US Army Corps of Engineers
Los Angeles District

County of Orange
Public Facilities & Resources Department

State of California

City of Newport Beach

Upper Newport Bay
Ecosystem Restoration Feasibility Study
Final Report
Technical Appendices

September 2000

ENGINEERING APPENDIX SYLLABUS

GENERAL

The Engineering Appendix includes evaluations of coastal engineering, estuarine, geotechnical, sedimentary, and dredging issues related to the Upper Newport Bay Feasibility Study. A primary tool of the analysis has been the development of numerical models of the hydrodynamics and sedimentation characteristics of Newport Bay. A summary of the modeling efforts is presented in this appendix.

BAY HISTORY

Significant sedimentation problems in Upper Newport Bay have become more evident during the past 40 years of development of the San Diego Creek watershed. A key turning point was during the winter storms of 1969. Prior to that time, storm flows to the Upper Bay were significantly less than the present. The Upper Bay looked very different with salt evaporation ponds located above the main dike and a large water skiing area below the dike. The salt evaporation ponds were destroyed by storm flows during the winter of 1969. Since that event, it has clearly become apparent that the health of the Upper Bay has been directly influenced by the control and/or removal of sediments that flow to the Bay during major storm periods. Over 5.5 million cubic yards of sediment have been dredged from Upper Newport Bay since the mid-1950s. Reserve managers and government interests have relied upon these continued dredging operations to preserve the balance of estuarine habitats since the establishment of the ecological reserve in the mid-1970s.

Water quality has also been a continued concern in the Upper Bay. Both chemical contamination and floating trash can foul the waters of the Bay. Efforts are underway to lower the level of contamination and sedimentation through controls placed within the watershed. The Corps is currently conducting a watershed feasibility study for Newport Bay. This study will investigate watershed issues and will supercede an earlier comprehensive watershed study performed by Boyle Engineers (1982).

ENGINEERING ANALYSES OF BASELINE CONDITIONS AND ALTERNATIVES

The preparation and calibration of the numerical models for this study included consideration of sediment characteristics, past dredging activities, past and present hydrodynamic conditions, and sediment transport within the watershed and the bay. Initial numerical modeling was completed for the baseline ("without project") condition and six project alternatives. The alternatives investigated various sizes of sedimentation basins within the Bay to better control the widespread deposition of sediments and associated adverse impacts to the estuarine habitats. Two of the initial alternatives were dropped from consideration because of resource agencies concerns. The "without project" condition and the four remaining alternatives were carried forward for detailed analysis using the numerical models.

For the without project condition, sedimentation was predicted for five year increments during the future 50 year period by repeating the historical sediment inflows for the individual years spanning the 25-year period of 1971-1996. For the four project alternatives, project scope and budget allowed only a 15-year modeling exercise. Initially, the 15-year model period utilized varying sediment flows from the 25-year historic period. When it became apparent that this approach was completely dependent on the selection of the magnitude and sequence of the annual sediment flows, a second modeling attempt was made in which a constant annual sediment inflow of 250,000 cy was assumed. This allowed a more reasonable comparison of the behavior of each alternative to common sedimentation loads. Finally, the model results were modified to approximate an annual inflow of 164,000 cy, the long-term annual average of sediment inflow to Newport Bay.

Projections of maintenance dredging intervals for each alternative were also estimated from the modeling of the project alternatives using an annual sediment input of 164,000 cy. Cost and work duration projections were prepared in order to evaluate the financial and economic impact of each alternative, and were based on past bay dredging projects including the recently completed Unit III project. Project alternatives that trapped the most sediment volumes in the basins provided the benefit of an increased maintenance interval between dredging operations. However, these alternatives also had increased durations of maintenance activities, ranging from 12 months to 30 months as the interval between maintenance operations increased. The maintenance intervals for the various alternatives vary from 7 to 24 years.

Evaluation of future dredging activity in the Upper Bay is assisted by the significant dredging history that has occurred during the 1956-1999 period. The most recent effort, conducted in 1998-1999, removed a total of 859,000 cy of sediment from the Unit I/III Basin (532,000 cy), the main access channel (252,000 cy), and Dover Shores (75,000 cy). Costs for the recent effort were evaluated to allow accurate projection of future costs. The most recent dredge work in the Upper Bay underscored the regulatory scrutiny that dominates dredge work in Southern California. Issues of significant environmental concern were related to sediment chemical contamination, accurate offshore sediment discharge, noise and air pollution created by the dredge activity, vessel traffic impacts, creation of turbidity during the course of the dredge work, creation of vessel wakes in the marsh areas, and ill will with local residents as a result of night-time operations. Such issues will continue to be problematic for those attempting to remove sediments from the Upper Bay in the future.

In addition to the dredging of the primary sedimentation basins, a number of restoration measures have also been considered for implementation. These include the deepening of small channels around wetlands to improve tidal circulation, the construction of wetlands from existing upland habitats, and improvements to the existing or new least tern islands.

In the past, dredge methods have concentrated on the use of large clamshell operations conducted from a floating barge. The crane–operated clamshell would discharge directly into a floating scow for transport and dumping of the dredged material at the offshore disposal site. During the course of this study, a second method of sediment removal was described and evaluated. This alternate method used a small, hydraulic dredge that would pipe the sediment-

water slurry to a barge docking area at Shellmaker Island. Using a chemical flocculation agent, sediment would be concentrated in the barge for ultimate transport and discharge at the offshore disposal site. The benefit of this method is to reduce the disruption of plant and animal species in the Upper Bay by eliminating the need for disposal scow transport within the Upper Bay. Implementation of this novel dredging method is contingent on further economic, logistical, and environmental analysis.

RECOMMENDED PLAN

Based on the careful consideration of all of the alternatives considered, the study team has selected Alternative 6 as the recommended plan. In summary, Alternative 6 included the following elements:

Unit I/III Basin

- *Increase basin depth to –20 ft (MSL), 1V:33 side slopes from 0 ft (MSL) to –3 ft and 1V:5H side slopes below.*
- *Maintain northeast corner of basin intact.*
- *Remove "kidney"-shaped least tern island (Skimmer Island).*
- *Dredge south-side channel around "hotdog" least tern island (Tern Island) (50 ft wide channel, -5 ft (MSL) bottom elevation, 1V:3H side slopes.*
- *Provide small boat access to "hot dog" least tern island (Tern Island) for vegetation removal.*
- *Add two- foot sand/shell layer to "hotdog" island (Tern Island) surface.*
- *Mudflat creation, bullnose section, NW corner of basin*
- *Extend grouted stone apron at the mouth of San Diego Creek for scour protection, from –14 ft MSL to – 20 ft MSL.*
- *Maintain access channel to Unit II Basin (-14 ft, MSL)*

Unit II Basin

- *Expand Unit II west, depth = -20 ft, MSL with 1V:33H side slopes between 0 ft (MSL) and –3 ft and 1V:5 side slopes below.*
- *Segment Main Dike*
- *Construct new least tern island adjacent to Dike.*
- *New Island, east side channel (–5 ft, MSL), 50 ft top width, 1V:3H side slopes.*
- *Dredge channel from Unit II to Santa Ana-Delhi Channel (-5 ft, MSL) depth, a 50 ft bottom width and 1V:3H side slopes).*
- *Maintain the dredge and barge access channel from the Unit II basin to the PCH Bridge at –14 ft (MSL).*

Other Areas

- *Middle Island, west side channel*
- *Shellmaker Island, east side channel*
- *Shellmaker Island, wetlands creation*
- *Shellmaker Island, small dendritic channel*

- *Northstar Beach, wetlands creation*
- *Plant eelgrass beds*

In order to create Alternative 6, the initial construction dredge volume is 2.12 million cubic yards, assuming the use of the clamshell dredge. Maintenance dredging requires the removal of 2.16 million cubic yards once every 21 years, on average.

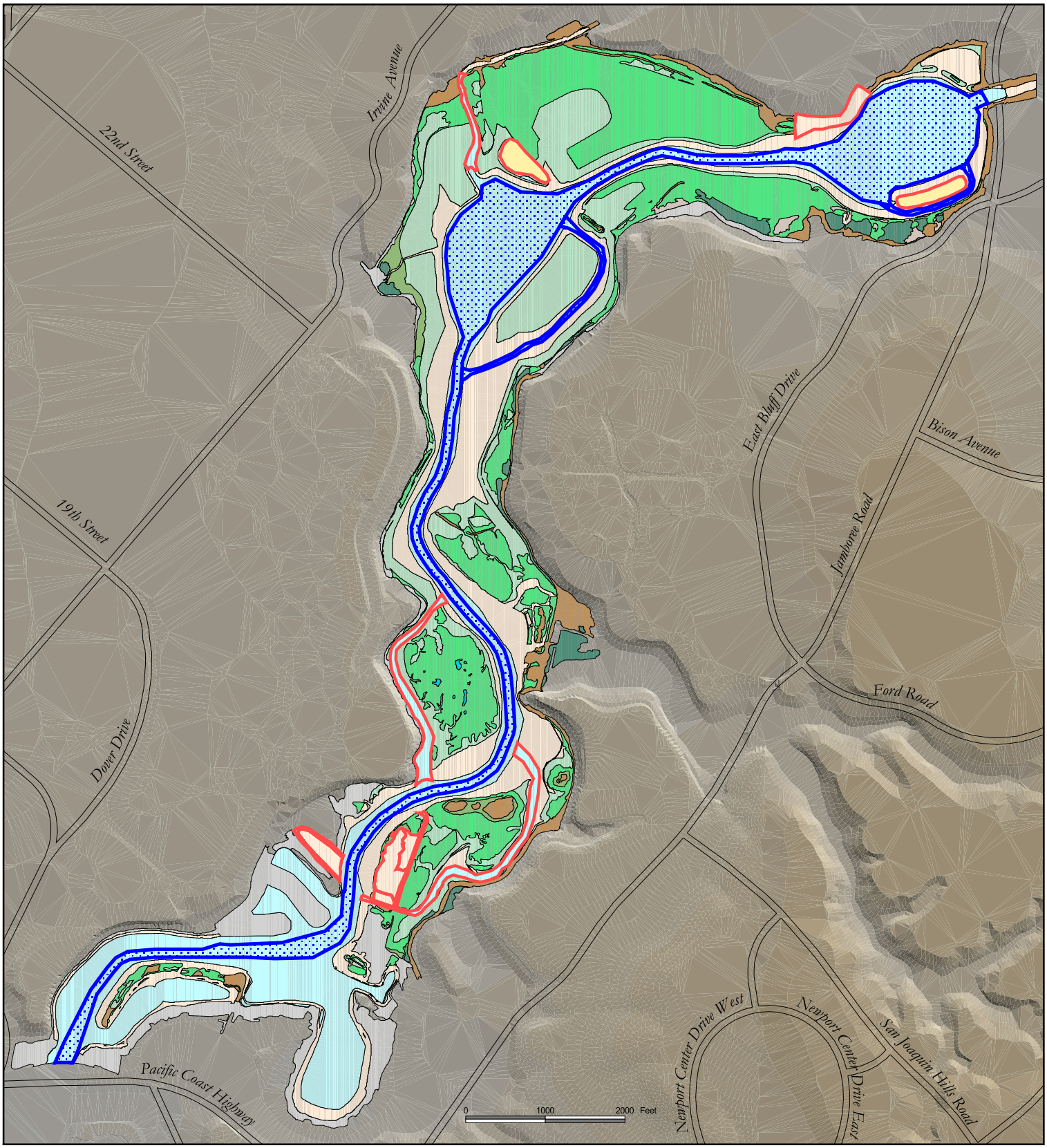
Project Costs for the Recommended Plan (Alternative 6)

Clamshell Dredge Alternative	
Initial Construction	*$32.48 Million*
Maintenance Interval	*21 Years*
Maintenance Cost/ Event	*$31.04 Million*
Net Present Value	*$42.64 Million*

The benefits of the Recommended Plan include the following:

- *Relatively large, deep sedimentation basins that are capable of trapping large volumes of sediment in the areas of the Upper Bay that have been used for this purpose since the 1980's.*
- *Maintenance dredging is expected to be infrequent, averaging each 21 years.*
- *Enhancement/Restoration of a number of other wetland sites.*
- *Significant increase (+46) of Habitat Units (HU's) related to sediment control and habitat restoration.*
- *Lowest annual cost per AAHU ($67,000) of any alternative considered.*

Construction of the Recommended Plan requires the use of large and small excavation machinery. It is presumed based on previous experience that the sedimentation basins will be excavated by a barge-mounted clamshell dredge. Given the environmental sensitivity of the Upper Bay, monitoring of sensitive species will be performed as the work progresses to avoid disrupting nesting areas. The proposed plan of construction includes beginning work north of the dike in mid-September, following the nesting seasons of the least tern and the light-footed clapper rail. Initially, the kidney-shaped least tern island (Skimmer Island) in the Unit I/III Basin will be removed and reconstructed near the Main Dike. The Unit I/III Basin construction (958,000 cy) will be dredged during the mid-September through February period, while the Unit II Basin (866,000 cy) will be excavated during the remainder of the year. The work will require about 23 months to complete.



Habitat Classification*

- Developed
- Freshwater Marsh
- High Salt Marsh
- Intertidal Mudflat
- Low Salt Marsh
- Middle Salt Marsh
- Approach Channel and Basin Limit
- Open Water
- Salt Panne
- Sandy Upland
- Upland
- Water
- Restoration Area

*Orange County Habitat Classification System - May 1992 with Modifications by the United States Army Corps of Engineers

Upper Newport Bay Vegetation
Alternative 6
Recommended Plan

County of Orange, California

DESIGNED AND PRODUCED BY:
Public Facilities and Resources Department
GIS Mapping Unit
Carmen Copil Oancea

DATA SOURCE:
Geomatics Land Information System Division: Survey File # HB-96/97-10
Color Infrared Aerial Photos Flown by: Lung & Associates - April 1997
Scale 1" = 270'
Vegetation Survey Field Check by M.E.C. Analytical Systems Inc. - October 1997
Model Elevations Determined by: Resources Management Associates

DATE: July 12, 2000

ENGINEERING APPENDIX
UPPER NEWPORT BAY FEASIBILITY STUDY

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1. GEOTECHNICAL EVALUATION

1.1 Physical Setting

Newport Bay is located at the southeastern terminus of the Los Angeles coastal plain and adjacent to the southern edge of the Inglewood-Newport Uplift. The Bay is a coastal estuary rimmed by steep bluffs up to 100 feet high, and is divided into two portions, the Lower Bay which parallels the coastline and is separated from the ocean by Balboa Peninsula, and the Upper Bay, which lies north of the Pacific Coast Highway bridge and extends 5 miles inland, as shown in Figure 1. The Upper Bay is bordered to the west by Costa Mesa, a flat-topped, uplifted landform composed primarily of Pliocene and Miocene age siltstones and shales. To the north lies the Tustin Plain, an alluvial floodplain composed of sediments derived from the surrounding San Joaquin and Santiago Hills, and to the east lie the San Joaquin Hills composed of uplifted Miocene and Oligocene sedimentary rocks (Trimble, 1981).

The perceptible bulge in the lower bay's sand spit (Balboa Beach) is a natural irregularity due to the presence of the Newport submarine canyon, which approaches shore at that point. The presence of the submarine canyon just offshore reduces the height of waves over the canyon and the adjacent surf, favoring sand deposition transported along the beach by southerly longshore currents.

The Bay receives terrigenous sediment primarily from two tributaries, San Diego Creek and the Santa Ana-Delhi Flood Control Channel. The Newport Bay watershed encompasses approximately 118 square miles of land with uses including agricultural, residential, urban, and open space (California Regional Water Quality Control Board (CRWQCB), 1989), as shown in Figure 2. San Diego Creek is by far the largest contributor, draining 105 square miles of the surrounding foothills and much of the Tustin Plain, and delivering 94% of the sediment carried annually to the Upper Bay (CRWQCB, 1989). The average annual volume of sediment being carried into the Bay is estimated to be 164,000 cy/year, based on the record spanning the 1972-1996 period.

1.2 Geologic History

The formation of Newport Bay began during the mid-Pleistocene Epoch when the Santa Ana River flowed around the north edge of Costa Mesa and emptied to the Pacific Ocean between the San Joaquin Hills and the eastern side of Costa Mesa. Sea level during this time was considerably lower than present, causing the Santa Ana River to down cut its channel into underlying bedrock, as much as 123 feet and creating the footprint of Newport Bay (Trimble, 1981). The boundaries of this initial erosion are preserved today as the surrounding bluffs. Channeling was followed by an overall rise in sea level, allowing the ocean to flood 7 to 10 miles inland of its present day stand. Subsequently, at the end of the Pleistocene, a combination of regional uplift (Norris and Webb, 1990) and eustatic changes in sea level caused the river to continue its course in the old valley, incising deeper into the former channel bottom (Moore & Taber, 1968). During the final Pleistocene glacial stage sea level was lowered about 300 feet,

causing significant downcutting of the active channel, and the formation of Newport Canyon. Since that time the bay has undergone an overall period of deposition throughout the Holocene as sea levels have risen worldwide.

Since the final significant erosive stage at the end of the Pleistocene, the Bay has undergone an overall period of deposition throughout the Holocene. Moore & Taber (1968) found scattered marine and estuarine deposits (fine silts and clays) near or immediately overlying bedrock in their numerous borings of the Upper Bay, as noted in Figure 3. Trimble (1981) extends three possible explanations for the deposition of this material. First, the Santa Ana River may have intermittently re-entered the Bay and deposited the fines at the head of the Bay. A second hypothesis is that the Santa Ana River shifted north of the Bay, providing sediment for a bay-mouth barrier island or spit, and creating a quiescent marine environment in which these fines could be deposited. And thirdly, the Santa Ana River may have changed course to the north, creating a barrier island, and flowing eastward through the Bay, behind the island. This explanation provides a mechanism in which both fine material and thin interbedded layers of sand could be deposited in a low energy environment provided by the barrier island.

At a much later time, but prior to 1824, Trimble (1981) believes the Bay mouth was open and the region was exposed to a high-energy environment. This resulted in wave erosion of the surrounding bluffs and the deposition of a well-sorted sand layer ranging in thickness from 6 feet at the head of the Bay to 12 feet at the mouth. The occurrence of this sandbar platform is supported in some of the Moore & Taber (1968) borings and cross sections (note sand lens on left side of Figure 3).

It is not clear if, or how often during the Holocene, the Santa Ana River meandered away from the Bay and emptied further northwest. Nonetheless, it has been documented that during the early 1800's the River was emptying into Newport Bay and that beginning in 1824, substantial flooding along the Santa Ana River delivered an excess of sediment to the River mouth, creating the nucleus of a sand spit. Rapid accretion continued along the spit and formed the entire Balboa peninsula by 1862 (CRWQCB, 1989). Then, in response to substantial sediment in-filling of the Bay by the Santa Ana River, the River was diverted in 1920 to its present course, a man-made outlet 1 ½ miles north of Newport Harbor (Norris and Web, 1990). Since the diversion of the Santa Ana River in 1920, Newport Bay has continued its process of sediment in-filling, albeit at a slower rate, by local tributaries and direct surrounding runoff. This in-filling process is a natural response to adjust the river valley gradient to present sea level and thus will continue indefinitely until either the Bay is filled, sea level falls, and/or the region is uplifted.

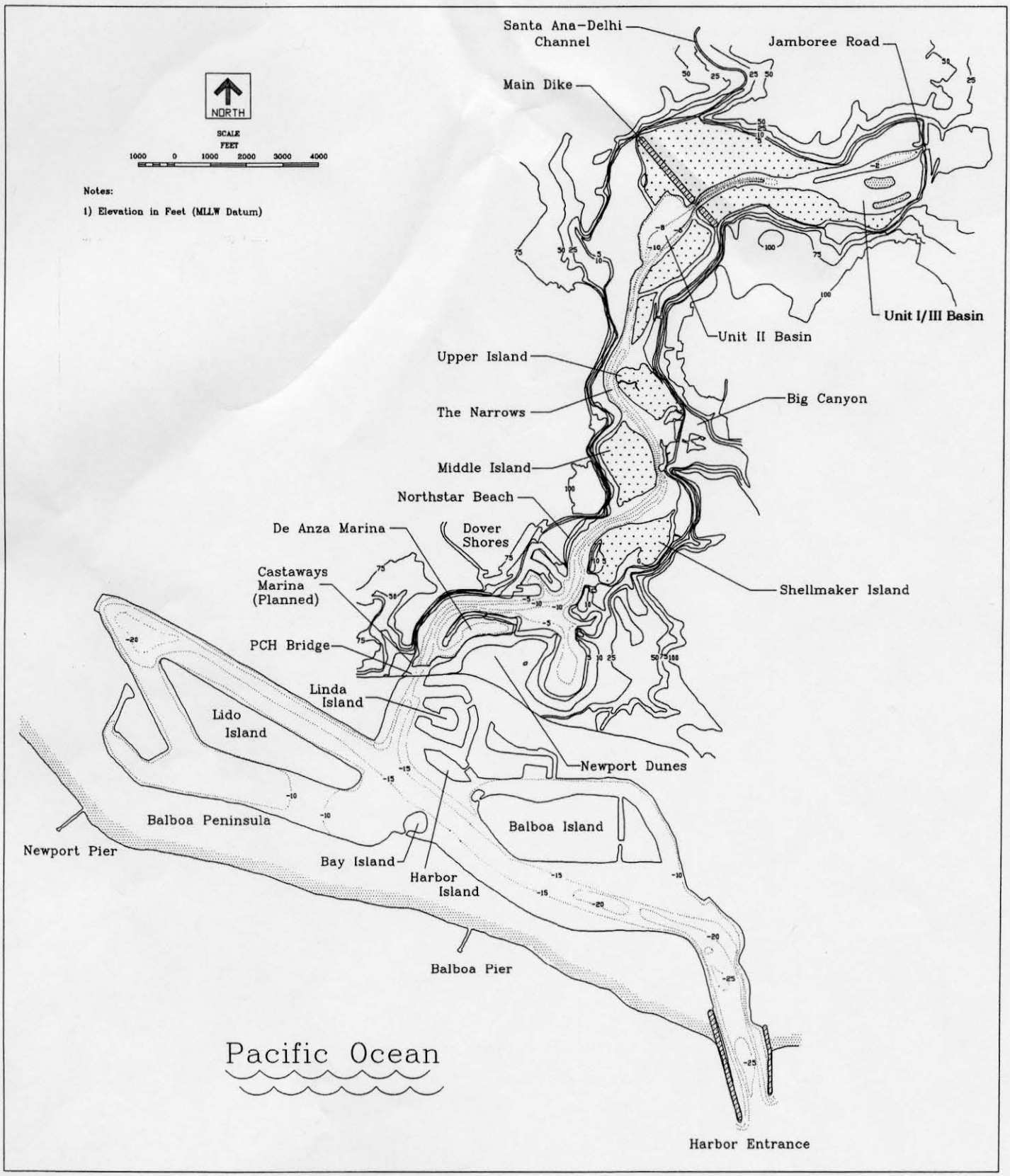


Figure 1: Newport Bay Location Map

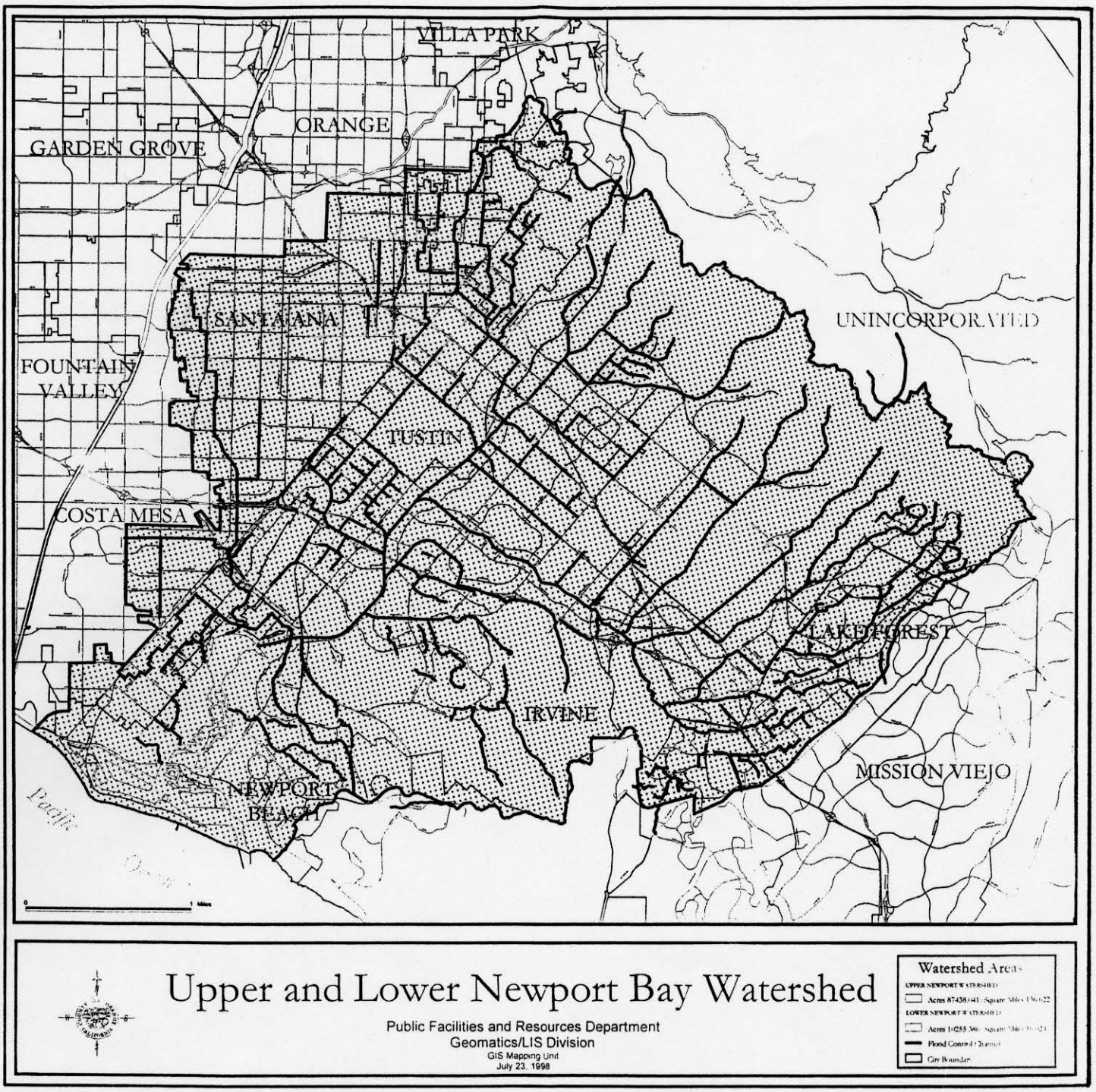
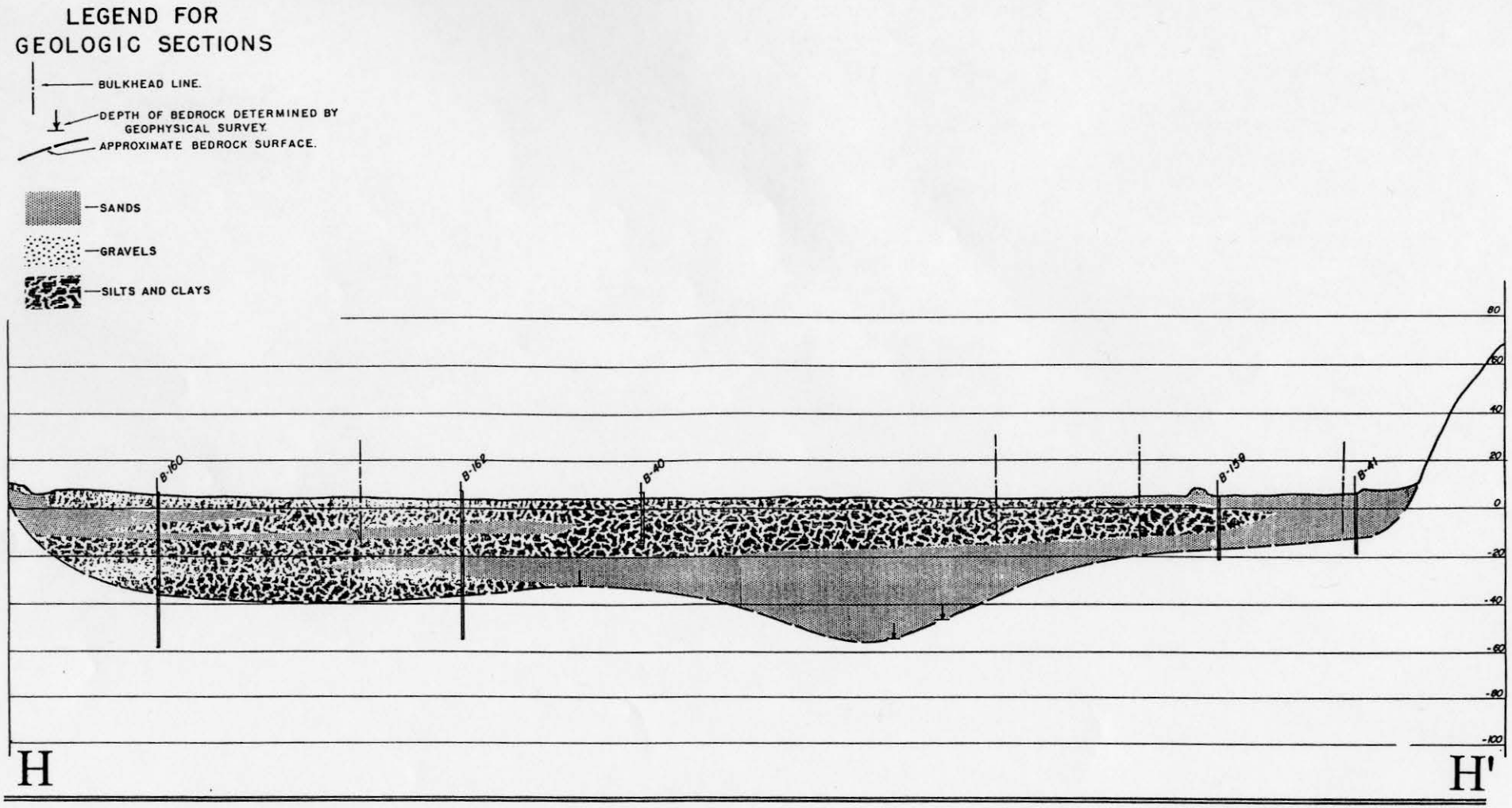


Figure 2: Upper Newport Bay Watershed



SECTION H-H'
(See Figure 4)

(after Moore & Taber, 1968)

Figure 3: Geologic Cross-Section from Upper Newport Bay

1.3 Stratigraphy

Three bedrock formations were exposed during downcutting periods of the Bay. Since the drowning of the Bay by rising sea level and its rapid sediment in-filling, however, bedrock presently underlies Holocene and Pleistocene alluvium and is only exposed on the surrounding bluffs with the exception of Coney Island, a small outcropping located just south of Shellmaker Island. Thus, based on the findings of a geophysical survey and borings conducted within the confines of the bluffs in the Upper Bay (Moore & Taber, 1968), bedrock is not generally encountered above -30 feet and is buried in most locations by 15 feet or more of Quaternary alluvium. Additionally, in some locations within the Upper Bay where the Santa Ana River had incised the deepest , bedrock is not found above –60 feet and may have 45 feet or more of sedimentary overburden (Figure 3).

The oldest exposed bedrock in the Upper Bay is the Monterey Formation, which is well bedded, diatomaceous shale deposited during the Miocene age. It is exposed along the bluffs between Pacific Coast Highway Bridge and Middle Island, and at Coney Island (Figure 4). The Capistrano Formation overlies the Monterey Formation and is characterized by a massive clayey siltstone of marine origin. It is most clearly exposed along the bluffs near Upper Island and is dated at Upper Miocene to Lower Pliocene. Unconformably overlying the Capistrano Formation is an unnamed sandstone of Late Pliocene to Early Pleistocene age. It is a light colored, fine to medium grained silty sandstone and is exposed along the bluffs north of Upper Island (Moore & Taber, 1968).

1.4 Sediment Characteristics

Throughout the Holocene, alluvium from several sources has been deposited in the Upper Bay. As discussed earlier, much of the deep, near-bedrock sediment was likely deposited by the Santa Ana River and by wave erosion of the surrounding bluffs when the Bay was opened and exposed. Following the permanent diversion of the Santa Ana River out of the Bay, much of the alluvium has been carried by the San Diego Creek and the small lateral tributaries, such as Santa Ana-Delhi and Big Canyon Wash. The resultant sedimentary record exhibits this variation in depositional environments and the laterally discontinuous nature of stream deposition experienced in the Upper Bay throughout the Holocene. Sediments range from clays to gravel, massive to thinly bedded, poorly to well sorted, and varies both horizontally and vertically across the region. Figure 5 illustrates this variability across the region in cross sections constructed by Moore & Taber (1968), and located as shown in Figure 4.

Shallow core sampling conducted by several organizations during the past twenty years in the Upper Bay (Marine Biological Consultants, 1981; Marine Biological Consultants, 1985, Kinnetics Laboratories, 1993) reveal considerable variation in the physical characteristics of near-surface sediment across the region. This variation is exemplified in samples collected within 200 feet of one another in the Dover Shores canals in which one sample contained 9% gravel, 49% sand, and 42% silt-clay, while another sample contained 7% sand and 93% silt-clay. Notwithstanding these variations, however, the region can be generally characterized as having the most sand and coarse silt at the northern end of the Upper Bay (Boyle Engineering, 1983),

and more silt and clay constituents in the lower region of the Upper Bay (Marine Biological Consultants, 1981) as shown in Figure 6.

Analysis of sediment cores prior to the most recent dredge program in Upper Newport Bay (Unit III Excavation, 1998-1999) is presented in Table 1. Sediment data was collected at Dover Shores, the Access Channel leading to the Unit II Basin, the Unit II Basin, and upper (0 to –7 ft) and lower (-7 to –14 ft) stratas of the Unit I/III Basin. Sediment variability includes a range of sand content from 16% to 61% (average = 39%), a clay content range of 21% to 57% (average = 34%), and a silt content range of 18% to 36% (average = 26%). The data is presented graphically in Figure 7.

Table 1: Sediment Size Analysis, Composite Core Samples, 1995

Location	% Silt	% Clay	% Sand
Dover Shores "A"	32.0	40.4	27.6
Dover Shore "B"	18.1	26.2	55.7
Access Channel	18.5	21.0	60.6
Unit II Basin	36.5	26.4	37.1
Unit I/III Basin (0 to –7 ft)	26.5	34.1	39.4
Unit I/III Basin (-7 to –14 ft)	26.9	57.3	15.8
Average =	**26.4**	**34.2**	**39.4**

Source: County of Orange, 1997

An extensive chemical analysis of sediment from the Upper Bay was conducted in 1985 (Marine Biological Consultants, 1985) in conjunction with the construction of the Unit II sediment basin in 1987. Additionally, Marine Biological Consultants (1981) obtained samples in 1980 and compiled historic sediment chemistry data available from this region. Also, a sediment-testing program was conducted in the Upper Bay in 1996 prior to dredging the Unit I/III Basin. Results from the historical compilations (1978-1980, 1985, 1996) are provided in Appendix 1, and include an analysis of trace metals, organic chemicals (pesticides, PCB's) and total petroleum hydrocarbons. None of the suite of organic chemicals analyzed in the 1985 samples were found above detection limits. Similarly, total petroleum hydrocarbons were not measured above the detection limit operating in 1985. It should be noted, however, that the detection limits of the analysis utilized in 1985 exceed the current minimum detection limits established by the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE, 1991).

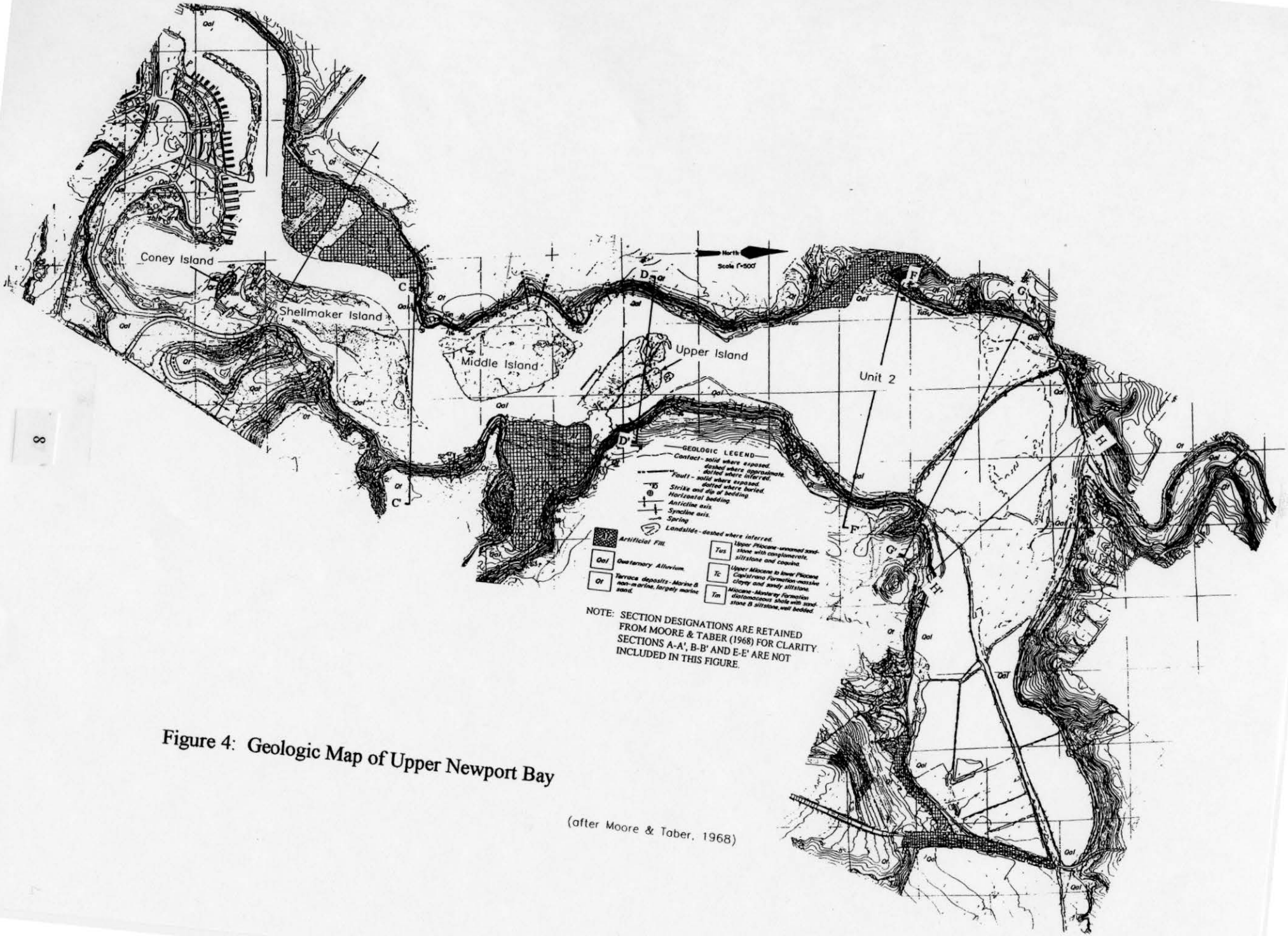
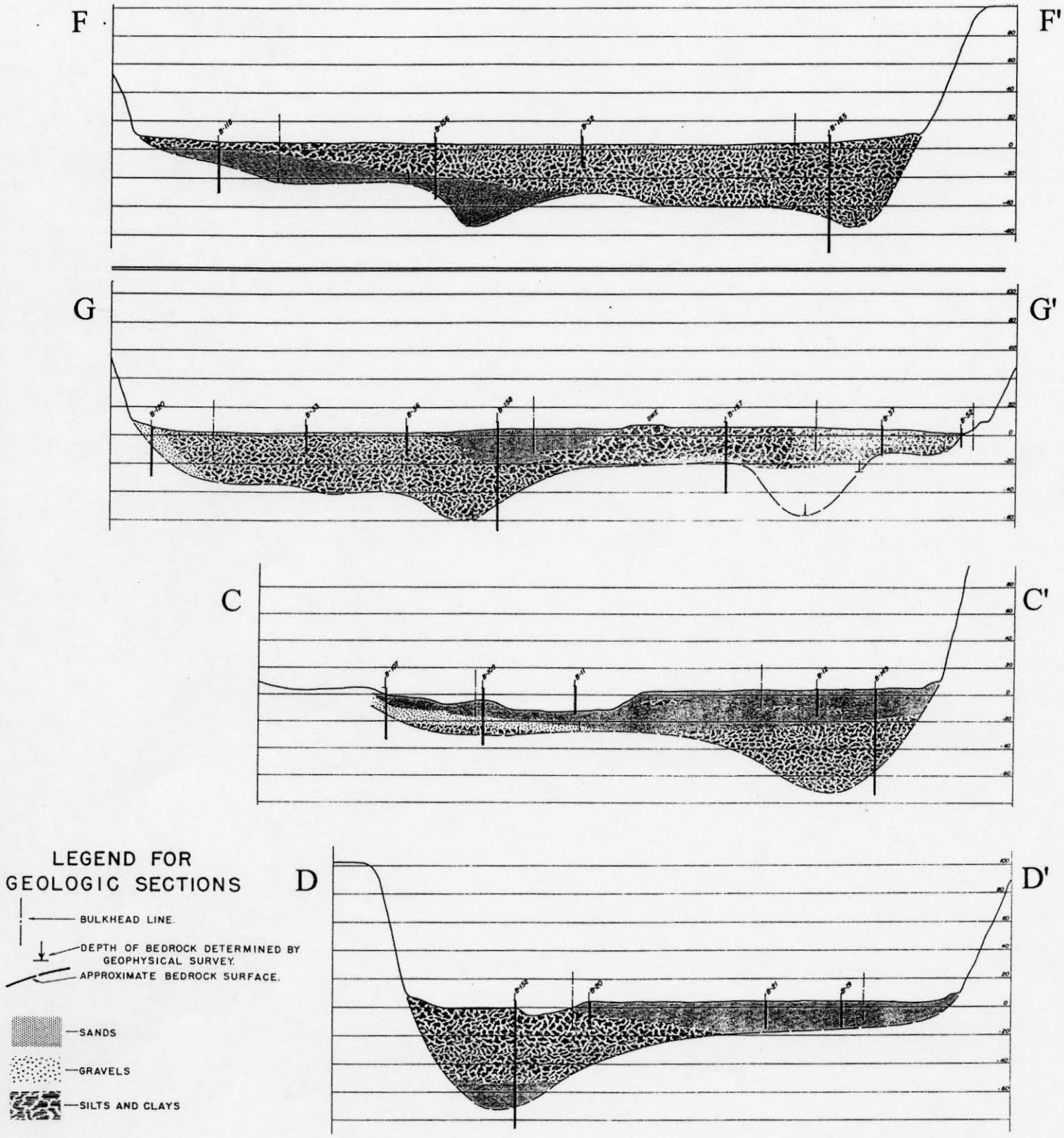


Figure 4: Geologic Map of Upper Newport Bay

(after Moore & Taber, 1968)



(after Moore & Taber, 1968)

D - D' GEOLOGIC SECTION LOCATIONS SHOWN ON FIGURE 3.

NOTE: SECTION DESIGNATIONS ARE RETAINED FROM MOORE & TABER (1968) FOR CLARITY SECTIONS A-A', B-B' AND E-E' ARE NOT INCLUDED IN THIS FIGURE

Figure 5: Geologic Cross-Sections Showing Variability of Alluvium Across Upper Newport Bay

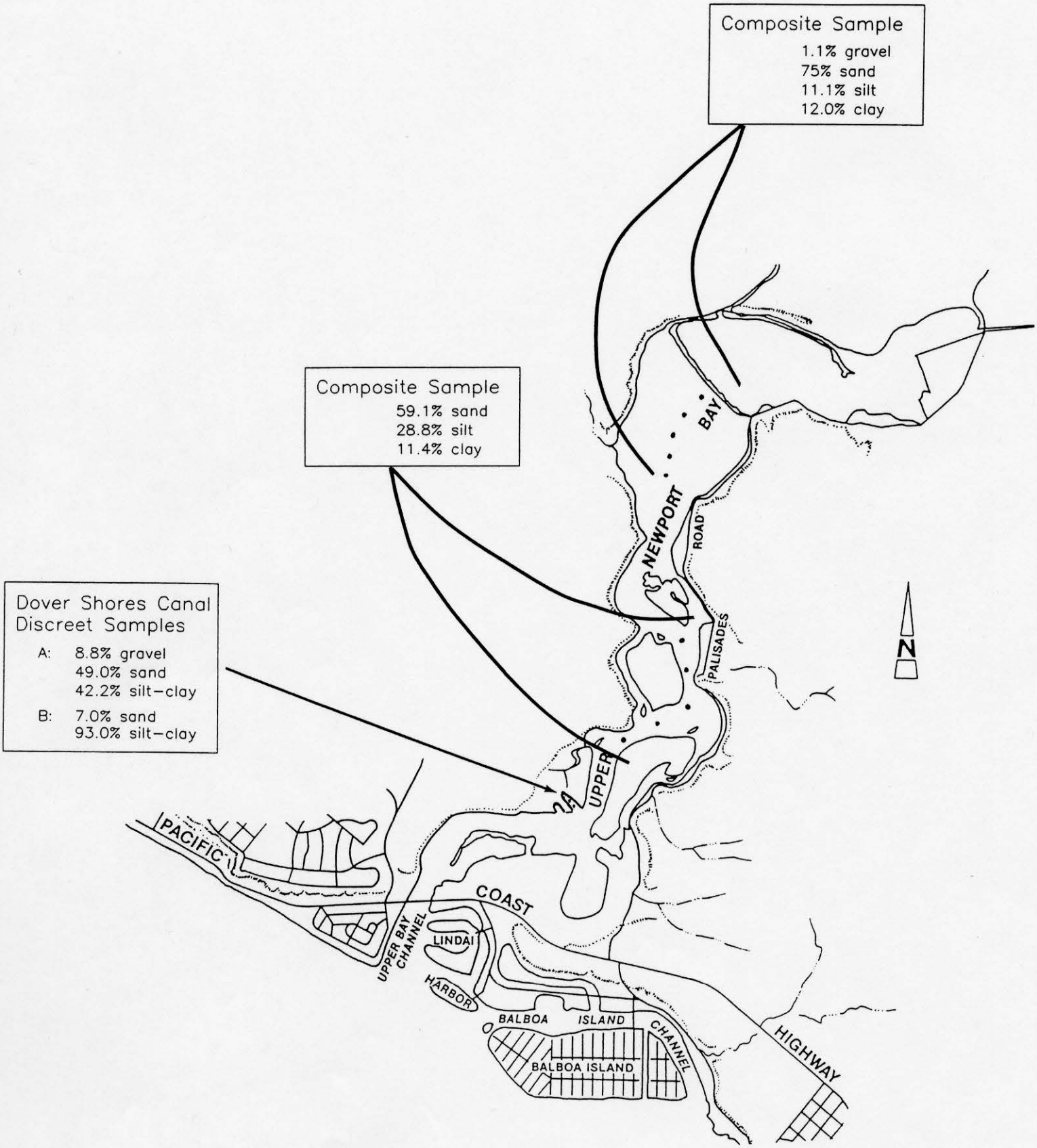


Figure 6: Near Surface Grain Size Variation Within Upper Newport Bay

Figure 7
Sediment Size Characteristics
1998-1999 Upper Newport Bay Dredging Program

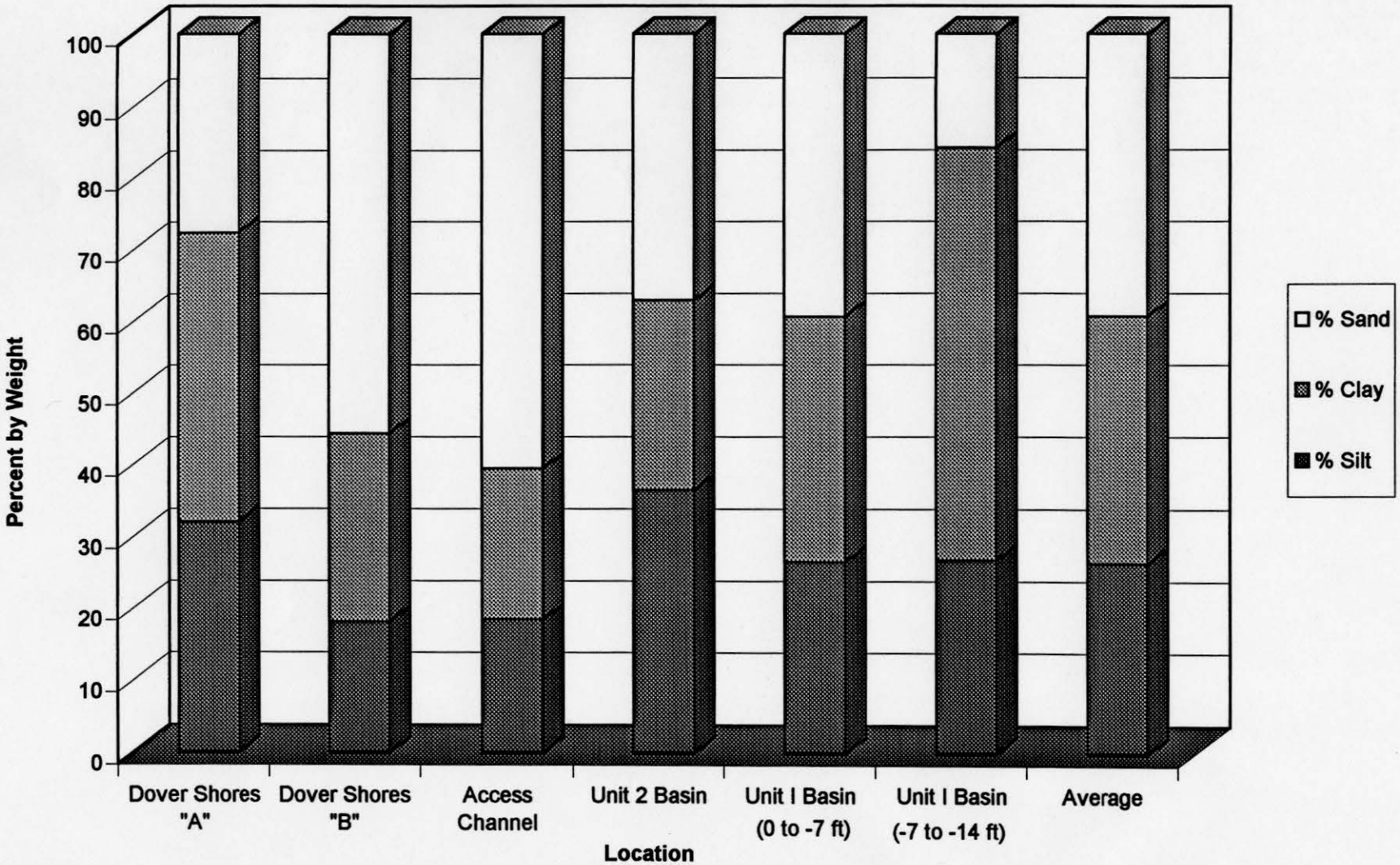


Table 2 presents a summary of chemical concentrations obtained in 1996 from the Unit I/III Basin in the Upper Bay and shows a comparison to metal concentrations detected from reference sediment (sediments collected at the LA-3 offshore disposal site), as well as with results of the historical data. Based on the 1996 data, most metals (arsenic, cadmium, chromium, copper, nickel and zinc) have higher concentrations at the Unit I Basin than are found at the LA-3 site offshore. Concentrations of lead, mercury, and silver have lower concentration within the Unit I/III Basin relative to LA-3. Concentrations of organotins, chlorinated pesticides, and petroleum hydrocarbons were not detected in the 1996 Unit I/III Basin sediment samples.

Table 2: Trace Metal Concentrations in Sediment Samples,
Upper Newport Bay

Trace Metals	LA-3 Reference (ppm)	1996 Unit I/III (ppm)	1985 Unit II (ppm)	1978-80 Newport Dunes to Shellmaker Is. (ppm)	OAET
Arsenic	4.0	9.8	0.52	8.0	50.0
Cadmium	0.8	0.95	2.8	0.09	5.0
Chromium	55	66	23.6	18.1	n/a
Copper	25	33	21.3	14.5	300
Lead	17	12	73.9	27.7	300
Mercury	0.3	0.04	1.06	0.07	1.0
Nickel	25	32	No Data	No Data	n/a
Selenium	0.8	0.85	No Data	No Data	n/a
Silver	0.3	0.22	No Data	No Data	n/a
Zinc	73	120	302	64.2	260

Notes:
1. Results from 1996 samples were determined from composite samples from Unit II.
2. Results from historical samples were determined from averaging discreet samples.
3. OAET abbreviates “Overall Adverse Effects Threshold” as determined by the National Oceanic and Atmospheric Administration.

1.5 Implications for Dredging

The project alternatives to provide improvement in the Upper Newport Bay environment will include the need for dredging to remove accumulated sediment. Although many other parameters must be evaluated to consider the acceptability of dredging operations, the analysis presented here is limited to consideration of the physical dredgibility (ability to dredge the material with standard clamshell, backhoe, or hydraulic dredging equipment) and the limitations to dredging given current guidelines for sediment chemical contaminants.

Based on extensive previous experience within the Upper Bay during the past 20 years, it is clear that dredging is possible in the Upper Bay by normal dredging methods. Bedrock is located far below any of the proposed dredge depths within the proposed dredge locations. Also, the dredge material is unconsolidated alluvium, ranging from clay to gravel. Both hydraulic and

clamshell dredging have been utilized in this region with success in the past. In 1987, a clamshell dredge and barges (3,000 cubic yard capacity) were used to remove over one million cy of sediment from the Upper Bay, at a rate of approximately 5,000-10,000 cy per day (Miller, 1992). During 1998-99, clamshell-dredging operations removed 784,000 cy of sediment from the Unit I/III Basin and the Access Channels. During this program, hydraulic dredging removed 75,000 cy from the Dover Shores area. The rate of dredge production varied significantly but averaged about 3,000 cy/day (T. Rossmiller, 1999).

The second consideration in determining the acceptability of dredging sediment from the Upper Bay is the need to meet the criteria established by the EPA and USACE for the evaluation of dredge material. The recent 1998-99 dredge program in the Upper Bay allowed offshore disposal of the material at the LA-3 dumpsite. All Federal and State requirements for dredged sediment quality were achieved in order for this offshore dumping to occur. It is presumed, however, that future dredging activity in the Upper Bay will only occur following comprehensive testing for chemical contaminants within the sediments. Such testing includes the determination of contaminant concentrations, as well as the biological effects of such contaminants through the performance of bioassay and bioaccumulation testing.

2. ESTUARINE/COASTAL ENGINEERING

In the estuarine environment of Upper Newport Bay, stream discharges and ocean tidal effects influence water movements, sediment distribution processes, and biological productivity. These relationships are complicated by daily onshore and offshore breezes, and by seasonal Santa Ana winds of high intensity.

Sediment movements within the Upper Bay are directed by hydraulic processes. Fine and coarse sediments undertake different transport modes. An accurate knowledge of the existing and future trends in sedimentation within the bay is critical to the overall health of this important ecosystem.

2.1 Water Level Fluctuations

The ocean tides at the entrance to Newport Bay are semi-diurnal, generally exhibiting two high tides and two low tides each day. Because the tidal heights are related to the phase relation of the sun and the moon, the heights of high and low tides vary continually throughout the 28-day cycle. The actual elevation reached by a particular tide is further influenced by wind set-up (generally important only during times of high speed Santa Ana winds from the north) and freshwater discharge (significant only during major winter storm runoff periods).

The National Ocean Service, NOAA, has collected tide data near the entrance to Newport Bay during th 1955-1994 period. Tide elevations that have been determined during this data collection period are presented in Table 3. The vertical datum used in future discussions of project alternatives will be Mean Sea Level (+2.76 ft, MLLW), based on the preference of the various regulatory agencies that are evaluating the project.

Table 3: Tide Elevations, Newport Harbor, California

Water Level Designation	**Elevation, feet**
Extreme Low Water	-2.16 (20 Jan 1988)
Mean Lower Low Water	0.0
Mean Low Water	0.93
National Geodetic Vertical Datum	2.72
Mean Sea Level	2.76
Mean Tide Level	2.79
Mean High Water	4.65
Mean Higher High Water	5.40
Extreme High Water	7.86 (28 Jan 1983)

Source: U.S. Department of Commerce, NOAA

To support the environmental evaluation of Upper Newport Bay, a tide and current data collection program was undertaken in June 1992. The primary objective of the study was to quantify the mean tidal elevations at several locations within Newport Bay, thereby providing a basis for determining appropriate elevations for the subtidal and intertidal habitat areas. A

secondary objective was to obtain measurements of current velocity within the Upper Bay, in order to foster a better understanding of the hydraulic and sedimentary conditions in the area. This data also provided important information that supported the accurate development and calibration of a numerical model of Newport Bay.

The approach adopted for defining the tidal characteristics within the Upper Bay consisted of: (1) installing two tide gauges in the Upper Bay for a one-month period (at Dover Shores and at the Main Dike), (2) obtaining the data recorded at the NOS Newport Bay Entrance tide gauge for the same period, and (3) comparing the various tidal means and extremes for the month at the three sites to provide a basis for estimating the long-term tidal characteristics within the bay. The locations of the tide gauges deployed for this study are indicated in Figure 8. Results of the study indicated that there exists a time lag between the times of high water at the Newport Harbor Entrance and locations further upstream. The time lag is 12 minutes at Dover Shores and 25 minutes at the Main Dike. At the Dike, the MHHW elevation is higher than at the Harbor Entrance by about 0.1 ft.

In the simulation of a very large winter flood that occurred on December 6, 1997, the water surface elevations were determined at a number of sites within the Upper Bay using the hydrodynamic model developed by Resource Management Associates, Inc. (RMA), of Suisun City, California (RMA, 1997). The peak discharge at San Diego Creek generated by the storm was 43,000 cfs. This massive inflow of freshwater raised the elevation of the water to nearly +11 ft (MSL) in the Unit I/III Basin, a level that was 11 feet higher than existed at the PCH Bridge at that time. The San Diego Creek hydrograph and the resulting water level rise caused by this storm inflow at various locations within Newport Bay is shown in Figures 9 and 10.

2.2 Tidal Currents

Review of data collected previously (Stevenson and Emery, 1958) provides an understanding of the tidal current regime within Newport Bay. In that study, the maximum current velocity measured at the entrance to Newport Bay was 5.8 ft/sec during a spring tide. It was also determined that average velocities vary between 0.8 and 2.3 ft/sec, dependent upon tidal range. Typically, slightly greater current speeds were noted during ebb rather than flood tides.

During the data collection program of 1992, the tidal currents were measured with a profiling current meter in the main channel of Upper Newport Bay just north of the Pacific Coast Highway (PCH) Bridge, at Shellmaker Island, and at the Main Dike. At each site, current data was collected at various water depths so that current variability with depth could be determined.

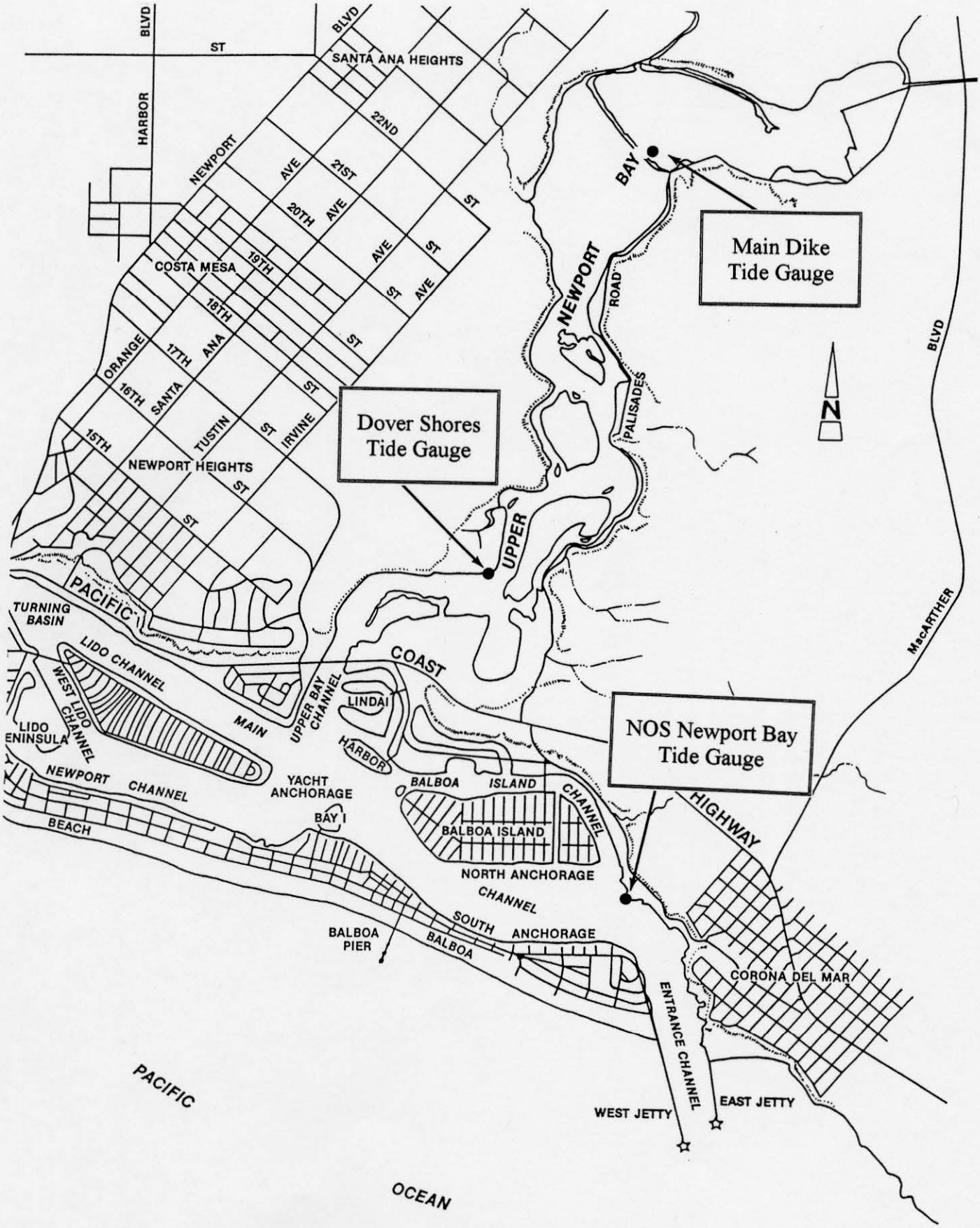


Figure 8: Tide Gauge Location Map

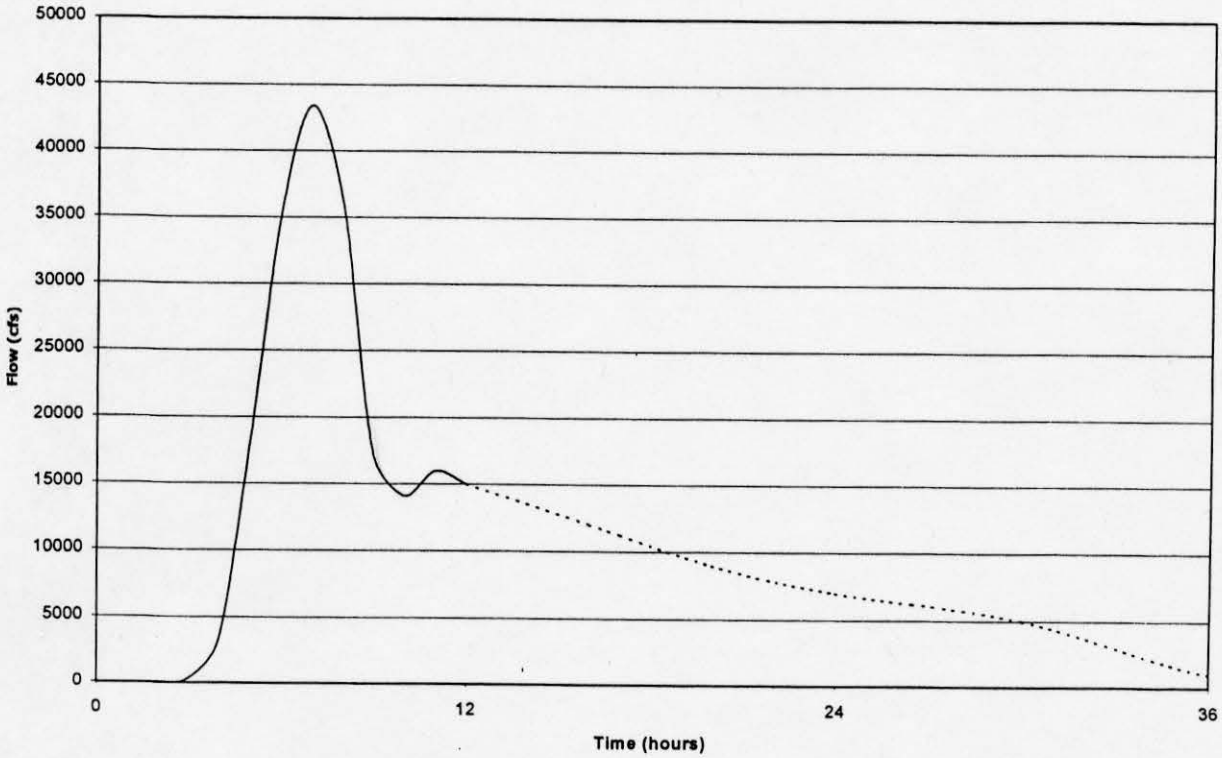


Figure 9: San Diego Creek inflow hydrograph for December 6, 1997 flood simulation (estimated data shown as dashed line).

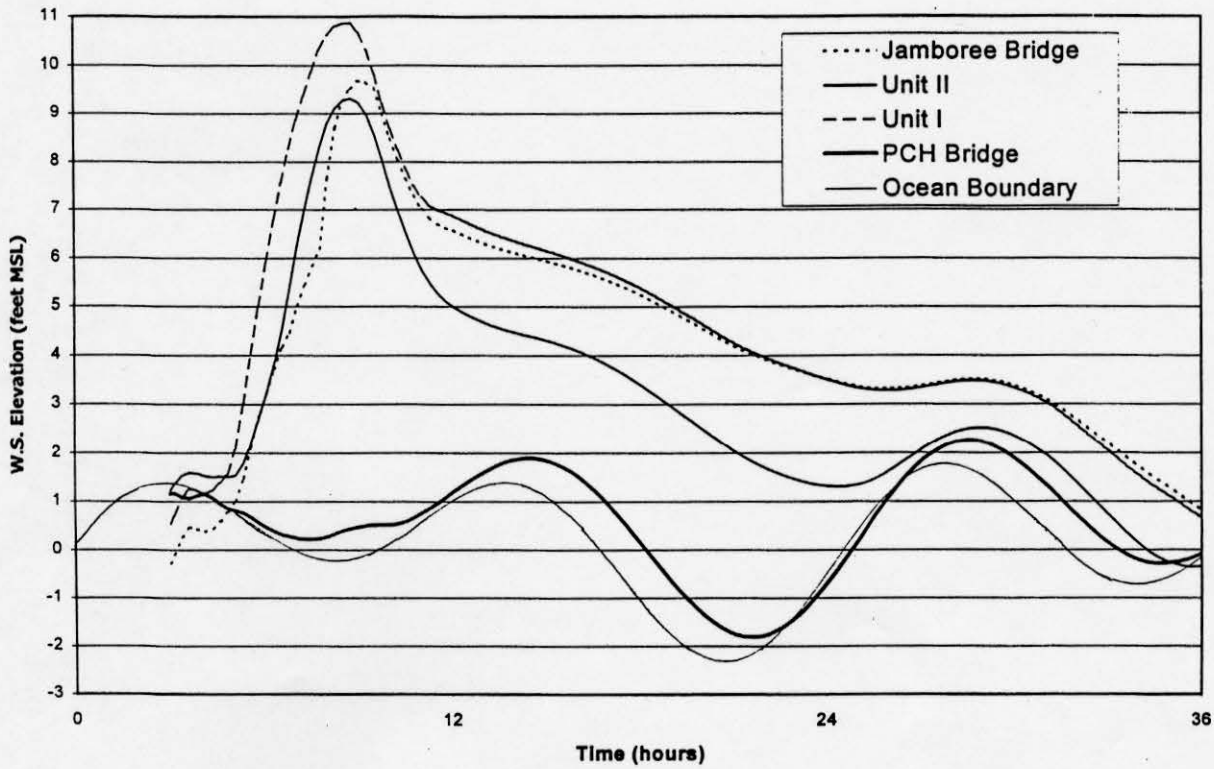


Figure 10: Computed water surface elevation time series for December 6, 1997 flood simulation.

With the exception of the initial current measurements acquired at Site 1 on 29 May 1992, all of the readings were obtained during periods of flood tides. Speeds were moderate, and tended to increase with distance above the channel bottom. The maximum values recorded were 1.7 ft/sec in the channel near Dover Shores, 1.3 ft/sec under the PCH Bridge, and 0.8 ft/sec at the Main Dike. Oppositely-directed currents in the water column, which might indicate strong stratification, were not observed. It must be noted, however, that tidal current observations were conducted during the dry weather flows of the summer. During peak flows promoted by winter storms, the large volume of fresh water entering the bay from San Diego Creek will create statified conditions.

Although the current speeds measured during the study program are capable of transporting fine-grained sediment, they are not highly erosive. Higher speeds are likely to occur during ebb flows from MHHW to MLLW (which occurred at night during the study program, and therefore were not documented), and during winter flood flows. Numerical modeling efforts indicate that maximum current speeds occur during winter storm discharge periods. For the simulation of a 10,000 cfs winter storm flow, peak ebb current speeds of 4 to 8 ft/sec exist in the channels of the Upper Bay (U.S. Army Corps of Engineers, Los Angeles District, February 1993). Thus, the highest current speeds that exist in the Upper Bay are caused by large freshwater flow events during winter storms. Tidal currents induced during fairweather periods are substantially smaller in magnitude.

2.3 Waves

Waves are formed within Upper Newport Bay in response to wind activity. The daily sea breeze causes a short period chop to develop readily. During the spring and summer months, the seabreeze develops in the late morning and can create waves heights of about 0.5 ft. Such modest waves are capable of resuspending bottom sediments in shallow water and transporting such sediments to the north within the bay. This sediment transport process, however, is unimportant in relation to the more intense movement of sediment to the south within the bay in response to ebb tidal currents and large storm discharges from San Diego Creek.

Larger waves are generated in response to high speed Santa Ana winds of the fall and winter period. The winds, typically flowing from the north, are funneled by the mesas that surround the Upper Bay and are capable of creating waves of one to two feet. Such waves have caused erosion of side channels and the marsh shoreline (Stevenson and Emery, 1958).

2.4 Fresh Water Inflows

The primary source of freshwater flowing into Upper Newport Bay is San Diego Creek. The flows from this stream are ephemeral, generally averaging about 30 cfs during the dry summer months. A comprehensive analysis conducted by Boyle Engineers (1982) suggested that the flows for extreme storm events might exceed 20,000 cfs during the 50-year event. In December 1997, a very large storm produced peak discharge from San Diego Creek of 43,000 cfs. Numerical modeling indicated that the water level increase imposed by this inflow was 11 feet above the expected tide level at the Unit I/III Basin.

Given the continually (albeit highly variable) freshwater flows into the Upper Bay, water salinities are less than those in the ocean a majority of time. Thus, the impact of San Diego Creek on the water properties of the Upper Bay are continual, with significant seasonal variations. In addition to San Diego Creek, two small watersheds contribute to the freshwater input to the Bay. The Santa Ana-Delhi Channel drains 18 square miles of fully urbanized terrain within Costa Mesa and Santa Ana. The sediment input of this channel is negligible, but it delivers substantial trash and urban debris during peak flow events. The second small watershed, Big Canyon, enters the Bay south of Upper Island and drains residential properties, again with limited sediment input.

Further discussion of sediment-laden freshwater inflows to the Upper Bay are presented in Section 3.2 of this report.

2.5 Hydraulic Mixing and Water Mass Movements

Water quality studies of the past have discovered vertical salinity gradients in Upper Newport Bay (Williams and North, 1970; Orange County EMA, 1989). Such salinity gradients are caused by the density differences between seawater and freshwater. Under periods of strong freshwater input from San Diego Creek, the dense seawater moves upstream at depth, covered by the less dense, fresh surface waters. This density-driven saltwater intrusion causes zones of seawater-freshwater mixing in response to wind stress, bottom-induced friction, fresh water flow velocity, and channel geometry. The location of the mixing zones varies greatly with the intensity of the freshwater flows. Modest storms can extend the mixing into the Lower Bay. Severe storms can cause the mixing zone to extent well past the harbor entrance and encompass the nearshore coastal zone. During the majority of the year when freshwater flows are slight, the mixing zone is confined to the northern portion of the Upper Bay (Orange County EMA, 1989).

2.6 Newport Bay Numerical Model

In support of the Upper Newport Bay Feasibility Study, a numerical model of the bay has been developed by Resource Management Associates, Inc. (RMA) of Suisun City, California. A similar model, yet with significantly less spatial resolution, was developed in conjunction with the Upper Newport Bay Reconnaissance Study of 1993. The model has been used to evaluate the hydrodynamic and sedimentation processes within the Bay in order to determine potential impacts of various project alternatives as well as for the future “no action” plan.

This finite element numerical model has been calibrated using tide and current data collected in 1992 as well as sedimentation patterns based on bathymetric comparisons spanning the late 1980’s and the most recent comprehensive survey of the Upper Bay conducted in 1997. Simulation of sedimentation resulting from both typical and extreme storm flows as well as dry weather redistribution has been successfully accomplished. A salinity study was performed using the model for both low freshwater inflows and extreme storm flows, including the massive storm of 6 December 1997, during which San Diego Creek achieved a peak discharge rate of 43,000 cfs. Future enhancements of the model have been sponsored by the Regional Water Quality Control

Board. These additional model capabilities will consider the processes associated with various chemical and bio-chemical mechanisms.

The graphical user interfaces (GUI's) for pre- and post processing of the model have been configured and utilized. GIS and bathymetric data layers provided by the County of Orange have been imported into the model pre-processor and used for construction of the finite element mesh. A list of documents that describe the development of the model and its application to Newport Bay is presented below. These documents should be referenced for further model details. All of the documents were authored by Resource Management Associates, Inc. (RMA).

- Draft Model and GUI Development and Implementation Report, Prepared for the U.S. Army Corps of Engineers, Los Angeles District under contract to Coastal Frontiers Corporation, 35 pages, August 1997

  Provided initial model set-up of bathymetric and topographic data. Performed hydrodynamic calibration using tide and current data collected in 1992 and preliminary calibration of sediment transport mechanisms.

- Final Model and GUI Development and Implementation Report, Prepared for the U.S. Army Corps of Engineers, Los Angeles District under contract to Coastal Frontiers Corporation, 65 pages + Appendices, October 1997

  Refined hydrodynamic model and sediment transport calibration. Performed 50-year "without project" simulation by repeating the actual 25-year sediment inflow record to provide the necessary 50-year sediment inflow data.

- Upper Newport Bay Numerical Model Development, Baseline Conditions Analysis, Prepared for the U.S. Army Corps of Engineers, Los Angeles District under contract to Coastal Frontiers Corporation, 56 pages, July 1998

  Provided further model refinement including wet weather and dry weather simulations. Analysis of a major storm inflow (peak fresh water discharge = 43,000 cfs) of 6 December 1997 was performed. The 50-year future "without project" condition was analyzed by developing bay-wide bathymetry at 5 year intervals.

- Draft Progress Report, Upper Newport Bay Salinity Model, Prepared for the U.S. Army Corps of Engineers, Los Angeles District under contract to Coastal Frontiers Corporation, 29 pages, October 1998

  Analyzed Newport Bay salinity fluctuations in response to both dry weather and wet weather freshwater inflows. Salinity data was provided from Orange County and the Irvine Ranch Water District for the 1995-1998 period.

- Upper Newport Bay Alternative Analysis, Prepared for the U.S. Army Corps of Engineers, Los Angeles District under contract to Coastal Frontiers Corporation, 55 pages, November 1999

  The RMA numerical model of Newport Bay was used to evaluate the sediment depositional impacts of four project alternatives relative to the "no action" plan. Fifteen-year simulations were performed for the five cases studied, utilizing historic sediment inflows from the 1977-78 to 1991-92 period. The average annual sediment inflow for this 15 year period was 169,000 cy. However, the variability of sediment inflow did not allow clear analysis of the loss of sediment trapping efficiency of each basin with time. Therefore, a second analysis was performed using a constant sediment inflow of 250,000 cy/year over a 15 year period. The evaluation of the project alternatives that resulted is discussed in Section 5 (Project Alternatives) of this report.

3. SEDIMENT TRANSPORT PROCESSES

3.1 Sediment Deposition Processes

Coarse-grained sediments are transported by hydraulic processes as discrete particles. Such sediments have high settling velocities in quiescent water and typically travel along the channel bottom as bed load. Finer-grained particles (fine sand and silt) can travel in suspension in the water flow for appreciable distances, as determined by the flow speed, turbulence, and the sediment grain size and density.

The evidence of significant retention of fluvial sediment in most estuaries and coastal wetlands is uncontestable. Schubel (1972) shows that bottom muds of Chesapeake Bay contain up to 50% clay particles (settling rates of 10^{-5} to 10^{-6} ft/sec). For the same estuary, Pritchard (1956) estimates an upward water flow rate of 10^{6} ft/sec to account for the distribution of salinity. Clearly, this fine-grained sediment should not have accumulated in the bay unless it settled as larger composite particles.

The process of particle agglomeration or "flocculation" in the presence of organic and inorganic salts is well documented (Krone, 1962; 1972). The phenomenon is dependent upon the fact that small particles have unbalanced charges near their boundaries. If immersed in an electrolyte (the brackish water of an estuary, for example), the particles will attract ions to satisfy this charge imbalance and, further, will attract a second outer layer of oppositely charged ions. The result is a double layer of ions clustered about the particle. The boundary charge depends on the nature and concentration of the electrolyte as well as the nature of the particles. When this charge is above a critical value, no flocculation will occur, even if particle concentrations are as high as 150 gm/liter (Krumbein and Pettijohn, 1938). However, an increase in electrolyte concentration decreases the boundary charge and causes particle attraction, provided the particles collide. In a suspension of particles which, by virtue of the salinity of the fluid, are capable of adherence, the extent of flocculation depends on the rate of collision. Particle collisions can be produced by random Brownian motion of sub-micron grains, grain settling, and water current action (Krone, 1972). As composite particles, or "floccules", form by the above processes, these larger grains will tend to sweep out smaller grains, and in addition, adherence of separate floccules will occur. Krone (1962) found that aggregation of previously formed floccules involved progressively weaker bonds and overall loss in floccule shear strength. Therefore, in a turbulent fluid, collisions are produced, but beyond some critical point, an increase in turbulence actually leads to disaggregation.

Results of laboratory studies of sediment flocculation have been performed. Using pure clay suspensions, Drake (1974) reported that flocculation begins abruptly at chlorinities of less than one part per thousand (ppt) (standard seawater exhibits a chlorinity of about 32 ppt). Chlorinities of about two ppt produced additional flocculation in montmorillonite but had little effect on illite and kaolinite.

The experiments of Krone (1962) are of special interest because they demonstrate the strong dependence of flocculation upon the particle concentration. This is due to the fact that

processes which cause collisions between particles proceed at rates which are directly proportional to particle content. Natural muds from San Francisco Bay were used for Krone's studies, therefore, they should be more representative of Newport Bay sediments than the pure clay suspensions discussed earlier. From Krone's work, it can be concluded that at sediment concentrations below 200 mg/liter in rivers and estuaries, physical flocculation is not an effective means of composite particle formation. However, particle concentrations commonly exceed 200 mg/liter in rivers and estuaries, and conditions of increasing salinity and internal shearing serve to support the flocculation process.

As the loose accumulation of fine-grained sediments settle in the quiescent waters of the Upper Bay, resuspension of the sediment is possible during periods of increased current. The unconsolidated surface layer of sediment (either coarse or fine grained) is capable of being entrained/resuspended and moved with the onset of increased current flow. Sand transport of discrete grains of sediment having high settling velocities tend to maintain equilibrium with the bed as a function of current and/or wave action, and do not normally become significantly more resistant to erosion as consolidation of the sediments occur. Conversely, the accumulation of fine-grained, cohesive sediments tends to densify with time, thereby becoming more resistant to erosion with depth within the deposit. Erosion of such consolidated cohesive sediments may be limited to just the weak surface layer when currents gain speed. It is important to note that cohesive fine-grained sediments grow stronger with depth below the water-sediment interface.

Sand delivery into the Upper Bay is driven by the incoming current of San Diego Creek. As storm waters exit the creek, cohesionless sand can rapidly settle to the bottom. Historical photos of the area typically indicate the nature of the delta-like sand deposits that form in this way. Subsequent storms can rework these sediments and the ambient creek flow can often maintain a channel within the delta deposit, even during low flow conditions. With time, mud flat deposits will stabilize under ongoing deposition of fine-grained sediments on the surface and ultimate colonization of the rising sediment mass by marsh species of vegetation. This vegetation will further enhance the rate of sediment deposition on these features by slowing the currents passing over them.

Most of the sediment delivered to Upper Newport Bay from San Diego Creek and the other streams within the watershed occurs during periods of storm runoff. Storm hydrographs for San Diego Creek exhibit short durations (typically one to two days in length) with high peak flows. The annual sediment input to the Upper Bay from San Diego Creek is listed in Table 4 for the period 1972-1996. The annual variation in sediment inflow is quite large, ranging from 6,000 cy (1971-72) to nearly 700,000 cy (1994-95). The average value over this 25 year period is 164,000 cy. This sediment inflow history is presented graphically in Figure 11.

3.2 Sedimentation History of Upper Newport Bay

The rate of sedimentation within Upper Newport Bay has varied greatly in time, due both to climatic variation and to fundamental changes in the physical setting of the bay and the watershed due to natural and human-induced causes. Stevenson and Emery (1958) present an interpretation

of the initial development of marsh environments within Upper Newport Bay as a result of a sequence of natural events.

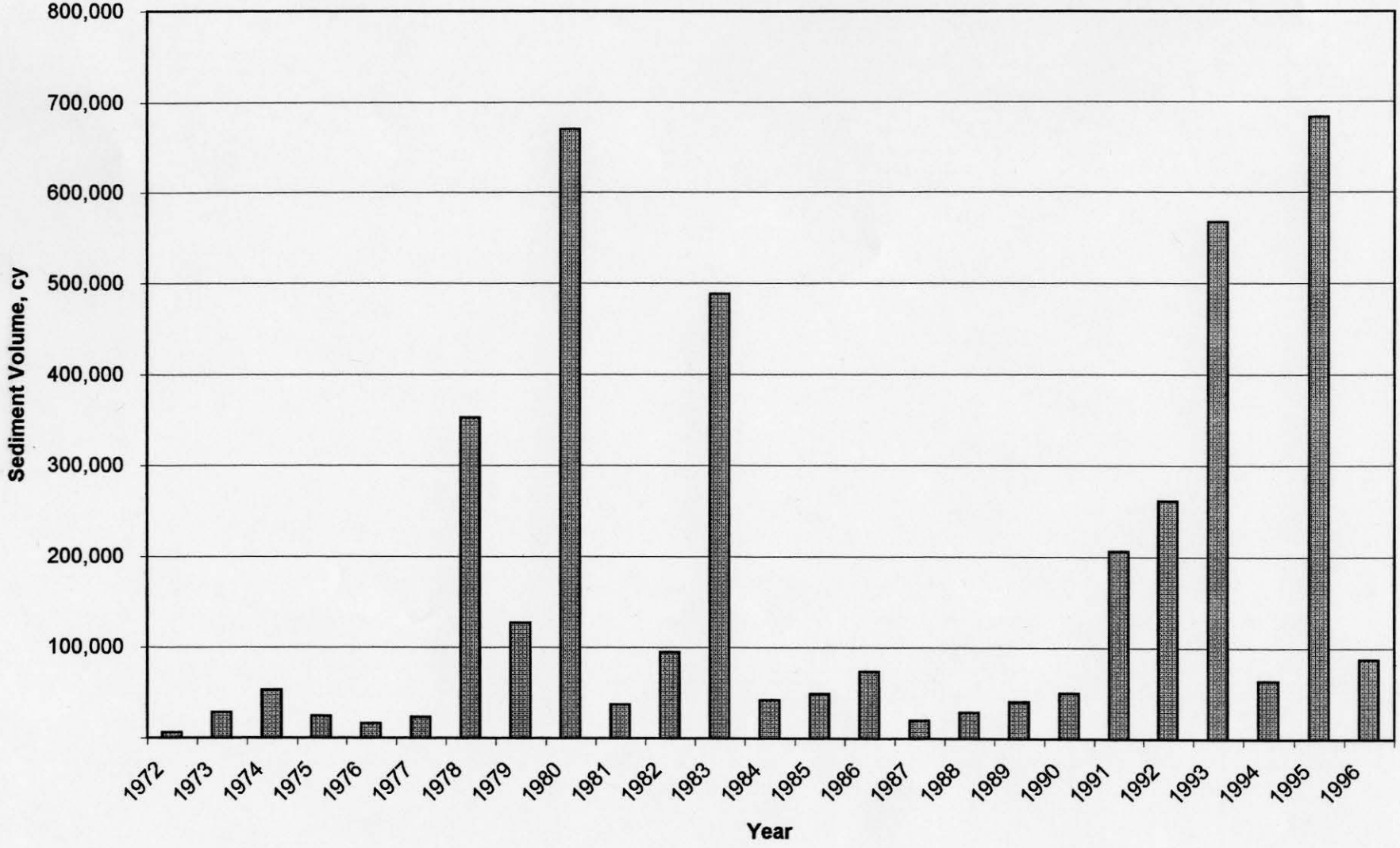
The great flood of 1825 caused the relocation of the Santa Ana River mouth from the Seal Beach area to the area near the base of the Balboa Peninsula. River sediment discharge initiated the formation of a barrier shoal/island complex at the bay entrance. Additional flooding in 1861 advanced the volume of the Balboa Peninsula. This sand spit formation protected the Upper Bay from ocean wave action and a second phase of marsh development commenced.

Table 4
Annual Sediment Inflow, Upper Newport Bay

Year, cy	**Sediment Inflow, cy**
1971-72	6,015
1972-73	28,566
1973-74	53,148
1974-75	24,459
1975-76	16,532
1976-77	23,380
1977-78	352,363
1978-79	127,073
1979-80	670,200
1980-81	37,406
1981-82	95,010
1982-83	488,160
1983-84	42,734
1984-85	49,664
1985-86	73,738
1986-87	20,378
1987-88	29,385
1988-89	40,872
1989-90	50,267
1990-91	205,879
1991-92	261,291
1992-93	566,806
1993-94	63,753
1994-95	683,104
1995-96	87,829
25-Year Average	***164,000***

RMA, 1997

Figure 11
Sediment Inflow to Upper Newport Bay



In these early years, the Santa Ana River meandered across the flood plain between the Huntington and Newport Mesas. This area, termed the "Willows" in those days, consisted of peat beds covered with tules, willows, and vines. This vegetation was effective in filtering suspended sand and silt from the river flow during non-storm conditions. During the late 1800's, the Willows was cleared and drained and the Santa Ana River was channelized. By 1912, the Santa Ana River was carrying large amounts of silt into Lower Newport Bay.

Following formation of the Balboa Peninsula sand spit, the Santa Ana River turned sharply east and flowed behind the spit, thereby facilitating deposition of its sediment load in Lower Newport Bay. This depositional regime continued until 1920 when the Santa Ana River was confined by levees and forced to discharge into the sea several miles west of Newport Bay. Therefore, Stevenson and Emery (1958) indicate that the silty marsh sediments of Upper Newport Bay were deposited between 1861 and 1920, and rest upon the sandy deposits that pre-date 1861. The infrequent flows of San Diego Creek were not considered important at that time in supplying the marsh with fine-grained sediments. It was not until the early 1960's when San Diego Creek was effectively channelized that discharge of storm flows and sediment into the Upper Bay dramatically increased.

Prior to the watershed changes that increased stormwater flows into the Upper Bay in the 1960’s, Stevenson and Emery (1958) measured sediment deposition rates of 0.1 - 0.13 ft/year in the northern and southern basins of the Upper Bay. With the construction of channel improvements of San Diego Creek in the mid-1960's, the discharge of storm water and sediment into the Upper Bay increased significantly. The influence of the major modification of the watershed delivery to the Upper Bay was experienced during the storm season of 1969. During this period, storm flows flooded the Salt Works dike complex, breached the Main Dike, and deposited about 400,000 cubic yards (cy) of sediment in the Upper Bay. With the knowledge that sedimentation rates within the Bay were dramatically increased given the recent changes in the San Diego Creek watershed, initial studies were undertaken to consider control of sedimentation within the Bay. While repeated precision surveying of the Upper Bay was not to become routine, methods of determining sediment flow into the Bay were attempted. Williams and North (1970) and Gietzen, et al. (1972) estimated water exchange by computing the volumes in the Upper Bay that were filled at successive stages of tides. These estimates agreed quite favorably. In 1979, the tidal prism calculations were again determined by the County of Orange. Based on these measurements, a tidal prism decrease of 180 acre-feet (290,400 cy) during the 1972-1979 period was noted, an average of 41,500 cy per year. More recently, a tidal exchange studies have been performed to determine the change in tidal prism within the Upper Bay (Waldner, 1996). Comparing data collected in 1993 and 1996, the tidal prism was decreased by 270 acre-feet (435,600 cy) below the +5 ft (MLLW) elevation. This corresponds to an average annual sediment deposition during this three-year period of 145,000 cy/year.

In the early 1980’s, Boyle Engineers (1982) undertook a comprehensive study of sediment delivery to Newport Bay. The predicted sediment delivery was based on the watershed conditions of 1980. While more recent developments in the watershed cast doubt on the Boyle findings, the Boyle study presents the most comprehensive projections of watershed hydrology available. As a result, the summarized findings of the Boyle study are worthy of presentation in this report. It

should be noted, however, that twenty years of new sediment inflow data is available for analysis in this study, thus inhibiting the accuracy of the Boyle projections. A new study of the San Diego Creek watershed is currently underway by the U.S. Army Corps of Engineers, Los Angeles District.

As shown in Table 5, Boyle Engineers (1982) developed estimates of peak discharge from San Diego Creek under storms of varying severity (including the 2-, 5-, 10-, 25-, 50-, and 100-year storm events) for both the existing (1980) condition, as well as the "ultimate" condition.

Table 5
Peak Flows and Volumes of Runoff
1980 and Ultimate Conditions of Development
San Diego Creek at Campus Drive

Return Period, years	Existing Conditions		Ultimate Conditions		% Increase	
	Peak Flow, cfs	Volume, acre-feet	Peak Flow, cfs	Volume, acre-feet	Volume, cfs	Peak Volume, acre-feet
2	3,280	2,130	5,310	3,840	62	80
5	7,260	5,130	9,980	7,680	37	50
10	10,390	7,650	13,400	10,710	29	40
25	14,330	10,990	17,60	14,580	23	33
50	19,380	16,260	22,120	19,970	14	23
100	22,300	19,050	25,070	22,940	12	20

Source: Boyle Engineers, 1982

The existing condition was based on measured flows from the creek and existing land use (urbanized, rural, agricultural, construction). At the time of the analysis, the total drainage area for the San Diego Creek watershed was (and is now) 118 square miles. Figure 12 indicates the watershed conditions that existed in 1980. In 1979-1980, the watershed was composed of the following uses: 23% agricultural, 47% urbanized, 28% open space, and 2% under construction. As is evident in Table 6, the average annual sediment volume deposited in the Upper Bay under the conditions existing in 1979-1980 lies between the quantity delivered by a storm having a return interval of between five and ten years.

The ultimate conditions of development assumes the maximum urban use of the San Diego Creek watershed that is probable to occur based on assumptions made in 1980 (Boyle Engineers, 1982). This was originally based on consideration of the Orange County General Plan (as amended in November 1979), the City of Irvine General Plan (February 1978), and the Plan of Development by The Irvine Company (February 1980). Under these plans developed over a decade ago, the ultimate condition of the watershed included 81% devoted to urbanized space, 8% rural, and 11% open space. No land was assumed to be used for agricultural purposes. Another projection of the nature of the watershed is based on more recent land use considerations and plans developed in the mid-1990's by the City of Newport Beach and the County of Orange,

as shown in Figure 13. In this scenario, a modest portion of the watershed (4 square miles) is presumed to remain devoted to agriculture.

Table 6
Sediment Supply to Upper Newport Bay
Conditions of 1980

Storm Return Period, Years	Sediment Input, Tons (1)	Particle Size Distribution (%)			
		Clay	Silt	Sand	Coarse Sand
2	12,400	60	22	17	2
5	56,800	45	38	16	1
10	109,400	41	42	16	1
25	186,000	38	44	17	1
50	353,200	37	44	17	1
100	443,400	43	39	17	1
Annual Average =	85,500	43	39	17	1

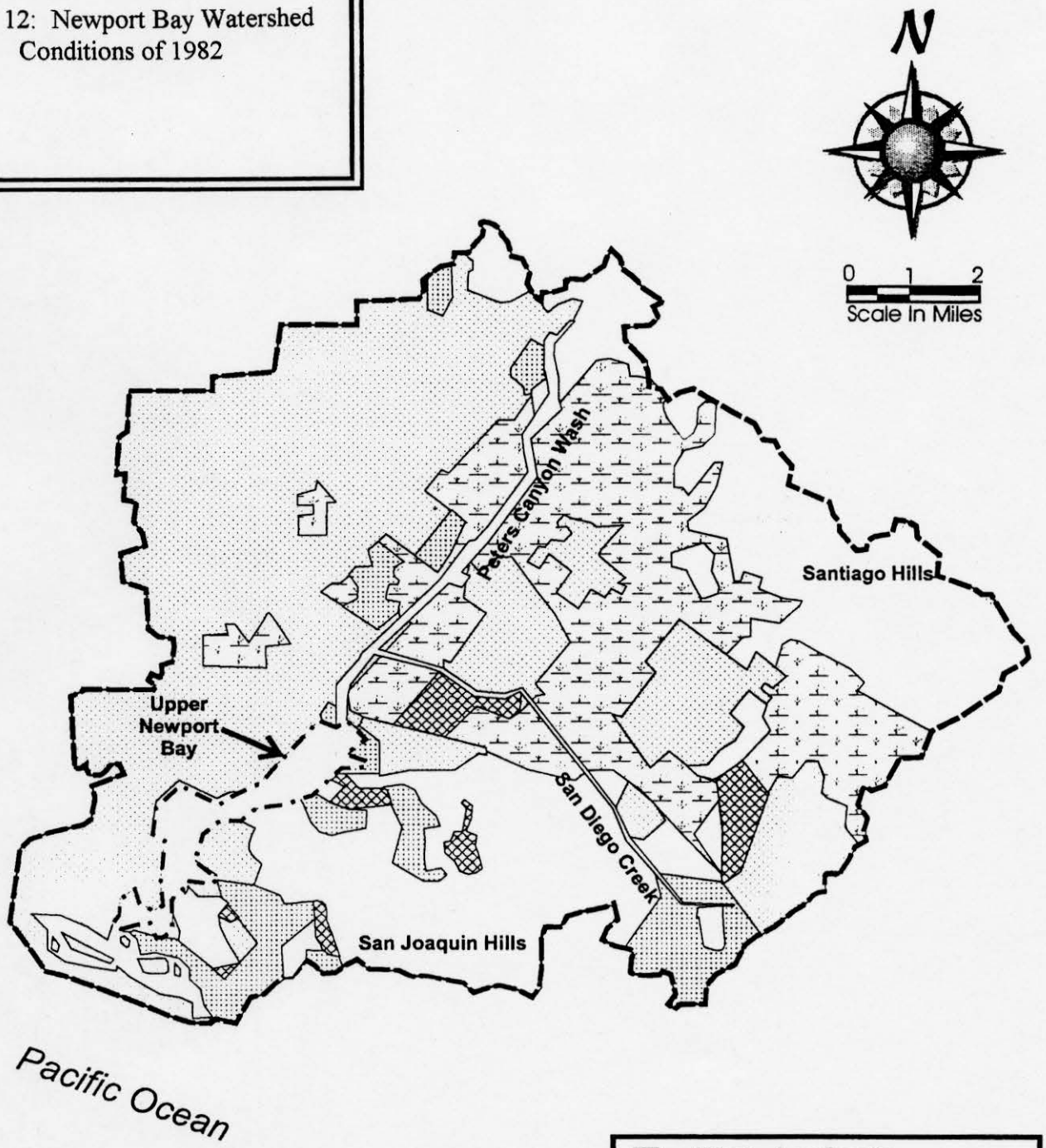
1. Measurement of dry density of Upper Bay sediments indicates that 1 cubic yard of sediment weighs 0.97 tons.
Source: Boyle Engineers, 1982

Given the Boyle Engineers sedimentation estimates (using “tons” as the unit of measure), a conversion from units of weight (tons) to units of volume (cubic yards) is helpful in both estimating the future infilling of Newport Bay and in determining future dredging requirements. This conversion has been estimated based on a previous geotechnical investigation of the Upper Bay (Moore and Taber, 1968). The densities of dredged sediments were noted to vary, however, the average dry density (72.2 pounds/cubic foot) equates to one cubic yard being equal to 0.97 tons. Based on this finding, “tons” and “cubic yards” are considered to be equivalent for the purposes of this study.

As the watershed becomes more urbanized, the channels will be subject to more severe erosion than under existing conditions. This is because urbanization causes increased runoff rates, and consequently, a higher sediment transport capacity in the receiving stream. However, urbanized landscapes severely limit sediment supply thereby reducing sediment concentrations in the waters flowing to Upper Newport Bay.

UPPER NEWPORT BAY ECOSYSTEM RESTORATION STUDY

Figure 12: Newport Bay Watershed Conditions of 1982

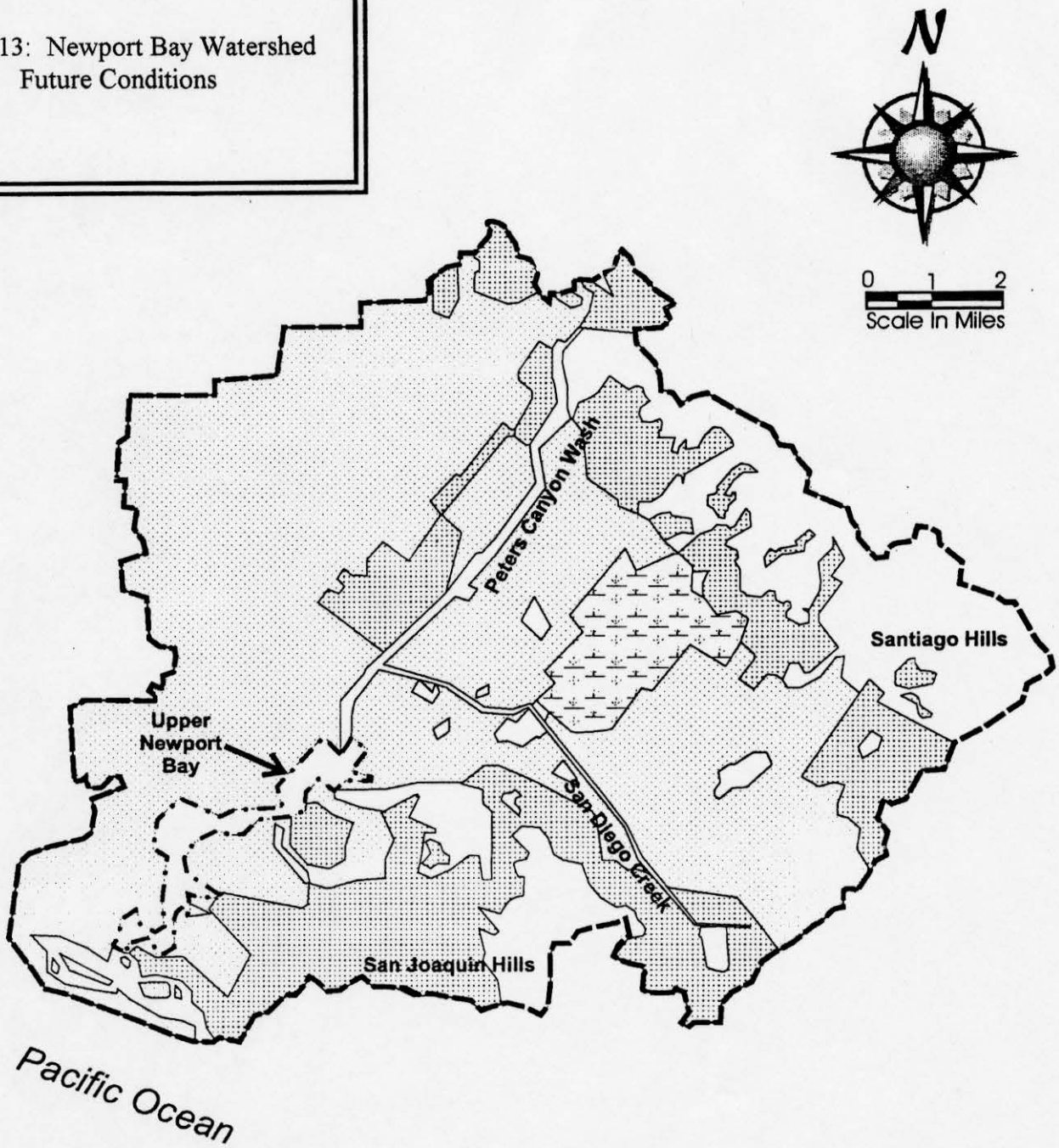


- Urban - Low Density
- Urban - Medium To High Density
- Agriculture
- Open Space
- Construction Area
- Watershed Boundary
- Upper Newport Bay Study Area

Source: USACE Reconnaissance Report, Upper Newport Bay, Orange County, CA February 1993

UPPER NEWPORT BAY ECOSYSTEM RESTORATION STUDY

Figure 13: Newport Bay Watershed Future Conditions



- Urban - Low Density
- Urban - Medium To High Density
- Open Space
- Agriculture
- Watershed Boundary
- Upper Newport Bay Study Boundaries

Sources: County of Orange, Land Use Map, 1995
City of Newport Beach, Land Use Map, 1996
City of Irvine, Comprehensive General Plan Update EIR, Land Use Map, 1994

3.3 Dredging History, Upper Newport Bay

Dredging activities within Upper Newport Bay have been relatively recent, dating to the mid-1950s. Initially, dredging activity was performed in support of the creation of a recreational water ski area in the vicinity of the present Unit II Basin. In the mid-1980's, the construction of two sedimentation basins (Unit I south of Jamboree Road and Unit II south of the Main Dike) and connecting channels allowed the removal of about two million cubic yards of sediment from the Upper Bay.

On several occasions, the disposal of the dredged material within Upper Newport Bay has been on the adjacent shore (at Big Canyon in the 1960's, and on the south side of San Diego Creek during the construction of the Unit I Sedimentation Basin in 1985). The large quantity of dredged material generated during the construction of the Unit II Sedimentation Basin and related channels in 1987 (1,100,000 cy) was taken by barge to the EPA sanctioned deep-water disposal site designated, LA-3 (located about 5 miles south from the Newport Harbor entrance).

The total quantity of dredged material removed from the Upper Bay during the 1956-1999 period has been substantial. As indicated in Table 7, the total quantity dredged during this 44-year period is nearly 5,600,000 cubic yards. This equals an average annual dredge volume of about 126,000 cy/year. When dredging has been performed, the dredged quantities have averaged nearly 396,000 cy per dredging event. Figure 14 presents the time history of dredging events in the Upper Bay.

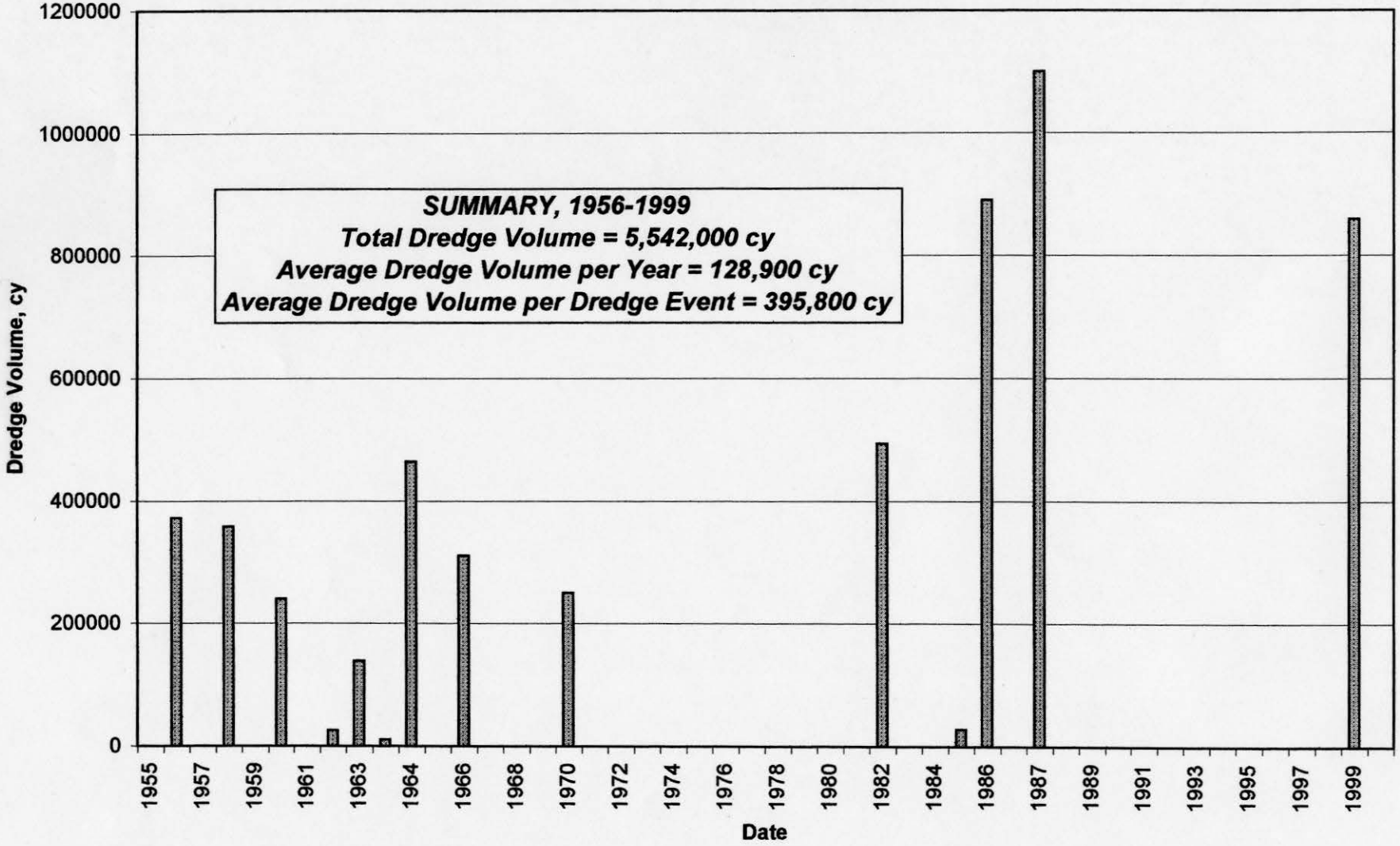
Local marina operators express ongoing concerns in reaction to shoaling depths at Newport Dunes, the De Anza Marina, and the Dover Shores residential community. Periodic dredging is required in these areas to maintain safe navigation depths. In 1998-99, 75,000 cy was removed from the Dover Shores marina area.

TABLE 7
UPPER NEWPORT BAY DREDGING HISTORY

Date	**Volume, cy**	Location
1956	372,500	Dredge Upper Newport Bay Aquatic Park
1958	358,100	Dredge Water Ski Area
1960	240,000	Open New Channels to Develop Recreation Area
1962	25,800	Dredge Ski Area
1962-63	139,000	Main Channel Dredging, Upper Bay
1963	11,000	Removal of Shell Breccia, Upper Bay
1963-64	464,000	General Dredging, Upper Newport Bay
1965-66	311,000	Development of Water Recreational Area
1970	250,000	Removal of Sediment from Water Ski Area
1982	493,000	Salt Works Basin Dredging to Create Ponded Water and Intertidal Habitat (50 acres)
1985	28,000	Tidal Wetland Creation (2.5 acres), Shellmaker Island
1985	890,000	Unit I Sedimentation Basin: Channel Widening: Saltworks to Main Dike (300' wide x 3,200' long), Saltworks Improvements: Island Removal, Deepen Basin to –4 ft (MLLW), 35+ Acre Basin Expansion
1987	1,100,000	Unit II Sedimentation Basin: Narrows to Main Dike, Channel Widening and Deepening Between Unit II Basin and Unit I Basin, Channel Dredging to Provide Dredge Access from Below PCH Bridge to Narrows
1998-99	859,000	Unit III Sedimentation Basin: Deepen the Unit I Basin to –14 ft (MSL) (532,000 cy), Maintain Barge Access to Lower Bay (252,000 cy), Dredge Dover Shores (75,000 cy)
Total =	**5,541,400**	

Average Dredge Volume per Year (1956-1999) = 125,900 cy
Average Dredge Volume per Dredge Episode = 395,800 cy

Figure 14
DREDGING EVENT HISTORY, 1956-1999



4. EXISTING ("Without Project") CONDITIONS, UPPER NEWPORT BAY

4.1 Overview

The existing (1999) bathymetric conditions in the bay are considered the starting point for the "without project" analysis, shown in Figure 15. The recently completed Unit I/III basin and access channel have been included. All areas outside of the footprint of the Unit I/III basin are assumed to be the beginning elevations that are used for the "without project" analysis. The Unit II basin is smaller and shallower than the original design implemented in the late 1980's, and the mudflats between and around the two least tern islands in the Unit I basin have not been restored.

For the future "without project" analysis, we have assumed that no dredging will occur in Upper Newport Bay, but watershed foothill basins and in-channel basins will be dredged and maintained to the levels described under the TMDL ("Total Maximum Daily Load") objectives imposed by the State Water Quality Control Board. This requires that each basin retains 50% sediment storage capacity at the beginning of any storm season. It is assumed that the sediment quantity and quality delivered from the watershed to the bay will not change under future conditions.

Based on the analysis of historical sediment inflow into Upper Newport Bay, the numerical model developed by RMA has been utilized to address sedimentation for the "without project" condition. Table 8 indicates the expected deposition at a number of Upper Bay locations over a 15-year period given historical sediment inflows of the past. Close inspection of this data indicates the nature of sedimentation in the Bay. Initially, one would believe that as sediment enters the bay, more sediment would deposit in the Unit I/III Basin (near the mouth of San Diego Creek) than at locations further south. In early years, this is true for both large and small sediment inflows (note the percent of "Depositional Volume" in Unit I/III for Years 1 and 4). As the Unit I/III Basin fills, it becomes less capable of trapping sediment, even for low flow years (note Years 12 and 13). For the Unit II Basin (which has not been dredged since the late 1980's), the percent of sediment trapped in this area is less sensitive to sediment inflow quantity or time sequence within the 15-year period (note the narrow range of percent deposited in the 15 year time series). South of the PCH Bridge, deposition quantities become greater with higher flows and with advancing time as areas further upstream experience sediment accumulation.

The "Accumulated Depositional Volume" presented in Table 8 indicates the tendency for sediment to be deposited further south within the Bay as sediment accumulates in the Upper Bay. Figure 16 shows the percent of the total sediment accumulation of four areas (Unit I/III, Unit II, Between Upper Island and PCH Bridge, South of PCH Bridge) in relation to the total sediment deposited within the Bay. The initially deep Unit I/III Basin accepts a reasonable large portion of the total (45%+) in the early years. The percent of the total accumulated in Unit I/III with time diminishes to less than 25% at the conclusion of the 15-year modeling period. Likewise, the relatively low percentage of sediment that flows to the south of the PCH Bridge steadily increases with time. Initially, less than 20% of the total accumulates in this area, followed by nearly 35% at the end of the study period. At the Unit II Basin, which does not currently offer a significant basin configuration due to previous sediment infilling, the percent accumulated decreases slightly,

from about 15% at the start of the study period to about 11% at the conclusion. The sediment accumulation between the Unit II Basin and the PCH Bridge steadily increases, rising from 14 to 22%.

Based on the RMA model analysis, the annual average sediment input to the Upper Bay from San Diego Creek is 164,000 cy, of which 153,000 cy (93%) settles within the confines of the Bay. The value of 153,000 cy/year that is presumed to be deposited on average in the Upper Bay based on the 25-year record (1972-1996) is greater than that predicted by Boyle Engineers in their earlier studies (Boyle Engineers, 1982). The Boyle work suggested an average annual value of 85,500 cy/year under the conditions that existed at that time, while the condition of ultimate development of the watershed would decrease the annual average sedimentation volume to about 64,500 cy/year. The Boyle analysis clearly states, however, that the assumptions made in the analysis yield an accuracy in the prediction that should be within a factor of 0.5 to 2.0 of Boyle's predicted value (Boyle Engineers, 1982). The value that we have noted (153,000 cy/yr) is 1.79 greater than that suggested by Boyle and, therefore, fits within that range.

Numerical modeling efforts have indicated the sedimentation pattern within Newport Bay during the 50-year “without project” condition. The sediment input is based on the historical 25-year record for the 1972-1996 period. The record is repeated to allow for the 50-year projection, as shown in the assumed annual sediment input for the model in Figure 17. Figure 18 shows the expected bathymetry for Newport Bay in Year 25. Significant findings for the Year 25 condition include substantial sedimentation in the Unit I/III Basin, at the Unit II Basin, within Dover Shores and the Dunes marinas, and in the channels immediately south of the PCH Bridge. The Year 50 bathymetric condition, shown in Figure 19, indicates loss of the channel north of the Main Dike, and significant sedimentation in all areas outside the main channel in the Upper Bay. Sedimentation continues south of the PCH Bridge in the channels adjacent to Lido and Harbor Isles. Sediment accumulation for the “without project” simulation is shown in Figure 20. Following Year 8, sediment accumulation in Unit I/III and Unit II is slight, with the sediment moving to locations futher downstream. At about Year 20, the Upper Bay accumulates sediment slowly, with the majority of the material moving beneath the PCH Bridge to the Lower Bay. At Year 50, a total of about 3 million cubic yards of material has accumulated in the Upper Bay. Sediment moving to the Lower Bay, only about 500,000 cy through Year 20, increases to a total of 3.5 million cubic yards through Year 50, indicating the effective trapping of sediment in the Upper Bay prior to its achieving its sediment storage capacity.

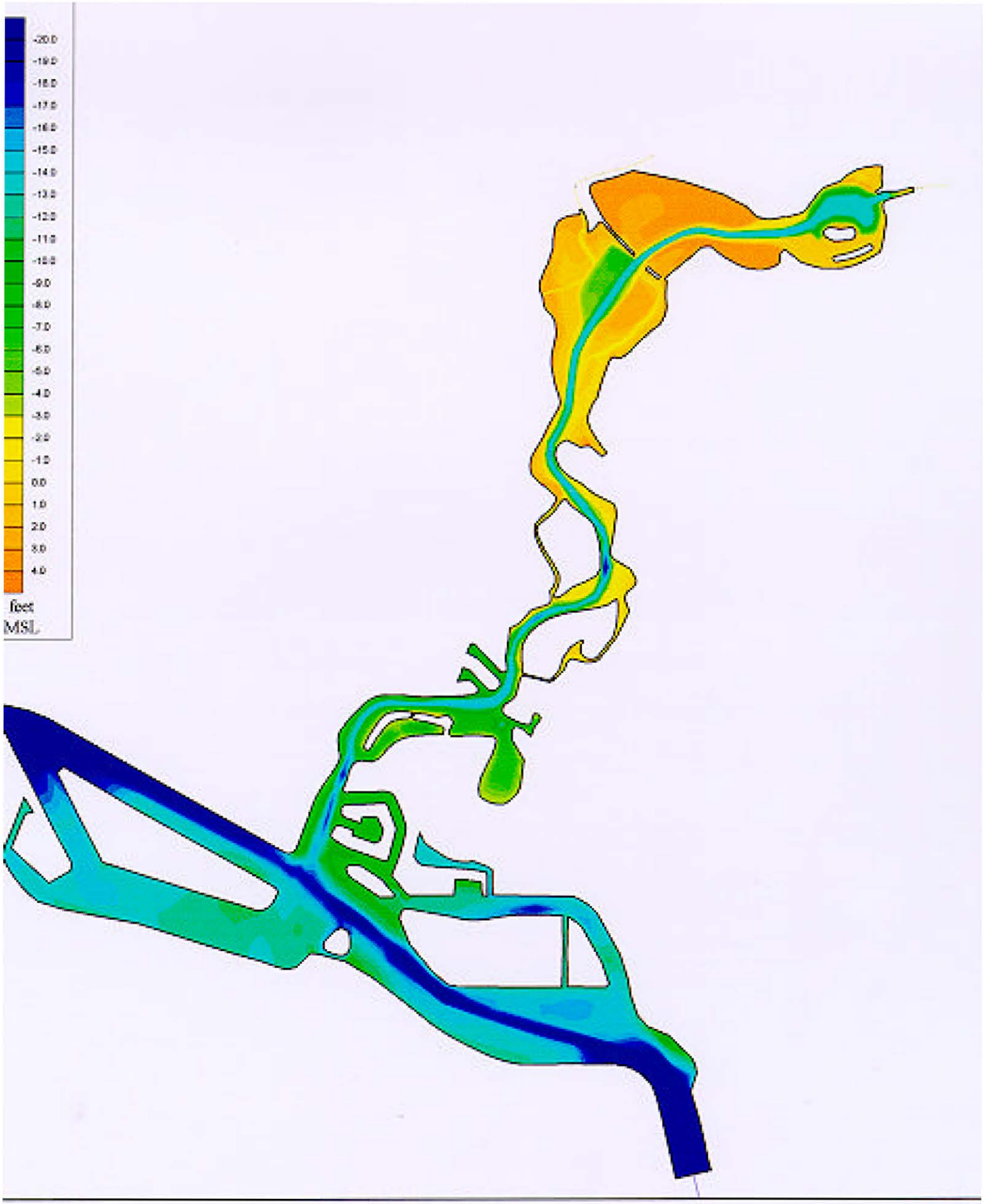


Figure 15: Newport Bay finite element mesh bathymetry, initial conditions for the 50-year future without project simulation.

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Table 8

FUTURE WITHOUT PROJECT CONDITION - 15 YEAR PROJECTION WITH NO MAINTENANCE

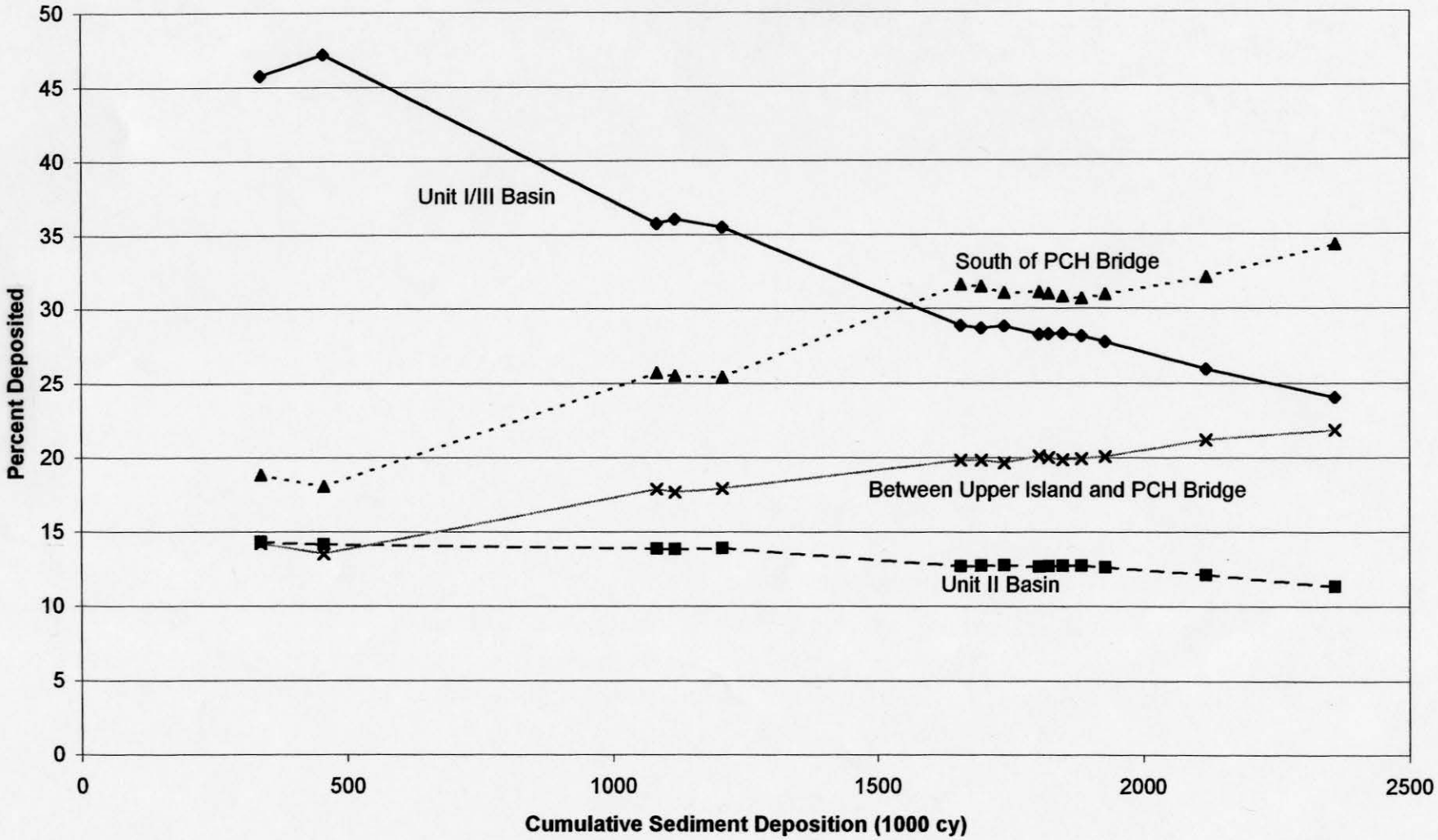
Total Accumulated Depositional Volume (1000 cubic yards & percent of Total)

End of Year	Total Volume	1 Unit I/III		2 Unit II		5 Upper Island to PCH		8 South of PCH bridge		3 Channel b/w Units I & II		4 Unit II to Upper Island		6 Area Bordering Unit II		7 Upper Marsh	
	cy	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%
1	337	154.3	45.8	48.3	14.3	47.9	14.2	63.4	18.8	11.3	3.4	6.6	2.0	4.3	1.3	0.9	0.3
2	456.5	215.5	47.2	64.6	14.2	61.7	13.5	82.4	18.1	17.2	3.8	8.6	1.9	5.2	1.1	1.2	0.3
3	1084.5	387.7	35.7	150.2	13.8	193.5	17.8	278.7	25.7	32	3.0	22.3	2.1	16.3	1.5	3.9	0.4
4	1118.9	403.3	36.0	154.7	13.8	197.3	17.6	285.1	25.5	35.1	3.1	23.1	2.1	16.4	1.5	4	0.4
5	1207.7	428.7	35.5	167.7	13.9	216.1	17.9	306.8	25.4	40.7	3.4	26.3	2.2	17.1	1.4	4.4	0.4
6	1657.6	478	28.8	210.2	12.7	328.1	19.8	524.3	31.6	49.1	3.0	35.9	2.2	24.6	1.5	7.3	0.4
7	1695.3	486.1	28.7	215.8	12.7	335.7	19.8	533.8	31.5	53.3	3.1	38.3	2.3	24.7	1.5	7.4	0.4
8	1738.6	501.1	28.8	221.5	12.7	341.4	19.6	540.6	31.1	60.6	3.5	41	2.4	24.8	1.4	7.6	0.4
9	1804.6	509.9	28.3	228.6	12.7	362.5	20.1	561.5	31.1	64.7	3.6	44.3	2.5	25.2	1.4	7.9	0.4
10	1822.8	515.6	28.3	231.2	12.7	364.2	20.0	565	31.0	68.1	3.7	45.3	2.5	25.3	1.4	8	0.4
11	1849.1	523.7	28.3	235	12.7	367	19.8	569.9	30.8	73	3.9	46.9	2.5	25.4	1.4	8.2	0.4
12	1884.2	530.3	28.1	239.4	12.7	375.5	19.9	577.9	30.7	77.7	4.1	49.5	2.6	25.5	1.4	8.4	0.4
13	1929.3	535.3	27.7	243.6	12.6	386.7	20.0	597.4	31.0	80.1	4.2	51.7	2.7	25.8	1.3	8.6	0.4
14	2119.6	549.7	25.9	257	12.1	449.3	21.2	680.9	32.1	86.6	4.1	59.1	2.8	27.6	1.3	9.5	0.4
15	2360.9	567.2	24.0	267.5	11.3	515	21.8	809.8	34.3	94.1	4.0	66	2.8	30.3	1.3	11.1	0.5

Depositional Volume for Year (1000 cubic yards & Percent of Total Change)

End of Year	Total Volume	1 Unit I/III		2 Unit II		5 Upper Island to PCH		8 South of PCH bridge		3 Channel b/w Units I & II		4 Unit II to Upper Island		6 Area Bordering Unit II		7 Upper Marsh	
	cy	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%
1	337	154.3	45.8	48.3	14.3	47.9	14.2	63.4	18.8	11.3	3.4	6.6	2.0	4.3	1.3	0.9	0.3
2	119.4	61.2	51.3	16.3	13.7	13.8	11.6	19	15.9	5.9	4.9	2	1.7	0.9	0.8	0.3	0.3
3	628.1	172.2	27.4	85.6	13.6	131.8	21.0	196.3	31.3	14.7	2.3	13.7	2.2	11.1	1.8	2.7	0.4
4	34.4	15.5	45.1	4.5	13.1	3.8	11.0	6.4	18.6	3.1	9.0	0.8	2.3	0.1	0.3	0.1	0.3
5	88.8	25.4	28.6	13	14.6	18.8	21.2	21.6	24.3	5.7	6.4	3.2	3.6	0.7	0.8	0.3	0.3
6	450	49.3	11.0	42.5	9.4	112.1	24.9	217.6	48.4	8.4	1.9	9.7	2.2	7.6	1.7	2.9	0.6
7	37.7	8.2	21.8	5.6	14.9	7.6	20.2	9.5	25.2	4.1	10.9	2.4	6.4	0.1	0.3	0.2	0.5
8	43.3	14.9	34.4	5.7	13.2	5.6	12.9	6.7	15.5	7.3	16.9	2.6	6.0	0.1	0.2	0.2	0.5
9	66	8.8	13.3	7	10.6	21.1	32.0	20.9	31.7	4.1	6.2	3.4	5.2	0.4	0.6	0.3	0.5
10	18.1	5.8	32.0	2.6	14.4	1.7	9.4	3.5	19.3	3.4	18.8	0.9	5.0	0.1	0.6	0.1	0.6
11	26.3	8.1	30.8	3.8	14.4	2.8	10.6	4.9	18.6	4.9	18.6	1.6	6.1	0.1	0.4	0.2	0.8
12	35.1	6.6	18.8	4.4	12.5	8.6	24.5	8	22.8	4.6	13.1	2.6	7.4	0.1	0.3	0.2	0.6
13	45.1	5	11.1	4.2	9.3	11.2	24.8	19.6	43.5	2.4	5.3	2.2	4.9	0.3	0.7	0.2	0.4
14	190.3	14.3	7.5	13.4	7.0	62.5	32.8	83.4	43.8	6.5	3.4	7.4	3.9	1.8	0.9	0.9	0.5
15	241.3	17.5	7.3	10.5	4.4	65.7	27.2	128.9	53.4	7.5	3.1	6.9	2.9	2.7	1.1	1.6	0.7

Figure 16
Percent Sediment Deposition by Location
(Model Output based on 15-Year Historical Inflow Data)



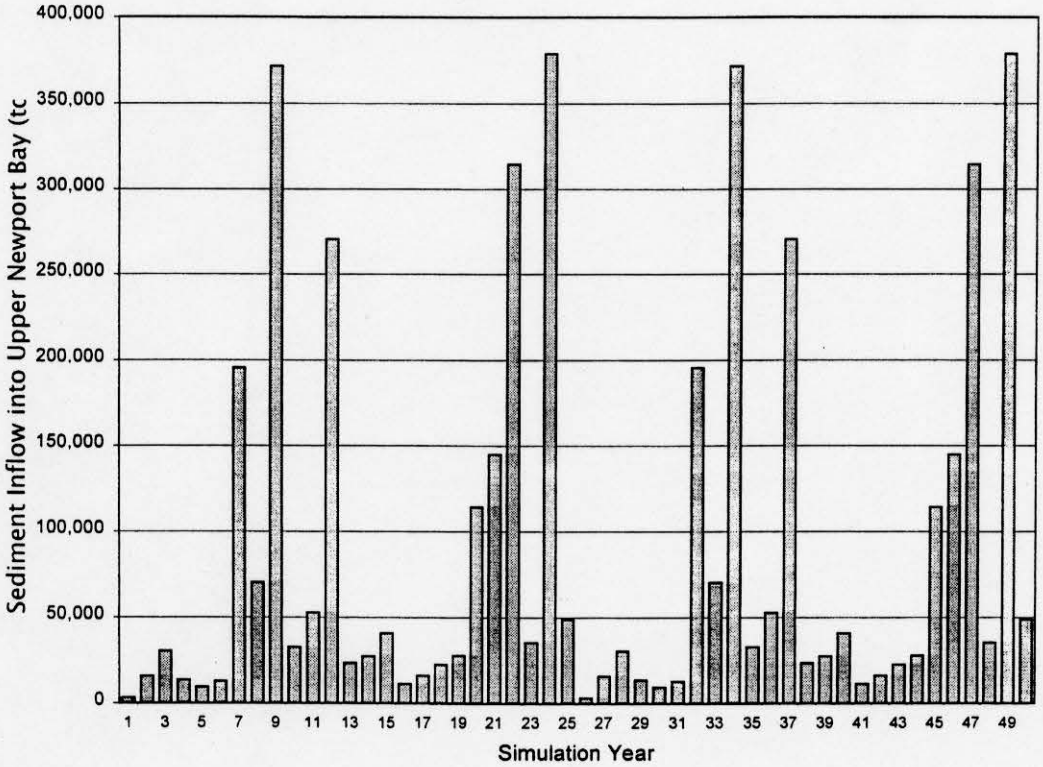


Figure 17: Yearly sediment loading for 50-year future without project simulation.

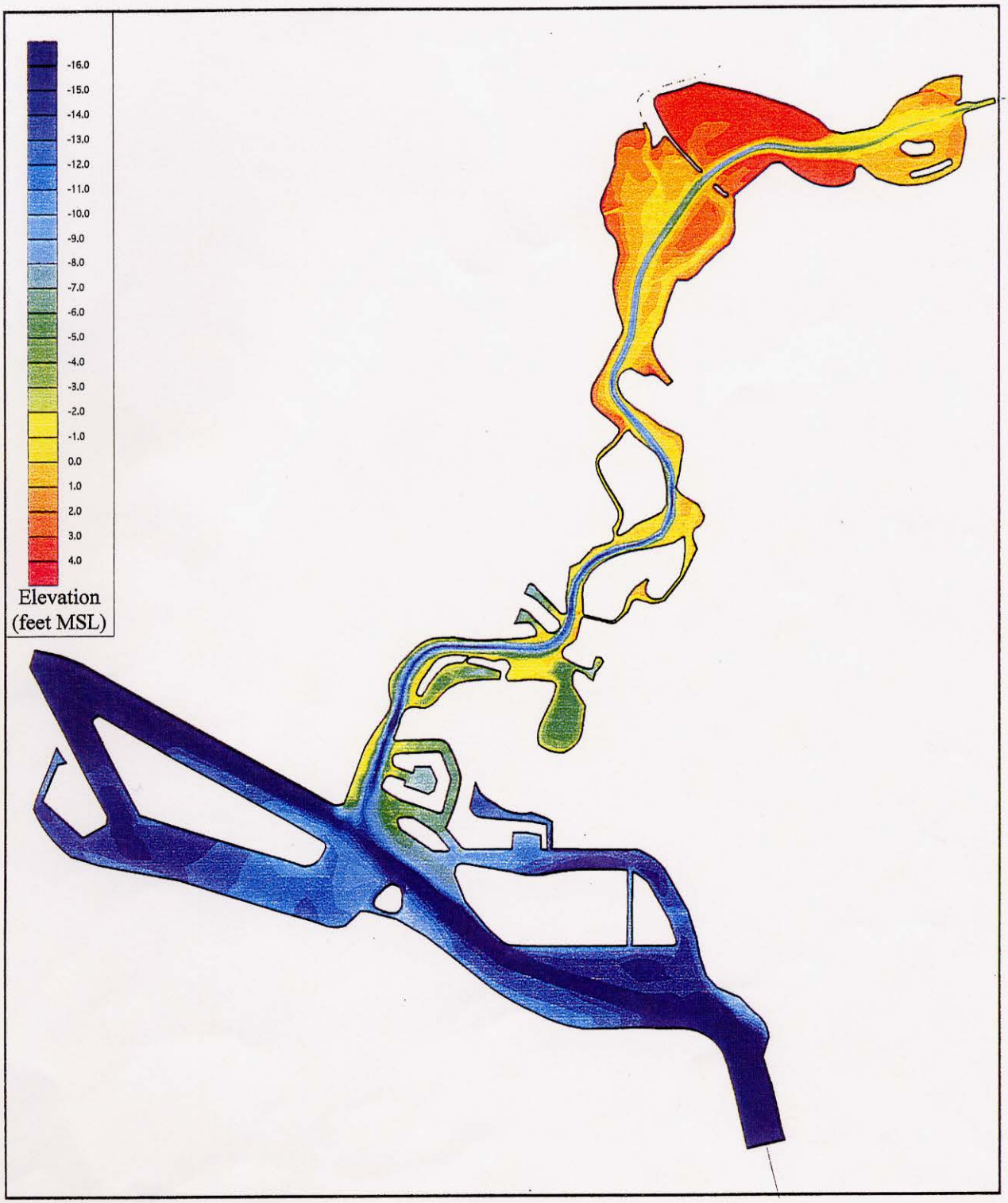


Figure 18: Newport Bay finite element mesh bathymetry, year 25 result from the 50-year future without project simulation.

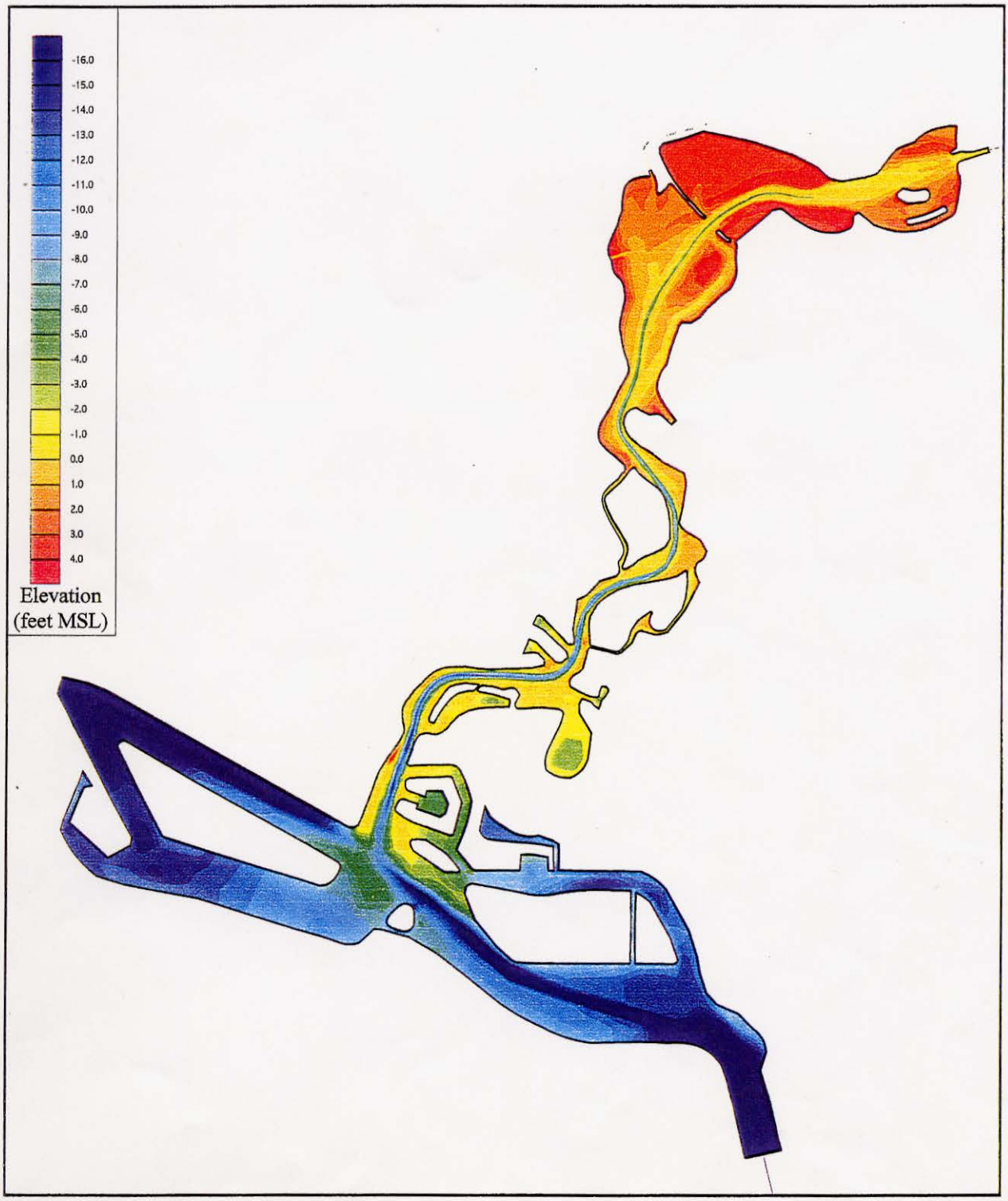


Figure 19: Newport Bay finite element mesh bathymetry, year 50 result from the 50-year future without project simulation.

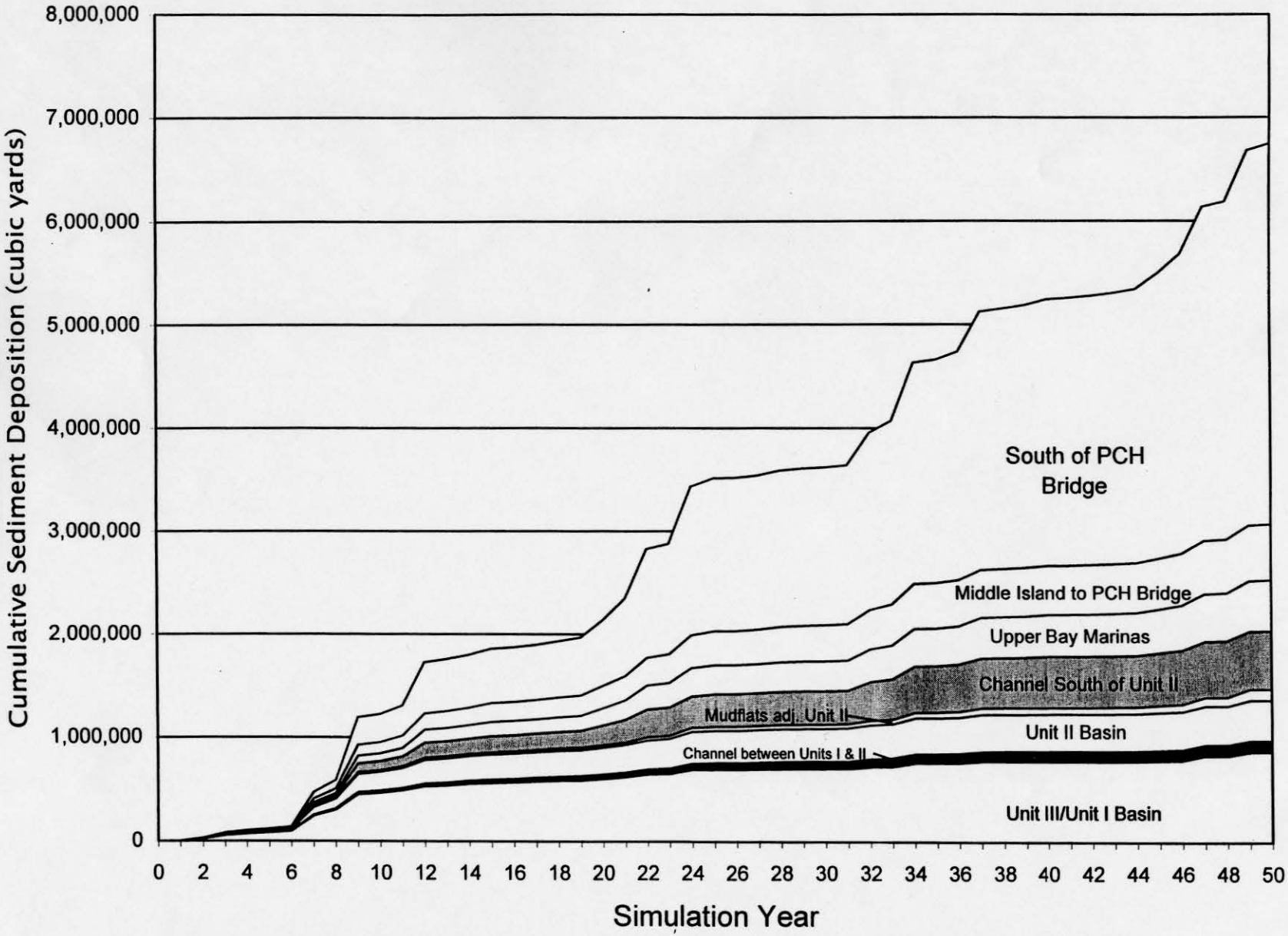


Figure 20: Cumulative sediment deposition by area for 50-year future without project simulation.

In order to determine the expected maintenance frequency for the remaining project alternatives, sedimentation results from the numerical model were developed for a uniform annual sediment inflow to the Upper Bay of 250,000 cubic yards. This simplifying assumption more clearly defined the patterns of sedimentation within the Bay, rather than the non-uniform historical annual sediment inflows presented previously in Table 8. The model was run for a period of 15 years to determine the nature of the sedimentation given this simplified (250,000 cy/year sediment inflow) approach. Later consideration realized that the average annual sediment input to the bay has actually been 164,000 cy during the 25-year period spanning 1972-1996, or 66% of the 250,000 cy used in the model analysis. Therefore, the sedimentation predicted by the model is expected to exceed the actual case, where the average annual inflows are less than that modeled. The model output for various locations within the Upper Bay using an annual sediment input of 250,000 cy is presented in Table 9. These results are shown graphically in Figure 21, indicating the percentage of sediment that settles by year in the Unit I/III Basin, the Unit II Basin, the area spanning Upper Island and the PCH Bridge, and that which escapes to the Lower Bay (south of the PCH Bridge). Important patterns to note include the rapid loss of capacity in the Unit I/III Basin coupled with the steady increase in sediment flow to the Lower Bay. This analysis indicates that under the "without project" plan, the sediment flow to the Lower Bay will exceed 30% of the total input in Year 4. By Year 15, over 55% of the annual inflow will be transported to the Lower Bay as the annual accumulation in the Unit I/III and Unit II Basins fall to below 5%. While the use of a constant sediment inflow of 250,000 cy per year is not realistic, the correlation between patterns of sedimentation in the Upper Bay with sediment flow to the Lower Bay is noteworthy.

4.2 On-Going Salt Marsh Expansion, Upper Newport Bay

Since the damaging flood of 1969 when the Main Dike was breached and the first major episode of sediment infilling of the Upper Bay occurred, the growth of salt marsh habitat within the bay has been rapid. This is due to the ongoing release of sediment into the bay from the San Diego Creek watershed that promotes the natural progression from subtidal areas to mudflats, and then (following growth of vegetation) into salt marsh. Previous recent history indicates clearly the ability of the Upper Bay to transition from open water to mudflat to marshland rapidly, when sediment inputs are excessive and dredging of the sediment basins are not accomplished in a timely manner.

Aerial photos from the 1970's and 1980's are capable of documenting the rate of salt marsh growth in Upper Newport Bay. In 1967, prior to the flood flows of 1969 that caused the Main Dike to breach, a small sedimentary delta existed above the Dike. At that time, however, no salt marsh existed in the salt evaporation ponds spanning the Main Dike and Jamboree Road. By 1975, aerial photography shows significant sediment deposition in the area above the Dike, however, vegetation that would indicate the commencement of salt marsh development was not noted. In 1978, photographic evidence indicates that sediment deposition had progressed, and vegetation upon the delta had begun north of the Dike. Therefore, the initial salt marsh development north of the Main Dike dates from about 1978. In June 1992, about 110 acres of salt marsh existed north of the Main Dike. Thus, the rate of salt marsh growth during the 1978-1992 period north of the Dike averaged about 8 acres/year.

Table 9: Future Without Project Condition – 15 Year Projection With No Maintenance

Table 9

FUTURE WITHOUT PROJECT CONDITION - 15 YEAR PROJECTION WITH NO MAINTENANCE

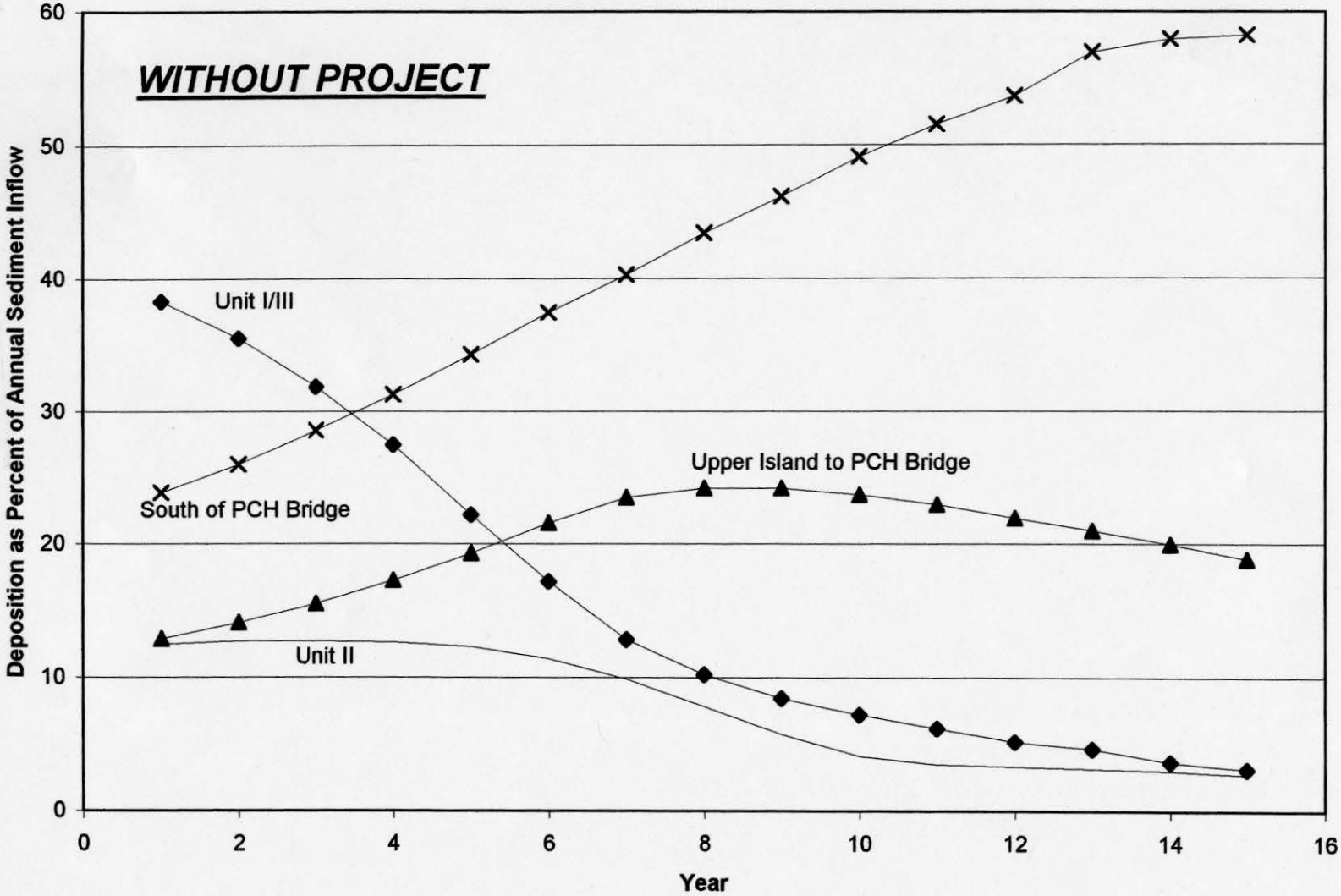
Total Accumulated Depositional Volume (1000 cubic yards & percent of Total)

End of Year	Total Volume	1 Unit I/III		2 Unit II		5 Upper Island to PCH		8 South of PCH bridge		3 Channel b/w Units I & II		4 Unit II to Upper Island		6 Area Bordering Unit II		7 Upper Marsh	
	cy	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%
1	234.5	95.7	40.8	31.1	13.3	32.2	13.7	59.6	25.4	7.9	3.4	3.8	1.6	3.4	1.4	0.7	0.3
2	469.6	184.3	39.2	62.9	13.4	67.5	14.4	124.5	26.5	15.1	3.2	7.6	1.6	6.2	1.3	1.4	0.3
3	705.4	263.8	37.4	94.7	13.4	106.3	15.1	195.9	27.8	21.9	3.1	11.6	1.6	9.0	1.3	2.2	0.3
4	941.8	332.4	35.3	126.3	13.4	149.4	15.9	274.0	29.1	28.9	3.1	16.1	1.7	11.6	1.2	3.0	0.3
5	1177.9	387.9	32.9	157.0	13.3	197.8	16.8	359.6	30.5	36.4	3.1	21.2	1.8	14.2	1.2	4.0	0.3
6	1414.1	430.9	30.5	185.5	13.1	251.6	17.8	453.1	32.0	44.3	3.1	27.1	1.9	16.7	1.2	5.0	0.4
7	1648.7	462.9	28.1	210.2	12.7	310.3	18.8	553.8	33.6	53.0	3.2	33.5	2.0	19.0	1.2	6.0	0.4
8	1881.9	488.4	26.0	229.8	12.2	370.7	19.7	662.2	35.2	62.7	3.3	40.0	2.1	21.1	1.1	7.0	0.4
9	2112.7	509.6	24.1	244.2	11.6	431.0	20.4	777.5	36.8	72.6	3.4	46.7	2.2	23.0	1.1	8.1	0.4
10	2343.8	527.7	22.5	254.5	10.9	490.3	20.9	900.2	38.4	82.9	3.5	53.7	2.3	25.1	1.1	9.4	0.4
11	2574.7	543.2	21.1	263.4	10.2	547.6	21.3	1029.1	40.0	93.1	3.6	60.3	2.3	27.1	1.1	10.8	0.4
12	2805.5	556.3	19.8	271.8	9.7	602.4	21.5	1163.3	41.5	103.4	3.7	66.7	2.4	29.2	1.0	12.4	0.4
13	3040.0	567.8	18.7	279.7	9.2	654.9	21.5	1305.6	42.9	113.6	3.7	72.7	2.4	31.3	1.0	14.2	0.5
14	3271.8	577.0	17.6	287.4	8.8	704.8	21.5	1450.4	44.3	124.3	3.8	78.3	2.4	33.5	1.0	16.1	0.5
15	3498.8	584.8	16.7	294.1	8.4	752.0	21.5	1596.0	45.6	134.4	3.8	83.9	2.4	35.3	1.0	18.1	0.5

Depositional Volume for Year (1000 cubic yards & Percent of Total Change)

End of Year	Total Inflow Volume	1 Unit I/III		2 Unit II		5 Upper Island to PCH		8 South of PCH bridge		3 Channel b/w Units I & II		4 Unit II to Upper Island		6 Area Bordering Unit II		7 Upper Marsh	
	cy	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%
1	250.0	95.7	38.3	31.1	12.4	32.2	12.9	59.6	23.8	7.9	3.2	3.8	1.5	3.4	1.4	0.7	0.3
2	250.0	88.6	35.4	31.8	12.7	35.2	14.1	64.9	26.0	7.1	2.8	3.8	1.5	2.9	1.2	0.7	0.3
3	250.0	79.5	31.8	31.8	12.7	38.8	15.5	71.4	28.6	6.9	2.8	4.0	1.6	2.7	1.1	0.8	0.3
4	250.0	68.6	27.4	31.6	12.6	43.2	17.3	78.1	31.2	7.0	2.8	4.5	1.8	2.6	1.0	0.9	0.4
5	250.0	55.4	22.2	30.7	12.3	48.3	19.3	85.6	34.2	7.4	3.0	5.1	2.0	2.6	1.0	0.9	0.4
6	250.0	43.0	17.2	28.5	11.4	53.9	21.6	93.5	37.4	7.9	3.2	5.9	2.4	2.5	1.0	1.0	0.4
7	250.0	32.1	12.8	24.7	9.9	58.7	23.5	100.7	40.3	8.7	3.5	6.4	2.6	2.3	0.9	1.0	0.4
8	250.0	25.5	10.2	19.6	7.8	60.4	24.2	108.4	43.4	9.6	3.8	6.5	2.6	2.0	0.8	1.1	0.4
9	250.0	21.1	8.4	14.4	5.8	60.4	24.2	115.3	46.1	9.9	4.0	6.7	2.7	1.9	0.8	1.1	0.4
10	250.0	18.1	7.2	10.3	4.1	59.2	23.7	122.7	49.1	10.3	4.1	7.0	2.8	2.0	0.8	1.3	0.5
11	250.0	15.5	6.2	8.8	3.5	57.4	23.0	128.9	51.6	10.2	4.1	6.7	2.7	2.1	0.8	1.4	0.6
12	250.0	13.0	5.2	8.4	3.4	54.8	21.9	134.2	53.7	10.2	4.1	6.4	2.6	2.1	0.8	1.6	0.6
13	250.0	11.6	4.6	8.0	3.2	52.5	21.0	142.3	56.9	10.3	4.1	6.0	2.4	2.1	0.8	1.8	0.7
14	250.0	9.2	3.7	7.6	3.0	49.9	20.0	144.8	57.9	10.7	4.3	5.6	2.2	2.2	0.9	1.9	0.8
15	250.0	7.9	3.2	6.8	2.7	47.2	18.9	145.5	58.2	10.2	4.1	5.7	2.3	1.8	0.7	2.0	0.8

Figure 21
Sediment Depostion by Year
(Constant Annual Sediment Inflow = 250,000 cy)



Another major area of salt marsh growth has occurred immediately below the Dike, located directly east of the Unit II Sedimentation Basin. Comparative aerial photos show that during the 1986-1992 time period, salt marsh in this area increased from 1.7 acres to 10.6 acres--an increase of over 500%. The annual rate of salt marsh growth at this location was 1.5 acres/year during the 1986-1992 period. Site inspection of this area indicates that salt marsh will continue to consume the mudflat habitat located immediately south of this salt marsh.

The delta of the Santa Ana - Delhi Channel has also been a site of salt marsh growth since 1978. Comparative air photo analysis indicates a total growth of 12.6 acres of salt marsh during the 1978-1992 period. The rate of growth of salt marsh in this area since 1978 is about one acre/year.

When these major areas of salt marsh are combined, the total increase in salt marsh habitat in the northern portion of Upper Newport Bay was 134 acres during the 1978-1992 period, averaging 9.6 acres/year. This salt marsh expansion will persist in the future should sedimentation within the Upper Bay be allowed to continue unchecked.

4.3 Long-Term Habitat Change Prediction

Prediction of the future habitat conditions within Upper Newport Bay has been determined using the results of the numerical model developed and implemented by Resource Management Associates, Inc. (RMA) (RMA, 1997; 1998, 1999) in combination with GIS mapping performed by the County of Orange.

In order to consider various portions of the Upper Bay, three sections have been defined:

- Section 1: Jamboree Road to the Main Dike;
- Section 2: the Main Dike to the north end of Middle Island;
- Section 3: Middle Island to the PCH Bridge.

At three time intervals—the present (Year 0), Year 20, and Year 50—acreage values for each of the seven habitat types are presented in Table 10. The future “Without Project” condition for Years 20 and 50 are graphically compared to the present (Year 0) condition in Figures 22 to 25. The three sections of the Upper Bay are shown in Figures 22 to 24 with the entire bay being portrayed in Figure 25. For Section 1, the “without project” conditions indicate a steep decline in open water area during the future 50 years, with a resulting increase in low and middle salt marsh. Section 2 of the Upper Bay (Figure 23) shows a less precipitous decline in open water area with a modest gain in salt marsh. In both Sections 1 and 2, the future indicates gains in mudflat acreage in 50 years relative to the present condition. In Section 3, the small salt marsh acreage does not change in the future, however, the open water declines significantly with a corresponding gain in mudflat. The majority of the open water to mudflat transformation occurs after Year 20. In considering the “without project” condition for the entire Upper Bay (Figure 25), the next 50 will see significant loss of open water (-71%) with a corresponding gain in mudflat (+59%). The salt marsh acreage will increase modestly (+23%).

Table 10 "Without Project" Habitat Acreage Years 0, 20, 50					
Segment 1 acres				% Habitat Change	
	yr-0	yr-20	yr-50	yr 0 to 20	yr 0 to 50
high salt marsh	0.0	0.0	23.2	0	23
intertidal mudflat	51.9	81.3	55.5	57	7
low salt marsh	32.2	35.6	48.5	11	51
middle salt marsh	99.2	99.8	102.8	1	4
open water	47.9	14.6	0.7	-70	-99
Segment 2 acres				% Habitat Change	
	yr-0	yr-20	yr-50	yr 0 to 20	yr 0 to 50
high salt marsh	4.7	4.7	10.3	0	119
intertidal mudflat	89.0	112.3	101.4	26	14
low salt marsh	83.6	83.1	96.3	-1	15
middle salt marsh	30.1	31.0	37.8	3	26
open water	45.5	22.1	7.2	-51	-84
Segment 3 acres				% Habitat Change	
	yr-0	yr-20	yr-50	yr 0 to 20	yr 0 to 50
high salt marsh	4.6	4.6	4.6	0	0
intertidal mudflat	76.3	101.1	164.1	33	115
low salt marsh	25.9	25.7	26.5	-1	2
middle salt marsh	53.3	53.3	53.3	0	0
open water	123.0	98.5	34.6	-20	-72
Total Acres				% Habitat Change	
	yr-0	yr-20	yr-50	yr 0 to 20	yr 0 to 50
high salt marsh	9.3	9.3	38.1	0	310
intertidal mudflat	217.2	294.7	321.0	36	48
low salt marsh	141.7	144.4	171.3	2	21
middle salt marsh	182.6	184.1	193.9	1	6
open water	216.4	135.2	42.5	-38	-80

Figure 22
Upper Newport Bay
Segment 1 (Jamboree Road to Main Dike) Habitat Changes
Without Project Condition Years 0,20,50

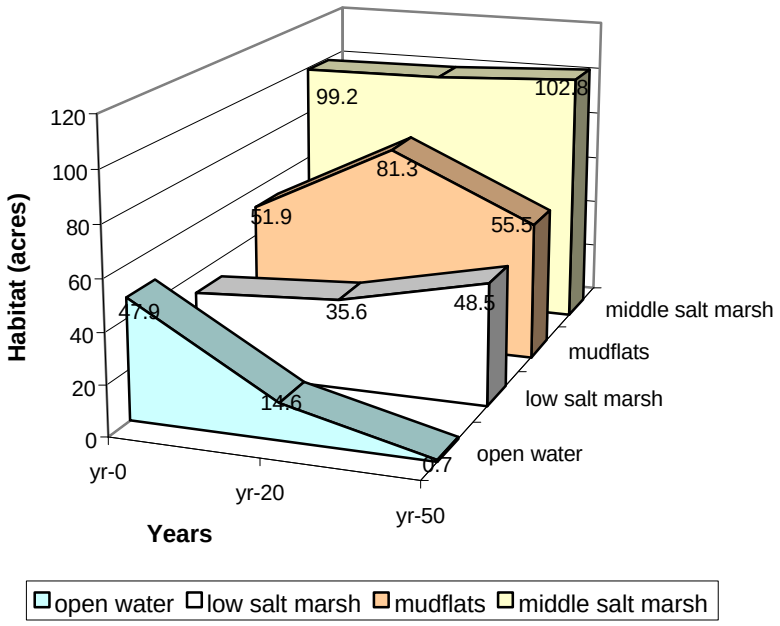


Figure 23
Upper Newport Bay
Segment 2 (Main Dike to Middle Island) Habitat Changes
Without Project Condition Years 0,20,50

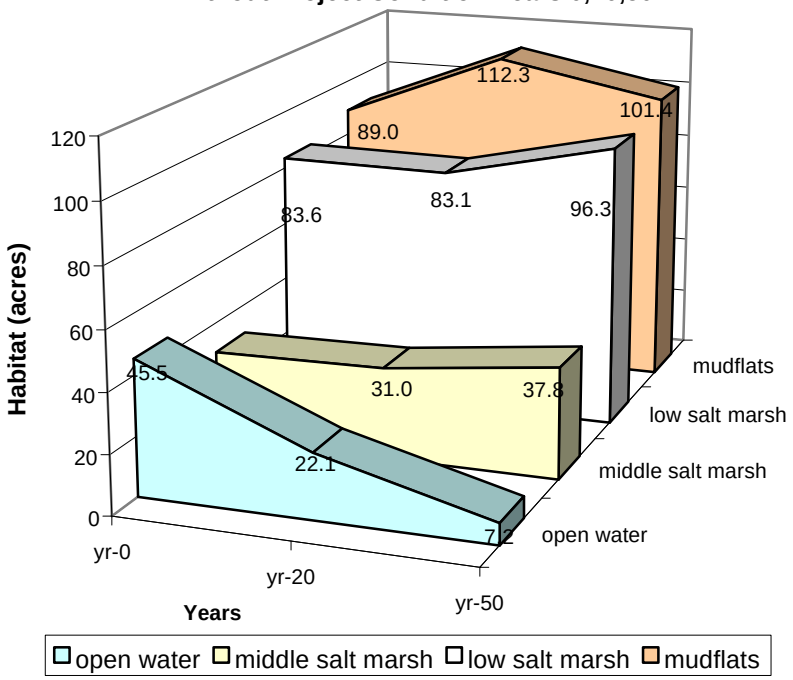


Figure 24
Upper Newport Bay
Segment 3 (Middle Island To PCH Bridge) Habitat Changes
Without Project Condition Years 0,20,50

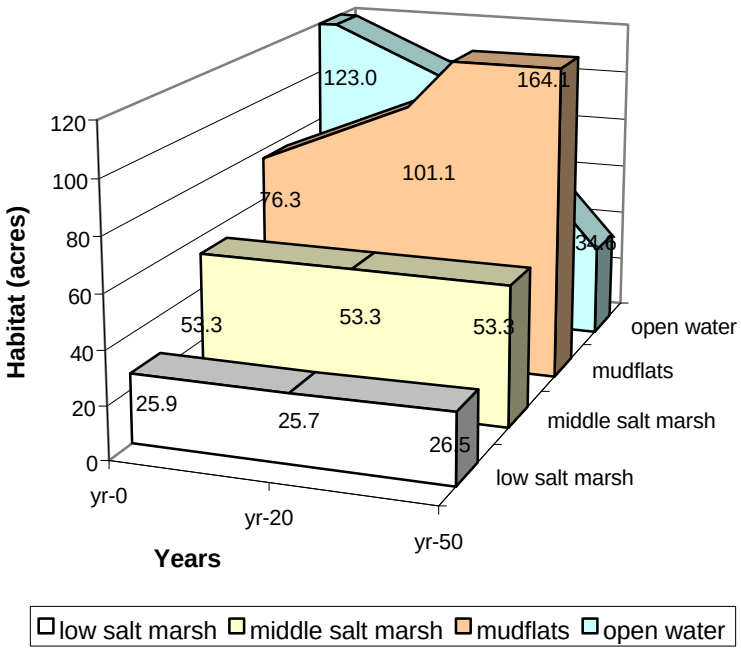
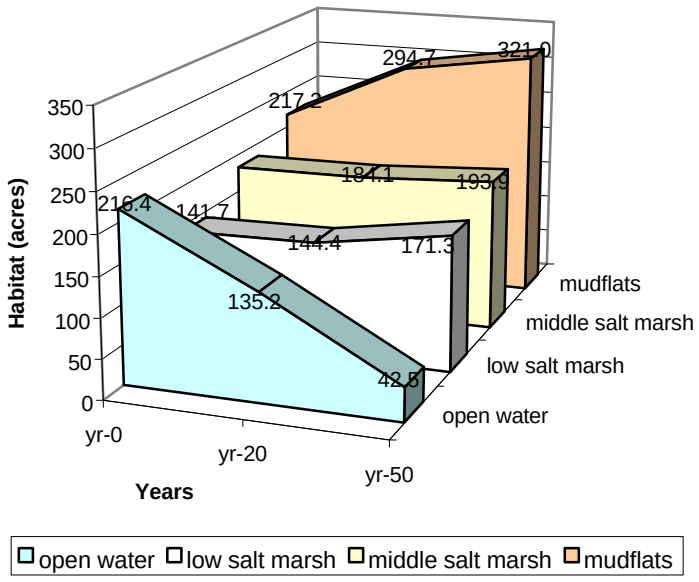


Figure 25
Upper Newport Bay
Total Area Habitat Changes
Without Project Condition Years 0,20,50



5. PROJECT ALTERNATIVES

The underlying goal of providing alternatives to enhance the environment of Upper Newport Bay is summarized by the goals and objectives suggested by the Upper Newport Bay Environmental Restoration Technical Advisory Group (TAG), as follows:

> *To restore, enhance, maximize and maintain the overall intrinsic ecological values provided in the Upper Newport Bay coastal estuarine system for fish and wildlife including sensitive communities, to provide a diversity of use (i.e. fisheries, waterfowl, shorebirds, fish-eating birds, mammals, recreation, education, research, etc.) and to promote a public awareness and appreciation of the unique habitat offered in this system now and in the future.*

In considering the potential needs of Upper Newport Bay based on these goals, the existing management plan of the Upper Newport Bay Ecological Reserve (California Department of Fish and Game, 1989) was carefully evaluated. Numerous options for improvement of Upper Newport Bay were described in that document, ranging from channel deepening to parking lot removal. Elements from that plan that have been evaluated for this report are the deepening of narrow side channels that exist along the east side of Shellmaker Island and the west side of Middle Island.

Several other options were considered for inclusion in this Feasibility Study, based on numerous discussions and meetings with the Federal and State resource agencies. These include the creation of a wetlands habitat at Northstar Beach (as suggested by representatives of the U.S. Fish and Wildlife Service), maintenance of the existing Unit I/III and Unit II Sedimentation Basins, creation/relocation of least tern islands, and maintenance of channels adjacent to existing islands.

The RMA numerical model of Newport Bay was used to evaluate the sediment storage capabilities of each alternative. Several methods of analysis were attempted to predict the comparative responses of each alternative to sediment inflows, and to estimate the maintenance intervals when re-dredging of the sediment basins would be necessary. This ability to predict the expected maintenance interval was key to the economic and environmental evaluations of the project alternatives. This approach was hampered by the lack of knowing the future sequence of sediment inflows. For example, the maintenance interval for dredging operations would be quite different during a cycle of dry years, as opposed to several years when major storm flows occurred. Initially, the RMA model was run with a fifteen-year sequence of variable sediment inflows that matched the sequence of actual flows during the 1978-1992 data collection period. This approach clearly showed the influence of the magnitude and timing of sediment inflows in determining the maintenance interval, but did not support a clear comparison of the alternatives. As a second approach, the RMA model was run for a 15-year period assuming a constant annual sediment inflow of 250,000 cubic yards. This use of a constant sediment inflow, while unrealistic, allowed the results for the various project alternatives to be directly compared. Based on the 25-year average annual sediment input of 164,000 cubic yards, however, the results of this second modeling approach over-predicted the expected sediment accumulation within the Bay. To better

estimate the sediment impacts for each alternative, the results of the model runs involving 250,000 cy/year inflow were simply reduced by 34% (the reduction to the the long-term average (164,000 cy/year) from the model constant annual sediment inflow (250,000 cy)). A more accurate analysis would have involved running the RMA model again, using a constant annual sediment input of 164,000 cy, however, the project funds were not available for this further modeling effort.

The following study components have been selected as Project Alternatives. Each alternative specifies the characteristics of the project in the vicinity of the Unit I/III Basin, the Unit II Basin, and other areas within the Upper Bay. Descriptions of each of the small restoration/enhancement measures that are common to all project alternatives are presented in Section 5.7 of this report.

5.1 Alternative 1

Alternative 1 is the configuration that was created by the dredge programs during the mid- to late-1980's in the Upper Bay. The elements of Alternative 1 are shown in Figure 26 and are summarized below:

Unit I/III Basin

- Retain the smaller and deeper Unit III configuration, dredged to –14 ft (MSL) with 1V:33H side slopes between 0 ft (MSL) and –3 ft and 1V:5H side slopes below.
- Re-establish a small trapezoidal channel between the least tern islands (50 ft top width, 1V:3H side slope, depth of -5 ft MSL)
- Add sand layer to surface of kidney-shaped least tern island.
- Maintain channel between the Unit I and II Basins (-14 ft, MSL)

Unit II Basin

- Re-create the original Unit II depth and configuration (–14 ft, MSL), 1V:33H side slopes between 0 ft (MSL) and –3 ft and 1V:5H side slopes below.
- Dredge channel from Unit II to Santa Ana-Delhi Channel (-5 ft, MSL) depth, a 50 ft bottom width and 1V:3H side slopes).
- Dredge channel on east side of New Island (–5 ft, MSL), 50 ft top width, 1V:3 side slopes.
- Maintain the dredge and barge access channel from the Unit II basin to the PCH Bridge at –14 ft (MSL).

Other Areas

(Described in Section 5.7 of this Appendix)

- Middle Island, west side channel
- Shellmaker Island, east side channel
- Shellmaker Island, small dendritic channel
- Shellmaker Island, wetlands creation
- Northstar Beach, wetlands creation
- Plant eelgrass beds
- Add sand layer to least tern islands

- Segment Main Dike

The RMA numerical model estimated sedimentation for the coming 15 year period given an annual sediment input of 250,000 cy, that has been reduced by 34% to better simulate the actual long-term sediment input of 164,000 cy/year. The results of this analysis are presented in Table 11. Figures 27 and 28 show the cumulative sediment deposition and the cumulative percent deposition for the 15 year period analyzed by the model. The information shown in Figure 27 indicates the increase of sediment flow to the Lower Bay (south of the PCH Bridge) as the amount of sediment stored in the Unit I/III and Unit II Basins decreases. In terms of percent of sediment deposited, the Unit I/III Basin decreases substantially with time, as shown in Figure 28. This analysis also shows that the percentage of sediment stored in Unit II increases until Year 9, as sediment passes the Unit I/III Basin, and then decreases as sediment storage becomes less effective in the Unit II Basin. In Year 7, the cumulative sediment deposition in the Lower Bay exceeds 30% of the total input.

To create the Alternative 1 configuration, assumed to occur in Year 4 following the completion of the recent 1998-1999 dredge program, the dredge volume is in the 814,000 – 889,000 cy range, dependent on the dredge method. When maintenance dredging is required, the sediment removal requirement is estimated to vary between 597,000 cy and 797,000 cy, dependent on the dredge method. The maintenance dredge interval has been estimated to be 7 years, as discussed in Section 5.8 of this report.

5.2 Alternative 2

The elements of Alternative 2 are listed below:

<u>Unit I/III Basin</u>

- Maximize sediment deposition in the basin.
- Remove both least tern islands
- Basin depth = –14 ft (MSL), 1V:33H side slopes from 0 ft (MSL) to –3 ft and 1V:5H side slopes below.
- Maintain the dredge and barge access channel from the Unit I/III Basin to the PCH Bridge at –14 ft (MSL).

<u>Unit II Basin</u>

- No action

Following early consideration of this alternative, it was determined that removal of both least tern islands in the Unit I/III Basin was unacceptable to the resource agencies. As a result, no further analysis of this alternative was performed.

ALTERNATIVE 1

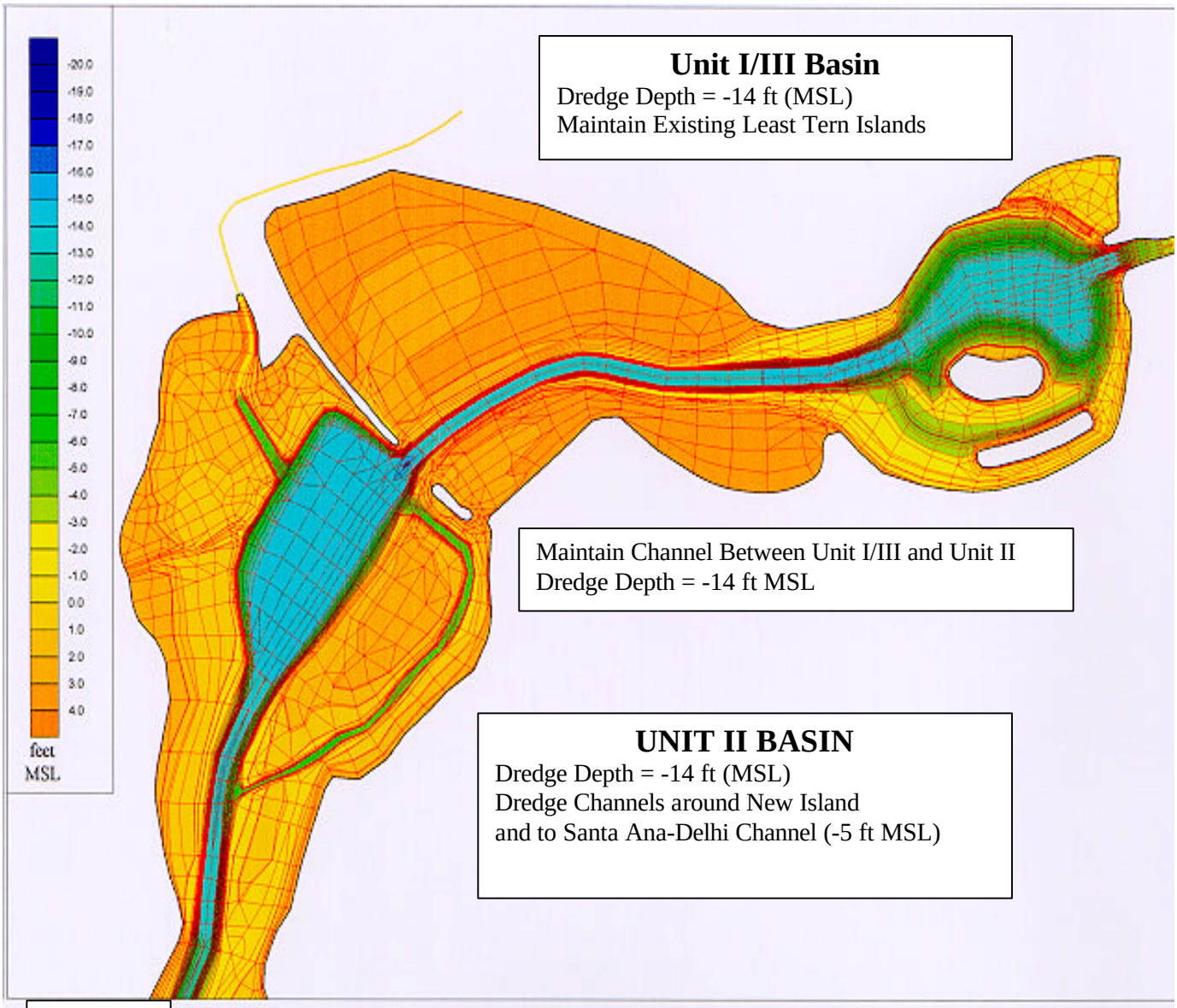


Figure 26: Alternative 1 Upper Bay finite element mesh and initial condition bathymetric contours.

Table 11

Alternative 1, Depositional Volumes--164,000 cy Annual Sediment Inflow

End of Year	Total Volume	1 Unit I/III		2 Unit II		5 Upper Island to PCH		8 South of PCH bridge		3 Channel b/w Units I &		4 Unit II to Upper Island		6 Area Bordering Unit II		7 Upper Marsh	
	cy	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%
1	154.4	69.0	44.7	21.9	14.2	16.6	10.7	35.5	23.0	4.4	2.8	2.0	1.3	4.3	2.8	0.7	0.5
2	309.4	132.8	42.9	45.5	14.7	34.6	11.2	73.8	23.8	8.6	2.8	4.2	1.4	8.4	2.7	1.5	0.5
3	465.2	190.6	41.0	71.0	15.3	54.3	11.7	115.5	24.8	12.7	2.7	6.4	1.4	12.4	2.7	2.4	0.5
4	621.4	241.1	38.8	98.7	15.9	75.8	12.2	160.9	25.9	16.8	2.7	8.7	1.4	16.2	2.6	3.3	0.5
5	777.9	282.8	36.4	129.1	16.6	99.6	12.8	210.0	27.0	21.1	2.7	11.3	1.5	19.7	2.5	4.3	0.5
6	933.8	316.2	33.9	161.8	17.3	125.2	13.4	262.4	28.1	25.6	2.7	14.0	1.5	23.1	2.5	5.3	0.6
7	1089.2	342.2	31.4	196.0	18.0	152.9	14.0	318.2	29.2	30.6	2.8	16.9	1.5	26.1	2.4	6.4	0.6
8	1243.8	362.0	29.1	230.1	18.5	182.4	14.7	377.5	30.3	35.7	2.9	19.7	1.6	29.0	2.3	7.5	0.6
9	1397.6	377.7	27.0	262.4	18.8	213.5	15.3	440.4	31.5	40.8	2.9	22.5	1.6	31.6	2.3	8.7	0.6
10	1549.6	390.4	25.2	291.2	18.8	246.0	15.9	506.4	32.7	46.2	3.0	25.5	1.6	34.0	2.2	9.9	0.6
11	1699.6	400.9	23.6	315.0	18.5	280.0	16.5	576.1	33.9	51.8	3.0	28.5	1.7	36.3	2.1	11.2	0.7
12	1851.2	409.9	22.1	334.8	18.1	314.7	17.0	651.7	35.2	57.6	3.1	31.7	1.7	38.2	2.1	12.6	0.7
13	2004.9	417.8	20.8	351.6	17.5	349.2	17.4	733.3	36.6	64.0	3.2	35.1	1.8	39.8	2.0	14.1	0.7
14	2158.3	424.8	19.7	365.2	16.9	382.5	17.7	818.8	37.9	71.0	3.3	38.6	1.8	41.5	1.9	15.9	0.7
15	2310.4	430.4	18.6	375.1	16.2	415.1	18.0	908.0	39.3	78.5	3.4	42.6	1.8	43.1	1.9	17.5	0.8

Figure 27
Alternative 1
Cumulative Sediment Deposition (164,000 cy/year)

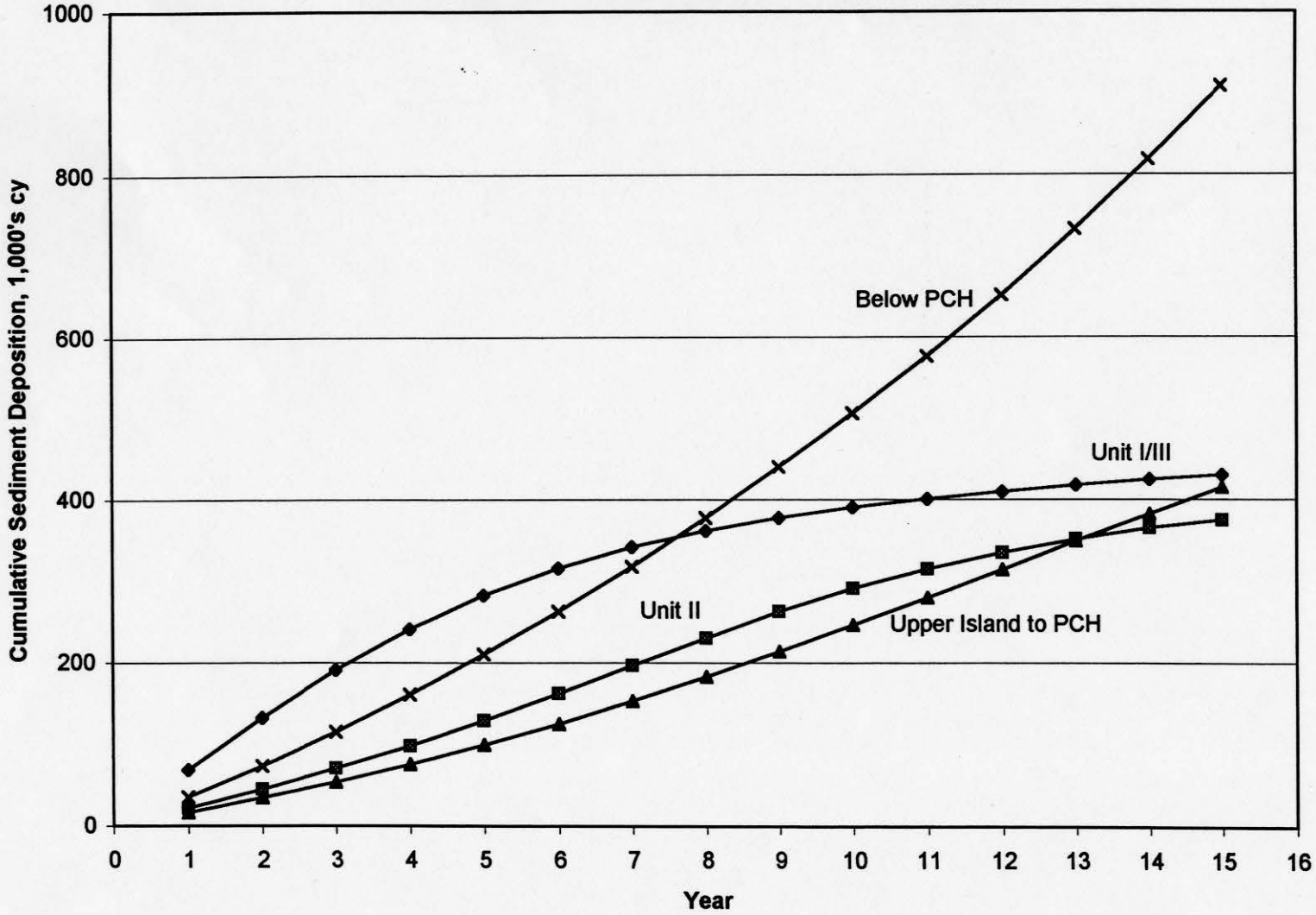
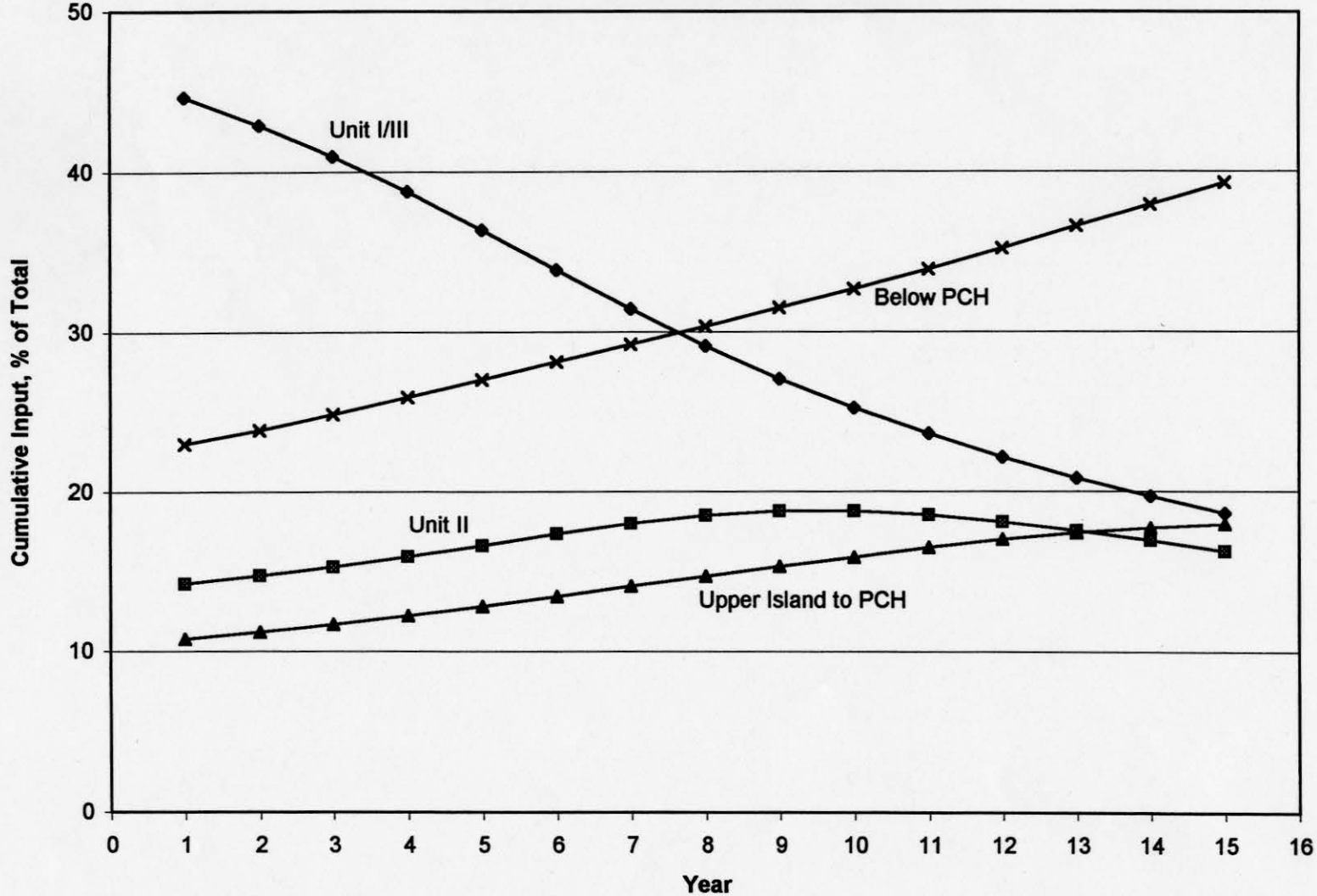


Figure 28
Alternative 1
Cumulative % Input (164,000 cy/year)



5.3 Alternative 3

The elements of Alternative 3 are listed below:

Unit I/III Basin

- Remove both exisiting least tern islands.
- Create one new least tern island in path of San Diego Creek flow.
- Dredge basin to =-14 ft, MSL, 1V:33H side slopes from 0 ft (MSL) to –3 ft and 1V:5H side slopes below.
- Maintain access channel to Unit II Basin

Unit II Basin

- Expand Unit II south and west, depth = -16 ft, MSL with 1V:33H side slopes from 0 ft (MSL) to –3 ft and 1V:5H side slopes below.
- Construct two least tern islands in Unit II area (one near west side of Dike, one on mudflat south of New Island)
- Dredge channel on east side of New Island (–5 ft, MSL), 50 ft top width, 1V:3 side slopes.
- Dredge channel from Unit II to Santa Ana-Delhi Channel (-5 ft, MSL) depth, a 50 ft bottom width and 1V:3H side slopes).
- Maintain the dredge and barge access channel from the Unit II basin to the PCH Bridge at –14 ft (MSL).

As in the case of Alternative 2, the resource agencies found the removal of the existing least tern islands in the Unit I/III Basin to be unacceptable. Therefore, no further analysis of Alternative 3 was performed.

5.4 Alternative 4

Alternative 4, shown in Figure 29, is intended to maximize the volume of the Unit I/III and Unit II Basins to the greatest extent possible. The individual elements of this plan are listed below.

Unit I/III Basin

- Increase basin depth to –20 ft (MSL), 1V: 33 side slopes from 0 ft (MSL) to –3 ft and 1V:5H side slopes below.
- Remove “kidney”-shaped island.
- Dredge south-side channel around “hotdog” least tern island.(50 ft top width, -5 ft (MSL) bottom elevation, 1V:3H side slopes
- Provide small boat access to “hot dog” least tern island for vegetation removal.
- Add two-foot sand/shell layer to “hotdog” island surface.
- Mudflat creation, bullnose section, NW corner of basin
- Maintain access channel to Unit II Basin (-14 ft, MSL)

Unit II Basin

- Expand Unit II south and west, depth = -20 ft, MSL with 1V:33H side slopes from 0 ft (MSL) to –3 ft and 1V:5H side slopes below.
- Segment Main Dike
- Construct new least tern island adjacent to Dike.
- New Island, east side channel (–5 ft, MSL), 50 ft top width, 1V:3 side slopes.
- Dredge channel from Unit II to Santa Ana-Delhi Channel (-5 ft, MSL) depth, a 50 ft bottom width and 1V:3H side slopes).
- Maintain the dredge and barge access channel from the Unit II basin to the PCH Bridge at –14 ft (MSL).

Other Areas

(Described in Section 5.7 of this Appendix)

- Middle Island, west side channel
- Shellmaker Island, east side channel
- Shellmaker Island, small dendritic channel
- Shellmaker Island, wetlands creation
- Northstar Beach, wetlands creation
- Plant eelgrass beds
- Add sand layer to least tern islands
- Segment Main Dike

The RMA numerical model was used to estimate the sediment deposition presented in Table 12 for a constant sediment inflow of 164,000 cy/year. Because the basins are large, the results of the 15-year model analysis were extrapolated to extend the analysis to 25 years. This was performed by fitting a third order polynomial equation to the 15-year data and using that equation to forecast the annual sedimentation through Year 25. The findings in Table 12 are shown graphically in Figures 30 and 31. Figure 30 presents the cumulative sediment deposition for the various areas of the Upper Bay (Unit I/III Basin, Unit II Basin, below the PCH Bridge, and Upper Island to PCH). Figure 30 indicates the cumulative percent input of sediment with time. On the basis of percent of total input, the Unit I/III decreases immediately as a site of sediment deposition, as shown in Figure 31. In contrast, the areas of the Bay located further south continue to accumulate increasing amounts of sediment with time. Sediment passing south of the PCH Bridge totals 30% of the total input in Year 30.

In order to create Alternative 4, a dredge volume of 2.638 to 2.713 million cubic yards is required, assuming that the constructing occurred in Year 4 following the 1999 completion of the Unit I/III dredge program. The periodic maintenance dredging requirement will range from 2.432 to 2.732 million cubic yards, dependent on dredge method. The maintenance dredging interval is estimated to be 24 years, as described in Section 5.8.

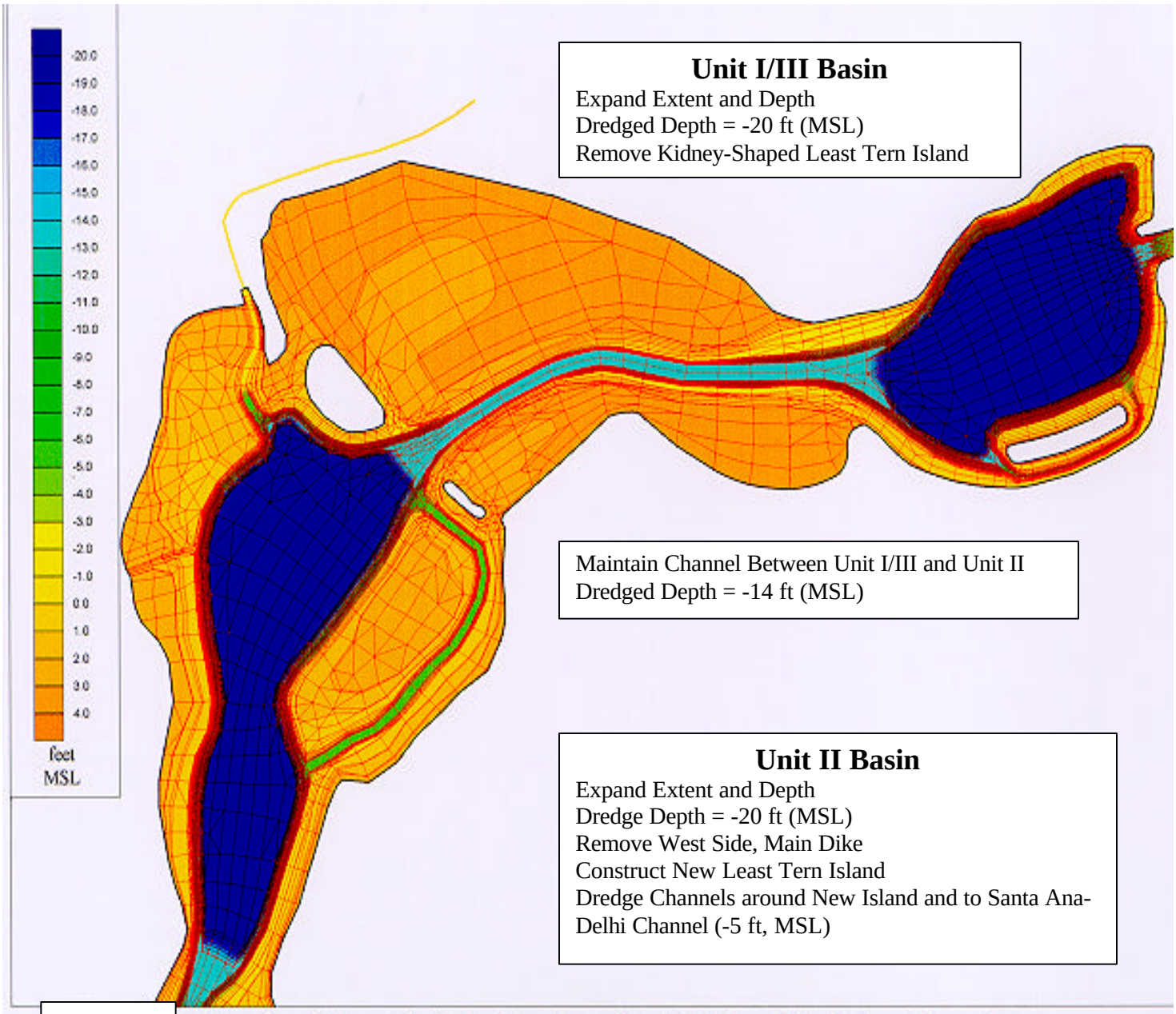


Figure 29: . Alternative 4 Upper Bay finite element mesh and initial condition bathymetric contours.

Table 12

Alternative 4, Depositional Volumes–164,000 cy Annual Sediment Inflow

End of Year	Total Volume	1 Unit I/III		2 Unit II		5 Upper Island to PCH		8 South of PCH bridge		3 Channel b/w Units I &		4 Unit II to Upper Island		6 Area Bordering Unit II		7 Upper Marsh	
	cy	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%
1	155.5	81.2	52.2	34.7	22.3	8.3	5.3	24.3	15.6	3.9	2.5	0.3	0.2	1.8	1.1	1.0	0.7
2	311.3	160.6	51.6	70.6	22.7	16.8	5.4	49.6	15.9	7.5	2.4	0.5	0.2	3.5	1.1	2.1	0.7
3	467.5	238.1	50.9	107.6	23.0	25.6	5.5	76.0	16.3	10.9	2.3	0.8	0.2	5.1	1.1	3.1	0.7
4	624.0	313.8	50.3	145.9	23.4	34.7	5.6	103.6	16.6	14.0	2.2	1.0	0.2	6.8	1.1	4.2	0.7
5	780.8	387.4	49.6	185.3	23.7	44.0	5.6	132.3	16.9	16.8	2.2	1.3	0.2	8.3	1.1	5.2	0.7
6	937.8	459.0	48.9	225.7	24.1	53.7	5.7	162.2	17.3	19.4	2.1	1.6	0.2	9.9	1.1	6.4	0.7
7	1095.1	528.5	48.3	267.0	24.4	63.6	5.8	193.4	17.7	21.9	2.0	1.8	0.2	11.3	1.0	7.5	0.7
8	1252.4	595.5	47.5	309.3	24.7	73.9	5.9	225.9	18.0	24.3	1.9	2.0	0.2	12.9	1.0	8.7	0.7
9	1409.6	659.3	46.8	352.8	25.0	84.7	6.0	259.8	18.4	26.6	1.9	2.3	0.2	14.3	1.0	9.9	0.7
10	1566.8	719.0	45.9	398.0	25.4	96.2	6.1	295.3	18.8	28.9	1.8	2.6	0.2	15.7	1.0	11.2	0.7
11	1723.8	773.5	44.9	445.3	25.8	108.4	6.3	332.8	19.3	31.2	1.8	2.8	0.2	17.2	1.0	12.5	0.7
12	1880.7	822.6	43.7	494.6	26.3	121.6	6.5	372.6	19.8	33.8	1.8	3.1	0.2	18.7	1.0	13.8	0.7
13	2037.1	866.8	42.5	545.5	26.8	135.4	6.6	414.3	20.3	36.5	1.8	3.5	0.2	20.1	1.0	15.2	0.7
14	2193.0	906.2	41.3	597.8	27.3	150.0	6.8	457.6	20.9	39.4	1.8	3.9	0.2	21.6	1.0	16.6	0.8
15	2348.3	940.2	40.0	651.7	27.8	165.7	7.1	502.8	21.4	42.4	1.8	4.3	0.2	23.0	1.0	18.0	0.8
16	2503.3	970.0	38.7	708.8	28.3	182.5	7.3	551.0	22.0	45.0	1.7	4.6	0.2	24.4	0.9	19.3	0.8
17	2658.3	990.0	37.2	767.7	28.9	200.4	7.5	601.4	20.7	47.6	1.7	4.9	0.2	25.8	0.9	20.5	0.8
18	2813.3	1005.0	35.7	828.9	29.5	219.5	7.8	654.3	23.3	50.3	1.7	5.3	0.2	27.2	0.9	21.8	0.8
19	2968.3	1020.0	34.4	892.6	30.1	239.8	8.1	709.8	23.9	52.8	1.6	5.6	0.2	28.6	0.9	23.0	0.8
20	3123.3	1030.0	33.0	958.7	30.7	261.6	8.4	768.1	24.6	55.2	1.6	5.9	0.2	30.0	0.9	24.2	0.8
21	3278.3	1040.0	31.7	1027.6	31.3	284.8	8.7	829.2	25.3	57.7	1.6	6.2	0.2	31.4	0.9	25.5	0.8
22	3433.3	1055.0	30.7	1099.2	32.0	309.4	9.0	893.3	26.0	60.0	1.5	6.5	0.2	32.8	0.9	26.7	0.8
23	3588.3	1067.0	29.7	1173.6	32.7	335.7	9.4	960.4	26.8	62.4	1.5	6.8	0.2	34.2	0.9	28.0	0.8
24	3743.3	1080.0	28.9	1251.0	33.4	363.6	9.7	1030.7	27.5	64.7	1.5	7.1	0.2	35.6	0.9	29.2	0.8
25	3898.3	1090.0	28.0	1331.5	34.2	393.3	10.1	1104.4	28.3	67.0	1.5	7.4	0.2	37.0	0.9	30.4	0.8

Figure 30
Alternative 4
Cumulative Sediment Deposition (164,000 cy/year)

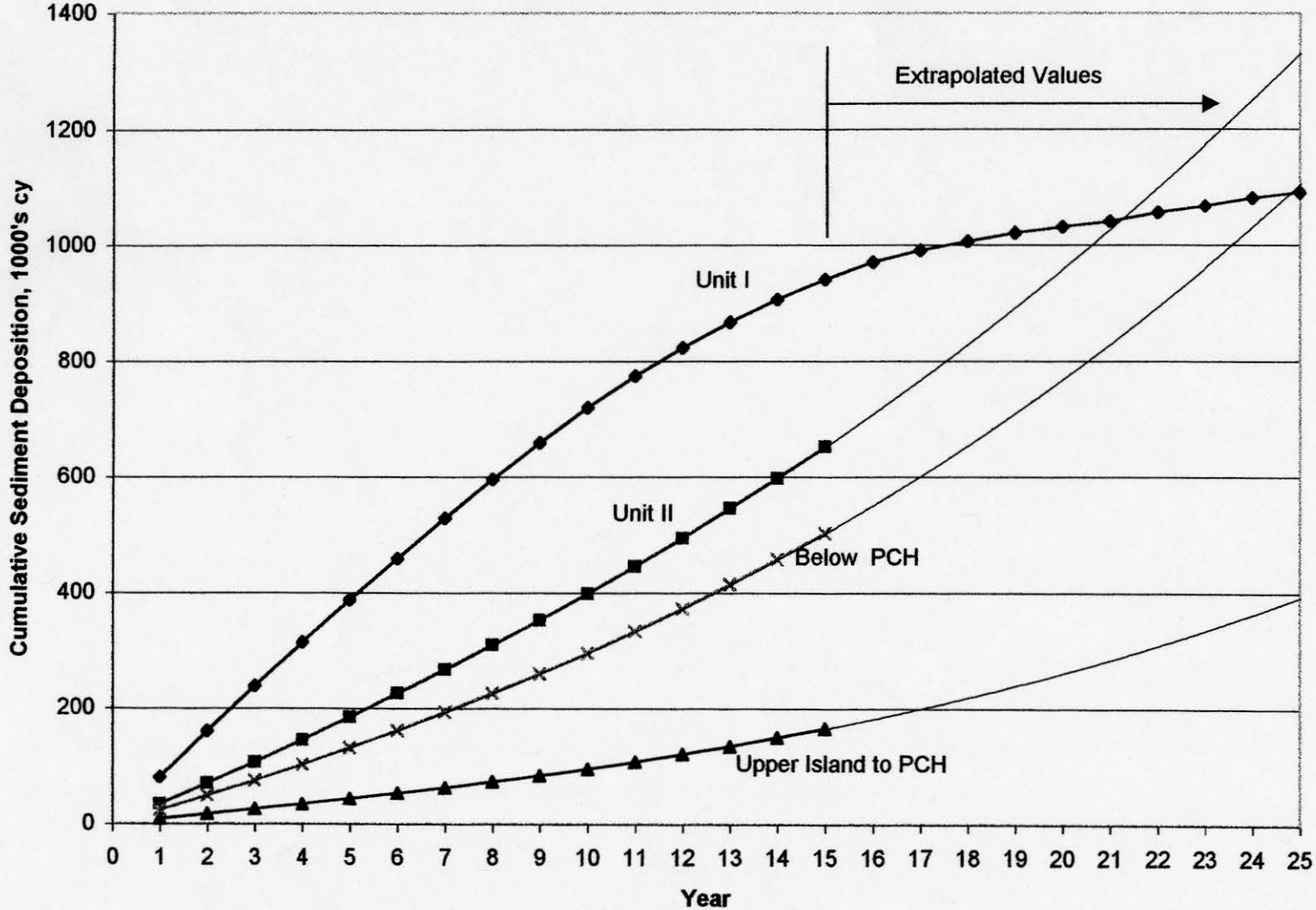
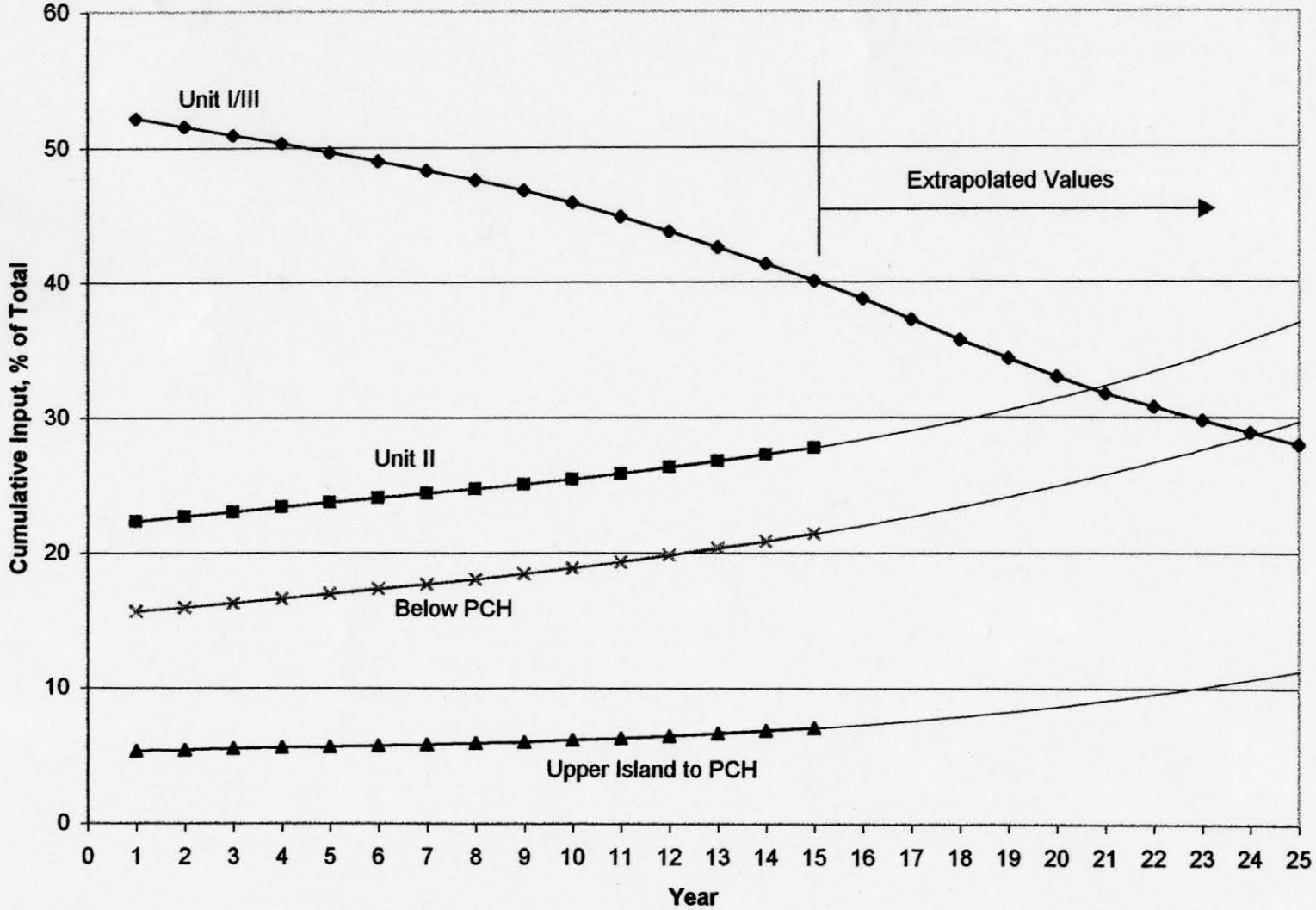


Figure 31
Alternative 4
Cumulative % Input (164,000 cy/yr)



5.5 Alternative 5

Alternative 5 is similar to the 1998-99 dredge program that created the Unit III basin. The removal of the large least tern island in the Unit I/III Basin and its relocation to the area near the dike results in a greater dredge requirement for the Unit I/III area. Figure 32 shows the elements of Alternative 5, as described below:

Unit I/III Basin

- Dredge basin depth to –14 ft (MSL), 1V: 33 side slopes from 0 ft (MSL) to –3 ft and 1V:5H side slopes below.
- Remove "kidney"-shaped island.
- Dredge south-side channel around "hotdog" least tern island.(50 ft top width, -5 ft (MSL) bottom elevation, 1V:5H side slopes
- Provide small boat access to "hot dog" least tern island for vegetation removal.
- Add two-foot sand/shell layer to "hotdog" island surface.
- Mudflat creation, bullnose section, NW corner of basin
- Maintain access channel to Unit II Basin (-14 ft, MSL)

Unit II Basin

- Segment Main Dike
- Construct new least tern island adjacent to Dike.
- New Island, east side channel (–5 ft, MSL), 50 ft top width, 1V:5 side slopes.
- Maintain the dredge and barge access channel from the Unit II basin to the PCH Bridge at –14 ft (MSL).

Other Areas

(Described in Section 5.7 of this Appendix)

- Middle Island, west side channel
- Shellmaker Island, east side channel
- Shellmaker Island, small dendritic channel
- Shellmaker Island, wetlands creation
- Northstar Beach, wetlands creation
- Plant eelgrass beds
- Add sand layer to least tern islands
- Segment Main Dike

Analysis of the RMA numerical model results have been estimated for the long-term average annual sediment inflow of 164,000 cy, as shown in Table 13. A graphical display of the model output is shown in Figure 33, which shows the volume of sediment depositing in the areas noted. The largest volume of sediment settles in the Unit I/III Basin, as this alternative does not re-create the Unit II Basin. In Figure 34, cumulative percent deposition indicates that as the Unit I/III Basin fills, and without any significant sediment storage capacity elsewhere in the Upper Bay, the movement of sediment to the Lower Bay proceeds efficiently. These findings suggest that 30% of the annual sediment inflow will pass to the Lower Bay in Year 10.

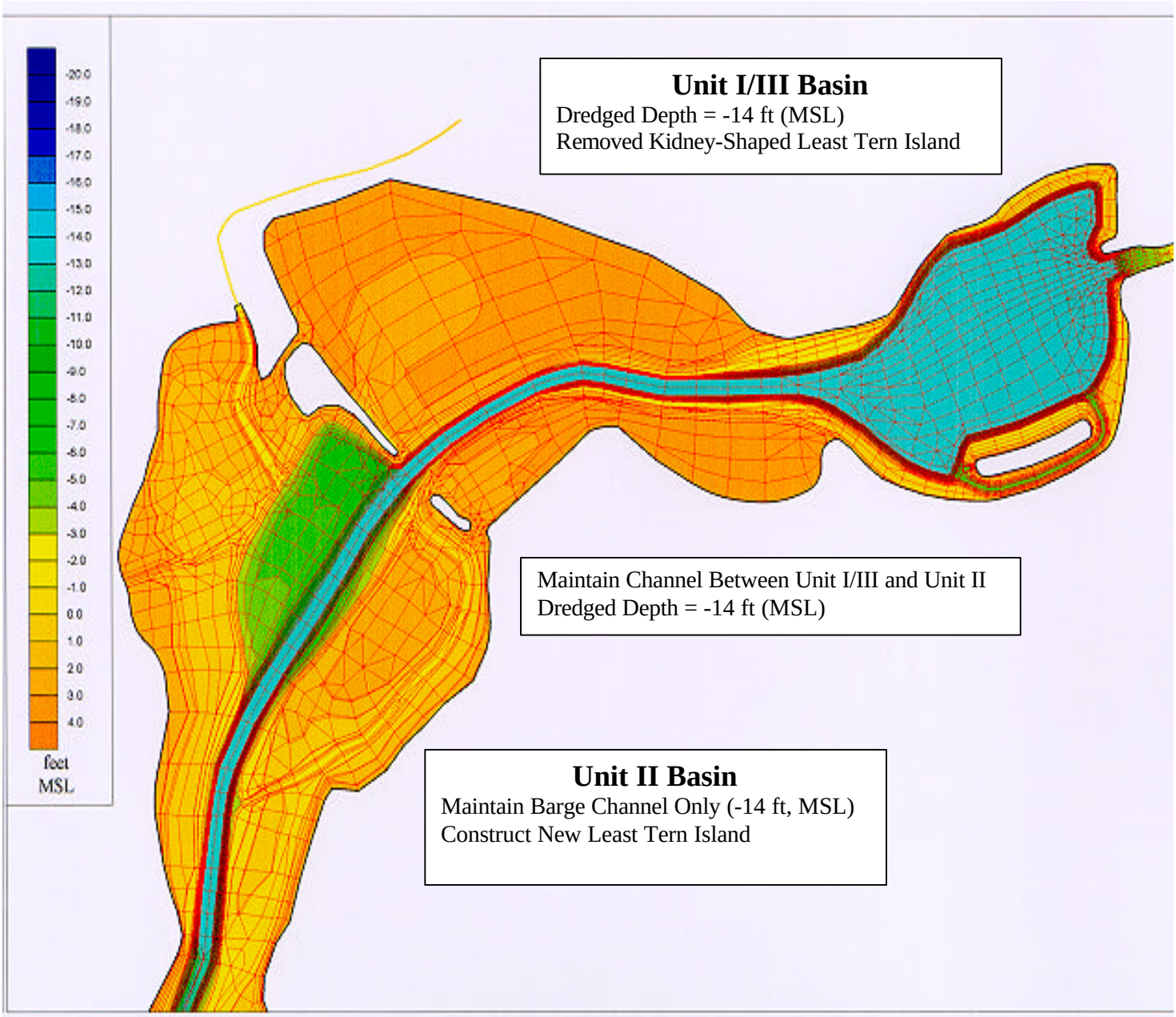


Figure 32: Alternative 5 Upper Bay finite element mesh and initial condition bathymetric contours

Table 13

Alternative 5, Depositional Volumes--164,000 cy Annual Sediment Inflow

End of Year	Total Volume	1 Unit I/III		2 Unit II		5 Upper Island to PCH		8 South of PCH bridge		3 Channel b/w Units I &		4 Unit II to Upper Island		6 Area Bordering Unit II		7 Upper Marsh	
	cy	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%
1	154.2	79.4	51.5	15.9	10.3	16.0	10.4	34.8	22.6	3.5	2.3	1.6	1.1	1.9	1.2	1.0	0.7
2	308.6	156.4	50.7	32.0	10.4	33.0	10.7	71.4	23.2	6.7	2.2	3.3	1.1	3.6	1.2	2.2	0.7
3	463.1	230.9	49.9	47.8	10.3	51.0	11.0	110.4	23.8	9.6	2.1	5.1	1.1	5.2	1.1	3.2	0.7
4	617.8	302.7	49.0	63.2	10.2	69.9	11.3	151.9	24.6	12.5	2.0	6.8	1.1	6.6	1.1	4.3	0.7
5	772.7	371.4	48.1	78.1	10.1	90.0	11.6	195.8	25.3	15.2	2.0	8.5	1.1	8.1	1.1	5.5	0.7
6	927.4	436.5	47.1	92.4	10.0	111.5	12.0	242.4	26.1	17.8	1.9	10.4	1.1	9.6	1.0	6.8	0.7
7	1082.1	497.1	45.9	105.7	9.8	134.9	12.5	292.2	27.0	20.5	1.9	12.5	1.2	11.2	1.0	8.1	0.7
8	1236.7	552.0	44.6	118.3	9.6	160.4	13.0	345.7	28.0	23.3	1.9	15.0	1.2	12.7	1.0	9.4	0.8
9	1390.3	600.3	43.2	130.0	9.3	187.8	13.5	402.8	29.0	26.5	1.9	17.8	1.3	14.0	1.0	10.9	0.8
10	1543.4	642.6	41.6	140.4	9.1	217.4	14.1	464.2	30.1	30.2	2.0	21.1	1.4	15.3	1.0	12.5	0.8
11	1696.0	678.6	40.0	148.7	8.8	249.2	14.7	529.8	31.2	34.4	2.0	24.6	1.5	16.5	1.0	14.1	0.8
12	1847.8	709.7	38.4	155.3	8.4	282.1	15.3	599.8	32.5	39.2	2.1	28.3	1.5	17.8	1.0	15.8	0.9
13	1999.4	736.0	36.8	161.0	8.1	315.5	15.8	673.8	33.7	44.3	2.2	32.0	1.6	19.0	0.9	17.6	0.9
14	2149.5	755.9	35.2	166.4	7.7	348.9	16.2	751.7	35.0	50.3	2.3	35.8	1.7	20.3	0.9	20.1	0.9
15	2298.2	769.6	33.5	171.3	7.5	382.0	16.6	833.3	36.3	57.3	2.5	39.6	1.7	21.9	1.0	23.2	1.0

Figure 33
Alternative 5
Cumulative Sediment Deposition (164,000 cy/yr)

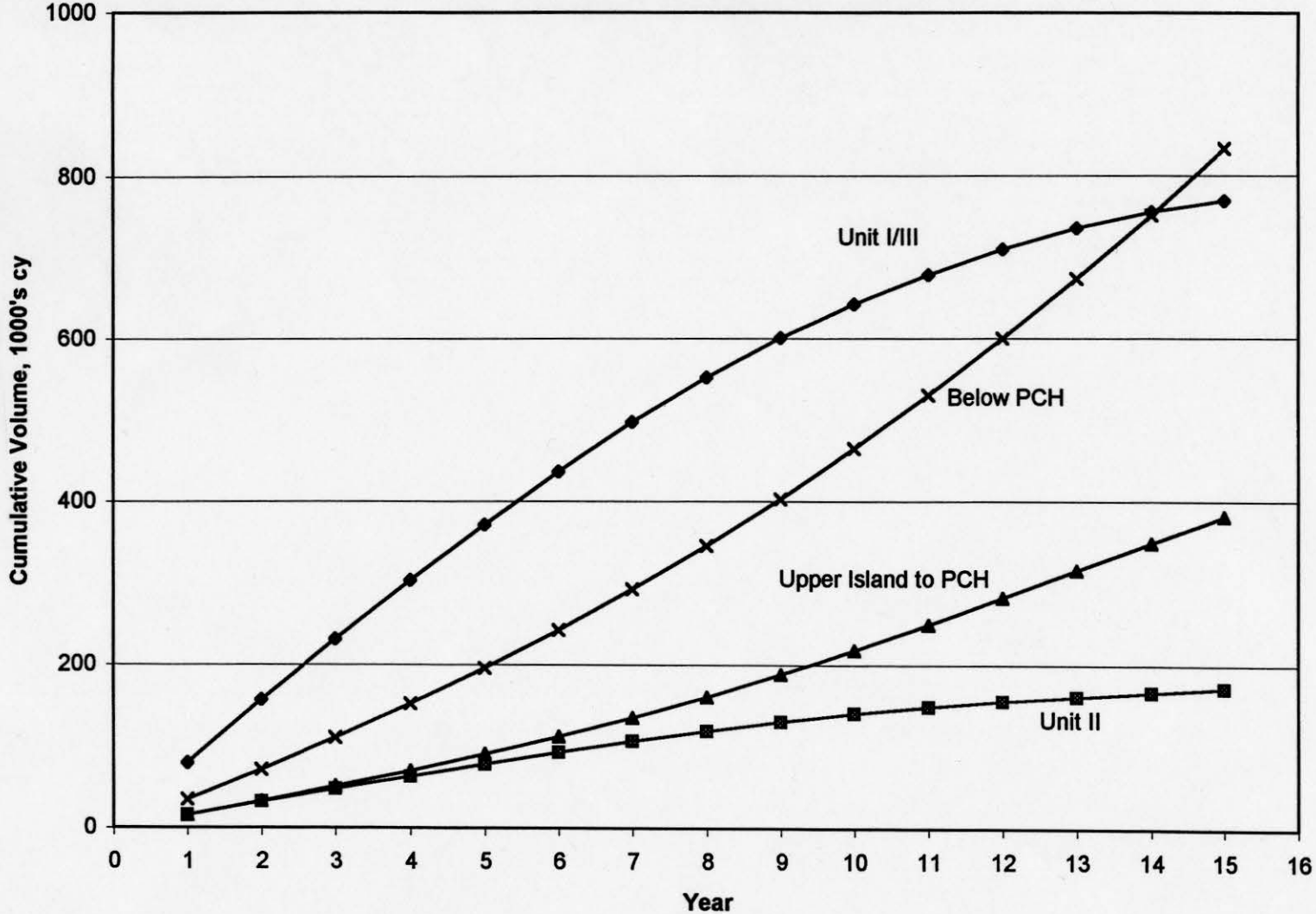
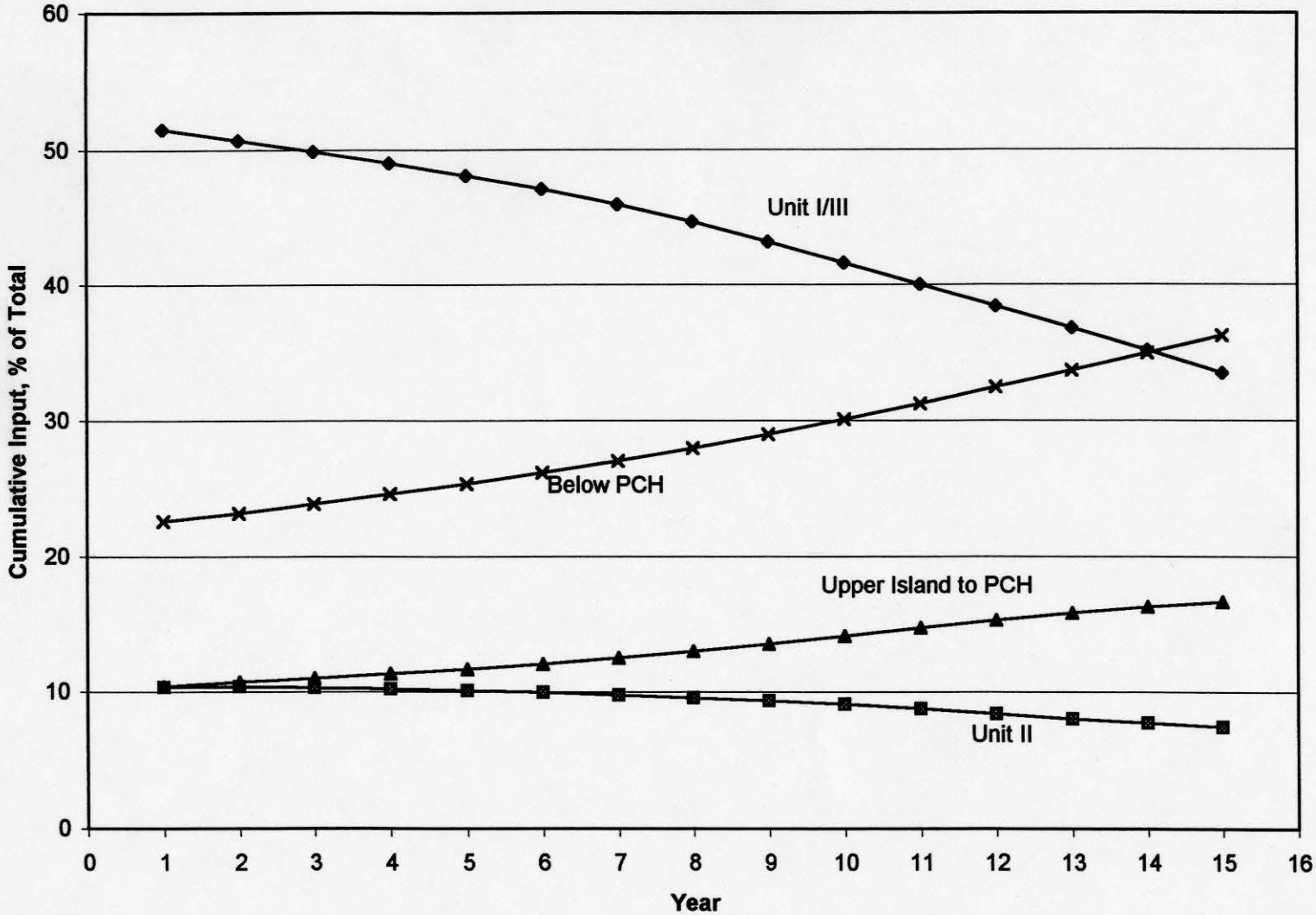


Figure 34
Alternative 5
Cumulative % Input (164,000 cy/year)



To create Alternative 5 in Year 4 following the conclusion of the 1998-99 Unit III dredge program, the dredge volume will be in the 896,000 to 971,000 cubic yard range. The maintenance dredge volume estimated to be excavated every 10 years will vary from 831,000 to 1,031,000 cy, dependent on dredge method. The selection of the 10 year maintenance interval is discussed in Section 5.8.

5.6 Alternative 6

Alternative 6 creates deep (-20 ft, MSL) basins at both the Unit I/III and Unit II sites. The elements of Alternative 6 are shown in Figure 35 and are described below:

Unit I/III Basin

- Increase basin depth to –20 ft (MSL), 1V: 33 side slopes from 0 ft (MSL) to –3 ft and 1V:5H side slopes below.
- Maintain northeast corner of basin intact.
- Remove "kidney"-shaped island.
- Dredge south-side channel around "hotdog" least tern island.(50 ft top width, -5 ft (MSL) bottom elevation, 1V:5H side slopes
- Provide small boat access to "hot dog" least tern island for vegetation removal.
- Add two foot sand/shell layer to "hotdog" island surface.
- Mudflat creation, bullnose section, NW corner of basin
- Maintain access channel to Unit II Basin (-14 ft, MSL)

Unit II Basin

- Expand Unit II west, depth = -20 ft, MSL with 1V:33H side slopes between 0 ft (MSL) and –3 ft and 1V:5 side slopes below.
- Segment Main Dike
- Construct new least tern island adjacent to Dike.
- New Island, east side channel (–5 ft, MSL), 50 ft top width, 1V:5 side slopes.
- Dredge channel from Unit II to Santa Ana-Delhi Channel (-5 ft, MSL) depth, a 50 ft bottom width and 1V:3H side slopes).
- Maintain the dredge and barge access channel from the Unit II basin to the PCH Bridge at –14 ft (MSL).

Other Areas

(Described in Section 5.7 of this Appendix)

- Middle Island, west side channel
- Shellmaker Island, east side channel
- Shellmaker Island, small dendritic channel
- Shellmaker Island, wetlands creation
- Northstar Beach, wetlands creation
- Plant eelgrass beds
- Add sand layer to least tern islands
- Segment Main Dike

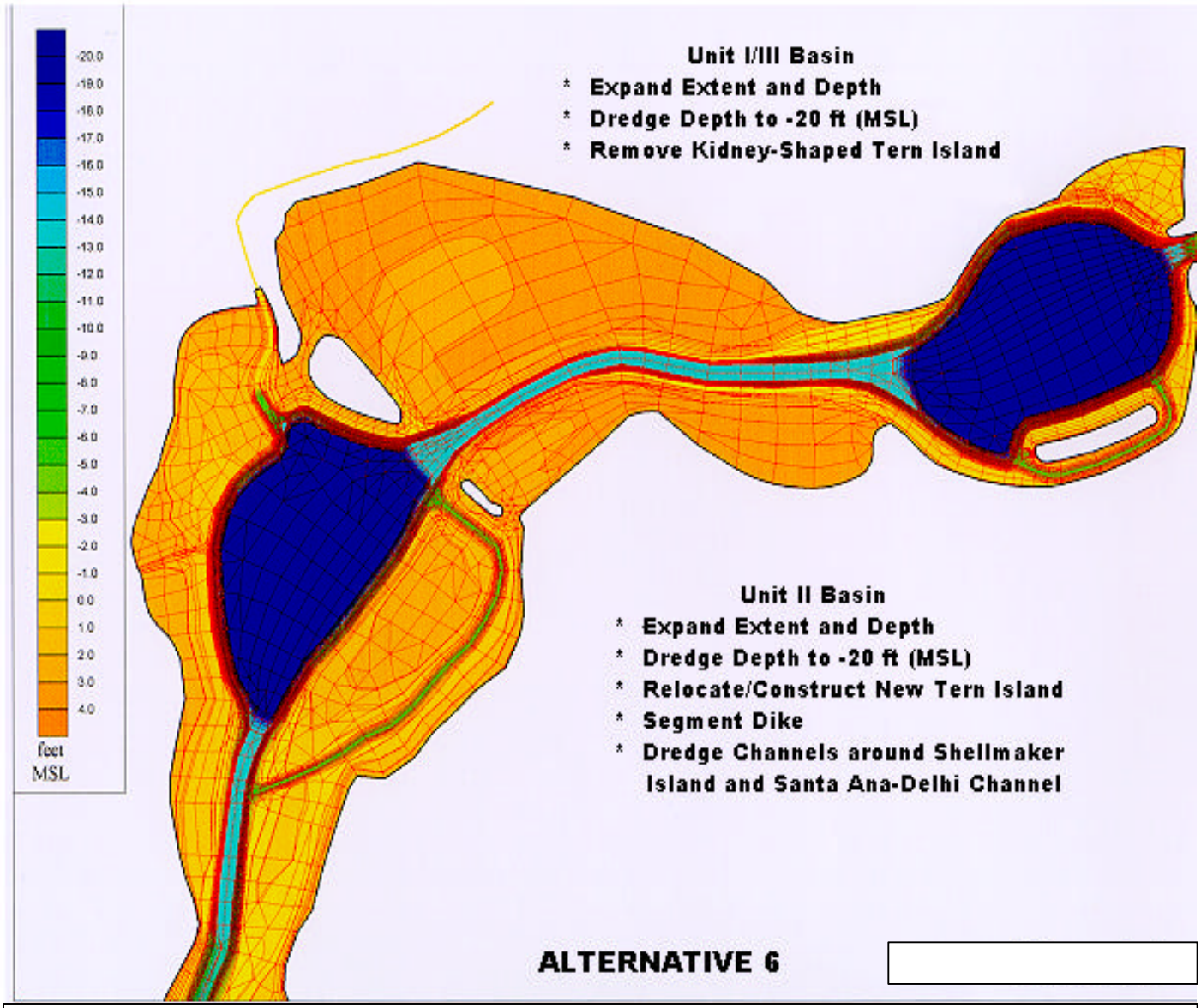


Figure 35: Alternative 6 Upper Bay finite element mesh and initial condition bathymetric contours

Table 14

Alternative 6, Depositional Volumes--164,000 cy Annual Sediment Inflow

End of Year	Total Volume	1 Unit I/III		2 Unit II		5 Upper Island to PCH		8 South of PCH bridge		3 Channel b/w Units I &		4 Unit II to Upper Island		6 Area Bordering Unit II		7 Upper Marsh	
	cy	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%	cy	%
1	154.8	78.7	50.8	25.6	16.6	11.7	7.5	29.5	19.1	4.3	2.8	1.0	0.6	2.8	1.8	1.1	0.7
2	309.9	155.3	50.1	52.4	16.9	23.9	7.7	60.4	19.5	8.2	2.6	2.0	0.6	5.4	1.7	2.2	0.7
3	465.2	229.7	49.4	80.2	17.2	36.4	7.8	92.8	20.0	11.8	2.5	3.0	0.6	8.0	1.7	3.3	0.7
4	620.7	301.3	48.5	109.0	17.6	49.5	8.0	126.8	20.4	15.2	2.5	3.9	0.6	10.5	1.7	4.5	0.7
5	776.5	370.4	47.7	138.9	17.9	63.0	8.1	162.4	20.9	18.4	2.4	4.9	0.6	12.9	1.7	5.7	0.7
6	932.6	437.1	46.9	169.5	18.2	77.0	8.3	199.8	21.4	21.3	2.3	5.9	0.6	15.1	1.6	7.0	0.7
7	1088.6	501.4	46.1	200.7	18.4	91.4	8.4	238.6	21.9	23.9	2.2	7.2	0.7	17.1	1.6	8.2	0.8
8	1244.7	563.1	45.2	232.6	18.7	106.3	8.5	279.1	22.4	26.4	2.1	8.5	0.7	19.1	1.5	9.5	0.8
9	1400.8	621.2	44.3	265.4	18.9	122.1	8.7	321.6	23.0	28.9	2.1	9.8	0.7	21.0	1.5	10.9	0.8
10	1556.7	675.2	43.4	299.2	19.2	138.6	8.9	366.0	23.5	31.4	2.0	11.2	0.7	22.8	1.5	12.3	0.8
11	1712.5	724.7	42.3	334.0	19.5	156.0	9.1	412.8	24.1	34.1	2.0	12.7	0.7	24.5	1.4	13.7	0.8
12	1868.0	770.1	41.2	369.8	19.8	174.0	9.3	461.6	24.7	36.9	2.0	14.1	0.8	26.2	1.4	15.2	0.8
13	2022.7	811.6	40.1	405.6	20.1	192.2	9.5	511.8	25.3	39.8	2.0	15.6	0.8	28.1	1.4	17.9	0.9
14	2176.9	848.7	39.0	442.2	20.3	211.2	9.7	563.9	25.9	42.9	2.0	17.2	0.8	30.0	1.4	20.8	1.0
15	2330.2	881.7	37.8	478.5	20.5	230.7	9.9	617.3	26.5	45.9	2.0	18.8	0.8	32.0	1.4	25.1	1.1
16	2485.2	908.0	36.5	516.7	20.8	251.6	10.1	674.2	27.1	51.2	2.0	21.1	0.8	35.7	1.4	28.0	1.1
17	2640.2	929.5	35.2	555.0	21.0	272.9	10.3	732.7	27.8	56.6	2.0	23.5	0.8	39.5	1.4	31.2	1.1
18	2795.2	955.0	34.2	593.8	21.2	295.1	10.6	793.2	28.4	62.4	2.0	26.0	0.8	43.5	1.4	34.5	1.1
19	2950.2	975.0	33.0	633.1	21.5	318.1	10.8	856.0	29.0	68.3	2.0	28.6	0.8	47.7	1.4	37.9	1.1
20	3105.2	995.0	32.0	672.9	21.7	342.0	11.0	920.9	29.7	74.6	2.0	31.3	0.8	52.0	1.4	41.5	1.1
21	3260.2	1010.0	31.0	713.1	21.9	366.7	11.2	988.1	30.3	81.1	2.0	34.1	0.8	56.6	1.4	45.3	1.1
22	3415.2	1030.0	30.2	753.7	22.1	392.3	11.5	1057.6	31.0	87.8	2.0	37.0	0.8	61.3	1.4	49.2	1.1
23	3570.2	1050.0	29.4	794.6	22.3	418.9	11.7	1129.4	31.6	94.9	2.0	40.1	0.8	66.3	1.4	53.3	1.1
24	3725.2	1065.0	28.6	835.9	22.4	446.3	12.0	1203.5	32.3	102.3	2.0	43.3	0.8	71.4	1.4	57.6	1.1
25	3880.2	1080.0	27.8	877.5	22.6	474.8	12.2	1280.0	33.0	110.0	2.0	46.7	0.8	76.8	1.4	62.1	1.1

Figure 36
Alternative 6
Cumulative Sediment Deposition (164,000 cy/year)

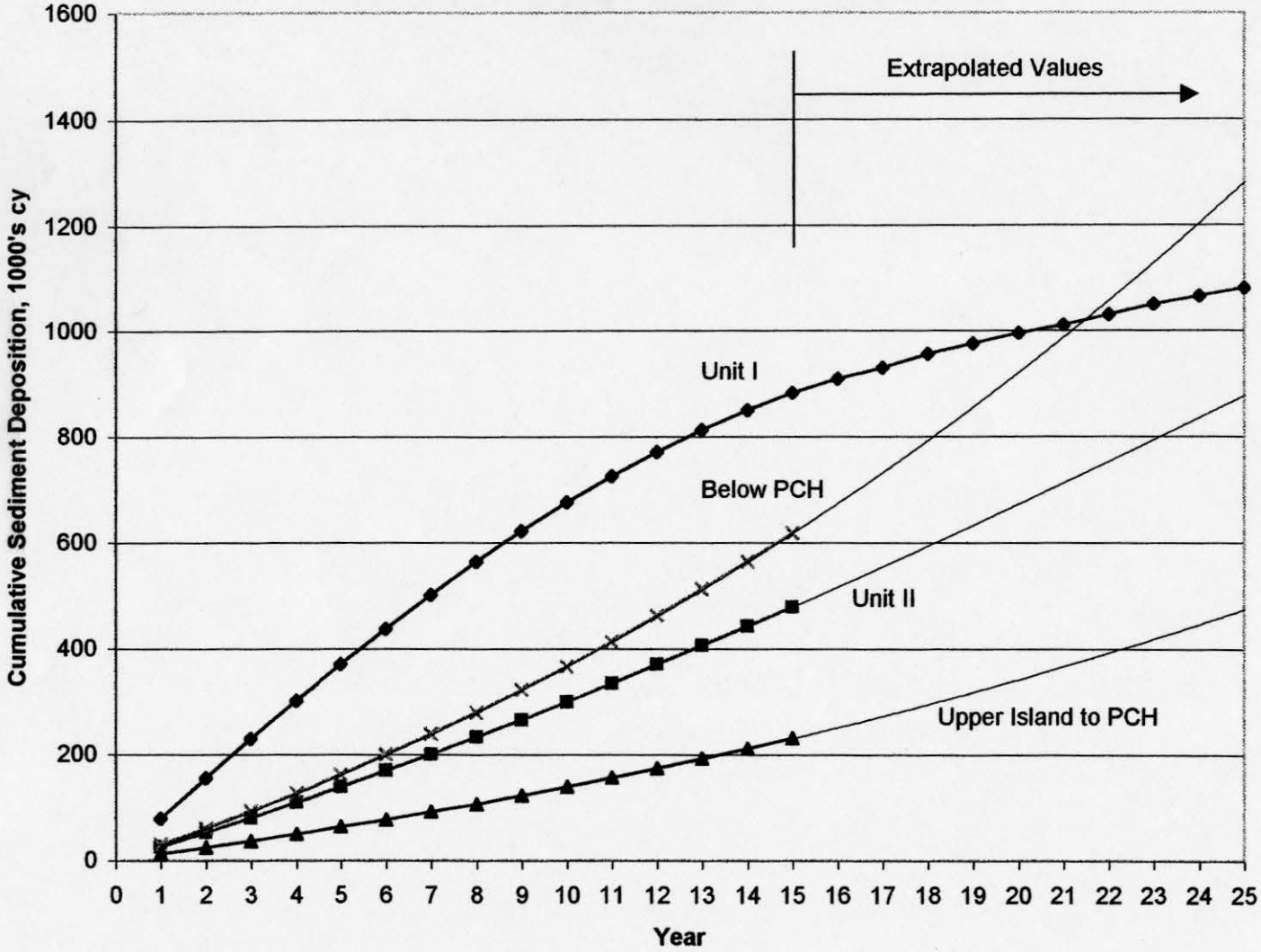
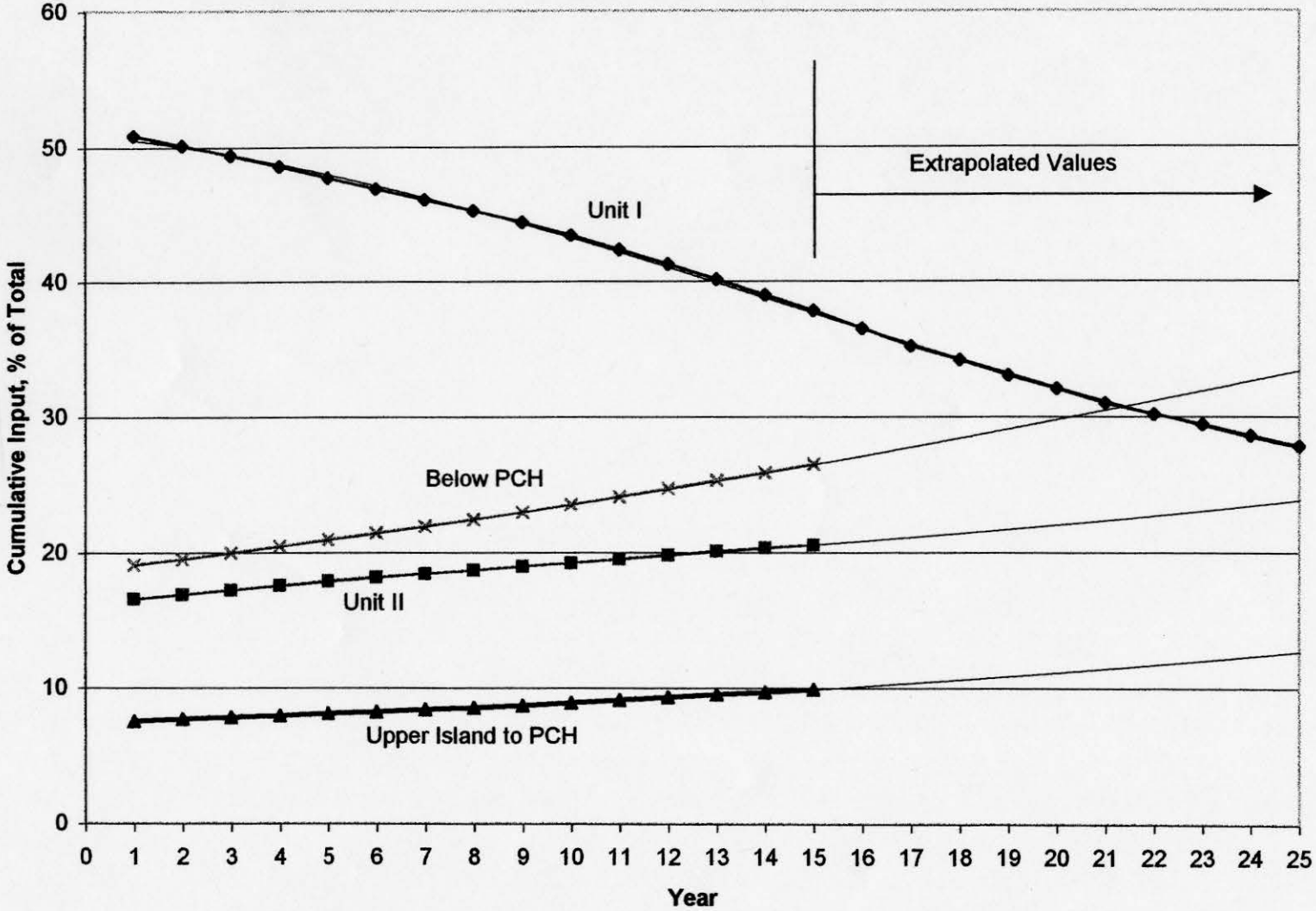


Figure 37
Alternative 6
Cumulative % Input (164,000 cy/year)



The RMA numerical model was used to estimate the sediment deposition for Alternative 6 in Table 14, for the long-term average annual sediment input of 164,000 cy. Figures 36 and 37 present this data in graphical form for a 25-year period. Because the RMA model was conducted for only 15 years, using an annual average sediment input of 250,000 cy, extrapolation of scaled depositional volumes was required. As is noted in Figure 36, the Unit I/III Basin accepts the largest volume of sediment in the early years, with significant secondary sedimentation occurring in Unit II. As these basins fill, substantial sediment flows south to the Lower Bay. As seen in Figure 37, sediment exceeding 30% of the inflow passes to the Lower Bay (south of PCH Bridge) in Year 20.

In order to create Alternative 6, the initial construction dredge volume will range from 2.047 million to 2.122 million cubic yards. Maintenance dredging requires the removal of 1.863 million to 2.163 million, dependent on dredging method. The maintenance dredging interval is estimated to be 21 years, as discussed in Section 5.8 of this report.

5.7 Ancillary Wetlands/Channel Restoration

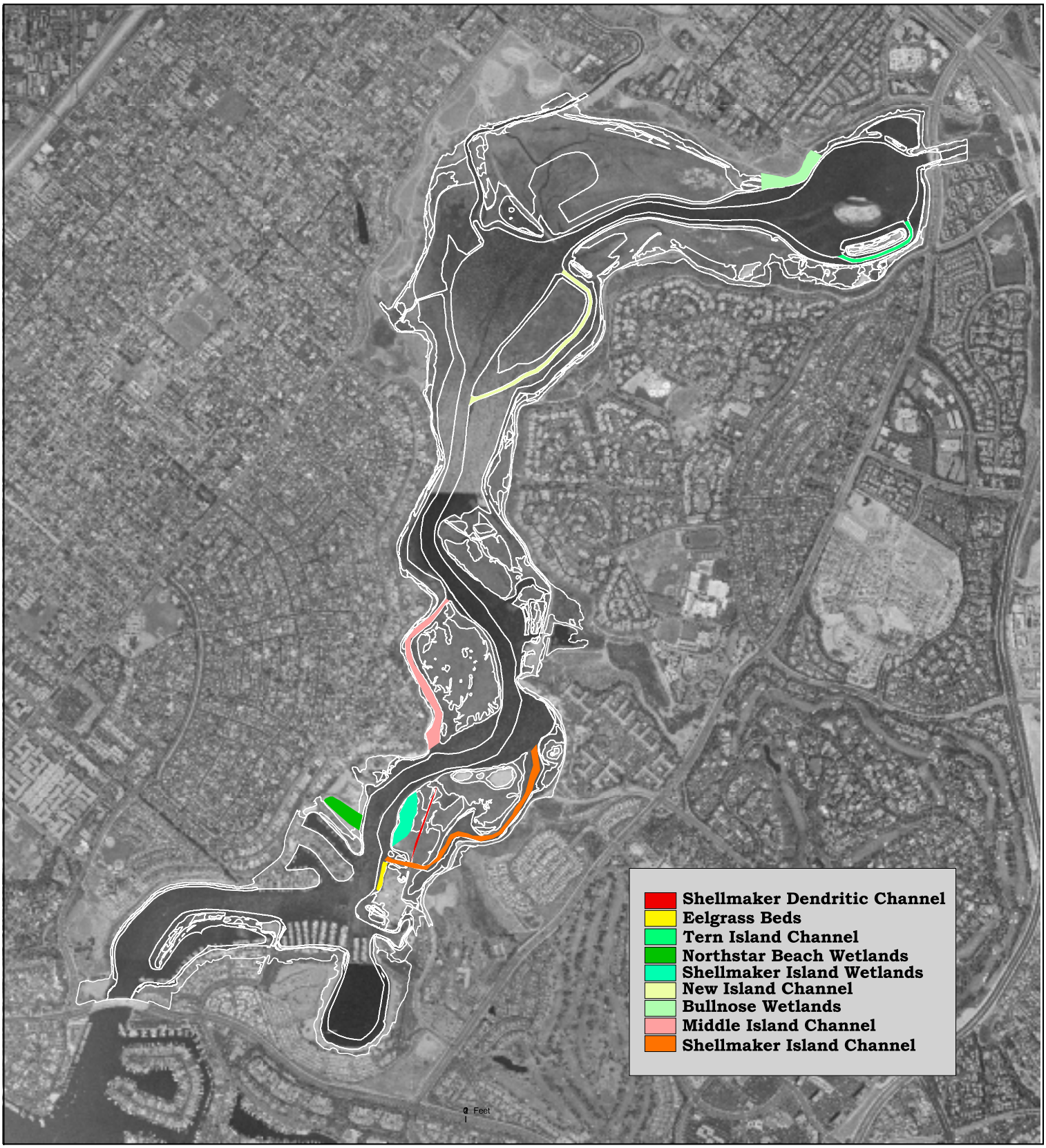
In addition to the large-scale dredge requirements of the various alternatives described in the previous section, the restoration measures described below will be included in Alternatives 4, 5, and 6. The location of a number of these restoration measures are shown in Figure 38, and are described below.

5.7.1 Unit I/III Hotdog Tern Island (Tern Island), South Side Channel

To provide tidal circulation and to prevent travel of terrestrial predators to the “hotdog” shaped least tern island in the Unit I/III Basin, a channel will be created around its southern perimeter. The dredging plan is to create a 50 ft wide channel with a depth of –5 ft (MSL), a bottom width of 20 ft, and side slopes of 1V:3H. This excavation over the 1,420 ft channel length would remove about 1.6 acres of mudflat. The excavation quantity is 9,200 cy. The location of the channel and a typical cross-section (A-A’) is presented in Figure 39. The work would be performed by a small hydraulic dredge disposing into an ocean-going barge located in deeper water nearby. Alternatively, a small backhoe operating from a shallow draft barge could excavate the channel with eventual transfer from the backhoe barge to the larger ocean-going barge for delivery to the LA-3 offshore dumpsite.

5.7.2 Mudflat Creation, Bullnose Section, Northwest Corner of Unit I/III

A degraded upland area in the northwest section of the Unit I/III Basin will be excavated to create a 3.7 acre intertidal mudflat. The elevation of this area will be reduced from +5 ft (MSL) to –2 ft thereby requiring 42,000 cy of excavation. The location of this wetland enhancement and typical cross-section B-B’ is shown in Figure 39. This work will be performed by backhoes operated from land. Disposal of the excavated soil would occur within the project area, or at the offshore LA-3 disposal site. Onshore disposal would require significant dump truck traffic within the area and is not considered to be the preferred disposal alternative.



Upper Newport Bay

Restoration Measures

County of Orange, California

DESIGNED AND PRODUCED BY:
Public Facilities and Resources Department
GIS Mapping Unit
Carmen Copil Cancea

DATA SOURCE:
Geomatics Land Information System Division: Survey File # HB-96/97-10

DATE: April 27, 2000

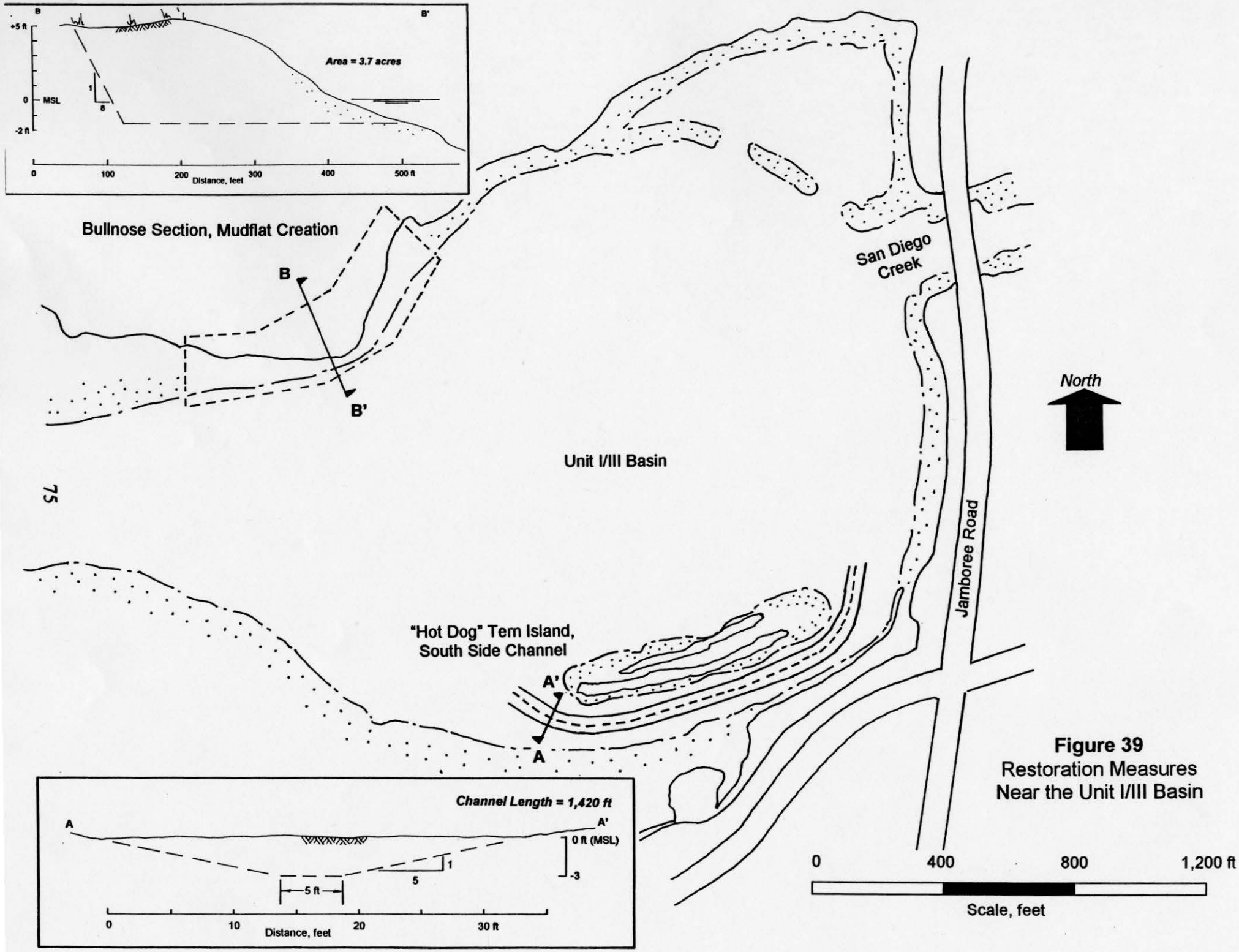


Figure 39
Restoration Measures
Near the Unit I/III Basin

5.7.3 New Island, East Side Channel

New Island has formed via sediment accumulation during the past 20 years just southeast of the Main Dike. The channel on the east side of New Island was originally constructed in concert with the creation of the Unit II Basin in the late 1980's. The restoration of this channel is proposed by excavation along its 3,800 ft length. The channel width will be 50 feet. The existing channel depth of -1.5 ft (MSL) will be lowered to -5 ft MSL. This deepening of the channel by 4.5 ft will result in a 29 ft bottom channel width and side slopes of 1V:3H. The total quantity of excavation for this channel is 19,500 cy. The total mudflat loss for this measure is 4.3 acres. Figure 40 presents the location and typical cross-section A-A' of this channel. Construction of this channel will either use a small hydraulic dredge or a small barge equipped with a backhoe. The former method will pump the sediment water slurry directly into a scow barge. The latter method will require a small barge to be immediately available to the excavation backhoe for temporary disposal, followed by transfer to the ocean-going scow barge. Disposal of this material will be at the LA-3 offshore dumpsite.

5.7.4 Middle Island, West Side Channel

The channel that passes between the Newport Mesa and Middle Island, shown in Figure 41, would be deepened to provide improved tidal circulation. This channel currently exhibits a minimum elevation of +1.5 ft (MLLW). By deepening this channel, water circulation would occur at all stages of the tide. For the reasons discussed previously, the bottom channel elevation proposed is -5 ft (MLLW) with a bottom width of 11 ft. Side slopes will be 1V:3H.

Figure 42 presents typical channel cross-sections for the existing and proposed cases. The required dredge quantity is about 19,500 cy for the 2,660-ft long channel. The method of dredging would be identical to that previously described for the Shellmaker Island channel. The low rate of sedimentation that has been documented within the existing channel since 1912 would yield a maintenance dredging interval of 50 years.

The beneficial impacts of creating a deeper channel at this location would be related to the increase in tidal prism of 2.8 acre-ft, and the resulting improvement in tidal circulation. The subtidal habitat would be increased, at the expense of a loss in shallow intertidal mudflat.

5.7.5 Shellmaker Island, East Side Channel

Currently, the 3,100-ft long channel that passes along the east side of Shellmaker Island has a bottom elevation of about +2.5 ft (MLLW). The channel is dry once the tide falls below Mean Sea Level. Deepening this channel to –5 ft (MSL) will provide water circulation around Shellmaker Island at all stages of the tide. The channel top width will be 50 ft and the bottom width will be 5 ft. The stagnant conditions that currently exist as the channel closes at low water will be modified by channel deepening. Figure 43 presents a conceptual view of this alternative.

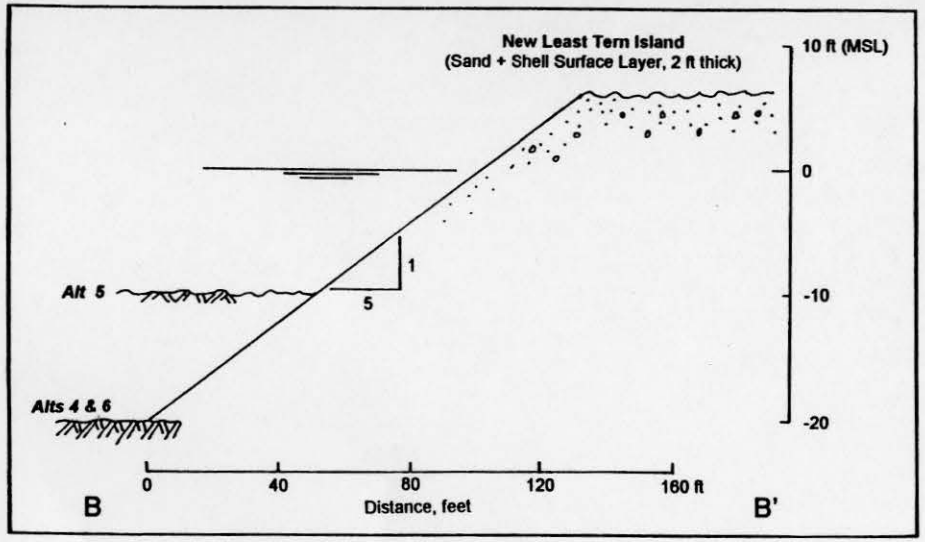
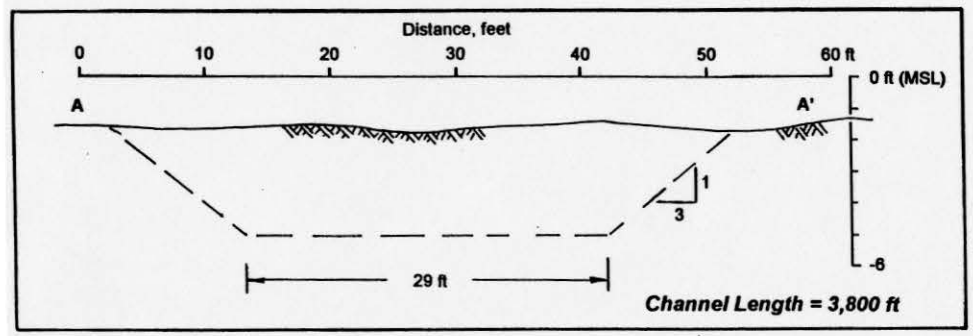
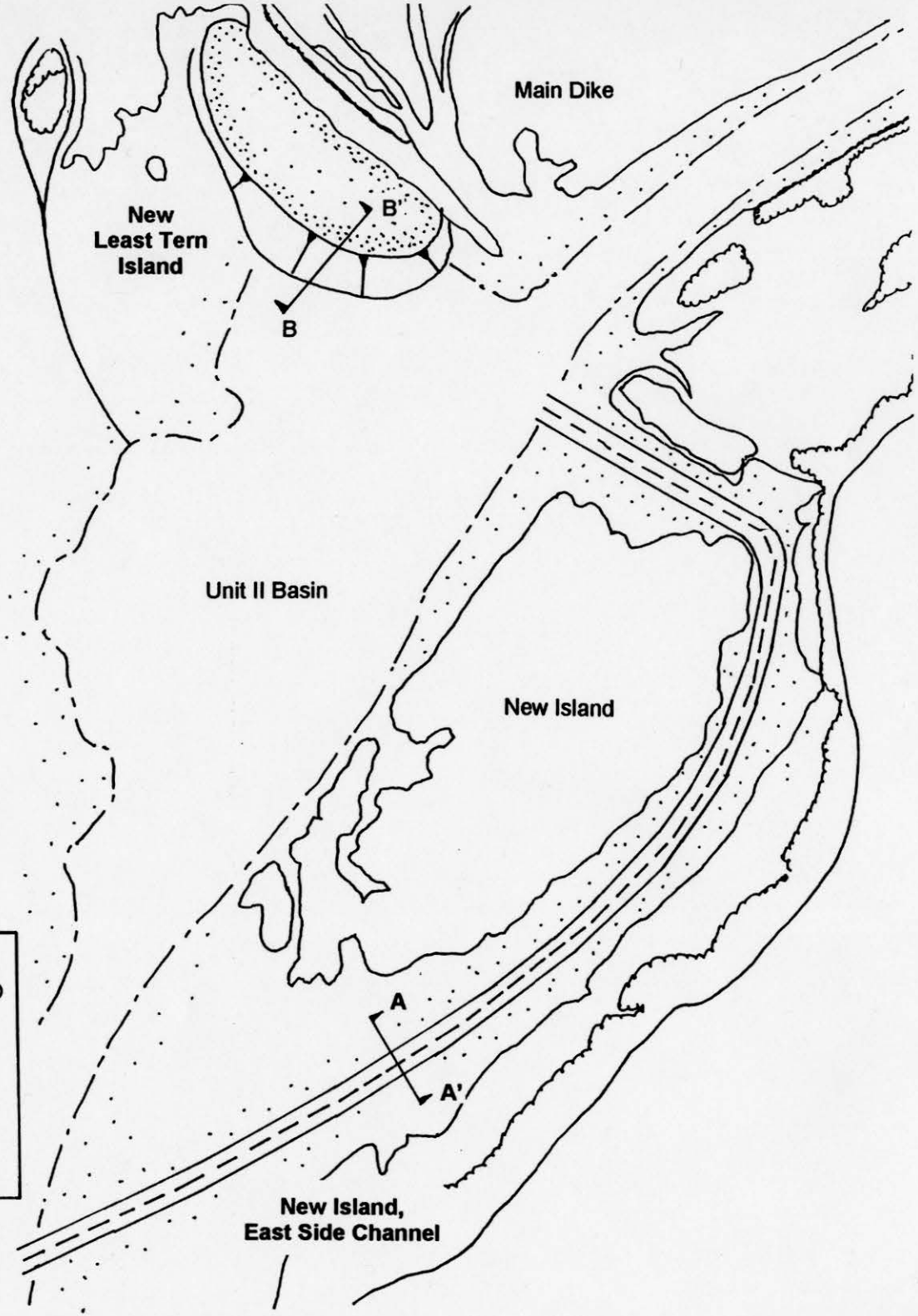
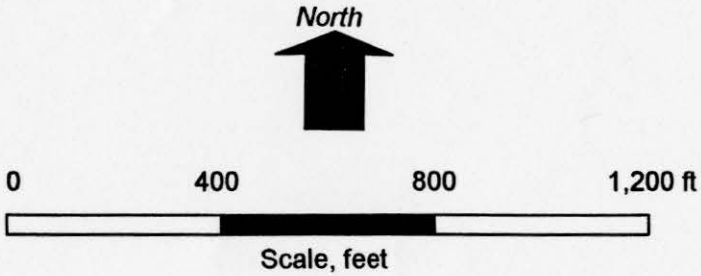
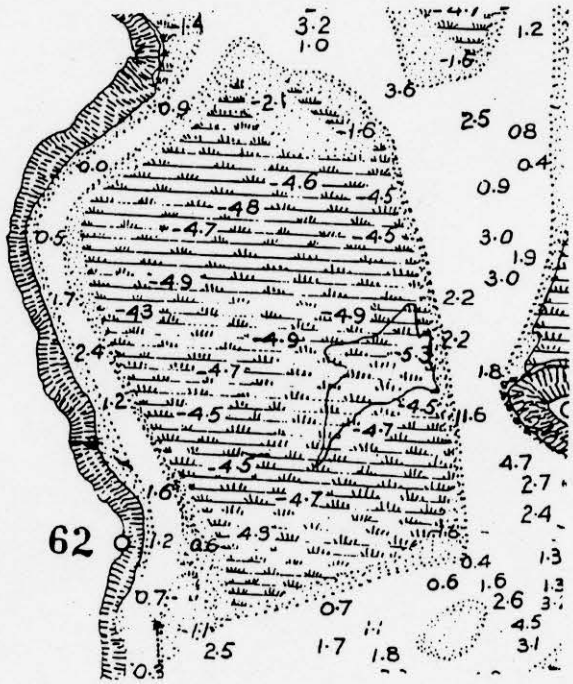


Figure 40
Restoration Measures Near Unit II Basin

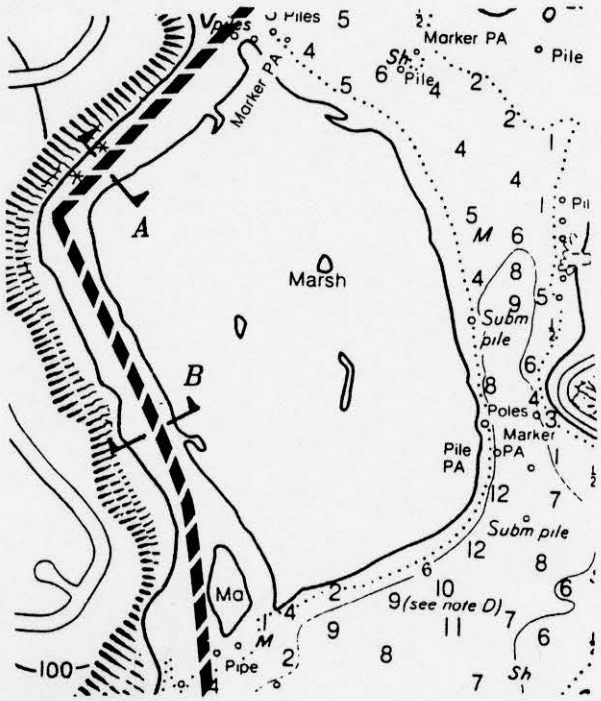






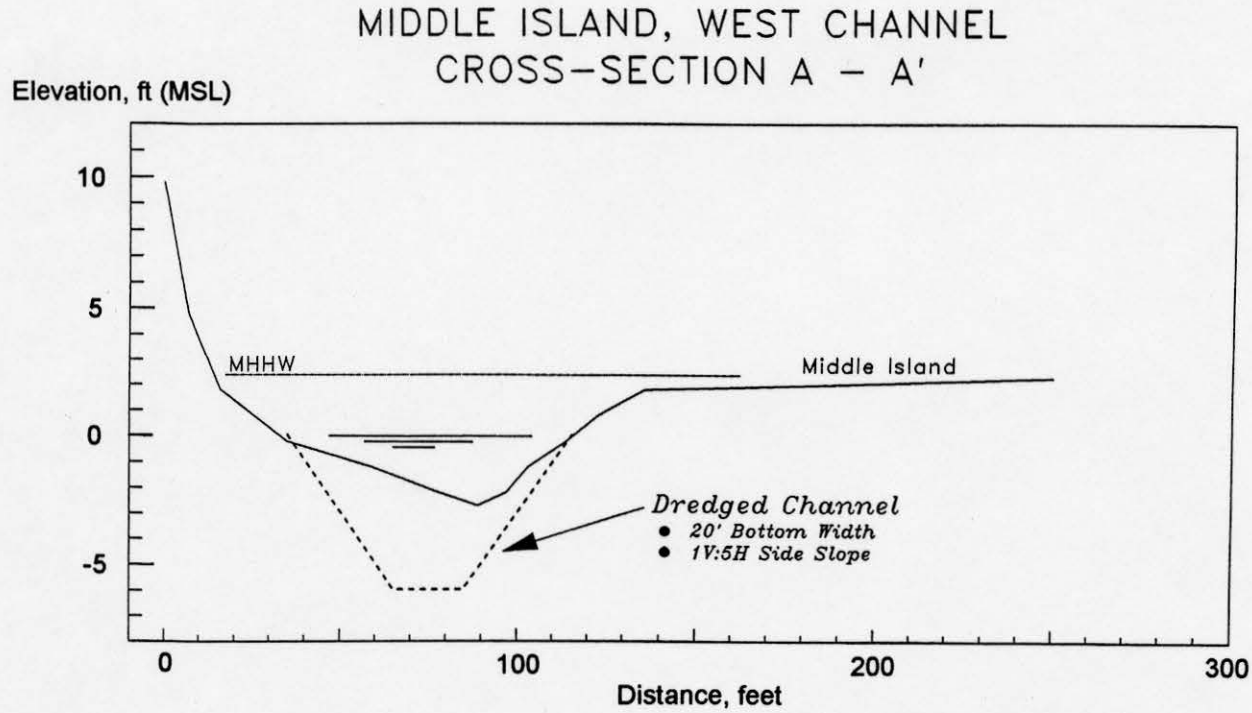


A. CONDITION IN 1912



B. EXISTING CONDITION

Figure 41: Channel Deepening, West Side Middle Island



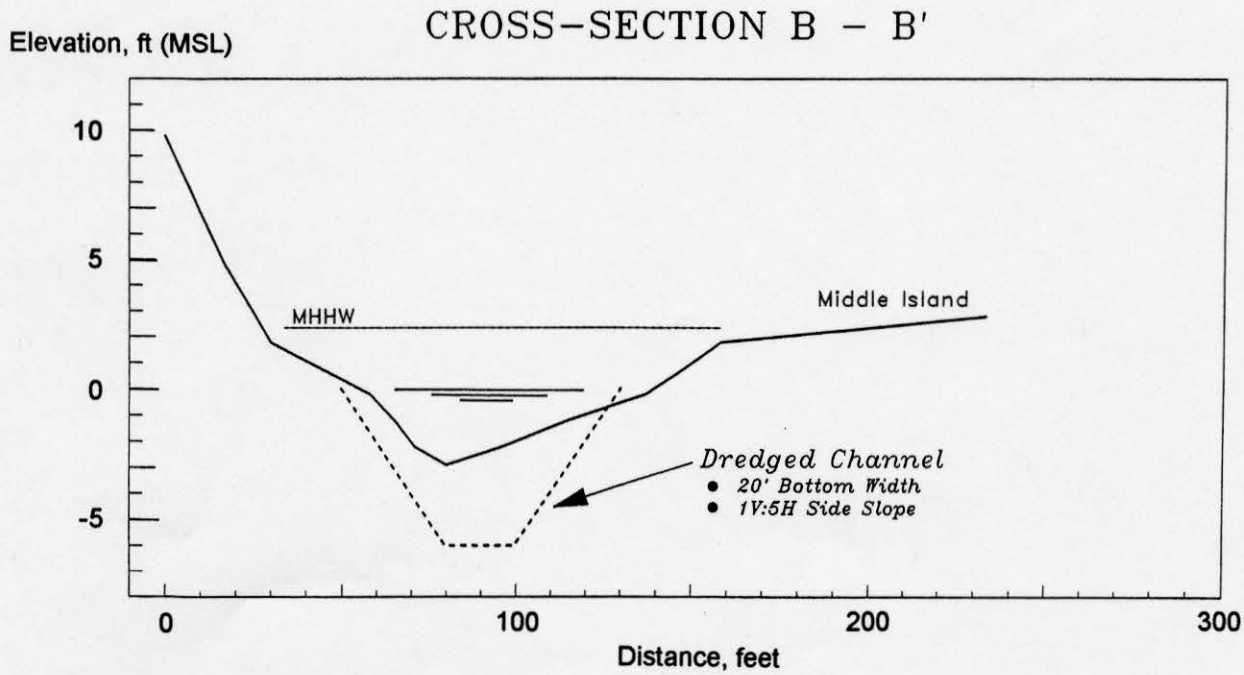


Figure 42: Channel Cross-Sections, West Side Middle Island

The extent of channel deepening was discussed with the resource agencies during the course of this study. The appropriate dredging effort in this area will minimize local disruption of the fish and wildlife while allowing cost-efficient dredge methods. In this effort, no destruction of existing salt marsh can be tolerated. Channel side slopes of 1V:3H are proposed. Previous dredge activity during the mid-1980's indicate that this slope is stable, given the fine-grained, cohesive nature of the deposited sediments. Based on these constraints, a nominal channel width of 20 ft is proposed at the design depth of -3 ft (MLLW). In several areas, however, the bottom channel width must be reduced to as little as five feet, in order to avoid encroachment on existing salt marsh. Figure 44 is presented to show typical channel cross-sections that presently exist. Superimposed on the existing channels are outlines of the proposed channel.

Deepening the channel in this way will provide an improvement in tidal circulation by increasing the tidal prism by 10.2 acre-ft. Further, subtidal habitat will be increased. Comparison of bathymetric data dating back to 1912 indicates that the shoaling rate in this channel is about 0.04 ft/year. Given this slow rate of shoaling, maintenance dredging of the channel is not expected to be necessary during the 50-year project life.

The shallow depth channel would be deepened using a small hydraulic dredge and pipelining the dredge spoil to the Shellmaker Island scow location. The dredge spoil would then be transported through Newport Harbor to the ocean dumpsite designated, LA-3, for disposal. The dredge quantity anticipated for removal within this channel is 24,000 cy.

The detrimental impacts of deepening the existing channel includes loss of existing intertidal mudflat habitat and the short-term disruption of the marsh by construction equipment.

5.7.6 Shellmaker Island, Small Dendritic Channel

In order to create additional intertidal wetlands, a narrow channel is proposed to be constructed along a depression aligned in a north-south direction on Shellmaker Island. The location of the channel is shown in Figure 45. The channel design is a bottom elevation of –5 ft (MSL) with a 10-foot bottom width. The side slopes of the channel are 1V:3H. Figure 46 presents the representation cross-section (A-A’) for this channel. The length of the channel is 1,270 feet, yielding an excavation quantity of 9,000 cy. Following discussions with the resource agencies, this channel creation is intended to be a demonstration measure, in order to evaluate the desirability of similar actions at other locations within the bay in the future.

This channel would increase the tidal prism of the Upper Bay by 4.6 acre-feet, and would allow tidal circulation between the main channel area and the side channel passing across Shellmaker Island. This new intertidal habitat would be created on the periphery of marshland and adjacent to degraded upland of the developed area on the south side of Shellmaker Island.

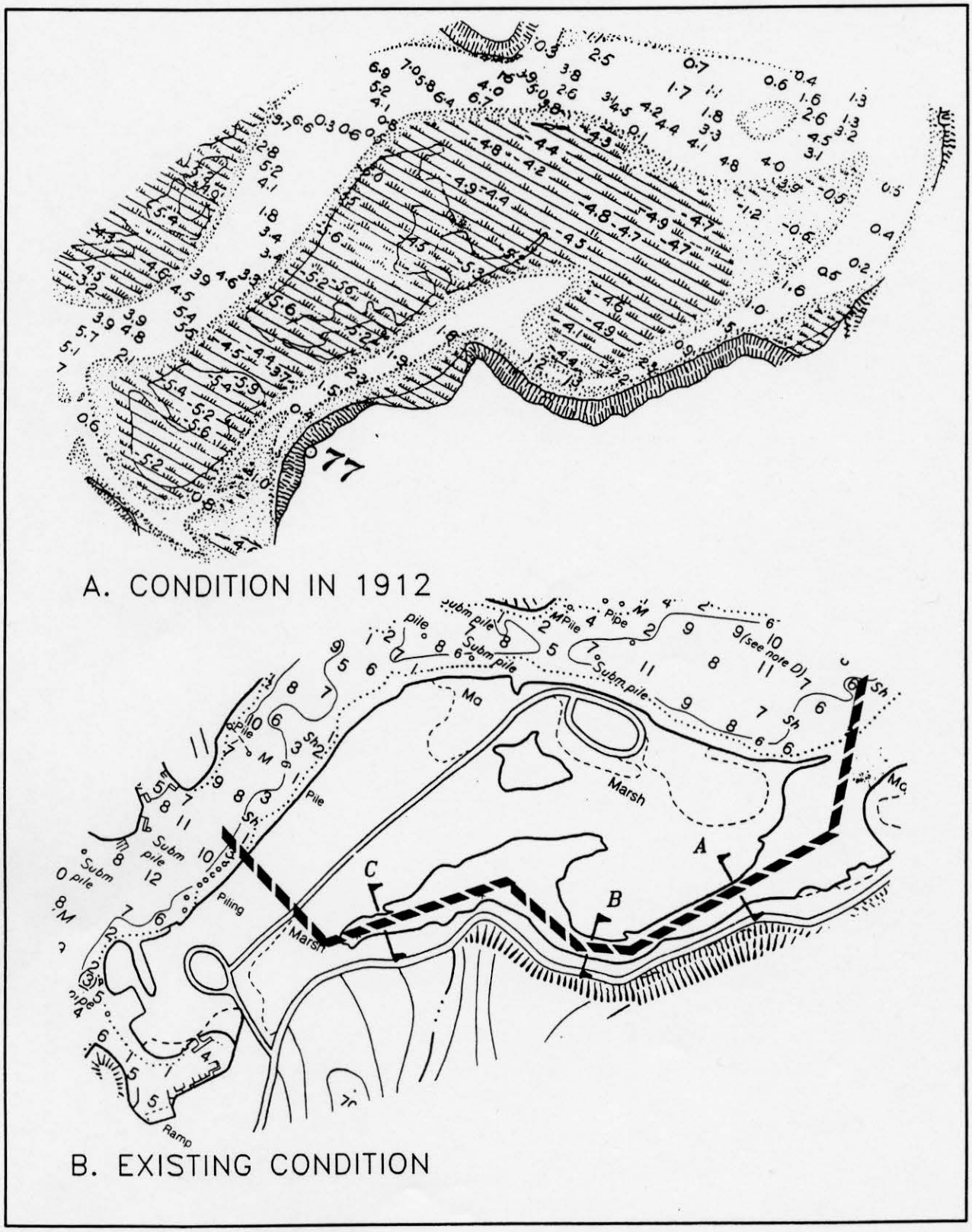
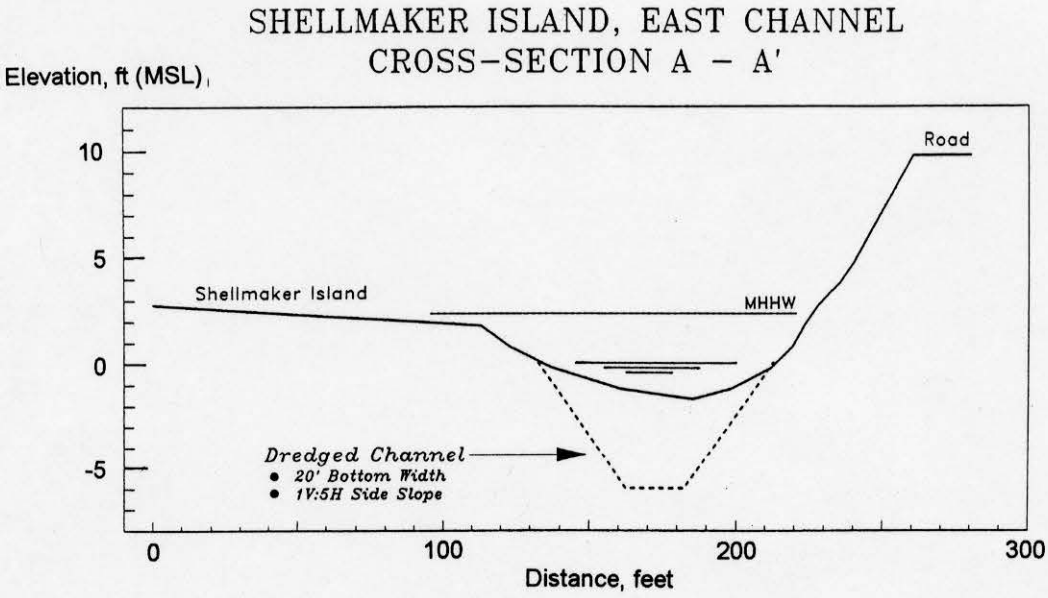
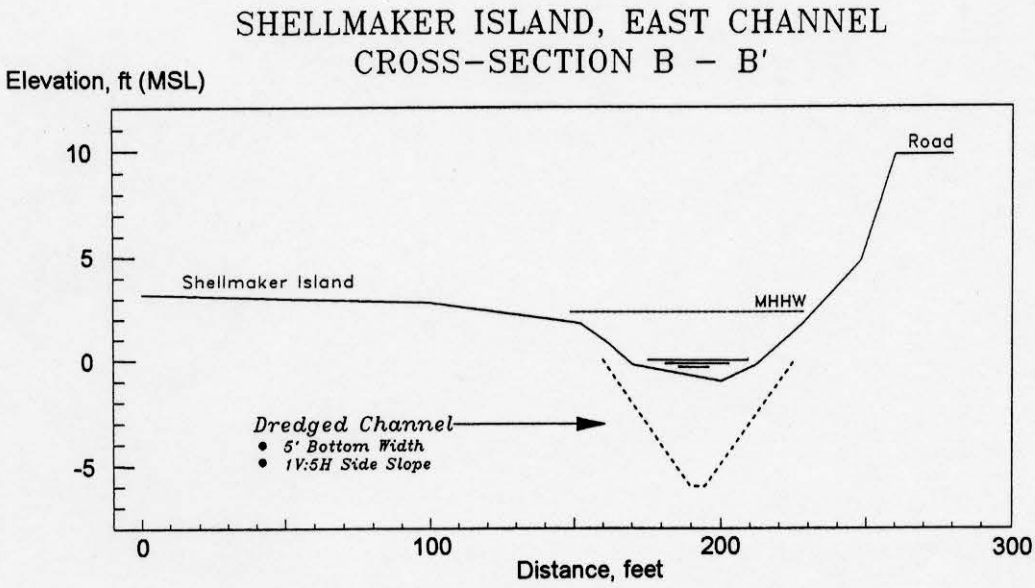


Figure 43: Channel Deepening, East Side Shellmaker Island





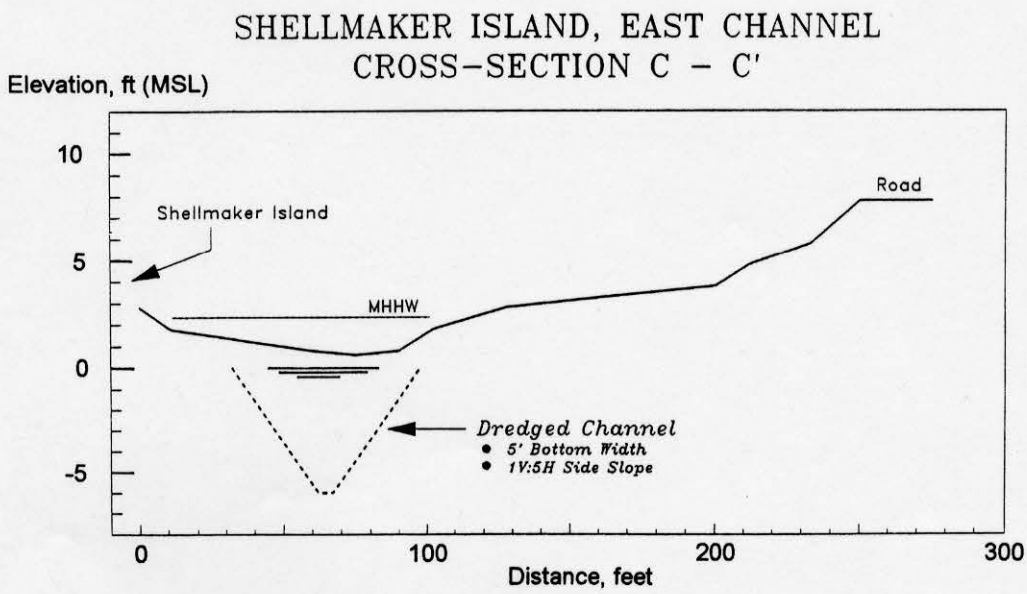


Figure 44: Channel Cross-Sections, East Side Shellmaker Island

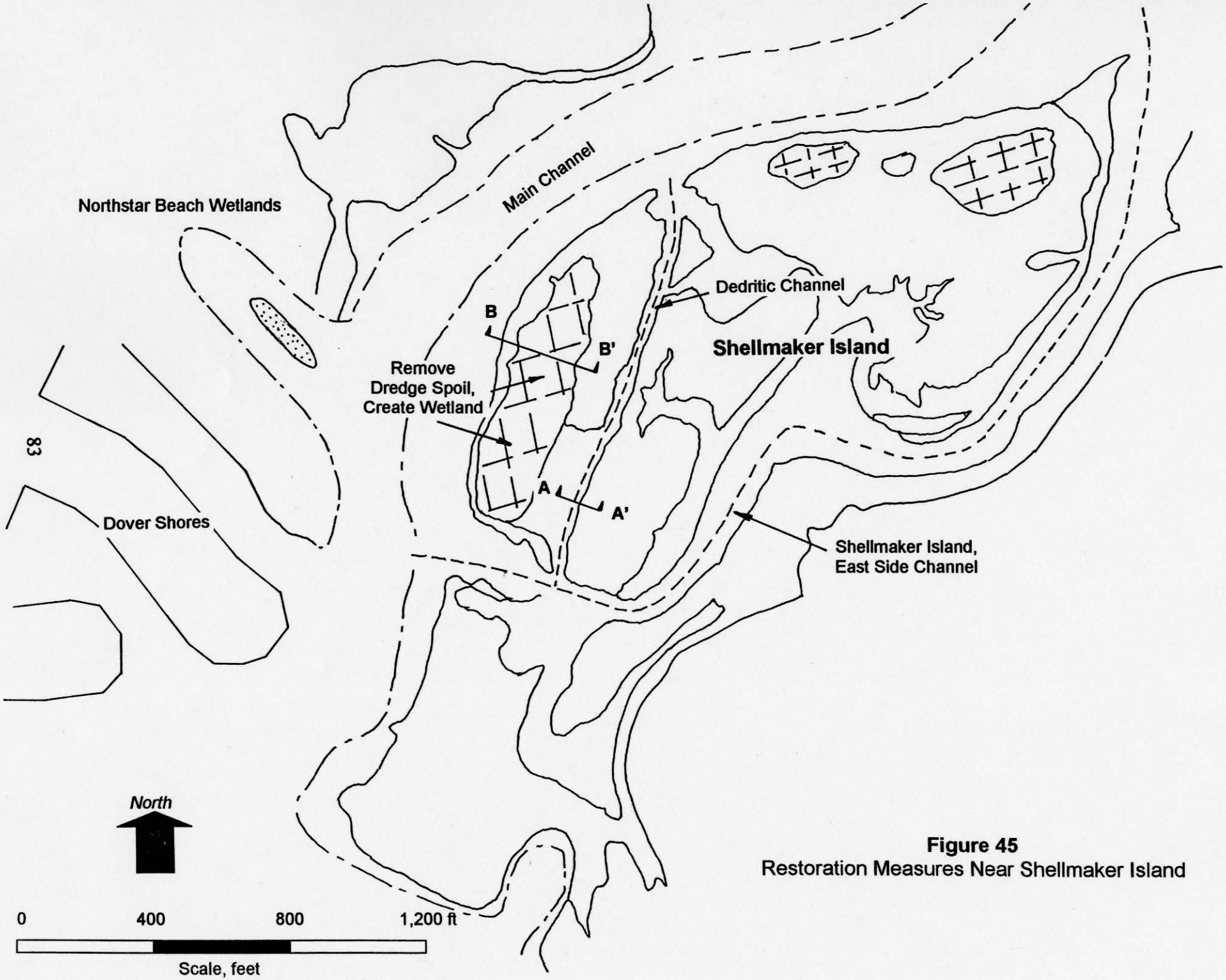


Figure 45
Restoration Measures Near Shellmaker Island

The method of construction would utilize land-based equipment. A backhoe would excavate the channel, starting at the north end. The excavated soils would be removed by front end loader, traveling along the unexcavated path of the channel to the south. By using the channel axis as the only route to the area of construction, the construction equipment would only pass over ground that would soon be excavated. The excavated materials could conceivably be used for the surface material needed for the new least tern island to be constructed adjacent to the Main Dike.

5.7.7 Shellmaker Island, Remove Dredge Spoil/Create Wetland

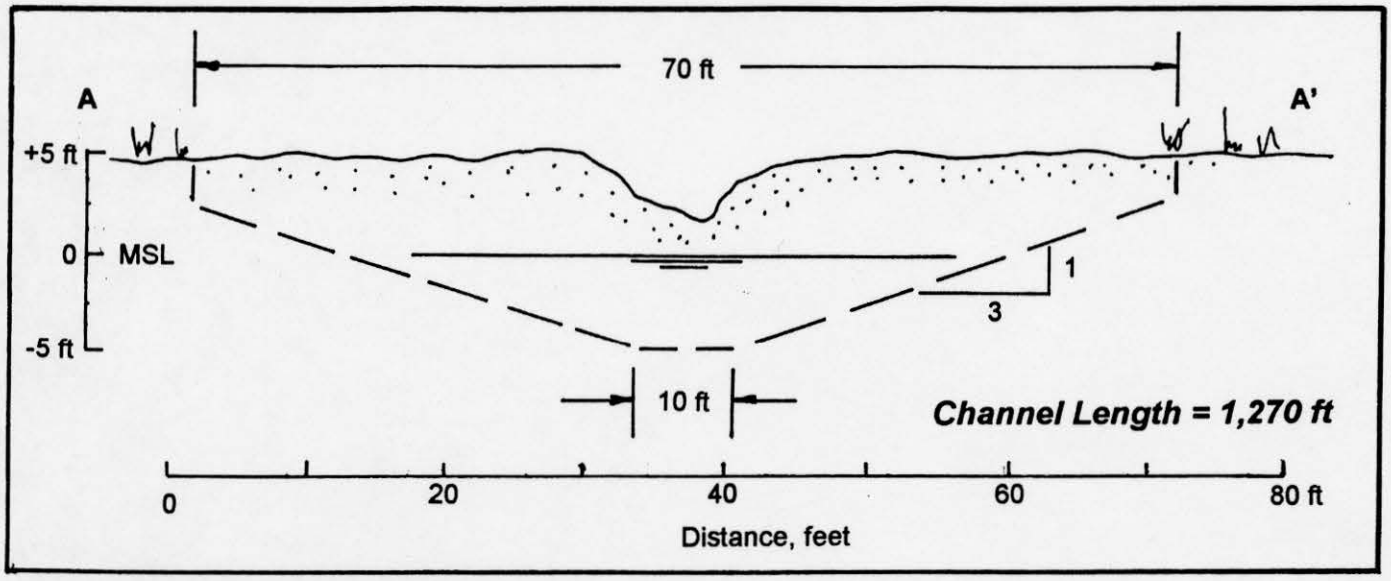
This wetlands restoration measure is located in the degraded upland area west of the proposed dendritic channel and north of the channel cut through the middle of Shellmaker Island, as shown in Figure 45. The existing elevation in this area of +5 ft (MSL) will be reduced by seven feet to –2 ft MSL. A representative cross-section (B-B') of the wetland creation is shown in Figure 46. This work would transfer about three acres of upland to intertidal mudflat. Excavation could be performed by backhoe working from the shore. The upland material may be used within the Upper Newport Bay reserve in the creation of the new least tern island. The total volume of excavation is 34,000 cy.

5.7.8 Northstar Beach, Wetlands Creation

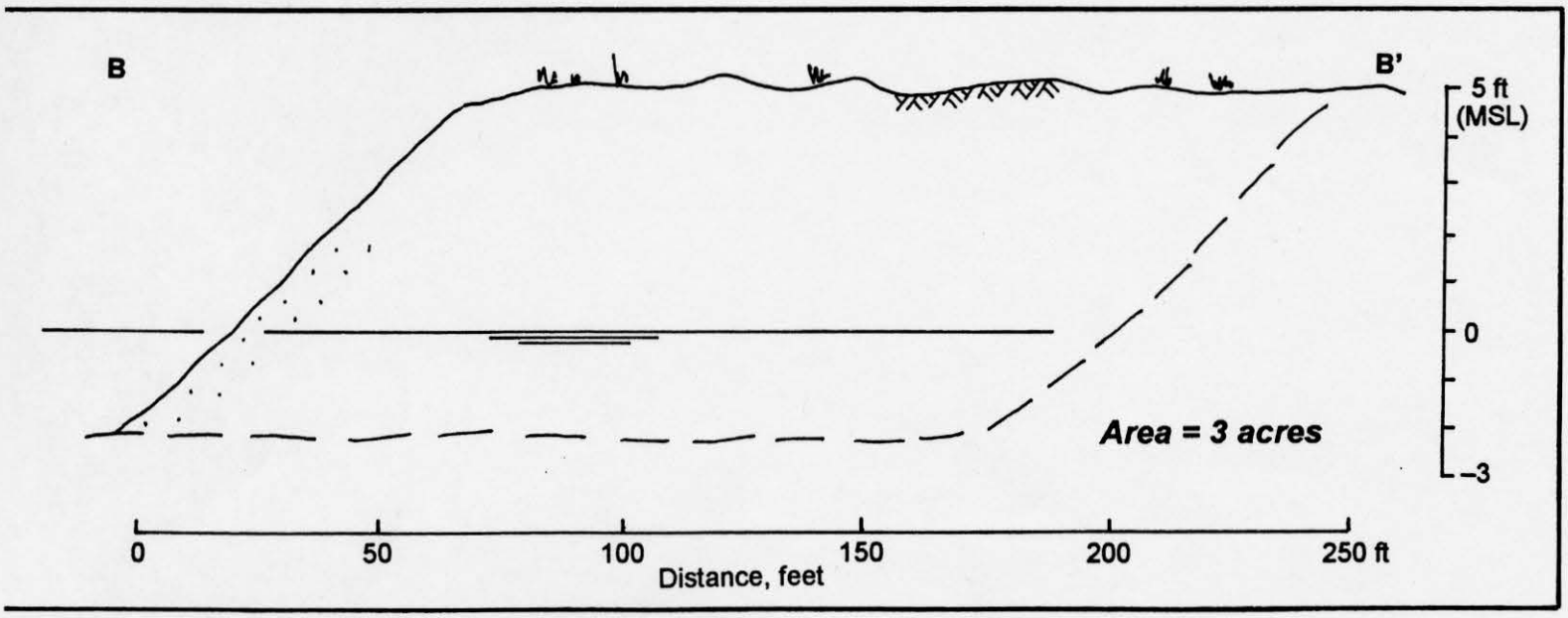
Directly south of the Newport Aquatic Center, a flat sand plain exists. This area, termed Northstar Beach, covers an area of about four acres, and is bounded on the south by the Dover Shores residential community. Photos of the area dating to the 1940's indicate that this area was once a wetlands environment. During the 1960's, however, development at this site included the dredging of sand onto this area, thereby eliminating its natural wetlands character. The location of this area with a comparison of the present condition relative to that of 1912 is shown in Figure 47.

Following a suggestion of the U.S. Fish and Wildlife Service, the conceptual design of a wetlands habitat at this location has been considered. The proposed wetland is presented in Figure 48. A shallow embayment with a low-lying island would be created. The total habitat area would encompass about three acres. Mudflat creation totalling 1.1 acres would result. The elevation of the mudflat island would be -2 ft (MSL), and would be surrounded by a shallow channel having a width of 20 ft and bottom elevation of -5 ft (MSL). A typical cross-section (A-A') is shown in Figure 48.

The total volume of sediment that would be excavated to construct this wetland would be about 36,800 cubic yards. The excavation would be performed "in the dry" by delaying the opening of the newly created channels to tidal waters until after the earthmoving work had been completed. It is believed that the excavated material at this site will be composed of clean sand, capable of being used as beach fill within Newport Bay or on the adjoining coastal beaches.



A. Shellmaker Island Dendritic Channel



B. Shellmaker Island Wetlands Creation

Figure 46: Typical Cross-Sections for Restoration Measures

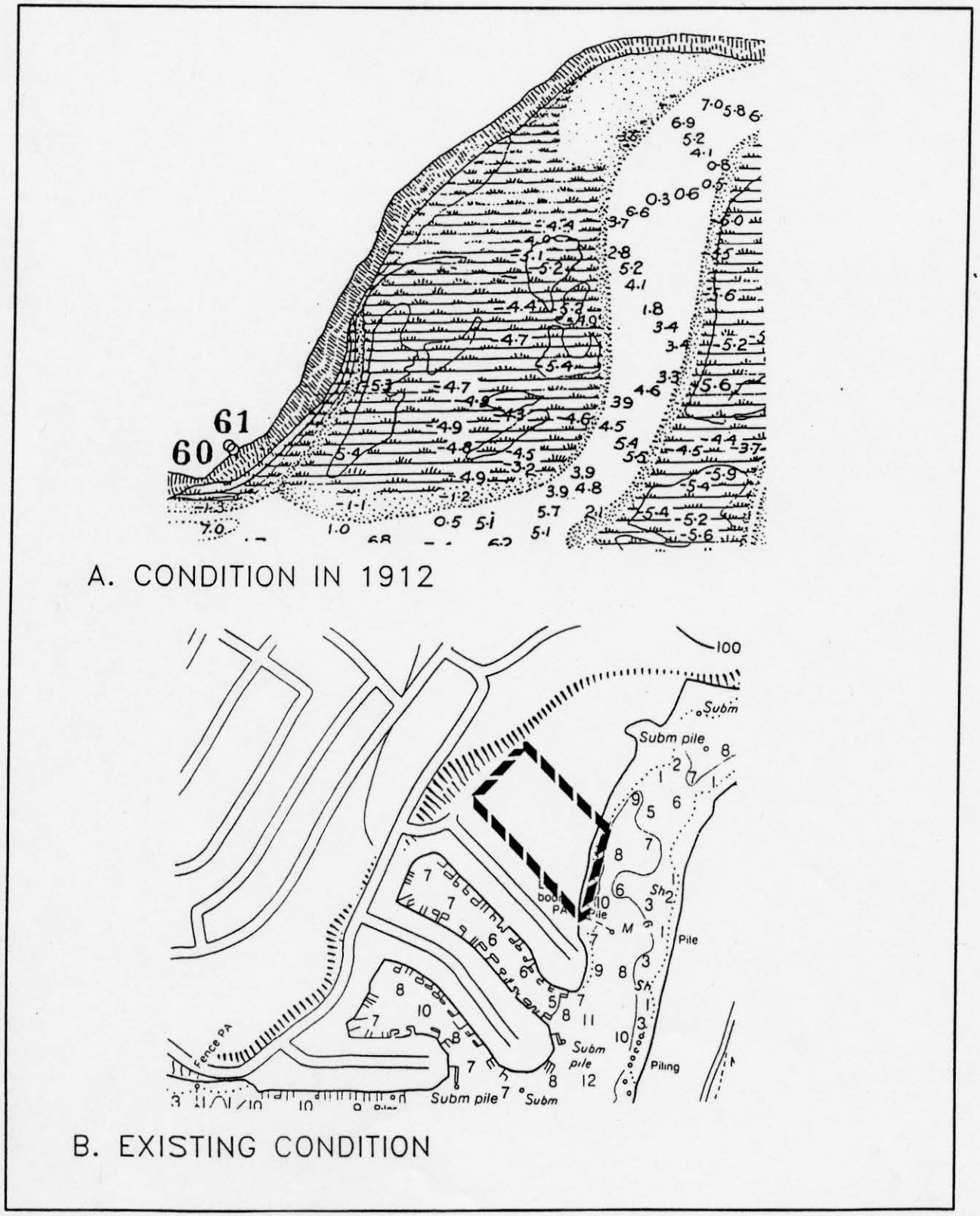
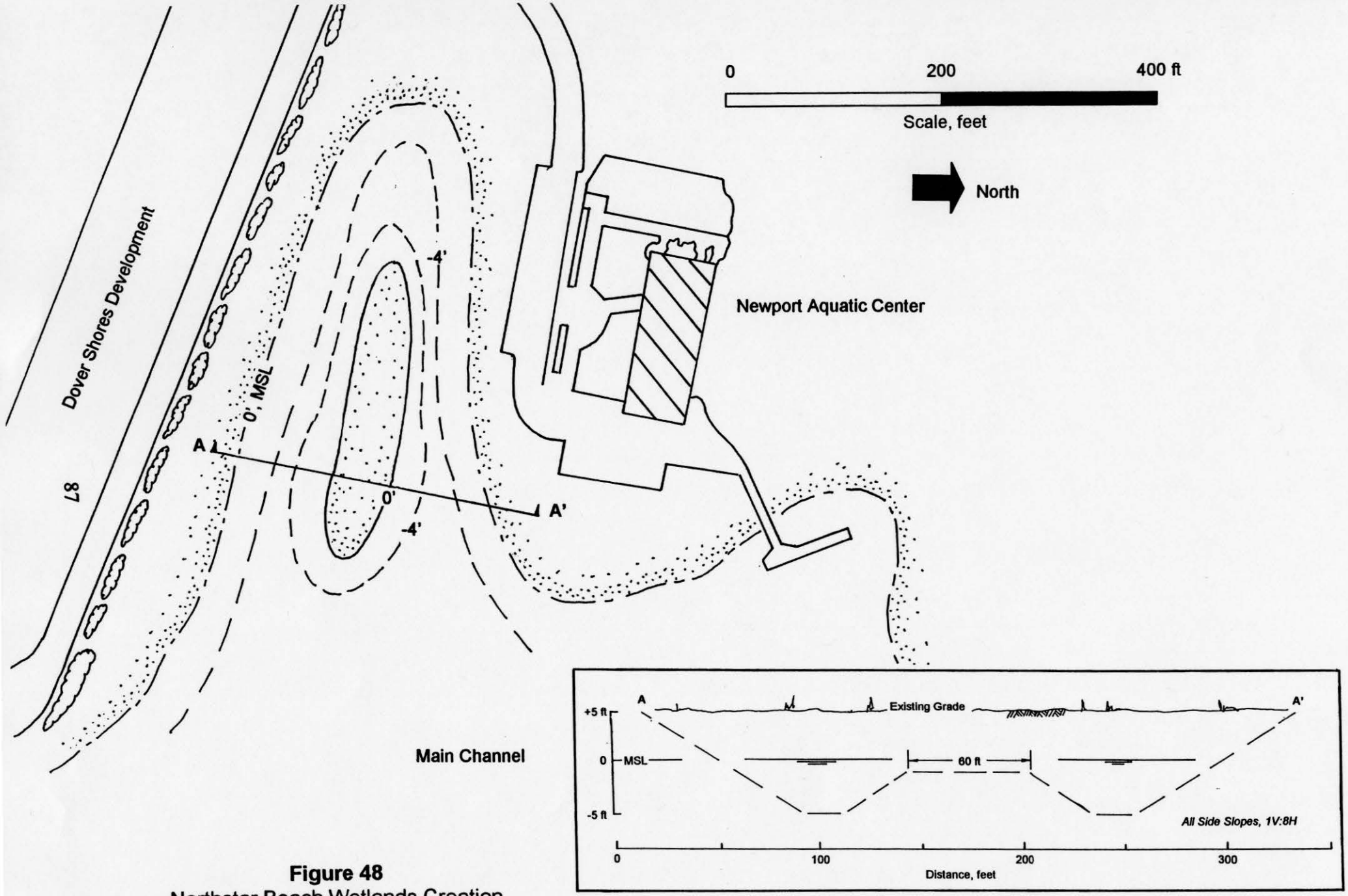


Figure 47: Northstar Beach Location Map



Typical Cross-Section

Figure 48
Northstar Beach Wetlands Creation

This option would serve to increase various habitats within the Bay: subtidal, intertidal mudflat, and (eventually) salt marsh. The tidal prism of Newport Bay would be increased by 13.4 acre-ft.

Potential disadvantages of this site for wetlands creation include its existing use as the site for the debris boom used by the City of Newport Beach to remove debris from bay waters during periods of flood flows. Also, the area is a popular recreational site being immediately adjacent to the boating activities of the Newport Aquatic Center. It is feasible, however, that providing a more natural setting at this location will not diminish the attractiveness of the Aquatic Center environment.

5.7.9 Plant Eelgrass Beds

One area of eelgrass bed restoration is proposed along the west side of Shellmaker Island. This plan would create new eelgrass habitat in areas that are not heavily traveled by boat traffic and which are not subject to excessive sedimentation. The proposed area for the introduction of eelgrass is 0.6 acres. The estimated cost of $47,500/acre has been developed based upon the proposed Section 206 project, which promotes eelgrass bed restoration in Lower Newport Bay.

5.7.10 Remove Unit I/III Least Tern Island/Construct New Tern Island by Salt Dike

Removal of the existing "kidney" shaped least tern island in the Unit I/III Basin is proposed in Alternatives 4, 5, and 6, in order to increase the sediment capacity of that basin. In addition to island removal, a least tern island of equal size will be construction adjacent to the Main Dike, near the Unit II Basin. Figure 40 presents the location of the new island and provides a typical cross-section (B-B'). The elevation of the toe of the new island would either be –14 ft (MSL) if Alternative 4 was selected, or –20 ft if Alternative 5 or 6 were selected.

In order to remove the island in the Unit I/III Basin, the surface five feet of material would be excavated for re-use at the new island site. Once this surface material was removed, dredging of the island foundation would be undertaken in order to deepen the Unit I/III Basin to the extent required. The necessary removal of the existing island would require an excavation of 150,000 cy if removed to Elev. –14 ft (MSL) (Alternatives 1 and 5) or 200,000 cy if removed to Elev. –20 (Alternatives 4 and 6).

Only the top five feet of the existing island is believed to be suitable for the new island construction. This would provide 40,000 cy for the new island. An additional 23,000 cy of sand would need to be imported to complete the construction of the new island. Importation of this sand would be from the sand accumulations on Interceptor Beach (near the Orange County Harbor Department Headquarters in the Lower Bay) or from wetland improvement excavations at Shellmaker Island or Northstar Beach, or from dredged areas within the Upper Bay that exhibit suitably high sand content.

Removal of the old island foundation (below that scavenged from the new island) would be accomplished during Unit I/III dredging activities. The dredging needs in the area of island

removal would be 110,000 to 160,000 cy to remove the base of the old island down to –14 ft or –20 ft, respectively. Three methods of removal of this sediment are possible: 1) clamshell to barge scow and then disposal at sea, 2) dredge hydraulically via pipeline during UnitI/III deepening , and 3) clamshell to barge and transfer to land on the north side of Unit I/III Basin then truck it to a disposal site. Option 3) can be eliminated because it calls for a land site capable of accepting 110,000 to 160,000 cy of saline sediment and must be transported in 11,000 to 16,000 truck loads (10 cy per truck) on the city streets.

In order to remove an existing least tern island, the following construction plan is proposed. Backhoes (Cat 245 or equivalent) would excavate between +5 ft and 0 ft (MSL) at a rate of 480 cy/hour per machine. For the 40,000 cy to be excavated, one machine would require 83 hours (9 days, single 12 hour shift). Two Cat 966 front-end loaders would tram the excavated material onto a barge (80 ft x 200 ft) that would be grounded against the island. The capacity of the barge is 2,500 cy per load. Sixteen barge trips would be necessary from the kidney island to the dike area for offloading the 40,000 cy from the old island site. At the site of the new tern island, loaders would tram the material off the barge and it would be spread by a bulldozer and track-rolled for compaction. Once the base material of 40,000 was spread and compacted, the remaining surface of 23,000 cy of sand would be transported in 10 barge loads (2,500 cy per barge) from its source within Newport Bay to the new least tern island near the Main Dike.

This scenario presumes that the existing “kidney” shaped island of the Unit I/III Basin can be dismantled prior to the construction of the new island near the dike. Consultation with the resource agencies indicates that this is feasible, assuming that island dismantling and construction avoids the least tern nesting season.

5.7.11 Add Sand to Hotdog Tern Island, Unit I/III Basin

Since the “hotdog” shaped Least Tern Island was constructed in the Unit I Basin in the mid-1980’s, invasive vegetation has covered its surface. Clean sand without vegetation is the preferred habitat for least terns. Therefore, to restore the least tern habitat on the hotdog island of the Unit I/III Basin, the existing vegetation will be removed from the island surface, and new sand with shell fragments will be placed and spread as the island cover.

The volume of new sand that will be provided will cover the three acre island to a depth of two feet, requiring a total of 9,700 cubic yards of sand. The source of the sand will be from the proposed restoration sites at Northstar Beach or Shellmaker Island, or from a sand beach accumulation located south of the Harbor Patrol office near the entrance to Newport Bay.

The vegetation removal would be performed with a small bulldozer, supported by manual labor. The new sand will be transported to the island from its borrow location via 2,500 cy barge. Large front-end loaders would move the sand from the barge onto the island where it would be spread with small bulldozers. The job is expected to require about six days to perform with single 12-hour shifts. One day to clear vegetation, two days to load and deliver sand, two days to spread sand. The estimated cost for this restoration measure is $10/cubic yard, in place.

5.7.12 Add Sand to Kidney Tern Island, Unit I/III Basin (Alternative 1 only)

Alternatives 4, 5, and 6 include the removal of the kidney-shaped least tern island from the Unit I/III Basin. For Alternative 1, the kidney island will remain, however, vegetation will be removed from the island surface and a two-foot layer of new sand will be placed and spread. The four acre island will require a total of 12,900 cy of sand. The sand will be acquired from other sites of restoration within Upper Newport Bay (Northstar Beach, Shellmaker Island) or from the sand beach accumulation near the Harbor Patrol office in the Lower Bay. The sand will be moved by barge, placed and spread by front-end loaders and small bulldozers. About five barge loads of sand would be required (2,500 cy barge capacity). About eight days would be required for this effort, working a single 12-hour day shift.

5.7.13 Segment Main Dike

The Main Dike currently provides direct access via footpath to sensitive habitat areas within the Upper Bay. On the west side, paths lead to the dike from the vicinity of the Santa Ana-Delhi Channel. On the east side, travel along the dike is directly from Back Bay Drive. Prevention of access along the Dike will be particularly important on the west side to prevent travel of people and predators to the proposed new least tern island at the northwest end of the Unit II Basin. To prevent overland travel along the dike, segments would be excavated via front-end loaders or a clamshell bucket. Minimum excavation is required and the sediments would be placed in ocean-going dump scows for disposal at the LA-3 offshore dumpsite.

5.7.14 Scour Protection at San Diego Creek (Alternatives 4 and 6 only)

At present, the scour protection apron at the mouth of San Diego Creek has been placed to the bottom elevation of the Unit III Basin (-14 ft, MSL). If Alternatives 4 or 6 are selected for construction, the scour protection apron must be extended downward to the proposed basin depth of –20 ft (MSL). The scour apron consists of grouted one-ton stone placed at a slope of 1V:1H (45° from horizontal) over a distance of 170 feet. The volume of grouted stone required for this apron totals 410 tons.

5.7.15 Education Kiosks

The installation of four small information kiosks are proposed along Back Bay Drive. The locations have not been specifically identified, however, they will likely be located at the typical stopping sites such as Shellmaker Island, Big Canyon, the Main Dike, and near the Unit I/III Basin. The cost estimates provided ($8,000 each) are based on similar kiosks constructed by the Corps of Engineers for other projects and discussions with recreational specialists and landscape architects.

5.8 Dredge Requirements

To consider life cycle costs, an estimate must be made for the dredging maintenance interval that will be required for each alternative. Given the variability of annual sediment inflows to

Newport Bay, the maintenance requirements are very much dependent on not just basin capacity, but also the sequence of sediment inflow. Initially, the RMA numerical model was used to perform a sedimentation analysis for each alternative for a 15-year period. The sediment inflow for the 15-year period was variable, given actual historical inflow data. That analysis was not helpful in considering maintenance interval since the degree of sedimentation was dependent on the arbitrary selection of the variable annual sediment inflows.

To assist in comparing the sedimentation behavior for all alternatives, the sedimentation analysis was performed for a constant sediment inflow of 250,000 cubic yards per year. This analysis indicated the nature of the sediment accumulation and the behavior of sediment bypassing south within the bay once the northerly sediment basins were approaching their ultimate capacities. A further refinement that proved helpful was to scale the results of the 250,000 cy/year inputs to the annual average input of 164,000 cy/year (based on a sediment inflow history spanning the 25-year period, 1972-1996). It is these scaled values of sedimentation volume that have previously been presented, both in tabular and graphical form. From these adjusted model results, the determination of maintenance dredging interval was estimated for each project alternative.

After careful consideration, the criteria that was selected to initiate maintenance dredging within the Upper Bay was three-fold, as follows:

1. Maintenance should be performed once the Unit I/III and Unit II Basins fail to capture 50% of the cumulative sediment inflow. Conversely, dredging must be initiated once 50% of the cumulative sediment deposits beyond these basins.

2. Maintenance dredging would be required once 30% of the cumulative annual sediment deposition occurs south of the Pacific Coast Highway (PCH) bridge.

3. Maintenance dredging would be required in a timely manner to prevent net changes in habitat types (e.g. open water transitioning to mudflat) within the Upper Bay. Analysis of this criterion is limited to the areas containing the Units I/III and II Basins and is based on the sediment storage capacity within the basins below –3 ft MSL.

The timing of maintenance dredging is directed at meeting the main ecological objectives of the Upper Newport Bay restoration (“*To restore, enhance, maximize and maintain the overall intrinsic ecological values provided in the Upper Newport Bay coastal estuarine system for fish and wildlife . . .* (Upper Newport Bay Environmental Restoration Technical Advisory Group (TAG)). The three criteria indicated above were selected based on sedimentation problems realized within the Upper Bay during the period spanning 1985 and 1997. All criteria relate to the need to dredge once the sedimentation basins lose efficiency in capturing incoming sediment, in order to decrease sediment flows to the south and to prevent large-scale changes in habitat type within the Upper Bay. As stated previously, the assessment of these criteria are based on the RMA modeling results utilizing an annual sediment inflow of 250,000 cubic yards, scaled downward to the average annual inflow of 164,000 cubic yards. For Alternatives 4 and 6, the 15

year modeling results needed to be extrapolated to beyond 20 years to estimate the maintenance dredging interval.

Tables 15 and 16 indicate the volumes of sediment to be dredged for the various project alternatives described previously. Table 15 presents the volume of dredging to create each alternative initially, presumed to occur in the Year 2003. Table 16 indicates the sediment volume to be dredged on a recurring maintenance basis, ranging in time interval from 7 years (Alternative 1) to 24 years (Alternative 4). Both tables provide information for two types/methods of dredge operations—using a large, ocean-going clamshell dredge, and using a small, land-based hydraulic dredge. Most methods of dredging have presumed a daily production rate of 3,000 cubic yards based on recent dredging experience in the Upper Bay (Rossmiller, personal communication). However, for Alternative 6 when a clamshell dredge is used, the daily production rate is assumed to be 4,000 cubic yards. Deeper digging without frequent dredge movement supports a higher production rate for the clamshell method for this alternative. A similar increase in productivity for Alternative 6 is not assumed for the hydraulic dredge option. Work days have been converted to months assuming 6 work days per week, 24-hour work days (of which only 20 hours are productive), with 90% efficiency during the remaining work time.

5.8.1 Alternative 1 Dredging Requirements

The dredging requirement to create the Alternative 1 configuration is estimated to be 889,000 cy for the clamshell method and 814,000 for the small hydraulic dredge method. The maintenance dredging interval was determined, based on the above-stated criteria, as follows:

Referring to Table 11, Criteria #1 is satisfied in Year 7, when the cumulative sediment passing the Unit I/III and Unit II basins exceeds 50%. Criteria #2 is satisfied in Year 8, when the volume of sediment passing south of PCH exceeds 30%. Criteria #3 is satisfied when the Unit I/III accumulates enough sediment (estimated to be about 500,000 cy) to achieve an elevation of –3 ft (MSL). Based on extrapolating the values shown in Figure 27, this is expected to occur about Year 25. As the first criteria for dredging is met in Year 7 (Criteria #1), that dredging interval has been selected. At that time, the expected maintenance dredge requirement is estimated to be 797,000 cy for the clamshell option and 597,000 for the hydraulic dredge option.

5.8.2 Alternative 4 Dredging Requirements

The dredging requirements to create the Alternative 4 configuration requires the removal of 2,713,000 cy of sediment if the clamshell method is used and 2,638,000 cy of sediment if the small hydraulic dredge is used. The dredge maintenance interval has been determined based on the previously stated criteria, as follows:

TABLE 15
UPPER NEWPORT BAY
FUTURE DREDGE VOLUMES AND FREQUENCIES

INITIAL DREDGING REQUIREMENTS

Dredge Method: Large, Ocean-going Clamshell Dredge

	Dredge Area							Time Required		
Alternative	Unit I/III	Unit II	Channel Between Units I & II	Channel Bordering Unit II	Dredge Access Channel	Other Measures*	**Total**	Work Days	Months**	Start, Relative to 1999
'No Project'	n/a	n/a	n/a	n/a	n/a		n/a	n/a	n/a	n/a
1	219,000	382,000	19,000	8,000	75,000	186,000	**889,000**	296	13	Year 4
4	1,118,000	1,297,000	20,000	8,000	75,000	195,000	**2,713,000**	678	29	Year 4
5	616,000	77,000	20,000	8,000	75,000	175,000	**971,000**	324	14	Year 4
6	958,000	866,000	20,000	8,000	75,000	195,000	**2,122,000**	531	23	Year 4

Dredge Method: Small, Land-based Hydraulic Dredge

	Dredge Area							Time Required		
Alternative	Unit I/III	Unit II	Channel Between Units I & II	Channel Bordering Unit II	Dredge Access Channel	Other Measures*	**Total**	Work Days	Months**	Start, Relative to 1999
'No Project'	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1	219,000	382,000	19,000	8,000	-	186,000	**814,000**	271	12	Year 4
4	1,118,000	1,297,000	20,000	8,000	-	195,000	**2,638,000**	879	38	Year 4
5	616,000	77,000	20,000	8,000	-	175,000	**896,000**	299	13	Year 4
6	958,000	866,000	20,000	8,000	-	195,000	**2,047,000**	682	30	Year 4

* Other Measures include: Wetlands creation at bullnose section of Land (NW Corner of Unit I/III), East Side Channel, New Island, West Side Channel, Middle Island, East Side Channel, Shellmaker Island, and Wetlands creation at Shellmaker Is. & Northstar Beach, and the small dendritic channel on Shellmaker Island.

** Work Days are converted to Months by assuming 6 work days per week with 90% efficiency.

TABLE 16
UPPER NEWPORT BAY
FUTURE DREDGE VOLUMES AND FREQUENCIES

MAINTENANCE DREDGING REQUIREMENTS

Dredge Method: Large, Ocean-going Clamshell Dredge

	Dredge Area						Time Required	
Alternative	Unit I/III	Unit II	Channel Between Units I & II	Channel Bordering Unit II	Dredge Access Channel	**Total**	Work Days	Months**
'No Project'	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1	343,000	196,000	31,000	27,000	200,000	**797,000**	266	12
4	1,080,000	1,251,000	65,000	36,000	300,000	**2,732,000**	683	30
5	643,000	141,000	31,000	16,000	200,000	**1,031,000**	344	15
6	1,010,000	714,000	82,000	57,000	300,000	**2,163,000**	541	24

Dredge Method: Small, Land-based Hydraulic Dredge

	Dredge Area						Time Required	
Alternative	Unit I/III	Unit II	Channel Between Units I & II	Channel Bordering Unit II	Dredge Access Channel	**Total**	Work Days	Months**
'No Project'	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1	343,000	196,000	31,000	27,000	-	**597,000**	199	9
4	1,080,000	1,251,000	65,000	36,000	-	**2,432,000**	811	35
5	643,000	141,000	31,000	16,000	-	**831,000**	277	12
6	1,010,000	714,000	82,000	57,000	-	**1,863,000**	621	27

** Work Days are converted to Months by assuming 6 work days per week with 90% efficiency.

In reference to Table 12, Criteria #1 is not satisfied within the 25 years for which data is presented. However, it is assumed that the sediment accumulation combined within the Unit I/III and Unit II Basins will fall below 50% in about Year 30. Criteria #2 is satisfied in Year 26 when the sediment passing to the Lower Bay exceeds 30%. Criteria #3, which requires accumulation of greater than 1.4 million cy in the Unit I/III Basin or 1.5 million cy in the Unit II Basin does not occur until about Year 24 (in Unit I/III). Therefore, the maintenance interval for Alternative 4 is 24 years, in conformance with Criteria #3. During each maintenance activity, the total volume of material to be dredged is 2,732,000 cy for the clamshell method and 2,432,000 for the small hydraulic dredge method.

5.8.3 Alternative 5 Dredging Requirements

To construct Alternative 5, 971,000 cy of sediment must be dredged if the clamshell method is used and 896,000 cy of sediment must be removed if the small hydraulic method is employed. The dredge maintenance interval has been selected based on an analysis of the previously described criteria, as follows:

Table 13 indicates that Criteria #1 is achieved in Year 11 when less than 50% of the sediment accumulation occurs in the Unit I/III and Unit II Basins. Criteria #2 is satisfied in Year 10 when the sediment passing below the PCH Bridge exceeds 30% of the input. Criteria #3 is difficult to estimate, however, the required filling of the Unit I/III and Unit II Basins is greater than the 15 years for which data has been compiled. Therefore, Criteria #2 dictates the maintenance interval to be 10 years. During each maintenance cycle, the sediment to be dredged is estimated to be 1,031,000 cy for the clamshell method and 831,000 cy for the small hydraulic dredge method.

5.8.4 Alternative 6 Dredging Requirements

The Alternative 6 configuration requires for initial construction a total of 2,122,000 cy of sediment if the clamshell method is used and 2,047,000 cy if the small dredge method is used. The dredge maintenance interval has been estimated using the previously described criteria, as follows:

Table 14 provides sediment accumulation data that indicates that Criteria #1 is achieved in Year 26, when less than 50% accumulates in the Unit I/III and Unit II Basins. Criteria #2 is satisfied in Year 21, when the sediment passing to the Lower Bay exceeds 30% of the total input. Criteria #3, which requires that the Unit I/II and/or the Unit II Basins fill to an average depth of –3 ft (MSL) requires in excess of 1.2 million cy of sediment in either basin. This appears to not occur until after Year 25. Therefore, Criteria #2 governs and indicates a maintenance interval for dredging of 21 years. For each maintenance cycle, the clamshell method will require a dredge quantity of 2,163,000 cy and the small hydraulic dredge will require 1,863,000 cy of sediment removal.

Table 17 presents the maintenance interval required for each project alternative for the various criteria. The choice of estimated maintenance interval (shown in ***bold italics***) is based on the earliest time at which any of the three criteria are met.

Table 17: Maintenance Interval Based on Sedimentation Criteria

Criteria	Alternative 1	Alternative 4	Alternative 5	Alternative 6
1 (50% Passing Unit II)	***7 years***	30 years	11 years	26 years
2 (30% Passing PCH)	8	26	***10***	***21***
3 (No Habitat Changes, Unit I/III)	>15	***24***	>15	23
3 (No Habitat Changes, Unit II)	>15	>24	>15	>25

6. CONSTRUCTION METHODS

6.1 Introduction

The nature of the environmental enhancement and sedimentation control that is being considered in Upper Newport Bay requires the removal of bottom sediments through dredging methods. The dredging methods that will be most efficient and economical will vary with the volume and location of dredging to be conducted. For the project alternatives under consideration, the required dredge quantities span a wide range, from 800,000 cubic yards (cy) to 2.7 million cubic yards. Small environmental enhancement components of the alternatives are of considerably smaller scale, ranging from 10,000 to 40,000 cy.

Large-scale dredging will be necessary to perform future maintenance through the periodic removal of accumulated sediments within the Unit I/III and Unit II sedimentation basins. Small-scale dredging efforts are necessary to conduct channel deepening in narrow channels around islands. Land excavation using land-based construction equipment is feasible for the removal or modification of existing islands, or for the creation of new wetland habitat in the Upper Bay.

During the early-1980's, the cities of Newport Beach and Irvine entered into an agreement with the Southern California Associations of Governments to determine methods to reduce the degradation of the Upper Newport Bay environment that resulted from the infilling of the bay by eroded sediments from the San Diego Creek watershed. As a result of this study, an Environmental Impact Report was prepared to support the dredging alternatives undertaken subsequently in the construction of the Unit II "in-bay" basin that was ultimately constructed in 1987 (City of Newport Beach, 1986). That document included a detailed description of dredging alternatives (Chaney, 1985). Because of the direct applicability of that work in relation to the proposed project alternatives being considered in this study, the findings of the earlier work are still valid. In addition, however, this study seeks to evaluate more recent dredging technology to determine if new methods exist that might accomplish the dredging goals while being less intrusive to the environmental habitats and neighboring residential communities of Upper Newport Bay.

6.2 Alternative Dredging Scenarios

The alternatives being considered for the improvement of Upper Newport Bay in this feasibility study encompass a range of alternative locations, dredge volume requirements, and channel depths.

All of the potential dredging locations require floating dredge equipment. In addition, land-based excavation will be required for the alternatives involving island removal and creation of new wetlands. Two methods of dredging in submerged conditions are appropriate to consider: clamshell dredging and hydraulic cutterhead suction dredging.

6.2.1 Clamshell (Backhoe) Dredging

The clamshell method of dredging relies on a barge- or land-mounted crane to operate the clamshell and place the solid sediment in an adjacent bottom dump scow. This method is also considered to be possible using a backhoe excavator working from the side of a floating barge. Using either the crane-supported clamshell or the backhoe operations, very little water is transported with the excavated sediment in the disposal scow.

The traditional clamshell dredging method incorporates a crane mounted barge to operate the clamshell for the direct deposit of dredged materials into ocean-going disposal scows located alongside. This method of dredging proved to be successful for the Unit II sedimentation basin excavation conducted in 1987 and for the Unit I/III dredging program of 1998-1999. A principal advantage of this method includes the placement within the disposal barge of dredged sediments with only incidental quantities of bay water. This allows all scows to depart for the LA-3 offshore dumpsite fully loaded with dredged material. This method, therefore, minimizes the number of barge loads transported through Newport Bay.

Unfortunately, use of the clamshell requires relatively deep draft channel conditions to allow free movement of the barges within the Upper Bay. In 1987 and to a lesser degree again in 1998-99, the operational depth that was specified and achieved was –14 ft (MSL). In order to allow passage of the clamshell dredge equipment and scows to the Unit II basin site, a channel with a width of 100 ft and bottom elevation of –14 ft (MSL) was dredged from just south of the Pacific Coast Highway Bridge to the Unit II basin, a total distance of 2.4 miles necessitating additional dredging requirements of as much as 500,000 cy. Therefore, periodic maintenance dredging efforts of the Unit I and Unit II basins will require re-dredging of some portion of the access channel as well. While this access channel was recognized as significantly increasing the Unit II basin excavation requirements, it was ultimately included in both the 1987 and 1998-1999 dredging programs with the understanding that this option included tangible additional benefits in terms of water mass flushing, sediment storage, and recreational access.

The clamshell dredge plan calls for a small tugboat to transport and hold an empty disposal scow near the dredge as another scow is filled while secured alongside the dredge barge. The filled scow would be pushed by the tug to a barge marshalling area below the Pacific Coast Highway Bridge. The full scow would be exchanged for an empty one for return to the dredge site in the Upper Bay. The filled scow would be pushed by ocean-going tug out of Newport Harbor to the disposal site at LA-3. A guide boat would accompany all tug and barge movements to improve the safety of the barge transport through the bay. The most recent Upper Bay dredge program required use of 1,500 cy scows operating 24-hours per day, 6 days per week. The duration of the program totaled 15 months (January 1998-April 1999) in order to dredge 859,000 cubic yards. The daily dredge output was highly variable, but averaged about 3,000 cubic yards. The slow rate of production, relative to earlier dredge programs in the Upper Bay, was caused by greater environmental awareness and scrutiny related to turbidity, vessel wake creation, noise, and endangered species monitoring.

6.2.2 Hydraulic Dredging

The hydraulic cutterhead suction dredging method utilizes water as the sediment transport medium, thereby incorporating large volumes of water in the sediment-water slurry that is delivered by pipeline to the disposal barge. This method, which was attempted during the most recent dredging effort in the Upper Bay, proved ineffective, primarily due to the cost of the large ocean-going equipment involved and the inability to efficiently deal with the excess water that delivered the dredged sediment to the disposal barges. Since the dredged material is mixed with water in order to transit the pipeline, dredged solids compose only about 20% by volume of the slurry. The remainder of the slurry is transport water. Because of the fine-grained nature of the sediments to be dredged in most areas of the Upper Bay, the settling velocities will be so slow that dewatering of the disposal barge to remove the transport water is not feasible without losing substantial portions of the dredged material in the process. In addition, should no methods be employed to clarify the dredge water, the dewatering action would induce substantial turbidity in the vicinity of the barge.

New technology exists that utilizes a small floating dredge of modest size that performs hydraulic dredge operations. These light-weight, self-propelled barges can be launched from the shore (Dunes Marina, Shellmaker Island, Jamboree Road). Initial discussions with two manufacturers of these small dredges indicate that their use will lessen the intrusive nature of the previously used ocean-going clamshell barges, while maintaining a reasonable rate of dredge production. The specifications of the small dredges under consideration are presented in Tables 18 and 19.

The rate of solids delivery through a 12-inch pipeline from the small dredge to the scow barges would be about 150 cy/hour, or 3,000 cy per 20-hour work day. To avoid intrusion of the sensitive Upper Bay habitat areas, the dredge spoil from the Unit I/III and Unit II Basins would be transported via pipeline along Back Bay Drive to the dump scow staging area off the south end of Shellmaker Island. Scows would be filled at this location and would then transit beneath the PCH Bridge and through the Lower Bay on its way to the offshore dumpsite. In order to pump the dredge spoils the required distance (15,000 ft), two booster pumps will be placed at 4,000 foot intervals along the Back Bay Drive pipeline route. A view of the small dredge and pipeline layout is shown in Figure 49. This dredge plan has a number of advantages relative to the previously used clamshell dredge methods, as described below.

- Potentially lower cost (procurement, operations, maintenance);
- Ability to perform fine dredge cuts and maneuver in narrow channels;
- Lower level of intrusion in the marsh areas of the Upper Bay due to:
    - + Small, self-propelled dredge unit;
    - + Lack of need for scow barges to transit into the Upper Bay, thereby limiting noise, lights, and vessel wakes;
    - + Lack of need to dredge access channel for scow barge access to Upper Bay.

The concern in the operation of the small dredge is the need to remove the water transported through the delivery pipeline to the scow barge prior to leaving the dock for the ocean dumpsite. Without concentrating the sediment in the scow, the sediment quantity within

each barge would be limited to about 20% of the barge capacity (the remaining 80% of the barge would carry bay water to the disposal site). In order to increase the volume of sediment in the scow, the dredge flow must be periodically directed to another available barge once the initial barge is filled to allow decanting of the water accumulated in the barge. Figure 50 presents an example of how this alternate dredge filling would be accomplished. At the scow marshalling area (presumed to be on the south end of Shellmaker Island) the hydraulic dredge output (3,000 gallons/minute) would be directed into one of three scows. A flocculation agent that promotes rapid sediment settling would be injected upstream of the discharge into each barge. As a scow fills with the sediment/water slurry, the dredge discharge would be directed to an adjacent barge. In the meantime, following sediment settling time of about 30 minutes, the clarified water would be pumped out of the barge directly into the bay. The alternating filling, settling, and decanting process would shift between three barges in a regular and predictable fashion. Figure 51 is presented to show the timeline of barge filling. As is evident, the fill time and decant time decreases as the barges become more full. During this process, the content of each barge would eventually increase to about 1,100 cy after six fill cycles. The time necessary for this filling would be about 20 hours, at which time all three barges would leave the marshalling area and travel to the LA-3 offshore dumpsite. Given the four hour travel time, the barges would be back to the marshalling area for the start of the next work day. The four hour period during which the hydraulic dredge would not be able to work because of the absence of the dump scows would be devoted to dredge maintenance, re-fueling, and moving within the dredge work area.

Table 18
SPECIFICATIONS
MODEL 6008 VERSI-DREDGE
Manufacturer:
Innovative Material Systems, Inc.
Olathe, Kansas

Dimensions

Length	43 feet	Draft	20 inches
Width	11 feet	Weight	26,500 lbs
Height	10.3 feet		

Flotation

Pontoons	4 each, 36 in x 39 in x 13.5 ft, internal bulkheads and stiffeners
Total Displacement	37,850 lbs

Working Capacity

Cut	9 feet wide x 22 inch deep
Maximum Working Depth	22 feet

Engine

Type: Cummins Diesel Model 6CTAA8.3, 6-cylinder, turbo charged

Rated Performance	300 HP @ 2,200 rpm
Fuel Capacity	220 gallons. Fuel tanks located in pontoons
Propulsion	Starwheel(Pat) Drive Self-Propulsion

Dredge Pump

Type	Georgia Iron Works Model LCC-M 200-610
Discharge Diameter	8 inch
Suction Diameter	10 inch
Impeller Diameter	24 inch
Sphere Passage	4.3 inches
Pump Performance	2,500 gallons/minute @ 170 ft TDH (water) @ 90 rpm, 77% efficiency

Cutterhead

Diameter	22 inches
Length	9 feet

Replaceable hardened steel excavator blades

Speed	Variable to 187 rpm
Torque	12,000 inch-lbs
Cutterhead Ladder	Truss boom with 10 inch SDR-21 HDPE discharge pipe

Controls

Electronic joystick controls located in a heated/air conditioned cabin

Table 19
SPECIFICATIONS
MODEL J-30-32 WIDE HULL DREDGE
Manufacturer:
W & S Development, Inc.
Greenbush, Michigan

Dimensions

Hull Length	50 ft	Draft	2 ft
Overall Length,		Hull Height	5 ft
(Including Ladder)	63 ft	Height, w/ Cab	10.5 ft
Width, w/ Pontoons	21.5 feet	Weight	80,500 lbs

Flotation

Four pressured tested pontoons, framed with angle iron truss construction

Working Capacity

Maximum Working Depth	25 feet
Maximum Cut Width at 25 ft	70 ft

Engine

Type	Caterpillar Diesel Model 3406, x-cylinder, turbo charged
Rated Performance	440 HP @ 2,200 rpm
Fuel Capacity	500 gallons, fuel tanks located in pontoons
Propulsion	10.75-inch diameter x 33 ft long spuds w/ anchor cables
Winches	Pullmaster, rated to 8,000 lbs line pull
Maxim Muffler for noise reduction	

Dredge Pump

Type	Thomas Model J-30
Discharge Diameter	10 inch
Suction Diameter	10 inch
Impeller Diameter	30 inch
Pump Performance	4,000 gallons/minute
Solids Production	196 cubic yards/hour

Cutterhead

Mounted on 3-inch Diameter Shaft, 7 blades (replaceable teeth)

Ladder Length	32 feet
Speed	Bi-directional, Variable to 40 rpm
Torque	5,800 inch-lbs
Cutterhead Ladder	Truss boom with 10 inch SDR-21 HDPE discharge pipe

Controls

Controls located in a heated/air conditioned cabin

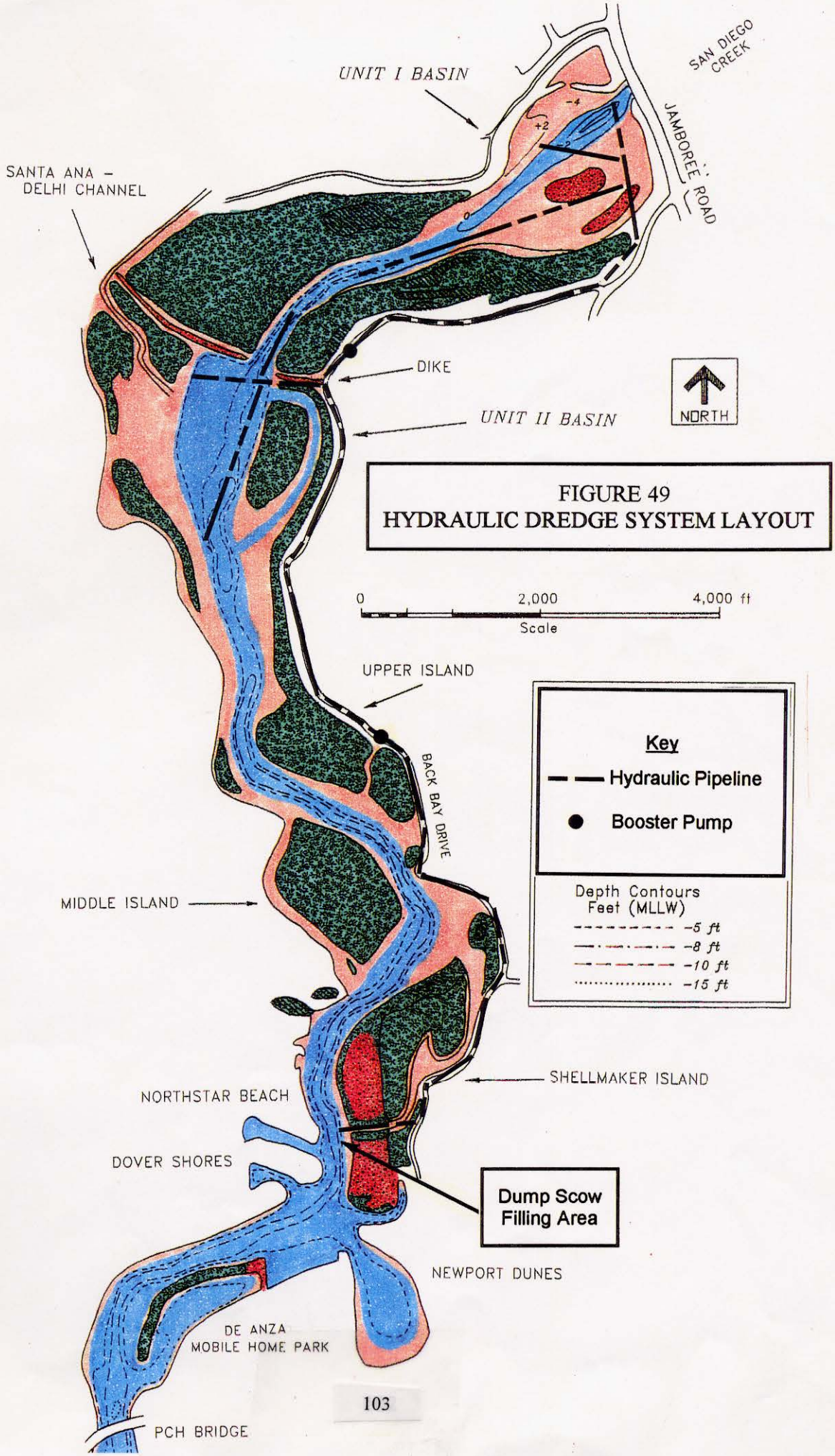


FIGURE 49
HYDRAULIC DREDGE SYSTEM LAYOUT

Small concentrations of chemical additives (common in the domestic potable water treatment industry) can be injected into the dredge discharge in order to increase the rate of sediment settling. Increasing settling rate in order to concentrate more sediment within each dump scow barge is considered essential in promoting cost-competiveness of the small hydraulic dredging program relative to the clamshell dredge method. Recently, a test of sediment settling using a flocculation agent has been conducted with Upper Newport Bay sediments. A chemical coagulant, "Nalcolyte 8100", produced by the Nalco Chemical Company, created dramatic improvement in water clarity in a brief period of time. It is anticipated that this or a similar coagulant would be injected into the high discharge (3,000 gallons/minute) dredge flow at a rate of 1.5 gallons per hour (based on in-house testing by Nalco). This results in a concentration in the dredge flow of about 8 parts per million. In the recent test, the initial turbidity of the simulated dredge water (400 NTU, estimated) was reduced to 5-7 NTU following the introduction of the chemical coagulant. Typical clarity of drinking water is 2-4 NTU. The Nalco Chemical Company has indicated, based on their use of this chemical in municipal potable water purification systems, that previous EPA and FDA approvals would confirm that this coagulant is judged to be safe for the Upper Bay application. In addition, the more rapid settling rate of the sediment within the barge would indicate more rapid settling of the sediment (i.e. reduced turbidity) within the receiving ocean water at the offshore dumpsite. Further evaluation of the use of chemical additives to clarify the water decanted from the dump scow is necessary, but the initial findings have been promising.

Each method of dredging (direct excavation using a clamshell or backhoes and hydraulic dredging using the small dredge) should be considered in light of project economics, environmental concerns, previous experience, and project construction efficiency. It is possible that the variation of habitat enhancement alternatives may necessitate different dredge methods at different locales.

Two sizes of disposal scows have been considered to transport the dredged sediment. These include barge capacities of 1,500 cy (150 ft x 25 ft), and 3,000 cy (260 ft x 45 ft). The 1,500 cy barge is more maneuverable and was used successfully in the 1998-99 dredge program in the Upper Bay. Given the large quantities of sediment considered for this study, dredge spoil disposal is proposed to occur at sea in the LA-3 dumpsite, located five miles southeast of the Newport Harbor Entrance. During periods of high tide, the empty barges ride high in the water and do not have sufficient vertical clearance to navigate beneath the Pacific Coast Highway Bridge. Therefore, during such periods, short-term delays in barge return to the Upper Bay may result.

The alternatives considered in this study present a variety of dredge requirements involving the Unit I/III Basin, the Unit II Basin, and the Access Channel connecting these basins to the Lower Bay. Depending on the alternative considered, maintenance dredging interval spans 7 to 24 years. Historically, large dredging volumes have been removed from the Upper Bay through the use of the clamshell/at-sea disposal barge method of dredging, based on the experience gained during the dredging of the Unit II sediment basin in 1987 and the most recent dredge program of 1998-1999. During the recent program, a total of 859,000 cy of sediment was

removed from the Unit I/III Basin (532,000 cy), the Access Channel leading to that basin (252,000 cy) and the Dover Shores area (75,000 cy).

Shallow water channel creation adjacent to existing islands cannot be created by the large clamshell equipment previously described. This is due to the limited channel width and the shallow channel depths, as well as the sensitive nature of the habitats of these project areas. The small, hydraulic dredges described previously are particularly well suited to these narrow, shallow channel applications. It is reasonable to consider this method of dredging for the channel alternatives adjacent to islands.

It has been assumed that the dredge work will encompass a 24-hour workday (2, 12-hour shifts), on a six day per week schedule. Noise issues are a concern with this type of equipment and the performance of work during the night should undergo further evaluation. During the Unit II basin dredging program of 1987 and the Unit I/III dredge program of 1998-1999, however, 24-hour/day operations were accomplished with limited (yet occasionally vocal) complaints from local residents. It is possible that use of the small, land-based dredge may be less intrusive, in that this method does not require transit of tugs and barges along the length of the Upper Bay. Barge traffic would solely exist between the Shellmaker Island staging area and the offshore disposal site.

6.3 Possible Dredge Spoil Disposal Sites

The disposal of dredged sediments from Upper Newport Bay has been accomplished in the past, with disposal occurring both onshore and at sea. In 1982, the excavated sediments from the Unit I Basin, located just below Jamboree Road, were placed on a site adjacent to San Diego Creek owned by the Irvine Company.

Given the large volumes of sediment to be dredged in support of this project and the lack of presently available land adjacent to the Upper Bay for disposal processing, it is assumed that the most viable method of dredge material disposal is at sea. The use of ocean-going barges to dispose of large volumes of sediment at the “LA-3” offshore disposal site was successfully accomplished during the Unit II sedimentation basin construction program in 1987 and more recently during the Unit I/III dredge program of 1998-1999. The location of the LA-3 dumpsite in relation to Newport Beach is shown in Figure 52. The round-rip travel time required to transit from the barge staging area at the south end of Shellmaker Island to the LA-3 dumpsite is about 4 hours.

Figure 50: Dump Scow Filling Scheme, Shellmaker Island

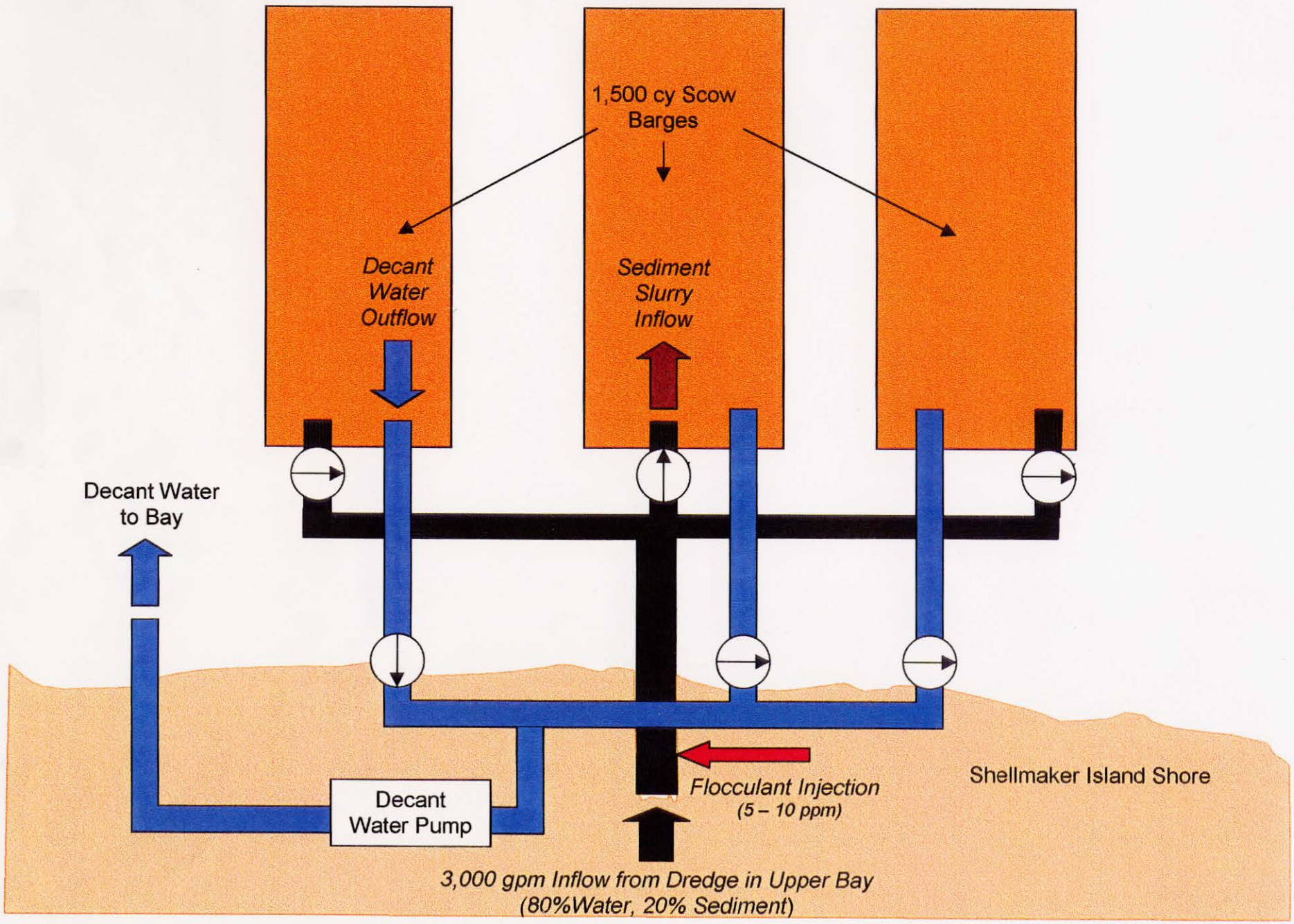
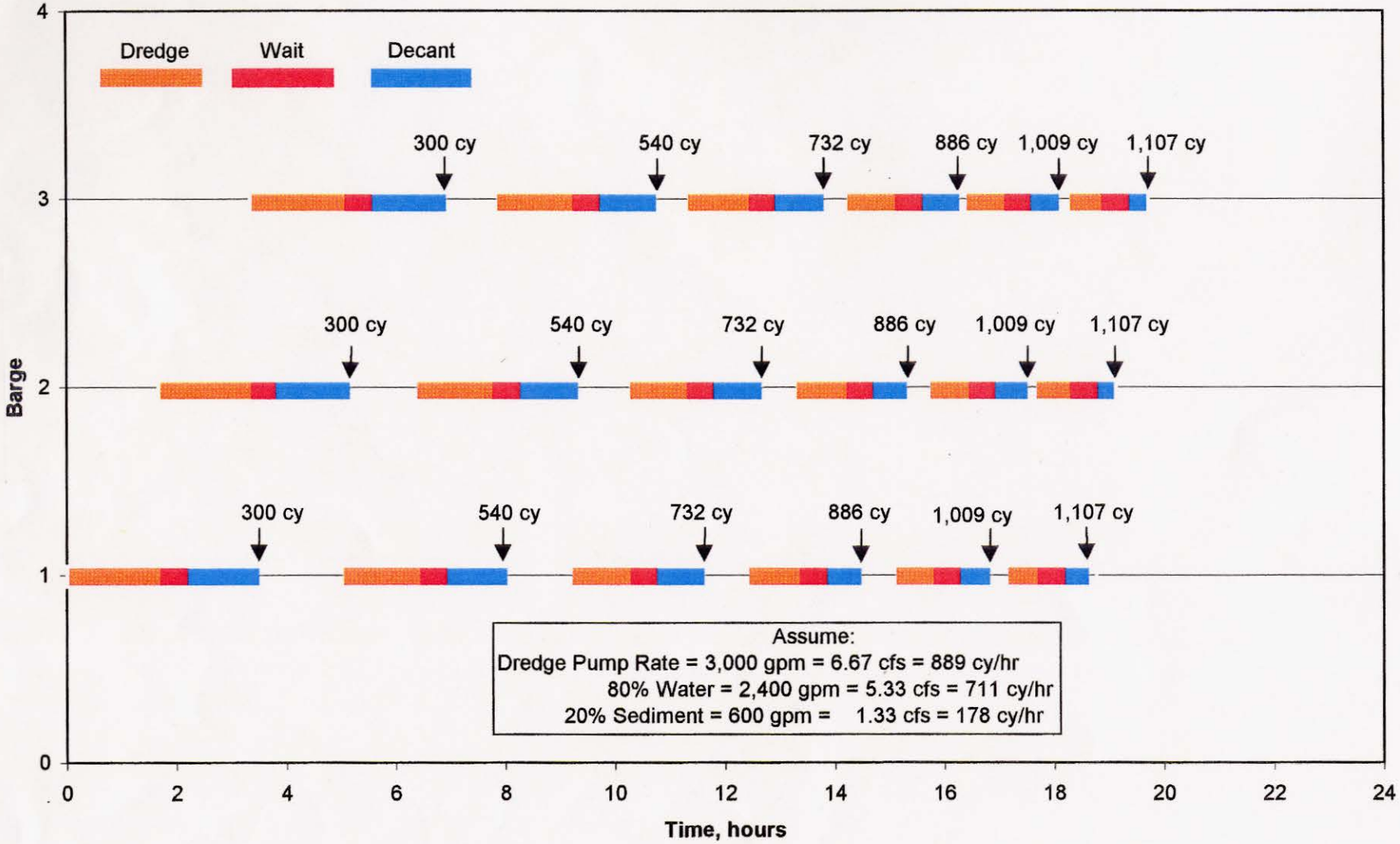


Figure 51
Successive Dredge Scow Filling Operation (3 Scows)



Given more stringent recent requirements for contaminant levels in dredged sediments that can be discharged at the LA-3 dumpsite, environmental analyses will be required prior to the final decision of the acceptability of this disposal option. At present, the U.S. Army Corps of Engineers and the Environmental Protection Agency are undertaking study and negotiations to allow offshore dumping at LA-3 to continue. Because there exist limited (if any) onshore sediment disposal options, and the only other Federally authorized sediment dumpsite (LA-2) lies off Los Angeles Harbor, well north of Newport Bay. The ability to perform maintenance dredging at Upper Newport Bay necessarily assumes the future availability of the LA-3 disposal site. In the recently authorized Water Resources Development Act of 1999, use of the LA-3 offshore disposal site has been approved through 2003.

Disposal of the dredged material at a new offshore dumpsite requires substantial effort to obtain approval by the EPA to designate such a dumpsite. In addition, when non-Federal interests perform the work, permits from the Corps of Engineers, Coastal Commission, and Regional Water Quality Control Board will be necessary. One obvious site that is substantially closer to Newport Harbor than the LA-3 dumpsite is in the deep waters of the Newport Submarine Canyon, located 2.5 miles west of the harbor entrance. To designate a new offshore dumpsite, the EPA requires a substantial amount of data collection in support of its Section 404 (b) 1 guidelines pursuant to the Clean Water Act and Section 103 guidelines to the Ocean Dumping Act. The EPA requires that all of the information developed in response to these guidelines be presented in the form of an Environmental Impact Statement (EIS) and processed under National Environmental Policy Act (NEPA) guidelines as part of the Corps of Engineers permit process. In anticipation of the Unit II dredging work of 1987, it was estimated that the time required to pursue an offshore dumpsite at Newport Submarine Canyon for the disposal of sediments from the Upper Bay would require three to four years at a cost of $500,000 to $1 million. At this time, it is planned that the LA-3 dumpsite will be re-authorized (or another site will be authorized in proximity to Newport Bay) for long-term use to allow future placement of dredge spoils from Upper Newport Bay.

Another method of dredged sediment disposal includes placement on the recreational beaches of Newport Bay or the adjacent ocean shore. Recent sediment testing performed for the 1998-1999 dredge effort indicates that the sediment dredged from the Upper Bay typically contains 40-80% silts and clays. Sediments with these high contents of fine-grained materials are not suitable for beach nourishment applications.

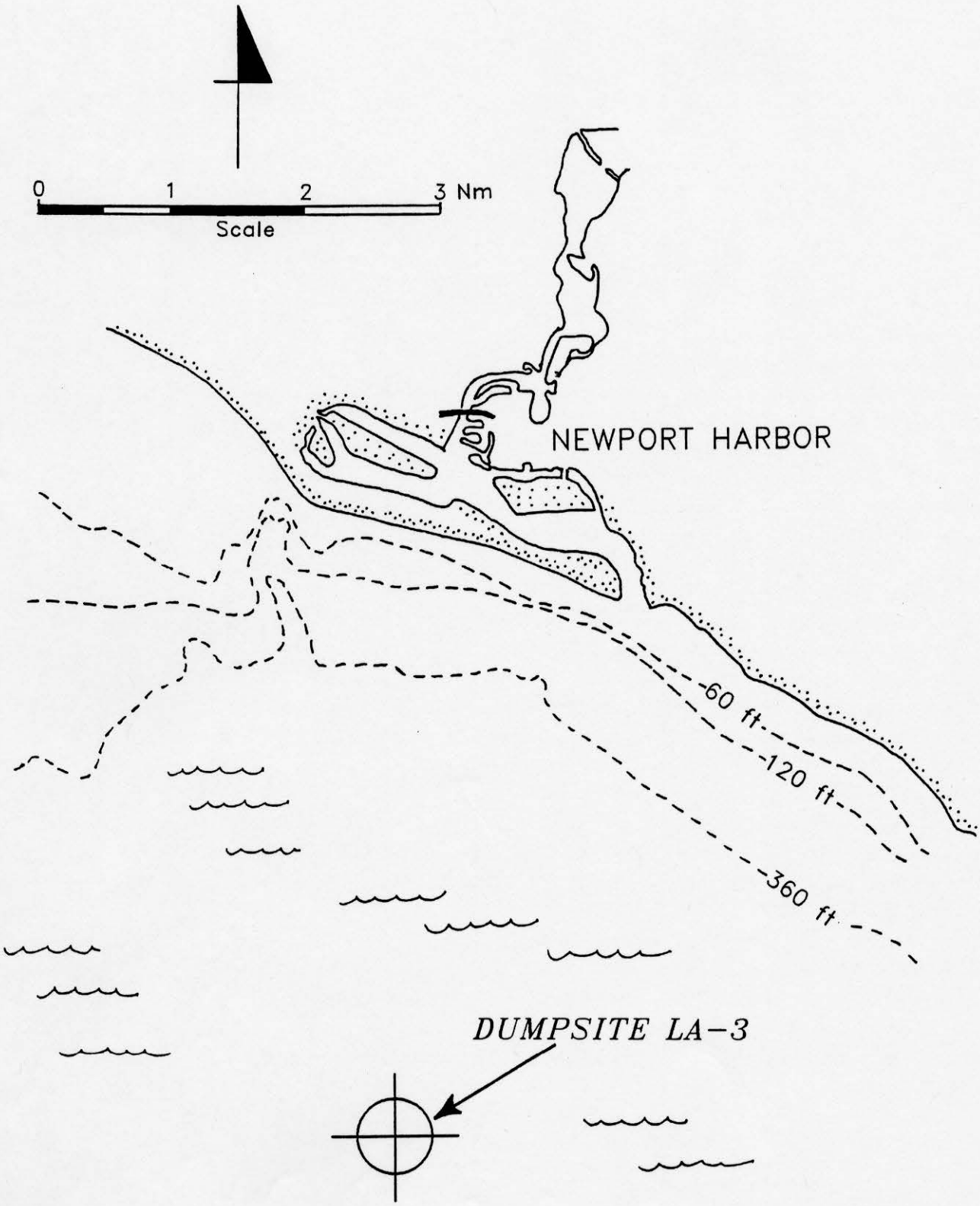


Figure 52: Offshore Dredge Disposal Dumpsite, LA-3

6.4 Regulatory Considerations

The proposed dredging activity, regardless of the dredging methods employed, will require permits from the California Coastal Commission, the U.S. Army Corps of Engineers, and the State Regional Water Quality Control Board. Agencies that are expected to express interest and/or concerns related to the dredging activity include the California Department of Fish and Game, the U.S. Fish and Wildlife Service, the Environmental Protection Agency (EPA), and the State Lands Commission. Disposal of dredged sediments at the LA-3 offshore dumpsite requires Corps of Engineers and Coastal Commission approval. Permitting approval is contingent on the results of a bioassay analysis to determine the environmental effects of any contaminants contained in the sediments to be discharged. In support of the Unit II basin excavation and disposal of 1987 and the more recent dredge work of 1998-99, bioassay work was performed successfully and the test results were satisfactory to allow the disposal of the dredged sediments at LA-3.

During the most recent dredging activity in Upper Newport Bay, several issues of environmental significance were experienced that should be addressed in future dredge programs. These issues trigger regulatory scrutiny and must be properly considered throughout the dredge program in order to avoid project delays caused by regulatory “stop work” orders and which may be accompanied by disciplinary measures and fines. This issues include the following:

- Inaccurate dredge spoil discharge at designated offshore disposal site.
- Project vessels operated at high speed within Newport Bay.
- Vessel/barge traffic in Lower Bay during periods of high recreational boat use.
- Creation of excessive noise and light near residential communities at night.
- Creation of excessive turbidity during dredging operations.
- Excessive air pollution by construction equipment due to inefficient operation.
- Monitoring and avoidance of rare and endangered species during operations.
- Grounding of deep-keeled construction vessels in narrow channels of Upper Bay.
- Erosion/inundation of sensitive wetlands caused by vessel wakes.

7. COST ESTIMATES

7.1 Dredge Cost Estimates

The estimation of costs to implement the alternatives using clamshell dredge methods are based on outputs of the Corps of Engineers Dredge Estimating Program (CDEP). Much of the analysis of dredge productivity and equipment types used for study alternatives have been based on the construction of the Unit II Basin in 1987, and the more recent Unit III dredging project (1998-99). The actual construction costs for these projects compared well with the CDEP estimates. The results show that the unit cost for clamshell dredging is estimated to be $9.75/cubic yard for the larger dredging Alternatives 4 and 6. However, for those project alternatives that require substantially reduced dredging volumes (Alternatives 1 and 5), the unit price of clamshell dredging is increased by 10%, from $9.75/cy to $10.75/cy.

For implementation of the small hydraulic dredge program, no project cost history exists in Upper Newport Bay. Coastal Frontiers Corporation developed preliminary costs for the purchase price of a hydraulic dredge, pumps, pipeline, and related equipment. These costs were amortized to develop an estimated cost per hour. Following the determination of the likely dredge productivity (cubic yards dredged per hour), a cost per cubic yard dredged was estimated, and other costs were then added based on the previous cost history of the scow barge transport and dumping at the offshore dump site.

The preliminary hydraulic dredge cost estimates are not included in this appendix although the preliminary costs showed that at a minimum, with the addition of a flocculation agent at the discharge pipe, productivity and unit costs for dredging would be comparable, or possibly less than the costs associated with clamshell dredging. Equipment and productivity assumptions related to the hydraulic dredge are still included in this section.

There were several significant concerns about the use of a hydraulic dredge. The approach for this study assumes the use of materials such as flocculation agents and discharge methods that have not been used in an estuarine system before. Hourly production rates are questionable. Resource agency representatives did express interest in the use of the hydraulic dredge approach because it reduces the need to dredge a channel from the southern border of the reserve to the lower end of the Unit II basin. However, the agency representatives were hesitant to support this dredging method without further studies due to concerns about the impacts associated with booster pumps for the pipeline(s), the potential location of pipes through sensitive habitat areas, and the potential turbidity problems near the discharge pipes and dump scows. Based on Corps, sponsors and resource agency concerns, a planning Pre-construction, Engineering and Design (PED) phase demonstration project would be proposed prior to project construction if this method was pursued any further. The cost of this demonstration project would likely range from $800,000 to $1,000,000.

For this study, costs were generated for the initial construction of the project alternatives in the year 2003, as well as to undertake maintenance-dredging activities at the necessary maintenance intervals throughout the 50-year project life.

The alternatives that have been considered have been previously listed in Tables 15 and 16 with the associated dredging/excavation requirements. It is presumed that the Unit I/III and II sedimentation basins will be dredged prior to achieving a basin depth of –7 ft (MSL).

As discussed previously, on-land excavation techniques can be used in creating the proposed wetlands at Northstar Beach and for the relocation/creation of least tern islands. The remainder of the work must rely on floating dredge equipment to remove the required sediment.

Basic assumptions regarding the dredge operations are listed below, and comply with the accepted dredging practice performed during the construction of the Unit II sedimentation basin in 1987 and the Unit I/III Basin in 1998-99.

- Dredge disposal scow capacity: 1,500 cy

- A 5-10 cubic yard capacity clamshell bucket will be used for excavation.

- Using multiple disposal scows to ensure no waiting time, the daily dredge production using the clamshell method is about 3,000 cy/day. Clamshell production will be higher (4,000 cy/day) for Alternatives 4 and 6, which require deeper digging without substantial additional lateral movement.

- Shallow-water dredging using hydraulic pipeline equipment will allow a 20% by volume sediment output from the dredge pipe. By alternately dredging, settling and decanting the excess water can be pumped from the barge. A flocculation agent will be used to increase sediment settling time such that the decanted water will exhibit acceptable clarity for direct discharge from the scow into the Upper Bay. It is anticipated that each 1,500 cy scow will travel to the offshore dumpsite with 1,000 cy of sediment aboard.

- Assuming multiple disposal scow use, the dredge rate of the hydraulic dredge method is assumed to be 150 cy of sediment per hour, yielding an average daily dredge rate of about 3,000 cy/day (presuming 20 hours of dredging per day).

- Disposal scow cycle time from dredge site to LA-3 offshore disposal site and return is four hours.

- Dredge operations will be performed 24 hours per day, six days per week.

- Dredge volumes include the necessary excavation of sediment from Unit I/III and Unit II Basins, which vary with each alternative. In addition, constant dredge volume was presumed for each alternative for the following dredge areas: channel between Units I/III and II, channel bordering the “hotdog” least tern island (Tern Island), channel bordering Unit II, east side channel around New Island, west side channel around Middle Island, and east side channel around Shellmaker Island.

- Dredging of the access channel connecting the Lower Bay and the Unit II Basin is estimated for the clamshell construction method (assuming a deep-draft barge will be required to transport the clamshell dredge to the Upper Bay). The small hydraulic dredge does not require this deeper channel, and no dredging of the access channel is assumed for this dredge method.

- Other project costs assumed to be equal for the initial construction of all alternatives include the excavation, transfer, and placement for the new least tern island, and work associated with the various wetland restoration/enhancement projects described in Section 5.7 of this report.

- Costs for survey operations and environmental monitoring were estimated on a monthly basis and applied to the operational duration of each project.

- The cost for pre-construction engineering and design (PE&D) and environmental study and documents were each set at $2 million for all project alternatives, based on estimates provided by the Project Manager. The cost for construction management (S&A) was set at 6.5% of the job cost.

- A contingency of 20% was applied to all costs, based on direction of the Corps of Engineers cost engineering staff.

- The mobilization cost for the various alternatives was set at $1,520,000 for the barge-mounted clamshell dredge, based on recent experience of Orange County for dredge work in the Upper Bay, and to address air quality conformity requirements.

- The price level date for cost estimation is October 1999.

- The cost estimates for the project alternatives are summarized in the attached tables. The tables indicate project first cost, cost per maintenance cycle, the project year when the maintenance is projected to occur and the net present value for the clamshell dredge. Figures are also attached that track the cash flow for each alternative.

7.2 Additional Cost Estimates

These additional cost estimates were developed using both CDEP and MCACES. A base unit cost of $9.00/cy was used for the excavation of side channels around the islands. Unit costs for the excavation activities totaled $8.00/cy at the land-based restoration sites. A cost of $4.00/cy was used for the capping projects, including the new tern island construction and the capping of the small tern island (Tern Island) with clean sand. Costs associated with the planting of eelgrass beds were based on an eelgrass bed restoration project proposed for Lower Newport Bay. District Real Estate staff provided a gross appraisal estimate in the Real Estate Plan. Chambers Group, working with the Environmental Protection Agency (EPA) and the South Coast Air Quality Management District (SCAQMD), developed the cost estimates associated with meeting the air conformity requirements in the Newport Bay area. Costs associated with the construction of the grouted stone apron were based on the actual costs of the prior construction

to –14 feet MSL, during the Unit III dredging project. Monitoring costs prior, during and subsequent to project construction are based on actual costs for monitoring activities for this study and for the Unit III dredging project. The following bullets summarize the additional costs. Details are presented in Appendix A, the detailed MCACES cost estimate for the recommended plan.

Excavation using land construction techniques has been assumed in the following restoration areas:

- Bullnose Section, NW of Unit I/III Basin
- Northstar Beach Wetlands Excavation and (possibly) transfer to New Tern Island
- Shellmaker Island Restoration and (possibly) transfer to New Tern Island
- Shellmaker Island Dendritic Channel

Side channel restoration activities include:

- "Hotdog" Tern Island (Tern Island)
- New Island, East Side Channel
- Middle Island, West Side Channel
- Shellmaker Island, East Side Channel

Other restoration activities include:

- Planting Eelgrass Beds on the Southwest Portion of Shellmaker Island
- Constructing a New Tern Island by the Main Dike at the Unit II Basin
- Adding Sand to the "hot dog" Tern Island
- Segmenting the Main Dike

Other activities include:

- Construction of Education Kiosks along Back Bay Drive
- Grouted Stone Apron for the Jamboree Road Bridge Slope Protection (Alts. 4 & 6 only)

Other project elements for which costs have been estimated include:

- Equipment Mobilization and Demobilization, including actions necessary to comply with Air Conformity Requirements
- Real Estate Administration and Acquisition Activities
- Lands, Easements, Relocations, Rights-of-way, and Disposal Sites (LERRDs) Requirements and Credit for the Sponsors
- Survey Operations
- Environmental Water Quality/Species Monitoring (During Construction)
- Environmental Habitat/Species Surveys (Pre-, During- and Post-Construction)

- Pre-Construction, Engineering and Design (PE&D, including surveys)
- Construction Management (S&A)

7.3 Alternative 1 Costs

The cost of Alternative 1 presumes an initial dredging/excavation requirement of 889,000 cy for the clamshell dredge method. Maintenance efforts, which would be performed on average every 7 years, would require 797,000 cy of dredging. The costs for the clamshell dredge method are shown in Table 20. Project initial construction costs are $17,184,000. The cost for maintenance every seven years is estimated to be $14,420,000 per maintenance dredging episode. The Net Present Value (assuming a 50 year project life and 6.625% interest) is $41.53 million for the clamshell method. Figure 53 shows the cost analysis for Alternative 1 graphically.

When the initial cost of construction is excluded from the economic analysis, the Net Present Value and Average Annual Cost of the maintenance operation can be calculated. Absent the initial construction cost, the net present value of the maintenance program is $15.14 million.

7.4 Alternative 4 Cost

The cost of Alternative 4 presumes an initial dredging/excavation requirement of 2,713,000 cy for the clamshell dredge method. Maintenance efforts, which would be performed on average every 24 years, would require 2,732,000 cy of dredging. Costs are presented in Table 21. Project initial construction costs are $40,146,000. The cost for maintenance every 24 years is estimated to be $38,432,000 per maintenance dredging episode. The Net Present Value (assuming a 50 year project life and 6.625% interest) is $50.16 million. Figure 54 shows the cost analysis for Alternative 4 graphically.

If the cost of the initial construction is excluded from the economic analysis, the net present value of the maintenance program is $10.01 million for the clamshell dredge method.

The costs for Alternative 4 and 6 reflect higher dredge productivities for the clamshell dredge method relative to all other alternatives. The clamshell dredge productivity is assumed to be 4,000 cy/day instead of 3,000 cy/day due to the greater basin depths.

7.5 Alternative 5 Cost

The cost of Alternative 5 presumes an initial dredging/excavation requirement of 971,000 cy for the clamshell dredge method. Maintenance efforts, which would be performed on average every 10 years, would require 1,031,000 cy of dredging. Costs are presented in Table 22. Project initial construction costs are $18,643,000. The cost for maintenance every 10 years is estimated to be $17,788,000 per maintenance dredging episode. The Net Present Value (assuming a 50 year project life and 6.625% interest) is $37.62 million. Figure 55 shows the cost analysis for Alternative 5 graphically.

If the initial project cost is excluded from the economic analysis, the net present value of the maintenance program along is $18.98 million for the clamshell dredge method.

7.6 Alternative 6 Cost

The cost of Alternative 6 presumes an initial dredging/excavation requirement of 2,122,000 cy for the clamshell dredge method. Maintenance efforts, which would be performed on average every 21 years, would require 2,163,000 cy of dredging. Costs are presented in Table 23. Project initial construction costs are $32,475,000. The cost for maintenance every 21 years is estimated to be $31,035,000 per maintenance dredging episode. The Net Present Value (assuming a 50 year project life and 6.625% interest) is $42.64. Figure 56 shows the cost analysis for Alternative 6 graphically.

If the initial project cost is excluded from the economic analysis, the net present value of the maintenance program along is $10.17 million for the clamshell dredge method.

ALTERNATIVE: 1

Construction Method: Ocean-Going Clamshell Dredge

Total Cost Summary	
Total Initial Cost =	$17,184,000
Net Present Value (6.625%, 50 years, inc. maint.) = $	41,528,000
Annual Cost =	$2,867,000

Maintenance Cost Summary	
Maintenance Cost (per event) =	$14,420,000
Net Present Value (6.625%, 50 years) =	$15,140,000
Annual Maintenance Cost =	$1,045,000

Initial Dredge Requirements:	**Volume, cy**
Unit I/III Basin	219,000
Unit II Basin	382,000
Channel Between Units I and II	19,000
Channel Bordering Unit II	8,000
Access Channels	75,000
	703,000

Wetlands/Channel Restoration Dredge Req's:	**Volume, cy**
Unit I/III Hotdog Tern Island, South side channel	-
Bullnose Section of Land, Northwest corner of Unit I/III	42,000
New Island, East Side Channel	20,000
Middle Island, West Side Channel	20,000
Shellmaker Island, East Side Channel	24,000
Shellmaker Island, Small Dendritic Channel	9,000
Shellmaker Island, Remove Dredge Spoil/Create Wetland	34,000
Northstar Beach Wetlands Creation	37,000
	186,000

Initial Construction, (Base Year 2002) 13 Months

MCACES Code of Accounts	Item	Quantity	Unit	Unit Price	Cost Without Contingency	Contingency* 20%	Cost With Contingency
12.02.01	Equipment Mobilization/Demobilization	1	Job	$ 1,267,000	$ 1,267,000	$ 253,400	$ 1,520,000
12.02.15	Dredge Sediment	703,000	cy	$ 10.75	$ 7,557,000	$ 1,511,400	$ 9,068,000
12.02.14	Unit I/III Hotdog Tern Island, South side channel	-	cy	$ -	$ -	$ -	$ -
	Bullnose Section of Land, Northwest corner of Unit I/III	42,000	cy	$ 8.00	$ 336,000	$ 67,200	$ 403,000
	New Island, East Side Channel	20,000	cy	$ 9.00	$ 180,000	$ 36,000	$ 216,000
	Middle Island, West Side Channel	20,000	cy	$ 9.00	$ 180,000	$ 36,000	$ 216,000
	Shellmaker Island, East Side Channel	24,000	cy	$ 9.00	$ 216,000	$ 43,200	$ 259,000
	Shellmaker Island, Small Dendritic Channel	9,000	cy	$ 9.00	$ 81,000	$ 16,200	$ 97,000
	Shellmaker Island, Remove Dredge Spoil/Create Wetland	34,000	cy	$ 8.00	$ 272,000	$ 54,400	$ 326,000
	Northstar Beach Wetlands Creation	37,000	cy	$ 8.00	$ 296,000	$ 59,200	$ 355,000
	Plant Eelgrass Beds	0.6	Acres	$ 47,778	$ 29,000	$ 5,800	$ 35,000
	Construct New Tern Island by Salt Dike (Unit II Basin)	-	cy	$ -	$ -	$ -	$ -
	Add Sand to Tern Islands (Hotdog and Kidney in Unit III)	22,600	cy	$ 4.00	$ 90,000	$ 18,000	$ 108,000
	Segment Main Dike	1	Job	$ 4,000	$ 4,000	$ 800	$ 5,000
	Education Kiosks	4	Sites	$ 8,000	$ 32,000	$ 6,400	$ 38,000
	Real Estate Admin/Acquisition Costs	1	Lump Sum	$ 36,000	$ 36,000	$ 5,400	$ 41,000
	Lands and Improvements (LERRDs Credit)	1	Lump Sum	$ 571,870	$ 572,000	$ 85,800	$ 658,000
12.02.99	Survey Operations	13	Months	$ 35,000	$ 455,000	$ 91,000	$ 546,000
12.02.99	Env. Water Quality/Species Monitoring during Const.	13	Months	$ 5,000	$ 65,000	$ 13,000	$ 78,000
	Env. Habitat/Species 2 Season Surveys During/Post Const	4	Seasons	$ 60,000	$ 240,000	$ 48,000	$ 288,000
				Subtotal =	$ 11,908,000	$ 2,351,200	$ 14,257,000
30	Pre-construction, Engineering, Design (PE&D)		Job				$ 2,000,000
31	Construction Management (S&A)		6.5%				$ 927,000
						Total =	$ 17,184,000

Construction Method: Ocean-Going Clamshell Dredge

Maintenance Dredge Requirements (7 Year Interval):	
Unit I/III Basin	343,000
Unit II Basin	196,000
Channel Between Units I and II	31,000
Channel Bordering Unit II	27,000
Access Channels	200,000
	797,000

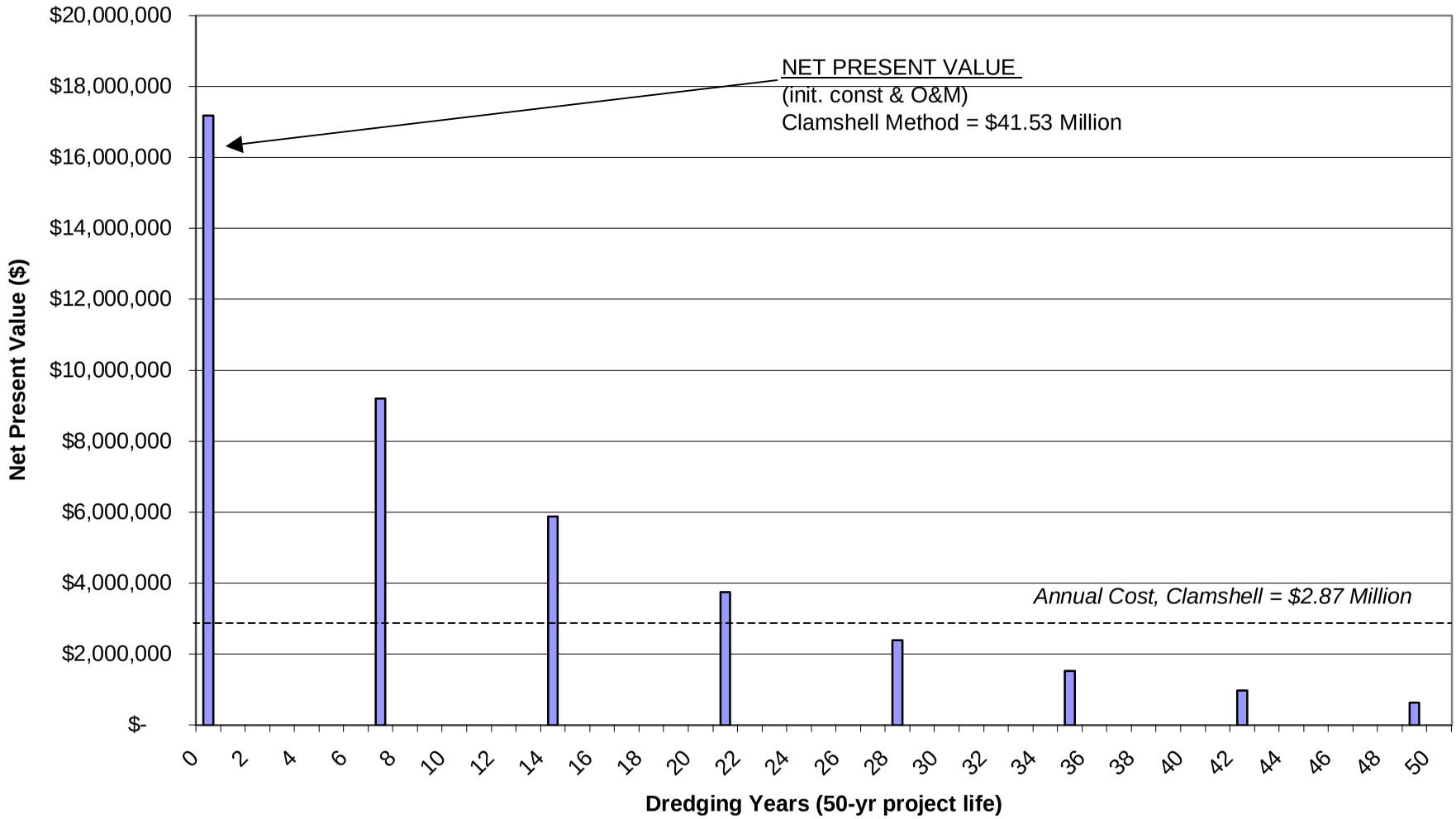
Maintenance Timeframe (mos): 12

Maintenance Operations

MCACES Code of Accounts	Item	Quantity	Unit	Unit Price	Cost Without Contingency	Contingency* 20%	Cost With Contingency
12.02.01	Equipment Mobilization	1	Job	$ 550,000	$ 550,000	$ 110,000	$ 660,000
12.02.15	Dredge Sediment	797,000	cy	$ 10.75	$ 8,568,000	$ 1,713,600	$ 10,282,000
12.02.99	Survey Operations	12	Months	$ 35,000	$ 420,000	$ 84,000	$ 504,000
12.02.99	Env. Water Quality/Species Monitoring during Const.	12	Months	$ 5,000	$ 60,000	$ 12,000	$ 72,000
	Env. Habitat/Species 2 Season Survey During Const	2	Seasons	$ 60,000	$ 120,000	$ 24,000	$ 144,000
				Subtotal =	$ 9,718,000	$ 1,943,600	$ 11,662,000
30	Pre-construction, Engineering, Design (PE&D)		Job				$ 2,000,000
31	Construction Management (S&A)		6.5%				$ 758,000
						Total =	$ 14,420,000

** Contingency percentage is based on ER1110-2-1302 dated 31 March 1994.*

FIGURE 53
Alternative 1 Cost Analysis



ALTERNATIVE: 4

Construction Method: Ocean-Going Clamshell Dredge

Total Cost Summary	
Total Initial Cost =	$40,146,000
Net Present Value (6.625%, 50 years, inc. maint.) =	$ 50,157,000
Annual Cost =	$ 3,463,000

Maintenance Cost Summary	
Maintenance Cost (per event) =	$38,432,000
Net Present Value (6.625%, 50 years) =	$10,011,000
Annual Maintenance Cost =	$691,000

Initial Dredge Requirements:	**Volume, cy**
Unit I/III Basin	1,118,000
Unit II Basin	1,297,000
Channel Between Units I and II	20,000
Channel Bordering Unit II	8,000
Access Channels	75,000
	2,518,000

Wetlands/Channel Restoration Dredge Req's:	**Volume, cy**
Unit I/III Hotdog Tern Island, South side channel	9,000
Bullnose Section of Land, Northwest corner of Unit I/III	42,000
New Island, East Side Channel	20,000
Middle Island, West Side Channel	20,000
Shellmaker Island, East Side Channel	24,000
Shellmaker Island, Small Dendritic Channel	9,000
Shellmaker Island, Remove Dredge Spoil/Create Wetland	34,000
Northstar Beach Wetlands Creation	37,000
	195,000

29 Months

MCACES Code of Accounts	**Initial Construction, (Base Year 2005)** Item	Quantity	Unit	Unit Price	Cost Without Contingency	Contingency* 20%	Cost With Contingency
12.02.01	Equipment Mobilization/Demobilization	1	Job	$ 1,267,000	$ 1,267,000	$ 253,400	$ 1,520,000
12.02.15	Dredge Sediment Control Features	2,518,000	cy	$ 9.75	$ 24,551,000	$ 4,910,200	$ 29,461,000
12.02.14	Unit I/III Hotdog Tern Island, South side channel	9,000	cy	$ 9.00	$ 81,000	$ 16,200	$ 97,000
	Bullnose Section of Land, Northwest corner of Unit I/III	42,000	cy	$ 8.00	$ 336,000	$ 67,200	$ 403,000
	New Island, East Side Channel	20,000	cy	$ 9.00	$ 180,000	$ 36,000	$ 216,000
	Middle Island, West Side Channel	20,000	cy	$ 9.00	$ 180,000	$ 36,000	$ 216,000
	Shellmaker Island, East Side Channel	24,000	cy	$ 9.00	$ 216,000	$ 43,200	$ 259,000
	Shellmaker Island, Small Dendritic Channel	9,000	cy	$ 9.00	$ 81,000	$ 16,200	$ 97,000
	Shellmaker Island, Remove Dredge Spoil/Create Wetland	34,000	cy	$ 8.00	$ 272,000	$ 54,400	$ 326,000
	Northstar Beach Wetlands Creation	37,000	cy	$ 8.00	$ 296,000	$ 59,200	$ 355,000
	Plant Eelgrass Beds	0.6	Acres	$ 47,778	$ 29,000	$ 5,800	$ 35,000
	Construct New Tern Island by Salt Dike (Unit II Basin)	63,000	cy	$ 4.00	$ 252,000	$ 50,400	$ 302,000
	Add Sand to Hotdog Tern Island	9,700	cy	$ 4.00	$ 39,000	$ 7,800	$ 47,000
	Segment Main Dike	1	Job	$ 4,000	$ 4,000	$ 800	$ 5,000
	Education Kiosks	4	Sites	$ 8,000	$ 32,000	$ 6,400	$ 38,000
	Grouted Stone Apron for Jamboree Rd. Slope Protection	400	Tons	$ 130	$ 52,000	$ 10,400	$ 62,000
	Real Estate Admin/Acquisition Costs	1	Lump Sum	$ 36,000	$ 36,000	$ 5,400	$ 41,000
	Lands and Improvements (LERRDs Credit)	1	Lump Sum	$ 571,870	$ 572,000	$ 85,800	$ 658,000
12.02.99	Survey Operations	29	Months	$ 35,000	$ 1,015,000	$ 203,000	$ 1,218,000
12.02.99	Env. Water Quality/Species Monitoring during Const.	29	Months	$ 5,000	$ 145,000	$ 29,000	$ 174,000
	Env. Habitat/Species 2 Season Surveys During/Post Const	4	Seasons	$ 60,000	$ 240,000	$ 48,000	$ 288,000
				Subtotal =	$ 29,876,000	$ 5,944,800	$ 35,818,000
30	Pre-construction, Engineering, Design (PE&D)		Job				$ 2,000,000
31	Construction Management (S&A)		6.5%				$ 2,328,000
						Total =	$ 40,146,000

Construction Method: Ocean-Going Clamshell Dredge

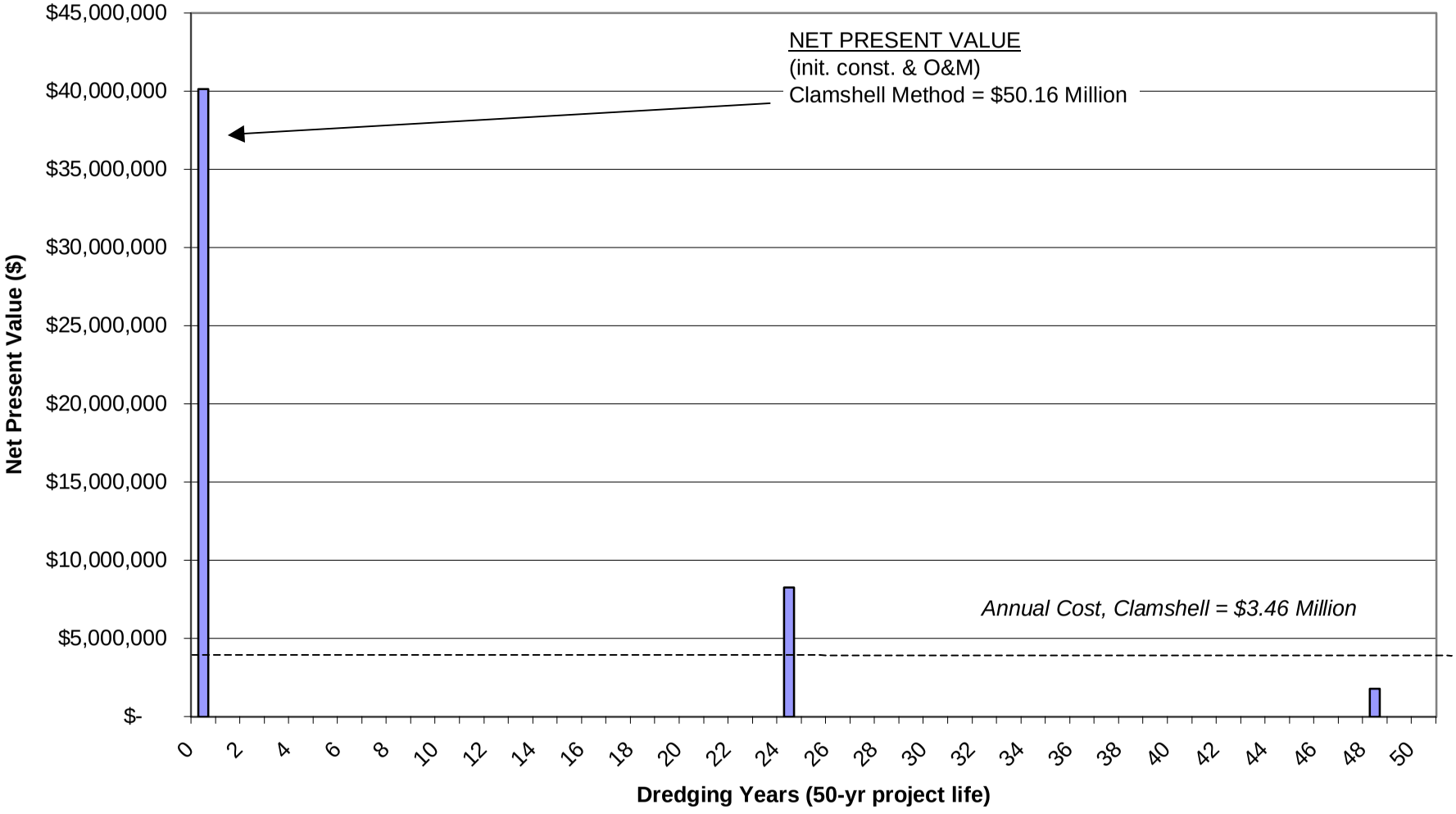
Maintenance Dredge Requirements (24 Year Interval):	
Unit I/III Basin	1,080,000
Unit II Basin	1,251,000
Channel Between Units I and II	65,000
Channel Bordering Unit II	36,000
Access Channels	300,000
	2,732,000

Maintenance Timeframe (mos): 30

MCACES Code of Accounts	**Maintenance Operations (24 Years)** Item	Quantity	Unit	Unit Price	Cost Without Contingency	Contingency* 20%	Cost With Contingency
12.02.01	Equipment Mobilization/Demobilization	1	Job	$ 550,000	$ 550,000	$ 110,000	$ 660,000
12.02.15	Dredge Sediment	2,732,000	cy	$ 9.75	$ 26,637,000	$ 5,327,400	$ 31,964,000
12.02.99	Survey Operations	30	Months	$ 35,000	$ 1,050,000	$ 210,000	$ 1,260,000
12.02.99	Env. Water Quality/Species Monitoring during Const.	30	Months	$ 5,000	$ 150,000	$ 30,000	$ 180,000
	Env. Habitat/Species 2 Season Survey During Const	2	Seasons	$ 60,000	$ 120,000	$ 24,000	$ 144,000
				Subtotal =	$ 28,507,000	$ 5,701,400	$ 34,208,000
30	Pre-construction, Engineering, Design (PE&D)		Job				$ 2,000,000
31	Construction Management (S&A)		6.5%				$ 2,224,000
							$ 38,432,000

** Contingency percentage is based on ER1110-2-1302 dated 31 March 1994.*

FIGURE 54
Alternative 4 Cost Analysis



ALTERNATIVE: 5

Construction Method: Ocean-Going Clamshell Dredge

Total Cost Summary	
Total Initial Cost =	$18,643,000
Net Present Value (6.625%, 50 years, inc. maint.) =	$ 37,623,000
Annual Cost =	$ 2,598,000

Maintenance Cost Summary	
Maintenance Cost (per event) =	$17,788,000
Net Present Value (6.625%, 50 years) =	$18,980,000
Annual Maintenance Cost =	$1,310,000

Initial Sediment Control Dredge Requirements:	**Volume, cy**
Unit I/III Basin	616,000
Unit II Basin	77,000
Channel Between Units I/III and II	20,000
Channel Bordering Unit II (Santa Ana-Delhi inlet)	8,000
Access Channels	75,000
	796,000

Wetlands/Channel Restoration Dredge Req's:	**Volume, cy**
Unit I/III Hotdog Tern Island, South side channel	9,000
Bullnose Section of Land, Northwest corner of Unit I/III	42,000
New Island, East Side Channel	-
Middle Island, West Side Channel	20,000
Shellmaker Island, East Side Channel	24,000
Shellmaker Island, Small Dendritic Channel	9,000
Shellmaker Island, Remove Dredge Spoil/Create Wetland	34,000
Northstar Beach Wetlands Creation	37,000
	175,000

Initial Construction (Base Year 2003) — 14 Months

MCACES Code of Accounts	Item	Quantity	Unit	Unit Price	Cost Without Contingency	Contingency* 20%	Cost With Contingency
12.02.01	Equipment Mobilization/Demobilization	1	Job	$ 1,267,000	$ 1,267,000	$ 253,400	$ 1,520,000
12.02.15	Dredge Sediment Control Features	796,000	cy	$ 10.75	$ 8,557,000	$ 1,711,400	$ 10,268,000
12.02.14	Unit I/III Hotdog Tern Island, South side channel	9,000	cy	$ 9.00	$ 81,000	$ 16,200	$ 97,000
	Bullnose Section of Land, Northwest corner of Unit I/III	42,000	cy	$ 8.00	$ 336,000	$ 67,200	$ 403,000
	New Island, East Side Channel	-	cy	$ 9.00	$ -	$ -	$ -
	Middle Island, West Side Channel	20,000	cy	$ 9.00	$ 180,000	$ 36,000	$ 216,000
	Shellmaker Island, East Side Channel	24,000	cy	$ 9.00	$ 216,000	$ 43,200	$ 259,000
	Shellmaker Island, Small Dendritic Channel	9,000	cy	$ 9.00	$ 81,000	$ 16,200	$ 97,000
	Shellmaker Island, Remove Dredge Spoil/Create Wetland	34,000	cy	$ 8.00	$ 272,000	$ 54,400	$ 326,000
	Northstar Beach Wetlands Creation	37,000	cy	$ 8.00	$ 296,000	$ 59,200	$ 355,000
	Plant Eelgrass Beds	0.6	Acres	$ 47,778	$ 29,000	$ 5,800	$ 35,000
	Construct New Tern Island by Salt Dike (Unit II Basin)	63,000	cy	$ 4.00	$ 252,000	$ 50,400	$ 302,000
	Add Sand to Hotdog Tern Island	9,700	cy	$ 4.00	$ 39,000	$ 7,800	$ 47,000
	Segment Main Dike	1	Job	$ 4,000	$ 4,000	$ 800	$ 5,000
	Education Kiosks	4	Sites	$ 8,000	$ 32,000	$ 6,400	$ 38,000
	Real Estate Admin/Acquisition Costs	1	Lump Sum	$ 36,000	$ 36,000	$ 5,400	$ 41,000
	Lands and Improvements (LERRDs Credit)	1	Lump Sum	$ 571,870	$ 572,000	$ 85,800	$ 658,000
12.02.99	Survey Operations	14	Months	$ 35,000	$ 490,000	$ 98,000	$ 588,000
12.02.99	Env. Water Quality/Species Monitoring during Const.	14	Months	$ 5,000	$ 70,000	$ 14,000	$ 84,000
	Env. Habitat/Species 2 Season Surveys During/Post Const	4	Seasons	$ 60,000	$ 240,000	$ 48,000	$ 288,000
				Subtotal =	$ 13,050,000	$ 2,579,600	$ 15,627,000
30	Pre-construction, Engineering, Design (PE&D)		Job				$ 2,000,000
31	Construction Management (S&A)		6.5%				$ 1,016,000
						Total =	$ 18,643,000

Construction Method: Ocean-Going Clamshell Dredge

Maintenance Dredge Requirements (10 Year Interval):	
Unit I/III Basin	643,000
Unit II Basin	141,000
Channel Between Units I and II	31,000
Channel Bordering Unit II	16,000
Access Channels	200,000
	1,031,000

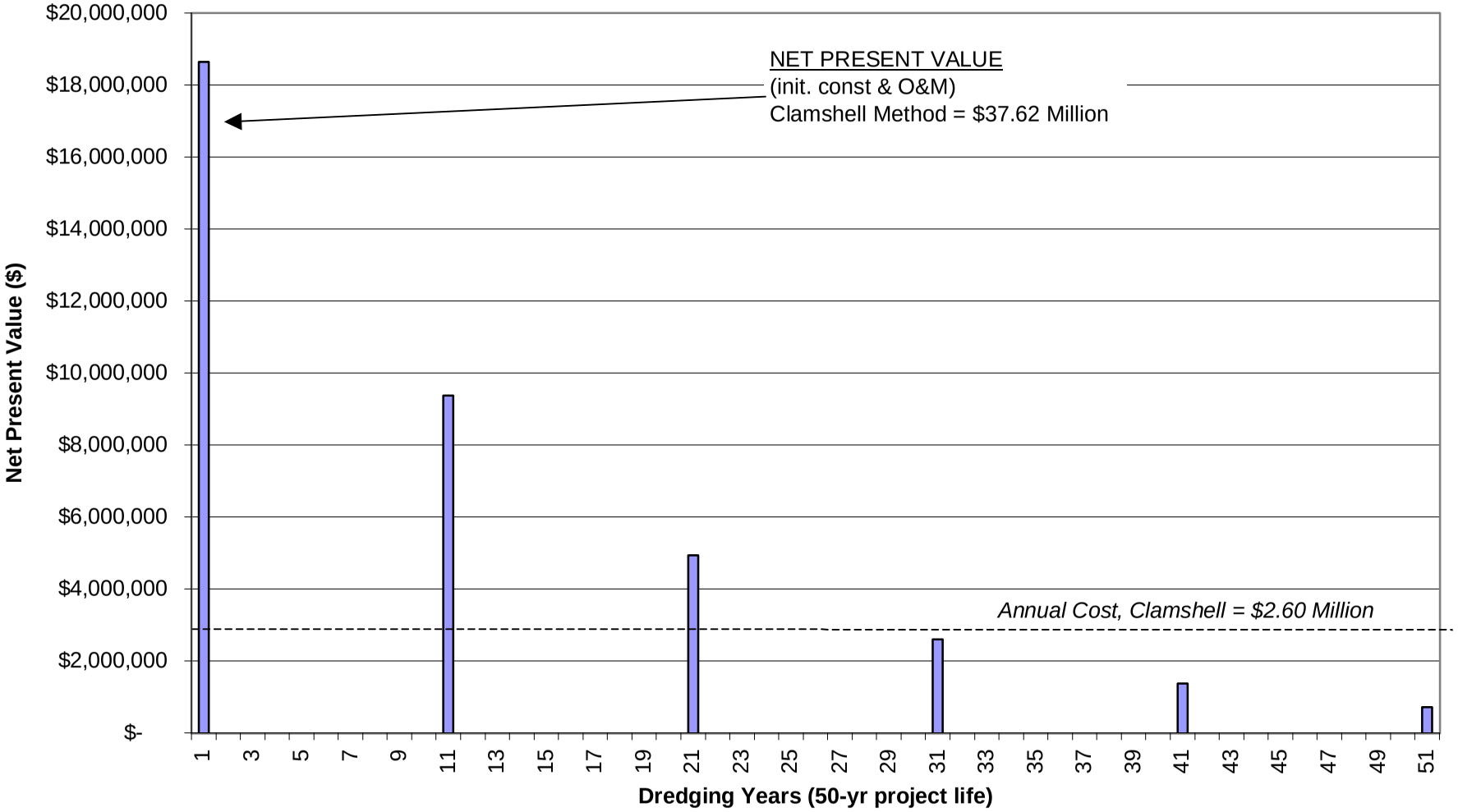
Maintenance Timeframe (mos): 15

Maintenance Operations

Code of Accounts	Item	Quantity	Unit	Unit Price	Cost Without Contingency	Contingency* 20%	Cost With Contingency
12.02.01	Equipment Mobilization/Demobilization	1	Job	$ 550,000	$ 550,000	$ 110,000	$ 660,000
12.02.15	Dredge Sediment	1,031,000	cy	$ 10.75	$ 11,083,000	$ 2,216,600	$ 13,300,000
12.02.99	Survey Operations	15	Months	$ 35,000	$ 525,000	$ 105,000	$ 630,000
12.02.99	Env. Water Quality/Species Monitoring during Const.	15	Months	$ 5,000	$ 75,000	$ 15,000	$ 90,000
	Env. Habitat/Species 2 Season Survey During Const	2	Seasons	$ 60,000	$ 120,000	$ 24,000	$ 144,000
				Subtotal =	$ 12,353,000	$ 2,470,600	$ 14,824,000
30	Pre-construction, Engineering, Design (PE&D)		Job				$ 2,000,000
31	Construction Management (S&A)		6.5%				$ 964,000
						Total =	$ 17,788,000

** Contingency percentage is based on ER1110-2-1302 dated 31 March 1994.*

FIGURE 55
Alternative 5 Cost Analysis



ALTERNATIVE: 6

Construction Method: Ocean-Going Clamshell Dredge

Total Cost Summary	
Total Initial Cost =	$32,475,000

Maintenance Cost Summary	
Maintenance Cost (per event) =	$31,035,000
Net Present Value (6.625%, 50 years) =	$10,167,000
Annual Maintenance Cost =	$702,000

Initial Sediment Control Dredge Requirements:	**Volume, cy**
Unit I/III Basin	958,000
Unit II Basin	866,000
Channel Between Units I/III and II	20,000
Channel Bordering Unit II (Santa Ana-Delhi inlet)	8,000
Access Channels	75,000
	1,927,000

Wetlands/Channel Restoration Dredge Req's:	**Volume, cy**
Unit I/III Hotdog Tern Island, South side channel	9,000
Bullnose Section of Land, Northwest corner of Unit I/III	42,000
New Island, East Side Channel	20,000
Middle Island, West Side Channel	20,000
Shellmaker Island, East Side Channel	24,000
Shellmaker Island, Small Dendritic Channel	9,000
Shellmaker Island, Remove Dredge Spoil/Create Wetland	34,000
Northstar Beach Wetlands Creation	37,000
	195,000

MCACES Code of Accounts	**Initial Construction (Base Year 2003)** Item	Quantity (23 Months)	Unit	Unit Price	Cost Without Contingency	Contingency* 20%	Cost With Contingency
12.02.01	Equipment Mobilization/Demobilization	1	Job	$ 1,267,000	$ 1,267,000	$ 253,400	$ 1,520,000
12.02.15	Dredge Sediment Control Features	1,927,000	cy	$ 9.75	$ 18,788,000	$ 3,757,600	$ 22,546,000
12.02.14	Unit I/III Hotdog Tern Island, South side channel	9,000	cy	$ 9.00	$ 81,000	$ 16,200	$ 97,000
	Bullnose Section of Land, Northwest corner of Unit I/III	42,000	cy	$ 8.00	$ 336,000	$ 67,200	$ 403,000
	New Island, East Side Channel	20,000	cy	$ 9.00	$ 180,000	$ 36,000	$ 216,000
	Middle Island, West Side Channel	20,000	cy	$ 9.00	$ 180,000	$ 36,000	$ 216,000
	Shellmaker Island, East Side Channel	24,000	cy	$ 9.00	$ 216,000	$ 43,200	$ 259,000
	Shellmaker Island, Small Dendritic Channel	9,000	cy	$ 9.00	$ 81,000	$ 16,200	$ 97,000
	Shellmaker Island, Remove Dredge Spoil/Create Wetland	34,000	cy	$ 8.00	$ 272,000	$ 54,400	$ 326,000
	Northstar Beach Wetlands Creation	37,000	cy	$ 8.00	$ 296,000	$ 59,200	$ 355,000
	Plant Eelgrass Beds	0.6	Acres	$ 47,778	$ 29,000	$ 5,800	$ 35,000
	Construct New Tern Island by Salt Dike (Unit II Basin)	63,000	cy	$ 4.00	$ 252,000	$ 50,400	$ 302,000
	Add Sand to Hotdog Tern Island	9,700	cy	$ 4.00	$ 39,000	$ 7,800	$ 47,000
	Segment Main Dike	1	Job	$ 4,000	$ 4,000	$ 800	$ 5,000
	Education Kiosks	4	Sites	$ 8,000	$ 32,000	$ 6,400	$ 38,000
	Grouted Stone Apron for Jamboree Rd. Slope Protection	400	Tons	$ 130	$ 52,000	$ 10,400	$ 62,000
	Real Estate Admin/Acquisition Costs	1	Lump Sum	$ 36,000	$ 36,000	$ 5,400	$ 41,000
	Lands and Improvements (LERRDs Credit)	1	Lump Sum	$ 571,870	$ 572,000	$ 85,800	$ 658,000
12.02.99	Survey Operations	23	Months	$ 35,000	$ 805,000	$ 161,000	$ 966,000
12.02.99	Env. Water Quality/Species Monitoring during Const.	23	Months	$ 5,000	$ 115,000	$ 23,000	$ 138,000
	Env. Habitat/Species 2 Season Surveys During/Post Const	4	Seasons	$ 60,000	$ 240,000	$ 48,000	$ 288,000
				Subtotal =	$ 23,873,000	$ 4,744,200	$ 28,615,000
30	Pre-construction, Engineering, Design (PE&D)		Job				$ 2,000,000
31	Construction Management (S&A)		6.5%				$ 1,860,000
						Total =	$ 32,475,000

Construction Method: Ocean-Going Clamshell Dredge

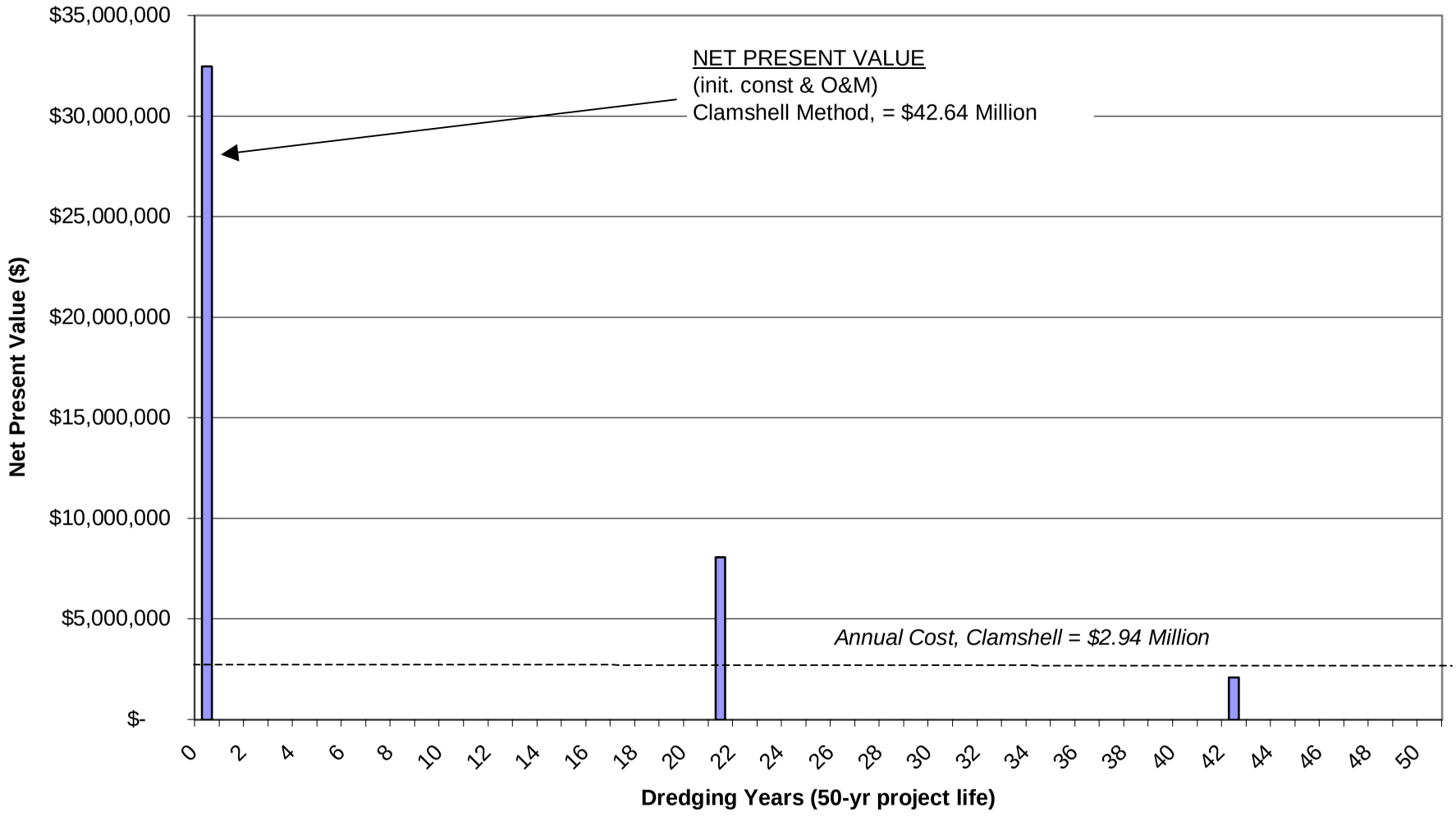
Maintenance Dredge Requirements (21 Year Interval):	
Unit I/III Basin	1,010,000
Unit II Basin	714,000
Channel Between Units I and II	82,000
Channel Bordering Unit II	57,000
Access Channels	300,000
	2,163,000

Maintenance Timeframe (mos): 24

MCACES Code of Accounts	**Maintenance Operations** Item	Quantity	Unit	Unit Price	Cost Without Contingency	Contingency* 20%	Cost With Contingency
12.02.01	Equipment Mobilization/Demobilization	1	Job	$ 550,000	$ 550,000	$ 110,000	$ 660,000
12.02.15	Dredge Sediment	2,163,000	cy	$ 9.75	$ 21,089,000	$ 4,217,800	$ 25,307,000
12.02.99	Survey Operations	24	Months	$ 35,000	$ 840,000	$ 168,000	$ 1,008,000
12.02.99	Environmental Monitoring	24	Months	$ 5,000	$ 120,000	$ 24,000	$ 144,000
	Env. Habitat/Species 2 Season Survey During Const	2	Seasons	$ 60,000	$ 120,000	$ 24,000	$ 144,000
				Subtotal =	$ 22,719,000	$ 4,543,800	$ 27,263,000
30	Pre-construction, Engineering, Design (PE&D)		Job				$ 2,000,000
31	Construction Management (S&A)		6.5%				$ 1,772,000
						Total =	$ 31,035,000

** Contingency percentage is based on ER1110-2-1302 dated 31 March 1994.*

FIGURE 56
Alternative 6 Cost Analysis



7.7 Dredging and Cost Summary

The various project alternatives require varying numbers of days to accomplish the dredging associated with the initial construction and with periodic maintenance dredging requirements. Table 24 summarizes the time requirements for each alternative for each dredging episode and in total for the entire 50-year life of the project.

Table 24: Total Dredge Days Required—50 Year Project Life

Dredge Method: Large Clamshell Dredge						
Alternative	Initial, cy	Maintenance Interval, yrs	Cycles	Day/Cycle	Maintenance Days	Total Days
1	296	7	7	266	1,860	2,156
4	678	24	2	683	1,366	2,044
5	324	10	5	344	1,718	2,042
6	531	21	2	541	1,082	1,612

The alternative costs are summarized in Table 25.

TABLE 25
COST SUMMARY
UPPER NEWPORT BAY FEASIBILITY STUDY
(Costs in 1999 Dollars)

Clamshell Dredge Alternative				
	Alternative 1	Alternative 4	Alternative 5	Alternative 6
Initial Construction	$17.18 Million	$40.15 Million	$18.64 Million	$32.48 Million
Maintenance Interval	7 Years	24 Years	10 Years	21 Years
Maintenance Cost (per event)	$14.42 Million	$38.43 Million	$17.79 Million	$31.04 Million
Net Present Value	$41.53 Million	$50.16 Million	$37.62 Million	$42.64 Million
Average Annual Cost	$2.87 Million	$3.46 Million	$2.60 Million	$2.94 Million

Net Present Value Based on 6.625% Interest Rate, 50 Year Life Following Construction

8. THE RECOMMENDED PLAN

Based on the careful consideration of all of the alternatives considered, the study team has selected Alternative 6 as the recommended plan to pursue. Alternative 6 has been previously described in Section 5.6 of this Appendix. In summary, Alternative 6 included the following elements:

Unit I/III Basin

(Shown in Detail in Figure 57 (Plan View) and Figure 59 (Section View))

- Increase basin depth to –20 ft (MSL), 1V: 33 side slopes from 0 ft (MSL) to –3 ft and 1V:5H side slopes below.
- Maintain northeast corner of basin intact.
- Remove "kidney"-shaped island (Skimmer Island).
- Dredge south-side channel around "hotdog" least tern island (Tern Island)(50 ft top width, -5 ft (MSL) bottom elevation, 1V:3H side slopes
- Provide small boat access to "hot dog" least tern island for vegetation removal.
- Add two-foot sand/shell layer to "hotdog" island surface.
- Mudflat creation, bullnose section, NW corner of basin
- Maintain access channel to Unit II Basin (-14 ft, MSL)

Unit II Basin

(Shown in Detail in Figure 58 (Plan View) and Figure 59 (Section View))

- Expand Unit II west, depth = -20 ft, MSL with 1V:33H side slopes between 0 ft (MSL) and –3 ft and 1V:5 side slopes below.
- Segment Main Dike
- Construct new least tern island adjacent to Dike.
- New Island, east side channel (–5 ft, MSL), 50 ft top width, 1V:3 side slopes.
- Dredge channel from Unit II to Santa Ana-Delhi Channel (-5 ft, MSL) depth, a 50 ft bottom width and 1V:3H side slopes).
- Maintain the dredge and barge access channel from the Unit II basin to the PCH Bridge at –14 ft (MSL).

Other Areas

(Described in Section 5.7 of this Appendix)

- Middle Island, west side channel
- Shellmaker Island, east side channel
- Shellmaker Island, small dendritic channel
- Shellmaker Island, wetlands creation
- Northstar Beach, wetlands creation
- Plant eelgrass beds
- Add sand layer to least tern islands
- Sedment Main Dike

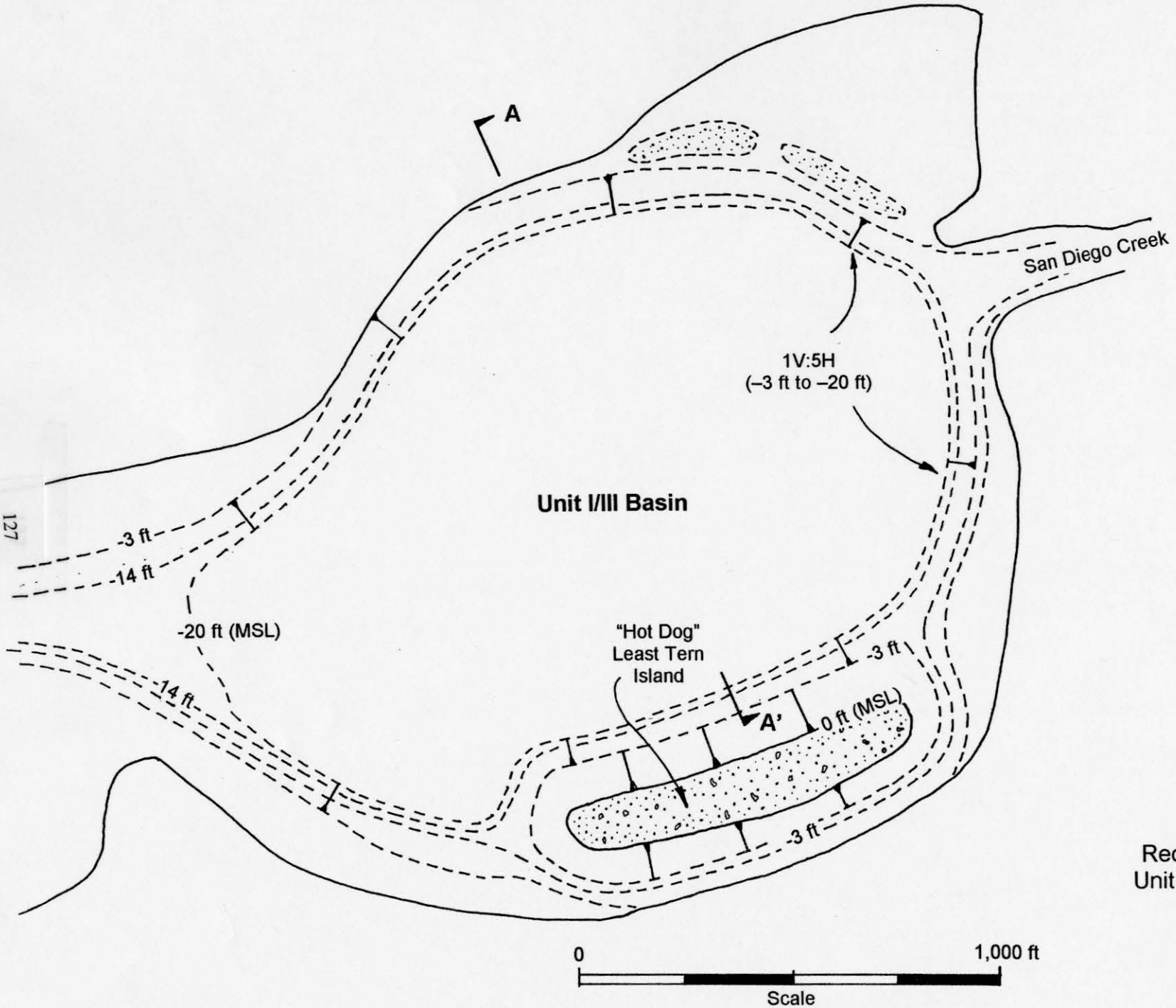


Figure 57
Recommended Plan
Unit I/III Configuration

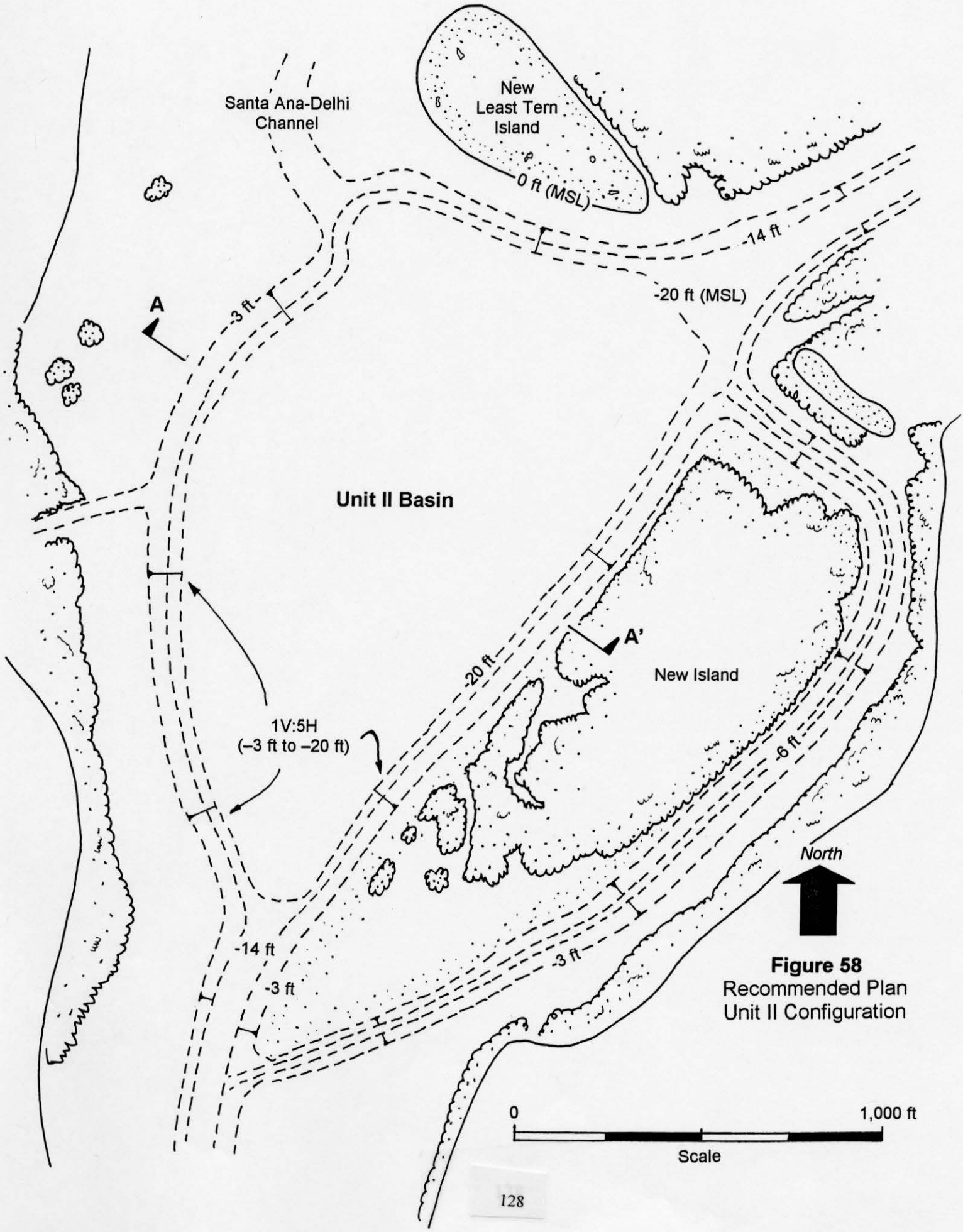
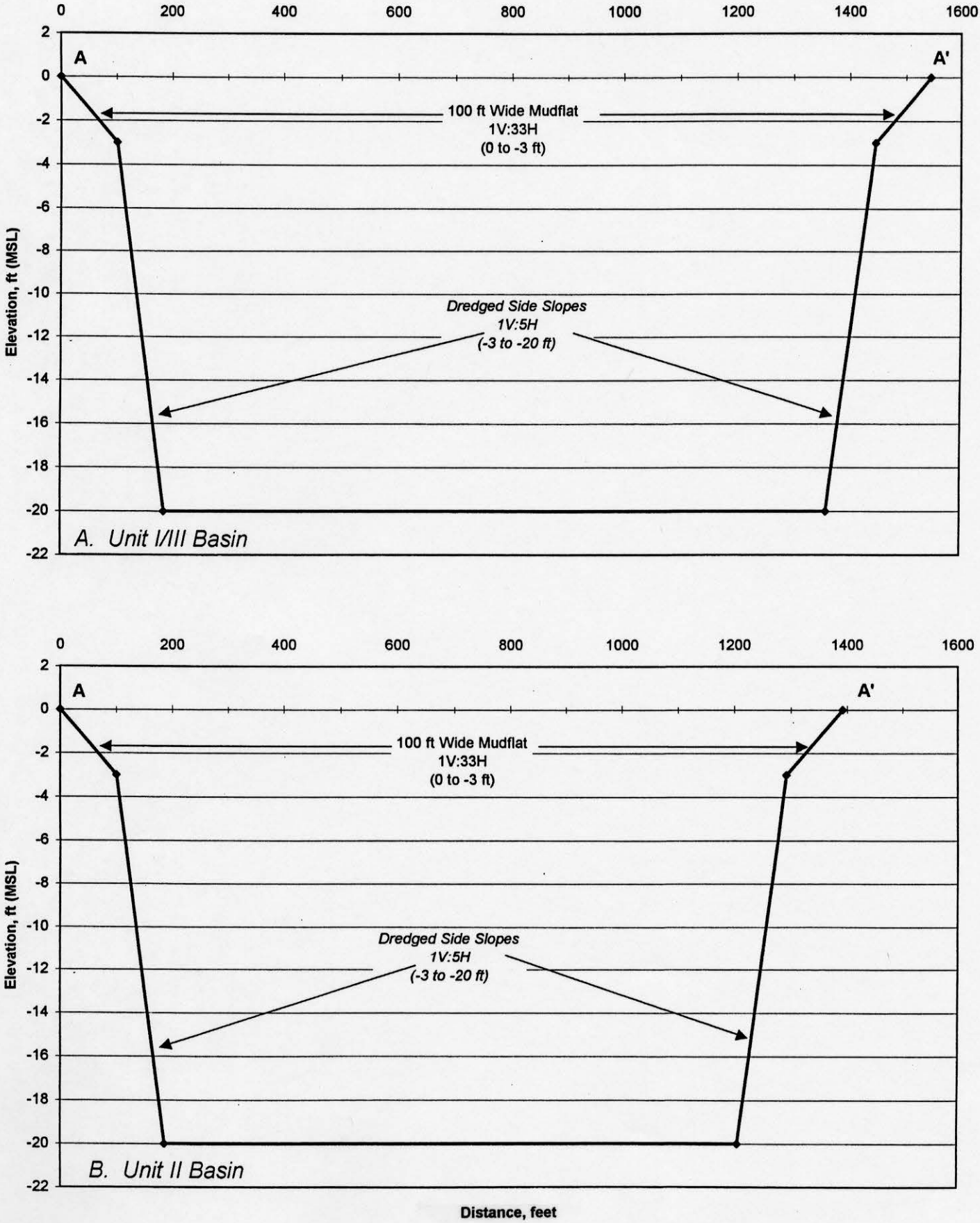


Figure 58
Recommended Plan
Unit II Configuration

Figure 59
Recommended Plan, Typical Cross-Sections



In order to create Alternative 6, the initial construction dredge volume is 2.122 million cubic yards. Maintenance dredging requires the removal of 2.163 million cubic yards of sediment. The maintenance-dredging interval is estimated to be once every 21 years, on average.

Project costs related to the Recommended Plan are shown in Table 26.

Table 26: Project Costs for the Recommended Plan (Alternative 6)

Clamshell Dredge Alternative	
Initial Construction	$32.48 Million
Maintenance Interval	21 Years
Maintenance Cost/Event	$31.04 Million
Net Present Value	$42.64 Million

The benefits of the Recommended Plan include the following:

- Relatively large, deep sedimentation basins that are capable of trapping large volumes of sediment in the areas of the Upper Bay that have been used for this purpose since the 1980's.
- Maintenance dredging is expected to be infrequent, averaging each 21 years.
- Enhancement/Restoration of a number of other wetland sites.
- Significant increase (+46) of Habitat Units (HU's) related to sediment control and habitat restoration.
- Lowest annual cost per AAHU ($67,000) of any alternative considered.
- Produced favorable response of the various resource agencies relative to the other alternatives considered.

8.1 Construction Sequence

Consideration has been given to the sequence of construction of the Recommended Plan. The ecological sensitivity of the work areas vary both in space and time. For the purpose of this planning exercise, it is assumed that working north of the Dike will be best performed from mid-September through February, to avoid the least tern and light-footed clapper rail nesting seasons. Work south of the Dike would be accomplished during the March 1 – September 15 period, although environmental monitoring will be performed in support of the construction effort and may indicate the lack of availability of specific areas of the Upper Bay if sensitive species are active.

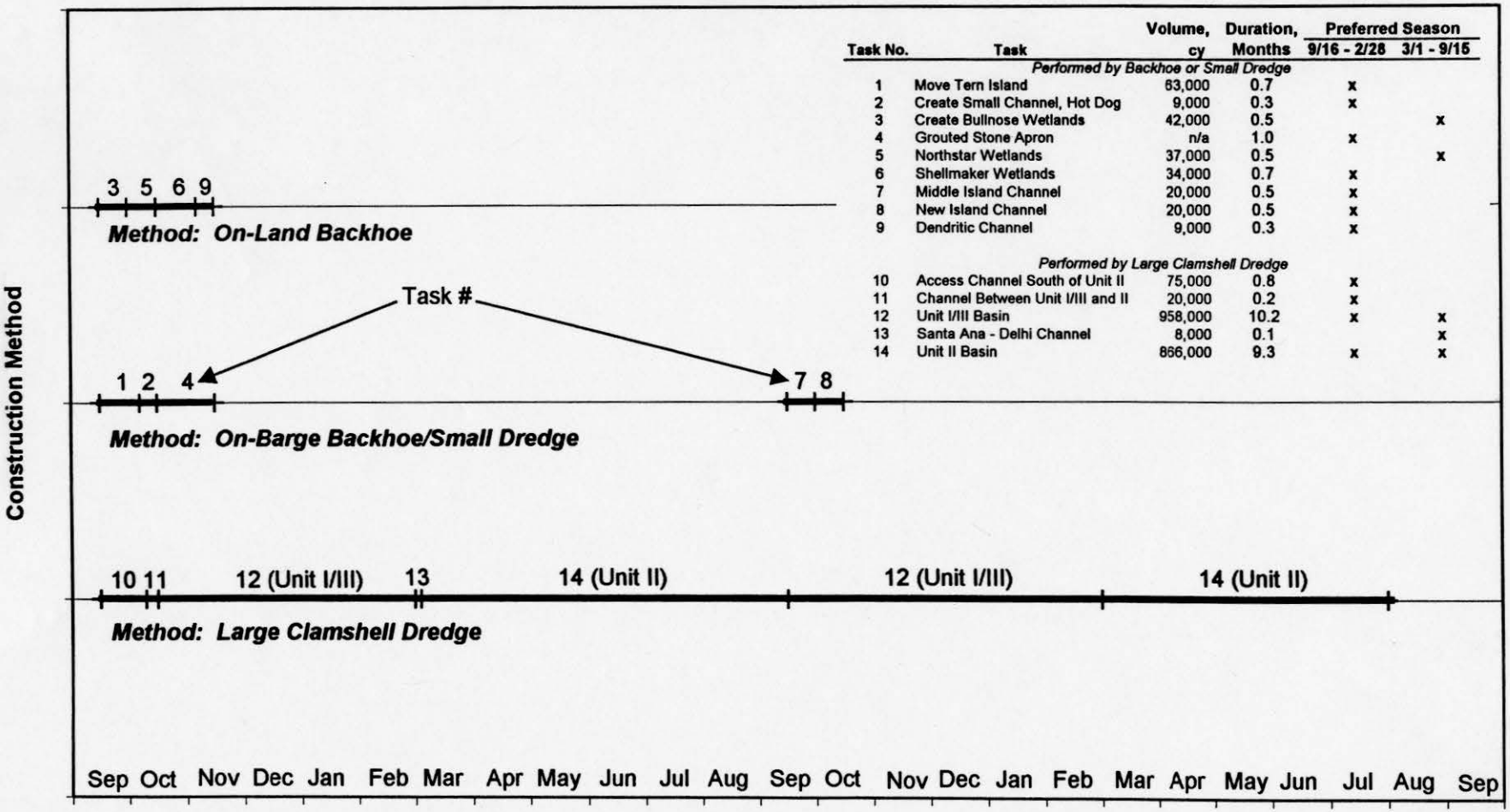
Figure 60 indicates a possible sequence of construction for the Recommended Plan. Construction tasks are referenced by number, excavation volumes and time requirements. Three methods of construction are shown: 1) On-land backhoe excavation; 2) On-barge excavation of small channels by backhoe or small dredge; and 3) Major excavation of the deep basins by the barge-mounted clamshell dredge.

Construction work would begin about mid-September. On-land excavation would commence using backhoes to create new wetlands in the bullnose area of the Unit I/III Basin and for the removal of the kidney-shaped least tern island. On-land excavation is also planned to produce the required sand layers for the new tern island near the dike and for the hotdog-shaped tern island in the Unit I/III Basin. The Main Dike would segmented at this time to prevent overland access to the new tern island.

As a parallel effort, the large clamshell dredge would begin channel deepening in order to travel from Shellmaker Island to the Unit I/III Basin. Channel clearance is expected to take about one month. Deepening of the Unit I/III Basin necessitates the downward extension of the 1-ton grouted rock scour apron near the mouth of San Diego Creek. That work would also be performed during this initial phase of construction, to avoid the potential storm flow periods of the mid-winter. The shallow channel around the hotdog-shaped tern island would be constructed by a small dredge or backhoe at this time. The large clamshell dredge would be capable of excavating about 4,000 cy of sediment per day to the design depth of –20 ft (MSL).

Work would shift seasonally from areas north of the dike to areas south of the dike. Two seasons of work will be required to dredge both the Unit I/III Basin (958,000 cy excavation) and the Unit II Basin (866,000 cy excavation). It is understood that the contractor charged with this work will plan and execute the job independently of this plan. However, there is a need to understand that the dredging work must be sensitive to the ecological disruption it causes within the Upper Bay and on-site monitoring may require flexibility in undertaking the work. Approximately twenty-three months is necessary to complete the construction phase of the Recommended Plan.

Figure 60
Example Construction Schedule
Recommended Plan (Alternative 6)



Task No.	Task	Volume, cy	Duration, Months	Preferred Season 9/16 - 2/28	Preferred Season 3/1 - 9/15
	Performed by Backhoe or Small Dredge				
1	Move Tern Island	63,000	0.7	x	
2	Create Small Channel, Hot Dog	9,000	0.3	x	
3	Create Bullnose Wetlands	42,000	0.5		x
4	Grouted Stone Apron	n/a	1.0	x	
5	Northstar Wetlands	37,000	0.5		x
6	Shellmaker Wetlands	34,000	0.7	x	
7	Middle Island Channel	20,000	0.5	x	
8	New Island Channel	20,000	0.5	x	
9	Dendritic Channel	9,000	0.3	x	
	Performed by Large Clamshell Dredge				
10	Access Channel South of Unit II	75,000	0.8	x	
11	Channel Between Unit I/III and II	20,000	0.2	x	
12	Unit I/III Basin	958,000	10.2	x	x
13	Santa Ana - Delhi Channel	8,000	0.1		x
14	Unit II Basin	866,000	9.3	x	x

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APPENDIX A

APPENDIX A

MCACES AND CDEP COST SUMMARIES

FOR THE RECOMMENDED PLAN

ALTERNATIVE 6
Construction Method: Ocean-Going Clamshell Dredge

Upper Newport Bay — DATE: August 30,2000 FINAL BY:ILT

Ecosystem Restoration Feasibility Study

MCACES Code of Accounts	Item	Quantity	Unit	Unit Price	Cost Without Contingency	Contingency* 20%	Cost With Contingency
12.02.01	Equipment Mobilization/Demobilization	1	Job	$ 1,267,000	$ 1,267,000	$ 253,400	$ 1,520,000
12.02.15	Dredge Sediment Control Features	1,927,000	cy	$ 9.75	$ 18,788,000	$ 3,757,600	$ 22,546,000
12.02.14	Unit I/III Hotdog Tern Island, South side channel	9,000	cy	$ 9.00	$ 81,000	$ 16,200	$ 97,000
	Bullnose Section of Land, Northwest corner of Unit I/III	42,000	cy	$ 8.00	$ 336,000	$ 67,200	$ 403,000
	New Island, East Side Channel	20,000	cy	$ 9.00	$ 180,000	$ 36,000	$ 216,000
	Middle Island, West Side Channel	20,000	cy	$ 9.00	$ 180,000	$ 36,000	$ 216,000
	Shellmaker Island, East Side Channel	24,000	cy	$ 9.00	$ 216,000	$ 43,200	$ 259,000
	Shellmaker Island, Small Dendritic Channel	9,000	cy	$ 9.00	$ 81,000	$ 16,200	$ 97,000
	Shellmaker Island, Remove Dredge Spoil/Create Wetland	34,000	cy	$ 8.00	$ 272,000	$ 54,400	$ 326,000
	Northstar Beach Wetlands Creation	37,000	cy	$ 8.00	$ 296,000	$ 59,200	$ 355,000
	Plant Eelgrass Beds	0.6	Acres	$ 47,778	$ 29,000	$ 5,800	$ 35,000
	Construct New Tern Island by Salt Dike (Unit II Basin)	63,000	cy	$ 4.00	$ 252,000	$ 50,400	$ 302,000
	Add Sand to Hotdog Tern Island	9,700	cy	$ 4.00	$ 39,000	$ 7,800	$ 47,000
	Segment Main Dike	1	Job	$ 4,000	$ 4,000	$ 800	$ 5,000
	Education Kiosks	4	Sites	$ 8,000	$ 32,000	$ 6,400	$ 38,000
	Grouted Stone Apron for Jamboree Rd. Slope Protection	400	Tons	$ 130	$ 52,000	$ 10,400	$ 62,000
	Real Estate Admin/Acquisition Costs	1	Lump Sum	$ 36,000	$ 36,000	$ 5,400	$ 41,000
	Lands and Improvements (LERRDs Credit)	1	Lump Sum	$ 571,870	$ 572,000	$ 85,800	$ 658,000
12.02.99	Survey Operations	23	Months	$ 35,000	$ 805,000	$ 161,000	$ 966,000
12.02.99	Env. Water Quality/Species Monitoring during Const.	23	Months	$ 5,000	$ 115,000	$ 23,000	$ 138,000
12.02.99	Env. Habitat/Species 2 Season Surveys During/Post Const	4	Seasons	$ 60,000	$ 240,000	$ 48,000	$ 288,000
	TOTAL CONSTRUCTION COST			Subtotal =	$ 23,873,000	$ 4,744,200	$ 28,615,000
30	Pre-construction, Engineering, Design (PE&D)		Job				$ 2,000,000
31	Construction Management (S&A)		6.5%				$ 1,860,000
	TOTAL PROJECT COST					Total =	$ 32,475,000

Notes:
(1) Method of Construction Type of Equipment: 10 CY Clamshell Dredge
(2) *Twenty percentage contingency based on ER 1110-2-1302 dated 31 March 1994.
(3) Off-shore disposal site, LA-3. Multiple scow will be used.
(4) Corps of Engineer Dredge Program (CEDEP) used as required for MCACES
(5) PE&D, S&A, cost provided by Study Manager

Upper Newport Beach Feasibility
Upper Newport Beach Feasibility
Study, Alternative 6, Dredge
and Wetlands Restoration

Designed By: U.S. ARMY CORPS OF ENGINEERS
Estimated By: IRENE LEYVA-TRACY

Prepared By: COST ENGINEERING UNIT
LOS ANGELES DISTIRCT

Preparation Date: 05/09/00
Effective Date of Pricing: 05/09/00
Est Construction Time: 660 Days

Sales Tax: 7.75%

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contained herein is For Official Use Only.

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Release 1.2c

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30 Account PE&D: Breakdown on Cost:

PPMD	$225,000
Coastal Engineering	$325,000
Cost Engineering	$ 50,000
Geotech	$200,000
Survey	$100,000
Field/Analy	$500,000
Spec's	$100,000
Environmental	$200,000
Real Estate	$ 50,000
QC Review EDMgmt	$ 50,000
Contingeny	$200,000
Estimate PE&D	$2,000,000

Per E-message dated May 17,2000 from J. Hutchinson Subject: FW: Irene's Table
Coordination between Don Spencer, Art Shak & Jim Hutchinson.

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No Backup Reports...

* * * END TABLE OF CONTENTS * * *

** PROJECT INDIRECT SUMMARY - Scope **

		QUANTITY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
01	Mob/Demob	1.00	EA	524,350	41,948	28,315	59,461	6,541	660,615	660614.93
03	Dredge Sediment Control Fea	1927000	CY	14,942,240	1,195,379	806,881	1,694,450	186,390	18,825,340	9.77
11	Wetlands/Channel Restoratio	60900.00	CY	471,755	37,740	25,475	53,497	5,885	594,352	9.76
20	Excavation Cost-Bullnose Se	48000.00	CY	235,483	18,839	12,716	26,704	2,937	296,679	6.18
30	Excavation Cost-Northstar B	27200.00	CY	178,684	14,295	9,649	20,263	2,229	225,119	8.28
35	Excavate Shellmaker, REMOVE	39000.00	CY	288,873	23,110	15,599	32,758	3,603	363,944	9.33
40	Plant Eelgrass Beds	0.60	ACR	22,754	1,820	1,229	2,580	284	28,667	47778.50
51	Constr New Tern Island/Salt	63000.00	CY	191,936	15,355	10,365	21,766	2,394	241,815	3.84
53	Add sand to Hotdog Tern Isl	9700.00	CY	29,552	2,364	1,596	3,351	369	37,232	3.84
55	Segment Main Dike	1.00	EA	3,450	276	186	391	43	4,347	4346.57
60	Grouted Stone for Apron	400.00	TON	41,217	3,297	2,226	4,674	514	51,928	129.82
62	Education Kiosks	4.00	EA	25,680	2,054	1,387	2,912	320	32,354	8088.39
63	Survey Operations	23.00	MOS	606,897	48,552	32,772	68,822	7,570	764,614	33244.10
65	Env. Wtr Quality/Species Mo	23.00	MOS	96,600	7,728	5,216	10,954	1,205	121,704	5291.47
66	Env. Habitat/Species 2 Seas	4.00	EA	190,500	15,240	10,287	21,603	2,376	240,006	60001.50
	Upper Newport Beach Feasibi	1.00	EA	17,849,971	1,427,998	963,898	2,024,187	222,661	22,488,715	22488715

CONTINGENCY 20%	4,497,743
SUBTOTAL	26,986,458
30 PE&D	2,000,000
SUBTOTAL	28,986,458
31 S&A 6.5%	1,884,120
TOTAL INCL OWNER COSTS	30,870,578

** PROJECT DIRECT SUMMARY - Scope **

		QUANTITY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
01	Mob/Demob	1.00	EA	24	10,000	50,000	0	464,350	524,350	524350.00
03	Dredge Sediment Control Features	1927000	CY	0	0	0	0	14942240	14,942,240	7.75
11	Wetlands/Channel Restoration	60900.00	CY	0	0	0	0	471,755	471,755	7.75
20	Excavation Cost-Bullnose Section	48000.00	CY	4,267	173,894	61,589	0	0	235,483	4.91
30	Excavation Cost-Northstar Beach	27200.00	CY	2,934	128,217	50,467	0	0	178,684	6.57
35	Excavate Shellmaker, REMOVE Dred	39000.00	CY	2,886	125,861	65,512	0	97,500	288,873	7.41
40	Plant Eelgrass Beds	0.60	ACR	270	22,415	0	339	0	22,754	37923.24
51	Constr New Tern Island/Salt Dike	63000.00	CY	3,150	137,724	54,212	0	0	191,936	3.05
53	Add sand to Hotdog Tern Island	9700.00	CY	485	21,205	8,347	0	0	29,552	3.05
55	Segment Main Dike	1.00	EA	0	0	0	0	3,450	3,450	3450.00
60	Grouted Stone for Apron	400.00	TON	284	8,459	1,610	18,400	12,748	41,217	103.04
62	Education Kiosks	4.00	EA	0	0	0	0	25,680	25,680	6420.00
63	Survey Operations	23.00	MOS	30,865	604,864	0	0	2,033	606,897	26386.84
65	Env. Wtr Quality/Species Monitor	23.00	MOS	0	0	0	0	96,600	96,600	4200.00
66	Env. Habitat/Species 2 Season	4.00	EA	0	0	0	0	190,500	190,500	47625.00
TOTAL	Upper Newport Beach Feasibility	1.00	EA	45,165	1232640	291,736	18,739	16306856	17,849,971	17849971

OVERHEAD - 8%	1,427,998
SUBTOTAL	19,277,969
HOME OFC - 5%	963,898
SUBTOTAL	20,241,867
PROFIT - 10%	2,024,187
SUBTOTAL	22,266,054
BOND - 1%	222,661
TOTAL INCL INDIRECTS	22,488,715
CONTINGENCY 20%	4,497,743
SUBTOTAL	26,986,458
30 PE&D	2,000,000
SUBTOTAL	28,986,458
31 S&A 6.5%	1,884,120
TOTAL INCL OWNER COSTS	30,870,578

** CONTRACTOR DIRECT SUMMARY **

	QUANTITY	UOM	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST
PR Prime Contractor								
RK Subcontract Stone Apron	1.00	EA	284	7,034	1,338	15,301	10,600	34,273
Subtotal Subcontract Work	1.00	EA	284	7,034	1,338	15,301	10,600	34,273
Subcontracts Incl Indirect	1.00	EA	284	8,459	1,610	18,400	12,748	41,217
Contractor's Own Work	1.00	EA	44,881	1224181	290,127	33916294108		17,808,754
PR Prime Contractor	1.00	EA	45,165	1232640	291,736	18,73916306856		17,849,971

** CONTRACTOR INDIRECT SUMMARY **

	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
PR Prime Contractor							
RK Subcontract Stone Apron	34,273	2,742	1,851	1,943	408	41,217	41217.09
Subtotal Subcontract Work	34,273	2,742	1,851	1,943	408	41,217	41217.09
Indirect on Subcontracts	41,217	3,297	2,226	4,674	514	51,928	51928.34
Indirect on Own Work	17,808,754	1,424,700	961,673	2,019,513	222,146	22,436,786	22436786
PR Prime Contractor	17,849,971	1,427,998	963,898	2,024,187	222,661	22,488,715	22488715

		QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
01. Mob/Demob												
USR	PR Mob/Demo					24.00	10000.00	50000.00	0.00	464350	524350.00	
		1.00	EA	N/A	0.00	24	10,000	50,000	0	464,350	524,350	524350.00
03. Dredge Sediment Control Features												
M	PR Dredging wt 10cy Clam					0.00	0.00	0.00	0.00	7.71	7.71	
	shell	958000	CY	N/A	0.00	0	0	0	0	7386180	7,386,180	7.71
M	PR Dredging wt 10cy Clam					0.00	0.00	0.00	0.00	7.71	7.71	
	shell	866000	CY	N/A	0.00	0	0	0	0	6676860	6,676,860	7.71
M	PR Dredging wt 10cy Clam					0.00	0.00	0.00	0.00	13.96	13.96	
	shell	20000	CY	N/A	0.00	0	0	0	0	279,200	279,200	13.96
M	PR Dredging wt 10cy Clam					0.00	0.00	0.00	0.00	8.00	8.00	
	shell	75000	CY	N/A	0.00	0	0	0	0	600,000	600,000	8.00
11. Wetlands/Channel Restoration												
M	PR Dredging wt 10cy Clam					0.00	0.00	0.00	0.00	7.71	7.71	
	shell	5500.00	CY	N/A	0.00	0	0	0	0	42,405	42,405	7.71
M	PR Dredging wt 10cy Clam					0.00	0.00	0.00	0.00	7.75	7.75	
	shell	17400	CY	N/A	0.00	0	0	0	0	134,850	134,850	7.75
M	PR Dredging wt 10cy Clam					0.00	0.00	0.00	0.00	7.75	7.75	
	shell	12200	CY	N/A	0.00	0	0	0	0	94,550	94,550	7.75
M	PR Dredging wt 10cy Clam					0.00	0.00	0.00	0.00	7.75	7.75	
	shell	15800	CY	N/A	0.00	0	0	0	0	122,450	122,450	7.75
M	PR Dredging wt 10cy Clam					0.00	0.00	0.00	0.00	7.75	7.75	
	shell	10000	CY	N/A	0.00	0	0	0	0	77,500	77,500	7.75
20. Excavation Cost-Bullnose Section												
L MIL	PR Clearing, machine loa					0.09	3.62	1.28	0.00	0.00	4.91	
	d spoils, 2	48000	CY	COEIB17	45.00	4,267	173,894	61,589	0	0	235,483	4.91

	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
30. Excavation Cost-Northstar Beach											
L MIL PR Excavating, bulk, doz					0.09	4.10	1.61	0.00	0.00	5.71	
er, large	31280	CY	CODTB10L	16.00	2,934	128,217	50,467	0	0	178,684	5.71
35. Excavate Shellmaker, REMOVE Dred											
L MIL PR Excavating, bulk, doz					0.06	2.62	1.03	0.00	0.00	3.66	
er, small	39000	CY	CODTB10L	25.00	2,340	102,309	40,271	0	0	142,580	3.66
L MIL PR Spread/compact, 200 H					0.01	0.60	0.65	0.00	2.50	3.75	
P dozer	39000	CY	COFCB32E	200.00	546	23,552	25,241	0	97,500	146,293	3.75
40. Plant Eelgrass Beds											
B USR PR Eelgrass transplant w					450.00	37358.99	0.00	564.25	0.00	37923.24	
ith divers	0.60	ACR	XDIVB	0.01	270	22,415	0	339	0	22,754	37923.24
51. Constr New Tern Island/Salt Dike											
L MIL PR Excavate & fill, doze					0.05	2.19	0.86	0.00	0.00	3.05	
r, move	63000	CY	CODTB10L	30.00	3,150	137,724	54,212	0	0	191,936	3.05
53. Add sand to Hotdog Tern Island											
L MIL PR Excavate & fill, doze					0.05	2.19	0.86	0.00	0.00	3.05	
r, move	9700.00	CY	CODTB10L	30.00	485	21,205	8,347	0	0	29,552	3.05
55. Segment Main Dike											
USR PR Segment Main Dike					0.00	0.00	0.00	0.00	3450.00	3450.00	
	1.00	EA		0.00	0	0	0	0	3,450	3,450	3450.00
60. Grouted Stone for Apron											
B RSM RK Rip-rap, 1 ton, machi					0.16	7.52	3.07	21.55	0.00	32.13	
ne placed	400.00	TON	UOEHB12G	12.50	64	3,616	1,476	10,366	0	15,458	38.65
M USR RK Grout, Material cemen					0.00	0.00	0.00	6680.50	0.00	6680.50	
t, only	1.00	EA	N/A	0.00	0	0	0	8,034	0	8,034	8034.02
MIL RK Traffic Control perso					172.41	2513.53	0.00	0.00	0.00	2513.53	
nnel	0.60	MO	UFLDFCLT1	0.01	103	1,814	0	0	0	1,814	3022.79
L MIL RK Field personnel, cons					172.41	2513.53	0.00	0.00	0.00	2513.53	
truction	0.50	MO	UFLDFCLT1	0.01	86	1,511	0	0	0	1,511	3022.79

60. Grouted Stone for Apron

	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
L USR RK Excavating, wet mater					0.15	6.56	2.79	0.00	245.00	254.35	
ial	40.00	CY	CODTB10W	10.00	6	315	134	0	11,786	12,235	305.88
USR RK Mobilization,					24.00	1000.00	0.00	0.00	800.00	1800.00	
	1.00	EA	N/A	0.00	24	1,203	0	0	962	2,165	2164.69
62. Education Kiosks											
USR PR Education Kiosks					0.00	0.00	0.00	0.00	6420.00	6420.00	
	4.00	EA		0.00	0	0	0	0	25,680	25,680	6420.00
63. Survey Operations											
L USR PR Surveyors(3)cut&fill					166.67	2429.75	0.00	0.00	11.05	2440.80	
monitoring	80.50	MO	UFLDSRVS1	0.01	13,417	195,595	0	0	890	196,484	2440.80
L MIL PR Surveyor (2) LA-3 Dis					166.67	2429.75	0.00	0.00	11.05	2440.80	
p monitor	69.00	MO	UFLDSRVS1	0.01	11,500	167,653	0	0	762	168,415	2440.80
USR PR Field personnel, Supe					172.41	7003.38	0.00	0.00	11.05	7014.43	
rintendent	34.50	MO	UFLDSUGE1	0.01	5,948	241,617	0	0	381	241,998	7014.43
65. Env. Wtr Quality/Species Monitor											
USR PR Environmental Monitor					0.00	0.00	0.00	0.00	4200.00	4200.00	
ing	23.00	MOS		0.00	0	0	0	0	96,600	96,600	4200.00
66. Env. Habitat/Species 2 Season											
USR PR Env. Habitat/species					0.00	0.00	0.00	0.00	47625	47625.00	
2 Season	4.00	EA		0.00	0	0	0	0	190,500	190,500	47625.00
TOTAL Upper Newport Beach F	1.00	EA			45,165	1232640	291,736	18,73916306856		17,849,971	17849971

MOBIL & DEMOB COST:	$524,350	BID QUANTITY	866,000 C.Y.
		UNIT COST...	$7.71 PER C.Y.
	Upper Newport Bch Dredging WTOUT OH'S	EXCAV. COST.	$6,676,860
CHECKLIST FOR INPUT DATA.		TIME.....	5.81 MONTHS

PG 1.....PROJECT -	Upper Newport Bch Dredging WTOUT OH'S
LOCATION -	Newport Beach, CA - Orange County
INVIT # -	Feasibility Study - UNIT II Basin, -20ft MSL
DATE OF EST. -	10 May 2000
EST. BY -	Irene Leyva-Tracy
MOB. BID ITEM # -	1
EXCAV. BID ITEM # -	2
PG 2.....TYPE OF EST. -	Planning Estimate
CONTRACTOR'S O.H. -	0.0%
CONTRACTOR'S PROFIT -	0.0%
CONTRACTOR'S BOND -	0.0%
PG 3...DREDGING AREA -	1,686,000 sf
REQ'D EXCAVATION -	866,000 cyds
PAY OVERDEPTH -	0 cyds
CONTRACT AMOUNT -	866,000 cyds
NOT DREDGED -	0 cyds
NET PAY -	866,000 cyds
NONPAY YARDAGE -	0 cyds
GROSS YARDAGE -	866,000 cyds
NONPAY HEIGHT -	0.0 ft overdig
TOTAL BANK HEIGHT -	13.9 ft
PG 4.....DREDGE SEL. -	10 CY CLAMSHELL
TYPE OF MATERIAL -	MUD
BUCKET SIZE -	10
BUCKET FILL FACTOR -	0.85
OPTIMUM BANK -	3.5
BANK FACTOR -	1.00
PG 5.....BUCKET CYCLE -	60 Seconds
OTHER FACTOR -	1.00 >
CLEANUP -	15% More Time
TIME EFFICIENCY -	85.0% of EWT
PG 6...TUG DESCRIPT. -	3000 HP Diesel--Twin Screw
PREPARE SCOW TOW -	10 min
HAUL DIST -	8 mi
SPEED TO D/A -	3 mph (160 min)
SPEED FROM D/A -	8 mph (60 min)
DUMP OR PUMPOUT -	10 min
DISENGAGE TOW -	10 min
TOW EFFICIENCY -	85 %
SCOW DESCRIPTION -	3,000 CY Split Hull Scow
USEABLE VOLUME -	50 %
% SOLIDS -	66.65 % (1,000 cy/load)

PG 7.....DREDGES -	1
SCOWS @ DREDGE -	1
TOWING VESSELS -	1
SCOWS PER TOW -	1
ADDITIONAL SCOWS -	3
TOT SCOWS ON JOB -	5
PG 8....QTRS ON DREDGE? -	NO
SURVEY BOAT? -	YES
CREW BOAT? -	NO
PG 9...SP COST/MO (1ST) -	$10,000 Monitoring
SP COST/MO (2ND-14TH) -	$0 From Sheet D\4
SPECIAL COST LS (1ST) -	$10,000 Permit
SP COST LS (2ND-14TH) -	$40,000 From Sheet E
PG 10....PRESENT YEAR -	2000
ECONOMIC INDEX -	5844
LAF -	1.190
INTEREST RATE -	6.750% /yr
TIME PERIOD -	January to June 2000
PIPELINE AVAILABILITY -	9 mos/yr
BUCKET AVAILABILITY -	10 mos/yr
HOPPER AVAILABILITY -	10 mos/yr
FUEL PRICE -	$1.01 /gal

EXCAVATION PRODUCTION -	444	cy/hr (gross)
EXCAVATION EWT -	85.0%	(621 hrs/mo)
EXCAVATION TIME -	3.14	months
HAULING PRODUCTION -	240	cy/hr (gross)
HAULING EWT -	85.0%	(621 hrs/mo)
HAULING TIME -	5.81	months
DREDGING TIME -	5.81	months
EXCAVAT EWT (ADJUSTED) -	336	hrs/mo (46.0% EWT)
HAULING EWT (ADJUSTED) -	621	hrs/mo (85.1% EWT)
PRODUCTION (GROSS) -	149,040	cy per month
PRODUCTION (CONTRACT) -	149,040	pay cy per month

MOBIL & DEMOB COST:	$0		BID QUANTITY	958,000	C.Y.
			UNIT COST...	$7.71	PER C.Y.
	Upper Newport Beach Dredging wtout OH'S		EXCAV. COST.	$7,386,180	
CHECKLIST FOR INPUT DATA.			TIME.....	6.43	MONTHS

PG 1.....PROJECT -	Upper Newport Beach Dredging wtout OH'S	
LOCATION -	Newport Beach, CA - Orange County	
INVIT # -	Feasibility Study - UNIT I/III Basin, -20ft MSL	
DATE OF EST. -	10 May 2000	
EST. BY -	Irene Leyva-Tracy	
MOB. BID ITEM # -	1	
EXCAV. BID ITEM # -	2	
PG 2.....TYPE OF EST. -	Planning Estimate	
CONTRACTOR'S O.H. -	0.0%	
CONTRACTOR'S PROFIT -	0.0%	
CONTRACTOR'S BOND -	0.0%	
PG 3...DREDGING AREA -	2,260,000	sf
REQ'D EXCAVATION -	958,000	cyds
PAY OVERDEPTH -	0	cyds
CONTRACT AMOUNT -	958,000	cyds
NOT DREDGED -	0	cyds
NET PAY -	958,000	cyds
NONPAY YARDAGE -	0	cyds
GROSS YARDAGE -	958,000	cyds
NONPAY HEIGHT -	0.0	ft overdig
TOTAL BANK HEIGHT -	11.4	ft
PG 4.....DREDGE SEL. -	10 CY CLAMSHELL	
TYPE OF MATERIAL -	MUD	
BUCKET SIZE -	10	
BUCKET FILL FACTOR -	0.85	
OPTIMUM BANK -	3.5	
BANK FACTOR -	1.00	
PG 5.....BUCKET CYCLE -	60	Seconds
OTHER FACTOR -	1.00	>
CLEANUP -	15%	More Time
TIME EFFICIENCY -	85.0%	of EWT
PG 6...TUG DESCRIPT. -	3000	HP Diesel--Twin Screw
PREPARE SCOW TOW -	10	min
HAUL DIST -	8	mi
SPEED TO D/A -	3	mph (160 min)
SPEED FROM D/A -	8	mph (60 min)
DUMP OR PUMPOUT -	10	min
DISENGAGE TOW -	10	min
TOW EFFICIENCY -	85	%
SCOW DESCRIPTION -	3,000	CY Split Hull Scow
USEABLE VOLUME -	50	%
% SOLIDS -	66.65	% (1,000 cy/load)

PG 7.....DREDGES -	1	
SCOWS @ DREDGE -	1	
TOWING VESSELS -	1	
SCOWS PER TOW -	1	
ADDITIONAL SCOWS -	3	
TOT SCOWS ON JOB -	5	
PG 8....QTRS ON DREDGE? -	NO	
SURVEY BOAT? -	YES	
CREW BOAT? -	NO	
PG 9...SP COST/MO (1ST) -	$10,000	Monitoring
SP COST/MO (2ND-14TH) -	$0	From Sheet D\4
SPECIAL COST LS (1ST) -	$10,000	Permit
SP COST LS (2ND-14TH) -	$40,000	From Sheet E
PG 10....PRESENT YEAR -	2000	
ECONOMIC INDEX -	5844	
LAF -	1.190	
INTEREST RATE -	6.750%	/yr
TIME PERIOD -	January to June 2000	
PIPELINE AVAILABILITY -	9	mos/yr
BUCKET AVAILABILITY -	10	mos/yr
HOPPER AVAILABILITY -	10	mos/yr
FUEL PRICE -	$1.01	/gal

EXCAVATION PRODUCTION	-	444	cy/hr (gross)
EXCAVATION EWT	-	85.0%	(621 hrs/mo)
EXCAVATION TIME	-	3.47	months
HAULING PRODUCTION	-	240	cy/hr (gross)
HAULING EWT	-	85.0%	(621 hrs/mo)
HAULING TIME	-	6.43	months
DREDGING TIME	-	6.43	months
EXCAVAT EWT (ADJUSTED)	-	336	hrs/mo (46.0% EWT)
HAULING EWT (ADJUSTED)	-	621	hrs/mo (85.1% EWT)
PRODUCTION (GROSS)	-	149,040	cy per month
PRODUCTION (CONTRACT)	-	148,989	pay cy per month

MOBIL & DEMOB COST: $0

Upper Newport Beach/WTOUT OH's

CHECKLIST FOR INPUT DATA.

BID QUANTITY	5,500	C.Y.
UNIT COST...	$7.71	PER C.Y.
EXCAV. COST.	$42,405	
TIME.....	0.04	MONTHS

PG 1.....PROJECT -	Upper Newport Beach/WTOUT OH's	
LOCATION -	Newport Beach, CA - Orange County	
INVIT # -	Feasibility Study - Hotdog Tern Island	
DATE OF EST. -	10 May 2000	
EST. BY -	Irene Leyva-Tracy	
MOB. BID ITEM # -	1	
EXCAV. BID ITEM # -	2	
PG 2.....TYPE OF EST. -	Planning Estimate	
CONTRACTOR'S O.H. -	0.0%	
CONTRACTOR'S PROFIT -	0.0%	
CONTRACTOR'S BOND -	0.0%	
PG 3...DREDGING AREA -	50,000	sf
REQ'D EXCAVATION -	5,500	cyds
PAY OVERDEPTH -	0	cyds
CONTRACT AMOUNT -	5,500	cyds
NOT DREDGED -	0	cyds
NET PAY -	5,500	cyds
NONPAY YARDAGE -	0	cyds
GROSS YARDAGE -	5,500	cyds
NONPAY HEIGHT -	0.0	ft overdig
TOTAL BANK HEIGHT -	3.0	ft
PG 4.....DREDGE SEL. -	10 CY	CLAMSHELL
TYPE OF MATERIAL -	MUD	
BUCKET SIZE -	10	
BUCKET FILL FACTOR -	0.85	
OPTIMUM BANK -	3.5	
BANK FACTOR -	0.86	
PG 5.....BUCKET CYCLE -	60	Seconds
OTHER FACTOR -	0.85	>
CLEANUP -	10%	More Time
TIME EFFICIENCY -	85.0%	of EWT
PG 6...TUG DESCRIPT. -	3000	HP Diesel--Twin Screw
PREPARE SCOW TOW -	10	min
HAUL DIST -	8	mi
SPEED TO D/A -	3	mph (160 min)
SPEED FROM D/A -	8	mph (60 min)
DUMP OR PUMPOUT -	10	min
DISENGAGE TOW -	10	min
TOW EFFICIENCY -	85	%
SCOW DESCRIPTION -	3,000	CY Split Hull Scow
USEABLE VOLUME -	50	%
% SOLIDS -	66.65	% (1,000 cy/load)

PG 7.....DREDGES -	1	
SCOWS @ DREDGE -	1	
TOWING VESSELS -	1	
SCOWS PER TOW -	1	
ADDITIONAL SCOWS -	0	
TOT SCOWS ON JOB -	2	
PG 8....QTRS ON DREDGE? -	NO	
SURVEY BOAT? -	YES	
CREW BOAT? -	NO	
PG 9...SP COST/MO (1ST) -	$2,500	Monitoring
SP COST/MO (2ND-14TH) -	$0	From Sheet D\4
SPECIAL COST LS (1ST) -	$0	Permit
SP COST LS (2ND-14TH) -	$0	From Sheet E
PG 10....PRESENT YEAR -	2000	
ECONOMIC INDEX -	5844	
LAF -	1.190	
INTEREST RATE -	6.750%	/yr
TIME PERIOD -	January to June 2000	
PIPELINE AVAILABILITY -	9	mos/yr
BUCKET AVAILABILITY -	10	mos/yr
HOPPER AVAILABILITY -	10	mos/yr
FUEL PRICE -	$1.01	/gal

EXCAVATION PRODUCTION -	338	cy/hr (gross)
EXCAVATION EWT -	85.0%	(621 hrs/mo)
EXCAVATION TIME -	0.03	months
HAULING PRODUCTION -	240	cy/hr (gross)
HAULING EWT -	85.0%	(621 hrs/mo)
HAULING TIME -	0.04	months
DREDGING TIME -	0.04	months
EXCAVAT EWT (ADJUSTED) -	441	hrs/mo (60.4% EWT)
HAULING EWT (ADJUSTED) -	621	hrs/mo (85.1% EWT)
PRODUCTION (GROSS) -	149,040	cy per month
PRODUCTION (CONTRACT) -	137,500	pay cy per month

MOBIL & DEMOB COST:	$0	BID QUANTITY	20,000 C.Y.
		UNIT COST...	$10.57 PER C.Y.
	Upper Newport Bch Dredging WTOUT OH's	EXCAV. COST.	$211,400
CHECKLIST FOR INPUT DATA.		TIME.....	0.20 MONTHS

PG 1.....PROJECT -	Upper Newport Bch Dredging WTOUT OH's	
LOCATION -	Newport Beach, CA - Orange County	
INVIT # -	Feas Sty - Channel Between UNITs I/III & II B	
DATE OF EST. -	10 May 2000	
EST. BY -	Irene Leyva-Tracy	
MOB. BID ITEM # -	1	
EXCAV. BID ITEM # -	2	
PG 2.....TYPE OF EST. -	Planning Estimate	
CONTRACTOR'S O.H. -	0.0%	
CONTRACTOR'S PROFIT -	0.0%	
CONTRACTOR'S BOND -	0.0%	
PG 3...DREDGING AREA -	680,520	sf
REQ'D EXCAVATION -	20,000	cyds
PAY OVERDEPTH -	0	cyds
CONTRACT AMOUNT -	20,000	cyds
NOT DREDGED -	0	cyds
NET PAY -	20,000	cyds
NONPAY YARDAGE -	0	cyds
GROSS YARDAGE -	20,000	cyds
NONPAY HEIGHT -	0.0	ft overdig
TOTAL BANK HEIGHT -	0.8	ft
PG 4.....DREDGE SEL. -	10 CY	CLAMSHELL
TYPE OF MATERIAL -	MUD	
BUCKET SIZE -	10	
BUCKET FILL FACTOR -	0.85	
OPTIMUM BANK -	3.5	
BANK FACTOR -	0.23	
PG 5.....BUCKET CYCLE -	40	Seconds
OTHER FACTOR -	1.00	>
CLEANUP -	10%	More Time
TIME EFFICIENCY -	85.0%	of EWT
PG 6...TUG DESCRIPT. -	3000	HP Diesel--Twin Screw
PREPARE SCOW TOW -	10	min
HAUL DIST -	8	mi
SPEED TO D/A -	3	mph (160 min)
SPEED FROM D/A -	8	mph (60 min)
DUMP OR PUMPOUT -	10	min
DISENGAGE TOW -	10	min
TOW EFFICIENCY -	85	%
SCOW DESCRIPTION -	3,000	CY Split Hull Scow
USEABLE VOLUME -	50	%
% SOLIDS -	66.65	% (1,000 cy/load)

PG 7.....DREDGES -	1	
SCOWS @ DREDGE -	1	
TOWING VESSELS -	1	
SCOWS PER TOW -	1	
ADDITIONAL SCOWS -	1	
TOT SCOWS ON JOB -	3	
PG 8....QTRS ON DREDGE? -	NO	
SURVEY BOAT? -	YES	
CREW BOAT? -	NO	
PG 9...SP COST/MO (1ST) -	$1,000	Monitoring
SP COST/MO (2ND-14TH) -	$0	From Sheet D\4
SPECIAL COST LS (1ST) -	$0	Cost with Unit I/III & II
SP COST LS (2ND-14TH) -	$0	From Sheet E
PG 10....PRESENT YEAR -	2000	
ECONOMIC INDEX -	5844	
LAF -	1.190	
INTEREST RATE -	6.750%	/yr
TIME PERIOD -	January to June 2000	
PIPELINE AVAILABILITY -	9	mos/yr
BUCKET AVAILABILITY -	10	mos/yr
HOPPER AVAILABILITY -	10	mos/yr
FUEL PRICE -	$1.01	/gal

EXCAVATION PRODUCTION -	159	cy/hr (gross)
EXCAVATION EWT -	85.0%	(621 hrs/mo)
EXCAVATION TIME -	0.2	months
HAULING PRODUCTION -	240	cy/hr (gross)
HAULING EWT -	85.0%	(621 hrs/mo)
HAULING TIME -	0.13	months
DREDGING TIME -	0.2	months
EXCAVAT EWT (ADJUSTED) -	621	hrs/mo (85.1% EWT)
HAULING EWT (ADJUSTED) -	411	hrs/mo (56.3% EWT)
PRODUCTION (GROSS) -	98,739	cy per month
PRODUCTION (CONTRACT) -	98,739	pay cy per month

MOBIL & DEMOB COST:	$534,803		BID QUANTITY	8,000	C.Y.
			UNIT COST...	$12.32	PER C.Y.
	Upper Newport Beach Dredging		EXCAV. COST.	$98,560	
CHECKLIST FOR INPUT DATA.			TIME.....	0.08	MONTHS

PG 1.....PROJECT -	Upper Newport Beach Dredging	
LOCATION -	Newport Beach, CA - Orange County	
INVIT # -	Feasibility Study - Channel Bordering Unit II	
DATE OF EST. -	10 May 2000	
EST. BY -	Irene Leyva-Tracy	
MOB. BID ITEM # -	1	
EXCAV. BID ITEM # -	2	
PG 2.....TYPE OF EST. -	Planning Estimate	
CONTRACTOR'S O.H. -	10.0%	
CONTRACTOR'S PROFIT -	5.0%	
CONTRACTOR'S BOND -	1.0%	
PG 3...DREDGING AREA -	375,000	sf
REQ'D EXCAVATION -	8,000	cyds
PAY OVERDEPTH -	0	cyds
CONTRACT AMOUNT -	8,000	cyds
NOT DREDGED -	0	cyds
NET PAY -	8,000	cyds
NONPAY YARDAGE -	0	cyds
GROSS YARDAGE -	8,000	cyds
NONPAY HEIGHT -	0.0	ft overdig
TOTAL BANK HEIGHT -	0.6	ft
PG 4.....DREDGE SEL. -	10 CY	CLAMSHELL
TYPE OF MATERIAL -	MUD	
BUCKET SIZE -	10	
BUCKET FILL FACTOR -	0.85	
OPTIMUM BANK -	3.5	
BANK FACTOR -	0.17	
PG 5.....BUCKET CYCLE -	30	Seconds
OTHER FACTOR -	1.00	>
CLEANUP -	10%	More Time
TIME EFFICIENCY -	85.0%	of EWT
PG 6...TUG DESCRIPT. -	3000	HP Diesel--Twin Screw
PREPARE SCOW TOW -	10	min
HAUL DIST -	8	mi
SPEED TO D/A -	3	mph (160 min)
SPEED FROM D/A -	8	mph (60 min)
DUMP OR PUMPOUT -	10	min
DISENGAGE TOW -	10	min
TOW EFFICIENCY -	85	%
SCOW DESCRIPTION -	3,000	CY Split Hull Scow
USEABLE VOLUME -	50	%
% SOLIDS -	66.65	% (1,000 cy/load)

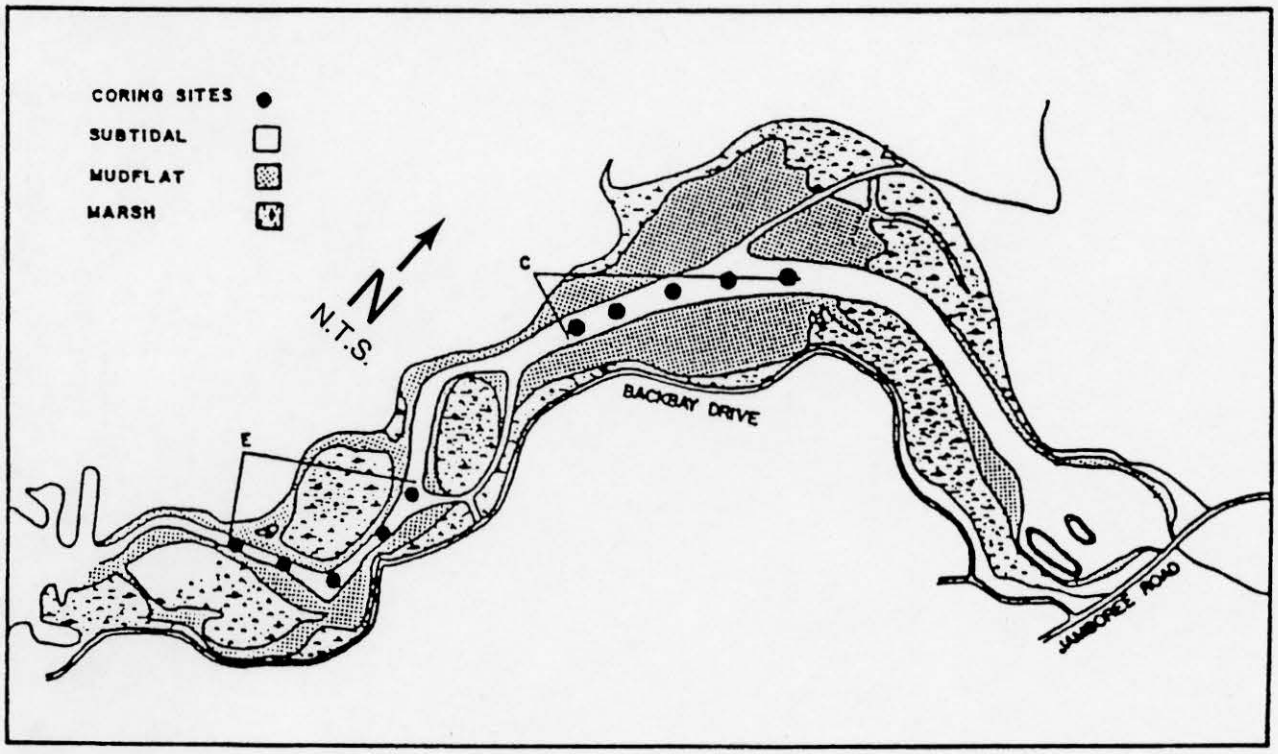
PG 7.....DREDGES -	1	
SCOWS @ DREDGE -	1	
TOWING VESSELS -	1	
SCOWS PER TOW -	1	
ADDITIONAL SCOWS -	1	
TOT SCOWS ON JOB -	3	
PG 8....QTRS ON DREDGE? -	NO	
SURVEY BOAT? -	YES	
CREW BOAT? -	NO	
PG 9...SP COST/MO (1ST) -	$0	Monitoring
SP COST/MO (2ND-14TH) -	$0	From Sheet D\4
SPECIAL COST LS (1ST) -	$0	Permit
SP COST LS (2ND-14TH) -	$0	From Sheet E
PG 10....PRESENT YEAR -	2000	
ECONOMIC INDEX -	5844	
LAF -	1.190	
INTEREST RATE -	6.750%	/yr
TIME PERIOD -	January to June 2000	
PIPELINE AVAILABILITY -	9	mos/yr
BUCKET AVAILABILITY -	10	mos/yr
HOPPER AVAILABILITY -	10	mos/yr
FUEL PRICE -	$1.01	/gal

EXCAVATION PRODUCTION	-	159	cy/hr (gross)
EXCAVATION EWT	-	85.0%	(621 hrs/mo)
EXCAVATION TIME	-	0.08	months
HAULING PRODUCTION	-	240	cy/hr (gross)
HAULING EWT	-	85.0%	(621 hrs/mo)
HAULING TIME	-	0.05	months
DREDGING TIME	-	0.08	months
EXCAVAT EWT (ADJUSTED)	-	621	hrs/mo (85.1% EWT)
HAULING EWT (ADJUSTED)	-	411	hrs/mo (56.3% EWT)
PRODUCTION (GROSS)	-	98,739	cy per month
PRODUCTION (CONTRACT)	-	98,739	pay cy per month

APPENDIX B

CHEMICAL ANALYSIS OF SEDIMENT COLLECTED FROM UPPER NEWPORT BAY

Location of Dredge and Sample Coring Sites



Trace Metal Analysis

Sample Type	Arsenic	Cadmium	Total Chromium	Copper	Mercury	Lead	Zinc
Sediment (mg/kg)							
Reference	0.3894	1.73	29.3	20.0	0.2562	11.6	141
Disposal	0.5905	1.71	28.4	19.2	0.9617	13.8	119
Dredge C	0.5232	2.80	23.6	21.3	1.0583	73.9	302
Dredge E	0.0871	1.15	10.7	11.3	0.7982	11.8	89.1

Total Petroleum Hydrocarbons Analysis

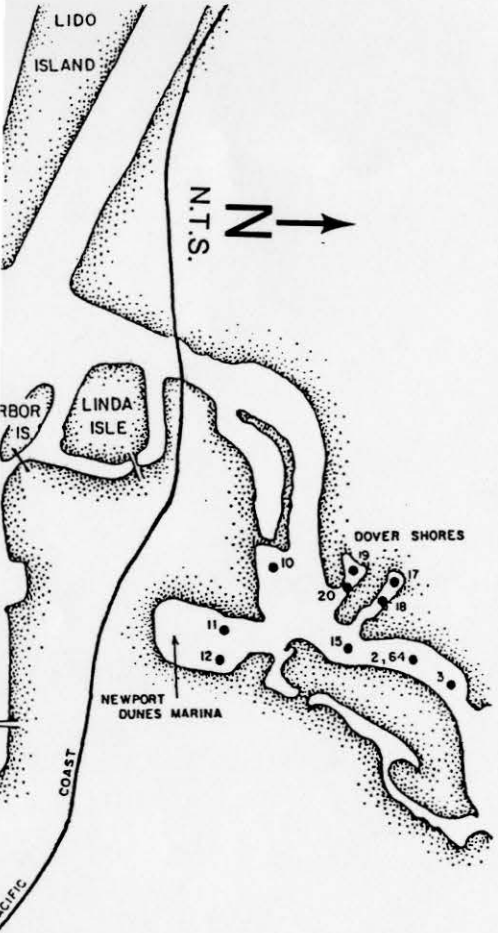
Sediment: (mg/kg)	
Disposal	<5
Dredge C	<5
Dredge E	<5

(source: Marine Biological Consultants, 1985)

Organic Chemical Analysis

Parameter	Disposal	Dredge C	Dredge E
Sediments			
Aldrin, mg/kg	<0.1	<0.1	<0.1
Chlordane, mg/kg	<0.5	<0.5	<0.5
Dieldrin, mg/kg	<0.1	<0.1	<0.1
Endosulfan I, mg/kg	<0.1	<0.1	<0.1
Endosulfan II, mg/kg	<0.1	<0.1	<0.1
Endosulfan sulfate, mg/kg	<0.3	<0.3	<0.3
Endrin, mg/kg	<0.2	<0.2	<0.2
Endrin aldehyde, mg/kg	<0.3	<0.3	<0.3
Heptachlor epoxide, mg/kg	<0.1	<0.1	<0.1
Heptachlor, mg/kg	<0.1	<0.1	<0.1
Aroclor 1016, mg/kg	<3	<3	<3
Aroclor 1221, mg/kg	<3	<3	<3
Aroclor 1232, mg/kg	<3	<3	<3
Aroclor 1242, mg/kg	<3	<3	<3
Aroclor 1248, mg/kg	<3	<3	<3
Aroclor 1254, mg/kg	<3	<3	<3
Aroclor 1260, mg/kg	<3	<3	<3
Aroclor 1262, mg/kg	<3	<3	<3
Toxaphene, mg/kg	<3	<3	<3
BHC, alpha isomer, mg/kg	<0.1	<0.1	<0.1
BHC, beta isomer, mg/kg	<0.1	<0.1	<0.1
BHC, delta isomer, mg/kg	<0.1	<0.1	<0.1
BHC, gamma isomer (Lindane), mg/kg	<0.1	<0.1	<0.1
p,p'-DDD, mg/kg	<0.1	<0.1	<0.1
p,p'-DDE, mg/kg	<0.1	<0.1	<0.1
p,p'-DDT, mg/kg	<0.3	<0.3	<0.3

(source: Marine Biological Consultants, 1985)

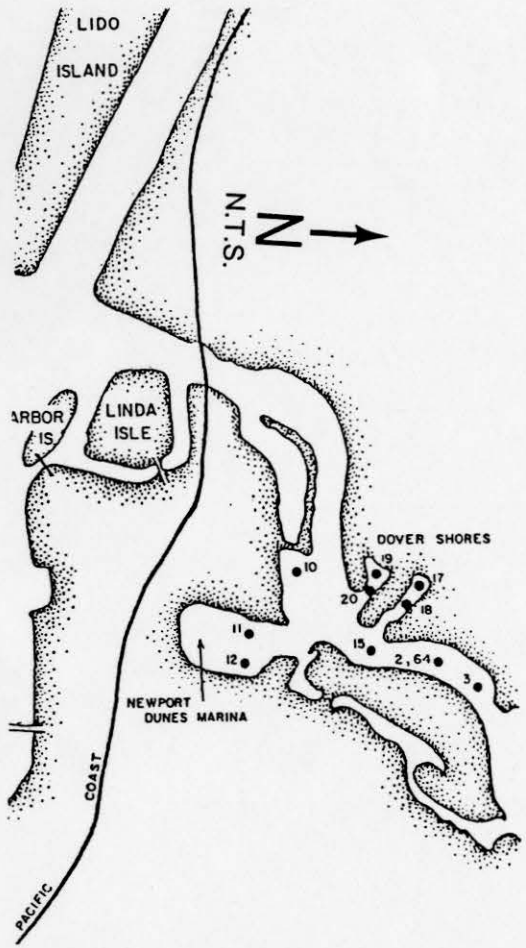


HISTORICAL SEDIMENT CHEMISTRY PARAMETERS
INORGANIC CONSTITUENTS

MBC 1981 Station No.	Report Station No.	Date	CONCENTRATION (mg/kg dry weight)									
			As	Ag	Cd	Cr	Cu	Fe	Ni	Pb	Zn	Hg
2	(B-3)	3/80	-	<0.81	<1.45	22.4	19.3	32.8	14.8	16.3	86.0	0.037
		8/80	-	<1.12	<1.44	22.7	21.8	38.2	20.4	20.5	101.5	0.043
3	(2)	9/75	<0.7	-	0.52	2.6	3.7	-	-	7.1	9.7	<0.05
		3/76	15	-	0.94	7.1	18.7	-	-	20	35	0.08
10	(B1)	1/79	8.4	2.0	2.0	40	29	-	29	79	144	0.12
11	(B2)	1/79	8.5	2.3	2.3	54	37	-	35	90	187	0.08
12	(B3)	1/79	7.4	2.2	1.1	51	30	-	35	72	143	0.10
17	(1)	9/79	-	-	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	-
18	(4)	9/79	-	-	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	-
19	(3)	9/79	-	-	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	-
20	(2)	9/79	-	-	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	-
64	UNBNSB	4/5/78	-	-	-	-	-	-	-	21.0	60.0	-
		11/1/78	-	-	-	-	19.0	-	-	25.0	70.0	-
		5/2/79	-	-	-	-	20.0	-	-	34.0	190.0	-

– indicates constituent not measured

(source: Marine Bioassay Laboratories, 1982)

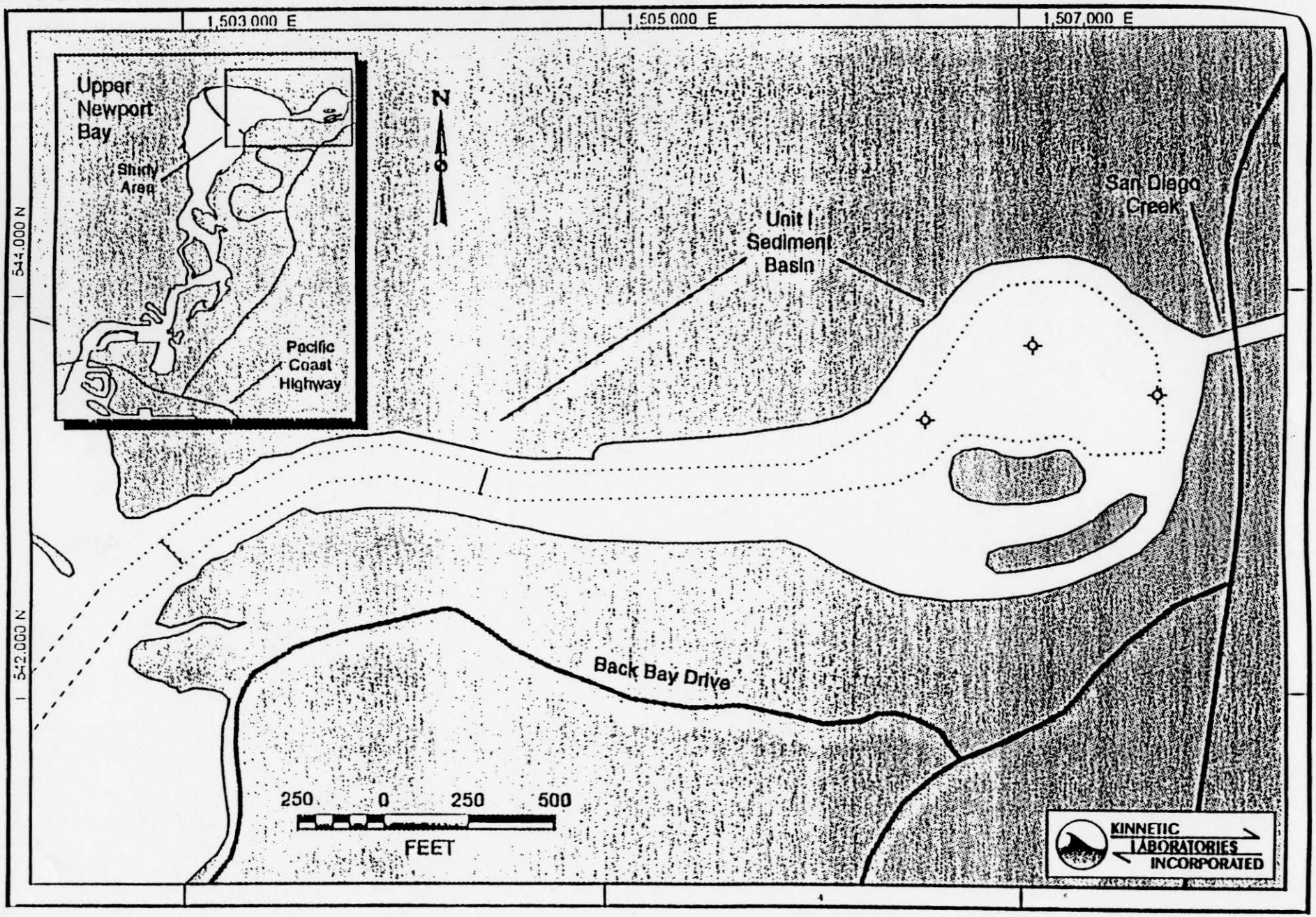


HISTORICAL SEDIMENT CHEMISTRY PARAMETERS
ORGANIC CONSTITUENTS

MBC 1981 Station No.	Report Station No.	Date	CONCENTRATION (µg/kg dry weight)				Citation Number
			DDTs	Pesticides	PCBs	TICH	
2	(B-3)	3/80	198	199	45	244	3
		8/80	507	508	23	531	3
3	(2)	9/75	<13	a	-	a	5
		3/76	<8	a	-	a	5
10	(B1)	1/79	570	770	200	970	3
			430	630	200	830	3
11	(B2)	1/79	340	540	200	740	3
12	(B3)	1/79	-	-	-	-	1
17	(1)	9/79	-	-	-	-	1
18	(4)	9/79	-	-	-	-	1
19	(3)	9/79	-	-	-	-	1
20	(2)	9/79	-	-	-	-	1
64	UNBNSB	4/5/78	-	-	-	-	5
		11/1/78	-	-	-	-	5
		5/2/79	-	-	-	-	5

– indicates constituent not measured

(source: Marine Bioassay Laboratories, 1982)



Vibracore Sampling Locations in the Unit I Sediment Basin, June 1996

Table 5. Bulk Sediment Chemistry Summary: Newport Beach, Unit I Bottom.

Analyte	Sampling Areas				
	NEWPORT UNIT I BOTTOM	STATION #1 REF	STATION #2 REF	LA3 REF (JUNE, 1995)	D.L.
GRAIN SIZE (% dry)					
Coarse Sand/Gravel ($\Phi < -1$)	0.0	0.0	0.0	0.0	-
Sand ($-1 \leq \Phi \leq 4$)	13.51	5.03	12.92	6.47	-
Silt ($5 \leq \Phi \leq 8$)	37.70	66.75	64.13	70.89	-
Clay ($\Phi \geq 9$)	48.78	28.22	22.95	22.64	-
INTERSTITIAL WATER					
Salinity (%)	16.0	34.5	33.0	32.0	-
pH	7.9	7.4	7.4	7.8	-
Total ammonia (ppm)	27.3	1.8	0.60	1.47	-
MISCELLANEOUS CHEMISTRIES					
Total sulfides (ppm, dry)	0.1	160	6.9	4.2	0.1
Water soluble sulfides (ppm, dry)	ND	0.2	0.2	0.3	0.1
Oil & Grease (ppm, dry)	ND	68	27	57	20
Petroleum Hydrocarbons (ppm, dry)	ND	46	ND	25	20
% Solids (%)	65	42	51	52	0.1
TOC (%)	0.5	1.0	0.7	0.67	0.1
METALS (ppm, dry wt)					
Arsenic	9.8	7.5	4.9	4.0	0.1
Cadmium	0.95	1.0	0.56	0.8	0.1
Chromium	66	68	52	55	0.1
Copper	33	35	23	25	0.1
Lead	12	18	9.6	17	0.1
Mercury	0.04	0.14	0.06	0.30	0.02
Nickel	32	34	26	25	0.1
Selenium	0.85	0.76	0.70	0.8	0.1
Silver	0.22	0.45	0.16	0.3	0.1
Zinc	120	120	90	73	2.0
ORGANOTINS (ppb, dry weight)					
Monobutyltin	ND	ND	2.0	ND	1.0
Dibutyltin	ND	ND	7.0	ND	1.0
Tributyltin	ND	ND	22	ND	1.0
Tetrabutyltin	ND	ND	ND	ND	1.0

ND = None Detected

Summary of Vibracore Samples within Unit I, Upper Newport Bay. Second Resampling Effort.

Station Sample I.D.	Date Time	Location		Seafloor Elevation (feet MLLW)	Projected Length (feet)	Pushed (feet)	Length Recovered (feet)	Sampling Interval (feet)	Sampling Interval (feet MLLW)	Met Rejection ?
		N. Latitude	W. Longitude							
U1-4	6 JUNE 1358	33°38.9674'	117°52.3407'	-0.3	14.0	13.5	12.75	7.0-12.75	-7.3 to -13.05	YES
U1-5	6 JUNE 1449	33°39.0160'	117°52.2151'	-0.85	14.0	13.25	13.25	7.0-13.25	-7.85 to -14.10	NO
U1-6	6 JUNE 1431	33°39.0195'	117°52.0572'	-1.2	14.0	14.5	14.5	7.0-14.0	-8.2 to -15.2	NO

Table 5, continued. Bulk Sediment Chemistry Summary: Newport Beach, Unit I Bottom.

Analyte	NEWPORT UNIT I BOTTOM	Sampling Areas STATION #1 REF	STATION #2 REF	LA3 REF (JUNE, 1995)	D.L.
CHLORINATED PESTICIDES (ppb, dry weight)					
Aldrin	ND	0.86	ND	ND	0.25-0.38
alpha-BHC	ND	ND	ND	ND	0.25-0.38
beta-BHC	ND	ND	ND	ND	0.25-0.38
delta-BHC	ND	ND	ND	ND	0.25-0.38
gamma-BHC (lindane)	ND	ND	ND	ND	0.25-0.38
alpha-Chlordane	ND	ND	ND	ND	2.5-3.8
gamma-Chlordane	ND	ND	ND	ND	2.5-3.8
4,4'-DDD	ND	6.7	1.1	3.8	0.25-0.38
4,4'-DDE	ND	50	8.4	37	0.25-0.38
4,4'-DDT	ND	ND	ND	ND	0.25-0.38
Dieldrin	ND	ND	ND	ND	0.25-0.38
Endosulfan I	ND	ND	ND	ND	0.25-0.38
Endosulfan II	ND	ND	ND	ND	1.0-1.5
Endosulfan sulfate	ND	ND	ND	ND	0.25-0.38
Endrin	ND	ND	ND	ND	5.0-7.7
Endrin Aldehyde	ND	ND	ND	ND	0.25-0.38
Endrin Ketone	ND	ND	ND	ND	0.25-0.38
Heptachlor	ND	ND	ND	ND	0.25-0.38
Heptachlor epoxide	ND	ND	ND	ND	0.25-0.38
Methoxychlor	ND	ND	ND	ND	5.0-7.7
Toxaphene	ND	ND	ND	ND	15-23
PCBs (ppb, dry weight)					
PCB 1242	ND	ND	ND	ND	10
PCB 1254	ND	48	ND	ND	15
PCB 1260	ND	ND	ND	ND	15
total PCBs	ND	48	ND	ND	15
PAHs (ppb, dry wt)					
Naphthalene	ND	ND	ND	ND	7.5-12
2-Methylnapthalene	ND	ND	ND	ND	7.5-12
2-Chloronapthalene	ND	ND	ND	ND	7.5-12
Acenaphthylene	ND	ND	ND	ND	7.5-12
Acenaphthene	ND	ND	ND	ND	7.5-12
Fluorene	ND	ND	ND	ND	7.5-12
Phenanthrene	ND	ND	ND	ND	7.5-12
Anthracene	ND	ND	ND	ND	7.5-12
Fluoranthene	ND	26	ND	18	7.5-12
Pyrene	ND	31	ND	21	7.5-12
Benzo(a)anthracene	ND	ND	ND	ND	7.5-12
Chrysene	ND	ND	ND	ND	7.5-12
Benzo(b)fluoranthene	ND	ND	ND	ND	7.5-12
Benzo(k)fluoranthene	ND	ND	ND	ND	7.5-12
Benzo(a)pyrene	ND	ND	ND	ND	7.5-12
Indeno[1,2,3-CD]pyrene	ND	ND	ND	17	10-15
Dibenzo(a,h)anthracene	ND	ND	ND	ND	10-15
Benzo[ghi]perylene	ND	ND	ND	ND	10-15
total PAHs	ND	57	ND	56	20
total phthalate esters	140	450	320	ND	7.5-12
total phenols	ND	ND	130	ND	10-150

ND = None Detected
* Reporting limit raised due to matrix interference. See Appendix C for actual limits.
[1] Data acquired outside of 40 day extraction hold time.

Table 6. Detection Limits and Analytes.

Analyte	Sediment wet wt (mg/Kg or ppm)
Arsenic	0.1
Cadmium	0.1
Chromium	0.1
Copper	0.1
Lead	0.1
Mercury	0.02
Nickel	0.1
Silver	0.1
Zinc	2.0
Selenium	0.1
Organotins	0.001
Aldrin	0.0005
Chlordane and related compounds	0.005
Dieldrin	0.0005
DDT & derivatives	0.0005
Endrin and derivatives	0.0005
Hexachlorocyclohexane isomers	0.0005
Toxaphene	0.03
Endosulfan I	0.002
Endosulfan II	0.0005
Endosulfan sulphate	0.01
Arochlor 1242	0.02
Arochlor 1254	0.02
Arochlor 1260	0.02
Total PCBs	0.02
Total phenols	0.020-0.10
Acenaphthene	0.02
Acenaphthylene	0.02
Anthracene	0.02
Benzo(a)anthracene	0.02
Benzo(a,e)pyrene	0.02
Benzo(ghi)perylene	0.02
Benzo(k)fluoranthene	0.02
Benzo(b)fluoranthene	0.02
Fluoranthene	0.02
Dibenzo(a,h)anthracene	0.02
Naphthalene	0.02
Indeno(1,2,3-c,d)pyrene	0.02
Fluorene	0.02
Chrysene	0.02
Phenanthrene	0.02
Pyrene	0.02
Total Phthalates	0.01
Grain size	--
TOC	0.1%
Petroleum Hydrocarbons	20
Oil and Grease	20
Total sulfides	0.1
Water soluble sulfides	0.1

REAL ESTATE PLAN

UPPER NEWPORT BAY

ECOSYSTEM RESTORATION

ORANGE COUNTY, CALIFORNIA

September 7, 2000
Submitted by: CESPL-RE Teresa Kaplan, Chief Real Estate Division
Prepared by: CESPL-RE Pete N. Garcia, Realty Specialist

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LIST OF EXHIBITS

"A" REAL ESTATE OWNERSHIP MAP
"B" SPONSOR'S ACQUISITION CAPABILITY

1. INTRODUCTION.

This appendix is prepared in accordance with ER 405-1-12, 12-16, Real Estate Plan, and presents the Real Estate requirements for the "Upper Newport Bay Ecosystem Restoration Project". This appendix will focus on the real estate requirements for Alternative #6 the recommended plan. Orange County Public Facilities Resource Department (OCPFRD), and the State of California, through the California Department of Fish and Game, will sponsor this proposed project. This study is authorized by Section 903 (b) of WRDA 86.

The purpose of the Project is to control the deposit of sediments in the ecological reserve, maintaining the balance of open water mudflat and marsh areas. More details of the study area are presented in the main report.

2. PROJECT DESCRIPTION/LANDS REQUIRED.

Newport Bay is located on the Southern California Coast, Approximately 40 miles south of Los Angeles and 75 miles north of San Diego. The Pacific Coast Highway (PCH) Bridge generally divides Newport Bay into upper and lower sections. The lower bay is a heavily developed recreational harbor with Federal Channels maintained by the Corps. The Upper Bay has three boat marinas near PCH Bridge, a boat launch ramp, and an undeveloped ecological reserve to the north.

The project affects 21 parcels, approximately 185 acres of land, and tidelands affecting 4 ownerships. Virtually all the real property required for the project is owned by the Project Sponsors. The City of Newport Beach shares an interest in one parcel with the County. Existing agreements allow this area to be used as a staging area for dredging activities. The Recommended Plan requires acquisition of 3.1 acres of a 5-acre parcel owned by the Irvine Co.

The twenty-one ownerships are shown on ***Exhibit "A" (Ownership Map).*** As with all cost shared projects the Project Sponsor is responsible for providing Lands, Easements, Rights-of-Way, and Relocations, and Disposal (LERRD) for the project. The Project Sponsors will be responsible for the acquisition of all required real estate. The estimated real estate cost for the Recommended Plan is $ 638,300.00. The Army Crops of Engineers, Los Angeles District, Appraisal Branch prepared the Gross Appraisal. It was

reviewed and approved by the Army Crops of Engineers, Chief of Appraisal Branch, Los Angeles District.

3. SPONSOR-OWNED LER

The Co-Sponsors own approximately 182 of the 185 acres of land and tidelands that support the project. There is a 5-acre parcel not owned by the sponsors that will require a partial fee taking of 3.1 acres to support the project. The Co-Sponsors own necessary lands for the dredging/restoration, access and staging areas. A parcel approximately .4 acres that may be used for a staging area is located to the south of Coney Island, the area is part of a large parking lot for the Newport Dunes complex. Newport Dunes is co-owned by Orange County and private interests. Existing agreements also allow this area to be used as a staging area for dredging activities.

4. PROPOSED NON-STANDARD ESTATES

Land or interests in land required for this project will be used for ecosystem restoration and for dredging. In accordance with paragraph 12-9 of ER 405-1-12, fee title is required for ecosystem restoration and easements are required for dredging. The State of California, through the California Department of Fish and Game and the County of Orange have prepared letters of intent to become Non-federal, Co-sponsors for the Project. The Project Sponsors own all the property required and is available for the project with the exception of approximately 3.1 acres that is currently owned by private interests. Additionally, temporary easements are required for work areas and access during construction of the project. Project Sponsors will be required to obtain Fee interest over all tracts that are required, standard easements, temporary work area easements, secure all adequate property rights for this project function as intended. There is no need for anything other than the standard estates.

5. EXISTING FEDERAL PROJECTS

There are no existing Federal Projects that lie fully or partially within the Project Area.

6. FEDERALLY OWNED LAND

There are no federally owned lands within the Project Area.

7. EXTENT OF NAVIGATION SERVITUDE

There are no lands that are subject to the applications of Navigational Servitude.

8. MAP

Ownership map will be included as exhibit "A"

9. EXTENT OF INDUCED FLOODING

No anticipated flooding induced by the construction or the operation and maintenance of the project is expected.

10. BASELINE COST ESTIMATE

Estimated real estate land values and administration cost, for the recommended plan are listed below.

19 APN's and 5 different property owners

a. Land and Improvements		$ 571,870.00
b. Administration /Acquisition Cost 3 ownership's		
Federal	@ $ 4,000 per ownership	$ 12,000.00
Non Federal	@ $ 8,000 per ownership	$ 24,000.00
c. PL 91 – 646 Relocation Assistance		$ 0
	Sub Total	$ 607,870.00
d. Contingencies (.05%)		$ 30,394.00
	Total Estimated Real Estate Cost Rounded	$ 638,300.00

11. PL 91-646 RELOCATION ASSISTANCE BENEFITS

No public Law 91-646 relocations have been identified.

12. DESCRIPTION OF PRESENT OR ANTICIPATED MINERAL ACTIVITY

There is no known mineral activity, nor have any deposits of oil, gas or minerals been identified within the project area.

13. PROJECT SPONSOR'S LAND ACQUISITION ABILITY

Co-Sponsors have the legal authority, the human resource capabilities, and the financial resources to sponsor this project. When a buyout plan is implemented, the Project Sponsors will provide tract appraisals for all lands they acquire for project purposes. Government appraisers will review and approve the appraisals for compliance with appraisal standards and for crediting purposes. The Government will monitor all real estate activities associated with the project to ensure compliance. The Project Sponsors will be advised in writing of the risks associated with acquiring land prior to the execution of the PCA. Assessment of the Real Estate Acquisition Capability of the County and the *State of California, the Non-Federal Co-Sponsors is shown on ***Exhibit "B"***.

14. ENACTMENT OF ZONING ORDINANCES

At this point there are no foreseen enactment of zoning ordinances to facilitate acquisition of real property.

15. LAND ACQUISITION SCHEDULE AND MILESTONES

The Project Co-Sponsors have not provided an official acquisition schedule. The Project Co-Sponsors are aware that no federal funds will be made available for this project prior to the execution of the Project Cooperation Agreement (PCA). The Project Co-Sponsors will be directed to begin real property acquisitions for the project only after the PCA is fully executed. The Project Co-Sponsors will be notified in writing of the risks of initiating the acquisition process in advance of the PCA being executed.

16. DESCRIPTION OF FACILITY/UTILITY RELOCATIONS

Existing bridges in the project area include the Jamboree Road Bridge and the PCH Bridge. No bridge modifications are necessary for the proposed project.

There is a deactivated Pacific Bell utility line crossing the Upper Bay below Big Canyon Wash. Pacific Bell has told the OCPFRD that this line may be reactivated in the future, although there are no plans for reactivation at this time. The utility line is located at –16 feet mean sea level (MSL), well below required dredge or disposal operations.

There is also a high-pressure gas line, and a water main and a sewer line located between –18 and –20 feet MSL under the PCH Bridge. These lines will not interfere with the proposed dredge or disposal operations.

Therefore, no facility or utility relocations are necessary for the project. If it is later discovered that facility or utility relocations are necessary, Project Sponsors will be responsible for the relocations.

17. KNOWN OR SUSPECTED PRESENSE OF CONTAMINANTS

No Hazardous, Toxic, and Radioactive Waste (HTRW) sites exist within the Upper and Lower bay. Some hazardous sites are located within the watersheds surrounding the Bay. No radioactive waste sites have been identified in the watersheds. Details are presented in Section 3.7 of the Environmental Impact Statement and Report (EIS/R).

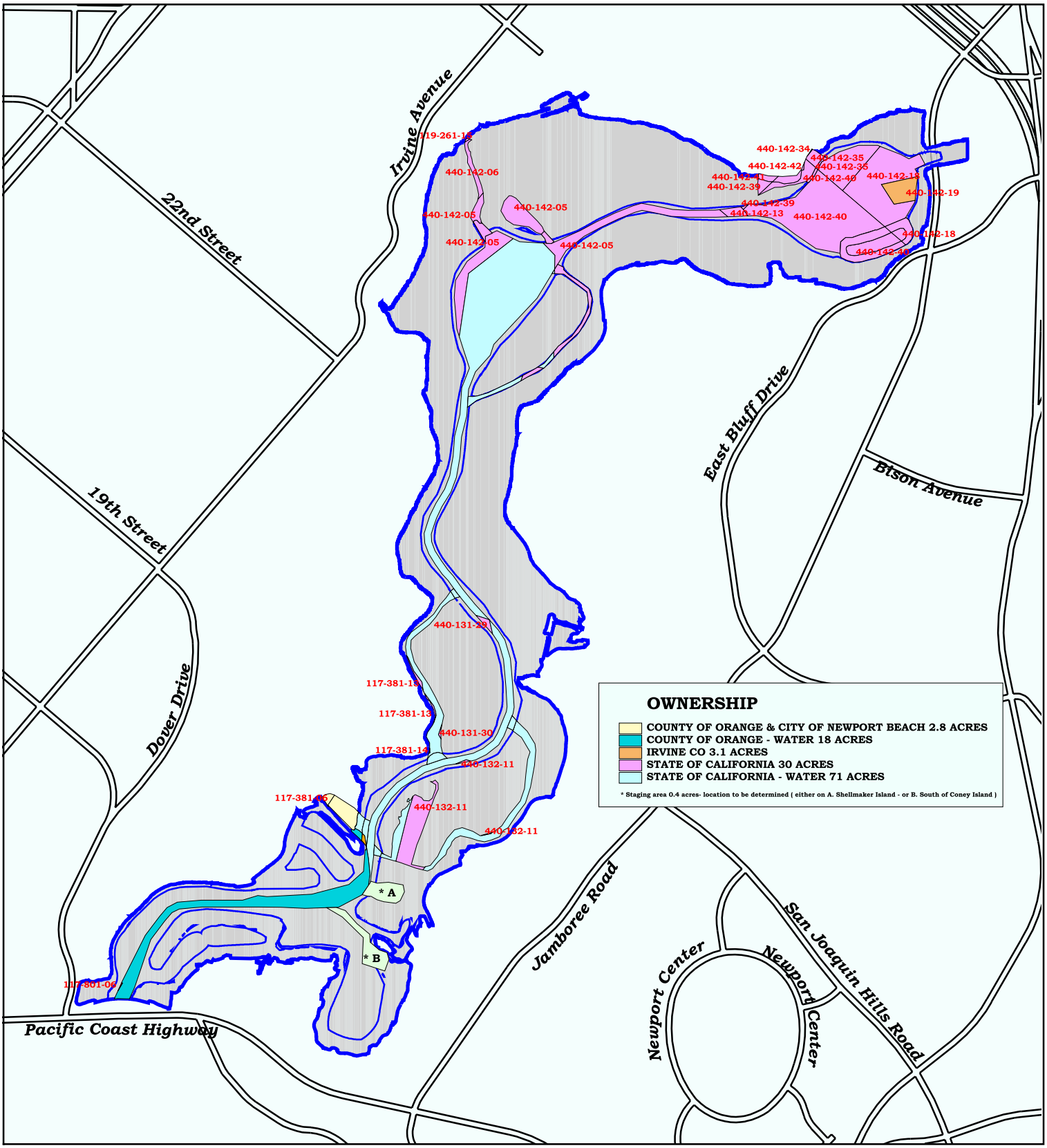
18. SUPPORT/OPPOSITION FOR PROJECT

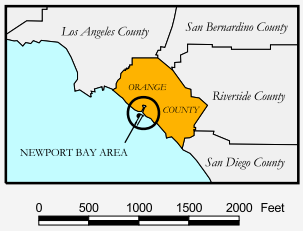
There is no known opposition to the project by landowners in the project area and none is anticipated, as the use of the project area will not change from its current use as an ecological preserve. Further, the major landowner in the project area is the State of California, which is a Co-Sponsor and acquired some of the land it currently owns for the purpose similar to the project purpose.

19. RECOMMENDATIONS AND SUMMARY

a. A meeting with the Project Co-Sponsors should be scheduled to discuss the real estate issues of the project, with emphasis on establishment of an acquisition schedule.

b. The District is in agreement with the Project Co-Sponsors that the recommended plan is environmentally sensitive and practical. Therefore it is recommended that the project be approved.





Upper Newport Bay Ownership

Approach Channel, Basin Limits and Restoration Areas

County of Orange, California

DESIGNED AND PRODUCED BY:
Public Facilities and Resources Department
GIS Mapping Unit
Carmen Copil Cencea

DATA SOURCE:
Geomatics Land Information System Division: Survey File # HB-96/97-10

DATE: August 9, 2000

ASSESSSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILTIES

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes?
YES

b. Does the sponsor have the power of eminent domain for this project?
YES

c. Does the sponsor have "quick-take" authority for this project?
YES

d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary?
NO

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn?
YES

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of federal projects including P.L. 91-646, as amended?
NO

b. If the answer to II.a. is "yes", has a reasonable plan been developed to provide such training?
N/A

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project?
YES

d. Is the sponsor's projected in-house staffing level sufficient considering its other workload, if any, and the project schedule?
YES

e. Can the sponsor obtain contractor support, if required in a timely fashion?
YES

f. Will the sponsor likely request U. S. Army Corps of Engineers assistance in acquiring real estate?
NO

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site?
YES

b. Has the sponsor approved the project/real estate schedule/milestones?

EXHIBIT B

NO

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other U. S. Army Corps of Engineers projects?
YES

b. With regard to this project, the sponsor is anticipated to be:
HIGHLY CAPABLE

V. Coordination:

a. Has this assessment been coordinated with the sponsor?
YES

b. Does the sponsor concur with this assessment?
YES

Prepared by:

Jim Hutchinson,
Project Manager

Reviewed and Approved by:

Chief,
Real Estate Division

EXHIBIT B