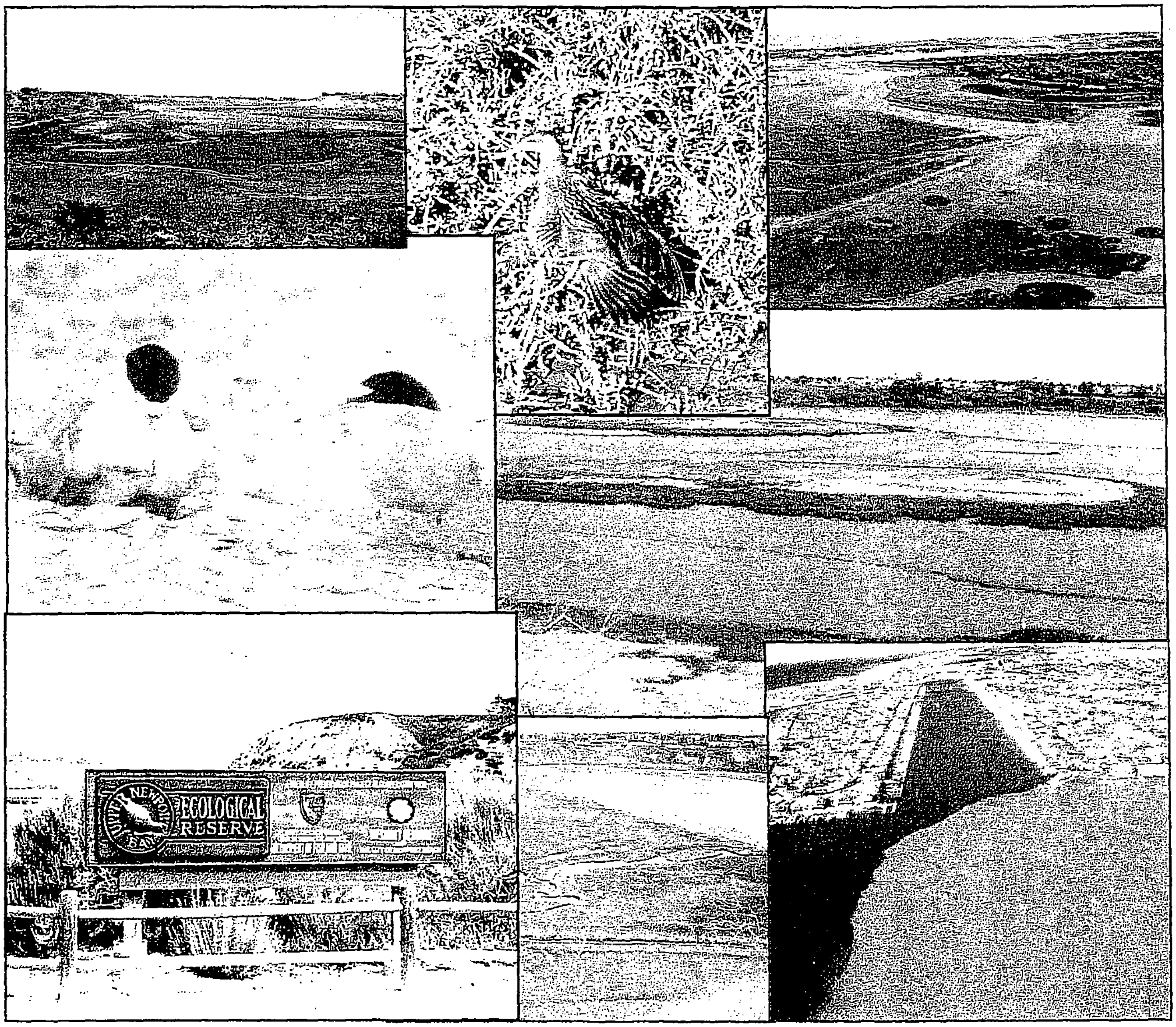
US Army Corps of Engineers
Los Angeles District

County of Orange
Public Facilities & Resources Department

State of California

City of Newport Beach



Upper Newport Bay
Ecosystem Restoration Feasibility Study
Final Report
Environmental Impact Statement/Report
September 2000

INTRODUCTION

Authority

The Upper Newport Bay ecosystem restoration feasibility study authorization is based on Section 841 of the Water Resources Development Act of 1986 (WRDA 86), Public Law 99-662, which states:

> "Subject to Section 903(b) of this Act, the project for navigation for Newport Bay Harbor, Orange County, California, authorized by the River and Harbor Act approved August 26, 1937 (50 Stat. 849), and Section 2 of the River and Harbor Act approved March 2, 1945 (59 Stat.21), is modified to authorize the Secretary to dredge and maintain a 250-ft wide channel in the Upper Newport Bay to the boundary of the Upper Newport Bay State Ecological Preserve to a depth of -15 ft (MLLW), and to deepen the channel in the existing project below the Pacific Coast Highway Bridge to a depth of -15 ft (MLLW), at a total cost of $3,500,000, with an estimated first Federal cost of $3,150,000 and an estimated first non-Federal cost of $350,000."

Section 903(b) of WRDA 86 states that a project authorization must include a favorable recommendation by the Chief of Engineers before approval by the Secretary of the Army. The project described in Section 841 of WRDA 86 was never authorized. The Corps initiated a reconnaissance study in the early 1990's based on this authority. During this study it became clear that there were significant sedimentation problems in the ecological reserve, located north of the proposed channel extension. For this reason, the reconnaissance study alternatives focused on addressing problems and needs in the ecological reserve.

Corps policies for restoration of fish and wildlife habitat during the time of the reconnaissance study required a direct link between a Federal project and the degraded habitat that was identified for restoration. Since development within the San Diego Creek watershed resulted in the most evident changes in the UNB ecosystem, the Corps concluded that there was no substantial link between the Federal project in LNB and habitat degradation in UNB. Therefore, it was determined that there was no Federal interest at that time in pursuing a feasibility study for ecosystem restoration. Political lobbying and expanded ecosystem restoration authorities, allowing for restoration studies and projects without a direct link to an existing Federal project, permitted the Corps to initiate the feasibility study in 1997.

More recent Corps policy has also allowed for consideration of Corps participation in restoration projects that are not directly linked to existing Federal projects. The policy for Corps involvement in ecosystem restoration and protection through Civil Works programs and activities is provided in Engineering Regulation 1165-2-501, "*Ecosystem Restoration in the Civil Works Program*", dated 30 September 1999. Corps guidance is available on the Internet at the Corps website at the Policy and Planning tabs located at http://www.usace.army.mil/inet/functions/cw/.

Federal Government involvement in environmental quality, which includes ecosystem restoration, is supported in law, Executive Order, and treaty. General statements regarding ecosystem restoration and protection can be found in the following documents, and are used as authorization for the Corps to participate in this study:

- Fish and Wildlife Coordination Act of 1958, as amended

- Federal Water Project Recreation Act of 1965, as amended
- National Environmental Policy Act of 1969, as amended
- Coastal Zone Management Act of 1972, as amended
- Water Pollution Control Act of 1972, as amended
- Marine, Protection, Research and Sanctuaries Act of 1972, as amended
- Endangered Species Act of 1973, as amended
- Coastal Wetlands Planning, Protection and Restoration Act of 1990 (Title III of Public Law 101-646)
- Executive Order 11990, the Protection of Wetlands
- Executive Order 11991, the Protection and Enhancement of Environmental Quality
- Water Resource Development Acts of 1986, 1988, 1990, 1992, 1996 and 1999

The Federal objective of project planning is defined in the "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies"(P&G), approved in March 1983. Guidance for conducting U.S. Army Corps of Engineers' (Corps) civil works planning studies is presented in revised Engineering Regulation 1105-2-100, "*Planning Guidance Notebook*", dated 22 April 2000.

Study Purpose

The purpose of Civil Works ecosystem restoration activities is to restore significant ecosystem function, structure, and dynamic processes that have been degraded. Ecosystem restoration efforts involve a comprehensive examination of the problems contributing to the system degradation and the development of alternative means for their solution. The intent of restoration is to partially and/or fully reestablish the attributes of a naturalistic, functioning, and self-regulating system.

This study considers what can be done in Newport Bay to restore degraded areas and ensure the future health of the estuarine habitats and species, and identifies the Federal interest in an ecosystem restoration project in Upper Newport Bay (UNB). This study is somewhat unique because parts of the Upper Newport Bay Ecological Reserve (UNBER) are also used to capture sediments from the watershed. Sediments will continue to deposit in the Bay no matter what control measures are implemented in the watershed. Therefore, one of the most important components of the study is sediment control, designing for the bulk of deposition in the bay to occur in one or more basins. The design and construction of two in-Bay sediment basins in the 1980's, in effect, addresses the same purpose. This study reviews what has already worked well and what can be improved upon through the redesign and maintenance of sediment basins and the restoration of degraded habitats. All measures are designed to improve the quality and long-term health of the estuarine habitats that support diverse and important species. Other benefits include better protecting sensitive habitats from human disturbances, maintaining navigation channels for the recreational slips in Lower Newport Bay and the southern portion of the Upper Bay, and consideration of recreational and educational improvements.

Study Scope

The scope of the feasibility study includes review, update and use of 1993 reconnaissance study results and consolidation of information that has been developed since the conclusion of that study. Study efforts include new and more detailed information to support baseline conditions of UNB and surrounding areas, recent bathymetric surveys and bioassay tests, numerical modeling studies, Geographic Information System (GIS) mapping, vegetative and species surveys, preparation and use of a Modified Habitat Evaluation Procedure (HEP), and cost effectiveness and incremental cost analyses. The study scope begins with the analyses of the historical, existing and 50-year future without project conditions to form the baseline conditions, identification of problems and needs, and goals and objectives. Studies continue by formulating alternative restoration measures, and combining measures to form alternative plans. Plans are compared to the baseline conditions, and other plans, to identify the recommended plan. The scoping process includes participation from numerous groups and individuals throughout the planning process.

Study Participants and Coordination

The Los Angeles District Corps and the Orange County Public Facilities & Resources Department (OCPFRD) are responsible for conducting and coordinating this Feasibility Study. The County of Orange and the State of California are the sponsors of the study. The County of Orange and the City of Newport Beach shared the fiscal contributions to the feasibility study. Both OCPFRD and the City of Newport have provided invaluable in-kind services including baseline surveys, bioassay testing, meeting coordination and dissemination of information to interested parties. The California Regional Water Quality Control Board (RWQCB) has also participated in the numerical modeling efforts, funding water quality aspects of the modeling. Other organizations that have participated in the study process to date include the following agencies and groups:

Federal Agencies

U.S. Department of Interior, U.S. Fish and Wildlife Service
Environmental Protection Agency
U.S. Department of Commerce, NOAA, National Marine Fisheries Service
U.S. Department of Commerce, NOAA, National Ocean Service
U.S. Department of Transportation, Coast Guard
Federal Aviation Administration

State Agencies

California Coastal Commission
California Department of Fish and Game
California Regional Water Quality Control Board

County of Orange Agencies

Public Facilities and Resources Department
Survey Division/Mapping Services and Applications
Parks and Recreation
Coastal Facilities
Flood Control
Sanitation District
Environmental Health

City of Newport Beach

Public Works
Utilities Department
Harbor Patrol
City Council
Attorney's Office
Executive Office

Local Committees/Groups

Newport Bay Water Quality Committee
Newport Bay Coordinating Council
Newport Bay/San Diego Creek Technical Advisory Committee
Dover Shores Homeowners
De Anza Bayside Marina
Newport Dunes Marina
Friends of Newport Bay
The Irvine Company
Newport Chapter of Surfriders
Defend the Bay
UNB Naturalists
Irvine Ranch Water District
California Coastal Conservancy
Newport Harbor Boy Scout Sea Base
Stop Polluting Our Newport
Harbor Quality Committee
San Joaquin Freshwater Marsh Reserve

Universities

University of California, Irvine
Orange Coast College

Public Interaction

Corps study participants have attended monthly meetings with the Upper Newport Bay Coordinating Council (UNBCC) to gather and disseminate information for the feasibility study. To facilitate the coordination of resource agencies and special interest groups required for the study, the UNB Environmental Restoration Technical Advisory Group (TAG) was formed. Meetings of this group and the HEP group have been held to provide a forum for the various agencies/groups with an interest in UNB to identify their concerns, goals, objectives, and potential restoration efforts for UNB.

A co-chaired public workshop was held in October 1998 to review the progress of the feasibility study and to discuss the California Department of Fish and Game's update of their management plan for the ecological reserve.

Prior Studies and Reports

Numerous studies have been conducted during the past 35 years describing the environmental and engineering issues related to UNB. Local interests and agencies have authored these studies in response to concern about Newport Bay sedimentation, debris flows, water quality, ecological development, and related issues. With the exception of articles written by U.S. Fish and Wildlife Service (USFWS) biologists describing threatened and endangered species at UNB, and the reconnaissance study, none of these reports has been authored by Federal agencies. Studies, reports and other data used for this feasibility study are referenced in the main report, the EIS/EIR and the technical appendices.

The Corps has a long history of involvement in Lower Newport Bay, participating in the construction of the Federal jetties and navigation channels that support about 9,000 boats within the Harbor.

Several Corps reports (1888, 1907, 1937, and 1943) that highlight the history of the Lower Bay are referenced in this report to describe the historic setting. In addition, the Federal harbor project at LNB requires condition surveys on a periodic basis. These surveys determine the extent of shoaling in the harbor and whether or not navigation channels need maintenance dredging. Based on the information contained within the Los Angeles District (LAD) Corps archives, condition surveys were conducted in 1889, 1933 (pre-Federal Project condition), 1936 ("as-built" Federal Project condition), 1950, 1962, 1974, 1984, 1988, 1991, 1994, 1995, 1996 and 1998.

The Corps became involved in the Upper Bay during the 1993 reconnaissance study that investigated the extension of a Federal navigation channel to the lower boundary of the ecological reserve to better serve the marinas in the lower portion of the Upper Bay. This reconnaissance study concluded that there was no Federal interest in pursuing a more detailed feasibility study at that time. Renewed emphasis placed on ecosystem studies and projects in the Civil Works program, and political lobbying, resulted in the Corps initiation of this feasibility study in 1997. A 905(b) expedited reconnaissance study was not prepared prior to the initiation of the feasibility study.

Total Maximum Daily Loads

The Environmental Protection Agency (EPA) and the California Regional Water Quality Control Board (RWQCB) have implemented Total Maximum Daily Loads (TMDL's) for the watershed and bay for sediment and nutrients and pathogens, and are drafting a TMDL for toxics. Pursuant to Section 303(d) of the Clean Water Act, the Regional Board has identified Upper Newport Bay and San Diego Creek as water quality limited. This means the water quality standards (beneficial uses and water quality objectives) are not being attained at this time. The TMDL objectives set limits for constituents in the watershed and within Newport Bay. The challenge for government and private agencies is to determine how to attain the TMDL's objectives, if at all possible. The plan formulation process for this study and the Corps watershed feasibility study will consider how alternative measures can address some of the TMDL objectives. In particular, sediment control alternative measures and maintenance activities identified in the recommended plan will be reviewed to see how well they address the TMDL objectives for bay sediments. Tidal flushing improvements will also be analyzed for the recommended plan, and potential impacts to TMDL nutrient objectives will be addressed.

The sediment TMDL addresses sediment transport, deposition and management. The Regional Board also identified Upper Newport Bay as water quality limited due to nutrients, bacterial contamination (which has resulted in shellfish harvesting and water-contact recreation bans in some areas of the Upper Bay), several heavy metals, and pesticides. The EPA and Regional Water Quality Control Board have prepared a Basin Plan for the watershed and Bay. The Basin Plan's impaired beneficial uses for the bay include consideration of wildlife and estuarine habitat; rare, threatened, or endangered species habitat; marine habitat; preservation of biological habitat of special significance (the Ecological Reserve); spawning, reproduction and development; commercial and sport fishing, and navigation.

Some of the major aspects of the sediment TMDL (RWQCB, 1998) are:

1) Maintain both the Unit III and Unit II basins to a minimum depth of 7 feet below mean sea level;

2) Ensure that sediment control measures to protect the bay habitats do not allow more than a 1% change from the existing acres;

3) Reduce the annual average sediment load in the watershed from a total of approximately 250,000 tons per year to 125,000 tons per year within 10 years, thereby reducing the sediment load to Newport Bay to approximately 62,500 tons per year. It is assumed that the rest of the material would be trapped in the watershed basins;

4) Implement sediment control measures in Upper Newport Bay such that the basins need not be dredged more frequently that about once every 10 years, and the long-term goal of reducing the frequency of dredging to once every 20 to 30 years;

5) All watershed in-channel and foothill sediment control basins shall be maintained to have at least 50% design capacity available prior to November 15 of each year.

Other aspects of the sediment TMDL include a monitoring program and a requirement to prepare topographic and vegetation surveys of the bay every three years. Changes to some of the sediment TMDL objectives, as currently written, may be revised based on the findings and recommendations of this feasibility study and the monitoring program.

The nutrient TMDL addresses nutrient loading to the Bay, particularly from the San Diego Creek watershed, and the contribution to seasonal algal blooms. The TMDL identifies tailwaters from commercial nurseries and agricultural lands as the predominant sources of nutrients, but recognizes the substantial reductions in nutrient loads over the years, primarily due to the introduction of drip irrigation systems and/or recycle systems. The TMDL states that these improvements coupled with the increased tidal flushing caused by the in-bay basins appear to have resulted in a substantial downward trend in nitrate concentrations in the Bay. However, algal blooms are still occurring in Newport Bay and San Diego Creek and, as a result, are listed as water quality impaired due to nutrients pursuant to Section 303(d) of the Clean Water Act.

The nutrient TMDL for the Bay and watershed provide loading targets and compliance schedules for seasonal and annual amounts of total nitrogen and phosphorus. There are 5, 10 and 15-year total nitrogen allocation targets for the watershed and bay, and 5 and 10-year allocation targets for total phosphorus. The nutrient load reduction targets will be incorporated into waste discharge requirements as effluent limits, load allocations, and wasteload allocations to ensure that the total inorganic nitrogen for the bay and watershed are achieved, and the Clean Water Act requirements for the implementation of a TMDL are satisfied.

The pathogen TMDL addresses bacterial contamination of the waters of Newport Bay. The two beneficial uses that can be affected are water-contact recreation and shellfish harvesting. The Orange County Health Care Agency (OCHCA) conducts routine bacteriological monitoring and more detailed sanitary surveys, and is responsible for closure of areas to recreational and shellfish harvesting uses if warranted by the survey results. The pathogen TMDL applies waste load allocations for fecal coliform for urban runoff, including storm water, and vessel waste. Initial work efforts are directed towards monitoring and assessment of existing conditions. This study's alternative measures, including the recommended plan, will not address the pathogen TMDL. Proposed dredging measures will be reviewed by other agencies to ensure that a recommended plan does not exacerbate the bacterial contamination problems within the Bay. The TMDL for toxics has not been drafted at this time.

Study Area Description

Newport Bay

Newport Bay is located on the Southern California coast, approximately 40 miles south of Los Angeles and 75 miles north of San Diego. From the harbor entrance at the rocky headland at Corona del Mar, Newport Bay extends in a north-northeast direction about 3.5 miles behind a narrow sand spit called the Balboa Peninsula.

Newport Bay is a combination of two distinct bodies of water, termed "Lower" and "Upper" Newport Bay. The 752-acre Lower Bay, where the majority of commerce and recreational boating exists, is formally a coastal lagoon (Stevenson and Emery, 1958). The 1,000-acre Upper Newport Bay is a drowned river valley and is geologically much older than the Lower Bay. High bluffs of the San Joaquin Terrace bound the Upper Bay on the east and the Newport Mesa on the west. The Pacific Coast Highway (PCH) Bridge divides Newport Bay into upper and lower sections. The Lower Bay is heavily developed (predominantly as residential properties), while the Upper Bay contains both a diverse mix of development in its lower reach, and an undeveloped ecological reserve to the north. The Bay is shown in Figure 1.1.

The Upper Bay is primarily an estuary with fresh water inflows from San Diego Creek, the Santa Ana - Delhi Channel, Big Canyon, local springs, and drainage from adjacent areas. The primary source of freshwater flowing into UNB is San Diego Creek. The flows from this stream are ephemeral, generally averaging about 30 cubic feet per second (cfs) during the dry summer months, but exceeding 30,000 cfs for extreme storm events. Given the continual and highly variable freshwater flows into the Upper Bay, water salinity levels are less than levels in the ocean a majority of the time. The impacts of San Diego Creek on the water properties of the Upper Bay are continual, with significant seasonal variations.

UNB is home to six federally and state sanctioned threatened and endangered species (five bird species, one plant species). Of the 50,000 acres of wetlands that existed in southern California in 1900, only about 25% (12,500 acres) presently remain. Three ecological reserves have been established by the State in the region--Upper Newport Bay, Bolsa Chica, and Buena Vista Lagoon (in San Diego County)--and protect a total of 1,480 acres of wetlands habitat.

The combination of fresh and salt water and the seasonal variability in salinity within the Bay promotes a variety of diverse habitats specifically adapted to life in an estuarine environment. The biodiversity of UNB is well documented. The Bay includes seven major habitat types and several hundred species of marine and terrestrial flora and fauna. Newport Bay fish diversity was the highest of the seven major coastal embayments between San Diego and Point Conception (Horn and Allen, 1976). In addition, the Bay provides critical habitat for commercially and ecologically important species of fish, such as California halibut, sand bass, gobies, topsmelt, and anchovy. Ecologically, the Bay environment is important to the offshore waters because a portion of the organics produced in the Bay, in the form of dead and/or decaying plant and animal matter, is exported out of Newport Bay to the open coastal waters, thereby contributing to offshore secondary production.

Land use varies greatly between the Lower Bay and the Upper Bay. The City of Newport Beach encompasses the bay. The Lower Bay is mainly a recreational harbor supporting approximately 9,000 boats and multiple residential and commercial facilities. Five man-made islands are located in the Lower Bay (Linda, Harbor, Balboa, Lido and Bay Islands). The Upper Bay also has three boat marinas near PCH Bridge, a mix of commercial and residential development, and a boat launch ramp. There are 670 boat slips in the Newport Dunes, Dover Shores and De Anza marinas. The 752-acre Upper Newport Bay Ecological Reserve begins from Shellmaker Island north to the Jamboree Road Bridge. The reserve area is the focus of this feasibility study. The reserve contains a mix of habitats including marine open water, mudflat, salt marsh, freshwater marsh, and riparian and upland zones.

Detailed habitat mapping of the Upper Bay was completed for this study. Mapping efforts included the use of infrared aerial photos, field verifications and topographic and bathymetric surveys. These efforts resulted in not only an existing habitat map, but also tools that could be used to predict future habitat changes. Details are explained in the engineering appendix. Existing habitat acres for the Upper Bay were mapped to the ten-foot mean sea level (+10 MSL) contour around the Bay. Total acres are shown in Table 1.1, and Upper Bay habitats are shown in Figure 1.2.

Table 1.1 Existing Upper Bay Habitat Types

Habitat Type	Existing Habitat Acreage	Elevation Range (ft –MSL)
Open Water (marine)	209.4	< -4.3
Intertidal Mudflat	240.4	-4.3 to +1.5
Low Salt Marsh	145.9	+1.5 to +3.0
Middle Salt Marsh	153.5	+3.0 to +4.0
High Salt Marsh	9.9	+4.0 to +5.0
Freshwater Marsh	17.6	> +5.0
Salt Panne	7.0	+4.0 to +5.0
Uplands	57.6	> +5.0
Developed Areas	71.8	
Total	913.1	

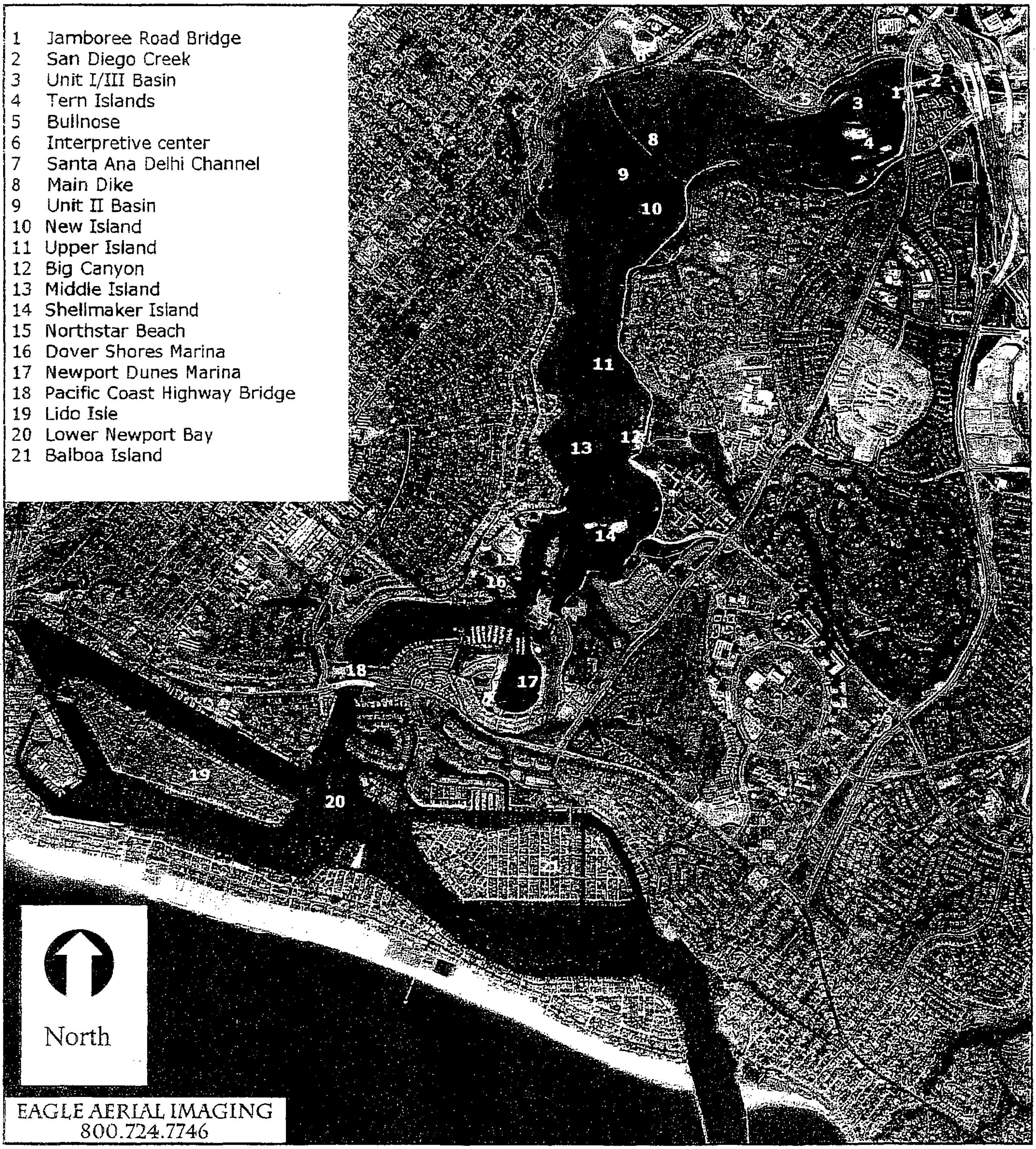
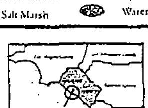


Figure 1.1 Upper and Lower Newport Bay

Scale: 1" = approx 3,000'

Habitat Classification*

- Developed
- Freshwater Marsh
- High Salt Marsh
- Intertidal Mudflat
- Low Salt Marsh
- Middle Salt Marsh
- Open Water
- Salt Panne
- Upland
- Water



Upper Newport Bay Vegetation

Figure 1.2 Upper Newport Bay Existing Habitat Types

County of Orange, California

DESIGNED AND PRODUCED BY:

Public Facilities and Resources Department
GIS Mapping Unit

DATA SOURCE:

Color Infrared Aerial Photos Flown by: Lung & Associates - April 1997
Vegetation Survey: Field Check by M.E.C. Analytical Systems Inc. - October 1997

DATE: December 9, 1999

The Upper Bay was further broken down into three segments to assist in the analysis of future impacts to habitats due to sedimentation. These segments, and surrounding areas, are described below:

Segment 1 extends from Jamboree Road Bridge to the main salt dike. This segment is nearly equal amounts of open water and mudflat around the Unit III (formerly Unit I) sediment basin. The basin was dredged in 1999 to depths of –11 feet Mean Sea Level (MSL) (or –14 feet Mean Lower Low Water (MLLW)). Two least tern islands, constructed during the dredging of the Unit I basin are also located in this segment adjacent to the Unit III basin area. There is a large expanse of valuable low and middle marsh habitat, used by clapper rails, in the northwest corner of this segment. A wide band of low and middle marsh, salt panne and freshwater marsh exists along the southern edge of this segment adjacent to Back Bay Drive. San Diego Creek enters the bay in the eastern portion of this segment under Jamboree Road Bride and empties into the Unit III basin. The tops of the bluffs on the southern side of this segment are mostly covered by residential development. Residential and commercial developments exist to the east, on the other side of Jamboree Road Bridge. The northwestern side of this segment is largely open space with a sloping hill to the bay. A multi-use trail parallels the bay along this portion of the segment. The County of Orange is constructing an interpretive center that is set into the slope overlooking the bay in the northwestern portion of this segment. The interpretive center is part of the first phase of a planned Upper Newport Bay Regional Park. Proposed park parcels are along both sides of this segment and most of Segment 2. Other phases of construction include trails, removal of exotic vegetation and planting of native species.

Segment 2 extends from the dike to the upper end of Middle Island. This segment includes the remnant main salt dike that was constructed in 1934 and abandoned in the 1960's. Salt evaporation ponds previously existed in the Segment 1 areas above the main dike. The Unit II sediment basin, constructed in 1987, is located immediately below the dike. Design depths for this basin are also –11 MSL (-14 MLLW), but in-filling has reduced existing depths to about –5 MSL. Large expanses of mudflats surround the basin. The Santa Ana-Delhi channel enters the Bay at the northwest corner of this segment. New Island is located in the northeastern area of this segment, adjacent to the Unit II basin. New Island was a small expanse of marsh habitat with large mudflats to the south of the island in the late 1980's. Today, marsh plants have expanded along the mudflat area, greatly increasing the size of the island. This island has also become valuable nesting habitat for clapper rails. Bands of low, middle, high and freshwater marshes extend along the eastern and western fringes of the segment. Upper Island, in the southeast corner of the segment by Back Bay Drive is more of a peninsula than an island today. A small channel that once ran down the eastern edge no longer exists due to sedimentation. The island is mostly made up of low and middle marsh areas, and once again provides valuable habitat for clapper rail. High bluffs are located on the east and west side of this segment. The eastern bluff has Back Bay Drive at the base with mostly residential development on the top of the bluffs. The western bluff is also mostly residential development for the lower half. The north west segment of the bluffs are mostly County of Orange open space lands.

Segment 3 stretches from Middle Island to PCH Bridge, and is a mix of estuarine habitat and development. Middle Island is located in the northwest corner of this segment, and contains a mix of low and middle marsh. The mouth of Big Canyon is on the northeast corner of this segment. The City of Newport Beach and the California Department of Fish and Game (CDFG) own the 58-acre canyon. Lush riparian growth covers much of the canyon bottom. The mouth of the canyon, adjacent to the ecological reserve, is a large freshwater marsh. The bluffs around Big Canyon and the bay are mostly residential development. Shellmaker Island on the eastern side of this segment is the southernmost of the Upper Bay islands, and is the southern border of the ecological reserve. The CDFG's Newport Bay offices are located at the southern tip of the island. The southern portion of Shellmaker Island is also leased by the University of California at Irvine (UCI) Rowing Base for rowing activities (2.4 acres) and as a base for dredging operations (1.9 acres). These facilities were in existence before the reserve was created and although their activities are allowed to continue they may not be expanded or intensified. Newport Dunes is a County of Orange aquatic park facility in UNB located to the south of Shellmaker Island, on the eastern side of this segment. Boat storage and the launch ramp are located in this area, and a recreational vehicle park, meeting rooms and other commercial facilities. The Newport Dunes Marina is also located at this facility. Tourists and residents consistently use the beaches and waters in this area. The De Anza Marina and spit are located to the south of Newport Dunes. The Dover Shores Marina is on the southwestern side of this segment, north of PCH Bridge and Castaways beach. This marina is all residential development. Bluffs above the western side of this segment are also mostly residential development. Northstar beach lies to the north of Dover Shores. The Newport Bay Aquatic Center is located north of this beach and south of Middle Island. The center houses small boats and kayaks for use in the bay.

Newport Bay Watershed

The Newport Bay watershed drains a total of 154 square miles (98,500 acres) of Orange County into the bay. The watershed is largely developed and the largest contributor of the bay's fresh water flows, sediment and other water quality problems is the 118 square mile San Diego Creek sub-watershed. Other freshwater inputs include the 18 square mile Santa Ana-Delhi Channel sub-watershed, Big Canyon and other local drainages. San Diego Creek empties into the Bay on the northern end under Jamboree Road and the Santa Ana-Delhi Channel drains into the Bay south of the main salt dike. The total watershed draining into Upper Newport Bay is shown in Figure 1.3, and Table 1.2.

Table 1.2 Drainage Areas of the Newport Bay Watershed

Sub-Watersheds	Drainage Area (acres)	Drainage Area (sq. miles)
San Diego Creek	47,300	73.9
Peters Canyon Wash (part of S.D. Creek Watershed)	28,200	44.1
Santa Ana-Delhi	11,000	17.2
Other Drainage Areas	12,000	18.8
Newport Bay Watershed Total:	98,500	154.0

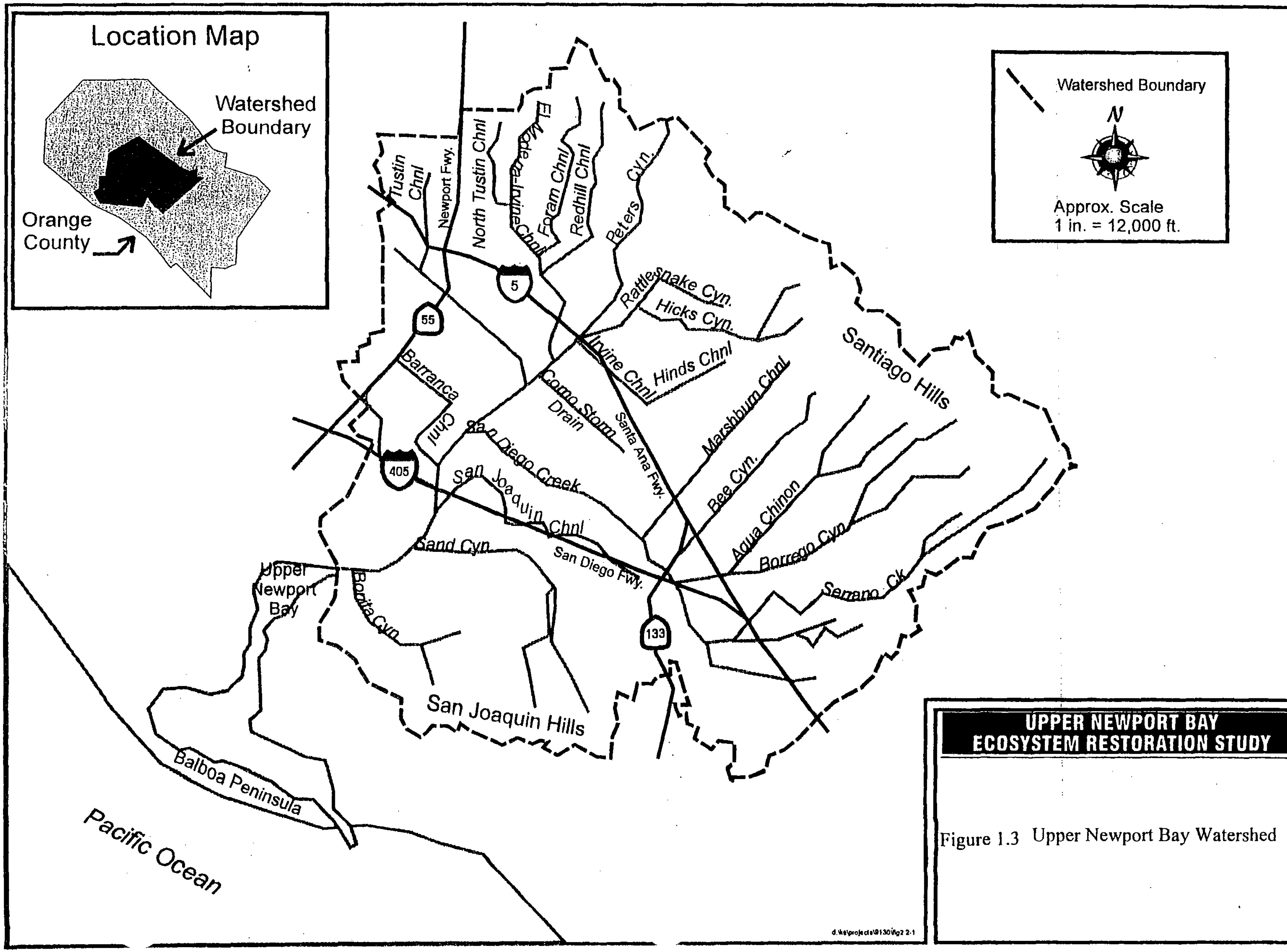


Figure 1.3 Upper Newport Bay Watershed

Three different geographical areas characterize the watershed. The rugged *foothill regions* are within the Santa Ana mountains and the Santiago Hills. These areas are steep sloped (15 to 75%) and highly erosive, receiving an average annual rainfall of about 17 inches. Limited vegetation and unstable drainage channels are some of the problems within this area. Cattle grazing, agricultural, and wildlife areas predominate this region. The flat *alluvial Tustin plain* averages 13 inches of rainfall with slopes ranging from 0 to 15%. The area once had an ephemeral lake and swamp. More recently, the Tustin plain has been used for agriculture for products such as citrus, avocados, truck crops, and grain and commercial nurseries, although land use changes are rapidly urbanizing these areas. The managed land use and mild slopes of this area lead to moderate erosion, except during the occurrence of severe storm events. This portion of the watershed produces the fine-grained sediments that eventually flow to the Upper Bay. The *coastal plain* also exhibits flat slopes and average rainfall of about 13 inches annually. This area is entirely urbanized, resulting in minimal erosion that affects Newport Bay.

Peters Canyon Wash and San Diego Creek are the two major tributaries that comprise the San Diego Creek sub-watershed. Peters Canyon Wash includes Peters Canyon, Rattlesnake Canyon and Hicks Canyon, all of which originate in the Santa Ana Mountains. The total watershed drained by Peters Canyon Wash is about 44 square miles. Once the tributaries reach the Tustin plain, the existing channels are improved and well defined. These channels have been realigned for the convenience of the agricultural users rather than follow the natural topographic contours. As a result flows are capable of leaving the channels during extreme storm periods and flow uncontrolled across the alluvial plain.

Above the junction with Peters Canyon Wash, San Diego Creek extends eastward to include a number of canyons that originate in the Santiago Hills (Bee Canyon, Round Canyon, Agua Chinon Wash, Borrego Canyon Wash, and Serrano Creek). Much of these channels have also been improved and there is also a potential for storm water overflow. The total drainage area of San Diego Creek above its junction with Peters Canyon Wash is about 46 square miles.

The demand for housing in Orange County has resulted in significant land use changes from agriculture to urban development within the San Diego Creek watershed, especially over the last several decades. The UNB watershed contains some of the most populous cities within Orange County, including Santa Ana, Tustin, Costa Mesa, Irvine, Lake Forest and Newport Beach. The watershed also includes some portions of unincorporated lands within Orange County. Overall, the land use character of the area is urban. Predominant land uses of the area include commercial and residential uses with scattered agricultural uses and open space areas such as parks, beaches, the San Joaquin Freshwater Marsh and Newport Bay. Also located within the central and eastern portions of the watershed are the Tustin and El Toro U.S. Marine Corps Air Stations, respectively. The University of California at Irvine (UCI) is located northeast of the Upper Bay and contains 1,500 acres of lands, some of which are dedicated to institutional uses such as university facilities and student housing.

The watershed area is home to booming retail commercial and professional enterprises, large-scale housing developments, and a strong tourist industry. The Irvine Ranch Company owns much of the undeveloped lands in the watershed. Figure 1.4 shows Newport Bay watershed land use (1999), and Table 1.3 summarizes current land use types for the watershed, based on the most recent available data (1999).

Table 1.3 Land Use Types in the San Diego Creek Watershed (1999[1])			
To Campus Drive	Acres	Square Miles	% of Total
Residential-Income	19,777	30.9	23
Commercial	9,554	14.9	11
Industrial	5,807	9.1	7
Vacant Land	19,493	30.5	23
Farm and Ranch (Agricultural Use)	5,800	9.1	7
Public & Semi-Public (Education and Religion)	403	0.6	0
Recreational	666	1.0	1
Transportation, Communication & Utility	1,312	2.1	2
No Assigned Land Use Code	5,578	8.7	7
No Data Available	16,450	25.7	19
Total	84,840	132.6	100
(1) Source: Orange County PFRD			

LA-3 Offshore Disposal Site

The EPA LA-3 offshore disposal site is one of five sites that have been used for disposal of dredged material within coastal areas of southern California. LA-3 has historically been used to dispose of dredged material from both Lower and Upper Newport Bay. The Unit III dredging project, completed in 1999, was the most recent large dredging project in the Bay (850,000 cubic yards) to use LA-3. The site is located on the slope of Newport Canyon at a depth of about 1,500 feet (457 meters), approximately 4 miles southwest of the entrance to Newport Harbor, as shown in Figure 1.5. The bottom topography is gently sloping from 1,350 feet to 1,575 feet. Situated at the foot of a submarine canyon, this area would be expected to receive sedimentation from erosion and nearshore transport into the canyon.

LA-3 is currently designated as a temporary site that will close on January 1, 2003 unless a site management plan is completed and approved. Studies are underway to prepare a management plan for the final site designation process as required by Section 102 of the Marine Protection, Research, and Sancutaries Act of 1972, and Section 582. WRDA 1996 allowed for the LA-3 site to remain open until January 2000 and WRDA 1999 extended the closure date to the year 2003. For this feasibility study, it is assumed that LA-3 will still be a viable site for future disposal of dredged material.

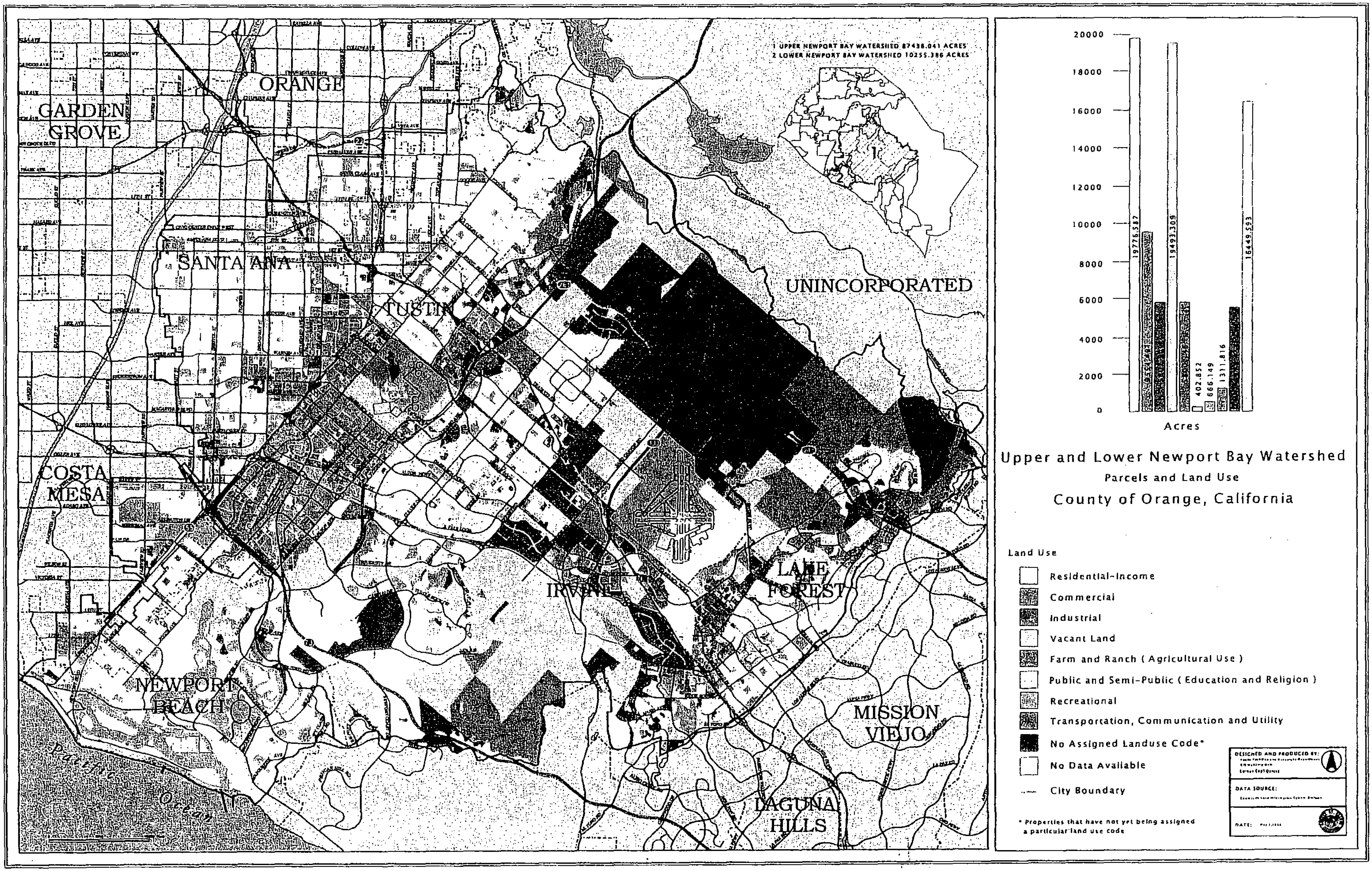


Figure 1.4 Newport Bay Watershed Existing Land Use

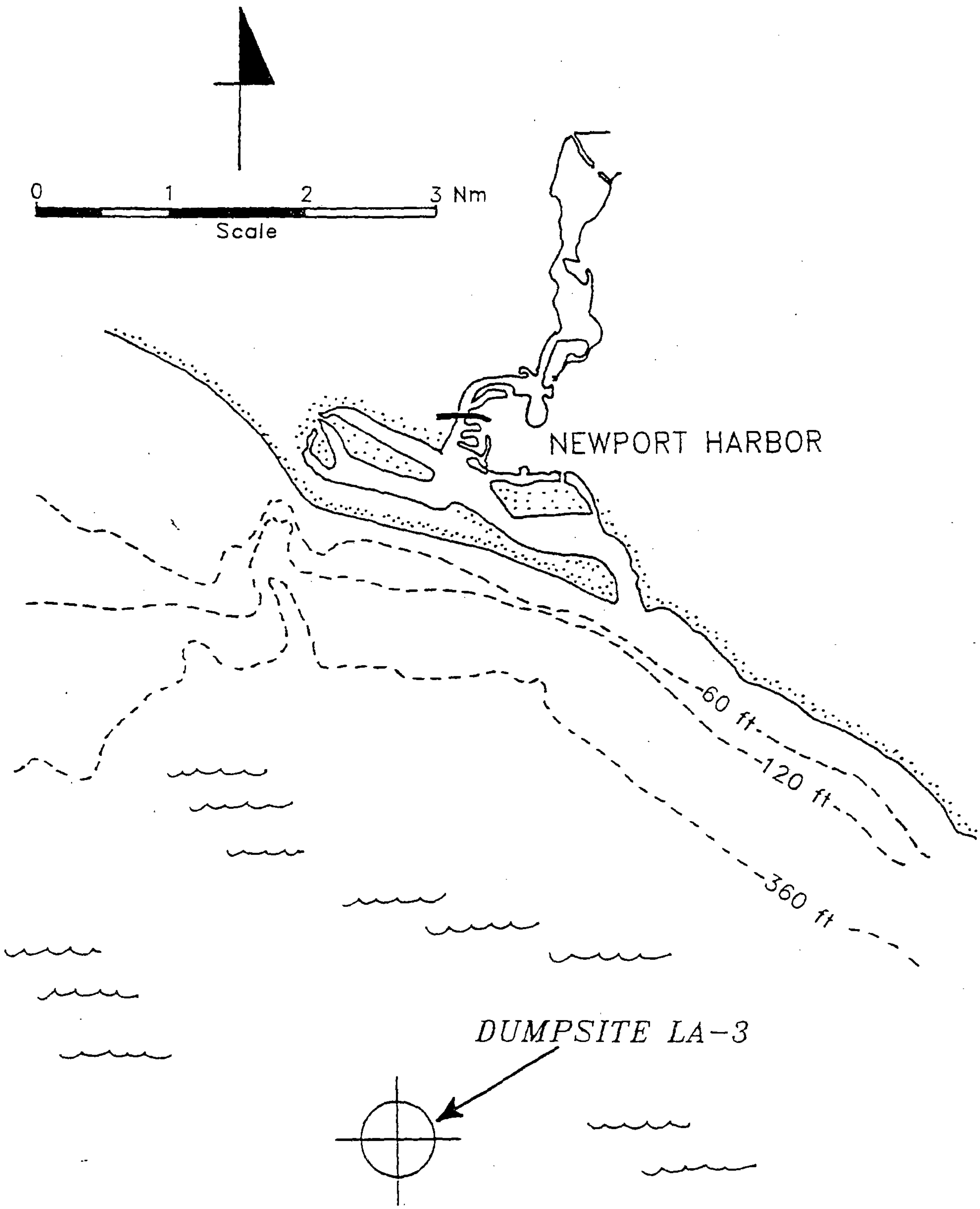


Figure 1.5 LA-3 Offshore Disposal Site

The next available ocean disposal site is LA-2, located about 20 miles to the north. LA-2 has received final designation, and is used by the Ports of Los Angeles and Long Beach. The cost of using this site would be significantly higher, and there are questions on available capacity at LA-2, which is limited, and in high demand. A requirement for disposal of Newport Bay and other Orange County projects at LA-2 could result in these projects being financially infeasible to local governments and private individuals.

Summary of the Planning Area

Defining the boundaries of the study area was not easy for this study. Many of the Bay's sedimentation and other water quality problems are directly related to the freshwater sources that drain into the Bay. It seems obvious that some of the solutions to the Bay's problems rely on what is done within the Newport Bay watershed, particularly the San Diego Creek watershed.

An early decision was made to focus studies and solutions to the problems on the receiving waters of Newport Bay, particularly within Upper Newport Bay. We debated whether or not we should include the watershed in this study in order to prepare alternative plans to control inflow problems near their source. The decision was made to limit the scope of alternatives to the Bay because so many other studies had already been initiated in the watershed, but also because of the ever-present time and funding constraints. There was also the issue of using the WRDA 86 study authority since it was somewhat limited in scope.

The Corps and Orange County have initiated a Newport Bay/San Diego Creek watershed feasibility study (1999), similar to two other watershed studies that began in 1998 (San Juan and Aliso Creeks). The Environmental Protection Agency (EPA) and the California Regional Water Quality Control Board (RWQCB) have recently implemented Total Maximum Daily Loads (TMDL's) for the watershed and bay. A Newport Bay Watershed Executive Committee (NBWEC) has been formed to provide a focal point for all studies and projects occurring within the watershed.We will focus restoration and sediment control measures for this study within the Upper Bay, realizing we cannot (and never intended to) ignore the watershed as being a vital component of the study area. Therefore, our study area includes Upper and Lower Newport Bay, the watershed surrounding the Bay, and dredged material disposal sites. Disposal sites may include upland areas, nearshore and beach disposal areas, and an EPA designated ocean disposal site (LA-3) that has, and continues to be used for disposal of dredged material from the Bay.

The Planning Process

There are six general planning steps that the Corps follows for any study. The planning process is iterative in nature so no step is entirely complete before moving on to the next step. Repeating the steps, in no particular order, is an integral aspect of the preparation of a planning report. In general the steps follow this order: specify problems and opportunities, inventory and forecast conditions, formulate alternative plans, evaluate effects of alternative plans, compare alternative plans, and select a recommended plan. The recommended plan eventually emerges through the process of repeating the planning steps and screening elements of the planning study. Screening is the ongoing process of eliminating what is no longer important or interesting from further consideration and therefore, the process of preserving what is important. The scoping process is a special kind of screening. It is a requirement of both the Principles and Guidelines (P&G) and NEPA, and identifies the most important issues raised by the proposed plan.

This report begins with a discussion of the baseline conditions, including some history of the study area, the existing conditions, and the likely future conditions of the bay based on existing problems and future opportunities.

INVENTORY OF BASELINE CONDITIONS

SUMMARY

Baseline conditions address an inventory of historic and existing conditions, and a forecast of future without project conditions. The information presented under baseline conditions will be used to formulate alternative measures that address study problems and opportunities. Upper Newport Bay's dynamic environment makes it difficult to define existing conditions. No one snapshot in time truly describes the seasonal changes in water quality or the number of species that occupy any given habitat type during migratory and breeding time periods.

Charting the future without project condition (+50 years) is somewhat elusive in nature. The most direct cause of future changes within the Bay is continued sedimentation. The bay bottom (the bathymetry) is constantly changing when sediments deposit in the Bay during winter storm seasons or when sediments are redistributed during the dry season by the effects of the tides and currents. Open water areas fill in becoming intertidal mudflats and eventually marsh. Other problems related to the fresh water inflows include high levels of nutrients that contribute to large algae blooms in the Bay and the presence of toxics and pathogens.

How much these problems affect the Bay in the future relies on what happens in the 154 square mile Newport Bay watershed, particularly the 118 square mile San Diego Creek watershed, the major contributor of sediments and nutrients to the Bay. The 18 square mile Santa-Ana Delhi channel and watershed does not transport much sediment to the Bay but there are concerns about other water quality impacts, particularly toxics and pathogens. The study area history discusses watershed sediment control measures constructed under the 208 plan that have reduced the amount of sediment delivered to the Bay over time. Actions being taken now within the watershed should continue to reduce the total inflow volume of sediments to the Bay over time, although some studies indicate that there may be little change in the future volumes of sediment because watershed development may increase channel erosion while overland erosion decreases. The future rate of Bay sedimentation remains questionable. We have made the general assumption that even if sediment delivery lessens, there will still be the need to dredge within the Upper Bay to maintain some balance of open water, mudflat and marsh areas.

This chapter begins with the historical changes in Newport Bay and the study area, plan formulation assumptions for existing and future without project conditions, evaluation tools used for the baseline condition analysis, an inventory of existing conditions and a forecast of future conditions.

BASELINE HISTORY

The history of Newport Bay and the watershed emphasizes how man has altered the natural processes in this area in the last century, and the consequences of doing so. Development activities have permanently altered the look and function of Lower and Upper Newport Bay and the watershed, limiting restoration opportunities. Historic land and water use changes, altered streams and dredging activities are important aspects to consider for both existing and future conditions.

Early Newport Bay

During the lowered sea level period of the Pleistocene Epoch the Santa Ana River, or its precursor, flowed into the northern end of Newport Bay and carved the deep channel offshore that has become known as the Newport Submarine Canyon. Following a period of coastal-wide submergence due to a rise in sea level, the Upper Bay re-emerged in the late Pleistocene as the sea level receded forming its current configuration. From the late Pleistocene to the early 1800's, the Upper Bay was connected directly to the Pacific Ocean and received only intermittent freshwater flow from the Santa Ana River, which meandered much throughout its history, and consistently overflowed its banks and shifted its main channel. After flowing directly into the back of Newport Bay, the channel shifted across the coastal plain to enter the ocean as far north as Alamitos Bay.

Native Americans inhabited the vicinity of Newport Bay at the time of the Spanish exploration and the mission period. Establishment of the missions at San Gabriel (1771) and San Juan Capistrano (1776) resulted in the gradual transfer of the natives from their small villages to the missions. In those early years, a native village, "Genga", existed on the Newport mesa. Newport Bay was called "Bolsa de Gengara" by the Spanish, in reference to the village. Following the establishment of Mexican rule, the name changed to "Bolsa de San Joaquin". The first American settlers referred to the area as "San Joaquin Bay" or "San Joaquin Slough".

At the time of the first European arrival at Newport Bay, the Santa Ana River meandered across the flood plain from the San Bernadino Mountains to the Pacific Ocean, between the Newport and Huntington Beach mesas. During the early 1800's, the Santa Ana River outflow deposited sediment at the wide mouth of Newport Bay, forming a barrier beach, sand shoals and barrier islands.

Santa Ana River flows formed braided channels prior to discharging into the west end of LNB. These smaller flows intertwined through a bog known as the "Willows", consisting 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 early pioneer period of the 1800's, the Willows were used as a source of firewood. It was eventually drained by ditches and planted with a variety of agricultural crops. With time, to prevent the ill effects of Santa Ana River flooding, the river was channelized to its point of entry into Newport Bay.

The date of the formation of the Balboa Peninsula sand spit is not known, but is assumed to have extended from the Huntington Beach mesa to the present location of Lido Island during the 1825-1858 period (Sherman, 1931). The final growth of the spit to its present location near Corona del Mar may have occurred in response to the single flood season of 1861-1862. This belief is in conflict with the written description of the U.S. Coast and Geodetic Survey surveyors of 1860 (a year before the major floods), when the coastwise length of the Bay was described as being five miles, approximately equal to that which exists today. From the time the Santa Ana River last entered the Back Bay until the early 1900's, sediment deposition seems to have been primarily from the local drainages around the Bay and silt from the Santa Ana River.

An early description of Newport Bay was provided by a surveyor of the U.S. Coast and Geodetic Survey, tasked with providing bathymetric survey data to the uncharted waters adjacent to the bay in 1860. The surveyor noted that the five-mile long lagoon "was separated from the ocean by a narrow strip of sand beach, over which heavy southeast and northwest swells wash in every gale. Over the sandbar at the entrance to the bay there is a frightful swell rolling and tumbling at all stages of the tide, making it dangerous to cross in boats of any kind." The survey that was planned was postponed until the following year, and then was delayed indefinitely due to the outbreak of the Civil War. The U.S. Coast and Geodetic Survey conducted the first comprehensive survey of Newport Bay by the United States in 1875. This first chart is pictured in Figure 2.1.

In the late 1860's, UNB was used as a landing to load hides, tallow, and hay, as well as other goods for export to San Diego and San Francisco. Although there is no current trace of its existence, the Upper Castaways area (north of PCH, on the west side of UNB) was the location of the shipping operation known as McFadden's Landing. Cargo was transferred from the warehouse to the landing base of the bluff, where it was loaded onto paddle-wheeled steamers and sailing schooners. In the mid 1900's, this site was occupied by the Castaways Restaurant and the Orange County Country Club. Chunks of the original concrete foundation and pieces of masonry can be found in this area.

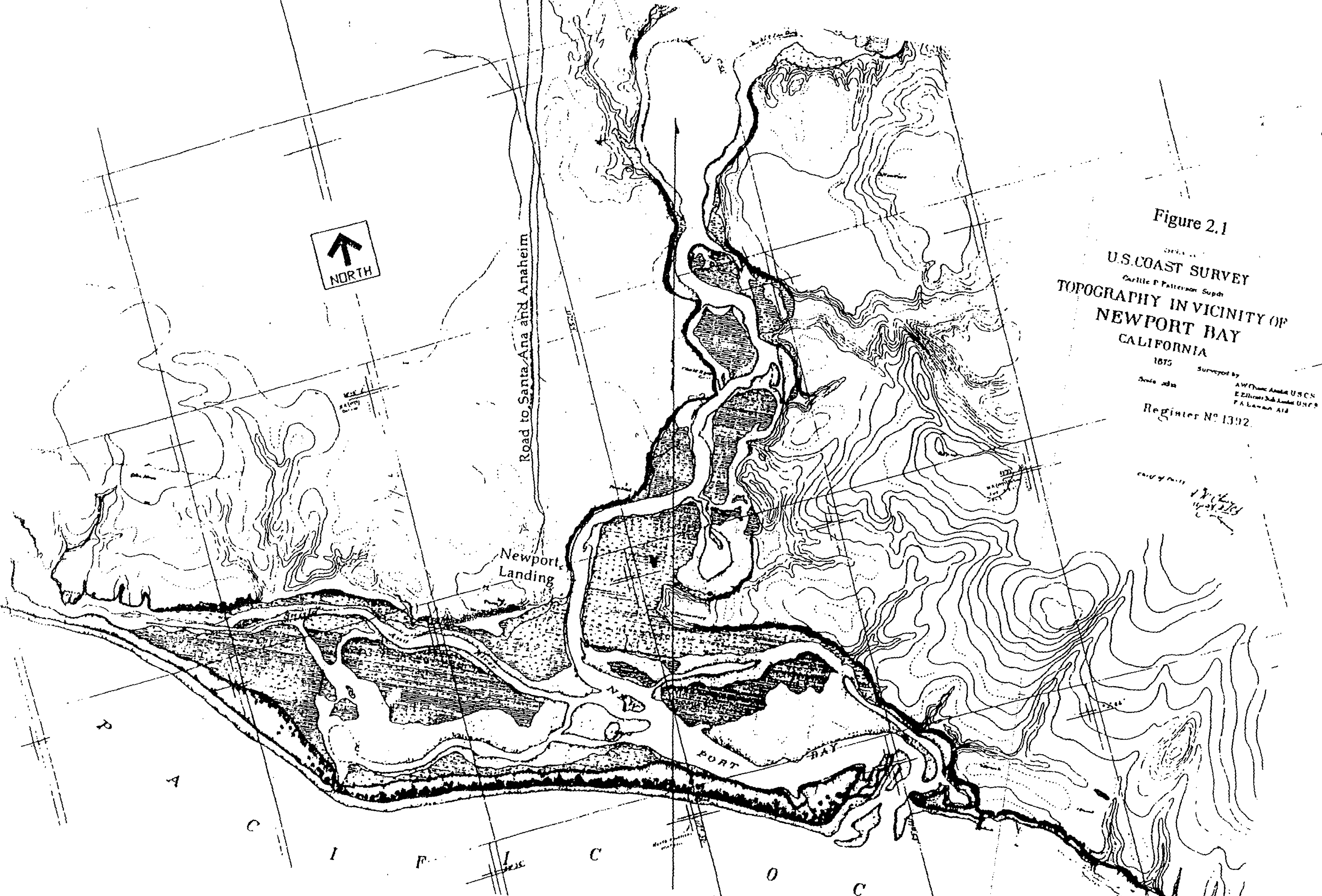
In the early 1900's, it was noted that Newport Bay had changed little since the time of the first survey of 1875. The Willows vegetation was effective in filtering suspended sand and silt from the river during non-storm conditions, limiting the sedimentation to about one-inch during 35 years in most areas of the bay. By channelizing the Santa Ana River, however, sediment and vegetative debris delivery to the bay increased substantially by 1914. A series of floods that occurred in the 1912-1916 period brought new pressures to undertake harbor improvements. One primary action was taken in 1916 when, under threat of extreme flooding of the Santa Ana River, an ocean outlet was formed west of the harbor. This unauthorized breaching was later reversed restoring river flow into west Newport Bay. Subsequent public outcry in response to the sedimentation and flood flows into the bay led to final rerouting of the river directly to the ocean at West Newport Beach in 1920, several miles west of Newport Bay.

San Diego Creek Watershed History

Areas surrounding Mission San Juan Capistrano were used for cattle ranching. The swampy western portion of the Tustin Plain, part of the San Diego Creek watershed, was named "Cienega de Las Ranas", or "Swamp of the Frogs" by mission priests. Storm flow from the Santiago and San Joaquin Hills mainly entered an ephemeral lake, adjacent to the swamp (see Figure 2.2). The outflow from this lake was blocked from UNB by a natural ridge several miles from UNB. Most of the flow emptied into the Santa Ana River.

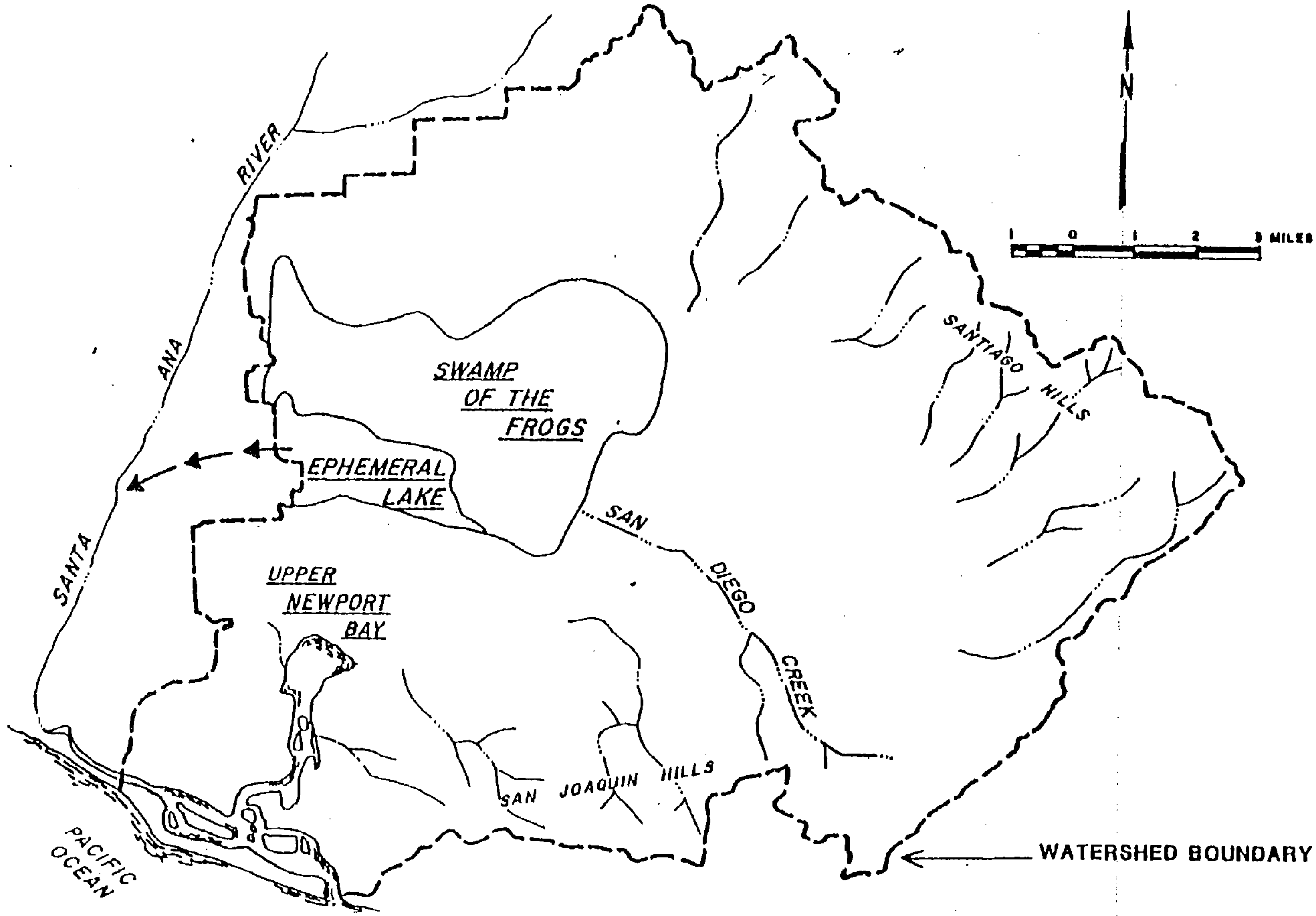
The ephemeral lake and the area to the north and east were usually swampy and marshy. These wet areas and the remainders of the Tustin Plain were later drained by ditches primarily constructed between 1902 and 1916 under the direction of James Irvine, Jr. to convert cattle and sheep pastures to agricultural land. The small irrigation ditches were originally used to drain low-lying areas and to flush out the alkali in the western portion of the watershed. Ditches in the eastern portion of the Tustin Plain were designed to remove the irrigation return flow and to prevent floodwater from inundating crop and orchard lands. The irrigation ditches were gradually expanded to integrate the natural drainage of San Diego Creek and channeled into Upper Newport Bay. Based on USGS topographic information, the drainage system was well developed by the early 1930's.

Figure 2.1



1875 U.S. Coast and Geodetic Survey of Newport Bay

Figure 2.2 Historic Watershed Hydrography



(Source: Boyle Engineering Corporation, 1983)

Creation of Newport Harbor

Prior to the attempts at harbor improvement, Newport Bay was plagued with dangerous entrance conditions and significant shoaling within the harbor area. Under large wave conditions, the entrance to the bay was impassable. Numerous shipwrecks and loss of life have been documented in those early years. For many years, pleas were made to the Federal Government to provide the funds to allow the construction of rock jetties at the harbor entrance, and the dredging of navigable channels throughout the harbor.

In the meantime, the City of Newport Beach and Orange County paid for much of the original harbor construction through bond measures. The City of Newport Beach began the construction of the first jetty at the harbor entrance in 1917. A 1919 Orange County Bond Election raised $500,000 to divert the Santa Ana River from Newport Bay, to lengthen the west jetty, to dredge a channel inside the bay, and to construct a wharf and railroad spur. Financial complications arose as the work was to get underway, and only a modified dredging operation was conducted. The west jetty was extended to 1,900 feet in 1921.

In the mid-1920's, General Lansing Beach, formerly of the Corps, was engaged to prepare a complete survey of reclamation needs for Newport Bay. The plan that developed included extending and enlarging the west jetty, construction of an east jetty from the rocky point of Corona del Mar, complete dredging of the Lower Bay, and raising of the islands of the bay wherever possible. The Upper Bay was considered at that time to have potential as an industrial harbor.

A 1927 city bond measure passed allowing both the construction of the east jetty and extension of the west jetty. Unfortunately, the entrance channel was still filled with shoals and the new west jetty configuration caused extreme erosion of the adjacent beach leading to the loss of a number of oceanfront homes. Given the growing importance of yachting to the area, private interests within Newport Beach collected sufficient funds to allow a limited dredging of the harbor entrance in 1928.

In the early 1930's, during the depth of the Depression, the National Recovery Act was seen by local interests to hold potential for the improvement of Newport Harbor. As a means of providing regional employment and business opportunity, the harbor work was seriously considered by Federal Agencies. The cost of the project to extend and rebuild the entrance jetties, and to dredge both the entrance and the harbor interior was $1.83 million. An endorsement by the Corps and the Public Works Administration resulted in a total Federal grant of $1.15 million. A County bond measure paid for the remainder. Following several delays, the dredging activity that resulted in Newport Harbor as it exists today commenced in 1934.

The completed Newport Harbor with its long jetties, deep channels, anchorages, and widened peninsula beaches (nourished from the dredge spoils of the harbor dredging) was dedicated in May 1936. The harbor dredging included the removal of 8.5 million tons of sand and 50,000 tons of rock. The 750-acre water area of the Lower Bay was dredged to a depth of -10 feet mean-lower-low-water (MLLW), the main channel to 20 feet, and the entrance channel to 25 feet. The dredged material was placed directly onto the beaches of the Balboa Peninsula. Approximately 210,000 tons of rock was used to extend the west jetty to a length of 2,830 feet. The east jetty length was extended to 1,673 feet.

Little is known about the estuarine habitats within Lower Newport Bay aside from a handful of surveys that had been completed prior to the beginning of harbor improvement measures in 1906. An unquantified amount of marsh, mudflat and shallow water was lost during harbor construction. This study is not investigating any ecosystem restoration measures in the Lower Bay to compensate for the loss of habitat during harbor construction.

Upper Bay Development

The configuration of the Back Bay began to change with the construction of the Pacific Coast Highway Bridge in 1921. Completion of the bridge reduced the size of the channel connecting the Upper and Lower Bays. The Main Dike was constructed in 1934 to support the commercial production of sea salt. San Diego Creek channel improvements occurred in the 1960's. The majority of the development of Newport Dunes Aquatic Park, Dover Shores, and the ski zone in the Unit II basin area occurred between 1956 and 1970. These alterations, along with the development of the Lower Bay and the Santa Ana River marshes, left the central portion of the Upper Bay as the last unaltered wetland in the area (CA Dept. of Fish and Game, 1989). At one time, the wetlands of Newport Bay and the Santa Ana River totaled 5,300 acres (CA Coastal Commission, 1982).

Watershed Development

Inland Orange County undertook rapid development following the conclusion of World War II. Prior to the channelization of the 1960's, San Diego Creek flowed through a flood plain that included the San Joaquin Marsh. In addition, a dam to trap irrigation water was located near the present site of the MacArthur Bridge. The flood plain and dam functioned as a sediment trap helping to buffer the Bay from unrestricted sediment transport. 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.

The lower reaches of San Diego Creek and Peters Canyon Wash were channelized for flood protection mostly during the 1960's when easements were granted to the Orange County Flood Control District. Improvements were made to provide protection for a 25-year flood. This increase in hydraulic efficiency within the watershed delivered greater freshwater flows and sediment to the Upper Bay.

Storm flows during 1969 flooded the salt works dike complex, breached the Main Dike, and deposited about 400,000 cubic yards (cy) of sediment in the Upper Bay. Local interests were concerned about the dramatic increase in sedimentation rates within the Bay, the long-term ecological health of the bay, and the impacts that continued sedimentation would have on the local boating activities of the Lower Bay. Comprehensive planning efforts and engineering studies of the sedimentation in Upper Newport Bay commenced in the early 1980's, under Section 208 of the 1972 Federal Clean Water Act. Sophisticated analyses of sediment sources and delivery processes were undertaken to determine the nature of future sedimentation of the Bay. Based on this analysis, a comprehensive "208 Plan" was prepared to control sediment delivery (see 208 Plan).

Upper Bay Dredging History (Pre-208 Plan)

Dredging activities within UNB have been relatively recent, dating to the mid-1950's. Initially, substantial dredging activities were performed in support of the creation of the Upper Newport Bay Aquatic Park and a recreational water ski area north of the Narrows. Later, 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 UNB 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 barges to the EPA sanctioned deep-water disposal site LA-3.

The total quantity of dredged material removed from the Upper Bay during the 1956-1970 period has been substantial. As indicated in Table 2.1, the total quantity dredged during this 14-year period is 2,171,400 cubic yards. This equals an average annual dredge volume of about 155,000 cy/year.

Table 2.1 Upper Newport Bay Dredging History

Date	Volume (cubic yards)	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
1985 (1)	28,000	Tidal wetland creation (2.5 acres), Shellmaker Island
TOTAL:	2,199,400	

(1) Wetlands creation dredging was not included in the calculation of average annual dredge volumes

Establishment of the Ecological Reserve

From the 1920's to the 1960's, there were many reports prepared that emphasized harbor development in the Upper Bay. By the mid-1960's, public opinion began to change and oppose development of the Upper Bay. Fish and Game undertook management of the Upper Newport Bay Ecological Reserve (UNBER) in 1975 for the purpose of maintaining and restoring coastal wetland habitats. Formation of the Ecological Reserve was made possible by adoption of the Newport Bay Settlement Agreement executed by Fish and Game, Orange County, the City of Newport Beach, and the Irvine Company for the purchase of 527 acres within Upper Newport Bay. The acquisition cost about $3.5 million, and funding came from the fines leveled against the oil companies involved in the 1969 Santa Barbara area oil spill. Additional adjoining parcels of land were added to the reserve at no cost through the transfer of administration of the tide and submerged lands from Orange County to the Department of Fish and Game. The "early action plan" was also funded with $1.1 million from the Santa Barbara oil spill fund. The total area of the Reserve achieved 752 acres by 1982 (Fish and Game, 1989).

The 752-acre Upper Newport Bay Ecological Reserve (UNBER) generally includes all of UNB from the southern end of Shellmaker Island, along the center line of Back Bay Drive to Jamboree Road, following the 10-foot contour on the north and east side to North Star Beach. The Reserve is under the jurisdiction of the California Department of Fish and Game. Upland areas of the Reserve are designated for recreational and environmental open space.

The CDFG, California Coastal Commission, U.S. Fish and Wildlife Service, and SCAG have identified the Reserve as a unique and valuable state resource. The Reserve is one of the last remaining coastal wetlands in southern California that continues to play a significant role in providing critical habitat for a variety of migratory waterfowl, shorebirds, and endangered species of birds and plants. The Upper Bay is an integral part of the Pacific Flyway, and the saltwater marsh, bay waters, and uplands provide habitat for 158 species of birds, 60 species of fish, and over 1,000 species of marine invertebrates.

<u>The 208 Plan</u>

In response to the ongoing threat to Newport Bay from sediment deposition, a comprehensive study, "Newport Bay Watershed, San Diego Creek Comprehensive Stormwater Sedimentation Control Plan" (Boyle Engineers, 1982) was sponsored by the Cities of Irvine and Newport Beach, and the Southern California Association of Governments. The sedimentation control alternatives that were implemented in response to the recommendations of that study were as follows:

1) *Early Action Plan* - Construction of two "in-channel" sedimentation basins in San Diego Creek and one 50-acre basin within the Bay. The in-channel upper basin extends about 2,000 feet from Campus Drive to 600 feet above the Sand Canyon Confluence. The lower basin extends 5,500 feet from MacArthur Boulevard to Campus Drive. A total of 500,000 cubic yards (cy) of sediment was dredged from the basin within the Bay, and 340,000 cy of sediment was removed from the basins in San Diego Creek. The project was completed in 1982 at a cost of $3.7 million.

2) *Unit I Sedimentation Basin* - In 1985, this action enlarged the previously constructed "in-bay" sedimentation basin from 50 to 85 acres. The basin was also deepened and a 300 ft wide and 3,200 ft long outlet channel was created. A total of 945,000 cy of sediment was removed from the Bay during this project at a cost of $4.1 million.

3) *Unit II Sedimentation Basin* - This project provided another sedimentation basin within the Bay, located just below the Main Dike at the southern end of the Unit I outlet channel. Side channels to the basin were created to support environmental enhancement. In addition, 100-ft wide dredge access channel was constructed from the Lower Bay to the Unit II Basin. The dredged quantity for the project was 1,200,000 cy of sediment. The project was completed in April 1988 at a total cost of $5.6 million.

4) *Unit III Sedimentation Basin* – 1998-99 in-bay basin construction project deepening a portion of the Unit I basin footprint. The project was completed in April 1999, with 860,000 cy dredged at a total cost of $6.5 million.

The entire 208 plan consists of the following: agricultural best management practices (BMPs) to reduce erosion from agricultural lands; construction site BMPs; the in-channel basins in the lower end of San Diego Creek to capture coarser sediments before they enter the Upper Bay; the in-Bay basins in the Upper Bay to capture fine particles; channel stabilization to reduce the erosion of earthen channels; foothill basins to capture sediments produced by natural erosion in the foothills; and monitoring. The Executive Committee for the Upper Newport Bay Sedimentation Control Plan include representation from the California Department of Fish and Game, the County of Orange, the City of Tustin, the city of Irvine, the City of Newport Beach, and the Irvine Company.

The 208 program is designed to evolve over the years from a "downstream control" to an "upstream control" system. The downstream control consists of the sediment basins in the Upper Bay and in San Diego Creek. The upstream system consists of the foothill basins and channel stabilization. These are installed as part of the land development process and under city and County flood control programs. Present-day constructed elements of the 208 plan are shown in Figure 2.3.

Table 2.2 208 Plan Upper Newport Bay Dredging History		
Date	Volume (cubic yards)	Location
1982	493,000	Salt works basin dredging to create ponded water and intertidal habitat (50 acres)
1985	890,000	Unit I sedimentation basin: channel widening: salt works 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. Unit II basin depth is –11 ft mllw.
1999	860,000	Unit III sedimentation basin (see description below): Restoration of a channel for access to slips in the lower portion of the Upper Bay, and a main channel for the dredge and barge equipment from the PCH bridge to the basin. The Unit III basin is located in a portion of the Unit I footprint, deepening the original basin depths of –4 ft mllw to –11 ft mllw.
TOTAL:	3,343,000	

The total quantity of average annual dredge volume removed from the Upper Bay under the 208 Plan during the 1982-1999 period is about 197,000 cy/year.

Unit III Project

The two in-bay basins trapped large amounts of the sediment from the San Diego Creek watershed, but were rapidly approaching their design capacity by the early 1990's. The reconnaissance study (1993) noted that the Unit I basin had reached it's design capacity and required restorative dredging. At the same time sediment deposition in the Unit II basin resulted in a loss of almost two-thirds of the original design capacity. More deposition occurred further down the Upper Bay and into the Lower Bay creating shoals in navigation channels and slips. By 1998, navigation channel widths were significantly reduced, and boats were running aground trying to enter the marinas or individual slips.

By 1998 the OCPFRD and other interests had taken the initiative to design, negotiate and award a dredging project to restore and increase the capacity of the upper basin, the Unit I basin. The newly termed "Unit III" basin and project removed about 859,000 cubic yards of sediment from PCH bridge to the upper basin. The majority of the dredged material was taken out of the basin (532,000 cy), but a dredge and barge access channel was also dredged from PCH Bridge to the southern portion of the Unit III basin (252,000 cy). Navigation channels and slips were also dredged in the Newport Dunes and Dover Shores marinas in the lower portion of the Upper Bay (75,000 cy). The disposal site of the dredged material was at the LA-3 offshore disposal site (see Figure 1.4). Dredging boundaries are shown on Figure 2.4.

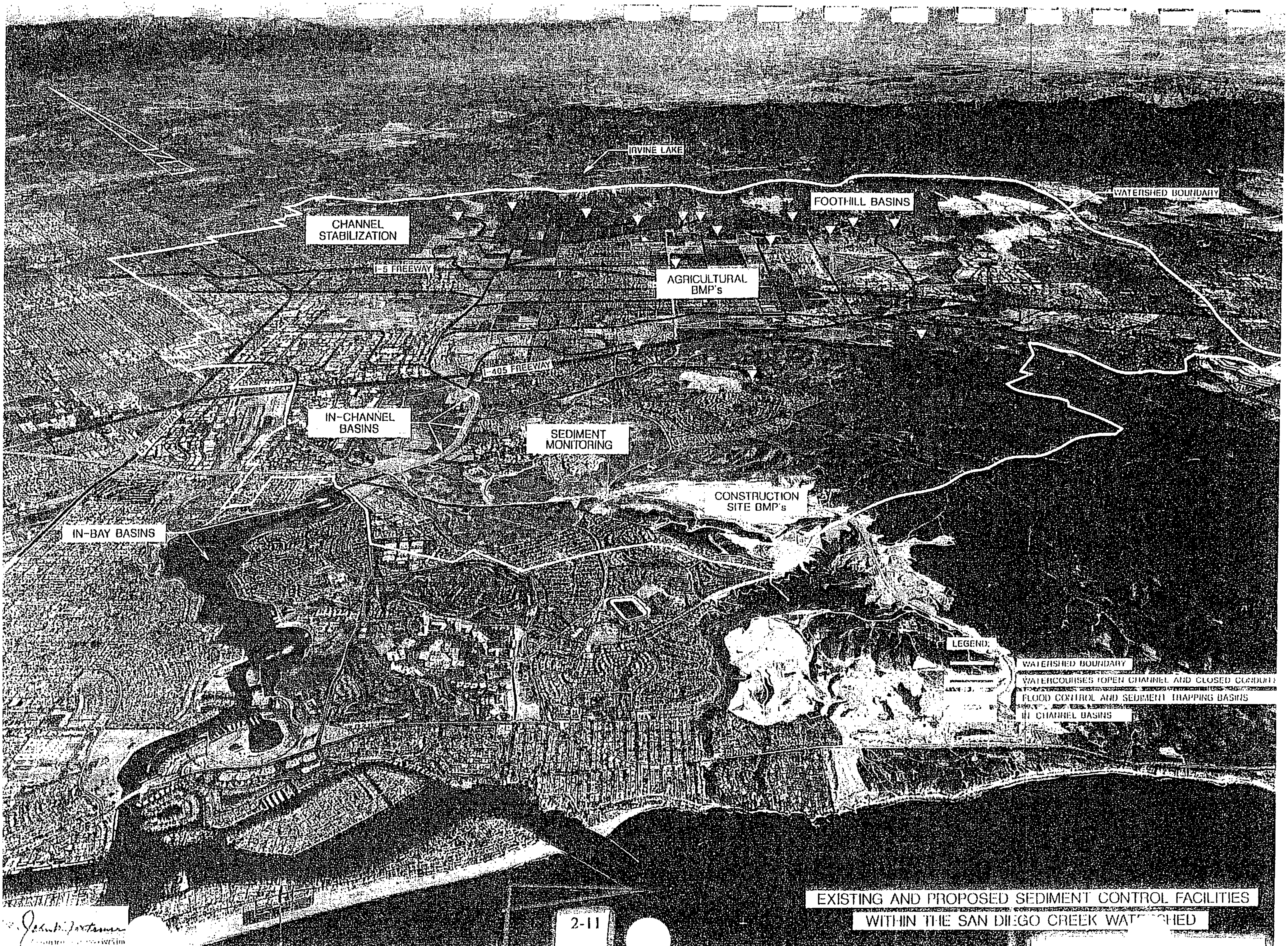


Figure 2.. The 208 Plan

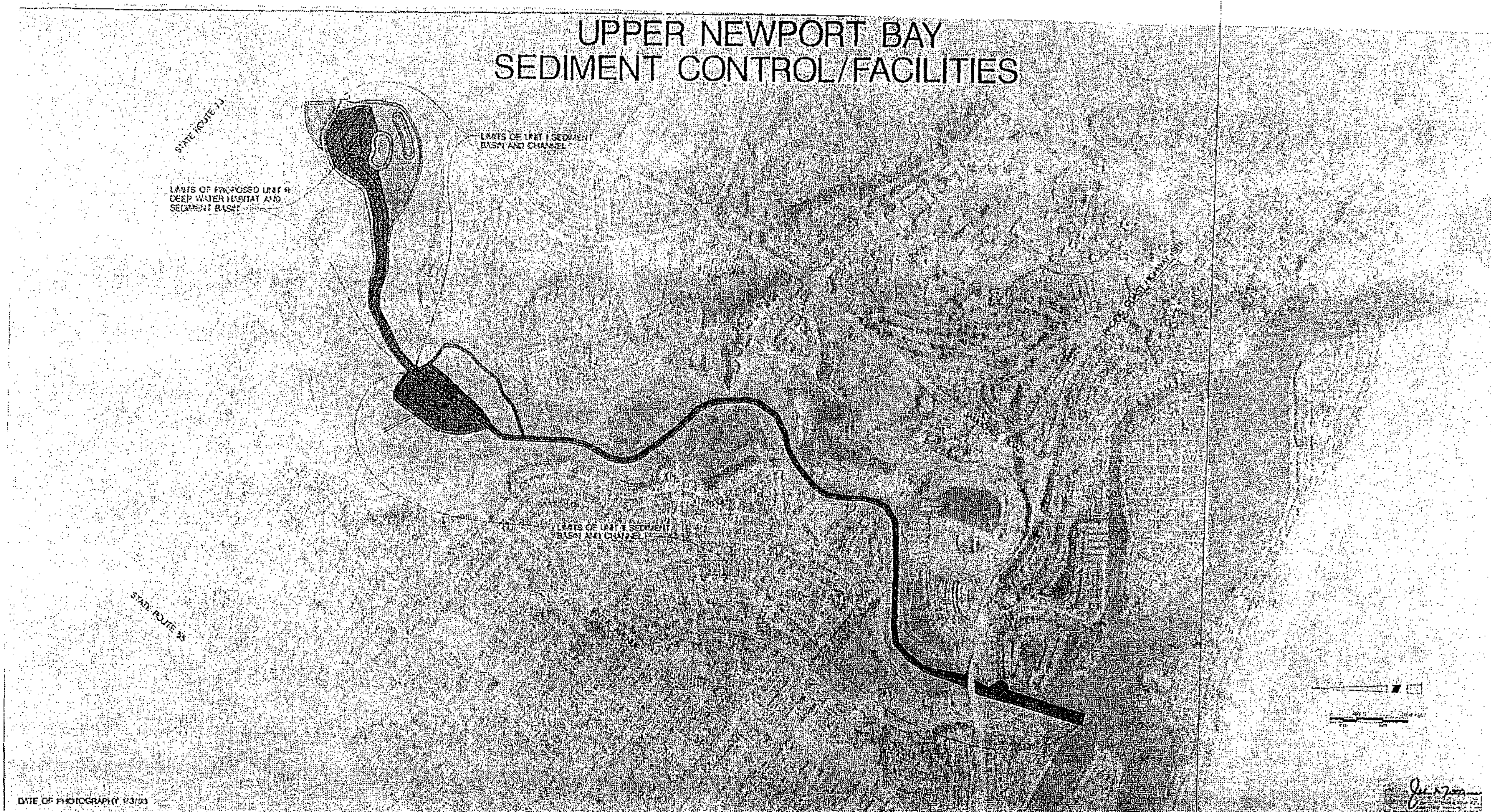


Figure 2.4 The Unit III Project

The initial basin design proposal was to maintain the same boundaries as the Unit I basin and deepen the portion of the basin below the mouth of San Diego Creek in order to increase storage capacity. The Unit I basin was dredged to –4 MLLW (-7 MSL) in 1985 and has now been dredged to –11 feet MLLW (-14 MSL). Resource agencies allowed for the deepening of this portion of the basin bordered by the northern shoreline and the larger 'kidney-shaped' tern island (Skimmer Island) but did not allow the restoration of a small channel between the two tern islands in the basin. Reasons for denial of the channel restoration between the islands were due to agency concerns about disturbance to nesting sites and the question of the worth of restoration of this channel where mudflats now exist. This constraint placed on the restoration of this channel, and the reasons for it were of particular concern during the formulation of alternative measures.

This project was an interim measure to curb the loss of open water habitat and potential loss of valuable habitat supporting a variety of sensitive species. Local funding for the project was very difficult to obtain. This study's baseline condition analysis assumes that the Unit III project is a one-time restoration measure that will not be maintained in the future. The basin is included in the existing condition description. It should be noted that the Unit II basin was not dredged as part of the Unit III dredging project, and is now in non-compliance with the TMDL objectives because existing depths are more shallow than the required –7 MSL depth, as specified in the sediment TMDL.

The Unit III project has provided this study with a wealth of information about dredging operations, production rates, transport and disposal issues, and chemical and bioassay testing that has been used for the formulation and evaluation of alternative plans.

The Corps also dredged Federal navigation channels in the Lower Bay below PCH Bridge (for the first time) in 1999 during the Unit III dredging project. About 277,000 cubic yards of material were dredged and disposed of at the LA-3 offshore disposal site. The need for this dredging project clearly shows that more storm in-flows will deposit sediment further down the Bay if the trapping efficiency of the existing in-bay basins declines significantly. There is still a significant shoaling problem in some of the channels and slips in Lower Newport Bay. Vessels have been running aground in 1999 and dredging actions are being considered at this time.

<u>Summary of Historic Changes to Bay Habitat Types</u>

The development of Newport Harbor led to significant changes in the natural configuration, depth, salinity regime, and environmental habitats of the Bay. Secondary effects included the commercial, industrial, and recreational growth of the economic base within Newport Beach in response to the creation of the harbor. The direct result of this increase in economic base also included deleterious environmental impacts within the Bay, including sewage and industrial pollution, public health concerns, and additional reduction in open water and wetland habitat in both Lower and Upper Newport Bay.

Detrimental ecological changes to Newport Bay that resulted either directly or indirectly from the Federal dredging project that created Newport Harbor in the mid-1930's are:

- ❑ The loss of sandy intertidal sandflat, mudflat, shallow subtidal unvegetated soft bottom, and eelgrass meadows that were replaced with open water and deeper channel habitats and benthic communities.

- ❑ The establishment of fouling communities with the introduction of hard substrate in the form of wharves, pilings, jetties, and boat floats which are typical of the communities found in the bay today.

- ❑ Certain areas of LNB have been affected by a combination of increased levels of pollution and reduced tidal circulation (particularly West Newport and the Rhine Channel). This has resulted in communities of benthic organisms that include few species, but high numbers of pollution-tolerant marine invertebrates and fishes.

The following summarizes development effects in UNB:

- ⇨ A significant amount of UNB channel, mudflat, and salt marsh habitat was dredged and filled for the development of the Newport Dunes Aquatic Park and De Anza Marina/Mobile Home development (approximately 125 acres) and the Dover Shores housing development and associated waterways (approximately 36 acres).

- ⇨ The construction of solar evaporation ponds and the Main Dike for salt production cut off all tidal influence to the area. The Western Salt Company removed approximately 130 acres of marshland above the dike in 1934. The storms of 1969 breached the Main Dike and re-introduced some tidal influence to the area. After 1969, a healthy mix of open water, mudflat and marsh habitats has gradually returned to this area (Segment 1) due to sediment deposition, natural marsh expansion and dredging (the Unit I and Unit III projects).

- ⇨ Sedimentation and increased suspended sediment loads in the Upper Bay have resulted in a decrease of benthic infaunal diversity, caused the disappearance of eelgrass from the Upper Bay, and has reduced the tidal prism. Constant runoff from the San Diego Creek watershed has shifted the benthic and fish community structure to include more estuarine and freshwater-occurring fauna.

- ⇨ Urbanization in the watershed has resulted in increased pollutant loading in the Upper Bay in the form of higher nutrient levels, pesticides, and heavy metals.

The 1989 Fish and Game Management Plan made a general comparison between Upper Bay habitat changes from 1929 to 1989 by splitting the Upper Bay into four zones. The two upper zones were consolidated and conditions were updated to reflect 1999 conditions. The comparison is shown in Table 2.3.

Table 2.3 1929-1999 Upper Bay Habitat Comparison		
	Pre-1929 Conditions	1999 Conditions (1)
Segment 1: (Jamboree Road to the Main Dike)	The Unit I/III basin area was mudflat and marsh bisected by tidal creeks, subject to tidal inundation. The southern end of the existing Unit I/III basin to the dike was predominantly marine and mudflat habitat bordered by salt marsh.	The Unit III sediment basin and perimeter mudflat and marsh areas. Fresh/brackish water marsh, salt panne and riparian vegetation fringe the perimeter of the area on the north and south. The same area is now predominantly salt marsh. Mudflats are much reduced and marine habitat is restricted to a central channel and subject to strong freshwater influence. Remnants of the Main Dike restrict tidal circulation.
	Large open water area bordered by mudflats with fringe of salt marsh. Upper Island was a true island.	Smaller open water area (Unit II basin) surrounded by mudflats and marsh. An island (New Island) has developed on the east side of the Unit II basin. A channel and marsh border New Island on the east side. Marsh vegetation is encroaching onto mudflat. Several acres of historic marsh at 23rd Street have been filled with dredge spoil. Upper Island is now a peninsula.
Segment 3: (Middle Island to PCH Bridge)	Similar to 1999 condition. What are now Dover Shores and North Star Beach was salt marsh. Shellmaker Island was a true island.	Parts of Shellmaker Island is no longer an island and more of a peninsula. Dover Shores dredged and filled with loss of salt marsh. 40% of the salt marsh on Shellmaker Island lost to filling and development. Constriction of marine channels due to shoaling and silt deposition. Limited salt marsh encroachment on the mudflats.

(1) Descriptions updated by the Corps to reflect 1999 conditions.

The rate of salt marsh expansion on UNB tidal flats was estimated on the basis of aerial photographic analysis of the vicinity of the Main Dike between 1984 and 1992. The area north of the Main Dike was returned to tidal influence following the storms of 1969 when stormwaters from San Diego Creek breached the salt works dike. Between 1978 and 1982, about 111 acres of salt marsh had developed, at an average rate of approximately 8 acres per year. Immediately south and east of the Main Dike, sediment deposition between 1969 and 1986 raised the mudflat elevations and allowed cordgrass and pickleweed to colonize the tidal flats. The salt marsh expanded from about 2 acres in 1986 to almost 11 acres in 1992 at an average rate of 1.5 acres per year. On the west side near the Santa Ana Delhi Channel, the marsh expanded 12 acres between 1984 and 1992, at a rate of 0.9 acres per year.

BASELINE CONDITION ASSUMPTIONS

- Existing condition bathymetric conditions in the Bay are based on OCPFRD's 1997 surveys with modifications to include the Unit III basin design and approach channel. Therefore, base conditions for the numerical modeling simulations are essentially the same as the existing condition bathymetry, and habitat acres also reflect existing conditions.

- The estimate of sediment volumes transported to the Bay in any frequency storm event will remain the same for the future without project condition. This study does not account for a potential decrease in future sediment delivery to the Bay due to watershed development or compliance with sediment TMDL objectives. Early in the feasibility study, we had to decide what assumptions would be made about the future sediment volumes transported to the Bay. TMDL objectives were still being drafted, and there were conflicting opinions about possible increases or decreases in channel and overland erosion from the watershed. The decision was made to use the 25-year historic San Diego Creek stream gage record for the modeling analyses, repeating the same gage record for years 26 to 50 to form a 50-year future record for the Bay hydrodynamic and sediment transport model. This is the impact of our conservative approach. If sediment inflow volumes for future storm events were overestimated, then proposed in-Bay basins would fill less quickly than we have assumed for this study. This means the actual intervals between Operations and Maintenance dredging for one or more basins in the recommended plan would be longer than we have estimated for the study, reducing the actual long-term maintenance costs.

- Local interests (see 208 plan) will continue to maintain in-stream and foothill San Diego Creek watershed sediment control basins for the 50-year future without project condition. This study assumed that maintenance of the watershed basins would remain the same as was done historically. Therefore, sediment delivery to the Bay would remain the same in future conditions for any storm event. For instance, a 10,000 cfs existing storm event would deliver the same volume of sediment to the bay as a future 10,000 cfs event. Local interests are required to take a more aggressive approach to the maintenance of the watershed basins, ensuring a minimum 50% storage capacity at the beginning of any storm season. This is to comply with sediment TMDL objectives. The effects on bay sedimentation rates will be investigated in the watershed feasibility study that is currently underway.

- Funding limitations will not allow local interests to maintain the two in-Bay basins in the future without project condition. The 208 plan identified cost sharing requirements for the agencies involved, including representatives from the State, the County, cities and the Irvine Company. The Unit III project validates the difficulties in obtaining funds for the cleaning of these in-bay basins. When we initiated the feasibility study, the Unit III dredging plans had been prepared, but no source of funding had been identified. Orange County PFRD eventually fronted the money for the entire Unit III project, but is still awaiting reimbursement from other agencies. Since there is currently so much trouble paying for these basin cleanouts, it is reasonable to assume that this will continue in the future, justifying the assumption of no dredging of the in-bay basins for the future without project conditions. This assumption is in non-compliance with the sediment TMDL objective that the two in-Bay basins be maintained to a minimum depth of –7' MSL.

- Maintenance dredging would continue in the lower portion of the Upper Bay and the Lower Bay federal channels for the future without project condition to ensure navigational access to the marinas and the boat launch ramp. This would have to be done at more frequent intervals due to the loss of sediment storage capacity in the Upper Bay basins.

BASELINE CONDITION EVALUATION TOOLS

Baseline conditions analyses are supported by habitat and species surveys prepared for this study; numerical modeling of Bay hydrodynamics, sediment transport and water quality; and a collection of other recent survey and study efforts. Another support tool includes use of the Orange County's Geographic Information System (GIS) to quantify habitat acreage and visually display habitat changes within the Bay. We are also using a modified Habitat Evaluation Procedure (HEP) as a measurement tool to quantify both positive and negative changes to the ecosystem for the future without project condition, and for the comparison of alternative plans.

Several methods were used to estimate existing habitat acreage. 1997 infrared aerial photos were used to assist in the identification of different habitat types. Vegetation and species field surveys were also conducted in October 1997. Bay bathymetry and topography that was taken in support of the recent Unit III dredging project was expanded to include other portions of the Upper Bay and reserve that were not covered in the initial work effort. Mapping limits were all areas within the Upper Bay to the +10 Mean-Sea-Level (MSL) contour. Orange County PFRD used all of this information to prepare an existing condition GIS vegetation map.

A relationship was made between habitat types and elevation ranges by using the GIS existing condition vegetation and contour mapping data. One output of the numerical model was the ability to show sediment deposition over time. By combining the elevation change data with the corresponding habitat types, we were able to use the model as an indicator of the growth or loss of habitats for the future without project condition and alternatives. Results were presented in the GIS.

The Bay's existing and future habitat acres were further broken down into three segments for the modified HEP in order to quantify changes in habitat units (HU's). The 'upper' section starts at Jamboree Road Bridge to the Main Dike, the 'middle' section extends from the dike to the upper end of Middle Island, and the 'lower' section is from Middle Island to PCH Bridge. The habitat units are used to express the value of a habitat in relation to species use, and proximity to other habitats and key parameters. Future without project and alternative conditions will be reflected in the changes in habitat units. Benefits related to restoration measures can be quantified by comparing the changes in habitat units.

Numerical Modeling

Resource Management Associates, Inc (RMA) have prepared a suite of numerical models to evaluate existing and future without project and alternative conditions in the bay. An earlier version of an RMA model was developed in support of the reconnaissance study. This study includes bay hydrodynamic, sediment transport, and water quality models. The first step was to prepare a finite element mesh for both Upper and Lower Newport Bay. The mesh is a series of polygons with over 8,600 nodes, or intersection points that cover all areas affected by fresh water flows and tidal action. Each node can provide a list of data regarding the effects of various tides, currents, wetting and drying of mudflats, storm and dry weather conditions and so on.

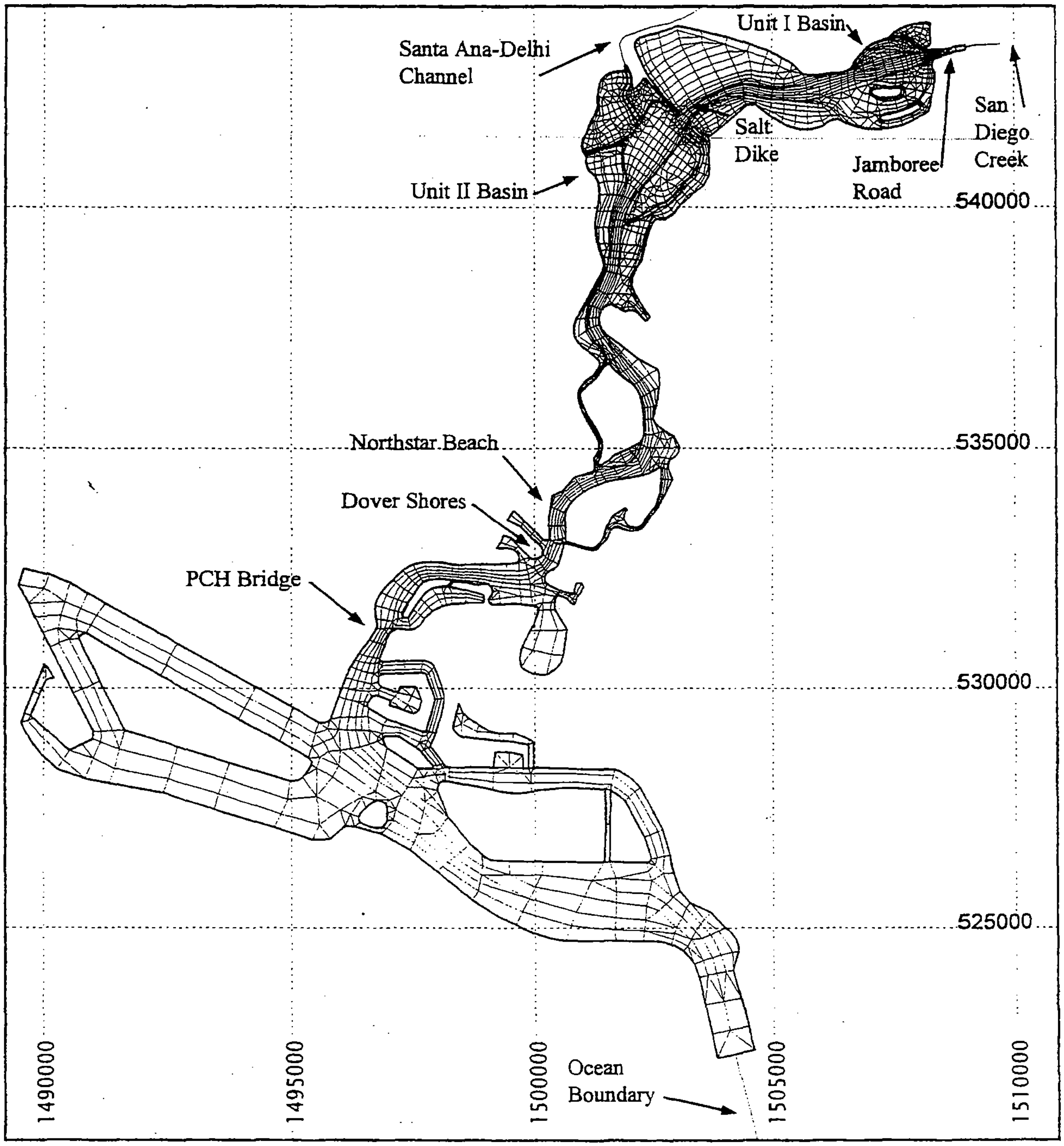


Figure 2.5 Newport Bay Finite Element Mesh

The suite of linked models, and Graphical User Interfaces (GUI's) allow the user to see animated simulations of existing and future conditions, and simplify the input of information into the model. The model allows us to stop and see what the Upper Bay would look like in any of the 50 future years of analysis, or view the animated results in order to see annual changes based on storm inflows, circulation patterns and previous sediment deposition within the Bay. Different dredging maintenance scenarios can also be investigated to compare alternatives and optimize a recommended plan. Initial efforts to calibrate water quality constituents were developed as part of this study. Further work has been funded by the RWQCB. Much of the water quality constituent modeling will not be available for this study. The suite of models is designed for use as a future management, decision-making and educational tool for bay and watershed activities. Other agencies are currently using the suite of models to address several of the TMDLs.

Model simulations showing changes to bathymetry and topography are fed into the Orange County GIS database. GIS allows us to link habitat types with certain elevation ranges. This allows the model results and GIS to be used as tools to aid the study team in evaluating impacts on vegetative and biological species counts, diversity, and distribution. A much more complete discussion of all of the modeling efforts is presented in the engineering appendix.

<u>Modeling Process</u>

Calibration of the hydrodynamic model was based on a comparison of measurements of Bay tides and currents taken during the 1992 reconnaissance study, and simulated model results using current Bay bathymetry. Sediment transport model calibration was based on San Diego Creek stream gage information gathered within the last ten years, and changes within the Bay bathymetry since the completion of construction of the two in-Bay basins. The finite element mesh was altered to match the bathymetric surveys of the Bay in 1987, and used as the initial conditions for the calibration simulation. The initial bathymetry for the model calibration simulation reflected the completed dredging for both Unit I (1985) and Unit II (1987). To compensate for the fact that Unit II was not completed until the 1988 water year sediment was not permitted to deposit in the model in or below Unit II until 1988. OCPFRD provided bathymetric data sets for the Upper Bay modeling efforts. Corps LNB harbor condition surveys were used for bathymetric data south of PCH Bridge

The sediment transport model was run for the ten years between 1987 and 1997. Comparisons were made between simulated deposition patterns and observed deposition patterns. Model inputs were adjusted, based on discrepancies in the results until calibration gave reasonable results.

Sediment properties required by the sediment transport model include the number and thickness of sediment bed layers, critical shear stress for erosion for each layer, sediment density for each layer, critical shear stress for deposition, and sediment particle settling rate. A five-layer model was used for Newport Bay. Sediment density estimates from previous studies in the Bay were used for this study. Newly deposited sediment was assumed to be less dense and more easily scoured than sediments which have been covered and have begun to consolidate.

Simplifying assumptions were made for wet and dry weather simulations. The amount of sediment inflow varies every year, based on the size, frequency and duration of storm events for any given year. For example, the 1997-98 El Nino winter storm season was particularly intense while the 1998-99 storm season was much milder. The assumption was made early in the study to use the 25+-year stream gage record for San Diego Creek and repeat it to get a 50-year stream gage record.

Sediment quantities were estimated for the 50-year future without project condition time period based on the 1987 to 1997 calibration period records of storm events. The single largest event was selected for a given year, and the entire estimate of yearly sediment inflow was assumed to enter the bay in that one winter storm event using a sediment load scaling factor. The factor relates to the ratio of the total sediment load estimated for that year to the sediment load introduced by the simulated storm. The inflow from San Diego Creek was assumed to be 95% of the total inflow to the Upper Bay, with the additional 5% coming from the Santa Ana-Delhi Channel. The sediment transport curve for San Diego Creek at Campus Drive was used to derive a smooth functional relationship between suspended sediment concentration and flow. Since the flood flows represent the primary factor for sediment transport in the wet season, a mean tide was used at the ocean boundary for these simulations. A five-day hydrograph was developed, with an associated 5-day hydrodynamic and sediment transport simulation. The Bay's bathymetry was updated, based on the model simulation. During a storm event the hydrodynamic model provides a good representation of the two-dimensional depth averaged flow regime (i.e. stratification is not simulated.).

For the dry weather simulation, 2 months of hydrodynamic and sediment transport simulations were run to simulate the effects of tides, wind and currents on bed shear and the redistribution of sediments within the Bay. A scaling factor was also applied to the dry weather simulation to represent 8 months of dry weather conditions every year. This method was repeated for every year of simulation. The inflow at San Diego Creek and Santa Ana-Delhi Channel were taken as 15 cfs (.42 cu.m/sec) and 1.5 cfs (.042 cu.m/sec), respectively. Inflow sediment concentrations for both streams were set to zero. A time dependent wind field was applied in the dry weather simulations only. The wind was varied linearly from 5 mph (8 kph) to 20 mph (32.2 kph) then linearly back to 5 mph over 12 hours simulating the typical daily cycle of the April to September period where peak winds develop in the afternoon.

The modeling effort placed special emphasis on the evaluation of mudflats. Bathymetric contours levels between -3.0 ft and +3.0 ft Mean Sea Level (MSL) approximately define the areas that are subject to wetting and drying. For most simulations, contours above 3 ft MSL (mean higher high water) were excluded from the finite element mesh, which includes the well-established marsh areas on the periphery of the Upper Bay. Although some of the marsh regions will be inundated at higher high water, they are covered by a relatively thin layer of water that does not significantly contribute to the tidal prism of the estuary. Further, the thick vegetation on the marsh prevents water from moving rapidly. These areas, therefore, have a relatively minor impact on the hydraulics of the system. As the sediment underlying the marsh consolidates, new sediment will be trapped to maintain the elevation relative to higher high water. This is a slow process, and the deposition rate on the marsh is very small relative to that the rest of the estuary. The mesh was expanded for a simulation of the December 7, 1997 storm event. This particularly large event inundated the entire Upper Bay above the salt dike.

<u>The Modified Habitat Evaluation Procedure (HEP)</u>

The HEP is a way for us to place a non-monetary 'value' on the habitats within the Upper Bay. HEP was originally developed for use by the U.S. Fish and Wildlife Service. This modified HEP has been specifically tailored for use in Newport Bay. The HEP takes an ecosystem approach through the identification of one or more indicator species for a certain habitat type, and the species relationship to other habitat types. The indicator species were carefully selected to represent native species that were once common and still exist today or are common now in the Upper Bay. Selection was based on numerous meetings with the Habitat Evaluation Group (HEG), made up of representatives from the FWS, NMFS, F&G, the County of Orange, the City of Newport and the RWQCB. The modified HEP analysis requires a consensus-based approach between the Corps, Sponsor and resource agency representatives. HEP results have been presented and modified, based on input from the larger Technical Advisory Group, including HEG members, EPA, the Coastal Conservancy, the Coastal Commission, the Newport Bay Naturalists and Friends of Newport Bay, and others.

We are using the HEP as a tool to quantify a value for existing conditions and measure the ecological changes that will occur in the Upper Bay for the future without project conditions. These values are compared to alternative values to determine what the best design is for sediment control basin(s) and environmental restoration measures. The HEP for this study has been simplified to cover the estuarine habitats that will be most affected in the future without project condition. These are marine open water, intertidal mudflat, and low, middle and upper marsh.

For each habitat type, values ranging from 0 to 1 are assigned to the different indicator species based on the value of that habitat for a given species. Use considerations include breeding, foraging and loafing. The scale from 0 to 1 is referred to as the Habitat Quality Index (HQI). The summation of the associated species HQI's result in a composite index of the quality of the habitat. For instance, open water areas were analyzed using two fish species and four bird species, and mudflats include one fish species and eight bird species as habitat indicators.

The HQI is multiplied by habitat acres to calculate Habitat Units (HU's). The Bay is split into three segments for the HEP analysis. Descriptions of the segments are described in the study area description. A detailed explanation of the preparation of the HEP for this study is presented in the HEP appendix to the EIS/R.

INVENTORY OF EXISTING CONDITIONS

Climate

The Newport Bay region lies within a climate regime that is characterized by short, mild winters and warm, dry summers. Average summer high and low temperatures (July) in the Newport Beach area are 74 F (23 C) and 61 F (16 C), respectively. Average winter high and low temperatures (January) are 63 F (17 C) and 45 F (7 C), respectively. Rainfall averages approximately 12 inches (.30 meters) per year. 90% of the annual rainfall occurs between November and April, with minor precipitation during summer months.

In Newport Beach, daytime winds normally occur from the west or southwest due to onshore flow from the Pacific Ocean. Average daytime maximum speeds are approximately 4 miles per hour (mph) in the summer decreasing to 2 mph during the winter. Nighttime predominant wind patterns generally find an easterly to northeasterly flow set up from the general offshore flow enhanced by the local thermal drainage. Average nighttime maximum speeds in the winter reach 2 mph and fall to a gentle 1.5 mph in the summer.

Strong onshore winds are generated at Newport Bay through the differential heating of land and sea. Wind waves of about 0.5 feet typically form in the spring and summer months within UNB. The funneling effect of the high bluffs that surround Newport Bay can create frequent periods of daytime winds in excess of 15 mph. Extreme northerly winds occur during periods of "Santa Ana" conditions, typically during the fall and winter period. Santa Ana winds can achieve speeds in excess of 40 mph 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).

Climate information was used for the development of the hydrodynamic model, particularly the effects of wind driven waves on the redistribution of sediments during the dry season, and of course storm inflows during the winter rainy season.

Hydrodynamics (Tides, Currents and Bathymetry)

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. Wind and freshwater discharge can further influence actual tidal elevations.

A tide and current data collection program was undertaken in June, 1992 in support of the numerical model that was developed for the reconnaissance study. The results of this study indicate that the tidal wave entering Newport Harbor is slightly attenuated as it propagates up the bay. Comparisons with tide data collected at the Main Dike of the Upper Bay indicate that the tides in the Upper Bay are slightly higher than those at the harbor entrance and the time of high tide in the Upper Bay is later than at the entrance by about 25 minutes.

Currents are primarily driven by tides and, during winter storms, freshwater inputs from the major stream flows. Tides are semi-diurnal, with two high tides and two low tides per day. Current speeds vary, but typical speeds are from 0.5 to 1.8 ft/sec (0.3 to 1.1 knots), although maximim ebb currents may reach 4 ft/sec (2.5 knots) during a 10,000 cubic feet per second (cfs) flood flow. Circulation in some parts of the Upper Bay is limited due to channel restrictions. Typical current speeds in the main channel areas of the Bay during non-storm periods are not considered erosive, but they are capable of transporting fine sediments re-suspended by waves.

Tidal information was used for the calibration of the hydrodynamic and sediment transport models. The modeling appendix details the preparation, calibration and use of the hydrodynamic model. The hydrodynamic model was the crux of the existing and future condition analyses. The hydrodynamic model was calibrated using pre-Unit III bathymetry for the Upper Bay for several reasons. The feasibility study began before the Unit III project and that time it was not known if the Unit III project would be fully funded. Calibration of the hydrodynamic model compared Orange County's detailed 1987 bay bathymetry and topography, after construction of the two in-bay basins (Units I and II), to detailed mapping for 1997 conditions, prepared in advance of the Unit III project. At that time, it was decided that the Unit III project would be addressed as a possible alternative. After the Unit III project was funded and construction began, the numerical model's bathymetry was changed to include the Unit III basin in the existing condition design for baseline analyses.

The hydrodynamic model outputs show current velocities and directions at all nodes of the finite element mesh. In general, current velocities are greatest at the more constricted main channel locations in the Upper Bay, particularly in the channel between the two basins and the channel below the Unit II basin to the PCH Bridge. Current magnitudes in the more shallow portions of the basins, side channels and all mudflat areas are considerably less than those found in the main channel. Algae blooms tend to propagate in areas with low current velocities. Low current areas in the Upper Bay include side channels around Middle Island and Shellmaker Island, the channel and mudflats immediately south of Middle Island, Newport Dunes and Dover Shores. Changes to current magnitudes and directions will be considered during the formulation of alternative measures.

Existing condition analyses also included a separate flood simulation of the December 6, 1997 storm event, the largest San Diego Creek runoff in recent history. This simulation was of particular interest because of the extreme conditions during that time period. Observed tides were 0.6 to 1.4 feet higher than the NOAA tide charts that year due to the effects of El Nino. Residents indicated that storm waters had inundated the salt dike (+7 MSL) around the peak of the storm. The model simulated water surface elevations in excess of +9 MSL during peak floods. In general, the model accurately predicted the areas of scour and deposition when compared to the 1997 post-flood bathymetry. Details are included in the modeling appendix.

<u>Surface Water</u>

The primary source for freshwater inputs to Newport Bay is from the San Diego Creek watershed, draining over three-quarters of the entire Newport Bay watershed. Other freshwater sources to the bay include urban and industrial runoff from Santa Ana-Delhi Channel, urban and residential runoff from Big Canyon Creek, and discharges from other minor point sources such as storm drains.

The San Diego Creek watershed includes two major channels, Peters Canyon Wash and San Diego Creek. Historical ranching and agriculture (see watershed history), and more recent development in the watershed have led to extensive channel construction and realignment that has altered the delivery of fresh water to the Bay. A watershed that was historically little more than 10 square miles has been expanded to 154 square miles. Piecemeal development and associated channel improvements has created a patchwork of concrete, riprap, earthen and natural channels. The result has been the delivery of more fresh water to the bay. With this came the problems of sediment, nutrients, toxics and pathogens (see TMDL's). Surface water quality has improved since the implementation of the 208 Plan, and nutrient controls, but many problems remain.

Hydrodynamic and sediment transport modeling included annual dry and wet weather simulations. Dry weather base flows for San Diego Creek typically range between 8 to 15 cubic feet per second (cfs). As is typical in the Southwest, winter storms produce short-duration but intense runoff, resulting in large volumes of freshwater flows to the bay. For instance, the December 6, 1997 storm event generated an estimated peak discharge of 39,000 cfs at San Diego Creek.

Five-day hydrographs were created to simulate annual storm inflows, delivering the estimated annual volume of sediment for the year in one storm flow hydrograph. Mean daily values for storms ranged from 6 cfs to 4500 cfs. Model results are presented in the engineering appendix.

Fresh water inputs represent an important source for suspended sediments, nutrients, bacteria, debris, and organic and inorganic pollutants to UNB. Erosion and transport of fertilizers used by agriculture and nursery facilities represent primary sources of nitrates and phosphates to the Bay. Some improvements have occurred to limit nutrient inputs, although San Diego Creek, Reaches 1 and 2, as well as Upper and Lower Newport Bay, are still considered impaired with respect to excessive nutrients (RWQCB, 1997). In 1993, nitrate concentrations in San Diego Creek reportedly were 16 mg/L, and exceeded the 13 mg/L of total inorganic nitrogen water quality objective. Recent (1996/97) monitoring performed by the Irvine Ranch Water District (IRWD) has shown comparable nitrate concentrations in San Diego Creek waters. Nutrient loadings from other streams are considerably lower. Nutrient inputs are important to Newport Bay because excessive loadings can contribute to eutrophication, which promotes large algal blooms that can, in turn, result in significant decreases in dissolved oxygen concentrations in Bay waters. Bacterial and chemical contaminant inputs from watershed runoff also affects the water quality, and debris discharges degrade the aesthetic quality of Bay waters.

Detailed discussions of water quality parameters are explained in the EIS/R. The Newport watershed and bay do not meet all of the 1972 Clean Water Act objectives, which is one of the primary reasons that TMDL's objectives have been implemented by EPA and the RWQCB for sediments, nutrients, and drafted for toxics and pathogens.

Groundwater

Groundwater near Newport Bay occurs within two zones separated by a semi-permeable clay layer. The upper zone is semi-perched, and spatially and seasonally discontinuous. Depth to ground water in the vicinity of San Diego Creek and the Upper Bay is very shallow (10 to 15 feet). Gradients and flow directions for the shallow aquifer are not well known, although some hydraulic connection with surface waters in San Diego Creek contribute to base flows for the creek, eventually draining into Newport Bay. The only ground water well in the immediate vicinity of Upper Bay is located near Campus Drive (UCI), and it is used intermittently to supply fresh water from the deeper aquifer to the San Joaquin Marsh.

The quality of the basin ground waters is affected by elevated concentrations of nitrates, total dissolved salts, and trace volatile organic compounds (VOC) such as trichloroethylene (TCE). Some of the basin ground waters, including the shallow aquifer in the Irvine area contain nitrogen concentrations up to 20 to 30 mg/L, which exceed federal drinking water standards (10 mg/L as nitrogen). Also, total dissolved salt concentrations in some ground waters exceed 1,000 mg/L, compared with a recommended maximum level of 500 mg/L. Nitrates, total dissolved salts, selenium, and TCE also affect ground water quality in the general Irvine area. The presence of excess salts and nitrates are attributable to agricultural practices, and TCE is from historical discharges of solvents and degreasers at El Toro Marine Corps Air Station (OCWD, 1994). A number of wellhead treatment programs are being conducted by the OCWD to cleanup ground waters and improve the water quality.

The quality of ground waters in the immediate vicinity of UNB is not well known because there are no production wells in the area (due to the presence of salt water). Ground waters extracted in the Irvine area currently are used for irrigation only, although OCWD is currently working on systems capable of treating ground waters to provide potable quality water.

Groundwater studies are not included in this feasibility study. The watershed feasibility study and other watershed studies will discuss the quality and use of groundwater, and the interaction of groundwater and surface water as it relates to water courses that empty into the Bay.

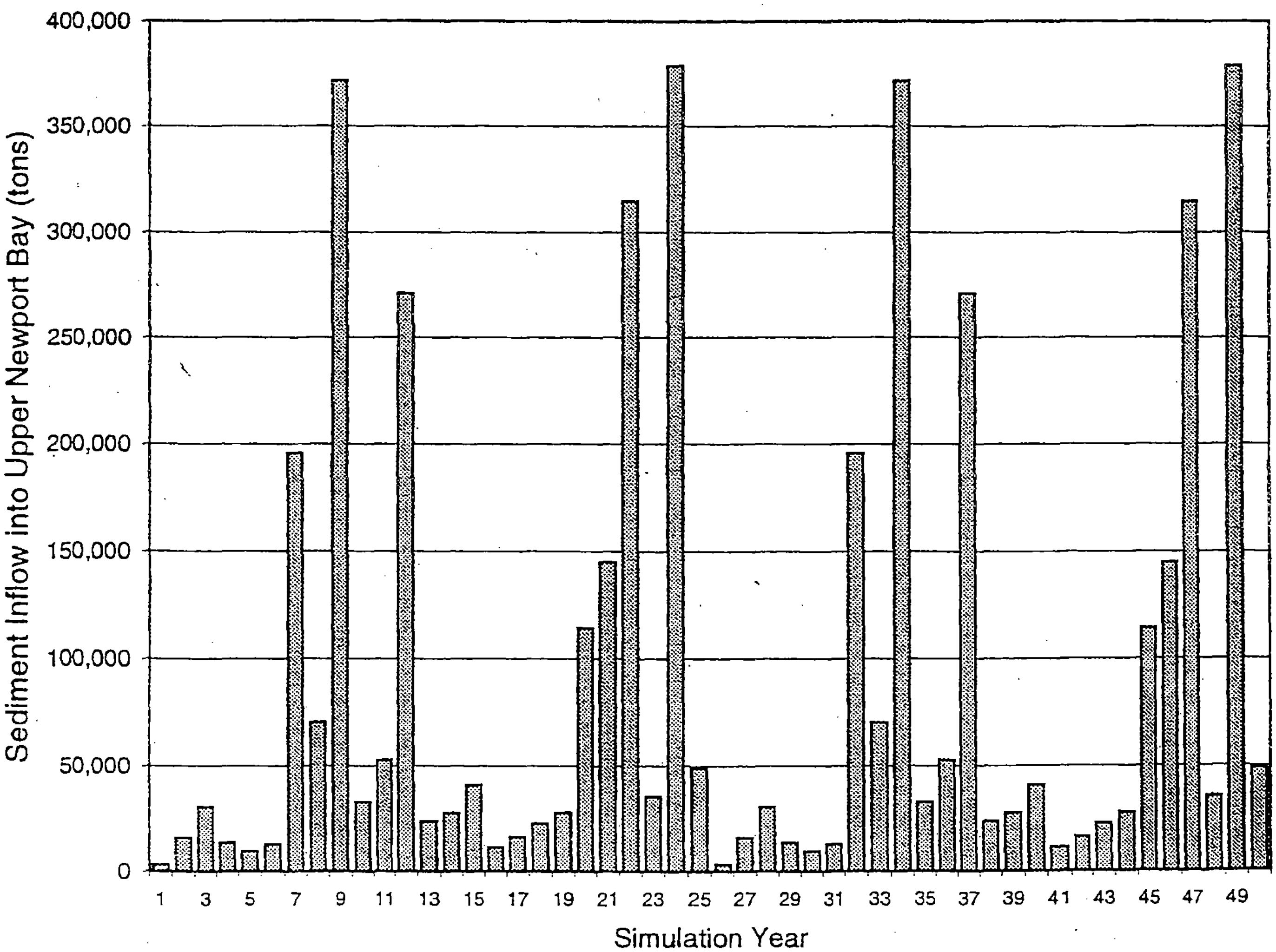
Sediments

Sedimentation in Newport Bay is the biggest existing and future problem for the ecological reserve. Past and present watershed changes have greatly altered freshwater inflows to the Upper Bay and have increased sediment inflows. Many measures have been implemented within the watershed and the bay to reduce the adverse impacts caused by sedimentation, as described in the history section of the report (see the 208 Plan). Even though these measures have reduced sediment inflow volumes, the measures taken cannot trap much of the fine sediments that are transported to the Bay during large storm events. An example is the particularly wet winter storm season of 1997-98 where large volumes of sediment deposited within the Bay during several storms. Sediments passed by the upper basin, which was filled to capacity prior to the Unit III project, through the Unit II basin and into the navigation channels and slips in the Upper and Lower Bay. Serrano Creek, a tributary of San Diego Creek, is an example of the severity of channel erosion in the watershed. An estimated 400,000 cubic yards of material eroded from the Serrano Creek channel during these same winter storms.

Newport Bay acts as a good sediment trap for fine-grained sediments. A process called flocculation occurs when fine sediments encounter saline waters, even when salinity levels are relatively low. Suspended fine sediments form small masses during flocculation and drop to the bed. This process is readily evident in the Bay due to the continued loss of open water areas and shoaling problems, even with the construction of the two in-Bay basins. For instance, prior to the construction of the basins (between 1972 and 1979), sedimentation caused a loss of 180 acre-feet in the tidal prism. Most of the sedimentation occurs within the –0.7 to +1.3 foot MSL tidal range (+2 to +4 foot MLLW). Therefore, the natural transition of habitats within the ecological reserve is from open water to mudflat and eventually to marsh. As the tidal prism diminishes, estuarine vegetation will have a more difficult time surviving and marsh habitat will likely transition to brackish or freshwater dominated species. Sedimentation is the driving force for this change.

The sediment transport model was calibrated by taking the bathymetric topographic conditions of the bay after the construction of the two in-bay basins in the late 1980's (1987) and 1997 detailed mapping, calculating elevation changes and the total volume of material deposited in the bay. Orange County provided 25 years of annual flow records for San Diego Creek (see baseline evaluation assumptions). The largest storm flow was used for a given year and sediment in-flows were delivered by a five-day representative hydrograph. An adjustment factor was added in order to simulate the estimated annual total volume of sediment delivered to the Bay by this one representative storm hydrograph. Storm inflows are shown in Figure 2.6.

Figure 2.6 50-Year Storm Flow Record



Sediments within Newport Bay vary from course sands to fine silts and clays, depending on water current, velocity, and depth. The coarsest sediments are typically located in areas where strong currents scour the bottom of the channel (i.e., near the Santa Ana Delhi Channel and under the PCH Bridge), leaving mostly sand and shell particles behind. Finer sediments, such as clays and silts characterize areas with low current velocities (i.e., sediment basins). Examples of composite grain sizes of sediment samples taken before the Unit III dredging project (1995 samples) and the Corps Lower Bay dredging project (1998) are shown in Table 2.4. Chemical and bioassay testing were also performed on samples taken for both the Unit III project and the Corps Lower Bay dredging project. All material passed the testing criteria and was disposed of at the LA-3 offshore disposal site.

Table 2.4 Sediment Grain Sizes in Newport Bay

Composite Samples	% Silt	% Clay	% Sand
Unit I/III Basin: top (surface to –7 MSL)	26.5	34.1	39.4
Unit I/III Basin bottom (-7 MSL to –14 MSL)	26.9	57.3	15.8
Unit II Basin	36.5	26.4	37.1
Access Channel	18.5	21.0	60.5
Dover Shores	25.0	33.3	41.7
Average of Upper Bay Samples	26.7	34.4	39.0
Lower Newport Bay	33.0	44.0	23.0
LA-3 Reference Site	68.7	24.8	6.5

Sediment grain sizes are important to consider for compatibility with disposal sites. The high percentage of fines in Newport Bay sediments precludes disposal of the dredged material along beaches or near shore areas. Sediments trapped in some of the watershed foothill and in-channel basins may be more compatible for beach disposal because of the higher percentages of sand.

The sediment quality of Newport Bay sediment is generally within acceptable limits for trace metal contaminants, trace organic contaminants and sediment toxicity. However, it is important to keep in mind that the sediment being deposited in some Newport Bay also contributes to the nutrient, heavy metals, and pesticides problems, since these constituents tend to adsorb to sediment particles. Previously dredged sediments within Newport Bay have been disposed of at the LA-3 offshore disposal sites and have passed bioassay tests. Grain size compatibility, not sediment quality has been the limiting factor for the disposal of dredged material at other sites near Newport Bay, particularly for near shore and beach disposal. Detailed sediment quality information is presented in Section 3.3.3 and 3.3.3.1 of the EIS/R.

Habitat Types

Vegetation surveys in support of the feasibility study were conducted in October 1997. Field surveys were supported through the use of 1997 infrared aerial photographs. Ten vegetation transects were placed in representative portions of the major wetland ecological communities found in the Bay. These transects were used to characterize the plant composition of each community and to delineate the boundaries between the communities. The seven ecological communities characterized include: open water, tidal mudflat, low salt marsh, middle salt marsh, high salt marsh, salt panne, and freshwater marsh. An effort was made to place transects within each large area of low, middle, and high salt marsh, and freshwater marsh, including degraded areas, while remaining aware of local sensitive species concerns. Detailed descriptions of survey methods and results including habitat types, species density and distribution, and habitat use are found in the EIS/R under Section 3.4 "Biological Resources".

In general, habitat types addressed in the report include marine, intertidal (mudflat), salt marsh, transitional dunes, riparian and freshwater marsh, and upland habitats. Greater focus was placed on the estuarine habitats that would be directly influenced by future sedimentation, namely marine, intertidal and salt marsh areas. Salt marsh was broken down into three ecological communities to designate low, medium, and high marsh areas. These three ecological communities were defined as having greater than fifty percent cordgrass, common pickleweed, and salt grass, respectively. The freshwater marsh designation includes brackish marsh communities.

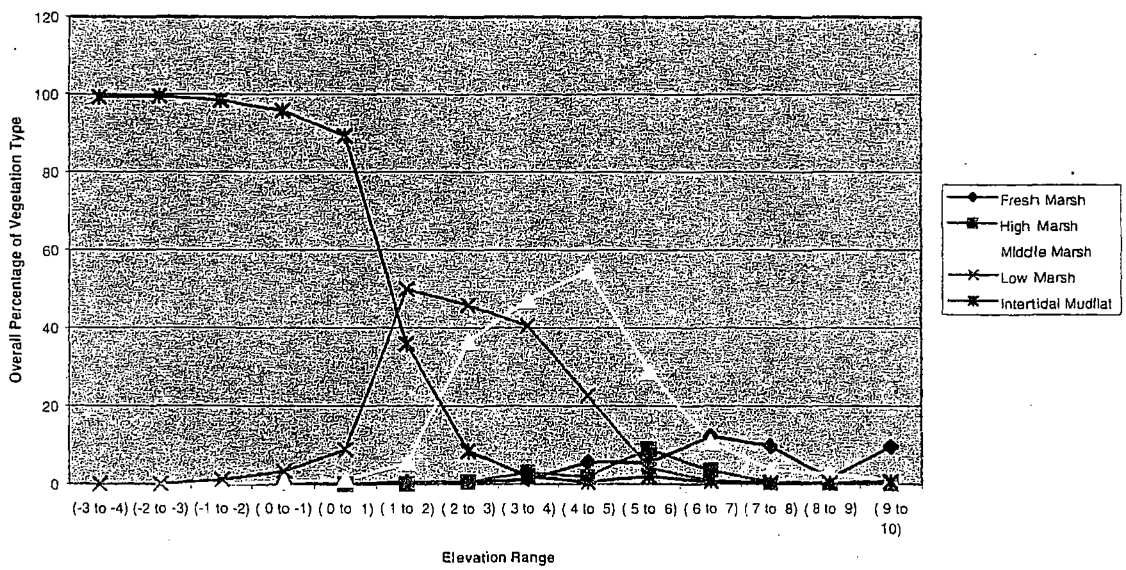
Orange County provided the detailed mapping of the Upper Bay that was used to identify existing habitat types and to determine future habitat changes. The Upper Bay was mapped in one-foot increments from the deepest waters to the +10 foot MSL contour. The major habitat types were overlain on the topographic mapping in their GIS database to correlate habitat types to elevation ranges, as shown in Table 2.5 and Figure 2.7. The grid used for the numerical modeling includes elevation data at every node. This elevation data was averaged to the nearest foot to show shapes on a foot-by-foot increment for input into the GIS. Modeling results reflected habitat changes for open water, intertidal mudflat, and low and middle salt marsh habitats. Higher elevation habitats were generally not included in the detailed hydrodynamic and sediment transport modeling grid since these habitats are beyond the typical sediment deposition range. A comparison of existing habitat types and model year 0 GIS outputs are shown in Table 2.5. Table 2.6 presents Model Year 0 habitat types used for the modified HEP analysis of existing conditions. The HEP analysis did not include freshwater marsh, upland or salt panne or developed areas in the analysis since no change is expected in those areas.

Table 2.5 Existing Habitat Acreage in UNB to + 10 MSL

Habitat Type	Existing Habitat Acreage	Elevation Range (Feet MSL)	Model Year 0 Acreage	Elevation Range for Model/GIS (ft MSL)
Open Water (marine)	209.4	< -4.3	216.4	<-4
Intertidal Mudflat	240.4	-4.3 to +1.5	217.2	-4 to +1
Low Salt Marsh	145.9	+1.5 to +3.0	141.7	+1 to +3
Middle Salt Marsh	153.5	+3.0 to +4.0	182.6	+3 to +4
High Salt Marsh	9.9	+4.0 to +5.0	9.3	+4 to +5
Freshwater Marsh	17.6	> +5.0	17.2	
Uplands	57.6	> +5.0	56.2	
Salt Panne	7.0	+4.0 to +5.0	6.6	
Developed Areas	71.8		70.7	
Total	913.1		917.9	

Table 2.6 Existing Habitat Acreage by Section for HEP Analysis				
Habitat Type	Section 1 acres: (Jamboree Road to Salt Dike)	Section 2 acres: (Salt Dike to top of Middle Island)	Section 3 acres: (Middle Island to PCH Bridge)	Total Acres by Habitat Type
Open Water (marine)	47.9	45.5	123.0	216.4
Intertidal Mudflat	51.9	89.0	76.3	217.2
Low Salt Marsh	32.2	83.6	25.9	141.7
Middle Salt Marsh	99.2	30.1	53.3	182.6
High Salt Marsh	0.0	4.7	4.6	9.3

Figure 2.7 Comparison of Vegetation Type vs Elevation



Some problems exist in all habitats of the Upper Bay. One of the most pervasive problems in and around the ecological reserve is the invasive weeds and plants. Resource agency representatives are interested in the removal of the exotic and invasive plants, but are concerned about the removal methods, and possible damage to sensitive plants or disturbance to endangered species. The managers of the ecological reserve, the Department of Fish and Game, are already taking some measures to remove invasive plants and re-vegetate sites with native plant material. This study includes coordination with resource agency representatives on opportunities to remove invasive plants.

Bay Waters

Water Quality

Section 3.3.2.2 of the EIS/R provides more detailed descriptions of bay water quality parameters, including temperature, salinity, dissolved oxygen, pH, turbidity, trace metals and organics, bacteria, and debris. A summary of water quality data is also described in this portion of the EIS/R. IRWD has done extensive testing of San Diego Creek and Upper Bay water quality for several years in support of a project where creek water has been diverted into a series of ponds in order to reduce nutrient levels, and later reintroduced to the creek. IRWD continuously recorded temperature, salinity and dissolved oxygen at three stations in the Upper Bay: one in the channel between the Unit I/III and Unit II basins, another in the Unit II basin, and a third by Shellmaker Island. The County has also taken monthly measurements at six Upper Bay stations and two stations in the Lower Bay. Water quality samples are taken for several days after storm events. All of this information, and other data, are being used to calibrate a water quality model for Newport Bay, funded by the Regional Water Quality Control Board. The model will have multiple uses, including being used as a tool to address TMDL objectives. While water quality is extremely important for this study, the water quality modeling efforts will not be completed before the end of this study. Salinity is one parameter that has been used in our analyses, particularly for the HEP.

Salinity values in the Bay can vary dramatically during and after winter storm events. The numerical modeling included the calibration of a salinity model for the Upper Bay using available salinity data at three stations throughout the Upper Bay. Details are included in the modeling appendix. Data included continuous surface salinity information for 1997 and 1998, and spot salinity measurements for multiple depths throughout 1995 to 1998. At this time, salinity simulations are depth-averaged approximations. For existing conditions, the dry weather salinity ranges from 28 parts per thousand (ppt) to 30 ppt in the Unit I/III basin, 30 to 32 ppt for the Unit II basin, and 32 and 33 ppt at the PCH Bridge area.

Wet weather simulations were calibrated using data from a November 1996 storm event when three days of multiple-depth data were available immediately following the event. For existing conditions, salinity levels begin at the same levels as those identified in the dry weather discussion and drop significantly during and after the storm event. Freshwater storm flows quickly dominate the Unit I/III basin dropping the salinity levels to nearly 0 parts per thousand (ppt) during the first day. Salinity levels slowly rise by approximately 7-to-8 ppt a day, taking about five days to fully recover to pre-storm levels. The Unit II basin salinity level also drops to nearly 0 ppt, but recovers in about four days. There are large daily fluctuations of about 5 ppt due to the influence of the tides in the Unit II basin during the recovery phase. Salinity levels in the PCH Bridge area dip to about 10 ppt, fluctuate due to tides during the recovery phase, and are back to normal levels in about four days.

There are daily and seasonal variations in water temperatures in Newport Bay. Minimum bay water temperatures are 13 to 16 degrees Celsius in the winter, and a maximum of 27 degrees Celsius in summer. Seasonal variations are greater in the Upper Bay due to the distance from the ocean, and extensive shallow water and mudflat areas. In 1999, water temperatures in the Upper Bay have been cooler than previous years. Overcast weather and cooler day temperatures have certainly been a factor, but the construction of the Unit III deep water basin (-14 MSL) may have also contributed to the lower temperatures. Temperature is an important water quality parameter to consider because higher water temperatures increase the extent of algae blooms in the bay during late spring, summer and fall seasons.

Dissolved oxygen (DO) levels in the bay do not always meet the basin plan objective of 5 mg/L or greater, meaning that the beneficial uses for the bay are not being met. 1996-97 surveys (Alex Horne Associates) identified short, but common summer episodes of low dissolved oxygen (DO) of less than 3 mg/L. DO saturation in summer was 7.1 mg/L (25° C, salinity 25 ppt). Low DO only occurred during low tide at night. The worst low DO was recorded in July 1996 when levels where less than 3 mg/L for more than 3 hours. The nutrient TMDL objectives may also have an impact on DO levels in the Bay by reducing incoming nutrient loads, thereby lessening the extent of algae blooms.

Some turbidity naturally occurs within estuarine systems, but levels are particularly high in the Upper Bay and have been high in the past in the Lower Bay (see algae discussion). Winter storms bring so much suspended sediment that turbidity levels drop to nearly zero, and last for days after the end of storms. Historically, eelgrass was present in at least the lower portions of the Upper Bay, but has completely disappeared today. Increased turbidity and a reduction in the tidal prism may be some reasons why there is no longer any eelgrass in the Upper Bay. Lowering turbidity levels and maintaining a healthy tidal prism is key to the possible reintroduction of eelgrass beds to the Upper Bay. There are recent reports about improved water clarity around the Newport Aquatic Center, where kayak users are able to see the bottom for the first time in years. It has also been reported that currents have increased in the vicinity of the aquatic center. The reason for the better clarity is likely due to the recent increase in the tidal prism after the completion of the Unit III dredging project. There is interest in reintroducing eelgrass to the lower portions of the Upper Bay, since this is a valuable habitat for a number of species. The Corps, the County and the City of Newport Beach are currently completing a pilot project to increase the extent of eelgrass beds in the Lower Bay, where conditions allow restoration to occur. The success of this program will be monitored over the next few years.

Algae

Tidal waters of UNB are rich in phytoplankton (floating algae) which can be nourished by nutrients entering the bay from the upland watershed. Algal mats occur year-round, but cover is most extensive during spring and summer when increased levels of nutrients and warmer water temperatures favor algal growth. Common forms include green algae, colonial diatoms, and blue-green algae. The presence of algae in Upper Newport Bay is a natural occurrence and is critical habitat for small organisms. The bottom cover of algae is consumed by herbivorous snails, fish, and birds and decomposed by bacteria that recycle nutrients back into the Newport Bay ecosystem. Too much algae blooms in the Bay cause problems because respiration and decomposition of algae can lower the dissolved oxygen concentrations in bay waters creating anoxic conditions that does not support biological organisms.

The EPA/Regional Water Quality Control Board nutrient TMDL specifically relates to the problem of nutrient contributions from San Diego Creek and other freshwater sources contributing to large algal blooms in the Upper Bay. Nutrient levels of creek waters were extremely high in the early 1980's. Large algae blooms in the Lower Bay fouled boat engines, limited water contact recreation activities and was an esthetic eyesore. Water visibility was less than two feet at times. Measures taken to better control nitrogen and phosphorus at source waters in the watershed have greatly reduced nutrient levels to about one-quarter of the levels in the mid-1980's. As a result, Lower Bay waters today are generally free of large algae blooms, but the algae problem has moved closer to the nutrient source (San Diego Creek), and is clearly evident in the Upper Bay. There are generally two blooms: the first is the philamentes algae that is present from April to August, and the second sea lettuce bloom from late July to December, peaking from September to November. Areas in the Upper Bay that are currently affected by algae blooms include the mudflat areas around the least tern islands in the Unit III basin; just below the dike on the east and west side by the Unit II basin; Upper, Middle, and Shellmaker Islands; North Star Beach; Newport Dunes; the southern end of Middle Island; and, at the UCI Rowing Center.

So many factors affect the growth of algae that it is difficult to state why one year may have less algae than another. This year (1999), for instance, algae are present in all of the areas mentioned above, but not in great quantities and not as early as usual. Reasons may include work being done in the watershed to further reduce nutrient levels, including IRWD's program to run San Diego Creek water through ponds to lower nutrient levels, or the recent completion of the Unit III project, or low water temperatures in the Bay earlier this year. The nutrient TMDL objectives should continue to lower nutrient levels of creek waters and improve conditions within the Bay. Study measures will try to further reduce potential algae growth by improving tidal circulation throughout the Upper Bay, also helping keep dissolved oxygen levels above the 5mg/L threshold.

Debris

The boating public and waterside residents have expressed concern regarding floating debris in Newport Bay. The debris can be both natural (branches, organic matter, oranges, plant life, etc.) or man-made (trash, plastic cups, paper products, etc.). Boat travel through UNB indicates the presence of large amounts of man-made debris lying at high tide elevations within the salt marsh areas. The problem becomes most intense during the heavy rain periods when the watershed delivers heavy runoff into the Upper Bay. During these periods large rafts of floating debris can move down from the Upper Bay to the Lower Bay, thereby creating hazards to navigation and potential clogging of boat cooling water intakes. The mass of these large floating debris rafts can cause structural damage to dock structures when impact speeds are high. Portions of the Lower Bay located to the west of the PCH bridge are particularly affected by the debris. Tidal action and wind carries the debris into the western end of the Lower Bay, from which there is no outlet. This debris can remain for weeks after major flow events, covering the water surface completely in some areas. The most significant contributor of floating trash, such as styrofoam cups and containers (flotsam and jetsam), is the Santa-Ana Delhi channel.

At the present time, the local interests pursue control of floating debris through source control (identification of sources, litter pick-up, vegetation detritus clean-up), educational/environmental awareness (stenciling storm drains, pamphlet distribution, public presentations at schools and civic groups), and damage control (debris pick-up in the Bay).

To collect debris prior to its reaching the Bay, the County of Orange uses inmate labor to collect trash from the channel of San Diego Creek. In 1990 and 1991, this effort encompassed at total of 1,750 and 1,300 man-hours, respectively. Despite these efforts, an estimated 200 tons of debris continues to enter the bay. The City of Newport Beach spends approximately $50,000 annually to clean up and haul away debris that collects in the basins of the Lower Bay and the local beaches. Private marina operators also expend efforts in cleaning the debris from their mooring areas. The marinas of the Upper Bay (Newport Dunes and De Anza Marina) may require several days to clean up and recover from large debris flow events.

The need for additional mechanisms to control or collect trash and debris was an issue to be addressed by this study. Recently, Orange County has installed two new trash and debris booms along the El Modina-Irvine and Santa Ana-Delhi channels. These collectors will be maintained periodically during the summer months and after each storm events. Graduate students are working on a design for a new trash and debris boom in the San Diego Creek channel. All of these efforts address the need for better trash and debris control in the Bay. Therefore this study will not address any additional measures to control trash and debris.

Fish

Newport Bay supports a diverse assemblage of pelagic (ocean) and demersal (bottom-orientated) fishes that occupy several different habitat types, including marsh channels and pools, mudflats, shallow sub-tidal channels and slopes, deeper channels, and marinas. At least 78 fish species have been identified from previous studies of UNB. The Bay is important habitat for its resident species, as a spawning ground for at least 10 species, and a nursery ground for the juveniles of 33 fish species. Details, including September 1997 survey results, are presented in Section 3.4.2.4 of the EIS/R.

Fish abundance, number of species, and biomass in UNB are highly variable due to changes in temperature, salinity, and productivity. In general, the lowest abundance occurs in late fall and winter when transient species such as California halibut leave the Bay for more coastal and offshore locations. In contrast, the greatest number of species and abundance usually occur in spring and summer when these same transient species re-enter the Bay, adding to the resident species of the fish community. Thus, although general species composition patterns are generally predictable, abundance and biomass patterns are less consistent and more difficult to accurately predict. Most numerous are the marine species that are attracted to the Bay by the rich supply of plankton and detritus. These small fish provide food for fish-eating birds and predatory fish. The Bay serves as a seasonal spawning and nursery ground for numerous coastal species. The halibut is especially important as a commercial fish species within Southern California waters. Bat rays and stingrays are common in the bay.

Eelgrass

Eelgrass is a flowering, marine vascular plant that forms meadows on mudflats and subtidal sediment in bays and estuaries. The meadows are important nursery habitat for marine fishes that seek the shelter of the beds for protection and forage on invertebrates that colonize the eelgrass blades and sediments. Eelgrass distribution is currently limited to Lower Newport Bay between the Newport Harbor entrance channel and Harbor Island. It disappeared from the Upper Bay between the late 1960's and the mid 1970s. Although the reason for its disappearance was never conclusively determined, increased siltation, higher turbidity, dredging, and the effects of destructive floods likely contributed to its disappearance. Eelgrass beds were historically present in many areas of the Upper Bay between the PCH Bridge and Shellmaker Island (Allen, 1976). As late as 1984, eelgrass beds had not recovered and attempts to restore eelgrass to the Bayside Peninsula and Shellmaker Island by transplantation were unsuccessful (Ware, 1985).

The Corps is working on a separate study with Orange County PFRD to increase the size and locations of eelgrass beds in Lower Newport Bay. This feasibility study will look at restoration of eelgrass beds in the lower portion of the Upper Bay as one of the study objectives. There are two proposed areas for restoration: one adjacent to the De Anza spit and the other across the channel by Castaways Beach. These areas once supported eelgrass. Turbidity seems to be the continuing problem related to reintroduction and long term survival of eelgrass in this area. On a positive note, the water clarity has drastically improved in the lower portion of the Upper Bay since the completion of the Unit III dredging project. There are reports that kayak users of the Newport Dunes Aquatic Center can see the bottom for the first time in years. This is likely due to the restoration/increase of the tidal prism, and the increased sediment trapping efficiency of the Unit I/III basin. Currents in this area may also be stronger, again due to the increased tidal prism.

Intertidal Habitat (Mudflat and Salt Marsh)

Intertidal habitat is located between the highest and lowest stages of the tide. Intertidal habitat has two main zones, dependent on elevation and duration of inundation. The lower of these zones is mudflat, gently sloping areas of soft mud inundated typically twice per day by tidal action. Mudflats support mats of algal growth which provide food for mollusks and burrowing worms. The mudflats are the primary feeding ground for shorebirds and ducks. Fish feed on the mudflats during periods of tidal inundation. Recent history has shown that mudflats are rapidly replacing open water zones in the Upper Bay.

Salt marsh vegetation occupies the mid- to upper-elevations of the intertidal zone. This zone is inundated less frequently and for shorter periods of time than the mudflat. The rise and fall of the tides and topography primarily determine the types of salt marsh vegetation. Within this zone, salt-tolerant (halophytic) plants grow at elevations between Mean Lower High Water (+3.4 feet MLLW) and Extreme High Water (+7.8 ft MLLW). This study separates salt marsh into three general vegetation zones: low marsh, characterized by the presence of cordgrass; middle marsh, dominated by common pickleweed and saltwort; and upper marsh, characterized by spiked shoregrass, saltgrass, and estuary sea-blite.

Cordgrass is exposed to long periods of submergence, which few other species can tolerate. It manages to survive on the tidal flats and anaerobic marsh soils by moving oxygen from the leaves through its hollow stem to the roots and rhizomes. Cordgrass tolerates saline conditions and it regulates internal salt balance by excreting excess salts through its leaves. Cordgrass provides critical nesting and breeding habitat for the endangered light-footed clapper rail. 1997 field surveys show that almost two-thirds of the low marsh areas are covered by cordgrass, with the majority of the remainder bare ground. Some pickleweed and saltwort also are present in low marsh areas.

Common pickleweed and saltwort dominate the middle marsh where vegetation is exposed to tidal inundation on the moderate high tides. Pickleweed has the broadest elevational range of any southern California marsh plant and grows low to the ground or bushy. Pickleweed is also dominant on salt flats above the Main Dike because it is tolerant of highly saline soils. Pickleweed can survive by concentrating salt in segmented stems, which break off, thereby ridding the plant of excess salt. The high-quality pickleweed marsh is critical breeding habitat for the state-listed endangered Belding's savannah sparrow. Common pickleweed covers almost half of the middle marsh areas.

Shoregrass, saltgrass, and estuary sea-blite are indicators of the high marsh, which extends to Extreme High Water during unusually high tides or storm tides. Over 40% of the high marsh plant cover is salt grass. The salt marsh bird's beak is also found within this zone. This state and federally listed endangered plant species occurs at several sites in high marsh habitats within the lower reaches of UNB. It is the only listed plant species confirmed to occur in the study area. A portion of one population located at the west end of Shellmaker Island was observed during the September 1997 botanical field work.

The characteristic birds of mudflat and marsh habitat are shorebirds and rails. The shorebirds occur by the thousands during fall and spring migration periods. With a few exceptions, the shorebirds are migrant species that do not breed at UNB. Savannah sparrows, including the Belding's subspecies, also commonly forage on the mudflat for insects. These species, as well as many of those mentioned under open water, also depend on mudflats as loafing/resting sites away from disturbance. Raptors are another group of birds that forage primarily for the birds feeding or loafing on the mudflat.

The ebb and flow of tides within UNB allows the mudflats and marshes to be available to fish much of the time. Several small fish species can survive in small burrows and pools when the tide recedes from the mudflats.

With urbanization, domestic cats and dogs have become common. The ongoing sedimentation within UNB has caused shoaling in several channels that separate marsh islands from the mainland shore. Under low tide conditions, lack of water in these channels allows predators, particularly foxes, coyotes, raccoons and domestic cats and dogs to easily access the islands. Predation of bird species on these islands occurs as a result. Small mammal populations may also be reduced by cat predation. A study objective is to try to reduce predation by isolating habitat areas (islands) where possible.

Riparian/Freshwater Marshes

Riparian and freshwater vegetation occur along the Santa Ana Delhi Channel and San Diego Creek; at the mouths of storm drains along Back Bay Drive; in Big Canyon; at North Star Beach; on the west side of the Bay near Irvine Avenue; and on Shellmaker Island. A stand of arroyo willows has colonized the higher elevations of dredge spoils on Shellmaker Island, and is surrounded by salt marsh. Vegetation in these habitats includes plants that require lots of water but tolerate low levels of salinity. Such plants include Pacific silverweed, alkali bullrush, cattails, and sedges. Common riparian plants are willows and mule fat. Over half of the freshwater marsh habitats are covered by narrow- and broad-leafed cattails.

Upper emergent wetlands occur sporadically around the Bay as a result of both surface drainage runoff and natural freshwater flown. Willows and mulefat dominate these riparian areas. Cattails and bulrushes characterize lower emergent wetlands. Significant fresh water and brackish water marshes have developed along the periphery of the Bay, due to increased runoff that drains the highlands of West Newport and East Bluff. These riparian areas are characterized by dense stands of bulrushes, rushes, cattails and sedges. Mitigation work in Big Canyon has also created a significant open freshwater pond and areas of cattails and bulrushes. Some wetland habitat is being invaded by pampas grass, particularly along Back Bay Road and the west side of the Bay. Attempts are being made to remove pampas grass from some areas.

During periods of heavy runoff, such as the winters of 1977-1978 and 1982-1983, brackish marsh vegetation is able to invade the lower salt marsh. Once established, the ability of these species to compete with salt marsh vegetation is dependent upon continued fresh water flows.

Upland Vegetation

Cliffs, bluffs and the mesa above the Upper Bay represent upland habitat. The drier slopes contain coastal sage scrub vegetation, typically including bush sunflower, prickly pear, black sage, and various wildflowers. North-facing mesas usually support denser vegetation, including large shrubs such as lemonadeberry and toyon. The mesa also supports introduced annual grasses and weeds resulting from earlier agricultural activities.

There are several barrancas on the on the western slopes of the Upper Bay, near the Unit II area, that have severely eroded over recent years. This had led to the loss of native vegetation, particularly coastal sage scrub. This study may consider stabilization and re-vegetation of the barrancas.

Threatened and Endangered Bird Species

Birds are most abundant in UNB from August through April when migrant and over-wintering waterfowl use the Bay during migration. A small migration of birds from the south occurs during summer. There are approximately 182 species that regularly inhabit Newport Bay over a calendar year, with only 33 species, being year-round residents. The Bay is valuable not only to the local resident bird community but to a large number of migratory species and populations that play intricate roles in other areas of the continent, South America and Hawaii. Details, including 1997 survey results, are presented in Section 3.4.1.3 of the EIS/R.

The 1997 surveys recorded the highest abundance of birds along the Unit I/III basin to Upper Island area, the lowest number from the southern end of Upper Island to Middle Island, and a moderate amount of birds from the southern end of Middle Island to PCH bridge. The shorebirds and skimmers in the Unit II basin mudflats moved to the Unit I/III basin islands during high tide conditions.

UNB is an important national resource for bird populations. In particular, five threatened and endangered bird species (light-footed clapper rail, least tern, Belding's Savannah sparrow, brown pelican, and peregrine falcon) reside in the Bay. Additional endangered bird species include the black rail, the snowy plover and the California gnatcatcher. As sedimentation processes proceed in the future, loss of tidal waters throughout much of the bay will diminish the habitats necessary to support the health of these populations.

The resident population of ***light-footed clapper rail*** represents about 65 percent of California's population of this state and federally listed endangered species. This subspecies is found only in the coastal marshes of Southern California and Baja. UNB has consistently supported the highest numbers of rails of any Southern California wetland, and is believed to be the only viable sub-population remaining in the United States. Extensive studies within the Bay over the past 15 years indicate that the population is generally increasing. Clapper rails are found throughout the Upper Bay, heavily utilizing cordgrass marsh for nesting at several locations, including Shellmaker Island, Middle Island, Upper Island, and in salt marsh habitat above the Main Dike. They are generalistic feeders, foraging on mudflat invertebrates such as crabs and snails. The rail's nesting season is from March to July. A 1990 census recorded 131 pairs, increasing to 142 pairs in 1993 (Zembal, 1993). 1998 surveys recorded 105 pairs of light-footed clapper rail (FWS, 1998). This dip in population was likely due to the severe 1997-98 El Nino winter storm season. Storm inflows, storm surge and higher observed tides, due to El Nino, led to the inundation of clapper rail nests. This was particularly true during the December 6, 1997 storm. The El Nino storm season also brought in a new predator, the arched swimming crab, that may have competed with the clapper rail and contributed to the decline. 1998 monitoring activities performed during the Unit III dredging project showed that clapper rails were not disturbed by the dredge or support equipment.

The State- and Federally listed endangered ***California least tern*** is a seasonal resident from April through early September. The majority of least terns migrate out of the region by late August. Two man-made islands were constructed within the upper basin in 1985 to provide habitat for least terns. Nesting populations have been noted on one of the islands. The 'kidney-shaped' tern island's surface area above tidal influence is about 4 acres, and the 'hotdog-shaped' tern island's surface area is about 3 acres. The channels that were originally constructed to separate these islands from the mainland have become mudflats. During low tides, predators have ready access to the islands thereby decreasing protection for the least terns. At the request of FWS, the Unit III dredging project excluded restoration of the channels around the least tern islands. Estimated populations of least terns have been decreasing this past decade, peaking at 70 pairs and 85 fledglings in 1990 and by 1995, approximately 38 pairs nested with no productivity. Least terns prefer sandy areas with no vegetation. The tern islands were originally designed without vegetation, but plants have established themselves on both of the islands. This may be another reason for the decreased numbers of terns. Fish and Game, as mangers of the ecological reserve, have removed vegetation from the islands in the past using boats to access the islands. It has been very difficult to access the islands for several years due to the loss of channels around the islands. More limited vegetation removal has occurred for several years on the islands.

The ***Belding's Savannah sparrow*** is a year-round resident with nesting activity occurring between mid-March through mid-August in high marsh habitat around the edges of the Bay and on the islands. It is distributed throughout UNB. This subspecies of savannah sparrow is state endangered and is a common resident of the salt marsh at Newport Bay. In 1991, approximately 199 pairs were recorded for UNB (James and Stadtlander 1991).

The ***California brown pelican***, a state and federally listed endangered species, is seen year-round at UNB. Numbers tend to be lower in late spring-early summer when the birds are nesting offshore, and higher in late summer and fall. Numbers have ranged from 0 to 44 birds during census counts by Sea and Sage Audubon. Habitats used by this species include open water, where it feeds on fish, and mudflat and salt panne for loafing.

The ***American peregrine falcon*** is uncommon in abundance but regular in its occurrence to Newport Bay. The peregrine falcon is state and federally listed as endangered. One or two individuals have typically been sighted in UNB during spring and/or fall in surveys by Sea and Sage Audubon. No breeding occurs within the study site but nesting is known to occur in Newport Beach. This species feeds on other birds and in particular migrant and/or wintering shorebirds and waterfowl.

Existing Condition HEP Results

Anyone observing the Upper Bay over the last decade has seen changes to the habitat types in the ecological reserve, particularly the loss of open water to mudflat and marsh areas, a natural progression that has been accelerated by watershed changes. For this study, it is necessary for the Corps to address the 'value' of the existing habitats in the Upper Bay and compare existing values to forecasted future conditions, with or without a project. This 'valuation' of habitat is presented in a non-monetary format, using Habitat Evaluation Procedures (HEP) for this study. A Technical Advisory Group (TAG) was formed to prepare the HEP, consisting of resource agency representatives from FWS, NMFS, CA Fish and Game, the RWQCB, Corps, Orange County, City of Newport and consultants. The U.S. Fish and Wildlife Service originally developed the HEP, which has been modified and specifically tailored for use in Newport Bay. The HEP for this study investigates the estuarine habitats and species potentially affected by future sedimentation in Newport Bay. This modified HEP is not all-inclusive, and is somewhat limited in scope due to available information. For instance, additional water quality parameters may have been used in the HEP if the numerical modeling had been completed for these parameters. The HEP went through several modifications during the course of the study. Details of all of the information shown below are presented in the HEP appendix to the EIS/R, including the selection of indicator species, the habitat quality index and the generation of habitat units for species and habitats.

Bay species were chosen to provide an indication of the value of certain habitats for existing and future conditions. All habitat types have more than one indicator species, because species multiple habitats for nesting, breeding or foraging. Using simple formulas, the indicator species were assigned a value between 0 and 1 for each habitat type that they use. The result is a habitat quality index, or HQI. The factors included in the determination of the HQI include salinity levels, water depths and the potential for human disturbance. Multiplying habitat acres by the HQI generates Habitat Units (HU's). Existing conditions HU's for species are shown in Table 2.7.

TABLE 2.7
TOTAL HU's BY INDICATOR SPECIES FOR ENTIRE BAY: EXISTING CONDITION S

Year 0						
	MOW	IMF	LSM	MSM	HSM	**Total**
Halibut	138	57	0	0	0	**195**
Anchovy	131	57	0	0	0	**188**
Western grebe	141	65	0	0	0	**206**
Lesser scaup	114	32	0	0	0	**146**
Least tern	138	57	0	0	0	**195**
Pintail	8	137	0	0	0	**145**
Great egret	0	87	57	18	1	**163**
Avocet	0	109	0	0	5	**113**
Clapper rail	0	0	71	55	2	**127**
Shorebirds	0	151	24	0	0	**175**
Belding's savannah sparrow	0	0	28	91	3	**122**
	672	751	180	164	10	**1776**

Table 2.8 presents the results in a slightly different manner, where the HU's are shown by habitat type. Each habitat is further broken down by segments, with Segment 1 extending Jamboree Road Bridge to the main dike, Segment 2 from the main dike to the upper end of Middle Island, and Segment 3 from Middle Island to PCH Bridge (see Study Area Description). Consideration was given to the possibility of favoritism of one habitat type over another due to the indicator species that were selected for the analysis. For instance, many of the selected indicator species use mudflats to a certain degree, but mudflats should not be valued higher than open water or marsh habitat for the HEP analysis. To address this, habitat units were divided by the number of indicator species for each habitat. We use the adjusted HU's for the benefit analysis of this study. The adjusted HU's are shown in Table 2.8.

TABLE 2.8 Total HUs by Habitat Type for the Without Project Condition						
Year 0						**Adjusted HU's**
Habitat	Segment 1	Segment 2	Segment 3	Total HU	# Species	**for # Species**
MOW	139	130	403	672	6	**112**
IMF	177	312	261	751	9	**83**
LSM	41	105	34	180	4	**45**
MSM	89	27	48	164	3	**55**
HSM	0	5	5	10	4	**3**
Total	**446**	**579**	**751**	**1776**		**298**

Bay Uses

Lower and Upper Bay Navigation

Newport Harbor contains 1,230 residential piers, 2,119 commercial slips and side ties, 1,221 bay moorings, and supports approximately 9,000 boats. The Corps is responsible for maintaining the navigation structures and navigable channels within LNB. The limits of the Federal project within the Bay are shown in Figure 2.8. The northern extremity of the Corps maintenance requirements at the present time is located at the PCH Bridge. The dimensions of the Federal navigation project in LNB are presented in Table 2.9.

Past maintenance dredging within the Federal project has been minimal dating back to the initial harbor channel construction in the mid-1930's, because of all the dredging projects in the Upper Bay. About 5.5 million cubic yards of sediment has been dredged from the Upper Bay since the mid-1950's (see Tables 2.1 and 2.2 in the Baseline History). Most of the dredging projects in the Lower Bay have been located outside of the Federal channels for local channel or slip access purposes and bulkhead work. Some dredging in the Federal channels was required during the construction of the Unit II basin in 1987 along 1,400 feet of the main channel south of PCH Bridge to accommodate dredge and scow passage to the Upper Bay. After the 1997-98 winter storm season, sediments depositing in Federal channels caused shoals that impeded navigation and led to vessel groundings. At the time, the Unit III basin had not been completed so the original Unit I basin had essentially filled beyond its design capacity. Channels were dredged to the west of Linda Isle and west-southwest of Harbor Island. Approximately 277,000 cubic yards (205,000 cubic meters) of sediment was dredged and disposed of at the LA-3 offshore disposal site. There are currently some additional shoaling problems in some of the Federal channels in the Lower Bay. Local interests are pursuing Corps dredging of these shoals.

Upper Bay navigation includes three marinas, a boat launch ramp, and crew boats at the University of California Irvine (UCI) rowing center and Newport Aquatic Center rowboats and kayaks. There are about 670 boat slips located in the Upper Bay at Newport Dunes, Dover Shores, and De Anza Marinas. The low clearance height of the Pacific Coast Highway Bridge and the relatively shallow channel depths effectively limit vessel entry into the Upper Bay. The vessels that utilize the Upper Bay are nearly all-small motor vessels (as opposed to high mast sailboats), having usual overall lengths of 20-50 ft and drafts in the 2 to 4 foot range. Shoaling has been a consistent problem for both Dover Shores and Newport Dunes. The Unit III project included dredging at Newport Dunes, totaling 75,000 cubic yards (of the total 859,000 cy). Based on dredging records since 1985, the marinas of Upper Newport Bay are required to dredge an average of 18,500 cy annually to promote safe boating operations.

Table 2.9 Newport Harbor Channel Depths for the Federal Navigation Project			
Channel	Project Dimensions		
	Width (ft)	Length (ft)	Depth (ft)
Entrance Channel	500	3,650	20
Corona del Mar Bend	200-500	1,800	20
Balboa Reach	200	3,000	20
Harbor Island Reach	200	4,300	20
Lido Isle Reach	200	4,900	20
West Lido Channel	500	5,500	10
Upper Bay Channel	400	2,000	10
Balboa Island Channel	200	7,000	10
Turning Basin	1,000	1,800	20
Yacht Anchorage	1,200	1,800	15

Recreation

Orange County has established a 138-acre passive recreational park on parcels surrounding UNB to protect, restore and enhance the natural resources of the site. The parcels include the Eastbluff, Westbay and Santa Ana Heights areas, lands to the east and west of the Units I and II basins. The general development plan includes construction of an interpretive center building and parking area on the Westbay parcel, near Irvine Avenue and University Drive. The interpretive center is now under construction, and is primarily designed as an underground structure with native grasslands on the rooftop, ensuring that critical views remain and natural habitat areas are maximized. Other facilities include trails, interpretive nodes, and outdoor gathering area and overlooks (General Development Plan, 1993).

Newport Harbor and the adjoining coastal areas of Newport Beach and Corona del Mar present significant recreational opportunities on a local and regional level. The area serves as a major vacation destination within Southern California and the Southwest. The Lower Bay, having an open-water area of about 600 acres, offers recreational opportunities to a wide range of boating enthusiasts; from single-person rowboats to large sailing and motor vessels that are capable of trans-ocean navigation.

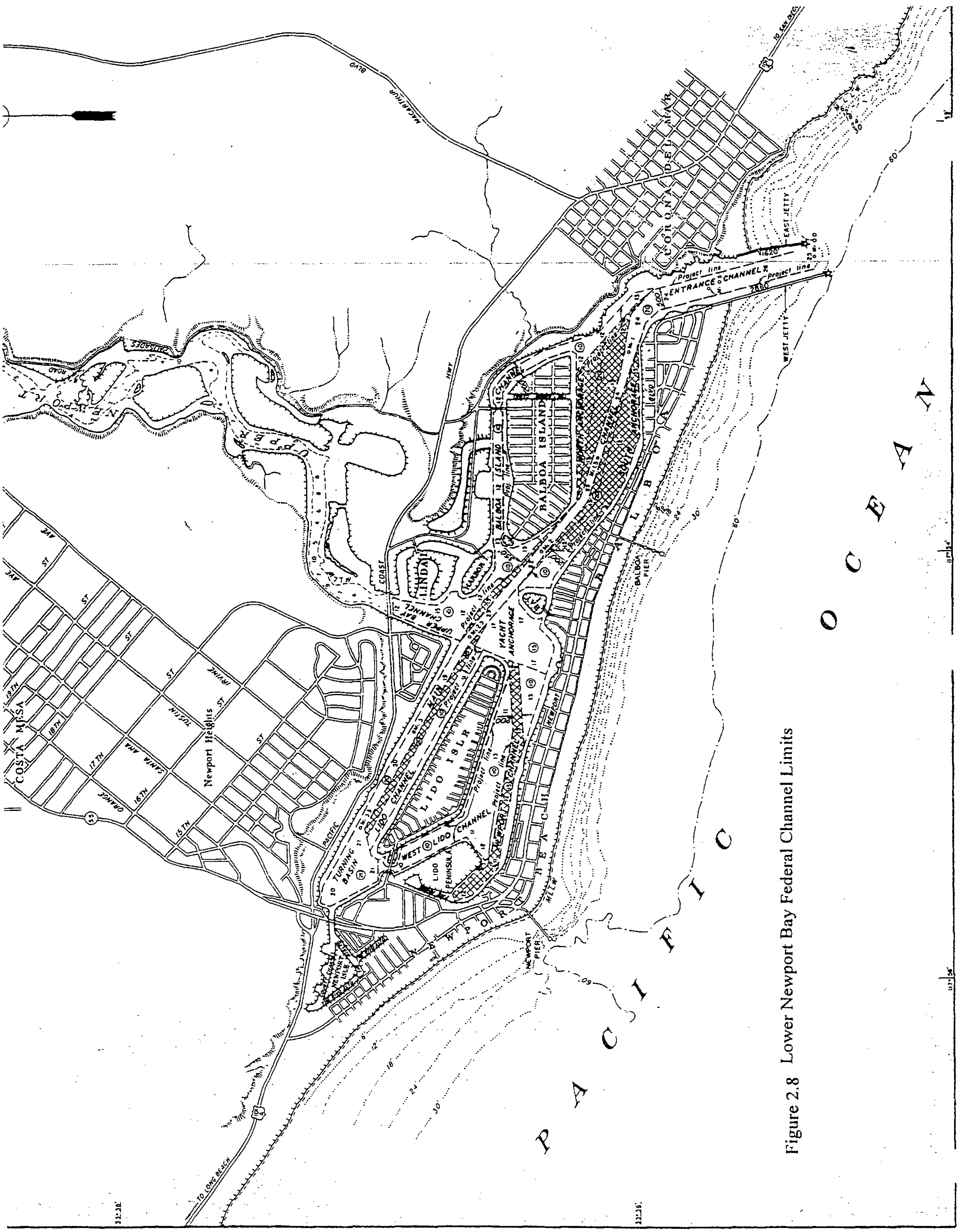


Figure 2.8 Lower Newport Bay Federal Channel Limits

The beaches of Newport Beach and Corona del Mar offer fine opportunities for ocean sports. Surfing, body surfing, swimming, surf fishing, picnicking, jogging, bird watching, photography, and beach combing are all popular pastimes. Several million visitors partake of activities on these beaches each year.

Recreational activities in UNB include birdwatching, hiking, bicycling, jogging, fishing, photography, ~~viewing natural habitat, and boating and fishing in the southern reaches of Upper Newport Bay.~~ Recreational use in the Ecological Reserve is mostly confined to passive recreational activities such as birdwatching, viewing habitat, walking, jogging, and photography. Kayaking, canoeing, and rowing are still allowed in the Reserve, and offer a unique view of different habitat areas.

Water uses of UNB have historically included water contact recreational activities such as water skiing, commercial fishing and sport fishing, wildlife habitat, preservation of rare species, marine habitat, and shellfish harvesting. However, the Upper Bay has been closed to body contact since 1974 and closed to shellfish consumption since 1978. These restrictions are primarily due to poor water quality resulting from nutrient enrichment, trace metals, and organics. While water contact activities are prohibited within the upper reaches of the Ecological Reserve for health reasons, swimming is allowed under the Reserve's regulations at North Star Beach (CDFG, 1985), unless posted otherwise.

UNB serves the casual boat user, because it contains the only boat launch ramp between Dana Point Harbor and Huntington Harbor. The boat launch ramp, located within the Newport Dunes Marina facilities, and the boathouses used to store kayaks and canoes for the Newport Aquatic Center and UCI's Rowing Base are all located in the lower reach of the Upper Bay. Three marinas are located within the lower reach of Upper Newport Bay. These marinas serve vessels that use the navigational channels located south of the PCH Bridge. The marinas form substantial business enterprises based upon their draw as waterside facilities. Both shallow water depth and environmental constraints such as contamination currently restrict recreational vessel use within Upper Newport Bay.

Commercial and sport fishing uses are dependent upon the Upper Bay's capability to provide spawning, foraging, and nursery grounds for commercial species. One species of particular importance settling in the Upper Bay is the California halibut, which is an essential component of the sportfishing industry and critical to the overall ecological value of marine habitat.

Newport Dunes is heavily used during the entire year as a recreational facility for vacationers. An RV park, meeting rooms, and a large outdoor swimming pool are also located within the Dunes property. Bayside facilities also include a large recreational beach used by local residents and visitors. Existing problems include shoaling within the marina's access channels and slips, and large algae blooms along the recreational beach and slip areas. Efforts to retrieve and remove algae cost Newport Dunes operators about $60,000/yr.

One of the most important and widely used access points to the Upper Bay is Back Bay Drive. This road is restricted to one-way northbound vehicular access automobile access from Jamboree Road by Newport Dunes to Eastbluff Drive. A heavily used bike trail is also located next to the road. Joggers, walkers and bird watchers also use this access. The Department of Fish and Game uses a parking lot located off of Back Bay Drive by Big Canyon as an educational site for giving lectures to visiting elementary to college level students. Back Bay Drive has been closed for extended periods of time in recent years because of bluff failures during the winter storm seasons and landslides blocking the road. In 1999, clapper rail nest sites were found adjacent to the road after landslides blocked access for months, further extending the timeframe for reopening the road. Users were extremely upset about the long closure. In addition to Back Bay Drive, Upper Newport Bay can be reached by trails located along Irvine Avenue, 16th Street, Cliff Drive, and PCH (Newport Beach, 1990). Alternative measures to stabilize the problem bluff areas above Back Bay Drive may be investigated as part of this study.

Education

The total ecological value and uniqueness of UNB produces unusual opportunities for public education and environmental awareness. It has been estimated that about 250,000 visitors use UNB each year. Such use encompasses recreation (boating, fishing, hiking, jogging, biking) as well as environmental observation and education. Monthly public tours of the Upper Bay are conducted that typically attract 1,000 to 2,000 people annually. Tours are also conducted to support the curriculum of the public schools of Orange County. For example, one-day natural history tours were provided to 1,100 fourth graders during the month of February 1985. Local universities, colleges, and conservation groups use UNB for field trips and individual study.

While the present efforts to provide on-site educational information to the casual visitor is modest (three interpretive displays along Back Bay Drive), the need for large-scale interpretive and educational development along the Upper Bay exists. As wetlands environments within southern California have diminished as a result of development, it is clear that those important wetlands that remain will be the subject of increased educational use.

Orange County will address many of the educational needs through construction of the regional park and interpretive center. This center will house displays and exhibits depicting the diverse resources of the bay. The estuarine environment will serve as the overriding theme, supported by three subthemes; physical resources, biological resources and cultural resources. Interpretation of the bay's physical resources includes its geology, hydrology, paleontology and climate. The biological resources themes will address species interdependence within the bay, the value of dispersion corridors, the existence and importance of biological diversity, threatened and endangered species, and the bay's role as a stop on the Pacific Flyway. Cultural resources include addressing archaeology, the history of the site and its future.

The construction of the interpretive center provides an excellent opportunity for interpretive displays of aspects of this study, including a simplified and interactive version of the numerical modeling studies. Other existing recreation and education opportunities for consideration during this study include the construction of information kiosks and signs along Back Bay Drive, and public trails and interpretive overlooks along the eastern and western bluffs of the bay. All of this would be coordinated with the work being done for the construction of the regional park and Fish and Game's update of the ecological reserve management plan.

Air Quality

The most important climatic and meteorological characteristics influencing air quality in the study area are the persistent temperature inversions, predominance of onshore winds in Orange County, mountain ridge and valley topography, and prevalent sunlight. Air quality is evaluated by measuring ambient concentrations of pollutants that are known to have deleterious effects. The degree of air quality degradation is then compared to *ambient air quality standards* (AAQS). Pollutants considered include Ozone (O_3), Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Suspended Particulate Matter (PM_{10} and $PM_{2.5}$), Sulfates (SO_4), Lead (Pb), Hydrogen Sulfide (H_2S), Vinyl Chloride, and Visibility Reducing Particles. The California AAQS are generally more stringent than the corresponding National standards. Air quality in the South Coast Air Basin (SCAB) regularly exceeds National AAQS for ozone, carbon monoxide, nitrogen dioxide, and suspended particulates. An analysis of the air quality impacts of different types of dredge and support equipment will be performed for this study. Details are presented in Section 3.5 of the EIS/R.

Noise

The noise environment around UNB can be characterized as quiet to moderately loud. The principal sources of noise in the general vicinity of UNB include motor vehicle traffic along roadways and highways, as well as departures and arrivals of aircraft at John Wayne Airport, and in years past from the El Toro Marine Air Station and Tustin Marine Corps Air Station.

John Wayne Airport is the closest and is located approximately one mile north of UNB. Aircraft arrivals and departures to and from John Wayne Airport pass above UNB, creating 60-decibel (dBA) noise contours over a majority of UNB. The El Toro Air Station is located approximately 7.5 miles east of UNB, while the Tustin Air Station is approximately 3.5 miles to the northeast. Both airports closed in 1999 in accordance with the Federal Base Realignment and Closure Action. However, it should be noted that the El Toro U.S. Marine Air Station may become an international airport in the near future. General flight patterns from military aircraft rarely affect the existing noise environment of UNB.

Roadways adjacent to the study area are mainly two-lane residential streets with minimal traffic volumes. However major thoroughfares, such as Pacific Coast Highway, Jamboree Road, and Route 73 are adjacent to UNB, and experience heavy traffic volumes. Pacific Coast Highway crosses the southern boundary of the study area and Jamboree Road crosses the northeastern boundary. Noise levels adjacent to major roadways like Pacific Coast Highway and Jamboree Road often exceed 65-70 decibels (dBA), which is usually characterized as a moderately loud noise level.

Noise generated from construction equipment, particularly from dredges, will be investigated for this study. Residents that live along the bluffs of Upper Newport Bay and marina residents in the lower portion of the Upper Bay complained about noise levels generated by the dredge and support equipment for the Unit III project even though noise levels were typically below 65 dBA. This amount of noise exposure was within the normally acceptable range for the City of Newport Beach (see Table 3.6-4 in the EIS/R). For the Unit III project, dredging was performed around the clock on weekdays and under restricted timeframes for the weekends. Some resource agencies were concerned about the possibility of the dredge and support equipment noise disturbing endangered species in portions of the ecological reserve. A camera was installed near Upper Island to document any potential disturbances to sensitive bird species, particularly the light-footed clapper rail, while the dredge operated in the area and during the passing of tugs and dump scows. No disturbance to nesting species was documented during the monitoring period.

Noise levels for the Corps 1998-99 dredging project in Lower Newport Bay were restricted to the City of Newport Beach's ordinance limits. Hours of operation were also restricted to 7-7 Monday-Friday, 8-7 Saturday, and no dredging on Sunday or holidays. More detailed descriptions of about ambient noise levels are presented in Section 3.6 of the EIS/R.

Hazardous, Toxic, and Radioactive Waste (HTRW)

No 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 EIS/R.

Cultural Resources

The history and prehistory of the Upper Bay area are relatively well documented through extensive archaeological research. The shoreline and bluffs surrounding the Upper Bay represent one of the most significant concentrations of prehistoric sites along the Southern California coastal region. There are approximately 60 individual prehistoric sites recorded on the bluff tops near the rim of the Upper Bay. For thousands of years, the Upper Bay provided a reliable and abundant hunting and gathering environment for prehistoric inhabitants. Concentrations of archaeological sites occur on Newport Mesa on the upper Castaways site, located in the vicinity of Irvine Avenue and University Drive, and on the east side of the Bay in the vicinity of the Big Canyon and Newporter North areas. Twelve sites have been identified within the boundary of the Ecological Reserve (CDFG, 1985). Details are presented in the Section 3.8 of the EIS/R.

Population Growth and Land Use

Most of the bay's problems can be attributed to the decades of population growth around the bay and watershed, especially the water quality issues of excessive sedimentation, nutrient loads, and the presence of toxics and pathogens. While much of the growth impacts were initially localized in nature, the cumulative effects of population growth and urbanization overwhelmed the watershed and bay's abilities to compensate for changed conditions. The western portion of the Newport Bay watershed is highly urbanized, and local drainages and large watercourses are a combination of concrete channels, underground conduits, and earthen or riprap channels. Few natural watercourses remain. The eastern half of the watershed is becoming more urbanized, with some remaining stretches of San Diego Creek and tributaries that are still natural channels. General existing watershed land uses are shown in Figure 1.3.

Newport Beach, California, the location of Newport Harbor, has a permanent population of 66,641 (1990), that swells to over 100,000 during the summer months. Newport Beach is a popular resort destination, with the Harbor and beach activities being primary attractions. The tourist industry is a primary element in the economic base of this area.

The City of Newport Beach and the County of Orange experienced a dramatic population boom between 1940 and 1970. Table 2.10 shows historic and current population data for the City of Newport Beach and the County of Orange.

An overall housing vacancy rate of 10% has been projected through the City's build-out date in 2010 (Newport Beach, 1992). In 1980, Orange County's comparable overall housing vacancy rate was 12.9%. These projections and the population figures indicate that the City of Newport Beach will grow at an average rate of 1.5 % per year through 2010 as compared to a 2.2% annual growth rate which has been projected by the Southern California Association of Governments for Orange County (Newport Beach, 1992). This variance in growth rates is related to the smaller portion of undeveloped residential acreage available in Newport Beach. Therefore, housing growth over the next fifty years beyond the 2010 build-out is expected to be limited.

Table 2.10 Historic and Current Population

City of Newport Beach			County of Orange		
Year	Population	Growth Rate (%)	Year	Population	Growth Rate (%)
1910	445		1910	34,436	
1920	894	100.9	1920	61,375	78.2
1930	2,203	146.4	1930	118,674	93.4
1940	4,483	101.4	1940	130,760	10.2
1950	12,120	173.1	1950	216,224	65.4
1960	26,565	119.2	1960	703,925	225.6
1970	49,442	86.1	1970	1,420,386	101.8
1980	62,556	26.5	1980	1,932,709	36.1
1990	66,641	6.5	1990	2,410,553	24.7
2000	78,327	17.5	2000	2,867,593	18.9

Note: Population projections for decades subsequent to 2020 are not available through regional, county or city planning agencies, or through academic institutions.

Source: Newport Beach, 1992 for 1910-1980 information and Southern California Association of Governments, 1994 for 1990 information. SCAG, 1994 for 1990-2010 information

Employment

In 1980, the City of Newport Beach Planning Department estimated the City's total non-construction employment to be 42,000. In January 1988, employment was estimated to be 58,255, a 39% increase (Newport Beach, 1992). The predominant types of employment within the City of Newport Beach are jobs related to administrative, professional, retail, financial, and recreational marine commercial enterprises (Newport Beach, 1990).

FORECAST OF FUTURE CONDITIONS

Summary

Imagine standing at the bluffs on top of Upper Newport Bay fifty years ago and thinking about what the bay and surrounding areas would look like today. There would certainly be a lot of different visions of the future conditions, each reflecting some of the actual changes that have occurred during that time period, but none that are entirely correct. This study looks at the most likely future conditions of the bay if little or no actions were taken to solve the problems or realize the opportunities. The forecast of future without-project conditions will be compared to alternative plans. In other words, we need to be able to say, "If we do nothing, this is going to happen, but if we take this course of action that is going to happen." Forecasting future conditions sometimes require that we make the best guess possible based on a limited amount of information. Fortunately, we also have developed tools that can assist us in the providing reasoned, scientific forecasts (better guesses). This section identifies the most likely future conditions within the bay, based on assumptions made throughout the planning process. Some assumptions are quite obvious. For instance, we assume that land use in the watershed will continue to change with more development replacing agricultural and open lands. We also assume that measures to improve general water quality and sediment erosion within the watershed will continue. The difficulty is to predict how these actions affect the Bay. For this reason, we have developed tools to help us address the future, and have made some simplifying assumptions where necessary. The following assumptions summarize the future condition forecasts of existing condition topics:

Climate: This study assumes that the climate will remain relatively the same for the period of analysis. The potential for sea level rise was not considered in future condition analyses. It is assumed that continued sediment deposition will likely compensate for any loss in habitat due to a gradual rise in sea level.

Hydrodynamics: Significant future changes in Bay hydrodynamics and sedimentation are discussed later in this section. Details are presented in the modeling appendix.

Surface Water: Increasing urbanization in the San Diego Creek watershed will cover proportionately greater areas with impermeable surfaces, which is expected to reduce rates of surface water infiltration and increase runoff. Previous reports (Boyle, 1980) predicted that peak flows in San Diego Creek would increase by 20 to 80% for ultimate (year 2030) versus 1980 conditions. No adjustment factor for storm inflows was used for the future condition numerical modeling and associated analyses. Historical stream gage records were used, as explained later in this section.

The future quality of fresh water inputs to UNB will also reflect ongoing activities within the watershed. The most likely impetus of change may be the TMDL's for the watershed and bay. It is not known how attainable the TMDL objectives are, but actions taken to address these objectives may reduce future sediment loads, nutrients (total nitrogen and phosphorus) and toxics and pathogens. Urbanization could also increase surface water levels of toxics and pathogens. Detailed water quality modeling has not been completed at this time, and it is not known what watershed actions may be taken to comply with the nutrient, toxics and pathogens TMDL objectives. This study makes the qualitative assumption that surface water quality will improve for the future without project condition.

Groundwater: Future demands for ground waters are expected to increase by approximately 10 to 15 percent over the next 15 years. Additional wastewater reclamation is expected to gradually replace imported supplies, and treatment/remediation efforts are also expected to increase, over the next ten to twenty years (OCWD, 1994). Subsequent demands for ground water are expected to increase at a relatively lower rate given anticipated population growth.

Sediments: There is no accounting for the potential sediment loading reductions to the Bay based on future watershed development and TMDL activities. As previously explained, there are two schools of thought regarding the impacts of development on the future sediment loads from San Diego Creek to the bay. Most believe that there should be a reduction in future sediment loads because of the increased urbanization of the watershed, and the potential for additional channel lining activities. But the natural channels that remain in the watershed could be subject to increased scour and erosion due to higher velocity and volume storm flows. There were many discussions about the use of some sort of Monte Carlo risk and uncertainty simulation to analyze future sediment loads associated with changing land uses, but the analyses were too time consuming and costly to model for this study. It is not known how effective current TMDL activities will be in reducing sediment inflows to the bay. Actions being taken right now require watershed sediment basins to have at least 50% storage capacity by mid-November of every year. Other measures to reduce sediment loads, aside from the ongoing use of best management practices (BMP's), have not been formulated yet. Therefore, a decision was made to take a conservative approach and use the historical storm flow record for the future analysis.

Sediment quality may also improve if TMDL compliance actions for toxics are successful in the watershed, although TMDL's for toxics has not been drafted at this time.

Habitat Types: Significant future changes are discussed later in this section. Details are discussed in the EIS/R.

Bay Waters: Future water quality conditions in UNB will reflect changes in the magnitude of contaminant mass loadings and the extent to which these materials are flushed due to tidal mixing and exchange with the ocean. Increased urbanization is expected to result in proportionately higher mass loadings of chemical contaminants, bacteria, and debris, although implementation of watershed management practices may be effective at offsetting or reducing these loadings. Future declines in agricultural activities within the watershed are also expected to result in reduced nutrient and pesticide loadings to UNB. Continued sedimentation within UNB would be expected to inhibit circulation and tidal exchange between the upper and lower portions of the Bay. Reduced circulation would limit flushing and dilution of nutrient and contaminant inputs and promote stagnation, eutrophication, and deposition and accumulation of particle-associated metals and trace organics. Freshwater influences in the bay would be much greater as deposition progresses and the tidal prism diminishes. These conditions would be expected to result in an overall decline in water quality in UNB.

With the high probability of increased algae blooms in the future without project condition and less tidal action in the Upper Bay, dissolved oxygen levels are expected to dip sharply in some areas during dry seasons. Areas of particular concern are within the upper section where there would be little future tidal influence, and shallow water conditions throughout the mudflat areas.

For the 50-year future without project condition salinity levels will not significantly change from the initial condition at the PCH Bridge. Large changes are predicted, however in the Unit I/III and Unit II basins. The daily range in salinity values will increase by approximately 450% in the Unit I/III basin, and by approximately 250% in the Unit II basin. Salinity ranges will be about 20 ppt to 29 ppt in the Unit I/III basin and 27 ppt to 32 ppt in the Unit II basin. For the wet weather simulation, year 50 salinity levels at the onset of the storm dropped approximately seven hours sooner than the initial condition.

Future sedimentation obviously contribute to higher fluctuations in salinity levels in the Upper Bay, especially in the Unit III basin area where much of the open water area will transition to mudflat. The change in salinity values is one of the factors included in the HEP analysis to identify potential impacts to habitat and species. If marsh areas are subjected to less tidal action and less saline conditions more brackish water or freshwater species may invade some areas, while other marsh areas will become sparser. The RWQCB is continuing salinity modeling.

Intertidal Habitat: Significant future changes are discussed later in this section.

Riparian/Freshwater Marshes: The future condition analysis assumes that there is no significant change to these habitat types in the ecological reserve.

Upland Vegetation: The future condition analysis assumes that there is no significant change to these habitat types in the ecological reserve.

Threatened and Endangered Bird Species: Significant future changes are discussed later in this section. Details are presented in the EIS/R.

HEP Results: Future condition HEP results are discussed later in this section. Details are presented in the HEP appendix.

Bay Uses: Future impacts are discussed later in this section.

Air Quality: No changes were considered for the future without project condition.

Noise: No changes were considered for the future without project condition.

HTRW: No changes were considered for the future without project condition.

Cultural and Paleontological Resources: No changes were considered for the future without project condition.

Population Growth and Land Use: Future changes are discussed later in this section.

Employment: The City of Newport Beach projects that employment will increase to 85,354 employees at the City's build-out point in 2010. The City is expected to have about 5% of the jobs in Orange County by 2010. The predominant types of employment within the City of Newport Beach are jobs related to administrative, professional, retail, financial, and recreational marine commercial enterprises. Given that the City is expected to reach build-out by 2010 and that the amount of developable land is currently limited, the employment base of Newport Beach is not expected to change dramatically over the next 50 years beyond the 2010 build-out.

Hydrodynamics and Sedimentation

As a result of continuing urbanization of the watershed, extensive sediment loading of UNB is expected to continue. The projected bathymetry for the 50-year future condition of UNB is based on numerical modeling of hydrological and sedimentation processes. The models use 25 years of historic stream gage records for San Diego Creek to simulate future sediment yields. The 25-year record was repeated to form 50 years of records of sediment loading to the Bay. The flow record was used to create representative storm flow hydrographs for the wet weather analyses. Each year a representative peak storm event is simulated to introduce sediment into the system. The net deposition from that simulation is scaled to represent the total sediment load for the year. A two-month dry weather simulation is performed to allow resuspension and redistribution of sediments. The net deposition from this period is scaled to represent nine months of dry weather. Annual estimates of sediment inflows are shown in Figure 2.6.

The models address the areas where sedimentation is predicted to have the greatest impact, namely in the main channels and basins and in adjacent mudflat and low-marsh intertidal elevations, up to approximately 2 feet above mean sea level. The sediment transport model redistributes sediments added to the Upper Bay based on flow and shear conditions simulated by the hydrodynamic model. Initial sedimentation, redistribution, and deposition of newly added and resuspended sediment results in altered sediment elevations accumulated over the 50-year period.

Some portions of the existing UNB habitat are not included in the numerical model mesh. In particular, the large portions of marsh between the southern end of the Unit I basin and the main dike is not part of the model. This should not be an issue because the model assumes that there is little sediment deposition within vegetated portions of UNB, above the mean high water mark (about +2 feet MSL), except for extreme storm events. One such event was the December 6, 1997 storm simulation, when water surface elevations in the Upper Bay exceeded +9 MSL during the peak flood event. Modeling included virtually all of the marsh areas up to +10 MSL. Model results were compared to post-flood bathymetry and accurately predicted the general areas of scour and deposition. The results show areas where between 1 and 1.5 feet of sediment was deposited in the marsh. Details are presented in the modeling appendix.

Future bay hydrodynamics will change considerably due sedimentation. Tidal circulation and tidal exchange will be severely limited over time. Sediment deposition will initially limit tidal circulation and exchange in the uppermost portion of the bay. By Year 10, open water areas in the upper basin will be filled to the pre-Unit III dredging levels and the Unit II basin open water areas will become mudflats, with the exception of a main channel through the whole area. The effects of reduced circulation and tidal exchange will continue to affect more of the Upper Bay as time progresses. Reduced circulation would limit flushing and dilution of nutrient and contaminant inputs and promote stagnation, eutrophication, and deposition and accumulation of particle-associated metals and trace organics. Even though the water quality of freshwater inputs to the bay may improve in the future, the loss of open water and reduced circulation, flushing and dilution of inputs would be expected to result in an overall decline in water quality in UNB.

While annual inflows vary greatly, average annual sediment delivery to the bay is estimated to be 164,000 cubic yards per year, of which an estimated 154,000 cy/yr of sediment is expected to deposit within the Bay, with the remaining 10,000 cy/yr going to the ocean. As Newport Bay fills in over time, the average amount of deposited sediment will decrease, with more material exiting the Bay. After 50 years, the predicted deposition volume in the Upper Bay is about 3,000,000 cubic yards. The predicted deposition volume in the Lower Bay is about 3,750,000 cubic yards. The model was not calibrated for deposition in the Lower Bay so the 3.75 million cubic yard value should only be considered as an indication of potential for deposition.

Graphical User Interfaces (GUI's) show annual deposition patterns in the bay for the future without project condition. All portions of UNB are expected to shoal relative to present conditions due to sediment accumulation. The Upper Bay would consist of a single channel from the mouth of San Diego Creek to the Lower Bay, with large areas of mud flats within the Units III and II basins. Depths within the channel will decrease gradually with distance from the head of the Bay from +2 ft to -2 ft MSL in the vicinity of The Narrows. Areas flanking the main channel in the vicinity of the Units III and II basins are predicted to be filled to an elevation of +2 ft MSL and the small channels that presently exist in these areas will be completely silted. Flow through the Upper Bay will be largely confined to the main channel. Model outputs of future sediment deposition patterns within Newport bay are shown on Figures 2.9 and 2.10. Details are presented in the engineering appendix.

Habitat Changes

Future changes to habitat types in the Upper Bay were analyzed using the model results and GIS. Shape files of the model outputs of the Upper Bay were created for existing conditions (year 0) and future years 20 and 50 and put into the Orange County GIS database. The results show that by year 20, both in-bay basins and water areas in the ecological reserve have become largely mudflat (< -4 MSL), with a main channel extending to the marinas. By year 50, tidal influence ends just north of the dike, and the marinas in the lower portion of the Upper Bay have filled in. The numerical model results actually show significant loss of open water habitat by year 10. The changes to the habitats analyzed in the HEP analysis are shown in Table 2.11.

Table 2.12 presents the changes to habitat types by segment for future years 20 and 50. Figures 2.11-2.13 show the changes to the habitats by segment. The loss of open water habitat throughout the Upper Bay is easily seen in these figures, particularly in Segment 1, where almost all of the existing open water areas would disappear by Year 50. Figures 2.14-2.16 also show the GIS outputs of the habitat changes.

Table 2.11 Future Without Project Condition Habitat Changes

Habitat Type	Model Year 0 (acres)	Model Year 20 (acres)	Model Year 50 (acres)	% Change from Yr. 0 to 50
Open Water	216.4	135.2	42.5	-80
Intertidal Mudflat	217.2	294.6	320.9	48
Low Salt Marsh	141.7	144.3	171.3	21
Middle Salt Marsh	182.6	184.1	194.0	6
High Salt Marsh	9.3	9.3	38.1	310

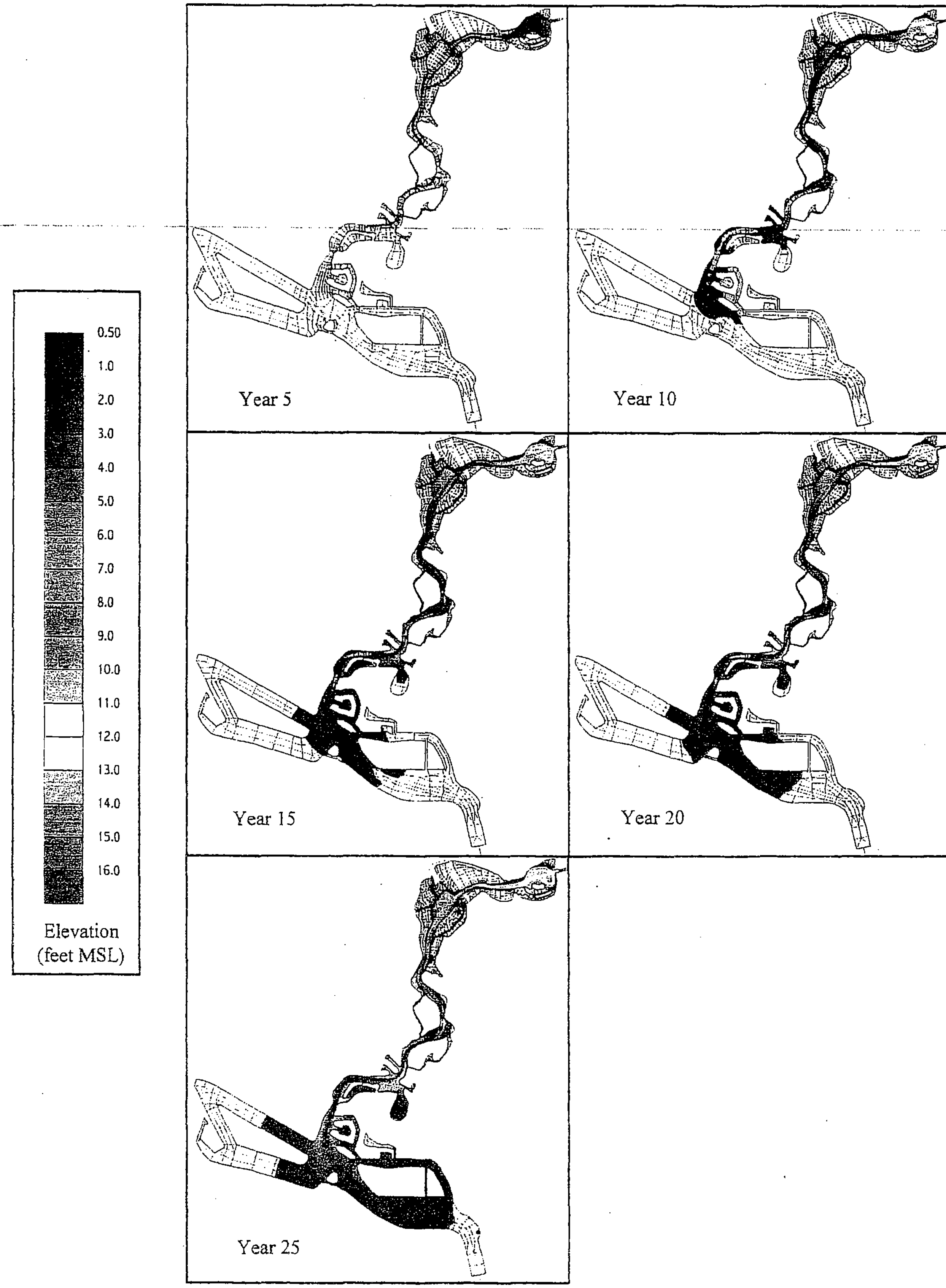


Figure 2.9 Future Sediment Deposition Patterns for Model Years 5, 10, 15, 20 and 25

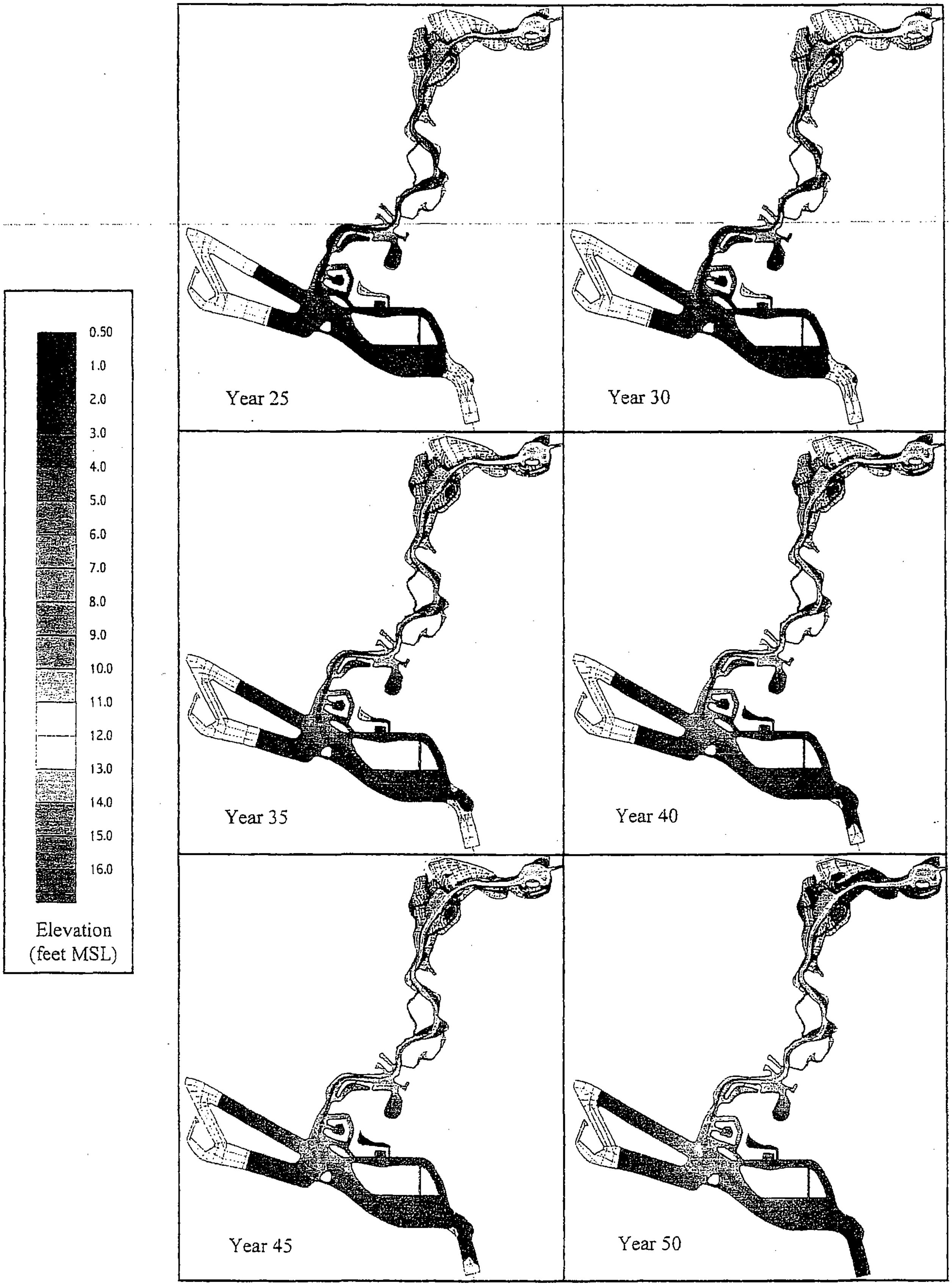


Figure 2.10 Future Sediment Deposition Patterns for Model Years 25, 30, 35, 40, 45 and 50

Table 2.12 Upper Newport Bay Future Without Project Condition Habitat Changes by Segment					
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	2
intertidal mudflat	51.9	81.3	55.5	57	
low salt marsh	32.2	35.6	48.5	11	5
middle salt marsh	99.2	99.8	102.8	1	
open water	47.9	14.6	0.7	-70	-9
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	11
intertidal mudflat	89.0	112.3	101.4	26	1
low salt marsh	83.6	83.1	96.3	-1	1
middle salt marsh	30.1	31.0	37.8	3	2
open water	45.5	22.1	7.2	-51	-8
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	
intertidal mudflat	76.3	101.1	164.1	33	11
low salt marsh	25.9	25.7	26.5	-1	
middle salt marsh	53.3	53.3	53.3	0	
open water	123.0	98.5	34.6	-20	-7

Figure 2.11 Segment 1 Without Project Condition Habitat Changes
Without Project Condition Years 0,20,50

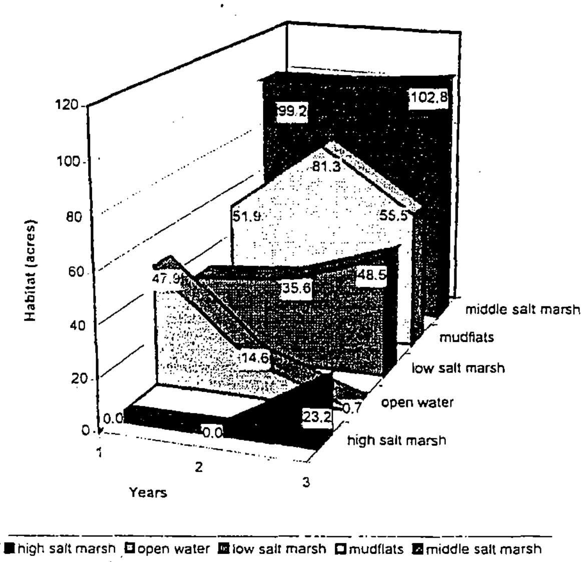


Figure 2.12 Segment 2 Without Project Condition Habitat Changes
Without Project Condition Years 0,20,50

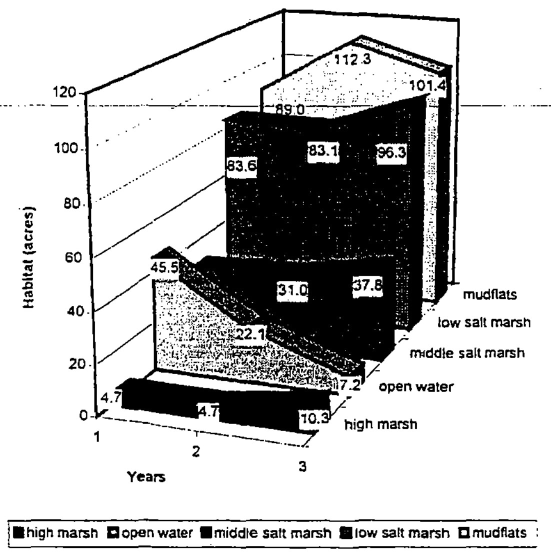
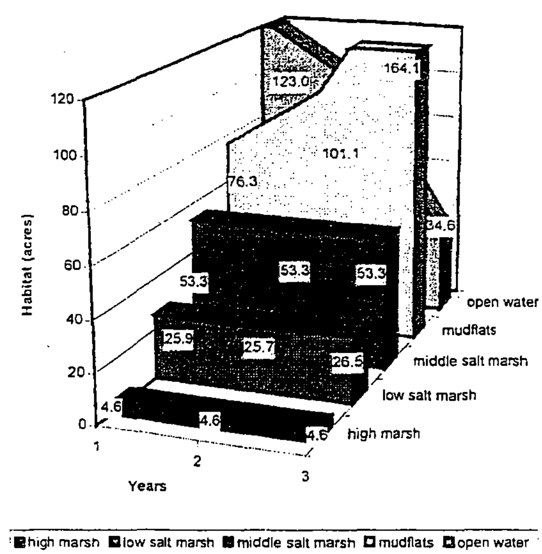
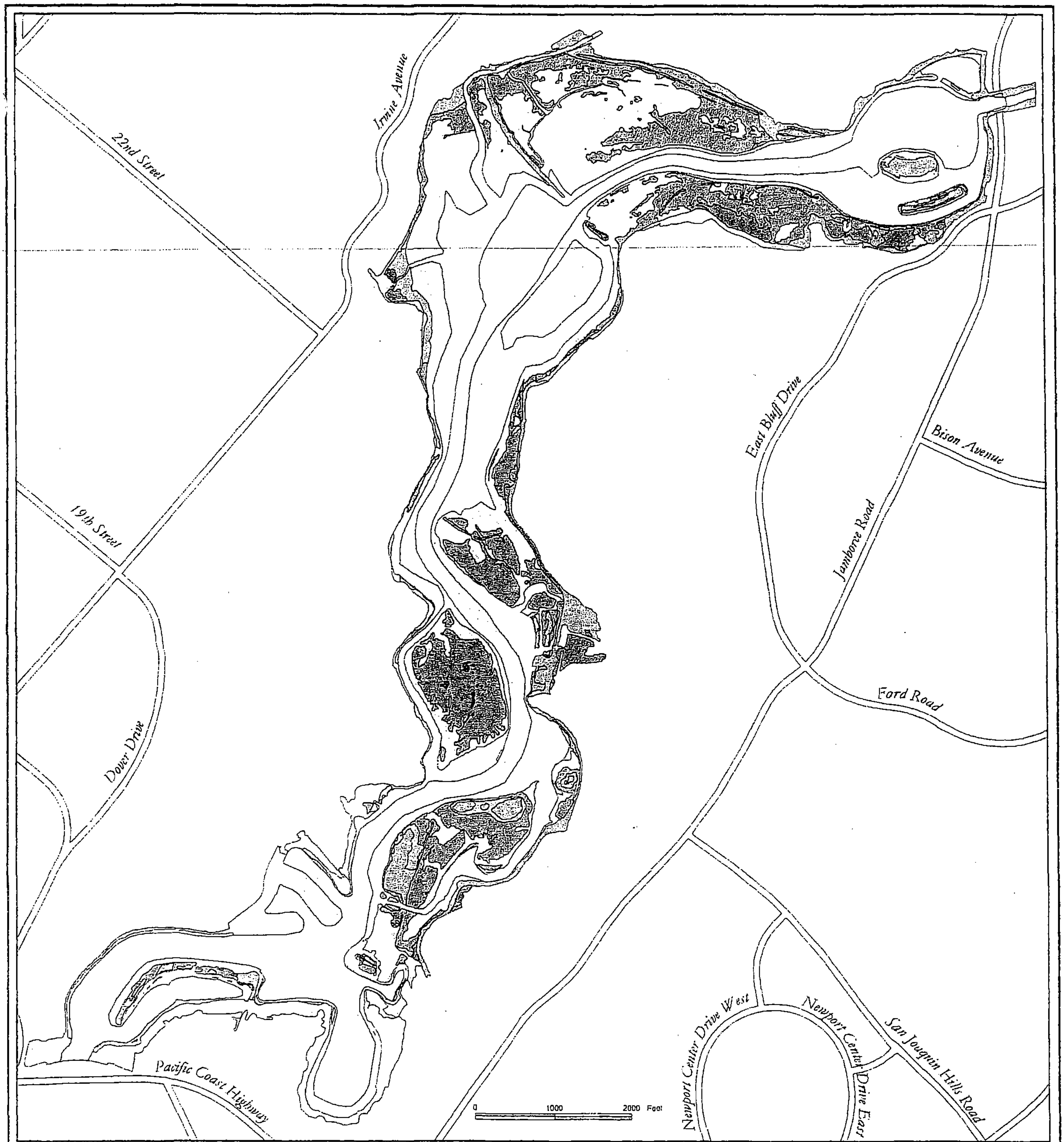


Figure 2.13 Segment 3 Without Project Condition Habitat Changes
Without Project Condition Years 0,20,50





Habitat Classification*

Developed	Middle Salt Marsh
Freshwater Marsh	Open Water
High Salt Marsh	Salt Panne
Intertidal Mudflat	Upland
Low Salt Marsh	Water

Figure 2.11

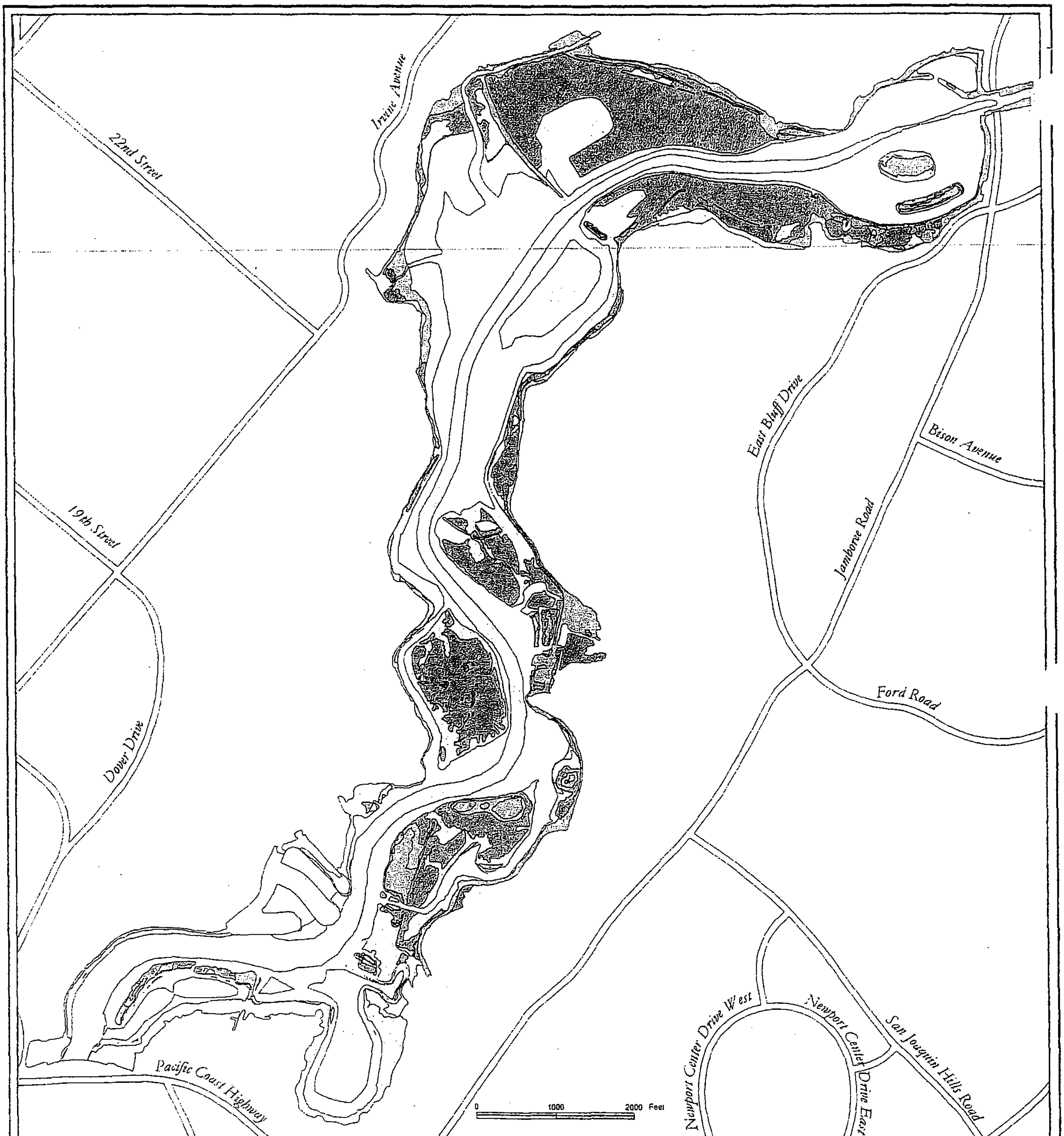
Upper Newport Bay Vegetation
Model Year 0

County of Orange, California

DESIGNED AND PRODUCED BY:

DATA SOURCE:

DATE:



Habitat Classification*

Developed	Middle Salt Marsh
Freshwater Marsh	Open Water
High Salt Marsh	Salt Panne
Intertidal Mudflat	Upland
Low Salt Marsh	Water

Figure 2.12

Upper Newport Bay Vegetation
Model Year 20

County of Orange, California

DESIGNED AND PRODUCED BY:

DATA SOURCE:

DATE:

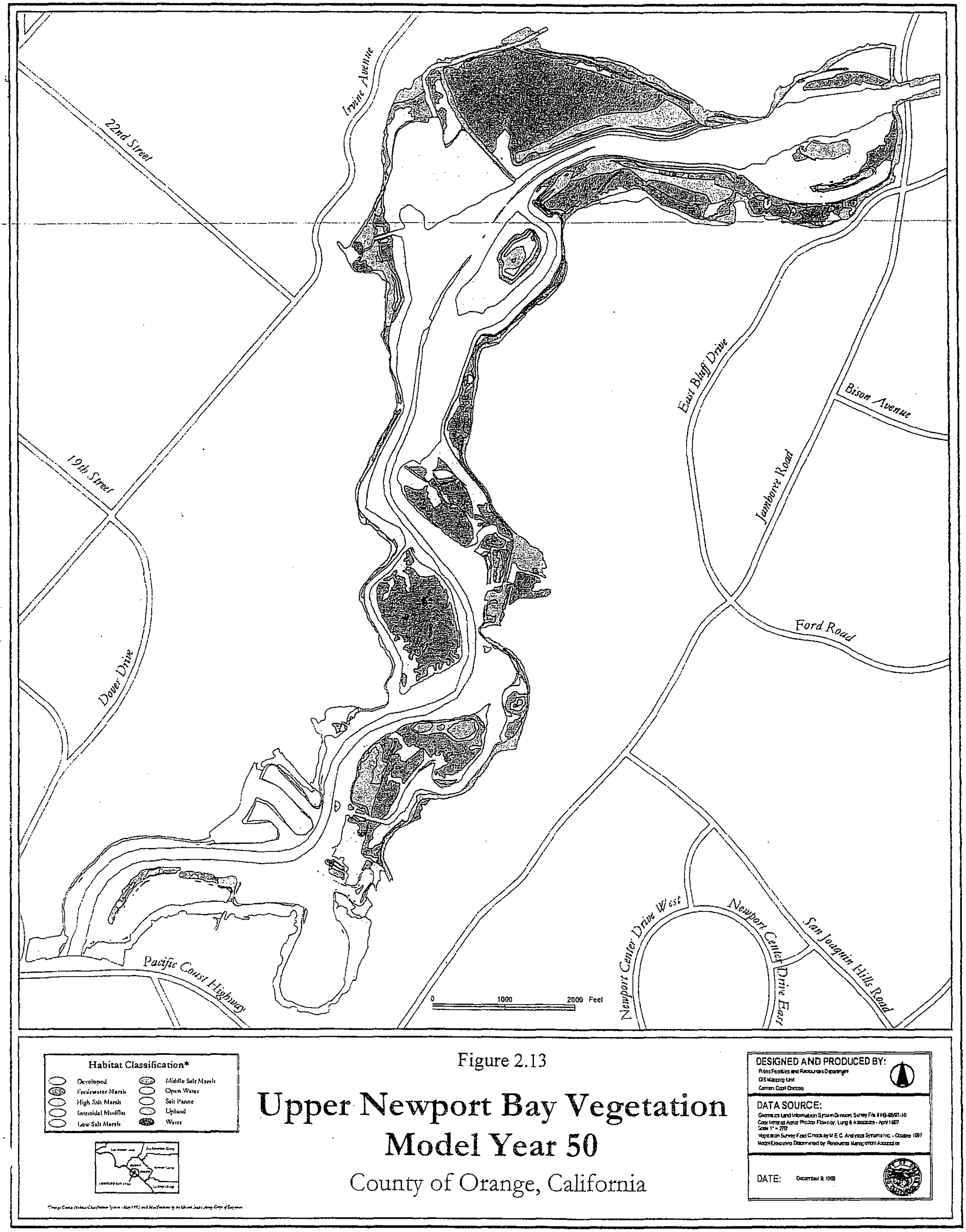


Figure 2.13

Upper Newport Bay Vegetation
Model Year 50

County of Orange, California

HEP Habitat and Species Impacts

The modified HEP analysis for the future without project conditions shows the decline in habitat values over time due to the loss of open water habitat and expansion of other habitats, degrading the quality of the estuarine ecosystem. The HEP for the future condition was also broken down into three segments (see Existing Condition HEP Results) and investigated for years 0, 20 and 50. The changes in habitat acres for years 0, 20, and 50 are shown in Figure 2.14. For Segment 1, from Jamboree Road Bridge to the main dike, open water acres are reduced by more than half by year 20 with little remaining by year 50. Mudflats replace open water areas by year 20, but slowly decline as low and middle marsh areas populate areas of higher deposition by year 50 (+1 to +4 feet MSL). Segment 2, from the main dike to Middle Island, also loses half of the existing open water areas during the first 20 years, and is reduced to one-third of the existing acres by year 50. Mudflat expansion again replaces open water acres for the first 20 years, and then low salt marsh dominates the northwest corner of the Unit II basin by year 50. Segment 3, from Middle Island to the PCH Bridge, has very little habitat changes during the first 20 years, but a substantial loss of open water and expansion of mudflat areas from year 20 to 50. This shows as time progresses more sediment will fill in open water areas further down the bay.

The HEP model outputs of existing and future without project conditions habitat units (HU's) are shown in Table 2.12. The total habitat units (HU's) were divided by the number of indicator species considered for each habitat type. Details are presented in the HEP appendix.

Figure 2.14 Without Project Condition Habitat Changes

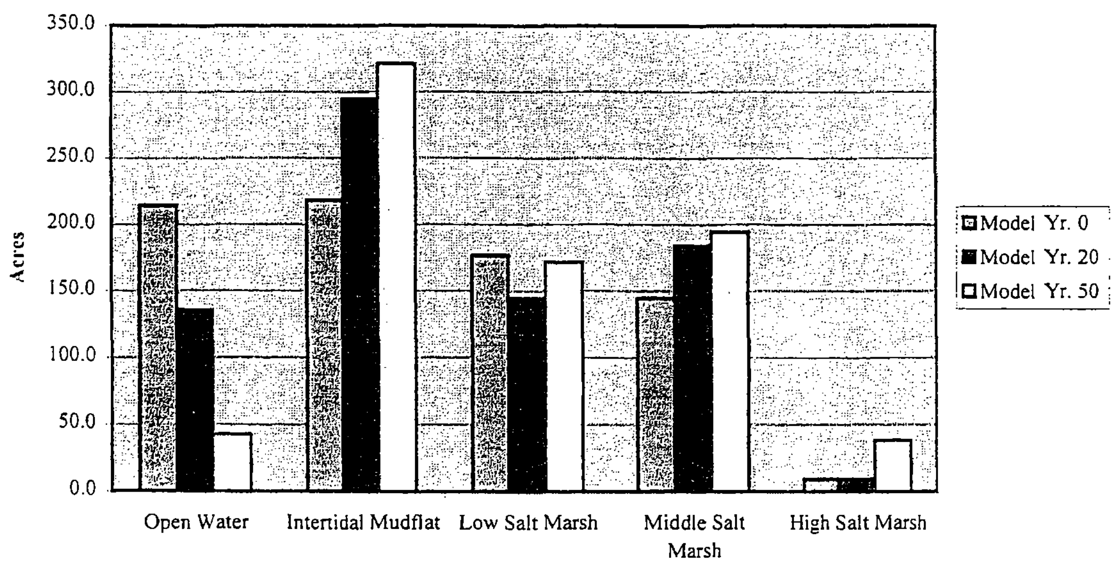


TABLE 2.12 Future Without Project HEP Results						
Year 0						**Adjusted HU's**
Habitat	Segment 1	Segment 2	Segment 3	**Total HU**	# Species	**For # Species**
MOW	139	130	403	672	6	**112**
IMF	177	312	261	751	9	**83**
LSM	41	105	34	180	4	**45**
MSM	89	27	48	164	3	**55**
HSM	0	5	5	10	4	**3**
Total	**446**	**579**	**751**	**1776**		**298**
Year 20						**Adjusted HU's**
Habitat	Segment 1	Segment 2	Segment 3	**Total HU**	# Species	**For # Species**
MOW	37	51	316	404	6	**67**
IMF	254	351	375	980	9	**109**
LSM	41	101	33	176	4	**44**
MSM	90	28	48	166	3	**55**
HSM	0	5	5	10	4	**3**
Total	**422**	**536**	**778**	**1736**		**278**
Year 50						**Adjusted HU's**
Habitat	Segment 1	Segment 2	Segment 3	**Total HU**	# Species	**For # Species**
MOW	2	16	101	119	6	**20**
IMF	157	313	588	1058	9	**118**
LSM	57	117	34	209	4	**52**
MSM	93	34	48	175	3	**58**
HSM	26	11	5	42	4	**10**
Total	**334**	**492**	**776**	**1603**		**258**

Adjustment factors were not applied to the HEP for the indicator species, but general trends of the future impacts to the species can be determined from the analysis, as shown in Table 2.13. Without taking into account the changes to water quality and the forage base, many of the bird species tend to benefit in the future, while the fish indicator species have significant adverse impacts due to the loss of marine habitat. The lesser scaup and least tern are two other indicator species that are adversely affected by the future habitat changes. For each species, the impacts related to future changes in habitat quality, water quality, human disturbances and so on were very difficult to quantify. Therefore, many of the qualitative impacts that affect different species are not reflected in the HEP model.

TABLE 3.13 TOTAL HU's BY INDICATOR SPECIES FOR ENTIRE BAY

Year 0	MOW	IMF	LSM	MSM	HSM	**Total**	
Halibut	138	57	0	0	0	**195**	
Anchovy	131	57	0	0	0	**188**	
western grebe	141	65	0	0	0	**206**	
lesser scaup	114	32	0	0	0	**146**	
least tern	138	57	0	0	0	**195**	
Pintail	8	137	0	0	0	**145**	
great egret	0	87	57	18	1	**163**	
Avocet	0	109	0	0	5	**113**	
clapper rail	0	0	71	55	2	**127**	
Shorebirds	0	151	24	0	0	**175**	
Belding's savannah sparrow	0	0	28	91	3	**122**	
	672	751	180	164	10	**1776**	
Year 20	MOW	IMF	LSM	MSM	HSM	**Total**	HU Change
Halibut	84	65	0	0	0	**150**	-46
Anchovy	76	65	0	0	0	**141**	-47
western grebe	82	88	0	0	0	**171**	-35
lesser scaup	72	37	0	0	0	**108**	-38
least tern	84	65	0	0	0	**150**	-46
Pintail	6	221	0	0	0	**226**	81
great egret	0	118	58	18	1	**195**	32
Avocet	0	147	0	0	5	**152**	39
clapper rail	0	0	72	55	2	**129**	2
Shorebirds	0	174	17	0	0	**191**	16
Belding's savannah sparrow	0	0	29	92	3	**124**	1
	404	980	176	166	10	**1736**	
Year 50	MOW	IMF	LSM	MSM	HSM	**Total**	HU Change
Halibut	25	69	0	0	0	**94**	-101
Anchovy	23	69	0	0	0	**92**	-96
western grebe	23	96	0	0	0	**119**	-87
lesser scaup	22	35	0	0	0	**56**	-89
least tern	25	74	0	0	0	**99**	-96
Pintail	1	242	0	0	0	**243**	98
great egret	0	128	69	19	4	**220**	57
Avocet	0	161	0	0	19	**180**	66
clapper rail	0	0	86	58	8	**151**	24
Shorebirds	0	185	20	0	0	**205**	30
Belding's savannah sparrow	0	0	34	97	11	**143**	20
	119	1058	209	175	42	**1602**	

The loss in volume of open water and increased freshwater influence, and degradation of water quality because of the reduction in the tidal prism will decrease the benthic and water column fish populations that the Upper Bay will support. The increased freshwater influence is also predicted to lower the diversity of the benthic invertebrate community. The reduced invertebrate and forage fish populations will reduce the food base for waterfowl and diving birds. Waterfowl and boaters will compete for the more limited open water areas in the Upper Bay. Overall if no action is taken, the diversity of the habitat mix in the Upper Bay will be reduced and there will be a corresponding loss in species richness.

Channel primary and secondary production will decline. Newport Bay's use as a spawning area for 10 fishes and a nursery area for 33 species would be severely impacted. The reduction of the nursery function could also have a regionally significant impact on nearshore fisheries, and an incremental effect on the sportfish and commercial industries in general. A reduction in the amount of openwater habitat and food sources would reduce habitat value for seabirds and other waterbirds, including endangered species such as the California least tern and California brown pelican.

Mudflats would sustain the greatest loss of habitat value and sediment accretion would promote the establishment of salt marsh on the future mudflats. This may initially benefit salt marsh communities, but over time, the salt marsh will degrade. The reduction in mudflat area would result in a regionally significant impact on avian resources because the acreage of shorebird roosting and foraging habitat would be significantly less. The reduction in mudflat area would also reduce the amount of food resources (mudflat invertebrates). A reduced food supply would be a primary factor in a decrease of numbers and diversity of shorebirds.

The combination of habitat loss and a reduction of available food resources would preclude wide-scale shorebird use in the Upper Bay, and possibly shift the distribution of shorebirds to other nearby beaches and wetlands. The ability of other wetlands to sustain high bird densities over a prolonged period in unknown at this time.

The loss of marine and mudflat habitat would be offset-by a significant increase in low and middle salt marsh. In areas that receive direct tidal inundation cordgrass would flourish. However, tidally influenced salt marsh may be cut off from tidal action in the future as accreted sediments block tidal channel creeks. As a result, drier, marsh soils will be more dry and saline and could reduce the amount of cordgrass. Pickleweed and other opportunist species may replace cordgrass, due to higher tolerance for drier and more saline conditions. The increasing amount of non-tidal wetlands would lower the overall ecological value of the Upper Bay. A comparable situation of degraded marsh habitat occurs in Bolsa Chica and Santa Ana River Marsh where portions of the marsh have been cut off from tidal flow. These areas are less productive and provide less habitat and protective cover for marsh wildlife.

Despite long-term increases in salt marsh acreage, the value of the habitat would be severely degraded and the current population of the endangered light-footed clapper rail would be threatened. Since UNB is considered a key center of this bird's population the loss of cordgrass habitat would be considered a regionally significant impact.

Prolonged freshwater runoff into the Bay would benefit brackish and freshwater channel communities at the expense of the marine community, providing low value marine habitat. Low channel salinity resulting from a decreased tidal prism would enhance the growth of a riparian corridor of willows, sycamores and mulefat along the channel banks in a manner which would be similar to conditions above the Main Dike prior to restoration work. Riparian and brackish water species would increase.

Some non-marine upland habitat will be created as a result of the sedimentation process, although most changes that would occur would be limited to the upper limits of the salt marsh characterized by changes from salt marsh to riparian habitat. In higher elevational areas away from channels salt flats may replace salt marsh. Although this habitat is not a productive one, it would provide roosting habitat and seasonal foraging habitat for wintering-over populations of shorebirds. Upland "islands" that provide nesting habitat for the endangered California least tern would become more readily accessible to predators, to the detriment of the tern population. With increasing freshwater influence, the saline soils of some high marsh and transition habitats near the head of the Bay would tend to be leached, making barren and high marsh areas more likely to support weedy non-native vegetation.

The loss of open water habitats, mudflat, and high value salt marsh could potentially cause a regionally significant reduction in the population of the California least tern, the light-footed clapper rail, and Belding's savannah sparrow. Foraging habitat for the California brown pelican and peregrine falcon would be greatly diminished and food resources within remaining marine subtidal habitats would be reduced because of the loss of habitat.

Adult least terns will have to forage farther from their nests in future conditions as the Unit I/III basin fills in. The potential for the least terns to abandon their nesting site would increase with a decrease in tidal influence in the Unit I/III Basin. Similarly, the incidence of predation on least terns by mammalian predators would probably increase as nest sites become increasingly accessible due to the elevation of surrounding marsh by sedimentation.

Endangered light-footed clapper rail cordgrass nesting habitat and tidal flat foraging habitat would slowly degrade beginning north of the Main Dike and extending into the area between the Narrows and Shellmaker Island. The reduction in value could result in emigration of individuals to cordgrass habitat lower in the Bay, as the degradation continues along a gradient between the main dike and the PCH Bridge. Besides a direct loss of habitat and an increase potential of predation by terrestrial predators, potential increases in population pressures may also contribute to a result in lowered reproductive success. As freshwater habitat is increased in the Bay, clapper rails will adapt to using this habitat. However, the maintenance of light-footed clapper rail populations will depend, in large part, on maintaining and expanding low marsh habitat.

Continuing sedimentation appears unlikely to affect salt marsh bird's beak or endangered species that occur in coastal sage scrub.

Bay Uses

Shoaling around the main channel used by the marinas in the lower portion of the Upper Bay will cause navigation problems by Year 20, particularly for the Dover Shores marina. By Year 50, the three marinas in the Upper Bay, the boat launch ramp and channels and slips in the Lower Bay will all encounter significant navigation problems.

Future Population Growth and Land Use

According to the City's General Plan, ultimate residential build-out is also projected to occur by the year 2010. Currently, the amount of land available for development within the City as a whole is limited. Specifically, there are no parcels of land available for development within the UNB area. The majority of lands within UNB is either within the boundaries of the ecological reserve or contains existing residential and planned community developments. Therefore overall land use of the Upper Bay is not expected to change dramatically over the next fifty years given the existing developed nature of the area and the projected build-out date of 2010.

It is anticipated that the highly urbanized San Diego watershed will continue to experience significant development. The ultimate condition of development assumes the maximum urban use of the San Diego Creek watershed. Under these plans developed nearly twenty years ago, the ultimate condition of the watershed included 81% devoted to urbanized space, 8% rural, and 11% open space. It was estimated that this future development would result in a 25% reduction in the volume of sediment delivered to the Bay from the 1980 condition (Boyle, 1982). This decrease is based on the elimination of construction and agriculture areas, both high sediment producing land uses.

Newer information may lessen early 1980's projections of future development within the San Diego Creek watershed, but not by much. Open space will be generally be limited to the foothills and lands set aside for the Natural Community Conservation Plan and Habitat Conservation Plan (NCCP/HCP). NCCP focuses on conservation of natural communities rather than individual species, while providing for the protection of species listed under the Federal and California Endangered Species Act (FESA,CESA). The purpose of the NCCP/HCP program is to create a multiple-species, multiple-habitat reserve system, implementing a long-term adaptive management program that will protect coastal sage scrub (CSS) and other habitats and species, while providing for economic uses that will meet the social and economic needs of the area.

In general, watershed development will likely increase the runoff to San Diego Creek, causing more fresh water delivery to UNB and lower salinity levels in the Bay for longer periods of time. Watershed development may decrease sediments delivered to the Bay from surface runoff, but increase channel erosion from unlined channels. Future development may also degrade water quality within San Diego Creek, adversely affecting Bay waters.

Table 2.14 Projected Future Population Growth

City of Newport Beach			County of Orange		
Year	Population	Growth Rate (%)	Year	Population	Growth Rate (%)
2010	84,385	7.7	2010	3,107,312	8.4
2020	88,098	8.4	2020	3,244,607	4.4[1]
2030	91,974	4.4[2]	2030	3,387,370	4.4[2]
2040	96,021	4.4[2]	2040	3,536,414	4.4[2]
2050	100,245	4.4[2]	2050	3,692,016	4.4[2]

[1] 2020 projections for Orange County provided by CSUF, 1997

[2] City and County population projections for decades subsequent to 2010 have been based on CSUF's projected Orange County growth rate between 2010 and 2020. Given the limited availability of developable land and the City's expected build-out by 2010, the City's population is not expected to increase dramatically after 2010. Similarly, projected County populations after 2010 are not expected to increase dramatically.

The total population of Orange County is expected to increase to 3,244,607 by 2020 (CSUF, 1997). Projected over a fifty year period, the County of Orange and City of Newport Beach populations are expected to grow to about 3.6 million and 100,000, respectively, by the year 2047.