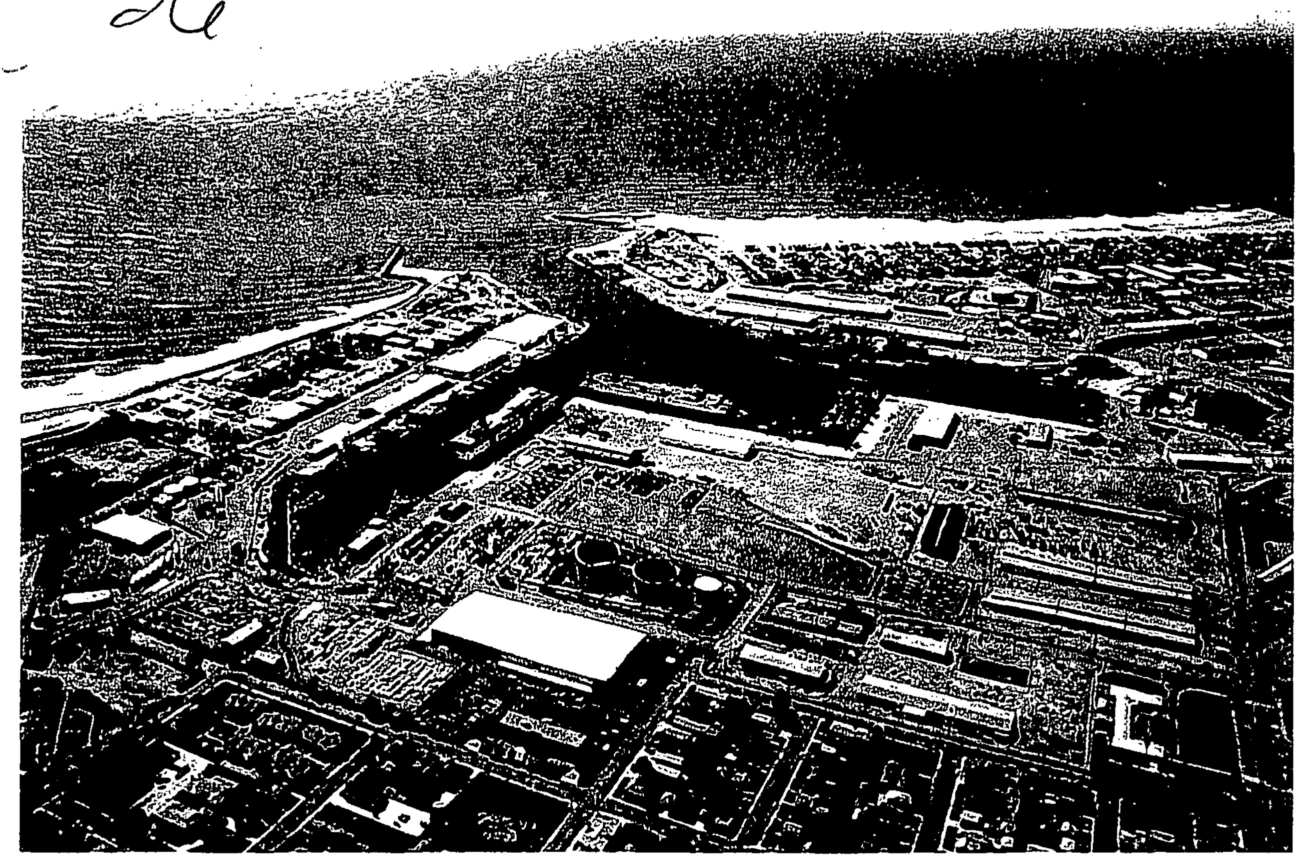
US Army Corps of Engineers®
Los Angeles District

*Port of Hueneme*
OXNARD HARBOR DISTRICT

# The Port of Hueneme, California

## Deep Draft Navigation Feasibility Study
## Draft Feasibility Report



February 1999

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# THE PORT OF HUENEME, PORT HUENEME, CALIFORNIA
# DRAFT FEASIBILITY STUDY

## Guide to Volume II



FEBRUARY 1999

THE PORT OF HUENEME, PORT HUENEME, CALIFORNIA
DRAFT FEASIBILITY STUDY

# APPENDIX "A"

# ECONOMIC ANALYSIS

FEBRUARY 1999

# PORT HUENEME FEASIBILITY STUDY

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## PURPOSE

The following presents an economic analysis of the potential benefits and costs associated with implementing navigation improvements to Port Hueneme Harbor, California. The Reconnaissance Study, which was completed in May 1994, indicated a potential Federal interest in deepening Port Hueneme's channel and turning basin to accommodate larger vessels.

## METHODOLOGY

Methodology employed for this economic update is in accordance with current Principles and Guidelines and standard economic practices. Benefits and costs have been computed utilizing the current Federal discount rate of 6 7/8 percent and are expressed in October 1998 dollars. The period of analysis is 50 years, with 2000 designated as the project base year.

## STUDY AREA

### Location

Port Hueneme Harbor (the "Port" or the "Harbor") is a deep-draft harbor located approximately 65 miles northwest of Los Angeles in southern Ventura County, California. The facilities occupy an area immediately west of the City of Port Hueneme. Channel Islands Harbor and the cities of Oxnard and Ventura are also near the Port, as shown on **Figure 1.**

### General Description of the Port

Port Hueneme lies within a shallow basin at the head of a sea canyon that extends from the Pacific Ocean. The existing Federal project (see **Figure 2**) consists of two jetties about 244 meters (800 ft) and 305 meters (1,000 ft) long; an approach channel about 244 meters (800 feet) long by 183 meters (600 feet) wide with a depth of 12.2 meters (40 ft); a 472 meter (1,550 ft) long entrance channel 91 meters (300 ft) wide and 11 meters (36 ft) deep; a central basin 366 meters (1,200 ft) long, 427 meters (1,400 ft) wide and 10.7 meters (35 ft) deep; and Channel A, which is 707 meters (2,320 ft) long, 122 meters (400 ft) wide and 10.7 meters (35 ft) deep.

The navigation approach generally follows the alignment of the Hueneme Submarine Canyon via a shipping safety fairway that is between 1 to 1.5 nautical miles wide. Navigation into the Harbor proceeds between the two rubble-mound jetties through the dredged channel. Pilotage is controlled by the narrowest width of the entrance channel which is about 91 meters (300 ft). Consequently, only one way traffic is permitted for large ships at the discretion of the pilots.

### Overview of Port Operations

The Port consists of two separate facilities: 1) Commercial international trade facilities and operations under the control and administration of the Oxnard Harbor District; and 2) Military facilities and operations under the control of the U.S. Naval Construction Battalion Center.

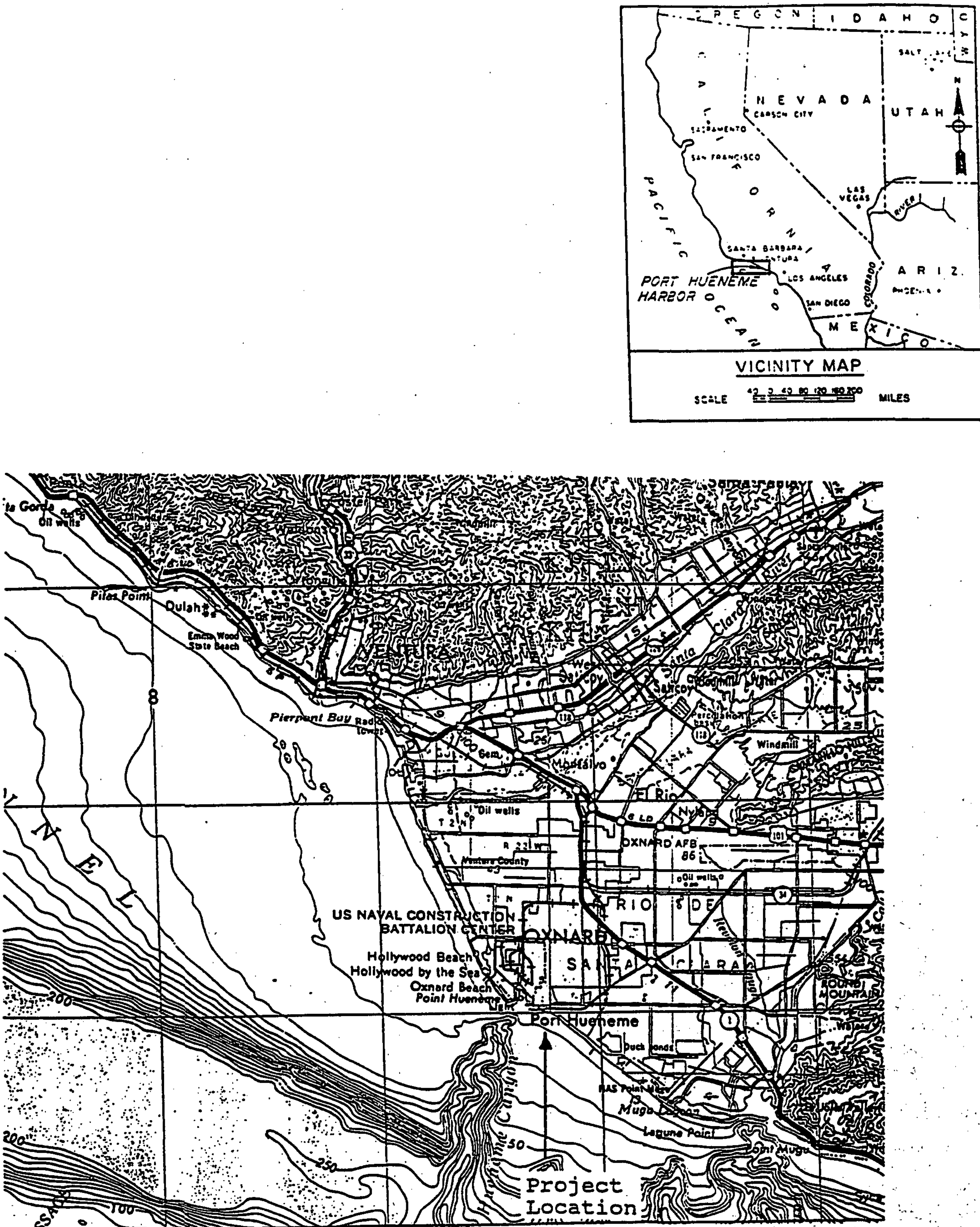


Figure -1 Vicinity Map
No Scale

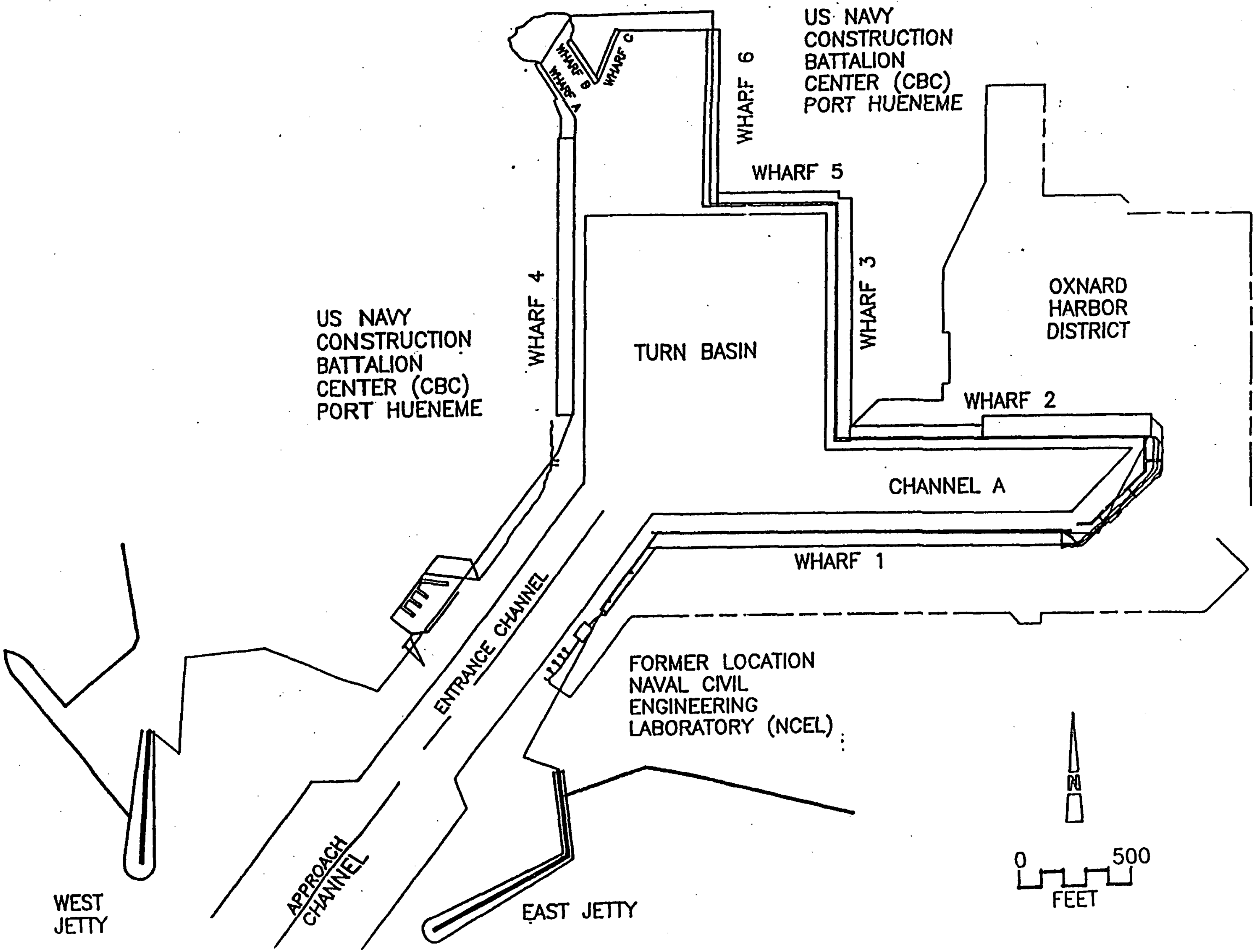


Figure 2. Existing Harbor Plan

Commercial Operations

The Port is the only U.S. Port of Entry in Ventura County and is also the only Foreign-Trade Zone (#205) in California's Central Coast region. The Port services a wide variety of international ocean shippers through its U.S. Port of Entry status. Additionally, the Foreign-Trade Zone designation enables the Port to add flexibility and convenience to its current customers, as well as importers throughout the region.

The Port ranks among the top seaports in California for general cargo throughput. Primary inbound cargoes include bananas, fresh tropical fruit, automobiles, machinery, wood pulp and general cargo. Primary outbound cargoes include citrus, fresh produce, automobiles, wood products and general cargo. The Port is now the top seaport in the U.S. for citrus exports and ranks among the top ten ports for automobile imports.

The Port recently completed construction on the most advanced on-dock refrigerated terminal in the NAFTA Trading Bloc and now has over 51,000 square meters (170,000 square ft) of on-dock refrigerated area serving international shippers.

The Oxnard Harbor District maintains five berths in Channel "A" for deep draft mooring and cargo transfer. Berths 1,2, and 3 are designated along an 550 meter (1,800 ft)-long concrete wharf adjacent to transit sheds that handle refrigerated and breakbulk commodities. Breakbulk cargo is handled by onboard ship cranes that primarily load and unload alongside Berths 1,2 and 3. Berths 4 and 5 on the opposite side of Channel "A" are located along a 442 meter (1,450 ft) long timber and concrete wharf. The berths are adjacent to open back lands that provide staging for automobile carriers and other roll-on/roll-off (ro-ro) cargo. Ro-ro vessels generally moor at Berths 4 and 5, and cargo is driven on or off ship under its own power.

Oil spill response and commercial fishing vessels have permanent moorings at the Port. Other commercial facilities include a livestock loading dock, automobile terminals, Southern California Edison (SCE) fuel storage tanks, vessel bunkering (fueling) facilities, office and maintenance buildings, and parking lots.

Military Operations

The U.S. Navy exercises overall control of the Naval Construction Battalion Center (CBC). The CBC provides maritime support for the Navy Construction Force. The military operates four deep water wharves, three wharves for small ship operations, covered and open storage facilities and a variety of material handling equipment to support the various cargo operations. The main customers of the naval base include 17 Department of Defense elements.

The Oxnard Harbor District also has a licensing agreement with the U.S. Navy to use the military wharves on a space available basis. As part of this agreement, the Navy retains a percentage of the fees charged by the Oxnard Harbor District for their use.

The Navy handles breakbulk, ro-ro, containerized and barge cargo in fulfillment of its military mission. The CBC performs container stuffing for the varied material that is processed at the Port.

## WATERBORNE COMMERCE

### Historic Movements

Table 1 which follows summarizes the total cargo movements at Port Hueneme for the years 1988 through 1996.

**Table 1**
Port Hueneme
Historic Cargo Movements
(1,000s of Short Tons)

| Year | Imports | Exports | Domestic | Total |
|---|---|---|---|---|
| 1988 | 299 | 84 | 240 | 623 |
| 1989 | 330 | 62 | 357 | 749 |
| 1990 | 312 | 100 | 161 | 574 |
| 1991 | 357 | 13 | 46 | 416 |
| 1992 | 386 | 60 | 28 | 474 |
| 1993 | 513 | 33 | 150 | 696 |
| 1994 | 481 | 268 | 65 | 814 |
| 1995 | 552 | 337 | 186 | 1,076 |
| 1996 | 566 | 214 | 163 | 943 |

As shown above, cargo movements through the Port increased steadily from 1991 through 1995. Increases in 1994 and 1995 were due primarily to a large increase in exports of citrus and fresh produce. Increases in receipts of fuel oil and fish led to the rebound in domestic tonnage for 1995. The overall decline in tonnage in 1996 was primarily attributable to a decrease in fruit exports.

Currently, the most important commodity movements at Port Hueneme are inbound domestic shipments of petroleum products, imports of motor vehicles, bananas and wood pulp and exports of fresh citrus and produce. The following presents an analysis of these commodity movements.

### Petroleum & Petroleum Products

The following table presents petroleum product movements through the Port for the period 1988 through 1996. This table includes domestic as well as foreign traffic.

**Table 2**
Port Hueneme
Petroleum & Petroleum Product Movements
(1,000s of Short Tons)

| Year | Petroleum Products |
|---|---|
| 1988 | 92 |
| 1989 | 248 |
| 1990 | 105 |
| 1991 | 0 |
| 1992 | 0 |
| 1993 | 132 |
| 1994 | 35 |
| 1995 | 113 |
| 1996 | 82 |

The table above includes inbound domestic bunker fuel shipments. During 1994, 1995 and 1996, inbound bunker fuel shipments totaled 27,000, 84,000, and 56,000 short tons, respectively. Tesoro Petroleum Company is the company which supplies bunker fuel to Port Hueneme. Currently, barges are utilized to transport bunker fuel from the Port of Long Beach to Port Hueneme. Tesoro purchases bunker fuel from refiners in the San Pedro area and barges the fuel a distance of approximately 65 nautical miles to Port Hueneme. Historical records furnished by the Oxnard Harbor District show that approximately 300,000 barrels per year (or 25,000 barrels per month) of bunker fuel are barged into the Port. A sample of shipment data during 1994 and 1995 shows an average of 31,543 barrels per barge.

Tesoro has attributed fluctuations in demand primarily to its largest customer at Port Hueneme -- Cool Carriers. Cool Carriers is a primary ocean carrier for Sunkist, which distributes fruit to the Far East and ports along the West Coast. A Tesoro representative indicated that Cool Carriers reduced the number of ships used on its Far East trade route in 1996, while apparently increasing the volume transported per delivery, resulting in a reduction in bunker fuel demand.

During the Reconnaissance Study, it was determined that transportation cost savings may be realized if Port Hueneme was deepened, as this might allow Tesoro to utilize tankers rather than barges to deliver the bunker. However, it has since been learned that Tesoro has decided to discontinue supplying bunker fuel to the entire California market, including Port Hueneme. Company officials indicated that their Port Hueneme bunker operations have not been profitable. Tesoro's Port Hueneme terminal facilities and operations have been for sale for over one year. As of the date of this report, a potential buyer had not been found, but a representative of the company stated that a corporate-level strategic decision had been made, and prospectuses had been distributed to potential buyers.

Two Tesoro Vice Presidents were contacted regarding the company's Port Hueneme operations. Neither stated that the company would use tankers to supply bunker to Port Hueneme, even if the Port were to be deepened. This was attributed primarily to low demand and high inventory carrying costs. However, it was noted that there were numerous other considerations other than transportation costs, such as the ability to take advantage of price fluctuations in the spot market.

Tesoro's representatives stated that the most-likely purchaser of the Port Hueneme bunker operations is an existing bunker fuel supplier in the Los Angeles/Long Beach area which will probably be substantially smaller than Tesoro. It was considered unlikely that the eventual purchaser would use tankers to deliver the bunker. It was also noted that tankers would probably not be an option for such smaller companies, since they would not have a fleet of tankers on time charter available as Tesoro does.

It is uncertain at this time: 1) how much longer Tesoro will continue to supply the Port Hueneme market before its bunker operations are sold; 2) whether Tesoro would utilize tankers to deliver bunker to Port Hueneme if it were to be deepened; and 3) how the eventual buyer will deliver bunker to the Port Hueneme market.

Motor Vehicles

Motor vehicles and parts are shipped to Port Hueneme from Japan and Europe on vehicle carriers or ro-ro vessels. Current motor vehicle imports include Mazda and Mitsubishi vehicles shipped from ports in Japan, and liner shipments of BMW, Jaguar, Land Rover, Mercedes, and Volvo vehicles from Europe. The liners travel through Europe, loading vehicles from various ports, then travel south along the east coast of the U.S., off-loading vehicles. The liners travel through the Panama Canal, then move up the west coast of the U.S., off-loading additional vehicles. Once the motor vehicles are unloaded at Port Hueneme, they are moved to staging areas and then on to preparation plants a few miles away, or directly to the preparation plants. The following table presents historical imports of motor vehicles at Port Hueneme.

**Table 3**
Port Hueneme
Motor Vehicle Imports
(1,000s of Short Tons)

| Year | Total | Year | Total |
|---|---|---|---|
| 1985 | 120 | 1991 | 143 |
| 1986 | 144 | 1992 | 125 |
| 1987 | 110 | 1993 | 137 |
| 1988 | 125 | 1994 | 185 |
| 1989 | 164 | 1995 | 159 |
| 1990 | 139 | 1996 | 159 |

Detailed data for 1994 shipments show that the vessels used to import vehicles tend to range from 10,000 to 28,000 deadweight tons (DWT), with lengths of 176 to 198 meters (577 to 650 ft), beams of 28 to 32 meters (91 to 106 ft), and design drafts of 8.2 to 11.6 meters (27 to 38 ft). During 1995, loaded drafts ranged from 5.8 to 9.4 meters (19 to 31 ft), with an average of 7.9 meters (26 ft). In 1995, approximately 104 shipments of motor vehicles were imported on 61 vessels. Only one shipment arrived during the year with a draft exceeding 9.1 meters (30 ft) -- one at 9.4 meters (31 ft). The average weight imported per vessel was approximately 1,520 short tons.

Bananas & Tropical Fruit

Bananas and other tropical fruit including coconuts and pineapples are imported from Chile, Ecuador, Mexico Costa Rica and Columbia on refrigerated cargo vessels (reefers). Most of the tropical fruit imports are bananas. They arrive in cartons and on pallets, and are unloaded into transit sheds for a short time until they can be trucked to their final West Coast destination (from the Mexican border to Vancouver B.C.). Occasionally, the bananas are not yet sold when the reefers arrive from South or Central America. Under those circumstances, the ships may remain anchored at sea or tied up at the dock until the bananas are sold and can be unloaded. Usually, the ships are unloaded and dispatched as fast as possible due to daily vessel costs. Bananas and tropical fruit are held in cold storage until sold. The Port negotiated a contract in October 1997 with Ecuador-based Noboa Group which increased banana imports by about 42% over the 1996 figure shown below, according to a July 28, 1998 *Los Angeles Times* article (pp. B1, B7).

**Table 4**
Port Hueneme
Banana/Tropical Fruit Imports
(1,000s of Short Tons)

| Year | Total | Year | Total |
|---|---|---|---|
| 1985 | 181 | 1991 | 183 |
| 1986 | 112 | 1992 | 199 |
| 1987 | 233 | 1993 | 222 |
| 1988 | 116 | 1994 | 208 |
| 1989 | 101 | 1995 | 272 |
| 1990 | 123 | 1996 | 293 |

In 1994, the reefers coming into the port with tropical fruit ranged in size from 5,440 to 16,950 DWT, with lengths of 109 to 170 meters (358 to 558 ft), beams of 16 to 26 meters (54 to 85 ft), and design drafts of 7.6 to 10.1 meters (25 to 33 ft). These vessels unloaded an average of over 3,000 short tons of tropical fruit. WCSC data for 1995 shows loaded drafts for vessels importing tropical fruit ranged from 5.2 to 8.8 meters (17 to 29 ft), with an average of about 7 meters (23 ft).

Fruit Exports

Historically, fresh fruit exports totaled less than 50,000 short tons. However, fresh fruit exports jumped to 242,000 short tons in 1994 and about 264,000 short tons in 1995. This increase was attributable to the completion of the Port's new large refrigerated storage facilities, which attracted Cool Carriers, primary ocean carrier for Sunkist, to relocate its citrus export operations from Long Beach to Port Hueneme. The Port lost some of its increased business in 1996, as Pacific Express Line moved its mostly breakbulk operations to Los Angeles. However, the Port has recently regained this business, as Pacific Express has ceased operations and Cool Carriers has taken over its operations. Most of the citrus is exported to Japan on reefer vessels.

**Table 5**
Port Hueneme
Fruit Exports
(1,000s of Short Tons)

| Year | Total | Year | Total |
|---|---|---|---|
| 1987 | 10 | 1992 | 50 |
| 1988 | 34 | 1993 | 17 |
| 1989 | 49 | 1994 | 242 |
| 1990 | 32 | 1995 | 264 |
| 1991 | 10 | 1996 | 188 |

As with tropical fruit imports, fruit exports are transported on reefer vessels. The vessel sizes described earlier for banana imports also apply to vessels exporting citrus. During 1995, the loaded drafts of reefers exporting fruit ranged from 4.9 to 10.7 meters (16 to 35 ft), with an average of about 7.6 meters (25 ft).

Wood Pulp

- Historical Operations

Aracruz Cellulose, S.A. (Aracruz) is a large manufacturer of bleached wood pulp (used for tissue and paper products) located in Esprito Santo, Brazil. Historically, Aracruz has utilized Norsul Internacional, S.A. (Norsul) to import wood pulp to Port Hueneme. Norsul is a Brazilian flag shipping company which operates a break-bulk parcel service to and from the west coast of North America and the east coast of South America (primarily Brazil). Aracruz's primary customer in Port Hueneme is Proctor & Gamble (P&G). P&G has a nearby plant which manufactures bathroom tissue and paper towels.

Shipments of wood pulp originate at Portocel, Brazil. Portocel is a private port jointly owned by Aracruz and Nippon Brazil, S.A. and is only about one mile from Aracruz's pulp manufacturing mill. According to *Lloyd's Ports of the World (1994)*, Portocel has a channel with a depth of 11 meters (36 ft ) and a turning basin with a depth of 10 meters (32.8 ft). Vessels arrive at Portocel already loaded with other cargo (primarily steel) loaded at prior ports of loading in Brazil. Portocel is the final port of loading. The loaded bulk carriers continue up the east coast of Brazil and cross to the west coast through the Panama Canal, which allows vessels with a maximum depth of 11.7 meters (39.5 ft). In most instances, the first port of call has been Long Beach. Up to 15,000 metric tons of steel is off loaded in Long Beach before the vessels call on Port Hueneme. Subsequent ports of discharge include Portland, Oregon, Seattle and Vancouver, Washington and ports in British Columbia. The following table summarizes wood pulp imports to Port Hueneme from 1985 to 1996.

| Table 6<br>Port Hueneme<br>Wood Pulp Imports<br>(1,000s of Short Tons) | | | |
|---|---|---|---|
| Year | Total | Year | Total |
| 1985 | 35 | 1991 | 29 |
| 1986 | 46 | 1992 | 35 |
| 1987 | 42 | 1993 | 26 |
| 1988 | 37 | 1994 | 35 |
| 1989 | 51 | 1995 | 87 |
| 1990 | 39 | 1996 | 69 |

Historically, imports of wood pulp averaged about 37,500 short tons per year. However, an expansion of the P&G plant resulted in a twofold increase in demand in 1995. This demand has been met primarily through more frequent shipments. Information regarding the plant's material and storage and handling capacity was not available. However, as shown above, demand, driven by the operational requirements of P&G, declined in 1996.

- Current Operations

In addition to Norsul, Aracruz now utilizes Nippon Brazil Forest Carriers (NBFC) to import wood pulp to Port Hueneme. The new service began on December 1995. NBFC is a joint venture between two transportation companies -- Norsul and Nippon Yusen Kaisah (NYK) of Japan. NBFC was formed primarily to carry wood pulp and forest products from Brazil to Japan, Korea and the Far East, but calls on some west coast ports, including Port Hueneme and Vancouver, B.C., Canada.

NBFC shipments of wood pulp also originate at Portocel, Brazil. Portocel is the second and final port of loading (the first port of loading is Vitoria, Brazil). The loaded bulk carriers continue up the east coast of Brazil, cross to the west coast through the Panama Canal, and then proceed up to Port Hueneme, which is the first port of discharge. Subsequent ports of discharge include Vancouver, B.C., Canada and Far Eastern Ports. The vessels then reload in Vancouver, B.C., Duncan Bay, B.C., and Conception, Chile before returning to Rio de Janeiro, Brazil for discharge.

- Vessel Characteristics

The majority of the wood pulp imported to Port Hueneme has arrived on two vessels: the Sea Pearl and Icepearl. These are 31,889 dead weight ton (DWT) vessels with lengths of 184 meters (604 ft), beams of 28 meters (93 ft) and design drafts of 10.8 meters (35.5 ft). In addition to these Norsul vessels, NBFC utilizes the following vessels to import wood pulp to Port Hueneme:

| Name | DWT | Length | Beam | Design Draft* |
|---|---|---|---|---|
| General Delgado | 29,095 | 175m (574') | 27m (90') | 10m (32.81') |
| General Villa | 29,152 | 175m (574') | 27m (90') | 10m (33.01') |
| General Tirona | 29,095 | 175m (574') | 28m (90') | 10m (32.81') |
| Alberni Dawn | 31,247 | 180m (589') | 28m (92') | 10m (33.96') |

** Lloyd's Ship Register lists these as maximum drafts for these vessels*

During the three year period ending December 1995, one vessel entered Port Hueneme with a draft of 10.7 meters (35 ft), and five entered at 10.4 meters (34 ft). However, in the 20 other shipments for which data is available, loaded drafts were 9.8 meters (32 ft) or less, and average drafts were less than 9.1 meters (30 ft). Based upon conversations with Norsul representatives, the instances when the vessels have arrived with drafts of over 10.1 meters (33 ft) correspond with those instances when Port Hueneme has been the first port of call. Although the Norsul vessels almost always stop off in Long Beach first, sometimes due to scheduling problems (such as when Proctor & Gamble needs an immediate delivery) the vessels have called on Port Hueneme first.

Generally, at least 0.6 meters (two ft) of underkeel clearance is desired when navigating in and out of ports. Given the fact that the entrance channel at Portocel is only 11 meters (36 ft) and the drafts of the Sea Pearl and Icepearl are 10.8 meters (35.5 ft), it is likely that these vessels must use the tide to exit the port when loaded to capacity. On the occasions when the vessels are loaded with drafts of over 10.1 meters (33 ft), it is possible that they may incur tidal delays when entering Port Hueneme, which has an entrance channel of 11 meters (36 ft) and Channel A, which is 10.7 meters (35 ft) (MLLW)[1]. This has been confirmed by a representative of Canada Maritime, who indicated that approximately two wood pulp importing vessels per year have incurred tidal delays entering the port. This figure corresponds with the data obtained from the Waterborne Commerce Statistics Center (WCSC), which shows six vessels entering the port with drafts over 10.1 meters (33 ft) over a three year period.

### Vessel Drafts

The following tables present the drafts of vessels (both foreign and domestic, excluding domestic fishing craft) using Port Hueneme for the years 1987 through 1996. This data was obtained from WCSC. It should be noted that bulk carriers, automobile carriers, ro-ro vessels, barges, liquid bulk carriers and other conventional transportation vessels only comprise about one quarter of the total calls at the Port. The remaining vessels entering/exiting Port Hueneme are comprised of fishing, livestock, offshore-oil related, and shallow draft vessels.

[1] It should be noted that the mean sea level is about three feet higher than mean lower low water level (MLLW). Thus, there is typically more depth available.

**Table 7**
**Port Hueneme**
**Vessel Drafts -- Inbound**

| Drafts (M) | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Avg./Yr. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| 11.9 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| 11.6 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 |
| 11.3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 |
| 10.7 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0.4 |
| 10.4 | 1 | 3 | 0 | 0 | 3 | 0 | 1 | 3 | 2 | 1 | 1.4 |
| 10.1 | 2 | 0 | 5 | 2 | 4 | 2 | 0 | 1 | 1 | 4 | 2.1 |
| 9.8 | 1 | 0 | 0 | 1 | 3 | 1 | 3 | 1 | 1 | 2 | 1.3 |
| 9.4 | 0 | 1 | 5 | 2 | 2 | 0 | 0 | 1 | 2 | 1 | 1.4 |
| 9.1 | 6 | 4 | 1 | 5 | 9 | 4 | 3 | 3 | 9 | 3 | 4.7 |
| 8.8 | 3 | 5 | 9 | 9 | 16 | 17 | 0 | 5 | 15 | 13 | 9.2 |
| 8.5 | 4 | 12 | 23 | 17 | 15 | 14 | 9 | 28 | 19 | 25 | 16.6 |
| 8.2 | 13 | 7 | 27 | 28 | 21 | 31 | 19 | 18 | 20 | 16 | 20.0 |
| 7.9 | 15 | 11 | 21 | 18 | 28 | 28 | 33 | 46 | 29 | 14 | 24.3 |
| ≤ 7.6 | 2,398 | 3,533 | 3,675 | 4,171 | 3,415 | 3,244 | 4,537 | 3,424 | 2,878 | 2,445 | 3,372 |
| TOTAL | 2,445 | 3,578 | 3,767 | 4,255 | 3,516 | 3,341 | 4,606 | 3,531 | 2,976 | 2,525 | 3,454 |

**Table 8**
Port Hueneme
Vessel Drafts -- Outbound

| Drafts (M) | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Avg./Yr. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11.6 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| 11.3 | 0 | 1 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0.4 |
| 11.0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| 10.7 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 1 | 0.6 |
| 10.4 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0.5 |
| 10.1 | 1 | 2 | 2 | 5 | 3 | 2 | 2 | 1 | 0 | 0 | 1.8 |
| 9.8 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 3 | 2 | 1.9 |
| 9.4 | 0 | 2 | 2 | 2 | 3 | 0 | 2 | 2 | 1 | 3 | 1.7 |
| 9.1 | 3 | 4 | 8 | 10 | 2 | 4 | 4 | 8 | 12 | 4 | 5.9 |
| 8.8 | 6 | 3 | 13 | 6 | 13 | 4 | 5 | 3 | 12 | 2 | 6.7 |
| 8.5 | 3 | 9 | 7 | 21 | 17 | 11 | 8 | 27 | 18 | 4 | 12.5 |
| 8.2 | 5 | 12 | 38 | 23 | 18 | 12 | 15 | 27 | 20 | 16 | 18.6 |
| 7.9 | 6 | 14 | 22 | 11 | 21 | 17 | 29 | 32 | 25 | 18 | 19.5 |
| ≤ 7.6 | 2,415 | 3,529 | 3,676 | 4,181 | 3,434 | 3,280 | 4,990 | 3,412 | 2,893 | 2,459 | 3,427 |
| TOTAL | 2,442 | 3,579 | 3,769 | 4,264 | 3,513 | 3,335 | 5,059 | 3,515 | 2,986 | 2,510 | 3,497 |

As shown in the prior two tables, about 98 percent of inbound and outbound vessels from Port Hueneme draft less than or equal to 7.6 meters (25 ft). Virtually all (99.8%) of the vessels utilizing the Port draft 9.1 meters (30 ft) or less. Since the main channel is maintained at 10.7 meters (35 ft), it is probable that most vessels are not constrained by the channel depth.

WCSC data indicate that only six inbound and outbound vessels drafted more than 10.7 meters (35 ft) over a ten year period (or less than one per year). Three of the movements, which are listed as having drafts of 11.3 (1987), 11.9 (1989) and 11.6 (1990) meters, are a motor vehicle carrier which has a design draft of 8.8 meters (29 ft), according to Lloyd's Register of Ships. As discussed previously, the deepest design draft for motor vehicle carriers in 1994 was 11.6 meters (38 ft), and most draft less than 9.8 meters (32 ft). Therefore, the drafts for these shipments are likely incorrect. The other three vessels which drafted more than 10.7 meters (35 ft) were two bulk carriers in 1988 drafting 11.3 meters (37 ft) and 11.6 meters (38 ft), respectively, and a tanker in 1990, drafting 12.2 meters (40 ft). Note that for the past six years for which data is available (1991-1996), only one vessel drafted over 10.7 meters (35 ft). This vessel was an outbound bulk carrier in 1992 most likely carrying wood pulp drafting 11.3 meters (37 ft).

## Use of Tides

According to pilot interviews, an underkeel clearance of 0.6 to one meter (two to three ft) from the lowest point on the vessel is standard at the Port. This is consistent with standard Corps formulae accounting for trim, squat and safety clearance. In general, underkeel clearance measured from the lowest point on the vessel should be about seven percent of the vessel design draft, and another three percent is added for trim if measured from the longitudinal center of the keel. Therefore, the deepest vessel that could safely use the existing harbor at mean lower low water (MLLW) would draw about 10.1 meters (33 ft) at its lowest point. Vessels drafting 10.4 meters (34 ft) or more at the lowest point may incur tidal delays. However, as the prior tables display, over the past seven years, an average of only three or four vessel calls per year may have involved tidal delays. It should be noted, however, that mean sea level (MSL) is at about +1 meter (+3 ft) relative to MLLW. Other than these vessels, the rest of the fleet calling at Port Hueneme from 1987 to 1996 drafted less than 10.1 meters (33 ft).

## ANALYSIS OF WITHOUT PROJECT CONDITIONS

**Existing Commodities/Fleet**

An analysis was conducted of the various types of commodities and vessels which currently call on Port Hueneme to determine whether the depth at the Port may be acting as a constraint. The following presents the conclusions:

Petroleum Products

Petroleum products, primarily consisting of bunker fuel and diesel fuel, are delivered to Port Hueneme on barges. Data obtained from WCSC indicates that these vessels drafted between 2.4 and 6.1 meters (8 and 20 ft) during 1994. Thus, these vessels are not constrained by the depths at Port Hueneme. A detailed analysis was conducted to determine the potential benefits of deepening the harbor to allow tankers to deliver bunker fuel. The analysis yielded the following conclusions:

1) There is no telling at this time how much longer Tesoro will continue serving the Port Hueneme bunker market.

2) Tesoro representatives have indicated the company has no intention of using tankers, regardless of whether the Port is deepened.

3) Tankers could be used to deliver bunker fuel to Port Hueneme today. Depths at the Port only act as a constraint for bunker fuel deliveries under extremely limited (and unlikely) circumstances.

4) It is highly unlikely that the eventual purchaser of Tesoro's operations will use tankers to supply bunker to Port Hueneme, since it is not economical to do so. This is true even if the Port experiences a substantial increase in demand.

Motor Vehicles

An analysis of the historical loaded drafts of vessels importing motor vehicles into Port Hueneme indicates that the depths at the Port are not constraining these operations. During 1995, approximately 104 shipments of motor vehicles were imported on 61 vessels. Only one shipment arrived during the year with a draft exceeding 9.1 meters (30 ft). The average loaded draft was 7.9 meters (26 ft), which is 2.7 meters (nine ft) less than the depth at the Port. It is therefore unlikely that deepening the Port would have any impact on imports of motor vehicles.

Fruit Imports/Exports

The same logic discussed above for motor vehicles also applies to fruit imports/exports. In 1995, the reefers importing and exporting fruit generally had design drafts of less than 9.1 meters (30 ft). Loaded drafts ranged from 4.9 to 10.7 meters (16 to 35 ft), with an average of about 7.6 meters (25 ft). Although one vessel arrived at the Port with a draft of 10.7 meters, there were not any other vessels importing or exporting fruit with a loaded draft greater than 9.1 meters (30 ft). It is therefore unlikely that deepening the Port would have any impact on fruit imports or exports.

Wood Pulp

According to Norsul Internacional, any one of six vessels could be utilized to ship wood pulp to Port Hueneme. These include the four NBFC ships (General Villa, General Delgado, General Tirona, and Alberni Dawn) plus the Sea Pearl and Icepearl. All of the NBFC vessels above draft less than 10.4 meters (34 ft), and three draft about 10.1 meters (33 ft). Thus, these vessels are not likely to suffer any delays either entering or exiting either Portocel or Port Hueneme. The Sea Pearl and Icepearl, which have design drafts of 10.8 meters (35.5 ft), almost always stop off in Long Beach and unload enough steel products such that they do not have any difficulty entering Port Hueneme. Thus, it does not appear that the drafts at Port Hueneme should have any impacts on wood pulp shipments except under the few instances (now even fewer with the introduction of the NBFC vessels) when either the Sea Pearl or Icepearl is used and scheduling does not allow them to first discharge steel products in Long Beach.

It should also be noted that the final port of loading in Brazil is Portocel, which has a depth of 11 meters (36 ft). This depth is only one foot deeper than the depth at Port Hueneme. In addition, the maximum allowable draft for vessels crossing the Panama Canal is 12 meters (39.5 ft). Vessels with drafts in excess of 10.8 meters (35.5 ft) are required to submit bilge keel information to the Canal authorities to ensure safe passage. Thus, deepening Port Hueneme would not likely have any significant impact on wood pulp operations.

**Future Commodities/Fleet**

Two companies have been identified which have indicated they plan on importing products into Port Hueneme in the future. The first is Hydro Agri International (HAI), which has made a commitment to import liquid fertilizer into Port Hueneme from Europe. The second is Charles E. Boyd & Associates (CEB), which has expressed its intention to import gypsum into Port Hueneme from Mexico. A report prepared by VZM/Transistem entitled "Future Channel Requirements for Port Hueneme" indicates that increased containerized traffic at the Ports of Long Beach and Los Angeles may eventually force some other bulk cargoes, especially steel, to be imported into alternative ports (e.g., Port Hueneme). However, these Ports have expressed their commitment to maintain their bulk cargo market share. At this time, there is not a sufficient foundation for projecting that the bulk cargoes identified in the VZM report, specifically steel, will be forced to relocate to Port Hueneme. The following sections will therefore focus on projected imports of liquid fertilizer and gypsum.

Liquid Fertilizer

- Overview

HAI is a subsidiary of Nosrk Hydro, ASA (Hydro), a Norwegian conglomerate with over 38,000 employees. Hydro manufactures and distributes products in a number of business segments, including agriculture, oil and gas, light metals, and petrochemicals. Hydro Agri Europe and HAI are the two business units in the agricultural segment.

Hydro is one of the world's leading producers of mineral fertilizer, with a world-wide distribution and marketing network. The company has 20 fertilizer production plants located in various countries (although none in the U.S.). HAI sells a wide range of fertilizer products in more than 100 countries and is a leader in the nitrogen fertilizer market.

HAI has made a commitment to sell liquid nitrogen-based fertilizer through Port Hueneme. The company has constructed three storage tanks, including two 16,000 metric ton (MT)[2] tanks and one 18,000 MT tank (for a total storage capacity of 50,000 MT). In addition, a pipeline connecting to the storage tanks has been constructed, as well as office facilities. The company commenced operations at the Port in January 1999.

The company currently sells fertilizer to Northern California agricultural customers through the Port of Stockton. Port Hueneme was identified as an ideal port to extend the company's market throughout Southern California.

- Supply

Liquid fertilizer sold through Port Hueneme will be supplied by HAI's manufacturing plants in Poland, Norway and Germany. Vessels chartered by HAI will deliver the product a distance of approximately 8,400 nautical miles from ports in Gdansk, Poland, Porsgrunn, Norway and Rostock, Germany directly to Port Hueneme via the Panama Canal. Currently, vessels import fertilizer from these ports into the Port of Stockton, California. In the future, vessels will first stop off in Port Hueneme to unload product and then proceed to the Port of Stockton.

In general, the European ports discussed above can accommodate vessels drafting up to 12.2 meters (40 ft). However, due to draft constraints at Stockton, smaller vessels have been used. Some of these vessels have included:

| | DWT | Draft (M) | Draft (ft) | Built |
|---|---|---|---|---|
| Champion Trader | 30,990 | 10.96 M | 35.96 ft | 1/78 |
| Iver Splendor | 29,820 | ± 10.9 M | 35.8 ft | 1/81 |
| Empress Trader | 24,221 | 9.69 M | 31.8 ft | 1/71 |
| Champion | 25,200 | 9.94 M | 32.6 ft | 1/74 |
| Chavchavadze | 16,231 | ± 9.0 M | 29.5 ft | 1/88 |

In general, these vessels have been in the 25,000-35,000 dead weight ton (DWT) range, with drafts generally less than 10.7 meters (35 ft). The Port of Stockton has an available depth of 10.7 meters (35 ft). However, assuming a required underkeel clearance at MLLW of about 0.91 meters (three ft), vessels drafting in the 10.7

[2] One metric ton = 1.1023 short tons

meter (35 ft) range (such as the Champion Trader and Iver Splendor) are required to enter the port light loaded at MLLW. WCSC data shows no vessels entering or exiting Stockton in 1996 with a draft exceeding 9.8 meters (32 ft).

Company representatives have indicated that smaller tanker vessels, such as the Empress Trader and Champion, are getting older, with many being turned into scrap metal. Note that these vessels were built in the early 1970's. As these older ships are being phased out, they are being replaced with larger, deeper-draft vessels. It is assumed that these smaller vessels will not be readily available in the future. Under without project conditions, it is assumed that 35,000 DWT vessels will be the minimum size available for this trade route. IWR statistics specify that foreign tankers of this size generally have maximum drafts of about 10.7 meters (35 ft).

- Demand

Hydro's agriculture sales have increased significantly over the past few years. The average compound growth rate between 1995 and 1997 was about 7.5 percent. The company anticipates continued strong fertilizer sales growth. Sales outside Western Europe are projected to double between 1996 and 2005, according to Hydro's 1997 Annual Report.

Fertilizer sales in the Northern California market have been experiencing rapid growth, as demonstrated by the following detail of fertilizer imports through the Port of Stockton:

| Fertilizer Imports | Short Tons | Metric Tons |
|---|---|---|
| 1996 | 166,000 | 151,000 |
| 1995 | 133,000 | 121,000 |
| 1994 | 101,000 | 92,000 |
| 1993 | 31,000 | 28,000 |
| 1992 | 86,000 | 78,000 |
| 1991 | 38,000 | 34,000 |

The above data show an average compound growth rate of over 34 percent. The company has estimated that 1998 demand through Stockton exceeded 200,000 MT.

Liquid fertilizer has experienced significant sales growth and continued growth is anticipated. In the past, dry fertilizers were used exclusively. Liquid fertilizer is easier to apply than dry fertilizer, since it can be applied through irrigation systems. Liquid fertilizer cannot displace dry fertilizer, since it does not contain all of the nutrients supplied by dry fertilizers. However, it provides a highly efficient method of applying nitrogen to crops, which is a key nutrient. Hence, while the dry fertilizer market is anticipated to experience slow growth, liquid fertilizer is expected to experience a much higher growth rate.

According to a representative of the California Fertilizer Association, the liquid fertilizer industry is growing in the markets most likely to be served by Port Hueneme (specifically Fresno, Imperial, Kern, Riverside, southern San Joaquin, Santa Barbara, Tulare and Ventura Counties) because of changes in crop patterns to more "specialized" crops which require more precise fertilizer inputs. Examples of such crops include fruits like strawberries and grapes, citrus, and vegetables as opposed to "non-specialized" crops, such as cotton and grains. Since liquid fertilizer can be pumped and metered, it is a more precise method of application relative to dry fertilizer. In addition, there is less worker exposure.

Data obtained from the California Department of Food and Agriculture (CDFA) for the counties listed in the prior paragraph validate the discussed growth in the liquid fertilizer segment. As shown below, for the eight county area, both dry and liquid fertilizer tonnage increased from 1991 through 1997.

| Year | Dry Tonnage | Liquid Tonnage | Total Tonnage |
|---|---|---|---|
| 1991 | 115,750 | 176,130 | 291,880 |
| 1992 | 125,590 | 198,260 | 323,850 |
| 1993 | 151,560 | 247,160 | 398,710 |
| 1994 | 146,330 | 215,590 | 361,920 |
| 1995 | 158,820 | 291,560 | 450,380 |
| 1996 | 130,450 | 255,600 | 386,050 |
| 1997 | 140,360 | 253,620 | 393,980 |

Although both segments experienced growth, liquid fertilizer tonnage utilization increased by nearly 44% relative to about 21% for dry fertilizer. Further, liquid fertilizer's percentage of the total market averaged over 65% in 1995-1997 relative to less than 61% in prior years. This increase can be attributable to the changes in crop patterns discussed earlier. According to CDFA statistics, specialized crops experienced growth over the decade ending 1987-1997. For example: strawberries increased from 19,200 acres to 22,600 acres; grapes grew from 656,400 acres to 675,700 acres; and oranges grew from 172,600 acres to 199,000 acres. However, non-specialized crops experienced declines. For example, cotton acreage declined from 1,351,800 to 1,065,000, and hay acreage declined from 1,680,000 to 1,500,000.

Based upon historical growth trends, industry analysis and information furnished by the Company, the following growth projections have been assumed for this analysis:

| | Stockton (MT) | | Port Hueneme (MT) |
|---|---|---|---|
| 1998 | 200,000 | 1999 | 44,000 |
| 1998-2000 | 10% | 1999-2002 | 13% |
| 2001-2005 | 5% | 2003-2007 | 8% |
| 2006-2020 | 3% | 2008-2020 | 3% |

Although detailed growth projections were not furnished by the Company, a representative indicated that the projections listed above are very reasonable and are actually somewhat lower than internal projections.

Due to the significant uncertainty regarding future fertilization methods, the size of the California agricultural industry, etc., demand beyond the year 2020 has been held constant. Table 9 below summarizes projected growth over the period of analysis for both Stockton and Port Hueneme.

**Table 9**
Projected Demand
Fertilizer Imports
(1,000s of Metric Tons)

| Year | Stockton | PH | Total |
|---|---|---|---|
| 2000 | 242 | 50 | 292 |
| 2010 | 358 | 108 | 466 |
| 2020-2049 | 481 | 151 | 632 |

- Customers

Existing and potential customers include fertilizer dealers and distributors. Some of these firms include Ag RX, Stanislaw County Farm Supply, Green Valley Farm Supply, Bear Valley Farm Supply and Western Farm Services. These firms have offices/outlets in the Oxnard area. Product would be sold through these customers and delivered directly from HAI's Port Hueneme storage facilities to the agricultural users via truck.

As discussed in the Industry Section, it is anticipated that customers eventually will span portions of six counties, including Fresno, Kern, Tulare, San Joaquin, Ventura and Santa Barbara counties. Stockton will continue to serve a portion of some of the northern-most counties. The Port Hueneme market is not anticipated to cannibalize sales through Stockton, since the Company does not sell to these markets from Stockton due to high trucking costs.

- Competitors

Current competitors in the California fertilizer market include Unocal (which ships product from Alaska through Portland and Sacramento), Terra (which ships product to California from the Midwestern U.S.) and a number of smaller companies. HAI believes that liquid fertilizer represents a growing market which will enable it to expand sales despite the presence of these competitors.

- Projected Transportation Costs

The total transportation costs for supplying both the Stockton and Port Hueneme markets with liquid fertilizer have been projected. Transportation costs were calculated for supplying both markets, since the vessels importing product into Port Hueneme would be continuing up the coast to Stockton. Any improvements to Port Hueneme allowing deeper draft vessels could reduce the number of vessel trips required to service both of these markets.

The following assumptions were incorporated into the analysis:

| | | |
|---|---|---|
| Size of Vessel Utilized | → | 35,000 DWT Tanker |
| Hourly Operating Cost (OC) | → | $768 (capped IWR cost for FY 98) |
| Maximum Cargo at Current Depth (MC) | → | 33,250 MT (Using Tides as Necessary) |
| Demand (D) | → | See Projections in Demand Section |
| Estimated Distance -- Europe to Stockton (Dst) | → | Approx. 8,800 Nautical Miles |
| Vessel Speed (S) | → | 14 knots |

For each year of the period of analysis, annual transportation costs were computed as follows:

1) Total Demand was calculated by adding demand estimates for Stockton and Port Hueneme
2) Number of trips required to meet projected demand for each year was calculated by dividing total demand by Maximum Cargo at Current Depth
3) Total number of trips per year was multiplied by 8,800 miles per trip to derive total miles per year
4) Transit time per year was derived by dividing total miles per year by vessel speed

5) Total transit time was multiplied by Hourly Operating Cost to derive annual transportation costs.
6) Expected tidal delay costs were added to derive total annual transportation costs. It was assumed that ships would load to capacity -- 10.7 meters (35 feet)-- which would require waiting for up to three feet of tides, depending upon the time the ship arrives. An analysis of tidal fluctuations indicates that three feet or more of tides are available approximately 46% of the time. Taking into account the probability that ships will be required to wait, as well as average waiting times, the expected waiting time per trip equals about two hours. Two hours of operating costs per trip have been added to account for tidal delay costs.

Transportation Cost ($TC_n$) = $[[[[(D_s+D_{ph})/MC] * 8,800] / S] * OC]$

The following table summarizes projected transportation costs over the period of analysis:

**Table 10**
Fertilizer Imports
Projected Transportation Costs
(Without Project Conditions)

| Year | Demand (MT) | Trips/Yr | Miles/Yr | Hrs/Yr | Total |
|---|---|---|---|---|---|
| 2000 | 292,000 | 9 | 79,200 | 5,657 | $4,359,000 |
| 2010 | 466,000 | 15 | 132,000 | 9,429 | $7,265,000 |
| 2020-2049 | 632,000 | 22 | 176,000 | 12,571 | $9,686,000 |

As shown on Table 10, transportation costs are projected to more than double over the period of analysis. The net present value (NPV) of these transportation costs is about $100.5 million. Annualized transportation costs total $7.166 million.

▸ Risk & Uncertainty Analysis

A Monte Carlo simulation model was developed using *Microsoft Excel* and *@Risk for Windows* software to ascertain the uncertainty regarding transportation cost estimates. Variables considered subject to uncertainty included:

1) Initial Demand for Stockton and Port Hueneme
2) Demand Growth Rates
3) Vessel Operating Costs

Triangular distributions were utilized. Minimum and maximum values were estimated based upon research and professional judgement. For example, initial demand estimates were assumed to have a range of ±20,000 metric tons from the expected value. Growth projection percentages were assumed to have a range of ±5% from the expected values. Finally, hourly operating costs were assumed to have a range of ±10% of the expected value. The output variable was without project expected annual operating costs.

The simulation resulted in mean expected annual transportation costs about $7.23 million, which is slightly higher than the computed value without running the simulation. This is due to a slight skewness in the output distribution. The standard deviation is about $1.121 million. The confidence levels are as follows:

| | |
|---|---|
| 5% | $5.7 million |
| 10% | $5.9 million |
| 50% | $7.1 million |
| 90% | $8.8 million |
| 95% | $9.3 million |

The above data indicates that there is a 90% chance that without project transportation costs would fall between $5.7 and $9.3 million.

Gypsum

- Overview

Charles E. Boyd & Associates (CEB) is a cargo broker involved in import, export and distribution services. They arrange transportation with charter vessels, and provide transportation terminal services. Most of the business' customers are under contracts, as opposed to spot market customers.

CEB has indicated that it intends to import gypsum from Mexico into Port Hueneme. Gypsum would be transported from ports in San Marcos Island (which is the site of a gypsum quarry producing about 2.7 million MT annually) and Manzanillo, Mexico. CEB is currently importing a small amount of gypsum from these ports into the ports of Stockton, Los Angeles, Long Beach and Redwood City. Port Hueneme is a desired port of entry since the gypsum would be sold primarily to agricultural users, many of which are in close proximity to the port. WCSC data shows that approximately 26,000 MT (29,000 short tons) of gypsum was imported into Stockton during 1996, with no imports shown for prior years. Most gypsum imported into the Southern California area comes into the Port of Long Beach. WCSC shows gypsum imported into Long Beach has fluctuated between 390,000 and 487,000 MT (430,000 and 537,000 short tons) between 1991 and 1996.

CEB is currently trying to secure deals with shipping companies, grinding mills (to process the gypsum) and fertilizer companies. It is uncertain when CEB will begin importing gypsum into the port. However, company officials have stated that they intend to commence operations as soon as possible, regardless of whether the port is deepened.

- Supply

As described above, gypsum would be obtained from quarries in Mexico. San Marcos Island and Manzanillo were identified as ports of loading. San Marcos Island has a depth alongside pier of about 12.8 meters (42 feet). The Port of Manzanillo has at least one terminal with a similar depth. Hence, these ports have deeper depths and can accommodate larger vessels than Port Hueneme.

Bulk carriers would be used to transport the gypsum. Based upon current depth limitations at Port Hueneme, the company has determined vessels such as the following could be utilized.:

| Vessel | DWT | Draft (M) | Draft (ft) |
|---|---|---|---|
| Cabo | 31,364 | 10.91 | 35.8' |
| Hai Wang Xing | 37,944 | 10.82 | 35.5' |

These vessels both fall within the general IWR specifications for 35,000 ton bulk vessels, with indicated maximum drafts of 10.7 meters (35 ft). Under without project conditions, it is assumed that this vessel size will be used for the trade route.

- Demand

Gypsum is sold primarily to cement grinders, wallboard manufacturers and agricultural users. Gypsum imported into Port Hueneme would be sold to agricultural users, primarily in the Oxnard area and California's central valley. Once ground finely, gypsum can be applied along with fertilizer to crops. It has the beneficial effect of improving soil structure and permeability, according to the *Center for Irrigation Technology's* internet pages. Port Hueneme is considered an ideal port to import gypsum due to its proximity to both potential customers in California's central valley and gypsum grinders in the Bakersfield, California area.

CEB anticipates high initial demand and strong growth once operations begin. Mr. Boyd attributed this to the high quality of Mexican gypsum compared to domestic sources. He also stated that domestically produced gypsum from Nevada and California is typically more expensive. According to Mr. Boyd, the company projects initial demand could be as high as 150,000 tons. CEB projects that its market share could eventually reach 300,000 tons.

For purposes of this analysis, the following demand projections have been utilized:

| | Demand (MT) |
|---|---|
| 1999 | 100,000 |
| 1999-2002 | 10% |
| 2003-2007 | 5% |
| 2008-2020 | 3% |

Due to the significant uncertainty regarding future fertilization methods, the size of the California agricultural industry, etc., demand beyond the year 2020 has been held constant. Table 9 below summarizes projected growth over the period of analysis.

**Table 11**
Projected Demand
Gypsum Imports
(1,000s of Metric Tons)

| Year | Total |
|---|---|
| 2000 | 110 |
| 2010 | 186 |
| 2020-2049 | 249 |

- Projected Transportation Costs

The total transportation costs for supplying the Port Hueneme market with gypsum have been calculated. Any improvements to Port Hueneme allowing deeper draft vessels could reduce the number of vessel trips required to service the market.

The following assumptions were incorporated into the analysis:

| | | |
|---|---|---|
| Size of Vessel Utilized | ➜ | 35,000 DWT Bulk Carrier |
| Hourly Operating Cost (OC) | ➜ | $576 (capped IWR cost for FY 98) |
| Maximum Cargo at Current Depth (MC) | ➜ | 33,250 (Using tides as necessary) |
| Demand (D) | ➜ | See Projections in Demand Section |
| Estimated Distance -- Mexico to PH (Dst) | ➜ | Approx. 1,265 Nautical Miles |
| Vessel Speed (S) | ➜ | 14 knots |

Annual transportation costs were calculated in the same manner as described for liquid fertilizer. The following table summarizes projected transportation costs over the period of analysis:

**Table 12**
Gypsum Imports
Projected Transportation Costs
(Without Project Conditions)

| Year | Demand (MT) | Trips/Yr | Miles/Yr | Hrs/Yr | Total |
|---|---|---|---|---|---|
| 2000 | 110,000 | 4 | 5,100 | 361 | $213,000 |
| 2010 | 186,000 | 6 | 7,600 | 542 | $319,000 |
| 2020-2049 | 249,000 | 8 | 10,100 | 723 | $426,000 |

As shown on Table 12, transportation costs are projected to double over the period of analysis. The net present value (NPV) of these transportation costs is about $4.6 million. Annualized transportation costs total $328,000.

- Risk & Uncertainty Analysis

A Monte Carlo simulation model was developed using *Microsoft Excel* and *@Risk for Windows* software to ascertain the uncertainty regarding transportation cost estimates. Variables considered subject to uncertainty included:

1) Initial Demand
2) Demand Growth Rates
3) Vessel Operating Costs

Triangular distributions were utilized for simplification purposes. Minimum and maximum values were estimated based upon research and professional judgement. For example, initial demand was assumed to have a range of ±50,000 metric tons from the expected value. Note that this range is substantially wider than for liquid fertilizer. This is because: 1) HAI has greater experience importing liquid fertilizer into the California market than CEB has importing gypsum; 2) HAI is a much larger firm with greater resources available to market its products to achieve target sales levels; and 3) greater research was conducted to derive initial demand estimates for liquid fertilizer relative to gypsum. Growth projection percentages were assumed to have a range of ±5% from the expected values. Finally, hourly operating costs were assumed to have a range of

±10% of the expected value. The output variable was without project expected annual operating costs.

The simulation resulted in mean expected annual transportation costs of about $331,000, which is slightly higher than the computed value without running the simulation. This is due to a slight skewness in the output distribution. The standard deviation is about $49,000. The confidence levels are as follows:

| | |
|---|---|
| 5% | $258,000 |
| 10% | $273,000 |
| 50% | $326,000 |
| 90% | $397,000 |
| 95% | $420,000 |

The above data indicates that there is a 90% chance that without project transportation costs would fall between $258,000 and $420,000.

## WITH PROJECT CONDITIONS

### Overview

For the commodities which have historically been imported into and exported out of Port Hueneme, the current depth and configuration at the Port does not appear to be constraining operations. Current and projected vessel requirements for these commodities show that existing depths are adequate. It appears that deepening the harbor would have little, if any, impact on transportation costs for these commodities.

Two new commodities -- liquid fertilizer and gypsum -- will be imported into the Port in the near future. Analysis indicates that deepening the channel and turning basin at the Port could reduce transportation costs for these commodities by allowing deeper draft vessels to be utilized, potentially reducing the number of vessel trips required.

Based upon a risk and uncertainty analysis, mean transportation costs for liquid fertilizer and gypsum imports under without project conditions have been estimated at $7.19 million and $328,000, respectively. The following presents an analysis of the alternatives under consideration and their potential benefits.

Alternative 1

Under Alternative 1, the approach channel would be deepened to 12.5 meters (41 feet), while the entrance channel, turning basin and Channel A would all be deepened to 11.5 meters (37.7 feet). This alternative would increase the depth of the entrance channel and inner harbor by about 0.8 meters (2.7 feet).

Alternative 2

Under Alternative 2, the approach channel would be deepened to 13 meters (42.7 feet), while the entrance channel, turning basin and Channel A would all be deepened to 12 meters (39.4 feet). This alternative would increase the depth of the entrance channel and inner harbor by about 1.3 meters (4.4 feet).

Alternative 3

Under Alternative 3, the approach channel would be deepened to 13.5 meters (44.3 feet), while the entrance channel, turning basin and Channel A would all be deepened to 12.5 meters (41 feet). This alternative would increase the depth of the entrance channel and inner harbor by about 1.8 meters (6 feet).

Alternative 4

Under Alternative 4, the approach channel would be deepened to 14 meters (45.9 feet), while the entrance channel, turning basin and Channel A would all be deepened to 13 meters (42.7 feet). This alternative would increase the depth of the entrance channel and inner harbor by about 2.3 meters (7.7 feet).

**Benefits**

Benefits from the different deepening alternatives derive from the ability to either load vessels more fully or utilize larger vessels, thus reducing the number of vessel trips required to supply the market area.

Alternative 1

- Liquid Fertilizer

As discussed previously, under without project conditions, it has been assumed that 35,000 DWT tankers will be used to transport liquid fertilizer from Europe to Port Hueneme and Stockton, California. Under Alternative 1, 11.5 meters (37.7 feet) of depth is available, representing an additional 0.8 meters (2.7 feet) relative to without project conditions. This depth is adequate to allow 35,000 DWT tankers to enter the Port fully loaded under most circumstances. However, it is more cost effective to use larger tankers under this alternative and use tides to the greatest extent possible to minimize vessel trips. It has been assumed that 50,000 DWT tankers would be utilized, which have a maximum draft of approximately 12.2 meters (40 feet). These vessels require about four feet of underkeel clearance, but could use up to four feet of tides to enter the harbor. The greater amount of cargo which these vessels can carry relative to 35,000 DWT tankers, even light-loaded, allows a reduction in transportation costs due to reduced vessel calls which more than offsets their higher hourly operating cost (IWR data for FY 1998 shows that the hourly operating cost for 50,000 DWT tankers is about $76 higher than for 35,000 DWT tankers).

The maximum cargo volume given the additional depth under this alternative is estimated at about 43,610 MT. Hence, an additional 10,360 MT can be carried per vessel trip. Assuming that these vessels make full utilization of tides, there is about a 79% probability that a tidal delay will be required. However, the expected waiting time is only about four hours. Although the waiting costs have been factored into transportation cost estimates, they are relatively insignificant considering the total transit time is over 620 hours per trip, and the additional loading enables fewer trips over the period of analysis.

Table 13 displays how the increase in vessel loading capacity for Alternative 1 translates into reduced vessel trips and transportation costs.

**Table 13**
**Alternative 1**
Fertilizer Imports
Projected Transportation Costs ($1,000s)

| | Without Project | | With Project | | |
|---|---|---|---|---|---|
| Year | Trips/Yr | Cost/Yr | Trips/Yr | Total | Reduction |
| 2000 | 9 | $4,359 | 7 | $3,738 | $621 |
| 2010 | 15 | $7,265 | 11 | $5,874 | $1,391 |
| 2020-2049 | 20 | $9,686 | 15 | $8,010 | $1,676 |

As shown above, initially two vessel trip per year, and eventually five vessel trips per year, are eliminated due to the ability to transport more cargo per trip. The NPV of projected transportation costs under Alternative 1 is about $84.389 million. The annualized value is approximately $6.018 million, which is $1,148,000 less than the computed value under without project conditions.

The simulation model described in the Without Project Conditions section was run with the additional input variable of the amount of additional cargo per vessel trip. The expected value was 10,360 MT, with a triangular distribution of ± 20%. Simulation results yielded a mean annual transportation cost of $6.151 million, with a standard deviation of $956,000. Mean transportation cost savings totaled $1,078,000, with a standard deviation of $439,000 and the following confidence levels:

| | |
|---|---|
| 5% | $389,000 |
| 10% | $544,000 |
| 50% | $1,059,000 |
| 90% | $1,633,000 |
| 95% | $1,839,000 |

- Gypsum

As discussed previously, under without project conditions, it has been assumed that 35,000 DWT bulk vessels will be used to gypsum from Mexico to Port Hueneme. Under Alternative 1, 11.5 meters (37.7 feet) of depth is available, representing an additional 0.8 meters (2.7 feet) relative to without project conditions. This depth is adequate to allow 35,000 DWT vessels to enter the Port fully loaded under most circumstances. However, it is more cost effective to use larger tankers under this alternative and use tides to the greatest extent possible to minimize vessel trips. It has been assumed that 50,000 DWT bulk vessels would be utilized, which have a maximum draft of approximately 12.2 meters (40 feet). These vessels require about four feet of underkeel clearance, but could use up to four feet of tides to enter the harbor. The greater amount of cargo which these vessels can carry relative to 35,000 DWT vessels, even light-loaded, allows a reduction in transportation costs due to reduced vessel calls which more than offsets their higher hourly operating cost (IWR data for FY 1998 shows that the hourly operating cost for 50,000 DWT bulk vessels is about $67 higher than for 35,000 DWT bulk vessels).

The maximum cargo volume given the additional depth under this alternative is estimated at about 43,720 MT. Hence, an additional 10,470 MT can be carried per vessel trip. Assuming that these vessels make full utilization of tides, there is about a 79% probability that a tidal delay will be required. However, the expected waiting time is only about four hours. Although the waiting costs have been factored into transportation cost estimates, they are relatively insignificant considering the total transit time is over 90 hours per trip, and the additional loading enables fewer trips over the period of analysis.

Table 14 displays how the increase in vessel loading capacity for Alternative 1 translates into reduced vessel trips and transportation costs.

**Table 14**
**Alternative 1**
Gypsum Imports
Projected Transportation Costs ($1,000s)

| | Without Project | | With Project | | |
|---|---|---|---|---|---|
| Year | Trips/Yr | Cost/Yr | Trips/Yr | Total | Reduction |
| 2000 | 4 | $213 | 3 | $182 | $31 |
| 2010 | 6 | $319 | 5 | $304 | $15 |
| 2020-2049 | 8 | $426 | 6 | $365 | $61 |

As shown above, throughout most of the period of analysis, one vessel trip is eliminated due to the ability to transport more cargo per trip. The NPV of projected transportation costs under Alternative 1 is about $4.06 million. The annualized value is approximately $290,000, which is $38,000 less than the computed value under without project conditions.

The simulation model described in the Without Project Conditions section was run with the additional input variable of the amount of additional cargo per vessel trip. The expected value was 10,470 MT with a triangular distribution of ± 20%. Simulation results yielded a mean annual transportation cost of $294,000, with a standard deviation of $43,000. Mean transportation cost savings totaled $37,000, with a standard deviation of $21,000 and the following confidence levels:

| | |
|---|---|
| 5% | $5,000 |
| 10% | $10,000 |
| 50% | $36,000 |
| 90% | $64,000 |
| 95% | $72,000 |

- Total Benefits

The combined total of mean transportation benefits for Alternative 1 is:

| | |
|---|---|
| Liquid Fertilizer | $1,078,000 |
| Gypsum | $37,000 |
| Total | $1,115,000 |

Alternative 2

- Liquid Fertilizer

Under Alternative 2, 12 meters (39.4 feet) of depth is available, representing an additional 1.3 meters (4.3 feet) relative to without project conditions. The maximum cargo volume given the additional depth under this alternative is estimated at about 46,485 MT. Hence, an additional 13,235 MT can be carried per vessel trip.

Table 15 displays how the increase in vessel loading capacity for Alternative 2 translates into reduced vessel trips and transportation costs.

**Table 15**
**Alternative 2**
Liquid Fertilizer Imports
Projected Transportation Costs ($1,000s)

| | Without Project | | With Project | | |
|---|---|---|---|---|---|
| Year | Trips/Yr | Cost/Yr | Trips/Yr | Total | Reduction |
| 2000 | 9 | $4,359 | 7 | $3,738 | $621 |
| 2010 | 15 | $7,265 | 11 | $5,874 | $1,391 |
| 2020-2049 | 20 | $9,686 | 14 | $7,476 | $2,210 |

The NPV of projected transportation costs under Alternative 2 is about $79.85 million. The annualized value is approximately $5.695 million, which is $1,471,000 less than the computed value under without project conditions.

Simulation results yielded a mean annual transportation cost of $5.785 million, with a standard deviation of $901,000. Mean transportation cost savings totaled $1,444,000, with a standard deviation of $464,000 and the following confidence levels:

| | |
|---|---|
| 5% | $735,000 |
| 10% | $875,000 |
| 50% | $1,416,000 |
| 90% | $2,048,000 |
| 95% | $2,246,000 |

▸ Gypsum

Under Alternative 2, 12 meters (39.4 feet) of depth is available, representing an additional 1.3 meters (4.3 feet) relative to without project conditions. The maximum cargo volume given the additional depth under this alternative is estimated at about 46,514 MT. Hence, an additional 13,264 MT can be carried per vessel trip.

Table 16 displays how the increase in vessel loading capacity for Alternative 2 translates into reduced vessel trips and transportation costs.

**Table 16**
**Alternative 2**
Gypsum Imports
Projected Transportation Costs ($1,000s)

| | Without Project | | With Project | | |
|---|---|---|---|---|---|
| Year | Trips/Yr | Cost/Yr | Trips/Yr | Total | Reduction |
| 2000 | 4 | $213 | 3 | $182 | $31 |
| 2010 | 6 | $319 | 4 | $243 | $76 |
| 2020-2049 | 8 | $426 | 6 | $365 | $61 |

The NPV of projected transportation costs under Alternative 2 is about $3.88 million. The annualized value is approximately $277,000, which is $51,000 less than the computed value under without project conditions.

Simulation results yielded a mean annual transportation cost of $276,000, with a standard deviation of $41,000. Mean transportation cost savings totaled $52,000, with a standard deviation of $22,000 and the following confidence levels:

| | |
|---|---|
| 5% | $18,000 |
| 10% | $25,000 |
| 50% | $51,000 |
| 90% | $79,000 |
| 95% | $89,000 |

▸ Total Benefits

The combined total of mean transportation benefits under Alternative 2 is:

| | |
|---|---|
| Liquid Fertilizer | $1,444,000 |
| Gypsum | $52,000 |
| Total | $1,496,000 |

Alternative 3

- Liquid Fertilizer

Under Alternative 3, 12.5 meters (41 feet) of depth is available, representing an additional 1.8 meters (6 feet) relative to without project conditions. The maximum cargo volume given the additional depth under this alternative is estimated at about 46,654 MT. Hence, an additional 13,404 MT can be carried per vessel trip. The increase in cargo volume is limited for Alternative 3. With full use of tides, tankers could load up to a maximum draft of 12.5 meters (41 feet) and use up to four feet of tide under this alternative for the necessary underkeel clearance. However, the vessels importing fertilizer must first cross the Panama Canal, which has a 12 meter (39.5 foot) draft constraint. Given this constraint, the tankers would only be using a maximum of .76 meters (2.5 feet) of tide to enter the Port under this alternative. The expected tidal delay for this alternative is about 1.5 hours (vs. about 4 hours under Alternative 2, which utilizes up to four feet of tides).

Table 17 displays how the increase in vessel loading capacity for Alternative 3 translates into reduced vessel trips and transportation costs.

**Table 17**
**Alternative 3**
Liquid Fertilizer Imports
Projected Transportation Costs ($1,000s)

| | Without Project | | With Project | | |
|---|---|---|---|---|---|
| Year | Trips/Yr | Cost/Yr | Trips/Yr | Total | Reduction |
| 2000 | 9 | $4,359 | 7 | $3,722 | $637 |
| 2010 | 15 | $7,265 | 10 | $5,318 | $1,947 |
| 2020-2049 | 20 | $9,686 | 14 | $7,445 | $2,241 |

The NPV of projected transportation costs under Alternative 3 is about $79.261 million. The annualized value is approximately $5.653 million, which is $1,513,000 less than the computed value under without project conditions.

Simulation results yielded a mean annual transportation cost of $5.738 million, with a standard deviation of $894,000. Mean transportation cost savings totaled $1,491,000, with a standard deviation of $465,000 and the following confidence levels:

| | |
|---|---|
| 5% | $786,000 |
| 10% | $918,000 |
| 50% | $1,464,000 |
| 90% | $2,080,000 |
| 95% | $2,304,000 |

- Gypsum

Under Alternative 3, 12.5 meters (41 feet) of depth is available, representing an additional 1.8 meters (6 feet) relative to without project conditions. The maximum cargo volume given the additional depth under this alternative is estimated at about 47,500 MT. Hence, an additional 14,250 MT can be carried per vessel trip. Note that drafts for this trade route are not constrained by the depth of the Panama Canal, as is the case for liquid fertilizer imports. Therefore, bulk vessels could load to capacity (or 12.2 meters/40 feet) under this alternative. Assuming a four feet underkeel clearance requirement, vessels would need to use maximum tides of three feet.

Table 18 displays how the increase in vessel loading capacity for Alternative 3 translates into reduced vessel trips and transportation costs.

**Table 18**
**Alternative 3**
Gypsum Imports
Projected Transportation Costs ($1,000s)

| | Without Project | | With Project | | |
|---|---|---|---|---|---|
| Year | Trips/Yr | Cost/Yr | Trips/Yr | Total | Reduction |
| 2000 | 4 | $213 | 3 | $178 | $35 |
| 2010 | 6 | $319 | 4 | $238 | $81 |
| 2020-2049 | 8 | $426 | 6 | $356 | $70 |

The NPV of projected transportation costs under Alternative 3 is about $3.7 million. The annualized value is approximately $266,000, which is $62,000 less than the computed value under without project conditions.

Simulation results yielded a mean annual transportation cost of $267,000, with a standard deviation of $39,000. Mean transportation cost savings totaled $64,000, with a standard deviation of $22,000 and the following confidence levels:

| | |
|---|---|
| 5% | $29,000 |
| 10% | $37,000 |
| 50% | $63,000 |
| 90% | $92,000 |
| 95% | $102,000 |

- Total Benefits

The combined total of mean transportation benefits under Alternative 3 is:

| | |
|---|---|
| Liquid Fertilizer | $1,491,000 |
| Gypsum | $64,000 |
| Total | $1,555,000 |

Alternative 4

- Liquid Fertilizer

Under Alternative 4, 13 meters (42.7 feet) of depth is available, representing an additional 2.3 meters (7.7 feet) relative to without project conditions. The maximum cargo volume given the additional depth under this alternative is estimated at about 46,654 MT. Hence, an additional 13,404 MT can be carried per vessel trip. The increase in cargo volume is limited to the same amount as specified for Alternative 3. With full use of tides, tankers could load up to a maximum draft of 12.5 meters (42.7 feet) and use up to four feet of tide under this alternative for the necessary underkeel clearance. However, the vessels importing fertilizer must first cross the Panama Canal, which has a 12 meter (39.5 foot) draft constraint. Given this constraint, the tankers would only be using a maximum of .24 meters (0.8 feet) of tide to enter the Port under this alternative. The expected tidal delay for this alternative is about 0.13 hours (vs. about 4 hours under Alternative 2 and 1.8 hour under Alternative 3).

Table 19 displays how the increase in vessel loading capacity for Alternative 4 translates into reduced vessel trips and transportation costs. Note that vessel trips are the same for Alternatives 3 and 4. However, Alternative 4 has slightly lower transportation costs than Alternative 3 due to a reduction in expected tidal delays.

**Table 19**
**Alternative 4**
Liquid Fertilizer Imports
Projected Transportation Costs ($1,000s)

| | Without Project | | With Project | | |
|---|---|---|---|---|---|
| Year | Trips/Yr | Cost/Yr | Trips/Yr | Total | Reduction |
| 2000 | 9 | $4,359 | 7 | $3,714 | $645 |
| 2010 | 15 | $7,265 | 10 | $5,306 | $1,959 |
| 2020-2049 | 20 | $9,686 | 14 | $7,429 | $2,257 |

The NPV of projected transportation costs under Alternative 4 is about $79.088 million. The annualized value is approximately $5.640 million, which is $1,526,000 less than the computed value under without project conditions.

Simulation results yielded a mean annual transportation cost of $5.729 million, with a standard deviation of $889,000. Mean transportation cost savings totaled $1,500,000, with a standard deviation of $468,000 and the following confidence levels:

| | |
|---|---|
| 5% | $792,000 |
| 10% | $920,000 |
| 50% | $1,474,000 |
| 90% | $2,102,000 |
| 95% | $2,327,000 |

▸ Gypsum

Under Alternative 4, 13 meters (42.7 feet) of depth is available, representing an additional 2.3 meters (7.7 feet) relative to without project conditions. The maximum cargo volume given the additional depth under this alternative is estimated at about 47,500 MT. Hence, an additional 14,250 MT can be carried per vessel trip. This is the same as for Alternative 3. However, Alternative 4 has lower projected transporation costs than Alternative 3 due to a reduced reliance on tides. Assuming a four feet underkeel clearance requirement, vessels would need to use maximum tides of 1.3 feet under Alternative 4, relative to 3 feet under Alternative 3.

Table 20 displays how the increase in vessel loading capacity for Alternative 4 translates into reduced vessel trips and transportation costs.

**Table 20**
**Alternative 4**
Gypsum Imports
Projected Transportation Costs ($1,000s)

| | Without Project | | With Project | | |
|---|---|---|---|---|---|
| Year | Trips/Yr | Cost/Yr | Trips/Yr | Total | Reduction |
| 2000 | 4 | $213 | 3 | $175 | $38 |
| 2010 | 6 | $319 | 4 | $233 | $86 |
| 2020-2049 | 8 | $426 | 6 | $350 | $76 |

The NPV of projected transportation costs under Alternative 4 is about $3.7 million. The annualized value is approximately $261,000, which is $67,000 less than the computed value under without project conditions.

Simulation results yielded a mean annual transportation cost of $262,000, with a standard deviation of $39,000. Mean transportation cost savings totaled $69,000, with a standard deviation of $22,000 and the following confidence levels:

| | |
|---|---|
| 5% | $35,000 |
| 10% | $42,000 |
| 50% | $68,000 |
| 90% | $98,000 |
| 95% | $107,000 |

▸ Total Benefits

The combined total of mean transportation benefits under Alternative 4 is:

| | |
|---|---|
| Liquid Fertilizer | $1,500,000 |
| Gypsum | $69,000 |
| Total | $1,569,000 |

## Summary

Table 21 summarizes mean expected annual transportation savings by alternative.

**Table 21**
Expected Annual Benefits by Alternative
($1,000s)

| | Fertilizer | Gypsum | Total |
|---|---|---|---|
| Alternative 1 | $1,078 | $37 | $1,115 |
| Alternative 2 | $1,444 | $52 | $1,496 |
| Alternative 3 | $1,491 | $64 | $1,555 |
| Alternative 4 | $1,500 | $69 | $1,569 |

Table 22 summarizes results of the Risk & Uncertainty analysis.

**Table 22**
Risk & Uncertainty Analysis
Summary

| | Mean Benefits | Std Dev. | 5% | 95% |
|---|---|---|---|---|
| Alternative 1 | $1,115 | $460 | $394 | $1,911 |
| Alternative 2 | $1,496 | $486 | $753 | $2,335 |
| Alternative 3 | $1,555 | $487 | $815 | $2,406 |
| Alternative 4 | $1,569 | $490 | $827 | $2,434 |

## Costs

The following table summarizes costs by alternative

**Table 23**
Port Hueneme
Expected Annual Costs by Alternative
($1,000s)

| | Alt 1 | Alt 2 | Alt 3 | Alt 4 |
|---|---|---|---|---|
| Mob/Demob | $900 | $900 | $900 | $900 |
| Wharf Modifications | $2,571 | $2,571 | $2,571 | $2,571 |
| Dredging | $1,166 | $1,649 | $2,163 | $2,694 |
| Subtotal | $4,637 | $5,120 | $5,634 | $6,165 |
| Contingency (25%) | $1,159 | $1,280 | $1,409 | $1,541 |
| Subtotal | $5,796 | $6,400 | $7,043 | $7,706 |
| PE&D (11%) | $638 | $704 | $775 | $848 |
| S&A (6.5%) | $377 | $416 | $458 | $501 |
| Total First Cost | $6,811 | $7,520 | $8,275 | $9,055 |
| IDC (1 Yr Const. Period) | $212 | $234 | $258 | $282 |
| Gross Investment | $7,023 | $7,754 | $8,533 | $9,337 |
| Annual Cost (50 yrs, 6 7/8%) | $501 | $553 | $609 | $666 |
| O&M | -- | -- | -- | -- |
| Total Annual Cost | $501 | $553 | $609 | $666 |

**Benefit/Cost Analysis**

Table 24 presents the benefit/cost analysis for the alternatives under consideration.

**Table 24**
Port Hueneme
Benefit/Cost Analysis

| | Alt 1 | Alt 2 | Alt 3 | Alt 4 |
|---|---|---|---|---|
| Expected Annual Benefits | $1,115 | $1,496 | $1,555 | $1,569 |
| Expected Annual Costs | $501 | $553 | $609 | $666 |
| Net Benefits | $614 | $943 | $946 | $903 |
| Benefit/Cost Ratio | 2.23 | 2.71 | 2.56 | 2.36 |

As shown above, net benefits for Alternatives 2 and 3 are approximately equal. The marginal increases in benefits for Alternatives 3 and 4 are limited by the fact that vessel drafts for liquid fertilizer imports are constrained by the Panama Canal. Therefore, reductions in transportation costs for these alternatives are primarily comprised of reductions in expected delay costs while awaiting sufficient tides. As noted earlier in this report, these costs are minimal compared to the overall transportation costs.

**Recommended Plan**

As described in the Benefit/Cost Analysis section above, Alternatives 2 (12M/39.4') and 3 (12.5M/41') have essentially equivalent net benefits. In order to optomize net NED benefits, an intermediate alternative has been evaluated, specifically dredging to 12.2M/40' (Alternative 2A).

Benefits

- Liquid Fertilizer

Under Alternative 2A, 12.2 meters (40 feet) of depth is available, representing an additional 1.5 meters (5 feet) relative to without project conditions. The maximum cargo volume given the additional depth under this alternative is estimated at about 46,654 MT. Hence, an additional 13,404 MT can be carried per vessel trip. The increase in cargo volume is limited. With full use of tides, tankers could load up to a maximum draft of 12.2 meters (40 feet) and use up to four feet of tide under this alternative for the necessary underkeel clearance. However, the vessels importing fertilizer must first cross the Panama Canal, which has a 12 meter (39.5 foot) draft constraint. Given this constraint, the tankers would only be using a maximum of 1.1 meters (3.5 feet) of tide to enter the Port. The expected tidal delay for this alternative is about 3 hours.

Table 25 displays how the increase in vessel loading capacity translates into reduced vessel trips and transportation costs.

**Table 25**
**Alternative 2A**
Liquid Fertilizer Imports
Projected Transportation Costs ($1,000s)

| | Without Project | | With Project | | |
|---|---|---|---|---|---|
| Year | Trips/Yr | Cost/Yr | Trips/Yr | Total | Reduction |
| 2000 | 9 | $4,359 | 7 | $3,731 | $628 |
| 2010 | 15 | $7,265 | 10 | $5,330 | $1,935 |
| 2020-2049 | 20 | $9,686 | 14 | $7,463 | $2,223 |

The NPV of projected transportation costs is about $79.45 million. The annualized value is approximately $5.666 million, which is $1,500,000 less than the computed value under without project conditions.

Simulation results yielded a mean annual transportation cost of $5.775 million, with a standard deviation of $874,000. Mean transportation cost savings totaled $1,483,000, with a standard deviation of $474,000 and the following confidence levels:

| | |
|---|---|
| 5% | $751,000 |
| 10% | $890,000 |
| 50% | $1,455,000 |
| 90% | $2,101,000 |
| 95% | $2,311,000 |

- Gypsum

The maximum cargo volume given the additional depth under this alternative is estimated at about 47,500 MT, or an additional 14,250 MT per vessel trip more than under without project conditions. Drafts for this trade route are not constrained by the depth of the Panama Canal, as is the case for liquid fertilizer imports. Therefore, bulk vessels could load to capacity (or 12.2 meters/40 feet) under this alternative. Assuming a four feet underkeel clearance requirement, vessels would need to use maximum tides of four feet.

Table 26 displays how the increase in vessel loading capacity translates into reduced vessel trips and transportation costs.

**Table 26**
**Alternative 2A**
Gypsum Imports
Projected Transportation Costs ($1,000s)

| | Without Project | | With Project | | |
|---|---|---|---|---|---|
| Year | Trips/Yr | Cost/Yr | Trips/Yr | Total | Reduction |
| 2000 | 4 | $213 | 3 | $182 | $31 |
| 2010 | 6 | $319 | 4 | $243 | $76 |
| 2020-2049 | 8 | $426 | 6 | $365 | $61 |

The NPV of projected transportation costs totals about $3.81 million. The annualized value is approximately $272,000, which is $56,000 less than the computed value under without project conditions.

Simulation results yielded a mean annual transportation cost of $274,000, with a standard deviation of $40,000. Mean transportation cost savings totaled $58,000, with a standard deviation of $22,000 and the following confidence levels:

| | |
|---|---|
| 5% | $24,000 |
| 10% | $30,000 |
| 50% | $56,000 |
| 90% | $86,000 |
| 95% | $94,000 |

- Total Benefits

The combined total of mean transportation benefits for Alternative 2A is:

| | |
|---|---|
| Liquid Fertilizer | $1,483,000 |
| Gypsum | $58,000 |
| Total | $1,541,000 |

- Risk & Uncertainty

The standard deviation for the total benefits of Alternative 2A is $496,000. The 95% confidence interval is therefore $549,000 to $2,533,000.

Costs

The following table displays the costs for Alternative 2A:

**Table 27**
**Alternative 2A**
Expected Annual Costs (in $1,000s)

| | |
|---|---|
| Mob/Demob | $900 |
| Wharf Modification | $2,571 |
| Dredging | $2,021 |
| Subtotal | $5,492 |
| Contingency (25%) | $1,373 |
| Subtotal | $6,865 |
| PE&D (11%) | $755 |
| S&A (6.5%) | $446 |
| Total First Cost | $8,066 |
| IDC (1 Yr Const. Period) | $251 |
| Gross Investment | $8,318 |
| Annual Cost (50 yrs, 6 7/8%) | $593 |
| O&M | -- |
| Total Annual Cost | $593 |

Benefit/Cost Analysis

Expected annual benefits and costs for Alternative 2A total $1,541,000 and $593,000, respectively. Net benefits equal $947,000, and the benefit/cost ratio is 2.60. This alternative is the NED plan, since it maximizes net benefits.

THE PORT OF HUENEME, PORT HUENEME, CALIFORNIA
DRAFT FEASIBILITY STUDY

# APPENDIX "B"

# REAL ESTATE ANALYSIS

FEBRUARY 1999

# The Port of Hueneme Feasibility Study
## Real Estate Appendix
## Table of Contents

**The Port of Hueneme Deep Draft Navigation Feasibility Study**
# Real Estate Appendix

## 1. Introduction

### 1.1 Location and Description of the Project

Port Hueneme Harbor is in Ventura County, California, which is located east of Santa Barbara County, South of Kern County and to the north and to the west of Los Angeles County. Approximately 35 miles of the county's southwestern border fronts on the Pacific Ocean. Port Hueneme Harbor is located on the ocean, mid-way along the coast, between the Santa Barbara and Los Angeles county lines. The city of Port Hueneme is located next to the harbor, the City of Oxnard is 16 kilometers to the south, and the City of Los Angeles is 105 kilometers southeast.

Port Hueneme Harbor is man-made, and was constructed by local interests in 1940. It originally provided 55 acres of protected water for commercial navigation. In 1942, the U.S. Navy acquired the entire port facility by condemnation. They subsequently added more wharf and terminal space. In 1947, the Navy leased the original wharf and some of the adjacent land area to the Oxnard Harbor District for commercial use. In 1961, ownership of the leased property was conveyed back to the Oxnard Harbor District thereby returning to them 22 acres of land and all the terminal facilities and wharfs which they had originally constructed. The Navy retained all facilities and wharfs which they had built, as well as all of the land which was adjacent to their terminals. In 1971, part of the harbor was dredged to a depth of 35 feet, and the remainder was dredged to that depth in 1975. The port now serves as a military and commercial port which can accommodate deep draft shipping needs.

The harbor incorporates the following: two rubble mound jetties about 244 m and 305 m long; an approach channel about 244 m long by 183 m wide with a depth of -12.2 m MLLW; a 472 m long entrance channel, 100.6 m wide at a depth of -11 m (-36 ft) MLLW; a turning basin 329 m long and 311 m wide with a depth of -10.7 m MLLW and Channel "A" which is 707 m long, 84 m wide, and a depth of -10.7 m MLLW.

### 1.2 Proposed Project

The Recommended Plan consists of the deepening of Port Hueneme Harbor including the approach channel (from -12.2 to 13.3 meters MLLW), the entrance channel (from -11 to -12.2 meters MLLW), and the turning basin and Channel "A" (from -10.7 to -12.2 meters MLLW). The harbor and the Recommended Plan features are shown in **Figure 1.2.**

### 1.3 Purpose of This Appendix

The purpose of this appendix is to examine the real estate required for the proposed project, as well as any associated for real estate costs.

### 1.4 Facilities and Utilities

There are no utilities, roadways or public facilities in the proposed project area which will require relocation.

### 1.5 HTRW

Investigations conducted as part of the feasibility study have shown that there were no HTRW issues or concerns in the study area

### 1.6 Mining or Gas and Oil Extraction

There are no mining or gas or oil extraction within the subject area.

### 1.7 Public Law 91-646

P.L. 91-646 ensures that persons displaced as a direct result of Federal or Federally assisted projects are treated fairly, consistently, and equitably so that such persons will not suffer disproportionate injuries as a result of projects designed for the benefit of the public as a whole. There are no P.L.91-646 relocations to consider within the proposed project area.

### 1.8 The Local Sponsor

The associated features of the proposed project consist of the dredging and deepening of Berths 1 and 5 and the associated wharf modification and stabilization of Wharves 1 and 2. The berthing areas and wharves along Channel "A" are owned and operated by the Local Sponsor, the Oxnard Harbor District. As the Local Sponsor, it is the Oxnard Harbor District's responsibility to construct and maintain any and all associated features of the proposed project. There are no real estate requirements for the construction of these associated features.

## 2 Real Estate Needs

### 2.1 The Harbor

The proposed project includes modification of the general navigation features of the harbor which consists of the dredging and deepening of the approach channel, entrance channel, turning basin, and Channel "A". These waters involved are subject to navigational servitude which is the Government's right to use, control and regulate the navigable waters of the United states and the submerged lands thereunder, for various commerce-related purposes. Under this right, which has been grated by the Commerce Clause of the U.S. Constitution, the Government will not acquire real property interests in the land to which the navigational servitude applies.

### 2.2 The Staging Area

The proposed dredging and wharf modification will require use of a portion of the U.S. Navy's Battalion Center property. (The property is zoned for industrial uses and permits staging activities.) The proposed staging site, which is located in the southwest corner of the Navy's lot, incorporates approximately 5,600 (square meters) $m^2$ of space. The area is shown in Figure 1.2. This portion of the lot is paved and is routinely used for similar uses by both the Navy and the Corps therefore, there would be no real estate costs associated with its use.

### 2.3 Dredged Material Disposal

As part of the proposed project, dredged material will be placed on or near shore of Hueneme Beach, located adjacent to the harbor's east jetty (refer to Figure 1.2). If a hydraulic dredge is used, a pipeline will convey the dredged material across lands owned by the Oxnard Harbor District to the beach. If a clam shell dredge and hopper barge is used, the barge, once filled will be maneuvered near shore of Hueneme Beach for placement of the material in the near shore zone. Hueneme Beach has been used in the past by the Corps as a dredged material disposal area in support of maintenance dredging operations of Port Hueneme Harbor and Channel Islands Harbor which is located approximately 2 km upcoast. Hueneme Beach is owned and maintained by the City of Port Hueneme. No real estate costs or requirements are expected with regard to dredged material disposal since the City of Port Hueneme will benefit from the replenishment of Hueneme Beach.

### 2.4 Estimated Dredging Costs

It is estimated that a total of 485,000 cubic meters will be dredged from the harbor, and disposed of at Port Hueneme Beach, at a cost of about $4.00 per cubic meter. The exception would be in an area of the harbor which is referred to as the "Pile Zone". The area was given the name when an underwater a diver making a geotechnical field investigation discovered numerous cutoff piles, up to 460 mm in diameter, protruding from the channel bottom. Subsequent research done to clarify the matter of the piles, shows that they are likely to be the remains of the original timber wharf which was built along the south side of the harbor when the harbor was constructed in 1939-1940. The wharf was removed in the early 1970's, under a contract administered by the Oxnard Harbor District, at the period when the replacement wharf 1 was being built, and when the widening and lengthening of channel "A" and the overall deepening of the harbor was taking place. Some of the piles appear to have been removed while others were snapped off or cutoff at or slightly above the mudline. Based on diver observations, it is estimated that approximately 350 piles remain.. Dredging in the "Pile Zone"will remove approximately 26,000 cubic meters of material at an estimated at $9.50 per cubic meter. This cost includes the disposal of the dredged material, as well as the cost of removing and disposing of the piles which will be transported to an upland landfill site. Aside from the unit dredging cost, there will be no additional costs associated with the disposal of the "Pile Zone" material.

## 3 Conclusion

Based on the findings described above, there are no real estate requirements or real estate costs associated with the construction of the proposed harbor deepening project at the Port of Hueneme.

THE PORT OF HUENEME, PORT HUENEME, CALIFORNIA
DRAFT FEASIBILITY STUDY

# APPENDIX "C"

# COST ENGINEERING ANALYSIS

FEBRUARY 1999

PORT HUENEME DEEPENING PROJECT
VENTURA COUNTY, CALIFORNIA
FEASIBILITY STUDY

COST ESTIMATE

1.01 Project Study Authorization: The Port Hueneme project was authorized to be studied by a June 10, 1992, Resolution of the Committee on Public Works and Transportation of the House of Representatives. Flood Control Act 70, Section 216 - Restudy of Completed Project.

1.02 Study Location and Description: The study location is approximately 104.6 kilometers (65 miles) northwest of Los Angeles in Ventura County. The study location is shown in Chapter 2 in Figure 2-1. The Port Hueneme Harbor is a deep-draft commercial and military harbor. The facilities occupy an area immediately west of the City of Port Hueneme. Channel Islands Harbor and the cities of Oxnard and Ventura are also near the Port.

1.03 General: This section presents preliminary cost estimates for the Feasibility Study on Port Hueneme Deepening Project, California. The cost estimates for the Port Hueneme project were prepared and calculated using computerized Corps of Engineers Dredging Estimating Program (CEDEP) developed by the U.S. Army Corps of Engineers in the Jacksonville District and the Walla Walla District and the Micro-Computer Aided Cost Estimating System (MCACES). The project is in metric measurements. The estimate was prepared in accordance with accepted construction cost estimating practice. Cost estimates were developed from information data provided by U.S. Army Corps of Engineers, Engineering Division, Coastal Engineering Section, Project Design Engineer representative and Planning Division, Coastal Resources Branch, North Coastal Section, Study Manager. Unit cost rates were estimated based on dredging quantities, equipment, material, and labor requirements, site-specific conditions, and scope of work. Overhead, profit, and bond were computed and distributed to the unit costs. Results were compared to historical bid abstracts where possible. Planning, Engineering and Design includes costs to produce design documents, plans and specifications, and any model testing necessary for the final design. The cost is based on a preliminary estimate coordinated with appropriate elements of the Los Angeles District. Supervision and Administration costs cover the administration of the contract during construction. The cost is also coordinated with appropriate elements of the Los Angeles District. Engineering Regulation ER 1110-2-1302, dated 31 March 1994, recommends a 25% contingency for the Feasibility study phase.

1.04 Estimating Assumptions: The estimating assumptions are as follows:

(a) Dredging will be accomplished utilizing pipeline and clamshell dredge equipment;

(b) hazardous and toxic waste is not expected to be encountered during construction;

(c) equipment, labor and material are sufficient in the local area to accomplish the work;

(d) construction equipment used on the job includes, but not limited to, hydraulic pipeline dredge, mechanical clamshell dredge, loaders, tractors, track-type bulldozers, and trucks. Construction labor including marine equipment, operators, oilers, truck drivers, dredge operators, divers, and labors are in adequate supply in the area;

(e) there are competent contractors in the southern California area to bid on the job once it is approved.

The project cost estimate to deepen the project's navigation approach, entrance channels, turning basin and the Oxnard Harbor District's berthing areas along Wharfs #1, and #2, are provided in Tables 1 thru 4. Preliminary wharf modifications is estimated to be a cost, including contingency of $3,213,000. It is assumed that the Mob/Demob, PE&D and S&A costs will be financed by both Operation and Maintenance(O&M)funds and Construction General(CG) funds. The cost sharing for these two fund items are to be computed based upon the percentage of the total dredged material quantity cost to be financed by each funding source. Construction will require the removal of an upper section of abandoned wood piles located in the turning basin and Berth 1, identified as the "pile zone".

1.05 Tables 1 thru 6: Tables 1 thru 6 present preliminary cost estimates for each of the project area depth components in the proposed plan. The method of construction is the use of a hydraulic pipeline dredge for the harbor excluding the area "pile zone". In the pile zone a mechanical dredge clamshell would be used to dredge to the project depth. The wood piles encountered will either be pulled out or cut off at the project depth. The sediment from the pile zone will be placed on a barge and disposed in the near shore at Hueneme Beach. O&M will not pay for over depth cost. The cost estimate tables were developed by transferring the estimated dollar figures from the CEDEP and MCACES programs.

FEASIBILITY STUDY, PORT HUENEME DEEPENING PROJECT, VENTURA COUNTY, CALIFORNIA, COST ESTIMATE

The tables are in metric measurements. The contents of the tables are as follows:

| Table | Title | Total Project Cost | Depth (m) MLLW |
|---|---|---|---|
| 1: | Operations & Maintenance* | $683,997 | 12.2 & 10.7 |
| 2: | Alternative 1 | $6,811,386 | 12.5 & 11.5 |
| 3: | Alternative 2 | $7,520,143 | 13 & 12 |
| 4: | Alternative 2a | $8,066,486 | 13.3 & 12.2 |
| 5: | Alternative 3 | $8,274,970 | 13.5 & 12.5 |
| 6: | Alternative 4 | $9,054,979 | 14 & 13 |

* Current Authorized Depth

The estimated total project cost includes Planning, Engineering, and Design (PE&D), and Construction Management (S&A). A contingency of 25% is added to the rest of the project to reflect the uncertainties with respect to quantities, cost, level of design and environmental concerns. The Planning, Engineering and Design cost was computed at 11% of the total dredge construction contract cost. The supervision and administration cost was computed at 6.5% of the total dredge construction contract cost.

1.06 Conclusion: After reviewing the cost estimates and comparing these to previous bids for similar project and historical data, this estimate constitutes a fair and reasonable government estimate. The input data is sufficient and widespread enough and the numbers are reasonable to be the best representation for the total cost for the project improvements.

## TABLE 1, O&M

| CODE OF ACCT | DESCRIPTION | QUANTITY m3 | UNIT | OVERDEPTH QUANTITY m3(0.5m) | UNIT | UNIT PRICE | COST WITHOUT CONTINGENCY | CONTINGENCY | COST WITH CONTINGENCY | Note (3) CONTINGENCY PERCENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | **PORT HUEMENE HARBOR DEEPENING PROJECT** | | | | | | | | | |
| | **PRELIMINARY COST ESTIMATE FOR FEASIBILITY STUDY** | | | | | | | | | |
| | Operations & Maintenance (O&M) | | | | | | | | | |
| 120A | MOB/DEMOB | 1 | JOB | 0 | LS | $300,500 | $300,500 | $75,100 | $375,600 | 25.0% |
| 1203B | PROJECT AREA - DEPTH (m) MLLW | | | | | | | | | |
| | APPROACH CHANNEL 12.2 | 13,500 | m3 | 0 | m3 | $4.40 | $59,400 | $14,900 | $74,300 | 25.0% |
| | ENTRANCE CHANNEL 10.7 | 11,300 | m3 | 0 | m3 | $4.45 | $50,285 | $12,600 | $62,885 | 25.0% |
| | TURNING BASIN 10.7 | 12,600 | m3 | 0 | m3 | $4.40 | $55,440 | $13,900 | $69,340 | 25.0% |
| | TOTAL( O&M )MATERIAL QUANTITY | 37,400 | m3 | | | | | | | |
| | | | | | | | | | | |
| | TOTAL( O&M ) DREDGE COST | | | | | | $465,625 | | $582,125 | |
| 30-- | PE&D | 1 | LS | | | $51,218.75 | $51,200 | | $64,034 | 11.0% |
| 31-- | S&A | 1 | LS | | | $33,593.63 | $33,600 | | $37,838 | 6.5% |
| | | | | | | | | | | |
| | TOTAL O&M PROJECT COST | | | | | | $550,425 | | $683,997 | |

NOTES:
(1) m - Depth in Meters (MLLW)
(2) m3-Volume in Cubic Meters
(3) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, recomendation of 25% contingency factor which represents a reasonable percentage for the construction feature of the cost estimate for a feasiblity phase.
(4) Eleven percent (11%) of Total Construction for PE&D.
(5) Six and a half percent (6.5%) of Total Construction for S&A.
(6) Scenario I , O&M will not pick-up any overdepth cost, per Study Manager.
(7) Method is the use of a Hydraulic pipeline dredge for the harbor project, excluding the "Pile Zone." A clamshell dredge will be used in the "Pile Zone."
Revised Mob/Demob per review comment, E-MAIL, dtd 10/24/97, ED-Cost Engineering.

## ALTERNATIVE 1

PORT HUEMENE HARBOR DEEPENING PROJECT
PRELIMINARY COST ESTIMATE FOR FEASIBILITY STUDY

| CODE OF ACCT | DESCRIPTION | QUANTITY | UNIT | OVERDEPTH QUANTITY m3(0.5m) | UNIT | UNIT PRICE | COST WITHOUT CONTINGENCY | CONTINGENCY | COST WITH CONTINGENCY | Note (3) CONTINGENCY PERCENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | **DREDGING COSTS** | | | | | | | | | |
| 120A | MOB/DEMOB | 1 | JOB | | LS | $900,000 | $900,000 | $225,000 | $1,125,000 | 25.0% |
| 1203B | PROJECT AREA - DEPTH (m) MLLW | | | | | | | | | |
| | APPROACH CHANNEL 12.5 | 25,200 | m3 | 29,400 | m3 | $3.65 | $199,290 | $49,800 | $249,090 | 25.0% |
| | ENTRANCE CHANNEL 11.5 | 38,600 | m3 | 23,000 | m3 | $3.60 | $221,760 | $55,400 | $277,160 | 25.0% |
| | TURNING BASIN 11.5 | 92,308 | m3 | 62,322 | m3 | $3.50 | $541,205 | $135,300 | $676,505 | 25.0% |
| | *TURNING BASIN (Pile Zone)* 11.5 | 5,892 | m3 | 3,978 | m3 | $10.99 | $108,471 | $27,100 | $135,571 | 25.0% |
| | GENERAL NAVIGATION FEATURES DREDGING COST | | | | | | $1,970,726 | $492,600 | $2,463,326 | |
| | Wharf #1 ( Berth 1 only, pile zone) 11.5 | 4,700 | m3 | 2,167 | m3 | $10.99 | $75,468 | $18,900 | $94,368 | 25.0% |
| | Wharf #2 (Berth 5 is 1/2 of Wharf 2) 11.5 | 3,050 | m3 | 1,400 | m3 | $4.65 | $20,693 | $5,200 | $25,893 | 25.0% |
| | BERTHING AREA DREDGING COST | | | | | | $96,161 | $24,100 | $120,261 | |
| | **TOTAL DREDGE COST** | | | | | | $2,066,887 | $516,700 | $2,583,587 | |
| 12-- | ASSOC COST (Wharf Modification) | 1 | JB | | LS | | $2,570,670 | $642,668 | $3,213,338 | 25.0% |
| | SUBTOTAL | | | | | | $4,637,557 | $1,159,368 | $5,796,925 | |
| 30-- | PE&D | 1 | LS | | | | | | $637,662 | 11.0% |
| 31-- | S&A | 1 | LS | | | | | | $376,800 | 6.5% |
| | **TOTAL PROJECT COST** | | | | | | | | $6,811,386 | |

NOTES:
(1) m - Depth in Meters (MLLW)
(2) m3-Volume in Cubic Meters
(3) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, *recomendation of 25% contingency factor* which represents a reasonable percentage for the construction feature of the cost estimate for a feasiblity phase.
(4) Eleven percent (11%) of Total Construction for PE&D.
(5) Six and a half percent (6.5%) of Total Construction for S&A.
(6) This cost estimate was developed based on the use of a hydraulic pipeline dredge for the harbor project, and the use of a clamshell dredge in the "Pile Zone."
Revised Mob/Demob per review comment, E-MAIL, dtd 10/24/97, ED-Cost Engineering.
** Wharf Modification includes Berths 1 (183m ) & Berth 5 (233m) and Channel Entrance Wharf (91.5m), A-E Noble Consultants, Inc.

ALTERNATIVE 2

PORT HUEMENE HARBOR DEEPENING PROJECT
PRELIMINARY COST ESTIMATE FOR FEASIBILITY STUDY

| CODE OF ACCT | DESCRIPTION | QUANTITY | UNIT | OVERDEPTH QUANTITY m3(0.5m) | UNIT | UNIT PRICE | COST WITHOUT CONTINGENCY | CONTINGENCY | COST WITH CONTINGENCY | Note (3) CONTINGENCY PERCENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | **DREDGING COSTS** | | | | | | | | | |
| 120A | MOB/DEMOB | 1 | JOB | 0 | LS | $900,000 | $900,000 | $225,000 | $1,125,000 | 25.0% |
| 1203B | PROJECT AREA - DEPTH (m) MLLW | | | | | | | | | |
| | APPROACH CHANNEL 13 | 51,500 | m3 | 32,100 | m3 | $3.50 | $292,600 | $73,200 | $365,800 | 25.0% |
| | ENTRANCE CHANNEL 12 | 64,100 | m3 | 23,000 | m3 | $3.55 | $309,205 | $77,300 | $386,505 | 25.0% |
| | TURNING BASIN 12 | 158,014 | m3 | 66,364 | m3 | $3.50 | $785,323 | $196,300 | $981,623 | 25.0% |
| | TURNING BASIN (PILE ZONE) 12 | 10,086 | m3 | 4,236 | m3 | $9.90 | $141,788 | $35,400 | $177,188 | 25.0% |
| | GENERAL NAVIGATION FEATURES DREGDING COST | | | | | | $2,428,916 | $607,200 | $3,036,116 | |
| | | | | | | | | | | |
| | Wharf #1 ( Berth 1 only, pile zone) 11.5 | 7,300 | m3 | 2,167 | m3 | $9.90 | $93,723 | $23,400 | $117,123 | 25.0% |
| | | | | | | | | | | |
| | Wharf #2 (Berth 5 is 1/2 of Wharf 2) 11.5 | 4,500 | m3 | 1,400 | m3 | $4.55 | $26,845 | $6,700 | $33,545 | 25.0% |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | BERTHING AREA DREDGING COST | | | | | | $120,568 | $30,100 | $150,668 | |
| | | | | | | | | | | |
| | **TOTAL DREDGE COST** | | | | | | $2,549,484 | $637,300 | $3,186,784 | |
| | | | | | | | | | | |
| 12-- | ASSOC COST (Wharf Modification **) | 1 | JB | | LS | | $2,570,670 | $642,668 | $3,213,338 | 25.0% |
| | | | | | | | | | | |
| | SUBTOTAL | | | | | | $5,120,154 | $1,279,968 | $6,400,122 | |
| | | | | | | | | | | |
| 30-- | PE&D | 1 | LS | | | | | | $704,013 | 11.0% |
| 31-- | S&A | 1 | LS | | | | | | $416,008 | 6.5% |
| | | | | | | | | | | |
| | **TOTAL PROJECT COST** | | | | | | | | $7,520,143 | |

NOTES:

(1) m - *Depth in Meters (MLLW)*

(2) m3-Volume in Cubic Meters

(3) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, recomendation of 25% contingency factor which represents a reasonable percentage for the construction feature of the cost estimate for a feasiblity phase.

(4) Eleven percent (11%) of Total Construction for PE&D.

(5) Six and a half percent (6.5%) of Total Construction for S&A.

(6) This cost estimate was developed based on the use of a hydraulic pipeline dredge for the harbor project, and the use of a clamshell dredge in the "Pile Zone."

Revised Mob/Demob per review comment, E-MAIL, dtd 10/24/97, ED-Cost Engineering.

** Wharf Modification includes Berths 1 (183m ) & Berth 5 (233m) and Channel Entrance Wharf (91.5m), A-E Noble Consultants, Inc.

ALTERNATIVE 2a

Table 4

PORT HUEMENE HARBOR DEEPENING PROJECT
PRELIMINARY COST ESTIMATE FOR FEASIBILITY STUDY

| CODE OF ACCT | DESCRIPTION | QUANTITY | UNIT | OVERDEPTH QUANTITY m3(0.5m) | UNIT | UNIT PRICE | COST WITHOUT CONTINGENCY | CONTINGENCY | COST WITH CONTINGENCY | Note (3) CONTINGENCY PERCENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | **DREDGING COSTS** | | | | | | | | | |
| 120A | MOB/DEMOB | 1 | JOB | 0 | LS | $900,000 | $900,000 | $225,000 | $1,125,000 | 25.0% |
| 1203B | PROJECT AREA - DEPTH (m) MLLW | | | | | | | | | |
| | APPROACH CHANNEL 13.2 | 62,000 | m3 | 33,000 | m3 | $3.85 | $365,750 | $91,400 | $457,150 | 25.0% |
| | ENTRANCE CHANNEL 12.2 | 77,000 | m3 | 23,000 | m3 | $4.00 | $400,000 | $100,000 | $500,000 | 25.0% |
| | TURNING BASIN 12.2 | 188,000 | m3 | 67,680 | m3 | $3.80 | $971,584 | $242,900 | $1,214,484 | 25.0% |
| | TURNING BASIN (PILE ZONE) 12.2 | 12,000 | m3 | 4,320 | m3 | $9.50 | $155,040 | $38,800 | $193,840 | 25.0% |
| | GENERAL NAVIGATION FEATURES DREDGING COST | | | | | | $2,792,374 | $698,100 | $3,490,474 | |
| | | | | | | | | | | |
| | Wharf #1 (Berth 1 only, pile zone) 12.2 | 7,653 | m3 | 2,167 | m3 | $9.50 | $93,290 | $23,300 | $116,590 | 25.0% |
| | | | | | | | | $0 | | 25.0% |
| | Wharf #2 (Berth 5 is 1/2 ofWharf 2) 12.2 | 4,935 | m3 | 1,400 | m3 | $5.65 | $35,793 | $8,900 | $44,693 | 25.0% |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | BERTHING AREA DREDGING COST | | | | | | $129,083 | $32,200 | $161,283 | |
| | | | | | | | | | | |
| | **TOTAL DREDGE COST** | | | | | | $2,921,457 | $730,300 | $3,651,757 | |
| | | | | | | | | | | |
| 12-- | ASSOC COST (Wharf Modification **) | 1 | JB | | LS | | $2,570,670 | $642,668 | $3,213,338 | 25.0% |
| | | | | | | | | | | |
| | SUBTOTAL | | | | | | $5,492,127 | $1,372,968 | $6,865,094 | |
| | | | | | | | | | | |
| 30-- | PE&D | 1 | LS | | | | | | $755,160 | 11.0% |
| 31-- | S&A | 1 | LS | | | | | | $446,231 | 6.5% |
| | | | | | | | | | | |
| | **TOTAL PROJECT COST** | | | | | | | | $8,066,486 | |

NOTES:
(1) m - Depth in Meters (MLLW)
(2) m3-Volume in Cubic Meters
(3) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, recomendation of 25% contingency factor which represents a reasonable percentage for the construction feature of the cost estimate for a feasiblity phase.
(4) Eleven percent (11%) of Total Construction for PE&D.
(5) Six and a half percent (6.5%) of Total Construction for S&A.
(6) This cost estimate was developed based on the use of a hydraulic pipeline dredge for the harbor project, and the use of a clamshell dredge in the "Pile Zone."
Revised Mob/Demob per review comment, E-MAIL, dtd 10/24/97, ED-Cost Engineering.
** Wharf Modification includes Berths 1 (183m ) & Berth 5 (233m) and Channel Entrance Wharf (91.5m), A-E Noble Consultants, Inc.

## ALTERNATIVE 3

| CODE OF ACCT | DESCRIPTION | QUANTITY | UNIT | OVERDEPTH QUANTITY m3(0.5m) | UNIT | UNIT PRICE | COST WITHOUT CONTINGENCY | CONTINGENCY | COST WITH CONTINGENCY | Note (3) CONTINGENCY PERCENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | **PORT HUEMENE HARBOR DEEPENING PROJECT PRELIMINARY COST ESTIMATE FOR FEASIBILITY STUDY** | | | | | | | | | |
| | **DREDGING COSTS** | | | | | | | | | |
| 120A | MOB/DEMOB | 1 | JOB | 0 | LS | $900,000 | $900,000 | $225,000 | $1,125,000 | 25.0% |
| 1203B | *PROJECT AREA - DEPTH (m) MLLW* | | | | | | | | | |
| | APPROACH CHANNEL 13.5 | 79,500 | m3 | 33,800 | m3 | $3.50 | $396,550 | $99,100 | $495,650 | 25.0% |
| | ENTRANCE CHANNEL 12.5 | 96,000 | m3 | 23,000 | m3 | $3.53 | $420,070 | $105,000 | $525,070 | 25.0% |
| | TURNING BASIN 12.5 | 228,796 | m3 | 68,620 | m3 | $3.45 | $1,026,085 | $256,500 | $1,282,585 | 25.0% |
| | *TURNING BASIN (PILE ZONE)* 12.5 | 14,604 | m3 | 4,380 | m3 | $9.31 | $176,741 | $44,200 | $220,941 | 25.0% |
| | GENERAL NAVIGATION FEATURES DREDGING COST | | | | | | $2,919,446 | $729,800 | $3,649,246 | |
| | | | | | | | | | | |
| | Wharf #1 (Berth 1 only, pile zone) 12.5 | 9,900 | m3 | 2,167 | m3 | $9.31 | $112,344 | $28,100 | $140,444 | 25.0% |
| | | | | | | | | | | |
| | Wharf #2 (Berth 5 is 1/2 ofWharf 2) 12.5 | 6,500 | m3 | 1,400 | m3 | $4.00 | $31,600 | $7,900 | $39,500 | 25.0% |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | BERTHING AREA DREDGING COST | | | | | | $143,944 | $36,000 | $179,944 | |
| | | | | | | | | | | |
| | **TOTAL DREDGE COST** | | | | | | $3,063,390 | $765,800 | $3,829,190 | |
| | | | | | | | | | | |
| 12-- | ASSOC COST (Wharf Modification **) | 1 | JB | | LS | | $2,570,670 | $642,668 | $3,213,338 | 25.0% |
| | | | | | | | | | | |
| | SUBTOTAL | | | | | | $5,634,060 | $1,408,468 | $7,042,528 | |
| | | | | | | | | | | |
| 30-- | PE&D (Federal cost) | 1 | LS | | | | | | $774,678 | 11.0% |
| 31-- | S&A (Federal cost) | 1 | LS | | | | | | $457,764 | 6.5% |
| | | | | | | | | | | |
| | **TOTAL PROJECT COST** | | | | | | | | $8,274,970 | |

NOTES:

(1) m - Depth in Meters (MLLW)

(2) m3-Volume in Cubic Meters

(3) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, recomendation of 25% contingency factor which represents a reasonable percentage for the construction feature of the cost estimate for a feasiblity phase.

(4) Eleven percent (11%) of Total Construction for PE&D.

(5) Six and a half percent (6.5%) of Total Construction for S&A.

(7) This cost estimate was developed based on the use of a hydraulic pipeline dredge for the harbor project, and the use of a clamshell dredge in the "Pile Zone."

Revised Mob/Demob per review comment, E-MAIL, dtd 10/24/97, ED-Cost Engineering.

** Wharf Modification includes Berths 1 (183m ) & Berth 5 (233m) and Channel Entrance Wharf (91.5m), A-E Noble Consultants, Inc.

ALTERNATIVE 4

| CODE OF ACCT | DESCRIPTION | QUANTITY | UNIT | OVERDEPTH QUANTITY m3(0.5m) | UNIT | UNIT PRICE | COST WITHOUT CONTINGENCY | CONTINGENCY | COST WITH CONTINGENCY | Note (3) CONTINGENCY PERCENT |
|---|---|---|---|---|---|---|---|---|---|---|
| | PORT HUEMENE HARBOR DEEPENING PROJECT PRELIMINARY COST ESTIMATE FOR FEASIBILITY STUDY | | | | | | | | | |
| | DREDGING COSTS | | | | | | | | | |
| 120A | MOB/DEMOB | 1 | JOB | 0 | LS | $900,000 | $900,000 | $225,000 | $1,125,000 | 25.0% |
| 1203B | PROJECT AREA - DEPTH (m) MLLW | | | | | | | | | |
| | APPROACH CHANNEL 14 | 108,200 | m3 | 35,500 | m3 | $3.50 | $502,950 | $125,700 | $628,650 | 25.0% |
| | ENTRANCE CHANNEL 13 | 130,700 | m3 | 23,000 | m3 | $3.50 | $537,950 | $134,500 | $672,450 | 25.0% |
| | TURNING BASIN 13 | 302,868 | m3 | 71,252 | m3 | $3.45 | $1,290,714 | $322,700 | $1,613,414 | 25.0% |
| | TURNING BASIN (PILE ZONE) 13 | 19,332 | m3 | 4,548 | m3 | $8.91 | $212,771 | $53,200 | $265,971 | 25.0% |
| | GENERAL NAVIGATION FEATURES DREDGING COST | | | | | | $3,444,385 | $861,100 | $4,305,485 | |
| | Wharf #1 (Berth 1 only, pile zone) 13 | 11,000 | m3 | 2,167 | m3 | $8.91 | $117,318 | $29,300 | $146,618 | 25.0% |
| | Wharf #2 (Berth 5 is 1/2 ofWharf 2) 13 | 7,100 | m3 | 1,400 | m3 | $3.85 | $32,725 | $8,200 | $40,925 | 25.0% |
| | BERTHING AREA DREDGING COST | | | | | | $150,043 | $37,500 | $187,543 | |
| | **TOTAL DREDGE COST** | | | | | | $3,594,428 | $898,600 | $4,493,028 | |
| 12-- | ASSOC COST (Wharf Modification, See | 1 | JB | | LS | | $2,570,670 | $642,668 | $3,213,338 | 25.0% |
| | SUBTOTAL | | | | | | $6,165,098 | $1,541,268 | $7,706,365 | |
| 30-- | PE&D (Federal cost) | 1 | LS | | | | | | $847,700 | 11.0% |
| 31-- | S&A (Federal cost) | 1 | LS | | | | | | $500,914 | 6.5% |
| | **TOTAL PROJECT COST** | | | | | | | | $9,054,979 | |

NOTES:

(1) m - Depth in Meters (MLLW)
(2) m3-Volume in Cubic Meters
(3) Contingency percentage is based on ER 1110-2-1302 dated 31 March 1994, recomendation of 25% contingency factor which represents a reasonable percentage for the construction feature of the cost estimate for a feasiblity phase.
(4) Eleven percent (11%) of Total Construction for PE&D.
(5) Six and a half percent (6.5%) of Total Construction for S&A.
(6) This cost estimate was developed based on the use of a hydraulic pipeline dredge for the harbor project, and the use of a clamshell dredge in the "Pile Zone."
Revised Mob/Demob per review comment, E-MAIL, dtd 10/24/97, ED-Cost Engineering.
** Wharf Modification includes Berths 1 (183m ) & Berth 5 (233m) and Channel Entrance Wharf (91.5m), A-E Noble Consultants, Inc.

CHECKLIST FOR INPUT DATA.

| | |
|---|---|
| BID QUANTITY | 124,251 C.Y. |
| UNIT COST... | $2.95 PER C.Y. |
| EXCAV. COST. | $366,539 |
| TIME........ | 0.40 MONTHS |

PORT HUENEME FEASIBILTY STUDY

PG 1 OF 9: PROJECT TITLES

| | |
|---|---|
| FILENAME - | PTHA13-2.WK1 |
| PROJECT - | PORT HUENEME FEASIBILTY STUDY |
| LOCATION - | VENTURA COUNTY, CA |
| INVIT # - | APPROACH-DEPTH 13.2 WT/OD |
| DATE OF EST. - | JAN 7, 1999 |
| EST. BY - | I.LEYVA-TRACY |
| MOB. BID ITEM # - | 1 |
| EXCAV. BID ITEM # - | 1 |
| TYPE OF EST. - | Planning Estimate |

PG 2 OF 9: EXCAVATION QTY'S

| | |
|---|---|
| DREDGING AREA - | 1,136,022 sf |
| REQ'D EXCAVATION - | 81,090 cyds |
| PAY OVERDEPTH - | 43,161 cyds |
| CONTRACT AMOUNT - | 124,251 cyds |
| NOT DREDGED - | 0 cyds |
| NONPAY YARDAGE - | 0 cyds |
| GROSS YARDAGE - | 124,251 cyds |
| NONPAY HEIGHT - | 0.0 ft overdig. |
| TOTAL BANK HEIGHT - | 3.0 ft |

PG 3 OF 9: MAXIMUM PIPELINE REQUIRED

| | |
|---|---|
| FLOATING - | 7,000 ft |
| SUBMERGED - | 2,000 ft |
| SHORE - | 0 ft |
| TOTAL - | 9,000 ft |
| COST CATEGORY - | 2 SAND |
| EQUIVALENT - | 100 ft |

PG 4 OF 9: MATERIAL FACTOR

| DESCRIPTION | FACTOR | PERCENTAGE % |
|---|---|---|
| MUD & SILT | 3 | 16 |
| MUD & SILT | 2.5 | 0 |
| MUD & SILT | 2 | 0 |
| LOOSE SAND | 1.1 | 0 |
| LOOSE SAND | 1 | 84 |
| COMP. SAND | 0.9 | 0 |
| STIFF CLAY | 0.6 | 0 |
| COMP. SHELL | 0.5 | 0 |
| SOFT ROCK | 0.4 | 0 |
| BLAST. ROCK | 0.25 | 0 |

RESULTANT
MATERIAL FACTOR - 1.12

PG 5 OF 9: DREDGE SELECTION

| | |
|---|---|
| DREDGE SELECTED - | 30" HYDRAULIC DREDGE |
| COMPUTED BANK FACTOR - | 0.53 |
| BANK FACTOR USED - | 1 > |
| OTHER FACTOR - | 1 > |
| CLEANUP - | 8% More Time |

PG 6 OF 9: HORSEPOWER CONSIDERATIONS

| | |
|---|---|
| CHART H.P. - | 10,232 hp |
| AVAILABLE H.P. - | 10,232 hp |
| BOOSTER H.P. - | 5,200 hp(ea) |
| LOSS PER BOOSTER - | 15% |

PG 7 OF 9: CHART PRODUCTION ANALYSIS

| | |
|---|---|
| AVE. PIPELINE - | 9,000 ft |
| BOOSTERS - | 0 |
| BOOSTER FACTOR - | 1.00 |
| % EFF WORK TIME (GROSS)- | 75.0% |
| MAX. POSSIBLE - | 33,427 ft |
| TOTAL HP AVAIL - | 10,232 hp |
| % EFF WORK TIME (NET) - | 75.0% |
| OPERATING TIME - | 240 hours per month |

PG 8 OF 9: GROSS PRODUCTION & LOCAL AREA FACTORS

| | |
|---|---|
| PRODUCTION OVERRIDE - | YES |
| NET PRODUCTION - | 1,300 net cy per hour |
| OPERATING TIME - | 240 hours per month |
| BASED ON - | 0 booster(s) |
| PAY PRODUCTION - | 310,626 pay cy per month |
| PRESENT YEAR - | 1997 |
| ECONOMIC INDEX - | 5332 |
| LAF - | 1.14 |
| INTEREST RATE - | 5.400% /yr |
| TIME PERIOD - | September 15 to March 15 |
| PLANT AVAILABLE - | 11 mos/yr |
| FUEL PRICE - | $0.90 /gal |

PG 9 OF 9: OTHER ADJUSTMENTS

| | |
|---|---|
| SPECIAL COST/MO - | $1,500 REQUIRED REPORTS |
| SPECIAL COST LS - | $2,500 REQUIRED PERMITS |
| CONTRACTOR'S O.H. - | 6.0% |
| CONTRACTOR'S PROFIT - | 5.0% |
| CONTRACTOR'S BOND - | 1.0% |

CHECKLIST FOR INPUT DATA.

PORT HUENEME FEASIBILTY STUDY

| | |
|---|---|
| BID QUANTITY | 130,790 C.Y. |
| UNIT COST... | $3.08 PER C.Y. |
| EXCAV. COST. | $402,833 |
| TIME........ | 0.44 MONTHS |

PG 1 OF 9: PROJECT TITLES

| | |
|---|---|
| FILENAME - | PTHE12-2.WK1 |
| PROJECT - | PORT HUENEME FEASIBILTY STUDY |
| LOCATION - | VENTURA COUNTY, CA |
| INVIT # - | ENTRANCE-DEPTH 12.2 WT/OD |
| DATE OF EST. - | JAN 8, 1999 |
| EST. BY - | I.LEYVA-TRACY |
| MOB. BID ITEM # - | 1 |
| EXCAV. BID ITEM # - | 1 |
| TYPE OF EST. - | Planning Estimate |

PG 2 OF 9: EXCAVATION QTY'S

| | |
|---|---|
| DREDGING AREA - | 495,699 sf |
| REQ'D EXCAVATION - | 100,708 cyds |
| PAY OVERDEPTH - | 30,082 cyds |
| CONTRACT AMOUNT - | 130,790 cyds |
| NOT DREDGED - | 0 cyds |
| NONPAY YARDAGE - | 0 cyds |
| GROSS YARDAGE - | 130,790 cyds |
| NONPAY HEIGHT - | 0.0 ft overdig. |
| TOTAL BANK HEIGHT - | 7.1 ft |

PG 3 OF 9: MAXIMUM PIPELINE REQUIRED

| | |
|---|---|
| FLOATING - | 7,000 ft |
| SUBMERGED - | 2,000 ft |
| SHORE - | 0 ft |
| TOTAL - | 9,000 ft |
| COST CATEGORY - | 2 SAND |
| EQUIVALENT - | 100 ft |

PG 4 OF 9: MATERIAL FACTOR

| DESCRIPTION | FACTOR | PERCENTAGE % |
|---|---|---|
| MUD & SILT | 3 | 16 |
| MUD & SILT | 2.5 | 0 |
| MUD & SILT | 2 | 0 |
| LOOSE SAND | 1.1 | 0 |
| LOOSE SAND | 1 | 84 |
| COMP. SAND | 0.9 | 0 |
| STIFF CLAY | 0.6 | 0 |
| COMP. SHELL | 0.5 | 0 |
| SOFT ROCK | 0.4 | 0 |
| BLAST. ROCK | 0.25 | 0 |

RESULTANT
MATERIAL FACTOR - 1.12

PG 5 OF 9: DREDGE SELECTION

| | |
|---|---|
| DREDGE SELECTED - | 30" HYDRAULIC DREDGE |
| COMPUTED BANK FACTOR - | 0.94 |
| BANK FACTOR USED - | 1 > |
| OTHER FACTOR - | 1 > |
| CLEANUP - | 8% More Time |

PG 6 OF 9: HORSEPOWER CONSIDERATIONS

| | |
|---|---|
| CHART H.P. - | 10,232 hp |
| AVAILABLE H.P. - | 10,232 hp |
| BOOSTER H.P. - | 5,200 hp(ea) |
| LOSS PER BOOSTER - | 15% |

PG 7 OF 9: CHART PRODUCTION ANALYSIS

| | |
|---|---|
| AVE. PIPELINE - | 9,000 ft |
| BOOSTERS - | 0 |
| BOOSTER FACTOR - | 1.00 |
| % EFF WORK TIME (GROSS) - | 75.0% |
| MAX. POSSIBLE - | 33,427 ft |
| TOTAL HP AVAIL - | 10,232 hp |
| % EFF WORK TIME (NET) - | 75.0% |
| OPERATING TIME - | 240 hours per month |

PG 8 OF 9: GROSS PRODUCTION & LOCAL AREA FACTORS

| | |
|---|---|
| PRODUCTION OVERRIDE - | YES |
| NET PRODUCTION - | 1,250 net cy per hour |
| OPERATING TIME - | 240 hours per month |
| BASED ON - | 0 booster(s) |
| PAY PRODUCTION - | 297,250 pay cy per month |
| PRESENT YEAR - | 1997 |
| ECONOMIC INDEX - | 5332 |
| LAF - | 1.14 |
| INTEREST RATE - | 5.400% /yr |
| TIME PERIOD - | September 15 to March 15 |
| PLANT AVAILABLE - | 11 mos/yr |
| FUEL PRICE - | $0.90 /gal |

PG 9 OF 9: OTHER ADJUSTMENTS

| | |
|---|---|
| SPECIAL COST/MO - | $1,500 REQUIRED REPORTS |
| SPECIAL COST LS - | $2,500 REQUIRED PERMITS |
| CONTRACTOR'S O.H. - | 6.0% |
| CONTRACTOR'S PROFIT - | 5.0% |
| CONTRACTOR'S BOND - | 1.0% |

CHECKLIST FOR INPUT DATA.

| | |
|---|---|
| BID QUANTITY | 334,404 C.Y. |
| UNIT COST... | $3.03 PER C.Y. |
| EXCAV. COST. | $1,013,244 |
| TIME........ | 1.11 MONTHS |

PORT HUENEME FEASIBILTY STUDY

PG 1 OF 9: PROJECT TITLES

| | |
|---|---|
| FILENAME - | PTHT12-2.WK1 |
| PROJECT - | PORT HUENEME FEASIBILTY STUDY |
| LOCATION - | VENTURA COUNTY, CA |
| INVIT # - | REMAINING T.BASIN-DEPTH 12.2 WT/O |
| DATE OF EST. - | JAN 8, 1999 |
| EST. BY - | I.LEYVA-TRACY |
| MOB. BID ITEM # - | 1 |
| EXCAV. BID ITEM # - | 1 |
| TYPE OF EST. - | Planning Estimate |

PG 2 OF 9: EXCAVATION QTY'S

| | |
|---|---|
| DREDGING AREA - | 1,620,237 sf |
| REQ'D EXCAVATION - | 245,885 cyds |
| PAY OVERDEPTH - | 88,519 cyds |
| CONTRACT AMOUNT - | 334,404 cyds |
| NOT DREDGED - | 0 cyds |
| NONPAY YARDAGE - | 0 cyds |
| GROSS YARDAGE - | 334,404 cyds |
| NONPAY HEIGHT - | 0.0 ft overdig. |
| TOTAL BANK HEIGHT - | 5.6 ft |

PG 3 OF 9: MAXIMUM PIPELINE REQUIRED

| | |
|---|---|
| FLOATING - | 7,000 ft |
| SUBMERGED - | 2,000 ft |
| SHORE - | 0 ft |
| TOTAL - | 9,000 ft |
| COST CATEGORY - | 2 SAND |
| EQUIVALENT - | 100 ft |

PG 4 OF 9: MATERIAL FACTOR

| DESCRIPTION | FACTOR | PERCENTAGE % |
|---|---|---|
| MUD & SILT | 3 | 16 |
| MUD & SILT | 2.5 | 0 |
| MUD & SILT | 2 | 0 |
| LOOSE SAND | 1.1 | 0 |
| LOOSE SAND | 1 | 84 |
| COMP. SAND | 0.9 | 0 |
| STIFF CLAY | 0.6 | 0 |
| COMP. SHELL | 0.5 | 0 |
| SOFT ROCK | 0.4 | 0 |
| BLAST. ROCK | 0.25 | 0 |

RESULTANT
MATERIAL FACTOR - 1.12

PG 5 OF 9: DREDGE SELECTION

| | |
|---|---|
| DREDGE SELECTED - | 30" HYDRAULIC DREDGE |
| COMPUTED BANK FACTOR - | 0.79 |
| BANK FACTOR USED - | 1 > |
| OTHER FACTOR - | 1 > |
| CLEANUP - | 8% More Time |

PG 6 OF 9: HORSEPOWER CONSIDERATIONS

| | |
|---|---|
| CHART H.P. - | 10,232 hp |
| AVAILABLE H.P. - | 10,232 hp |
| BOOSTER H.P. - | 5,200 hp(ea) |
| LOSS PER BOOSTER - | 15% |

PG 7 OF 9: CHART PRODUCTION ANALYSIS

| | |
|---|---|
| AVE. PIPELINE - | 9,000 ft |
| BOOSTERS - | 0 |
| BOOSTER FACTOR - | 1.00 |
| % EFF WORK TIME (GROSS)- | 75.0% |
| MAX. POSSIBLE - | 33,427 ft |
| TOTAL HP AVAIL - | 10,232 hp |
| % EFF WORK TIME (NET) - | 75.0% |
| OPERATING TIME - | 240 hours per month |

PG 8 OF 9: GROSS PRODUCTION & LOCAL AREA FACTORS

| | |
|---|---|
| PRODUCTION OVERRIDE - | YES |
| NET PRODUCTION - | 1,250 net cy per hour |
| OPERATING TIME - | 240 hours per month |
| BASED ON - | 0 booster(s) |
| PAY PRODUCTION - | 301,265 pay cy per month |
| PRESENT YEAR - | 1997 |
| ECONOMIC INDEX - | 5332 |
| LAF - | 1.14 |
| INTEREST RATE - | 5.400% /yr |
| TIME PERIOD - | September 15 to March 15 |
| PLANT AVAILABLE - | 11 mos/yr |
| FUEL PRICE - | $0.90 /gal |

PG 9 OF 9: OTHER ADJUSTMENTS

| | |
|---|---|
| SPECIAL COST/MO - | $1,500 REQUIRED REPORTS |
| SPECIAL COST LS - | $2,500 REQUIRED PERMITS |
| CONTRACTOR'S O.H. - | 6.0% |
| CONTRACTOR'S PROFIT - | 5.0% |
| CONTRACTOR'S BOND - | 1.0% |

MOBIL & DEMOB COST: $314,818

| | |
|---|---|
| BID QUANTITY | 34,190 C.Y. |
| UNIT COST... | $7.29 PER C.Y. |
| EXCAV. COST. | $249,244 |
| TIME........ | 0.48 MONTHS |

PORT HUENEME

CHECKLIST FOR INPUT DATA.

## PG 1 OF 9: PROJECT TITLES

| | |
|---|---|
| FILENAME - | A:\PILEZNE.WK1 |
| PROJECT - | PORT HUENEME |
| LOCATION - | VENTURA HARBOR, VENTURA COUNTY |
| INVIT # - | PILE ZONE 6% + BERTH 1 DEPTH 12.2 |
| DATE OF EST. - | JAN 5, 99 |
| EST. BY - | I. LEYVA-TRACY |
| MOB. BID ITEM # - | 1 |
| EXCAV. BID ITEM # - | 1 |
| TYPE OF EST. - | Planning Estimate |

## PG 2 OF 9: EXCAVATION QTY'S

| | |
|---|---|
| DREDGING AREA - | 149,803 sf |
| REQ'D EXCAVATION - | 25,706 cyds |
| PAY OVERDEPTH - | 8,484 cyds |
| CONTRACT AMOUNT - | 34,190 cyds |
| NOT DREDGED - | 0 cyds |
| NONPAY YARDAGE - | 0 cyds |
| GROSS YARDAGE - | 34,190 cyds |
| NONPAY HEIGHT - | 0.0 ft overdig. |
| TOTAL BANK HEIGHT - | 6.2 ft |

## PG 3 OF 9: EXCAVATION PRODUCTION WORKSHEET

| | |
|---|---|
| DREDGE SELECTED - | 10 CY Clamshell Dredge |
| TYPE OF MATERIAL - | MUD |
| BUCKET SIZE - | 10 |
| BUCKET FILL FACTOR - | 0.75 |
| OPTIMUM BANK - | 3.5 |
| BANK FACTOR - | 0.50 |

## PG 4 OF 9: EXCAVATION PRODUCTION WORKSHEET

| | |
|---|---|
| BUCKET CYCLE TIME - | 50 Seconds |
| OTHER FACTOR - | 1.00 > |
| CLEANUP - | 25% More Time |
| TIME EFFICIENCY - | 45.0% of EWT |

## PG 5 OF 9: HAULING PRODUCTION WORKSHEET

| | |
|---|---|
| TUG DESCRIPTION - | 3000 HP Diesel--Twin Screw |
| PREPARE SCOW TOW - | 15 min |
| HAUL DIST - | 1.5 mi |
| SPEED TO D/A - | 10 mph |
| SPEED FROM D/A - | 10 mph |

## PG 5 OF 9: HAULING PRODUCTION WORKSHEET

| | |
|---|---|
| DUMP OR PUMPOUT - | 2 min |
| DISENGAGE TOW - | 10 min |
| TOW EFFICIENCY - | 60 % |
| SCOW DESCRIPTION - | 3000 CY Split Hull Scow |
| USEABLE VOLUME - | 90 % |
| % SOLIDS - | 80 % |

## PG 6 OF 9: EQUIPMENT MATCHING

| # OF PIECES: | Used |
|---|---|
| DREDGES - | 1 |
| SCOWS PER DREDGE - | 1 |
| TOWING VESSELS - | 1 |
| SCOWS PER TOW - | 1 |
| ADDITIONAL SCOWS - | 0 |
| TOT SCOWS ON JOB - | 2 |

## PG 7 OF 9: SPECIAL LABOR & EQUIPMENT

| | |
|---|---|
| QUARTERS ON DREDGE? - | NO |
| SURVEY BOAT? - | NO |
| CREW BOAT? - | YES |

## PG 8 OF 9: LOCAL AREA FACTORS

| | |
|---|---|
| PRESENT YEAR - | 1997 |
| ECONOMIC INDEX - | 5332 |
| LAF - | 1.140 |
| INTEREST RATE - | 5.400% /yr |
| TIME PERIOD - | SEPT TO MAY |
| PLANT AVAILABLE - | 9 mos/yr |
| FUEL PRICE - | $1.50 /gal |

## PG 9 OF 9: OTHER ADJUSTMENTS

| | |
|---|---|
| SPECIAL COST/MO - | $10,000 DISPOSAL OF 300 WOOD |
| SPECIAL COST LS - | $25,000 Permit |
| CONTRACTOR'S O.H. - | 10.0% |
| CONTRACTOR'S PROFIT - | 10.0% |
| CONTRACTOR'S BOND - | 1.0% |

CHECKLIST FOR INPUT DATA.

PORT HUENEME FEASIBILTY STUDY

| | |
|---|---|
| BID QUANTITY | 8,286 C.Y. |
| UNIT COST... | $4.33 PER C.Y. |
| EXCAV. COST. | $35,879 |
| TIME........ | 0.03 MONTHS |

PG 1 OF 9: PROJECT TITLES

| | |
|---|---|
| FILENAME - | A:\PHW2B5.WK1 |
| PROJECT - | PORT HUENEME FEASIBILTY STUDY |
| LOCATION - | VENTURA COUNTY, CA |
| INVIT # - | WHARF 2 DPT 12.2, BERTH 5 IS 1/2 |
| DATE OF EST. - | JAN 7, 1999 |
| EST. BY - | I.LEYVA-TRACY |
| MOB. BID ITEM # - | 1 |
| EXCAV. BID ITEM # - | 1 |
| TYPE OF EST. - | Planning Estimate |

PG 2 OF 9: EXCAVATION QTY'S

| | |
|---|---|
| DREDGING AREA - | 29,769 sf |
| REQ'D EXCAVATION - | 6,455 cyds |
| PAY OVERDEPTH - | 1,831 cyds |
| CONTRACT AMOUNT - | 8,286 cyds |
| NOT DREDGED - | 0 cyds |
| NONPAY YARDAGE - | 0 cyds |
| GROSS YARDAGE - | 8,286 cyds |
| NONPAY HEIGHT - | 0.0 ft overdig. |
| TOTAL BANK HEIGHT - | 7.5 ft |

PG 3 OF 9: MAXIMUM PIPELINE REQUIRED

| | |
|---|---|
| FLOATING - | 7,000 ft |
| SUBMERGED - | 2,000 ft |
| SHORE - | 0 ft |
| TOTAL - | 9,000 ft |
| COST CATEGORY - | 2 SAND |
| EQUIVALENT - | 100 ft |

PG 4 OF 9: MATERIAL FACTOR

| DESCRIPTION | FACTOR | PERCENTAGE % |
|---|---|---|
| MUD & SILT | 3 | 16 |
| MUD & SILT | 2.5 | 0 |
| MUD & SILT | 2 | 0 |
| LOOSE SAND | 1.1 | 0 |
| LOOSE SAND | 1 | 84 |
| COMP. SAND | 0.9 | 0 |
| STIFF CLAY | 0.6 | 0 |
| COMP. SHELL | 0.5 | 0 |
| SOFT ROCK | 0.4 | 0 |
| BLAST. ROCK | 0.25 | 0 |

RESULTANT
MATERIAL FACTOR - 1.12

PG 5 OF 9: DREDGE SELECTION

| | |
|---|---|
| DREDGE SELECTED - | 30" HYDRAULIC DREDGE |
| COMPUTED BANK FACTOR - | 0.98 |
| BANK FACTOR USED - | 1 > |
| OTHER FACTOR - | 1 > |
| CLEANUP - | 10% More Time |

PG 6 OF 9: HORSEPOWER CONSIDERATIONS

| | |
|---|---|
| CHART H.P. - | 10,232 hp |
| AVAILABLE H.P. - | 10,232 hp |
| BOOSTER H.P. - | 5,200 hp(ea) |
| LOSS PER BOOSTER - | 15% |

PG 7 OF 9: CHART PRODUCTION ANALYSIS

| | |
|---|---|
| AVE. PIPELINE - | 9,000 ft |
| BOOSTERS - | 0 |
| BOOSTER FACTOR - | 1.00 |
| % EFF WORK TIME (GROSS)- | 75.0% |
| MAX. POSSIBLE - | 33,427 ft |
| TOTAL HP AVAIL - | 10,232 hp |
| % EFF WORK TIME (NET) - | 75.0% |
| OPERATING TIME - | 240 hours per month |

PG 8 OF 9: GROSS PRODUCTION & LOCAL AREA FACTORS

| | |
|---|---|
| PRODUCTION OVERRIDE - | YES |
| NET PRODUCTION - | 1,250 net cy per hour |
| OPERATING TIME - | 240 hours per month |
| BASED ON - | 0 booster(s) |
| PAY PRODUCTION - | 276,206 pay cy per month |
| PRESENT YEAR - | 1998 |
| ECONOMIC INDEX - | 5767 |
| LAF - | 1.18 |
| INTEREST RATE - | 5.400% /yr |
| TIME PERIOD - | September 15 to March 15 |
| PLANT AVAILABLE - | 9 mos/yr |
| FUEL PRICE - | $1.00 /gal |

PG 9 OF 9: OTHER ADJUSTMENTS

| | |
|---|---|
| SPECIAL COST/MO - | $1,500 REQUIRED REPORTS |
| SPECIAL COST LS - | $7,000 REQUIRED PERMITS |
| CONTRACTOR'S O.H. - | 5.0% |
| CONTRACTOR'S PROFIT - | 5.0% |
| CONTRACTOR'S BOND - | 1.0% |

| PROJECT AREA | DEPTH | AREA | AREA FACTOR | QUANTITY | OVERDEPTH | SECTION TOTAL |
|---|---|---|---|---|---|---|
| | m MLLW | sq m | | cu m | cu m (0.5 m) | cu m |
| | | | | | | |
| Wharf #1 | 11.5 | 12941 | 1 | 14,100 | 6,500 | 20,600 |
| (Berths 1-2-3) | 12 | | | 20,400 | 6,500 | 26,900 |
| | 12.2 | | | 1/3 22,960 | 6,500 | 29,460 |
| | 12.5 | | | 26,800 | 6,500 | 33,300 |
| | 13 | | | 33,100 | 6,500 | 39,600 |
| | | | | | | |
| Pile Zone | 11.5 | 9765 | 0.75 | 10,575 | 4,875 | 15,450 |
| within Wharf #1 | 12 | | | 15,300 | 4,875 | 20,175 |
| | 12.2 | | | 17,220 | 4,875 | 22,095 |
| (Clamshell | 12.5 | | | 20,100 | 4,875 | 24,975 |
| Portion) | 13 | | | 24,825 | 4,875 | 29,700 |
| | | | | | | |
| Remaining | 11.5 | 3176 | 0.25 | 3,525 | 1,625 | 5,150 |
| Wharf #1 | 12 | | | 5,100 | 1,625 | 6,725 |
| | 12.2 | | | 5,740 | 1,625 | 7,365 |
| (Cutter-Suction) | 12.5 | | | 6,700 | 1,625 | 8,325 |
| Portion) | 13 | | | 8,275 | 1,625 | 9,900 |
| | | | | | | |
| Wharf #2 | 11.5 | 5537 | 0.43 | 6,100 | 2,800 | 8,900 |
| | 12 | | | 8,100 | 2,800 | 10,900 |
| | 12.2 | | | 1/2 9,870 | 2,800 | 12,670 |
| | 12.5 | | | 11,500 | 2,800 | 14,300 |
| | 13 | | | 14,200 | 2,800 | 17,000 |
| | | | | | | |
| Wharf #3 | 11.5 | 5129 | 0.4 | 5,600 | 2,600 | 8,200 |
| | 12 | | | 8,200 | 2,600 | 10,800 |
| | 12.2 | | | 9,180 | 2,600 | 11,780 |
| | 12.5 | | | 10,700 | 2,600 | 13,300 |
| | 13 | | | 13,200 | 2,600 | 15,800 |
| | | | | | | |
| Wharf #5 | 11.5 | 2827 | 0.22 | 3,100 | 1,400 | 4,500 |
| | 12 | | | 4,500 | 1,400 | 5,900 |
| | 12.2 | | | 5,050 | 1,400 | 6,450 |
| | 12.5 | | | 5,900 | 1,400 | 7,300 |
| | 13 | | | 7,300 | 1,400 | 8,700 |
| | | | | | | |
| Wharf #4 | 11.5 | 4795 | 0.37 | 5,200 | 2,400 | 7,600 |
| | 12 | | | 7,500 | 2,400 | 9,900 |
| | 12.2 | | | 8,500 | 2,400 | 10,900 |
| | 12.5 | | | 9,900 | 2,400 | 12,300 |
| | 13 | | | 12,200 | 2,400 | 14,600 |
| | | | | | | |
| BERTH AREA TOTAL | | | Cutter Portion | Clam Portion | Entire Cutter | |
| | 11.5 | | 34,350 | 15,450 | 49,800 | |
| | 12 | | 44,225 | 20,175 | 64,400 | |
| | 12.2 | | 49,165 | 22,095 | 71,260 | |
| | 12.5 | | 55,525 | 24,975 | 80,500 | |
| | 13 | | 66,000 | 29,700 | 95,700 | |

# ATTACHMENT 1

Wharf Modification Preliminary Cost Estimates

Channel Entrance Wharf (91.5m)

| Item | Unit | Unit Cost | Quantity | Amount |
|---|---|---|---|---|
| Mobilization/ demobilization | ls | $2,000 | 1 | $2,000 |
| Fender System | | | | |
| Remove existing fender system | m | $98 | 91 | $9,000 |
| Purchase 46x19.8m ACZA piles | m | $49 | 457 | $22,500 |
| Install piles @ 183cm o.c. | ea | $200 | 38 | $7,500 |
| Furnish and install 30x30 wale w/ blocking | mbm | $4,264 | 4 | $18,720 |
| Install fender and chain (Lord 2F4-390) | m | $4,198 | 91 | $384,000 |
| Toe Wall | | | | |
| Furnish AZ13 sheet pile (9.2m @ 4.48 kg/sm) | kg | $0.88 | 89,673 | $78,912 |
| Coat sheets (.23 sm/m of wall @ 244mm) | sm | $16.14 | 1,093 | $17,640 |
| Drive sheets (10 pairs of doubles/day) | m | $519.88 | 91 | $47,550 |
| Sub-total | | | | $587,822 |
| Overhead and profit @ 25% | | | | $146,956 |
| Contingency @ 25% | | | | $146,956 |
| Total Channel Entrance Wharf (Rounded) | | | | $880,000 |

Berths 1, 2, and 3 (549m + 24m)

| Item | Unit | Unit Cost | Quantity | Amount |
|---|---|---|---|---|
| Mobilization/ demobilization | ls | $2,000 | 1 | $2,000 |
| Fender System | | | | |
| Remove existing fender system | m | $98 | 573 | $56,370 |
| Purchase 46x19.8m ACZA piles | m | $49 | 4,655 | $229,003 |
| Install piles @ 183cm o.c. | ea | $200 | 313 | $62,633 |
| Furnish and install 30x30 wale w/ blocking | mbm | $4,264 | 26 | $112,320 |
| Install fender and chain (Lord 2F4-390) | ea | $2,280 | 313 | $714,020 |
| Toe Wall | | | | |
| Furnish AZ13 sheet pile (9.2m @ 4.48kg/sm) | kg | $0.88 | 561,650 | $494,252 |
| Coat sheets (.23 sm/m of wall @ 305mm) | sm | $16.14 | 8,557 | $138,107 |
| Drive sheets (10 pairs of doubles/day) | m | $519.88 | 573 | $297,822 |
| Sub-total | | | | $2,106,527 |
| Overhead and profit @ 25% | | | | $526,632 |
| Contingency @ 25% | | | | $526,632 |
| Total Berths 1, 2, and 3 (Rounded) | | | | $3,160,000 |

Berth 5 (744 lf)

| Item | Unit | Unit Cost | Quantity | Amount |
|---|---|---|---|---|
| Mobilization/ demobilization | ls | $2,000 | 1 | $2,000 |
| Fender System | | | | |
| Remove existing fender system | m | $98 | 227 | $22,320 |
| Purchase 46x19.8m ACZA piles | m | $49 | 2,457 | $120,900 |
| Install piles @ 183cm o.c. | ea | $200 | 124 | $24,800 |
| Furnish and install 30x30 wale w/ blocking | mbm | $4,264 | 11 | $46,426 |
| Install fender and chain (Lord 2F4-390) | ea | $2,280 | 124 | $282,720 |
| Toe Wall | | | | |
| Furnish AZ13 sheet pile (9.2m @ 4.48 kg/sm) | kg | $0.88 | 222,388 | $195,702 |
| Coat sheets (.23 sm/m of wall @ 397mm) | sm | $16.14 | 2,710 | $43,747 |
| Drive sheets (10 pairs of doubles/day) | m | $519.88 | 227 | $117,924 |
| Sub-total | | | | $856,539 |
| Overhead and profit @ 25% | | | | $214,135 |
| Contingency @ 25% | | | | $214,135 |
| Total Berth 5 (Rounded) | | | | $1,280,000 |

THE PORT OF HUENEME, PORT HUENEME, CALIFORNIA
DRAFT FEASIBILITY STUDY

# APPENDIX "D"

# COASTAL ENGINEERING ANALYSIS

FEBRUARY 1999

# PORT HUENEME HARBOR
# VENTURA COUNTY, CALIFORNIA

## FEASIBILITY STUDY FOR DEEP DRAFT NAVIGATION

## COASTAL ENGINEERING APPENDIX D

Prepared By

Coastal Engineering Section
U.S. Army Corps of Engineers
Los Angeles District

February 1999

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PORT HUENEME HARBOR

FEASIBILITY STUDY

## 1.0 INTRODUCTION

### 1.1 Study Authority

The study was authorized by Section 208 of the 1965 Flood Control Act.

### 1.2 Purpose and Scope

The purpose of this report is to provide the basic data and requirements necessary to support the feasibility study for the Corps of Engineers' navigation-related dredging of the Port Hueneme Harbor.

## 2.0 EXISTING CONDITIONS

### 2.1 Project Location

Port Hueneme Harbor is a deep-draft commercial and military harbor located approximately 106 km (66 mi) northwest of Los Angeles in Ventura County. The facilities occupy an area immediately west of the City of Port Hueneme. Channel Islands Harbor and the cities of Oxnard and Ventura are also near the Port as shown in Figure D-1.

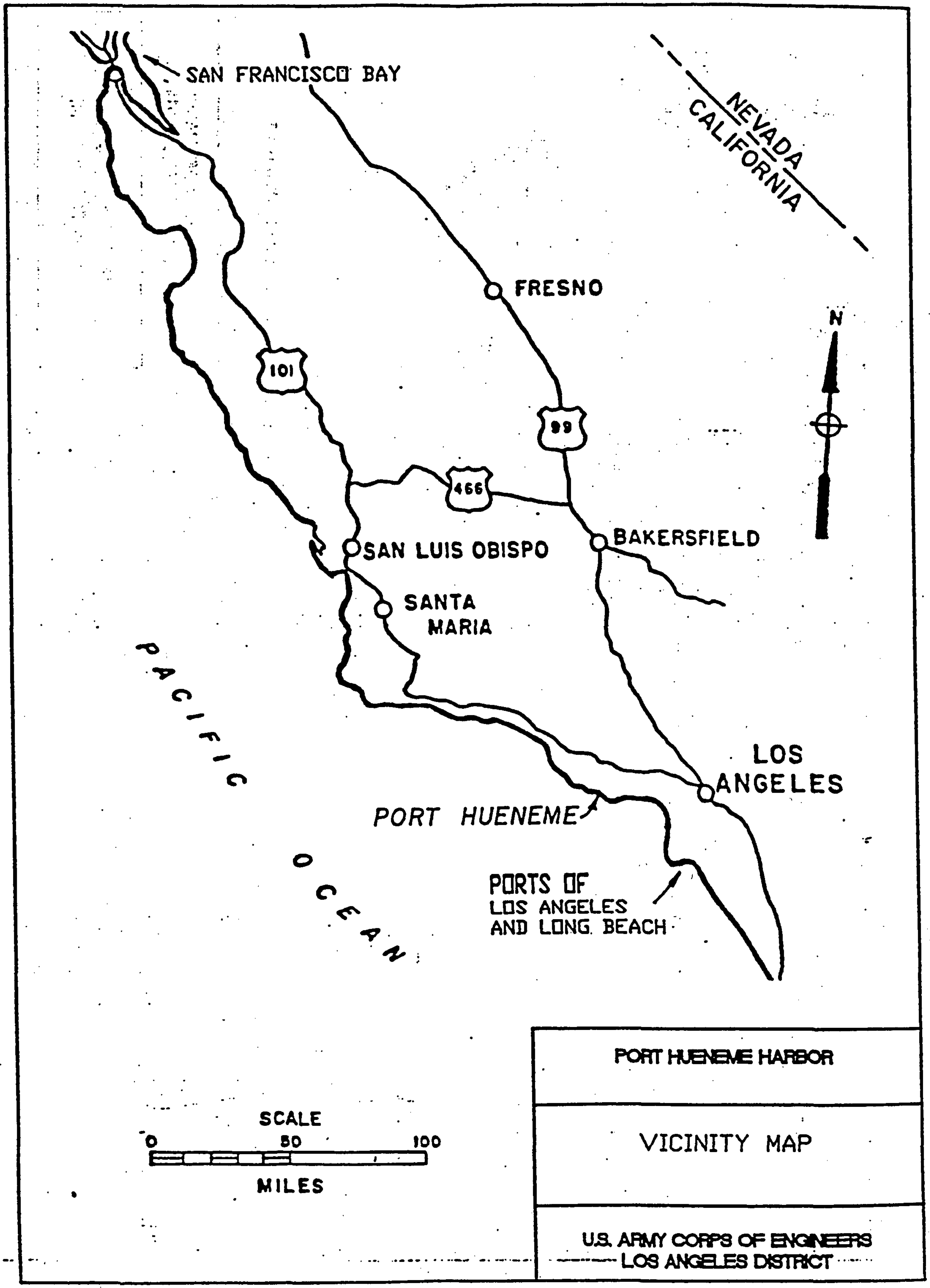

SAN FRANCISCO BAY
NEVADA
CALIFORNIA
FRESNO
N
101
99
466
SAN LUIS OBISPO
BAKERSFIELD
SANTA MARIA
PACIFIC
OCEAN
LOS ANGELES
PORT HUENEME
PORTS OF LOS ANGELES AND LONG BEACH
SCALE
0
50
100
MILES
PORT HUENEME HARBOR
VICINITY MAP
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Figure D-1

## 2.2 Existing Navigation Features

Port Hueneme, shown in Plate D-1, consists of several structures:

- two jetties about 244 m (800 ft) and 305 m (1,000 ft) long;
- an approach channel about 244 m (800 ft) long by 183 m (600 ft) wide with a depth of -12.2 m (-40 feet), Mean Lower Low Water Datum (MLLW);
- a 472 m (1,550 ft) long entrance channel, 100.6 m (330 ft) wide at a depth of -11 m (-36 ft), MLLW;
- a central basin 329 m (1,080 ft) long and 311 m (1,020 feet) wide with a depth of -10.7 (-35 ft) MLLW;
- and Channel A which is 707 m (2,320 ft) long, 84 m (275 ft) wide, and a depth of -10.7 (-35 ft) MLLW.

The approach to Port Hueneme generally follows the alignment of the Hueneme Submarine Canyon via a shipping safety fairway that is 1.8 km (1 nautical mi) to 2.8 km (1.5 nautical mi) wide as shown in Figure D-2 (NOS 1987). Navigation into the Harbor proceeds between the two rubble-mound jetties through a dredged channel. Pilotage is controlled by the narrowest width of the entrance channel. Consequently, only one way traffic is permitted for large ships at the discretion of the Navy and Oxnard Harbor District.

Currently, the most important commodity imports into Port Hueneme are motor vehicles, bananas, and wood pulp. An important export commodity is citrus.

## 2.3 Physical Characteristics

The coastline around Port Hueneme is a broad alluvial plain reaching from Ventura to Point Mugu. The shoreline contains some of the widest sandy beaches within the Santa Barbara/Ventura region, most of it is publicly owned and available for recreation. The low backshore areas support a variety of land uses including commercial, residential, petroleum production, recreation, and military uses. Three harbors, Ventura, Channel Islands and Port Hueneme, play important roles in regulating the littoral transport within the area (Noble 1989).

### 2.3.1 Climate

The Port Hueneme Harbor area has a mild and equitable climate. The National Weather Service records at the facility indicate an average annual temperature of 15° C (59° F). Prevailing seasonal winds are northwesterly during the summer and westerly during the winter. During the fall and early winter, northeasterly desert winds known as the "Santa Anas" blow infrequently and for only short periods. Winds in excess of 10.7 m/s (24 mph) have occurred on an average of 35 days a year. Winds in excess of 17.0 m/s (38 mph) have occurred on an average of one day a year (U.S. Army 1968).

Table D-1 summarizes a more complete tabulation of wind occurrence between 1969 and 1978. The data indicates that wind speeds in excess of 7.7 m/s (15 knots) generally occur about 22% of the time. This velocity is considered to be the threshold condition whereupon navigation becomes difficult for the larger vessels. At wind speeds above 8.8 m/s (17 knots), auto carrier ships do not sail into or out of the harbor due to limited maneuverability in the entrance channel (U.S. Army 1994).

Sea fog hampers navigation most often from July through October. August and September are considered the worst months for fog occurrence. Visibility falls below 1 km (0.5 mi) on about 5 to 10 days per month during the fog season (NOS 1980). Generally, visibility is at its lowest in the early morning hours when the air is coolest. As the air warms, the cloud basis slowly rise and visibility increases to a maximum in the mid afternoon.

Table D-1: AVERAGE WIND SPEED-DIRECTION FREQUENCY DISTRIBUTION (Hours)

| SPEED m/s (knots) | DIRECTION (Deg) 346 to 15 | 16 45 | 46 75 | 76 105 | 106 135 | 136 165 | 166 195 | 196 225 | 226 255 | 256 285 | 286 315 | 316 345 | HOURS SUB-TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0-2.56 (0 - 4.9) | 75.4 | 264.3 | 366.7 | 374.3 | 397.2 | 229.1 | 99.6 | 156.4 | 156.4 | 194.5 | 215.2 | 231.8 | 2,760.8 |
| 2.57-5.14 (5 - 9.9) | 42.9 | 180.6 | 337.0 | 357.8 | 251.1 | 162.6 | 114.1 | 105.2 | 280.2 | 499.6 | 230.4 | 211.0 | 2;772.6 |
| 5.15-7.71 (10 - 14.9) | 26.3 | 14.5 | 26.3 | 43.6 | 56.1 | 89.3 | 18.0 | 9.7 | 49.8 | 685.0 | 186.9 | 132.9 | 1,338.3 |
| 7.72-10.29 (15 - 19.9) | 14.5 | 22.2 | 31.1 | 28.4 | 33.2 | 38.7 | 4.1 | 2.8 | 9.0 | 340.4 | 204.1 | 133.5 | 862.1 |
| 10.30-12.85- (20 - 24.9) | 10.3 | 8.3 | 24.2 | 13.1 | 27.0 | 15.9 | 0.0 | 0.7 | 0.0 | 187.5 | 168.1 | 101.0 | 556.2 |
| 12.86-15.43 (25 - 29.9) | 4.1 | 6.9 | 16.6 | 7.6 | 17.3 | 9.0 | 0.0 | 0.0 | 0.7 | 83.0 | 70.6 | 57.5 | 273.4 |
| 15.44-18.00 (30 - 34.9) | 0.7 | 2.8 | 13.8 | 9.7 | 9.0 | 4.8 | 0.0 | 0.0 | 0.0 | 39.4 | 29.1 | 12.4 | 121.9 |
| 18.01-20.58 (35 - 39.9) | 0.0 | 0.0 | 8.3 | 2.8 | 4.1 | 0.0 | 0.0 | 0.0 | 0.0 | 16.6 | 4.8 | 3.4 | 40.1 |
| 20.59-23.14 (40 - 44.9) | 0.0 | 0.7 | 9.0 | 0.7 | 4.8 | 0.0 | 0.0 | 0.0 | 0.0 | 3.4 | 1.4 | 0.7 | 20.8 |
| 23.15-25.72 (45 - 49.9) | 0.0 | 0.0 | 2.8 | 0.7 | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0:7 | 0.0 | 1.4 | 7.0 |
| 25.73-28.29 (50 - 54.9) | 0.0 | 0.0 | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.7 | 0.7 | 4.9 |
| 28.29- 30.81 (55 - 59.9) | 0.0 | 0.0 | 0.0 | 0.0 | 1.4 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.1 |
| | 174.3 | 500.4 | 838.7 | 838.8 | 802.6 | 550.1 | 235.8 | 274.8 | 496.1 | 2,050.9 | 1,111.3 | 886.3 | 8,760.1 |

Source: Pacific Weather Analysis, 1993. Daily records recorded between 1969 to 1978 @ 34d 10' 47" N, 119d 28' 05" W at 20 meter elevation.

### 2.3.2 Topography

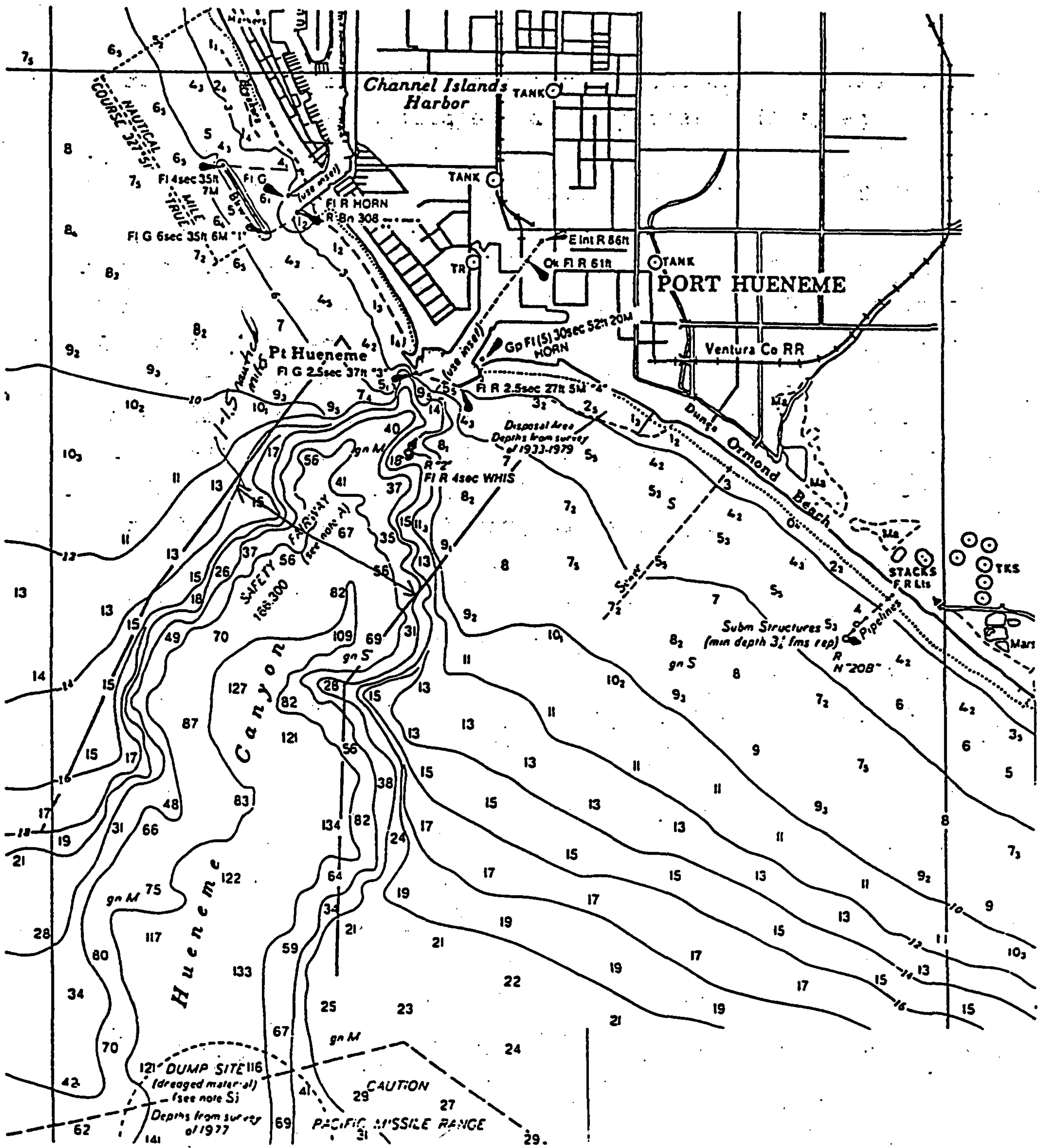
Port Hueneme Harbor is located on the southwest edge of the Oxnard plain. The terrain which borders the Pacific Ocean, has an average width of about 16 km (10 mi) and is relatively flat lowland. The plain slopes southwest from the Camarillo Hills with a gradient of about 2.5V:1000H (12 to 15 ft per mi). Average elevations over the facility range from +4.0 to +5.5 m (+13 to +18 ft) MLLW datum.

### 2.3.3 Foundation Conditions

Foundation explorations conducted in 1965, 1971, 1983, and 1996 logged subsurface soil conditions throughout the Harbor channels and basins. The materials encountered were naturally-deposited soils which classified as silty sands, sand-silty sands, gravelly silty sands and borderline sand-silty sands. The largest cobble encountered was 20 cm (8 in). No beds with large percentages of cobbles were encountered. In general, the foundation conditions were considered suitable for port development, and no unusual difficulty was anticipated for hydraulic dredging operations. It is estimated that 300 to 400 cut-off timber piles are located in the area to be dredged. The piles are remnants of a wooden wharf built during the original construction of the harbor in the late 1930's. The piles were cut off at approximately -10.7 m (-35 ft) MLLW in the early 1970's during the early stages of deepening and widening of Channel A. The piles are wooden, typically about 0.2 m to 0.3 m (9 to 11 inches) in diameter, and extend to approximate tip elevation of -15 to -16 meters (49 to 53 feet) MLLW.

### 2.3.4 Bathymetry

The area offshore of Port Hueneme was last surveyed by the National Ocean Service in 1976. Figure D-2 shows measured surroundings in fathoms, and shows the Harbor entrance's close proximity to the head of the Hueneme submarine canyon. The bottom slope for the first 152 m (500 ft) immediately offshore of the jetties parallel to the navigation channel is about




PORT HUENEME HARBOR

NAVIGATION APPROACH TO PORT HUENEME

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Source: National Ocean Service, 1987
Navigation Chart, 18725

1V:50H. However, further offshore the profile steepens to about 1V:9H as the presence of the canyon becomes more dominant. Project depth in the approach channel is approximately 12 m (40 ft) below MLLW datum.

The survey data of Port Huneme used for analysis was performed by the Corps of Engineers in March 1996 as part of regular maintenance. Pending funding, surveys are done annually to provide information about the need for dredging more frequently than the normal 5 or 6 year period. The data from this survey is shown in Plate D-2.

### 2.3.5 Tides

Port Hueneme Harbor experiences tides of diurnal inequality. Tidal characteristics with reference to datum of MLLW, equal to 0.0 m, were obtained from NOAA publication of tidal datums taken at Port Hueneme, dated 12/10/84. Tidal characteristics are summarized in Table D-2. Storm surge is relatively small (less than 0.3 m) along the Southern California coast when compared with tidal fluctuations.

Table D-2: Tides

| Tidal Characteristics | m (ft) MLLW |
|---|---|
| Extreme High Observed (2/4/58) | 2.3 (7.7) |
| Mean Higher High Water (MHHW) | 1.7 (5.5) |
| Mean High Water (MHW) | 1.4 (4.7) |
| Mean Tide Level (MTL) | 0.87 (2.8) |
| Mean Low Water (MLW) | 0.30 (.98) |
| Lowest Observed Water Level (1/7/51) | -0.71 (-2.3) |

Source: NOAA 1984

2.3.6 Waves

Port Hueneme Harbor is partially sheltered from waves by the adjacent coast and offshore islands. Deep water swell can approach the Harbor from the southwest through Anacapa passage and from the south through the south opening of Santa Barbara Channel. The largest waves propagate to the site from the west through Santa Barbara Channel. Due to the geometry of the channel, these waves are restricted to a narrow band of directional approach, as shown in Figure D-3.

Analysis of historic hindcast and measured data sets is available from the dates of 1956 through 1958, 1956 through 1975, 1958 through 1988, and 1969 through 1978. The predominant and average wave direction is from 270 degrees azimuth. During the summer months deep water swells can approach from the southern sections. Southerly waves generated locally can also occur during prefrontal winds associated with winter extra-tropical weather fronts.

2.3.6.1 Deep Water Wave Climate

Wind waves and swell which comprise the prevailing and storm wave climate within the Port Hueneme shoreline are produced by four basic meteorological patterns: Eastern Pacific High, Eastern Pacific Low, Tropical Cyclones, and Southern Hemisphere Low (SHL).

Eastern Pacific Anticyclone. During the vast majority of the time, the region is under the influence of high pressure. Variations in the position, size, and intensity of the so-called Eastern Pacific high are brought about by changes in the upper air flow which alternately lead to windy periods followed by periods of relative calm. The strongest winds occur with high pressure centered west to northwest of the area. Spring is the windiest time of the year; not only is the surface high well developed off the coast, but cold air aloft combines with surface heating to cause cyclogenesis over the desert regions, and intense pressure gradients develop. Windy conditions in the outer coastal waters occur periodically throughout the summer, but frequently

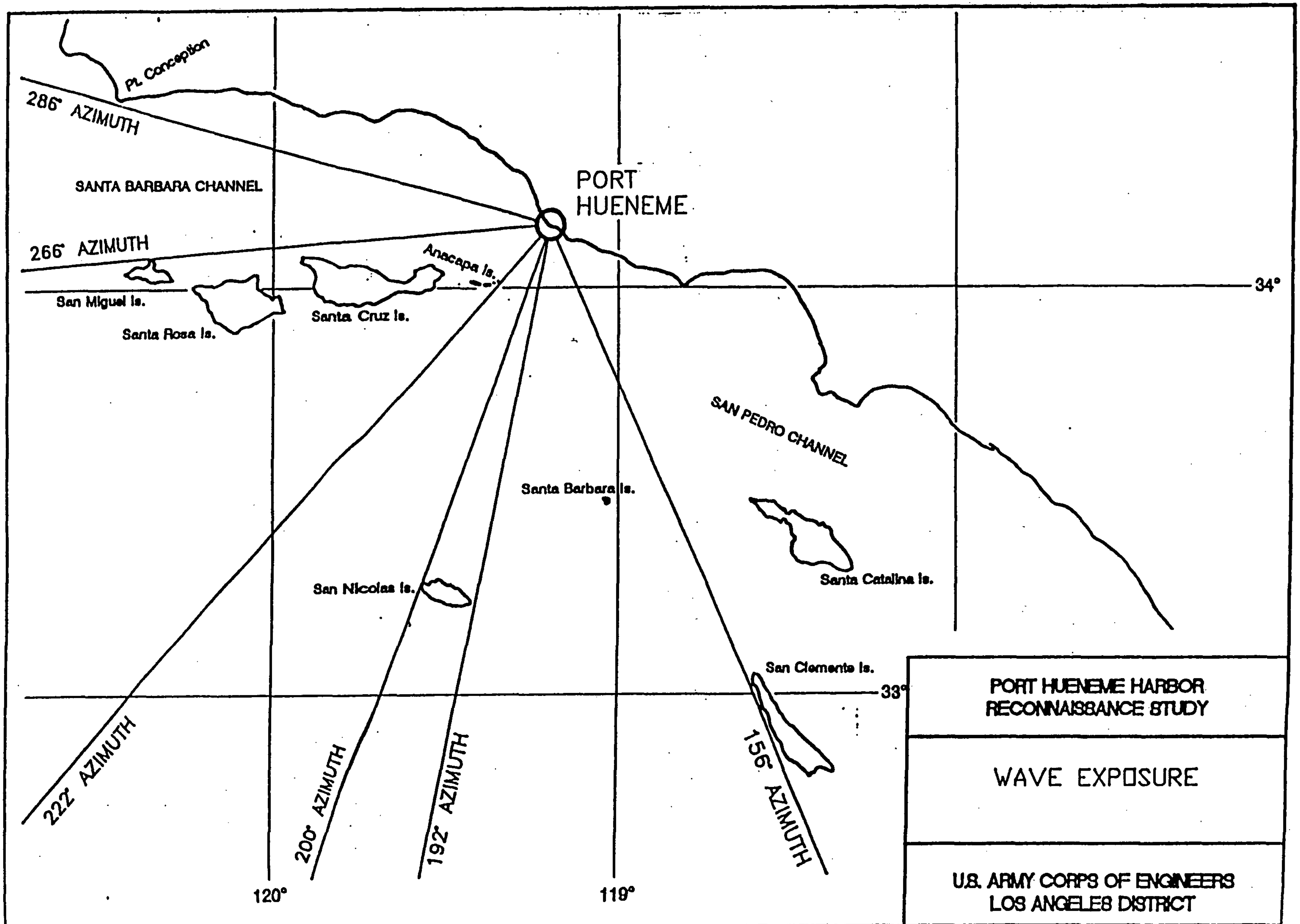

Pt. Conception
286° AZIMUTH
SANTA BARBARA CHANNEL
PORT HUENEME
266° AZIMUTH
Anacapa Is.
San Miguel Is.
Santa Rosa Is.
Santa Cruz Is.
34°
SAN PEDRO CHANNEL
Santa Barbara Is.
Santa Catalina Is.
San Nicolas Is.
San Clemente Is.
33°
222° AZIMUTH
200° AZIMUTH
192° AZIMUTH
156° AZIMUTH
120°
119°
PORT HUENEME HARBOR
RECONNAISSANCE STUDY
WAVE EXPOSURE
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Figure D-3

the Pacific high shifts northward and thermal trough conditions intensify in the Central Valley. When this happens, the region of strong, northwest winds is confined to Northern California, and a weak eddy circulation develops off Southern California accompanied by light winds.

During the months of November to February, the mean surface position shifts inland. Light winds are, therefore, much more common than during spring and summer months. However, with an intense buildup of high pressure inland, strong northeasterly winds (Santa Anas) occur in exposed areas of Southern California.

Extratropical Cyclones of the Northern Hemisphere. During the winter season, migratory low pressure centers of the North Pacific are the most important source of wave energy to reach southern California. Most commonly, these storms track eastward through the mid-Pacific before turning northward into the Gulf of Alaska. Swells generated by westerly winds in the southwest sector of these storms travel a great circle path into Southern California, arriving most commonly from 285 to 295 degrees in deep water outside the islands. The average decay distance is about 1,900 km (1,200 mi). More southerly storm tracks occur on occasion, some winters much more frequently than others. During stormy years, strong westerly winds extend into the far eastern Pacific and decay distances are much shorter, but very rarely do these winds maintain their strength all the way into the southern California coast.

Tropical Cyclones. The west coast of Mexico tropical cyclone is a regular, frequently occurring, meteorological phenomenon during the summer and early fall. Satellite coverage in recent years has revealed an average of about 14 of these storms per year, most of which have attained hurricane intensity. Generally, these tropical storms track westward, but it is not uncommon that they follow a more northwesterly track toward Southern California. Several have come very close to the area in recent years before either turning northeastward into Baja, California or rapidly weakening in the cold waters off the coast. Following a prolonged heat wave in September 1939, a tropical storm moved directly into the Los Angeles Basin with near hurricane force winds. Moderate to high swells from these storms occur on average of two to three times a year, but the project area is well protected by headlands and offshore islands from the predominate approach direction of 155 to 170 degrees.

Extratropical Cyclones of the Southern Hemisphere. Waves generated off Antarctica and New Zealand travel thousands of miles before reaching southern California from directions ranging from 170 to 215 degrees. Southern Hemisphere swell occurs for the most part between the months of March and October, with extreme events tending to be bimodal, peaking during the early and late summer. The period is long, with maximum energy most often in the 15 to 17 second range but on occasion as high as 18 to 20 seconds. Because they are nearly monochromatic, swells tend to occur in sets usually about 5 minutes apart, but sometimes as infrequently as 20 minutes. Deep water wave heights are rarely greater than 1.5 m (5 ft), but these waves will sometimes break at 4.5 to 6 m (15 to 20 ft) or more in well exposed areas.

2.3.6.2 Shallow Water Wave Transformation

Deep water waves are altered by the proximity of the offshore islands, refraction and shoaling as they propagate toward Port Hueneme Harbor. The complex bathymetry of the submarine canyon just offshore of the Harbor entrance has a dissipating effect on the approaching waves.

Three databases were reviewed to estimate wave conditions within the eastern Santa Barbara Channel near the site. Corps of Engineers' Wave Information Studies (WIS) consist of wave hindcast information estimated over the period of record of 1956 through 1975 (U.S. Army 1992). The data set excludes southern swell. A more recent summary of annual wave statistics was prepared by Pacific Weather Analysis for the years 1969 through 1978 for a site about 24 km (15 mi) west-northwest of Port Hueneme. This data is considered to provide the most relevant information to the site. Recorded observations from a shallow water gauge are also available for a site at the nearby Channel Islands Harbor.

Table D-3 summarizes the average wave recurrence statistics from the eastern Santa Barbara Channel hindcast location. The data represents contributions attributable to Eastern Pacific extra-tropical high and low pressure systems. The hindcast station has a somewhat different exposure to waves from the south-southeast to south-southwest than does Port Hueneme, because of island sheltering; however, it is well representative of the site for waves from 260 to 280 degree azimuth sector which occur over 94% of the time in an average year. Tabulations of wave occurrence for the southerly sector of 166 to 195 degrees indicates that the total annualized frequency of occurrence from that direction is less than 3%. The remaining 3% applies to waves arriving at the reference site from the onshore sector (e.g., east), to which Port Hueneme Harbor is not exposed (U.S. Army 1989).

The frequency of occurrence of southern hemisphere swell has been reviewed from synoptic hindcasts prepared by Marine Advisors in 1961. Wave data for a location approximately 18.5 km (10 nautical mi) south of San Nicolas Island, at 32.3 degrees N, 119.6 degrees W and a wave approach sector of 165 to 222 degrees azimuth are presented in Table D-4 below. This data cannot apply, intact, to Port Hueneme Harbor because of island sheltering (San Nicolas and Anacapa) and, to some degree, decay distance; however, it is evident that Southern Hemisphere Low waves can impinge upon the coastal section near the project site during the summer. As previously mentioned, this activity is bi-modal in time with spring and fall peaks of activity. The frequency of occurrence of SHL waves, if extrapolated to the Port Hueneme coastal sector amounts to 17.2% for the sector 165 to 184 degrees, and 11.4% for the sector 215 to 224 degrees. If it is assumed that the Channel Islands of Santa Cruz and Anacapa block passage of these long period waves, it still follows that a small percentage of the waves in the 165 to 184 degree sector impact the area of interest.

2.3.6.3 Storm Waves

Extreme wave occurrence was estimated by the Corps of Engineers to a first approximation using data developed for the nearby Channel Islands Harbor (U.S. Army 1985). The recurrence probabilities for extreme wave heights are listed in Table D-5.

Table D-3: Average Annual Wave Frequency Distribution*

By significant wave height:

| HEIGHT RANGE, m (ft) | PERCENTAGE |
|---|---|
| 0.31 - 0.91 (1 - 2.9) | 58.48 |
| 0.91 - 1.83 (3 - 5.9) | 27.82 |
| 1.83 - 2.74 (6 - 8.9) | 6.35 |
| 2.74 - 3.66 (9 - 11.9) | 0.92 |
| 3.66 - 4.57 (12 - 14.9) | 0.36 |
| 4.57 - 5.49 (15 - 17.9) | 0.04 |
| 5.49 - 6.40 (18 - 20.9) | 0 |
| >6.40 (>21) | 0 |

By wave period:

| PERIOD RANGE (SEC) | PERCENTAGE |
|---|---|
| <7.9 | 22.16 |
| 8 - 9.9 | 27.18 |
| 10 - 11.9 | 24.05 |
| 12 - 13.9 | 11.80 |
| 14 - 15.9 | 6.96 |
| >16 | 0.71 |

Source: U.S. Army 1989.

*Wave hindcast data for location 34.18°N, 119.47°W (Platform Grace)

Table D-4: Southern Hemisphere Swell Statistics

| | T (sec.) | 12 - 13.9 | 14 - 15.9 | 16 - 17.9 | 18 - 19.9 | 20 - 21.9 |
|---|---|---|---|---|---|---|
| | H, m (ft.) | Annual Frequency of Occurrence, percent | | | | |
| Direction of approach = 165-174° | 0.03- 0.30 (0.1 - 0.9) | 1.1 | 1.1 | 0.5 | | * |
| | 0.31- 0.61 (1.0 - 1.9) | 2.5 | 1.8 | 0.8 | 0.2 | 9.2 |
| | 0.61-0.91 (2.0 - 2.9) | 0.3 | 0.5 | * | | * |
| | 0.91-1.21 (3.0 - 3.9) | 0.1 | | | | |
| Direction of approach = 175-184° | 0.03-0.30 (0.1 - 0.9) | 1.8 | 1.0 | 0.4 | 0.1 | 0.1 |
| | 0.31-0.30 (1.0 - 1.9) | 2.2 | 1.4 | 0.5 | | |
| | 0.61-0.91 (2.0 - 2.9) | 0.4 | 0.1 | 0.1 | | |
| | 0.91-1.21 (3.0 - 3.9) | | | * | | |
| Direction of approach = 205-214° | 0.03-0.30 (0.1 - 0.9) | 1.1 | 0.5 | * | * | |
| | 0.31-0.61 (1.0 - 1.9) | 3.1 | 2.4 | 0.3 | | |
| | 0.61-0.91 (2.0 - 2.9) | 0.3 | 0.5 | 0.2 | | * |
| | 0.91-1.21 (3.0 - 3.9) | 0.1 | 0.2 | 0.2 | * | |
| Direction of approach = 215-224° | 0.03-0.30 (0.1 - 0.9) | 0.7 | 0.1 | | | |
| | 0.31-0.61 (1.0 - 1.9) | 2.9 | 1.3 | 0.1 | 0.1 | |
| | 0.61-0.91 (2.0 - 2.9) | 2.1 | 2.1 | 0.5 | * | |
| | 0.91-1.21 (3.0 - 3.9) | 0.4 | 0.7 | 0.4 | * | |
| Hindcast station at 32.3°N, 119.6°W<br>Source: Marine Advisors, 1961 | | | | | | |

* - less than 0.1%

Table D-5: Significant Wave Heights for Various Return Periods

| Return Probability, years | Significant Wave Height, m (ft) |
|---|---|
| 100 | 5.6 (18.3) |
| 50 | 4.0 (13.2) |
| 25 | 3.2 (10.5) |
| 10 | 2.7 (8.8) |
| 5 | 1.8 (6.0) |

Source: U.S. Army 1985

2.3.7 Coastal Processes

Port Hueneme is located within the Santa Barbara littoral cell that is bounded by Point Conception and Point Mugu. The 155 km (96 mi) cell is the longest shoreline unit in Southern California. The Harbor area is bounded by the Silver Strand Beach and Hueneme Submarine Canyon.

Littoral transport of sand along the Santa Barbara cell is most influenced by the wave climate and material source. The dominant direction of movement is from north to south in response to an alongshore component of wave energy that is oriented downcoast during 94 percent of an average year. The net total transport volume from north to south at the Channel Island Harbor is about 918,000 cu m (1,200,000 cu yd) per year on average. Silver Strand Beach, located between Channel Islands Harbor and Port Hueneme, has been relatively stable over the past 50 years. Historical data indicates that since 1973, an average of about 50,000 cu m (65,000 cy) per year has been placed on Silver Strand. From Port Hueneme to Point Mugu, it is estimated that about 700,000 cu m (900,000 cu yd) per year is transported downcoast (Bailard 1985, Noble 1989).

### 2.3.8 Entrance Channel Shoaling

Minimum shoaling has been observed within the approach and the entrance channel in the past. Maintenance dredging within the channel area is infrequent. The last recorded maintenance dredging was completed in January 1991, when approximately 125,400 cu m (164,000 cu yd) of sand was removed from the approach and entrance channels. Comparisons of the post survey in January 1991 and condition surveys in July 1992 and February 1993 indicate that very minor shoaling had occurred immediately adjacent to the west jetty and parts of the approach channel. This observed shoaling may be attributed to overspill of the longshore sediment at the west jetty and the reverse longshore transport from south of the harbor, where the dredged sediment from the maintenance dredging at the Channel Islands Harbor is disposed. Prior to this work the area was dredged in 1983, which translates to an average annual accumulation rate of about 15,300 to 19,000 cu m (20,000 to 25,000 cu yd) per year.

### 2.4 Without Project Conditions

The average design draft of the vessels entering the harbor is 7.6 m (25 ft). The draft of the wood pulp vessels ranges from 7.6 to 10.1 m (25 to 33 ft), of the citrus vessels ranges from 4.9 to 9.1 m (16 to 30 ft), and the auto carriers are about 7.6 m (25 ft). The current depth of the harbor is -10.7 m (-35 ft) MLLW.

Poor maneuverability in the entrance channel and turning basin are primarily experienced by the large auto carriers, due to their great sail area (freeboard). Difficulty in maneuverability in Channel A is experienced when two vessels of 27.4 m (90 ft) beams or greater are tied alongside Wharves 1 and 2.

Both the Navy and the Oxnard Harbor District have expressed concern over potentially hazardous conditions in the entrance channel. Pilots at Port Hueneme have indicated that they feel that occasional gyre-like currents occurring between the jetties makes navigation hazardous, especially when combined with a strong wind 8.9 m/s (roughly 17 knots). Several of the larger car carriers will not enter the port under these conditions, and preliminary interviews indicate there have been a few cases of these vessels being delayed.

Some pilots will transit the entrance channel at a higher speed than normal to improve control. However, due to the configuration of the harbor, vessels entering do not have much space to reduce speed once they have cleared the entrance channel.

## 2.5 Design Vessels

The design vessel assumed for this project is a 50,000 DWT tanker. Based upon U.S. Army Corps of Engineers Headquarters memorandum dated 24 April 1996, subject: Economic Guidance Memorandum 95-2 (Revision): Fiscal Year 1995 Deep Draft Vessel Operating Cost Estimates. Appendix A of this memorandum provides estimated Tanker (Double Hull and Non-Double Hull), ship characteristics. For a 50,000 DWT tanker, the ship characteristics are: 206 m (676 ft) length overall, 12 m (39.3 ft) draft, and a 31.4 m (103 ft) beam. The volumetric displacement is approximately 45,900 cu m (60,000 cu yd), and the ship block coefficient (the ratio of the ship's volumetric displacement to the product of the ship's beam, length and draft) is 0.6.

# 3.0 HARBOR NAVIGATION AND SIMULATION

## 3.1 Aids-To-Navigation

There are lights on the end of each jetty (numbered 3 and 4), and buoys on either side of the beginning of the entrance channel (numbered 5 and 6). There is also a light at the northernmost end of the east jetty (Port Hueneme Lighthouse) and a range set up northeast of the turning basin for use in positioning vessels in the entrance channel.

## 3.2 Pilots' Strategy

The pilots' strategy for entering the port is of concern in determining the channel design because it outlines the factors that the pilot looks for in ensuring the safety of the vessel. The strategy is based on experience, and should be used in combination with the EM guidelines as support.

During a visit to Port Hueneme by Corps of Engineers representatives (Risko 1996), Port Pilot Captain Andrew M. Harvey discussed his navigation strategy for entering Port Hueneme. Upon entering the approach channel, tug boats are tied to the vessel. The approach is normally made at 3.09 m/s (6 knots). A Venturi effect in the approach channel sometimes requires speeds of nearly 5.1 m/s (10 knots) to overcome. Once the jetties are cleared, engines are stopped near Buoys 5 and 6 of the entrance channel. At the end of the entrance channel, engines are backed down with the aid of the tugs to 'kill' vessel way (momentum). Backing down the engines will sometimes result in the bow dropping 1 m (3 ft). By the end of the entrance channel, upon entering the turning basin, the vessel is guided by the tugs at about 0.5 m/s (1 knot). In docking at the Harbor District's wharves, the pilot usually docks the tankers bow first. After unloading, the vessel is backed out into the turning basin, turned by the tugs, and exits the harbor.

Of primary concern to the pilot when entering the harbor are the wind conditions. Wind speeds have to be less than 12.9 m/s (25 knots) for the pilot to attempt to enter the harbor. The sea and currents are generally not factors to consider presently when deciding whether to approach the channel. However, as deeper-draft vessels are brought into port, cross currents become more of a significant factor, indicating a need to widen the harbor's approach channel by approximately one beam length (30 m). Tides are not of concern for vessels with less than 9.75 m (32 ft) draft.

### 3.3 Ship Simulation Studies

A ship simulation study was conducted at the Star Center Training and Research facility, located in Dania, Florida from 26 to 30 July 1993, for Port Hueneme. The design vessel used was a 288.6 m (947 ft) FSL-7 cargo ship, assisted by four tugs. Turning in the basin with current dimensions was ruled out due to the ship's size. The following conditions needed to be met by the simulator, according to the study, in order for the ship to enter safely:

- wind < 6.2 m/s (12 knots)
- current < 0.3 m/s (0.5 knots)
- daylight operations only
- 0.9 m (3 ft) keel clearance
- 4 tug use required
- 2 pilots aboard
- no more than 1 ship at Wharves 5 and 6
- no more than 1 ship at Wharf 1 east of the channel line
- no ship or watercraft on Wharf 4
- 8.0 km (5 mi) visibility inbound/ 4.8 km (3 mi) outbound
- 0600 arrival time ideal

It was also recommended by the study that a wind measurement system be placed on the jetties, that a current measurement system be placed in the buoys at 4.6 m (15 ft) and 6.1 m (20 ft) depths, and that the wider harbor channel would expand safety margins of operations and operational parameters.

## 4.0 CHANNEL DIMENSIONS

Discussions of the channel width, depth and length follow. All discussions and calculations regarding dimensions are performed guided by draft EM 1110-2-1613, dated 8 Jan

1994, titled "Hydraulic Design of Deep Draft Navigation Projects", unless otherwise specified.

## 4.1 Channel Depth Criteria

Channel depth is based on the loaded draft of the design vessel plus underkeel clearance. The underkeel clearance is determined by considering vessel squat, the potential dynamic effects upon the vessel, and safety clearance. Therefore, the deepest vessel that could safely use the existing harbor at MLLW would draw about 10 m (33 ft) at it's lowest point. Vessels drafting 10.5 m (34 ft) or more at the lowest point may incur tidal delays.

### 4.1.1 Trim

Trim is the relation of a ship's floating attitude to the water, considered from bow to stern. When properly trimmed, the stern is usually lower in the water than the bow, or, in other words, the bow draft is less than the stern draft. Trim is not included as part of the underkeel clearance determination, since underkeel clearance is measured from the lowest point of the vessel as a whole.

### 4.1.2 Effects of Fresh Water

The effects of freshwater are neglected since the study area is a sea (salty) water environment.

### 4.1.3 Squat

As stated in the draft EM 1110-2-1613: "A ship in motion will be lowered (ship sinkage vertically) below the still water surface because of the increased velocity past the ship causing the pressure on the ship hull to be decreased. This phenomena occurs in deep, open water situations such as out at sea as well as in shallow water."

It is assumed that the vessel speeds will be as follows:

| Channel Reach | Speed |
|---|---|
| Approach | 11 km/hr (6 knots) |
| Entrance | 2 km/hr (1 knot) |
| Turning Basin | 2 km/hr (1 knot) |
| Slip | 2 km/hr (1 knot) |

Squat measurement is dependent on the ship block coefficient, ship length, beam, draft, and depth Froude number, as well as the dimensions of the channel. A WES computer program was used to calculate squat, with varied depth of the channels, the loaded draft of the ship, and the speed of the vessel. In the approach channel, for depths ranging from 12.5 m (41.0 ft) to 13.5 m (44.3 ft), the squat remained around 0.25 m (0.8 ft). Varying the entrance channel's depths from 11.5 m (37.7 ft) to 12.5 m (41.0 ft) resulted in a squat that was 0.1 m (0.3 ft) and below. The turning basin was tested with the same depths as the entrance channel and the squat was approximately 0.005 m (0.02 ft).

#### 4.1.4 Vertical Effects from Wave Motion

Based upon a kinematic model and a case study on the Columbia Rivermouth, a recommended value of ship vertical movement below the still water surface is about 1.2 times the wave height. If the average wave height in and around the approach channel is assumed to be 1 m (3.3 ft), then the vertical motion will be approximately 1.2 m (3.9 ft). In the entrance channel, waves are very small, perhaps 0.25 m (0.8 ft), so the vertical motion is around 0.3 m (1 ft). The waves in the turning basin are, for practical purposes, negligible, so vertical effects from waves here are estimated to be 0.1 m (0.3 ft).

#### 4.1.5 Safety Clearance

As stated in EM 1110-2-1613: "In the interest of safety, a clearance of at least [0.6 m] two feet is normally provided between the bottom of a ship and the design channel bottom to avoid damage to ship hull, propellers, and rudders from bottom irregularities and debris. When the bottom of the channel is hard consisting of rock, consolidated sand, or clay, the clearance should be increased to at least [0.9 m] three feet." Since the bottom of the channel is not expected to be hard, it is recommended that [0.6 m] two feet be allowed for safety clearance, inside and outside the breakwaters. This represents 5.1% of the vessel fully-loaded draft.

### 4.1.6 Underkeel Clearance

Underkeel clearance is the vertical distance below the lowest point of the vessel. The gross underkeel clearance is the sum of the effects of fresh water, squat, vertical motion from waves, and safety clearance, as summarized on table D-6. The resultant recommended underkeel clearance for the vessels approaching the harbor is 2.0 m (6.6 ft), or 17 % of the vessel's fully-loaded draft. The recommended underkeel clearance in the entrance channel is 1.0 m (3 ft), or 8 % of the draft. And in the turning basin, the recommended underkeel clearance is approximately 0.7 m (2.3 ft), 6 % of the draft.

Table D-6 Underkeel Clearance

| | Approach Channel meters (feet) | Entrance Channel meters (feet) | Turning Basin meters (feet) |
|---|---|---|---|
| Squat | 0.25 (0.82) | 0.09 (0.30) | 0.005 (0.016) |
| Vertical Motion | 1.2 (3.9) | 0.3 (1.0) | 0.1 (0.3) |
| Safety Clearance | 0.6 (2.0) | 0.6 (2.0) | 0.6 (2.0) |
| Total | 2.05 (6.72) | 0.99 (3.3) | 0.705 (2.32) |
| Recommended Clearance | 2.0 (6.6) | 1.0 (3.3) | 1.0 (3.3) |

## 4.2 Channel Width Criteria

### 4.2.1 Traffic Requirements

Both the approach and the entrance channels are designed to handle only one-way traffic.

### 4.2.2 Width for Straight Sections Inside the Breakwater

For channel width design criteria, aforementioned guidance (EM 1110-2-1613) recommends multipliers of the design vessel beam based upon maximum currents, channel cross-section, and aids-to-navigation. The maximum current ranges from 0 to 0.25 m/s (0.5 knots). The channel cross-section is dredged (trench) type. The design vessel beam is 31.4 m (103 ft). If the aids-to-navigation are rated as best, the multiplier is 2.75, resulting in a channel width of 86.4 m (283 ft). This is 14.2 m (47 ft) less than the existing entrance channel width of 100.6 m (330 ft), about 14% less. If the aids-to-navigation are rated as average due to the interference during certain hours from the sun, and interference from increasing numbers of city lights, the multiplier is 3.5, resulting in a channel width of 109.9 m (361 ft). This is 9.3 m (31 ft) more than the existing entrance channel width of 100.6 m (330 ft), about 10% more. These differences are not considered significant, and an adjustment in entrance channel width is not recommended.

## 5.0 CHANNEL DESIGN

Since the existing channel dimensions, other than the depth, are all reasonably close to the recommended measurements, only the depth of the harbor is recommended to be changed. Existing dimensions are again listed below:

Existing Navigation Features

- two jetties about 244 m (800 ft) and 305 m (1,000 ft) long;
- an approach channel about 244 m (800 ft) long by 183 m (600 ft) wide with a depth of -12.2 m (-40 feet), Mean Lower Low Water Datum (MLLW);
- a 472 m (1,550 ft) long entrance channel 91 m (330 ft) wide at a depth of -11 m (-36 ft), MLLW;
- a central basin 329 m (1,080 ft) long and 311 m (1,020 feet) wide with a depth of -10.7 (-35 ft) MLLW;
- and Channel A which is 707 m (2,320 ft) long, 84 m (275 ft) wide, and a depth of -10.7 (-35 ft) MLLW.

## 6.0 TURNING BASIN CRITERIA

Turning basins are required only when absolutely necessary, such as when the distance required to back a ship into berth is more than four or five berth lengths, or where an oil tanker has to be turned around to be moored with its bow heading out for safety reasons.

### 6.1 Turning Basin Dimensions

The size of the turning basin should call for a minimum turning diameter of 1.2 times the length overall for a low current (<0.26 m/s or 0.5 knots). The design vessel's length overall is 206 m (676 ft), so the turning diameter should be at least 247.2 m (811 ft). The actual basin dimensions of 329.2 m (1080 ft) by 310.9 m (1020 ft) satisfy the requirement.

## 7.0 DREDGED MATERIAL QUANTITIES

Four alternate deepening plans were evaluated based on the underkeel clearance requirements presented in previous sections. Channel and turning basin dimensions were maintained to the limits of the existing project since these dimensions are fairly close to the requirements obtained using the "design" vessel and guidance in EM-1110-2-1613. Plate D-3 depicts the design of the harbor and the alternative depths.

The table D-7 shows the estimated material quantities, in cubic meters, for deepening the harbor approach channel, entrance channel and turning basin to various depths, in meters. Dredge quantities are based on depth conditions within the harbor that existed at the time of the March 1996 condition survey, and include a 0.5 m overdepth dredging allowance. Quantities include the amount needed for maintenance dredging. The first set of rows show the quantities for the existing project depth. The remaining sets present the quantity required to deepen the project depth in one-half meter increments.

Table D-8 displays the quantity of material for deepening the berthing areas to the four alternative depths. Bathymetric data was only available at the berth along the Wharf 1 area. So dredge quantities for the berths along the other wharf areas were proportioned by surface area comparison to the berth along Wharf 1 area. "Pile Zone" quantities were also proportioned by surface area comparison to the turning basin surface area.

Table D-7 Approach Channel, Entrance Channel and Turning Basin[1] Dredging Quantities

| PROJECT AREA | DEPTH | QUANTITY | OVERDEPTH | SECTION TOTAL | TOTAL | TOTAL W/ WHARF |
|---|---|---|---|---|---|---|
| | m MLLW | cu m | cu m (0.5 m) | cu m | cu m | cu m |
| Approach | 12.2 | 13,500 | 24,200 | 37,700 | | |
| Entrance | 10.9 | 11,300 | 17,900 | 29,200 | | |
| T-Basin | 10.7 | 12,600 | 46,600 | 59,200 | | |
| Total (Entire Cutter) | | 37,400 | 88,700 | | 126,100 | |
| | | | | | | |
| Approach | 12.5 | 25,200 | 29,400 | 54,600 | | |
| Entrance | 11.5 | 38,600 | 23,000 | 61,600 | | |
| T-Basin (Total) | 11.5 | 98,200 | 66,300 | 164,500 | | |
| Pile Zone (6%) | 11.5 | 5,892 | 3,978 | 9,870 | 9,870 | 25,320 |
| T-Basin Remain | 11.5 | 92,308 | 62,322 | 154,630 | | |
| Total(Cutter Portion) | | 156,108 | 114,722 | | 270,830 | 305,180 |
| Total (Entire Cutter) | | 162,000 | 118,700 | | 280,700 | 330,500 |
| | | | | | | |
| Approach | 13 | 51,500 | 32,100 | 83,600 | | |
| Entrance | 12 | 64,100 | 23,000 | 87,100 | | |
| T-Basin (Total) | 12 | 168,100 | 70,600 | 238,700 | | |
| Pile Zone (6%) | 12 | 10,086 | 4,236 | 14,322 | 14,322 | 34,497 |
| T-Basin Remain | 12 | 158,014 | 66,364 | 224,378 | | |
| Total(Cutter Portion) | | 273,614 | 121,464 | | 395,078 | 439,303 |
| Total (Entire Cutter) | | 283,700 | 125,700 | | 409,400 | 473,800 |
| | | | | | | |
| Approach | 13.5 | 79,500 | 33,800 | 113,300 | | |
| Entrance | 12.5 | 96,000 | 23,000 | 119,000 | | |
| T-Basin (Total) | 12.5 | 243,400 | 73,000 | 316,400 | | |
| Pile Zone (6%) | 12.5 | 14,604 | 4,380 | 18,984 | 18,984 | 43,959 |
| T-Basin Remain | 12.5 | 228,796 | 68,620 | 297,416 | | |
| Total(Cutter Portion) | | 404,296 | 125,420 | | 529,716 | 585,241 |
| Total (Entire Cutter) | | 418,900 | 129,800 | | 548,700 | 629,200 |
| | | | | | | |
| Approach | 14 | 108,200 | 35,500 | 143,700 | | |
| Entrance | 13 | 130,700 | 23,000 | 153,700 | | |
| T-Basin (Total) | 13 | 322,200 | 75,800 | 398,000 | | |
| Pile Zone (6%) | 13 | 19,332 | 4,548 | 23,880 | 23,880 | 53,580 |
| T-Basin Remain | 13 | 302,868 | 71,252 | 374,120 | | |
| Total(Cutter Portion) | | 541,768 | 129,752 | | 671,520 | 737,520 |
| Total (Entire Cutter) | | 561,100 | 134,300 | | 695,400 | 791,100 |

[1] Turning Basin includes Channel A.

Table D-8 Berthing Area Dredging Quantities

| PROJECT AREA | DEPTH | AREA | AREA FACTOR | QUANTITY | OVERDEPTH | SECTION TOTAL |
|---|---|---|---|---|---|---|
| | m MLLW | sq m | | cu m | cu m (0.5 m) | cu m |
| | | | | | | |
| Wharf #1 | 11.5 | 12941 | 1 | 14,100 | 6,500 | 20,600 |
| (Berths 1-2-3) | 12 | | | 20,400 | 6,500 | 26,900 |
| | 12.5 | | | 26,800 | 6,500 | 33,300 |
| | 13 | | | 33,100 | 6,500 | 39,600 |
| | | | | | | |
| Pile Zone | 11.5 | 9765 | 0.75 | 10,575 | 4,875 | 15,450 |
| within Wharf #1 | 12 | | | 15,300 | 4,875 | 20,175 |
| (Clamshell | 12.5 | | | 20,100 | 4,875 | 24,975 |
| Portion) | 13 | | | 24,825 | 4,875 | 29,700 |
| | | | | | | |
| Remaining | 11.5 | 3176 | 0.25 | 3,525 | 1,625 | 5,150 |
| Wharf #1 | 12 | | | 5,100 | 1,625 | 6,725 |
| (Cutter-Suction) | 12.5 | | | 6,700 | 1,625 | 8,325 |
| Portion) | 13 | | | 8,275 | 1,625 | 9,900 |
| | | | | | | |
| Wharf #2 | 11.5 | 5537 | 0.43 | 6,100 | 2,800 | 8,900 |
| | 12 | | | 8,100 | 2,800 | 10,900 |
| | 12.5 | | | 11,500 | 2,800 | 14,300 |
| | 13 | | | 14,200 | 2,800 | 17,000 |
| | | | | | | |
| Wharf #3 | 11.5 | 5129 | 0.4 | 5,600 | 2,600 | 8,200 |
| | 12 | | | 8,200 | 2,600 | 10,800 |
| | 12.5 | | | 10,700 | 2,600 | 13,300 |
| | 13 | | | 13,200 | 2,600 | 15,800 |
| | | | | | | |
| Wharf #5 | 11.5 | 2827 | 0.22 | 3,100 | 1,400 | 4,500 |
| | 12 | | | 4,500 | 1,400 | 5,900 |
| | 12.5 | | | 5,900 | 1,400 | 7,300 |
| | 13 | | | 7,300 | 1,400 | 8,700 |
| | | | | | | |
| Wharf #4 | 11.5 | 4795 | 0.37 | 5,200 | 2,400 | 7,600 |
| | 12 | | | 7,500 | 2,400 | 9,900 |
| | 12.5 | | | 9,900 | 2,400 | 12,300 |
| | 13 | | | 12,200 | 2,400 | 14,600 |
| | | | | | | |
| BERTH AREA TOTAL | | | Cutter Portion | Clam Portion | Entire Cutter | |
| | 11.5 | | 34,350 | 15,450 | 49,800 | |
| | 12 | | 44,225 | 20,175 | 64,400 | |
| | 12.5 | | 55,525 | 24,975 | 80,500 | |
| | 13 | | 66,000 | 29,700 | 95,700 | |

## 8.0 CONSTRUCTION REQUIREMENTS

### 8.1 Construction Method

Two construction methods are anticipated at this time. One method is to dredge the entire area with a cutter-suction hydraulic pipeline dredge, including the area where the timber pile remants are located. Another method is to dredge the "pile zone" separately using a clamshell dredge. The remaining area would still be dredged with a cutter-suction dredge. The quantity tables, tables D-7 and D-8, show quantities for these two methods: quantities for dredging the entire area with cutter-suction pipeline dredge are indicated by "entire cutter"; and quantites for dredging with both clamshell and cutter-suction pipeline dredges are indicated by titles "pile zone" or "clam portion", and "cutter portion", respectively.

### 8.2 Equipment Description

Equipment for dredging is a hydraulic cutter suction pipeline dredge and/or a clamshell dredge. A hopper dredge may also be used.

### 8.3 Environmental Conditions

It is assumed at this writing (August 1996) that since placement of the dredged material is to be directly on the beach, the "environmental window" is applicable to construction operations of the proposed project. Placement of material should be between September 15 and March 15, to avoid the least tern foraging season and the grunion spawning season.

### 8.4 Maintenance

Maintenance requirements are assumed to be the same as existing maintenance requirements. Maintenance dredging is expected to be approximately 175,000 cm (250,000 cy) every 8 years.

## 9.0 DISPOSAL OF DREDGED MATERIAL

### 9.1 General

Material dredged from the project area will be transported and deposited within the limits of the disposal area (Hueneme Beach). The character of materials, i.e. physical grain size, will allow the direct placement of dredge material on the beach for the beneficial effects of beach nourishment. An optional nearshore disposal site may be provided to allow flexibility in the selection of construction equipment while still realizing beneficial use of the dredge material. Debris and other unsuitable material, including wooden piles, encountered will become property of the Contractor and removed from the site. Disposal of material above elevations indicated on the drawings will not be permitted.

### 9.2 Sediment Quality

Bulk sediment chemistry test results revealed that there were elevated levels of cadmium in the sediment samples. However, it was concluded that these levels would not prohibit the disposal of dredged sediments on the downcoast beaches. Results of the organotin tests indicate that the material is suitable for beach nourishment.

### 9.3 Disposal Site

The dredged material will be deposited at Hueneme Beach, immediately downcoast of the East Jetty of Port Hueneme Harbor, as indicated in the disposal plan drawings, or in an optional nearshore disposal site. The wooden piles will be deposited at a suitable land disposal site.

### 9.4 Method of Disposal

The dredged material could be moved using a hydraulic cutter suction pipeline dredge, a hopper dredge, or a clamshell dredge. Material could be placed on the beach or be deposited in such a way as to create an offshore berm approximately parallel to the shoreline. The berm would be located between the -3.0 m (-10 ft) and -9.1 (-30 ft) MLLW contours. The wooden piles will need to be removed and disposed of separate from the sediment.

## 10.0 REFERENCES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## 11.0 ADDENDUM

### 11.1 NED Plan

The plan formulation process resulted in a NED (National Economic Development) plan, identified in the main report as Alternative 2A. The general navigation features of the plan consists of: deepening the approach channel to -13.2 m (-43 feet) MLLW; and deepening the entrance channel and turning basin to -12.2 m (-40 feet) MLLW. Associated costs include: wharf modifications to the entrance channel wharf; deepening the berth area at Berth 1 and 5 to -12.2 m (-40 feet) MLLW; and wharf modifications at Berth 1 and Berth 5. The optimum depth determined has not previously been evaluated in this appendix, so this addendum section is provided for that purpose.

### 11.2 NED Dredge Quantities

Quantities for deepening to the NED depths described above were estimated based upon an interpolation of the quantities determined for dredging to previously proposed depths. The quantities are presented below.

#### 11.2.1 Approach, Entrance and Turning Basin Quantities

| Area | Depth (m) | Quantity (cm) | Overdepth (cm) | Total (cm) |
|---|---|---|---|---|
| Approach | 13.2 | 62,000 | 33,000 | 95,000 |
| Entrance | 12.2 | 77,000 | 23,000 | 100,000 |
| Turning Basin | 12.2 | 200,000 | 72,000 | 272,000 |
| Pile Zone (6%) (Clamshell) | 12.2 | 12,000 | 4,320 | 16,430 |
| Turning Basin Remaining | 12.2 | 188,000 | 67,680 | 255,680 |
| Total Cutter | 12.2 | 327,000 | 123,680 | 450,680 |

#### 11.2.2 Berth 1 and 5 Quantities

The quantity for dredging Berth 1 is assumed to be one-third of the quantity for dredging Wharf 1 to a depth of -12.2 m (-40 ft) MLLW. Dredging quantity for Wharf 1 to a depth of -12.2 m (-

40 ft) MLLW is proportioned as described in paragraph 7.0 DREDGED MATERIAL QUANTITIES. Berth 1 dredging quantity is 22,960 cm divided by 3 equals 7,653 cubic meters. The quantity for dredging Berth 5 is assumed to be one-half of the quantity for dredging Wharf 2 to a depth of -12.2 m (-40 ft) MLLW, determined similarly to Berth 1. Berth 5 dredging quantity is 9,870 cm divided by 2 equals 4,935 cubic meters.

11.2 Design Vessel

The design vessel is a 50,000 DWT tanker, (206m (676 feet) length, 31.4 m(103 feet) beam width and 12 m (39.3 feet) draft. The commodity is liquid fertilizer. No additional evaluation of the ship's relation to the navigation areas is necessary.

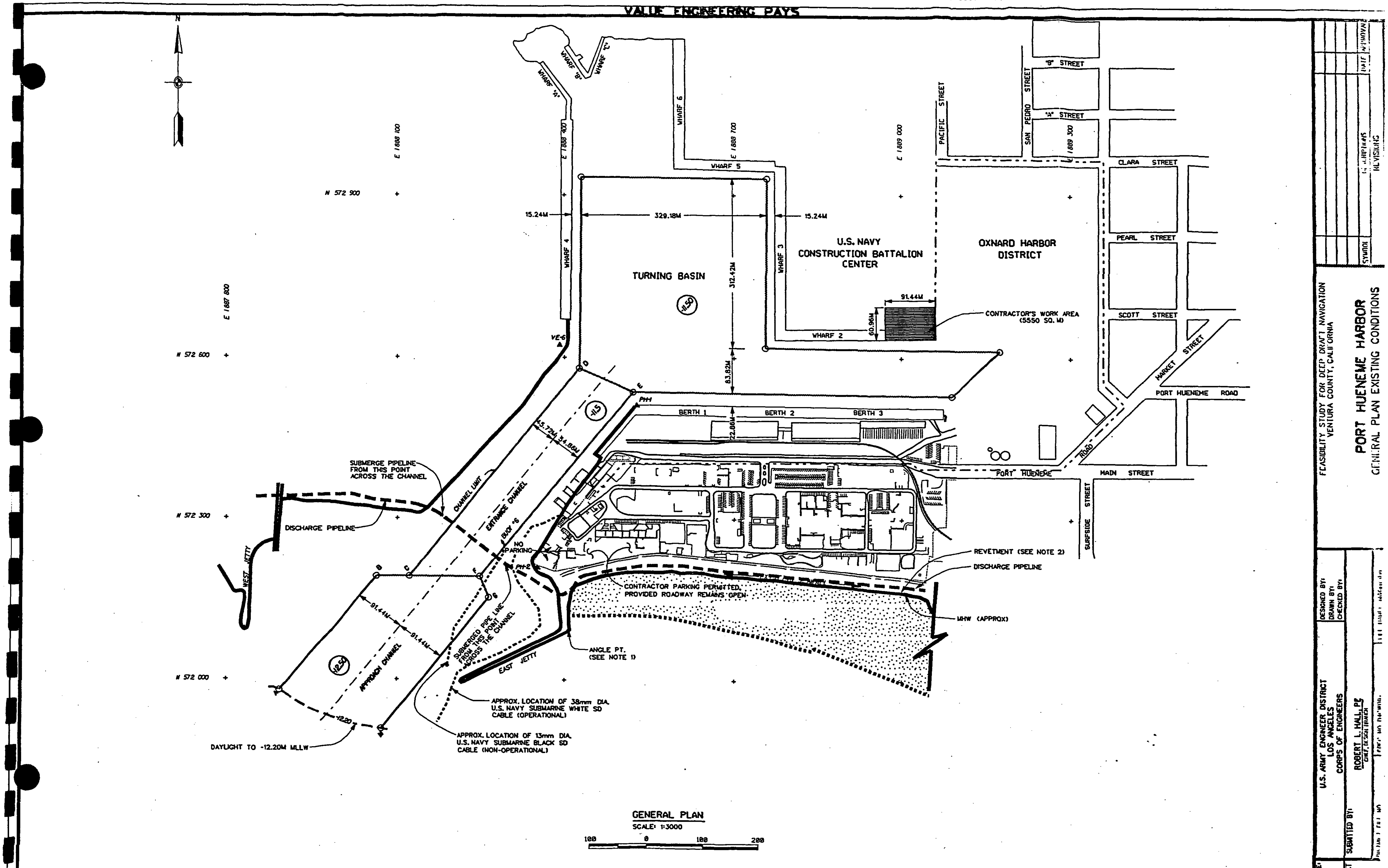
11.3 Navigation Safety

A wood pulp carrier has been brought safely into Port Hueneme Harbor on a regular basis. The vessel's length is 184 meters (603 feet) and beam width is 28 meters (92 feet). Another large vessel safely brought in regularly is the car carrier, whose length is about 213 meters (700 feet) and width is 32 meters (106 feet). These dimensions are comparable to the design vessel. Per telephone conversation (02-05-99) with Captain Carl Dingler, Port Pilot at Port Hueneme, bringing in the heavier tanker vessel at the deepened depth presents a requirement for additonal stopping power. Assuming the vessel itself has adequate stopping power, the additional need can be accomodated with the use of more powerful tugs (tractor tugs). Based upon the similiarity between the design vessel and the existing large vessels visiting the Port, a ship simulation study for studying navigational safety does not appear to be warranted.

11.4 Future Studies

Provided a waiver from ship simulation studies is granted, the project may proceed directly to Plans and Specifications. This is with the understanding that the necessary wharf modifications will be completed by the sponsor prior to the commencement of the deepening of the approach channel, entrance channel, turning basin, and berth areas. (It is understood that the Project Cooperation Agreement (PCA) will address this issue.) If ship simulation studies are necessary, then a Design Documentation Report will be required prior to the Plans and Specifications preparation.

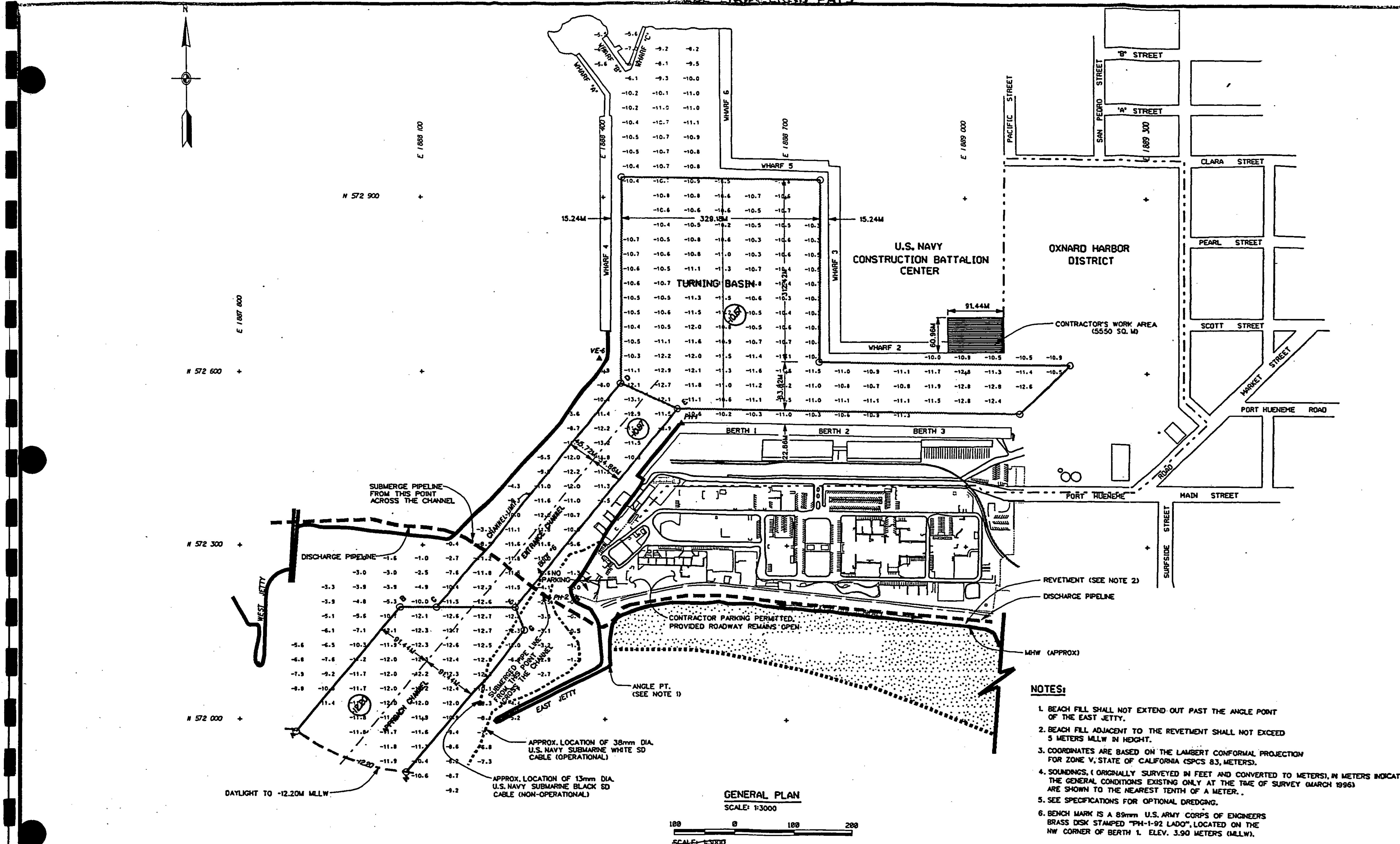
During the PED phase, in order to prepare the Plans and Specifications, there will need to be: an understanding of the environmental committtments; recent hydrographic surveys of the dredge areas; evaluation of the benefits of a side-scan sonar/magnetometer survey for identification and quantification of harbor bottom debris, and the survey itself if determined to be appropriate; review of the plans for wharf modifications.



VALUE ENGINEERING PAYS
N
WHARF "A"
WHARF "B"
WHARF "C"
WHARF 6
WHARF 5
WHARF 4
WHARF 3
WHARF 2
E 1888 100
E 1888 400
E 1888 700
E 1889 000
E 1889 300
E 1887 800
N 572 900
N 572 600
N 572 300
N 572 000
15.24M
329.18M
15.24M
312.42M
83.82M
22.86M
91.44M
60.96M
TURNING BASIN
U.S. NAVY
CONSTRUCTION BATTALION
CENTER
OXNARD HARBOR
DISTRICT
CONTRACTOR'S WORK AREA
(5550 SQ. M)
"B" STREET
"A" STREET
CLARA STREET
PEARL STREET
SCOTT STREET
MARKET STREET
PORT HUENEME ROAD
PORT HUENEME ROAD
MAIN STREET
PACIFIC STREET
SAN PEDRO STREET
SURFSIDE STREET
BERTH 1
BERTH 2
BERTH 3
VE-6
PH-1
PH-2
45.72M
54.86M
SUBMERGE PIPELINE FROM THIS POINT ACROSS THE CHANNEL
CHANNEL LIMIT
ENTRANCE CHANNEL
BUOY 'S
NO PARKING
DISCHARGE PIPELINE
WEST JETTY
91.44M
91.44M
APPROACH CHANNEL
SUBMERGED PIPE LINE FROM THIS POINT ACROSS THE CHANNEL
EAST JETTY
ANGLE PT. (SEE NOTE 1)
CONTRACTOR PARKING PERMITTED, PROVIDED ROADWAY REMAINS OPEN
REVETMENT (SEE NOTE 2)
DISCHARGE PIPELINE
MHW (APPROX)
-12.20
DAYLIGHT TO -12.20M MLLW
APPROX. LOCATION OF 38mm DIA. U.S. NAVY SUBMARINE WHITE SD CABLE (OPERATIONAL)
APPROX. LOCATION OF 13mm DIA. U.S. NAVY SUBMARINE BLACK SD CABLE (NON-OPERATIONAL)
GENERAL PLAN
SCALE: 1:3000
100 0 100 200
FEASIBILITY STUDY FOR DEEP DRAFT NAVIGATION
VENTURA COUNTY, CALIFORNIA
PORT HUENEME HARBOR
GENERAL PLAN EXISTING CONDITIONS
REVISIONS
SYMBOL
DESIGNED BY:
DRAWN BY:
CHECKED BY:
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
SUBMITTED BY:
ROBERT L. HALL, PE
SCALE:
SHEET
OF


PLATE D-1

VALUE ENGINEERING PAYS




## NOTES:

1. BEACH FILL SHALL NOT EXTEND OUT PAST THE ANGLE POINT OF THE EAST JETTY.
2. BEACH FILL ADJACENT TO THE REVETMENT SHALL NOT EXCEED 5 METERS MLLW IN HEIGHT.
3. COORDINATES ARE BASED ON THE LAMBERT CONFORMAL PROJECTION FOR ZONE V, STATE OF CALIFORNIA (SPCS 83, METERS).
4. SOUNDINGS, ( ORIGINALLY SURVEYED IN FEET AND CONVERTED TO METERS), IN METERS INDICATE THE GENERAL CONDITIONS EXISTING ONLY AT THE TIME OF SURVEY (MARCH 1996) ARE SHOWN TO THE NEAREST TENTH OF A METER.
5. SEE SPECIFICATIONS FOR OPTIONAL DREDGING.
6. BENCH MARK IS A 89mm U.S. ARMY CORPS OF ENGINEERS BRASS DISK STAMPED "PH-1-92 LADO", LOCATED ON THE NW CORNER OF BERTH 1. ELEV. 3.90 METERS (MLLW).

SYMBOL | DESCRIPTION | DATE | APPROVAL
REVISIONS

FEASIBILITY STUDY FOR DEEP DRAFT NAVIGATION
VENTURA COUNTY, CALIFORNIA

PORT HUENEME HARBOR
CONDITION SURVEY

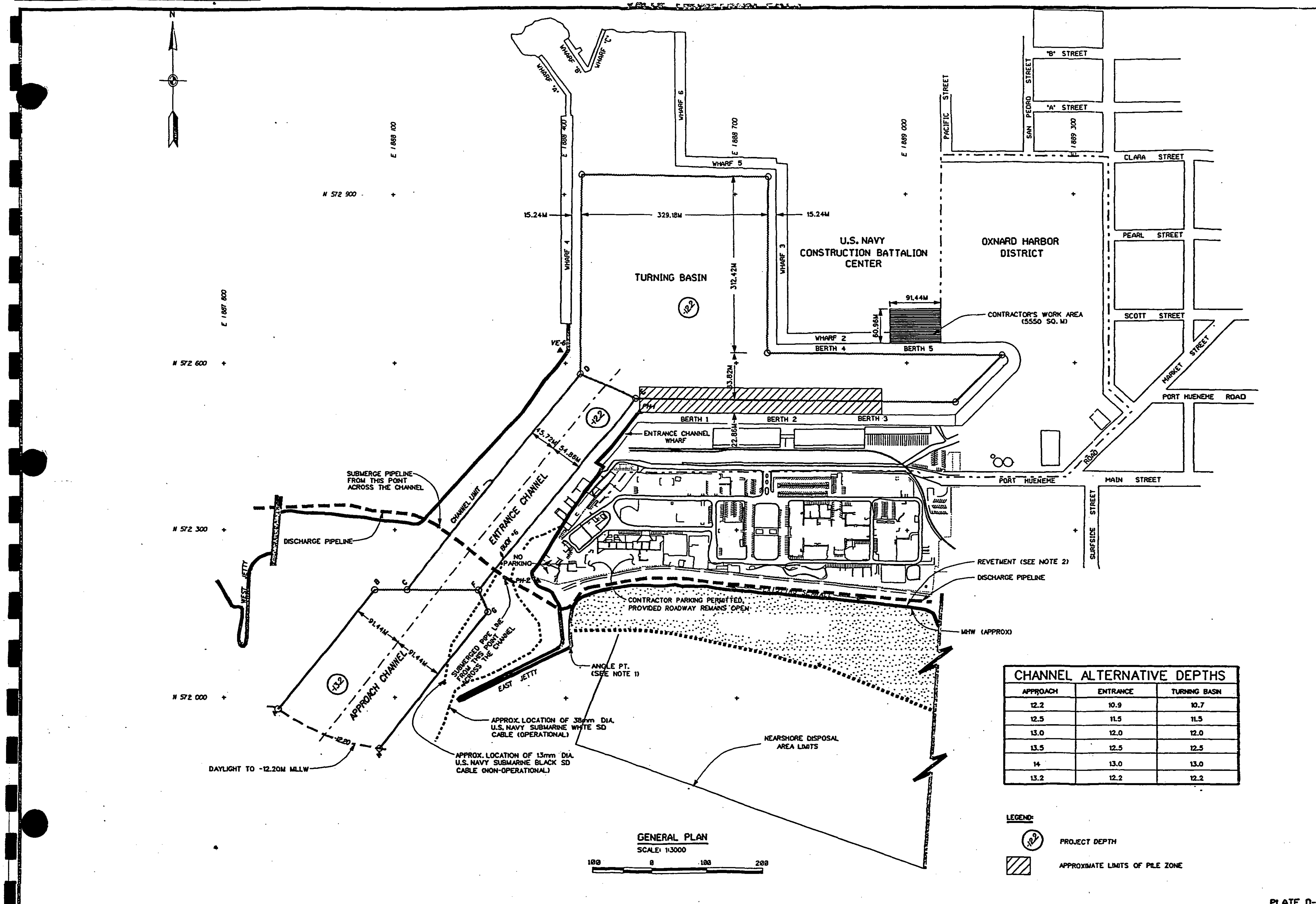
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SUBMITTED BY:
ROBERT L. HALL, PE
CHIEF, DESIGN BRANCH

SCALE:
SHEET OF

PLATE D-2




**CHANNEL ALTERNATIVE DEPTHS**

| APPROACH | ENTRANCE | TURNING BASIN |
|---|---|---|
| 12.2 | 10.9 | 10.7 |
| 12.5 | 11.5 | 11.5 |
| 13.0 | 12.0 | 12.0 |
| 13.5 | 12.5 | 12.5 |
| 14 | 13.0 | 13.0 |
| 13.2 | 12.2 | 12.2 |

FEASIBILITY STUDY FOR DEEP DRAFT NAVIGATION
VENTURA COUNTY, CALIFORNIA

**PORT HUENEME HARBOR**
CHANNEL ALTERNATIVE DEPTHS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUBMITTED BY:
CHIEF, DESIGN BRANCH
FILE NAME: PH96PD.DGN
DISTRICT FILE NO.
SPEC. NO. DACW09-
SCALE:
SHEET of SHEETS
SYMBOL | DESCRIPTIONS | DATE | APPROVAL
REVISIONS

PLATE D-3

SAFETY PAYS

THE PORT OF HUENEME, PORT HUENEME, CALIFORNIA
DRAFT FEASIBILITY STUDY

# APPENDIX "E"

# GEOTECHNICAL ENGINEERING ANALYSIS

FEBRUARY 1999

Port Hueneme
Harbor Deepening
Geotechnical Appendix

# I. INTRODUCTION

1.1 Location and Description of the Project. Port Hueneme Harbor is located in Ventura County on the coast of California. The Harbor is immediately west of the city of Port Hueneme, 5 kilometers southwest of the city of Oxnard, 16 kilometers south of the city of Ventura and 105 kilometers northwest of Los Angeles Harbor. The harbor is a man-made landlocked harbor connected to the sea by a jetty-protected entrance channel. The outer part of the entrance channel terminates at the head of a submarine canyon which offers an excellent deep-water approach to the harbor. The harbor consists of two rubble mound jetties with an 183 meters wide Approach Channel and an 472 meters long Entrance Channel leading into a Turning Basin.

1.2 Proposed Project. The proposed project consists of the deepening of Port Hueneme Harbor including the approach channel (from -12.2 to a maximum of -14 meters MLLW), the entrance channel (from -11 to a maximum of -13 meters MLLW), and the turning basin and slip A (from -10.7 to a maximum of -13 meters MLLW). The existing and maximum proposed project depths are indicated on Plate 1. The project is currently in the feasibility phase, in which the federal interest and preferred plan are to be developed.

1.3 Purpose and Scope. This report contains a geotechnical evaluation of the harbor area at Port Hueneme, Ventura County, California. It addresses the nature and character of the materials underlying the area proposed for harbor deepening by dredging. This evaluation is based on a review of subsurface exploration and sampling by diving, design data, and testing. Locations and logs of holes are shown on Plates 1 through 3.

# II. GEOLOGY AND PHYSIOGRAPHY

2.1 Physiography. Port Hueneme Harbor is located at the southwest edge of the Oxnard Plain, about 5 kilometers southwest of Oxnard, California. The plain, which extends into the Pacific Ocean, has an average width of about 16 kilometers and is a relatively flat lowland which extends from the Santa Clara River 13 kilometers to the north, to the Santa Monica Mountains/Pt. Mugu 13 kilometers to the south. The plain slopes southwest from the Camarillo Hills with a gradient of 2.27 to 2.84 meter per kilometer to the Pacific Ocean and extends seaward into the ocean for at least 3.2-4.8 kilometers. The plain was built by the Santa Clara River during Late Pleistocene time, and is a broad floodplain formed by meandering streams and backfilled lagoons. During Holocene time Calleguas Creek and the Santa Clara River both deposited alluvial material onto the plain. Windblown sands, back-bay deposits and other shallow marine sediments were also deposited along the ocean front.

There are two submarine canyons in the vicinity of Port Hueneme, the closest is Hueneme Canyon which begins at the edge of the harbor and extends seaward in a south direction for about 9.7-11.3 kilometers to a depth of about 366 meters. The farthest is the Mugu submarine canyon, found 13 kilometers downcoast of the harbor at the edge of the Santa Monica Mountains. This canyon extends about the same distance and direction as Hueneme Canyon to a depth of about 549 meters. These canyons have no relation to the present drainage systems and are thought to have originated during Pleistocene time.

2.2 Regional Geology. The coastal portion of the Oxnard plain is underlain by marine and non-marine sediments of Quaternary and Tertiary age, as described below:

2.2.1 Quaternary Sediments (Holocene and Pleistocene). The Holocene sediments are marine and non-marine (alluvial) sediments of streambed origin, coastal tidelands deposits of lagoonal origin, deltaic deposits from the Santa Clara River and Calleguas Creek and wind blown dune deposits along the coast. The sediments are unconsolidated silty sands, silts, clays and harbor bottom muds. The maximum thickness of the Holocene deposits is 61 meters. The unnamed Upper Pleistocene sediments are alluvial material of similar origin and are described as sand, gravel, and interbedded silt and clay with a total maximum thickness of about 80 meters. The Lower Pleistocene deposits consist of the San Pedro formation and the Santa Barbara formation, both described as interbedded silts, sands and clays. The total thickness of the Holocene and Pleistocene unconsolidated sediments is about 457 meters (Page, 1963 and Calif. DWR, 1965).

2.2.2 Tertiary Sediments. The Tertiary consolidated bedrock, which is exposed in the nearby highland and mountain areas, underlies the Holocene and Pleistocene deposits below 457-meter depth.

2.3 Site Geology. Information regarding the site geology was determined by a literature search, dive exploration and field reconnaissance of the harbor facilities. The site is on a portion of the Oxnard plain which is underlain by about 61 meters or more of unconsolidated Holocene marine and non-marine sediments which consists of lenticular beds of gravel, sand, silt and clay reworked by littoral currents and wave action. Nearby tidal marshes contain mud, silt and peat. The Holocene alluvium overlies unnamed deposits of non-marine clay, silt, sand and gravel tentatively classified as late Pleistocene geologic age, which probably exceed 305 meters in thickness. The deposits of wind-blown sand occur along the beach north of the harbor entrance. The materials to be dredged consist predominantly of silty sands, poorly graded sands with silt, and poorly graded sand. Small intervals of silty clayey sand, sandy silty clay, silt, and gravel, with occasional cobbles, and possibly boulders, will also be encountered.

2.4 Faulting. Four major faults or fault zones occur near the project area: The Oak Ridge fault, the Ventura fault, the Santa Monica-Malibu Coast-Anacapa fault and the Santa Cruz Island-Point Dume fault. All of these faults are active.

The west-southwest trending Oak Ridge fault begins near the Santa Susana Mountains in Los Angeles County, parallels the Santa Clara River to the Pacific Ocean, then continues offshore for about 32 kilometers. This fault lies about 13 kilometers north of the project area. This is the closest fault to Port Hueneme.

The Ventura fault lies about 1.6-3.2 kilometers north of the Oak Ridge fault and trends east-west.

The Santa Monica-Malibu Coast-Anacapa fault begins in Los Angeles County near West Hollywood, trends east-west and follows the coastline to Point Dume, then continues offshore to Anacapa Island. The fault is located about 13 kilometers south of the project area.

The Santa Cruz Island-Point Dume fault begins in Santa Monica, trends offshore and trends in an east-west direction, 5 to 11.3 kilometers south of the Malibu Coast fault. The fault passes south of Anacapa Island and continues west bisecting Santa Cruz Island.

The Sycamore Canyon fault, lies 13 kilometers east of the project area. This fault extends from the Pacific Ocean about 16 kilometers in a northeast direction towards Camarillo, and is not considered active.

2.5 Subsidence. A literature search indicates that subsidence is not a concern in the project area. The Hazards Appendix of the Ventura County General Plan states that subsidence has occurred along the Oxnard Plain, but is less than 15.2 mm per year along the coast. The more serious subsidence is found 8.0-9.7 kilometers inland from Port Hueneme in the vicinity of Highway 1 and is thought to be due to ground water withdrawal. A California State Division of Oil & Gas (1977) study stated that "..the entire Oxnard Plain has a history of subsidence since the first elevation benchmarks were set in 1920. The maximum amount of surface subsidence since 1920 is about 0.6 meters" (CSDOG 1977, pg. 4). Plate 1 of that report, a contour map entitled "Cumulative Subsidence 1951-1960", indicates that the 0.03 meters contour crosses the east jetty at the Entrance Channel. Plate 11 of the same report is a contour map entitled "Average Yearly Subsidence", and none of the contours extend to the jetties. The 6 to 21.3 mm contours stop at the north edge of the Harbor near the Navy Construction Battalion Base.

## III. INVESTIGATION

### 3.1 1983 Sediment Sampling.

The Corps of Engineers sampled 43 holes scattered throughout the harbor complex. The holes varied in depth from 1.2 to 4.3 meters. The materials encountered during this exploration were sands and silty sands with an occasional surface layer of a soft black silt. No bedrock was encountered.

### 3.2 1996-1997 Investigation

To characterize dredge materials for proposed harbor deepening, 12 test holes were placed (March 1996) in the Approach Channel, Entrance Channel, and Turning Basin. Sediment samples were obtained from the test holes and analyzed for gradation and chemical characteristics. Locations and logs of test holes are shown on Plates 1 through 3.

Additional explorations were conducted in May 1996 to investigate a subsurface hard layer that was identified the previous March and to resample sediments at the 12 test hole locations for organotin testing. The organotins required retesting because the initial tests failed laboratory quality control criteria. During the May 1996 explorations, numerous cutoff piles were observed protruding from the channel bottom. Two of these piles were subsequently pulled for observation and creosote testing in August 1997.

A bulk sediment chemistry testing program was implemented to determine the suitability of the sediment for different disposal options. Parameters, methods, and detection limits used in the program were based on the standard sediment analyses presented in Appendix D of the joint EPA/Los Angeles District Regional Implementation Agreement (RIA), draft dated 3 September 1993. The RIA is a regional document put together by EPA, Region IX, and the Los Angeles District to supplement the requirements contained in *Evaluation of Dredged Material Proposed for Ocean Disposal*, EPA-503/8-91/001, dated February 1991. This document is commonly referred to as "The Green Book" and contains guidance for ocean disposal of dredge materials.

### 3.2.1 Sampling Technique and Locations

The sampling equipment used was a hand-operated drive sampler. The drive sampler consists of a transparent Lexan sampling tube, 41.3 mm i.d. and up to 3 meters long, placed in a frame with a slide hammer. Samples were taken to the proposed maximum dredge depth plus 0.5 meters allowable overdredge or to the maximum length of the tube not including the length required to remain above the mudline used to extract the tube). Two drive samples were taken at each sampling location, one for physical samples and one for chemical samples. Table 1 contains a summary of the sampling data including the mudline elevation, penetration, and tip elevation for each location.

### 3.2.2 Sampling Procedure

3.2.2.1 Physical Samples. Samples were collected to characterize the sediments physical properties (grain size and plasticity). The sampling procedure consisted of cutting open the sediment-filled tube, visually logging and photographing the sample, and taking representative samples of each interval containing a distinctive material type. Representative samples were obtained by taking a uniform amount of material from the total depth of each identified interval, where the minimum interval was 0.1 m and the maximum length was typically 1.0 m. The material was double bagged in sealable plastic bags, labeled, and placed in a shipping container. A minimum sample size of 500 grams was taken for all physical samples.

3.2.2.2 Chemical Samples. The procedure for chemical sampling consisted of the following steps. After the sample was brought to the surface and while still in the tube, it was visually verified that the material was similar to that obtained for the physical samples. A samples was then taken for chemical testing for the depth interval below the mudline of 0.0 m to approximately 0.6 m. Additional samples were taken for deeper depth intervals but were not tested. These deeper samples were to be tested in the event that the surface layer contained significant concentrations of contaminants and would have been used to delineate the depth of any contaminant plume. Samples were obtained by cutting the tube for the interval of interest, capping, tapping, labeling, and placing the tube in a sealable plastic bag. The packaged tube was then placed in an ice chest filled with ice.

3.2.2.3 Sample Shipment. All chemical samples were shipped via overnight delivery to the Corps South Pacific Division Laboratory (SPD Lab) in Sausalito, California. Chemical samples remained on ice at all times prior to arrival at SPD Lab. Physical samples were hand delivered to the Corps of Engineers, Los Angeles district Soils Laboratory the day after sampling was completed. Chain of Custody records were maintained for all samples.

3.2.2.4 Physical Testing. Physical testing was conducted on all physical samples obtained. Testing included sieve analysis (with sieve sizes #4, 7, 10, 14, 18, 25, 45, 60, 80, 120, 170, 200, and 230), and Atterberg Limit determinations.

The results of the physical testing is shown on the logs. See Plates 2 and 3. The materials encountered typically consisted of poorly graded and silty sands. The northwest corner of the turning basin represented by holes DCH96-1 and -2 contains a surface layer 0.3 to 0.6 m thick composed of a silty clayey sand and sandy silty clay. Holes DCH96-4 and -9 encountered silts below elevations -13.2 and -12.6 m MLLW, respectively, with corresponding percents passing the No. 200 sieve of 95 and 68.

3.2.2.5 Chemical Testing. Chemical testing was conducted on samples from all 12 locations for the surface interval (0.0 to approximately 0.6 m). As mentioned previously in section 2.2, additional soil samples were collected and tested for organotins from the same locations.

The results of the sediment chemical testing is shown in Tables 2. Results were forwarded to Environmental Branch for determination of disposal options suitability.

Creosote testing was also conducted on material samples collected from one of the pulled piles. The results of the creosote tests are shown in Table 4.

3.2.3 Subsequent Diver Survey

During the March 1996 investigations, divers had encountered an apparent layer of dense material which varied in depth below the mudline from 0.3 to 1.8 m. The layer was located in the vicinity of DCH96-8. This discovery raised a concern about unknown obstacles that may be buried underneath the mudline and would be hazardous to the dredge operation. Therefore, diver surveys were performed on 20 May 1996 to verify the size, continuity and depth of the hard layers or objects below mudline near the west end of wharf 1. The result of the survey indicated that the layer encountered is probably a small pocket/layer of gravel and possibly small cobbles. Debris such as stone to 0.3 m dia., sheet metals, wood debris, trash, tires and Mooring and Howser lines were also observed on the surface in the survey area.

Several piles, up to an estimated 460 mm in diameter, were also discovered during this exploration. A subsequent literature search revealed that the piles are likely the remains of the original timber wharf constructed along the south side of the harbor. This wharf, along with its modern replacement is commonly designated wharf 1. The wooden wharf was constructed at the same time as the harbor in the late 1930s and early 1940s. The wharf was removed in the early 1970s under a contract administered by the Oxnard Harbor District at the same time as the construction of the replacement wharf 1, the widening and lengthening of slip A and the overall deepening of the harbor. Some of the piles appear to have been removed while others were snapped off or cutoff at or slightly above the mudline. A pile pulling operation was performed on 5 August 1997 to collect more information on the remaining timber piles. Results of the pile pulling operation are listed in paragraph V.

## IV. COMPATIBILITY ANALYSIS

4.1 General. The compatibility comparison of the dredge materials with the disposal beach materials are based on particle size gradation. Compatibility guidelines and analyses are discussed in the following paragraphs.

An analysis of the bulk sediment chemistry results is beyond the scope of this report. However, coordination between EPA, Region IX, and Environmental Branch, Los Angeles District, has determined that the proposed dredge sediment is suitable for disposal on the beach or nearshore.

4.2 Guidelines. The Los Angeles District Corps of Engineers has established quantitative guidelines for compatibility of borrow material to receiving beach material. A grain size distribution envelope of the receiving beach material is developed, which shows finest and coarsest limits from the No.

230 to the No. 4 sieve. A composite gradation curve is developed for each of the borrow materials, where a composite gradation is defined as the weighted mean gradation of all the types of materials found in a designated area, or in this case from a selected diver core hole. Borrow material with a composite gradation curve which plots within the limits of the receiving beach material envelope is said to be compatible with the receiving beach material. In addition, materials are considered compatible when: (1) borrow material is coarser than the coarse limit curve of the receiving beach material if not restricted by aesthetic reasons; and, (2) material passing the No. 200 sieve exceeds the finer limit by a maximum of 10 percentage points.

4.3 Dredge Material and Receiving Beach Compatibility. A receiving beach material envelope was developed in June 1985. Grain-size characteristics at the disposal beach are not expected to have changed since 1985. Therefore, additional disposal beach investigations were not necessary for this study. The coarse limit and fine limit of the material passing the No. 200 sieve are 1 and 47 percent, respectively. The gradation curves for the coarse and fine limits are shown in Figure 1 and the values tabulated on Table 3. These limits are based on samples taken along the range line at sta. 1316+75, at depths of +1.5, 0.0, -1.8, -3.7, -5.5, -7.3, and -9.1 m MLLW, on 6 June 1985. Surface samples at -1.8 m MLLW and below were sampled with a handline operated "petite Ponar" grab sampler operated from a LARC-5 boat. Material above the MLLW elevation was collected by hand. The Hydrographic Survey Section provided position control over the rangeline while sampling on the boat.

The composite gradations of the dredged area were then calculated and plotted against the disposal beach envelope. Figures 2 through 5 contain the composite gradation curves for each hole location of the entire diver core. Figures 6 through 9 contain the composite gradation curves for each hole location down to the maximum proposed dredge depth plus the 0.6 m allowable overdredge.

According to the guidelines, dredged materials are compatible with materials on the disposal beach. Because of the relatively low fines content of the dredge materials, these materials may be placed directly on the beach. However, the abandoned wood piles in the vicinity of wharf 1 will require either complete removal or cutting off their upper portions within the proposed dredging depths. In either case, upland disposal will likely be required for the piles.

## V. PILE PULLING AND TESTING

5.1 Pile Quantities and Locations. Several groups of piles were discovered inside the channel near wharf 1 which are believed to be the remnants of the wooden wharf built in the late 1930's and early 1940s. Based upon an Appraisal Report, dated 17 November 1938, it was estimated that 1536 piles were initially installed. See Plate 4. In order to identify the approximate location and number of piles inside the dredging area, a field investigation was conducted on 5 August 1997. Based on diver observations, it is estimated that 300 piles remain. Two piles were pulled during the investigation to determine the general condition, typical diameters and lengths, and to obtain samples for chemical analysis. The location the piles were pulled from is shown on Plate 1.

5.2 Pile Information. The following information was collected regarding the piles:

Table 5. Pile Information

| | Length (meter) | Top Dia. (mm) | Top Elev. (meter) | Tip Dia. (mm) | Tip Elev. (meter) | Max. Force to pull the pile (KN) |
|---|---|---|---|---|---|---|
| Pile 1 | 3.58 | 229 | 11.43 | 178 | 15.01 | 53-62 |
| Pile 2 | 4.65 | 267 | 11.43 | 191 | 16.08 | 80 |

5.3 Pile Pulling Process. The divers first jetted away the material around the top of the piles to provide room to attach the lines. Then, the large Navy YD Crane, berthed at Port Hueneme, pulled the lines to extract the piles. The jet probe was left on and placed adjacent to the piles during the pulling process. Video was made of the bottom including random piles to provide regulatory agencies with information concerning the bottom conditions and benthic community on and around the piles. Both piles were in good condition with minimal deterioration evident. Neither pile had significant biological growth evident when brought to the surface.

5.4 Chemical Testing. Chemical samples were collected at the following distances from the from the top of pile 2: 0.08, 0.76, and 4.57 meters. Samples consisted of a 15 mm cross sectional slice that was broken up and placed in jars. The jars were placed on ice and shipped to SPD lab for analysis of creosote concentrations. Both piles contained creosote based on visual observations. The chemical test results are shown on Table 4.

## VI. DREDGEABILITY

According to the ease of penetration obtained during diver coring, empirical data indicates the materials are dredgeable to depths reached during the explorations. Dredging operations should not encounter problems with any of the materials penetrated by the drive sampler in any area for this project. Suitable types of dredging equipment include hydraulic cutterhead, hopper, and clamshell dredges. Although a hydraulic cutterhead dredge could be used to remove the piles, a clamshell may prove to be more economical and efficient. Previous dredging at Port Hueneme, including both maintenance dredging and new work, has been accomplished using a hydraulic cutterhead dredge. Typical materials to be encountered will range from silty to poorly graded sands with relatively small zones of finer grained materials. Trash and other debris representative of an active working commercial harbor, as well as gravels, cobbles, and possibly small boulders will also be encountered.

The Character of Material paragraph in the Dredging section of the specifications should contain the following statement or similar to account for materials observed by the divers but that are not a part of the logs:

> Although not shown on the logs, trash and debris observed on the bottom included large pieces of sheet metal, various diameters and lengths of lines and cables, and boulders to 0.6 m. A layer of gravels and possibly cobbles was identified near DCH96-8.

## VII. SLOPE STABILITY

A slope stability analysis was conducted using the Infinite Slope method as presented in *Geotechnical Engineering in the Coastal Zone*, IR CERC-87-1. A dredged cut slope of 1H:3V was determined to be stable based on this static slope stability analysis. Some localized sloughing should be expected due to propeller wash and other factors but is not anticipated to affect normal operations and maintenance. Wharves adjacent to berths being deepened will require modification as shown on figures 10 through 18.

## VIII. REFERENCES

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Table 1. Summary of Hole Data

| Hole No. | Mudline Elevation MLLW (Meter) | Penetration (Meter) | Tip Elevation MLLW (Meter) |
|---|---|---|---|
| Turning Basin | (proposed maximum dredge depth: -13 m) | | |
| DCH96-01 | -11.0 | 2.7 | -13.7 |
| DCH96-02 | -10.7 | 2.7 | -13.4 |
| DCH96-03 | -10.7 | 2.9 | -13.6 |
| DCH96-04 | -10.5 | 2.8 | -13.3 |
| DCH96-05 | -10.9 | 2.7 | -13.6 |
| DCH96-06 | -10.8 | 2.3 | -13.1 |
| DCH96-07 | -11.1 | 2.6 | -13.7 |
| DCH96-08 | -11.4 | 2.4 | -13.8 |
| DCH96-09 | -11.1 | 2.3 | -13.4 |
| Slip A | (proposed maximum dredge depth: -13 m) | | |
| DCH96-10 | -10.7 | 2.5 | -13.2 |
| Entrance Channel | (proposed maximum dredge depth: -13 m) | | |
| DCH96-11 | -11.6 | 2.6 | -14.2 |
| Approach Channel | (proposed maximum dredge depth: -14 m) | | |
| DCH96-12 | -12.0 | 2.3 | -14.3 |

## Table 2A. 1996 CHEMICAL TESTING RESULTS FOR PORT HUENEME, CA
(Samples 1 - 6)

| | Testing Method | Sediment Detection Limits | Units * | DCH96-01 -11.0 to -11.2 | DCH96-02 -11.0 to -11.2 | DCH96-03 -11.0 to -11.2 | DCH96-04 -11.0 to -11.2 | DCH96-05 -11.0 to -11.2 | DCH96-06 -11.0 to -11.2 |
|---|---|---|---|---|---|---|---|---|---|
| A. PHYSICAL OR CONVENTIONAL | | | | | | | | | |
| Total Solids/Dry Weight | Plumb 1981 | 0.1 | % | 61 | 75 | 70 | 70 | 82 | 71 |
| Total Volatile Solids | " | 0.1 | % | 101 | 82.8 | 103 | 83.8 | 64.1 | 71.1 |
| pH | " | 0.1 | pH units | 8.3 | 8.3 | 8.3 | 8.4 | 8.9 | 8.4 |
| Ammonia | " | 0.1 | mg/kg | 4.7 | 2.0 | 1.3 | 1.1 | 4.1 | 2.5 |
| Total Organic Carbon (TOC) | EPA 9060 | 0.1 | % | 6.4 | 0.727 | 0.619 | 0.5 | 0.4 | 7.93 |
| Total Sulfides | Plumb 1981 | 0.1 | mg/kg | ND | ND | ND | 280 | 36 | ND |
| Oil and Grease | EPA 413.2 | 20.0 | mg/kg (wet) | 236 | 59.4 | 156 | 50.5 | 114 | 214 |
| B. METALS | | | | | | | | | |
| Arsenic (As) | EPA 6010 | 0.1 | mg/kg | 3.0 | 0.96 | 2.1 | 3.6 | 5.2 | 2.5 |
| Cadmium (Cd) March 96 Result | " | " | " | 0.34 | 0.14 | 0.34 | 0.24 | 0.87 | 0.3 |
| Cadmium (Cd) May 96 Result | " | " | " | 0.34 | 0.14 | 0.34 | 0.24 | 0.87 | 0.3 |
| Chromium (Cr) | " | " | " | 13.5 | 5.6 | 12.3 | 7.1 | 21.6 | 10.3 |
| Copper (Cu) | " | " | " | 6.9 | 3.1 | 12.3 | 4.8 | 31.3 | 14.3 |
| Lead (Pb) | " | " | " | 4.5 | 1.5 | 8.5 | 2.5 | 16.8 | 6.1 |
| Mercury (Hg) March 96 Result | EPA 7471 | 0.02 | mg/kg | 0.12 | 0.09 | 0.14 | 0.18 | 0.31 | 0.12 |
| Mercury (Hg) May 96 Result | " | 0.02 | mg/kg | 0.12 | 0.09 | 0.14 | 0.15 | 0.08 | 0.12 |

* Based on dry weight, unless specified otherwise.

Table 2A. (cont.) 1996 CHEMICAL TESTING RESULTS FOR PORT HUENEME, CA
(Samples 1 - 6)

| | Testing Method | Sediment Detection Limits | Units * | DCH96-01 -11.0 to -11.2 | DCH96-02 -11.0 to -11.2 | DCH96-03 -11.0 to -11.2 | DCH96-04 -11.0 to -11.2 | DCH96-05 -11.0 to -11.2 | DCH96-06 -11.0 to -11.2 |
|---|---|---|---|---|---|---|---|---|---|
| Nickel (Ni) | EPA 6010 | 0.1 | mg/kg | 9.3 | 4.0 | 6.9 | 5.7 | 12.9 | 6.1 |
| Selenium (Se) | " | " | " | ND | ND | ND | ND | ND | ND |
| Silver (Ag) | " | " | " | ND | ND | ND | ND | ND | 0.13 |
| Zinc (Zn) | " | " | " | 29.2 | 11.2 | 30.5 | 17.7 | 71.5 | 30.3 |
| C. PESTICIDES | | | | | | | | | |
| Total Chlorinated Pesticides | EPA 8080 | 0.02 | mg/kg | ND | ND | ND | ND | ND | ND |
| Aldrin | " | " | " | ND | ND | ND | ND | ND | ND |
| Chlordane and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Dieldrin | " | " | " | ND | ND | ND | ND | ND | ND |
| DDT and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Dndosulfan and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Endosulfan and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Endrin and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Heptachlor and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Hexachlorocyclohexane (HCH) and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Methoxychlor | " | " | " | ND | ND | ND | ND | ND | ND |
| Toxaphene | " | 0.03 | mg/kg | ND | ND | ND | ND | ND | ND |

* Based on dry weight, unless specified otherwise.

Table 2A. (cont.) 1996 CHEMICAL TESTING RESULTS FOR PORT HUENEME, CA
(Samples 1 - 6)

| | Testing Method | Sediment Detection Limits | Units * | DCH96-01 -11.0 to -11.2 | DCH96-02 -11.0 to -11.2 | DCH96-03 -11.0 to -11.2 | DCH96-04 -11.0 to -11.2 | DCH96-05 -11.0 to -11.2 | DCH96-06 -11.0 to -11.2 |
|---|---|---|---|---|---|---|---|---|---|
| D. ORGANIC COMPOUNDS | | | | | | | | | |
| D.1. ORGANOTINS | | | | | | | | | |
| Monobutyltin | NOSC Method | 0.001 | mg/kg | ND | ND | ND | ND | ND | ND |
| Dibutyltin | " | 0.001 | mg/kg | 18 | 16 | 34 | 19 | 6 | 9 |
| Tributyltin | " | 0.001 | mg/kg | 21 | 16 | 30 | 21 | 8 | 6 |
| Tetrabutyltin | " | 0.001 | mg/kg | ND | ND | ND | ND | ND | ND |
| D.2. PETROLEUM HYDROCARBONS | | | | | | | | | |
| Total Recoverable Petroleum Hydrocarbons (TRPH) | EPA 418.1 | 5.0 | mg/kg | 57.4 | 24.6 | 42.8 | 25.6 | 184 | 48.3 |
| D.3. PHENOLS | | | | | | | | | |
| Total Phenol | EPA 8270 | 0.03 | mg/kg | ND | ND | ND | ND | ND | ND |
| 2,4-Dimethylphenol | " | " | " | ND | ND | ND | ND | ND | ND |
| 2,4,6-Trichlorophenol | " | " | " | ND | ND | ND | ND | ND | ND |
| Para-chloro-meta-cresol | " | " | " | ND | ND | ND | ND | ND | ND |
| 2-Chlorophenol | " | " | " | ND | ND | ND | ND | ND | ND |
| 2,4-Dichlorophenol | " | " | " | ND | ND | ND | ND | ND | ND |
| 2-Nitrophenol | " | 0.05 | mg/kg | ND | ND | ND | ND | ND | ND |
| 4-Nitrophenol | " | 0.05 | mg/kg | ND | ND | ND | ND | ND | ND |
| 2,4-Dinitrophenol | " | 0.05 | mg/kg | ND | ND | ND | ND | ND | ND |
| 4,6-Dinitro-o-cresol | " | 0.03 | mg/kg | ND | ND | ND | ND | ND | ND |

* Based on dry weight, unless specified otherwise.

Table 2A. (cont.) 1996 CHEMICAL TESTING RESULTS FOR PORT HUENEME, CA
(Samples 1 - 6)

| | Testing Method | Sediment Detection Limits | Units * | DCH96-01 -11.0 to -11.2 | DCH96-02 -11.0 to -11.2 | DCH96-03 -11.0 to -11.2 | DCH96-04 -11.0 to -11.2 | DCH96-05 -11.0 to -11.2 | DCH96-06 -11.0 to -11.2 |
|---|---|---|---|---|---|---|---|---|---|
| Pentachlorophenol | EPA 8270 | 0.1 | mg/kg | ND | ND | ND | ND | ND | ND |
| D.4. PHTHALATES | | | | | | | | | |
| Total phthalates | EPA 8270 | 0.01 | mg/kg | ND | ND | ND | ND | 0.049 | 0.021 |
| Bis (2-ethylhexyl) phthalate | " | " | " | ND | ND | ND | ND | 0.049 | 0.021 |
| Butyl Benzyl phthalate | " | " | " | ND | ND | ND | ND | ND | ND |
| Di-n-butyl phthalate | " | " | " | ND | ND | ND | ND | ND | ND |
| Diethyl phthalate | " | " | " | ND | ND | ND | ND | ND | ND |
| Dimethyl phthalate | " | " | " | ND | ND | ND | ND | ND | ND |
| Di-n-octyl phthalate | " | " | " | ND | ND | ND | ND | ND | ND |
| D.5. POLYCHOLRINATED BIPHENYLS (PCB) | | | | | | | | | |
| Total PCB Congeners | EPA 8080 | 0.02 | mg/kg | ND | ND | ND | ND | ND | ND |
| Individual Congeners (Tetra-, Penta-, Hexa-Isomers) | " | 0.02 | mg/kg | ND | ND | ND | ND | ND | ND |
| D.6. POLYNUCLEAR AROMATICS HYDROCARBONS (PAH) | | | | | | | | | |
| Total PAHs | EPA 8270 | 0.02 | mg/kg | ND | ND | 0.23 | ND | 1.26 | 0.86 |
| Acenaphthene | " | " | " | ND | ND | ND | ND | ND | ND |
| Naphthalene | " | " | " | ND | ND | ND | ND | ND | ND |
| Acenaphthylene | " | " | " | ND | ND | ND | ND | ND | ND |

* Based on dry weight, unless specified otherwise.

Table 2A. (cont.) *1996 CHEMICAL TESTING RESULTS FOR PORT HUENEME, CA*
(Samples 1 - 6)

| | Testing Method | Sediment Detection Limits | Units * | DCH96-01 -11.0 to -11.2 | DCH96-02 -11.0 to -11.2 | DCH96-03 -11.0 to -11.2 | DCH96-04 -11.0 to -11.2 | DCH96-05 -11.0 to -11.2 | DCH96-06 -11.0 to -11.2 |
|---|---|---|---|---|---|---|---|---|---|
| Anthracens | EPA 8270 | " | " | ND | ND | ND | ND | 0.054 | 0.056 |
| Phenanthrene | " | " | " | ND | ND | ND | ND | 0.04 | 0.03 |
| Fluorene | " | " | " | ND | ND | ND | ND | ND | ND |
| Fluoranthene | " | " | " | ND | ND | 0.039 | ND | 0.08 | 0.1 |
| Benzo (a) anthracene | " | " | " | ND | ND | ND | ND | 0.074 | 0.072 |
| Benzo (a) pyrene | " | " | " | ND | ND | 0.04 | ND | 0.17 | 0.11 |
| Benzo (b) fluoranthene | " | 0.02 | mg/kg | ND | ND | 0.034 | ND | 0.18 | 0.11 |
| Benzo (k) fluoranthene | " | " | mg/kg | ND | ND | 0.046 | ND | 0.24 | 0.15 |
| Chrysene | " | " | mg/kg | ND | ND | 0.04 | ND | 0.15 | 0.13 |
| Benzo (g,h,i) perylene | " | " | mg/kg | ND | ND | ND | ND | 0.073 | ND |
| Dibenzo (a,h) anthracene | " | " | mg/kg | ND | ND | ND | ND | 0.037 | ND |
| Indeno (1,2,3-cd) pyrene | " | " | mg/kg | ND | ND | ND | ND | 0.082 | 0.04 |
| Pyrene | " | " | mg/kg | ND | ND | 0.031 | ND | 0.077 | 0.066 |

* Based on dry weight, unless specified otherwise.

## Table 2B. 1996 CHEMICAL TESTING RESULTS FOR PORT HUENEME, CA
(Samples 7 - 12)

| | Testing Method | Sediment Detection Limits | Units * | DCH96-01 -11.0 to -11.2 | DCH96-02 -11.0 to -11.2 | DCH96-03 -11.0 to -11.2 | DCH96-04 -11.0 to -11.2 | DCH96-05 -11.0 to -11.2 | DCH96-06 -11.0 to -11.2 |
|---|---|---|---|---|---|---|---|---|---|
| A. PHYSICAL OR CONVENTIONAL | | | | | | | | | |
| Total Solids/Dry Weight | Plumb 1981 | 0.1 | % | 78 | 67 | 78 | 76 | 80 | 72 |
| Total Volatile Solids | " | 0.1 | % | 81.9 | 78.3 | 69.8 | 76.8 | 80.9 | 72.8 |
| pH | " | 0.1 | pH units | 8.4 | 8.3 | 8.2 | 8.6 | 8.7 | 8.3 |
| Ammonia | " | 0.1 | mg/kg | 2.1 | 2.1 | 1.9 | 1.6 | 1.6 | 1.8 |
| Total Organic Carbon (TOC) | EPA 9060 | 0.1 | % | 4.53 | 4.51 | 5.91 | 0.5 | 3.73 | 6.47 |
| Total Sulfides | Plumb 1981 | 0.1 | mg/kg | ND | ND | ND | ND | ND | ND |
| Oil and Grease | EPA 413.2 | 20.0 | mg/kg (wet) | 140 | 41.7 | 130 | 114 | 169 | 242 |
| B. METALS | | | | | | | | | |
| Arsenic (As) | EPA 6010 | 0.1 | mg/kg | 1.8 | 1.4 | 2.5 | 2.3 | 1.8 | 2.6 |
| Cadmium (Cd) March 96 Result | " | " | " | 0.26 | 0.18 | 0.27 | 0.27 | 0.25 | 0.47 |
| Cadmium (Cd) May 96 Result | " | " | " | | | | | | |
| Chromium (Cr) | " | " | " | 8.9 | 7.0 | 11.7 | 9.0 | 8.4 | 12.1 |
| Copper (Cu) | " | " | " | 8.1 | 5.5 | 13.1 | 15.1 | 9.3 | 15.6 |
| Lead (Pb) | " | " | " | 3.7 | 2.4 | 4.4 | 7.3 | 6.2 | 9.3 |
| Mercury (Hg) March 96 Result | EPA 7471 | 0.02 | mg/kg | 0.11 | 0.1 | 0.1 | 0.31 | 0.1 | 0.15 |
| Mercury (Hg) May 96 Result | " | 0.02 | mg/kg | 0.11 | 0.1 | 0.1 | 0.1 | 0.1 | 0.15 |

Table 2B. (cont.) 1996 CHEMICAL TESTING RESULTS FOR PORT HUENEME, CA
(Samples 7 - 12)

| | Testing Method | Sediment Detection Limits | Units * | DCH96-01 -11.0 to -11.2 | DCH96-02 -11.0 to -11.2 | DCH96-03 -11.0 to -11.2 | DCH96-04 -11.0 to -11.2 | DCH96-05 -11.0 to -11.2 | DCH96-06 -11.0 to -11.2 |
|---|---|---|---|---|---|---|---|---|---|
| Nickel (Ni) | EPA 6010 | 0.1 | mg/kg | 5.1 | 4.0 | 7.1 | 5.4 | 5.3 | 7.4 |
| Selenium (Se) | " | " | " | ND | ND | ND | ND | ND | ND |
| Silver (Ag) | " | " | " | ND | ND | ND | ND | ND | ND |
| Zinc (Zn) | " | " | " | 22.9 | 16.2 | 30.7 | 22.3 | 24.9 | 38.0 |
| C. PESTICIDES | | | | | | | | | |
| Total Chlorinated Pesticides | EPA 8080 | 0.02 | mg/kg | ND | ND | ND | ND | ND | ND |
| Aldrin | " | " | " | ND | ND | ND | ND | ND | ND |
| Chlordane and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Dieldrin | " | " | " | ND | ND | ND | ND | ND | ND |
| DDT and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Dndosulfan and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Endosulfan and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Endrin and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Heptachlor and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Hexachlorocyclohexane (HCH) and Derivatives | " | " | " | ND | ND | ND | ND | ND | ND |
| Methoxychlor | " | " | " | ND | ND | ND | ND | ND | ND |
| Toxaphene | " | 0.03 | mg/kg | ND | ND | ND | ND | ND | ND |

* Based on dry weight, unless specified otherwise.

Table 2B. (cont.) 1996 CHEMICAL TESTING RESULTS FOR PORT HUENEME, CA
(Samples 7 - 12)

| | Testing Method | Sediment Detection Limits | Units * | DCH96-01 -11.0 to -11.2 | DCH96-02 -11.0 to -11.2 | DCH96-03 -11.0 to -11.2 | DCH96-04 -11.0 to -11.2 | DCH96-05 -11.0 to -11.2 | DCH96-06 -11.0 to -11.2 |
|---|---|---|---|---|---|---|---|---|---|
| D. *ORGANIC COMPOUNDS* | | | | | | | | | |
| D.1. ORGANOTINS | | | | | | | | | |
| Monobutyltin | NOSC Method | 0.001 | mg/kg | ND | ND | ND | ND | ND | ND |
| Dibutyltin | " | 0.001 | mg/kg | 2 | 9 | ND | 16 | 2 | ND |
| Tributyltin | " | 0.001 | mg/kg | ND | 13 | ND | 39 | 4 | 2 |
| Tetrabutyltin | " | 0.001 | mg/kg | ND | ND | ND | ND | ND | ND |
| D.2. PETROLEUM HYDROCARBONS | | | | | | | | | |
| Total Recoverable Petroleum Hydrocarbons (TRPH) | EPA 418.1 | 5.0 | mg/kg | 44.2 | 21 | 22 | 53 | 23.4 | 87 |
| D.3. PHENOLS | | | | | | | | | |
| Total phenol | EPA 8270 | 0.03 | mg/kg | ND | ND | ND | ND | ND | ND |
| 2,4-Dimethylphenol | " | " | " | ND | ND | ND | ND | ND | ND |
| 2,4,6-Trichlorophenol | " | " | " | ND | ND | ND | ND | ND | ND |
| Para-chloro-meta-cresol | " | " | " | ND | ND | ND | ND | ND | ND |
| 2-Chlorophenol | " | " | " | ND | ND | ND | ND | ND | ND |
| 2,4-Dichlorophenol | " | " | " | ND | ND | ND | ND | ND | ND |
| 2-Nitrophenol | " | 0.05 | " | ND | ND | ND | ND | ND | ND |
| 4-Nitrophenol | " | 0.05 | " | ND | ND | ND | ND | ND | ND |
| 2,4-Dinitrophenol | " | 0.05 | " | ND | ND | ND | ND | ND | ND |
| 4,6-Dinitro-o-cresol | " | 0.03 | " | ND | ND | ND | ND | ND | ND |

* Based on dry weight, unless specified otherwise.

Table 2B. (cont.) 1996 CHEMICAL TESTING RESULTS FOR PORT HUENEME, CA
(Samples 7 - 12)

| | Testing Method | Sediment Detection Limits | Units * | DCH96-01 -11.0 to -11.2 | DCH96-02 -11.0 to -11.2 | DCH96-03 -11.0 to -11.2 | DCH96-04 -11.0 to -11.2 | DCH96-05 -11.0 to -11.2 | DCH96-06 -11.0 to -11.2 |
|---|---|---|---|---|---|---|---|---|---|
| Pentachlorophenol | EPA 8270 | 0.1 | mg/kg | ND | ND | ND | ND | ND | ND |
| D.4. PHTHALATES | | | | | | | | | |
| Total phthalates | EPA 8270 | 0.01 | mg/kg | ND | ND | 0.021 | ND | ND | 0.035 |
| Bis (2-ethylhexyl) phthalate | " | " | " | ND | ND | 0.021 | ND | ND | 0.035 |
| Butyl Benzyl phthalate | " | " | " | ND | ND | ND | ND | ND | ND |
| Di-n-butyl phthalate | " | " | " | ND | ND | ND | ND | ND | ND |
| Diethyl phthalate | " | " | " | ND | ND | ND | ND | ND | ND |
| Dimethyl phthalate | " | " | " | ND | ND | ND | ND | ND | ND |
| Di-n-octyl phthalate | " | " | " | ND | ND | ND | ND | ND | ND |
| D.5. POLYCHOLRINATED BIPHENYLS (PCB) | | | | | | | | | |
| Total PCB Congeners | EPA 8080 | 0.02 | mg/kg | ND | ND | ND | ND | ND | ND |
| Individual Congeners (Tetra-, Penta-, Hexa-Isomers) | " | 0.02 | mg/kg | ND | ND | ND | ND | ND | ND |
| D.6. POLYNUCLEAR AROMATICS HYDROCARBONS (PAH) | | | | | | | | | |
| Total PAHs | EPA 8270 | 0.02 | mg/kg | ND | 0.53 | 0.48 | 0.38 | 0.12 | 1.58 |
| Acenaphthene | " | " | " | ND | ND | ND | ND | ND | ND |
| Naphthalene | " | " | " | ND | ND | ND | ND | ND | ND |
| Acenaphthylene | " | " | " | ND | ND | ND | ND | ND | 0.043 |
| Anthracens | " | " | " | ND | 0.041 | 0.033 | 0.021 | ND | 0.089 |

* Based on dry weight, unless specified otherwise.

Table 2B. (cont.) 1996 CHEMICAL TESTING RESULTS FOR PORT HUENEME, CA
(Samples 7 - 12)

| | Testing Method | Sediment Detection Limits | Units * | DCH96-01 -11.0 to -11.2 | DCH96-02 -11.0 to -11.2 | DCH96-03 -11.0 to -11.2 | DCH96-04 -11.0 to -11.2 | DCH96-05 -11.0 to -11.2 | DCH96-06 -11.0 to -11.2 |
|---|---|---|---|---|---|---|---|---|---|
| Phenanthrene | EPA 8270 | 0.02 | mg/kg | ND | 0.031 | 0.042 | ND | ND | 0.078 |
| Fluorene | " | " | " | ND | ND | ND | ND | ND | ND |
| Fluoranthene | " | " | " | ND | 0.085 | 0.097 | 0.025 | ND | 0.13 |
| Benzo (a) anthracene | " | " | " | ND | 0.049 | ND | ND | ND | 0.092 |
| Benzo (a) pyrene | " | " | " | ND | 0.056 | 0.05 | 0.074 | 0.028 | 0.2 |
| Benzo (b) fluoranthene | " | 0.02 | mg/kg | ND | 0.053 | 0.055 | 0.078 | 0.026 | 0.24 |
| Benzo (k) fluoranthene | " | " | mg/kg | ND | 0.079 | 0.061 | 0.097 | 0.026 | 0.19 |
| Chrysene | " | " | mg/kg | ND | 0.086 | 0.087 | 0.041 | ND | 0.12 |
| Benzo (g,h,i) perylene | " | " | mg/kg | ND | ND | ND | ND | ND | 0.091 |
| Dibenzo (a,h) anthracene | " | " | mg/kg | ND | ND | ND | ND | ND | 0.06 |
| Indeno (1,2,3-cd) pyrene | " | " | mg/kg | ND | ND | ND | ND | ND | 0.1 |
| Pyrene | " | " | mg/kg | ND | 0.047 | 0.058 | 0.039 | 0.039 | 0.15 |

* Based on dry weight, unless specified otherwise.

Table 3. Coarsest, Average and Finest Limits of Beach Composite Material.

| Beach Composite # Sieves | 7 | 10 | 14 | 18 | 25 | 35 | 45 | 60 | 80 | 120 | 170 | 200 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coarsest | 97 | 95 | 91 | 82 | 69 | 60 | 54 | 33 | 5 | 1 | 1 | 1 |
| Average | 99 | 99 | 98 | 97 | 95 | 93 | 90 | 78 | 63 | 51 | 33 | 22 |
| Finest | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 94 | 69 | 47 |

Table 4. Pile Chemistry Test Results

| Parameter | method | units | 0 m reporting limit | 0 m result | 0.6 m reporting limit | 0.6 m result | 4.6 m reporting limit | 4.6 m result |
|---|---|---|---|---|---|---|---|---|
| phenol | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| bis(2-chloroethyl)ether | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 2-chlorophenol | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 1,3-dichlorobenzene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 1,4-dichlorobenzene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| benzyl alcohol | EPA 8270 | mg/kg | 660 | ND | 2000 | ND | 660 | ND |
| 1,2-dichlorobenzene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 2-methylphenol | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| bis(2-chloroisopropyl)ether | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 4-methylphenol | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| n-nitroso-di-n-propylamine | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| hexachloroethane | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| nitrobenzene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| isophorone | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 2-nitrophenol | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 2,4-dimethylphenol | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| benzoic acid | EPA 8270 | mg/kg | 1700 | ND | 5000 | ND | 1700 | ND |
| bis(2-chloroethoxy)methane | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 2,4-dichlorophenol | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 1,2,4-trichlorobenzene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| naphthalene | EPA 8270 | mg/kg | 330 | 5700 | 990 | 15000 | 330 | ND |
| 4-chloroaniline | EPA 8270 | mg/kg | 660 | ND | 2000 | ND | 660 | ND |
| hexachlorobutadiene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 4-chloro-3-methylphenol | EPA 8270 | mg/kg | 660 | ND | 2000 | ND | 660 | ND |
| 2-methylnapthalene | EPA 8270 | mg/kg | 330 | 1400 | 990 | 4100 | 330 | ND |
| hexachlorocyclopentadiene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 2,4,6-trichlorophenol | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 2,4,5-trichlorophenol | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 2-chloronaphthalene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 2-nitroaniline | EPA 8270 | mg/kg | 1700 | ND | 5000 | ND | 1700 | ND |
| dimethylphthalate | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| acenaphthylene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 2,6-dinitrotoluene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 3-nitroaniline | EPA 8270 | mg/kg | 1700 | ND | 5000 | ND | 1700 | ND |
| acenaphthene | EPA 8270 | mg/kg | 330 | 24000 | 990 | 7300 | 330 | ND |
| 2,4-dinitrophenol | EPA 8270 | mg/kg | 1700 | ND | 5000 | ND | 1700 | ND |
| 4-nitrophenol | EPA 8270 | mg/kg | 1700 | ND | 5000 | ND | 1700 | ND |
| dibenzofuran | EPA 8270 | mg/kg | 330 | 14000 | 990 | 4300 | 330 | ND |
| 2,4-dinitrotoluene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| diethylphthalate | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 4-chlorophenyl-phenylether | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| fluorene | EPA 8270 | mg/kg | 330 | 19000 | 990 | 6000 | 330 | ND |
| 4-nitroaniline | EPA 8270 | mg/kg | 1700 | ND | 5000 | ND | 1700 | ND |

Distance from top of pile: 0 m, 0.6 m, 4.6 m

ND - non detected

## Table 4. Pile Chemistry Test Results (cont.)

| | | | Distance from top of pile | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 0 m | | 0.6 m | | 4.6 m | |
| Parameter | method | units | reporting limit | result | reporting limit | result | reporting limit | result |
| 4,6-dinitro-2-methylphenol | EPA 8270 | mg/kg | 1700 | ND | 5000 | ND | 1700 | ND |
| n-nitrosodiphenylamine | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 4-bromophenyl-phenylether | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| hexachlorobenzene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| pentachlorophenol | EPA 8270 | mg/kg | 1700 | ND | 5000 | ND | 1700 | ND |
| phenanthrene | EPA 8270 | mg/kg | 330 | 45000 | 990 | 15000 | 330 | ND |
| anthracene | EPA 8270 | mg/kg | 330 | 11000 | 990 | 3900 | 330 | ND |
| di-n-butylphthalate | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| fluoranthene | EPA 8270 | mg/kg | 330 | 24000 | 990 | 7400 | 330 | ND |
| pyrene | EPA 8270 | mg/kg | 330 | 19000 | 990 | 6100 | 330 | ND |
| butylbenzylphthalate | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| 3.3'-dichlorobenzidine | EPA 8270 | mg/kg | 660 | ND | 2000 | ND | 660 | ND |
| benzo(a)anthracene | EPA 8270 | mg/kg | 330 | 600 | 990 | 1900 | 330 | ND |
| chrysene | EPA 8270 | mg/kg | 330 | 480 | 990 | 1600 | 330 | ND |
| bis(2-ethylhexyl)phthalate | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| di-n-octylphthalate | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| benze(b)fluoranthene | EPA 8270 | mg/kg | 330 | 340 | 990 | 1000 | 330 | ND |
| benzo(k)fluoranthene | EPA 8270 | mg/kg | 330 | 430 | 990 | 1300 | 330 | ND |
| benzo(a)pyrene | EPA 8270 | mg/kg | 330 | 330 | 990 | 1100 | 330 | ND |
| indeno(1,2,3-cd)pyrene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| dibenz(a,h)anthracene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |
| benzo(g,h,i)perylene | EPA 8270 | mg/kg | 330 | ND | 990 | ND | 330 | ND |

ND - non detected

# PORT HUENEME
## RECEIVING BEACH GRADATION CURVES

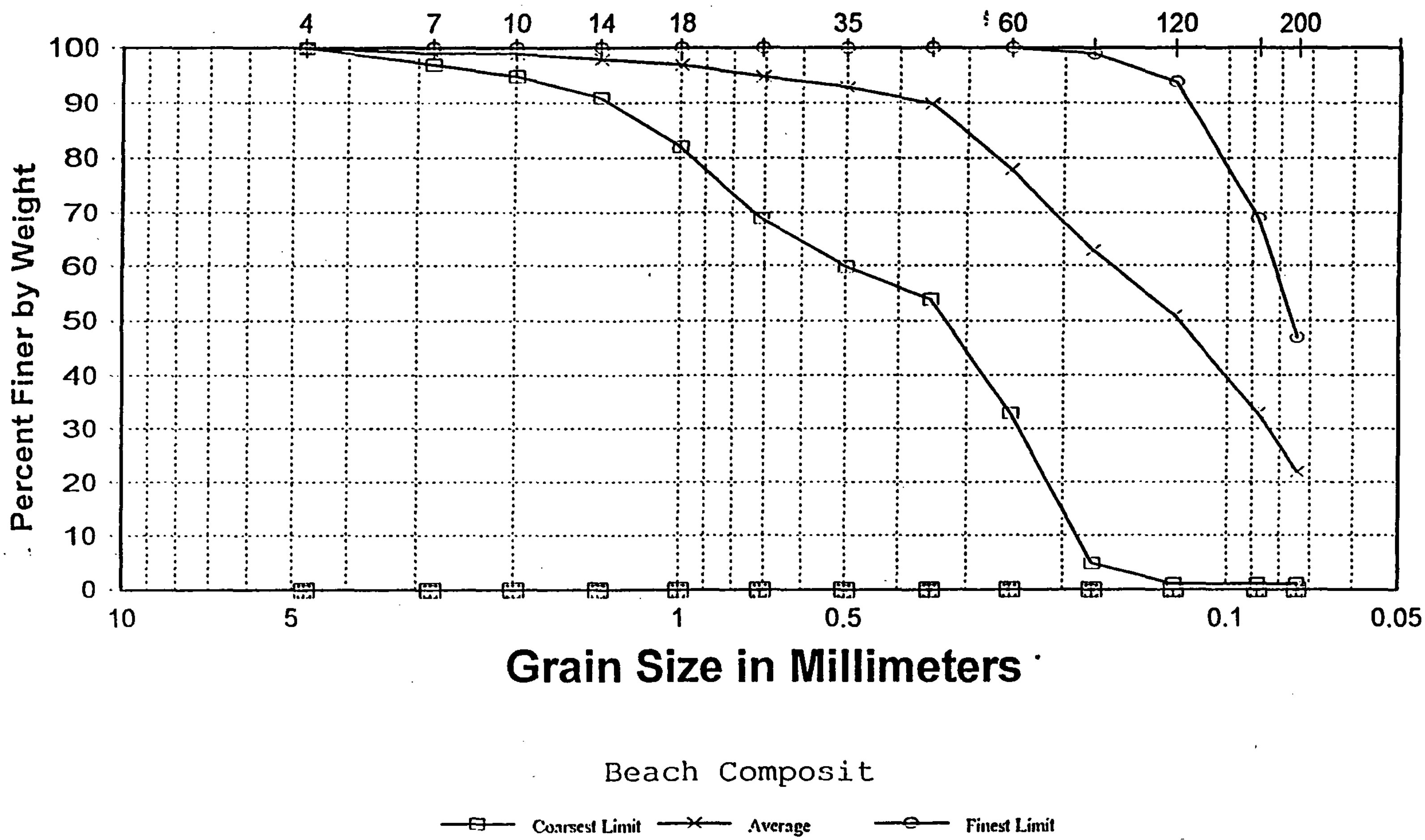



Figure 1

# PORT HUENEME (Sample 1-3)

GRADATION CURVES FOR THE ENTIRE LENGTH OF THE CORE

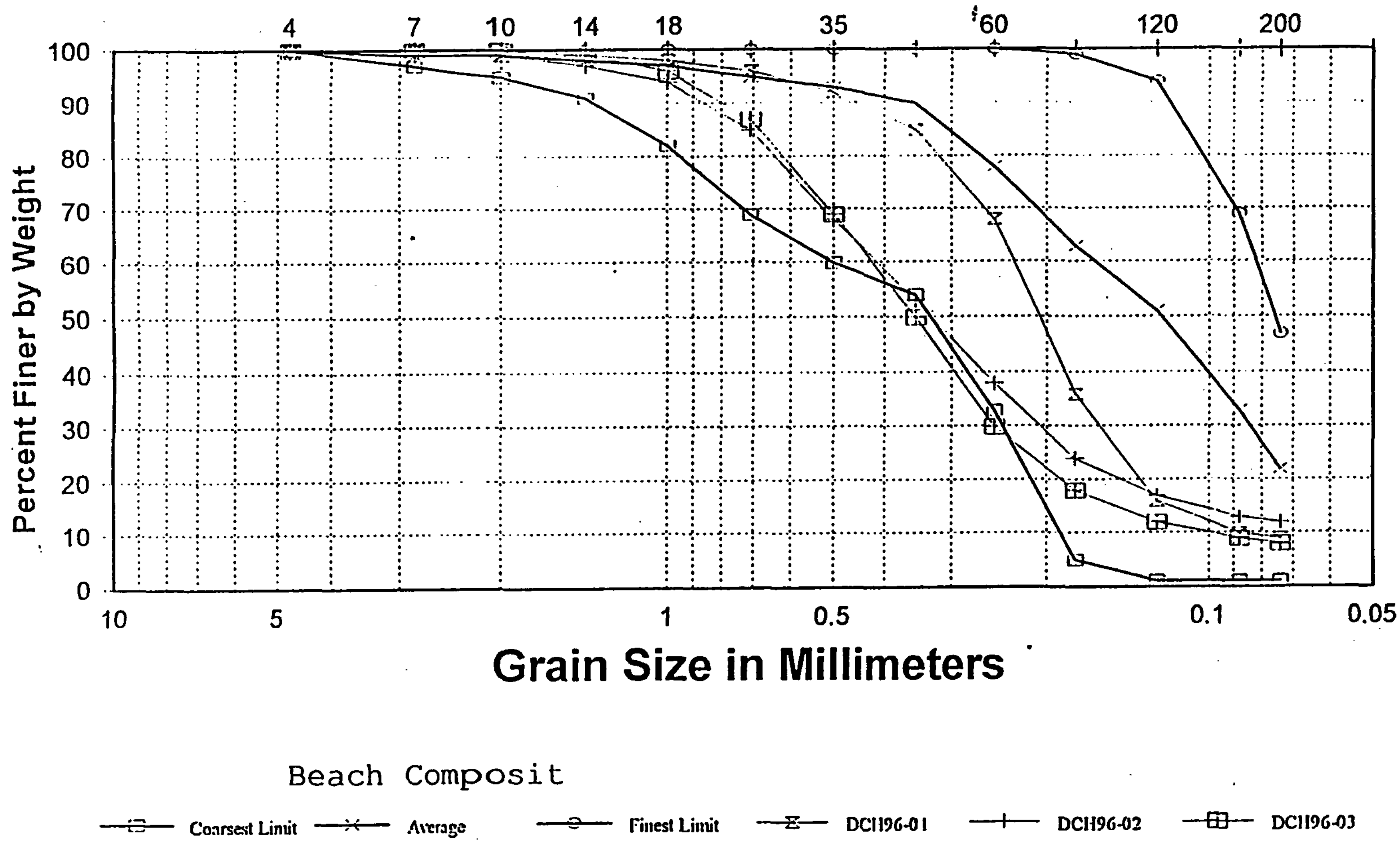



Figure 2

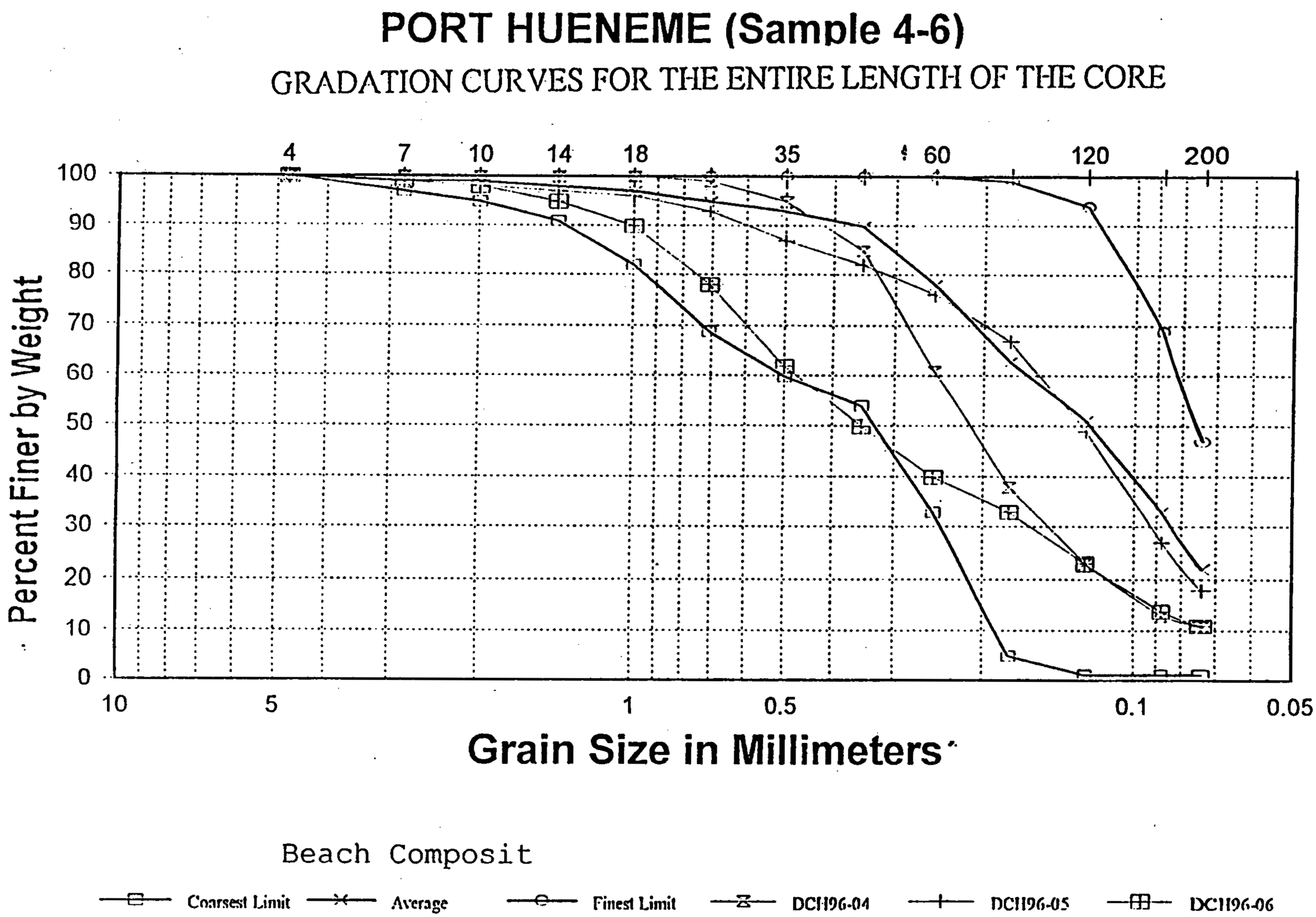

PORT HUENEME (Sample 4-6)
GRADATION CURVES FOR THE ENTIRE LENGTH OF THE CORE
4
7
10
14
18
35
60
120
200
100
90
80
70
60
50
40
30
20
10
0
Percent Finer by Weight
10
5
1
0.5
0.1
0.05
Grain Size in Millimeters
Beach Composit
Coarsest Limit
Average
Finest Limit
DCH96-04
DCH96-05
DCH96-06

Figure 3

# PORT HUENEME (Sample 7-9)

GRADATION CURVES FOR THE ENTIRE LENGTH OF THE CORE

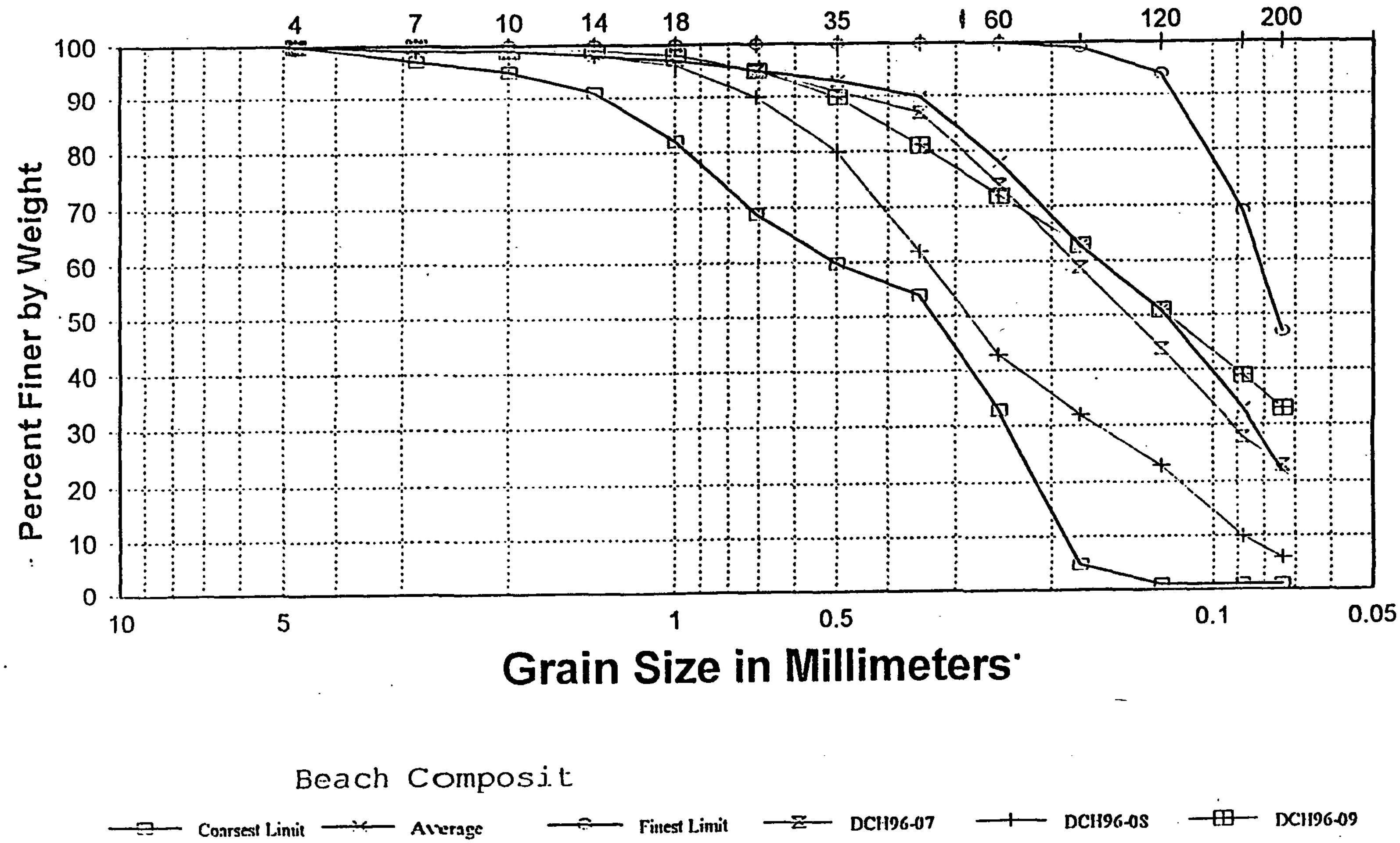



Figure 4

# PORT HUENEME (Sample 10-12)

GRADATION CURVES FOR THE ENTIRE LENGTH OF THE CORE

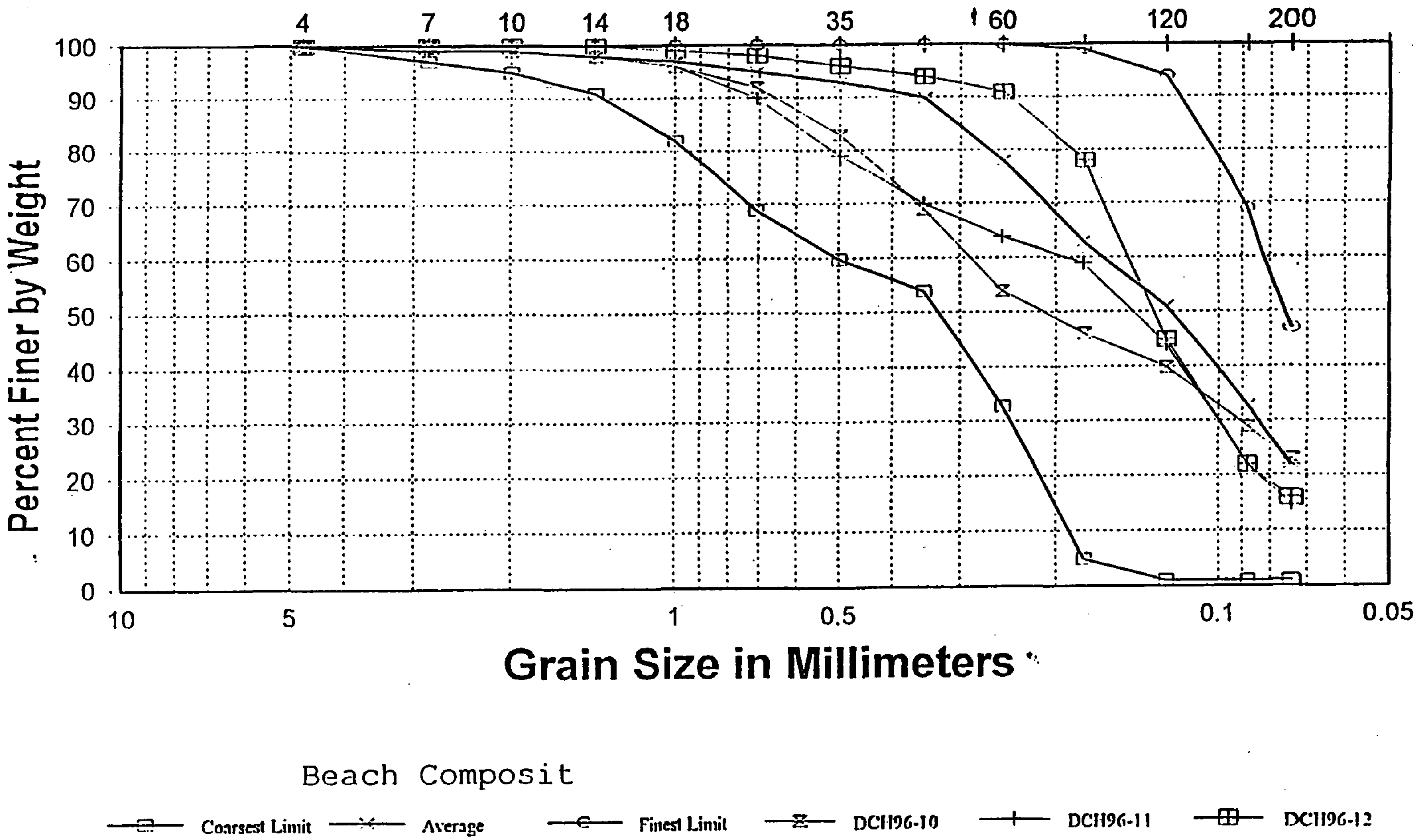



Figure 5

# PORT HUENEME (Sample 1-3)

GRADATION CURVES TO PROJECT DEPTH plus 0.6 m OVER DREDGE

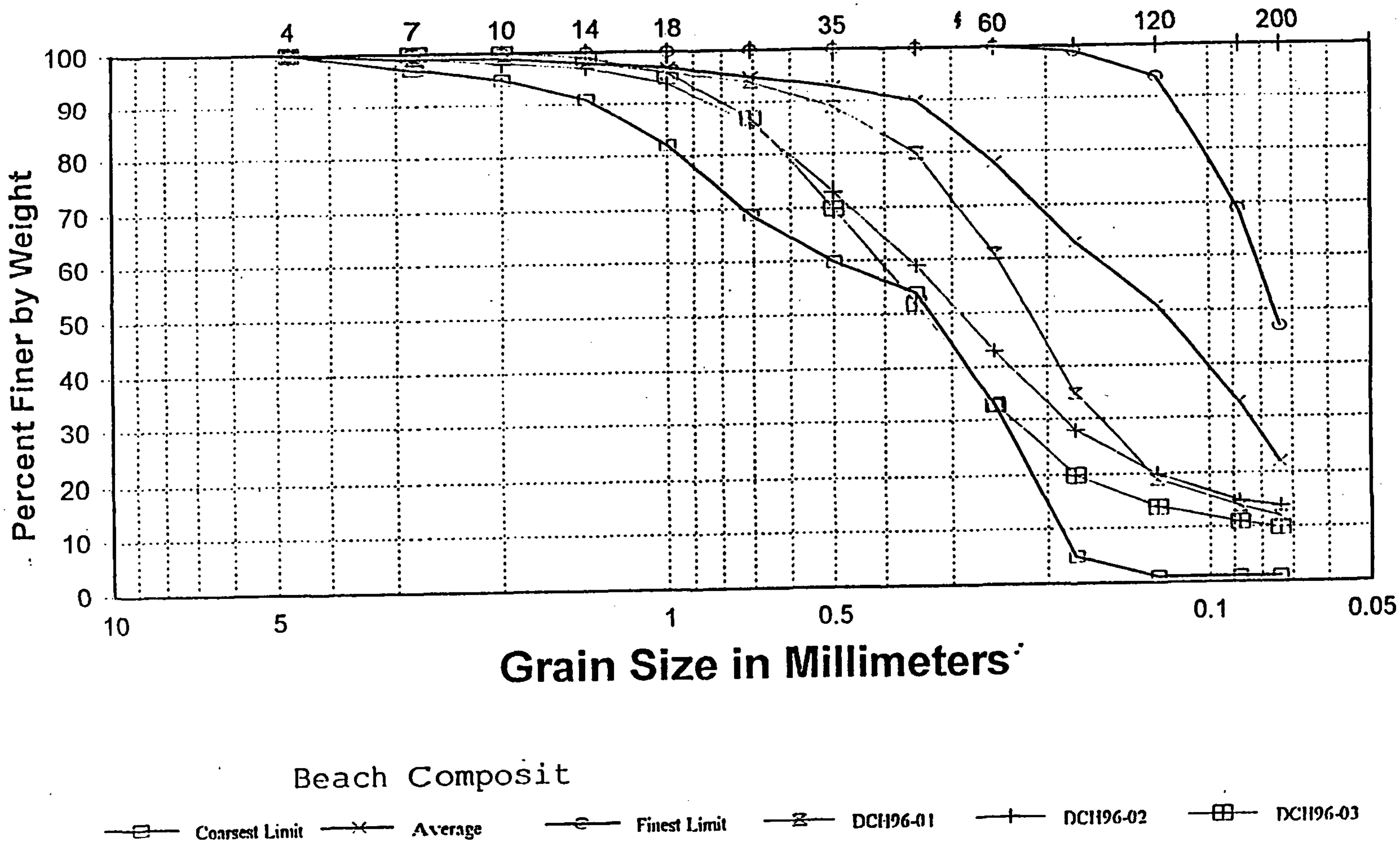



Figure 6

# PORT HUENEME (Sample 4-6)

GRADATION CURVES TO PROJECT DEPTH plus 0.6 m OVER DREDGE

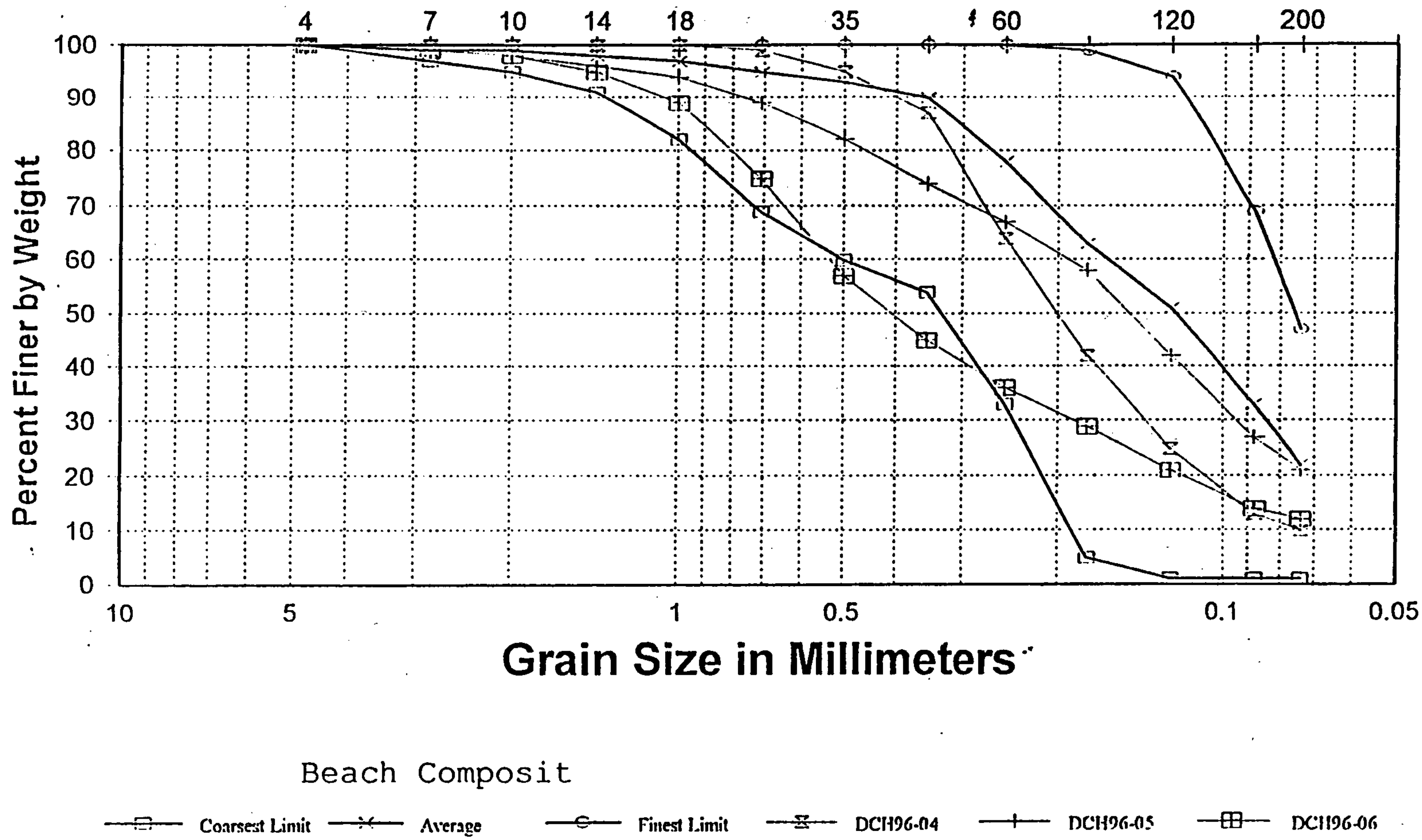



Figure 7

# PORT HUENEME (Sample 7-9)

GRADATION CURVES TO PROJECT DEPTH plus 0.6 m OVER DREDGE

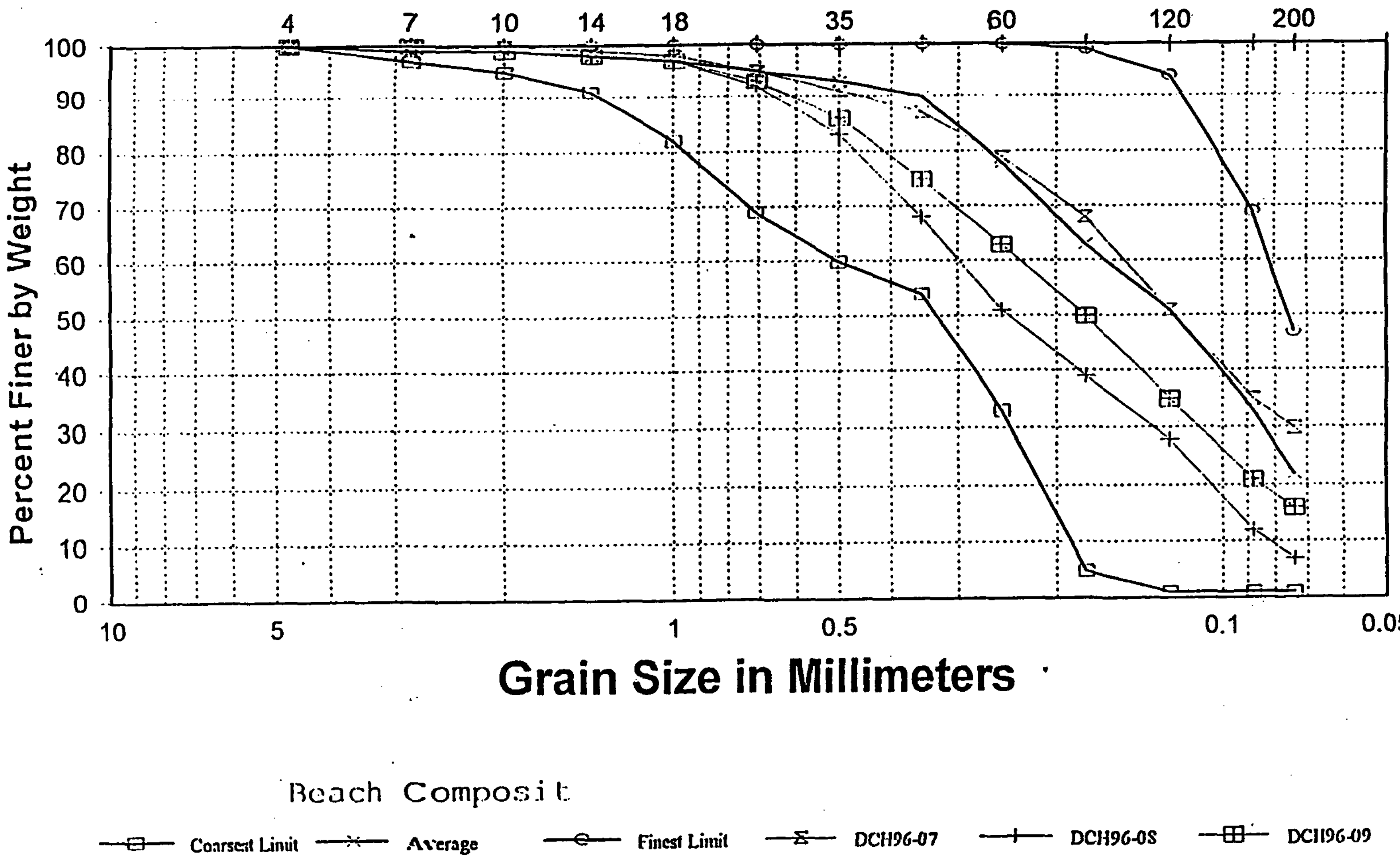



Figure 8

# PORT HUENEME (Sample 10-12)

GRADATION CURVES TO PROJECT DEPTH plus 0.6 m OVER DREDGE

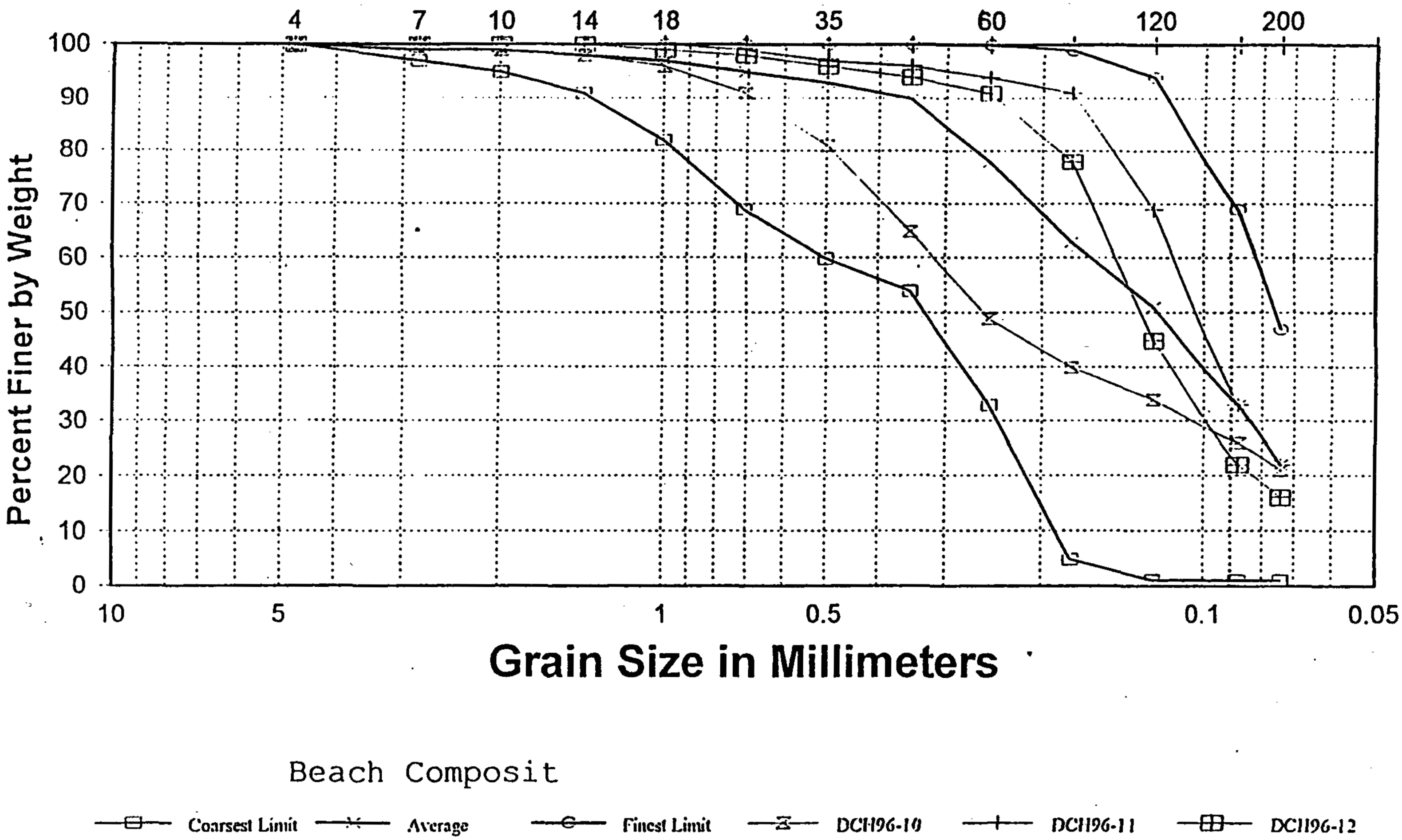
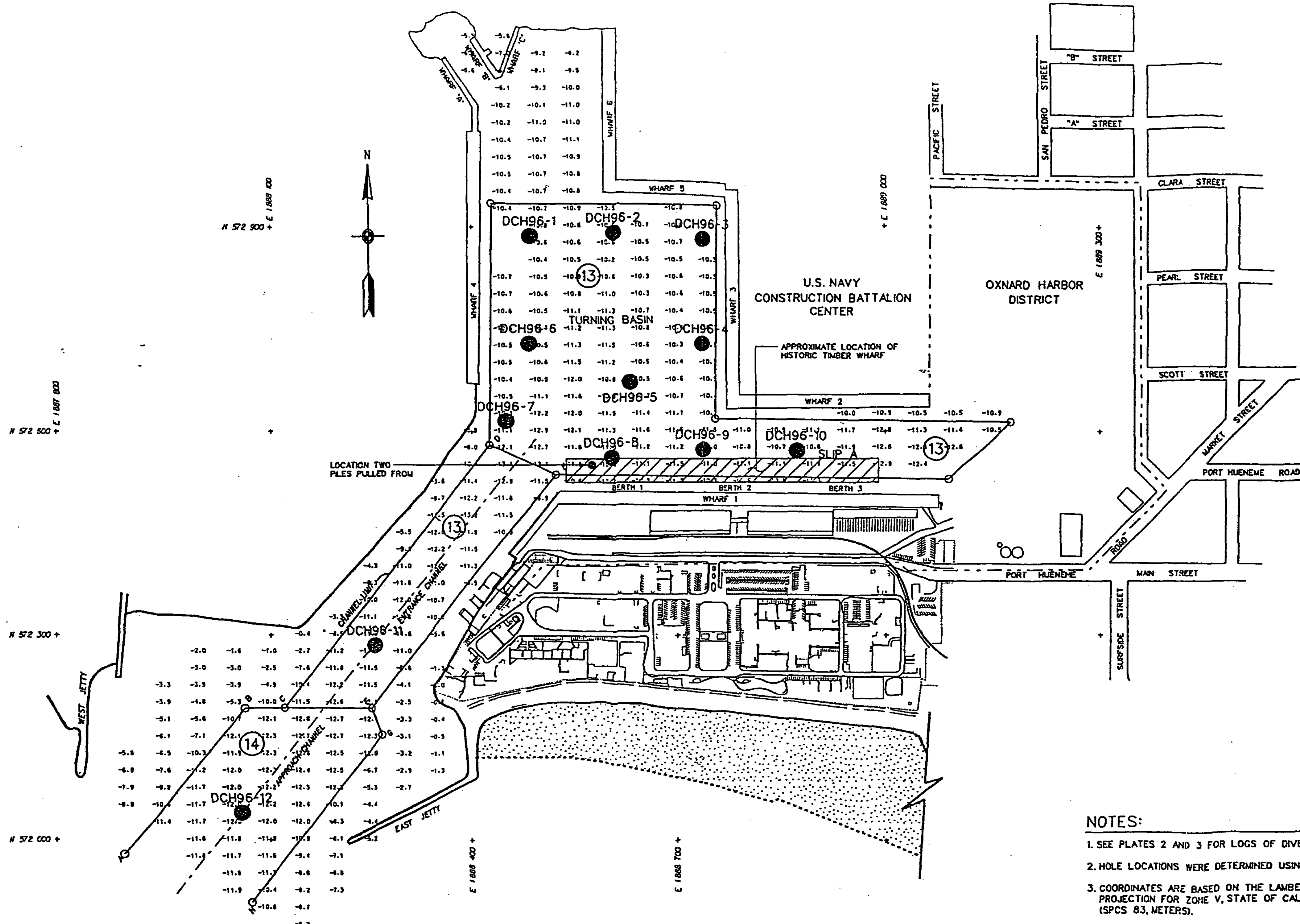



Figure 9




PLAN OF EXPLORATION

100 0 100 200

## NOTES:

1. SEE PLATES 2 AND 3 FOR LOGS OF DIVER CORE HOLES.
2. HOLE LOCATIONS WERE DETERMINED USING DGPS.
3. COORDINATES ARE BASED ON THE LAMBERT CONFORMAL PROJECTION FOR ZONE V, STATE OF CALIFORNIA (SPCS 83, METERS).
4. SOUNDINGS, IN METERS INDICATE THE GENERAL CONDITIONS EXISTING ONLY AT THE TIME OF SURVEY (MARCH 1995) AND ARE SHOWN TO THE NEAREST TENTH OF A METER.

## LEGEND:

DCH96-8 ● DIVER CORE HOLE, YEAR, NUMBER AND LOCATION.

(13) MAXIMUM PROPOSED DREDGE DEPTH.

THIS PROJECT WAS DESIGNED BY THE LOS ANGELES DISTRICT OF THE U.S. ARMY CORPS OF ENGINEERS. THE INITIALS OR SIGNATURES AND REGISTRATION DESIGNATIONS OF INDIVIDUALS APPEAR ON THESE PROJECT DOCUMENTS WITHIN THE SCOPE OF THEIR EMPLOYMENT AS REQUIRED BY ER 1110-1-8152.

SIGNATURES AFFIXED HEREON INDICATE OFFICIAL RECOMMENDATION AND APPROVAL OF ALL THE DRAWINGS IN THIS SET.

| SYMBOL | DESCRIPTIONS | DATE | APPROVAL |
|---|---|---|---|
| | REVISIONS | | |

FEASIBILITY STUDY FOR DEEP DRAFT NAVIGATION
VENTURA COUNTY, CALIFORNIA

PORT HUENEME HARBOR

PLAN OF EXPLORATION

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: GREG D.
DRAWN BY: ENRIQUE N.
CHECKED BY: JIM F.

SUBMITTED BY: ABBAS T. ROODSARI
CHIEF, GEOTECHNICAL BRANCH

SCALE:
SHEET OF SHEETS
DISTRICT FILE NO.
SPEC. NO. DACW09-97-D-0009
FILE NAME: GPH97PE.DGN

PLATE 1

SAFETY PAYS

PEBBLES:\COASTAL\HUENEME\DREDG...

## DCH96-1

| ELEV. (m) -11 | DEPTH (m) 0.0 | SOIL CLASS | -2.25 4 | -1.5 7 | -1.0 10 | -0.5 14 | 0.0 18 | +0.5 25 | +1.0 35 | +1.5 45 | +2.0 60 | +2.5 80 | +3.0 120 | +3.5 170 | +3.75 200 | +4.0 230 | LL | PI | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.6 | SC-SM | 100 | 98 | 97 | 95 | 91 | 86 | 78 | 69 | 58 | 44 | 34 | 28 | 29 | 24 | 27 | 6 | SILTY CLAYEY SAND: black, loose, occasional gravel to 12.7mm, 12.7mm layer of silt starting at 0.3mm |
| | 1.2 | SP-SM | | | | 100 | 99 | 95 | 94 | 83 | 81 | 32 | 15 | 10 | 9 | 8 | - | np | POORLY GRADED SAND with SILT: dark grey, medium dense to dense. |
| | 2.0 | SP | | | 100 | 99 | 99 | 98 | 95 | 88 | 65 | 28 | 8 | 3 | 2 | 2 | - | np | POORLY GRADED SAND: grey, occasional shells and shell fragments to 6.35mm, finer sand interval from 1.4m to 1.5m, occasional gravel to 6.35mm, dense. |
| -13.7 | 2.7 | SP | | | | | | | 100 | 86 | 88 | 40 | 10 | 2 | 2 | 2 | - | np | |

## DCH96-2

| ELEV. (m) -10.7 | DEPTH (m) 0.0 | SOIL CLASS | -2.25 4 | -1.5 7 | -1.0 10 | -0.5 14 | 0.0 18 | +0.5 25 | +1.0 35 | +1.5 45 | +2.0 60 | +2.5 80 | +3.0 120 | +3.5 170 | +3.75 200 | +4.0 230 | LL | PI | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.3 | CL-ML | | | | 100 | 99 | 98 | 95 | 91 | 83 | 74 | 65 | 56 | 52 | 49 | 23 | 7 | SANDY SILT CLAY: black, very soft to soft, high water content. |
| | 0.6 | SP-SM | | 100 | 99 | 98 | 96 | 91 | 80 | 62 | 38 | 21 | 13 | 9 | 7 | 7 | - | np | POORLY GRADED SAND with SILT: dark grey, medium dense. |
| | 1.2 | SP-SM | 100 | 98 | 97 | 94 | 89 | 81 | 68 | 53 | 35 | 21 | 14 | 10 | 9 | 9 | - | np | grey, medium dense to dense, 63.5mm thick intervals of silt. |
| | 2.3 | SP-SM | 100 | 98 | 98 | 97 | 94 | 85 | 70 | 56 | 39 | 21 | 11 | 7 | 6 | 5 | - | np | dense, occasional shell to 3.18mm, finer sand between 1.4m and 1.7m. |
| -13.4 | 2.7 | SP-SM | | | 100 | 89 | 95 | 79 | 51 | 32 | 20 | 12 | 8 | 6 | 5 | 5 | - | np | occasional shell to 6.35mm. |

## DCH96-3

| ELEV. (m) -10.7 | DEPTH (m) 0.0 | SOIL CLASS | -2.25 4 | -1.5 7 | -1.0 10 | -0.5 14 | 0.0 18 | +0.5 25 | +1.0 35 | +1.5 45 | +2.0 60 | +2.5 80 | +3.0 120 | +3.5 170 | +3.75 200 | +4.0 230 | LL | PI | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.5 | SM | | | 100 | 99 | 98 | 92 | 78 | 61 | 41 | 29 | 22 | 17 | 15 | 13 | - | np | SILTY SAND: black, very loose to medium dense, 152.4mm very soft layer at surface, few leaves, 25.4mm soft silty layer at 0.5m. |
| | 0.9 | SM | | 100 | 99 | 95 | 98 | 85 | 73 | 57 | 39 | 27 | 21 | 18 | 18 | 18 | - | np | black to dark grey, medium dense, 25.4mm soft silty layers at 0.6m and 0.8m. |
| | 1.4 | SP-SM | | | 100 | 99 | 97 | 90 | 74 | 55 | 34 | 18 | 12 | 9 | 8 | 8 | - | np | POORLY GRADED SAND with SILT: grey, medium dense to dense. |
| | 2.2 | SP | | | 100 | 98 | 94 | 81 | 58 | 38 | 20 | 10 | 6 | 4 | 4 | 4 | - | np | POORLY GRADED SAND: grey, medium dense to dense. |
| -13.5 | 2.8 | SP | | | | 100 | 97 | 88 | 68 | 46 | 25 | 12 | 7 | 5 | 4 | 4 | - | np | |

## DCH96-4

| ELEV. (m) -10.5 | DEPTH (m) 0.0 | SOIL CLASS | -2.25 4 | -1.5 7 | -1.0 10 | -0.5 14 | 0.0 18 | +0.5 25 | +1.0 35 | +1.5 45 | +2.0 60 | +2.5 80 | +3.0 120 | +3.5 170 | +3.75 200 | +4.0 230 | LL | PI | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.6 | SM | | | | 100 | 99 | 98 | 93 | 85 | 67 | 48 | 32 | 20 | 16 | 13 | - | np | SILTY SAND: dark grey, medium dense. |
| | 0.9 | SM | | | | 100 | 93 | 98 | 96 | 90 | 78 | 55 | 31 | 22 | 14 | 9 | - | np | |
| | 1.2 | SM | | | | | 100 | 99 | 99 | 97 | 91 | 79 | 55 | 25 | 18 | 16 | - | np | |
| | 1.7 | SP | | | | | | 100 | 98 | 91 | 85 | 31 | 13 | 5 | 3 | 2 | - | np | POORLY GRADED SAND: dark grey, medium dense. |
| | 2.7 | SP | | | | | 100 | 96 | 93 | 78 | 37 | 12 | 3 | 1 | 1 | 1 | - | np | grey. |
| -13.3 | 2.8 | ML | | | | | | 100 | 99 | 98 | 95 | 94 | 95 | 95 | 95 | 93 | - | np | SILT: olive, hard. |

## UNIFIED SOIL CLASSIFICATION SYSTEM

| MAJOR DIVISIONS | | | GROUP SYMBOLS | TYPICAL NAMES |
|---|---|---|---|---|
| COARSE GRAINED SOILS More than half of material is larger than no. 200 sieve size. | GRAVELS More than half of coarse fraction is larger than no. 4 sieve size. | Clean Gravels | GW | Well graded gravels, gravel-sand mixtures, little or no fines. |
| | | | GP | Poorly graded gravels, gravel-sand mixtures, little or no fines. |
| | | Gravels with fines | GM | Silty gravels, gravel-sand-silt mixtures. |
| | | | GC | Clayey gravels, gravel-sand-clay mixtures. |
| | SANDS More than half of coarse fraction is smaller than no. 4 sieve size. | Clean Sands | SW | Well graded sands, gravelly sands, little or no fines. |
| | | | SP | Poorly graded sands, gravelly sands, little or no fines. |
| | | Sands with fines. | SM | Silty sands, sand-silt mixtures. |
| | | | SC | Clayey sands, sand-clay mixtures. |
| FINE GRAINED SOILS More than half of material is smaller than no. 200 sieve size. | SILTS AND CLAYS | Low liquid limit. | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts, with slight plasticity. |
| | | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. |
| | | | OL | Organic silts and organic silty clays of low plasticity. |
| | | High liquid limit. | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts. |
| | | | CH | Inorganic clays of high plasticity, fat clays. |
| | | | OH | Organic clays of medium to high plasticity, organic silts. |
| Highly organic soils | | | Pt | Peat and other highly organic soils. |

NOTES:

1. BOUNDRY CLASSIFICATION: SOILS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE DESIGNATED BY COMBINATIONS OF GROUP SYMBOLS. FOR EXAMPLE, GW-GC, WELL GRADED GRAVEL-SAND MIXTURE WITH CLAY BINDER.
2. ALL SIEVE SIZES ON THE CHART ARE U.S. STANDARD.
3. THE TERMS "SILT" AND "CLAY" ARE USED RESPECTIVELY TO DISTINGUISH MATERIALS EXHIBITING LOWER PLASTICITY FROM THOSE WITH HIGHER PLASTICITY. THE MINUS NO. 200 SIEVE MATERIAL IS SILT IF THE LIQUID LIMIT AND PLASTICITY INDEX PLOT BELOW THE "A" LINE ON THE PLASTICITY CHART, AND IS CLAY IF THE LIQUID LIMIT AND PLASTICITY INDEX PLOT ABOVE THE "A" LINE ON THE CHART.
4. THE SOIL CLASSIFICATION SYSTEM IS BASED ON THE AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM).
   A. (ASTM) D2487 STANDARD TEST METHOD FOR CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES.
   B. (ASTM) D2488 STANDARD RECOMMENDED PRACTICE FOR DESCRIPTION OF SOILS (VISUAL MANUAL PROCEDURE).

## LEGEND

DCH96-3 DIVER CORE HOLE, YEAR AND NUMBER

-1.5 -1.5 PHI SIZE.
7 NO. 7 SIEVE.
100 PERCENT OF MATERIAL, BY WEIGHT, PASSING NO. 7 SIEVE.

LL LIQUID LIMIT.
PI PLASTICITY INDEX (LIQUID LIMIT - PLASTIC LIMIT).
NP NONPLASTIC.

## GENERAL NOTES

1. LOGS OF EXPLORATION INDICATE GEOTECHNICAL CONDITIONS AT THAT TIME AND LOCATION. CONDITIONS CAN CHANGE. STRATIFICATION LINES SHOWN ON LOGS REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES.
2. DIVER CORES WERE OBTAINED IN MARCH 1996 UTILIZING A DIVER OPERATED SLIDE HAMMER WITH FRAME TO DRIVE A 41mm ID BY 3m LEXAN TUBE INTO THE SEDIMENT.
3. ALL ELEVATIONS WERE DETERMINED BY LEAD-LINE AND TIDE TABLES AND ARE BASED ON MLLW.
4. ALL DEPTHS ARE BELOW OCEAN FLOOR.

## NOTE:

1. SEE PLATE 1 FOR LOCATION OF DIVER CORE HOLES.

SAFETY PAYS

| SYMBOL | DESCRIPTIONS | DATE | APPROVAL |
|---|---|---|---|
| | REVISIONS | | |

FEASIBILITY STUDY FOR DEEP DRAFT NAVIGATION
VENTURA COUNTY, CALIFORNIA

PORT HUENEME HARBOR

LOGS OF EXPLORATION

DESIGNED BY: GREG D.
DRAWN BY: ENRIQUE H.
CHECKED BY: JIM F.

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

SCALE:

SUBMITTED BY:
ABBAS T. ROODSARI
CHIEF, GEOTECHNICAL BRANCH

SHEET of SHEETS

DISTRICT FILE NO.

SPEC. NO. DACW09-97-B-0009

FILE NAME: GPHD7NLDGN

PLATE 2

PEBBLES:\COASTAL\HUENEME\DREDG.N3

## DCH96-5

| ELEV. (m) | DEPTH (m) | SOIL CLASS | -2.25 4 | -1.5 7 | -1.0 10 | -0.5 14 | 0.0 18 | +0.5 25 | +1.0 35 | +1.5 45 | +2.0 60 | +2.5 80 | +3.0 120 | +3.5 170 | +3.75 200 | +4.0 230 | LL | PI | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -11.1 | 0.0 | | | | | | | | | | | | | | | | | | |
| | 0.4 | SM | 100 | 99 | 98 | 97 | 95 | 90 | 81 | 69 | 54 | 42 | 32 | 25 | 22 | 21 | - | np | SILTY SAND: black, loose to medium dense. |
| | 1.3 | SM | 100 | 98 | 96 | 93 | 89 | 82 | 71 | 60 | 53 | 47 | 37 | 25 | 19 | 15 | - | np | black for first 0.2m, remainder dark grey to grey, medium grained sand from 0.7m to 0.8m and 0.9m to 1m. |
| | 2.1 | SM | | | | | | | 100 | 99 | 97 | 84 | 57 | 32 | 22 | 18 | - | np | grey. |
| -13.8 | 2.7 | SP-SM | | | | | | 100 | 99 | 98 | 95 | 87 | 66 | 23 | 10 | 6 | - | np | POORLY GRADED SAND with SILT: grey, medium dense, occasional shell fragments. |

## DCH96-6

| ELEV. (m) | DEPTH (m) | SOIL CLASS | -2.25 4 | -1.5 7 | -1.0 10 | -0.5 14 | 0.0 18 | +0.5 25 | +1.0 35 | +1.5 45 | +2.0 60 | +2.5 80 | +3.0 120 | +3.5 170 | +3.75 200 | +4.0 230 | LL | PI | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -10.8 | 0.0 | | | | | | | | | | | | | | | | | | |
| | 0.5 | SM | 100 | 99 | 99 | 98 | 96 | 90 | 82 | 76 | 67 | 54 | 37 | 25 | 21 | 18 | - | np | SILTY SAND: black to dark grey, loose. |
| | 1.4 | SP-SM | 100 | 99 | 98 | 93 | 88 | 70 | 46 | 31 | 23 | 18 | 13 | 10 | 9 | 8 | - | np | POORLY GRADED SAND with SILT: dark grey/olive, medium dense, occasional gravel to 19.1mm |
| | 1.8 | SP-SM | 100 | 98 | 95 | 89 | 80 | 81 | 40 | 25 | 22 | 19 | 14 | 10 | 8 | 8 | - | np | grey. |
| -13.1 | 2.3 | SP-SM | 100 | 99 | 98 | 99 | 98 | 97 | 94 | 85 | 67 | 54 | 36 | 17 | 10 | 7 | - | np | |

## DCH96-7

| ELEV. (m) | DEPTH (m) | SOIL CLASS | -2.25 4 | -1.5 7 | -1.0 10 | -0.5 14 | 0.0 18 | +0.5 25 | +1.0 35 | +1.5 45 | +2.0 60 | +2.5 80 | +3.0 120 | +3.5 170 | +3.75 200 | +4.0 230 | LL | PI | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -11.1 | 0.0 | | | | | | | | | | | | | | | | | | |
| | 0.3 | SM | | | | 100 | 99 | 98 | 95 | 91 | 84 | 75 | 60 | 44 | 38 | 34 | - | np | SILTY SAND: black, loose to medium dense. |
| | 1.1 | SM | | | | 100 | 99 | 98 | 95 | 92 | 86 | 77 | 62 | 47 | 42 | 39 | - | np | |
| | 1.8 | SP-SM | | 100 | 99 | 98 | 96 | 91 | 85 | 73 | 68 | 52 | 32 | 16 | 12 | 10 | - | np | POORLY GRADED SAND with SILT: grey, medium dense, silt layer from 1.2m to 1.3m |
| | 2.4 | SP-SM | 100 | 99 | 99 | 98 | 97 | 94 | 90 | 83 | 55 | 27 | 15 | 8 | 7 | 6 | - | np | occasional shell fragments. |
| -13.7 | 2.6 | SP-SM | 100 | 99 | 99 | 99 | 99 | 99 | 98 | 96 | 90 | 61 | 68 | 27 | 11 | 6 | - | np | |

## DCH96-8

| ELEV. (m) | DEPTH (m) | SOIL CLASS | -2.25 4 | -1.5 7 | -1.0 10 | -0.5 14 | 0.0 18 | +0.5 25 | +1.0 35 | +1.5 45 | +2.0 60 | +2.5 80 | +3.0 120 | +3.5 170 | +3.75 200 | +4.0 230 | LL | PI | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -11.4 | 0.0 | | | | | | | | | | | | | | | | | | |
| | 0.3 | SM | | 100 | 99 | 98 | 96 | 91 | 83 | 73 | 60 | 47 | 35 | 19 | 14 | 12 | - | np | SILTY SAND: black, loose to medium dense. |
| | 0.9 | SP-SM | | | 100 | 99 | 99 | 88 | 89 | 73 | 52 | 39 | 27 | 10 | 8 | 4 | - | np | POORLY GRADED SAND with SILT: dark grey, medium dense. |
| | 1.7 | SP-SM | 100 | 99 | 99 | 97 | 93 | 88 | 75 | 59 | 43 | 35 | 29 | 10 | 5 | 4 | - | np | brown, occasional shell fragments. |
| -13.8 | 2.4 | SP-SM | 100 | 99 | 98 | 97 | 94 | 88 | 76 | 52 | 29 | 18 | 12 | 7 | 5 | 4 | - | np | brown to grey. |

## DCH96-9

| ELEV. (m) | DEPTH (m) | SOIL CLASS | -2.25 4 | -1.5 7 | -1.0 10 | -0.5 14 | 0.0 18 | +0.5 25 | +1.0 35 | +1.5 45 | +2.0 60 | +2.5 80 | +3.0 120 | +3.5 170 | +3.75 200 | +4.0 230 | LL | PI | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -11.1 | 0.0 | | | | | | | | | | | | | | | | | | |
| | 0.3 | SM | | | | | 100 | 99 | 98 | 93 | 82 | 84 | 39 | 20 | 15 | 12 | - | np | SILTY SAND: dark grey, loose to medium dense, thin layer of silt at surface. |
| | 1.1 | SP-SM | | | 100 | 99 | 98 | 95 | 88 | 74 | 59 | 45 | 27 | 13 | 9 | 7 | - | np | POORLEY GRADED SAND with SILT: dark grey, medium dense. |
| | 1.5 | SP-SM | 100 | 99 | 97 | 95 | 91 | 84 | 71 | 57 | 45 | 35 | 24 | 13 | 9 | 8 | - | np | coarser grained with depth. |
| -13.4 | 2.3 | ML | | | | | 100 | 99 | 99 | 98 | 98 | 97 | 95 | 88 | 79 | 68 | - | np | SILT with SAND: dark grey/olive, firm to very firm. |

## DCH96-10

| ELEV. (m) | DEPTH (m) | SOIL CLASS | -2.25 4 | -1.5 7 | -1.0 10 | -0.5 14 | 0.0 18 | +0.5 25 | +1.0 35 | +1.5 45 | +2.0 60 | +2.5 80 | +3.0 120 | +3.5 170 | +3.75 200 | +4.0 230 | LL | PI | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -10.7 | 0.0 | | | | | | | | | | | | | | | | | | |
| | 0.8 | SM | | 100 | 99 | 98 | 97 | 92 | 82 | 85 | 45 | 34 | 27 | 22 | 19 | 17 | - | np | SILTY SAND: dark grey to olive, loose to medium dense, 50.8mm very soft silty layer on surface. |
| | 1.5 | SP-SM | 100 | 99 | 98 | 97 | 94 | 89 | 75 | 52 | 29 | 18 | 14 | 11 | 10 | 9 | - | np | POORLY GRADED SAND with SILT: olive, medium dense. |
| -13.2 | 2.5 | SM | | | 100 | 99 | 97 | 95 | 90 | 86 | 82 | 79 | 71 | 51 | 38 | 28 | - | np | SILTY SAND: olive, medium dense to dense. |

## DCH96-11

| ELEV. (m) | DEPTH (m) | SOIL CLASS | -2.25 4 | -1.5 7 | -1.0 10 | -0.5 14 | 0.0 18 | +0.5 25 | +1.0 35 | +1.5 45 | +2.0 60 | +2.5 80 | +3.0 120 | +3.5 170 | +3.75 200 | +4.0 230 | LL | PI | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -11.8 | 0.0 | | | | | | | | | | | | | | | | | | |
| | 0.6 | SM | | | | | | | | 100 | 99 | 96 | 75 | 39 | 28 | 22 | - | np | SILTY SAND: dark grey to grey, medium dense. |
| | 0.9 | SM | | | | | | | | 100 | 99 | 96 | 72 | 27 | 18 | 11 | - | np | grey, medium dense. |
| | 1.4 | SM | | | | | 100 | 99 | 99 | 98 | 97 | 92 | 69 | 33 | 22 | 15 | - | np | |
| -14.2 | 2.6 | SP | 100 | 99 | 98 | 93 | 90 | 78 | 53 | 33 | 21 | 14 | 9 | 8 | 4 | 3 | - | np | POORLY GRADED SAND: grey, medium dense to dense, shell fragments, gravel to 31.75mm, |

## DCH96-12

| ELEV. (m) | DEPTH (m) | SOIL CLASS | -2.25 4 | -1.5 7 | -1.0 10 | -0.5 14 | 0.0 18 | +0.5 25 | +1.0 35 | +1.5 45 | +2.0 60 | +2.5 80 | +3.0 120 | +3.5 170 | +3.75 200 | +4.0 230 | LL | PI | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -12.0 | 0.0 | | | | | | | | | | | | | | | | | | |
| | 0.8 | SM | | | 100 | 99 | 98 | 94 | 87 | 81 | 75 | 83 | 48 | 29 | 22 | 16 | | np | SILTY SAND: dark grey, medium dense to dense, 50.8mm soft layer at surface. |
| | 1.7 | SM | | | | | | | | 100 | 98 | 83 | 48 | 20 | 14 | 11 | | np | dark grey to grey. |
| -14.3 | 2.3 | SP-SM | | | | | | | | 100 | 99 | 86 | 43 | 15 | 10 | 8 | | np | POORLY GRADED SAND with SILT: dark grey to grey, medium dense to dense. |

NOTES:

1. SEE PLATE 1 FOR LOCATION OF DIVER CORE HOLES.
2. SEE PLATE 2 FOR CLASSIFICATION SYSTEM, LEGEND AND GENERAL NOTES.

SAFETY PAYS

| SYMBOL | DESCRIPTIONS | DATE | APPROVAL |
|---|---|---|---|
| | REVISIONS | | |

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: GREG D.
DRAWN BY: ENRIQUE H.
CHECKED BY: JIM F.

SUBMITTED BY: ABBAS T. ROODSARI
CHIEF, GEOTECHNICAL BRANCH

FEASIBILITY STUDY FOR DEEP DRAFT NAVIGATION
VENTURA COUNTY, CALIFORNIA

PORT HUENEME HARBOR

LOGS OF EXPLORATION

SCALE:

SHEET of SHEETS

DISTRICT FILE NO.

SPEC. NO. DACW09-97-B-0009

FILE NAME:

PLATE 3

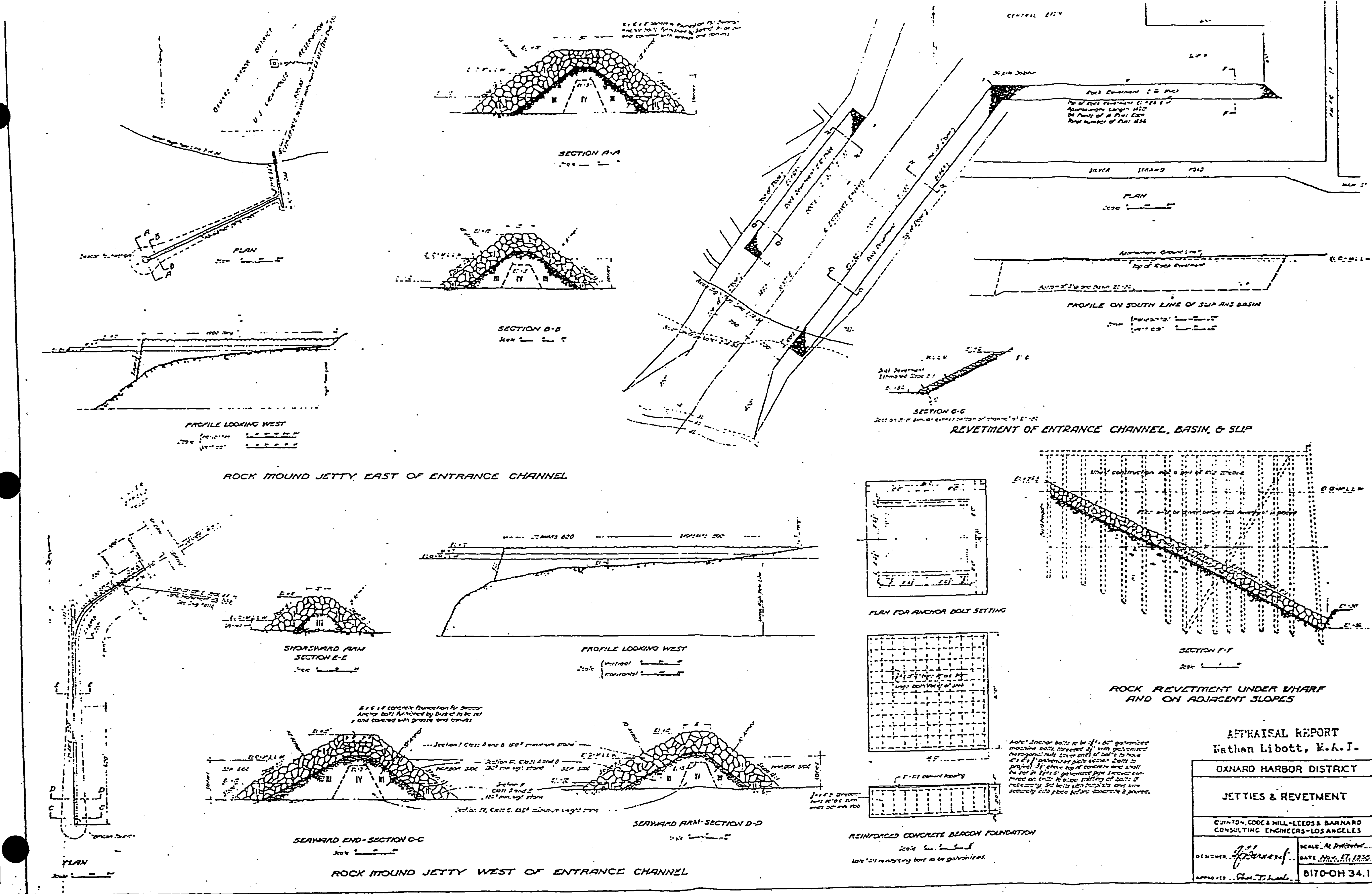
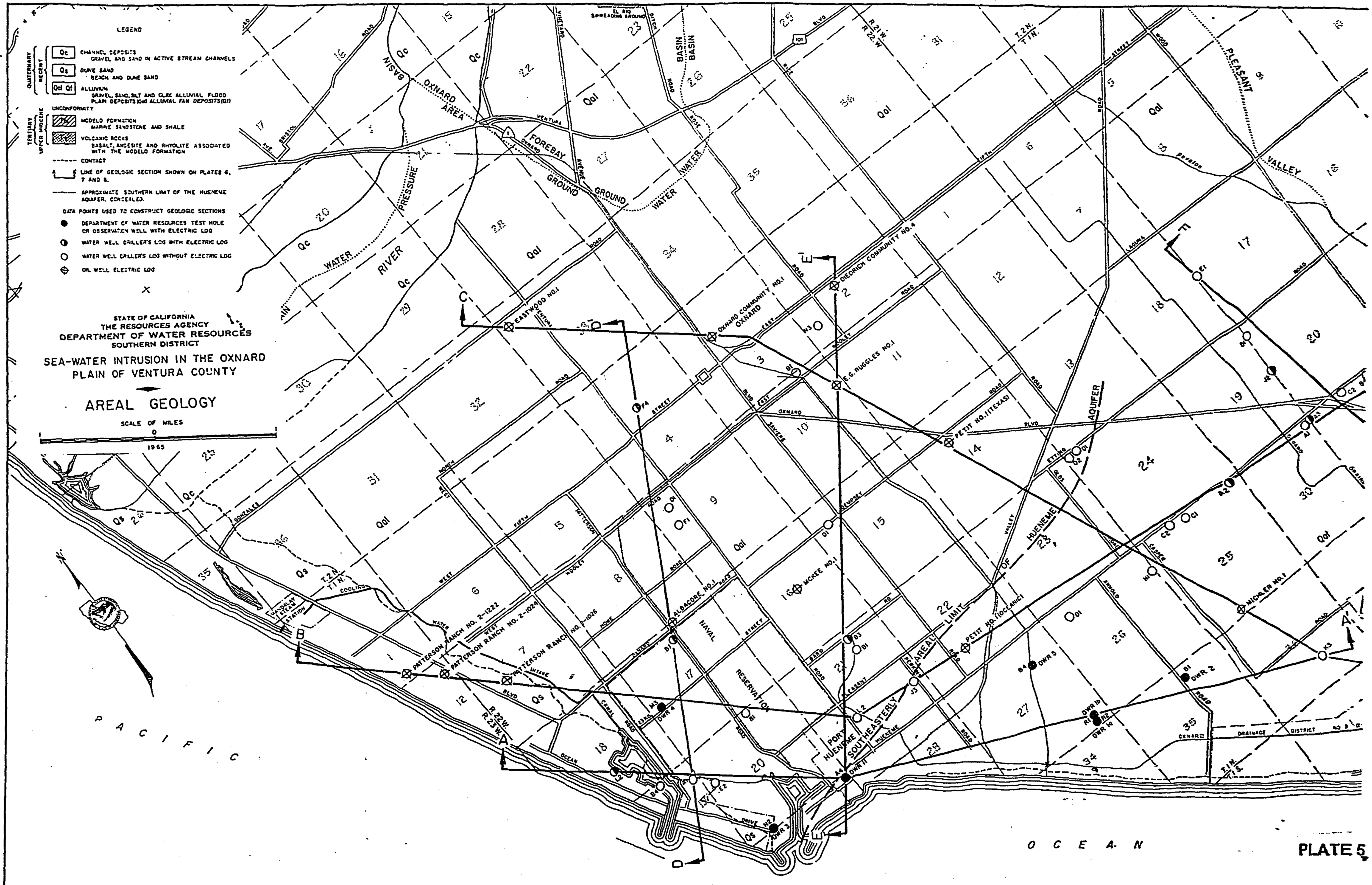
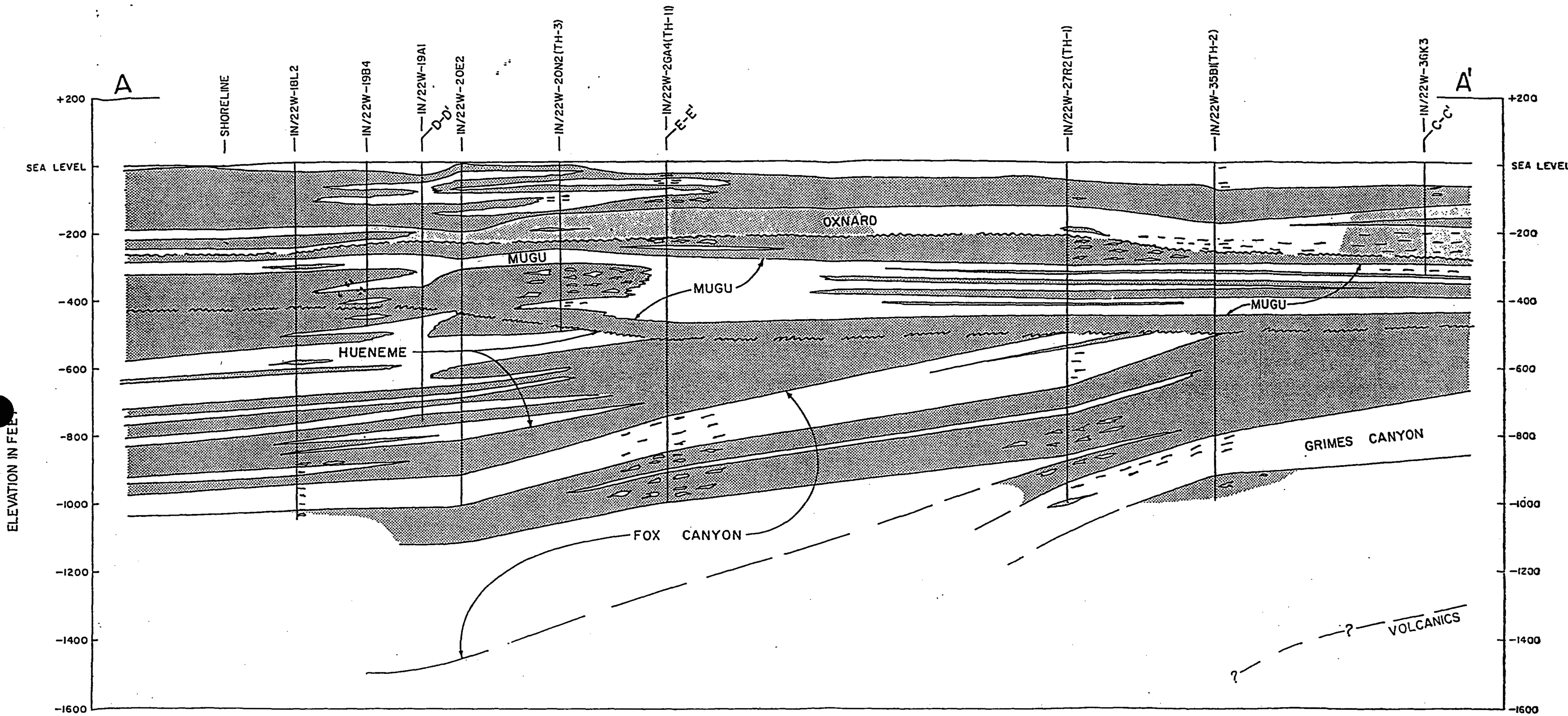

SECTION A-A
PLAN
SECTION B-B
PROFILE LOOKING WEST
ROCK MOUND JETTY EAST OF ENTRANCE CHANNEL
SILVER STRAND ROAD
PLAN
PROFILE ON SOUTH LINE OF SLIP AND BASIN
SECTION G-G
REVETMENT OF ENTRANCE CHANNEL, BASIN, & SLIP
PLAN FOR ANCHOR BOLT SETTING
SECTION F-F
ROCK REVETMENT UNDER WHARF AND ON ADJACENT SLOPES
SHOREWARD ARM SECTION E-E
PROFILE LOOKING WEST
SEAWARD END-SECTION C-C
SEAWARD ARM-SECTION D-D
REINFORCED CONCRETE BEACON FOUNDATION
PLAN
ROCK MOUND JETTY WEST OF ENTRANCE CHANNEL
APPRAISAL REPORT
Nathan Libott, M.A.I.
OXNARD HARBOR DISTRICT
JETTIES & REVETMENT
QUINTON, CODE & HILL-LEEDS & BARNARD
CONSULTING ENGINEERS-LOS ANGELES
DATE Nov. 17, 1950
8170-OH 34.1

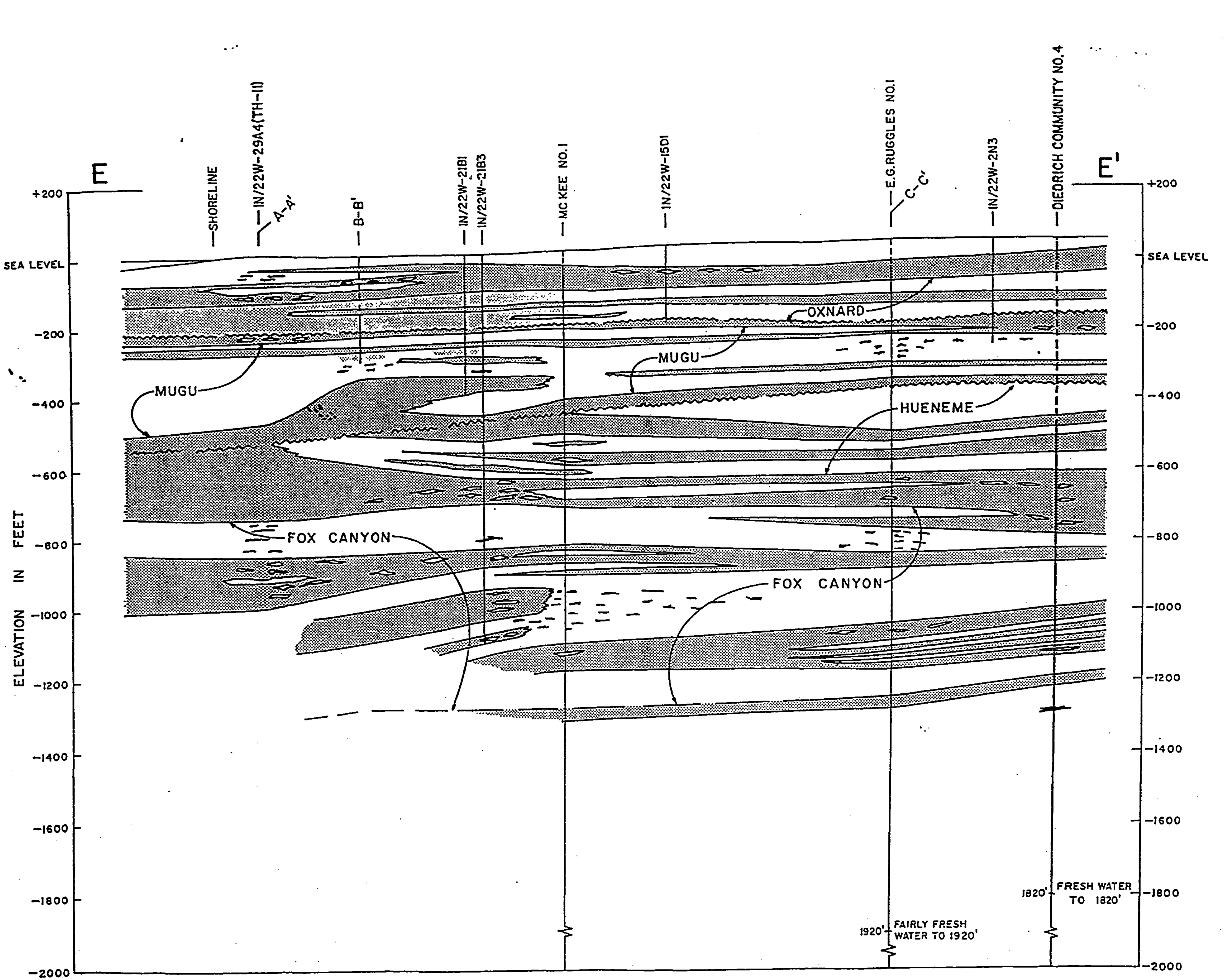
PLATE 4


LEGEND
QUATERNARY
RECENT
Qc CHANNEL DEPOSITS
GRAVEL AND SAND IN ACTIVE STREAM CHANNELS
Qs DUNE SAND
BEACH AND DUNE SAND
Qal Qf ALLUVIUM
GRAVEL, SAND, SILT AND CLAY ALLUVIAL FLOOD PLAIN DEPOSITS (Qal) ALLUVIAL FAN DEPOSITS (Qf)
UNCONFORMITY
TERTIARY
UPPER MIOCENE
MODELO FORMATION
MARINE SANDSTONE AND SHALE
VOLCANIC ROCKS
BASALT, ANDESITE AND RHYOLITE ASSOCIATED WITH THE MODELO FORMATION
CONTACT
LINE OF GEOLOGIC SECTION SHOWN ON PLATES 6, 7 AND 8.
APPROXIMATE SOUTHERN LIMIT OF THE HUENEME AQUIFER, CONCEALED.
DATA POINTS USED TO CONSTRUCT GEOLOGIC SECTIONS
DEPARTMENT OF WATER RESOURCES TEST HOLE OR OBSERVATION WELL WITH ELECTRIC LOG
WATER WELL DRILLER'S LOG WITH ELECTRIC LOG
WATER WELL DRILLER'S LOG WITHOUT ELECTRIC LOG
OIL WELL ELECTRIC LOG
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
SEA-WATER INTRUSION IN THE OXNARD PLAIN OF VENTURA COUNTY
AREAL GEOLOGY
SCALE OF MILES
0
1
1965
OXNARD FOREBAY GROUND WATER BASIN
OXNARD AREA
PRESSURE
SANTA CLARA RIVER
PLEASANT VALLEY
HUENEME AQUIFER
SOUTHEASTERLY AREAL LIMIT OF HUENEME AQUIFER
NAVAL RESERVATION
PORT HUENEME
PACIFIC OCEAN
EASTWOOD NO.1
OXNARD COMMUNITY NO.1
DIEDRICH COMMUNITY NO.4
E.G. RUGGLES NO.1
PETIT NO.1 (TEXAS)
PETIT NO.1 (OCEANIC)
MCKEE NO.1
ALBACORE NO.1
MICHLER NO.1
PATTERSON RANCH NO. 2-1222
PATTERSON RANCH NO. 2-1024
PATTERSON RANCH NO. 2-1026
DWR 2
DWR 3
DWR 4
DWR 5
DWR 11
DWR 1A
DWR 1B
R.22 W.
R.23 W.
R.21 W.
T.2 N.
T.1 N.
T.1 S.
OXNARD DRAINAGE DISTRICT NO. 3
PLATE 5



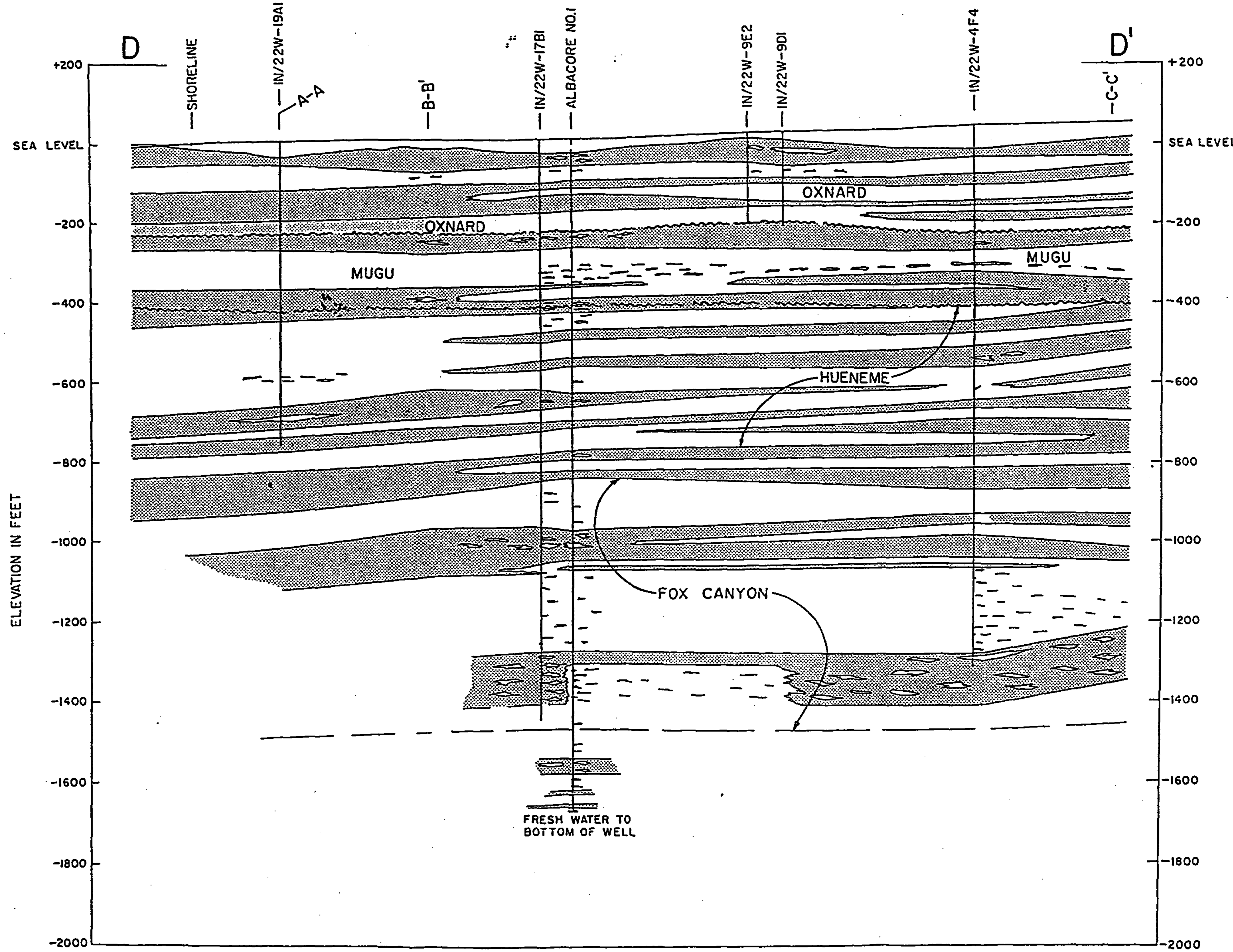
A
A'
SHORELINE
IN/22W-18L2
IN/22W-19B4
IN/22W-19A1
D-D'
IN/22W-20E2
IN/22W-20N2(TH-3)
IN/22W-26A4(TH-1)
E-E'
IN/22W-27R2(TH-1)
IN/22W-35B1(TH-2)
IN/22W-36K3
C-C'
+200
SEA LEVEL
-200
-400
-600
-800
-1000
-1200
-1400
-1600
ELEVATION IN FEET
OXNARD
MUGU
MUGU
MUGU
HUENEME
GRIMES CANYON
FOX CANYON
?
?
VOLCANICS


PLATE 5A

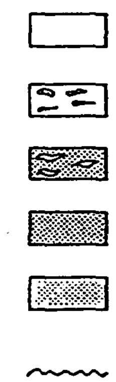


E
E'
SHORELINE
IN/22W-29A4(TH-1)
A-A'
B-B'
IN/22W-21B1
IN/22W-21B3
MC KEE NO.1
IN/22W-15D1
E.G.RUGGLES NO.1
C-C'
IN/22W-2N3
DIEDRICH COMMUNITY NO.4
+200
SEA LEVEL
-200
-400
-600
-800
-1000
-1200
-1400
-1600
-1800
-2000
ELEVATION IN FEET
OXNARD
MUGU
MUGU
HUENEME
FOX CANYON
FOX CANYON
1920'
FAIRLY FRESH WATER TO 1920'
1820'
FRESH WATER TO 1820'


PLATE 5B




## LEGEND



AQUIFER
COARSE GRAINED MATERIALS COMPRISED OF SAND AND GRAVEL

MODERATELY PERMEABLE MATERIALS COMPRISED OF CLAYEY AND SILTY SAND AND GRAVEL, OR SAND AND GRAVEL CONTAINING CLAY AND SILT LENSES

SLIGHTLY PERMEABLE MATERIALS COMPRISED OF SANDY AND GRAVELLY CLAY AND SILT, OR CLAY AND SILT CONTAINING SAND AND GRAVEL LENSES

AQUICLUDE
FINE GRAINED MATERIALS COMPRISED OF SILT AND CLAY

AQUIFER
DEGRADED BY SEA-WATER INTRUSION AND CONTAINING MORE THAN 100 PPM CHLORIDE

UNCONFORMITY

NOTE: LOCATION OF GEOLOGIC SECTIONS SHOWN ON PLATE 5

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

# SEA-WATER INTRUSION IN THE OXNARD PLAIN OF VENTURA COUNTY

## GEOLOGIC SECTIONS A-A', D-D, AND E-E'

HORIZONTAL SCALE OF FEET
2000 0 2000 4000 6000

1965

PLATE 5C

# ATTACHMENT 1
Wharf Modification Preliminary Designs

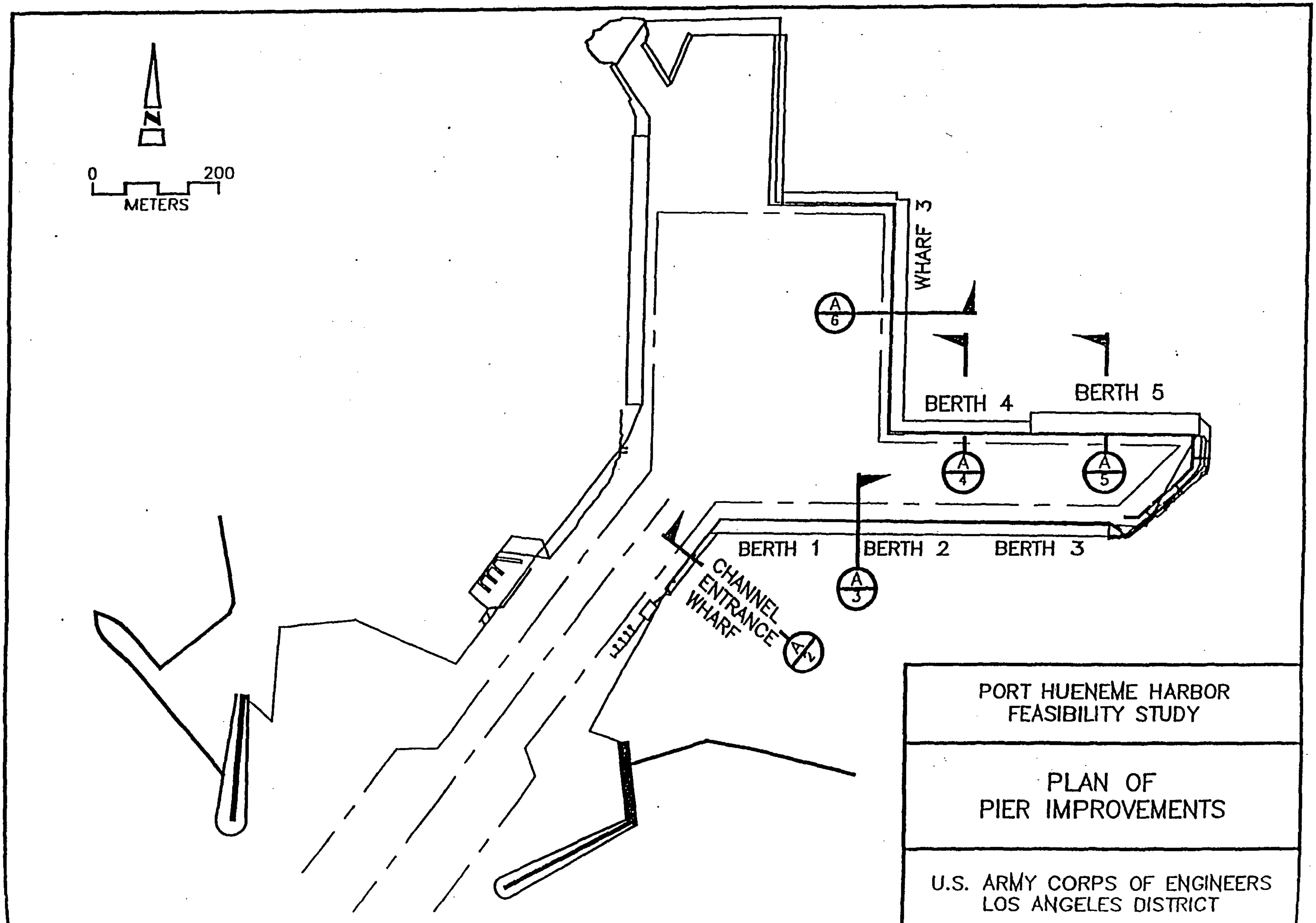

N
0
200
METERS
WHARF 3
A
6
BERTH 4
BERTH 5
A
4
A
5
BERTH 1
BERTH 2
BERTH 3
A
3
CHANNEL
ENTRANCE
WHARF
A
2
PORT HUENEME HARBOR
FEASIBILITY STUDY
PLAN OF
PIER IMPROVEMENTS
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Figure 10

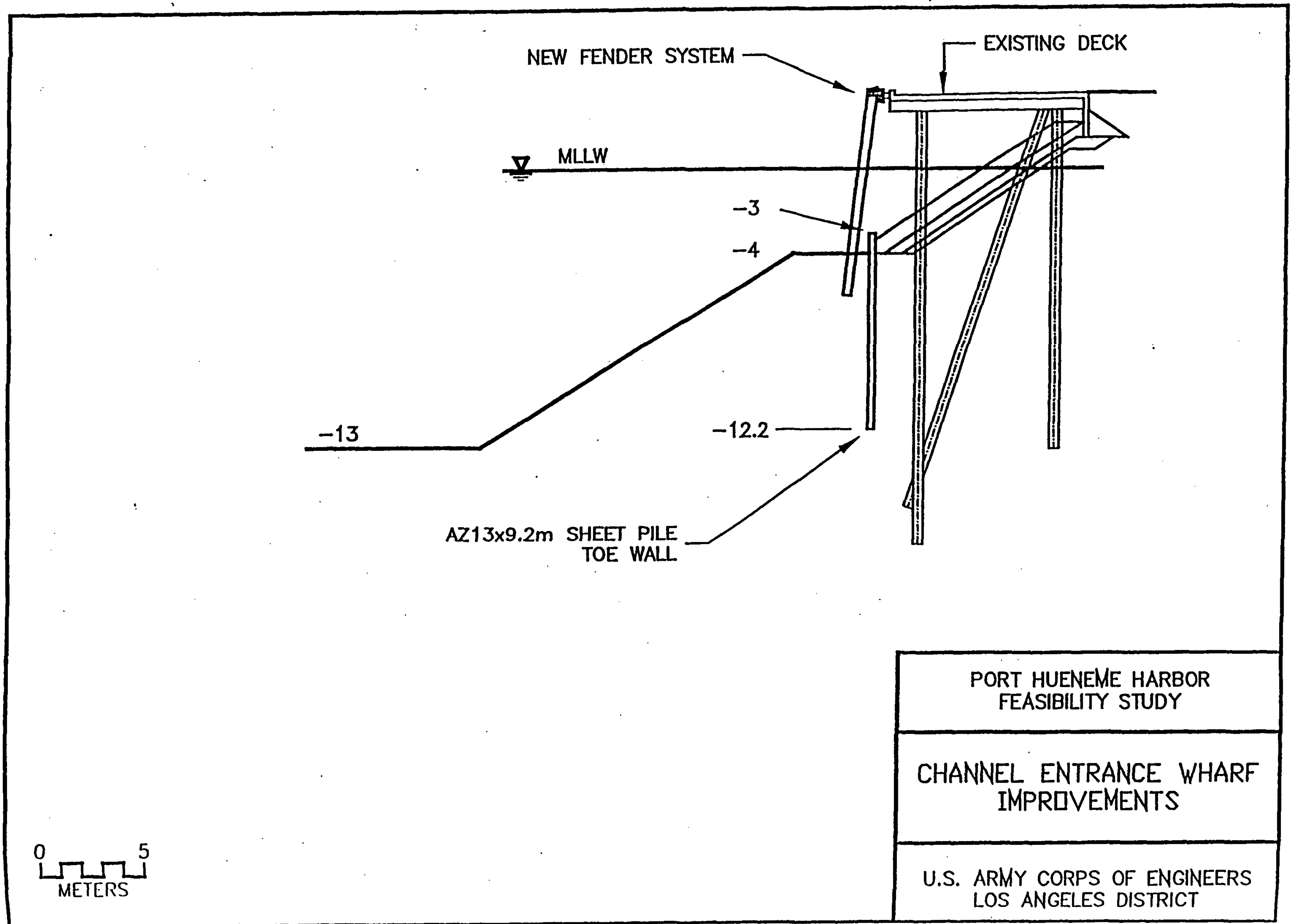

NEW FENDER SYSTEM
EXISTING DECK
MLLW
-3
-4
-13
-12.2
AZ13x9.2m SHEET PILE
TOE WALL
0
5
METERS
PORT HUENEME HARBOR
FEASIBILITY STUDY
CHANNEL ENTRANCE WHARF
IMPROVEMENTS
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Figure 11

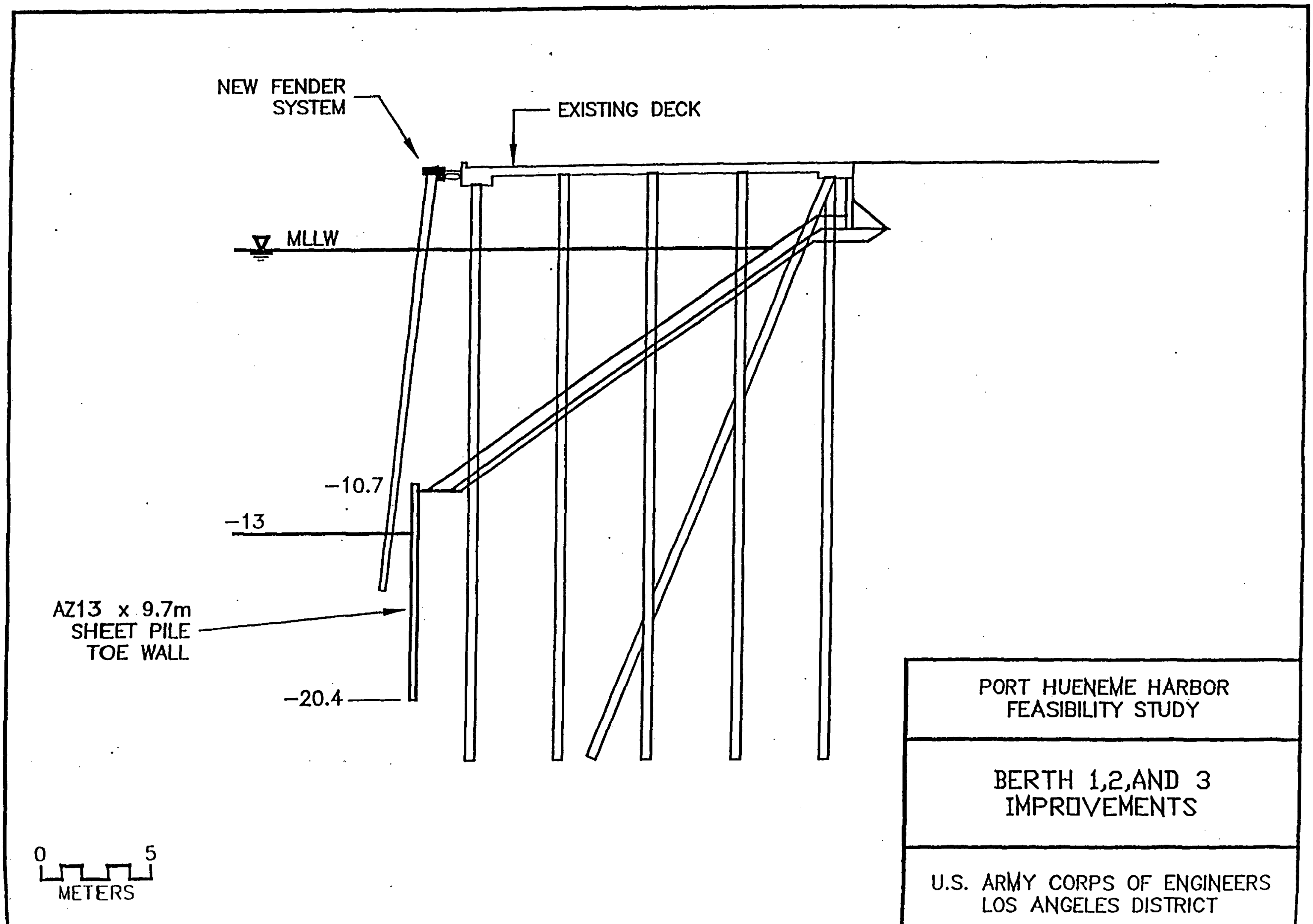
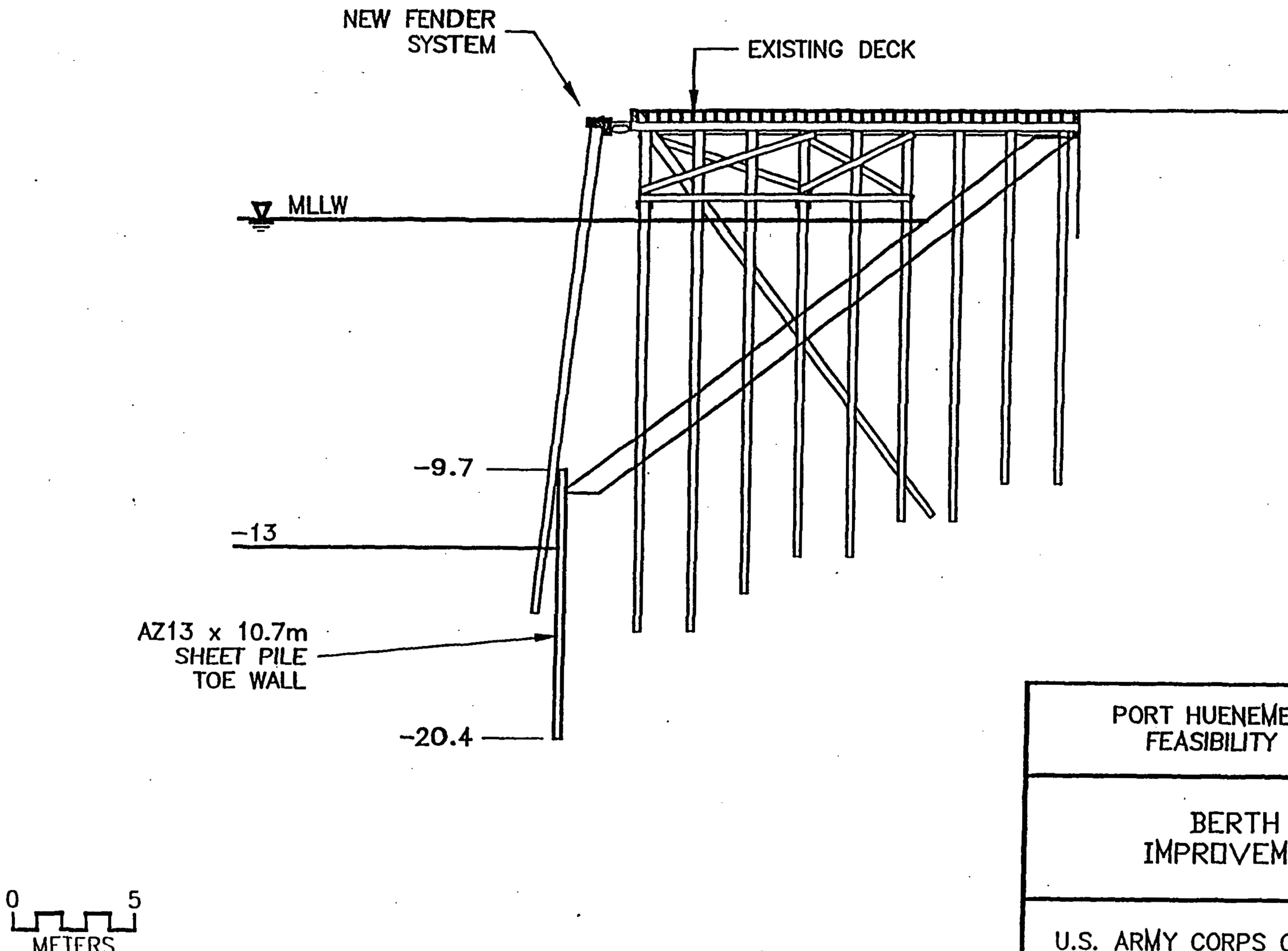

NEW FENDER SYSTEM
EXISTING DECK
MLLW
-10.7
-13
AZ13 x 9.7m SHEET PILE TOE WALL
-20.4
0
5
METERS
PORT HUENEME HARBOR FEASIBILITY STUDY
BERTH 1,2,AND 3 IMPROVEMENTS
U.S. ARMY CORPS OF ENGINEERS LOS ANGELES DISTRICT

Figure 12




PORT HUENEME HARBOR
FEASIBILITY STUDY

BERTH 4
IMPROVEMENTS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Figure 13

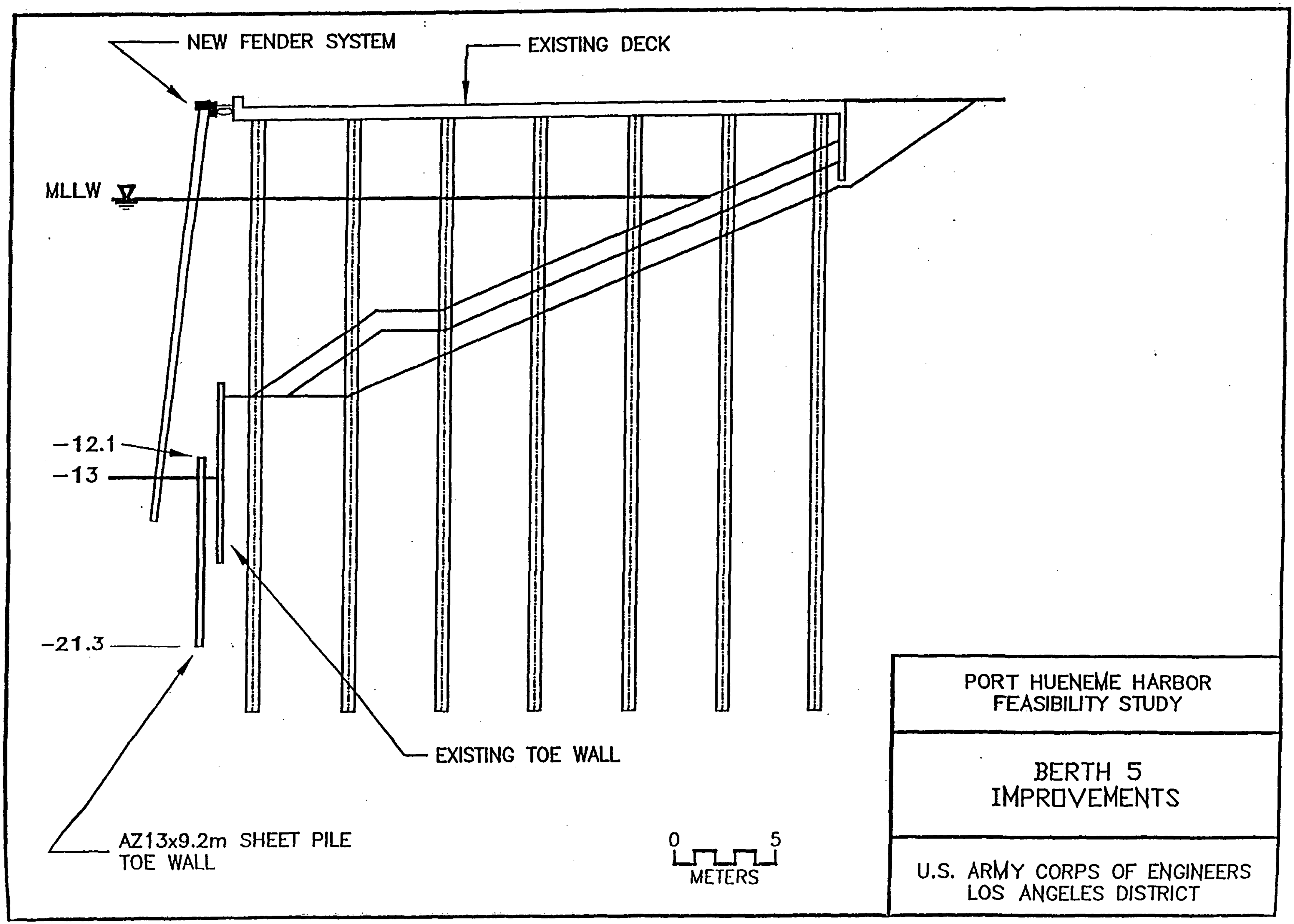

NEW FENDER SYSTEM
EXISTING DECK
MLLW
-12.1
-13
-21.3
EXISTING TOE WALL
AZ13x9.2m SHEET PILE
TOE WALL
0
5
METERS
PORT HUENEME HARBOR
FEASIBILITY STUDY
BERTH 5
IMPROVEMENTS
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Figure 14

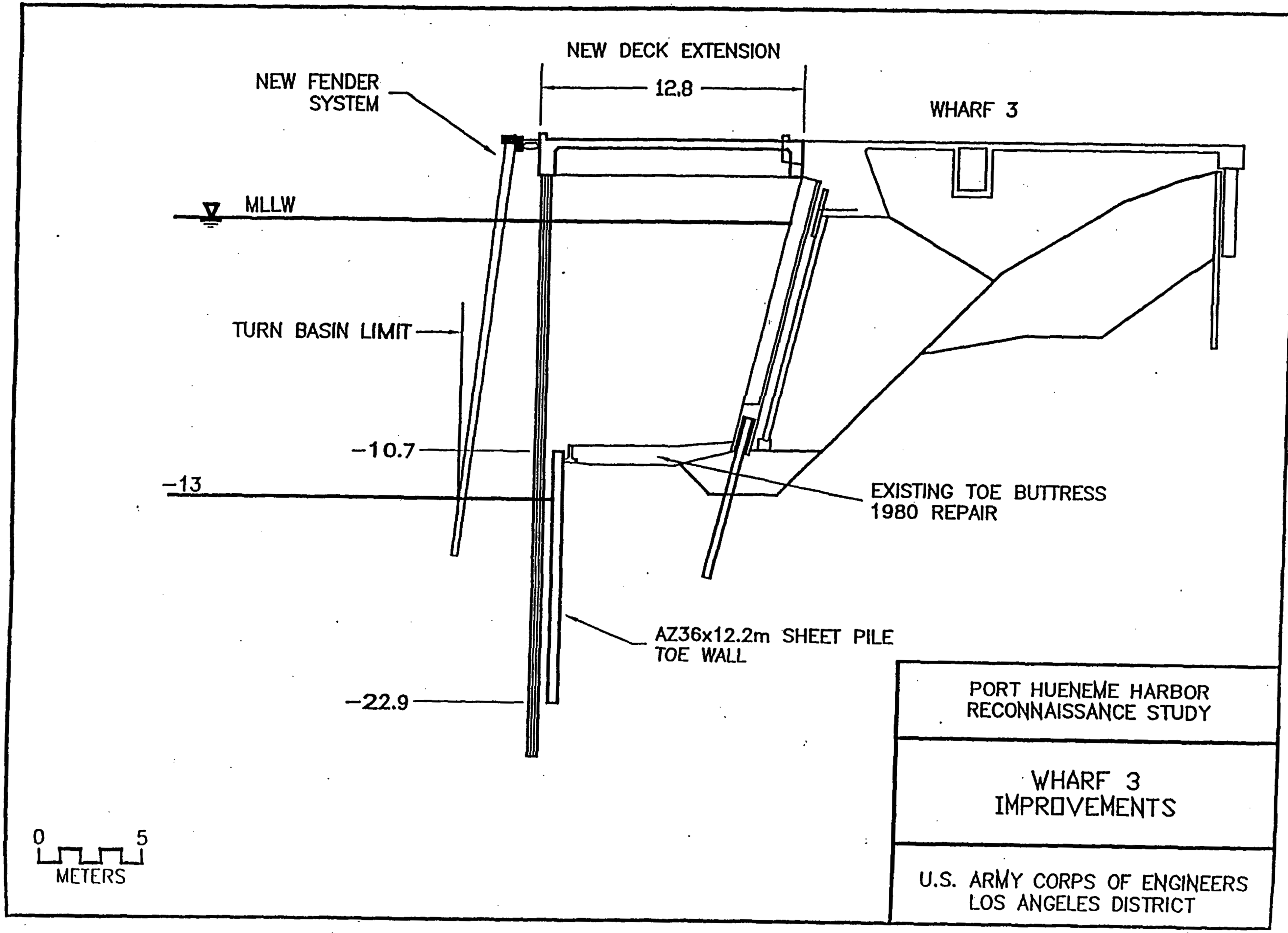
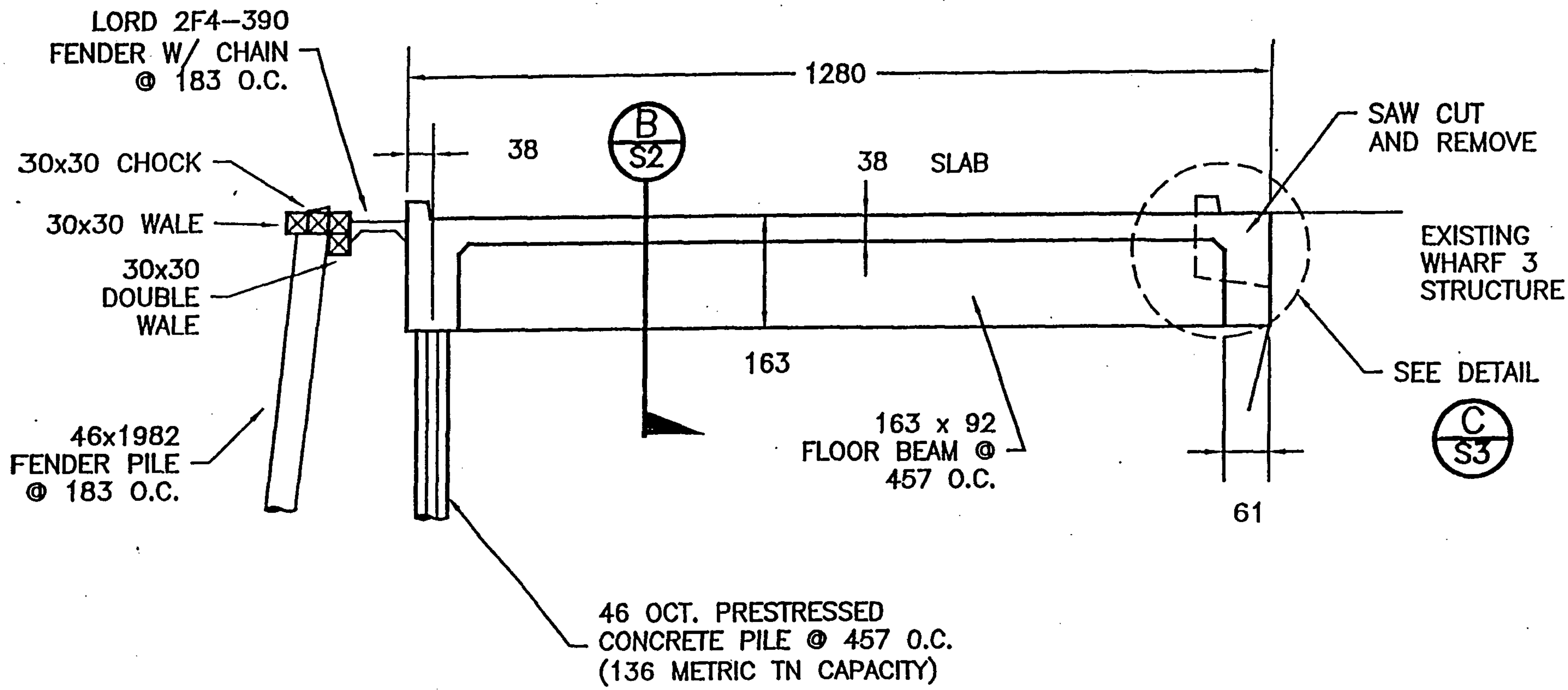
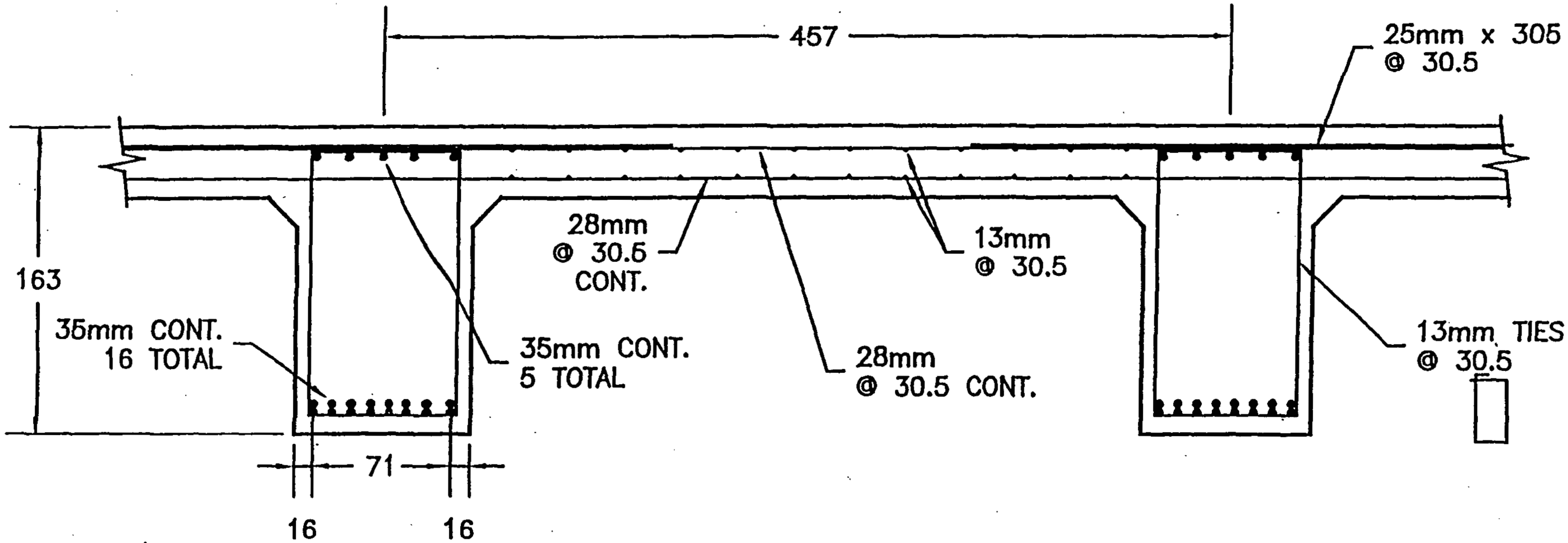

NEW DECK EXTENSION
12.8
NEW FENDER SYSTEM
WHARF 3
MLLW
TURN BASIN LIMIT
-10.7
-13
EXISTING TOE BUTTRESS
1980 REPAIR
AZ36x12.2m SHEET PILE
TOE WALL
-22.9
0
5
METERS
PORT HUENEME HARBOR
RECONNAISSANCE STUDY
WHARF 3
IMPROVEMENTS
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

Figure 15




A
S1
TRANSVERSE SECTION
SCALE: 1:9.6

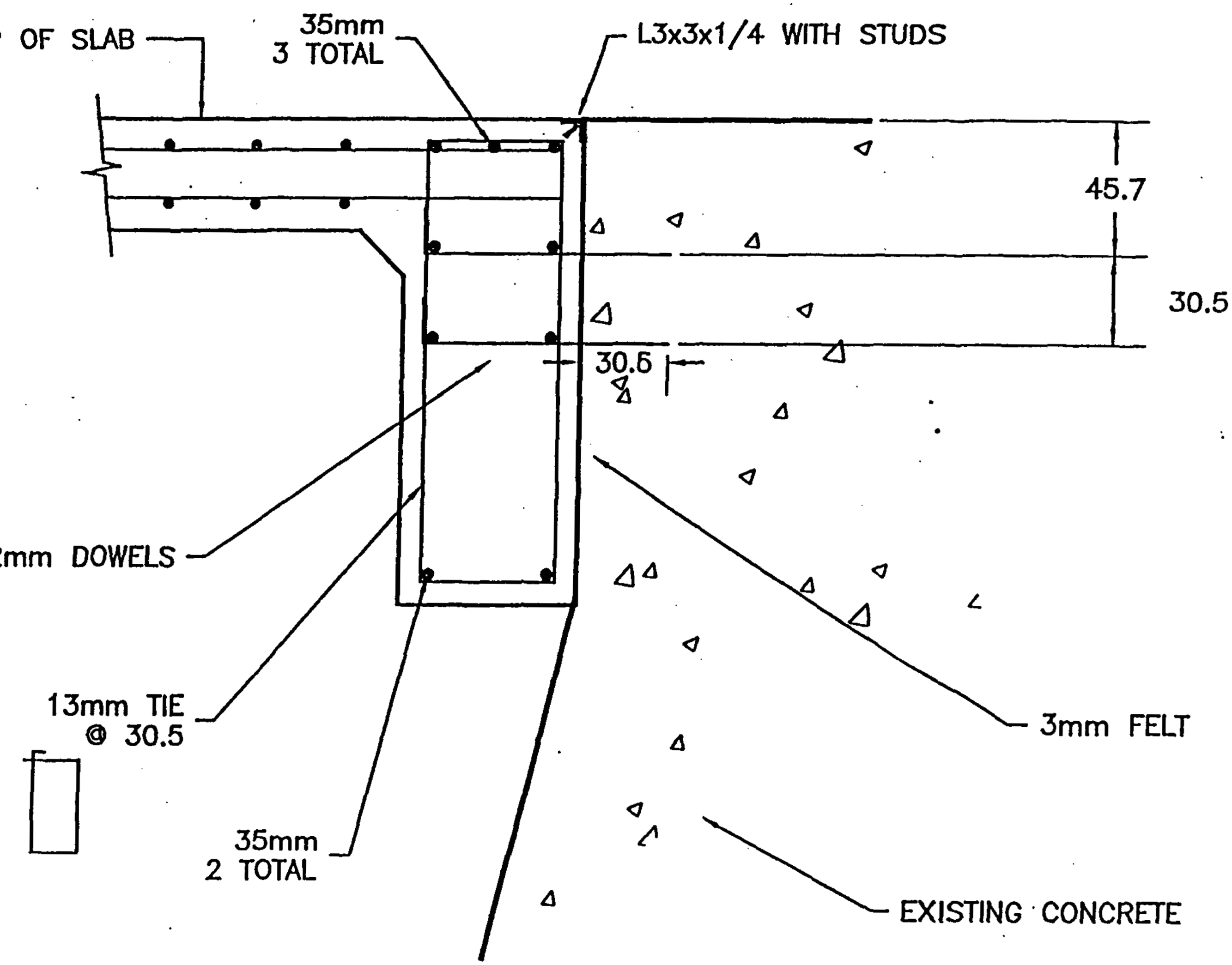
*Figure 16*




# B/S2 LONGITUDINAL SECTION

SCALE: 1:36

Figure 17




# DECK CONNECTION DETAIL

C / S3

SCALE: 1:24

Figure 18