

ENVIRONMENTAL IMPACT STATEMENT
FOR
LOS ANGELES/LONG BEACH (LA-2)
OCEAN DREDGED MATERIAL DISPOSAL SITE
SITE DESIGNATION

U.S. Environmental Protection Agency
Region 9
San Francisco, California

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Comments on this administrative action should be addressed to:

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Comments must be received no later than:

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ABSTRACT

The proposed action is the designation of an ocean disposal site for dredged material off Los Angeles, California. The site will be used in conjunction with dredged material disposal for Federal projects and permits issued under Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended. The interim site, referred to as LA-2, has been used for disposal of material dredged from the navigation channels of Los Angeles and Long Beach Harbors since the 1970s.

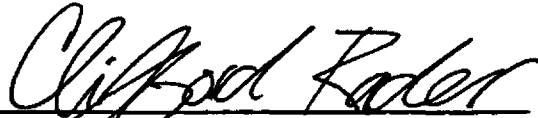
Continued use of the site is not expected to cause any significant long-term adverse environmental effects. The sediments and the benthic community have been altered by previous disposal operations at the proposed site. The smothering effect on the benthos caused by sediment inundation is expected to continue, but it is not considered to be a significant environmental impact at the LA-2 site. Water quality impacts, which are temporarily experienced during disposal operations, are expected to be minimal. Short-term effects on inhabitants of the water column will be negligible. Few of the potentially adverse environmental effects of dredged material disposal at the proposed site are likely to be irreversible or involve any irretrievable commitment of resources. A management plan, to be developed in a subsequent document by EPA and COE as a major part of the site designation process, will ensure that environmental impacts do not become significant.

The seven major alternatives considered in this draft environmental impact statement are: 1) No Action, 2) Delayed Action, 3) Landfilling of Port Areas, 4) Landfilling at Sanitary Landfills, 5) Beach Nourishment, 6) Ocean Disposal at the LA-2 Site, and 7) Ocean Disposal at Two Alternative Ocean Sites. After detailed field investigations and analysis of each alternative, the U.S. Army Corps of Engineers, Los Angeles District determined that ocean disposal at a designated dredged material disposal site was the only viable alternative for the proposed action. The three sites considered for designation include: the LA-2 site, a shallow water site, and a deep water site. The Preferred Alternative identified in this environmental impact statement is the designation of the LA-2 site for continued use. This decision is based on the lack of significant long-term environmental impacts at the LA-2 site, the potential for disposal activities to adversely affect the alternative sites, and the demonstrated need for an ocean disposal site for dredged material.

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OCEAN DREDGED MATERIAL DISPOSAL SITE
SITE DESIGNATION

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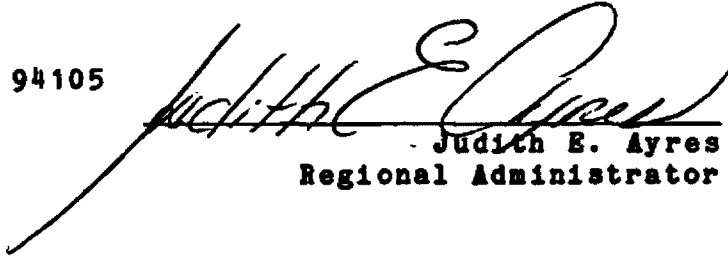

Judith E. Ayres
Regional Administrator

TABLE OF CONTENTS

COVER SHEET	1
ABSTRACT	111
AGENCY CONCURRENCE	1v
TABLE OF CONTENTS	v
LIST OF FIGURES	viii
LIST OF TABLES	x
LIST OF ABBREVIATIONS	xiii
EXECUTIVE SUMMARY	S-1

CHAPTER 1. INTRODUCTION

1.1. <u>General Introduction</u>	1-1
1.1.1 Historical Background	1-1
1.1.2 Dredged Material Permitting	1-4
1.1.3 Dredging Operations	1-6
1.2. <u>Purpose of and Need for Action</u>	1-7
1.3. <u>Proposed Action</u>	1-8
1.4. <u>Areas of Controversy</u>	1-9
1.5. <u>Issues to be Resolved</u>	1-10
1.6. <u>Regulatory Framework</u>	1-12
1.7. <u>Relationship to Previous NEPA Actions or Other Facilities That May be Affected by Designation of the Disposal Site</u>	1-18

CHAPTER 2. ALTERNATIVES

2.1. <u>Description of Alternatives</u>	2-1
2.1.1 Preferred Alternative (LA-2 ODMS)	2-1
2.1.2 No Action Alternative	2-3
2.1.3 Delayed Action Alternative	2-3
2.1.4 Landfilling Alternatives in Port Areas	2-4
2.1.5 Land Disposal Alternatives at Sanitary Landfills	2-5
2.1.6 Beach Nourishment Alternative	2-6
2.1.7 Alternative Ocean Disposal Sites	2-7

2.2.	<u>Discussion of Alternatives</u>	2-9
2.2.1.	Alternatives Not Considered for Further Analysis	2-9
2.2.2.	Compliance of the Three ODMDS Alternatives with General Criteria for the Selection of Sites (40 CFR 228.5)	2-9
2.2.3.	Comparison of the Three ODMDS to EPA's 11 Specific Criteria for Site Selection 40 CFR 228.6(a)	2-12
2.2.4.	Selection of the Preferred Alternative	2-12

CHAPTER 3. AFFECTED ENVIRONMENT

3.1.	<u>Ocean Disposal Site Characteristics</u>	3-1
3.1.1.	Proposed Use of the Site	3-3
3.1.2.	Existence and Effects of Current and Previous Discharges and Dumping in the Area, Including Cumulative Effects 40 CFR 228.6(a)(7)	3-3
3.1.3.	Feasibility of Surveillance and Monitoring 40 CFR 228.6(a)(5)	3-5
3.2.	<u>Physical Environment</u>	3-6
3.2.1.	Meteorology and Air Quality	3-6
3.2.2.	Physical Oceanography of the Southern California Bight 40 CFR 228.6(a)(6)	3-8
3.2.3.	Water Column Characteristics 40 CFR 228(a)(9)	3-13
3.2.4.	Regional Geology	3-22
3.2.5.	Sediment Characteristics	3-24
3.3.	<u>Biological Environment</u>	3-32
3.3.1.	Plankton Community	3-32
3.3.2.	Kelp Community	3-35
3.3.3.	Benthic Biology	3-38
3.3.4.	Fish	3-47
3.3.5.	Coastal Birds	3-53
3.3.6.	Marine Mammals	3-54
3.3.7.	Rare, Threatened and Endangered Species	3-56
3.3.8.	Marine Sanctuaries and Areas of Special Biological Significance	3-60
3.3.9.	Potentiality for the Development or Recruitment of Nuisance Species in the Disposal Site 40 CFR 228.6(a)(10)	3-62
3.4.	<u>Socioeconomic Environment</u>	3-63
3.4.1.	Commercial Fishing	3-63
3.4.2.	Commercial Shipping	3-68

3.4.3.	Oil and Gas Development	3-70
3.4.4.	Military Usage	3-75
3.4.5.	Recreational Activities	3-76
3.4.6.	Cultural Resources	3-83
3.4.7.	Public Health and Welfare	3-83

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

4.1.	<u>Introduction</u>	4-1
4.2.	<u>LA-2 ODMDS Alternative (Preferred Alternative)</u>	4-9
4.2.1.	Effects on Physical Environment	4-9
4.2.2.	Effects on Biological Environment	4-13
4.2.3.	Effects on Socioeconomic Environment	4-19
4.3.	<u>No Action Alternative</u>	4-23
4.4.	<u>Shallow Water Site</u>	4-24
4.4.1.	Effects on the Physical Environment	4-24
4.4.2.	Effects on the Biological Environment	4-26
4.4.3.	Effects on the Socioeconomic Environment	4-28
4.5.	<u>Deep Water Site</u>	4-30
4.5.1.	Effects on the Physical Environment	4-31
4.5.2.	Effects on the Biological Environment	4-32
4.5.3.	Effects on the Socioeconomic Environment	4-33
4.6.	<u>Management of the Disposal Site</u>	4-35
4.7.	<u>Relationship Between Short-term Use and Long-term Resource Uses</u>	4-37
4.8.	<u>Irreversible or Irretrievable Commitment of Resources</u>	4-38

CHAPTER 5. COORDINATION

5.1.	<u>Public Involvement</u>	5-1
5.2.	<u>Interagency Workshop</u>	5-1
5.3.	<u>Formal Consultations</u>	5-21
5.4.	<u>Requested Reviewers</u>	5-21

CHAPTER 6.	<u>List of Preparers</u>	6-1

CHAPTER 7.	<u>References</u>	7-1

APPENDIX A. REPORT OF FIELD SURVEY

APPENDIX B. DETAILED FIELD SURVEY DATA (not included with EIS;
available upon request from COE, LA Office)

APPENDIX C. NUMERICAL SIMULATION OF DREDGED MATERIAL DISPOSAL

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
S-1. Map of the Project Region	S-2
S-2. Map of the Project Area	S-3
S-3. Map of Major Biological Resources in the Project Area	S-7
S-4. Major Socioeconomic Features in the Project Area	S-8
1-1. Map of the Project Area	1-2
1-2. Evaluation Process for Dredge Material Permit Review	1-5
1-3. Other Major Facilities in the Project Vicinity	1-19
2-1. Location of Alternative Disposal Sites in the San Pedro Shelf and Basin	2-2
3-1. Location of Discharge Outfalls and Other Ocean Disposal Sites in the Project Area	3-2
3-2. Generalized Depiction of Typical Wind Regimes Offshore of Palos Verdes Peninsula	3-7
3-3. Three Major Currents which Influence the Southern California Bight	3-9
3-4. Seasonal Variations in Currents of the Southern California Bight	3-11
3-5. Average Seasonal Variation of Temperature in Channel Islands Area between Santa Catalina Island and San Clemente Island	3-14
3-6. Geological Features in the Vicinity of Palos Verdes	3-23
3-7. Location of Major Sediment Types of San Pedro Shelf and Direction of Bottom Transport During an Upwelling Event	3-26
3-8. Location of Federal and State Biological Reserves in the Project Area	3-61
3-9. Principal Commercial Fish Species and Average Annual Catch by Block in Project Area	3-66

LIST OF FIGURES (CONTINUED)

<u>Figure</u>	<u>Page</u>
3-10. Commercial Shipping Lanes and Zones of Military Operation in the Project Area	3-73
3-11. Oil and Gas Development in the Project Area	3-74
3-12. Sportfishing Resources in the Project Area	3-78
3-13. Principal Recreational Areas in the Project Area	3-82
3-14. Other Cultural Features of the Project Area	3-84

LIST OF TABLES

<u>Table</u>	<u>Page</u>
S-1. Summary of Impacts and Mitigation Measures for the LA-2 Site	S-13
S-2. Summary of Impacts and Mitigation Measures for the No Action Alternative	S-15
S-3. Summary of Impacts and Mitigation Measures for the Shallow Water Alternative	S-16
S-4. Summary of Impacts and Mitigation Measures for the Deep Water Alternative	S-18
1-1. Permits Issued by the COE for Disposal of Dredged Material at the LA-2 Site	1-3
1-2. Summary of Compliance of Alternatives with Environmental Protection Statutes and Other Environmental Requirements	1-13
2-1. General Comparison Between Geographical Position, Depth of Water, Bottom Topography, and Distance from the Coast for the Alternative Ocean Disposal Sites	2-8
2-2. Comparison of Alternative Ocean Disposal Sites Based on EPA's 11 Specific Site Designation Criteria	2-13
3-1. Concentrations of Trace Metals as Suspended Particulates in the Water Column in Micrograms Per Liter (ug/l)	3-21
3-2. Grain Size Distribution for the LA-2 and Reference Sites	3-27
3-3. Concentrations of Trace Metals in Sediments, Micrograms Per Dry Weight (ug/g), Mean Range	3-29
3-4. Concentrations of Hydrocarbons in Sediments in Micrograms per Gram Dry Weight (ug/g)	3-30
3-5. Common Phytoplankton Species of the Study Area	3-33
3-6. Major Zooplankton Taxa in the Southern California Bight	3-36
3-7. Dominant Benthic Infauna of the San Pedro Shelf from 9.3 Fathoms (17 m) to 131 Fathoms (240 m)	3-40

<u>Table</u>	<u>Page</u>
3-8. Dominant Benthic Infauna of the Slope Off Huntington and Laguna Beaches from 88 Fathoms (161 m) to 284 Fathoms (520 m)	3-41
3-9. Dominant Benthic Infauna of the San Pedro Basin from 340 Fathoms (622 m) to 485 Fathoms (888 m)	3-42
3-10. Dominant Epifauna of the LA-2 and Reference Sites	3-46
3-11. Common Fish Larvae of the Southern California Bight	3-49
3-12. Families of Fish Inhabiting the Pelagic Environment in the Southern California Bight ...	3-52
3-13. Marine Mammals of the Southern California Bight	3-55
3-14. Rare, Threatened or Endangered Species of the Southern California Bight	3-57
3-15. Weight and Value of Landings of Commercial Fish at Los Angeles Area Ports and in California, 1981-1983	3-64
3-16. Value of Commercial Fish Landing by Port, Los Angeles Area, 1981-1983	3-65
3-17. Annual Catch in Pounds of Commercial Fish by Blocks of Origin in the Los Angeles Area, 1976, 1977 and 1981	3-67
3-18. Waterborne Commerce and Projected Cargo Capacity at the Ports of Los Angeles and Long Beach,.....	3-69
3-19. Cargo Projections of Waterborne Cargo for the Ports of Los Angeles and Long Beach	3-71
3-20. 1980-2020 Total Acreage Requirements	3-72
3-21. Existing and Projected Number of Participation Days for Ocean-related Recreational Activities for Los Angeles and Orange Counties, 1980, 1985 and 1990	3-77
3-22. Number of Sportfish Caught and Number of Anglers on Commercial Passenger Fishing Vessels for Each Port in the Los Angeles Area, 1977 and 1981	3-79

<u>Table</u>	<u>Page</u>
3-23. Number of Sportfish Caught in Each California Department of Fish and Game Block in the Vicinity of the LA-2 ODMDS in 1977	3-81
4-1. Summary of Impacts and Mitigation Measures for the LA-2 Site	4-2
4-2. Summary of Impacts and Mitigation Measures for the No Action Alternative	4-4
4-3. Summary of Impacts and Mitigation Measures for the Shallow Water Alternative	4-5
4-4. Summary of Impacts and Mitigation Measures for the Deep Water Alternative	4-7
5-1. Issues Identified During the Scoping Process ...	5-11
5-2. Attendees at the Interagency Workshop on Ocean Disposal at the LA-2 and LA-5 Sites	5-18

LIST OF ABBREVIATIONS

ASBS	Areas of Special Biological Significance
BLM	U.S. Bureau of Land Management
CalCOFI	California Cooperative Oceanic Fisheries Investigations
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
COE	U.S. Army Corps of Engineers
CSWQCB	California State Water Quality Control Board
CSWRCB	California State Water Resources Control Board
DO	Dissolved oxygen
DOE	U.S. Department of Energy
EIR	environmental impact report
EIS	environmental impact statement
EPA	Environmental Protection Agency
FWS	U.S. Fish and Wildlife Service
JWPCP	Joint Water Pollution Control Project
LACSD	Los Angeles County Sanitation District
LPC	limited permissible concentration
MMS	U.S. Minerals Management Service
MPRSA	Marine Protection, Research, and Sanctuaries Act of 1972
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
OCS	outer continental shelf
ODMDS	Ocean Dredged Material Disposal Sites

PAR	Port Access Routes
PCB	polychlorinated biphenyls
RCRA	Resource Conservation and Recovery Act
SCCWRP	Southern California Coastal Water Research Project
SHPO	State Historic Preservation Officer
TDS	total dissolved solids
TSP	total suspended particulates
TSS	Traffic Separation Schemes
USCG	U.S. Coast Guard

As	arsenic
B	boron
Cd	cadmium
Co	cobalt
CO	carbon monoxide
Cr	chromium
Cu	copper
Fe	iron
HC	hydrocarbons
Hg	mercury
Mb	molybdenum
Mn	manganese
NO _x	nitrogen oxides
Oz	ozone
Pb	lead
pH	hydrogen ion concentration
Se	selenium
Zn	zinc

List of Measurements

cm/s	centimeters per second
ft	feet
gm ²	grams per square meter
g/C/m ² /day	grams per Centigrade degree per square meter per day
km	kilometers
m	meters
mg/l	milligrams per liter
mg/m ²	milligrams per square meter
mm	millimeters
m ³	cubic meters
nmi	nautical miles
ppt	parts per thousand
ug/g	microgram per gram
ug/kg	microgram per kilogram
ug/l	microgram per liter
um	micro meters

Conversions

1 fathom = 0.547 meters

1 meter = 0.3048 feet

1 nautical mile = 0.54 kilometers

1 kilometer = 1.609 statute miles

cubic meters = 0.7646 cubic yards

EXECUTIVE SUMMARY

S.1. INTRODUCTION

This Environmental Impact Statement (EIS) evaluates the designation of an ocean dredge material disposal site (ODMDS) located southwest of the Ports of Los Angeles and Long Beach in southern California (Figures S-1, S-2). The Environmental Protection Agency (EPA), Region 9 is issuing this EIS, in close cooperation with the Army Corps of Engineers, (COE) Los Angeles District, according to Title I of the Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972 and as required by EPA's national policy on the designation of ocean disposal sites (39 FR 37119, October 24, 1974).

The EIS has been prepared to document compliance with EPA's site designation criteria at 40 CFR 228. A full range of alternatives has been examined to determine the best means for managing ocean disposal of dredge material. The goal of this management program is to authorize disposal of dredge material without unreasonable degradation of the ocean with respect to human health and the marine environment.

The Preferred Alternative is to designate the LA-2 site, as the site for disposal of dredged material from the Ports of Los Angeles and Long Beach. This site has been used as an interim disposal site since the 1970s. Maintenance dredging of channels and expansion of dock capacities are essential to sustain economic growth and strategic use of the ports. The designated site can be used for the disposal of dredged material from Federal projects and permit applications only after the applicant establishes that the dredged material will not exceed the capacity of the site and that the material is in compliance with EPA and COE criteria and regulations. The LA-2 site and the two alternative ocean disposal sites were evaluated according to EPA's site selection criteria (40 CFR 228.5 and 228.6). No advantages were found in moving the disposal site from the interim LA-2 location to a shallow water or a deep water location.

A wide range of alternatives were considered in the EIS to determine the most suitable disposal site. These alternatives included:

- A. Ocean Disposal at the LA-2 Site (Preferred Alternative),
- B. No Action,
- C. Delayed Action,
- D. Landfilling in Port Areas,
- E. Landfilling at Sanitary Landfill Sites,
- F. Beach Nourishment,
- G. Ocean Disposal at a Shallow Water Site, and
- H. Ocean Disposal at a Deep Water Site.

Preliminary analyses indicated that alternatives other than ocean disposal were either inadequate, not feasible, or more environmentally damaging. The major alternatives evaluated

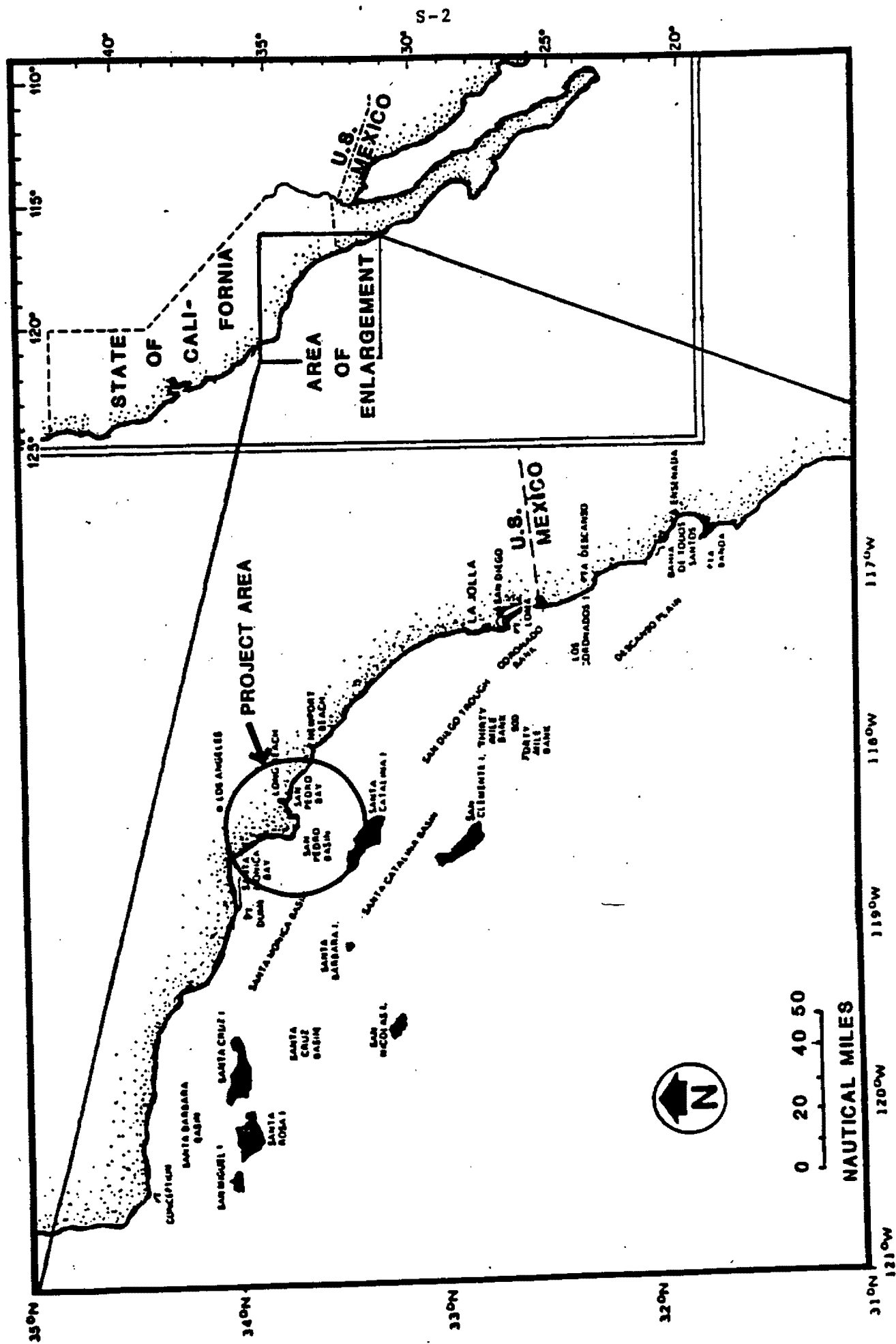


FIGURE 8-7. MAP OF PROJECT REGION

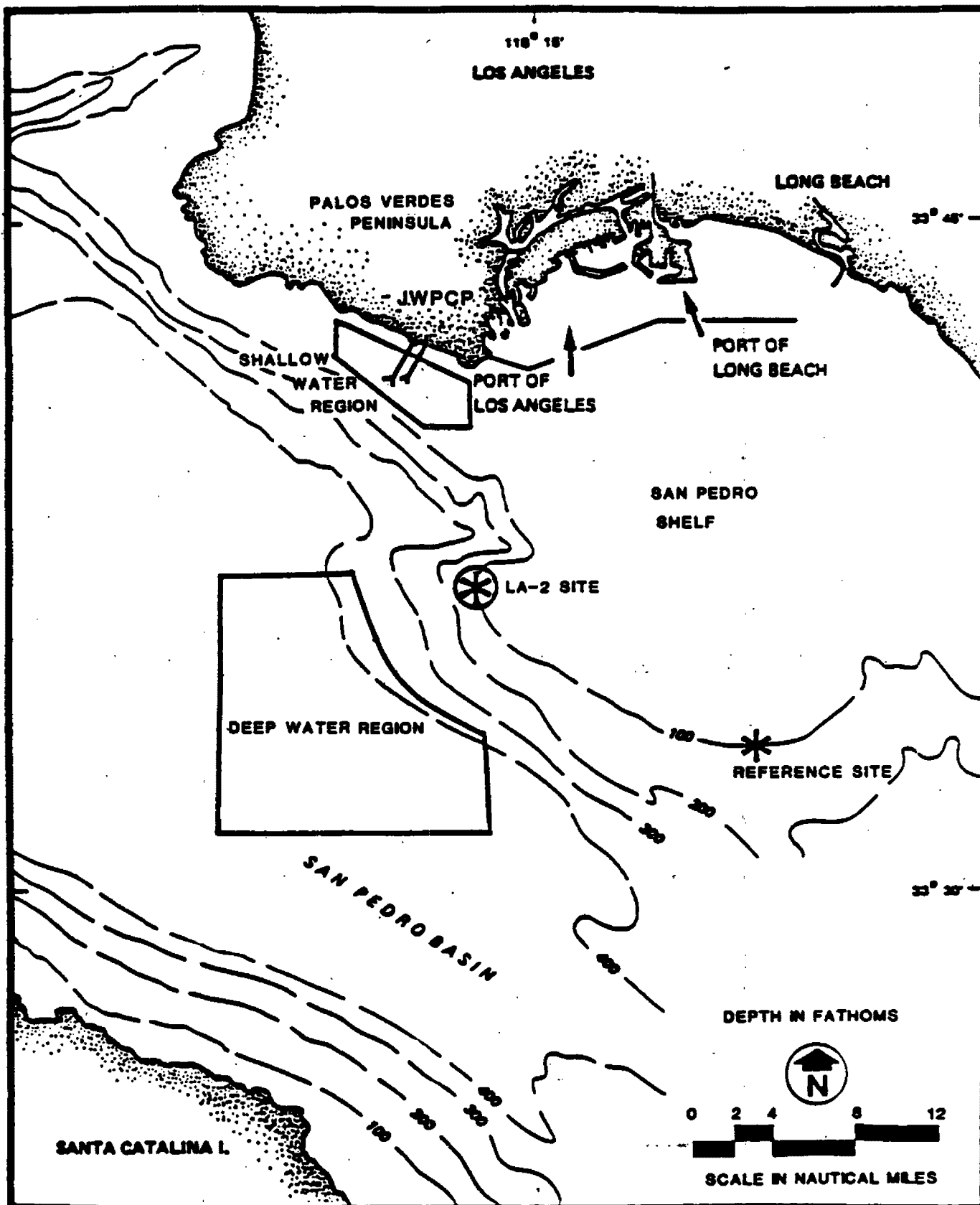


FIGURE S-2. MAP OF THE PROJECT AREA

JWPCP: LOS ANGELES COUNTY JOINT WATER POLLUTION CONTROL PROJECT AT WHITES POINT

through detailed environmental analyses were ocean disposal at the LA-2 site, a shallow water site, and a deep water site. The other alternatives were considered infeasible for the adequate disposal of dredged material from the Los Angeles and Long Beach Harbor areas.

S.2. PHYSICAL ENVIRONMENT

The three potential ocean disposal sites are located on the coastal shelf off the Palos Verdes Peninsula, on the slope leading to the San Pedro Basin, and in the San Pedro Basin. They are shallow water, near-slope, and deep water regions, respectively. The near-slope site is the location of the LA-2 interim disposal site and is referred to as the LA-2 site. This area of the Southern California Bight is characterized by a narrow mainland shelf followed by a complex series of basins and ridges. Prominent sediment deposits of sands and muds are present on the shelf, basins, and intervening slopes. Numerous earthquakes have been reported in the offshore area between Los Angeles and Orange Counties and Santa Catalina Island.

Physical oceanographic conditions in the Southern California Bight are dominated by the California current system. This system consists of the California Current, the California Undercurrent, the Southern California Countercurrent, upwelling conditions present from March to June, and associated eddies that affect coastal areas. The oceanic currents that flow over the shelf are complex and variable. Surface currents are influenced by wind patterns, while the deeper currents are influenced by the tides, geostrophic currents, and complex submarine topography.

Water quality at the LA-2 site is indistinguishable from the water quality of nearby areas. Temperature, dissolved oxygen, pH, salinity, turbidity, and concentrations of metals, oil and grease, and chlorinated hydrocarbons are not significantly different from a nearby reference site. Water quality at the deep water site is expected to be similar to that of the LA-2 site. Water quality at the shallow water site is a function of the proximity to the Los Angeles County Joint Water Pollution Control Project (JWPCP) sewage outfall at Whites Point on the Palos Verdes Peninsula. The effluent discharged from these outfalls impacts the quality of nearshore water. Disposal of dredge material at the shallow water site, although small in comparison to total effluent output, may cause cumulative impacts in the immediate area.

Sediment quality at the LA-2 site is significantly different from a nearby reference site. A greater range of fine and coarse sediments are present, they are more poorly sorted, and concentrations of metals, pesticides and polychlorinated biphenyls (PCBs) are higher. This is a result of past disposal activities during the interim designation period.

Sediments at the deep water site are relatively undisturbed by previous activities, although dissolved oxygen levels would be low as a result of natural conditions at great depths. The deeper sediments, composed of silts and clays, are expected to be finer than the LA-2 site. Levels of contaminants would be low; however, concentrations of some metals are naturally high in deep basin sediments because these ions are released in reduced, oxygen-depleted environments.

Sediment quality at the shallow water site, not impacted by the JWPCP sewage outfalls, is coarser than the other two sites because sand is the main component. Near the outfalls, the sediment is finer and sediment quality is degraded by higher levels of biological oxygen demand, heavy metals, pesticides, PCBs, and total organic carbon.

A field survey conducted for this EIS indicates that disposal activities have caused significant changes in the characteristics of bottom sediments. If permanent designation were approved for dredged material disposal, sediment degradation would be a continuing effect at the LA-2 site, while it would be a new effect at the two alternative sites. At the shallow water site, where sediment quality has been degraded by discharges of municipal waste, sediment quality would be additionally degraded by disposal of dredged material.

S.3. BIOLOGICAL ENVIRONMENT

The benthic community will be affected most by disposal activities at any of the designated disposal sites. Benthic infauna and epifauna of the LA-2 site are typical of the southern California slope community (Jones and Fauchald, 1977) although diversity is depressed in comparison to a nearby reference site. The benthic community of the deep water site is low in biomass and diversity (Hartman and Barnard, 1958; Fauchald and Jones, 1978a), while the benthic organisms at the shallow water site vary directly with proximity to the Whites Point outfalls (SCCWRP, 1973).

Disposal of dredged material may cause lower species diversity and species abundance of infauna, epifauna and demersal fish at each site. Direct causes of these changes are smothering, alteration of sediment characteristics, the potential increase in the concentration of toxic substances, and increased body tissue burdens of some chlorinated hydrocarbons. This would be a continuation of the observed conditions at the LA-2 site, but these effects would be new at the two alternative sites. The severity of the effects which might result from the introduction of toxic substances may be less significant at the shallow water site, where the benthos is already degraded considerably by discharge of municipal effluents. Impacts to deep water infauna and epifauna may be less than presently occurring at the LA-2 site because material reaching the deep basin will be dispersed over a greater area.

Upper water column organisms such as plankton, pelagic fish, pinnipeds and cetaceans are not expected to be affected by disposal activities in the ocean. Most of the threatened and endangered species found in southern California waters do not require any of the potential disposal areas for critical habitat. However, because the shallow water site is close to shore, feeding and nesting activities of the California least tern and brown pelican, as well as inhabitants of nearshore kelp beds, could be affected.

There are three State ecological reserves, eight State marine life refuges, a State reserve for all of Santa Catalina Island, the Channel Islands National Marine Sanctuary, and a National Wildlife Refuge at Seal Beach in the vicinity of the LA-2 site (Figure S-3). Seven of the State reserves and refuges are also designated as Areas of Special Biological Significance. The closest of these reserves, the Abalone Cove Ecological Reserve, is located approximately 5.4 nautical miles (nmi) (10 kilometers or km) north of the LA-2 site. This small area of coastal kelp beds would probably not be impacted by the ODMDS disposal activities because prevailing currents would carry contaminants away from this area. All of the other designated areas of biological significance are 15 or more nmi (28 km) from the LA-2 site. No significant environmental impacts are expected to affect any of these State or Federal areas.

S.4. SOCIOECONOMIC ENVIRONMENT

The Los Angeles area is an important center for commercial fishing. In 1983, landings at Los Angeles area ports accounted for 51 percent of the weight and 46 percent of the total value of all landings in California (COE, 1985). Locally, the most important commercial fisheries are northern anchovy, Pacific bonito, jack mackerel, Pacific mackerel, rock crab, market squid, and sea urchin. The effects on commercial fishing are expected to be negligible.

Los Angeles and Long Beach Harbors play a very important role in the nation's waterborne commerce. More than 8,000 vessels call at the two ports annually and the number is expected to increase to 16,000 if dredging plans are completed (COE, 1985). Vessel traffic in the harbor vicinity is routed through a system of Traffic Separation Schemes (TSS) and Port Access Routes (PAR) established by the U.S. Coast Guard (USCG) to enhance safety (Figure S-4). The LA-2 site is located within a mile of the southbound lane of the TSS and over a mile from the southwestern corner of a precautionary area.

The disposal of dredge material could present two potential hazards to commercial navigation including mounding within the disposal site, and interference of disposal barges with vessel traffic. USCG has expressed concern that disposal barges may cause confusion for traffic as they cross the inbound lane of the TSS to reach the disposal site. COE has incorporated

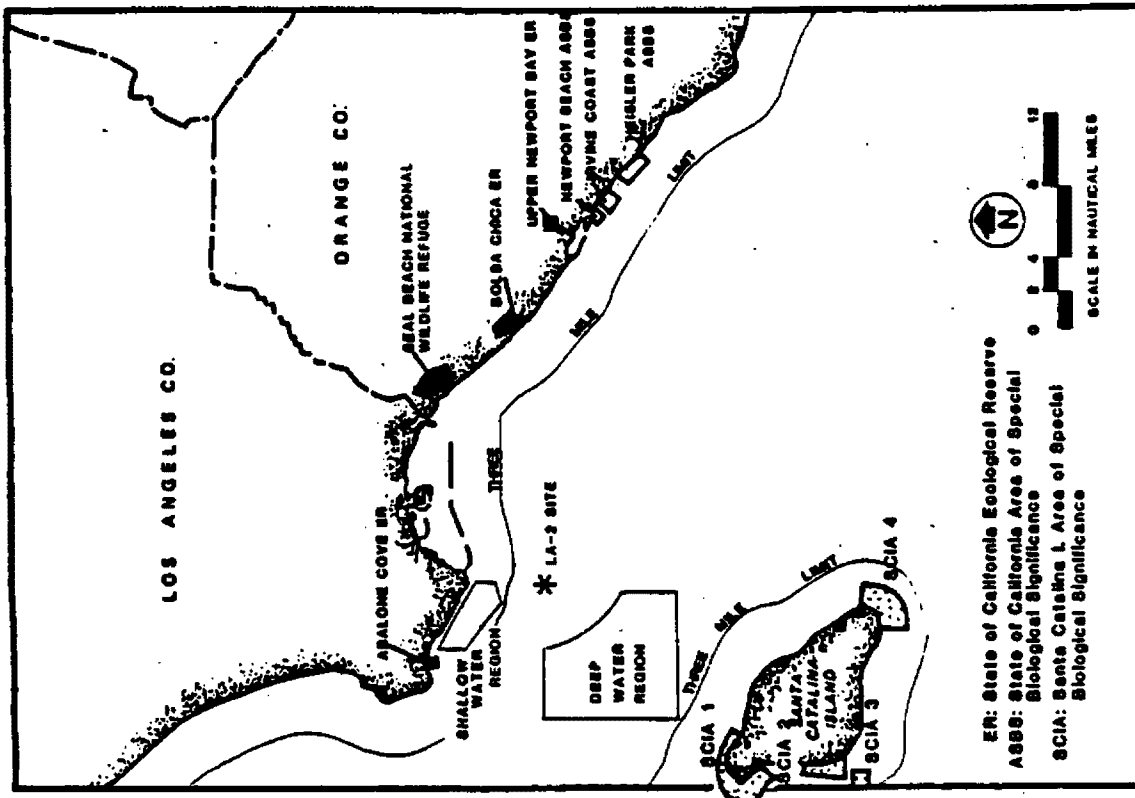
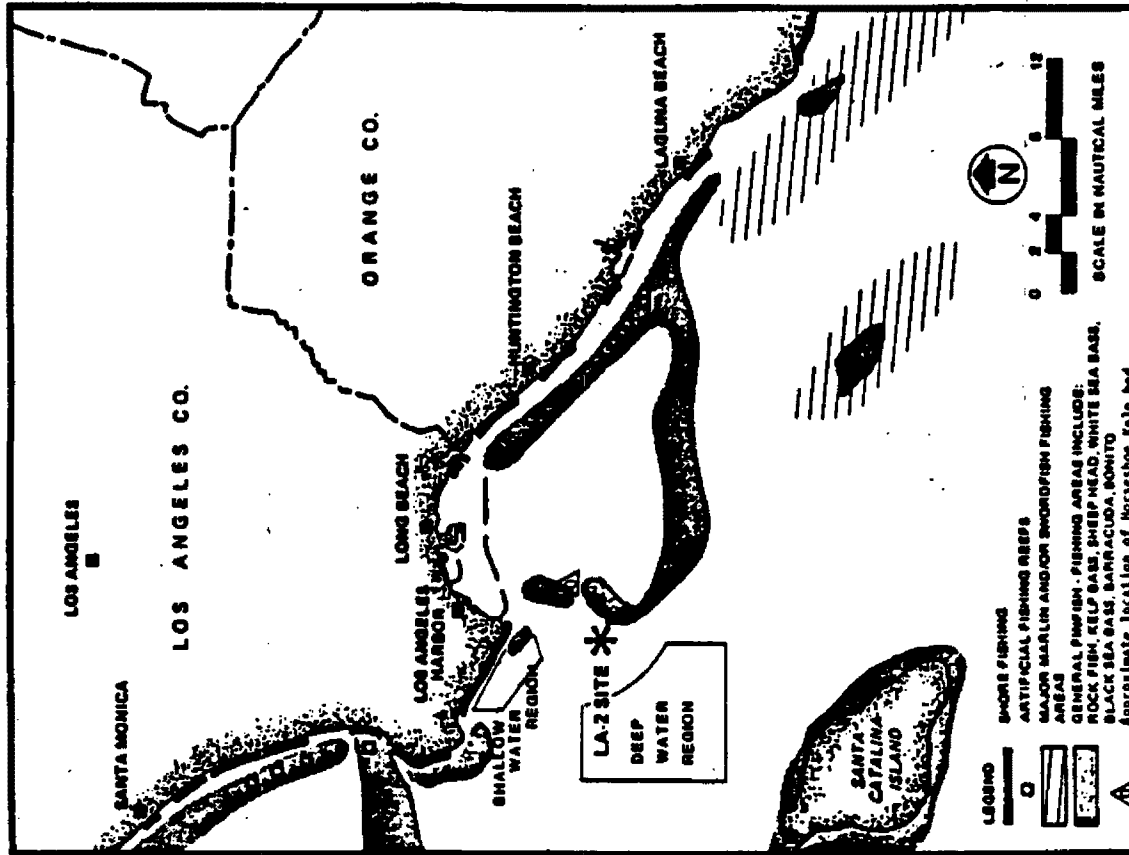


FIGURE 8-3 MAP OF MAJOR BIOLOGICAL RESOURCES IN THE PROJECT AREA

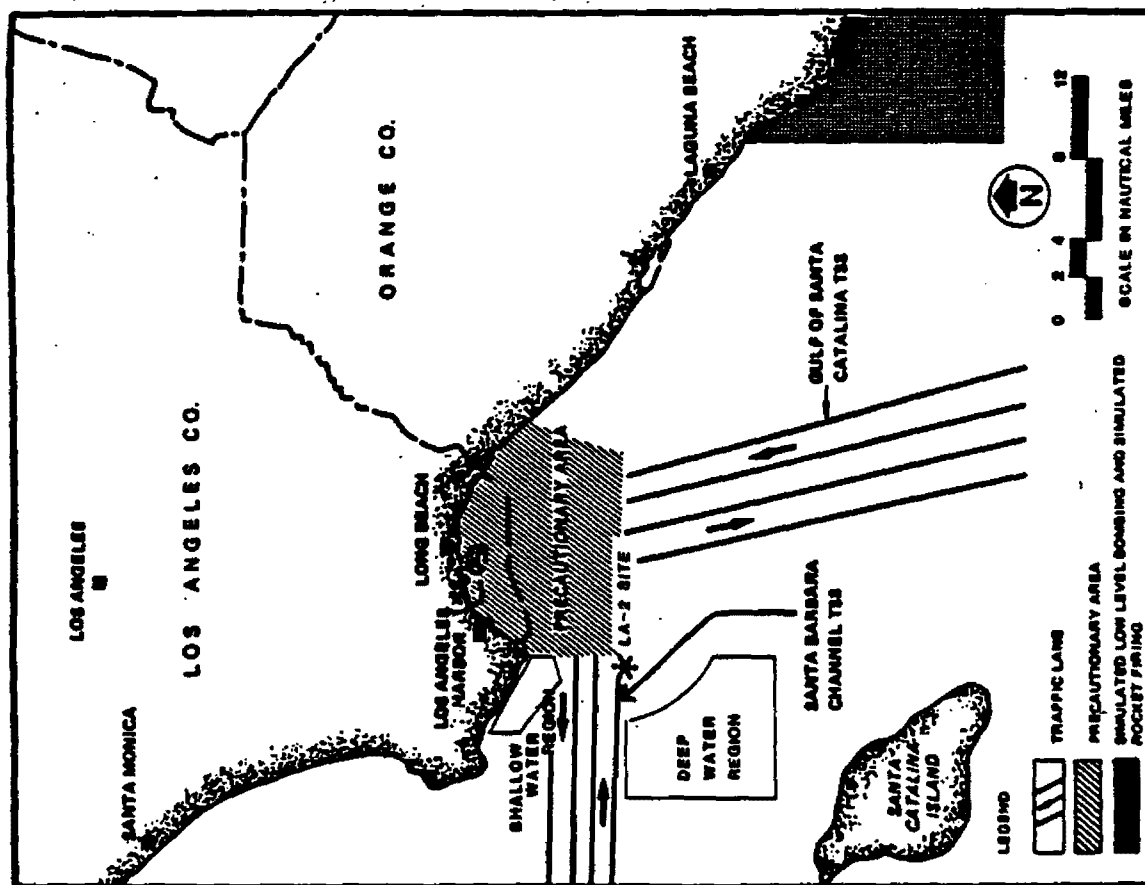
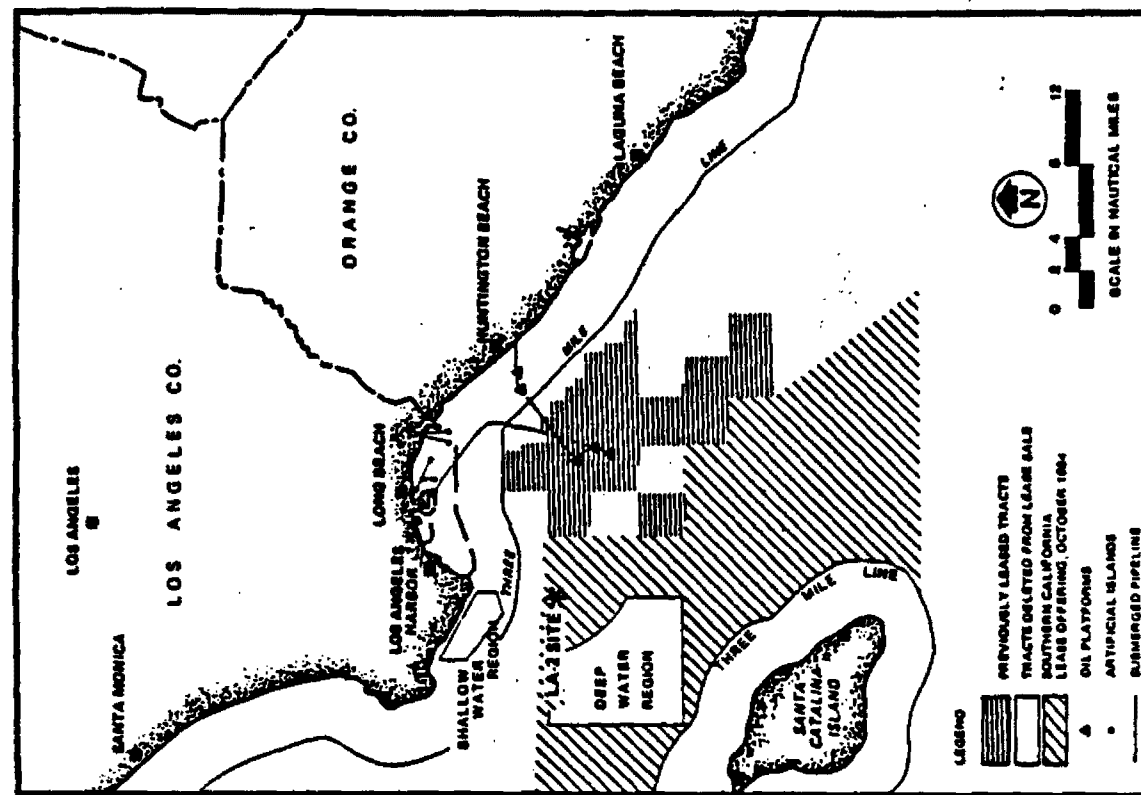


FIGURE 8-4. MAJOR SOCIOECONOMIC FEATURES IN THE PROJECT AREA (CONTINUED ON NEXT PAGE)

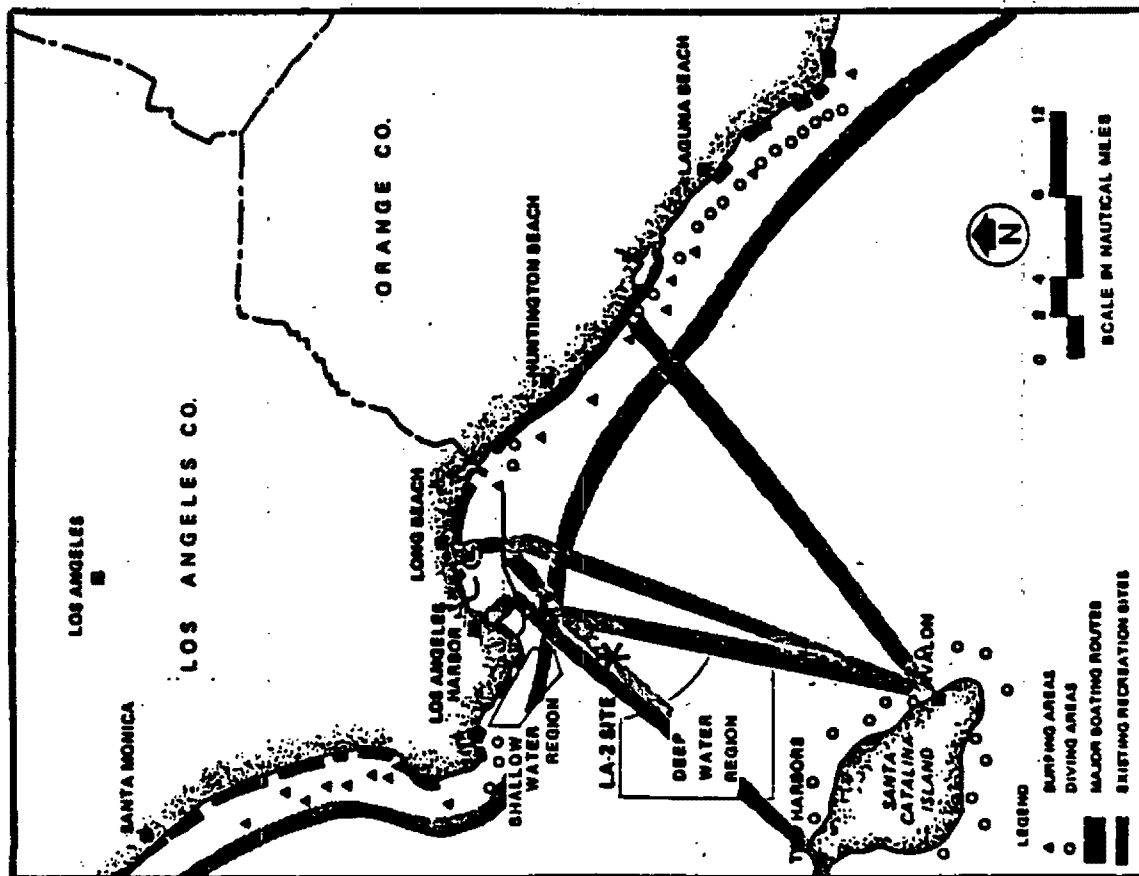
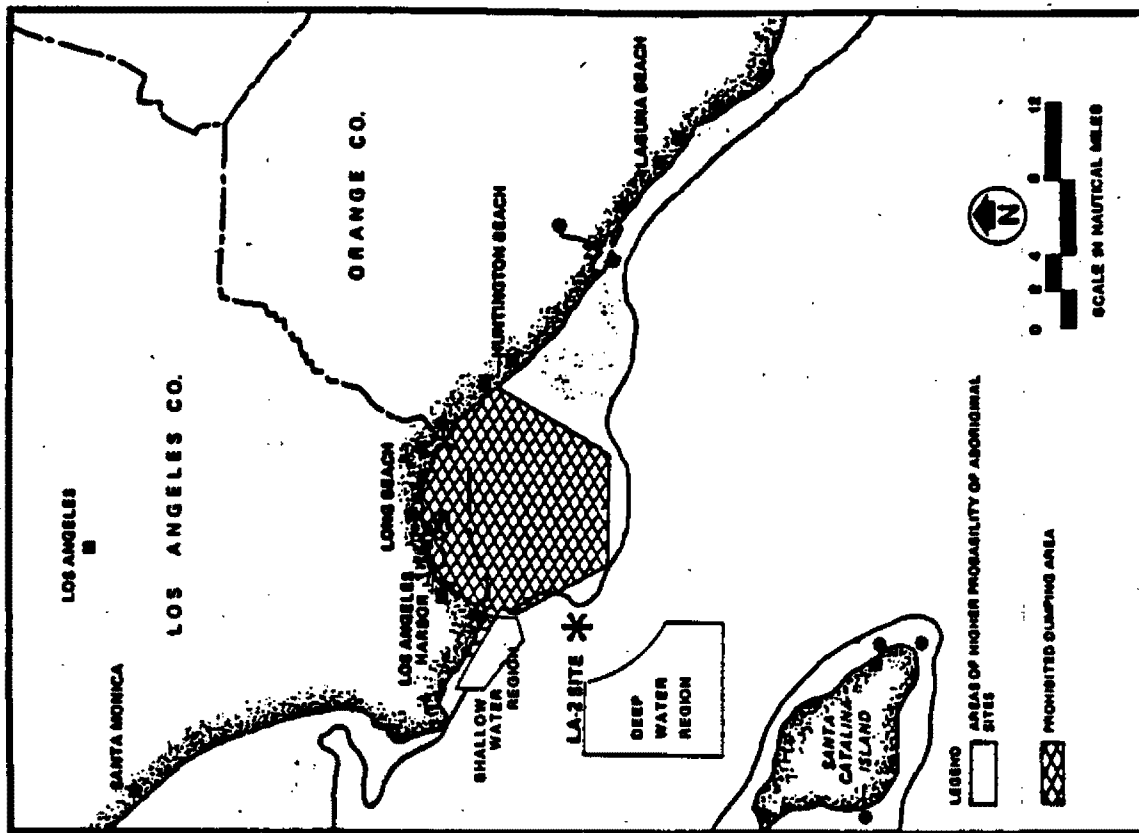


FIGURE S-4. MAJOR SOCIOECONOMIC FEATURES IN THE PROJECT AREA (CONTINUED FROM PREVIOUS PAGE)

special conditions into all permits to dispose materials at LA-2 site to avoid potentially confusing situations. These conditions include: 1) disposal in the approved site as far from the shipping lanes as possible, 2) notification of dumping to the USCG, and 3) submittal by the permittee of a disposal report upon completion of the project. Other conditions may be imposed as needed. Potential for vessel conflict is considerably less if the shallow water site is used for disposal; however, mounding problems may be greater.

The area offshore of southern California is one of the nation's largest naval operating locations. Navy exercises are conducted continuously throughout the year and involve substantial vessel movement near the Ports of Los Angeles and Long Beach. Most of the military operations take place far beyond the immediate coastal areas, but military vessels travel between the ports on a regular basis. Disposal activities will not pose a significant danger or cause interference with military vessels. Potential impacts would be lowest at the shallow water site.

Oil and gas activities offshore of Los Angeles and Orange Counties are regulated by State and Federal agencies. Six artificial islands off the Port of Long Beach, two platforms, and two marine terminals are located within the State waters. Offshore structures in Federal waters include two platforms, and one production facility approximately 8.8 nmi (16 km) east of the LA-2 site.

Federal leases have been awarded for 15 full or partial tracts and the nearest leased area is approximately four miles east of the LA-2 site. Neither the tract containing the LA-2 site nor any tracts in the general vicinity were leased during Lease Sale 80 held in October 1984. Since the tract containing the LA-2 site was not sold in the lease offering, direct interference between drilling and disposal activities is not anticipated in the foreseeable future. The shallow water site is located within the State designated oil and gas sanctuary and no impacts to oil and gas development are anticipated if this site is selected for disposal. The likelihood of future oil or gas development in the vicinity of the LA-2 site remains uncertain.

In 1980, Los Angeles and Orange Counties experienced 81 million participation days of ocean-related recreational activities (California Department of Parks and Recreation, 1984). This demand is expected to grow by more than 10 percent during the 1980-1990 period. Activities which are expected to experience highest growth include sailing, sportfishing, power boating, and scuba diving. The recreational activity most likely to be affected by disposal activities is pleasure boating. No incidents have been reported during the nine years that the LA-2 site has been used as an interim disposal site. Impacts on other recreational activities are considered to be minimal.

The offshore region of southern California is known to contain numerous cultural resources. Over 450 known historic shipwrecks have occurred in southern California, most of them near Los Angeles or San Diego. Neither the tract containing the LA-2 site nor any tract in the immediate vicinity of the site has been identified as a location for historic shipwrecks or other cultural resources. Potential impacts to cultural resources are greater at the shallow water site and nonexistent at the deep water site.

As stated in MPRSA, no materials considered to be hazardous may be disposed at an ODMDS. Therefore, the potential for health hazards is considered to be minimal because increases in disposal activities beyond those permitted in the past several years are not anticipated. Potential impacts to human safety are considered very low because strict monitoring of traffic by USCG in the zone of operation will be maintained. Public health and safety effects are similar at the two alternative ocean sites.

S.5. MAJOR CONCLUSIONS

1. The preferred alternative is the formal designation of the LA-2 site as an ODMDS for continuing use according to EPA directive 40 CFR 228.5(e).
2. The alternatives of No Action, Delayed Action, Landfilling in Port Areas, Disposal at Sanitary Landfills, and Beach Nourishment are not feasible, nor can they accommodate the major portion of the dredge material expected to be generated by future dredging projects.
3. Compared to a nearby reference site and to other sites in the area, the LA-2 site has a greater range of grain sizes and more poorly sorted sediments, elevated levels of trace metals and chlorinated hydrocarbons, oils and greases in the sediment, less diverse infauna, less abundant epifauna, and less diverse demersal fish.
4. Disposal of dredge material at the LA-2 site would maintain the conditions listed in Conclusion 3. Designation of either of the other sites would introduce these conditions as new environmental impacts. Therefore, the LA-2 site is the most environmentally suitable site for disposal of dredged material, primarily because the environmental effects of disposal activities already exist and designation will prevent degradation of other areas.
5. Disposal is not expected to have significant adverse effects on other aspects of the physical and biological environment.
6. The effects of dredged material disposal would add significantly to existing degradation of the benthic environment at the alternative shallow water site, which is presently affected by large discharges of municipal waste.

7. Disposal is not expected to have significant effects on socioeconomic resources for any of the three alternative sites.
8. The moderate, localized environmental effects of ocean disposal of dredged material are considered acceptable in light of the economic benefits of dredging and the infeasibility and/or adverse environmental effects of alternative disposal methods.

Tables S-1, S-2, S-3, and S-4 summarize the impacts and potential mitigation measures for disposal at the LA-2 site, no action and disposal at the shallow water or deep water sites. Classes of environmental impacts used in these tables are defined as:

- Class I - Significantly adverse impacts that cannot be mitigated to insignificance. This means that no measures could be taken to avoid or reduce these adverse effects to insignificant or negligible levels.
- Class II - Significant adverse impacts that can be mitigated to insignificance. These impacts are potentially similar in significance to Class I impacts, but the severity of the impact can be reduced or avoided by implementation of mitigation measures discussed under each heading.
- Class III - Adverse but insignificant impacts, or no effect anticipated. No mitigation measures are required for these impacts or effects.
- Class IV - Beneficial impacts. These impacts would improve conditions relative to the preproject baseline conditions. They are further subdivided as significant or insignificant where applicable.

Chapter 4 of this EIS describes these impacts in detail and discusses their significance.

**Table S-1. Summary of Impacts and Mitigation Measures for the LA-2 Site
(Refer to text in Chapter 4 for detailed explanation.)**

Impacts					Potential Mitigation Measures				
Description	Class				Scope (1)			Term (2)	
	I	II	III	IV	S	L	R	S	E
PHYSICAL ENVIRONMENT									
Air Quality			X		X			X	
Water Quality			X		X				X
- turbidity, DO	X				X			X	No mitigation measures proposed because effects are short-term.
- trace metals, DDTs, PCBs, oils and greases	X				X			X	
Geology									
- sediment grain size	X				X				X
- sediment quality	X				X				X
BIOLOGICAL ENVIRONMENT									
Plankton			X		X			X	
Kelp			X				X		X
Benthic Infauna	X				X				X
Benthic Epifauna	X				X				X
Demersal Fish	X					X		X	
Pelagic Fish			X			X			X
Coastal Birds			X				X		X
Marine Mammals			X			X			X
Threatened and Endangered Species			X			X			X
Marine Sanctuaries and ASBS			X				X		X
(CONTINUED)									

(1) = Scope Definitions

S = site, 1000 yd (914 m) radius from center of designated ODMDS.

L = local, up to 1 nmi outside of site.

R = region, beyond local vicinity of ODMDS.

(2) = Term

S = short, less than or equal to 5 hours.

E = extended, greater than 5 hours.

Table S-2. Summary of Impacts and Mitigation Measures for the No Action Alternative (Refer to text in Chapter 4 for detailed explanation.)

- Impacts					Potential Mitigation Measures				
Description	Class				Scope (1)			Term (2)	
	I	II	III	IV	S	L	R	S	E
PHYSICAL ENVIRONMENT				X	X			X	
BIOLOGICAL ENVIRONMENT				X	X			X	
SOCIOECONOMIC ENVIRONMENT									
Commercial Shipping and Military Use		X					X	X	
Public Health, Safety, Aesthetics				X		X		X	

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nm outside of site.
R = region, beyond local vicinity of ODMDS.

(2) = Term
S = short, less than or equal to 5 hours.
E = extended, greater than 5 hours.

Table S-3. Summary of Impacts and Mitigation Measures for the Shallow Water Alternative (Refer to text in Chapter 4 for detailed explanation.)

Impacts					Potential Mitigation Measures				
Description	Class				Scope (1)			Term (2)	
	I	II	III	IV	S	L	R	S	E
PHYSICAL ENVIRONMENT									
Air Quality			X			X		X	
Water Quality									
- turbidity, DO		X			X			X	
- trace metals, DDTs, PCBs, oil and grease		X			X			X	
Geology									
- sediment grain size		X			X				X
- sediment quality		X			X				X
BIOLOGICAL ENVIRONMENT									
Plankton			X			X		X	
Kelp		X					X		X
Benthic Infauna		X				X			X
Benthic Epifauna		X				X			X
Demersal Fish		X			X				X
Pelagic Fish			X				X		X
Coastal Birds			X				X		X
Marine Mammals			X			X			X
Threatened and Endangered Species				X		X			X
Marine Sanctuaries and ASBS		X				X			X
(CONTINUED)									
(1) = Scope Definitions S = site, 1000 yd (914 m) radius from center of designated ODMDS. L = local, up to 1 nmi outside of site. R = region, beyond local vicinity of ODMDS.									
(2) = Term S = short, less than or equal to 5 hours. E = extended, greater than 5 hours.									

Table S-4. Summary of Impacts and Mitigation Measures for the Deep Water Alternative (Refer to text in Chapter 4 for detailed explanation.)

Impacts					Potential Mitigation Measures				
Description	Class				Scope (1)			Term (2)	
	I	II	III	IV	S	L	R	S	E
PHYSICAL ENVIRONMENT									
Air Quality			X			X		X	
Water Quality			X			X			X
- turbidity, DO	X					X		X	
- trace metals, DDTs, PCBs, oils and greases	X					X		X	
Geology									
- sediment grain size	X				X				X
- sediment quality	X				X				X
BIOLOGICAL ENVIRONMENT									
Plankton			X			X		X	
Kelp			X			X			X
Benthic Infauna	X					X			X
Benthic Epifauna	X					X			X
Demersal Fish	X					X		X	
Pelagic Fish			X			X			X
Coastal Birds			X				X		X
Marine Mammals			X			X			X
Threatened and Endangered Species			X			X			X
Marine Sanctuaries and ASBS			X				X		X
(CONTINUED)									

(1) = Scope Definitions
 S = site, 1000 yd (914 m) radius from center of designated ODMDS.
 L = local, up to 1 nmi outside of site.
 R = region, beyond local vicinity of ODMDS.

(2) = Term
 S = short, less than or equal to 5 hours.
 E = extended, greater than 5 hours.

Table S-4 (continued). Summary of Impacts and Mitigation Measures for the Deep Water Alternative (Refer to text in Chapter 4 for detailed explanation.)

Impacts					Potential Mitigation Measures				
Description	Class				Scope (1)			Term (2)	
	I	II	III	IV	S	L	R	S	E
SOCIOECONOMIC ENVIRONMENT									
Commercial Fishing			X		X	X		X	
Commercial Shipping									
- interference			X			X		X	
- port access				X		X		X	
Oil and Gas Development									
- present			X		X			X	
- future		X			X			X	Site oil facilities in part of tract far removed from disposal site.
Military Usage			X		X	X		X	
Sport Fishing			X		X			X	
Other Recreational Activities			X		X			X	
Cultural Uses			X		X			X	
Public Health and Welfare									
- health			X			X		X	
- safety			X		X			X	Disposal during daylight hours of weekdays only.
Aesthetics			X			X		X	

(1) = Scope Definitions

S = site, 1000 yd (914 m) radius from center of designated ODMDS.

L = local, up to 1 nmi outside of site.

R = region, beyond local vicinity of ODMDS.

(2) = Term

S = short, less than or equal to 5 hours.

E = extended, greater than 5 hours.

CHAPTER 1. INTRODUCTION

1.1. GENERAL INTRODUCTION

1.1.1. Historical Background

The U.S. Environmental Protection Agency (EPA) designated the LA-2 ocean dredged material disposal site (ODMDS) (Figure 1-1) as an interim site for disposal of dredged material off Los Angeles, California (42 FR 2462, January 11, 1977). This was made possible through EPA's authority under Section 102 of the Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972 (33 U.S.C. 1401 et seq.). The Act established a permit program for ocean disposal of dredged and nondredged material that mandated the determination of environmental impacts, designation of sites, enforcement of permit conditions and management of the disposal sites. EPA's regulations pertaining to MPRSA require that, during the interim period, the effects of dredged material disposal on the marine environment be fully considered prior to final designation of a site.

Interim designation was originally issued for a three year period, but EPA extended the interim designation of the LA-2 site in 1980 and issued a schedule for final designation by February 1, 1983 as the result of litigation (National Wildlife Federation v. Costle 14 ERC 1600, et seq., 1980). Subsequently, an extension until December 31, 1988 was granted (50 FR 6943, February 19, 1985) to allow completion of field studies, environmental evaluation and preparation of the environmental impact statement (EIS).

It is EPA's policy to publish an EIS for all ODMDS designations (39 FR 37119, October 21, 1974). As a result of the need of the U.S. Army Corps of Engineers (COE) for an ODMDS off Los Angeles, EPA requested that the COE, Los Angeles District prepare the disposal site EIS because they had the necessary technical expertise to evaluate conditions on the San Pedro Shelf and Basin and they issued permits for ocean disposal at the interim site. EPA retains responsibility for the EIS and related public coordination.

Since 1977, COE has issued permits for disposal of approximately 2.1 million yd³ of dredged material at the LA-2 site (Table 1-1). Most of these permits were issued for specific disposal projects. The Ports of Los Angeles and Long Beach have multi-year permits for disposal of dredged material from channel maintenance activities. In 1981, the Port of Los Angeles was issued a permit to dispose of 100,000 yd³ per year of dredged material between June 1982 and June 1987. A limit of 200,000 yd³ per year was placed on material to be disposed at the LA-2 site. The Port of Long Beach had a permit from October 1982 to October 1985 to dispose up to 50,000 yd³ of dredged material per year.

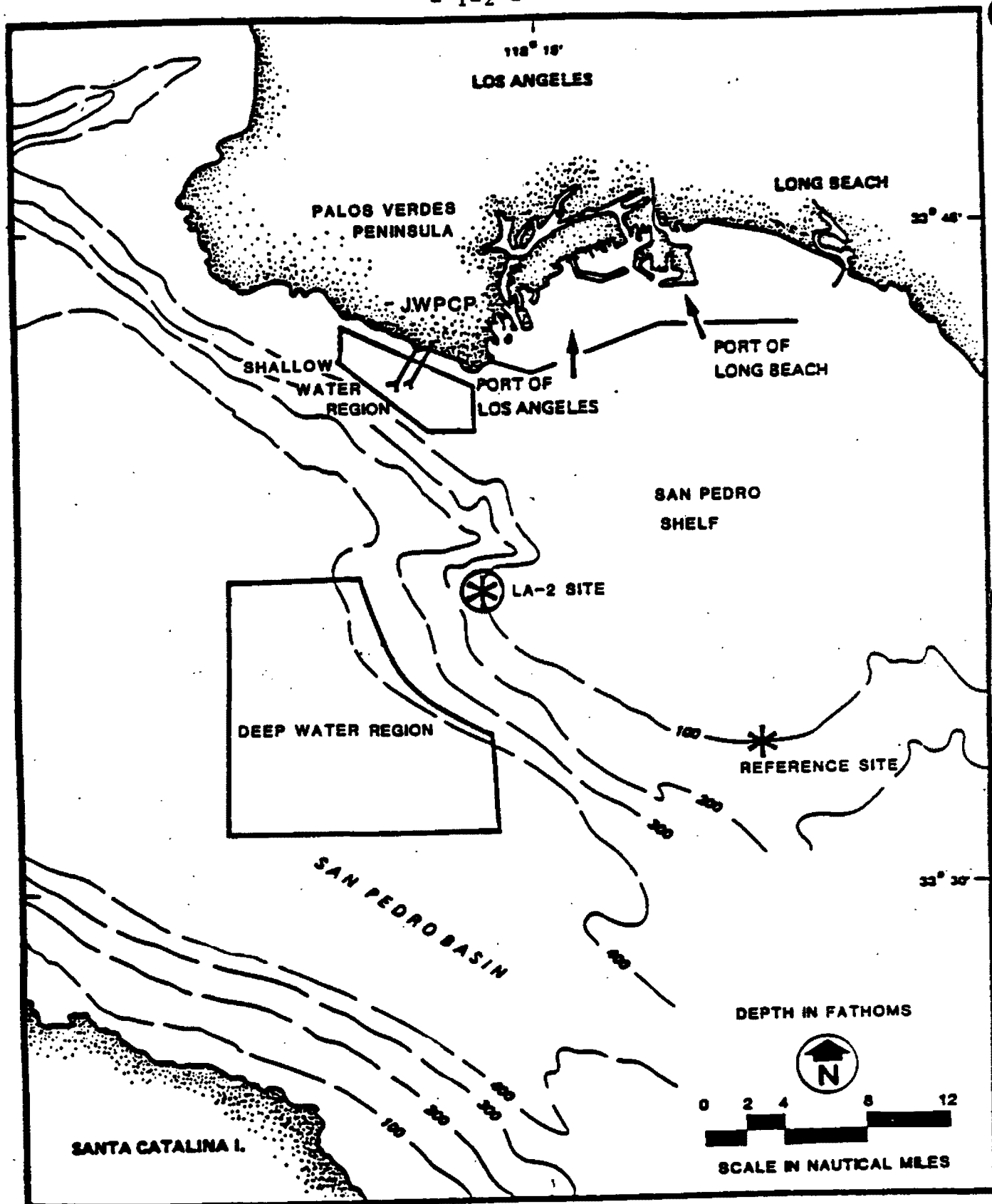


FIGURE 1-1. MAP OF THE PROJECT AREA

JWPCP: LOS ANGELES COUNTY JOINT WATER POLLUTION CONTROL PROJECT AT WHITES POINT

Table 1-1. Permits Issued by the COE for Disposal of Dredged Material at the LA-2 Site (a)

Year Final Action Taken	Permit Application Number	Permitted Disposal Allowed (b)	Actual Annual Disposal Under COE Permits (b)
1978	78-0160	100,000	100,000
1979	-----	-----	0
1980	79-0133	60,000	60,000
1981	81-0089	330,000	430,000 (c)
	81-0090	500,000	
1982	81-0114	75,000	688,000 (c)
	81-0127	340,000	
	81-0218	40,000	
	82-0003	83,000	
	82-0061	150,000	
1983	83-0086	15,000	
	83-0045	122,000	165,000
1984	-----	0	122,000
1985	85-0042		8,200
	85-0080		
	85-0194	185,000	
1986	85-0201	<u>65,000</u>	<u>43,000</u>
TOTAL		2,065,000	1,616,200

(a) All dredged material disposed was silt/sand.
(b) Cubic yards.
(c) Volumes are higher due to special projects, particularly the deepening of the Los Angeles Harbor Channel in 1982.
(COE, unpublished information, 1987)

Prior to 1977, the LA-2 site was used occasionally for disposal of dredged material and no disposal of dredged material resulting from COE projects has taken place at LA-2. The total amount of material disposed at the LA-2 site from COE-permitted projects has averaged approximately 180,000 yd³ per year, with a range between 8,200 yd³ and 688,000 yd³ over the past nine years. Future disposal activity is not expected to be greater than the historic use of the site because dredged material from newly planned projects at the ports may be used for landfills in harbor area or harbor expansion projects (COE, 1985).

Dredging operations are usually short-term activities involving a few days or weeks in a given year. During the dredging period, barges make two to four trips a day depending upon the size of the barge. Maintenance dredging activity at the Los Angeles and Long Beach Harbors is small in comparison to many California harbors. An exception to this generalization was the dredging project that deepened the Los Angeles Harbor Channel in 1982. Over a period of three months, the contractor made 125 trips to the LA-2 site to dispose of 100,000 yd³ of material.

Formal designation of the LA-2 site would continue ocean disposal of environmentally acceptable material at this interim location. Permitted projects would include disposal of dredged material from areas within the ports that do not involve approved diked disposal plans and disposal of acceptable dredged material from areas within the ports, provided that there are no practicable alternatives to ocean disposal.

1.1.2. Dredged Material Permitting

Use of the LA-2 site for dredged material disposal will be assessed on an individual project basis in accordance with the provisions of EPA's Ocean Dumping Regulations (40 CFR 220-225, 227-228) and COE's dredged material disposal permitting process under Section 103 of MPRSA. Each application for a COE permit to dispose of dredged material at the LA-2 site is reviewed for environmental acceptability in accordance with established guidelines and in compliance with mitigative restrictions that will be defined in the final site designation EIS. Figure 1-2 outlines the cycle used by EPA and COE to evaluate permit requests for ocean disposal of dredged material.

Dredged material must meet several COE criteria before it can be considered for ocean disposal. The material can be disposed of without further testing if it meets the following criteria (33 CFR 227.13):

- A. The material is composed predominantly of rock, sand or gravel and it will be dredged from areas of high current or wave energy;
- B. The material is composed predominantly of sand, gravel or shell compatible in grain size with the receiving beach; or

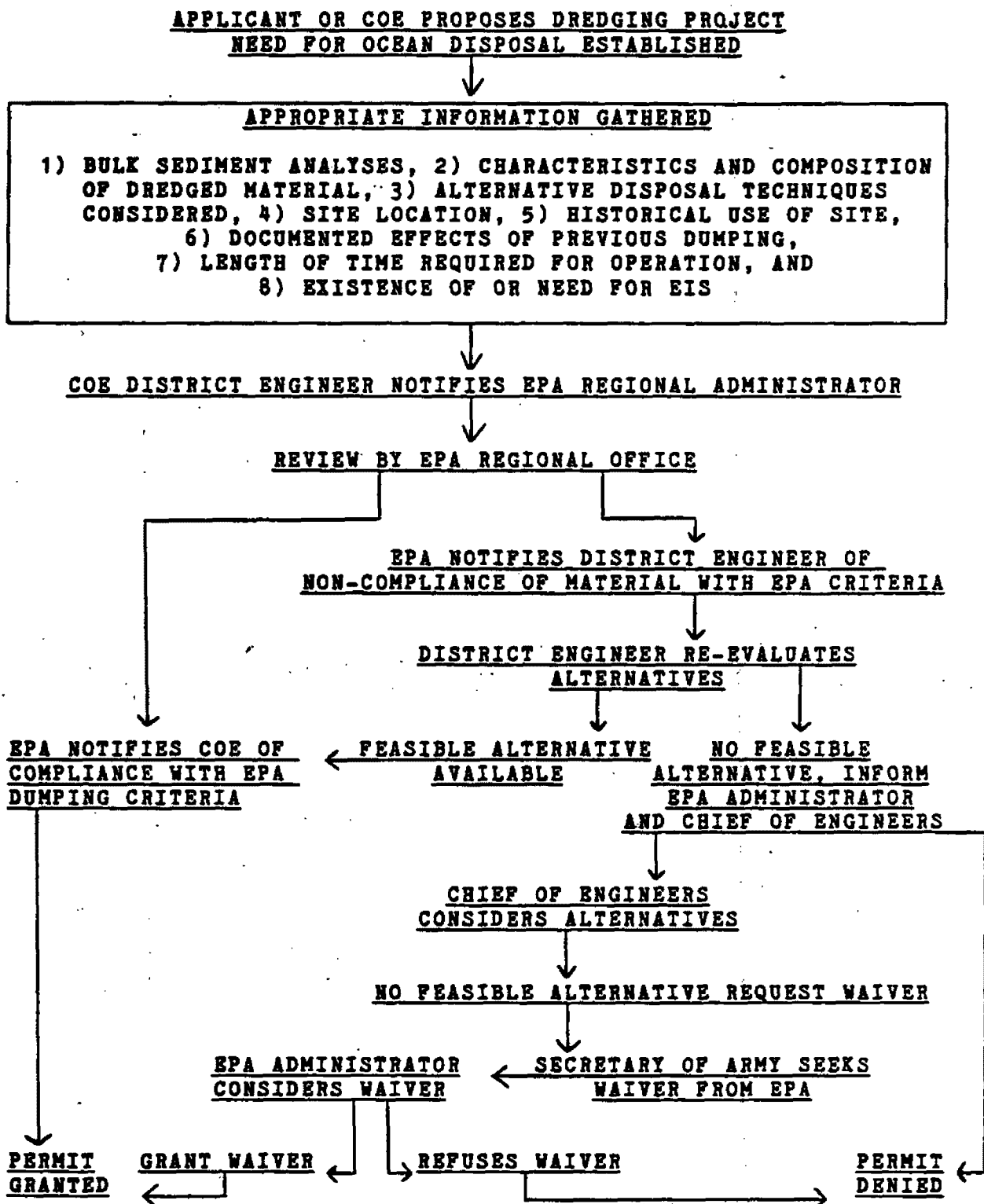


Figure 1-2. Evaluation Process for Dredged Material Permit Review.

- C. The material is substantially the same as substrate at the proposed disposal site and it is from a location far removed from known existing or historical pollution sources so as to provide reasonable assurance of being unpolluted.

If the material does not meet these criteria, EPA regional policy requires that the material be subjected to bulk sediment analyses (including priority pollutant scans, tests for organotin derivatives and other pollutants identified by the California State Water Resources Control Board as potentially toxic substances); and the liquid, suspended particulate, and solid phases must be subjected to bioassay and bioaccumulation tests with appropriate sensitive species. The suspended particulate and solid phase tests must not indicate significant mortality or sublethal effects, including bioaccumulation of contaminants. The liquid phase must comply with applicable State water quality standards and Federal marine water quality criteria. The liquid phase should not exceed 0.01% of the concentration shown to be acutely toxic to the marine organisms used in the bioassay tests (33 CFR 227.13(a)(2)). In addition, the dredged material must not contain certain prohibited materials such as high level radioactive wastes or more than trace levels of certain other materials such as organohalogens, mercury compounds, cadmium, oil of all kinds, or known carcinogens (40 CFR 227.6).

The liquid phase of the disposal plume must be in compliance with the limited permissible concentration (LPC) of contaminants after allowance for initial mixing (40 CFR 227.27). When there are no applicable water quality criteria, the levels of contaminants in the receiving water may not exceed 0.01% of the concentration shown to be acutely toxic (33 CFR 227.27). If the dredged material is found to be unsuitable for ocean disposal, it must be disposed of by other means, such as a sanitary landfill or a diked disposal area. Otherwise, a dredging permit will not be issued.

1.1.3. Dredging Operations

Several alternative operational procedures for ocean disposal of dredged material may be used. In general, dredge operations involve either hopper, clamshell or hydraulic techniques. The dredged material is emptied into split hull barges with a capacity ranging from 500 to 4,000 yd³. During the barge loading phase, attempts are made to maximize the density of dredged material so that the number of haul cycles can be reduced.

Barges are towed by tug boats which travel the most direct route practicable between the project site and the dump site. For dredging projects within the Ports of Los Angeles or Long Beach, the breakwater entrance for the respective port is used to enter the territorial sea. The barges must clear the U.S. Coast Guard (USCG) precautionary zone (see Figure 3-10) to

prevent conflicts with other vessels. Ocean dumping, which can occur during permitted times, commences once the barge has moved into the designated position within the disposal site. The site is typically an area with a 1,000 yard radius (920 meters (m)). Material is released by opening the bottom of the split hull barge, or by pumping the contents through an onboard pipeline to a submerged outlet.

Cumulative dredge quantities should not exceed the practicable capacity at the LA-2 site within the foreseeable future, because the depth of water at the site is great (60 to 170 fathoms) (118 to 320 m), the area of the site is large (0.76 square nautical miles (nmi) or 2.6 kilometers (km)), and material dispersal and settling characteristics are environmentally satisfactory (see Appendix C, p. C-4). If expansion plans at the ports are implemented, the quantities of dredged material proposed for ocean disposal may be reduced (Geraldine Knatz, Port of Long Beach, personal communication, March 1984). A major portion of the dredged material from the proposed port expansion project for the year 2020 will be used to create new areas for port use and will not be dumped at the LA-2 site.

1.2. PURPOSE OF AND NEED FOR ACTION

MPRSA requires EPA and COE to consider "human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities" (Section 103(a)) in their evaluation of Federal projects and permit applications for ocean disposal of dredged material. As part of this evaluation, consideration must be given to utilizing ocean disposal sites designated by EPA pursuant to Section 102(c) of MPRSA and 40 CFR 228.12.

Since 1977, ocean disposal of dredged material permitted by COE Los Angeles District has been authorized at the LA-2 site which has been designated by EPA on an interim basis. Use of this site for ocean disposal has been an essential element of COE's compliance with the requirements of MPRSA and their ability to carry out their statutory responsibility for maintaining the nation's navigation waterways.

In order to maintain waterways in the Los Angeles and Long Beach Harbor areas, COE considers it essential that an environmentally acceptable ocean disposal site be identified, evaluated, and permanently designated for continued use. This site may be used only after each dredging project has been reviewed by EPA and COE to certify that the proposed ocean disposal of dredged material complies with the criteria and requirements of EPA and COE regulations.

Dredged material from previous dredging projects in the Los Angeles area has been dumped at sites on land and in the ocean. Locations of these disposal sites are decided on a case-by-case

basis, depending upon environmental and economic considerations. COE first examines material dredged from the harbor to determine if it is appropriate for alternative means of disposal including, but not limited to, land disposal, beach nourishment, and capping techniques. Past environmental investigations for port dredging projects revealed that land disposal alternatives generally are not practicable due to the densely urbanized character of the surrounding area. If these alternatives are not appropriate, then materials that comply with the EPA's environmental impact criteria of 40 CFR 227 are usually dumped in the ocean. A designated ocean disposal site is required to meet COE's permitting needs.

In this EIS several alternatives to ocean disposal of large amounts of dredged material have been evaluated in detail. The conclusions reached by COE have eliminated options other than ocean disposal due to infeasibility of disposal and economic criteria.

Final designation of the ODMDS will provide a long-term means for ocean disposal of acceptable dredged material principally from the Ports of Los Angeles and Long Beach. These independent port systems are two of the country's most important harbors. Foreign and domestic cargo ships annually carry about 85 to 90 million tons of cargo to and from the ports (COE, 1985). The majority of these ships are deep-draft vessels. Also, the Port of Long Beach contains a U.S. Naval facility that functions principally as a ship repair and refitting center. Maintenance of channel depths and expansion of dock capacities are essential to sustaining the ports as vital components of national defense, and State and national economies.

COE requested that EPA permanently designate an ocean disposal site suitable for dredged material from the Los Angeles and Long Beach Harbor areas. In response to COE's stated need, EPA and COE have completed the necessary studies for selection, evaluation, and designation of the most suitable site for the ocean disposal of dredged material (40 CFR 228.4(e)). This document, prepared through a cooperative effort between EPA and COE, provides the public and decision-makers with relevant information to assess the impacts associated with the designation of the ODMDS serving the Los Angeles and Long Beach Harbors.

1.3. PROPOSED ACTION

The proposed action is the designation of an ODMDS for continued use. A number of alternatives were considered to identify the most suitable and least environmentally damaging site. These included: 1) No Action; 2) Delayed Action; 3) Landfilling in Port Areas; 4) Landfill at Sanitary Landfill Sites; 5) Beach Nourishment; 6) LA-2 ODMDS; and 7) Two alternative ocean disposal sites, a shallow water site and a deep water site.

Preliminary analyses indicated that all alternatives other than ocean disposal were either inadequate, not feasible, or more environmentally damaging. Detailed environmental analyses were carried out for the three ocean disposal sites. The goal of this document is to identify the most suitable and least environmentally damaging site for ocean disposal of dredged materials. Determination of the need for ocean disposal for individual Federal projects and COE permitted projects is accomplished as part of the permitting process on a case-by-case basis; consequently, these determinations are beyond the scope of the EIS.

The LA-2 site and the two alternative ocean disposal sites were evaluated according to criteria established in EPA's Ocean Disposal Regulations and Criteria. No advantages were seen in moving the site from the interim location to either the deep water or the shallow water location. Final designation of the existing LA-2 ODMDS was determined to be the Preferred Alternative.

1.4. AREAS OF CONTROVERSY

In general, the issue of disposing of various materials in the ocean is controversial. This controversy tends to be focused on ocean disposal of materials such as radioactive waste, toxic chemicals, explosives, etc. In sufficient quantities and at sensitive locations, these materials pose significant environmental hazards; however, disposal of these materials is not permitted at an ODMDS.

Ocean disposal of dredged material has not been particularly controversial historically because:

- A. The permitted material is exclusively composed of marine and/or estuarine sediment that has passed stringent quality control criteria (33 CFR 227),
- B. Ocean disposal of this type of material is not expected to have long-term adverse environmental effects, and
- C. Detailed bioassay and chemical tests are used to screen the material before ocean disposal is authorized.

The findings of this EIS support the relatively noncontroversial nature of ocean disposal of dredged material. There are no known major areas of controversy with concerned agencies that were contacted. Although there is indirect evidence that past disposal at the LA-2 site has affected sediment characteristics and biota, these effects appear to be moderate in nature and localized. There is no evidence of regional environmental effects. Levels of contaminants in sediments and tissues of organisms are not significantly elevated above those observed in organisms from a nearby reference site. Despite heavy commercial, military, and recreational use of the San Pedro

Shelf and Basin, no significant interference between dredged material disposal and these other uses has been reported.

One concern related to designation of ocean disposal sites is the enforcement of the location of barge dumping. There is widespread concern that barge operators may sometimes dispose of dredged material outside the dump site. This practice, known as "short-dumping," is the disposal of material prior to arrival at the designated site to save costs associated with a longer haul.

Under MPRSA, the USCG is assigned responsibility by the Secretary of Transportation for conducting surveillance of disposal operations to ensure compliance with the permit conditions and to discourage unauthorized disposal (33 U.S.C. 1417(c)). Surveillance is accomplished by means of spot checks of disposal vessels for valid permits, interception or escorting of dump vessels, use of shipriders, and aircraft overflights during dumping.

Alleged violations are referred by USCG to EPA for appropriate enforcement action (33 U.S.C. 1415 and 40 CFR 22.36). Civil penalties include a maximum fine of \$50,000, and criminal penalties involve a maximum fine of \$50,000 and/or a one year jail term. If administrative enforcement action is not appropriate, the Department of Justice may be requested to initiate actions in court for criminal violations of the terms of MPRSA.

1.5. ISSUES TO BE RESOLVED

This EIS shows that the LA-2 site differs from a nearby reference site and other nearby sites in sediment characteristics, abundance and diversity of biota, and concentrations of sediment contaminants. In order to conservatively evaluate the environmental impacts associated with the proposed project, EPA and COE assumed that the differences listed above are effects of past disposal of dredged material at the LA-2 site. The possibility that these differences are at least partly due to natural or human causative factors not related to dredged material disposal is discussed in Chapter 4, Environmental Consequences.

EPA and COE have collected data and evaluated previous reports to resolve issues related to environmental impacts from disposal of dredged material. The dynamic nature of the coastal marine environment of the Southern California Bight has made it extremely difficult to determine the exact causes and effects of environmental variations observed in the vicinity of LA-2.

The mechanisms governing environmental characteristics at the disposal site will be significantly clarified through a site management program jointly developed and administered by EPA Region 9 and COE Los Angeles District. The two Federal agencies will evaluate potential impacts through studies of the physical

and environmental effects of disposal activities at the site, laboratory and field studies of the effects of dredged material on biological communities, and extensive sampling of environmental parameters along distance gradients from the disposal site to determine cumulative effects on surrounding habitats. This EIS incorporates the results of oceanographic studies at other sites in the area to provide relevant information on the direction, magnitude and variability of currents and vertical mixing characteristics in the offshore environment. A field survey was also undertaken at the LA-5 site and a nearby reference site during 1983 and 1984 to collect comparative data on water chemistry and sediment and biologic characteristics. The results of this field survey are discussed in detail in Chapter 3. Appropriate monitoring may also be performed as part of the site management program.

During the interagency workshop held for the designation study, it was suggested that pelagic fish should be sampled and the potential impact from suspended sediment on these species should be assessed. There was particular concern for the northern anchovy (Engraulis mordax) because of its commercial and ecological importance, its prevalence over the shelf-slope break area containing the LA-2 site, and the fact that it is a particulate filter feeder. A specific study of anchovies in the area of the LA-2 site was not possible for inclusion in the EIS. All indications are that dredged material disposal adversely affects water quality only temporarily until mixing and currents disperse the suspended sediment to background levels (see Appendix C, p. C-7). Based on this, it is concluded that there would not be a significant effect on pelagic fish, including the northern anchovy.

Despite these assumptions, the issue of the effect of disposal activities on pelagic fish species is somewhat unresolved due to the lack of data on the sensitivity to suspended sediment of these species. A more conclusive assessment of the impact of disposal on pelagic fish would require sampling of the community at the disposal site at several depths and on several occasions, preferably in all seasons of the year. It would also require field and/or laboratory studies of the effect of suspended sediment and associated contaminants on anchovies and other pelagic species.

It was also suggested at the interagency workshop that histopathological studies be performed on organisms collected at the disposal site in lieu of determination of contaminant tissue burdens. Histopathologic studies are considered to be a more direct measure of the biological effects of toxic substances than determining the tissue concentration of the substances. Histopathology is, indeed, a useful diagnostic tool where the organisms under investigation are resident in the area of potential contamination and cannot or would not leave as contaminant levels rise. However, the usefulness of this technique would probably be limited in studies of very mobile or

transient demersal or pelagic fishes. Tissue burdens of any absorbed or ingested contaminants might indicate the potential for pathological effects but actual histopathological evidence of these effects would be extremely difficult to collect because the affected animals would either leave the contaminated area or be sufficiently debilitated to be removed from the population by predation before detectable histopathologies could be found.

Because of the lack of precedent for histopathologic studies as part of site designation and budget constraints, this type of analysis was not included in the EIS investigations. A systematic histopathologic examination of selected resident organisms might prove to be a very useful tool in future monitoring programs of the selected site.

1.6. REGULATORY FRAMEWORK

An international treaty, as well as Federal and State laws and regulations, apply to the designation of an ODHDS. The relevance of these statutes to the proposed action and related compliance requirements are described below. Table 1-2 summarizes the compliance status of these laws in regard to the proposed action.

1.6.1. International Treaty

The principal international agreement governing ocean dumping is the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (26 UST 2403: TIAS 8165), also known as the London Dumping Convention. This agreement became effective on August 30, 1975, after ratification by 15 contracting countries, including the United States. Ocean dumping criteria incorporated into MPRSA permits for ocean dumping, have been adapted from the provisions of the London Dumping Convention. Thus, when a material is found to be acceptable for ocean disposal under MPRSA, it is also acceptable under the London Dumping Convention.

1.6.2. Federal Laws and Regulations

1.6.2.1. Marine Protection, Research and Sanctuaries Act of 1972, as amended (33 U.S.C. 1401 et seq.)

MPRSA regulates the transportation and ultimate disposal of materials in the ocean, and prohibits ocean disposal of certain wastes. Section 102 of the Act allows EPA to promulgate environmental evaluation criteria for COE permit actions, to retain review authority over the COE permits, and to designate ocean disposal sites for dredged material disposal. EPA's regulations for ocean dumping are published at 40 CFR 220 to 229. This EIS relates to designation of an ocean disposal site rather than permitting of dredged material disposal; therefore, it only relates to the last category of these criteria.

Table 1-2 Summary of Compliance of Alternatives with Environmental Protection Statutes and Other Environmental Requirements

Federal	Proposed Action (LA-2 Site)	Shallow Water Alternative	Deep Water Alternative
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention), 26 UST 2403: TIAS 8165.	Full	Full	Full
Marine Protection, Research and Sanctuaries Act, 22 U.S.C. 1401, <u>et seq.</u>	Full	Full	Full
National Environmental Policy Act as amended, 42 U.S.C. 4341 <u>et seq.</u>	Partial*	Partial*	Partial*
Clean Water Act as amended (Federal Water Pollution Control Act) 33 U.S.C. 1251 <u>et seq.</u>	N/A	N/A	N/A
Clean Air Act as amended, 42 U.S.C. 1451, <u>et seq.</u>	N/A	Partial*	N/A
Fish and Wildlife Coordination Act as amended, U.S.C. 661 <u>et seq.</u>	N/A	N/A	N/A
Coastal Zone Management Act as amended, 16 U.S.C. 1456 <u>et seq.</u>	Partial*	Partial*	Partial*
Endangered Species Act as amended, 16 U.S.C. 1531 <u>et seq.</u>	Full	Full	Full
National Historic Preservation Act as amended, 16 U.S.C. 470, <u>et seq.</u>	Full	Full	Full
Executive Order 11593, Protection and Enhancement of the Cultural Environment, 36 FR 8921.	Full	Full	Full

(Continued)

Table 1-2 (Continued). Summary of Compliance of Alternatives with Environmental Protection Statutes and Other Environmental Requirements

Federal	Proposed Action (LA-2 Site)	Shallow Water Alternative	Deep Water Alternative
Executive Order 12372, Intergovernmental Review of Major Federal Programs, 47 FR 3059.	Full	Full	Full
California Coastal Act of 1976, as amended, PRC Sec. 3000 <u>et seq.</u>	N/A	N/A	N/A
California Environmental Quality Act, PRC Sec. 21001	N/A	N/A	N/A
* Full compliance upon issuance of a Final Environmental Impact Statement.			

Section 103 of the Act sets forth requirements for obtaining COE permits to transport dredged material for the purpose of ocean disposal. COE's regulations for ocean dumping are published at 33 CFR 209.145 and 33 CFR 320 to 330.

1.6.2.2. National Environmental Policy Act (NEPA) of 1969
(42 U.S.C. 4341 et seq.)

NEPA requires that environmental consequences and alternatives be considered before a decision is made to implement a Federal project. It also establishes requirements for preparation of an environmental impact statement for major Federal projects having potentially significant environmental impacts. This EIS has been prepared to fulfill NEPA requirements.

The President's Council on Environmental Quality has published regulations for implementing NEPA at 40 CFR 1500-1508. EPA'S NEPA regulations are published at 40 CFR 6 and COE's regulations for implementing NEPA are published at 33 CFR 220.

1.6.2.3. Clean Water Act of 1977 (33 U.S.C. 1251 et seq.)

This Act was passed to restore and maintain the chemical, physical and biological integrity of the nation's waters. Specific sections of the Act control the discharge of pollutants and wastes into aquatic and marine environments. Section 404 established a permit program to regulate the discharge of dredged material into the waters of the United States inside of the boundary line drawn to differentiate coastal waters from oceanic waters. This section is not applicable to the proposed action because it does not apply to the designation of ODMS.

A major section of the Clean Water Act that applies to ocean disposal of dredged material is Section 401. This section concerns the certification by the State that the permitted action complies with State water quality standards. The applicability of Section 401 water quality certification by the State for ocean dumping projects is being evaluated by EPA and COE at this time.

1.6.2.4. Clean Air Act as Amended (42 U.S.C. 1451 et seq.)

This Act is intended to protect the nation's air quality by regulating the emission of air pollutants. It is not applicable to the proposed action (designation of an ocean dredged material disposal site). The Act is applicable to permits and planning procedures related to actual disposal within the three mile territorial sea limit.

1.6.2.5. Fish and Wildlife Coordination Act of 1958
(16 U.S.C. 661 et seq.)

This Act requires that water resource development programs be performed in consideration of wildlife conservation. The Act

is not applicable to dredged material disposal site designation, but is applicable to the evaluation of permits and water resource development projects. All permitted uses of a designated disposal site will comply with the Act.

**1.6.2.6. Coastal Zone Management Act of 1972
(16 U.S.C. 1456 et seq.)**

This Act regulates development and use of the coastal zone, and encourages the State to develop and implement coastal zone management programs. Federally permitted projects must be certified consistent with approved State programs under Section 307(c) of the Act.

Although the proposed disposal site lies outside the three mile boundary of State waters, use of the site could potentially affect the State's coastal zone. In accordance with a 1984 decision by the U.S. Supreme Court (Watt v. California), the California Coastal Commission has indicated it will not review administrative actions such as site designations for consistency with the California Coastal Zone Management Plan. The California Coastal Commission will continue to review both permit applications for dredging projects and transport of dredged materials through the coastal zone, Federal determination of consistency for Federal dredge projects, and for consistency with the California plan.

1.6.2.7. Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.)

This Act protects species designated as threatened or endangered by prohibiting Federal actions from jeopardizing the continued existence of such species. Section 7 of the Act requires that consultation regarding protection of such species be conducted with the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service prior to project implementation. This consultation is documented in Chapter 5, Exhibits 9, 10 and 11.

**1.6.2.8. National Historic Preservation Act of 1966
(16 U.S.C. 470 et seq.)**

This Act is intended to preserve and protect historic and prehistoric resources. Federal agencies are required to identify cultural resources that may be impacted by a project, and to coordinate project activities with the State Historic Preservation Officer (SHPO). The SHPO has determined that the designation of LA-2 does not involve cultural resources listed on or eligible for the National Register of Historic Places. This consultation process is documented in Chapter 5, Exhibit 12.

1.6.3. Executive Orders

1.6.3.1. Executive Order 11593, Protection and Enhancement of the Cultural Environment (36 FR 8921, May 15, 1971)

This executive order requires the initiation by Federal agencies of measures necessary to direct their policies, plans and programs in such a way so that federally owned sites, structures and objects of historical, architectural or archaeological significance are preserved, restored and maintained for the inspiration and benefit of the people. Compliance with this order was coordinated with SHPO and is documented in Chapter 5, Exhibit 12.

1.6.3.2. Executive Order 12372, Intergovernmental Review of Major Federal Programs (47 FR 3059, July 16, 1982)

Requires Federal agencies, to the extent permitted by law, to utilize the State process to determine official views of State and local elected officials and communicate with State and local officials as early in the program planning cycle as is reasonably feasible to explain specific plans of action. The Resources Agency of California was contacted to notify appropriate State agencies (see Chapter 5, Exhibit 6).

1.6.4. State of California

1.6.4.1. California Coastal Act of 1976, Public Resources Code Section 3000 et seq.

This Act establishes the California Coastal Zone Management Plan, which has been approved by the U.S. Department of Commerce. All Federal actions which affect the coastal zone must be determined to be as consistent as practicable with this plan.

In accordance with a U.S. Supreme Court decision, the California Coastal Commission has indicated that it will not conduct consistency reviews for administrative Federal actions such as disposal site designation. The Coastal Commission will conduct consistency review of permit applications for dredging projects and transport of dredged material through the coastal zone for disposal (see Exhibit 13).

1.6.4.2. California Environmental Quality Act (CEQA), June, 1986 Public Resources Code Section 21001

CEQA establishes requirements similar to those of NEPA for consideration of environmental impacts and alternatives, and preparation of an environmental impact report (EIR) prior to implementation of applicable projects. Although the proposed action is a Federal action concerning sites outside State boundaries and does not fall under the purview with CEQA. This EIS is consistent with CEQA requirements.

1.7. RELATIONSHIP TO PREVIOUS NEPA ACTIONS OR OTHER FACILITIES THAT MAY BE AFFECTED BY DESIGNATION OF THE DISPOSAL SITE

There are several NEPA actions or facilities in the project area which could possibly be affected by continued disposal of dredged material at the Preferred or Alternative Sites. Since disposal activity occurs over open ocean water, no facilities or structures are directly impacted. Rather, distribution of dredged material from the disposal site could interact with disposal from other projects causing cumulative impacts to the water quality, sediment quality, and marine biological environment. These projects are briefly described below and their locations are shown in Figure 1-3.

1.7.1. THUMS Disposal Site

The THUMS disposal site in the San Pedro Basin was designated by EPA for the disposal of drilling muds and cuttings from oil and gas drilling islands in Long Beach Harbor. The site is a circular area with a 1.5 nmi (2.8 km) radius, centered at 33° 34' 30" North by 118° 27' 30" West. Water depth at the site is 485 fathoms (890 m). Approximately 100,000 yd³ per year of muds and cuttings are authorized for disposal at the site over the next three years. This site is approximately 10 nmi (18 km) west-southwest of the LA-2 site, 4 nmi (7 km) west of the closest portion of the deep water site, and 11 nmi (20 km) southwest of the shallow water site.

1.7.2. JWPCP Outfall

The Joint Water Pollution Control Project (JWPCP) of the Sanitation District of Los Angeles County discharges an average of 356 million gallons per day of treated municipal waste through two outfalls at Whites Point on the Palos Verdes Peninsula. The outfalls are within the shallow water site are approximately 5 nmi (9 km) north of the LA-2 site, 4 nmi (7 km) north of the closest part of the deep water site.

1.7.3. Hyperion Outfall

The Hyperion sewage treatment plant of the City of Los Angeles has two outfall pipes which discharge into Santa Monica Bay. One pipe discharges an average of 400 million gallons per day of treated municipal effluent. Its seaward end is located at 33° 55' 45" North by 118° 33' 15" West at an approximate water depth of 27 fathoms (50 m). Another pipe discharges an average of four to five million gallons per day of treated municipal sludge. It is located at 33° 55' 34" North by 118° 33' 15" West at an approximate water depth of 33 fathoms (60 m). These outfalls are approximately 22 nmi (41 km) northwest of the LA-2 site, 14 nmi (26 km) northwest of the shallow water site, and 18 nmi (34 km) north of the deep water site.

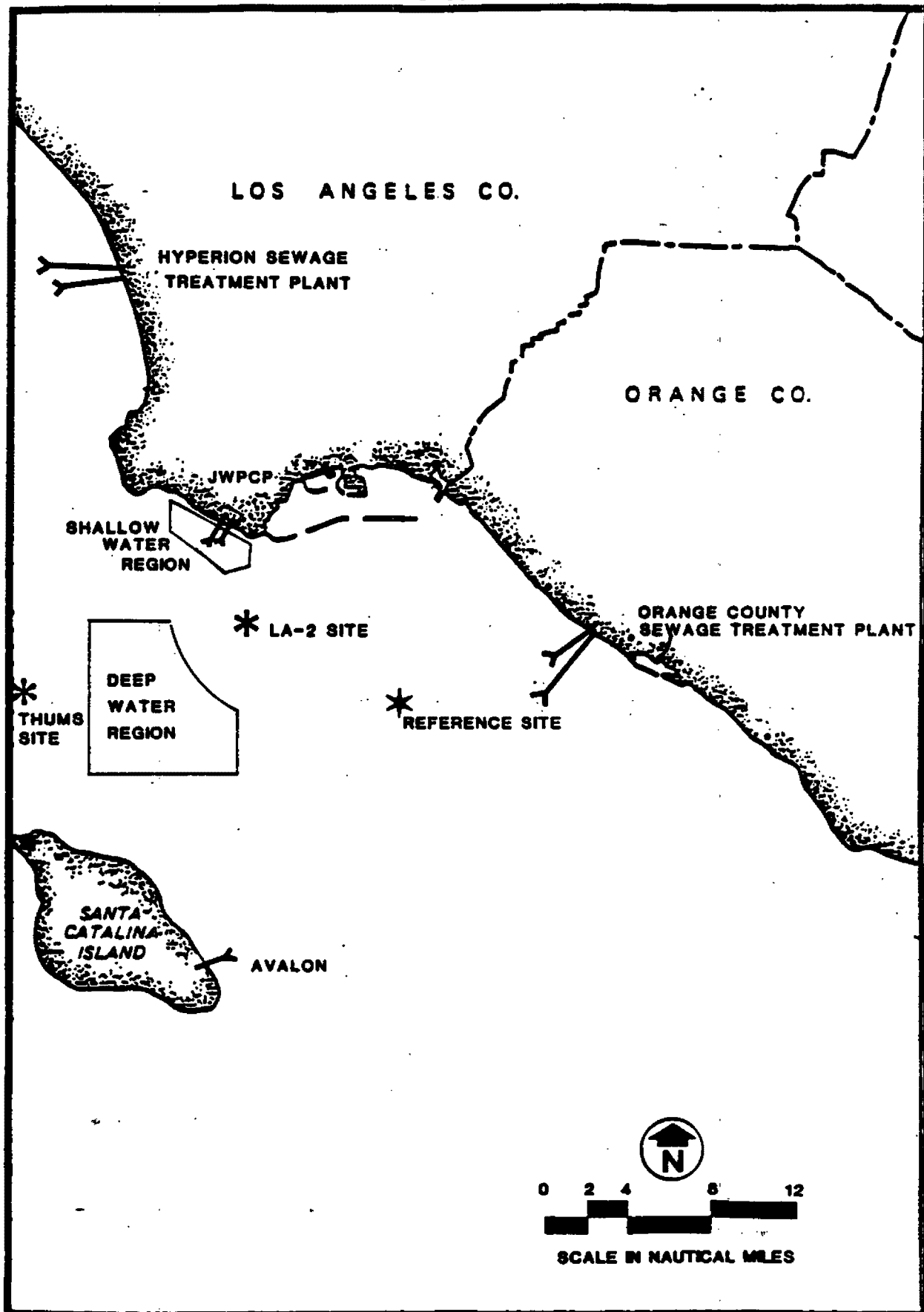


FIGURE 1-3. OTHER MAJOR FACILITIES IN THE PROJECT VICINITY

JWPCP: LOS ANGELES COUNTY JOINT WATER POLLUTION CONTROL PROJECT AT WHITES POINT

1.7.4. Orange County Outfall

Orange County has a sewage outfall pipe that discharges approximately 250 million gallons per day in San Pedro Bay. Its seaward end is located at 33° 35' 36" North and 118° 00' 36" West. This outfall is approximately 14 nmi (26 km) east of the LA-2 site, 17 nmi (31 km) southeast of the shallow water site, and 13 nmi (25 km) east of the deep water site.

1.7.5. Avalon Outfall

Off Santa Catalina Island, another sewage outfall pipe discharges approximately 0.36 million gallons per day in San Pedro Channel. Its seaward end is located at 33° 20' 25" North and 118° 18' 42" West. This outfall is approximately 16.5 nmi (30.5 km) south of the LA-2 site, 21 nmi (39 km) south of the shallow water site, and 10 nmi (18.5 km) south of the deep water site.

1.7.6. 2020 Project

In November of 1985, the Ports of Los Angeles and Long Beach and the COE Los Angeles District prepared a Programmatic EIS/EIR on the 2020 Project. The four phase project proposes to place 2,600 acres of landfill in the San Pedro Harbor area and breakwater. Phase 1, which may involve 800 acres of landfill, is currently being evaluated for feasibility and permitting action.

CHAPTER 2. ALTERNATIVES

This chapter of the EIS includes a description of each of the major alternatives considered during the development of the preferred alternative. Evaluation of a reasonable range of alternatives is required by NEPA (40 CFR 1502.14). Comparisons of potentially feasible alternatives in relation to EPA's five general disposal site criteria and 11 specific disposal site selection criteria (40 CFR 228.5 and 228.6) are presented to summarize the information for the potential sites. The detailed discussion of each specific criterion can be found in Chapters 3 and 4.

2.1. DESCRIPTION OF ALTERNATIVES

2.1.1. Preferred Alternative (LA-2 ODMDS)

The preferred alternative for designation of a site for disposal of dredged material from the Ports of Los Angeles and Long Beach is final designation and continued use of the LA-2 ODMDS. This is also the environmentally preferred alternative because it is desirable to restrict existing environmental effects to one site and not impose them at new sites or compound environmental impacts observed at already stressed sites.

The LA-2 site is located at coordinates 33° 37' 06" North latitude by 118° 17' 24" West longitude, which is 4.7 nautical miles (nmi) west of the breakwater at San Pedro, California (see Figure 2-1). The site includes all areas within a 1,000 yard (914 m) radius of the center coordinates. The underlying sea floor slopes toward the west with an approximate depth range between 65 and 175 fathoms (118 and 320 m). Beyond the site limits, the seafloor slopes downward to a maximum depth of approximately 547 fathoms (1,000 m) in the San Pedro Basin.

The nearest interim ODMDSs are located to the north, about 50 nautical miles (93 km) away, off Port Hueneme (LA-1), and to the south, about 19.6 nautical miles (36 km) away, off Newport Beach (LA-3). The LA-1 site and LA-3 site have interim site designation status without scheduled expiration dates. In the future, environmental studies will be conducted and EISs will be prepared prior to final designations of these sites.

The LA-2 ODMDS has been identified as the preferred alternative because:

- A. The site is close enough to the expected dredging sites to keep transportation distances and costs to an acceptable level,
- B. The site is far enough offshore and in deep enough water to prevent disposed material from reaching productive nearshore habitats or amenity areas and minimize potential environmental damage,

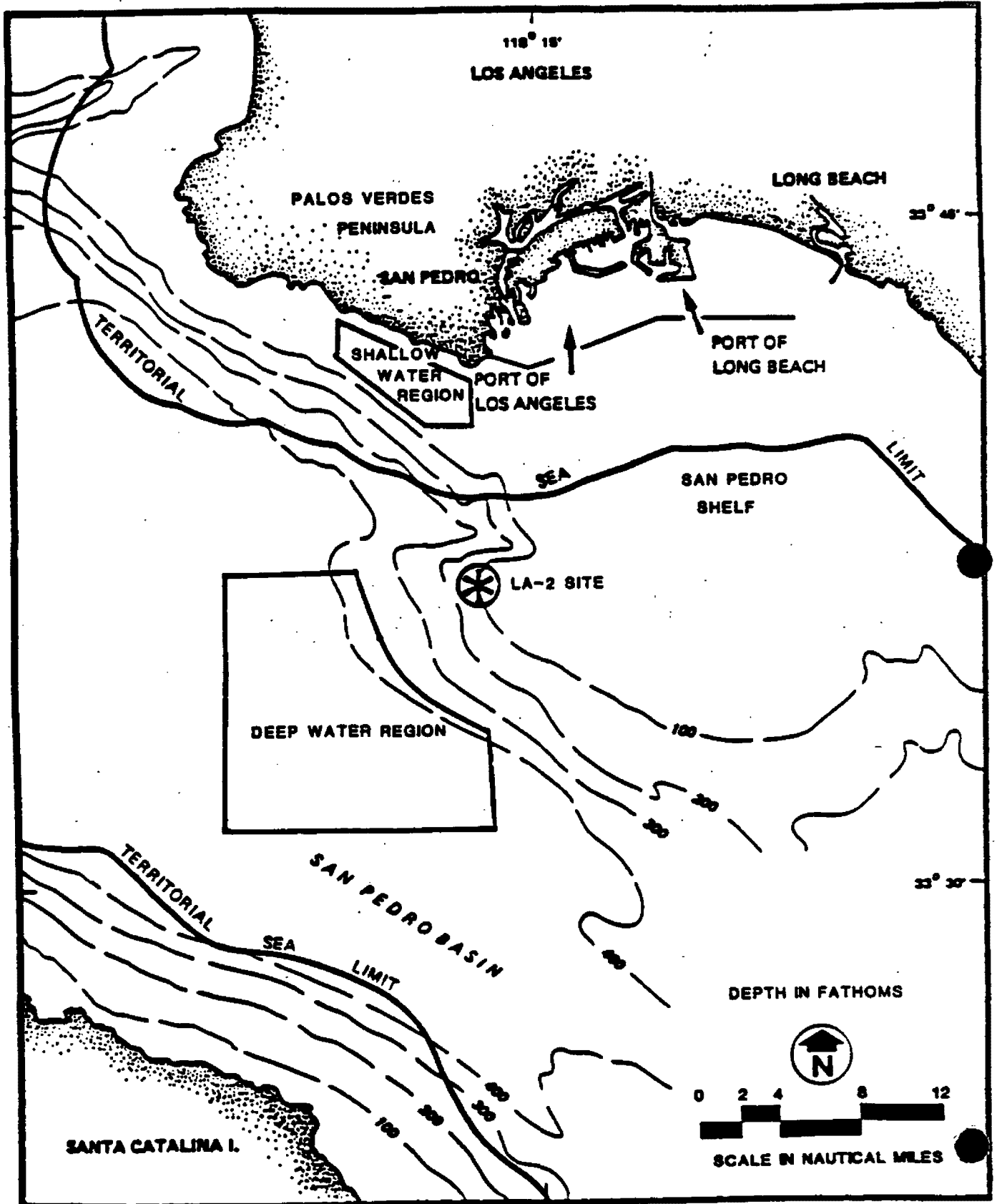


FIGURE 2-1. LOCATION OF ALTERNATIVE OCEAN DISPOSAL SITES IN THE SAN PEDRO SHELF AND BASIN

- C. The site has been used for dredge material disposal on an interim basis since 1977, and
- D. The site characteristics comply with EPA's siting criteria (40 CFR 228.5 and 228.6).

2.1.2. No Action Alternative

Selection of the No Action Alternative would mean that final designation of an appropriate ODMDS would not be made by EPA. This would cause the interim status of the LA-2 site to expire and there would no longer be a readily accessible site of ocean disposal of dredge material in the vicinity of the ports of Los Angeles and Long Beach.

Under the EPA's Ocean Dumping Regulations and Criteria (40 CFR 228.12(a)) and in accordance with the requirements of Section 102(a) of MPRSA, "various sites were approved for ocean dumping ... on an interim basis pending completion of baseline or trend assessment surveys and designation for continuing use or termination of use." The criteria further state that the interim designations were based upon historical usage and were not intended to satisfy the criteria for final designation and continuing use.

If EPA selected the No Action Alternative, which would prevent final designation of the site for continued use and prohibit further use of the LA-2 site, the action would be in conflict with the intent of MPRSA. COE would then be required to either:

- A. Develop an acceptable alternative disposal method (e.g., land-based or within a confined water body),
- B. Independently develop information sufficient to select an acceptable ocean site for disposal, under section 103(d) of MPRSA, or
- C. Modify or cancel dredging projects that depend on ocean disposal as the only feasible method for disposal of the dredged material (40 CFR 228.4).

As discussed in Chapter 1, dredging is essential to the maintenance and operation of the nationally important ports, as well as other adjacent areas. Therefore, the No Action Alternative is not an acceptable alternative because it would eliminate an ocean disposal site within a reasonable distance of the ports and severely affect existing and planned port uses.

2.1.3. Delayed Action Alternative

EPA designated the LA-2 site as an interim site for a three year period (42 FR 2462, January 11, 1977). In 1980, the agency extended the interim designation and issued a schedule for

publishing the EIS and final designation based on a consent agreement that was reached in a law suit concerning the disposition of ocean disposal sites. Three additional extensions of interim status for the site were granted by EPA in order to allow time for field studies, EIS preparation, and public review. The final date for designation of consent agreement sites has now been set for December 31, 1988.

A Delayed Action Alternative should be considered only if a completely new alternative is being developed, and delaying the start of the process could have some environmental or economic benefits based on new information. Since the LA-2 site has been used for a substantial period, EPA and COE do not anticipate that alternative sites, other than the two discussed in this EIS, will be developed for disposal of large quantities of dredged material. If the proposed action is delayed, the interim designation may expire and dumping at the LA-2 interim site would not be authorized unless another extension was granted by EPA. EPA cannot continue to grant extensions without valid reasons for doing so in light of the court's decision on the consent agreement.

In this instance, the need for ocean disposal of dredged material is a continuing concern and requires conclusion of the site designation process in the most expeditious manner possible. Delaying the designation of a site would not be a viable alternative nor would it provide any advantage over the preferred alternative. Unless this study is found to be unacceptable on scientific grounds, the Delayed Action Alternative cannot be considered as an acceptable alternative.

2.1.4. Landfilling Alternatives in Port Areas

Use of the dredged material for landfilling, also referred to as the creation of fastlands, is reviewed here as a possible alternative to ocean disposal. The dredged material could be used for landfilling marine areas in the Ports of Los Angeles and Long Beach, or landfilling subsided areas at the Port of Long Beach.

2.1.4.1. Landfilling of Marine Areas

The Ports of Los Angeles and Long Beach have used dredged material in the past to create landfills as the need has arisen, if the available material is suitable for fill (COE, 1980). Both ports have plans to expand land areas and will need suitable fill (COE, 1985).

Essential dredging in the harbors is not expected to coincide with the need to create new land areas, an issue that has been experienced with previous projects as well. It is also possible that a large portion of dredge material may not comply with guidelines issued to regulate dredging and filling projects under Section 404 of the Clean Water Act. Material dredged from

the harbors is not always suitable for fill because the proportion of fine sediments may be high compared to the requirements of permits and the Section 404(b)(1) guidelines. COE must have alternative means for disposal of the dredged material if the landfilling alternatives are not approved. Options for landfilling will be evaluated on a project-by-project basis. For the purposes of this EIS, EPA and COE are assuming that a major portion of the material dredged from the ports will have to be disposed of at a suitable ocean disposal site. Consequently, the landfilling alternative in marine areas is not a viable alternative to dispose of this material.

2.1.4.2. Landfilling of Subsided Areas

The Port of Long Beach has considered using dredged material to fill areas at the port that have subsided in response to the extraction of underground oil. This alternative avoids the expense of transporting the material elsewhere for disposal. Port authorities have concluded that this land filling in subsided areas option is not feasible, because it would seriously interfere with existing oil extraction operations at the port, and the operations would require moving many oil wells at a high cost (Geraldine Knatz, Port of Long Beach, personal communication, March, 1984). In addition, much of the dredged material available is not suitable for fill because the material has a high silt content which is unsuitable for structural support. Therefore, landfilling of subsided areas at the Port of Long Beach is not a feasible alternative for dredged material disposal.

2.1.5. Land Disposal Alternatives at Sanitary Landfills

There are two sanitary landfill sites in Los Angeles County which could be considered as possible alternative land disposal sites. The sites are: Puente Hills, a Class II-1 landfill in Whittier, and BKK Corporation, a Class I landfill in West Covina.

A Class II-1 landfill can accept solid waste, certain solid hazardous wastes, some nonhazardous liquids such as petroleum products, but no liquid hazardous waste. A Class I landfill can accept all materials that a Class II-1 landfill can accept, plus liquid and solid hazardous wastes in accordance with the provisions of applicable Resource Conservation and Recovery Act (RCRA) permits, but no bulk liquid hazardous wastes. Both types of landfills can accept dredged material suitable for ocean disposal, or dredged material considered too contaminated for ocean disposal, if it meets RCRA permit conditions and the capacity of the landfills can accommodate the dredge material.

The Puente Hills landfill can accept dredged material for disposal only after it has been dewatered and is odor-free. Since the Ports of Los Angeles and Long Beach have little available land area to store and dewater this material, it is not possible to meet the disposal criteria of this landfill for large dredging projects.

The Puente Hills site will not accept brines, defined as materials with conductivity values or total dissolved solids (TDS) concentrations above certain levels, or heavy metal concentrations above standards defined in Title 22, Division 4, of the California Code. In some cases, material dredged from the Ports of Los Angeles and Long Beach may not meet these requirements, especially those for conductivity and TDS. In addition, Puente Hills is limited to accepting a maximum of 113,000 tons (dry weight) of material per day. Port dredging often produces more than 113,000 tons (dry weight) of material per day for a period of several weeks. This would use all of the Puente Hills capacity for the duration of a dredging project. Monopolizing the use of the landfill in this way will place a severe burden on disposal needs of urban areas, especially since Los Angeles County is already experiencing shortage of sanitary landfill sites close to refuse generating urban centers.

Finally, the cost of handling and transporting the dredged material from ports to the Puente Hills site is estimated to be almost four times higher than ocean disposal (Geraldine Knatz, Port of Long Beach, personal communication, March, 1984). Handling of materials by trucks would create increased transportation and air pollution impacts that may be unacceptable. This option would be feasible for a limited number and size of dredging projects; however, it is not considered a viable alternative to ocean disposal for large dredging projects.

The BKK Landfill has been a Class I site until recently and could accept all dredged material whether or not it was considered too contaminated for ocean disposal. Recent problems at the site have forced BKK to close. The problems of capacity, cost of handling, traffic congestion and impacts on air quality are the same for the BKK site as for the Puente Hills site. Hence, this site is not a viable alternative to ocean disposal.

2.1.6. Beach Nourishment Alternative

The use of dredged material for beach nourishment is encouraged in areas suffering from erosion, especially if the material is compatible with the grain size distribution of the receiving beach. Impacts on biological communities and water quality must also be considered before beach nourishment is permitted.

This method of dredged material disposal is often infeasible for dredging projects because grain size distribution of the material is not compatible with beaches in the area. Selection of the beach nourishment and/or land disposal methods are evaluated by COE on a case-by-case basis for each permit, and are not feasible alternatives for disposal of large amounts of dredged material removed from the ports. Therefore, the beach disposal alternative has been eliminated from further consideration in this DEIS.

2.1.7. Alternative Ocean Disposal Sites

The disposal of large amounts of acceptable dredged material in the ocean may be the best solution to long-term management of the overall dredging program for the Ports of Los Angeles and Long Beach. The Purpose of and Need for Action section of this EIS (Section 1.2) outlines the major advantages and necessities for designation of an ODMDS. The two alternatives discussed below were developed as a range of NEPA alternatives to the Preferred Alternative.

The LA-2 site is presently the only site with an established location (Figure 2-1). Table 2-1 is a brief comparative table that shows the major differences in the three potential ocean disposal sites. The alternative sites would be located in two regions: a shallow water region and a deep water region. These two areas were chosen to assess the relative logistical and environmental advantages and/or disadvantages of designating the disposal site in other oceanic locations. COE has determined that there is no advantage in moving the site to a new location at similar depth.

Changing the location of the site to another area would not result in decreased disposal impacts, but would cause new environmental impacts at a location that is either under environmental stress from other discharge activities or one that has been undisturbed. Discussion of the alternative sites is not limited to any specific site within the shallow water and deep water regions. This approach precludes an arbitrary choice of site locations and allows maximum consideration of the feasibility of using a particular site in either region.

2.1.7.1. Shallow Water Site

This site is located off the Palos Verdes Peninsula near the JWPCP sewage outfall at Whites Point (see Figure 2-1). The maximum water depth here is approximately 70 fathoms (125 m). The major considerations in evaluating this site are: the proximity to and synergistic effects of the sewage outfalls at Whites Point, fishing and boating areas, kelp beds, cultural resources, navigation lanes, and shoreline resources. The affected area is within the three-mile State of California territorial boundary. Selection of this alternative would be subject to a consistency determination under Section 307(c) of the Coastal Zone Management Act and water quality consistency certification under Section 401 of the Clean Water Act.

This site has the advantage of being located close to shore, which reduces disposal costs. The shallow water region was chosen off the Palos Verdes Peninsula because unacceptable interference with commercial shipping, oil and gas development, and other ocean disposal activities are possible in other shallow water areas on the San Pedro Shelf. COE has determined that this alternative should be evaluated in detail in the EIS.

Table 2-1. General Comparison Between Geographical Position, Depth of Water, Bottom Topography, and Distance from the Coast for the Alternative Ocean Disposal Sites

Site	Coordinates or Region	Water Depth Fathoms (m)	Bottom Topography	Distance Offshore (nmi/km)
LA-2	Centered at 33° 37' 06" North by 118° 17' 24" West	65 - 175 (118 - 320)	Ridge Slope	5/9
Shallow Water	Nearshore Region	11 - 91 (20 - 165)	Ridge Slope	1-2/2-4
Deep Water	Slope or Basin Region	350 - 500 (640 - 896)	Gently Sloping to Flat Plain	5-10/9-18

2.1.7.2. Deep Water Site

The deep water site is located southwest of the LA-2 site on the lower portion of the continental slope in the San Pedro Basin. This region is approximately five to ten nmi (9 to 19 km) from shore with water depth at the site ranging from 350 to 500 fathoms (640 to 896 m).

Major considerations in evaluating this site are: distance from shore, potential oil and gas activities, conflicts with commercial fishing, and potential for increases in short dumping. Advantages of this site include a naturally depauperate benthic fauna and a disposal site that is off the mainland shelf.

Disadvantages of the site include: increased dispersal of sediment throughout the water column which could potentially affect fish populations, and dispersal over a larger area of ocean bottom creating a larger, unconcentrated area of impact. Increased distance to the site will result in proportionately increased degradation of air quality and increased consumption of limited energy resources; however, these impacts are considered to be negligible. COE determined that this site should be evaluated in detail in the EIS.

2.2. DISCUSSION OF ALTERNATIVES

2.2.1. Alternatives Not Considered for Further Analysis

The No Action Alternative and the Delayed Action Alternative were completely eliminated from further consideration in the EIS. Neither of these two alternatives would satisfy the basic purpose of the site designation process, nor are they in the best interest of economic growth of the Los Angeles and Long Beach Harbors. EPA and COE have determined that one of the best solutions to harbor dredging operations is to dispose of the dredged material in the ocean at a fully designated site.

The alternatives for Landfilling in Port Areas, Land Disposal at Sanitary Landfills and Beach Nourishment will be evaluated by COE and EPA on a permit-specific basis. These options are not viable for disposal of large quantities of dredged material that are predicted from major port projects in the coming years. Consequently, these alternatives have been eliminated from further evaluation in this site designation EIS, but they remain as options to be considered in individual permits.

2.2.2. Compliance of the Three ODMDS Alternatives with General Criteria for the Selection of Sites (40 CFR 228.5)

2.2.2.1. General Criteria 40 CFR 228.5(a)

The dumping of materials into the ocean will be permitted only at sites or in areas selected to

minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shellfisheries, and regions of commercial or recreational navigation.

Disposal at the LA-2 site has not interfered with commercial fishing, sportfishing or recreational activities in the area. Even though the site is located near the USCG Traffic Separation Schemes (TSS), vessel traffic interference has been insignificant despite considerable use of nearby areas by commercial, military and recreational vessels. The present situation is sufficiently free from hazard to be acceptable to the USCG, and special conditions imposed by COE on disposal permits will assure negligible risks from interference between disposal operations and shipping. The alternative sites have been specially selected so as to minimize the potential impact of commercial or recreational activities.

2.2.2.2. General Criteria 40 CFR 228.5(b)

Locations and boundaries of the disposal sites will be so chosen that temporary perturbations in water quality or other environmental conditions during initial mixing caused by disposal operations anywhere within the site can be expected to be reduced to normal ambient seawater levels or to undetectable concentrations or effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery.

The LA-2 site is 4.7 nmi (8.7 km) from the nearest beach or shoreline, 40 nmi (74 km) from the nearest marine sanctuary, and 6 nmi (11 km) from the nearest Area of Special Biological Significance (ASBS) at Abalone Cove. Dilution and dispersal by local mixing currents will reduce water quality perturbations resulting from disposal at the LA-2 or deep water sites to background levels in much shorter distances, so that there is essentially no likelihood of disturbance of such areas from disposal at either of these sites. There are no geographically limited fisheries in the region.

The shallow water site, however, is situated near the Palos Verdes Peninsula. Under certain wave and current conditions, water quality perturbations from disposal operations may affect local beaches, shorelines, kelp beds, or the Abalone Cove Ecological Reserve. The shallow water site also includes some popular fishing locations which could be disturbed by these water quality perturbations. An evaluation of these impacts is contained in Chapter 4.

2.2.2.3. General Criteria 40 CFR 228.5(c)

If at any time during or after disposal site evaluation studies, it is determined that existing

disposal sites presently approved on an interim basis for ocean dumping do not meet the criteria for site selection set forth in Sections 228.5 through 228.6, the use of such sites will be terminated as soon as suitable alternate disposal sites can be designated.

There is no indication that disposal at the LA-2 site or the deep water site do not or would not meet these criteria. There is some indication that dredged material disposal at the shallow water site might not meet criteria for water quality, sediment quality, and biologic conditions. Chapters 3 and 4 discuss these criteria in detail.

2.2.2.4. General Criteria 40 CFR 228.5(d)

The sizes of ocean disposal sites will be limited in order to localize for identification and control any immediate adverse impacts and permit the implementation of effective monitoring and surveillance programs to prevent adverse long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation study.

The size of the proposed ocean sites is limited to a circular area with a 1,000 yard (914 m) radius. This will limit possible environmental effects to the immediate vicinity of the designated site. Effective surveillance and monitoring of disposal operations (33 USC 1417) at the designated site are feasible given this restricted area. The size, configuration and location of the site is prescribed as part of this site evaluation study.

2.2.2.5. General Criteria 40 CFR 228.5(e)

EPA will, wherever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been used historically.

The LA-2 site is located at the 100 fathom (183 m) contour near the edge of the continental shelf. The LA-2 site has been used for disposal of dredge material on an interim basis since 1977. This is the only site that meets the criteria for designation of a site that has been used for disposal of dredged material in the past.

Selection of other alternative sites was made deliberately to examine the merits of sites other than the LA-2 site. The deep water site was chosen in an oceanic basin, off the mainland shelf, while the shallow water site was chosen close to shore on the mainland shelf. Neither of these sites completely satisfy the above general criteria.

2.2.3. Comparison of the Three ODMDS to EPA's 11 Specific Criteria for Site Selection 40 CFR 228.6(a)

The detailed discussion of each of the 11 criteria is contained in the Chapter 3, Affected Environment, and Chapter 4, Environmental Consequences. A summary table of these comparisons (Table 2-2) is presented here to support the decision process in selecting the Preferred Alternative over the other viable alternatives.

2.2.4. Selection of the Preferred Alternative

Introduction of large amounts of sediment are expected to alter the natural environmental conditions at any site. The LA-2 site has been affected by the disposal of dredged material in the past. The key issue for the LA-2 ODMDS is that the dredged material disposal impacts have not unreasonably degraded the marine environment over the past ten years.

The predicted environmental effects of a dredged material disposal site in the deep water region are similar to those identified for the LA-2 site, although greater impacts to pelagic fish and lesser impacts to benthic organisms may occur at the deep water site. The severity of the environmental impacts at the deep water site are expected to be insignificant. Conversely, the predicted environmental effects for a dredged material disposal site in the shallow water region are predicted to be quite significant compared to the effects at the other two sites.

Changing the location of the ODMDS from the LA-2 interim site would impact an area previously unaffected by disposal of a large amount of dredged material, and disposal would contribute significantly to environmental impacts already imposed on sensitive coastal ecosystems in the shallow water region. If a new site was designated, two sites off the California coast would then be experiencing environmental impacts, including the initial recovery phase at the LA-2 interim site and the initial detrimental phase imposed on the newly designated site. Surveillance of dumping by USCG and other agencies, which is necessary to discourage illegal dumping activities, would be considerably more difficult at the deep water site than it is presently at the LA-2 site. For these reasons and others, the U.S. Fish and Wildlife Service (USFWS) opposes moving the site to an unimpacted location (Jack Fancher, USFWS, personal communication, June 26, 1984).

EPA and COE have determined that the final designation of the LA-2 site should be the preferred alternative. Implementation of this action will involve a detailed site management program, including a site monitoring program of biological resources, effects on the surrounding area and tracking of all disposal activities. This program will be published by EPA and COE in a separate document. Before the site management program is released in a final form, a draft will be made available for public review and comment.

Table 2-2. Comparison of Alternative Ocean Disposal Sites Based on EPA's 11 Specific Site Designation Criteria

40 CFR 228.6(a) Criteria	LA-2 Site	Shallow Water Site	Deep Water Site
1. Geographical position, depth of water, bottom topography and distance from coast.	33° 37' 06" north by 118° 17' 24" west, depth 65 to 175 fathoms (118 to 320 m), ridge slope, 5 nmi from coast.	See Figure 2-1, depth 11 to 91 fathoms (20 to 165 m), ridge slope, 1 to 2 nmi from coast.	See Figure 2-1, depth 350 to 500 fathoms (640 to 896 m), gentle slope to flat basin, 6 to 10 nmi from coast.
2. Location in relation to breeding, spawning, nursery, feeding or passage areas of living resources in adult or juvenile stages.	Feeding and breeding area for resident species. No known special migratory breeding or nursery areas. Nearby gray whale migration route.	Feeding and breeding area for resident species. May support more spawning and nursery areas than offshore areas. Nearby gray whale migration route.	Feeding and breeding area for resident species. Fauna less abundant and less diverse than in shallow water region. Nearby gray whale migration route.
3. Location in relation to beaches and other amenity areas.	Approximately 6 nmi from Palos Verdes beaches. Other areas too far to be of concern.	Approximately 1 nmi from Palos Verdes beaches.	Approximately 6 nmi from Palos Verdes beaches. Others too distant to be of concern.
4. Types and quantities of wastes proposed to be disposed of, and proposed methods of release, including methods of packing the waste, if any.	Predominantly silts and clays dredged from Los Angeles and Long Beach harbors. Average annual volume expected to be approximately 120,000 yd ³ . Predominantly split hull barges.	Same as LA-2 site.	Same as LA-2 site.

Table 2-2 (Continued). Comparison of Alternative Ocean Disposal Sites Based on EPA's 11 Specific Site Designation Criteria

40 CFR 228.6(a) Criteria	LA-2 Site	Shallow Water Site	Deep Water Site
5. Feasibility of surveillance and monitoring.	USCG conducts spot surveillance. Monitoring feasible, but somewhat complicated by depth and topography.	USCG conducts spot surveillance. Monitoring facilitated by short travel distance and shallow depth.	USCG conducts spot surveillance. Monitoring feasible, but complicated by great depth and long travel time.
6. Dispersal, horizontal, transport and vertical mixing characteristics of the area, including prevailing current direction and velocity, if any.	Vertical mixing and currents will disperse fine material to the northwest, the prevailing current direction, or southeast. Coarser sediment reaching the bottom would be transported offshore by currents and sediment slumping on the slope.	More material would reach the bottom than at the LA-2 site because the site is shallower. Material not deposited would be dispersed along the coast and possibly inshore of the site. Prevailing current direction to the northwest. Material reaching the bottom would be transported offshore.	Less material would reach the bottom due to greater depths. Suspended material would be widely transported to the southeast and northwest deep in the San Pedro Basin. Little transport of material would occur at the bottom.
7. Existence and effects of current and previous discharges and dumping in the area (including cumulative effects).	Some negative impacts on sediments and biota detected from past disposal. No expected interaction with other discharges.	Site is in the vicinity of the Los Angeles County sewage outfall which has been found to have adverse impacts on water quality and biota. Cumulative effects are probable.	San Pedro Basin sediment may be impacted by disposal of THUMS drilling muds. Disposal of dredged material could have a cumulative effect on sediment deposition.

Table 2-2 (Continued). Comparison of Alternative Ocean Disposal Sites Based on EPA's 11 Specific Site Designation Criteria

40 CFR 228.6(a) Criteria	LA-2 Site	Shallow Water Site	Deep Water Site
8. Interference with shipping, fishing, recreation, mineral extraction, desalination, fish and shellfish culture, areas of special scientific importance and other legitimate uses of the ocean.	Minor interference with shipping and fishing. Oil and gas lease tracts are located in site area, impacts to industry are unknown at this time. No impacts to other uses of the ocean.	Likelihood of interference with shipping and fishing. Oil and gas leases prohibited in area. Impacts on industry unknown at this time. Proximity to shore and ASBS site indicate likelihood of some impacts on other legitimate uses.	Minor interference with shipping and fishing. Oil and gas lease tracts are located within the region. Impacts on industry are unknown at this time. Impacts to other uses of the ocean are negligible.
9. Existing water quality and ecology of the site as determined by available data or by trend assessment or baseline surveys.	Good water quality. Significantly adverse effects of past disposal operations on sediment quality and the community structure of benthic fauna and demersal fish have been detected.	Water quality, sediment quality and much of the biota of the area have been adversely affected by the discharge of sewage in the area.	Water quality and benthic ecology generally undisturbed and near natural conditions.
10. Potentiality for the development of nuisance species at the disposal site.	Species characteristic of stressed conditions have been detected at the site and determination of nuisance status still has to be identified.	Populations of nuisance species are well developed near the sewage outfalls. The effect of the outfalls is more important to the degraded conditions than disposal of dredged material would be for the establishment of nuisance species.	Nuisance species not present at this previously undisturbed site.

Table 2-2 (Continued). Comparison of Alternative Ocean Disposal Sites Based on EPA's 11 Specific Site Designation Criteria

40 CFR 228.6(a) Criteria	LA-2 Site	Shallow Water Site	Deep Water Site
11. Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.	No known shipwrecks in vicinity. No known aboriginal remains at the site.	Shipwrecks known to be in the shallow water region, as well as remains of aboriginal sites. Impact depends on exact location of the site.	Some potential for shipwrecks in the deep water region; impact depends on location of the site. No known aboriginal remains.

CHAPTER 3. AFFECTED ENVIRONMENT

3.1. OCEAN DISPOSAL SITE CHARACTERISTICS

The three alternative disposal sites are within an open embayment along Southern California, called the Southern California Bight. This continental borderland consists of a narrow, shallow and flat mainland shelf; a complex series of deep basins, submergent ridges or islands; and, at its westernmost edge, the continental slope which descends to the abyssal depths of the Pacific Ocean. Slopes leading down to the basins from the mainland shelf or the intervening ridges are an additional physical feature of importance. Submarine canyons bisect the mainland and insular shelves throughout the bight.

The shallow water, LA-2, and deep water disposal sites are respectively shelf, near-slope, and basin environments (see Figure 3-1). The shallow water site at approximately 70 fathoms (125 m) is located on the Palos Verdes Shelf, a very narrow section of the mainland shelf directly fronting the Palos Verdes Peninsula. South of the Palos Verdes Peninsula, a curvature in the shoreline forms San Pedro Bay. Here the mainland shelf is called the San Pedro Shelf. It is gently sloping and 11 nmi (20 km) at its widest point. Depths on its western edge reach 100 fathoms (175 m) before a steep slope drops off into the San Pedro Basin (Karl, et al., 1980). The LA-2 site is located at the top edge of this slope in 65 to 175 fathoms (118 to 320 m). This location is near the head of San Pedro Sea Valley, a submarine canyon. The San Pedro Basin separates the Palos Verdes and San Pedro shelves from Santa Catalina Island. Because of its close proximity to land, San Pedro Basin has received much sedimentation from erosion and is shallower and flatter than basins further out (EPA, 1985). The deep water disposal site is located in the San Pedro Basin at depths ranging from 350 to 500 fathoms (640 to 896 m).

In describing the affected environment, this chapter will focus on features of the Southern California Bight which are typical of the three alternative disposal sites. Whenever possible, values typical of shallow water shelves, deep water basins, and the intervening slopes are presented for comparison. In addition, values are presented from a field survey undertaken for this EIS at the LA-2 site and a nearby reference site. The reference site has depths approximately the same as the LA-2 site, and no disposal activities have occurred there. Samples were collected at these two sites of the water column, sediment, and marine fauna in August and December 1983, and March and April 1984. Data from the field survey (Appendix A) is presented in this chapter as an indication of the existing conditions of the LA-2 site. In Chapter 4, field survey data is further examined as an indication of past and future impacts of dredged material disposal.

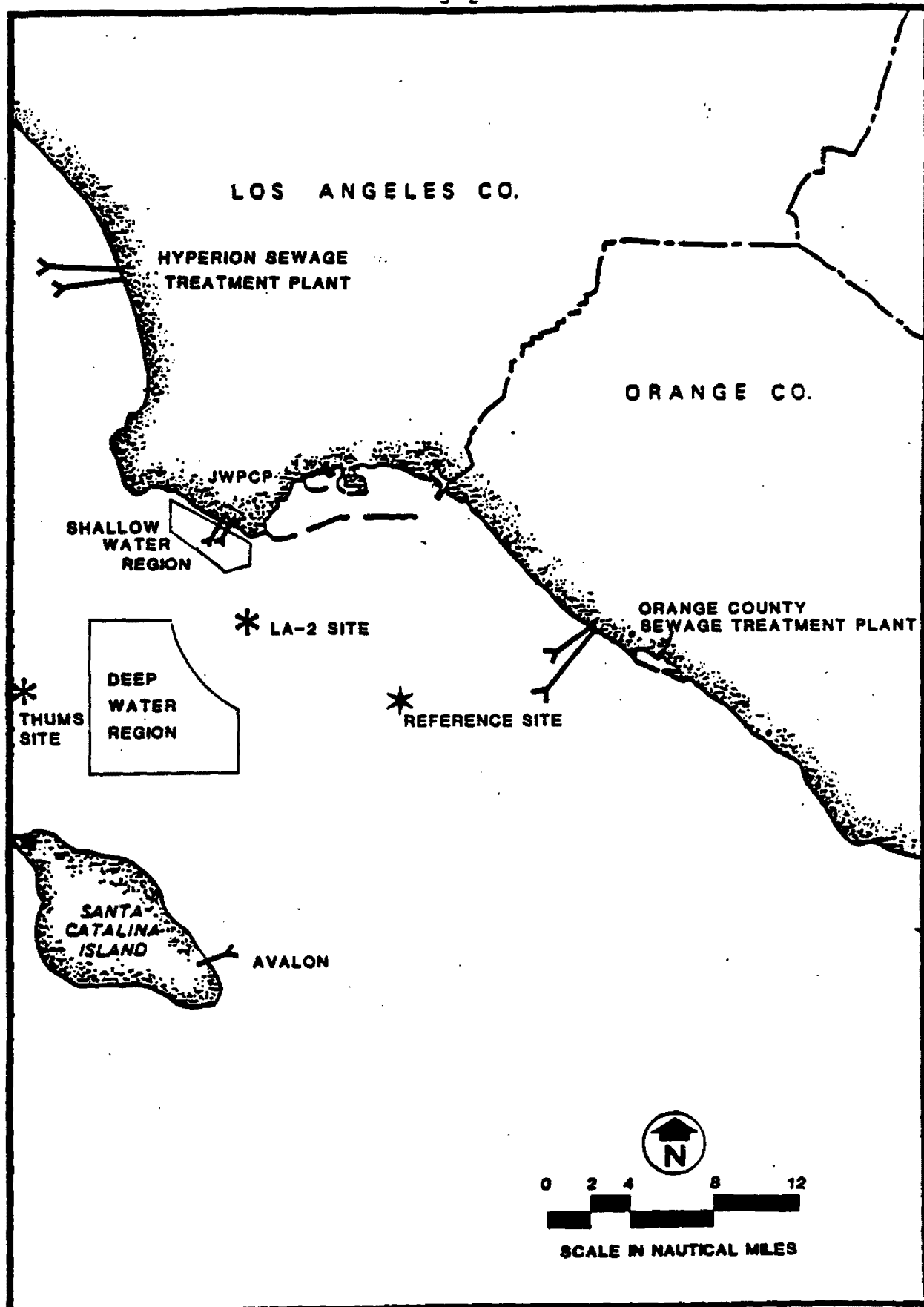


FIGURE 3-1. LOCATION OF DISCHARGE OUTFALLS AND OTHER OCEAN DISPOSAL SITES IN THE PROJECT AREA

JWPCP: LOS ANGELES COUNTY JOINT WATER POLLUTION CONTROL PROJECT AT WHITES POINT

3.1.1. Proposed Use of the Site

The ocean dredged material disposal site (ODMDS) will be used solely for the disposal of dredged material that has been evaluated by permitting criteria of COE and EPA (33 CFR 227 and 40 CFR 225), and authorized for dumping under Section 103 of MPRSA. The site will be designated for continuing use subject to the design of a site management program, site monitoring data, and the needs of site users (40 CFR 228.3 and 228.7 through 228.10). If unreasonable environmental impacts are detected by EPA and/or COE during any phase of the management and evaluation process, modification of the disposal site location or its continued use may be made (40 CFR 228.11).

The total amount of material to be disposed at the site should average 180,000 yd³ per year. The dredged material consists predominantly of sand, silt, and clays dredged from the Ports of Los Angeles and Long Beach. Dredging operations will be conducted a few days or weeks in any given year, and will generate two to four barge trips a day during that time period. At the dredge site, split hull barges having volumes from 500 to 4,000 yd³ will be loaded and towed by tug boats to the dump site. At the dump site, material will be released by opening the bottom of the split hull barge, or by pumping the contents through an onboard pipeline to a submerged outlet.

3.1.2. Existence and Effects of Current and Previous Discharges and Dumping in the Area, Including Cumulative Effects 40 CFR 228.6(a)(7)

There are many discharges into the marine environment in the Southern California Bight. It is not feasible or necessary to describe all of them and their effects in the EIS. This section is intended to describe significant discharges into the ocean in the vicinity of the ODMDS alternatives where potential cumulative or synergistic impacts are possible (see Figure 3-1).

3.1.2.1. THUMS Drilling Muds and Cuttings Disposal Site

The THUMS disposal site, in the San Pedro Basin, was designated by EPA for the disposal of drilling muds and cuttings from oil and gas drilling islands in Long Beach Harbor (50 FR, 9273, March 7, 1985). The site is a circular area with a 1.5 nmi (2.8 km) radius, centered at 33° 34' 30" North by 118° 27' 30" West, approximately 16 nmi (30 km) southwest of the Long Beach breakwater. Water depth at the site is approximately 485 fathoms (890 m).

Primary environmental impacts will result from the settling of drilling mud particles to the basin floor between 0.6 and 14 nmi (1 and 26 km) northwest of the dump site. This will cause short term turbidity, a small decrease in primary productivity, temporary loss of zooplankton biomass, smothering of benthic organisms, and alteration of the benthic community structure

through a shift in the distribution of sediment grain size. Fish are not expected to be impacted, as they can move out of the immediate area during discharge activities. The discharge material does not contain toxic materials which could accumulate in the biological system of the basin. Biological loss is estimated to be minimal, as the impacts within the water column (turbidity, phytoplankton, zooplankton) will be confined within the initial dilution zone (428.300 m^3), and the existing benthic community of the basin has low productivity, low density, low diversity, and random spatial dispersion (EPA, 1985).

The THUMS site is approximately 10 nmi (18 km) west/southwest of the LA-2 site, 4 nmi (7 km) west of the closest portion of the deep water site, and 11 nmi (20 km) southwest of the shallow water site. These distances preclude the overlapping of sedimentation between the disposal activities. There is a possibility that diffuse plumes of clay and silt particles from the LA-2 or deep water sites will interact with diffuse plumes of mud particles from the THUMS site. Prevailing currents would tend to keep these plumes separated, however, and any cumulative effect would occur within the deep waters of the San Pedro basin at very diffuse levels.

3.1.2.2. Municipal Waste Discharges at Whites Point

The Joint Water Pollution Control Project (JWPCP) of the Sanitation Districts of Los Angeles County discharges an average of 356 million gallons per day of secondarily treated municipal waste through two outfalls at Whites Point on the Palos Verdes Peninsula. These discharges have been shown to have significant adverse effects on water quality, sediment quality, benthic invertebrate communities and demersal fish populations in the vicinity of the shallow water site. Consequently, disposal of dredged material at the shallow water site would allow cumulative impacts on the marine environment in addition to the separate environmental impacts of municipal waste discharge and dredged material disposal. These cumulative impacts would include the introduction of a greater amount of contaminants to the area, and the addition of particulate matter that could serve as sites for metal adsorption, organic chemical adsorption and bacterial growth.

Because the discharge from the JWPCP outfall pipes moves predominantly to the northwest, no interaction or cumulative impact is expected with any disposal at the LA-2 site which is approximately 5 nmi (9 km) to the south, or with any disposal at the deep water site which is approximately 4 nmi (7 km) to the southwest.

3.1.2.3. Other Municipal Waste Discharges

There are several other locations in the vicinity where municipal waste is discharged into the ocean. These include the City of Los Angeles Hyperion plant which discharges

approximately 400 million gallons per day into Santa Monica Bay, the Orange County plant which discharges approximately 250 million gallons per day into San Pedro Bay, and the Avalon plant on Santa Catalina Island which discharges approximately 0.36 million gallon per day into San Pedro Channel. The Hyperion discharge is 22 nmi (41 km), 14 nmi (26 km) and 18 nmi (34 km) from the LA-2 site, shallow water site, and deep water site, respectively. Likewise, the Orange County discharge is an approximate distance of 14 nmi (26 km), 17 nmi (31 km) and 13 nmi (30 km) from these sites; the Avalon discharge is at an approximate distance of 16.5 nmi (31 km), 21 nmi (39 km) and 10 nmi (18.5 km) from these sites. These distances are great enough that, along with predominant current directions and geological barriers, no interaction or cumulative impacts are expected between these discharges and disposal at any of the three alternative sites.

3.1.3. Feasibility of Surveillance and Monitoring
40 CFR 228.6(a)(5)

Surveillance and site management are conducted by the USCG, EPA and COE. Under Section 107(c) of MPRSA, the USCG conducts surveillance to ensure compliance with the permit conditions and to discourage unauthorized disposal (33 USC 1417). Additional surveillance, site management and enforcement responsibilities are delegated to EPA (40 CFR 22.36) and COE (33 CFR 226).

Monitoring operations at all three alternative sites would require considerable time and effort to provide the type of high quality data that is necessary for ODMDS management (40 CFR 228.3). Bottom topographic features, oceanic conditions, and meteorological conditions affect most sampling efforts. Sampling difficulty increases as the depth of the site increases; however, accurate sampling is possible at all sites.

Monitoring the impacts at the shallow water site will be more difficult because dredged material disposal impacts may not be indistinguishable from impacts associated with direct discharges of municipal/industrial wastes and nonpoint sources. This is especially true for cumulative or synergistic impacts. On the other hand, travel to the site would take a relatively short time, and the shallow depth would reduce sampling time for deployment and retrieval of sampling gear.

Monitoring the deep water site would require more time to deploy and retrieve sampling equipment, and travel time to and from the site would be longer. An advantage of the deep water site is that the bottom is a flat plain of soft sediment and bottom sampling should be relatively easy. Therefore, the deep water site may not be much more expensive to monitor than the shallow water site of the LA-2 site.

3.2. PHYSICAL ENVIRONMENT

3.2.1. Meteorology and Air Quality

The climate of the southern California coastal and offshore area is classified as Mediterranean coastal, with warm dry summers and relatively wet, mild winters. Extreme variations in yearly temperatures are uncommon. The mean air temperature ranges from 12°C to 15°C in January, and from 14°C to 22°C in August (Kimura, 1974).

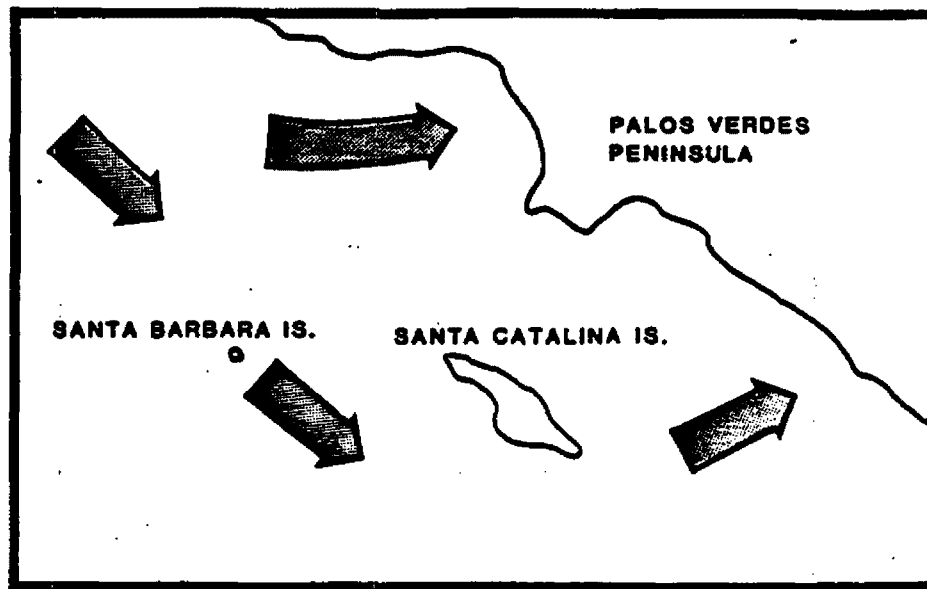
Average annual precipitation in the coastal region ranges between 10 and 15 inches. Precipitation tends to decrease as the distance offshore increases. Most precipitation occurs during the months of October through April and variations are possible in monthly and seasonal totals.

The dominant wind pattern for southern California is one of northwest winds offshore, modified near the coast by local topography and land-sea breeze phenomenon. During the summer months, the sea breeze or stratus regime predominates, occurring 50% of the time. It is associated with coastal fog, stratus clouds and persistent westerly to northwesterly winds averaging 8 knots (Kimura, 1974). Due to the Santa Catalina eddy, these northwesterly winds blow southeasterly to southwesterly along the shore of the bight, especially during the night and early morning hours (see Figure 3-2). The eddy is caused by the orientation of the mountains and the coast which run north to south but abruptly change east to west immediately north of Point Conception.

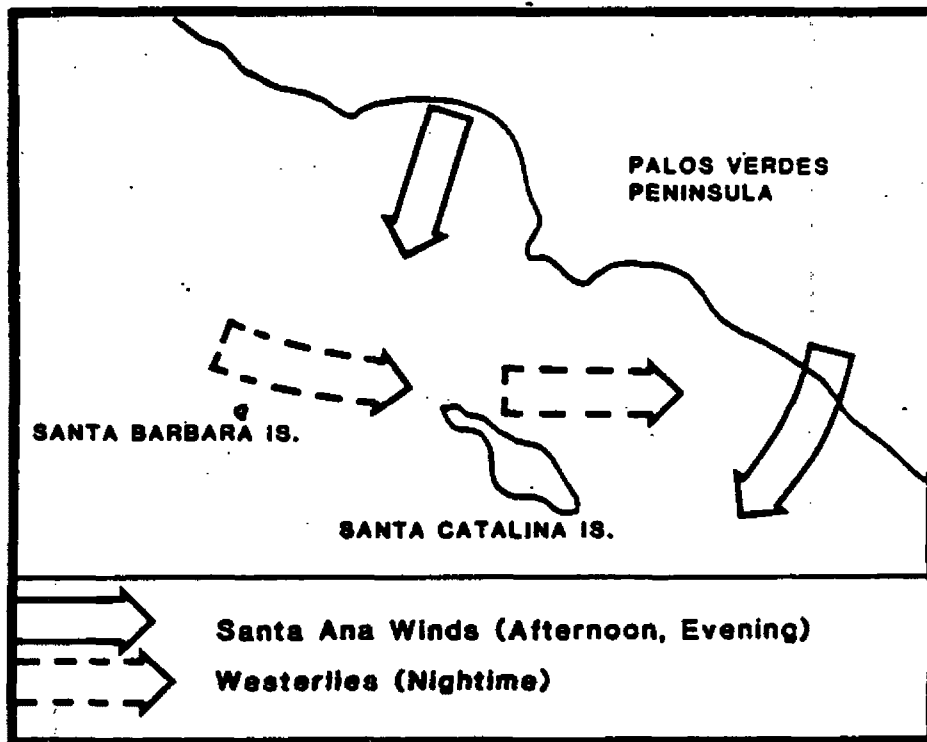
The winter months experience more variable wind patterns than the summer months; however, a land-sea breeze regime is the most common. It is characterized by northeast winds during the afternoon and evening and westerly winds after sunset (see Figure 3-2). The northeast winds, known as the Santa Ana winds, are the result of a high pressure cell over the western states (Dames and Moore, 1984).

During the spring when strong northwest winds prevail, the maximum intensity of upwelling occurs. The net direction of surface waters shows a tendency to a westerly bend. This phenomenon is due to the Coriolis Effect and it results in an extensive vertical flow of water.

No wind measurements are available for the individual disposal sites. As the alternative sites are relatively close, wind conditions are expected to be similar, with the shallow water site experiencing winds of less intensity and more variety due to its proximity to land.



SUMMER SEA BREEZE



WINTER SEA BREEZE

Source: Damas & Moore, 1984



NO SCALE

FIGURE 3-2. GENERALIZED DEPICTION OF TYPICAL WIND REGIMES OFFSHORE OF PALOS VERDES PENINSULA

Air quality in a particular area depends upon the prevailing weather conditions, local terrestrial topography and the amount of pollutants being emitted into the air. In California, the pollutants that frequently exceed air quality standards are ozone (O_3), total suspended particulates (TSP), nitrogen oxides (NO_x), and carbon monoxide (CO) (California Air Resources Board, 1981).

The proposed project would involve ships hauling dredged material and consequently, there would be an increase in the amount of NO_x , CO, TSP, and hydrocarbons (HC) released in the region. Utilizing the standard dispersion equations, it was determined, based on the hauling ships' horsepower, the ships' fuel consumption, the number of round trips per year, and the distance of each trip, that there would be no significant impact on southern California air quality. Therefore, the amount of air pollutants generated by hauling dredged material to any of the proposed dump sites would be insignificant.

3.2.2. Physical Oceanography of the Southern California Bight 40 CFR 228.6(a)(6)

This section summarizes regional and local information concerning ocean currents, upwelling, waves, and tides in the Southern California Bight with an emphasis on nearshore circulation. A more detailed account of the various aspects of the regional currents can be found in Hickey (1979).

3.2.2.1. System of Currents

The dominant hydrographic feature along the California coast is the California Current which controls the general water character and circulation of the area (Jones, 1971) (Figure 3-3). The California Current originates in colder northern waters and flows southward along the west coast of the North American continent. At Point Conception where the coastline turns in an easterly direction, the California Current continues in a southerly direction along the continental slope. It is considered the western boundary of the Southern California Bight. Beneath the California Current at a depth of approximately 275 fathoms (500 m), the California Undercurrent flows in a northerly direction.

Near the 32° latitude, the California Current swings eastward toward Baja California, and splits into northerly and southerly flows. The portion which flows northerly enters the Southern California Bight and is called the Southern California Countercurrent. It occupies the top 110 fathoms (200 m) of the water column. Upon encountering the Channel Islands and Point Conception, this flow either continues northward or turns back and flows southeast along the continental shelf. This looping feature of the surface eddy current system is sometimes called the Southern California Eddy (Jones, 1971).

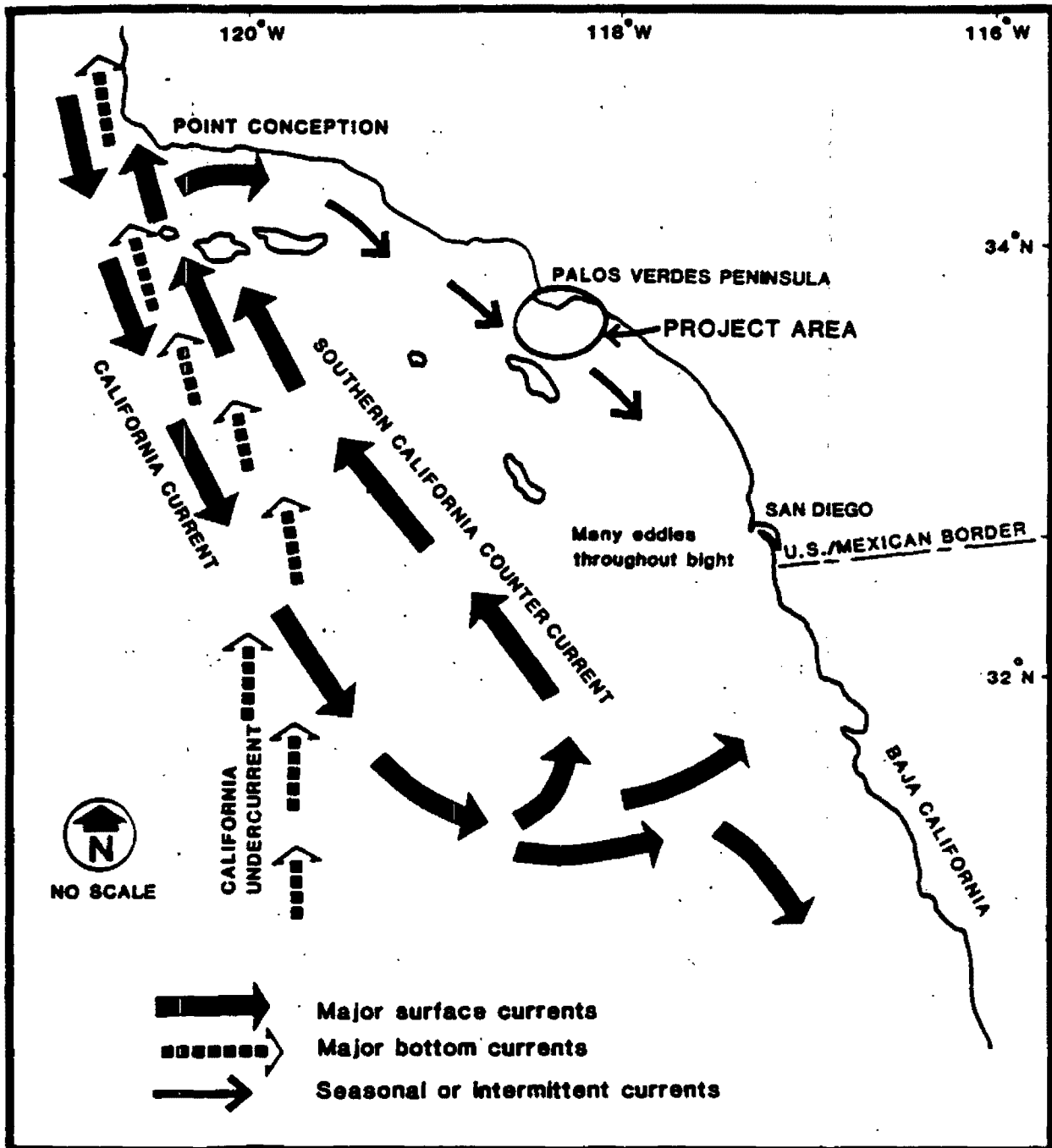


FIGURE 3-3. THREE MAJOR CURRENTS WHICH INFLUENCE THE SOUTHERN CALIFORNIA BIGHT

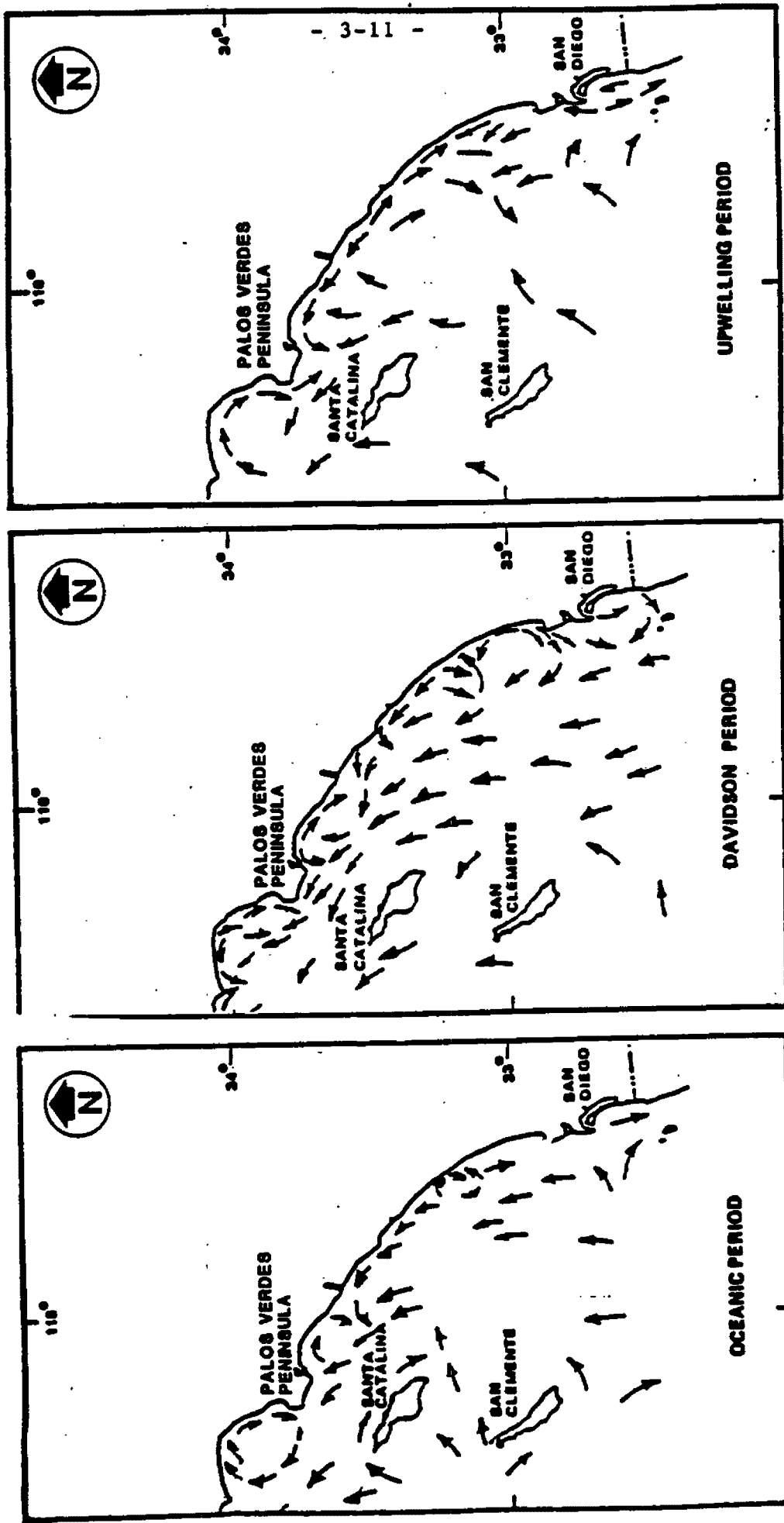
Gorsline and Grant (1972) found the southerly inshore current best developed during the fall and winter when they measured velocities of 20 to 100 centimeters per second (cm/s). The inshore current was found to be much more restricted and compressed toward the shelf during the spring. Measurements of the countercurrent revealed that the flow was strongest at the surface, 5 to 30 cm/s, and closest to shore during the spring. The geostrophic speed of the countercurrent was calculated to be about 12 to 18 cm/s by Sverdrup and Fleming (1941). Pavlova (1966) demonstrated that the volume transported by the countercurrent is only slightly less than that of the California Current.

This current system manifests three seasons as shown in the seasonal current patterns for the study area (Figure 3-4) and described below:

- A. During the Oceanic period from July to November, the southward flowing California Current dominates the nearshore current patterns, and the Southern California Eddy is well developed.
- B. During the Davidson period from December to February, the California Undercurrent becomes stronger and partially displaces the California Current westward. The Southern California Eddy is weak.
- C. During the Upwelling period from March to June, alongshore winds strengthen and drive surface water offshore due to the Coriolis Effect. At deeper layers, cold water flows toward the shore and rises to compensate for the displaced surface water. This is a coastal event that may be more intense in certain locations depending on the bottom topography and current strength.

Parachute drouge and drift bottle studies show that the currents in the Southern California Eddy have a complex nature of flow and that flows calculated based on the geostrophic currents may not be completely valid. Countercurrents, eddy currents and upwelling conditions form a complicated system that has both large and small scale variations in flow direction (Maloney and Chan, 1974).

Surface currents are heavily influenced by wind forces and submarine topography. Deeper currents are mainly influenced by tides, undercurrent, and basin topography. Localized eddies and other current features are constantly forming, interacting and dissipating. Despite the three recognized current periods, the prevailing current at a particular time and place is changeable and difficult to predict. Current fluctuations much shorter than the recognized current periods are observed in mainland shelf waters (T.J. Hendricks, Physical Oceanographer, Southern California Coastal Water Research Project, personal communication, 1984).



SOURCE: BLM, 1978

FIGURE 3-4. SEASONAL VARIATIONS IN CURRENTS OF THE SOUTHERN CALIFORNIA BIGHT

Several studies indicate how current conditions may vary at the three disposal sites. Hendricks (1980) found net movement of currents on the Palo Verdes Shelf at 31 fathoms (55 m) was northwesterly at speeds of 4.5 to 5.5 cm/sec during a five month period in the summer of 1979. As the Palos Verdes Peninsula juts out into the bight, the Southern California Eddy has more influence here than in recessed areas such as San Pedro Bay. Studies of the JWPCP sewage outfall state that surface currents are predominately to the east except during autumn and winter when westerly currents occur. Below the thermocline, currents usually have a net flow northwest at 3 cm/sec. Effluent plumes from the outfall are released at depths of approximately 30 fathoms (55 m), and net transport is predicted to the northwest at flows of 3.0 to 5.5 cm/sec. Upwelling is frequent along the Palos Verdes Shelf during the spring (EPA, 1987).

The San Pedro Shelf is subject to many eddies and reversals in current flow. A plume model developed for the LA-2 site (described in Appendix C), used a northwesterly flow at 7.95 cm/sec as the prevailing current based on observations made in other studies (Hendricks, 1980 and 1982; Hendricks and Stubbs, 1984; Winant, 1983). A southeasterly flow at the same speed was also evaluated as this is a relatively common reversal in the area. During a period of spring upwelling, Karl et al. (1980, 1981) found that water moved onto the San Pedro Shelf in the vicinity of San Pedro Sea Valley and spread southeasterly, winds moved the surface flow in a similar direction, and a midwater wedge is hypothesized to have moved shoreward.

San Gabriel Canyon appears to modify the shelf current system by creating a corridor across the shelf and down its slope (Karl, 1980). It is unknown whether San Pedro Sea Valley (near the LA-2 site) operates in a similar manner, although both submarine canyons head on the San Pedro Shelf at a distance greater than 2 nmi (3.7 km) from shore.

In the deep waters of the bight's basins, bottom waters are filled by the California Undercurrent flowing across the continental slope (Malouta et al., 1981), and moving through the basins in a northwesterly direction. The weak flow at the bottom of San Pedro Basin is normally less than 0.05 cm/sec (EPA, 1985).

3.2.2.2. Waves

Waves (swell) from the northern Pacific dominate the winter and spring oceanic conditions of the bight when major storm systems are more intense. Southerly swells occur during summer and fall when hurricanes are off southern Mexico and tropical storms are present in the southern Pacific.

Wind waves (sea) formed locally respond to northwest winds from the Pacific high pressure regions, winds of the Santa Catalina Eddy, and the Santa Ana winds. Wave convergence zones

occur over the San Pedro Shelf and affect bottom topographic features to depths of approximately 182 fathoms (100 m).

No large tsunamis have been recorded in the southern California area because the wave refraction over the basin and ridge bathymetry of the region dissipates the force of the waves. No tsunamis have been formed by local earthquakes during historical times.

3.2.2.3. Tides

Southern California, including the San Pedro Channel, has mixed semidiurnal tides that move from southeast to the northwest. These tides are characterized by unequal tidal amplitudes causing two high and low tides each day. During periods when the unequal tidal amplitude is great, the tides tend to resemble diurnal tides, one high and one low per day. The daily tidal range varies from 1 to 3 m.

3.2.3. Water Column Characteristics 40 CFR 228.6(a)(9)

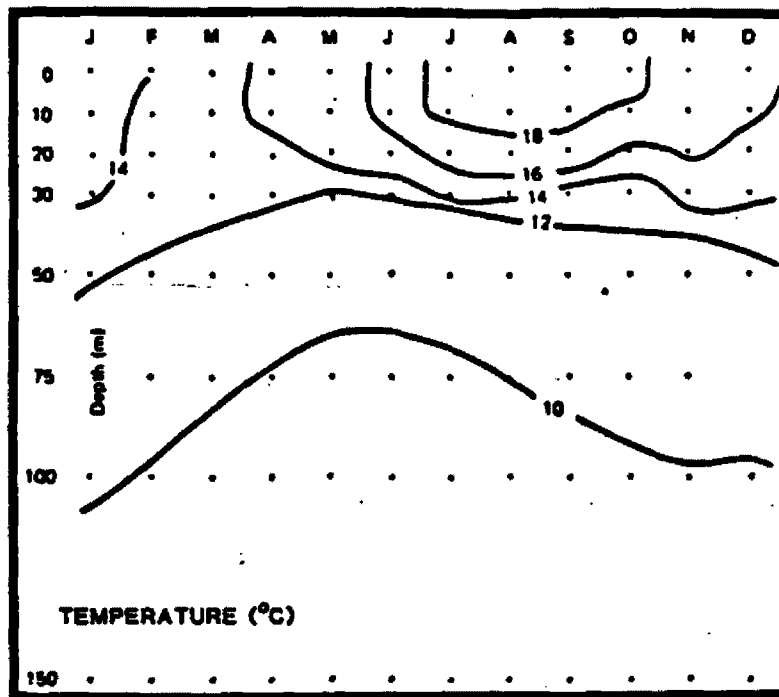
3.2.3.1. Temperature

Surface temperatures in the Southern California Bight normally range between 12.5°C in the winter, to 19.5°C in the summer (Maloney and Chan, 1974), with maximum variations between 11°C and 23°C (BLM, 1978). Maximum temperatures in the surface mixed layer occur from August through October, while minimum temperatures are reached between February and April. Daily and seasonal effects are registered in the water column between 5 and 27 fathoms (10 and 50 m).

The shallow water region over the Palos Verdes Shelf is expected to follow the patterns. In the month of October between 1980 and 1983, surface water temperatures were observed between 16.1° to 22.3°C while in March they ranged between 14.3° and 17.7° C. Bottom temperatures at 33 fathoms (60 m) during the same period have been observed at 11.2° to 16.2°C and 10.6° to 13.1°C respectively (Tetra Tech, 1984b). Satellite observations indicate that winter surface temperature patterns along this shelf are weak and variable, appearing well mixed across the region. Spring upwelling events bring cold water to the nearshore, displace warm water, and so create strong thermal gradients (Jones et al., 1984).

At depths between 55 and 165 fathoms (100 to 300 m), the water temperatures of the Southern California Bight generally decrease to a range between 6.5° to 11°C (BLM, 1978). See Figure 3-5 for average seasonal variations with depth at a location between Santa Catalina Island and San Clemente Island.

Water temperature measurements made during the field study compared favorably with these values (Appendix A, p. A-18). Maximum surface temperatures recorded in the August survey



SOURCE: JONES, 1971

FIGURE 3-5. AVERAGE SEASONAL VARIATION OF
TEMPERATURE IN CHANNEL ISLANDS AREA
BETWEEN SANTA CATALINA ISLAND
AND SAN CLEMENTE ISLAND

ranged from 19.9° to 21.5°C. Minimum surface temperatures recorded in the December survey ranged from 13.8° to 14.8°C. The yearly surface temperature variation was between 5.2° and 7.5°C depending on the station (Appendix B, p. B-20).

At 55 fathoms (100 m), temperatures showed a smaller range from 9.7° to 12.0°C. Maximum temperatures were again found in the August survey, while minimum temperatures at most stations were found during the May survey. With the maximum depth at the eight sampling stations ranging from 70 to 170 fathoms (129 to 312 m), the bottom temperatures ranged from 7.9° to 11.0°C. Maximum values were found for all stations during August, while minimum values varied according to the depth of each station. At the shallower stations (approximately 70 fathoms or 129 m), minimum temperatures were found during the May survey. At the deeper stations (greater than 100 fathoms or 198 m), minimum temperatures were found during the December survey.

These figures indicate stratification in the water column. During the summer, the field survey indicated an upper water column thermocline existed between 5 and 27 fathoms (10 and 50 m). The thermocline was essentially absent in winter, with temperatures decreasing more or less steadily from surface to bottom.

There were no significant water temperature differences between LA-2 and the reference site (Appendix A, p. 19). In waters of the Southern California Bight deeper than 165 fathoms (300 m), temperatures are generally less than 8° C (Chan, 1974). Temperatures at the bottom of the San Pedro Basin have been reported at 5°C (EPA, 1985).

3.2.3.2. Salinity

Salinity values are not known to be highly variable in the Southern California Bight. The surface water is more saline during the summer and autumn than in the winter and spring due to the greater amount of rain in the winter and the increased evaporation in the summer. Variations in salinity measurements across the San Pedro Channel and vertically in the water column are generally small, ranging between 32.9 and 34.5 parts per thousand (ppt) (Allan Hancock Foundation, 1965).

On the mainland shelf, while the surface water varies due to the influence of freshwater runoff and evaporation, at depths below 8 fathoms (15 m), salinity is frequently isohaline. At the JWPCP sewage outfall, average salinity during the winter was 33.4 ppt with little variation, while in the spring, salinity varied greatly from 33.5 ppt near the surface to 33.2 ppt at depths of 7 fathoms (13 m), to 33.7 ppt near the bottom (Tetra Tech, 1984b). At slope and basin depths of 110 to 275 fathoms (200 to 500 m), the mixing zone between major surface currents and undercurrents occurs. Here the salinity can vary from 33.8 to 34.4 ppt depending on the dominance of these currents (Maloney and Chan, 1974).

Salinity measurements taken during the field survey showed a wider range with many values lower than has been historically reported. Although the wet months of November and December of 1983 may explain some of the low values, other values are considered errors in measurement. Not including those values considered most questionable, the range was 30.3 to 34.4 ppt with many of these values falling near the lower half (Appendix A, p. A-23). There were no significant salinity differences between the LA-2 site and the reference site. Salinity generally increased slightly from surface to bottom. Salinity at the bottom of San Pedro Basin has been reported at 34.4 ppt (EPA, 1985).

3.2.3.3. Hydrogen Ion Concentration (pH)

A narrow range of pH values is expected for waters in the Southern California Bight because the ocean is a well buffered solution. The Allan Hancock Foundation (1965) found a range of pH from 7.5 to 8.6 along the southern California coast with an average of 8.1. At 38 to 55 fathoms (70 to 100 m), the pH generally decreases to a range of 7.6 to 7.8, while at the deep oxygen-minimum layer in the basins, the pH has been reported at 7.5. In the field survey, pH ranged from 7.0 to 8.5 with a mean of 8.0. At 55 fathoms (100 m), the pH ranged from 7.0 to 8.2. Concentrations of pH showed a decrease with depth and there were no significant differences between the LA-5 and reference sites (Appendix A, p. A-26).

3.2.3.4. Turbidity

Turbidity in the water column is caused by suspended inorganic and organic material. It limits the amount of light transmission and therefore affects the level of photosynthesis. The inorganic particles are mostly sediments entering the water through river outfalls and land erosion. Waves and currents may also resuspend small particles on the bottom of shallow waters particularly during periods of upwelling. As a result, water over sandy bottoms tends to be clearer than water over muddy bottoms. The concentration of plankton influences turbidity, with seasonal blooms of these organisms restricting the depth of light penetration.

Sewage outfalls introduce both organic and inorganic sediments which locally increase turbidity. At the JWPCP sewage outfall, a correlation has been found between the level of suspended solids discharged and the depth of the euphotic zone (EPA, 1987). This indicates that turbidity on the Palos Verdes Shelf has increased due to this discharge. Transmissivity is a measurement of light transmitted through the water column, and is one indication of turbidity. In the month of October between 1980 and 1983, transmissivity at the outfall was measured at 27 to 67% near the surface of the water, and 23 to 79% at the bottom. In the month of March during the same time period, transmissivity was recorded at 30 to 62% at the surface waters, and 25 to 76% along the bottom (Tetra Tech, 1984b).

On the San Pedro Shelf, turbidity generally decreases seaward of the shoreline (Karl, 1980). Shallow waters tend to have a high degree of turbidity throughout the water column. Turbidity generally decreases as the turbid water moves toward deeper waters and is diluted by the greater volume of water. Fine sized sediments such as clays and silts often remain in suspension for longer periods of time than sands, and are distributed over greater distances by local water circulation patterns (Gorsline et al., 1984).

Water clarity conditions at the alternative disposal sites is expected to follow these general patterns but vary widely under natural conditions. Transmissivity measured during the field survey averaged 96.4 percent and showed little variation with depth (Appendix A, p. 26). No significant differences were noted during the study period or at any sample station. Turbidity is also closely associated with sediment transport as discussed in Section 3.2.5.2.

3.2.3.5. Dissolved Oxygen

The surface layers of the ocean are usually saturated with dissolved oxygen (DO), and DO concentration generally decreases with increasing depth. Average DO values in the vicinity of the project site are 5.5 to 5.9 milligrams per liter (mg/l) in the surface waters and decrease to 1.8 to 2.2 mg/l at 110 fathoms (200 m) (National Ocean Data Center, 1974).

In the San Pedro Channel, a subsurface DO maximum develops in late spring and summer at approximately 27 fathoms (50 m), and continues through the fall and early winter. This corresponds to the bottom of the wind-mixed layer, and is thought to be caused by the temperature/density pycnocline that prevents the mixing of colder oxygenated water with the surface water mass (Reid, 1962).

Ambient DO levels at the JWPCP sewage outfall have been reported at 5.1 mg/l to 6.3 mg/l (EPA, 1987). In the month of October between 1980 and 1983, DO levels at the surface have been observed between 7.2 and 9.0 mg/l, and at the bottom (33 fathoms or 60 m) ranging from 5.0 to 7.7 mg/l. In the month of March during the same time period, the surface DO ranged from 7.6 to 9.8 mg/l, and the bottom DO ranged from 4.0 to 6.5 mg/l (Tetra Tech, 1984b). However, compounds in the sewage outfall cause a decrease in DO concentration within the dilution zone surrounding the outfall pipes.

During the field surveys, surface DO levels ranged from 7.5 to 13.2 mg/l (Appendix A, p. A-22). Unusually high DO levels of 12 and 13 mg/l were only found during the December survey and may be an error in measurement. At 55 fathoms (100 m) the range was from 4.3 to 9.2 mg/l. DO levels were lower at the bottom, ranging from 4.3 to 9.2 mg/l. Much of this variation was due to variation in the depth of bottom stations. Although dissolved

oxygen generally decreased with depth, a maximum was usually noted at depths of 6 to 27 fathoms (10 to 50 m) in the May and August surveys. Such a subsurface maximum has been associated in other studies with thermal stratification in the water column. Under such a condition, oxygen is entrapped in upper layers by the seasonal thermocline (Reid, 1962). There were no significant differences in dissolved oxygen between LA-2 and the reference site (Appendix A, p. A-23).

Maximum DO levels were found in the December survey throughout the water column. Minimum DO levels at the surface were found during the March survey for the LA-2 site, and during the August survey for the reference site. Minimum temperatures at 55 fathoms (100 m) and at the bottom were found during December at both sites.

In the deeper waters of the basins, dissolved oxygen levels are extremely low. In San Pedro Basin, the DO at the bottom of the water column has been reported at a level of 0.2 mg/l (EPA, 1985).

3.2.3.6. Nutrients

The most important nutrients for the growth of phytoplankton in marine waters are nitrates, phosphates, and silicates. Concentrations of the three nutrients tend to be low near the surface and generally increase in concentration with depth until approximately 275 to 825 fathoms (500 to 1,500 m). At these depths, concentrations of nitrates and phosphates then decrease (EPA, 1985). The highest nutrient concentrations occur during the upwelling season.

Near the surface where light penetration is greatest, nitrate is the primary limiting factor for the growth of phytoplankton. Surface nitrate concentrations vary from 0.1 mg/l during the Davidson period to more than 8.0 mg/l during the upwelling period. At 50 fathoms (90 m) nitrate concentrations range from 0.2 to 0.4 mg/l (SCCWRP, 1973).

Near sewage outfalls, ammonium concentrations are often elevated. Off Whites Point, average organic nitrogen concentrations in the water column have been reported at less than 0.1 mg/l as nitrogen; however, ammonia concentrations measured in May 1973 ranged from less than 0.1 mg/l (nitrogen) near the surface, to as much as 1.6 mg/l (nitrogen) at a depth of 24 fathoms (44 m) (Tetra Tech, 1974b). Near the floor of the San Pedro Basin, ammonium levels of 0.25 to 0.40 mg/l in the water column have been reported, with total organic nitrogen levels reported at 0.10 to 0.12 mg/l (Chan, 1974).

The concentration of phosphate is between 0.5 and 0.8 mg/l in surface waters, approximately 3.0 mg/l at 275 fathoms (500 m), and a maximum of approximately 3.7 mg/l at 495 fathoms (900 m) (Chan, 1974; BLM, 1978).

Silicate concentrations increase more or less steadily with depth. Surface silicate concentrations vary between 10 and 20 mg/l.

Nutrient concentrations were not sampled during the field survey.

3.2.3.7. Trace Metals

Low concentrations of trace metals are essential for metabolic processes. Some of these metals include boron (B), cobalt (Co), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mb), selenium (Se), and zinc (Zn). These same metals may also be toxic at higher concentrations when bioaccumulation of the elements causes adverse effects higher trophic levels (SCCWRP, 1973).

Trace metals enter the ocean from natural sources associated with suspended particles, as dissolved ions carried in runoff, or resuspended from sediment layers. These natural concentrations plus amounts added by anthropogenic activities, mainly associated with the discharges of municipal and industrial waste treatment plants, are the main sources of heavy metals. Through various chemical pathways over a long period of time, heavy metals precipitate out of the water column and become incorporated into the sediments.

Analysis of trace metal concentration is especially difficult in the water column as water movement makes these levels highly transitory. Analyses of heavy metal concentrations are also made difficult because:

- A. Concentrations of metals in marine waters and sediments may be near their limit of detection by present analytical techniques;
- B. Uncertainty about the physical/chemical state of the metals and sample contamination add a degree of analytic variability; and
- C. Concentrations of particular heavy metals vary with distance from shore or discharge points, depth, rainfall, currents, upwelling, plankton populations, size of suspended particulate and sediment grain size (SCCWRP, 1973).

Concentrations of trace metals tend to be low in the Southern California Bight, except near sewage outfalls and other pollution sources. Most metals detected in the water column are those associated with suspended particulates. A study conducted for the U.S. Bureau of Land Management (BLM) (Bruland and Franks, 1977), compared the concentrations of heavy metals as suspended particulates in nearshore and basin water masses off southern California. They found that nearshore waters away from

pollution sources tend to have lower metal concentrations than offshore areas. Suspended particulates include only a portion of the trace metals in the water column, as dissolved metals are also present. However, the particulate trace metal concentration is often the only parameter examined as it is more easily measured with accuracy, and it is assumed to more readily expose anthropogenic perturbations in the marine environment (Bruland and Franks, 1977).

Table 3-1 shows nearshore and inner basin values found in the BLM study which indicate possible levels prior to dumping at the LA-2 site and levels in a deep water region.

The Palos Verdes Peninsula area is particularly noted for the effect of sewage and industrial discharges on nearshore waters (MMS, 1983). Measurements made in the early 1970's showed a clear increase in the concentration of heavy metals in the water column near the sewage outfall at Whites Point (SCCWRP, 1973). Since that time, the treatment level at the JWPCP has significantly improved and past values are no longer indicative of the current condition. Water samples at the JWPCP have not recently been taken to analyze for metals in the water column. Emphasis is now placed on examining metal concentration in sediments. Section 3.2.5.3 discusses typical levels found in sediments near sewage outfalls and in cleaner waters.

In the field study, concentrations of arsenic (As), cadmium (Cd), chromium (Cr), Cu, lead (Pb), mercury (Hg), and Zn were not detected in the water column (Appendix A, p. A-33). However, the limits of detection in this field survey were near or above typical levels reported by the BLM study for these metals (see Appendix A, A-16). As a consequence, the only conclusion which can be drawn from the field survey is that previous dumping at the LA-2 site has not appreciably elevated the level of these metals in the water column on a long term basis.

3.2.3.8. Hydrocarbons

A BLM study has found a range of dissolved hydrocarbons in the waters of the Southern California Bight from $<0.001 + 0.02$ mg/l (BLM, 1981b). Because of difficulties in sampling and analyzing hydrocarbons in the water column, more emphasis has been placed on examining levels of hydrocarbons in sediments as discussed in Section 3.2.5.4.

Historically, natural offshore oil and gas seeps have been observed in several locations near the Palos Verdes Peninsula and at the northern tip of Santa Catalina Island. They are transient seeps associated with the numerous faults and folds in the region, and could be activated or reactivated by tectonic or seismic movement (Dennis, 1974).

Table 3-1. Concentrations of Trace Metals as Suspended Particulates in the Water Column in Micrograms Per Liter (ug/l).

	ARSENIC (Ar)	CADMIUM (Cd)	CHROMIUM (Cr)	COPPER (Cu)	LEAD (Pb)	MERCURY (Hg)	ZINC (Zn)
<u>BLM Study (a)</u>							
Nearshore							
Surface Water	ND	0.0012	ND	≤0.0038	0.0032	ND	0.016
Deep Water	ND	≤0.0015	0.062	0.012	0.0053	ND	0.011
Inner Basins							
Surface Water	ND	0.0018	ND	<0.002	0.0025	ND	0.016
Deep Water	ND	0.0005	ND	<0.0034	0.0018	ND	0.008
<u>Field Survey</u> (b)	No concentrations of metals were detected in the field survey at these levels of detection:						
Levels of Detection	2	2	20	10	50	0.2	5
(a) = Bruland and Franks, 1977 (b) = Appendix A, p. A-33 ND = No Data							

Oils and greases are also introduced to the bight's water by human activities. Oil and grease levels measured in the water at control stations in the bight annually ranged from <0.01 to 0.46 milligram per square meter (mg/m^2) (surface film hexane extractable materials), while at stations near the JWPCP outfalls they annually ranged from <0.01 to 65.8 mg/m^2 (Tetra Tech, 1984b). In the field survey, volumes of water (rather than a surface film), were sampled for oil and grease. Using this sampling method, oil and grease were undetected at levels of 0.1 mg/l .

McDermott and Heesen (1975) found that levels of chlorinated hydrocarbons in waters outside Los Angeles Harbor were higher than for Newport Bay, California and San Diego Harbors, but were still extremely low: 0.000006 to 0.000012 mg/l DDT and 0.000002 mg/l PCB 1254. Payne et al. (1976) reported ranges of values for surface and nearbottom water in the Southern California Bight: 0.00003 to 0.02 mg/l for the dissolved fraction and <0.000002 to 0.002 mg/l for the particulate fraction. In the field survey chlorinated hydrocarbon concentrations (DDTs and PCBs) in the water column were below detection limits at both the LA-2 and the reference sites. The detection limits for the hydrocarbons tested in this field survey are listed in Appendix A (p. A-16). As the levels of detection for the field survey were greater than or close to the maximum levels reported by McDermott and Heesen and Payne et al., it follows that no DDTs or PCBs would be detected. As a consequence, the only conclusion which can be drawn from the field survey is that past dumping at the LA-2 site has not appreciably elevated the levels of chlorinated hydrocarbons in the water column on a long-term basis.

3.2.4. Regional Geology

The features seaward of the Los Angeles-Long Beach area are submerged extensions of the Peninsular Ranges of southern California and Baja California (Figure 3-6). The highly irregular topography of the basins and ridges parallel the structural orientation of the onshore ranges.

The LA-2 site lies on the coastal shelf and the continental slope at depths ranging from 65 to 175 fathoms (118-320 m). The shelf consists mainly of tightly folded upper Neogene sandstone and shale with extensive deposits of Quaternary sands and muds as much as 656 feet (200 m) thick (Vedder et al., 1980). The inner shelf is incised by gullies, most of which were carved by subaerial erosion during past geologic times.

Many active faults have been found on the mainland shelf and in the inner basins including the Newport-Inglewood fault (see Figure 3-6) and two unnamed potentially active fault zones along the base of Santa Monica and San Pedro Shelves. Numerous earthquakes have been reported in the offshore area between the Los Angeles-Orange County coastline and Santa Catalina Island.

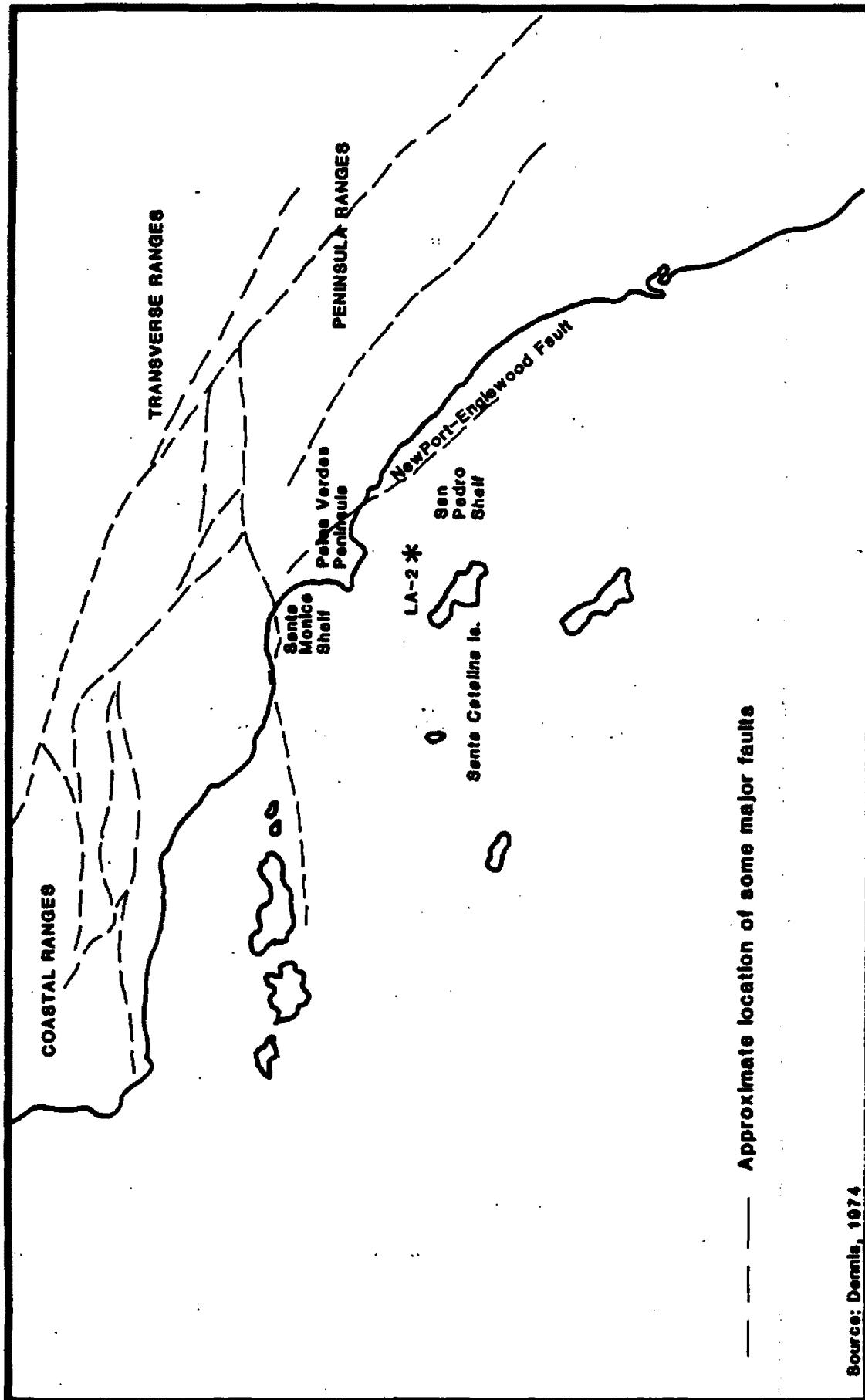


FIGURE 3-6. GEOLOGICAL FEATURES IN THE VICINITY OF PALOS VERDES

Prominent sediment deposits are present on the slope seaward of Point Fermin in the San Pedro Shelf area as a result of sediment transport (MMS, 1983).

3.2.5. Sediment Characteristics

Mainland shelf areas are characterized by the presence of coarse, terrigenous sediments (Allan Hancock Foundation, 1959). In deeper slope habitats, finer sediments are present (MMS, 1983); occasional slumping of finer sediments creates an unstable substrate on the continental slope and also provides sediment to the basin floors. Nearshore basins typically have high sedimentation rates dominated by land-derived detritus. Terrigenous materials have accumulated in the inner basins, producing extensive basin plains. The characteristics of sediment in the slope areas are intermediate between that of shelf and basin areas.

3.2.5.1. Grain Size

Characteristics of the bottom sediments in the Southern California Bight are influenced by local submarine features and oceanographic conditions. The finer sediment fractions of silt and clay are common in the deeper portion of the bight, while at intermediate depth locations, such as that of the LA-2 site, roughly equal proportions of sand and fine sediment are typically found. In shallower waters on the mainland shelf, coarser sand fractions increase.

For example, Drake et al. (1985) have identified the major types of surface sediments on the San Pedro Shelf (Figure 3-6). Those found in the vicinity of the shallow water site are fine to medium sized sands and muds at an approximate depth less than 16 fathoms (30 m) with a mean diameter of 92 micrometers (μm), and at deeper depths, finer muds with a mean diameter of less than 62 μm . In the vicinity of the LA-2 site, the finer muds predominate as sediment.

In the field survey, samples of bottom sediments were generally sandy-silt (Appendix A, p. A-61). The size of the sediments at the LA-2 site showed a greater range on the average than those at the reference site (Table 3-2). The mean grain size of samples taken at the LA-2 site was 4.44 phi units (46.1 μm) (variance of 0.90, 95% confidence level of ± 0.20), while the mean grain size of samples taken at the reference site was 4.43 phi units (46.4 μm) (variance of 0.45, 95% confidence level of ± 0.13). The LA-2 site samples averaged 1% gravel, 59% sand, 28% silt, and 12% clay. The reference site averaged less than 1% gravel, 64% sand, 28% silt, and 8% clay (Appendix A, p. A-62 to A-65).

Bottom sediments which have been found at 258 to 266 fathoms (470 to 484 m) of the San Pedro Basin in other studies consisted of primarily greenish mud and varying amounts of "oozy, blue, green gray muds". Mean particle size was less than 62 μm in diameter (Hartman and Barnard, 1958).

3.2.5.2. Sediment Transport

Net sediment transport in the vicinity of the shallow water site has been estimated to be toward the northwest (EPA, 1987). On the San Pedro Shelf, sediment transport on the bottom and surface layers has been reported to the southeast during upwelling periods, and bottom transport has been estimated as to the south during nonupwelling periods (Karl et al., 1980). Sediments from shallow waters appear to accumulate in or at the heads of San Pedro Sea Valley and other submarine canyons (see Figure 3-7). Most material initially deposited on the shelf is expected to be resuspended and eventually transported down the gradient of slopes and basin floors (Schwalbach and Gorsline, 1985). Fine particles which remain suspended for longer periods of time are expected to follow the same route in a more direct fashion (Gorsline et al., 1984). The slopes of the mainland shelf and canyons are also subject to slides, delivering additional sediment to the basins (Field and Edwards, 1980). Some of these slides are several kilometers wide and 50 m thick. This is an important process transporting sediment downslope and into the basins.

Within the San Pedro Basin, sediment is expected to flow slowly northwest with the weak currents and descend through the water column until it reaches the bottom or achieves neutral buoyancy (Appendix C, p. C-6).

3.2.5.3. Trace Metals

Trace metals are incorporated into benthic sediments in a variety of ways similar to the means discussed in the section on water column characteristics (Section 3.2.3.7). Sediment metal concentrations tend to be higher in basins than on the mainland shelf in southern California, but the highest levels occur near sewage outfalls such as those off Whites Point (SCCWRP, 1973).

Table 3-3 presents values for trace metal concentration in sediments of the Southern California Bight, along with those values found in the field survey. For some studies, only ranges are given because concentrations of trace metals vary considerably in coastal waters and average values are too easily misinterpreted (SCCWRP, 1973).

The first set of values shows ranges for trace metals which have been found in dredged materials from the Ports of Los Angeles and Long Beach. Even though the LA-2 site values are often elevated compared to those at the reference site, they are considerably lower than those levels found in these undiluted dredged materials.

The second set of values is from the Word and Mearns (1978) study undertaken in 1977. Various parameters along the 33 fathom (60 m) isobath were measured from Point Conception to the US/Mexico border, and control stations were chosen as representing background levels not overly influenced by pollutants.

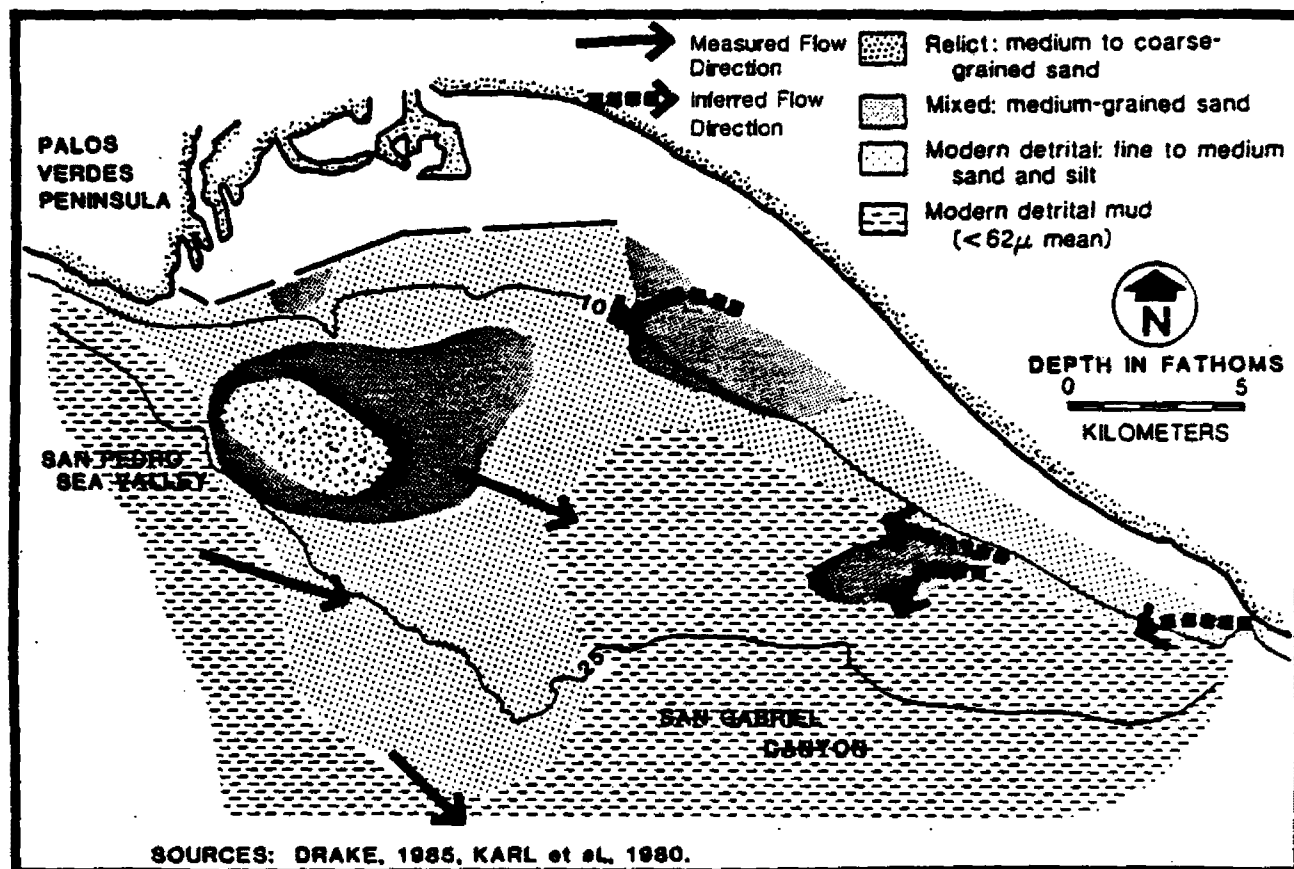


FIGURE 3-7. LOCATION OF MAJOR SEDIMENT TYPES OF SAN PEDRO SHELF AND DIRECTION OF BOTTOM TRANSPORT DURING AN UPWELLING EVENT

Table 3-2. Grain Size Distribution for the LA-2 and Reference Sites

Range of Grain Size (PHI)	$\bar{x}$	LA-2 Site 95% C.I.	$\bar{x}$	Reference Site 95% C.I.
-1 to 00	>0.1	>0.1 - 0.2	>0.1	>0.1
00 to 01	1.9	1.4 - 2.5	>0.1	>0.1 - 0.1
02 to 02	10.3	8.5 - 12.1	0.5	0.3 - 0.6
02 to 03	21.6	19.3 - 24.0	8.4	6.3 - 10.4
03 to 04	23.7	20.2 - 27.3	55.0	51.6 - 58.2
04 to 05	11.8	10.4 - 13.3	17.9	15.8 - 20.0
05 to 06	6.4	5.9 - 6.9	5.4	4.5 - 6.3
06 to 07	5.2	4.5 - 5.9	2.4	2.0 - 2.9
07 to 08	4.6	3.9 - 5.3	1.8	1.5 - 2.2
08 to 09	3.5	2.9 - 4.0	1.4	1.1 - 1.7
09 to 10	1.6	1.3 - 1.8	0.9	0.7 - 1.1
10 to 11	3.2	2.7 - 3.6	2.2	1.9 - 2.5
11 to 12	1.3	1.0 - 1.7	0.9	0.8 - 1.0
12 to 13	1.8	1.6 - 2.1	1.5	1.2 - 1.7
13 to 14	0.6	0.5 - 0.8	0.5	0.4 - 0.6
14 to 15	>0.1	>0.1 - 0.2	0.2	0.1 - 0.3

95% Confidence Interval (C.I.) = $\bar{x} \pm 1.96 \frac{s}{\sqrt{n}}$

PHI unit = $-\log_2 x$ where x is diameter in millimeters

Appendix A, p. A-67 to A-70

The third set of values is from a 1980 survey by Hershelman et al. (1982) of sediment metal levels in the Santa Monica Basin (just north of the San Pedro Basin). Trace metal concentrations were found to increase with water depth, probably because deeper waters have sediments of fine particles with which trace metals are often associated. Only those ranges at stations along the 33 fathom (60 m) isobath of the Hershelman et al. 1982 study are given in Table 3-3.

The second and third set of values represent shallow water concentrations of metals under relatively undisturbed conditions. They are presented here as general indicators of undisturbed conditions, and also to reveal the level of disturbance already created at the shallow water site by the JWPCP sewage outfall.

The fourth set of values is from a study by Swartz et al. (1986) on the Palos Verdes Shelf along the 33 fathom (60 m) isobath at the JWPCP outfall and at increasing distances down current (up to 28 nmi or 15 km to the north) in 1983. The ranges show the recent influence of the JWPCP in the vicinity of the proposed shallow water disposal site, and have maximum values substantially greater than those for the 33 fathom (60 m) control sites discussed above.

Information on metal concentrations in sediments of deeper waters (not close to regulated discharges) is not as readily available. However, Hershelman et al. (1977) have collected and they are presented in Table 3-3 as an indication of the pre-dredging condition at the LA-2 site, and the existing condition at the deepwater site data from other studies in basins west of the mainland shelf. The Chen and Lu values were obtained in 1974 from sediments around Santa Catalina Island. The Bruland et al., 1974 values are from anaerobic sediments in the deep waters of Santa Barbara and Soledad Basins.

In the field study, concentrations of Cd, Cr, Pb, Hg, and Zn at the reference site were within the range of values found for sediments in other studies within the region (see Table 3-3). None of the other studies reviewed included measurement of As. Concentrations of all these metals at the LA-2 site, however, generally exceeded regional values and also those found at the reference site (Appendix A, p. A-43). Samples from the LA-2 site showed variable concentrations of heavy metals.

3.2.5.4. Hydrocarbons

Petroleum hydrocarbons encountered in the marine environment may originate from man's activities, such as offshore drilling and production operations, oil tanker operations, coastal refineries, atmospheric transport of combustion products, coastal municipal and nonrefinery industrial wastes, and urban and river runoff. Natural sources of hydrocarbons include biological production by organisms and submarine oil seeps.

Table 3.4. Concentrations of Hydrocarbons in Sediments in Micrograms per Gram Dry Weight (ug/g)

<u>OIL AND GREASES</u>		<u>RANGE</u>
Palos Verdes Peninsula (a)		291 - 6180
LA-2 Site (b)		25 - 287
Reference Site (b)		23 - 87
<u>CHLORINATED HYDROCARBONS</u>		
	Mean, (95% Confidence Interval)	
	<u>Range</u>	
	<u>DDTs</u>	<u>PCBs</u>
Shallow Water Control Sites (c)	0.02 (0-0.04) <0.001 - 0.09	0.01 (0.002-0.02) <0.002 - 0.04
All Shallow Water Sites (c)	<0.001 - 175.2	<0.002 - 10.9
Palos Verdes Shelf (d)		
4 nmi (2 km) downcurrent from JWPCP outfall	94	11
22 nmi (12 km) downcurrent from JWPCP outfall	34	2.2
Field Survey (e)		
LA-2 Site	0.103 (0.067 - 0.139) 0.005 - 0.755	0.212 (0.154 - 0.270) <0.010 - 0.648
Reference Site	0.026 (0.021 - 0.031) 0.008 - 0.048	0.061 (0.040 - 0.082) 0.018 - 0.212
(a) Schwartz et al., 1986. (b) Appendix A, p. A-37. (c) Word & Mearns, 1978. (d) Heesen & Young, 1977. (e) Appendix C.		

Several natural oil seeps have been reported near Whites Point, in the San Pedro Channel and at the northern tip of Santa Catalina Island. None of these are currently active (Dennis, 1974). Distinction of environmental hydrocarbons among these various sources has only recently been attempted (Winzler and Kelly, 1977). For example, pentacyclic triterpenes have been used to distinguish crude oils from biologically derived hydrocarbons (BLM, 1981b).

In 1983, levels of hydrocarbon oil and grease on the Palos Verdes Shelf ranged from 6180 micrograms per gram (ug/g) dry weight near the JWPCP outfall to 291 ug/g at a station 28 nmi (15 km) downcurrent (Swartz et al., 1986).

Concentrations of oil and grease were generally lower than these values, however, levels in sediments at the LA-2 site were significantly greater than those at the reference site (Appendix A, p. A-33), although the concentrations were variable (see Table 3-4).

The major input of chlorinated hydrocarbons to southern California sediments, especially pesticides and PCBs, is thought to be municipal wastewater discharges. Other significant sources include industrial wastes, past dumping practices, river and surface runoff, and aerial fallout. The highest concentrations of chlorinated hydrocarbons are found in or near harbors and urban centers California State Water Resources Control Board (CSWRCB), 1980.

Although emissions of chlorinated hydrocarbons from municipal discharges have decreased in recent years, concentrations in sediments remain high, particularly near outfalls. Word and Mearns (1978) reported a mean dry weight concentration of 0.02 ug/g for total DDT, and 0.01 ug/g for total PCBs at control stations where the influence of polluting sources was judged to be minimal. Near municipal outfalls, dry weight concentrations were as high as 175 ug/g for total DDT and 11 ug/g for total PCBs.

Sediment concentrations of DDTs and PCBs at the LA-2 site—were significantly higher than those at the reference site and showed highly variable concentrations (Appendix A, p. A-38). The mean total DDT dry weight concentration at LA-2 was approximately 0.10 ug/g which is slightly higher than the maximum value in the range for control stations of Word and Mearns, and higher than the 0.03 ug/g mean value for the reference station.

The mean total dry weight concentration of PCB at the LA-2 site was 0.21 ug/g which exceeds the range for control stations of Word and Mearns, and the 0.06 ug/g mean value for the reference station, but is much lower than levels measured near outfalls. Other pesticides were not detected in sediments during the field survey at the levels of detection (Appendix A, p. A-16).

3.3. BIOLOGICAL ENVIRONMENT

The Southern California Bight is geographically situated in a biological transition zone between the cold water biota of the Oregonian Province north of Point Conception and the warm water, subtropical biota of the Panamic Province south of Magdalena Bay, Mexico. Intermixing of currents from these two provinces in this region of extremely variable geology, from rugged submarine rock outcroppings to very fine sediment deposits, encourages rich and diverse biological associations. A large number of endemic species and numerous representatives of the adjacent provinces are found throughout the Bight.

This section of the EIS describes the biological environment to document compliance with EPA's 11 specific site selection criteria. General ecological descriptions 40 CFR 228.6(a)(9) and the location of these resources in relation to spawning, nursery, feeding, and passage areas of living resources 40 CFR 228.6(a)(2) are discussed throughout this section.

3.3.1. Plankton Community

The mixing of waters from northern and southern currents influences the species diversity and abundance of planktonic organisms in the Southern California Bight. Primary productivity is regulated by water temperatures, light intensity, and the availability of nutrients in the euphotic zone, the latter usually resulting from the upwelling of colder, deep waters into warmer, surface waters. Plankton productivity is highest during the summer (July to October) and lowest during the winter months (October to December) (Owen, 1974). Primary productivity varies in proportion to the distance from shore, higher in nearshore regions and decreasing with distance offshore.

3.3.1.1. Phytoplankton

Approximately 280 species of phytoplankton from California waters were reported by Riznyk (1977): 160 diatom, 112 dinoflagellate, and 6 silicoflagellate species. Sixty species were reported in Santa Monica Bay (Resig, 1961). Phytoplankton work previously conducted offshore of southern California includes the works of Allen (summarized in Riznyk, 1974), Balech (1960), Resig (1961), and California State Water Quality Control Board (CSWQCB) (1965).

Because of the mixing action of the California current plankton species present at each of the sites discussed in this section are expected to be very similar. Table 3-5 lists common phytoplankton of the Southern California Bight. The relative abundance of a particular species may vary somewhat from the inshore shallow reference sites to the offshore deep sites. The distribution of the species and their abundances are controlled

Table 3-5. Common Phytoplankton Species of the Study Area

DIATOMS	DINOFLAGELLATES
<u>Asterionella japonica</u>	<u>Ceratium fusus</u>
<u>Biddulphia longicruris</u>	<u>C. tripos</u>
<u>Chaetoceros compressus</u>	<u>C. furca</u>
<u>C. debilis</u>	<u>Dinophysis acuminata</u>
<u>C. didymus</u>	<u>Gonyaulax polyedra</u>
<u>C. socialis</u>	<u>Gymnodinium splendens</u>
<u>Ditylum brightwellii</u>	<u>Noctiluca scintillans</u>
<u>Eucampia zoodiacus</u>	<u>Peridinium sp.</u>
<u>Nitzschia spp.</u>	<u>Prorocentrum micans</u>
<u>Rhizosolenia spp.</u>	
<u>Skeletonema costatum</u>	SILICOFLAGELLATES
<u>Thalassionema nitzschioides</u>	<u>Dictyocha fibula</u>
COCCOLITHOPHORES	<u>Distephanus speculum</u>
<u>Coccolithus huxleyi</u>	
Riznyk, 1974.	

by several factors including amount of light, currents, intensity of grazing, temperature and upwelling events (BLM, 1981b). Phytoplankton variability is evident on a seasonal basis as well as over long-term periods in which it has been related to oceanographic and meteorological events (Balech, 1960).

California Cooperative Oceanic Fisheries Investigations (CalCOFI) data presented for 1969 (Owen, 1974) displays primary productivity variations for the Southern California Bight region. Values are highest within the nearshore regions and decrease with distance offshore. Standing crop estimates, integrated over the upper 150 m (445 ft.) display differences between sampling periods (highest between July to October 1969 and lowest between October to December) and area along the California coast (highest in southern California, decreasing offshore beyond a highly productive band 51 to 108 nmi (100 to 200 km) along the coast. Production values for an area of coastal waters from San Pedro to San Diego range from 20 grams per square meter (g/m^2) (October to December) to 90 g/m^2 (July to September). Productivity ranges from approximately 0.3 to 1.4 $\text{g/C/m}^2/\text{day}$, integrated over the euphotic zone. Near sewage outfalls such as Whites Point, productivity can increase to 2.0 to 2.5 $\text{g/C/m}^2/\text{day}$ (Epply et al., 1972).

3.3.1.2. Zooplankton

Zooplankton are instrumental in the transfer of energy from the phytoplankton to the higher trophic levels including fishes, birds, and marine mammals. Studies dealing with Southern California Bight zooplankton are listed in Seapy (1974).

In the California Current system, at least 546 invertebrate and 2,000 vertebrate species of fish larvae are estimated to occur (Kramer and Smith, 1972), representing 23 major taxa among 9 animal phyla. The zooplankton include both temporary (nanoplanktonic) and permanent (holoplanktonic) forms which range in depth distribution from the surface to at least 3,282 fathoms (6,000 m) (Holton et al. 1977).

The primary source of zooplanktonic information is the CalCOFI program which originated in 1949. Data are available from numerous sampling stations within the Southern California Bight region from surface to depths of 77 fathoms (140 m).

Bathypelagic coelenterates (cnidarians) in the southern California basin were investigated by Hartman and Emery (1956). Siphonophores dominated the fauna of the bottom of San Pedro Basin, feeding on bathypelagic animals living above the surface of the anoxic sediments. Atstatt and Seapy (1974) studied planktonic decapod crustaceans in San Pedro and Santa Catalina Basins to depths of 356 fathoms (650 m) using an Isaacs Kidd midwater trawl. Abundances never exceeded 49/1000 m^3 . Sergestes similis was the dominant species in each sample.

Factors influencing zooplankton density and distribution within the study area include advection or currents and the winds that cause currents long-term meteorological and oceanographic changes (Berner and Reid, 1961, Radovich, 1961) and nutrient/temperature relationships (Reid, 1962).

Several endemic species occur within the California Current system. Most species, however, vary geographically, seasonally, and yearly due primarily to changes in current patterns. These include the chaetognath Sagitta bieri, the copepod Eucalanus bungi californicus, the hyperiid amphipod Hyperietta stebbingi, and the squid Abocaliopsis ielis. Table 3-6 summarizes the major zooplankton taxa in the bight (BLM, 1978).

Nearshore waters have been found to support higher populations of benthic invertebrates and fishes than offshore waters, including the larval stages of the Dungeness crabs Cancer magister, pink shrimp Pandalus jordanni, Crangon shrimp, and several species of bottom dwelling flatfishes (BLM, 1981b).

Patterns of vertical distribution of zooplankton relate to such variables as light, phytoplankton density, food, and life history patterns. Individual species show differing depth maxima (Alvarino, 1964). Most species within the waters of the continental slope are neritic forms, with occasional oceanic and migratory abyssal forms found during upwelling periods.

3.3.2. Kelp Community

Beds of giant kelp, Macrocystis pyrifera, grow on rocky substrate off the Palos Verdes Peninsula including the entire area designated as the shallow water site. Kelp beds are a valuable and expanding underwater habitat in the shallow water site. These kelp forests provide food and shelter for marine fish and invertebrates, many with importance to sport and commercial fisheries. They are also popular diving areas and the kelp is harvested for commercial use. A detailed description of the ecology of kelp beds can be found in Foster and Schiel, 1985.

In 1982, the Palos Verdes beds covered 287 hectares (700 acres) generally to a depth of no greater than 6.5 fathoms (12 m). Historically, these beds have fluctuated greatly in size and location. In 1928, it is estimated that they covered 728 hectares (1,800 acres) to a depth of 10 fathoms (18 m). In the 1940's, the beds began a period of decline until 1968 when the Palos Verdes giant kelp beds had completely disappeared. In 1974, kelp plants began to reestablish and kelp communities have shown a significant rate of recovery since then (Wilson, 1982).

Man-made and natural factors seem to have influenced both the decline and recent recovery of these kelp beds. Negative factors include: disposal of sewage at Whites Point, over-grazing by sea urchins and other herbivores, the elimination of

Table 3-6. Major Zooplankton Taxa in the Southern California Bight

Major Taxa	Common Species	Distribution Remarks
CNIDARIA	<u>Syncoryne eximia</u> <u>Phialiadium gregarium</u>	Hydromedusae Hydromedusae
CTENOPHORA	<u>Pleurobrachia bachei</u> <u>Beroe</u> sp.	Common in nearshore plankton. Reported from south of the area. Densities of less than 50/10,000 m ³ of water in the upper 60 fathoms (110 m).
CHAETOGNATHA	<u>Sagitta euneritica</u> <u>S. bierei</u> <u>S. enflata</u> <u>S. minima</u>	No seasonability pattern or inshore to offshore difference in abundance.
POLYCHAETA	<u>Vanadis formosa</u> <u>Torrea candida</u> <u>Tomopteris elegans</u> <u>Travislopsis lobifera</u>	Offshore distribution to (200 km). Can be extremely abundant. Cold water form.
MOLLUSCA		
Pelecypoda	<u>Mytilus</u> spp.	
Pteropoda	<u>Limacina helicina</u>	
Heteropoda	<u>Atlanta peron</u> <u>Atlanta</u> sp. <u>Carinaria japonica</u>	
Cephalopoda	<u>Abraliopsis felis</u> <u>Gonatus onyx</u>	
CRUSTACEA		
Copepoda	<u>Libinocera trispinosa</u> <u>Acartia tonsa</u> <u>A. clausi</u> <u>Calanus helgolandicus</u> <u>C. pacificus</u> <u>Rhincalanus nasutus</u> <u>Oithona similis</u>	Dominant in surface samples in Santa Barbara Channel, maximum abundance in November. Abundant in summer months. All stages abundant in May to June. Most common species. Juveniles abundant in July to August, adults abundant in May to June. Most abundant cyclopoid copepod from samples off Scripps Institution.

(CONTINUED)

Table 3-6 (Continued). Major Zooplankton Taxa in the Southern California Bight

Major Taxa	Common Species	Distribution Remarks
Cirripeda	<u>Balanus</u> spp.	Barnacles
Amphipoda	<u>Vibilia armata</u>	Captured at surface at night and at 109 fathoms (200 m) in the day.
Cladocera	<u>Penia avirostris</u>	Maximally abundant in December, 1969 in Santa Barbara Channel
	<u>Evadne nordmanni</u>	Abundant in July to August, 1968 in nearshore waters off La Jolla
	<u>Podon polyphemoides</u>	
	<u>Evadne spinifera</u>	
	<u>E. tergestina</u>	
Euphausiida	<u>Euphausia pacifica</u>	
	<u>Nematoscelis difficilis</u>	
	<u>Nyctiphanes simplex</u>	
	<u>Stylocheiron longicorne</u>	
	<u>Thysanoessa gregaria</u>	
	<u>T. spinifera</u>	
Decapoda	<u>Sergestes similis</u>	Recorded from 356 fathoms (650 m) trawls.
	<u>Cancer magister</u>	Dungeness crab
	<u>Pandalus jordani</u>	Pink shrimp
	<u>Pugettia producta</u>	Kelp crab
	<u>Crangon</u> spp.	Shrimp
THALIACEA	<u>Doliolum denticulatum</u>	Abundant in nearshore waters in summer.
(BLM, 1978)		

sea urchin predators such as the sea otter (Enhydra lutris), increased sedimentation, storm damage, and perhaps warm temperatures with an associated decrease in nutrients in ocean waters. Positive factors include: a reduction in the volume of suspended solids and toxic substances discharged from the Whites Point outfall, commercial harvesting of red sea urchins (Strongylocentrotus franciscanus), kelp transplantation programs, direct control of sea urchins, removal of competing vegetation, and favorable environmental conditions such as improved transparency of the ocean waters (Wilson et al., 1980).

3.3.3. Benthic Biology

The macrofauna of subtidal benthic communities in general within the Southern California Bight are influenced by a variety of factors including bathymetry, substrate type, oceanic and localized currents, biogeographic location, and oxygen concentrations. The nearshore deep sea basins located between the mainland and first line of islands and ridges are quite broad and relatively shallow 492 fathoms (900 m) as a consequence of rapid sedimentation. Offshore basins are deeper with less plains and greater slope habitat than inshore basins. Outer basins also have relatively higher levels of oxygen than inner basins (BLM, 1981a).

To facilitate comparisons of various sites and coordinate findings with those in the literature, benthic invertebrate fauna are divided into infauna, animals living in bottom sediments and epifauna, animals living on the surface of the sediments. This distinction is not completely valid for some forms which occupy both habitats but is useful for the following discussion.

3.3.3.1. Infauna

The benthic infauna communities of the Southern California Bight have been the subject of many studies (Hartman, 1955 and 1966; Hartman and Barnard, 1958; Allan Hancock Foundation, 1965; Jones, 1969; SCCWRP, 1973; Jones and Fauchald, 1977; Fauchald and Jones, 1978a,b,c; Word and Mearns, 1979). These studies have described five major marine benthic environments in the Southern California Bight, each with several habitats determined primarily by sediment characteristics. The five environments are: 1) the mainland shelf between the shoreline and 5 fathoms (10 m), 2) the island shelf between 0 and 55 fathoms (100 m), 3) the slope and irregular areas between 55 fathoms (100 m) and the deep-sea basins, 4) the ridge and bank tops between (55 and 164 fathoms (100 and 300 m), and 5) the deep basin habitats in excess of 164 fathoms (300 m). Various biological communities occur within each habitat. The mainland shelf, continental slope, and basin habitats are most relevant to the alternative ODMDS sites.

Mainland shelf environments exhibit high species abundance and standing crop compared to other major habitats. Polychaetes, mollusks and crustaceans are the major taxonomic groups represented. Total infaunal density varies greatly, averaging approximately 5,000 organisms/m² (BLM, 1978).

Species richness, biomass, and density of the mainland shelf benthos has been shown to be significantly reduced in the area of sewage outfalls compared to other inshore shelf locations (Thompson, 1982, Swartz et al., 1986). Seasonal changes in inshore benthic communities are more evident than those in deeper areas of the shelf and basin owing to storm patterns, currents and water temperature effects. Peak reproduction occurs in late winter through early summer and juvenile recruitment occurs through late summer. Dynamic ocean processes and high community diversity in nearshore mainland shelf habitats produce patchy distributions of organisms (Jones, 1969). Table 3-7 lists dominant infaunal invertebrates of the San Pedro Shelf.

The continental slope macrofauna populations exhibit random patterns with respect to distribution, abundance, and diversity of species. These values are lower than mainland shelf areas because the population factors are related to depth. The slope fauna is a transitional community between shelf species and obligate deep-sea fauna. As with the shelf fauna, polychaetes tend to dominate, followed by crustaceans, mollusks and echinoderms.

Total density of infauna ranges from approximately 2,000 organisms/m² to 11,000 organisms/m² (Jones, 1969). Table 3-8 lists the dominant benthic infauna of the slope offshore of Huntington Beach/Laguna Beach, the closest slope area to the LA-2 site for which extensive data are available. Species abundance decreases with depth, due to decreasing dissolved oxygen concentrations (Jones and Fauchald, 1977). The dominant feeding methods of the fauna are surface deposit feeding and suspension feeding. Little seasonal change has been observed in deep slope faunal communities because environmental conditions remain relatively constant.

The deep-sea basins of southern California support a depauperate benthic fauna (Hartman and Barnard, 1958; Fauchald and Jones, 1978c), due primarily to extremely low dissolved oxygen levels. Infaunal density ranges from 11 organisms/m² to 120 organisms/m² (BLM, 1978). Surface deposit feeders dominate the community and populations of species vary considerably among basins; however, a few species of polychaetes and mollusks are present in most of the basins. Two species of polychaetes, Eclysippe trilobatus and Phyllochaetopterus limicolus, are particularly widespread. Common benthic infauna of the San Pedro Basin are listed in Table 3-9.

Table 3-7. Dominant Benthic Infauna of the San Pedro Shelf from 9.3 Fathoms (17 m) to 131 Fathoms (240 m).

Taxa	Abundance ($\bar{x}$ individuals/sample)
POLYCHAETA	
<u>Lumbrineris</u> sp.	4.8
<u>Prionospio malmgrani</u>	3.6
<u>Pectinaria californiensis</u>	1.7
Cirratulidae spp.	8.1
<u>Glycera</u> spp.	2.9
MOLLUSCA	
Pelecypoda	
<u>Parvilucina tenuisculpta</u>	10.7
<u>Tellina carpenteri</u>	3.2
<u>Axinopsida serricata</u>	2.7
<u>Macoma yoldiformis</u>	1.3
CRUSTACEAN	
Ostracoda	
<u>Euphilomedes carcharondonta</u>	4.8
NEMERTEA spp.	3.2
ECHINODERMATA	
Ophiuroidea	
Amphiuridae sp.	5.8
(Jones, 1969)	

Table 3-8. Dominant Benthic Infauna of the Slope Off
Huntington and Laguna Beaches from 88 Fathoms
(161 m) to 284 Fathoms (520 m).

Taxa	Abundance ($\bar{x}$ individuals/site)
POLYCHAETA	
<u>Pectinaria californensis</u>	3.2
<u>Maldane sarsi</u>	2.1
<u>Lumbrineris</u> sp.	1.4
<u>Paraprionospio pinnata</u>	0.9
<u>Mediomastus californensis</u>	0.7
<u>Prionospio cirrifer</u>	0.5
MOLLUSCA	
Aplacophora	
<u>Limifossor fratula</u>	0.6
Pelecypoda	
<u>Mysella tumida</u>	1.0
<u>Cyclocardia ventricossa</u>	0.5
CRUSTACEA	
<u>Ampelisca macrocephala</u>	1.4
ECHINODERMATA	
<u>Amphiodia urtica</u>	1.1
Jones and Fauchald (1977)	

Table 3-9. Dominant Benthic Infauna of the San Pedro Basin
from 340 Fathoms (622 m) to 485 Fathoms (888 m).

Taxa	Abundance ($\bar{x}$ individuals/sample)
POLYCHAETA	
<u>Elysippe trilobatus</u>	4.9
<u>Aricidea complex</u>	1.4
<u>Phyllochaetopteros spp.</u>	4.9
<u>Spiophanes sp.</u>	1.9
MOLLUSCA	
<u>Mitrella permodesta</u>	2.7
<u>Tomburchus redondoensis</u>	0.4
<u>Cadulus californicus</u>	0.3
CRUSTACEA	
<u>Lillieborgia cota</u>	0.3
Fauchald and Jones (1978c)	

The San Pedro Basin benthic macrofauna community is randomly distributed and numerically dominated by minor phyletic groups (BLM, 1981b). Similar to other basin habitats, San Pedro Basin supports few species and low population densities. The benthic fauna are typically deposit feeders, since the basin acts as a food trap. In comparison to other basins, San Pedro Basin exhibits the lowest standing crop (Hartman and Barnard, 1958) and lower species richness and diversity than Santa Cruz and San Nicholas Basins.

An area within the middle and deeper areas of the San Pedro Basin, delineated by a contour near the 458 fathoms (837 m) depth and about 55 fathoms (100 m) below the sill depth, supports a very sparse and impoverished fauna. Seventy samples from subsill depth yielded a total of 115 species (Hartman and Barnard, 1958) and a density of 31 animals per m^2 . In this area, two polychaetes (Phyllochaetopterus sp. and Protis pacifica) and a scallop (Cyclopecten sp.) were the dominant organisms. This impoverished habitat is a result of the extremely low oxygen levels. The minimum oxygen levels generally correspond to the sill depth at 274 to 383 fathoms (500 to 700 m) caused by decomposition of organic material before reaching the basin floors (Emery, 1960).

3.3.3.2. Infauna of LA-2 Site

The LA-2 site lies partly on the continental shelf and partly on the continental slope. Depth ranges between 11 and 91 fathoms (20 and 165 meters). The benthic infauna taxa of the site are generally similar to those reported for other slope locations in the region (Appendix A, p. A-72). Surface deposit feeders and suspension feeders predominate. In approximate order of abundance and diversity, the dominant groups are polychaetes, crustaceans, mollusks and echinoderms. Abundant species in samples collected using a modified van Veen grab were: the polychaetes Spiophanes berkeleyorum, Tharyx sp., M. ambiseta, P. californiensis, and T. gracilis; and the clam, A. serricata.

Total density of infauna ranged from 2,000 to 11,000 organisms/ m^2 . The number of species per 0.1 m^2 ranged from 42 to 105. Both species density and abundance decreased with depth (Appendix A, Figures A-10 to A-13). It is difficult to compare these values to those of other studies because sampling gear and mesh sizes were different; however, comparisons between LA-2 and the reference site were possible. Values for species diversity and species richness were generally higher at the reference site and the number of individuals at the disposal site was greater than the recorded values at the corresponding stations in the reference area. These differences were associated with differences between the two sites in sediment characteristics. LA-2 sediments were both coarser and more poorly sorted than the reference site (Appendix A, p. A-70).

The species composition of the LA-2 site is indicative of moderate pollution stress, according to the classification of Thompson (1982). Of the indicator species identified, those typical of the transition zone that are found at LA-2 include Mediomastus sp., A. serricata, Parvilucina tenuisculpta, and Euphilomedes producta. Species that characterize the control zone, Amphiodia urtica and Spiophanes missionensis, and the contaminated zone, Capitella capitata and Tharyx sp., were also prevalent.

3.3.3.3. Epifauna

Unlike the infauna, the abundance of epifauna generally increases with depth over the mainland shelf and much of the continental slope (Word and Mearns, 1977). Species abundance and diversity of epifauna decrease very sharply in the deep basins (Brown and Shenton, 1973). Many classes of epifaunal species have very large depth ranges. Echinoderms, for example, are the numerically dominant class of organisms at most depths, although their diversity is often low. Common species include the sea urchins Lytechinus pictus and Allocentrotus fragilis, the sea cucumber Parastichopus californicus, and the seastar Astropecten verrilli. The shrimp Sicyonia ingentis is also a species that is commonly collected in trawls.

The two most commonly used methods of sampling benthic fauna are grab/core samplers, and trawls. Grabs and cores are used primarily to sample infauna, while trawls are used to sample demersal fish and, somewhat incidentally, epibenthic fauna. The two methods produce very different results, as can be seen by comparing species lists from grab/core studies in the Southern California Bight such as Fauchald and Jones (1979) and Jones (1969) to those from trawl studies such as those conducted by the Southern California Coastal Water Research Project (SCCWRP) (SCCWRP, 1973; Moore et al., 1983). It is, therefore, not useful to compare the present data to results from grab/core studies. The following sections summarize and discuss these data in a manner commensurate with the nonquantitative nature of the sampling. Because the primary purpose of the trawling was to collect animals for tissue contaminant analysis, no attempt was made to sample in a rigorous quantitative manner (by careful measuring the area swept by each trawl, for example). Therefore, the data cannot support detailed quantitative analysis of density, diversity, biomass, etc. The data can be used, however, to characterize in general the epibenthic macroinvertebrate fauna of the sites by assessing major trends and patterns in principal species present, number of species and overall abundance.

Table 3-10 shows principal species, number of species, and number of individuals of epibenthic microinvertebrates captured in otter trawls at the LA-2 disposal and reference sites, by depth of trawl station. In all, sampling at these two sites produced 93 species. Extensive trawling by SCCWRP (Moore et

al., 1983) produced over 500 species. The comparatively limited results of the present study are not surprising considering the limited depth range (71 to 171 fathoms or 129-312 m) and duration (64 mostly 5-minute trawls) of the sampling.

The trawls were dominated by crustaceans and echinoderms in both abundance and species composition. Three species were particularly abundant: the sea urchins Allocentrotus fragilis and Lytechinus pictus, and the shrimp Sicyonia ingentis. Together these three species accounted for 72 percent of the invertebrate individuals caught in the trawls. L. pictus was the most abundant species but occurred in relatively few trawls, indicating a patchy distribution. Other common species in the trawls were the sea cucumbers Parastichopus californicus and Spatangus californicus, and the shrimp Crangon zorca and Spirontocaris holmesi. All of these species are common components of trawl samples from the region (Moore et al., 1983).

Neither site shows any obvious depth-related trend in number of species, except for some indication of lower number of species at the mid-depth station 108 fathoms (198 m) at the reference site. There is a clear pattern, however, of highest abundance at the mid-depth station at the disposal site, and at the shallow station at the reference site. This is somewhat at odds with the results of SCCWRP surveys, which generally show an increase in the abundance of epibenthic invertebrates with depth over this depth range (Word and Mearns, 1977; Moore et al., 1983). Moore et al. (1983) also found increasing numbers of species with depth. It should be noted that, in the SCCWRP surveys, increasing depth generally coincides with increasing distance from sewage outfalls, which have been shown to depress benthic populations. Of the commonly encountered species listed above, only A. fragilis was consistently abundant at the deep station 171 fathoms (312 m); this species was also abundant at the mid-depth stations. C. zorca was most abundant at the shallow station.

There is no clear difference between the disposal and reference sites in number of species. There is evidence, however, that invertebrates are more abundant at the reference site. More individuals were caught at the reference site during each of the four sampling periods, and almost twice as many total individuals were caught at the reference site as at the disposal site. Disposal of dredged material may have caused a reduction in the epibenthic invertebrates population at the disposal site, through smothering, change in sediment characteristics, or change in food supply.

Regarding principal species, L. pictus and S. californicus are more abundant at the reference site. C. zorca is more abundant at the disposal site, and this appears to be true for S. ingentis also. The relation between this pattern of more abundant echinoderms at the reference site and more abundant crustaceans at the disposal site is not known, nor is the relation of either of these patterns to disposal. On the other hand, the second most abundant species, A. fragilis, shows no apparent preference for either site.

Table 3-10. Dominant Epifauna of the LA-2 and Reference Sites

<u>DISPOSAL SITE</u>			
	<u>Principal Species</u>	<u>Number of Species</u>	<u>Number of Individuals</u>
Shallow Station (129 m)	<u>Sicyonia ingentis</u> <u>Parastichopus californicus</u>	30	586
Mid-Depth Station (198 m)	<u>Crangon zorca</u> <u>Sicyonia ingentis</u> <u>Spirontocaris holmesi</u> <u>Allocentrotus fragilis</u>	31	1,670
Deep Station (312 m)	<u>Allocentrotus fragilis</u>	28	770
Overall Site	<u>Sicyonia ingentis</u> <u>Allocentrotus fragilis</u>	70	3,026
<u>REFERENCE SITE</u>			
	<u>Principal Species</u>	<u>Number of Species</u>	<u>Number of Individuals</u>
Shallow Station (129 m)	<u>Sicyonia ingentis</u> <u>Spatangus californicus</u> <u>Lytechinus pictus</u>	32	4,262
Mid-Depth Station (198 m)	<u>Sicyonia ingentis</u> <u>Parastichopus californicus</u> <u>Allocentrotus fragilis</u>	19	855
Deep Station (312 m)	<u>Allocentrotus fragilis</u>	31	555
Overall Site	<u>Sicyonia ingentis</u> <u>Allocentrotus fragilis</u>	53	5,672
Appendix A, p. A-85			
Fathom = 1.829 meters			

As part of the EIS, EPA and COE determined that a common benthic epifaunal organism should be tested for toxic substances. Studies of tissue samples from S. ingentis were tested for the accumulation of toxic substances. There was no significant difference ($p = 0.05$) in the concentration of any heavy metals in the muscle tissues of shrimp from either the LA-2 site or the reference site. Concentrations of oil and grease were below detection limits and it is assumed that there is no significant difference between the two areas (Appendix A, p. A-34). Similarly, there is little or no evidence of a consistent elevation of DDT isomer or PCB tissue concentrations at the disposal site relative to concentrations observed at the reference site (Appendix A, p. A-40). Tissue levels of pesticides and PCBs vary among surveys, and among samples within each survey. The highest values (1740 ug/kg dry weight) in individual tissue samples were often, but not always, observed at the disposal sites. The significance of these apparent elevations is uncertain because of the small number of successful analyses at the reference site.

Natural variability in the tissue concentrations of chlorinated hydrocarbons may result from: (1) exposure to any of the other contaminated areas within the Southern California Bight, (2) feeding habits of individuals, or (3) differential ability of individuals to metabolize contaminants (Jeff Cross, SCCWRP, personal communication, 30 September 1985). In addition, although standard analytical techniques were used, there is not adequate data to quantify analytical variability, so that no firm conclusions can be made regarding natural variability.

It should be noted that tissue levels of trace metals and chlorinated hydrocarbons at LA-2 were much lower than levels in S. ingentis from locations near the Hyperion outfall in Santa Monica Bay and the Whites Point outfalls off the Palos Verdes Peninsula (Brown et al., 1984).

3.3.4. Fish

The San Pedro Basin fish fauna consists of distinct vertically distributed fish communities, including species common to mainland and island shelf areas, mesopelagic deep sea or midwater species and bathypelagic demersal fishes. Various transient and resident species occur within the basin area (Ebeling et al., 1970). Of the 554 species (representing 129 families) of coastal marine fishes known to occur off California (Miller and Lea, 1972), 481 species (87%) are found in southern California waters from Point Conception to the Mexican border. The list compiled by Miller and Lea includes only part of the deep-sea fauna. As the distance north from southern California increases, the number of species decreases. Fish abundance and biomass increase with depth to the lower portions of the coastal slope. These factors decrease in the deep-sea basin where few juveniles are found (Allen and Mearns, 1977). Below 109 and 164

fathoms (200 and 300 m) the number of species varies directly with decreasing temperature and dissolved oxygen concentrations.

Ahlstrom (1959, 1965, 1969) summarized information on the extensive CalCOFI collections of fish eggs and larvae in the California Current. The distribution of fish larvae is highly dependent upon the spawning areas of the parents and the hydrographic conditions prevailing in the area. Because most of the coastal waters are transported in either a northern or southern direction, larvae spawned in coastal areas tend to be retained there (Richardson and Percy, 1977). The distribution and abundance of fish larvae and eggs vary by season over the Southern California Bight depending on the species. For some species, for example the northern anchovy (Engraulis mordax) and the several species of rockfish (Scorpaenidae spp.), larvae occur throughout the bight area during most of the year.

In the CalCOFI data, 12 larval types (species or genus) comprised 90 to 93 percent of all larvae collected (Table 3-11). The northern anchovy (E. mordax) and Pacific hake (Merluccius productus) represented 40 to 60% of the catch. Larvae of deep sea pelagic fishes composed 20 to 40% of all larvae taken in CalCOFI cruises from 1955 to 1960. Three families represented 90% of the deep sea fishes and were the most important species in offshore oceanic waters. These were the larvae of the myctophid lanternfishes, the gonostomatid lightfishes and the deep sea smelts (Bathylagidae) (Ahlstrom, 1969). Ahlstrom (1965) found larvae of subarctic species in winter and spring and those of subtropical species in the warmer summer months.

3.3.4.1. Demersal Fish

The demersal fish of the Southern California Bight have been the subject of numerous studies which have reported several basic distribution patterns (Mearns and Allen, 1973; SCCWRP, 1973; Stephens et al., 1973; Allen and Mearns, 1977; Word et al., 1977; Moore and Mearns, 1980; Moore et al., 1983). In nearshore areas between 6-50 fathoms, common demersal fish are speckled sanddab (Citharichthys stigmaeus), California tonguefish (Symphurus atricauda), horneyhead-turbot (Pleuronichtys verticalis), white surfperch (Phanerodon furcatus), shiner surfperch (Cymatogaster aggregata), and white croaker (Genyonemus lineatus).

In deeper shelf environments between 55 and 219 fathoms (100 and 400 m), demersal fish tend to be dominated by flatfish (Pleuronectidae) and rockfish (Scorpaenidae). Common species include: Dover sole (Microstomus pacificus), slender sole (Lyopsetta exilis), rex sole (Glyptocephalus zachirus), Pacific sanddab (Citharichthys sordidus), stripetail rockfish (Sebastes saxicola), splitnose rockfish (Sebastes diporproa), shortspine thornyhead (Sebastolobus alascanus), pink surfperch (Zalembeus rosaceus), plainfin midshipman (Porichthys notatus), and shortspine combfish (Zaniolepis frenata). These fish feed on a variety of prey species including: epifauna such as ostracods, mysid shrimp and other crustaceans, infauna such as polychaetes and bivalves; zooplankton such as copepods and tunicates; and other demersal fish.

Table 3-11. Common Fish Larvae of the Southern California Bight

Genus Species	Common Name
<u>Engraulis mordax</u>	Northern anchovy
<u>Merluccius productus</u>	Pacific hake
<u>Sebastes</u> spp.	Rockfish
<u>Citharichthys</u> spp.	Sanddabs
<u>Bathylagidae</u>	Deep-sea smelts
<u>Myctophidae</u>	Lanternfishes
<u>Gonostomatidae</u>	Lightfishes
<u>Sardinops caerulea</u>	Pacific sardine
<u>Trachurus symmetricus</u>	Jack mackerel
<u>Parophrys vetulus</u>	English sole
<u>Isopsetta isolepis</u>	Butter sole
<u>Microgadus proximus</u>	Pacific tomcod
(BLM, 1978)	

3.3.4.2. Demersal Fish of the LA-2 Site

Otter trawl samples at five stations within the LA-2 site collected 38 demersal fish species from 15 families (Appendix A, p. A-75 to A-79). The trawl catch was dominated by Pleuronectidae and Scorpaenidae. Three species were particularly abundant and frequently collected in the trawls, L. exilis, C. sordidus and Z. frenata. Together these three species accounted for 76% of the individuals caught. Other commonly caught species were M. pacificus, P. notatus, the halfbanded rockfish (Sebastes semicinctus), S. diporopora, S. saxicola, S. alascanus, and the yellowchin sculpin (Icelinus quadriseriatus). All of these species are well known common components of the demersal fish fauna found over the continental shelf of southern California (Horn, 1974; SCCWRP, 1973; Stephens et al., 1973; Moore et al., 1983)). Based on the results of previous studies listed above, Z. frenata and L. exilis were more abundant than expected, while S. saxicola, G. zachirus, and Z. rosaceus less abundant than expected.

There is some indication that demersal fish are less abundant and less diverse at the LA-2 site, compared to a nearby reference site (Appendix A, p. A-74). More individuals were caught at the reference site during each of the four sampling periods, and in 9 of 12 stations sampling (3 depths, 4 periods) (Appendix A, Table A-30). More species were caught at the reference site overall (43 vs. 38), during 3 of the 4 sampling periods, and in 8 of 12 station samplings. These differences may be related to the previous disposal of dredged material, although the reason for lower catches at the disposal site is not clear.

Infaunal benthic community density was greater at the disposal site stations during all four surveys than at almost all corresponding depth reference site stations (see Appendix A, Section A.3.3). Although the infaunal community at the disposal site could be separated from that at the reference site, in many of the classification analyses there is nothing to suggest that disposal site organisms were unacceptable as prey to the fish community.

Major differences were found in trawl epibiota density between the first two and last two surveys. Since fish abundance and diversity trends did not vary similarly it is unlikely there is a direct relationship between epibiota density and fish catch. The difference in fish catch between disposal and reference sites may simply reflect avoidance of the disposal sites by some species and individuals as a response to the increased frequency of disturbance within the disposal site. Of course, it is possible that depauperate fish and invertebrate fauna at LA-2 relative to the reference site is due to natural differences between the sites.

Contaminants in demersal fish of the Southern California Bight vary according to the type of toxicant. Levels of pesticides and PCBs tend to be low in offshore areas and other areas distant from pollutant sources (SCCWRP, 1973; Kaplan, 1977). These same contaminants tend to be higher in nearshore species, particularly near sewage outfalls such as the Whites Point outfall on the Palos Verdes Peninsula (BLM, 1978). Trace metal levels do not show this pattern (BLM, 1981b).

Levels of heavy metals (As, Cd, Cr, Cu, Hg, Pb, and Zn), oil and grease, and chlorinated hydrocarbons (pesticides and PCBs) were analyzed in tissue samples of L. exilis and C. sordidus collected at the LA-2 site. Tissue levels of metals at the LA-2 site were not higher than those at the reference site (Appendix A, p. A-40), and compared favorably with levels reported in the literature for the Southern California Bight (Appendix A, p. A-42). For pesticides and PCBs, there was little or no evidence of a consistent elevation of DDT isomer or PCB tissue concentrations at the LA-2 site relative to concentrations at the reference site (Appendix A, p. A-40). Levels at the LA-2 and reference site also compared well with literature values (Appendix A, p. A-40, A-43; Sherwood et al., 1980).

3.3.4.3. Pelagic Fish

Pelagic fish were not sampled as part of the present study. Horn (1974) provided a list of 80 species from 30 families that are pelagic species found in southern California waters. The Southern California Bight contains nearshore as well as offshore pelagic communities. Population diversity is illustrated in the list of fish presented in Table 3-12.

More than 50% of the 80 species of pelagic fish are rare and almost 75% are either rare or uncommon based on an occurrence evaluation by Miller and Lea (1972), and Horn (1974). The numerically dominant species are several of sport and commercial species include the following: E. mordax, Pacific saury (Cololabis saira), jack mackerel (Trachurus symmetricus), yellowtail (Seriola dorsalis), California barracuda (Sphyræna argentea), M. productus, Pacific mackerel (Scomber japonicus), Pacific bonito (Sarda chiliensis), albacore (Thunnus alalunga) and Pacific butterflyfish (Peprilus simillimus). These species feed primarily on zooplankton and other pelagic fish.

3.3.4.4. Deep-Sea Fish

Many deep sea fishes undergo periodic vertical migrations and, therefore, may be found in the upper 55 to 274 fathoms (100 to 500 m) layer of the ocean. However, they are members of a rather distinctive group since they live at least part of their lives in waters several hundred to thousands of meters deep. These fishes are generally small (<300 mm long), black or dark

Table 3-12. Families of Fish Inhabiting the Pelagic Environment
In the Southern California Bight

<u>RARE</u>	<u>COMMON</u>
Dories (Zeidae)	Anchovies (Engraulidae)
Crestfish (Lophotidae)	Hakes (Merlucciidae)
Oarfish (Regalecidae)	Sauries (Scomberesocidae)
Ribbonfish (Trachipteridae)	
Louvars (Luvaridae)	
<u>EPIPELAGIC</u>	<u>WIDE DEPTH RANGE</u>
Flyingfish (Exocoetidae)	Pomfrets (Bramidae)
Halfbeaks (Hemirhamphidae)	Swordfish (Xiphiidae)
Needlefish (Belonidae)	Mackerels (Scombridae)
Molas (Molidae)	Medusafish (Centrolophidae)
	Squaretails (Tetragonuridae)
<u>COASTAL</u>	<u>OFFSHORE</u>
Anchovies (Engraulidae)	Opahs (Lamprididae)
Herrings (Clupeidae)	Dolphinfish (Coryphaenidae)
Jacks (Carangidae)	Cutlassfish (Trichiuridae)
Butterfish (Stromateidae)	Billfish (Istiophoridae)
	Pomfrets (Bramidae)
	Squaretails (Tetragonuridae)
(Miller and Lea, 1972)	

with silvery reflective sides and frequently with luminescent organs. Members of the families Myctophidae (lanternfish), Bathylagidae, and Gonostomidae are the most abundant deep sea fishes off southern California, and they occupy central positions in oceanic food webs. These families, especially the Myctophidae, appear to occupy important positions in the trophic structure of offshore waters comparable to that of the anchovy in shallow, more inshore waters (Horn, 1974). Deep-sea fish feed primarily on deep sea crustaceans such as euphausiids and copepods, chaetognaths, and other fish. In turn, the deep-sea fish serve as food for cetaceans, tunas, sharks, and billfish.

The heterogeneity and transitional nature of the southern California deep water environment produces a relatively diverse fish fauna for the region. Approximately 30 families and 93 species of deep water fishes are known in the Southern California Bight (Horn, 1974). According to Fitch and Lavenberg (1968) two deep-sea families, lanternfish (Myctophidae) and lightfish (Gonostomatidae), are the two most abundant fish groups in the world oceans.

This generalization also holds for southern California waters. The five principal deep water families for the region in terms of number of species are: Myctophidae, 16 species; bigscales (Melamphaeidae), 9 species; hatchetfish (Sternoptychidae), 7 species; Gonostomatidae, 6 species; and deep-sea smelts (Bathylagidae), 5 species. The species most frequently collected by Ebeling et al. (1970) were Leuroglossus stilbius, a mesopelagic bathylagid, and two mesopelagic myctophids, Stenobranchius leucopsarus and Triphoturus mexicanus. Paxton (1967) concluded that S. leucopsarus and T. mexicanus were the dominant myctophids in the San Pedro Basin.

3.3.5. Coastal Birds

The avifauna of the San Pedro Basin region of the Southern California Bight is extremely varied and highly transient. Birds which might occur in the LA-2 area or other offshore areas consist of pelagic or littoral species which feed on epipelagic fishes and marine invertebrates either at the surface or by shallow diving. Common offshore pelagic species include Common Loon, Arctic Loon, Red-throated Loon, Western Grebe, Horned Grebe, Eared Grebe, Pied-billed Grebe, Pink-footed Shearwater, Sooty Shearwater, Black-vented Shearwater, Black Storm-petrel, Brown Pelican, Double-crested Cormorant, Black Brant, Surf Scoter, Red-breasted Merganser, Glaucous-winged Gull, Western Gull, California Gull, Ring-billed Gull, Mew Gull, Bonaparte's Gull, Heerman's Gull, Forster's Gull, Elegant Tern, and Caspian Tern.

Although the Southern California Bight is not as significant a breeding locale for coastal species as is the northern portion of the State (Farallon Islands northward), it does contain the entire California breeding populations of Black

Storm-Petrels, Xantus Murrelets and Brown Pelicans (Sowls et al., 1980). The breeding colonies of these three species are located on the Channel Islands at considerable distance from the LA-2 and other sites under consideration. Little effect upon the breeding efforts of these species would be expected. Preferred breeding areas for most of the other common pelagic species are either dispersed along the California coast or located at more northerly breeding colonies. The designation of the LA-2 disposal site is not likely to affect any of the avian species which occur in the San Pedro Basin.

3.3.6. Marine Mammals

Within the Southern California Bight, 32 species of marine mammals have been recorded. The bight is the richest of all temperate water areas in terms of abundance and species. Most marine mammals are broadly distributed, seasonal migrants that are not dependent on the habitat that will be affected by the project. Therefore, the designation of the San Pedro Basin disposal site is not likely to affect any of the listed species.

3.3.6.1. Pinnipeds

The Southern California Bight supports a large number of seals and sea lions (Table 3-13A). Six species are present, although the Guadalupe fur seal (Arctocephalus townsendi) is considered a rare visitor to this area. Pinnipeds tend to be concentrated offshore at the northern Channel Islands, where essentially all breeding, pupping, most foraging and hauling out occurs. The most important rookeries are on San Miguel Island. Other important pinniped areas are located on San Nicolas, San Clemente and Santa Barbara Islands.

Pinnipeds are found in smaller numbers along the mainland coast as well, where the main activity is hauling out. Feeding occurs in both nearshore and offshore waters, with some species swimming daily across the channel to feed over offshore banks and ridges. The California sea lion (Zalophus californianus) and the harbor seal (Phoca vitulina) are the two most common pinniped species along the mainland coast and in the vicinity of LA-2.

3.3.6.2. Cetaceans

Of the 29 species of cetaceans that have been identified in the Southern California Bight (Table 3-13B), 10 species are common (Dailey, 1974). All of these species are either transient or migratory. The gray whale (Eschrichtius robustus) and the Pacific bottlenose dolphin (Tursiops truncatus) are the most common inshore species in the vicinity of the LA-2 site and shallow water region within 8 nmi (15 km) of the coast (Dailey, 1974).

Table 3-13. Marine Mammals of the Southern California Bight

Species	Estimated North American Pacific* Population
A. PINNIPEDS	
California sea lion (<u>Zalophus californianus</u>)	157,000
Steller sea lion (<u>Eumetopias jubata</u>)	10,000
Northern elephant seal (<u>Mirounga angustirostris</u>)	100,000
Harbor seal (<u>Phoca vitulina</u>)	42,000
Northern fur seal (<u>Callorhinus ursinus</u>)	4,000
Guadalupe fur seal (<u>Arctocephalus townsendi</u>)	1,600
TOTAL PINNIPEDS	314,600
B. CETACEANS	
Common dolphin (<u>Delphinus delphis</u>)	900,000
Pacific bottlenose dolphin (<u>Tursiops truncatus</u>)	ND
White-sided dolphin (<u>Lagenorhynchus obliquidens</u>)	40,000
Northern right whale dolphin (<u>Lissodelphis borealis</u>)	ND
Dall's porpoise (<u>Phocoenoides dalli</u>)	920,000
Pacific pilot whale (<u>Globicephala macrorhynchus</u>)	ND
California gray whale (<u>Eschrichtius robustus</u>)	18,000
TOTAL CETACEANS	1,878,000
* Excluding Alaska	
ND = No Data Available	
(NMFS, 1986)	

Five cetaceans which occur in California waters (California gray whale, blue whale, Sei whale, humpback whale, and sperm whale) are designated as endangered species by the federal government. All marine mammals, however, are afforded complete protection under the Marine Mammals Protection Act of 1972.

3.3.7. Rare, Threatened and Endangered Species

Table 3-14 lists rare, threatened and endangered species that occur in the offshore Southern California Bight and immediate coastal areas. Most of these species do not occur in the project vicinity, nor do they make regular use of the area. Designation of an ODMDS in or near the San Pedro Basin is not expected to affect any endangered species. Species of particular interest in the project area are discussed below.

3.3.7.1. Gray Whale (*Eschrichtius robustus*)

The gray whale population has shown marked recovery in recent years as a result of protection under the Endangered Species Act. In the most recent survey by the National Marine Fisheries Service (NMFS, 1985), the present population is estimated to be 17,000. These animals migrate through the Southern California Bight twice a year between their summer feeding grounds off Alaska and Canada, and their winter calving areas in the coastal lagoons of Baja California.

The San Pedro Basin is a principal gray whale migration route, and the Palos Verdes Peninsula is a favorite whale watching location. Gray whales pass near and/or through the alternative disposal sites in the San Pedro Basin on their twice-yearly migrations. The major migratory route is between the mainland shore and the Channel Islands. The whales tend to swim closer to shore, often less than 0.5 nmi (1 km), from February to March on their northward migration when calves are present, than on the southward migration from December to January.

3.3.7.2. California Brown Pelican (*Pelicanus occidentalis californicus*)

The brown pelican population has shown strong recovery in recent years since the banning of the use of DDT. Due to the mobility of this species, it is difficult to estimate the total size of the California population, but breeding pairs have numbered roughly 2,000 to 3,000 in recent years (FWS, 1985). A notable exception to this estimate was that only 850 breeding pairs were observed in 1984. This was thought to be a temporary decrease, and the California pelican population is expected to grow or remain constant in the near future.

In the Southern California Bight, pelican rookeries are located on Anacapa Island, Scorpion Rock on Santa Cruz Island, Santa Barbara Island, and the Los Coronados Islands off northern

Table 3-14. Rare, Threatened or Endangered Species of the Southern California Bight

Species	California Distribution	Federal Status	State Status
PLANTS			
Salt marsh bird's beak (<u>Cordylanthus martinimus</u> spp. <u>martimus</u>)	Coastal marshes of Santa Barbara, Ventura, Orange and San Diego Counties.	E	E
REPTILES			
Leatherback turtle (<u>Dermochelys coriacea</u> <u>sechlegelii</u>)	Tropical and subtropical seas of west coast; some stray as far north as Vancouver Island, B.C.	E	N/A
Loggerhead sea turtle (<u>Caretta caretta</u>)	Offshore.	T	N/A
Green sea turtle (<u>Chelonia mydas</u>)	Offshore.	E	N/A
Pacific Ridley's turtle (<u>Lepidochelys olivacea</u>)	Rare visitors offshore.	E	N/A
BIRDS			
American peregrine falcon (<u>Falco peregrinus anatum</u>)	Territories along coastal California between Oregon and Mexico.	E	E
Southern bald eagle (<u>Haliaeetus leucocephalus</u>)	Mainly in interior of state some found along the coast and on Catalina Island.	E	E
California brown pelican (<u>Pelecanus occidentalis californicus</u>)	Statewide along coast. Breeding only on Anacapa Island and Scorpion Rock in So. California.	E	E

(CONTINUED)

Table 3-14 (Continued). Rare, Threatened or Endangered Species of the Southern California Bight

Species	California Distribution	Federal Status	State Status
California least tern (<u>Sterna albifrons browni</u>)	Breeding from San Francisco Bay to Mexico.	E	E
Lightfooted clapper rail (<u>Rallus longirostris levipes</u>)	Salt marshes of Santa Barbara, Ventura, Orange, and San Diego Counties.	E	E
California black rail (<u>Lateralis jamaicensis carturniculus</u>)	Salt marshes of Santa Barbara, Ventura, Orange and San Diego Counties.	N/A	R
Belding's savannah sparrow (<u>Passerculus sandwichensis beldingi</u>)	Tidal estuaries; So. California to N. Baja.	N/A	E
MAMMALS			
Southern sea otter (<u>Enhydra lutris nereis</u>)	Santa Cruz south to Pismo Beach.	T	N/A
Guadalupe fur seal (<u>Arctocephalus townsendi</u>)	Offshore, Channel and San Nicolas Islands.	E	R
Blue whale (<u>Balaenoptera musculus</u>)	Offshore.	E	N/A
Fin whale (<u>Balaenoptera physalus</u>)	Offshore.	E	N/A
Sei whale (<u>Balaenoptera borealis</u>)	Offshore.	E	N/A
Gray whale (<u>Eschrichtius robustus</u>)	Nearshore, normally within 8 nmi of the mainland shore.	E	N/A

(CONTINUED)

Table 3-14 (Continued). Rare, Threatened or Endangered Species of the Southern California Bight

Species	California Distribution	Federal Status	State Status
Humpback whale (<u>Megaptera</u> <u>novaengliae</u>)	Nearshore.	E	N/A
Pacific right whale (<u>Eubalaena</u> <u>glacialis japonica</u>)	Offshore.	E	N/A
Sperm whale (<u>Physeter</u> <u>catodon</u>)	Offshore.	E	N/A
E = Endangered R = Rare T = Threatened N/A = Not Applicable			

Mexico. The rookeries on Santa Barbara Island are approximately 40 nmi (74 km) west-southwest of the LA-2 site and 35 nmi (65 km) from the deep water region. During the nesting season between March and July, pelicans feed primarily in the vicinity of the rookeries. During the remainder of the year, pelicans are common throughout coastal southern California and they feed in nearshore areas, offshore waters and close to their resting places along the coast.

3.3.7.3. California Least Tern (*Sterna albifrons browni*)

Arriving from unknown wintering areas, California least terns nest from approximately April to August on sandy beaches from Baja California to San Francisco Bay. The California population is currently estimated at approximately 1,200 nesting pairs (California Department of Fish and Game, 1983). The endangered status of this species is partly due to encroachment on its nesting and feeding areas by development and other disturbance by humans.

Nesting sites in the vicinity of the LA-2 site are Venice Beach, Playa del Rey, Terminal Island, San Gabriel River mouth, Cerritos Lagoon, Costa del Sol, Anaheim Bay, Surfside Beach, Huntington Beach, Bolsa Chica, and upper Newport Bay. The closest of these sites, Terminal Island, is approximately 7 nmi (13 km) north of the LA-2 site. Least terns feed in estuaries, rivers and streams, and to a lesser extent in nearshore marine waters near their nesting locations.

3.3.8. Marine Sanctuaries and Areas of Special Biological Significance

The 1,200 acre Seal Beach National Wildlife Refuge and the 1,200 acre Bolsa Chica Ecological Reserve which encompass most of the estuaries and salt marshes inland from Anaheim Bay and southward along the coast are approximately 15 and 18 nmi (28 and 33 km) east respectively from the LA-2 site (Figure 3.8). The location of these two important refuges behind the Anaheim Bay breakwater effectively prevents any impact upon them from the ODMDS. The Upper Newport Bay Ecological Reserve is similarly protected from the influence of marine water flow by Newport Bay and a breakwater.

The Abalone Cove Ecological Reserve on the Palos Verdes Peninsula is the closest biological reservation. 5.5 nmi (10 km) directly north of the LA-2 site, this sensitive area of kelp beds would probably not be impacted by the LA-2 ODMDS disposal activities because prevailing currents would carry any plume contaminants away from this area.

Seven Areas of Special Biological Significance (ASBS) are located around the LA-2 site. These ASBS areas were designated by the California State Water Resources Control Board (CSWRCB) in 1976 to protect species or biological communities from

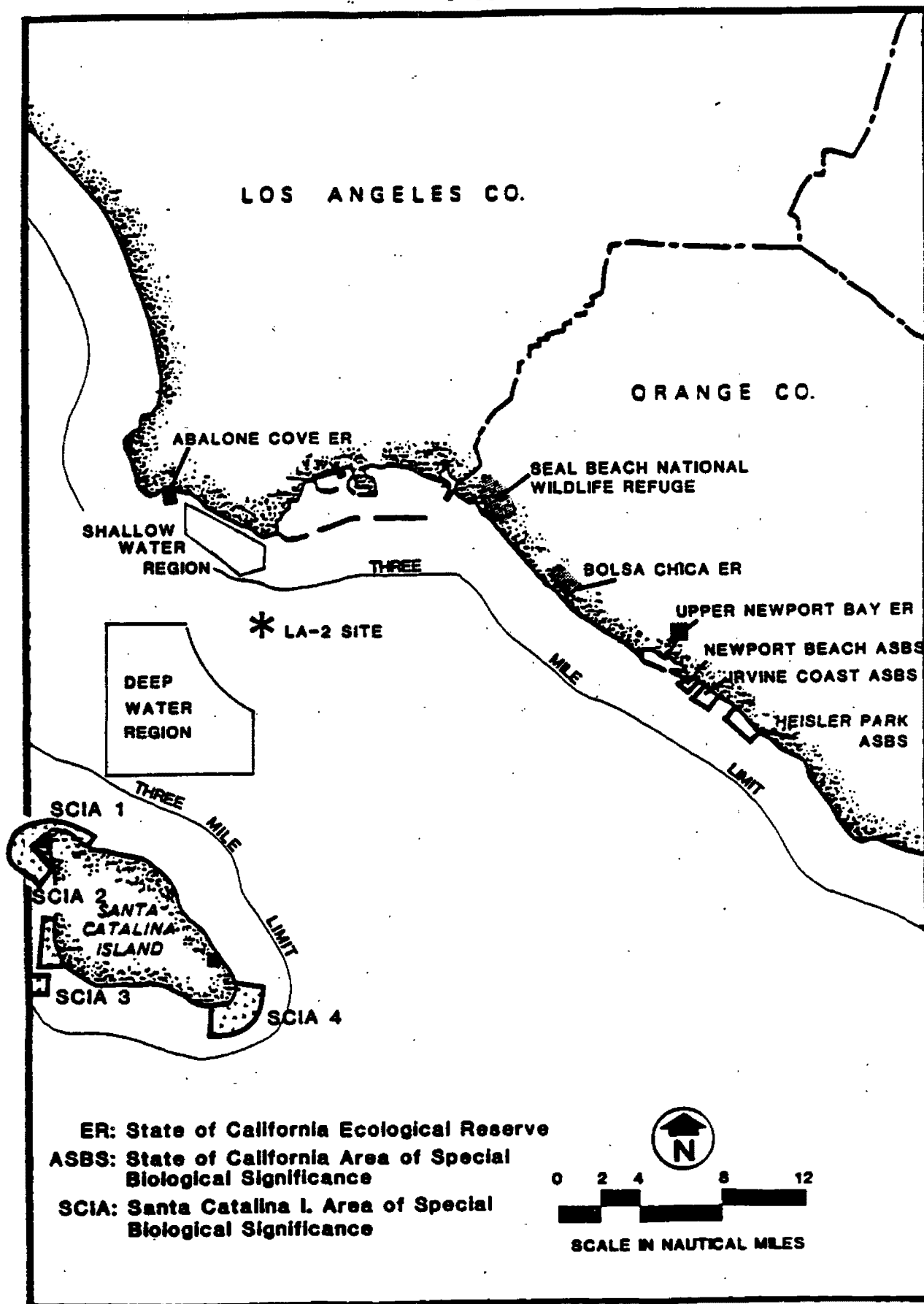


FIGURE 3-8. LOCATION OF FEDERAL AND STATE BIOLOGICAL RESERVES IN THE PROJECT AREA

alteration of natural water quality (CSWRCB, 1976). Newport Beach Marine Life Refuge, Irvine Coast Marine Life Refuge and Heisler Park Ecological Reserve are 20 to 24 nmi (37 to 44 km) east of the LA-2 site. The prevailing northwest currents flow away from these sites. Along with the distance from the LA-2 site to these areas, northwest currents are expected to prevent any impact from the ODMDS on the sites. The same criteria of distance and removal from prevailing currents effectively prevent any impact from the LA-2 site upon the four ASBS areas, Santa Catalina Island-Subareas 1-4, situated on the seaward side of Santa Catalina Island. These sites are located between 15 and 25 nmi (28 and 46 km) southwest of the LA-2 site.

The Channel Islands National Marine Sanctuary is the only established Federal marine sanctuary in the southern California area. Marine sanctuaries are ocean areas designated under the National Oceanic and Atmospheric Administration's (NOAA) authority in Title III of MPRSA. The purpose of this section of MPRSA is to preserve or restore natural areas, recreation activities and ecological and aesthetic values through conservation of unique areas. NOAA's Office of Coastal Zone Management is authorized to carry out the provisions of Title III of MPRSA. The closest part of the sanctuary to the LA-2 site is the area around Santa Barbara Island which is 35 nmi (65 km) to the west. Movement of suspended material from the ODMDS is not expected to impact the Channel Islands National Marine Sanctuary.

The State of California has designated oil and gas sanctuaries within the three mile limit of its jurisdiction (Figure 3.8). The oil and gas sanctuaries are specifically excluded from oil and gas leasing in order to protect the scenic and wildlife values of the area. Except for those areas already leased, almost all coastal areas of Los Angeles and Orange Counties are designated as oil and gas sanctuaries administered by the State Lands Commission. The preferred LA-2 site is located within an area of Proposed Southern California Lease Offering and it is less than 2 nmi (4 km) south of the coastal zone deleted by the State from lease sale. Some movement of suspended material from the ODMDS could be expected to enter this area.

3.3.9. Potentiality for the Development or Recruitment of Nuisance Species in the Disposal Site 40 CFR 228.6(a)(10)

The sediments of some southern California ports and outfall discharge areas support high densities of characteristic invertebrate species that are considered indicators of polluted sediments. Common species of this type are:

Polychaetes

Capitella capitata

Tharyx tessellata

Bivalve

Parvilucinia tenuisculpta

Amphipods

Corophium acherusicum
Corophium insidiosum
Podocerus brasiliensis

Three of these species, C. capitata, Tharyx sp., and P. tenuisculpta, are common in highly polluted areas such as industrial ports and sewage discharge sites. It is possible that any elevated abundance of these species at the LA-2 site is due to disposal of dredged material, and continued disposal would be likely to maintain this situation.

Disposal is most likely to promote development of nuisance species at the shallow water site, because these species are likely to be uncommon there at present and because environmental conditions there are most similar to those of the shallow habitats in which these species are normally most abundant. At the deep water site, the potential for disposal to result in establishment of nuisance species is uncertain, but would seem to be low because of low dissolved oxygen levels, low food supply, and general conditions are very different from those of the shallow habitats where the species are normally most abundant.

3.4. SOCIOECONOMIC ENVIRONMENT

3.4.1. Commercial Fishing

Los Angeles area ports are an important center for commercial fishing. The 260 million pounds of commercial fish landed in 1983 were valued at about \$85.1 million. This represents approximately 51.5% of the total catch weight and 45.7% of the total value of all commercial landings in California (Table 3-15). Between 1981 and 1983, the value of landings at Los Angeles area ports declined from about \$112.0 million to \$85.1 million. However, the Los Angeles area portion of the state total value for commercial landings has increased from 39.9% to 45.7% due to a greater overall decline in the total state landings.

The landings of commercial fish between 1981 and 1983 for each port in the Los Angeles area are shown in Table 3-16. In 1983, the most important port was Terminal Island which accounted for 88.4% of the value for commercial landings in the area. However, a large part of the landings were tuna that were not caught in local waters. The most important local commercial fisheries include the northern anchovy, Pacific bonito, jack mackerel, Pacific mackerel, rock crab, market squid, and sea urchin.

Figure 3-9 shows the principal species and the average annual catch by blocks of origin in the Los Angeles area. This information is based on unpublished data from the California Department of Fish and Game (1984). Fish and Game Block 740 which contains the LA-2 site, as well as most of the neighboring blocks, produced an average of more than 500,000 tons of commercial fish for 1976, 1977 and 1981 (Table 3-17).

Table 3-15. Weight and Value of Landings of Commercial Fish at
Los Angeles Area Ports and in California, 1981-1983

DESCRIPTION	1981	1982	1983
A. LANDINGS (millions of lbs)			
Los Angeles Area	337.4	339.8	262.3
California	780.0	687.7	513.2
Los Angeles Percentage of State Total	43.3	49.4	51.1
B. VALUE OF LANDINGS (thousands of \$)			
Los Angeles Area	111,950	89,207	85,079
California	280,077	229,323	186,092
Los Angeles Percentage of State Total	39.9	38.9	45.7
California Department of Fish and Game (1984).			

Table 3-16. Value of Commercial Fish Landing by Port, Los Angeles Area, 1981-1983

PORT	1981		1982		1983	
	Value (\$1,000)	%	Value (\$1,000)	%	Value (\$1,000)	%
Terminal Island	98,929	88.4	75,654	84.8	73,600	86.5
San Pedro	9,774	8.7	10,402	11.7	9,189	10.8
Los Angeles	168	0.2	1,216	1.4	96	0.1
Wilmington	1,451	1.3	377	0.4	963	1.1
Long Beach	89	0.1	144	0.2	114	0.1
Newport Beach	348	0.3	431	0.5	224	0.3
Dana Point	380	0.3	395	0.4	384	0.5
Avalon	168	0.2	122	0.1	100	0.1
Other Ports	625	0.5	466	0.5	409	0.5
TOTAL	111,950		89,207		85,079	

California Department of Fish and Game (1984).

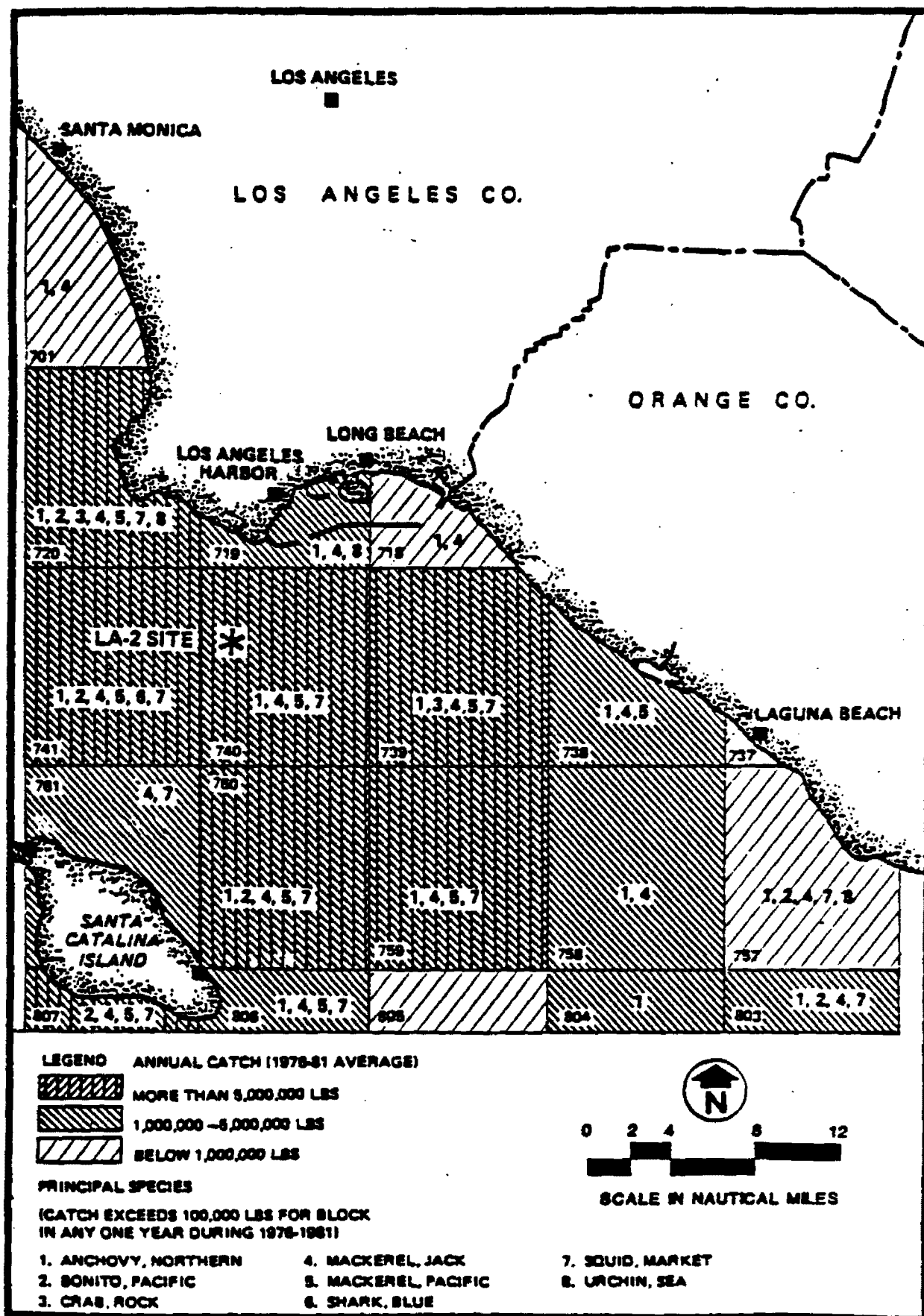


FIGURE 3-9. PRINCIPAL COMMERCIAL FISH SPECIES AND AVERAGE ANNUAL CATCH BY BLOCK IN PROJECT REGION

Table 3-17. Annual Catch in Pounds of Commercial Fish by Blocks of Origin in the Los Angeles Area, 1976, 1977 and 1981

Block Number	Fish Catch (1,000 lbs)		
	1976	1977	1981
701	227.9	149.7	1,095.2
718	113.2	175.5	390.7
719	1,290.6	1,759.2	1,231.0
720	13,250.6	7,614.8	5,948.0
737	59.8	NA	29.6
738	1,440.1	1,904.0	1,390.7
739	5,584.1	7,669.6	3,847.2
740	23,480.8	25,597.0	6,983.9
741	30,329.2	41,509.8	31,153.6
757	855.9	599.6	1,214.5
758	3,427.9	3,280.2	2,218.0
759	6,068.8	8,566.3	2,338.1
760	3,326.5	5,691.8	6,732.3
761	7,039.0	3,623.0	1,495.9
803	1,149.8	4,296.6	266.3
804	1,430.2	1,778.8	84.0
805	1,284.1	706.6	28.7
806	193.9	443.9	2,972.2
807	8,275.1	7,725.4	10,607.6
TOTAL	108,827.5	123,091.8	80,027.5
NA = Not Available			
California Department of Fish and Game (1984).			

The total catch in Block 740 amounted to approximately 23.5 million pounds in 1976 and 25.6 million in 1977. In 1981, it fell to 7.0 million pounds, but most other blocks in the area also experienced decline in catch during that year. Although 31 species of fish and invertebrates were reported caught in Block 740 in 1981, five species, including Pacific bonito, Pacific Mackerel, jack mackerel, northern anchovy, and market squid, accounted for 99.5% of the total catch.

The total annual landings of commercial fish varies considerably from year to year depending in part on fish availability, market demand, weather conditions, and harvest regulations. For example, in Block 740 there was a large drop in the catch for northern anchovy and jack mackerel from about 23.0 million pounds in 1976 to about 3.5 million pounds in 1981. At the same time, Pacific mackerel catch increased from 124,000 pounds in 1976 to 3.3 million pounds in 1981.

3.4.2. Commercial Shipping

Los Angeles and Long Beach Harbors play a very important role in the nation's waterborne commerce. The two ports combined account for more than 30 million tons of foreign trade annually (COE, 1985). In addition, they handle an equivalent amount of domestic cargo that is shipped to or from destinations in the United States.

One of the fastest growth areas in international trade for the United States is landbridge (water/rail) operations. The Ports of Los Angeles and Long Beach are well positioned to expand their market share of this traffic during the next two decades with increasing emphasis on trade among the Pacific rim countries. In 1980, over 10 million tons of containerized cargo passed through the ports, of which almost 40% was related to landbridge activities. More than 8,000 vessels call at the Ports of Los Angeles and Long Beach annually (Table 3-18).

Petroleum continues to be an important component of the port tonnage and, with discovery of Santa Maria crude oil, domestic crude oil handling may increase. A major shift in energy resource demands could result in the ports becoming a major outbound shipping point for coal and other conventional fuels.

The demand for cargo throughput in the Ports of Los Angeles and Long Beach is expected to increase 167% over 1980 levels by the year 2020. By optimizing the existing lands within the port boundaries, the ports would be able to handle 150.13 million short tons as shown in Table 3-18. The forecasts for the harbors are based on the expected demands within their market areas. Alternate ports were surveyed to determine their own capacity and anticipated growth to determine whether cargo could be rerouted. These other ports have in the past twenty years had to embark on their own expansion plans to accommodate the

Table 3-18. Waterborne Commerce and Projected Cargo Capacity at the Ports of Los Angeles and Long Beach

A. WATERBORNE COMMERCE						
Year	LOS ANGELES		LONG BEACH		TOTAL	
	No. of Vessels	Million Metric Tons	No. of Vessels	Million Metric Tons	No. of Vessels	Million Metric Tons
1978	3,881	38.6	3,293	33.9	7,180	72.5
1979	3,950	40.2	3,789	39.5	7,739	79.7
1980	3,865	41.0	4,132	43.8	7,997	84.8
1981	4,196	38.4	4,287	49.1	8,483	87.5
1982	3,750	35.1	4,685	54.5	8,435	89.6

B. PROJECTED CARGO CAPACITY WITHOUT PROJECT			
Cargo Type	1983 Base Year Cargo Demand	Year 2020 Cargo Demand	Year 2020 Cargo Capacity
Dry Bulk	10.55	63.39	30.60
Liquid Bulk	53.32	84.96	83.48
General Cargo	8.98	12.35	10.44
Container	<u>10.67</u>	<u>62.51</u>	<u>25.61</u>
Total	83.52	223.21	150.13

Cargo projections are in millions of short tons.

COE (1985)

general increase in cargo through West Coast ports. Within the State of California the Coastal Commission has established a policy of encouraging expansion of existing commercial harbors rather than developing new ports. Due to the remoteness of any other large commercial harbor to service the Los Angeles-Long Beach Harbor market area, rerouting of anticipated commerce is not cost effective.

The flow of cargo through the ports is thus expected to increase to the extent that existing water depths cannot accommodate the ships in the projected cargo fleet. COE cargo projections for the Ports of Los Angeles and Long Beach indicate total cargo demand to be 223.21 million short tons by the year 2020. These totals and their distribution by cargo class are shown on Table 3-19. Under the most likely "Future Without Project Condition," meeting the projected growth in cargo will be impaired by the limitation posed by the existing channel depths and the lack of adequate terminal facilities. The ports have determined that 2600 acres of new land will be required to meet the projected year 2020 cargo demands. This assumes the highest and best use of existing port lands. The shortfall in terminal acres by type is shown on Table 3-20.

Vessel traffic offshore of southern California is routed through a system of traffic separation schemes (TSS) and port access routes (PAR) that are established by the USCG (Figure 3-10). The TSS serves to provide a separation of opposing flows of traffic and PAR provides for precautionary areas where vessels must navigate with particular caution. Two TSSs, consisting of a northbound lane, a southbound lane and a separation zone between the two lanes, feed into the Los Angeles and Long Beach Harbor region. The TSS and PAR were both modified in November 1983 to increase safety and ease of vessel movement in this area. The LA-2 site is located within a mile of the southbound lane of the Santa Barbara Channel TSS and a little over a mile from the southwestern corner of the precautionary area.

3.4.3. Oil and Gas Development

The southern California offshore area contains large reserves of oil and gas. MMS (1983) has estimated recoverable reserves in the southern California Outer Continental Shelf (OCS) to be 860 million barrels of oil and 1.73 trillion cubic feet of gas.

Offshore oil and gas activity in the Los Angeles and Orange County area is regulated by State and Federal agencies. State agencies regulate resource development in areas from the mean high tide line seaward to the three-mile limit. Areas beyond the three-mile limit are managed by MMS of the U.S. Department of the Interior. Six artificial islands off the coast at Long Beach, two platforms and two marine terminals are located within State waters (Figure 3-11). Offshore structures in Federal waters include two platforms and one production facility located about 8.8 nmi (16 km) east of the LA-2 site.

Table 3-19. Cargo Projections of Waterborne Cargo for the Ports
of Los Angeles and Long Beach

(millions of short tons per year)

Cargo Class	1983	2020
Container	10.67	62.51
Automobiles	.60	1.32
Break-bulk	8.38	11.03
Petroleum bulk	52.67	83.88
Other liquid bulk	.65	1.08
Dry bulk - grain	2.95	6.10
Dry bulk - other	<u>7.60</u>	<u>57.29</u>
TOTAL	83.52	223.21

Table 3-20. 1980-2020 Total Acreage Requirements

	YEAR				
	1980	1990	2000	2010	2020
Terminal Type					
Container	-0-	282	533	904	1,271
Break Bulk	-0-	25	50	63	77
Automobile	-0-	23	52	77	102
Petroleum	-0-	6	11	7	4
Other Liquid Bulk	-0-	-1	-2	-1	-1
Grain	-0-	2	4	6	8
Other Dry Bulk	-0-	<u>70</u>	<u>86</u>	<u>209</u>	<u>297</u>
Total Terminal Acres	-0-	407	734	1,265	1,758
Ancillary Acres	-0-	<u>203</u>	<u>367</u>	<u>632</u>	<u>879</u>
Total Acreage Requirements	-0-	610	1,101	1,897	2,637
	===	===	=====	=====	=====

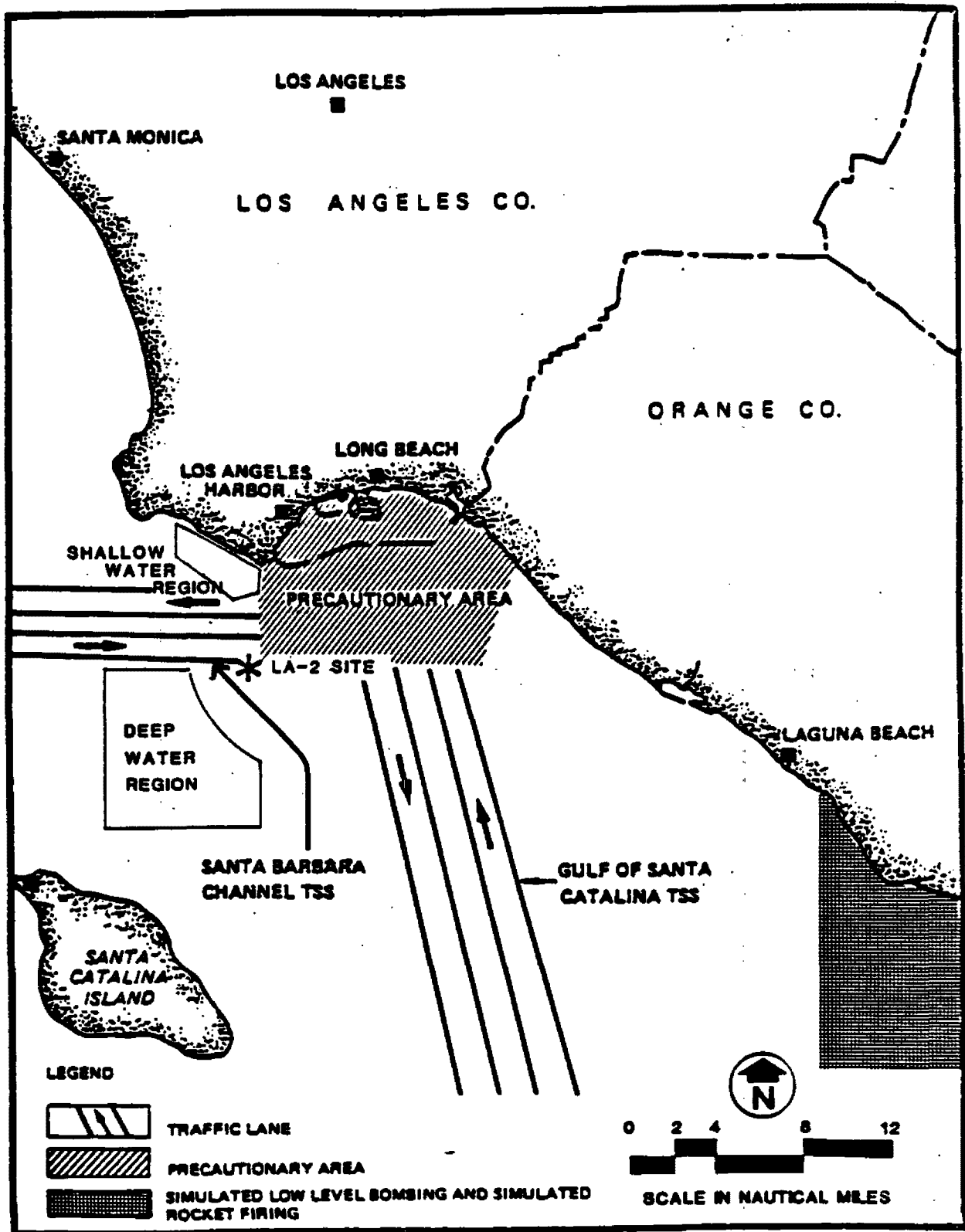


FIGURE 3-10. COMMERCIAL SHIPPING LANES AND ZONES OF MILITARY OPERATION IN THE PROJECT AREA

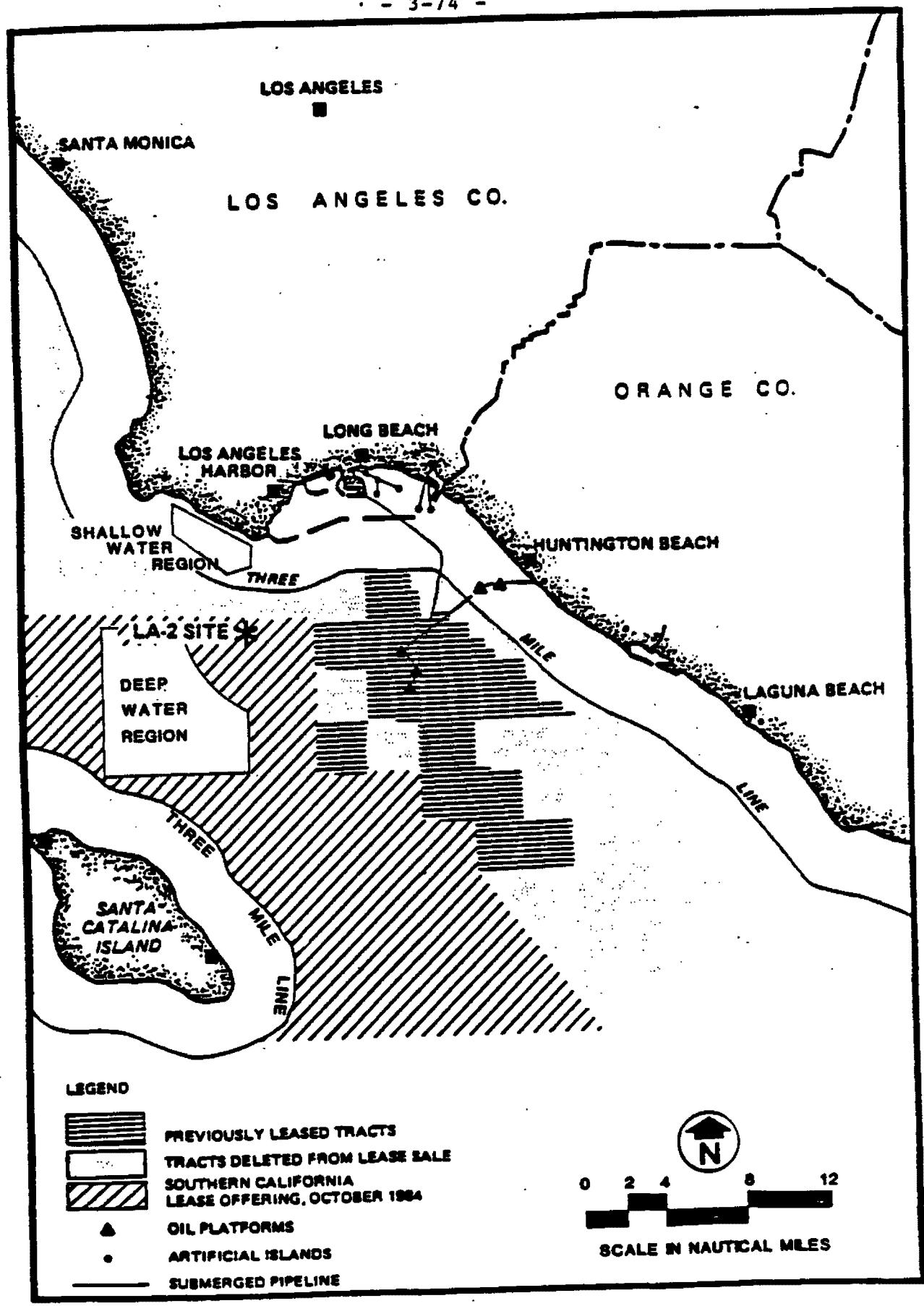


FIGURE 3-11. OIL AND GAS DEVELOPMENT IN THE PROJECT AREA

At the present time, all of the oil and gas produced in the Los Angeles area is transported to the shore by pipelines. One pipeline connects the platforms and production facility in the Federal waters to Pier J at Long Beach. Another pipeline connects the platform in Federal waters to the two platforms in the State waters and then continues to Huntington Beach. All of the six artificial islands are also connected to the shore at Long Beach via their own pipeline system.

Leases have been awarded for 15 full or partial tracts in the Federal waters off Los Angeles and Orange Counties. The nearest leased area is about 3.5 nmi (6 km) east of the LA-2 site. The tract containing the LA-2 site, and tracts to the south of the site, were offered in OCS Lease Sale 80 in October 1984. Neither the tract containing LA-2 nor any in the general vicinity were leased in the sale. The tracts north of the site were deleted from consideration due to the requirements of the TSS implemented by the USCG for the safe navigation near the Los Angeles-Long Beach Harbor area, and concerns expressed by the State.

The likelihood of future oil or gas development in the vicinity of the LA-2 site is uncertain at this time. No OCS tracts have been leased in the deep water region. The shallow water region is in the State oil and gas sanctuary. No production facilities exist or are planned in the vicinity of either of these regions.

3.4.4. Military Usage

The area offshore of southern California is one of the nation's largest naval operating area (see Figure 3-10). The largest amphibious marine training base on the west coast is located at Camp Pendleton about 35 nmi (65 km) southeast of Long Beach. Activities at this facility include simulated low altitude bombing, rocket and gunnery practice, and other activities which require unencumbered maneuvering space for airplanes, surface vessels and submarines. Naval exercises are conducted continuously throughout the year and involve substantial vessel movement near the Ports of Los Angeles and Long Beach (MMS, 1983).

Most of the military operations take place far beyond the immediate coastal areas outside the Los Angeles-Long Beach Harbor. It is only the military vessel traffic in and out of the harbors that may be of any concern in connection with the activities related to the LA-2 site. The U.S. Navy maintains a shipyard and a support activity center on Terminal Island. In conjunction with this facility, the Navy has planned to move 25 to 30 ships from San Diego to Terminal Island between 1981 and 1986. According to USCG records, an average of 2 to 3 military vessels come into or leave the Terminal Island facility each day (L.A. Onstad, Commander, USCG, 11th District, personal communication, March 1984).

3.4.5. Recreational Activities

Major ocean-related recreational activities in the Los Angeles area are sportsfishing, sightseeing, beachcombing, picnicking, swimming, wading, sunbathing, diving, surfing, sailboating, and powerboating. The two activities affected will be sportsfishing and boating.

Table 3-21 gives the number of participation days for ocean-related recreational activities in 1980 and projected demand for 1985 and 1990. In 1980, Los Angeles and Orange Counties recorded 81.3 million participation days of ocean-related recreational activity and this demand is expected to grow by more than 10% during the 1980-1990 period (California Department of Parks and Recreation, 1984). Activities which are expected to experience highest growth between 1980 and 1990 include: sailing (21%), sportsfishing (18%), powerboating (15%), and scuba diving (14%).

3.4.5.1. Sportsfishing

Sportsfishing charters in the Los Angeles area originate from a number of harbors and sportsfishing takes place at most of the piers in the area (Figure 3-12). Four fishing modes are commonly used for sportsfishing: shore casting; pier fishing; skiff, party boat or commercial passenger fishing vessels; and skin and scuba diving. Shore and pier fishing are by far the most popular methods, although more fish are caught per hour from boats. Since party boat fishing is the activity most likely to be affected by the project-related activities, the discussion below pertains mainly to this method of sportsfishing.

Party boats in the Los Angeles area operate mostly from San Pedro, Long Beach, Seal Beach, Balboa, and Dana Point Harbors. Table 3-22 provides the number of sportfish caught and the number of anglers reported by boats operating from these harbors for 1977 and 1981.

In 1977, Seal Beach reported the largest number of fish caught, representing 8.3% of the total sportfish catch in the State (California Department of Fish and Game, 1984). The five harbors combined reported a catch of almost 0.9 million fish accounting for about 23% of the total State catch of 4.8 million. The local percentage of anglers was somewhat lower (21%) than the percentage of fish caught, indicating a larger catch per angler ratio compared to the State figure as a whole. In 1981, the total number of sport fish caught in the Los Angeles area increased to almost 1.4 million; however, the portion of the area State total catch remained unchanged at 23%.

Sportsfishing has fluctuated from year to year, perhaps as a result of improved facilities at some of the harbors. For example, Seal Beach, which reported the second largest number of anglers in 1977, ranked fifth among the five Los Angeles area

Table 3-21. Existing and Projected Number of Participation Days for Ocean-related Recreational Activities for Los Angeles and Orange Counties, 1980, 1985 and 1990

Activity	Participation Days (in thousands of days)					
	Los Angeles County			Orange County		
	1980	1985	1990	1980	1985	1990
Power boating	2,051	2,202	2,330	847	923	966
Sailing	1,785	2,048	2,145	708	824	885
Salt water fishing	3,483	3,776	4,039	1,843	2,048	2,268
Ocean swimming	17,440	18,102	18,788	9,312	9,959	10,622
Scuba and skin diving	1,223	1,329	1,394	455	497	528
Body surfing	7,745	7,729	7,992	4,144	4,264	4,572
Board surfing	7,745	7,729	7,992	4,144	4,264	4,572
Sunbathing	10,306	10,857	11,174	3,175	3,418	3,591
Beachcombing	2,026	2,128	2,195	629	675	709
Beach games	4,319	4,494	4,695	1,310	1,388	1,478
TOTAL PER YEAR	55,922	558,158	60,432	25,380	27,026	28,851

	Study Area Total		
	1980	1985	1990
Power boating	2,898	3,125	3,298
Sailing	2,493	2,872	3,030
Salt water fishing	5,326	5,824	6,307
Ocean swimming	26,752	28,061	27,410
Scuba and skin diving	1,678	1,826	1,992
Body surfing	11,889	11,993	12,564
Board surfing	11,889	11,993	12,564
Sunbathing	13,481	14,275	14,765
Beachcombing	2,655	2,803	2,904
Beach games	5,629	5,882	6,173
TOTAL PER YEAR	81,302	85,184	89,283

California Department of Parks and Recreation (1984).

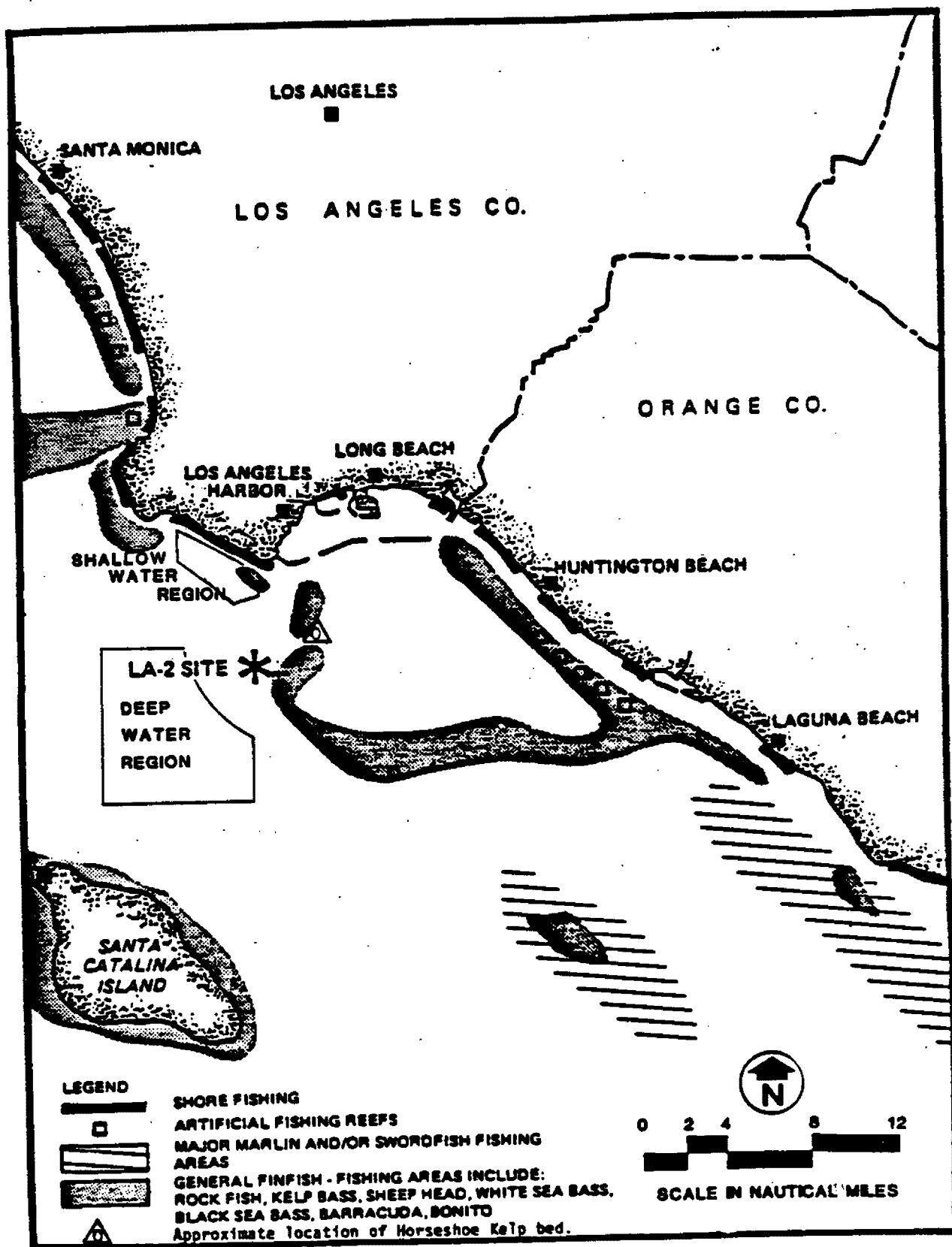


FIGURE 3-12. SPORTFISHING RESOURCES IN THE PROJECT AREA

Table 3-22. Number of Sportfish Caught and Number of Anglers on Commercial Passenger Fishing Vessels for Each Port in the Los Angeles Area, 1977 and 1981.

Port	<u>Sportfish Caught</u>			
	<u>1977</u>		<u>1981</u>	
	<u>Number of Fish</u>	<u>% of State</u>	<u>Number of Fish</u>	<u>% of State</u>
San Pedro	250,800	5.2	522,583	8.3
Long Beach	130,094	2.7	378,620	6.0
Seal Beach	404,495	8.3	272,031	4.3
Balboa	151,278	3.1	346,927	5.5
Dana Point	182,265	3.8	267,705	4.2
Los Angeles Area Total	1,118,932	23.1	1,787,866	28.3
State Total	4,849,472		6,314,534	
	<u>Anglers</u>			
	<u>1977</u>		<u>1981</u>	
	<u>Number of Anglers</u>	<u>% of State</u>	<u>Number of Anglers</u>	<u>% of State</u>
San Pedro	24,904	3.5	58,874	7.1
Long Beach	12,506	1.7	40,754	4.9
Seal Beach	37,529	5.2	33,723	4.1
Balboa	30,003	4.2	45,123	5.4
Dana Point	44,739	6.2	43,474	5.2
Los Angeles Area Total	149,681	20.9	221,939	26.7
State Total	716,536		830,653	
California Department of Fish and Game (1984)				

harbors in 1981. Overall, the party boat fishing activity appears to be increasing in popularity over the years as shown by the increasing number of anglers as well as a larger catch reported at almost all the harbors.

Over 100 species have been recorded in the southern California sport catch (California Department of Fish and Game, 1984). However, only about 10 species are caught in large numbers. The most commonly caught species by number and by block off origin are shown in Table 3-23. In Fish and Game Block 740, which contains the LA-2 site, the 10 most commonly caught species accounted for 98% of the total catch. Three species (Pacific mackerel, unspecified rockfish, and spotted scorpion fish) alone represented 76% of the total catch from the block. Similarly, these 10 species accounted for more than 95% of the total from almost each block in the project site vicinity.

3.4.5.2. Boating

The recreational activity most likely to be affected by the project-related activities is boating. Boating is not limited to any specific area although concentrated activity can be found in areas with suitable harbors and marinas such as Los Angeles and Long Beach Harbors, Long Beach Marina, Huntington Harbor, Newport Beach Harbor and Dana Point Harbor along the Los Angeles-Orange County coastlines. Avalon Bay and Two Harbors on Santa Catalina Island are also areas of concentrated boating activity.

In terms of ocean traffic, the offshore islands are one of the major destinations for boaters. The boats usually follow a straight route between the harbor or marina on the mainland to the harbors at Santa Catalina Island. From the Los Angeles and Long Beach Harbors, this route passes over or very close to the LA-2 site. Santa Catalina is the most visited destination because landing there is relatively unrestricted and major anchorages are located at Avalon and Two Harbors. In addition to privately owned pleasure boats, regular ferry service is available from Los Angeles, Long Beach, and Newport Beach Harbors to Santa Catalina Island.

3.4.5.3. Other Recreational Activities

Other major ocean-related recreational activities in the Los Angeles area are sightseeing, beachcombing, picnicking, swimming, wading, sunbathing, diving, and surfing. Sightseeing and beachcombing are enjoyed along the entire coast. Picnicking, swimming, wading, and sunbathing tend to be concentrated along public beaches where recreational facilities are easily accessible (Figure 3-13). Due to a large concentration of population in southern California, the warm climate of the region, and a worldwide reputation for beautiful beaches, coastal recreational facilities in the Los Angeles area are used by large numbers of people each summer day. None of these activities are expected to be affected by designation of an ODMS.

Table 3-23. Number of Sportfish Caught in Each California Department of Fish and Game Block in the Vicinity of the LA-2 ODMDS in 1977

Fish Species	Number of Fish Caught per Block			
	LA-2 Site Block 740	Block 718	Block 719	Block 720
Pacific bonito	1,887	78	1,078	8,935
Pacific mackerel	30,940	5,220	54,055	47,092
California barracuda	4,595	1,425	5,135	2,605
Unspecified rockfish	58,719	3,058	167,461	67,070
Spotted scorpionfish	11,025	1,557	25,899	1,300
Kelp bass	10,653	1,356	6,135	11,224
Barred sand bass	6,656	6,225	1,641	7,907
White croaker	75	7,550	15	1,455
Halfmoon	3,385	217	351	16,100
Ocean whitefish	4,624	171	25,446	7,167
Other fish	2,047	1,663	2,015	2,914
AREA TOTAL	132,358	28,951	293,815	167,503

	Block <u>739</u>	Block <u>741</u>	Block <u>759</u>	Block <u>760</u>	Block <u>761</u>
Pacific bonito	1,622	NA		1,177	6,053
Pacific mackerel	17,466	NA		1,242	4,749
California barracuda	473	NA		17	279
Unspecified rockfish	75,358	NA	798	7,410	7,746
Spotted scorpionfish	2,876	NA	4	55	385
Kelp bass	1,812	NA		1,288	13,039
Barred sand bass	N/C	NA	113	85	
White croaker	866	NA			
Halfmoon	19	NA		1,209	5,668
Ocean Whitefish	574	NA		8	498
Other fish	1,185	NA	10	282	1,774
AREA TOTAL	110,158	NA	812	12,801	40,276

NA = Data for block 741 not available.

California Department of Fish and Game (1984).

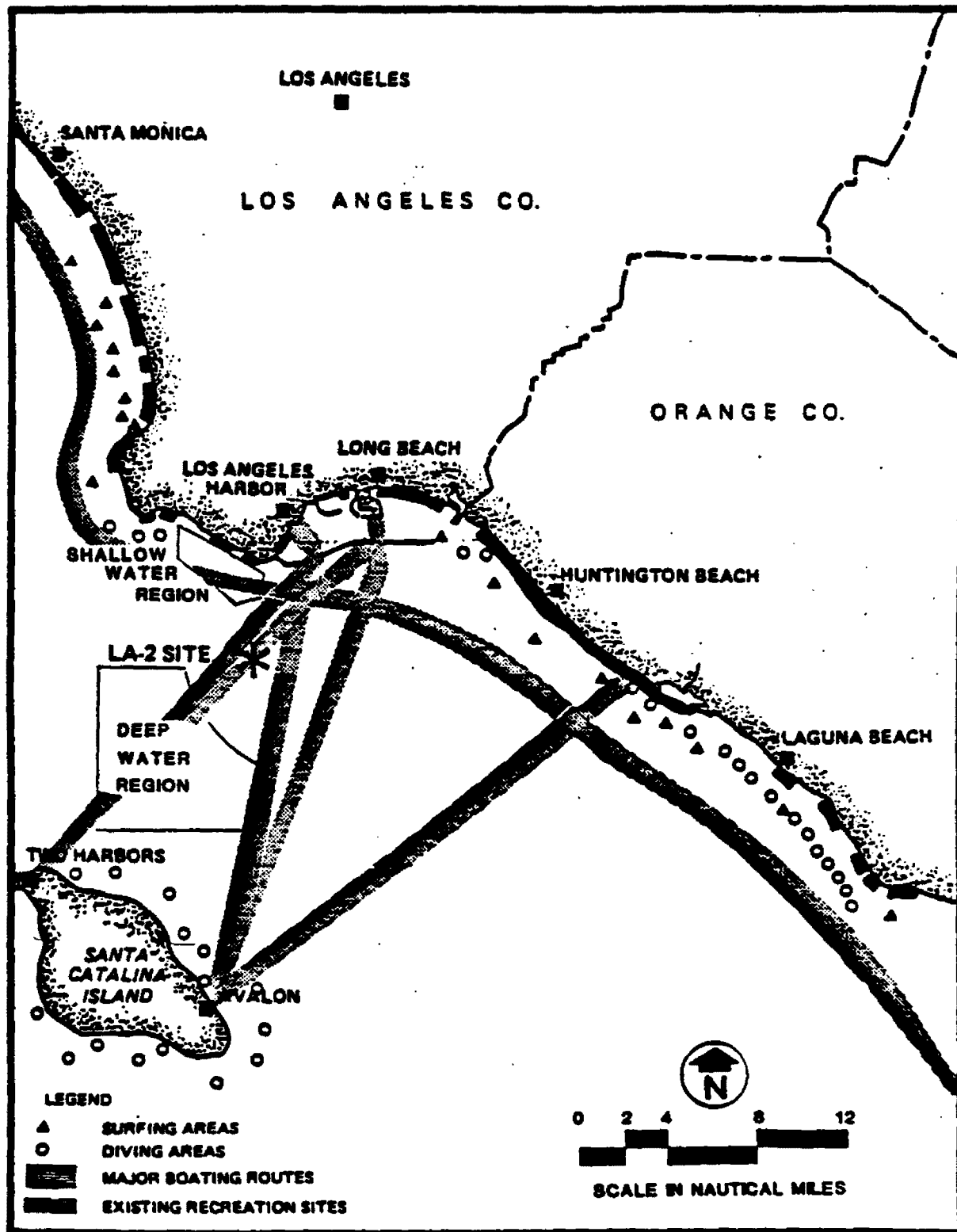


FIGURE 3-13. PRINCIPAL RECREATIONAL AREAS IN THE PROJECT AREA

Diving occurs along the coast off Palos Verdes Peninsula in Los Angeles County, along the Orange County coast, and along the shores of Santa Catalina Island.

Surfing is a popular sport activity along the Santa Monica Bay to the northwest of the LA-2 site, and along the Orange County coast to the east. There has been a large increase in surfing over the past few years due to the use of wet suits to protect the surfers from the cold. This allows the sport to be practiced over the entire year rather than just during the warmer season.

3.4.6. Cultural Resources

Cultural resources relevant to offshore areas are prehistoric and historic remains comprising a nonrenewable resource base that provides archaeologists and historians with information for reconstruction of past cultural systems and behaviors. The offshore region of southern California is believed to contain numerous cultural resources. Types of submerged resources are aboriginal remains, and sunken ships and aircrafts (see Figure 3-14). Extensive dredging and construction in the Los Angeles and Long Beach Harbor areas has already destroyed almost all traces of prehistoric cultural data in the harbor areas (Tetra Tech, 1984a). The most probable resource that could be encountered in the study area is shipwrecks.

The shipwrecks and other historic resources previously known in the study area were inventoried and assessed by a number of former studies (Marshall, 1978). A recent study by MMS (1983) has updated an earlier study conducted by Stickel et al. in 1978. These reports have documented the potential for the presence of shipwrecks which may be a significant cultural resources. Over 450 known historic shipwrecks have occurred in southern California, with most of them either near Los Angeles or San Diego. Based upon water depth and known cultural resource location data, MMS has identified 26 Federal oil and gas lease tracts in the LA-2 study area having cultural resource sensitivity. Neither the Federal tract containing the LA-2 site nor any tract in the immediate vicinity of the site has been identified as sensitive for historic shipwrecks or other cultural resources. The nearest tract with known cultural resources is about 7 nmi (13 km) southeast of the LA-2 site.

3.4.7. Public Health and Welfare

Ensuring that public health and welfare are not adversely affected by ocean disposal of dredged materials is a primary concern to EPA and COE. Public health and welfare can be affected in a number of ways. Only three issues, health, safety, and aesthetics, are discussed.

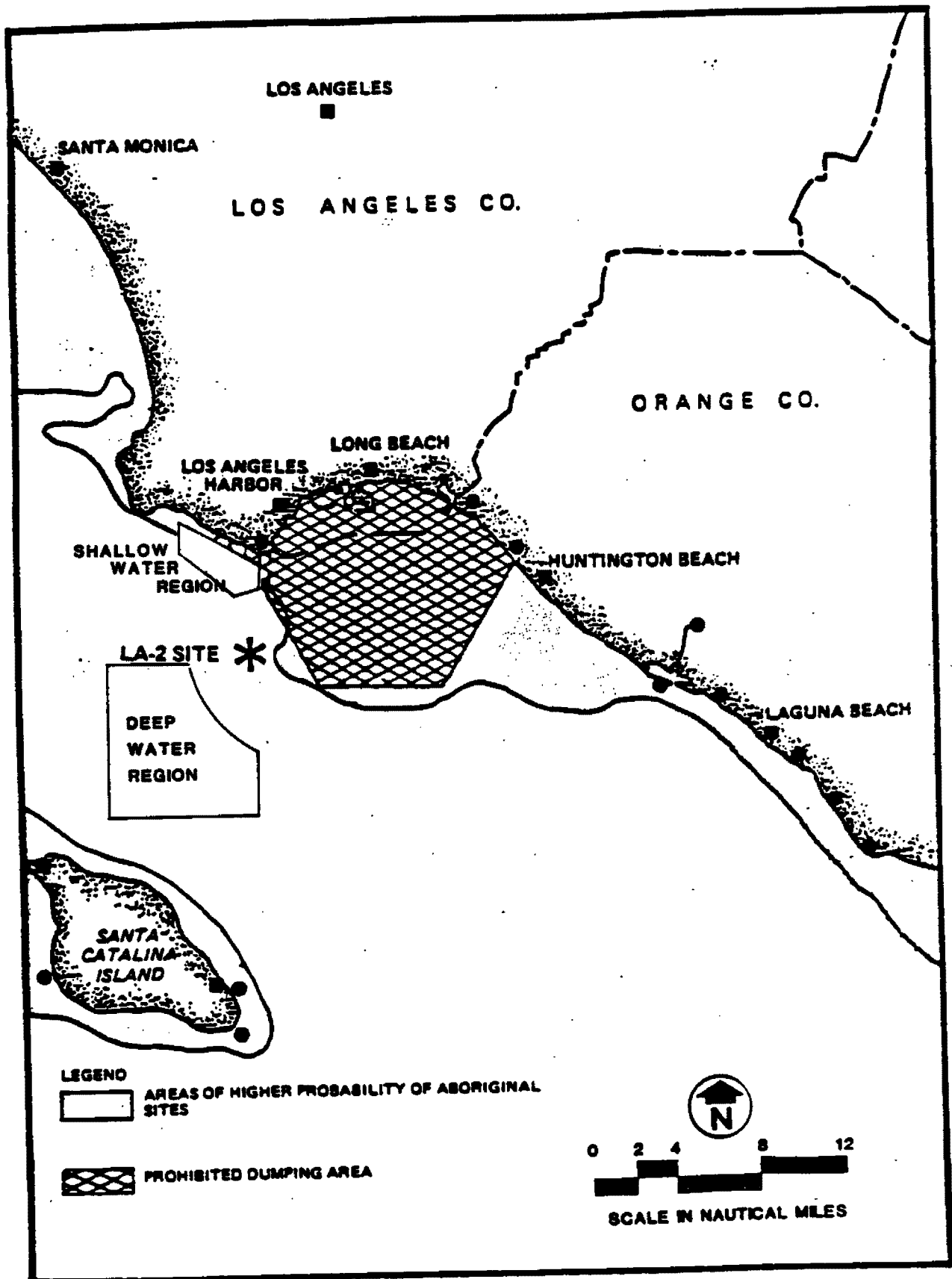


FIGURE 3-14. OTHER CULTURAL FEATURES OF THE PROJECT AREA

Health hazards may arise if the chemical nature of the materials has the potential for bioaccumulation of toxic substances in organisms. Potential impacts on human health can be inferred from bioassay and bioaccumulation tests performed on marine animals. Since the LA-2 study area provides large amounts of commercial fish for human consumption, the public health issue gains added importance.

The disposal of dredged material could present hazards to navigation either as a result of mounding within the disposal site, or as a result of interference of the disposal barges with shipping traffic. As described in the commercial shipping section (Section 3.4.2), traffic in the Los Angeles-Long Beach Harbor area is heavy and a precautionary area has been established by USCG to reduce navigation hazards. In addition to commercial shipping traffic, Navy vessels and a large number of fishing and recreational boats also use the area between the Los Angeles-Long Beach Harbor and the LA-2 site. Another possibility of traffic hazard exists as a result of interference between the disposal barges and the traffic generated by offshore oil and gas developments. The LA-2 site lies in an area where federal tracts were open for lease offerings in October 1984, however neither the tract containing the LA-2 site nor any tracts in the general vicinity were leased during the lease sale in October 1984. Therefore, since the tract containing the LA-2 site was not sold in the lease offering, direct interference (traffic hazards) between drilling and disposal activities is not anticipated in the foreseeable future.

A third aspect of the public health and welfare issue is the effects of dredged material disposal on the aesthetics of the area. The LA-2 site is located only about 4.4 nmi (8 km) offshore from the breakwaters at San Pedro, California. These waters are heavily utilized by people engaged in sportfishing and recreational boating. The site also lies along the main traffic route between the Los Angeles-Long Beach Harbor and Santa Catalina Island, which is one of the major tourist attractions in southern California. Potential impacts and mitigation measures related to public health will be discussed in the Environmental Consequences chapter.



CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

4.1. INTRODUCTION

This chapter assesses the impacts of the proposed project alternatives on the physical, biological, and socioeconomic environmental segments discussed in Chapter 3. Any site designated ODMDS is expected to have some environmental impacts on the biological community within the designated area. It is the purpose of this EIS to determine the probable or known severity of impacts expected at the site and the significance of potential impacts outside the boundaries of the ODMDS related to human health and the marine environment.

The classification system used in this EIS to determine levels of environmental impact is similar to that used by MMS (1984) to evaluate impacts for the Point Arguello Oil Field Development Plan. The environmental impacts are divided into the following classes:

- Class I - Significantly adverse impacts that cannot be mitigated to insignificance. This means that no measures could be taken to avoid or reduce these adverse effects to insignificant or negligible levels.
- Class II - Significant adverse impacts that can be mitigated to insignificance. These impacts are potentially similar in significance to Class I impacts, but the severity of the impact can be reduced or avoided by implementation of mitigation measures discussed under each heading.
- Class III - Adverse but insignificant impacts, or no effect anticipated. No mitigation measures are required for these impacts or effects.
- Class IV - Beneficial impacts. These impacts would improve conditions relative to the pre-project baseline conditions. They are further subdivided as significant or insignificant where applicable.

The term "significant" is used in this chapter to characterize the magnitude of the potential impact. For the purposes of the EIS, a significant impact is a substantial or potentially substantial change to resources in the vicinity of the ODMDS or the area adjacent to the ODMDS.

In the discussions of each subject area below, criteria used to distinguish between significant and insignificant impacts are provided. To the extent feasible, distinctions are also made between the scope of local and regional significance, and short-term versus long-term duration. Mitigation measures are discussed where appropriate. A summary of the impacts and mitigation measures is presented in Tables 4.1, 4.2, 4.3 and 4.4.

Table 4-1 (continued). Summary of Impacts and Mitigation Measures for the LA-2 Site (Refer to text in Chapter 4 for detailed explanation.)

Impacts					Potential Mitigation Measures				
Description	Class				Scope (1)			Term (2)	
	I	II	III	IV	S	L	R	S	E
SOCIOECONOMIC ENVIRONMENT									
Commercial Fishing									
Fish stocks			X				X	X	
- fishing fleet safety			X			X		X	
Commercial Shipping				X			X	X	
- safety			X			X		X	
- mounding			X		X			X	
- port access				X			X	X	
Oil and Gas Development									
- present drilling			X			X		X	
- future drilling		X				X		X	Siting facilities away from immediate disposal area.
- future oil transport				X			X	X	
Military Usage									
- traffic interference			X			X	X	X	
- naval ship access				X			X	X	
Sport Fishing			X			X		X	
Other Recreational Activities			X			X		X	
Cultural Uses			X			X		X	
Public Health and Welfare									
- health			X				X	X	
- safety			X			X		X	
(1) = Scope Definitions S = site, 1000 yd (914 m) radius from center of designated ODMDS. L = local, up to 1 nmi outside of site. R = region, beyond local vicinity of ODMDS. (2) = Term S = short, less than or equal to 5 hours. E = extended, greater than 5 hours.									

Siting facilities away from immediate disposal area.

4.2. LA-2 ODMDS ALTERNATIVE (PREFERRED ALTERNATIVE)

The principal effect of disposal of dredged material at the LA-2 site is the introduction of substantial amounts of sediment and associated contaminants into a small area. It is important to note that significant impacts may be expected at any site designated as the final ODMDS by virtue of the accumulation of large amounts of disposed dredged material. Furthermore, this EIS is on designation of a permanent disposal site, while dredged material is specifically reviewed under the COEs permitting regulations. Designation of the LA-2 site is expected to maintain the observed effects of past disposal, such as fluctuations in grain size distribution and increases in concentrations of trace metals, oil and grease, pesticides, and PCBs. In turn, these factors are expected to continue affecting the benthic fauna of the site, causing less diverse infauna and less abundant epifauna and encouraging the presence of several species indicative of moderate pollution.

Other mechanisms by which disposal is expected to affect benthic fauna at the disposal site include smothering and interference with feeding processes. These effects on benthic fauna are expected to be at least partly responsible for maintaining a less diverse and reduced demersal fish fauna compared to populations that exist at the reference site. In addition, any elevation in the levels of pesticides or PCBs in the dredged materials disposed at the site may be reflected in the levels found in the tissues of invertebrates and fish at the LA-2 site.

Significant effects of disposal on the sediment and benthic fauna are likely to be limited to the immediate site vicinity, and no significant effects are expected on the sediments or benthic fauna of the area surrounding the LA-2 site or the region in general. The effects of disposal on water quality of the site are expected to be localized and transitory, so that no significant long-term effect is expected on the plankton or pelagic fish of the site or of its surroundings and no significant effects are expected on marine mammals or endangered species.

4.2.1. Effects on Physical Environment

Environmental effects on the physical environment were assessed for each alternative by identifying and/or quantifying potential sources of contamination or alteration. This approach included review of existing literature, modeling of the dredged material discharge plume, and analysis of field data collected at the LA-2 and reference site.

Criteria for assigning impacts to aspects of the physical environment as significantly adverse under Class I or Class II, were:

- A. The likelihood of a relatively large degree of change from baseline conditions as indicated by analagous situations and previous studies,
- B. The persistence of adverse impacts long enough to measurably affect receiving waters or benthic environments, or
- C. The relative volume of water or area of the sea floor adversely affected thereby determining whether the level of significance is local or regional.

4.2.1.1. Meteorology and Air Quality

Disposal of dredged material at the LA-2 site will not have a significant effect on the meteorology or air quality of the local area (Class III). COE does not anticipate that there will be any increase beyond the current number of disposal trips to the site, and there have not been any significant air quality impacts detected to date.

4.2.1.2. Physical Oceanography

Final designation of the LA-2 site for dredged material disposal will have no significant effect on physical oceanography (Class III). Physical oceanographic parameters such as currents, waves, and tides are important in how they determine the mixing of the water column and the transport of sediment. These forces, in turn, affect the fate of the disposed dredged material. Bottom currents and mid-water currents are especially important in determining the direction and extent of sediment transport at a disposal site. Tidal currents may also contribute to the transport of disposal material, but these currents do not usually add net directional effects. The role of these parameters in determining water column and sediment quality impacts are discussed below. It should be noted that the effect of waves mixing bottom sediments and increasing turbidity by resuspension of bottom sediments were not projected for the LA-2 site.

4.2.1.3. Water Quality

Continued disposal of dredged material at the LA-2 site is not expected to have any long-term effects on water quality in the local area or region. This conclusion is based on water quality data from the field survey that show no significant difference in water temperature, pH, turbidity, and DO between the LA-2 site which has been used for disposal since 1977 and the reference site. These levels are also within the range of values found for these parameters in undisturbed areas of the bight. Values for salinity were lower than has been historically reported but this variance appears to be due to errors in field measurement rather than disposal activities.

Considering the frequency of disposal, the anticipated quantities of suspended sediment, the volume and dilution capacity of the local water column and currents, and the ambient concentrations of suspended particulates and contaminants, disposal is not expected to have a significantly adverse effect on the water quality of the project area (Class III). This overall rating is supported by the fact that the water quality of the LA-2 site is indistinguishable from that of the reference site despite at least 10 years of disposal at the LA-2 site.

Short term impacts to water quality in the immediate vicinity of the LA-2 site can be expected at the time of dredged material disposal (Class I). The dredged material will be dispersed by currents in a plume cloud causing an increase in turbidity and possibly a reduction in dissolved oxygen. As discussed in more detail under Section 4.2.1.5, after the initial disposal and with a prevailing northwest current, it is predicted that the plume will be diluted to a negligible concentration of 4 to 5 mg/l within 5 hours. Levels of increased turbidity are predicted to occur up until this time for a pathway 1524 m (5,000 feet) long at a maximum diameter of 914 m (1,000 feet) and maximum depth of 100 fathoms (55 m). Original turbidity levels of 150 mg/l will decrease markedly down current and towards the outside edges of the plume.

Increased turbidity and reduced DO in the water column have been determined as a Class I impact since they cannot be mitigated. This is a local effect of short-term duration so no mitigation measure is proposed.

Trace metals, chlorinated hydrocarbons (pesticides and PCBs), oils and greases were not detected during the field survey in the water column. Such contaminants that are associated with the dredged material sink to the bottom or are greatly diluted by currents. Impacts immediately after disposal would be of a temporary nature and in a local area (Class I); therefore, no mitigation measure is proposed. It should be noted that the levels of detection in the field survey were often above or near levels of these contaminants reported for other unpolluted areas of the bight.

4.2.1.4. Geology

The final designation of the LA-2 site for dredged material disposal will add a layer of sediment to the ocean floor. Since the LA-2 site is a slope from the mainland shelf to San Pedro Basin, cumulative sedimentation could lead to slumping of material down the slope's gradient. This is a common natural occurrence, and disposal activities are not expected to add to it significantly.

4.2.1.5. Sediment Transport

To evaluate the effect of disposal on turbidity and bottom sedimentation at the LA-2 site, a model was developed simulating the dispersal of the dredged material (Appendix C). The model assumes that disposal will be from a split hull barge with a load of 800 yd³ (612 m³) of dredged material. Simulations were run with currents either to the northwest at 8 cm/s (0.261 feet/s), or to the southeast at 8 cm/s (0.261 feet/s).

For the simulation of prevailing northwest currents, all of the gravel (1 yd³ or 0.8 m³) will settle to the bottom 1.25 hours after barge dumping. It will cover an area of 1116 m² (12,000 ft²) in a layer 0.07 cm (0.03 inches) thick, centered 18 m (60 feet) down current from the discharge point. All of the sand (102 yd³ or 78 m³) will also settle to the bottom, and it will cover an area of 8184 m² (88,000 ft²) in a layer 0.96 cm (0.38 inches) thick, centered 396 m (1300 feet) down current.

Within this area of gravel and sand deposition, a small quantity of the finer particles will also be deposited: 20% or 19 m³ (25 yd³) of silt, and 10% or 1.8 m³ (2.3 yd³) of clay. The rest of the silt and clay will descend in a plume down through the water column at a slower rate. It will be transported by northwest currents to deeper waters where it will reach neutral buoyancy at a depth of 100 fathoms (55 m).

As these finer particles are transported by currents, they will be dispersed and diluted. After 1.25 hours the concentration of the suspended particles in a plume cloud with a diameter of 427 m (1,400 feet) will be 150 mg/l at the center, decreasing to zero at its outside limits.

After five hours, the plume will be transported 1524 m (5000 feet) down current. At this point, the plume will be diluted to a concentration of less than 4 to 5 mg/l, with a maximum diameter of 914 m (3000 feet). The finer particles will remain in suspension indefinitely, over long distances, and will be greatly diluted by prevailing currents.

For the simulation of prevailing southeast currents, deposition of all materials will be within 457 m (1500 feet) of the discharge point at depths between 83 and 100 fathoms (151 to 182 m), covering an area of 10,230 m² (110,000 ft²) in a layer averaging 0.29 cm (0.11 inches) thick. In some areas the deposition will be thicker than this average value.

This model does not include resuspension and slumping which would tend to expand the area of deposition but lessen the thickness of the deposition layer. Furthermore, this is a simulation of one disposal activity only; cumulative impacts will result from the total number of trips undertaken throughout the year. Since disposal activities are expected to be separated in most instances by several hours if not days or

weeks, cumulative effects to the concentration of the plume or the total area of deposition are not expected. However, numerous disposal activities will result in a progressively thicker layer of deposition with time in the local area of the disposal site (Class I).

4.2.1.6. Sediment Quality

Sediment in the vicinity of the LA-2 disposal site is the component of the physical environment expected to be most significantly affected by disposal, because large amounts of disposed dredged material will permanently alter natural sediment conditions at the disposal site (Class I). The most significant potential effects are changes in grain size distribution, increased concentrations of contaminants, biological oxygen demand (BOD) and chemical oxygen demand (COD). There is evidence that some of these effects have already occurred at the LA-2 site due to past disposal operations. The sediments of the LA-2 site show a greater range of grain sizes than those at the reference site (see Table 3-2).

Concentrations of trace metals, chlorinated hydrocarbons, oils and grease in sediments at the LA-2 site were higher than those at the reference site and other unpolluted areas of the bight (see Tables 3-3 and 3-4 for comparative values). These differences may be due to disposal activities or natural factors, but they are probably due to both.

Assuming the worst case, that all differences between the LA-2 site and reference site have been caused by past disposal activities, grain size differences and contaminant levels in sediments can be expected to persist at the LA-2 site if final designation allows continued disposal (Class I). It is also likely that bacteria and organic matter associated with disposal sediments have caused and will continue to cause increased BOD and COD in the sediments at LA-2 (Class I).

4.2.2. Effects on Biological Environment

Potential effects on marine communities were examined for each alternative site based on the susceptibility of each community to direct or indirect impacts resulting from disposal of dredged material. Potential effects were analyzed in relation to the baseline data for the various communities described in Chapter 3.

Criteria used in this section to assign significance to a potential impact are considered:

- A. Significant only to the site if impacts to biological communities are not expected to occur outside of a 1,000 yard (914 m) radius of the designated ODMS,

- B. Locally significant if judged likely to cause or substantially contribute to a measurable change in species composition or distribution in a particular habitat located within 1 nmi (1.8 km) outside of the project site, and
- C. Regionally significant if judged likely to cause or substantially contribute to measurable changes in the function or recovery of any habitat of special importance, or a change in population of any species of recognized regulatory, commercial, scientific, or recreational importance beyond the local vicinity of the ODMDS.

4.2.2.1. Plankton Community

Plankton could be adversely affected by dredged material disposal through mortality due to entrainment in the sediment plume, exposure to contaminants, reduction in photosynthetic productivity due to lowered light levels (Pequegnat, 1978; Wright, 1978), or interference with feeding processes. Sullivan and Hancock (1977) concluded that any adverse impacts on plankton would be so small as to be undetectable superimposed on large natural fluctuations in plankton populations. Any such temporary effects from the disposal of dredged material should be insignificant (Class III).

Modeling of the disposal plume at the LA-2 site (see Section 4.2.1.5.) shows that the discharge is expected to sink to the bottom quickly, and that significant suspended sediment concentrations would occur well below the euphotic zone. Some small amount of fine sediment will be suspended in surface waters, but should be diluted to background levels relatively quickly by the ambient current. Decreased light transmittance, and the associated potential for reduced photosynthesis should also be temporary, localized, and not significant. Studies show that increased turbidity and reduction in light penetration from disposal of dredged materials causes short-term adverse effects on phytoplankton, but no long-term effects on primary productivity (Wright, 1978; Hirsch, et al., 1978). Mortality of phytoplankton due to entrainment should likewise be localized, temporary, and insignificant.

Zooplankton may also be entrained in the plume and killed or exposed to contaminants. In addition, suspended sediment may interfere with filter-feeding zooplankton (FWS, 1980). Because zooplankton occur throughout the water column, exposure of zooplankton to the disposed sediment, including the plume of suspended sediment at deeper depths, will be greater than that for phytoplankton. However, almost all suspended and liquid phase bioassay tests on dredged material proposed for ocean disposal from Los Angeles and Long Beach Harbors have shown no significant mortality for planktonic species in the initial mixing zone.

Beyond the initial mixing zone, dilution and transport reduce turbidity and contaminant levels quickly. Mortality due to entrainment of zooplankton in the plume will be small. The impact on this community should be localized, temporary, and negligible in comparison to the reproductive capacity of zooplankton species (Class III).

4.2.2.2. Kelp Community

Disposal at the LA-2 site is not expected to have an effect on the kelp beds off the Palos Verdes Peninsula since 5 nmi (9 km) separate this site from the closest kelp bed and no disposal material is expected to travel this distance towards shallow waters (Class III). The nearby Horseshoe Kelp Bed does not actually include any kelp beds nor is it expected to in the future.

4.2.2.3. Benthic Invertebrate Community

Benthic communities are the component of the biological environment most likely to be affected by disposal. Disposal affects the benthos through smothering by deposited sediment, deposited or suspended sediment interfering with feeding mechanisms, toxic effects of contaminants, and altering sediment characteristics which change the suitability of the habitat (Class I).

During each disposal operation the sediment discharged will accumulate to a depth of 0.38 inches (0.96 cm) over an approximate area of 88,000 ft² (8,184 m²) centered 300 feet (396 m) downcurrent from the point of release from the split-hull barge. Significant mortality of benthic fauna due to smothering would occur in the areas of deepest sedimentation within the disposal site only (Class I). In surrounding areas experiencing less sediment deposition, mortality should be high only among nonmobile species (Richardson et al., 1978). Some mobile species are known to be capable of burrowing up through as much as 12.5 inches (32 cm) of overburden sediment (Mauer et al., 1978). These species and many of the epifauna species may survive the temporary inundation following each disposal event.

Modeling results indicate that disposal will cause greater turbidity of waters up to 5 hours after disposal, in a pathway 5,000 feet (1,524 m) down current from the disposal site and varying in width from 300 feet (91 m) to 3,000 feet (914 m) (see Section 4.2.1.5). Suspended sediments will interfere with feeding processes of benthic fauna. Both smothering and interference with feeding mechanisms will persist during disposal operations, which can last up to several weeks or months. This is long enough to cause significant faunal changes in the affected areas (Class I). The intermittent scheduling of dredging projects or management of disposal operations within the site can provide sufficient time for partial recolonization and recovery of benthic fauna from disposal effects.

Some tests of materials disposed at LA-2 showed accumulation of pesticides and PCBs, but levels were not sufficient to cause significant mortality (Marine Bioassay Laboratories, 1980, 1981, 1982 a,b,c,d, 1984 a,b; Marine Biological Consultants, 1980, 1982). The elevated levels of pesticides and PCBs in the tissues of S. ingentis collected at the LA-2 site indicate the potential for toxicological effects. These higher tissue levels of pesticides and PCBs seem likely to be due to disposal, although the mobility of S. ingentis and lack of statistical significance for the data complicates interpretation of the data. Unlike the situation for pesticides and PCBs, there were no apparent differences in the levels of metals in the tissues of S. ingentis sampled at the LA-2 and reference sites. It is difficult to determine to what extent the observed differences between the LA-2 site and the reference site are caused by disposal at LA-2.

Lowered species diversity, greater abundance of infauna, and a lower abundance of epifauna are attributed to altered sediment conditions at the LA-2 site. Sediment differences between the two sites, which may be responsible for the differences in the benthos, could be due to disposal or to natural factors such as slope, currents, or location in relation to sediment sources. Both explanations, or a combination of the two, are plausible. Resolution of this issue would require more extensive sampling and analysis of the sediments and fauna of the region than was possible for this study. EPA and COE will develop a site management program (see Section 4.6) as a mitigative measure to manage and monitor the site in an attempt to resolve these issues.

The preceding analysis indicates that measured differences between LA-2 and the reference site in benthic communities could very well be due to previous disposal activities, although natural factors could also be involved. Assuming that all of the observed differences are effects of past disposal, it is predicted that these effects will continue if the LA-2 site is designated as the ODMDS. In this case, continued disposal at levels similar to past activity may not have any additional, significant effects on benthic populations. It is quite certain that continued disposal at the site will prevent the benthic community from returning to predisposal or "normal" conditions. Because the impacts are restricted to an already affected site, no significant adverse environmental impact to the Southern California Bight is expected from continued disposal at this site (Class III).

4.2.2.4. Fish Community

A. Demersal Fish

The results of demersal fish sampling conducted for the EIS study indicate that past disposal actions may have had an adverse effect on the fish fauna of the LA-2 site. Compared to

the reference site, fewer individuals and fewer species were collected at the LA-2.

At this time, the only known explanation, which could account for the consistent differences observed between LA-2 and the reference site, is disposal at the site. The somewhat depauperate fish fauna at the LA-2 site relative to the reference site may also be due to the depauperate benthic infauna, the principal food source for demersal fish. As described above, differences in sediment characteristics between LA-2 and the reference site appear to have caused the depauperate benthic infauna. Differences between the fish fauna of the two sites could also be related to topographic relief, currents and proximity to locally significant habitats.

If populations at the site are affected by disposal operations, or if disposal quantities increase significantly in the future, additional adverse effects (Class I) may result from continued use of the site. Assuming that future disposal quantities and actions will be similar to those in the past, and bioassay tests of demersal fish continue to allow ocean disposal of acceptable dredged material, regional effects on the Southern California Bight demersal fish population are expected to remain insignificant (Class III). Even if dredged material disposal activities increase, local impacts on the site would be greater (Class I), but regional impacts on the San Pedro Basin and Southern California Bight are still expected to remain insignificant (Class III).

B. Pelagic Fish

Although pelagic fish were not sampled as part of the present study, there is little reason to believe that these populations, including that of the commercially important anchovy, would be adversely affected by continued disposal at the site (Class III).

The northern anchovy (Engraulis mordax), one of the principal commercial fish species of southern California, is known to be particularly abundant in surface waters overlying the continental slope, location of the LA-2 site, and there is no reason to believe that the site waters are any exception. Northern anchovy is one of the principal commercial species caught in the California Department of Fish and Game Block (878) containing the site (CDFG, 1935). Anchovies are pelagic (open water/surface) species, and so are not likely to be affected by the benthic sediment regime or sediment suspended at depth.

Disposed material is expected to remain confined in the discharge plume and sink to the bottom. This will remove most of the disposed material from the surface and mid-water zones where many pelagic fish live (see Section 4.2.1.5.). Sediments and associated contaminants remaining in the water column would be diluted and transported relatively quickly by the ambient currents, so that any adverse effects on the pelagic environment would be localized and temporary (Class III).

4.2.2.5. Coastal Birds

The continued use of the LA-2 site will not adversely affect any of the coastal birds living in or immigrating through the San Pedro Basin (Class III). The location of this site, more than 4 nmi from the nearest shore, effectively eliminates any impacts on inshore species. More pelagic forms may utilize the brief supply of food provided from dredged materials (i.e., dislocated or dead marine organisms) at the time of disposal (Class IV). This additional food supply would be considered incidental in the diet of scavengers.

4.2.2.6. Marine Mammals

Disposal at the LA-2 site should not have any adverse effects on marine mammals (Class III). Their large size, mobility and intelligence minimizes the possibility of direct effects of disposal on marine mammals. These animals will avoid the disposal vessel and discharged plume, which will be very localized and temporary. The disposal site is not in or near any important marine mammal feeding or breeding areas.

The naturally less productive environment of the LA-2 site, situated on the slope of the San Pedro Basin, minimizes its use as a preferred feeding area for most marine mammals which utilize richer areas nearer shore. The continued use of the LA-2 site would, therefore, present less disruption to marine mammal populations than the shallow water alternative.

4.2.2.7. Threatened and Endangered Species

Disposal at the LA-2 site is not expected to adversely affect any threatened or endangered species (Class III). FWS and NMFS have concurred with this assessment (see Chapter 5). The rare, threatened or endangered species in the area either:

- A. Conduct feeding and breeding activities in locations strictly associated with coastal land areas too far from the disposal site to be affected,
- B. Occur farther offshore, to the north or are so rarely near the disposal site to have a significant potential for being affected, or
- C. They use the area temporarily as a migratory route and could effectively avoid any disposal operation.

The continued use of the LA-2 site would greatly reduce potential effects on rare or endangered species which might be affected by the disposal of dredged materials in either shallow water or terrestrial alternatives nearer to refuge locations.

4.2.2.8. Marine Sanctuaries and Areas of Special Biological Significance

No state or national wildlife or marine refuge or Area of Special Biological Significance (ASBS) is in the immediate vicinity or within an area of influence of the LA-2 site (see Figure 3-8). Continued disposal of dredged materials will not impact any such areas (Class III).

4.2.3. Effects on Socioeconomic Environment

In this section, potential impacts on socioeconomic resources are identified and possible mitigation measures are introduced. Each individual component of the socioeconomic environment is evaluated based the nature of potential impacts. For the purposes of the assessment, it is assumed that all resources which may be affected by the proposed action are both significant and important. This procedure gives all known resources the full benefit of consideration in NEPA planning and review process. Where possible, mitigation measures are proposed to reduce any impacts. Net beneficial impacts are considered to be those impacts that preserve or enhance any natural condition or major resources of the project area.

4.2.3.1. Commercial Fishing

Harvesting of commercially important fish from the California Department of Fish and Game block where LA-2 site is located has been high (see Figure 3-9 and Table 3-17 even though the demersal fish fauna of the LA-2 site is depauperate compared to that of the reference site. Continued disposal operations at the site will not adversely affect commercially important demersal fish on a regional level (Class III). Other important commercial fish species caught near the LA-2 site and within the San Pedro Channel are pelagic. Therefore, there should be no effect of disposal on the stocks of commercially harvested fish or on the viability of the commercial fishing industry of the region (Class III).

Since ocean disposal of dredged material is infrequent from the Los Angeles and Long Beach Harbors, the number of barges involved in transporting dredged material varies considerably during the year. The normal time span for a dredging project is usually a few weeks to several months long (Shannon Cunniff, COE, Los Angeles District, personal communication). No interference or accident between these barges and the commercial fishing fleet has been reported by USCG in the past (Class III).

4.2.3.2. Commercial Shipping

The disposal of dredged material could present two potential hazards to navigation: interference of the disposal barges with vessel traffic, and mounding within the disposal site. These hazards have already been considered in the existing permitting program, and actions have been taken so they no longer pose a significant impact (Class III).

No hazard to vessel traffic is expected at the LA-2 site because it is located south of the inbound lane of the Santa Barbara Channel TSS. USCG has expressed concern that disposal barges may cause confusion for inbound traffic. This is possible because disposal vessels will have to cross the inbound TSS lane to reach the disposal site (L.A. Onstad, Commander, USCG, 11th District, personal communication, March 1984). As a result, COE has already incorporated a special condition into all permits for use of the LA-2 site that requires disposal of materials "...as far from the Gulf of Catalina Traffic Separation Scheme as is practical" (Class III). Immediately to the east of inbound TSS is the PAR area outside the harbor where traffic is strictly monitored. Due to this monitoring, incidents involving dredged disposal vessels and commercial shipping are uncommon.

Extensive mounding of accumulated material at the LA-2 site is not expected, because disposed material will be dispersed by currents, slumping or any seismic events. The depth of water over the site will allow safe passage of all known commercial vessels (Class III).

A net beneficial impact of the ocean disposal of dredged material is the improvement and maintenance of shipping lanes, channels and docking areas for both ports (Class IV). Dredging in the Los Angeles and Long Beach Harbor areas is associated primarily with channel deepening projects. The goal of channel deepening is to provide access to the area for larger more efficient commercial vessels which results in transportation savings since larger vessels can carry more goods. It is essential to maintain access to the ports and to enable them to grow, within acceptable environmental management goals, so southern California can compete with other west coast ports.

4.2.3.3. Oil and Gas Development

Neither the tract containing the LA-2 site nor any tracts in the nearby surrounding area were leased as a result of OCS Lease Sale #80 in October 1984. Further oil and gas development in the San Pedro Channel is uncertain. Existing oil and gas production facilities are at least 8.8 nmi (16 km) away from the LA-2 site and the possibility that they will be affected by disposal of dredged material is not significant (Class III).

MMS is encouraging future development in the southern California OCS as a whole. With the potential increase in oil exploration and development activities, boat traffic between Los Angeles and Long Beach Harbors and offshore oil and gas development sites will increase. This will increase the potential for accidents between the disposal barges and supply boat traffic. Most of the area between the harbors and the LA-2 site falls within the precautionary zone established by USCG. In this zone, traffic is strictly monitored to minimize the potential for conflicts or accidents. In addition, disposal

barges will operate infrequently, averaging approximately 50 trips per year. No interference or accident between disposal vessels and vessels serving offshore oil and gas facilities has been reported by USCG in the past. Transportation conflicts are expected to be minimal and insignificant (Class III).

In the event that future oil and gas developments are proposed for the tract containing the LA-2 site, conflicts between this development and dredged material disposal could be avoided by siting the oil facilities in a part of the tract far removed from the disposal site if possible (Class II). Significant sediment accumulation is expected only in the immediate site vicinity of the ODMDS. This is likely to be feasible with modern drilling technologies. In addition, disposal vessels would operate so as to avoid any oil development structures and operations.

Final designation of the LA-2 site could indirectly reduce the consumption of petroleum resources (Class IV). Average consumption of petroleum to transport dredged material to the LA-2 site would remain the same; however, by allowing the improvement and maintenance of port channels and facilities, the disposal activity allows use of more efficient commercial shipping as described in Section 4.2.3.2.

4.2.3.4. Military Usage

Although the area off southern California is the most heavily utilized naval operating area on the west coast, most of the military operations take place far beyond the immediate coastal areas outside the Los Angeles and Long Beach Harbors. The disposal of dredged material at the LA-2 site does not pose any danger to military activities (Class III).

Military vessels which travel in and out of the Los Angeles and Long Beach Harbors may face interference from the disposal barges, but the probability of interference is negligible because the frequency of ocean disposal trips is low and traffic in the precautionary area is strictly monitored. No incidents involving the disposal barges have been reported over the past 10 years since the disposal site was given interim designation (Class III). Dredged materials from Anaheim Bay are occasionally disposed at the LA-2 site. Since this bay is frequently used by naval vessels, designation of the LA-2 as a permanent disposal site will allow continued dredging at Anaheim Bay and therefore continued access by deep draft Naval Vessels (Class IV).

4.2.3.5. Recreational Activities

4.2.3.5.1. Sportfishing

Sportfishing is usually carried out in shallow waters close to the shore. The 100 fathom (183 m) line is considered to be the outer boundary for sportfishing by party boats. Many of the

most important sportfish of the area are pelagic species, which are not expected to be affected by disposal (Class III).

Because the demersal fish fauna of LA-2 site is depauperate, bottom fishing within the site boundaries could be adversely affected by long-term disposal of dredged material (Class I). However, sportfishing in this area is rare due to the depth. The effect of disposal on demersal fish is likely to be localized, so that disposal should not affect demersal fish populations in other areas which do support greater levels of sportfishing. This includes the Horseshoe Kelp bed, a popular and productive fishing area which actually does not contain any kelp beds (Figure 3-12). This area is approximately 1.8 nmi (3 km) east of the disposal site and too far to be affected by disposal. Therefore, disposal is not expected to significantly affect sportfishing on a regional level (Class III).

No accidents involving sportfishing vessels and disposal vessels have been reported by USCG over the past 10 years, during which the LA-2 site has been used on an interim basis. While the potential for accidents between dredged material barges and fishing boats exists, the probability of such incidents is extremely low due to the low level of dredging activity, and the small number of disposal trips required each year (Class III) and the position of the traffic lanes just beyond the dump site boundaries.

4.2.3.5.2. Boating

The recreational activity most likely to be affected by disposal operations at the LA-2 site is pleasure boating. A considerable number of boats operate between the Los Angeles and Orange County Harbors and the two harbors at Santa Catalina Island. Boats from the Los Angeles and Long Beach Harbors follow a straight route to harbors at Santa Catalina Island. Almost the same route is followed by the disposal barges. Hence, a potential for conflict exists; however, the frequency of ocean disposal activity is so low that the probability of accidents is almost negligible (Class III). The potential for accidents is further reduced because disposal operations rarely occur on the weekends when recreational boating is expected to be highest. No incidents have been reported since 1977 when ocean disposal started at the site on an interim basis.

4.2.3.5.3. Other Recreational Activities

Most ocean-related recreational activities occur at the beaches or in nearshore areas. These include sightseeing, beachcombing, picnicking, swimming, wading, sunbathing, diving, windsurfing and surfing. Disposal activities at the LA-2 site will not impact these nearshore recreational activities (Class III). Reduced water clarity will be caused temporarily by disposal of material at the site. This may cause some short term inconvenience and lack of site appeal if some recreational

boaters happen to be in the immediate area during actual disposal (Class I). However, the LA-2 site is more than 5.5 nautical miles (10 km) from the Los Angeles and Orange County coasts and other amenity areas. No impacts on the visual aesthetics of beach visitors are expected from the disposal activity (Class III).

4.2.3.6. Cultural Resources

MMS (1983) has identified 26 federal oil and gas lease tracts in the LA-2 study area having cultural resource sensitivity. Neither the federal tract containing the LA-2 site nor any tract in the immediate vicinity of the site has been identified as a location for historic shipwrecks or other cultural resources. Based on this information and the information obtained from SHPO (see Exhibit 12) no impacts on cultural resources are anticipated (Class III).

4.2.3.7. Public Health and Welfare

Impacts on three aspects of public health and welfare, including health, safety, and aesthetics, are discussed in this section. Health hazards may arise if the chemical nature of the materials has the potential for bioaccumulation of toxic substances in organisms. Under the COE permitting system, sediment analyses, bioassays and bioaccumulation tests are conducted on all materials prior to disposal at the LA-2 site. No materials considered hazardous may be disposed of at the site. Therefore, the potential for health hazards is not considered to be significant (Class III).

Human safety could be jeopardized as a result of interference by the disposal barges with shipping traffic, commercial and sportfishing boat traffic, recreational boat traffic, and Navy vessel traffic. The LA-2 site has been used on an interim basis over the past 10 years and no incidences of conflict or accidents have been reported during this period. With no anticipated increase in disposal activities in the foreseeable future and with strict monitoring of traffic by USCG in the zone of operation, impacts on human safety are considered to be very low (Class III).

4.3. NO ACTION ALTERNATIVE

If the No Action Alternative is selected by EPA, interim designation of LA-2 would expire and there would be no ocean site for disposal of dredged materials in the Los Angeles and Long Beach area (Class I). Discontinued use of LA-2 for disposal would lead to recovery of the ecosystem at the site from the impacts of past disposal (Class IV). The rate and extent of this recovery, and the length of time that residual effects of past disposal would persist, are not known. As normal sedimentation occurred at the site, levels of contaminants in the top layers of the sediment would decrease.

Concentration of contaminants in fish and invertebrate tissues could change, and the benthic invertebrate fauna and demersal fish populations would shift toward conditions more similar to those of the surrounding areas (Class IV) given present conditions at unimpacted sites.

Interference with commercial fishing, recreation, shipping, oil and gas development would be reduced to zero (Class IV); however, cessation or significant curtailment of dredging in the Ports of Los Angeles and Long Beach could impair the ability of these facilities to fully support commerce and trade or the needs of the U.S. Navy base at Long Beach and Anaheim Bay Naval Base. This could have serious adverse effects on the economy of the region, state, and nation, and on the military readiness of the Navy (Class I). It is not possible to quantify these effects at this time.

As stated in the "Purpose of and Need for Action" (Section 1.2), it is the intent of this EIS to identify and designate an ODMDS that is suitable for use by COE for Federal projects and permitted projects under Section 103 of MPRSA. Selection of the No Action Alternative by EPA will force COE to designate a suitable ODMDS through their authority under Section 103 of MPRSA. Selection of the No Action Alternative is not an adequate response by EPA to the request by COE for the designation of an ODMDS through a cooperative relationship between the two Federal agencies (Class I). Therefore, EPA will seek to designate an ODMDS based on the Preferred Alternative described in this EIS.

4.4. SHALLOW WATER SITE

The ecosystem effects at the shallow water site would depend on the exact location of the site. Dredged material disposal may further degrade the shallow water region to a significant degree in areas presently impacted by discharges from the Whites Point outfalls. The effects caused by disposal operations would be small relative to outfall effects. Monitoring of environmental impacts in the shallow water region may not be able to identify the sources or specific causes of environmental degradation.

The farther the site is located from the outfalls, the larger would be the relative impact of dredged material disposal. The benthic fauna of nearshore shelf areas, except for demersal fish populations, is generally more abundant and diverse than that of the slope environment at the LA-2 site. In areas not significantly affected by the outfalls, environmental impacts would probably be greater than at the LA-2 site if the shallow water site was designated as the ODMDS.

4.4.1. Effects on the Physical Environment

The same impact criteria used to evaluate the physical environment under the Preferred Alternative apply to this section.

4.4.1.1. Meteorology and Air Quality

Final designation of the shallow water site for ocean dredged material will not have a significant effect on the meteorology or air quality of the area (Class III). The COE does not anticipate any increase beyond the current number of disposal trips and there have not been any significant air quality impacts detected to date due to dumping at the LA-2 site. Therefore, based on the air pollutant dispersion calculations which provided very similar numbers for all three sites, there will be no significant air quality impact due to disposal of dredged material at the shallow water site.

4.4.1.2. Physical Oceanography

Disposal at the shallow water site will not affect physical oceanography (Class III). Physical oceanographic parameters such as currents, waves and tides will determine the effects of disposal on water and sediment quality.

4.4.1.3. Water Quality

More material is expected to be deposited on the bottom at the shallow water site and at a quicker rate than at the LA-2 site due to the shallower depth. Therefore, the Class I effects of turbidity, dissolved oxygen, nutrients, and contaminants in the water column would occur in a smaller area. Some deposited material would be resuspended by wave action, but in general less material would remain in suspension than at the LA-2 site. A mitigation measure for these effects could be that dredged material disposal will not be authorized during times of heavy wave action or strong onshore currents.

The relative effect of disposal actions on water quality would be substantially lower than at the LA-2 site, because of the existing degraded water quality in the shallow water region in relation to the Whites Point outfalls. Disposal of dredged material near these outfalls may compound impacts on water quality in the area, by increasing input of suspended solids, particulate material and associated contaminants.

4.4.1.4. Geology

Disposal at the shallow water site would cause increased sedimentation, and because of the relatively existing shallow depths, mounding may occur.

4.4.1.5. Sediment Quality

As described above, a greater proportion of disposed dredge material is expected to be deposited at the shallow water site than at the LA-2 site. This poses a potential for greater impact on sediment quality (Class I). Sediments at the shallow water site are coarser than those naturally occurring at the

LA-2 site and difference in grain size distribution between the disposed dredged material and the shallow water site may be greater. Therefore, it is likely that overall sediment quality at the shallow water site would be significantly altered if the site was designated (Class I).

Greater input to bottom sediments of BOD, oil and grease, trace metals, and chlorinated hydrocarbons associated with disposed sediment would occur at the shallow water site than at the LA-2 site based on the assumption that more material would be deposited on the bottom (Class I). Disposal may add considerably to the already degraded sediment quality in the shallow water region due to the influence of the sewage discharge at Whites Point. However, the effect of dredged material disposal alone is small relative to the major effects of the outfalls.

4.4.2. Effects on the Biological Environment

The same criteria used to evaluate the biological environment under the Preferred Alternative apply to this section.

4.4.2.1. Plankton Community

Effects of disposal on plankton at the shallow water site should not be significant or substantially different from effects at the LA-2 preferred site (Class III).

4.4.2.2. Kelp Community

Disposal of dredged materials at the shallow water site would increase the amount of suspended solids and turbidity of the water, at least on a temporary basis, after every disposal activity. Suspended solids and turbidity of the Whites Point sewage discharge have been associated with some of the decline in kelp beds along the Palos Verdes Peninsula (Wilson et al., 1980). Likewise, the disposal of dredged material at the shallow water site could be expected to have a similar effect by covering rocky surfaces necessary for kelp attachment, reducing the depth of the euphotic zone, and perhaps exposing the kelp to toxic compounds. This would not only impact the existing kelp beds but would also discourage the recovery of kelp to areas of former colonization and to deeper depths (Class I). Fish and other species associated with kelp beds would be indirectly impacted.

4.4.2.3. Benthic Invertebrate Community

Disposal at the shallow water site is expected to adversely affect the benthic community in a similar way to that encountered at the LA-2 site (Class I). These sediment impacts include smothering, interference with feeding, toxic effects of associated contaminants, and changes in the physical properties

of the bottom sediments. In areas of the shallow water region influenced by the Whites Point sewage outfalls, the benthic fauna is already disturbed and degraded due to the effects of municipal waste discharge (Thompson, 1982). Dredged material disposal would cause additional adverse effects on the benthos; these effects would be small relative to those caused by outfall discharges (Class III). In addition, the organisms that have colonized areas influenced by the outfalls are likely to be more tolerant of turbidity, low dissolved oxygen, contaminants and other short-term impacts associated with dredged material disposal.

In areas of the shallow water region not significantly influenced by municipal discharges, the benthic fauna is likely to be more diverse and abundant than that at the LA-2 site. In these areas, disposal would have a greater relative impact on benthic fauna, particularly where they have not been affected by past dredged material disposal.

4.4.2.4. Fish Community

Disposal of dredged material at the shallow water site would have a significantly adverse effect on demersal fish (Class I). Effects would occur due to turbidity, reduced dissolved oxygen, toxic effects of contaminants, and effects on their principal benthic food sources.

In areas of the shallow water region influenced by the Whites Point sewage outfalls, the fish community is already disturbed and degraded due to the effects of municipal and industrial waste discharges (Allen and Mearns, 1977). Fish that exist in areas influenced by the outfalls are likely to be more tolerant of turbidity, low dissolved oxygen, and contaminants than those of the LA-2 site. Disposal actions in these areas would have additional adverse effects on demersal fish, although the impacts would be small relative to the overwhelming effects of outfall discharges (Class III).

In areas of the shallow water region not significantly influenced by municipal discharges, the demersal fish fauna is likely to be less diverse and abundant than the naturally occurring populations found in the vicinity of the LA-2 site (Allen and Mearns, 1977). In these nearshore areas, disposal would also be expected to have a less severe impact on demersal fish (Class III) and disposal of dredged material is not expected to have any effect on nearshore pelagic fish populations (Class III). The fish community associated with kelp beds, however, would be adversely affected if sedimentation due to disposal activities disturbed kelp beds.

4.4.2.5. Coastal Birds

The establishment of a shallow water, inshore ODMDS nearer to breeding and nesting sites of coastal birds, is not expected to increase the potential for impacts on such species (Class

III). Disposal activities in nearshore waters would be expected to attract large numbers of opportunistic scavengers (i.e., gulls) which might disturb natural feeding assemblages or predatory activities. Otherwise no significant impacts on bird populations are expected at the shallow water site.

4.4.2.6. Marine Mammals

Because of human habitation and use of the shore areas in the vicinity of the proposed shallow water ODMDS, only occasional use of the area is made by pinnipeds for hauling out. No significant rookeries are located near the shallow water site though some feeding by marine mammals does take place in the rich inshore kelp beds. As in the case of the LA-2 site, none of the activities of marine mammals are expected to be significantly impacted in this area (Class III).

4.4.2.7. Threatened and Endangered Species

Environmental impacts on endangered species are not expected if the shallow water site is designated as the ODMDS (Class III). Gray whales, equally abundant in the shallow water region as they are near the LA-2 site, should not be affected by disposal. The shallow water region is more likely to support feeding by the California brown pelicans and the California least tern because it is closer to shore. However, disposal is not expected to significantly affect the pelagic fish of the region which are their principal food source. Consequently, no impacts are predicted for pelican or tern populations.

4.4.2.8. Marine Sanctuaries and Areas of Special Biological Significance

The shallow water site is seaward of Abalone Cove Ecological Reserve, a sensitive area of tidepools and kelp beds located off the Palos Verdes Peninsula. Occasional shoreward currents could carry the dredged material disposal plume from the shallow water site into the reserve (Class I). The kelp beds are in a recovery phase from past impacts, and increased turbidity and sedimentation associated with a disposal plume would reduce available light, cover rocky surfaces necessary for kelp attachment, silt over young plants or benthic fauna or foliage, and possibly expose the tidepools and kelp communities to toxic compounds, causing significantly adverse environmental impacts to the area.

4.4.3. Effects on the Socioeconomic Environment

The same impact criteria used to evaluate the socioeconomic environment under the Preferred Alternative apply to this section.

4.4.3.1. Commercial Fishing

Disposal activities at the shallow water site will affect commercial fishing to a lesser extent than at the LA-2 site (Class III). Commercially caught fish are not as abundant in the shallow water region as they are further out to sea.

4.4.3.2. Commercial Shipping

The potential for conflict between disposal vessels and commercial shipping is considerably lower if the shallow water site is used for disposal (Class III). The shallow water site is closest to the shoreline and fewer disposal barges will have to cross the designated traffic separation lanes. Only a small section of the precautionary area will have to be crossed to reach the shallow water disposal site. In addition, disposal at the shallow water site would be beneficial for the ports because dredging could continue (Class IV).

4.4.3.3. Oil and Gas Development

No oil and gas development activities are planned or proposed in the shallow water region and no conflicts or impacts are anticipated (Class III). Energy consumption, associated with transport of dredged material, would decrease slightly because the distance to the site is less, but this effect is negligible.

4.4.3.4. Military Usage

Except for the military vessels moving in and out of the ports, no military activities take place close to the shore. Disposal at the shallow water site would have no impacts or interference with military activities off the southern California coast (Class III).

4.4.3.5. Recreational Activities

4.4.3.5.1. Sportfishing

Sportfishing is usually carried out in shallow waters close to the shore. The potential for impacts on sportfishing is greater at the shallow water site compared to the LA-2 or deep water sites because kelp beds may be affected. No unique areas for sportfishing occur in the shallow water site area and disposal operations would not cause significant infringements on present sportfishing efforts (Class III).

4.4.3.5.2. Boating

The potential for conflict between disposal vessels and pleasure boats is somewhat increased by disposal in the shallow water region as a greater amount of such boating occurs in shallow water. Also, there is a potential for grounding in the shallow water region caused by successive disposal, and this could cause a hazard to boating by decreasing water depth (Class I).

4.4.3.5.3. Other Recreational Activities

Similar to sportfishing, recreational activities (excluding boating) are usually carried out closer to the shore. Potential impacts on nearshore activities are somewhat greater at the shallow water site than at the LA-2 or deep water sites (Class II). A mitigation measure for these potential impacts would be to locate the disposal site in an area as far as possible from primary nearshore recreational locations.

4.4.3.6. Cultural Resources

The shallow water site lies close to the areas of higher probability of aboriginal sites. Disposal at this site also has a greater potential for impacting shipwrecks since most of them have been known to occur in shallow water regions of up to 50 fathoms (91 m) depth. In order to mitigate these potential impacts close coordination with the SHPO will be maintained to avoid locating the disposal site in an area that would affect cultural resources (Class II).

4.4.3.7. Public Health and Welfare

Impacts on the public health, safety and aesthetics, discussed earlier for the LA-2 preferred site (Section 4.2.3.7.) are expected to be similar for the shallow water site. The proximity to shore of the shallow water ODMDS could slightly increase safety impacts because of the necessity for dredging activities to be conducted nearer to activities of sportfishing and pleasure boats as well as the shipping lanes. Disposal activities could be restricted to daylight hours to lessen the potential for unsafe interference (Class II).

4.5. DEEP WATER SITE

Any significant impacts predicted for the deep water site would be new and classified as Class I impacts. Impacts from disposal activities on the physical and biological environments of the deep water site should be approximately the same as the impacts observed at the LA-2 site. This is based on the assumption that disposal at the two sites will have similar adverse effects on sediment quality, benthic invertebrates and demersal fish. Impacts on water quality, pelagic fish, marine mammals, threatened and endangered species are expected to be insignificant.

Disposal at the deep water site would have less immediate impact on the benthic environment and a greater impact on the pelagic environment because more disposed material would be suspended and dispersed in the water column. In addition, the benthic invertebrate and demersal fish fauna of the deep water site are less diverse and less abundant than those of the LA-2 site. However, a counterbalancing consideration is that the sediments, benthos, and fish population of the deep water site

are in a relatively undisturbed condition, while these resources at the LA-2 site have already been affected by past disposal. Recognition of the undisturbed nature of the deep water site was instrumental in the selection of the LA-2 site as the Preferred Alternative. No significant adverse impacts to the Southern California Bight ecosystem are expected from ocean disposal at the deep water site.

4.5.1. Effects on the Physical Environment

The same impact criteria used to evaluate the physical environment under the Preferred Alternative apply to this section.

4.5.1.1. Meteorology and Air Quality

Final designation of the deep water site for ocean dredged material will not have a significant effect on the meteorology or air quality of the area (Class III). The COE does not anticipate any increase beyond the current number of disposal trips and there have not been any significant air quality impacts detected to date due to dumping at the LA-2 site. Therefore, based on the air pollutant dispersion calculations which provided very similar numbers for all three sites, there will be no significant air quality impact due to disposal of dredged material at the deep water site.

4.5.1.2. Physical Oceanography

Disposal at the deep water site would not affect physical oceanography (Class III). Physical oceanographic parameters such as currents and waves will determine the extent of disposal impacts on water quality and sediment quality.

4.5.1.3. Water Quality

At the deep water site, more material is expected to remain in suspension in the water column than at the LA-2 site due to the greater depth and the presence of a permanent thermocline, although the suspended material will be diluted in a much greater volume of water than at the LA-2 site. Therefore, the effects on turbidity, dissolved oxygen, nutrients, and contaminant levels on water quality would be more widespread than at the LA-2 site but the effect would be temporary and concentrations would quickly become dilute (Class I). The amount of material introduced to the San Pedro Basin is also expected to be insignificant compared to the amount of material brought into the basin by the Southern California Eddy (Hickey, 1979).

4.5.1.4. Geology

Disposal of dredged material at the deep water site would not affect the geological parameters of the area (Class III).

4.5.1.5. Sediment Quality

Deposition of dredged material at the deep water site would be spread out over a wider area compared to the LA-2 site due to the deeper depths and the movement of fine material by deep currents along the thermocline. Sediment grain size distribution, biological oxygen demand, and concentrations of trace metals, chlorinated hydrocarbons, oils and greases would be affected by disposal but the effect would be more widespread and at lower levels. However, the existing sediment quality in the deep water region is undisturbed compared to that of the LA-2 site.

The overall impact on sediments of the deep water site is adverse because the environmental effects are new; however, the significance of the impact will be spread out over a larger area (Class I). The regional environmental impact of these effects to the Southern California Bight should be equivalent to the observed impact of past disposal at the LA-2 site.

4.5.2. Effects on the Biological Environment

The same criteria used to evaluate the biological environment under the Preferred Alternative apply to this section.

4.5.2.1. Plankton Community

Effects of disposal on plankton at the shallow water site should not be significant or substantially different from effects at the LA-2 site (Class III).

4.5.2.2. Kelp Community

Disposal at the deep water site will not have a significant effect on kelp communities because the disposal material is not expected to travel the 5.5 nm (10 km) separating these locations (Class III).

4.5.2.3. Benthic Invertebrate Community

The effect of disposal on the benthos of the deep water site is expected to be approximately the same as that observed at the LA-2 preferred site (Class I). Less sediment and associated contaminants will reach the bottom at the deep water site. The benthic populations of the deep basins are known to be less diverse and less abundant than the shelf or slope fauna (BLM, 1978). This is true for benthic fauna at the deep water site even taking into account the disturbed nature of the LA-2 site.

In addition, the deep water benthic invertebrates are tolerant of low DO levels (Hartman and Barnard, 1958; Fauchald and Jones, 1978) and may be less affected by altered DO than

species inhabiting the LA-2 site. Benthic populations in the deep water site have not been subjected to significant impacts related to disposal of dredged material. Designation of the deep water site would cause environmental impacts of a significant nature which could alter the benthic invertebrate populations in the area (Class I).

4.5.2.4. Fish Community

Fish populations of the deep basins are known to be more depauperate than those of the shelf and slope environments (Allen and Mearns, 1977). Therefore, the fish fauna of the deep water site is naturally less diverse and less abundant than that of the LA-2 site.

If the deep water site is designated as the ODMDS for the Los Angeles area, the effects associated with dredged material disposal could significantly impact the demersal fish fauna in a manner similar to that observed at the LA-2 site (Class I). The impact may be diminished because less dredged material and associated contaminants would reach the bottom at the deep water site, thus the potential for toxicological effects on fish and effects on primary food sources would be somewhat reduced. Disposal operations at the deep water site should not have any impact on pelagic fish (Class III).

4.5.2.5. Coastal Birds

Because of the mid-channel location, disposal of dredged material at the deep water site will not have a significant effect on coastal bird populations (Class III).

4.5.2.6. Marine Mammals

Because of the mid-channel location, disposal at the deep water site is not expected to have significant impacts on marine mammals (Class III).

4.5.2.7. Threatened and Endangered Species

Because of the mid-channel location, disposal at the deep water site is not expected to impact threatened or endangered species (Class III).

4.5.2.8. Marine Sanctuaries and Special Resource Areas

Primarily because of its mid-channel location, disposal of dredged material at the deep water site is not expected to affect marine sanctuaries or areas of special biological significance (Class III).

4.5.3. Effects on the Socioeconomic Environment

The criteria used to evaluate the socioeconomic environment of the deep water site are the same as the criteria described for the Preferred Alternative.

4.5.3.1. Commercial Fishing

Commercially important fish are more abundant in the deep water site area than at the LA-2 or shallow water sites. This area of the coastal sea does not contain any exclusive or unique stocks of fisheries resources and the impacts on commercial fishing would be no greater than at the LA-2 site. Due to the infrequent disposal needs and the short duration of the disposal activity, the actual interference of disposal with fishing will be minimal, no significant impacts on commercial fishing are anticipated (Class III).

4.5.3.2. Commercial Shipping

The potential for interference of the disposal barges with commercial vessels is the same whether the dredged material disposal takes place at the deep water site or at the LA-2 site. In both cases disposal barges will be crossing the precautionary area and the traffic separation lanes. Close monitoring by USCG will reduce the significance of this effect to a negligible level (Class III). The probability of conflict is greater at sites farther out at sea compared to the shallow water site. Designation of the deep water site would be a significant beneficial impact for the commercial shipping because the maintenance of the ports would provide continued access for the industry (Class IV).

4.5.3.3. Oil and Gas Development

Impacts of disposal at the deep water site will be comparable to those at the LA-2 site. Compared to the shallow water site, the potential for conflict is greater at the deep water site. However, multiple use of the site would be possible and the impacts are considered not to be significant (Class III). Energy consumption associated with transport of dredged material to the site is likely to double because the distance to the deep water site is twice as far as the distance to LA-2.

4.5.3.4. Military Usage

No military operations take place in the deep water region. Military vessels which travel in and out of Los Angeles and Long Beach Harbors may face interference with the disposal barges, but the probability of such interference is negligible (Class III). Impacts at the deep water site will be comparable to those at the LA-2 site and relatively more than those at the shallow water site.

4.5.3.5. Recreational Activities

4.5.3.5.1. Sportfishing

Little, if any, sportfishing occurs in water depths greater than 100 fathoms. No impacts on sportfishing are anticipated if

dredged material disposal occurs in the deep water site area (Class III).

4.5.3.5.2. Other Recreational Activities

Impacts of disposal activity on recreational boating in the deep water site area will be similar to those at the LA-2 site, but less than the potential impacts at the shallow water site. Potential for conflict between the disposal vessels and recreational boats exists but the frequency of ocean disposal is expected to be so low that the probability of conflict will be insignificant (Class III). Positioning the deep water site as far from major recreational boating traffic areas may be a net beneficial impact by further reducing the possibility of accidents (Class IV).

4.5.3.6. Cultural Resources

No known aboriginal cultural resource sites will be impacted by the disposal activities at the deep water site. The potential for impacting a shipwreck is much lower at the deep water site compared to the LA-2 site or shallow water site (Class III).

4.5.3.7. Public Health and Welfare

Impact on the public health and safety discussed earlier for the LA-2 preferred site (Section 4.2.3.7) are expected to be similar for the deep water site. The greater distance from shore of this alternate site could reduce, to some extent, the already low potential for significant effects on the public health and welfare.

4.6. MANAGEMENT OF THE DISPOSAL SITE

Existing COE and EPA procedures, including bulk sediment analyses, acute and chronic toxicity tests, and bioaccumulation tests will continue to be required for MPRSA Section 103 permits and Federal dredging projects to evaluate the suitability of the material to be disposed at the designated ODMDS. These requirements will ensure that significant environmental impacts are prevented from developing at the site.

For more effective site management, the COE, Los Angeles District, has imposed special conditions as discussed below, on permits to dispose of dredged material at the designated site. The purpose of Condition 1 is to minimize interference with commercial shipping and the purposes of Conditions 2 and 3 are to facilitate surveillance and monitoring, documenting amounts and characteristics of disposed material, and assessing impacts of disposal.

COE 103 Permit Conditions

- A. All ocean dumping permits shall be sent to the Captain of the Port. The permittee shall notify the U.S. Coast Guard, Captain of the Port 48 hours prior to dumping of dredged material at the disposal site at the following address:

Commanding Officer
Marine Safety Office
Los Angeles/Long Beach
165 North Pico Avenue
Long Beach, California 90802
(213) 590-2315

- B. For every calendar year in which ocean disposal of dredged material occurs, the permittee shall submit the following information to COE Los Angeles District before February 1 of the next year:

1. Permit number,
2. Mode of dredging,
3. Mode of transportation,
4. Form of dredged material,
5. Frequency of dumping,
6. Start date of dumping,
7. Completion date of dumping,
8. Chemical composition of dredged material,
9. Solubility of dredged material,
10. Density of dredged material,
11. pH of dredged material,
12. Percent sand silt and clay of dredged material,
13. Method of packaging,
14. Method of release,
15. Procedure and method for tank washing, and
16. Total cubic yards dumped.

- C. Dredged material authorized for ocean dumping must be disposed of only in the approved dump area, and should be done as far from the Gulf of Catalina Traffic Separation Scheme (TSS) as is practical.

A further condition that may be imposed on some permits will be a requirement to monitor effects of the disposal operation on water quality and ecology at the time of disposal. The need to implement a long-term management and monitoring program to improve understanding of the environmental impacts of all disposal at the site will be addressed in a supplementary Site Management Program and Site Monitoring Plan to be issued after final designation of the ODMDS.

The site management plan will include long-term management and monitoring of the site. The broad list of management areas

listed below identifies general considerations pertinent to site management. Major elements of the site management program will include:

- A. Evaluation of sediment movement towards important biological resources outside of or in close proximity to the site boundaries,
- B. Periodic evaluation of trace metal and/or chlorinated hydrocarbon levels in tissues of selected organisms at the site, and
- C. Evaluation of sediment quality at the site and adjacent to the area.

4.7. RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM RESOURCE USES

The proposed action is not expected to affect biological resources of the region. Certain components of the biological environment of the immediate site, such as benthic invertebrates and demersal fish, may be adversely affected. Impacts will persist as long as the site continues to be used for disposal. Cessation of disposal would permit a gradual recovery of the benthic communities to normal levels over time.

The LA-2 site has been used for 10 years and disposal activities have not interfered, nor are they expected to interfere, with the long-term use of any resources at the site. Commercial fishing and sportfishing have not been impaired to any measurable extent because the site constitutes a very small percentage of the total fishing grounds in the San Pedro Channel.

Potential for conflict exists if oil and gas discoveries are made at the site as a result of future leases offered by the U.S. Department of the Interior, but at the present time this appears unlikely. In addition, it is possible that recovery of oil and gas in the vicinity of the site could be achieved without significant interference with disposal activities. Therefore, the economic productivity of the site area or of the region should not be affected by continued disposal.

In conclusion, the only effect on site resources that is expected to result from the proposed action is a relatively minor decrease in the biological productivity of the immediate site, which is a dynamic effect. The loss of some biological resources at the site is offset by the significant benefit to commercial, military and recreational traffic from the future dredging of the Los Angeles and Long Beach Harbors and the subsequent disposal of this dredged material at an environmentally suitable location. Lack of a fully designated ocean disposal site capable of accepting large quantities of dredged material would have serious adverse effects on the economic productivity of the Los Angeles area.

4.8. IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

The irreversible or irretrievable resources committed to the proposed action of final designation of the LA-2 site will remain the same as those committed to the interim site. These include:

- A. Commitment of energy resources used as fuel for dredges, pumps, and disposal vessels,
- B. Commitment of economic resources incurred as costs associated with ocean disposal, and
- C. Commitment or dedication of the benthic environment of the immediate disposal site in the form of degradation of sediment quality, benthos, and demersal fish fauna for the duration of disposal at the site.

These commitments, however, are less significant than the economic advantages of disposing of dredged material at the LA-2 site and the effect of new environmental impacts on resources described in alternative disposal schemes.

CHAPTER 5. COORDINATION

5.1. PUBLIC INVOLVEMENT

A Notice of Intent (NOI) to prepare an environmental impact statement was published in the Federal Register on November 10, 1983 (Exhibit 1). This NOI was published concurrently with COE Publication 84-LA2-S(HH) (Exhibit 2). Public and regulatory agency comments were accepted regarding the scope of the EIS for the designation of the LA-2 interim site as an ODMDS for continued use. Several Federal, State and local agencies, and interested public groups submitted comments by the closing date of January 16, 1984. These comments are summarized in Table 5-1, and individual letters follow as Exhibits 3 through 8.

Most of the comments identified in the letters were later repeated in an interagency workshop held on June 26, 1984. The responses to these comments appear in the discussion related to the interagency workshop. A note to that effect is made under each comment letter. Responses not covered in the interagency workshop are given directly following the comment letter.

5.2. INTERAGENCY WORKSHOP

An interagency workshop on the designation of the LA-2 interim ODMDS as a final site was held on June 26, 1984 and a list of attendees is provided in Table 5-2. The purpose of the workshop was:

- A. Disseminate detailed information about site surveys,
- B. Obtain feedback from other agencies on the results of these studies, and
- C. Solicit comments from other agencies on the designation issues prior to the actual preparation of the EIS.

The workshop participants reviewed the respective roles of EPA and COE with regard to the site designation process and monitoring studies. The study plan was discussed and some preliminary results were displayed. All attendees were given a booklet covering the information presented in the oral briefing. Comments recorded during the workshop are presented below.

5.2.1. Issue 1

USCG was concerned that the LA-2 site is located too close to vessel traffic lanes and that there is a potential for vessel incidents to occur. They requested that the site be moved farther offshore. Harvey Beverly (Regulatory Branch, COE Los Angeles District) outlined the history of discussions between USCG, EPA and COE. USCG did not pursue their request further after learning what was involved in the site designation process. Jack Fancher (U.S. Fish and Wildlife Service)

EXHIBIT 1

51680

Federal Register / Vol. 48, No. 219 / Thursday, November 10, 1983 / Notices

5447-01-218-2373
5447-01-223-0029
5447-01-223-0030

Class 8445

R. N. Trueman, Cotton
5447-01-073-0013
5443-01-073-0016
5443-01-073-0015

Deletion

After consideration of the relevant matter presented, the Committee has determined that the commodity listed below is no longer suitable for procurement by the Federal Government under 41 U.S.C. 46-48c, 85 Stat. 77.

Accordingly, the following commodity is hereby deleted from the Procurement List 1984:

Class 8440

Belt, Coat
5440-00-984-3878
C. W. Fletcher,

Executive Director.

(FR Doc. 83-29355 Filed 11-9-83; 9:45 am)
BILLING CODE 5020-32-01

Procurement List 1984 Corrections of Proposed Additions

In FR Doc. 83-29355, published October 28, 1983 (48 FR 49904), the NSN for the item under Belt, Tool, Repairman's is corrected to read 5140-00-529-2317.

In FR Doc. 83-29355, published October 28, 1983 (48 FR 49904), under Class 9505, wherever 9905 appears change to 9505.

C. W. Fletcher,

Executive Director.

(FR Doc. 83-29355 Filed 11-9-83; 9:45 am)
BILLING CODE 5020-32-01

Procurement List 1984; Establishment; Correction

In FR Doc. 83-28332 appearing at page 48415 in the issue for Tuesday, October 18, 1983, make the following corrections:

1. On page 48417, third column, fifth line from the bottom, Table, Wood, change to read "Table, Office, Wood." Same column, second line from the bottom, Tables, Steel, change to read "Table, Steel".

2. On page 48418, first column, eighth line from the top, Costumer, Wood, change to read "Costumer, Wood, Executive".

3. On page 48423, second column, first three lines, Food Services, Department of Air Force, Sheppard Air Force Base, Texas should be listed under "SIC 5812".

4. On page 48424, third column, ninth line from the bottom, insert "9100

Brookville Road, Silver Spring, Maryland (SH)".

E. R. Alley, Jr.,

Acting Executive Director.

(FR Doc. 83-30612 Filed 11-9-83; 9:45 am)
BILLING CODE 5020-32-01

DEPARTMENT OF DEFENSE

Department of the Army Corps of Engineers

Intent To Prepare Draft Environmental Impact Statement (DEIS) for Proposed Final Designation of LA 2 Interim Ocean Dumping Site, Offshore of Los Angeles County, Calif.

AGENCY: Army Corps of Engineers, DOD.

ACTION: Notice of Intent To Prepare a Draft Environmental Impact Statement (DEIS).

SUMMARY: 1. *Proposed Action.* The Los Angeles District (LAD) of the U.S. Army Corps of Engineers will prepare a Draft Environmental Impact Statement to identify the impacts associated with the final designation of an ocean disposal site for dredge material off of Los Angeles (Site No. LA 2). The LA 2 dumpsite consists of the area within 1000 yards of a center point at 33°37'06"N., 118°17'36" W.

Preparation of the DEIS regarding the final designation of the disposal site will be accomplished by the U.S. Army Corps of Engineers at the request of the Environmental Protection Agency (EPA). Since documentation in support of final designation must have EPA approval (EPA is responsible for final disposal site designation), the U.S. Army Corps of Engineers will be coordinating closely with the EPA.

To establish baseline data for the site, LAD began comprehensive field sampling in summer 1983 which will repeat for three consecutive seasons. The sampling plan includes 5 sampling stations at the dumpsite; one station is located at the center of the dumpsite and the other 4 are spaced at 90° intervals around outer edge of the dumpsite, 1000 yards from the center.

Three sample stations will be located at the adjacent Reference (control) site. These stations represent similar depths as those stations located at the dumpsite's center, shallowest and deepest sampling stations.

The center coordinates of the LA 2 reference site is:

33°34'08" N., 118°11'43" W.

Project tasks are focused primarily on benthic resources, although other biological, physical, cultural and socio-

economic aspects will be considered. The DEIS will analyze the need for the ocean disposal site by addressing the present and potential future use of the site for disposal of uncontaminated dredge spoil and by addressing the availability of land disposal sites.

2. *Alternatives.* Alternatives to the proposed project include (a) no action, (b) utilization of land disposal sites, or (c) designation of alternative ocean disposal sites. Other alternatives may be identified through the scoping process.

3. *Scoping Process.*

a. *Public Involvement.* An extensive mailing list has been prepared which includes affected Federal, State, and local agencies and other interested private organizations and parties. Each entity on the mailing list will receive a copy of the scoping public notice which will have details of the proposed studies.

b. *Significant Issues.* Significant issues to be analyzed in depth in the DEIS will include: The need for the project, alternatives to the project, impacts to benthic habitats and biota (including endangered species); water quality and circulation, water use, aesthetics, socio-economics, and transportation. Tissue and sediment chemistry will be analyzed and bioaccumulation potential addressed as part of assessing the impacts to benthic habitat and biota. Other potentially significant issues may be identified through the scoping process.

4. *Scoping Meetings.* The Corps of Engineers will circulate a public notice soliciting comments regarding the scope of the DEIS rather than holding a scoping meeting.

5. *Publication of the DEIS.* The Draft Environmental Impact Statement is expected to be available to concerned agencies and the interested public for review and comment in November 1984.

Paul W. Taylor,

Colonel, Corps of Engineers, District Engineer.

(FR Doc. 83-30612 Filed 11-9-83; 9:45 am)
BILLING CODE 5710-02-01

DEPARTMENT OF ENERGY

Western Area Power Administration

Rio Grande Project; Proposed Power Rate Adjustment

AGENCY: Western Area Power Administration, DoE.

ACTION: Notice of proposed power rate adjustment—Rio Grande Project, New Mexico.



Public Notice

US Army Corps of Engineers

Los Angeles District

P.O. Box 2711

Los Angeles, CA 90053

EXHIBIT 2

SPLCO-R (84-LA2-S(HB))

Date NOV 30 1983 Comment Deadline: JAN 16 1984

To Whom It May Concern:

Your comments are invited on the scope of an Environmental Impact Statement (EIS) on the proposed Final Designation of the LA 2 Interim Ocean Dumping Site, offshore of Los Angeles County, California (figures 1 and 2).

SCOPING

In the scoping process, public comment helps determine the scope of an EIS, i.e., the plan of study, the impacts and possible alternatives to be considered. Through the scoping process the significant issues which should be addressed in depth by the EIS are identified.

PROPOSED PROJECT AND STUDY PLAN

The LA 2 dumpsite is a 100 fathom (600 foot) deep circular disposal site with a radius of 1000 yards and a center located at 33° 37' 06" N, 118° 17' 36" W. This dumpsite was given Interim status by the Environmental Protection Agency in 1977. Final designation, pursuant to the Marine Protection, Research, and Sanctuaries Act of 1972, as amended, is necessary if its use as a dumpsite for dredge spoil is to be continued. The EPA requested that the U.S. Army Corps of Engineers (USACE) prepare the EIS required prior to final disposal site designation by the EPA. Therefore, the U.S. Army Corps of Engineers will prepare a Draft Environmental Impact Statement (DEIS) for the Proposed Final Designation of LA 2 Interim Ocean Dumping Site pursuant to: the National Environmental Policy Act (NEPA) of 1969; the Council On Environmental Quality Regulations on Implementing NEPA Procedures (40 Code of Federal Regulations (CFR) 1505-1508); and the Corps of Engineers regulations: Policy and Procedures For Implementing NEPA (33 CFR 230). The U.S. Army Corps of Engineers has filed a Notice of Intent to prepare this document. (Concurrently, USACE is preparing an EIS for the Final Designation of LA 5 Interim Ocean Dumpsite, located off of San Diego.)

USACE is undertaking a comprehensive field sampling and data analysis program to: 1) obtain the information necessary for accurate ecological assessment, and 2) create a scientifically sound baseline of existing conditions at the site. The project tasks primarily focus upon benthic resources, although other biological, physical, cultural, and socio-economic aspects will be considered.

Historic data on biological, physical, and chemical oceanography, transportation networks, and disposal events will be obtained from the private and public sector. Data will be obtained from a literature search, published and unpublished government data, and interviews with local experts. Data will be used to establish a historic baseline which can be compared to existing conditions.

SUBJECT: The Scope of an Environmental Impact Statement on the Proposed Final Designation of the LA 2 Interim Ocean Dumping Site

Four seasonal field surveys will be conducted with sufficient detail to adequately assess existing conditions and trends. Sampling is designed to be statistically justifiable, repeatable, and utilizes technically appropriate methods. Field surveys will include sampling of the infauna, epifauna, fish, sediment, chemical and physical oceanography at the dumpsite and the adjacent reference site. Field surveys will include:

1) **ORGANISMAL SAMPLING.** Quantitative seasonal inventory of benthic marine fish and invertebrates will be sampled via otter trawls. Infauna sampling will be made with a 0.1 m² bottom grab. Otter trawl stations will correspond to infaunal sampling stations. Voucher specimens will be fixed and stored at the Los Angeles District office of the Corps of Engineers.

2) **PHYSICAL OCEANOGRAPHIC SAMPLING.** Water column profiles of temperature, salinity, pH, dissolved oxygen, and water transmissivity will be performed at two stations at each site (dumpsite and reference site). Replicate profiles will be made. Vertical spacing of sampled depths will be sufficient to define the major pycnoclines in the water column and to satisfy any requirements of biological or physical modeling analyses.

3) **CHEMICAL OCEANOGRAPHIC SAMPLING.** Water bottles will collect samples for analysis of concentration of suspended solids, heavy metals (Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg), Lead (Pb), Arsenic (As), Zinc (Zn), PCBs, petroleum hydrocarbons, and total organohalogenes. Samples will be collected approximately 4 meters above the bottom and 5 meters below the surface.

4) **SEDIMENT SAMPLING.** A vertical core sample will be taken from the 0.1 m² bottom grab. Grain size distribution of each sample will be determined. Laboratory analysis of sediment chemistry and tissue chemistry will also be performed. Analysis will be for Cd, Cr, Cu, Hg, Pb, As, Zn pesticides (including chlorinated hydrocarbons), total organohalogenes, PCBs, and petroleum hydrocarbons. Standard methods and Environmental Protection Agency testing procedures will be followed. Target species for tissue chemistry will be 1) a benthic-feeding flat fish, the Pacific Sanddab (Citharichthys sordidus) and 2) the filter-feeding shrimp, Sicyonia spp..

Speed, direction and vertical structure of water body movement at each site will be derived from historical data and not measured directly.

This data will in part be used to describe the biotic and oceanographic conditions of the project environment. Data will also be used to assess the differences between the dumpsite and reference (control) site; these differences may indicate the impacts of ocean disposal of dredged material at the dumpsite. The socio-economic setting of the project will be addressed via discussion of those aspects of the project area most likely to be affected by the final designation of the dumpsites. These include: commercial and sport fisheries, coastal recreation, cultural resources, offshore oil development, marine transportation, dredge and disposal operations, and sewage outfalls.

SUBJECT: The Scope of an Environmental Impact Statement on the Proposed Final Designation of the LA 2 Interim Ocean Dumping Site

CONTENT AND STRUCTURE OF THE EIS

The EIS will be structured in accordance with the following outline:

1. Summary

- a. Major Conclusions
- b. Areas of Controversy
- c. Issues to be Resolved

2. Purpose and Need for Action

a. Proposed Action

- (1) Route description
- (2) Barge description
- (3) Dredging type
- (4) Scope of disposal
 - (a) A need for action
 - (b) Stages of implementation
 - (c) Life of the project
 - (d) Historic

b. Interrelationship With Other Policies, Plans, and Projects

- (1) Federal Government: Outer Continental Shelf
- (2) State: California
- (3) Local Ports
- (4) Private industry (proposed projects and ongoing studies)

3. Alternatives Including Proposed Action

a. The Environmental Impacts of the Proposed action

- (1) Introduction
- (2) Existing environment (direct and indirect impacts of operation).
- (3) Water resources and quality: Marine
- (4) Biota: Marine

SUBJECT: The Scope of an Environmental Impact Statement on the Proposed Final Designation of the LA 2 Interim Ocean Dumping Site

(5) Use plans - (coastal and ocean route)

b. Alternatives to the Proposed Action

(1) No action

(2) Delayed action

(3) Land disposal

(4) Alternative ocean disposal sites

c. Comparative Impacts of Alternatives

d. Mitigating Measures Not Included in the Proposed Action

(1) Methodology for determining mitigating measures

(2) Mitigating measures

(3) Measures required by Federal agencies

(4) Measures required by State of California and other entities

4. Affected Environment

a. Environmental Conditions

(1) Southern Pacific Coastal Climatic Region, emphasizing Ports and Disposal Sites.

(2) Identification of marine ecosystem components in the area:

(a) Abiotic

(b) Biotic

(3) Physical setting of disposal site and its reference site

(a) Physiography

(b) Geology

(c) Sedimentology

(4) Water resources, quality, and uses: ocean

(5) Water quality standards:

(a) Federal

(b) State

(c) Local

SUBJECT: The Scope of an Environmental Impact Statement on the Proposed Final Designation of the LA 2 Interim Ocean Dumping Site

(6) Water use (how the proposed action conforms or conflicts with the objectives and specific terms of existing or proposed Federal, State, and local land/water use plans, policies, and controls, if any, for the area affected).

(7) Recreation and recreational values

(a) Historic trends

(b) Present trends

(8) Use plans, controls, and constraints:

(a) Coastal and ocean transportation routes

(b) Existing policies

(c) Trends of conflicts

b. Significant Resources

(1) Resources identified as significant in laws, regulations, and guidelines

(2) Critical resources

(3) Species of concern such as: unique, threatened, rare, and Endangered species, and ecologically important species.

5. Environmental Consequences

a. The Environmental Impacts of the Proposed Actions

(1) Introduction

(a) Methodology of impacts analysis

(b) Existing impacts

(c) Potential for impacts

(2) Existing environment (direct and indirect impacts of operation)

(a) Physical and chemical oceanography

(b) Marine ecosystem

(c) Sedimentology

(3) Water resources and quality: marine

(4) Biota: marine

(5) Use plans - (coastal and ocean route)

SUBJECT: The Scope of an Environmental Impact Statement on the Proposed Final Designation of the LA 2 Interim Ocean Dumping Site

(a) Transportation (marine)

(b) Socioeconomic characteristics

b. Alternatives to the Proposed Action:

(1) No Action

(2) Delayed action

(3) Land disposal

(4) Alternative ocean disposal sites

c. Mitigating Measures Not Included in the Proposed Action

(1) Methodology for determining mitigating measures

(2) Mitigating measures

(3) Measures required by Federal agencies

(4) Measures required by State of California and other entities

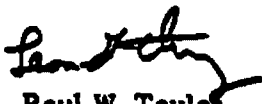
6. List of Preparers

COMMENTS

Your written comments will help us to identify public concerns over the final designation of the disposal site and focus the EIS on significant issues. Please send your comments to:

**U.S. Army Engineer District
ATTN: SPLCO-R (84-LA2-S(HB))
P.O. Box 2711
Los Angeles, California 90053**

For further information, call Harvey Beverly, Regulatory Branch, (213) 688-5606.

for  *LTC*
**Paul W. Taylor
Colonel, Corps of Engineers
District Engineer**

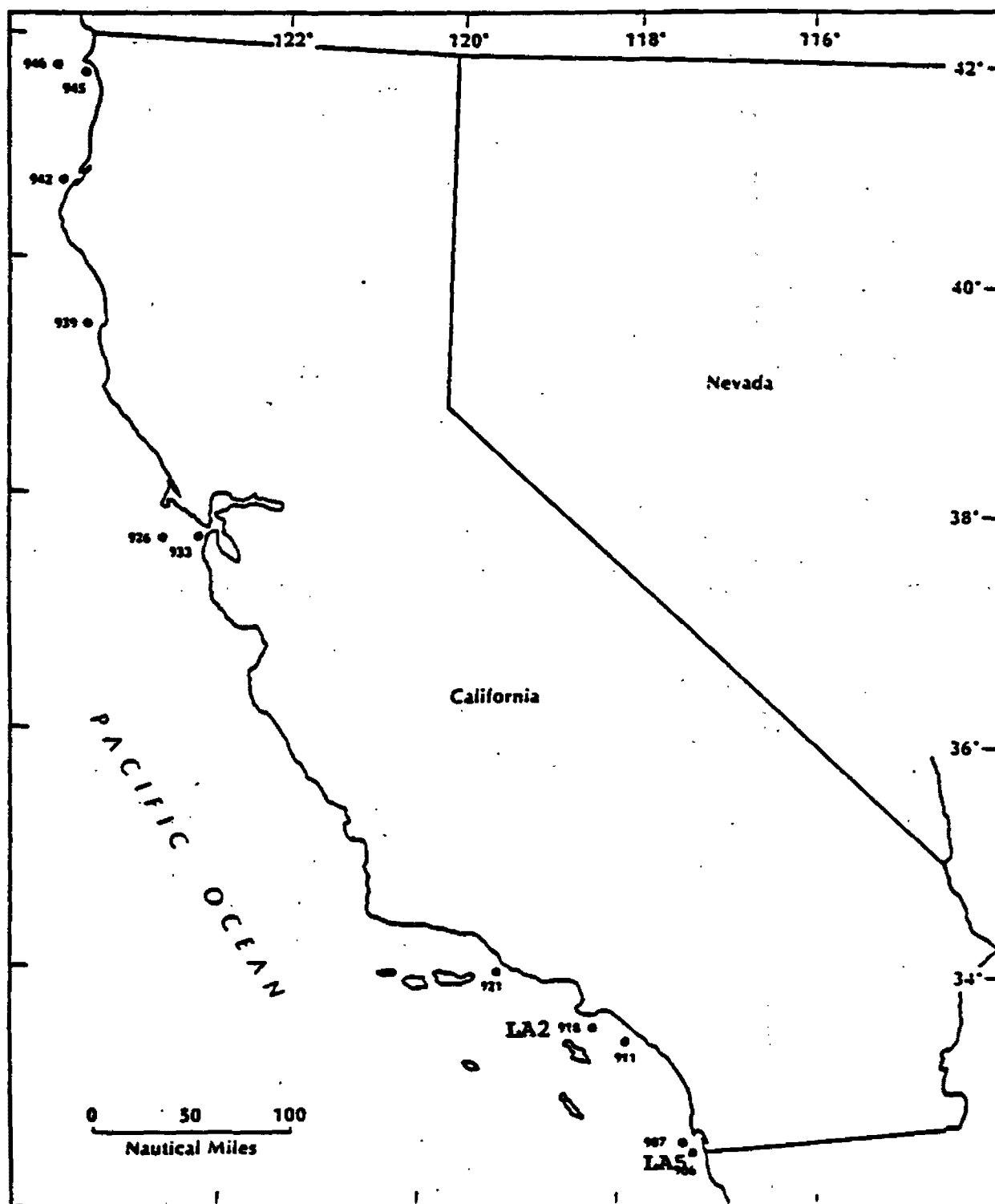
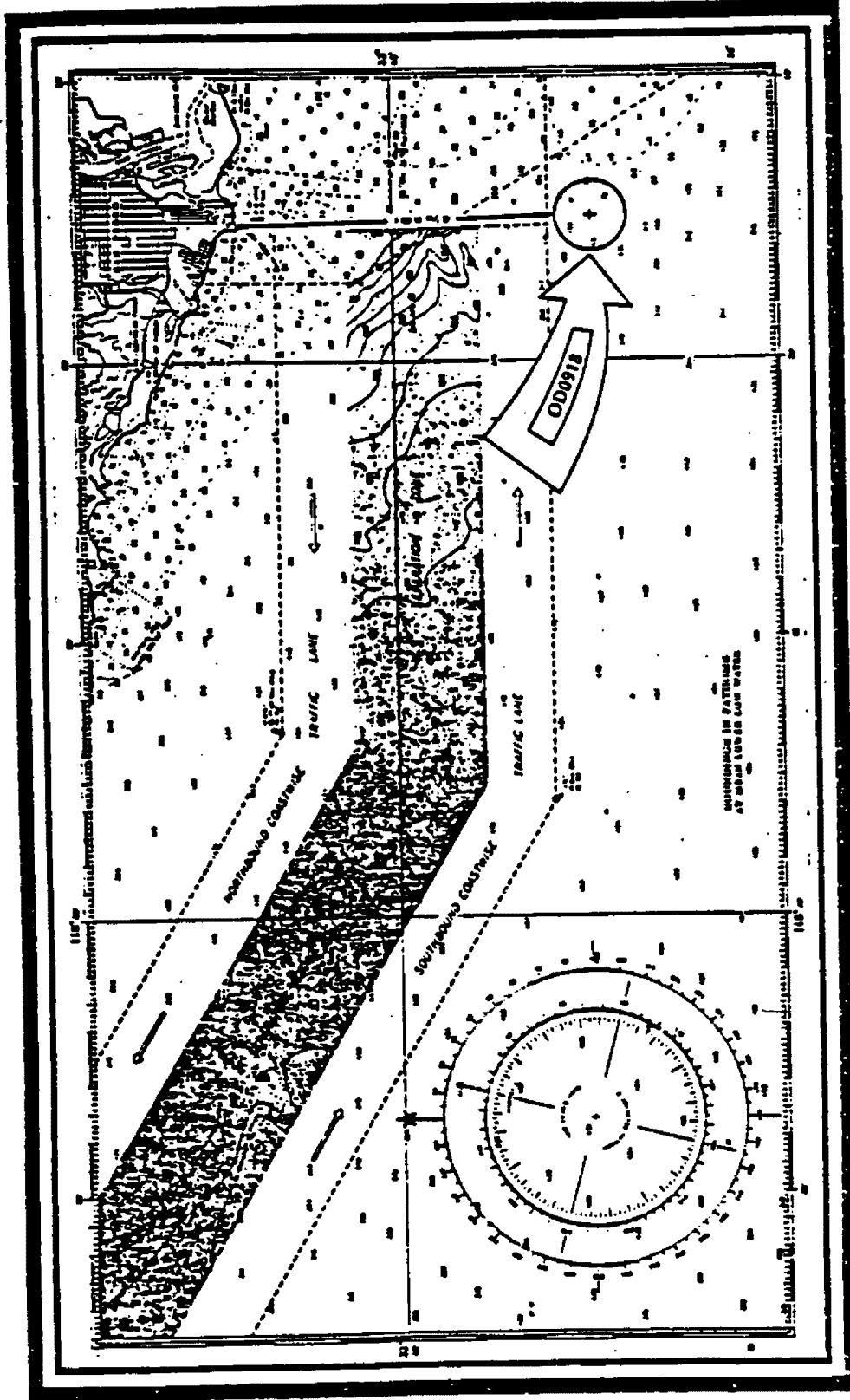


FIGURE 1: EPA REGION IX OCEAN DISPOSAL SITES



Navigation Chart No. NOS 18746
 Area 0.76 Square Nautical Miles
 Local Navigational Aids Loran A & C, Omega, EDOF, Radar
 Material Type Dredged Material

Boundary Coordinates 1,000 Yard Radius
 Center Coordinates 33°37'00"N, 118°17'34"W

000918
 Los Angeles, CA

FIGURE 2: LA2 OCEAN
 DUMP SITE

September 1980

Table 5-1. Issues Identified During the Scoping Process

AGENCY	ISSUES AND COMMENTS
U.S. Coast Guard	Concern with respect to traffic safety if the LA-2 site is finally designated.
National Marine Fisheries Service	Recommended that topics of commercial and recreational fishing be highlighted in the EIS.
U.S. Fish and Wildlife Service	Suggested use of a berm trawl in place of an otter trawl for demersal fish samples. Also suggested midwater trawl samples.
The Resources Agency of California (9 State Agencies)	No comments at this time, but they will review the DEIS. Conveyed the California Coastal Commission comment consistency certification will be required on the EIS. This was later retracted by the Commission. (See Exhibit 13).
Regional Water Quality Control Board, Santa Ana Region.	No comments at this time.
Southern California Association of Governments	No comments at this time.



DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
COMMANDER (MES)
ELEVENTH COAST GUARD DISTRICT
UNION BANK BLDG.
400 OCEANGATE
LONG BEACH, CA. 90802

16475/30COE
9 January 1984

From: Commander, Eleventh Coast Guard District
To: District Engineer, U. S. Army Corps, Los Angeles District
Subj: COE Public Notice dated 30 November 1983

1. A review of the proposed dump site location raises some concern with respect to traffic safety; especially if there is high vessel traffic density associated with a large dumping project at LA2. Current traffic patterns for the area are governed by the Traffic Separation Scheme (TSS), shown in figure 2 of your notice, and the International Navigational Rules. There is the possibility that vessels going to and from the dump site may cross the TSS in violation of Rule 10 of the Navigational Rules. This could result in a dangerous situation and lead to a casualty. Likewise, because LA2 is adjacent to the eastbound traffic lane, vessels using the traffic lane could be confused as to the intentions of the dumping vessel. To mitigate these potential problems, recommended routes and dump headings could be established.

2. If you have any questions please call me or LCDR VARANKO at (213 590-2301).

Sincerely,

L. A. ONSTAD
Commander, U. S. Coast Guard
Chief, Marine Environmental
Protection/Port Safety Branch
By direction of the District Commander

Copy: MSO LA/LB
CCGD11 (dpl) (e)

RESPONSE: See Section 5.2.1 for further discussion. As a result of the Coast Guard's concern, the COE has incorporated a special condition into all permits to dispose materials at LA 2 site (see Section 4.2.3.2 and 4.6).



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southwest Region
300 South Ferry Street
Terminal Island, California 90731

December 20, 1983

F/SWR33:JJS
1503-01.d

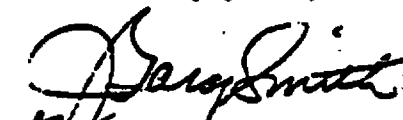
Colonel Paul W. Taylor
District Engineer
Corps of Engineers
P.O. Box 2711
Los Angeles, CA 90053

Dear Colonel Taylor:

We have reviewed Public Notices Nos. 84-LA2-S and 84-LA5-S requesting comments on the scope of environmental impact statements (EIS) for the proposed final designations of the LA-2 and LA-5 Interim Ocean Dumping Sites off Los Angeles and San Diego respectively. In general, the content and structure proposed for each EIS thoroughly covers those areas of concern to the National Marine Fisheries Service.

The only apparent deficiency we can see concerns the subjects of commercial and recreational fishing. The texts of both Public Notices state that these topics will be covered in the discussions involving socio-economic settings. Because of the importance of thoroughly considering the implications of long-term dumping at each of the interim sites on fishing, we recommend that the topics of commercial and recreational fishing be specifically highlighted in the content section of each EIS.

Sincerely yours,


Lloyd S. Anders, Jr.
Acting Regional Director

cc:
CDPG, Long Beach
FWS, Laguna Niguel

RESPONSE: See Sections 3.4.1, 3.4.5.1, 4.2.3.1, 4.2.3.5.1





United States Department of the Interior

FISH AND WILDLIFE SERVICE ECOLOGICAL SERVICES

24000 Avila Road
Laguna Niguel, California 92677

January 5, 1984

Commander
Los Angeles District
Corps of Engineers
P.O. Box 2711
Los Angeles, California 90053

Attention: Regulatory Branch

Re: PN 84-LA2-S and PN 84-LA5-S EIS Scoping Notices
for Ocean Dump Site Designation

Dear Colonel Taylor:

The Fish and Wildlife Service (FWS) has examined the referenced public notices and finds that no significant topic within our purview has been overlooked.

With regard to the field sampling program, we suggest that the FWS be given the opportunity to review and comment on the biological study plan prior to its implementation. Further, we suggest that the proposed otter trawl fish sampler be replaced with a beam trawl which includes a device for measuring the actual bottom area swept by the trawl. Often, a significant failing of otter trawl sampling is that bottom time and area swept by the net is only estimated, rather than actually determined, thus introducing considerable error. The addition of midwater trawl samples should also be considered, in order to assess the presence of fishes normally associated with the water column, as well as the bottom.

Please contact Mr. Jack Fancher on this matter, should the need arise, at FTS 796-4270.

Sincerely yours,

Dale A. Pierce
Dale A. Pierce
Acting Field Supervisor

cc: CDFG, MRR, Long Beach, CA
NMFS, Terminal Island, CA
EPA, Reg. IX, San Francisco, CA

RESPONSE: See Section 5.2.2.

Resources Building
1416 Ninth Street
95814

GEORGE DEUKMEJIAN
GOVERNOR OF
CALIFORNIA

EXHIBIT 6

(916) 445-5656

Department of Conservation
Department of Fish and Game
Department of Forestry
Department of Boating and Waterways
Department of Parks and Recreation
Department of Water Resources



THE RESOURCES AGENCY OF CALIFORNIA
SACRAMENTO, CALIFORNIA

Air Resources Board
California Coastal Commission
California Conservation Corps
Colorado River Board
Energy Resources Conservation
and Development Commission
Regional Water Quality
Control Boards
San Francisco Bay Conservancy
and Development Commission
Solid Waste Management Board
State Coastal Conservancy
State Lands Commission
State Reclamation Board
State Water Resources Control
Board

Colonel Paul W. Taylor
Army Corps of Engineers
Post Office Box 2711
Los Angeles, CA 90053

January 13, 1984

Public Notice 84-LA2S (Interim Ocean Dumping Site)

Dear Colonel Taylor:

The State agencies listed below have reviewed the subject public notice and have provided comments used in writing this response. The Resources Agency concurs in these findings.

The Coastal Commission comments that it will provide comments regarding this proposed action for: (1) EPA's DEIS on Designation of an Ocean Dumping Site in the San Pedro Basin for the Ocean Disposal of Drilling Fluids and Cuttings (August 1983) and (2) the U.S. Army's DEIS for the Proposed Final Designation of LA 2 Interim Ocean Dumping Site.

In addition, the Commission comments that a federal consistency certification will be required for EPA's final disposal site designation action.

Because we have received no adverse comments, the State will not object to issuance of the Corps permit.

Sincerely,

A handwritten signature in dark ink, appearing to read "Gordon F. Snow".

GORDON F. SNOW, Ph.D.

Assistant Secretary for Resources

cc: Department of Boating and Waterways
Department of Parks and Recreation
State Water Resources Control Board
Department of Fish and Game
Wildlife Conservation Board
Department of Water Resources
State Lands Commission
Coastal Commission
Department of Health Services

RESPONSE: See Section 5.3

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SANTA ANA REGION**6809 INDIANA AVENUE, SUITE 200
RIVERSIDE, CALIFORNIA 92506

PHONE: (714) 684-9330

EXHIBIT 7



December 27, 1983

U.S. Army Corps of Engineers - LA
Attn: SPLCO - R (84-LA2 - S (HB)
P.O. Box 2711
Los Angeles, CA 90053Re: The Scope of an Environmental Impact Statement on the
Proposed Final Designation of the LA 2 Interim Ocean
Dumping Site

Gentlemen:

We have reviewed the public notice which describes the scoping process for this Environmental Impact Statement (EIS) and have no comments to offer at this time. We look forward to review of the data obtained by the comprehensive field sampling program proposed, as well as the EIS, when available.

Sincerely,

*Joanne E. Schneider*Joanne E. Schneider
Environmental Specialist

JES:ww

RESPONSE: No response needed.

EXHIBIT 8



600 South Commonwealth Avenue • Suite 1000 • Los Angeles • California • 90005 • 213/385-1000

AREAWIDE CLEARINGHOUSE MEMORANDUM

PROJECT APPLICANT: US Army Corps of Engineers

SCH NO.:

PROJECT TITLE: LA 2 Interim Ocean Dumping Site
offshore of Los Angeles County
SPLCO.R (84-LA2-S(HB))

SCAG NO.: LA 31608-DF

DATE: January 4, 1984

The project title and SCAG number should be used in all correspondence with SCAG concerning this project. Correspondence should be sent to the attention of the Clearinghouse Coordinator. Staff can be reached by telephone at (213) 385-1000.

FINAL DISPOSITION

☒ We have concluded review of the above project and have determined that it is of local significance and does not warrant clearinghouse comments.

☐ We have concluded review of the above project and have determined that it is of area-wide significance and generally consistent with regional policies.

☐ We have concluded review of the above project and have determined that it is regionally significant. Comments on this project are attached.

☐ In conducting the areawide notification for this project, SCAG received the attached comments from outside agencies.

Wendy A. Murphy
Clearinghouse Official
WENDY MURPHY
Clearinghouse Official

RESPONSE: No response needed.

2011-01-10 11:01:21

Table 5-2. Attendees at the Interagency Workshop on Ocean Disposal at the LA-2 and LA-5 Sites

NAME	ORGANIZATION
Eric Yunker	EPA Region 9, Ocean Dumping Coordinator
Harvey Beverly	COE Los Angeles District, Regulatory Branch
Terry Breyman	COE Los Angeles District, Environmental Section
Shannon Cunniff	COE Los Angeles District, Environmental Section
William Van Peeters	COE Los Angeles District, Environmental Section
Jack Fancher	U.S. Fish and Wildlife Service
Martin J. Kenney	U.S. Fish and Wildlife Service
James E. Mahoney	U.S. Coast Guard
Lewis A. Schinazi	California Regional Water Quality Control Board, Los Angeles Region (4)
Jim Steele	California Department of Fish and Game
Pete Xander	California Coastal Commission
Don Cadien	MBC Applied Environmental Sciences
Michael Sowby	MBC Applied Environmental Sciences
Rick Ware	MBC Applied Environmental Sciences
Tom Grieb	Tetra Tech, Inc.
Raj Mathur	Tetra Tech, Inc.
Ted Turk	Tetra Tech, Inc.

opposed moving the site because this would cause impacts to an as yet undisturbed location. Shannon Cunniff (Environmental Section, COE Los Angeles District) agreed with this point and noted that the LA-2 site had been used since 1977. It was generally agreed that the site should not be moved to another location.

5.2.2. Issue 2

Jim Steele of the California Department of Fish and Game and Jack Fancher of the U.S. Fish and Wildlife Service stated that site designation studies should address impacts to pelagic and mid-water fish. Jim Steele specifically mentioned that the effects of suspended fine sediment on anchovies should be studied. Jack Fancher suggested that mid-water trawls should be made to sample the pelagic fish population in the area. Shannon Cunniff explained that field studies had already been initiated and that these studies were focused on benthic resources because this portion of the biological environment would be the most significantly affected resource of the area. She noted that monitoring studies included in the site management program could include a study of mid-water fish and other means of assessing the impacts of suspended fine sediment.

Jack Fancher noted that the FWS comment letter on the Notice of Intent recommended that a beam trawl with a device to measure bottom time be used in lieu of an otter trawl. Tom Grieb (Tetra Tech, Inc.) and Shannon Cunniff noted that quantitative abundance estimates were not the objective of the trawl survey and that it is not necessary to know the exact bottom distance traversed. Furthermore, it was explained that tow speed, cable angle, cable length and cable vibration are monitored carefully to ensure uniform bottom time for the trawls. Sample of a questionable nature, such as those trawls that bounce along the bottom, are discarded and the trawl is made again.

5.2.3. Issue 3

Jim Steele suggested that histopathological studies be performed in lieu of or in addition to muscle tissue contaminant analyses of selected organisms. Shannon Cunniff pointed out that COE has limited funding and that this is a preliminary baseline type of survey. There does not appear to be a precedent for this level of detail in a study of this nature. Materials disposed of at the site have already been subjected to bioassay tests to determine the suitability of the material for ocean disposal. Therefore, it is assumed that the material is relatively clean. Tom Grieb added that histopathological analyses are not yet a standard technique and the proper protocols would require research and development. If this study or future monitoring studies indicate a need for such studies, then the requirement for histopathological analyses could be included in the scope of work for site characterization.

5.2.4. Issue 4

Jim Steele recommended that the ice cream cone worm, Pectinaria sp., be used for tissue burden studies. Don Cadien (MBC Applied Environmental Sciences) noted that the small size of this polychaete requires that an unacceptably large number of bottom samples would have to be taken in order to obtain sufficient numbers of the organisms. Furthermore, analysis of whole Pectinaria sp. would measure toxics in the gut, including ingested sediment, as well as the tissues.

5.2.5. Issue 5

The problem of short dumping was discussed. USCG is responsible for monitoring proper disposal positions. Jim Steele and Bill Van Peeters (Environmental Section, COE Los Angeles District) suggested that a radar target could be placed on the disposal barge to allow verification of the dump location by USCG personnel. Harvey Beverly noted that the COE Regulatory Branch would consider adding this condition to COE Section 103 permits. Dumping on the way to the site still remains a concern.

5.2.6. Issue 6

Robert Hoffman (National Marine Fisheries Service) asked if there was any feasible alternative to the designation of LA-2, since land disposal was not a feasible alternative. Shannon Cunniff noted that several alternative ocean sites and land alternatives would be considered in the EIS. Alternative ocean disposal sites include a shallow water site and a deep water site.

5.2.7. Issue 7

Jack Fancher asked why COE had not coordinated better with concerned agencies prior to initiation of the field studies. Harvey Beverly and Shannon Cunniff explained that the scheduling and funding of the project made extensive coordination impossible and that Russ Bellmer, formerly COE's District Senior Ecologist and responsible for the scope of work, reported coordination on an informal basis with agencies prior to development of the work plan.

5.2.8. Issue 8

At several points, the site monitoring program was referred to as a means of incorporating other agencies' recommendations for site studies. Eric Yunker (EPA) noted that a detailed site monitoring program would probably not be incorporated into the EIS, but that it could be part of EPA's Record of Decision on the EIS that is published concurrently with the final designation package.

5.3 Formal Consultations

Formal consultation required by the Endangered Species Act was initiated with the U.S. Fish and Wildlife Service on January 4, 1984 and with the National Marine Fisheries Service on January 11, 1984 and November 11, 1984. The responses to consultation report letters are shown as Exhibits 9, 10 and 11.

Coordination with the California State Historic Preservation Officer, as required by the National Historic Preservation Act, was initiated and a response was received on December 7, 1984. This response is shown as Exhibit 12.

Consultation with the California Coastal Commission regarding coastal zone consistency review was initiated. In the Commission's letter, dated November 9, 1984, they indicated that a consistency determination was not required for final designation of the dredged material site (Exhibit 13). The Commission will continue to review all permit actions under Section 103 of MPRSA to determine consistency.

5.4. REQUESTED REVIEWERS

Comments were requested from the following organizations:

5.4.1. Federal Agencies and Offices

Council on Environmental Quality
Department of Commerce
 National Oceanic and Atmospheric Administration
 National Marine Fisheries Service
 Maritime Administration
Department of Defense
 Army Corps of Engineers
 Navy
Department of Health and Human Services
Department of the Interior
 Fish and Wildlife Service
 Minerals Management Service
Department of Transportation
 Coast Guard
National Science Foundation

5.4.2. State and Municipal Offices

State of California
 State Resources Agency
 Department of Fish and Game
 State Historic Preservation Office
County of Los Angeles
City of Los Angeles
City of Long Beach
Port of Los Angeles
Port of Long Beach

EXHIBIT 9



United States Department of the Interior

FISH AND WILDLIFE SERVICE
SACRAMENTO ENDANGERED SPECIES OFFICE
1230 "N" Street, 14th Floor
Sacramento, California 95814

FEB 03 1984

In reply refer to: SESO

#1-1-84-SP-129

Mr. Carl F. Enson
Chief, Planning Division
Department of the Army
Los Angeles District
Corps of Engineers
P.O. Box 2711
Los Angeles, California 90053

Subject: Request for List of Endangered and Threatened Species in
the Area of LA 2 Ocean Disposal Site, Los Angeles County,
California

Dear Mr. Enson:

This is in reply to your letter of January 4, 1984, requesting a list of listed and proposed endangered and threatened species that may occur within the area of the subject project. Your request and this response are made pursuant to Section 7(c) of the Endangered Species Act of 1973 as amended (PL 95-632).

We have reviewed the most recent information and to the best of our knowledge there are no listed or proposed species within the area of the project. We appreciate your concern for endangered species and look forward to continued coordination. If you have further questions, please contact Mr. Ralph Swanson of our office at (FIS) 448-2791 or (916) 440-2791.

Sincerely,

Gail C. Kobetich
Project Leader

RESPONSE: No response needed.



DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southwest Region
300 South Ferry Street
Terminal Island, California 90731

EXHIBIT 10

February 2, 1984

F/SWR31:DJS
1514-05

Mr. Carl F. Enson
Chief, Planning Division
Los Angeles District
Army Corps of Engineers
P.O. Box 2711
Los Angeles, CA 90053

Dear Mr. Enson:

This responds to your January 11, 1984 information requests concerning endangered, threatened, or candidate species that may be affected by the proposed designation of the LA2 and LA5 ocean disposal sites.

The enclosed list indicates those species which may be present in the project area. The gray whale is most likely of these species to be found in these areas. As this species would occur only transiently in these small areas as it migrates along the west coast, we believe that conducting an informal consultation may satisfy the requirements of Section 7(c) of the Endangered Species Act. We would appreciate receiving a copy of the DEIS for these projects and believe these documents may be used in place of submitting formal Biological Assessments.

We have received another request from the Corps of Engineers (COE) for a similar project in the Humboldt Bay, California region. We recommend that all three documents address the cumulative effects of these projects to listed or candidate species. In addition, if the COE concludes in the DEIS that the projects may affect populations of any listed or candidate species, the COE should initiate the formal consultation process.

If you have any further questions please contact Mr. Dana J. Seagars of our Marine Mammal Program at (FTS) 796-2518 or (213) 548-2518.

Sincerely yours,

Rodney R. McInnis
Acting Regional Director

Enclosure

RESPONSE: No response needed.



EXHIBIT 10, Pg. 2

Enclosure
Species Which May Be Present in Project Areas

<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>
Gray whale	(<u>Eschrichtius robustus</u>)	Endangered
Right whale	(<u>Eubalaena glacialis</u>)	Endangered
Blue whale	(<u>Balaenoptera musculus</u>)	Endangered
Fin whale	(<u>B. physalus</u>)	Endangered
Sei whale	(<u>B. borealis</u>)	Endangered
Humpback whale	(<u>Megaptera novaengliae</u>)	Endangered
Sperm whale	(<u>Physeter macrocephalus</u>) [<u>catodon</u>]	Endangered
Green sea turtle	(<u>Chelonia mydas</u>)	Endangered
Leatherback sea turtle	(<u>Dermochelys coriacea</u>)	Endangered
Pacific Ridley sea turtle	(<u>Lepidochelys olivacea</u>)	Endangered
Loggerhead sea turtle	(<u>Caretta caretta</u>)	Threatened
Guadalupe fur seal	(<u>Arctocephalus townsendi</u>)	Candidate



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southwest Region
300 South Ferry Street
Terminal Island, California 90731

EXHIBIT 11

November 26, 1984

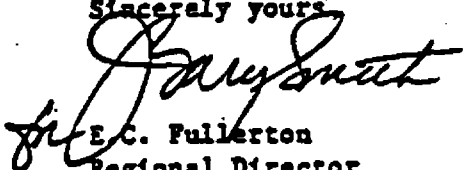
F/SWR33:DJS
1514-05

Mr. Carl F. Enson
Chief, Planning Division
Los Angeles District
Army Corps of Engineers
P.O. Box 2711
Los Angeles, CA 90033

Dear Mr. Enson:

We have reviewed your November 11, 1984 determination that populations of listed endangered, threatened or candidate species will not be affected adversely by the proposed final designation of the LA2 and LA5 ocean disposal sites for dredged materials. We concur with your conclusion. We see no need to proceed further with the consultation process prescribed in Section 7 of the Endangered Species Act.

Sincerely yours,


E.C. Fullerton
Regional Director

RESPONSE: No response needed.



EXHIBIT 12

State of California - The Resources Agency
OFFICE OF HISTORIC PRESERVATION
DEPARTMENT OF PARKS AND RECREATION
P.O. Box 2390
Sacramento, CA 95811
(916) 445-8006

Date: 7 December 198

Project No.: CoE 841024 B
and CoE 841024 C

TITLE: LA 2 and LA 5 DUMP SITES

The item cited above was received in this office on _____
Thank you for consulting us pursuant to 36 CFR 800.

We concur in your determination that this undertaking:

- ☒ does not involve National Register or eligible properties.
☐ will not affect National Register or eligible properties.

The provisions of 36 CFR 800.7 apply if previously unidentified National Register or eligible resources are discovered during construction.

Contact Nicholas Del Cioppo of our staff if you have any questions.

Marion Mitchell-Wilson

Marion Mitchell-Wilson, Deputy State Historic Preservation Officer
Acting Chief, Office of Historic Preservation

RESPONSE: No response needed.

State of California George Deukmejian, Governor

EXHIBIT 13

California Coastal Commission
SOUTH COAST DISTRICT
245 West Broadway, Suite 380
P.O. Box 1450
Long Beach, California 90801-1450
(213) 590-5771

November 9, 1984

Shannon Cunniff
Environmental Section
Department of the Army
L. A. District, Corps of Engineers
P.O. Box 2711
Los Angeles, CA 90053

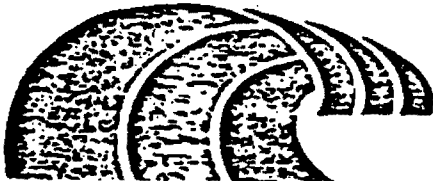
Re: LA 2 and LA 5 Ocean Disposal Site Selection

Dear Shannon,

Thank you for your coordination with the Coastal Commission regarding the COE ocean disposal site studies for dredged material placement at disposal sites LA 2 and LA 5. As you are aware, on January 11, 1984, the U. S. Supreme Court issued a decision in Watt vs. California concerning consistency determinations by the State of California for federal activities which may affect the coastal zone. The 5-4 ruling reversed two lower court rulings and determined that an administrative action, such as an Outer Continental Shelf oil and gas lease sale, is not subject to review by the State under Section 307(c)(1) of the Coastal Zone Management Act. While a bill was introduced a few weeks later to change the CZMA to permit such state review of these federal agency decisions, the Bill -- HR 4559 -- died in committee. It is expected that it will be reintroduced when the 99th Congress convenes early next year.

In the meantime, the Coastal Commission would continue to have consistency review and permit authority over dredging projects and the shipment of materials through the coastal zone that may adversely affect coastal resources. We appreciate the level of involvement that you have afforded the Commission, and I am confident that the "unofficial" review of the potential impacts

RESPONSE: No response needed.

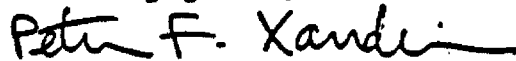


November 9, 1984
Page 2

of the designation of two disposal sites for further placement of dredged materials by our agency and other State agencies concerned with resource protection and management will ensure that the projects and monitoring programs will be thorough and helpful.

Again, thank you for your effort to keep the Coastal Commission involved and informed. I am looking forward to assisting you in any way I can in the future on this and other projects by the COE.

Sincerely yours,



Peter F. Xander
Staff Planner

PFX/sws

cc: Tom Tobin
Liz Fuchs
Mary Hudson

5.4.3. Private Organizations

American Cetacean Society
Audubon Society
Cousteau Society
National Wildlife Federation
Oceanic Society
Sierra Club

5.4.4. Academic/Research Institutions

California State University, Long Beach
Scripps Institute of Oceanography, La Jolla
University of California, Los Angeles
University of California, Santa Cruz

CHAPTER 6. LIST OF PREPARERS

NAME	EXPERTISE	EXPERIENCE	RESPONSIBILITY
<u>U.S. Environmental Protection Agency</u>			
Patrick J. Cotter, M.Sc.	Ocean Disposal Program, EIS preparation and Oceanography	Three years as EIS Reviewer and Regional Ocean Disposal Program Contact	Review and editing of EIS
Phillip Oshida, M.Sc.	Ocean Disposal Program, Bioassay Evaluation, and Oceanography	Two years in Oceans and Estuaries Section, Seven Bioassay Lab Manager SCCWRP	Review and editing of EIS
Eric Yunker, M.Sc.	Ocean Disposal Program	Four years as Regional Ocean Dumping Coordinator	Review of work plan and coordination on EIS content
<u>U.S. Army Corps of Engineers</u>			
Harvey W. Beverly	Ocean Disposal Regulations	Seven years as Permit Manager, seven years as Hydrographic Surveyor	Technical review of regulatory concerns

NAME	EXPERTISE	EXPERIENCE	RESPONSIBILITY
Terrance L. Breyman, M.Sc.	Ecology	Six years as COE Ecologist and 13 years as Biologist with Federal government and consulting firms	Technical review of EIS
Shannon E. Cunniff, M.A.	Ecosystems Analysis and Impact Analysis	Four years as Environmental Coordinator and Ecologist for COE, seven years environmental education	Project Environmental Coordinator
John H. Kennedy, M.A.	Environmental and Community Planning	Six years as Environmental Section Chief, seven years as Geographer and Community Planner for COE	Review of EIS
Gloria Lauter, M.A.	Archaeology and Cultural Resources	Three years as COE Archaeologist and five years as Consulting Archaeologist	Project Cultural Resources Coordinator
Patricia Martz, Ph.D.	Archaeology and Cultural Resources	Eight years as COE Archaeologist	Technical review of archaeology and cultural resources
Clifford D. Rader, M.A.	Environmental Planning and Regulatory	Five years as Environmental Coordinator, three years as Chief of the Regulatory Section	Review of EIS, regulatory issues

NAME	EXPERTISE	EXPERIENCE	RESPONSIBILITY
<u>Contractor: Tetra Tech, Inc.</u>			
Arthur Babcock, M.Sc.	Physical Oceanography	Ten years environmental consulting and research	Physical oceanography and water quality assessment
Robert Barrick, B.S.	Chemistry	Six years environmental consulting and research	Analysis and interpretation of chemical data
Dale Brandon, Ph.D.	Marine Geology	Twenty years environmental consulting and research	Physical oceanography and sediment quality assessment
Thomas H. Grieb, M.A.	Marine Biology and Biostatistics	Ten years environmental consulting and benthic fauna assessment	Statistical analysis of all data
Thomas Leung	Ocean Engineering	Ten years environmental consulting and research	Numerical modeling of fate of disposal material
Raj Mathur, Ph.D.	Socioeconomic and Cultural Resource	Eight years environmental consulting and 20 years research and teaching	Socioeconomic and cultural resource assessment
Jeffery Stern, B.Sc.	Oceanography	Five years environmental consulting and research	Analysis and interpretation of chemical data

NAME	EXPERTISE	EXPERIENCE	RESPONSIBILITY
Ted R. Turk, Ph.D.	Marine Ecology	Six years environmental consulting and five years environmental research and teaching	Contractor Project and Document Manager and Biological Assessment
Frank Wu, Ph.D.	Ocean Engineering	Fifteen years environmental consulting and research	Numerical modeling of fate of disposal material
<u>Contractor: MBC</u> <u>Applied Environmental Sciences</u>			
Donald B. Cadlen, Ph.D.	Invertebrate Taxonomy and Ecology	Twenty years environmental consulting and research	Director of taxonomy laboratory
John N. Bonfiglio, Ph.D.	Chemistry	Eight years biochemistry and organic chemistry	Director of chemical laboratory analyses
David W. Connally, M.Sc.	Oceanography	Ten years physical oceanography and plankton ecology	Contractor Project Manager and collection of physical oceanographic data

NAME	EXPERTISE	EXPERIENCE	RESPONSIBILITY
Michael L. Sowby, M.A.	Biological Oceanography	Fifteen years toxicology studies and fish and plankton ecology	Fish data collection and laboratory chemical analysis
Robert R. Ware, M.A.	Marine Biology	Twelve years benthic ecology and sediment processes	Contractor Project Manager and inverte- brate taxonomy
R. Craig Wingert, Ph.D.	Fisheries Biology	Fifteen years fish ecology and taxonomy	Director of fish data collection
<u>Contractor: Earth Metrics Incorporated</u>			
C. Michael Hogan, Ph.D.	Physics	Twenty years of experi- ence in water chemistry	Principal in Charge
Gary Deghi, M.S.	Ecology	Eleven years environ- mental analysis and consulting	Project coordinator responsible for project management and ecological analyses
David A. Mullen, Ph.D.	Environmental Biology	Twenty years environ- mental research and consulting	Preparation of Bio- logical and general sections, Project Manager

NAME	EXPERTISE	EXPERIENCE	RESPONSIBILITY
Cindy A. Roessler, B.A.	Biology	Four years coastal zone management	Preparation of Physical Environment and Oceanographic sections
Sepehr Haddad, M.S.	Economic Analysis	Four years economic analysis and consulting	Preparation of Socio-economic sections
Jane Staten, B.S.	Environmental Engineering	Analyses of air quality assessments	Preparation of Air Quality sections

CHAPTER 7. LITERATURE CITED

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**DRAFT
ENVIRONMENTAL IMPACT STATEMENT**

**FINAL DESIGNATION OF A
DREDGED MATERIAL DISPOSAL SITE OFF
LOS ANGELES, CALIFORNIA**

Los Angeles County, California

**APPENDIX A
REPORT OF FIELD SURVEY**

U.S. ENVIRONMENTAL PROTECTION AGENCY



TABLE OF CONTENTS

	<u>Page</u>
APPENDIX A - REPORT OF FIELD SURVEY	
A.1 INTRODUCTION.....	A-1
A.2 METHODS.....	A-1
A.2.1 Field Methods.....	A-1
A.2.2 Laboratory Methods.....	A-7
A.2.3 Quality Control.....	A-12
A.2.4 Statistical Analysis.....	A-17
A.3 RESULTS AND DISCUSSION.....	A-18
A.3.1 Physical Oceanography.....	A-18
A.3.2 Chemistry.....	A-26
A.3.3 Benthic Infauna.....	A-43
A.3.4 Demersal Fish and Epibenthic Macroinvertebrates.....	A-73
A.4 REFERENCES.....	A-88

LIST OF FIGURES

<u>Number</u>		
A-1	Sampling Stations at Disposal and Reference Sites.....	A-2
A-2	Temperature Profiles at LA2 Disposal Site, Station 1.....	A-21
A-3	Dissolved Oxygen Profiles at LA2 Disposal Site, Station 1...	A-24
A-4	Salinity Profiles at Site LA2.....	A-25
A-5	Mean and 95 Percent Confidence Intervals for Trace Sediment Concentration (Dry Wt.) at LA2 Disposal and Reference Sites.....	A-29
A-6	Mean and 95 Percent Confidence Intervals for Tissue Trace Metal Concentrations (Dry Wt.) <u>Sicyonia ingentis</u> , Survey 1 LA2.....	A-34
A-7	Mean and 95 percent Confidence Intervals for Tissue Trace Metal Concentrations (Dry Wt.) <u>Citharichthys sordidus</u> , Survey 2 LA2.....	A-35
A-8	Mean and 95 Percent Confidence Intervals for Tissue Trace Metal Concentrations (Dry Wt.) <u>Lyposetta exilis</u> , Survey 3 LA2.....	A-36

TABLE OF CONTENTS (Continued)

Page

LIST OF FIGURES (Continued)

A-9	Mean and 95 Percent Confidence Intervals for Oil and Grease Sediment Concentration (Dry Wt.) at LA2 Disposal and Reference Sites.....	A-37
A-10	Mean Values and 95 Percent Confidence Intervals for Infaunal Community Indices, Survey 1.....	A-45
A-11	Mean Values and 95 Percent Confidence Intervals at Each Sampling Station for Infaunal Community Indices, Survey 2...	A-46
A-12	Mean Values and 95 Percent Confidence Intervals at Each Sampling Station for Infaunal Community Indices, Survey 3...	A-47
A-13	Mean Value at Each Sampling Station for Infaunal Community Indices, Survey 4.....	A-48
A-14	Mean Number of Individuals per Replicate Sample at Reference- and Disposal-Site Sampling Locations.....	A-59
A-15	Numerical Classification Results. Dendrograms Depict the Similarity in Infaunal Community Structure Among Eight Stations.....	A-60

LIST OF TABLES

A-1	Sampling and Collection Dates, LA 2 Disposal and Reference Sites.....	A-3
A-2	Isobaths (in meters) of Otter Trawl Sampling Stations at the LA 2 Disposal and Reference Sites.....	A-5
A-3	Summary of the Number of Otter Trawl Collections Obtained at Each Station for Each Site.....	A-5
A-4	Depth Variation (M) of Sampling Stations.....	A-14
A-5	Detectability Limits for the Various Heavy Metals and Organic Compounds Analyzed.....	A-16
A-6	Temperature Profiling Data at Site LA 2.....	A-19
A-7	Dissolved Oxygen Profiling Data at Site LA 2.....	A-22
A-8	pH Profiles at Site LA 2.....	A-27

TABLE OF CONTENTS (Continued)

	<u>Page</u>
LIST OF TABLES (Continued)	
A-9 Transmissivity Profile at Site LA 2.....	A-28
A-10 Comparison of the Range and Median of Selected Pesticide and PCB Concentrations in Sediments.....	A-39
A-11 Comparison of the Range of Selected Pesticide and PCB Concentrations in Tissues.....	A-41
A-12 Metals Concentrations at Control Sites in the Southern California Bight.....	A-42
A-13 Number of Taxa Accounting for a Fixed Proportion of the Total Individuals at a Sampling Station.....	A-49
A-14 Results of ANOVA Tests for Differences in the Mean Value of Biological-Community Variables.....	A-51
A-15 One-Way ANOVA Results for Comparison of Mean Values for Species Diversity and Species Richness Among Disposal Site Stations 1, 3, and 5.....	A-52
A-16 One-Way ANOVA Results for Comparison of the Mean Number of Taxa and Number of Individuals Among Disposal Site Stations 1, 3, and 5.....	A-53
A-17 Comparison of the Mean Value for Shannon-Weaver Diversity of Replicate Samples ($0.1/m^2$) at the Reference- and Disposal-Site Sampling Locations.....	A-55
A-18 Comparison of the Mean Number of Taxa per Replicate Sample at the Reference- and Disposal-Site Sampling Locations.....	A-56
A-19 Comparison of the Mean Number of Individuals per Replicate Sample at the Reference- and Disposal-Site Sampling Locations.....	A-57
A-20 Mean Values of Number of Taxa, Number of Individuals and Shannon-Weaver Diversity for Individual Replicate Samples ($0.1/m^2$).....	A-58
A-21 Summary of Sediment Grain-Size Analysis. Survey 1.....	A-62
A-22 Summary of Sediment Grain-Size Analysis. Survey 2.....	A-63
A-23 Summary of Sediment Grain-Size Analysis. Survey 3.....	A-64

TABLE OF CONTENTS (Continued)

	<u>Page</u>
LIST OF TABLES (Continued)	
A-24 Summary of Sediment Grain-Size Analysis. Survey 4.....	A-65
A-25 Grain-Size Analysis - Sediment Weight Distribution by Phi Intervals. Survey 1.....	A-67
A-26 Grain-Size Analysis - Sediment Weight Distribution by Phi Intervals. Survey 2.....	A-68
A-27 Grain-Size Analysis - Sediment Weight Distribution by Phi Intervals. Survey 3.....	A-69
A-28 Grain-Size Analysis - Sediment Weight Distribution by Phi Intervals. Survey 4.....	A-70
A-29 Pearson Product-Moment Correlation Coefficients Between Selected Infaunal Community Indices and Physical-Chemical Variables.....	A-71
A-30 Summary of Fish Caught in Otter Trawls at LA 2 Disposal and Reference Sites.....	A-75
A-31 Summary of Macroinvertebrates in Otter Trawls from LA 2 Disposal and Reference Sites.....	A-81

APPENDIX A - REPORT OF FIELD SURVEY

A.1 INTRODUCTION

A.1.1 A field survey was conducted to collect site-specific biological, sedimentological, physical and chemical data for the LA 2 (Los Angeles) interim dredged material disposal site, and at a nearby reference site between August 1983 and May 1984. The purpose of the survey was to provide data with which to assess the effects of past disposal at the site, and to provide a baseline for comparison with results of future site monitoring to assess the effects of continued use of the site. Field sample collection and laboratory analyses were conducted by MCB Applied Environmental Sciences. Data analysis and interpretation were performed by Tetra Tech, Inc.

A.1.2 The biological aspects of the survey focused on benthic resources - benthic infauna, demersal fishes, and epibenthic macroinvertebrates. Demersal fishes and epibenthic organisms were collected primarily to obtain selected species for tissue chemical analysis, and secondarily to provide a general characterization of the fish and macroinvertebrate communities. To characterize the physical and chemical environment, samples were taken to determine grain size of bottom sediments and suspended particle loads in the water column. In addition, vertical profiles of water temperature, salinity, dissolved oxygen, hydrogen ion concentration (pH), and transmissivity were gathered. Chemical analyses included trace metals; chlorinated hydrocarbons; and petroleum hydrocarbons in sediment, fish and invertebrate tissues, and the water column.

A.2 METHODS

A.2.1. FIELD METHODS. The LA 2 interim disposal site (Figure A-1) is located approximately six miles offshore Los Angeles Harbor. Field surveys were conducted during August and December 1983, February/March and April/May 1984. Dates of sampling for each task were given in Table A-1, and the number and arrangement of stations are presented in Figure A-1. All sampling was performed aboard the R/V Westwind, a 48 ft. vessel equipped with a Raynav 6000 LORAN C navigation system which electronically interfaces with the autopilot and an EPSCO navigational plotter. Sampling gear was deployed and retrieved with a stern-mounted "A" frame.

A.2.1.1 Benthic Infauna

A.2.1.1.1 Infaunal samples were taken at five (5) stations at the disposal site and at three (3) stations at the reference site (Figure A-1). At the disposal site, three stations were located across the bathymetric gradient (one at the center of the site, one 1,000 yards (914 meters) inshore, and one 1,000 yards (914 m) offshore from the center) to characterize changes in the benthic fauna over the depth range encompassed in the site boundaries (1,000 yard (914 m) radius from center). Two additional stations were located at the upcoast and downcoast boundaries of the site, at the same depth as the center stations, to characterize spatial variation within the site at a constant depth. The three stations at the reference site were located across the

KEY:
 ● BENTHIC STATION
 ▲ BENTHIC & PHYSICAL OCEANOGRAPHIC STATION
 ■ BENTHIC, PHYSICAL & CHEMICAL OCEANOGRAPHIC STATION
 — OTTER TRAWL TRACK

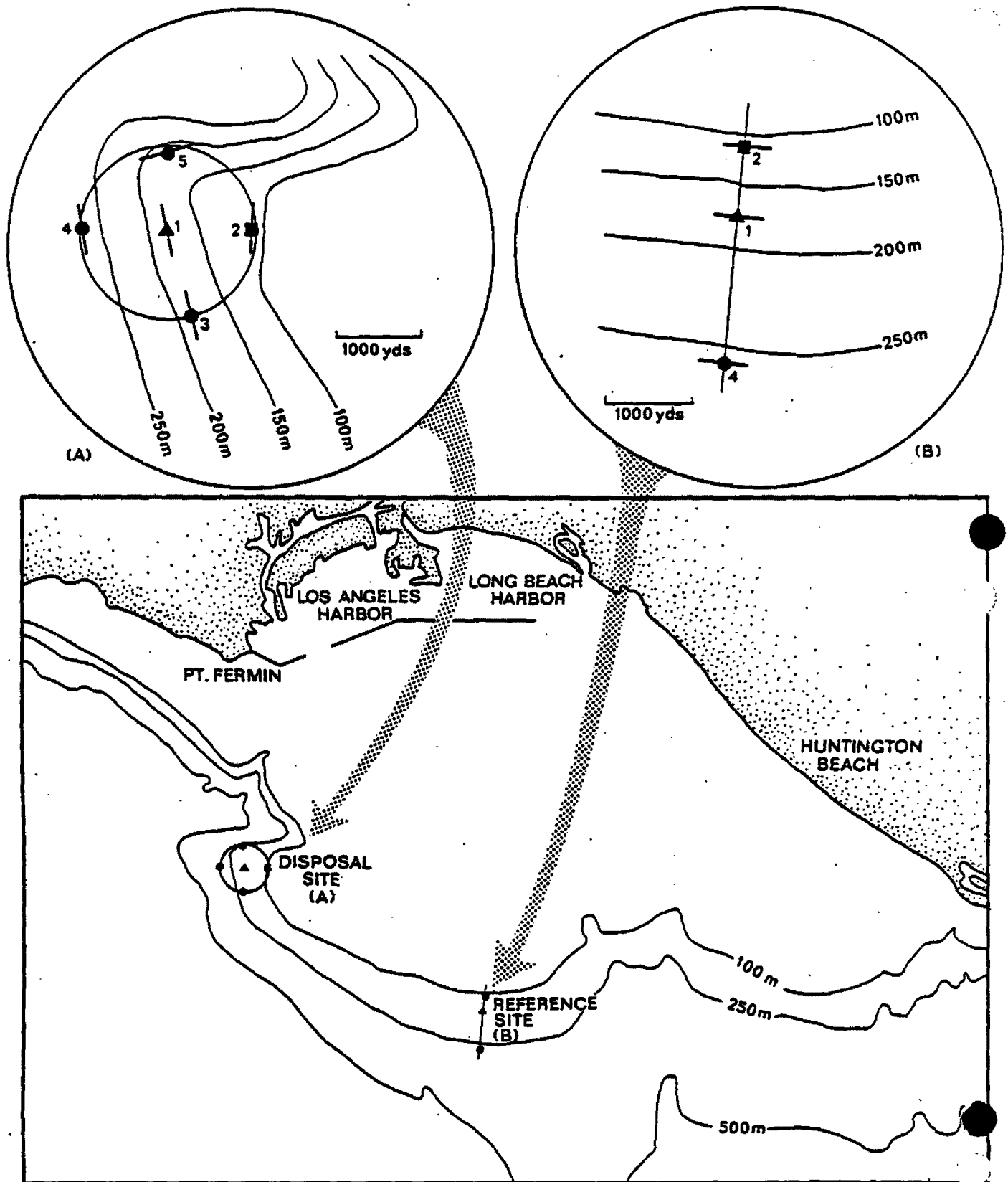


FIGURE A-1 SAMPLING STATIONS AT DISPOSAL AND REFERENCE SITES

TABLE A-1. SAMPLING AND COLLECTION DATES, LA 2 DISPOSAL AND
REFERENCE SITES

Benthic Infauna Sediment, and Sediment Chemistry	Fish and Macro- invertebrates and Tissue Chemistry	Physical Oceanographic and Water Column Chemistry
August Survey		
17-18 August 1983	16, 31 August 1983	30 August 1983
December Survey		
15-16 December 1983	5 December 1983	16 December 1983
March Survey		
7-8 March 1984	5 March 1984	9 March 1984
April Survey		
5, 11 May 1984	9 April 1984	7 May 1984

¹In the August, December, and March surveys grab samples were taken after trawl surveys. Even though every means possible was used to locate the sampling stations, it is highly improbable to exactly land a bottom grab in the same location as the bottom trawl due to the extreme depth of the site and site relocation techniques; therefore, trawling surveys performed prior to grab samples had no effect on grab sample data.

bathymetric gradient at the same depths as the three cross-gradient stations at the disposal site. Four replicate grab samples were taken at each station during each of the four sampling episodes.

A.2.1.1.2 Infaunal samples were collected with a Van Veen grab. The gear used was chain-rigged, as recommended by Word (1976), and sampled a 0.1 m² surface area. To obtain paired biological and sediment samples, grabs were deployed in tandem at opposite ends of a 1 m bar when weather and sea state permitted.

A.2.1.1.3 Collected sediments were screened in running seawater through a sequence of screens (5.0 mm, 1.0 mm, and 0.5 mm) on a high volume, low pressure wash box developed by Dr. A.G. Carey of Orange State University. Retained sediments and organisms were rinsed into shallow plastic pans and anesthetized in 6 percent magnesium chloride solution for 1/2 to 3/4 hour, then bagged, labeled, and fixed in 10 percent seawater formalin solution.

A.2.1.2 Demersal Fishes and Macroinvertebrates/Tissue Collections

A.2.1.2.1 Demersal fishes and epibenthic macroinvertebrates were sampled at the same intervals as infauna at the designated LA 2 interim disposal site and reference site. Samples dates and the location of sampling stations are presented in Table A-1 and Figure A-1 respectively.

A.2.1.2.2 Five (5) stations were established at the disposal site, with three (3) stations at the reference site. Otter trawl stations at the disposal and reference sites were located along isobaths that correspond to the depths of infaunal sampling stations (Table A-2).

A.2.1.2.3 Sampling was conducted using a 7.6 m semi-balloon otter trawl net. All tows were made in the daytime between 0800-1800 hours. Gear deployment, towing scope (i.e., cable to depth ratio) and gear retrieval were rigorously standardized to ensure that all samples were obtained in an identical manner. All tows were made at a vessel speed of 2.0-2.5 knots for a duration of 5 minutes except during the initial survey when 10 minute tows were conducted. These initial 10 minute trawl periods resulted in the loss of five otter trawl nets. Subsequently, the tow time was reduced to 5 minutes to minimize survey interruptions and costs. The purpose and quality of the program were not impacted significantly by the decreased trawl periods because the primary purpose was to collect tissue for chemical analysis; the number of shrimp and fish collected was, however, probably lower than it might have been with 10 minutes tows. (The lack of tissue data reported from some surveys results from discovering procedural errors in chemical analyses and having insufficient tissue remaining for reanalysis.) Towing speeds were monitored by means of a deck readout flowmeter. Towing distances were estimated by determining the distance between the starting and ending point of each trawl track using LORAN C coordinates for these points.

A.2.1.2.3.1 The 7.6 m semi-balloon otter trawl is the standard sized net used in southern Californian benthic fish surveys. Its dimensions are very similar to those used by Moore et al. (1982) to sample fish populations in the Bight between 1977 and 1982. A comparison of net dimensions indicated that similar segments of the demersal fish and epibenthic populations would be collected.

TABLE A-2. ISOBATHS (IN METERS) OF OTTER TRAWL SAMPLING STATIONS AT THE LA2 DISPOSAL AND REFERENCE SITES

Site	Station	Isobath (m)
Disposal	1	198
	2	129
	3	198
	4	312
	5	198
Reference	1	198
	2	129
	4	312

TABLE A-3. SUMMARY OF THE NUMBER OF OTTER TRAWL COLLECTIONS OBTAINED AT EACH STATION FOR EACH SITE

Site	Station	Season				Total
		W1	Sp2	Su3	F4	
LA2 Disposal	1	2	2	2	2	8
	2	2	2	2	2	8
	3	2	2	2	2	8
	4	2	2	2	2	8
	5	2	2	2	2	8
		<u>10</u>	<u>10</u>	<u>10</u>	<u>10</u>	<u>40</u>
LA2 Reference	1	2	2	2	2	8
	2	2	2	2	2	8
	4	2	2	2	2	8
		<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>24</u>
Total		16	16	16	16	64

1 = Winter, 2 = Spring, 3 = Summer, 4 = Fall

A.2.1.2.4 Two replicate samples were obtained at each station during each sampling period, which resulted in the quarterly collection of 16 otter trawl samples. A total of 64 otter trawl collections were obtained over the one year study period. A summary of the number of otter trawl collections obtained at each site and station is presented in Table A-3.

A.2.1.2.5 All otter trawl samples were processed in the field. All collected fishes and macroinvertebrates were identified and enumerated by species. Identification of fishes was based on Miller and Lea (1972). Standard lengths were obtained for 125 individuals per fish species in each replicate sample. Aggregate weights were also obtained for each fish species in each replicate sample. Macroinvertebrates were identified using current taxonomic information. Fish or invertebrates whose field identification was uncertain were returned to the laboratory for further examination. Voucher specimens for all fish and macroinvertebrate species were retained, and preserved for delivery to the Corps of Engineers.

A.2.1.2.6 Target fish and macroinvertebrate species for tissue contaminant analysis were selected on the basis of having sufficient tissue from the desired species and the close association of those species with the dump-site and reference areas. During the August 1983 survey, a sanddab (Citharichthys sordidus), the slender sole (Lyopsetta exilis), and a shrimp (Sicyonia ingentis) satisfied these requirements. The Pacific sanddab (Citharichthys sordidus) and the ridgeback prawn (Sicyonia ingentis) were selected at this time. During subsequent surveys, Citharichthys sordidus was not captured in sufficient quantities for analysis, and the slender sole (Lyopsetta exilis) was substituted for tissue analyses. The slender sole was selected because it shares a common habitat with the Pacific sanddab, and because it was one of the few fish caught in sufficient quantities to perform tissue analyses. Feeding data are not available for the slender sole. Other soles from the area have been shown to have diets similar to that of the sanddab in that they are both benthic feeders preying primarily on polychaetes and crustaceans (Manzanilla and Cross, 1982). The soles' diets differ from that of the sanddab in containing a slightly higher percentage of burrowing and tubicalous forms, and somewhat varying proportions of polychaetes and crustaceans. Overall, the substitution of slender sole for Pacific sanddab is reasonable.

A.2.1.2.7 Tissue Preparation. Flat fish (i.e., slender sole and Pacific sanddab) and shrimp were removed from the otter trawl collections and composited by species. Approximately 50 grams of tissue from each species were obtained when sufficient tissue was available. The composite technique was required, as neither individual flatfish or shrimp provided sufficient tissue to perform all required analyses. The fish were wrapped in labeled, hexane-rinsed, oven-dried aluminum foil and immediately frozen. At dockside, the frozen samples were transferred into insulated 60 liter ice chests with the frozen commercial coolant "Blue Ice" to prevent thawing during transport to the laboratory.

A.2.1.3 Sedimentological and Chemical Collections. Four replicate sediment samples were collected at each of the infaunal stations (Figure A-1). Each replicate was collected independently using a 0.1 m² modified Van Veen sampler. Geological and sediment chemistry samples were taken within the same

sediment grab. A vertical core was taken in the grab centerline for grain size analysis, transferred to a pre-labeled bag, and stored at ambient temperature until return to the laboratory. Samples for both organic and inorganic chemistry analyses were collected through the access panels of the grab and from the upper 5 cm of the middle of the grab sample to reduce disturbance and the possibility of sample contamination. Samples were collected in glass jars and preserved, when necessary, following the procedures outlined in Plumb (1981). Collected samples were placed under refrigeration and returned to the laboratory where they were stored at 4°C until analysis.

A.2.1.4 Physical and Chemical Oceanographic Sampling

A.2.1.4.1 The oceanographic sampling plan was divided into physical oceanographic and chemical oceanographic components. Physical oceanographic sampling included water column profiles of temperature (°C), salinity (o/oo), hydrogen ion concentration (pH), dissolved oxygen (mg/l), and water transmissivity (%). The sampling profile was designed to be sufficient to define the major pycnoclines in the water column and to satisfy requirements of biological and physical modeling analyses. Physical oceanographic measurements were conducted at two stations at each of the sampling sites. Profiles were recorded at the center station at the disposal site as well as the innermost (closest to shore) station. All parameters were recorded on descending and ascending phases of the profile. A Market Mark VI Water Quality Profiler, coupled with a Market Mark VIII XMS Transmissometer with a 0.25 m light path-length was used to collect the data. Physical oceanographic data were recorded onto data sheets in the field. Instruments were calibrated versus factory standards prior to and on return from each sampling cruise.

A.2.1.4.2 Chemical oceanographic collections included suspended solids (mg/l), heavy metals (ppm), total chlorinated hydrocarbons (ppm), polychlorinated biphenyls (ppm), pesticides (ppm), and petroleum hydrocarbons (oil and grease; ppm). Three replicate samples were collected from a depth of 5 m below the surface and 5 m above the bottom at the center of each dumpsite and reference site using an array of Van Dorn water bottles. Collection, storage, and preservation of water samples followed EPA (1979a, b) and Plumb (1981) procedures.

A.2.2 LABORATORY METHODS

A.2.2.1 Benthic Infauna

A.2.2.1.1 After return to the laboratory and within four days of collection, samples were logged in, rinsed with tap water on a 0.5 mm screen to remove residual formalin, and transferred to 70 percent isopropyl alcohol for preservation. Each of the three sample fractions from each replicate was separately sorted under a low-power dissecting microscope to recover organisms from retained sediments and debris. If the replicate was one pre-selected at random for quality control re-sort, sediments and debris from each fraction were saved for examination by the sorting supervisor. Organisms removed from each fraction were separated into categories to facilitate later identification. Specimens from the 5.0 mm and 1.0 mm fractions were combined prior to identification.

A.2.2.1.2 Sorted sample fractions were signed out by systematists and analyzed under dissecting and compound microscopes to identify and count the organisms they contained. Specimens of all phyla other than Protista and Nematoda were identified to lowest possible taxon (usually species) and recorded on laboratory bench sheets. Samples of species which could not be identified with certainty by MBC staff were submitted to outside specialists for identification or confirmation. Species for which no description could be found in existing literature were given provisional names (i.e., Bruzelia sp. B). Specimens of all specific level taxa were removed from the samples, labeled, and placed in a voucher museum to be maintained at the COE Los Angeles District Office.

A.2.2.1.3 Data on the bench sheets was reviewed by the supervising systematist for completeness and accuracy. A backup file copy of each corrected sheet was made and the original forwarded for data analysis.

A.2.2.1.4 Fishes and Macroinvertebrates. Fishes and macroinvertebrate specimens which were not field identifiable were returned to the laboratory for positive identification. Samples of species which would not be identified with certainty by MBC staff were submitted to outside specialists for identification or confirmation. Field data were reviewed by supervising fish and invertebrate systematists for completeness and accuracy, copied, and the original forwarded for data analysis.

A.2.2.1.5 Sedimentology. Sand grain size distributions of each sediment sample were determined using a settling tube very similar to that described by Gibbs (1974). The device used a differential transformer to sense the load exerted by sediment as it settled and accumulated in a pan near the base of the settling column. The strip chart output from the load sensor was converted to a cumulative frequency plot of the sizes of the particles constituting the samples. The results of the modified settling tube are the same as expected from Gibbs (1974) methodology. The silt-clay distribution was determined by hydrometer method based on the settling rates of different sized particles and fluid density (ASTM, 1963). Gravel fraction grain size distribution was determined on standard sieves using a shaker table.

A.2.2.1.6 Grain sizes were reported in phi units ($\phi = \log_2$ diameter in millimeters). The range of phi sizes examined were approximately -5 phi to 15 phi. Grain size data were converted to the cumulative frequency of the occurrence of grain size classes. Statistical parameters (mean grain size, sorting, skewness, and kurtosis) of each grain size distribution were determined using moment measures (Krumbein and Pettijohn, 1938; Sharp and Fan, 1973).

A.2.2.1.7 Sedimentological data were reviewed by the sediment laboratory supervisor and project manager, copied, and sent through data processing and computer analysis. Hard copy and computer tapes were forwarded for data analysis.

A.2.2.2 Sediment Chemistry

A.2.2.2.1 Inorganic Chemistry. Sediment samples were analyzed for arsenic, cadmium, chromium, copper, mercury, lead, and zinc. Metals other than arsenic and mercury were digested using the HNO_3 digestion procedure described by Plumb (1981). Samples were filtered to remove mineral residue and the final volume adjusted to a convenient size which eased handling but did not effect results. The sample was subsequently analyzed on a Varian 875 atomic absorption spectrophotometer.

A.2.2.2.2 Sediment samples for mercury analyses were analyzed using a cold vapor technique. Digestion of the sediment was accomplished using the protocol described by Plumb (1981). The procedure consisted of an initial digestion using concentrated H_2SO_4 and HNO_3 followed by the addition of potassium permanganate and potassium persulfate. Analyses were performed on a Varian 875 atomic absorption spectrophotometer fitted with a mercury vapor generator.

A.2.2.2.3 Arsenic samples were also prepared according to the procedure of Plumb (1981). Weighed sediment samples were fused with potassium pyrosulfate at 320°C for 15 minutes. The cooled sample was dissolved in deionized distilled water and concentrated HCl . Analysis was performed on a Varian 875 atomic absorption spectrophotometer fitted with an arsenic generator.

A.2.2.2.4 Organic Chemistry. Sediment samples were analyzed for petroleum hydrocarbons (grease and oils), total chlorinated hydrocarbons, polychlorinated biphenyls (PCBs), and pesticides (including chlorinated hydrocarbons). Petroleum hydrocarbons were analyzed in sediment samples according to Method 403E in Standard Methods for Examination of Water and Wastewater (APHA, 1980). Weighed samples were extracted with trichlorotrifluoroethane and the extract combined. Extracts were then treated with silica gel to remove biogenic material, filtered into tared flasks and the halogenated solvent removed in vacuo. The residue was determined by weight difference.

A.2.2.2.5 Sediment samples for chlorinated hydrocarbons were analyzed according to the protocol described in Plumb (1981). Weighed sediment samples were extracted for 18 hours in Soxhlet apparatus with acetone/hexane. The resultant extract was reduced to 30 ml in vacuo. The extract was then subjected to Florisil partitioning. Fraction I was eluted from the Florisil column using 6 percent diethyl ether/hexane while fraction II was eluted with 15 percent diethyl ether/hexane. Analysis was performed on a Varian Series 6000 gas chromatograph.

A.2.2.2.6 An interference peak was recorded near the retention time of Arochlor 1242 in all sediment analyses, so that it was not possible to quantify the exact amount of this compound present. All values for Arochlor 1242 were therefore reported as maximum concentrations.

A.2.2.2.6.1 The interference peak was found when running Arochlor 1242 analyses. The interference was caused by a contaminant that was found in extraction thimbles and other apparatus used in the extraction. It was

corrected by running a blank and subtracting it out. Because the interference falls on the largest peak produced by Arochlor 1242, another correction method can be to use a smaller Arochlor 1242 peak; however, this is often more difficult because the smaller peaks overlap with other Arochlors.

A.2.2.3 Tissue Chemistry.

A.2.2.3.1 Tissue Preparation. Upon arrival at the laboratory, tissue samples were logged in and held at a constant -18°C until analysis was begun.

A.2.2.3.2 All dissections were performed in a clean environment on tempered plate glass, measuring 50 x 30 x 0.3 cm, to prevent contamination of the tissue samples. Utensils and working surfaces were initially washed with detergent, rinsed at least three times with tap water and once with distilled water, and rinsed with a 20 percent nitric acid solution, tap water and distilled water prior to each dissection. To minimize possible contamination during muscle tissue dissections, laboratory personnel wore surgical latex gloves when handling samples.

A.2.2.3.3 Standard length measurements for the fish and carapace length measurements for the shrimp were taken to the nearest millimeter prior to dissection of the muscle tissue. Whole body weights to the nearest hundredth of a gram for both the fish and shrimp were also recorded. All specimens were then scrubbed and rinsed in deionized water to remove any sediment particles that may have been attached to the tissue surface.

A.2.2.3.4 Fish dissection was initiated with a cross-cut incision using a stainless steel scalpel with a carbon steel blade. The incision penetrated 1 to 2 mm through the skin beginning at a point approximately in line with the end of the operculum at the base of the dorsal fin and extended posteriorly past the pectoral fin, terminating at the base of the anal fin. For larger fish in the sample, a second incision was made along the vertebral column adjacent to the lateral line. The skin layer was then peeled away from the underlying muscle tissue using stainless steel forceps and the exposed tissue was scraped away using plain glass microscope slides. The procedure was repeated on the underside of the fish and the total tissue amount from each fish was combined and weighed to the nearest hundredth (0.01) of a gram. Between 10 and 20 fish were needed from each station to obtain sufficient tissue for analysis.

A.2.2.3.5 Shrimp (*Sicyonia ingentis*) muscle tissue dissections were initiated by removing the tail section of the thorax. The surrounding carapace was peeled away from the muscle tissue, and the digestive gut was removed by making an incision along the dorsal surface with a glass microscope slide. The gut and its contents were washed away with deionized water. Prepared tissue was weighed to the nearest hundredth of a gram. The procedure was repeated with sufficient shrimp to form a composite sample of approximately 50 grams per station.

A.2.2.3.6 After the fish and shrimp tissues were composited, each sample was divided into approximately two equal parts. One-half was placed in labeled plastic "Whirl-pak" bags for heavy metal analysis, while the other half was

wrapped in hexane-rinsed, oven-dried aluminum foil for hydrocarbon analysis. both samples were then immediately frozen for later chemical analyses.

A.2.2.3.7 Inorganic Chemistry. Tissue samples for trace metal analyses (arsenic, cadmium, copper, chromium, mercury, lead, zinc) were homogenized, weighed, and subjected to digestion procedures outlined for sediments. Samples for all analyses but arsenic were subjected to nitric acid digestion. Samples for mercury analyses were subjected to further digestion using the potassium permanganate/hydroxylamine-sulfate procedure, while samples for arsenic analysis were fused with potassium pyrosulfate and then dissolved in deionized distilled water and concentrated HCl. Analyses were performed on a Varian 875 atomic absorption spectrophotometer following the procedures outlined for sediments. In cases where sufficient tissue for separate digestion and analysis for arsenic, mercury, and the remaining heavy metals were not available, the priority for analysis was: (1) the suite of metals Cd, Cu, Cr, Pb, and Zn; (2) Hg; and (3) As.

A.2.2.3.8 Organic Chemistry. Tissue samples for petroleum hydrocarbons were analyzed according to the method of Warner (1976). The sample was first homogenized, weighed, and subjected to a sodium-hydroxide digestion to saponify any biogenic lipids. The sample was subsequently extracted with ether several times. The ether layers were combined, dried with magnesium sulfate, and concentrated to 1.0 ml. The concentrated ether extract was then subjected to column chromatography using silica gel as described in the procedure. The fractions were then concentrated to 1 ml, charged with an internal standard (nonane), and analyzed on a Varian 6000 gas chromatograph.

A.2.2.3.9 Tissue samples were analyzed for total chlorinated hydrocarbons (including pesticides and PCBs) according to the methods described by the EPA (1980). The micro-method consisted of homogenizing a 0.5 g sample of tissue and extracting with acetonitrile several times. The acetonitrile extracts were combined, diluted with water and extracted with hexane (3 x 50 ml). The hexane extracts were combined, dried, and concentrated to a final volume of 2 ml. The concentrated extract was further purified by elution through a small Florisil column with 1 percent methanol in hexane. Two fractions were collected, concentrated to 1 ml and injected onto the gas chromatography unit for analysis.

A.2.2.4 Physical and Chemical Oceanographic Analysis

A.2.2.4.1 Physical oceanographic parameters (dissolved oxygen, pH, temperature, salinity, and transmissivity) were recorded onto computer coding sheets in the field. Chemical oceanographic water samples were analyzed for total suspended solids, heavy metals, chlorinated hydrocarbons, total chlorinated hydrocarbons, PCBs, and petroleum hydrocarbons (grease and oils).

A.2.2.4.2 Total suspended solids in the seawater were determined using Method 290C in Standard Methods for Examination of Water and Wastewater (APHA, 1980). One liter of seawater was filtered through a standard glass-fiber filter. The retaining material and the filter were dried at 103° to 105°C. The weight of the suspended material was then determined and expressed as mg/l.

A.2.2.4.3 Analyses of seawater for heavy metals were performed following the methods described in Plumb (1981). For all metals except mercury and arsenic, a chelation-extraction procedure was performed on 100 ml of water samples. The extract was then analyzed on a Varian 875 instrument.

A.2.2.4.4 Arsenic levels in the seawater samples were determined using the arsine generation method. Samples were treated with concentrated nitric acid and the resultant solution analyzed on a Varian 875 instrument fitted with an arsine generator.

A.2.2.4.5 Chlorinated hydrocarbons in seawater samples were extracted using the methylene chloride/hexane (MC/hexane) procedures outlined in Plumb (1981). One liter of seawater was extracted using MC/hexane. The extract was concentrated and subjected to partitioning using a Florisil column. Fraction I was eluted with 6 percent ether in petroleum ether. Fraction II was eluted with 15 percent diethylether in petroleum ether.

A.2.2.4.6 Petroleum hydrocarbon (grease and oil) levels in seawater were determined following Method 503A of Methods for Examination of Water and Wastewater (APHA, 1980). Oil and grease were extracted from 1 liter water samples using trichlorotrifluoroethane. The weight of the grease and oil was then determined and the results reported in ppm (mg/l).

A.2.3 QUALITY CONTROL

A.2.3.1 Benthic Infauna

A.2.3.1.1 Quality control procedures start with appropriate design and execution of field sampling, including appropriate station location and relocation.

A.2.3.1.2 Rationale for location of reference site was selection of a site as far as possible from the disposal site in a direction opposite the general net bottom current flow. This flow was expected to be northwesterly (Hendricks, 1983a), thus reference site was selected to the southeast of the disposal site (Figure A-1). In the Los Angeles area southeast of LA 2 a number of other inputs which introduce particulate matter and/or anthropogenic contaminants are present. Care was taken in siting the reference area to minimize the potential effect of other extraneous inputs. The site chosen as a reference for the LA 2 site included supported a biota which was reportedly similar to that expected from the site (Hartman, 1955) and was as far to the southeast of LA 2 along the appropriate depth contours as possible without entering the influence of the Orange County Sanitation District wastefield (Hendricks, 1983b).

A.2.3.1.3 The accuracy of station location with the LORAN C system in use on the sampling vessel is estimated at ± 150 ft. or better. Repeatability (station relocation) is estimated at a minimum of ± 50 ft. In practice, accuracy and repeatability of station location were increased by application of a maximum acceptable depth variation of ± 3 m about the station mean depth. This was attainable at most stations, but not at the deepest station at the LA 2 disposal site. The bottom at this station consisted of a steep

shale slope with pockets and ledges containing accumulated soft sediments. A wider depth variation was allowed there because of the patchiness of appropriate bottom type and the inability of the grab to bite on a shale substrate. Data on sample depth variability were provided in Table A-4. Loran C coordinates were established during the initial August survey. During subsequent surveys, the position of the sampling station was reestablished according to the known coordinates. Tidal variation was accounted for in the selection of each station during each survey, given the tidal condition at the time of sampling.

A.2.3.1.4 Criteria for acceptance of a grab sample as adequate were: (1) penetration depth of at least 6 cm at the shallowest part of the sample; and (2) lack of evidence of "washing" or selective removal of fine materials from the grab during retrieval. Although samples of 6 cm penetration were taken and used, they are only kept where grab success was low and greater penetration could not be achieved without excessive effort. Average penetration depth was 11.3 ± 2.5 cm. Penetration depth measurements were made from the grab top to the sediment surface using a pre-calibrated rule prepared to read distance to grab bottom. Readings were taken along the grab midline from near the grab center prior to removal of the sample from the grab.

A.2.3.1.5 Acceptance or rejection of grab samples was performed by the deck supervisor for each watch. Data relating to each gear drop were recorded on a benthic grab collection record. Acquisition of other samples for sediment chemistry, organic carbon, and grain size was also supervised and verified by the deck watch supervisor.

A.2.3.1.6 All samples were checked in when they arrived at the laboratory immediately following field surveys. All samples were inventoried for damage or abnormalities, and checked for proper fixation and storage. A pre-selection random 15 percent of the sorted sample residue were examined by a sorting supervisor for animals passed over during sorting, and a running efficiency percentage for each sorter maintained. Sorters having efficiencies of less than 95 percent were replaced. Any additional specimens recovered during re-sort were combined with those from the first sort prior to identification. All identifications were double-checked by the supervising systematist. Questionable or uncertain identifications were confirmed or corrected by the following outside specialists: M. Bergan - Holothuroidea, J. Ljubenkov - Cnidaria, B. Myers - Ostracoda, P. Scott - Bivalvia, J. Shrake - Aplacophora, B. Thompson - Echuira and Sipuncula, S. Williams - Polychaeta.

A.2.3.1.7 The supervising systematist checked the identifications for consistency and spelling. Voucher type specimens of undescribed species were prepared for reference to ensure consistency throughout the entire program.

A.2.3.2 Fishes. Quality control of the deployment and retrieval phase of each otter trawl sample was the responsibility of the field team leader. He verified proper otter trawl deployment at the beginning of each tow. The retrieval phase was also closely scrutinized by the field team leader to determine if any twists in the otter boards had occurred during the descent.

TABLE A-4. DEPTH VARIATION (M) OF SAMPLING STATIONS*

Station	Sampling Month				
	Aug	Dec	Feb/Mar	Apr/May	<u>±</u>
Disposal					
1	195-204	192-210	196-200	198-200	199+4.2 m
2	129-134	127-130	124-131	127-131	129+2.1 m
3	197-199	198-206	196-197	195-197	198+3.0 m
4	307-315	298-313	307-315	307-313	308+5.2 m
5	197-201	193-201	196-200	198-200	199+2.2 m
Reference					
1	195-197	197-198	196-197	195-197	197+.98 m
2	130-133	127-129	125-130	126-131	129+2.2 m
4	303-307	304-308	307-312	307-309	307+2.5 m

* Unadjusted for tidal variations.

If incorrectly deployed, the sample was discarded and the station resampled. Presence of net tears or large debris which reduced the efficiency of the trawl also resulted in station resampling.

A.2.3.3 Chemistry

A.2.3.3.1 All collection and handling procedures were performed in the field in accordance with Army Corps/EPA recommended procedures (Plumb, 1981; EPA 1979a, b; 1980). Collected samples were stored in the appropriate containers and marked with an identification number. These numbers were recorded on field collection sheets and returned to the laboratory with the samples. During the initial storage and transport to the laboratory, water and sediment samples were stored at approximately 4°C and tissue samples were frozen.

A.2.3.3.2 Upon receipt at the laboratory, all samples were separated by type and catalogued against an enclosed packing list and the field data sheets. Containers were inspected for integrity and numbers or labels for clarity and any deviations noted. A systematic custodianship of samples was undertaken to ensure the samples were not lost or misplaced. Samples were then stored in accordance with Army Corps/EPA procedures (EPA, 1979, b; 1980) until analysis.

A.2.3.3.3 A checkout-from-storage procedure was instituted to track all samples during the various inhouse analysis procedures or when samples were shipped to outside contractors. Inhouse analysts signed for all samples on removal from storage and noted all procedures used for individual samples during that analysis. Samples delivered to outside contractors were signed for on an individual basis.

A.2.3.3.4 Sample preparation for each analysis was performed following the methods outlined in Plumb (1981), EPA (1979a, b; 1980) or Standard Methods for the Examination of Water and Wastewater (APHA, 1980). All sample preparation was conducted with clean glassware that was: (1) washed in Alkonox and rinsed in distilled water; (2) rinsed with methanol and then acetone before storage at 100°C overnight; (3) capped with kiln-fired and solvent-rinsed aluminum foil during storage; and, (4) rinsed with additional solvent immediately before use. The highest grade solvents were used in sample preparation to reduce the possibility of contamination. The precision of sample preparation procedures was checked by analyzing spiked samples and sample preparation blanks. All sample containers were properly marked with an identification number during all preparation procedures to ensure that sample contamination or loss did not occur.

A.2.3.3.5 All analyses were performed following accepted methods outlined in the publications previously cited. Detection limits for each analysis are presented in Table A-5. All analyses were performed within the prescribed time limits. Randomly selected samples were sent to an outside laboratory for inter-laboratory comparison of results.

A.2.3.3.6 The reliability and precision of all instrumentation was checked daily. Both analytical blanks and standards were analyzed with actual samples under normal operating conditions. The results of all analyses were recorded in a project log and maintained in a fireproof file.

TABLE A-5. DETECTABILITY LIMITS FOR THE VARIOUS HEAVY METALS AND ORGANIC COMPOUNDS ANALYZED

Metals	Detectability Limits (ppm)	Organics	Detectability Limits (ppm)
Arsenic	0.002	O'P-DDE	0.001
Cadium	0.002	O'P-DDE	0.002
Chromium	0.02	O'P-DDD	0.001
Copper	0.01	O'P-DDD	0.002
Lead	0.05	O'P-DDT	0.001
Mercury	0.0002	P'P-DDT	0.002
Zinc	0.005	PCB 1242	0.007
		PCB 1254	0.013
		PCB 1260	0.034
		A-BCH	0.001
		Lindane	0.001
		B-BHC	0.001
		Heptachlor	0.001
		Epoxide	0.001
		Petroleum Hydrocarbons*	0.1

* Oil and grease.

A.2.3.3.7 All stock standards were prepared on a bi-yearly basis using the highest grade solvents, metals, and organics. Standards for chlorinated hydrocarbon analysis were permanently sealed. All standards were stored under refrigeration and protected from ultraviolet light.

A.2.3.3.8 Data developed from the various analyses were examined by both inhouse personnel and outside consultants. Any data point or group of data points that were questionable were re-analyzed to ensure their accuracy.

A.2.4 STATISTICAL ANALYSIS

A.2.4.1 Study Design The sampling stations at LA 2 are shown in Figure A-1. Five sampling locations were selected from within the disposal site. Three stations were located on the bathymetric centerline of the site and a single station was positioned on both the inshore and offshore nominal edges of the site. This configuration forms a cross pattern with a station located in the center of the site and transect of three stations both longshore and across the bathymetric gradient. Three stations were selected within the reference site. These were located across the bathymetric gradient at the same depth as the stations within the disposal site. This sampling layout provided reference stations for comparison of physical-chemical and biological variables at three depths within the disposal site. The three stations located along the same isobath within the disposal site provided data for making similar comparisons within the disposal area.

A.2.4.2 Statistical Analysis. Statistical comparisons of sediment chemistry and biological variables were conducted with the data from individual surveys. The analysis of variance (ANOVA) was used to test for statistical significance of observed differences in selected variables both between sites and within the disposal site. Three ANOVA models were used. First, the fixed-effects one-way ANOVA was used to make comparisons among stations from both the reference and disposal sites. Second, the one-way design was used to test for differences in selected variables at the three longshore stations (station 1, 3, and 5) within the disposal site. Third, a two-way ANOVA was used to test simultaneously for differences due to depth and for differences between the reference and disposal sites.

A.2.4.2.1 The underlying assumptions of the ANOVA can be stated as follows:

1. The measures of the dependent variable at each station are normally distributed;
2. The distribution of these measures in each treatment population has the same variance (i.e., variances are homogeneous), and
3. The errors associated with all measurements are statistically independent (i.e., no spatial or temporal correlation among samples).

However, simulation studies have shown that the effects of moderate heterogeneity and deviations from normality have a minimal effect on Type I error probabilities (Glass *et al.*, 1972; Grieb, 1984). For all analysis presented in this report tests for homogeneity of variance were conducted. In

those data sets which violated the assumption of homogeneity of variance, transformations were applied to reduce the degree of heterogeneity. All statistical comparisons were made with data collected during a single survey, and based on the sampling procedures spatial correlation was assumed to be minimal.

A2.4.2.2 In all one-way analyses in which a significant test result was obtained, an a posteriori multiple-range test was performed to identify where differences were located among group means. The Statistical Package for the Social Sciences (SPSS; Nie et al., 1975) was used for all ANOVA tests.

A.2.4.2.3 Numerical classification methods (Clifford and Stephenson, 1975) were used in the analysis of the benthic infauna data (Section A.3.3). Numerical classification encompasses a wide variety of techniques that can be used to distinguish groups of entities (e.g., sample sites) according to similarity of attributes (e.g., species). Using these techniques, the similarity of group commonly used similarity coefficients such as Jaccard, Bray-Curtis, Canberra metric, and Euclidean distance. Classification begins with the compilation of matrix of similarity coefficients (index scores) between all possible pairs of entities. One of a variety of available clustering methods is then used to form associations among entities and to graphically display groups of entities with similar attributes.

A.2.4.2.4 For all numerical classification analyses presented in this report the Bray-Curtis Dissimilarity Index (Boesch, 1977) was used to develop the initial matrix of similarity, and the unweighted pair-group method using arithmetic averages (Sneath and Skoal, 1973) was used as the clustering strategy. The numerical classification analysis were conducted using a computer program developed by Tetra Tech, Inc. Many of the programs in this package are modified versions of those presented by Andenberg (1972).

A.3 RESULTS AND DISCUSSION

A.3.1 PHYSICAL OCEANOGRAPHY. This section describes the results of the vertical profiles taken at each station measuring temperature, dissolved oxygen, conductivity (salinity), pH, and transparency (transmissivity). All water profile data are compiled in Table B-1 in Appendix B.

A.3.1.1 Temperature. Historical data sources indicated that the sea surface temperature in the Southern California Bight normally ranges from 12.5°C to 19.5°C (Maloney and Chan, 1974) with extreme ranges from 11°C to 23°C (BLM, 1978). These extreme temperatures are normally attributable to the local climate (SCCWRP, 1973). Maximum sea surface temperatures are experienced during the summer and fall (August - September) with minimum temperatures during the winter (December to February). Data collected during this survey agree well with these historical sources.

Table A-6 presents the profiling data for the surface, 100 meters, and bottom at each station for the four surveys. Maximum sea surface temperatures were recorded during Survey 1 (August 1983) and ranged from 19.9°C to 21.5°C. Minimum surface temperatures occurred during Survey 2 (December) and ranged

TABLE A-6. TEMPERATURE PROFILING DATA AT SITE LA2
Dashes indicate no data.

	Disposal		Reference	
	<u>Station 1</u>	<u>Station 2</u>	<u>Station 1</u>	<u>Station 2</u>
Survey 1 (Aug)				
Surface	21.5°C	21.2°C	20.9°C	19.9°C
100 m	12.0	11.8	11.5	--
Bottom	10.1	11.0	10.4	--
Survey 2 (Dec)				
Surface	14.6	13.8	14.8	14.7
100 m	9.8	10.0	10.2	10.3
Bottom	7.6	9.7	7.9	10.1
Survey 3 (Mar)				
Surface	15.6	15.5	15.6	16.1
100 m	11.3	11.0	11.1	10.7
Bottom	9.0	10.0	8.9	10.4
Survey 4 (May)				
Surface	16.5	17.1	16.9	17.1
100 m	9.8	9.8	9.7	9.8
Bottom	8.4	9.0	8.5	9.6

from 13.8°C to 14.8°C. The yearly range in surface temperatures was between 5.2°C and 7.5°C, depending on the station, which compares favorably with that expected normally.

The temperatures at 100 m showed a much smaller range, as expected (BLM, 1978), with temperatures from 9.7°C to 12.0°C. Maximum temperatures were again found in August (Survey 1) but, apart from Disposal Site, Station 1, minimum temperatures at 100 m were found during Survey 4 (May 1984). Bottom temperatures showed a wider range between stations due to the differences in depth of each station. Yearly fluctuations at each station compared with those experienced at the 100 m depth (2-3°C). Maximum bottom temperatures were experienced during Survey 1 (August) while minimum temperatures were found during Survey 2 at the deeper stations (Disposal and Reference Stations 1) and during survey 4 at the shallower stations. These data indicate that the fluctuations in temperature at depths in excess of 100 m are controlled to a greater extent by water mass movements and seasonal currents than by the climatic heating and cooling which control temperatures in the upper 100 m (Chan, 1974).

Figure A-2 shows the temperature profiles for each survey collected at the Disposal Site, Station 1. These profiles are typical of those collected at all stations for both sites. The seasonal thermocline between 10 and 50 meters created by summertime heating of the surface layer (Allan Hancock Foundation, 1965) is well developed during Survey 1. Surveys 2 and 3 show the absence of any thermocline with steady decrease in temperature from surface to bottom. Survey 4 (May 1984) taken at the beginning of the warm season, shows the initial stages of development of the seasonal thermocline.

No significant differences between the disposal or reference sites or between stations at each site in either temperatures, temperature ranges, or seasonal fluctuations were noted.

A.3.1.2 Dissolved Oxygen. The Allan Hancock Foundation (1965) found that dissolved oxygen levels in the California Bight are dependent on temperature, salinity, and biological processes such as respiration, photosynthesis, and oxidation. Dissolved oxygen values are normally near or at saturation levels at the surface with generally declining values with depth.

Table A-7 shows the dissolved oxygen levels at the surface, 100 m, and bottom for the four surveys in this study. Surface values ranged from 7.5 ppm to 13.2 ppm. Values to 100 m depths showed the concentration decline mentioned above with values ranging from 4.3 ppm to 9.2 ppm. At the bottom values showed a wider range (2.9 to 8.9 ppm) due to the variance in water depth at each station, but continued to show declining concentration with depth. Excluding Survey 2 (December 1983) the ranges become even smaller with surface values from 7.5 to 9.9 ppm, 100 m values of 4.3 ppm to 6.6 ppm, and bottom values of 2.9 to 5.7 ppm. Although no consistent differences were found between sites or between stations at each site, Survey 2 did record significantly higher values than the other three surveys.

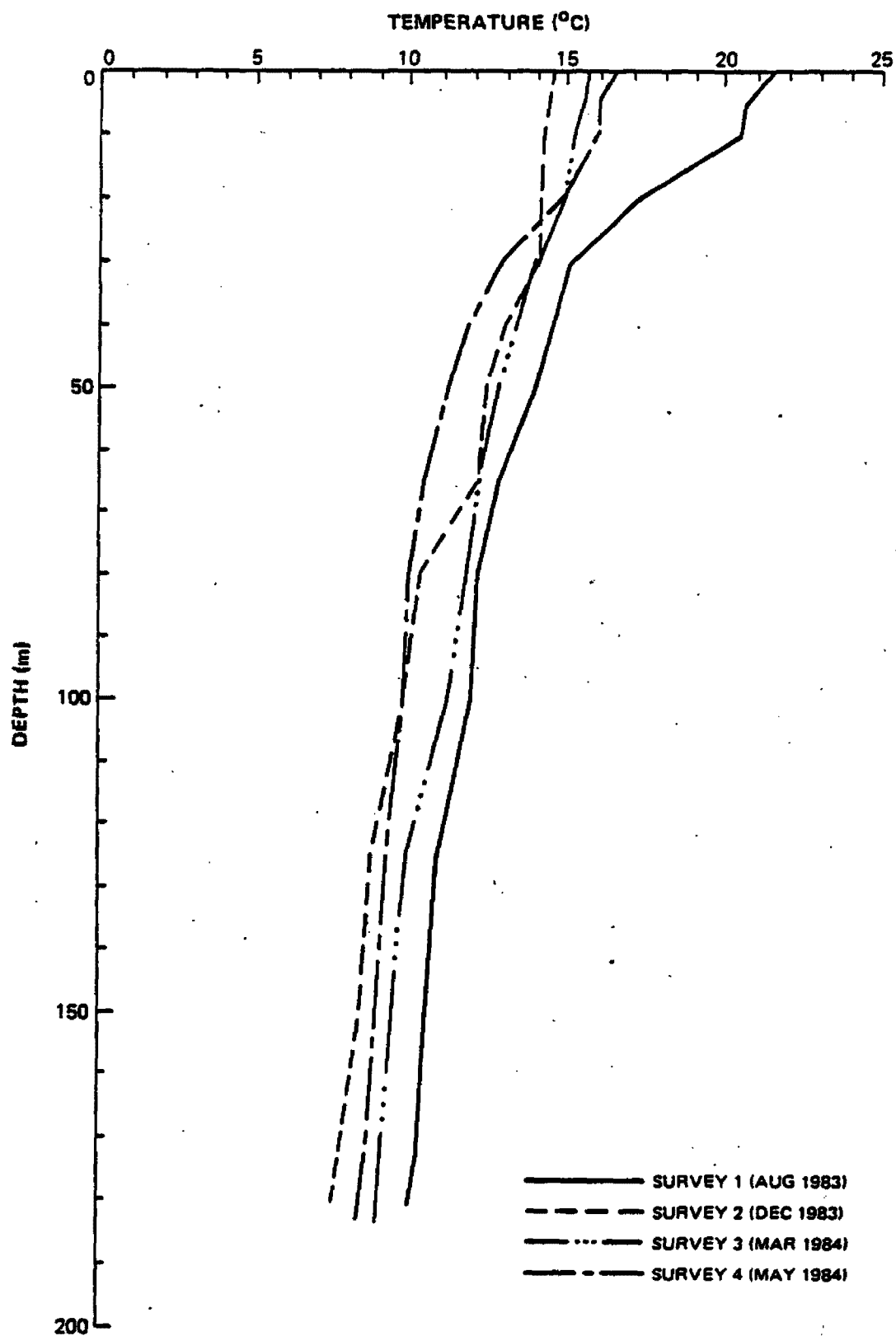


FIGURE A-2 TEMPERATURE PROFILES AT LA2 DISPOSAL SITE, STATION 1.

TABLE A-7. DISSOLVED OXYGEN PROFILING DATA AT SITE LA2
Dashes indicate no data.

	Disposal		Reference	
	<u>Station 1</u>	<u>Station 2</u>	<u>Station 1</u>	<u>Station 2</u>
Survey 1 (Aug)				
Surface	8.3	8.8	7.5	7.8
100 m	6.6	6.5	5.9	-
Bottom	4.4	5.7	4.4	-
Survey 2 (Dec)				
Surface	12.3	12.6	13.2	13.2
100 m	8.5	8.6	9.1	9.2
Bottom	7.8	8.3	5.7	8.9
Survey 3 (Mar)				
Surface	8.2	8.3	9.9	9.1
100 m	5.7	6.1	5.8	5.3
Bottom	4.1	5.3	4.1	4.9
Survey 4 (May)				
Surface	8.8	9.0	9.2	8.3
100 m	4.3	4.4	4.8	4.6
Bottom	2.9	3.5	3.5	4.4

Figure A-3 shows the dissolved oxygen profiles at the LA2 Disposal Site, Station 1, for each of the four surveys. Once again, the decline of concentration with depth can be noted, as can a subsurface maximum between 10 m and 50 m for Surveys 1 (August 1983) and 4 (May 1984). Reid (1962) found that this subsurface maximum developed in the late spring and continued through the fall. He concluded that this maximum was tied to the seasonal variation in temperature in the upper layers and was found when the seasonal thermocline was present. This seasonal subsurface maximum is a phenomenon found throughout much of the Pacific Ocean and is thought to be associated with entrapment of oxygen by the seasonal thermocline and not with increased photosynthetic activity.

As with the temperature data, no significant differences in dissolved oxygen concentrations were found between sites or between stations at each site. Values recorded fell within those described by historical sources. (Maloney and Chan, 1974; Chan, 1974; AHF, 1965.)

A.3.1.3 Salinity. Salinity measurements were taken through the use of a conductivity probe which measures the electrical resistivity of the water. Salinity values were then calculated from the conductivity and temperature values using a standard conversion algorithm.

Salinity values in the Southern California Bight normally range from approximately $32.9^{\circ}/\text{oo}$ to $34.5^{\circ}/\text{oo}$ (AHF, 1965). Seasonal salinity variations are generally small with highest salinities recorded during the summer and fall. This has been attributed to the increased precipitation during the winter and the greater evaporation during the summer.

Figure A-4 presents representative salinity profiles for the LA 2 Disposal and Reference Sites. Additional salinity data were presented in Table B-1 in Appendix B. Wider range in salinity was recorded during these four surveys than has been historically reported. In particular, salinities calculated for Surveys 2 and 4 are unexpectedly low, raising some question about the reliability of these values. Questionable data have not been presented in the profile plots but all but the most questionable data have been included in Table B-1. Coastal waters are generally susceptible to salinity fluctuations in the surface layer caused by excessive runoff, and the particularly wet November and December experienced during 1983 may explain the decreased salinity values experienced during Survey 2. However, this effect cannot explain the Survey 4 results, and moreover is not normally seen below the upper 10-20 m. Very small errors in calibrating or reading the conductivity sensor can lead to calculated salinity fluctuations of 1-2 ppt and is a more likely explanation for the decreased salinities experienced throughout the water column on some surveys.

Figure A-4 shows a slight salinity increase with depth and is due to the mixing of more saline bottom waters with the surface water (Maloney and Chan, 1974).

No significant salinity differences were noted between sites or between stations at each site.

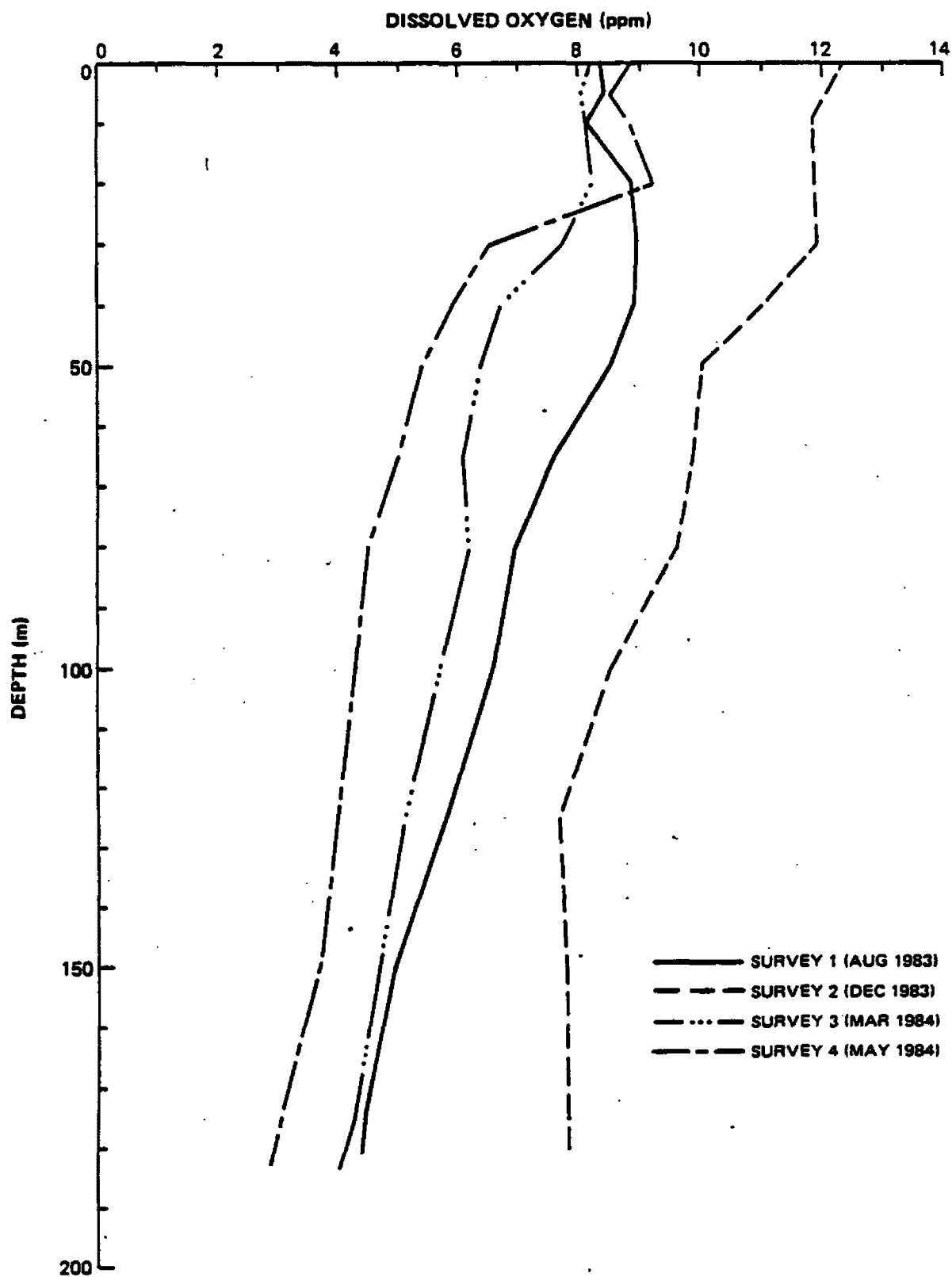


FIGURE A-3 DISSOLVED OXYGEN PROFILES AT LA2 DISPOSAL SITE, STATION 1.

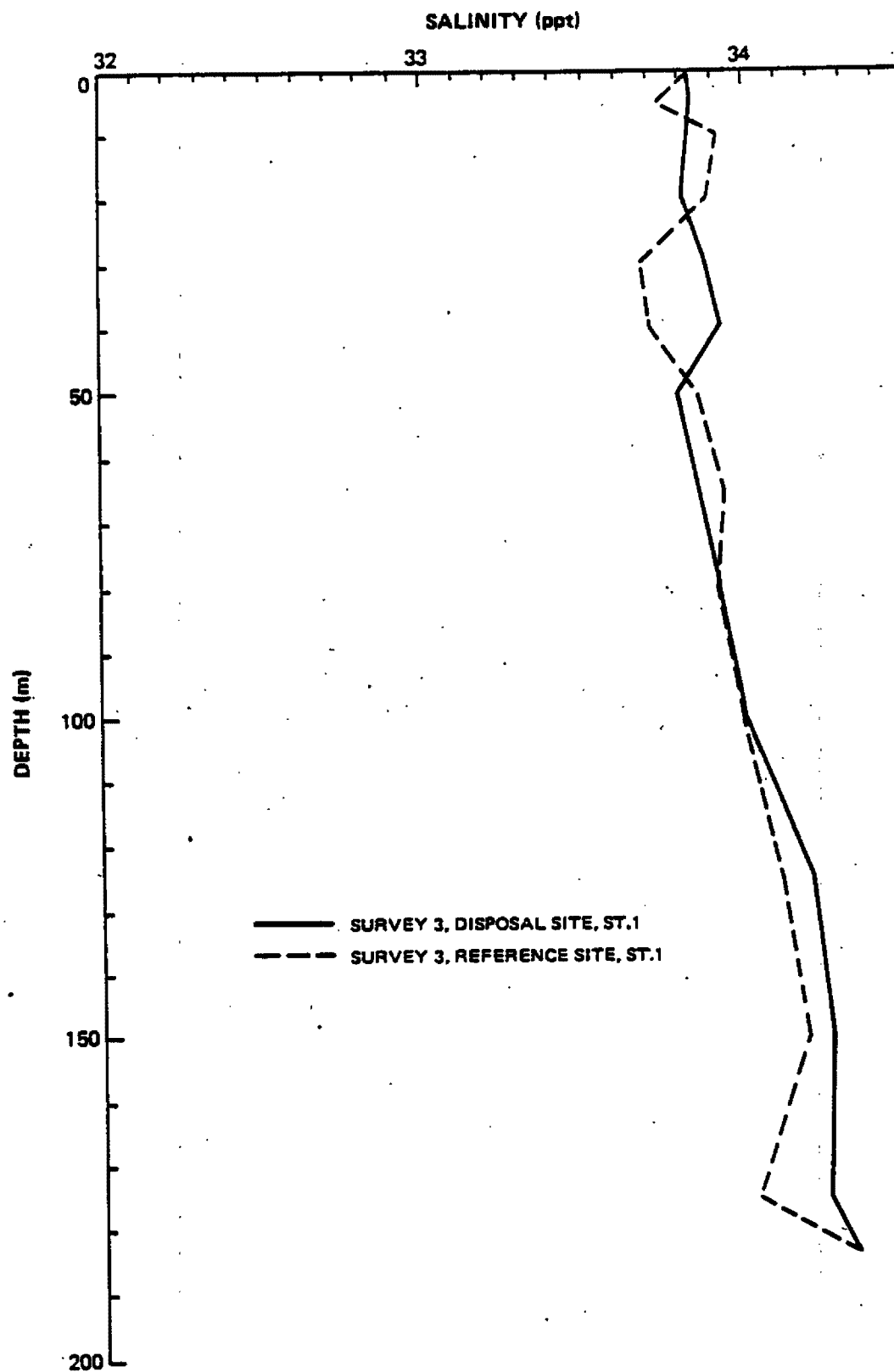


FIGURE A-4 SALINITY PROFILES AT SITE LA2

A.3.1.4 Hydrogen Ion Concentration (pH). All values of pH at site LA2 fell within the range of 7.0 to 8.6. This compares favorably with the range of 7.5 to 8.6 described by the Allan Hancock Foundation report (1965). A slight decrease in pH with depth was also noted.

Table A-8 shows the pH profile data at the Disposal and Reference Sites, for each survey. These data show the pH decrease with depth and the lack of significant pH differences between sites or stations at each site.

Because the ocean is a buffered solution, a very narrow range of pH is to be expected. Large transient shifts in pH are usually associated with regions with sewage outfalls or with transient events such as ocean disposal.

A.3.1.5 Transparency. Transparency measurements were made using a standard transmissometer. Percent transmissivity was recorded and values for the surface, 100 m, and bottom were presented in Table A-9. Values averaged 96.4 percent and showed little variation with depth. No significant differences between the disposal or reference sites or between stations at each site were noted.

A.3.2 CHEMISTRY. Results from the analyses of sediments, tissues, and the water column are tabulated at the end of this section (Table B-2). These analyses include metals, oil and grease, pesticides, and PCBs from the LA2 disposal and reference sites. Detection limits are included for each parameter analyzed. Statistical analyses were conducted on at least one survey from each site, for each parameter, to test significance of the results when obvious trends existed. Analyses were performed as needed on selected surveys when no trends were obvious to facilitate interpretation. Three types of ANOVA were conducted on the chemistry data:

1. One-way ANOVA with all stations from a selected site included.
2. One-way ANOVA with only stations 1, 3, and 5 from the disposal site.
3. Two-way ANOVA with stations 1, 2, and 4 from both the disposal site and the reference site. The two factors are station and type (reference or disposal).

Multiple Range Tests were conducted for those one-way analyses with significant ($\alpha=0.05$) test results. A test for homogeneity of variance was run for each analysis. The purpose of these tests is described in the data analysis section (A.2.4). Interpretation of these results is presented below.

A.3.2.1 Metals

A.3.2.1.1 Sediments. Sediment acid-extractable metals concentrations for all four surveys are compared in Figure A-5 for the disposal and reference sites. Inspection of Figure A-5 indicates that, for each metal, levels at the disposal stations are higher than those at the reference stations. Significant ANOVA results ($\alpha=0.05$) for the heterogeneity among stations and between the disposal and reference sites support this conclusion. The increase in the variance among replicates at disposal site stations over the

TABLE A-8. pH PROFILES AT SITE LA2
 Dashes indicate no data due to equipment malfunction
 realized after return from study sites.

	Disposal		Reference	
	<u>Station 1</u>	<u>Station 2</u>	<u>Station 1</u>	<u>Station 2</u>
Survey 1 (Aug)				
Surface	8.2	8.3	8.2	8.2
100 m	8.1	8.0	8.2	-
Bottom	8.1	8.0	8.2	-
Survey 2 (Dec)				
Surface	8.1	8.3	8.3	8.3
100 m	8.0	7.5	7.9	7.7
Bottom	7.8	7.3	7.4	7.4
Survey 3 (Mar)				
Surface	8.5	8.5	8.5	8.5
100 m	8.2	8.2	7.2	7.0
Bottom	7.6	7.8	-	7.0
Survey 4 (May)				
Surface	7.8	7.8	8.1	8.4
100 m	-	-	7.6	-
Bottom	-	-	7.5	-

TABLE A-9. TRANSMISSIVITY PROFILE AT SITE LA2

	Disposal		Reference	
	<u>Station 1</u>	<u>Station 2</u>	<u>Station 1</u>	<u>Station 2</u>
Survey 1 (Aug)				
Surface	8.9%	94.8%	85.4%	97.3%
100 m	94.7	96.9	94.0	-
Bottom	99.2	98.5	99.9	94.8
Survey 3 (Mar)				
Surface	98.3	100.0	99.4	96.1
100 m	97.7	97.3	97.4	97.8
Bottom	100.0	98.6	99.4	97.9
Survey 4 (May)				
Surface	98.2	100.0	97.5	96.2
100 m	96.4	92.6	96.4	97.4
Bottom	93.0	87.4	90.2	95.1

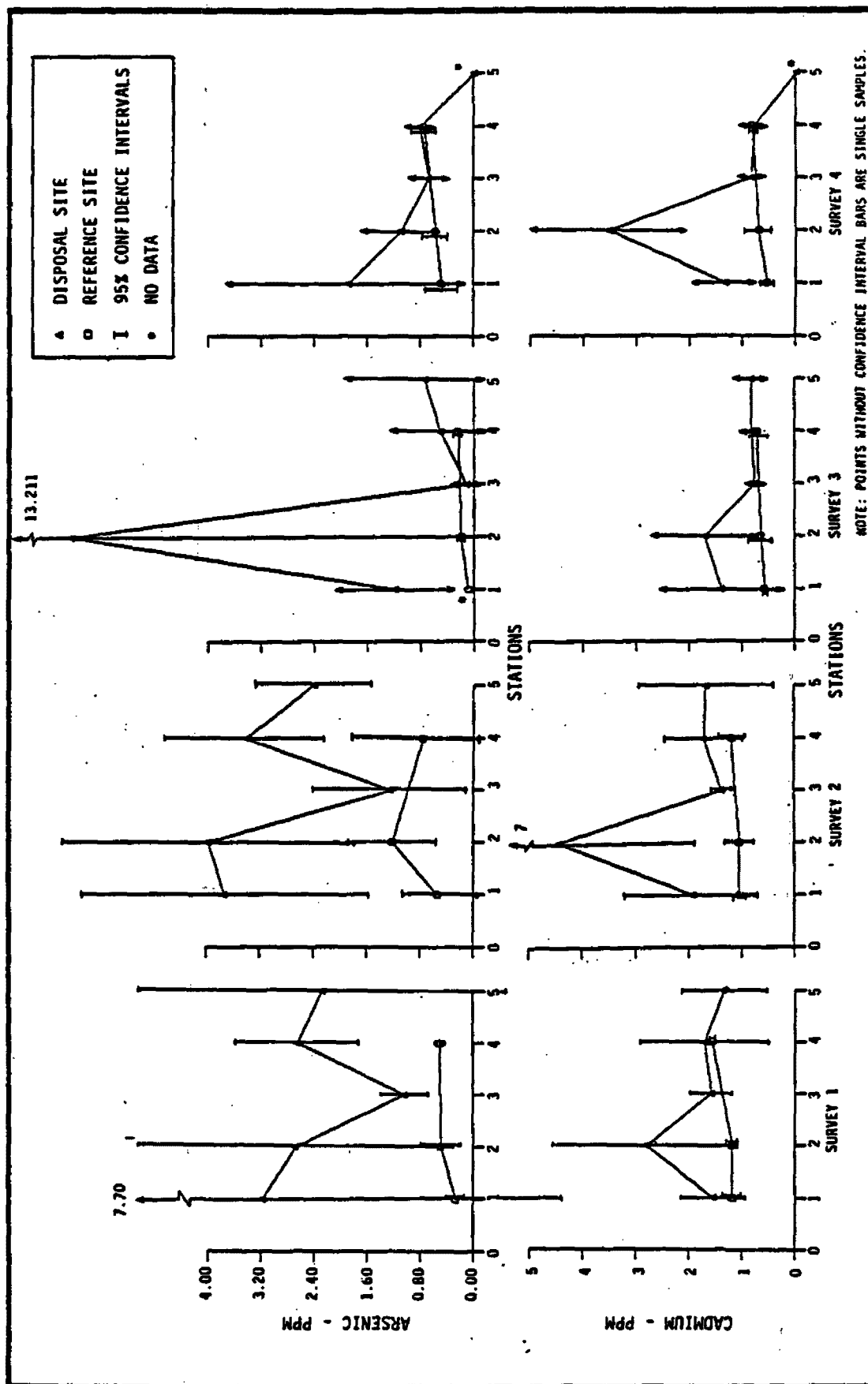


FIGURE A5. MEAN AND 95% CONFIDENCE INTERVALS FOR TRACE SEDIMENT CONCENTRATION (DRY WT) AT LA 2 DISPOSAL AND REFERENCE SITES. CONNECTING LINES ARE TO ENHANCE READABILITY AND DO NOT INDICATE TRENDS.

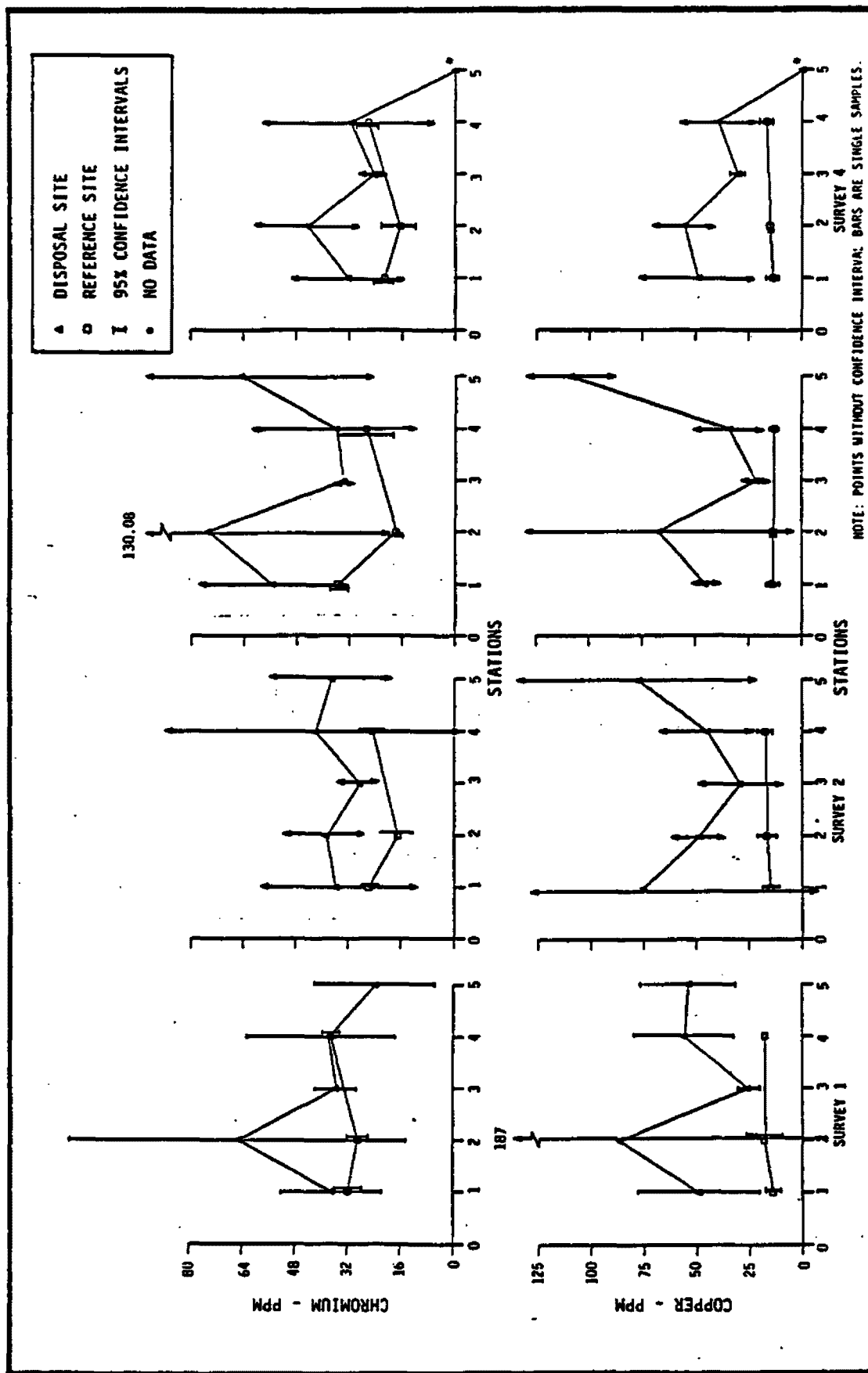


FIGURE A-6 (CONTINUED)

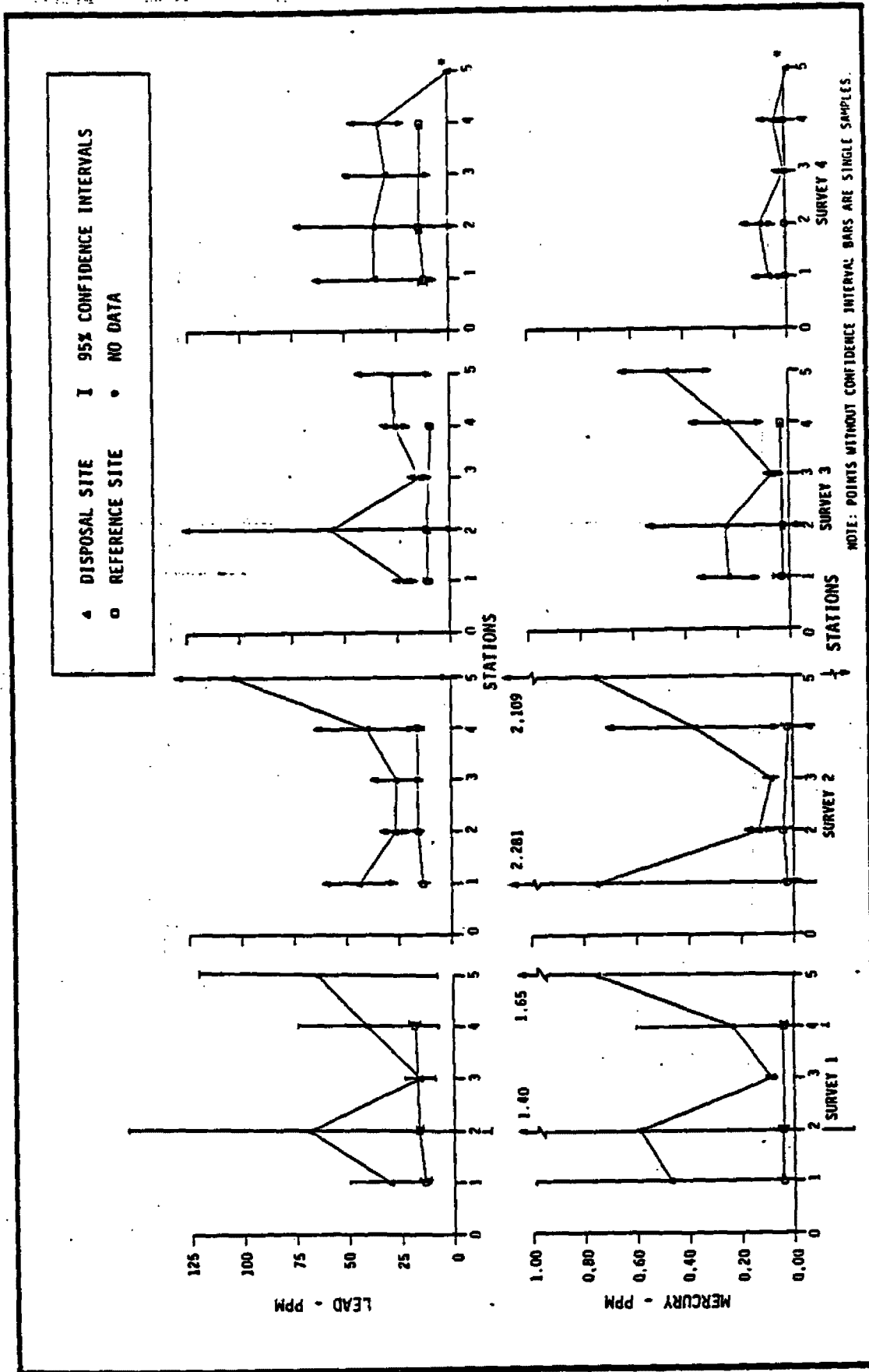
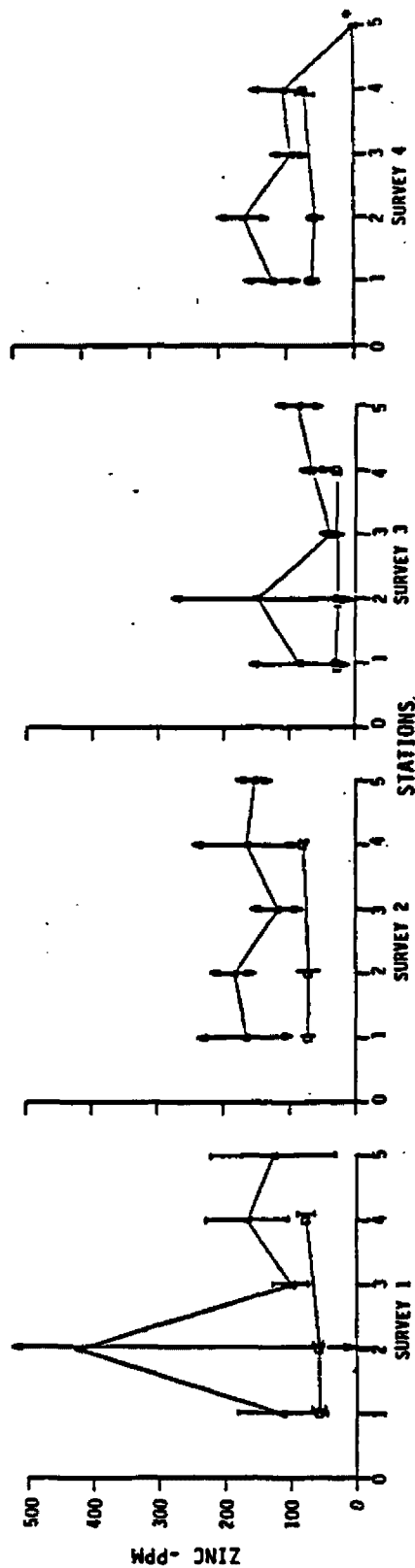
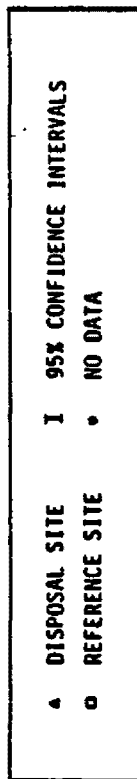


FIGURE A-5 (CONTINUED)



NOTE: POINTS WITHOUT CONFIDENCE INTERVAL BARS ARE SINGLE SAMPLES.

FIGURE A-5 (CONTINUED)

reference stations suggests spotty concentrations of the metals at the disposal site. Significant differences among disposal site stations 1, 3, and 5 along the 170 m isobath (to remove depth trends) is additional evidence of the spotty contamination of metals at the dump site. There are no depth trends in the metal concentrations at either site. Station 3 approaches reference levels for each metal. This is the upcurrent station for most of the year and appears not to receive much input from dumping in comparison to natural input.

A.3.2.1.2 Water Column. Metals were undetected in the water column analyses at the detection limits listed in Table A-5. Therefore, a comparison of disposal and reference site water quality conditions cannot be made.

A.3.2.1.3 Tissues. One epibenthic macroinvertebrate and two demersal fish species were used for tissue analyses. The ridgeback prawn (Sicyonia ingentis) was sampled during all four surveys. The Pacific sanddab (Citharichthys sordidus) was collected during the first two surveys, but was replaced with the slender sole (Lyopsetta exilis) for the final two surveys because low catches of the former did not yield enough tissue for analyses. Figures A-6, A-7 and A-8 are representative plots of metal concentrations for all three species. All tissue metals data are not plotted in order to conserve space, but these data are presented in Table B-2. Tissue metals analyses are incomplete in some surveys due to insufficient tissue quantities. The lack of sufficient tissue results in many cases from discovering faulty analytical techniques; insufficient tissue remained to allow complete analysis of chlorinated hydrocarbons, PCBs and metals. For each of the three species, there is no significant difference ($\alpha=0.05$) in the concentration of any metal in the muscle tissue between dump and reference sites. Tissue metal concentrations were consistently higher in the slender sole than in the Pacific sanddab. This may be due to dietary or physiological differences between these two species.

A.3.2.2 Oil and Grease

A.3.2.2.1 Sediments. Oil and grease analyses were conducted on sediment samples from Surveys 2 through 4. Samples were not collected for analyses during the first survey. Results of these analyses for the disposal and reference sites are plotted in Figure A-9. Mean values of the control sites were compared in a one-way ANOVA test and the values for Survey 2 are significantly different ($\alpha=0.05$) from the Surveys 3 and 4. Therefore, Survey 2 will not be included in the interpretation of the results.

A.3.2.2.2 Oil and grease concentrations at the LA2 disposal site are significantly elevated ($\alpha=0.05$) over reference values. Differences in the elevation at individual stations at the disposal site among surveys suggests spot contamination of the site. Significant test results ($\alpha=0.05$) for heterogeneity among disposal Stations 1, 3, and 5 supports this conclusion. Disposal Station 5 is not significantly elevated in either survey and the spatial extent of oil and grease contamination may not reach the deeper portion of the site. However, because of the spotty nature of the other stations, elevated levels at Station 5 cannot be ruled out.

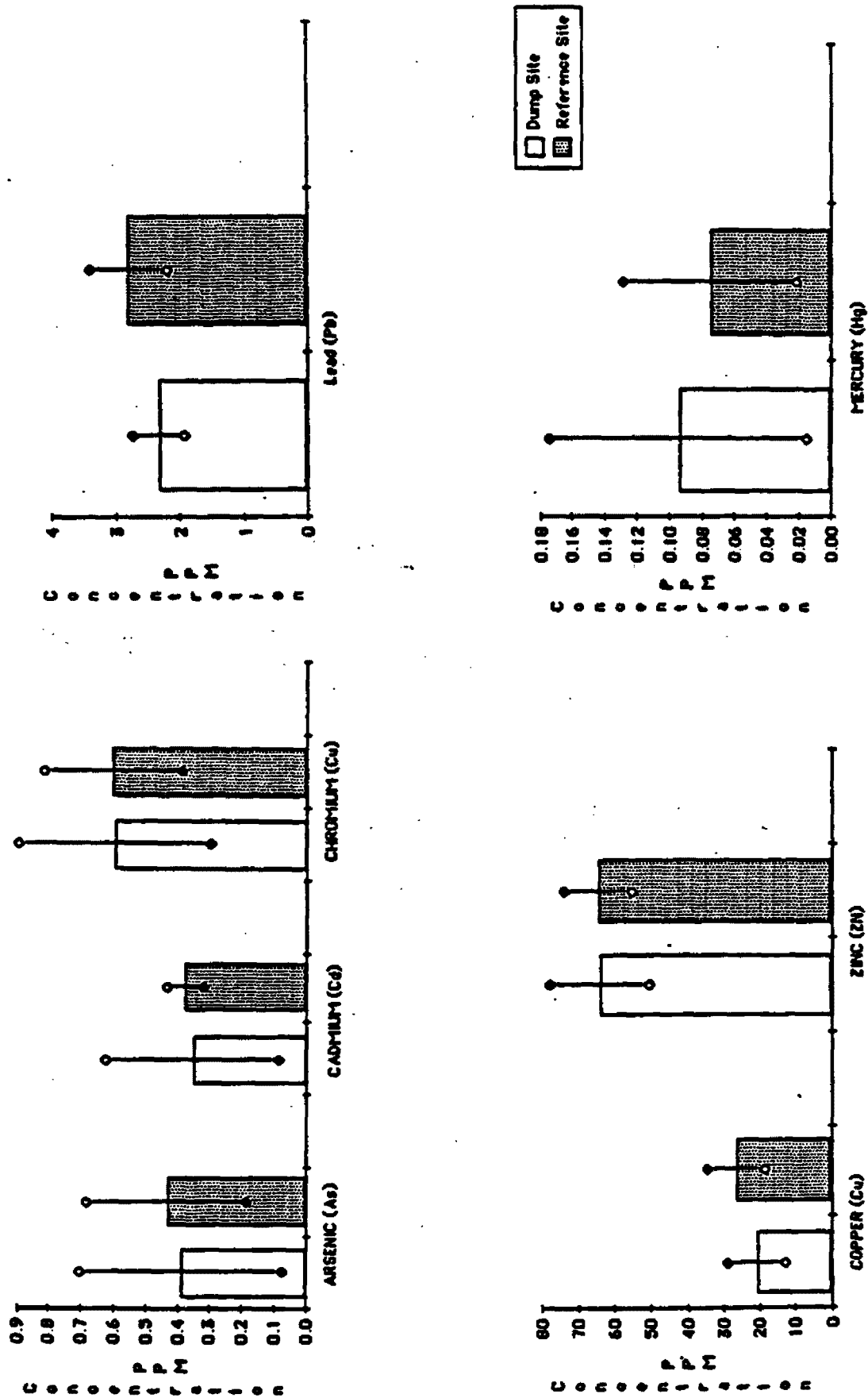


FIGURE A-6 MEAN AND 95% CONFIDENCE INTERVALS FOR TISSUE TRACE METAL CONCENTRATIONS (DRY WT.) *SICYONIA INGENTIS*. SURVEY 1 LA2

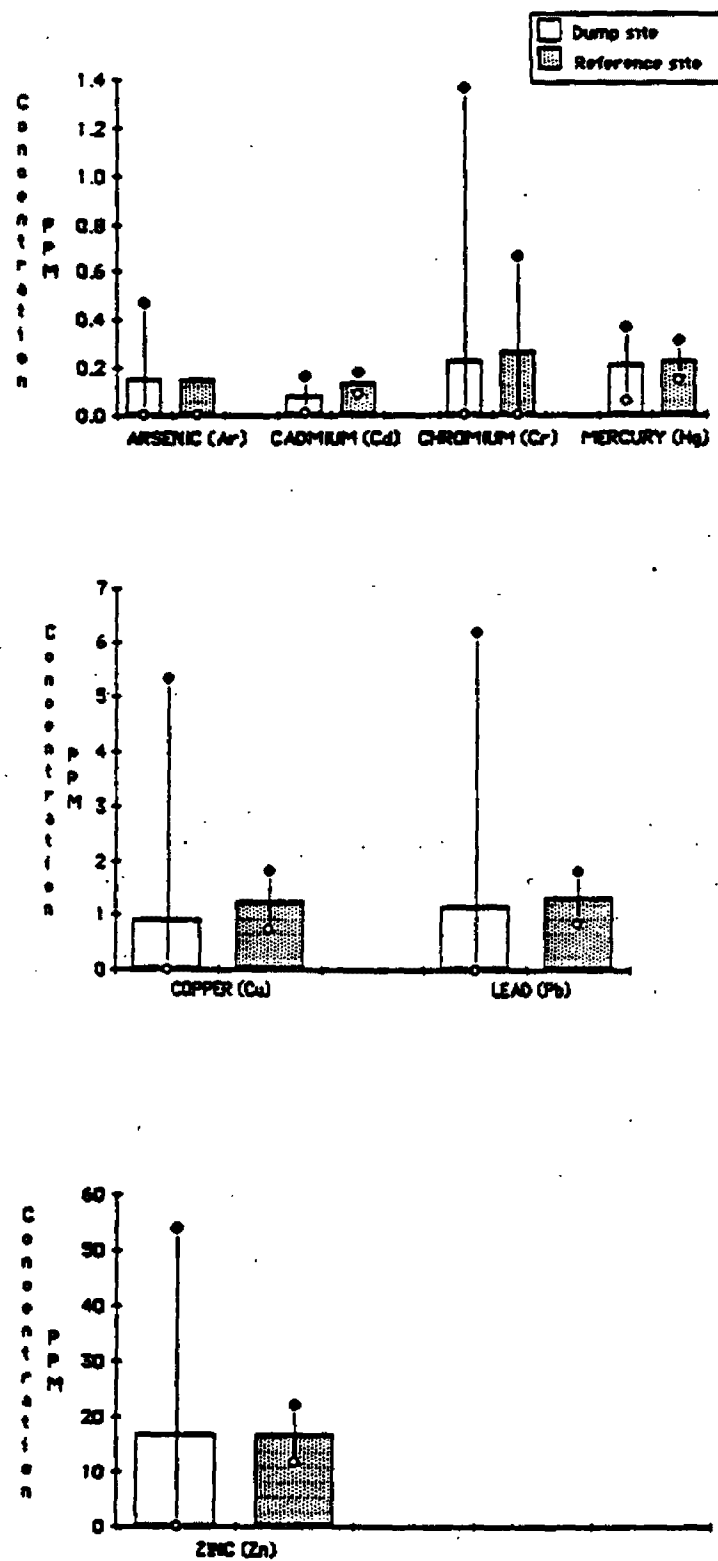


FIGURE A-7 MEAN AND 95% CONFIDENCE INTERVALS FOR TISSUE TRACE METAL CONCENTRATIONS (DRY WT.) *CITHARICHTHYS SORDIDUS*. SURVEY 2 LA2

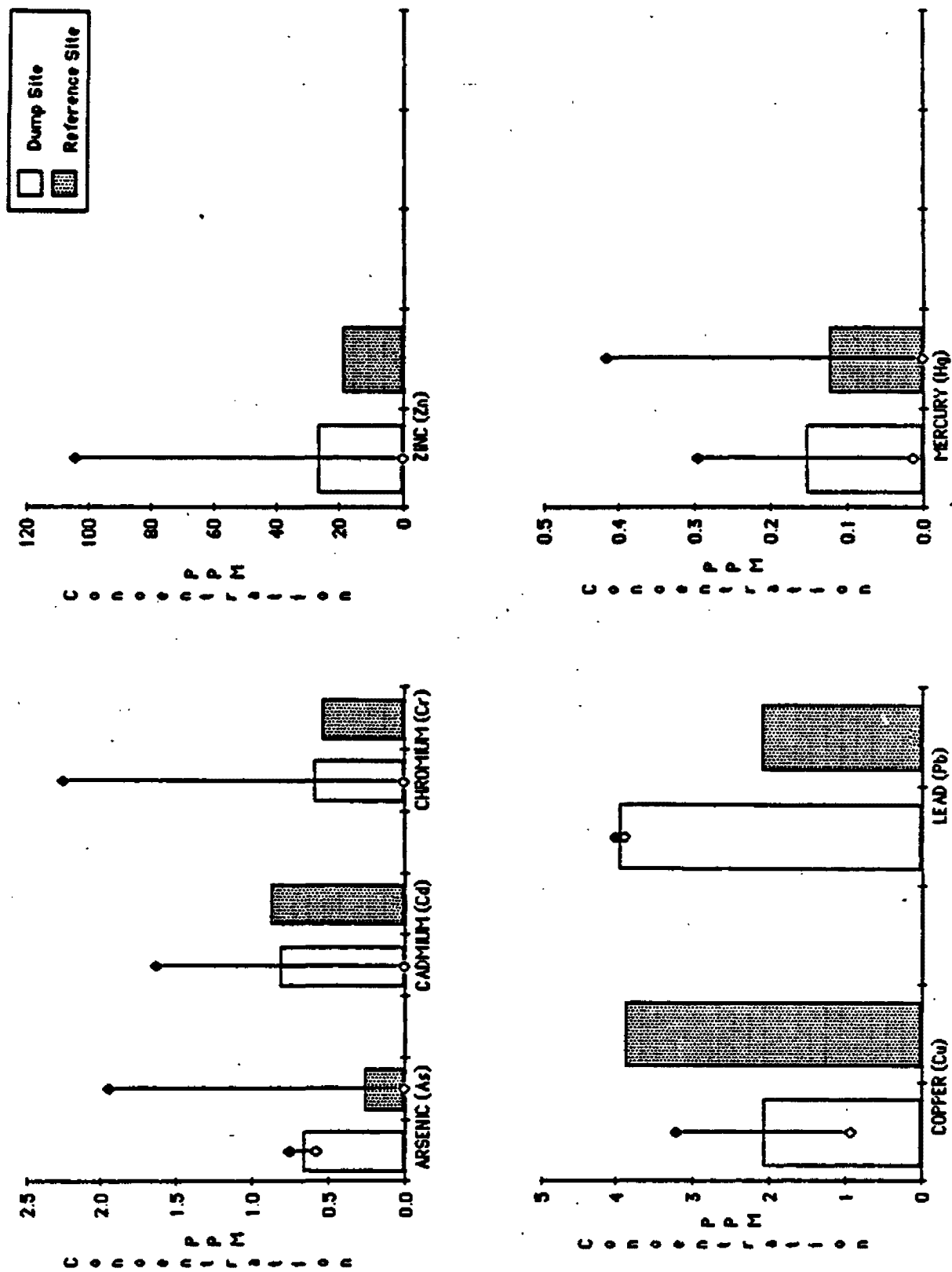


FIGURE A-8 MEAN AND 95% CONFIDENCE INTERVALS FOR TISSUE TRACE METAL CONCENTRATIONS (DRY WT. %). L'YOPSETTA EX/LIS. SURVEY 3 LA2

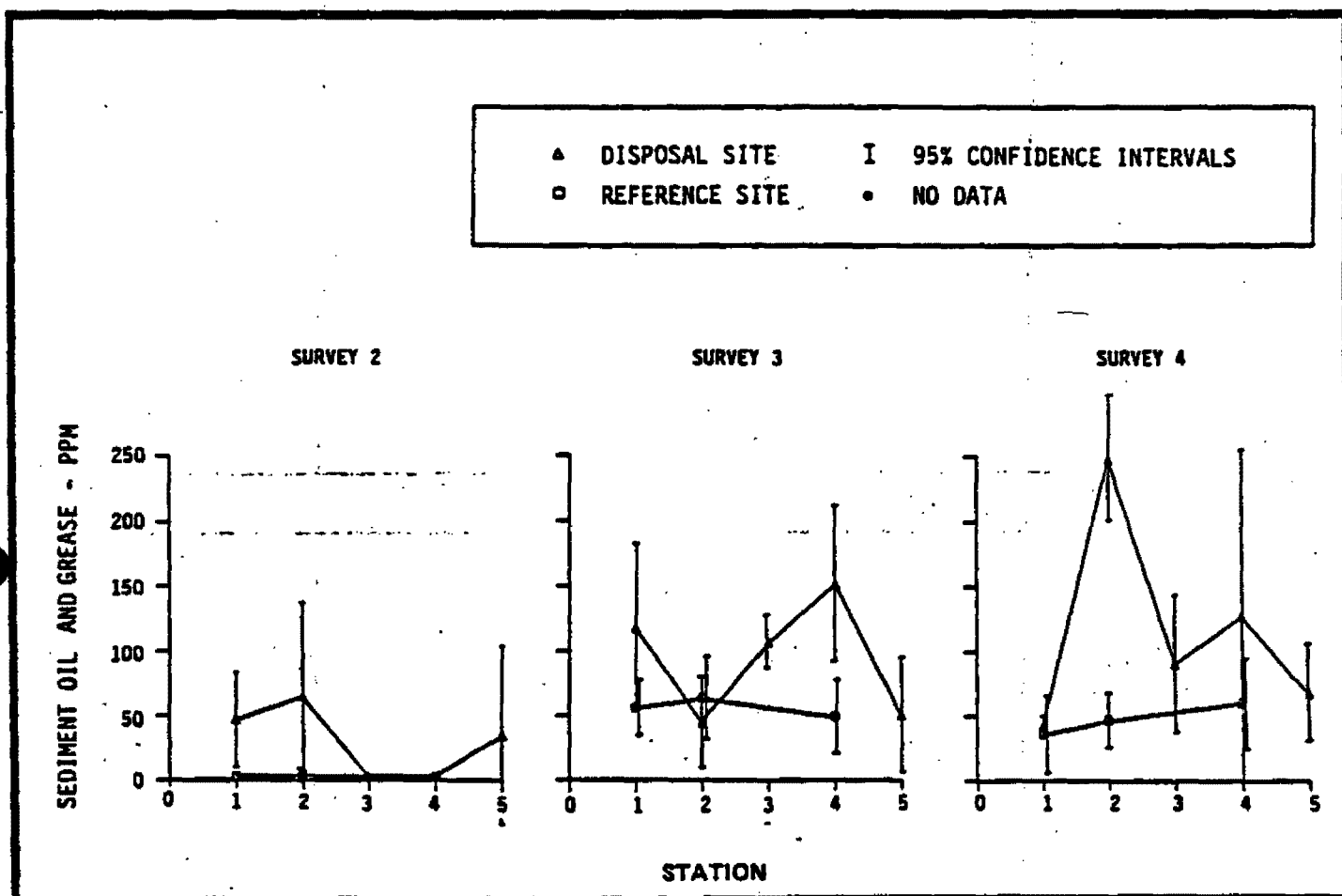


FIGURE A9. MEAN AND 95% CONFIDENCE INTERVALS FOR OIL AND GREASE SEDIMENT CONCENTRATION (DRY WT) AT LA 2 DISPOSAL AND REFERENCE SITES. CONNECTING LINES ARE TO ENHANCE READABILITY AND DO NOT INDICATE TRENDS.

A.3.2.2.3 Water Column. Oil and grease concentrations in the water column are below the detection limit of 0.1 mg/l for all samples. Therefore, a comparison of disposal and reference site water quality conditions cannot be made.

A.3.2.2.4 Tissues. Oil and grease analyses were not conducted on all tissue samples because of limited sample size. Concentrations were below the detection limit of 1 mg/kg for those samples analyzed, and the data are not included in the tables accompanying this section. Therefore, a comparison of disposal and reference site tissue oil and grease concentrations cannot be made.

A.3.2.3 Chlorinated Hydrocarbons

A.3.2.3.1 Sediments. Pesticides and PCBs were analyzed at all sediment stations. All pesticides other than DDTs were undetected at a detection limit of 1 ug/kg (dry weight) in all samples. Ranges and median concentrations of selected DDTs and PCBs at the disposal site are compared with the reference site in Table A-10. DDT isomers that are excluded do not exhibit any significant elevation over reference values. Surveys 1 and 2 are not included in Table A-10 because an analytical fraction of the sample extract sometimes containing DDTs and PCBs was not analyzed and added into the totals in Surveys 1 and 2. The procedural error involved the extraction for four different chlorinated hydrocarbon fractions: (1) hexane fraction, (2) 6 percent ether in hexane, (3) 15 percent ether in hexane and (4) chloroform. Compounds in fractions 1 and 2 do not clearly separate and the chemical technician misidentified the compounds based on their respective retention times. This likely resulted in an underestimation of values for the first two surveys. After the second survey, it was discovered that adding in this additional fraction resulted in a more reliable analysis for these contaminants, and this procedure was followed for Surveys 3 and 4. Limiting the discussion to the data from Survey 3 and 4 results in a clearer picture of the pattern of chlorinated hydrocarbon levels in the study sites. Chlorinated hydrocarbon data from Surveys 1 and 2 are included in Table B-2.

A.3.2.3.2 The LA2 disposal site exhibits significantly elevated levels ($\alpha=0.05$) of p,p'-DDE, p,p'-DDD, and p,p'-DDT in the sediments. The o,p isomer concentrations are not elevated over reference levels. p,p'-DDT concentrations also significantly increase ($\alpha=0.05$) with depth in Survey 4. The reason for this is not clear, and could be an artifact of Survey 4 data. The compound's metabolites, p,p'-DDD and p,p'-DDE, do not exhibit similar depth trends although DDT is usually rapidly metabolized in the marine environment (Callahan et al. 1979).

A.3.2.3.3 Table A-6 also compares PCB levels at the disposal and reference sites. Median PCB 1260 values are higher at the disposal site than at the reference site. PCB 1260 concentrations are significantly elevated ($\alpha=0.05$) over reference values in both Survey 3 and 4. The large ranges suggest spot contamination of the disposal site. A significant test ($\alpha=0.05$) for heterogeneity among stations supports this conclusion. There is no depth trend in the distribution of PCB 1260.

TABLE A-10. COMPARISON OF THE RANGE AND MEDIAN OF SELECTED
PESTICIDE AND PCB CONCENTRATIONS IN SEDIMENTS^a

Parameter (ug/kg dry wt)	Site	Survey 3	Survey 4
p,p'-DDE	D	3-660 (38) ^b	7-97 (50)
	Ref	8-24 (13)	24-37 (28)
p,p'-DDD	D	3-40 (16)	2-62 (14)
	Ref	2-12 (2)	2-5 (2)
p,p'-DDT	D	2-25 (3)	2-20 (4)
	Ref	2-8 (2)	2 (2)
PCB 1242	D	7-590 (27)	7-570 (48)
	Ref	7-90 (8)	7-150 (48)
PCB 1254	D	13-420 (13)	13-190 (16)
	Ref	13-15 (13)	13-17 (13)
PCB 1260	D	34-140 (51)	34-330 (56)
	Ref	34-170 (34)	34 (34)

^a Data for surveys 1 and 2 are excluded because of analytical procedure differences (see text for discussion).

^b Median values given in parentheses.

D = Disposal site.

Ref = Reference site.

A.3.2.3.4 The ranges and median concentrations of PCB 1242 and PCB 1254 at the disposal site suggest elevation of these PCB mixtures over reference values. However, these data must be interpreted with caution because of the considerable interference observed in the chromatographic region used to quantitate these Arochlors (particularly in the region used for PCB 1242). These interferences result from elemental sulfur and from additional coeluting organic residues.

A.3.2.3.5 Water Column. All pesticides and PCBs were undetected in the water column at the detection limits stated in Table A-5, so that comparisons cannot be made of the disposal and reference sites water quality conditions.

A.3.2.3.6 Tissues. Interpretation of DDT and PCB results in tissues is limited to the last two surveys for the same reasons as those stated above in the sediment section. The limited amount of tissue resulting in few duplicates per site, combined with the high variability of the results, is expected to result in no significant separation of these parameters from reference levels. A more detailed analyses than was possible under the limitations of this study may be able to determine trends. Table A-11 lists the range of selected pesticide and PCB concentrations in tissues from the disposal site stations 2 and 5. Median values were not calculated because of the limited number of samples at each site.

A.3.2.3.7 There is little or no evidence of a consistent elevation of DDT isomer or PCB tissue concentrations at the disposal site relative to concentrations observed at the reference site. Based on the tissue data summarized in Table A-11, there are no readily apparent trends in concentrations; apparent elevations of pesticides and PCBs vary among surveys, and among samples within each survey. The highest values (1740 ug/kg dry weight) in individual tissue samples are often, but not always, observed at the disposal sites. The significance of these apparent elevations is uncertain because of the smaller number of successful analyses at the reference site (1 to at most 3 samples per survey).

A.3.2.3.8 Natural variability in the tissue concentrations of chlorinated hydrocarbons may result from (1) exposure to any of the other contaminated areas within the southern California Bight (discussed in the body of the EIS) or (2) feeding habits of individuals (e.g., a marked preference of sediment-ingesting polychaetes over mysid shrimp) or (3) differential ability of individuals to metabolize contaminants (Jeff Cross, SCCWRP, pers. comm., 30 Sept. 85). In addition, although standard analytical techniques were used, there is not adequate data to quantify analytical variability, so that no firm conclusions can be made regarding natural variability.

A.3.2.4 Comparison to Literature Values

A.3.2.4.1 One check on the quality of the data is to compare reference site values with those in the literature. Table A-12 lists metal concentrations for sediments, water column, and tissues at control sites from various studies

TABLE A-11. COMPARISON OF THE RANGE OF SELECTED PESTICIDE AND PCB CONCENTRATIONS IN TISSUES^a

Parameter (ug/kg dry wt)	Species	Site	Survey 3	Survey 4
p,p'-DDE	S	D	270-1,740	360-860
		Ref	65	350-640
	L	D	430-950	180-240
		Ref	260-540	130-370
o,p'-DDT	S	D	1-21	8-22
		Ref	1	4-22
	L	D	1-48	7-30
		Ref	1-22	1-8
p,p'-DDT	S	D	2-15	6-12
		Ref	2	3-17
	L	D	2-17	3-19
		Ref	8-14	2-19
PCB 1242	S	D	3-43	3-85
		Ref	3	5-21
	L	D	3	3
		Ref	3	3
PCB 1254	S	D	130-260	6-200
		Ref	6	6-66
	L	D	6-190	6-45
		Ref	6-92	6-51

^a Survey 1 and 2 are excluded because of analytical procedure differences (see text for discussion). PCB 1260 was undetected at 34 ug/kg in all samples.

S = Sicyonia ingentis.

L = Lyopsetta exilis.

D = Disposal site.

Ref = Reference site.

TABLE A-12. METALS CONCENTRATIONS AT CONTROL SITES IN THE SOUTHERN CALIFORNIA BIGHT

Source	As	Cd	Cr	Metals Cu	Pb	Hg	Zn
<u>Surface Sediments (ug/g dry wt.)</u>							
Sherwood (1982)	-	-	13-19	8.1-9.4	3-5	-	44-46
Hershalman et. al. (1981)	-	0.26-1.3	24-50	6.4-19	5.2-29	-	32-71
Word & Mearns (1979)	-	0.1-1.4	6.5-43	2.8-31	2.7-12	-	9.8-62
Hershalman et. al. (1977)	-	0.2-0.5	34-62	13-21	6.2-12	0.02-0.05	54-75
Chen & Lu (1974)	-	1.4-2.1	26-60	11-18	20-78	0.04-0.09	32-65
Bruland et. al. (1974)	-	1.0-2.0	90-150	28-35	5-30	-	85-100
<u>Water Column (ug/l)</u>							
DOI (1983)	-	0.0005	-	<0.0034	0.0018	-	0.008
Garrison (1981)	-	0.004	0.1	0.08	0.005	0.001	0.01
Morel et. al. (1975)	-	0.1	0.2	3.0	0.04	0.03	10
<u>Tissues (ug/g wet wt)</u>							
Sherwood (1982) Dover sole	-	-	0.01	0.07	<0.09	-	1.9
Young et. al. (1981)	-	-	-	-	-	-	-
Pacific sanddab	-	-	0.03-0.08	0.09-0.37	<0.24	0.05-0.16	2.7-6.1

in the southern California Bight. Metals concentrations in sediments from the reference site are within the range of literature values. At the disposal site, however, the concentrations of Cd, Cu, Hg and Zn, and to a lesser extent Cr and Pb, generally exceed literature values. Water column analyses detection limits are all above reported metals concentrations in the literature and it follows that no metals would be detected. Tissue concentrations corrected to wet weight for the slender sole (Lyopsetta exilis) (17.1% solids) and the Pacific sanddab (Citharichthys sordidus) (19.0% solids) also compare favorably with published values; both range from less than, to slightly greater than, the values listed in Table A-12. There are no reported values in the literature for the ridgeback prawn (Sicyonia ingentis) or other penaeid shrimp.

A.3.2.4.2 Information on pesticide and PCB concentrations for control sites in the southern California Bight is scarce. However, the limited published values do compare with reference values in this study. Sediment concentrations of <3 to 70 and <2 to 40 ug/kg for the sums of DDTs and PCBs, respectively (Young and Gossett, 1980; Word and Mearns, 1979) bracket the median sediment values for those parameters listed in Table A-10. The exception is total PCBs, which exceeded literature ranges at some stations at the disposal site. Ranges of 11 to 101 and 3 to 37 ug/kg wet weight for the sums of DDTs and PCBs, respectively, were calculated for the slender 17.1 percent solid. These ranges are included in the ranges of 6 to 20 and 13 to 43 ug/kg wet weight for the sum of DDTs and PCBs respectively, reported by Sherwood et al. (1980) for dover sole (Microstomus pacificus) at a California Bight control station. Literature data for the slender sole are not available for direct comparison. There are no reported values in the literature for ridgeback prawn. Values for the Pacific sanddab are not compared because of questions about the data from Surveys 1 and 2 (A.3.2.3.1).

A.3.3 BENTHIC INFAUNA. All infauna data collected at the LA2 interim disposal site and the corresponding reference area are presented in Appendix Tables B-3A, B-3B, B-3C and B-3D. Each table summarizes the data collected in one of the four field surveys. The abundance of individual taxa is presented for each replicate sample. Additionally, calculated summary information such as indices of diversity, the total number of taxa and total number of individuals is presented for each replicate sample and for combined samples within a station. A complete list of taxa identified in all four surveys is presented in Appendix Table B-3E.

A.3.3.1 Data Analysis. The infaunal data were analyzed to provide information on existing biological conditions and to determine the effect of the disposal of dredged material on benthic communities at this interim disposal site. Three sets of analyses were conducted. First, biological community indices such as diversity, number of taxa and number of individuals were compared among sampling stations. Second, numerical classification methods were used to examine the relationship among sampling stations in terms of biological community structure. Third, the correlation between biological and physical-chemical variables was evaluated. The focus of these analyses was on the comparison of spatial differences within the disposal site and between the disposal site and the reference stations. The results of these analyses are provided below.

A.3.3.1.1 Community Indices. Four community indices were calculated for each infaunal sample: Shannon-Weaver Diversity (Shannon and Weaver, 1944), Margalef's Species Richness (Margalef, 1957), the total number of taxa and the total number of individuals. Shannon-Weaver Diversity (H') and Species Richness (D) were calculated as:

$$H' = -\sum \frac{n_i}{N} \log \frac{n_i}{N}$$

$$D = \frac{S-1}{\ln N}$$

where:

S = number of taxa

N = number of individuals

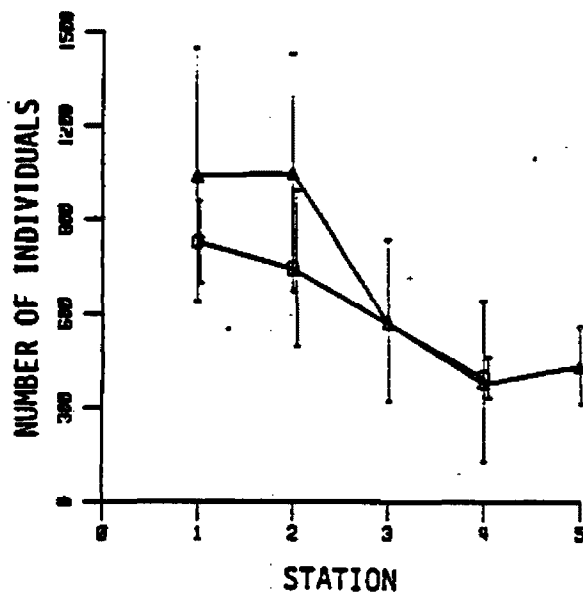
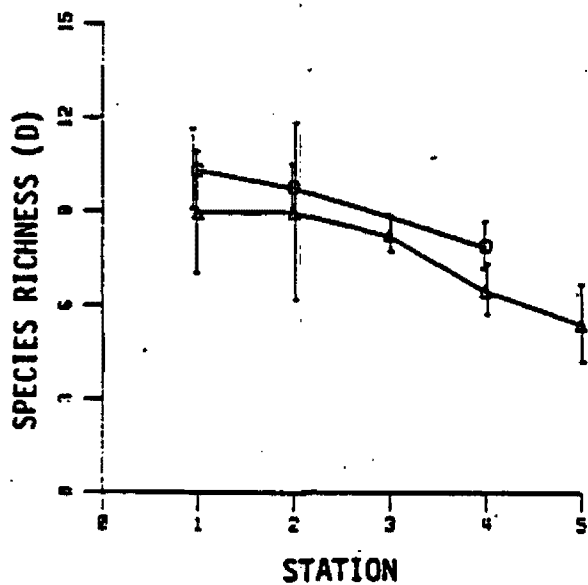
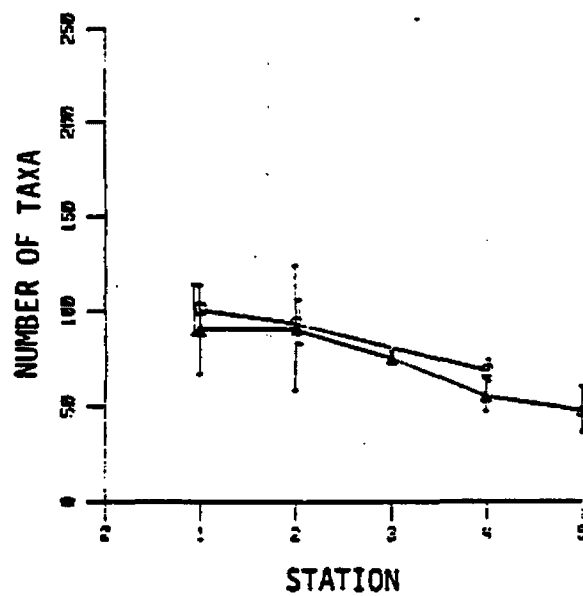
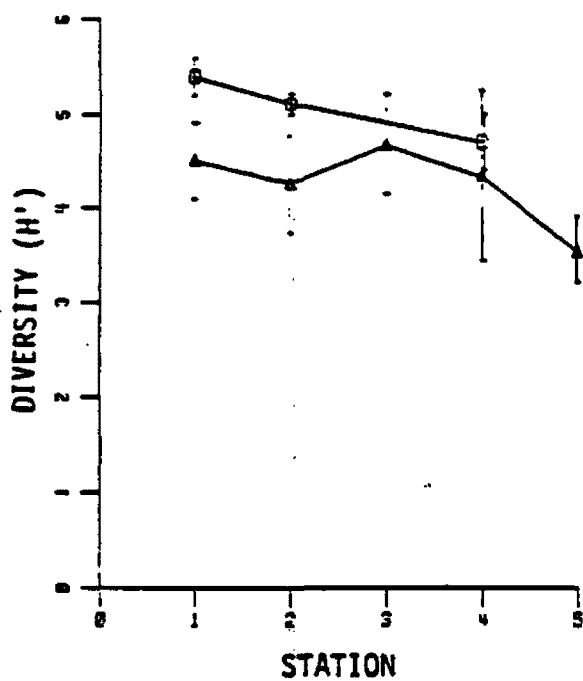
n_i = number of individuals in the i^{th} taxon

A.3.3.1.2 The mean value of these indices, calculated for each sampling station, is plotted by survey in Figures A-10 - A-13. The mean values and 95 percent confidence intervals for each station were calculated from four replicate samples. These graphical summaries provide a useful means for comparison of the selected biological variables among collection areas (disposal site versus reference site) and between stations. For example, Stations 1, 2 and 4 are located at different depths, but each station is at the same approximate depth at both the disposal and reference sites (see Figure A-1).

A.3.3.1.3 As indicated in Figures A-10 - A-13, consisted differences were observed between the reference and disposal sites for the mean values of diversity (H') and the number of individuals. The mean value of diversity measured at stations in the reference area (Station 1, 2 and 4) was greater than or equal to the mean value measured at corresponding stations from the disposal area in all but a single case. Differences in diversity were most apparent in the first two surveys. The mean abundance of organisms at the disposal site was greater than or equal to the mean abundance at the reference site in all cases except Station 2 in Survey 3. For example, differences of a factor of two were observed in the mean abundance of organisms between the disposal and reference areas in Survey 2 (Figure A-11).

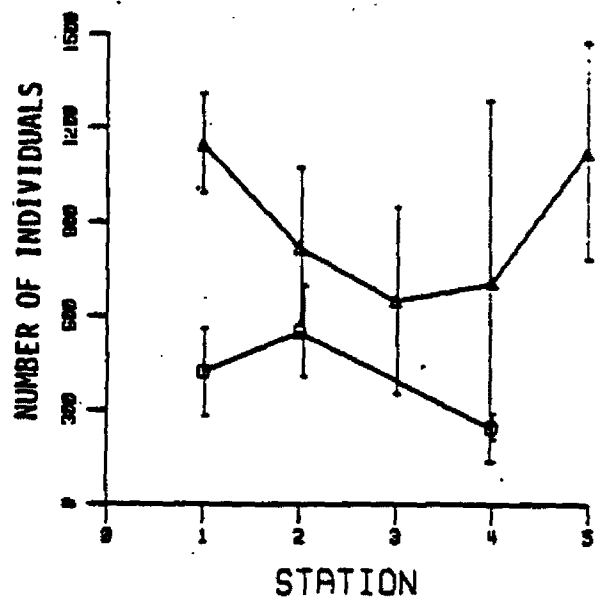
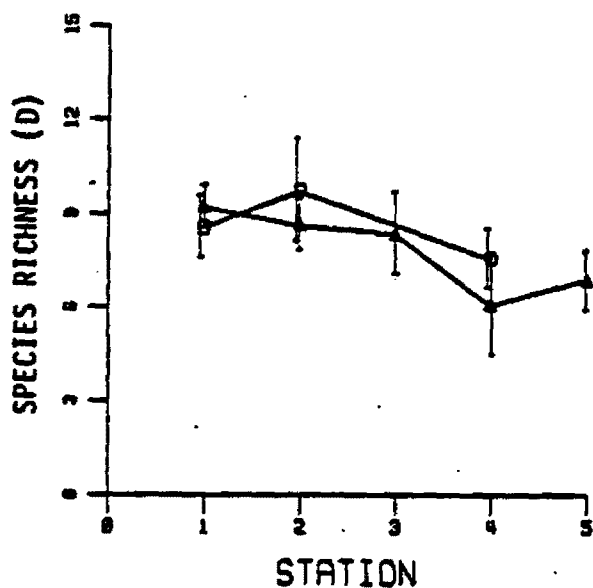
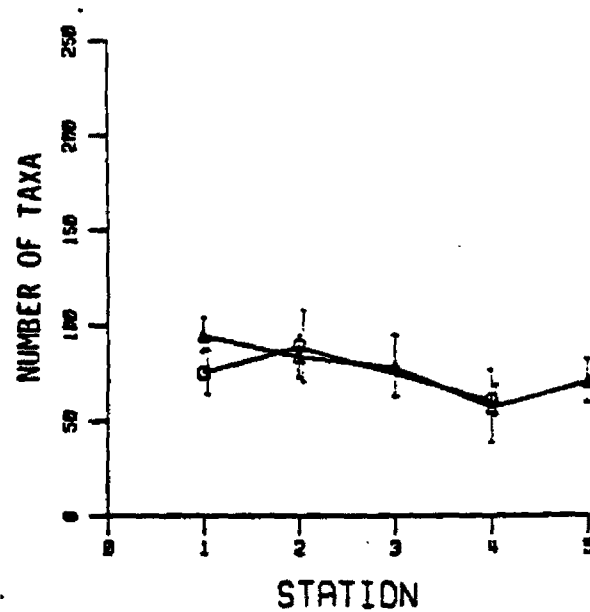
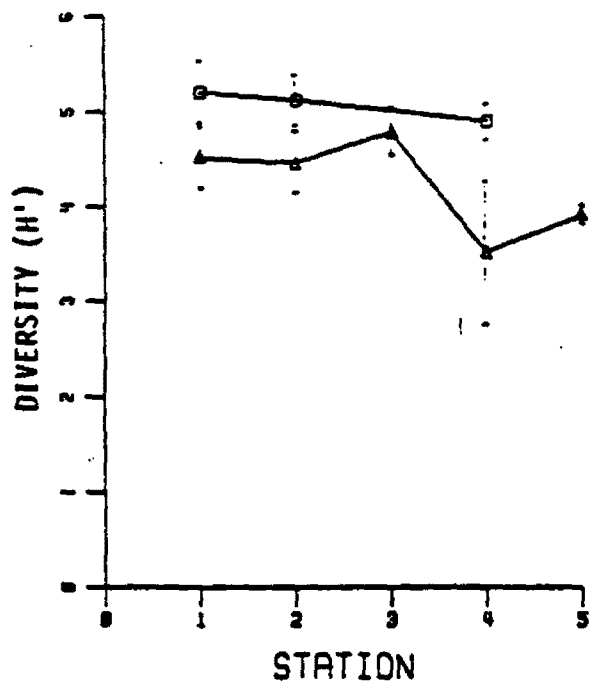
A.3.3.1.4 These differences in the diversity of organisms and the dominance of individual taxa between the disposal- and reference-site stations are demonstrated in Table A-13. The number of taxa accounting for a fixed proportion of the total individuals at each sampling station is presented for Survey 1. At the disposal-site stations, a fewer number of taxa accounted for each selected proportion of the sample. Examination of the most abundant taxa at each station indicates that the dominant taxa were similar at both the disposal- and reference-site sampling stations, but that these taxa exhibit a greater degree of dominance within the disposal area.

A.3.3.1.5 Although consistent differences between the disposal and reference sites were observed in the mean values of species richness and number of taxa during the first sampling event, these differences were not persistent throughout the four surveys.



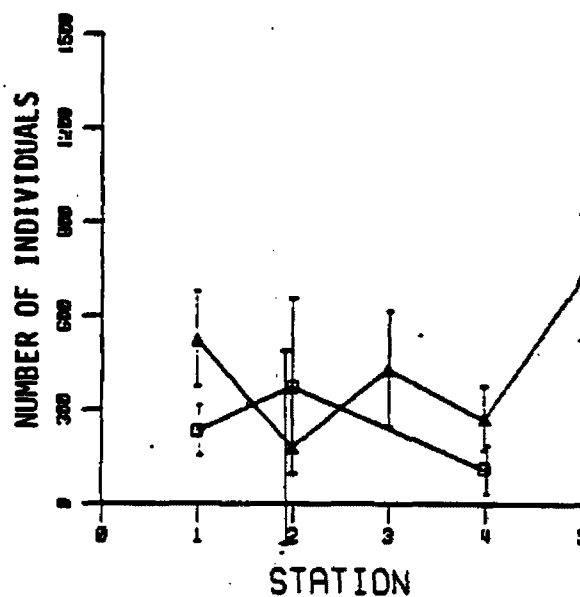
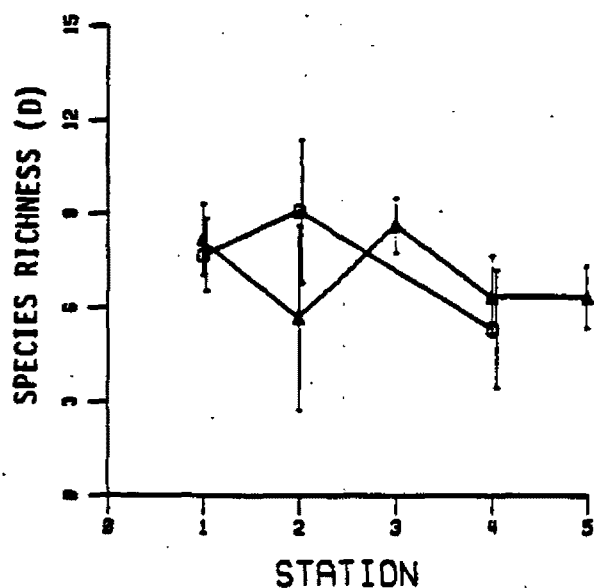
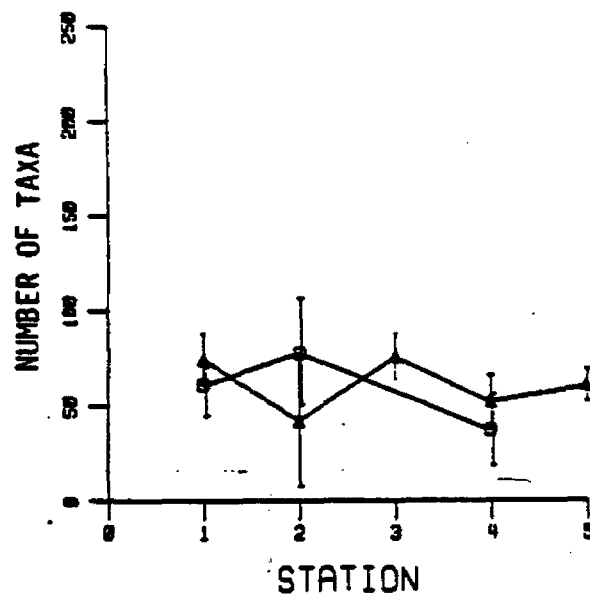
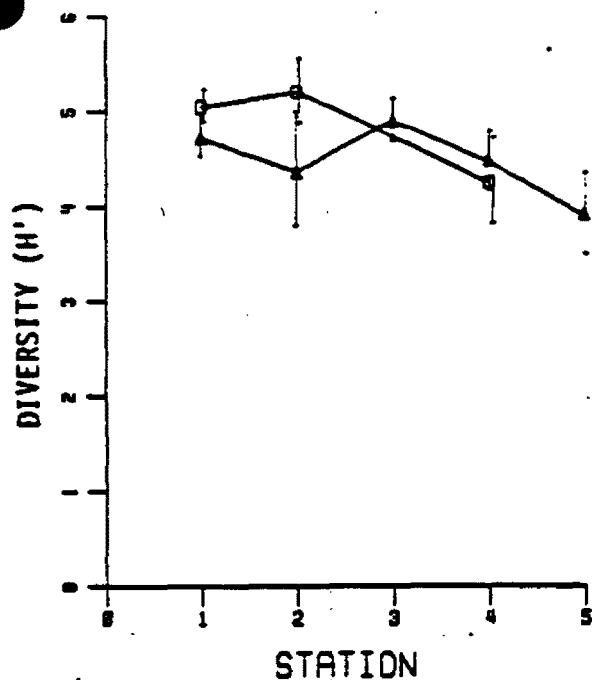
□ Reference Site Station
 △ Disposal Site Station

FIGURE A10. MEAN VALUES AND 95% CONFIDENCE INTERVALS FOR INFAUNAL COMMUNITY INDICES. SURVEY 1. CONNECTING LINES ARE TO ENHANCE READABILITY AND DO NOT INDICATE TRENDS.



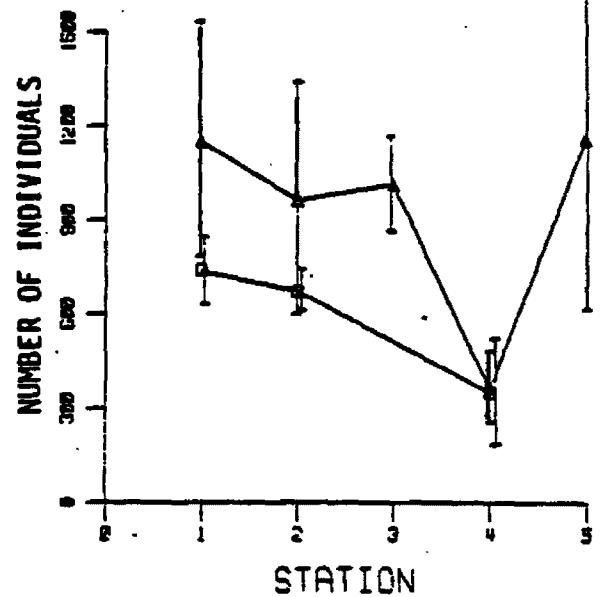
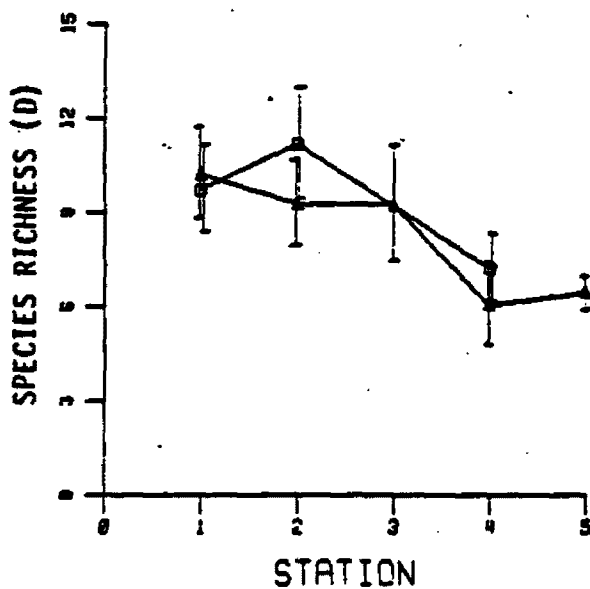
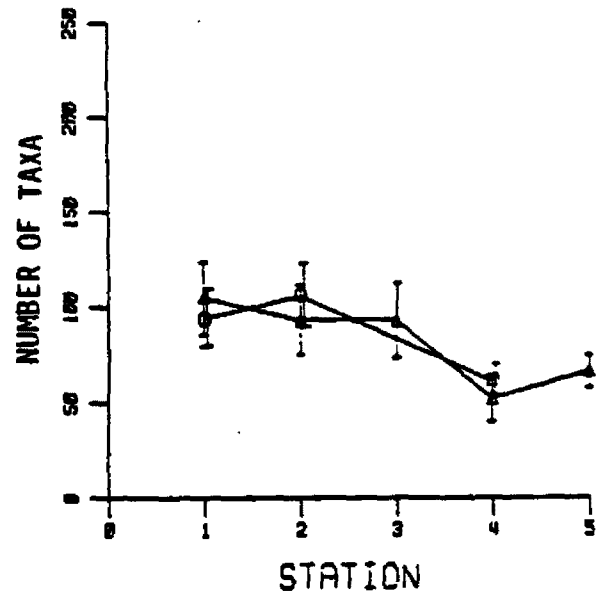
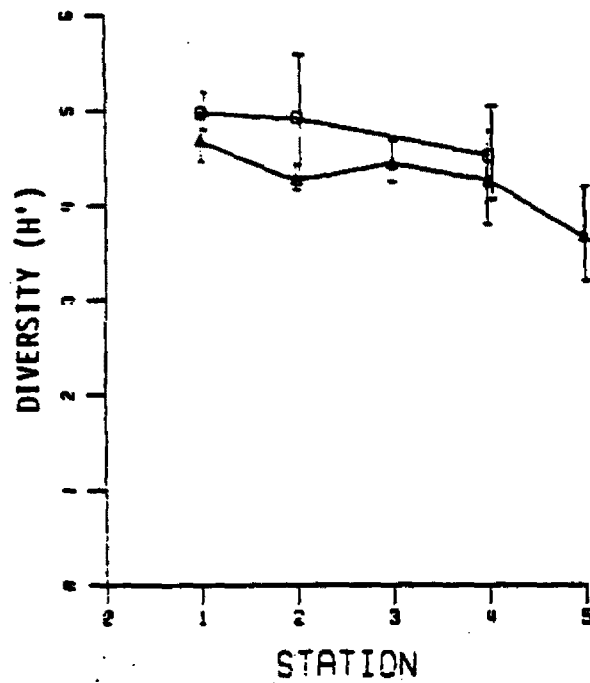
□ Reference Site Station
 △ Disposal Site Station

FIGURE A11. MEAN VALUES AND 95% CONFIDENCE INTERVALS AT EACH SAMPLING STATION FOR INFAUNAL COMMUNITY INDICES. SURVEY 2. CONNECTING LINES ARE TO ENHANCE READABILITY AND DO NOT INDICATE TRENDS.



□ Reference Site Station
 △ Disposal Site Station

FIGURE A12. MEAN VALUES AND 95% CONFIDENCE INTERVALS AT EACH SAMPLING STATION FOR INFAUNAL COMMUNITY INDICES. SURVEY 3. CONNECTING LINES ARE TO ENHANCE READABILITY AND DO NOT INDICATE TRENDS.



□ Reference Site Station
 △ Disposal Site Station

FIGURE A13. MEAN VALUES AT EACH SAMPLING STATION FOR INFAUNAL COMMUNITY INDICES. SURVEY 4. CONNECTING LINES ARE TO ENHANCE READABILITY AND DO NOT INDICATE TRENDS.

TABLE A-13. NUMBER OF TAXA ACCOUNTING FOR A FIXED PROPORTION OF THE TOTAL INDIVIDUALS AT A SAMPLING STATION. Survey 1.

Station ¹	Proportion of Total Individuals in Sample				Five Most Abundant Taxa
	0.50	0.60	0.75	0.90	
D1	4	6	13	37	<u>Tharyx sp.</u> <u>Spiophanes berkeleyorum</u> <u>Mediomastus ambiseta</u> <u>Tauberia gracilis</u> <u>Axinopsida serricata</u>
D2	3	6	13	34	<u>Tharyx sp.</u> <u>S. berkeleyorum</u> <u>M. ambiseta</u> <u>Pectinaria californiensis</u> <u>Decamastus gracilis</u>
D3	4	7	15	43	<u>M. ambiseta</u> <u>S. berkeleyorum</u> <u>Tharyx sp.</u> <u>T. gracilis</u> <u>D. gracilis</u>
D4	5	7	13	34	<u>Tharyx sp.</u> <u>A. serricata</u> <u>M. ambiseta</u> <u>Chloeia pinnata</u> <u>Nephtys cornuta franciscana</u>
D5	2	3	6	21	<u>S. berkeleyorum</u> <u>Tharyx sp.</u> <u>D. gracilis</u> <u>A. serricata</u> <u>P. californiensis</u>
R1	9	13	25	56	<u>M. ambiseta</u> <u>S. berkeleyorum</u> <u>T. gracilis</u> <u>P. californiensis</u> <u>Amphiodia urtica</u>
R2	8	11	19	48	<u>Ophiuroidea spp.</u> <u>M. ambiseta</u> <u>P. californiensis</u> <u>S. berkeleyorum</u> <u>Tharyx sp.</u>
R4	7	11	21	45	<u>M. ambiseta</u> <u>N. cornuta franciscana</u> <u>T. gracilis</u> <u>Minusplo cirrifera</u> <u>Nephtys sp.</u>

¹Station designation: D = Disposal site; R = Reference site.

A.3.3.1.6 Examination of Figures A-10 - A-13 also indicates the effect of depth on the mean values of all variables. At both the reference and disposal sites, the minimum values for all variables were generally observed at the deepest station (Station 4), which was located at approximately 310 m.

A.3.3.1.7 Observed differences in the four community indices were tested for statistical significance. The results of two sets of analyses are described below. First, the observed differences in community indices between Stations 1, 3, and 5 within the disposal site were tested with the one-way ANOVA. second, a two-way ANOVA was used to test simultaneously for differences due to depth within sites and for differences in the mean value of community indices between the reference and disposal sites. The results of these analyses are summarized in Table A-14.

A.3.3.1.8 The results of the one-way ANOVA presented in Table A-14 indicate the statistical significance of observed differences in the values of all four community variables at Stations 1, 3 and 5 within the disposal site area. Observed differences in the number of individuals were statistically significant in all but one survey, and the values of species diversity, number of taxa and species richness among the three stations were significantly different in all four surveys.

A.3.3.1.9 In those cases in which a significant ANOVA test result was obtained, an a posteriori multiple-range test was performed to identify where differences were located among the group means. The results of these tests for difference in the mean values of community variables among disposal Stations 1, 3 and 5 are presented in Tables A-15 and A-16. As indicated in Table A-15 a similar pattern in the differences in mean values of species diversity and species richness among stations was observed. Maximum values were observed at Stations 1 and 3 (see Figure A-1), and minimum values were always observed at Station 5. A similar pattern was observed for the mean number of taxa reported from the different stations (Table A-16). Significant differences in the mean number of taxa per replicate sample were observed in all surveys. The minimum value always occurred at Station 5, and in the majority of samples the maximum number of taxa was found at Station 1 in the center of the disposal site. Generally, however, the mean values at Stations 1 and 3 were not significantly different.

A.3.3.1.10 The results of a posteriori tests for differences in the mean values of number of individuals among disposal Stations 1, 3 and 5 are presented in Table A-16. Statistically significant differences were observed in three of the four surveys, but the pattern of these differences was not consistent. The maximum number of individuals occurred at either Stations 1 or 2 in the first three surveys, and the values were approximately equal among the three stations in the final survey.

A.3.3.1.11 The results of two-way ANOVA tests for differences in the community indices due to depth and type of station (reference or disposal site) are presented in Table A-14. These results reflect the differences observed in the plots of these data (Figures A-10 - A-13). Mean values of all four variables showed a significant differences associated with sampling depth (130 to 310 m) and type of station. These analyses also indicate the

TABLE A-14. RESULTS OF ANOVA TESTS FOR DIFFERENCES IN THE MEAN VALUE OF BIOLOGICAL-COMMUNITY VARIABLES

SURVEY	VARIABLE	ONE-WAY ANOVA (Location within Dumpsite)	TWO-WAY ANOVA		
			(Source of Variation)		
			Depth	Type	Depth x Type
1	Diversity (H')	* ¹	*	*	n.s.
	Species Richness (D)	*	*	*	n.s.
	No. of Taxa	*	*	n.s.	n.s.
	No. of Individuals	*	*	*	n.s.
2	Diversity (H')	*	*	*	*
	Species Richness (D)	*	*	*	*
	No. of Taxa	*	*	n.s.	*
	No. of Individuals	*	*	*	n.s.
3	Diversity (H')	*	*	*	*
	Species Richness (D)	*	*	n.s.	*
	No. of Taxa	*	*	n.s.	*
	No. of Individuals	*	*	n.s.	*
4	Diversity (H')	*	*	*	n.s.
	Species Richness (D)	*	*	*	*
	No. of Taxa	*	*	n.s.	*
	No. of Individuals	n.s. ²	*	*	*

1 Statistical test results significant at $p = 0.05$

2 Statistical test results not significant at $p = 0.05$

TABLE A-15. ONE-WAY ANOVA RESULTS FOR COMPARISON OF MEAN VALUES FOR SPECIES DIVERSITY AND SPECIES RICHNESS AMONG DISPOSAL SITE STATIONS 1, 3, AND 5. Values enclosed by the same symbol are not different by a multiple-range test.

Survey	Species Diversity		
	5	<u>Station</u> 1	3
1	3.55	4.52	4.67
2	3.94	4.54	4.80
3	3.92	4.73	4.90
4	3.67	4.45	4.69

Survey	Species Richness		
	5	<u>Station</u> 1	3
1	5.39	8.21	8.94
2	6.89	8.35	9.22
3	6.33	8.16	8.64
4	6.46	9.24	10.25

TABLE A-16. ONE-WAY ANOVA RESULTS FOR COMPARISON OF THE MEAN NUMBER OF TAXA AND NUMBER OF INDIVIDUALS AMONG DISPOSAL SITE STATIONS 1, 3 AND 5. Values enclosed by the same symbol are not different by a multiple-range test.

Survey	Mean Number of Taxa/0.1 m ²		
	<u>Station</u>		
	5	1	3
1	48.2	90.5	75.7
2	70.7	94.7	78.7
3	61.0	74.7	76.2
4	66.5	105.2	93.2

Survey	Mean Number of Individuals/0.1 m ²		
	<u>Station</u>		
	5	1	3
1	433.0	1038.2	574.7
2	1118.2	1149.0	648.5
3	722.0	524.5	427.7
4*	1155.7	1154.5	1104.2

* Differences among mean values not statistically significant.

existence of depth X sample-type interaction. The observed interaction in Surveys 2, 3 and 4 was due both to the relative magnitude of effects among stations and to differences in the direction of effects at stations within the two sampling areas.

A.3.3.1.12 Examples of the observed effects of sampling location and sample depth indicated in the two-way ANOVA are presented in Tables A-17 - A-19. The mean value of species diversity in samples at Stations 1, 2 and 4 within the reference site is compared with the mean values observed at the corresponding stations within the disposal area in Table A-17. Diversity at the reference site was in all but a single case greater than the reported diversity from the disposal area. Minimum diversity values were generally found at the deepest stations at both sampling locations. The interaction between sampling depth and location observed in Surveys 2 and 3 (Table A-14) was due to the relative magnitude of the effect at Station 4 (Surveys 2 and 3).

A.3.3.1.13 As shown in Table A-14 statistically significant differences between the reference and disposal sites for the number of taxa per replicate sample were not observed. The mean values for this variable which were compared in the two-way ANOVAs are presented in Table A-18. The mean number of taxa at the corresponding reference and disposal sites was similar. However, statistically significant differences due to sampling depth were observed (Table A-14), and as shown in Table A-18 minimum values for both the reference and disposal sites were observed at the deepest station (Station 4).

A.3.3.1.14 The results of the two-way ANOVA's indicate the existence of significant differences in the mean abundance of organisms between the reference and disposal sites in all four surveys (Table A-14). In three of the four surveys, depth was shown to have a significant effect on the total abundance of organisms. As shown in Table A-19 the mean number of individuals at the disposal-site stations was greater than the number observed at the reference-site stations. Similar to the relationship observed with the other community variables, an inverse relationship was found to exist between depth and number of individual organisms. The data presented in Table A-20 are plotted in Figure A-14. These figures indicate the consistent differences in the mean number of individuals between the reference and disposal sites and the decreased abundance at the deepest of the three stations (Station 4). Seasonal variability in the abundance of organisms was also evident. For all three stations at both the reference and the disposal sites, the minimum number of individuals was observed in the third survey which was conducted during the period March 7-8, 1984.

A.3.3.1.15 Numerical Classification. Numerical classification methods (Described in Section A.2.4) were used to define groups of sampling stations (entities) based on similarities in the abundance of infaunal organisms (attributes). These analyses were conducted with replicate samples combined at each station.

A.3.3.1.16 The results of the numerical classification conducted for each survey with sampling stations as entities are presented in Figure A-15. For each survey, the similarity in infaunal species composition among either stations (five disposal-site and three reference-site stations) is depicted

TABLE A-17. COMPARISON OF THE MEAN VALUE FOR SHANNON-WEAVER DIVERSITY OF REPLICATE SAMPLES ($0.1/m^2$) AT THE REFERENCE- AND DISPOSAL-SITE SAMPLING LOCATIONS

SURVEY	STATION	REFERENCE SITE	DISPOSAL SITE
1	1	5.40	4.52
	2	5.11	4.26
	4	4.70	4.34
2	1	5.20	4.54
	2	5.13	4.48
	4	4.91	3.53
3	1	5.05	4.73
	2	5.21	4.38
	4	4.26	4.49
4	1	4.98	4.69
	2	4.92	4.27
	4	4.53	4.25

TABLE A-18. COMPARISON OF THE MEAN NUMBER OF TAXA PER REPLICATE SAMPLE AT THE REFERENCE- AND DISPOSAL-SITE SAMPLING STATIONS

SURVEY	STATION	NUMBER OF TAXA/0.1m ²	
		REFERENCE SITE	DISPOSAL SITE
1	1	101.2 (87.85-114.65)*	90.5 (66.95-114.05)
	2	94.0 (82.75-105.25)	91.0 (58.24-123.76)
	4	69.0 (63.34-74.66)	55.75 (47.19-64.31)
2	1	75.5 (63.84-87.16)	94.7 (86.19-103.31)
	2	89.5 (70.92-108.08)	84.2 (74.42-94.08)
	4	61.0 (53.20-68.80)	57.5 (38.22-76.78)
3	1	61.2 (50.91-71.59)	74.7 (61.48-88.02)
	2	78.0 (50.11-105.89)	42.2 (7.53-76.97)
	4	37.2 (19.24-55.26)	52.2 (38.47-66.03)
4	1	93.7 (79.03-103.47)	105.2 (86.49-124.01)
	2	106.0 (88.96-123.04)	93.0 (74.96-111.04)
	4	62.0 (53.28-70.72)	52.5 (41.14-63.86)

*95% Confidence Interval

TABLE A-19. COMPARISON OF THE MEAN NUMBER OF TAXA PER REPLICATE SAMPLE
AT THE REFERENCE- AND DISPOSAL-SITE SAMPLING STATIONS

SURVEY	STATION	NUMBER OF TAXA/0.1m ²	
		REFERENCE SITE	DISPOSAL SITE
1	1	829.5 (697.16-961.84)*	1038.2 (634.65-1441.85)
	2	745.2 (500.33-990.17)	1048.0 (672.52-1423.48)
	4	400.7 (333.66-467.84)	382.2 (126.58-637.92)
2	1	424.2 (287.63-560.87)	1149.0 (988.69-1309.31)
	2	550.2 (404.48-696.02)	820.5 (576.36-1064.64)
	4	245.5 (207.46-283.54)	707.0 (134.91-1279.09)
3	1	233.7 (151.45-316.05)	524.5 (371.13-677.87)
	2	372.7 (92.91-652.59)	179.5 (-128.10-487.10)
	4	111.5 (37.80-185.20)	272.2 (168.56-375.94)
4	1	740.7 (634.63-846.87)	1154.5 (784.21-1524.79)
	2	673.5 (608.09-738.91)	965.2 (600.13-1330.37)
	4	354.5 (186.14-522.86)	365.7 (257.02-474.48)

* 95% Confidence Interval

TABLE A-20. MEAN VALUES OF NUMBER OF TAXA, NUMBER OF INDIVIDUALS AND SHANNON-WEAVER DIVERSITY FOR INDIVIDUAL REPLICATE SAMPLES (0.1/m²)

Survey	Group ¹	A				C	D	B	
	Station ²	D1	D2	D3	D5	D4	R4	R1	R2
Number of Taxa (rank ³)									
1		90.5 (4)	91.0 (3)	75.7 (5)	48.2 (8)	55.2 (7)	69.0 (6)	101.2 (1)	94.0 (2)
2		94.8 (1)	84.2 (3)	78.7 (4)	70.7 (6)	57.5 (8)	61.0 (7)	75.5 (5)	89.5 (2)
3		74.7 (3)	42.2 (7)	76.2 (2)	61.0 (5)	52.2 (6)	37.2 (8)	61.2 (4)	78.0 (1)
4		105.2 (2)	93.0 (5)	93.2 (4)	66.5 (6)	52.5 (8)	62.0 (7)	93.7 (3)	106.0 (1)
Number of Individuals (rank)									
1		1038 (2)	1048 (1)	575 (5)	433 (6)	382 (8)	400 (7)	829 (3)	745 (4)
2		1149 (1)	820 (3)	648 (5)	1118 (2)	707 (4)	245 (8)	424 (6)	550 (7)
3		524 (2)	179 (7)	427 (3)	722 (1)	272 (5)	111 (8)	233 (6)	372 (4)
4		1154 (2)	965 (4)	1014 (3)	1156 (1)	366 (7)	354 (8)	741 (5)	674 (6)
Diversity (rank)									
1		4.52 (5)	4.26 (7)	4.67 (4)	3.55 (8)	4.34 (6)	4.70 (3)	5.39 (1)	5.11 (2)
2		4.54 (5)	4.48 (6)	4.80 (4)	3.94 (7)	3.53 (8)	4.92 (3)	5.21 (1)	5.13 (2)
3		4.73 (4)	4.38 (6)	4.90 (3)	3.92 (8)	4.49 (5)	4.26 (7)	5.05 (2)	5.21 (1)
4		4.69 (3)	4.27 (6)	4.45 (5)	3.68 (8)	4.26 (7)	4.53 (4)	4.98 (1)	4.93 (2)

¹Station groups defined on the basis of numerical classification results from the first two surveys (Figure A-15)

²Station designation: R = Reference site; D = Disposal site.

³Stations are ranked within each survey on the basis of computed values of the indicated community index.

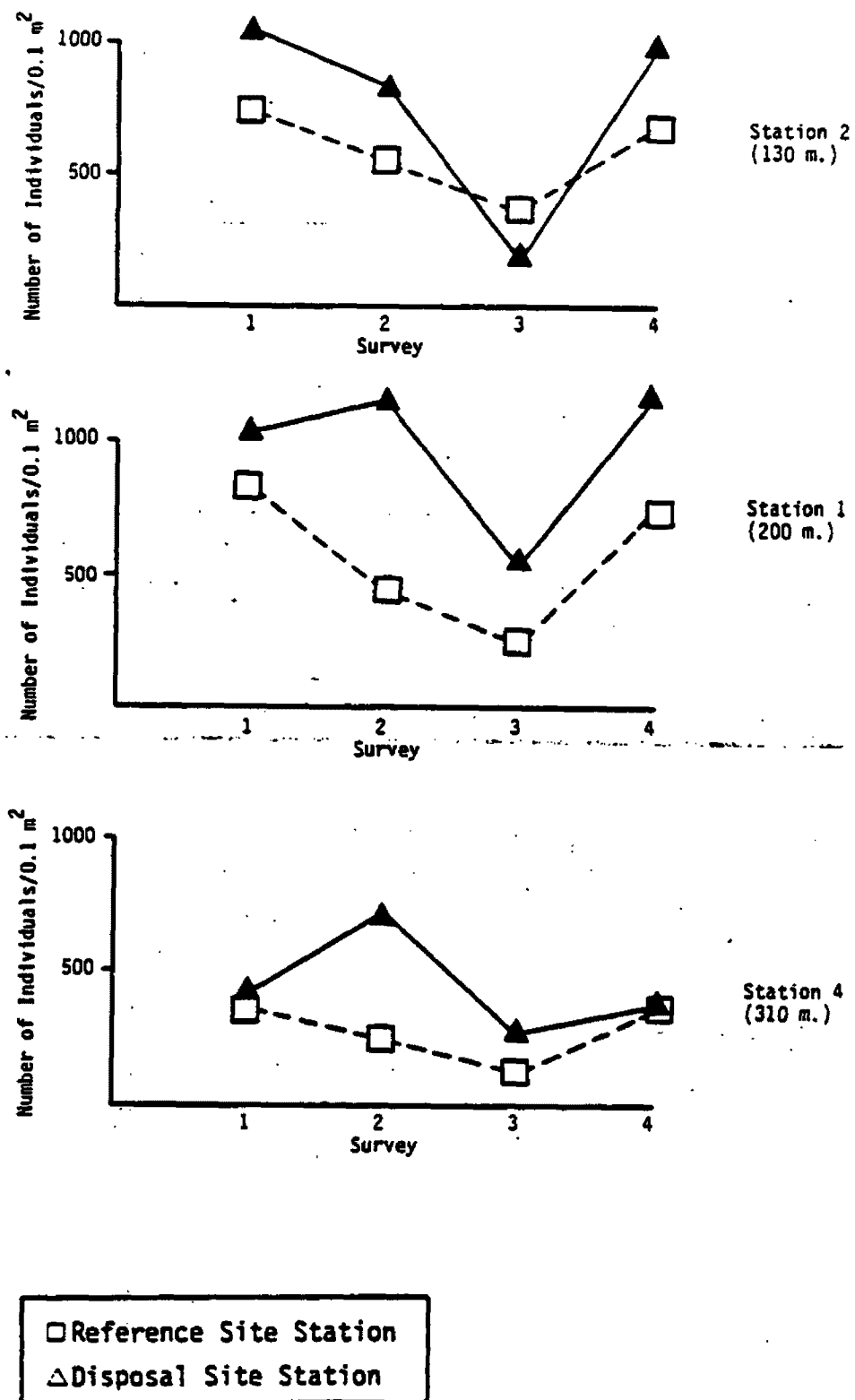


FIGURE A14. MEAN NUMBER OF INDIVIDUALS PER REPLICATE SAMPLE AT REFERENCE - AND DISPOSAL-SITE SAMPLING LOCATIONS. CONNECTING LINES ARE TO ENHANCE READABILITY AND DO NOT INDICATE TRENDS.

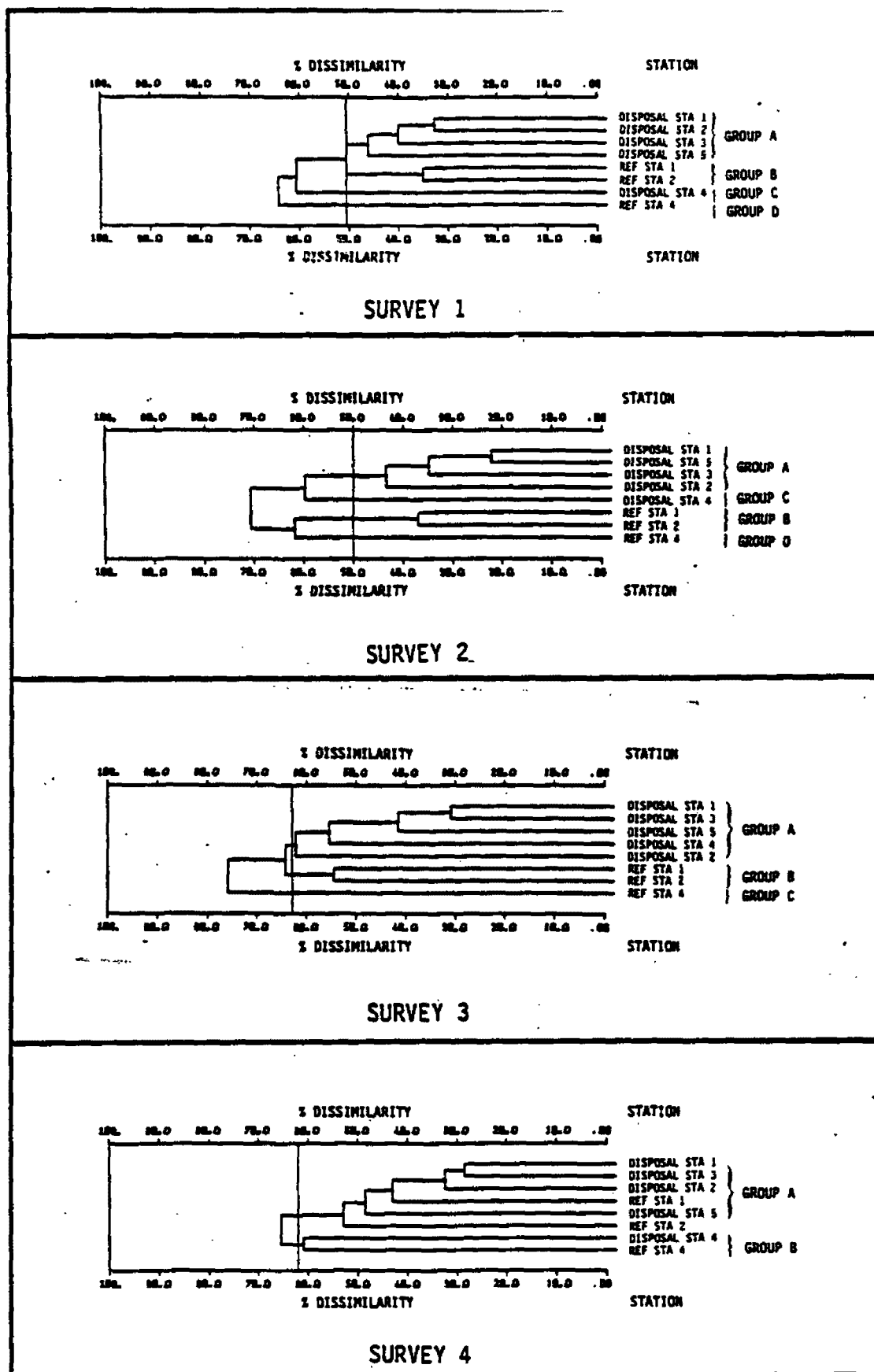


FIGURE A15. NUMERICAL CLASSIFICATION RESULTS. DENDROGRAMS DEPICT THE SIMILARITY IN INFAUNAL COMMUNITY STRUCTURE AMONG EIGHT STATIONS.

in dendrograms. For each survey these stations were partitioned into two to four groups. The delineation of the groups is somewhat of a subjective process. Group selections were made by drawing a line across the dendrogram at a selected level of similarity and defining as a station-group each branch of the dendrogram crossing that level of similarity (Figure A-15). The objective in the group selection process is to preserve the distinct cluster of entities in the dendrogram.

A.3.3.1.17 The results of the classification analysis were similar for the first three surveys. In the first two surveys, four groups of stations, designated A, B, C and D, were identified. Group A consisted of Stations 1, 2, 3 and 5 from the disposal site, and Group B consisted of Stations 1 and 2 from the reference site. Groups C and D were composed of Station 4 from the disposal and reference sites, respectively. In Survey 3, Station 4 showed a greater similarity to the other disposal-site stations, and only three groups of stations were defined. As shown in Figure A-15, reference-site Stations 1 and 2 display consistent similarity in Surveys 1-3, and reference-site Station 4 displayed a high degree of dissimilarity with the other station groups in these surveys. In Survey 4, two groups of stations were defined (Figure A-15). One group (Group B) consisted of the deep-water stations (Station 4) at both the reference and disposal sites. The other group (Group A) consisted of Stations 1, 2, 3 and 5 from the disposal site as well as Stations 1 and 2 from the reference site, which in the previous three surveys showed a high degree of similarity only at each other.

A.3.3.1.8 In an effort to account for the observed similarities among stations, values of the previously defined community indices as well as the physical (i.e., sediment) characteristics of the habitats within each of the defined groups were compared. Consistent differences in the values of computed community indices (see A.3.3.1) were evident among station Groups A, B, C and D (defined in the first two surveys, Figure A-15) over all surveys. In Table A-20, the mean values of Shannon-Weaver Diversity, Number of Taxa and Number of Individuals are presented by individual stations within these four groups. Additionally, the rank of these stations based on the computed values are shown for each survey. In most surveys, the largest number of taxa occurred in station Groups A or B. The greatest abundance of organisms was always found in station Group A, while the diversity of organisms was always greatest in station Group B. The deep-station groups (C and D) were generally characterized by having the fewest taxa and low abundance of organisms. Although these relationships between the community indices and the four groups defined in the first two surveys were consistent over all surveys, Groups A, B, C and D were not consistently defined. The greatest deviation from this pattern of similarity among stations occurred in Survey 4 in which reference Stations 1 and 2 were more similar to those stations within the disposal area than to each other. This may be related to the decrease in species diversity at reference Stations 1 and 2 in the final survey.

A.3.3.1.19 The sediment grain size characteristics at the sampling stations (Figure A-1) are presented in Tables A-21 - A-24. Similarities were observed between disposal- and reference-site sediment characteristics based on the percentage of material in the gravel, sand, silt and clay components. Generally, sediments at all stations consisted of sandy-silt. However, the

TABLE A-21. SUMMARY OF SEDIMENT GRAIN-SIZE ANALYSIS. Survey 1.

TYPE STATION	STATION	REPLICATE	SAMPLING DEPTH (M)	MEAN GRAIN SIZE	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT	PERCENT CLAY
DISPOSAL	1	1	198	4.13	0.00	63.44	27.98	8.13
	1	2	203	3.91	0.88	67.61	24.31	6.92
	1	3	204	3.75	0.31	74.49	17.31	5.74
	1	4	197	3.64	0.57	74.89	20.10	4.30
	2	1	129	5.36	0.69	41.44	41.03	16.61
	2	2	130	3.70	2.01	72.40	20.50	5.92
	2	3	130	4.83	0.00	48.84	34.14	14.31
	2	4	134	4.18	0.00	63.66	28.49	7.48
	3	1	197	4.06	0.00	68.77	27.52	3.62
	3	2	197	3.99	0.17	72.37	23.63	3.50
	3	3	197	4.03	0.00	66.83	29.89	3.48
	3	4	197	4.03	0.40	61.60	33.08	4.86
	4	1	309	4.86	0.00	34.66	30.87	13.32
	4	2	319	4.69	0.00	54.10	34.49	10.71
	4	3	307	4.23	0.00	66.22	22.64	10.62
	4	4	311	4.55	0.00	60.39	26.28	12.78
	5	1	200	3.96	0.40	62.74	27.61	9.08
	5	2	201	3.44	1.50	69.32	19.39	9.64
	5	3	201	3.83	2.48	79.43	13.80	4.20
	5	4	201	3.79	0.82	63.48	12.00	3.39
REFERENCE	1	1	193	4.41	0.00	65.31	26.90	7.21
	1	2	195	4.27	0.00	48.36	24.96	4.17
	1	3	197	4.42	0.00	70.05	21.75	7.79
	1	4	196	4.38	0.00	67.76	24.95	6.91
	2	1	130	4.29	0.00	74.35	16.96	8.20
	2	2	131	4.38	0.00	72.52	17.99	8.95
	2	3	133	4.31	0.00	73.52	18.01	8.00
	2	4	133	4.20	0.00	73.98	19.60	7.07
	4	1	304	4.91	0.00	35.49	57.19	4.98
	4	2	304	4.83	0.00	37.88	54.75	7.02
	4	3	308	4.97	0.00	39.09	51.15	9.34
	4	4	304	5.03	0.00	38.53	51.53	9.54

TABLE A-2.2. SUMMARY OF SEDIMENT GRAIN-SIZE ANALYSIS. Survey 2.

TYPE STATION	STATION	REPLICATE	SAMPLING DEPTH (m)	MEAN GRAIN SIZE	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT	PERCENT CLAY
DISPOBAL	1	1	192	3.36	3.98	72.98	19.82	6.99
	1	2	194	4.93	0.00	54.87	31.97	13.67
	1	3	192	3.50	0.00	38.51	39.76	21.21
	1	4	210	3.18	11.69	41.84	13.36	9.52
	2	1	130	2.19	0.00	15.91	58.10	25.60
	2	2	130	3.63	0.00	26.93	54.21	14.34
	2	3	127	3.87	7.46	23.32	36.79	31.76
	2	4	128	3.63	0.00	36.30	40.81	22.51
	3	1	200	4.21	0.00	66.06	26.10	7.32
	3	2	204	4.30	0.00	63.56	30.14	6.19
	3	3	206	4.30	0.00	60.76	31.99	7.10
	3	4	198	4.50	0.00	61.41	30.13	7.91
	4	1	313	4.23	0.00	63.58	25.91	9.81
	4	2	300	4.01	0.00	68.35	20.84	9.55
	4	3	299	4.40	0.00	58.97	30.88	8.75
	4	4	298	3.79	2.12	70.24	17.82	9.04
	5	1	197	4.21	5.26	56.59	21.41	14.73
	5	2	200	4.17	0.00	61.46	24.75	12.20
	5	3	193	3.10	0.00	82.99	8.47	7.42
	5	4	201	4.23	0.00	62.02	22.91	13.38
REFERENCE	1	1	198	3.91	0.00	76.57	20.15	3.26
	1	2	197	4.06	0.00	73.99	20.03	5.89
	1	3	198	3.94	0.00	76.10	18.18	5.61
	1	4	197	4.10	0.00	75.98	17.13	4.70
	2	1	127	4.01	0.00	77.74	19.14	3.13
	2	2	128	3.98	0.00	75.21	18.44	6.06
	2	3	129	3.82	0.00	79.08	16.96	3.89
	2	4	128	3.88	0.00	78.16	13.24	6.46
	4	1	305	4.81	0.00	52.47	37.47	8.79
	4	2	305	4.72	0.00	49.92	41.61	7.91
	4	3	304	4.79	0.00	52.53	39.33	7.01
	4	4	305	4.62	0.00	51.23	39.56	8.63

TABLE A-2.3 SUMMARY OF SEDIMENT GRAIN-SIZE ANALYSIS. Survey 3.

TYPE STATION	STATION	REPLICATE	SAMPLING DEPTH (M)	MEAN GRAIN SIZE	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT	PERCENT CLAY -
DISPOSAL	1	1	200	3.59	0.00	46.72	31.14	20.59
	1	2	198	3.20	0.00	47.20	32.31	19.14
	1	3	197	4.03	0.00	37.33	31.60	30.11
	1	4	196	4.82	0.00	37.82	33.88	17.88
	2	1	127	3.92	4.87	44.11	20.79	8.84
	2	2	131	4.44	0.22	38.32	26.79	12.91
	2	3	127	4.44	0.00	19.00	48.15	32.84
	2	4	127	4.29	0.00	23.92	49.01	25.12
	3	1	197	4.83	0.00	56.40	34.33	7.96
	3	2	197	4.39	0.00	61.38	31.46	4.40
	3	3	196	4.47	0.00	60.02	31.98	4.81
	3	4	196	4.84	0.00	52.21	34.16	9.99
	4	1	307	3.35	2.25	78.80	17.53	4.83
	4	2	312	3.99	3.17	66.39	19.47	9.44
	4	3	307	3.57	9.41	60.69	18.49	9.89
	4	4	309	3.82	0.00	71.24	19.61	7.94
	5	1	200	3.56	1.84	71.06	17.74	8.39
	5	2	196	3.07	9.59	62.45	17.17	10.05
	5	3	197	3.08	0.00	78.09	14.60	4.33
	5	4	199	3.87	0.00	74.27	16.09	8.93
REFERENCE	1	1	196	4.34	0.00	70.26	21.14	7.28
	1	2	197	4.20	0.00	69.90	22.55	6.61
	1	3	196	4.28	0.00	70.82	20.90	7.13
	1	4	197	4.19	0.00	70.70	21.61	7.49
	2	1	129	4.08	0.00	73.34	19.73	6.71
	2	2	128	3.98	0.00	74.60	19.75	4.73
	2	3	127	4.26	0.00	70.37	20.79	7.51
	2	4	125	4.39	0.00	67.60	22.09	8.77
	4	1	308	5.14	0.00	40.96	46.71	10.76
	4	2	307	5.11	0.00	47.83	38.98	11.23
	4	3	312	5.20	0.00	44.33	42.20	12.38
	4	4	308	5.14	0.00	41.48	45.29	11.42

TABLE A-24. SUMMARY OF SEDIMENT GRAIN-SIZE ANALYSIS. Survey 4.

TYPE STATION	STATION	REPLICATE	SAMPLING DEPTH [M]	MEAN GRAIN SIZE	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT	PERCENT CLAY
DISPOSAL	1	1	200	4.81	2.17	54.64	24.16	16.68
	1	2	198	4.34	4.48	52.08	24.09	16.10
	1	3	198	3.43	0.00	70.83	18.71	10.26
	1	4	198	3.59	0.00	41.34	36.58	19.63
	2	1	131	5.08	0.00	47.27	34.46	17.04
	2	2	127	4.24	0.00	19.14	58.79	25.41
	2	3	130	4.43	0.00	14.24	59.89	25.34
	2	4	130	5.83	0.00	29.94	46.37	23.14
	3	1	196	4.80	0.00	60.73	27.03	10.53
	3	2	197	4.53	0.00	61.43	28.54	8.68
	3	3	195	4.84	0.00	62.78	27.82	8.30
	3	4	196	4.44	0.00	62.11	29.71	7.18
	4	1	307	5.28	1.39	43.07	30.83	19.91
	4	2	309	3.54	0.00	78.98	14.04	4.23
	4	3	313	3.83	3.62	63.34	21.03	8.49
	4	4	313	3.88	2.92	64.80	21.79	9.16
	5	1	200	3.12	0.00	82.98	9.80	4.53
	5	2	200	3.97	0.00	33.36	41.49	22.07
	5	3	200	4.22	0.00	43.08	21.36	11.78
	5	4	200	4.79	0.00	50.14	34.50	13.34
REFERENCE	1	1	197	4.26	0.00	73.28	18.33	7.23
	1	2	196	4.10	0.00	73.31	17.92	5.77
	1	3	195	4.13	0.00	76.27	16.21	6.73
	1	4	193	4.12	0.00	74.91	17.93	6.20
	2	1	130	4.10	0.00	79.34	12.42	4.80
	2	2	131	3.92	0.00	78.36	16.31	4.77
	2	3	128	3.98	0.00	74.65	18.03	6.34
	2	4	126	4.00	2.99	70.16	17.97	7.93
	4	1	307	5.04	0.00	47.03	40.33	11.08
	4	2	307	5.11	0.00	51.57	34.48	11.90
	4	3	308	5.16	0.00	44.84	41.58	11.73
	4	4	307	5.36	0.00	39.26	42.57	14.08

distribution of sediments at the reference-site stations showed less variation over the four surveys than the disposal-site stations. Sediment at reference-site Stations 1 and 2 consisted of between 66-79 percent sand and 13-27 percent silt in all surveys. Sediments at reference-site Station 4, the deepest station at 310 m, consisted of approximately equal fractions of sand and silt. The disposal-site stations exhibited greater variation both among replicate samples and between surveys. For example, at Station 2 sandy sediments represented 41-72 percent of the total in the first survey (Table A-21) and 16-36 percent in the second survey (Table A-22). Disposal-site stations generally exhibited a larger proportion of clays than the reference stations, but the contribution of these sediments to the total was also highly variable. For example, clay represented 4-8 percent of the total sediments at disposal-site Station 1 in the first survey (Table A-21) and 7-21 percent in the second survey (Table A-22). Sediments at disposal-site Station 3 were most similar to those at reference-site Stations 1 and 2.

A.3.3.1.20 To further demonstrate the greater degree of variability in sediment characteristics at the disposal-site stations, the sediment grain-size distribution for one-unit phi intervals over the range -1 to +13 is presented for all samples in Tables A-25 - A-28. Characteristically, the reference-site sediments were composed primarily of very fine sand to coarse silt (phi intervals 2-4). The larger sediments (phi intervals greater than 2) represented less than 3 percent of the total in all reference-site samples. Likewise, a consistent pattern was observed in the small contribution of very fine sediments to the total. At the disposal-site stations, sediments were widely distributed over the different phi intervals, and both the coarse and fine sediment intervals were well represented at all stations.

A.3.3.1.21 Correlation Analysis. Special sampling gear was used in these field surveys which allowed infaunal samples and sediment samples for physical-chemical analyses to be collected in tandem. Sixty-nine of the 128 samples (54 percent) collected in the four surveys represent paired infauna/sediment samples. The data from these 69 samples were used to determine the correlation between biological and environmental variables.

A.3.3.1.22 A summary of the correlations that existed between the infaunal community indices and environmental variables measured during this study is presented in Table A-29. Statistically significant correlations were observed between infaunal community indices and sediment grain-size characteristics. Species diversity and species richness were negatively correlated with the proportion of medium to fine sand in the samples and positively correlated to the proportion of very fine sand and coarse silt. Similarly, the total number of taxa showed a statistically significant negative correlation to the proportion of medium sand and a positive correlation with the proportion of very fine sand in the samples. This pattern was reversed with number of individuals. The total number of individuals per sample was positively correlated with medium and fine sand and negatively correlated with coarse and medium silt. These results reflect the differences in the community variables among stations summarized in Table A-20. The number of taxa and diversity were highest at the reference stations where the greatest proportion of the sediments in the samples were between the phi-unit intervals of 3 to 5.

TABLE A-25. GRAIN-SIZE ANALYSIS - SEDIMENT WEIGHT DISTRIBUTION BY PHI INTERVALS. Survey 1.

TYPE STATION	STATION	REPLICATE	PHI-1 to PHI00	PHI00 to PHI01	PHI01 to PHI02	PHI02 to PHI03	PHI03 to PHI04	PHI04 to PHI05	PHI05 to PHI06	PHI06 to PHI07	PHI07 to PHI08	PHI08 to PHI09	PHI09 to PHI10	PHI10 to PHI11	PHI11 to PHI12	PHI12 to PHI13	PHI13 to PHI14	PHI14 to PHI15
DISTRIBUTION	1	1	0.00	3.20	10.97	24.46	32.13	4.92	3.79	0.81	4.24	4.24	1.93	0.00	0.00	0.00	0.00	0.00
	1	1	0.00	1.72	9.47	20.12	24.37	0.24	7.18	0.81	4.24	4.24	1.93	0.00	0.00	0.00	0.00	0.00
	1	1	0.00	0.48	10.72	21.12	23.42	0.12	4.03	0.81	4.24	4.24	1.93	0.00	0.00	0.00	0.00	0.00
	2	1	0.00	0.18	10.92	21.22	23.24	7.26	4.72	4.78	3.04	1.40	1.32	0.34	0.44	0.24	0.21	0.21
	2	1	0.00	0.21	7.31	18.28	19.84	3.41	11.58	14.41	3.12	7.24	3.04	1.24	1.88	0.49	0.71	0.71
	2	2	0.00	0.24	7.47	27.79	30.40	6.40	7.80	6.44	3.44	0.82	1.28	0.47	0.49	0.00	0.00	0.00
	2	2	0.00	0.26	9.97	27.64	14.78	11.43	3.87	7.20	3.22	7.73	3.74	0.00	0.00	0.00	0.00	0.00
	2	2	0.00	0.41	8.47	26.83	37.44	17.39	5.12	3.28	1.03	4.03	1.74	0.00	0.00	0.00	0.00	0.00
	2	2	0.00	0.34	3.26	10.93	37.44	12.95	3.43	3.28	1.73	0.78	0.82	0.33	0.43	0.14	0.07	0.07
	2	2	0.00	0.40	3.26	10.41	32.24	19.09	3.48	3.42	1.28	0.78	0.77	0.31	0.48	0.17	0.18	0.18
	2	2	0.00	0.23	3.26	10.41	32.24	19.09	3.48	3.42	1.28	0.78	0.77	0.31	0.48	0.17	0.18	0.18
	2	2	0.00	0.44	7.37	11.42	43.44	20.49	4.01	4.44	3.77	3.72	1.12	0.00	0.00	0.00	0.00	0.00
	2	2	0.00	0.44	7.37	11.42	43.44	20.49	4.01	4.44	3.77	3.72	1.12	0.00	0.00	0.00	0.00	0.00
	2	2	0.00	0.44	7.37	11.42	43.44	20.49	4.01	4.44	3.77	3.72	1.12	0.00	0.00	0.00	0.00	0.00
	2	2	0.00	0.44	7.37	11.42	43.44	20.49	4.01	4.44	3.77	3.72	1.12	0.00	0.00	0.00	0.00	0.00
	2	2	0.00	0.44	7.37	11.42	43.44	20.49	4.01	4.44	3.77	3.72	1.12	0.00	0.00	0.00	0.00	0.00
	2	2	0.00	0.44	7.37	11.42	43.44	20.49	4.01	4.44	3.77	3.72	1.12	0.00	0.00	0.00	0.00	0.00
	2	2	0.00	0.44	7.37	11.42	43.44	20.49	4.01	4.44	3.77	3.72	1.12	0.00	0.00	0.00	0.00	0.00
	2	2	0.00	0.44	7.37	11.42	43.44	20.49	4.01	4.44	3.77	3.72	1.12	0.00	0.00	0.00	0.00	0.00
	2	2	0.00	0.44	7.37	11.42	43.44	20.49	4.01	4.44	3.77	3.72	1.12	0.00	0.00	0.00	0.00	0.00
	2	2	0.00	0.44	7.37	11.42	43.44	20.49	4.01	4.44	3.77	3.72	1.12	0.00	0.00	0.00	0.00	0.00
REFERENCE	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83
	1	1	0.00	0.00	0.00	0.00	42.20	19.00	4.24	2.24	1.20	0.98	0.08	0.74	1.43	0.47	0.83	0.83



TABLE A-26. GRAIN-SIZE ANALYSIS - SEDIMENT WEIGHT DISTRIBUTION BY PHI INTERVALS. Survey 2.

TYPE STATION	STATION	REPLICATE	PHI-1 to PHI-0	PHI-0 to PHI-1	PHI-1 to PHI-2	PHI-2 to PHI-3	PHI-3 to PHI-4	PHI-4 to PHI-5	PHI-5 to PHI-6	PHI-6 to PHI-7	PHI-7 to PHI-8	PHI-8 to PHI-9	PHI-9 to PHI-10	PHI-10 to PHI-11	PHI-11 to PHI-12	PHI-12 to PHI-13	PHI-13 to PHI-14	PHI-14 to PHI-15
DISPOSAL																		
1	1	1	0.00	1.92	14.98	24.11	19.97	4.67	4.89	2.43	2.19	1.94	0.94	1.89	0.67	1.16	0.37	0.00
1	1	2	0.00	0.84	2.33	18.74	31.74	9.99	10.77	6.96	4.49	4.03	2.44	3.12	0.82	2.10	0.52	0.00
1	1	3	0.00	1.33	9.87	18.83	7.78	11.11	6.37	10.83	9.23	6.63	2.44	4.44	1.52	3.33	0.45	0.00
1	1	4	0.00	0.39	7.95	34.43	18.83	4.04	3.42	3.03	2.89	2.34	0.96	3.98	0.79	2.01	0.48	0.00
2	2	1	0.00	0.44	2.23	7.17	8.07	28.40	10.30	9.39	11.81	7.98	3.76	9.01	1.98	3.27	0.00	0.00
2	2	2	0.00	0.80	4.39	11.77	9.07	27.89	9.31	6.72	6.29	4.11	0.70	5.25	1.43	3.37	0.92	0.00
2	2	3	0.00	0.49	3.91	10.42	9.17	27.89	9.31	10.41	11.22	11.91	3.74	9.25	2.19	4.43	0.94	0.00
2	2	4	0.00	0.49	3.91	10.42	9.17	27.89	9.31	10.41	11.22	11.91	3.74	9.25	2.19	4.43	0.94	0.00
3	3	1	0.00	0.48	1.93	16.88	48.77	13.93	8.37	9.34	8.94	8.07	1.94	1.96	1.83	2.79	0.00	0.00
3	3	2	0.00	0.48	1.93	16.88	48.77	13.93	8.37	9.34	8.94	8.07	1.94	1.96	1.83	2.79	0.00	0.00
3	3	3	0.00	0.48	1.93	16.88	48.77	13.93	8.37	9.34	8.94	8.07	1.94	1.96	1.83	2.79	0.00	0.00
3	3	4	0.00	0.44	0.94	3.14	34.78	19.02	9.74	2.12	0.43	1.21	1.94	0.83	0.49	0.44	0.00	0.00
4	4	1	0.00	0.44	0.94	3.14	34.78	19.02	9.74	2.12	0.43	1.21	1.94	0.83	0.49	0.44	0.00	0.00
4	4	2	0.00	1.08	10.42	30.89	21.19	9.79	8.74	3.12	2.93	2.37	1.06	2.06	0.74	1.27	0.41	0.00
4	4	3	0.00	1.08	10.42	30.89	21.19	9.79	8.74	3.12	2.93	2.37	1.06	2.06	0.74	1.27	0.41	0.00
4	4	4	0.00	1.08	10.42	30.89	21.19	9.79	8.74	3.12	2.93	2.37	1.06	2.06	0.74	1.27	0.41	0.00
4	4	5	0.00	1.08	10.42	30.89	21.19	9.79	8.74	3.12	2.93	2.37	1.06	2.06	0.74	1.27	0.41	0.00
5	5	1	0.34	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	2	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	3	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	4	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	5	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	6	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	7	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	8	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	9	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	10	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	11	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	12	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	13	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	14	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	15	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	16	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	17	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	18	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	19	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
5	5	20	0.00	1.78	12.76	34.74	22.11	11.87	9.31	2.87	3.11	1.90	1.12	3.07	0.76	1.87	0.48	0.00
REFERENCE																		
1	1	1	0.00	0.00	0.00	8.73	78.84	12.03	4.11	0.34	2.77	0.19	1.85	0.12	0.93	0.03	0.12	0.00
1	1	2	0.00	0.00	0.00	7.32	44.47	14.75	3.12	0.70	1.44	1.14	1.84	0.02	1.14	0.44	0.44	0.00
1	1	3	0.00	0.00	0.00	6.47	70.17	12.71	2.43	1.81	0.23	2.41	1.84	0.02	2.03	0.13	0.03	0.00
1	1	4	0.00	0.00	0.00	4.40	49.58	11.40	2.75	1.17	0.41	0.20	3.03	0.23	2.03	0.16	1.03	0.00
2	2	1	0.00	0.00	0.00	1.21	74.93	13.43	2.41	0.47	0.41	0.20	1.73	0.01	1.21	0.03	0.12	0.00
2	2	2	0.00	0.00	0.00	1.33	39.30	12.44	2.40	1.94	0.92	1.17	1.94	0.01	1.33	0.03	0.04	0.00
2	2	3	0.00	0.00	0.00	12.37	43.99	11.77	2.41	1.43	0.24	1.33	0.43	2.01	0.15	0.00	0.00	0.00
2	2	4	0.00	0.00	0.00	10.99	38.73	11.49	2.15	1.24	3.01	3.00	0.33	2.01	0.70	1.03	0.40	0.00
4	4	1	0.00	0.00	0.00	1.47	50.60	23.87	8.11	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	2	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	3	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	4	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	5	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	6	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	7	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	8	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	9	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	10	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	11	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	12	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	13	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	14	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	15	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	16	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	17	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	18	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	19	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00
4	4	20	0.00	0.00	0.00	1.23	48.39	27.74	8.07	2.48	3.08	3.47	0.63	2.70	0.19	1.03	0.40	0.00



TABLE A-27. GRAIN-SIZE ANALYSIS - SEDIMENT WEIGHT DISTRIBUTION BY PHI INTERVALS. Survey 3.

TYPE STATION	STATION	REPLICATE	PHI-1 to PHI00	PHI00 to PHI01	PHI01 to PHI02	PHI02 to PHI03	PHI03 to PHI04	PHI04 to PHI05	PHI05 to PHI06	PHI06 to PHI07	PHI07 to PHI08	PHI08 to PHI09	PHI09 to PHI10	PHI10 to PHI11	PHI11 to PHI12	PHI12 to PHI13	PHI13 to PHI14	PHI14 to PHI15
DISPOSAL	1	1	0.00	0.31	4.03	23.83	17.13	9.32	7.12	7.43	7.09	3.04	2.43	0.00	7.48	0.11	4.44	0.00
	1	2	0.00	1.70	9.00	19.09	16.33	12.31	6.70	4.06	7.34	3.93	2.30	3.22	1.47	3.20	0.82	0.00
	1	3	0.00	1.31	7.34	19.91	16.37	12.31	9.44	4.77	11.16	8.13	4.42	9.11	3.38	4.74	1.11	0.00
	1	4	0.00	0.42	4.84	17.98	12.38	7.42	3.73	3.41	3.22	3.23	2.16	3.42	1.37	2.23	0.34	0.00
	2	1	0.00	0.71	7.34	26.36	27.78	7.98	4.76	4.39	3.46	3.08	0.31	2.76	0.74	2.00	0.50	0.00
	2	2	0.00	0.33	6.33	24.48	24.76	12.61	3.92	3.48	4.78	3.34	1.32	3.47	1.04	2.48	0.46	0.00
	2	3	0.00	0.28	2.71	6.24	7.77	13.11	7.23	11.12	12.37	10.03	7.91	0.00	13.03	0.31	1.43	0.00
	2	4	0.00	0.40	2.41	6.34	12.87	19.91	11.04	9.16	8.88	6.01	3.42	7.33	2.13	4.41	1.20	0.00
	3	1	0.00	0.30	1.44	9.78	14.40	22.90	4.92	1.83	3.48	2.00	0.18	2.74	0.71	1.84	0.43	0.00
	3	2	0.00	0.32	1.37	3.40	33.89	33.43	4.31	2.34	0.98	0.28	1.75	2.74	1.97	0.44	0.30	0.00
	3	3	0.00	0.35	1.38	4.48	33.41	33.42	9.70	1.61	1.03	0.91	0.33	2.32	0.49	1.70	0.44	0.00
	3	4	0.00	0.00	1.83	3.19	33.19	33.03	6.38	2.81	1.93	1.00	0.38	3.44	0.97	2.32	0.42	0.00
	4	1	0.00	1.44	14.14	29.84	20.98	10.22	3.83	1.98	1.83	1.83	0.64	1.37	1.84	1.33	1.17	0.00
	4	2	0.00	1.42	11.42	33.03	14.88	4.43	4.37	2.83	3.84	1.83	0.83	2.23	1.88	1.24	0.42	0.00
	4	3	0.00	1.42	14.44	33.10	19.08	9.33	3.07	2.70	2.91	2.01	0.52	2.37	1.88	1.24	0.42	0.00
	4	4	1.19	4.76	23.14	28.09	13.77	3.81	4.18	4.03	3.73	2.97	1.64	0.89	0.47	1.34	0.00	0.00
	5	1	0.00	6.12	22.21	22.11	13.01	4.41	4.35	2.94	3.46	2.35	1.77	0.00	2.30	0.41	2.22	0.00
	5	2	1.50	9.78	30.69	27.46	8.48	5.19	3.73	1.84	3.42	1.74	1.34	2.09	0.30	1.41	0.32	0.00
	5	3	0.00	2.34	26.72	36.19	11.00	7.38	4.41	2.14	3.12	1.74	1.30	1.96	1.39	0.89	0.43	0.00
REFERENCE	1	1	0.00	0.00	0.00	3.79	44.91	14.49	4.34	1.26	0.87	1.01	0.34	2.70	0.74	1.82	0.47	0.00
	1	2	0.00	0.00	0.00	8.15	44.75	17.77	3.37	0.21	1.00	1.92	0.32	2.02	0.48	1.34	0.31	0.00
	1	3	0.00	0.00	0.00	3.42	43.40	13.84	3.33	0.44	1.03	1.23	0.73	2.43	0.47	1.44	0.43	0.00
	1	4	0.00	0.00	0.00	7.03	43.47	13.59	3.31	1.42	1.09	1.34	1.10	2.47	0.49	1.34	0.30	0.00
	2	1	0.00	0.00	0.00	17.44	33.48	14.24	2.89	1.23	1.37	0.22	3.02	0.26	2.02	0.17	1.02	0.00
	2	2	0.00	0.91	13.45	40.04	13.19	14.31	3.03	1.43	1.11	0.24	0.19	1.94	0.49	1.31	0.31	0.00
	2	3	0.00	0.00	1.24	34.88	13.91	14.31	4.81	1.41	1.80	1.02	0.47	2.49	0.80	1.82	0.51	0.00
	2	4	0.00	2.33	44.39	14.29	14.31	14.31	4.81	1.41	1.74	1.41	0.41	3.32	0.83	2.24	0.34	0.00
	4	1	0.00	0.47	2.33	20.31	39.78	28.47	10.78	3.80	3.44	2.41	1.31	3.38	0.84	2.28	0.34	0.00
	4	2	0.00	0.00	0.33	1.43	43.43	22.10	8.34	3.38	2.31	1.37	1.31	2.09	1.12	2.74	0.71	0.00
	4	3	0.00	0.00	0.33	1.29	43.43	22.10	11.74	4.93	2.44	2.04	1.44	4.29	1.14	2.42	0.43	0.00
	4	4	0.00	0.30	0.30	1.30	39.48	20.80	7.73	3.43	2.11	2.41	1.01	3.74	1.04	2.33	0.47	0.00



TABLE A-28. GRAIN-SIZE ANALYSIS - SEDIMENT WEIGHT DISTRIBUTION BY PHI INTERVALS. Survey 4.

TYPE STATION	STATION	REPLICATE	PHI-1 to PHI-0	PHI-0 to PHI-1	PHI-1 to PHI-2	PHI-2 to PHI-3	PHI-3 to PHI-4	PHI-4 to PHI-5	PHI-5 to PHI-6	PHI-6 to PHI-7	PHI-7 to PHI-8	PHI-8 to PHI-9	PHI-9 to PHI-10	PHI-10 to PHI-11	PHI-11 to PHI-12	PHI-12 to PHI-13	PHI-13 to PHI-14	PHI-14 to PHI-15
DISPICAL	1	1	0.00	1.43	9.86	31.04	12.21	4.12	9.01	3.32	3.44	3.78	2.81	4.74	1.23	3.22	0.98	0.00
	1	1	0.00	1.78	7.83	27.11	18.24	7.43	4.28	3.43	4.91	3.98	2.21	4.74	1.47	2.90	0.82	0.00
	1	1	0.00	0.24	19.03	39.27	14.27	7.84	4.28	3.43	4.91	3.98	2.21	4.74	1.47	2.90	0.82	0.00
	2	2	0.00	0.47	7.43	19.44	11.40	7.43	4.28	3.43	4.91	3.98	2.21	4.74	1.47	2.90	0.82	0.00
	2	2	0.00	0.40	6.86	21.47	10.36	16.46	8.31	3.85	4.91	3.98	2.21	4.74	1.47	2.90	0.82	0.00
	2	2	0.00	0.34	2.29	6.42	4.38	27.43	12.32	9.78	13.84	7.11	3.48	4.49	2.01	3.39	0.00	0.00
	2	2	0.00	0.40	9.24	13.93	10.37	16.46	12.32	9.78	13.84	7.11	3.48	4.49	2.01	3.39	0.00	0.00
	2	2	0.00	0.00	1.43	4.30	32.82	16.31	4.23	3.94	10.71	4.81	1.29	3.39	1.03	2.29	0.88	0.00
	2	2	0.00	0.00	1.43	4.30	32.82	16.31	4.23	3.94	10.71	4.81	1.29	3.39	1.03	2.29	0.88	0.00
	2	2	0.00	0.00	1.43	4.30	32.82	16.31	4.23	3.94	10.71	4.81	1.29	3.39	1.03	2.29	0.88	0.00
	2	2	0.00	0.00	1.43	4.30	32.82	16.31	4.23	3.94	10.71	4.81	1.29	3.39	1.03	2.29	0.88	0.00
	2	2	0.00	0.00	1.43	4.30	32.82	16.31	4.23	3.94	10.71	4.81	1.29	3.39	1.03	2.29	0.88	0.00
	2	2	0.00	0.00	1.43	4.30	32.82	16.31	4.23	3.94	10.71	4.81	1.29	3.39	1.03	2.29	0.88	0.00
	2	2	0.00	0.00	1.43	4.30	32.82	16.31	4.23	3.94	10.71	4.81	1.29	3.39	1.03	2.29	0.88	0.00
	2	2	0.00	0.00	1.43	4.30	32.82	16.31	4.23	3.94	10.71	4.81	1.29	3.39	1.03	2.29	0.88	0.00
	2	2	0.00	0.00	1.43	4.30	32.82	16.31	4.23	3.94	10.71	4.81	1.29	3.39	1.03	2.29	0.88	0.00
	2	2	0.00	0.00	1.43	4.30	32.82	16.31	4.23	3.94	10.71	4.81	1.29	3.39	1.03	2.29	0.88	0.00
	2	2	0.00	0.00	1.43	4.30	32.82	16.31	4.23	3.94	10.71	4.81	1.29	3.39	1.03	2.29	0.88	0.00
	2	2	0.00	0.00	1.43	4.30	32.82	16.31	4.23	3.94	10.71	4.81	1.29	3.39	1.03	2.29	0.88	0.00
REFERENCE	1	1	0.00	0.23	0.23	4.14	44.45	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	1	1	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	1	1	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00
	2	2	0.00	0.00	0.23	14.82	40.41	12.74	5.47	1.24	1.48	1.47	0.47	2.34	0.70	1.59	0.44	0.00



TABLE A-29. PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS BETWEEN SELECTED INFAUNAL COMMUNITY INDICES AND PHYSICAL-CHEMICAL VARIABLES. Correlations based on 69 samples.

<u>Grain-Size Characteristics (phi Intervals)</u>	<u>Species Diversity</u>	<u>Species Richness</u>	<u>Number of Taxa</u>	<u>Number of Individuals</u>
Medium Sand (01-02)	-0.7456 P=0.000	-0.5627 P=0.000	-0.3812 P=0.001	0.2386 P=0.024
Fine Sand (02-03)	-0.6039 P=0.000	-0.2894 P=0.008	-0.0987 P=0.210	0.4045 P=0.000
Very Fine Sand (03-04)	0.7098 P=0.000	0.3963 P=0.000	0.2079 P=0.043	-0.3569 P=0.001
Coarse Silt (04-05)	0.3613 P=0.001	0.0914 P=0.228	-0.0728 P=0.276	-0.4258 P=0.000
Medium Silt (05-06)	-0.2499 P=0.019	-0.1515 P=0.107	-0.1285 P=0.146	0.0079 P=0.474
<u>Sediment Metal Concentration</u>				
Cu	-0.5488 P=0.000	-0.2931 P=0.007	-0.1269 P=0.149	0.3464 P=0.002
Pb	-0.4473 P=0.000	-0.2550 P=0.017	-0.1312 P=0.141	0.2686 P=0.013
Hg	0.4604 P=0.000	-0.3547 P=0.001	-0.2396 P=0.024	0.1534 P=0.104
Zn	-0.5361 P=0.000	-0.2385 P=0.024	-0.0886 P=0.234	0.3074 P=0.005
As	-0.4354 P=0.000	-0.1188 P=0.167	0.0245 P=0.421	0.3785 P=0.001
Cd	-0.2054 P=0.045	0.0289 P=0.407	0.1022 P=0.202	0.2295 P=0.029
Cr	-0.3157 P=0.004	-0.1525 P=0.106	-0.0804 P=0.256	0.1320 P=0.140
<u>Sample Depth</u>	-0.2834 P=0.009	-0.5109 P=0.000	-0.5451 P=0.000	-0.3676 P=0.001



Moreover, the highest values for total number of individuals were observed at stations within the disposal area where the coarse sediments were more abundant.

A.3.3.1.23 Statistically significant correlations were observed between sediment metal concentrations and infaunal community indices (Table A-29). These correlations were negative between species diversity and the concentrations of all seven metals analyzed. Statistically significant negative correlations were also observed between species richness and four of the metals (Cu, Pb, Hg and Zn). Only the correlation between the number of taxa and mercury concentration was statistically significant. Statistically significant positive correlations were observed between the number of individuals and the concentration of five of the metals (Cu, Pb, Zn, As and Cd). These latter results probably do not mean that higher numbers of individuals result from higher metal levels, but that both metal levels and number of individuals are positively correlated with a third variable, in this case percent silt.

A.3.3.1.24 All four community indices were negatively correlated with depth. These results generally support the previous observations concerning the effects of station location on these infaunal community indices. The minimum values for the community indices were generally observed at the deepest stations (approximately 310 m) at both the disposal and reference sites.

A.3.3.2 Summary. The results presented in this section indicate the existence of differences in the benthic infaunal community between the reference- and disposal-area sampling sites. Graphical and statistical methods were used to demonstrate the existence of differences in the values of three community indices (diversity, species richness and number of individuals). Values of species diversity and species richness were generally elevated at the reference site, and the number of individuals at the disposal site was greater than the recorded values at the corresponding stations in the reference area. However, the number of taxa identified at both the disposal-site and reference site stations were similar.

A.3.3.2.1 Consistent differences were also observed in the number of taxa, species diversity and species richness between sampling sites within the disposal area. Values of all three community variables at disposal-site Stations 1 and 3 were greater than those recorded at Station 5 in each of the four surveys. These observed differences were not related to differences in sampling depth since all three stations were located on the same isobath within the disposal area.

A.3.3.2.2 Numerical classification analysis was also used to identify differences in the infaunal community characteristics between the reference and disposal sites. These differences were attributed to differences in both the occurrence and abundance of infaunal taxa among the sampling stations. These analyses also demonstrated the existence of differences in infaunal community structure as a function of depth.



A.3.3.2.3 The observed biological differences appeared to be primarily related to differences in sediment grain-size characteristics. The major difference in the sediment characteristics between the reference and disposal sites was the distribution among size-class intervals. The distribution of sediments in the disposal-site samples were characterized as much more variable both between replicates and among surveys. Sediment samples from within the disposal area also contained a higher percentage of both coarse sand and clays than samples from the reference area. Within the disposal site this variability was highest at Station 5, which also showed the lowest values of diversity, species richness and number of taxa among the three stations located at the same depth. Based on modeling of the dredge-spoil plume during dumping (Appendix C), it is plausible that these observed differences in sediment characteristics could result from dumping activity.

A.3.3.2.4 The results of the sediment chemistry analyses presented in Section A.3.2 indicated that sediment metal concentrations within the disposal area were significantly elevated above the reference site. Additionally, the results of the correlation analyses presented in Table A-29 indicated the existence of statistically significant (albeit low) negative correlations between three community indices (species diversity, species richness and number of taxa) and sediment metal concentrations. However, lacking specific information on the accumulation of metals in the tissue of infaunal organisms there is insufficient evidence to attribute observed biological difference to sediment metal concentrations.

A.3.4 DEMERSAL FISH AND EPIBENTHIC MACROINVERTEBRATES. A complete list, enumerated by species, of fish and invertebrates captured in otter trawls at the LA 2 disposal and reference sites during each of the four sampling periods is provided in Appendix B, Table B-4. The following sections summarize and discuss these data in a manner commensurate with the non-quantitative nature of the sampling. Because the primary purpose of the trawling was to collect animals for tissue contaminant analysis, we did not attempt to sample in a rigorous quantitative manner (by carefully measuring the area swept by each trawl, for example). Therefore, the data cannot support detailed quantitative analysis of density, diversity, biomass, etc. The data can be used, however, to characterize in general the fish and epibenthic macroinvertebrate fauna of the sites by assessing major trends and patterns in principal species present, number of species and overall abundance.

A.3.4.1 Demersal Fish

A.3.4.1.1 Overall Characterization. Table A-25 shows principal species, number of species and total number of individuals of demersal fish captured in otter trawls at the LA 2 disposal and reference sites, broken down by sampling period (season) and depth of trawl station. In all, sampling at these two sites produced 52 species representing 20 families. Miller and Lea (1972) list 481 species in 129 families as occurring in southern California (Pt. Conception to Mexican border); and earlier, more extensive studies have reported 213 species in 66 families (Horn, 1974) and 121 species in 41 families (SCCWRP, 1973). The present study, therefore, represents a minority



of the southern California demersal fish fauna, which is not surprising considered the limited depth range (129-312m) and duration (64 mostly 5-minute trawls) of the sampling.

A.3.4.1.2 The trawl catch was dominated by flatfish (primarily family Pleuronectidae) and rockfish (Scorpaenidae) (Table B-4). Three species were particularly abundant and frequently encountered in the trawls. These were the slender sole, Lyopsetta exilis (618 individuals in 50 trawls); the Pacific sanddab, Citharichthys sordidus (937 individuals in 31 trawls); and the shortspine combfish, Zaniolepis frenata (363 individuals in 42 trawls). Together, these three species accounted for 76 percent of the individuals caught. Other commonly caught species were the Dover sole (Microstomus pacificus), the plainfin midshipman (Porichthys notatus), the halfbanded rockfish (Sebastes semicinctus), the spitnose rock fish (S. diploproa), the stripetail rockfish (S. saxicola), the shortspine thornyhead (Sebastolobus alascanus), and the yellowchin sculpin (Icelinus quadriseristus). All of these species are well-known common components of the mid- to deep-water demersal fish fauna of southern California (Horn, 1974; SCCWRP, 1973; Stephens, 1973; Moore et al., 1983). Based on the results of previous studies, the shortspine combfish and the slender sole were perhaps more abundant than would be expected, while the stripetail rockfish, the rex sole (Glyptocephalus zachirus), and the pinksurf perch (Zalembeius rosaceus) were perhaps under-represented (Table B-4).

A.3.4.1.3 Variation with Depth. The data for the more common species show no obvious deviations from previously reported depth distributions. The slender sole, while caught at all depths, tended to be more frequently encountered at the mid-depth (198 m) and deep (312 m) stations than at the shallow stations (129 m) (Tables A-30 and B-4). The shortspine combfish was more abundant at the shallow and mid-depth stations, as was the Pacific sanddab. The plainfin midshipman and Dover sole were most abundant at the shallow stations. Among the Scorpaenidae, the stripetail rockfish and the halfbanded rockfish were most common at the shallow and mid-depth stations, while the spitnose rockfish and the yellowchin sculpin were most common at the mid-depth and deep stations. Table B-4 can be referred to for depth-related distribution of less abundant species.

A.3.4.1.4 As in other studies, abundance and diversity of demersal fish is lowest at the deepest station. At the disposal site, abundance is greatest at the mid-depth station, although number of species is similar at the shallow and mid-depth stations (Table A-30). At the reference site, however, both abundance and number of species were greatest at the shallow station, while the mid-depth and deep stations were similar in number of species. The pattern at the disposal site is more similar to that observed by SCCWRP (Moore et al., 1983).

A.3.4.1.5 Differences Between Disposal and Reference Sites. There is evidence that demersal fish are less abundant and diverse at the disposal site than at the reference site. More individuals were caught at the reference site during each of the four sampling periods, and in 9 of 12 stations sampling (3 depths, 4 periods) (Table A-30). More species were caught at the reference site overall (43 vs. 38), during 3 of the 4 sampling periods, and in



TABLE A-30. SUMMARY OF FISH CAUGHT IN OTTER TRAWLS AT LA 2 DISPOSAL AND REFERENCE SITES.

Two replicate trawls are combined for each station.

Numbers in parentheses are for all three mid-depth stations combined.

	AUGUST 1983 (10-minute trawls)			REFERENCE SITE		
	DISPOSAL SITE					
	Principal Species	Number of Species	Number of Individuals	Principal Species	Number of Species	Number of Individuals
Shallow Station (129 m)	<u>Citharichthys sordidus</u> Pacific sanddab <u>Zanlotepis frenata</u> Shortspine combfish <u>Sebastes semicinctus</u> Halibanded rockfish	19	122	<u>Citharichthys sordidus</u> Pacific sanddab <u>Uca</u> quadriserialatus Yellowchin sculpin <u>Porichthys notatus</u> Plainfin midshipman <u>Sebastes saxicola</u> Stripetail rockfish	17	224
Mid-Depth Station (198 m)	<u>Lyopsetta exilis</u> Slender sole <u>Zanlotepis frenata</u> Shortspine combfish	19 (20)	291 (418)	<u>Citharichthys sordidus</u> Pacific sanddab <u>Zanlotepis frenata</u> Shortspine combfish	11	286
Deep Station (312 m)	<u>Sebastes alascanus</u> Shortspine thorny- head <u>Sebastes diploproa</u> Splitnose rockfish <u>Lyopsetta exilis</u> slender sole	7	75	---	3	8
Overall Site	<u>Lyopsetta exilis</u> Slender sole <u>Zanlotepis frenata</u> Shortspine combfish	28 (29)	488 (615)	<u>Citharichthys sordidus</u> Pacific sanddab	21	518



TABLE A-30 Cont'd.

DECEMBER 1983

	DISPOSAL SITE		REFERENCE SITE	
	Principal Species	Number of Species Number of Individuals	Principal Species	Number of Species Number of Individuals
Shallow Station (129 m)	<u>Zanlolepis frenata</u> Shortspine combfish <u>Sebastes semicinctus</u> Halfbanded rockfish	13 66	<u>Citharichthys sordidus</u> Pacific sanddab <u>Zanlolepis frenata</u> Shortspine combfish <u>Porichthys notatus</u> Plainfin midshipman	14 312
Mid-Depth Station (198 m)	<u>Zanlolepis frenata</u> Shortspine combfish <u>Lyopsetta exilis</u> slender sole <u>Sebastes saxicola</u> Stripetail rockfish	13 (18) 181 (309)	<u>Citharichthys sordidus</u> Pacific sanddab <u>Zanlolepis frenata</u> Shortspine combfish	14 195
Deep Station (312 m)	<u>Sebastolobus alascanus</u> Shortspine thorny-head	7 46	<u>Lyopsetta exilis</u> Slender sole <u>Citharichthys sordidus</u> Pacific sanddab <u>Bathyagonus pentacanthus</u> Starnose	16 132
Overall Site	<u>Zanlolepis frenata</u> Shortspine combfish	22 (23) 293 (421)	<u>Citharichthys sordidus</u> Pacific sanddab <u>Zanlolepis frenata</u> Shortspine combfish	25 639



TABLE A-30 Cont'd.

MARCH 1984

	<u>DISPOSAL SITE</u>		<u>REFERENCE SITE</u>	
	<u>Principal Species</u>	<u>Number of Species</u>	<u>Principal Species</u>	<u>Number of Species</u>
Shallow Station (129 m)	<u>Lyopsetta exilis</u> Slender sole	5	<u>Citharichthys sordidus</u> Pacific sanddab <u>Icelinus tenuis</u> Spotfin sculpin	14
Mid-Depth Station (198 m)	<u>Lyopsetta exilis</u> slender sole <u>Sebastes semicinctus</u> Halibanded rockfish <u>Zanlotepis frenata</u> Shortspine combfish	9 (10)	<u>Citharichthys sordidus</u> Pacific sanddab <u>Lyopsetta exilis</u> Slender sole	38
Deep Station (312 m)	---	4	<u>Lyopsetta exilis</u> Slender sole	30
Overall Site	<u>Lyopsetta exilis</u> Slender sole	11 (11)	<u>Citharichthys sordidus</u> Pacific sanddab <u>Lyopsetta exilis</u> Slender sole	224



TABLE A-30 Cont'd.

MAY 1984

	<u>DISPOSAL SITE</u>		<u>REFERENCE SITE</u>			
	<u>Principal Species</u>	<u>Number of Species</u>	<u>Number of Individuals</u>	<u>Principal Species</u>	<u>Number of Species</u>	<u>Number of Individuals</u>
Shallow Station (129 m)	Zanlolepis frenata Shortspine combfish <u>Microstomus pacificus</u> Dover sole <u>Lyopsetta exilis</u> Slender sole	6	25	Citharichthys sordidus Pacific sanddab Zanlolepis frenata Shortspine combfish <u>Microstomus pacificus</u> Dover sole	12	112
Mid-Depth Station (198 m)	<u>Lyopsetta exilis</u> Slender sole <u>Sebastes semicinctus</u> Halfbanded rockfish	6 (11)	48 (188)	<u>Lyopsetta exilis</u> Slender sole <u>Citharichthys sordidus</u> Pacific sanddab	7	51
Deep Station (312 m)	---	4	8	<u>Lyopsetta exilis</u> slender sole	7	25
Overall Site	<u>Lyopsetta exilis</u> Slender sole	12 (14)	81 (221)	Citharichthys sordidus Pacific sanddab <u>Lyopsetta exilis</u> slender sole	15	188

TABLE A-30 Cont'd.

ALL SURVEYS COMBINED

	<u>DISPOSAL SITE</u>		<u>REFERENCE SITE</u>			
	<u>Principal Species</u>	<u>Number of Species</u>	<u>Number of Individuals</u>	<u>Principal Species</u>	<u>Number of Species</u>	<u>Number of Individuals</u>
Shallow Station (129 m)	<u>Zanlolepis frenata</u> Shortspine combfish <u>Lyopsetta exilis</u> Slender sole <u>Sebastes semicinctus</u> Halfbanded rockfish	22	236	<u>Citharichthys sordidus</u> Pacific sanddab <u>Zanlolepis frenata</u> Shortspine combfish <u>Porichthys notatus</u>	25	804
Mid-Depth Station (198 m)	<u>Lyopsetta exilis</u> slender sole <u>Zanlolepis frenata</u> Shortspine combfish <u>Sebastes semicinctus</u> Halfbanded rockfish	22 (24)	577 (1,067)	<u>Citharichthys sordidus</u> Pacific sanddab <u>Zanlolepis frenata</u> Shortspine combfish <u>Lyopsetta exilis</u> Slender sole	18	570
Deep Station (312 m)	<u>Sibastolobus semicinctus</u> Shortspine Thornyhead	11	130	<u>Lyopsetta exilis</u> slender sole	19	195
Overall Site	<u>Lyopsetta exilis</u> Slender sole <u>Zanlolepis frenata</u> Shortspine combfish	38	951 (1,441)	<u>Citharichthys sordidus</u> Pacific sanddab <u>Lyopsetta exilis</u> slender sole	43	1,569



8 of 12 station samplings. These differences may be related to the disposal of dredged material, although the reason for lower catches at the disposal site is not clear. Infaunal benthic community density was greater at the disposal site stations during all four surveys than at almost all corresponding depth reference site stations (see section A.3.3). Although the infaunal community at the disposal site could be separated from that at the reference site in many of the classification analyses there is nothing to suggest that disposal site organisms were unacceptable as prey to the fish community. Major differences were found in trawl epibiota density between the first two and last two surveys. Since fish abundance and diversity trends did not vary similarly it is unlikely there is a direct relationship between epibiota density and fish catch. The difference in fish catch between disposal and reference sites may simply reflect avoidance of the disposal sites by some species and individuals as a response to the increased frequency of disturbance within the disposal site.

A.3.4.1.6 Regarding principal species, there is some indication that the Pacific sanddab is less abundant at the disposal site than at the reference site, and that the slender sole is less abundant at the reference site (Tables A-30 and B-4). The cause of this apparent difference between the sites, and whether it is relative to disposal, is not known.

A.3.4.1.7 Seasonal Variation. There are no obvious seasonal variations in the trawl data, except that the December 1983 sampling produced considerably more individuals and species than the March and May 1984 sampling (Table A-30). The August 1983 sampling, which produced the most individuals and species of all samplings, consisted of 10-minute trawls (as opposed to 5-minute trawls for the other samplings).

A.3.4.2 Epibenthic Macroinvertebrates. The two most commonly used methods of sampling benthic fauna are grab/core samplers, and trawls. Grabs and cores are used primarily to sample infauna, while trawls are used to sample demersal fish and, somewhat incidentally, epibenthic fauna. The two methods produce very different results, as can be seen by comparing species lists from grab/core studies in the Southern California Bight such as Fauchald and Jones (1979) and Jones (1979) to those from trawl studies such as those conducted by the Southern California Coastal Water Research Project (SCCWRP, 1973; Moore et al., 1983). It is, therefore, not useful to compare the present data to results from grab/core studies, and these data will be compared only to results from previous trawl studies in the region.

A.3.4.2.1 Overall Characterization. Table A-31 shows principal species, number of species, and number of individuals of epibenthic microinvertebrates captured in otter trawls at the LA 2 disposal and reference sites, broken down by sampling period (season) and depth of trawl station. In all, sampling at these two sites produced 93 species. Extensive trawling by SCCWRP (Moore et al., 1983) produced over 500 species. The comparatively limited results of the present study are not surprising considering the limited depth range (129-312 m) and duration (64 mostly 5-minute trawls) of the sampling.



TABLE A-31. SUMMARY OF MACROINVERTEBRATES IN OTTER TRAWLS FROM LA 2 DISPOSAL AND REFERENCE SITES.
Two trawls at each station are combined.
Numbers in parentheses are for all three mid-depth stations combined.

AUGUST 1983
(10-minute trawls)

	DISPOSAL SITE		REFERENCE SITE	
	Principal Species	Number of Species	Principal Species	Number of Species
Shallow Station (129 m)	<u>Sicyonia ingentis</u> shrimp <u>Rossia pacifica</u> <u>Parastichopus californicus</u> sea cucumber	17	<u>Lytechinus pictus</u> sea urchin <u>Sicyonia ingentis</u> shrimp <u>Spatangus californicus</u> sea cucumber	14
Mid-Depth Station (198 m)	<u>Sicyonia ingentis</u> shrimp <u>Crangon zoeae</u> shrimp <u>Spirontocaris holmesi</u> shrimp <u>Allocentrotus fragilis</u> sea urchin	21(31)	<u>Lytechinus pictus</u> sea urchin <u>Parastichopus californicus</u> sea cucumber <u>Allocentrotus fragilis</u> sea urchin	9
Deep Station (312 m)	<u>Allocentrotus fragilis</u> sea urchin	14	<u>Allocentrotus fragilis</u> sea urchin <u>Pleuroncodes planipes</u> crab	10
Overall Site	<u>Sicyonia ingentis</u> shrimp <u>Allocentrotus fragilis</u> sea urchin	32(41)	<u>Lytechinus pictus</u> sea urchin <u>Allocentrotus fragilis</u> sea urchin	27
		1,194(1,560)		1,268



TABLE A-31 Cont'd.

DECEMBER 1983

	DISPOSAL SITE		REFERENCE SITE	
	Principal Species	Number of Species Number of Individuals	Principal Species	Number of Species Number of Individuals
Shallow Station (129 m)	<u>Sicyonia ingentis</u> shrimp <u>Parastichopus californicus</u> sea cucumber	11 184	<u>Lytechinus pictus</u> sea urchin <u>Spatangus californicus</u> sea cucumber <u>Sicyonia ingentis</u> shrimp	14 660
Mid-Depth Station (198 m)	<u>Allocentrotus fragilis</u> sea urchin <u>Tragon zaca</u> shrimp <u>Spirontocaris holmes</u> shrimp <u>Brisopsis pacifica</u> sea urchin	19(28) 385(1,166)	<u>Allocentrotus fragilis</u> sea urchin <u>Sicyonia ingentis</u> shrimp	14 260
Deep Station (312 m)	<u>Allocentrotus fragilis</u> sea urchin	14 224	<u>Allocentrotus fragilis</u> sea urchin	14 132
Overall Site	<u>Allocentrotus fragilis</u> sea urchin <u>Sicyonia ingentis</u> shrimp	32(39) 793(1,574)	<u>Allocentrotus fragilis</u> sea urchin <u>Sicyonia ingentis</u> shrimp	27 1,052



TABLE A-31 Cont'd.

MARCH 1984

	<u>DISPOSAL SITE</u>		<u>REFERENCE SITE</u>	
	<u>Principal Species</u>	<u>Number of Species</u>	<u>Principal Species</u>	<u>Number of Species</u>
Shallow Station (129 m)	<u>Parastichopus californicus</u> sea cucumber <u>Sicyonia ingentis</u> shrimp	13	<u>Lytechinus pictus</u> sea urchin <u>Spatangus californicus</u> sea cucumber	15
Mid-Depth Station (198 m)	<u>Crangon zoeae</u> shrimp <u>Allocentrotus fragilis</u> sea urchin <u>Sicyonia ingentis</u> shrimp <u>Spatangus californicus</u> sea cucumber	16(23)	<u>Parastichopus californicus</u> sea cucumber	1,501
Deep Station (312 m)	<u>Allocentrotus fragilis</u> sea urchin	11		4
Overall Site	<u>Allocentrotus fragilis</u> sea urchin <u>Sicyonia ingentis</u> shrimp	25(29)	<u>Allocentrotus fragilis</u> sea urchin <u>Lytechinus pictus</u> sea urchin	15
				96
				25
				1,609

TABLE A-31 Cont'd.

MAY 1984

	DISPOSAL SITE		REFERENCE SITE	
	Principal Species	Number of Species	Principal Species	Number of Species
Shallow Station (129 m)	<u>Sicyonia ingentis</u> shrimp	17	<u>Lytechinus pictus</u> sea urchin <u>Spatangus californicus</u> sea cucumber	16
Mid-Depth Station (198 m)	<u>Allocentrotus fragilis</u> sea urchin <u>Sicyonia ingentis</u> shrimp <u>Crangon zoeae</u> shrimp	12(20)	<u>Sicyonia ingentis</u> shrimp <u>Allocentrotus fragilis</u> sea urchin	13
Deep Station (312 m)	<u>Allocentrotus fragilis</u> sea urchin	6	<u>Allocentrotus fragilis</u> sea urchin <u>Spatangus californicus</u> sea cucumber	11
Overall Site	<u>Sicyonia ingentis</u> shrimp <u>Allocentrotus fragilis</u> sea urchin	24(27)	<u>Allocentrotus fragilis</u> sea urchin <u>Spatangus californicus</u> sea cucumber	25
				1,146
				365
				232
				1,743



TABLE A-31 Cont'd.

ALL SURVEYS COMBINED

	DISPOSAL SITE		REFERENCE SITE	
	Principal Species	Number of Species	Principal Species	Number of Species
Shallow Station (129 m)	<u>Sicyonia ingentis</u> shrimp <u>Parastichopus californicus</u> sea cucumber	30	<u>Lytechinus pictus</u> sea urchin <u>Spatangus californicus</u> sea cucumber <u>Sicyonia ingentis</u> shrimp	32
Mid-Depth Station (198 m)	<u>Crangon zoeae</u> shrimp <u>Allocentrotus fragilis</u> sea urchin <u>Sicyonia ingentis</u> shrimp <u>Spirontocaris holmesi</u> shrimp	31(45)	<u>Allocentrotus fragilis</u> sea urchin <u>Sicyonia ingentis</u> shrimp <u>Parastichopus californicus</u> sea cucumber	19
Deep Station (312 m)	<u>Allocentrotus fragilis</u> sea urchin	28	<u>Allocentrotus fragilis</u> sea urchin	31
Overall Site	<u>Allocentrotus fragilis</u> sea urchin <u>Sicyonia ingentis</u> shrimp	70	<u>Allocentrotus fragilis</u> sea urchin <u>Sicyonia ingentis</u> shrimp	53
		402		4,262
		1,670(4,255)		855
		770		555
		2,842(5,427)		5,672

A.3.4.2.2 The trawls were dominated by crustaceans and echinoderms in both abundance and species composition (Table A-31 and B-4). Three species were particularly abundant: the sea urchins Allocentrotus fragilis (2,444 individuals in 56 trawls) and Lytechinus pictus (3,345 individuals in 19 trawls), and the shrimp Sicyonia ingentis (2,232 individuals in 47 trawls). Together these three species accounted for 72 percent of the invertebrate individuals caught in the trawls. Note that L. pictus was the most abundant species but occurred in relatively few trawls, indicating a patchy distribution. Other common species in the trawls were the sea cucumbers Parastichopus californicus and Spatangus californicus, and the shrimp Crangon zorca and Spirontocaris holmesi. All of these species are common components of trawl samples from the region (Moore et al., 1983).

A.3.4.2.3 Variations with Depth. Neither site shows any obvious depth-related trend in number of species, except for some indication of lower number of species at the mid-depth station (198 m) at the reference site (Table A-31). There is a clear pattern, however, of highest abundance at the mid-depth station at the disposal site, and at the shallow station (129 m) at the reference site. This is somewhat at odds with the results of SCCWRP Surveys, which generally show an increase in the abundance of epibenthic invertebrates with depth over this depth range (Word and Mearns, 1977; Moore et al., 1983). Moore et al. (1983) also found increasing numbers of species with depth. It should be noted that, in the SCCWRP surveys, increasing depth generally coincides with increasing distance from sewage outfalls, which have been shown to depress benthic populations. Of the commonly encountered species listed above, only Allocentrotus fragilis was consistently abundant at the deep station (312 m); this species was also abundant at the mid-depth stations. Crangon zorca was most abundant at the shallow station. The older common species were abundant at both the shallow and mid-depth stations (Table A-31).

A.3.4.2.4 Differences Between Disposal and Reference Sites. There is no clear difference between the disposal and reference sites in number of species. There is evidence, however, that invertebrates are more abundant at the reference site. More individuals were caught at the reference site during each of the four sampling periods, and twice as many total individuals were caught at the reference site as at the disposal site. Disposal of dredged material may have caused a reduction in epibenthic invertebrates population at the disposal site, through smothering, change in sediment characteristics, or change in food supply.

A.3.4.2.5 Regarding principal species, Lytechinus pictus and Spatangus californicus are more abundant at the reference site. Crangon zorca is more abundant at the disposal site, and this appears to be true for Sicyonia ingentis also. The relation between this pattern of more abundant echinoderms at the reference site and more abundant crustaceans at the disposal site is not known, nor is the relation of either of these patterns to disposal. On the other hand, the second most abundant species, Allocentrotus fragilis, shows no apparent preference for either site.

A.3.4.2.6 Seasonal Differences. The data show no obvious seasonal trends in abundance or diversity, except for some indication of decreasing abundance (and possibly number of species) at the disposal site over the course of the study (Table A-31). In general, the December 1983, March 1984, and May 1984 data compare well to the August 1983 data in terms of abundance and number of species, even though the August survey as the only one to use 10-minute trawls; the others used 5-minute trawls.

A.3.4.2.7 The sea urchin Lytechinus pictus is much more abundant in the winter sample (March) than in the others, possibly reflecting seasonal recruitment in this species. None of the other principal species shows obvious seasonal patterns.



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DRAFT
ENVIRONMENTAL IMPACT STATEMENT

FINAL DESIGNATION OF A
DREDGED MATERIAL DISPOSAL SITE OFF
LOS ANGELES, CALIFORNIA

Los Angeles County, California

APPENDIX B
DETAILED FIELD SURVEY DATA

U.S. ENVIRONMENTAL PROTECTION AGENCY

AVAILABLE UPON REQUEST



DRAFT
ENVIRONMENTAL IMPACT STATEMENT

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APPENDIX C
NUMERICAL SIMULATION OF
DREDGED MATERIAL DISPOSAL

U.S. ENVIRONMENTAL PROTECTION AGENCY



TABLE OF CONTENTS

APPENDIX C. NUMERICAL SIMULATION OF DREDGED MATERIAL DISPOSAL

	<u>Page</u>
C.1 INTRODUCTION	C-1
C.2 MODEL CONCEPTS	C-1
C.3 INPUT DATA	C-2
C.4 RESULTS	C-4
C.5 CONCLUSIONS	C-10
C.6 REFERENCES	C-13

APPENDIX C. NUMERICAL SIMULATION OF DREDGED MATERIAL DISPOSAL

C.1 INTRODUCTION

To assist in evaluating the effect of dredged material disposal on water quality (turbidity), and the extent and quantity of deposition of material on the bottom, disposal from a barge was simulated using models developed for the Corps of Engineers Dredged Material Research Program by Koh and Chang (1973). Modifications to these models have been made by Brandsma and Divoky (1978) and Wu and Leung (1983). The models used were the 1) instantaneous dump model (DMF) which assumes the entire barge load of material is discharged instantaneously (as from a split-hull barge); and 2) continuous discharge or jet model (DMFJ), which simulates the discharge as coming from a submerged pipe with prescribed pipe size, volume of material, time for discharge, and velocity of discharge. The characteristics and application of these models are discussed further in following sections.

C.2 MODEL CONCEPTS

Both models assume that release occurs in an ocean characterized by a prescribed density and velocity gradient. The behavior of the dumped material is assumed to be separated into three phases: convective descent, during which the dump cloud or discharge jet falls under the influence of gravity, entraining water and being influenced by the ambient current; dynamic collapse, occurring when the descending cloud either impacts the bottom or arrives at the level of neutral buoyancy at which descent is retarded and horizontal spreading dominates; and long-term passive dispersion, commencing when the material transport and spreading is determined more by ambient currents and turbulence than the dynamics of the disposal operation.

Because split-hull barges are typically used for disposal of dredge spoil at the LA 2 site, it was decided that the instantaneous dump model (DMF) was a better approximation of disposal operations than the continuous discharge of the jet model (DMFJ). DMF is an approximation, albeit an acceptable one, because emptying of a split-hull barge is not instantaneous but takes approximately 30 seconds. It was felt that the jet system would

impart unrealistically large momentum to the discharged plume. Subsequent running of DMFJ corroborated this, which predicted the plume reaching bottom (600 ft) in unrealistically short time (approximately 1 minute) and high velocity (5.1-7.5 ft/sec). Therefore, the DMF model was used in all simulations.

C.3 INPUT DATA

Input data required for the operation of the model can be grouped into (a) a description of the ambient environment at the disposal site, (b) characterization of the dredged material, (c) data describing the disposal operation, and (d) model coefficients. Model coefficient values used were the suggested average values built into the model, because these values have been shown to be good general approximations and because there was no conclusive evidence to justify changes. The other types of needed information are given below with the input values.

The first parameters required for the model are the horizontal grid over which the movement of disposed material is described, and the total simulation time (in this case, 24 hours). A grid size of 2,000 ft was chosen as providing acceptable resolution of material dispersion while establishing an area large enough to contain essentially all of the material after 24 hours of dispersal. The 24-hour simulation showed that the status of the disposal material changed little after the first few hours, so a 5-hour simulation was also run.

Number of grids in X-direction (North - South)	= 24
Number of grids in Z-direction (East - West)	= 24
Grid spacing	= 2,000 ft
Water depth of discharge grid	= 600 ft (column 12, row 12)
Long term time step	= 3,600 sec; also 900 sec.
Total simulation time	= 24 hours; also 5 hours
<u>Discharge Parameters</u>	
Initial radius of cloud	= 21.77 ft [based on
Initial volume of cloud	= 21598 cu ft. dimensions of typical split hull barge]
Initial depth of cloud centroid	= 15 ft
Ship traveling towards East at 7.2 ft/sec	

Characteristics of Discharged Materials:

Item	(gm/cc) Density	(cuft/cuft) Concentration	(ft/sec) Fall Velocity	Voids Ratio	(ft) Particle Dia.
Gravel	2.6	.0013	1.910	.8	0.0218
Sand	2.6	.1276	.047	.8	0.000452
Silt	2.6	.1551	.0021	.8	0.0000850
Clay	2.6	.0293	.0000036	.8	0.00000353
Fluid	1.0	.6867	-	-	-

Dredged material characteristics were calculated from a study of the sediments of Long Beach Harbor (MBC, 1982).

Bulk Parameters:

Bulk density = 1.5 gm/cc
Aggregate voids ratio = 0.8

Ambient Conditions:

Current - Northwest - 0.261 ft/sec
- Southeast - 0.261 ft/sec

Summer Density Profile:

Depth (ft)	0	33	98	131	328	410	443	2050
Density (gm/cc)	1.024	1.024	1.029	1.029	1.029	1.034	1.034	1.036

Winter Density Profile:

Depth (ft)	0	131	164	410	492	574	623	3000
Density (gm/cc)	1.025	1.025	1.026	1.026	1.027	1.026	1.026	1.027

Current speeds are based on Hendricks (1980, 1982), Hendricks and Stubbs (1984), and Winant (1983). Density profiles are based on data from August and February surveys for the present study. Current velocity was assumed to decrease from the surface to 0.261 ft/sec. at 40 ft depth, to zero at the bottom, according to a logarithmic function defining a gradual decrease in velocity through most of the water column and then rapid decrease to zero in the last few meters above the bottom.

SIMULATIONS

<u>Case</u>	<u>Density</u>	<u>Current</u>
1	Summer	Northwest
2	Winter	Northwest
3	Summer	Southeast
4	Winter	Southeast

C.4 RESULTS

End of Convective Descent

<u>Northwest Current</u>	
Bottom Encounter (sec)	146.00 (summer) 122.00 (winter)
Bottom Encounter Velocity (ft/sec)	1.39 (summer) 2.46 (winter)

These results show that the discharged plume does not reach neutral buoyancy in the water column but encounters the bottom with positive velocity. Descent is slower in the summer because the greater density near the bottom (below the pycnocline) retards sinking of the plume. Results for the southeast current are not shown because they are essentially the same as those for the northwest current.

End of Collapse Phase

<u>End of Collapse Phase</u>	<u>Northwest Current</u>	
	<u>Summer</u>	<u>Winter</u>
Time (sec) after discharge	313	206
Distance (ft) from discharge	818	706
Percent solid remaining in plume		
Gravel	0	0
Sand	1.82	1.17
Silt	2.74	1.55
Clay	2.68	1.52

These results show that collapse of the plume on the bottom occurs fairly rapidly (3½ to 5 minutes after discharge) and not far horizontally (700-800 ft) from the discharge site. All of the gravel and essentially all of the finer sediments no longer remain in the plume, indicating that the plume has in fact collapsed and ceased to exist as a dynamic entity. This does not mean that the material no longer in the plume has settled to the bottom (see next section). Again, the results for the southeast current are essentially the same as those for the northwest current and so are not shown.

Passive Dispersion Phase: Materials Settled to Bottom

Time(hr)	Solid	S U M M E R		W I N T E R	
		% Settled	Distance (ft)	% Settled	Distance (ft)
1.25	gravel	100	65	100	61
	sand	100	1240	100	1375
	silt	18.2	815	8.4	-
	clay	10.0	815	0	706
2.50	silt	20.1	815	8.4	-
	clay	10.0	815	0	706
3.75	silt	20.1	815	8.4	-
	clay	10.0	815	0	706
5.00	silt	20.1	815	8.4	-
	clay	10.0	815	0	706
6	silt	20.1	815	8.4	-
	clay	10.0	815	0	706
12	silt	20.1	815	8.4	-
	clay	10.0	815	0	706
18	silt	20.1	815	8.4	-
	clay	10.0	815	0	706
24	silt	20.1	815	8.4	-
	clay	10.0	815	0	706

Passive Dispersion Phase: Materials Suspended in Water Column - SUMMER

Time (hr)	Solid	% Suspended	Distance (ft)	Depth (ft)	Concentration (mg/l)
1.25	silt	81.8	1888	602	130
	clay	90.0	1783	599	18
2.50	silt	79.9	3086	610	51
	clay	90.0	2828	599	51
3.75	silt	79.9	4262	619	8.2
	clay	90.0	3875	599	15
5.00	silt	79.9	5438	629	4.6
	clay	90.0	4923	599	2.7
6	silt	79.9	6377	636	6.52
	clay	90.0	5760	599	0.215
12	silt	79.9	6377	636	6.52
	clay	90.0	5760	599	0.215
18	silt	79.9	17678	727	1.548E3
	clay	90.0	17058	599	0.0212
24	silt	79.9	23327	772	0.452
	clay	90.0	22709	599	0.0107

Passive Dispersion Phase: Materials Suspended in Water Column - WINTER

Passive Time (hr)	Solid	% Suspended	Distance (ft)	Depth (ft)	Concentration (mg/l)
1.25	silt	91.6	1814	602	140
	clay	100	1725	601	20
250	silt	91.6	2988	612	50
	clay	100	2793	601	11
3.75	silt	91.6	4163	621	8.6
	clay	100	3862	601	5.8
5.00	silt	91.6	5339	631	0.7
	clay	100	4933	601	3.4
6	silt	91.6	6278	638	4.85
	clay	100	5787	601	0.118
12	silt	91.5	11927	684	3.67E-7
	clay	100	10940	601	0.0317
18	silt	91.4	17577	729	1.59E-4
	clay	100	16102	601	0.0135
24	silt	91.3	23228	774	0.678
	clay	100	21273	601	0.00728

These results show that, by the first time step in the passive dispersion phase (1.25 hr), all of the gravel and sand discharged has settled to the bottom. The distribution of settled gravel is centered about 60 ft down current (northwest) from the discharge point, while the settled sand is centered about 1,300 ft northwest of the discharge point. The total volume of gravel (28.1 cu ft) is deposited in an area of approximately 12,000 sq ft, with an average thickness of 0.03 in. (0.07 cm). The total volume of sand (2,756 cu ft) is deposited in an area of approximately 88,000 sq ft, with an average thickness of 0.38 in. (0.96 cm).

The fate of the finer sediment fractions, silt and clay, is very different. After 1.25 hours, only about 20% (670 cu ft) of the silt and 10% (63 cu ft) of the clay have settled to the bottom. This settling is a result of cloud collapse, as shown by the center of the settled silt and clay approximating that of the collapsed cloud (815 or 706 ft vs. 818). No appreciable additional settling of silt or clay has occurred after 1.25 hours. This is because all silt and clay that did not settle quickly has been transported by the current northwest into deeper water and has reached neutral buoyancy in the water column, at a depth of 600 to 770 ft depending on the fraction and the season (which affects near-bottom density). It is somewhat surprising that more silt and clay are deposited in the summer when near-bottom densities are higher. It can only be assumed that greater vertical

mixing in winter in the absence of a strong pycnocline enhances suspension.

The distribution and concentration of suspended silt and clay in the water column over time are shown in the above table, and in Figures C-1 and C-2. Suspended silt and clay are shown being transported (together in a single cloud) from the discharge site to the northwest by the ambient current, and undergoing dispersion and dilution. After five hours, both fractions have been diluted to negligible concentrations (less than 3 mg/l maximum), have been transported approximately 5,000 feet down current, and have a maximum diameter of approximately 3,000 ft. Both fractions occur in their highest shown concentrations after 1.25 hours: silt at 130 mg/l (winter), and clay at 20 mg/l (winter). These peak concentrations occur at the center of the cloud and decrease to zero over the 1,400 ft maximum diameter of the cloud. Concentrations are certainly higher before 1.25 hours, but this information is not available from the model with the time steps used. Clay concentrations are lower than silt concentrations because clay made up a much smaller fraction of the discharged material. Concentrations are higher in the summer than in the winter because a larger percentage of both fractions remains suspended in the summer.

With a southeast current, all of the suspended silt and clay is transported into areas shallower than the neutral buoyancy depth of either fraction, so that deposition of all sediments is expected within 1,500 ft of the discharge point (depth 500 ft). This results in deposition over an area of approximately 110,000 sq ft in the following volumes and thicknesses:

<u>Fraction</u>	<u>Volume</u>	<u>Mean Thickness</u>
Gravel	28.1 cu ft	0.003 in. (0.008 cm)
Sand	2,756 cu ft	0.30 in. (0.76 cm)
Silt	3,350 cu ft	0.37 in. (0.93 cm)
Clay	633 cu ft	0.07 in. (0.18 cm)
Total	6,767 cu ft	0.74 in. (1.88 cm)

The disposed material will not settle evenly over the area (for example, it is likely that much of the settling will occur well short of 1,500 ft), so that thickness of deposition will exceed 0.74 in. in some areas.

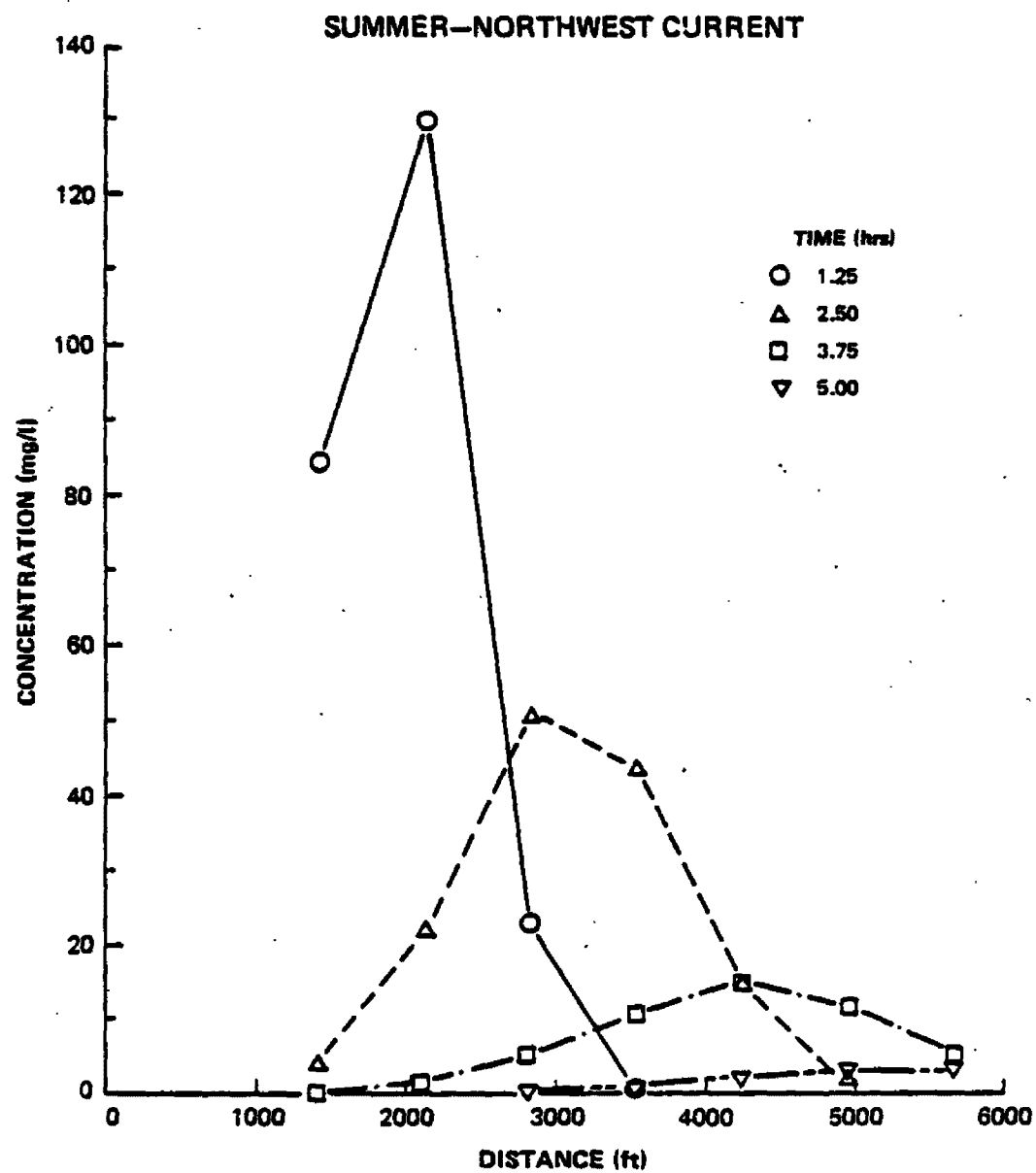


FIGURE C-1 CONCENTRATION OF SILT IN WATER COLUMN VS. DISTANCE FROM DISCHARGE POINT AND TIME AFTER DISCHARGE

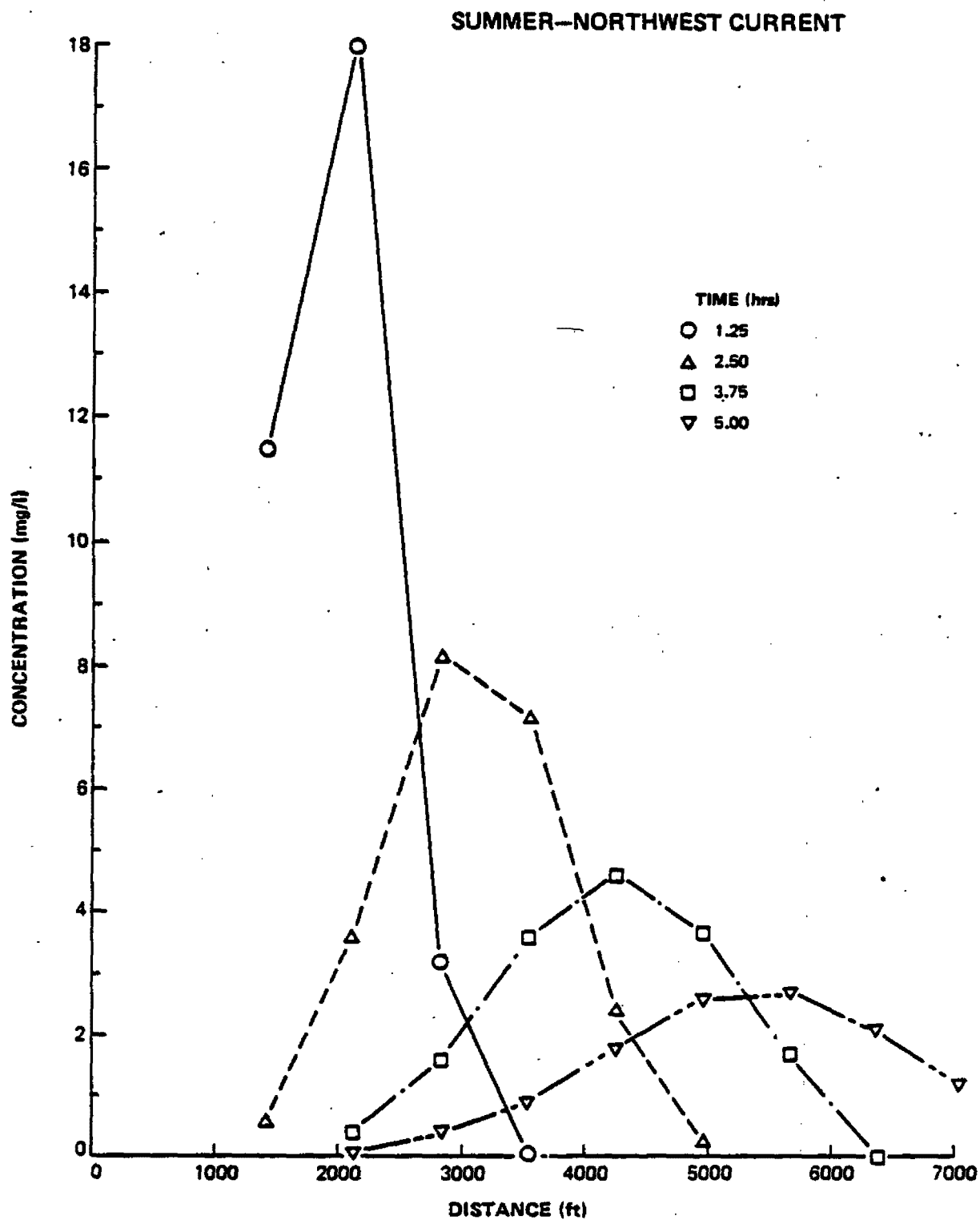


FIGURE C-2 CONCENTRATION OF CLAY IN WATER COLUMN VS. DISTANCE FROM DISCHARGE POINT AND TIME AFTER DISCHARGE.

C.5 CONCLUSIONS

The modeling results show that the fate of the disposed material depends greatly on the direction of the ambient current. Flow to the northwest (the prevailing current direction in the site area) carries the plume of discharged material into deeper water, so that, while all of the sand and gravel settles to the bottom, most of the silt and clay remains in suspension indefinitely (centered at 600-800 feet depth) and is transported long distances by the current and diluted. This suspended silt and clay represents almost half of the disposed sediment. The general result would be the same with any offshore current transporting the plume into deeper water. With the current flowing to the southeast (a relatively common condition in the site area), the plume is transported into shallower waters, and all discharged sediment is predicted to be deposited on the bottom. Any onshore current would produce the same general result, although the area over which deposition would occur (and thus the thickness of the deposition) would depend on exact current direction.

Regarding suspended silt and clay under northwest current conditions, the model predicts a peak concentration at the center of the cloud of approximately 150 mg/l 1.25 hr. after disposal, the earliest time that such data is available in the model (concentrations are certainly higher prior to 1.25 hr.). At this time, the cloud is centered approximately 2,000 ft. downcurrent from the discharge point, and concentration of suspended sediment decreases to zero over a cloud radius of approximately 1,500 ft. Five hours after discharge, the maximum combined (silt and clay) concentration of suspended sediment has decreased to 4-5 mg/l, and the cloud has a radius of approximately 3,000 ft. and is centered approximately 5,000 ft. downcurrent. These are the results of the disposal of one barge load (800 cu. yds.) of dredged material. A representative dredging job of 50,000 cu. yds. would require disposal of approximately 63 barge loads, which poses the potential for superimposing of disposed barge loads. On most dredging jobs, however, barge emptyings occur at least six hours apart due to the time required for filling and transport, so that superimposing of suspended sediment clouds would be slight.

With a northwest current, deposition of disposed sediment is predicted to occur over a total area of approximately 88,000 sq. ft. In the area where deposition of all sediment fractions occurs (32,000 sq ft), combined average thickness of deposited sediments is 0.59 in.(1.5 cm) per barge load. For deposited sediment, superimposing of successive barge loads is expected. In the extreme case of exact coincidence of successive depositions and no movement of deposited sediments, disposal of 50,000 cu. yd. (63 barge loads) of dredged material would result in deposition of approximately 220,000cu. ft. (8,200 cu yd) of sediment over 88,000 sq. ft. (2.0 acres) of bottom. In the 32,000 sq. ft.(0.7 acres) where all four fractions are deposited, total average thickness would be 37.2 in.(94.5 cm). In the additional 56,000 sq. ft.(1.3 acres), only sand would be deposited, to an average total thickness of 8.0 in.(20.3 cm). Although not included in the DMF and DMFJ models, resuspension, slumping and other movement of deposited sediment certainly occur at the disposal site. Disposal of 50,000 cu yd would take at least 3-4 weeks, so that these mechanisms would have considerable time to disperse deposited sediments, thus substantially reducing thickness of accumulated sediment while increasing the area affected. The fact the successive depositions would not coincide exactly would add to this effect. Unfortunately, the models and data that would be needed to quantify this effect are not available.

With a southeast current, disposal of 63 barge loads of dredged material would result in deposition of 15,800 cu. yd. of sediment (gravel, sand, silt and clay) over approximately 110,000 sq. ft.(2.6 acres), at an average thickness of 46.5 in.(118.0 cm).

These simulations have shown that disposal of a representative 50,000 cu. yds. of dredged material can result in accumulation of the order of several feet of disposed sediment over approximately 2-3 acres of sea floor. As discussed above, accumulated thickness would be significantly reduced, and affected area increased, by resuspension and/or bed load movement of sediments during the several weeks required to complete disposal. Regardless of this effect, this deposition represents a major impact on the benthic sediment regime of the affected area. With a northwest current, the fact that most of the material deposited is sand, while silt and clays are

largely suspended, means that disposal could result in a significant coarsening of the area's benthic sediments if the pre-existing sediments are largely finer fractions (silt). With a southeast current, all disposed sediments (approximately 60% silt and clay) are expected to be deposited. Bottom sediments could be made finer as a result, depending on the grain size of pre-existing sediments.

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