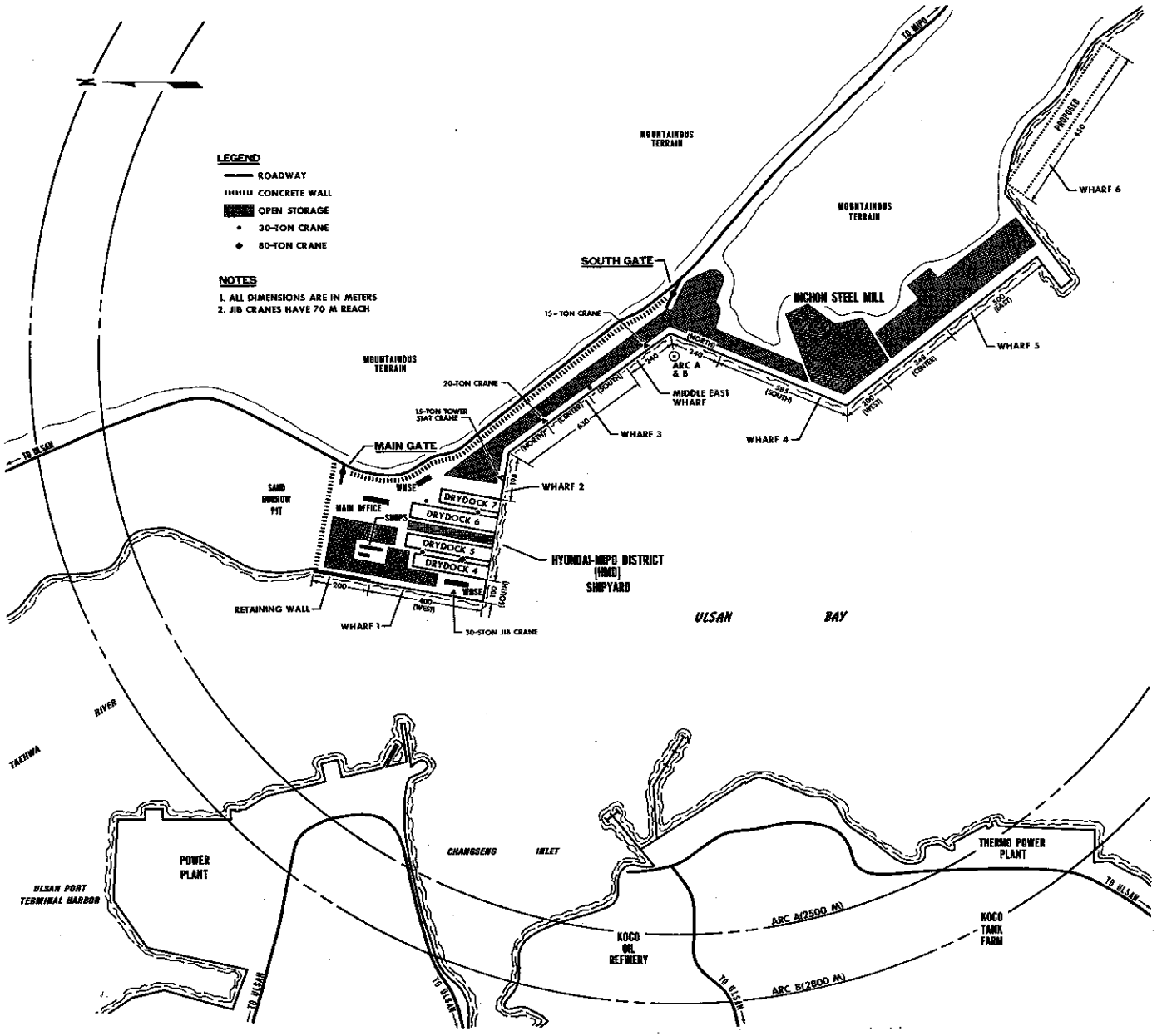


Figure YO-2. Site map.

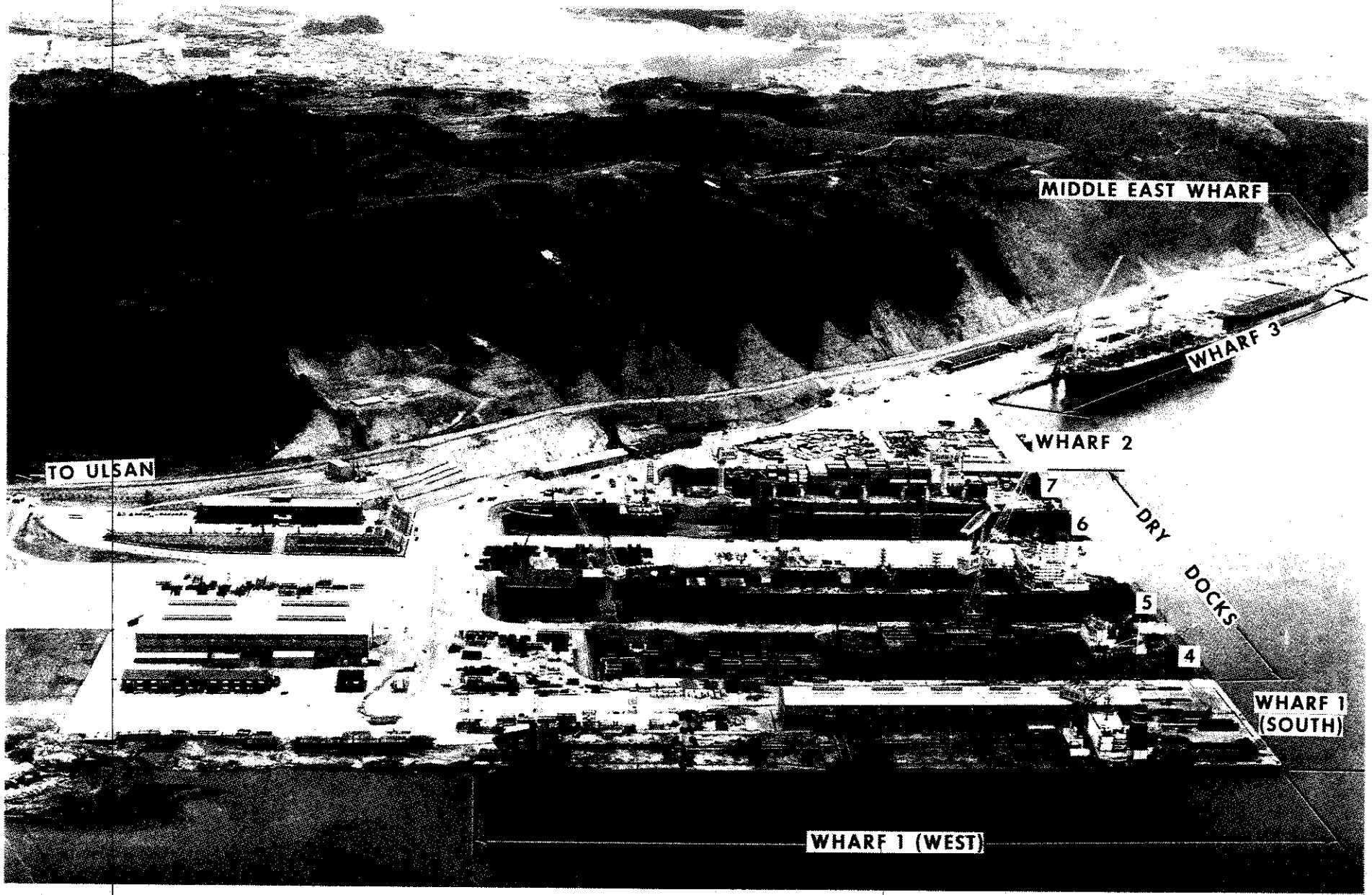


Figure YO-3. Aerial view of Yompo Terminal.

TABLE YO-1
PORT OF YOMPO
OPERATED BY: ULSAN DISTRICT MARITIME AND PORT ADMINISTRATION

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m	(ft)	Individual Berth	Berth Length m	(ft)	Approximate Apron Width (ft)	MLW m	(ft)	Approximate Apron Height Above MLW m	(ft)	Deck Strength (psf)	Serviced by Rail-Mounted Crane	Rail Access to Apron
Wharf 1	West,	Marginal	400	(1,312)	West	400	(1,312)	Open	7.0	(23.0)	2.0	(6.56)	838	Yes	No
	South				South	100	(328)	Open	7.5	(24.6)	2.0	(6.56)	838	No	No
Wharf 2	1	Marginal	198	(649)	1	198	(649)	Open	6.8	(22.3)	2.0	(6.56)	838	No	No
Wharf 3	North,	Marginal	630	(2,066)	North	210	(689)	Open	7.0	(23.0)	2.0	(6.56)	838	Yes	No
	Center,				Center	210	(689)	Open	8.0	(26.2)	2.0	(6.56)	838	Yes	No
	South				South	210	(689)	Open	9.0	(29.5)	2.0	(6.56)	838	Yes	No
Middle East Wharf	1	Marginal	240	(787)	1	240	(787)	Open	11.0	(36.1)	2.0	(6.56)	838	Yes	No
Wharf 4	North,	Marginal	825	(2,706)	North	240	(787)	Open	10.0	(32.8)	2.0	(6.56)	838	Yes	No
	South				South	585	(1,919)	Open	7.0	(23.0)	2.0	(6.56)	838	Yes	No
Wharf 5	West,	Marginal	1048	(3,438)	West	200	(656)	Open	10.0	(32.8)	2.0	(6.56)	838	Yes	No
	Center,				Center	348	(1,142)	Open	8.5	(27.9)	2.0	(6.56)	838	Yes	No
	East				East	500	(1,640)	Open	10.0	(32.8)	2.0	(6.56)	838	Yes	No

Rail-Mounted Cranes	Serving Berths	Roll-on/Roll-off Facilities	Serving Berths	Open Storage m^2	(acres)	Serving Berths	Covered Storage m^2	(ft^2)	Serving Berths
30-STON, jib	Wharf 1	None	-	20 000	(4.9)	All	975	(10,490)	All
15-STON, stiff-leg	Wharf 2			15 000	(3.7)	All	4140	(44,542)	Wharf 1
30-STON, jib	Wharf 3			15 000	(3.7)	Wharf 1			
20-STON, jib				7 600	(1.9)	Drydocks 5 & 6			
15-STON, jib	Middle East Wharf			17 250	(4.3)	Wharf 2			
20-STON, jib	Wharf 4			34 800	(8.6)	Wharf 3			
				65 000	(16.1)	Wharf 4			
20-STON, jib	Wharf 5			210 000	(51.9)	Wharf 5			

*Estimated values.

TABLE YO-2
WHARF CRANES

Location	Type	Capacity (STON)	Quantity
Wharf 1	Jib	30	1
Wharf 2	Stiff-leg	15	1
Wharf 3	Jib	20	1
	Jib	30	1
Middle East wharf	Jib	15	1
Wharf 4	Jib	20	2
Wharf 5	Jib	20	2

TABLE YO-3
DRYDOCK FACILITIES

Dock	Length m (ft)	Width m (ft)	Dock Depth m (ft)	Entrance Depth m (ft)	Crane Service
4	330 (1,082)	65 (213)	12.5 (41)	10 (32.8)	Jib, 30- and 80-STON
5	380 (1,246)	65 (213)	12.5 (41)	10 (32.8)	Same as above
6	380 (1,246)	65 (213)	12.5 (41)	10 (32.8)	Jib (two), 30-STON
7	265 (869)	65 (213)	12.5 (41)	10 (32.8)	Same as above

a. (U) RORO Operations. Wharves 3 (south), 4 (north), and 5 (west, center, and east) and the Middle East wharf have some RORO capability. Since aprons at these wharves are open, side-ramp RORO operations are possible; however, because of draft limitations, the Maine-class RORO vessels with slewed stern ramps cannot be berthed at wharf 3 (south), 4 (north), or 5 (east and west). The draft at berth 5 (west) is deep enough only for the Comet.

Although no facilities are available for straight stern-ramp operations, these operations may be possible. A ship berthed at the Middle East wharf could rest its stern ramp on the apron of wharf 4 (north) and a ship berthed at wharf 5 (east) could rest its stern ramp on the jetty, which is located at the southeast end of the wharf. The apron widths at the Middle East wharf and wharf 5 (east) are adequate for side-ramp RORO operations, so simultaneous side-ramp and stern-ramp discharge of the ship would be possible at these sites. The feasibility of this operation would depend on the specific height of the stern ramp relative to the height of the dock. None of the berths can accommodate the T-AKR vessels's length and draft requirements.

b. (U) Breakbulk Operations. US-flag breakbulk vessels can be berthed at wharves 3 (south), 4 (north), and 5 (west, center, and east) and the Middle East wharf. The shallow-draft Korean-flag breakbulk vessels can be berthed at all of the wharves. Rail-mounted jib cranes with lifting capacities that range from 15 to 30 STON are available on wharves 1, 3, 4, and 5 and the Middle East wharf. These cranes can be used to unload breakbulk cargo, but their capacities are inadequate for heavy lifts. There are no obstructions on the wharves that would interfere with breakbulk operations. The port also has seven mobile cranes, but their capacities are also inadequate for heavy lifts. Therefore, if heavy military unit equipment is to be lifted, heavy-lift cranes would have to be provided at all wharves.

c. (U) LASH and SEABEE Operations. LASH and SEABEE barges could be unloaded from all available port berths; however, to maximize berthing capability, deep-draft berths should be reserved for oceangoing vessels and shallow-draft berths should be used to discharge barges whenever possible. Therefore, wharves 1 (west and south), 2, 3 (north and center), and 4 (south) would provide suitable berths for either type of barge if cranes were available to support unloading operations. These wharves provide space for 178 LASH or 111 SEABEE lighters. Wharves 1 (west), 3, and 4 (south) have rail-mounted cranes and wharf 2 has a stiff-leg crane that could be used to discharge barges. The port also maintains seven mobile cranes - two 20-, three 30-, one 36-, and one 50-STON.

Based on the suggested method of operation, each crane would establish a loading position and would require adequate wharfage for two barges. Barge storage would be best accomplished adjacent to one of the wharves recommended for barge unloading operations. This would only slightly reduce the wharfage available for barge operations, while providing a convenient and secure staging location for the barges. The port has three tugboats that could provide towing services.

LASH and SEABEE vessels can be berthed only at the anchorages in Ulsan Harbor. Although these anchorages are sometimes vulnerable to rough seas from the south, they are sheltered sufficiently; so barge operations should be possible most of the time.

d. (U) Container Operations. None of the wharves at Yompo Port were designed or intended to be used as berths for container ships. However, wharves 3 (south), 4 (north), and 5 (east) and the Middle East wharf could accommodate container ships. The drafts at wharves 3 (south) and 4 (north) are not adequate for all container ships used in this study. The port has no container cranes or mobile cranes with adequate capacity for discharging container ships. However, the wharf cranes could be equipped with suitable gear and used for container operations. The port has abundant open storage space that could be used for staging containers, but the current use of these areas would have to be suspended to make the space available. The seven mobile cranes available at the port could be positioned in these areas and used to load and unload containers from chassis. To prevent double handling of containers, the containers could be loaded directly onto chassis as they are discharged from the ship and then transported from the port on the same chassis. Therefore, although no wharves at the terminal are designed for container operations, container ships could be accommodated at selected berths.

e. (U) Summary of Berth Availability. The berths available at the Yompo Port terminal for different types of US-flag and Korean-flag vessels are summarized in tables YO-4 and YO-5, respectively. The tables show, for each type of vessel, the number each berth could accommodate or the characteristics that make the berth unsuitable. As shown in the tables, wharves 3 (south), 4 (north), and 5 (east and west) and the Middle East wharf provide the best berths for large, oceangoing breakbulk vessels. The drafts at these wharves are restricted to some of the vessels used in

TABLE YO-4
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF YOMPO

US-Flag Ship Type	Berths											
	Wharf 1			Wharf 3			Middle East	Wharf 4		Wharf 5		
	West	South	Wharf 2	North	Center	South	Wharf	North	South	West	Center	East
RORO												
GTS Callaghan	a,d	a,c,d	a,c,d	a,c,d	a,c,d	1,d	1	1,d	a,d	c,d	a,d	2
USNS Comet	a,d	a,c,d	a,d	a,d	a,d	1,d	1	1,d	a,d	1,d	2,d	3
Maine-class	a,d	a,c,d	a,c,d	a,d	a,d	a,d	1	a,d	a,d	a,c,d	a,d	a
Breakbulk												
C4 Mariner-class	a	a,c	a	a	a	a	1	1	a	1	a	2
C4-5-58a	a	a,c	a	a	a	a	1	1	a	1	a	2
C3-5-38a	a	a,c	a	a	a	1	1	1	a	1	a	3
C3-5-33a	a	a,c	a	a	a	1	1	1	a	1	a	3
Barge												
LASH C8-5-81B	a,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,f	a,c,f	a,f	a,f
LASH barge	21	5	10	11	11	11	12	12	31	10	18	26
SEABEE C8-5-83A	a,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,f	a,c,f	a,f	a,f
SEABEE barge	13	3	6	7	7	7	8	8	19	6	11	16
Seatrain												
Georgia-class	a	a,c	a	a	a	1	1	1	a	1	2	2
Puerto-class	a	a,c	a	a	a	1	1	1	a	1	2	2
Container												
C6-5-1W	a	a,c	a,c	a	a	1	1	1	a	c	a	2
C7-5-68E	a	a,c	a,c	a,c	a,c	a,c	1	1	a	c	a	2
C8-S-85B	a	a,c	a,c	a	a	a	1	a	a	a,c	a	a
RORO/Container												
C5-5-78	a	a,c	a	a	a	a	1	a	a	a	a	a
T-AKR (SL-7)	a	a,c	a,c	a,c	a,c	a,c	c	a,c	a	a,c	a	a
Breakbulk/Container												
C5-S-37E	a	a,c	a	a	a	a	1	1	a	1	a	2
C4-5-10	a	a,c	a	a	a	a	1	1	a	1	a	2

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container-handling equipment.
f - Inadequate draft for barge ship at berth, however, ship could be unloaded from anchorage.

TABLE YO-5
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF YOMPO

Korean-Flag Ship Type	Berths											
	Wharf 1			Wharf 3			Middle East	Wharf 4		Wharf 5		
	West	South	Wharf 2	North	Center	South	Wharf	North	South	West	Center	East
Breakbulk												
Type 1	11	2	5	5	5	5	6	5	16	9	14	12
Type 2	5	1	2	2	2	2	3	2	7	4	6	6
Type 3	5	1	2	2	2	2	3	2	7	4	6	5
Type 4	4	1	2	2	2	2	2	2	6	3	5	5
Type 5	4	1	2	2	2	2	2	2	6	3	5	5
Type 6	3	b	1	1	1	1	2	1	5	3	4	4
Type 7	a	a,b	a	a	1	1	1	1	a	2	3	3

a - Inadequate draft at berth.
b - Inadequate berth length.

this study. Also, wharves 1 (west and south), 2, 3 (north and center), and 4 (south) provide suitable berths for barge operations and could also accommodate some of the Korean-flag shallow-draft breakbulk vessels.

Container ships could be berthed at wharves 3 (south), 4 (north), and 5 (east) and the Middle East wharf; however, these wharves were not designed for container operations. Drafts at wharves 3 (south) and 4 (north) are restricted for some container ships. Jib cranes with capacities between 5 and 30 STON are available on all of the wharves to support discharge operations. Side-ramp and slewed stern-ramp RORO operations are possible at all of the deep-draft berths. Straight stern-ramp operations may be possible for ships berthed at the Middle East wharf, with stern ramps positioned on wharf 4 (north), and at wharf 5 (east), with stern ramps positioned on the jetty located east of the wharf. None of the berths are adequate for the T-AKR vessel or the LASH and SEABEE vessels.

f. (U) Safety Considerations. The Yompo terminal is located on the west coast of a mountainous peninsula that forms the eastern shore of Ulsan Bay. It is situated at the base of the mountain and is isolated from other activities on the peninsula. However, the Korean Oil Company (KOCO) tank farm, with a storage capacity of 8,848 million barrels, is located west of the terminal across the Ulsan Harbor, about 2000 meters (6,560 feet) from the wharves. Therefore, it falls within the 2500-meter (8,200-foot) quantity-distance arc established for a notional breakbulk ammunition

ship and the 2800-meter (9,184-foot) arc established for a notional container ship. Naturally, other activities falling within these arcs include the HMD ship repair facilities and the Inchon Steel Mill facilities.

2. (U) Materials Handling Equipment. Besides its 7 mobile cranes, the port has 11 forklifts available - one 4.5-, one 7.5-, six 10-, and three 15-STON. These forklifts could be used to load general cargo into vans if portable ramps were provided.

3. (U) Storage Areas

a. (U) Open Storage. The port has a total of 384 650 square meters (95.1 acres) of open storage areas located adjacent to the wharves. These areas currently support the industrial missions of HMD and the Inchon Steel Mill. Before they could be used for staging military unit equipment, these areas would have to be cleared and their current use, suspended. The areas have good highway access but no rail access. The location and surface condition of these areas are shown in table YO-6.

b. (U) Covered Storage. The port terminal has no transit sheds on the wharves. Two warehouses, providing 5115 square meters (55,032 square feet) of covered storage, are available. The larger warehouse is adjacent to wharf 1 and the other is north of drydock 7.

c. (U) POL Storage. The port has no POL storage facilities; however, the KOCO tank farm is located across Ulsan Bay from the terminal. The tank farm has a storage capacity of 8,848 million barrels, consisting of 3,695 million barrels of crude oil storage and 5,153 million barrels of refined POL products.

TABLE YO-6
OPEN STORAGE

Location	Size m^2	Size acres	Surface
North of drydock 5	20 000	4.9	Concrete
North of wharf 1	15 000	3.7	Concrete
Adjacent to wharf 1	15 000	3.7	Concrete
Between drydocks 5 & 6	7 600	1.9	Concrete
Adjacent to wharf 2	17 250	4.3	Concrete
Adjacent to wharf 3	34 800	8.6	Concrete
East of wharf 4	40 000	9.9	Concrete
Adjacent to wharf 4	25 000	6.2	Concrete
Adjacent to wharf 5	170 000	42.0	Concrete
East of wharf 5	40 000	9.9	Concrete
Total	384 650	95.1	

4. (U) Rail Operations. Rail loading operations are not possible at the Yompo Port terminal since rail access to the terminal is not available. The rail facilities closest to the port are at the Ulsan Railroad Station, located on the east side of Ulsan City. As discussed in paragraph A4, the station has no end ramps, but portable ramps or mobile cranes could be used to load flatcars. Further, the station has no cranes or other materials handling equipment, so this equipment would have to be obtained from external sources. Since the station has a side dock, boxcars could be loaded if forklifts were made available. The station has five sidings that can handle a maximum of 80 railcars.

5. (U) Truck Operations. Highway access between the terminal and the main supply route will be

suitable once the unnamed port access road is completed. The road is currently surfaced with a mixture of soil and gravel, which becomes extremely muddy when it rains. The two-lane road is to be paved by the end of 1983 or in early 1984. Since the port has no truck docks or end-loading ramps, portable equipment or mobile cranes would be required for truck-loading operations. The seven mobile cranes available could lift nonroadable equipment onto flatbed trucks. Trucks could be loaded in the large, open storage areas adjacent to the wharf aprons. Cranes discharging breakbulk vessels or barges could load the discharged equipment directly onto trucks positioned on the aprons adjacent to the ship. This would prevent the equipment from being handled twice. Cargo to be loaded into vans would be discharged from the ship and transported to an open area, where portable ramps would be required for forklifts to load vans. The port has 11 forklifts that could be used but no portable ramps.

6. (U) Security. The port is located at the base of a mountain that runs along the entire length of the terminal's eastern perimeter. The perimeter of the HMD section of the port is surrounded by an unlighted concrete wall topped with wire. Also, this section of the port is backed by mountainous terrain. The port mountains an adequate security force. Guards are posted at the two access gates throughout the day and periodically patrol throughout the terminal.

D. (U) Support Services

1. (U) Pilotage. Pilotage is mandatory for entrance into the Port of Yompo. Four pilots and one pilot boat are available to provide pilot service throughout the day. These pilots also serve the Ports of Ulsan, Mipo, and Onsan and usually board ship at the quarantine anchorage located in the lower section of Ulsan Bay. Two additional pilots are expected to be hired in 1984.

2. (U) Harbor Craft. Three berthing tugboats, all rated at 2,600 horsepower, are available for use at the Port of Yompo.

3. (U) Stevedores. About 770 stevedores are registered with the Ulsan Branch of the National Docker's Union. These stevedores, which also serve the Ports of Ulsan, Onsan, and Mipo, would be available for cargo operations at the Port of Yompo. Gang size varies according to the type of cargo, but the stevedores are divided into 35 groups, with 22 stevedores per group. Each group consists of two teams, with 11 stevedores each. The local stevedore companies in Ulsan are:

a. Daewon Express Company, Ltd.

b. Dongbang Forwarding Company, Ltd.

c. Global Enterprises Company, Ltd.

d. Korea Express Company, Ltd.

e. A-Nam Transportation Company, Ltd.

f. Hyopsin Heavylift Company, Ltd.

g. Sambo Transportation Company, Ltd.

E. (U) Future Developments

The port is constructing a new wharf, wharf 6, which is expected to be 450 meters (1,476 feet) long with a draft of 10 meters (32.8 feet). The wharf, to be completed in 1984, is located south of wharf 5 and is expected to have open aprons and wharf cranes.

The port access road is being paved and is expected to be completed in early 1984. The two-lane road is being constructed by the city of Ulsan as the first phase of the project that will eventually provide a four-lane road to the terminal. No dates have been established for the construction of the two additional lanes.

F. (U) Summary

The Port of Yompo, an industrial port, supports ship repair and rebuilding activities of the Hyundai Mipo Dockyard Company and construction and assembly activities of the Inchon Steel Mill, which develops large marine structures. Wharves 3 (south), 4 (north), and 5 (east, center, and west) and the Middle East wharf provide the best berths for large oceangoing vessels; however, the drafts at the wharves are restrictive for some of the US-flag vessels used in this study. Wharves 1 (west and south), 2, 3 (north and center), and 4 (south) provide suitable berths for barge operations and can also accommodate most of the Korean-flag shallow-draft breakbulk vessels. None of the wharves are designed for container operations, but the deep-draft berths could accommodate container ships. Wharf cranes with capacities between 15 and 30 STON are available on all of the wharves to support discharge operations. Side-ramp and slewed stern-ramp RORO operations are possible at all of the deep-draft berths, and straight stern-ramp operations are possible from the Middle East wharf and wharf 5 (east). None of the berths can accommodate the T-AKR or LASH and SEABEE vessels. Based on shipping capabilities of the wharves, individual berth rankings have been computed in tables YO-7 and YO-8 for various shipping operations. The rankings indicate the berths that are best suited for each shipping operation and the relative suitability of the other selected berths.

The port has no rail access but rail facilities are available nearby, at the Ulsan Railroad Station. If support equipment were provided, this station could be developed as a low-volume railcar loading site; however, the station has neither end-loading ramps nor materials handling equipment to support railcar loading operations.

Highway access from the terminal to the main supply route, Korean 7, will be suitable for military unit equipment once the port's access road is completed. Terminal roads leading from the two gates are in excellent condition and provide suitable access to the wharves. The terminal has no truck docks or end-loading ramps, but the seven mobile cranes available at the port could be used to load flatbed trucks. The port also has 11 forklifts that could be used to load vans if portable ramps were made available.

The terminal has a total of 384 650 square meters (95.1 acres) of open storage and 5115 square meters (55,032 square feet) of covered storage. No POL storage is available. Pilot service is available and

TABLE YO-7
INDIVIDUAL BERTH RATING (BB/RORO)

Ideal Berth Factors	Berths					
	Wharf 3 South	Wharf 4 North	Wharf 5 West	Wharf 5 Center	Wharf 5 East	Middle East Wharf
Berth length	16	20	16	20	20	20
Alongside depth	14	18	18	12	18	20
Backup area	1	10	10	10	10	1
Apron width	20/20	20/20	20/20	20/20	20/20	20/20
Transit shed	0/NR	0/NR	0/NR	0/NR	0/NR	0/NR
Distribution shed	0/NR	0/NR	0/NR	0/NR	0/NR	0/NR
Apron tracks	0	0	0	0	0	0
Deck loading	10	10	10	10	10	10
Heavy-lift cranes	7	7	7	7	7	7
Berth type	10	10	10	10	10	10
Truck tailgate	0	0	0	0	0	0
Rail end ramp	0	0	0	0	0	0
Truck access	5	5	5	5	5	5
Ship service facilities	4	4	4	4	4	4
Conditional age of facility	10	10	10	10	10	10
RORO stern ramp	NR/5	NR/5	NR/5	NR/5	NR/5	NR/5
Total Points	97/102	114/119	110/115	108/113	114/119	107/112
Ranking	5/5	1/1	2/2	3/3	1/1	4/4

NR - Not rated.

TABLE YO-8
INDIVIDUAL BERTH RATING (BARGE)

Ideal Berth Factors	Berths					
	Wharf 1 West	Wharf 1 South	Wharf 2	Wharf 3 North	Wharf 3 Center	Wharf 4 South
Length	10	8	10	10	10	10
Alongside depth	10	10	10	10	10	10
Backup area	5	5	8	5	5	10
Apron width	10	10	10	10	10	10
Consolidation shed	2	2	0	0	0	0
Apron tracks	0	0	0	0	0	0
Anchorage diameter	10	10	10	10	10	10
Conditional age of facility	10	10	10	10	10	10
Deck loading	10	10	10	10	10	10
Heavy-lift cranes	7	0	5	7	7	5
Berth type	10	10	10	10	10	10
Truck tailgate	0	0	0	0	0	0
Rail end ramp	0	0	0	0	0	0
Truck access	5	5	5	5	5	5
Tug availability	8	8	8	8	8	8
Barge lay area	10	10	10	10	10	10
Total Points	107	98	106	105	105	108
Ranking	2	5	3	4	4	1

mandatory, and the port is serviced by three tugboats and about 770 stevedores, which also serve the Ports of Ulsan, Mipo, and Onsan.

The port is located at the base of a mountain on the western shore of the peninsula that forms the eastern short of Ulsan Bay. The site is isolated from other activities and populated areas. However, the KOCO tank farm, which has a POL storage capacity of 8,848 million barrels, is located west of the terminal across the Ulsan Harbor, about 2000 meters (6,560 feet) from the wharves. This falls within the 2500-meter (8,200-foot) quantity-distance arc established for a notional breakbulk ammunition ship and the 2800-meter (9,184-foot) arc established for a notional container ship. The HMD ship repair and rebuilding facilities and the Inchon Steel Mill facilities also fall within these arcs.

(U) PORT OF ULSAN

A. (U) General Description

1. (U) Location and General Uses. The Port of Ulsan (fig UL-1) is located on the eastern seacoast of Korea. It is about 4 kilometers (2.5 miles) east of the central business district of Ulsan, 63 kilometers (39 miles) north of Pusan, and 415 kilometers (258 miles) southeast of Seoul. The port, which is under the jurisdiction of the Ulsan District Maritime and Port Administration, first became prominent during the 1960's when Ulsan was selected for development into a major industrial area. The local industrial complex supports a diversified petrochemical industry that resulted from a joint venture between Korean Oil Company and Gulf Oil Company to develop the first major oil refinery in the country. This venture was followed by the development of other refineries and factories that produce a variety of materials such as sugar, fertilizer, cement, wood products, and chemicals. Therefore, the port is surrounded by a growing industrial complex that generates most of the shipping activity at the port.

The Ulsan Port terminal handles mostly bulk materials. The main commodities are sugarcane, coal, lumber, cement, and other raw materials used by the local industries. POL materials for the local petrochemical industry are handled at a location south of the port terminal, which will be discussed later.

Ulsan Port terminal is situated at the north end of Ulsan Bay, near the mouth of Taehwa River, on a peninsula that is formed by Changseng Inlet to the south, Taehwa River to the north, and Ulsan Bay to the east. The port terminal actually consists of three separate terminal areas some distance apart. The Coal pier and wharves 1 and 2 (fig UL-2) form one area in the northern section of the terminal harbor. Wharves 3, 4, and 5, the second area, are centrally located along the western shore of the terminal harbor, and General wharf, lighterage wharves 1, 2, and 3, and the LST ramp, the third area, are located along the western shore of Ulsan Harbor, which is some distance south of the terminal harbor.

Other wharves have been developed along Changseng Inlet for the small POL tankers, the Korean Coast Guard, and the shallow-draft vessels used by the local fishing industry. These wharves are unsuitable for military operations and, thus, are not discussed further in this study, The land area south of Changseng Inlet is also a peninsula and is bordered by the Changseng Inlet to the north, Oehwang River to the south, and Ulsan Bay to the west (fig UL-1). A large petrochemical refinery and a POL tank farm have been developed on the peninsula by the Korean Oil Company (KOCO). The refinery and tank farm occupy about 1 869 700 square meters (462 acres) and are located in the northern and southern sections of the peninsula, respectively. KOCO has a pier on and two POL dolphins at the mouth of Changseng Inlet. It also has two tanker moorings with submerged pipelines running from the southwest section of the peninsula. The dolphins handle refined POL products and can accommodate shallow-draft ships. The moorings handle crude oil from deep-draft supertankers and VLCC. The Port of Onsan is located south of this peninsula, at the mouth of Oehwang River. (This port is discussed in detail under "Port of Onsan.")

The city of Ulsan also supports Hyundai Shipbuilding and Heavy Industries Company, Ltd (HHI), the largest shipbuilding and ship repair dockyards in

Korea, and Hyundai Mipo Dockyard Company, Ltd (HMD), which also has extensive ship repair facilities. These industrial complexes are located respectively on the eastern and western shores of the peninsula that forms the eastern boundary of Ulsan Bay. HHI is discussed in detail under "Port of Mipo," and HMD, under "Port of Yompo." HMD also maintains facilities at the Port of Mipo and is discussed under that port.

2. (U) Harbor. Ulsan Bay, encompassing a water area of 10 million square meters (2,471 acres), is a large natural bay that can be divided into two sections, upper and lower. The upper section, commonly called Ulsan Harbor, lies between two rugged, mountainous peninsulas. The peninsulas form the eastern and western shores of the harbor and protect ships from the prevailing winds. Ulsan Harbor runs north from the tip of the eastern peninsula to the mouth of Taehwa River, a distance of about 4.0 kilometers (2.5 miles), and ranges in width from about 1.6 kilometers (1 mile) in the south to about 0.8 kilometer (0.5 mile) in the north. Taehwa River, which flows from the west into the head of Ulsan Bay, has shallow water depths and mud flats that prevent cargo movement. The HMD wharves occupy the eastern shores of the harbor. On the western shore of the harbor are the Ulsan Port terminal, the oil pipeline dolphins of the KOCO refinery, and a wharf that serves a thermoelectric powerplant.

The channel leading to the Ulsan Port terminal has been dredged to a minimum draft of 12.5 meters (41 feet) over a width of 200 meters (656 feet) and has no overhead obstructions. Average depth in the harbor varies from about 18.3 meters (60 feet) at the south end to about 9.5 meters (31.2 feet) at the entrance to Changseng Inlet. The depth tapers to about 0.5 meter (1.6 feet) near the Ulsan Port terminal and the mouth of Taehwa River.

Changseng Inlet is a narrow channel that extends westward about 3.2 kilometers (2 miles). A wharf to the KOCO refinery is located about 1.2 kilometer (0.8 mile) from the entrance to the inlet. The shoals and the narrow width of the inlet (37 meters (121 feet) at one point) make ship navigation difficult.

The lower section of Ulsan Bay is directly south of Ulsan Harbor and is exposed to the open sea on the east and south. The mainland of Korea forms the the western boundary of the bay. The outer boundary of this section is defined by an arc that runs from the southern tip of the peninsula, which forms the eastern boundary of Ulsan Harbor, to a point about 2.4 kilometers (1.5 miles) south of the Port of Onsan. The Port of Onsan is located at the mouth of Oehwang River, which flows from the west into Ulsan Bay. The lower section of Ulsan Bay averages about 3 kilometers (1.9 miles) in width and 5 kilometers (3.1 miles) in length.

The bottom of Ulsan Bay is a mixture of sand, mud, and heavy, sticky clay that provides good holding ground for the 23 anchorages listed in table UL-1. Most of these anchorages are located along each side of the entrance channel in both the upper and lower sections of the bay. A quarantine anchorage, which measures 800 meters (2,624 feet) by 2400 meters (7,872 feet), is located immediately south of the eastern peninsula at coordinates 35°27'20"N, 129°25'00"E. The draft at this anchorage varies from 35 meters (115 feet) in the northwest end to 25 meters (82 feet) in the southeast end. The northern anchorages, which

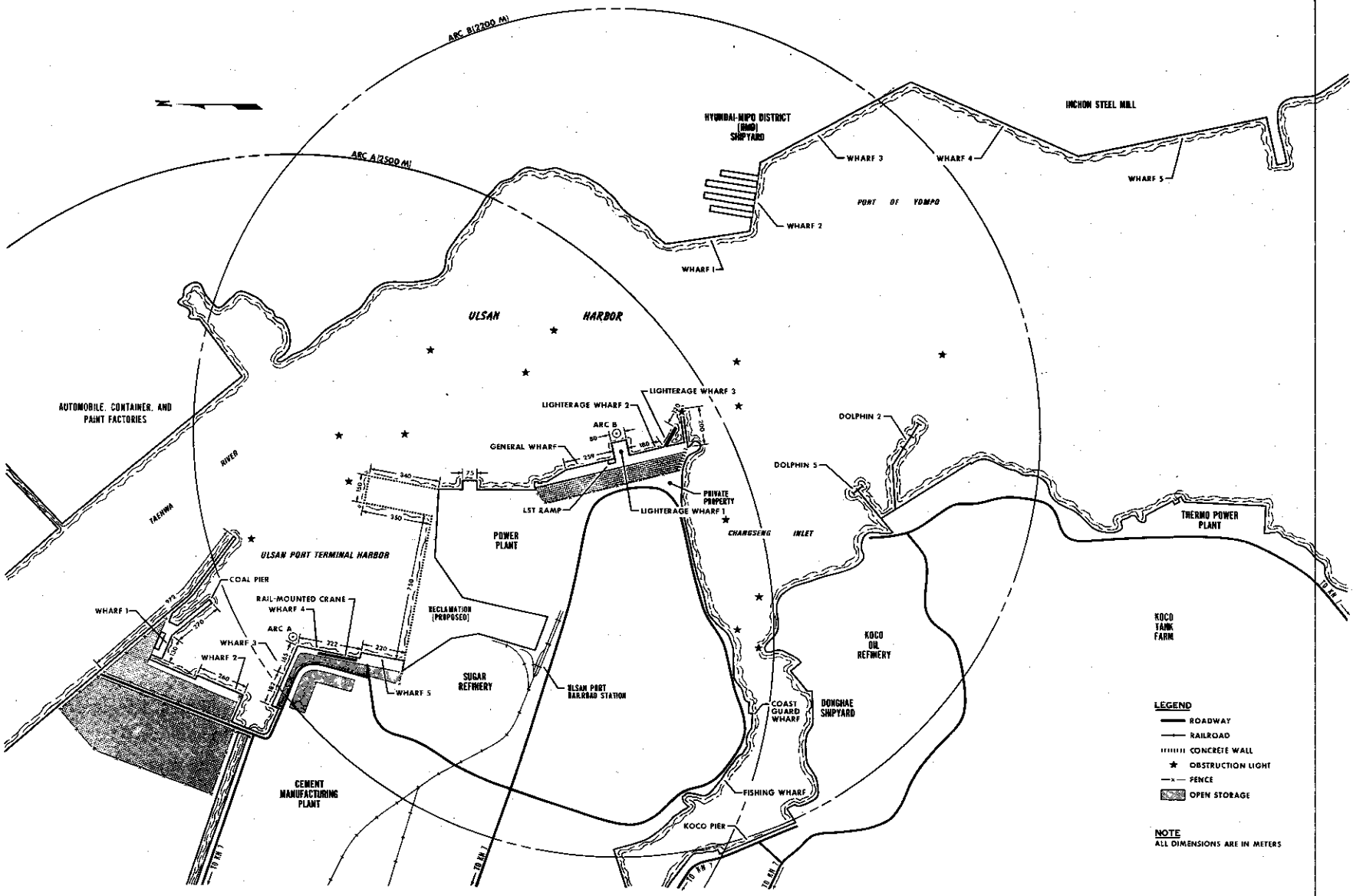


Figure UL-2. Site map.

TABLE UL-1
ULSAN ANCHORAGE DATA

Anchorage Designation	Geographic Location	Site Characteristics				
		Diameter m	(ft)	Depth m	(ft)	Bottom Type
M-1	lat 35°29'29"N long 129°23'55"E	400	(1,312)	11.0	(36.1)	Mud
M-2	lat 35°29'33"N long 129°24'13"E	400	(1,312)	10.4	(34.1)	Mud
M-3	lat 35°29'17"N long 129°23'57"E	400	(1,312)	11.8	(38.7)	Mud
M-4	lat 35°29'22"N long 129°24'20"E	400	(1,312)	10.1	(33.1)	Mud
M-5	lat 35°29'12"N long 129°24'11"E	400	(1,312)	11.4	(37.4)	Mud
M-6	lat 35°29'02"N long 129°23'59"E	400	(1,312)	12.5	(41.0)	Mud
M-7	lat 35°28'48"N long 129°24'05"E	500	(1,640)	12.9	(42.3)	Shells
M-8	Not used					
M-9	Not used					
M-10	Not used					
M-11	lat 35°28'40"N long 129°23'36"E	500	(1,640)	14.3	(46.9)	Sand
M-12	lat 35°28'24"N long 129°23'39"E	500	(1,640)	16.0	(52.5)	Sand
M-13	lat 35°28'06"N long 129°23'40"E	600	(1,968)	18.0	(59.0)	Sand
M-14	lat 35°27'44"N long 129°23'33"E	800	(2,624)	19.6	(64.3)	Sand
M-15	lat 35°27'07"N long 129°24'25"E	600	(1,968)	26.0	(85.3)	Mud
M-16	lat 35°26'48"N long 129°24'41"E	800	(2,624)	30.0	(98.4)	Mud

TABLE UL-1 - cont

Anchorage Designation	Geographic Location	Site Characteristics				
		Diameter m	(ft)	Depth m	(ft)	Bottom Type
M-17	lat 35°26'11"N long 129°23'03"E	600	(1,968)	24.0	(78.7)	Mud
M-18	lat 35°25'43"N long 129°22'51"E	800	(2,624)	25.0	(82.0)	Mud
M-19	lat 35°25'43"N long 129°23'27"E	800	(2,624)	26.5	(86.9)	Mud
M-20	lat 35°26'23"N long 129°25'05"E	1200	(3,936)	39.0	(127.9)	Mud
M-21	lat 35°25'28"N long 129°24'02"E	1000	(3,280)	31.0	(101.7)	Mud
M-22	lat 35°26'06"N long 129°25'48"E	1200	(3,936)	50.0	(164.0)	Mud
M-23	lat 35°27'30"N long 129°25'36"E	1000	(3,280)	40.0	(131.2)	Mud

are in the upper section of the bay and surrounded by mountains, are the most protected anchorages; however, all of the anchorages are vulnerable to strong winds and rough seas that approach the bay from the south. The occurrence of rough seas is predominantly from November to March. Heavy fog occurs from April to late August but most frequently in June and July. Ulsan is located within the typhoon belt and typically experiences two typhoons each year. The average tidal range for the port is only 0.5 meter (1.6 feet), which does not affect shipping. The mean high water interval is 7 hours 20 minutes.

Restricted areas surround the two mooring buoys located in the lower section of the bay just north of the entrance to Onsan Port. The moorings are used by deep-draft supertankers and VLCCs to discharge crude oil that is pumped through submerged pipes to the KOCO tank farms. Another restricted area surrounds a mooring buoy in the extreme southern end of the harbor, south of the entrance to Onsan Port.

Silting in the bay is gradual and occurs most frequently during the rainy and typhoon seasons. Silt from Taehwa River amounts to about 45 000 cubic meters (58,818 cubic yards) annually. Most of the silting occurs in the river channel at the mouth of Taehwa River, near the breakwater of Ulsan Port terminal. The harbor and channel are affected to a small degree by this silting, so soundings are performed annually to monitor water depths. Dredging is performed as needed to maintain water depths throughout the harbor and in the channel. During 1983, areas near the Coal pier were dredged; port officials plan to dredge the channel in 1984.

3. (U) Highway Access. The Ulsan Port terminal actually consists of three smaller terminals that are all separated by some distance. The road network in the immediate vicinity of the terminals consists of two-lane paved roads, suitable for military unit equipment. These unnamed port access roads lead from the terminal access gates to Local Route 1056, which runs west to a traffic circle and joins with Local Route 1054 and Korean Route 14.

The distance from the terminals to this traffic circle varies from 8 to 9.7 kilometers (5 to 6 miles). More than half of this distance consists of four-lane arterials suitable for military unit equipment. From the traffic circle, Korean 14 runs south to Pusan, as well as north for 2.3 kilometers (1.4 mile) and intersects with Korean Route 7. Local 1054 runs west from the traffic circle and intersects with Korean 7 at a distance of 5 kilometers (3.1 miles). Korean 7 is a north-south route running along the entire east coast of Korea. About 6 kilometers (3.7 miles) south of the traffic circle, Korean 7 intersects Superhighway 8. Superhighway 8 runs west about 14 kilometers (8.7 miles) and intersects Superhighway 1. Superhighway 1 is a four-lane limited access route that runs north to Seoul and south to Pusan. The access route has no vertical clearance obstructions and would provide good highway access from the port for military unit equipment and supply trucks.

4. (U) Railroad Access. A branch line from the Korean East Coast Railroad runs east toward Ulsan; however, since the trackage does not extend to the port terminal, the terminal has no rail access. In Ulsan, the branch line splits into two spurs that continue eastward. One of the spurs extends south to Changseng Inlet and provides access to a major railyard serving the KOCO refinery. This railyard is used extensively by tanker cars carrying POL and would not make a good railcar loading site for military cargo and equipment. The other spur extends eastward toward the port and terminates at the Ulsan Port Railroad Station. This station is located about 1.3 kilometer (0.8 mile) from the southern wharves, 1.9 kilometers (1.2 mile) from the central wharves, and 3.2 kilometers (2 miles) from the northern wharves. Highway access from the port to the station is suitable for military unit equipment. The station has about

2043 meters (6,700 feet) of track but no end-loading ramps, side docks, cranes, or materials handling equipment, which would be required for railcar loading operations. Therefore, if this station were used, all support equipment would have to be supplied from external sources.

5. (U) Airports. No helipad areas are designated near the port, although open areas are available for helicopter operations. The closest airports are located in Pohang, about 77 kilometers (48 miles) north of the port, and in Pusan, about 63 kilometers (39 miles) south of the port. The Pohang Airport has a concrete runway that is 2134 meters (7,000 feet) long and 46 meters (150 feet) wide and is capable of supporting intertheater aircraft. The Pusan Airport has an asphalt runway that is 2012 meters (6,600 feet) long and 46 meters (150 feet) wide. The runway is capable of supporting only intratheater aircraft.

B. (U) Ulsan Port Terminal

1. (U) Berthing. The wharves at the port (fig UL-2) are divided into three separate areas. The northern wharves consist of the Coal pier (fig UL-3) and wharves 1 (fig UL-4) and 2 (fig UL-5). Both the Coal pier and wharf 2 are suitable for deep-draft oceangoing vessels, but the draft at wharf 1 restricts its use.

Wharves 3 (fig UL-6), 4 (fig UL-7), and 5, which are located in the central section of the harbor terminal, all have suitable berths for deep-draft vessels. However, wharf 4 is encumbered with an elevated conveyor system and bulk loaders. The bulk loaders are mounted on rails that raise above the apron surface. Therefore, the bulk loaders must be pushed aside to accommodate ship discharge operations, and care must be exercised to prevent the rails from being damaged. The wharf is especially desirable for breakbulk operations since a rail-mounted wharf crane with a 58-STON lifting capacity is available for discharge operations.

The wharves located south of the terminal harbor, along the western shore of Ulsan Harbor, all have shallow-draft berths that are not suitable for any of the US-flag vessels used in this study. However, these berth facilities, which include the General wharf (fig UL-8) and an LST ramp (fig UL-9), would be suitable for barge or breakbulk operations using shallow-draft Korean ships. Therefore, the deep-draft berths at the Ulsan Terminal are located at the Coal pier and wharves 2, 3, 4, and 5. The specific characteristics of the berths at the Port of Ulsan are summarized in table UL-2. Based on these characteristics, suitable berths for various types of vessels will be determined below.

a. (U) RORO Operations. Side-ramp and slewed stern-ramp RORO operations at the Port of Ulsan are possible at the Coal pier and wharves 2, 3, and 5; however, the draft at wharf 3 is not adequate for the Maine-class RORO vessels. The port has no ramps designed for straight stern ramps, but stern-ramp operations may be possible from wharf 4. Ships berthed at that wharf could rest their ramps on the apron of wharf 5. The apron width at wharf 4 is insufficient for side-ramp RORO operations, so simultaneous side-ramp and stern-ramp discharge would not be possible at this site. The feasibility of this operation would also depend on the specific height of the stern ramp

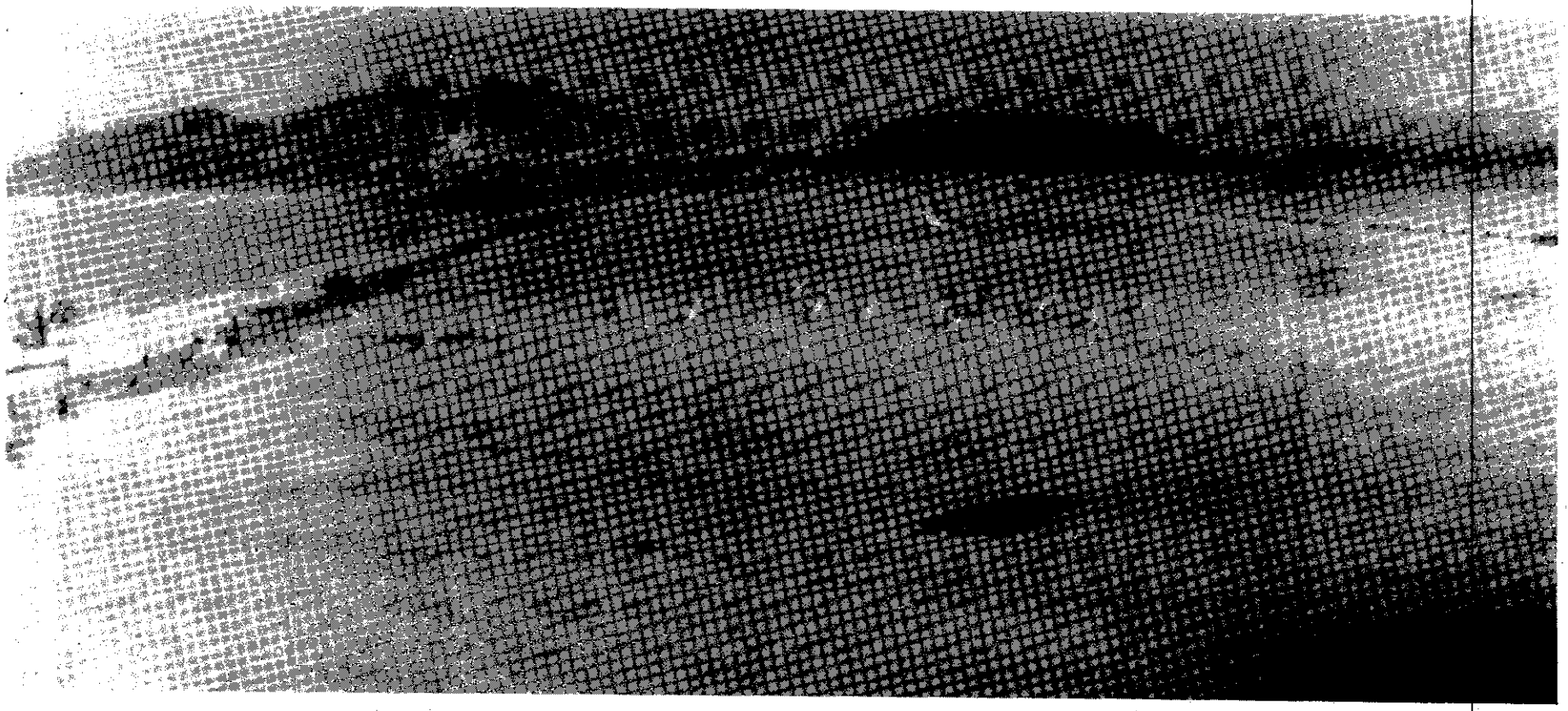


Figure UL-3. Coal pier (northwestward view).

relative to the height of the dock. None of the berths can accommodate the T-AKR vessel because of its length and draft requirements. The LST ramp at the southern wharves has inadequate draft and berth length for the RORO vessels used in this study.

b. (U) Breakbulk Operations. The Coal pier and wharves 2, 3, 4 (south), and 5 provide a number of berths that can be used by US-flag and Korean-flag breakbulk vessels. The shallow-draft Korean-flag breakbulk vessels can be berthed also at wharf 1, wharf 4 (north), General wharf, and lighterage wharves 1, 2, and 3. A 58-STON, rail-mounted wharf crane is available at wharf 4; however, heavy-lift mobile cranes would be required at the other berths. The capacities of the mobile cranes available at the port are inadequate for heavy-lift breakbulk operations. Operations on wharf 4 would require that the bulk loaders be pushed aside to allow the shore-based cranes to move between hatches. Unloading operations may require

Figure UL-4. Wharf 1 (westward view).

Figure UL-5. Wharf 2 (northward view).

more time than usual at this wharf due to the proximity of the elevated conveyor systems, which limit the space available for crane operations. Also, vehicles unloaded from the ship would have to traverse the raised rails that support the bulk loaders. If these crossings were made with care to prevent damage to the rail, operations would be slowed. The other berths have no obstructions that would interfere with breakbulk operations.

c. (U) LASH and SEABEE Operations. LASH and SEABEE barges could be unloaded from all available port berths; however, to maximize berthing capability, deep-draft berths should be reserved for oceangoing vessels and barges should be discharged at shallow-draft berths whenever possible. Therefore, if mobile cranes were available, wharf 1, wharf 4 (north), General wharf, and lighterage wharves 1, 2, and 3 would provide suitable berths for either type of barge. ~~The terminal has access to the eight mobile cranes~~

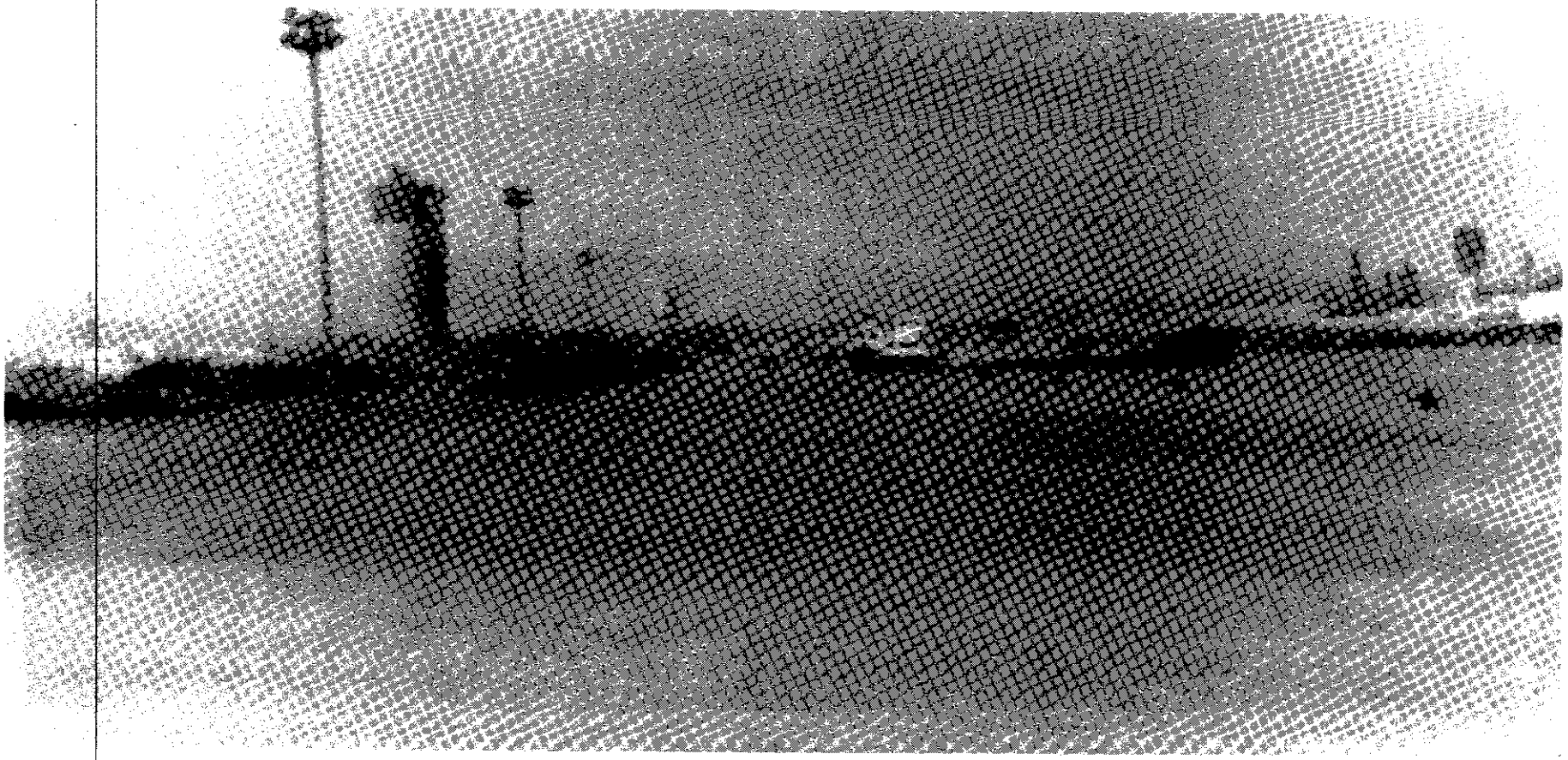


Figure UL-6. Wharf 3 (westward view).

shown in table UL-3, which could support barge operations at these wharves. Based on normal barge operations, a loading position and adequate wharfage for two barges should be established for each crane. Barges could be staged adjacent to wharf 1, along the southern shore of the port terminal harbor, or in Ulsan Harbor, directly opposite the lighterage wharves on the east side of the harbor channel. Seven tugboats are available at the port to provide towing services. LASH and SEABEE vessels can be berthed only at the anchorages in Ulsan Harbor. Although these anchorages are vulnerable to rough seas from the south, they are sheltered sufficiently, so barge operations should be possible most of the time.

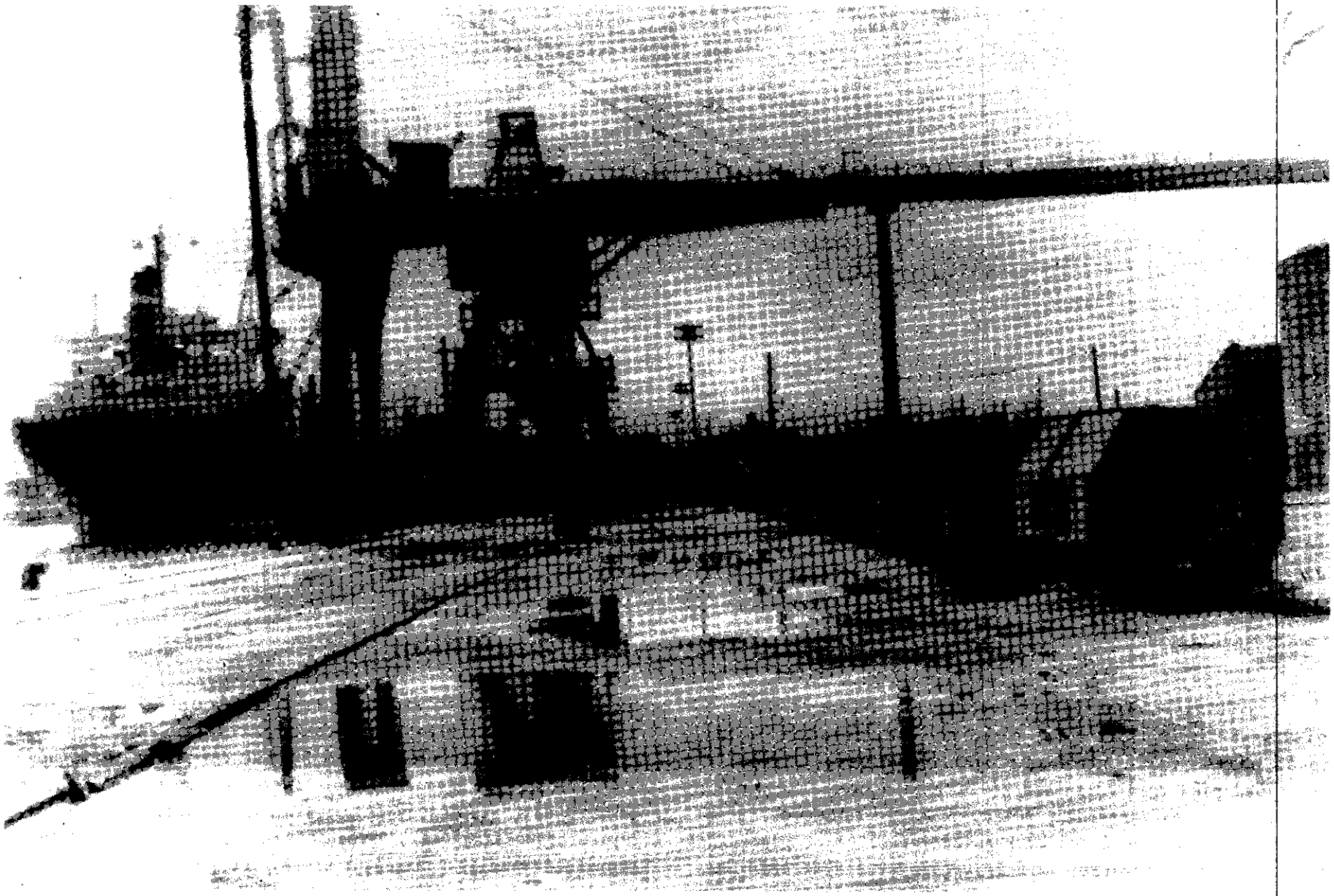


Figure UL-7. Wharf 4 (southward view).

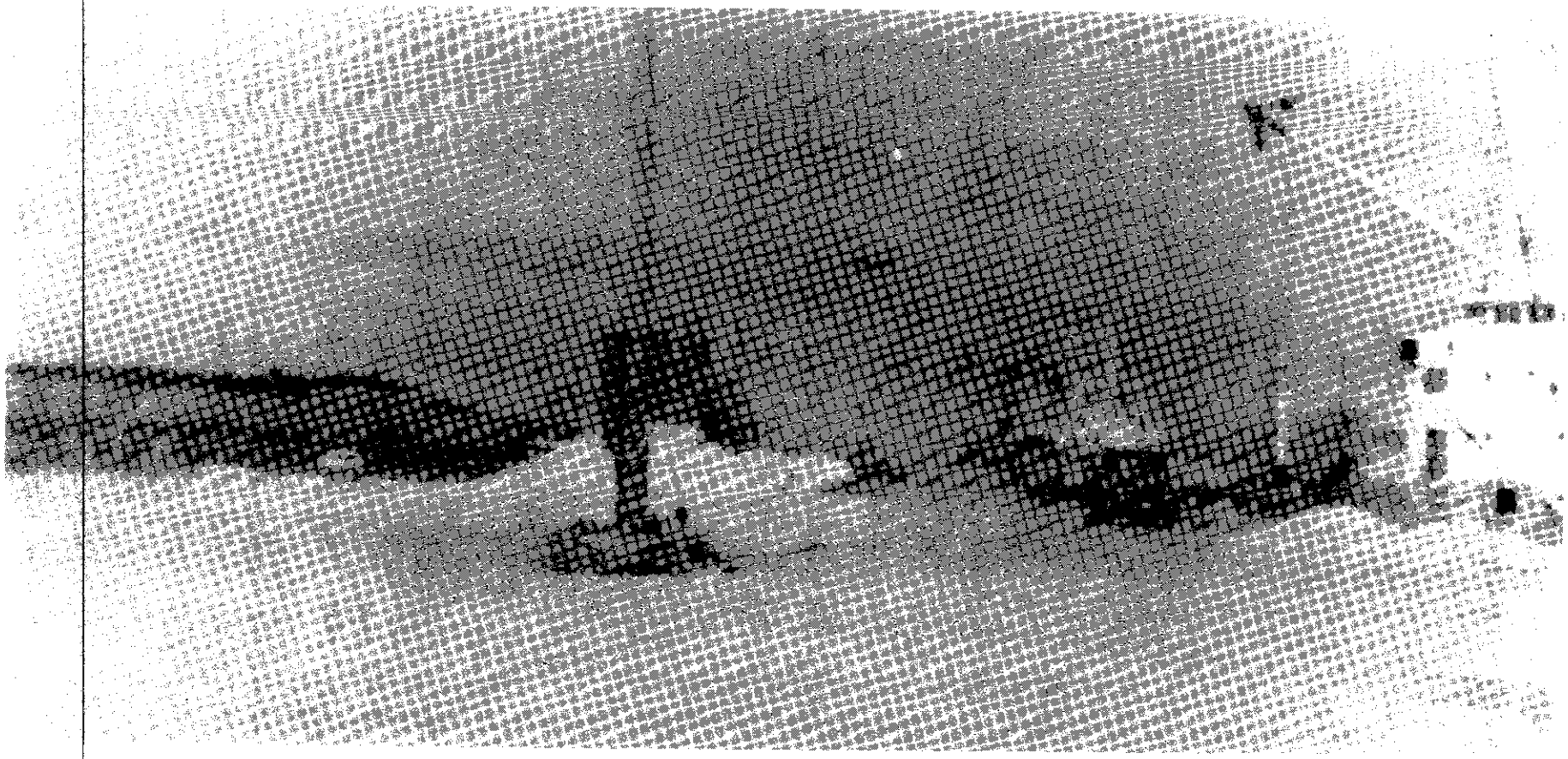


Figure UL-8. General wharf (northward view).

d. (U) Container Operations. None of the wharves at Ulsan Port were designed or intended to be used as berths for container ships. However, berths at the Coal pier and wharves 2, 3, and 5 could accommodate container vessels. Wharf 3 would only be suitable for shallow-draft container ships. The port has no container cranes, and only one available mobile crane has adequate capacity for handling containers from non-self-sustaining container ships. Wharf 2 has a large, open storage area adjacent to its open apron that would provide abundant space for container operations. Wharves 3 and 5 have smaller open storage areas that could be used to temporarily store containers. The port maintains no container handling equipment; however, cranes are available for handling containers at the storage sites. To prevent additional handling of containers at storage sites, containers could be loaded directly onto chassis as they are

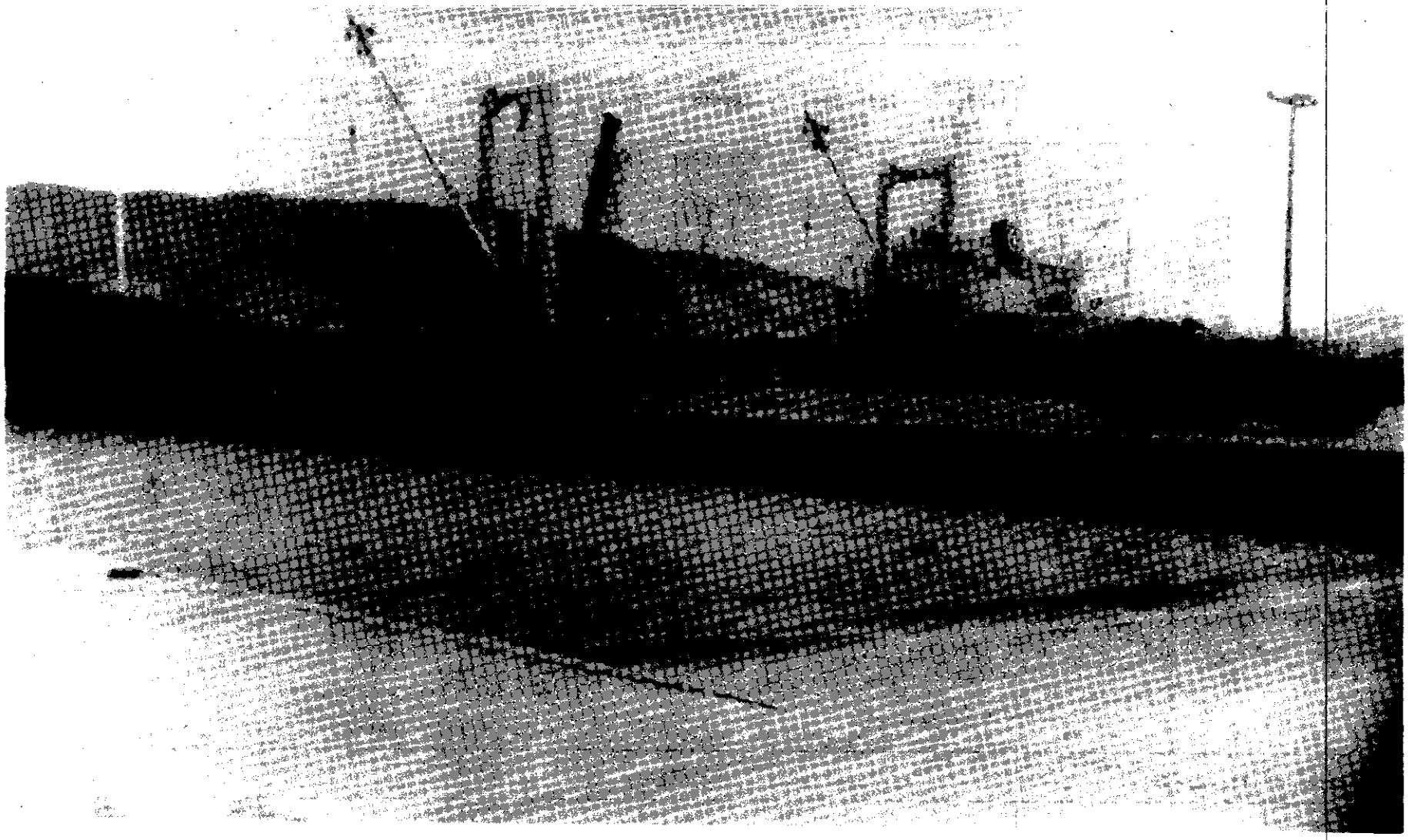


Figure UL-9. LST ramp (eastward view).

TABLE UL-2
PORT OF ULSAN
OPERATED BY: ULSAN DISTRICT MARITIME AND PORT ADMINISTRATION

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m (ft)	Individual Berth	Berth Length m (ft)	Approximate Apron Width m (ft)	MLW m (ft)	Approximate Apron Height Above MLW m (ft)	Deck Strength* (psf)	Serviced by Rail-Mounted Crane	Rail Access to Apron
Coal pier	1	Pier	270 (886)	1	270 (886)	23 (75)	12.0 (39.4)	2.7 (8.9)	628	No	No
Wharf 1	1	Marginal	130 (426)	1	130 (426)	15 (49)	7.5 (24.6)	2.2 (7.2)	628	No	No
Wharf 2	1	Marginal	260 (853)	1	260 (853)	open	12.0 (39.4)	2.2 (7.2)	628	No	No
Wharf 3	West	Marginal	347 (1,138)	West	173 (567)	open	9.0 (29.5)	2.2 (7.2)	628	No	No
	East			East	174 (571)						
Wharf 4	North	Marginal	322 (1,056)	North	161 (528)	10 (32.8)	7.5 (24.6)	2.2 (7.2)	628	Yes	No
	South			South	161 (528)	10 (32.8)	9.0 (29.5)				
Wharf 5	1	Marginal	220 (722)	1	220 (722)	open	11.0 (36.1)	2.2 (7.2)	628	No	No
General wharf	1	Marginal	229 (751)	1	229 (751)	open	7.5 (24.6)	2.0 (6.6)	628	No	No
Lighterage wharf 1	1	Pier	80 (262)	North	80 (262)	open	5.0 (16.4)	2.0 (6.6)	628	No	No
				Head	80 (262)	open	5.0 (16.4)	2.0 (6.6)	628	No	No
				South	80 (262)	open	5.0 (16.4)	2.0 (6.6)	628	No	No
Lighterage wharf 2	1	Marginal	180 (590)	1	180 (590)	open	5.0 (16.4)	2.0 (6.6)	628	No	No
Lighterage wharf 3	1	Marginal	120 (394)	1	120 (394)	open	5.0 (16.4)	2.0 (6.6)	628	No	No

Rail-Mounted Cranes	Serving Berths	Roll-on/Roll-off Facilities	Serving Berths	Open Storage m^2 (acres)	Serving Berths	Covered Storage	Serving Berths
58-STON Whirley	Wharf 4	LST ramp	Lighterage wharf 1	25 000 (6.2)	Wharf 1	None	-
				114 200 (28.2)	Wharf 2		
				20 820 (5.1)	Wharf 3		
				15 895 (3.9)	Wharf 5		
				27 600 (6.8)	General and Lighterage wharves		

*Estimated values.

TABLE UL-3
MOBILE CRANES

Capacity (STON)	Quantity	Motive Power	Owner/User
70	1	Diesel	Sebang Enterprise Co
60	1	Diesel	Korea Express Co
40	1	Diesel	Sambo Express Co
30	1	Diesel	Hyopsin Heavy Cargo Trans Co
25	1	Diesel	Tongbang Trans Co
20	1	Diesel	Korea Express Co
20	1	Diesel	Sambo Express Co
20	1	Diesel	A-Nam Trans Co

discharged from the ship and then transported from the port on the same chassis. Therefore, berths are available at the port that could accommodate container ships, but these berths were not designed to support container operations.

e. (U) Summary of Berth Availability. The berths available at the Ulsan Port Terminal for different types of US-flag and Korean-flag vessels are summarized in tables UL-4 and UL-5, respectively. The tables show, for each type of vessel, the number each berth could accommodate or the characteristics that make the berth unsuitable.

As shown in the tables, the Coal wharf and wharves 2, 3, 4 (south), and 5 provide the best berths for large oceangoing breakbulk vessels. The drafts at wharves 3 and 4 (south) are inadequate for some of the vessels used in this study. A 58-STON wharf crane is available at wharf 4 (south) for breakbulk operations; however, the wharf is also encumbered with an elevated conveyor system and two bulk loaders mounted on rails that raise above the apron surface. Side-ramp and slewed stern-ramp RORO operations are possible at the Coal wharf and wharves 2, 3, and 5. Straight stern-ramp operations may be possible for ships berthed at wharf 4 (south) with stern ramps positioned on wharf 5. The draft at wharf 4 is inadequate for all RORO vessels and the apron widths are too narrow for side-ramp RORO operations. Container ships could be berthed at the Coal pier and wharves 2, 3, and 4; however, none of these wharves were designed to support container operations. Wharf 1, General wharf, and lighterage wharves 1, 2, and 3 provide suitable berths for barge operations and can also accommodate some of the shallow-draft Korean-flag breakbulk vessels. LASH and SEABEE vessels must be anchored in Ulsan Harbor during barge operations since none of the berths can accommodate these vessels. The T-AKR is too large for any of the berths at the Port of Ulsan.

f. (U) Safety Considerations. Ulsan Port terminal is located about 4 kilometers (2.5 miles) east of the central business district of Ulsan; a population of about 10,000 is located within 2000 meters (6,560 feet) of the wharves. Land use within 2800 meters (9,184 feet) of the wharves is primarily industrial. The large KOCO refinery is located about 2500 meters (8,200 feet) southwest of the wharves, and the KOCO tank farm, with a total capacity of 8,848 million barrels, is located about 4 kilometers (2.5 miles) south of the port terminal. Other industries within the vicinity of the terminal include a thermoelectric powerplant, a sugar refinery, and a cement manufacturing plant. These industries border terminal property and are within 1000 meters (3,280 feet) of the wharves. In addition, manufacturing plants for automobiles, containers, and paint are located on Taehwa River opposite the port terminal and within 1500 meters (4,920

TABLE UL-4
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF ULSAN

US-Flag Ship Type	Berths										
					Wharf 4						
	Coal Pier	Wharf 1	Wharf 2	Wharf 3	North	South	Wharf 5	General Wharf	Lighterage Wharf 1	Lighterage Wharf 2	Lighterage Wharf 3
RORO											
GTS Callaghan	1,d	a,b,c,d	1,d	1,d	b,c,d	b,c	1,d	a,d	a,c	a,c,d	a,c,d
USNS Comet	1,d	a,b,c,d	1,d	2,d	b,d	b	1,d	a,d	a,c	a,d	a,c,d
Maine-class	1,d	a,b,c,d	1,d	a,d	a,b,c,d	a,b,c	1,d	a,d	a,c	a,c,d	a,c,d
Breakbulk											
C4 Mariner-class	1	a,c	1	a	a,c	a,c	1	a	a	a	a,c
C4-5-58a	1	a,c	1	a	a,c	a,c	1	a	a	a	a,c
C3-5-38a	1	a,c	1	2	a	1	1	a	a	a	a,c
C3-5-33a	1	a,c	1	2	a	1	1	a	a	a	a,c
Barge											
LASH C8-5-81B	a,f	a,c,f	a,f	a,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f
LASH barge	14	6	13	18	8	8	11	12	12	9	6
SEABEE C8-5-83A	1	a,c,f	c	a,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f	a,c,f
SEABEE barge	9	4	8	11	5	5	7	7	8	6	4
Seatrain											
Georgia-class	1	a,c	1	2	a,c	1	1	a	a	a	a,c
Puerto-class	1	a,c	1	2	a,c	1	1	a	a	a	a,c
Container											
C6-5-1W	1	a,c	1	1	a,c	c	1	a	a,c	a,c	a,c
C7-5-68E	1	a,c	1	a	a,c	a,c	1	a	a,c	a,c	a,c
C8-S-85B	1	a,c	1	a	a,c	a,c	1	a	a,c	a,c	a,c
RORO/Container											
C5-5-78	1	a,b,c	1	a	a,b,c	a,b,c	a,b,c	a	a	a,c	a,c
T-AKR (SL-7)	c	a,b,c	c	a	a,b,c	a,b,c	a,b,c	a,c	a,c	a,c	a,c
Breakbulk/Container											
C5-S-37E	1	a,c	1	a	a,c	a,c	1	a	a	a,c	a,c
C4-5-10	1	a,c	1	a	a,c	a,c	1	a	a	a	a,c

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container-handling equipment.
f - Inadequate draft for barge ship at berth; however, ship could be unloaded from anchorage.

TABLE UL-5
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF ULSAN

Korean-Flag Ship Type	Berths										
					Wharf 4						
	Coal Pier	Wharf 1	Wharf 2	Wharf 3	North	South	Wharf 5	General Wharf	Lighterage Wharf 1	Lighterage Wharf 2	Lighterage Wharf 3
Breakbulk											
Type 1	7	3	7	9	4	4	6	6	18	5	3
Type 2	3	1	3	4	2	2	2	3	9	2	1
Type 3	3	1	3	4	2	2	2	3	9	2	1
Type 4	3	1	2	3	1	1	2	2	a	a	a
Type 5	3	1	2	3	1	1	2	2	a	a	a
Type 6	2	1	2	3	1	1	2	2	a	a	a
Type 7	2	a	2	2	a	1	1	a	a	a	a

a - Inadequate draft at berth.

feet) of the wharves. Therefore, most of these activities fall well within the 2500-meter (8,200-foot) quantity-distance arc established for a notional breakbulk ammunition ship and the 2800-meter (9,184-foot) arc established for a notional container ship.

2. (U) Materials Handling Equipment. Besides the mobile cranes available at the port terminal, the forklifts listed in table UL-6 are also available. These forklifts would be required to load general cargo materials into conveyance vehicles. Eleven forklifts with capacities of 6 tons or less are available at the port. Local stevedore companies also own and operate about 80 cargo trucks and 28 trailers.

3. (U) Storage Areas

a. (U) Open Storage. The port has seven areas that provide a total of 203 715 square meters (50.3 acres) of open space suitable for marshaling military equipment. These areas are located immediately adjacent to the wharves or along the wharf facilities. The surface conditions and exact location of the seven areas are listed in table UL-7. Highway access to these areas is adequate for unit equipment; however, rail access is not available.

b. (U) Covered Storage. The port terminal has neither transit sheds nor storage warehouses. The commercially owned covered-storage facilities located

TABLE UL-6
MATERIALS HANDLING EQUIPMENT - ULSAN

Capacity (STON)	Quantity	Motive Power	Owner
6	1	Diesel	Korea Express Co
5	1	Diesel	A-Nam Trans Co
5	1	Diesel	Korea Express Co
3.5	1	Diesel	Sebang Enterprise Co
3.5	1	Diesel	Hyopsin Trans Co
3.5	1	Diesel	Korea Express Co
3	1	Diesel	Sebang Enterprise Co
2	1	Diesel	Sebang Enterprise Co
2	1	Diesel	Hyopsin Heavy Cargo Trans Co
2	1	Diesel	Sambo Trans Co
2	1	Diesel	Tongbang Trans Co

TABLE UL-7
OPEN STORAGE

Location	Size m^2	Size (Acres)	Surface
Northwest of wharf 1	25 200	(6.2)	Soil and gravel
Adjacent to wharf 2	37 700	(9.3)	Pavement
West of wharf 2	76 500	(19.0)	Soil and gravel
Adjacent to wharf 3	20 820	(5.1)	Pavement
Adjacent to wharf 5	6 600	(1.6)	Pavement
West of wharf 5	9 295	(2.3)	Soil
Adjacent to General wharf and lighterage wharves 1, 2, and 3	27 600	(6.8)	Pavement
Total	203 715	(50.3)	

near the port are shown in table UL-8. The availability of these facilities for military cargo is uncertain.

c. (U) POL Storage. The port has no POL storage facilities; however, numerous storage tanks are scattered throughout the area surrounding the terminal. These tanks support the POL requirements of the various industrial complexes located near the port

TABLE UL-8
COVERED FACILITIES

Location	Dimensions m^2	Dimensions (ft^2)	Height	Predominant Use	Owners
EQ329313	38 107	(410,000)	50	Bagged fertilizer	Hanguk Fertilizer Co
EQ322308	8 551	(92,000)	40	Bagged fertilizer	Choson Fertilizer Co
EQ318305	1 580	(17,000)	16	PUC products	Hanguk PUC Co
EQ336306	372	(4,000)	16	Paper bags	Ssangyong Cement Co
EQ335300	30 672	(330,000)	14	Fertilizer	Yongnam Chemical Co
EQ343294	43 684	(470,000)	19	Bagged sugar	Samyang Sugar Refinery
Total	122 966	(1,323,000)			

terminal. A large tank farm owned by KOCO is located about 4 kilometers (2.5 miles) south of the terminal. This tank farm has a storage capacity of 8,848 million barrels, consisting of 3,695 million barrels of crude oil storage and 5,153 million barrels of refined POL.

4. (U) Rail Operations. Rail loading operations are not possible at the Ulsan Port terminal since rail access to the terminal is not available. The rail facilities closest to the port are located at the Ulsan Port Railroad Station, between 1.3 and 3.2 kilometers (0.8 and 2 miles) from the various wharf locations. As discussed in paragraph A4, this station has no end ramps, but portable ramps or mobile cranes could be used to load flatcars. In addition, the station has no cranes or other materials handling equipment, so they must be provided from external sources. Also, since the station does not have a side dock, boxcars would have to be loaded from portable ramps. About 2,043 meters (6,700 feet) of track are available at the station to support operations.

5. (U) Truck Operations. The terminal has three different wharf locations, all some distance apart. The road access from the wharves to Korean 7, the main supply route, is suitable for military equipment. The

port has no truck docks or end-loading ramps, so portable equipment or mobile cranes would be required for truck-loading operations. The port has eight mobile cranes that could be used to lift nonroadable equipment onto flatbed trucks. The trucks could be loaded in one of the several large, open storage areas adjacent to the wharf aprons. Cranes discharging breakbulk vessels or barges could load the discharged equipment directly onto trucks positioned on the aprons adjacent to the ship. This procedure would prevent the equipment from being handled twice. Cargo to be loaded into vans would be discharged from the ship and transported to an adjacent open area, where portable ramps would be required for forklifts to load cargo into vans. The port has 11 forklifts that could be used but no portable ramps.

6. (U) Security. Each of the three separate wharf locations are surrounded by concrete walls or wire fences. The entire perimeter of each area is lighted, and access to and from the areas is permitted only through manned security gates. The port has seven guard posts, which are manned throughout the day. Security guards also patrol throughout each of the three wharf areas.

D. (U) Support Services

1. (U) Pilotage. Pilotage is mandatory for entrance into the Port of Ulsan. Four pilots and one pilot boat are available to provide pilot service throughout the day. These pilots also serve the Ports of Mipo, Onsan, and Yompo and usually board ship at the quarantine anchorage located in the lower section of Ulsan Bay. The port plans to hire two additional pilots in 1984.

2. (U) Harbor Craft. Seven berthing tugboats - one 650 horsepower (hp), one 1,5000 hp, one 2,000 hp, one 2,200 hp, two 2,600 hp, and one 3,200 hp - are available for use at the Port of Ulsan. The port also has 18 wood and steel barges that vary between 100 and 300 STON in capacity. These harbor craft are also used at the Port of Onsan.

3. (U) Stevedores. About 770 stevedores are registered with the Ulsan Branch of the National Docker's Union. They serve the Port of Ulsan, as well as the Ports of Mipo, Onsan, and Yompo. Gang size varies according to the type of cargo, but the stevedores are divided into 35 groups, with 22 stevedores per group. Each group consists of two teams, with 11 stevedores each. The following companies are located in Ulsan:

a. Daewon Express Company, Ltd.

b. Dongbang Forwarding Company, Ltd.

c. Global Enterprises Company, Ltd.

d. Korea Express Company, Ltd.

e. A-Nam Transportation Company, Ltd.

f. Hyopsin Heavylift Company, Ltd.

g. Sambo Transportation Company, Ltd.

4. (U) Supplies and Utilities. Freshwater is available at water points at the wharves and can be supplied to ships at anchorage from three water barges ~~operating at the port.~~

E. (U) Future Developments

Port officials plan to begin construction of several new wharf facilities in 1984. The small inlet along the southern shore of the port terminal is to be reclaimed and a new marginal wharf, wharf 6, is to be constructed. The wharf may be designed for container operation; however, this was uncertain at the time of the field visit. Port officials also plan to reclaim additional area in the southeast quadrant of the port terminal for the development of a new wharf, wharf 7. Also in 1984 the area between wharves 2 and 3 is to be reclaimed so wharf 2 can be extended south to join wharf 3. These projects would add about 1010 meters (3,313 feet) of marginal wharfage and, thus, greatly increase the throughput capability of the port.

F. (U) Summary

The Port of Ulsan consists of three separate wharf areas. The north area has two deep-draft wharves, the Coal pier and wharf 2, and one shallow-draft wharf, wharf 1. The central area has three deep-draft wharves, wharves 3, 4 (south), and 5, and one shallow-draft wharf, wharf 4 (north); the south area has all shallow-draft wharves. The port is characteristically industrial and handles mainly bulk materials such as coal, sugarcane, cement, and lumber. The wharves can accommodate breakbulk operations as well as side-ramp and slewed stern-ramp RORO operations. No straight stern-ramp facilities are available, but stern-ramp RORO operations are possible for vessels berthed at wharf 4 with ramps positioned on wharf 5. The T-AKR vessel and the LASH and SEABEE vessels cannot be berthed at the wharves, and none of the wharves are designed for commercial container operations. Based on the shipping capabilities of the wharves at Ulsan Port terminal, individual berth rankings have been computed in tables UL-9 and UL-10 for various shipping operations at selected berths. The rankings indicate the berths that are best suited for each shipping operation and the relative suitability of the other selected berths.

TABLE UL-9
INDIVIDUAL BERTH RATING (BARGE)

Ideal Berth Factors	Berths				
	Wharf 1	General Wharf	Lighterage Wharf 1	Lighterage Wharf 2	Lighterage Wharf 3
Length	8	10	10	10	8
Alongside depth	10	10	9	9	9
Backup area	8	5	5	5	5
Apron width	9	10	10	10	10
Consolidation shed	0	0	0	0	0
Apron tracks	0	0	0	0	0
Anchorage diameter	10	10	10	10	10
Conditional age of facility	10	10	10	10	10
Deck loading	9	9	9	9	9
Heavy-lift cranes	5	7	9	9	7
Berth type	10	10	5	10	10
Truck tailgate	0	0	0	0	0
Rail end ramp	0	0	0	0	0
Truck access	5	5	5	5	5
Tug availability	10	10	10	10	10
Barge lay area	10	10	10	10	10
Total Points	104	106	102	97	103
Ranking	2	1	4	5	3

The port has no rail access but rail facilities are available close to the port at the Ulsan Port

TABLE UL-10
INDIVIDUAL BERTH RATING (BB/RORO)

Ideal Berth Factors	Berths				
	Coal Pier	Wharf 2	Wharf 3	Wharf 4 South	Wharf 5
Length	20	20	20	10	18
Alongside depth	20	20	14	14	20
Backup area	2	10	5	0	2
Apron width	20/20	20/20	20/20	20/20	20/20
Transit shed	0/NR*	0/NR	0/NR	0/NR	0/NR
Distribution shed	0/NR	0/NR	0/NR	0/NR	0/NR
Apron tracks	0	0	0	0	0
Deck loading	8	8	8	8	8
Heavy-lift cranes	0	0	0	9	0
Berth type	8	10	10	10	10
Truck tailgate	0	0	0	0	0
Rail end ramp	0	0	0	0	0
Truck access	5	5	5	5	5
Ship service facilities	4	4	4	4	4
Conditional age of facility	10	10	10	10	10
RORO stern ramp	NR/5	NR/5	NR/5	NR/5	NR/5
Total Points	97/102	107/112	96/101	84/89	97/102
Ranking	2/2	1/1	3/3	4/4	2/2

*NR - Not rated.

Railroad Station. Although this station could be used as a railcar loading site, many limitations, including no end-loading ramps, only one side-loading dock, and no materials handling equipment, reduce its capability to support railcar loading operations.

Highway access from each of the three wharf areas is provided by unnamed access roads that lead to Korean 7. The access to Korean 7, which varies between 8 and 9.7 kilometers (5 and 6 miles) from the wharf areas, is suitable for military unit equipment. Although the terminal has no truck docks or end-loading ramps, the port has eight mobile cranes available that could be used to load flatbed trucks. The port also has access to 11 forklifts that could be used to load vans if portable ramps were made available.

The terminal has seven large areas that provide a total of 203 715 square meters (50.3 acres) of open storage. The port has no covered storage or POL storage facilities, although they are available near the port. Pilot service is available and mandatory, and the port is serviced by seven tugboats and about 770 stevedores.

Although the port terminal is located 4 kilometers (2.5 miles) east of the city of Ulsan, a population of about 10,000 lies within 2000 meters (6,560 feet) of the wharves. Land use surrounding the port is primarily industrial and includes the large KOCO refinery, about 2500 meters (8,200 feet) from the wharves, and the KOCO tank farm, with a capacity of 8,848 million barrels, about 4000 meters (13,120 feet) from the wharves. Several other major industrial complexes lie within 2000 meters (6,560 feet) of the wharves. Most of these activities fall well within the 2500-meter (8,200-foot) quantity-distance arc established for a notional breakbulk ammunition ship and the 2800-meter (9,184-foot) arc established for a notional container ship.

(U) PORT OF ONSAN

A. (U) General Description

1. (U) Location and General Uses. The Port of Onsan (fig ON-1), located on the eastern seacoast of Korea, is about 16 kilometers (9.9 miles) south of the central business district of Ulsan, 47 kilometers (29.2 miles) north of Pusan, and 431 kilometers (267.8 miles) southeast of Seoul. This industrial port is under the jurisdiction of the Ulsan District Maritime and Port Administration. The port handles mainly bulk materials, which include POL, copper, zinc, and other minerals associated with the industries that surround the port.

2. (U) Harbor. The Port of Onsan is located at the mouth of Oehwang River, which flows from the west and empties into Ulsan Bay. The port is situated on a natural inlet in the lower section of Ulsan Bay. Since this part of the bay is open to the Sea of Japan, breakwaters were constructed to enhance the natural protection already afforded the harbor.

The length of the north and south breakwaters is 1350 meters (4,428 feet) and 1010 meters (3,313 feet), respectively. During adverse weather, the breakwaters provide good protection for ships in the harbor, but during extremely bad weather, the harbor is no longer a safe haven. The southeast access channel to the harbor has no overhead obstructions. It changes course in the harbor and runs south toward the wharf area. The channel width is 200 meters (656 feet), and the draft varies from about 18 meters (59 feet) between the breakwaters to about 11 meters (36 feet) near the wharf. The average tidal range in the harbor is 0.4 meter (1.3 feet) and the mean high water interval is 7 hours 25 minutes.

Although Oehwang River must run through the harbor to empty into Ulsan Bay, it does not cause a silting problem in the harbor. The port does not have a dredging program, but soundings are taken periodically throughout the harbor to ensure that established drafts are maintained. The bottom of the harbor is composed mainly of mud and shells with occasional outcroppings of rock toward the shores.

No turning basins have been designated in the harbor, but space is available in the northern section of the harbor for a turning basin with a diameter of 450 meters (1,476 feet) and a minimum draft of 16 meters (52 feet). Another turning basin with a diameter of 350 meters (1,148 feet) and a draft of 12 meters (39 feet) could be located in the southern section of the harbor. However, use of these areas would block channel access and may restrict the use of fishing nets in the vicinity. Nets are currently used throughout the harbor. Although the harbor has no anchorages, numerous anchorages are available in Ulsan Bay. These anchorages are described under "Port of Ulsan."

3. (U) Highway Access. An unnamed road provides access from the port to the main supply route. The road extends about 1.5 kilometers (0.9 mile) from Main Gate (the only gate at the port) to Local Route 1019. Local 1019 leads north about 10.1 kilometers (6.3 miles) and intersects with Korean Route 14. Korean 14 runs south to Pusan, as well as north about 6.8 kilometers (4.2 miles) to Ulsan and Korean Route 7, the main supply route in this region. Korean 7, a north-south route, extends along the entire east coast of Korea. Korean 7 intersects Superhighway 8, a four-lane limited access road, about 6 kilometers (3.6 miles) south of Ulsan. Superhighway 8 runs west about

14 kilometers (8.7 miles) and intersects Superhighway 1, a four-lane limited access road that leads north to Seoul and south to Pusan. The access route consists of all two- or four-lane roads, with no overhead clearance restrictions. This route would be suitable for military unit equipment and supply trucks.

4. (U) Rail Access. Since the trackage from the Korean National Railroad does not extend to the port terminal, the port does not have rail access. The trackage nearest the port is at the Onsan Railroad Station, which is located about 1 kilometer (0.6 mile) south of the wharf. The branch line that provides access to the station separates from the main-line network in Namchang and runs west to the station. Spur tracks from the station run north to provide access to the local zinc, copper, and POL refineries and POL tank farm. The station has a total of 2197 meters (7,206 feet) of trackage; however, 793 meters (2,601 feet) of this trackage is not through track. This includes a 702-meter (2,302-foot) siding and a 91-meter (298-foot) spur track. The railcar capacities of these lines are 54 and 7 railcars, respectively. The station has no end-loading ramps or side docks, but a portable ramp could be positioned at the end of the spur track and used to end load flatcars. Nor does it have cranes, materials handling equipment, or switching locomotives. The zinc, copper, and POL refineries all own and operate their own switching locomotives and perform their own switching operations. The station has about 16 200 square meters (4 acres) of unpaved, open storage space adjacent to the spur track. Highway access from the port terminal to the station is suitable for military unit equipment and supply trucks.

5. (U) Airports. No helipads are available near the port. The closest airports are located in Pohang, about 92 kilometers (57 miles) north of the port, and in Pusan, about 48 kilometers (30 miles) south of the port. Pohang Airport has a concrete runway that is 2134 meters (700 feet) long and 46 meters (150 feet) wide. The airport is capable of supporting intertheater aircraft. Pusan Airport has an asphalt runway that is 2012 meters (6,600 feet) long and 46 meters (150 feet) wide. The runway is capable of supporting only intratheater aircraft.

B. (U) Onsan Port Terminal

1. (U) Berthing. The terminal (fig ON-2) has only one wharf (fig ON-3). The wharf has adequate draft and length to accommodate deep-draft oceangoing vessels. However, the wharf is encumbered with an elevated conveyor system and a rail-mounted 12.5-STON whirley crane equipped with a clamshell for handling bulk materials. The conveyor system is located about 12 meters (39 feet) from the edge of the apron and, thus, restricts the apron space available for shipping operations. Since the rails supporting the cranes are raised above the apron surface, they would be subject to damage from mobile cranes, RORO ramps, and vehicles driven onto the apron.

The harbor also has a POL dolphin located in its northern section. The specific characteristics of the wharf and dolphin are summarized in table ON-1. Based on the characteristics of the wharf, its suitability for unloading various types of vessels will be determined as follows.

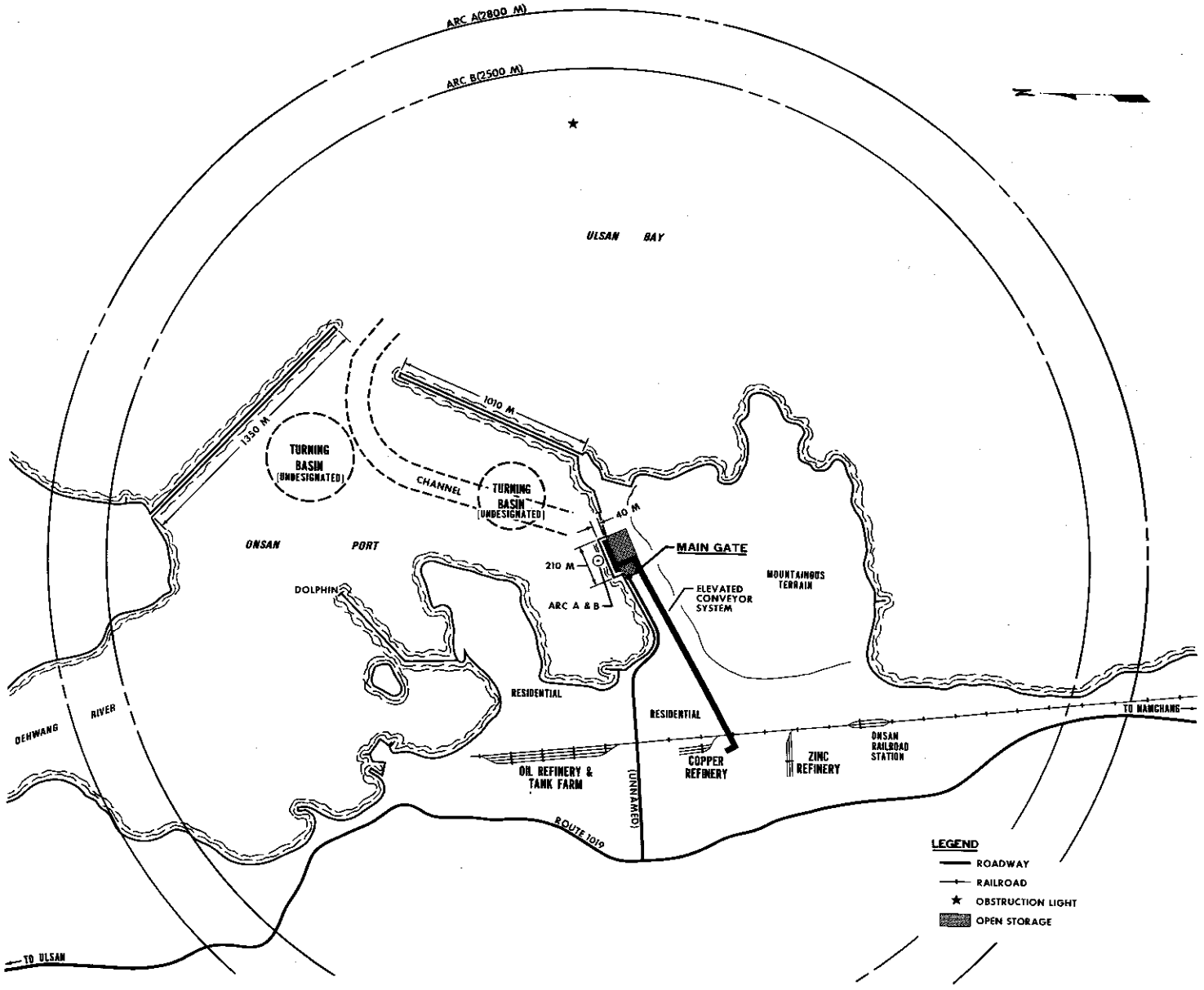


Figure ON-2. Site map.

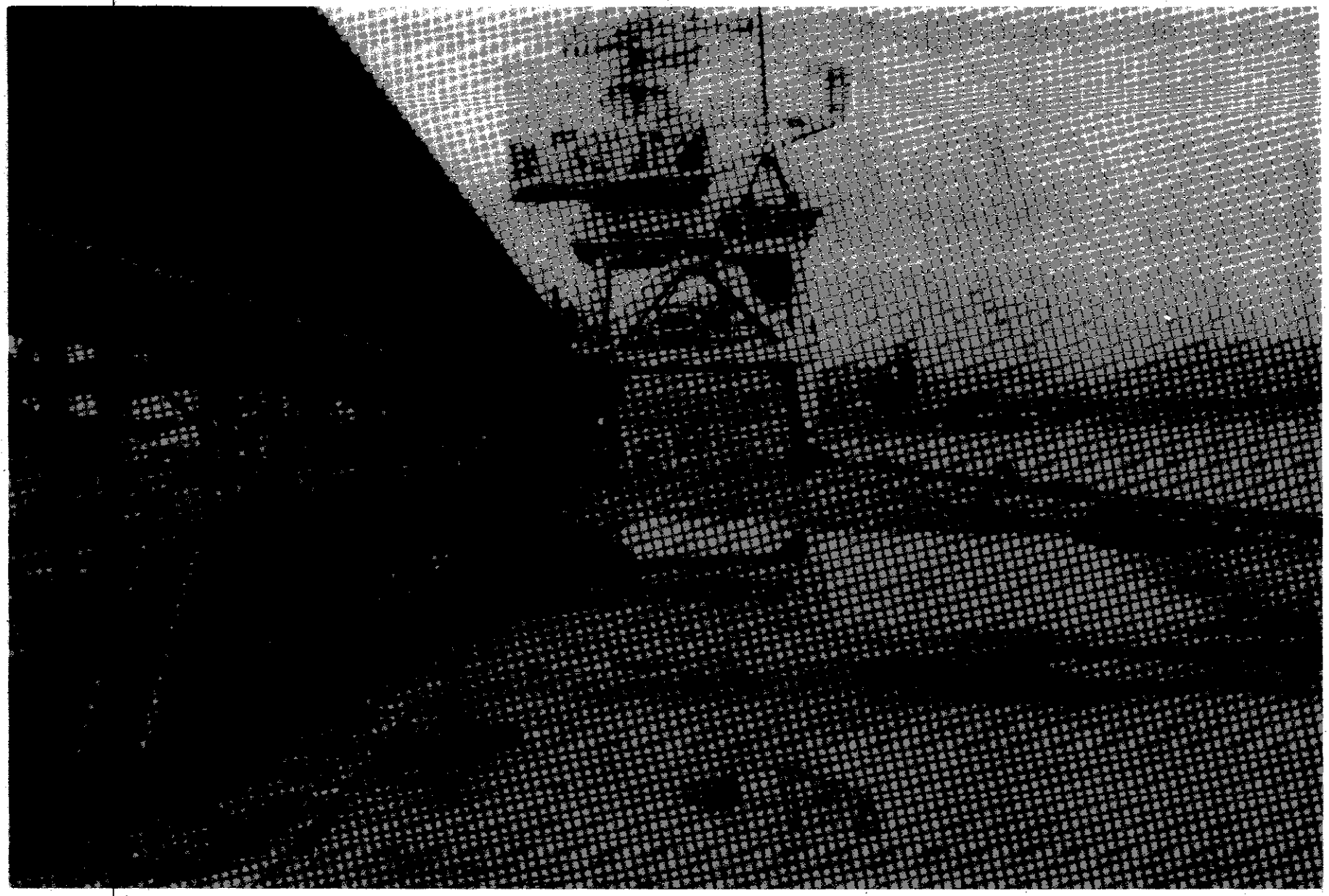


Figure ON-3. Raw material wharf (southwestward view).

TABLE ON-1
PORT OF ONSAN
OPERATED BY: ULSAN DISTRICT MARITIME AND PORT ADMINSTRATION

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m (ft)	Individual Berth	Berth Length m (ft)	Approximate Apron Width m (ft)	MLW m (ft)	Approximate Apron Heigh Above MLW m (ft)	Deck Strength[1] (psf)	Serviced by Rail-Mounted Crane	Rail Access to Apron
Raw materials wharf	1	Marginal	210 (689)	1	210 (689)	12 (39.4)	11.0 (36.1)	2.2 (7.2)	628	Yes[2]	No
POL dolphin	1	Dolphin	800 (2,624)	1	800 (2,624)	NA[3]	12.0 (39.4)	NA	NA	NA	NA

Rail-mounted cranes	Serving Berths	Roll-on/Roll-off Facilities	Serving Berths	Open Storage m^2 (acres)	Serving Berths	Covered Storage	Serving Berths
12.5-STON whirley crane	Raw materials wharf	None	-	12 600 (3.1)	Raw materials wharf	None	-

[1] Estimated values.
[2] Crane is currrently equipped with a clamshell bucket and is used to load bulk materials.
[3] NA - not applicable.

a. (U) RORO Operations. The wharf has no facilities for straight stern-ramp RORO operations, and the conveyor system restricts the apron width, so side-ramp RORO operations are not possible. Since the apron width would be adequate for slewed stern-ramp operations, the wharf could accommodate one Maine-class RORO vessel. However, care would be required in positioning the ramp on the wharf so that the rail supporting the crane is not damaged. The crane could be pushed aside as needed to provide space for discharging slewed stern-ramp vessels. The wharf has insufficient length and apron width to accommodate the T-AKR vessel.

b. (U) Breakbulk Operations. The wharf is capable of supporting all of the US-flag and Korean-flag breakbulk vessels. The apron width is adequate for discharge operations; however, the wharf crane, with a capacity of only 12.5 STON, could not handle heavy lifts. Also, since the port has no heavy lift mobile cranes, these cranes must be provided for military unit equipment. The proximity of the elevated conveyor system limits the space available for crane operations and may slow unloading operations.

c. (U) LASH and SEABEE Operations. LASH and SEABEE barges could be unloaded at the wharf; however, the port has no mobile cranes and the wharf crane is incapable of handling heavy lifts. As a result, heavy-lift mobile cranes would have to be supplied to support barge discharge operations. During normal barge operations, each crane would establish a loading

position and would require adequate wharfage for two barges. Therefore, based on the wharf's barge capacity of 11 LASH or 7 SEABEE barges, several cranes could be used to establish multiple loading sites along the wharf. Abundant space is available throughout the harbor for staging barges. The seven tugboats described under "Port of Ulsan" also provide tug service at the Port of Onsan. The large LASH and SEABEE vessels could be berthed only at the anchorages in Ulsan Harbor. These anchorages, which are also described under "Port of Ulsan," are vulnerable to rough seas from the south and east, but they are sufficiently sheltered so that barge operations should be possible most of the time.

d. (U) Container Operations. The wharf is not intended to be used as a container ship berth, although it can accommodate the physical characteristics of most of the container ships used in this study. The port has no container or mobile cranes that could be used to discharge container ships, nor does it have the container handling equipment or large open storage areas for handling and staging containers. To prevent double handling of containers at staging areas, containers could be loaded directly onto chassis as they are discharged from the ship and then transported to the port on the same chassis. However, truck access to and from the apron is very restricted because of the elevated conveyor system and the rail-mounted crane. Therefore, although the wharf could accommodate container ships, many limitations reduce the capacity of the wharf to handle containers.

e. (U) Summary of Berth Availability. The capability of the wharf at the Port of Onsan to handle various US-flag and Korean-flag vessels is summarized in tables ON-2 and ON-3, respectively. The tables show, for each type of vessel, the number the wharf could accommodate or the characteristics that make the wharf unsuitable.

As shown in the tables, the wharf can accommodate both US-flag and Korean-flag vessels. While the wharf could support slewed stern-ramp RORO operations, no facilities are available for straight stern-ramp operations. Also, the narrowness of the apron prevents side-ramp RORO operations and the wharf is inadequate for the T-AKR vessel. If cranes were made available, barges could be handled at the wharf, and LASH and SEABEE vessels could be anchored in Ulsan Bay. The wharf can accommodate most of the container ships used in this study; however, port facilities and equipment necessary for container operations are not available.

f. (U) Safety Considerations. The area surrounding the Onsan Port Terminal is not heavily populated. A population of only 3,000 lies within 2000 meters (6,560 feet) of the wharf. The wharf is situated at the foot of a hill that rises to an elevation of 90 meters (295 feet) just south of the port. Land use near the port is mainly industrial and includes an oil refinery and tank farm, which are located about 1000 meters northwest of the wharf. The farm has a capacity of 4,537 million barrels. Copper and zinc refineries are located about 1200 and 1500 meters (3,936 and 4,920 feet) from the wharf, respectively. Therefore, these activities fall well within the 2500-meter (8,200-foot) quantity-distance arc established for a notional break-bulk ammunition ship and the 2800-meter (9,184-foot) arc established for a notional container ship.

TABLE ON-2
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF ONSAN

US-Flag Ship Type	Berth: Raw Materials Wharf
RORO	
GTS Callaghan	b,c,d
USNS Comet	b,d
Maine-class	1,d
Breakbulk	
C4 Mariner-class	1
C4-5-58a	1
C3-5-38a	1
C3-5-33a	1
Barge	
LASH C8-5-81B	a,c,f
LASH barge	11
SEABEE C8-5-82A	a,c,f
SEABEE barge	7
Seatrain	
Georgia-class	1
Puerto-class	1
Container	
C6-5-1W	1,e
C7-5-68E	c,e
C8-S-85B	1,e
RORO/Container	
C5-5-78	b,e
T-AKR (SL-7)	b,c,e
Breakbulk/Container	
C5-5-37E	1,e
C4-5-10	1,e

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.
f - Inadequate draft for barge ship at berth; however, ship could be unloaded from anchorage.

TABLE ON-3
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF ONSAN

Korean-Flag Ship Type	Berth: Raw Materials Wharf
Breakbulk	
Type 1	5
Type 2	2
Type 3	2
Type 4	2
Type 5	2
Type 6	1
Type 7	2

2. (U) Materials Handling Equipment. The only lifting capability at the port is the 12.5-STON wharf crane. The port maintains two 5-STON and one 2-STON diesel forklifts that could be used to load general cargo into vans if portable ramps were made available.

3. (U) Storage Areas

a. (U) Open Storage. The port terminal has only one open storage area (fig ON-4), which is located immediately south of the wharf. This area consists of 6000 square meters (1.5 acres) of paved surface adjacent to the apron and 6600 square meters (1.6 acres) of rough, graded soil surface between the paved area and the hill on the southern boundary of the port. Since the paved storage area is separated from the wharf apron by the elevated conveyor system, access between the

Figure ON-4. Open storage area (southwestward view).

open area and the apron is only possible at either end of the conveyor system. The soil surface area would be suitable only during dry weather and would require regrading before it could be used.

b. (U) Covered Storage. The port terminal has no covered storage facilities.

c. (U) POL Storage. The port maintains no POL storage facilities; however, a large tank farm is located about 1 kilometer (0.6 mile) northwest of the wharf. POL materials are pumped through submerged pipes that run from the tank farm to ships tied to a dolphin in Onsan Harbor. The total storage capacity of the farm is 4,537 million barrels, consisting of 2,400 million barrels of crude oil, 1,200 million barrels of finished products, 667 million barrels of lube oil, and 270 million barrels of intermediate products.

4. (U) Rail Operations. Railcar loading operations are not possible at the Onsan Port terminal since rail access to the terminal is not available. The rail facilities closest to the port are at the Onsan Railroad Station, about 1 kilometer (0.6 mile) south of the port. Highway access from the port to the station is suitable for military unit equipment and supply trucks. As discussed in paragraph A4, the station has no side docks, end ramps, cranes, materials handling equipment, or switching engines. One spur track, with a 7-railcar capacity, could be equipped with a portable end ramp, and one siding, with a 54-railcar capacity could be used for railcar storage. Therefore, the station has no current railcar loading capacity; but, with support equipment enhancements, a limited loading capability could be developed.

5. (U) Truck Operations. Truck access to and from the terminal is through Main Gate, the only access gate. All roads on the terminal are paved and in good condition, so truck travel would not be impeded. However, wharf access is restricted by the elevated conveyor system, and the rail-mounted crane is accessible only from either end of the conveyor system. Since the port has no truck side-loading docks or end-loading ramps, portable equipment and mobile cranes would be required for truck loading. Also, the port has no mobile cranes that could be used to load flatbeds and has only three forklifts that could be used to load vans if portable ramps were provided. Vans could be loaded in the open area adjacent to the wharf, and flatbeds, positioned on the apron next to the ship, could be loaded by the cranes used to discharge the ship.

6. (U) Security. Security measures used at the port terminal provide a low level of security. The terminal has no perimeter barriers and employs only one guard per shift. This guard is posted at Main Gate. Since the wharf is backed by a hill along its southern border, perimeter barriers to secure the area would be required only at either end of the wharf. Therefore, the level of security at the port could be increased easily and rapidly if needed.

D. (U) Support Services

1. (U) Pilotage. Pilotage is mandatory for entrance into the Port of Onsan. Four pilots and one pilot boat are available to provide pilot service throughout the day. These pilots also serve the Ports of Ulsan, Mipo, and Yompo and usually board ship at the quarantine anchorage located in the lower part of Ulsan Bay. Two additional pilots are expected to be hired in 1984.

2. (U) Harbor Craft. Seven berthing tugboats - one 650 horsepower (hp), one 1,500 hp, one 2,000 hp, one 2,200 hp, two 2,600 hp, and one 3,200 hp - are available for use at the Port of Onsan. The port also has access to 18 wooden and steel barges that vary between 100 and 300 STON in capacity. These harbor craft are also used at the Port of Ulsan.

3. (U) Stevedores. About 770 stevedores are registered with the Ulsan Branch of the National Docker's Union. They serve the Ports of Ulsan, Mipo, and Yompo as well as Onsan. Gang size varies according to the type of cargo, but the stevedores are divided into 35 groups, with 22 stevedores per group. Each group consists of two teams, with 11 stevedores each. The stevedore companies in Ulsan are:

a. Daewon Express Company, Ltd.

b. Dongbang Forwarding Company, Ltd.

c. Global Enterprises Company, Ltd.

d. Korea Express Company, Ltd.

e. A-Nam Transportation Company, Ltd.

f. Hyopsin Heavylift Company, Ltd.

g. Sambo Transportation Company, Ltd.

E. (U) Future Developments

Presently, the port has no future development projects.

F. (U) Summary

The Port of Onsan is an industrial port that handles mainly bulk materials such as POL, copper, zinc, and other minerals associated with the industries that surround the port. The port has only one marginal wharf. This wharf has an adequate draft for most of the US-flag vessels and all of the Korean-flag vessels used in this study. However, the wharf cannot accommodate the T-AKR vessel or the LASH and SEABEE vessels. It can support slewed stern-ramp RORO operations, but not side-ramp or straight stern-ramp operations. The wharf has a 12.5-STON whirley crane that could accomplish light lifts from breakbulk ships and barges. Various limitations reduce the container capability of the port, although the berth can accommodate most of the container ships used in this study. Based on these shipping capabilities of the wharf, the wharf has been rated in tables ON-4 and ON-5.

The port has no rail access, but rail facilities are available close to the port at the Onsan Railroad Station. If support equipment were provided, this station could be developed as a low-volume railcar loading site; however, at present, the station has no end-loading ramps, side docks, or materials handling equipment to support railcar loading operations. Highway access from the terminal to the main supply routes is adequate for military unit equipment and supply trucks. Terminal roads are paved and are suitable for military unit equipment; however, wharf access is restricted by the bulk conveyor system and the rail-mounted cranes. The terminal has no end ramps, side docks, or mobile cranes and has only three forklifts that could be used to load vans if portable ramps were provided.

TABLE ON-4
INDIVIDUAL BERTH RATING (BB/RORO)

Ideal Berth Factors	Berth
	Raw Materials Wharf
Length	16
Alongside depth	20
Backup area	2
Apron width	14/5
Transit shed	0/NR
Distribution shed	0/NR
Apron tracks	0
Deck loading	8
Heavy-lift cranes	3
Berth type	10
Truck tailgate	0
Rail end ramp	0
Truck access	5
Ship service facilities	4
Conditional age of facility	10
RORO stern ramp	NR/5
Total Points	92/88
Ranking	1/1
NR - not rated	

TABLE ON-5
INDIVIDUAL BERTH RATING (BARGE)

Ideal Berth Factors	Berth
	Raw Materials Wharf
Length	10
Alongside depth	10
Backup area	8
Apron width	7
Consolidation shed	0
Apron tracks	0
Anchorage diameter	10
Conditional age of facility	10
Deck loading	9
Heavy-lift cranes	5
Berth type	10
Truck tailgate	0
Rail end ramp	0
Truck access	5
Tug availability	3
Barge lay area	10
Total Points	97
Ranking	1

The port has one 12 600-square-meter (3.1-acre) open storage area. However, only half of the area is paved and the remaining half would require grading before it could be used. The terminal has no covered storage or POL storage facilities. Pilot service is available and mandatory, and the port has access to the seven tugboats and 770 stevedores that also serve the Port of Ulsan.

The port is not located near heavily populated areas, but a population of 3,000 is located within 2000 meters (6,560 feet) of the wharf. A hill forms the southern border of the terminal and industrial complexes are located to the north and west. Industries surrounding the terminal include copper and zinc refineries, which are about 1200 and 1500 meters (3,936 and 4,920 feet) from the wharf, respectively. Also, a large oil refinery and tank farm, with a total storage capacity of 4,537 million barrels, are located about 1000 meters (3,280 feet) from the wharf. Therefore, these activities fall well within the 2500-meter (8,200-foot) quantity-distance arc established for a notional break-bulk ammunition ship and the 2800-meter (9,184-foot) arc established for a notional container ship.

V. SOUTH COAST PORTS (U)

(U) PORT OF PUSAN

A. (U) General

1. (U) Location and General Uses. The Port of Pusan, which is under the jurisdiction of the Pusan District Maritime and Port Authority, is located on the southeastern corner of the Korean Peninsula. This port is the largest in Korea and is located in the second largest city, which has a population of 3.5 million, in Korea. Currently, the port handles more than 25 million MTON of import-export cargo annually. The predominant commodities moving through the port include coal, grain, cement, wheat, fertilizer, and logs, as well as different types of military cargo.

This port played a vital role in the Korean Conflict, when it was the largest US-operated military port overseas, with monthly volumes of more than 1/2 million tons of military and relief cargo and over 1-1/2 million troops using the port as a port of entry or debarkation.

2. (U) Harbor. Pusan's harbors are approached from the Korea Strait, which is the wide passage of water lying between the southeast coast of Korea and Tsushima Island in Japan.

The northern inner harbor of Pusan is entered between Seungdu-Mal on the north and Yeong-Do Island on the south (fig P-1). Oryug-Do, a chain of high rocks, extends about 800 meters (1/2 mile) southwestward from Seungdu-Mal. These rocks rise to an elevation of 66.4 meters (218 feet) and mark the northeastern edge of the harbor limits. Lights are used on Oryug-Do

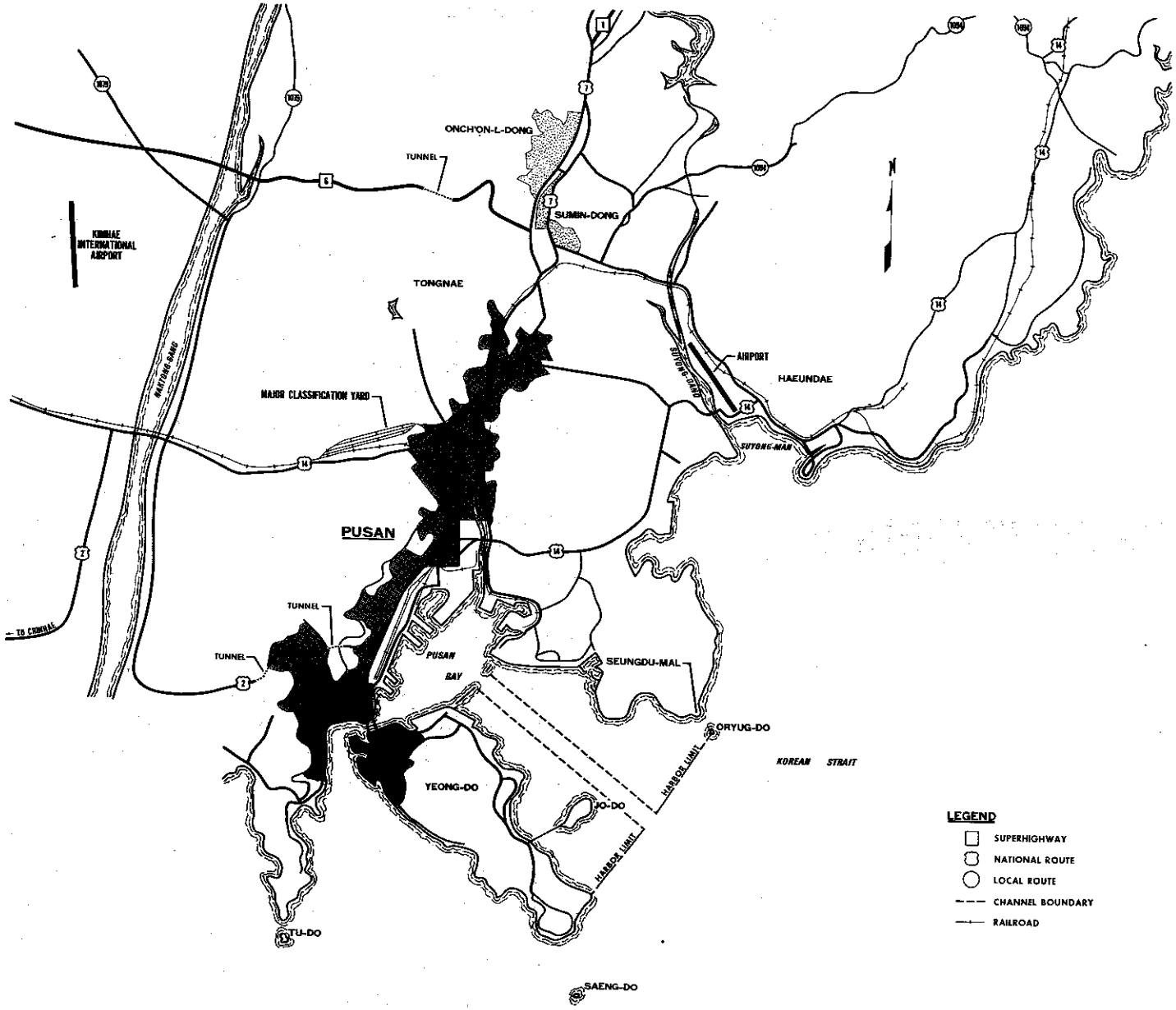


Figure P-1. Vicinity map.

and the southeast extremity of Yeong-Do. Also, fog signals are sounded at these stations.

Vessels should approach the inner harbor (fig P-2) bearing 310°, with their lights on the head of the north breakwater. This course leads vessels to about 275 meters (300 yards) southwest of shallow water. When the beam of Kochi-Cho's light buoy can be seen about 400 meters (440 yards) off the port bow, vessels should adjust their course to pass midway between the heads of the breakwaters.

The entrance to the southern harbor of Pusan is about 4 miles wide and is located between Saeng-Do Island, about 1.2 kilometer (3/4 mile) south of Yeong-Do Island, and the Tu-Do Island, directly south of Pusan South Harbor.

Pusan's inner harbor is about 5 kilometers (3 miles) long and 1.8 kilometers (1.4 mile) wide. This natural coastal harbor is sheltered from the north and west by surrounding hills and from the south by Yeong-Do Island. The inner harbor is also protected from the southeast by two breakwaters that extend across most of the inner harbor entrance. This harbor is considered a typhoon shelter and is ice free throughout the year.

Within the inner harbor, the mean high water interval is 8 hours 4 minutes. The mean tidal range is 1.4 meter (4.7 feet), the spring rise is 1.6 meters (5.4 feet), and the neap rise is 1.2 meter (4.1 feet).

Pusan's outer harbor is about 5.6 kilometers (3.5 miles) long and 4.8 kilometers (3 miles) wide at its widest areas. It is protected from the north and west by surrounding hills and from the south by Yeong-Do Island. Since breakwaters protect these outer waters, strong winds from the east and south can cause swells of critical proportions. The main passage to the inner harbor runs through the middle of the outer habor. The passage is 180 meters (590 feet) wide, with an average depth of 13 meters (42.6 feet).

Pusan's south harbor is 1.3 kilometer (0.8 mile) long and 0.8 kilometer (0.5 mile) wide. The harbor is protected on the north and west by surrounding hilly terrain and on the east by Yeong-Do Island. Although breakwaters stretch across most of the harbor on the south, strong winds and severe storms from the south can create high seas within this harbor. The south harbor is used primarily by coastal vessels. Most deep-draft vessels cannot enter this harbor because of the draft limitations of 5.9 meters (19.3 feet).

Anchorages are located in both the inner and outer harbors (fig P-2). The critical characteristics of these anchorages are listed in table P-1. As can be seen, the E-series anchorages in the inner harbor and most of the anchorages in the outer harbor are suitable for the types of oceangoing vessels that would call at the Port of Pusan. A quarantine anchorage, which is located in the outer harbor, is also provided. The bottoms of these anchorages are predominantly mud and thus provide good holding ground.

Weather in the area of Pusan would have little effect on operations within the inner harbor. Since this harbor is protected naturally, typhoons and severe

storms affect the port only about twice a year. The prevailing winds, which are northerly and northwesterly, are generally moderate. Rain falls on the average of 105 days per year and the annual precipitation rate is about 54 inches. Rain generally occurs most frequently from June through September. Periods of fog occur most frequently from mid-May to mid-July; however, they are of short duration and visibility is rarely under 500 feet.

3. (U) Highways. Highway access with at least a 4.3-meter (14-foot) vertical clearance is available via Superhighways 1 and 6. Vehicles exiting the port from the berths along the western side of the harbor (piers 1 through 6) would travel Port Road (fig P-3), an eight-lane undivided city arterial, and Korean Route 7 to Superhighway 1, in the northern suburbs of Pusan. The majority of Port Road to Korean 7 is a four-lane undivided city arterial requiring movement through a railroad underpass that narrows to one lane in each direction. This route to Superhighway 1 covers a distance of 16.1 kilometers (10 miles).

Essentially the same route is used for access to Superhighway 6, Korea's southern east-west superhighway. The distance to Superhighway 6 is 22.3 kilometers (7 miles). Other routes that can transport cargo west from the city are Korean Routes 2 and 14 (fig P-1). Korean 2 eventually runs back into Korean 14 about 21 kilometers (13 miles) out of the city, where the roadways must pass over the Naktong-Gang River via a four-lane bridge.

Use of Korean 14 does not require passage through any tunnel to exit the city. This road is one of the access roads to Kimhae International Airport; Superhighway 6 is the other. Korean 14 intersects Superhighway 6 near the city of Kimhae, and Korean Route 25 at Chinyong.

Korean 14 also can be used to transport cargo northward. This route, which is a secondary highway to the city of Ulsan, runs about 67 kilometers (42 miles) to the north of Pusan where access to Superhighway 1 can be gained.

Korean 7 also runs north to Ulsan; however, it intersects Superhighway 8 about 61 kilometers (38 miles) north of Pusan. Superhighway 8 is a 21-kilometer (13-mile) -long, four-lane highway that runs east-west from Korean 7 to Superhighway 1.

Vehicles exiting this port from the eastern side of the inner harbor (piers 7 and 8) must use a two-lane, two-way city street (fig P-4) that provides access to Korean 7 or 14. This street is in marginal condition because of heavy truck use. Also, it is heavily congested during the morning and evening peak-travel periods. Still, it is usable for convoys and the heavy truck traffic associated with military cargo operations.

In summary, from a physical capability standpoint, highway access to and from the berth facilities in Pusan is adequate to support military operations.

4. (U) Rail Access. The city of Pusan is served by two rail lines. Line 1, or the Gyecongbu line, is a standard-gauge, double-track line and is considered to be the main railroad line in Korea. This line exits the city northwest toward Taegu and Seoul. Direct access

TABLE P-1
PUSAN ANCHORAGE DATA

Anchorage Designation	Geographic Location	Site Characteristics				
		Diameter m	(ft)	Depth m	(ft)	Bottom Type
A-1	lat 35°05'27"N long 129°06'03"E	500	(1,640)	10.5	(34.5)	Mud
A-2	lat 35°05'14"N long 129°06'15"E	500	(1,640)	16.0	(52.5)	Mud
A-3	lat 35°05'08"N long 129°06'33"E	500	(1,640)	17.5	(57.4)	Mud
A-4	lat 35°05'02"N long 129°06'53"E	500	(1,640)	21.0	(68.9)	Mud
A-5	lat 35°04'42"N long 129°07'07"E	500	(1,640)	28.0	(91.9)	Mud
A-6	lat 35°05'28"N long 129°06'27"E	500	(1,640)	13.5	(44.3)	Mud
A-7	lat 35°05'27"N long 129°06'46"E	500	(1,640)	16.0	(52.5)	Mud
A-8	lat 35°05'26"N long 129°07'06"E	500	(1,640)	11.5	(37.7)	Mud/Shell
A-9	lat 35°04'58"N long 129°07'12"E	500	(1,640)	29.0	(95.1)	Mud
A-10	lat 35°05'16"N long 129°07'22"E	500	(1,640)	21.0	(68.9)	Gravel
M-1	lat 35°05'57"N long 129°05'03"E	500	(1,640)	9.4	(30.8)	Mud/Shell
M-2	lat 35°05'52"N long 129°05'19"E	500	(1,640)	10.4	(34.1)	Mud
M-3	lat 35°05'48"N long 129°05'35"E	500	(1,640)	10.6	(34.8)	Mud
M-4	lat 35°05'40"N long 129°05'52"E	500	(1,640)	11.3	(37.1)	Mud

TABLE P-1 - cont

Anchorage Designation	Geographic Location	Site Characteristics				
		Diameter m	(ft)	Depth m	(ft)	Bottom Type
M-5	lat 35°05'30"N long 129°04'44"E	500	(1,640)	10.0	(32.8)	Mud
M-6	lat 35°05'19"N long 129°04'58"E	500	(1,640)	11.0	(36.1)	Mud/ Sand
O-1	lat 35°06'12"N long 129°04'30"E	1 050 m x 530 m (3,445 ft x 1,739 ft)		6-9	(19.7-29.5)	Mud
O-2	lat 35°05'45"N long 129°04'10"E	1 050 m x 630 m (3,445 ft x 2,067 ft)		6-9	(19.7-29.5)	Mud
Quarantine	lat 35°04'55"N long 129°05'20"E	1 180	3,872	11-15	(36.1-49.2)	Mud
Inner Harbor						
E-1	lat 35°05'53"N long 129°02'58"E	400	(1,312)	9.5	(31.2)	Mud
E-2	lat 35°06'02"N long 129°03'07"E	400	(1,312)	10.8	(31.4)	Mud
E-3	lat 35°06'09"N long 129°03'18"E	400	(1,312)	10.8	(35.4)	Mud
E-4	lat 35°06'15"N long 129°03'32"E	400	(1,312)	10.0	(32.8)	Mud
E-5	lat 35°06'22"N long 129°03'21"E	400	(1,312)	10.0	(32.8)	Mud
E-6	lat 35°06'15"N long 129°03'06"E	400	(1,312)	10.8	(35.4)	Mud
S-1	lat 35°05'37"N long 129°02'32"E	200	(656)	7.5	(24.6)	Mud
S-2	lat 35°05'41"N long 129°02'32"E	200	(656)	7.5	(24.6)	Sand/ Shell
S-3	lat 35°05'43"N long 129°02'45"E	200	(656)	7.5	(29.5)	Mud/ Shell
S-4	lat 35°05'44"N long 129°02'53"E	200	(656)	12.0	(39.4)	Mud

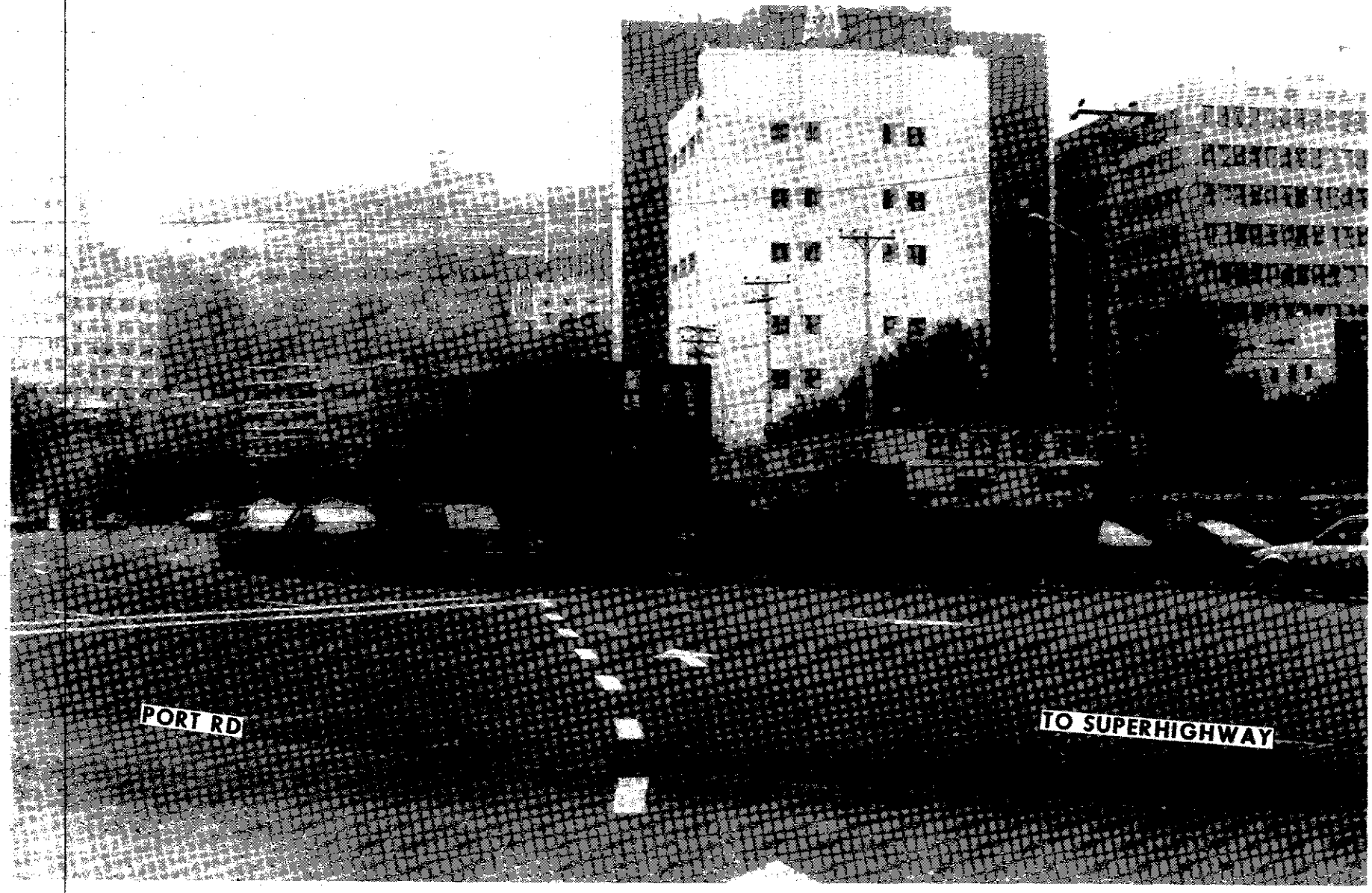


Figure P-3. Port road adjacent to pier 1 (westward view).

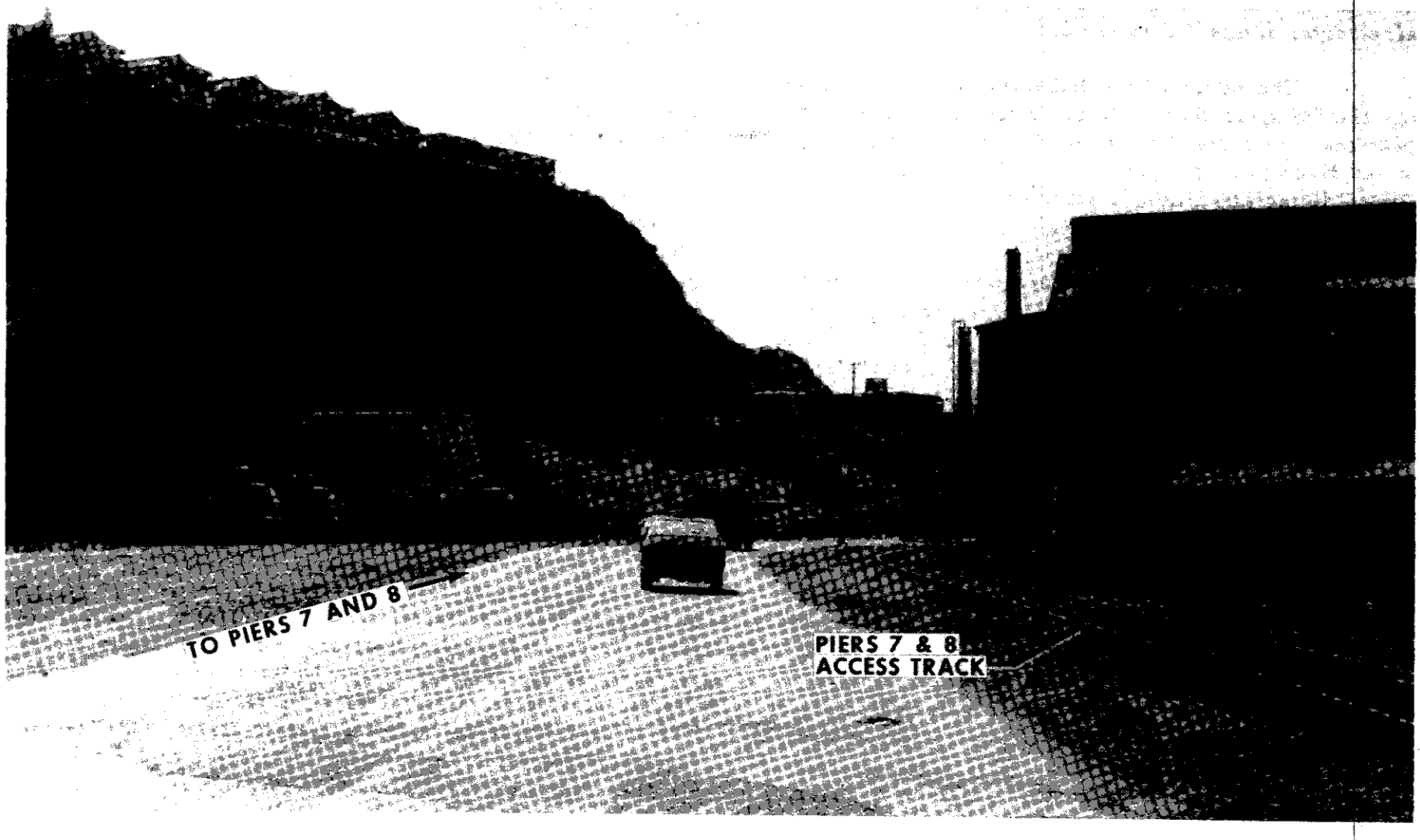


Figure P-4. Piers 7 and 8 access road (eastward view).

to this line via interchange or classification yards can be gained from piers 1 through 6.

The second line that serves Pusan is line 75, or the Donghae Nambu line. This standard-gauge, single-track line exits the city to the northeast toward Ulsan and Kyongju. In Kyongju, line 75 interchanges with line 2 (Jung'ang line), a standard-gauge, single-track line that runs to Seoul.

Three other small lines serve the suburbs of Pusan. Lines 84 and 85 serve the Kaya and Pujon sections of the city to the north. Line 87, or the Uam line, serves the western side of the inner harbor and piers 7 and 8. Line 87 interchanges with line 1.

Rail service to all pier areas is good. Interchange and classification yards in Pusan are adequate to sustain large-scale military cargo operations.

5. (U) Airports. Two airports are located in the Pusan area. Kimhae International Airport, the largest of the two, is located about 22 kilometers (13.7 miles) northwest of the city just south of Superhighway 6. It has one runway 2743 meters (9,000 feet) long and is capable of handling intertheater and intratheater aircraft.

Pusan Airport, located adjacent to the city of Haeundae, is about 12.8 kilometers (8 miles) from the port facilities in Pusan. It has one runway 2011 meters (6,600 feet) long and is capable of handling intratheater aircraft.

B. (U) Facilities at Piers 1 and 2 and Central Wharf

1. (U) Berthing. Three general cargo berths and one ferry berth are located at pier 1, and six general cargo berths are located at pier 2. Four general/bulk cargo berths are located at the Central wharf. Portions of pier 1 and the Central wharf are shown in figures P-5 and P-6. A total of 2,031, 3,036, and 2,120 linear feet of berthing space is available at these two piers and wharf, respectively. The individual characteristics of these berths are summarized in table P-2. The type of ship operations that could be performed at these berths under normal operating procedures are discussed below.

a. (U) RORO Operations. No facilities are available to support stern-ramp RORO operations at piers 1 and 2 or the Central wharf. The ferry terminal has a small stern-ramp facility that possibly could be used; however, it is constructed for light vehicles only, and side-ramp operations are not possible because of its limited apron width. All of the general cargo berths at these two piers and wharf have adequate apron widths for side-ramp RORO operations; however, only berths 3, 5, 6, 8, 9, and 11 through 14 have adequate drafts for the most common type of side-ramp RORO ships. The slewed stern ramps of a Maine-class RORO vessel cannot be positioned at any of the piers 1 and 2 and Central wharf facilities because of draft limitations. No shore-based ramps are available for the Ponce/Great Land-class RORO vessels. If a ramp were available or carried on the vessel, berth 8 at pier 2 and the Central wharf berths are the only berths with enough berth length and apron width to dock this type of vessel; however, arrival draft of the vessel could not exceed 10 meters (32.9 feet). Adequate open storage area is

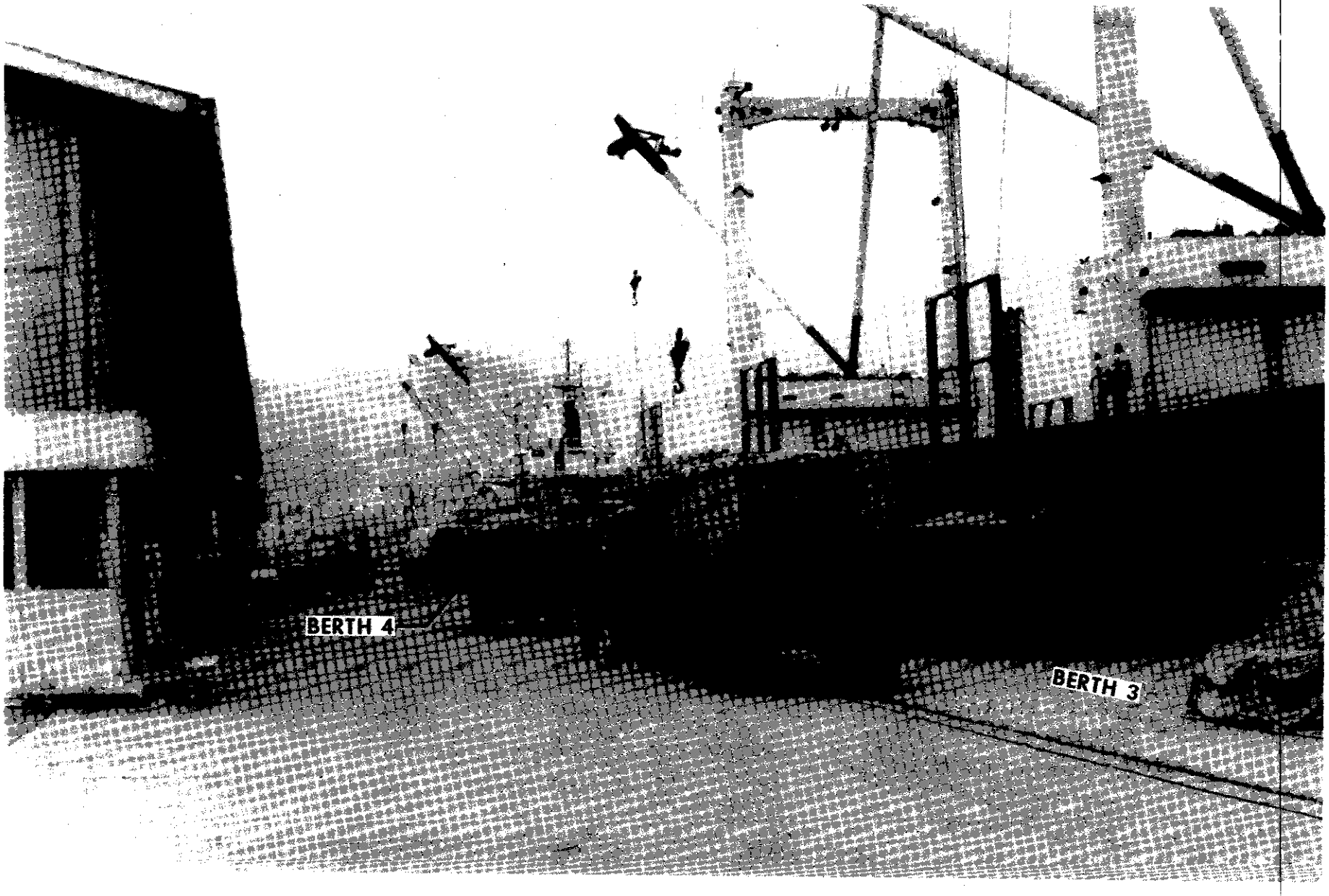


Figure P-5. Pier 1 (northwestward view).

Figure P-6. Discharge operations along Central wharf (northward view).

TABLE P-2
PORT OF PUSAN (PIERS 1 AND 2 AND CENTRAL WHARF)
OPERATED BY: PUSAN DISTRICT MARITIME AND PORT ADMINISTRATION

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Berth Length m	Continuous Berth Length (ft)	Individual Berth	Berth Length m	Berth Length (ft)	Approximate Apron Width m	Approximate Apron Width (ft)	MLW m	MLW (ft)	Approximate Apron Height Above MLW m	Approximate Apron Height Above MLW (ft)	Deck Strength (psf)	Serviced by Rail-Mounted Crane	Railcar Access to Apron
Coastal Ferry wharf	South pier	Pier	249	(817)	NA	249	(817)	30	(98.4)	5	(16.4)	2.8	(9.2)	600	No	No
	North pier	Pier	286	(938)	NA	286	(938)	20	(65.6)	6.5	(21.3)	2.8	(9.2)	600	No	No
Pier 1	Freight quay	Pier	120	(394)	1	120	(394)	40	(131)	6.5	(21.3)	3.3	(10.8)	800	No	No
	Passenger	Pier	200	(656)	2	200	(656)	8	(26.2)	8.5	(28)	3.3	(10.8)	800	No	No
	NE side	Pier	499	(1,637)	3	250	(820)	20	(65.6)	9	(29.5)	3.3	(10.8)	800	No	No
					4	249	(817)	20	(65.6)	8	(26.2)	3.3	(10.8)	800	No	No
Pier 2	SW side	Pier	388.5	(1,275)	5	194	(636)	22	(72.2)	10	(32.8)	3	(9.8)	800	No	No
					6	194	(637)	22	(72.2)	10	(32.8)	3	(9.8)	800	No	No
	Head	Pier	117.4	(385)	7	117.4	(385)	20	(65.6)	7	(23)	3	(9.8)	800	No	No
	NE side	Pier	419.4	(1,376)	8	139.8	(459)	22	(72.2)	10	(32.8)	3	(9.8)	800	No	No
					9	139.8	(459)	22	(72.2)	9	(29.5)	3	(9.8)	800	No	No
					10	139.8	(459)	22	(72.2)	8	(26.2)	3	(9.8)	800	No	No
Central	Freight	Marginal	464.2	(2,120)	11	161.6	(530)	25	(82)	9	(29.5)	2.5	(8.2)	800	No	No
					12	161.6	(530)	25	(82)	9	(29.5)	2.5	(8.2)	800	No	No
					13	161.6	(530)	25	(82)	9	(29.5)	2.5	(8.2)	800	No	No
					14	161.6	(530)	25	(82)	9	(29.5)	2.5	(8.2)	800	No	No

available for marshaling or staging vehicles, and deck strength of the piers is acceptable. In summary, piers 1 and 2 and the Central wharf could accept up to nine RORO ships without excessive congestion.

b. (U) T-AKR Operations. None of the berths at piers 1 and 2 and the Central wharf are adequate for T-AKR vessel, mainly because of the inadequate drafts alongside berths.

c. (U) Breakbulk Operations. Nine typical US-flag breakbulk ships could be berthed at piers 1 and 2 and the Central wharf (table P-3). One each could be docked at berths 3, 5, 6, 8, and 11 through 14. Table P-3 summarizes why the other berths are inadequate. Since no fixed gantry cranes exist at these piers, mobile cranes may be needed to supplement the ship's gear if heavy lifts are required.

Use of these berths by allocated Korean-flag vessels would result in more efficient use of the piers. Almost all of the Korean-flag vessels could be berthed at these piers, as shown in table P-4.

Both of these piers and the Central wharf are lighted for nighttime operations, and both piers have transit sheds for consolidation and/or distribution of cargo if necessary. These two piers and the Central

TABLE P-3
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF PUSAN (PIERS 1 AND 2 AND CENTRAL WHARF)

US-Flag Ship Type	Berths							
	Pier 1				Pier 2			Central Wharf
	1	2	3	4	5-6	7	8-10	11-14
RORO								
GTS Callaghan	a,c,d	a,b,c	1,d	a,d	1,d	a,c,d	1,d	3,d
USNS Comet	a,c,d	b	1,d	a,d	2,d	a,c,d	2,d	4,d
Maine-class	a,c	a,b,c	a	a	a	a,c	a	a
Breakbulk								
C4 Mariner-class	a,c	a	a	a	2	a,c	2	a
C4-5-58a	a,c	a	a	a	2	a,c	2	a
C3-5-38a	a,c	1	1	a	2	a,c	2	4
C3-5-33a	a,c	a	1	a	2	a,c	2	4
Barge								
LASH C8-5-81B	c,f	c,f	f	c,f	f	c,f	f	f
LASH barge	6	10	13	13	20	6	22	34
SEABEE C8-5-82A	c,f	c,f	c,f	c,f	f	c,f	f	f
SEABEE barge	4	6	8	8	13	3	14	21
Seatrain								
Georgia-class	a,c	1	1	a	2	a,c	2	3
Puerto-class	a,c	1	1	a	2	a,c	2	3
Container								
C6-5-1W	a,c,e	a,c,e	a,e	a,e	1,e	a,c,e	1,e	a,e
C7-5-68E	a,c,e	a,c,e	a,e	a,e	a,e	a,c,e	a,e	a,e
C8-S-85B	a,c,e	a,c,e	a,e	a,e	a,e	a,c,e	a,e	a,e
RORO/Container								
C5-5-78	a,c	a,b	a	a	a	a,c	a	a
T-AKR (SL-7)	a,c	a,b,c	a,c	a,c	a	a,c	a	a
Breakbulk/Container								
C5-5-37E	a,c	a	a	a	2	a,c	2	a
C4-5-10	a,c	a	a	a	2	a,c	2	a

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.
f - Inadequate draft for barge ship at berth, however, ship could be unloaded from anchorage.

TABLE P-4
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY -
PORT OF PUSAN (PIERS 1 AND 2 AND CENTRAL WHARF)

Korean-Flag Ship Type	Berths							
	Pier 1				Pier 2			Central Wharf
	1	2	3	4	5-6	7	8-10	11-14
Breakbulk								
Type 1	3	5	7	7	11	3	11	18
Type 2	1	2	3	3	5	1	5	8
Type 3	1	2	3	3	5	1	5	8
Type 4	1	2	2	2	4	1	4	7
Type 5	1	2	2	2	4	1	4	7
Type 6	a	1	2	2	3	1	3	5
Type 7	a,b	1	1	1	3	a,c	3	5

a - Inadequate draft at berth.
b - Inadequate berth length.

wharf are considered excellent for a combination of US-flag and Korean-flag breakbulk discharge operations.

d. (U) LASH and SEABEE Operations. LASH and SEABEE barges can be accommodated at all berths on piers 1 and 2 and the Central wharf; however, mobile cranes and supporting MHE would be required. Piers 1 and 2 can provide 80 LASH or 50 SEABEE barge positions. The Central wharf can provide 34 LASH or 21 SEABEE barge positions. (These figures do not include use of the ferry terminal.) Adequate staging and barge lay areas are available south and east of the piers and east of the Central wharf. Because of their deep-draft requirements, LASH and SEABEE vessels would have to be anchored in the outer harbor in one of the designated anchorages, which have at least 41- and 39-foot depths for LASH and SEABEE vessels.

e. (U) Container Operations. Container handling facilities and conventional container-handling equipment are unavailable at piers 1 and 2 and the Central wharf. The large, open storage areas needed for a container operation are available at the Central wharf but not at piers 1 and 2. If mobile container cranes and other conventional container-handling equipment were made available, the Central wharf could be used as an alternative container port facility.

f. (U) Safety Considerations. As shown in figure P-2, piers 1 and 2 and the Central wharf are located in downtown Pusan near the south side of the city. If an ammunition ship were to be worked at any of these berths, about one-half of the city of Pusan would fall within a quantity-distance arc of 2200 meters. This area includes inhabited buildings, schools, industrial areas, government offices, shipyards, and an estimated population of 2 million.

g. (U) Summary of Berth Availability. Berth available at the locations discussed previously are summarized in tables P-3 and P-4. Included are only those berths that could accommodate the designated vessels without extraordinary docking or materials handling procedures. As shown, these facilities can accommodate many of the typical US-flag and Korean-flag vessels that would call at this port. Based on this information and the onsite inspection of the facilities, piers 1 and 2 are best suited for breakbulk and lighterage operations. Currently, the Central wharf is ideal for breakbulk, RORO, and lighterage operations. With supplemental container equipment, the Central wharf could also be used for container operations.

2. (U) Storage Areas.

a. (U) Open Storage. Piers 1 and 2 and the Central wharf have several improved open storage

areas (figs P-7 through P-9). Open storage areas available for each berth and their general capacity, condition, and use are listed in table P-5. A total of 42 231 square meters (454, 615 square feet) of open storage area is available at these two piers and the wharf. Most of these areas are currently used for storage of bulk products and general cargo. All of these storage areas are suitable for staging vehicles and unit equipment if necessary.

b. (U) Covered Storage. Transit sheds are located adjacent to most berths on piers 1 and 2, but Central wharf has no transit sheds. Transit sheds or warehouses available for covered storage are listed in table P-5. Piers 1 and 2 have two and three transit sheds, respectively; all are served by rail. Each of these warehouses has loading docks that would permit boxcar or truck loading operations. A total of 17 592 square meters (189, 377 square feet) of covered storage is available at these two piers. The transit sheds at pier 1 have 30 doors from which to conduct transfer operations, and the three sheds at pier 2 have a total of 40 doors. These warehouses are in good shape and are considered suitable for military cargo transfer operations.

c. (U) POL Storage. Major storage facilities for petroleum products occupy two locations in Pusan and are owned by the Korean Oil Company (KOCO) and Honam Oil Company (CALTEX). These storage tanks are listed in table P-6 along with their location, use, capacity, and ownership. Bunkering is available for vessels, but the Pusan KMPA should be notified at least 24 hours before the fuel is needed.

3. (U) Rail Operations. The Korean National Railroad operates over the trackage within the port area and provides access to the piers and transit sheds. Piers 1 and 2 and the Central wharf have access trackage to their respective facilities; however, this trackage serves only the open storage areas and the transit sheds. None of the aprons have access spurs to facilitate direct ship-to-railcar transfers. In the middle of pier 1 are two spurs that provide 30 flatcar- or boxcar-loading positions (based on 60-foot equivalents), and in the middle of pier 2 are four spurs that can provide 56 flatcar- or boxcar-loading positions. The Central wharf trackage, which serves only the open storage areas, provides 82 flatcar- or boxcar-loading positions along three spurs. Trackage at these facilities is adequate to sustain military cargo operations.

4. (U) Truck Operations. Piers 1 and 2 have truck docks that run along the entire length of one side of their transit sheds (fig P-7). These transit sheds provide about 60 and 80 positions, respectively, for loading trucks (based on two positions per door). Other locations are available for loading trucks, including the Central wharf; however, loading operations would depend on the availability of portable ramps and mobile cranes for transferring cargo. All of the loading docks are in good condition and can sustain large-scale military operations.

5. (U) Security. Piers 1 and 2 and the Central wharf are bounded on the north by Port Road and on all other sides by water. All of the facilities are surrounded by perimeter fences on the landside and by water on all other sides. Each pier or wharf has one gate entrance, which is constantly manned. Also, security guards constantly patrol throughout the area

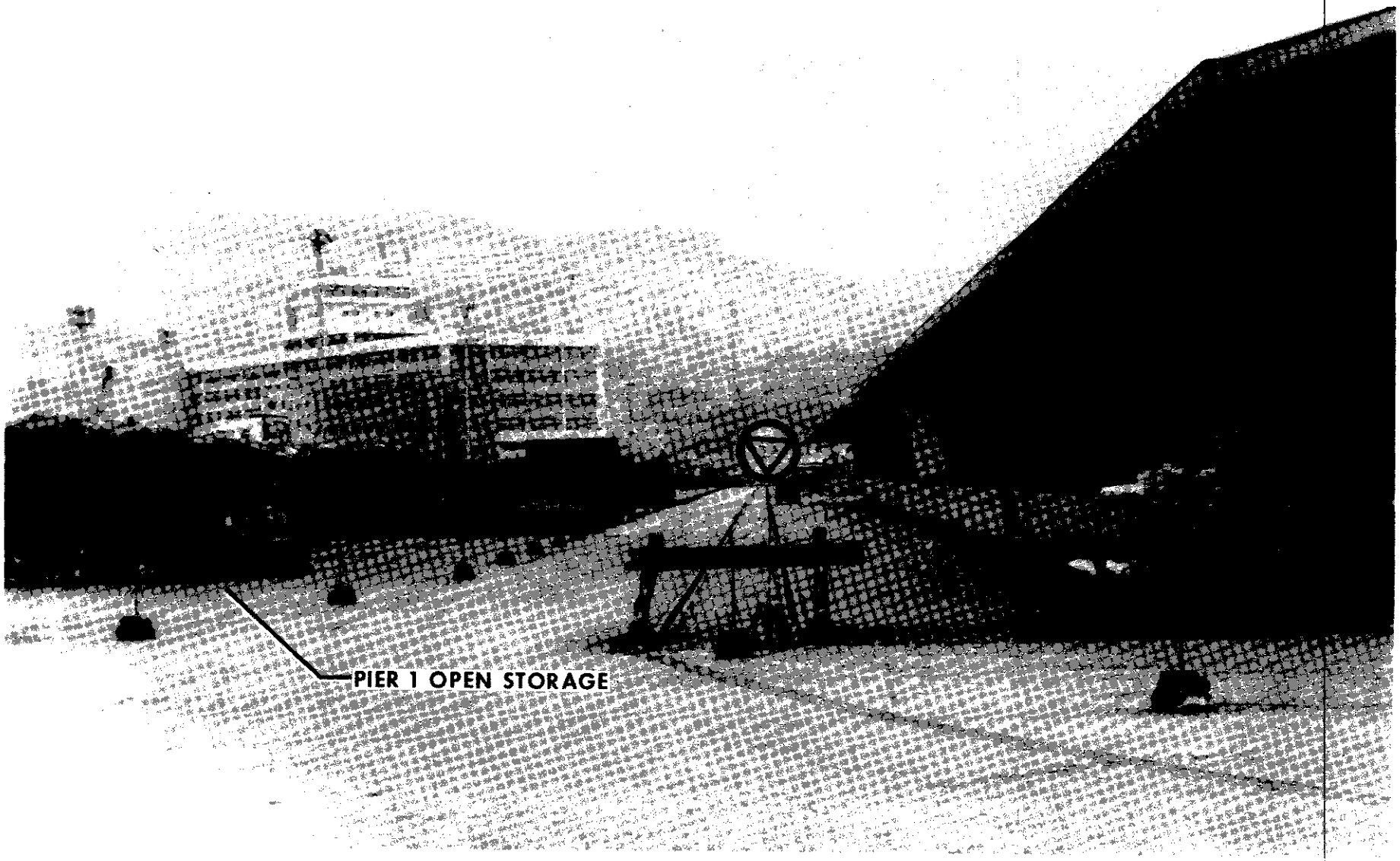


Figure P-7. Pier 1 open storage area (northwestward view).

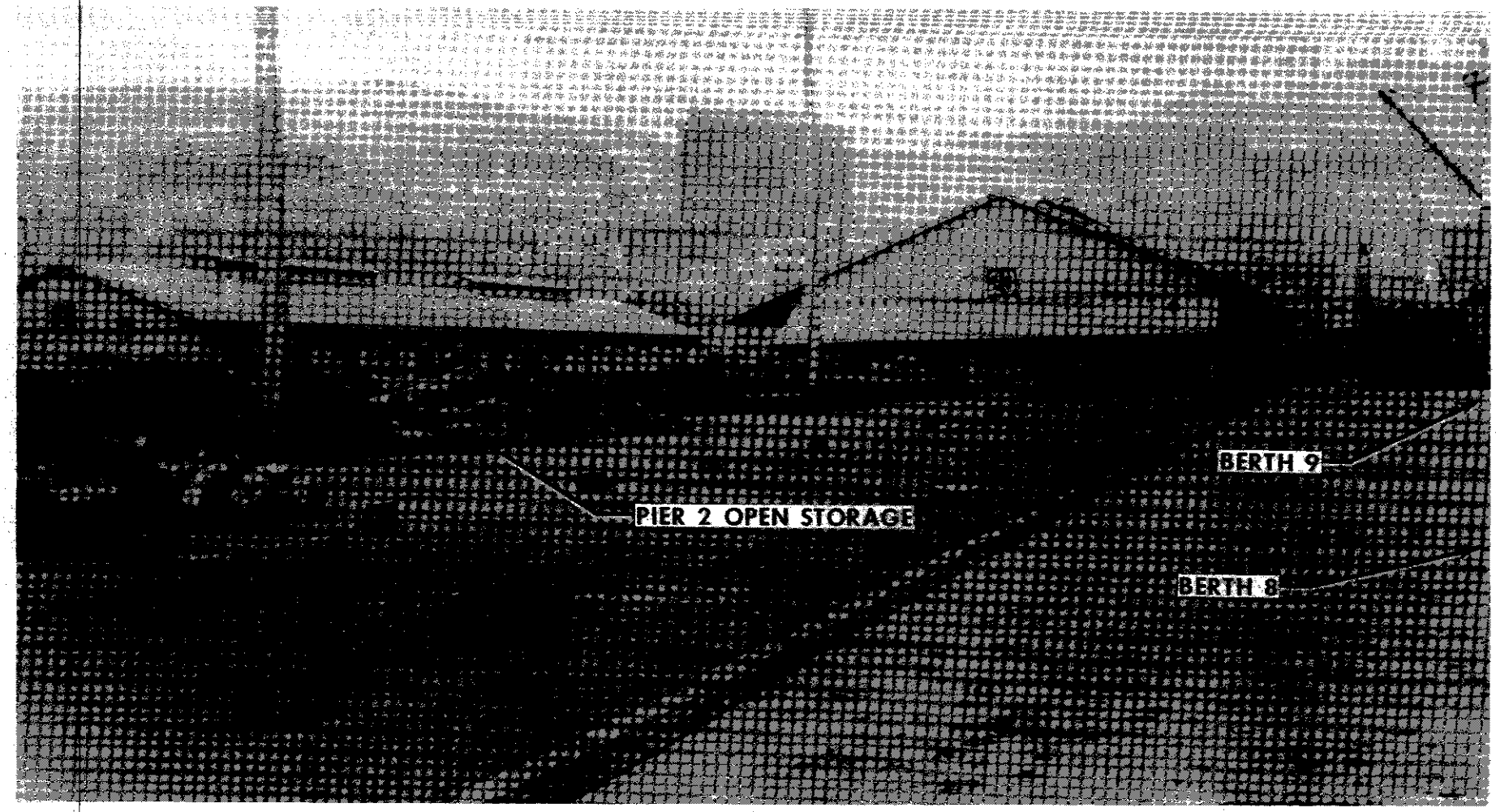


Figure P-8. Pier 2 open storage area (northwestward view).

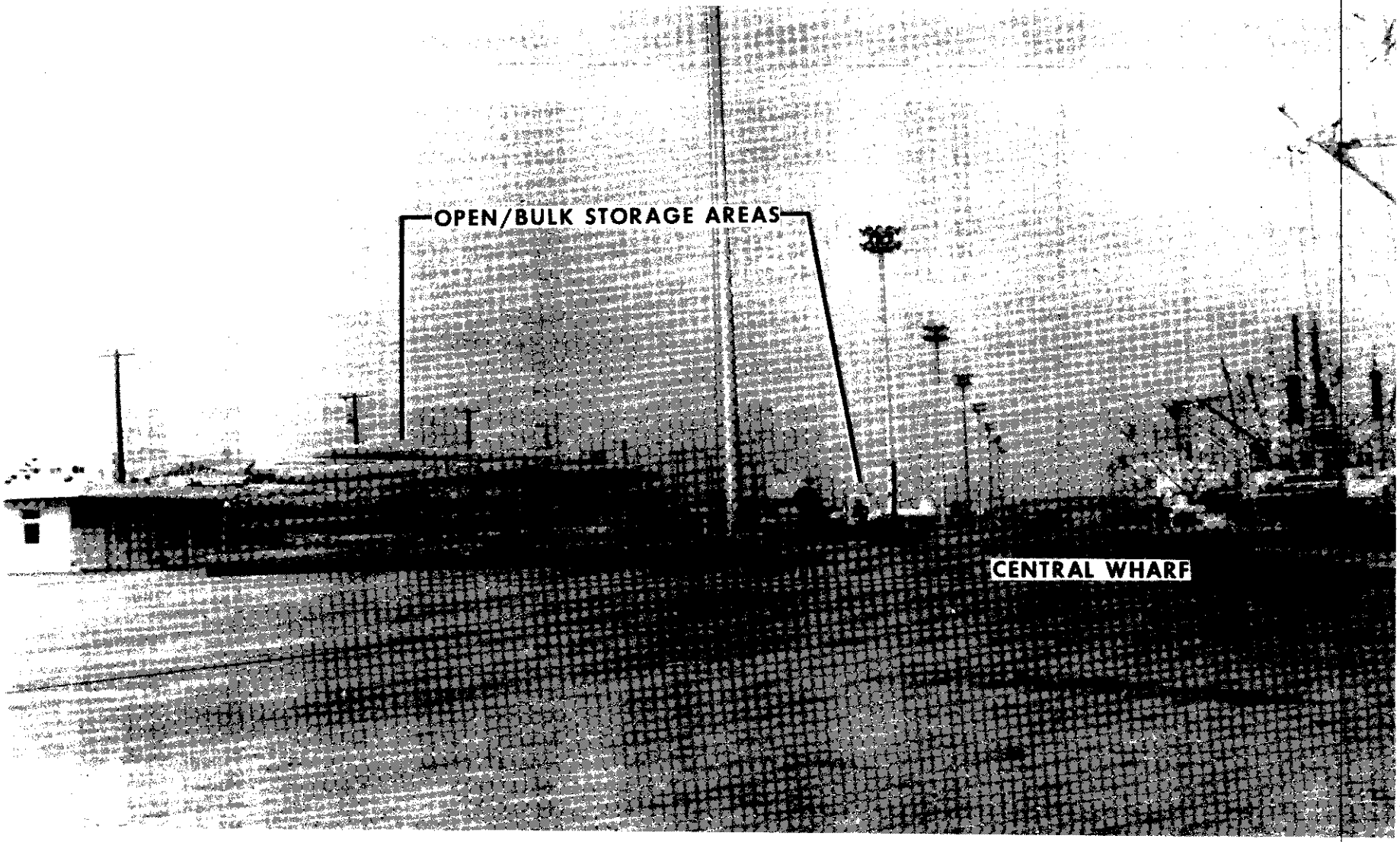


Figure P-9. Central wharf open storage area (northward view).

TABLE P-5
STORAGE FACILITIES FOR PORT OF PUSAN

Type of Storage and Location of Berths Served	Number of Storage Areas	Total Space m^2	Total Space (ft^2)	Storage Capacity (tons)	Current Use	Condition	Owner
Open Storage							
Pier 1	8	14 000	(150,709)		General cargo	Good	Pusan KMPA
Pier 2	8	11 037	(118,813)		General cargo	Good	Pusan KMPA
Central wharf	8	17 194	(185,093)		Bulk products	Excellent	Pusan KMPA
Pier 3	9	16 501	(177,633)		General cargo	Excellent	Pusan KMPA
Pier 4	7	15 202	(163,649)		General cargo	Excellent	Pusan KMPA
Piers 5 and 6	2	356 000	(3,832,326)		Containers	Excellent	Pusan KMPA
Pier 7	3	80 665	(868,355)		Coal/Iron ore	Good	Pusan KMPA
Pier 8	2	41 336	(444,471)		General cargo	Excellent	US Army/ROK Army & Navy
Coastal ferry pier	1	468	(5,038)		Vehicles/ Passengers	Good	Pusan KMPA
Intl ferry pier	1	11 479	(123,571)		Vehicles/ Passengers	Good	Pusan KMPA
Lighter wharf 1	1	2 643	(28,451)		General cargo	Good	Pusan KMPA
Lighter wharf 2	1	6 862	(73,869)		General cargo	Good	Pusan KMPA
Lighter wharf 3	1	6 612	(71,178)		General cargo	Good	Pusan KMPA
Lighter wharf 4	1	24 133	(259,791)		Graphite	Good	Pusan KMPA
Lighter wharf 5	1	34 337	(369,636)		Coal	Good	Pusan KMPA
Lighter wharf 6	1	975	(10,496)		Coal	Good	Pusan KMPA
Lighter wharf 7	1	3 480	(37,462)		General cargo	Good	Pusan KMPA
Pusan storage facility	NVAL	49 980	(538,033)		General cargo	Fair	US Army
Others	NVAL	135 509	(1,458,749)		Various cargo	Fair	Pusan KMPA
Covered Storage							
Pier 1	2	8 170	(87,950)	24,000	General cargo	Good	Pusan KMPA
Pier 2	3	9 422	(101,427)	28,266	General cargo	Good	Pusan KMPA
Pier 3	4	13 603	(146,435)	20,000	General cargo	Excellent	Pusan KMPA
Pier 4	4	13 600	(146,403)	20,000	General cargo	Excellent	Pusan KMPA
Pier 5	1	5 117	(55,730)	2,975	Containers	Excellent	Pusan KMPA
Pier 6	2	20 499	(220,671)	11,514	Containers	Excellent	Pusan KMPA
Pier 8	3	6 407	(68,890)		General cargo	Excellent	US Army/ROK Army
Tongmyong pier	1	3 600	(38,753)	3,600	General cargo	Fair	Tongmyong Lumber Co
Pusan storage facility	NVAL	27 220	(293,022)		General cargo	Fair	US Army

TABLE P-6
POL STORAGE FACILITIES
FOR PORT OF PUSAN

Geographic Location	Number of Tanks	Storage Capacity (bbl)	Type of Fuel	Owner
EP054833	1	3,000	MOGAS(prem)	KOCO
	1	10,000	MOGAS (reg)	KOCO
	2	20,000	Diesel	KOCO
	2	9,400	Diesel	KOCO
	1	10,000	Heavy oil	KOCO
	1	103,600	Bunker C	KOCO
	6	22,200	Bunker C	KOCO
Total	14	178,200		
EP083849	3	30,000	MOGAS	CALTEX
	1	50,000	Diesel	CALTEX
	1	30,000	Diesel	CALTEX
	5	1,500	Solvent	CALTEX
	2	20,000	Kerosene	CALTEX
	1	30,000	Heavy oil	CALTEX
	1	75,000	Bunker C	CALTEX
	1	50,000	Bunker C	CALTEX
	1	30,000	Bunker C	CALTEX
Total	16	316,500		

to control vehicular traffic and maintain surveillance. The pier and wharf facilities as well as the perimeter fences are well lighted at night for security reasons.

6. (U) Materials Handling Equipment. The Port of Pusan has an extensive supply of MHE available for conducting port operations. The large heavy-lift and fixed MHE are owned and maintained by the Pusan KMPA. The smaller MHE is owned, operated, and maintained by local contractors. Table P-7 lists MHE that is available for marine cargo operations in Pusan. No fixed MHE is positioned at piers 1 and 2 or the Central wharf.

TABLE P-7
MATERIALS HANDLING EQUIPMENT - PUSAN

Type of Equipment	Size	Quantity	Owner/User
Standard MHE			
Mobile crane	51-ton	39	Contractor
	50-ton	47	Contractor
Forkcrane	11-ton	5	Contractor
	10-ton	9	Contractor
Forklift	40-ton	6	Contractor
	15-ton	23	Contractor
	6-10-ton	63	Contractor
	3-5-ton	97	Contractor
	3-ton	65	Contractor
Tractor	30-ton	149	Contractor
	30-ton	335	Contractor
	15-ton	65	Contractor
Trailer	30-ton	458	Contractor
	30-ton	126	Contractor
	15-ton	2	Contractor
Jib crane	25-ton	2	Pier 7
Grain unloader		2	Pier 5
Coal unloader		2	Pier 7
Coal reclaimer		2	Pier 7
Container MHE			
Container crane	40.5-ton	2	Pier 6
	30.5-ton	6	Piers 5 and 6
	37.5-ton	1	Pier 3
Transtainer	50.0-ton	2	Piers 5 and 6
	40.5-ton	4	Piers 5 and 6
	30.5-ton	10	Piers 5 and 6
Straddle carrier	30.5-ton	14	Piers 5 and 6
Bridge crane	30.5-ton	1	Pier 6
Yard hustler	40-ft	44	Piers 5 and 6
	35-ft	2	Piers 5 and 6
	20-ft	39	Piers 5 and 6
Chassis	40-ft	654	Contractor
	35-ft	272	Contractor
	30-ft	90	Contractor
	20-ft	205	Contractor

TABLE P-7 - cont

Type of Equipment	Size	Quantity	Owner/User
Floating MHE			
Floating crane	540-ton	1	Contractor
	150-ton	1	Duk Yangg Company
	120-ton	1	Heuna-a Salvage, Ltd
	100-ton	1	US Army, Pusan Terminal
	60-ton	1	Pusan KMPA
	50-ton	4	Contractor
Tug (steel)	100-GT	7	4 (KMPA); 3 (private)
	50-GT	5	Private
	30-GT	12	Private
	20-GT	7	Private
Tug (wooden)	50-GT	1	Private
	30-GT	14	Private
Lighter barge	100-GT	116	Contractor
	76-100-GT	62	Contractor
	30-75-GT	4	Contractor
POL barge	180-GT	10	Pusan O.S. Assoc
	75-GT	13	Pusan O.S. Assoc
	30-GT	1	Pusan O.S. Assoc
	20-GT	1	Pusan O.S. Assoc
	15-GT	1	Pusan O.S. Assoc
Water barge	120-GT	5	Contractor
	75-GT	3	Contractor
	30-GT	1	Contractor
	20-GT	1	Contractor
	15-GT	1	Contractor

C. (U) Piers 3 and 4 Facilities

1. (U) Berthing. These two piers have 15 general cargo berths and one container berth - 6 general cargo berths and one container berth on pier 3 and 9 general cargo berths on pier 4. Piers 3 and 4 have 3,498 and 4,294 linear feet of berthing space, respectively, for deep-draft oceangoing vessels. Figures P-10 through P-12 show some of the berths at these facilities. The individual characteristics of these berths are summarized in table P-8. The type of ship unloading operations that could be performed at these berths under normal operating procedures is discussed below.

a. (U) RORO Operations. No facilities are available at these piers to support stern-ramp RORO operations. All apron widths are adequate for side-ramp operations, and alongside drafts are good except for berths 18 and 26 at the head of each pier. Both piers have adequate staging and marshaling area for RORO operations. Mobile cranes with enough lift capacity to remove heavy equipment and vehicles from decks are available through private contractors. None of the berths at these two piers have sufficient alongside drafts for berthing a Maine-class, slewed stern RORO ship. However, if a ship of this type were lightened prior to berthing, these facilities could be used.

No shore-based ramps are available for the Ponce/Great Land-class RORO vessels at these piers. These ships could berth at piers 3 and 4 if they carried their own ramps or if ramps were made available.

b. (U) T-AKR Operations. All vessel support systems except alongside draft are adequate for a T-AKR vessel at piers 3 and 4. If the arrival draft is 32 feet or less, then this type of ship could be berthed at either pier 3 or 4.

c. (U) Breakbulk Operations. Ten typical US-flag breakbulk ships could be berthed concurrently at piers 3 and 4, as shown in table P-9. Korean-flag ships could be docked at those berths that have insufficient drafts or berth lengths. Table P-10 lists the

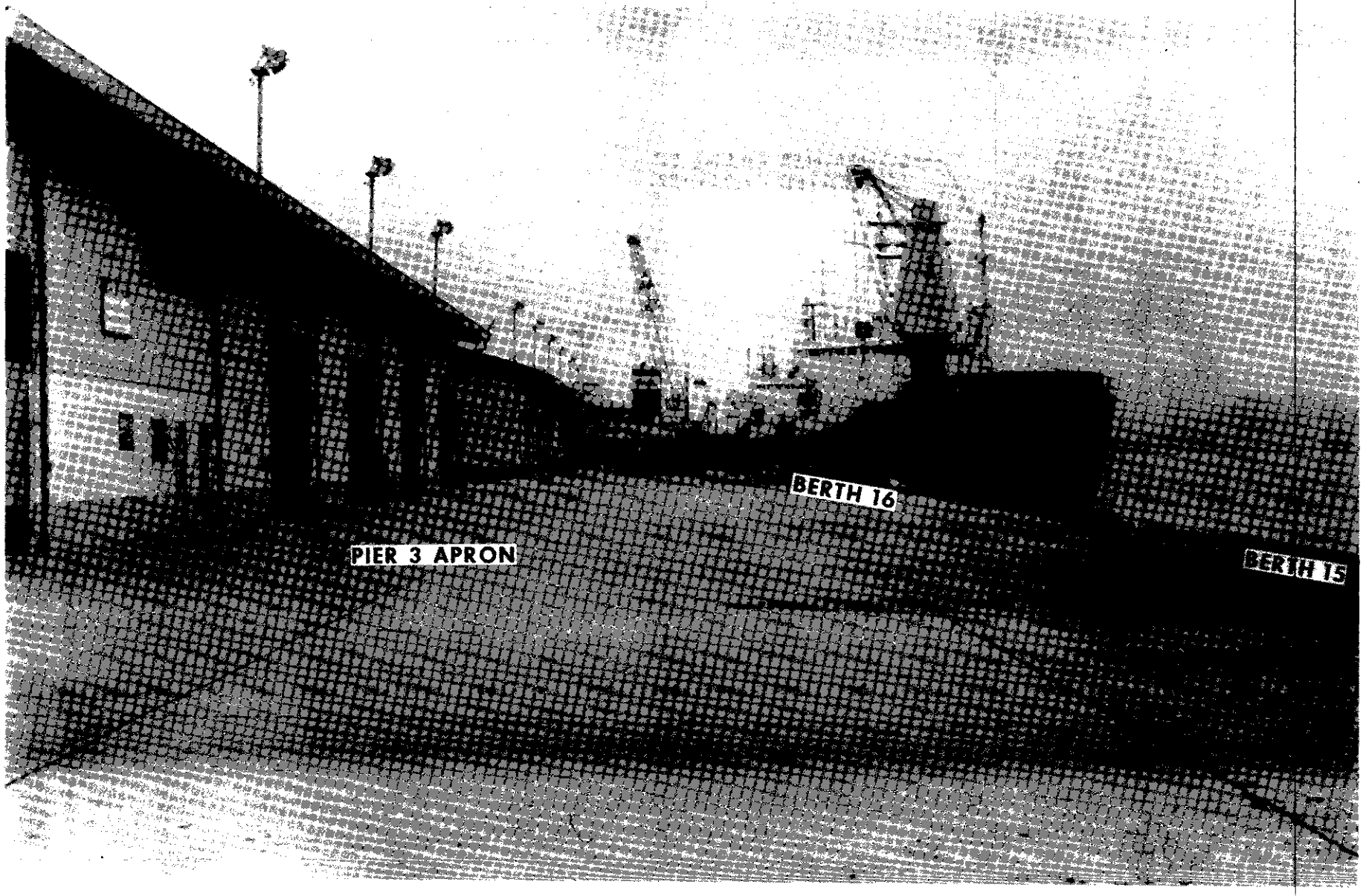


Figure P-10. Pier 3 on southwest side (southeastward view).

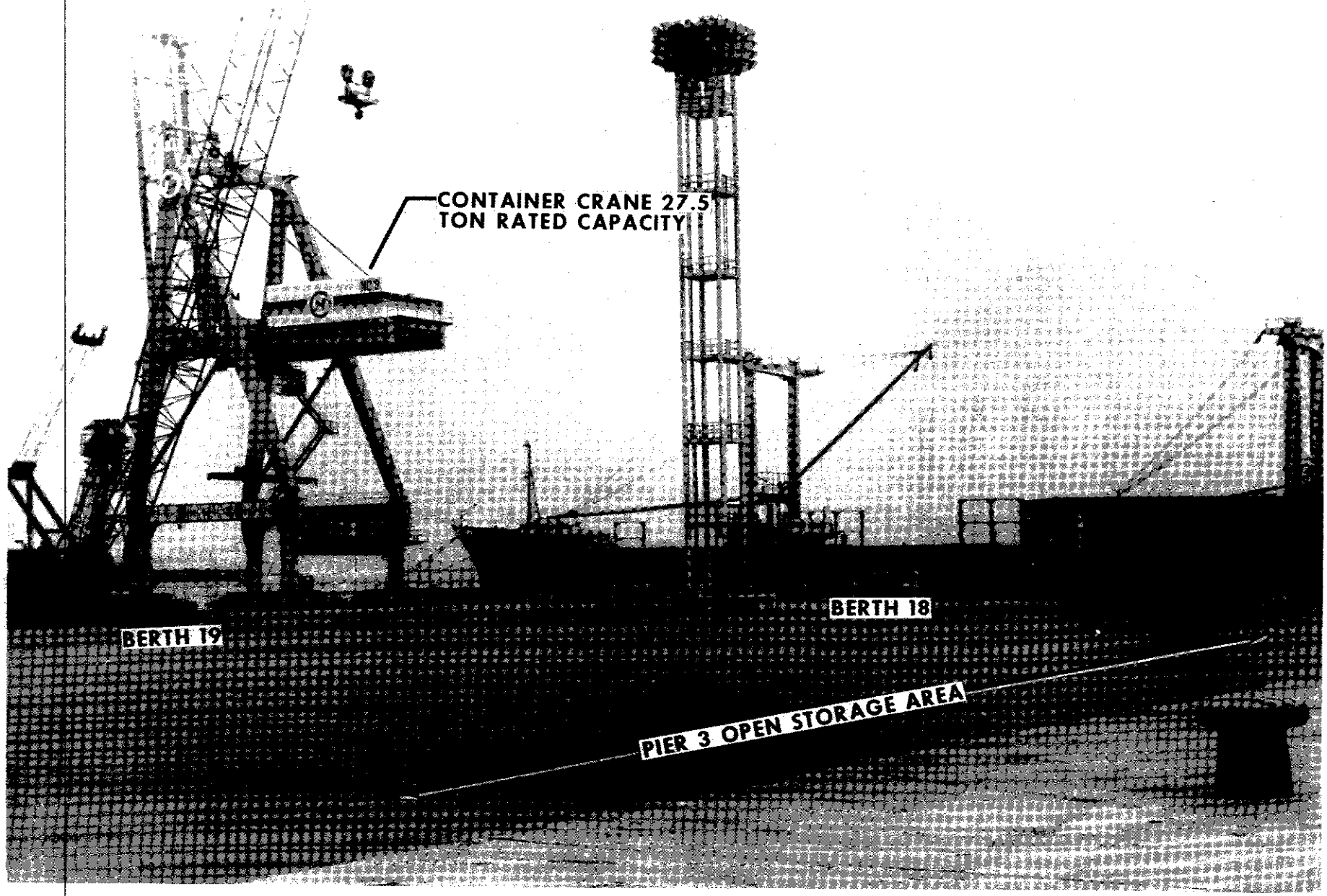


Figure P-11. Container berth at pier 3 (northeastward view).

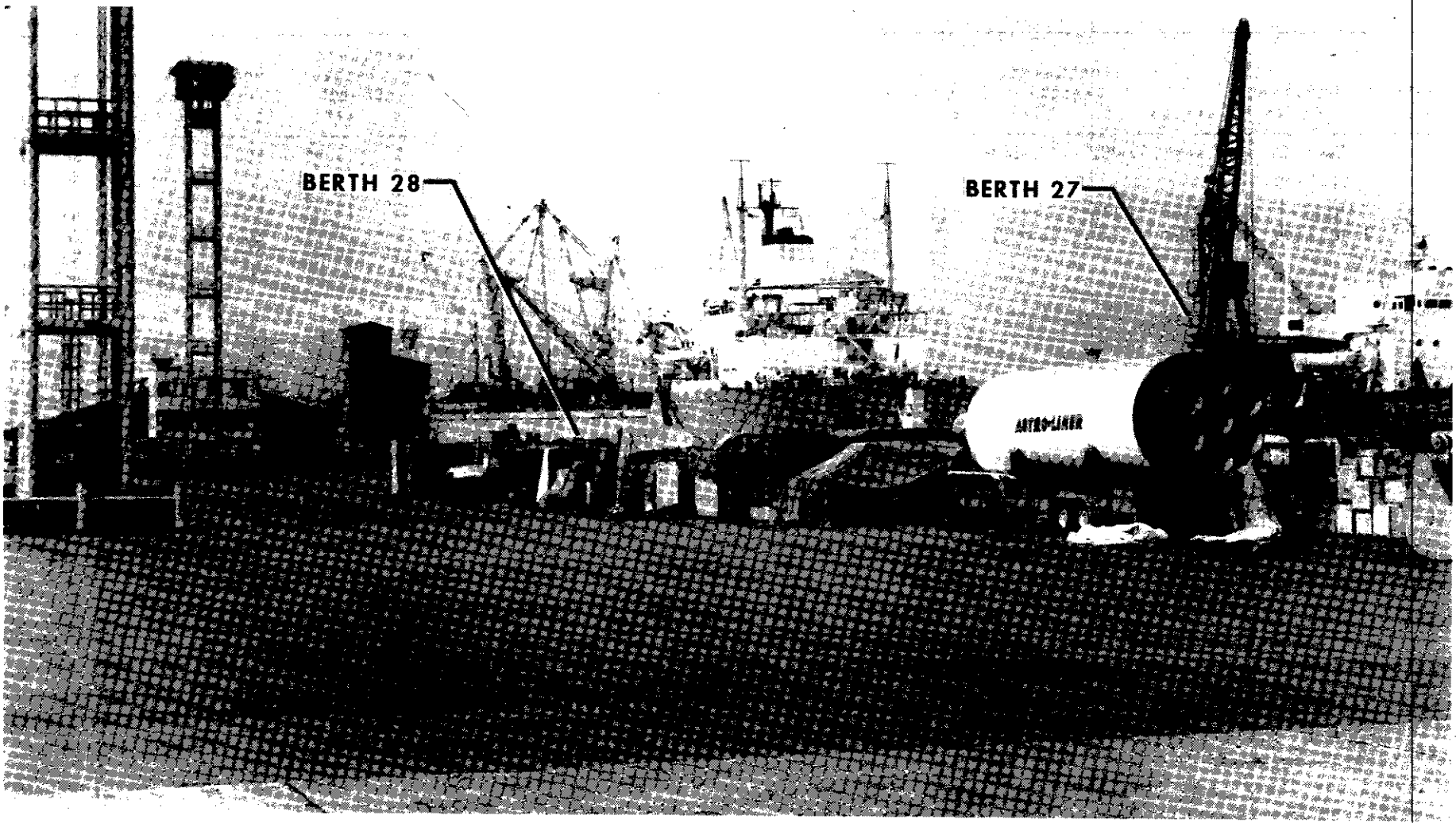


Figure P-12. Pier 4 (northward view).

TABLE P-8
PORT OF PUSAN (PIERS 3 AND 4)
OPERATED BY: PUSAN KMPA

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m	Continuous Length (ft)	Individual Berth	Berth Length m	Berth Length (ft)	Approximate Apron Width m	Approximate Apron Width (ft)	MLW m	MLW (ft)	Approximate Apron Height Above MLW m	Approximate Apron Height Above MLW (ft)	Deck Strength (psf)	Serviced by Rail-Mounted Crane	Railcar Access to Apron
Pier 3	SW side	Pier	451	(1,480)	15	150	(492)	23	(75.5)	9	(29.5)	3	(9.8)	800	No	No
					16	150	(492)	23	(75.5)	10	(32.8)	3	(9.8)	800	No	No
					17	151	(495)	23	(75.5)	10	(32.8)	3	(9.8)	800	No	No
	Head	Pier	145.5	(477)	18	145.5	(477)	20	(65.6)	7	(23.0)	3	(9.8)	800	No	No
	NE side	Pier	470.2	(1,543)	19	156.7	(514)	23	(75.5)	10	(32.8)	3	(9.8)	800	Yes	No
					20	156.7	(514)	23	(75.5)	10	(32.8)	3	(9.8)	800	No	No
					21	156.7	(514)	23	(75.5)	9	(29.5)	3	(9.8)	800	No	No
Pier 4	SW side	Pier	558.2	(1,831)	22	139.6	(458)	19	(62.3)	9	(29.5)	3	(9.8)	800	No	Yes
					23	139.6	(458)	19	(62.3)	10	(32.8)	3	(9.8)	800	No	Yes
					24	139.6	(458)	19	(62.3)	10	(32.8)	3	(9.8)	800	No	Yes
					25	139.5	(458)	19	(62.3)	10	(32.8)	3	(9.8)	800	No	Yes
	Head	Pier	145.5	(477)	26	145.5	(477)	20	(65.6)	7.5	(24.6)	3	(9.8)	800	No	No
	NE side	Pier	405.4	(1,330)	27	135	(443)	30	(98.4)	10	(32.8)	3	(9.8)	800	No	No
					28	135	(443)	30	(98.4)	10	(32.8)	3	(9.8)	800	No	No
					29	135	(443)	15	(49.2)	10	(32.8)	3	(9.8)	800	No	No
			200	(656)	30	200	(656)	20	(65.6)	9	(29.5)	3	(9.8)	800	No	No

capability of these piers to berth Korean-flag ships and the number of each type that could be berthed.

No rail-mounted heavy-lift cranes are located at these piers except for the container crane at berth 19. This crane could be configured to perform a breakbulk-type heavy lift, but this is not a preferable option. Conventional ship's gear will be required at these piers for discharge operations. Mobile heavy-lift cranes and barge derricks are available within the Pusan port complex and will be brought in to perform heavy lifts if necessary. Both piers have high-intensity tower lighting for nighttime operations as well as transit sheds for consolidation and/or distribution of cargo. Also these piers have excellent truck and rail access for breakbulk operations and are considered excellent for a combination of US-flag and Korean-flag breakbulk discharge operations.

d. (U) LASH and SEABEE Operations. All the necessary vessel support systems for LASH and SEABEE barge operations are available at piers 3 and 4, except mobile cranes and supporting MHE would be required. These piers can berth 122 LASH or 79 SEABEE barges if they are used exclusively for barges. Adequate staging and barge lay areas are available east of the Central wharf or north of pier 4. Cranes and MHE are available to offload barges; however, availability would be based on other mobile crane requirements throughout the port. Actual berths that would

TABLE P-9
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF PUSAN (PIERS 3 AND 4)

US-Flag Ship Type	Berths										
	Pier 3					Pier 4					
	15	16-17	18	19-20	21	22	23-25	26	27-28	29	30
RORO											
GTS Callaghan	c,d	1,d	a,c,d	1,d	c,d	c,d	1,d	a,c,d	1,d	b,c,d	c,d
USNS Comet	c,d	1,d	a,c,d	2,d	1,d	c,d	2,d	a,c,d	1,d	b,c,d	1,d
Maine - class	a,c	a	a,c	a	a,c	a,c	a	a,c	a	a,c	a,c
Breakbulk											
C4 Mariner-class	a,c	1	a,c	1	a,c	a,c	2	a,c	1	c	a
C4-5-58a	a,c	1	a,c	1	a,c	a,c	2	a,c	1	c	a
C3-5-38a	1	2	a,c	2	1	c	2	a,c	1	c	1
C3-5-33a	1	2	a,c	2	1	c	2	a,c	1	c	1
Barge											
LASH C8-5-81B	c,f	f	c,f	f	c,f	c,f	f	c,f	f	c,f	c,f
LASH barge	8	16	7	16	8	7	22	7	14	7	10
SEABEE C8-5-82A	c,f	f	c,f	f	c,f	c,f	f	c,f	f	c,f	c,f
SEABEE barge	5	10	4	10	5	4	14	4	9	4	6
Seatrain											
Georgia-class	c	1	a,c	1	c	c	2	a,c	1	c	1
Puerto-class	c	1	a,c	1	c	c	2	a,c	1	c	1
Container											
C6-5-1W	c,e	1,e	a,c,e	1	c,e	c,e	2,e	a,c,e	1,e	c,e	c,e
C7-5-68E	a,c,e	1,e	a,c,e	1	a,c,e	a,c,e	1,c	a,c,e	1,e	c,e	a,c,e
C8-S-85B	a,c,e	a,e	a,c,e	a	a,c,e	a,c,e	a,c	a,c,e	a,e	a,c,e	a,c,e
RORO/Container											
C5-S-78	a,c	a	a,c	a	a,c	a,c	a	a,c	a	a,b,c	a
T-AKR(SL-7)	a,c	a	a,c	a	a,c	a,c	a	a,c	a,c	a,b,c	a,c
Breakbulk/Container											
C5-S-37E	a,c	1	a,c	1	a,c	a,c	2	a,c	1	c	a
C4-S-10	a,c	1	a,c	1	a,c	a,c	2	a,c	1	c	a

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.
f - Inadequate draft for barge ship at berth; however, ship could be unloaded from anchorage.

TABLE P-10
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF PUSAN (PIERS 3 AND 4)

Korean-Flag Ship Type	Berths										
	Pier 3					Pier 4					
	15	16-17	18	19-20	21	22	23-25	26	27-28	29	30
Breakbulk											
Type 1	4	8	4	8	4	3	11	4	7	3	5
Type 2	2	4	1	4	2	1	5	1	3	1	2
Type 3	1	3	1	4	2	1	5	1	3	1	2
Type 4	1	3	1	3	1	1	4	1	3	1	2
Type 5	1	3	1	3	1	1	4	1	3	1	2
Type 6	1	2	1	2	1	1	3	1	2	1	1
Type 7	1	2	a	2	1	1	3	a	2	1	1

a - Inadequate draft at berth.

be used for discharging barges depend on the number and type of vessels occupying other berths.

Sufficient tugs with adequate horsepower are available to tow barges from anchorages to berths and back again.

e. (U) Container Operations. Pier 3 has one container berth (berth 19), which is located at the northeast corner of the pier. The alongside draft is sufficient for most container ships in the US-flag fleet. The berth has one rail-mounted container crane with a rated capacity of 27.5 tons. This lift capacity is sufficient for 20- and 35-foot containers and some 40-foot containers. The berth is used mainly for container feeder vessels and currently handles moderate numbers of containers compared with piers 5 and 6. Sufficient open storage and staging area is available to support a container discharge operation.

Some self-sustaining container ships could be berthed at other locations at piers 3 and 4. At pier 3, berth 17 would be adequate and at pier 4, berths 25, 27, and 28 could accommodate this type of ship. These same berths can be used for non-self-sustaining container ships, except mobile container cranes would need to be positioned at these locations along with other supporting MHE. If it is assumed that adequate container MHE were available, up to five container ships could be berthed simultaneously at piers 3 and 4.

f. (U) Safety Considerations. If a breakbulk or a container ammunition ship were to be berthed at these facilities, about two-thirds of Pusan would fall within a quantity-distance (Q-D) arc of 2200 meters, and almost the entire city within a Q-D arc of 2800 meters. These areas include an estimated population of 2.3 and 3.3 million, respectively, in addition to inhabited buildings, public highway and rail routes, most of Pusan's rail facilities, the largest container facility in the country, and most of the other piers and wharves.

g. (U) Summary of Berth Availability. The berths available for different ship types are summarized in tables P-9 and P-10. They include only those berths that could accommodate the particular type of ship without extraordinary docking or materials handling procedures. The tables also give the number of each ship type the wharf or berth can dock or the reasons that the pier cannot handle the particular ship type. As shown in these tables, piers 3 and 4 can handle most of the ship types in the US-flag fleet and all the breakbulk Korean-flag ship types. In summary, these piers can accommodate breakbulk, RORO, and container ships and barges without extraordinary docking procedures.

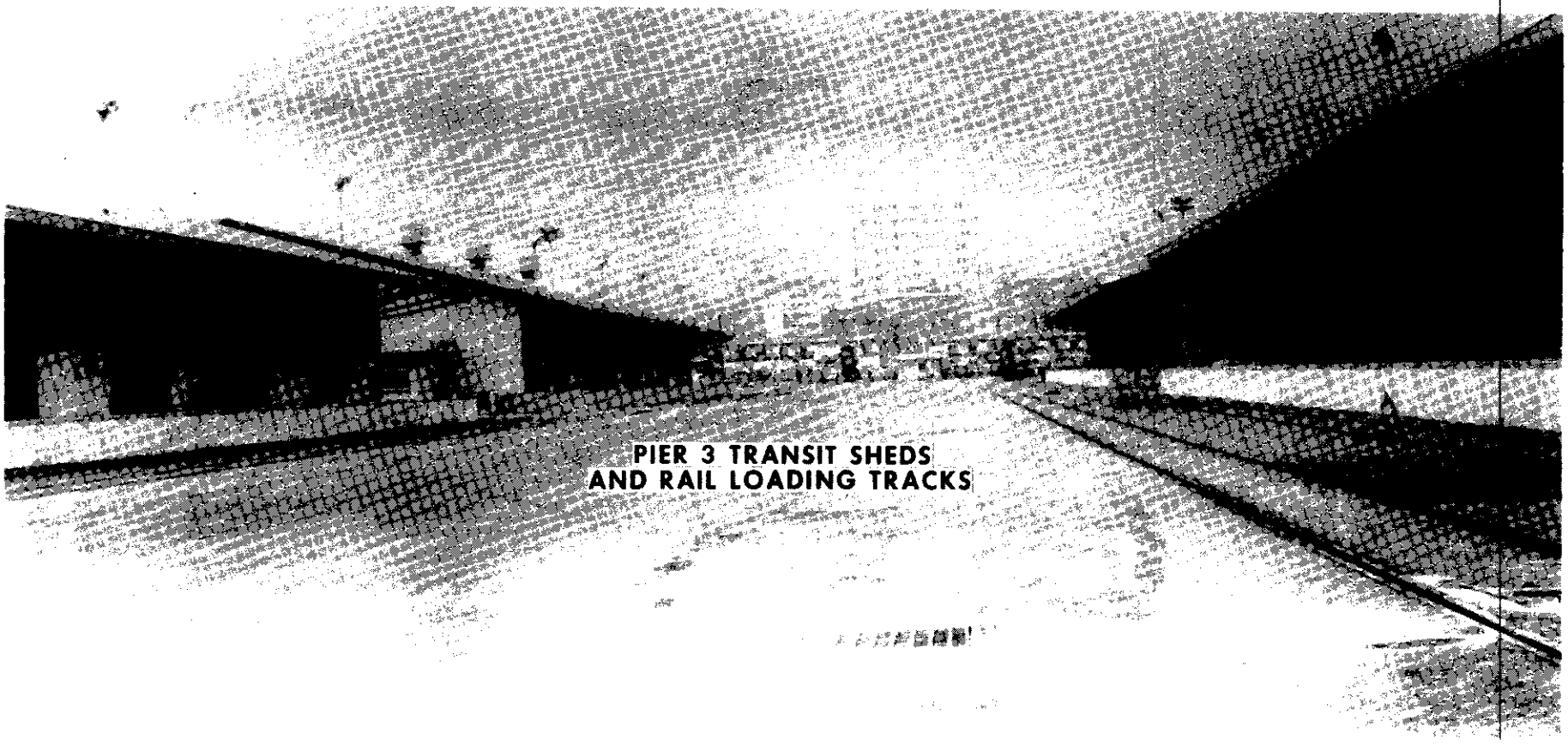


Figure P-13. Open storage area between pier 3 transit sheds (northwestward view).

The piers are best suited for breakbulk and side-ramp RORO operations. Berth 19 is best suited for container operations.

2. (U) Storage Areas

a. (U) Open Storage. Piers 3 and 4 have several improved open storage areas. The size, general capacity, condition, and general use of these areas are summarized in table P-5. Also, figures P-13 and P-14 illustrate some of these areas. A total of 16 501 square meters (177,633 square feet) of open storage is available on pier 3, and 15 202 square meters (163,649 square feet), on pier 4. Although most of the open storage area is currently used for storage of general cargo and vehicles, these storage areas are also suitable for

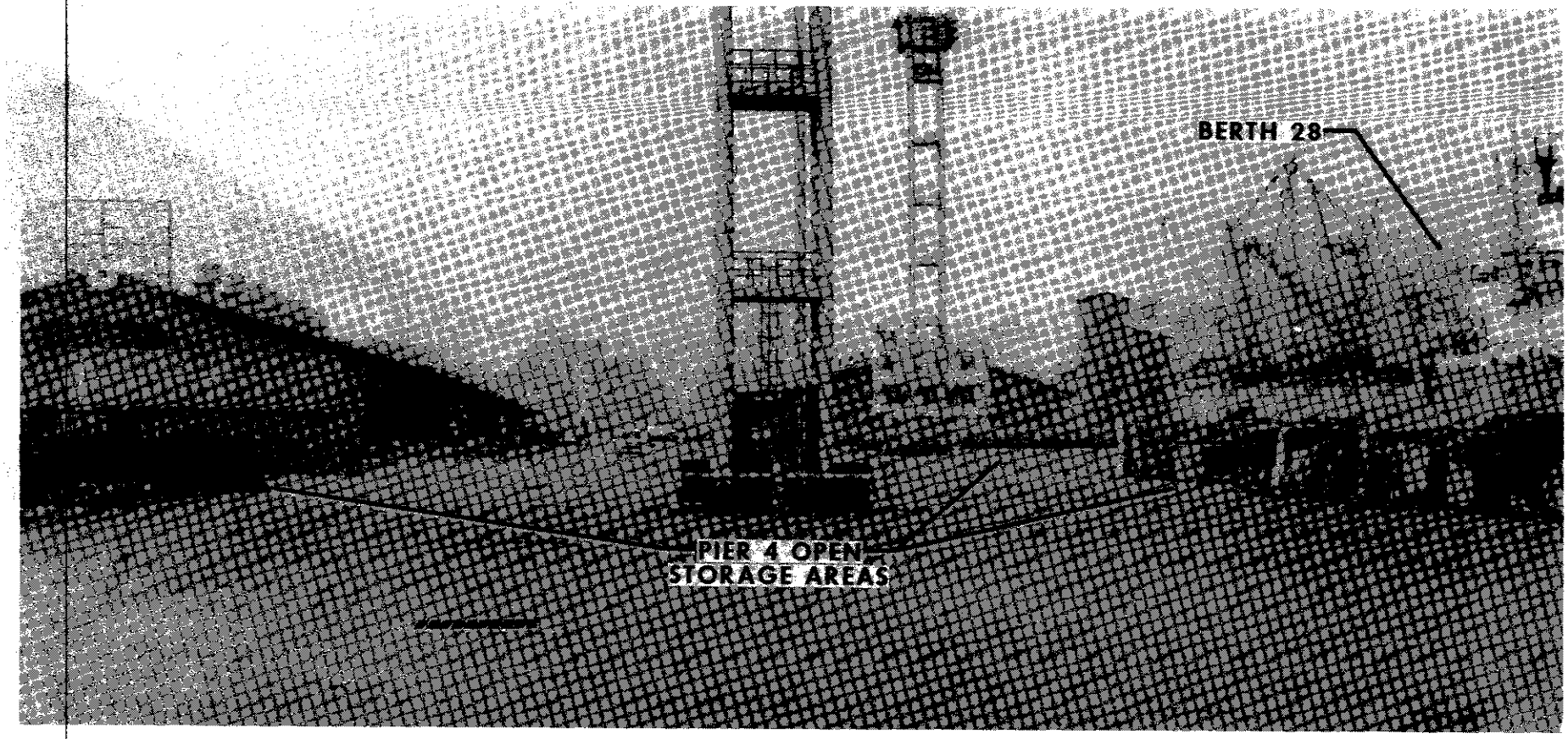


Figure P-14. Open storage areas along pier 4 (northwestward view).

storage and/or staging of military general resupply and unit equipment.

b. (U) Covered Storage. Piers 3 and 4 each have four transit sheds. The storage capacity of these transit sheds is listed in table P-5. The combined storage capability of these piers is 27 203 square meters (292,838 square feet). All of the transit sheds are served by rail and have loading docks that would permit boxcar- or truck-loading operations. These loading docks are located on just one side of the warehouses and their configuration would permit truck tailgate transfer operations. Piers 3 and 4 each have 24 doors along their transit sheds to serve truck-loading positions.

c. (U) POL Storage. Major POL storage facilities are identified in table P-6. No POL storage tanks are located at these piers.

3. (U) Rail Operations. As discussed earlier, the KNR operates over the trackage within the port area and provides access to piers 3 and 4. Rail access to pier 3 extends from Port Road to the southeastern end of the transit sheds and consists of four spur tracks with a static capacity of about 87 railcars. Two of these spur tracks run alongside of the transit sheds, the other two run down the middle of the pier.

Pier 4 has rail service to the transit shed as well as an apron track that provides rail service to berths 22 through 25. This pier has five spur tracks that provide a static capacity of about 135 railcars. Four of these spur tracks are located in the middle of the pier.

The trackage at piers 3 and 4 is adequate to sustain military cargo operations.

4. (U) Truck Operations. Piers 3 and 4 have truck docks that run along the entire length of one side of their transit sheds. These facilities provide 48 truck tailgate loading positions at each pier, based on two positions per transit-shed door. Other loading positions at these piers would depend on the availability of portable ramps, forklifts, and mobile cranes for transferring cargo. All of the loading docks are in good shape and can sustain large-scale military cargo transfer operations.

5. (U) Security. Piers 3 and 4 are bounded on the north by Port Road and on all other sides by water. Perimeter fences surround all the pier facilities on the landside. Each pier has one gate entrance, which is always manned. Security guards continually patrol throughout the pier areas; they also control traffic within these areas. The pier areas and the perimeter fences are well lighted at night for security reasons.

6. (U) Cargo Handling Equipment. Of the two piers, only pier 3 has fixed cargo-handling equipment, which consists of a 500-ton rail-mounted container crane with a rated lift capacity of 27.5 tons. This rail-mounted container crane serves the length of berth 19.

Other MHE required at piers 3 and 4 can be obtained upon request and on an as-needed basis from the Pusan KMPA, the local stevedoring companies, and the private contractors. Table P-7 lists the MHE that is available in the local Pusan area.

D. (U) Facilities at Piers 5 and 6

1. (U) Berthing. One bulk grain berth and four container berths are available for use at piers 5 and 6. All of the berthing space along these piers is suitable for deep-draft oceangoing vessels. The individual characteristics of these berthing spaces are summarized in table P-11. Except for the bulk grain berth, these piers are used exclusively for container ship operations. Because this Pusan facility is the largest container port in Korea and because most containerized cargo in Korea moves through these piers, alternative types of ship unloading operations will not be discussed in detail.

a. (U) Bulk Grain Operations. Berth 31 of pier 5 is devoted exclusively to bulk grain operations

TABLE P-11
PORT OF PUSAN (PIERS 5 AND 6)
OPERATED BY: PUSAN KMPA

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m	Continuous Length (ft)	Individual Berth	Berth Length m	Berth Length (ft)	Approximate Apron Width m	Approximate Apron Width (ft)	MLW m	MLW (ft)	Approximate Apron Height Above MLW m	Approximate Apron Height Above MLW (ft)	Deck Strength (psf)	Serviced by Rail-Mounted Crane	Railcar Access to Apron
Pier 5	31-33	Marginal	1066	(3,498)	31	371	(1,217)	20	(65.6)	12.5	(41)	3.3	(10.8)	800		
					32	330	(1,083)	50	(164)	12.5	(41)	3.3	(10.8)	1,000	Yes	No
					33	329	(1,079)	50	(164)	12.5	(41)	3.3	(10.8)	1,000	Yes	No
Pier 6	34-35	Marginal	603	(1,978)	34	301	(988)	50	(164)	13.5	(44)	3.3	(10.8)	1,000	Yes	No
					35	302	(991)	50	(164)	13.5	(44)	3.3	(10.8)	1,000	Yes	No

and is unsuitable for other cargo handling operations because of its layout and design. The silos can store 16,000 tons of grain and the cranes can discharge up to 800 tons of grain per hour. Berth 31 is served by its own access road and railroad trackage, which are separated by fences from the container facility.

b. (U) Container Operations. Berths 32 through 35 are the main container berths for the Port of Pusan. They provide 1262 meters (4,141 feet) of continuous wharfage. As many as five typical container ships can berth at piers 5 and 6 at any one time. These piers have eight rail-mounted container cranes to accommodate container ships. Four of these cranes operate on pier 5 and each crane has a rated lift capacity of 30.5 tons. The other four cranes operate on pier 6. Two of these cranes have a 40.5-ton lift capacity and the others have a 30.5-ton lift capacity. Portions of the container piers are shown in figure P-15.

These container piers, which are the most modern container discharge facilities in Korea, have all the necessary vessel support systems to sustain a large military container operation. Abundant open storage is available as shown in figure P-16 and provisions for highway and rail operations are excellent. Figures P-17 and P-18 show some of the truck and rail facilities at the container piers.

The truck processing area (fig P-17), which has eight gates, is located about 305 meters (1,000 feet) from Port Road. This control point maintains an orderly flow of trucks in and out of the container piers and is located far enough from Port Road so bottlenecks that could develop at the gates would be minimal.

The bridge-crane transfer area consists of two rail spurs and a truck transfer area. Each of these spurs is about 350 meters (1,148 feet) long and has a static rail-holding capacity of 38 flatcars (based on 60-foot equivalents).

The container piers use a lift-on/lift-off operation for the container cranes along the berths. Containers on chassis with yard tractors are shuttled

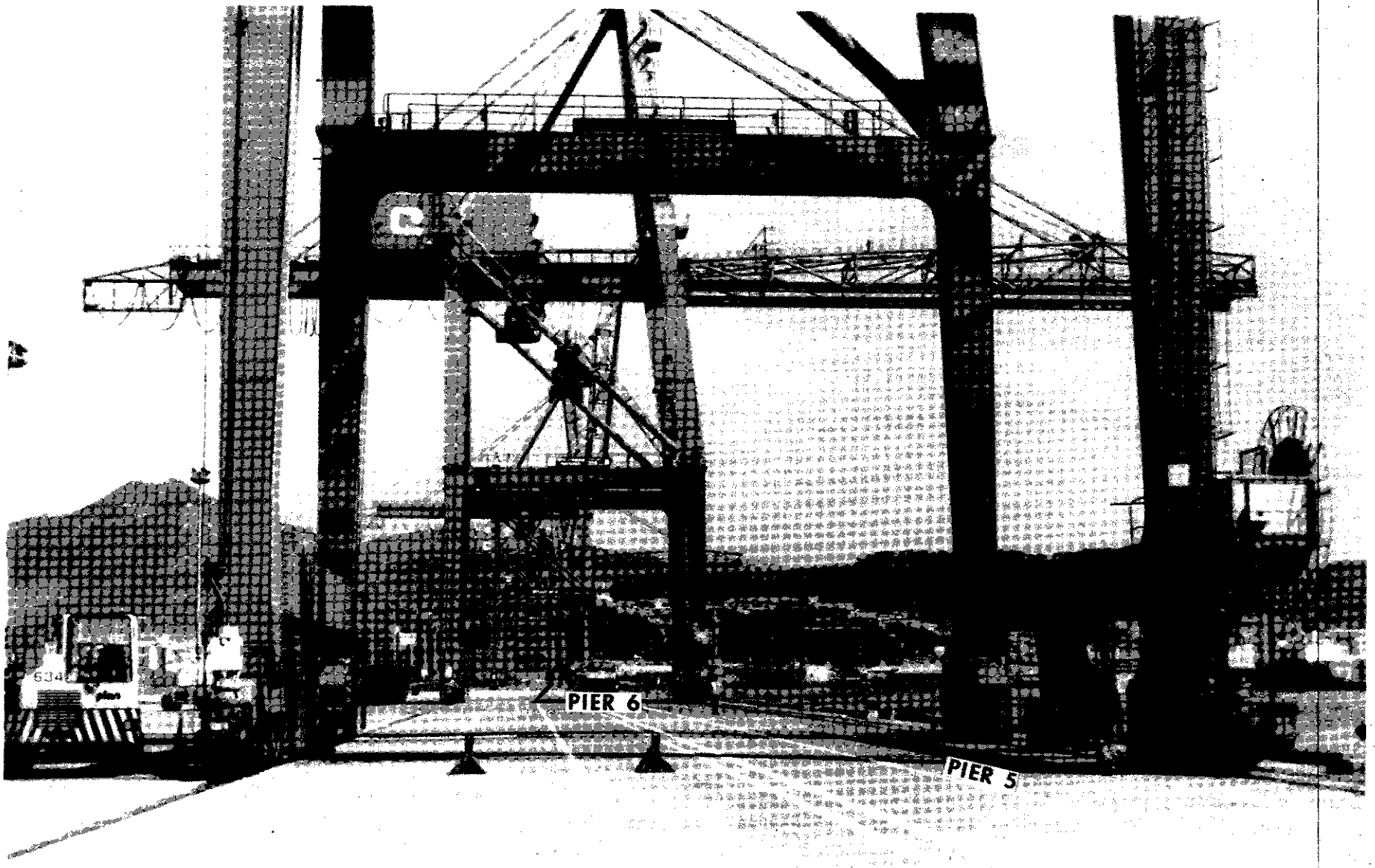


Figure P-15. Container berths at piers 5 and 6 (northeastward view).

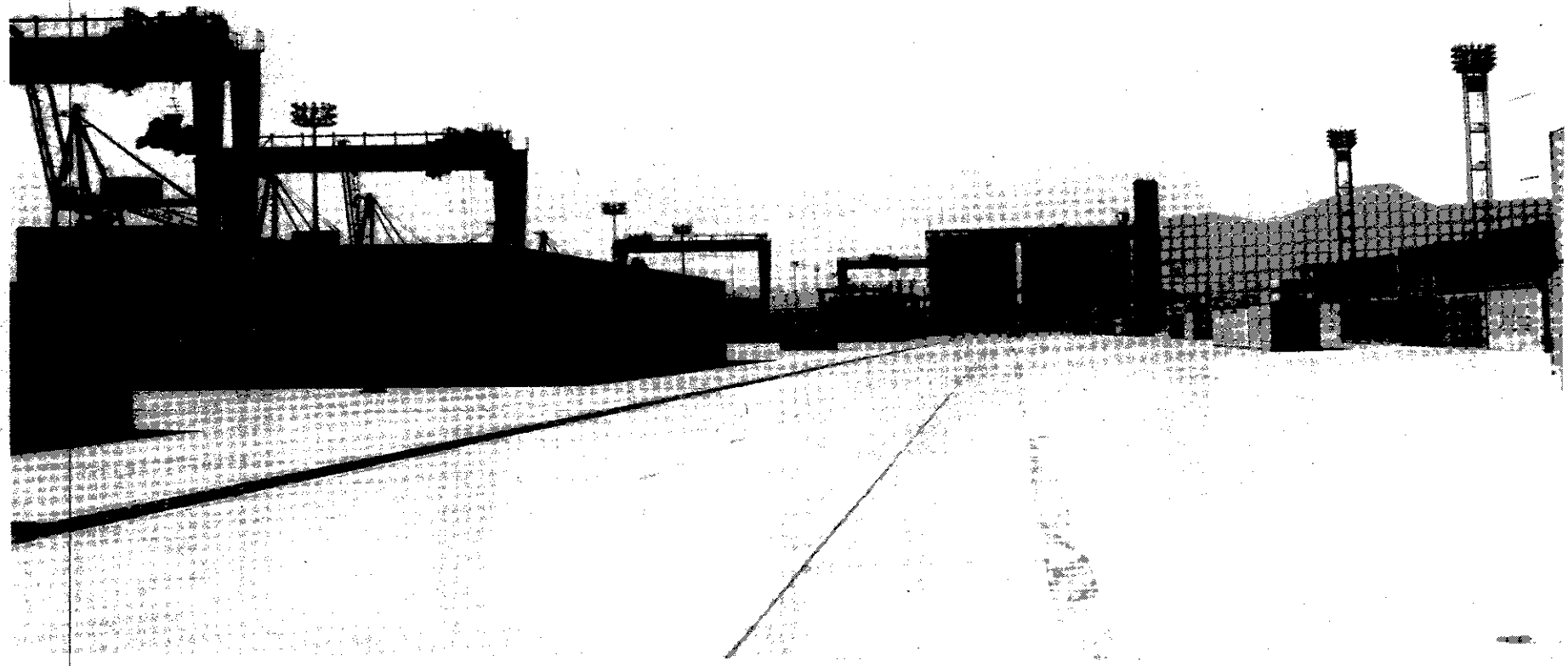


Figure P-16. Container storage yards at piers 5 and 6 (southwestward view).

between the berth and the storage areas and then transferred via a transtainer. Containers are stacked on the ground three high and five or six rows wide with no aisle space between them. Although the length of the rows varies throughout the port, it is usually equal to six containers. Figure P-19 illustrates this type of operation.

Piers 5 and 6 have a container freight station consisting of three buildings in the northwestern corner of the piers. These buildings serve trucks only and are used for consolidating and restuffing containers and/or trucks when single containers arrive with multiple destinations.

A maintenance garage is also located at this facility to service tractor-trailers and yard hustlers as well as other terminal equipment.

c. (U) Alternative Ship-Type Operations. As mentioned previously, piers 5 and 6 are used exclusively for container operations. Other types of ship

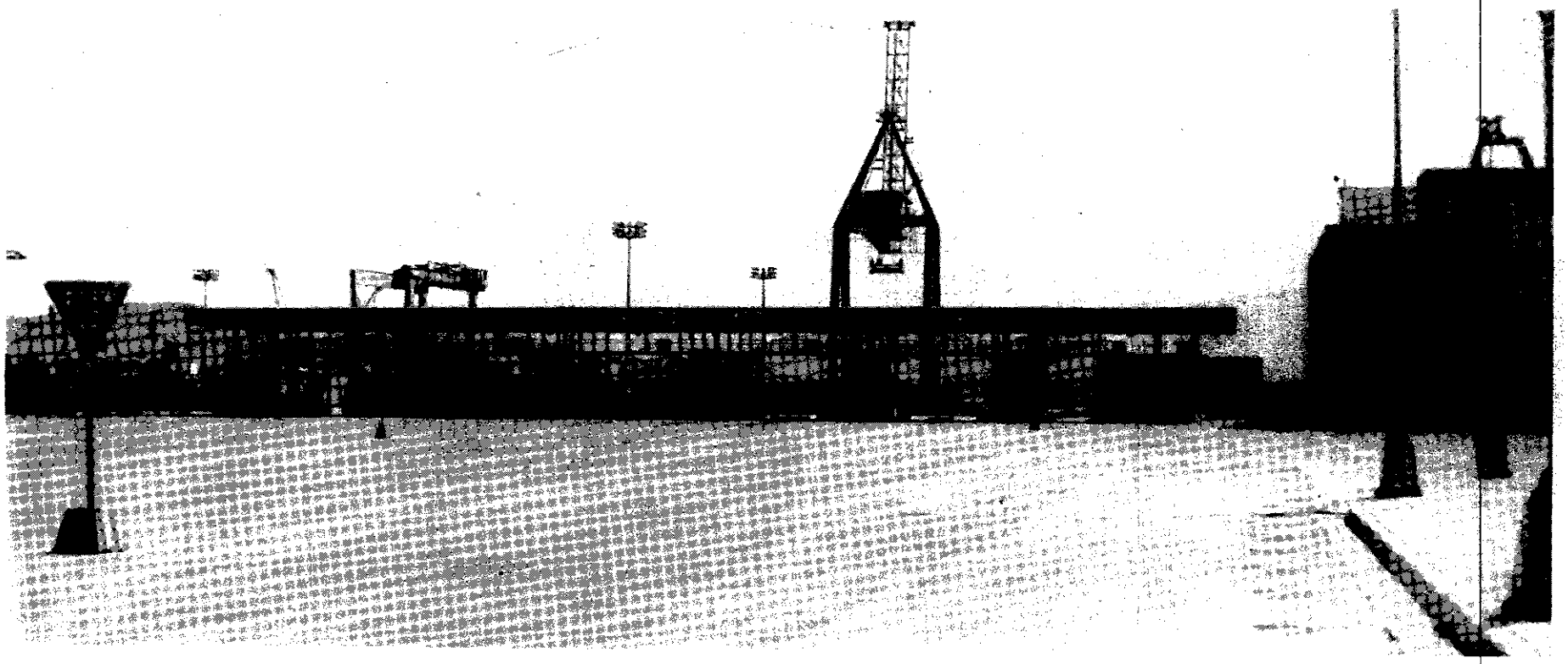


Figure P-17. Piers 5 and 6 in and out processing gates (southeastward view).

operations are not expected to be performed at these facilities. However, if for some reason another type of ship had to be discharged here, its operations could be accomplished. The reception capability of other vessel types in the US-flag fleet are shown in table P-12. Table P-13 shows the reception capability by ship type for Korean-flag ships.

d. (U) Safety Considerations. If a container ammunition ship were to berth at pier 5 or 6 for discharge operations, almost the entire city of Pusan would fall within a Q-D arc of 2800 meters (fig P-2). This area includes inhabited buildings, schools, public highway and rail routes, industrial areas, government offices, most of the Pusan inner harbor area, and an estimated population of 3.3 million.

e. (U) Summary of Berth Availability. The berth capacity for different vessel types is summarized in tables P-12 and P-13. Although these tables indicate the number of each ship type that these piers could

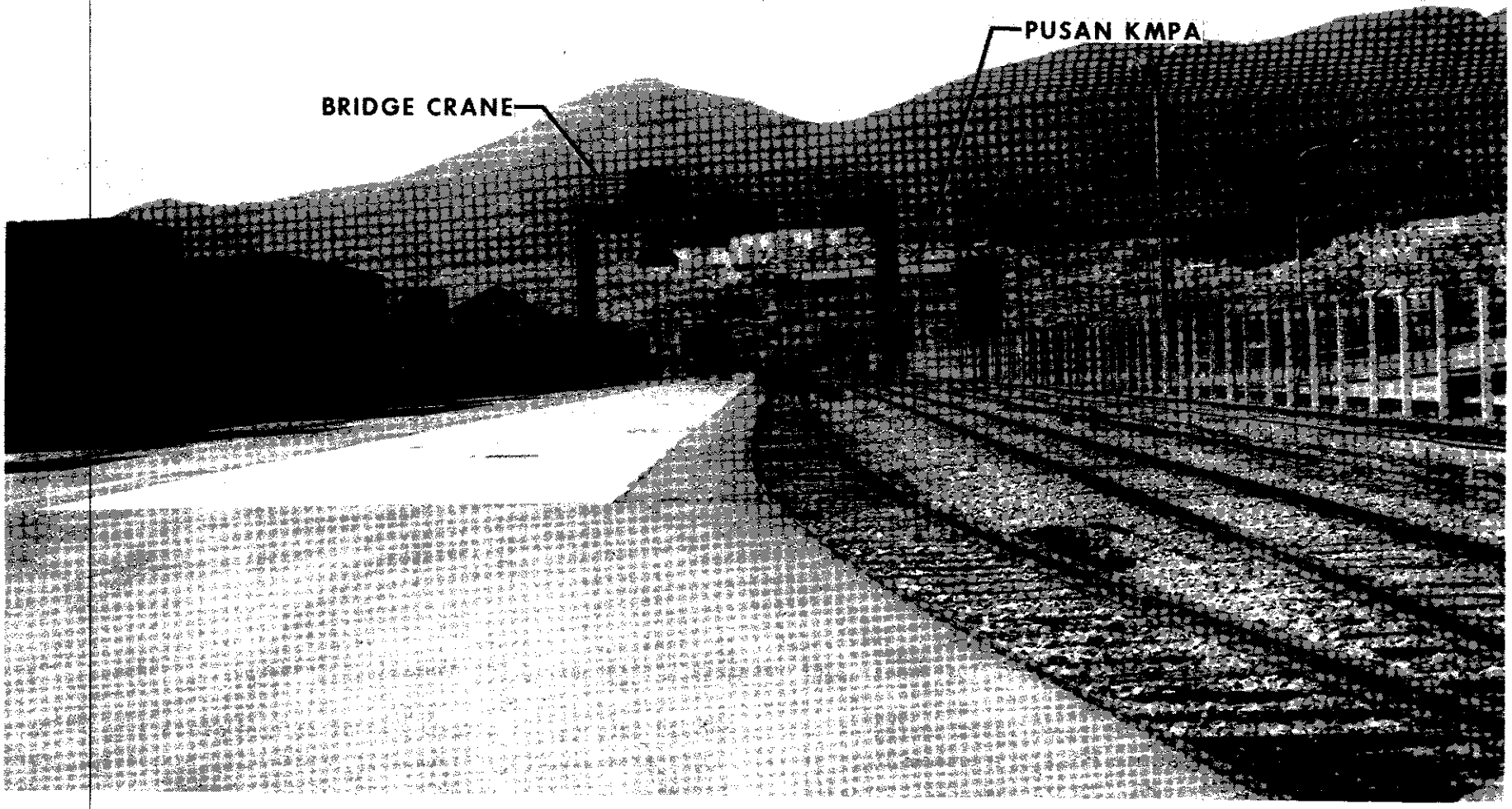


Figure P-18. Piers 5 and 6 bridge crane transfer area (westward view).

Figure P-19. Typical container storage configuration at piers 5 and 6 (southwestward view).

TABLE P-12
SUMMARY OF US-FLAG BERTH AVAILABILITY -
PORT OF PUSAN (PIERS 5 AND 6)

US-Flag Ship Type	Berths		
	Pier 5		Pier 6
	31	32-33	34-35
RORO			
GTS Callaghan	1	2	2
USNS Comet	2	4	3
Maine-class	1	2	2
Breakbulk			
C4 Mariner-class	2	3	3
C4-5-58a	2	3	3
C3-5-38a	2	4	4
C3-5-33a	2	4	4
Barge			
LASH C8-5-81B	1	2	2
LASH barge	19	35	32
SEABEE C8-5-82A	1	2	2
SEABEE barge	12	22	20
Seatrain			
Georgia-class	2	3	3
Puerto-class	2	3	3
Container			
C6-5-1W	1	3	2
C7-5-68E	1	2	2
C8-S-85B	1	3	2
RORO/Container			
C5-5-78	2	3	3
T-AKR (SL-7)	1	2	2
Breakbulk/Container			
C5-5-37E	2	3	1
C4-5-10	2	3	1

TABLE P-13
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY -
PORT OF PUSAN (PIERS 5 AND 6)

Korean-Flag Ship Type	Berths		
	Pier 5		Pier 6
	31	32-33	34-35
Breakbulk			
Type 1	10	18	17
Type 2	4	8	8
Type 3	4	8	7
Type 4	4	7	6
Type 5	4	7	6
Type 6	3	6	5
Type 7	2	5	4

handle, it is expected that piers 5 and 6 will be used exclusively for container ships.

2. (U) Storage Areas

a. (U) Open Storage. Piers 5 and 6 have over 80 acres of improved open storage areas available (fig P-20). These open storage areas and their general capacity, condition, and current use are listed in table P-5. A total of 356 000 square meters (3,832,326 square feet) is available for container storage, staging,

Figure P-20. Container open storage area (southwestward view).

and transferring. Part of this open storage is for refrigerated (reefer) containers. There are 140 container receptacles; 70 of them are 220 volts each and 70 are 440 volts each; all are 60 cycles.

b. (U) Covered Storage. Three container freight station buildings located at piers 5 and 6 have a total storage area of 25 616 square meters (276, 401 square feet). These buildings are used for consolidation, transfer, and restuffing of cargo for containers or transfer of cargo from containers to conventional trucks.

3. (U) Rail Operations. Rail service is available to berth 31 at pier 5 (grain terminal) and to the open storage areas of piers 5 and 6. Berth 31 has two spurs, located just north of the berth, that provide a total static capacity of 30 railcars. The bridge crane area, which provides rail service for rubber-to-rail transfer operations, has two spurs with a total static capacity of 38 flatcars. These spurs have a direct access line to Pusan's major classification yards. All spurs have overhead high-intensity lights to facilitate night-loading operations.

4. (U) Truck Operations. All three container freight station buildings have loading docks available for truck or container transfer operations. Figures P-21 and P-22 illustrate two of these buildings. The

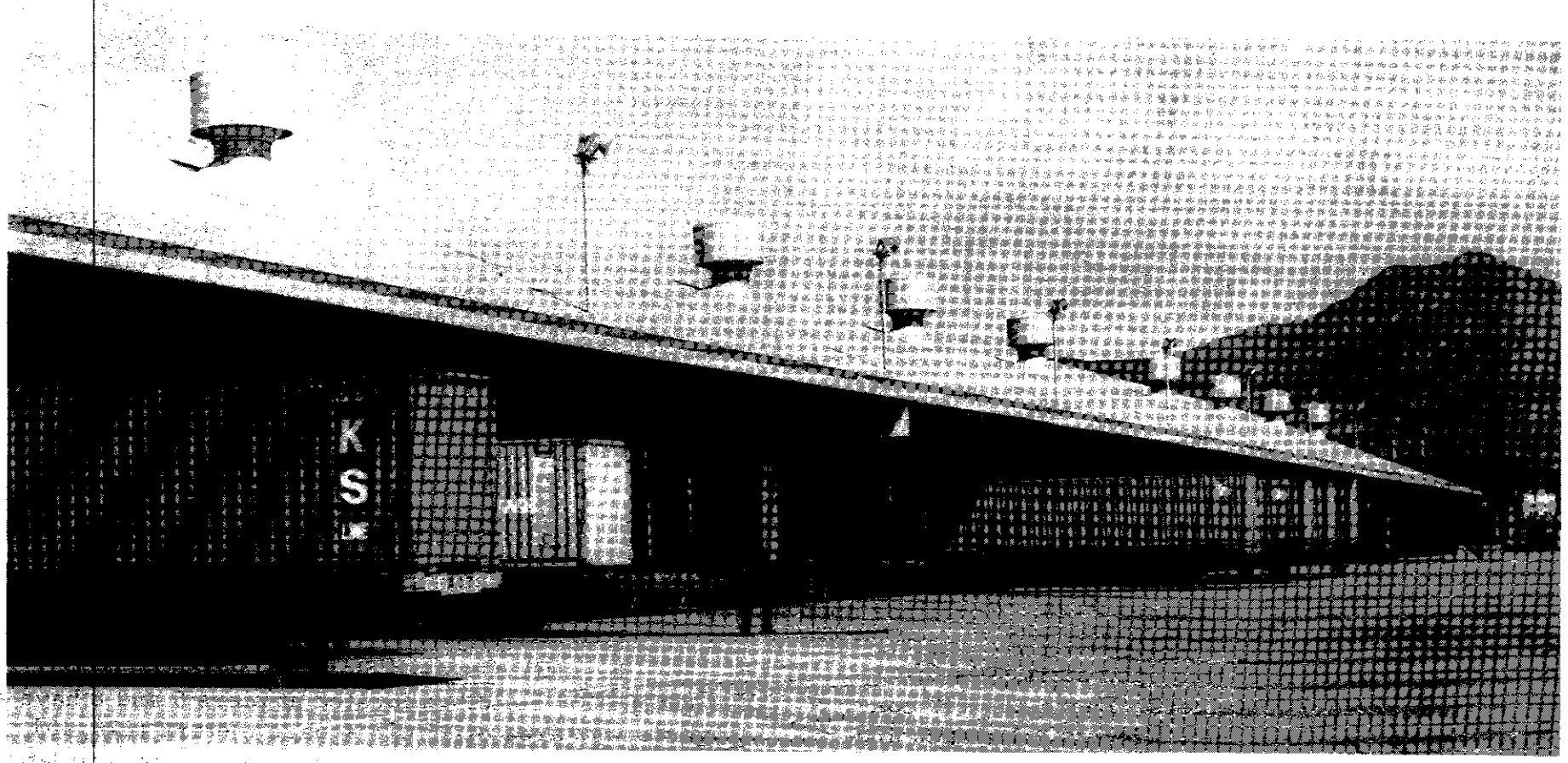


Figure P-21. Container freight station for piers 5 and 6 (northeastward view).

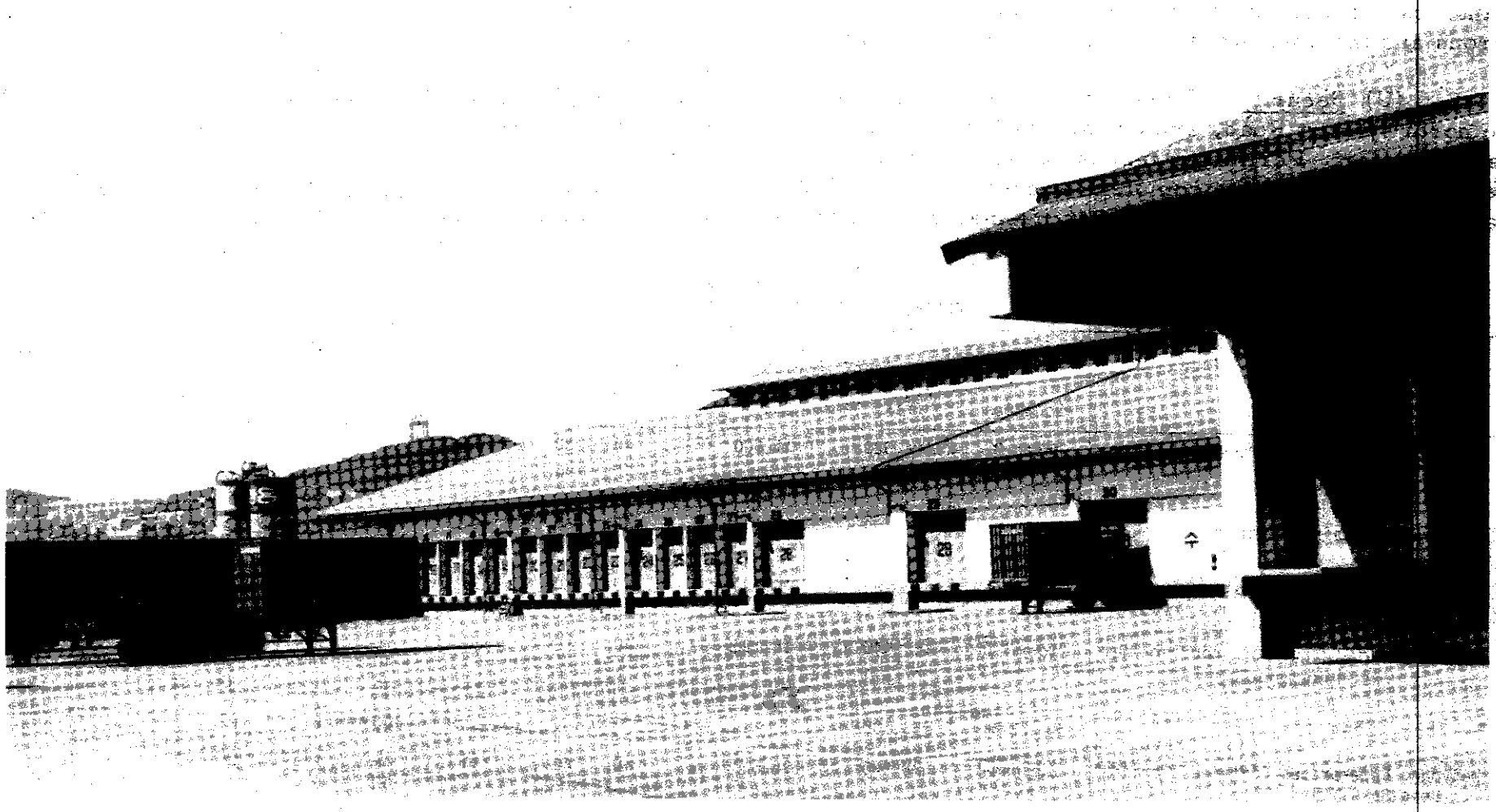


Figure P-22. Unloading docks at piers 5 and 6 CFS (northwestward view).

three buildings have a total of 240 bays for container truck transfer operations. Other container freight stations located in the Pusan area are listed in table P-14. Also listed in this table is the capacity of the open and covered storage areas, as well as the equipment each company uses for handling containers.

Other truck operations involve direct ship-to-chassis, bridge crane, or transtainer-to-chassis

transfers. These operations take place on the pier aprons and the open storage areas west of the piers.

5. (U) Security. Piers 5 and 6 are bounded on the north by Port Road, and on the east, south, and west by water. Perimeter fences secure the facility on the northern side of the complex. Access can be gained via one entrance/exit road that has manned control gates for vehicles and passengers. The pier complex is guarded round-the-clock and guard towers are strategically located throughout the facility. The perimeter fence, the piers, and the storage areas are well lighted with high-intensity tower lighting during darkness.

6. (U) Materials Handling Equipment (MHE). All MHE needed to conduct container operations is located

TABLE P-14
CONTAINER FREIGHT STATIONS IN THE PUSAN AREA

Facility	Location	Container Yard Size (ft^2)	Container Freight Station Size (ft^2)	Equipment Available: Chassis Size (ft)	Chassis No.	Tractors No.	Cranes Size (ton)	Cranes No.	Forklifts Size (ton)	Forklifts No.	Reefers Volts	Reefers No.
A-Nam Tongun Container Yard	Unsan-D	194,320	11,600	40	50	31	75	1	8	1		
							30	1	3	1		
							25	1	2	2		
Chunkyung Container Terminal	Anrak-D	206,400	52,300	40	50	30	55	1	5	2		
									2	2		
Chunusa Container Terminal	Jaesong-D	547,980	45,190	20	20	40	35	2	2	5	220V	20
				40	174		Top lift - 2				440V	20
Dongbang Forwarding Container Terminal	Mangmi-D	151,440	15,190	40	50	39	70	2	10	2	220V	10
							40	1	8	1	440V	10
							25	1	3	5		
							20	1	2	7		
	Bumil-D	53,100					150	2	16	1		
Daiyoung Enterprises Container Terminal (Dong-Bu C.Y.)	Jaesong-D	88,960	35,600	40	40	30	40	2	2	7		
							90	1				
FEMTCO Container Terminal	Jaesong-D	304,520	21,420	40	20	10	40	1	1	2		
									10	1	220V	10
									35	1		
Global Enterprises Container Terminal	Jaesong-D	527,870	22,310	20	15				30	1	220V	30
	Minlak-D	36,480		20	10		225	1	10	4		
				40	37		127	1	9	3	220V	25
	Jachon-D	155,600	12,170	40	37	157	90	5	4	1		
				40	75		70	2	3	9		
	Soojung-D	160,120		40	51		30	1	2	10		
	Banyou-D	313,400		40	107		15	2	1	2		

TABLE P-14 - cont

Facility	Location	Container Yard Size (ft^2)	Container Freight Station Size (ft^2)	Equipment Available: Chassis Size (ft)	Chassis No.	Tractor No.	Cranes Size (ton)	Cranes No.	Forklifts Size (ton)	Forklifts No.	Reefer Volts	Reefer No.
Hanjin Transportation Container Terminal	Jaesong-D	209,400	45,010	35	272		Gantry	1				
							250	1	5	2		
	Bumil-D	264,880	8,200	40	76	91	127	1	3	1	H/G set	
							40T/T	2			440V	16
	Jachon-D	46,970		40	103	T/R 20	11	1	2	6		
							10	2				
Hyupsihn Choong-Ha Container Terminal	Kamman-D	145,140	13,880	20	13	24	75	1	8	2	220V	20
				40	20		40	1	3	3		
							35	1	3	3		
							25	1				
Hyupsung Container Terminal	Yongho-D	264,270	20,070	40	39	65	75	1	35	1	440V	20
									20	1		
									2	3		
Korea Container Terminal	Kuojae-	66,580	12,170	20	28		225	1	13	2	220V	42
				40	182		90	1	5	1		
	Wooam-	416,360	53,880	40	30	110	127	1	10	2	M/G Set	
							75	2	3	5	(-10)	
							50	2				
	Koosou-D	332,560					40T/T	2				
	Soojung-D	106,750					25	1				
Sam-Ik Shipping Container Terminal	Kamman-D	293,130	34,250	20	10	132	90	1	23	2	220V	24
				40	245		40T/T		4	2	440V	4
							1		2	1	H/G Set	
											(-5)	
Shinil Shipping Container Terminal	Jaesong-D	121,340	3,630	20	4	31	75	1	7	1		
				40	52							
Korea Express Co Container Terminal	Jachon-D	314,620	38,930	40	199		250	1			220V	10
	Wooam-D	215,310	47,650				127	1	35	2		
							100	4				
		94,500	11,250	20	20	T/R 35	35T/T					
				40	61		1					
	Jocki-D	58,100	13,770	40	23	115	50	1	10	6	220V	10
							40T/T		128	19		
							2					
	Soojung-D	183,790	20,850									

at these piers. Container MHE available in the Port of Pusan is listed in table P-7. As can be seen in figures P-16 and P-23, the piers have an abundant supply of transtainers and straddle-carriers. They also have eight container cranes to work container ships.

E. (U) Facilities at Pier 7 and 8

1. (U) Berthing. Four bulk cargo berths are available at pier 7 and five general cargo berths are available at pier 8. Pier 7 is privately owned and

Figure P-23. Straddle carriers at piers 5 and 6 (eastward view).

pier 8 is occupied by the United States and Republic of Korea (ROK) Armies.

Berth 44 is used by the ROK Navy and thus is not available for cargo discharge operations. Berths 38 through 42 are most suitable for deep-draft ocean vessels. The individual characteristics of these berths are summarized in table P-15. The type of ship unloading operations possible at these berths under normal operating procedures is discussed below.

a. (U) RORO Operations. No facilities are available at these two piers for stern-ramp RORO ships. Pier 7 is used exclusively for bulk-type operations, so RORO operations are infeasible. Pier 8, however, has adequate vessel support systems to conduct side-ramp or slewed stern RORO operations. Site maps for the US and ROK berths are shown in figures P-24 and P-25. The pier has adequate open staging area needed for RORO operations, and the US Army has a 100-ton barge derrick capable of making heavy lifts off the deck of a RORO ship.

No shore-based ramps are availabe for the Ponce/Great Land-class RORO vessels at these berths. If a ramp were available or if the ship carried a ramp onboard, then this ship could use pier 8.

TABLE P-15
PORT OF PUSAN (PIERS 7 AND 8)
OPERATED BY: PUSAN KMPA

Pier	Inclusive Berths	Design	Continuous Length m	Continuous Length (ft)	Individual Berth	Berth Length m	Berth Length (ft)	Approximate Apron Width m	Approximate Apron Width (ft)	MLW m	MLW (ft)	Approximate Apron Height Above MLW m	Approximate Apron Height Above MLW (ft)	Deck Strength (psf)	Serviced by Rail-Mounted Crane	Railcar Access to Apron
Pier 7	36-37	Pier	337	(1,106)	36	168	(552)	20	(65)	8	(26)	3.3	(10.8)	800	No	No
					37	169	(554)	20	(65)	8	(26)	3.3	(10.8)	800	No	No
	38-39	Pier	320	(1,050)	38	160	(525)	20	(65)	10.5	(34)	3.3	(10.8)	800	No	No
					39	160	(525)	20	(65)	10.5	(34)	3.3	(10.8)	800	No	No
Pier 8	40-42	Pier	535	(1,755)	40	178	(585)	20	(65)	10	(32.8)	3.3	(10.8)	600	No	Yes
					41	178	(585)	20	(65)	10	(32.8)	3.3	(10.8)	600	No	Yes
					42	178	(585)	20	(65)	10	(32.8)	3.3	(10.8)	600	No	Yes
	43	Pier	165	(541)	43	165	(541)	20	(65)	9	(29.5)	3.3	(10.8)	600	No	No
	44	Pier	190	(623)	44	190	(623)	20	(65)	7.5	(24.6)	3.3	(10.8)	600	No	No

In summary, pier 8 is acceptable for RORO operations. Previous exercises conducted by the US Army at this pier confirm this conclusion.

b. (U) T-AKR Operations. Pier 8 could not berth a T-AKR vessel unless the vessel has an arrival draft of less than 32.8 feet. If alongside drafts were adequate, one T-AKR could be berthed alongside berths 40 through 42.

c. (U) Breakbulk Operations. Four typical US-flag breakbulk ships could be berthed at pier 8 alongside berths 40 through 43. No rail-mounted heavy-lift cranes are available at pier 8, but the barge derrick can be used instead. Apron tracks run along the entire length of berths 40 through 42 and could be used to facilitate direct ship-to-railcar transfers. Conventional ship's gear is used primarily for discharge operations; however, mobile cranes could be made available if necessary to supplement ship's gear.

Lights are available at pier 8 for nighttime operations. Three transit sheds are located at this facility for consolidation, storage, and/or transfer operations.

d. (U) LASH and SEABEE Operations. All of the necessary vessel support systems for LASH and SEABEE barge operations except mobile cranes and supporting MHE are available at piers 7 and 8. Since pier 7 is privately owned and primarily designed for bulk operations, only pier 8 is considered usable for LASH and SEABEE operations. Pier 8 can accommodate 36 LASH or 23 SEABEE barges. Adequate staging and barge lay areas are available north of pier 8.

Cranes and MHE are available to unload barges; however, availability would be based on other mobile crane requirements throughout the port. Actual barge positions worked depend on the number and type of vessels occupying the berths.

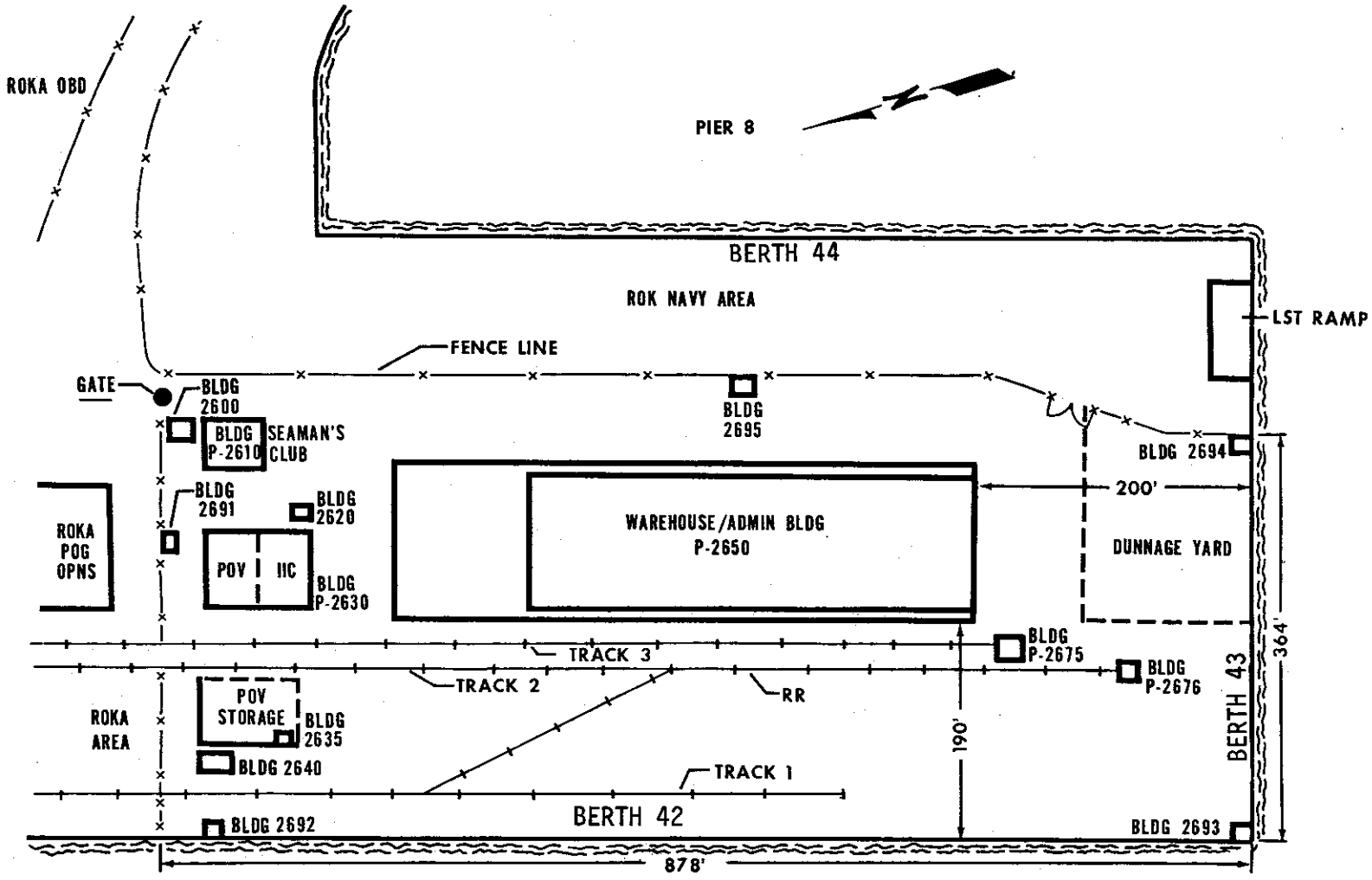


Figure P-24. Site map of US side of pier 8.

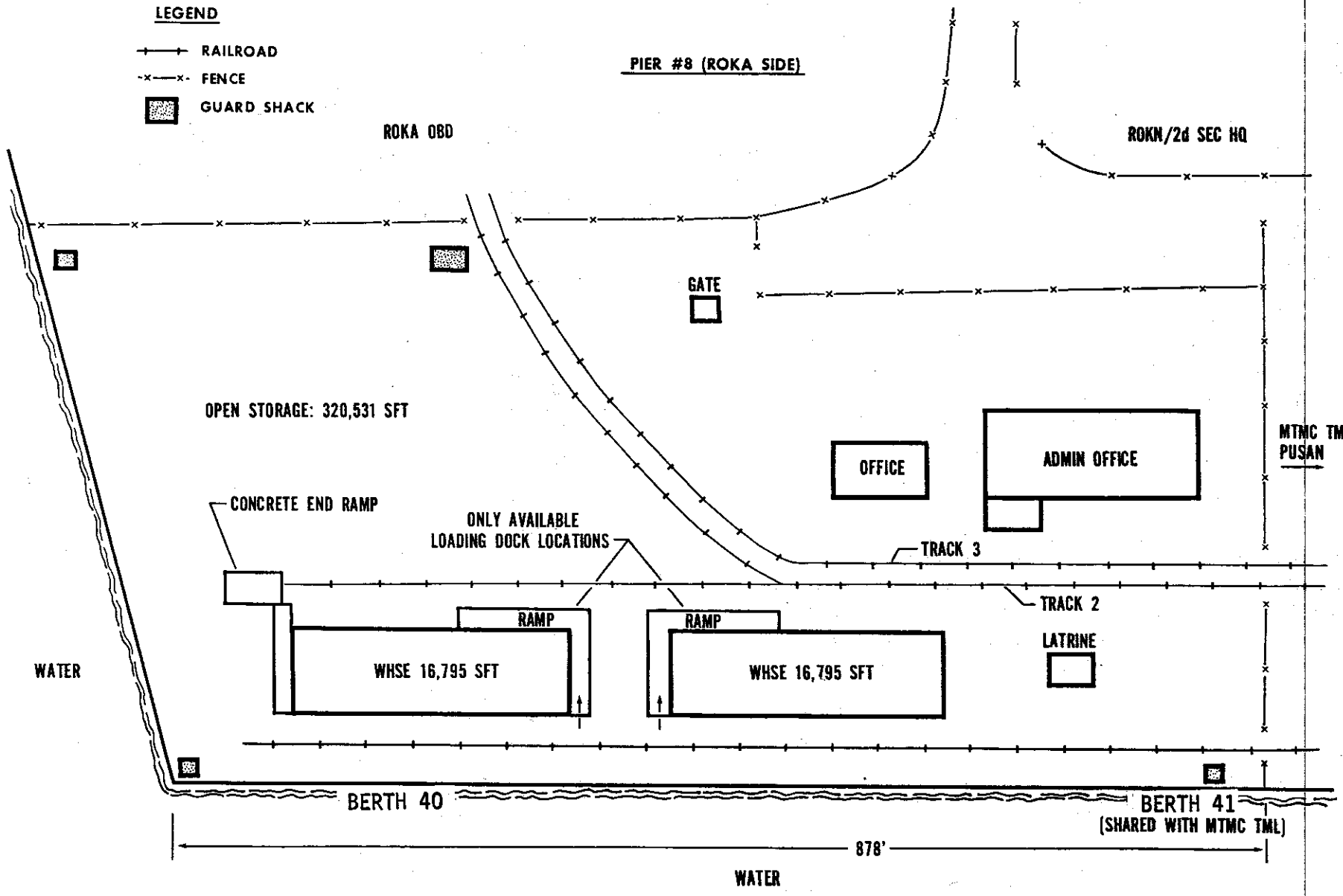


Figure P-25. Site map of ROK Army side of pier 8.

Sufficient tugs with adequate horsepower are available to tow barges from anchorages to berths and back again.

e. (U) Container Operations. Container and conventional materials handling equipment are unavailable at pier 8. Currently, some container stuffing and unstuffing is accomplished by the US Army at this pier; however, it involves mostly privately owned vehicles. If a container ship were to dock at pier 8, it would have to use berths 40 through 42. All these berths have the necessary physical characteristics to berth a container ship except for container handling equipment. Based on available berth space, up to two container ships could be discharged at pier 8 if container handling equipment were available. Since open staging area is limited containers would have to be drayed to another site for marshaling.

f. (U) Safety Considerations. If an ammunition ship were to dock at pier 8, it probably would be a breakbulk vessel. About one-third of the city of Pusan would fall within a Q-D arc of 2500 meters (fig P-2). This area includes inhabited buildings, schools, public highway and rail routes, ROK Army and Navy installations, piers 3 through 7, and an estimated population of 1.2 million.

g. (U) Summary of Berth Availability. The berth capacity for different vessel types are summarized in tables P-16 and P-17. Included are only those berths that could accommodate the particular type of vessel without extraordinary docking or materials handling procedures. The tables also give the number of each ship type that the pier can berth or the characteristics that make the pier unsuitable for the particular ship

TABLE P-16
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF PUSAN (PIERS 7 AND 8)

US-Flag Ship Type	Berth				
	Pier 7		Pier 8		
	36-37	38-39	40-42	43	44
RORO					
GTS Callaghan	a,d	1,d	2,d	c,d	a,c,d
USNS Comet	a,d	2,d	3,d	1,d	a,d
Maine-class	a,d	1,d	a,d	a,c,d	a,c,d
Breakbulk					
C4 Mariner-class	a	1	3	a,c	a
C4-5-58a	a	1	3	a,c	a
C3-5-38a	a	2	3	1	a
C3-5-33a	a	2	3	1	a
Barge					
LASH C8-5-81B	f	f	f	c,f	c,f
LASH barge	17	17	28	8	10
SEABEE C8-5-82A	f	f	f	c,f	c,f
SEABEE barge	11	10	18	5	6
Seatrain					
Georgia-class	a	1	3	c	a
Puerto-class	a	1	3	c	a
Container					
C6-5-1W	a	1	2	c	a,c
C7-5-68E	a	1	2	a,c	a,c
C8-S-85B	a	1	a	a,c	a,c
RORO/Container					
C5-5-78	a	1	a	a,c	a
T-AKR (SL-7)	a	a	a	a,c	a,c
Breakbulk/Container					
C5-5-37E	a	1	2	a,c	a
C4-5-10	a	1	3	a,c	a

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.
f - Inadequate draft for barge ship at berth; however, ship could be unloaded from anchorage.

type. As shown in table P-16, berths 38 through 42 can accommodate most ships in the US-flag and Korean-flag fleet. However, berths 38 and 39 are bulk-type berths and are not very suitable for standard cargo ships.

TABLE P-17
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF PUSAN
(PIERS 7 AND 8)

Korean-Flag Ship Type	Berths				
	Pier 7		Pier 8		
	36-37	38-39	40-42	43	44
Breakbulk					
Type 1	9	9	15	4	5
Type 2	4	4	7	2	2
Type 3	4	4	7	2	2
Type 4	3	3	6	1	2
Type 5	3	3	6	1	2
Type 6	3	2	4	1	1
Type 7	2	2	4	1	a

a - Inadequate draft at berth.

2. (U) Storage Areas

a. (U) Open Storage. Piers 7 and 8 have several improved and unimproved open storage areas (figs P-24 through P-26). Table P-5 gives the total open storage area available at each pier and gives its capacity, condition, and general use. A total of 80 665 square meters (868, 355 square feet) and 41 336 square meters (444, 471 square feet) are available at piers 7 and 8, respectively. Most of the pier 7 area is used for storage of bulk coal. Most of pier 8 open storage is used for import-export POV storage, dunnage, and other general cargo. The only storage area suitable for staging of vehicles is at pier 8.

b. (U) Covered Storage. No covered storage area is available at pier 7. Pier 8 has three buildings that provide a total covered storage area of 6407 square meters (68,890 square feet). One building is located at MTMC Pusan Terminal and the other two are located on the ROK side of pier 8.

3. (U) Rail Operations. The KNR operates over the trackage at piers 7 and 8. Each pier has one access line that branches off into several spurs on the pier. Pier 7 has three spurs. Pier 8 has one apron spur and two other spurs that provide a total static capacity of 33 flatcar or 18 boxcar loading positions. Trackage at these facilities is adequate to sustain military cargo operations. In addition, a rail end-loading ramp is available at the end of one spur at pier 8 (fig P-27).

4. (U) Truck Operations. Truck-loading docks for transferring general bulk-type cargo are available at pier 8. The warehouse on the US side of pier 8 can provide 28 truck-loading positions. Figure P-28 illustrates some of these positions. The two small warehouses on the ROK side of the pier can provide an additional four truck-loading positions. All of the loading docks are in good shape and can sustain large-scale military operations. Also, the rail end ramp can be used for loading flatbed trucks, along with mobile

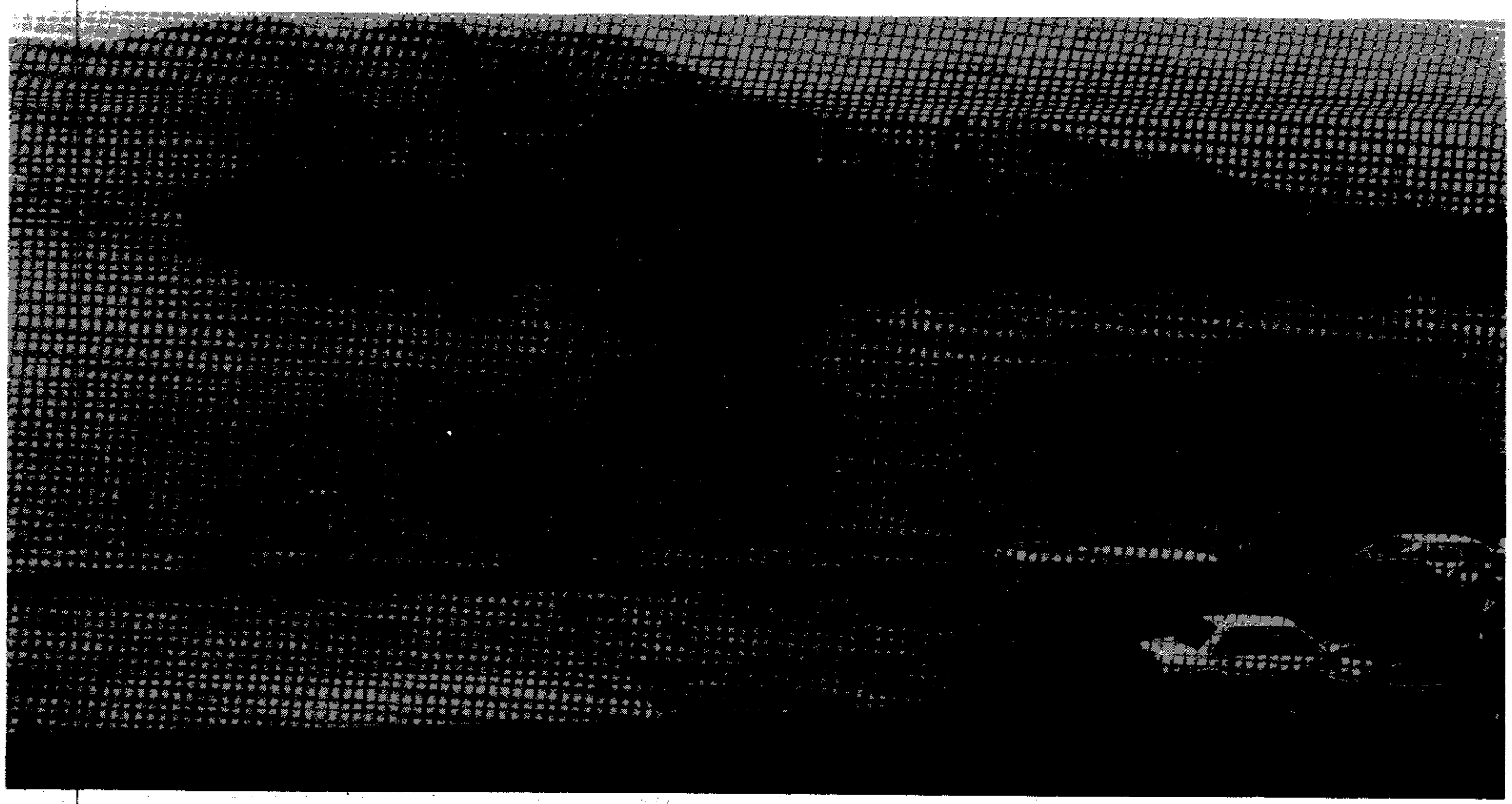


Figure P-26. Pier 7 (northwestward view).

cranes and/or forklifts that can lift cargo and/or unit equipment onto trucks.

5. (U) Security. Piers 7 and 8 are landlocked on one side and surrounded by water on the other three sides. The landsides have perimeter fences and the piers are guarded round-the-clock. Of all Pusan's berths, pier 8 has the best security by virtue of collocation with the ROK Army and Navy installations. Vehicles must clear two checkpoints before gaining access to the pier. Both piers are lighted during darkness and security guards constantly patrol throughout the area and attend to the gates.

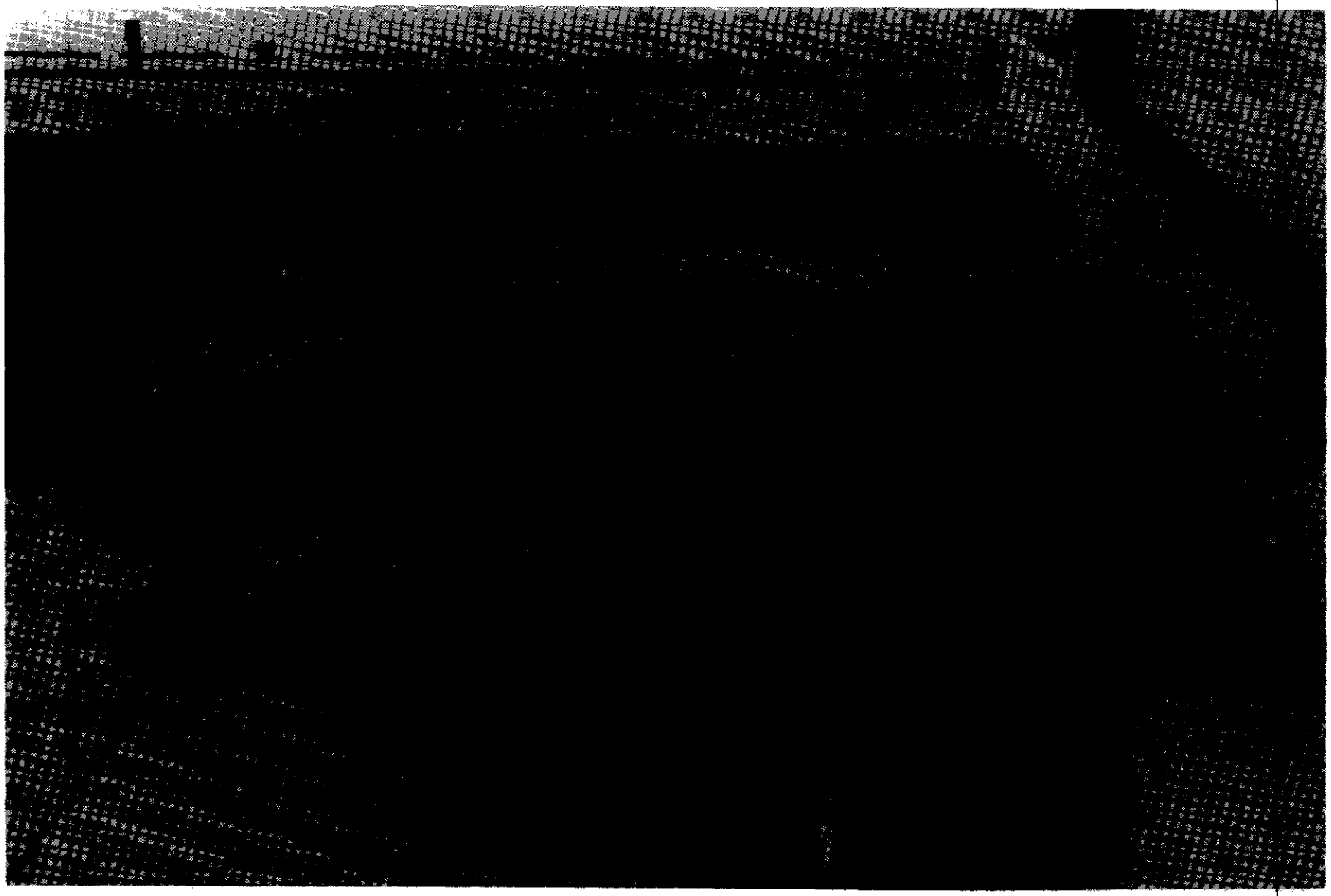


Figure P-27. Rail end-loading ramp at pier 8.

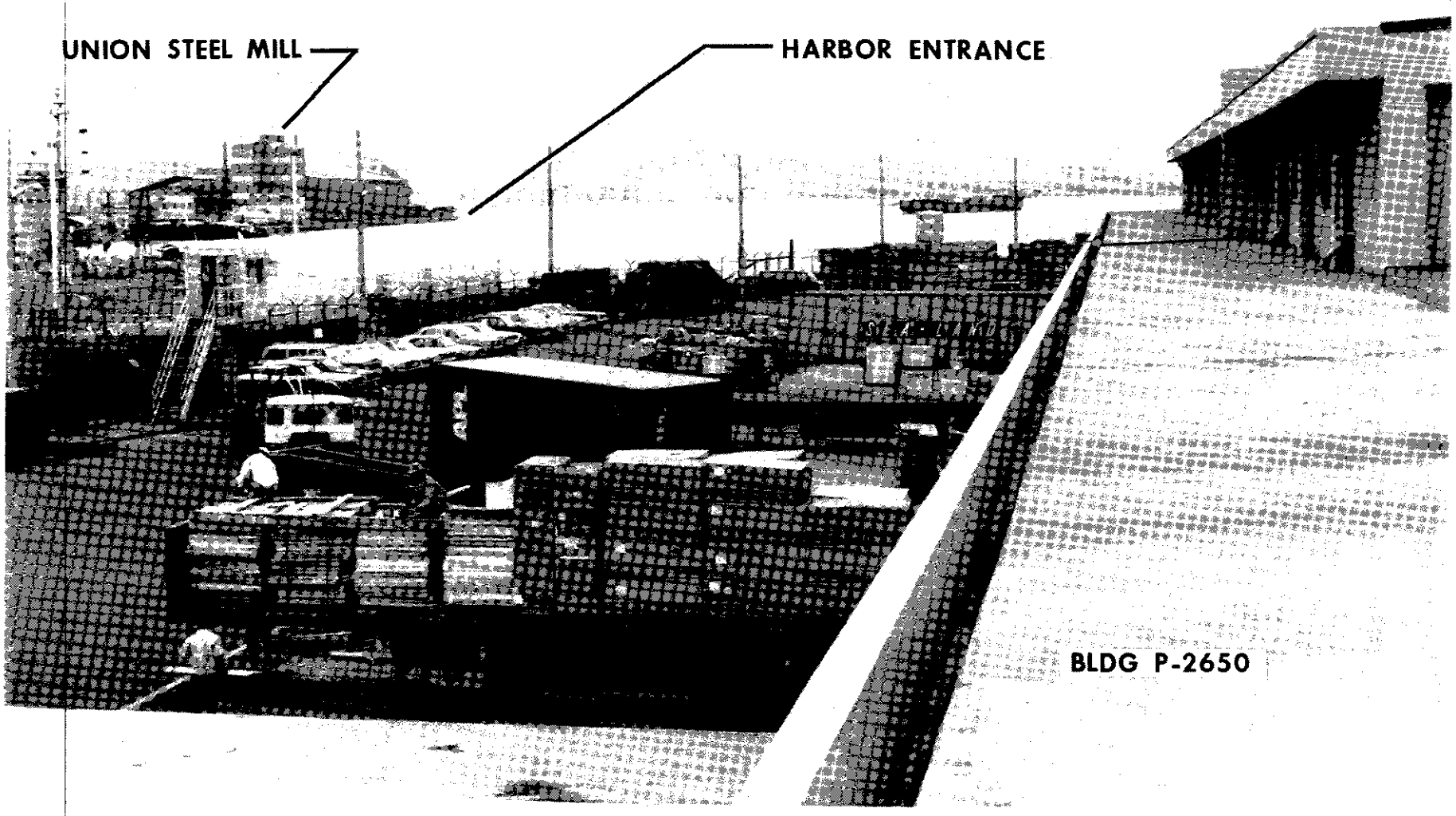


Figure P-28. Breakbulk and container loading area at pier 8 (southward view).

6. (U) Materials Handling Equipment. All MHE needed to conduct bulk-product discharge operations is located at pier 7. All MHE needed to conduct break-bulk, RORO, and barge operations is currently located at pier 8, but is owned and operated by the contracted stevedore company. The 100-ton barge derrick is owned by the US Army. A complete listing of other major MHE in the Port of Pusan is listed in table P-7.

F. (U) Private Facilities

1. (U) Berthing. Eight general cargo bulk-type berths and three fuel-type berths are operated by five different companies throughout the Port of Pusan. However, only berth 47 is suitable for conducting military dry-cargo discharge operations from deep-draft oceangoing vessels. The individual characteristics of the berths (berths 45 through 55) are summarized in table P-18. The type of ship unloading operations possible at these berths using normal operating procedures is discussed below.

a. (U) RORO Operations. None of the private facilities have the necessary vessel support systems to support RORO operations. If berths 46 and 47 of Union Steel Mill (figs P-29 and P-30) were dredged to an appropriate depth, then they would be the best berths to use for an alternative discharge site.

b. (U) T-AKR Operations. None of the vessel support systems necessary to berth a T-AKR vessel are adequate at these facilities. Berth 49 has an adequate berth length and apron width, but does not have the necessary alongside draft.

c. (U) Breakbulk Operations. None of the private berth facilities are adequate for typical US-flag breakbulk vessels. Berths 47 through 51 can accommodate some typical Korean-flag breakbulk vessels. Conventional ship's gear would be required for discharge operations unless mobile cranes are available.

TABLE P-18
PORT OF PUSAN (PRIVATE FACILITIES)
OPERATED BY: VARIOUS OPERATORS

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m	Continuous Length (ft)	Individual Berth	Berth Length m	Berth Length (ft)	Approximate Apron Width m	Approximate Apron Width (ft)	MLW m	MLW (ft)	Deck Strength (psf)	Serviced by Rail-Mounted Crane	Railcar Access to Apron
Union Steel Mill	45 - 48	Marginal	400	(1,312)	45	70	(230)	30	(98)	4.5	(14.8)	600	No	No
					46	30	(98)	30	(98)	4.5	(14.8)	600	No	No
					47	200	(656)	28	(92)	7.5	(24.6)	600	No	No
					48	100	(328)	28	(92)	5.5	(18)	600	No	No
Kuktong Shell Petrl Co	49	Marginal	500	(1,641)	49	500	(1,641)	25	(82)	6	(19.7)	600	No	No
Tongmyong Lumber Co	50 - 53	Pier	399	(1,309)	50	90	(295)	25	(82)	7	(23)	600	No	No
					51	140	(459)	25	(82)	7	(23)	600	No	No
					52	50	(164)	25	(82)	7	(23)	600	No	No
					53	119	(390)	18	(59)	4.5	(14.8)	600	No	No
Honam Oil Co	54	Dolphin			54					8.5	(27.9)		No	No
KOCO	55	Dolphin			55					10.5	(34.4)		No	No

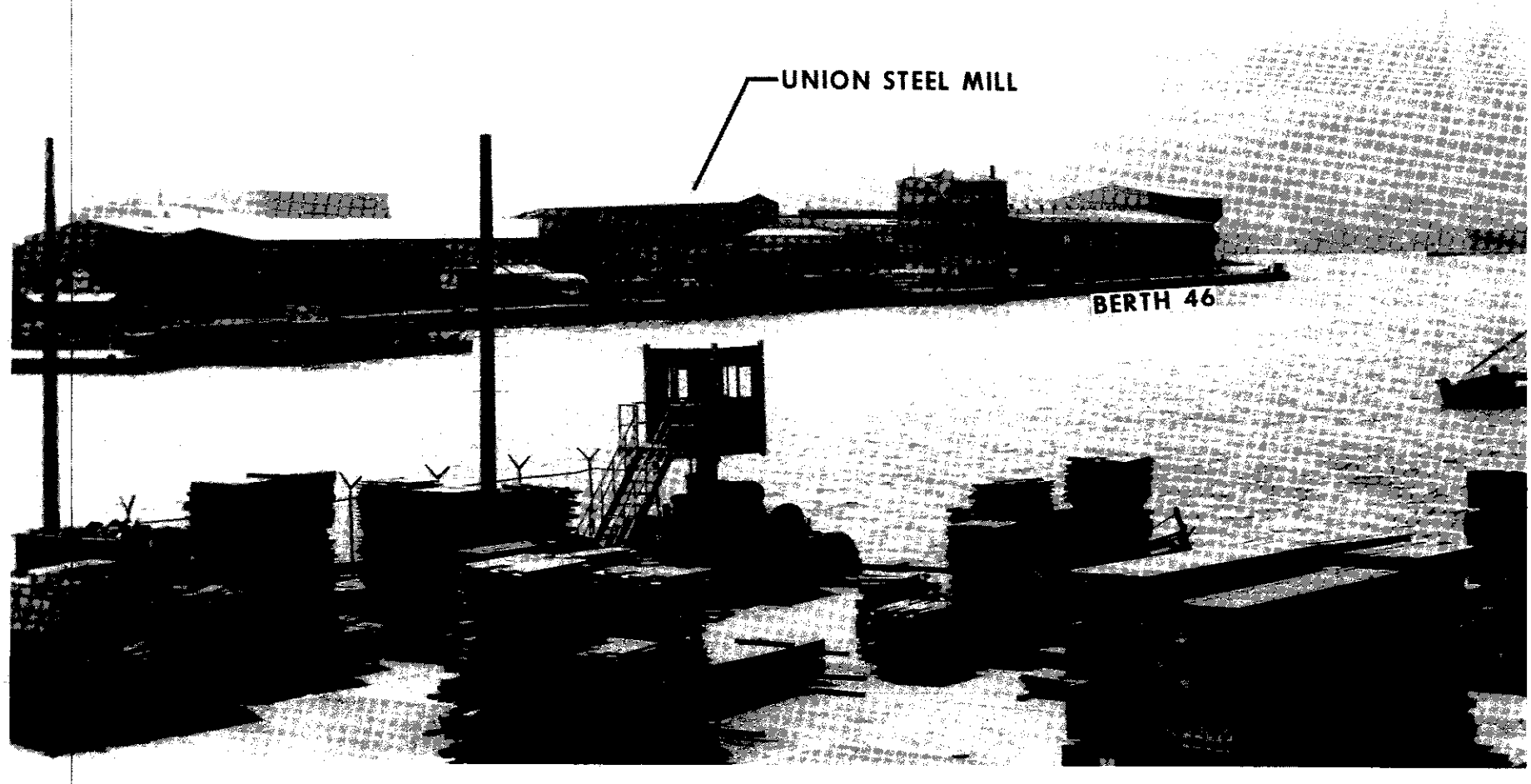


Figure P-29. Berth 46 at Union Steel Mill (southward view).

Most of these facilities do not have lights of sufficient intensity for nighttime operations, so cargo discharging would be limited to 10 hours per day.

d. (U) LASH and SEABEE Operations. LASH and SEABEE operations are possible at berths 45 through 53 if sufficient mobile cranes and MHE are available. These berths have a barge capability of 64 LASH or 39 SEABEE barges. Actual barge discharge positions depend on the availability of MHE and the number and type of vessels occupying the other berths.

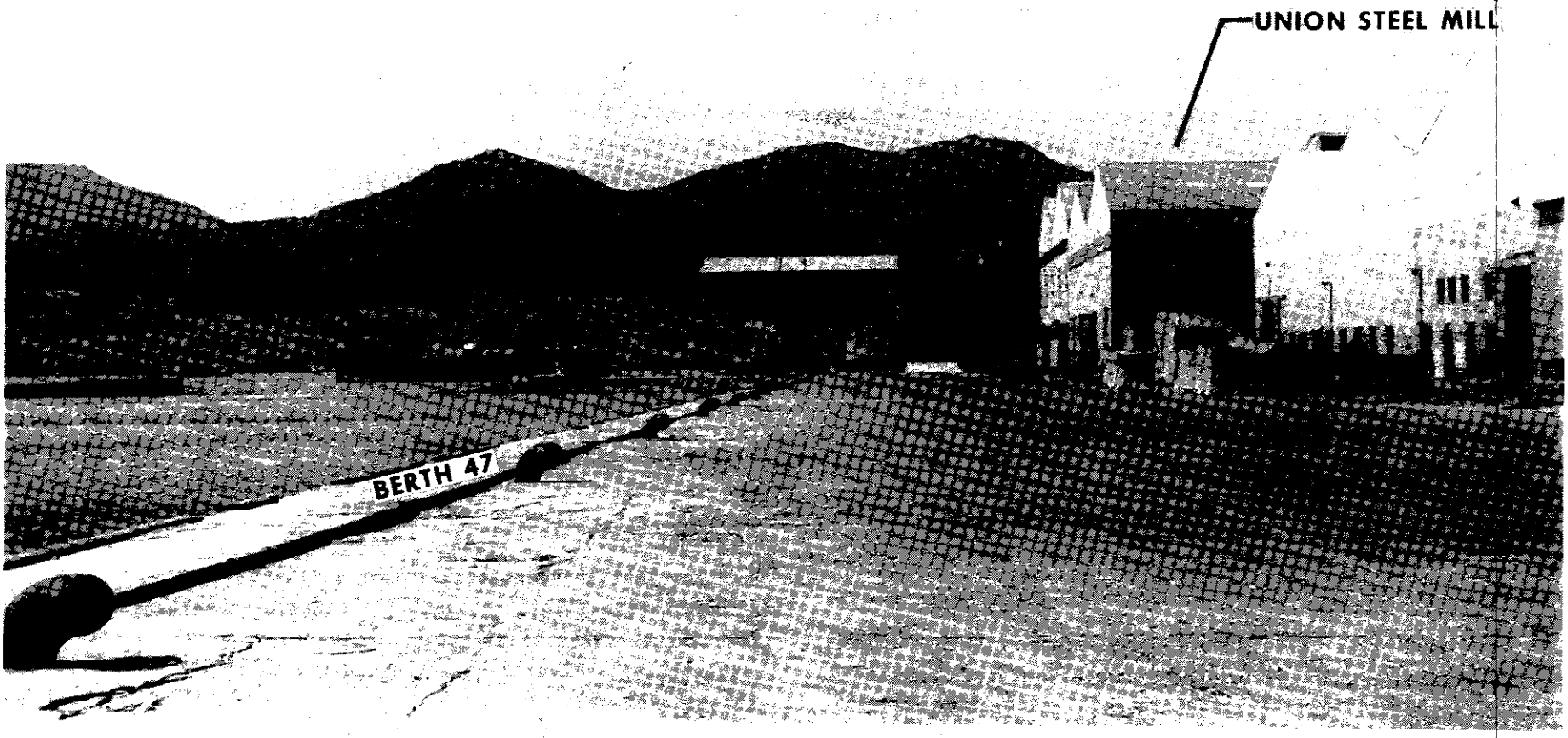


Figure P-30. Berth 47 at Union Steel Mill (northwestward view).

Sufficient tugs with adequate horsepower are also available to tow barges between anchorages and berths and back again.

e. (U) Container Operations. Currently, container operations are not possible at any of the private facilities. This is due mainly to inadequate drafts and lack of conventional container handling equipment.

f. (U) Safety Considerations. Since none of these private facilities have adequate vessel support systems to berth a typical US-flag vessel, conventional ammunition discharge operations will not be considered at these locations.

g. (U) Summary of Berth Availability. The berth capability for different vessel types is summarized

in tables P-19 and P-20. As shown, none of the typical US-flag vessels can be accommodated at these private berths. However, some typical Korean-flag vessels can be docked. Table P-20 gives the number of each ship type that the berth can dock or the characteristics that make the berth unsuitable for the particular ship type.

2. (U) Storage Areas. Because of the nature of activities at these private berths, only limited open and covered storage areas are available. Table P-5 lists the total storage area available at these berths. Most of the open storage area is on the aprons of the berths. The only covered storage is located at Tongmyong Lumber Company; it provides 3600 square meters (38,753 square feet).

3. (U) Rail Operations. The closest rail facilities are located at pier 8. No rail service is available to any of the private berths.

4. (U) Truck Operations. Except for Union Steel Mill, none of the private berths have truck-loading docks. Cargo transfer operations would require use of forklifts and mobile cranes to lift cargo onto flatbed trucks. Highway access to the private berths is poor and requires movement over narrow city streets with grades exceeding 10 percent.

5. (U) Security. All of the private berths discussed above are located in densely populated areas of the city. The Union Steel Mill facilities (berths 45 through 47) have good security arrangements, consisting of perimeter fences, security guards, guard towers, and other preventive measures. The other private facilities have adequate security for their respective operations.

6. (U) Materials Handling Equipment. A list of MHE available at these facilities was not available; however, local stevedore companies could provide the MHE needed for discharge operations. All of the major MHE available in Pusan is shown in table P-7.

G. (U) Lighterage Wharves

1. (U) Berthing. Seven lighterage wharves are available along the western shoreline of the inner harbor. These wharves are usable for barge operations only. The individual characteristics of these wharves are summarized in table P-21.

2. (U) LASH and SEABEE Operations. LASH and SEABEE operations are possible at lighter wharves 1 through 6 if sufficient mobile cranes and MHE are available. Lighter wharf 7 alongside draft is insufficient for these types of barges. Figure P-31 shows typical lighterage operations taking place at lighter wharf 4. These wharves have a barge capacity of 77 LASH or 44 SEABEE barges. Actual barge discharge positions depend on the availability of MHE and the number and type of vessels occupying other berths.

The areas east of the Central wharf and the barge lay basin can be used to stage or store barges. Sufficient tugs with adequate horsepower are available to tow barges from anchorages to berths and back again.

3. (U) Storage Areas. Only open storage is available at lighter wharves 1 through 7. A total of 79 042

TABLE P-19
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF PUSAN (PRIVATE FACILITIES)

US-Flag Ship Type	Berths								
	45	46	47	48	49	50	51	52	53
RORO									
GTS Callaghan	a,c,	a,c	a,c	a,c	a	a,c	a,c	a,c	a,c
USNS Comet	a,c,	a,c	a,c	a,c	a	a,c	a,c	a,c	a,c
Maine-class	a,c	a,c	a,c	a,c	a	a,c	a,c	a,c	a,c
Breakbulk									
C4 Mariner-class	a,c	a,c	a	a,c	a	a,c	a,c	a,c	a,c
C4-5-58a	a,c	a,c	a	a,c	a	a,c	a,c	a,c	a,c
C3-5-38a	a,c	a,c	a	a,c	a	a,c	a,c	a,c	a,c
C3-5-33a	a,c	a,c	a	a,c	a	a,c	a,c	a,c	a,c
Barge									
LASH C8-5-81B	f,c	f,c	f,c	f,c	f	f,c	f,c	f,c	f,c
LASH barge	3	1	10	5	26	4	7	2	6
SEABEE C8-5-82A	f,c	f,c	f,c	f,c	f	f,c	f,c	f,c	f,c
SEABEE barge	2	1	6	3	16	3	4	1	3
Seatrain									
Georgia-class	a,c	a,c	a	a,c	a	a,c	a,c	a,c	a,c
Puerto-class	a,c	a,c	a	a,c	a	a,c	a,c	a,c	a,c
Container									
C6-5-1W	a,c,	a,c	a,c	a,c	a	a,c	a,c	a,c	a,c
C7-5-68E	a,c,	a,c	a,c	a,c	a	a,c	a,c	a,c	a,c
C8-S-85B	a,c,	a,c	a,c	a,c	a	a,c	a,c	a,c	a,c
RORO/Container									
C5-5-78	a,c	a,c	a	a,c	a	a,c	a,c	a,c	a,b,c
T-AKR (SL-7)	a,c	a,c	a,c	a,c	a	a,c	a,c	a,c	a,b,c
Breakbulk/Container									
C5-5-37E	a,c	a,c	a	a,c	a	a,c	a,c	a,c	a,c
C4-5-10	a,c	a,c	a	a,c	a	a,c	a,c	a,c	a,c

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.
f - Inadequate draft for barge ship at berth; however, ship could be unloaded from anchorage.

TABLE P-20
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF PUSAN (PRIVATE FACILITIES)

Korean-Flag Ship Type	Berths								
	45	46	47	48	49	50	51	52	53
Breakbulk									
Type 1	2	b	5	2	14	2	3	1	3
Type 2	a,b	a,b	2	1	6	1	1	b	a
Type 3	a,b	a,b	2	1	6	1	1	b	a
Type 4	a,b	a,b	2	1	5	1	1	b	a
Type 5	a,b	a,b	2	a	5	1	1	b	a
Type 6	a,b	a,b	1	a,b	a	b	1	b	a
Type 7	a,b	a,b	a	a,b	a	a,b	a	a,b	a,b

a - Inadequate draft at berth.
b - Inadequate berth length.

square meters (850,883 square feet) is available. Table P-5 lists the specific storage area available to each lighter wharf. All of these areas are located directly adjacent to the wharves and are currently used for temporary storage of bulk-type products and general cargo.

4. (U) Rail Operations. Rail service is available to the backup open storage areas of lighter wharves 4 and 5. None of the other lighterage facilities have rail service. The single spur that serves lighter wharves 4 and 5 has a static capacity of 13 railcars. This spur is currently used to service the grain silos adjacent to lighter wharf 4.

5. (U) Truck Operations. None of these facilities have truck-loading docks for cargo transfer operations. These operations will require the use of mobile cranes

TABLE P-21
PORT OF PUSAN (LIGHTERAGE WHARVES)
OPERATED BY: PUSAN KMPA

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m	Continuous Length (ft)	Individual Berth	Berth Length m	Berth Length (ft)	Approximate Apron Width m	Approximate Apron Width (ft)	MLW m	MLW (ft)	Approximate Apron Height Above MLW m	Approximate Apron Height Above MLW (ft)	Deck Strength (psf)	Serviced by Rail-Mounted Crane	Railcar Access to Apron
Lighter-Wharves	L/W 1	Marginal	159	(522)	L/W 1	159	(522)	24	(78.7)	3.5	(11.5)	3	(9.8)	600	No	No
	L/W 2	Marginal	282	(928)	L/W 2	282	(928)	24	(78.7)	4.5	(14.8)	2.5	(8.2)	600	No	No
	L/W 3	Marginal	291	(954)	L/W 3	291	(954)	18	(59)	3.5	(11.5)	3	(9.8)	600	No	No
	L/W 4 to L/W 7	Marginal	957.4	(3,142)	L/W 4	365.5	(1,199)	18	(59)	4.5	(14.8)	3	(9.8)	600	No	No
					L/W 5	294.9	(968)	18	(59)	3.5	(11.5)	3	(9.8)	600	No	No
					L/W 6	102	(335)	18	(59)	3	(9.8)	3	(9.8)	600	No	No
					L/W 7	195	(640)	20	(65.6)	2.5	(8.2)	3	(9.8)	600	No	No

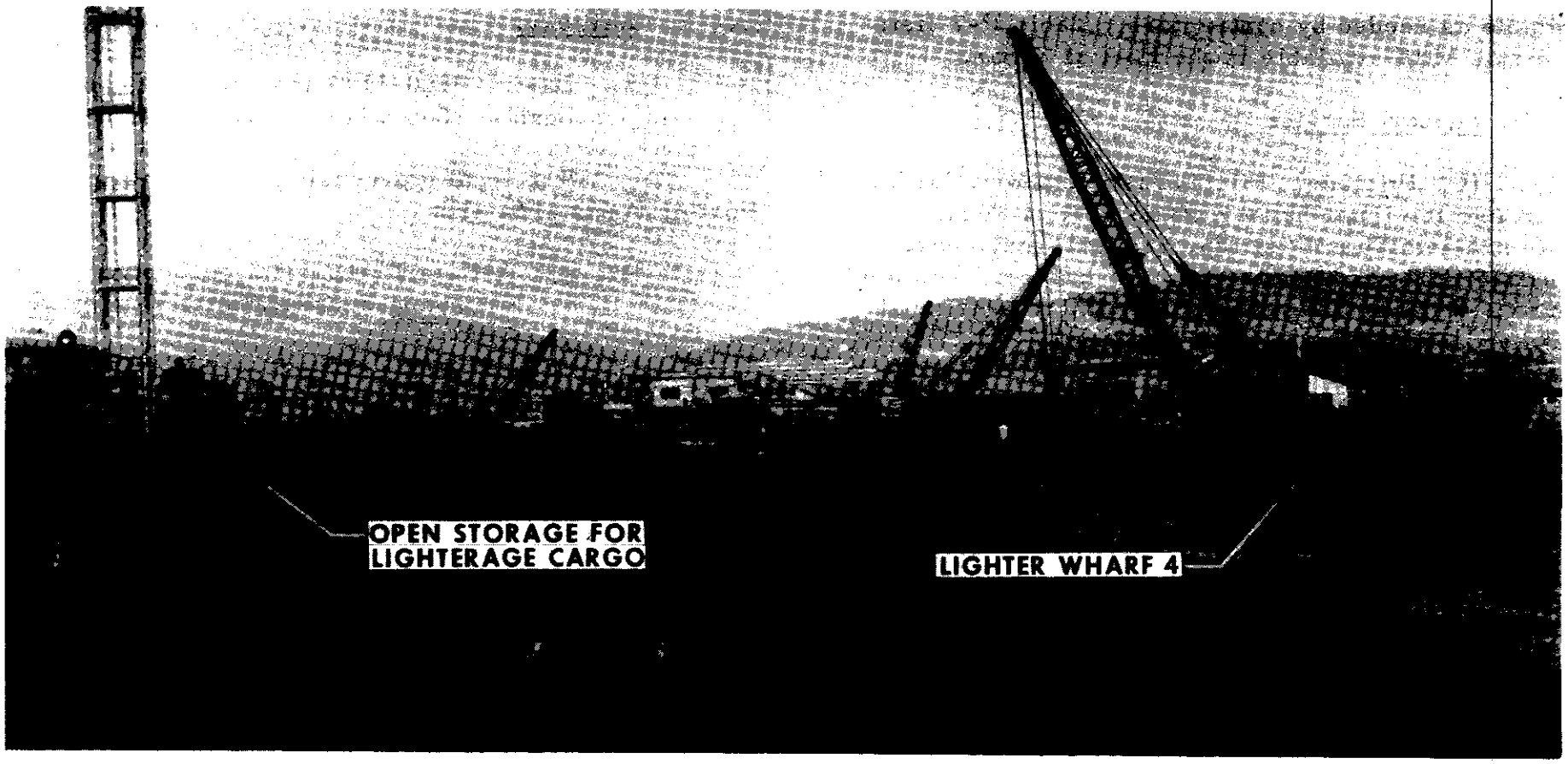


Figure P-31. Typical lighterage operations in Pusan (northeastward view).

and/or forklifts for truck loading. Highway access to all of these facilities is excellent with direct access to Korean Route 7.

6. (U) Security. All of the lighter wharves have good security arrangements. Lighter wharves 1, 2, 3, 4 require access through the adjacent pier gates, while wharves 5 through 7 have their own access. All facilities are surrounded by perimeter fences and all gates are manned by security guards. Security guards also patrol throughout the lighter wharves to control vehicles and maintain surveillance.

7. (U) Materials Handling Equipment. No MHE is specifically dedicated to the lighter wharves. MHE for barge discharge or loading operations is made

available as needed by contractors. Table P-7 lists the major MHE available in the Port of Pusan.

H. (U) Support Service

1. (U) Pilotage. Pilotage is mandatory for entrance into the inner harbor of the Port of Pusan. Pilots are available either day or night; they board vessels off the entrance to the outer harbor. The pilot boat is a white launch that displays the international pilot flag when a pilot is aboard.

2. (U) Harbor Craft. Besides the berthing tugs operated by the Pusan District KMPA, there are about 40 other private tugs and more than 180 lighterage vessels. These harbor craft are listed by type in table P-7.

3. (U) Stevedores. Currently, over 4,500 stevedores are registered with the Pusan Branch of the National Docker's Union. Also, each pier and/or wharf has its own local labor union.

All port labor charges covering commercial operations fall under a general tariff agreement called "Port Tariff in Korea," which covers all ports.

Working hours for both commercial and military cargo are conducted in two shifts. They are:

Commercial:

Day: 0800-1200 and 1300-1700 hours
Night: 1800-2400 and 0100-0500 hours

Military:

Day: 0800-1145 and 1300-1845 hours
Night: 1800-2345 and 0100-0645 hours

The local stevedoring companies in the Port of Pusan area are:

a. A-Nam Transportation Company, Ltd.
b. Chunyang Transportation Company, Ltd.
c. Daedong Transportation Company, Ltd.
d. Daeyoung Enterprise Company, Ltd.
e. Dongbang Forwarding Company, Ltd.
f. Global Enterprises Company, Ltd.
g. Hanjin Transportation Company, Ltd.
h. Hyopsin Heavylift Company, Ltd.
i. Kukjei Enterprise Company, Ltd.
j. Korea Container Terminal Company, Ltd.
k. Samick Shipping Company, Ltd.
l. Samchang Enterprise Company, Ltd.
m. Korea Express Company, Ltd.
n. Woosung Industrial Company, Ltd.

The stevedore gangs usually consists of 16 men with productivity rates varying between 28 to 60 STON per hour per gang.

I. (U) Future Development

Pusan's port development program consists of three phases. Phases 1 and 2 have been completed and phase 3 is scheduled to begin this year.

Phase 3, which involves several projects for Pusan's outer harbor, is projected to cost more than 150 billion won (200 million dollars). This development plan is illustrated in figure P-32.

One project involves construction of a third container wharf that is 780 meters (2, 560 feet) in length and capable of berthing three container ships. Part of this project also requires reclamation of the background area adjacent to the new container wharf and construction of a new container yard and container freight station.

Another project involves extension of the rail trackage from the Munkyon area to the new container wharf and improvement and realignment of the roads into this facility.

The last phase involves construction of two additional breakwaters, with a total length of 2700 meters (8, 859 feet), across the outer harbor entrance to provide protection to these new port facilities.

These projects are scheduled for completion in 1988. As a result, annual cargo handling capability will more than double and berth reception capability will increase to 79 berths.

J. (U) Summary

Currently, the Port of Pusan can berth and discharge breakbulk, RORO, and container ships as well as LSTs and LASH and SEABEE barges. Individual rankings for all berths within the Port of Pusan are shown in tables P-22 through P-24.

The best facilities for breakbulk and/or RORO operations are those at piers 8, 2, 3, and 4, in that order. Pier 1 is good for shallow-draft coastal vessels (21- to 29-foot draft). The other facilities throughout the port are also excellent; however, some berths are more suitable because of their configuration. The best berths for RORO operations are berths 40, 41, and 42 at pier 8; berths 8 and 9 at pier 2; berth 20 at pier 3; and berths 24, 25, 27, and 28 at pier 4. It is important to note here that some of the berths rank lower than others for RORO operations, but this is only because of their designated berth length.

LASH and SEABEE barge operations are possible at most piers and wharves within the port. However, since an adequate number of lighter wharves exist, only they were evaluated. Lighter wharves 4 and 5 are the best facilities to use within the Port of Pusan.

Piers 5 and 6, the designated container facilities for the Port of Pusan, are the best container receiving and discharging facilities in the country. Adequate container freight stations exist throughout the city of Pusan to support extensive container operations. All berths are excellent; however, the berths (berths 34 and 35) at pier 6 are considered to be the best of the two piers because of their highly rated container cranes (40. 5 tons) and their deep alongside draft (44 feet).

In summary, the Port of Pusan has excellent facilities to support all types of vessel discharge operations. It also has the necessary backup vessel support systems to sustain these operations.

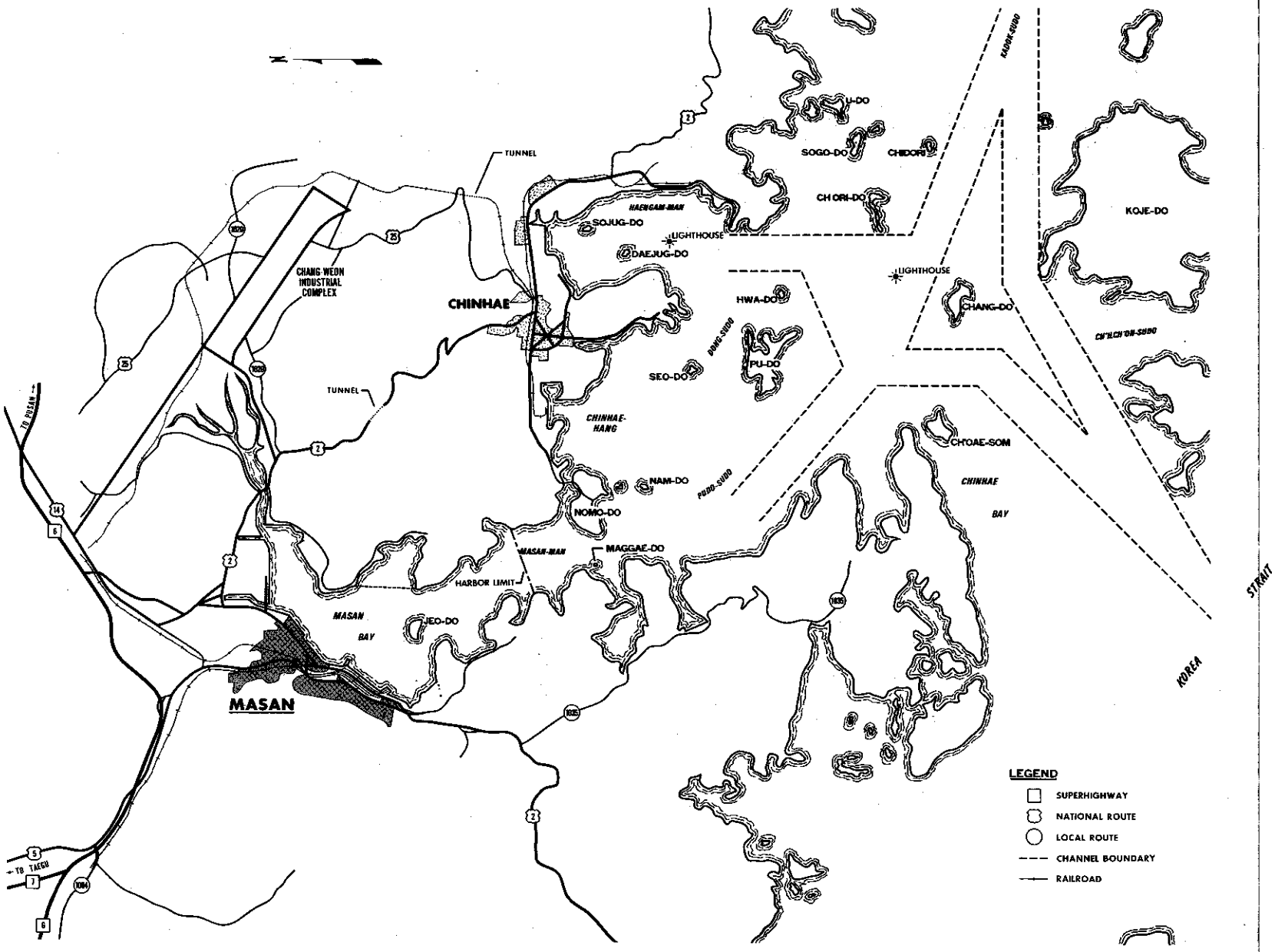


Figure MA-1. Vicinity map.

(U) PORT OF MASAN

A. (U) General

1. (U) Location and General Uses. The Port of Masan, which is under the jurisdiction of the Masan District Maritime and Port Authority, is located on the southern coast of the Korean Peninsula, about 5 miles northwest of Chinhae Bay. Although this port complex has been previously overshadowed by the nearby Port of Pusan, it is now considered the gateway to the western part of Kyongnam Province. This is primarily due to the steady increase in daily traffic generated by the Masan Free Export Zone and the Chang-Weon Machine Industrial Complex. Additionally, export goods are trucked into Masan from Taegu and the Kumi Industrial Complex, both of which are located in East Central Korea. Currently, this port handles more than 3 million measurement tons of export and import cargo. The predominant commodities moving through the port include iron, steel, oil, cement, minerals, and other general cargo.

2. (U) Harbor. From Chinhae Bay (fig MA-1), the approach to the Port of Masan is via the western channel of the Korea Strait. From these straits, vessels must pass through Kadok-Sudo and Pudo-Sudo channels before reaching the harbor limits located in Masan Bay. Masan Bay, which consists of and upper and lower bay, can be approached through either Pudo-Sudo or Dong-Sudo channels.

Pudo-Sudo channel, the northwesterly continuation of Kadok-Sudo, is entered between Chang-Do and Chidori Islands. It is a narrow inlet about 10 miles long. The Port of Chinhae is at its northeastern end and the Port of Masan is at its northwestern end. This channel, south of the harbor limits of Masan, has been wire-dragged to depths between 28 and 33 feet.

Masan-Man, the inner bay at the extreme northwestern end of Pudo-Sudo, extends about 5 miles to the northwest. Access to this bay is via a narrow channel between the western tip of Nomo-Do and Maggae-Do, a small island with a lighthouse about 600 yards to the west. This channel is dredged to 41 feet, is 820 feet wide, and is free from dangers up to Jho-Do Island (fig MA-2). On each side of this island are channels about 1,500 feet wide. However, the northwestern channel, which is the approach to the piers 1 and 2 and Central wharf areas, is dredged to only 24 feet. Most oceangoing vessels should enter upper Masan Bay via the northeastern channel, which is dredged to 36 feet. Reefs, drying rocks, and islets dot the northwestern approach, and the most dangerous points are marked by buoys. Caution must be exercised in transiting the channels and harbor because fishing nets are sometimes stretched into and across the channels.

The Port of Masan is located within a natural coastal harbor that is about 3 miles long and 7 miles wide at its southern portion and 2 miles wide at its northern portion. Within the harbor area, the mean high water interval is 8 hours 19 minutes. The mean tidal range is 4.4 feet, the spring rise is 6.2 feet, and the neap rise is 4.5 feet. The harbor is afforded natural protection on the north, east, and west by surrounding hills and on the south by islands. It is considered a typhoon shelter and is ice free throughout the year.

TABLE C-6
INDIVIDUAL BERTH RATING (BB/RORO)

Ideal Berth Factors	Berths 1	2
Length	16	16
Alongside depth	20	20
Backup area	1	1
Apron width	20/20	20/20
Transit shed	0	0
Distribution shed	0	0
Apron tracks	10	0
Deck loading	8	8
Heavy-lift cranes	5	5
Berth type	8	10
Truck tailgate	0	0
Rail end ramp	0	0
Truck access	5	5
Ship service facilities	6	5
Conditional age	5	5
RORO stern ramp	0	0
Total Points	104/104	95/95
Ranking	1/1	2/2

TABLE C-7
INDIVIDUAL BERTH RATING (BARGE)

Ideal Berth Factors	Berths 3	4
Length	10	10
Alongside depth	10	9
Backup area	5	5
Apron width	10	10
Consolidation shed	0	0
Apron tracks	0	0
Anchorage diameter	10	10
Conditional age of facility	7	7
Deck loading	9	9
Heavy-lift cranes	0	0
Berth type	10	10
Truck tailgate	0	0
Rail end ramp	0	0
Truck access	5	5
Tug availability	0	0
Barge lay area	10	10
Total Points	86	85
Ranking	1	2

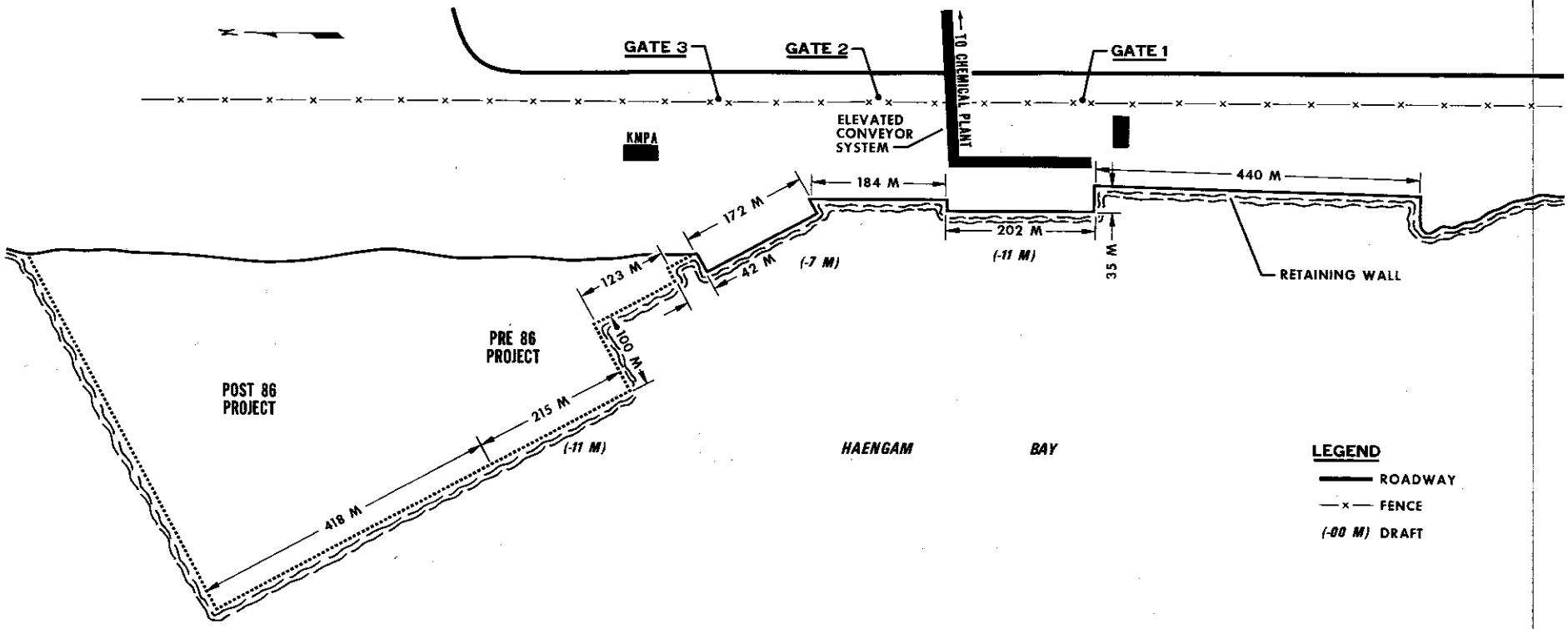


Figure C-10. Future development for Port of Chinhae.

f. Korea Express Co., Ltd.
g. International Enterprise Co., Ltd. (US Army-contracted)

D. (U) Future Development

The development of port facilities in Chinhae has been divided into two phases. All construction will be north of the existing chemical plant wharves and involves additional lighterage and deep-draft berths. Figure C-10 illustrates how the port will be developed over the next 6 years.

The first phase will add two lighterage wharves with lengths of 123 and 100 meters (404 and 328 feet). It will also add a 215-meter (705-foot) deep-draft berth that will be dredged to 36 feet.

The second phase of the project extends the berth for an additional 418 meters (1,371 feet) of continuous wharfage and dredges it to a draft of 36 feet. This project is planned to be completed between 1986 and 1990. When completed, the berthing capability for deep-draft oceangoing vessels will be tripled.

E. (U) Summary

The Port of Chinhae can currently berth breakbulk, RORO, and LASH or SEABEE barges. The primary usefulness of this port is for ammunition loading/unloading at the ammunition pier. Breakbulk operations at berth 2 for general/unit equipment-type cargo is possible but difficult, because of the current usage and physical configuration of the berth. Berths 3 and 4 would be well suited for lighterage operations if harbor craft (such as tugboats) and mobile cranes were more readily available.

Individual berth rankings for all berths are shown in tables C-6 and C-7. The ammunition pier has the best rating of berths 1 and 2 for breakbulk- and RORO-type cargo. However, for contingency purposes, berth 1 should be used exclusively for breakbulk ammunition. Suitable berths are located in Masan that could be used for cargo discharge involving unit equipment or resupply.

The ammunition pier is not recommended for container operations because of the physical limitations of its vessel support systems. Even a self-sustaining container operation would be difficult because of the limited amount of container storage area available (without container handling equipment, 64 vans could be grounded or 92 vans could be stored on chassis).

Use of other port facilities (berths 2 through 4) within the Port of Chinhae for military cargo discharge is not recommended because of either the berths' physical characteristics or their lack of adequate vessel support systems.

on two sides, totally fenced, and protected by guards 24 hours a day. Access to this pier can be gained by a single road and gate, and the whole facility is lighted. An added benefit to security is the remote location of this pier on the end of a peninsula.

The chemical plant wharves are located in a more populated area, but security is adequate. The wharves are totally surrounded by a 10-foot-high concrete fence and can be reached via three gates. Although security guards watch the facility, the gates are not continually manned. No lights are located along the wharf area; however, the perimeter fences have streetlights along the entire eastern side of the facility. Thus, this facility can be easily secured if necessary.

6. (U) Cargo Handling Equipment. All MHE at the port facilities are owned either by contractors or the US military. The MHE available for military cargo transfer and discharge is listed in table C-5. Most of this MHE is suited to palletized loads, but none have the capability of being used for military cargo transfer and discharge operations, especially the heavy-lift capability required for tracked vehicles.

C. (U) Support Services

1. (U) Pilotage. Pilotage for the Port of Chinhae is compulsory; however, pilots are currently available only during daylight hours. Pilots can board in position latitude 35°02' N - longitude 128°47.5' E. Those ships waiting for a pilot should anchor in a recommended anchorage situated northeast of the recommended track 306°/126° and extending from about 1 mile west to about 2 miles southeast of Yon Do Island.

TABLE C-5
MATERIALS HANDLING EQUIPMENT - CHINHAE

Type Equipment	Size	Quantity	Owner/User
Mobile Cranes	12.5-Ton	2	MTMC Pusan Terminal
	20-Ton	1	MTMC Pusan Terminal
Forklifts	2-Ton	7	International Enterprise Co.
	3-Ton	25	International Enterprise Co.
	7.5-Ton	7	International Enterprise Co.
	3-Ton	1	Korea Express Co.

2. (U) Harbor Craft. The ammunition pier and chemical plant wharves currently have no tugboats available. Tug service is usually arranged through the Masan KMPA, which has a 1,000-horsepower berthing tug. In addition, Masan also has several private companies that can provide small tugboats and lighter barges if needed.

3. (U) Stevedores. About 470 stevedores are registered with the Masan and Chinhae Branch of the National Docker's Union. Gang size varies according to commodity, but usually is between 16 and 18 members for general cargo and bulk operations. The local stevedoring companies available to Chinhae Port facilities are:

a. Dongbang Forwarding Company, Ltd.
b. Global Enterprise Company, Ltd.
c. Hijupshin Heavylift Company, Ltd.
d. Jim Heung Company.
e. Sewha Tong-un Company, Ltd.

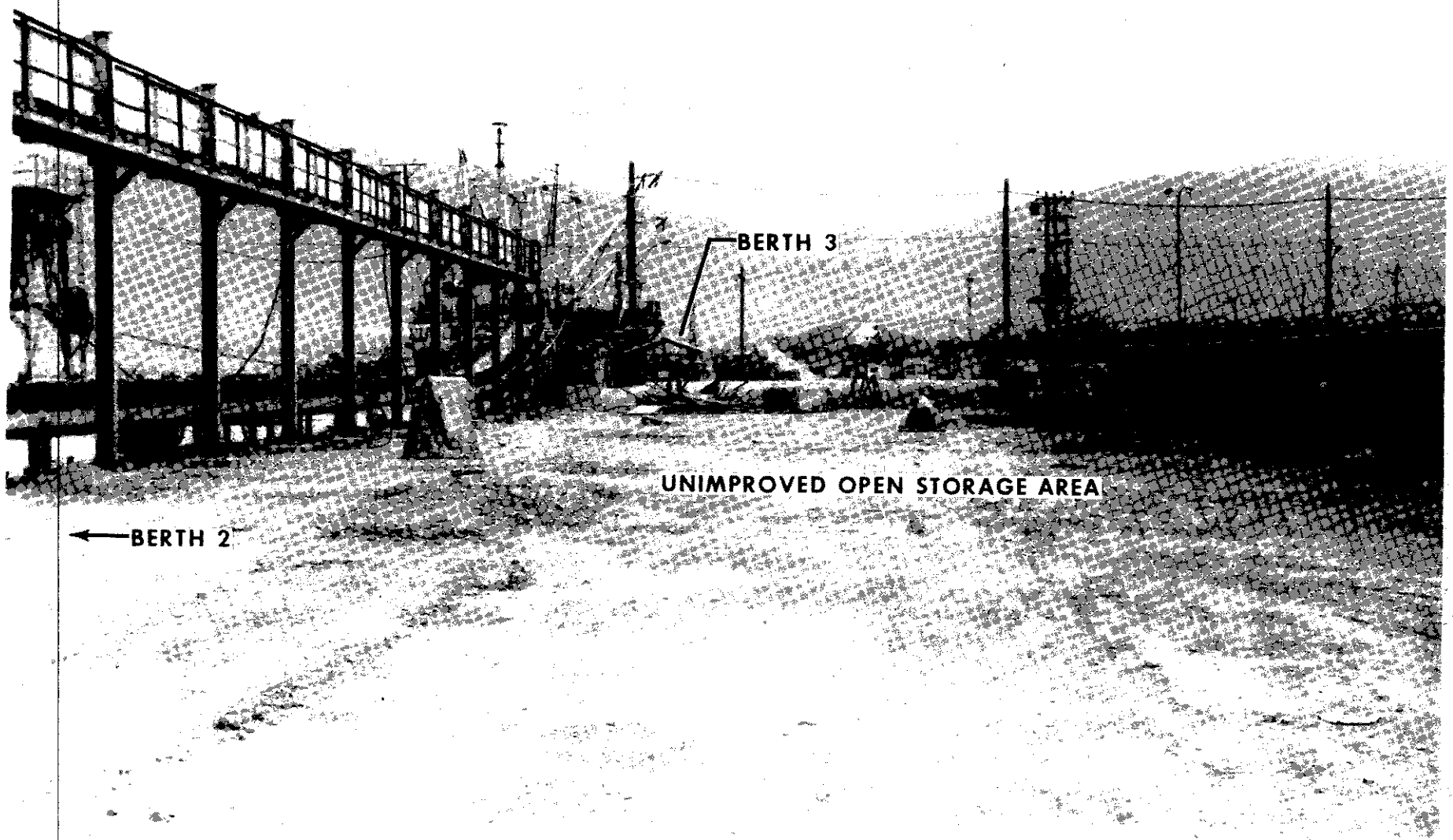


Figure C-9. Berths 2 and 3 open storage areas (northward view).

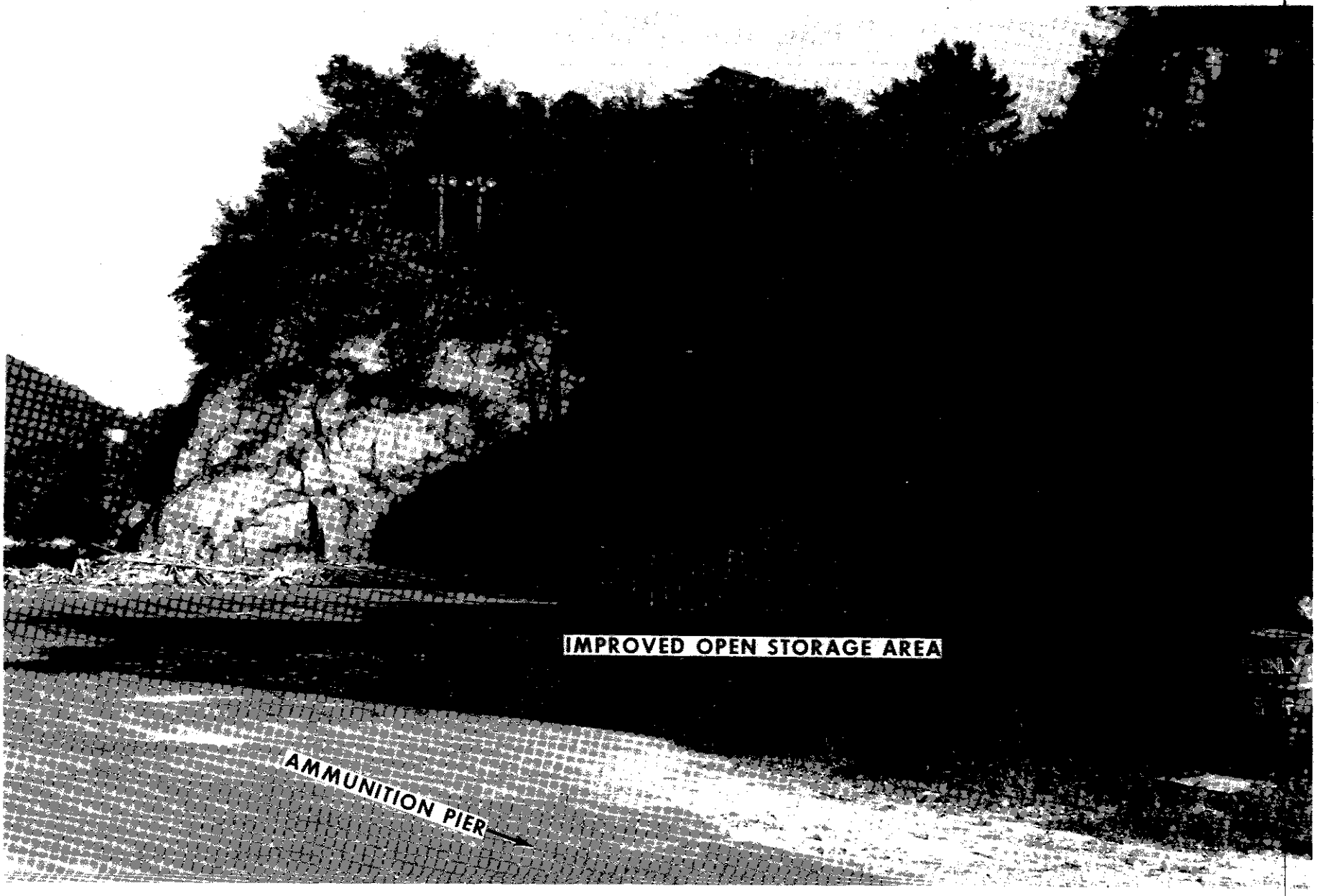


Figure C-8. Ammunition pier open storage area (eastward view).

TABLE C-4
STORAGE FACILITIES FOR PORT OF CHINHAE

Type Storage/ Location/ Berths Served	Number of Storage Areas	Total Space m^2	Total Space (ft^2)	Storage Capacity (tons)	Current Use	Condition	Owner/Remarks
Open Storage							
Ammunition Pier Berth 1	1	3 255	(35,000)	9,765	Ammunition	Good	MTMC Pusan Terminal
Chemical Plant Wharves Berths 2-4	3	15 016	(161,460)	45,000	Bulk products (phosphate and potash)	Fair	Chemical Plant

c. (U) POL Storage. No storage facilities for petroleum products are located in the areas adjacent to the chemical plant wharves or ammunition pier. Some storage for bunker-type fuel is available at the ROK Navy Base; however, the quantity is not included within the scope of this study.

3. (U) Rail Operations. Rail service is available directly to the apron of the ammunition pier. With the two tracks on the apron of the pier and the small interchange yard adjacent to the open storage yard, this facility has a static capacity of 58 boxcars. When boxcars are spotted on the apron, the working area between the ship and the railcars is limited to 30 feet. The nearest classification yard to the ammunition pier is located in downtown Chinhae (fig C-1), about 4.5 miles from the pier. This classification yard has a static and operational capacity of 101 and 61 railcars, respectively. This yard is the end of the Jinhae line, or line 81.

The access line to the ammunition pier also runs past the chemical plant wharves. The chemical plant has an access spur to this line but the wharves do not. This spur is located about 2,000 feet northwest of these wharves.

4. (U) Truck Operations. No loading docks or ramps are available at any of the Chinhae port facilities. All truck loading requires high-masted forklifts and/or mobile cranes. This MHE is available at the ammunition pier for large-scale truck operations. However, MHE is limited at the chemical plant wharves, and the most efficient truck-loading operation at that site would involve direct ship-to-truck transfer of military cargo. Direct ship-to-truck transfer at the ammunition pier is possible but difficult because of the limited apron width.

5. (U) Security. The ammunition pier has an excellent security arrangement. It is bounded by water

containers from an NSS container ship. Alternatives to this problem will be discussed in detail in another section of this report.

e. (U) Safety Considerations. Berth 1 is currently the site of the only authorized peacetime ammunition pier in Korea. It has a NEW limitation of 1.5 million pounds that has been waivered to 3 million pounds by the EUSA/USFK ACofS, J-4, and the DCSLOG, ROK Army. With a quantity-distance arc of 2500 meters (fig-2), two small villages fall within the arc. These villages have an estimated population of about 300 people each and are protected from the pier by the hilly terrain. In addition to these villages, part of the chemical plant and its wharves would also fall within the quantity-distance arcs.

If a breakbulk ammunition ship were to be docked at berth 2, a much larger portion of the outskirts of Chinhae would fall within a quantity-distance arc of 2200 meters. This area would include inhabited buildings, schools, factory areas, fuel storage tanks, and an estimated population of about 40,000. Physical facilities such as the truck hoppers and an elevated conveyor system would make ammunition discharge operations difficult at this location.

f. (U) Summary of Berth Availability. The different types of vessels that could be berthed at the chemical plant wharves and the ammunition pier are summarized in tables C-2 and C-3. Included are only those berths that could accommodate a particular type of vessel expediently without extraordinary docking or materials handling procedures. Also indicated is the number each berth could accommodate or the characteristics that make the berth unsuitable. As can be seen, berths 1 and 2 are best suited for breakbulk, seatrain, and combination breakbulk/container vessel types. Berths 3 and 4 could be used for lighterage operations or the small Korean-flag breakbulk vessels.

2. (U) Storage Areas

a. (U) Open Storage. The Chinhae port facilities have both improved and unimproved open storage areas. The total storage area available for each berth and its general capacity, condition, and current use are listed in table C-4. A total of 23,400 square feet of improved storage area and 11,600 square feet of unimproved storage area are available for the ammunition pier. This is just enough area for staging ammunition from an average breakbulk ship. The improved area is bordered on three sides by sheer cliffs, as can be seen in figure C-8. These cliffs provide a natural barrier to the surrounding countryside in the case of an accident. The unimproved areas are located alongside the access road to the pier.

Open storage at the chemical plant is broken into three areas that support each berth. The area behind berths 2 and 3 is unimproved (fig C-9) and is used to store bulk products. The area behind berth 4 is a combination of improved and unimproved space (fig C-7) and is used for storage of general cargo and/or bulk products. The only area suitable and large enough for staging of unit equipment is that behind berth 4.

b. (U) Covered Storage. No covered storage facilities are available at any of these berths.

Figure C-7. Berth 4 at Chemical Plant wharves (northward view).

Because of the lack of mobile cranes and tugboats, these wharves should be considered only as backup facilities.

d. (U) Container Operations. Container handling facilities and conventional container-handling equipment are unavailable at Chinhae's port facilities. The physical systems required to support container operations such as berth lengths, large open storage areas, and container handling equipment are inadequate.

These shortfalls were substantiated recently at the ammunition pier, when the adequacy of handling containers from a non-self-sustaining (NSS) container ship was tested. These tests showed that the pier in its present configuration could not handle

Figure C-6. Berth 3 at Chemical Plant wharves (southward view).

TABLE C-2
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF CHINHAE

US-Flag Ship Type	Berths 1	2	3	4
RORO				
GTS Callaghan	c,d	c,d	a,c,d	a,c,d
USNS Comet	1,d	1,d	a,d	a,c,d
Maine-class	c	c	a,c	a,c
Breakbulk				
C4 Mariner-class	1	1	a	a
C4-S-58a	1	1	a	a
C3-S-38a	1	1	a	a
C3-S-33a	1	1	a	a
Barge				
LASH C-S-81B	c	a,c	a,c	a,c
LASH barge	9	10	9	9
SEABEE C-S-82A	c	a,c	a,c	a,c
SEABEE barge	6	6	6	5
Seatrain				
Georgia-class	1	1	a	a
Puerto-class	1	1	a	a
Container				
C6-S-1W	c,e	1,e	a,c,e	a,c,e
C7-S-68E	c,e	c,e	a,c,e	a,c,e
C8-S-85B	c,e	c,e	a,c,e	a,c,e
RORO/Container				
C5-S-78	c	1	a	a,c
T-AKR (SL-7)	c	c	a,c	a,c
Breakbulk/Container				
C5-S-37E	1	1	a	a,c
C4-S-10	1	1	a	a

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.

TABLE C-3
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF CHINHAE

Korean-Flag Ship Type	Berths 1	2	3	4
Breakbulk				
Type 1	5	5	5	4
Type 2	2	2	2	2
Type 3	2	2	2	2
Type 4	2	2	2	1
Type 5	2	2	2	1
Type 6	1	1	a	a
Type 7	1	1	a	a

a - Inadequate draft at berth.

because the cargo will generally be palletized and easily handled by ship cranes.

c. (U) LASH and SEABEE Operations. LASH and SEABEE barges can be accommodated at berths 1 through 4. However, since berths 1 and 2 would be used mainly for deep-draft vessels, berths 3 and 4 are the most likely for barge operations. These berths, shown in figures C-6 and C-7, can accommodate 18 LASH or 11 SEABEE barges. Barges could be staged anywhere in Haengam-Man, north of the lighthouse and west of the wharves.

Two major shortfalls exist at this port with regard to lighterage operations. Tugboats are unavailable except from Masan or Pusan, and MHE is limited. Cranes and forklifts are available at the ammunition pier; however, they would not necessarily be available for lighterage operations at berths 3 and 4, except when ammunition ships were not being worked.

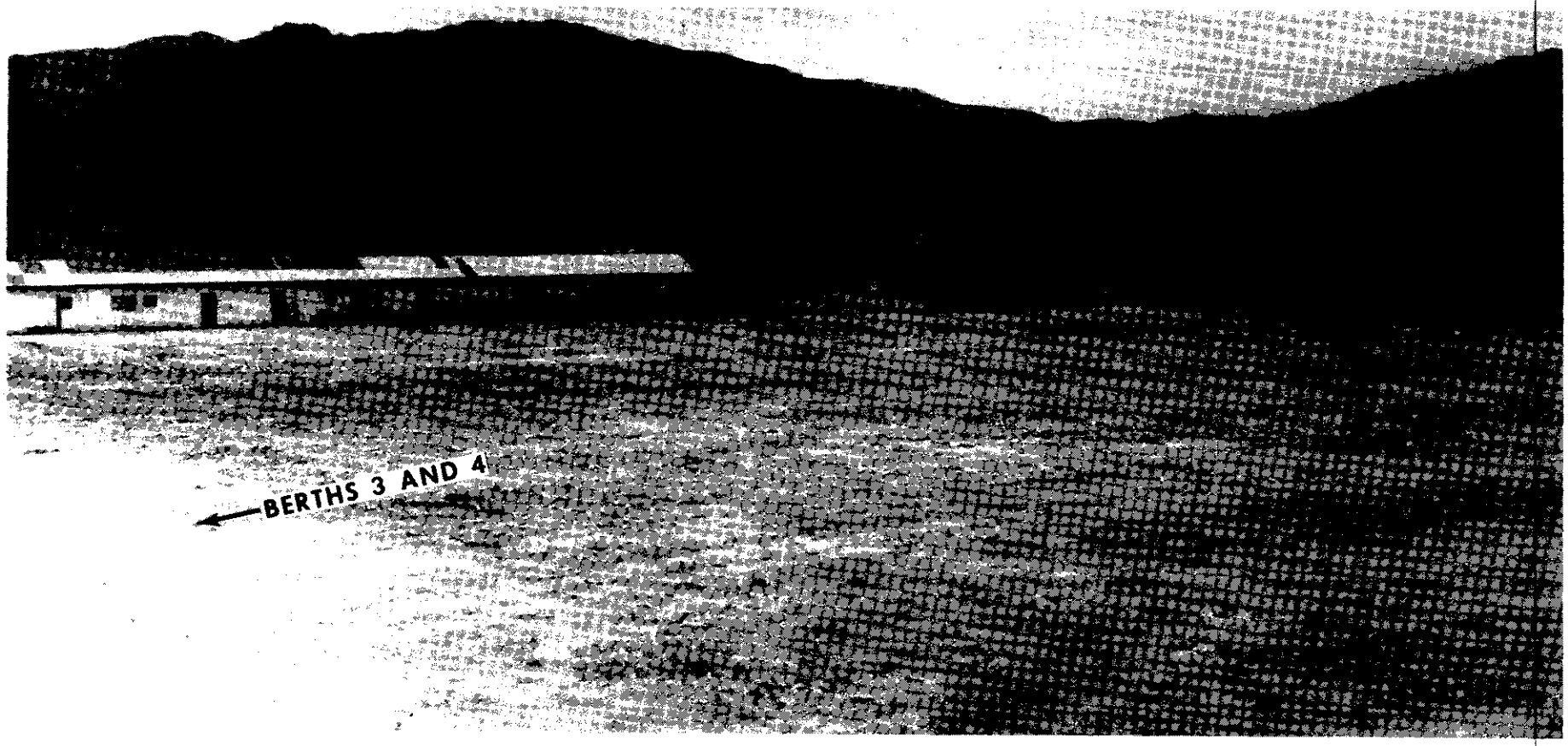


Figure C-5. Staging and marshaling areas at berths 3 and 4 (northward view).

Mobile cranes with enough capacity to conduct heavy lifts from ship's holds are unavailable at these facilities. Breakbulk discharge operations will have to be conducted using only ship's gear if heavy-lift cranes cannot be made available from other locations. Therefore, these berths should not be used for vessels containing major end items of unit equipment, such as tracked vehicles, because most of the ship's gear would be incapable of making these heavy lifts.

Employing these berths for breakbulk resupply operations would be the better solution

TABLE C-1
PORT OF CHINHAE
OPERATED BY: MASAN DISTRICT MARITIME AND PORT AUTHORITY

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m	Continuous Length (ft)	Individual Berth	Berth Length m	Berth Length (ft)	Approximate Apron Width m	Approximate Apron Width (ft)	MLW m	MLW (ft)	Approximate Apron Height Above MLW m	Approximate Apron Height Above MLW (ft)	Deck Strength (psf)	Serviced by Rail-Mounted Crane	Rail Access to Apron
Ammo Pier	1	Pier	183	(600)	1	183	(600)	27.4	(89.9)	12	(39)	2.1	(6.9)	600	No	Yes
Chemical plant wharves	2	Marginal	202	(663)	2	202	(663)	30	(98)	11	(36)	2.1	(6.9)	600	Yes	No
Lighter wharves	3-4	Marginal	356	(1,168)	3	184	(604)	30	(98)	6.5	(21.3)	2.1	(6.9)	800	No	No
					4	172	(564)	30	(98)	6	(19.7)	2.1	(6.9)	800	No	No

Rail-Mounted Cranes	Serving Berths	Roll-on/Roll-off Facilities	Serving Berths	Open Storage	Serving Berth	Covered Storage
1	2	None				

b. (U) T-AKR Operations. None of the berths at the ammunition pier or the chemical plant wharves are adequate to berth the T-AKR because they lack the continuous wharfage needed to berth a ship of this size.

c. (U) Breakbulk Operations. Two US-flag breakbulk ships can be berthed simultaneously at berths 1 and 2, as shown in table C-2. Table C-3 illustrates the berths' ship reception capabilities for Korean-flag vessels.

Although the ammunition pier has the physical capability to berth a ship on each side, such use is not recommended because the pier is only 90 feet wide and its net explosive weight (NEW) limitations is limited to 1.5 million pounds, waived to 3 million pounds. Since most breakbulk ships that use this pier approach the 3-million-pound limit, a second ship cannot be berthed at this facility. Further discussion of this pier and recommendations to enhance its capability are presented later in this report.

Berth 2 of the chemical plant wharves can accommodate breakbulk ships; however, the elevated conveyor system and truck-loading hoppers located along the wharf would hinder breakbulk operations.

Berth 1 is the only lighted berth for night operations. The lights are not the high-intensity tower variety, but are adequate for allowing 24-hour port operations.

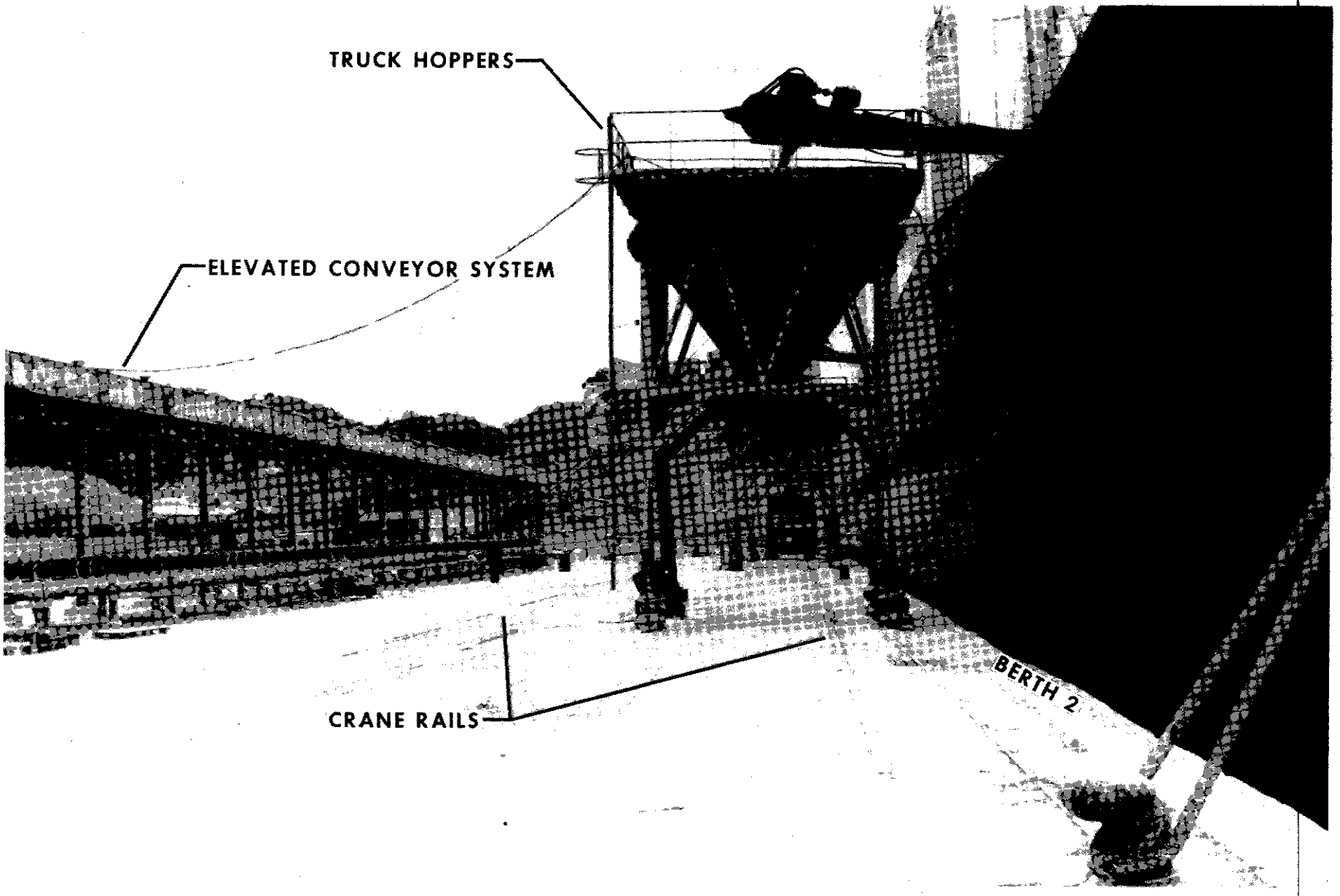


Figure C-4. Berth 2 at Chemical Plant wharves (southward view).

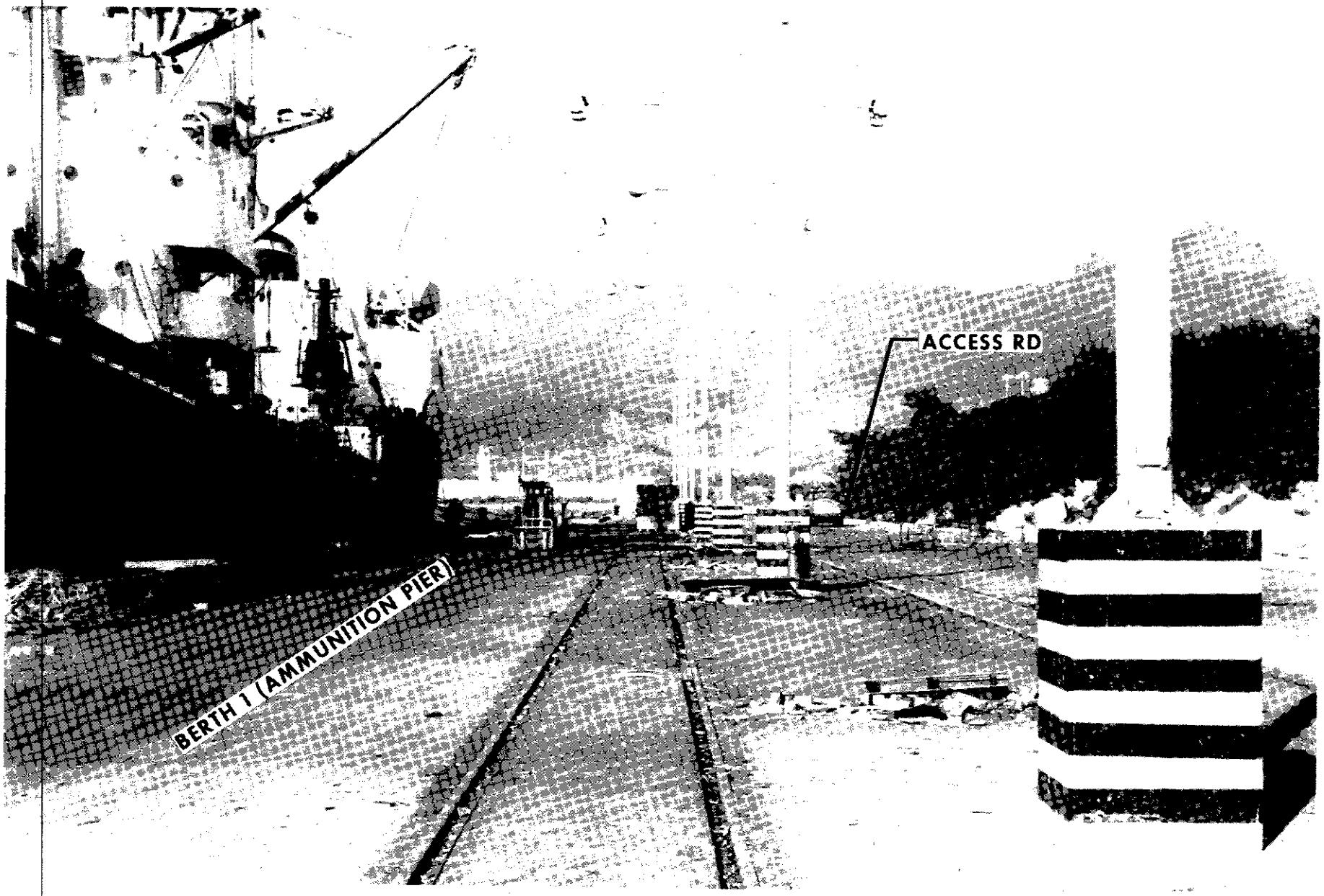


Figure C-3. Ammunition pier at Chinhae (eastward view).

These highways all have at least a 16-foot vertical clearance except Korean 2 between Chinhae and Masan, which has a limit of 11-1/2 feet.

Access to or from the chemical plant wharves can be by three gates, each of which has one lane each for inbound and outbound movements. The access to the ammunition pier is limited to one gate, which provides one lane for both inbound and outbound movements.

Highway access to and from these port facilities is adequate for military cargo operations and would permit military convoys and heavy trucks for resupply.

4. (U) Rail Access. The city of Chinhae is served by a single-track, standard-gauge rail line (line 81). This line runs from the city northward about 13.8 miles to Changwon, where it connects to the single-track Gyeongjeon line (line 88). Line 88 runs east-west across the country and interchanges with the Pusan-to-Seoul double-track main line (line 01) and the Jeonra line (line 04).

About 4,040 feet of rail sidings are within the Chinhae area. Rail service is available to the ammunition pier. No rail access is available to the chemical plant wharves; however, a spur to the chemical plant is located about 2,000 feet to the northwest.

5. (U) Airports. The nearest airfield in the Chinhae area is the military airstrip located along the eastern shore of Haengam-Man. This strip is about 1,000 feet long and has limited usage by intratheater aircraft.

Masan has a regional airstrip located about 2 miles northwest of the Chang-Weon Industrial Complex. Its runway is 3,000 feet long and can be used by intratheater aircraft. The nearest intertheater airport, Kimhae International, is located about 24 miles east of Chinhae via Korean 2. This airport has a 9,000-foot runway.

B. (U) Port Facilities

1. (U) Berthing. One ammunition berth (fig C-3) and one general/bulk-type cargo berth (fig C-4) are located along the western shore of Haengam-Man in Chinhae. Also, 1,168 feet of continuous wharfage is available for lighterage operations. The individual characteristics of these berths are summarized in table C-1. The types of ship unloading possible at these berths with normal operating procedures are discussed below.

a. (U) RORO Operations. No facilities are available at these berths to support stern-ramp RORO operations. Berth 1 is the only berth that has an adequate apron width for side-ramp RORO operations. Although berths 1 and 2 have adequate drafts, most slewed-stern RORO vessels could not be accommodated because the berths are not long enough. No shore-based ramps are available for the Ponce/Great Land-class ship, nor could these berths accommodate the length of these ramps. The staging and marshaling area for RORO operations is inadequate at berth 1. The backup area behind berths 3 and 4 (fig C-5) could be used for staging and marshaling RORO cargo if operations were conducted at berth 2 via a smaller (less than 650 feet long) slewed-stern RORO vessel. In summary, RORO operations are not recommended at these facilities because of physical inadequacies.

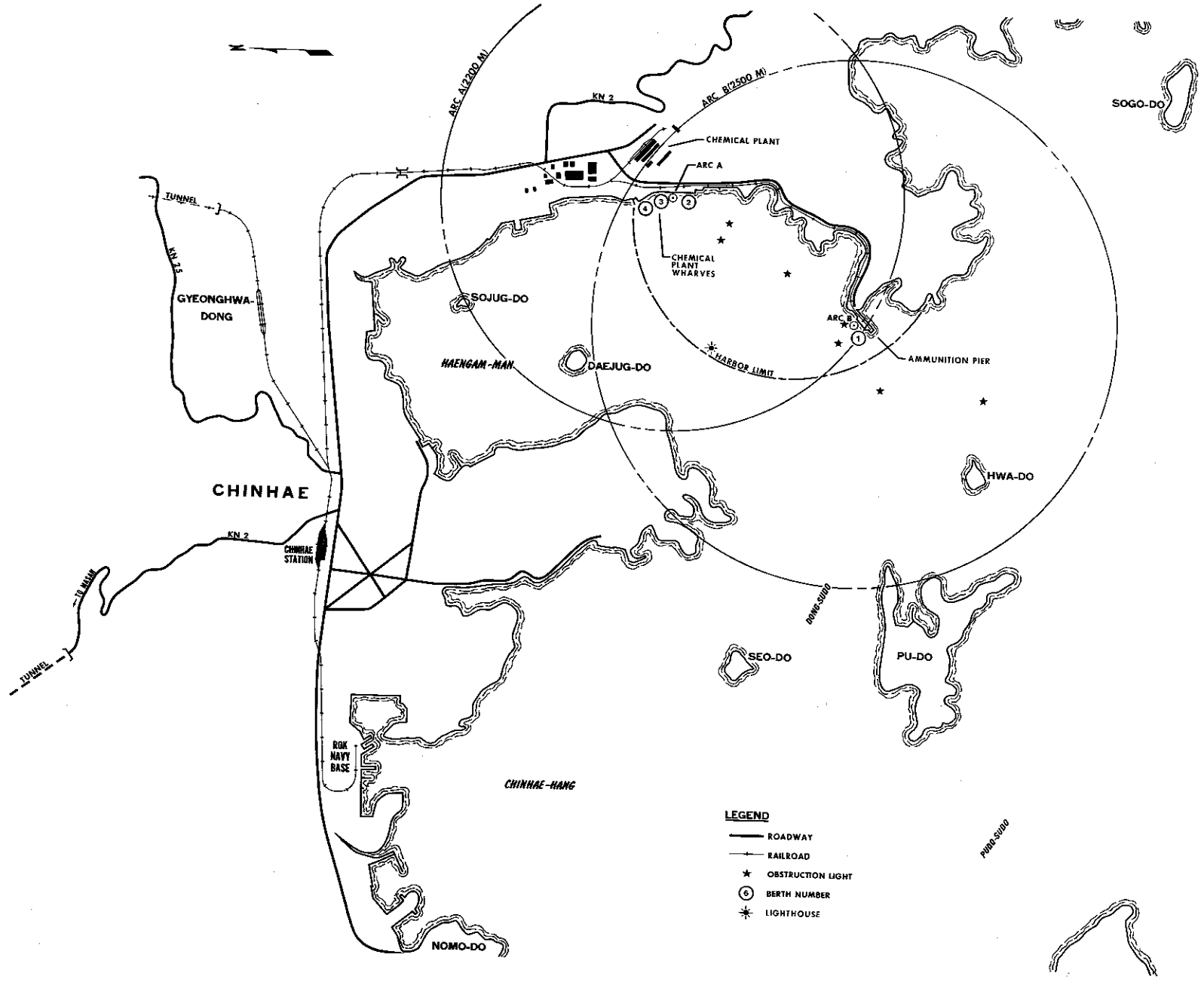


Figure C-2. Site map.

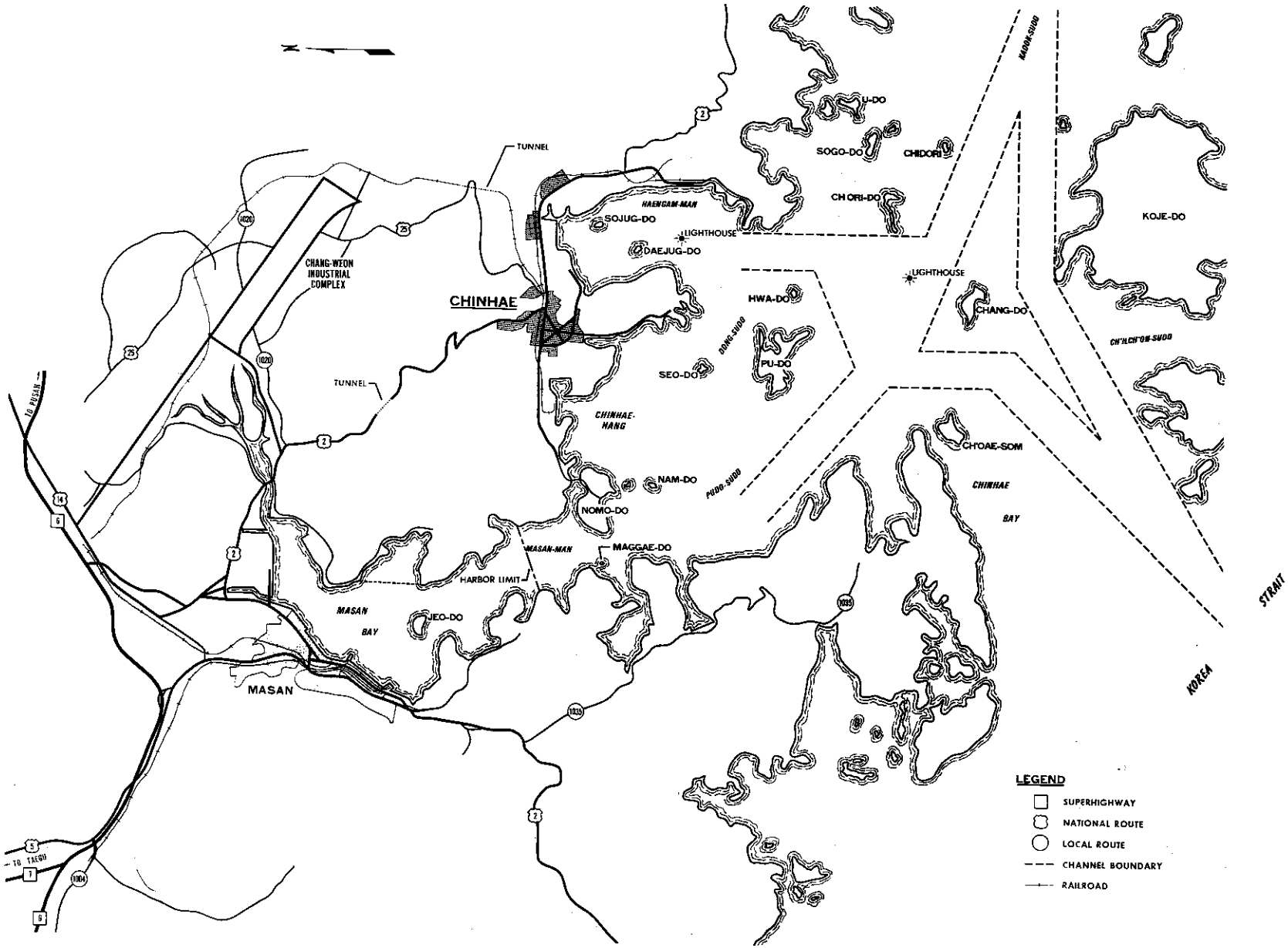


Figure C-1. Vicinity map.

(U) PORT OF CHINHAE

A. (U) General

1. (U) Location and General Uses. The Port of Chinhae, considered the neighbor of the Port of Masan, is under the direct jurisdiction of the Masan District Maritime and Port Authority. This port is located on the eastern side of the southern coast of the Korean Peninsula and is the site of a major Korean naval base. It has a commercial port facility with the only designated peacetime ammunition pier in the country. Chemical plant wharves are located about 4 miles southeast of downtown Chinhae. The ammunition pier, which is operated and maintained by the ROK Army, is located 1.8 miles farther south of the commercial wharves. The predominant commodities moving through the port include cement, grain, chemicals, and ammunition.

2. (U) Harbor. From the Korea Strait (fig C-1), the approach to the Port of Chinhae is by way of the Kadok-Sudo channel to the lighthouse located between Chori-Do and Chang-Do Islands and then north toward Daejug-Do. Haengam-Man, location of the Chinhae Port facilities, is approached via a 3-mile-long, 1,608-foot-wide, 39.4-foot-deep channel. The channel is well marked by obstruction lights and buoys.

The Port of Chinhae facilities (fig C-2) are located within a natural coastal harbor that is about 3 miles long and 1.2 mile wide. The harbor is afforded natural protection on the north, east, and west by hills and peninsulas and on the south by islands. It is considered a typhoon shelter and is ice free throughout the year.

Within the harbor area, the mean high water interval is 8 hours 17 minutes. The mean tidal range is 6.8 feet, the spring rise is 8.3 feet, and the neap rise is 5.2 feet.

Anchorages are not designated for the Port of Chinhae. However, the area between Sogo-Do and Hwa-Do Islands is sufficient to provide at least five anchorages with drafts at MLW ranging from 29 to 41 feet. The bottoms of these anchorages are predominantly sand and mud.

Weather in the area of Chinhae is moderate and will have little effect on cargo operations. The chemical plant wharves are completely protected by the natural harbor, so swells will reach the critical stage only during severe storms and typhoons. The ammunition pier is located on the extreme southern tip of the harbor and, thus, is more susceptible to the effects of stormy seas. The prevailing winds are moderate, and fog occurs often in March and April and occasionally in May through August. Precipitation averages about 60 inches per year and occurs most frequently from June through August.

3. (U) Highways. Vehicles exiting the port's berths would use a local road to the center of the city and then Korean Route 2 north to Superhighway 6. Access to the superhighway can also be gained via Korean Route 25 northbound to Korean Route 14 and then northeast to the interchange. The distance to the superhighway via Korean 2 is about 15 miles; the road for the first 10 miles is two lanes and for the last 5 miles is four lanes. The distance to the superhighway via Korean 25 is also 15 miles; however, 6 miles of this road is gravel, which limits the capability at this time.

This port should be used for ammunition loading/unloading operations only as a last resort. It is an undesirable alternative because of its proximity to a city of 3.5 million people and the exposure levels to the city and surrounding port and industrial areas. Since the Port of Pusan is the most important and largest in Korea, the only ammunition that should be unloaded at its berths is small arms ammunition.

TABLE P-23
INDIVIDUAL BERTH RATING (CONTAINER)

Ideal Berth Factors	Berths				
	Pier 3	Pier 5		Pier 6	
	19	32	33	34	35
Length	2	20	20	18	18
Alongside depth	26	20	20	20	20
Backup area	4	20	20	20	20
Apron width	10	10	10	10	10
Consolidation shed	0	10	10	10	10
Apron tracks	0	0	0	0	0
Materials handling equipment	10	10	10	10	10
Deck loading	8	8	8	8	8
Heavy-lift cranes	7	3	3	10	10
Berth type	5	10	10	10	10
Truck tailgate	9	9	9	9	9
Rail end ramp	0	0	0	0	0
Truck access	8	8	8	8	8
Ship service facilities	6	6	6	6	6
Conditional age of facility	10	10	10	10	10
Total Points	95	144	144	149	149
Ranking	3	2	2	1	1

TABLE P-24
INDIVIDUAL BERTH RATING (BARGE)

Ideal Berth Factors	Berths						
	L/W 1	L/W 2	L/W 3	L/W 4	L/W 5	L/W 6	L/W 7
Length	10	10	10	10	10	10	10
Alongside depth	8	8	8	8	8	5	0
Backup area	5	5	5	10	10	5	5
Apron width	10	10	9	9	9	9	10
Consolidation shed	0	0	0	0	0	0	0
Apron tracks	0	0	0	0	0	0	0
Anchorage diameter	10	10	10	10	10	10	10
Conditional age of facility	9	9	9	9	9	9	9
Deck loading	9	9	9	9	9	9	9
Heavy-lift cranes	0	0	0	0	0	0	0
Berth type	10	10	10	10	10	10	10
Truck tailgate	0	0	0	0	0	0	0
Rail end ramp	0	0	0	0	0	0	0
Truck access	8	8	8	8	8	8	8
Tug availability	10	10	10	10	10	10	10
Barge lay area	10	10	10	10	10	10	10
Total Points	99	99	98	103	103	93	91
Ranking	2	2	3	1	1	4	5

TABLE P-22 - cont

Ideal Berth Factors	Berths												
	Pier 8				Private Facilities								
	41	42	43	44	45	46	47	48	49	50	51	52	53
Length	10	10	10	16	2	1	16	5	20	5	5	2	5
Alongside depth	18	18	14	12	6	6	10	8	8	10	10	10	6
Backup area	1	1	1	1	1	1	1	1	1	1	1	1	1
Apron width	20/20	20/20	18/18	18/18	18/18	18/18	20/20	20/20	20/20	20/20	20/20	20/20	20/20
Transit shed	6	6	6	0	0	0	0	0	0	2	2	2	2
Distribution shed													
Apron tracks	7	7	0	0	0	0	0	0	0	0	0	0	0
Deck loading	8	8	8	8	8	8	8	8	8	8	8	8	8
Heavy-lift cranes	10	10	10	10	0	0	0	0	0	0	0	0	0
Berth type	10	10	8	8	10	10	10	10	10	8	8	8	8
Truck tailgate	9	9	9	0	0	0	0	0	0	0	0	0	0
Rail end ramp	9	9	0	0	0	0	0	0	0	0	0	0	0
Truck access	8	8	8	8	5	5	5	5	5	5	5	5	5
Ship service facilities	6	6	6	6	5	5	5	5	5	5	5	5	5
Conditional age of facility	10	10	10	10	5	5	5	5	5	5	5	5	5
RORO stern ramp	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5
Total Points	132/131	132/131	110/109	99/104	62/67	61/66	80/85	67/72	82/87	69/72	69/72	66/69	63/66
Ranking	1/1	1/1	3/3	8/7	24/24	25/25	17/18	21/22	16/17	20/22	20/22	22/23	23/25

TABLE P-22 - cont

Ideal Berth Factors	Berths										
	Pier 4						Pier 7				Pier 8
	25	26	27	28	29	30	36	37	38	39	40
Length	5	5	5	5	5	5	10	10	10	10	10
Alongside depth	18	12	18	18	18	14	12	12	18	18	18
Backup area	1	1	1	1	1	1	5	5	5	5	1
Apron width	20/20	20/20	18/18	18/18	18/18	18/18	20/20	20/20	20/20	20/20	20/20
Transit shed	0	0	0	0	2	0	0	0	0	0	6
Distribution shed											
Apron tracks	7	0	0	0	0	0	7	7	0	0	7
Deck loading	8	8	8	8	8	8	10	10	10	10	8
Heavy-lift cranes	0	0	0	0	0	0	5	5	5	5	10
Berth type	8	8	8	8	8	8	10	10	10	10	10
Truck tailgate	0	0	0	9	9	0	0	0	0	0	4
Rail end ramp	0	0	0	0	0	0	0	0	0	0	0
Truck access	8	8	8	8	8	8	8	8	8	8	8
Ship service facilities	6	6	6	6	6	6	6	6	6	6	6
Conditional age of facility	10	10	10	10	10	10	8	8	8	8	10
RORO stern ramp	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5
Total Points	91/96	78/83	82/87	91/96	93/96	78/83	101/106	101/106	100/105	100/105	118/117
Ranking	13/12	18/19	16/17	13/12	12/12	18/19	6/5	6/5	7/6	7/6	2/2

TABLE P-22 - cont

Ideal Berth Factors	Berths											
	Central Wharf		Pier 3							Pier 4		
	13	14	15	16	17	18	19	20	21	22	23	24
Length	10	10	5	5	5	5	10	10	10	5	5	5
Alongside depth	14	14	14	18	18	5	18	18	14	14	18	18
Backup area	1	1	1	1	1	1	1	1	1	1	1	1
Apron width	20/20	20/20	20/20	20/20	20/20	20/20	20/20	20/20	20/20	20/20	20/20	20/20
Transit shed	0	0	2	2	0	0	0	2	2	2	2	2
Distribution shed												
Apron tracks	7	7	0	0	0	0	0	0	0	7	7	7
Deck loading	8	8	8	8	8	8	8	8	8	8	8	8
Heavy-lift cranes	0	0	0	0	0	0	5	5	5	0	0	0
Berth type	10	10	8	8	8	8	8	8	8	8	8	8
Truck tailgate	0	0	9	9	0	0	0	9	9	9	9	9
Rail end ramp	0	0	0	0	0	0	0	0	0	0	0	0
Truck access	8	8	8	8	8	8	8	8	8	8	8	8
Ship service facilities	6	6	6	6	6	6	6	6	6	6	6	6
Conditional age of facility	10	10	10	10	10	10	10	10	10	10	10	10
RORO stern ramp	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5
Total Points	94/99	94/99	91/94	91/94	84/89	71/76	94/99	106/108	102/105	98/101	102/105	102/105
Ranking	11/10	11/10	13/13	13/13	15/15	19/21	11/21	4/4	5/6	9/8	5/6	5/6

TABLE P-22
INDIVIDUAL BERTH RATING (BB/RORO)

Ideal Berth Factors	Berths										
	Ferry Wharf	Pier 1		Pier 2						Central Wharf	
	1	3	4	5	6	7	8	9	10	11	12
Length	5	16	16	16	16	5	5	5	5	10	10
Alongside depth	12	14	14	18	18	12	18	18	12	14	14
Backup area	1	1	1	1	1	1	1	1	1	1	1
Apron width	20/20	20/20	20/20	20/20	20/20	20/20	20/20	20/20	20/20	20/20	20/20
Transit shed	0	2	2	2	2	0	0	2	2	0	0
Distribution shed											
Apron tracks	0	0	0	0	0	0	0	0	0	7	7
Deck loading	8	8	8	8	8	8	8	8	8	8	8
Heavy-lift cranes	0	0	0	0	0	0	0	0	0	0	0
Berth type	8	8	8	8	8	8	8	8	8	10	10
Truck tailgate	0	9	9	9	9	0	9	9	9	0	0
Rail end ramp	0	0	0	0	0	0	0	0	0	0	0
Truck access	8	8	8	8	8	8	8	8	8	8	8
Ship service facilities	6	6	6	6	6	6	6	6	6	6	6
Conditional age of facility	10	10	10	10	10	10	10	10	10	10	10
RORO stern ramp	0/10	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5
Total Points	78/88	102/105	102/105	106/109	106/109	78/82	93/98	95/98	89/92	94/99	94/99
Ranking	18/16	5/6	5/6	4/3	4/3	18/20	12/11	10/11	14/14	11/10	11/10

Anchorages and turning basins are located in both upper and lower Masan Bays. Their locations are illustrated in figure MA-2. The critical characteristics of the anchorages and turning basins are listed in table MA-1. As can be seen, anchorages A-4, A-5, and A-8 are the best suited for the types of oceangoing vessels that would call at Masan. A quarantine anchorage is also provided as shown. The bottoms of these anchorages are predominantly mud and provide good holding ground.

Weather in the area surrounding Masan will have little effect on cargo operations. Because of the protected natural harbor, swells reach critical proportions only during severe storms or typhoons. The prevailing winds are moderate and fog occurs frequently in March and April and occasionally from May through August. Precipitation averages about 60 inches per year and occurs most frequently from June through August.

3. (U) Highways. Highway access with at least a 16-foot vertical clearance is available from Superhighway 6. Vehicles exiting the port from wharf 3 and the East wharf would use Korean Route 2 west to Korean Route 14, then north to the superhighway interchange. This route is about 6000 meters (3.7 miles) long and is at least four lanes the entire distance, with no vertical or horizontal clearance problems.

Superhighway 6 runs east-west from Pusan to Sunchon, where it becomes Superhighway 3, and north to Taejon. Also accessible from Superhighway 6 is Superhighway 7, which runs north from Masan to Taegu and connects with Superhighway 1, which runs north to Seoul. Superhighway 6 is a four-lane divided

TABLE MA-1
MASAN ANCHORAGE DATA

Anchorage Designation	Geographic Location	Site Characteristics: Diameter m	Diameter (ft)	Depth m	Depth (ft)	Bottom Type
A-1	lat 35°11'06"N long 128°34'52"E	500	(1,640)	9.5	(31.2)	Mud
A-2	lat 35°10'49"N long 128°35'00"E	400	(1,312)	7.8	(25.6)	Mud
A-3	lat 35°10'41"N long 128°34'43"E	400	(1,312)	8.5	(27.9)	Mud
A-4	lat 35°09'54"N long 128°35'00"E	600	(1,969)	11.0	(36.1)	Mud
A-5	lat 35°09'42"N long 128°35'22"E	500	(1,640)	10.5	(34.5)	Mud
A-6	lat 35°09'48"N long 128°35'45"E	400	(1,312)	9.0	(29.5)	Mud
A-7	lat 35°09'37"N long 128°36'38"E	400	(1,312)	9.0	(29.5)	Shells
A-8	lat 35°09'15"N long 128°36'23"E	600	(1,969)	11.5	(37.7)	Mud
A-9	lat 35°09'09"N long 128°35'45"E	400	(1,312)	9.5	(31.2)	Mud
Quarantine	lat 35°08'45"N long 128°35'00"E	900	(2,953)	13.5	(44.3)	Mud/Shells
Turning Basin T-1	lat 35°12'20"N long 128°36'06"E	400	(1,312)	11.0	(36.1)	Mud
T-2	lat 35°12'10"N long 128°35'36"E	600	(1,969)	12.0	(39.4)	Mud
T-3	lat 35°11'14"N long 128°35'28"E	500	(1,640)	12.0	(39.4)	Mud

expressway from Pusan to Masan and a two-lane undivided expressway from Masan westward. Superhighway 7 is also a two-lane undivided expressway.

Access into and out of the wharf 3 area is by a gate located just west of the entrance to the free export zone. This gate has two lanes for each direction of traffic and can process a truck in or out in about 1 minute.

Access into and out of the East wharf is via a 1-kilometer (0.6-mile) -long two-lane local road. The wharf has no security gates yet, but it can be entered or exited via three different access points.

Highway access to and from the wharves within this port are excellent and would permit military convoys and heavy truck movement for resupply operations.

4. (U) Rail Access. The city of Masan is served by a single-track, standard-gauge rail line (line 88). This line runs from the city northeastward about 24 miles to the city of Samnangjin, where it connects with the Pusan-to-Seoul double-track main line (line 01). Line 88 also runs westward from Masan via Chinju to the Sunchon junction, where it interchanges to line 04 northward. Lines 88 and 04 are single-track, standard-gauge rail lines.

About 19,000 feet of rail sidings are within the city of Masan. Rail service to the port area is available at pier 1 and about 600 feet inshore from the Central wharf. Wharves 3 and 4 have no rail access. Three passenger stations within the Masan area can provide the following facilities:

Facility	Type of Facility	Capacity
Masan Station	1 loading platform	7 boxcars
Buk-Masan Station	1 loading platform	2 boxcars
Ku-Masan Station	1 loading platform	5 boxcars

5. (U) Airports. Masan has one regional airstrip located about 5 miles northeast of the city and about 2 miles northwest of the Changwon Industrial Complex. The runway is 3,000 feet long and could be used by intratheater aircraft. The only other airports near Masan are the military airfield at Chinhae and Kimhae International Airports located about 10 miles east of Pusan. These airports are about 11 and 30 miles from Masan, respectively.

B. (U) Western Shore Facilities

1. (U) Berthing. Five general/bulk-type cargo berths are located along the western shore of upper Masan Bay in the downtown Masan area. Also, 3,353 feet of continuous wharfage is available for shallow-draft barge operations along the Central wharf and another 1,385 feet, along piers or wharfage unsuitable for deep-draft vessels. The individual characteristics of these berths are summarized in table MA-2. The types of ship unloading options possible at these berths with normal operating procedures are discussed below.

a. (U) RORO Operations. No stern-ramp facilities are available to support stern-ramp RORO operations. Only berths 3 and 4 at pier 1 have adequate apron widths for side-ramp operations (figs MA-3 and MA-4). However, the 25-foot drafts alongside these berths are inadequate for most side-ramp RORO ships. The slewed stern ramps of a Maine-class RORO vessel

TABLE MA-2
PORT OF MASAN
OPERATED BY: MASAN DISTRICT MARITIME AND PORT AUTHORITY

Pier/Berth Face/Side	Inclusive Berths	Design	Continuous Length m	Continuous Length (ft)	Individual Berth	Berth Length m	Berth Length (ft)	Approximate Apron Width m	Approximate Apron Width (ft)	MLW m	MLW (ft)	Deck Strength (psf)	Serviced by Rail-Mounted Crane	Rail Access to Apron
Western shore	Powerplant wharf	Marginal	115	(377)	1	115	(377)	20	(65)	8	(26)	615	No	No
	Pier 1	Finger												
	South	pier	102	(335)	2	102	(335)	15	(49)	2	(6)	615	No	No
	Head		141	(463)	3	141	(463)	15	(49)	7.5	(25)	615	No	No
	North		202	(663)	4	202	(663)	15	(49)	7.5	(25)	615	No	No
	Central wharf	Marginal	1 022	(3,353)	5	204	(670)	20	(65)	1.5	(5)	Unk	No	No
					6	204	(670)	20	(65)	1.5	(5)	Unk	No	No
					7	204	(670)	20	(65)	1.5	(5)	Unk	No	No
					8	204	(670)	20	(65)	1.5	(5)	Unk	No	No
					9	204	(673)	20	(65)	1.5	(5)	Unk	No	No
	Cement dolphin	Dolphin	88	(289)	10	88	(289)	None		7	(23)	NA	No	No
	Pier 2	Finger												
	South	pier	120	(394)	11	120	(394)	10	(33)	2	(6)	Unk	No	No
	Head		65	(213)	12	65	(213)	10	(33)	6	(20)	Unk	No	No
	North		200	(656)	13	200	(656)	10	(33)	3		Unk	No	No
Wharf 3	14-15	Marginal	420	(1,378)	14	210	(689)	20	(65)	11	(36)	615	No	No
					15	210	(689)	20	(65)	11	(36)	615	No	No
East wharf	16-20	Marginal	1 050	(3,445)	16	210	(689)	50	(164)	11	(36)	1,000 Est	No	No
					17	210	(689)	50	(164)	11	(36)	1,000 Est	No	No
					18	210	(689)	50	(164)	11	(36)	1,000 Est	No	No
					19	210	(689)	50	(164)	11	(36)	1,000 Est	No	No
					20	210	(689)	50	(164)	11	(36)	1,000 Est	No	No
Kwihyon wharf (under construction)	21-20	Marginal	420	(1,378)	21	210	(689)	Unk	Unk	11	(36)	615	No	No
					22	210	(689)	Unk	Unk	11	(36)	615	No	No

could be positioned on the aprons of berths 4 and 13 because these berths have adequate length and more than 30 feet of apron width. However, these berths do not have an adequate draft to accommodate this type of ship. No shore-based ramps are available for the Ponce/Great Land-class ship and none of these berths could accommodate the length of these ramps. In summary, none of the western shore berths are adequate for RORO operations.

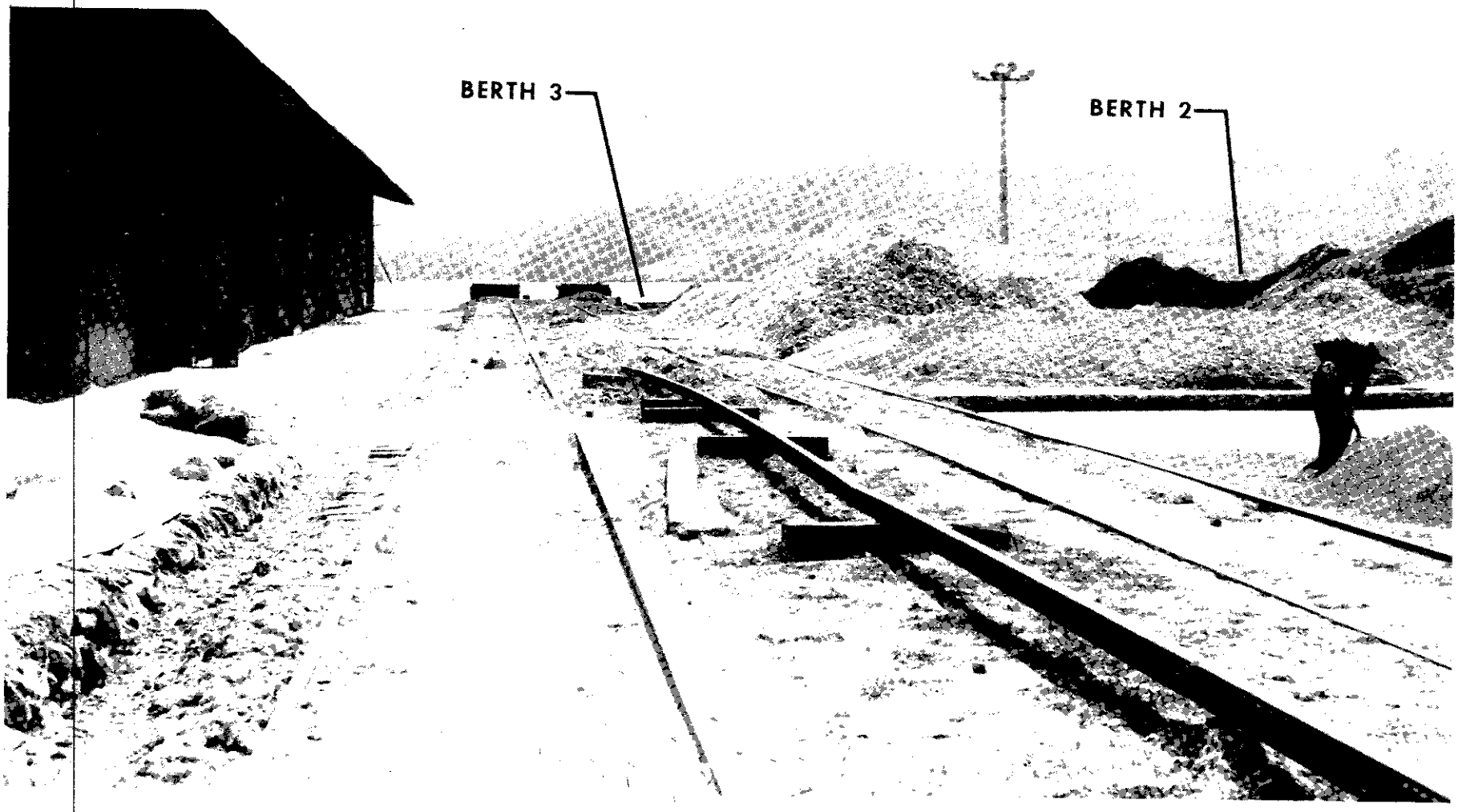


Figure MA-3. Pier 1 (eastward view).

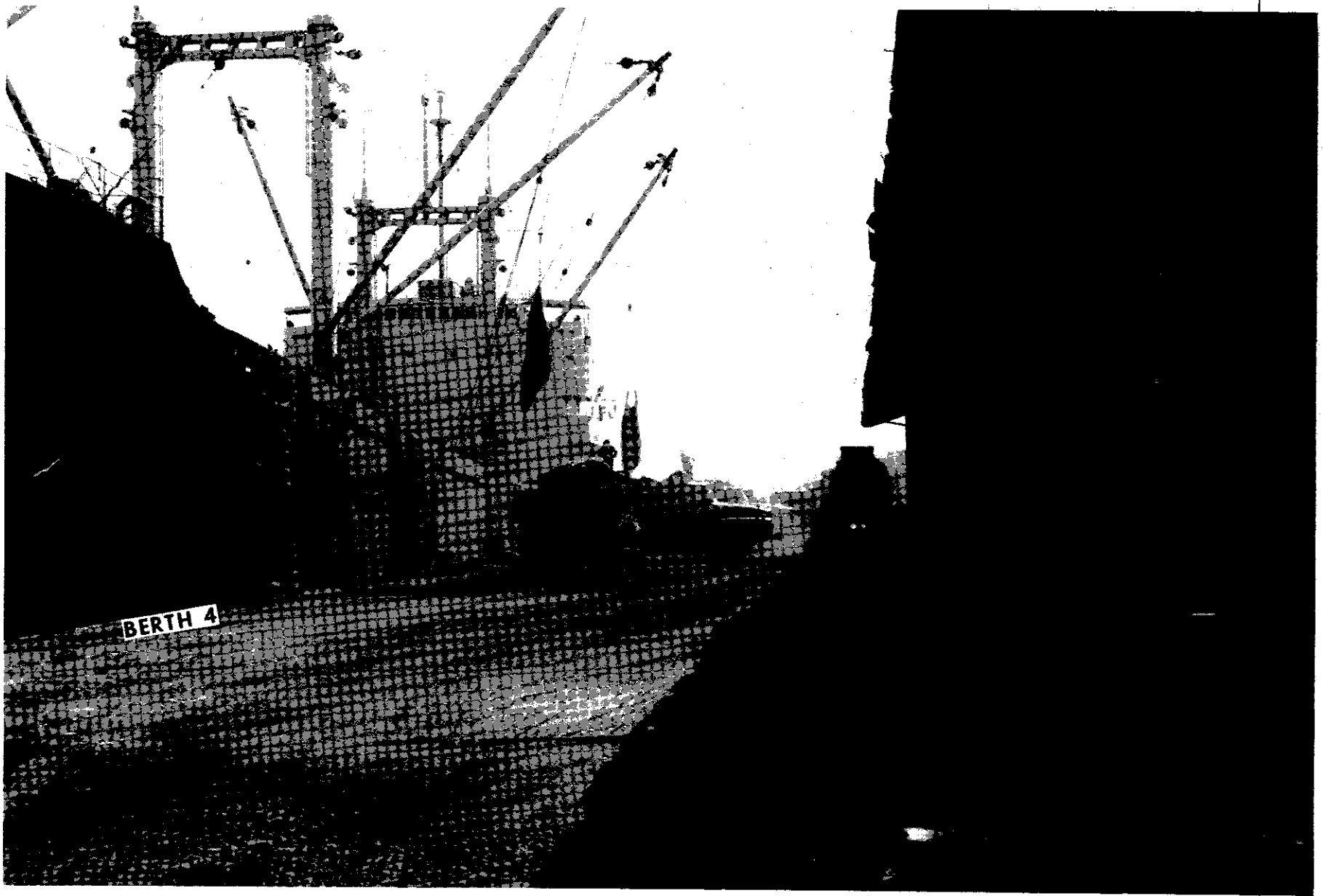


Figure MA-4. Berth 4 of pier 1 (eastward view).

b. (U) Breakbulk Operations. The berthing facilities at all potentially usable berths for military breakbulk operations are inadequate for most ships in the US-flag fleet. This is primarily due to inadequate depths, berth lengths, and pierside facilities. Table MA-3 summarizes why berths 1 through 13 are inadequate.

Use of the JSCP-allocated Korean-flag ships reveals that these breakbulk facilities still would tend to be inadequate. The adequacy and inadequacies of these berths for the allocated Korean shipping are summarized in table MA-4.

c. (U) LASH and SEABEE Operations. LASH and SEABEE barges can be accommodated at berths 1, 3, 4, and 12 (figs MA-5 through MA-7). Berth 13 can handle LASH barges only. These berths could provide 36 LASH barge or 15 SEABEE positions; however, actual berths used would depend on the number and type of other ships occupying the various berths. Barges could be staged south of pier 1 or east of the Central wharf.

LASH and SEABEE vessels would most likely have to be anchored in lower Masan Bay in one of the designated anchorages because of draft limitations in upper Masan Bay.

Since the Port of Masan does not own any MHE, privately owned mobile cranes would have to be brought in to offload barges.

d. (U) Container Operations. Container handling facilities and conventional container-handling equipment are not available at the western shore port facilities. The physical systems required to support container operations, such as drafts, berth lengths, and large open storage areas, are not available or are not adequate.

e. (U) Safety Considerations. If a breakbulk ammunition ship were to dock at one of these berths, more than half of the city of Masan would fall within a quantity-distance arc of 2500 meters (fig MA-2). This area includes inhabited buildings, schools, industrial areas, fuel storage tanks, and an estimated population of 24,000. Because of these considerations and the port's physical constraints, ammunition operations are not feasible at this location.

f. (U) Summary of Berth Availability. Berths available for different types of vessels are summarized in tables MA-3 and MA-4. Included are only those berths that could accommodate the particular type of vessel expediently without extraordinary docking or materials handling procedures. The tables also show, for each type of vessel, the number each berth could accommodate or the characteristics that make the berth unsuitable. As can be seen, the western shore facilities are not suited to most vessel types and are adequate for lighterage operations only.

2. (U) Storage Areas

a. (U) Open Storage. The western shore port facilities have both improved and unimproved acreage for open storage. The total open storage area available for each berth area and its general capacity, condition, and current use are listed in table MA-5. A total of 581,307 square feet of open storage area is available; however, most of it is unimproved and is

TABLE MA-3
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF MASAN (WESTERN SHORE)

US-Flag Ship Type	Berths												
	1	2	3	4	5	6	7	8	9	10	11	12	13
RORO													
GTS Callaghan	a,c,d	a,c,d	a,c,d	a,d	a,d	a,d	a,d	a,d	a,d	a,b,c,d	a,c,d	a,c,d	a,c,d
USNS Comet	a,c,d	a,c,d	a,c,d	a,d	a,d	a,d	a,d	a,d	a,d	a,b,c,d	a,c,d	a,c,d	a,d
Maine-class	a,c	a,c	a,c	a	a	a	a	a	a	a,b,c	a,c	a,c	a,c
Breakbulk													
C4 Mariner-class	a,c	a,c	ac	a	a	a	a	a	a	a,b,c	a,c	a,c	a
C4-5-58a	a,c	a,c	ac	a	a	a	a	a	a	a,b,c	a,c	a,c	a
C3-5-38a	a,c	a,c	ac	a	a	a	a	a	a	a,b,c	a,c	a,c	a
C3-5-33a	a,c	a,c	ac	a	a	a	a	a	a	a,b,c	a,c	a,c	a
Barge													
LASH C8-5-81B	f	a,c	f	f	a	a	a	a	a	a,b,c	a,c	f	f
LASH barge	Yes	a	Yes	Yes	a	a	a	a	a	a,b,c	a	Yes	Yes
SEABEE C8-5-83A	f	a,c	f	f	a	a	a	a	a	a,b,c,	a,c	f	a,c
SEABEE barge	Yes	a	Yes	Yes	a	a	a	a	a	a,b,c	a	Yes	a
Seatrain													
Georgia-class	a,c	a,c	a,c	a	a	a	a	a	a	a,b,c	a,c	a,c	a
Puerto-class	a,c	a,c	a,c	a	a	a	a	a	a	a,b,c	a,c	a,c	a
Container													
X6-5-1W	a,c,e	a,c,e	a,c,e	a,e	a,e	a,e	a,e	a,e	a,e	a,b,c,e	a,c,e	a,c,e	a,c,e
C7-5-68E	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	a,b,c,e	a,c,e	a,c,e	a,c,e
C8-S-85B	a,c,e	a,c,e	a,c,e	a,e	a,e	a,e	a,e	a,e	a,e	a,b,c,e	a,c,e	a,c,e	a,c,e
RORO/Container													
C5-5-78	a,c	a,c	a,c	a	a	a	a	a	a	a,b,c	a,c	a,c	a
T-AKR (SL-7)	a,c	a,c	a,c	a	a	a	a	a	a	a,b,c	a,c	a,c	a

a - Inadequate draft at berth.
b - Inadequate apron width for ship ramps.
c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.
f - Inadequate draft for barge ship at berth, however, ship could be unloaded from anchorage.

TABLE MA-4
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF MASAN (WESTERN SHORE)

Korean-Flag Ship Type	Berths												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Breakbulk													
Type 1	3	a	4	5	a	a	a	a	a	c	a	1	a
Type 2	1	a	1	2	a	a	a	a	a	c	a	b	a
Type 3	1	a	1	2	a	a	a	a	a	c	a	b	a
Type 4	1	a	1	2	a	a	a	a	a	c	a	b	a
Type 5	1	a	1	2	a	a	a	a	a	c	a	b	a
Type 6	1	a,b	1	1	a	a	a	a	a	b	a	a,b	a
Type 7	a	a,b	a	a	a	a	a	a	a	a,b	a,b	a,b	a

a - Inadequate draft at berth.
b - Inadequate berth length.

used for storage of bulk products such as coal, cement, fertilizer, and grain. The only area suitable for staging of unit equipment is the area available on pier 1.

b. (U) Covered Storage. Transit sheds, which are either adjacent to or near all berths, provide a total of 146,080 square feet of covered storage area. These warehouses or transit sheds are listed in table MA-5. Only the transit shed located at pier 1 is served by rail. All others have doors too narrow to permit the use of forklifts. Except for the Central wharf facilities, most of the warehouses in this area are in a rundown condition and are not suitable for modern cargo transfer operations.

c. (U) POL Storage. Storage facilities for petroleum products are located in several areas adjacent to western shore berth facilities. These storage tanks are listed in table MA-6, which also gives locations, use, capacity, and ownership of the respective storage tanks. Bunkering is available for vessels; however, KMPA offices must be informed of the quantity desired at least 24 hours in advance.

3. (U) Rail Operations. The Korean National Railroad owns and maintains the railroad track within the port area and provides access to the berths and transit sheds. Only pier 1 has an access track; the track serves the rear of the transit shed, where it branches into four tracks. Apron tracks and end ramps are unavailable. The facilities at the Central wharf and pier 2 do not have direct rail service; however, rail sidings are available about 600 feet west of these facilities.

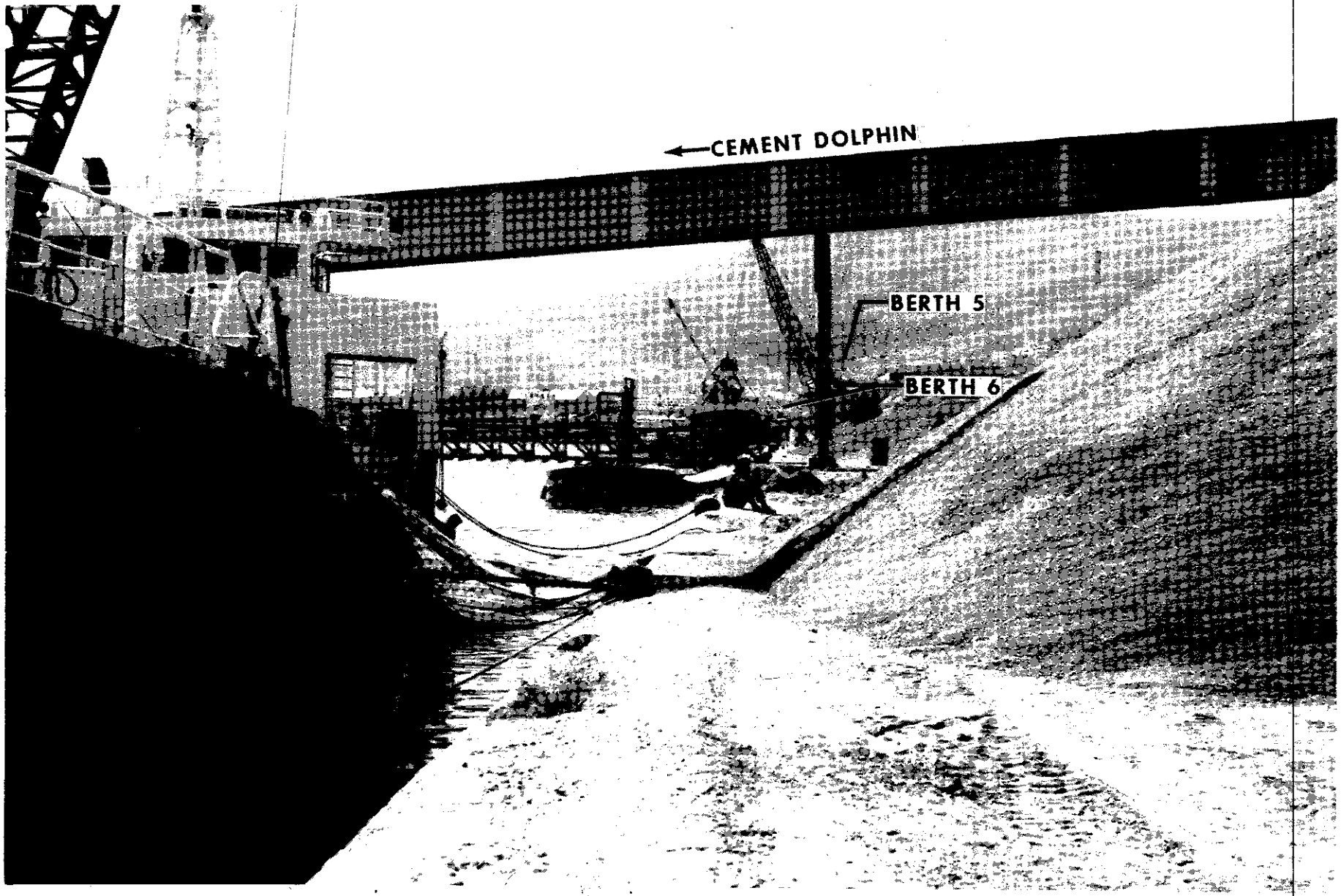


Figure MA-5. Central wharf berths (southwestward view).

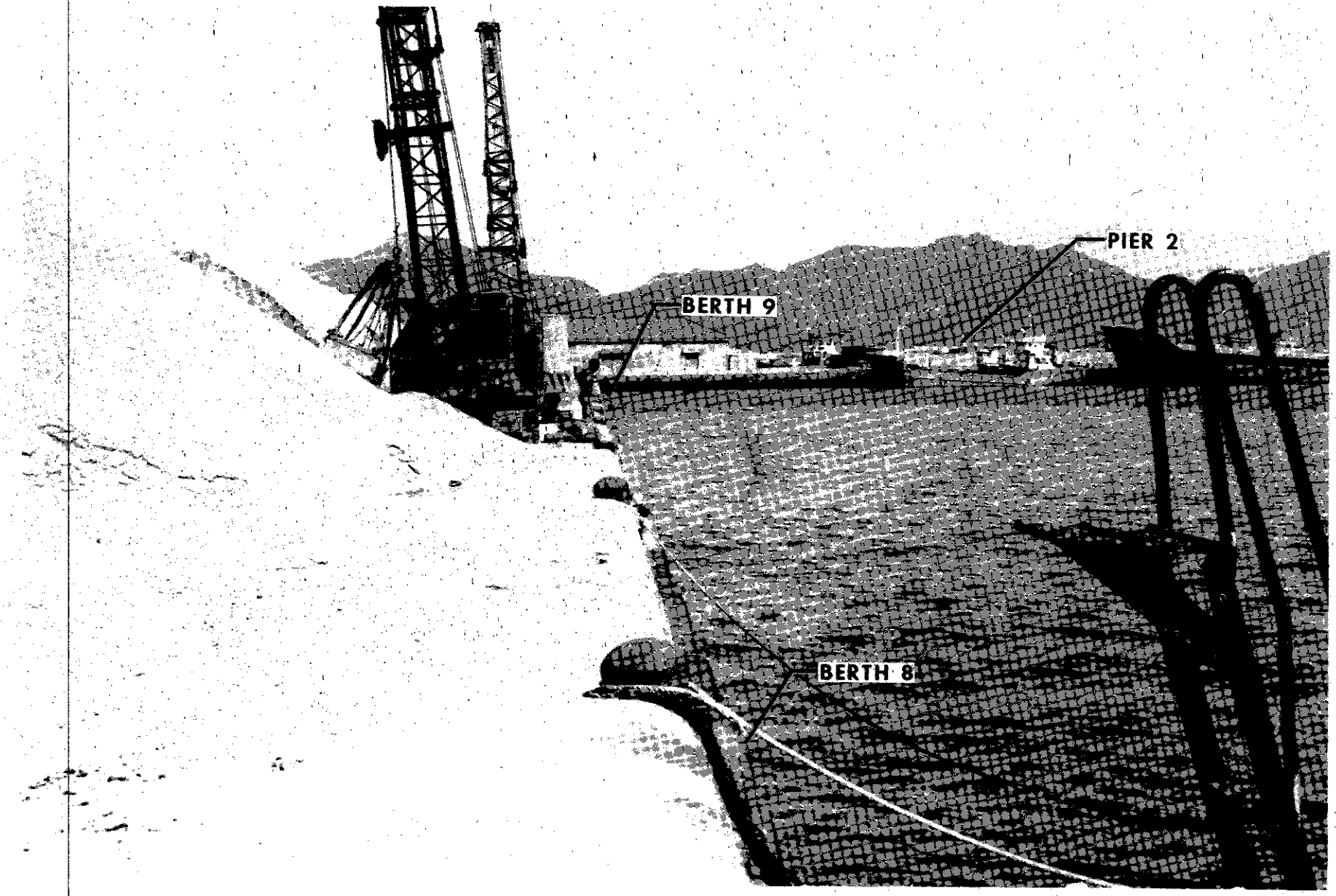


Figure MA-6. Central wharf berths (northeastward view).

Figure MA-7. North side of pier 2 (southeastward view).

TABLE MA-5
STORAGE FACILITIES FOR PORT OF MASAN

Type Storage/ Location Berths Served	Number of Storage Areas	Total Space m^2	Total Space (ft^2)	Storage Capacity (tons)	Current Use	Condition	Owner/Remarks
Covered Storage							
Pier 1, berths 2-4	1	2 930	(31,541)	8,800	Bulk products	Poor	Masan District KMPA
	1	400	(4,306)	1,200	Bulk products	Fair	Sechang Trade Company
Central wharf, berths 5-10	3	2 910	(31,326)	8,700	General cargo, bulk products	Good	Custom House
Pier 2, berths 11-13	9	7 330	(78,907)	22,000	General cargo, bulk products	Fair	Korea Express Company
Wharf 3, berths 14-15	1	6 000	(64,590)	61,200	General cargo	Good	Free Export Zone
East wharf, berths 16-20	9	40 800 [a]	(439,210) [a]	122,400 [a]	General cargo	NA	One at 120 x 50 m, five at 120 x 40 m, and three at 120 x 30 m
Open Storage							
Pier 1, berths 2-4	1	6 000	(172,239)	48,000	Bulk products	Good	Concrete and gravel deck
Central wharf, berths 5-10	1	36 000	(387,539)	108,000	General cargo, bulk products	Poor	Sand and gravel deck
Pier 2, berths 11-13	1	2 000	(21,529)	6,000	Tug and fishing boat pier	Poor	Sand and gravel deck
Wharf 3, berths 14-15	1	28 000	(301,419)	84,000	General cargo, lumber	Good	Concrete deck
East wharf, berths 16-20	1	52 500 [b]	(564,980) [b]	157,500 [b]	NA	Excellent	Concrete deck

[a] These facilities were not in place at the time of the field phase of study; however, construction is to begin in 1984.
[b] These figures are based on total open area currently available. This will be reduced when transit sheds are constructed.

TABLE MA-6
POL STORAGE FACILITIES
FOR PORT OF MASAN

Geographic Location	Number of Tanks	Storage Capacity (bbl)	Type Fuel	Owner/Remarks
DP 611942	3	14,560	MOGAS	Korean Oil Company
	2	6,260	Diesel	Korean Oil Company
	2	6,260	Kerosene	Korean Oil Company
	3	19,280	Bunker C	Korean Oil Company
DP 611938	1	1,080	Diesel	Chung'ang Oil Co.
	2	1,570	Heavy oil	Chung'ang Oil Co.
DP 619950	1	270	Diesel	Kyongnam Oil Co.
	2	1,200	Heavy oil	Kyongnam Oil Co.
Not available	1	60	Kerosene	Kyonghyang Oil Co.
	1	500	Heavy oil	Kyonghyang Oil Co.
	1	2,260	Bunker C	Kyonghyang Oil Co.
Not available	2	3,620	Diesel	Yuwon Industrial Company
DP 601923	1	360	Diesel	Powerplant, KEPCO
	2	5,900	Heavy oil	KEPCO
	1	25,000	Bunker C	KEPCO

4. (U) Truck Operations. None of the western shore facilities have truck docks located on the premises (fig MA-8). At all locations, portable ramps would be required or equipment and cargo could be crane lifted onto a transporting vehicle. Since these facilities are currently used for bulk products, facilities for loading general cargo and/or unit equipment for large-scale military operations are nonexistent or inadequate.

5. (U) Security. The western shore facilities of this port are located in the downtown area of Masan, along the lower western shore of upper Masan Bay. Perimeter fences surround the entire facility. Gates are located at the entrance to each pier or wharf and are continually manned. Security guards continually patrol throughout the terminal area to control vehicular traffic and maintain surveillance. The pier and wharf areas are not well lighted but streetlights illuminate most perimeter fencing.

6. (U) Cargo Handling Equipment. The Port of Masan KMPA has no materials handling equipment. All MHE available throughout the city is privately owned, yet it is available through contractors to work ships. The following MHE is available for western shore, wharf 3, and East wharf facilities:

Mobile Cranes	Capacity (ton)	Quantity
	30	1
	25	2
	20	3
Forklifts	6	2
	5	4
	3	2
Lighter Barges	150-200	3
	100	9
	50	5

C. (U) Wharf 3 and East Wharf Facilities

1. Berthing. Seven general cargo berths are located at these facilities. Wharf 3, located in the free export zone, has two berths and the East wharf, located on the eastern shore of upper Masan Bay (figs MA-8 and MA-9), has five berths. Wharf 3 and the East wharf have 1,378 and 3,445 feet, respectively, of continuous wharf available for deep-draft oceangoing vessels. The individual characteristics of these berths are summarized in table MA-2. The types of ship

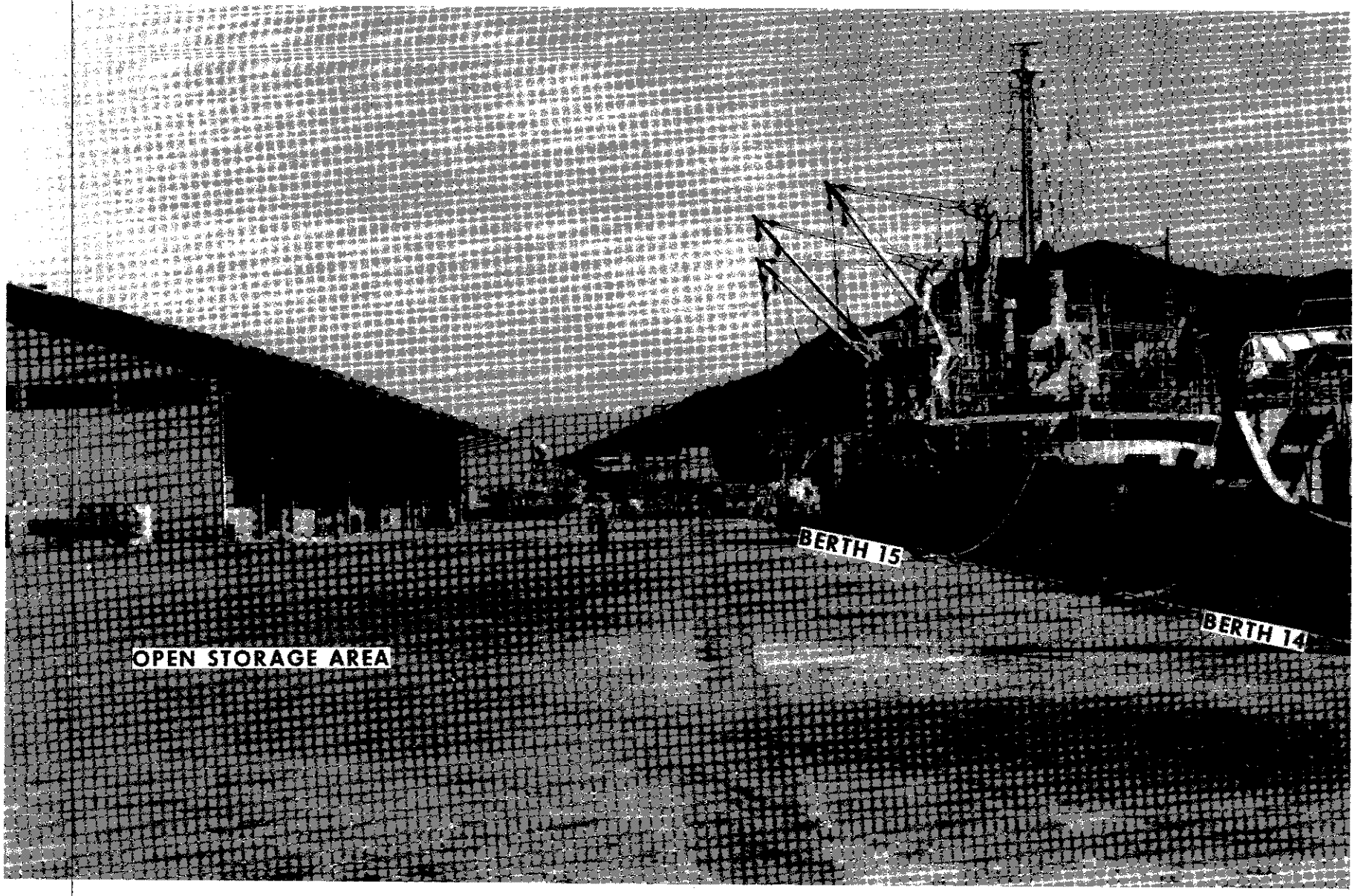


Figure MA-8. Wharf 3 berths (eastward view).

unloading operations normally possible at these berths are discussed below.

a. (U) RORO Operations. No stern-ramp facilities are available at these berths to support stern-ramp RORO operations. The apron widths at all berths are adequate for RORO side-ramp operations, and alongside drafts are adequate for designated side-ramp RORO ships. The slewed stern ramps of a Maine-class RORO vessel could be positioned on the aprons of berths 14 and 15 and 16 through 20.

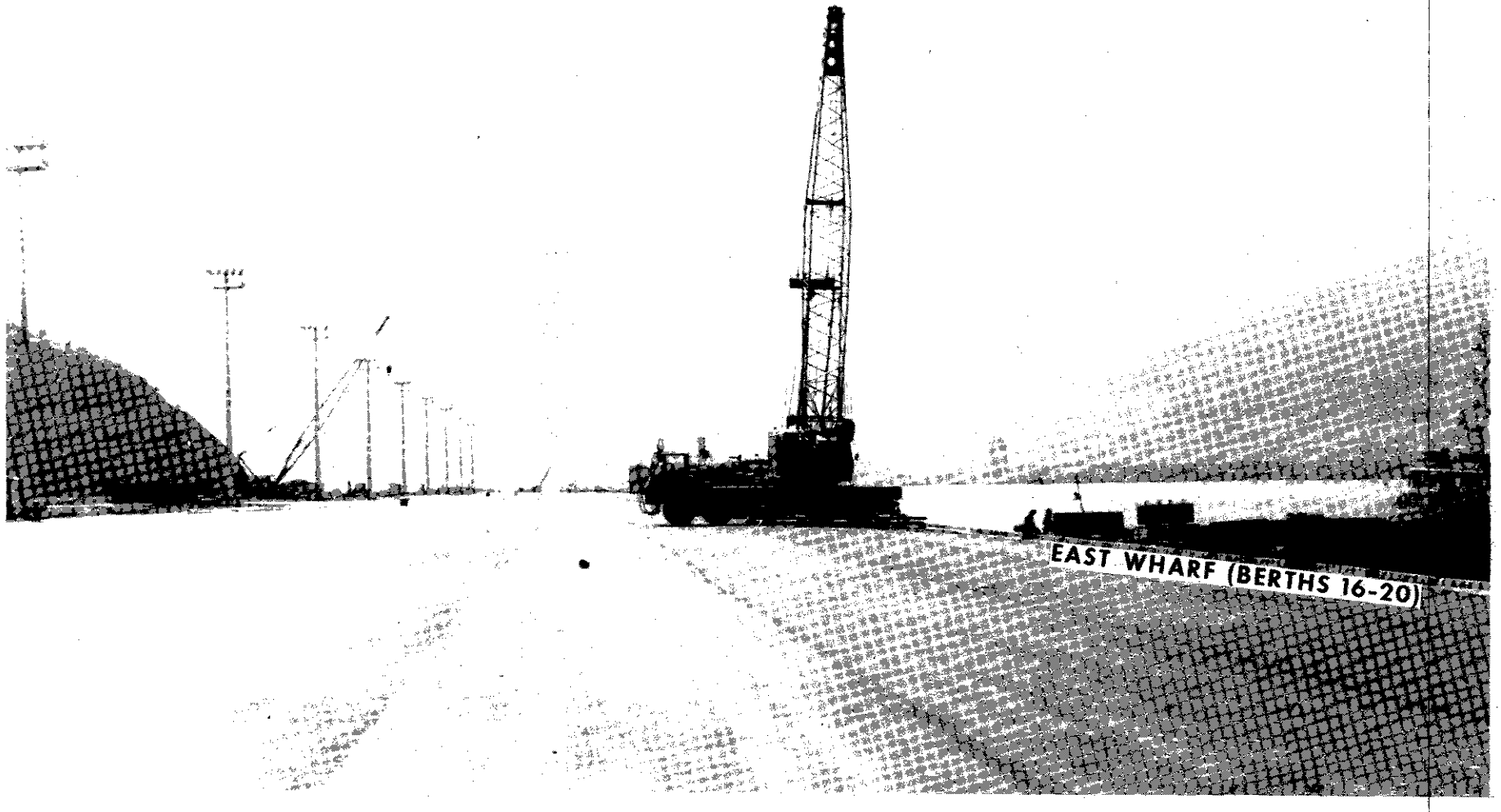


Figure MA-9. East wharf berths (southwestward view).

No shore-based ramps are available for the Ponce/Great Land-class vessel; if they were, only berths 16 through 20 could provide the approximately 100 feet of apron width required for these ramps.

Backup marshaling areas are adequate for all classes of RORO ships that could call at these berths. More than 800,000 square feet of improved and 500,000 square feet of unimproved open storage areas are suitable for staging military vehicles.

b. (U) T-AKR Operations. The berth lengths at wharf 3 and East wharf are adequate to berth T-AKR vessels. One could be accommodated at wharf 3 and three at the East wharf. If the T-AKR arrived fully loaded with equipment and fuel, it would exceed the draft at these berths by 8 inches at MLW. However, based on Navy "draft arrival" at maximum tank, the T-AKR will draw 36.1 feet; therefore, it can be accommodated at these berths.

c. (U) Breakbulk Operations. Nine breakbulk ships could be berthed simultaneously at these wharves, two at berths 14 and 15 and six at berths 16 through 20. Mobile cranes would be required at some of these berths to supplement ship tackle operations. Although conventional general cargo at a port is usually moved to and from vessels by ship's gear, crawler and mobile cranes with lifting capacities up to 150 tons may be required for lifting heavy tracked vehicles. Since no floating cranes or derricks for making heavy lifts at shipside are based at this port, they probably will have to be obtained from private sources (such as local shipyards) or the nearby Port of Pusan.

Wharf 3 has no lights for night operations while the East wharf has excellent high-intensity tower lighting, which would allow 24-hour port operations.

d. (U) LASH and SEABEE Operations. LASH and SEABEE barges can occupy berths 14 through 20 with no problem, except mobile cranes and supporting MHE would be required. These berths could provide a total of 77 LASH barge or 49 SEABEE positions. Adequate staging or barge lay areas are available in several places within upper Masân Bay.

As with the western shore facilities, LASH and SEABEE vessels would have to be anchored in lower Masan Bay in one of the designated anchorages because of draft limitations in upper Masan Bay anchorages.

e. (U) Container Operations. Container handling facilities and conventional container-handling equipment are not available at either wharf 3 or the East wharf. The large, open storage area needed for container operations is not available at wharf 3. However, adequate open area and some of the physical systems required to support container operations are available at the East wharf. If mobile cranes and other container handling equipment were made available to this facility, it could easily be used for container port operations.

f. (U) Safety Considerations. As can be seen in figure MA-1, wharf 3 is closer to the population center of Masan than the East wharf and, consequently, would expose a larger percentage of the city if ammunition ships were worked there. From wharf 3, about

one-third of the city would fall within a quantity-distance arc of 2500 meters (fig MA-2). This area includes inhabited buildings, schools, a shipyard and other industrial areas, and an estimated population of 130,000.

From the East wharf, only a small portion of the city and the free export zone would fall within a quantity-distance arc of 2500 meters. If a containerized ammunition ship were unloaded from this wharf, the quantity-distance arc would increase to 2800 meters. These areas include inhabited buildings, wharf 3, a shipyard and other industrial complexes, plus estimated populations of 67,000 and 80,000 respectively for the 2500-meter and 2800-meter arcs.

g. (U) Summary of Berth Availability. Berths available are summarized in tables MA-7 and MA-8. Included are only those berths that could accommodate the designated vessels expediently without extraordinary docking or materials handling procedures. These berths can accommodate almost all US-flag and Korean-flag designated shipping. Only deep-draft LASH and SEABEE ships could not be accommodated alongside these berths. Since wharf 3 and the East wharf are continuous, ships such as the GTS Callaghan, T-AKR (SL-7), and C7-5-68E, could still be accommodated, but would require more than one berth. Table MA-7 indicates this by showing berth availability at every other berth. Based on the information gathered for this port and on the onsite inspection, the facilities at wharf 3 and the East wharf are well suited for RORO, breakbulk, and lighterage operations. If mobile container equipment were provided, the East wharf would be an excellent facility to conduct container operations.

2. (U) Storage Areas

a. (U) Open Storage. The wharf 3 and East wharf facilities have both improved and unimproved open storage areas. Table MA-5 lists the total open storage area available for each berth and gives its general capacity, condition, and current use. A total of 866,399 square feet of open storage area is available at these two wharves. The wharf 3 open storage area, portions of which are shown in figure MA-10, is all hardstand and is currently used for general cargo and logs. The East wharf has improved and unimproved open storage available as illustrated in figure MA-11. This area is new and not currently used. However, it is an excellent site and has plenty of room to conduct helicopter operations. Both sites are well suited for staging and marshaling of unit equipment and vehicles.

b. (U) Covered Storage. Wharf 3 has one transit shed with a total capacity of 64,590 square feet. This shed was built in 1978 and is in good condition, but it has no loading docks and is not served by rail. The East wharf currently has no covered storage facilities. However, nine are planned, which would provide a total of 439,210 square feet of covered storage.

c. (U) POL Storage. No storage facilities for petroleum products are located in the areas adjacent to wharf 3 or the East wharf. Table MA-6 indicates those facilities are available within the Masan Port complex.

3. (U) Rail Operations. No rail service currently exists to wharf 3 and the East wharf. The nearest rail to wharf 3 is the main line that runs adjacent to

TABLE MA-7
SUMMARY OF US-FLAG BERTH AVAILABILITY - PORT OF MASAN (WHARF 3 AND EAST WHARF)

US-Flag Ship Type	Berths								
	14	15	16	17	18	19	20	21	22
RORO									
GTS Callaghan	1,d	c,d	1,d	c,d	1,d	c,d	1,d	c,d	1,d
USNS Comet	1,d	1,d	1,d	1,d	1,d	1,d	1,d	1,d	1,d
Maine-class	1	1	1	1	1	1	1	1	1
Breakbulk									
C4 Mariner-class	1	1	1	1	1	1	1	1	1
C4-5-58a	1	1	1	1	1	1	1	1	1
C3-5-38a	1	1	1	1	1	1	1	1	1
C3-5-33a	1	1	1	1	1	1	1	1	1
Barge									
LASH C8-5-81B	c,f	c,f	c,f	c,f	c,f	c,f	c,f	c,f	c,f
LASH barge	11	11	11	11	11	11	11	11	11
SEABEE C8-5-82A	c,f	c,f	c,f	c,f	c,f	c,f	c,f	c,f	c,f
SEABEE barge	7	7	7	7	7	7	7	7	7
Seatrain									
Georgia-class	1	1	1	1	1	1	1	1	1
Puerto-class	1	1	1	1	1	1	1	1	1
Container									
C6-5-1W	1,e	1,e	1,e	1,e	1,e	1,e	1,e	1,e	1,e
C7-5-68E	1,e	c,e	1,e	c,e	1,e	c,e	c,e	c,e	1,e
C8-5-85B	1,e	1,e	1,e	1,e	1,e	1,e	1,e	1,e	1,e
RORO/Container									
C5-5-78	1	1	1	1	1	1	1	1	1
T-AKR (SL-7)	1	c	1	c	1	c	1	c	1
Breakbulk/Container									
C5-53-37E	1	1	1	1	1	1	1	1	1
C4-5-10	1	1	1	1	1	1	1	1	1

c - Inadequate berth length.
d - No stern-ramp facilities.
e - No container handling equipment.
f - Inadequate draft for barge ship at berth; however, ship could be unloaded from anchorage.

TABLE MA-8
SUMMARY OF KOREAN-FLAG BERTH AVAILABILITY - PORT OF MASAN (WHARF 3 AND EAST WHARF)

Korean-Flag Ship Type	Berths								
	14	15	16	17	18	19	20	21	22
Breakbulk									
Type 1	5	5	5	5	5	5	5	5	5
Type 2	2	2	2	2	2	2	2	2	2
Type 3	2	2	2	2	2	2	2	2	2
Type 4	2	2	2	2	2	2	2	2	2
Type 5	2	2	2	2	2	2	2	2	2
Type 6	1	1	1	1	1	1	1	1	1
Type 7	1	1	1	1	1	1	1	1	1

Superhighway 6 into the city of Masan about 1 mile west of the wharf. The nearest rail to the East wharf is an elevated line that runs near the Changwon Industrial Complex, about 3 miles to the east of the wharf.

4. (U) Truck Operations. No loading docks or ramps are available for loading trailers, vans, or flatbed trucks at these wharves. Portable ramps or mobile cranes would be required for loading heavy equipment or vehicles onto trucks. Any large-scale truck-loading operation would require large quantities of forklifts and mobile cranes and would be labor-intensive. The most efficient truck-loading method at these wharves would involve direct ship-to-truck transfer of military cargo being moved to depots up-country.

5. (U) Security. Wharf 3 has an excellent security arrangement. It is surrounded by water on three sides and on the north, a perimeter fence borders the free export zone. Two gates are available at wharf 3; however, only the main gate on the northwest side of the terminal is used. The main gate is continually manned and security guards continually patrol throughout the terminal area. The wharf and staging areas are not lighted; however, the perimeter fence has streetlights along its entire length.

The East wharf has little in the way of security at this time because it is still under construction. There was no perimeter fencing at the time of the field survey and only two guards patrolled the area. Tower lighting is available. However, the wharf is located in a remote area, so large-scale cargo operations would require additional extensive security

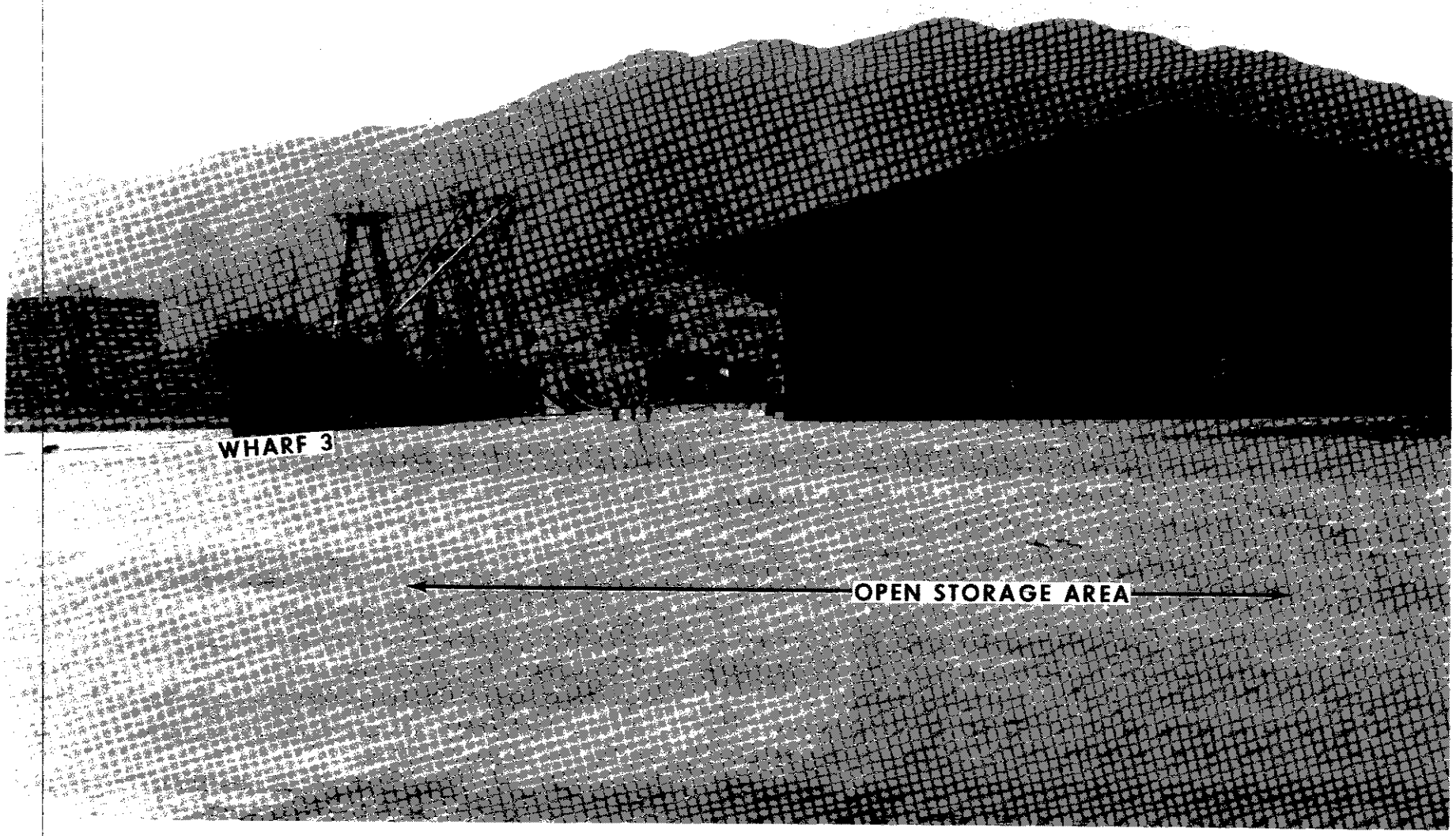


Figure MA-10. Wharf 3 open storage area (westward view).

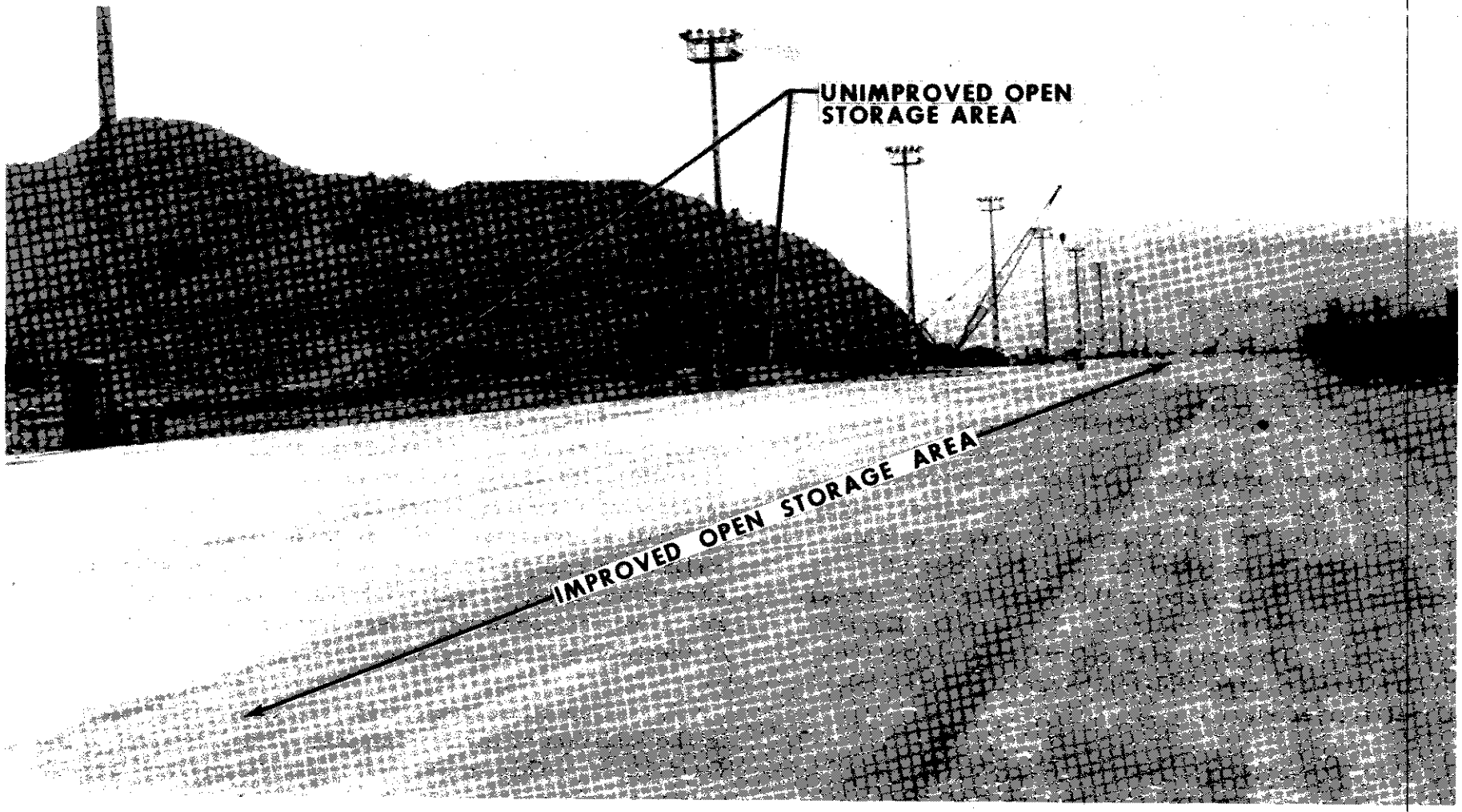


Figure MA-11. East wharf improved and unimproved storage areas (southwestward view).

arrangements to control potential pilferage and/or sabotage.

D. (U) Support Service

1. (U) Pilotage. Pilotage is mandatory for entrance into the Port of Masan and can be arranged from either the Kadok-Do pilot station or the Masan quarantine anchorage. The references for the pilot stations are:

Pilot station (Kadok-Do)	latitude 34°58'20"N longitude 128°48'14"E
Quarantine anchorage	latitude 35°08'45"N longitude 128°35'00"E

2. (U) Harbor Craft. Masan currently has one berthing tugboat of 1,000 horsepower, which is owned and operated by the Masan District Marine Bureau. A number of other private companies can provide small tugboats and lighter barges. Three steel-bottom tugs, rated at 310, 110, and 88 horsepower, are available and three wooden tugs, rated at 120, 100, and 60 horsepower, are also based in the Masan area. These smaller tugs, however, could only be used for lighterage operations. The port also can provide three 150- to 200-ton barges, nine 100-ton barges; and five 50-ton barges if needed.

3. (U) Stevedores. About 470 stevedores are registered to the Masan and Chinhae Branch of the National Docker's Union. Gang size varies according to the type of cargo, but usually it is 16 to 18 members for the general and bulk cargo operations found at this port. The local stevedore companies in Masan are:

Dongbang Forwarding Co, Ltd.
Global Enterprise Co, Ltd.
Hyupshin Heavylift Co, Ltd.
Jim Heung Company
Sewha Tong-Un Co, Ltd.
Korea Express Co, Ltd.

E. (U) Future Development

The development of port facilities on the eastern shore is a two-phase project. The first phase was partially completed in 1982 - the East wharf that is to be used mainly in support of the Changwon Industrial Complex. Nine transit sheds remain to be completed at this wharf, along with the perimeter fencing, administration buildings, and entrance roadways.

The second phase of the Masan Port development plan involves construction of another wharf facility south of the East wharf (fig MA-2). This facility will include 1,378 feet of continuous wharfage and will accommodate two or three oceangoing vessels. Estimated completion date of the Kwihyon wharf is sometime in 1985. Although fill work was underway, actual wharf construction had not yet begun at the time of the field survey (fig MA-12).

One other project in the early planning stages is the addition of three container gantry cranes to the East wharf. This is planned for 1986 and will greatly enhance port capability.

F. (U) Summary

The Port of Masan can currently berth breakbulk, RORO, and LASH or SEABEE barges. The

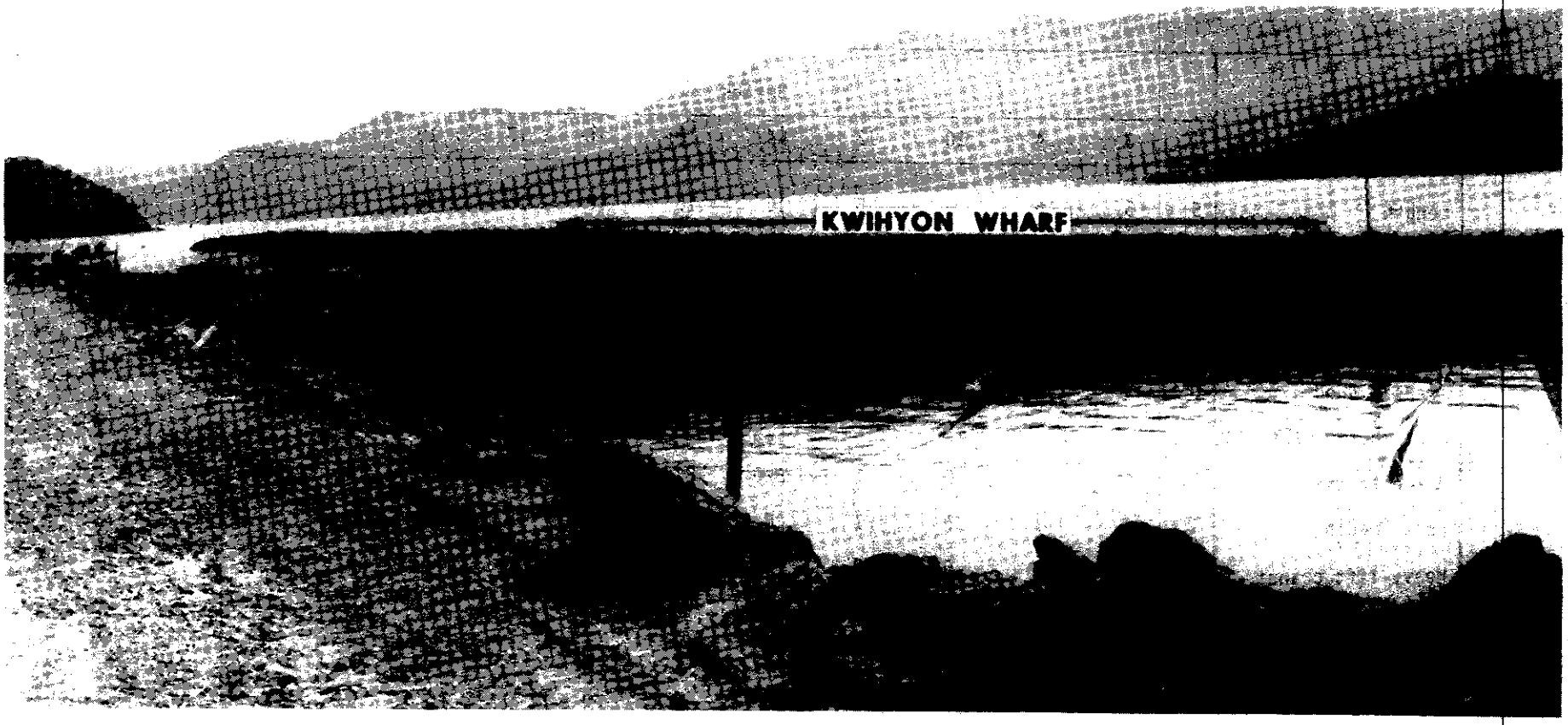


Figure MA-12. Site of future Kwihyon wharf (southward view).

usefulness of this port lies mainly in use of wharf 3 and East wharf. Individual berth rankings in the port complex are shown in tables MA-9 and MA-10. Berths 14 through 20 are the best in this complex for break-bulk and side-ramp/slewed stern-ramp RORO operations. With the exception of no rail service, these berths are highly capable of sustaining most unit equipment and resupply cargo operations.

Use of the western shore facilities for break-bulk/RORO military cargo operations is not recommended because of draft limitations, age of the facilities, inadequate decks, and limited marshaling and staging areas. Lighterage operations are possible at berths 1, 3, 4, 12, and 13 but are not recommended. There are physical limitations, such as inadequate apron width and decking for forklift and mobile crane operations.

TABLE MA-9
INDIVIDUAL BERTH RATING (BB/RORO)

Ideal Berth Factors	Berths											
	1	3	4	10	12	14	15	16	17	18	19	20
Length	5	5	16	5	5	16	16	16	16	16	16	16
Alongside depth	12	12	12	12	12	20	20	20	20	20	20	20
Backup area	1	1	1	0	1	2	2	2	2	2	2	2
Apron width	20	18	18	0	10	20/20	20/20	20/20	20/20	20/20	20/20	20/20
Transit shed	0	2	2	2	2	2	2	0	0	0	0	0
Distribution shed												
Apron tracks	1	1	1	0	1	8/0	8/0	8/0	8/0	8/0	8/0	8/0
Deck loading	1	1	1	0	1	8	8	8	8	8	8	8
Heavy-lift cranes	0	0	0	0	0	0	0	0	0	0	0	0
Berth type	10	8	8	0	8	10	10	10	10	10	10	10
Truck tailgate	0	0	0	0	0	0	0	0	0	0	0	0
Rail end ramp	0	0	0	0	0	0	0	0	0	0	0	0
Truck access	5	8	8	8	8	8	8	8	8	8	8	8
Ship service facilities	5	5	5	5	5	5	5	5	5	5	5	5
Conditional age of facility	8	5	5	8	5	8	8	10	10	10	10	10
RORO stern ramp	0	0	0	0	0	0	0	0	0	0	0	0
Total points	67	65	76	40	57	99/91	99/91	99/91	99/91	99/91	99/91	99/91
Ranking	4	5	3	7	6	2	2	1	1	1	1	1

TABLE MA-10
INDIVIDUAL BERTH RATING (BARGE)

Ideal Berth Factors	Berths							
	2	5	6	7	8	9	11	13
Length	8	10	10	10	10	10	8	10
Alongside depth	0	0	0	0	0	0	0	8
Backup area	5	5	5	5	5	5	5	5
Apron width	9	10	10	10	10	10	10	10
Consolidation shed	2	2	2	2	2	2	6	6
Apron tracks	0	0	0	0	0	0	0	0
Anchorage diameter	10	10	10	10	10	10	10	10
Conditional age of facility	5	5	5	5	5	5	5	5
Deck loading	2	2	2	2	2	2	2	2
Heavy-lift cranes	0	0	0	0	0	0	0	0
Berth type	5	10	10	10	10	10	5	5
Truck tailgate	0	0	0	0	0	0	0	0
Rail end ramp	0	0	0	0	0	0	0	0
Truck access	8	8	8	8	8	8	8	8
Tug availability	3	3	3	3	3	3	3	3
Barge lay area	10	10	10	10	10	10	10	10
Total points	67	75	75	75	75	75	72	80
Ranking	4	2	2	2	2	2	3	1

Better use of the berth can also be made for other activities. All other western shore facilities are inadequate because of draft limitations. Use of wharf 3 or the East wharf for lighterage operations is possible only if mobile cranes are added.

Container operations at wharf 3 or the East wharf are possible if mobile container equipment is used and/or if a container-capable terminal service company is stationed at these facilities. Of the two wharves, the East wharf is better suited to container operations because of the amount of continuous wharfage available and extensive improved storage and marshaling areas.

If during emergencies, a vessel loaded with ammunition had to be discharged within the Port of Masan complex, the East wharf would be the best facility. Its location away from dense population centers and the large, open storage area available for transferring cargo to inland transport modes make this wharf the most ideal for ammunition operations.

(U) PORT OF OKPO

A. (U) General

1. (U) Location and General Uses. The Port of Okpo, which is under the Changsungpo Branch of the Masan KMPA, is located on the northeastern end of Koje-Do Island on the southern coast of the Korean Peninsula. This port is a private facility owned and operated by Daewoo Shipbuilding and Heavy Machinery, Ltd. The port facilities have deep-draft berths and currently handle cargo only for their plant. The predominant commodities include steel, iron, aluminum, and other general industrial-type cargos.

2. (U) Harbor. The approach to Okpo Bay is via the western channel of the Korea Strait. From this strait, vessels must approach the harbor limits by proceeding north along a longitude of 128°50' until reaching a point north of the Changsungpo Peninsula at a latitude of about 34°54'. Vessels should than proceed westward toward the harbor lights and into Okpo Bay. The inner harbor of Okpo Bay (fig OK-1) has an average depth of 14.5 meters (47.6 feet).

Entry to the inner harbor of Okpo Bay is via a 980-foot (300-meter) -wide channel through the breakwaters, marked by harbor lights, on the northern side of the bay. This port is located within a natural coastal harbor about 1.3 miles long and 1 mile wide. The harbor is afforded landmass protection from all directions except the northeast, where breakwaters serve to reduce wave action.

Within the harbor area, the mean high water interval is 8 hours 18 minutes. The mean tidal range is 4.9 feet, the spring rise is 5.0 feet, and the neap rise is 4.3 feet.

No specific anchorages are designated for this port. However, the inner harbor is well protected and can accommodate up to four large ocean-going vessels without much disturbance. The bottoms of these anchorages are predominantly mud and do not provide good anchorage if the winds are from the northeast; these winds cause sea rises.

Weather in this area could affect cargo movements. Although the harbor does have natural protection, it is exposed directly to the Korea Strait, and storms approaching from the northeast would create swells of critical proportions. Precipitation averages about 70 inches per year and occurs most frequently from June through August.

3. (U) Highways. Highway access with at least a 16-foot vertical clearance is available from Okpo to Superhighway 6 via Korean Route 14, a distance of about 117 kilometers (73 miles). Korean 14 is a two-lane, two-way, paved highway with no vertical or horizontal clearance limits. However, the bridge that provides access to Koje-Do Island has a weight limitation and Korean 14 on Koje-Do Island is a mountainous road with grades of up to 10 percent.

Access into and out of Daewoo Shipbuilding and Heavy Machinery, Ltd, is excellent and can be gained via numerous gates.

Highway access to and from these port facilities is good and would permit military convoys and heavy truck movement for resupply operations.

4. (U) Rail Access. Koje-Do Island and the Port of Okpo are not served by rail. The nearest rail facilities are located in the city of Sacheon, about 83 kilometers (52 miles) to the northwest where access to the Jinsam line (line 82) is available.

B. (U) Port Facilities

1. (U) Berthing. Two general cargo wharves and one container wharf are available within the port facilities at Okpo (fig OK-2). All of the berthing space along these wharves and pier is suitable for deep-draft ocean vessels. The individual characteristics of these berthing spaces are summarized in table OK-1. The type of ship-unloading operations possible at these berths with normal procedures are discussed below.

a. (U) RORO Operations. No facilities are available at these wharves to support stern-ramp RORO operations. In the unlikely event that one of the drydocks was not being used, it could be flooded and a RORO ship could be backed into the drydock where stern-ramp operations would be performed. Obviously, this is the exception rather than the rule.

The apron widths, berth lengths, and depths at wharves 1 and 3 are adequate to conduct side-ramp RORO operations. Wharf 1, or Northwest wharf, is shown in figures OK-3 and OK-4. This wharf also has adequate open staging area needed for RORO operations and jib cranes with enough lift capacity to remove heavy equipment (up to 50 tons) from a ship's deck.

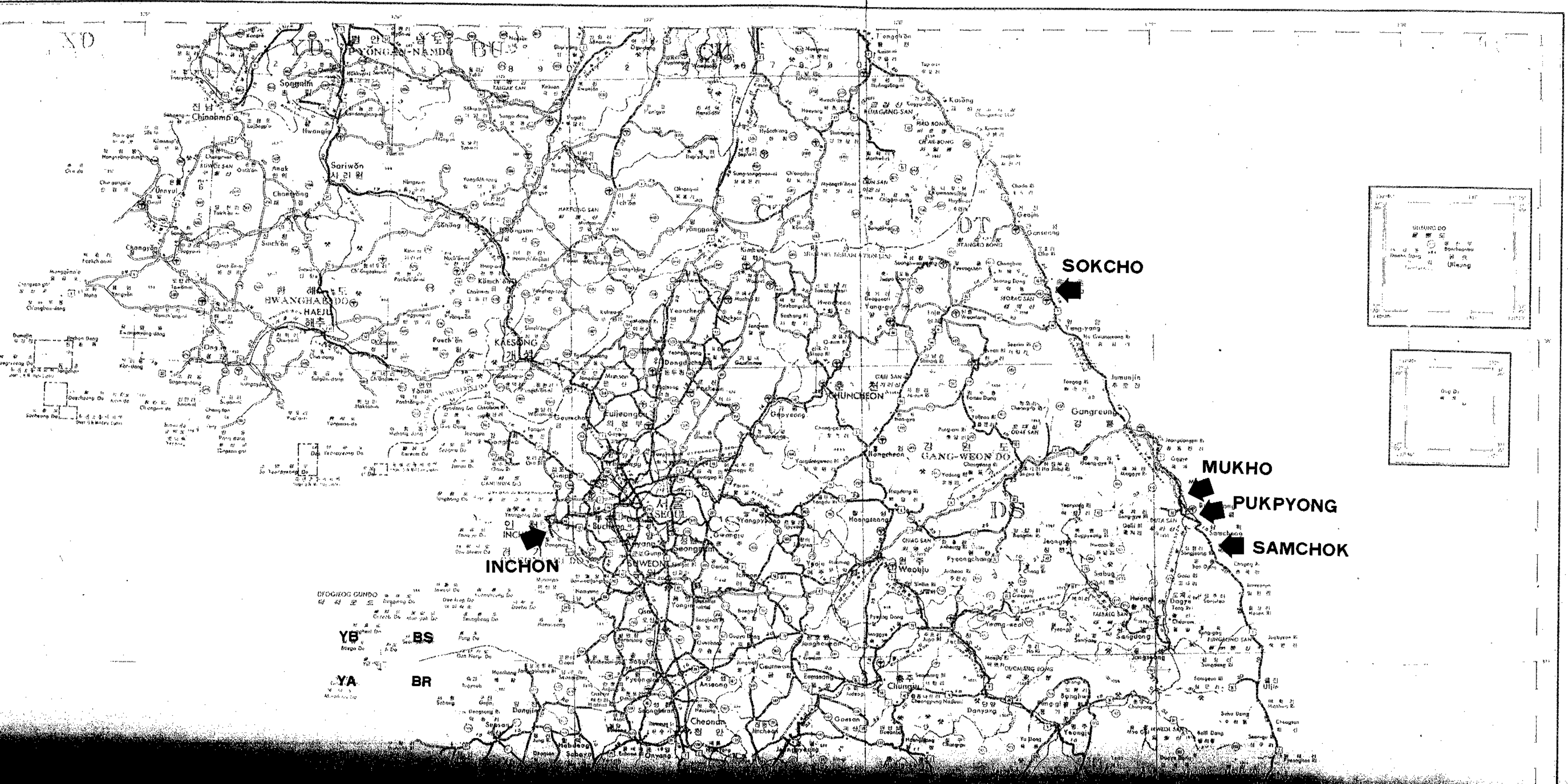
Wharf 3, or Southwest wharf, also has adequate vessel support systems for conducting side-ramp RORO operations. As illustrated in figure OK-5, this wharf was still under construction at the time of the site visits. However, it is scheduled for completion by the end of 1984. Two jib cranes similar to those at wharf 1 will also be installed at this wharf. The wharf can be used in its present configuration if necessary. RORO ships that have slewed stern ramps can also be berthed at wharves 1 and 3.

No shore-based ramps are available for the Ponce/Great Land-class RORO vessel at these berths. If a ramp were made available, or if the ship carried its ramp onboard, then these ships could use wharf 1 or 3.

Over 800,000 square feet of open storage area is available for marshaling or staging areas; this is adequate for all classes of RORO ships.

b. (U) T-AKR Operations. The vessel support systems necessary to berth a T-AKR vessel are adequate at wharves 1 and 3. Both of these wharves provide enough length to simultaneously berth four of these type of ships.

c. (U) Breakbulk Operations. Eight typical US-flag breakbulk ships could be berthed at wharves 1 and 3. Rail-mounted heavy-lift and mobile cranes are available at wharf 1 if needed. Conventional ship's gear is required for discharge operations at wharf 3


SOKCHO
MUKHO
PUKPYONG
SAMCHOK
INCHON
SEOUL
CHUNCHEON
GANG-WEON DO
HWANGHAE DO
KAESONG
YB
BS
YA
BR

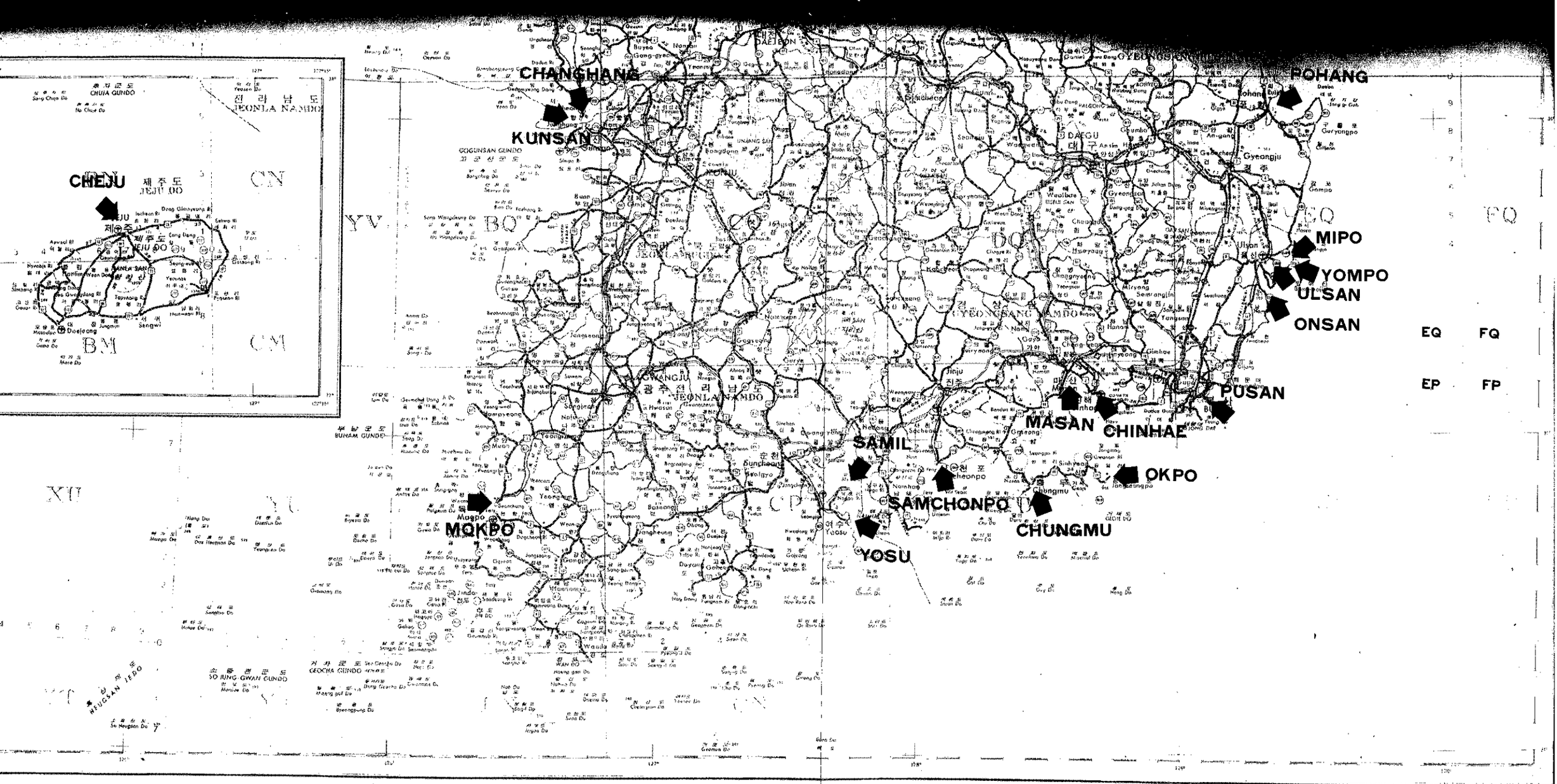
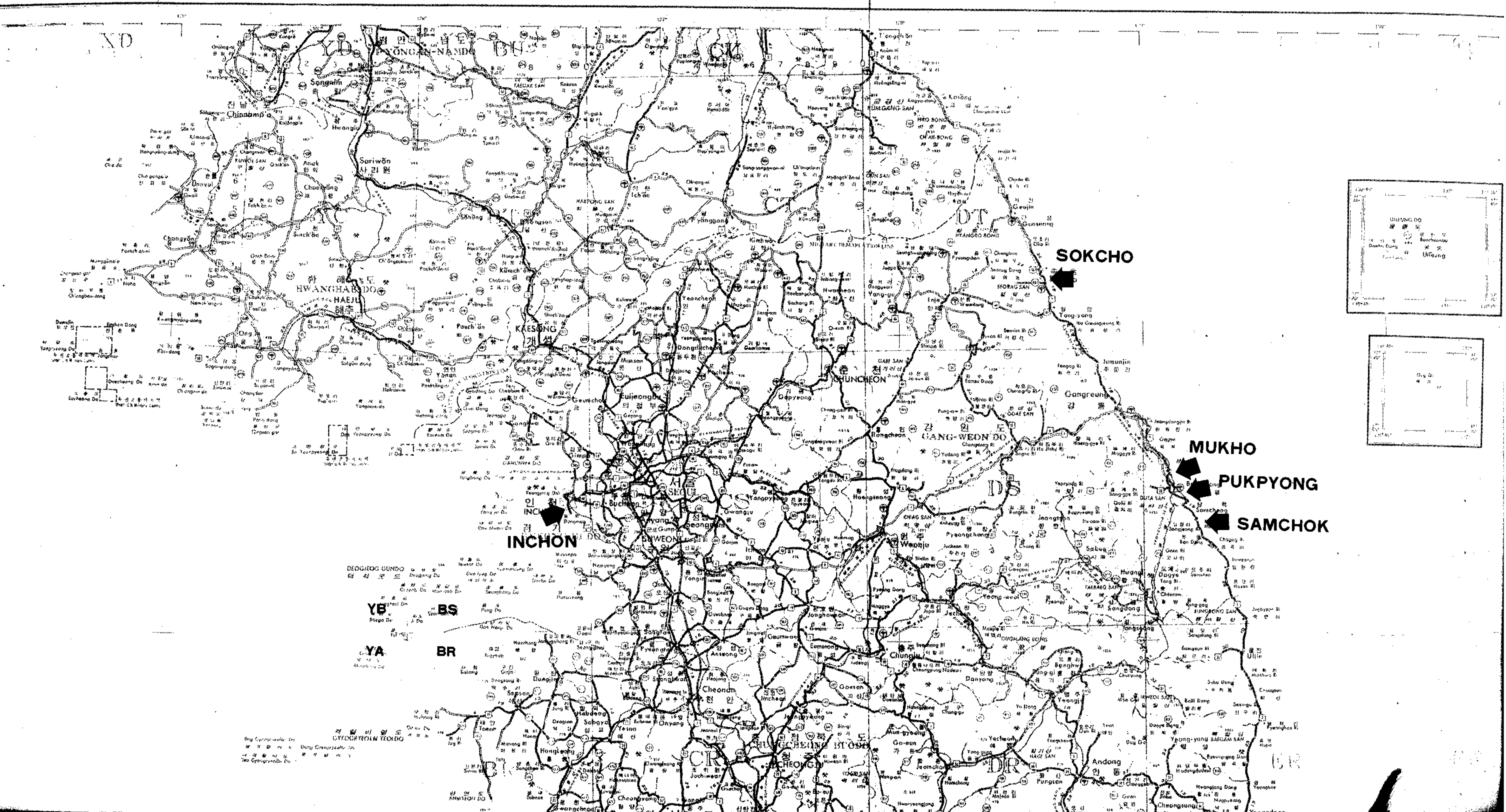


Figure I-1. Site map of Korea.



SOKCHO
MUKHO
PUKPYONG
SAMCHOK
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YA
BR
SEOUL
KAESONG
CHUNCHEON
HAEJU
GANG-WEON DO

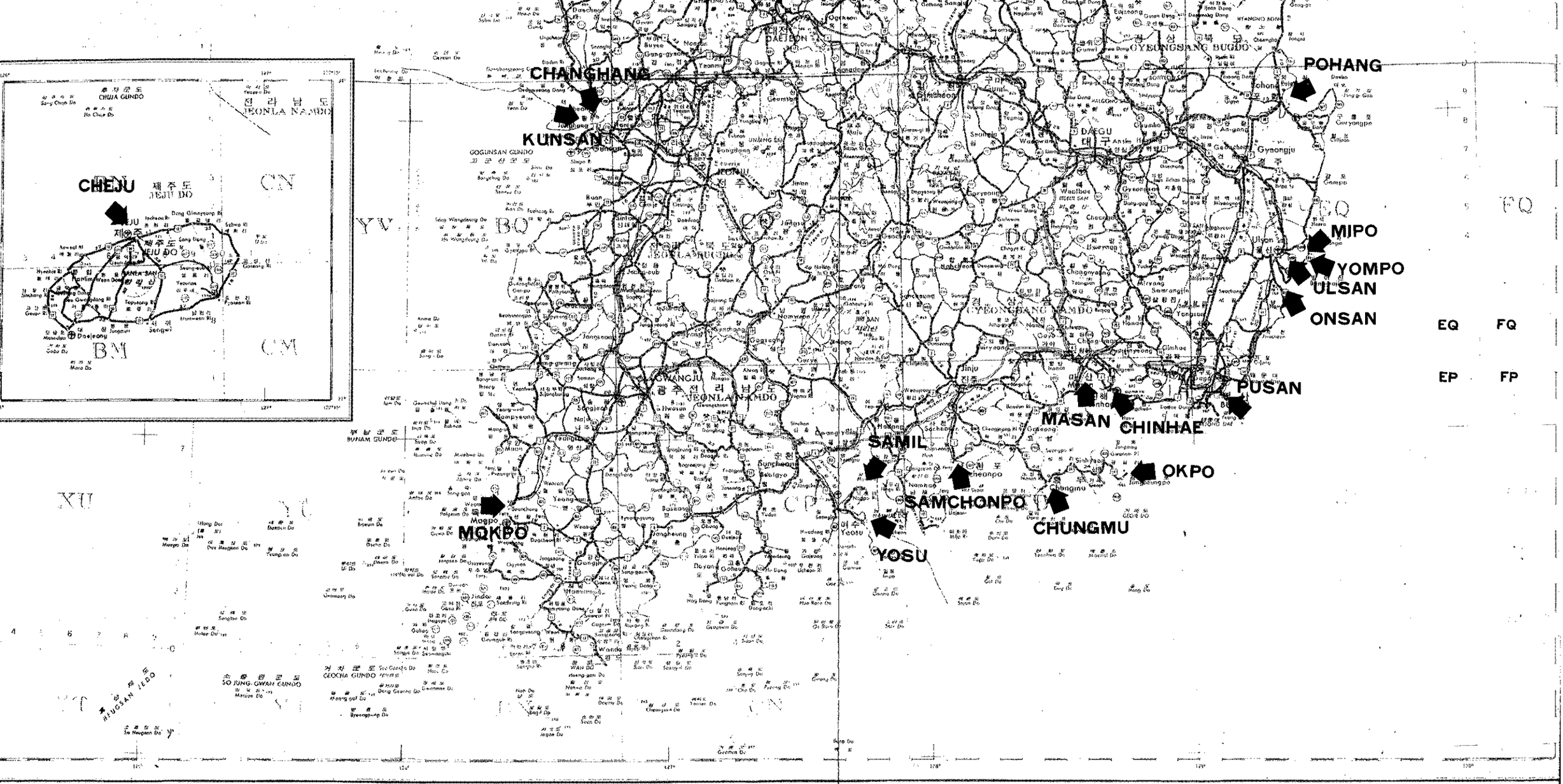
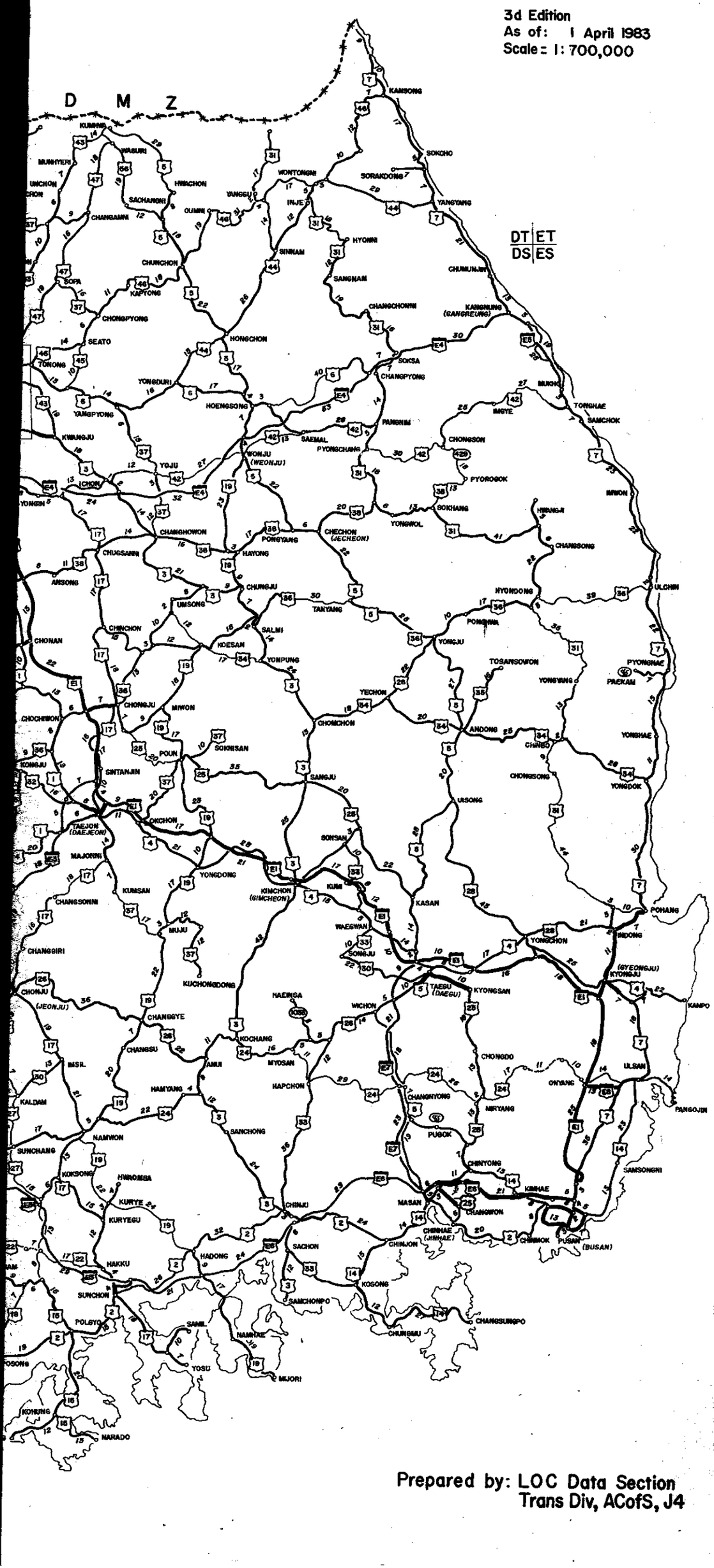
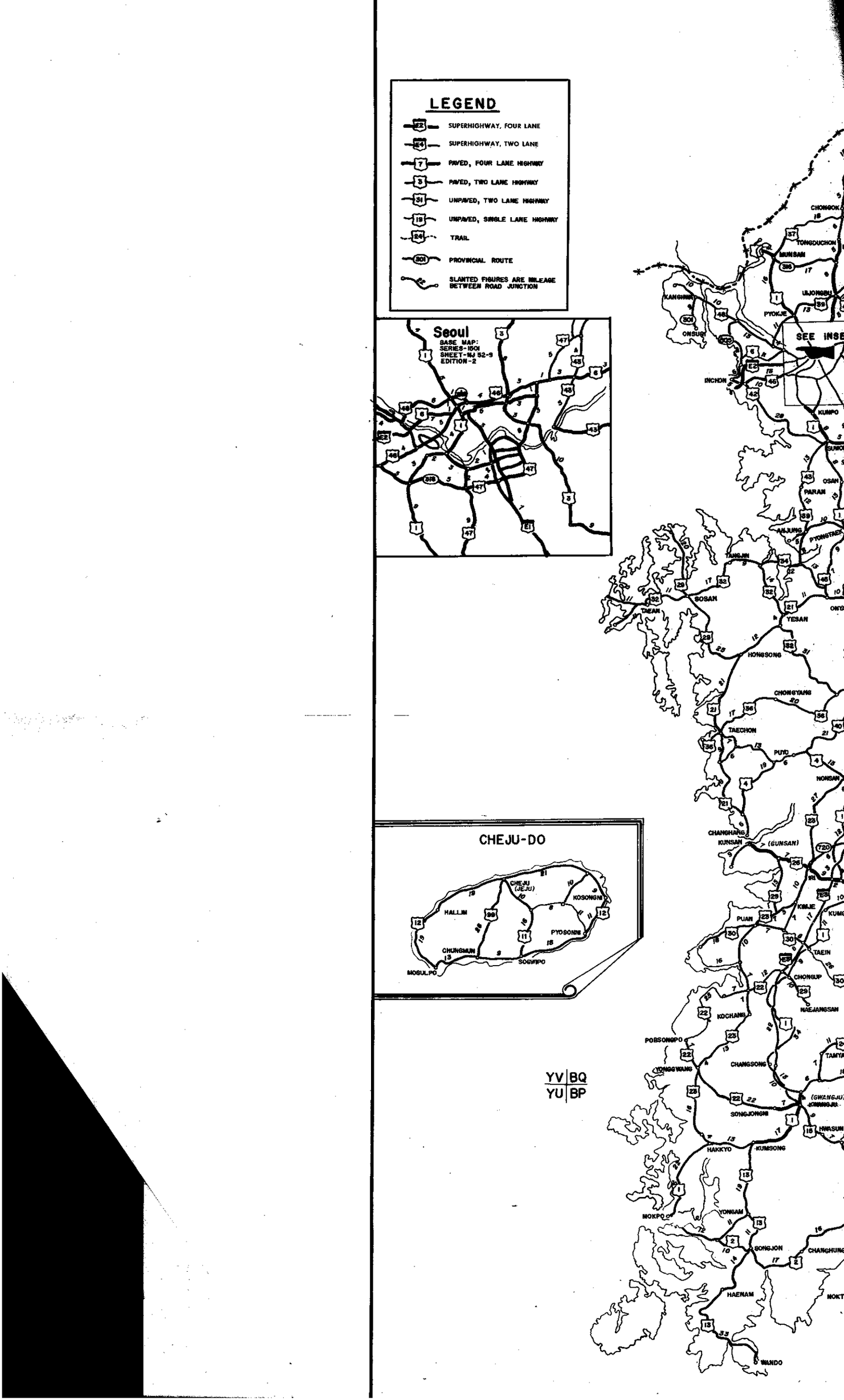


Figure I-1. Site map of Korea.

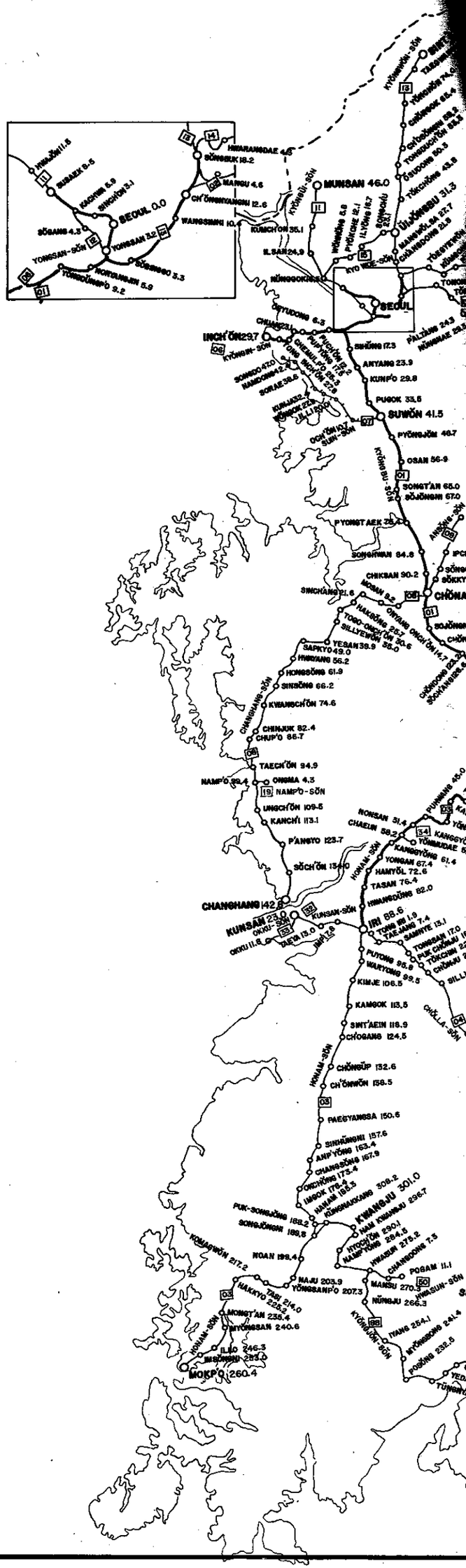


Prepared by: LOC Data Section
Trans Div, ACofS, J4


LEGEND
SUPERHIGHWAY, FOUR LANE
SUPERHIGHWAY, TWO LANE
PAVED, FOUR LANE HIGHWAY
PAVED, TWO LANE HIGHWAY
UNPAVED, TWO LANE HIGHWAY
UNPAVED, SINGLE LANE HIGHWAY
TRAIL
PROVINCIAL ROUTE
SLANTED FIGURES ARE MILEAGE BETWEEN ROAD JUNCTION
Seoul
BASE MAP:
SERIES-1501
SHEET-NJ 52-9
EDITION-2
CHEJU-DO
CHEJU (JEJU)
KOSONGNI
HALLIM
PYOSONNI
CHUNGMUN
SOGWIPO
MOSULPO
SEE INSE
CHONGOK
TONGDUCHON
MUNSAN
UIJONGBU
KANGHWA
PYOKJE
ONSUNG
INCHON
KUMPO
PAJU
OSAN
PARAN
ANJUNG
PYONGTAEK
TANGJIN
SOSAN
TAEAN
YESAN
HONGSONG
CHONGYANG
TAECHON
PUYO
NONSAN
CHANGHANG
KUNSAN
(GUNSAN)
KIMJE
PUAN
TAEIN
CHONGUP
NAEJANGSAN
KOCHANG
POSONGPO
CHANGSONG
YONGGWANG
SONGJONGNI
(GWANGJU)
HWASUN
NAKKYO
KUMSONG
MOKPO
YONGAM
SONGJON
CHANGHUNG
HAENAM
WANDO
YV|BQ
YU|BP

Prepared by LOC Data Section
Trans Br ACofS J4
Di: Jan 81

BASE MAP: KOREA ROAD MAP
SERIES L 351
SHEET 2 (Southern Korea)
EDITION 3 KMS
SCALE 1: 700,000



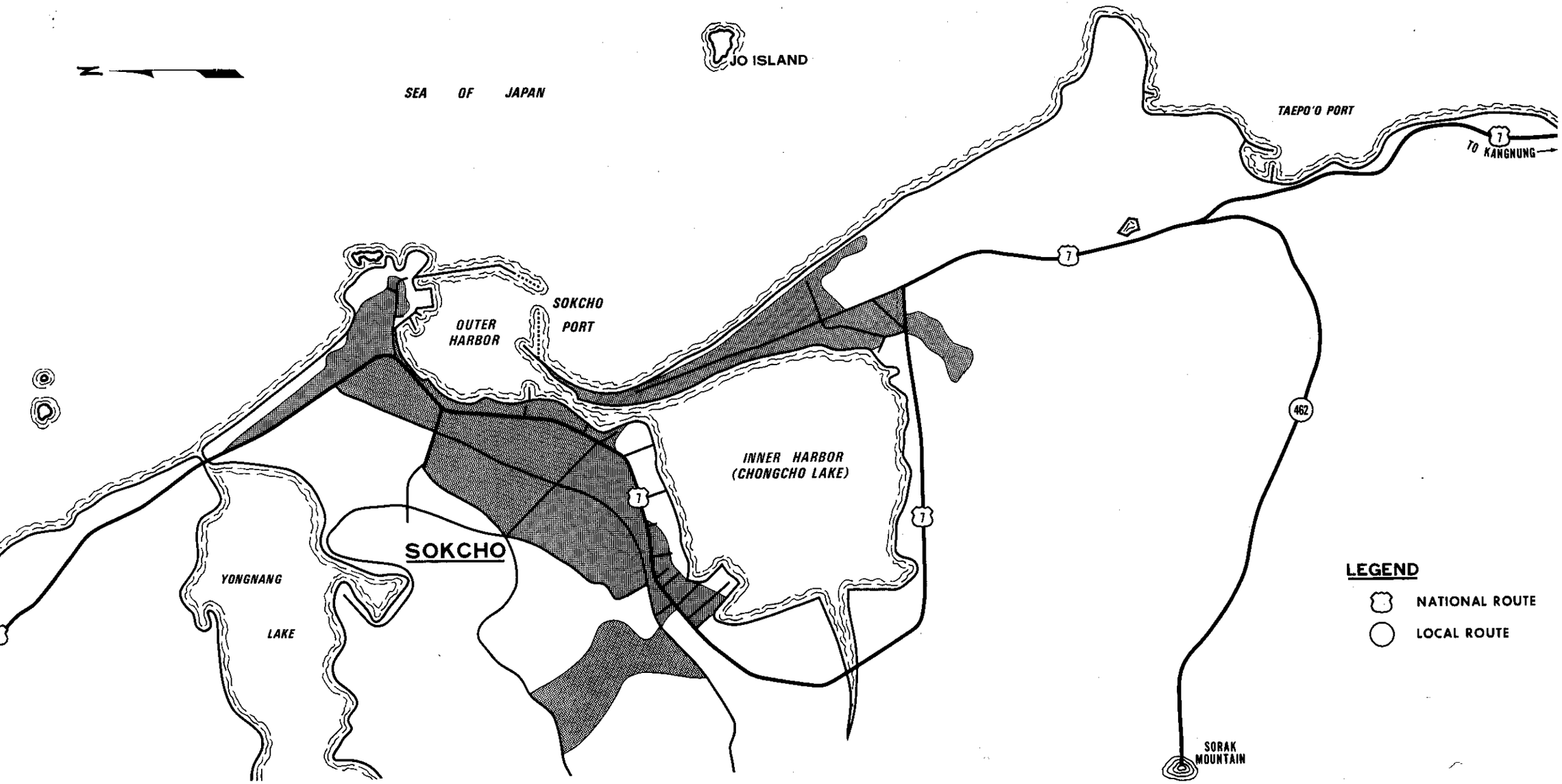


Figure SO-1. Vicinity map.

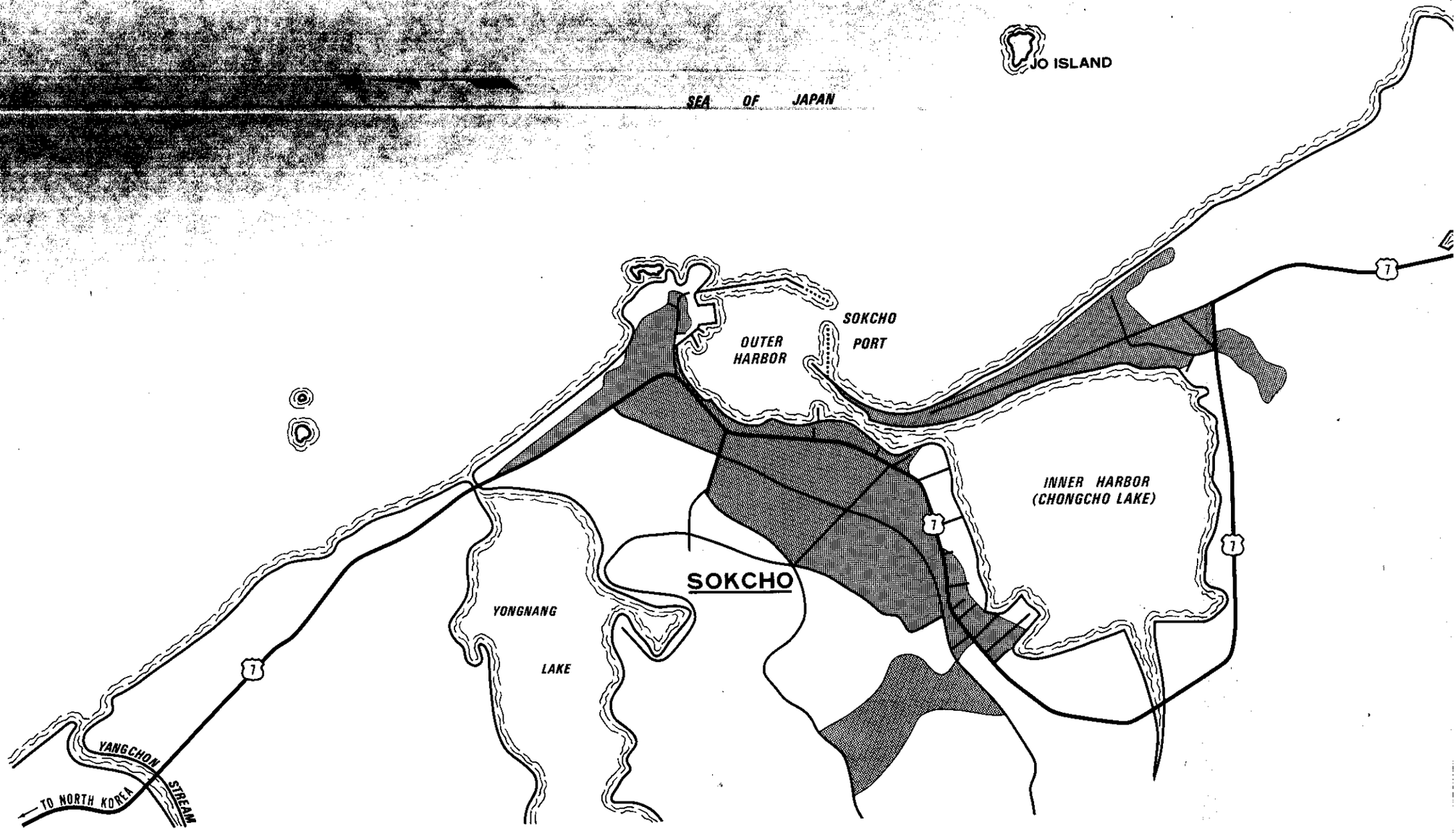
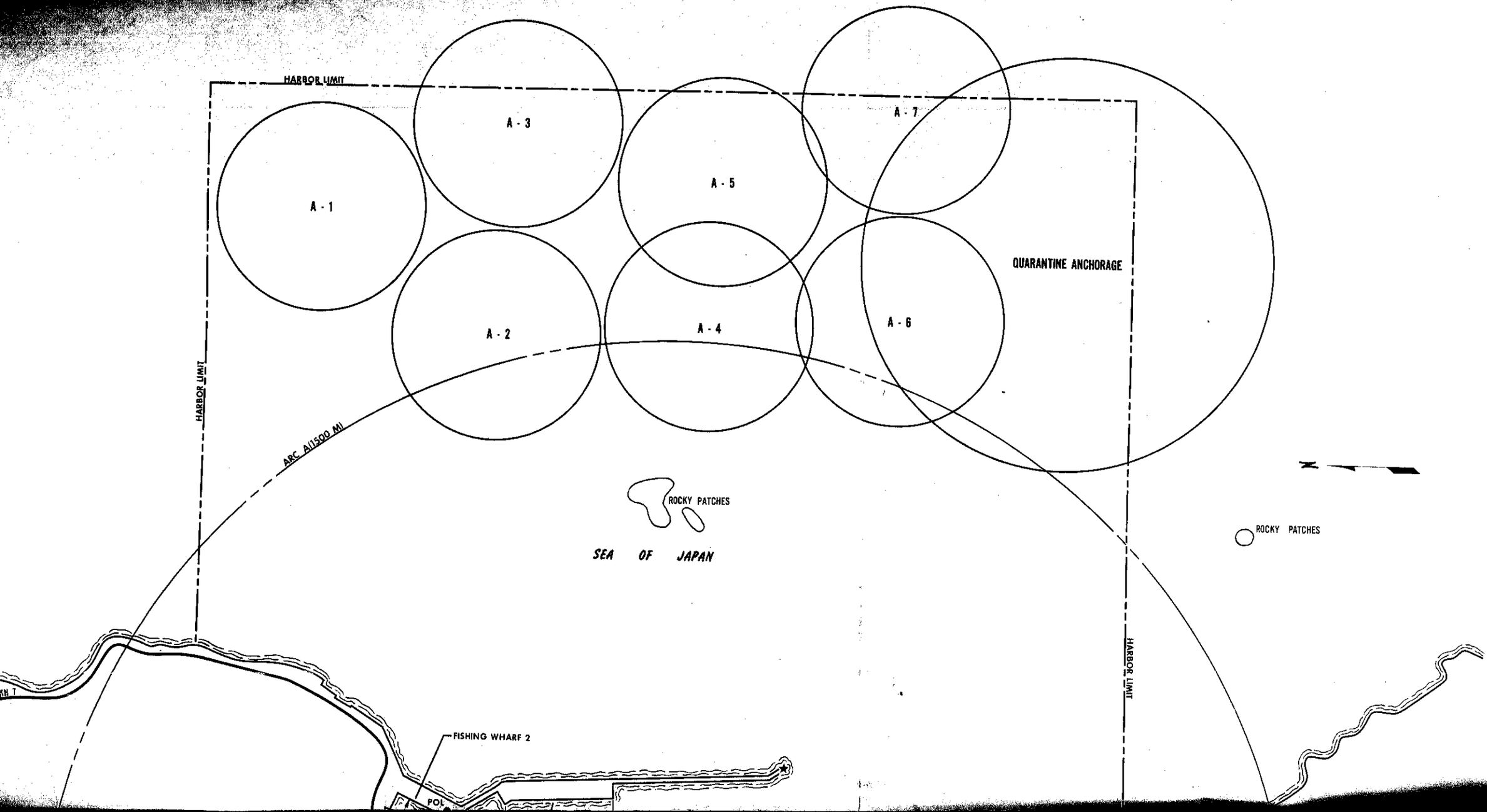
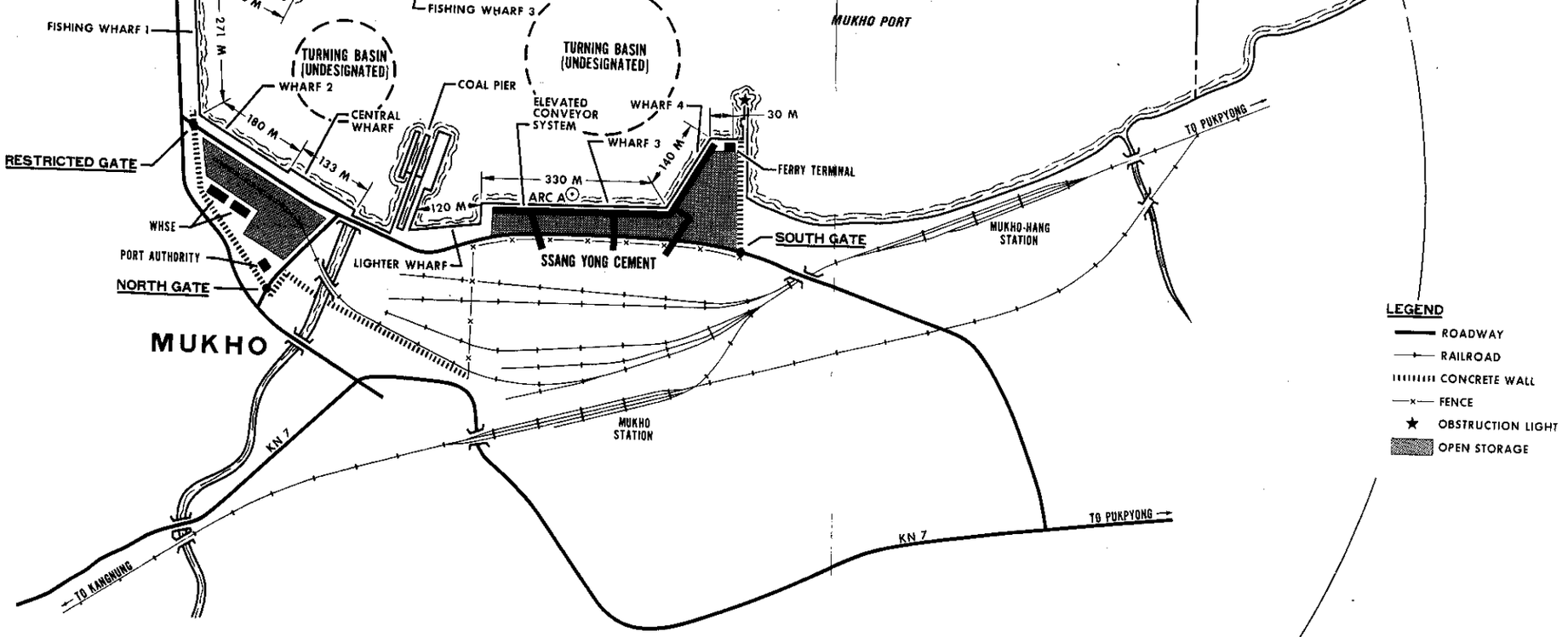
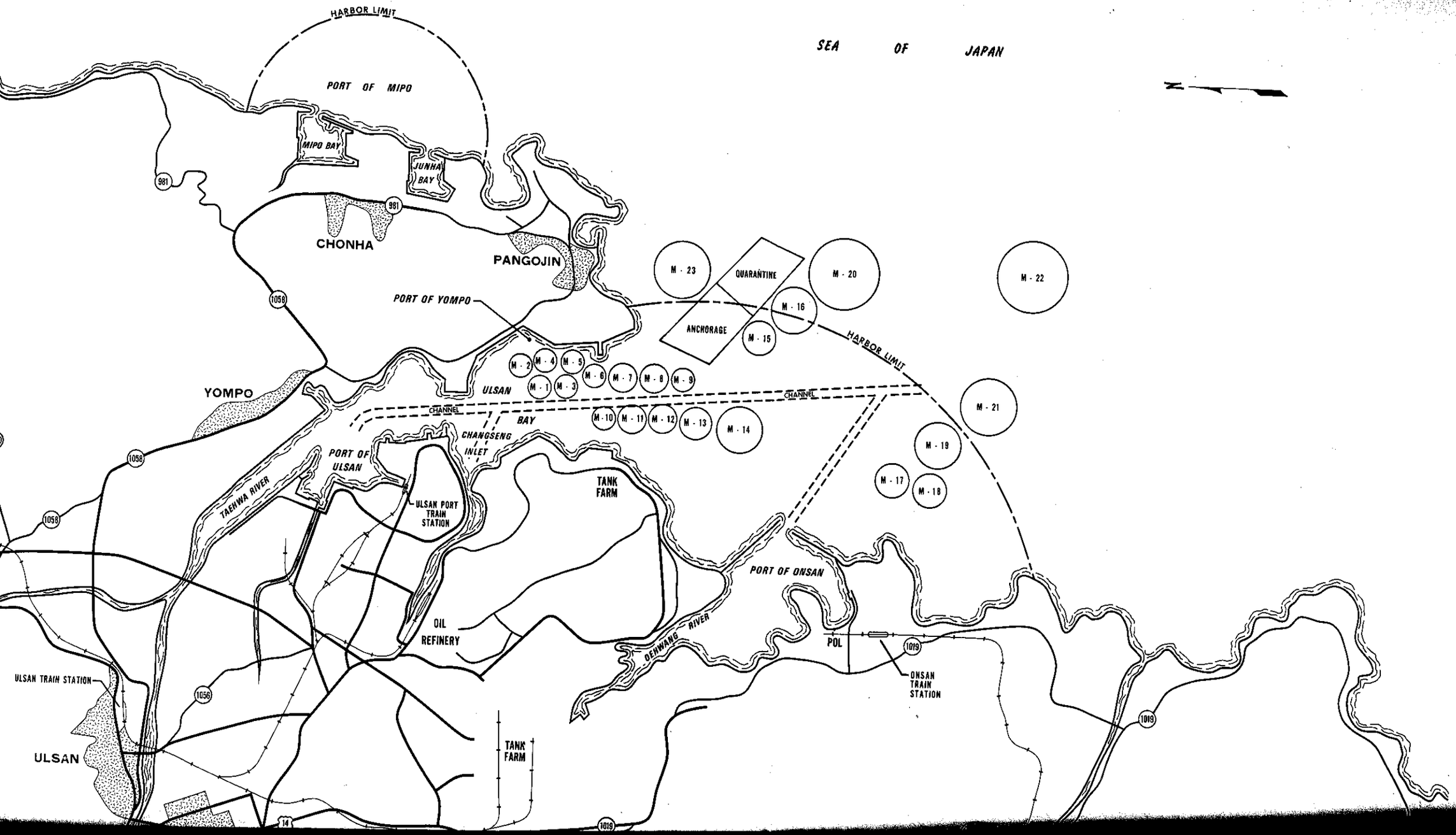


Figure SO-1. Vicinity map.


HARBOR LIMIT
A - 1
A - 2
A - 3
A - 4
A - 5
A - 6
A - 7
QUARANTINE ANCHORAGE
HARBOR LIMIT
ARC A(1500 MI
ROCKY PATCHES
SEA OF JAPAN
N
ROCKY PATCHES
HARBOR LIMIT
FISHING WHARF 2
POL


MUKHO PORT
FISHING WHARF 1
271 M
TURNING BASIN (UNDESIGNATED)
WHARF 2
CENTRAL WHARF
COAL PIER
FISHING WHARF 3
TURNING BASIN (UNDESIGNATED)
ELEVATED CONVEYOR SYSTEM
WHARF 4
30 M
WHARF 3
140 M
180 M
133 M
330 M
120 M
ARC A
RESTRICTED GATE
FERRY TERMINAL
TO PUKPYONG
WHSE
PORT AUTHORITY
NORTH GATE
LIGHTER WHARF
SSANG YONG CEMENT
SOUTH GATE
MUKHO-HANG STATION
MUKHO
MUKHO STATION
KN 7
TO KANGNUNG
KN 7
TO PUKPYONG
LEGEND
ROADWAY
RAILROAD
CONCRETE WALL
FENCE
OBSTRUCTION LIGHT
OPEN STORAGE

MU-2. Site map.


HARBOR LIMIT
SEA OF JAPAN
PORT OF MIPO
MIPO BAY
JUNHA BAY
981
981
CHONHA
PANGOJIN
1058
PORT OF YOMPO
M - 23
QUARANTINE
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M - 22
M - 16
ANCHORAGE
M - 15
HARBOR LIMIT
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M - 4
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M - 9
M - 1
M - 3
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CHANNEL
CHANNEL
BAY
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M - 11
M - 12
M - 13
M - 14
M - 21
M - 19
M - 17
M - 18
YOMPO
1058
CHANGSENG INLET
PORT OF ULSAN
TAEHWA RIVER
ULSAN PORT TRAIN STATION
TANK FARM
1058
PORT OF ONSAN
OIL REFINERY
OEHWANG RIVER
POL
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ONSAN TRAIN STATION
ULSAN TRAIN STATION
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ULSAN
TANK FARM
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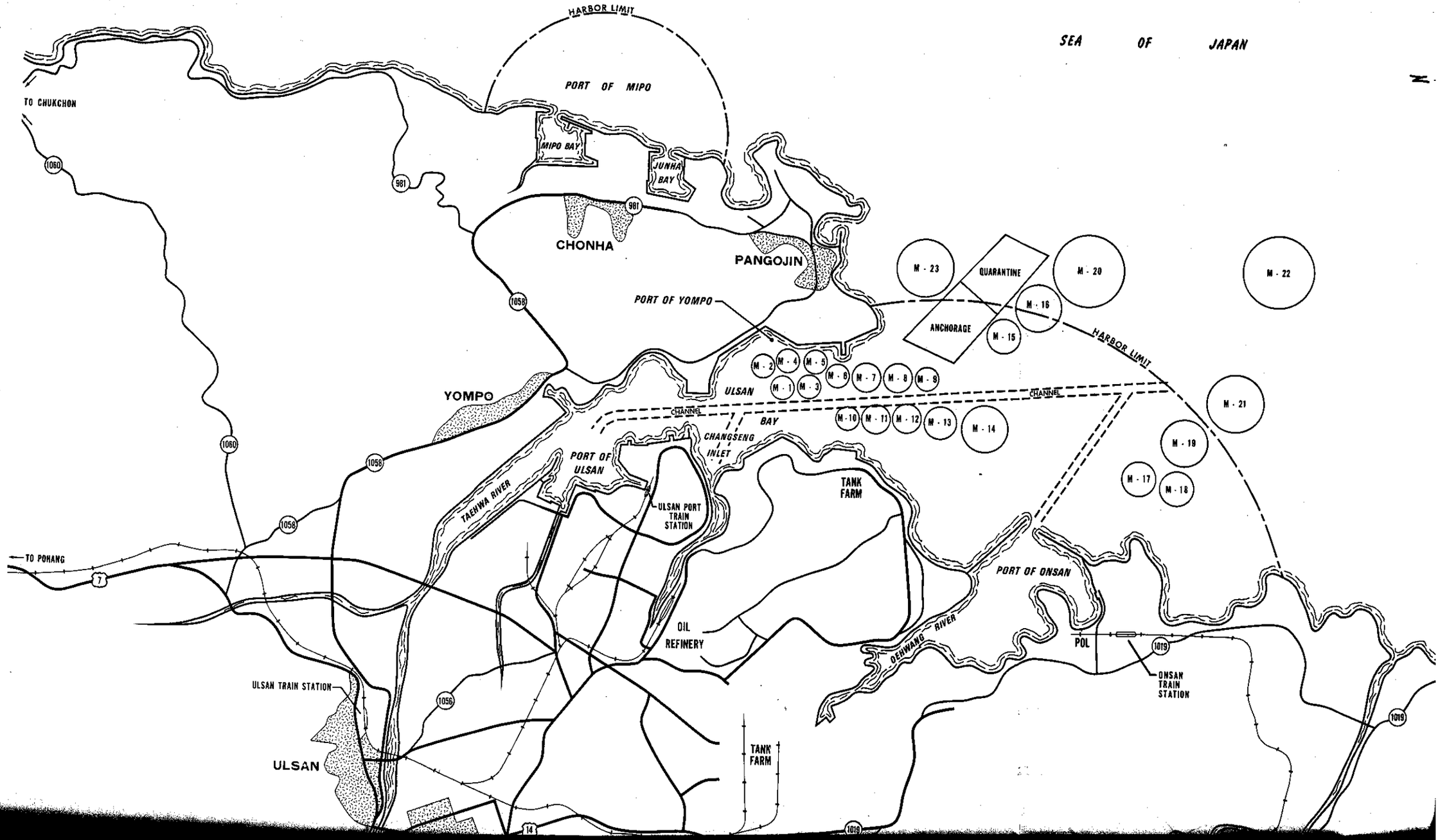
1019


SEA OF JAPAN
HARBOR LIMIT
PORT OF MIPO
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JUNHA BAY
TO CHUKCHON
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981
CHONHA
PANGOJIN
1058
PORT OF YOMPO
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ANCHORAGE
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CHANGSENG INLET
PORT OF ULSAN
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TAEHWA RIVER
ULSAN PORT TRAIN STATION
TANK FARM
TO POHANG
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PORT OF ONSAN
OIL REFINERY
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ULSAN TRAIN STATION
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TANK FARM
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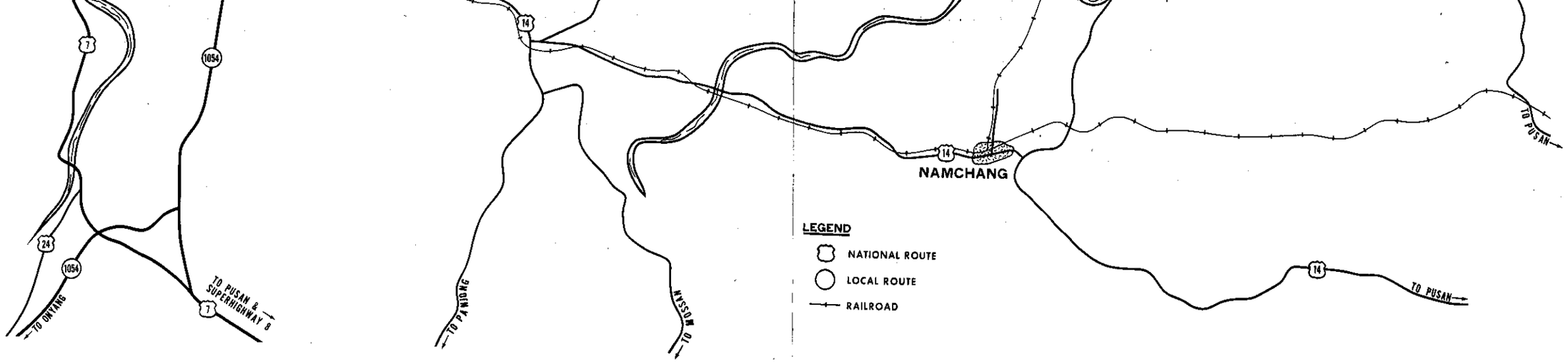
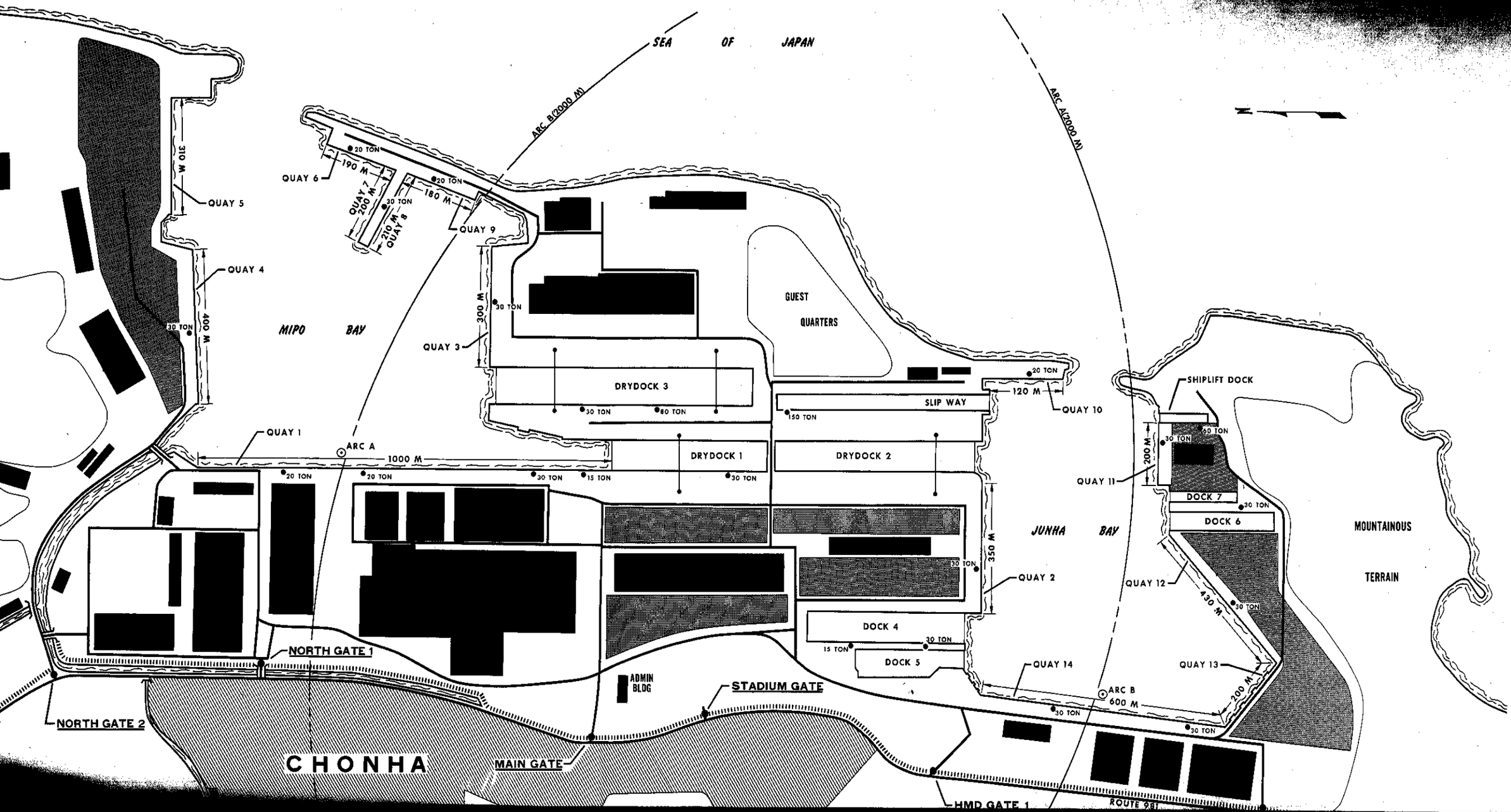
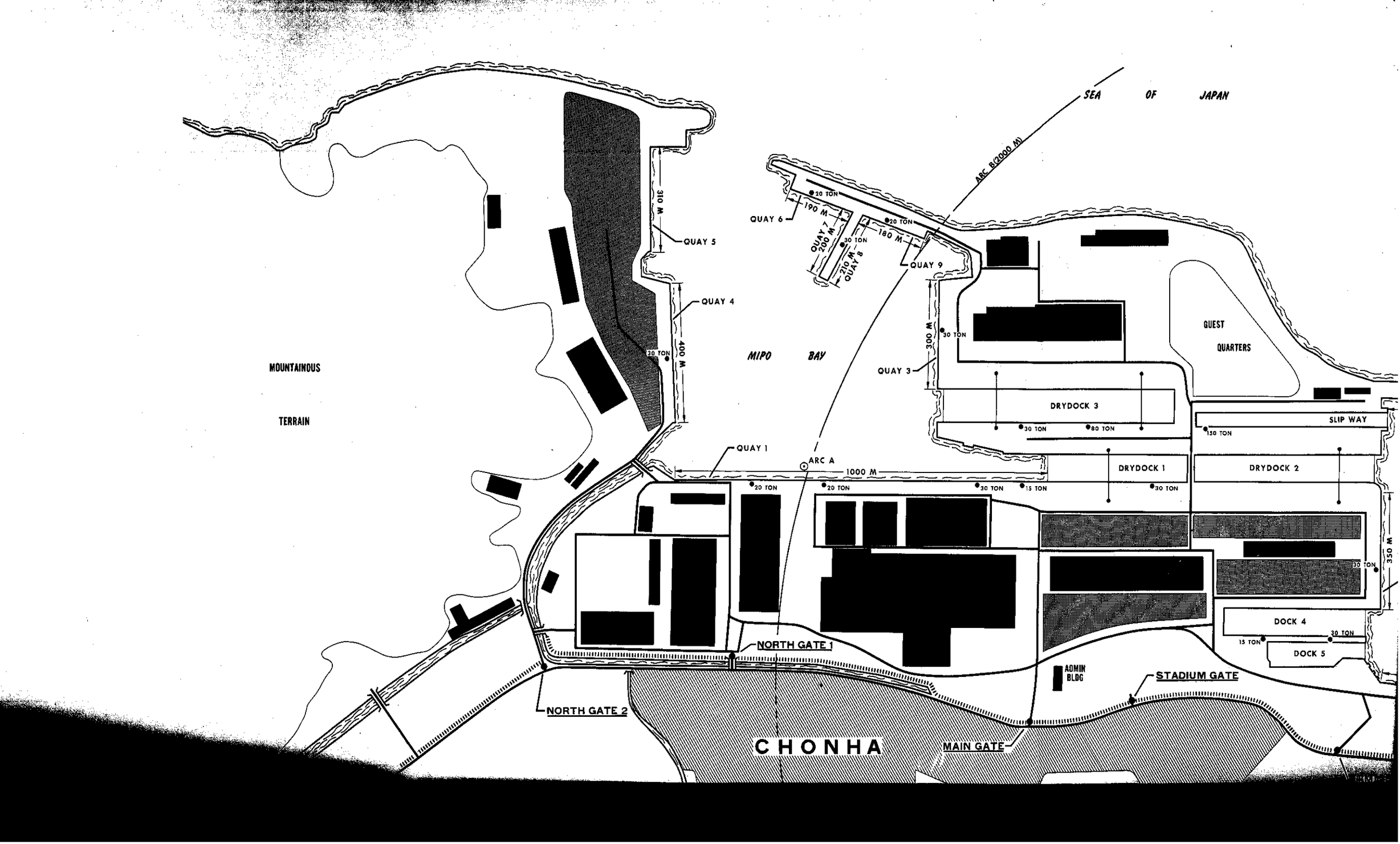


Figure MI-1. Vicinity map.


SEA OF JAPAN
ARC B(2000 M)
ARC A(2000 M)
MIPO BAY
JUNHA BAY
GUEST QUARTERS
QUAY 1
QUAY 2
QUAY 3
QUAY 4
QUAY 5
QUAY 6
QUAY 7
QUAY 8
QUAY 9
QUAY 10
QUAY 11
QUAY 12
QUAY 13
QUAY 14
ARC A
1000 M
ARC B
600 M
310 M
400 M
300 M
190 M
200 M
210 M
180 M
120 M
200 M
350 M
430 M
200 M
20 TON
30 TON
60 TON
80 TON
150 TON
15 TON
DRYDOCK 1
DRYDOCK 2
DRYDOCK 3
DOCK 4
DOCK 5
DOCK 6
DOCK 7
SLIP WAY
SHIPLIFT DOCK
ADMIN BLDG
NORTH GATE 1
NORTH GATE 2
STADIUM GATE
MAIN GATE
HMD GATE 1
CHONHA
ROUTE 981
MOUNTAINOUS TERRAIN


SEA OF JAPAN
ARC B(2000 M)
MOUNTAINOUS
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MIPO BAY
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GUEST QUARTERS
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SLIP WAY
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ADMIN BLDG
NORTH GATE 1
NORTH GATE 2
STADIUM GATE
MAIN GATE
CHONHA

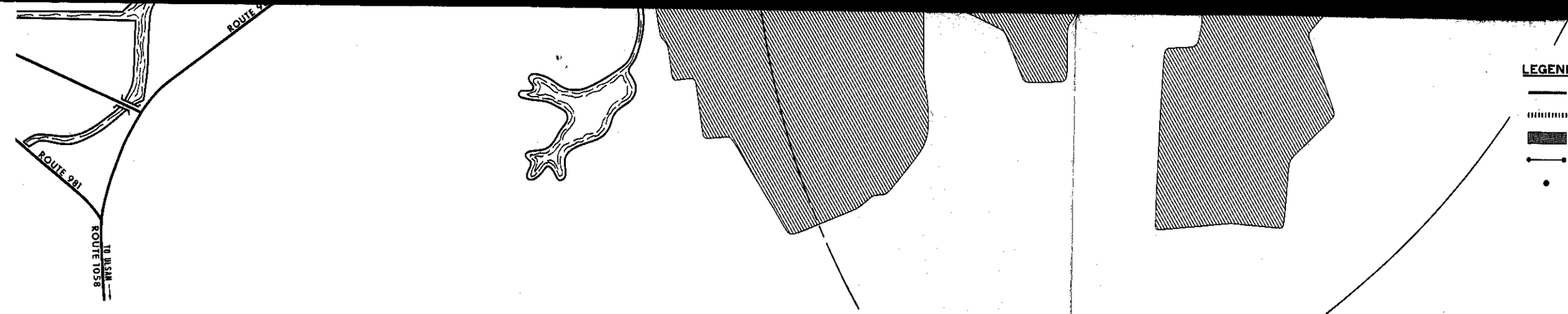


Figure MI-2. Site map.

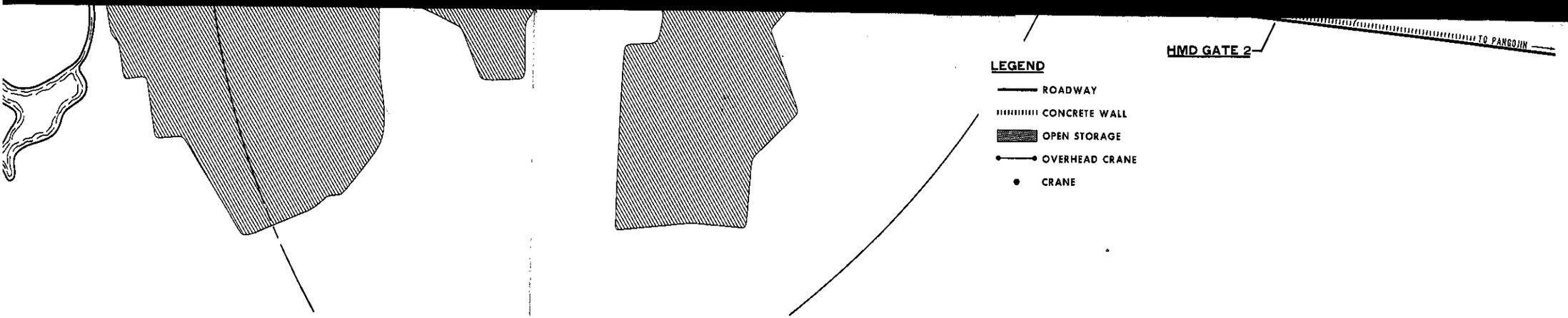
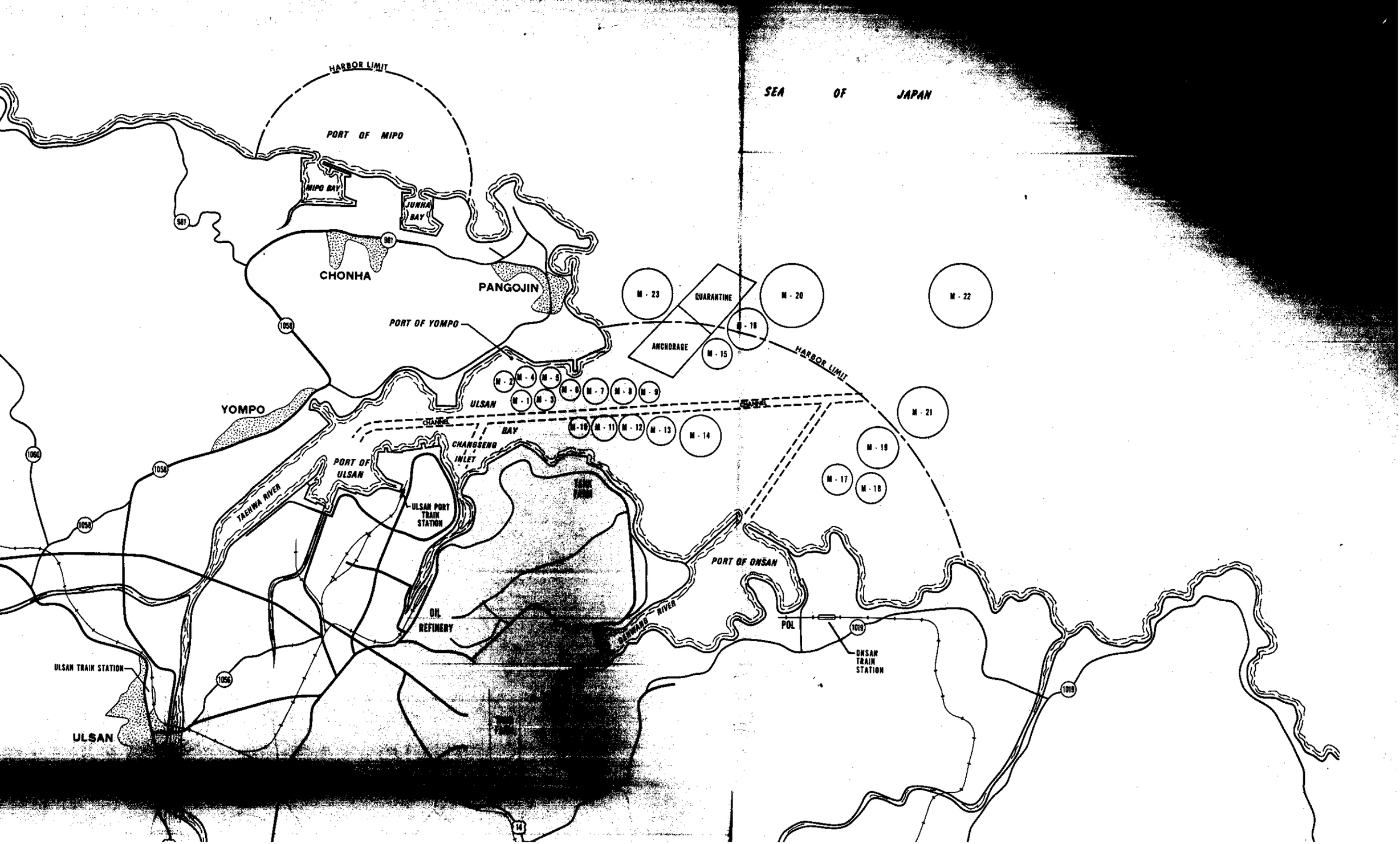


Figure MI-2. Site map.


SEA OF JAPAN
HARBOR LIMIT
PORT OF MIPO
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JUNHA BAY
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PANGOJIN
PORT OF YOMPO
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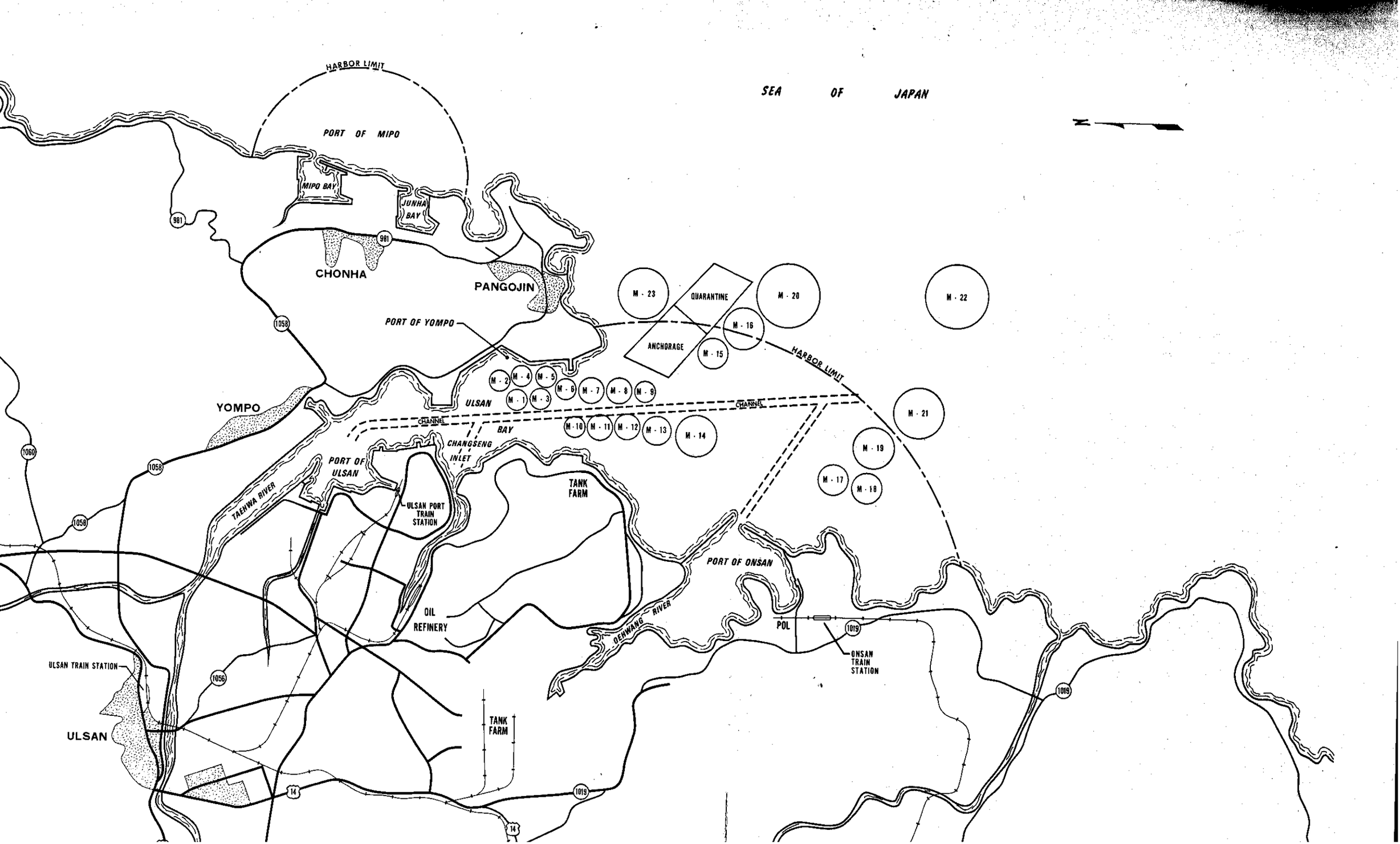
SEA OF JAPAN
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CHANGSENG INLET
PORT OF ULSAN
M-17
M-18
TAEHWA RIVER
ULSAN PORT TRAIN STATION
TANK FARM
PORT OF ONSAN
OIL REFINERY
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ULSAN
TANK FARM
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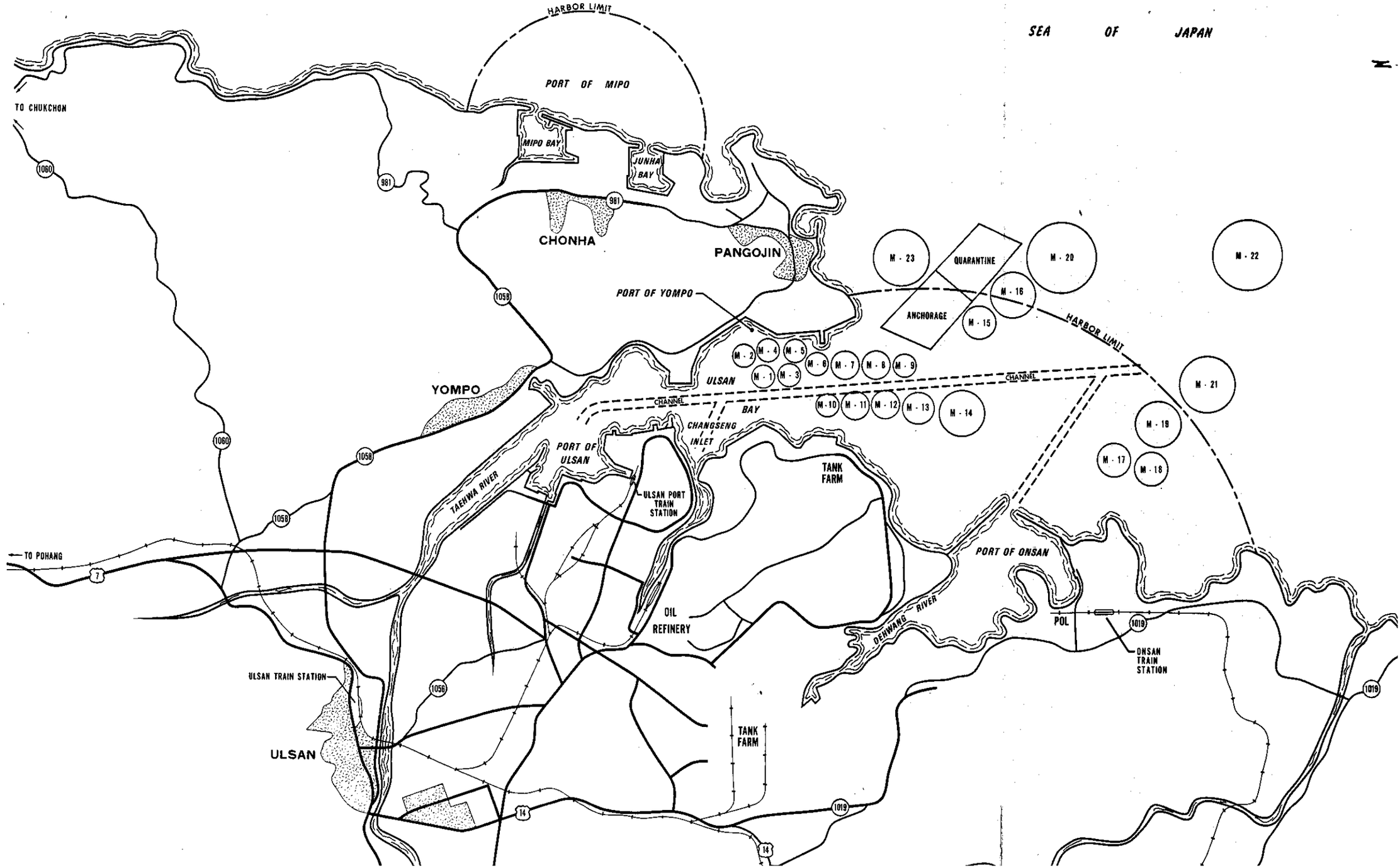
SEA OF JAPAN
HARBOR LIMIT
PORT OF MIPO
MIPO BAY
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TO CHUKCHON
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PANGOJIN
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TAEHWA RIVER
ULSAN PORT TRAIN STATION
TANK FARM
TO POHANG
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PORT OF ONSAN
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DEHWANG RIVER
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ULSAN
TANK FARM
14

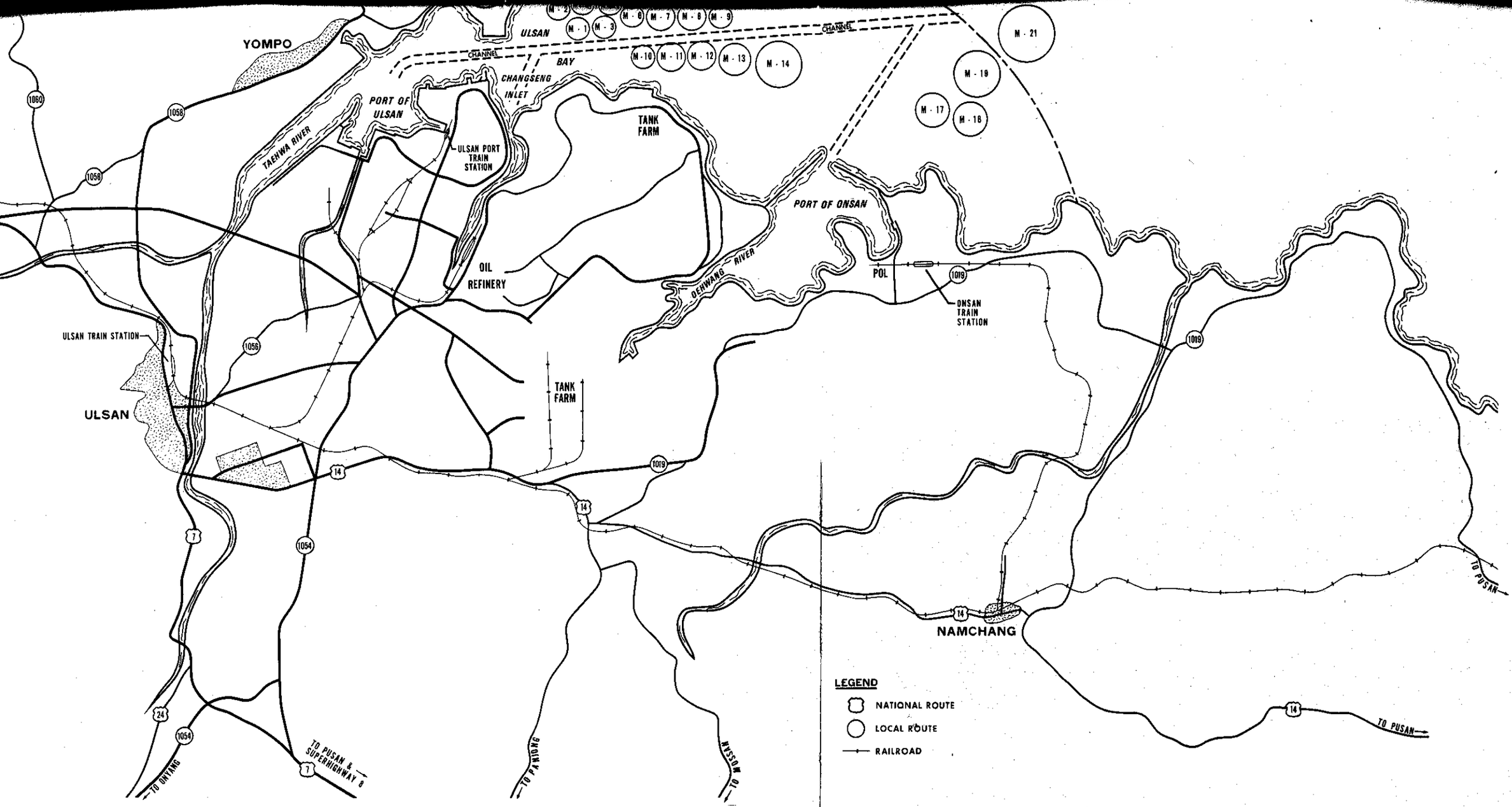
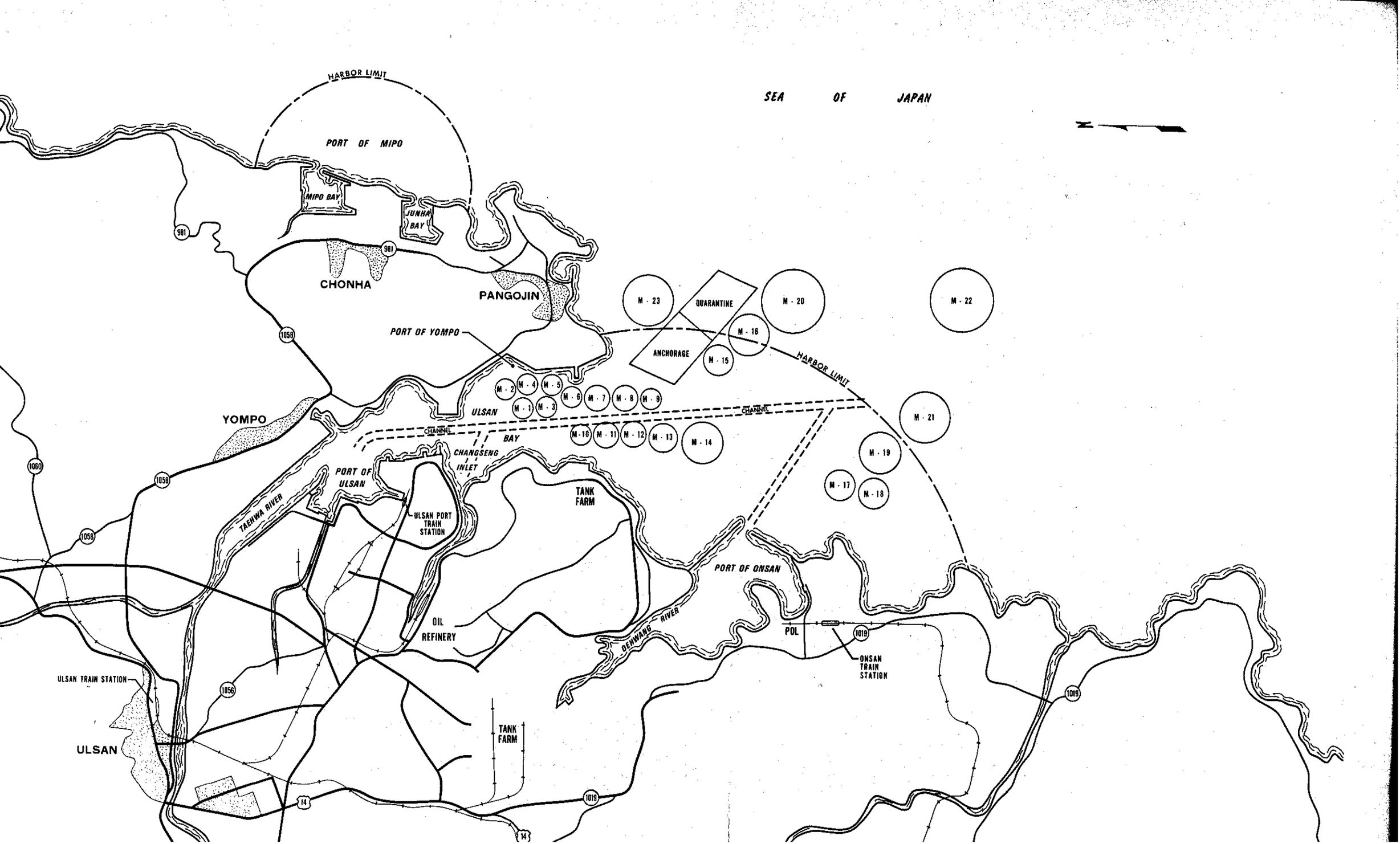


Figure YO-1. Vicinity map.


HARBOR LIMIT
SEA OF JAPAN
PORT OF MIPO
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JUNHA BAY
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CHONHA
PANGOJIN
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PORT OF YOMPO
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CHANNEL
CHANNEL
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CHANGSENG INLET
PORT OF ULSAN
M - 17
M - 18
TAEHWA RIVER
ULSAN PORT TRAIN STATION
TANK FARM
1058
PORT OF ONSAN
OIL REFINERY
DEHWANG RIVER
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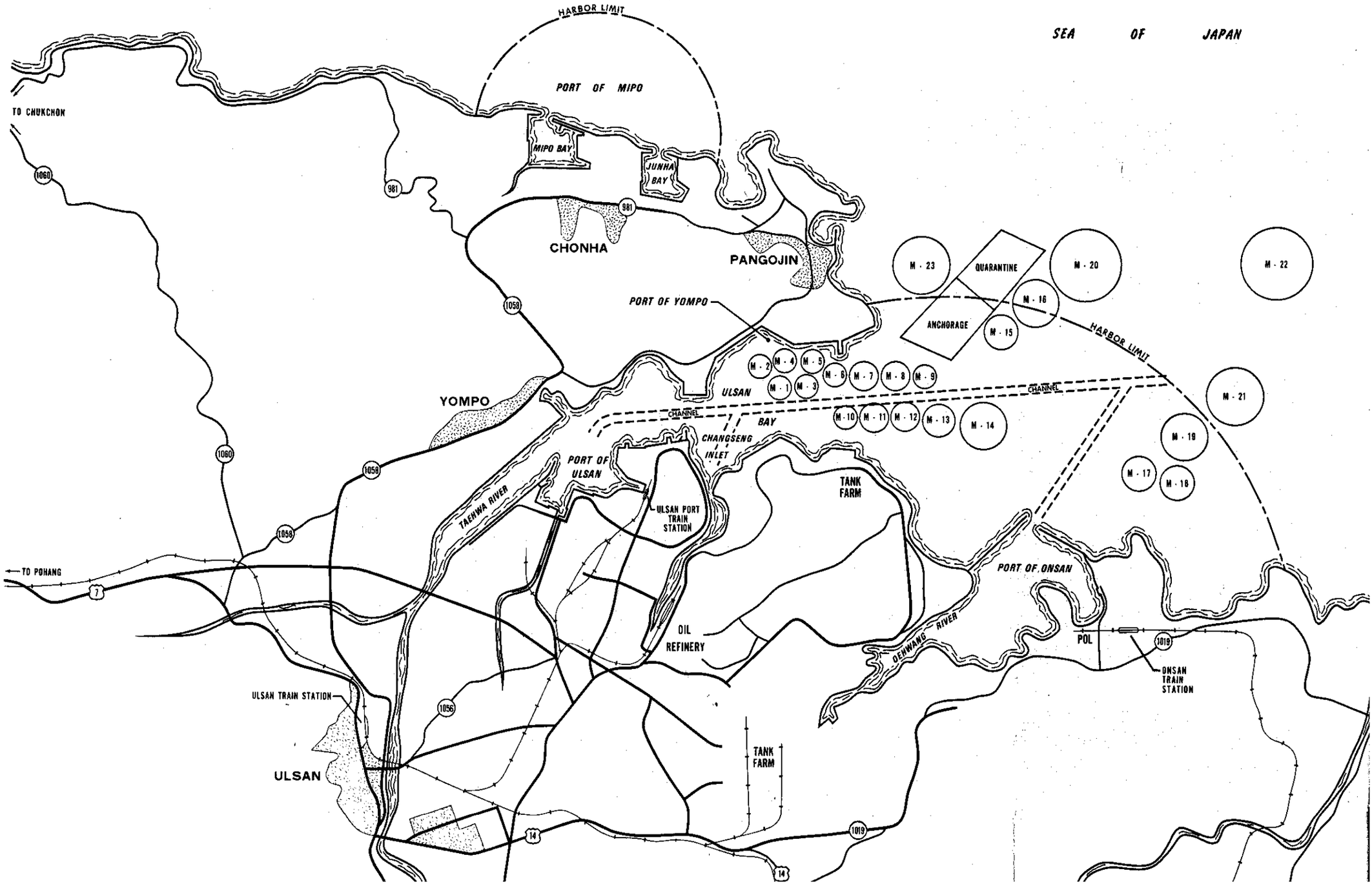
TANK FARM
14
1019
14


SEA OF JAPAN
HARBOR LIMIT
PORT OF MIPO
TO CHUKCHON
MIPO BAY
JUNHA BAY
1060
981
CHONHA
PANGOJIN
1058
PORT OF YOMPO
M - 23
QUARANTINE
M - 20
M - 22
M - 16
ANCHORAGE
M - 15
HARBOR LIMIT
M - 2
M - 4
M - 5
M - 6
M - 7
M - 8
M - 9
M - 1
M - 3
ULSAN BAY
CHANNEL
YOMPO
M - 10
M - 11
M - 12
M - 13
M - 14
M - 21
M - 19
M - 17
M - 18
CHANGSENG INLET
PORT OF ULSAN
TAEHWA RIVER
ULSAN PORT TRAIN STATION
TANK FARM
TO POHANG
7
PORT OF ONSAN
OIL REFINERY
DEHWANG RIVER
POL
1019
ONSAN TRAIN STATION
ULSAN TRAIN STATION
1056
TANK FARM
ULSAN
14

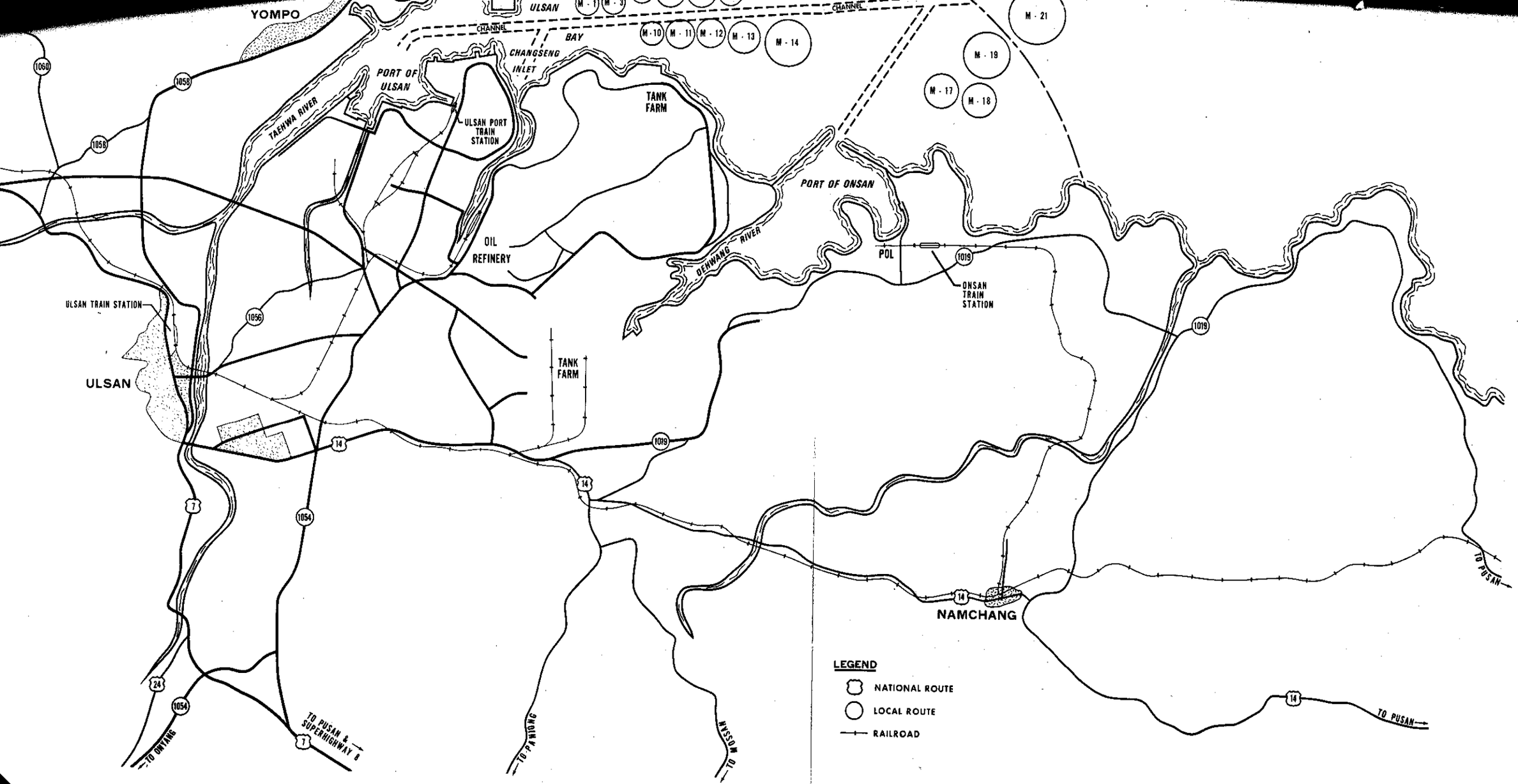
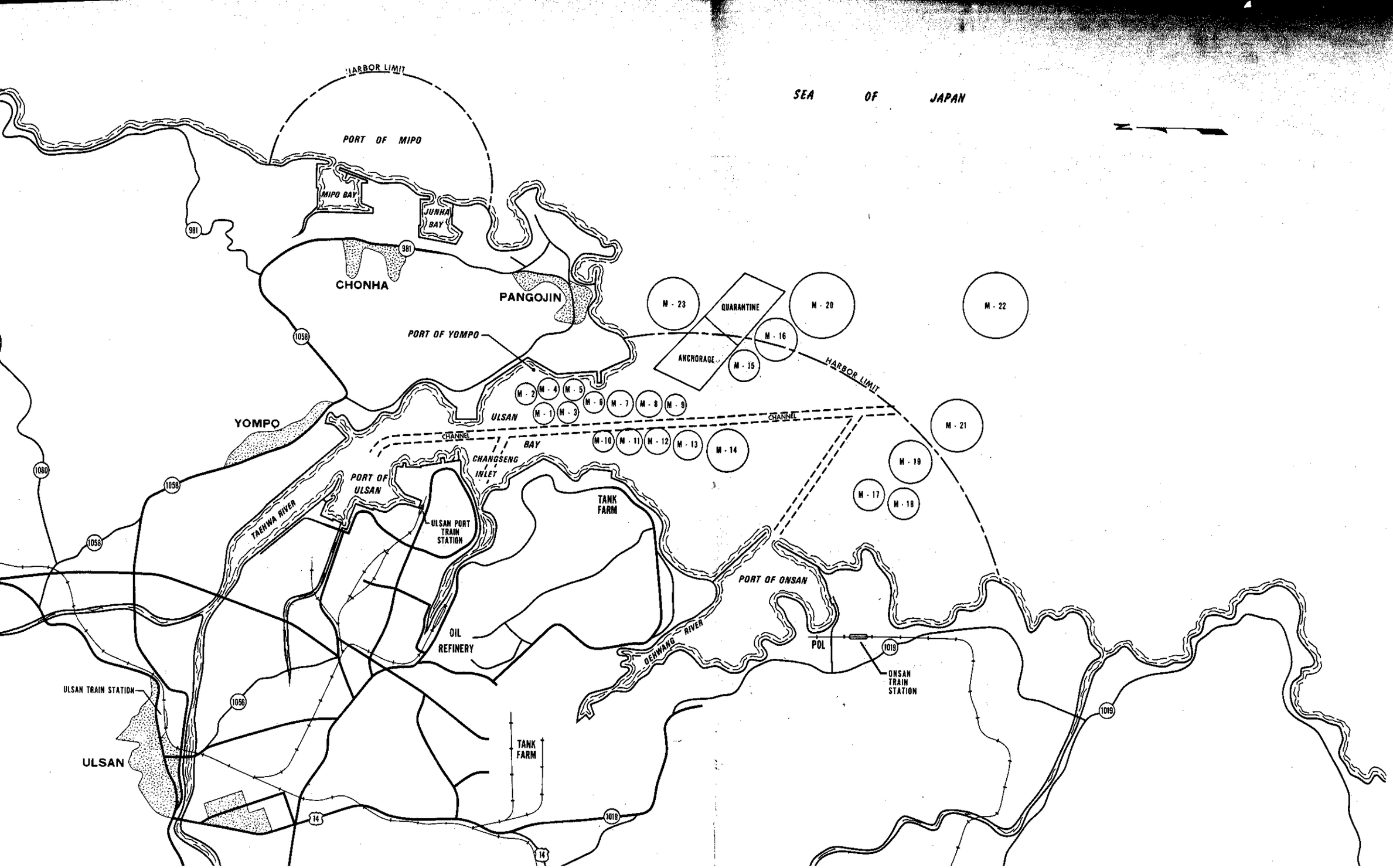
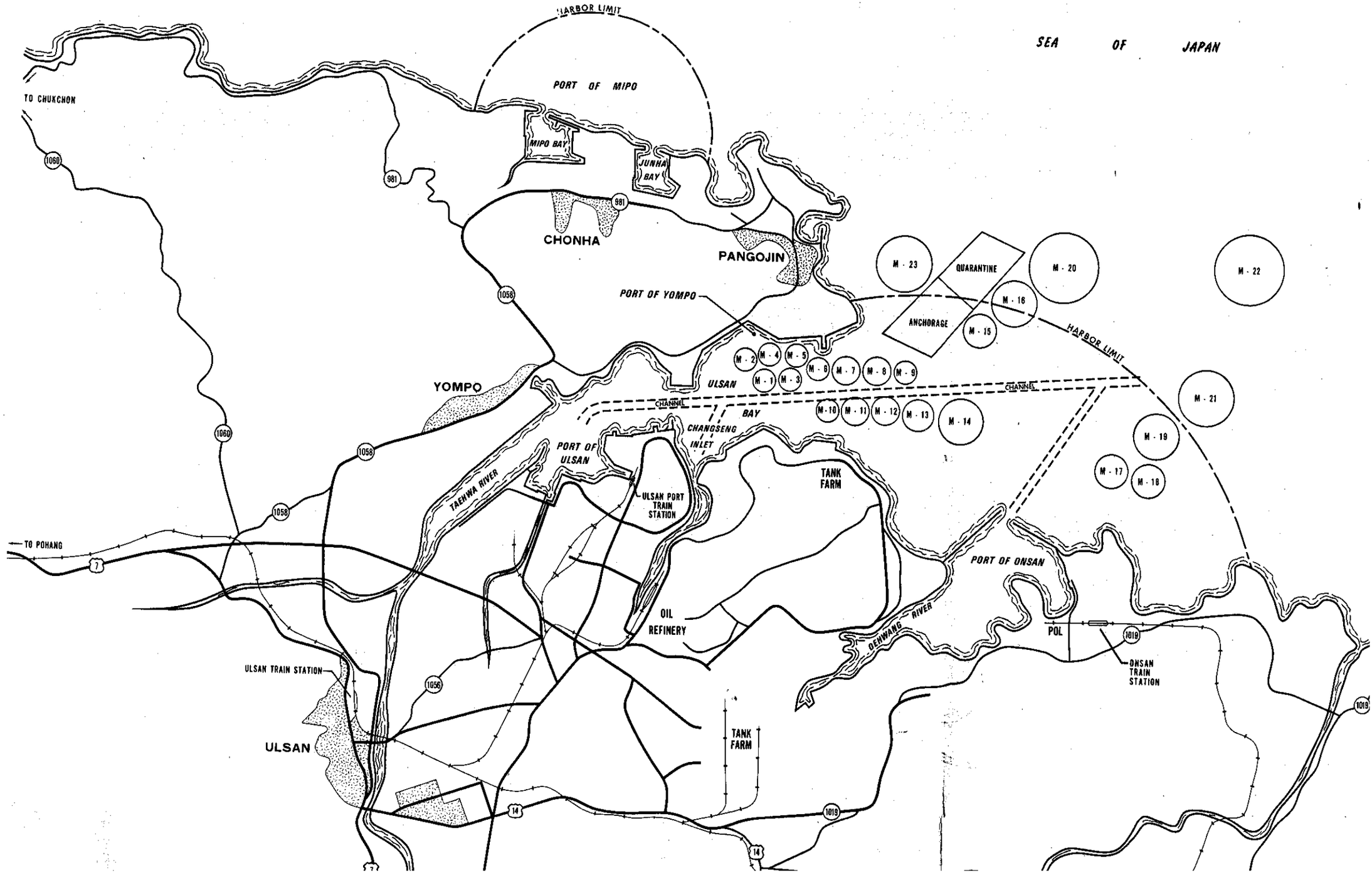


Figure UL-1. Vicinity map.


SEA OF JAPAN
HARBOR LIMIT
PORT OF MIPO
MIPO BAY
JUNHA BAY
981
CHONHA
PANGOJIN
1058
PORT OF YOMPO
M - 23
QUARANTINE
M - 20
M - 22
M - 16
ANCHORAGE
M - 15
HARBOR LIMIT
M - 2
M - 4
M - 5
M - 6
M - 7
M - 8
M - 9
M - 1
M - 3
ULSAN
CHANNEL
BAY
M - 10
M - 11
M - 12
M - 13
M - 14
M - 21
M - 19
M - 17
M - 18
YOMPO
1060
CHANGSENG INLET
PORT OF ULSAN
TAEHWA RIVER
ULSAN PORT TRAIN STATION
TANK FARM
PORT OF ONSAN
OIL REFINERY
DEHWANG RIVER
POL
1018
ONSAN TRAIN STATION
ULSAN TRAIN STATION
1056
ULSAN
TANK FARM
14
1019


SEA OF JAPAN
HARBOR LIMIT
PORT OF MIPO
MIPO BAY
JUNHA BAY
TO CHUKCHON
1080
981
CHONHA
PANGOJIN
1058
PORT OF YOMPO
M - 23
QUARANTINE
M - 20
M - 22
M - 16
ANCHORAGE
M - 15
HARBOR LIMIT
M - 2
M - 4
M - 5
M - 6
M - 7
M - 8
M - 9
M - 1
M - 3
ULSAN BAY
CHANNEL
M - 10
M - 11
M - 12
M - 13
M - 14
M - 21
M - 19
M - 17
M - 18
YOMPO
1060
CHANGSENG INLET
PORT OF ULSAN
TAEHWA RIVER
ULSAN PORT TRAIN STATION
TANK FARM
TO POHANG
7
PORT OF ONSAN
OIL REFINERY
DEHWANG RIVER
POL
1019
ONSAN TRAIN STATION
ULSAN TRAIN STATION
1056
ULSAN
TANK FARM
14

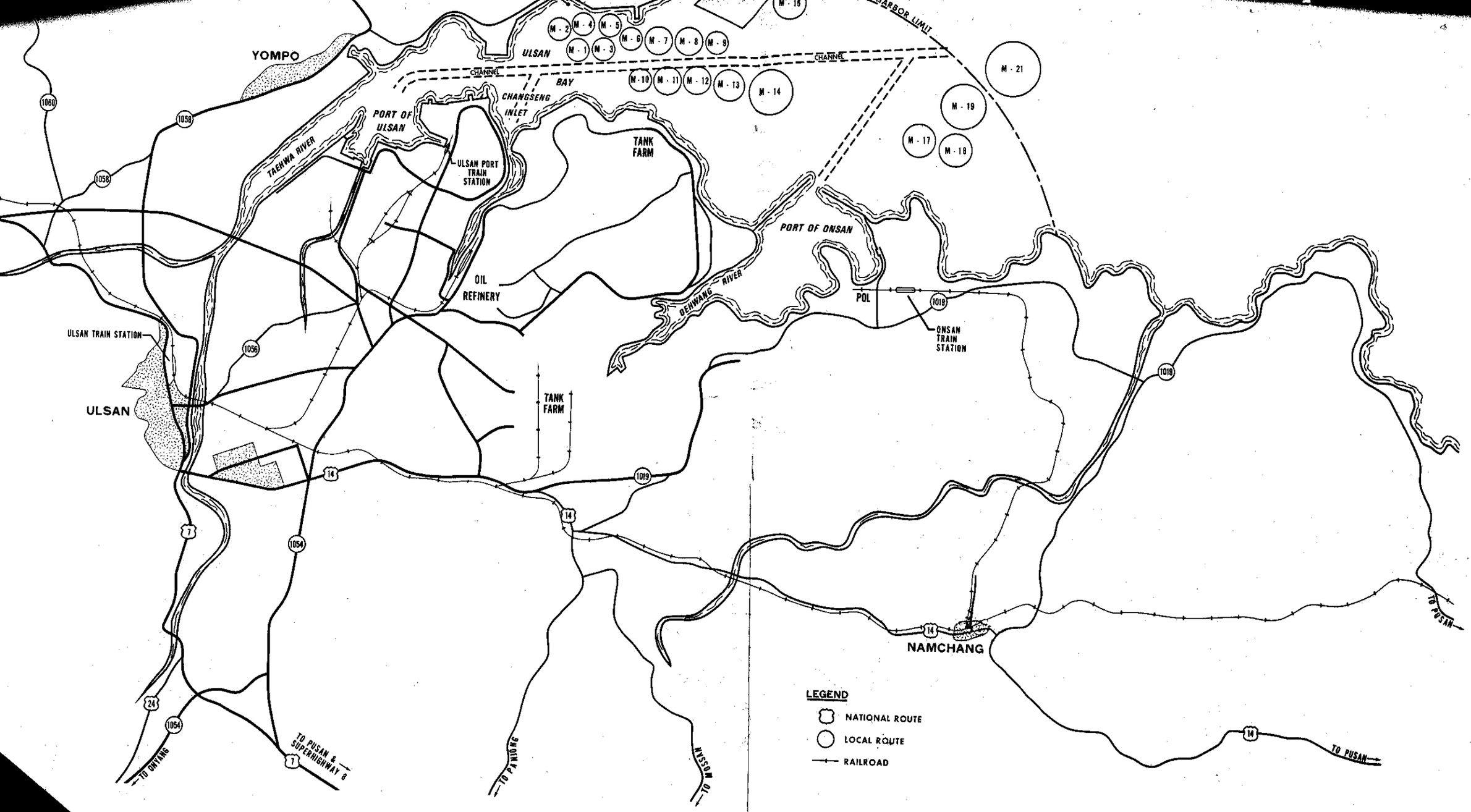
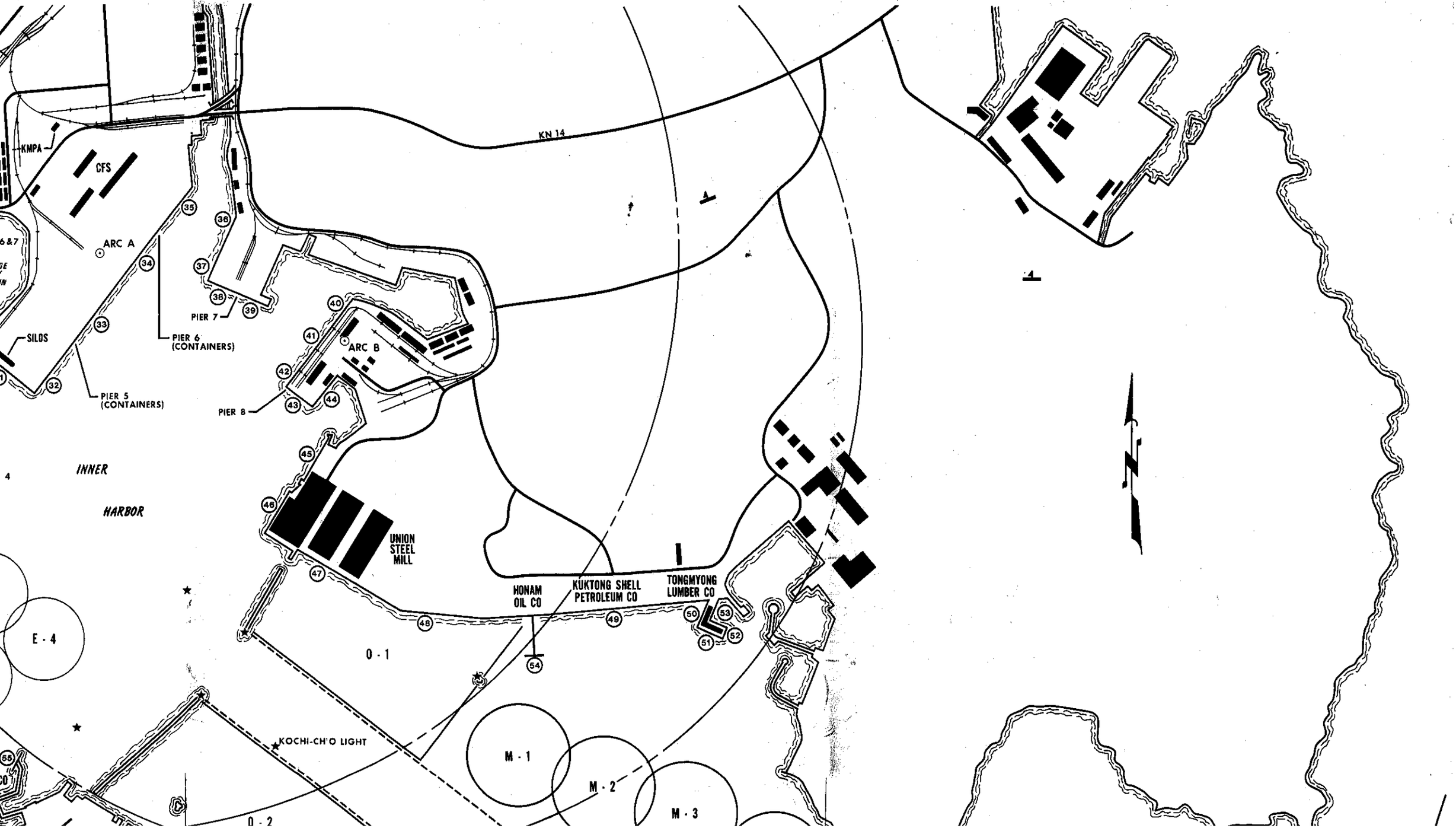
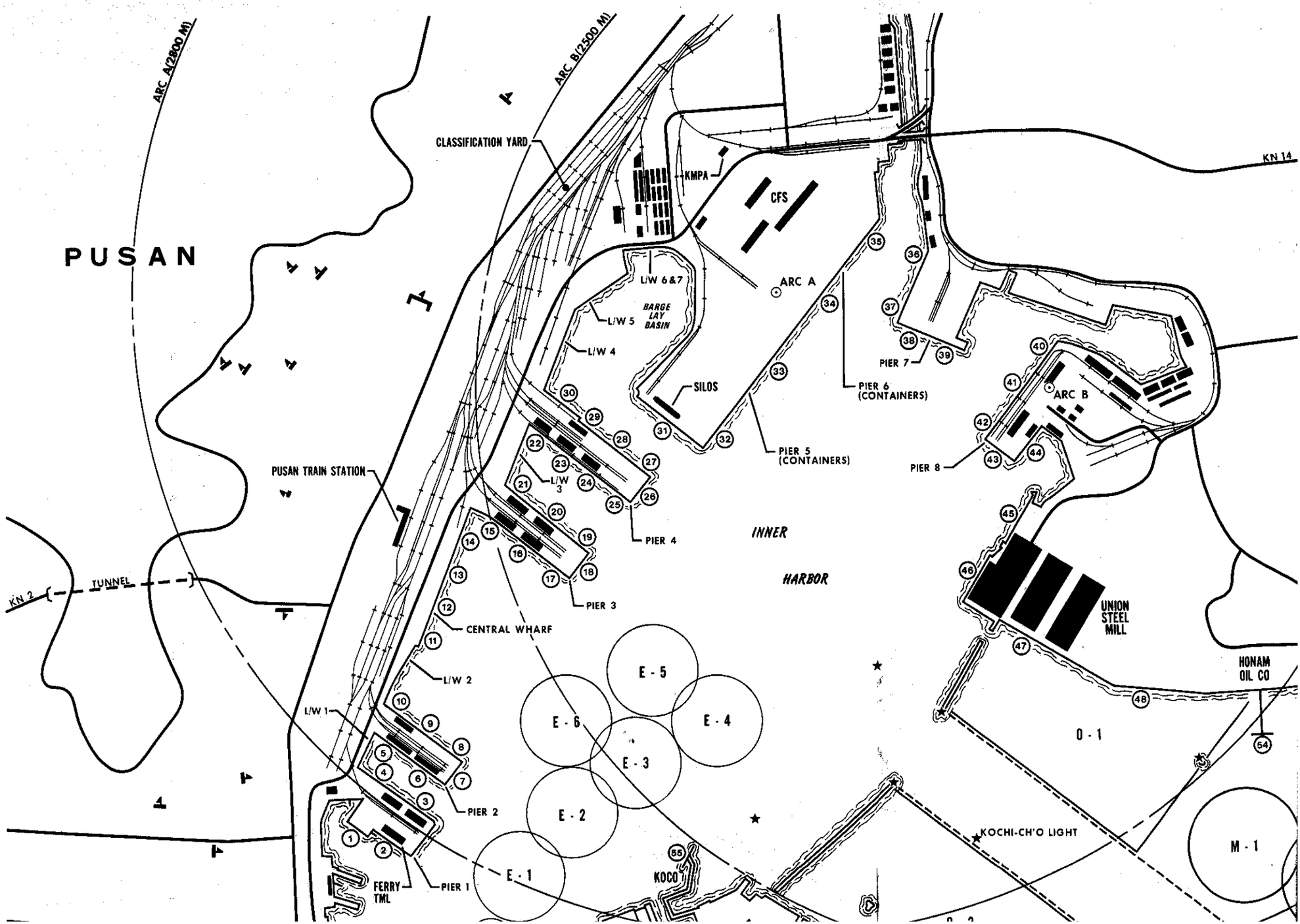


Figure ON-1. Vicinity map.


KMPA
CFS
KN 14
ARC A
ARC B
PIER 7
PIER 6
(CONTAINERS)
PIER 5
(CONTAINERS)
PIER 8
SILOS
INNER
HARBOR
UNION
STEEL
MILL
HONAM
OIL CO
KUKTONG SHELL
PETROLEUM CO
TONGMYONG
LUMBER CO
E - 4
O - 1
O - 2
M - 1
M - 2
M - 3
KOCHI-CH'O LIGHT
35
36
34
37
38
39
40
33
41
42
43
44
32
45
46
47
48
49
50
51
52
53
54
55


PUSAN
ARC A(2800 M)
ARC B(2500 M)
CLASSIFICATION YARD
KMPA
CFS
KN 14
ARC A
L/W 6&7
BARGE LAY BASIN
L/W 5
L/W 4
SILOS
PIER 7
PIER 6 (CONTAINERS)
ARC B
PIER 5 (CONTAINERS)
PIER 8
PUSAN TRAIN STATION
L/W 3
PIER 4
INNER
HARBOR
KN 2
TUNNEL
PIER 3
CENTRAL WHARF
UNION STEEL MILL
HONAM OIL CO
L/W 2
L/W 1
E - 5
E - 6
E - 4
E - 3
E - 2
E - 1
O - 1
PIER 2
KOCHI-CH'O LIGHT
M - 1
FERRY TML
PIER 1
KOCO

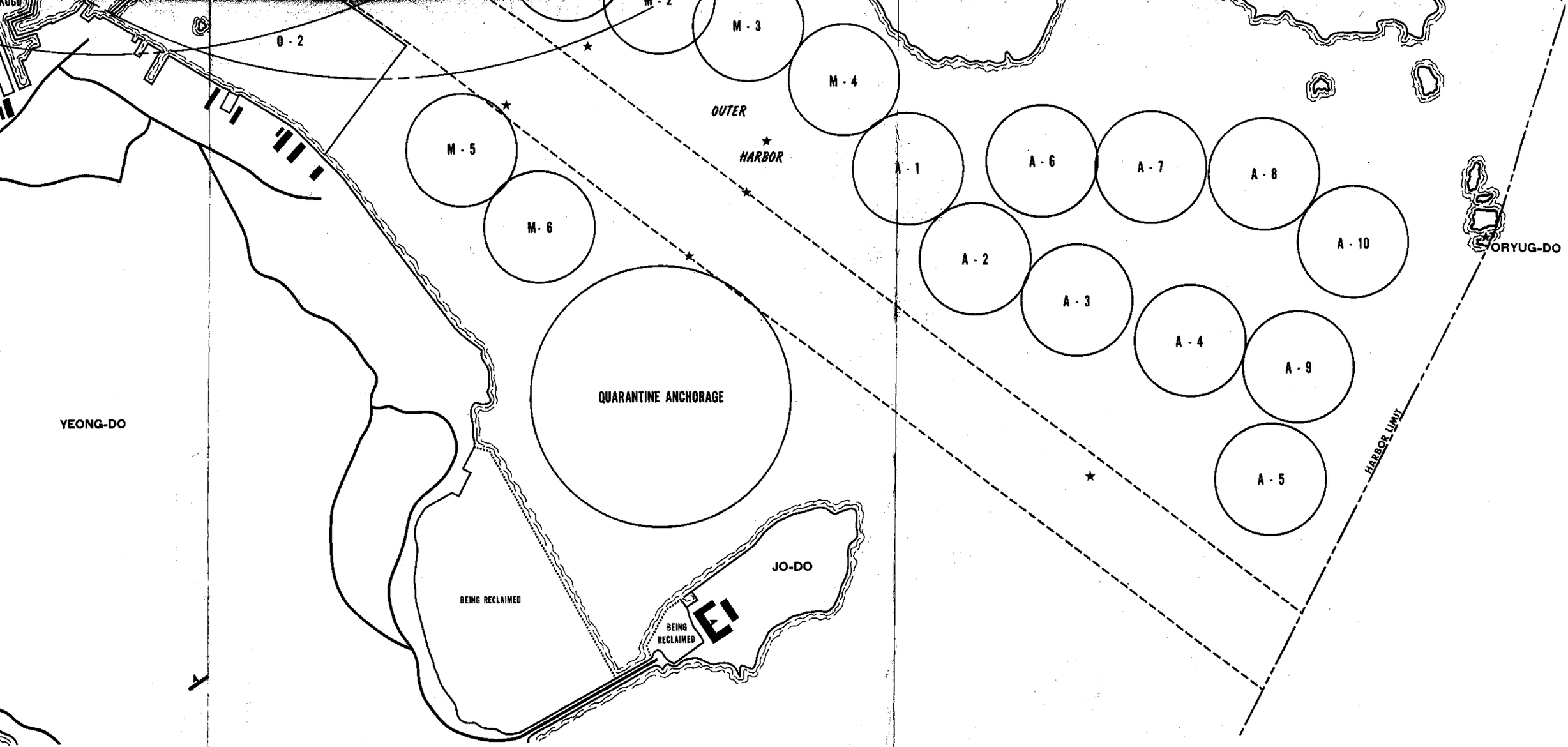


Figure P-2. Site map.

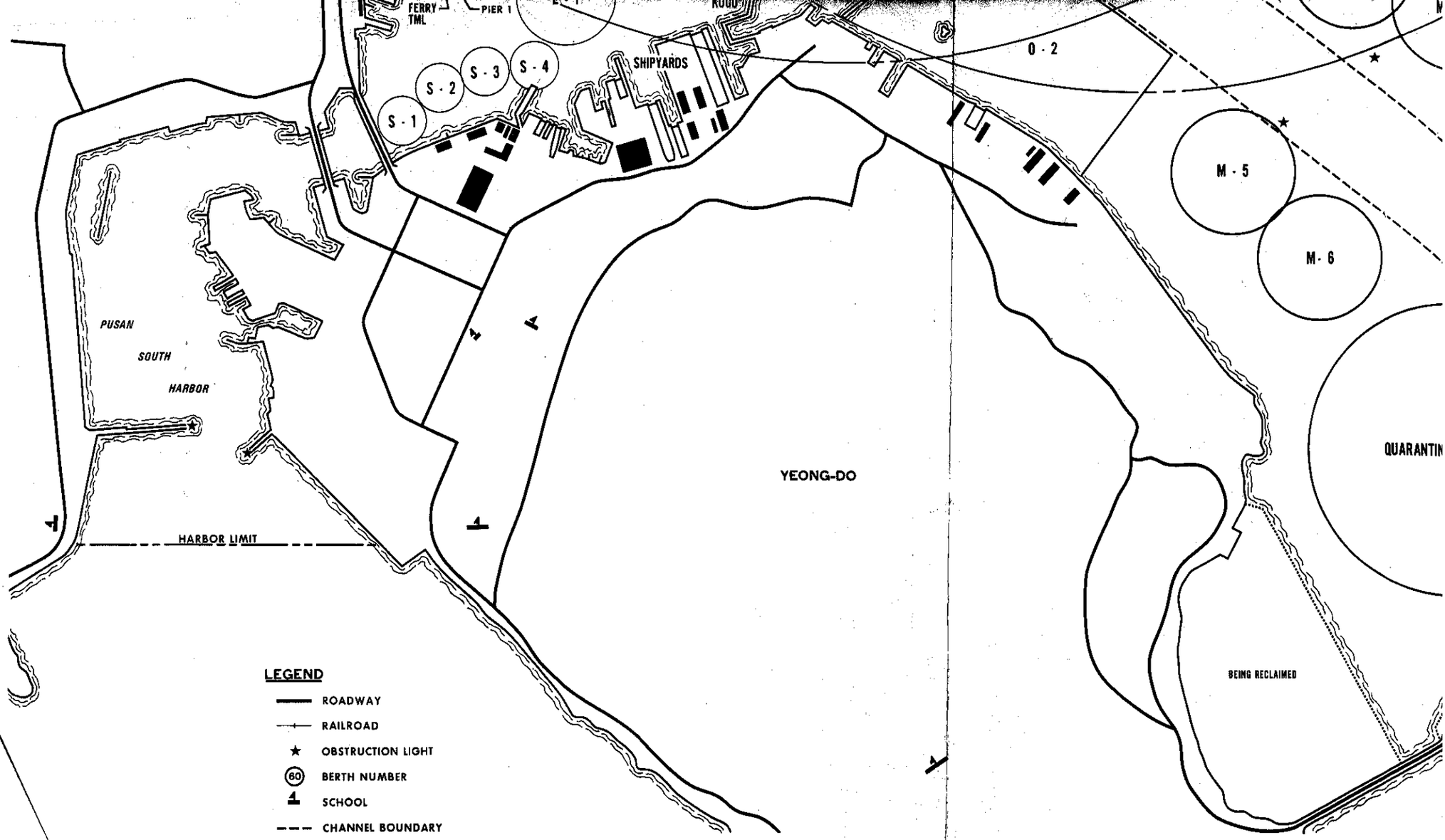
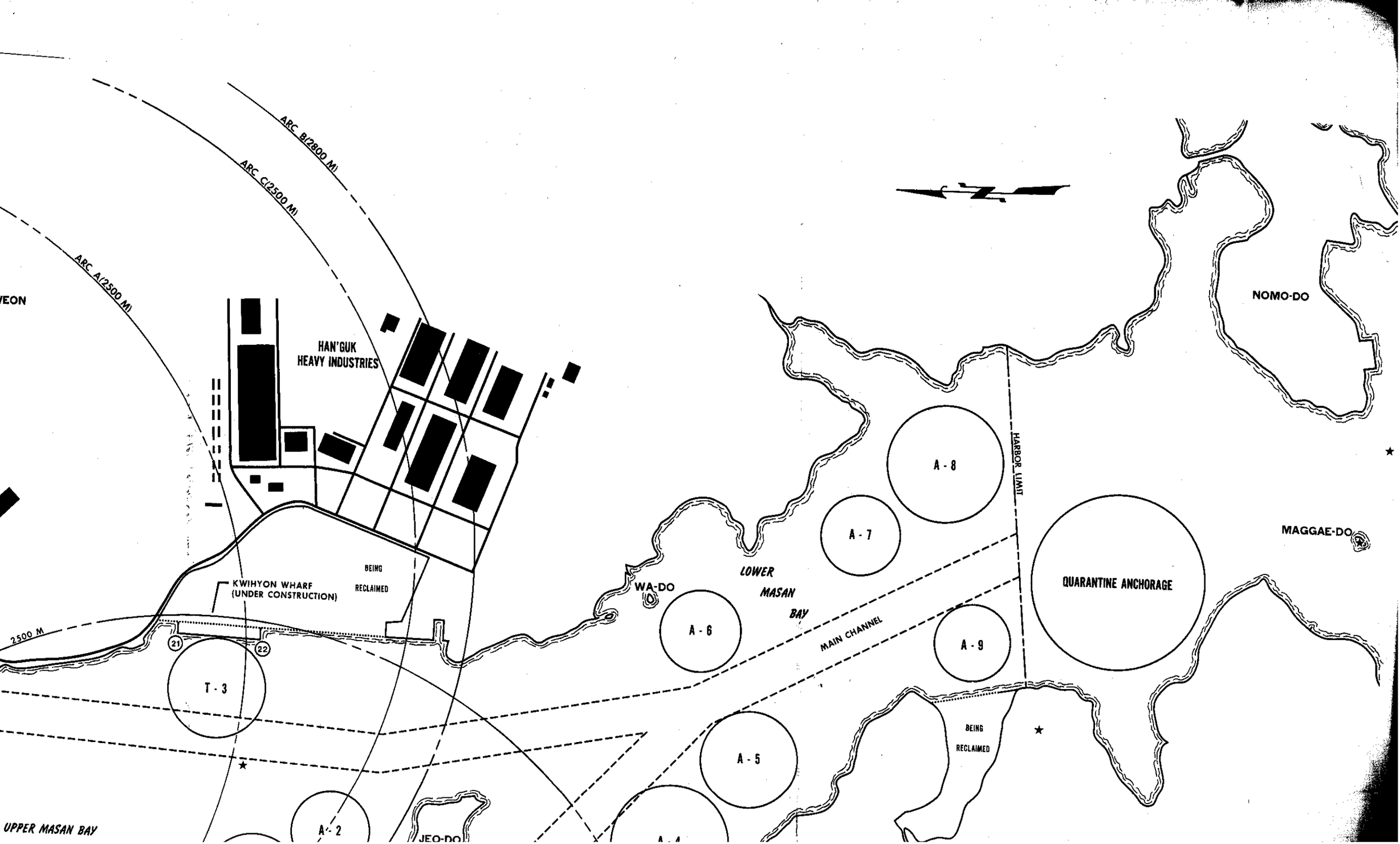
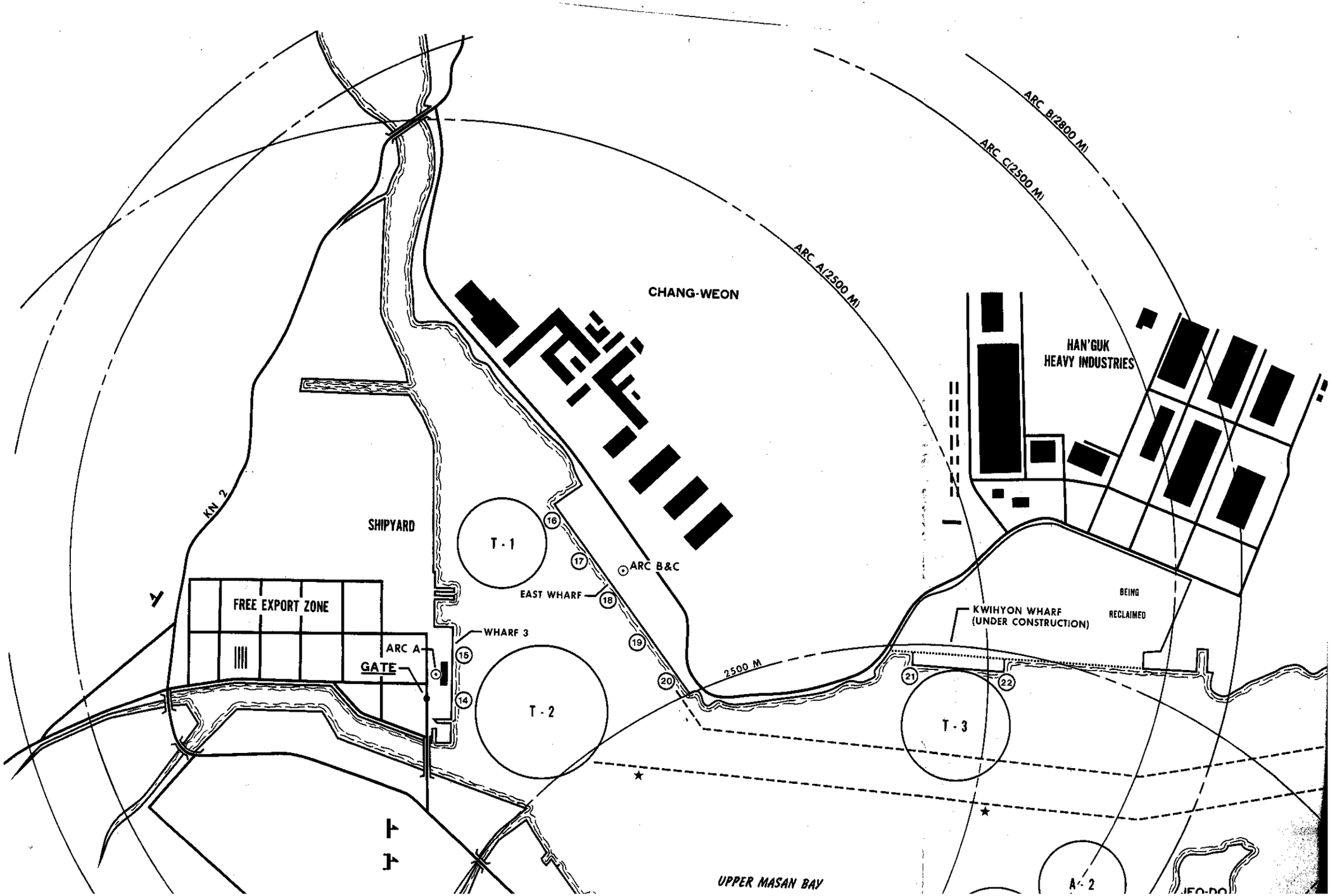


Figure P-2. Site map.


ARC B(2800 M)
ARC C(2500 M)
ARC A(2500 M)
VEON
HAN'GUK
HEAVY INDUSTRIES
BEING
RECLAIMED
KWIHYON WHARF
(UNDER CONSTRUCTION)
2500 M
21
22
T - 3
WA-DO
LOWER
MASAN
BAY
A - 6
A - 7
A - 8
A - 9
A - 5
A - 2
A - 4
MAIN CHANNEL
HARBOR LIMIT
NOMO-DO
MAGGAE-DO
QUARANTINE ANCHORAGE
BEING
RECLAIMED
UPPER MASAN BAY
JEO-DO


ARC B(2800 M)
ARC C(2500 M)
ARC A(2500 M)
CHANG-WEON
HAN'GUK
HEAVY INDUSTRIES
KN 2
SHIPYARD
T-1
16
17
ARC B&C
EAST WHARF
18
19
20
FREE EXPORT ZONE
WHARF 3
ARC A
GATE
15
14
T-2
2500 M
KWIHYON WHARF
(UNDER CONSTRUCTION)
BEING
RECLAIMED
21
22
T-3
UPPER MASAN BAY
A-2

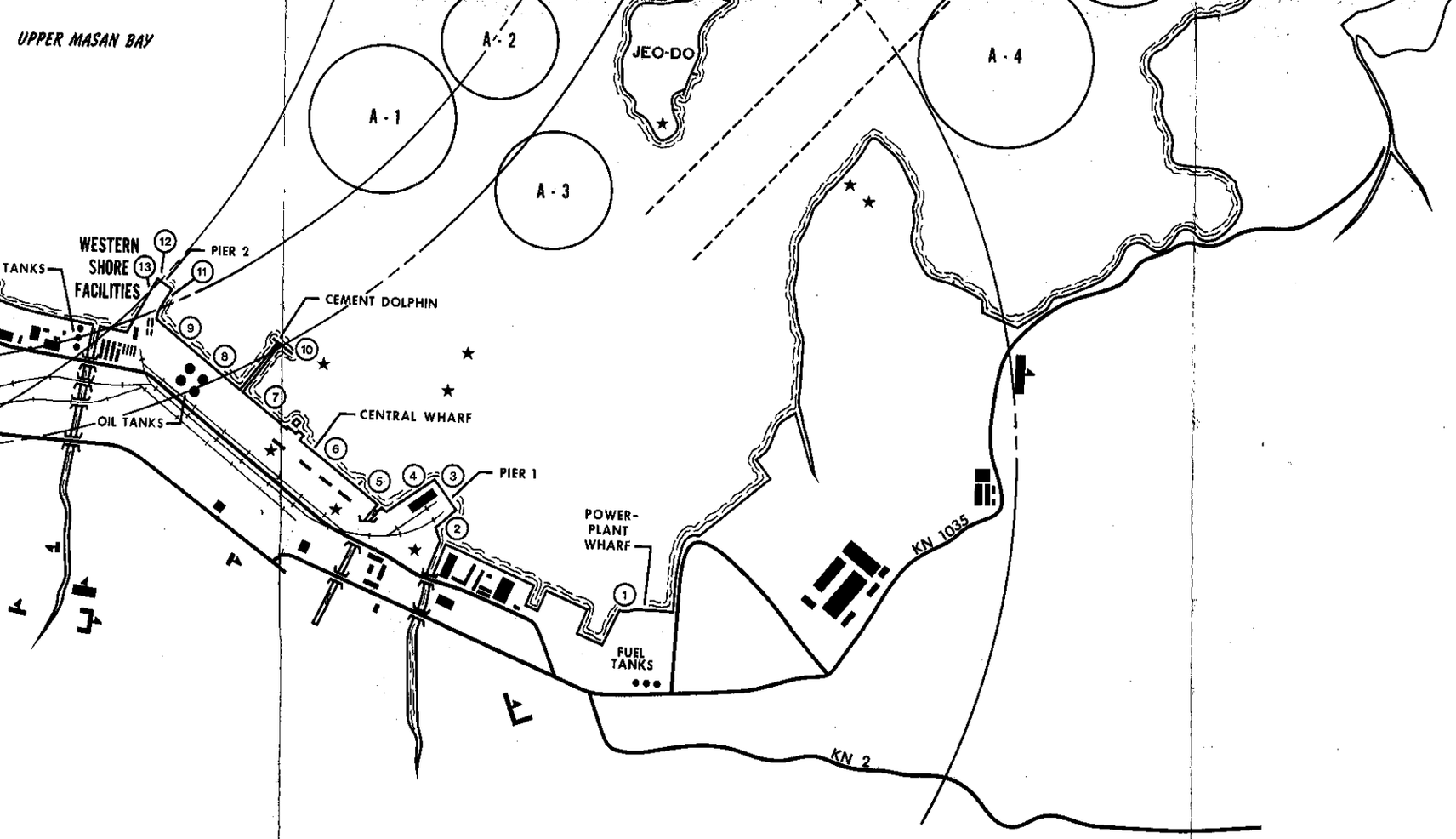


Figure MA-2. Site map.

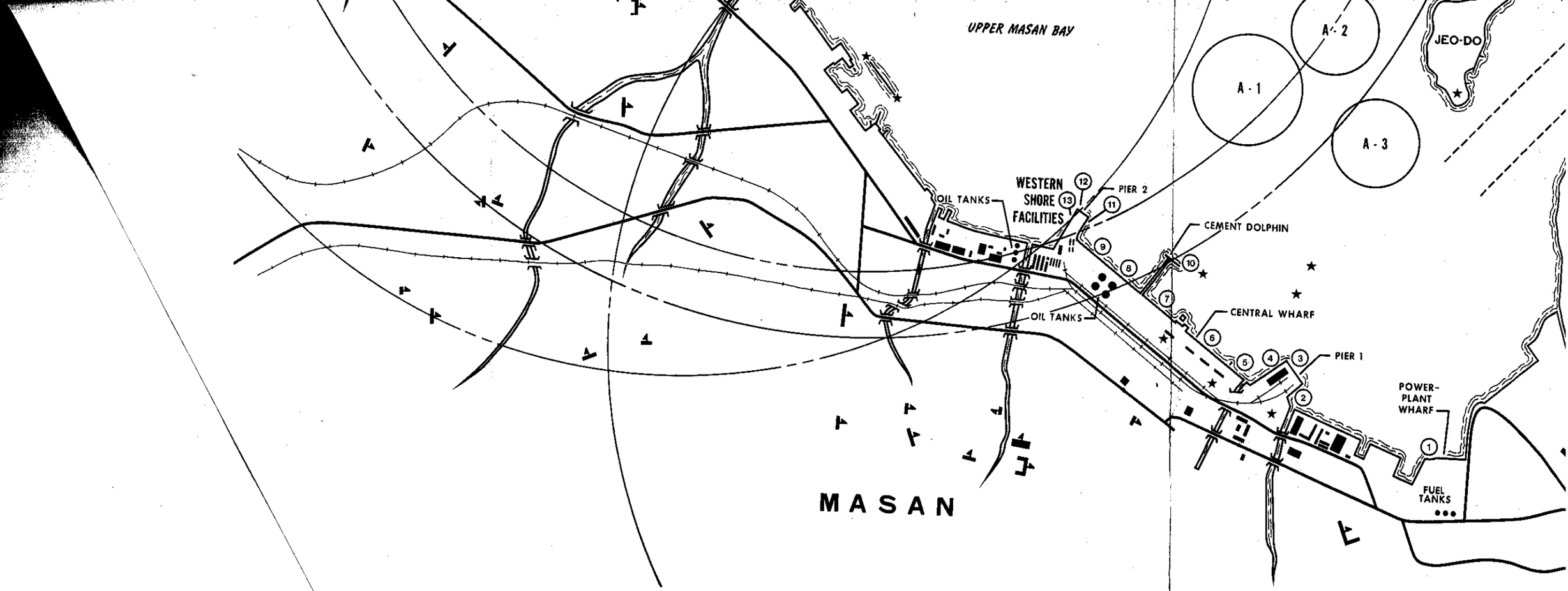
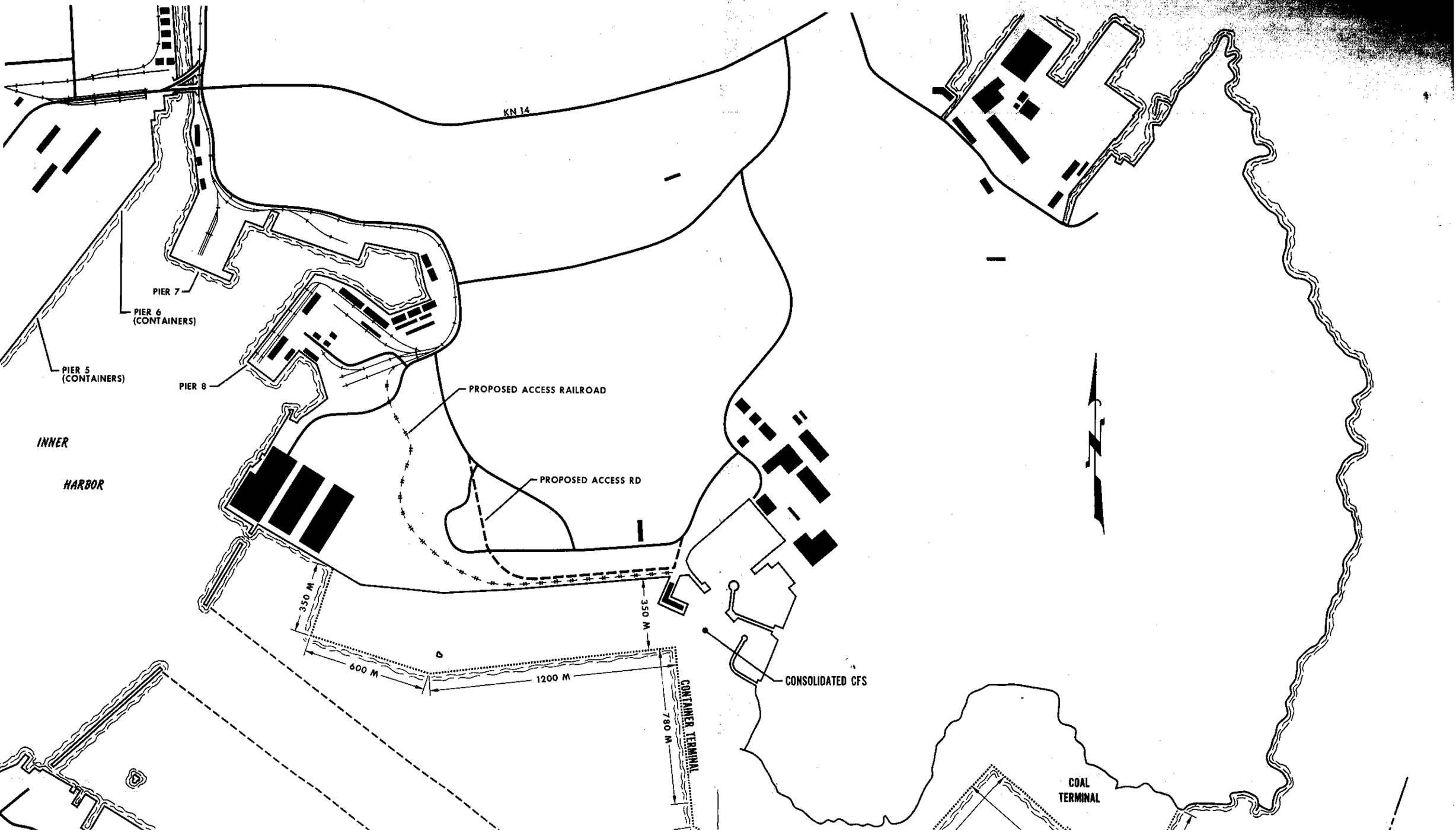


Figure MA-2. Site map.


KN 14
PIER 7
PIER 6
(CONTAINERS)
PIER 5
(CONTAINERS)
PIER 8
INNER
HARBOR
PROPOSED ACCESS RAILROAD
PROPOSED ACCESS RD
350 M
350 M
600 M
1200 M
780 M
CONTAINER TERMINAL
CONSOLIDATED CFS
COAL
TERMINAL

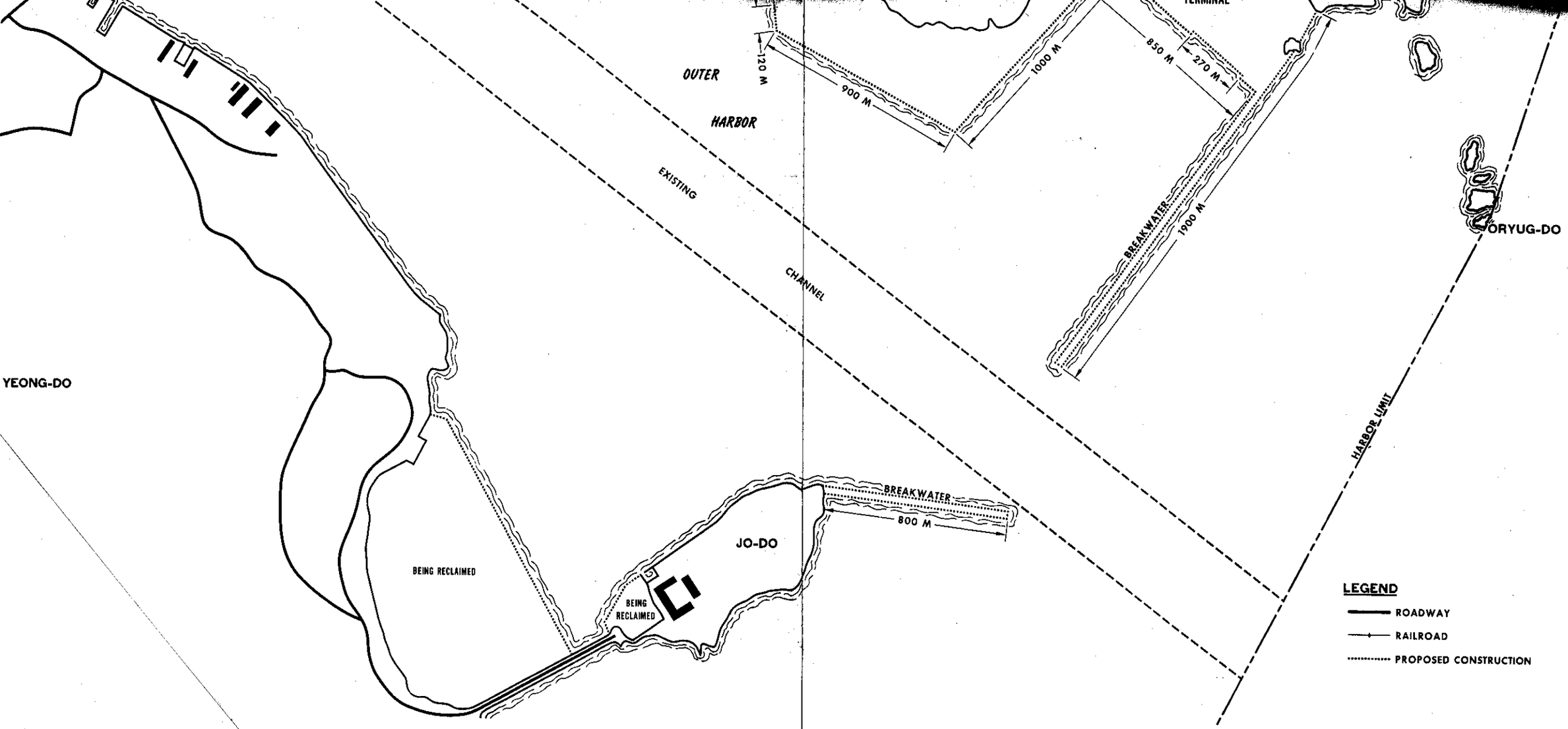


Figure P-32. Pusan's outer harbor development plan.