United States
Environmental Protection
Agency

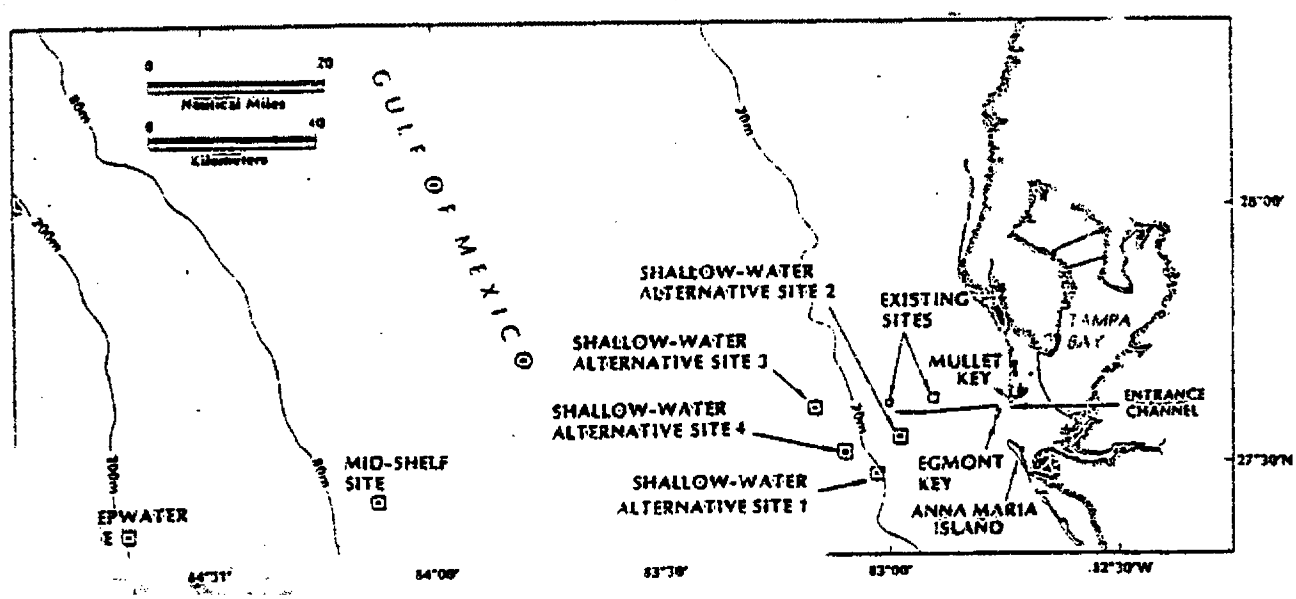
Office of Water
Criteria and Standards Division
Washington, DC 20460

SEPTEMBER 1983
800R83102

EPA

Final

ENVIRONMENTAL IMPACT STATEMENT (EIS) for TAMPA HARBOR, FLORIDA OCEAN DREDGED MATERIAL DISPOSAL SITE DESIGNATION



METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measure

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	2.54	centimeters	cm
ft	feet	30.	centimeters	cm
yd	yards	0.9	meters	m
fm	fathoms	1.8	meters	m
mi	statute miles	1.6	kilometers	km
nmi	nautical miles*	1.9	kilometers	km

*1 nautical mile = 6.076 feet = 1.15 statute miles

Symbol	When You Know	Multiply by	To Find	Symbol
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
nmi^2	square nautical miles	3.4	square kilometers	km^2
		MASS (weight)		
oz	ounces	28.	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2,000 lbs)	0.9	tonnes†	t

†1 tonne = 1,000 kg = 1 metric ton

Symbol	When You Know	Multiply by	To Find	Symbol
		VOLUME		
fl oz	fluid ounces	30.	milliliters	ml
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	0.55(°F) - 32	Celsius temperature	°C
		VELOCITY		
in/s	inches per second	2.5	centimeters per second	cm/s
ft/s	feet per second	30.	centimeters per second	cm/s
ft/min	feet per minute	0.5	centimeters per second	cm/s
mph	miles per hour	1.6	kilometers per hour	kph
kn	knots**	51.	centimeters per second	cm/s
kn	knots (nautical miles per hour)	1.9	kilometers per hour	kph

1 knot = 1.15 mph

Approximate Conversions from Metric Measure

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
m	meters	0.6	fathoms	fm
km	kilometers	0.6	statute miles	mi
km	kilometers	0.5	nautical miles*	nmi

*1 nautical mile = 6.076 feet = 1.15 statute miles

Symbol	When You Know	Multiply by	To Find	Symbol
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	11.	square feet	ft^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
km^2	square kilometers	0.3	square nautical miles	nmi^2
		MASS (weight)		
g	grams	0.4	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes†	1.1	short tons (2,000 lb)	

†1 tonne = 1,000 kg = 1 metric ton

Symbol	When You Know	Multiply by	To Find	Symbol
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.1	quarts	qt
l	liters	0.3	gallons	gal
m^3	cubic meters	35.	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	1.8(°C) +32	Fahrenheit temperature	°F
		VELOCITY		
cm/s	centimeters per second	0.4	inches per second	in/s
cm/s	centimeters per second	0.03	feet per second	ft/s
cm/s	centimeters per second	2.0	feet per minute	ft/min
cm/s	centimeters per second	0.02	knots (nautical miles per hr)**	kn
kph	kilometers per hour	0.6	miles per hour	mph
kph	kilometers per hour	0.5	knots	kn

**1 knot = 1.15 mph

FINAL

ENVIRONMENTAL IMPACT STATEMENT (EIS)
for
TAMPA HARBOR, FLORIDA
OCEAN DREDGED MATERIAL DISPOSAL
SITE DESIGNATION

SEPTEMBER 1983

U.S. ENVIRONMENTAL PROTECTION AGENCY
Criteria and Standards Division
Washington, D.C. 20460

ENVIRONMENTAL PROTECTION AGENCY

FINAL

ENVIRONMENTAL IMPACT STATEMENT (EIS)
FOR
TAMPA HARBOR, FLORIDA
OCEAN DREDGED MATERIAL DISPOSAL
SITE DESIGNATION

Prepared by: U.S. Environmental Protection Agency
Criteria and Standards Division (WH-585)
Washington, D.C. 20460

SUMMARY SHEET

ENVIRONMENTAL IMPACT STATEMENT
FOR
TAMPA HARBOR, FLORIDA
OCEAN DREDGED MATERIAL DISPOSAL SITE DESIGNATION

( ) Draft
(X) Final
( ) Supplement to Draft

ENVIRONMENTAL PROTECTION AGENCY
CRITERIA AND STANDARDS DIVISION

1. Type of action.

   (X) Administrative/Regulatory action
   ( ) Legislative action

2. Description of the action.

The action is the designation of a Tampa Harbor Dredged Material Disposal Site, to be managed by the U.S. Environmental Protection Agency (EPA), Region IV. The site designated is square-shaped, centered at 27°31'27"N, 83°04'54"W, covers 4 nmi^2, and is 18 nmi southwest of the mouth of Tampa Bay, Florida. The site will receive designation for a period of three years for the disposal of dredged material resulting from dredging from the Tampa Bay area. The purpose of the action is to provide an environmentally and economically acceptable ocean location for the disposal of dredged material, which complies with the environmental impact criteria of the Ocean Dumping Regulations (40 CFR Parts 220-229).

3. Environmental effects of the action.

Adverse environmental effects of the action include: (1) smothering of the benthos within the designated site and (2) habitat alteration of the site. Adverse impacts within the site are unavoidable, but the disposal operations will be regulated to prevent unacceptable environmental degradation outside site boundaries.

4. Alternatives including the action.

The alternatives including the action are: (1) no action, which would leave no designated ocean site for the disposal of dredged material from the Tampa Harbor project, or (2) use of another ocean disposal site selected from the alternatives examined.

5. Federal, State, and local agencies, and other sources from whom comments have been received:

<u>Federal Agencies</u>

Department of Commerce
National Oceanic and Atmospheric Administration (NOAA)
Department of Defense
Army Corps of Engineers
Department of Health and Human Services
Department of the Interior
National Science Foundation

<u>State and Local Agencies</u>
State of Florida, Office of the Governor
State of Florida, Department of State
Manatee County Board of Commissioners

Florida Department of Natural Resources
Florida Department of Environmental Regulation
Florida Cooperative Extension Service
Tampa Port Authority
Hillsborough County Environmental Protection Commission
Tampa Bay Regional Planning Council
Gulf of Mexico Fishery Management Council

Private Organizations

Florida Skin Divers Association
Mote Marine Laboratory

Other Sources

Avery Gould
Mrs. R. Bailey
Captain Larry Borden

6. The final statement has been officially filed with the Director, Office of Environmental Review, EPA.

7. The Draft Environmental Impact Statement was made available to the Council on Environmental Quality and the public in November, 1982.

8. Comments on the final EIS are due within 30 days from the date of EPA's publication of Notice of Availability in the Federal Register which is expected to be ___________.

Comments should be addressed to:

Criteria and Standards Division (WH-585)
401 M Street, SW
Environmental Protection Agency
Washington, D.C. 20460

Copies of the Final EIS may be obtained from:

Environmental Protection Agency
Criteria and Standards Division (WH-585)
401 M Street, SW
Washington, D.C. 20460
(202) 245-3036

The Final EIS may be reviewed at the following locations:

Environmental Protection Agency
Region IV
345 Courtland Street, NE
Atlanta, Georgia 30308

U.S. Army Corps of Engineers
Jacksonville District
P.O. Box 4970
400 West Bay Street
Jacksonville, FL 32232

Tampa-Hillsborough County Public Library
Special Collections Department
900 North Ashley Street
Tampa, FL 33602

SUMMARY

This Environmental Impact Statement (EIS) provides the information necessary for the permanent designation of a Tampa Harbor Dredged Material Disposal Site (ODMDS). The purpose of the action is to provide the most environmentally and economically acceptable ocean location for the disposal of material dredged from the Tampa Bay area.

Based on the need to continue dredging projects in the Tampa Bay area, the Environmental Protection Agency (EPA) designated two Tampa Harbor ODMDS's for interim use in 1977 (40 CFR Part 228). These disposal sites were identified as Site A, approximately 13 nautical miles from Egmont Key, and Site B, approximately 9 miles from Egmont Key. In December 1980, the initial designation was extended to February 1983. In May 1982, action was brought in Federal District Court by Manatee County to halt disposal of dredged material at Site A (Manatee County v. Gorsuch, 82-248-T-GC(M.D. Fla. 1982)). By order dated December 21, 1982, the Court found for the plaintiffs, and halted all disposal of dredged material at Site A as of 24 December 1982. Unless this action is taken by EPA, an EPA-designated ODMDS will not be available for the disposal of dredged material from the Tampa Bay area.

PURPOSE AND NEED FOR ACTION

A disposal site in the ocean is needed to receive material dredged from the Tampa Bay area. At present, portions of the Channel System are being deepened. Operation and maintenance dredging will be necessary to maintain the Channel depths. Without the deepening and operation and maintenance dredging, economically important ship traffic would be reduced from the ports of Tampa, Old Tampa, and Hillsborough Bays.

ALTERNATIVES INCLUDING THE PROPOSED ACTION

Alternatives to the proposed action include no action or designation of an alternative ocean site other than the proposed site. Non-ocean disposal methods were considered by the U.S. Army Corps of Engineers (Cf. Letter from Harrison D. Ford, District Counsel for the Corps' Jacksonville District, on July 14, 1983, to Joseph Freedman, Office of General Counsel, EPA) to be less desirable than disposal in the ocean, because of the quantity of sediments to be dredged, the limited receiving capacity of land disposal sites, and economic and environmental concerns. The Corps must also consider alternatives before authorizing individual disposal projects. Thus, this EIS does not consider in great detail non-ocean alternatives for disposal of dredged material.

By taking no action, no ocean disposal site would be designated. Therefore, the Corps would be required to: (1) use an acceptable alternative disposal method; (2) independently justify use of an ocean disposal site; or (3) modify or cancel the existing Tampa Harbor Project.

Three general ocean environments off Tampa Bay, Florida, were considered in which to locate a site for disposal in the ocean. These are: (1) shallow-water (depths less than 30m, located from the shore to approximately 25 nmi offshore), (2) mid-Shelf (depths from 30 to 200m, approximately 25 to 75 nmi offshore), and (3) deepwater Slope (depths greater than 200m, approximately 105 nmi offshore).

The Mid-Shelf and Deepwater Sites are not considered acceptable locations for an ODMDS because of the considerably increased additional expense associated with the extreme transport distances.

Sites A and B and the Shallow-Water Alternative Sites were evaluated for suitability for disposal of material dredged from the Tampa Bay area. Evaluations of the physical, chemical, and biological processes within this near

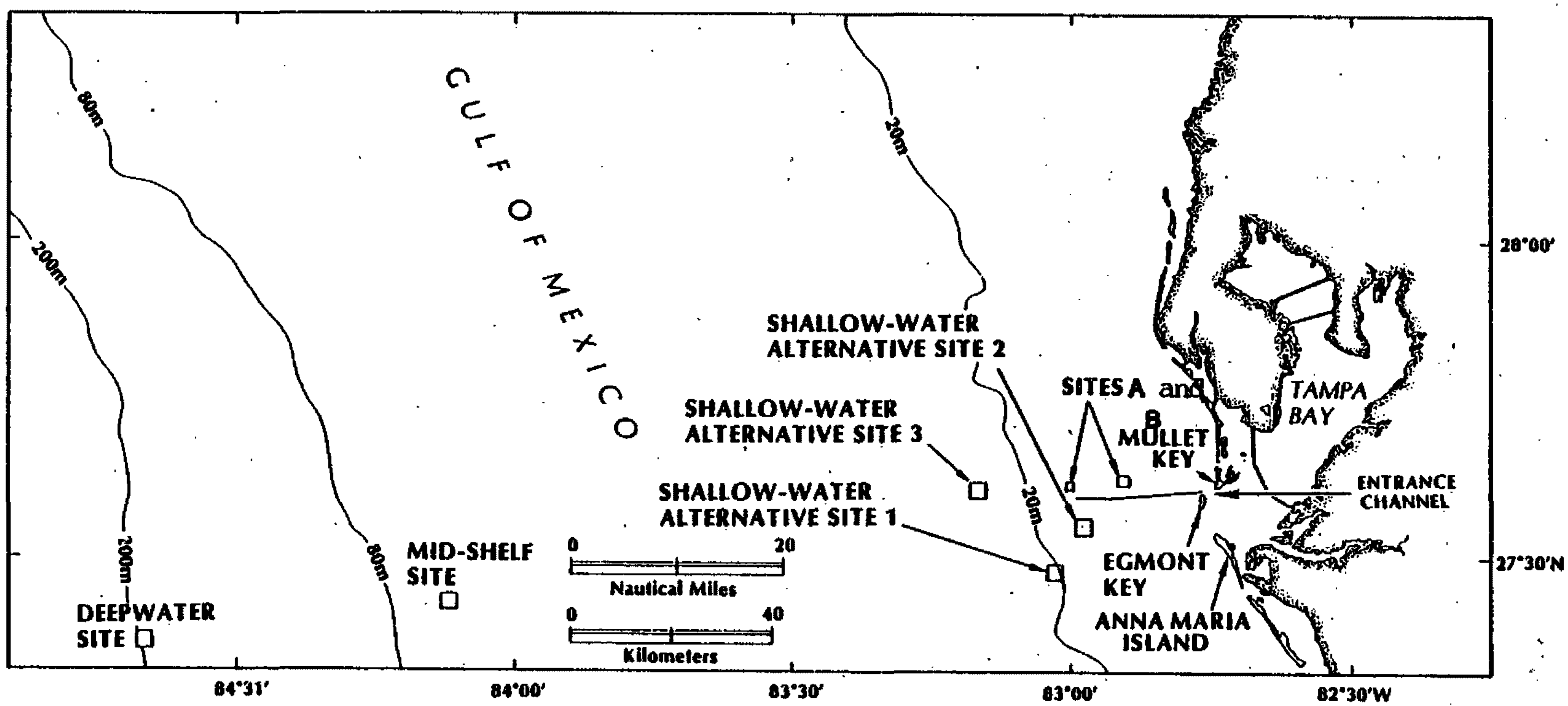


Figure S-1. Tampa Harbor ODMDS and Alternative Disposal Sites shore region were based on historical data and on extensive recent surveys of the area.

The alternative sites considered are shown in Table S-1. The boundary coordinates are:

(1) The previously designated sites (Sites A and B) (interim designation):

Inner:	27°38'08"N, 83°55'06"W		Outer:	27°37'28"N,	83°00'09"W
Site B	27°38'08"N, 82°54'00"W		Site A	27°37'34"N,	82°59'19"W
	27°37'08"N, 82°54'00"W			27°36'43"N,	82°59'13"W
	27°37'08"N, 82°55'06"W			27°36'37"N,	83°00'03"W

(2) Shallow-Water Alternative Site 4:

27°32'27"N,	83°03'46"W
27°30'27"N,	83°03'46"W
27°30'27"N,	83°06'02"W
27°32'27"N,	83°06'02"W

Sites A and B have areas of 1 nmi^2 and 0.68 nmi^2, respectively, and are about 13 and 9 nmi, respectively, from the mouth of Tampa Bay. Depths at the sites range from 10m to 17m. These sites received a total of 2,531,500 yd^3 of dredged material between 1969 and 1980. Of this total, 1,901,800 yd^3 were disposed at Site B between 1969 and 1973. Between 1973 and mid-1980, neither site was used for dredged material disposal. Between June 1980, and the end of December 1982, 4,939,600 yd^3 was dumped at Site A.

Shallow-Water Alternative Site 4 is 5 nmi southwest of Site A in water depths of approximately 22m. It is 4 nmi^2 in area, and has not been previously used for dredged material disposal.

The previously designated sites and Shallow-Water Alternative Sites were evaluated utilizing the results of the following surveys: IEC, Appendix A; EPA, Appendices B and C; Corps, Appendix D; Mote Marine, Appendix E; EPA, Appendix F. Because of the density of attached marine organisms evidenced in several surveys, Alternative Sites 1, 2, and 3 were eliminated from detailed consideration.

Sites A and B and Shallow-Water Alternative Site 4 are compared by applying the 11 specific site-selection criteria listed at 40 CFR Part 228.6 of the Ocean Dumping Regulations. Cf. Table S-1. The following are most important criteria in the comparison, and are indicated by an asterisk (*) in Table S-1.

LOCATION IN RELATION TO BEACHES AND OTHER AMENITY AREAS

The central west Florida Shelf is utilized for recreational diving, recreational and commercial fishing. These activities are commonly associated with hard bottom outcrops, which provide habitats for many species of flora and fauna unassociated with sandy-bottom areas.

The previously designated sites are relatively small and are located in a general area of hard bottoms. Shallow-Water Alternative Site 4 is five nmi farther from shore than Site A. Shallow-Water Alternative Site 4 will provide a sandy-bottom environment with few hard bottom areas and is of sufficient size to permit the disposal of dredged material without unacceptable adverse effects.

DISPERSAL, HORIZONTAL TRANSPORT, AND VERTICAL MIXING CHARACTERISTICS OF THE AREA, INCLUDING PREVAILING CURRENT DIRECTION AND VELOCITY, IF ANY

Seasonal climatic conditions are the primary influences on dispersal and vertical mixing conditions. Ocean water currents produce an alternating north and south transport of sediments, depending on the season. Current velocities, which vary with depth, are dependent on the wind-induced stress and Loop Current influence, but are generally less than 1 kn. Tropical storms and hurricanes produce strong bottom currents (3 to 4 kn), which can profoundly affect dumped material. Vertical mixing is also dependent on temperature and salinity stratification.

TABLE S-1
SUMMARY OF THE 11 SPECIFIC CRITERIA AS APPLIED
TO SITES A AND B AND SHALLOW-WATER ALTERNATIVE SITE

Criteria as Listed at 40 CFR §228.6	Sites A and B	Shallow-Water Alternative Site 4
1. Geographical position, depth of water, bottom topography and distance from coast	See Figure S-1; 10m to 17m; rolling sand/shell bottom area with hard-bottom outcrops; 9 nmi (Site B) and 13 nmi (Site A) to closest point of land	See Figure S-1; 20-23m; rolling sand/shell bottom; very limited hard-bottom outcrops; no major topographical relief; 18 nmi to Egmont Key
2. Location in relation to breeding, spawning, nursery, feeding, or passage of living resources in adult or juvenile phases	Known breeding and spawning grounds in general region; feeding grounds for transient oceanic fish and other wide-ranging pelagic species	Same as Sites A and B
*3. Location in relation to beaches and other amenity areas	Site B within 9 nmi of nearest developed beaches; Site A within 13 nmi of nearest developed beaches; recreational commercial fishing on hard-bottom areas near the sites; artificial reefs constructed within 3 nmi of Site B.	18 nmi to nearest developed beaches; little or no recreational diving, sport or commercial fishing; no known hard-bottom outcrops
4. Types and quantities of wastes proposed to be disposed of, and proposed methods of release, including methods of packing the wastes, if any	4.3 million yd^3 of dredged material from the Tampa Harbor Deepening Project; Future operation and maintenance dredging estimated at 1.1 million yd^3 per year; none of the material will be packaged; sediments are fine sands and silts transported by hopper dredge, barge or scow	Same as Sites A and B
5. Feasibility of surveillance and monitoring	CE and U.S. Coast Guard will survey disposal operations; monitoring easy due to shallow water	Same as Sites A and B
*6. Dispersal, horizontal transport, and vertical mixing characteristics of the area, including prevailing current direction and velocity, if any	Dispersion and horizontal transport will occur primarily to the north and south, resulting from wind-induced seasonal currents, vertical mixing inhibited only during late-summer stratification; Tampa Bay may periodically influence site water characteristics and currents; sediments disposed at these sites may be transported into the entrance channel	Characteristics similar to Sites A and B; less influence from Tampa Bay water discharge; sediments less likely to be transported back into entrance channel

*A criterion especially relevant to site selection

TABLE S-1 (Continued)

Criteria as Listed at 40 CFR §228.6	Sites A and B	Shallow-Water Alternative Site 4
*7. Existence and effects of current and previous discharges and dumping in the area (including cumulative effects)	Site B was used from 1969-73 (1.9 million yd^3); Site A since 1980 (4.4 million yd^3). Between 1973 and mid-1980 no disposal activity occurred; indication is that Site B has recovered; a low mound exists at Site A.	No disposal has ever occurred at this site
*8. Interference with shipping, fishing, recreation, mineral extraction, desalination, fish and shellfish culture, area of special scientific importance, and other legitimate uses of the ocean	Possible conflict of interests with recreational diving and fishing, and commercial fishing activities	No interference expected with recreational or commercial interests
	No interference with shipping, mineral extraction, desalination, fish or shellfish culture, or areas of special scientific importance	No interference with shipping, mineral extraction, desalination, fish and shellfish culture, or areas of special scientific importance
9. The existing water quality and ecology of the sites as determined by available data, or by baseline surveys	Clean oceanic water low in nutrients, suspended solids, and anthropogenic contaminants; Tampa Bay water discharge may occasionally affect water quality; plankton and nekton communities consist of subtropical and tropical species; benthic community primarily consists of polychaete worms and crustacea	Water quality similar to the Sites A and B; however, the increased distance from Tampa Bay will result in reduced influence from Bay water discharge
	Hard-bottom outcrops known to occur in close proximity to the outside of the outer site	No significant hard-bottom outcrops are known to occur at this site
10. Potentiality for the development or recruitment of nuisance species in the disposal sites	Nuisance species have not been developed or recruited; animals present prior to 1980 disposal activity similar to those presently found outside the site	Disposal operations would have effects similar to those at Sites A and B.
11. Existence at or in close proximity to the site of any significant natural or cultural features of historical importance	No known features exist at or near Sites A and B.	Same as Sites A and B.

Dispersal of dumped sediments (particularly the volume projected from the Tampa Harbor Project) may adversely affect hard-bottom outcrops in and near Sites A and B. Relocation of the disposal site to an area containing no significant hard bottom outcrops will present less conflict with amenity areas and commercial fishing. Shallow-Water Alternative Site 4 will provide a large sandy-bottom area for disposal of dredged material.

EXISTENCE AND EFFECTS OF CURRENT AND PREVIOUS DISCHARGES AND DUMPING IN THE AREA (INCLUDING CUMULATIVE EFFECTS)

Disposal of dredged material has occurred only at Sites A and B. Between 1969 and 1973 all disposal occurred at Site B. Disposal activity was resumed in 1980, utilizing Site A only. During a five-year period (1969 to 1973) approximately 1.9 million yd^3 of dredged material were disposed at Site B. Corps records indicate that 4,939,600 yd^3 of dredged material were disposed of at Site A between June 1980, and the end of December 1982.

In 1973, the Corps established the Dredged Material Research Program (DMRP), a five-year, $30-million research effort. The objectives of the program were (1) to understand why and under what conditions dredged material disposal might result in adverse environmental impacts, and (2) to develop procedures and disposal options to minimize adverse impacts (Corps, 1977). Studies supported by the DMRP have reported that no significant long-term effects occur at sandy-bottom habitats in high-energy environments. These studies have shown that the most significant effects are burial and changes in physical characteristics of site sediment, resulting in changes of benthic biological characteristics which may persist for 7 to 12 months, although recolonization may occur within 3 months. Thus, the relocation of Sites A and B to an area with an uninterrupted sandy bottom will minimize potential environmental impacts.

Alternative Site 4 will provide 4 nmi^2 of sand bottom. Planned disposal of the dredged material over the entire area of Site 4 will minimize adverse environmental effects within the site. Dispersion of material outside the site boundaries is expected to occur, if at all, only in extremely minimal amounts. Such dispersion is not expected to have unacceptable adverse environmental effects.

INTERFERENCE WITH SHIPPING, FISHING, RECREATION, MINERAL EXTRACTION, DESALINATION, FISH AND SHELLFISH CULTURE, AREAS OF SPECIAL SCIENTIFIC IMPORTANCE, AND OTHER LEGITIMATE USES OF THE OCEAN

Disposal activities at Sites A and B may have conflicted with recreational diving and fishing and commercial fishing. The relocation of the disposal site will minimize or eliminate any conflicts.

AFFECTED ENVIRONMENT

The Continental Shelf west of Tampa Bay is a plateau of Pleistocene limestone with a young drowned karst topography. The Continental Shelf extends approximately 100 nmi across the Gulf from the mouth of Tampa Bay. The Shelf gradient averages 0.5 m/km, and is characterized by a gently rolling bottom, irregularly covered by a thin veneer of unconsolidated sediments, punctuated by localized sinkholes, fissures, and rock outcrops. The outcrops provide substrates for both living and Pleistocene coral, algae, and associated calcareous organisms. Most of the living corals are found shoreward of the 10m isobath, although some exist to 60m. Within 20 nmi of shore, sediments are predominantly quartz, with increasing quantities of carbonaceous shell fragments towards the mid-Shelf.

The central west Florida region has a subtropical climate with two distinct seasons: summer and winter. Summers are dominated by the Bermuda-Azores high-pressure system, producing persistent southeasterly tradewinds. Winters are affected by cold fronts moving from the northwest, and extratropical cyclones moving from the southwest.

Water circulation in the eastern Gulf of Mexico is dominated by the Gulf Loop Current and detached cyclonic eddies. The degree of penetration of the Loop Current into the Gulf varies seasonally and fluctuates from year to year. The main body of the current usually reaches its northenmost limit during summer. During winter, the current is generally confined to the southern Gulf. Wind directions, frequencies, and magnitudes also affect local ocean currents, which in turn, influence the distribution of sediments and nutrients. Ocean current velocities generally range up to 0.7 kn, but may increase to 3 to 4 kn during severe tropical storms or hurricanes.

As with other Gulf of Mexico coastal areas, abundances of diatoms and dinoflagellates are greatest inshore, and decrease with increasing distance from shore. Generally, diatom abundance exceeds that of dinoflagellates; however, periodic outbreaks of large numbers of dinoflagellates result in "red tide" conditions. Red tides occur primarily during late summer and autumn.

Zooplankton comprise a wide variety of larval and adult forms representing many phyla. Zooplankton volume and abundance of fish eggs and larvae have been observed to peak in spring and summer.

Approximately 400 species of fish inhabit the central west Florida Shelf. Nekton communities are classified primarily by type of substratum: nekton associated with soft substrates are predominantly of temperate origin, whereas those associated with hard bottom outcrops are generally derived from Caribbean and West Indian populations. The three species reported as most abundant in nearshore waters are the leopard searobin, sand perch, and tomtate.

A variety of infaunal and epifaunal species inhabit the previously designated and Shallow-Water Alternative Sites. Sandy substrates are dominated by sea lancelets, crustaceans, polychaete worms, molluscs, and echinoderms. Hard bottom outcrops are inhabited by soft and hard corals, echinoderms, sponges, molluscs, and teleosts.

Marine grasses and algae may be associated with either sandy substrata or rock outcrops; however the larger diversity of benthic plants occurs on rock outcrops.

Recreational diving and fishing are popular activities in central west Florida, and the offshore area in which Sites A and B are located contains several desirable locations. In 1978, the combined value of offshore recreational and commercial fish landings totaled over $9 million; pink shrimp, red and black grouper, and red snapper were the major species of economic importance.

Other commercial activities include oil and gas exploration, production, and shipping. However, disposal of dredged material does not interfere with these activities, and in the case of commercial shipping, a direct benefit is gained. Similarly, economic benefits are gained for many commercial and industrial enterprises in the Tampa Bay region, and thus indirectly, the general population of Florida.

ENVIRONMENTAL CONSEQUENCES

Previous disposal of dredged material at Sites A and B has not been monitored to determine specific environmental effects. However, before 1980 disposal volumes were relatively small, totaling approximately 2 million yd^3 between 1969 and 1973, and all material was disposed at Site B. Studies of dredged material disposal operations conducted at other locations in continental U.S. waters have determined that no significant long-term adverse effects result from dumping dredged sediments on sandy substrate habitats. Short-term effects of disposal are temporary, including localized increases in water column turbidity and temporary reductions in the abundance of bottom-dwelling animals. Mounds of dredged material may persist for several months or longer. The physical characteristics of dredged sediments may be dissimilar to existing sediment characteristics, resulting in changes to the benthic biological characteristics of the affected site. In comparison, hard bottom areas support marine organisms which are not adapted to burial or high levels of siltation. Therefore, dredged material disposal in areas with hard bottom outcrops may result in more significant environmental consequences than at areas without such outcrops or with minimal outcroppings.

Based on analysis of liquid-phase elutriate samples, certain constituents present in trace amounts may be released into the water during disposal. These materials include nutrients (ammonia, nitrite and nitrate compounds, and phosphorus compounds), heavy metals, and organic compounds. However, the estimated volume released and calculated dilution of the materials indicate that these constituents would be reduced to background levels and would not be an environmental concern within the permitted four-hour period of initial dilution.

This designation is expected to have minimal impact on threatened or endangered species occurring in the region. Turtle species inhabiting the area (including the hawksbill turtle, leatherback turtle, green sea turtle, and loggerhead turtle) are wide-ranging oceanic species, and the size of any of the Shallow-Water Alternative Sites is a small fraction of their potential feeding range. Other species that may feed in the area are cetaceans and brown pelicans. The general area of the sites under consideration do not contain unique feeding or breeding grounds for any of these species, and site use is not anticipated to affect their survival.

The possibility of long-term adverse biological effects resulting from contaminants in the dredged material is extremely low. Dredged material must meet certain bioassay and bioaccumulation criteria (outlined at 40 CFR 227.27) to ensure that the material is suitable for ocean disposal. In addition, all Shallow-Water Alternative Sites are in open water, which ensures a supply of fresh oxygenated seawater over the affected area. Long-term release of contaminants into the water should be below detection levels.

Disposal operations at Shallow-Water Alternative Site 4 would not interfere with any long-term use of resources. The only resources lost by disposal are: (1) sand for landfill, (2) energy expended for the transport of dredged materials, and (3) money spent on disposal. The losses are offset by the benefit to commerce from dredging the channel system, and subsequent disposal of dredged material at an environmentally suitable ocean disposal site. Adverse environmental effects of the proposed action include: (1) smothering of the benthos within the designated site and (2) possible habitat alteration of the site. Adverse impacts within the site are unavoidable, but the disposal operations will be monitored to prevent unacceptable environmental degradation outside the boundaries.

To ensure that any adverse environmental effects will be identified, a monitoring program will be established to supplement historical data. The primary purpose of this monitoring program will be to determine whether disposal at the selected site significantly affects areas outside the site, and to detect long-term effects occurring in or around the site. Monitoring plans may include the survey of appropriate bottom-dwelling animals, periodic bathymetric studies, and tests for bioaccumulation, if there is reason to believe that dredged material constituents could be bioaccumulated. If necessary, other physical, chemical, or biological parameters will be measured. Monitoring of Shallow-Water Alternative Site 4 will occur at regular intervals over the three-year term of the site's designation, and will be measured against a control site approximately five nautical miles southeast of Shallow-Water Alternative Site 4. The control site has similar topological conditions to Site 4; i.e., it is sandy-bottomed, flat, and in approximately the same depths of water.

CONCLUSIONS

Of the sites examined, Shallow-Water Site 4 is most environmentally acceptable for disposal of the large volumes of dredged material from the Tampa Bay area. Based on the outcome of recent surveys of four Shallow-Water Alternative Sites, EPA has determined that Shallow-Water Alternative Site 4 is the alternative with the fewest hard-bottom areas which may be affected by dredged material disposal, and that its designation will not have significant adverse effects on the environment. Shallow-Water Alternative Site 4 is therefore recommended for designation as the Tampa Harbor ODMDS for a period of three years.

ORGANIZATION OF THE EIS

p The EIS is organized into six Chapters and five Appendices. Four Chapters omprise the main body of the EIS:

- o Chapter 1 specifies the purpose and need for the action, (i.e., designation of a Tampa Harbor ODMDS). Background information on the disposal of dredged material is presented, together with the legal framework guiding EPA in the selection and designation of disposal sites. Responsibilities of the Corps in disposal of dredged material in the ocean, and the history of dredged material disposal at Sites A and B, are summarized.

- o Chapter 2 discusses alternative locations for the disposal of dredged material in the ocean and the no-action alternative. Alternatives are evaluated using the 11 site-selection criteria listed at 40 CFR 228.6. Guidelines for a monitoring plan are also presented.

- o Chapter 3 describes the affected environment of Sites A and B and the Shallow-Water Alternative Sites.

- o Chapter 4 describes the potential environmental consequences of dredged material disposal at Sites A and B and the Shallow-Water Alternative Sites.

Chapters 5 and 6, and Appendices A to F, provide supplementary information. Chapter 5 lists the authors of the EIS. Chapter 6 contains the glossary, list of abbreviations, and references cited in the text. Mathematical conversion factors are provided on the inside front cover. Appendices A to F present summaries and analyses of data collected during the IEC, Corps, Mote Marine, and EPA surveys.

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Chapter 1

PURPOSE OF AND NEED FOR ACTION

The Ports of Tampa, Old Tampa, and Hillsborough Bays are among the nation's leading ports in terms of shipping traffic and cargo tonnage. Ship access to the harbors depends on the continued dredging of navigation channels and berthing areas. The action taken in this EIS is the final designation of a Tampa Harbor Ocean Dredged Material Disposal Site located in the nearshore region west of Tampa Bay.

GENERAL

The action addressed in this Environmental Impact Statement (EIS) is the designation for a period of three years of an Ocean Dredged Material Disposal Site (ODMDS) in the Tampa Bay area. The purpose of the action is to provide the most environmentally and economically acceptable location for the ocean disposal of materials dredged from Tampa Bay. This EIS presents the information needed to evaluate the suitability of ocean disposal areas for final designation and is based on a series of disposal site environmental studies. The environmental studies and final designation process are conducted in accordance with the requirements of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA) (86 Stat. 1052), as amended (33 U.S.C.A. 1401 et seq.) and the Environmental Protection Agency's (EPA) Ocean Dumping Regulations and Criteria (40 CFR 220-229).

Based on an evaluation of all reasonable alternatives, the action recommended in this EIS is to designate Shallow Water Alternative Site 4 as the Tampa Harbor ODMDS for a period of three years. The boundary coordinates of the site (Figure 1-1) are: 27°32'27"N, 83°03'46"W; 27°30'27"N, 83°03'46"W; 27°30'27"N, 83°06'02"W; 27°32'27"N, 83°06'02"W. The site is approximately 18 nmi offshore, has an average depth of 22m, and an area of 4 nmi^2.

The designation of an ocean dredged material disposal site by EPA does not by itself authorize the disposal of dredged material at that site. That disposal must be authorized by the Corps of Engineers, subject to its public participation procedures (Cf. 33 CFR 209.145), and subject to possible disapproval by EPA.

LEGISLATION AND REGULATORY BACKGROUND

In 1972, Congress enacted the Marine Protection, Research, and Sanctuaries Act (MPRSA), which regulates the transportation for the purpose of dumping and the ultimate dumping of materials into ocean waters. In general, the Act prohibits ocean dumping except in accordance with permits issued by EPA, or in the case of dredged materials, the Corps of Engineers. Permits issued by the Corps are subject to EPA approval under Sections 103(c) and (d) of the Act.

Pursuant to Section 102(a) of the MPRSA, EPA has promulgated regulations establishing criteria for evaluating ocean dumping permit applications (Cf. 40 CFR Part 227). Section 103(b) of the MPRSA requires the Corps to apply those criteria in making determinations whether to issue permits for the ocean disposal of dredged material.

Section 102(c) authorizes EPA to designate recommended sites for dumping. This EIS is prepared in connection with such a site designation. In issuing permits for the ocean disposal of dredged material, the Corps is required by Section 103(b) of the Act to utilize EPA-designated sites, to the extent feasible.

The Corps is authorized, pursuant to Section 103(e) of the Act, in lieu of issuing permits for Federal projects, to issue regulations requiring application of the same criteria and procedures which apply to the issuance of permits. The Corps has issued such regulations (Cf. 33 CFR 209.145).

Thus, authorization for ocean disposal of dredged material is a two-step process. First, a recommended disposal site must be designated by EPA. Second, the Corps, applying the regulatory criteria promulgated by EPA, must issue a permit, or follow equivalent administrative procedures.

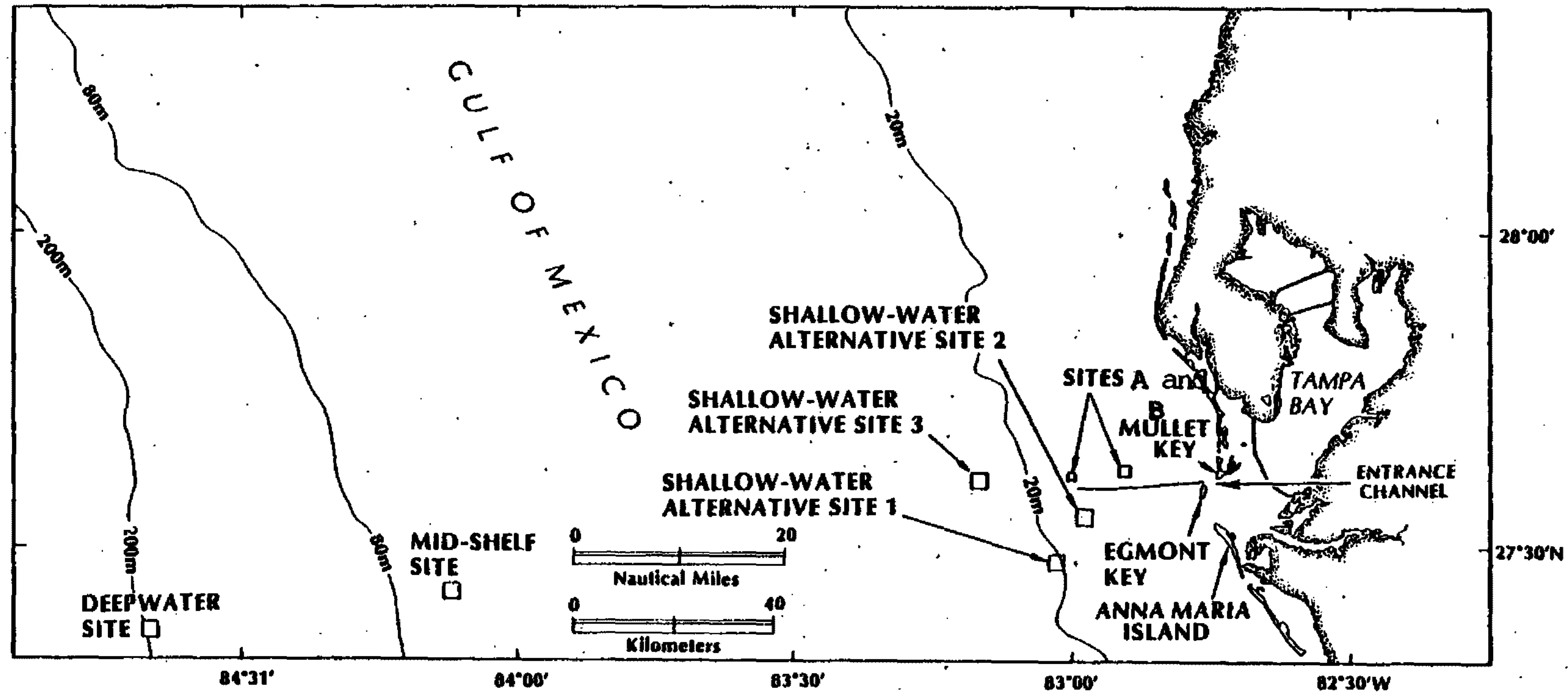

Figure 1-1. Tampa Harbor ODMDS and Alternate Disposal Sites

1. Site Designation

Pursuant to Section 102(c) of the MPRSA, EPA has promulgated regulations governing the designation of ocean disposal sites (Cf. 40 CFR Part 228). The regulations provide that designation will be based on environmental studies of the site, regions adjacent to the site, and historical knowledge of disposal in areas similar to the site (Cf. 40 CFR Part 228.4). EPA also established general and specific criteria to be considered in the site designation process (Cf. 40 CFR Parts 228.5 and 228.6).

Due to the need of the Corps to proceed with dredging in the Tampa Bay area, EPA designated two sites (Sites A and B) on an interim basis, without completing the studies required for final site designation. The interim designations of Sites A and B expired in February, 1983; no dredged material is currently being ocean disposed in the Tampa Bay area. The required site designation studies have now been completed. (The primary investigations were EPA surveys that took place in May 1982, and February, March, and April 1983. Other studies included IEC investigations in October 1979, and January 1980; an EPA investigation in October 1981; and a Corps investigation in April 1982). On the basis of those studies, and evaluation of the regulatory factors (Cf. Chapter 2), this EIS recommends the designation of a dredged material disposal site in the Tampa Bay area for a period of three years.

In the event that one or more selected areas are deemed suitable for designation, it is EPA's position that the site designation process, including the disposal site(s) evaluation study and the development of the EIS, fulfills all statutory requirements for the selection, evaluation, and designation of an ODMDS.

2. Ocean Dumping Evaluation Procedures

Section 103(a) of the MPRSA allows the ocean dumping of dredged maerial only after a determination that "the dumping will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, or economic potentialities." In making this determination, the Corps must apply the environmental criteria promulgated by EPA at 40 CFR Part 227. Those criteria include: (1) an evaluation of the chemical and physical impacts of the proposed dumping on marine life (Subpart B); (2) a determination that there is a demonstrated need for ocean disposal (Subpart C); (3) an evaluation of the impact of the proposed dumping on esthetic, recreational, and economic values (Subpart D); and (4) an evaluation of the impact of the proposed dumping on other uses of the ocean. As noted earlier, an EPA-designated disposal site must be used where feasible.

Prior to issuing a dredged material permit or authorizing a Federal project involving the ocean disposal of dredged material, the Corps must notify EPA, which may disapprove the proposed disposal. Under certain limited circumstances set forth in Section 103(d) of the MPRSA, the Corps may request a waiver from EPA, which is to be granted, unless EPA "finds that the dumping of the material will result in an unacceptably adverse impact on municipal water supplies, shellfish beds, wildlife, fisheries (including spawning and breeding areas), or recreational areas...."

TABLE 1-1
RESPONSIBILITIES OF FEDERAL DEPARTMENTS
AND AGENCIES FOR REGULATING OCEAN DISPOSAL UNDER MPRSA

Department/Agency	Responsibility
U.S. Environmental Protection Agency	Issuance of waste disposal permits, other than for dredged material
	Establishment of criteria for regulating waste disposal
	Enforcement actions
	Site designation and management
	Overall ocean disposal program management
	Research on alternative ocean disposal techniques
U.S. Department of the Army Corps of Engineers	Issuance of permits for transportation of dredged material for disposal
	Approval of projects involving disposal of dredged material
	Recommendation of disposal site locations
U.S. Department of Transportation Coast Guard	Surveillance
	Enforcement support
	Issuance of regulations for disposal vessels
	Review of permit applications
U.S. Department of Commerce National Oceanic and Atmospheric Administration	Long-term monitoring and research
	Comprehensive ocean dumping impact and short-term effect studies
	Marine sanctuary designation
U.S. Department of Justice	Court actions
U.S. Department of State	International agreements

PERMIT ENFORCEMENT

Under MPRSA the Commandant of the U.S. Coast Guard (USCG) is assigned responsibility by the Secretary of Transportation to conduct surveillance of disposal operations to ensure compliance with the permit conditions and to discourage unauthorized disposal. Alleged violations are referred to EPA for appropriate enforcement. Civil penalties include a maximum fine of $50,000; criminal penalties involve a maximum fine of $50,000 and/or a one-year jail term. Where administrative enforcement action is not appropriate, EPA may request the Department of Justice to initiate relief actions in court for violations of the terms of MPRSA. 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.

The Commandant of the Coast Guard has published guidelines for ocean dumping surveillance and enforcement in Commandant Instruction 16470.2B, dated 29 September 1976. An enclosure to the instruction is an Interagency Agreement between the Corps and the USCG regarding surveillance and enforcement responsibilities over Federally contracted ocean dumping activities associated with Federal Navigation Projects. Under the agreement, the Corps "recognizes that it has the primary surveillance and enforcement responsibility over these activities." The Corps directs and conducts the surveillance effort over contract dumpers engaged in ocean disposal activities, except in New York and San Francisco; the USCG retains primary responsibility for surveillance in these two areas. In all other areas, the USCG will respond to specific requests from the Corps for surveillance missions. The USCG retains responsibility for surveillance of all dredged material ocean dumping activities that are not associated with Federal Navigation Projects.

The Act authorizes a maximum criminal fine of $50,000 and jail sentence of up to one year for every unauthorized dump or violation of permit requirements, or a maximum civil fine of $50,000. Any individual may seek an injunction against an unauthorized dumper with possible recovery of all costs of litigation.

INTERNATIONAL CONSIDERATIONS

The principal international agreement governing ocean dumping is the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention), which became effective in August 1975, upon ratification by 15 contracting countries including the United States (26 UST 2403: TIAS 8165). There are now 47 contracting parties. Designed to control dumping of wastes in the ocean, the Convention specifies that contracting nations will regulate disposal in the marine environment within their jurisdiction and prohibit disposal without permits. Certain hazardous materials are prohibited (e.g., radiological, biological, and chemical warfare agents, and high-level radioactive matter). Certain other materials (e.g., cadmium, mercury, organohalogens and their compounds, oil and persistent, synthetic or natural materials which float or remain in suspension) are also prohibited except if present as trace contaminants, or if rapidly rendered harmless. Other materials (e.g., arsenic, lead, copper, zinc, cyanides, fluorides, organosilicon, and pesticides) are not prohibited from ocean disposal, but require special care. Permits are required for ocean disposal of materials not specifically prohibited. The nature and quantities of all ocean-dumped material, and the circumstances of disposal, must be periodically reported to the Intergovernmental Maritime Consultative Organization (IMCO) which is responsible for administration of the Convention.

EPA's ocean dumping criteria are based on the provisions of the London Dumping Convention (LDC) and include all the considerations listed in Annexes I, II, and III of the LDC. Thus, when a material is found to be acceptable for ocean dumping under the EPA ocean dumping criteria, it is also acceptable under the LDC.

CORPS OF ENGINEERS NATIONAL PURPOSE AND NEED

The need to use an ocean disposal site must be established by the Corps in issuing a permit to dispose at that site, or in the Corps' administrative procedures required for authorization of a Federal project.

Section 103 of Title I requires the Corps to consider in its evaluation of Federal projects and Section 103 permit applications the effects of ocean disposal of dredged material on human health, welfare, or amenities, or the marine environment, ecological systems, and economic potentialities. As part of this evaluation, consideration must be given to utilizing, to the extent feasible, ocean disposal sites designated by the EPA pursuant to Section 102(c).

Since 1977 the Corps has used those ocean disposal sites designated by EPA on an interim basis. Use of these interim-designated sites for ocean disposal has been an essential element in the Corps' compliance with the requirements of the MPRSA and its ability to carry out its statutory responsibility for maintaining the nation's navigable waterways. To continue to maintain U.S. waterways, the Corps considers it essential that environmentally acceptable ocean disposal sites be identified, evaluated, and designated for continued use pursuant to Section 102(c). These sites will be used after review of each project has established that the proposed ocean disposal of dredged material is in compliance with the criteria and requirements of EPA and Corps regulations.

CORPS OF ENGINEERS LOCAL NEED

Collectively, the Ports of Tampa, Old Tampa, and Hillsborough Bays are among the leading ports in the United States, ranking seventh in total tonnage and third in export tonnage. In 1979, approximately 49.8 million short tons of cargo passed through Tampa Bay; the oceanborne foreign trade amounted to $1.87 billion (Tampa Bay Port Authority, 1979). Total foreign and domestic imports amounted to 22,411,557 short tons, and exports totaled 27,418,884 short tons. The Port Authority of Tampa Bay estimates that about 36,000 persons are directly or indirectly employed in port industries throughout the Tampa Bay region. (Cf. Letter from Thomas J. O'Connor, Director of Port Services, Tampa Port Authority, on August 16, 1983, to Jonathan E. Amson, Office of Water Regulations and Standards, EPA).

The economic viability of these ports depends on the continued use of Federal and non-Federal navigation channels and berthing areas. The shipping channels in Tampa Bay are shallow, and without deepening, would prevent passage of modern deep-draft vessels. Thus, dredging is required to provide and maintain sufficient operating depths for vessel traffic. At present, navigation channels for ocean-going vessels are being increased from 34- to 43-ft depths, whereas recreational boat channels generally have depths from 6 to 15 ft. The main channel improvements are scheduled for completion in early 1986.

Approximately 8 to 10 million yd^3 of sediments being dredged in improvement of the Tampa Bay main channel and in maintenance of St. Petersburg Harbor and Port Tampa channel are now scheduled for disposal in the ocean, including 3.6 million yd^3 remaining from the Tampa Harbor Project. Sediments to be dredged in improvement of other portions of the Tampa Bay channels may also be scheduled for disposal at an ocean site, but disposal plans have not been formulated yet. Estimates of future channel maintenance dredging volumes are expected to be 1.1 million yd^3 annually. Sites A and B (Figure 1-1) are centered at 27°37'38"N, 82°54'37"W, and 27°37'03"N, 82°59'42"W, respectively. These sites received a total of 2,531,500 yd^3 of dredged materials between 1969 and 1980. Of this total, 1,901,800 yd^3 were disposed at Site B between 1969 and 1973, and in the summer of 1980, 630,000 yd^3 were disposed at Site A. Between 1973 and mid-1980, neither site was used for dredged material disposal. Between June 1980, and the end of December 1982, 4,939,600 yd^3 was dumped at Site A. This included 263,650 yd^3 taken from St. Petersburg Harbor (completed in May 1981), and 662,900 yd^3 taken from Port Tampa Channel (completed in March 1982).

Prior to the use of Sites A and B, two other sites were utilized. One site (centered at 27°35'39"N, 82°44'36"W) was 0.5 nmi east of Egmont Key at the mouth of Tampa Bay. Another site (centered at 27°33'45"N, 82°50'42"W) was 4.5 nmi west of Egmont Key. These sites received a combined total of 6,152,000 yd^3 of dredged materials between 1951 and 1967.

Chapter 2

ALTERNATIVES INCLUDING THE PROPOSED ACTION

The action addressed in this EIS is the designation of an environmentally and economically acceptable ODMDS in the Gulf of Mexico, offshore of Tampa Bay, Florida. The designated site will be used for the ocean disposal of material from the Tampa Bay area. In addition to the two previously designated Sites A and B, four Shallow-Water Alternatives (1,2,3, and 4), a Mid-Shelf Alternative, and a Deepwater Alternative are discussed. However, the Mid-Shelf, Deepwater, and three of the Shallow-Water Alternatives are eliminated from detailed evaluation on the basis of environmental sensitivity and/or economics. The 11 criteria of 40 CFR §228.6 are the bases for comparing the environmental impacts associated with disposal at the two previously designated Sites and one Shallow-Water Alternative Site considered in greater detail in this EIS. The potentially significant environmental impacts resulting from disposal of the dredged material are the smothering of benthos and temporarily increased water turbidity.

This chapter presents the alternatives, including No Action, considered in designating a Tampa Bay, Florida ODMDS for a period of three years. The feasibility of non-ocean disposal methods is also briefly discussed. In addition to the two previously designated Sites, six Alternative Sites (Figure 1-1) are discussed to determine which is most suitable as an ocean disposal site for material dredged from the Tampa Bay area. These sites include four Shallow-Water Alternatives, a Mid-Shelf Alternative, and a Deepwater Alternative. Alternatives were initially screened on the basis of environmental and economic suitability. Hence, areas within three miles immediately north and west of the previously designated Sites were eliminated because of the presence of hard bottom areas and artificial reefs, which are known fishing and diving areas. In addition, at the suggestion of the State of Florida, three sites, identified as State Sites X, Y, and Z, were examined. The Corps also examined a site identified as Site 2A. These sites are discussed later in this chapter of the FEIS.

Waters less than 10m deep were eliminated because of potential shoaling. The Mid-Shelf and Deepwater Sites were located to avoid potentially environmentally sensitive areas, such as mid-Shelf hard bottoms and areas of commercial finfishing; however, because of the environmental sensitivity of deeper water low-energy environments and the economics of long-distance transport, these two sites are eliminated from a detailed comparison using the 11 criteria of 40 CFR §228.6.

Analyses of data obtained from numerous oceanographic surveys (see Appendices to A to F) performed off Tampa Bay led to a decision to eliminate three of the Shallow-Water Alternative Sites from a detailed comparison using the criteria of 40 CFR §228.6. A brief summary of each survey and the reasons for each site's elimination are presented in this chapter.

Those sites which were initially considered as potentially suitable ocean disposal sites are presented below:

- Previously designated interim Sites (Inner B and Outer A) - Water depth less than 20m, 9 and 13 nmi from shore, respectively
- Shallow-Water Alternative Site 1 - Water depth of 20m, 16 nmi from shore (this alternative discussed, but not analyzed according to the 11 regulatory criteria)
- Shallow-Water Alternative Site 2 - Water depth less than 20m, 13 nmi from shore (this alternative is discussed, but not analyzed according to the 11 regulatory criteria)
- Shallow-Water Alternative 3 - Water depth less than 30m, 23 nmi from shore (this alternative is discussed, but not analyzed according to the 11 regulatory criteria)
- Shallow-Water Alternative Site 4 - Water depth less than 24m, 18 nmi from shore

- o Mid-Shelf Alternative Site - Water depth greater than 70m, 70 nmi from shore (this alternative is discussed, but not analyzed according to the 11 regulatory criteria)

- o Deepwater Alternative Site - Water depth greater 200m, 105 nmi from shore (this alternative is discussed, but not analyzed according to the 11 regulatory criteria.

These sites represent three of the four major marine environments (Shallow Shelf, Deep Shelf, and Slope) off Tampa Bay (Collard and D'Asaro, 1973). Sites A and B and the Shallow-Water Alternative Sites are in a generally high-energy environment influenced by wave action and storms. The Mid-Shelf Site and Deepwater Alternative Site are in a relatively low-energy environment influenced by the Gulf of Mexico Loop Current and intrusions of deep Gulf waters.

Disposal at Shallow-Water Alternative Site 4, Mid-Shelf, or Deepwater Sites would require increased disposal, monitoring, and surveillance costs because all sites are further from shore than the Sites A and B or Shallow-Water Alternative Site 2. However, using Shallow-Water Alternative Site 4 would add only 10 nmi to the present round-trip distance to Site A; the Mid-Shelf Site and Deepwater Site would result in increased round-trip distances of 114 nmi and 182 nmi, respectively.

NO-ACTION ALTERNATIVE

The no-action alternative would be to refrain from designating an EPA-approved ocean site for the disposal of dredged material from the Tampa Bay area. By taking no action, no ocean disposal site would be designated. Therefore, the Corps would be required to: (1) use an acceptable alternative disposal method; (2) independently justify use of an ocean disposal site; or (3) modify or cancel the existing Tampa Harbor Project.

The Corps' Jacksonville District (CE, 1974) examined the issue of land-based disposal and concluded the following:

> Alternative disposal of the dredged material along the shoreline of Tampa Bay was considered. Assuming that the areas would be filled 10 feet above existing elevation, 6.1 square miles of disposal area would be needed. This would mean filling 4,000 to 5,000 feet into the bay along 40,000 feet of shoreline. Dikes would have to be built just upland of the shoreline at the expense of the local sponsor. Material from the deepening of the harbor would be pumped to form dikes on the bayside of the areas and maintenance material would be pumped inside the areas. Problems would be encountered with the natural inflow of drainage water along the shoreline. Environmentally valuable shoreline areas would be destroyed under this plan.
>
> Upland disposal areas for maintenance and construction dredged spoil have been sought since 1972. Undeveloped areas adjacent to the bay were identified from U.S. Geological Survey Quadrangle Sheets and later field investigated by the Corps of Engineers and/or the Tampa Port Authority. The only potential spoil disposal areas were located on McDill Air Force Base and the east side of Hillsborough Bay between Deland Creek and Alafia River. Easements could not be obtained for either area, and consequently, maintenance has not been performed since 1972, although funds have been available. Present indications are that private lands would not be available for disposal purposes without costly and lengthy condemnation proceedings by the local sponsor. The cost of land purchase, diking, and longer pumping distances are all factors which have been considered in deriving the present plan. However, the single factor which dictates against the use of upland disposal areas is the unavailability of suitable upland acreage.

Regarding diked disposal islands, rock and other hard materials would have to settle out to the bottom of the barge and be dropped outside the diked disposal area. The finer materials could then be pumped into the diked disposal area. Mechanical equipment would then have to be used to pick up the rock dropped by the barge, and dispose of this hard material inside the dikes. The double handling of this material would, in and of itself, render the operation expensive and cause environmental concerns. In addition, there is no area known where this alternative has been tried successfully (Cf. Letter from H.D. Ford, District Counsel for Corps' Jacksonville District, to Joseph Freedman, Office of General Counsel, EPA, cited previously).

In addition, the capacity of the existing diked disposal islands in Tampa Bay is not sufficient to receive the volume of dredged material from the construction phase of the Tampa Harbor Project. Further, construction to increase the capacity of the existing diked disposal islands or to create new islands would not be economically feasible. The use of diked disposal islands may also have unacceptable environmental impacts by (1) reducing the circulation patterns within Tampa Bay, (2) increasing turbidity with a concomitant reduction in primary productivity, and (3) the possibility of erosion of dike walls after deposition of construction phase dredged material.

Based on these factors, the No-Action Alternative is not considered to be an acceptable alternative to the proposed action. However, the subject of land-based disposal or any other feasible alternative mentioned in the Ocean Dumping Regulations and Criteria (40 CFR 227.15) is not being permanently set aside in favor of ocean disposal. The need for ocean dumping must be demonstrated each time a permit application for ocean disposal is made or a Federal project considered. At that time, the availability of other feasible alternatives must be assessed. Further, disposal areas must be obtained by the local sponsor under the provisions of the authorization for the Tampa Harbor Project. Upland disposal areas are not available within any reasonable price constraints, and the method of disposing of the materials containing rock and other hard material in Tampa Bay appears to have environmental consequences which would likely be unacceptable. In addition, the cost of performing such work would probably render this alternative unacceptable.

In sum, the material being dredged in the Tampa Harbor Project is not suitable for disposal in the diked disposal areas. In addition, upland areas have been explored and have been found to be not available within any reasonable price range.

DISPOSAL IN THE OCEAN

Selection of an appropriate ocean disposal site(s) requires identification and evaluation of suitable areas for receiving the dredged sediments. Identification of these areas relies on available information obtained from previous site-specific and synoptic oceanographic studies. Specific alternative sites may be identified within these areas, based on historic data and information and recommendations from State and Federal resource agencies and the district and division offices of the Corps.

SITE SELECTION

A sustained effort has been mounted over the past few years to locate an environmentally and economically acceptable ocean disposal site for the Tampa Bay area. This effort involved the collection and analysis of both historical records and field survey data. A discussion and summary of the results of this effort are presented below. The results of these studies led to the elimination of a number of alternative sites from further detailed consideration.

SITE SELECTION SEQUENCE

The two previously designated sites (A and B) were designated on an interim basis in January 1977 (42 FR 2462, 40 CFR 228.12). The interim designation was for a three-year period. In December 1980, the interim designation was extended to February 1983.

The EPA entered into a contract with Interstate Electronics Corporation (IEC) in 1977 for the evaluation of interim-designated sites and the preparation of EIS's. The Corps joined this effort in 1978 by providing financial support, reviews, and consultation. The Tampa Bay interim-designated sites were included in the contract effort along with a number of other interim-designated ODMDS's.

IEC initiated its studies of the Gulf of Mexico near Tampa Bay in 1979. Initial screening of historical data and information indicated that three general areas should be considered for the location of a permanently-designated ODMDS: Shallow-Water, Mid-Shelf, and Deepwater. The previously designated sites are located in the Shallow-Water Area. It was determined during the initial screening that areas within three miles immediately north and west of the previously designated sites should be eliminated from consideration because of the presence of hard bottom areas and artificial reefs. Waters less than 10m deep also were eliminated because of potential shoaling.

In order to obtain more information on the previously designated sites and the Shallow-Water area, field surveys were planned. IEC implemented surveys on Sites A and B and the immediately surrounding areas in September-October 1979 and January 1980 (Appendix A). IEC concluded that those sites might not be the most environmentally acceptable locations for dredged material disposal. IEC recommended that further studies be conducted on potential alternative sites.

In April 1981, Mote Marine Laboratory (MML) of Sarasota, Florida, at the request of the Manatee County Board of County Commissioners, began a study to evaluate the effects of offshore disposal of sediments dredged from Bayboro Harbor, St. Petersburg, FL (See Appendix E). The study was conducted at Site A. The study concluded that partially buried hard bottom habitats were present at the boundaries of the disposal site. Living hard bottom communities, including hard corals, soft corals, and sponges were observed beyond the limit of the disposal site (Rice et al., 1981).

One of the recommendations of the MML report was that, based on the study, dredged material disposal at Site A be discontinued and efforts be directed toward locating an alternative site(s).

Subsequently, using the Ocean Survey Vessel ANTELOPE, EPA performed a reconnaissance survey of the Tampa Bay area in October 1981. Using side scan sonar and fathometer tracings provided by IEC, EPA divers observed and photographed the bottoms of Alternative Shallow-Water Sites 1, 2, and 3 (Cf.

Figure 1-1). Evaluation of the divers' observations and photographs (Appendix C) indicated that Alternative Site 1 contained hard bottom outcrops and numerous animal and plant communities. For this reason, Alternative Site 1 was eliminated from further detailed evaluation. Alternative Site 2 was determined to be marginally acceptable, due to a finger of hard bottom communities extending into the site from the eastern boundary of the site. The western and southern portions of the site consisted of sandy bottoms. Alternative Site 3 appeared to be sandy-bottomed over its entire area.

Based on the results of the reconnaissance survey, more in-depth surveys were planned. In April 1982, the Corps planned and implemented a survey of the area southwest of Alternative Site 2, known as Site 2A. In May 1982, EPA planned and implemented surveys of the two previously designated Sites, Alternative Site 3, and an area southwest of Site 2A identified as Alternative Site 4.

The Corps initiated its study in April 1982, and issued its report in May 1982. The report (Appendix D) found that Alternative Site 2A was environmentally unacceptable due to the presence of extensive areas of exposed rock. Based on this finding by the Corps and on EPA's finding during its reconnaissance survey, Sites 2 and 2A were eliminated from further detailed consideration.

The in-depth survey implemented by EPA in May 1982 (Cf. Appendix C), included videotaping of the bottom of Site A, a transect of the ocean floor between Site A and Shallow-Water Alternative Site 3, and a transect of the ocean floor in a southwest direction from Alternative Site 2A. During the course of the videotaping, an extensive sandy-bottomed area southwest of Alternative Site 2 was discovered. This area, designated Alternative Site 4, was surveyed in addition to Alternative Site 3, and the two previously designated Sites.

Examination of the videotape of Alternative Site 3 revealed much more hard-bottom areas than had been revealed by the results of the reconnaissance survey of October 1981. These new results led to the elimination of Alternative Site 3 from further detailed consideration.

Due in part to the public comments received in response to the Draft Tampa Bay Bay EIS, EPA planned and implemented another survey in February, March, and April, 1983. This survey examined in intense detail Alternative Site 4, and a Control Site approximately five miles southeast of Alternative Site 4; Sites A and B were examined in lesser detail. The survey consisted of extensive videotaping of the bottom of Alternative Site 4 and the Control Site, as well as side scan sonar mapping of both sites. Three other sites, identified as State Sites X, Y, and Z, at approximate distances of 27, 28, and 30 nmi, respectively, west of Egmont Key, were also examined in briefer detail, with videotape recordings.

SITES CONSIDERED IN DETAIL

This section presents a brief synopsis of those sites considered to be best suited to receive permanent designation to receive dredged material from the Tampa Bay area. These sites include Site A, Site B, and Alternative Site 4. A discussion of both the mid-Shelf and Deepwater Alternative Sites is also presented.

Previously Designated Sites

The nearshore region (which includes all Shallow-Water Alternative Sites) is a sandy-bottom area characterized by localized rock outcrops, which are often affected by strong currents capable of resuspending and transporting natural sediments and dredged material (Holliday, 1978). Flora and fauna are typical of the nearshore shallow-Shelf region (Collard and D'Asara, 1973; Lyons and Collard, 1974). Dawes and Breedveld (1960) identified 157 species of benthic marine algae on the west Florida Continental Shelf. In the vicinity of Sites A and B and the Shallow-Water Alternative Sites, a number of perennial and annual subtropical and tropical species occur. The dominant animal species inhabiting sandy-bottom regimes are small infauna that burrow into the sand and feed on suspended and deposited particulate matter (Cf. Appendix A).

Near the previously designated sites, limestone (hard bottom) rock outcrops are fairly common. Hard bottoms can serve as habitats for numerous species of algae, invertebrates, and fish. In addition, several artificial reefs have been constructed north of the sites. Both hard bottoms and artificial reefs can provide recreational fishing and scuba diving to residents and vistors of Tampa Bay. In addition, hard bottom areas can be used for commercial fishing of some fish species.

Disposal of quantities of dredged material may result in an adverse impact to hard bottoms due to burial or siltation. However, this possibility is dependent on the amount of material disposed of and on the ultimate direction of mass transport of dumped material. The limited knowledge of water current phenomena in this region suggests that dumped sediments will move predominantly in a northerly or southerly direction, depending on the season. Hard bottom areas are more numerous and have greater vertical relief to the north and west than to the south and east of Site A. The nearest artificial reef is five nmi northeast of the Site A. In 1981, the Manatee County, Florida Board of County Commissioners funded a study to examine Site A and its surrounding environment (Rice et al., 1981). This examination of Site A and surrounding areas indicated the presence of a limestone ledge, and associated fauna located approximately 1.0 nmi northwest of the site.

A distance of several miles between a disposal site and a potentially affected area will provide for extensive dilution of a turbidity plume and dispersion of deposited materials transported away from the site by currents. Thus, artificial reefs five nautical miles away are quite unlikely to be adversely affected by disposal operations, but hard bottom areas within one mile of Site A may be adversely affected.

Shallow-Water Alternative Site 4

Shallow-Water Alternative Site 4, located 18 nmi west of Egmont Key, is in waters 20-23 meters deep and has an area of 4.0 nmi^2. No dredged material has been dumped at this site. Two site-specific surveys were conducted in May 1982 and February, March, and April 1983, by EPA to determine water, sediment, and infaunal characteristics of the site (Cf. Appendices C and F). A detailed evaluation of this site using the 11 specific criteria of the Ocean Dumping Regulations is presented later in this chapter.

Mid-Shelf Alternative Site

The Mid-Shelf Alternative Site (Figure 1-1) is 70 nmi west of Tampa Bay at the 70m depth contour. No dumping has occurred and no environmental studies have been conducted at this site, although the Florida Department of Natural Resources (FDNR) did maintain a study site approximately 15 nmi to the northwest during their Hourglass Cruise studies (Joyce and Williams, 1969).

Adverse effects from the disposal of dredged material are most likely to affect bottom-dwelling (or benthic) organisms (Wright, 1978; Brannon, 1978). According to Oliver et al. (1977), shallow-water, high-energy benthic communities recover more quickly from disturbances, such as the disposal of dredged material, than communities in deeper water. Animals of a shallow-water area must be adapted to periodic burial under sediments, and thus are less likely to be affected by burial under dredged material than animals of lower-energy environments, such as in mid-Shelf waters. Thus, disposal at the Mid-Shelf

Alternative Site would be more likely to have a long-term adverse effect on the benthos than disposal at a Shallow-Water Alternative Site.

Transporting dredged material 57 nmi beyond Site A would create an immense economic disadvantage. It is estimated that the increased distance would add approximately $0.15/yd^3/mi to disposal operations, or $17,100 per hopper vessel load.

Based on these environmental and economic considerations, the Mid-Shelf Alternative Site is not considered to be a reasonable alternative for dredged material disposal, and it is eliminated from further consideration.

Deepwater Alternative Site

The Deepwater Alternative Site (Figure 1-1) was selected to examine the feasibility of a site beyond the Continental Shelf in deep water, on the Continental Slope. No known commercial or recreational fishing activities occur that distance from shore. The site is removed from all shipping fairways and oil lease sales.

On the Continental Slope, the Loop Current becomes the predominant influence of water circulation, and the environment is oceanic in nature. Biological productivity diminishes substantially when compared to the Continental Shelf, and bottom characteristics are distinctly different from those of the Shallow-Water Alternative Sites.

During periods of Loop Current intrusions, dredged material released at the Deepwater Site may be subject to substantial lateral transport before reaching the bottom because of the high-velocity (2 kn) current. The turbidity plume (consisting of fine-grained sediments in suspension) may be transported great distances with the Loop Current. Thus, disposed sediments may be substantially dispersed and diluted prior to reaching the bottom (Hubertz, 1967). The dispersion may have an important beneficial influence in mitigating adverse impacts on benthic fauna.

Pequegnat et al., (1978) examined the potential environmental effects of deep-water disposal at several locations in the Gulf of Mexico. In the eastern Gulf, they identified a large region south of Alabama and the Florida panhandle that is a viable deepwater disposal site. However, no areas were identified for the western Florida Continental Slope.

Pequegnat et al., (1978) argued that a deepwater site could be suitable for the disposal of dredged material, and noted that huge volumes of water in the deep oceans would dilute and assimilate large volumes of dumped sediment. Biological effects from disposal would be minimal because of lower organism densities in the deep oceans as compared to the Continental Shelf. According to Pequegnat et al., (1978), **"...the deep ocean, particularly beyond the 1000m isobath, will never contribute over one percent of the total world fish catch, and that will be entirely of pelagic origin."**

Although the Deepwater Alternative Site supports a lower density of organisms, these organisms would be far more sensitive to adverse effects from disposal. The Continental Shelf environment is much more variable than the environment of deep-sea organisms (Grassle, 1967; Pequegnat et al., 1978). For example, deep-sea organisms are not subjected to temperature stresses and sediment movements that occur in a high-energy, shallow-water environment. According to Slobodkin and Saunders (1969), a perturbation (such as dredged material disposal) which would have a small effect on groups of organisms in stressful environments (e.g., a shallow-water environment) **"may be catastrophic when applied"** to groups of organisms in a relatively constant environment, such as oceanic deepwater areas.

Shallow-water, high-energy communities recover more quickly from disturbances, such as the disposal of dredged material, than communities in deepwater (Oliver *et al.* 1977). According to Hirsch *et al.* (1978) **"habitat disruptions due to disposal are minimized at disposal sites which have a naturally unstable or shifting substrate due to wave or current action."** Shallow-water disposal sites, therefore, would be likely to have less long-term habitat disruption as the result of the disposal of dredged material. Hirsch *et al.* (1978) added, **"when disposed sediments are dissimilar to bottom sediments at the sites, recolonization of the dredged material will probably be slow and carried out by organisms whose life habits are adapted to the new sediment."** Continental Shelf sediments are largely sand, with some silt, but sediments off the Shelf are usually clay (Greenman and LeBlanc, 1956). Thus, dredged material sediments are likely to differ from deepwater disposal site sediments, and this difference increases the likelihood of adverse effects of disposal on deepwater benthos.

The average transportation cost of dredged material from Tampa Bay would be approximately $0.15/yd^3/mile beyond Site A. The distance from Tampa Bay to the Deepwater Site is approximately 105 nmi. Thus, the cost is estimated to be an additional $13/yd^3 to transport dredged material to a site on the Continental Slope. Increased transportation costs would total $26,000 per hopper dredge load, assuming a hopper dredge capacity of 2,000 yd^3. The adverse economics of transporting dredged materials more than 100 nmi to the west Florida Continental Slope precludes the Deepwater Alternative Site as a viable alternative, and it is eliminated from further consideration.

SUMMARY

The alternatives that will be considered in detail for the disposal of dredged material from the Tampa Bay area are Sites A and B and Alternative Site 4. A more detailed evaluation and comparison of these alternatives using the 11 specific criteria of Part 228.6 of the Ocean Dumping Regulations follows.

DETAILED CONSIDERATION
OF THE NEARSHORE ALTERNATIVE SITES

This EIS addresses the designation of a Tampa Bay ODMDS for the disposal of material dredged from the Tampa Bay area. The selection is based on the 11 specific criteria of Part 228.6 of the Ocean Dumping Regulations (Federal Register, 11 January 1977). EPA established the 11 criteria to constitute "an environmental assessment of the impact of the use of the site for disposal;" and used them to make critical comparisons between Sites A and B and the other viable alternative sites.

In the following sections, the 11 specific criteria are discussed for two Previously Designated Sites (Inner Site B and Outer Site A) and Shallow-Water Alternative Site 4. Discussion of the sites relies on information presented in Chapter 3, which deals with the affected environments, and on information presented in Chapter 4, which deals with environmental consequences.

(1) GEOGRAPHICAL POSITION, DEPTH OF WATER, BOTTOM TOPOGRAPHY, AND DISTANCE FROM COAST (40 CFR §228.6[a][1])

PREVIOUSLY DESIGNATED SITES

Sites A and B have received limited periodic use since 1969. These sites are 13 and 9 nmi from Egmont Key, respectively (Figure 1-1). Site B has an area of 1 nmi^2, an average water depth of 10m, and corner coordinates of 27°38'08"N, 82°55'06"W; 27°38'08"N, 82°54'00"W; 27°37'08"N, 82°54'00"W; 27°37'08"N, 82°55'06"W. Site A has an area of 0.68 nmi^2, an average water depth of 17m, and corner coordinates of 27°37'28"N, 83°00'09"W; 27°37'34"N, 82°59'19"W; 27°36'43"N, 82°59'13"W; 27°36'37"N, 83°00'03"W.

Hard bottoms occur in numerous scattered locations on the western Florida Shelf in the vicinity of these two sites. These hard bottoms result in biologically significant and productive habitats, as do several artificial reefs constructed north of Sites A and B. The area occupied by Sites A and B is predominantly sandy bottom; however, data have been collected showing evidence of hard bottoms at the boundaries of Site A, and divers have observed other hard bottoms within 0.5 nmi west of Site A (Mote Marine, 1981).

SHALLOW-WATER ALTERNATIVE SITE 4

The geographic position of Shallow-Water Alternative Site 4 is shown in Figure 1-1. The site occupies 4 nmi^2, is 18 nmi from Egmont Key, and has an average water depth of 22m. Corner coordinates are: 27°32'27"N, 83°03'46'W; 27°30'27"N, 83°03'46"W; 27°30'27"N, 83°06'02"W; 27°32'27"N, 83°06'02"W.

Shallow-Water Alternative Site 4 has never been used for dredged material disposal and is devoid of major topographic features. A videotape taken of this area in May 1982 by EPA revealed no rock or hard-bottom outcroppings and low vertical relief. That EPA survey determined that the site is predominantly characterized by the presence of fine sands, coarse silts, and sand waves of up to 6" in height interspersed with shell hash. Another EPA survey of this area in February, March, and April 1983 fully corroborated the earlier studies. Vast areas of flat, uninterrupted sandy bottoms were seen on the videotape recordings, broken only by occasional patches of small sand waves with moderate amounts of shell hash between sand ripples. A small area of scattered hard and soft corals were seen in the northwest quadrant of the site, but the density of the growth was far more sparse than in any area examined previously in the Tampa Bay area. The area was examined in extraordinary detail with the videotape camera: over 35 nmi of videotape was obtained within and immediately surrounding the site, which is only two nmi on a side.

(2) LOCATION IN RELATION TO BREEDING, SPAWNING, NURSERY, FEEDING, OR PASSAGE AREAS OF LIVING RESOURCES IN ADULT OR JUVENILE PHASES (40 CFR §228.6[a][2])

ALL SITES

Tampa Bay is a nursery area for many commercially and recreationally important species (e.g., pink shrimp and several species of telosts). Some species which mature in the bay eventually move offshore to inhabit the coastal waters, where they remain as adults. Each year adults migrate into the bay to spawn, then return to offshore habitats. Others species migrate from the bay into open waters only to spawn, then return to the bay.

Some species, such as king mackerel, Spanish mackerel, bluefish, and several clupeids, migrate north and south in offshore waters in response to seasonal stimuli. These species spawn in offshore waters leaving eggs, larvae, and juveniles to develop in open waters as planktonic organisms.

PREVIOUSLY DESIGNATED SITES

Sites A and B have predominantly sandy bottoms with characteristically associated flora and fauna, although survey data indicate that hard bottom may occur within and near the sites. Rock outcrops have been noted north and west of the sites. Several artificial reefs have been constructed north of the sites, and one artificial reef is within three nmi of Site B.

Hard bottoms and artificial reefs may support species that cannot survive on sandy substrates. Bottom currents may periodically transport disposed material toward these areas. Therefore, it is possible that hard bottom areas and artificial reefs periodically will be adversely affected by redistributed material disposed at Sites A and B.

SHALLOW-WATER ALTERNATIVE SITE 4

Use of Shallow-Water Alternative Site 4 is not anticipated to affect any biologically unique habitats or interfere with spawning or migration activities. The site was selected on the basis of its remoteness from any known hard bottom areas. EPA surveys in May 1982 and February, March, and April 1983 determined that this site contains far fewer hard bottom areas than any of the other Shallow-Water Alternative Sites examined, and the hard bottom areas noted are far less dense than any comparable area seen at other Shallow-Water Alternative Sites.

(3) <u>LOCATION IN RELATION TO BEACHES AND OTHER AMENITY AREAS</u>
(40 CFR §228.6[a][3])

PREVIOUSLY DESIGNATED SITES

Sites A and B are 13 and 9 nmi, respectively, west of Egmont Key, and the beaches of Long and Mullet Keys.

Amenity areas in the vicinity of Sites A and B include Tampa Bay, as well as Long, Egmont, Passage, and Mullet Keys. Recreational fishing and diving may occur anywhere in this region. However, because of the proximity of these sites to the Bay, hard bottom, and artificial reefs, more recreational activity is likely to occur in this region than at a more distant alternative. In fact, a number of popular fishing locations are identified in this region by the Florida Department of Natural Resources. In addition, local divers reputedly consider areas immediately north and west of Sites A and B excellent for diving.

SHALLOW-WATER ALTERNATIVE SITE 4

The nearest amenity areas to Shallow-Water Alternative Site 4 are Tampa Bay, the beaches of Anna Maria Island, and offshore fishing and scuba diving areas. The site is located 18 nmi west of Egmont Key. Recreational fishing and diving may occur anywhere in the nearshore waters.

However, most of these activities are limited to high-relief hard bottom areas, artificial reefs, and sunken vessels, all of which are removed from the site. Some scuba diving and fishing activities may occur in the vicinity of Site 4, although these activities are probably less frequent than similar use in the vicinity of Sites A and B.

A recent study by the Corps corroborates the minimal use of Shallow-Water Alternative Site 4 by recreational fishermen and divers. On twelve successive weekends as well as occasionally during the week between mid-March and early June 1983, the area of Site 4 was overflown by aircraft, which noted any vessels that were seen within the area. On only one occasion was a vessel seen in Site 4; on June 1, 1983, a single dive boat was seen anchored within the area of the site. On no weekend days during the surveillance period were any vessels seen within the boundaries of Site 4. Determination of the boundaries of Site 4 was aided by the presence of an anchored float at the center of Site 4, which was emplaced there at the beginning of the surveillance period. Although party boat or commercial fishing or recreational diving may occur in the general vicinity of Shallow-Water Alternative Site 4, no interference with these activities is anticipated in any way.

(4) TYPES AND QUANTITIES OF WASTES PROPOSED TO BE DISPOSED OF, AND PROPOSED METHODS OF RELEASE, INCLUDING METHODS OF PACKING THE WASTE, IF ANY (40 CFR §228.6[a][4])

ALL SITES

Approximately 8 to 10 million yd^3 of sediments dredged or to be dredged from the Tampa Bay area and St. Petersburg Harbor during the ongoing harbor improvement project have been disposed or scheduled for disposal in the ocean, including 3.6 million yd^3 remaining from the Tampa Harbor Project. Sites A and B received a total of 2,531,500 yd^3 of dredged materials between 1969 and 1980. Of this total, 1,901,800 yd^3 were disposed at Site B between 1969 and 1973; in the summer of 1980, 630,000 yd^3 were disposed at Site A. Between 1973 and mid-1980, neither site was used for dredged material disposal. Between June 1980, and the end of December 1982, 4,939,600 yd^3 was dumped at Site A. Approximately 3.6 million yd^3 of dredged material from the deepening project is projected to be dumped at Alternative Site 4 along with an estimated 1.1 million yd^3 of operation and maintenance dredged material per year.

In five samples of material dredged from St. Petersburg Harbor, representing a worst case of contaminated dredged material for disposal, an average of 79% by weight (ranging from 99% to 47%) of the material was sand or coarser-grained material (Pittsburg Testing Laboratory, unpublished). The sediments have been subjected to required testing and are environmentally acceptable for ocean disposal, in accordance with 40 CFR §227.13(c) (Jones, Edmunds, and Associates, 1979).

Hopper dredges have been used for the maintenance dredging of the Tampa Bay area, although barges and scows may be used, as necessary. The dredged material, which is not packaged, is released when the bottom doors on the hoppers are opened while the vessel is underway.

(5) FEASIBILITY OF SURVEILLANCE AND MONITORING (40 CFR §228.6[a][5])

Surveillance is relatively easy because Sites A and B and Alternative Site 4 are within 18 nmi of the Florida shoreline. Either U.S. Coast Guard aircraft or day-use boats can be used for surveillance. Another possible method (more appropriate for the Mid-Shelf or Deepwater Sites) is the use of shipriders.

Monitoring (discussed in detail later in this chapter) is feasible at all alternative sites, although the existence of hard bottoms would require a more complex monitoring plan than a site with virtually entirely sandy bottoms.

(6) DISPERSAL, HORIZONTAL TRANSPORT, AND VERTICAL MIXING CHARACTERISTICS OF THE AREA, INCLUDING PREVAILING CURRENT DIRECTION AND VELOCITY, IF ANY (40 CFR §228.6[a][6])

ALL DISPOSAL SITES

In shallow water nearly all the dredged material falls to the bottom immediately after dumping (Pequegnat et al., 1978). Only a small portion of the finer fraction is lost from the main settling surge, and this portion settles as individual particles over a substantially longer period of time.

Sites A and B and Alternative Site 4 are all within 18 nmi of Egmont Key; in this region, ocean currents are influenced by prevailing winds and tidal currents. The combination of these influences results in variable current directions and velocities. Bottom currents are less responsive to the influence of wind than are surface currents, but within 25 to 30 nmi of shore in this area, bottom currents often tend to parallel surface current directions, although substantial vertical shears (near 180°) may occur (Mote Marine Laboratory, 1980). Results of recent studies off Clearwater indicate that during reversals in tides, bottom currents are less influenced by wind, and often are of greater magnitude than surface currents (ibid.).

Normally, net bottom currents flow at speeds up to 0.7 kn to the north or south. The currents, which are influenced by winds, tidal flow, and wave action, are potentially capable of transporting and dispersing dredged material over wide areas. During extraordinary meterological events, such as tropical storms and hurricanes, current speeds might reach 3 to 4 kn.

Analyses of the data obtained by the May 1982 EPA survey (see Appendix C) indicated the presence of a mound at Site A where approximately 4.9 million yd^3 were dumped since 1980. Analysis of the data collected by the February, March, and April 1983 EPA survey (see Appendix F) indicated that mound had been substantially reduced in the intervening 10-12 months, probably by action of the winter storms of 1982-1983, and by the dragging operations of the Corps several months earlier. In October 1982, the Corps discovered that the mound at Site A was exceeding the minimal required Coast Guard navigational clearances, so the top of Site A was dragged with a heavy metal beam to reduce its height. Although temporary mounds have been observed at other Gulf disposal sites (Estes and Scrudato, 1977), evidence indicates that mounds do not persist in the dynamic environment of the shallow Gulf waters. This evidence is supported by the data collected at Site A. No mound is present at Site B where an average annual volume of 204,000 yd^3 was dumped in the five calendar years from 1960 through 1973.

A consideration in selecting a location for an ODMDS is the potential for disposed sediments to be transported by water currents into the shipping channel, which lies approximately 1.25 nmi south of Sites A and B. Such deposition would create additional maintenance work. Currents generally flow southward during winter and northward during summer. Hence, sediments dumped at Sites A and B prior to, or during, winter may be redeposited in the shipping channel by bottom currents. Since Alternative Site 4 is located southwest of the beginning of the shipping channel, potential problems with the deposition of the sediments into the shipping channel are virtually nonexistent.

Following normal winter storms (and possibly at other times) the waters of the West Florida Shelf in the Tampa area are characterized by heavy layers of natural siltation. This was clearly seen and videotaped in the EPA February, March, and April 1983 surveys. In depths of 40 to 80 feet, often the bottom 20 to 30 feet of the water column consisted of visually impenetrable water filled with fine-grained natural siltation. This material is likely to be naturally weathered karst from the underlying limestone layers of the shelf, and was seen throughout the entire area, from Site A to Shallow-Water Alternative Site 4.

(7) EXISTENCE AND EFFECTS OF CURRENT AND PREVIOUS DISCHARGES AND DUMPING IN THE AREA (INCLUDING CUMULATIVE EFFECTS) (40 CFR §228.6[a][7])

ALL SITES

The dredged material contains no prohibited materials and only trace concentrations of restricted contaminants (Tables 4-2 and 4-3). Material proposed for future disposal will contain a large percentage of particles smaller than sand, and therefore will require further testing. Tests on appropriately sensitive marine animals have shown that metals and hydrocarbons present in the material dredged from St. Petersburg harbor are nontoxic and do not appear to increase the potential for bioaccumulation of toxic substances (Jones, Edmunds and Assoc., 1979). Naturally laid-down material dredged from main channel areas presumably will have minimal contamination, thus further reducing the potential for bioaccumulation.

Because the dredged material is environmentally acceptable in accordance with the Ocean Disposal Regulations, the most likely adverse impact of disposal will be the burial of some bottom-dwelling (benthic) organisms (Wright, 1978; Hirsch et al., 1978). This effect is mitigated by the high-energy environment, which is periodically subject to severe storms. Thus, the benthic communities at Sites A and B and Shallow-Water Alternative Sites are adapted to periodic stresses, and are more likely to recover rapidly from burial than a community in a stable, low-energy environment (Oliver et al., 1977).

Although dredged material disposal may cause some localized decrease in benthic fauna, fairly rapid recolonization has been observed at similarly affected areas within three months after disposal operations ceased. At the Galveston, Texas ODMDS, organisms which colonized the affected areas were members of the surrounding unaffected areas, and no nuisance species were noted (Henry, 1976). A recent benthic investigation at Sites A and B (Taylor, 1982) concluded that "after a recovery period of about nine years, bottom conditions at Dump Site B appear to be about as good, or perhaps even better than one would expect to find in almost any natural, unaltered level bottom area along the shallow shelf off Tampa Bay".

Similarly, changes in water quality following disposal at this site have been of short duration (less than four hours), and have been confined within relatively small areas. No major differences in teleost and shellfish species or numbers have been found between stations within a similar affected site and control stations; the effects of disposal on phytoplankton, zooplankton, and epibenthic and pelagic fishes were concluded to be minimal (Corps, 1979b).

PREVIOUSLY DESIGNATED SITES

Only the previously designated Sites have received dredged materials. Hard bottom areas occur near Sites A and B and these may be adversely affected by silt and sand as a result of normal hydrodynamic processes. There is no exact method to determine how or where dumped sediments will disperse once released; however, adverse effects could result in the vicinity of the disposal site due to suspended particulate matter and dispersion of sediment following disposal operations.

SHALLOW-WATER ALTERNATIVE SITE 4

No disposal operations have occurred at Shallow-Water Alternative Site 4.

(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 (40 CFR §228.6[a][8])

PREVIOUSLY DESIGNATED SITES

Use of Sites A and B would not interfere with shipping, mineral extraction, desalination, fish and shellfish culture, or areas of special scientific importance. However, recreational and commercial fishing activities are known to occur in nearby areas.

Site B lies outside the safety fairway; Site A extends partially into the safety fairway. Hopper dredges must operate within shipping lanes when dredging and traveling to the disposal site. Any danger can be mitigated by: (1) use of the U.S. Coast Guard's area Vessel Traffic System, (2) extra caution and awareness by the captains of hopper dredges, (3) use of onboard radar, and (4) announcements of dredging schedules to captains, pilots, and ship personnel.

No resource development occurs in the vicinity of Sites A and B. The nearest Bureau of Land Management oil and gas leasing is 55 nmi to the southwest.

Hard bottoms and artificial reefs occur in the vicinity of Sites A and B. These areas provide recreational fishing and diving for local residents and vacationers. Interference with recreational activities may result from two potential sources following disposal operations: (1) the turbidity plume may produce short-term effects on water quality, and (2) deposited material may be transported toward sensitive hard bottom areas over the long term. However, both of these possibilities are dependent on volume of material disposed, as well as on current direction and magnitude, which are seasonally variable and subject to prevailing wind and tidal influence.

SHALLOW-WATER ALTERNATIVE SITE 4

As discussed for Sites A and B above, disposal at Shallow-Water Alternative Site 4 would not interfere with shipping, mineral extraction, desalination, fish and shellfish culture, or areas of special scientific importance. Because of its distance from the coast, this site is removed from areas of heavier recreational use, and has little significant commercial fishery use. The recent Corps aircraft overflight study (cited in the discussion in 40 CFR §228.6[a][3], above), corroborates this minimal use.

(9) THE EXISTING WATER QUALITY AND ECOLOGY OF THE SITE, AS DETERMINED BY AVAILABLE DATA OR BY TREND ASSESSMENT OR BASELINE SURVEYS (40 CFR §228.6[a][9])

ALL ALTERNATIVE SITES

Several studies detail the existing water quality (Saloman and Taylor, 1972; Saloman, 1973a, 1973b, and 1974; Saloman and Collins, 1974; Collins and Finucane, 1974) and ecology (Springer and Woodburn, 1960; Saloman et al., 1968; Smith et al., 1975; Dawes et al., 1967; Dawes and Breedveld, 1969; Saunders and Glenn, 1969; Steidinger and Williams, 1970; Cobb et al., 1973; Cairns, 1977; Topp and Hoff, 1972; Serafy, 1979; Huff and Cobb, 1979) of the region containing the alternative sites. The EPA also has conducted several surveys of Sites A and B as well as of the Shallow-Water Alternative Site. Water quality in this area is influenced by Tampa Bay as well as coastal processes. In addition, the Loop Current seasonally influences Shelf water circulation patterns, which in turn, modify nearshore water quality.

All nearshore sites can be expected to share the same sandy-bottom assemblage of marine organisms; the Nearshore (or Shallow-Shelf) assemblage (Collard and

D'Asaro, 1973; Lyons and Collard, 1974) is in a high-energy nearshore environment (Holliday, 1978). At Sites A and B relative abundance of species varies both within sampling stations, as well as between stations. In areas where hard bottom outcrops occur, typical faunal assemblages can be expected, which also will vary in relative abundance of species.

Studies of disposal operations at Galveston, Texas have shown no detectable changes in the ecology of that region. Henningsen (1977) stated that, "dredging and dredged material disposal did not appear detrimental to nekton", which included teleost and shrimp species. The benthic community, which is the assemblage most likely to be affected by dredged material disposal, was temporarily reduced in numbers after dumping, but was repopulated within three months by animals from the surrounding unaffected area (Henry, 1976). Similar effects are anticipated as a result of dredged material disposal at the alternative sites west of Tampa Bay.

(10) <u>POTENTIALITY FOR THE DEVELOPMENT OR RECRUITMENT OF NUISANCE SPECIES IN THE DISPOSAL SITE</u> (40 CFR §228.6[a][10])

ALL SITES

Sediments dredged from the Tampa Harbor area may be enriched with nutritive substances such as nitrogen or phosphorus. In the marine environment, nitrogenous compounds (e.g., NH_3^{+1}, NO_2^{-2}, NO_3^{-3}) are usually the limiting nutrients of primary productivity, whereas phosphate (PO_4^{-2}) is occasionally found in excessive quantities. However, this relationship is variable and subject to localized influences. In Tampa Bay, nitrogen is thought to be the limiting factor (Graham et al., 1954; and Odum et al., 1974).

Nutrients have been measured in liquid-phase elutriate samples from sediments taken from the Tampa Harbor Channel and St. Petersburg Harbor (Table 4-3). Comparison of nutrient values in dredged material to nutrient values in Tampa Bay waters indicates that localized short-term increases may occur, but no increase in ambient value is expected beyond the initial mixing period. Hence, disposal operations are not expected to promote red tide blooms or development of other nuisance species.

(11) <u>EXISTENCE AT OR IN CLOSE PROXIMITY TO THE SITE OF ANY SIGNIFICANT NATURAL OR CULTURAL FEATURES OF HISTORICAL IMPORTANCE</u> (40 CFR §228.6[a][11])

ALL SITES

The Florida State Division of Archives has no record of natural or cultural features of historical importance at or near any of the sites.

CONCLUSIONS

The eleven specific site selection criteria demonstrate the preferability of designating a Shallow-Water Alternative Site 4 rather than one or both of Sites A and B on the following bases:

- A limestone shelf is believed to occur 0.5 nmi northwest of Site A, and small outcrops are suspected to occur within the site. An artificial reef has been constructed within 3 nmi of Site B.

- Hard bottoms can provide habitat for species of fish and invertebrates that would have difficulty surviving on sandy bottoms. Hard bottoms also can provide habitat for scuba diving and fishing. Hard bottoms are known to occur in far greater density and number in the vicinity of Sites A and B than in the vicinity of Shallow-Water Alternative Site 4.

- A sandy bottom will experience less significant adverse effects from the dumping of dredged sediments, since species which normally inhabit sandy bottoms are better adapted to burial and habitat modifications.

- Bathymetric, videotape, and side scan surveys performed at Shallow-Water Alternative Site 4 indicated that disposal of dredged material at that site would affect the fewest hard bottoms, since this area is virtually entirely sandy bottomed.

- Shallow-Water Alternative Site 4 is the preferred site based on evaluation of historical and survey data, and using the 11 specific criteria of the Ocean Dumping Regulations (40 CFR §228.6).

RECOMMENDED USE OF THE SITE

All future uses of a site for dredged material disposal must comply with the EPA Ocean Dumping Regulations, a requirement which brings prospective dumping into compliance with the MPRSA and the London Dumping Convention. The Corps and EPA determine compliance with the Ocean Dumping Regulations on a case-by-case basis when applications for disposal permits and Federal project test results are evaluated. General guidelines for determining acceptability of dredged material proposed for release at a site are outlined below.

TYPES OF DREDGED MATERIAL

All dredged material scheduled for disposal must comply with the Ocean Dumping Regulations elutriate, bioassay, and bioaccumulation test procedures. Disposal of this material should not cause unacceptable adverse effects outside the designated dump site, nor should this material cause long-term, adverse or chronic effects at a site.

DREDGED MATERIAL LOADINGS

The remaining volume of dredged material from the present deepening project that will require ocean disposal is approximately 3.6 million yd^3. Following the completion of the Tampa Harbor improvement project in 1985, operation and maintenance dredging may produce an average annual volume of 1.1 million yd^3 of dredged sediments, although this figure may be modified following future sedimentation studies. Historically, maintenance dredging has not always been conducted on an annual basis, but rather on an as-needed basis every one to five years.

DISPOSAL METHODS

Present Corps disposal methods at the previously designated Tampa Harbor ODMDS are acceptable for continued use. Material is dredged by hydraulic, clamshell, or hopper dredges, and is transported to the site by hopper dredges, barges, or scows. The material is released through the bottom of the vessel over a period of three minutes or less while the vessel is underway.

MONITORING THE DISPOSAL SITE

Section 228.9 of the Ocean Dumping Regulations establishes that the impact of dumping in a disposal site and surrounding marine environment will be evaluated periodically for certain types of effects. The information used to make the disposal impact evaluation may include data from monitoring surveys. EPA as well as State and local governmental representatives and scientists will establish a monitoring program to supplement the historical site data (40 CFR §228.9). The monitoring plan will be developed by determining appropriate monitoring parameters, frequency of sampling, and the areal extent of the survey. Factors considered in making the determination include frequency and volumes of disposal, physical and chemical nature of the dredged material, dynamics of the site, and life histories of any monitored species.

The primary purposes of the monitoring program are to determine whether disposal at the site is significantly affecting areas outside the site, and to detect long-term adverse effects. Consequently, monitoring efforts must survey the site and surrounding areas, including control sites and areas which are likely to be affected (as indicated by environmental factors, such as prevailing sediment transport). The results of adequate surveys will provide early indications of potential significant adverse effects outside the site.

GUIDELINES FOR THE MONITORING PLAN

The following sections outline the recommended monitoring requirements for disposal of dredged material at the Tampa Harbor ODMDS, pursuant to Section 228.10 of EPA's Ocean Dumping Regulations. The monitoring requirements for the Tampa Disposal Site will be determined by EPA Headquarters staff, with input from local and State officials, as well as EPA and Corps Regional office staffs. The monitoring plan will be subject to potential revision when sampling results and data analysis become available. Changes in the plan may be made after this review.

The requirements for the monitoring plan at the selected site may be determined by applying the six considerations outlined below.

(1) MOVEMENT OF MATERIALS INTO ESTUARIES OR MARINE SANCTUARIES, OR ONTO OCEANFRONT BEACHES OR SHORELINES

Survey data collected at Sites A and B in 1979, 1980, and 1982 indicate that sediments are predominately sand with some gravel and a small percentage of fines, with no indication of gross contamination. The 1980 survey showed changes from the 1979 survey in several parameters. No disposal activities had occurred during the interim period, suggesting that sediments in this region are highly dynamic and that dumped sediments can be transported away from these sites. In the area of Alternative Site 4, water currents generally move north or south due to seasonal climatic conditions and Loop Current influence. As a result, dumped sediments will not be transported toward estuaries, oceanfront beaches, or shorelines.

A monitoring plan should be designed to detect the movement of materials from the site, utilizing sampling stations both within and outside the site. Sampling stations may be distributed along transects oriented at right angles, parallel and perpendicular to the coast, and of sufficient length to cross the selected site and extend a minimum of 0.5 nmi beyond the site boundaries. To the extent possible, transects also should be oriented toward outlying hard bottom outcrops. At least one control station should be established in the vicinity of the designated site, outside of areas influenced by sediment transport. Monitoring may be accomplished by grain size analysis, and analysis of trace metals if present in dredged sediments above ambient levels. Appropriate trace metals for monitoring would include mercury and cadmium.

(2) MOVEMENT OF MATERIALS TOWARD PRODUCTIVE FISHERY OR SHELLFISHERY AREAS

Outside Tampa Bay the most productive fishery and shrimping areas occur in the vicinity of hard bottom areas within 15 nmi of shore. Monitoring efforts designed to track the movement of deposited material can also determine the extent to which hard bottoms are likely to be affected.

(3) ABSENCE FROM THE DISPOSAL SITE OF POLLUTION-SENSITIVE BIOTA CHARACTERISTIC OF THE GENERAL AREA

The benthic infaunal communities that inhabit the selected Shallow-Water Alternative Site may undergo changes in composition as a result of dredged material disposal. However, because pollution-sensitive species such as hard and soft corals occur only to an extremely limited extent in the selected site, monitoring of these species need not be made. In the event that substantial hard bottom outcrops are detected within 0.5 nmi beyond the boundaries of Site 4, monitoring of these hard bottom areas should be initiated.

(4) PROGRESSIVE, NONSEASONAL CHANGES IN WATER QUALITY OR SEDIMENT COMPOSITION AT THE DISPOSAL SITE ATTRIBUTABLE TO DREDGED MATERIAL

Measurable changes in water quality due to dredged material disposal are quite unlikely to occur, or be detectable, because of:

- Limited release to the water column of contaminants (they are bound to the sediments), as well as large dilution factors;
- Transient nature of ocean water masses;
- High natural variability in water column chemical parameters and biota.

For these reasons, monitoring the water column for long-term chronic changes is quite unlikely to produce useful results, and is therefore not proposed.

Disposal is likely to change sediment characteristics within the site. Grain size analyses should be made at stations nearest the site for additional indications of movement of dredged material from the site over the sandy bottom.

Chemical compounds present in dredged material (Table 4-3) which are of environmental concern include total organic carbon, ammonia, oil and grease, and trace metals (mercury and cadmium). Initially, sediment sampling should occur twice a year, during winter and summer seasonal conditions, to determine the direction and extent of dispersion of dumped sediments.

(5) PROGRESSIVE, NONSEASONAL CHANGES IN COMPOSITION OF NUMBERS OF DEMERSAL, OR BENTHIC BIOTA AT OR NEAR THE DISPOSAL SITE ATTRIBUTABLE TO DREDGED MATERIAL

Benthic infauna are more sensitive to dredged material disposal because of their sedentary habit. Numerically dominant organisms associated with varying environmental conditions are the most appropriate species to study. Monitoring results may indicate any biotic changes that extend beyond the boundaries of the site. However, macrofauna populations of sandy-bottom substrates in this region are very diverse and dynamic. Therefore, monitoring the effects of dredged material disposal on infauna may produce indefinite and ambiguous results, except in severely affected locations.

(6) ACCUMULATION OF MATERIAL CONSTITUENTS (INCLUDING WITHOUT LIMITATIONS, HUMAN PATHOGENS) IN MARINE BIOTA AT OR NEAR THE SITE

Determining the level of possible contaminants (*e.g.*, trace metals or chlorinated hydrocarbons) in benthic infauna is difficult, due to the small size of the animals, limitations of present culture techniques, and the possibility of contamination from sediments ingested by the organism. Large organisms which can be dissected, and discrete tissues examined, typically do not inhabit a specific sandy-bottom location, but forage in large areas or migrate seasonally. At sandy-bottom habitats, such as those found at Shallow-Water Alternative Site 4, no species has been identified as having any value for assessment of potential bioaccumulation of possible contaminants. Other Corps districts are currently testing the value of a larger epifaunal organism, the mussel (*Mytilus edulis*), as an indicator of bioaccumulation. This species can be placed in test cages at the site. If the mussel turns out to be a feasible indicator, their incorporation into the monitoring plan may be considered.

The possible contamination of human food species is of greatest concern, although the levels of contaminants in teleosts are not an indication of where or when the fish was exposed to the contaminant source. If contaminant levels in a particular species was determined to be of concern, individuals of that species could be caged inside and outside the site to determine the site's contribution (if any) to the observed levels.

Chapter 3

AFFECTED ENVIRONMENT

This chapter describes the environmental characteristics of the shallow water environment of the Gulf of Mexico west of Tampa Bay. Topics discussed include physical, chemical, and biological characteristics of the affected oceanographic environment, as well as commercial and recreational activities. Significant differences in observations made at the various sites considered are presented and discussed. Sites A and B are located in an area containing limestone rock outcrops that provide a habitat for sensitive species of marine flora and fauna. Suggested Shallow-Water Alternative Site 4 is in an area of primarily sandy bottom with a minimum of rock outcrops in its vicinity. Species inhabiting sandy bottoms are adapted to the dynamics of a relatively unstable and shifting heterogeneous habitat.

This chapter describes the environmental characteristics that may be affected by dredged material disposal west of Tampa Bay, Florida. Characteristics discussed are those susceptible to significant adverse impacts and are generally categorized as geological, chemical, or biological. Additional information, such as physical oceanography and meteorology, is presented because these natural physical processes also influence the fate and effect of the disposed dredged material. Commercial and recreational resources that may be affected by dredged material disposal are discussed in detail. Specific information relating to each of the viable alternative disposal sites is presented. Data and methods from all the various surveys made of all sites are presented in Appendices A-F.

ENVIRONMENTAL CHARACTERISTICS

Climate

Climatic parameters of interest at an ODMDS are air temperature, rainfall, wind statistics, storm occurrences, and fog. Air temperature interacts with surface waters, and particularly during warm periods, influences the vertical stability of the water. Rainfall increases coastal freshwater runoff, thereby locally decreasing surface salinity and intensifying the vertical stratification of the water. Coastal runoff also can contribute suspended sediments and various chemical pollutants. Winds and storms can generate waves and currents which resuspend and transport deposited dredged material. A high incidence of fog during particular seasons may affect navigational safety and limit disposal operations.

The Tampa Bay region has a subtropical climate with two distinct seasons: summer and winter. The seasonal changes occur in April-May and October-November. Summers characteristically are warm and humid with persistent southeast tradewinds. Winters generally are mild, with cold fronts moving from the northwest; occasionally tropical cyclones move in from the southwest, or slow, warm fronts move in from the south (Fernandez-Partagas, 1975).

Mean air temperatures range from 15.8°C in the coldest month (January) to 27.9°C in the warmest month (August); the annual mean air temperature is 22.3°C (USDOC, 1978). Precipitation is highest during the summer thundershower season, occurring from June through September (Figure 3-1). Mean annual rainfall is about 125 cm (ibid.).

Heavy fogs generally occur during the night and early morning in the late autumn, winter, and early spring; they dissipate soon after sunrise. Thick fogs rarely occur during daytime, and visibility of less than 0.25 mi occurs on an average of 24 days a year (Table 3-1).

Wind directions, frequencies, and speeds affect local ocean currents, which in turn, may affect the distribution of sediments and nutrients. Prevailing winds are southeasterly and easterly (Ichiye et al., 1973). Afternoon wind velocities average 7.2 kn in summer, and 8.9 kn during winter (USDOC, 1978). From January through August, winds characteristically blow offshore in the mornings and onshore in the afternoons.

Tropical storms and hurricanes produce high winds and seas that can redistribute significant amounts of bottom sediments in relatively shallow waters. Florida experiences an average of 1.7 tropical storms per year.

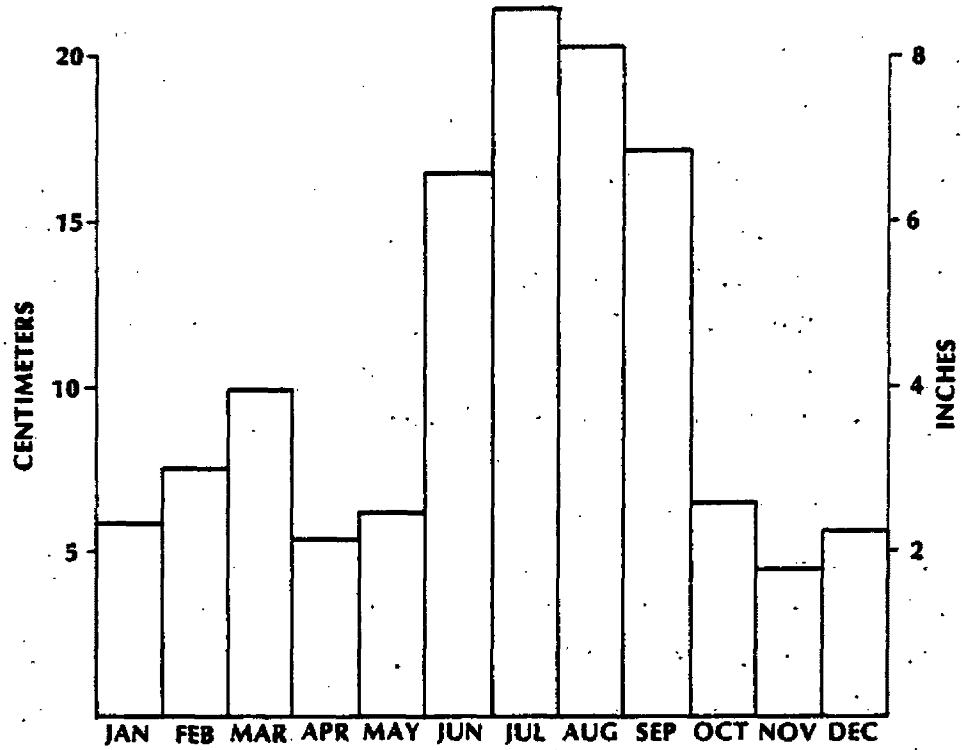

Figure 3-1. Mean Precipitation by Month for a 30-Year Period
Source: Adapted from USDOC, 1978 (data from National Weather Service, Tampa Bay)

TABLE 3-1
DAYS WITH VISIBILITY LESS THAN OR EQUAL TO 0.25 MI FOR A 29-YEAR PERIOD

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Days	6	3	3	2	1	0	0	0	0	1	3	5

Source: USDOC, 1978

Individual years, however, can range from no storms to five (Ichiye et al., 1973). Figure 3-2 gives the percentage of probability of occurrence for different types of tropical storms in the vicinity of Tampa Bay.

PHYSICAL OCEANOGRAPHY

Physical oceanographic parameters determine the nature and extent of the mixing zone, thereby influencing sediment transport and the chemical environment at an ODMDS. Strong temperature or salinity gradients inhibit mixing of surface and bottom waters, whereas waves aid mixing, resuspend bottom sediments, and affect the turbidity of the water. Currents, especially bottom currents, determine the direction and extent of sediment transport within and from the ODMDS. Tidal currents may also contribute to the transport of dumped material.

WATER MASSES

Circulation in the eastern Gulf of Mexico is dominated by a permanent Gulf Loop Current with detached cyclonic eddies (Figure 3-3). Temperature/salinity diagrams of the core of the Loop Current characterize it as a mixture of subtropical underwater and Antarctic intermediate water (Molinari et al., 1975a). The subtropical underwater has a maximum salinity of about 36.75 parts per thousand (ppt) at 22°C; this water is normally used as a tracer of Loop Current movements.

CURRENTS

The Loop Current is a continuation of the Yucatan Current, originating outside the Gulf of Mexico in the western Cayman Sea. The current flows north through the Yucatan Channel and penetrates into the Gulf in a clockwise loop before exiting eastward through the Straits of Florida. The main body of the current reaches its northernmost limit of about 27°30'N in the summer, after which an anti-cyclonic eddy usually separates from the main loop. During winter the loop is generally confined to the southeastern Gulf and passes through the Straits of Florida with little intrusion into the main body of the Gulf (Hubertz, 1967; Leipper, 1970). The degree of penetration of the Loop Current into the Gulf

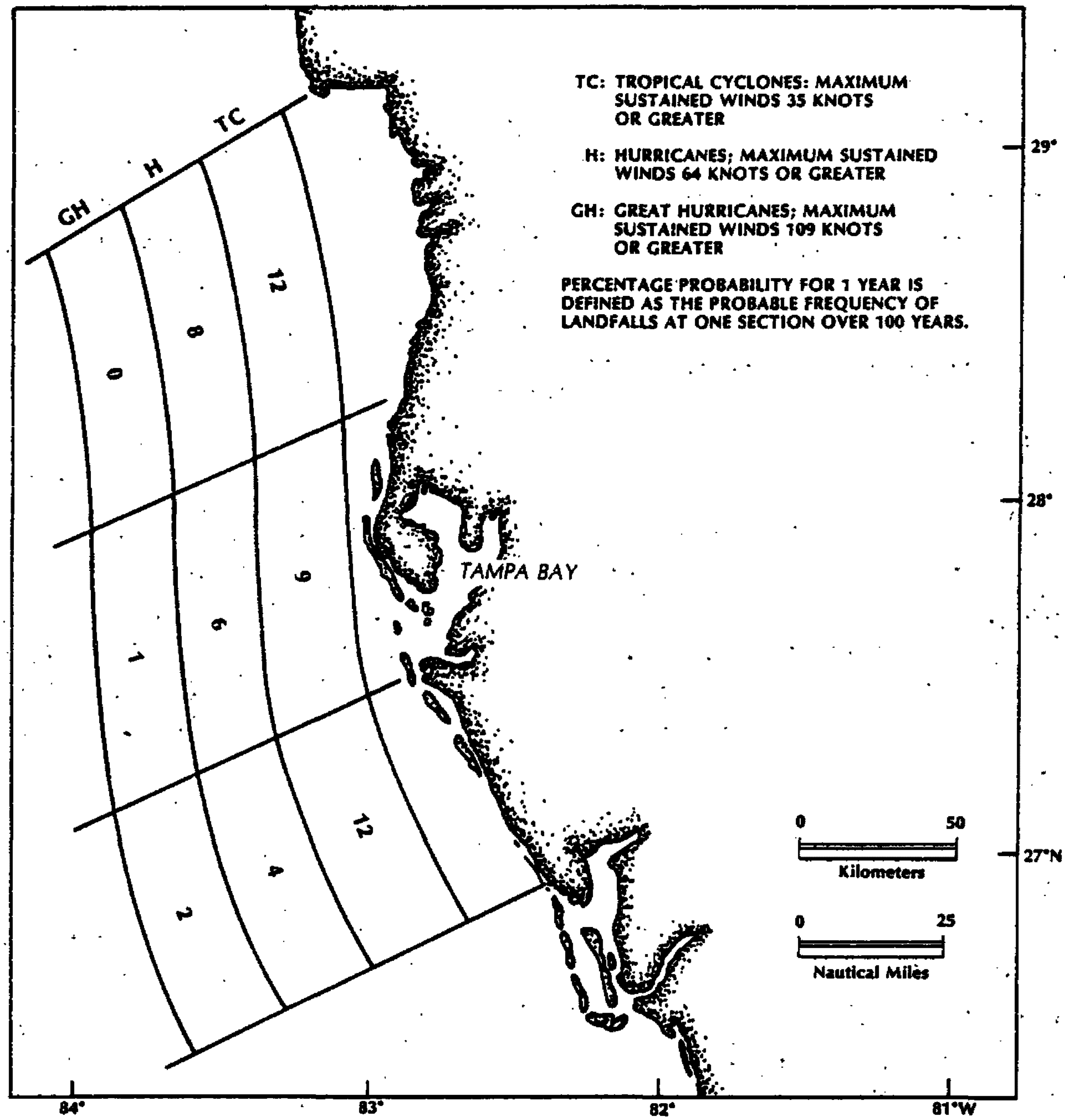

Figure 3-2. Percentage Probability of Occurrences of Landfall of Tropical Cyclones in 1 Year
Source: Adapted from Ichiye et al., 1973

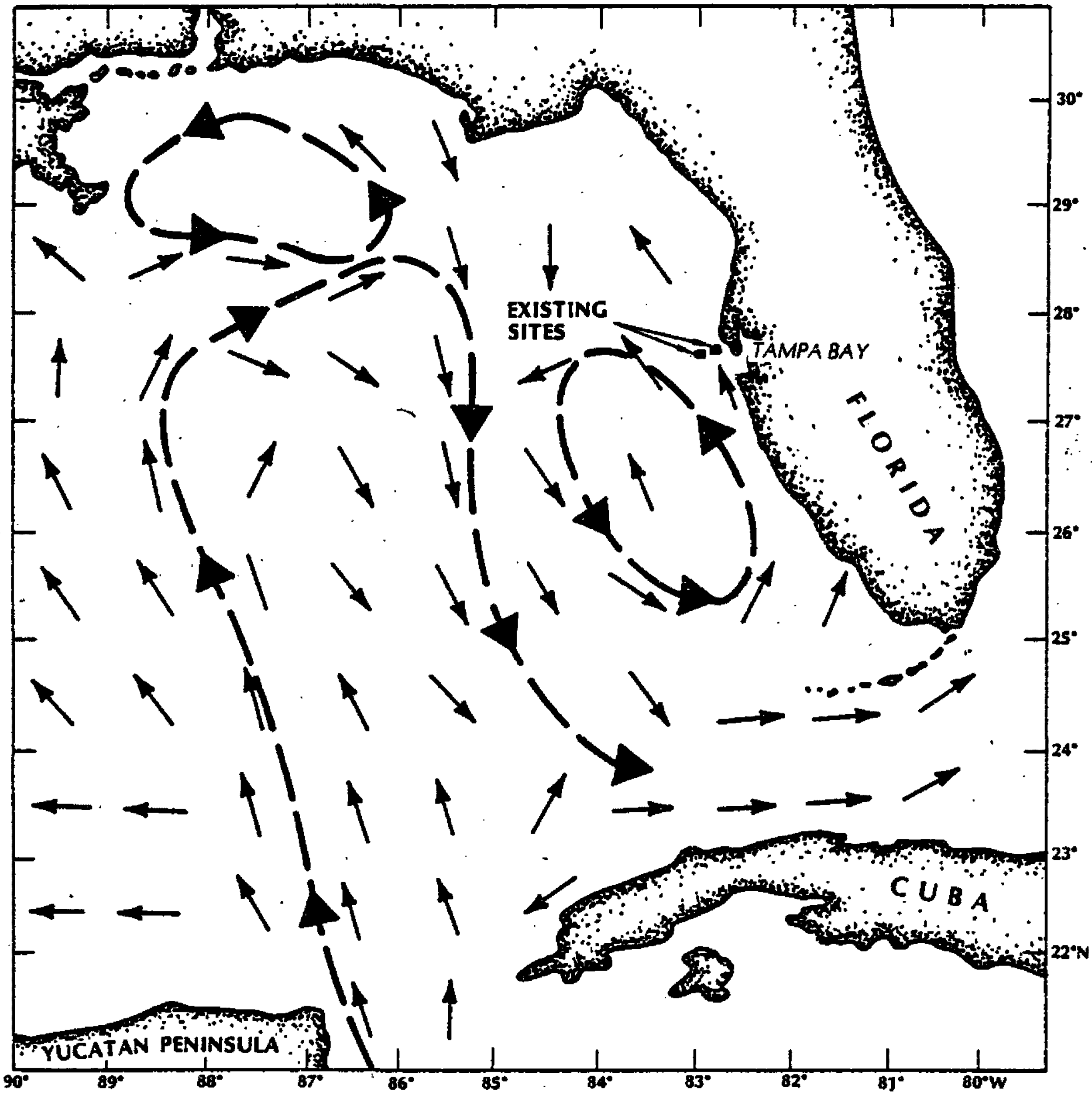

Figure 3-3. Typical Loop Current in September with Detached Cyclonic Eddies
Source: Ichiye *et al.*, 1973

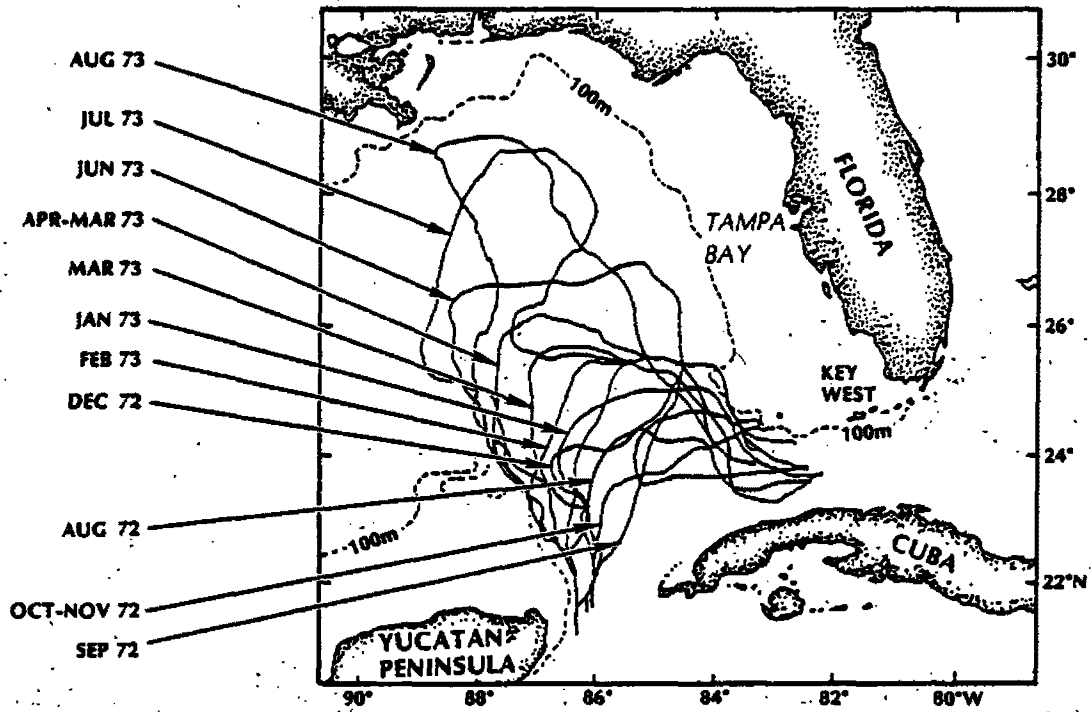

Figure 3-4. Degree of Intrusion of the Loop Current Over an Annual Cycle (1972-1973)
Source: Maul, 1977

fluctuates from year to year (Figure 3-4), and until recently was thought to vary seasonally. However, Molinari and Festa (1978) found the mean position of the northern edge of the Loop Current to be at 26°N, with penetration occurring in any season.

The Loop Current can be viewed simplistically as a river of saline Caribbean water flowing through the Gulf. There is little mixing of Loop Current water with Shelf water. Some entrainment of coastal water occurs at the periphery of the Current, inducing a net southward transport of bordering Shelf water toward the Straits of Florida (Tolbert and Salsman, 1964).

Little systematic knowledge of circulation patterns at Sites A and B or the Shallow-Water Alternative Sites is available. Some broad conclusions can be drawn from the data on general circulation over the West Florida Shelf. Circulation over the Continental Shelf is heavily influenced by meanders and eddies with spin-off from the Loop Current. Eddies create low frequency (5 to

20 day) localized fluctuating current patterns, in the 10-30 cm/s velocity range (Chew et al., 1959). Mean currents, averaged over periods of a month or longer, tend to flow parallel to bottom contours at velocities of approximately 10 cm/s (Mooers and Price, 1975). These mean currents show seasonal variations with a net southerly nearshore flow during winter and northerly flow during the summer (Figure 3-5). Superimposed on the mean flow patterns are wind-induced surface currents, bottom currents, nearshore tidal currents, and upwellings.

Drift card studies of surface currents inshore of 83°W over the West Florida Shelf were conducted by Hela et al. (1955). Results showed a wind-induced net movement of surface water toward the northwest in July, and toward the southwest in November, at speeds of approximately 8 cm/s during both seasons.

Mean bottom currents, ranging up to 5 cm/s, have been reported for more northerly Mississippi, Alabama, and Florida sites (Figure 3-5; Mooers and Price, 1975). Relatively strong bottom currents, creating a bottom turbidity layer, have been reported along the 30m contour west of Tampa Bay (Joyce and Williams, 1969). Bottom currents measured at a station 147m deep about 80 nmi southwest of Sites A and B were highly variable, with a velocity ranging up to 20 cm/s, producing a resultant current vector of 2 cm/s to the north-northwest (Plaisted et al., 1975).

Tidal currents play an important role in the redistribution of sediments in the vicinity of Sites A and B and the Shallow-Water Alternative Sites (Figure 3-6). A tongue of quartz sand, in otherwise predominantly carbonate sediments, protrudes about 20 nmi seaward from the mouth of Tampa Bay. This tongue of quartz sand is believed to have been formed by strong tidal currents, capable of moving sand further offshore (Gould and Steward, 1956).

Upwelling may contribute to the formation of bottom currents. Lenses of cold saline water have been reported on the bottom at more northerly Mississippi, Alabama, and Florida sites (Manheim et al., 1976), suggesting that this cold saline water was a remnant of Loop Current water which had been upwelled and stranded. This phenomenon appears to be seasonal, occurring primarily in the

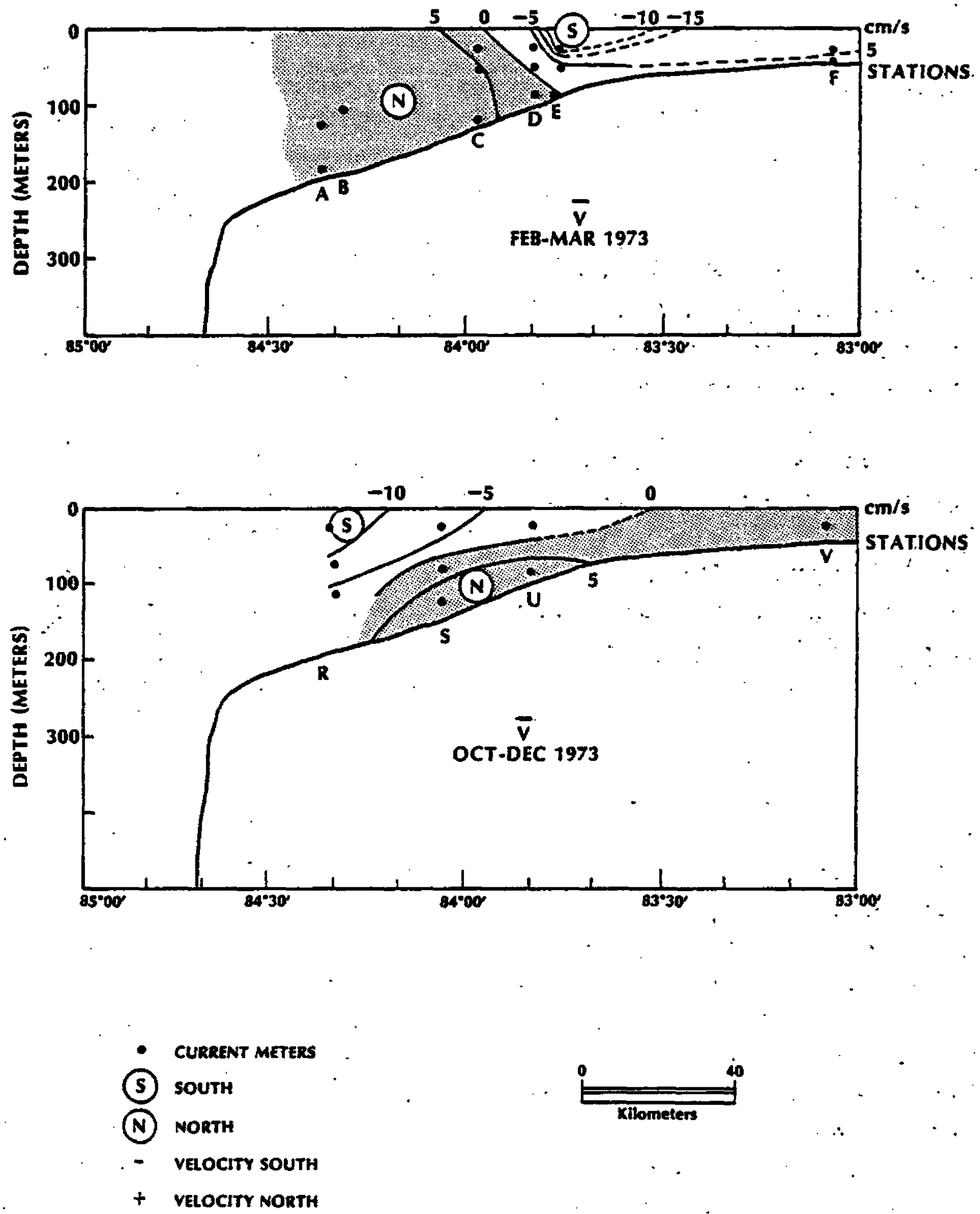

Figure 3-5. Vertical Sections of Longshore Current Velocity Components Along 26°N Latitude from Moored Current Meters
Source: Mooers and Price, 1975

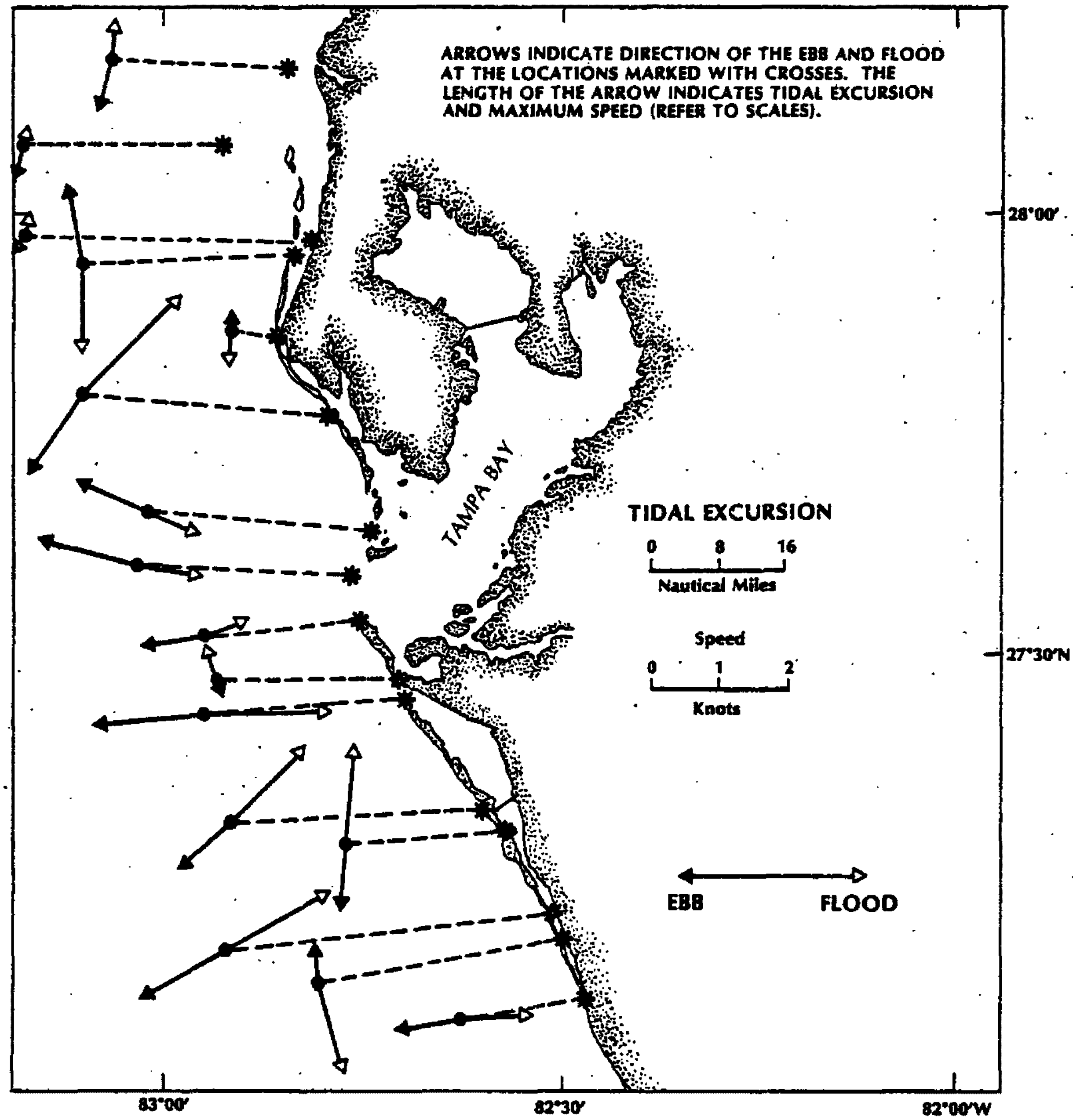

Figure 3-6. Tidal Currents Near Tampa Bay
Source: Ichiye et al., 1973

summer when intrusions of the Loop Current into the Gulf are at their peak. Manheim et al. (1976) reported the presence of a lens of cold saline water near the bottom (depth 30m), whereas inshore waters were vertically well-mixed three days after the effects of Hurricane Eloise.

TEMPERATURE

Usually little difference exists between surface and bottom temperatures in shallow Shelf waters (<30m). During summer, surface and bottom temperatures may reach 30°C, and in winter, they may decline to 17°C. These conditions have been observed at Sites A and B and at the more northerly Mississippi, Alabama, and Florida sites (Molinari et al., 1975b). When a thermocline is present, temperature differentials between the surface and the bottom may be as large as 5°C (Molinari et al., 1975b). During the summer, the density stratification intensifies in the shoreward direction, with the thermocline moving shoreward from the deep Gulf. During the winter, it becomes more diffuse and deepens (Figure 3-7). The seasonal aspect of thermocline development on the Shelf is a result of the intrusion of colder Loop Current waters.

Further inshore, a thermocline is usually present for short periods during spring and summer. However, the area occupied by Sites A and B and the Shallow-Water Alternative Sites is shallow enough to allow mixing throughout the water column, making the existence of a colder bottom layer highly variable, and allowing the water column structure to change frequently (Saloman et al., 1964; Finucane and Dragovich, 1966; Dragovich et al., 1966; NODC, 1980; Molinari et al., 1975b).

Survey data collected during 1979 and 1980 by IEC indicate weak thermocline stratification during summer and winter. In the vicinity of Sites A and B the water column was well mixed, with a maximum temperature differential of 0.9°C during summer and 0.5°C during winter. Data collected during the May 1982, EPA survey corroborated these earlier results; the maximum temperature differential for readings at all stations at Sites A and B and Shallow-Water Alternative Site 4 was 1.0°C.

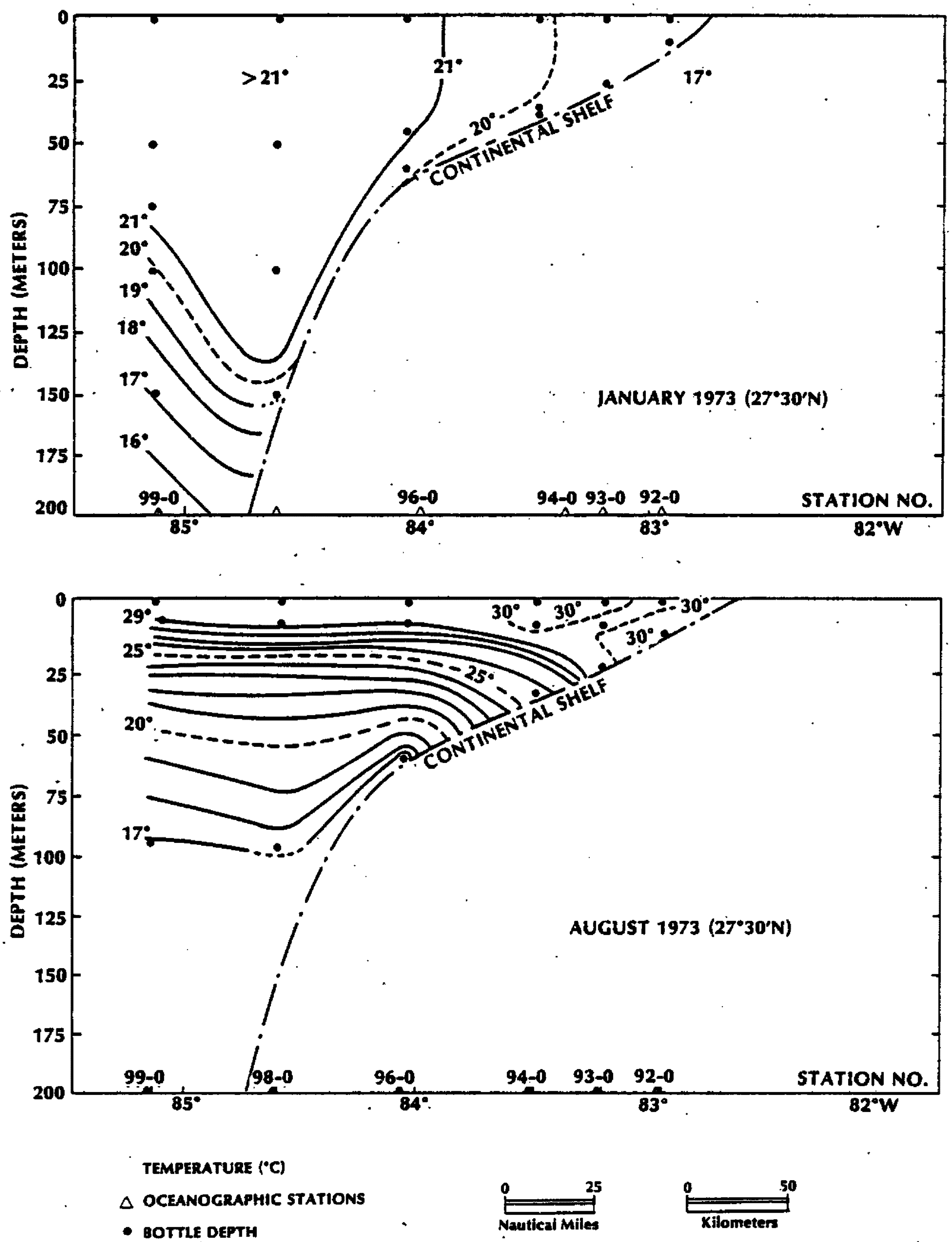

Figure 3-7. Temperature Profiles Along 27°30'N for January and August 1973
Source: Molinari *et al.*, 1975b

Salinity variations in Shelf water are primarily a function of shoreward movement of Loop current water associated with the northward summer migration of the Loop (Figure 3-8). Dense layers of cool saline Loop Current water occasionally upwell onto the Shelf. These dense layers can penetrate to Sites A and B and the Shallow-Water Alternative Sites, producing salinity changes greater than one ppt between the surface and bottom. Salinity values within a one-degree radius from Shallow-Water Alternative Site 1 ranged from 32.3 to 36.16 ppt in 1967; this is an unusually large variation. Fluctuations within one season normally are in the two ppt range (NODC, 1980).

The Florida southwestern drainage basin from Tarpon Springs to Key West accounts for less than one percent of the total river discharges into the Gulf of Mexico (Schroeder, 1975). Consequently, river runoff does not have a significant influence on the salinity of Shelf water in the area.

Surveys of Sites A and B and Alternative Site 4 reveal weak salinity stratification. Salinities were generally lower during summer than winter due to freshwater rain runoff, which is characteristic for the central west Florida Shelf. Salinity increased with distance from shore. The most pronounced differences occurred during summer, when maximum surface to bottom salinity values differed by 3.28 ppt. Winter values were nearly homogeneous. Data collected during the May 1982, EPA survey strikingly demonstrate the increase in salinity with increased distance from shore. Site B, Site A, Alternative Site 4 and Alternative Site 3 are 9, 13, 18, and 24 nmi respectively from Egmont Key; the maximum salinity values at each of these four locations were 35.69, 36.27, 36.50, and 36.53 ppt, respectively.

WAVES

Jordan (1973) presents a summarization of U.S. Naval oceanographic and meteorologic data reports published in 1963 and 1970. The later report (U.S. Naval Weather Service Command, 1970) presents wave-height data from an area bounded by 25°N to 27°N, and 84°W to the Florida coast. The earlier report (U.S. Naval Oceanographic Office, 1963) presents data from the area of north of 25°N and east of 85°W. The areas covered by these two reports provide wave-height data for the region occupied by all Shallow-Water Alternative Sites and Sites A and B.

Data show that the most severe wave conditions occur during winter months (excluding hurricanes), when waves approach from the north and northwest.

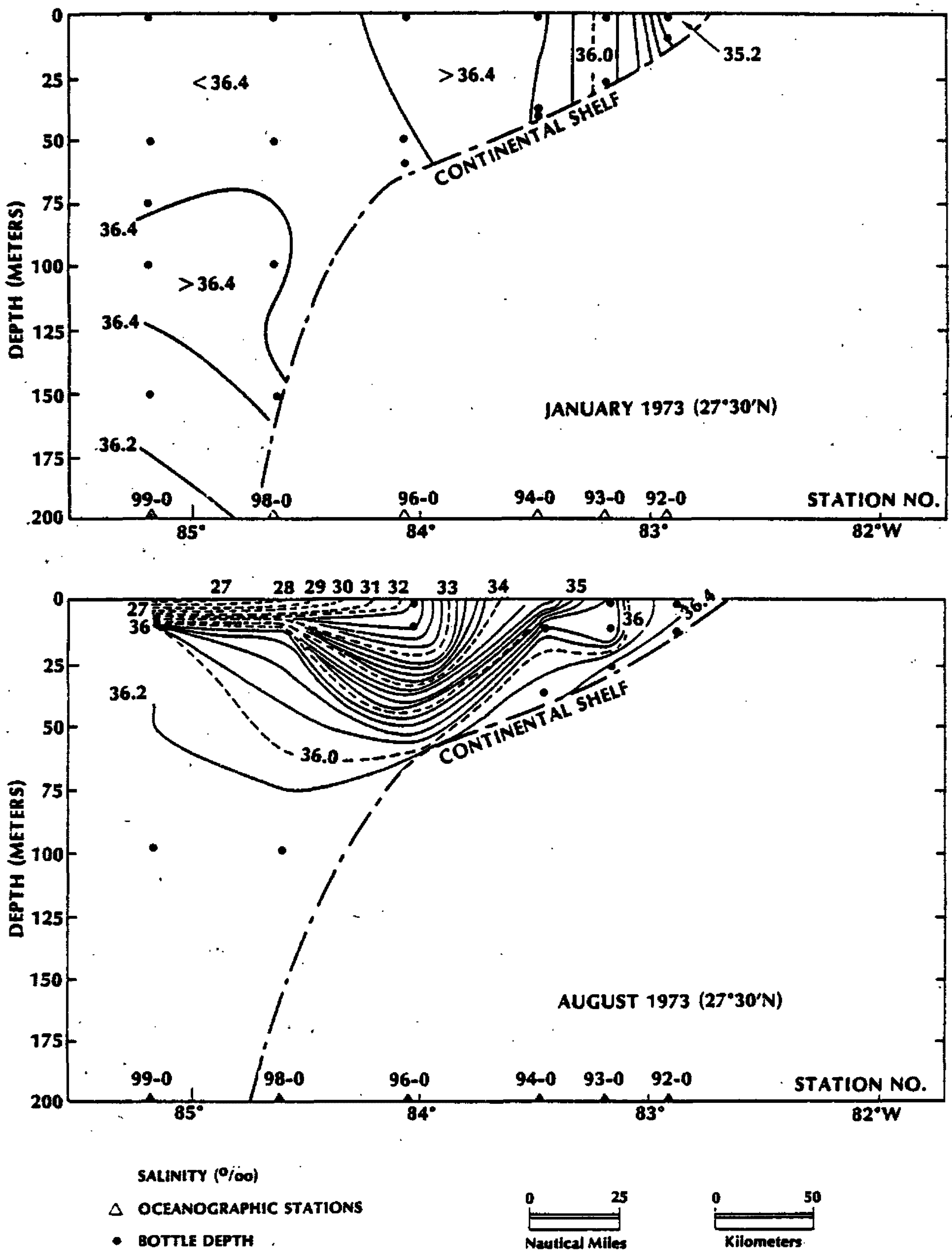

Figure 3-8. Salinity Profiles Along 27°30'N for January and August 1973
Source: Molinari et al., 1975b

During winter, waves greater than 4m represented only about one percent of all observations, waves between 2m and 4m were 20 to 30% of the observations, and waves less than 2m represented 70 to 80% of all observations. During summer, 80 to 90% of all observations were reported less than 1m, 10 to 20% of wave observations were between one and four meters in height, and less than one percent of the observed wave heights were greater than 4m.

GEOLOGY

Geological information relevant to an ODMDS includes bathymetry, sediment data, and dredged material characteristics. Bathymetric data can provide information on bottom stability, shoaling, and persistence of sediment mounds. The texture of bottom sediments strongly influences the composition of the resident benthic biota. Differences in sediment size distribution between natural ODMDS sediments and dredged material may be used as an indicator of the area of bottom affected by the dredged material. Changes in sediment grain size resulting from dumping can produce changes in both chemical characteristics and species composition of benthic biota.

The West Florida Continental Shelf extends seaward 115 nmi from Tampa Bay to a depth of 200m (Shepard, 1973). The Continental Slope starts at 200m and extends to the edge of the Florida Escarpment, at 1,600m to 2,400m (Jordan and Stewart, 1959).

There is an abrupt change in the nature of the Continental Shelf, Slope, and Escarpment at about 27°N latitude. North of approximately 27°N, the bedrock is primarily clastic sedimentary rocks with a thick covering of sediments. This northern Slope is broad, and slopes evenly to the escarpment at 1,600m. The northern escarpment has a smooth, steeply sloping face. In contrast, the southern Shelf, Slope, and Escarpment are mainly composed of limestone, with some marls and evaporites, overlain by a thin layer of predominantly carbonate sediments. The southern escarpment starts deeper (at 2,000 to 2,400m) and is heavily gullied, with a lesser gradient than the northern escarpment (Jordan and Stewart, 1959; Pequegnat et al., 1978).

The Continental Shelf west of Tampa Bay is a plateau of Pleistocene limestone with a young drowned karst topography (Price, 1954). The Shelf gradient averages

0.5m/km; it is characterized by a gently rolling bottom, irregularly covered by a thin veneer of unconsolidated sediments, and punctuated by localized sinkholes, fissures, and rock outcrops. The rocky outcrops can provide substrates for coral, algae, and associated calcareous organisms. Most of the living corals are found shoreward of the 20m contour, although they do exist to 60m (Gould and Stewart, 1956).

Nearshore sediments off Tampa Bay are predominantly quartz. The proportion of carbonate sediments increases with increasing distance offshore, and about 20 nmi from the coast, at a depth of approximately 30m, sediments are mainly composed of carbonate shell fragments (Figure 3-9). Grain size distributions are highly varied; there is little or no progressive change in grain size with depth or distance from shore (Figure 3-10). Instead, particle distributions are related to the composition of the sediments rather than physical processes. With the exception of the high quartz zones, within 20 nmi from shore most of the unconsolidated sediments appear to have originated from weathering of submerged coastal plain sediments or Pleistocene reefs, or the trituration of calcareous remains of benthic organisms (Gould and Stewart, 1956).

Doyle and Sparks (1980) have suggested that longshore coastal currents may cause alternating north and south transport of quartz sands with no resulting net drift. Such a system may result in dumped sediments being redispersed in a similar north and south pattern in the vicinity of a Shallow-Water Alternative Site, with no resultant net movement from the site.

Sediment samples collected at Sites A and B and surrounding areas by IEC in 1979 and 1980 indicate a variable substratum and dynamic environment. Sediments included gravel, sand, silt, and clay, dominated by a 74.8 to 99.9% weight fraction of sand (median phi = +1.69) with no obvious spatial trends. Fines content decreased with increasing distance from shore. Corps' records show that no dredged material disposal occurred at either Site A or Site B between December 1973 and June 1980. Therefore, it is highly likely that differences in sediment composition resulted from natural causes.

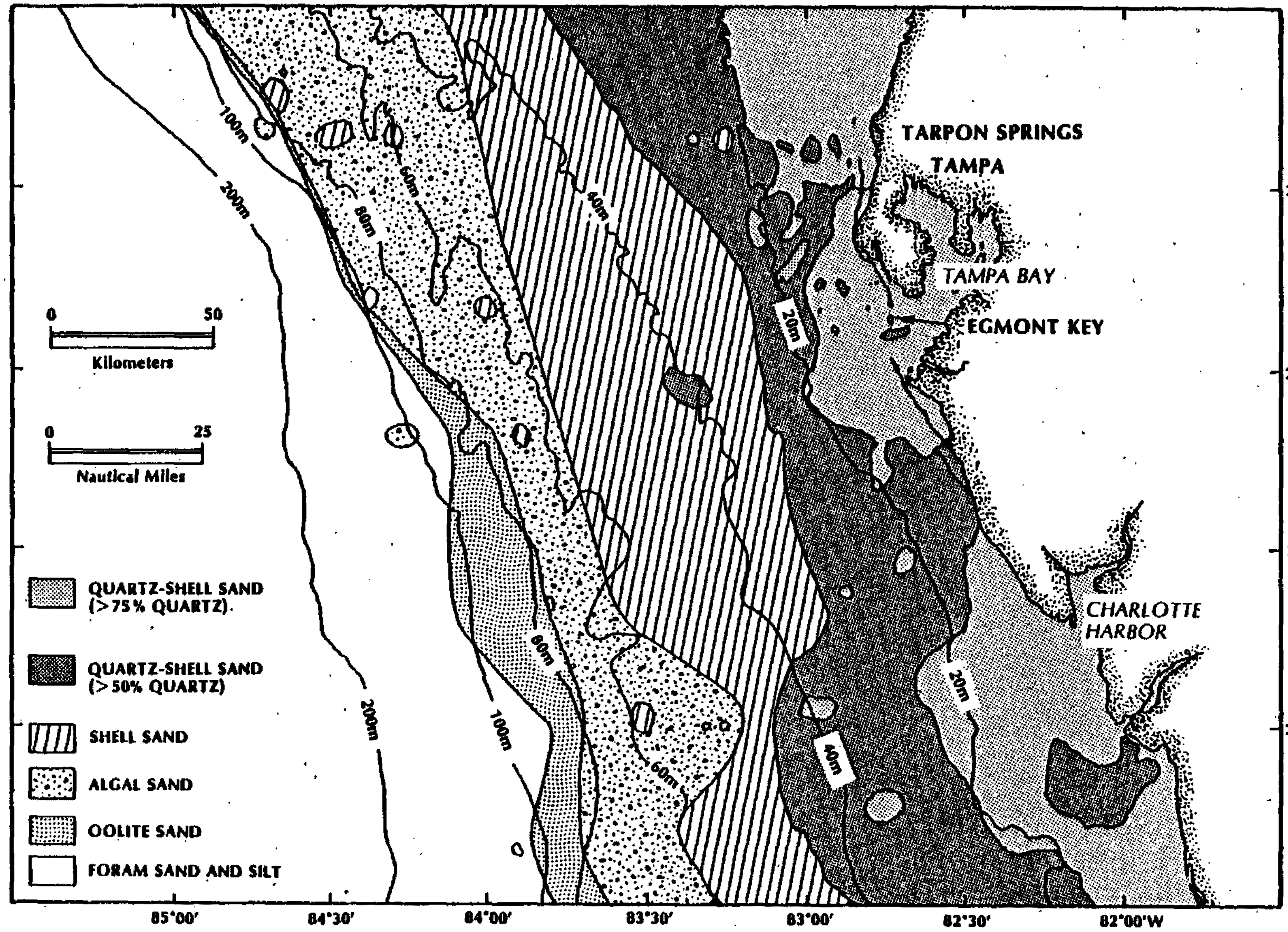

Figure 3-9. Bottom Character of West Florida Shelf
Source: Gould and Stewart, 1956

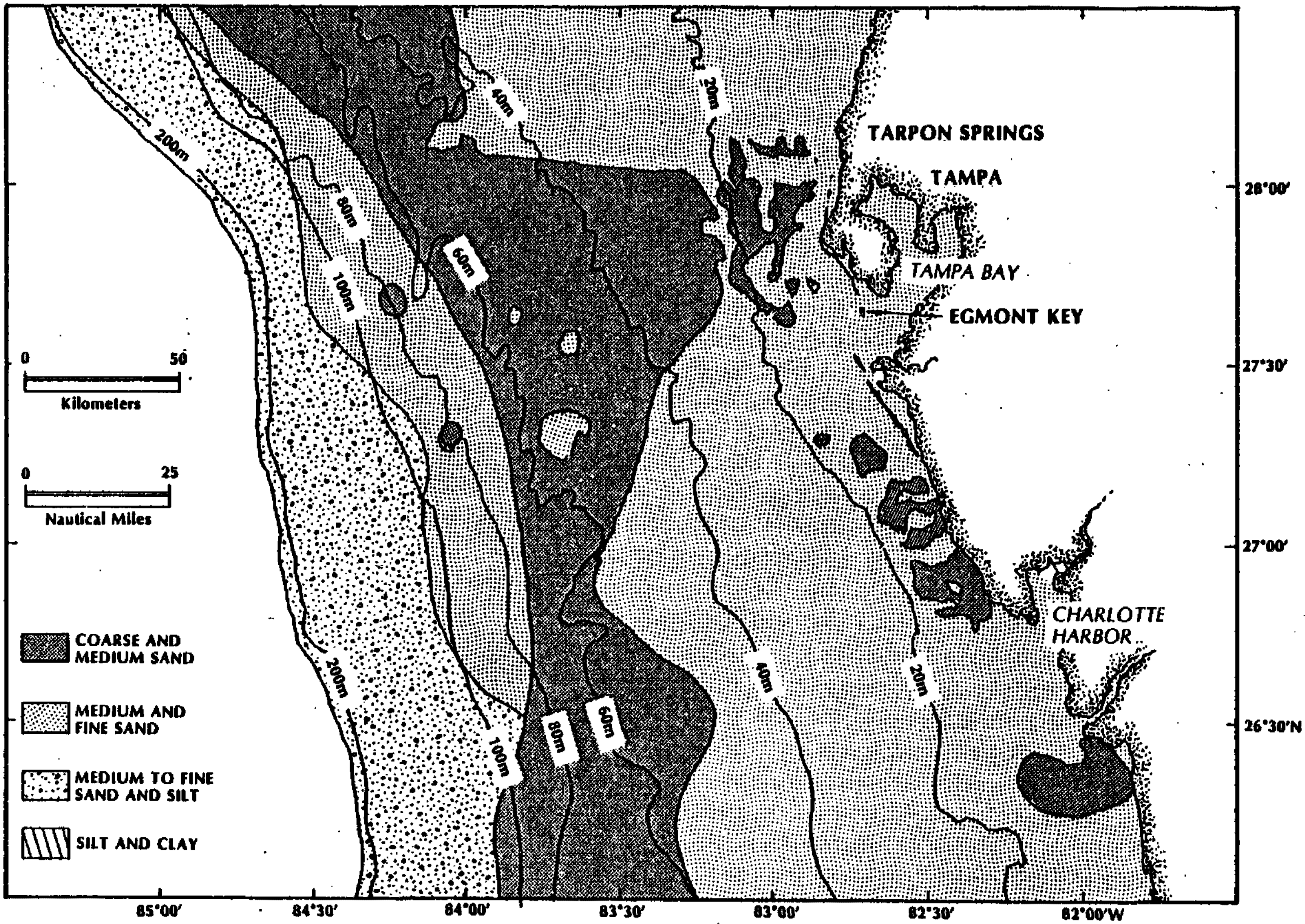

Figure 3-10. Grain Size Distribution of West Florida Shelf
Source: Gould and Stewart, 1956

Sediment data obtained during the May 1982, EPA survey was analyzed and grouped (I - VII) according to the percentage of various components found. A high degree of within-station heterogeneity was evident from the analysis. The southeast corner of Alternative Site 4 yielded samples of both the very sandy, moderately coarse habitats (Groups II and III) and the most coarse sediments (Group VII). The southwest corner of the site had sediment samples varying from high sand, low silt (Group VIA) to high sand, medium silt (Group VIC). Sediments from the center, northeast, and northwest corners of Alternative Site 4 contained finer-textured samples and showed the most internal homogeneity.

BOTTOM TOPOGRAPHY

On the Continental Shelf there are local variations in bottom relief, ranging from rocky outcrops to rolling sandy hills, with a general relief of 1 to 2m (Figure 3-11, Tables 3-2, and 3-3). Corals are distributed on the inner part of the Shelf in small patches, with mounds occasionally rising a few feet above the limestone and sediment substratum (Gould and Stewart, 1956).

In the vicinity of Sites A and B, at about 82°55'W, an area of rocky outcrops (hard bottom areas) 1 to 2m high begins; artificial reefs are present north of Sites A and B. Both bottom types can provide habitat for benthic organisms and teleosts. A recent survey of Site A and its surrounding areas by divers from Mote Marine Laboratory indicated the presence of a limestone ledge, about one mile west of the site.

EPA conducted a diver observation survey in October 1981. Observations of Shallow-Water Alternative Sites 1, 2, and 3 revealed that Shallow-Water Alternative Sites 1 and 2 had scattered rock outcrops with low (1m or less) vertical relief. Interspersed between these scattered outcrops were large patches of flat sand and shell hash. Shallow-Water Alternative Site 1 was observed to have a moderate amount of hard bottom area; Shallow-Water Alternative

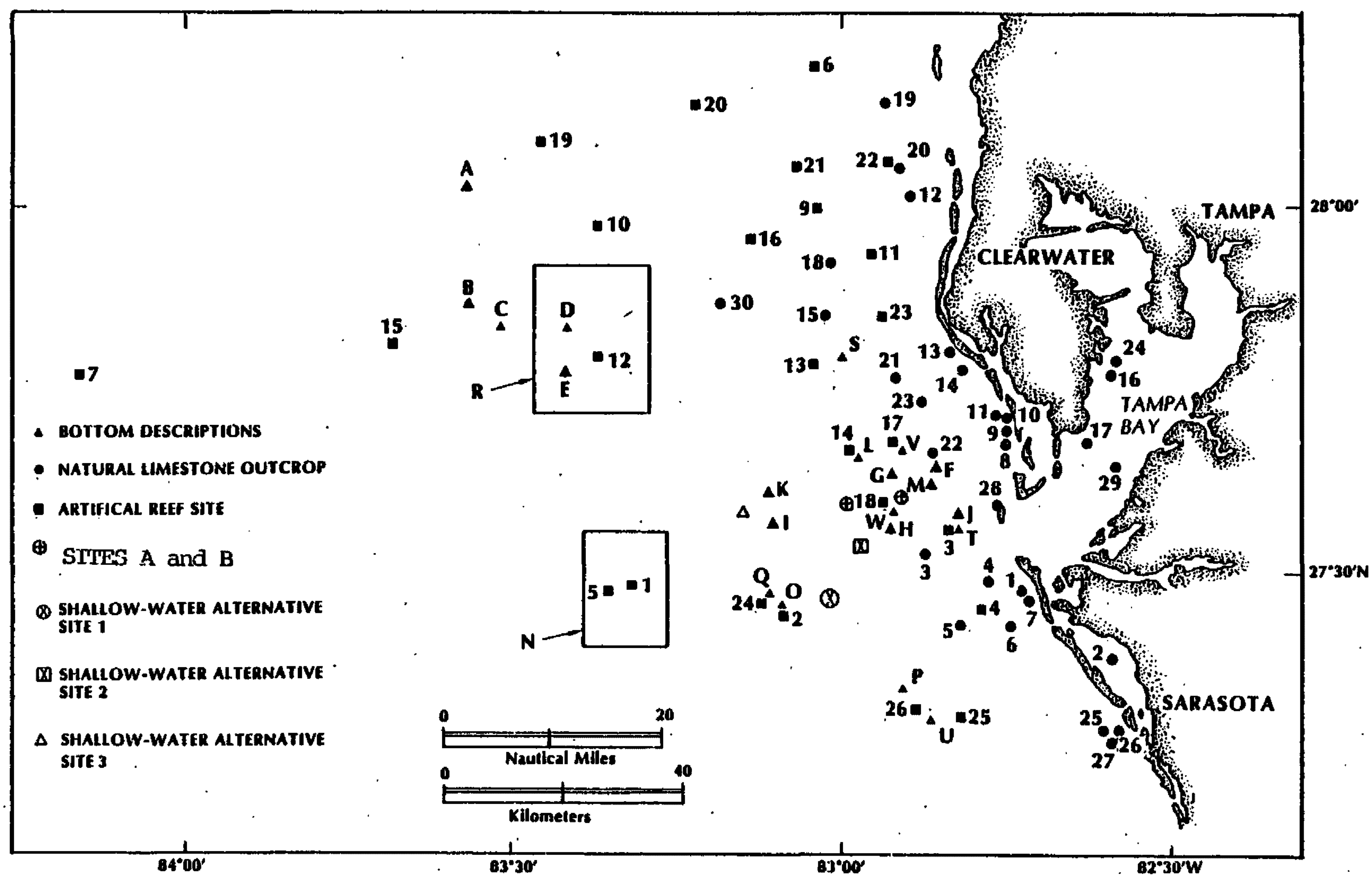

Figure 3-11. Locations of Bottom Descriptions, Hard-Bottom Areas, and Artificial Reefs on the West Florida Shelf (see Tables 3-2 and 3-3)

Site 2 had less. Divers did observe a finger of hard bottom extending from the eastern boundary of Site 2 to slightly west of the center of the site. Shallow-Water Alternative Site 3 was characterized by divers to be featureless, flat terrain, with a thin layer of silt over a sand and shell hash veneer. However, the May 1982, EPA study of Shallow-Water Alternative Site 3 revealed that the previous conclusions by divers in the October 1981, study were incorrect; Shallow-Water Alternative Site 3 was shown to be rich in both species diversity and quantification of organisms. Videotape taken across the entire width of Shallow-Water Alternative Site 3 revealed considerable patches of coralline growth interspersed between areas of flat, featureless sandy bottom. These patches of hard and soft bottom habitat were irregularly spaced between the areas of sandy bottom.

During the EPA May 1982 survey, a videotape camera was towed across the entire width of Site 4 at a speed of approximately two knots, generally from the eastnortheast to the westsouthwest boundary of the site. During the greater portion of the run (a distance of 2.4 nautical miles), the bottom of the site consisted of a flat, featureless, sandy bottom. Occasionally, sand waves two to three feet apart (from crest to crest) were seen; in several instances, light to occasionally heavy amounts of shell cobble were seen in the troughs of the sand waves. Very rarely were soft coral communities noted during the videotape transect of Site 4; when they were seen, the communities were extremely sparse and of low height. No hard coral communities were noted during the videotape transect. Water clarity was good throughout the camera tow; water depths at Site 4 ranged from 68 to 73 feet.

During the February, March, and April 1983 EPA survey, a color television camera with constant videotape recording was towed extensively over Site 4 at a tow speed of approximately 0.8 knots. The camera was towed at approximate one-quarter mile intervals in a northwest-southeast direction (following Loran C coordinate lines), and then in a northeast-southwest direction (also following Loran lines), also at approximate one-quarter mile intervals. A total of 22 transects across the site were made in this manner, providing extraordinary details concerning the bottom topography of Site 4. In addition, a complete transect around Site 4 was done with the camera at a distance of approximately one-quarter mile beyond the periphery of the site. In total, over 35 nautical miles of transects within and immediately surrounding Site 4 were recorded on videotape, providing an extremely complete and statistically significant record of the bottom.

The February, March, and April 1983 EPA survey fully corroborated and provided additional details on the May, 1982 EPA survey. Vast areas of flat uninterrupted sandy bottoms were seen, broken only by occasional areas of small sand waves ranging in height from one to six inches. The larger (4" to 6") sand waves were occasionally interspersed with moderate amounts of fine to coarse shell hash. Generally, the larger sand waves appeared to be coarser in texture, and were more likely to have interspersed shell hash; the smaller sand waves appeared to be composed of finer sand, and were far less likely to be associated with shell hash.

A small area of scattered hard and soft coralline communities was noted in the northwest quadrant of Site 4; the area generally ran in a northwest-southeast direction, and was seen in less than half of the total area of the quadrant. With the exception of a very small area of coralline communities seen at the extreme northeast corner of the site, no other areas of Site 4 were seen to have any but extremely minimal coralline communities. Over 83% of the area of Site 4 is virtually totally devoid of coralline growths; of the remainder, less than 17% is occupied by scattered coralline communities, and only 0.8% of the area of Site 4 can be characterized as being populated by dense coralline growths. In addition, the density of the scattered coralline communities seen in the northwest quadrant of Site 4 was far more sparse than in any of the other Shallow-Water Alternative Sites that have been examined.

The clarity of the water during the time (late March - early April) that the videotape recordings at Site 4 were made was quite good; no problems were encountered during either daytime or evening recording. The towed camera sled was equipped with 1350 watts of high-intensity tungsten underwater lights, so recording was possible (and was done) 24 hours a day at various times. The water depths at Site 4 ranged from 70 to 83 feet.

In addition, a Control Site approximately five nautical miles southeast of Site 4 was examined in an identical manner as Site 4 with the videotape camera. This Control Site was selected to serve as a comparator during the monitoring program scheduled to begin once disposal of dredged material has been initiated; the site is at the same depth contour as Site 4, and revealed quite similar bottom topography. If anything, the Control Site exhibited slightly more dense coralline communities, which should serve as excellent comparators for the disposal operations at Site 4. Over eight nautical miles of transects were run at the Control site, which is one nautical mile square.

During the end of the February, March, and April 1983 EPA survey, three sites suggested by the State of Florida were also examined with the videotape camera. These sites are approximately 27, 28, and 30 nautical miles from Egmont Key. (In actuality, the State of Florida suggested only Loran coordinates for three points at distances of 27, 28, and 30 nautical miles from Egmont Key; the EPA survey established circular sites one nautical mile in diameter, with the suggested points at the centers of the sites). Examination of State Sites X, Y, and Z (27, 28, and 30 nmi. respectively from Egmont Key) with the color videotape camera revealed particularly interesting bottom topography. State Site Z (30 nmi from Egmont Key) showed denser hard and soft coralline communities than has been seen at any site examined previously, including the richly diverse and dense patches of coralline growth at Shallow-Water Alternative Site 3. The growths at State Site Z were also as tall or possibly taller than the growths seen at Site 3, even though State Site Z is approximately six nautical miles further west than Site 3. Consequently, State Site Z was eliminated from further detailed consideration.

State Sites X and Y showed similar bottom topography; both sites had flat, sandy bottoms with minimal relief and sand waves. Site Y was characterized by the presence of immense quantities of the invertebrate Melitta quinquiesperforata, commonly known as sand dollars. At no time during the transects of State

TABLE 3-2
BOTTOM DESCRIPTIONS OF WATERS ADJACENT TO TAMPA BAY

Location and Source*	Latitude (N)	Longitude (W)	Depth (m)	Topographic Description
A[1] B[1]	28°01' 27°52.5'	83°35' 83°34'	36 36	Soft silt
C[1] D[1]	27°50' 27°50'	83°31' 83°25'	33 30	Moderate layer of soft silt over fairly hard-compacted bottom with shell rubble and rocky crevices
E[1]	27°45.5'	83°25'30"	32	Similar to C and D, but with less shell rubble and rocky crevices
F[2]	27°39'	82°52'	9 to 11	Hard, flat sediments with occasional low, rocky reef areas and patches of shell
G[2] H[2] I[2]	27°39' 27°35' 27°35'	82°56'30" 82°56' 83°07'	12 12 26	Flat bottom evenly covered with coarse sediments mixed with finer silt; many high (1m) patches of limestone reef, very irregular with cliffs, caves, and terraces
J[3]	27°35'	82°50'	7	Quartz sand and crushed shell with fine silt layer; limited hard substrate; strongly influenced by estuarine nature of bay systems
K[3]	27°37'	83°07'	20	Abundant limestone outcroppings, up to 1m above bottom, composed of shells and quartz sand; outcrops support living stony corals
L[4]	27°40'	82°59'	13	Rocky bottom, relief of several feet, rocks scattered over sand and shell bottom with heavy vegetation
M[5]	27°38'	82°51' (approx.)	11	Almost entirely sand/shell bottom; unstable and shifting bottom
Site A	27°37'	83°00'	16	1 to 2m rocky areas that project through sand/shell substrate
Site B	27°37'	82°55'	14	Rolling sand/shell bottom with few reef Site ledges; less rocky outcrops than above
N[4]	27°24' to 27°35'	83°15' to 83°23'	27 to 38	Sand and shell bottom; patches of exposed rock reef with sponge and coral growth
O[4]	27°27'	83°05'	22 to 28	Area of about 5 mi^2; rock and coral patches scattered on a sand and shell bottom; relief of 4 to 5 ft on the rocky areas
P[4]	27°21'	82°56'	21 to 23	Rocky area on sand and shell bottom; maximum relief of 6 ft; rugged rock formations; heavy invertebrate growth
Q[4]	27°28'	83°07'		Flat bottom; patches of flat rock with drop of 3 feet; heavy growth on the edges of the rocks
R[4]	27°42' to 27°53'	83°16' to 83°28'	16 to 30	Southern portion has a rolling sand and shell bottom with scattered rock and sponges; northern portion has flat sand and shell bottom with rocky areas of moderate relief; numerous ledges and crevices

TABLE 3-2 (Continued)

Location and Source*	Latitude (N)	Longitude (W)	Depth (m)	Topographic Description
S[4]	27°47'	82°58' to 83°04'	15 to 16	Small artificial reef built on surrounding rock and mud bottom; dropped in 1959; mild relief
T[4]	27°34'	82°50'	6 to 8	Hard bottom of sand and shell; flat with sparse grass growth
U[4]	27°17' to 27°22'	82°53'	15	Bottom of sand and shell surrounding a patch of flat rock 6 mi long and 1 mi wide; many deep crevices and caves
V[4]	27°41'	82°55'	11	Sand and flat rock of low relief; additional rock in the vicinity; wreck of an old barge supplemented with auto bodies and other junk; most drops were made about 1955
W[4]	27°36'	82°56'	2 to 27	Large and varied area; channel depth averages 25 ft; one rocky depression 90 ft in depth at north end of Egmont Key; bottom mostly sand and mud; offshore end of Channel most productive

*Sources: [1]Doyle et al., [2]1974; Moe and Martin, 1965; [3]Joyce and Williams, 1969; [4]Moe, 1963; [5]Smith, 1980 (personal communication)

Site Y were the sand dollars not seen, and often the videotape revealed dozens of the organism at a single time. Site Y had an average density of over four animals per linear meter. This site is apparently a rare and unique biological area, for this dense phenomenon has not been seen at any of the five Shallow-Water Alternatives Sites examined (1, 2, 2A, 3, or 4), or at either of Sites A or B. Consequently, State Site Y was eliminated from further detailed consideration.

State Site X was also characterized by the presence of quantities of sand dollars, although they were not as dense at Site X as at Site Y. Site X had flat uninterrupted sandy bottoms over the entire area examined, and minimal algal patches were seen throughout the videocamera transects. Although State Site X may be environmentally acceptable for the disposal of dredged material, more site-specific information would have to be obtained on the site to propose a designation for this purpose.

The water clarity during the video camera examination of the three State Sites was excellent at all times; water depths ranged from 96 to 105 feet.

SUSPENDED PARTICULATE MATTER AND TURBIDITY

In the nearshore zone, concentrations of suspended particulate matter (SPM) in the water column are greater during winter than summer (Manheim et al., 1972). In the winter, fine bottom sediments, disturbed by wind and wave turbulence, are suspended uniformly throughout the water column. At the more northerly Mississippi, Alabama, and Florida sites, SPM values around 0.5 mg/liter have been measured (Figure 3-12). The particulate matter is a fine, mobile fraction of local bottom sediments. Winter transmissivities (T) do not exceed 55%. During summer, the effects of water stratification and reduced turbulence is apparent with clear water (T = 85%) overlying near-bottom nepheloid layers, resulting from interaction of currents with the bottom (Figure 3-13). The suspended particulates are limited to this narrow nepheloid band, where SPM values occur in the range of 0.1 to 0.2 mg/liter (Manheim et al., 1976).

TABLE 3-3
ARTIFICIAL REEFS AND HARD-BOTTOM AREA DESCRIPTIONS

Location	Latitude (N)	Longitude (W)	Depth (m)	Distance (mi)	Composition
• 1	27°29'30"	82°44'05"	6.5	1.0	Barge, metal junk, concrete pipe, tires
• 2	27°23'51"	82°35'49"	3.7	1.0	Tires, broken concrete, sewer tile
• 3	27°32'15"	82°52'42"	12.0	7.8	Tires, concrete pipe
• 4	27°29'57"	82°47'00"	9.0	3.5	Tires, concrete pipe
• 5	27°26'33"	82°49'12"	12.0	7.9	Tires, concrete pipe
• 6	27°26'33"	82°44'48"	9.0	3.1	Tires, concrete pipe
• 7	27°29'20"	82°43'47"	10.0	1.2	Autos
• 8	27°41'05"	82°45'08"	6.0	1.0	Junk, tires
• 9	27°42'03"	82°45'06"	6.0	1.0	Junk, tires
• 10	27°43'01"	82°45'09"	6.0	0.8	Junk, tires
• 11	27°43'07"	82°46'02"	6.0	1.6	Junk, tires
• 12	28°00'57"	82°53'42"	9.0	3.8	Concrete pilings, steel barges, tires culverts
• 13	27°47'06"	82°50'02"	6.5	0.8	Tire, metal junk, concrete rubble
• 14	27°47'00"	82°49'08"	6.5	1.3	Tire, metal junk, concrete rubble
• 15	27°51'54"	83°01'48"	14.0	10.6	235-ft LSM, concrete pillbox
• 16	27°46'32"	82°35'48"	5.0	1.3	Tires, concrete rubble, clay pipes
• 17	27°40'56"	82°38'01"	3.0	1.3	Tires concrete rubble, clay pipes
• 18	27°55'36"	83°01'24"	15.0	10.4	110-ft barge
• 19	28°08'03"	82°55'51"	8.0	5.3	Tires, concrete culverts
• 20	28°03'02"	82°54'33"	8.0	4.5	Concrete culverts, tires, concrete pilings
• 21	27°46'18"	82°54'54"	10.0	6.3	Tires
• 22	27°40'36"	82°52'51"	11.0	7.6	Concrete culvert, tires, concrete pilings and slabs
• 23	27°44'30"	82°52'51"	9	6.1	Tires, concrete culvert
• 24	27°47'11"	82°35'37"	11	1.0	Concrete rubble, 32-ft steel hull ship
• 25	27°18'06"	82°35'36"	8	2.1	Tires, fiberglass, concrete rubble
• 26	27°18'06"	82°35'36"	8	1.3	Tires, fiberglass, concrete rubble
• 27	27°17'06"	82°36'00"	8	2.2	Tires, fiberglass, concrete rubble
• 28	27°36'00"	82°46'00"	27	0.4	Unbroken concrete pipe
• 29	27°39'17"	82°35'28"	8	2.1	Autos
• 30	27°52'30"	83°11'24"	26	20.3	
■ 1	27°29'30"	83°19'00"	37	34.3	Sand and shell bottom; rock, sponge, and coral growth
■ 2	27°27'00"	83°05'00"	25	22.0	Sand and shell bottom with rock and coral patches
■ 3	27°34'00"	82°50'00"	8	4.5	Sand and shell bottom; sparse grass growth
■ 4	27°34'00"	82°47'30"	9	5.3	Sand and shell bottom with grassy areas
■ 5	27°29'00"	83°21'00"	18	36.4	Rocky bottom, sand and shell around rocks

TABLE 3-3 (Continued)

Location	Latitude (N)	Longitude (W)	Depth (m)	Distance (mi)	Composition
■ 6	28°11'00"	83°02'00"	10	10.8	Flat and rough rock ledges and crevices
■ 7	27°46'00"	84°09'00"	60	79.8	Productive limestone ridge with areas of sand and shell
■ 8	27°55'00"	84°30'00"	80	100.4	Sand and shell bottom with limestone relief
■ 9	27°59'30"	83°02'00"	11	12.3	Sand and shell bottom with scattered rock
■ 10	27°58'00"	83°22'00"	27	31.8	Sand and shell bottom with rock, sponge, and coral growth
■ 11	26°56'00"	82°57'00"	8	6.5	Flat bottom; scattered low rock with coral growths
■ 12	27°47'30"	83°22'00"	28	31.8	Sand and shell bottom with sponges, rocks, ledges
■ 13	27°47'00"	83°01'00"	16	12.3	Small artificial reef on rock and mud bottom
■ 14	27°40'00"	82°59'00"	12	14.6	Sand and shell bottom with rocks and vegetation
■ 15	27°48'00"	83°40'00"	40	49.9	Mud and sand bottom with rock patches
■ 16	27°57'00"	83°08'00"	15	17.6	Sand bottom with exposed rock
■ 17	27°41'00"	82°55'00"	11	10.5	Sand and flat rock; barge, autos, and junk
■ 18	27°36'00"	82°56'00"	22	10.4	Sand and mud bottom with rocks in depressions
■ 19	28°05'00"	83°27'00"	25	37.1	Sand and shell bottom with rock, sponge, coral
■ 20	28°08'00"	83°13'00"	20	22.3	Sand and shell bottom with rocky areas
■ 21	28°03'00"	83°04'00"	13	13.76	Rocky bottom, shell, coral, and vegetation
■ 22	28°03'00"	82°55'00"	9	4.8	Sand and shell with rocky areas; autos and junk
■ 23	27°51'00"	82°56'00"	22	4.9	Sand and shell bottom; rugged rock with invertebrate growth
■ 24	27°28'00"	83°07'00"	30	23.7	Patches of flat rock with heavy growth on edges
■ 25	27°19'00"	82°49'00"	16	11.1	Rock ledges with sand and shell bottom
■ 26	27°19'30"	82°53'00"	15	14.3	Sand and shell bottom surrounding a patch of rock

Source: Florida Sea Grant 1979, Map A (Recreation Use Reefs in Florida Artificial and Natural)

Water clarity generally increases with increasing distance from shore. Offshore suspensates typically have a high combustible organic component, which indicates that they are chiefly of biogenic origin. Nearshore suspensates have a high carbonate fraction, reflecting their mineralogic origin. Regional differences in the mineralogy of bottom sediments is reflected in the nature of the suspended material. This supports the theory that most of the suspended sediments are derived from local bottom sediments (Manheim et al., 1972).

Surveys of Sites A and B and Shallow-Water Alternative 4 show predictable trends of decreasing turbidity with distance from shore, and greater concentrations of SPM during winter. However, SPM values at Sites A and B were generally higher than those measured at Mississippi, Alabama, and Florida sites during other summer and winter periods (Manheim et al., 1976; Betzer et al., 1979). The generally higher values at Sites A and B may be a result of shallower water depths.

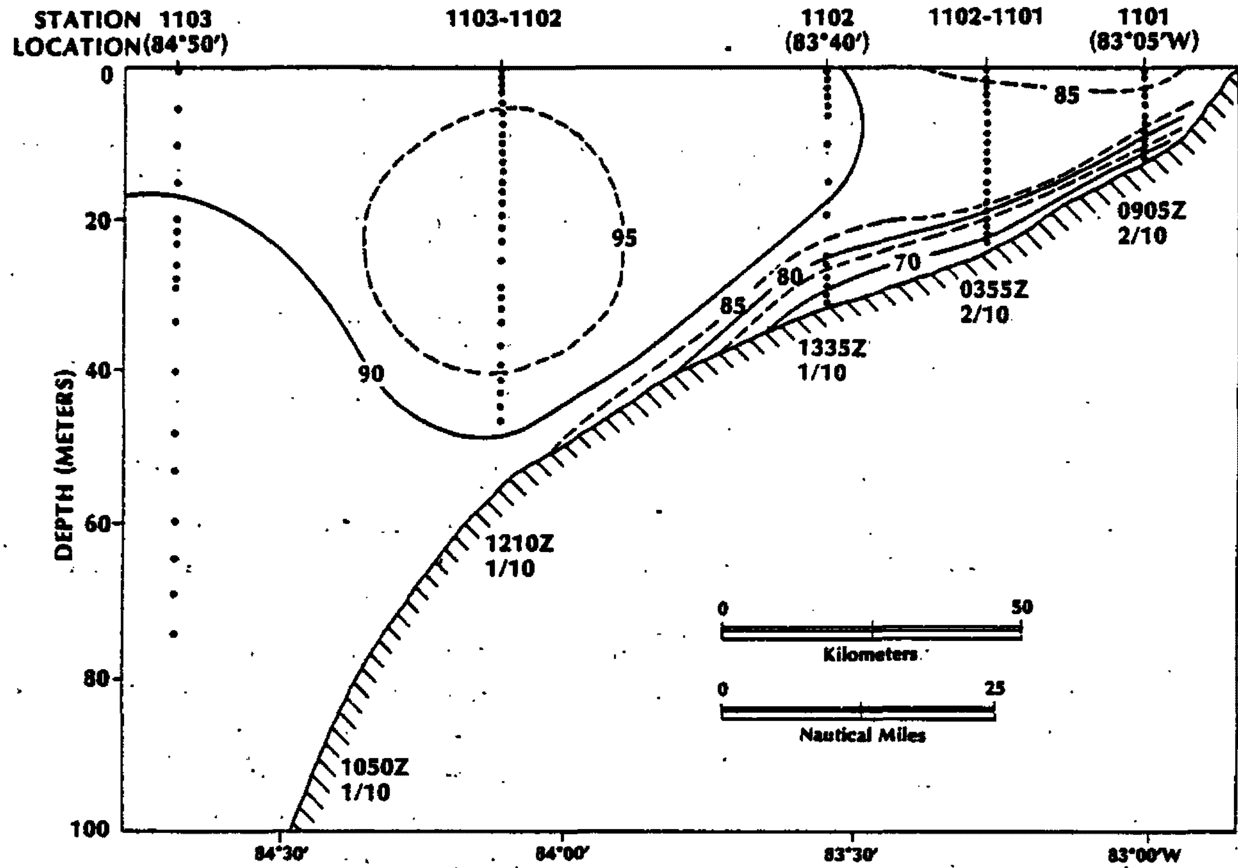

Figure 3-12. Percent Light Transmission Profile at 27°55' for January and February 1975
Source: Manheim, Steward, and Carder, 1976

Examination of the areas at and in the vicinity of Shallow-Water Alternative Site 4 during the earlier portions of the February, March, and April 1983 EPA survey fully corroborated the work cited above by Manheim et al. from the Mississippi, Alabama, and Florida sites and other surveys. During late February and early March, the lower half of the water column at and in the vicinity of Site 4 was particularly heavy in suspended particulate matter, so that visibility below 40 feet was no more than 1 to 2 feet with the videotape camera, even with the full array of underwater lighting.

CHEMICAL CHARACTERISTICS

WATER COLUMN

Trace Metals

Sources of trace metals in the marine environment include the weathering of rocks, urban and industrial runoff, outfalls, and atmospheric fallout. Since

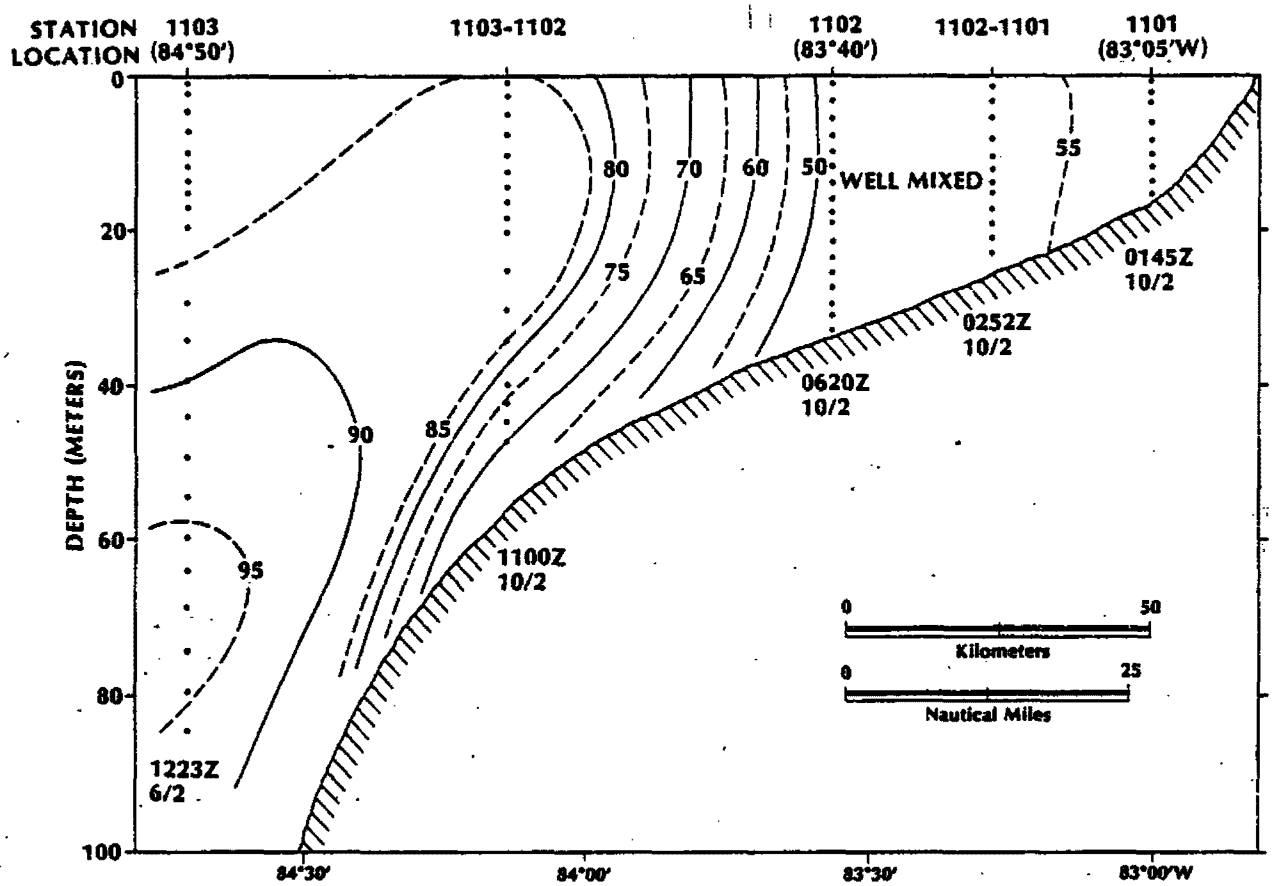

Figure 3-13. Percent Light Transmission Profile at 27°55' for September 1975
Source: Manheim, Steward, and Carder, 1976

rivers, bays, and outfalls are major contributors of trace metals, levels tend to be higher in the coastal zone than in the open ocean. Site A, however, is 13 nmi offshore, and waters there are typical of the eastern Gulf of Mexico, which have been found to contain levels of trace metals similar to those found in the western Caribbean (El-Sayed et al., 1972).

Levels of selected trace metals measured at Sites A and B and Shallow-Water Site 4 are presented in the Appendices. With the exception of lead, the levels of trace metals are similar to open ocean levels (Forstner and Whittman, 1979), indicating a relatively clean marine environment. Lead concentrations probably reflect the proximity to the Tampa-St. Petersburg metropolitan area, and associated particulate lead fallout and freshwater runoff.

Nutrients

Extrapolation from limited data indicates that nutrient levels (nitrate, phosphate, and silicate) at Sites A and B and Shallow-Water Site 4 are uniformly low, with little seasonal variation. Work of Graham et al. (1954) on the seasonal distribution of phosphate in the region indicates that phosphate levels are on the low end of overall ranges for the Gulf (Table 3-4). This is in agreement with the fact that eastern Gulf water originates in the western Caribbean, which is generally low in nutrients (Atwood et al., 1976).

As a result of nearby phosphate mining and processing activities, Tampa Bay contains high levels of inorganic and organic phosphates (Hobbie, 1974). However, there is no conclusive evidence indicating that Tampa Bay has any effect on phosphate levels of nearshore Gulf waters. In any case, surface water located 13 nmi offshore (i.e., at Site A) is oceanic and contains low concentrations of inorganic phosphate (0.08 ug-at/liter). Vertical distribution of phosphate 13 nmi offshore was relatively uniform year-round (Graham et al., 1954).

Organic Carbon, Petroleum, and Chlorinated Hydrocarbons

Dissolved organic carbon (DOC) and particulate organic carbon (POC) have not been measured in waters near the Shallow-Water Alternative Sites, but are assumed to fall within the range of organic carbon occurring elsewhere in Gulf Shelf waters (i.e., DOC: 0.58 to 2.35 mg C/liter [mean 1.08]; POC: 0.022 to 1.911 mg C/liter [mean 0.214]) (El-Sayed et al., 1972).

The organic carbon in Shelf waters is composed mainly of biogenic material (e.g., fulvic and humic acids, carbohydrates, and natural lipids); however, anthropogenic contaminants, such as petroleum or chlorinated hydrocarbons, may occur in trace amounts. Nonvolatile chlorinated hydrocarbons at Sites A and B, such as PCB, DDT, and DDT metabolites, were all below detection limits.

TABLE 3-4
AVERAGE VALUES OF NUTRIENTS FOUND IN GULF OF MEXICO WATERS
(µg-at/liter)

Nutrient	Range	Mean	Standard Deviation
Nitrate	0.01 to 2.20	0.23	0.61
Phosphate	0.01 to 2.26	0.22	0.29
Silicate	0.01 to 35.5	3.86	4.25

Source: El Sayed et al., 1972

Dissolved Oxygen

Oxygen levels measured at Sites A and B in September 1979, and January 1980, ranged from 3.60 to 6.12 ml/liter (83 to 137% saturation). Oxygen levels measured at Alternative Site 4 ranged from 7.4 to 7.9 ml/liter. All surface and most bottom water samples were above saturation. Comparable historical data values reported in the region of Sites A and B (Collins and Finucane, 1974) ranged from 1.54 to 5.80 ml/liter. Oxygen levels at Sites A and B in May, 1982 ranged from 7.0 to 8.3 ml/liter, and at Alternative Site 4 in the same time period ranged from 7.2 to 7.9 ml/liter. All these values were above saturation levels.

SEDIMENTS

Trace Metals

Analysis of sediments at Sites A and B and Alternative Site 4 revealed uniformly low levels of mercury, cadmium, and lead within and outside site boundaries. The low levels of anthropogenic pollutants are consistent with expectations, considering the 13 nmi distance from shore. Mississippi, Alabama, and Florida studies also revealed relatively low levels of metals in sediments (Table 3-5) (Presley et al., 1974).

Results of surveys at Sites A and B and the Shallow-Water Sites compared to a study by Presley et al. (1974), vary due to differences in analytical procedures. However, all surveys indicate no extraordinary inputs of metals to the West Florida Shelf sediments.

TABLE 3-5
SEDIMENT HEAVY METAL CONCENTRATIONS
IN MID-SHELF AREAS WEST OF PINELLAS COUNTY

Latitude (N)	Longitude (W)	Fe (%)	Cd (ppm)	Cu (ppm)	Cr (ppm)	Ni (ppm)	Pb (ppm)	V (ppm)	Ba (ppm)
27°56.5'	83°53'	0.19	<0.05	5	14	2	4	8	56
28°00.5'	83°45'	0.18	<0.05	4	23	3	6	4	52
27°57.5'	83°42.5'	0.18	<0.05	4	10	1	6	5	36
28°01'	83°35.5'	0.12	<0.05	4	21	2	7	5	76
27°52.5'	83°34'	0.14	<0.05	4	21	4	3	5	36
27°50'	83°31'	0.24	<0.05	3	20	3	7	4	36
27°56'	83°27.5'	0.12	<0.05	5	23	1	6	4	41
27°50'	83°25'	0.15	<0.05	4	19	2	6	-	69
27°45.5	83°25.5'	0.15	<0.05	4	9	3	6	4	40

Source: Presley, B., C. Linadau, and J. Trefrey, 1974

Organic Carbon, Petroleum, and Chlorinated Hydrocarbons

Total organic carbon (TOC) levels in sediments of Sites A and B and the Shallow-Water Sites are patchy, with most levels below the average TOC value (2.5 mg/g) for the Florida Shelf (Emery and Uchupi, 1972). Oil and grease levels (determined by weight) are also patchy and generally low. Petroleum hydrocarbons were not measured at Sites A and B. However, chlorinated hydrocarbon levels at all sites are either below detection limits or extremely low, and petroleum hydrocarbon levels are expected to be similar. There are no known oil seeps in the region.

BIOLOGY

Biota in the water column and benthic environments of the ODMDS are described in this section. Water column biota include phytoplankton, zooplankton, and nekton; benthic biota are composed of infaunal and epifaunal organisms, including demersal fish. The infauna are generally sedentary and cannot readily emigrate from an area of disturbance. Infauna, therefore, can be important indicators of environmental conditions. Dredged material disposal will have only short-term effects on planktonic communities because of their natural patchiness and the transient nature of the water masses they inhabit. Nekton generally are not adversely affected by dredged material disposal because of their high mobility.

PLANKTON

A survey of plankton populations in the vicinity of Sites A and B and the Shallow-Water Alternative Sites showed that the populations were similar to those found in other parts of the Gulf, indicating the Loop Current exerts a dominant influence on the planktonic populations. Marine plankton can be divided into two main groups: phytoplankton (plant plankton) and zooplankton (animal plankton).

Phytoplankton

Diatoms and dinoflagellates are the dominant phytoplankton groups that occur in the vicinity of Sites A and B and the Shallow-Water Alternative Sites. Abundances in the Gulf of Mexico are greatest inshore, and decrease with increasing distance from shore (Hulbert and Corwin, 1972; Steidinger and Williams, 1970; Saunders and Glenn, 1969). Saunders and Glenn (1969) reported diatom abundance of inshore waters to be 16 times greater than transitional waters and 128 times greater than offshore waters. A list of the dominant species of diatoms and dinoflagellates collected in the vicinity of Tampa Bay is given in Table 3-6.

Generally, diatom abundance exceeds that of dinoflagellates (Steidinger, Davis and Williams, 1967). Seasonal peaks in abundance of diatoms occur in mid-winter and summer for offshore and inshore populations, respectively (Saunders and Glenn, 1969). Dinoflagellate abundance usually peaks in summer and autumn (Steidinger and Williams, 1970).

In contrast to abundance, diatom diversity is lowest inshore and increases to a maximum offshore (Saunders and Glenn, 1969). Dinoflagellate diversity follows a trend similar to diatoms; however, the greatest diversity occurs in transitional waters (Steidinger and Williams, 1970).

TABLE 3-6
DOMINANT SHELF SPECIES REPORTED FROM VICINITY OF TAMPA BAY*

Diatoms	Dinoflagellates
Rhizosolenia alata	Gonyaulax monilata
R. setigera	Gymnodinium breve
R. stolterfothii	Gonyaulax polygramma
Skeletonema costatum	Katodinium glaucum
Leptocylindrus spp.	Oxyrrhis marina
Rhizosolenia fragilissima	Gyrodinium fissum
Hemidiscus hardmanianus	Torodinium robustum
Guinardia flaccida	Katodinium rotundatum
Bellerochea malleus	Gyrodinium sp.
Cerataulina pelagica	Amphidinium crassum

* Species are presented in order of decreasing dominance

Sources: Saunders and Glenn, 1969; Steidinger and Williams, 1970

Uncontrolled blooms of dinoflagellates such as Ptychodiscus brevis occur periodically and result in a condition known as "red tide." Red tides occur primarily in late summer or autumn, when the following three conditions exist: (1) an increase in population size (triggered by some environmental change), (2) supportive salinity, temperature, nutrient, and growth factors, and (3) maintenance by hydrological and meteorological forces (Steidinger, 1975a and 1975b).

The impact of red tides on marine communities can be severe. Heavy mortalities of marine life have been documented and attributed to poisoning by dinoflagellate toxins; secondary effects include oxygen depletion, hydrogen sulfide poisoning, and bacterial and fungal infections (Smith, 1975; Smith, 1976a; Gunter et al., 1948; Torpey and Ingle, 1966; Quick and Henderson, 1975a and 1975b). However, red tide outbreaks have long been recorded off the west coast of Florida; none have ever been associated specifically with dredged material disposal.

Zooplankton

Information on the zooplankton community of the western Florida Shelf is limited. However, data from Mississippi, Alabama, and Florida studies (Maturo et al., 1974) can be used to characterize dominant taxa that would be expected to occur in the vicinity of Sites A and B and the Shallow-Water Alternative Sites (Table 3-7). Results of these studies indicated that chaetognaths, calanoid and cyclopoid copepods, shrimp and crab larvae, pteropods, larvaceans, tunicates, ostracods, other crustaceans, and fish eggs were typical members of the community. These organisms were considered to be a fairly typical Gulf of Mexico offshore assemblage (Maturo et al., 1974). Houde and Chitty (1976) reported that zooplankton volumes and abundance of fish eggs and larvae were greatest in the spring and summer.

NEKTON

The nekton community off Tampa Bay (including several important species of shrimp) is influenced primarily by sediment characteristics. Smith (1976b) found that, in general, fauna associated with soft substrates are predominantly of temperate origin, whereas hard bottom fauna are derived from Caribbean and West Indian populations.

In the vicinity of Sites A and B and the Shallow-Water Alternative Sites, 60 species of nekton have been collected (Table 3-8). The 10 most abundant species were leopard searobin (*Prionotus scitulus*), sand perch (*Diplectrum formosum*), tomtate (*Hemulon aurolineatum*), pinfish (*Lagodon rhomboides*), blackcheek tonguefish (*Symphurus plaguisa*), jackknife fish (*Equetus lanceolatus*), pigfish (*Orthopristis chrysoptera*), fringed flounder (*Etropus crossotus*), spotted wiff (*Citharichthys macrops*), and pink shrimp (*Penaeus duorarum*). These species are characteristic of sandy and rocky habitats, and are found from the intertidal zone to water depths of 200 meters.

The dominant fish taxa occur throughout most of the year in the vicinity of Sites A and B and the Shallow-Water Alternative Sites, although offshore

TABLE 3-7
ZOOPLANKTON COLLECTED DURING MAFLA STUDIES

Globigerina sp.	Oncaea sp.
Other protozoans	Other cyclopoids
Siphonophores	Copepod copepodites
Medusae	Copepod nauplii
Polychaete larvae	Lucifer faxoni
Gastropod veligers	Other shrimp-like forms
Pteropods	Crab larvae
Bivalve larvae	Other crustaceans
Cladocerans	Echinoderm larvae
Ostracods	Chaetognaths
Centropages furcatus	Oikopleuridae
Eucalanus sp.	Fritillaridae
Undinula vulgeris	Other tunicates
Other calanoids	Fish eggs
Harpacticoids	Fish larvae
Corycaeus sp.	Other zooplankton
Oithona sp.	

Source: Maturo et al., 1974

migrations linked with spawning cycles have been reported for pinfish, pigfish, and fringed flounder (Moe and Martin, 1965). Most of these dominant species are thought to spawn in the spring and summer, with the exception of Lagodon rhomboides, which spawns in winter and spring, and Prionotus scitulus, which spawns in late summer and fall (Moe and Martin, 1965; Smith, 1976b).

In the vicinity of Sites A and B and the Shallow-Water Alternative Sites, penaeid shrimp are an important component of the nekton community. The dominant species in the area are Sicyonia brevirostris (rock shrimp), Solenocera atlantidis, Metapenaeopis goodei, and Penaeus duorarum (pink shrimp). Each of these species feed and move toward the surface at night, then are largely inactive during the day, remaining on the bottom (Saloman, 1968; Huff and Cobb, 1979). Studies of gut contents of these shrimp indicate that they are generalized benthic carnivores with crustaceans and molluscs dominating their diets (Huff and Cobb, 1979).

TABLE 3-8
NEKTON TAXA COLLECTED IN DEPTH RANGES OCCUPIED BY SITES A and B AND SHALLOW-WATER ALTERNATIVE SITES

Scientific Name	Common Name	10 Most Abundant Species	Commercial Importance	Moe and Martin, 1965	EPA/TEC, 1979-1980	Remarks
Gymnura micrura	Smooth butterfly ray			X		Shore to more than 55m
Gymnothorax ocellatus	Ocellated moray				X	Middle Shelf spp.
Ophichthus gomesi	Shrimp eel				X	Shallow bay and shore
Harengula pensacolae	Scaled sardine				X	Shallow waters
Anchoa hepsetus	Striped anchovy				X	Shallow to moderate depths
Synodus foetens	Inshore lizardfish				X	Inshore to 45m
Synodus intermedius	Sand diver			X		40m to 100m
Trachinocephalus myops	Snake fish				X	40m to 90m
Arius felis	Sea catfish		X		X	Bay out to 30m
Opsanus pardus	Leopard toadfish			X	X	Offshore, more than 30m
Porichthys porosissimus	Atlantic midshipman			X		Shallow to moderate depths
Antennarius ocellatus	Ocellated frogfish			X		Offshore
Urophycis floridanus	Southern hake			X		Shore to more than 30m
Ophidion beani	Longnose cusk-eel			X		Offshore
Ophidion grayi	Blotched cusk-eel			X	X	20m to 50m
Ophidion holbrooki	Bank cusk-eel			X	X	10m to 40m
Ophidion welshi	Crested cusk-eel			X		Usually 20m
Centropristis ocyurus	Bank sea bass		X		X	20m to more than 90m
Centropristis striata	Black sea bass		X	X		?
Diplectrum bivittatum	Drawf sand perch				X	20m to 70m
Diplectrum formosum	Sand perch	2	X	X	X	Moderate depths
Lutjanus synagris	Lane snapper		X	X		Shore to 400m
Eucinostomus gula	Silver jenny			X	X	Only in Gulf, high-salinity water
Haemulon aurolineatum	Tomtate	3			X	Moderate depths
Orthopristis chrysoptera	Pigfish	8	X	X	X	Shallow water
Calamus nodosus	Knobbed porgy				X	10m to 80m
Lagodon rhomboides	Pinfish	4		X	X	Inshore and bays to 40m
Bairdiella chrysura	Silver perch			X		Bays and shallow waters
Cynoscion arenarius	Sand sea trout		X	X	X	Shallow waters
Equetus lanceolatus	Jackknife fish	7			X	Deep water
Equetus umbrosus	Cubbyu				X	Offshore reefs
Leiostomus xanthurus	Spot		X	X		Estuaries to more than 40m
Menticirrhus americanus	Southern kingfish			X		Bays and moderate depths
Micropogon undulatus	Atlantic croaker		X	X		Estuaries to more than 40m
Chaetodipterus faber	Atlantic spadefish			X		Bays to moderate depths
Scarus taeniopterus	Princess parrotfish				X	?
Astroscopus y-graecum	Southern stargazer			X		Inside 130m rare
Neomerinthe hemingwayi	Spinycheek scorpionfish				X	50m to 130m
Scorpaena brasiliensis	Barbfish			X	X	Bays and shore
Prionotus carolinus	Northern searobin				X	Shore to 65m
Prionotus salmonicolor	Blackwing searobin				X	10m to 65m
Prionotus scitulus	Leopard searobin	1		X	X	Inshore and bays to 45m
Prionotus tribulus	Bighead searobin			X		Estuaries to 25m
Bothus lunatus	Peacock flounder		X		X	?
Bothus ocellatus	Eyed flounder		X	X		20m to 90m
Citharichthys macrops	Spotted whiff	10	X		X	Deeper than 30m
Citharichthys spilopterus	Bay whiff	-	X		X	Inshore to more than 35m
Etropus crossotus	Fringed flounder	9	X	X	X	10m to 65m
Paralichthys albigutta	Gulf flounder		X	X	X	Deep water
Syacium papillosum	Dusky flounder		X	X	X	20m to more than 90m
Symphurus plagiusa	Blackcheek tongue fish	6	X	X	X	Estuaries to 20m
Aluterus schoepfi	Orange filefish				X	Offshore reefs
Monacanthus ciliatus	Fringed filefish				X	Shallow grassy bays
Monacanthus hispidus	Planehead filefish				X	Shore to more than 35m
Monacanthus setifer	Pygmy filefish				X	More than 20m
Lactophrys quadricornis	Scrawled cowfish			X	X	10m to 75m
Sphoeroides nephelus	Southern puffer				X	Inshore to 5m
Sphoeroides spengleri	Bandtail puffer				X	More than 10m, inshore
Chilomycterus schoepfi	Striped burrfish				X	Shore to more than 30m
Penaeus duorarum	Pink shrimp	5	X		X	Bay to more than 130m

Although there is some variation, shrimp species are most abundant in late summer and autumn. Pink shrimp are unique among these species in using estuarine areas in Tampa Bay as nurseries. Inshore migrations of small postlarvae occur primarily from March through June and offshore migrations of large shrimp (85 to 140 mm) occur from April through July (Huff and Cobb, 1979; Eldred et al., 1963).

Associated with pink shrimp distributions are the following teleosts, most of which are prevalent on the Continental Shelf: silver jenny (Eucinostomus gula), sand perch (Diplectrum formosum), leopard searobin (Prionotus scitulus), fringed flounder (Etropus crossotus), pigfish (Orthopristis chrysopterus), dusky flounder (Syacium papillosum), tomtate (Haemulon aurolineatum), and Atlantic bumper (Chloroscombrus chrysurus) (Chittenden and McEachran, 1976).

Eighteen of the species listed (Table 3-8) have commercial value; the most important is pink shrimp (Penaeus duorarum), and seven species of flounder. These species account for $5.4 million of the total commercial fisheries catch of Pinellas, Hillsborough, and Manatee Counties (NMFS, 1978).

Several commercially and recreationally important species reportedly utilize Tampa Bay as a nursery area during juvenile life stages (Sykes and Finucane, 1966). In this regard the Bay can be an important habitat in the development of a number of offshore species. More than 90% of the species harvested require an estuarine environment in their life histories (Sykes 1964, 1968; Gunther, 1967).

The black mullet (Mugil cephalus) has been extensively studied due to its commercial importance, ranking first in terms of total weight landed, and second in economic value for all commercial species taken during 1978 in the tri-county area (NMFS, 1979). However, this species is most often fished in estuarine and nearshore coastal waters, and does not frequent the areas occupied by Sites A and B and the Shallow-Water Alternative Sites. Black mullet spawn in open waters between October and January. Newly hatched larvae maintain an oceanic planktonic existence for several weeks before moving into estuarine waters as juveniles during the autumn. For the next two to three years they remain in the estuary while developing into sexually mature adults. As adults, they migrate into oceanic waters only during the annual spawning period.

MARINE MAMMALS

The Gulf of Mexico supports both a seasonal and permanent marine mammal population of cetaceans (whales, dolphins, and porpoises) and sirenians (manatees) (BLM, 1978). Pinnipeds (seals and sea lions) are present only in small numbers; their presence is the result of introduction by man (D. Odell, personal communication*).

The Gulf serves as summer mating and calving grounds, and winter feeding grounds for 16 species of whales and 8 species of dolphins and porpoises (Table 3-9). Common dolphins and whales include the bottlenose dolphin (Tursiops truncatus), spotted dolphin (Stenella plagiodon), short finned pilot whale (Globicephala macrorhyncus), and the sperm whale (Physeter catodon). Most whales occur well offshore, beyond the Continental Shelf, whereas dolphins and porpoises occur both in shallow and deep waters (BLM, 1978).

The West Indian manatee (Trichechus manatus) is the only species of manatee found in the Gulf. In the Tampa Bay region, manatees generally inhabit inland waterways, usually less than 3m deep, seldom venturing offshore. Their principal source of nutrition is aquatic vegetation growing in shallow coastal and bay waters.

BENTHOS

The benthic community offshore of Tampa Bay was classified into three major types by Collard and D'Asaro (1973): Shallow Shelf (Figure 3-14), Deep Shelf (Figure 3-15), and Slope (Figure 3-16). This classification is based on the limited literature available on the offshore communities. The types are identified by changes in species composition, which reflect affinities to either the Carolinian or Caribbean faunal provinces.

* D. Odell, Professor, University of Miami, Miami, Florida, 1980

TABLE 3-9
SPECIES OF MARINE MAMMALS IN THE GULF OF MEXICO

Cetaceans	Behavior
Minke whale (*Balaenoptera acutorostrata*)	Possible winter resident; feed on euphausiids and small fish
Bryde's whale (*Balaenoptera edeni*)	Possibly year-round; feed on small schooling fishes, some euphausiids, and other crustaceans
Sei whale* (*Balaenoptera borealis*)	Possible winter resident; winter calving and mating; feed on copepods, euphausiids, and various small fishes
Fin whale* (*Balaenoptera physalus*)	Possible winter resident; mating and calving in winter; feed mostly on euphausiids
Blue whale* (*Balaenoptera musculus*)	Uncommon; feed on euphausiids
Humpback whale* (*Megaptera novaeangliae*)	Possible winter resident; feed on euphausiids
Black right whale* (*Eubalaena glacialis*)	Possible winter resident; winter mating and calving; feed on copepods
Rough-toothed dolphin (*Steno bredanensis*)	Rare; feed on fish and squid
Bottlenose dolphin (*Tursiops truncatus*)	Common; year-round; feed mostly on fish; breed year-round
Spinner dolphin (*Stenella longirostris*)	May be year-round; probably feed on fish and squid
Spotted dolphin (*Stenella frontalis*)	Uncommon; feed on fish and squid
Atlantic spotted dolphin (*Stenella plagiodon*)	Common; year-round; feed primarily on squid
Striped dolphin (*Stenella coeruleoalba*)	Uncommon; feed on fish, squid and crustaceans
Common dolphin (*Delphinus delphis*)	May be year-round near Shelf edge; feed on fish and copepods
Risso's dolphin (*Grampus griseus*)	Uncommon; feed on cephalopods

TABLE 3-9 (Continued)

Cetaceans	Behavior
Pygmy killer whale (Feresa attenuata)	Rare; little known
False killer whale (Pseudorca crassidens)	Uncommon; feed on fish
Short-finned pilot whale (Globicephala macrorhyncha)	Year-round in deep water; probably feed on squid and fish
Killer whale (Orcinus orca)	Uncommon; feed on fish, cephalopods, and other cetaceans
Sperm whale* (Physeter catodon)	Winter resident or possibly year-round; calving in summer; feed on cephalopods and some fish
Pygmy sperm whale (Kogia breviceps)	Year-round; feed on squid and pelagic crustaceans, such as shrimp
Dwarf sperm whale (Kogia simus)	Uncommon, possibly year-round; feed on squid and pelagic crustaceans, such as shrimp
Goose-beaked whale (Ziphius cavirostris)	Rare; feed on squid and deepwater fishes
Gervais beaked whale (Mesoplodon europaeus)	Rare; little known
Sirenean	
West Indian manatee* (Trichechus manatus)	Presently not found west of Aucilla and Port St. Joe Rivers, Florida; feed on aquatic vegetation

* Endangered species, Federal Register, 1979

Source: BLM, 1978

However, Lyons and Collard (1974) further divided the Shelf into five regions corresponding to floral and faunal changes as a function of depth: Shoreward, Shallow Shelf, Middle Shelf I, Middle Shelf II, and Deep Shelf (Figure 3-17). The Shoreward region (depths less than 10m) is comprised of temperate and subtropical estuarine species with low biological diversity. The Shallow Shelf, extending from 10m of water to 30m and containing Sites A and B and the

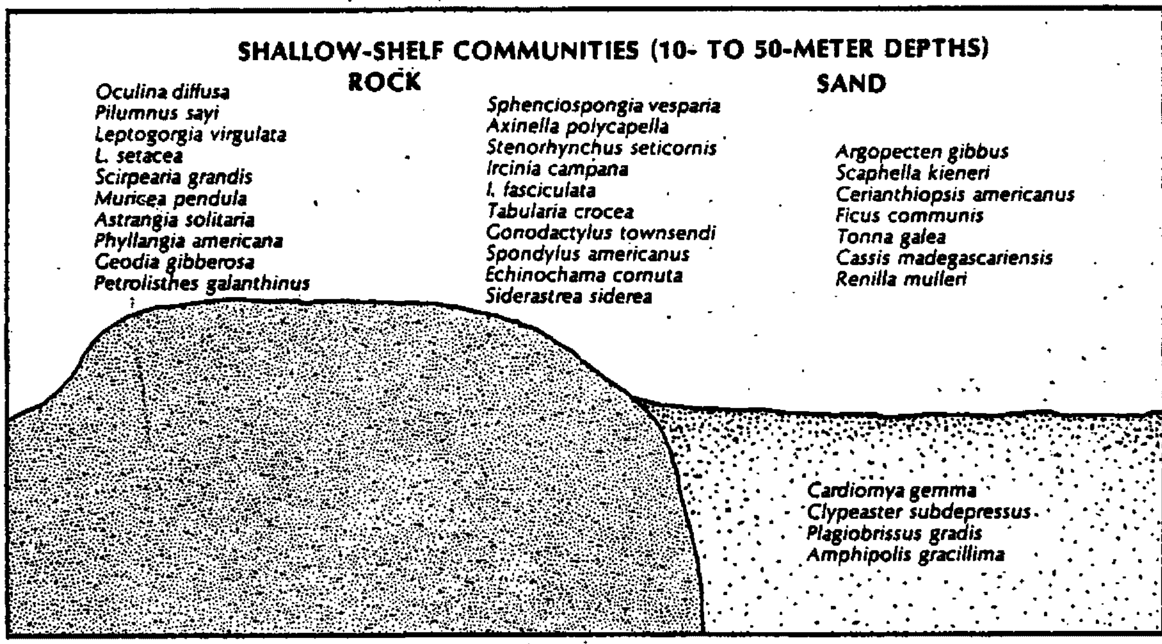

Figure 3-14. Shallow-Shelf Benthic Communities Offshore of Tampa Bay
Source: Collard and D'Asaro, 1973

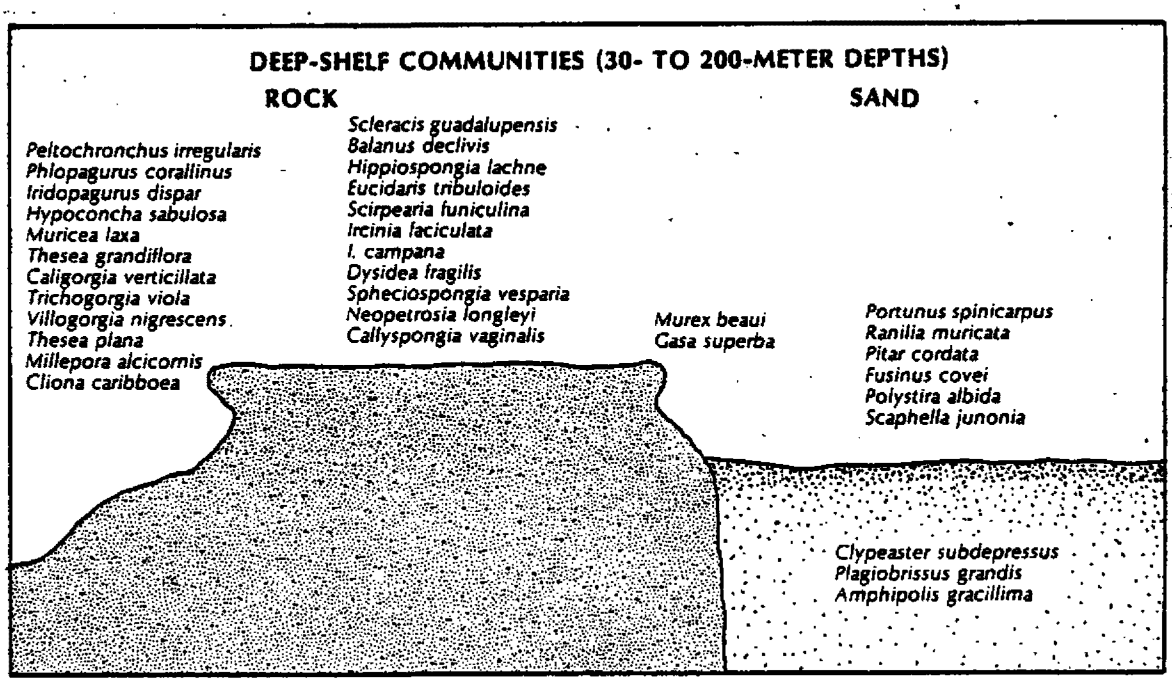

Figure 3-15. Deep-Shelf Benthic Communities Offshore of Tampa Bay
Source: Collard and D'Asaro, 1973

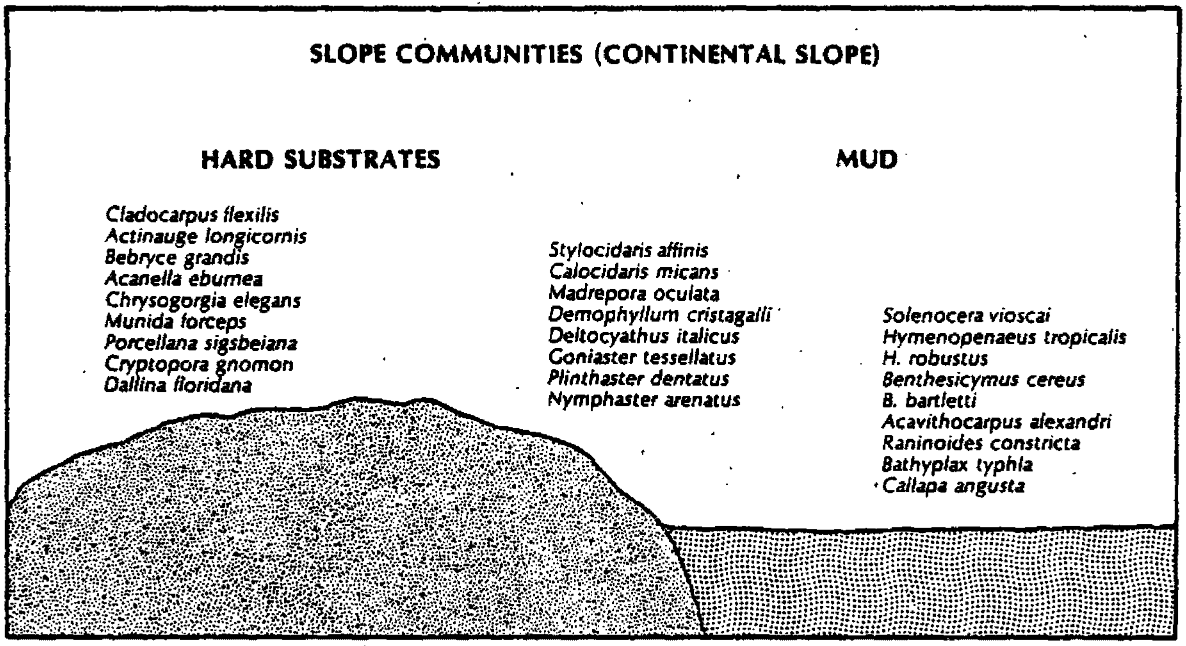

Figure 3-16. Slope Benthic Communities Offshore of Tampa Bay
Source: Collard and D'Asaro, 1973

Shallow-Water Alternative Sites, consists of inshore temperate and subtropical species with the addition of tropical Gulf species. Biological diversity within the Shallow Shelf region is high. The Middle Shelf I and II regions, with depth ranges of 30m to 60m, and 60m to 140m, respectively, contain predominantly tropical species with occasional inshore species. The Mid-Shelf Alternative Site is in the Middle Shelf II region. Biological diversity is greater at Middle Shelf I depths than at Middle Shelf II depths. The Deep Shelf region ranges from 104m to 200m of water where biological diversity is low and dominated by deepwater tropical species. The Deepwater Alternative Site is at the lower limit of the Deep Shelf region.

Shoreward Region

The Shoreward region, 0 to 10m, has rolling topography, a quartz-sand bottom overlain by a fine layer of silt, and is inhabited primarily by echinoderms and other coarse sand dwellers. Occasional small (less than one meter in height)

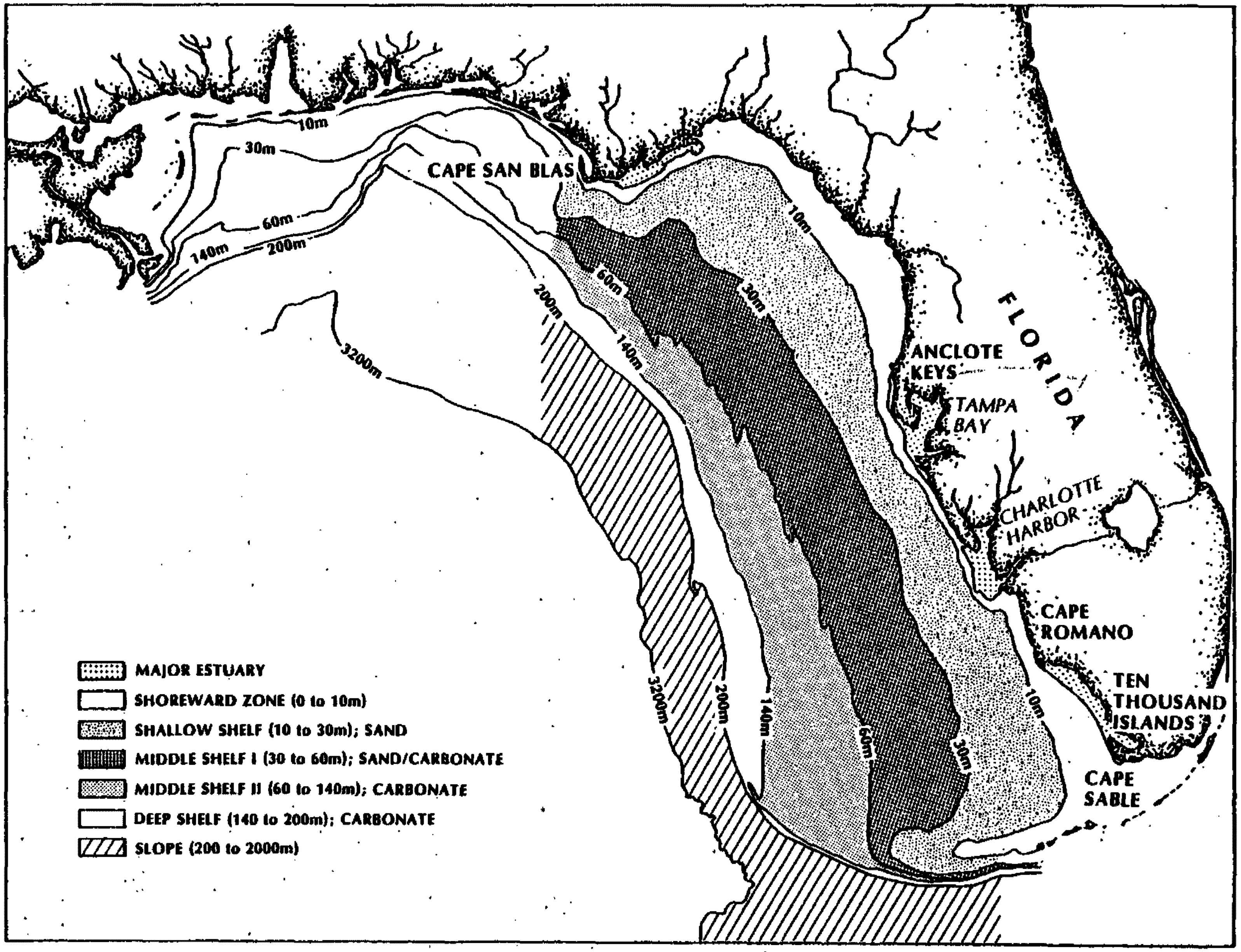

Figure 3-17. Faunal Zones and Associated Sediment Types Along the West Florida Shelf
Source: Lyons and Collard, 1974

limestone rock outcrops, paralleling the shoreline, rise through the sediment layer. The outcrops support a variety of epifaunal organisms, such as solitary corals, algae, pholadids, and polychaetous annelids.

Species abundance and diversity at depths less than 10m is low, a function of the shifting substrata and the inability of many organisms to survive the stress of wave action and temperature fluctuations. Lyons and Collard (1974) reported the region was dominated by temperate molluscs and echinoderms; vegetation was scarce. Joyce and Williams (1969) observed extremely high numbers of sand dollars (Mellitta quinquiesperforata) and sea urchins (Lytechinus variegatus); molluscs (Atrina sp. and Busycon sp.), hydroids, and a few sponges were also present. The occasional rock outcrops support communities of hard corals, bryozoans, tubeworms, and calcareous algae (Gould and Steward, 1956). Phillips and Springer (1960) also reported varying numbers of molluscs (Arca sp. and Spondylus sp.) on the rock outcrops.

Shallow Shelf

Beginning at a depth of 10m, and extending to 30m, the nearshore quartz sand-shell topography is gradually replaced by carbonate sediments. Limestone outcrops occur in greater numbers and may rise one or two meters from the bottom, supporting a diverse assemblage of flora and fauna. Joyce and Williams (1969) characterized this region as a typical Gulf patch reef community.

At Shallow-Shelf depths, temperate and tropical species are present due to intrusion of Loop Current water. Associated with rock outcrops are crustaceans, molluscs, scleractinians (hard corals), alcyonarians (soft corals), and other invertebrate species (Lyons and Collard, 1974). Phillips and Springer (1960) reported a wide variety of benthic flora, identifying 186 taxa of plants attached to rock outcrops or epiphytic on other plants. The shallow-water rock outcrops were described by Smith (1976b) as covered with an overlay of scleractinians (Cladocora arbuscula and Solenastrea hyades) and loggerhead sponge (Spheciospongia vesparia), along with the green alga (Caulerpa sp.), and coralline algae (Halimeda sp. and Udotea sp.). Echinoids, tunicates, and sabellid polychaetes also were observed. Numbers of grouper, flatfish, snapper, grunt, and other reef fishes were present, as well as Florida spiny and Spanish lobsters (G. Smith, personal communication*). Reefs and rocky outcrops of this region have been characterized as biologically sensitive areas (G. Smith, personal communication*; BLM, 1978).

Results of the EPA May 1982, survey demonstrated the similarity of Alternative Sites 3 and 4 located in this shallow shelf environment (Cf. Appendix C). The two sites were generally very similar in sediment and polychaete composition. As previously mentioned, however, Alternative Site 3 contains numerous hard bottom areas with attached coralline communities. The polychaetes characteristic of Sites 3 and 4 were primarily species typical of sandy, soft-bottomed habitats. Many of these species, such as Aglaophamus verrilli, Paraprionospio primata, and Owenia fusiformis were widespread across the study area, but reached their highest abundances in the finer-textured samples. The analysis of results revealed a relatively high degree of distinct species-habitat groupings in the shallow-water environment; however, these results must be interpreted within the context of the overall natural variability of the shallow-water benthic community. The communities may vary considerably due to periodic environmental influences such as storms, hurricanes, periods of high freshwater runoff, and temperature changes, which may drastically modify the benthic habitat. The high physical energy associated with high wind and wave activity may drastically alter the nearshore sediment composition. Typically, some areas will be scoured, whereas others will be subject to a high level of deposition of sedimentary materials. These periodic episodes of high bottom currents may drastically change the distribution of sedimentary components in an area, ultimately causing a concomitant change in the associated faunal composition. These periods of high energy also disperse dredged material, restoring the habitat to natural conditions, and allowing the recovery of the previously established communities following the cessation of dumping activities. Thus, analyses of this benthic environment should be regarded as part of a continually ongoing process of ecological change and adaptation.

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* G.Smith, Professor, Indian River College, Fort Pierce, Florida, 1980

Middle Shelves I and II

The area between 30 and 60m (Middle Shelf I) has the highest diversity found off Tampa Bay (Lyons and Collard, 1974). Beyond 60m, to a depth of 140m (Middle Shelf II), diversity and productivity decline. At depths greater than 60m, rock outcrops diminish in size and number, and the bottom is composed primarily of irregularly distributed carbonate sediments ranging from hard, compact sand and silt, to shell rubble with silt (Doyle et al., 1974).

Flora and fauna characteristic of the Middle Shelf I include loggerhead sponges, calcareous algae (Lithothamnion sp.), foraminiferans, alcyonarians, tropical algae, decapod crustaceans (Stenopus hispidus and Penaeus duorarum), and bryozoans (Stegaporella magnilabris and Hippopotralliela marginata) (Joyce and Williams, 1969; Lyons and Collard, 1974; Hopkins, 1974; Smith, 1976b).

In the Middle Shelf II region, biological diversity and abundance drop substantially and fewer rock outcrops are present. Sediments are primarily carbonates, composed of skeletons of coralline algae, bryozoans, and shell rubble. Sponges, corals, and living bryozoans occur, but are scarce, and limited to the few rock outcrops present. Molluscs (Chamys sp.), crustaceans (Munida sp.), echinoderms (Astropecten sp. and Echinaster sp.), and the alga Caulerpa predominate the region (Lyons and Collad, 1974; Hopkins, 1974).

Deep Shelf

In the Deep Shelf area (140 to 200m), biological diversity further decreases. Poor light penetration and a flat carbonate substatum provide minimal habitat for organisms. A number of species of the Middle Shelf II zone occur; however, species composition changes occur at about 140m (Lyons and Collard, 1974).

RARE AND ENDANGERED SPECIES

Six endangered species of whales reportedly occur in the Gulf of Mexico: sei (Balaenoptera borealis), fin (Balaenoptera physalus), blue (Balaenoptera musculus), humpback (Megaptera novaeangliae), right (Eubalaena glacialis), and sperm (Physeter catodon) (January 17, 1979, 44 Federal Register 3636). The Gulf serves as a winter feeding, mating, and calving ground for all species. Most whales remain offshore, beyond the Continental Shelf in deep waters; however, the right whale is primarily coastal, and occasional inshore sitings of other species occur (D. Odell, personal communication*).

A critical habitat has been designated for the West Indian manatee (Trichechus manatus) in and around Tampa Bay. Its range is normally restricted to inland waterways near coastal inlets in depths of 1 to 3m of water, but manatees have also been observed in shallow coastal waters, traveling along shallow-water rock outcrops (BLM, 1978).

Five endangered and threatened species of turtles migrate from the Caribbean to nest along the Gulf coast of Florida: hawksbill (Eretmochelys imbricata), loggerhead (Caretta caretta), green (Chelonia mydas), Atlantic ridley (Lepidochelys kempii), and leatherback (Dermochelys coriacea). The turtles range from Cedar Keys south to the Dry Tortugas as well as in open Gulf waters; however, they are usually found in shallow waters, less than 15m. They commonly occur near shallow reefs and in lagoons and nest on sandy beaches.

Twelve endangered species of birds occur in the eastern Gulf of Mexico and Florida; however, only one, the brown pelican (Pelecanus occidentalis), can be found offshore. Brown pelicans nest along several coastal sites in west central Florida, and feed primarily on fish captured in nearshore waters.

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*D. Odell, Professor, University of Miami, Miami, Florida, 1980

PRESENT AND POTENTIAL ACTIVITIES IN THE VICINITY OF THE SITE

FISHERIES (Recreational and Commercial)

Sites A and B and the Shallow-Water Alternative Sites are offshore of Pinellas, Manatee, and Hillsborough Counties. Pinellas County has the second-, third-, and sixth-largest commercial, party, and charter boat fleets, respectively, in the State of Florida. Hillsborough and Manatee Counties have moderate fishing activity in comparison to Pinellas County (Moe, 1963). In 1978, the recreational and commercial landings in these counties totaled over $9.4 million, or 16% of the total Florida west coast landings. Shrimp, red and black grouper, and red snapper are the major species of economic importance (NMFS, 1978).

Commercial finfishing in the immediate vicinity of Sites A and B and Shallow-Water Alternative Sites is limited, with most occurring further offshore. However, Sites A and B are in the vicinity of areas utilized for recreational fishing by charter, party, and private boat operators (Figure 3-18). A number of rock outcrops, artificial reefs, and designated fish havens are located approximately three nmi north of Site B. Species commonly taken in this area by recreational fishermen (Table 3-10) include grouper, mackerel, redfish, red snapper, grunt, bluefish, and spotted seatrout (Moe, 1963).

Commercial fishing in the offshore waters of west central Florida is limited, totaling less than 3,500 tons in 1978 (NMFS, 1979). This catch is limited to a few species, the most important of which are grouper, scamp, black mullet, and red snapper. The offshore commercial shellfish industry harvests pink and rock shrimp, stone crab, lobster, and calico scallop.

The level of commercial finfishing is relatively constant year-round, except for Manatee County, which has seasonal peaks of activity during April-May and October-November. Party and charter boat fisheries have some degree of activity

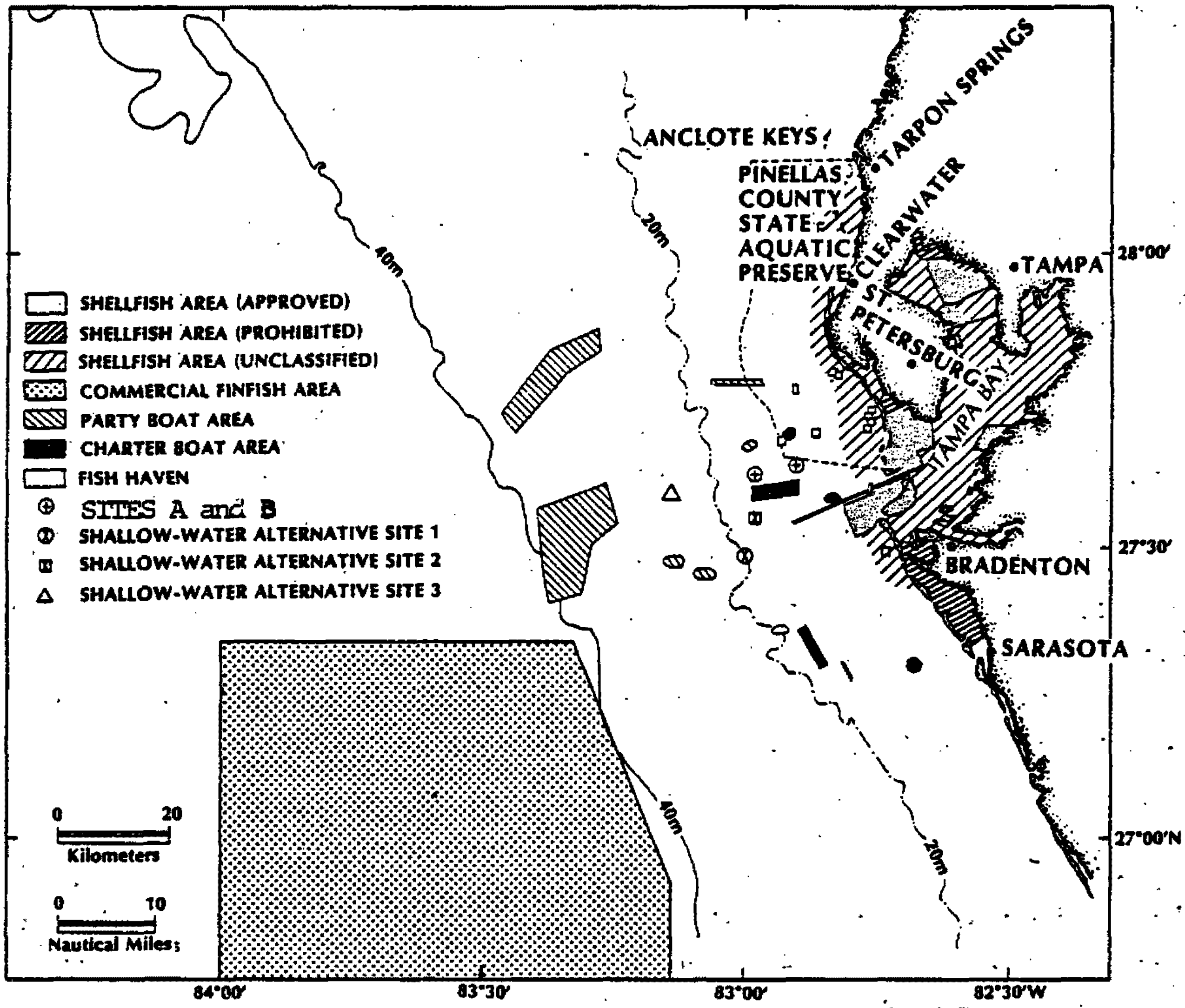

Figure 3-18. Fishery Areas in Tampa Bay and Adjacent Waters
Source: MOE, 1963, FDNR Shellfish Harvesting Atlas

year-round. However, the peak seasons for party boats are January-March and June-July; for charter boats, the peak occurs during March-May and October-November.

Shellfish comprised 59% of all commercial species taken off Hillsborough, Manatee, and Pinellas Counties, representing 66% of the catch value. Pink and rock shrimp comprised 97% of the total shellfish tonnage (2,066 tons), and represented 96% of the commercial value. However, some of the landings in the Tampa-St. Petersburg area were reported taken from waters outside the immediate area.* Calico scallops (Argopecten gibbus) and stone crabs (Menippe mercenaria) were the second and third most important shellfish species taken offshore of the tri-county area. Large commercial catches of pink shrimp have infrequently been recorded offshore of Egmont Key. These catches occur during April-July, when larger shrimp migrate offshore from Tampa Bay.

* Florida Department of Natural Resources, Personal communication, 1982.

TABLE 3-10
IMPORTANT FISHES OF THE OFFSHORE FISHERY OF COASTAL COUNTIES

County	Status of Fish	Type of Vessel		
		Commercial	Party	Charter
Manatee	Most abundant fishes in the catch	Red grouper Red snapper Black grouper	Black grouper Red grouper Red snapper	King mackerel Red grouper Bluefish
	Most preferred fishes	Red snapper Yelloweye snapper Black grouper	Black grouper Red grouper Red snapper	King mackerel Black grouper Red grouper
Hillsborough	Most abundant fishes in the catch	Red grouper Red snapper Black grouper		
	Most preferred fishes	Red snapper Black grouper Red grouper		
Pinellas	Most abundant fishes in the catch	Red grouper Black grouper Red snapper	Red grouper Black grouper Grunts	Spanish mackerel King mackerel Black grouper
	Most preferred fishes	Red snapper Black grouper Red grouper	Black grouper Red grouper Grunts	King mackerel Spanish mackerel Black grouper

Small squid and sponge fisheries exist in the area; however, neither are as economically important as the shrimp fisheries.

A sardine fishery is presently in a developmental stage. In the past, this species has not been commercially fished due to poor demand. However, increased commercial value of sardines is promoting a widening interest among fishermen of this region.

MARINE RECREATION

The Florida marine environment provides recreational opportunities for residents and visitors, producing revenue for local business and the State. Sportfishing, swimming, sailing, pleasure boating, beachcombing, and diving are important recreational activities (Table 3-11). In 1975, approximately $115 million was spent in the State on activities associated with marine recreation (i.e., tackle, boating fees, fuel, and services), more than any other state on the Gulf or East Coasts (NMFS, 1977).

However, as noted earlier in Chapter 2 of this FEIS, a recent Corps study examined the minimal use of Shallow-Water Alternative Site 4 by recreational fishermen and divers. On only one occasion over twelve successive weeks between mid-March and June 1983, was a vessel seen in Site 4. On June 1, 1983, a single dive boat was noted within the site. On no weekend days during the surveillance period were any vessels seen within Site 4.

TABLE 3-11
RECREATIONAL ACTIVITIES OF THE FLORIDA MARINE ENVIRONMENT
(thousands)

Activity	Households	Participants
Swimming	1,388	4,026
Beachcombing	981	2,760
Finfishing	954	2,101
Pleasure boating	711	1,847
Shellfishing	419	989
Sailing	295	598
Diving	263	462

Source: NMFS, 1977

In 1975, 98 million pounds of finfish were caught by recreational fishermen on the west coast of Florida (NMFS, 1975); the most abundant was the spotted seatrout (*Cynoscion nebulosus*), which totalled 6.4 million pounds. Approximately 27 million pounds of shellfish were collected during 1975 by recreational fishermen (NMFS, 1975).

Numerous public and private beaches occupy the coast of western Florida. Fort De Soto County Park, located on Mullet Key, is the recreational beach nearest Sites A and B. The park provides year-round recreation for an estimated 1.5 million people (W. Grabowski, personal communication*).

The State of Florida also has established an aquatic preserve, encompassing the length of Pinellas County, extending from the shoreline to the 3-mile limit. Site B is southwest of the preserve, Site A is westsouthwest of the preserve, and Shallow-Water Alternative Site 4 is approximately 15 nmi southwest of the preserve. Egmont and Passage Keys, located at least 18 nmi east of Site 4, are designated by the U.S. Fish and Wildlife Service as wildlife refuges.

SHIPPING

The Port of Tampa Bay is vital to the economy of both Florida and the United States. Based on tonnage, the Port of Tampa ranks fourth in the nation in export goods, and in overall tonnage is the eighth-largest port in the United States (Corps, 1974).

In 1979, the Port of Tampa had an import tonnage of over 49 million tons, valued at $490 million, and an export tonnage of 19 million tons, valued at over $1.2 billion. Major commodities include the export of phosphate rock (representing in excess of 97% of all export goods), citrus fruits and seafood, and the import of sulphur, petroleum products, and foreign trucks.

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*W. Grabowski, Park Director, Fort De Soto Park, Pinellas County, Florida, 1980

OIL AND GAS EXPLORATION AND DEVELOPMENT

The nearest active oil and gas leases, part of the Bureau of Land Management (BLM) Outer Continental Shelf (OCS) Oil and Gas Lease Sale No. 65, are approximately 55 nmi to the southwest of Sites A and B, and 50 nmi southwest of Shallow-Water Alternative Site 4 (Figure 3-1). The nearest proposed leases (BLM, 1980), OCS Nos. A66 and 66, are approximately 40 nmi south of Shallow-Water Alternative Site 1, and 46 nmi south of Sites A and B (Figure 3-19). The distance of these sites to the oil and gas lease sites eliminate any problem of interference of dredged material disposal operations with drilling or production operations.

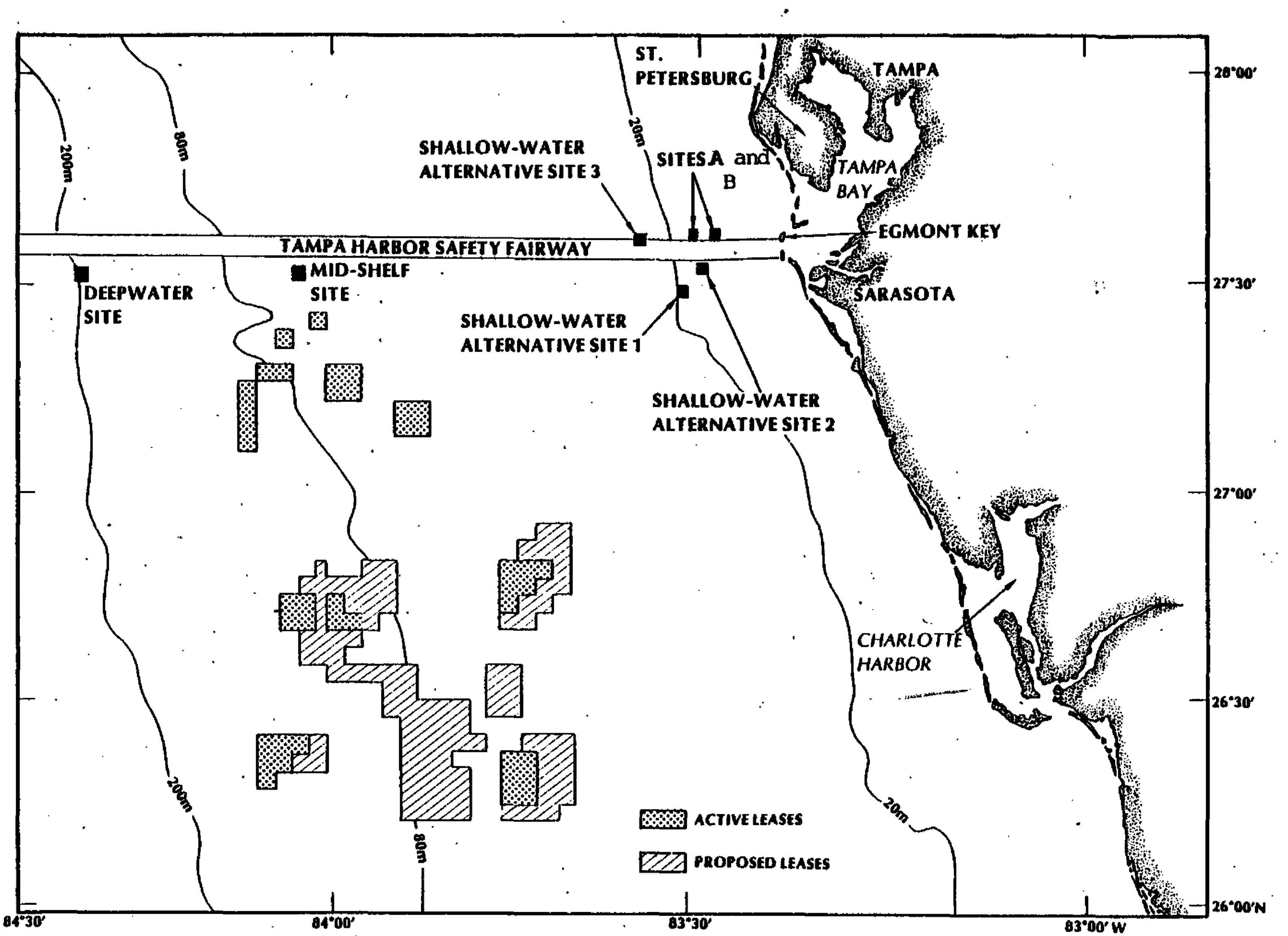

Figure 3-19. Central West Florida Outer Continental Shelf Oil Lease Tract Areas and Tampa Harbor Safety Fairway

Chapter 4

ENVIRONMENTAL CONSEQUENCES

Possible adverse effects on hard bottom communities resulting from burial may occur when dredged material disposal is performed. This impact would be mitigated by disposal at Shallow-Water Alternative Site 4. Recent surveys of this Site have confirmed that fewer hard bottom areas occur within and in the vicinity of Shallow-Water Alternative Site 4 than in any of the other Shallow-Water Alternative Sites examined. Water quality impacts are expected to be absolutely minimal at Shallow-Water Alternative Site 4.

DREDGED MATERIAL TRANSPORT

Unavoidable minor and temporary disruptions of harbor and channel traffic will occur as a result of dredging, transportation, and disposal of dredged material. Most inconveniences will be caused by dredging; minor inconveniences may be caused by transportation of the dredged material through Tampa Bay.

Transportation costs of hauling dredged materials from the bay to a disposal site is directly affected by location. Transport of dredged material to Sites A and B has cost approximately $5/yd^3 ($10,000/vessel load, assuming the use of a 2,000 yd^3 hopper dredge). (A recent letter from the Corps indicates that 2,800 to 3,200 yd^3 barges may be used in the remaining phases of the Tampa Harbor Project. Cf. Letter from Major General John F. Wall, Director of Civil Works, U.S. Army, on August 19, 1983, to Jonathan E. Amson, Office of Water Regulations and Standards, EPA). Additional expenses for fuel, labor, and equipment rental are directly related to the distance between the dredging and disposal sites, and time involved in dredged material disposal. The Corps estimates the costs for additional transport distances beyond Sites A and B will average $0.15/yd^3/nmi. Cost estimates for hopper dredge transport of dredged material to several sites are presented in Table 4-1. Based on this cost comparison, the added expense per vessel load of dredged material precludes the use of a mid-Shelf or deepwater disposal site alternative; the additional transport distance required to use Shallow-Water Alternative Site 4 has the smallest economic impact on disposal operations. (Cf. Letters from Col. Alfred B. Devereaux, Jr., District Engineer for the Corps' Jacksonville District, on April 29, 1983, to Ms. Patricia M. Glass, Vice Chairman of the Manatee County Board of County Commissioners, and on May 13, 1983, to Edward W. Chance, Chairman of the same Board).

TABLE 4-1

COMPARATIVE TRANSPORTATION COSTS*

	Distance From Tampa Bay (nmi)	Additional Transport Distance (nmi)	Costs Per Round Trip Vessel Load+ (dollars)
Site B	9	-	0
Site A	13	-	0
Shallow-Water Alternative Site 4	18	5	1,470
Mid-Shelf Site	70	57	17,100
Deepwater Site	104	91	27,300

*Based on Corps cost figures

+Estimated costs are those required in addition to the present $10,000/vessel load to Sites A and B; costs based on a 2,000 yd^3 barge. A recent letter from the Corps indicates that 2,800 to 3,200 yd^3 barges may be used in the remaining phases of the Tampa Harbor Project. Cf. p. 4-1.

EFFECTS ON PUBLIC HEALTH AND SAFETY

Ensuring that public health and safety are not adversely affected by ocean disposal of dredged materials is EPA's primary concern. Health hazards may arise if the material has the potential for toxic bioaccumulation in organisms, and there is a possibility that these organisms could be consumed by the public. Navigational safety hazards may arise from potential shoaling of the material, and from the movement of disposal vessels to and from the ODMDS.

Potential impacts on human health can be inferred from bioassay and bioaccumulation tests performed on marine animals. The results of these tests performed on Tampa Bay dredged materials (considered later in this Chapter) do not indicate any potential human health hazards.

Navigational safety is not expected to be adversely affected by disposal operations. Although there is a risk of collision when any vessel is underway, the degree of probability is negligible, due to the relatively few transits by disposal vessels.

Navigational hazards as a result of shoaling of dredged material is considered minimal. At shallow water, high-energy sites, dredged material accumulates only temporarily in mounds (Bastian, 1975). Any potential navigational hazards at Site 4 are expected to be substantially less than at Site A due to the increased area and depth of Site 4.

EFFECTS ON THE ECOSYSTEM

The effects of ocean disposal of dredged material on the ecosystem may cause public concern. Some effects, such as burial of benthic organisms and habitats, are immediately apparent; others, such as bioaccumulation of sediment-bound contaminants, may be subtle and difficult to assess. Short-term effects on biological communities can be difficult to differentiate from natural fluxes in diversity and community composition. Long-term adverse effects can be the most difficult to assess, because the effects may be indirect or cumulative.

The degree of effect on the ecosystem depends on a number of factors: sediment characteristics of the dredged material, the degree of similarity between dredged material and sediments at the disposal site, the amount of material to be disposed, the frequency of disposal, chemical characteristics of the dredged material, nutrients associated with dredged material, and turbidity associated with disposal.

The following discussion of effects on the ecosystem is divided into two sections: (1) effects on water and sediment quality, and (2) effects on the biota. This division facilitates comparison between effects on the physical environment, which in turn, directly and indirectly affects the biota.

WATER AND SEDIMENT QUALITY

Oceanic dredged material disposal may affect a number of environmental parameters. This type of disposal has been observed and studied at a variety of locations and depths. Studies at other disposal sites allows comparisons to be drawn, and predictions made, concerning the expected behavior of dredged material when disposed at the site designated in this EIS.

The following discussion addresses potential effects of disposal on turbidity, nutrients, dissolved oxygen, trace metals, and organic compounds, based on analyses of sediments from the Tampa Harbor Main Channel and from Sites A and B (Table 4-2), and analyses of elutriate tests on sediment samples from the Tampa Harbor Main Channel and St. Petersburg Harbor (Table 4-3).

TURBIDITY

The method of dredging and the amount of water contained in dredged sediments will influence the behavior of materials after release. Tampa Harbor sediments are primarily fine sand with silt and clay fractions, whereas channel sediments are medium to coarse sand overlain with fine sand and silt (Corps, 1974). Because of the similar depths at Sites A and B and Shallow-Water Alternative Sites (10 to 27m), it is anticipated there will be little difference in the behavior of dredged material during disposal.

The disposal characteristics of dredged material after release into the water has been described by Bokuniewicz et al. (1978) as occurring in three phases:

(1) Descent as a well-defined jet of high-density fluid that may contain solid blocks of material, with ambient water entrained;

(2) Impact with the bottom; and

(3) Formation of surge: a horizontally-spreading bottom movement that radiates from the center of impact until driving forces are sufficiently reduced to allow deposition to occur.

TABLE 4-2
RESULTS OF SEDIMENT ANALYSIS
(ppm)

	Main Channel* Sediments	Site A,B † Sediments	Average Value
TOC	-	530 to 4,420	147.8
Ammonia-N	100 to 620	-	
Nitrate-N	0 to 1	-	
Nitrite-N	-	-	
Organic Nitrogen	190 to 330	-	
Oil and Grease	-	120 to 2,940	788.0
Ortho Phosphate	-	-	
Total Phosphate	340 to 3,700	-	
Arsenic	2 to 5	-	
Beryllium	-	-	
Cadmium	1 to 2	0.002 to 0.09	0.03
Copper	3 to 4	-	
Chromium	4 to 7	-	
Iron	870 to 3,900	-	
Lead	25 to 52	<0.003 to 0.50	0.13
Mercury	0.06 to 0.25	<0.00009 to 0.01	0.00
Nickel	7 to 14	-	
Selenium	0 to 18	-	
Silver	-	-	
Zinc	6 to 10	-	
Vanadium	-	-	
Petroleum Hydrocarbons	-	-	

- Not analyzed

* Corps, 1974 (average values not reported)

† EPA/IEC, 1979 and 1980 (determined by weak acid leach discussed in Appendix A)

TABLE 4-3
RESULTS OF CHEMICAL ANALYSIS OF THE LIQUID-PHASE ELUTRIATE TESTS OF SEDIMENTS FROM OLD TAMPA BAY AND ST. PETERSBURG HARBOR
(mg/liter [ppm])

	TB	Control	SP	Control
Ammonia-N	7.7	0.04	5.53	0.20
Nitrite-N	<0.10	<0.01	0.07	0.04
Nitrate-N	0.01	0.01	0.06	0.24
Organic Nitrogen	2.2	0.10	1.47	<0.20
Ortho Phosphate	9.6	0.03	4.03	0.46
Total Phosphorus	10.8	0.15	4.27	0.80
Cadmium	<0.001	<0.001	0.06	0.066
Lead	<0.01	<0.01	0.31	0.34
Mercury	0.0003	<0.0001	0.0011	0.0006
Total Organic (Carbon)	9.0	5.0	8.33	4.0
Petroleum Hydrocarbons	None detected	None detected	19.6	21.0
Oil and Grease	<0.2	<0.2	Not Reported	<0.2

TB = Tampa Bay
SP = St. Petersburg Harbor (values equal average of three samples)
Source: Jones, Edmunds and Associates (1979, 1980)

The rate of descent and amount of residual turbidity is determined by particle size, concentration, moisture content, and cohesiveness of the dredged material. The clods will fall at varying rates, depending on their size (Table 4-4), and will form the leading edge of a downward-flowing jet which contains the loose silt and clay. The jet will entrain considerable amounts of water and become less dense. Fine sand, which represents most of the material to be dredged, (Cf. Appendix C of DEIS), descends slowly at a rate of 1.8 cm/s (Graf, 1971). Silts and clays in suspension may remain in the water column for up to several days (depending on the degree of flocculation), and during this period the fine-grained sediments will be spread out thinly over the surrounding seafloor.

TABLE 4-4
SETTLING VELOCITIES FOR SAND AND ROCK PARTICLES

	Particle Diameter (mm)	Settling Velocity (cm/s)	Sites A and B	Shallow-Water Alternative Site 1	Shallow-Water Alternative Site 2	Shallow-Water Alternative Site 3
Fine gravel	11.2	45.0	33	29	44	60
	8.0	40.0	38	33	50	68
	5.66	35.0	43	37	57	77
Coarse sand	4.00	31.0	48	42	55	87
	2.83	25.0	60	52	80	108
	2.00	20.0	75	65	100	135
	1.41	16.0	94	82	125	169
Medium sand	1.00	13.0	115	100	154	208
	0.71	10.0	150	130	200	270
	0.51	7.0	214	186	286	386
	0.31	3.0	500	433	666	900
Fine sand	0.25	3.0	500	433	666	900
	0.18	1.8	833	722	1,111	1,500

Note: Velocity = time to settle to bottom (seconds)

Sources: Adapted from Chave and Miller, 1977; Tetra Tech, 1977

As discussed above, most of the dredged material sinks as a jet, but some of it will remain suspended and cause temporary turbidity. Calculations of the initial mixing zone at Sites A and B and the Shallow Water Alternative Sites during a 10m thermocline condition indicate a dilution factor of 1:3,668 for suspended particulate matter (SPM). Dilution and dispersion will reduce suspended particulate levels to nearby ambient levels relatively quickly, over several hours. Natural SPM levels measured in local bottom waters range from 0.5 to 2.9 mg/liter (Table A-3).

A bottom turbidity plume caused by dredged material and indigenous sediment results from impact of the disposed material on the seafloor. The seafloor at Shallow-Water Alternative Site 4 is in large part sand; thus, indigenous material should redeposit rapidly in the local area (Table 4-4). The finer-grained dredged materials, however, will remain in suspension longer, and will be dispersed over a somewhat wider area of seafloor.

Short-term turbidity may affect biotal respiratory surfaces by clogging gills, interfering with feeding activity of coral polyps and zooplankton, reducing photosynthetic activity by decreasing light penetration, promoting flocculation of phytoplankton, and increasing sorption of essential nutrients or toxic contaminants (Table 4-5) (Stern and Stickel, 1978; Pequegnat et al., 1978). The environmental consequences of increased turbidity are related to concentration and the type of organisms present in the affected environment. Because of the potential sensitivity of hard bottom communities to siltation and sedimentation, these areas should be exposed to lesser amounts of disposal activity, where possible.

NUTRIENT RELEASE

Greater concentrations of nutrients are usually present in sediment than in the overlying water. Mechanical disturbance, such as disposal of dredged material, releases some of these nutrients (Table 4-3). The primary dissolved nutrients in sediment interstitial water are NO_2^{-1}, NO_3^{-1}, NH_3^{+4}, and PO_4^{-3}; the concentrations of these radicals are related to the decomposition of organic matter (Pequegnat et al., 1978).

The release of nutrients, especially ammonia, from disposed dredged material can stimulate growth of marine plants, and in heavy concentrations, can be toxic (ibid.). In most sediments, ammonia is stable under anoxic conditions below 2 cm, and can accumulate in interstitial water to high levels. Phosphorus (generally found as PO_4^{-3} and organic phosphates) is commonly associated with domestic wastewater, but may be found when organically rich sediments decompose. In Tampa Bay, the elevated phosphorus levels may be caused by discharges from the phosphate industry. Since red tides occur periodically in the vicinity of Tampa Bay, the increased nutrient availability to phytoplankton may be of concern. The occurrence of undesirable effects, however, are dependent on the concentrations of constituents released, oxygen levels, mixing characteristics, and diluting capacities of receiving waters (ibid.).

TABLE 4-5
SHORT-TERM EFFECTS OF DREDGED
MATERIAL DISPOSAL AT NEARSHORE ALTERNATIVE SITES

Effect (Turbidity)	Sites A and B and Shallow-Water Alternative Sites
1. Reduce light penetration	Can be important to phytoplankton and phytobenthos Can have effects on hard-bottom areas
2. Flocculate phytoplankton	Can be important in estuaries and above thermocline in neritic waters
3. Decrease availability of food	May be important; dilution of food particles with useless material
4. Drive mobile organisms out of the environment	Temporary effect
5. Affect respiratory surfaces	Can be important
6. Sorption of toxic materials	Can be important to filter feeders

Source: Adapted from Pequegnat et al. (1978)

Released nutrients are affected by a number of physical and chemical processes (the most important of which is dilution), reducing levels of released nutrients immediately. Soluble phosphorus is reduced by re-adsorption on oxidized iron and manganese present in seawater. Ammonia is unstable in oxygenated waters and is rapidly oxidized to nitrates by nitrifying bacteria. In addition, high ammonia levels will be lowered to ambient levels rapidly by dilution, and will cause no adverse effects. Therefore, any nutrients released are not anticipated to enhance the potential for causing red tides.

OXYGEN DEMAND

Chemical And Biological Oxygen Demand Levels

Particulate matter with potentially high oxygen demand is generally present in dredged material, and is released into the water on disposal. Reduced inorganic matter, including sulfur compounds, iron, and manganese, which is readily oxidized by free oxygen in the water, imposes a chemical oxygen demand (COD) on the aquatic ecosystem. Those organic substances which are oxidized by bacteria in the presence of oxygen also impose biochemical oxygen demand (BOD) on the ecosystem.

Schubel *et al.* (1978) showed that the effect that oxygen-demanding material has on the water column is a function of the length of time the material resides in the water, and the amount of water available for dilution. Only a small fraction of the oxidizable components in dredged material are reactive before the majority of the discharged particulate matter settles to the bottom. Reduced elements present in interstitial water appear to be the most reactive, and are the only components which place a rapid oxygen demand on the water column. The oxidizable particulates simply settle on the seafloor before imposing any oxygen demand (*ibid.*). The study concluded that the apparent oxygen demand of fine-grained estuarine sediments removed by pipeline dredge, with water contents of 80% (such as the material dredged from Tampa Harbor) is approximately 0.4 mg O_2/g of sediment dredged.

POTENTIALLY TOXIC TRACE ELEMENTS

Oxidation Reduction Control Mechanisms

The term "trace elements" refers to a group of elements which includes arsenic, beryllium, cadmium, copper, chromium, iron, lead, manganese, mercury, nickel, selenium, and zinc, among others. Natural processes in aquatic ecosystems tend to concentrate trace elements in bottom sediments, and a number of these are toxic to marine organisms at elevated levels (Stoker and Seager, 1976). A general concern about dredged material disposal is that trace elements contained in disposed sediments may subsequently deteriorate water quality, and adversely affect marine organisms.

Estuarine sediments such as harbor-dredged materials tend to be depleted of oxygen (anoxic) below 2 cm in depth, resulting in an oxygen-reduced environment. Microbial action in reduced environments encourages formation of sulfides, ammonia, and reduced forms of iron and manganese. Sulfides of trace elements are stable in such reduced environments (Burkes and Engler, 1978); however, when noncohesive sediments are disposed of into oxygenated water, these sulfides oxidize. Oxidized metals, with the exception of iron and manganese, are more soluble than their reduced forms, creating possible sources of contamination. However, such releases are offset by co-precipitation with oxides of iron and manganese and re-absorption onto sediment particles.

DMRP Results

DMRP studies indicate that there may be limited releases of trace elements during ocean disposal. Investigation of sediments show that manganese is the only trace metal consistently released during ocean disposal (Brannon, 1978); other trace elements occasionally released in small quantities include mercury, lead, cadmium, nickel, iron, and manganese. However, iron and manganese both oxidize rapidly, and scavenge other metallic ions from solution (Jenne, 1978; Burks and Engler, 1978).

Elutriate Test Results

Liquid-phase elutriate test results from recent Tampa Bay dredging projects indicate that disposed sediments will release only small quantitites of certain metals (Jones, Edmunds, and Associates, 1979 and 1980). Sediments tested from St. Petersburg Harbor showed only arsenic, mercury, and vanadium liquid-phase samples elevated above control levels. In all of the elevated samples, the greatest increase occurred in one test for arsenic, in which the element was elevated by a factor of seven; two other arsenic values were elevated only by factors of two and three. All other sample values were at or below control values. Elutriate samples from Tampa Harbor upper-main channel showed only mercury above control levels, and this only by a factor of three. Again all other metals tested (12) were measured at or below control values. Based on these findings, and considering the large dilution factor involved (1:3,668), sediments disposed at any designated ODMDS should have no significant effect on receiving water quality.

ORGANIC COMPOUNDS

Organic matter passing through the water column during disposal operations will settle on the bottom, where it will be subject to bacterial decomposition. Changes in the redox potential of the sediment will occur as oxygen is depleted by metabolization of organics by bacteria (Pequegnat et al., 1978). Anoxic conditions could result; however, Pequegnat et al. (1978) stated this should not be a problem unless there is very frequent disposal and/or high organic loads in the disposed sediments.

Of more concern are the synthetic organic compounds produced by man. Organic substances such as petroleum hydrocarbons and chlorinated hydrocarbons are frequent contaminants in marine environments. Potential effects of these compounds after ocean disposal are unknown. However, it is known that these compounds are relatively insoluble in water, and will tend to be absorbed by particulate matter, or absorbed by aquatic organisms (Burks and Engler, 1978; Stoker and Seager, 1976). Due to their low solubility in water, these compounds tend to concentrate in sediments, especially in estuaries and harbors where sedimentation rates are generally high. The contaminant sources derive from municipal and industrial wastes, urban and agricultural runoffs, and accidental and chronic spillages. Once deposited in sediments, these compounds are relatively stable.

Results of elutriate tests indicate that petroleum hudrocarbons are present in Tampa Bay, and are released and bioaccumulated in low concentrations (Tables 4-3 and 4-6). Bioaccumulation tests using these sediments showed that petroleum hydrocarbons were not detected in tissues of the clam Mercenaria mercenaria taken from the St. Petersburg boat slip area, but were detected at low levels (<1.0 ug/g) in sediments from the channel area (Table 4-6). Bioaccumulation tests to determine PCB uptake showed that uptake levels were lowest from sediments midway up Tampa Bay Channel (<0.01 ug/g), and highest at the mouth of the bay and upper channel (<0.01 to 0.04 ug/g (Table 4-6)). PCB uptake tests were not performed for St. Petersburg Harbor sediments.

BIOLOGICAL EFFECTS

Direct effects of disposal operations on the biota include damage from sediment clumps impacting the bottom, as well as burial. The response of an organism may range from no visible effect, to a stress response, to death, depending on the extent of the disposal operation and the characteristics of the dredged material. A stress reaction or death may have as great an environmental consequence on the associated benthic community as on the organism in question, because organisms are closely associated through an often complex web of feeding relationships. A simplified food web with potential adverse impacts from dredged material disposal is presented in Figure 4-1. Assessment of adverse impacts is often difficult to interpret because effects may not be evident until higher trophic levels are affected.

TABLE 4-6
CHEMICAL ANALYSES FROM BIOACCUMULATION TESTS*
(ppm [μg/g])

Petroleum Hydrocarbons

Replicate	Control	SP1	SP2	SP3
1	ND	ND	ND	ND
2	ND	ND	ND	ND
3	ND	ND	ND	ND
4	ND	ND	ND	ND
5	ND	ND	ND	ND

Petroleum Hydrocarbons

Replicate	Control	TB1	TB2	TB3
1	<1.0	<1.0	<1.0	<1.0
2	<1.0	<1.0	<1.0	<1.0
3	<1.0	<1.0	<1.0	<1.0
4	<1.0	<1.0	<1.0	<1.0
5	<1.0	<1.0	<1.0	<1.0

Polychlorinated Biphenals†

Replicate	Control	TB1	TB2	TB3
1	0.04	0.04	<0.01	0.10
2	<0.01	0.02	<0.01	0.03
3	<0.01	0.03	<0.01	<0.01
4	0.03	0.03	<0.01	<0.01
5	<0.01	<0.01	<0.01	0.04
$\bar{x}$ =	0.02	0.026	0.01	0.038
CSS =	0.0008	0.00052	-	0.00548
s^2 =	0.0002	0.00013	-	0.00137

† Variances were heterogeneous; therefore, the approximate test of equality of means given by Sokal and Rohlf was used.

F = 0.571 (Not significant)
$F_{.05(2,7)}$ = 4.74

* Test species _Mercenaria mercenaria_ (clam)
ND = None detected
SP = St. Petersburg Harbor
TB = Tampa Bay Main Channel

Source: Jones, Edmunds, and Associates (1979 and 1980)

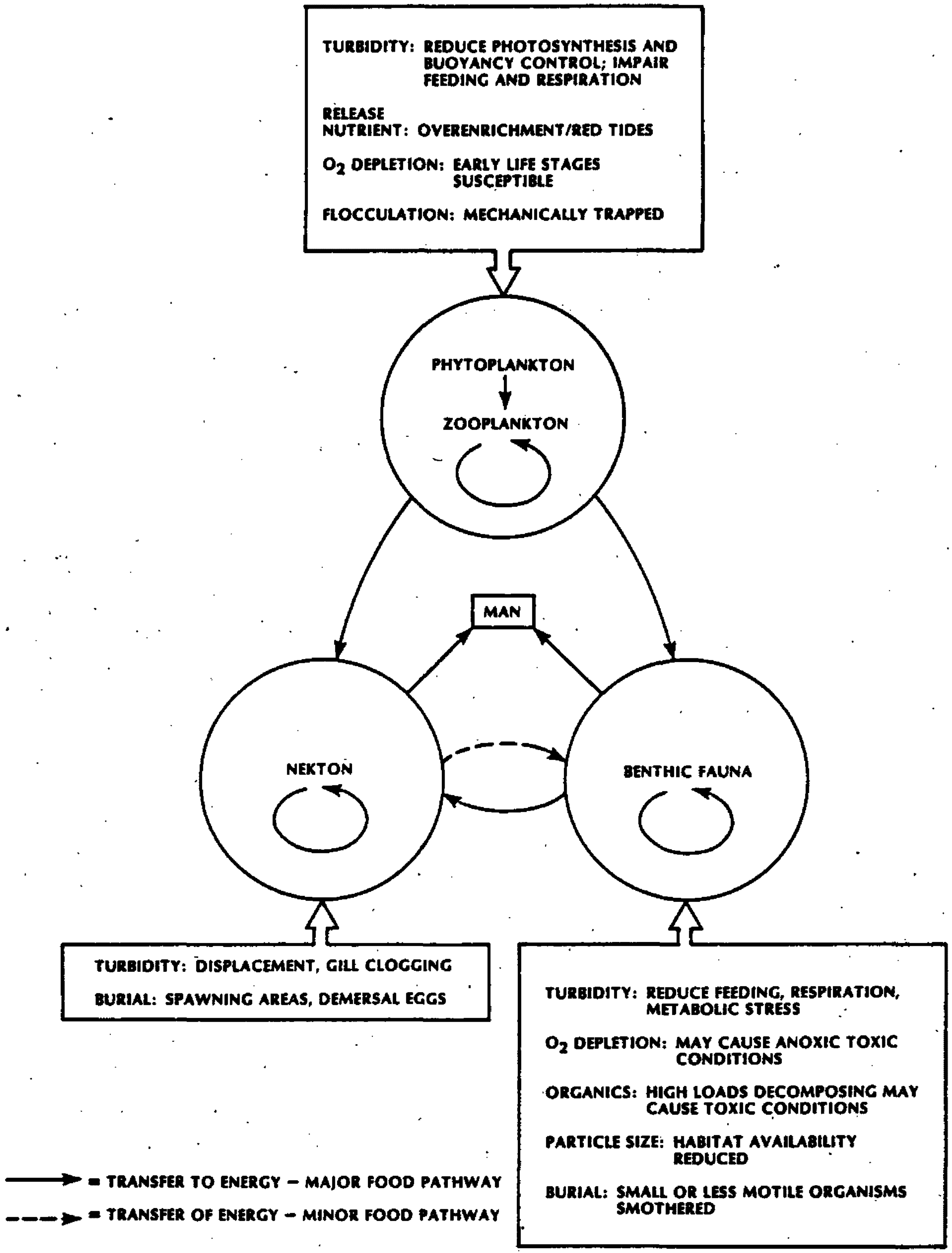

Figure 4-1. Major Food Pathways of Marine Organisms (with potential impacts from dredged material disposal, not including degradation and nutrient input process)

PLANKTON

Direct adverse effects on plankton populations from disposal operations arise primarily from turbidity effects. The turbidity caused by disposal of dredged material at Shallow-Water Alternative Site 4 will have minor short-term adverse environmental effects on plankton communities, including: (1) mortality due to mechanical or abrasive properties (impairing feeding and respiration), (2) possible reduction of photosynthetic activity by interference with light penetration, and (3) entrainment in falling dredged material, and transport to the bottom.

The effects of dredged material disposal have been synthesized in several DMRP reports (Hirsch et al., 1978; Stern and Stickle, 1978; Wright, 1978). These studies have concluded that effects on open ocean planktonic populations will be highly localized and transitory, and adverse impacts may be mitigated by stimulated growth from nutrient inputs. Other studies indicate that long-term impacts on primary productivity from disposal of dredged material are highly unlikely (Taylor and Saloman, 1968; Wright, 1978; Hirsch et al., 1978). Factors contributing to the low potential impact at open ocean sites include dilution, mixing, low levels of contaminants in dredged material, and the patchy and motile nature of planktonic populations (Sullivan and Hancock, 1977).

Impact on plankton communities at Shallow-Water Alternative Site 4 is expected to be very limited and of quite short duration. The volume of ocean in which plankton might be adversely affected can be estimated by considering the volume of initial mixing. During summer, with a thermocline at 10 meters, Shallow-Water Alternative Site 4 would have an initial mixing zone volume of 2.3×10^6 m^3. During nonstratified periods, the initial mixing zone volume would be 4.7×10^6 m^3 for Shallow-Water Alternative Site 4. Thus, the initial mixing zone volume would be over twice as large as the middle summer months for the majority of the year.

Bioassays on grass shrimp larvae revealed no significant mortality from suspended particulates (at 100% elutriate sample concentration) from Tampa Bay channel locations, and two of three boat slip sites in St. Petersburg Harbor (see Elutriate Test Results, previous section). Dredged material from any future channel improvement or maintenance projects is predicted to be similar to channel sediments previously tested by bioassay. Based on findings from other studies and bioassay results, effects on plankton are expected to be very localized, transitory, and insignificant.

NEKTON

Results from the DMRP indicate that the nekton community is the least sentitive to dredged material disposal because of their mobility (Wright, 1978; Pequegnat et al., 1978). Dredged material disposal in the vicinity of a nekton community may result in three responses: (1) avoidance of the area by sensitive species due to residual turbidity; (2) changes in the benthic community due to burial; and (3) damage to spawning grounds which may reduce population size, or cause shifts in local species dominance. At Shallow-Water Alternative Site 4, these factors are anticipated to have little effect on the nekton community. Although commercial fisheries are economically important and are known to exist in the vicinity of Tampa Bay, no regularly active fishing sites have been identified at or in the vicinity of Shallow-Water Alternative Site 4. In contrast, rock outcrops near Sites A and B serve as habitats supporting sport and commercial fishing activities.

BENTHOS

Direct effects on benthic populations from dredged material disposal arise primarily from burial and resultant smothering. Other effects may be turbidity, high organic sediment loads, oxygen depletion, changes in sediment particle size, and habitat alteration. Effects are generally greatest on benthic fauna, because of their limited mobility and the time required to restore the area to predisposal conditions (Pequegnat et al., 1978; Wright 1978).

Turbidity may adversely affect benthic organisms through changes in feeding habits, photosynthesis, and respiration. Sublethal responses may include increased mucus production, pseudofecal production, reduced feeding response, and increased respiration rates, all of which cause increased metabolic stress (Pequegnat _et al._, 1978). The degree of impact will depend on concentration of suspended particulates, their duration in the water column, and the type of organisms present (_e.g._, sessile filter feeders are more affected than burrowing deposit feeders).

Adverse turbidity effects could be relatively high at Sites A and B because of the scattered presence of hard bottom flora and fauna in the areas surrounding the site. Impacts should be substantially less severe at Shallow-Water Alternative Site 4 because very few hard bottom areas occur either within or surrounding the site.

If a nepheloid layer is present at Sites A and B or the Shallow-Water Alternative Sites (which is the case at the more northerly Mississippi, Alabama, Florida Outer Continental Shelf study area used by the Department of Interior; SUSIO, 1974), the fine particulates from the dredged material may contribute to this layer. Although it is not known what type of effect this may have at Shallow-Water Alternative Site 4, it is anticipated that suspended sediments introduced by dredged material disposal will be indistinguishable from naturally occurring suspended material.

Changes in benthic species abundance and composition have been documented for ocean dredged material disposal areas. Changes in community structure increase with increased disparity between site sediments and dredged material (Pequegnat _et al._, 1978). The dynamics of the receiving environment are also an important consideration; the more naturally variable the environment, the less effect dredged material disposal will have (Hirsch _et al._, 1978). This occurs because organisms living in high energy environments are normally extremely adaptable to natural fluctuations.

Recolonization of dredged material disposal sites depends on a number of factors, including the characteristics of the receiving environment, composition of the dredged material, the disparity between site and dredged sediments, and the indigenous fauna (Hirsch et al., 1978).

In a four-year study, Oliver et al. (1977) monitored recovery of benthic fauna following dredged material disposal. The general pattern of recovery consisted of an initial recolonization by larvae of opportunistic polychaetes (e.g., Capitella capitata), and immigration of mobile crustaceans (cumaceans and certain amphipods). This was followed by a gradual recolonization by the predisturbance fauna. The fauna of shallow high energy environments recovered quickly, within 7 to 12 months.

Based on the data presented above, the impact of dredged material disposal is expected to be much less at Shallow-Water Alternative Site 4 than at Sites A and B because of the very limited extent of hard bottoms. Adverse effects should also be substantially lower at Shallow-Water Alternative Site 4 than Sites A and B because of reduced commercial and recreational uses of the area.

FISHERIES

Short-term avoidance of locally higher turbidity is predicted to be the only significant environmental effect on fisheries.

THREATENED AND ENDANGERED SPECIES

All Federal agencies are required to carry out programs for conservation of threatened or endangered species, and to ensure that actions "...authorized, funded, or carried out by them do not jeopardize the continued existence of such endangered...and threatened species, or result in the destruction or modification of habitat of such species..." (16 USC §1536[a]).

TABLE 4-7

SUMMARY OF SHORT-TERM EFFECTS ON

DISPOSAL SITES OF DREDGED MATERIAL DISPOSAL

Effect	Result
1. Smother benthic organisms	Can be important because of the high proportion of epibenthic species
2. Reduce spawning areas	May be important
3. Reduce phytobenthos cover	Locally important
4. Change in grain size distribution	May reduce diversity

Source: Pequegnat et al., 1978

Endangered species reported from the Gulf of Mexico (discussed in Chapter 3) include whales, turtles, the manatee, and the brown pelican.

Although whales use the Gulf as feeding, mating, and calving grounds, most are located well offshore, beyond the Continental Shelf. Site use is not expected to interfere in any way with whales, considering their substantial range and the limited size of the disposal site.

Sea turtle populations occur on the west coast of Florida, frequenting shallow patch reefs, rock ledges, and estuarine lagoons; the turtles also nest on beaches. Alternative Shallow-Water Site 4 is in waters with very limited patch reefs. No significant impacts on turtles are anticipated from the use of Shallow-Water Alternative Site 4 for dredged material disposal.

The feeding range of the brown pelican extends over all of the West Florida Shelf in the Tampa area. However, any site used should not in any way significantly affect the feeding activities of the pelican, because of the infrequent nature of dumping activities, and because Alternative Site 4 is extremely small in relation to the total feeding area available.

EFFECTS ON RECREATION, ECONOMICS, AND AESTHETICS

RECREATION

The nearshore areas of Tampa Bay are used for sport diving and fishing. Rock outcrops and several artificial reefs occur offshore, and most recreational diving and fishing activities take place in these nearshore areas.

Several designated fish havens and rock outcrops are located near Sites A and B. Moe (1963) reported a charter boat fishing area close to Sites A and B (Figure 3-11). Potential adverse effects on recreational activities in the area of Sites A and B are expected to be greater than at Alternative Site 4, because of the relative density of rock outcrops in the vicinity of Sites A and B.

Recreational fishing and diving activities are not known to occur at Shallow-Water Alternative Site 4 other than on a very occasional basis. This site is characterized by very low relief sandy bottoms. A recent study by the Corps corroborates the minimal use of Shallow-Water Alternative Site 4 by recreational fishermen and divers. On twelve successive weekends as well as occasionaly during the week between mid-March and early-June 1983, the area of Site 4 was overflown by aircraft, which noted any vessels that were seen within the area. On only one occasion was a vessel seen in Site 4; on June 1, 1983, a single dive boat was seen anchored within the area of the site. On no weekend days during the surveillance period were any vessels seen within the boundaries of Site 4. Determination of the boundaries of Site 4 was aided by the presence of an anchored float at the center of Site 4, which was emplaced there at the beginning of the surveillance period. Although party boat or commercial fishing or recreational diving may occur in the general vicinity of Shallow-Water Alternative Site 4, no interference with these activities is anticipated in any way.

ECONOMICS

Commercial finfishing activities exist seaward of Sites A and B and the Shallow-Water Alternative Sites; therefore, there would be no direct interference by disposal operations. Approved shellfishing areas occur close to shore (Figure 3-18), thereby mitigating interference to these areas during disposal operations.

Small charter and party boat operations may frequent areas around the Alternative Site 4, although usually not within the actual site. Disposal of dredged materials in the ocean will create a localized turbid plume during, and immediately after, disposal operations, which may cause displacement of nekton. However, the turbid plume is short-lived, and direct interference with these fishing operations will be minimal and transitory.

AESTHETICS

Disposal of dredged material will result in a localized turbid plume that will reduce water clarity at the site. Because Alternative Site 4 is located approximately 18 nmi offshore, adverse impacts on visual aesthetics from shore will be non-existent.

POTENTIAL UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS AND MITIGATING MEASURES

Potential unavoidable adverse effects from dredged material disposal that may occur at Shallow-Water Alternative Site 4 include:

- Localized turbid plumes, which will temporarily lower water quality.

- Probable displacement of fish during, or immediately following, disposal operations.

- Smothering of non-motile or less motile benthic biota by burial under dredged material.

- Change in sediment composition, which may alter abundance, diversity, or community structure.

The effects described above would occur at any ODMDS. Most of these effects, however, are of short duration and have a limited effect, due to the rapid dilution of the material after release. Other impacts pose little environmental consequence because of the limited size of the site. Changes in community structure are lessened by the great degree of environmental variability in the high energy, shallow-water area. Based on all data and information available, Shallow-Water Alternative Site 4 possesses the attributes necessary to minimize adverse effects associated with ocean dredged material disposal in the Tampa Bay region.

RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

Tampa Bay is an important harbor for commercial shipping and fishing activities. The continued use of the harbor is essential for the economic viability of the region. Maintenance dredging of the harbor is necessary to keep the harbor open.

The offshore areas of Tampa Bay are diverse, ranging from flat sand to patch reef habitats. Hard bottom habitat can be sensitive to burial and siltation associated with dredged material disposal. Therefore, the relationship between short-term use and long-term productivity can be considerably improved by locating a designated ODMDS in an area with the fewest hard bottom areas. This has been done with the designation of Alternative Shallow-Water Site 4, which has been demonstrated to have a minimum of significant hard bottom areas, and by far the least amount of hard bottom of any area studied in the vicinity of Tampa Bay.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

Resources committed upon implementation of the proposed action include:

- Loss of the dredged material for use as landfill or beach nourishment material.

- Loss of energy in the form of fuel required to transport barges to and from the disposal site. Transport to more distant sites requires more fuel than to nearshore sites.

- Loss of economic resources due to the high costs of ocean disposal at sites far from land. Ocean disposal costs, however, may be lower than alternative land-based disposal costs, resulting in a net economic gain.

- Loss of constituents, such as trace metals in the dredged material, because existing technology is not adequate for efficient recovery.

- Loss of biota smothered by dredged material during disposal operations.

- Loss of habitat.

Chapter 5

COORDINATION

Preparers of the Final EIS

This Final EIS was issued by the Environmental Protection Agency's Ocean Dumping EIS Task Force. The document was based on the Draft EIS issued in November 1982 by the EIS Task Force. Revisions using data supplied by EPA's October 1981, May 1982, and February, March, and April 1983, surveys were prepared by Jonathan E. Amson and Joseph N. Hall. Mr. Amson received his B.S. in Biochemistry from St. Lawrence University, and his M.S. from New York University's Osborn Laboratories of Marine Science, specializing in marine physiology of chondrichthyean and teleost vertebrates. Mr. Hall received his B.S. in Biology from Southwestern Missouri State University, and his M.S. from Southeastern Massachusetts University, specializing in marine microbiology and water quality.

Reviews of the Draft EIS were also provided by:

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U.S. Environmental Protection Agency
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EPA Headquarters
- Office of Research and Development
- Office of General Counsel
- Office of Federal Activities

Chapter 6

GLOSSARY, ABBREVIATIONS, AND REFERENCES

GLOSSARY

ABUNDANCE	The number of individuals of a species inhabiting a given area. Normally, a community of several component species will inhabit an area. Measuring the abundance of each species is one way of estimating the comparative importance of each component species.
ADSORB	To adhere in an extremely thin layer of molecules to the surface of a solid or liquid.
ALKALINITY	The number of milliequivalents of hydrogen ions neutralized by one liter of seawater at 20°C. Alkalinity of water is often taken as an indicator of its carbonate, bicarbonate, and hydroxide content.
AMBIENT	Pertaining to the undisturbed or unaffected conditions of an environment.
AMPHIPODA	An order of crustaceans (primarily marine) with laterally compressed bodies, which generally appear similar to shrimp. The order consists primarily of three groups: hyperiideans, which inhabit open ocean areas; gammarideans, which are primarily bottom dwellers; and caprellideans, common fouling organisms.
ANTHROPOGENIC	Relating to the effects or impacts of man on nature. Construction wastes, garbage, and sewage sludge are examples of anthropogenic materials.
APPROPRIATE SENSITIVE BENTHIC MARINE ORGANISMS	Pertaining to bioassay samples required for ocean dumping permits, "at least one species each representing filter-feeding, deposit-feeding, and burrowing species chosen from among the most sensitive species accepted by EPA as being reliable test organisms to determine the anticipated impact on the site" (40 CFR §227.27).
APPROPRIATE SENSITIVE MARINE ORGANISMS	Pertaining to bioassay samples required for ocean dumping permits, "at least one species each representative of phytoplankton or zooplankton, crustacean or mollusk, and fish species chosen from among the most sensitive species documented in the scientific literature or accepted by EPA as being reliable test organisms to determine the anticipated impact of the wastes on the ecosystem at the disposal site" (40 CFR §227.27).
ASSEMBLAGE	A group of organisms sharing a common habitat.

BACKGROUND LEVEL	The naturally occurring concentration of a substance within an environment which has not been affected by unnatural additions of that substance.
BASELINE CONDITIONS	The characteristics of an environment before the onset of an action which can alter that environment; any data serving as a basis for measurement of other data.
BASELINE SURVEYS AND BASELINE DATA	Surveys and data collected prior to the initiation of actions which may alter an existing environment.
BENTHOS	All marine organisms (plant or animal) living on or in the bottom of the sea.
BIOACCUMULATION	The uptake and assimilation of materials (e.g., heavy metals) leading to elevated concentrations of the substances within organic tissue, blood, or body fluid.
BIOASSAY	A method for determining the toxicity of a substance by the effect of varying concentrations on growth or survival of suitable plants, animals or micro-organisms; the concentration which is lethal to 50% of the test organisms or causes a defined effect in 50% of the test organisms, often expressed in terms of lethal concentration (LC_{50}) or effective concentration (EC_{50}), respectively.
BIOMASS	The quantity (wet weight) of living organisms inhabiting a given area or volume at any time; often used as a means of measuring the productivity of an ecosystem.
BIOGENIC	Produced by living organisms.
BIOTA	Animals and plants inhabiting a given region.
BIOTIC GROUPS	Assemblages of organisms which are ecologically, structurally, or taxonomically similar.
BLOOM	A relatively high concentration of phytoplankton in a body of water resulting from rapid proliferation during a time of favorable growing conditions generated by nutrient and sunlight availability.
BOD	<u>B</u>iochemical <u>O</u>xygen <u>D</u>emand or <u>B</u>iological <u>O</u>xygen <u>D</u>emand; the amount of dissolved oxygen required by aerobic micro-organisms to degrade organic matter in a sample of water usually held in the dark at 20°C for 5 days; used to assess the potential rate of substrate degradation and oxygen utilization in aquatic ecosystems.
BOREAL	Pertaining to the northern geographic regions.

CEPHALOPODS	Exclusively marine animals constituting the most highly evolved class of the phylum Mollusca (e.g., squid, octopus, and Nautilus).
CETACEANS	Large marine mammals represented as whales and porpoises.
CHAETOGNATHA	A phylum of small planktonic, transparent, wormlike invertebrates known as arrow-worms; they are often used as water-mass tracers.
CHLORINITY	The quantity of chlorine equivalent to the quantity of halogens contained in 1 kg of seawater; may be used to determine seawater salinity and density.
CHLOROPHYLL a	A specific chlorophyll pigment characteristic of higher plants and algae; frequently used as a measure of phytoplankton biomass.
CHLOROPHYLLS	A group of oil-soluble, green plant pigments which function as photoreceptors of light energy for photosynthesis and primary productivity.
COELENTERATA	A large diverse phylum of primarily marine animals, members possessing two cell layers and an incomplete digestive system, the opening of which is usually surrounded by tentacles. This group includes hydroids, jellyfish, corals and anemones.
COLIFORMS	Bacteria residing in the colons of mammals; generally used as indicators of fecal pollution.
CONTINENTAL RISE	A gentle slope with a generally smooth surface between the Continental Slope and the deep ocean floor.
CONTINENTAL SHELF	That part of the Continental Margin adjacent to a continent extending from the low water line to a depth, generally 200m, where the Continental Shelf and the Continental Slope join.
CONTINENTAL SLOPE	That part of the Continental Margin consisting of the declivity from the edge of the Continental Shelf down to the Continental Rise.
CONTOUR LINE	A line on a chart connecting points of equal elevation above or below a reference plane, usually mean sea level.
CONTROLLING DEPTH	The least depth in the approach or channel to an area, such as a port, governing the maximal draft of vessels which can enter.
COPEPODS	A large diverse group of small planktonic crustaceans representing an important link in oceanic food chains.

CRUSTACEA	A class of arthropods consisting of animals with jointed appendages and segmented exoskeletons composed of chitin. This class includes barnacles, crabs, shrimps and lobsters.
CURRENT DROGUE	A surficial current measuring assembly consisting of a weighted current cross, underwater sail or parachute and an attached surface buoy; it moves with the current so that average current velocity and direction can be obtained.
CURRENT METER	An instrument for measuring the speed of a current, and often the direction of flow.
DECAPODA	The largest order of crustaceans; members have five sets of locomotor appendages, each joined to a segment of the thorax; includes crabs, lobsters, and shrimps.
DEMERSAL	Living at or near the bottom of the sea.
DENSITY	The mass per unit volume of a substance, usually expressed in grams per cubic centimeter (1g water in reference to a volume of 1 cc @ 4°C).
DETRITIVORES	Animals which feed on detritus; also called deposit-feeders.
DETRITUS	Product of decomposition or disintegration; dead organisms and fecal material.
DIATOMS	Microscopic phytoplankton characterized by a cell wall of overlapping silica plates. Sediment and water column populations vary widely in response to changes in environmental conditions.
DIFFUSION	Transfer of material (e.g., salt) or a property (e.g., temperature) under the influence of a concentration gradient; the net movement is from an area of higher concentration to an area of lower concentration.
DINOFLAGELLATES	A large diverse group of flagellated phytoplankton with or without a rigid outer shell, some of which feed on particulate matter. Some members of this group are responsible for toxic red-tides.
DISCHARGE PLUME	The region of water affected by a discharge of waste which can be distinguished from the surrounding water.
DISPERSION	The dissemination of discharged matter over large areas by natural processes (e.g., currents).
DISSOLVED OXYGEN	The quantity of oxygen (expressed in mg/liter, ml/liter or parts per million) dissolved in a unit volume of water. Dissolved oxygen (DO) is a key parameter in the assessment of water quality.

DIVERSITY (species) — A statistical measurement which generally combines the measure of the total number of species in a given environment and the number of individuals of each species. Species diversity is high when it is difficult to predict the species or the importance of a randomly chosen individual organism, and low when an accurate prediction can be made.

DOMINANT SPECIES — A species or group of species which, because of their abundance, size, or control of the energy flow, strongly affect a community.

EBB CURRENT, EBB TIDE — Tidal current moving away from land or down a tidal stream.

ECHINODERMS — Exclusively marine animals which are distinguished by radial symmetry, internal skeletons of calcareous plates, and water-vascular systems which serve the needs of locomotion, respiration, nutrition, or perception; includes starfishes, sea urchins, sea cucumbers and sand dollars.

ECONOMIC RESOURCE ZONE — The oceanic area within 200 nmi from shore in which the adjacent coastal state possesses exclusive rights to the living and non-living marine resources.

ECOSYSTEM — The organisms in a community together with their physical and chemical environments.

EDDY — A circular mass of water within a larger water mass which is usually formed where currents pass obstructions, either between two adjacent currents flowing counter to each other, or along the edge of a permanent current. An eddy has a certain integrity and life history, circulating and drawing energy from a flow of larger scale.

ENDEMIC — Restricted or peculiar to a locality or region.

ENTRAIN — To draw in and transport by the flow of a fluid.

EPIFAUNA — Animals which live on or near the bottom of the sea.

EPIPELAGIC — Of, or pertaining to, that portion of the oceanic zone into which enough light penetrates to allow photosynthesis; generally extends from the surface to about 200m.

ESTUARY — A semienclosed coastal body of water which has a free connection to the sea, commonly the lower end of a river, and within which the mixing of saline and fresh water occurs.

FAUNA — The animal life of any location, region, or period.

FINFISH	Term used to distinguish "normal" fish (e.g., with fins and capable of swimming) from shellfish, usually in reference to the commercially important species.
FLOCCULATION	The process of aggregating a number of small, suspended particles into larger masses.
FLOOD TIDE, FLOOD CURRENT	Tidal current moving toward land, or up a tidal stream.
FLORA	The plant life of any location, region, or period.
GASTROPODS	Molluscs which possess a distinct head (generally with eyes and tentacles), a broad, flat foot, and usually a spiral shell (e.g., snails).
GYRE	A closed circulation system, usually larger than an eddy.
HERBIVORES	Animals which feed chiefly on plants.
HOPPER DREDGE	A self-propelled vessel with capabilities to dredge, store, transport, and dispose of dredged materials.
HYDROGRAPHY	That science which deals with the measurement of the physical features of waters and their marginal land areas, with special reference to the factors which affect safe navigation, and the publication of such information in a form suitable for use by navigators.
ICHTHYOPLANKTON	That portion of the planktonic mass composed of fish eggs and weakly motile fish larvae.
INDICATOR SPECIES	An organism so strictly associated with particular environmental conditions that its presence is indicative of the existence of such conditions.
INDIGENOUS	Having originated in, being produced, growing, or living naturally in a particular region or environment; native.
INFAUNA	Aquatic animals which live in the bottom sediment.
INITIAL MIXING	Dispersion or diffusion of liquid, suspended particulate, and solid phases of a waste material which occurs within 4 hours after dumping.
IN SITU	[Latin] In the original or natural setting (in the environment).
INTERIM DISPOSAL SITES	Ocean disposal sites tentatively approved for use by the EPA.
INVERTEBRATES	Animals lacking a backbone or internal skeleton.

ISOBATH	A line on a chart connecting points of equal depth below mean sea level.
ISOTHERMAL	Approximate equality of temperature throughout a geographical area.
KARST	A type of topography formed over limestone, dolomite, or gypsum, caused by dissolution, and characterized by closed depressions or sinkholes, caves, and underground drainage.
LARVA	A young and immature form of an organism which must usually undergo one or more form and size changes before assuming characteristic features of the adult.
LITTORAL	Of or pertaining to the seashore, especially the regions between tide lines.
LONGSHORE CURRENT	A current which flows in a direction parallel to a coastline.
LORAN-C	Long Range Aid to Navigation, type C; low-frequency radio navigation system having a range of approximately 1,500 mi radius.
MAIN SHIP CHANNEL	The designated shipping corridor leading into a harbor.
MAINTENANCE DREDGING	Periodic dredging of a waterway, necessary for continued use of the waterway.
MESOPELAGIC	Pertaining to depths of 200m to 1,000m below the ocean surface.
MICRONUTRIENTS	Microelements, trace elements, or substances required in minute amounts; essential for normal growth and development of an organism.
MIXED LAYER	The upper layer of the ocean which is well mixed by wind and wave activity.
MOLLUSCA	A phylum of unsegmented animals most of which possess a calcareous shell; includes snails, mussels, clams, and oysters.
MONITORING	As used herein, observation of environmental effects of disposal operations through biological and chemical data collection and analyses.
NEKTON	Free swimming aquatic animals which move independently of water currents.
NEMATODA	A phylum of free-living and parasitic unsegmented worms; found in a wide variety of habitats.

NERITIC	Pertaining to the region of shallow water adjoining the seacoast, and extending from the low-tide mark to a depth of about 200m.
NEUSTON	Organisms which are associated with the upper 5 to 20 cm of water; mainly composed of copepods and ichthyoplankton.
NUISANCE SPECIES	Organisms of no commercial value, which, because of predation or competition, may be harmful to commercially important organisms.
OMNIVOROUS	Pertaining to animals which feed on animal and plant matter.
ORGANOHALOGEN PESTICIDES	Pesticides whose chemical constitution includes the elements carbon and hydrogen, plus a common element of the halogen family: bromine, chlorine, fluorine, or iodine.
ORTHOPHOSPHATE	One of the salts of orthophosphoric acid; an essential nutrient for plant growth.
OXIDE	A binary chemical compound in which oxygen is combined with another element, metal, nonmetal, gas, or radical.
PARAMETER	Values or physical properties which describe the characteristics or behavior of a set of variables.
PATHOGEN	An entity producing or capable of producing disease.
PCB(s)	Polychlorinated biphenyl(s); any of several chlorinated compounds having various industrial applications. PCB's are highly toxic pollutants which tend to accumulate in the environment.
PELAGIC	Pertaining to water of the open ocean beyond the Continental Shelf and above the abyssal zone.
PERTURBATION	A disturbance of a natural or regular system; any departures from an assumed steady state of a system.
pH	The acidity or alkalinity of a solution, determined by the negative logarithm to the base 10 of the hydrogen ion concentration (in gram-atoms per liter), ranging from 0 to 14 (lower than 7 is acid, higher than 7 is alkaline).
PHOTIC ZONE	The layer of a body of water that receives sufficient sunlight for photosynthesis.
PHYTOPLANKTON	Minute passively floating plant life in a body of water; the base of the food chain in the sea.

PLANKTON	The passively floating or weakly swimming, usually minute animal and plant life in a body of water.
PLUME	A patch of turbid water, caused by the suspension of fine particles following a disposal operation.
POLYCHAETA	The largest class of the phylum Annelida (segmented worms); benthic marine worms distinguished by paired, lateral, fleshy appendages provided with bristles (setae) on most segments.
PRECIPITATE	A solid which separates from a solution or suspension by chemical or physical change.
PRIMARY PRODUCTIVITY	The amount of organic matter synthesized by producer organisms (primarily plants) from inorganic substances per unit time and volume of water. Plant respiration may or may not be subtracted (net or gross productivity, respectively).
PROTOZOANS	Mostly microscopic, single-celled animals which constitute one of the largest populations in the ocean. Protozoans play a major role in the recycling of nutrients.
QUALITATIVE	Pertaining to the non-numerical assessment of a parameter.
QUANTITATIVE	Pertaining to the numerical measurement of a parameter.
RECRUITMENT	Addition to a population of organisms by reproduction or immigration of new individuals.
RELEASE ZONE	An area defined by the locus of points 100m from a vessel engaged in dumping activities; will never exceed the total surface area of the dumpsite.
RUNOFF	That portion of precipitation upon land which ultimately reaches streams, rivers, lakes and oceans.
SALINITY	The amount of salts dissolved in water; expressed in parts per thousand ($^{o}/oo$, or ppt).
SHELF WATER	Water which originates in, or can be traced to the Continental Shelf, differentiated by characteristic temperature and salinity.
SHELLFISH	Any invertebrate, usually of commercial importance, having a rigid outer covering, such as a shell or exoskeleton; includes some molluscs and arthropods; term is the counterpart of finfish.
SHIPRIDER	A shipboard observer, assigned by the U.S. Coast Guard to ensure that a waste-laden vessel is dumping in accordance with permit specifications.

SLOPE WATER	Water which orginates from, occurs at, or can be traced to the Continental Slope, differentiated by characteristic temperature and salinity.
SPECIES	A group of morphologically similar organisms capable of interbreeding and producing fertile offspring.
STANDARD ELUTRIATE ANALYSIS	A test used to determine the types and amounts of constituents which can be extracted from a known volume of sediment by mixing with a known volume of water.
STANDING STOCK	The biomass or abundance of living material per unit volume of water, or area of sea-bottom.
SUBSTRATE	The solid material upon which an organism lives, or to which it is attached (e.g., rocks, sand).
SURVEILLANCE	Systematic observation of an area by visual, electronic, photographic, or other means for the purpose of ensuring compliance with applicable laws, regulations, permits, and safety.
SUSPENDED SOLIDS	Finely divided particles of a solid temporarily suspended in a liquid (e.g., soil particles in water).
THERMOCLINE	A vertical temperature gradient in some layer of a body of water, which is appreciably greater than the gradients above or below it; a layer in which such a gradient occurs.
TRACE METAL OR ELEMENT	An element found in the environment in extremely small quantities; usually includes metals constituting 0.1% (1,000 ppm) or less, by weight, in the earth's crust.
TRANSMITTANCE	In defining water clarity, an instrument which can transmit a known quantity of light through a standard distance of water to a collector. The percentage of the beam's energy which reaches the collector is expressed as transmittance.
TREND ASSESSMENT SURVEYS	Surveys conducted over long periods to detect shifts in environmental conditions within a region.
TROPHIC LEVELS	Discrete steps along a food chain in which energy is transferred from the primary producers (plants) to herbivores and finally to carnivores and decomposers.
TURBIDITY	Cloudy or hazy appearance in a naturally clear liquid caused by a suspension of colloidal liquid droplets, fine solids, or small organisms.
VECTOR	A straight or curved line representing both direction and magnitude.

WATER MASS — A body of water, identified by its temperature-salinity values, or chemical composition, consisting of a mixture of two or more water types.

ZOOPLANKTON — Weakly swimming animals whose distribution in the ocean is ultimately determined by current movements.

ABBREVIATIONS

BLM	Bureau of Land Management
C	Carbon
°C	Degrees Centigrade
CE	U.S. Army Corps of Engineers
CFR	Code of Federal Regulations
DA	District Administrator (CE)
DMRP	Dredged Material Research Program
DO	Dissolved Oxygen
DOC	U.S. Department of Commerce
DOC	dissolved organic carbon
DOI	U.S. Department of the Interior
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FDNR	Florida Department of Natural Resources
FWPCA	Federal Water Pollution Control Act
FWPCAA	Federal Water Pollution Control Act Amendments
g	gram(s)
hr	hour(s)
IEC	Interstate Electronics Corporation
IMCO	Inter-Govermmental Maritime Consultative Organization
k	kilogram(s)
kHz	kilohertz
km	kilometer(s)
kn	knot(s)
MAFLA	Mississippi, Alabama, Florida
m	meter(s)
m^2	square meter
mg	milligram(s)
mm	millimeter(s)
MPRSA	Marine Protection, Research, and Sanctuaries Act
N	north
ng	nanogram
NEPA	National Environmental Policy Act

nmi	nautical mile(s)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOO	Naval Oceanographic Office
NTU	Nephelometric turbidity units
NUSC	Naval Underwater Systems Center
OCS	Outer Continental Shelf
ODMDS	Ocean Dredged Material Disposal Site
PL	Public Law
POC	particulate organic carbon
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand ($^{o}/oo$)
$^{o}/oo$	parts per thousand (ppt)
%	percent
RA	Regional Administrator (EPA)
s	second(s)
SPM	suspended particulate matter
T	transmissivity
TOC	total organic carbon
TSS	total suspended solids
µ	micron
µg	microgram(s)
µg-at	microgram atom(s)
µmole	micromole
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
W	west
wt	weight
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)

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