904/R-94-009

EPA

United States Environmental Protection Agency

Region IV

345 Courtland Street

Atlanta, Georgia 30365

FINAL ENVIRONMENTAL IMPACT STATEMENT

for

the Designation of an

Ocean Dredged Material Disposal Site

Located Offshore

Tampa, Florida

September, 1994

904/R-94-009

ENVIRONMENTAL IMPACT STATEMENT FOR THE DESIGNATION OF AN OCEAN DREDGED MATERIAL DISPOSAL SITE LOCATED OFFSHORE TAMPA, FLORIDA

Cooperating Agency

U.S. Army Corps of Engineers

Jacksonville District

Comments or inquiries should be directed to:

W. Bowman Crum, Chief
Coastal Programs Section
U.S. Environmental Protection Agency
Region IV
345 Courtland Street, NE
Atlanta, Georgia, 30365
(404)347-3555

APPROVED BY:

Patrick M Tobin for
John H. Hankinson, Jr.
Regional Administrator

8-29-94
Date

PREFACE

This document was prepared by the U.S. Environmental Protection Agency, Region IV, with assistance from Battelle Memorial Institute. The U.S. Army Corps of Engineers, Jacksonville District, is a cooperating agency in the preparation of this document.

The Jacksonville District is responsible for those parts of the document that address need and alternatives. Region IV is responsible for all other parts of the document. Both agencies share responsibility for the Site Management and Monitoring Plan.

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SUMMARY SHEET

FINAL
ENVIRONMENTAL IMPACT STATEMENT

FOR

THE DESIGNATION OF AN OCEAN DREDGED MATERIAL DISPOSAL SITE LOCATED OFFSHORE TAMPA, FLORIDA

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

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV

1. Type of action.

   (X) Administrative/Regulatory action
   ( ) Legislative action

2. Description of the action.

   The proposed action is the permanent designation of an Ocean Dredged Material Disposal Site (ODMDS) offshore Tampa, Florida to be managed by the U.S. Environmental Protection Agency (EPA), Region IV. The proposed site (Site 4) is square-shaped, covers 4 nmi^2, and its boundary coordinates are as follows:

NW	27°32'27"N,	83°06'02"W
NE	27°32'27"N,	83°03'46"W
SW	27°30'27"N,	83°06'02"W
SE	27°30'27"N,	83°03'46"W

   This site is proposed to receive designation for the disposal of suitable dredged materials resulting from the Tampa Harbor Federal Project and from possible other government or private projects in the greater Tampa Bay area.

   The purpose of the action is to recommend an environmentally acceptable ocean location for the disposal of dredged materials that comply with the environmental impact criteria of the Ocean Dumping Regulations (40 CFR Parts 220-229). Ultimately, this process is intended to result in the final designation of an acceptable ODMDS.

3. Environmental effects of the proposed action.

Adverse environmental effects of the proposed action may include (1) mounding, (2) smothering of the benthos, (3) possible habitat alteration of the site, and (4) temporary water quality perturbations. Adverse impacts within the site are unavoidable, but the disposal operations will be regulated to prevent unacceptable adverse impacts outside site boundaries.

4. Alternatives to the proposed action.

The alternatives to the proposed action are (1) no action, which would require the Corps of Engineers (CE) to use an acceptable non-ocean alternative disposal site, not to dredge, or designate their own site under Section 103 of the Marine Protection, Research, and Sanctuaries Act, of 1972 as amended or (2) designate one or more ocean disposal sites other than the one recommended.

5. Federal, State, public, and private organizations from whom comments have been requested.

Federal Agencies and Offices

Advisory Council on Historic Preservation
National Marine Fisheries Service
Council on Environmental Quality
Department of Defense and All Services
Environmental Government Affairs
Federal Highway Administration
Federal Maritime Commission
Federal Power Commission
Gulf of Mexico Fishery Management Council
Honorable Bob Graham (U.S. Senate)
Honorable Connie Mack (U.S. Senate)
Honorable Dan Miller (U.S. House of Representatives)
Honorable Sam Gibbons (U.S. House of Representatives)
Honorable Michael Bilarakis (U.S. House of Representatives)
Honorable C.W. "Bill" Young (U.S. House of Representatives)
Minerals Management Service
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
National Ocean Survey
National Park Service
National Science Foundation
Office of Coastal Zone Management

Pentagon
U.S. Air Force
U.S. Army Corps of Engineers, Jacksonville District
U.S. Army Corps of Engineers, South Atlantic Division
U.S. Coast Guard
U.S. Department of Agriculture - Forest Service
U.S. Bureau of Mines
U.S. Department of Commerce
U.S. Department of Health and Human Services
U.S. Department of Housing and Urban Development
U.S. Department of Transportation
U.S. Department of the Interior
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Food and Drug Administration
U.S. Forest Service
U.S. Geological Survey
U.S. Navy

State and Local Agencies

Agriculture Stabilization and Conservation Service
Apalachee Regional Planning Council
Board of Trustees of the Internal Improvement Trust Fund
Bureau of Marine Research
Charlotte County Conservation Council
City of Clearwater Public Works Engineering
City of St. Petersburg Planning Office
City of St. Petersburg Port Authority
Department of Archives, History, and Records Management
Department of Environmental Resources Management
Department of General Services
Department of Legal Affairs
Department of State
Division of Forestry
Environmental Regulation Commission
Florida Department of Agriculture and Consumer Services
Florida Department of Environmental Regulation
Florida Department of Natural Resources
Florida Department of Transportation
Florida Game and Fresh Water Fish Commission
Florida Historic Preservation Office
Florida House of Representatives
Honorable Lesley J. Miller, Jr. (59th District)
Honorable Mary Figg (60th District)
Honorable Chris Corr (62nd District)
Honorable James T. Hargrett, Jr. (63rd District)
Honorable Helen Gordon Davis (64th District)
Honorable Elvin L. Martinez (65th District)
Honorable John Laurent (66th District)

Florida Inland Navigation District
Florida Marine Fisheries Commission
Florida Senate
  Honorable James Hargrett (21st District)
  Honorable Donald C. Sullivan (22nd District)
  Honorable Malcolm E. Beard (23rd District)
Florida Soil and Water Conservation Council
Florida State UAW-CAP Council
Gulf States Marine Fisheries Commission
Health Program Office
Hillsborough County Commissioners Office
Hillsborough County Environmental Protection Commission
Honorable Lawton Chiles (Governor, State of Florida)
Honorable Sandra W. Freedman (Mayor, City of Tampa)
Honorable Patricia Glass (Manatee County Commissioner)
Manatee County Commission
Manatee County Pollution Control Director
Manatee Port Authority
Miami River Coordinating Committee
North Brevard Environmental Action Committee
Office of Environmental Coordination
Office of Planning and Budgeting
Pinellas County Board of County Commissioners
Pinellas County Environment Management
Polk County Coalition for the Environment
Research Hydrologist - Everglades National Park
Sarasota Board of Commissioners
Secretary of State's Office
South Florida Water Management District
Southwest Florida Regional Planning Council
Southwest Florida Water Management District
State Planning and Development Clearinghouse
State Treasurer's Office
Tampa Bay Regional Planning Council
West Florida Regional Planning Council

Private Organizations

Action
AGC - Florida Westcoast Chapter
Alert Citizens Tri-City Alliance
Apalachee Audubon Society
Citizens Committee 100
Clean Ocean Action
Coalition to Cease Ocean Dumping
Collier County Conservancy, Inc.
Committee on Pollution, City of Boca Raton, Inc.
Conservation Consultants
Continental Shelf Associates
The Council of Clean Air
Environmental Engineering Consultants

Environmental Information Center of the Florida Conservation Foundation, Inc.
Envisions, Inc.
Florida Audubon Society
Florida Bass Chapter
Florida Coalition for Clean Water
Florida Conservation Foundation, Inc.
Florida League of Anglers
Florida Local Environmental Regulation Association
Florida Wildlife Federation
Friends of the Everglades
Gulf Coast Lung Association
Harbor Branch Oceanographic Institution, Inc.
Hillsborough Environmental Coalition
Information
International Women's Fishing Association
Isaak Walton League of America, Inc.
IWLA - Florida Division
Lemon Bay Conservancy
ManaSota - 88
Manatee County Audubon Society
Mote Marine Laboratory
National Audubon Society
National Resources Defense Council
National Wildlife Federation
Nature Conservancy
Oceanic Society
Organized Fishermen of Florida
RACAL Survey, Inc.
Save Our Bays Association, Inc.
Sierra Club - Florida Chapter
Sierra Club - Sarasota Manatee Commission
Sierra Club - Tallahassee Group
Southeastern Fisheries Association, Inc.
Submariners Sports
Survive
Tampa Audubon Society
Tampa Port Authority
Tropical Audubon Society
Ybor City Civitan Club

Universities and Other Sources

D. Odell, University of Miami
Florida Presbyterian College
Florida Sea Grant Extension Program
Florida State University
J. Culter, Mote Marine Laboratory
JRB Associates, Inc. (now Scientific Applications International Corporation)
Manatee Junior College

Miami-Dade Community College
R. Culp, CAIS, University of Georgia
T. Hopkins, University of South Florida
University of Florida
University of Georgia, Center for Applied Isotope Studies
University of Miami - RSMAS
University of South Florida
University of Tampa

6. The Final Environmental Impact Statement (FEIS) has been officially filed with the Office of Federal Activities. EPA, Washington, DC Headquarters Office.

7. Comments on the FEIS are due to EPA, Region IV, by the end of the 30-day review period, on __________. Verification of the review period dates is possible through review of the Friday issues of the Federal Register during the time of the start of the review period for the FEIS Notice of Availability. These dates can also be confirmed by calling EPA, Region IV in Atlanta, Georgia (404/347-1740) or EPA Headquarters in Washington DC (202/ 260-5075).

Comments should be addressed to:

Mr. W. Bowman Crum, Chief
Coastal Programs Section
Environmental Protection Agency
Region IV
345 Courtland Street, NE
Atlanta, GA 30365

SUMMARY

This Environmental Impact Statement (EIS) considers the permanent designation of an Ocean Dredged Material Disposal Site (ODMDS) offshore Tampa, Florida. The purpose of the action is to provide the most environmentally and economically acceptable ocean location for the disposal of material dredged from greater Tampa Bay, Florida.

Based on the need to continue dredging projects in the Tampa Bay area, the U.S. Environmental Protection Agency (EPA) originally designated two ODMDSs offshore Tampa Bay. These sites included Site A, approximately 13 nautical miles (nmi) from Egmont Key, and Site B, 9 nmi 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 vs. Gorsuch, 82-248-T-GC (M.D. FLA. 1982)). By order dated December 21, 1982, the court filed for the plaintiffs and halted all disposal of dredged material at Site A as of December 24, 1982. Between 1982 and 1983, EPA conducted surveys of alternative disposal sites. In 1983, EPA recommended a site (Site 4), located 18 nmi from Egmont Key, for dredged material disposal on an interim basis. During the period of interim designation, additional information was compiled at other potential sites 25 to 35 nmi from shore (i.e., Site 5, including alternative Sites 5A, 5B, and 5MS-C). The suitability of permanent designation of Site 4 and a site within Site 5 is evaluated in this EIS. The Draft EIS was circulated for public comment in June 1993. In the interim, EPA and the Corps of Engineers has been working with the State of Florida to resolve outstanding issues. Unless this action is taken by EPA, an EPA-designated ODMDS will not be available for the disposal of suitable dredged material from the Tampa Bay area.

PURPOSE AND NEED FOR ACTION

An ocean disposal site would provide an ocean alternative that could receive suitable material dredged from greater Tampa Bay. The U.S. Army Corps of Engineers (CE) has determined that operation and maintenance dredging of the Channel System will be necessary to maintain the channel depths and that without dredging, economically important ship traffic would be reduced at the ports of Tampa, Old Tampa, and Hillsborough Bays. The CE has indicated that there is a need for an ocean disposal site to accept material not suitable for beach nourishment and for which there is no other suitable disposal option.

ALTERNATIVES TO THE PROPOSED ACTION

The EPA and the CE are responsible for evaluating the need for and alternatives to ocean dumping according to the Ocean Dumping Regulations (40 CFR 228). The Jacksonville District of the CE has agreed to be a cooperating agency in the preparation of this EIS responsible for the information contained in this EIS regarding the need for and alternatives to ocean disposal. Where the need for ocean dumping has been established, potential sites for the disposal of dredged material are evaluated. The Ocean Dumping Regulations (40 CFR 228.5 and 228.6) specify 5 general and 11 specific criteria that constitute "an environmental assessment of the impact of the use of the site for disposal." These criteria were used to compare Site 4 and the alternative sites within Site 5. General criteria for site selection include:

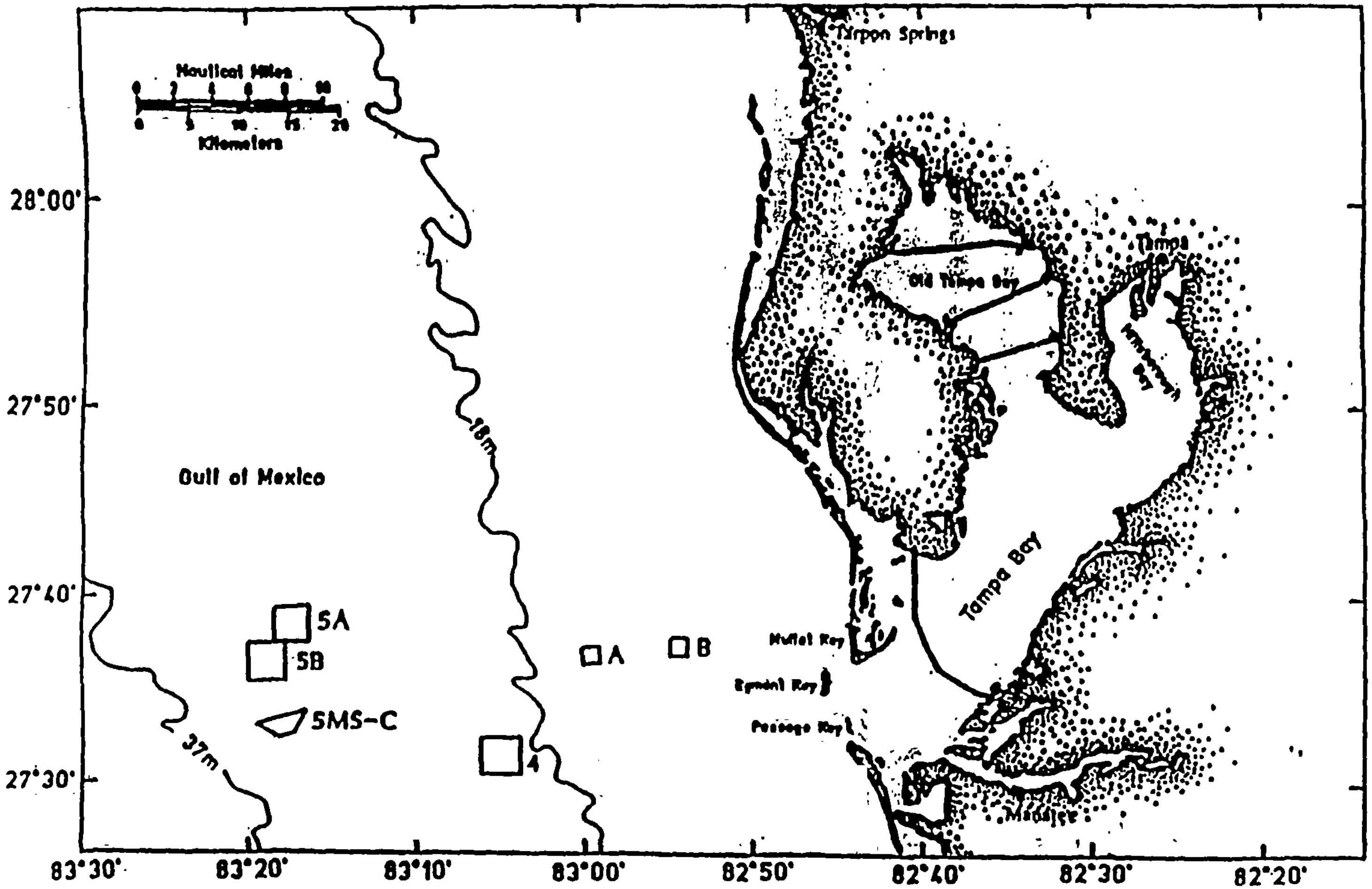
- Potential interferences by disposal operations with other marine activities and resources,
- Potential perturbations of water quality,

- Impacts on beaches and other amenity areas,
- Previous use of an area for dredged material disposal,
- Geographic location.

Two ocean areas seaward of Tampa were evaluated for suitability for final or permanent designation as ocean dredged material disposal sites. The evaluation was conducted on the basis of general and specific criteria of the Ocean Dumping Regulations (40 CFR Part 228) promulgated by the EPA under the authority established by the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972 as amended. The alternative sites evaluated included the interim-designated Site 4 and an offshore site not previously used for ocean disposal, Site 5, which includes alternative Sites 5A, 5B, and 5MS-C. The no-action alternative, namely, not designating a site, was also evaluated.

Site 4 was designated for a period of three years (US EPA, 1983) and was used from May 1984 to November 1985 for disposal of dredged material. Site 4 is 4 nmi^2 in area and 18 nmi from shore. Both pre- and post-disposal surveys have been conducted at Site 4 by Continental Shelf Associates (CSA, 1986a, b, c), the University of Georgia Center for Applied Isotope Studies (CAIS, 1988), and Mote Marine Laboratory (MML, 1988) in cooperation with EPA, Environmental Services Division (ESD). Supplemental surveys on Site 4 and the surrounding areas have been done by EPA, Region IV. The alternative sites within Site 5 are located 30 nmi off Egmont Key. No dredged material disposal has occurred at Site 5.

Nearshore open water Gulf alternative disposal sites are discussed in Appendix A. These nearshore alternatives are also reviewed in project-specific EISs and are regulated under Section 404 of the Clean Water Act.



TAMPA HARBOR ODMDS AND ALTERNATIVE DISPOSAL SITES.

AFFECTED ENVIRONMENT

The west Florida continental shelf extends seaward about 200 km from Tampa Bay to a depth of 200 m. The shelf gradient averages 0.5 m per km. The shoreward zone off Tampa Bay contains sediments composed of quartz sand, with varying amounts of shell (Gould and Stewart, 1956). Hard substratum is often limited to the shells of large molluscs. Sediments at both Sites 4 and 5 (including the three alternative Sites 5A, 5B, and 5MS-C) are characterized as coarse to fine sands with varying but minor amounts of silt and gravel-sized particles (US EPA, 1983).

Phytoplankton assemblages in this area of the eastern Gulf are dominated by diatoms and dinoflagellates. Periodically, uncontrolled blooms of the dinoflagellate _Ptychodiscus brevis_ cause a condition known as red tide. Red tides usually occur in late summer and throughout autumn. Zooplankton population densities and distributions are affected by the Gulf Loop Current.

Scattered limestone rock outcrops occur on the shallow shelf and in deeper water and are inhabited by sponges, corals, bryozoans, tunicates, and a diverse motile fauna of crustaceans, polychaetes, molluscs, echinoderms, and fishes. Fifty-nine species of fishes have been reported offshore of the Tampa Bay (Moe and Martin, 1965; US EPA/IEC, 1981). Commercially important invertebrates off Tampa Bay include the pink shrimp (_Penaeus duorarum_) and the rock shrimp (_Sicyonia brevirostris_).

Benthic algal species are sometimes associated with sandy substrata; however, most species are limited to hard substrata and limestone outcrops.

Recreational diving and fishing are popular activities in central and western Florida. In the Tampa Bay area, the total value of finfish and shellfish landings averages $20 million per year. Five major species of finfish are caught in Tampa Bay:

drum, flounder, mullet, sea trout, and sheepshead.

ENVIRONMENTAL CONSEQUENCES

Site 4 was used from May 1984 to November 1985 for disposal of dredged material. The effects of dredged material disposal at Site 4 have been addressed previously by EPA (US EPA, 1983). Effects of dredged material disposal on the physical, chemical, and biological environment at Site 4 have also been monitored (CSA 1986a, b, c; 1987; CAIS, 1988; MML, 1988; US EPA, 1991).

Effects of dredged material disposal at Site 4 may be limited to increases in suspended sediment concentrations, mounding, and smothering of benthic infauna. Because nearshore waters are characteristically turbid, temporary increases in suspended particulate concentrations due to disposal operations are considered insignificant. No cumulative impacts on the chemical environment have been observed or are anticipated at Site 4.

Monitoring studies at Site 4 did not detect any clear relationships between the presence of dredged material constituents and measured changes in the epifaunal or infaunal communities (CSA, 1987; MML, 1988). Infaunal sampling did not reveal any effects of disposal of dredged material at Site 4 monitoring stations. There was no indication that stations with dredged material in surficial sediments developed an unusual or distinctive infauna. Divers in the disposal area, however, observed that the disposal mound had been colonized heavily by algae (Codium and Gracilaria) and epifauna (hydroids, bryozoans, ascidians, sea urchins, and arrow crabs). A variety of fishes were also observed near dredged material on the seafloor (CSA, 1987). A recent survey by EPA divers showed that boulders on the disposal mound were encrusted by calcareous algae, sponges, ascidians, and tube coral to nearly 100% coverage, creating new habitat (see Appendix F). While the creation of this new habitat was not the intent of past disposal, it represents a resource that EPA will try to protect through appropriate site management.

No dumping has occurred at the alternative sites within Site 5. Therefore, any discussion of effects of dredged material disposal on the environment is speculative. No persistent changes in water quality would be expected; however, disposal of dredged material may alter the existing sediment texture. Adverse impacts of dumping on biota would include smothering of infauna and alterations in the composition of benthic assemblages. Impacts would be expected to be similar to those at Site 4.

ORGANIZATION OF THE EIS

This EIS is organized as follows:

- Chapter 1 specifies the purpose and need for the proposed action, presents the initial background information relevant to the dredging and disposal sites, and discusses the legal framework guiding EPA's selection and designation of disposal sites and the COE's responsibilities in ocean disposal of dredged material.

- Chapter 2 discusses the no-action alternative and the alternative locations for the disposal of dredged material in the ocean, and the non-ocean alternatives.

- Chapter 3 describes the affected environment of the alternative sites.

- Chapter 4 analyzes the environmental consequences of dredged material disposal at the alternative areas by applying the five general criteria in CFR 228.5 and the 11 site-selection criteria contained in 40 CFR 228.6.

- Chapter 5 lists the authors of the EIS.

- Chapter 6 contains a glossary and a list of abbreviations used in the text.

- o Appendix A presents an evaluation of the nearshore disposal alternatives.
- o Appendix B presents a narrative summary of the video surveys conducted by Mote Marine Laboratory and JRB Associates, Inc.
- o Appendix C presents the Site Management and Monitoring Plan.
- o Appendix D presents plates showing the Tampa Bay channels.
- o Appendix E presents a 1993 study of upland disposal sites by the Jacksonville District.
- o Appendix F presents the October 1991 EPA Video Survey Report.
- o Appendix G presents the Coastal Zone Management Act Consistency Determination Statement.
- o Appendix H presents the results of short-term transport and deposition evaluations.
- o Appendix I presents comment letters received for the Draft EIS, and responses to those comments.

CHAPTER 1.0 INTRODUCTION

1.1 PURPOSE AND NEED FOR ACTION

Tampa, Old Tampa, and Hillsborough Bays are among the nation's leading ports in shipping traffic and cargo tonnage (U.S. Environmental Protection Agency (EPA), 1983). Ship access to the harbors depends on periodic maintenance dredging of navigation channels and berthing areas. It is estimated that maintenance dredging will produce approximately 276,000 yd^3 of predominantly sand material and 82,000 yd^3 of predominantly silt material per year. Material produced during such dredging must be disposed in an environmentally and economically acceptable manner. Designation of a local ocean site would provide an ocean disposal alternative for suitable dredged material.

The ocean disposal alternative has been determined by the U.S. Army Corps of Engineers (CE) as essential to meeting their obligations to maintain safe navigation. While some materials are suitable for beach nourishment, and upland sites do exist, nonsuitable materials and the economic feasibility of transport drive the need for a suitable ocean site. The possibility of an emergency dredging situation in order to keep the Port facilities open also supports the need for an ocean site.

1.2 GENERAL INTRODUCTION

The action addressed in this Environmental Impact Statement (EIS) is the final designation of an Ocean Dredged Material

Disposal Site (ODMDS) offshore Tampa Bay, Florida. The purpose of the action is to provide the most environmentally and economically acceptable location for the ocean disposal option for suitable materials dredged from the greater Tampa Bay area. This EIS presents the information needed to evaluate the suitability of offshore ocean disposal areas for final designation and is based on a series of environmental studies of potential disposal sites. The environmental studies and final designation process were conducted in accordance with the requirements of the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972 as amended (33 U.S.C. 1401 et seq.) and EPA's Ocean Dumping Regulations and Criteria (40 CFR 220-229).

The designation of an ODMDS by EPA does not by itself authorize the disposal of dredged material at that site. All disposals must be authorized by the CE, subject to its public participation procedures (cf. 33 CFR 209.145), and subject to possible disapproval by EPA pursuant to the Ocean Dumping Regulations and Criteria. All dredged materials proposed for ocean disposal must be determined to meet the criteria and found to be suitable for ocean disposal by EPA (see Section 1.4.2). Certification under Section 401 of the Clean Water Act is also needed from the State if the ODMDS is located within State waters. The preferred disposal site is located outside State of Florida waters.

1.3 PROPOSED ACTION

The proposed action is the final designation of an ODMDS. The proposed action does not exempt any specific project proposing to use the site from additional environmental review, nor does it exempt the dredged materials from compliance with the Ocean Dumping Regulations and Criteria prior to disposal at a designated site.

1.4 LEGISLATION AND REGULATORY FRAMEWORK

In 1972, Congress enacted the Marine Protection, Research, and Sanctuaries Act (MPRSA), which regulates 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 CE. Permits issued by the CE 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) (see Chapter 4). Section 103(b) of the MPRSA requires the CE to apply those criteria in determining 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 materials, the CE is required by Section 103(b) of the Act to utilize EPA-designated sites, to the extent feasible.

The CE is authorized by Section 103(e) of the Act to issue regulations for federal projects based on the same criteria and procedures used in permitting.

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 CE, applying the regulatory criteria promulgated by EPA, must issue a permit, or follow equivalent administrative procedures. Applicants can be either governmental or private entities.

1.4.1 Site Designation

Pursuant to Section 102(c) of MPRSA, EPA has promulgated regulations governing the designation of ocean disposal sites (40

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

Because the CE needed to proceed with dredging in the Tampa Bay area, EPA designated two sites (Sites A and B) on an interim basis. The interim designations of Sites A and B expired in February 1983 (US EPA, 1983).

As part of a Final EIS (1983), EPA then considered the following sites for designation as ODMDSs: previously designated interim Sites A and B; Shallow Water Alternative Sites 1, 2, 3, and 4; a mid-shelf alternative site; and a deep-water alternative site. The Final EIS recommended the designation of Shallow Water Alternative Site 4 as the Tampa Harbor ODMDS for three years (US EPA, 1983). Interim designation of Site 4 became effective November 1983 and expired November 1986. Currently no dredged material is being disposed in Tampa Bay.

In response to public comments on the interim designation of Site 4, EPA began a series of environmental studies to evaluate potential ocean disposal sites in the vicinity of 30 nmi off Egmont Key. Site 4 is evaluated as an ODMDS in this EIS.

1.4.2 Ocean Dumping Evaluation and Permitting Procedures

Section 103(a) of MPRSA allows the ocean dumping of dredged material 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 determining this, the CE must apply the environmental criteria promulgated by EPA (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 aesthetic, 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 CE must notify EPA, who may disapprove the proposed disposal. Under certain limited circumstances set forth in Section 103(d) of the MPRSA, the CE may request a waiver from EPA. The waiver should 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...."

1.4.3 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 is not appropriate, EPA may request the Department of Justice to initiate relief actions in court for violations of the terms of MPRSA. Surveillance includes spot checks of disposal vessels for valid permits, interception or escorting of dump vessels, and use of shipriders and aircraft during dumping.

The Commandant of the U.S. Coast Guard (USCG) has published guidelines for surveillance and enforcement of ocean dumping in

Commandant Instruction 16470.2B, dated 29 September 1976. An enclosure to the instruction is an Interagency Agreement between the CE and the USCG regarding surveillance and enforcement responsibilities over federally contracted ocean dumping activities associated with federal navigation projects. Under the agreement, the CE "recognizes that it has the primary surveillance and enforcement responsibility over these activities." The CE directs and conducts surveillance 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 CE for surveillance missions. The USCG retains responsibility for surveillance of all dredged material ocean dumping activities 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.

1.4.4 International Considerations

The principal international agreement covering 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 its wastes, and refined petroleum products; and persistent plastics and other synthetic or natural materials which float or remain in suspension in the sea) 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 and their by-products) 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 and include all the considerations listed in Annexes I, II, and III of the Convention. Thus, when a material is found to be acceptable for ocean dumping under the EPA ocean dumping criteria, it is also acceptable under the London Dumping Convention.

CHAPTER 2.0 ALTERNATIVES

2.1 HISTORY OF OCEAN DISPOSAL SITE SELECTION IN TAMPA BAY

Over the past decade, an effort has been made 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 consideration (US EPA, 1983).

Sites A and B, located 13 and 9 nmi from shore (Figure 2-1), respectively, were designated on an interim basis in January 1977 (42 FR 2462, 40 CFR 228.12). In December 1980, the interim designation was extended to February 1983.

EPA entered into a contract with Interstate Electronics Corporation (IEC) in 1977 for the evaluation of interim-designated sites and the preparation of EISs. The CE 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 ODMDSs.

IEC initiated studies of the environment near Tampa Bay in 1979. Initial screening of historical data and other available information indicated that three general areas should be considered for the location of a permanently designated ODMDS: shallow water, mid-shelf, and deep water. The previously designated Sites A and B are both located in shallow water. 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

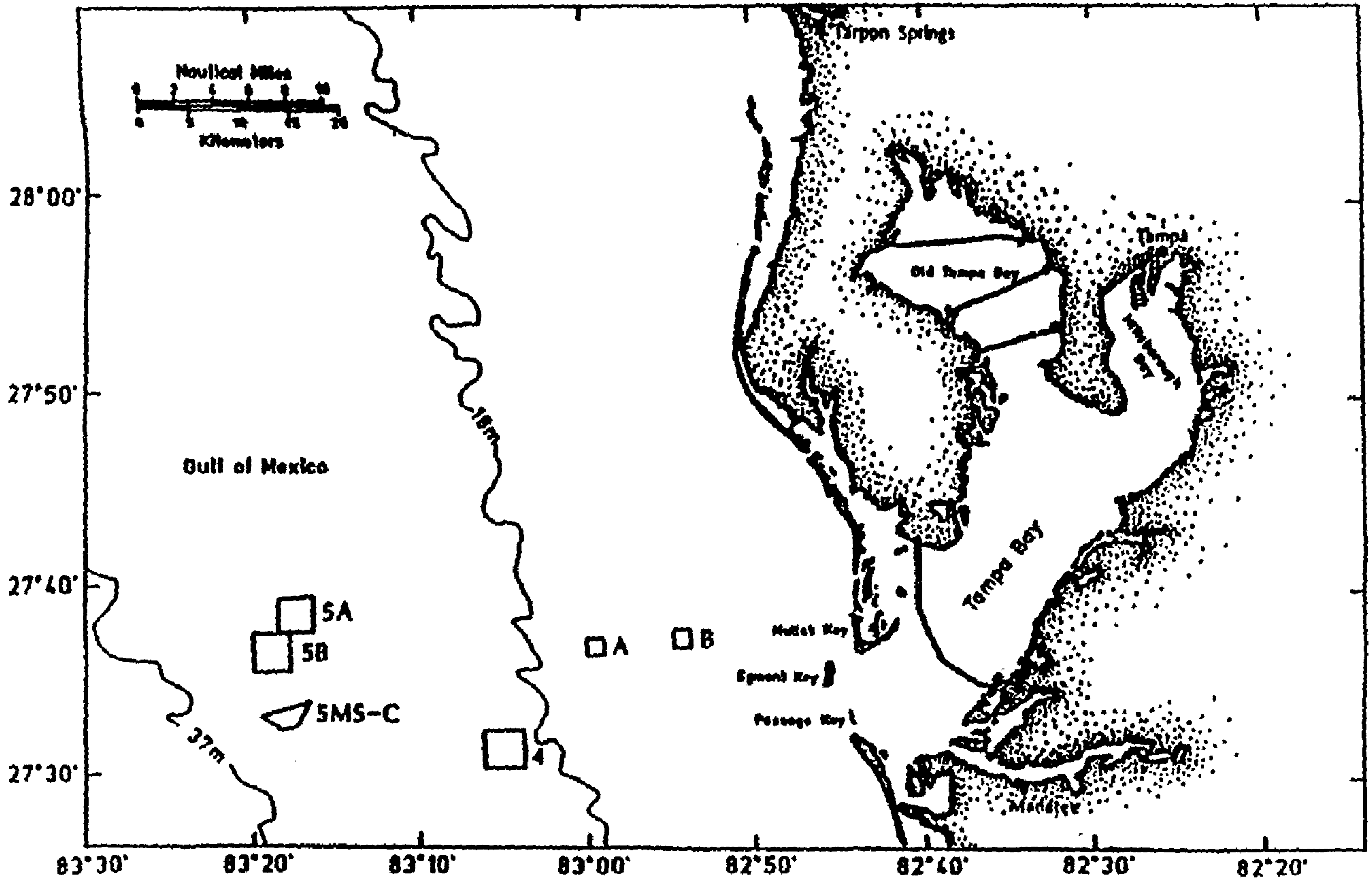


FIGURE 2-1. TAMPA HARBOR ODMDS AND ALTERNATIVE DISPOSAL SITES.

of the presence of hard-bottom areas and artificial reefs. Waters less than 10 m deep also were eliminated because of potential shoaling. Subsequent field surveys conducted by EPA in September and October 1979 and January 1980 revealed that these 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 Commissioners, began a study to evaluate the effects of offshore disposal of sediments dredged from Bayborough Harbor, St. Petersburg, FL (US EPA/MML, 1981). MML concluded that partially buried hard-bottom habitats were present at the boundaries of Site A and recommended that dredged material disposal at Site A be discontinued and efforts be directed toward locating an alternative site(s).

Subsequently, EPA performed a reconnaissance survey of Alternative Shallow Water Sites 1, 2, and 3 in October 1981. Diver observations and photographs indicated that Alternative Site 1 contained hard-bottom outcrops and numerous animal and plant communities (US EPA, 1983). For this reason, Alternative Site 1 was eliminated from detailed evaluation. Alternative Site 2 was determined to be only marginally acceptable, due to a finger of hard-bottom communities extending into the site from the eastern boundary. The western and southern portions of the site consisted of sandy bottoms. Alternative Site 3 appeared to consist of sandy bottom over the entire area.

In April 1982, the CE surveyed Alternative Sites 2 and 2A (an area southwest of Alternative Site 2) and found that Alternative Site 2A was environmentally unacceptable due to extensive areas of exposed rock. Based on this finding and on EPA's findings during the reconnaissance survey, Sites 2 and 2A were eliminated from further detailed consideration (US EPA, 1983). In the same year (May 1982), EPA implemented an in-depth survey that included video surveillance and taping of the bottom at 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 (US EPA, 1983). Videotapes of Alternative Site 3 revealed much more hard-bottom area than had been revealed in October 1981 and led to the elimination of Alternative Site 3 from further consideration. During the videotaping, an extensive sandy-bottom area (later designated Alternative Site 4) southwest of Alternative Site 2 was discovered and included in the survey.

EPA then implemented another survey during February, March, and April 1983. This survey consisted of extensive videotaping and side-scan sonar mapping of the bottom of Alternative Site 4 and a control site located five miles southeast of Alternative Site 4. Three other sites, identified as State Sites X, Y, and Z, at approximately 27, 28, and 30 nmi, respectively, west of Egmont Key, were also examined in brief detail. Only videotapes were made at these three sites.

The Final EIS for Ocean Disposal Site Designation (US EPA, 1983) recommended Site 4, an area located approximately 18 nmi from Egmont Key and containing extensive sand-bottom area, for dredged material disposal on an interim basis. Disposal of materials at Site 4 was initiated in May 1984 and continued until November 1985 when dumping was terminated. 3.44 million cubic yards of dredged material were dumped at the site. During the interim designation period, monitoring surveys were conducted at Site 4 both before and after disposal operations (CSA, 1987).

Additional information was compiled, and surveys conducted (MML, 1983; JRB, 1984) at other potential sites 25 to 35 nmi from shore. In particular, information obtained by Mote Marine Laboratory (MML, 1983) from commercial and recreational fishermen and from recreational SCUBA divers was used to delineate possible alternative sites that did not contain known fishing reefs or shipwrecks.

Seven such possible sites were located in the vicinity of 30 nmi off Egmont Key. These are State Sites X, Y, Z (discussed in the 1983 Final EIS), Sites A, B, and C as surveyed and identified by Mote Marine Laboratory (MML, 1983), and Site 30MS-C as surveyed and identified by EPA and reported by JRB (1984) [Sites A and B are identical to Sites 30MS-1 and 30MS-2 reported by JRB, 1984.] Of the seven sites, three have been both sampled for infauna and surveyed by video: Sites A, B, and 30MS-C. They were chosen as the alternative locations for Site 5 (Chapter 3). To avoid confusion with other previously designated and considered sites, these sites are referred to as Sites 5A, 5B, and 5MS-C, respectively (Figure 2-1).

2.2 DESCRIPTION OF ALTERNATIVES

The possible alternatives considered in designating an ODMDS are discussed in this chapter. Possible alternatives include the proposed action, designation of other ocean disposal sites, non-ocean alternatives, and the no-action alternative.

In general, the feasibility of land disposal of dredged materials for beach nourishment, fill for upland areas, or creation of diked disposal islands (i.e., bay islands) depends on the capacity of existing land disposal sites, location of the dredging projects, and characteristics of the dredged materials. Inland water and Gulf nearshore disposal alternatives (see Appendices A and E) are regulated by Section 404 of the Clean Water Act and do not require the designation of an ocean disposal site. These alternatives are considered in project- specific EISs, as appropriate.

The CE's need for a permanent ocean site for disposal of materials from maintenance and new dredging operations was discussed generically in the "Final Environmental Impact Statement Tampa Harbor Project" (CE, 1975) and "Supplement to the

Final Environmental Impact Statement, Tampa Harbor Project" (CE, 1977) and summarized in the "Final Environmental Impact Statement for Tampa Harbor, Florida, Ocean Dredged Material Disposal Site Designation" (US EPA, 1983). The possibility of upland disposal or other feasible alternatives is not eliminated through the ocean site designation process. The need for ocean dumping must be demonstrated with each permit application for ocean disposal.

In 1993, the CE performed a study of upland sites in the vicinity of Tampa Harbor for disposal of dredged material (see Appendix E). The purpose of the study was to determine the availability and feasibility of using upland sites in comparison to an ODMDS for Tampa Harbor. Upland sites underwent an analysis of environmental engineering and economic criteria. The economic assessments included the cost to purchase the required land, construct the necessary features, and transport the dredged material to the site. The analysis involved environmental and economic impacts of offshore and upland disposal to obtain a cost comparison which would indicate the most feasible method of disposal. The analysis and evaluation presented in the study include information and conditions existing at the end of 1992 and the beginning of 1993. A more detailed study would be required to implement any upland site recommended in this report.

The primary focus of this study was the Tampa Harbor Federal Navigation channel. Any material dredged from local access channels and berthing areas was not a consideration at that time. The Manatee Harbor channel, which has its own upland site for future construction and maintenance work, and the St. Petersburg Harbor channel were excluded from this study.

The initial analysis involved 77 potential upland disposal sites located in three counties. Environmental evaluations determined that ten sites were unsuitable for disposal. A field trip revealed development on four sites, making them unsuitable for further consideration. Additionally, three sites were inaccessible by pipeline due to Interstate 275. Pipeline access problems to one site resulted in unacceptable environmental impacts, making it unsuitable for further study. The initial cost comparison between ocean and upland alternatives indicated 26 upland sites were more costly than the ocean alternatives. The final cost evaluation was a real estate analysis on the property values of the remaining sites. During this phase, future development plans eliminated another site. The combined costs of real estate, dredging and site preparation eliminated two additional sites. Table 21 of Appendix E contains the final 30 sites considered suitable along with the cuts and dredge types in making the final feasibility determination. Disposal islands 2D and 3D are also included in the table for comparison purposes.

The results presented in Table 21 (Appendix E) demonstrate the need for an ODMDS for the Tampa Harbor Federal Project. No upland sites were found to be feasible from the environmental, engineering and economic aspects for 26.5 miles of the federal channel stretching from the Egmont Bar Channel through Tampa Bay Cut B (see Figure 5, Appendix E).

2.2.1 No-Action Alternative

The no-action alternative would result in no permanent designation of an ocean dredged material disposal site. Consequently, the CE would be required to use an acceptable alternative disposal method (e.g., land disposal) or modify or cancel the existing dredging and disposal program. Alternatively, the CE could request a permit for dumping dredged materials at an ocean site that would be subject to the provisions in Section 103 of the MPRSA. The permit request would be evaluated according to criteria specified in Section 102 of MPRSA to determine whether dumping would unreasonably degrade or endanger human health, welfare, or the marine environment. These ocean disposal sites would be used after a review of each project has established that the proposed ocean disposal of dredged material is in compliance with the criteria and requirements of CE and EPA regulations. These same criteria apply to assessments of impacts associated with permanent site designation as discussed in this EIS.

2.2.2 Ocean Disposal Alternatives

Selection of an appropriate site requires identifying and evaluating suitable areas for receiving the dredged materials. Identification of these areas relies on available information obtained from previous site-specific and synoptic oceanographic studies. Specific alternative (or candidate) sites may be identified within these areas based on historic and current use of the area, the existence of previously used disposal sites, and recommendations from state and federal resource agencies and the district and division offices of the CE.

The potentially suitable alternative sites for dredged material disposal are the previously designated Site 4, located 18 nmi west of Egmont Key and Site 5 (i.e., either Sites 5A, 5B, or 5MS-C), located approximately 30 nmi from shore (Figure 2-1). In general, other previously used and candidate alternative sites, nearshore areas within three miles of the previously used sites, and areas in water depths less than 10 m were eliminated from further consideration because of the presence of live bottoms or reef areas, or due to concerns about potential shoaling problems in shallow water areas (US EPA, 1983). The possible disposal of dredged materials at mid-shelf or deep-water alternative sites was discussed by EPA (1983). No previous disposal has occurred within either area, the environmental impacts resulting from disposal operations are poorly known, and the economic costs associated with the extended transport distances are prohibitive. Consequently, EPA eliminated potential mid-shelf and deep water alternative sites from further consideration.

2.2.2.1 Site 4

The Final EIS for the Tampa Harbor ODMDS recommended designation of Site 4 for three years (US EPA, 1983). The site was used from May 1984 to November 1985 for disposal of materials from a project to deepen the channel. The site has an area of 4 nmi^2 and is located approximately 18 nmi west-southwest of the entrance to Tampa Bay (Figure 2-1). The average water depth at Site 4 is 22 m. The bottom topography is primarily flat sand with occasional ripples and shell hash. A small area of hard and soft coral is located in the northwest quadrant of the site, and a very small area of coral is located at the extreme northeast corner of the site (US EPA, 1983). Prior to the onset of disposal of dredged material, the sediments at Site 4 were characterized as fine-grained sands and coarse silts with varying but minor amounts of gravel.

Several surveys have been conducted at Site 4, including a pre-disposal survey in April 1984, a series of post-disposal surveys from August 1984 through July 1985, a sediment mapping and biological survey in 1987 and an EPA diver survey in October 1991. The objective of these surveys was to determine whether materials dumped at Site 4 were transported in quantities sufficient to cause significant adverse environmental effects to the environment around the site. Data collected from the 1984-1985 surveys have been published in a series of monitoring survey reports and are summarized in CSA (1987). Separate reports on the sediment mapping results and the biological survey were prepared by the University of Georgia Center for Applied Isotope Studies (CAIS, 1988) and MML (1988), respectively. In the Site 4 monitoring plan, the presence of disposed dredged material, serious warning, and significant adverse environmental effects were defined to provide a decision point for potentially halting disposal operations. A serious warning, for example, would necessitate an increased monitoring frequency from every 45 days to monthly. Significant adverse environmental effects, in contrast, would stop disposal operations entirely until analyses confirmed the significant effects.

The 1984-1985 monitoring surveys provided visual evidence of scattered lumps of dredged materials within Site 4. These lumps were attributed to small amounts of debris falling from the disposal barge after the majority of the material had been released. There was no visual indication that these materials were transported out of the disposal site. Results from geochemical analyses of the bottom sediments provided evidence for the presence of dredged materials within the site and at the site boundary. Dredged materials were also detected in areas of hard bottom within the site. However, both the infaunal data and photography of a live-bottom area provided limited information to evaluate the biological effects from the dredged materials (CSA, 1986c). The data did not indicate that criteria for "serious warning" or "significant adverse environmental effects" had been achieved, although the extent of possible biological effects was still poorly known.

The 1987 sediment mapping technique (CAIS, 1988) indicated the presence of sediments with properties indicative of dredged material in the vicinity of the disposal area and beyond the north, northwest, and southeast boundaries of the site. These results suggest that transport of dredged material to areas outside the site boundary may be occurring. However, additional evaluation of both soft- and hard-bottom communities by EPA, Region IV, Environmental Services Division (ESD) in cooperation with Mote Marine Lab provided no evidence of an adverse impact on the fauna in the vicinity of Site 4 (MML, 1988).

The 1991 EPA diver survey revealed that large boulders on the disposal mound were nearly 100% colonized by calcareous algae, sponges, ascidians, and tube coral. Visually, fish were abundant and included butterfly fish, wrasse, damselfish, angelfish, highhats, grunts, snapper, jacks, needlefish, barracuda, and grouper, with the latter being the most abundant sport/commercial fish observed (Appendix F).

2.2.2.2 Site 5 (Sites 5A, 5B, and 5MS-C)

Sites 5A, 5B, and 5MS-C within Site 5 are located approximately 30 nmi off Egmont Key in water depths ranging from 29 to 35 m (Figure 2-1). The bottom topography of these sites is primarily flat sand with some relief from scattered algal patches or low relief corals (JRB, 1984). No disposal of dredged material has occurred at these sites. These three sites were sampled by MML and EPA using a combination of remote (e.g., video and side-scan sonar) and discrete sampling methods (MML, 1983; JRB, 1984). The MML (1983) video survey covered the entire area of each of the three sites; the EPA survey (JRB, 1984) covered only part of each site. These surveys are discussed in Appendix B.

Video transects of Site 5A revealed that 79 percent of the surface area consists of flat, sandy bottom with scattered patches of algae (Caulerpa). Twenty-one percent of the area consists of scattered hard bottom, but no extensive hard-bottom areas exist (MML, 1983). Sediments are moderately heterogeneous, ranging from very coarse sands to very fine sands (JRB, 1984).

Video transects of Site 5B revealed that 90 percent of the area consists of flat, sandy bottom, and 10 percent consists of scattered hard bottom. No extensive hard bottom was observed (MML, 1983). Sediments at Site 5B generally are comparable to those at Site 5A, and consist of coarse to very fine sands (JRB, 1984).

Based on video data (MML, 1983), Site 5MS-C is part of an area containing scattered and extensive hard bottom. Sediments at Site 5MS-C are the most heterogeneous and contain the greatest percentage of fine sediments.

2.2.3 Non-ocean Alternatives

Between 1950 and 1990 the CE dredged approximately 104,500,000 cubic yards (cy) of material from the federal navigation channel in Tampa Harbor. Of that quantity, 4,800,000 cy were disposed on upland sites; 5,000,000 cy were placed on diked Bay disposal sites; and 94,700,000 cy were disposed in open water Gulf of Mexico sites. Eighty-seven percent of the material disposed in the ocean was from new work; the rest was largely from maintenance of channels in Hillsborough Bay and the outer Bay channels.

Diked disposal area locations for the Tampa Harbor Deepening Project are shown on plates 1-6 from the final supplement to the project EIS (the final EIS was filed August 8, 1975; a final supplement to the EIS was filed June 3, 1977; and a supplementary information report was filed August 1, 1980). Sites designated as submerged maintenance disposal areas have never been used. Although placement of dredged material in open water for habitat development is a frequently mentioned alternative, federal and State resource protection agencies as well as local environmental action groups have consistently opposed additional filling of the Bay bottom with maintenance-dredged material, except for such purposes as filling old channels to natural Bay bottom levels.

Candidate channels for filling, such as Seddon Channel (the Hillsborough River outlet) and Garrison Channel (connecting Seddon and Sparkman Channels) have been considered for clean material disposal. Garrison Channel is no longer a federal navigation channel, having been deauthorized by Congress, and it could be used for disposal. Its capacity would be determined by survey of the extent of sedimentation now present. Seddon and Sparkman Channels are authorized navigation channels, and deauthorization would be necessary before they could be filled.

Disposal of dredged material in old phosphate mining pits located in eastern Hillsborough County and in Polk County has been considered. This would involve hauling material over public roads and would risk ground water contamination with salt from the dredged material.

The Tampa Port Authority's disposal plan is to use the disposal islands (D/A 2D and D/A 3D) in the northeastern part of the project for disposal of material from the Hillsborough Bay area; the sites afford capacity for disposal of as much as 30 years of maintenance material. However, recent information from the CE indicates that both disposal areas are near or at capacity. Material from all other channels is projected for disposal in a designated Gulf of Mexico ocean disposal site.

Lacking an ocean disposal site and faced with critical conditions in Cut G, the Port has found it necessary to make an exception to the Tampa Bay disposal plan. The Tampa Bay Bar Pilots have limited the draft of vessels using Cut G. This has resulted in shippers loading vessels to less than capacity. The Tampa Port Authority has therefore granted permission, for one time only, to dispose of maintenance dredged material from Cut G material in the diked disposal area, D/A 3D. Long term disposal of Cut G material on the diked disposal areas is not feasible since this would shorten the disposal areas' period of availability for disposal of material from Hillsborough Bay.

The ocean disposal option for material of all types has been determined by the CE to be essential to carry out its mission of maintaining safe navigation. Sand dredged from the entrance channel may be placed on adjacent beaches; however, material from the entrance channel and upper channels (Cut G and Port Tampa channel) is typically silt unsuitable for beach nourishment. The CE desires to place this material in the ocean because they have determined that no alternative sites are available within a feasible transport distance. The CE also believes that an ocean disposal site must also be available for disposal in the event of an emergency, when time constraints do not permit beach disposal.

The CE has recently completed a new survey of upland disposal options for material dredged from the Tampa Harbor Federal

Project (see Appendix E). This study concludes that no upland sites are environmentally, engineeringly, or economically feasible for a 26.5 mile portion of the Federal channel from the Egmont Bar Channel through Tampa Bay Cut B. An ocean site is needed for any material from these areas that is not suitable for beach nourishment.

The CE will submit a dredged material disposal plan (DMDP) to the State with each water quality certification application that includes disposal of materials dredged from state waters or sovereignty lands into the ODMDS. The State will concur with, or object to, such plan in accordance with the federal consistency procedures of the Coastal Zone Management Act and the Florida Coastal Management Program. The DMDP will be reviewed prior to each dredging event to allow for alternative disposal designs ro cost-sharing mechanisms. The DMDP will include a detailed evaluation of disposal options according to the following hierarchy of preferences: beach disposal of beach quality material (>10% fines); nearshore disposal of beach compatible material (meets NTU standards approved by the State); other beneficial uses; upland disposal; or ocean disposal. The State of Florida and/or the local sponsor will pay increased costs, according to appropriate cost-sharing ratios, for choosing a disposal option determined by the CE not to be the least costly alternative.

2.3 DISCUSSION OF THE ALTERNATIVES

As noted in Section 2.2.2, the potentially suitable alternatives for a dredged material disposal site are previously designated Site 4, located 18 nmi west-southwest of the entrance to Tampa Bay, and Site 5 (i.e., Site 5A, 5B, or 5MS-C), located approximately 30 nmi off Egmont Key. Surveys designed to monitor the disposal of dredged material at Site 4 did not indicate that criteria for "serious warning" or "significant adverse environmental effects" have been exceeded.

With respect to the designation of an area at Site 5, Site 5MS-C is part of an area containing mainly scattered and extensive hard bottom (MML, 1983). Sites in that area were not considered as candidate sites by MML (1983). Also, according to information mapped in Beccasio et al. (1982), Site 5MS-C lies partly within a general habitat boundary for red snapper, red grouper, grunts, dolphin, gag, and sea bass. Based on these ecological considerations, Site 5MS-C was eliminated from consideration as a dredged material disposal site.

In choosing between Sites 5A and 5B, data collected by both MML (1983) and EPA (JRB, 1984) were considered. Video data indicate that Site 5B contains a higher percentage of sand and a lower percentage of scattered hard bottom than does Site 5A (90 percent sand at 5B vs. 79 percent sand at 5A) (MML, 1983). Within Site 5A, JRB (1984) identified three habitat areas ranging from coarse and medium sands with gravel, to fine and very fine sands, and coarse silts. At Site 5B, however, only two habitat categories were represented (three of the four stations fell into one category--coarse and medium sands with gravel). Because many taxa in the JRB (1984) study were consistently representative of particular habitats, Site 5A may be considered more biologically diverse than Site 5B. However, average species diversity (H') at Sites 5A and 5B is comparable (3.43 and 3.33, respectively). In addition, the average total taxa at Sites 5A and 5B are also very similar (63 vs. 68, respectively).

Further consideration of designating either Site 5A or 5B has been discontinued due to the distance offshore. The CE has stated that they would never use a site at these distances. Further evaluation and subsequent designation of a site that would not be used are not efficient uses of federal money.

In summary, the alternative that will be considered in detail in this EIS for the disposal of dredged material from the Tampa Bay area is Site 4 (Figure 2-2).

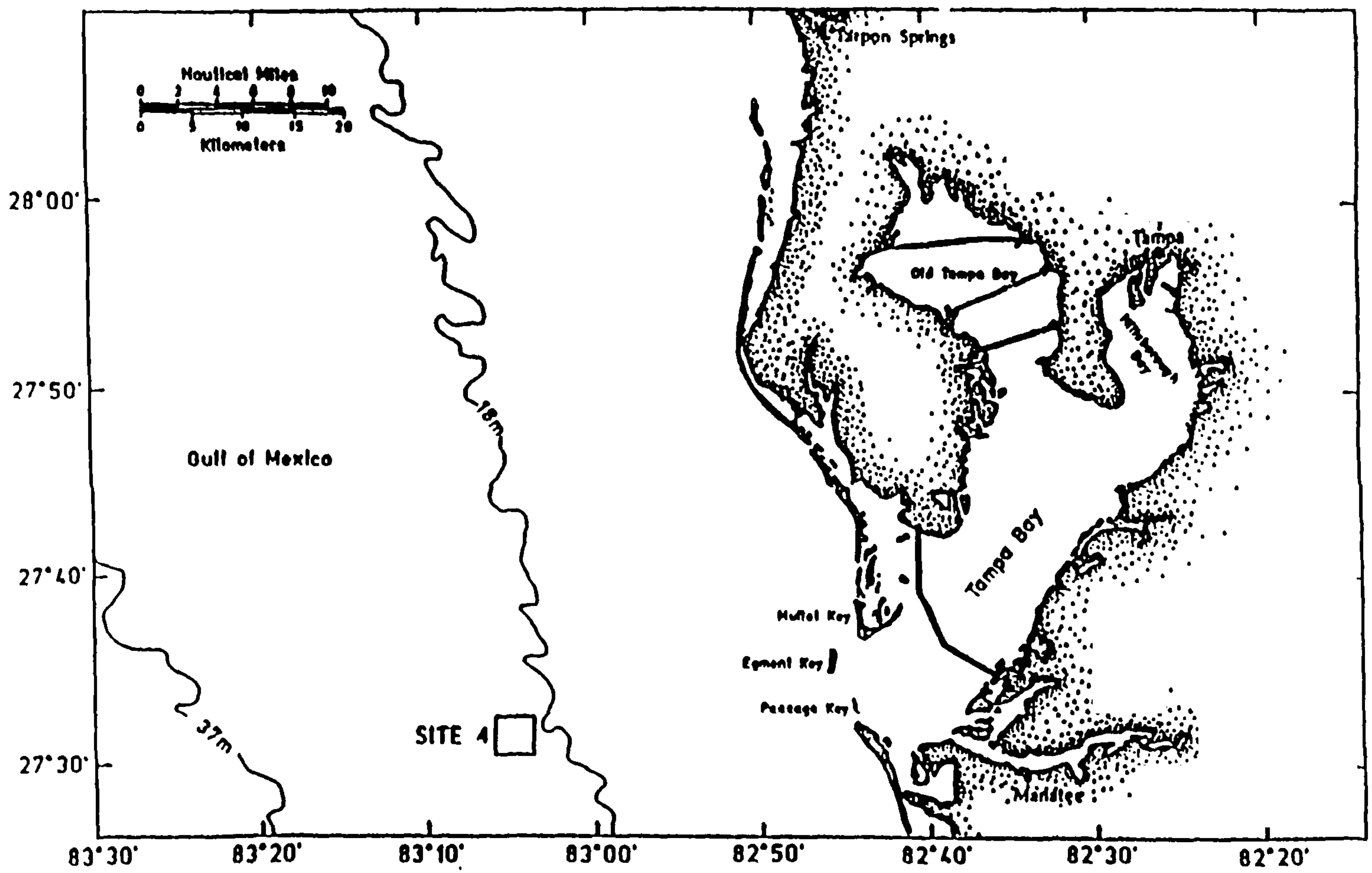


FIGURE 2-2. LOCATION OF ALTERNATIVE DREDGED MATERIAL DISPOSAL SITE 4 OFF TAMPA BAY, FLORIDA.

CHAPTER 3.0 AFFECTED ENVIRONMENT

3.1 OCEAN DISPOSAL SITE CHARACTERISTICS

3.1.1 Site Location

In November 1983, EPA designated Site 4 for a 3-year period as the Tampa Bay offshore site for disposal of dredged materials (Figure 2.2). Site 4 is 18 nmi (33 km) west-southwest of the mouth of Tampa Bay in water depths of about 22 m. The boundary coordinates of Site 4 are

NW 27°32'27"N, 83°06'02"W
NE 27°32'27"N, 83°03'46"W
SW 27°30'27"N, 83°06'02"W
SE 27°30'27"N, 83°03'46"W

The site configuration is square with an area of 4 nmi^2. The bottom topography of Site 4 is primarily flat sand with occasional sand ripples and shell hash. A small area of hard and soft coral is located in the northwest quadrant of the site, and a very small area of coral is located at the extreme northeast corner of the site (US EPA 1983). Dredged material was disposed at the site from May 1984 to November 1985 (CSA, 1986c). The area and a nearby control site (Site 4C) were monitored regularly from April 1984 to July 1986 (CSA, 1987). Continued disposal at Site 4 is the alternative evaluated in this EIS.

3.1.2 Proposed Use

It is anticipated that operation and maintenance dredging in Tampa Bay will generate an approximate annual average of 1.1 million yd^3 of sediments; however, maintenance dredging historically has been conducted on an as-needed, rather than an annual, basis. Although additional volumes of sediment may be generated by as yet unidentified navigational improvement projects (e.g., creation of new channels or enlargement of existing channels), the amount of material or period of disposal cannot presently be estimated.

The specific characteristics of the dredged material will depend on where it is obtained. Sediments throughout the Tampa Bay area typically are sands and shelly sands (CE, 1975). The percentage of shell fragments tends to increase with proximity to the mouth of the Bay. Localized deposits of silts and clays are found in some areas (e.g., Old Tampa Bay, Hillsborough Bay, upper Tampa Bay and Boca Ciega Bay) (Taylor and Saloman, 1969). The silt and clay content of material dredged from Tampa Bay generally is greater than that found at all alternative and previously considered disposal sites (Battelle, 1986c; JRB, 1983, 1984). All dredged material intended for disposal at the designated offshore site must comply with specifications of the Ocean Dumping Regulations (42 FR 2482, Jan. 11, 1979; 40 CFR 220), including acceptable performance test procedures established jointly by EPA and the CE.

Dredged material will be transported to the disposal site in hoppers, barges, or scows. The material is released at the designated disposal site through the bottom of the vessel while underway.

3.1.3 Feasibility of Surveillance and Monitoring

Site 4 is sufficiently close to shore (18 nmi) to be readily accessible for monitoring. Discrete sampling and remote monitoring (e.g., grab sampling, towed cameras, and continuous seafloor sediment sampling) have been conducted at the site. Although scattered hard bottom occupies a small portion of the site, there are no extensive areas of unique hard bottom that would complicate quantitative sampling of infaunal organisms and bottom sediments. In fact, pre- and post-disposal monitoring surveys were conducted routinely at Site 4 from 1984 through 1985. Monitoring surveys included continuous recording of current speed and direction, collection and analysis of sediments, photographic monitoring of hard-bottom epibiota, and visual observations by SCUBA divers (CSA, 1984; CSA, 1986a,b, c). Continuous seafloor sediment sampling for selected trace metals and gamma-ray-emmitting isotopes was performed in 1987 by the University of Georgia Center for Applied isotope Studies (CAIS, 1988) which permitted discrete positioning of stations for infaunal sampling in dredged material.

Dredged material from Tampa Bay has been shown to have characteristic concentrations of strontium and phosphorous (CSA, 1987). These concentrations are sufficiently different from concentrations in ambient sediments in Site 4 that they can be used to trace the movement of the dredged material. Continuous sampling of seafloor sediments for selected trace metals and gamma-ray-emitting isotopes was performed in 1987 by the University of Georgia Center for Applied Isotope Studies (CAIS) (CAIS, 1988).

Monitoring of further disposal activities is discussed in a Site Management and Monitoring Plan (SMMP) (see Appendix C).

3.1.4 Existence and Effects of Previous Dumping

3.1.4.1 PHYSICAL AND CHEMICAL ENVIRONMENT

Between 1951 and 1985, 101.6 million cubic yards of dredged material were removed from Tampa Bay (Table 3-1). Prior to 1984,

TABLE 3-1. HISTORY OF DREDGED MATERIAL DISPOSAL AT OCEAN SITES IN THE TAMPA AREA.

Date	Class	Contractor	Cuts	Quantity (cu. yd.)	Type of Material	Location of Disposal Area
1951	Maintenance	Government	Egmont and Mullet Key	197,406	a	?
11/55 to 2/56	New Work	Government	Egmont and Mullet Key	869,324	a	2 mi
1956	New Work	Standard	Tampa Bay Channel	6,369,625	a	?
11/56 to 1/57	New Work	Government	Egmont and Mullet Key	2,760,810	a	?
1957	New Work	Standard	Hillsborough Bay Channels	7,118,998	a	?
11/57 to 12/57	New Work	Government	Egmont and Mullet Key	416,448	a	3.02 mi
1958	New Work	Standard	Sparkman and Ybor	1,367,738	a	?
8/58 to 10/58	New Work	Government	?	796,642	a	2.04 mi
1959	New Work	Standard	Pt. Tampa Channel and Turning Basin	3,365,631	a	?
1959	New Work	American	Alafia River and Turning Basin	3,707,275	a	?
12/60 to 1/61	Maintenance	Government	Seddon and Garrison	84,624	a	2.8 mi UHB
6/61 to 11/61	Maintenance	Huffman	Hillsborough Bay and Alafia River	1,265,199	a	?
7/62	Maintenance	Government	Egmont	390,428	a	2.2 mi Ocean
7/66 to 12/66	Maintenance	Huffman	Pt. Sutto, Alafia, Gadsden Cut D	1,392,540	a	?
11/67 to 12/67	Maintenance	Government	Egmont	155,203	a	0.8 mi Ocean

TABLE 3-1. (Continued).

Date	Class	Contractor	Cuts	Quantity (cu. yd.)	Type of Material	Location of Disposal Area
6/68 to 8/68	Maintenance	Hendry	Hillsborough Channel and Alafia Channel and TB	696,959	a	?
5/69 to 6/69	Maintenance	Government	Egmont	675,392	a	3-4 mi
12/70	Maintenance	Government	Egmont	96,500	a	1 mi
9/71 to 11/71	Maintenance	Government	Egmont and Mullet Keys	657,352	a	3-4 mi - Site B
8/73 to 9/73	Maintenance	Government	Egmont and Mullet keys	472,581	a	Site B (?)
11/75 to 11/77	New Work	Western	Egg & cut 1	3,300,761	a	?
1/77 to 9/79	New Work	CAC	Egmont and Mullet Keys	6,855,623	a	?
11/77 to 5/80	New Work	Western	Alafia and East Bay	12,065,370	a	?
7/78 to 12/78	Maintenance	Transtate	Alafia and Sparkman	1,685,874	a	?
8/78 to 12/80	New Work	T L James	Egmont Key, Sec 1C MK-Merritt	7,828,374	a	Site A (?)
5/80 to 8/80	New Work	Government	Cut F and Gasden Point	401,692	Silt, Organic Silt, Sand, shell	48 ft. depth - Site A
6/80 to 7/80	New Work	Government	Cut F and Gasden Point	261,585	Silt, organic silt, Sand, shell	48 ft. depth - Site A
1/80 to 11/82	New Work	American	Gasden Point and AC	12,082,276	a	Site A
5/81 to 12/82	Maintenance	Bohemia	Cut F and Turning Basin	3,301,060	a	Site A
10/81 to 1/82	Maintenance	Merritt	Sparkman Cut and Hillsborough	964,505	a	Site A
2/82 to 7/83	New Work	Hendry	Turning Basin, B, C, and D	5,630,652	a	Site A (?)

TABLE 3-1. (Continued).

Date	Class	Contractor	Cuts	Quantity (cu. yd.)	Type of Material	Location of Disposal Area
11/81 to 3/82	Maintenance	Great Lakes	Cut G, Port Tampa	840,236	a	Site A (?)
1/82 to 11/82	Maintenance	Great Lakes	Egmont Key	1,142,250	a	Site A (?)
8/82 to 7/83	New Work	Norfolk	Turning Basin, E & F	3,781,222	a	Site (?)
6/83 to 11/83	Maintenance	C-Way	Alafia River and Turning Basin	516,190	a	Site (?)
5/84 to 12/85	New Work	Great Lakes	Sec 2C-3B	3,141,272	a	Site 4
Total				101,569,987	a	

Type of material not readily accessible from COE record.

most disposal activity occurred within 9 nmi of the harbor mouth. However, actual locations of all dredged material disposal activities are not available.

Between May 1984 and November 1985, Site 4 received 3.44 million cubic yards of dredged material from a harbor deepening project in Tampa Bay (CSA, 1987). This material was deposited in a rectangular disposal area centered approximately 0.15 nmi south of the center of Site 4 (Figure 3-1). The disposal area was located with the long axis in the east-west direction and had dimensions of approximately 0.15 nmi by 0.9 nmi.

The location of the dredged material within the disposal area was confirmed by diver observation, chemical analysis for phosphate and strontium, and bathymetric profiling; these activities were conducted during disposal and approximately seven months after completion of disposal activities (CSA, 1987). In their study, CSA found that the dumping activity had resulted in the sediments in the central and southern portions of the disposal area having higher phosphate and lower strontium concentrations relative to background conentrations. Phosphate concentrations at some locations were twice the average background concentration (CSA, 1987). Deposition of dredged material, which has lower strontium and organic carbon concentrations in the fine sediment than does natural offshore sediment, had reduced the concentrations of these parameters in sediments of the central and southern portions of Site 4.

Consolidated clumps of dredged material outside of the project's disposal corridors but within the larger area of Site 4 were noted during ongoing disposal operations (CSA, 1987). These large clumps of clay-like material were observed by divers during repeated surveys of the site and were presumed to have fallen from the barges after the completion of the majority of each disposal operation. These materials were found primarily to the north and east of the disposal area, and some clumps were found

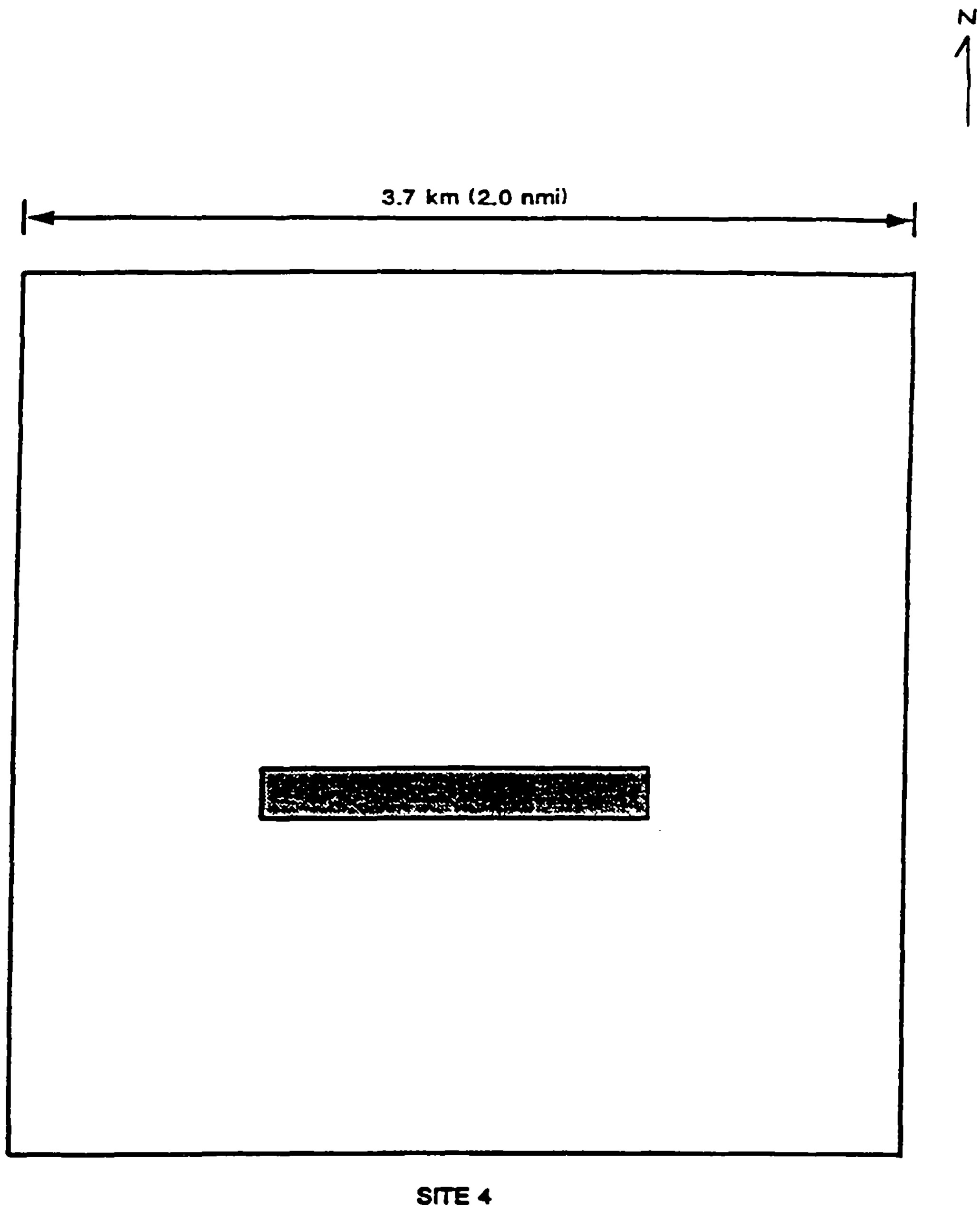


FIGURE 3-1. RELATIONSHIP OF ACTUAL DISPOSAL AREA TO SITE 4.

to the southwest. This material was not observed on the south, west, or northwest borders of the disposal site. Surveillance beyond the site boundaries was not performed as part of the CSA study; therefore, it is not known whether these clumps were present outside the site. Subsequent surveys conducted by EPA divers indicated that boring organisms such as polychaetes and bivalves were contributing to the breakdown of these clumps (D. Hicks and P. Murphy, EPA Region IV, personal communication, August 22, 1988).

In July 1986, eight months after completion of disposal operations, divers observed substantial differences in relief (2 to 12 m) in the disposal area relative to the surrounding sediments. The disposal mound was relatively flat. During the dives conducted in March and July 1985, fine-grained sediment was noted on the surface of the mound, and some winnowing of this material was observed by the divers in July 1985. However, in July 1986 fine-grained sediments were noticeably missing from the surface at the top of the mound. Divers observed that fine sediments were located on the slope of the mound, suggesting they had been moved and deposited by local currents. At the same time, heavy colonization of the dredged material mound was apparent (CSA, 1987).

Subsequent to the CSA monitoring program, three additional surveys of the area were conducted by the University of Georgia, CAIS in cooperation with EPA, ESD, Region IV. Two new remote sensing devices were used along multiple transects within the disposal site and in areas immediately (approximately 0.5 nmi) outside its boundaries; ground-truth samples were collected from a selected number of stations. The first remote device was a continuous seafloor sediment sampler (CS^3) capable of collecting and preparing fine-grained sediment samples for immediate shipboard analysis by X-ray fluorescence (XRF) elemental analysis. The CS^3 system was used to collect and analyze samples from 487 stations. Iron, manganese, and titanium were measured with this system.

The second device was a towed sled capable of detecting gamma radiation from surficial (0 to 20 cm) seafloor sediments. The gamma sled was used to analyze 360 sites and obtain information on potassium (K-40), bismuth (Bi-214), and tellurium (Tl-208).

Six sediment samples were collected by EPA divers during the June 1987 survey; three samples were collected within Site 4 and three samples were collected outside the boundaries of the site. Results of the chemical analysis of these samples showed the high phosphorus concentrations typical of those reported for dredged material in sediments from Site 4 in the vicinity of the disposal area and from one location immediately north of the site (CAIS, 1988). Phosphorus concentrations in all other samples were at background levels for the region.

Generally, samples with high phosphorus concentrations relative to background concentrations also had high iron concentrations relative to background concentrations (CAIS, 1988). Therefore, high concentrations of iron in the sediments were considered indicative of the presence of dredged material. In their 1987 survey, CAIS (1988) found extensive regions of relatively high concentrations of iron in the vicinity of the disposal area and extending northward into areas beyond the northern boundary of Site 4 (Figure 3-2A). Areas with iron concentrations above background levels were also observed in the northeast portion and in the southwest corner of the site. These results support the reported presence and distribution of dredged material within the site as documented by CSA (1987) from data collected during and after disposal operations.

The gamma-emitting isotope Bi-214 is associated with phosphate-rich sediment and was interpreted by CAIS to indicate the presence of dredged material (R. Culp, CAIS, personal communication, June 6, 1988). The sediment analysis by CAIS (1988) revealed relatively high values of Bi-214 in the vicinity

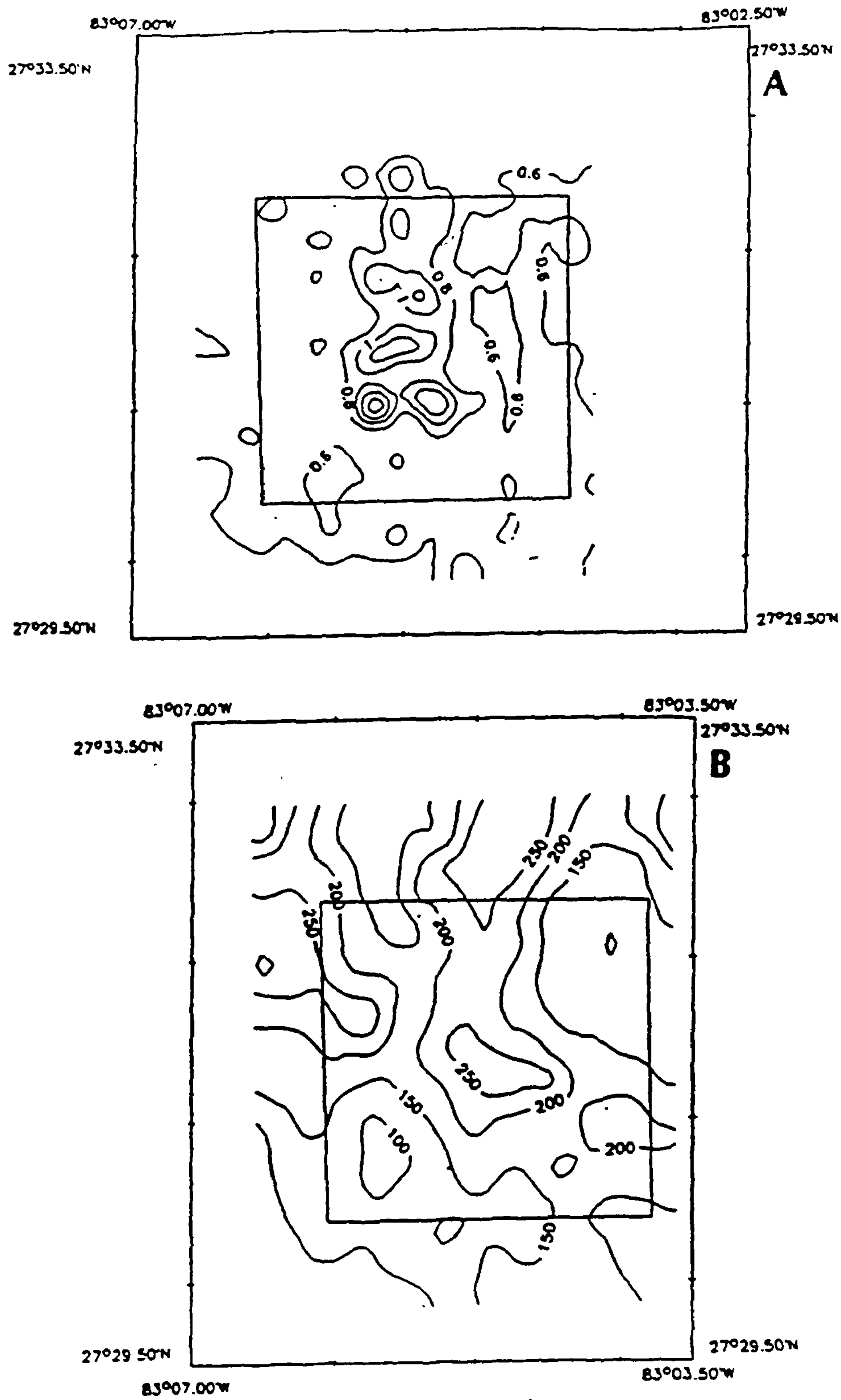


FIGURE 3-2. A. CONTOUR MAP OF PERCENT Fe_2O_3 AT SITE 4.
B. CONTOUR MAP OF Bi-214 ABSOLUTE ACTIVITY LEVELS AT SITE 4.

of the disposal area, with contours of high Bi-214 extending towards the north, northwest, and, possibly, to the southeast (Figure 3-2B). These results support the data on iron concentrations collected by the CS^3 system.

Two additional surveys have been performed at Site 4 since the June 1987 survey discussed above. The CS^3 system was not used in the later surveys because it could not collect adequate volumes of fine-grained sediment; only the gamma sled was used. During one of these additional surveys, the track lines were extended 2 nmi outside of the site on the west, north, and south, and 1 nmi on the east (R. Culp, CAIS, personal communication, June 16, 1988). The preliminary results of this survey confirmed the Bi-214 results of the June 1987 survey and determined that the contour of high Bi-214 extends further north and northwest. High concentrations were found approximately 2 nmi due north of the site, 1 nmi due south of the southeast corner of the site, and in an area to the northwest of the site (R. Culp, CAIS, personal communication, June 16, 1988). These results suggest transport of dredged material to areas outside the site boundary. Direct measurements of sediment transport that conclusively demonstrate the source of these Bi-214-rich sediments have not been made.

Ocean current data (see Section 3.2.2) indicate that water movement in the area of Site 4 is primarily towards the southeast with a variable northwesterly component (CSA, 1987). Review of available current data also suggests that current velocity and direction result in limited cross-shelf transport of materials from the coast (D. Hicks and P. Murphy, EPA Region IV, personal communication, August 22, 1988). The long-term water movement measured in this area is consistent with the potential for distribution of dredged material outside the site. However, short-term sediment trap data obtained during disposal activities were inconclusive in determining post-depositional movement of the dredged material. Based on the concentrations of phosphorus and strontium, and deposition rates of strontium and phosphate determined by sediment trap data, no movement to the boundary of the site was detected (CSA, 1987). It is important to note, however, that the sensitivity of the gamma sled would allow detection of dredged material signatures not normally afforded by conventional sediment trap analyses.

Finally, surface-wave-induced sediment transport out of the site boundaries may occur during extreme weather conditions such as hurricanes, possibly on the order of 7 to 12 percent of the time (CSA, 1987).

Even though the conditions for sediment transport at the site may occur, there is a low probability that consistent net transport of the dredged material from Site 4 will occur. Bathymetric data obtained in June 1987 (CAIS, 1988) indicated a topographic high in the vicinity of the disposal area, suggesting that the majority of the dredged material remained in place.

In summary, recently available data indicate that the present distribution of dredged material within Site 4 is similar to the distribution found during and immediately following disposal operations. A mound of dredged material is located in the southern half of the site and additional material is scattered throughout the northern half of the site. Several areas to the north, northwest, and southeast of the disposal site potentially contain dredged material. Limited transport of material within the site was observed seven months after dredging operations were ended. Substantial benthic colonization on the surface of the dredged material mound within seven months of the last disposal may also have inhibited further movement.

3.1.4.2 BIOLOGICAL ENVIRONMENT

Other than presumed burial of infauna directly under the mound of dredged material, there has been no demonstrated effect of disposal on infaunal communities within Site 4. There is no evidence that the hard-bottom areas in the vicinity of Site 4 have been adversely affected by disposal operations (CSA, 1986a, b, c; MML, 1988).

MML, in cooperation with EPA, ESD, Region IV, evaluated the fauna at seven locations, five near the outside perimeter of Site 4 and two within the control area (MML, 1988) (Figure 3-3). Station placement was directed by the results of the sediment mapping technique discussed above. All locations contained both soft- and hard-bottom habitats, which were sampled using two different methods. A diver-operated suction sampler was used to obtain quantitative samples of the macroinfauna of the thin sediment layer overlying the hard-bottom at six stations. Six replicate core samples were taken at each soft-bottom station.

Tables 3-2 and 3-3 summarize the community parameters for the soft- and hard-bottom stations, respectively. The number of infaunal taxa at the hard-bottom stations ranged from 193 at Station B2 to 287 at Station B3. Fewer taxa were found in the soft-bottom stations, probably because the sample size was much smaller (MML, 1988). The number of taxa at the soft-sediment stations ranged from 80 at Station B1 to 175 at Station C2 (Table 3-2). None of the stations was dominated by opportunistic taxa indicative of disturbed sediments.

Diversity was high at all soft-bottom stations (H' = 3.72 to 4.29), with the lowest value found at the control site (C2) and higher values found at stations identified by CAIS (1988) as areas to which dredged material may have moved. Diversity was even higher in the sediments associated with the hard-bottom areas (Table 3-3). Although the diversity was highest in the control areas, it was not significantly lower in the areas where dredged material might be present. Even though Station B2 had fewer taxa than the other stations, the H' value was greater than 4.0, indicating a diverse environment (Table 3-3).

An analysis of similarity among all of the stations sampled by

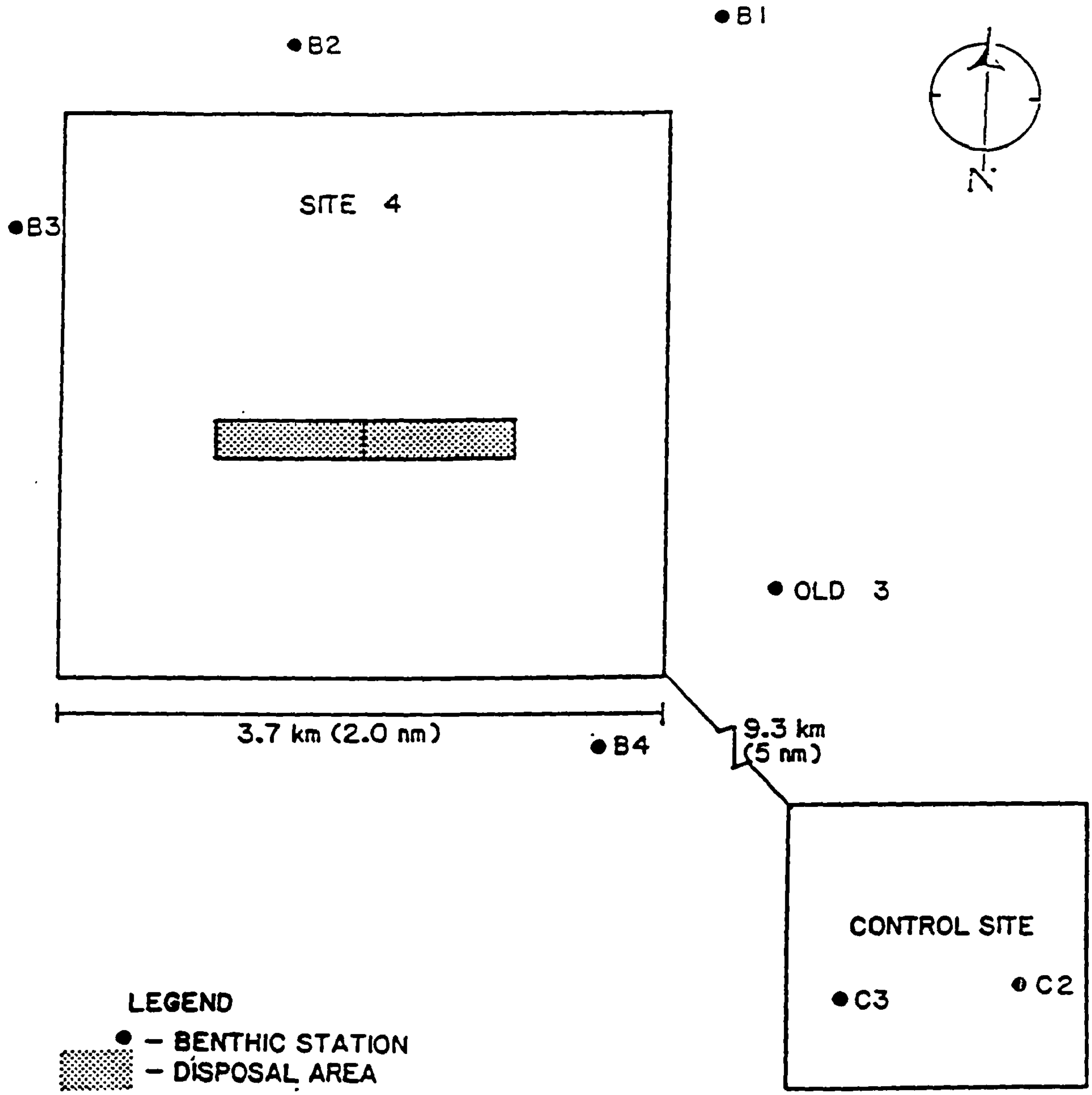


FIGURE 3-3. STATIONS SAMPLED BY MOTE MARINE LABORATORY IN AUGUST 1987 (FROM MML, 1988).

TABLE 3-2. SUMMARY OF COMMUNITY PARAMETERS FOR THE SEVEN SOFT-BOTTOM BENTHIC STATIONS IN THE VICINITY OF THE SITE 4 DISPOSAL AREA (Modified from MML, 1988).

Station	Total Taxa	No. of Indiv.	Density No./m^2	Evenness (Pielou's J')	Diversity $\hat{H}'$	Shannon Index H'	Margalef's Index
Old 3	128	387	7956	0.96	4.49	4.28	18.9
C2	175	1296	26,644	0.87	4.36	4.15	22.8
C3	99	407	8367	0.89	3.95	3.72	14.5
B1	80	186	3824	1.01	4.26	3.86	13.1
B2	85	290	5962	0.91	3.87	3.73	13.1
B3	114	394	8100	1.02	4.52	4.21	18.0
B4	128	474	9745	0.98	4.60	4.29	19.6
$\bar{X}$	115	490	10,085	-	-	-	-
(±SD)	(±32)	(±367)	(±7549)	-	-	-	-

$\bar{X}$=Mean.
SD=Standard deviation.
-=Not applicable.

TABLE 3-3. SUMMARY OF COMMUNITY PARAMETERS FOR THE SIX HARD-BOTTOM BENTHIC STATIONS IN THE VICINITY OF THE SITE 4 DISPOSAL AREA (Modified from MML, 1988).

Station	Total Taxa	No. of Indiv.	Density No./m^2	Evenness (Pielou's J')	Diversity $\hat{H}'$	Shannon Index H'	Margalef's Index
Old 3	256	1508	4021	0.91	4.91	4.65	30.8
C3	280	2039	5437	0.88	4.84	4.49	32.4
B1	209	1458	3888	0.85	4.34	4.15	23.7
B2	193	1006	2683	0.94	4.76	4.07	24.1
B3	287	2106	5616	0.85	4.64	4.45	31.1
B4	230	1215	3240	0.86	4.59	4.38	28.2
$\bar{X}$	243	1555	4148	-	-	-	-
(±SD)	(±38)	(±440)	(±1172)	-	-	-	-

$\bar{X}$=Mean.
SD=Standard deviation.
--=Not applicable.

MML indicated a distinction between the hard-bottom and soft-bottom stations (Figure 3-4). With the exception of Station B2, which was least similar to the other hard-bottom stations, the level of similarity among all hard-bottom stations was about 0.5. Although there were differences in the levels of similarity among the soft-bottom stations, there was no clear difference between control and potentially impacted stations.

Based on these results, MML concluded that there were no measurable or adverse impacts on the benthic fauna as a result of dredged material disposal at Site 4 (J. Culter, MML, personal communication to D. Hicks, September 26, 1988).

The 1991 EPA video of the disposal mound indicates that the rocky irregular relief of the material provides both cover and attached food sources for the variety of fish attracted to the mound. The amount of sessile invertebrates attached to the boulders also demonstrates the good habitat provided by the mound (Appendix F).

3.2 PHYSICAL ENVIRONMENT

3.2.1 Meteorology and Climate

The climate of the eastern Gulf of Mexico can be classified as subtropical with two distinct seasonal periods. During the spring and summer, the area is dominated by the western portion of the Bermuda high pressure cell. The climate during this period is warm and humid with persistent southeast tradewinds. Thunderstorms occur at frequent intervals from June through September. During the fall and winter, weather patterns are dominated by an anticyclonic cell over northeast Texas resulting in persistent north winds in the eastern Gulf. The fall and winter climate is mild, with cold fronts moving into the area

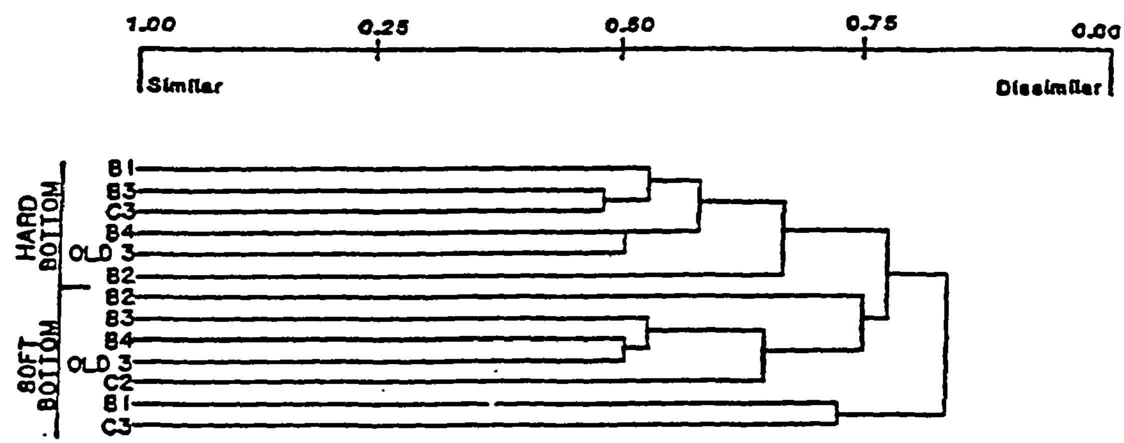


FIGURE 3-4. CLUSTER ANALYSIS OF INFAUNAL DATA COLLECTED IN AUGUST 1987 BY MOTE MARINE LABORATORY (FROM MML, 1988).

from the northwest, occasional extratropical cyclones approaching from the southwest, and occasional warm fronts approaching from the south.

The mean annual temperature for the Tampa Bay area is 22.3°C. August is the warmest month with a mean temperature of 27.9°C, while January is the coldest month with a mean temperature of 15.8°C. Mean annual rainfall is about 125 cm with approximately 60 percent of this precipitation associated with summer thunderstorms (US DOC, 1978). Wind speed is generally 7 to 10 knots throughout the year.

Heavy fogs are reported for 14 percent of the days between June and September. The fog generally appears during the night and early morning and dissipates soon after sunrise. Heavy fog occurs on only 2 percent of the days from April through October (US DOC, 1978; CE, 1975). These data reflect conditions in the Tampa Bay area; data are unavailable for the offshore waters near the alternative disposal sites.

Florida experiences an average of 1.7 tropical storms per year, although for individual years, the number of storms may vary from zero to five. During any year, the probability of landfall in the Tampa Bay area has been estimated at 9 percent for tropical cyclones (maximum sustained wind speed >35 knots), 6 percent for hurricanes (>64 knots), and 1 percent for great hurricanes (>109 knots) (Ichiye et al., 1973). The high winds and wave action associated with hurricanes could resuspend and redistribute significant amounts of bottom sediments in coastal waters, and thus affect transport and fate of disposed dredged materials.

3.2.2 Physical Oceanography

Circulation in the eastern Gulf of Mexico is dominated by the Loop Current and detached cyclonic eddies along its northern boundary (Figure 3-5). The Loop Current is a continuation of the Yucatan Current which originates in the western Cayman Sea. The current enters the Gulf of Mexico through the Yucatan Channel between the Yucatan Peninsula and Cuba, makes a clockwise loop through the Gulf of Mexico, and exits eastward through the Straits of Florida. The degree of intrusion of the Loop Current into the Gulf varies. The mean position of the northern edge is 26°N, but this position may fluctuate between 24° and 28°N (Maul, 1977).

Off western Florida, most of the Loop Current water does not mix with shelf waters because the main portion of the Loop Current is generally confined to areas seaward of the 100-m isobath. However, cyclonic eddies may detach from the northern edge of the Loop Current, move on to the shelf, and mix with shelf waters. Upwelled remnants of cold, saline Loop Current water have been reported on the shelf off Mississippi, Alabama, and Florida (Manheim et al., 1976). Some shelf water may be entrained along the boundary of the Loop Current, resulting in southward transport of outer shelf water through the Straits of Florida (Tolbert and Salsman, 1964).

Circulation on the western Florida continental shelf is heavily influenced by eddies from the Loop Current. The eddies create low frequency (5 to 20 days), locally fluctuating current patterns with velocities of 10 to 30 cm/sec (Chew et al., 1959). Studies conducted on the shelf about 180 km south of the disposal sites indicate mean bottom current velocities of 5 to 10 cm/sec with flow parallel to bathymetric contours (Mooers and Price, 1975). These mean currents are seasonally variable, with net southerly flow during the winter on the inner and mid-shelf and northerly flow during the summer.

Mean bottom currents up to 5 cm/sec have been reported on the Mississippi, Alabama, and Florida shelf north of the alternative disposal areas (Mooers and Price, 1975). Bottom currents capable

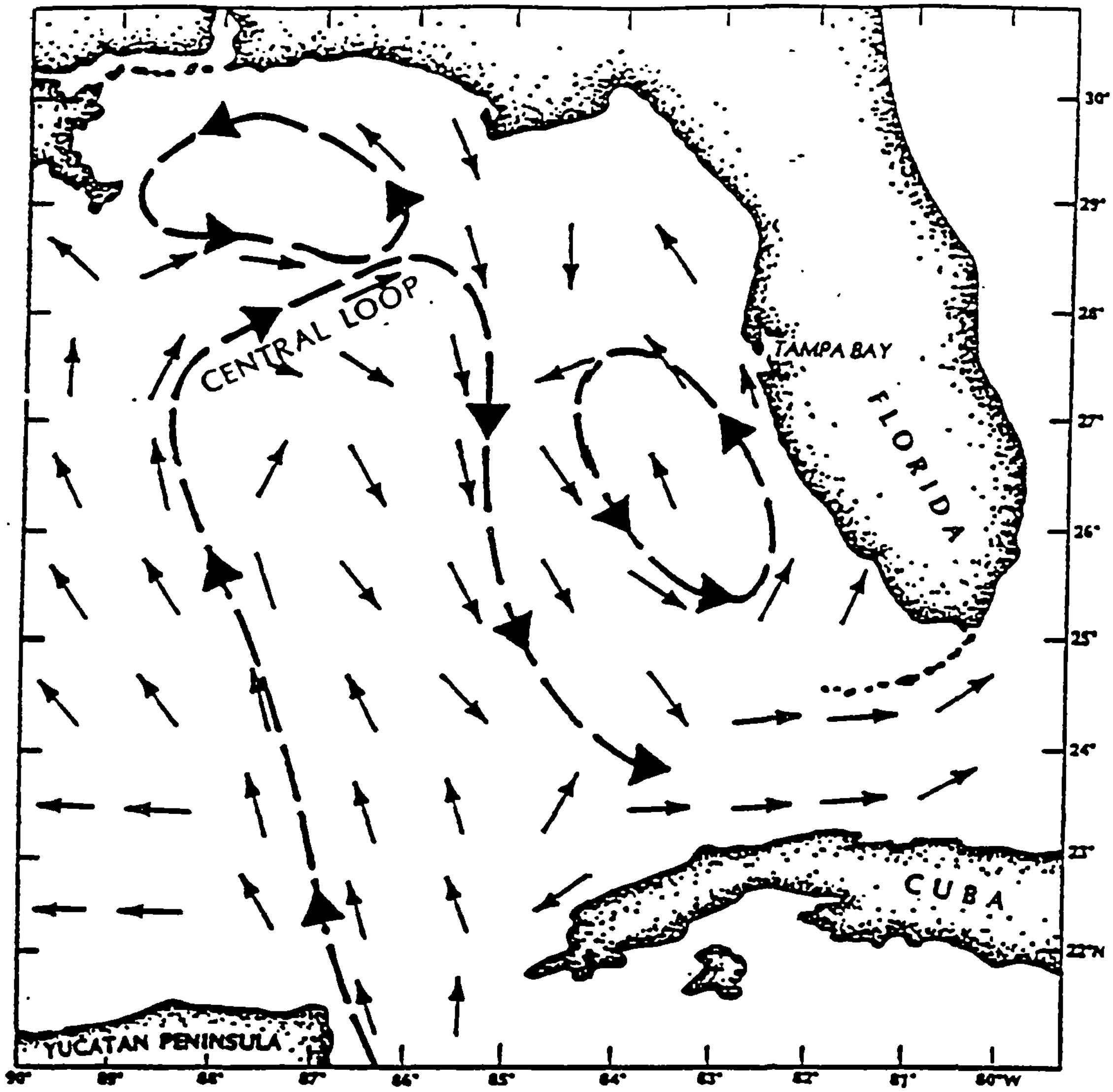


FIGURE 3-5. TYPICAL SURFACE CURRENT PATTERNS ASSOCIATED WITH THE LOOP CURRENT AND DETACHED CYCLONIC EDDIES IN SEPTEMBER 1970 (AFTER ICHIYE ET AL., 1973).

of creating a bottom turbidity layer have been reported along the 30-m isobath west of Tampa Bay (Joyce and Williams, 1969). Drift card studies of surface currents on the west Florida shelf inshore of 83°W indicated a wind-induced northwesterly movement in July and southwesterly flow in November, with velocities of about 8 cm/sec during both seasons (Hela et al., 1955).

Extensive bottom current data for Site 4 are available from the continuous recording current meters deployed at the site in 1984 and 1985 (Battelle, 1986a,b,c; CSA, 1984). Current velocities at Site 4 generally average about 6 cm/sec throughout the year, with occasional (weekly to monthly) brief periods in which current velocities reach 20 cm/sec. Current direction is predominantly to the south and southeast throughout the year, although a northerly and northwesterly component also is apparent in the summer and fall.

Wave heights on the inner and mid-shelf off Tampa Bay are greatest in the winter (excluding periods of hurricanes) when waves approach from the north and northwest. During winter, wave heights less than 2 m comprise 70 to 80 percent of the observations, waves between 2 and 4 m represent 20 to 30 percent of the observations, and wave heights over 4 m are reported in only 1 percent of the observations (Jordan, 1973). During summer, 80 to 90 percent of wave heights are less than 1 m; waves between 1 and 4 m represent 10 to 20 percent of the observations, and less than 1 percent of the observed wave heights are greater than 4 m. No specific data for wave heights at Sites 4 have been collected during the recent monitoring studies.

Sediment transport models suggest that the critical shear stress necessary to initiate particle motion would be exceeded approximately 12 percent of the time for silt-sized particles and 7 percent of the time for 0.5-mm sand-sized particles (CSA, 1987). Such models do not account for effects of major atmospheric disturbances such as hurricanes that frequent this region (see Section 3.2.1). These events may be expected to influence currents and wave height, and therefore sediment movement within the disposal areas. No quantitative data exist to support or reject this supposition.

3.2.3 Water Column Characteristics

3.2.3.1 Temperature

The water column over the shallow shelf (<30m) generally exhibits very weak temperature and/or salinity stratification. Surface and bottom water temperatures may reach 30°C in summer and decrease to 17°C in winter (Figure 3-6). When a thermocline is present, differences in the temperatures of surface and bottom waters on the shelf shoreward of the 30-m isobath may reach 5°C (Molinari et al., 1975), although the range in temperatures often is much smaller. The strongest vertical gradients are associated with the intrusion of cool, saline Loop Current eddy waters.

Water column characteristics were surveyed in September and October 1983 (JRB, 1984). Temperatures ranged from 26.3 to 27.2°C at the surface and 26.2 to 26.9°C at the bottom. The mean vertical temperature differential was 0.3°C.

3.2.3.2 Salinity

Salinity on the shelf off Tampa Bay is affected by upwelling of saline Loop Current water and, to a lesser extent, freshwater input. Because upwelling and freshwater input are more prevalent during the summer, the potential for vertical stratification is greater during this period (Figure 3-7). Salinity on the shelf generally increases both with depth and distance from shore

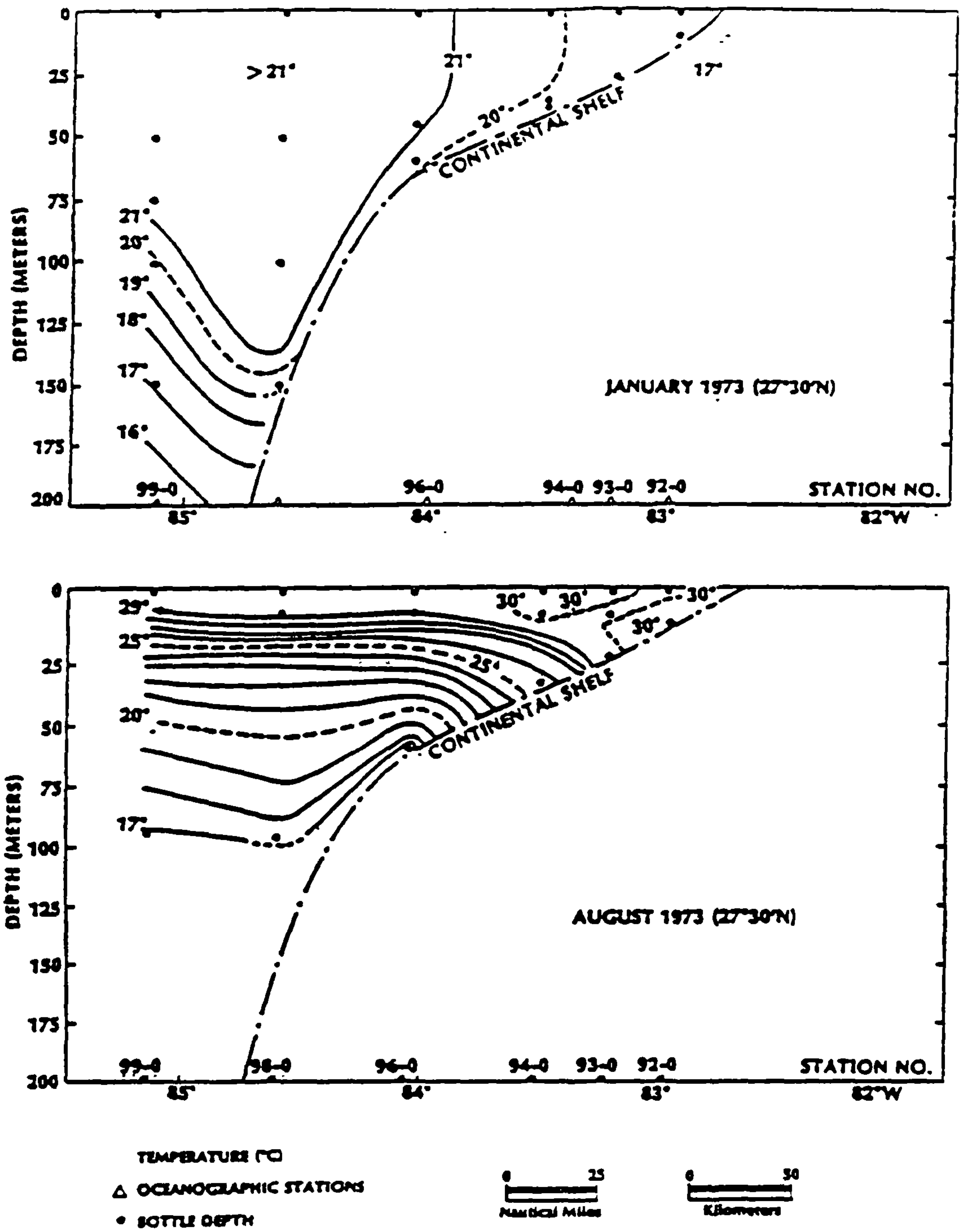


FIGURE 3-6. TEMPERATURE PROFILES ALONG 27°30'N FOR JANUARY AND AUGUST 1973 (FROM MOLINARI ET AL., 1975).

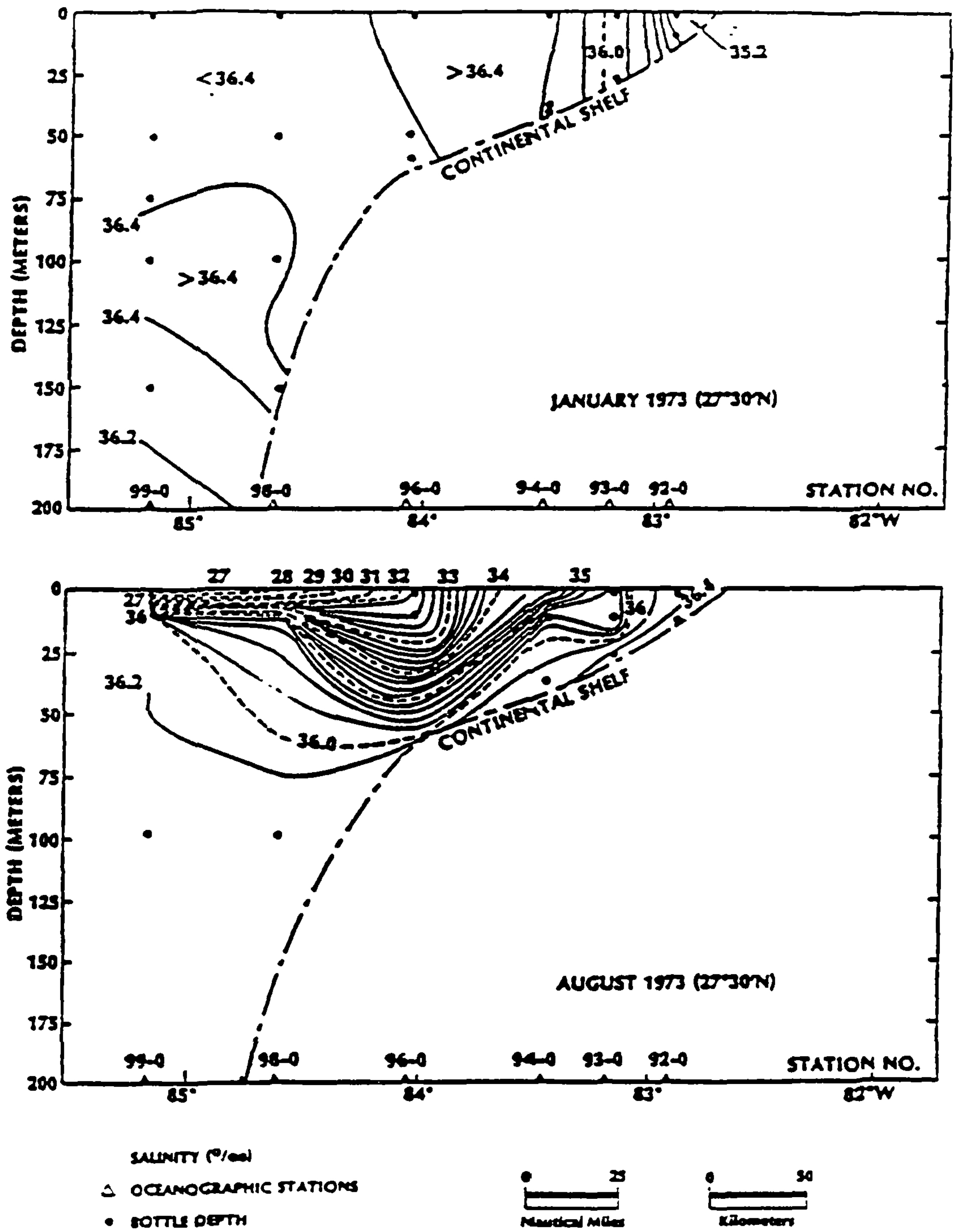


FIGURE 3-7. SALINITY PROFILES ALONG 27°30'N FOR JANUARY AND AUGUST 1973 (FROM MOLINARI ET AL., 1975).

(EPA/IEC, 1981).

At Site 4, salinity in September and October 1983 ranged from 35.07 to 35.52 ppt at the surface and from 35.01 to 36.65 ppt at the bottom (JRB, 1984). The mean vertical salinity gradient was 0.2 ppt.

3.2.3.3 Dissolved Oxygen

Dissolved oxygen (DO) concentrations near the alternative disposal sites are generally above saturation levels. Concentrations decrease with depth, and there is some evidence of increased values with distance from shore (JRB, 1984). Oxygen concentrations ranged from 7.2 to 7.9 ml/l in September 1979, January 1980, and May 1982 (US EPA, 1983). In September and October 1983, DO concentrations were 5.9 to 6.6 ml/l in surface water and 5.2 to 6.1 ml/l in bottom waters (JRB, 1984).

3.2.3.4 Turbidity

There is a general pattern of decreasing turbidity with distance from shore due to input of suspended sediments from rivers, resuspension of bottom sediments by waves and tides, and biological primary productivity in nearshore coastal waters. This inshore-offshore trend was clearly apparent in the data of Manheim et al. (1976) collected about 50 km north of the previously considered alternative disposal sites (Figure 3-8). Suspended sediments in nearshore areas tend to have a higher carbonate fraction than do the suspended particulates from the outer shelf, which are primarily biogenic. The mineralogy of nearshore suspended material also closely parallels regional trends of bottom sediment mineralogy, indicating a local origin either from resuspension of bottom sediments or terrigenous

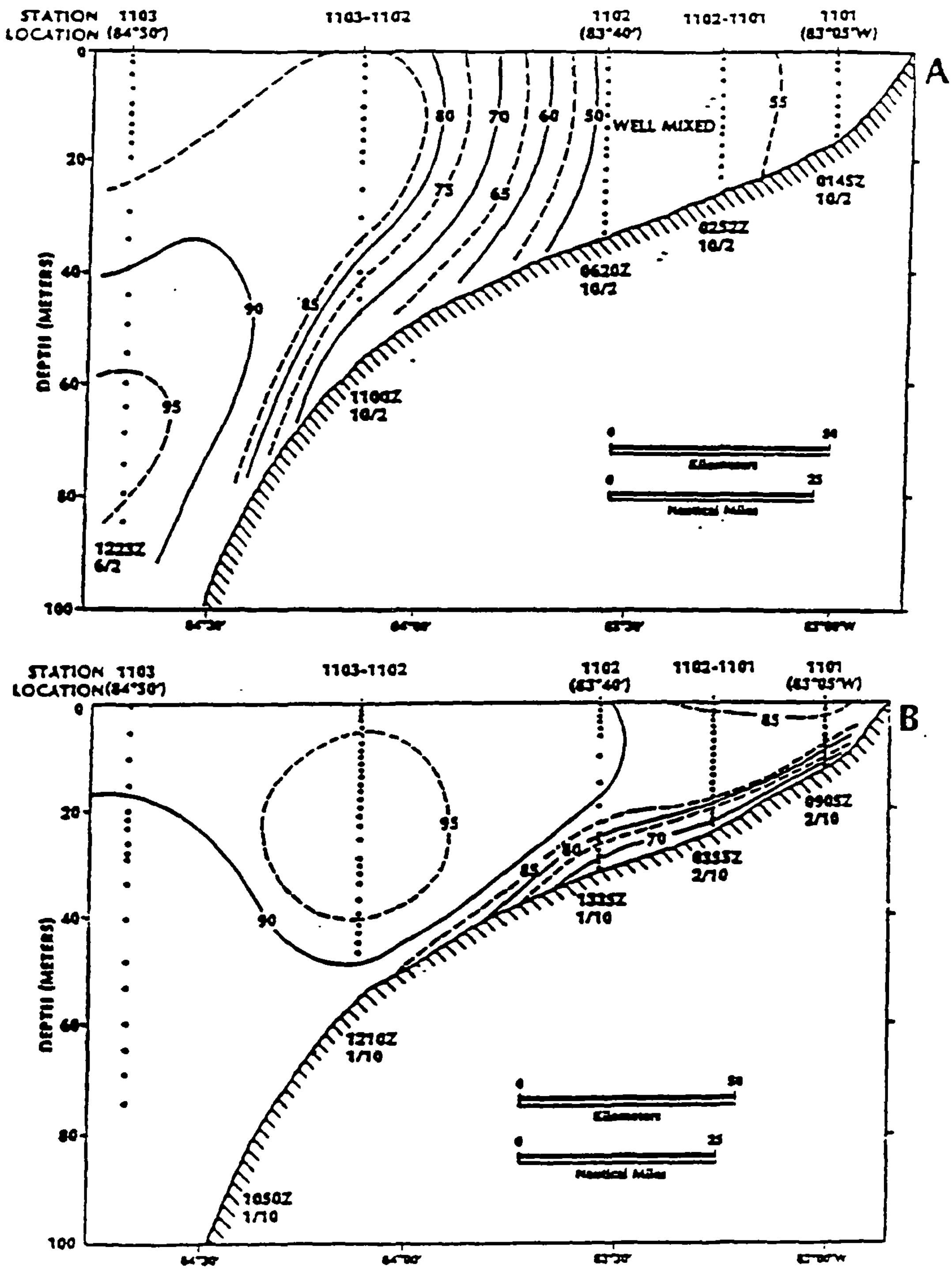


FIGURE 3-8. PERCENT LIGHT TRANSMISSION PROFILES AT 27°55'N
A. JANUARY AND FEBRUARY 1975. B. SEPTEMBER 1975.
(FROM MANHEIM ET AL., 1976).

runoff.

Figure 3-8 illustrates the seasonality of turbidity levels typical of coastal waters on the western Florida shelf (Manheim et al., 1976). Winter transmissivity levels do not exceed 55 percent in shelf waters shoreward of 30 nmi. Turbidity levels are vertically homogeneous, with only a slight increase in near-bottom waters. During summer, the reduced turbulence results in transmissivities in excess of 85 percent throughout the water column, except higher turbidity levels associated with a near-bottom nepheloid layer.

During the fall of 1983, turbidity levels at Site 4 averaged 0.46 NTU (0.28-0.72) and 0.45 NTU (0.25-0,64) for surface and bottom waters, respectively (JRB, 1984). The similarity between surface and bottom waters at Site 4 indicate a great degree of water column mixing at this site.

3.2.3.5 Nutrients

Although data are very limited, nutrient (e.g., nitrate, phosphate, and silicate) concentrations in the area of Site 4 are typically low with little seasonal variation. Data for the region from Graham et al. (1954) indicate that phosphate levels are on the low end of the overall range for the Gulf. This finding is consistent with the fact that eastern Gulf water originates in the western Caribbean, an area with generally low nutrient levels (Atwood et al., 1976). Tampa Bay waters contain high levels of phosphates, but there is no evidence that the Bay waters have a measurable influence on nutrient conditions at the disposal sites (US EPA, 1983).

3.2.3.6 Trace Metals and Chlorinated Hydrocarbons

Water column analyses for a variety of contaminants have been conducted at sites northeast of Site 4. With the exception of lead, trace metal concentrations are typical of levels reported previously for Florida waters (State University System Institute of Oceanography (SUSIO), 1974). Elevated lead concentrations probably reflect the influence of lead fallout and freshwater runoff from the Tampa-St. Petersburg metropolitan area. During surveys in 1979 and 1980 by IEC (1981), dissolved mercury (Hg) concentrations from less than 3.0 to 11.2 ng/l in September-October, and from less than 3.0 to 3.7 ng/l in January were measured. Dissolved cadmium (Cd) concentrations ranged from 3.6 to 167 ng/l in September- October, and from 0.7 to 14.0 ng/l in January. Dissolved lead (Pb) concentrations ranged from 13.3 to 163 ng/l in September-October, and were less than 200 ng/l in January. Particulate Hg concentrations ranged from 0.7 to 5.0 ng/l in September-October, and from 2.1 to 4.3 ng/l in January. Particulate Cd ranged from 14.1 to 31.3 ng/l in September-October, and from 3.9 to 9.7 ng/l in January. Particulate Pb ranged from 8.8 to 58.7 ng/l in September-October, and from 5.0 to 23.8 ng/l in January (IEC, 1981).

3.2.4 Regional Geology and Sediment Characteristics

The west Florida continental shelf extends seaward about 200 km from Tampa Bay to a depth of 200 m (Shepard, 1973). The continental slope extends from a depth of 200 m to the edge of the Florida Escarpment at a depth of 1600 to 2400 m (Jordan and Steward, 1959). The shelf west of Tampa Bay is a plateau of Pleistocene limestone with a drowned karst topography (Price, 1954). The shelf gradient averages 0.5 m/km and the bathymetry is characterized by a gently rolling bottom, irregularly covered by a thin veneer of unconsolidated sediments, and punctuated by sinkholes, fissures, and rock outcrops. The outcrops provide substrata for attachment of coral, algae, and associated hard-bottom organisms. Most of the living corals are found shoreward of the 20-m contour, although they do exist to a depth of 60 m (Gould and Stewart, 1956).

Nearshore sediments off Tampa Bay are predominantly quartz sands. The proportion of carbonate sediments increases with distance offshore, until about 40 km from the coast at a depth of 30 m, where the sediments are primarily carbonate shell fragments (Figure 3-9). Sediments are predominantly sands with no consistent depth-related gradient in grain size (Figure 3-10). With the exception of the nearshore quartz zones, most of the unconsolidated sediments 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).

Prior to the onset of dredged material disposal, the sediments of Site 4 were characterized as coarse to fine-grained sands with varying but minor amounts of either silt or gravel-sized particles (US EPA, 1983). The median grain size ranged from 0.14 to 3.4 phi (0.91 to 0.09 mm). The mean percent composition of the sediments was 2.3 percent gravel, 87 percent sand, and 9.7 percent silt (JRB, 1984). In localized areas, gravel reached 38.1 percent and silt reached 25.6 percent. Clay particles typically were absent, but were reported to constitute about 2 percent of some samples (JRB, 1983, 1984).

Video observations made prior to dredged material disposal at Site 4 indicated that the majority of the site (48.5 percent) consisted of flat, featureless sandy bottom lacking visible life. Large scale sand ripples composed an additional 32 percent of the bottom area. Scattered live-bottom areas and densely populated bottoms constituted 16.9 percent and 0.8 percent, respectively,

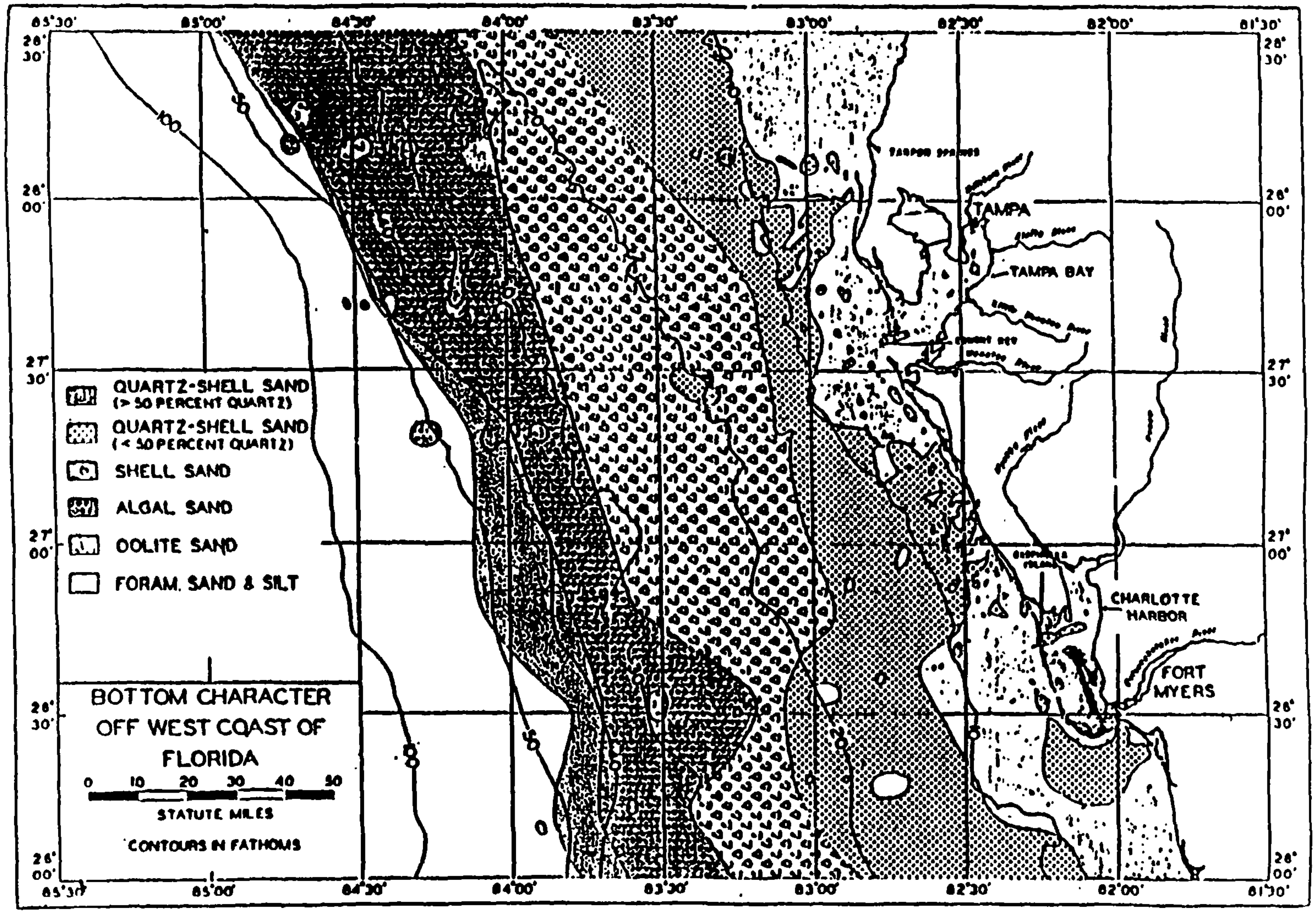


FIGURE 3-9. BOTTOM CHARACTER OF WEST FLORIDA SHELF (FROM GOULD AND STEWART, 1956).

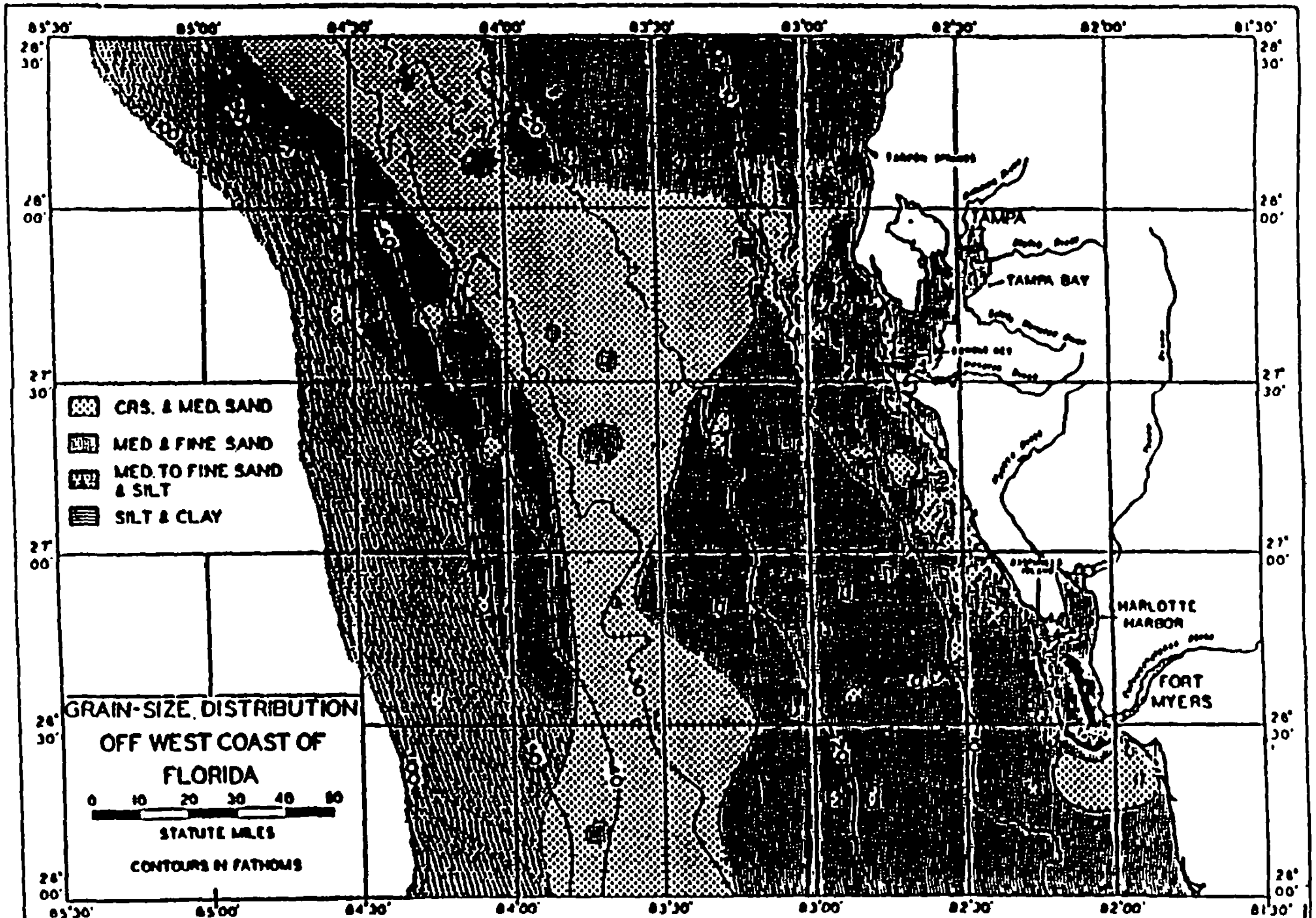


FIGURE 3-10. GRAIN SIZE DISTRIBUTION OF SEDIMENTS ON THE WEST FLORIDA SHELF (FROM GOULD AND STEWART, 1956).

of the surveyed bottom area (US EPA 1983).

Monitoring subsequent to dredged material disposal has indicated some changes in sediment composition within the boundaries of Site 4 (Battelle, 1986a,b,c; CSA, 1984). Stations affected by disposal have a higher phosphate content, a lower strontium content, and a lower percentage of total organic carbon in the fine fraction. No disposal-related differences in the percentage of clay or silt/clay have been detected. Natural spatial variability in these parameters and positioning error in locating stations may have obscured such changes if any did occur. Lumps of dredged sediments were seen occasionally in areas within the site which were east, north, and northeast of the disposal area. Chemical evidence for the presence of dredged materials was noted at several locations throughout the site, indicating that dispersal of dredged material by water currents was not limited to the direction of the predominant bottom current (CSA, 1987).

3.3 BIOLOGICAL ENVIRONMENT

3.3.1 Plankton

3.3.1.1 Phytoplankton

Diatoms and dinoflagellates dominate the plankton communities in the eastern Gulf. A typical phytoplankton assemblage for the eastern Gulf waters is presented in Table 3-4. A list of dominant shelf species of diatoms and dinoflagellates collected near Tampa Bay is given in Table 3-5.

During the Hourglass Cruises conducted in 1965-67 by the Florida Department of Natural Resources (FDNR), 232 dinoflagellate taxa were collected between St. Petersburg and Ft.

TABLE 3-4. TAXA COMMONLY FOUND IN COASTAL AND OPEN GULF WATER ASSEMBLAGES IN THE GULF OF MEXICO (From Steidinger, 1973).

DIATOMS	DINOFLAGELLATES
Chaetoceros compressum	Blepharocysta splendorman's
Guinardia flaccida	Ceratium furca
Hemiaulus hauckii	C. fuscus
Plagiogramma vanheukii	C. brichoceros
Rhizosolenia robusta	C. massiliense
R. umbricata	C. carriense
Thalassiothrix frauenfeldii	C. tripos
	Diplopsalis lenticula var. asymmetrica
	Heteraulacus polyedricus
	Peridinium spp.
	Podolampas spp.

TABLE 3-5. DOMINANT PHYTOPLANKTON SPECIES FROM THE SHELF IN THE VICINITY OF TAMPA BAY (from US EPA, 1983).[a]

DIATOMS	DINOFLAGELLATES
Rhizosolenia alata	*Gonyaulax monilata*
R. setigera	*Ptychodiscus brevis*
R. stolterfothii	*Gonyaulax polygramma*
Skeletonema costatum	*Katodinum 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*

[a]Species are listed in order of decreasing dominance.

Meyers, Florida. Generally, diatom abundance exceeds that of dinoflagellates (Steidinger et al., 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 that of diatoms; however, the greatest diversity occurs in transitional waters (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) (see Section 3.3.10).

3.3.1.2 Zooplankton

The zooplankton population in the Gulf is basically homogenous from Texas to middle Florida (T. Hopkins, University of South Florida, personal communication, January 21, 1987). The dominant factor affecting zooplankton distribution and production in the Gulf of Mexico is the Loop Current (Hopkins, 1973). The waters of the Loop Current vary significantly with season and are constantly changing, resulting in a zooplankton population with a distinct seasonality (Houde and Chitty, 1976). For example, when the Loop Current moves over the continental shelf, it often brings open-ocean fauna to the Tampa Bay area.

Zooplankton collected from Mississippi, Alabama, and Florida during the Mississippi, Alabama, Florida (MAFLA) studies are listed in Table 3-6. Copepods, pteropods, chaetognaths, shrimp and crab larvae, and fish eggs are characteristic members of offshore zooplankton in the Gulf of Mexico (T. Hopkins, University of South Florida, personal communication, January 21, 1987). Species collected off Tampa Bay are listed in Table 3-7.

3.3.2 Benthic Algae

There is a rich benthic algal flora of perennial and annual, subtropical and tropical species on the inner continental shelf along the Florida Gulf coast (Dawes and Breedveld, 1969). Most species are limited to hard substrata, but the green alga *Caulerpa* is reported to form extensive growths on smooth areas (shell and quartz sand) between limestone outcroppings at 18.3 mi off Tampa Bay (Joyce and Williams, 1969). Phillips and Springer (1960) reported an abundant and varied algal flora on limestone reefs at 10.5 to 18 m depth off Johns Beach in Pinellas County, north of Tampa Bay. Epiphytic flora, a large percentage of which are red algae, accounted for nearly half of the 158 species reported. These authors noted vast carpets of the green alga, *Halimeda scabra*, composed of plants two to three inches tall, on reefs at 13.5 to 18 m depth. The green alga *Rhipocephalus phoenix* and the brown alga *Sargassum filipendula* were often associated with the *Halimeda*. Crustose coralline algae in the genera *Goniolithon* and *Lithothamnion* were occasionally observed as large knobby growths on the reefs. Smith (1976a) reported species of the green algae *Halimeda*, *Udotea*, and *Penicillus* as characteristic of the back reef zone of shallow (12-18 m) mid-eastern Gulf reefs.

Dark algal patches were commonly observed on the flat or slightly rippled sandy areas of Site 4 prior to the dumping of

TABLE 3-6. ZOOPLANKTON COLLECTED DURING MAFLA STUDIES. (Adapted from US EPA, 1983).

PROTOZOA
- *Globigerina* sp.
- Other protozoans

HYDROZOA
- Siphonophores
- Medusae

ANNELIDA
- Polychaete larvae

MOLLUSCA
- Gastropod veligers
- Pteropods
- Bivalve larvae

CRUSTACEA
- Cladocerans
- Ostracods
- Copepods
  - Calanoids
    - *Centropages furcatus*
    - *Eucalanus* sp.
    - *Undinula vulgaris*
    - Other calanoids
  - Harpacticoids
  - Cyclopoids
    - *Corycaeus* sp.
    - *Oithona* sp.
    - *Oncaea* sp.
    - Other cyclopoids
  - Copepod copepodites
  - Copepod nauplii
- Decapods
  - *Lucifer faxoni*
  - Other shrimp-like forms
  - Crab larvae
- Other crustaceans

ECHINODERMATA
- Echinoderm larvae

CHAETOGNATHA
- Chaetognaths

CHORDATA
- Tunicates
  - Oikopleuridae
  - Fritillaridae
- Other tunicates
- Fish eggs
- Fish larvae

Other zooplankton

TABLE 3-7. ZOOPLANKTON SPECIES COLLECTED OFF TAMPA BAY IN DEPTHS OF 30 M AND/OR 14 M. SPECIES MARKED WITH AN ASTERISK OCCURRED AT 14 M. (From Hopkins et al., 1981)

COPEPODA

- Acartia danae
- Arcocalanus longicornis*
- Calocalanus pavo
- Candacia bipinnata
- C. curta
- C. pachydactyla
- Centropages violaceous
- Copilia mirabilis
- Corycaeus lautus
- C. speciosus*
- Eucalanus sewelli
- Euchaeta marina
- E. paraconcinna
- Farranula gracilis
- Macrosetella gracilis
- Microsetella rosea
- Nannocalanus minor
- Paracandacia simplex
- Pontella plumata
- Rhincalanus cornutus
- Scolecithrix danae
- Temora stylifera
- T. turbinata*
- Undinula vulgaris*

EUPHAUSIACEA

- Stylocheiron carinatum

DECAPODA

- Lucifer faxoni*

dredged sediments (US EPA, 1983). At two live-bottom stations (areas covered by algae, sponges, corals, and other biota) surveyed within Site 4 during three post-disposal cruises (CSA, 1986a,b,c), benthic algae accounted for approximately 37 and 61 percent of the biotic cover. Algal species observed by divers at live-bottom stations within or in the immediate vicinity of Site 4 included Halimeda sp., Udotea sp., Sargassum sp., Gracilaria sp., and unidentified coralline forms. Recent diver surveys show encrusting of the disposal mound boulders by calcareous algae (Appendix F).

3.3.3 Benthic Invertebrates

The shallow sandy areas are inhabited by species from more inshore waters as well as by tropical species. Analysis of the polychaete communities at previously designated Sites A, B, 3, and 4 (combined) revealed a high degree of distinct species-habitat groupings (US EPA, 1983). In general, the species diversity and density of the polychaete communities decreased with increasing depth and increasing percent fines, with the gravelly habitats generally supporting the most diverse communities. Six of 45 polychaete families each accounted for greater than 5 percent of the total composition: Spionidae, Syllidae, Eunicidae, Sabellidae, Onuphidae, and Nephtyidae.

Scattered limestone rock outcrops on the shallow shelf and in deeper water are inhabited by sponges, corals, bryozoans, tunicates, and a diverse motile fauna of crustaceans, polychaetes, molluscs, echinoderms, and fish (FDNR, 1983a). A similar assemblage in 18.3 m off Tampa Bay was described by Joyce and Williams (1969) as a typical Gulf reef community. Organisms noted during reconnaissance of a partially buried rocky area previously designated Site A (14 m depth) included gorgonian octocorals (mainly Muricea elongata); the hard corals Stephanocoenia michelinii, Siderastrea radians, Millepora alcicornis, Cladocora arbuscula, Solenastrea hyades, Isophyllia sinuosa, Manicina areolata, Scolymia lacera, and Phyllangia americana; the asteroid Echinaster sp.; the sea urchin Diadema antillarum; unidentified sponges; and unidentified holothurians (sea cucumbers). Every attached sponge and gorgonian support numerous ophiuroids (brittle stars, probably Ophiothrix) (FDNR, 1983b).

Carbonate sediments of the middle shelf I zone (30-60 m) contain loggerhead sponge and coral communities supporting many other tropical species. Communities are highly diverse and contain more species than are found in the inshore zones (Lyons and Collard, 1974). In the middle shelf II (60-140 m) region, few rock outcrops are found. Dominant sessile epifaunal organisms are sponges, bryozoans, ascidians, and alcyonarians attached to small rocks and shells. Small molluscan and crustacean species are very common (Lyons and Collard, 1974). Species diversity decreases at the deep shelf depths, but many species typical of the middle shelf II zone also occur here (Lyons and Collard, 1974).

Site 4 is predominately characterized by fine sands and coarse silts (US EPA, 1983). As seen in video surveys, the vast majority of this area was devoid of visible life, though sand dollars and dark "algal" patches were commonly observed (US EPA, 1983). Large-scale sand ripples, containing few visible benthic organisms, also accounted for a large portion of Site 4. Annelids, arthropods, molluscs, echinoderms, and miscellaneous phyla accounted for 62, 15, 9, 3, and 10 percent, respectively, of the total number of individuals in benthic cores (Barry Vittor & Associates, Inc., unpublished data). Numerically dominant infaunal species are shown in Table 3-8.

Portions of Site 4 contain live bottom. At two such stations surveyed during three post-disposal cruises (CSA, 1986a,b,c),

TABLE 3-8. DOMINANT[1] INFAUNA AT SITE 4 (PRIOR TO THE DUMPING OF DREDGED SEDIMENTS). THE NUMBERS FOLLOWING EACH TAXA REPRESENT THE NUMBER OF STATIONS WHERE THE TAXON WAS DOMINANT.

Taxon	0.016-m^2 core Barry Vittor[2] April 1984 (8 stations)	0.13-m^2 box core JRB Associates (1984) Sept/Oct 1983 (2 stations)
Annelida		
Archiannelida		
Polygordius spp.	1	-
Oligochaeta	5	2
Polychaeta		
Capitellidae		
Mediomastus spp.	-	1
Chrysopetalidae		
Paleanotus sp. A	1	-
Dorvilleidae		
Protodorvillea kefersteini	3	-
Eunicidae		
Eunice vittatta	-	1
Goniadidae		
Goniadides carolinae	2	1
Maldanidae	-	1
Nephtyidae		
Aglaophamus verrilli	3	2
Nereididae		
Ceratocephale oculata	2	-
Ceratocephale sp. B	1	-
Nereis pelagica	-	1
Opheliidae		
Armandia maculata	7	-
Oweniidae		
Owenia sp. A	2	-
Paraonidae		
Aricidea taylori	1	-
Aricidea sp. C	-	1
Cirrophorus spp.	4	1
Pilargidae		
Ancistrosyllis hartmanae	1	-
Sabellidae		
Fabriciola trilobata	2	-
Spionidae	1	-
Apoprionospio dayi	1	-
Paraprionospio pinnata	3	-
Prionospio cristata	-	1

TABLE 3-8. (Continued).

Taxon	0.016-m^2 core Barry Vittor[2] April 1984 (8 stations)	0.13-m^2 box core JRB Associates (1984) Sept/Oct 1983 (2 stations)
Syllidae		
Pionosyllis gesae	2	-
Arthropoda		
Amphipoda		
Monoculodes nyei	2	-
Isopoda		
Xenanthura brevitelson	2	-
Ostracoda	7	-
Brachiopoda	3	-
Glottidia pyramidata	-	1
Echinodermata		
Asteroidea	1	-
Echinoidea	2	-
Mollusca		
Gastropoda		
Strombiformis auricinctus	1	-
Bivalvia	3	-
Lucinidae	-	1
Tellina spp.	1	-
Tellina texana	-	1
Platyhelminthes		
Turbellaria	1	-
Rhynchocoela	4	-
Sipuncula		
Aspidosiphon albus	4	-

[1] Comprising at least 2 percent of total number of individuals at any station.

[2] Compiled by Barry Vittor & Associates, Inc., Survey I (April 1984) unpublished data.

biota covered approximately 8 and 38 percent, respectively, of the bottom surface. Sand covered greater than 50 percent of the bottom at both stations, although rock and shell rubble were also present. Epifaunal species observed by divers at live-bottom stations within or in the immediate vicinity of Site 4 are listed in Table 3-9. Many of these groups of organisms were present during EPA's recent video of the disposal mound (see Appendix F).

3.3.4 Demersal and Pelagic Fish

Fifty-nine species of fishes have been reported offshore of Tampa Bay by Moe and Martin (1965) and EPA/IEC (1981) (see Table 3-10). The most abundant species were leopard searobin *Prionotus scitulus*, sand perch *Diplectrum formosum*, tomtate *Haemulon aurolineatum*, pinfish *Lagodon rhomboides*, blackcheek tonguefish *Symphurus plagiusa*, jackknife fish *Equetus lanceolatus*, pigfish *Orthopristis chrysoptera*, fringed flounder *Etropus crossotus*, and spotted wiff *Citharichthys macrops*. These species are characteristic of sandy and rocky habitats and are found from the intertidal zone to water depths of 200 m.

The dominant fish taxa occur throughout most of the year in the vicinity of Sites 4 and 5A, although offshore 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, except *Lagodon rhomboides*, which spawns in winter and spring, and *Prionotus scitulus*, which spawns in late summer and fall (Moe and Martin, 1965; Smith, 1976a).

The following teleosts, most of which are prevalent on the continental shelf, are associated with the pink shrimp, *Penaeus duorarum*: silver jenny *Eucinostomus gula*, sand perch *Diplectrum formosum*, leopard searobin *Prionotus scitulu* , fringed flounder

TABLE 3-9. EPIBIOTA OBSERVED BY DIVERS AT SITE 4 OR IN THE IMMEDIATE VICINITY (CSA, 1986a,b,c; 1987)[1].

CHLOROPHYTA (Green Algae)

- *Caulerpa* sp.
- *Codium* sp.
- *Halimeda* sp.
- *Udotea* sp.

PHAEOPHYTA (Brown Algae)

- *Sargassum* sp.

RHODOPHYTA (Red Algae)

- *Gracilaria* sp.
- *Spyridia* sp.
- Unid. coralline algae

ANTHOPHYTA (Flowering Plants)

- *Halophila decipiens*

PORIFERA (Sponges)

- *Aiolochroia crassa*
- *Aplysina fistularis*
- *Axinella polycapella*
- *Axinella* sp.
- *Cinachyra alloclada*
- *Cinachyra* sp.
- *Cliona* sp.
- *Epipolasis lithophaga*
- *Geodia gibberosa*
- *Homaxinella waltonsmithi*
- *Ircinia* sp.
- *Oxeostilon burtoni*
- *Phakellia folium*
- *Placospongia melobesioides*
- *Placospongia* sp.
- *Pseudaxinella* sp.
- *Siphonodictyon* sp.
- *Teichaxinella* sp.

CNIDARIA

OCTOCORALLIA (Octocorals)

- *Eunicea* sp.
- *Muricea* sp.

SCLERACTINIA (Hard Corals)

- *Cladocora arbuscula*
- *Isophyllia* sp.
- *Manicina areolata*
- *Meandrina* sp.
- *Phyllangia americana*
- *Scolymia lacera*
- *Siderastrea radians*
- *Solenastrea hyades*
- *Stephanocoenia michelinii*

MOLLUSCA

BIVALVIA (Clams)

- *Arca zebra*
- *Pteria colymbus*
- *Spondylus americanus*

ARTHROPODA

DECAPODA (Crabs)

- *Stenorhynchus seticornis*

BRYOZOA (Moss Animals)

- *Celleporaria albirostris*
- *C. magnifica*
- *Celleporaria* sp.
- *Scrupocellaria* sp.

ECHINODERMATA

ASTEROIDEA (Sea Stars)

- *Astropecten* sp.
- *Echinaster* sp.

OPHIUROIDEA (Basket Stars)

- *Astrophyton muricatum*

ECHINOIDEA (Sea Urchins)

- *Arbacia punctulata*
- *Diadema antillarum*
- *Lytechinus* sp.
- *Encope* sp. (Sand dollar)

HOLOTHUROIDEA (Sea Cucumbers)

- *Isostichopus badionotus*

CHORDATA

ASCIDIACEA (Sea Squirts)

- *Didemnum candidum*
- *Didemnum* sp.
- *Polycarpa circumarata*
- *Styela* sp.
- Unidentified Didemnidae

1 Immediate vicinity includes Control Site (5 nmi southeast of Site 4) and Station OLD-3 (0.7 nmi east of Site 4).

TABLE 3-10. DEMERSAL AND PELAGIC SPECIES OF TELEOST FISH REPORTED OFFSHORE OF THE TAMPA BAY AREA.

Scientific Name	Common Name	10 Most Abundant Species	Commercial Importance	Moe and Martin, 1965	EPA/LEC, 1979-1980	Remarks
Gymnura micrura	Smooth butterfly ray			x		Shore to more than 55 m
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 45 m
Synodus intermedius	Sand diver			x		40 m to 100 m
Trachinocephalus myops	Snake fish				x	40 m to 90 m
Arius felis	Sea catfish		x		x	Bay out to 30 m
Opsanus pardus	Leopard toadfish		x	x		Offshore, more than 30 m
Porichthys porosissimus	Atlantic midshipman			x	x	Shallow to moderate depths
Antennarius ocellatus	Ocellated frogfish			x		Offshore
Urophycis floridanus	Southern hake			x		Shore to more than 30 m
Ophidion beani	Longnose cusk-eel			x		Offshore
Ophidion grayi	Blotched cusk-eel			x	x	20 m to 50 m
Ophidion holbrooki	Bank cusk-eel			x	x	10 m to 40 m

TABLE 3-10. (Continued).

Scientific Name	Common Name	10 Most Abundant Species	Commercial Importance	Moe and Martin, 1965	EPA/LEC, 1979-1980	Remarks
Ophidion welshi	Crested cusk-eel			x		Usually 20 m
Centropristis ocyurus	Bank sea bass		x		x	20 m to more than 90 m
Centropristis striata	Black sea bass		x	x		
Diplectrum bivittatum	Dwarf sand perch				x	20 m to 70 m
Deplectrum formusum	Sand perch	2	x	x	x	Moderate depths
Lutjanus synagris	Lane snapper		x	x		Shore to 400 m
Eucinostomus gula	Silver jenny			x	x	Only in Gulf, high-salinity water
Haemulon aurolineatum	Tomtate	3			x	Moderate depths
Orthopristis chrysoptera	Pigfish	6	x	x	x	Shallow water
Calamus nodosus	Knobbed porgy				x	10 m to 80 m
Lagodon rhomboides	Pinfish	4		x	x	Inshore and bays to 40 m
Bairdiella chrysura	Silver perch			x		Bays and shallow waters
Cynoscion arenarius	Sand sea trout		x	x	x	Shallow waters

TABLE 3-10. (Continued).

Scientific Name	Common Name	10 Most Abundant Species	Commercial Importance	Moe and Martin, 1965	EPA/LEC, 1979-1980	Remarks
Prionotus tribulus	Bighead searobin			x		Estuaries to 25 m
Bothus lunatus	Peacock flounder		x		x	
Bothus ocellatus	Eyed flounder		x	x		20 m to 90 m
Citharichthys macrops	Spotted whiff	10	x		x	Deeper than 20 m
Citharichthys spilopterus	Bay whiff		x		x	Inshore to more than 35 m
Etropus crossotus	Fringed flounder	9	x	x	x	10 m to 65 m
Paralichthys albigutta	Gulf flounder		x	x	x	Deep water
Syacium papillosum	Dusky flounder		x	x	x	20 m to more than 90 m
Symphurus plagiusa	Blackcheek tongue fish	6	x	x	x	Estuaries to 20 m
Aluterus schoepfi	Orange filefish				x	Offshore reefs
Monacanthus ciliatus	Fringed filefish				x	Shallow grassy bays
Monacanthus hispidus	Planehead filefish				x	Shore to more than 35 m
Monacanthus setifer	Pygmy filefish				x	More than 20 m
Lactophrys quadricornis	Scrawled cowfish			x	x	10 m to 75 m
Sphoeroides nephelus	Southern puffer				x	Inshore to 5 m
Sphoeroides spengleri	Bandtail puffer				x	More than 10 m, inshore
Chilomycterus schoepfi	Striped burrfish				x	Shore to more than 30 m

TABLE 3-10. (Continued).

Scientific Name	Common Name	10 Most Abundant Species	Commercial Importance	Moe and Martin, 1965	EPA/LEC, 1979-1980	Remarks
Equetus lanceolatus	Jackknife fish	7			x	Deep water
Equetus umbrosus	Cubbyu				x	Offshore reefs
Leiostomus xanthurus	Spot		x	x		Estuaries to more than 40 m
Menticirrhus americanus	Southern kingfish			x		Bays and moderate depths
Micropogon undulatus	Atlantic croaker		x	x		Estuaries to more than 40 m
Chaetodipterus faber	Atlantic spadefish			x		Bays to moderate depths
Scarus taeniopterus	Princess parrotfish				x	
Astroscopus y-graecum	Southern stargazer			x		Inside 130 m rare
Neomerinthe hemingwayi	Spinycheek scorpionfish				x	50 m to 130 m
Scorpaena brasiliensis	Barbfish			x	x	Bays and shore
Prionotus carolinus	Northern searobin				x	Shore to 45 m
Prionotus salmonicolor	Blackwing searobin				x	10 m to 65 m
Prionotus scitulus	Leopard searobin	1		x	x	Inshore and bays to 45 m

Etropus crossotus, pigfish Orthopristis chrysopterus, dusky flounder Syacium papillosum, tomtate Haemulon aurolineatum, and Atlantic bumper Chloroscombrus chrysurus (Chittenden and McEachran, 1976).

Seventeen of the species listed in Table 3-10 have commercial value. The most important are seven species of flounder. The black mullet (Mugil cephalus) ranked second in economic value for all commercial species taken during 1978 in the tri-county area (Pinellas, Hillsborough, and Manatee Counties) (US EPA, 1983). However, this species is usually caught in estuarine and nearshore coastal waters, and does not frequent Site 4.

Based on information mapped in Beccasio et al. (1982), Site 4 does not lie within any areas designated as general habitat boundaries for particular fish species. Such boundaries often surround reefs. Table 3-11 lists fish species observed by divers at live-bottom stations within or in the immediate vicinity of Site 4 during three post-disposal cruises (CSA, 1987). Many of the same species were observed on the disposal mound by EPA divers during a recent video survey of the site (see Appendix F).

3.3.5 Pelagic Invertebrates

The most noteworthy pelagic invertebrates off Tampa Bay are the penaeid shrimps (superfamily Penaeidea). Dominant species in the area are the commercially important pink shrimp Penaeus duorarum and rock shrimp Sicyonia brevirostris, as well as Solenocera atlantidis and Metapenaeopis goodei. Each of these species feeds and moves into the water column at night, and is largely inactive during the day, when they remain on the bottom (Huff and Cobb, 1979). Studies of gut content indicate that these species are generalized benthic carnivores, with crustaceans and bivalve molluscs dominating their diets (Huff and

TABLE 3-11. FISHES OBSERVED BY DIVERS AT HARD-BOTTOM STATIONS IN SITE 4 DURING POST-DISPOSAL SURVEYS III THROUGH VII (CSA, 1987).

Species	Common Name
Balistes capriscus	Gray triggerfish
Calamus sp.	Unidentified porgy
Caranx crysos	Blue runner
Centropristis ocyurus	Bank sea bass
Centropristis striata	Black sea bass
Chaenopsis ocellata	Bluethroat pikeblenny
Chaetodon ocellatus	Spotfin butterflyfish
Chaetodon sedentarius	Reef butterflyfish
Coryphopterus sp.	Unidentified goby
Diplectrum formosum	Sand perch
Epinephelus morio	Red grouper
Equetus acuminatus	High-hat
Equetus lanceolatus	Jackknife-fish
Equetus umbrosus	Cubbyu
Euthynnus alletteratus	Little tunny
Gobiosoma macrodon	Tiger goby
Gymnothorax nigromarginatus	Blackedge moray
Haemulon aurolineatum	Tomtate
Haemulon plumieri	White grunt
Halichoeres maculipinna	Clown wrasse
Halichoeres sp.	Unidentified wrasse
Holacanthus bermudensis	Blue angelfish
Ioglossus calliurus	Blue goby
Lachnolaimus maximus	Hogfish
Lutjanus synagris	Gray snapper
Microgobius carri	Seminole goby
Mycteroperca microlepis	Gag
Opsanus pardus	Leopard toadfish
Pomacentrus leucostictus	Beaugregory
Pomacentrus partitus	Bicolor damselfish
Pomacentrus variabilis	Cocoa damselfish
Prionotus sp.	Unidentified searobin
Rypticus maculatus	Whitespotted soapfish
Scomberomorus maculatus	Spanish mackerel
Serraniculus pumilio	Pygmy sea bass
Serranus subligarius	Belted sandfish
Sphoeroides spengleri	Bandtail puffer
Synodus intermedius	Sand diver

Cobb, 1979). Data collected during the Hourglass Cruises off the west coast of central Florida indicated that maximum abundances of *M. goodei* were reached in the summer and fall, of *S. brevirostris* in the late summer and fall, of *S. atlantides* in the fall and spring, and of *P. duorarum* in the fall through early spring. Other species which have been collected off Tampa Bay are *Trachypenaeus constrictus*, *Sicyonia laevigata*, and *S. typica* (Huff and Cobb, 1979; Eldred et. al., 1961).

Pink shrimp (*P. duoarum*) are unique among the above species they use estuarine areas in Tampa Bay as nurseries. After over-wintering in the estuarine areas, the subadults recruit to offshore areas (Huff and Cobb, 1979).

3.3.6 Coastal and Sea Birds

The avian population in the Gulf of Mexico consists of shorebirds, wading birds, waterfowl, raptors, sea birds, and songbirds (Beccasio et al., 1982). The Gulf serves as a migration route and overwintering ground for a variety of species (Table 3-12) (R.T. Paul, National Audubon Society, personal communication, January 14, 1987). In the lower portion of the Tampa Bay system, there are several important breeding and feeding areas for birds. Among them are two National Wildlife Refuges (NWR) (Passage Key and Pinellas) and a National Audubon Sanctuary island (Figure 3-11). Two Aquatic Preserves (Terra Ceia and Pinellas County) have also been designated in the area, and are administered by the Department of Natural Resources (R.T. Paul, National Audubon Society, personal communication, January 14, 1987) (Figure 3-12).

Black skimmers, least terns, American oyster catchers, and snowy plovers nest on a small barrier island off Cabbage Key. Least terns and snowy plovers also nest at Mullet Key, a county

TABLE 3-12. BIRD SPECIES OBSERVED NESTING IN AND AROUND TAMPA BAY (Richard T. Paul, National Audubon Society, Personal Communication, January 14, 1987).[a]

Pinellas Wildlife Refuge (Tarpon Key) and Washburn Sanctuary

- Anhinga
- Black-Crowned Night Heron
- Brown Pelican
- Cattle Egret
- Double-Crested Cormorant
- Glossy Ibis*
- Great Blue Heron
- Great Egret
- Green-backed Heron
- Little Blue Heron
- Magnificent Frigatebirds
- Reddish Egret
- Snowy Egret
- Tricolored Heron
- White Ibis
- Yellow-Crowned Night Heron

Passage Key National Wildlife Refuge

- American Oyster Catchers (6-8 pairs annually)
- Black Skimmers (up to 250 pairs)
- Brown Pelicans (35 observed in 1987)
- Laughing Gulls (2000 to 15,000 pairs)
- Least Terns (approximately 50 pairs)
- Royal Terns (600 to 1100 pairs)
- Snowy Plovers (occasional siting)

[a]Data available for nesting pairs only at Passage Key.
[b]Nests only at Washburn.

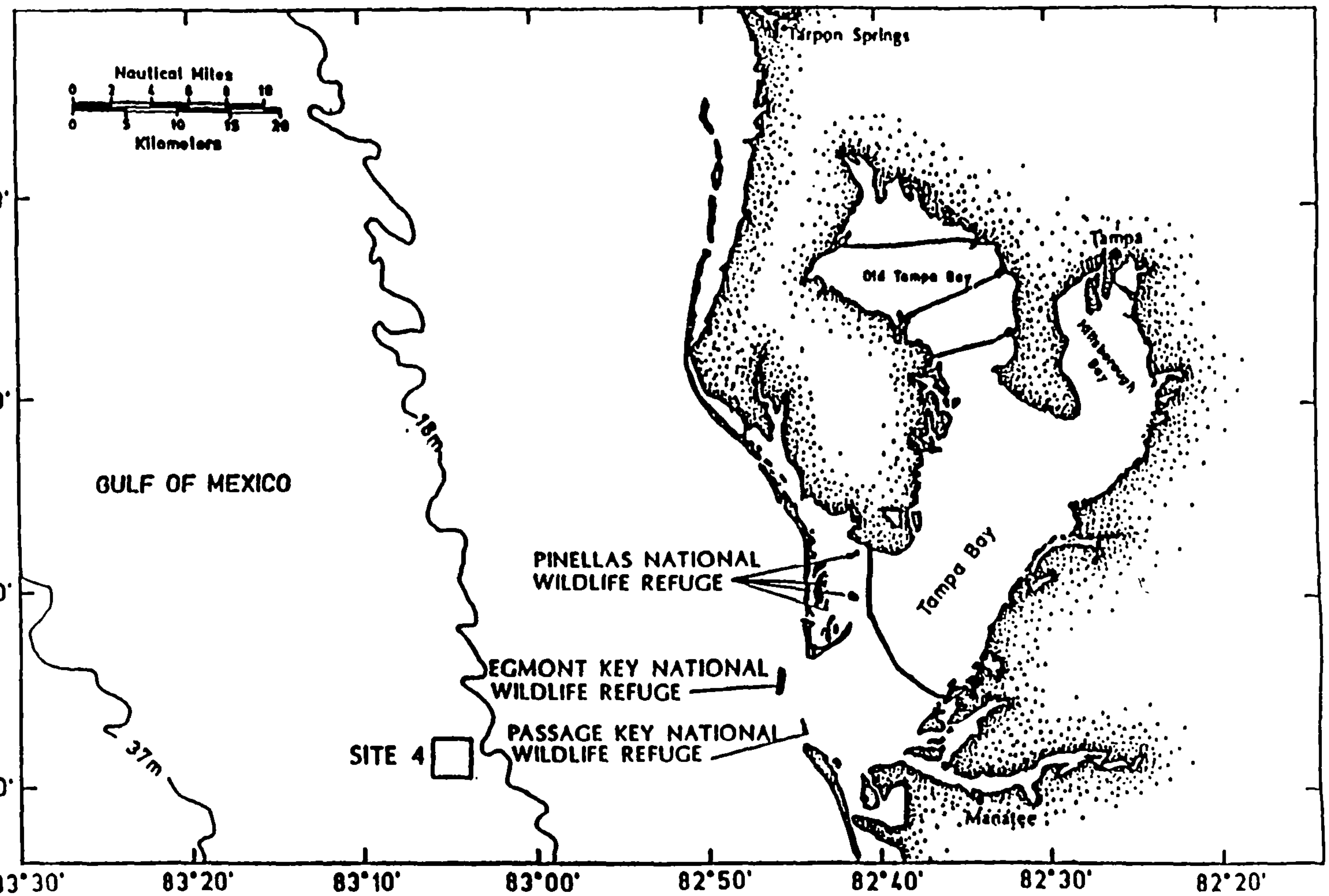


FIGURE 3-11. TAMPA HARBOR NATIONAL WILDLIFE REFUGES.

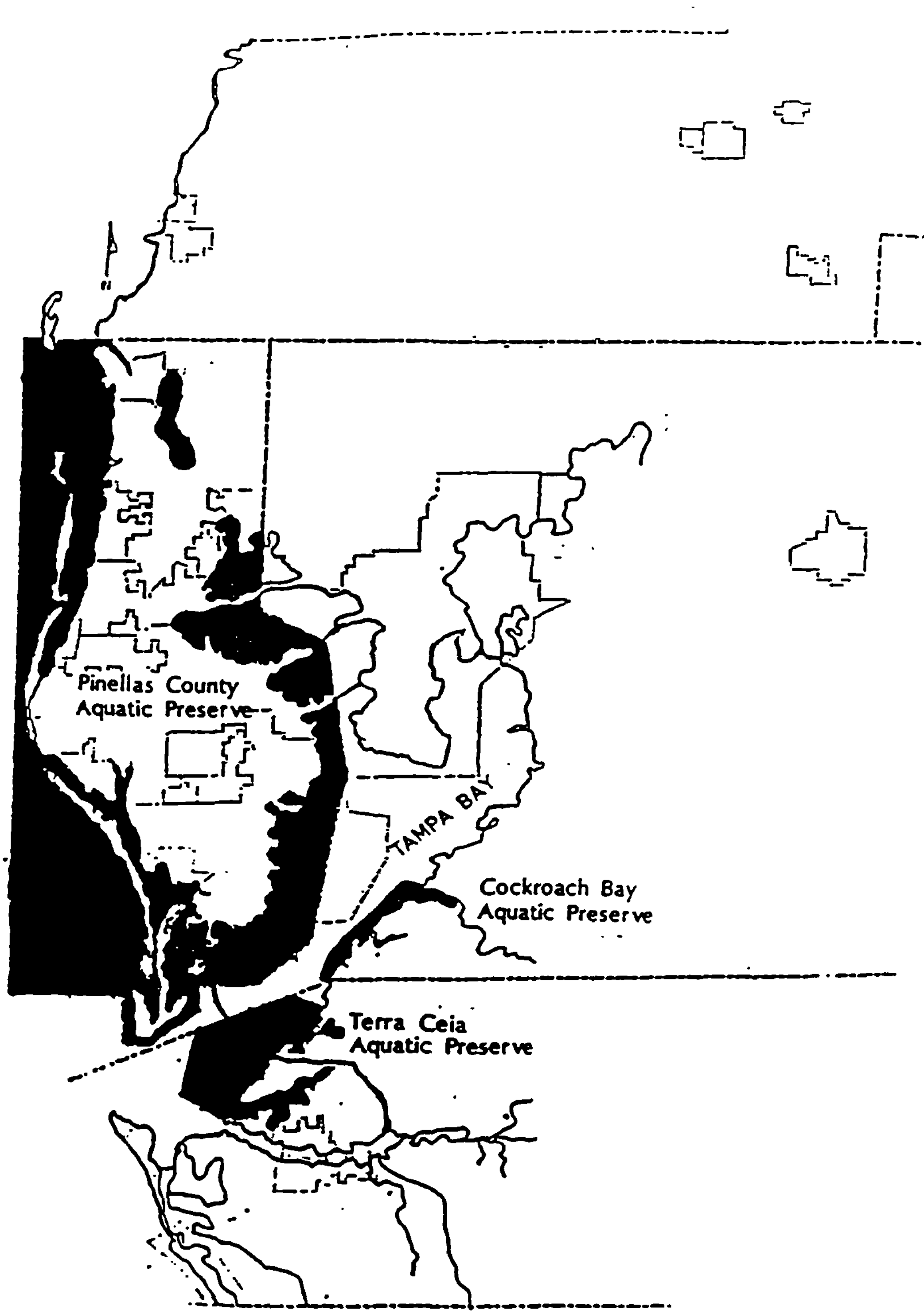


FIGURE 3-12. TAMPA BAY AQUATIC PRESERVES.

park (R.T. Paul, National Audubon Society, personal communication, January 14, 1987). Little is known about the biology of the few truly pelagic bird species, such as petrels, found in open gulf waters more than 10 km offshore (Woolfenden and Schreiber, 1973). Beaches of Passage Key, Mullet Key, and Bunces Pass are used by large numbers of migrant and wintering shorebirds. Other significant seasonal migrants or winter visitors include gulls, terns, common loons, horned grebes, lesser scaup, and possibly other waterfowl.

3.3.7 Marine Mammals

A variety of cetaceans including dolphins, porpoises, and whales inhabit the Gulf of Mexico (Table 3-13). Manatees (sirenians) are also found among the marine mammals of the area (Caldwell and Caldwell, 1973). As a result of man's introduction, seals and sea lions (pinnipeds), although not permanent residents, have been found occasionally in the Gulf. For example, sea lions have been found in the Gulf after escaping from zoos (D. Odell, University of Miami, personal communication, January 21, 1987).

Little is known of the life histories of whales inhabiting the Gulf of Mexico. Specifically, there are few data on the seasonality of whale species because sightings and strandings are so sporadic (Caldwell and Caldwell, 1973). It is uncertain which whales use the Gulf for mating and calving (C. Oravetz, National Marine Fisheries, personal communication, January 14, 1987).

Bottlenose dolphins (Tursiops truncatus) are common in the Tampa area. The sperm whale may also approach the continental shelf in the Tampa area; however, most whale species occur offshore (D. Odell, University of Miami, personal communication, January 21, 1987).

The West Indian manatee (Trichechus manatus), a herbivorous

TABLE 3-13. SPECIES OF MARINE MAMMALS IN THE GULF OF MEXICO (from US EPA 1983a, Schmidly, 1981; and D. Odell, University of Miami, personal communication).

Cetaceans	Behavior
Minke whale (Balenoptera acutorostrata)	Possible winter resident; feed on euphausiids and small fish
Byrde's whale (Balenoptera edeni)	Possibly year-round; feed on small fishes, some euphausiids, and other crustaceans
Sei whale* (Balenoptera 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* (Balenoptera musculus)	Uncommon; feed on euphausiids
Humpback whale* (Megaptera novaeangliae)	Possible winter resident; feed on euphausiids
Black right whale* (Eubalaena glacialis)	Possible winter resident; feed on copepods
Bottlenose dolphin (Tursiops truncatus)	Common; year-round; feed mostly on fish; spring-summer calving and mating
Atlantic spotted dolphin (Stenella frontalis)	Common; year-round; feed primarily on squid
Bridled dolphin (Stenella attenuata)	Uncommon; feed on fish, squid, and shrimp
Short-snouted spinner dolphin (Stenella clymene)	Widely distributed, no life information information available
Spinner dolphin (Stenella longirostris)	May be year-round; probably feed on fish and squid
Common dolphin (Delphinus delphis)	May be year-round near shelf edge; feed on fish

TABLE 3-13. (Continued).

Cetaceans	Behavior
Risso's dolphin (Grampus griseus)	Uncommon; feed on cephalopods
Pygmy killer whale (Feresa attenuata)	Rare; little known
False killer whale (Pseudorca crassidens)	Uncommon; feed on fish and squid
Short-finned pilot whale (Globicephala macrorhyncha)	Year-round in deep water; probably feed on squid
Killer whale	Uncommon; feed on fish, (Orcinus orca) 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 clatirostris)	Summer range ends just west of the Suwanee River, Florida; feed on aquatic vegetation

* Endangered species, Federal Register, 1986

mammal, is often found in canals, rivers, estuaries, and saltwater bays, but can also be found as far as 3.2 nmi off the coast of Florida (Beccasio et al., 1982). In the Tampa Bay region, manatees generally inhabit waters less than 3 m deep; consequently, it would be very unlikely to find manatees in the deeper waters of Site 4 (approximately 22 m) (D. Odell, University of Miami, personal communication, January 21, 1987).

3.3.8 Rare, Threatened, or Endangered Species

Endangered and threatened species of marine reptiles, mammals, and birds are known to exist in the Gulf of Mexico (Caldwell and Caldwell, 1973). Species with special status that may be present in the Tampa Bay area are listed in Table 3-14.

Four species of endangered sea turtles, including the green, hawksbill, Kemp's ridley, and leatherback, and one threatened species, the loggerhead, are found in the Gulf of Mexico (Beccasio et al., 1982). The loggerhead is the only sea turtle known to nest with any frequency along the Gulf coast of Florida. However, the other species of turtles may be found nesting at Passage Key and Egmont Key National Wildlife Refuges (see Figure 3-11) (C. Oravetz, National Marine Fisheries Service, personal communication, January 14, 1987).

Six endangered whale species have been reported in the Gulf of Mexico (Schmidly, 1981). The sperm whale (Physeter catodon), however, is the only species that might be expected to occur near Tampa Bay and even then only rarely (C. Oravetz, National Marine Fisheries Service, personal communication, January 14, 1987).

The West Indian manatee (Trichehus manatus) is a Federally listed Endangered Species and is protected in the state of Florida (Caldwell and Caldwell, 1973). The U.S. Fish and Wildlife Service has listed Tampa Bay as a critical habitat for the manatee (Department of the Interior (DOI), 1986). Threatened

TABLE 3-14. ENDANGERED (E) AND THREATENED (T) SPECIES IN THE GULF OF MEXICO (U. S. Department of the Interior, U.S. Fish and Wildlife, 1986, Federal Register 50 CFR 17.11 and 17.12).

SPECIES		STATUS
AQUATIC REPTILES		
Sea Turtles		
Green	*Chelonia mydas*	E
Hawksbill	*Eretmochelys imbricata*	E
Kemp's (Atlantic) ridley	*Lepidochelys kempii*	E
Leatherback	*Dermochelys coriacea*	E
Loggerhead	*Caretta caretta*	T
MARINE MAMMALS		
Whales		
Finback	*Balaenoptera physalus*	E
Humpback	*Megaptera novaengliae*	E
Right	*Balaena glacialis*	E
Sei	*Balaenoptera borealis*	E
Sperm	*Physeter catodon*	E
Sirenian		
West Indian Manatee	*Trichechus manatus*	E
BIRDS		
Cuban snowy plover	*Charadrius alexandrinus*	E
Least tern	*Sterna albifrons*	T
Bald eagle	*Haliaetus leucocephalus*	T
Peregrine falcon	*Falco pergrinus*	E
Brown pelican	*Pelecanus occidentalis*	T

and endangered bird species may also be found in the Gulf of Mexico (Table 3-14). The brown pelican in particular uses the Gulf coast and sheltered waters for nesting (R.T. Paul, National Audubon Society, personal communication, January 14, 1987). The Cuban snowy plover is a rare species that may breed on beaches and sand bars during summer (Beccasio et al., 1982).

3.3.9 Marine Sanctuaries and Special Biological Resource Areas

There are no marine sanctuaries (federal or state) in the Tampa Bay area (J. Urquhart, FDNR, personal communication, January 16, 1987). There are, however, state aquatic preserves near Tampa Bay (Figure 3-12). These preserves are submerged land areas of special concern that are regulated by the state. They include

- Cockroach Bay Aquatic Preserve
- Terra Ceia Bay Aquatic Preserve
- Pinellas County Aquatic Preserve
- Boca Ciega Bay Aquatic Preserve
- Caladesi Island Aquatic Preserve

Site 4 is not located within or proximate to any of these preserves.

The Florida Department of Environmental Regulation has also designated Tampa Bay as "Outstanding Florida Water." Consequently, the area is regulated by special rules and permitting procedures (J. Urquhart, FDNR, personal communication, January 16, 1987).

3.3.10 Potential for Development or Recruitment of Nuisance Species

Toxic red tides, caused mostly by dinoflagellates, are known to occur on the west coast of Florida (Steidinger and Williams, 1970). 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, 1976b; Gunter et al., 1948; Quick and Henderson, 1975a and 1975b).

Blooms of dinoflagellates, for example *Ptychodiscus brevis*, are often associated with variations in salinity, temperature, nutrient levels, and onshore winds (Rounsefell and Dragovich, 1966). Many different physical mechanisms such as winds, tides, upwellings, and currents can concentrate motile dinoflagellate populations (Steidinger, 1983). Studies have also suggested the importance of resting cysts in the initiation of dinoflagellate blooms (Steidinger, 1975b). Steidinger and Haddad (1981) indicate that blooms begin in an initiation zone located 18 to 74 km offshore. Variations in the vertical distribution of cysts within sediments may be important to the timing and magnitude of the red tide bloom (Anderson et al., 1982).

3.4 SOCIOECONOMIC ENVIRONMENT

Over 1.6 million people reside in the three counties (Pinellas, Hillsborough, and Manatee) that border Tampa Bay. The Bay area population has increased by 45 percent since 1970; rapid population and industrial expansion have coincided with ecological decline in the area (e.g., the demise of scallop and oyster fisheries). Although economic benefits have been realized in shipping (Tampa is the third largest U.S. port in terms of foreign exports), other industries based on ecologically dependent resources are beginning to suffer.

Economic growth and development is difficult to manage in Tampa Bay because of the myriad of federal, state, and regional regulatory agencies in the area. In addition, 17 local political entities contribute to the fragmented management framework (Figure 3-13). Because no single agency has overall authority for the Bay, there is no comprehensive management of the ecological and economic resources of the Bay. However, the Tampa Bay Regional Planning Council has initiated a few major studies to address Bay management issues and to develop comprehensive management plans.

3.4.1 Commercial Fishing

From 1979 to 1984, the total value of finfish and shellfish landings on Florida's west coast (a 30-county area) averaged approximately $106 million a year, not including further economic impacts in processing, wholesale, and retail markets (Tampa Bay Regional Planning Council, 1986). In Tampa Bay, the total value of landings in a four-county area (Pinellas, Hillsborough, Manatee, and a combination of Pasco and Citrus counties) averaged approximately $20 million a year. The landings reported for Pinellas County account for 49 percent of the catch of the four-county area, the largest percentage of any of the counties. Pinellas County landings averaged 9 percent of the regional total.

Five major species of finfish are caught commercially in Tampa Bay: drum, flounder, mullet, seatrout, and sheepshead. Shellfish species common to Tampa Bay waters include hard clams, blue crabs, stone crabs, oysters, and bait shrimp.

During 1984, a total of 1952 commercial fishermen were issued

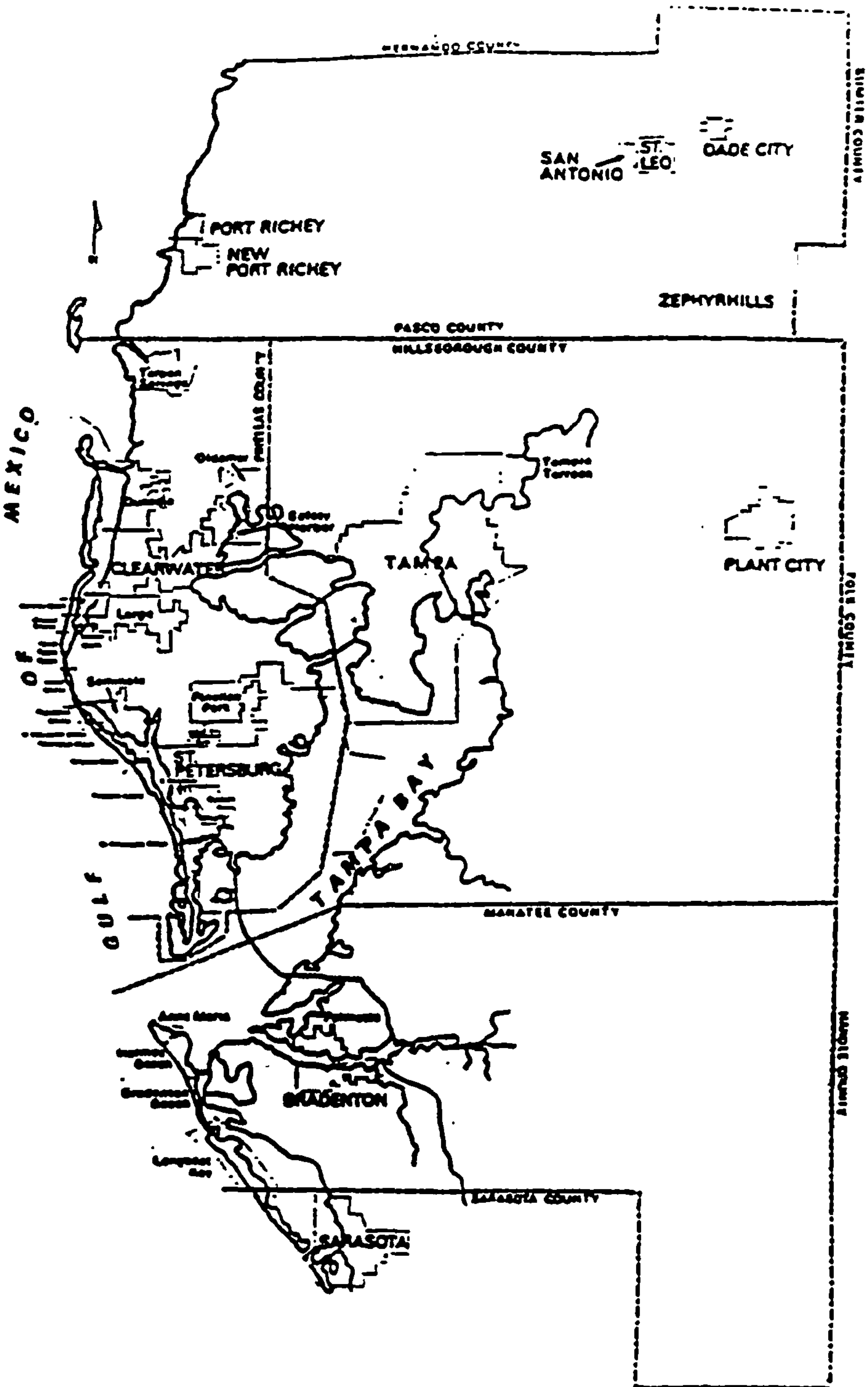


FIGURE 3-13. POLITICAL BOUNDARIES WITHIN THE TAMPA BAY REGION.

saltwater products licenses to earn their living. Residing in Hillsborough, Manatee, and Pinellas counties, these fishermen represent 10 percent of all fishermen in Florida.

Economic benefits of commercial fishing in Tampa Bay are also represented by the seafood processing and wholesaling industry. In 1984, data collected for Hillsborough, Pinellas, and Pasco counties indicated that 46 establishments were engaged in seafood processing and wholesaling. Each plant employed an average of 200 persons per month over the one-year period (Tampa Bay Regional Planning Council (TBRPC), 1986).

3.4.2 Commercial Shipping in Tampa Bay

Commercial shipping is an important economic factor in the Tampa Bay area. The following discussion indicates the magnitude of this importance. However, the data supporting the discussion do not represent the economic value of maintaining the shipping channel. If the channel were not maintained at the current depth shipping would not occur, which would change the economic value of shipping in the area.

During 1983-84, nearly 46 million tons of cargo, mostly phosphate, passed through the port of Tampa. In the preceding year, industry representatives claimed that 90 percent of the port's revenues were generated from phosphate exports (Amson, 1982). Other commodities included petroleum products, dry bulk such as coal and aragonite, and liquid bulk such as sulfur, ammonia, and phosphoric acid. Over 1 million tons of cargo, handled at the port of Tampa includes steel products, bananas, meat, and poultry products (TBRPC, 1986).

Each ton of cargo handled during 1984 contributed an average of $6.42 in direct primary benefits to the local economy. Therefore, the estimated 45.7 million tons handled at the port of Tampa provided approximately $294 million in direct benefits to the port during 1984 (TBRPC, 1986). Such trade can only be accommodated by dredged channels that allow for passage of large vessels. Testimony given in 1982 suggested that vessels had been light-loaded because of the shallowness of the Bay. An industry representative suggested that an additional $14 million in revenues could have been realized during 1969-1982 if the Tampa Bay shipping channels had been deepened (Amson, 1982).

Net economic gains may be passed on to shippers and receivers who use the port of Tampa. These benefits could be realized locally or in more distant geographic areas. One way to measure the net economic benefits associated with Tampa is to estimate the cost of using an alternative port or transportation method and then calculate the transportation savings accrued by using the port of Tampa. In 1979, Booz, Allen and Hamilton used this method and determined that nearly $174 million in transportation savings resulted from use of the Port of Tampa. Updated figures for 1984 indicate an impact on savings of $281.3 million in transportation costs through use of the Port (TBRPC, 1986).

3.4.3 Recreational Fishing

Resident and tourist populations generate economic gains through direct expenditures on food, lodging, boat rental, fuel, and maintenance, and through indirect expenditures which are more difficult to quantify. A multiplier effect is generally recognized in connection with tourist expenditures where tourist dollars originating outside of the state spark a cycle of spending within the state. Indirect consequences of direct expenditures include additional jobs, wages, and tax revenues. To quantify indirect expenditures, direct expenditures are multiplied by an estimated number derived by calculating sales and basic income (export employment) vs. nonbasic income (local employment).

The following discussion is based on information taken from Bell et al., 1982. The number of saltwater recreational fishermen in Tampa Bay consists of both residents and tourists. In 1980, it was estimated that 250,380 residents fished in the Southwest Gulf (state planning Region 4). In addition, 374,820 tourists fished in Region 4 which includes Tampa Bay. The total angler population of Region 4 (tourists and residents) spent $207,324,803 on variable expenditures in 1980. These expenditures vary in amount with the number of days spent fishing and include the maintenance costs on boats and fishing gear. Expenditures on new boats and gear are not included in variable costs because these expenses do not vary with the number of days spent fishing. However, it is not possible to determine what proportion of this expenditure is for the area offshore of Tampa Bay. The total economic value of recreational saltwater fishing in Tampa Bay was estimated to be $197,382,616 in 1983 (TBRPC, 1986).

The four fish most frequently caught by anglers in the state of Florida are snapper, seatrout, grouper, and catfish. Other species include king mackerel, dolphinfish, bluefish, kingfish, croaker, pinfish, spot, grunt, cobia, and red snapper. However, among tourists and residents, the perception that fish stocks are declining has been growing since 1960. The recreational catch has gradually declined in the Gulf while fishing efforts have increased. Also, the daily catch has decreased each year, as particularly noticed by anglers fishing for grouper, seatrout, and snappers.

It is feared that tourist expenditures may decline in the area if fishery stocks continue to decline. Competition between recreational anglers and commercial fishermen for existing stocks has been documented, which could lead to a greater loss of tourist and resident dollars in the Tampa Bay area, as well as Florida as a whole.

3.4.4 Other Recreational Activities

In 1982, the Tampa Bay Regional Planning Council established a committee to conduct a survey to evaluate the recreational uses of Tampa Bay. In addition to fishing, recreational boating (including motorboating, racing, and sailing), water skiing, camping, nature studying, picnicking, scuba diving, and swimming were identified as popular activities. From 1979 to 1985, the number of registered pleasure boats has steadily increased to totals of 34,541 in Pinellas County, 33,447 in Hillsborough County, and 11,067 in Manatee County. In 1984, approximately $184 million in retail sales were reported for motorboats, yachts, and marine accessories in the tri-county area (TBRPC, 1986).

Activities in Tampa Bay related to boating, such as snorkeling, scuba diving, swimming, fishing, and water skiing, depend upon how boaters perceive water quality and clarity and ease of access to the Bay. Nationwide coverage of the dredging activities may encourage people to dive further south (in the Keys) or on the eastern Florida coast (e.g., West Palm Beach). Excluding some of the private facilities such as private clubs and residences, 47 public and private marinas are located within Tampa Bay boundaries. Also, small boat owners have access to boat ramps. The total economic value of recreational activities other than fishing in Tampa Bay area is estimated to be $22,793,540 (in 1983 dollars). This estimate was based on the unit-day approach, where the user value of $2.95 per day was estimated. The documented number of occasions where boat ramps were used and beach activities were pursued was multiplied by the use value ($2.95/occasion) to arrive at the $2,793,540 figure (TBRPC, 1986).

3.4.5 Oil and Gas Exploration and Development

The nearest active oil and gas leases, part of the Minerals Management Service (MMS) Outer Continental Shelf (OCS) Oil and Gas Lease Sale No. 65, are approximately 50 nmi to the southwest of Site 4. The distance of this site to the oil and gas lease areas eliminates any interference of dredged material disposal operations with drilling or production operations (US EPA, 1983).

3.4.6 Historical Sites and Shipwrecks

There is a sunken vessel near Site 4. However, the name and age of the vessel are not known and it is not possible to determine its historical significance (Florida Skin Divers Association, 1982). At various locations in the general vicinity of Site 4, there are small patch reefs on which limited SCUBA diving has occurred (Florida Skin Divers Association, letter dated July 12, 1982).

Several public and private beaches occupy the coast of western Florida. Fort DeSoto County Park, located on Mullet Key, is the recreational beach closest to the alternative disposal sites. The park provides year-round recreation for an estimated 1.5 million people (US EPA, 1983).

Florida also has established an aquatic preserve, encompassing the length of Pinellas County, extending from the shoreline to the 3-mile limit. Alternative Site 4 is approximately 15 nmi southwest of the preserve. Egmont and Passage Keys, located 18 nmi east of Site 4, are designated by the U. S. Fish and Wildlife Service as wildlife refuges (US EPA, 1983).

CHAPTER 4.0 ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This chapter provides the scientific and analytical basis for evaluation and comparison of the alternatives described in Chapter 2. The following discussion includes the environmental consequences of the no-action alternative and the ocean disposal alternative, Site 4. The environmental consequences are discussed as they relate to the ecosystem and the socioeconomic resources described in Chapter 3.

The effects of dredged material disposal at Site 4 have been addressed previously by EPA (1983). Some of the effects on the physical and biological environment at Site 4 have also been monitored (CSA 1986a, b, c; 1987).

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 they may be indirect or cumulative.

4.2 NO-ACTION ALTERNATIVE

The no-action alternative implies one of three possible actions: (1) dredging operations would be discontinued, (2) nearshore alternatives would be used for deposition of dredged materials as fill (see Appendix A), or (3) dredged materials would be dumped at a non-EPA-designated ocean site. Assessments of environmental impacts associated with these actions are restricted to generalized effects because specific information on a potential disposal site is lacking.

Discontinuing maintenance dredging operations would result in no potential for future environmental impacts from disposal of dredged material. However, the option to discontinue dredging is not consistent with the continued use of Tampa as a port (as discussed in Chapter 1) because the CE must provide dredging operations to maintain navigable depths in the shipping channels (L. Saunders, Jacksonville District CE, personal communication, 1987). Consequently, further analysis of this option relative to other alternative actions would be inappropriate.

Nearshore alternatives for deposition of dredged material as fill have been used previously by the CE for materials from new and maintenance dredging projects. These alternatives include beach nourishment, island creation, and submerged stockpiling. Impacts associated with the use of these alternatives are discussed in Appendix A.

Alternatively, the CE has the option to request use of an ocean disposal site, with concurrence from EPA, on a case-by-case basis if EPA does not permanently designate a site. In this instance, the CE would probably request a permit to dump materials at Site 4 (L. Saunders, Jacksonville District, CE, personal communication, 1987). The potential environmental consequences associated with disposal of dredged material at this site are discussed in detail in Section 4.3.

4.3 OCEAN DISPOSAL ALTERNATIVE

The Ocean Dumping Regulations (40 CFR Parts 228.5-228.6) contain 5 general and 11 specific criteria that constitute the basis for the selection of ocean disposal sites and the environmental assessment of impacts from dumping at those sites. Three of the specific criteria are discussed in Chapter 3: (1)

the site locations (Geographic Position, Depth of Water, Bottom Topography, and Distance from Coast: 40 CFR 228.6 [a][1]), (2) proposed use of the site(s) (Types and Quantities of Waste to be Disposed of and Proposed Methods of Release, Including Methods of Packing the Waste, If Any: 40 CFR 228.6 [a][4]), and (3) feasibility of surveillance and monitoring (Feasibility of Surveillance and Monitoring: 40 CFR 228.6 [a][5]).

A summary of the general criteria as applied to the candidate disposal site (Site 4) is presented in Section 4.3.1. The specific criteria including the environmental effects of dredged material disposal on the physical, biological, and socioeconomic environments of those sites are discussed in Section 4.3.2. The unavoidable adverse impacts and possible mitigation measures for the proposed action are discussed in Sections 4.3.3 and 4.3.7, respectively. Classes of impacts, as defined in the Ocean Dumping Site Designation Delegation Handbook (US EPA, 1986), are identified where possible and are defined as follows:

1. Class I effects are unavoidable significant impacts;
2. Class II effects are significant impacts which can be feasibly mitigated or avoided;
3. Class III effects are impacts which are not significant and do not require mitigations; and
4. Class IV effects are beneficial impacts.

Some of the effects of dredged material disposal on the physical and biological environment at Site 4 have been monitored by CSA (1986a, b, c; 1987) and CAIS (1988). Results from these monitoring surveys provide a basis for defining classes of effects at Site 4.

TAMPA, FLORIDA OCEAN DISPOSAL SITE EIS
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4.3.1 General Criteria (40 CFR 228.5)

4.3.1.1 The dumping of materials into the ocean will be permitted only at sites or in areas selected to minimize the interference of disposal activities in the marine environment, particularly avoiding areas of existing fisheries or shellfisheries and regions of heavy commercial or recreational navigation (40 CFR 228.5 [a])

Site 4 is located offshore in order to minimize interference with recreational activities popular along the Florida coast. Some interference may occur during dredging and disposal activities. The site is located outside designated navigation lanes and designated fishing grounds.

4.3.1.2 Locations and boundaries of disposal site will be so chosen that temporary perturbations in water quality or other environmental conditions during initial mixing caused by disposal operations anywhere within the site can be expected to be reduced to normal ambient seawater levels or to undetectable contaminant concentration or effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery. (40 CFR 228.5 [b])

Because nearshore waters are characteristically turbid, temporary increases in suspended particulate concentrations due to disposal operations at Site 4 are considered insignificant. The location of the site at 18 nmi from shore will allow water quality conditions to return to ambient levels, thereby preventing a plume from reaching any shoreline area.

4.3.1.3 If at any time during or after disposal site evaluation studies, it is determined that existing disposal sites presently approved on an interim basis for ocean dumping do not meet the criteria for site selection set forth in 40 CFR 228.5-228.6, the use of such sites will be terminated as soon as suitable alternate disposal sites can be designated. (CFR 40 228.5 [c])

Studies conducted to date indicate that disposal of dredged material at Site 4 meets the requirements in 40 CFR 228.5-228.6. No adverse environmental effects have been detected.

4.3.1.4 The sizes of ocean disposal sites will be limited in order to localize for identification and control any immediate adverse impacts and permit the implementation of effective monitoring and surveillance programs to prevent adverse long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation study. (40 CFR 228.5 [d])

Site 4 covers a total 4 nmi^2; a much smaller area within this site has actually been used for disposal of dredged materials. Specific areas for disposal are limited within this site as described in the detailed SMMP that is included in Appendix C.

4.3.1.5 EPA will, wherever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been historically used (40 CFR 228.5 [e])

Site 4 was designated in November 1983 for a 3-year period and has been used previously for disposal of dredged material. A deep-water site beyond the continental shelf was considered as an alternative (US EPA, 1983) but was found to be economically unfeasible and was therefore dropped from further consideration.

4.3.2 Specific Criteria (40 CFR 228.6)

4.3.2.1 Location in relation to breeding areas, spawning, nursery, feeding, or passage areas of living resources in adult or juvenile phases (40 CFR 228.6 [a][2])

Tampa Bay is a nursery area for many commercially and recreationally important species (such as pink shrimp and several species of fish) (US EPA, 1983). Some species that mature in the Bay eventually move offshore into coastal waters where they remain as adults. Additionally, the adult phases of several species migrate into and out of the Bay to spawn. Other species such as king mackerel, Spanish mackerel, bluefish, and several clupeid species migrate seasonally north and south in waters off the Florida coastline. These species spawn in offshore waters, and the egg, larval, and juvenile stages are planktonic. However, it is unlikely that these migration routes or spawning locations are restricted geographically to the vicinity of Site 4. Therefore, impacts on migration and spawning are considered non-significant (Class III) because the effects from dredged material disposal would not interfere significantly with critical biological activities.

Breeding, spawning, nursery, and feeding activities for demersal fishes probably occur near live-bottom features in the vicinity of Site 4. However, the available information (e.g., Beccasio et al., 1982) suggests that Site 4 does not lie within areas designated by the U.S. Fish and Wildlife service as general habitat boundaries for particular fish species. Therefore, significant differences in the effects from disposal operations on these activities are not indicated.

The birds, mammals, reptiles, and rare and endangered species that occur near Site 4 are discussed in Sections 3.3.6 through 3.3.8. Several bird species migrate, nest, feed, and overwinter near Tampa Bay, with nesting sites for several species of birds and sea turtles on barrier islands and the nearshore keys. The migration paths of sea turtles and large marine mammals near the alternative sites are poorly known. It is unlikely that localized and intermittent dredged material disposal operations at Site 4 would adversely affect migration, feeding, or nesting of mammals, reptiles, or rare and endangered species.

4.3.2.2 Location in Relation to Beaches and Other Amenity Areas (40 CFR 228.6 [a][3])

The alternative ocean Site 4 is approximately 18 nmi from the closest beaches of the coastal barrier islands near the mouth of Tampa Bay. Amenity areas for recreational fishing and diving are present throughout the nearshore region, particularly at scattered hard-bottom reefs (US EPA, 1983). Some diving and fishing may occur near Site 4, although less frequently than at sites closer to shore (US EPA, 1983).

Due to the large distances between the alternative ocean sites and the shoreline, it is unlikely that dredged material disposal at Site 4 would have any effect on the coastal beaches. Although EPA (1983) reported that recreational diving and fishing may occur near Site 4, disposal of dredged material is not expected to interfere with these activities in any way. Any interference with these activities would consist of temporary, small-scale displacement of diving activities to nearby areas during active disposal operations (Class III).

4.3.2.3 Disposal, horizontal transport, and vertical mixing characteristics of the area, including prevailing current directions and velocity, if any (40 CFR 228.6 [a][6])

The dispersion and transport of dredged materials dumped at Site 4 were not assessed directly during the monitoring studies (1984-1986) (CSA, 1987); however, some current measurements and sediment trap observations are available and provide information to evaluate sediment dispersion and accumulation at the disposal site. Sediment mapping techniques used by CAIS (1988) provide some insight on the distribution of dredged materials disposed at Site 4. Additionally, suspended disposal plume transport has been modelled (see Appendix H), and the SMMP has been modified based on information provided by the model results.

Under average current conditions, sand-sized dredged materials dumped at Site 4 settled rapidly to the bottom within about 275 m of the point of discharge. Some silt and clay-sized sediments were transported farther away from the discharge point by horizontal currents before settling (CSA, 1987). Williams (1983) predicted that only about 2.5 percent of the discharge mass was entrained as a disposal plume. Thus, the fraction of the initial discharged mass that is dispersed from the site as a suspended sediment plume would be relatively small.

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Subsequent dispersion and transport of deposited materials will depend on the frequency of bottom currents with sufficient energy to initiate motion of sediment materials. Williams (1983) used current and wave data for Site 4 to estimate bedload transport of deposited dredged materials. Based on these estimates, bottom turbulence required to transport silt particles (0.03-mm diameter) would be exceeded 44 days per year, whereas conditions necessary for transporting sand particles (0.5-mm diameter) would be exceeded 25 days per year. However, the majority of sediment transport and dispersion activity would probably be associated with surface-wave-induced turbulence during storms (CSA, 1987).

The current meter data collected during the Site 4 monitoring program suggest that sediment transport in southerly and southeasterly directions would predominate, although some dispersion in east-west or northerly directions could be expected due to tidal currents and near-bottom circulatory currents, respectively (Ichiye et al., 1973; Danek and Lewbel, 1986). The rates of sediment accumulation (mounding) were not measured during the monitoring study; however, measurements of the three-dimensionality of the mound at Site 4 are available from EPA. Sediment transport from Site 4 was, however, measured using sediment traps. Sediment trap data suggest that dredged material was deposited at one or more stations during each survey. Deposition rates measured with the traps varied spatially and could not be linked to dredged material (CSA, 1987).

Data on levels of bismuth-214 and iron in sediments sampled along extensive transects through and beyond the boundaries of the disposal site indicated the presence of dredged material at several points beyond the Site 4 boundaries (CAIS, 1988). In a June 1987 survey, the University of Georgia CAIS found regions of relatively high concentrations of iron (attributed to dredged material) in the vicinity of the disposal area and extending beyond the site boundary. High levels of Bi-214, also associated with dredged material, were found to the north, northwest, and south of the site. These results suggest that transport of dredged material to areas outside the site boundary may be occurring.

4.3.2.4 Existence and effects of current and previous discharges and dumping in the area, including cumulative effects (40 CFR 228.6 [a][7])

Effects on the Physical Environment. Specific effects of the particulate plume on the water column at Site 4 were not assessed during the monitoring program. The dredged material plume contains elevated concentrations of suspended sediments that result in localized increases in turbidity levels and decreased light transmittance. These effects typically are short term and localized, as the small percentage of the particulate mass is dispersed by currents and sinks to the bottom (see Appendix H).

In general, physical effects on the benthic environment from dredged material disposal can include alterations in sediment grain size, smothering of infaunal and/or epifaunal organisms, and mounding of sediments with potential burial of low relief features on the bottom. Dredged material disposal at Site 4 may have resulted in changes in the percentages of sediment clay and fines, although during the monitoring program these changes could not be attributed unequivocally to dredged material disposal (CSA, 1987).

Effects on the Chemical Environment. In general, changes in water quality, other than turbidity, associated with dumping are relatively localized and short term; long-term or chronic impacts typically are negligible (e.g., Wright, 1978; Brannon et al., 1978). For example, releases of nutrients are common from both polluted and non-polluted sediments dredged from coastal areas (Windom, 1976). Results of chemical analysis of the liquid-phase elutriate tests of sediments from Old Tampa Bay and St.

Petersburg Harbor demonstrated releases of ammonia and orthophosphate (Jones, Edmunds and Associates, 1979; 1980). These localized releases of nutrients at the disposal site may stimulate phytoplankton productivity in a small area for a short time (Windom, 1975); whereas elevated concentrations of ammonia sufficient to cause toxicity to aquatic organisms are unlikely (Brannon et al., 1978). Subsequent decreases in concentrations of dissolved nutrients would result from mixing and dilution, as well as uptake by phytoplankton (CE, 1980).

Dredged sediments may also contain elevated levels of certain trace metals and hydrocarbon compounds. Trace metals typically are associated with the particles in the disposal plume and are rapidly removed from the water column during sinking of the main plume mass (Brannon et al., 1978). Long- term release of trace metals from dredged materials to overlying waters is minimal (Brannon et al., 1978; Windom, 1975, 1976). Chemical analyses of dredged materials from Old Tampa Bay and St. Petersburg Harbor indicated negligible releases of cadmium, lead, and mercury (Jones, Edmunds and Associates, 1979; 1980). Relatively greater solubilization of manganese and iron may be expected, but oxidation, particle scavenging, and dilution would also reduce the concentrations of the dissolved phase of these metals, typically within several hours of discharge (Brannon et al., 1978).

Chlorinated or petroleum hydrocarbons associated with the dredged materials probably would remain with the particulate fraction following dumping, although some solubilization may occur depending upon the water solubility and partitioning behavior of individual compounds. Chemical tests of dredged materials indicated no detectable releases of petroleum hydrocarbons (Jones, Edmunds and Associates, 1979; 1980).

Sediments from Site 4 and dredged material intended for disposal at Site 4 were analyzed for several chemical elements and compounds prior to dumping. Results from these analyses indicated that dredged material could be distinguished chemically from surficial and suspended sediments collected between Site 4 and control sites by its significantly lower strontium and higher phosphate concentrations. After dumping at Site 4 started, statistically significant differences in concentrations of these two tracers at the site boundary indicated the presence of dispersed dredged sediments (CSA, 1987).

The University of Georgia CAIS conducted a sediment mapping survey at Site 4, and evaluated levels of iron and the gamma-emitting isotope Bi-214 (CAIS, 1988). These two tracers are associated with phosphate-rich sediments and were used as indicators of the presence of dredged material. Extensive regions of relatively high concentrations of iron were found in the vicinity of the disposal area and extending northward into areas beyond the northern boundary of Site 4. Areas with iron concentrations above background levels were also observed in the northwest portion and the southwest corner of the site. Relatively high values of Bi-214 were found in the vicinity of the disposal area, with contours of high Bi-214 extending to the north, northwest, and possibly to the southeast.

Effects on the Biological Environment. In general, aquatic organisms may be adversely impacted by dredged material disposal by temporary increases in turbidity, changes in the physical or chemical characteristics of the habitat, smothering or burial, and introduction of pollutants (Hirsch et al., 1978). The magnitude of impacts would depend on the similarity of the dredged sediments to existing sediments at the site, frequency of dumping, thickness of the overburden, types of organisms present, and physical characteristics of the habitat (Pequegnat et al., 1978).

The effects of dredged material disposal on plankton at Site 4 were not evaluated during the monitoring study. In general, effects on plankton are difficult to assess because of the inherently high natural variability (Sullivan and Hancock, 1977).

Some phytoplankton, zooplankton, and ichthyoplankton may be entrained in a temporary turbidity plume, and thereby subjected to decreased light transmittance and exposed to suspended particulates and released contaminants (Wright, 1978). Elevated concentrations of suspended particles may temporarily inhibit filter-feeding planktonic larvae over a localized area, although the extent of this impact is unknown.

EPA (1983) reported that bioassay tests of material dredged from Tampa Bay indicated no significant mortality to grass shrimp larvae exposed to the suspended particulate phase. Based on these results, EPA (1983) predicted that impacts on plankton from dredged material disposal would be localized, episodic, and insignificant (Class III).

The results of studies at Site 4 indicated that the composition of the infaunal community varied in relation to the spatial distribution of grain-size composition, as well as to differences in bottom depth (JRB, 1982; CSA, 1987; MML, 1988). The CSA (1987) study also showed a seasonal variation in the infaunal community composition. The inferred relationship between sediment grain size parameters and infaunal community parameters suggests that alterations to sediment texture from dredged material disposal could produce concomitant changes in the infaunal composition. However, results from the Site 4 monitoring program provided no conclusive evidence for an effect from dredged material disposal on the infaunal parameters measured at Site 4 (CSA, 1987). CSA (1987) concluded that the absence of detectable effects probably was due to the small amounts of dredged materials present at the monitoring stations; however, greater effects would be expected at locations receiving larger amounts of dredged materials. In these latter areas, direct deposition of large volumes of dredged materials would result in burial of infauna, with accompanying decreases in the abundance and species richness of the infauna (e.g., JRB, 1982). The magnitude of these changes would be expected to diminish with distance and time since the last dumping event, as the influence from sediment accumulation is attenuated by dispersion and mixing.

Adverse impacts typically are limited to the non-motile species (Richardson et al., 1977); some active or motile species are capable of burrowing up through 32 cm or more of overburden (Mauer et al., 1978). Burial and smothering would result in localized decreases in abundance of infaunal organisms. Recently deposited sediments will be recolonized by motile infaunal organisms burrowing up through the substratum and by species migrating in from adjacent undisturbed areas (Hirsch et al., 1978). Recolonization patterns and rates will be influenced by the composition of the adjacent communities and the suitability of the substratum for particular species.

Additional impacts to the benthos from potential exposure to suspended particulates and/or changes in the sediment and water quality are difficult to assess from existing data. Neither the CSA (1987) monitoring study nor the additional study by MML (1988) at Site 4 detected any clear relationships between the presence of dredged material constituents and changes in the infaunal community.

Potential effects from dredged material disposal on hard-bottom epifaunal organisms also may result from burial by deposited sediments, exposure to elevated suspended particulate concentrations, or exposure to contaminants associated with the suspended particulates. Attached organisms are unable to burrow through an overburden or migrate to an unimpacted area. Hard-bottom areas, although limited in extent, also provide important habitat for reef fishes. Consequently, potential impacts from dredged material disposal on hard-bottom habitats are a primary factor governing selection of an appropriate disposal site.

The hard-bottom areas within Site 4 are characterized as scattered, with sparse coverage of sessile epifauna (CSA, 1987;

JRB, 1984). During the CSA (1987) survey of Site 4, a relatively low percent of coverage by total biota (as compared with other nearby areas), algae, sponges, and corals was observed at the hard-bottom site closest to the disposal area. However, because no pre-disposal data were available for this site, it was not possible to evaluate the extent of disposal-related impacts, although there was no indication of significant differences in the species composition at this site relative to those at hard-bottom sites further from the disposal area. Therefore, there was no evidence that any increases in sediment deposition rates or elevated suspended sediment concentrations had caused discernible changes to the epifaunal community.

The magnitude of impacts on epifaunal organisms would depend on the rates of deposition and removal of sediment compared to the ability of epifaunal organisms to withstand periodic burial. For example, the frequency of bottom shear stresses necessary to resuspend and transport sediments deposited on scattered hard-bottom features may be sufficient to remove small amounts of accumulated materials, but additional materials may exceed the tolerances of organisms to burial. Impacts to epifaunal communities potentially could be significant (Class II), but could be mitigated by limiting the dumping area to sand-bottom areas located several kilometers or more from hard-bottom features. It is important to note that sessile invertebrates did colonize the disposal mound and have survived under the post-disposal conditions (see Appendix F).

In addition to the larger epifaunal organisms, a substantial macroinfaunal community that far outnumbers the larger epifaunal components in terms of species and individuals is found in the layer of unconsolidated sediments that is usually found overlying the hard-bottom habitat MML (1988). If dredged material disposal had resulted in accumulation of fine sediments on both the soft- and hard-bottom areas in the vicinity of Site 4, the infaunal constituents of those sediments would be highly similar. In fact, MML found no indication of similarity between the infauna associated with the two types of habitat, and concluded that there were no discernible impacts due to dredged material disposal (MML, 1988).

The effects of dredged material disposal on nekton were not evaluated during the Site 4 monitoring program. However, results from studies in other areas have indicated that nekton, because of their high mobility, are not adversely affected by dredged material disposal (e.g., Wright, 1978). Localized burial of infauna may decrease the abundance of fish prey items, causing temporary declines in finfish abundances and diversity. Some inhibitory effects on fish gills or feeding structures also may occur, but these are usually minor (Wright, 1978).

4.3.2.5 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])

The designation of an ocean dump site for dredged material will have small effects on the socioeconomic environment regardless of the site selected for designation. The beneficial impacts on shipping from the dredging activities that necessitate an ocean dump site generally overcompensate for the adverse impacts on commercial fishing and recreational use of the marine environment. This section presents the implications of dumping at Site 4 and possible interferences with uses of the ocean.

Commercial Shipping. Commercial shipping would be the primary benefactor of site designation. In addition, no adverse effects on shipping would occur as Site 4 is outside of the Tampa Bay shipping fairway, and transit lanes for barged material through Tampa Bay and to the site are designed to minimize interference with commercial and recreational traffic. There is a risk of collision when any vessel is underway; however, the probability is negligible, because of the relatively few transits by disposal vessels.

Oil And Gas Exploration and Development. There are no oil and gas development activities in Tampa Bay. Site 4 is approximately 50 nmi from the nearest oil or gas lease area lease area. Physical separation of dredged material disposal from any existing or proposed oil or gas development activities precludes significant impacts.

Commercial Fishing. In general, the value or productivity of the commercial fisheries will not be affected by the use of either alternative ocean site. Essentially all of the shellfishery is in the Bay or nearshore coastal waters, and the offshore finfishery focuses on reef areas, which are not found in Site 4. Thus, physical separation of the site from major commercial fishing activity will minimize impacts.

Recreational Use. The major recreational use of marine waters in the Tampa Bay area is in the Bay and nearshore coastal area. Except for major trips in pleasure boats and sportfishing, relatively little activity occurs more than 1 or 2 nmi offshore of Egmont Key.

Little recreational use occurs near Sites 4 and 5A. Although pleasure boating may occur in the area, it is not a major activity except for boats passing through to other ports. EPA (1983) reported that Site 4 was used infrequently by divers and fishermen.

Other Activities. Desalinization, fish and shellfish culture, and mineral extraction activities do not occur at Site 4.

4.3.2.6 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])

Site-specific information concerning the water quality and ecology at alternative ocean Sites 4 and 5A is presented in Sections 3.2 and 3.3. The effects from previous dredged material disposal operations at Site 4 are discussed in Section 4.3.4.

4.3.2.7 Potential for the Development or Recruitment Nuisance Species in the Disposal Site (40 CFR 228.6 [a][10])

During the Site 4 monitoring program, there was no indication that dredged material disposal caused long-term changes in water or sediment quality that would promote the recruitment or colonization of the site by nuisance species. No effects were detected from dredged material disposed on the infaunal species composition (CSA, 1987; MML, 1988). The presence of bacteria or pathogens in the bottom sediments or fish and macroinvertebrate organisms was not measured during the monitoring survey. Localized releases of nutrients at the disposal site may stimulate phytoplankton productivity in a small area for a short time (Windom, 1975); resulting in algal blooms and/or a shift in dominant algal species (CE, 1978). The specific role of dredged material for introducing nuisance species has not been studied extensively.

4.3.2.8 Existence at or in Close Proximity to the Site of Any Significant Natural or Cultural Features of Historical Importance (40 CFR 228.6 [a][11])

The absence of major historical or natural features in the area of the candidate dumpsite precludes significant impacts associated with dredged material disposal at this site.

4.3.3 Unavoidable Adverse Impacts

Potential unavoidable adverse impacts from dredged material disposal at Site 4 include (1) formation of temporary, localized turbidity plumes, (2) temporary reduction of benthos at the site due to burial and smothering of non-motile infauna and/or epifauna, and (3) possible alterations in sediment texture or chemical composition. Plumes of suspended sediment associated with sinking dredged materials result in increases in turbidity levels, suspended particulate concentrations, and decreased light transmittance. With the possible exception of alterations in sediment texture and chemical composition, these effects are short-term and are dissipated by natural dispersion, mixing, and eventual sinking of particles.

Deposition of dredged materials will bury and smother localized populations of benthic organisms, reducing abundances and diversity of the benthic communities in the immediate area of dumping. The magnitude of this impact will depend on the spatial extent of the affected area, volume of dredged material released, rates of natural dispersion, and specific tolerances of affected species to periodic burial. The recovery of impacted areas will reflect the ability of buried organisms to burrow through the sediment layer and the ability of adjacent populations to recolonize the area. Burial of epifaunal organisms could cause more severe impacts if the exposure exceeded the tolerances of individual species for periodic burial.

Finally, grain size characteristics between the dredged materials and the existing site sediments could exacerbate impacts to the benthic fauna. Alterations in the bottom sediment texture could affect the survival of existing species or recruitment of new species. Because sediments should have passed bioassay tests, appreciable increases in concentrations of sediment-associated contaminants and accumulation of these materials by exposed organisms are not expected.

4.3.4 Cumulative Impacts

The effects of the disposal of dredged materials at Site 4 have been monitored by CSA (1986a,b,c, 1987). Cumulative impacts may be assessed based on those data and on the results of the sediment mapping performed by CAIS (1988). The significance of any impacts from dredged material disposal will be determined by the frequency of disposal, the volume of the disposed materials, and the duration of the disposal operations.

The dredged material dumped at the site was non-toxic and contained very low concentrations of trace metals and hydrocarbons. No cumulative impacts on the chemical environment were observed by CSA (1987) at Site 4. CAIS (1988) found high levels of bismuth-214 and iron in sediments sampled along transects through the site and beyond the boundaries of the site.

Adverse impacts to plankton, epifauna, and infauna from increased turbidity, changes in the chemical or physical characteristics of the habitat, or smothering of organisms by burial would be temporary (Hirsch et al., 1978). The impacts of dredged materials on plankton at Site 4 were not evaluated during the recent monitoring study (CSA, 1987). Nevertheless, the effects of the disposal of dredged materials would have been difficult to assess because of the natural high variability in plankton populations (Sullivan and Hancock, 1977). Nekton would not be adversely impacted by the disposal of dredged materials because of the high mobility of the nekton (Wright, 1978). A change in the fauna would be expected if the site is used regularly for dredged material disposal (L. Saunders, Jacksonville District CE, personal communication, May 6, 1987).

The recent studies at Site 4 did not detect any clear relationships between the presence of dredged material constituents and measured changes in the infaunal community (CSA< 1987; MML, 1988). In addition, there was no clear evidence that any increases in suspended sediment concentrations or in the sediment deposition rates had resulted in detectable changes in the epifaunal communities (CSA, 1987).

Mounding may create a reef-like system. Amberjack, a species of fish not typically found in the open waters, were observed inhabiting mounds of dredged material at Site 4, behaving as if the mounds were typical reefs. This species is normally found inhabiting shipwrecks and other submerged structures. It is not known how long these mounds will persist at the site. However, the shifting of sediments is a naturally occurring phenomenon in the eastern Gulf of Mexico (L. Saunders, Jacksonville District CE, personal communication, May 6, 1987).

During monitoring activities conducted by an EPA contractor, during and after the disposal operations, it was evident that assemblages of various sessile animals, such as sponges and ascidians, were beginning to colonize some areas of the mound where larger consolidated clay boulders were present. In 1988, EPA divers conducted cursory video recordings which revealed that armoring of the clay boulders was still evident in some areas but that boring by macroinvertebrates was causing fragmentation of the consolidated clay.

In October, 1991, EPA divers revisited the mound to visually assess the extent of fragmentation of the consolidated clay boulders and observe the status of sessile invertebrate colonization (see Appendix F). In summary, the survey revealed that both the rubble and boulder material consisted primarily of rock with porosity varying from limestone to solid rock. Larger boulders were encrusted by calcareous algae, sponges, ascidians, and tube coral (Cladocora sp.). In many cases, the entire surface of the rocks was near 100% colonized by these varying assemblages of biota. Fish were abundant and included butterfly fish, wrasse, damselfish, angelfish, highhats, grunts, snapper, jacks, grouper, needlefish and barracuda, with grouper being the most abundant sport/commercial fish observed (Appendix F).

4.3.5 Relationship Between Short-Term Use and Long-Term Impacts

Tampa Bay is an important area for commercial shipping and fishing. The economy of the region surrounding the Bay relies heavily upon the continued use of the harbor for these activities (EPA, 1983). Ongoing dredging to maintain navigable depths in the shipping channels of Tampa Bay is essential for the continued economic health of the region.

Long-term impacts of dredged materials at a disposal site may be minimized by locating the site in an area with few hard-bottom areas and with sediment composition similar to that of the dredged materials (EPA, 1983). However, several temporary impacts may be seen as a result of the disposal of dredged material at Site 4. Temporary impacts may include an increase in turbidity of the water column, temporary loss of species, and disruption of the community.

There may be an increase in the turbidity of the water column during and after disposal activities. This increase would result in a decrease in the amount of light transmitted through the water column, a decrease in photosynthetic activity, and, consequently, a decrease in the primary productivity of the area (CE, 1978). Increased turbidity may prevent adequate light penetration, thereby inhibiting the growth of seagrasses and other plants. This would result in a loss of spawning areas and protective covering for fish and invertebrates (US EPA, 1983).

Nutrient levels may also increase. Phytoplankton moves with the water mass and will have maximum opportunity to react with the excessive nutrients in the suspended dredge materials. This could be significant because algal blooms could develop or a shift in algal species dominance might occur (CE, 1978).

If the disposed sediments are dissimilar to the naturally occurring sediments of the disposal site, the habitat could dramatically change at the site (CE, 1978). This change in habitat could lead to the selection of a different community structure (i.e., different species, different relative abundances). In studies conducted by the U.S. Department of Interior, Fish and Wildlife Service on hopper disposal in San Francisco and San Pablo Bays, disposal operations were found to significantly decrease the abundances and numbers of species in the benthic environment, including demersal fish. Even though some species were reestablished in the area within a few months, the species diversity index did not return to pre-dumping levels during the study (CE, 1972). Conversely, community recovery rates may be faster if the dredged materials are similar in grain-size composition to the original sediments of the site (CE, 1978).

The development of mounds of disposed materials could result in several significant changes to the environment at the site, including a change in bathymetry, localized burial of infauna and epifauna, and the development of anoxic conditions. Localized burial of epifauna and infauna may decrease the abundance of fish prey, causing a decrease in the finfish abundances and diversity at the disposal site.

4.3.6 Irreversible or Irretrievable Commitment of Resources

Use of an offshore site for disposal of dredged materials from Tampa Harbor may result in the following irreversible or irretrievable commitments of certain resources:

- Permanent loss of suitable dredged materials for use as landfill or beach nourishment material (US EPA, 1983).

- Fuel, labor, and equipment rental expenses will be incurred during transport of the dredged material to and from the disposal site. The total of these expenses will increase as the distance to the disposal site increases (US EPA, 1983).

- o The chemical characteristics of the bottom sediments at the site may be changed (US EPA, 1983).
- o Loss of existing habitat to certain species (US EPA, 1983).
- o Temporary loss of organisms at the site due to smothering by the dredged material as well as loss of habitat (US EPA, 1983).

4.3.7 Mitigation Measures

Adverse impacts from dumping at Site 4 (identified in the previous sections) are considered insignificant, except potential effects to exposed hard-bottom biota from accumulation on the bottom of dredged materials (US EPA, 1983). The results from the Site 4 monitoring study could not demonstrate unequivocally a relation between disposal of dredged material and a reduction in percent coverage by hard-bottom biota, although some effect was inferred (CSA, 1987). Furthermore, CSA (1987) predicted that any additional accumulation of dredged materials on hard-bottom substrata could exceed the tolerances of epifaunal organisms to periodical burial. Thus, the balance between sediment accumulation rates and the tolerances of epifaunal organisms to burial may be critical to the extent of adverse effects seen at and near Site 4. Consequently, an important mitigation measure is to avoid hard-bottom areas. This is of particular importance considering the findings of EPA's recent video survey of disposal mound (Appendix F). While habitat creation was not the purpose of disposal, the communities that now exist should be protected to the extent possible.

Results from monitoring efforts could potentially be used to define the maximum discharge rate of dredged materials that would not result in excessive mortality due to burial and/or smothering. Alternatively, disposal operations could be restricted to those months when bottom current velocities are strongest (i.e., fall and winter; CSA, 1987) and the frequency of significant sediment transport events are highest relative to those encountered during other seasons. In this case, dredged material dispersion would be maximized and accumulation of sediments on hard substrata would be discouraged. Finally, periodic bioassay and bioaccumulation testing of dredged materials would ensure that dredged materials remain non-toxic to marine organisms, or would facilitate identification of potential environmental problems and subsequent planning for further mitigating measures.

Specific responsibilities and the framework for management/monitoring plans for ODMDSs in the southeast under the jurisdiction of EPA/Region IV, are established in a regional Memorandum of Understanding (MOU) between EPA/Region IV and the CE/South Atlantic Division. This MOU has led toward the development of a site-specific management/monitoring plan for the Tampa ODMDS (see Appendix C). Such site-specific management may include strategically locating and/or orienting dredged material within the site boundaries relative to predominant current patterns. Monitoring should involve sediment mapping of disposed material to determine any movement of material off of the site. Determination of the significance of any biological impacts of dredged material outside ODMDS boundaries would then be appropriate. The existence, magnitude, and implementation of a site plan is dependent upon available funding and coordination between EPA and the CE.

4.4 DISCUSSION OF THE ALTERNATIVES

Interim designation of Site 4 expired in November 1985. The no-action alternative would refrain from designating an EPA-designated ocean site for the disposal of dredged material from Tampa Bay. By taking no action, the present ocean Site 4 would not receive final designation, nor would an alternative ocean disposal site be designated. However, based on the information presented in this EIS, ocean disposal of dredged material from Tampa Bay is a feasible alternative.

Site 4 received periodic use between May 1984 and November 1985. It is located 18 nmi from Egmont Key and has an average depth of 22 m. The site is characterized by the presence of fine sands and silts.

The 11 specific site selection criteria (40 CFR 228.6) discussed in the previous sections and outlined in Table 4-1 demonstrate the possibility of designating Site 4 on the following basis:

- The bottom topography of Site 4 is characterized by sand with few hard-bottom areas.
- Site 4 is removed from beaches and other recreational areas. It is also unlikely that migration and spawning locations are restricted geographically to Site 4.
- Monitoring at Site 4 has not demonstrated any adverse changes to the biological communities occupying the area. Effects of further dredged material disposal is expected to be the same.

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TABLE 4-1. SUMMARY TABLE OF ENVIRONMENTAL CONSEQUENCES.

Criteria as listed at 40 CFR 228.6	Site 4
1. Geographical position; depth of water; bottom topography; distance from coast.	Depth 20-23 m; rolling sand/shell bottom, very limited hardbottom outcroppings; no major topographical relief; 18 nmi to Egmont Key. See Figure 2-2.
2. Location in relation to breeding, spawning, nursery, feeding, or passage of living resources in adult or juvenile phases.	Not within areas designated as general habitat boundaries for designated fish species; migration, feeding, nesting, overwintering of birds, mammals, reptiles and endangered species occur closer to shore; any impacts would be insignificant.
3. Location in relation to beaches and other amenity areas.	Approximately 20 nmi to beaches of the coastal barrier islands; occasional recreational diving, sport or commercial fishing.
4. Types and quantities of wastes proposed to be disposed of, and proposed methods of release, including methods of packing the waste, if any.	3.44 million yd^3 of dredged material from the Tampa Harbor Deepening Project already deposited at this site. Future operation and maintenance dredging estimated at 276,000 yd^3 of predominantly sand material and 82,000 yd^3 of predominantly silt material per year.
5. Feasibility of surveillance and monitoring.	Site readily accessible for monitoring because of close proximity to shore and shallow water; Appendix C is the SMMP.
6. Dispersal, horizontal transport, and vertical mixing characteristics of the area, including prevailing current direction and velocity, if any.	Less than 3% of discharged mass will become entrained in a plume; sand-sized sediments will settle to the bottom within 275 m of discharge point; transport primarily in S to SE direction; most transport due to surface wave-induced turbulence during storms.
7. Existence and effects of current and previous discharges and dumping in the area (including cumulative effects).	Short-term increases in turbidity, phytoplankton productivity, and nutrients (ammonium, and orthophosphates); negligible release of trace metals and chlorinated or petroleum hydrocarbons from sediments; increase in percent clay and fines; mounding; effects on epifauna diminished with time.
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.	No interference with oil and gas exploration (nearest oil/gas lease is 50 nmi seaward), recreation, fishing; no desalination or fish and shellfish culturing occurring at the site.
9. The existing water quality and ecology of the site as determined by available data and by baseline surveys.	Low in nutrients, suspended solids, and anthropogenic contaminants; plankton and nekton communities consist of subtropical tropical species; benthos primarily consists of polychaete worms and crustacea.
10. Potential for the development or recruitment of nuisance species in the disposal site.	Populations of nuisance species have not been developed or been recruited; animals present prior to 1980 disposal activity are similar to those presently found in and around thesite.
11. Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.	None known to exist.

CHAPTER 5.0 COORDINATION

Preparation of this EIS was a joint effort involving scientific and technical staff from several organizations. This chapter briefly presents the qualifications and contributions of each primary author, listed here alphabetically.

DIANA BAUMWALL

Ms. Baumwall holds a B.A. in Political Science from Pennsylvania State University. She is employed by Scientific Applications International Corporation (SAIC) in McClean, Virginia.

Ms. Baumwall wrote Section 3.4 of Chapter 3.

REA BOOTHBY

Mr. Boothby holds a M.S. in Fisheries from Louisiana State University. He is the EIS Coordinator for the Environmental Branch of Planning Division with the U.S. Army Corps of Engineers in Jacksonville, Florida.

Mr. Boothby coordinated the EIS for the District.

GARY COLLINS

Mr. Collins holds a B.S. degree in Biology from the College of Charleston and a M.S. in Bio-Environmental Oceanography from Florida Institute of Technology. He is an Environmental Scientist with EPA Region IV in Atlanta, Georgia.

Mr. Collins replaced Mr. Hoberg as EPA reviewer and coordinator for the EIS in July, 1991. He was also responsible for drafting the Site Management and Monitoring Plan (SMMP).

JUDITH GALE

Ms. Gale holds a B.A. degree in Social Sciences from Chatham College and a M.F.S. in Natural Resources Management from Yale

University. She is a Research Scientist with Battelle Ocean Sciences in Duxbury, Massachusetts.

Ms. Gale was instrumental in the early development of this EIS. She wrote sections of Chapter 1 and provided editorial and technical review of Chapter 3.

CHRISTIAN HOBERG

Mr. Hoberg holds a B.S. in Biology from the University of Miami (Florida) and an M.S. in Marine Science from the University of Miami Rosenstiel School of Marine and Atmospheric Science. He is an Environmental Scientist with EPA Region IV in Atlanta, Georgia.

Mr. Hoberg was an EPA reviewer and coordinator for the EIS from March 1989 until July 1991.

CARLTON HUNT

Dr. Hunt holds a B.A. in Chemistry from Doane College, an M.S. in Chemical Oceanography from the University of Connecticut, and a Ph.D in Chemical/Geological Oceanography from the University of Connecticut.

Dr. Hunt wrote Section 3.1.4 of Chapter 3.

ROBERT KELLEY

Dr. Kelley holds a B.S. in Biology from Hobart College and a Ph.D. in Zoology/Ecology from the University of North Carolina. He is a Senior Project Manager with Scientific Applications International Corporation (SAIC) in McClean, Virginia.

Dr. Kelley wrote Section 3.4 of Chapter 3.

MICHAEL KRAVITZ

Mr. Kravitz holds a B.S. in Biology from State University of New York at Stony Brook and an M.A. in Marine Science from The College of William and Mary. He is a Researcher with Battelle Ocean Sciences in Duxbury, Massachusetts.

Mr. Kravitz wrote Sections 2.2 and 2.3 of Chapter 2, and section 3.3 of Chapter 3.

NANCY MACIOLEK

Dr. Maciolek holds a B.A. in Biology from Boston University, an M.A. in Zoology from University of Texas at Austin, and a Ph.D. in Biology from Boston University. She is a Senior Research Scientist with Battelle Ocean Sciences in Duxbury, Massachusetts.

Dr. Maciolek was the technical reviewer of the entire EIS.

TIM MURPHY

Mr. Murphy holds a B.S. in Civil Engineering from Auburn University. He is a study manager in Navigation Section of Planning Division with the U.S. Army Corps of Engineers in Jacksonville, Florida.

Mr. Murphy prepard the Disposal Area Study (Appendix E).

CHARLES PHILLIPS

Mr. Phillips holds a B.A. degree in Biological Sciences from University of California, Santa Barbara and an M.A. degree in Marine Biology from San Francisco State University. He is an Oceanographer with Scientific Applications International Corporation (SAIC) in La Jolla, California.

Mr. Phillips wrote Section 2.2 of Chapter 2, Sections 3.1 and 3.2 of Chapter 3, and Sections 4.2 and 4.3 of Chapter 4. He assisted in the preparation of sections of Chapter 4 for which others had primary responsibility.

REGINALD ROGERS

Mr. Rogers holds a B.S. in Fisheries Biology from Auburn University and an M.S. in Marine Biology from the University of Hawaii. He was an Ecologist with the U.S. EPA Region IV in Atlanta, Georgia, since retired.

Mr. Rogers was the principal EPA coordinator for the EIS prior to 1989.

LLOYD SAUNDERS

Dr. Saunders holds a Ph.D. in Biology from University of Waterloo (Ontario). He was the Chief Administrator of the Environmental Resources Branch with the U.S. Army Corps of Engineers in Jacksonville, Florida.

Dr. Saunders wrote Appendix A. He is now in Project Management, Office of the Chief of Engineers, Washington, DC.

TRACY STENNER

Ms. Stenner, the EIS coordinator and principal author, holds a B.S. degree in Biology from Emory University and an M.S. degree in Marine Ecology from Northeastern University. She is a Research Scientist with Battelle Ocean Sciences in Duxbury, Massachusetts.

Ms. Stenner coordinated and assisted in the preparation of Chapters 1, 2, Section 3.3, Sections 4.1 and 4.5 of Chapter 4, and Appendix A. She also wrote the executive summary.

HEATHER TRULLI

Ms. Trulli holds a B.A. in Biological Sciences from Hope College. She is a Researcher with Battelle Ocean Sciences in Duxbury, Massachusetts.

Ms. Trulli wrote Sections 4.3 and 4.4 of Chapter 4, Chapters 5, 6, and 7, and Appendix B.

CHAPTER 6.0 GLOSSARY AND ABBREVIATIONS

6.1 GLOSSARY

ALCYONARIAN Any anthozoan of the class Alcyonaria, which includes the precious corals, sea fans, and sea feathers.

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 (primarily marine) of the class Crustacea 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, which are common fouling organisms.

ANNUAL Performed every year.

ANTHROPOGENIC Relating to the effects or impacts of man on nature. Construction wastes, garbage, and sewage sludge are examples of anthropogenic materials.

APPROPRIATE SENSITIVE MARINE ORGANISM	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 Part 227.27).
ASCIDIAN	A sessile tunicate, or sea squirt, of the class Ascidiacea.
ASSEMBLAGE	A group of organisms sharing a common habitat.
BACKGROUND LEVEL	The naturally occurring concentration of a substancewithin an environment that has not been affected by unnatural additions of that substance.
BASELINE CONDITION	The characteristics of an environment before the onset of an action that can alter that environment.
BASELINE SURVEY AND BASELINE DATA	Survey conducted and/or data collected prior to the initiation of actions that may alter an existing environment; any data serving as a basis for measurement of other data.
BATHYMETRY	The measurement of the depths and contours of the bottoms of oceans, seas, or lakes. Submerged mountain ranges, unusually deep areas, shoals, etc., may be of particular interest.
BENTHOS	All marine organisms (plant or animal) living on or in the bottom of the ocean.
BIOACCUMULATION	The uptake and assimilation of materials (e.g., heavy metals) leading to elevated concentrations of the substances within tissue, blood, or body fluid of a living organism.
BIOASSAY	A method for determining the toxicity of a substance by observing the effects of varying concentrations on growth or

survival of suitable plants, animals, or microorganisms; the concentration that 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.

BIOLOGICAL	Relating to living organisms and life processes.
BIOMASS	The total mass of organic material of a species per unit of area or volume, such as 100 grams of fish per square meter of ocean surface. This term is used to express population density.
BIOGENIC	Produced by living organisms.
BIOTA	Animals and plants inhabiting a given region.
BIOTIC GROUPS	Assemblages of organisms that are ecologically, structurally, or taxonomically similar.
BLOOM	A relatively high concentration of phytoplankton in a body of water resulting from rapid proliferation during favorable growing conditions generated by availability of nutrient and sunlight.
BOD	Biochemical Oxygen Demand or Biological Oxygen Demand; the amount of dissolved oxygen required by aerobic microorganisms 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.
BRYOZOAN	An invertebrate of the phylum Bryozoa, which includes organisms commonly called moss animals.
CARNIVORE	A flesh-eating animal.

CEPHALOPOD — Exclusively marine animals constituting the most highly evolved class of the phylum Mollusca (e.g., squid, octopus, and Nautilus).

CETACEAN — Marine mammal, of the order Cetacea, including whales, porpoises, and dolphins.

CHAETOGNATHA — A phylum of small planktonic, transparent, worm-like invertebrates known as arrow-worms.

CHEMICAL — Relating to the scientific study of the composition, structure, properties, and reactions of a substance or a system of substances.

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 photosynthetic pigment characteristic of higher plants and algae; frequently used as a measure of phytoplankton biomass.

CHLOROPHYLL — A group of oil-soluble, green plant pigments that function as photoreceptors of light energy for photosynthesis and primary productivity.

CNIDARIA — A large diverse phylum of primarily marine animals; its member possess two cell layers and an incomplete digestive system, with the opening usually surrounded by tentacles. This group includes hydroids, jellyfish, corals, and anemones. Formally called Coelenterata.

COLIFORM — Bacteria residing in the colons of mammals; generally used as indicators of fecal pollution.

CONTINENTAL RISE — The gentle slope with a generally smooth surface between the continental slope and the deep ocean floor, extending from depths of 2000 to 3500 m and with an average slope of 1-10m/km.

CONTINENTAL SHELF	That part of the continental margin extending from the low water line to a depth of 200 m, where the continental slope begins.
CONTINENTAL SLOPE	That part of the continental margin consisting of the declivity from the edge of the continental shelf down to the continental rise. The continental slope generally extends from 200 m to 2000 m, with an average slope of 70 m/km, or 4 degrees.
CONTOUR LINE	A line on a chart connecting points of equal elevation above or below a reference plane, usually mean sea level.
CONTROL	In experimental work, a standard against which observations and results can be checked in order to determine their validity.
CONTROLLING DEPTH	The shallowest depth in the approach or channel to an area, such as a port, governing the maximal draft of vessels which can enter.
COPEPODA	A large diverse order 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 current-measuring assembly consisting of an attached surface buoy, an underwater sail or parachute, and a weighted current cross. As the assembly moves with a current, it is tracked electronically at specific time intervals, enabling the determination of an average current velocity and direction.
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. This order 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 (g water in reference to a volume of 1 cc at 4°C). This term is interchangeable with the term "abundance."
DETRITIVORE	An animal that feeds on detritus; also called deposit-feeder.
DETRITUS	The product of decomposition or disintegration; dead organisms and fecal material.
DIATOM	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.
DINOFLAGELLATE	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 and distinguishable from the surrounding water.
DISPERSION	The dissemination of discharged matter over large areas by natural processes such as currents.
DISSOLVE	To pass or cause to pass into solution.

DISSOLVED OXYGEN	The quantity of oxygen (expressed in mg/liter, ml/liter, or parts per million) in solution in a unit volume of water. Dissolved oxygen (DO) is a key parameter in the assessment of water quality.
DIVERSITY (SPECIES)	A statistical measurement that 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 thatbecause of their abundance, size, or control of the energy flow, strongly affect a community.
DREDGE	To clean, deepen, or widen with a machine that removes sand or mud, especially from the bottom of a body of water.
EBB CURRENT, EBB TIDE	Tidal current moving away from land or down a tidal stream.
EC_{50}	The concentration that results in a mean 50 percent reduction in the test parameter - i.e., 50 percent reduction growth or fecundity, etc.
ECHINODERM	An exclusively marine animal of the phylum Echinodermata, whose members are distinguished by radial symmetry, internal skeletons of calcareous plates, and water-vascular systems that serve the needs of locomotion, respiration, nutrition, or perception. The phylum Echinodermata includes starfishes, sea urchins, sea cucumbers, and sand dollars.
ECOLOGY	The study of the interrelationships between organisms and their environment.
ECONOMIC RESOURCE ZONE	The largely unexplored region of the ocean that extends 200 nmi seaward from the coast and brings within the national jurisdiction over 3 million nmi^2 of

submarine land. This zone contains valuable natural resources found in the water, on the seabed, and below the seabed.

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

EDDY A circular mass of water within a larger water mass; an eddy 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.

ENDANGERED SPECIES A species threatened with extinction.

ENDEMIC Restricted or peculiar to a locality or region.

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

EPIBIONT An organism living on the surface of another organism.

EPIFAUNA Benthic animals living on the surface of the bottom materials.

EPIPELAGIC Associated with that portion of the oceanic zone into which enough light penetrates to allow photosynthesis; generally extends from the surface to about 200 m.

EPIPHYTE A plant that grows upon another plant but is not parasitic.

ESTUARY A semienclosed coastal body of water that 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 — The 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.

FORAMINIFERAL TEST — A calcareous shell from any member of the protozoan order Foraminifera, usually perforated by small openings.

GASTROPOD — A mollusc with a distinct head (generally with eyes and tentacles), a broad, flat foot, and usually a spiral shell (e.g., snails).

GENUS/GENERA — A subdivision of a family that includes one or more closely related species.

GEOLOGICAL — Dealing with the structure of a particular area of the earth's surface.

GORGONIAN OCTOCORAL — A coral of the order Gorgonacea characterize by the possession of a skeleton containing horn-like material (gorgonin). This group includes sea whips, sea feathers, and sea fans.

GYRE — A closed circulation system, usually larger than an eddy.

HERBIVORE — An animal that feeds chiefly on plants.

HETEROGENEOUS — Consisting of dissimilar parts, elements, or ingredients; not uniform.

HOPPER DREDGE — A self-propelled vessel with capabilities to dredge, store, transport, and dispose of dredged materials.

HYDROGRAPHY	The science that deals with the measurement of the physical features of waters and their marginal land areas.
ICHTHYOPLANKTON	That portion of the plankton composed of fish eggs and weakly motile fish larvae.
INDICATOR SPECIES	An organism so strictly associated with particular environmental conditions that its presence indicates 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 that live in the bottom sediment.
INITIAL MIXING	Dispersion or diffusion of liquid, suspended particulate, and solid phases of a waste material that occurs within 4 hours after dumping.
INJUNCTION	A court order forbidding or calling for a certain action.
IN SITU	[Latin] In the original or natural setting (in the environment).
INTERIM DISPOSAL SITE	An ocean disposal site tentatively approved by the US EPA for use.
INVERTEBRATE	An animal lacking a backbone or internal skeleton.
ISOBATH	A line on a chart connecting points of equal depth below mean sea level.
ISOTHERM	A line on a chart connecting points having the same temperature.
JURISDICTION	The right or power to interpret and apply.
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.

KNOT	A unit of speed; one nautical mile per hour, or approximately 1.15 statute mile per hour.
LARVAL/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.
LC_{50}	The concentration of a substance that is lethal (deadly) to 50 percent (lethal concentration of 50 percent) of the test organisms.
LITTORAL	Of or pertaining to the seashore, especially the region between tide lines.
LIVE BOTTOM	Areas covered by algae, sponges, corals, and other biota.
LONGSHORE CURRENT	A current flowing parallel to a coastline.
LORAN-C	Long Range Navigation, type C; a low-frequency radio navigation system having a range with a radius of approximately 1500 mi.
MAIN SHIP CHANNEL	The designated shipping corridor leading into a harbor.
MAINTENANCE DREDGING	Periodic dredging of a waterway, necessary for the continued use of the waterway.
MESOPELAGIC	Pertaining to depths of 200 m to 1000 m below the ocean surface.
METEOROLOGICAL	Concerned with atmospheric phenomena.
MICRONUTRIENT	Substance essential in minute amounts for normal growth and development of an organism.
MIXED LAYER	The upper layer of the ocean that 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	Observation of environmental effects of disposal (or other) operations through biological and chemical data collection and analyses.
MOTILE	Capable of movement.
NAUTICAL MILE	An international unit of distance equal to 1852 m or, approximately, 6076 ft.
NEKTON	Free-swimming aquatic animals that move independently of water currents.
NEMERTEAN	Any member of the phylum Rhynchocoela (Nemertinea), which includes the proboscis worms or ribbon worms.
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 200 m.
NEUSTON	Organisms associated with the air-to-sea interface to a depth of 20 cm; composed mainly of copepods and ichthyoplankton.
NUISANCE SPECIES	Organisms of no commercial value, that, because of predation or competition, may be harmful to commercially important organisms.
OLIGOCHAETA	A small class of the phylum Annelida; worm-like organisms characterized by simple bodies without appendages.
OMNIVOROUS	Pertaining to animals that feed on animal and plant matter.
OPHIUROID	An echinoderm of the class Ophiuroidea, which includes brittle stars, basket stars, and serpent stars.
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.

OSTRACOD	A crustacean of the subclass Ostracoda that possesses a bivalve carapace.
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 thatdescribe the characteristics or behavior of a set of variables.
PATHOGEN	An entity producing or capable of producing disease.
PCB	Polychlorinated biphenyl; any of several chlorinated compounds having various industrial applications. PCBs are pollutants that tend to accumulate and persist in the environment.
PELAGIC	Pertaining to water of the open ocean beyond the continental shelf and above the abyssal zone.
PERENNIAL	Lasting from year to year.
PERTURBATION	A disturbance of a natural or regular system; any departure 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).
PHI	A ratio scale used to measure grain size. The phi scale is a logarithmic transformation of the Wentworth scale. Modern grain-size data are nearly always stated in terms of phi.
PHOTIC ZONE	The layer of a body of water that receives sufficient sunlight for photosynthesis.

PHYLUM/PHYLA	A taxonomic grouping constituting the largest division of the animal or plant kingdoms.
PHYTOPLANKTON	Microscopic, 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.
PLEISTOCENE	The first era of the Quarternary period (geologic time) characterized by repeated glaciation and the first indications of social life in man.
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 that separates from a solution or suspension by chemical or physical change.
PRIMARY PRODUCTIVITY	The amount of organic matter synthesized by organisms (primarily phytoplankton) from inorganic substancesper unit time and volume of water. Plant respiration may or may not be subtracted (net or gross productivity, respectively).
PROTOZOAN	Mostly microscopic, single-celled animals that constitute one of the largest populations in the ocean. Protozoans play a major role in recycling nutrients.
QUALITATIVE	Pertaining to the non-numerical assessment of a parameter.
QUANTITATIVE	Pertaining to the numerical measurement of a parameter.
RECONNAISSANCE SURVEY	A survey to explore an area, especially to obtain data.

RECRUITMENT	Addition to a population of organisms by reproduction or immigration of new individuals.
RED TIDES	The recurrence of enormous numbers of dinoflagellates, especially Gonyaulax and Ptychodiscus in waters off the coasts of Florida and California, resulting in reddish hue of waters by day and luminescence by night.
RELEASE ZONE	An area defined by the locus of points at a distance of 100 m from a vessel engaged in dumping activities; will never exceed the total surface area of the dumpsite.
RUNOFF	That portion of precipitation upon land ultimately reaches streams, rivers, lakes, and oceans.
SAFETY FAIRWAY	A navigable lane or corridor of a river or bay through which boats and ships enter or depart and in which no artificial island or fixed structure, whether temporary or permanent, is permitted.
SALINITY	The amount of salts dissolved in water, expressed in parts per thousand (°/oo, or ppt).
SANCTUARY	A place giving refuge.
SATURATE	To soak or load to capacity.
SESSILE	Attached, sedentary, incapable of movement.
SHELF WATER	Water that 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; the 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.

SHOAL — A shallow place in a body of water, such as a sandbar or sandbank.

SILT — Sedimentary material consisting of fine mineral particles found especially at the bottom of bodies of water.

SLOPE WATER — Water that originates from, occurs at, or can be traced to the continental slope, differentiated by characteristic temperature and salinity.

SPAWN — To produce and deposit eggs.

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 that can be extracted from a known volume of water.

STANDING STOCK — The biomass or abundance of living material per unit volume of water, or area of sea-bottom.

SUBSTRATUM — 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 — Freely moving without falling or sinking.

SUSPENDED SOLID — Finely divided particles of a solid temporarily suspended in a liquid (e.g., soil particles in water).

TAXONOMY — The science of classification; that is, the arrangement of plants and animals into groups based on their natural relationships.

TELEOSTS	Any fish of the class Osteichthyes characterized by the possession of a bony skeleton.
THERMOCLINE	A vertical temperature gradient in some layer of a body of water, that is appreciably greater than the gradients above or below it; a layer in which such a gradient occurs.
TOPOGRAPHY	The physical features of a place or region.
TOXICITY	Quality, state, or relative degree of being poisonous.
TRACE	A constituent, as a chemical compound orelement, present in less than standard (i.e., minute) amounts.
TRACE METAL OR ELEMENT	An element found in the environment in extremelysmall quantities; usually includes metals constituting 0.1% (1,000 ppm) or less, by weight, in the earth's crust.
TRANSMISSIVITY	The state or quality of being capable of conveying something from one point to another, as in the ability of water to allow light to penetrate to a certain depth or over a certain depth range.
TRANSMITTANCE	The fraction of radiant energy that passes through a medium, such as water, to a further boundary or point.
TREND ASSESSMENT SURVEY	Surveys conducted over long periods to detect shifts in environmental conditions within a region.
TROPHIC LEVEL	Discrete step along a food chain in which energy is transferred from the primary producers (plants) to herbivores and finally to carnivores and decomposers.
TUNICATE	Any member of the subphylum Urochordata; a sea squirt.
TURBID	Opaque with suspended sediment or foreign particles.

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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.

6.2 ABBREVIATIONS

BLM	Bureau of Land Management
C	Carbon
°C	Degrees Celcius
Cd	Cadmium
CFR	Code of Federal Regulations
cm	Centimeters
COE	U.S. Army Corps of Engineers
DA	District Administrator (CE)
DMRP	Dredged Material Research Program
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DOI	U.S. Department of the Interior
E	East
EC_{50}	Effective concentration. (see Glossary)
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FDNR	Florida Department of Natural Resources
FR	Federal Register
FWPCA	Federal Water Pollution Control Act
FWPCAA	Federal Water Pollution Control Act Amendments
g	Gram
Hg	Mercury
h	Hour

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IEC	Interstate Electronics Corporation
IMCO	Inter-Governmental Maritime Consultative Organization
kg	Kilogram
kHz	Kilohertz
km	Kilometer
kn	Knot
l	Liter
LC_{50}	Concentration of material lethal to 50 percent of the test organisms.
MAFLA	Mississippi, Alabama, Florida
m	Meter
m^2	Square meter
mg	Milligram
mm	Millimeter
MML	Mote Marine Laboratory
MMS	Minerals Management Service
MPRSA	Marine Protection, Research, and Sanctuaries Act
N	North
ng	Nanogram
NEPA	National Environmental Policy Act
nmi	Nautical mile
nmi^2	Square nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atomospheric Administration
NOO	Naval Oceanographic Office
NTU	Nephelometric Turbidity Unit
NUSC	Naval Underwater Systems Center

CHAPTER 7.0 REFERENCES

Amson, J. 1982. Summary testimony given at the hearing on Tampa Bay Dredged Material Disposal Project expansion. Conducted by the U.S. Army Corps of Engineers, St. Petersburg, FL, 30 June 1982. Jonathan Amson, U.S. EPA Criteria and Standards Division.

Anderson, D. and D. Wall. 1978. Potential importance of benthic cysts of Gonyaulax tamarensis and G. excavata in initiating toxic dinoflagellate blooms. J. Phycol 14(2): 224-234.

Anderson, D.M., D.G. Aubrey, N.A. Tyler, and D.W. Coates. 1982. Vertical and horizontal distributions of dinoflagellate cysts in sediments. Limnol. Oceanog. 27:757-765.

Atwood, D.C., P. Duncan, M.C. Stalcup, and M.J. Barcelona. 1976. Ocean thermal energy conversion: resource assessment and environmental impact for proposed Puerto Rico site. University of P.R., Mayaguez.

Battelle. 1986a. Tampa Harbor Dredged Material Disposal Monitoring Study (Survey III Report). Prepared for the U.S. Environmental Protection Agency by Battelle New England Marine Research Laboratory under Contract No. 68-01-6986. 72 p., 5 appendices.

Battelle. 1986b. Tampa Harbor Dredged Material Disposal Monitoring (Survey IV Report). Prepared for the U.S. Environmental Protection Agency by Battelle New England Marine Research Laboratory under Contract No. 68-01-6986. 120 p., 5 appendices.

Battelle. 1986c. Tampa Harbor Dredged Material Disposal Monitoring (Survey V Report). Prepared for the U.S. Environmental Protection Agency by Battelle New England Marine Research Laboratory under Contract No. 68-01-6986. 121 p., 5 appendices.

Beccasio, A.D., Fotheringham, N., Redfield, A.E., et al. 1982. Gulf coast ecological inventory: User's guide and information base. Washington, DC: Biological Services Program, U.S. Fish and Wildlife Service, 191 p.

Bell, F.W., P.E. Sorenson, and V.R. Leeworthy. 1982. The Economic Impact of Saltwater Recreational Fisheries in Florida. Sea Grant Project No. R/FR-16, Report Number 47, Florida Sea Grant College. 26 p.

Booz, Allen, and Hamilton. 1979. Economic Assessment of the Port of Tampa. Tampa Port Authority (EDA Project Number 04-06-01533), cited in Tampa Bay Regional Planning Council, 1986.

Brannon, J.M., R.H. Plumb, Jr., and I. Smith. 1978. Long-term release of contaminants from dredged material. Dredged Material Research Program Technical Report D-78-49. U.S. Army Corps of Engineer Waterways Experiment Station, Vicksburg, MS. 87 p.

Burks, S.A. and R.M. Engler. 1978. Water quality impacts of aquatic dredged material disposal (laboratory investigations). Dredged Material Research Program Technical Report DS-78-4. U.S. Army Corps of Engineer Waterways Experiment Station, Vicksburg, MS. 45 p.

CAIS. See Center for Applied Isotope Studies (University of Georgia).

Caldwell, D.K. and M.C. Caldwell. 1973. Marine Mammals in the Eastern Gulf of Mexico. In: J.I. Jones, R.E. Ring, M.O. Rinkel, and R.E. Smith (eds.), A Summary of the Knowledge of the Eastern Gulf of Mexico, pp. IIII-1-IIII-4. State University System of Florida Institute of Oceanography.

Center for Applied Isotope Studies, University of Georgia. 1988. Rapid Surveillance of Dredged Material Site Sediments by Continuous Seafloor Sampling and Analysis. Prepared for Battelle Ocean Sciences under contract to the U.S. Environmental Protection Agency Office of Marine and Estuarine Protection. 88 p.

Chew, F., J.J. Bein, and J.H.G. Stimson. 1959. A data report of Florida Gulf coast cruises. Tech. Rep. to ONR by Univer. of Miami, Mar. Lab. pp. 59-109.

Chittenden, M.E. and J.D. McEachran. 1976. Composition, ecology, and dynamics of demersal fish communities on the northwestern Gulf of Mexico Continental Shelf, with a similar synopsis for the entire Gulf. Texas A & M Univ., Sea Grant Coll. TAMU SG-76-208.

COE. See U.S. Army Corps of Engineers.

Continental Shelf Associates. 1984. First Quarterly Report, Tampa Harbor Dredged Material Disposal Monitoring Study. Prepared for Camp Dresser and McKee, Inc. under contract to the U.S. Environmental Protection Agency, Office of Marine and Estuarine Protection. 54 p., 5 appendices.

Continental Shelf Associates. 1986a. Second Quarterly Report (Survey III), Tampa Harbor Dredged Material Disposal Monitoring Study. Prepared for Battelle Washington Environmental Program Office, Washington, D.C., 73 p.

Continental Shelf Associates. 1986b. Third Quarterly Report (Survey IV), Tampa Harbor Dredged Material Monitoring Study. Prepared for Battelle Washington Environmental Program Office, Washington, D.C., 80 p.

Continental Shelf Associates. 1986c. Fourth Quarterly Report (Survey V), Tampa Harbor Dredged Material Monitoring Study. Prepared for Battelle Washington Environmental Program Office, Washington, D.C., 91 p.

Continental Shelf Associates. 1987. Synthesis Report, Tampa Harbor Dredged Material Disposal Monitoring Study. Draft report prepared for U.S. Environmental Protection Agency, Washington, D.C. 146 p. and appendices.

CSA. See Continental Shelf Associates.

Danek, L.J. and G.S. Lewbel (eds.). 1986. Southwest Florida Shelf Benthic Communities Study - Year 5 Annual Report. A final report by Environmental Science and Engineering, Inc. and LGL Ecological Research Associates, Inc. to the U.S. Department of the Interior, Minerals Management Service, New Orleans, LA - Contract No. 14-12-0001-30211.

Dawes, C.T. and J.F. von Breedveld. 1969. Memoirs of the Hourglass Cruises: Benthic Marine Algae. Mar. Res. Lab., Florida Dept. Nat. Res. Vol. I, Part II, 45 p.

Department of the Interior. 1986. Endangered and Threatened Wildlife and Plants. U.S. Fish and Wildlife Service, U.S. Department of the Interior. January 1, 1986. 50 CFR 17.11 and 17.12.

Eldred, B., R.M. Ingle, K.D. Woodburn, R.F. Hutton, and H. Jones. 1961. Biological observations on the commercial shrimp, Penaeus duorarum Burkenrod, in Florida waters. Fla. Sta. Bd. Conserv., Mar. Lab. Ser. No 60. 139 p.

FDNR. See Department of Natural Resources.

Florida Department of Natural Resources. 1983a. Comments by the Florida Dept. of Natural Resources. In: Appendix G to the Draft EIS for Tampa Harbor, Florida, Ocean Dredged Material Disposal Site Designation, September 1983, U.S. Environmental Protection Agency.

Florida Department of Natural Resources. 1983b. Interoffice Memorandum by the Florida Dept. of Natural Resources. In: Appendix G to the Draft EIS for Tampa Harbor, Florida, Ocean Dredged Material Disposal Site Designation, September 1983, U.S. Environmental Protection Agency.

Gould, H.R. and R.H. Stewart. 1956. Continental terrace sediments in the northeastern Gulf of Mexico. In: J.L. Hough and H.W. Menards (eds.), Finding Ancient Shorelines. Society of Economic Paleontologists and Mineralogists. Special Pub. 3, Tulsa, OK.

Graham, H.W., J.M. Amisan, and K.T. Marvin. 1954. Phosphorus content of waters along the west coast of Florida. U.S. Fish and Wildlife Service, Spec. Sci. Rep. Fish. No. 122. 43 p.

Gunter, G., R.H. Williams, C.C. Davis, and F.G.W. Smith. 1948. Catastrophic mass mortality of marine animals and coincident phytoplankton bloom on the west coast of Florida (Nov. 1946-August 1947). Ecol. Monogr. 18(3): 311-324.

Hela, I., D. deSylva, and C. A. Carpenter. 1955. Drift currents in the red tide area of the easternmost region of the Gulf of Mexico. Rep. to Fla. Bd. of Cons., Univ. Miami Mar. Lab., 55-11, 31 p.

Hirsch, N.D., L.H. DiSalvo, and R. Peddicord. 1978. Effects of dredging and disposal on aquatic organisms. Dredged Material Research Program Technical Report DS-78-5. U.S. Army Corps of Engineer Waterways Experiment Station, Vicksburg, MS. 41 p.

Hopkins, T.L. 1973. Zooplankton. In: J.I. Jones, R.E. Ring, M.O. Rinkel, and R.E. Smith (eds.), A Summary of the Knowledge of the Eastern Gulf of Mexico, pp. IIIJ-1-IIIJ-21. State University System of Florida Institute of Oceanography.

Hopkins, T.L., D.M. Milliken, L.M. Bell, E.J. McMichael, J.J. Heffernan, and R.V. Cano. 1981. The landward distribution of oceanic plankton and micronekton over the west Florida continental shelf as related to their vertical distribution. J. Plankton Res. 3:645-658.

Houde, E.D. and N. Chitty. 1976. Seasonal abundance and distribution of zooplankton, fish eggs, and fish larvae in the eastern Gulf of Mexico, 1972-1974. NOAA Technical Report, NMFS SSRF-701.

Huff, J.A. and S.P. Cobb. 1979. Panaeoid and Sergestoid Shrimps (Crustacea: Decapods). Memoirs of the Hourglass Cruises. Fla. Dept. Nat. Res. Lab. 5(4):1-102.

Ichiye, T., Han-Hsiung Kuo, and M.R. Carnes. 1973. Assessment of currents and hydrography of the eastern Gulf of Mexico. Contrib. No. 601. Dept. Oceanogr., Texas A&M Univ.

Jones, Edmunds, and Associates. 1979. Results of bioassay evaluation of sediments from St. Petersburg Harbor, Florida. Final report prepared for Dept. of the Army, Jacksonville District, U.S. Army Corps of Engineers. 32 p.

Jones, Edmunds, and Associates. 1980. Results of bioassay evaluation of sediments from St. Petersburg Harbor, Florida. Final report prepared for Dept. of the Army, Jacksonville District, U.S. Army Corps of Engineers. 54 p.

Jordan, C.L. 1973. The physical environment: Climate. In: A Summary of the Knowledge of the Eastern Gulf of Mexico. State Univ. System Fla. Inst. Oceanogr. (SUSIO)

Jordan, G.F. and H.B. Stewart. 1959. Continental Slope off south Florida. Bull. Amer. Assoc. Petr. Geol. 43(5): 974-991.

Joyce, E.A. and J. Williams. 1969. Memoirs of the Hourglass Cruises: Rationale and Pertinent Data. Fla. Dept. Nat. Res. Lab. 1(1):1-50.

JRB Associates. 1982. Characterization of the benthic environment at four existing and alternative Tampa Bay offshore dredged material disposal sites. Prepared for the U.S. Environmental Protection Agency. Washington, D.C. 136 p.

JRB Associates. 1983. Studies and sample analysis for Tampa Bay surveys nos. 3 and 4 (February/March/April, 1983). Prepared for the U.S. Environmental Protection Agency. 38 p.

JRB Associates. 1984. Final Report on studies and sample analyses for Tampa Bay survey no. 5 (September/October 1983). Prepared for the U.S. Environmental Protection Agency. 118 p.

Lyons, W.G. and S.B. Collard. 1974. Benthic invertebrate communities of the eastern Gulf of Mexico. Fla. Dept. Nat. Res., Mar. Res. Lab. Contrib. No. 223. pp. 157-165.

Manheim, F.T., R.G. Steward, and K.C. Carder. 1976. Transmissometry and particulate matter distribution on the eastern Gulf of Mexico Shelves. MAFLA SURVEY, 1975-76.

Maul, G.A. 1977. The annual cycle of the Gulf Loop Current. Part I: Observations during a one-year time series. J. Mar. Res. 35(1): 29-47.

Mauer, D.L., R.T. Keck, T.C. Tinsman, W.A. Leatherm, C.A. Wethe, M. Huntzinger, C. Lord, and T.M. Church. 1978. Vertical migration of benthos in simulated dredged material overburdens, Volume 1: Marine benthos. Dredged Material Research Program Technical Report D-78-35. U.S. Army Corps of Engineer Waterways Experiment Station, Vicksburg, MS. 108 p.

MML. See Mote Marine Laboratory.

Moe, M.A. and G.T. Martin. 1965. Fishes taken in monthly trawl samples offshore of Pinellas County, Florida, with new additions to the fish fauna of the Tampa Bay area. Tulane Stud. Zool. 12(4):129-151.

Molinari, R.L., D. Cochrane, and G.A. Maul. 1975. Deep basin oceanographic conditions and general circulation. In: Compilation and summation of historical existing physical oceanographic data from the eastern Gulf of Mexico in support of the creation of a MAFLA sampling program. BLM 08550-CT-16. State Univ. System Fla. Inst. Oceanogr. (SUSIO).

Mooers, C.N.K. and J.F. Price. 1975. General Shelf circulation. In: compilation and summary of historical and existing physical oceanographic data form the eastern Gulf of Mexico in support of the creation of a MAFLA sampling program. BLM 08550-CT4-16. State Univ. System Fla. Inst. of Oceanogr. (SUSIO).

Mote Marine Laboratory. 1983. Preliminary survey of potential dredged material disposal sites off Tampa Bay, Florida. Submitted to Camp Dresser and McKee, Inc., Annandale, VA, September 1983. 36 p.

Mote Marine Laboratory. 1988. Evaluation of hard bottom and adjacent soft-bottom macrofaunal communities in the vicinity of the Tampa Bay material ocean disposal site 4. Prepared for the U.S. Environmental Protection Agency Office of Marine and Estuarine Protection under Contract No. 68-03-3319 to Battelle Ocean Sciences. 60 p. and appendices.

Newell, G.E. and R.C. Newell. 1973. Marine plankton: a pratical guide. Hutchinson Educational. 244 p.

Pequegnat, W.E., O.D. Smith, R.M. Darnell, B.J. Presley, and R.D. Reid. 1978. An assessment of the potential impact of dredged material disposal in the open ocean. Dredged Material Research Program Technical Report D-78-2. U.S. Army Corps of Engineer Waterways Experiment Station, Vicksburg, MS. 642 p.

Phillips, R.C. and V.G. Springer. 1960. Observations on the offshore benthic flora in the Gulf of Mexico off Pinellas County, Florida. Amer. Midland Nat. 64(2):362-381.

Price, W.A. 1954. Shorelines and coasts of the Gulf of Mexico. In: Gulf of Mexico, its origins, waters, and marine life. U.S. Fish and Wildlife Serv., Fish. Bull. No. 89: 39-65.

Quick, J.A. and G.E. Henderson. 1975a. Evidences of new icthyointoxicative phenomena in Gymnodinium breve red tides. Fla. Dept. Nat. Res., Mar. Res. Lab. Contrib. No. 249. 11 p.

Quick, J.A., and G.E. Henderson. 1975b. Effects of Gymnodinium breve red tide on fishes and birds: A preliminary report on behavior, anatomy, hematology, and histopathalogy. Fla. Dept. Nat. Res., Mar. Res. Lab. Contrib. No. 241. 28 p.

Raymont, John E.G. 1983. Plankton and Productivity in the Ocean. Volume - Zooplankton. Pergamon Press, Elmsford, NY. 824 p.

Rice, S.A., G.W. Patton, and S. Mahaderan. 1981. An ecological study of the effects of offshore dredge material disposal with special reference to hard-bottom habitats in the eastern Gulf of Mexico. Technical Report prepared for Manatee County Chamber of Commerce. Bradenton, FL. 45 p.

Richardson, M.D., A.G. Carey, J.A. Colgate, and W.A. Colgate. 1977. Aquatic disposal field investigations, Columbia River Disposal Site, Oregon. Appendix C: The effects of dredged material disposal on benthic assemblages. Dredged Material Research Program Technical Report D-77-30. U.S. Army Corps of Engineer Waterways Experiment Station, Vicksburg, MS. 411 p.

Rounsefell G.T. and A. Dragovich. 1966. Correlation between oceanographic factors and abundance of the Florida red tide (Gymnodinium breve Davis), 1954-61. Bull. Mar. Sci. 16(3): 404-422.

Saunders, R.P. and D.A. Glenn. 1969. Diatoms. Memoirs of the Hourglass Cruises. Vol I. (3), 199 p.

Schmidly, D.J. 1981. Marine Mammals of the Southeastern United States Coast and the Gulf of Mexico. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C. FWS/OBS - 80/41. 163 p.

Shepard, F.P. 1973. Submarine Geology. Harper & Rowe, NY. 557 p.

Smith G.B. 1975. The 1971 red tide and its impact on certain reef communities in the mid-eastern Gulf of Mexico. Environ. Letters. 9(2): 141-152.

Smith, G.B. 1976a. Ecology and distribution of eastern Gulf of Mexico reef fishes. Fla. Dept. Nat. Res., Mar. Res. Lab. No. 19. 78 p.

Smith G.B. 1976b. The impact of fish-killing phytoplankton blooms upon mideastern Gulf of Mexico reeffish communities. In: Bullis, H.R. and A.C. Jones (eds.). Proceedings: Colloquium on snapper-grouper fishery resources of the western central Atlantic Ocean. Florida Sea Grant Coll. Progress. No. 17.

Steidinger, K.A. 1973. Phytoplankton. In: J.I. Jones, R.E. Ring, M.O. Rinkel, and R.E. Smith (eds.), A Summary of the Knowledge of the Eastern Gulf of Mexico, pp. IIIE-1 - IIIE-17. State University System of Florida Institute of Oceanography.

Steidinger, K.A. 1975a. Implications of dinoflagellate life cycles on initiation of Gymnodinium breve red tides. Envir. Letters 9(2):129-139.

Steidinger, K.A. 1975b. Basic factors influencing red tides. In: V.R. LoCiero, (ed.), Proceedings of the First International Conference on Toxic Dinoflagellate Blooms, pp. 153-163. Mass. Sci. Tech. Found., Wakefield, MA.

Steidinger, K.A. 1983. A re-evaluation of toxic dinoflagellate biology and ecology. Prog. Phyc. Res. 2:147-188.

Steidinger, K.A. and K. Haddad. 1981. Biologic and hydrographic aspects of red tides. Bioscience 31(11): 814-819.

Steidinger, K.A. and J. Williams. 1970. Dinoflagellates. Memoirs of the Hourglass Cruises. Vol. II. Fla Department of Natural Resources Laboratory. Contribution No. 147. 251 p.

Steidinger, K.A., J.T. Davis, and J. Williams. 1967. Dinoflagellate studies on the inshore waters of the west coast of Florida, Fla. St. Bd. Conserv. Prof. Paper Series No. 9. p. 4-48 (in part only).

Sullivan, B. and D. Hancock. 1977. Zooplankton and dredging research perspectives from a critical review. Water Resources Bull. 13:461-467.

SUSIO, 1974. Final report on the baseline environmental survey of the MAFLA lease areas CY 1974. State University System Florida Inst. Oceanogr., 16th Ann. Ses: 113-120.

Tampa Bay Regional Planning Council. 1986. Documenting the economic importance of Tampa Bay. 143 p + 2 appendices.

Taylor, J.L. and C.H. Saloman. 1969. Sediments, oceanographic observations, and floristic data from Tampa Bay, Florida, and adjacent waters, 1965-1969. U.S. Fish and Wildlife Service *Data Report 34. 562 p.*

TBRPC. See Tampa Bay Regional Planning Council.

Tolbert, W.H. and G.G. Salsman. 1964. *Surface circulation of the* eastern Gulf of Mexico as determined by drift bottle studies. J. Geoph. Res. 69(2):223-230.

U.S. Army Corps of Engineers. *1972. Disposal of Dredge Spoil,* Problem Identification and Assessment and Research Program Development. Technical Report H-72-8. 121 p., Appendices.

U.S. Army Corps of Engineers. *1975.* Final Environmental Impact Statement, Tampa Harbor Project. 295 p.

U.S. Army Corps of Engineers. 1977. Supplement to the Final Environmental Impact Statement, Tampa Harbor Project. 150 p.

U.S. Army Corps of Engineers. 1978. Aquatic Dredged Material Disposal Impacts. Technical Report DS-78-1. 57 p.

U.S. Army Corps of Engineer Waterways Experiment Station (Environmental Laboratory). 1980. Final Summary, Dredged Material Research Program. Shore and Beach 48:35-41.

U.S. Department of Commerce. 1978. Tampa Bay Circulatory Survey. 1963. Oceanog. Circ. Report No. 2. NOAA. NOS NOS002728. 39 pp.

U.S. DOC. See U.S. Department of Commerce.

U.S. EPA. See U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 1983. Final Environmental Impact Statement for Tampa Harbor, Florida, Ocean Dredged Material Disposal Site Designation, September 1983. U.S. Environmental Protection Agency, Criteria and Standards Division, Washington, D.C.

U.S. Environmental Protection Agency, 1986. Ocean dumping site designation delegation handbook for dredged material. Prepared by SAIC under contract to Battelle for EPA Office of Marine and Estuarine Protection. 100 p.

U.S. Environmental Protection Agency/IEC. 1981. Report of Field Study. Appendix A to the Final Environmental Impact Statement for Tampa Harbor, Florida, Ocean Dredged Material Disposal Site Designation. U.S. Environmental Protection Agency and Interstate Electronics Corporation.

U.S. Environmental Protection Agency/MML. 1981. Appendix E to the Final Environmental Impact Statement for Tampa Harbor, Florida, Ocean Dredged Material Disposal Site Designation. Effects of dredged sediments from Bayboro Harbor, St. Petersburg at Site A. U.S. Environmental Protection Agency and Mote Marine Laboratory.

Williams, D.T. 1983. Tampa Bay Dredged Material Disposal Site Analysis. Hydraulics Laboratory. U.S. Army Corps of Engineer Waterways Experiment Stations, Vicksburg, MS. Misc. Paper No. HL-83-8. 46 p.

Windom, H.L. 1975. Water quality aspects of dredging and dredge spoil disposal in estuarine environments. pp 559-571. In: L.E. Cronin (ed.) Estuarine Research, Volume 2: Geology and Engineering. Academic Press, Inc.

Windom, H.L. 1976. Environmental aspects of dredging in the coastal zone. pp. 91-109. In: C.P. Straub (ed.) Critical Reviews in Environmental Control. CRC Press.

Woolfenden, G.E. and Ralph W. Schreiber. 1973. The common birds of the eastern Gulf of Mexico: their distribution, seasonal status, and feeding ecology. In: J.I. Jones, R.E. Ring, M.O. Rinkel, and R.E. Smith (eds.), A Summary of the Knowledge of the Eastern Gulf of Mexico, pp. IIIJ-1-IIIJ-21. State University System of Florida Institute of Oceanography.

Wright, T.D. 1978. Aquatic dredged material disposal impacts. Dredged Material Research Program Technical Report D-78-1. U.S. Army Corps of Engineer Waterways Experiment Station, Vicksburg, MS. 57 p.

APPENDIX A

NEARSHORE ALTERNATIVES

INTRODUCTION

The maintenance material from the Skyway Bridge west to the sea buoy has historically been predominantly sand. There is probably also some sand shoaling east of the Skyway Bridge. This sandy material must be removed from the channel to maintain navigation depths but is located too far from the diked disposal areas for disposal there. Past studies have indicated that placing sand on a sand substratum has relatively minor and short-term environmental impacts. There is also an opportunity for habitat creation through beach nourishment and island creation. The state of Florida has indicated a desire to retain "beach quality" sand on the beaches or at least in the littoral drift system. The economics, resource conservation, and environmental effects support the nearshore disposal of dredged material that is predominantly sand.

Some alternatives that should be considered for the disposal of sand are beach nourishment, island creation, and submerged stockpiling for future beach nourishment. All of these alternatives have costs, benefits, and environmental impacts that should be evaluated individually. Beach nourishment could be used on Mullet Bay and Egmont Key. The human users of Mullet Key would benefit from maintenance of the public beaches while Egmont Key would provide additional habitat for colonial-nesting shorebirds. Islands could be created north and south of Egmont Key. These islands would dissipate wave energy and provide nesting and resting habitat for shorebirds. Submerged berms or stockpiles of sand could be created offshore of Treasure Island, Long Key, Sand Key, and Anna Maria Island. These submerged disposal areas would reduce wave energy, contribute to littoral sand supply, and provide a source of sand for future beach nourishment. Lack of sand for protection of highly developed and vulnerable areas is a serious concern in Florida.

BEACH NOURISHMENT

Investigations and research performed by many organizations and scientists, including the U.S. Army Corps of Engineers, have found that beach nourishment is one of the most desirable and cost-effective means of restoring and protecting eroding shorelines (COE, 1987). Beach nourishment is usually accomplished by borrowing sand from inshore or offshore locations and transporting it to the eroding beach by truck, hopper dredge, or hydraulic pipeline. Beneficial impacts of beach nourishment include protection of shoreline structures, preservation of recreational resources, and protection and preservation of wildlife shoreline habitat, such as beaches used by turtles for nesting, by birds for nesting or foraging, or by benthic invertebrates for colonization. When material from maintenance dredging is suitable for nourishment, that is, free from toxic elements and of grain-size composition comparable to that of the project beach, two benefits are achieved: beach restoration and safe disposal of the material.

Adverse impacts of beach nourishment operations include displacement of substrata, changes in topography or bathymetry of the borrow and nourishment areas, destruction of nonmotile benthic communities, generation of turbidity and suspension of sediments, disturbance of motile fish and benthic shellfish, interruption of vessel traffic, and inconvenience to beach users. Most of the impacts associated with offshore dredging and placement of material on a beach are temporary, such as turbidity generated by dredging and sand placement, and disturbance to shore and sea life. For example, Reilly and Bellis (1983) found beach nourishment affects organism density and community structure both during and after nourishment. Organisms on the beach at the time of beach nourishment were killed, adult intertidal organisms failed to return from their nearshore-offshore overwintering refuges, and larval recruitment inhibited by the greater water turbidity associated with the nourishment operations. Mobile species living in beach areas move out of the area to avoid potential impacts and often return within a week. Animals unable to move often die.

However, destruction of benthic communities by smothering is generally compensated by colonization by larvae and/or adults of similar species. Nourished beaches and borrow pits are repopulated within a relatively short period in most areas. Important long-lived species, such as mussels, do not recover as quickly (Nelson and Pullen, 1985). However, analyses of benthic macroinfauna and surface sediment samples from Panama City beaches and beaches in Indialantic and Melbourne, Florida, showed no long-term adverse environmental effects as a result of beach nourishment (Culter and Mahavedan, 1982; Gorzelany and Nelson, 1983).

Potentially the most serious impact of offshore dredging is the loss or damage to major commercial species of benthic shellfish, seagrass beds, corals, and sea turtles. Damage can be minimized or avoided by careful selection of borrow areas, precise positioning of dredging equipment, and use of dredging equipment that minimizes sedimentation and turbidity. Seagrass beds and corals damaged by dredging can recover, but the recovery time may extend over several years. Renourishment of beaches can also affect nesting turtles. By scheduling nourishment operations in the late fall to avoid egg-laying seasons, it is possible to avoid adverse effects on turtles living and nesting along the beaches (David Nelson, U.S. Army Waterways Experiment Station, personal communication, May 1, 1987). A succession of short nourishment projects carried out in nonsequential order would also have less long-term impact than a single large-scale project (Reilly and Bellis, 1983). Monitoring programs, including relocation of nests, can also reduce or eliminate adverse effects.

ISLAND CREATION

Years of dredging by the Corps of Engineers, state agencies, and private industry has resulted in the creation of more than 2000 islands formed from disposal of dredged material throughout U.S. coastal areas, Great Lakes, and riverine waterways. Many of these islands have become valuable resources of wildlife habitat, but many others have lost their attraction as wildlife habitat because of encroachment by man or inadequate management. The primary wildlife species utilizing these created islands in Florida waters are 37 species of colonial-nesting waterbirds, including pelicans, cormorants, herons, ibises, gulls, and terns, some of which are threatened or endangered in large parts of their ranges. The islands offer the birds protection from ground predators, seclusion from man, and nesting substrata similar to natural nesting sites. Creation of new islands is a useful environmental tool when a need is demonstrated for nesting habitat in a particular area, and if the benefits to the birds exceed negative impacts of construction to benthic organisms or current flow. Decisions on island creation should depend on field studies and/or consultation with wildlife biologists and on coordination with appropriate federal and state agencies and the private sector to insure that all concerns are evaluated.

One factor to consider in island creation is timing of construction, preferably during the fall or winter preceding the next breeding season. The need to maintain channels may, however, require dredging at any time of the year. Another factor is the physical design of the island: island creation must insure that an island is permanently emergent at high water levels, that it will be no smaller than 5 acres and no larger than 50 acres, and that an overall elevation of between 3 to 10 feet above mean high water is achieved with slopes no greater than a 3-foot rise in 100 feet. An island with a kidney shape can provide a cove to facilitate marsh development and benthic colonization, and selective planting can increase the island's attractiveness to wildlife. In the estuaries of west central Florida, such islands dissipate wave energy with subsequent natural development of seagrass beds in the lee of the islands.

Adverse impacts associated with island construction are similar to some of those associated with beach nourishment. Such impacts include displacement of substrata, loss of benthic organisms, alteration of currents and bathymetry, and generation of sediment suspension and turbidity. By creating islands, the Bay's bottom habitat is lost and replaced with a new habitat. Thus, numbers and types of species change; invertebrate species may be smothered and birds will colonize the new island. Many species that might potentially use the islands must have barren areas to breed successfully. Islands are often ultimately overrun by shrubs, thus limiting their value to the birds (Tampa Bay Regional Planning Council, 1985). Prevention of this and other problems involves the careful placement of dredged material and selection of the disposal season to prevent disruption of active nesting (John Lunds, U.S. Army Waterways Experiment Station, personal communication, May 1, 1987). Development of monitoring and management plans is important and recommended for the successful use of islands as a nearshore disposal alternative.

SUBMERGED STOCKPILING

Submerged stockpiling of dredged material in the littoral zone can be an effective aid in beach nourishment. The decision on whether to employ this method depends on field studies and historic records to provide a thorough understanding of the prevailing patterns of winds, waves, and currents affecting movement of sand at the submerged disposal site. It has been successfully employed offshore of northern St. Petersburg Beach. If all factors are favorable, this method has the advantage of nourishing an eroding beach in a natural manner, and reducing or avoiding impacts associated with direct placement of the sand on the beach by mechanical means. Beneficial and adverse impacts of this method are otherwise similar to those for direct nourishment with regard to impacts at the offshore borrow site. The same precautions are recommended to curtail or eliminate those impacts.

Disposal of this material in the littoral zone, however, by hydraulic pipeline or hopper dredge could generate more turbidity and suspended sediment conditions for a longer period over a broader area, depending on the method of disposal (pipeline or hopper dredge) and the percentage of fines in the dredged material. Caution should be exercised in the selection of the material to be dredged and disposal operations should be timed as nearly as practical to the winter when biological activity is at its lowest ebb. Monitoring of material placed in the littoral zone in the Tampa Harbor dredging project has shown that water quality has not been adversely affected, and benthic populations and species diversity improved over pre-project conditions (Taylor, 1986). Experience at Virginia Beach, Virginia, where an underwater berm was constructed using coarse-grained dredged material, indicates that the method can serve several functions: provide aquatic habitat, protect the shoreline by dissipating storm waves, stockpile material for beach nourishment, and reduce maintenance dredging in some tidal inlets.

SUMMARY

Habitat development offers a disposal technique that is, in many situations, a feasible alternative to open-water or upland disposal options. Dredged material can be used effectively to maintain the size of eroding beaches. Creating island habitats can provide critical nesting areas for birds. As previously mentioned, the feasibility of habitat development centers on several factors including the nature of the dredged material, the site selection, the engineering design, the cost of the alternatives, the environmental impacts, and public approval. All of these factors must be considered in evaluating nearshore disposal alternatives.

REFERENCES

COE. See U.S. Army Corps of Engneers.

Culter, J.K. and S. Mahadevan. 1982. Long-term effects of beach nourishment on the benthic fauna of Panama City Beach Florida. U.S. Army Corps of Engineers, Miscellaneous Report No 82-2.

Gorzelany, J.F., Jr. and W.G. Nelson. 1983. The effects of beach replenishment on the benthos of a sub-tropical Florida beach. Mar. Environ. Res. 21: 75-94.

Nelson, D.A. and B.J. Pullen. 1985. Environmental considerations in using beach nourishment for erosion protection. In: Brodtmann, N.V. (ed.), The Second Water Quality and Wetlands Conference Proceedings. New Orleans, LA, October 1985.

Reilly, F.J. and V.J. Bellis. 1983. The ecological impact of beach nourishment with dredged materials on the intertidal zone at Bogue Banks, North Carolina. U.S. Army Corps of Engineers, Miscellaneous Report No. 83-3.

Tampa Bay Regional Planning Council. 1983. The future of Tampa Bay. A report to the Florida Legislature and the Tampa Bay Regional Planning Council by the Tampa Bay Management Study Commission. 242 p.

Taylor, John L. 1986. Benthic Monitoring Studies, Tampa Harbor Project, Florida.

U.S.Army Corps of Engineers. 1987. Beneficial uses of dredged material, EM 1110-2-5026, Department of the Army, U.S. Army Corps of Engineers, Washington, D.C.

APPENDIX B

SUMMARY OF VIDEO SURVEYS

INTRODUCTION

Within Site 5, five potential sites for the disposal of dredged material from the Tampa Bay area were selected by EPA to be surveyed. These five sites, discussed herein as Survey Sites 1 through 5, were located between 25 and 35 nmi from Egmont Key (Figure B-1); the LORAN C coordinates of each site are presented in Table B-1.

Mote Marine Laboratory (MML) conducted the first video survey of the potential sites in August/September 1983. Based on the results of this survey, three candidate sites were selected for consideration as disposal sites. These sites were located within Survey Sites 2, 3, and 5, and were named Candidate Site A (later renamed Site 5A), Candidate Site B (later renamed Site 5B), and Candidate Site C (eventually eliminated), respectively.

In September/October 1983, JRB Associates (JRB) conducted a video survey, the objective of which was to collect quality assurance data for comparison with the earlier video survey by MML. The JRB survey provided data for specific portions of Survey Sites 2, 3, and 4; JRB designated their survey sites as Sites 30MS-1 (= MML Survey Site A, renamed Site 5A), 30MS-2 (= MML Survey Site B, renamed site 5B), and 30MS-C (later renamed Site 5MS-C).

Table B-2 indicates the approximate comparability of sites surveyed by MML and JRB. Figure B-1 shows the physical relationship of the survey sites within Site 5. Three areas were chosen by EPA for consideration as potential dredged material disposal sites within Site 5; these three sites were named Sites 5A, 5B, and 5MS-C. MML Candidate Site A and JRB Site 30MS-1 were considered comparable and the area was renamed Site 5A. MML Candidate Site B and JRB Site 30MS-2 were considered comparable and the area was renamed Site 5B. MML Candidate Site C and JRB Site 30MS-C were considered unique and not comparable. MML Candidate Site C was eliminated from

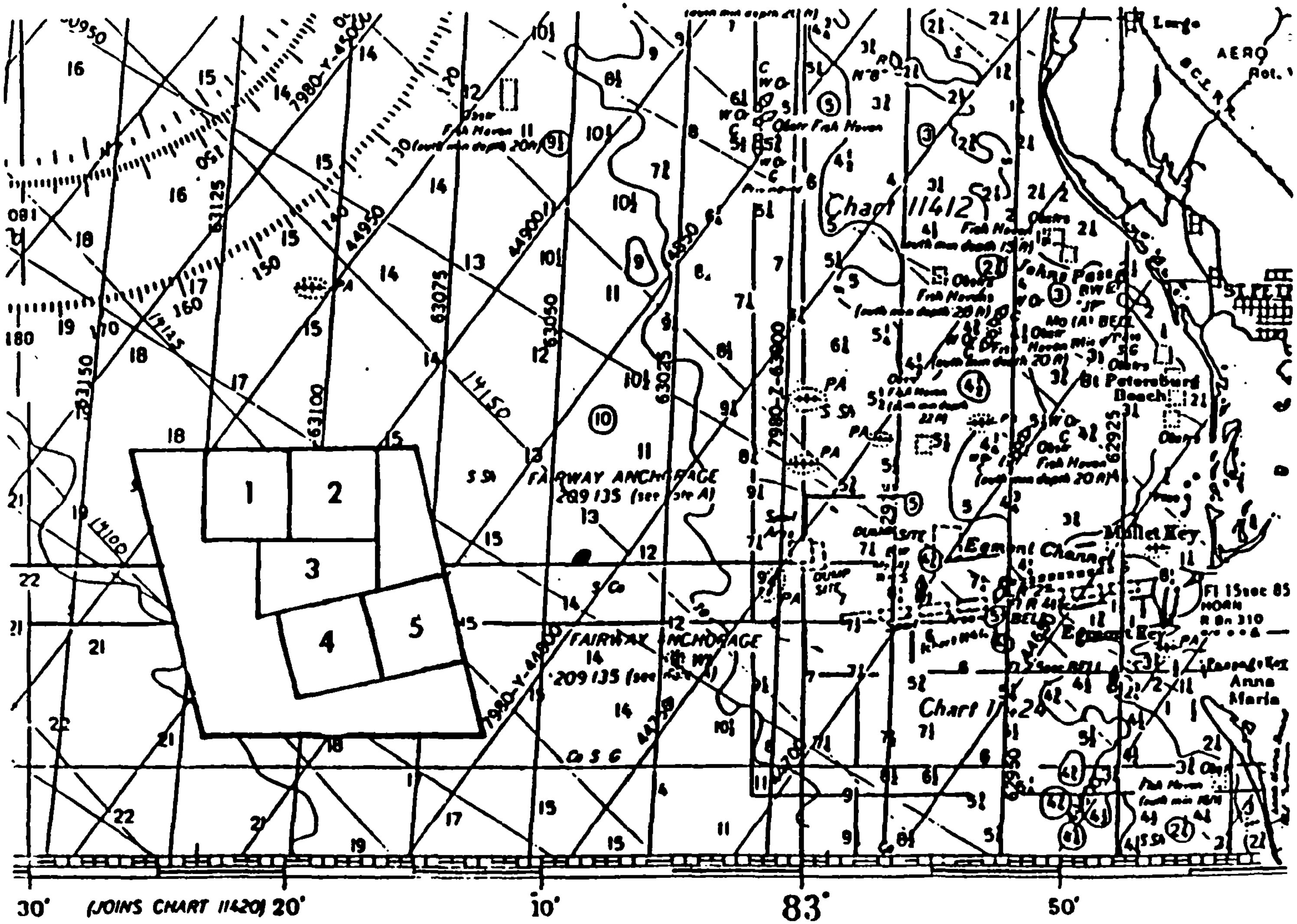

FIGURE B-1. LOCATION OF SURVEY SITES 1 THROUGH 5 (WITHIN SITE 5) SURVEYED IN 1983 BY MOTE MARINE LABORATORY (MML) AND JRB ASSOCIATES (JRB) (ADAPTED FROM MML, 1983).

TABLE B-1. LORAN C COORDINATES FOR THE FIVE SURVEY AREAS AND THREE CANDIDATE AREAS SURVEYED BY MOTE MARINE LABORATORY FROM AUGUST 25 TO SEPTEMBER 1, 1988 (FROM MML, 1983).

Coordinates	LORAN C			
Sites	Northwest	Northeast	Southwest	Southeast
Survey Site 1	14118.4 44951.0	14127.2 44925.0	14110.0 44931.0	14118.7 44904.9
Survey Site 2	14127.2 44925.0	14135.7 44898.9	14118.7 44904.9	14127.5 44878.9
Survey Site 3	14114.4 44915.1	14127.4 44878.9	14108.2 44897.4	14122.8 44866.9
Survey Site 4	14110.7 44892.0	14121.0 44871.9	14105.0 44866.9	14115.3 44846.9
Survey Site 5	14121.0 44871.9	14131.0 44850.0	14115.3 44846.9	14125.0 44823.5
MML Candidate Site A (Renamed Site 5A)	14127.5 44910.0	14133.1 44892.8	14122.0 44896.9	14127.5 44878.9
MML Candidate Site B (Renamed Site 5B)	14118.5 44907.5	14124.1 44890.2	14113.0 44894.0	14118.5 44877.1
MML Candidate Site C (Eventually eliminated)	14124.5 44864.7	14131.0 44850.0	14120.4 44847.5	14125.0 44823.5

TABLE B-2. COMPARABILITY OF NAMES OF VIDEO SURVEY SITES WITHIN SITE 5 DISCUSSED IN THE MAIN TEXT OF THIS EIS AND IN APPENDIX B. In some cases, comparability is only approximate (see inset in Figure B-8 for relationships).

EPA Survey Final Sites	MML Candidate Sites[a]	Sites[a]	JRB Name[b]
1			c
2	A	30MS-1	5A
3	B	30MS-2	5B
4		30MS-C	5MS-C
5	C		d

[a]MML and JRB Sites are located within the boundaries of but do not correspond exactly to the EPA Survey Site.

[b]Name as used in main text of this EIS.

[c]No specific potential disposal area was identified within this site.

[d]Eliminated from consideration because of high percentage of hard bottom.

consideration as a potential disposal site because of the high percentage of hard bottom in the area. JRB Site 30MS-C was renamed Site 5MS-C.

MOTE MARINE LABORATORY (AUGUST 25 TO SEPTEMBER 1, 1983)

Survey Sites 1 and 2 were adjacent and were therefore surveyed together as one large site measuring 3 by 6 nmi (area 18 nmi^2). Survey Sites 4 and 5 were also adjacent and were surveyed as one large area. Site 3 was irregularly shaped and covered an area of approximately 8.9 nmi^2. Transects were arranged at 0.25-nmi intervals, resulting in 13 transects in Survey Sites 1 and 2, 10 transects in Survey Site 3, and 13 transects in Survey Sites 4 and 5. A total of 45 nmi^2 of the ocean bottom was surveyed using a combination of underwater television, side-scan sonar, and diver observations.

One of three classifications was assigned based upon the relative abundance of sand and exposed or cryptic hard bottom. The classification was based on a summary of bottom characteristics observed since the preceding navigation fix; additional information was added based on side-scan sonar observations. An "S" was assigned to areas that were predominantly sand, an "SHB" was assigned to areas of sand interspersed with hard bottom (scattered hard bottom), and an "EHB" was assigned to areas of extensive or nearly continuous hard bottom. MML did not attempt to differentiate between degrees of scattered hard bottom, and broad characterizations were made based on the television data. On the television monitor, hard-bottom habitats were identified by the presence of exposed rock, large holes in the bottom, reefs, or hard-bottom-associated organisms such as stump corals and sponges (attached to sand-covered rock).

Survey Sites 1 and 2

According to fathometer readings, the water depth increased gradually from approximately 26 m on the eastern edge of Survey Site 2 to approximately 30 m on the western boundary of Survey Site 1 (Figure B-2). The topography of the bottom was flat with occasional sand waves, and there was little variation in water depth. The most irregular topography was found in the southeastern portion of Survey Site 2, where sudden depth changes of as much as 2.5 m in a distance less than 100 m were observed.

Figure B-3 presents the final characterization of the bottom habitats. The predominant habitat within Survey Sites 1 and 2 was sand with scattered patches of algae (Caulerpa). The most extensive areas of uninterrupted sandy bottom were found in the northeast quadrant and south central areas of Survey Site 1, and in the southeast quadrant and north central section of Survey Site 2.

A large area of scattered hard bottom was located on the central border between Survey Sites 1 and 2. To the northeast of this large area, and within Survey Site 2, were three smaller scattered hard-bottom areas. Five additional relatively small scattered hard-bottom areas were identified in Survey Site 1: three in the northwest quadrant and two in the southwest quadrant. One small area of extensive hard bottom was located in the northwest quadrant of Survey Site 1.

A reef oriented northeast to southwest was located in the central area of Site 1. The reef appeared to be approximately 1000 m in length with a vertical relief of nearly 2 m. The reef was composed of broken rock and ledges, and abundant fish populations were present. Two smaller reefs were found to the west and northwest of the larger reef. These smaller reefs were characterized by a relief of less than 1 m and contained large fish populations and abundant growth of attached hard-bottom organisms.

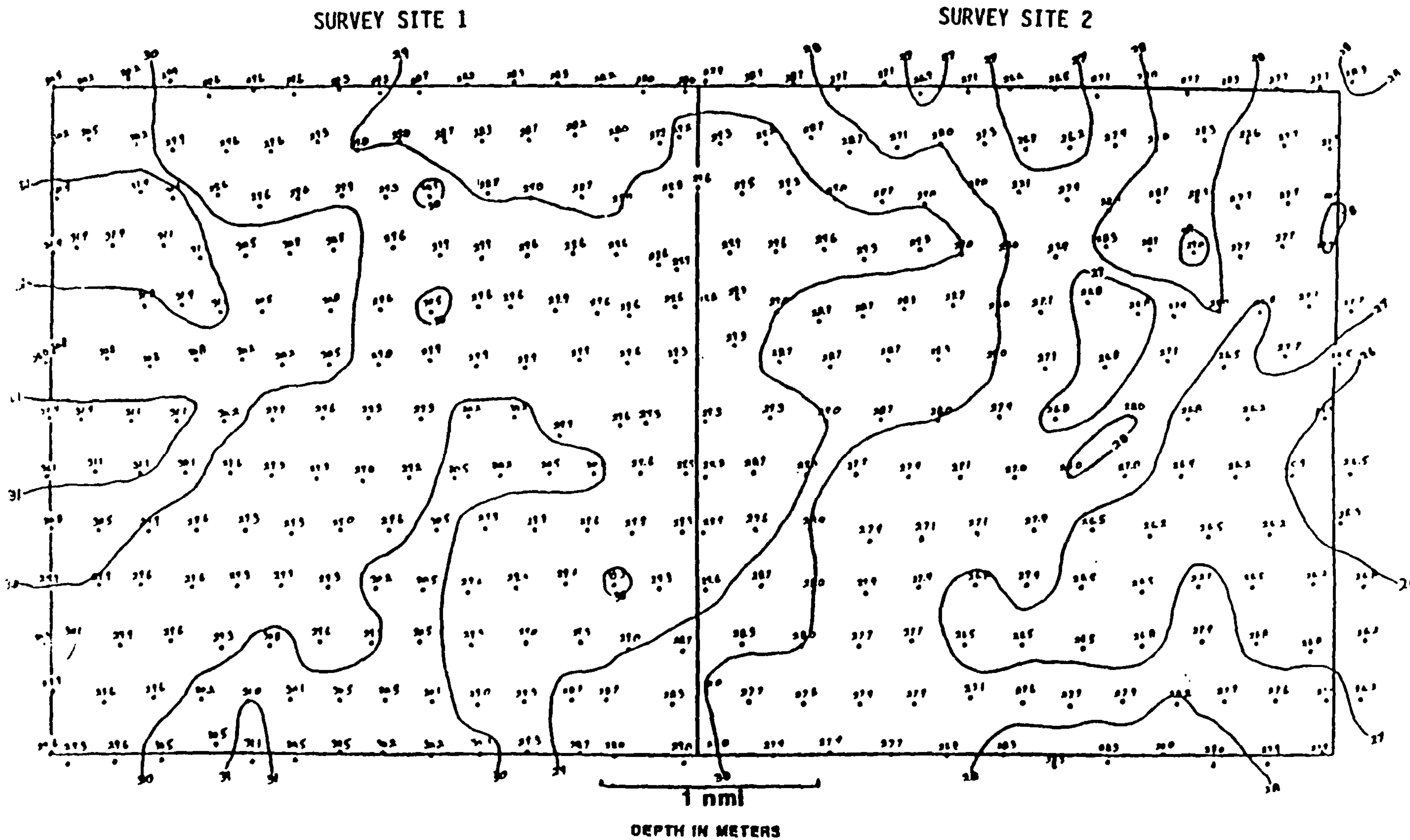

FIGURE B-2. BATHYMETRIC CHART OF SURVEY SITES 1 AND 2 (FROM MML, 1983).

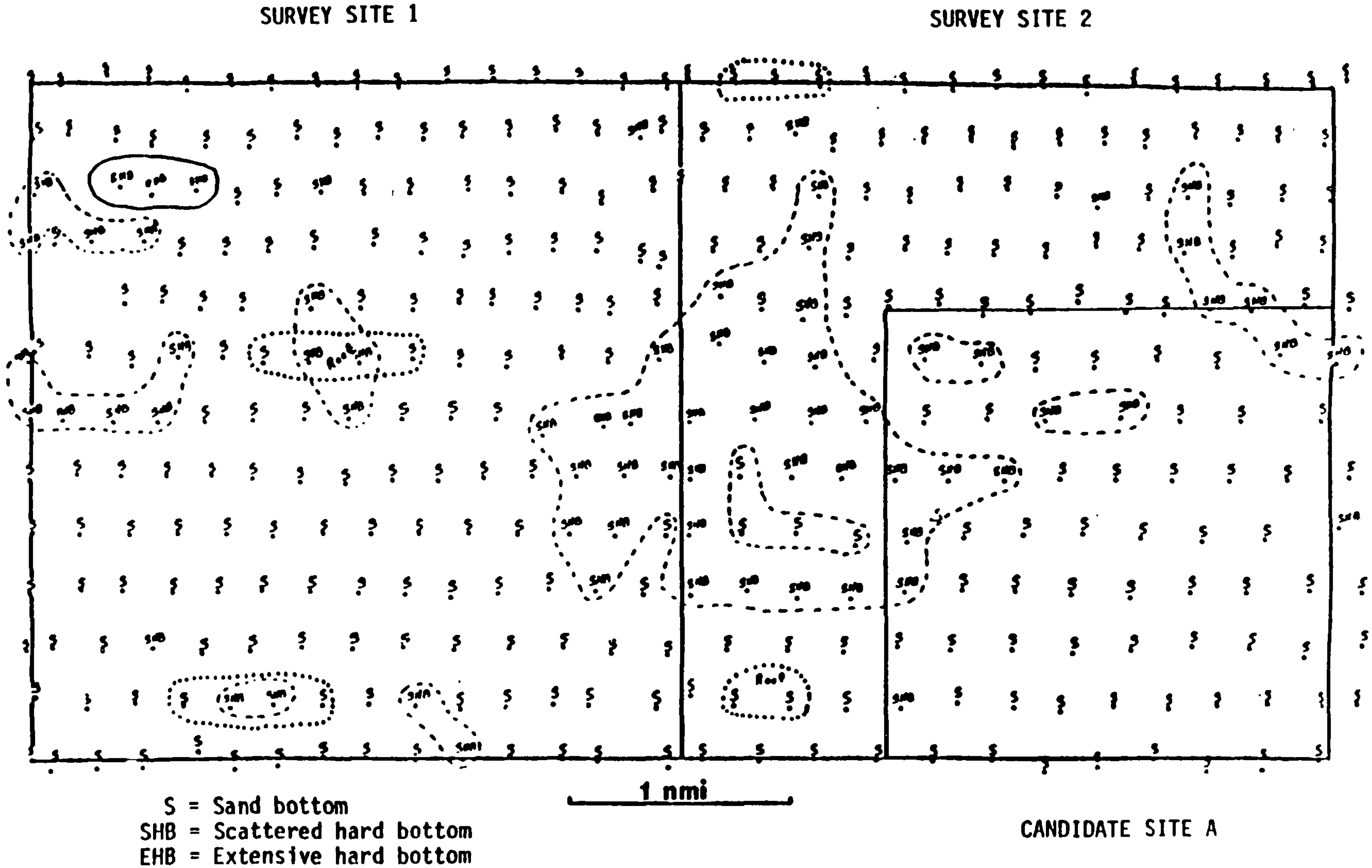

FIGURE B-3. LOCATION OF CANDIDATE SITE A (SITE 5A IN TEXT) WITHIN SURVEY SITE 2 AND DISTRIBUTION OF BOTTOM CHARACTERISTICS (FROM MML, 1983).

Survey Site 3

The bathymetry of Survey Site 3 is presented in Figure B-4. Water depth increased from 28 m on the eastern border to 31 m on the western edge of the site. The most variable topography within the site was located in the central area along the western border. A slight ridge with a localized trough to the south was located in the north-central section of the site.

Survey Site 3 contained large areas of predominantly sandy bottom along the northern border and southward into the central and western sections (Figure B-5). Scattered hard-bottom habitats were found in the southeastern quadrant and along the western border of the site. There were no significant reefs or ledges. The hard-bottom areas were characterized by low relief and a thin covering of sand with a light to moderate growth of attached organisms.

A SCUBA dive was made in a region of scattered hard bottom in the southeast quadrant of the site. The water depth was 30.5 m, and the topography was generally flat with sand ripples. The bottom was sparsely covered with fish and invertebrates, and hard corals, sponges, and other attached organisms were observed on hard strata covered with 2.5 to 20 cm of coarse sand. Although actual temperatures were not measured, a thermocline of approximately $\pm$ 5°C was detected around 21 m.

Survey Sites 4 and 5

Water depths at Survey Sites 4 and 5 ranged from 25 m at the southeast corner of Site 5 to 31 m on the western border of Site 4 (Figure B-6). Depths generally increased from east to west in a general steady slope, with a slight trough extending eastward from the center of the two sites. Two small ridges were observed near the center of the western border of Site 4. The most variable

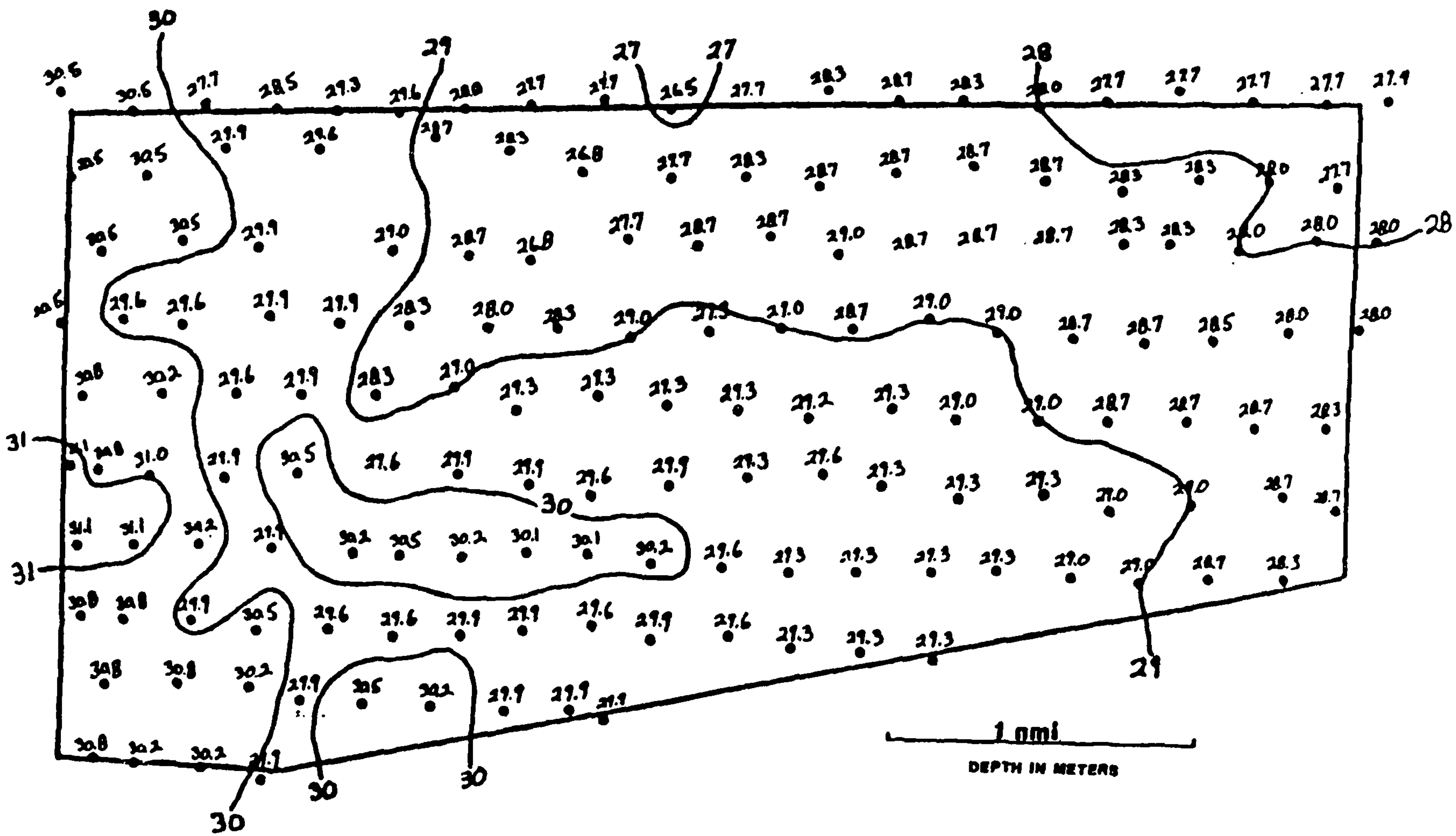

FIGURE B-4. BATHYMETRIC CHART OF SURVEY SITE 3 (FROM MML, 1983).

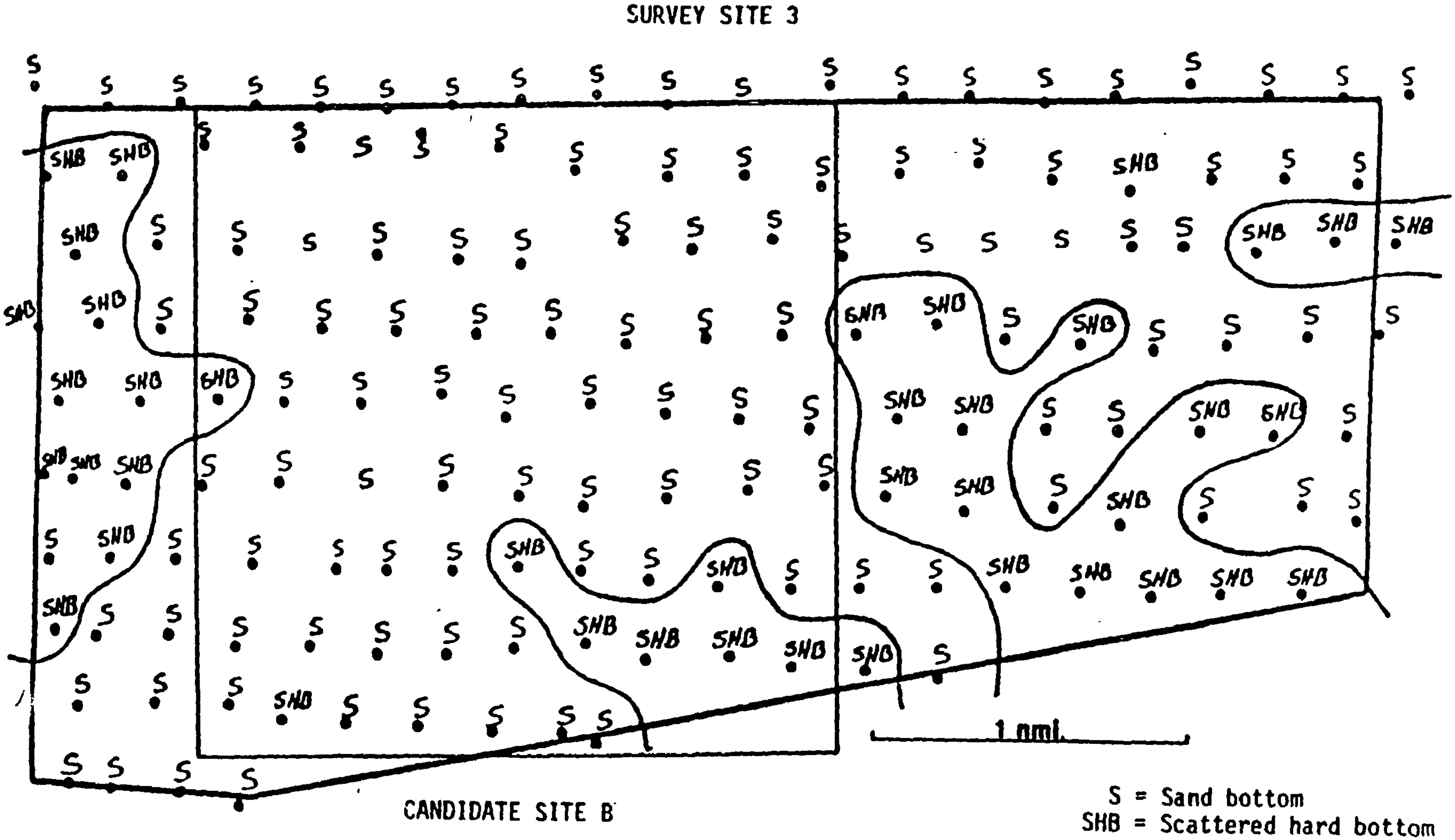

FIGURE B-5. LOCATION OF CANDIDATE SITE B (SITE 5B IN TEXT) WITHIN SURVEY SITE 3 AND DISTRIBUTION OF BOTTOM CHARACTERISTICS (FROM MML, 1983).

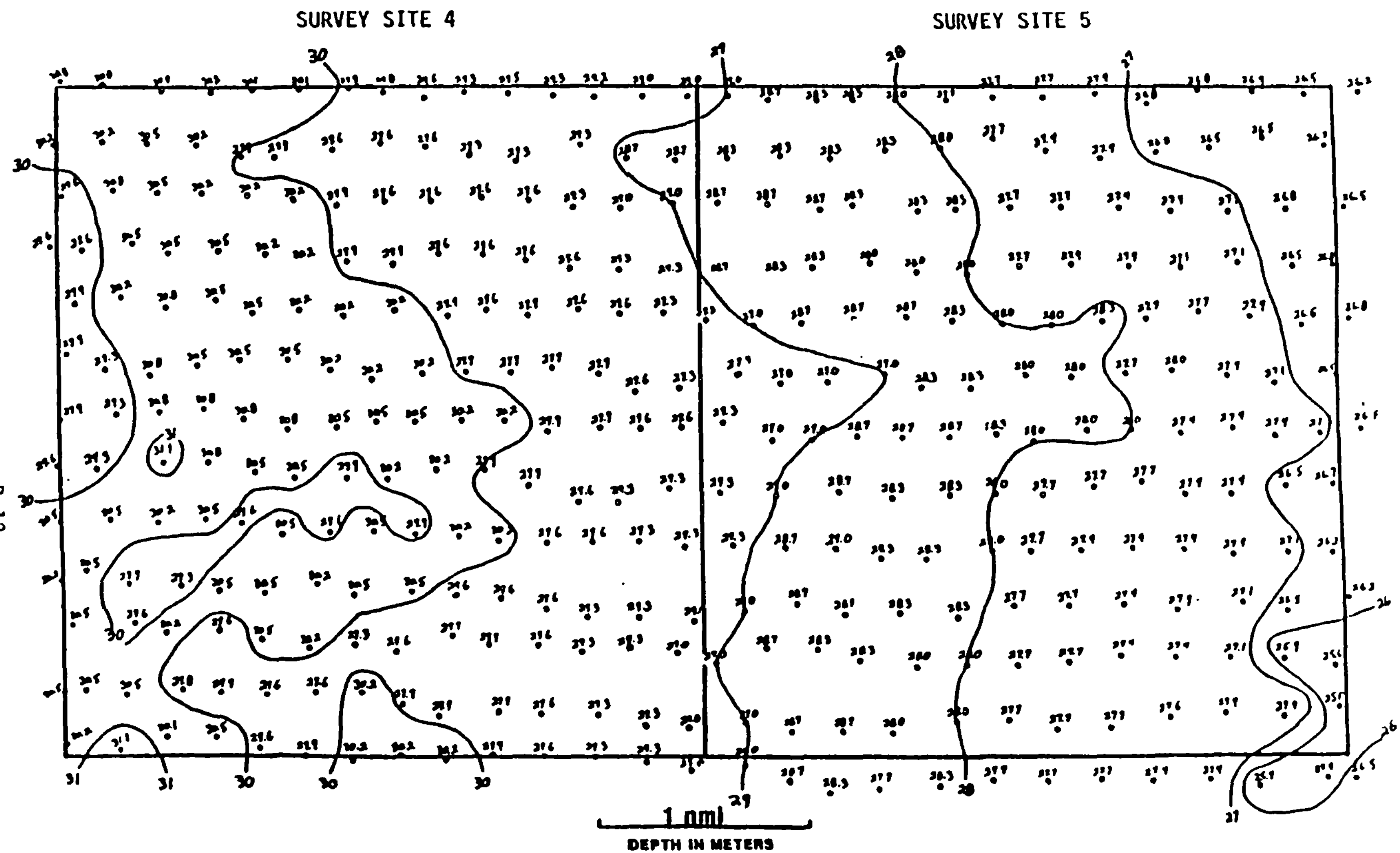

FIGURE B-6. BATHYMETRIC CHART OF SURVEY SITES 4 AND 5 (FROM MML, 1983).

topography was near the southern edge of the western border of Survey Site 4, where rises and depressions of approximately 1 m over relatively short horizontal distances occurred.

The bottom habitats of Survey Sites 4 and 5 were predominantly sand with scattered hard bottom (Figure B-7). Predominantly sandy bottom was observed in the central area of Site 5 and on the western edge of Site 4. These areas contained no evidence of flora or fauna associated with hard-bottom habitats. The scattered hard bottom was characterized by occasional exposed rocks and attached organisms penetrating the sand. These areas were characterized by low relief with a thin layer of sand over underlying limestone, an observation confirmed by SCUBA divers near the west central border of Survey Site 5. Two areas of extensive hard bottom were found in the central and south-central regions of each site along the common border of the sites. Numerous associated fish and moderate to extensive growth of algae and populations of invertebrates characterized these areas. No large reefs were observed, but side-scan sonar did reveal the presence of scattered elevations and depressions in the area of the hard-bottom habitats. The general relief over the hard-bottom areas was less than 1 m.

Selection of Candidate Sites

Three candidate sites for dredged material disposal were chosen from within the areas surveyed. Each candidate site was square (2 nmi on each side). The location of the candidate sites, Site A (renamed Site 5A), Site B (renamed Site 5B), and Site C, within Survey Sites 2, 3, and 5, respectively, are presented in Table B-1. Based on information available at the time of the study, the candidate sites were located within the least environmentally sensitive sections of the survey areas. The relative compositions of bottom characteristics for the five survey areas and the candidate sites are summarized in Table B-3.

MML Candidate Site A (= JRB Site 30MS-1; renamed Site 5A),

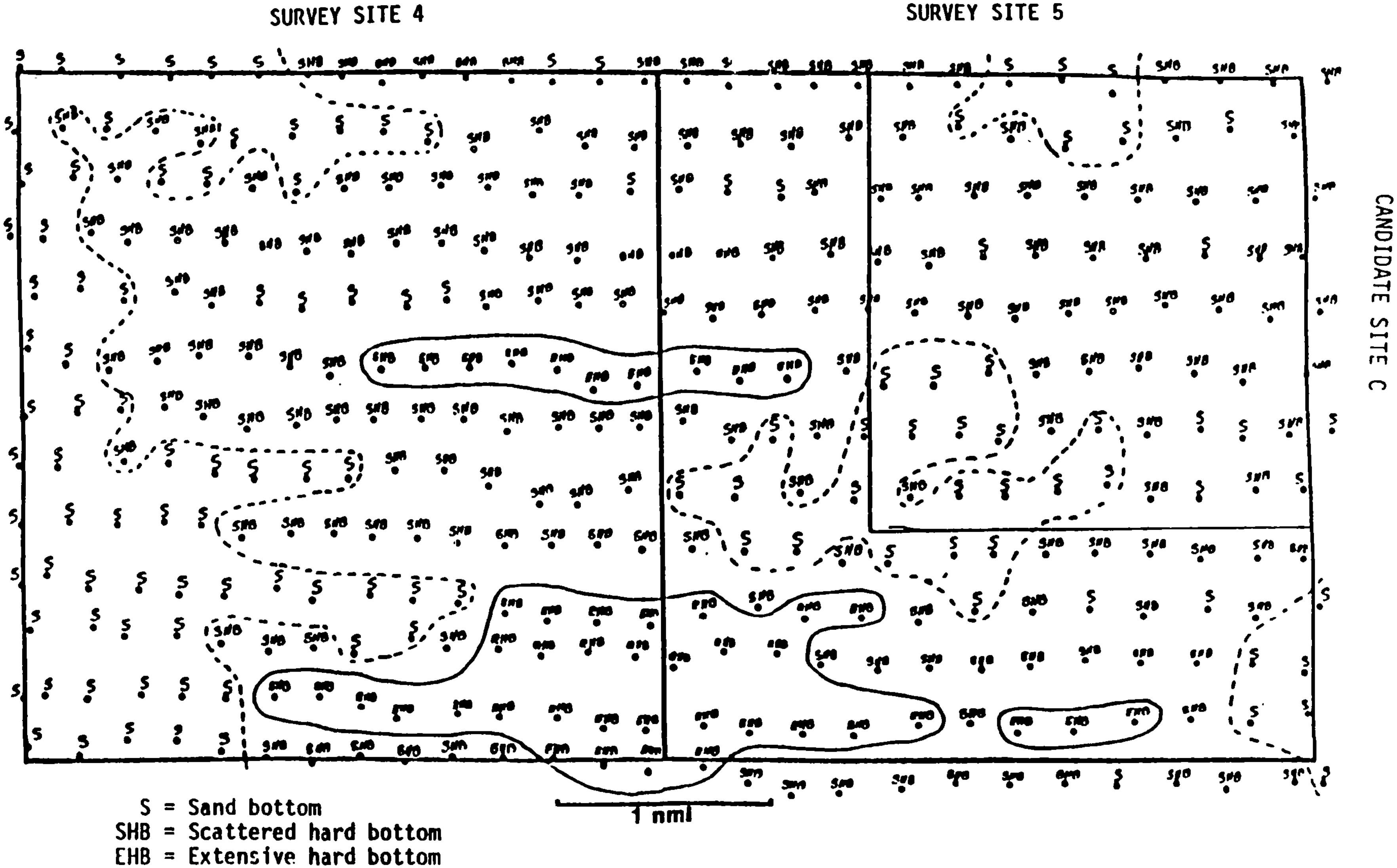

FIGURE B-7. LOCATION OF CANDIDATE SITE C WITHIN SURVEY SITES 4 AND 5 AND DISTRIBUTION OF BOTTOM CHARACTERISTICS (FROM MML, 1983).

TABLE B-3. RELATIVE COMPOSITION OF BOTTOM CHARACTERISTICS FOR FIVE SURVEY AREAS AND THREE CANDIDATE AREAS (FROM MML, 1983).

	Sand Bottom		Scattered Hard Bottom		Extensive Hard Bottom	
Survey Areas	Number[1]	Percent	Number[1]	Percent	Number[1]	Percent
Mote Marine Laboratory (1983)						
Survey Sites 1 and 2	293	80.3	69	18.9	3	0.8
Candidate Site A (Renamed Site 5A)	52	78.8	14	21.2	0	0.0
Survey Site 3	116	74.4	40	25.6	0	0.0
Candidate Site B (Renamed Site 5B)	70	89.7	8	10.3	0	0.0
Survey Sites 4 and 5	112	34.3	194	54.0	42	11.7
Candidate Site C (Eliminated)	24	35.3	44	64.7	0	0.0
All MML Sites	532	60.5	303	34.4	45	5.1
JRB Associates (1983)						
Site 30MS-1 (Renamed Site 5A)	133	94	9	6	0	0
Site 30MS-2 (Renamed Site 5B)	72	69	32	31	0	0
Site 30MS-C (Renamed Site 5MS-C)	34	92	3	8	0	0

[1]Number of navigation points at which the characteristic was observed.

which is located in the southeast corner of Survey Site 2, contains mostly sand bottom with a few areas of scattered hard bottom; this site has a higher percentage of scattered hard bottom than the larger Survey Sites 1 and 2 combined. The site is approximately 79 percent sand bottom and contains no extensive hard-bottom areas.

MML Candidate Site B (= JRB Site 30MS-2; renamed Site 5B) is located in the west central area of Survey Site 3. Of the three candidate sites, this site contains the highest percentage of sand-bottom areas (90 percent) and the lowest percentage of hard-bottom areas (10 percent).

MML Candidate Site C (not directly comparable to any JRB site; eventually eliminated) is located in the northeast quadrant of Survey Site 5. This site contains the highest percentage of hard-bottom areas (65 percent) and the lowest percentage of sand-bottom areas (35 percent) of the three candidate sites. Videotapes of the survey areas revealed several transects with very widely scattered hard-bottom communities and primarily sandy bottoms. Because of the high percentage of hard-bottom areas, Candidate Site C was eliminated from further consideration as a potential site for disposal of dredged material.

JRB ASSOCIATES (SEPTEMBER/OCTOBER 1983)

A total of 20 nmi of sea bottom was surveyed along four 2-nmi transects in each of Sites 30MS-1 (renamed Site 5A) (Transects 1-4) and 30MS-2 (renamed Site 5B) (Transects 5-8) and two 1-nmi transects in Site 30MS-C (renamed Site 5MS-C) (Transects 9 and 10). However, the actual path of Transect 5 is not known because the LORAN coordinates on the videotape could not be deciphered.

During each transect, a navigational position was recorded every 3 minutes. All observations, such as bottom type, LORAN coordinates, and tape counter readings, made during one 3-min interval were summarized and recorded at the end of the interval.

Bottom habitats were classified as sand, scattered hard bottom, or extensive hard bottom in accordance with the classification system used by MML. Both extensive and scattered hard-bottom areas were distinguished by the presence of exposed hard substrates such as coral ledges or rocks; attached epifaunal organisms such as sponges, tunicates, and hard and soft corals; or an irregular bottom relief with epifaunal organisms or schools of reef fishes. Scattered hard-bottom areas may have been covered with a layer of sand but hard- substrate epifauna were observed protruding through the sand cover. Extensive hard-bottom areas had a minimal sand cover, and exposed rock had a dense coral substrate, with a typical relief of 1 to several feet.

Site 30MS-1

No extensive hard-bottom areas were observed at Site 30MS-1 (= MML Candidate Site A; renamed Site 5A). Approximately 6 percent of the area surveyed was classified as scattered hard bottom (Figure B-8); the largest area of hard bottom was found in the central area of the eastern boundary of the site. Two additional scattered hard-bottom areas, characterized by low densities of attached epifauna, were found at the eastern end of Transect 2 just outside the eastern boundary of the site.

Approximately 94 percent of the area surveyed within Site 30MS-1 was characterized as sandy bottom with flat topography. Scattered patches of algae (probably Caulerpa sp.), shell hash, and worm tube complexes were observed, particularly near the western boundary of the survey area.

Site 30MS-2

Sand bottom dominated the northwestern portion of the area surveyed in Site 30MS-2 (= MML Candidate Site B; renamed Site 5B)

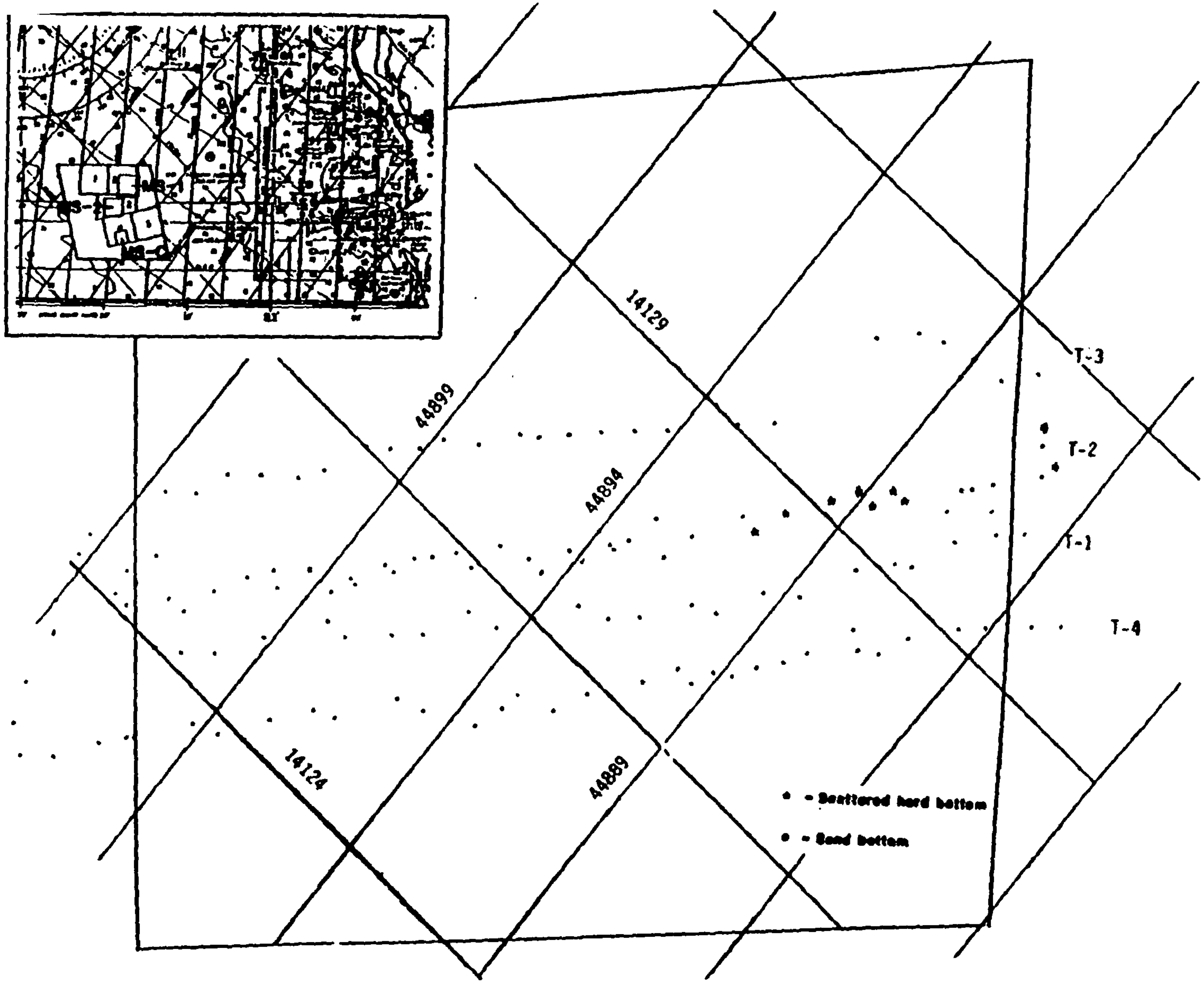

FIGURE B-8 LOCATION OF VIDEO OBSERVATIONS AT SITE 30MS-1 (SITE 5A IN TEXT) WITHIN SURVEY SITE 2 AND DISTRIBUTION OF BOTTOM CHARACTERISTICS. A STAR INDICATES SCATTERED HARD BOTTOM AREAS AND A DOT INDICATES SAND BOTTOM AREAS. (FROM JRB, 1984).

(Figure B-9). Approximately 31 percent of the area surveyed was classified as scattered hard bottom, with the greatest occurrences found in the eastern and central portions of the study area. A few areas of scattered hard bottom were found south of the sandy areas in the western section of the survey area. No extensive hard-bottom areas were identified.

Site 30MS-C

Approximately 92 percent of the area surveyed at Site 30MS-C (renamed Site 5MS-C) was characterized as sandy bottom (Figure B-10), which was generally flat with occasional ripples and intermittent algal patches. Only 9 percent of the bottom substrate was characterized as scattered hard bottom. The three scattered hard-bottom areas observed were characterized by solitary corals and low densities of epifaunal organisms such as sponges. No extensive hard-bottom areas were observed.

COMPARISON OF RESULTS OF THE TWO STUDIES

JRB (1984) evaluated the reproducibility and replicability of interpretations of the MML and JRB video surveys. Three different quality control examinations were performed: (1) portions of the MML and JRB videotapes were reanalyzed using the same methods followed during the original analysis, (2) continuous sequences of the JRB videotapes from Survey Sites 2 and 3 were reanalyzed, and (3) videotapes of areas observed during both surveys were directly compared.

In the reanalysis of portions of the MML tapes, 88 out of 883 MML observation points (or navigational fixes) were reexamined and a percent difference calculated for each substrate identified (Table B-4). MML found 58 percent sand coverage and 2 percent scattered

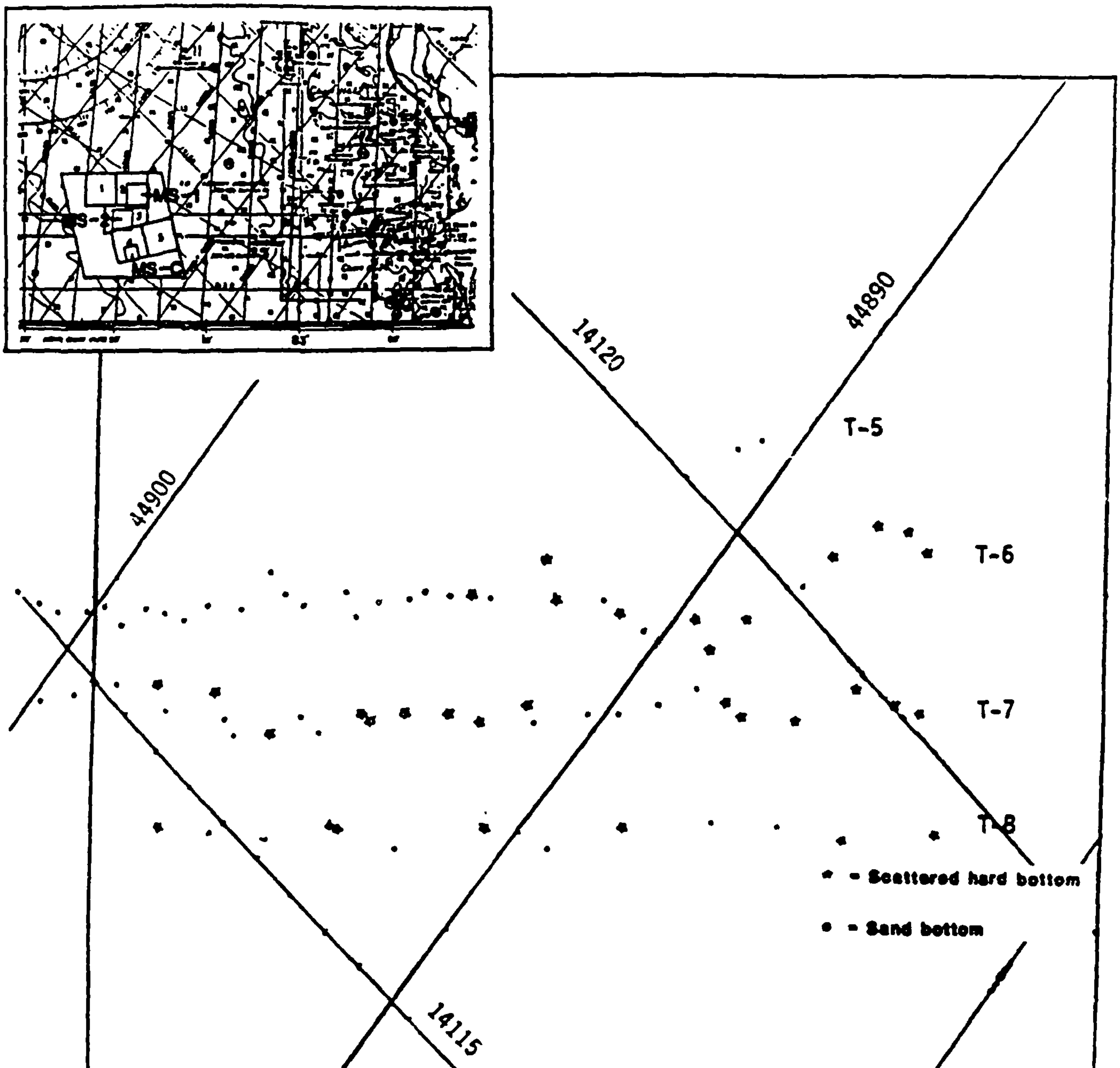

FIGURE B-9 LOCATION OF VIDEO OBSERVATIONS AT SITE 30MS-2 (SITE 5 B IN TEXT) WITHIN SURVEY SITE 3 AND DISTRIBUTION OF BOTTOM CHARACTERISTICS. A STAR INDICATES SCATTERED HARD BOTTOM AREAS AND A DOT INDICATES SAND BOTTOM AREAS. (FROM JRB, 1984).

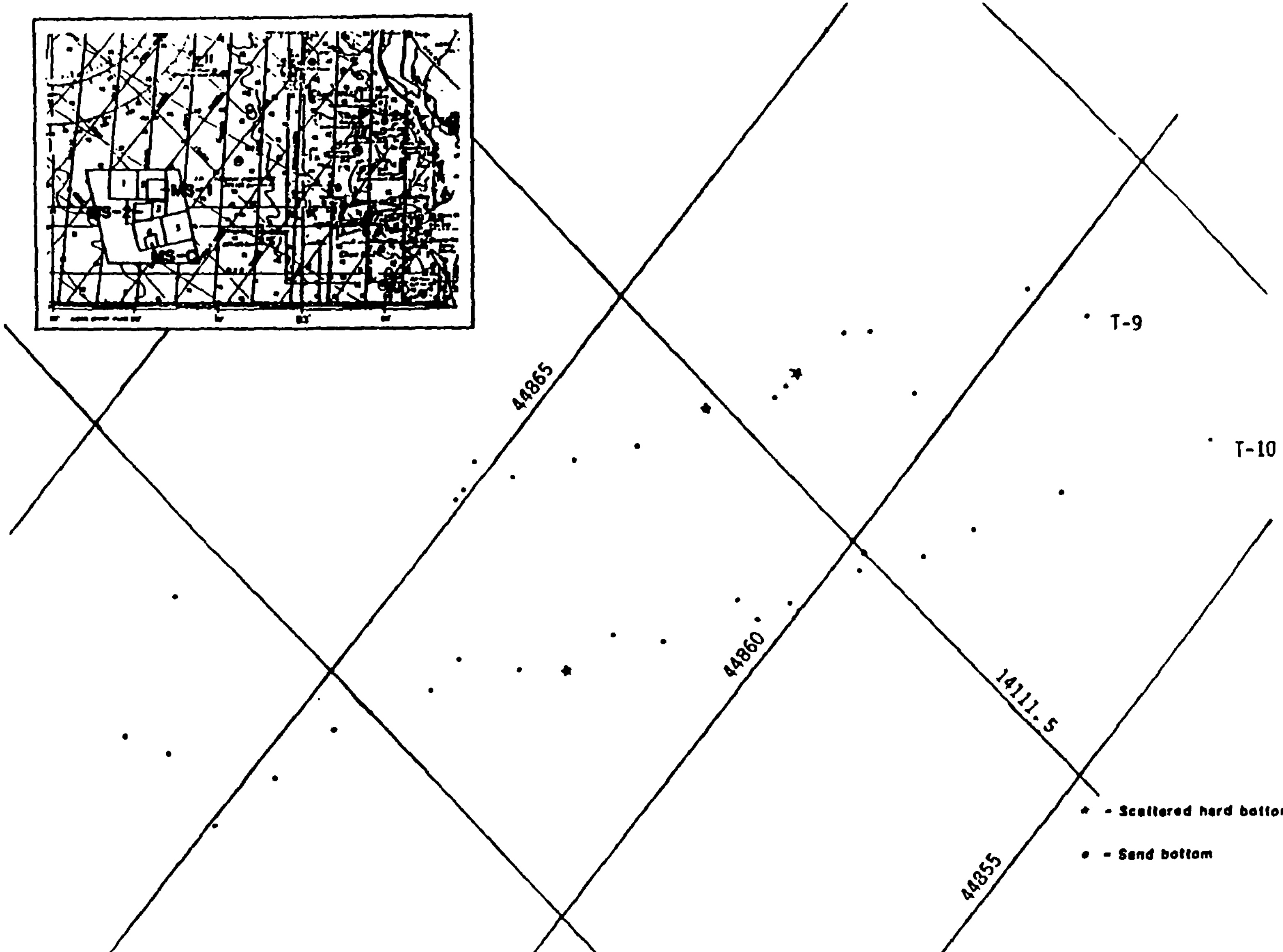

FIGURE B-10 LOCATION OF VIDEO OBSERVATIONS AT SITE 30MS-C (SITE 5 MS-C IN TEXT) WITHIN SURVEY SITE 4 AND DISTRIBUTION OF BOTTOM CHARACTERISTICS. A STAR INDICATES SCATTERED HARD BOTTOM AREAS AND A DOT INDICATES SAND BOTTOM AREAS. (FROM JRB, 1984).

TABLE B-4. RESULTS OF QUALITY CONTROL ANALYSIS OF MML (1983) AND JRB (1984) VIDEO SURVEYS (ADAPTED FROM JRB, 1984).

	Sand Bottom		Scattered Hard Bottom		Extensive Hard Bottom	
	Number[1]	Percent	Number[1]	Percent	Number[1]	Percent
Method 1						
Individual Observations(Survey Sites 1 through 5) from MML Survey						
MML (Original)	51	58	37	42	0	0
JRB (QC)	59	67	29	33	0	0
Difference	--	9	--	9	--	0
Video Sequences from JRB survey (Survey Sites 2 and 3)						
JRB (Original)	37	73	14	27	0	0
JRB (QC)	44	86	7	14	0	0
Difference	--	13	--	13	--	0
Method 2						
Videotape Sequences from MML Survey, Percent Bottom Coverage (Survey Site 2)						
MML	--	79	--	21	--	0
JRB (QC)	--	85	--	15	--	0
Difference	--	6	--	6	--	0
Contoured Bottom Types (Survey Site 2)						
MML	0.477678g	88	0.06530g	12	0	0
JRB (QC)	0.46678g	87	0.07070g	13	0	0
Difference	0.01089g	1	0.00540g	1	0	0

[1]For Method 1 and Percent Bottom Coverage for Method 2, this column refers to number of observations. For Contoured Bottom Types for Method 2, this column refers to weight in grams (g).

hard-bottom coverage. In the reanalysis, JRB found 67 percent sand coverage and 33 percent scattered hard-bottom coverage. Discrepancies in substrate types occurred at 9 percent of the observation points, or at 8 out of 88 points examined.

Nine randomly selected 15-min sequences of the JRB tapes, or a total of 51 observational points, from Survey Sites 2 and 3 were reexamined (Table B-4). The original analysis by JRB reported 73 percent sand coverage and 27 percent scattered hard-bottom coverage. Upon reanalysis, JRB found 86 percent sand coverage and 14 percent scattered hard-bottom coverage.

Discrepancies occurred at 14 percent (7 out of 51 observations) of the observational points. This difference was approximately 1.5 times higher than the discrepancy found in the reanalysis of the MML videotapes.

Continuous sequences of the MML videotapes from Survey Site 2 were reviewed (Table B-4). MML estimated 79 percent sand coverage, 21 percent scattered hard-bottom coverage, and 0 percent extensive hard-bottom coverage. During the reanalysis, JRB estimated 85 percent sand coverage and 15 percent hard bottom coverage. Therefore, discrepancies were found in 6 percent of the sequences reviewed.

Substrate characterizations made by MML and JRB for sequences of the MML videotapes at Survey Site 2 were plotted onto base maps. Contoured bottom types from both analyses were cut out and each contour was weighed separately. The MML contour weights indicated 88 percent sand coverage, 12 percent scattered hard-bottom coverage, and no extensive hard-bottom coverage. The JRB contour weights indicated 87 percent sand coverage and 13 percent scattered hard bottom. This comparison resulted in a 1 percent difference in the results (Table B-4).

Both MML and JRB collected video records in portions of Survey Sites 2 and 3. However, only a small portion (20 percent) of the areas directly correspond in the two surveys. Of the 142 observations made by JRB in this small overlapping area, 94 percent of the bottom was characterized as sand and 6 percent was characterized as scattered hard bottom. MML reported this same area as having 79 percent sand and 21 percent scattered hard bottom.

Differences between the original results and the quality control results were attributed to several factors. The MML classification at each navigational fix was based on a summary of observations in the preceding 3 minutes of videotape. During the reanalysis, short sequences of the videotape from immediately before and after the navigational fix were reviewed by JRB. Therefore, the JRB observations were based on slightly different intervals. In addition, the viewing of continuous sequences by MML resulted in judgments based on previous observations. Random spot checks during the quality control evaluation would not have included these previous observations.

In some cases, the videotape picture was not clear enough to accurately classify the bottom substrate. In the original analyses, the side-scan sonar and fathometer could have been used to resolve this problem by providing information on bottom characteristics outside the field of view. However, side scan sonar cannot distinguish between exposed rock and rock covered with a thin layer of sand, and this method may have led to an overestimation of exposed hard-bottom coverage in some cases.

Discrepancies between the two surveys of the same area may be attributable to natural processes. A period of approximately 2 months separated the two surveys, and natural movement of the sand may have occurred. Small to moderate relief features (less than 4 ft in height) in hard-bottom areas may have variable amounts of sand cover depending upon seasonal differences. Larger or smaller areas of hard-bottom features may be exposed or buried due to seasonal differences in sediment transport and deposition.

In addition to natural processes, variations in sampling methods may have contributed to discrepancies between the two sets of data. For example, if the video cameras were not at the same level during both tapings, one series of observations may have been made from a greater height off the bottom. This would have resulted in a greater viewing area. Other sampling errors may have included variability in navigation systems and electrical interference that affected resolution.

In summary, varying degrees of replicability were achieved, depending on the method of reanalysis. Spot-checking short sequences of videotape would underestimate scattered bottom coverage; greater reproducibility would result from reviewing continuous sequences. When contour plots of substrates were actually cut out and weighed, discrepancies in percent coverage were minimal.

The replicability of different video records for the same area from different times is limited by the variability caused by natural movement of the sand (due to storm-induced turbulence) with resulting changes in the thickness of the sand veneer. In addition, sampling conducted using different sampling equipment and technicians may introduce sampling errors.

REFERENCES

JRB. See JRB Associates.

JRB Associates. 1984. Final report on studies and sample analyses for Tampa Bay survey no. 5 (September/October 1983). Prepared for the U.S. Environmental Protection Agency. 118 p.

MML. See Mote Marine Laboratory.

Mote Marine Laboratory. 1983. Preliminary survey of potential dredge material disposal sites off Tampa Bay, Florida. Submitted to Camp Dresser and McKee, Inc., Annandale VA, September 1983. 36 p.

APPENDIX C

SITE MANAGEMENT AND MONITORING PLAN

TAMPA, FLORIDA ODMDS

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APPENDIX C:
Site Management and Monitoring Plan

Introduction. It is the responsibility of EPA under the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972 to manage and monitor each of the Ocean Dredged Material Disposal Sites (ODMDSs) designated by the EPA pursuant to Section 102 of MPRSA. As part of this responsibility, this management and monitoring plan has been developed to specifically address the deposition of dredged material into the Tampa ODMDS.

SITE MANAGEMENT

Section 228.3 of the Ocean Dumping Regulations (40 CFR 220-229) states: "Management of a site consists of regulating times, rates, and methods of disposal and quantities and types of materials disposed of; developing and maintaining effective ambient monitoring programs for the site; conducting disposal site evaluation studies; and recommending modifications in site use and/or designation." The plan may be modified if it is determined that such changes are warranted as a result of information obtained during the monitoring process.

Management Objectives. There are three primary objectives in the management of each ODMDS. These are:

- Protection of the marine environment;
- Beneficial use of dredged material whenever practical; and
- Documentation of disposal activities at the ODMDS.

The following sections provide the framework for meeting these objectives to the extent possible.

Material volumes. The Tampa ODMDS was first used in May, 1984 for disposal of material for harbor deepening. The following table outlines expected disposal at the ODMDS as projected by the Jacksonville District.

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TABLE: Volumes of Dredged Material Disposed at Tampa Site and Estimated Average 1993-1998.

Completion Date	Type of Action	Volume (cubic yards)	Composition
1985	New work	3,141,272	unavailable
FY95	Maintenance	1,100,000	silty sand, fines
FY96	Maintenance	1,000,000	silty sand, fines
FY97	Maintenance	600,000	silty sand, fines
FY99	Maintenance	500,000	silty sand, fines

There are no proposed limitations on the quantity of material that may be placed at the site.

Material suitability. The only source of material expected to be placed at the site is maintenance material. These materials will consist of mixtures of silt, clay and sand in varying percentages.

The Tampa ODMDS is sectioned so that different types of materials will be placed at different locations to avoid potential adverse impacts to resources. Extensive colonization has occurred on the mound created by previous disposal of consolidated materials. Therefore, the area of the mound will be restricted to the disposal of material that consists of at least 90 % gravel or larger grain size. No disposal shall occur directly on any portion of the mound (as shown in Figure 1). Disposal of all other material is restricted to that area within the site identified in Figure 1 as "Disposal Zone" north of the mound. The size of this area will provide sufficient room for proposed volumes. Additionally, plume modelling results (Appendix [illegible]) show that disposal within this zone will ensure that no impacts occur to the mound or to those areas outside the northern boundary of the site.

The suitability of dredged material for ocean disposal must be verified by the COE and agreed to by EPA prior to each disposal event. Verification will be valid for three years from the time last verified. Approval may be given by EPA for an additional two years if conditions have not changed and no adverse impacts have occurred or are expected. Verification will involve: 1) a case-specific evaluation against the exclusion criteria (40 CFR 227.13(b)), 2) a determination of the necessity for bioassay

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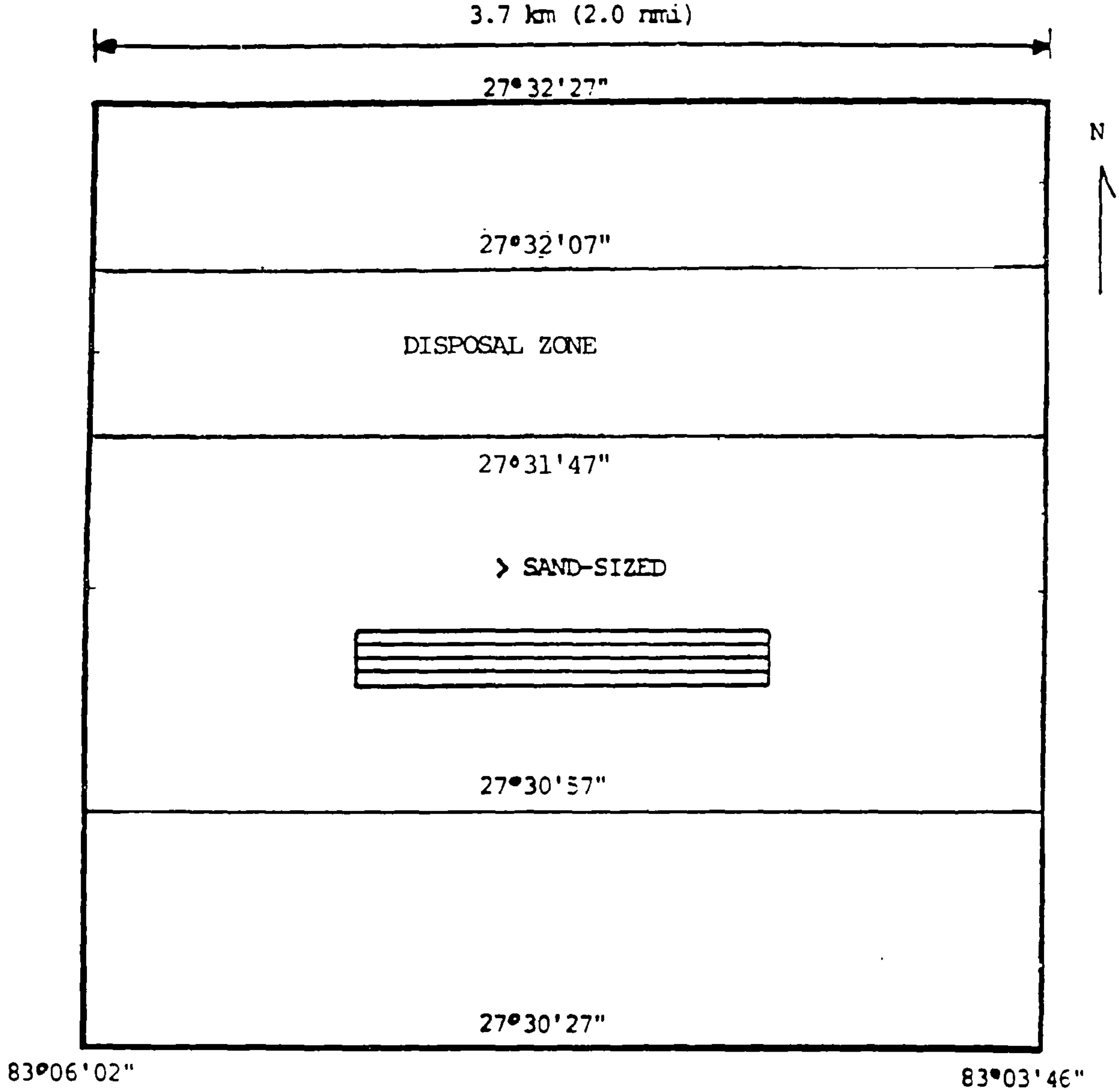

SITE 4

Figure 1

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(toxicity and bioaccumulation) testing for non-excluded material based on the potential for contamination of the sediment since last tested, and 3) carrying out the testing and determining that the non-excluded, tested material is suitable for ocean disposal.

Documentation of verification will be completed prior to use of the site. Documentation for material suitability for dredging events proposed for ocean disposal more than 5 years since last verified will be a new 103 evaluation and public notice. Documentation for material suitability for dredging events proposed for ocean disposal less than 5 years but more than 3 years since last verified will be an exchange of letters between the COE and EPA.

Should EPA conclude that a reasonable potential exists for the proposed dredged material to have been contaminated, acceptable testing will be completed prior to use of the site. Testing procedures to be used will be consistent with the EPA/COE testing manual ('green book') and any regional implementation guidance. Only material determined to be suitable through the MPRSA 103 verification process by the COE and EPA will be placed at the designated ocean disposal site.

Time of disposal. At present no restrictions have been determined to be necessary for disposal related to seasonal variations in ocean current or biotic activity. As monitoring results are compiled, should any such restrictions appear necessary, disposal activities will be scheduled so as to avoid adverse impacts. Additionally, if new information indicates that endangered or threatened species are being adversely impacted, restrictions may be incurred.

Disposal Technique. No specific disposal technique is required for this site.

Utilization of any beach-compatible dredged material for beach nourishment is encouraged by EPA. Disposal of coarser material should be planned to allow placement within or accessible to the littoral zone, to the maximum extent practical and following the provisions of the Clean Water Act.

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SITE MONITORING

Part 228 of the Ocean Dumping Regulations establishes the need for evaluating the impacts of disposal on the marine environment. Section 228.9 indicates that the primary purpose of this monitoring program is to evaluate the impact of disposal on the marine environment by referencing the monitoring results to a set of baseline conditions. Section 228.10(b) states that in addition to other necessary or appropriate considerations, the following types of effects will be considered in determining to what extent the marine environment has been impacted by materials disposed at an ocean site (excerpted):

1. Movement of materials into estuaries or marine sanctuaries, or onto oceanfront beaches, or shorelines;

2. Movement of materials toward productive fishery and shellfishery areas;

3. Absence from the disposal site of pollution-sensitive biota characteristic of the general area;

4. Progressive, non-seasonal, changes in water quality or sediment composition at the disposal site, when these changes are attributable to materials disposed of at the site;

5. Progressive, non-seasonal, changes in composition or numbers of pelagic, demersal, or benthic biota at or near the disposal site, when these changes can be attributed to the effects of materials disposed at the site; and

6. Accumulation of material constituents (including without limitation, human pathogens) in marine biota at or near the site.

Part 228.10(c) states: "The determination of the overall severity of disposal at the site on the marine environment, including without limitation, the disposal site and adjacent areas, will be based on the evaluation of the entire body of pertinent data using appropriate methods of data analysis for the quantity and type of data available.

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Impacts will be classified according to the overall condition of the environment of the disposal site and adjacent areas based on the determination by the EPA management authority assessing the nature and extent of the effects identified in paragraph (b) of this section in addition to other necessary or appropriate considerations."

Frequency of monitoring will be based on frequency of disposal and previous monitoring results.

Baseline Monitoring. The results of investigations presented in this EIS will serve as the main body of baseline data for the monitoring of the impacts associated with the use of the Tampa ODMDS (see DEIS).

A bathymetric survey will be conducted by the COE or site user prior to dredging cycle or project disposal. The number of transects required will be dependent upon the length of the disposal operation and the quantity of material proposed for disposal. The surveys will be taken along lines spaced at 200-foot intervals or less and be of sufficient length to adequately cover the disposal area. Accuracy of the surveys will be ± 1.0 feet. These surveys will be referenced to the appropriate datum and corrected for tide conditions at the time of survey. No additional pre-disposal monitoring at this site is proposed.

Disposal Monitoring. For all disposal activities, the dredging contractor will be required to prepare and operate under an approved electronic verification plan for all disposal operations. As part of this plan, the contractor will provide an automated system that will continuously track the horizontal location and draft condition (vertical) of the disposal vessel from the point of dredging to the disposal area, and return to the point of dredging. Required digital data are as follows:

(a) Date;

(b) Time;

(c) Vessel Name;

(d) Dump Number;

(e) Map Number on which dump is plotted;

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(f) Beginning and ending coordinates of the dredging area for each load, and the beginning and ending coordinates for each dump and the compass heading at the beginning of each dump;

(g) Shoal Number from which dredged material came; and

(h) Volume and brief description of material disposed.

As a follow-up to the baseline bathymetric survey, the COE or other site user will conduct a post-disposal bathymetric survey. The number of transects required will be the same as in the baseline survey.

The user will be required to prepare and submit to the COE daily reports of operations and a monthly report of operations for each month or partial month's work.

Material Tracking and Disposal Effects Monitoring. Based on the type and volume of material disposed, various monitoring surveys can be used to determine if and where the disposed material is moving, and what environmental effect the material is having on the site and adjacent area. A tiered approach will be used to determine the level of monitoring effort required following each disposal event.

An interagency SMMP team, consisting of representatives of EPA, COE, State of Florida and the user(s), will be established at the time when use of the ODMDS is proposed. Other agencies, such as National Marine Fisheries Service (NMFS), will be asked to participate where appropriate. This SMMP team will evaluate existing monitoring data, the type of proposed disposal (i.e., O&M vs. construction), the type of material (i.e., sand vs. mud), location of placement within the ODMDS and quantity of proposed material. This team will then make recommendations to the responsible agency on appropriate monitoring techniques, level of monitoring, significance of results and potential management options.

The monitoring program for the area will address possible changes in bathymetric, sedimentological, chemical, and biological aspects of the ODMDS and surrounding area as a result of the disposal of dredged material at the site, as appropriate.

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Initially, the level of monitoring proposed will focus on tracking the material to determine if it moves, in sufficient quantities, toward known resources. Sediment mapping will be done approximately 12 to 24 months after the initial disposal under the final designation is complete. The results of this mapping will be reviewed by the SMMP team, which will recommend the appropriate monitoring to study potential impacts, if necessary.

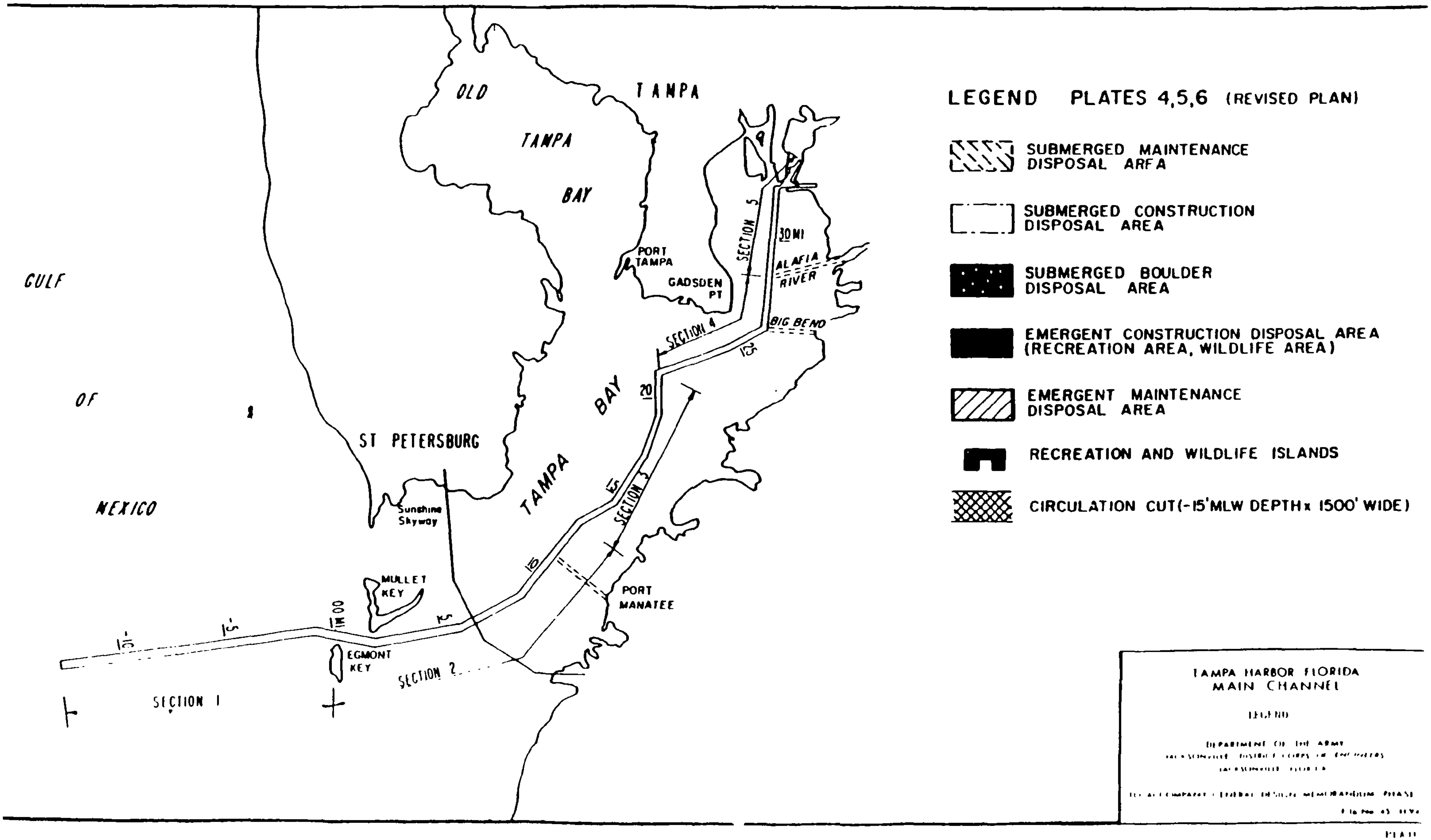
Close coordination between EPA, COE, the State of Florida, and the user(s) will be maintained during development of the detailed survey plans and evaluation of results. Should the initial disposal at the permanently-designated ODMDS result in unacceptable adverse impacts, further studies may be required to determine the persistence of these impacts, the extent of the impacts within the marine system, and/or possible means of mitigation. In addition, the management plan presented may require revision based on the outcome of the monitoring program.

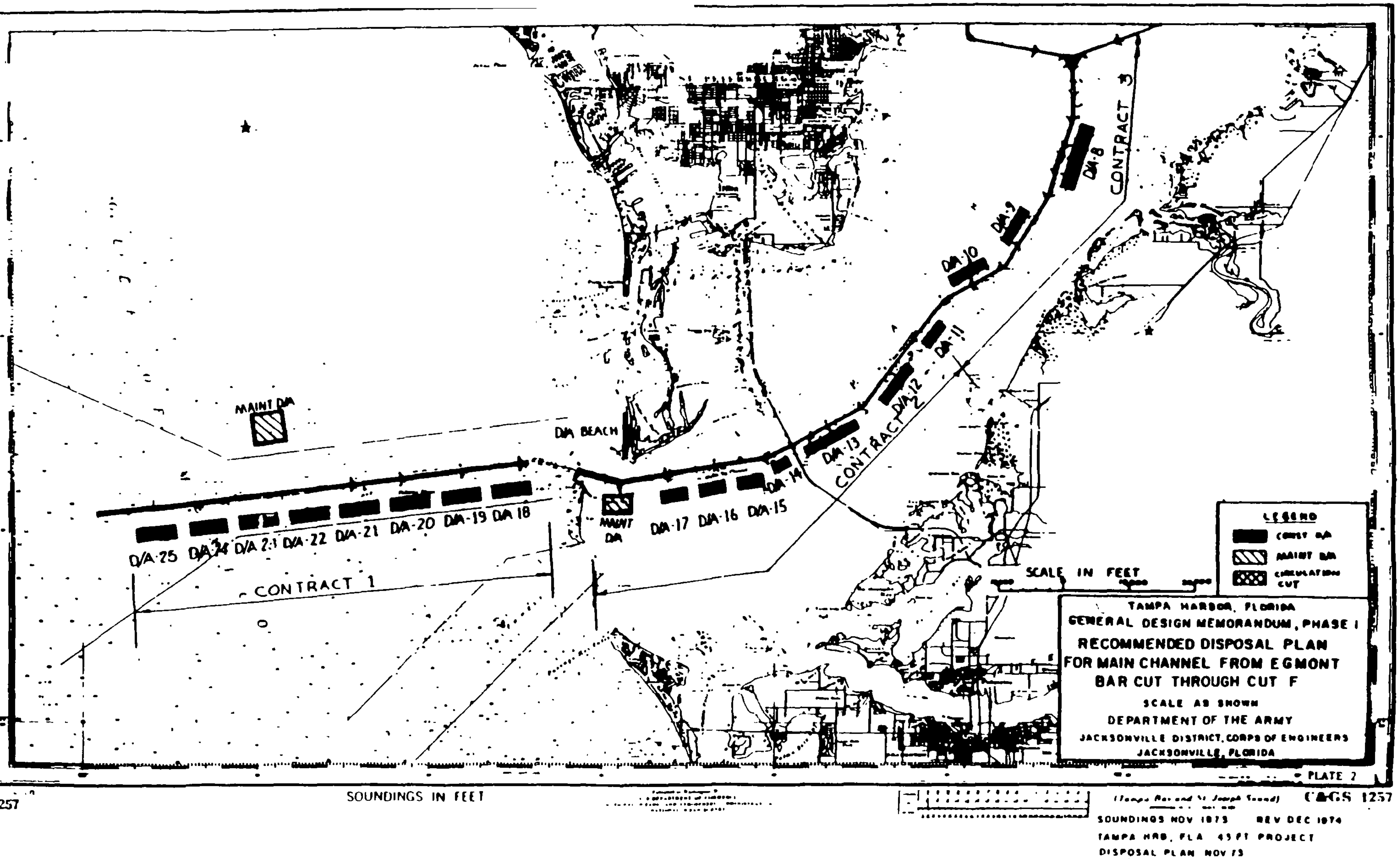
Reporting and Data Formatting. Any data collected will be provided to federal and state agencies as appropriate. Data will be provided to other interested parties requesting such data to the extent possible. EPA requires data to be in the National Ocean Data Center (NODC) format, where appropriate. Data will be provided to members of the SMMP team for all surveys (including bathymetric) in a report generated by the action agency. The report should indicate how the survey relates to the SMMP and list previous surveys at the Tampa ODMDS. Reports should be provided within 90 days (bathymetric surveys within 45 days) after completion. Exception to the time limit will be possible if outside contracts stipulate a longer period of time. The report should provide data interpretations, conclusions, and recommendations, and should project the next phase of the SMMP.

Modification of ODMDS SMMP. A need for modification of the use of the Tampa ODMDS because of unacceptable impacts is not anticipated. However, should the results of the monitoring surveys indicate that continuing use of the ODMDS would lead to unacceptable impacts, then either the ODMDS Management Plan will be modified to alleviate the impacts, or the location of the ODMDS would be modified. Regardless, this plan will be reviewed annually by the SMMP team for necessary revisions.

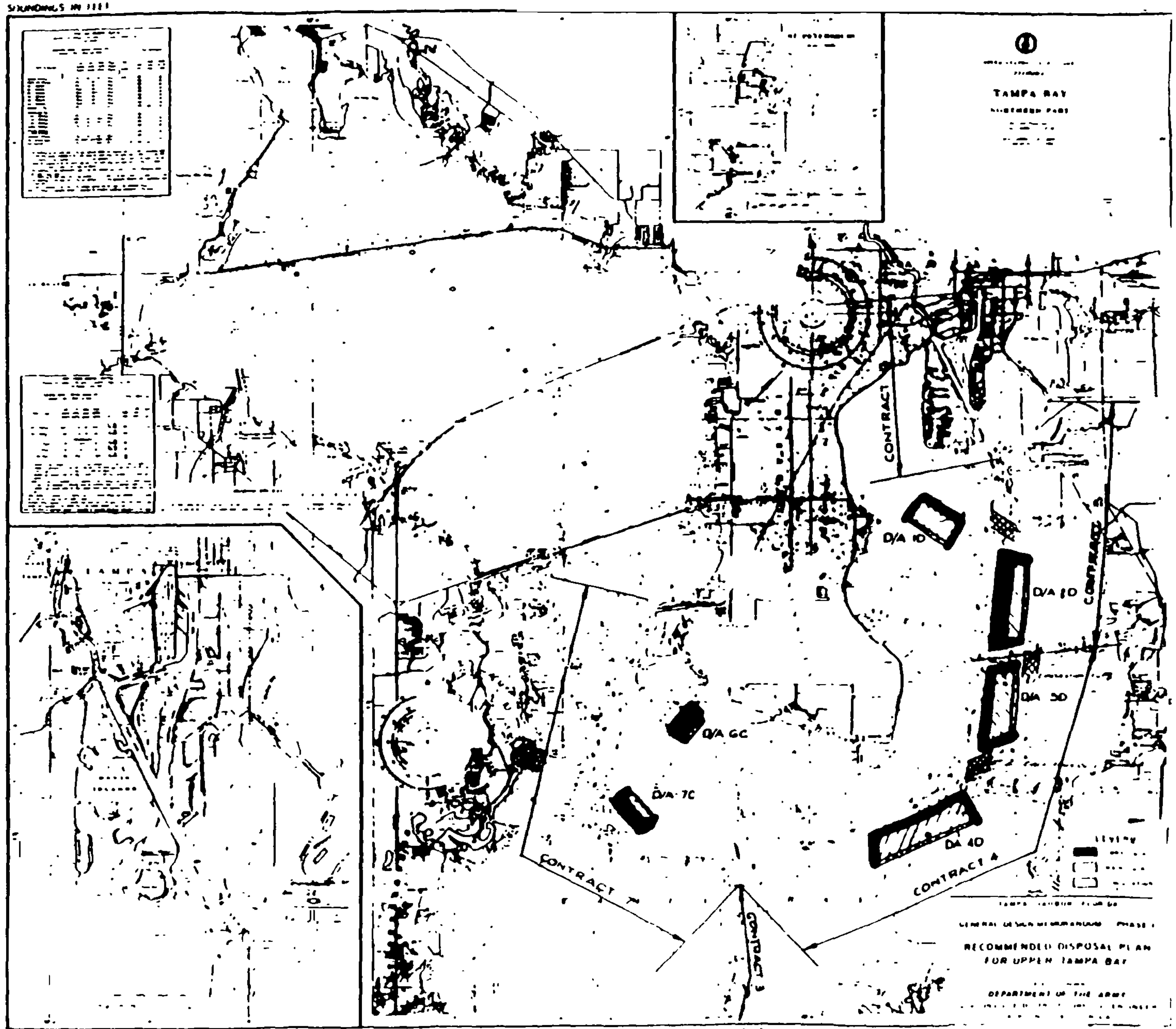
APPENDIX D

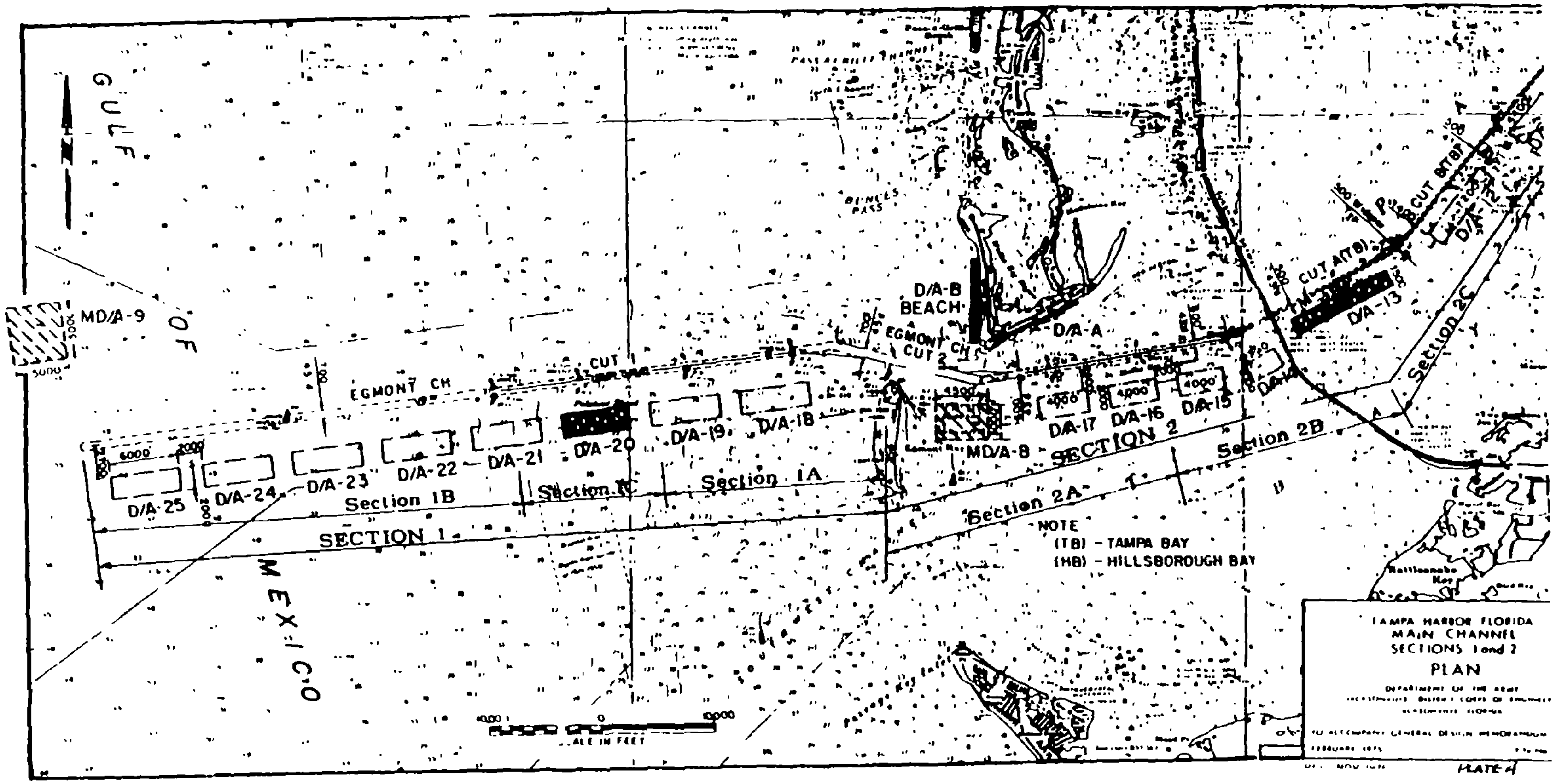
Plates, Tampa Bay Channels and Disposal Areas

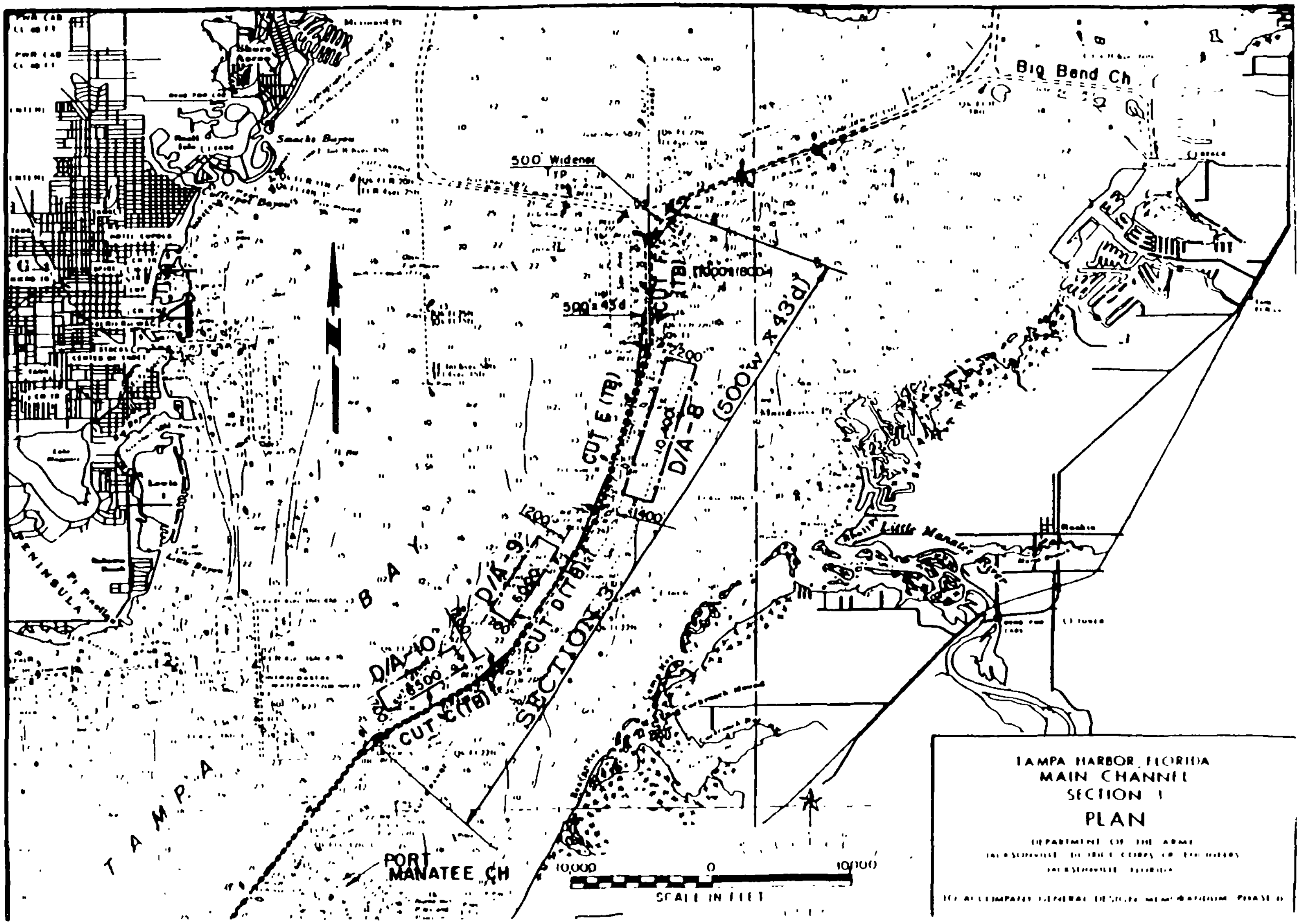

OLD
TAMPA
BAY
TAMPA
PORT TAMPA
GADSDEN PT
SECTION 5
30 MI
ALAFIA RIVER
BIG BEND
SECTION 4
25
20
TAMPA BAY
GULF
OF
MEXICO
ST PETERSBURG
Sunshine Skyway
TAMPA
15
SECTION 3
10
MULLET KEY
PORT MANATEE
0 MI
EGMONT KEY
SECTION 2
SECTION 1
LEGEND PLATES 4,5,6 (REVISED PLAN)
SUBMERGED MAINTENANCE DISPOSAL AREA
SUBMERGED CONSTRUCTION DISPOSAL AREA
SUBMERGED BOULDER DISPOSAL AREA
EMERGENT CONSTRUCTION DISPOSAL AREA (RECREATION AREA, WILDLIFE AREA)
EMERGENT MAINTENANCE DISPOSAL AREA
RECREATION AND WILDLIFE ISLANDS
CIRCULATION CUT(-15'MLW DEPTH x 1500' WIDE)
TAMPA HARBOR FLORIDA
MAIN CHANNEL
LEGEND
DEPARTMENT OF THE ARMY

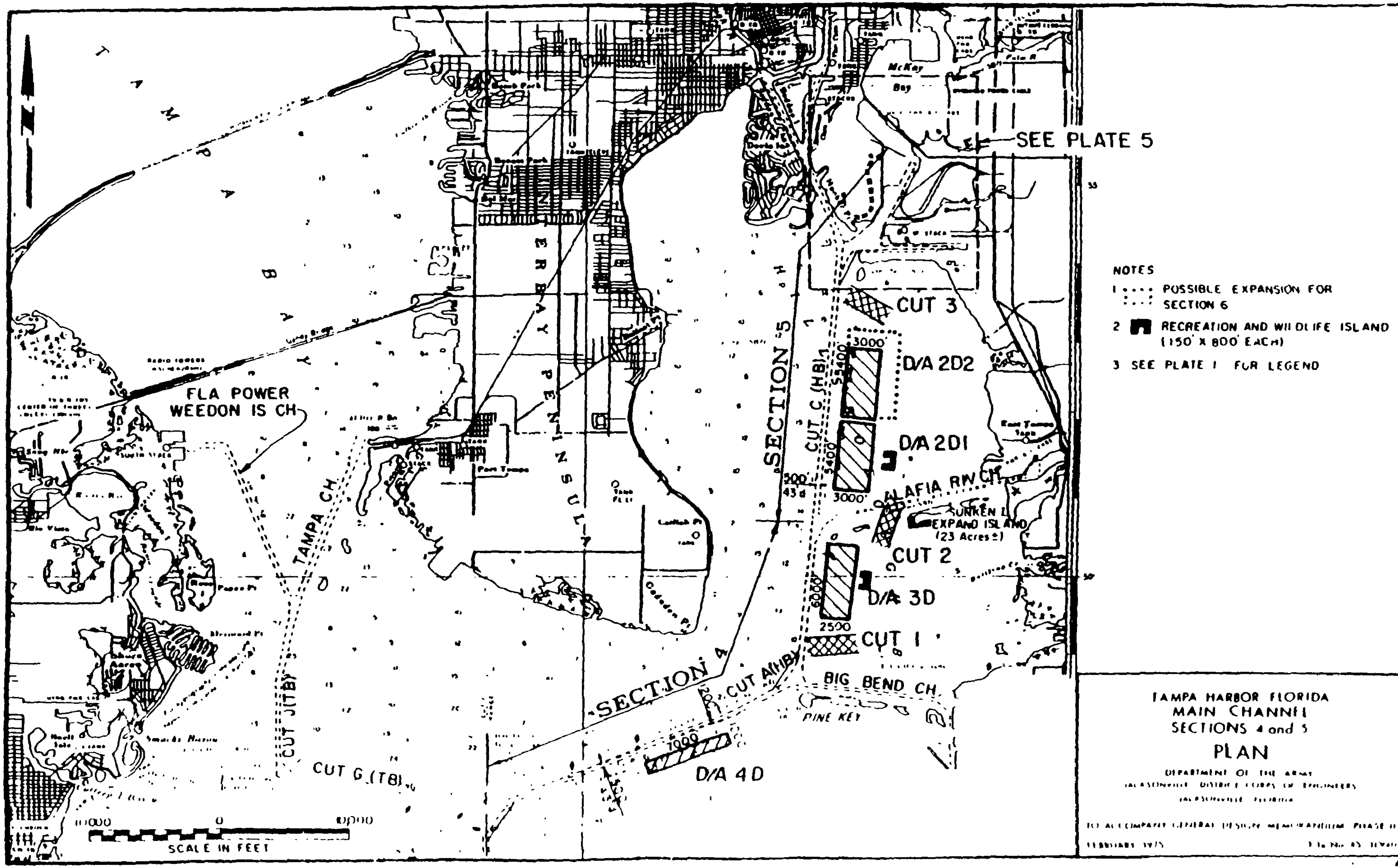


MAINT D/A
D/A BEACH
D/A 8
D/A 9
D/A 10
D/A 11
D/A 12
D/A 13
D/A 14
D/A 15
D/A 16
D/A 17
MAINT D/A
D/A 18
D/A 19
D/A 20
D/A 21
D/A 22
D/A 24
D/A 25
CONTRACT 1
CONTRACT 2
CONTRACT 3
LEGEND
SCALE IN FEET
TAMPA HARBOR, FLORIDA
GENERAL DESIGN MEMORANDUM, PHASE I
RECOMMENDED DISPOSAL PLAN
FOR MAIN CHANNEL FROM EGMONT
BAR CUT THROUGH CUT F
SCALE AS SHOWN
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
PLATE 2
SOUNDINGS IN FEET
C&GS 1257
SOUNDINGS NOV 1973 REV DEC 1974
TAMPA HRB, FLA 43 FT PROJECT
DISPOSAL PLAN NOV 73


TAMPA BAY
CONTRACT
D/A 3D
D/A 4D
D/A 6C
D/A 7C
CONTRACT 4
CONTRACT 3
RECOMMENDED DISPOSAL PLAN
FOR UPPER TAMPA BAY
DEPARTMENT OF THE ARMY


GULF
OF
MEXICO
MD/A-9
EGMONT CH
CUT
D/A-25
D/A-24
D/A-23
D/A-22
D/A-21
D/A-20
D/A-19
D/A-18
D/A-B
BEACH
EGMONT CH
CUT 2
D/A-A
MD/A-8
D/A-17
D/A-16
D/A-15
D/A-14
D/A-13
CUT A(TB)
CUT B(TB)
Section 1B
Section 1C
Section 1A
SECTION 1
SECTION 2
Section 2A
Section 2B
Section 2C
NOTE
(TB) - TAMPA BAY
(HB) - HILLSBOROUGH BAY
TAMPA HARBOR FLORIDA
MAIN CHANNEL
SECTIONS 1 and 2
PLAN
PLATE 4


Big Bend Ch
500' Widener TYP
500 x 43d
CUT F (TB)
CUT E (TB)
D/A-8
(500W x 43d)
D/A-9
D/A-10
CUT D (TB)
CUT C (TB)
SECTION 3
TAMPA BAY
PORT MANATEE CH
Smacks Bayou
Little Manatee
PENINSULA
10,000
0
10,000
SCALE IN FEET
TAMPA HARBOR, FLORIDA
MAIN CHANNEL
SECTION 3
PLAN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1 POSSIBLE EXPANSION FOR SECTION 6
2 RECREATION AND WILDLIFE ISLAND (150' X 800' EACH)
3 SEE PLATE 1 FOR LEGEND
TAMPA BAY
INTERBAY PENINSULA
FLA POWER WEEDON IS CH
TAMPA CH
SECTION 5
SECTION 4
CUT C (HB)
CUT 3
CUT 2
CUT 1
D/A 2D2
D/A 2D1
D/A 3D
D/A 4D
ALAFIA RIV CH
SUNKEN I. EXPAND ISLAND (23 Acres±)
CUT A (HB)
BIG BEND CH
PINE KEY
CUT J (TB)
CUT G (TB)
3000
5400
3000
2500
6000
1000
10000
0
10000
SCALE IN FEET
TAMPA HARBOR FLORIDA
MAIN CHANNEL
SECTIONS 4 and 5
PLAN

APPENDIX E

UPLAND DISPOSAL SITES STUDY

BY CE/JAX, 1993

TAMPA HARBOR

DISPOSAL AREA STUDY

TAMPA HARBOR DISPOSAL AREA STUDY

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TAMPA HARBOR
DISPOSAL AREA STUDY

INTRODUCTION

The Jacksonville District of the U.S. Army Corps of Engineers performed this study to determine the availability of upland sites in the vicinity of Tampa Harbor for disposal of dredged material. The purpose of the study was to determine the availability and feasibility of using upland sites in comparison to offshore dredged material disposal site (ODMDS) for Tampa Harbor. Upland disposal sites underwent an analysis of environmental, engineering, and economic criteria. The economic assessments included the cost to purchase the required land, construct the necessary features, and transport the dredged material to the site. The analysis involves environmental and economic impacts of offshore and upland disposal to obtain a cost comparison which would indicate the most feasible method of disposal. The analysis and evaluation presented in this study include information and conditions existing at the end of 1992 and the beginning of 1993. Further, more detailed study would be required to implement any upland site recommended in this report.

As this study is primarily for the disposal of dredged material from the Tampa Harbor Federal Project, the Federal navigation channel was the major concern. Any material dredged from local access channels and berthing areas was not a consideration at this time. The Manatee Harbor channel was also excluded from this study as it is not part of the Tampa Harbor Federal Project. The Manatee Port Authority has its own upland disposal site for future construction and maintenance work. The St. Petersburg Harbor channel was excluded as it is not part of the Tampa Harbor Federal Project. Figure 1 is provided to show the extent of the Federal project at Tampa Harbor.

INITIAL INVESTIGATIONS

Initial investigations centered on obtaining and reviewing any previous disposal area studies for Tampa and other harbors. The Tampa Port Authority commissioned Greiner, Incorporated to develop a dredged material management plan which included upland disposal areas. Pertinent sections of the plan were made available to this office. Prior studies and reports provided a methodology for an upland area evaluation which included environmental, engineering, and economic considerations. The Hillsborough County Planning Commission provided a county comprehensive plan which contained valuable information related to aspects of environmental and cultural resources, future land use, and zoning. Information in each of the previous studies was helpful in preparing for this analysis and understanding the problems associated with dredged material disposal.

SHOAL CHARACTERISTICS

The initial analysis involved a determination of dredged material quantity and classification as well as the dredging interval for every cut or section of the harbor. A dredging history on the Federal channel is available in the Jacksonville District Office. That history contains the quantity of material removed from specific channel sections (cuts) during each dredging event with a recorded time frame. Analysis of the data determined the annual shoaling rate and dredging interval of each cut in the harbor. After determination of the annual shoaling rate and dredging interval, an analysis of the U.S. Army Corps of Engineers' Condition of Channel Reports for Tampa Harbor provided the location and average depth of shoals within each cut. Shoal quantity, surface area, and depth are important factors related to dredging costs for shoal removal. The results of that analysis are presented in table 1.

SITE IDENTIFICATION

Selection Criteria - To enable potential site identification, specific criteria had to be established with regard to size, shape, use, and boundary conditions. Potential sites with 10 acres or less in size or any dwelling on it were not a consideration. Wetlands or other environmentally sensitive areas were also avoided as potential sites. For any small site, shape would be a consideration to enable sufficient settling time for the return water to meet required water quality standards. Property boundaries influenced site selection because severance damages are a consideration in real estate values. Severance damages are paid to a property owner when purchasing a portion of a parcel of land that devalues the remaining sections. In designating potential sites utilization of the entire parcel was a major consideration to avoid any additional severance costs. With the criteria in place, the selection process went forward to identify the geographical boundaries as a means of limiting the scope of the search.

PAGE NOT

AVAILABLE

DIGITALLY

TABLE 1
TAMPA HARBOR
HARBOR CUT AND
SHOAL CHARACTERISTICS

CUT NAME	CUT LENGTH (FEET)	DISTANCE TO ODMDS (MILES)	ANNUAL SHOALING (CY)	DREDGE INTERVAL (YEARS)	TOTAL QUANTITY (CY)	SURFACE AREA (FEET^2)	PROJECTED SHOALING (FEET)	MATERIAL TYPE
EGMONT 1	67,016	14	320,000	10	3,200,000	8,500,000	10.2	SAND
EGMONT 2	13,290	22	500	10	5,000	38,000	3.6	SAND
MULLET	22,000	25	2,500	10	25,000	68,000	9.9	SAND
A	16,661	29	15,000	5	75,000	203,000	10.0	SAND
B	20,955	32	11,000	10	110,000	1,310,000	2.3	SAND
C	10,512	35	100					
D	13,154	37	2,000	10	20,000	300,000	1.8	SAND
E	12,500	40	400					
F	9,523	42	6,000	10	60,000	800,000	2.0	SAND
G	16,392	44	65,000	10	650,000	3,562,000	4.9	SILTY
J	6,700	47	300					
J2	5,887	48	25					
K	13,000	50	1,000	20	20,000	194,250	2.8	SILTY
PT TAMPA	2,000	51						
GADSEN	20,255	44	20,000	10	200,000	1,441,750	3.7	SANDY
A(HB)	6,045	46	39,000	4	156,000	1,140,000	3.7	SANDY
BIG BEND	11,616	48	45,000	7	315,000	1,554,000	5.5	SANDY
C(HB)	32,498	50	110,000	10	1,100,000	7,632,500	3.9	SANDY
ALAFIA	18,392	51	110,000	5	550,000	1,776,500	8.4	SANDY
SUTTON	4,152	53	75,000	5	375,000	1,346,000	7.5	SILTY
EAST BAY	5,762	54	20,000	5	100,000	444,000	6.1	SILTY
D(HB)	7,778	54	35,000	5	175,000	540,000	8.8	SILTY
SPARKMAN	7,778	55	30,000	5	150,000	777,750	5.2	SILTY
YBOR	4,308	56	10,000	10	100,000	557,500	4.8	SILTY
SEDDON	6,983	55						

Distance to ODMDS is from the center of the cut to the center of the ODMDS
Quantities include 2 feet of overdepth dredging.
Cuts with no quantity information do not have a history of shoaling.

Geographical Boundaries - The identification of initial geographical boundaries usually involve a consideration for pipeline access to any potential site. Interstates I-75 and I-275 form a barrier to pipelines and served as the eastern and northern boundaries. The shoreline at the Gulf of Mexico forms the western limit. Equipment limitations relating to pumping dredged material to potential sites define the southern boundary. A detailed dredging analysis includes the maximum pumping distance for this study as approximately 10 miles from the hydraulic dredge plant or pumpout plant location. Geographical boundaries and equipment limitations greatly reduced the extent of potential site locations.

Site Selection - Recent aerial photography (1991) in conjunction with the previous Greiner study and the Hillsborough County Comprehensive Plan were of assistance in determining potential upland disposal site locations. Utilizing the previously mentioned selection criteria and geographical boundaries, the identification of 59 potential sites was possible in Hillsborough County. The site selection process identified 14 potential areas in Manatee County and 4 in Pinellas County. A total of 77 potential upland disposal sites met the selection criteria and were within the identified geographical boundaries. Ownership or willingness of the owner to sell was not a consideration in this study.

Site Characteristics - The selected sites were then measured from scaled drawings to determine size and perimeter. Site numbers and characteristics are provided in table 2 with most site locations being presented in figure 2. Exact site locations are not identified due to real estate requirements.

SITE VERIFICATION

Examination of aerial photographs of each selected site enabled an environmental scientist to make initial observations concerning any significant environmental resources in the area. Any site with significant environmental resources was either dropped from consideration or redefined to avoid impacting those resources (see table 3). During initial site selection, the assumption was that each site remained as presented in the 1991 aerial photography and that pipeline access to each site would not provide site utilization. A site verification trip provided a more current identification and characterization of each site. The site inspection verified the land use and current conditions of the sites under consideration.

TABLE 2
TAMPA HARBOR DISPOSAL AREA STUDY
UPLAND SITE CHARACTERISTICS

SITE NUMBER	ESTIMATED AREA (ACRES)	ESTIMATED PERIMETER (FEET)
HILLSBOROUGH COUNTY		
H-1	12.7	3,010
H-2	61.8	7,310
H-3	22.4	4,400
H-4	42.9	7,670
H-5	138.3	10,670
H-6	247.8	18,250
H-7	551.5	23,780
H-8	141.2	11,560
H-9	67.5	7,830
H-10	92.9	9,970
H-11	380.6	20,890
H-12	125.3	11,410
H-13	672.5	243,520
H-14	186.3	15,740
H-15	176.9	11,150
H-16	110.9	8,860
H-17	195.3	12,870
H-18	339.2	16,480
H-19	42.3	6,530
H-20	161.7	11,900
H-21	546.3	19,240
H-22	119.0	10,600
H-23	55.8	7,000
H-24	188.9	11,510
H-25	467.1	13,910
H-26	149.1	12,680
H-27	395.3	16,670
H-28	78.7	7,640
Big Bend Area		
1	284.2	17,340
2	41.3	6,960
3	183.0	15,410
4	238.4	7,900
5	160.1	15,640
6	80.0	6,300
7	51.5	5,920
8	87.0	8,490
9A	484.3	20,140
9B	590.3	22,350
10	322.0	15,510

TABLE 2 (Cont'd)
TAMPA HARBOR DISPOSAL AREA STUDY
UPLAND SITE CHARACTERISTICS

SITE NUMBER	ESTIMATED AREA (ACRES)	ESTIMATED PERIMETER (FEET)
Big Bend Area (Cont'd)		
11	158.0	14,700
12	70.3	7,200
13	295.0	10,780
14	398.0	17,970
15	176.3	10,450
16	227.0	13,780
17	483.0	18,030
18	96.0	10,260
19	261.0	15,750
20A	238.8	13,720
20B	123.0	9,720
20C	311.0	15,550
21	102.7	9,600
22	370.0	17,420
23	155.0	13,710
24	313.0	15,940
25	215.9	12,690
26	217.0	15,990
27	176.0	13,720
28	104.0	11,110
	MANATEE COUNTY	
M-1	194.0	13,230
M-2	427.0	18,630
M-3	745.7	30,520
M-4	239.1	16,400
M-5	67.2	7,620
M-6	27.2	5,450
M-7	59.6	9,200
M-8	25.2	4,610
M-9	161.4	10,840
M-10	30.0	4,600
M-11	273.2	15,830
M-12	615.0	26,470
M-13	174.0	500
M-14	211.0	15,080
	PINELLAS COUNTY	
P-1	87.2	8,940
P-2	46.5	7,090
P-3	131.2	10,650
P-4	55.9	6,320

PAGE NOT

AVAILABLE

DIGITALLY

TABLE 3
TAMPA HARBOR DISPOSAL AREA STUDY
INITIAL UPLAND SITES ELIMINATED OR RECONFIGURED

SITE NUMBER	ESTIMATED AREA (ACRES)	ESTIMATED PERIMETER (FEET)	INITIAL ELIMINATION OR RECONFIGURE FACTOR
		HILLSBOROUGH COUNTY	
H-5	138.3	10,670	Reconfigured/Combined w/Site H-10
H-24	188.9	11,510	Development in Progress
H-25	467.1	13,910	Development in Progress
Big Bend Area			
4	238.4	7,900	Reconfigured to Avoid Development
5	160.1	15,640	Environmental Concerns
6	80.0	6,300	Reconfigured to Avoid Access Problem
7	51.5	5,920	Environmental Concerns
13	295.0	10,780	Environmental Concerns
14	398.0	17,970	Environmental Concerns
15	176.3	10,450	Environmental Concerns
17	483.0	18,030	Environmental Concerns
18	96.0	10,260	Environmental Concerns
21	102.7	9,600	Environmental Concerns
22	370.0	17,420	Environmental Concerns
26	217.0	15,990	Environmental Concerns
		MANATEE COUNTY	
M-8	25.2	4,610	Development in Progress
		PINELLAS COUNTY	
P-1	87.2	8,940	Environmental Related Pipeline Access
P-2	46.5	7,090	Pipeline Access
P-3	131.2	10,650	Pipeline Access
P-4	55.9	6,320	Pipeline Access

Changed Conditions - Site visits identified minor changes in site conditions had taken place since the aerial photography was taken in 1991. Conditions at sites H5, H24, H25, and M8 differed from the aerial photography. Each of the four sites were under development for residential housing. Sites H5, H24, H25, and M8 were no longer suitable and received no further consideration in this study.

Pipeline Access - An acceptable access route is necessary to the upland disposal site location. Access routes that must cross major highways, railroads, and other land parcels must take into account any environmental impacts and costs considerations to determine the practicality of such an action. Direct access to a site via an inland waterway is the most desired condition. Navigable waters of the United States do not require real estate easements. Small streams, canals, and drainage ditches can also provide access without an easement if they are attached to navigable waters. Access along highways and railroads is also possible and usually achieved by passing through bridges and culverts. Site P2 was eliminated because of limited access due to environmental conditions. Access to the site was inhibited by a thick stand of mangroves along the shoreline. Interstate 275 blocked access to sites P1, P3, and P4 which were removed from further consideration in this study.

DETAILED SITE ANALYSIS

The detailed site analysis considered the specific characteristics of each site in order to determine preparation requirements and capacity for material disposal. Preparation requirements included such items as clearing and grubbing, dike construction, and weir installation, all of which directly influence costs. Quantification of the work items enabled the development of costs for each site. The total estimate cost of all the work items to prepare a site is then divided by the site capacity to provide a cost per cubic yard ($/cy). Combining that unit cost with the dredging cost provides a total cost per cubic yard to utilize each site for disposal.

SITE SPECIFICS

An accurate determination of conditions at each site is essential in developing the correct site preparation cost. Site capacity depends upon the amount of usable area and dike heights at the site. Dike heights need to be established and the site area cleared for utilization. Each component is directly related to the utilization cost of a potential site.

Site Capacity - The volume of material that can be placed within the diked area is defined as the site capacity. Site capacity has three components, usable area within the dikes, dike height, and bulking factor. The sites were first identified in the initial site analysis and further reviewed during a visit. The usable area has an influence on determining the dike height. Further engineering studies would determine the maximum dike height for each site. The vast majority of potential sites have large acreages which could economically and engineeringly support dike heights of at least 20 feet. A freeboard of two feet in the dike height was a factor in estimating the site capacity. For a dike height of 20 feet, the freeboard consideration would limit material placement to a height of 18 feet. Material used for dike construction normally comes from inside the disposal perimeter of the area. The assumption is that each site has suitable material for dike construction. The dike material from inside the disposal area provides additional space for dredged material disposal The bulking factor varies according to dredged material characteristics. Sand has a bulking factor of 1 while silt can have a bulking factor of 1.5. Based on previous dredging experience and the nature of the dredged material in the harbor, the bulking factor should be approximately 1.3. Based upon the above information, the estimated capacity of each potential site was calculated and is provided in table 4.

Site Preparation - Preparation of a potential site for use as a disposal area involves planning and design for dike construction, installation of water control structures (weirs), provisions for returning water from the site, and clearing the site of trees and brush for efficient use. The number of weirs required for a disposal area depends upon disposal area and dredge size. For sites in this study, the area in each is sufficient to accommodate a 30 inch hydraulic dredge. To handle the discharge water from that dredge, each site would need six weirs at a cost of $75,000 per unit. Site clearing costs depended upon the amount and density of trees and bushes to be removed from an area. The aerial photography was valuable in determining this factor at each site. Table 5 provides the range of costs for clearing and grubbing. Site 1 is an example for estimating the clearing and grubbing cost. The site is a light to medium wooded area that is estimated to cost $413,130 to clear and grub. The value is derived from the 284 acres site size multiplied by the $1,450 per acre clearing category. The estimated cost for dike construction is $1.90 per cubic yard with the quantity provided in table 4. Mobilization and demobilization costs for moving equipment to and from the construction site also depends primarily upon the quantity of material in table 4 for dike construction. Table 6 provides the range of costs employed for mobilization and demobilization. To cover the cost of uncertainties in the estimate, a contingency item is estimated at 25 percent of construction costs. Costs for engineering and design (E&D) and construction management (CM) are a percent of the total estimated construction costs. The combined percentage is 15.

TABLE 4
TAMPA HARBOR DISPOSAL AREA STUDY
UPLAND SITE DATA

SITE NUMBER	SITE SIZE (ACRES)	PERIMETER LENGTH (FEET)	DIKE X-SECTION (FEET^2)	DIKE QUANTITY (CY)	DIKE HEIGHT (FEET)	BULKING FACTOR	CAPACITY DIKED AREA (CY)
HILLSBOROUGH COUNTY							
H1	13	3,010	1,600	178,400	20	1.3	290,000
H2	62	7,310	1,600	433,200	20	1.3	1,385,000
H3	30	4,800	1,600	284,400	20	1.3	670,000
H4	43	7,670	1,600	454,500	20	1.3	961,000
H6	248	18,250	1,600	1,081,500	20	1.3	5,540,000
H7	552	23,780	1,600	1,409,200	20	1.3	12,331,000
H8	141	11,560	1,600	685,000	20	1.3	3,150,000
H9	68	7,830	1,600	464,000	20	1.3	1,519,000
H10	97	10,190	1,600	603,900	20	1.3	2,167,000
H11	380	18,190	1,600	1,077,900	20	1.3	8,489,000
H12	125	11,400	1,600	675,600	20	1.3	2,792,000
H13	673	24,300	1,600	1,440,000	20	1.3	15,034,000
H14	186	15,600	1,600	924,400	20	1.3	4,155,000
H15	177	11,150	1,600	660,700	20	1.3	3,954,000
H16	111	8,860	1,600	525,000	20	1.3	2,480,000
H17	195	12,870	1,600	762,700	20	1.3	4,356,000
H18	339	16,480	1,600	976,600	20	1.3	7,573,000
H19	42	6,530	1,600	387,000	20	1.3	938,000
H20	162	11,900	1,600	705,200	20	1.3	3,619,000
H21	546	19,240	1,600	1,140,100	20	1.3	12,197,000
H22	119	10,600	1,600	628,100	20	1.3	2,658,000
H23	56	7,000	1,600	414,800	20	1.3	1,251,000
H26	117	10,500	1,600	622,200	20	1.3	2,614,000
H27	395	16,670	1,600	987,900	20	1.3	8,824,000
H28	79	7,640	1,600	452,700	20	1.3	1,765,000
Big Bend Area							
1	284	17,340	1,600	1,027,600	20	1.3	6,344,000
2	41	6,960	1,600	412,400	20	1.3	916,000
3	180	15,410	1,600	913,200	20	1.3	4,021,000
4	96	7,900	1,600	468,100	20	1.3	2,144,000
6	54	6,300	1,600	373,300	20	1.3	1,206,000
8	87	8,490	1,600	503,100	20	1.3	1,943,000
9A	484	20,140	1,600	1,193,500	20	1.3	10,812,000
9B	590	22,350	1,600	1,324,400	20	1.3	13,180,000
10	322	15,510	1,600	919,100	20	1.3	7,193,000
11	158	14,700	1,600	871,100	20	1.3	3,529,000
12	70	7,200	1,600	426,700	20	1.3	1,564,000
16	227	13,780	1,600	816,600	20	1.3	5,071,000
19	261	15,750	1,600	933,300	20	1.3	5,830,000
20A	237	13,720	1,600	813,000	20	1.3	5,294,000
20B	123	9,720	1,600	576,000	20	1.3	2,748,000

TABLE 4 (Cont'd)
TAMPA HARBOR DISPOSAL AREA STUDY
UPLAND SITE DATA

SITE NUMBER	SITE SIZE (ACRES)	PERIMETER LENGTH (FEET)	DIKE X-SECTION (FEET^2)	DIKE QUANTITY (CY)	DIKE HEIGHT (FEET)	BULKING FACTOR	CAPACITY DIKED AREA (CY)
Big Bend Area (Cont'd)							
20C	311	15,550	1,600	921,500	20	1.3	6,947,000
23	155	13,710	1,600	812,400	20	1.3	3,462,000
24	360	15,940	1,600	944,600	20	1.3	8,042,000
25	238	12,690	1,600	752,000	20	1.3	5,317,000
27	176	13,720	1,600	813,000	20	1.3	3,932,000
28	104	11,110	1,600	658,400	20	1.3	2,323,000
MANATEE COUNTY							
M1	194	13,230	1,600	784,000	20	1.3	4,334,000
M2	427	18,630	1,600	1,104,000	20	1.3	9,539,000
M3	745	30,520	1,600	1,808,600	20	1.3	16,642,000
M4	239	16,400	1,600	971,900	20	1.3	5,339,000
M5	67	7,620	1,600	451,600	20	1.3	1,497,000
M6	27	5,450	1,600	323,000	20	1.3	603,000
M7	60	7,500	1,600	444,400	20	1.3	1,340,000
M9	161	10,840	1,600	642,400	20	1.3	3,596,000
M10	30	4,600	1,600	272,600	20	1.3	670,000
M11	273	15,830	1,600	938,100	20	1.3	6,098,000
M12	615	26,470	1,600	1,568,600	20	1.3	13,738,000
M13	174	12,500	1,600	740,700	20	1.3	3,887,000
M14	211	15,080	1,600	893,600	20	1.3	4,713,000

TABLE 5
TAMPA HARBOR DISPOSAL AREA STUDY
CLEARING AND GRUBBING COST RANGES

CLEARING CATEGORY	COST PER ACRE
Light (no trees)	$ 560
Light (with trees)	1,230
Light to Medium	1,450
Medium	1,680
Medium to Heavy	2,130
Heavy	2,460

TABLE 6
TAMPA HARBOR DISPOSAL AREA STUDY
MOBILIZATION AND DEMOBILIZATION COST RANGES

CUBIC YARDS	COSTS
30,000 to 311,000	$ 56,000
312,000 to 1,099,000	112,000
1,100,000 to 1,299,000	168,000
1,300,000 to 5,000,000	224,000

Site Cost Summary - The purpose of the detailed site analysis is to determine he site preparation costs for the disposal of material. Table 7 provides a site ost summary for each element of cost associated with a potential upland lisposal site. The last column in that table provides a cost per cubic yard of lredged material placed in each site. That unit cost comes from dividing the otal cost by the capacity. The site cost is only a portion of the entire cost for ıpland disposal. The remaining facets of dredging and real estate are discussed n the following text.

DETAILED DREDGING ANALYSIS

Dredging involves both the removal of material from the channel bottom and ransportation to the designated disposal area. The analysis examined five nethods of dredging. Hopper dredging and clamshell dredging with barge ransport provide the most efficient methods for estimating costs to dispose of naterial in the offshore dredged material disposal site (ODMDS). The raditional hydraulic dredging with pipeline for pumping material to an upland ite provides an efficient method for moving dredged material to upland lisposal sites. Analysis of upland disposal sites at extreme distances involved wo modified methods of dredging to enable more economical transport. Iopper dredging to discharge material at a pumpout location where the naterial is hydraulically moved through a pipeline to an upland disposal site. A imilar method is possible with a clamshell dredge and barge transport to the ame pumpout location where the material is again hydraulically moved hrough a pipeline to an upland disposal site. The previous two methods work est over long distances where access to upland areas for disposal would not be easible using a traditional hydraulic dredge. As stated in the geographical oundaries section of this study, hydraulic dredging has a pumping limit of 10 niles which is based primarily on equipment limitations such as pipeline ıvailability. Some respected experts in the dredging field consider only a 5 mile umping distance as reasonable based upon the availability of pipeline. For this tudy, however, the limit was extended to ensure all possible alternatives for ıpland locations in the vicinity of Tampa Harbor received full consideration.

)CEAN DISPOSAL

The dredging analysis included two methods for ocean disposal of dredged naterial as mentioned earlier. Hopper dredging and transport as well as lamshell dredging with barge transport are both applicable methods for ocean lisposal. The ocean disposal site is the proposed ODMDS located approximately '.6 miles southwest of the entrance marker for the Tampa Harbor Federal Channel. Figure 3 provides a location map for the proposed ODMDS.

TABLE 7
TAMPA HARBOR DISPOSAL AREA STUDY
SITE PREPARATION COSTS

SITE NUMBER	DIKE QUANTITY (CY)	MOB & DEMOB ($)	DIKE CONSTR ($)	CLEARING & GRUBBING ($)	CONTROL STRUCTURES ($)	SUBTOTAL ($)	CONTINGENCY @ 25% ($)	E&D AND CM @ 15% ($)	TOTAL ($)	SITE CAPACITY (CY)	COST ($/CY)
HILLSBOROUGH COUNTY											
H1	178,100	55,950	338,800	16,000	450,000	860,750	215,200	129,100	1,205,050	290,000	4.16
H2	432,900	111,900	823,510	34,690	450,000	1,420,100	355,000	213,000	1,988,100	1,385,000	1.44
H3	284,400	55,950	541,010	61,550	450,000	1,108,510	277,100	166,300	1,551,910	670,000	2.32
H4	454,200	111,900	864,020	52,930	450,000	1,478,850	369,700	221,800	2,070,350	961,000	2.15
H6	1,081,200	111,900	2,056,770	138,760	450,000	2,757,430	689,400	413,600	3,860,430	5,540,000	0.70
H7	1,409,400	223,800	2,681,100	926,530	450,000	4,281,430	1,070,400	642,200	5,994,030	12,331,000	0.49
H8	684,800	111,900	1,302,700	78,890	450,000	1,943,490	485,900	291,500	2,720,890	3,150,000	0.86
H9	463,800	111,900	882,290	1,693,720	450,000	3,137,910	784,500	470,700	4,393,110	1,519,000	2.89
H10	603,900	111,900	1,148,800	119,400	450,000	1,830,100	457,500	274,500	2,562,100	2,167,000	1.18
H11	1,078,000	111,900	2,050,680	637,830	450,000	3,250,410	812,600	487,600	4,550,610	8,489,000	0.54
H12	675,600	111,900	1,285,190	69,940	450,000	1,917,030	479,300	287,600	2,683,930	2,792,000	0.96
H13	1,440,000	223,800	2,739,310	1,129,630	450,000	4,542,740	1,135,700	681,400	6,359,840	15,034,000	0.42
H14	924,400	111,900	1,758,490	104,070	450,000	2,424,460	606,100	363,700	3,394,260	4,155,000	0.82
H15	660,400	111,900	1,256,280	99,030	450,000	1,917,210	479,300	287,600	2,684,110	3,954,000	0.68
H16	524,800	111,900	998,330	62,100	450,000	1,622,330	405,600	243,300	2,271,230	2,480,000	0.92
H17	762,800	111,900	1,451,070	109,100	450,000	2,122,070	530,500	318,300	2,970,870	4,356,000	0.68
H18	976,400	111,900	1,857,410	720,750	450,000	3,140,060	785,000	471,000	4,396,060	7,573,000	0.58
H19	387,000	111,900	736,190	23,500	450,000	1,321,590	330,400	198,200	1,850,190	938,000	1.97
H20	704,900	111,900	1,340,930	199,410	450,000	2,102,240	525,600	315,300	2,943,140	3,619,000	0.81
H21	1,140,100	167,850	2,168,810	305,490	450,000	3,092,150	773,000	463,800	4,328,950	12,197,000	0.35
H22	628,300	111,900	1,195,150	146,480	450,000	1,903,530	475,900	285,500	2,664,930	2,658,000	1.00
H23	414,900	111,900	789,260	31,330	450,000	1,382,490	345,600	207,400	1,935,490	1,251,000	1.55
H26	622,200	111,900	1,183,610	316,790	450,000	2,062,300	515,600	309,300	2,887,200	2,614,000	1.10
H27	987,900	111,900	1,879,280	663,010	450,000	3,104,190	776,000	465,600	4,345,790	8,824,000	0.49
H28	453,000	111,900	861,700	97,240	450,000	1,520,840	380,200	228,100	2,129,140	1,765,000	1.21
Big Bend Area											
1	1,027,600	111,900	1,954,720	413,130	450,000	2,929,750	732,400	439,500	4,101,650	6,344,000	0.65
2	412,400	111,900	784,590	68,820	450,000	1,415,310	353,800	212,300	1,981,410	916,000	2.16
3	912,900	111,900	1,736,590	261,850	450,000	2,560,340	640,100	384,100	3,584,540	4,021,000	0.89
4	468,100	111,900	890,450	27,980	450,000	1,480,330	370,100	222,000	2,072,430	2,144,000	0.97

TABLE 7 (Cont'd)
TAMPA HARBOR DISPOSAL AREA STUDY
SITE PREPARATION COSTS

SITE NUMBER	DIKE QUANTITY (CY)	MOB & DEMOB ($)	DIKE CONSTR ($)	CLEARING & GRUBBING ($)	CONTROL STRUCTURES ($)	SUBTOTAL ($)	CONTINGENCY @ 25% ($)	E&D AND CM @ 15% ($)	TOTAL ($)	SITE CAPACITY (CY)	COST ($/CY)
Big Bend Area (Cont'd)											
6	373,300	111,900	710,190	98,470	450,000	1,370,560	342,600	205,600	1,918,760	1,206,000	1.59
8	503,100	111,900	957,070	107,090	450,000	1,626,060	406,500	243,900	2,276,460	1,943,000	1.17
9A	1,193,600	167,850	2,270,590	595,760	450,000	3,484,200	871,100	522,600	4,877,900	10,812,000	0.45
9B	1,324,400	223,800	2,519,490	726,230	450,000	3,919,520	979,900	587,900	5,487,320	13,180,000	0.42
10	919,300	111,900	1,748,760	396,350	450,000	2,707,010	676,800	406,100	3,789,910	7,193,000	0.53
11	871,100	111,900	1,657,110	229,840	450,000	2,448,850	612,200	367,300	3,428,350	3,529,000	0.97
12	426,700	111,900	811,650	39,170	450,000	1,412,720	353,200	211,900	1,977,820	1,564,000	1.26
16	816,700	111,900	1,553,630	482,620	450,000	2,598,150	649,500	389,700	3,637,350	5,071,000	0.72
19	933,300	111,900	1,775,480	379,680	450,000	2,717,060	679,300	407,600	3,803,960	5,830,000	0.65
20A	812,800	111,900	1,546,190	397,800	450,000	2,505,890	626,500	375,900	3,508,290	5,294,000	0.66
20B	575,800	111,900	1,095,390	206,460	450,000	1,863,750	465,900	279,600	2,609,250	2,748,000	0.95
20C	921,600	111,900	1,753,160	522,010	450,000	2,837,070	709,300	425,600	3,971,970	6,947,000	0.57
23	812,400	111,900	1,545,510	225,480	450,000	2,332,890	583,200	349,900	3,265,990	3,462,000	0.94
24	944,500	111,900	1,796,790	604,260	450,000	2,962,950	740,700	444,400	4,148,050	8,042,000	0.52
25	752,200	111,900	1,430,870	399,480	450,000	2,392,250	598,100	358,800	3,349,150	5,317,000	0.63
27	812,800	111,900	1,546,190	374,190	450,000	2,482,280	620,600	372,300	3,475,180	3,932,000	0.88
28	658,100	111,900	1,251,970	58,190	450,000	1,872,060	468,000	280,800	2,620,860	2,323,000	1.13
MANATEE COUNTY											
M1	784,000	111,900	1,491,400	238,790	450,000	2,292,090	573,020	343,810	3,208,920	4,325,000	0.74
M2	1,104,000	111,900	2,100,140	525,590	450,000	3,187,630	796,910	478,140	4,462,680	9,539,000	0.47
M3	1,808,500	167,850	3,440,310	1,583,940	450,000	5,642,100	1,410,530	846,320	7,898,950	16,642,000	0.47
M4	972,100	111,900	1,849,230	401,160	450,000	2,812,290	703,070	421,840	3,937,200	5,339,000	0.74
M5	451,600	111,900	859,080	112,460	450,000	1,533,440	383,360	230,020	2,146,820	1,497,000	1.43
M6	323,200	111,900	614,820	45,320	450,000	1,222,040	305,510	183,310	1,710,860	603,000	2.84
M7	444,400	111,900	845,380	127,570	450,000	1,534,850	383,710	230,230	2,148,790	1,340,000	1.60
M9	642,300	111,900	1,221,850	270,240	450,000	2,053,990	513,500	308,100	2,875,590	3,596,000	0.80
M10	272,700	111,900	518,760	16,790	450,000	1,097,450	274,360	164,620	1,536,430	670,000	2.29
M11	938,100	111,900	1,784,550	336,040	450,000	2,682,490	670,620	402,370	3,755,480	6,098,000	0.62
M12	1,568,700	223,800	2,984,140	757,000	450,000	4,414,940	1,103,740	662,240	6,180,920	13,738,000	0.45
M13	740,400	111,900	1,408,460	214,180	450,000	2,184,540	546,140	327,680	3,058,360	3,887,000	0.79
M14	893,700	111,900	1,700,090	259,720	450,000	2,521,710	630,430	378,260	3,530,400	4,713,000	0.75

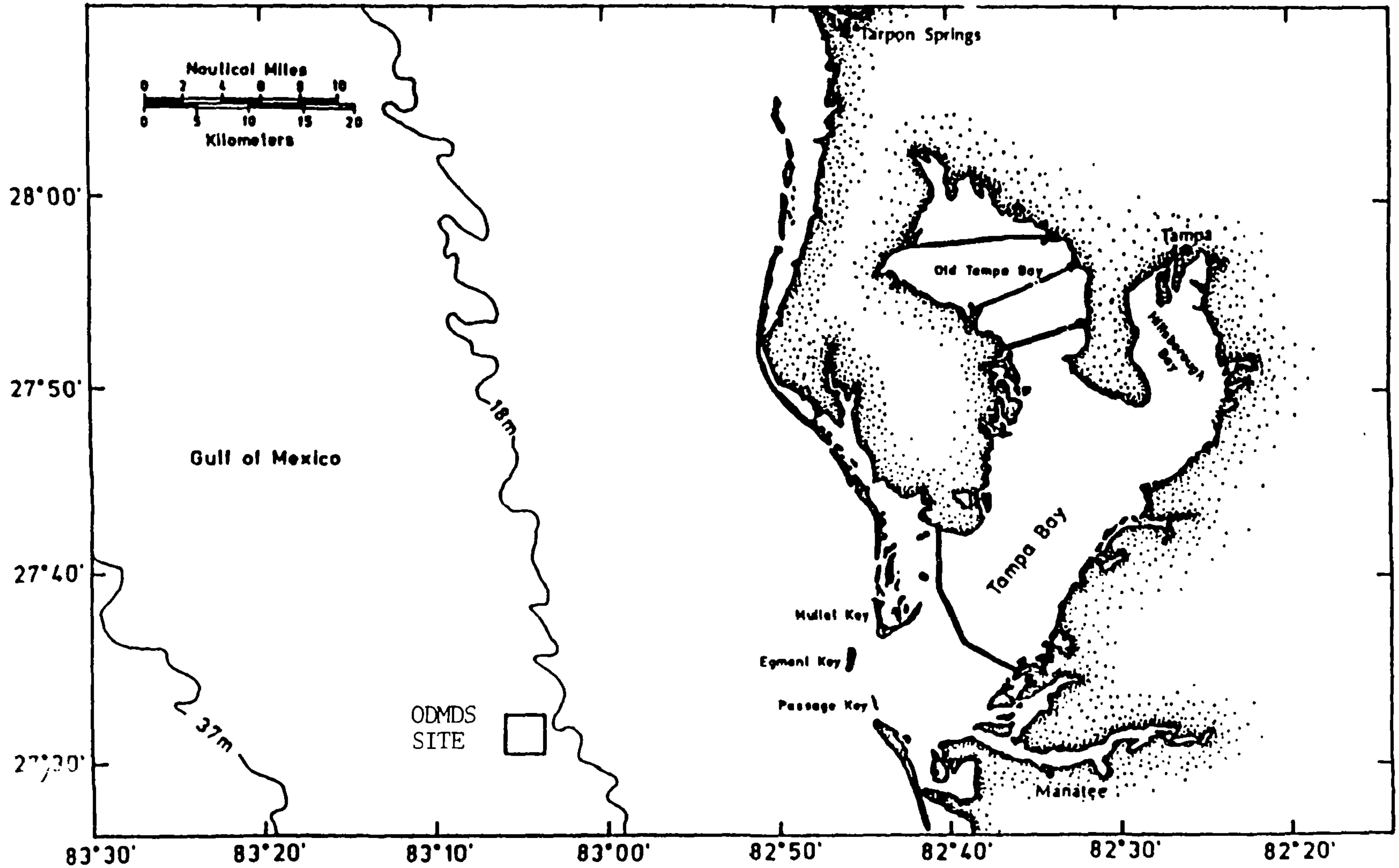


FIGURE 3. LOCATION OF ALTERNATIVE DREDGED MATERIAL DISPOSAL SITE OFF TAMPA BAY, FLORIDA.

Hopper Dredge Estimates - The hopper dredge for estimating purposes has a carrying capacity of 3,600 cubic yard (cy). A hopper dredge hydraulically removes shoal material from the channel bottom and places it in a hopper on the dredge. As soon as the hopper is full, the dredge proceeds to the ODMDS where the bottom of the hopper opens and the material is deposited on the bottom. The material classification which greatly influences dredging efficiency and therefore costs was discussed earlier in the shoal characteristics section of this study. As stated in the same section, the Federal project was broken into sections or cuts identical to normal operations in the harbor (see figure 1). The cuts were then grouped into areas that could conceivably be dredged during one maintenance event. This grouping increases the amount of material removed during one dredging event which reduces the cost per cubic yard of any overhead or sunk cost (mobilization, demobilization, permits, and testing). A sample estimate to hopper dredge one of the Tampa Harbor cuts is provided in table 8. Note that the unit cost given at the top excludes any costs related to mobilization, contingencies, engineering and design, as well as construction management. Table 9 provides the total dredging and disposal costs for each cut in the Tampa Harbor Federal Project as well as the assumed grouping of cuts for each dredging event. The costs for mobilization and demobilization are prorated over that group of cuts. As shown in table 9, hopper dredge costs increase rapidly with increases in the distance to the ODMDS.

Clamshell Estimates - The clamshell dredging techniques are similar to the hopper dredge. The clamshell removes shoal material from the channel bottom and deposits it in an ocean going barge for transport to the ODMDS. One benefit of the clamshell operation is that with multiple barges the clamshell dredge can operate almost continuously. However, the additional equipment does cost more to mobilize to the dredging location. The clamshell dredge operates with a 12 cubic yard bucket for estimating purposes and uses a maximum of 4 barges for transporting the material. The number of barges influences the operating efficiency of the dredge and a maximum of 4 is within reason to be available for such an operation. table 10 provides a sample estimate summary which is similar to the hopper dredge estimate in table 8. Again, the mobilization and other costs absent in table 8 are also absent in clamshell sample estimate. Table 11 provides the total dredging and disposal costs using a clamshell for each cut grouping shown in table 9. As with the hopper dredge costs, distance to the ODMDS is a primary factor influencing clamshell dredging costs.

TABLE 8
TAMPA HARBOR DISPOSAL AREA STUDY
HOPPER DREDGE ESTIMATE
CUT C(HB)

CHECKLIST FOR INPUT DATA. UNIT $. $11.89 /CY
Planning Est. 22 Jan 1993 TOTAL.. $13,079,000 JOB COST
TIME... 15.15 MONTHS

PG 1 OF 14: PROJECT TITLES

PROJECT -	CUT C(HB)
LOCATION -	Tampa Harbor Disposal Area Study
INVIT # -	Preliminary
BID ITEM # -	
FILENAME -	THF301
EST -	Al Fletcher/Tim Mur
MIDPT DATE -	Mar-93
DESCRIPTION ENTERED-	

PG 13 OF 14: MARKUPS USED

O.H.	15%
PROFIT	10%
BOND	1.000%

MOBILIZATION COST

$250,000

LOCATION: CUT C(HB)

50 MI TO CDMDS

1,100,000 CY

7,633,000 SF (SURFACE AREA)

1,500 CY PER LOAD

40 % MUD
60 % SAND
0 % GRAVEL

1.0 FT OVERDIG
(NON-PAY)

PG 2 OF 14: EXCAVATION QTY'S

DREDGING AREA -	7,633,000 sf
REQ'D EXCAVATION -	1,100,000 cyds
% MUD -	40%
% SAND -	60%
% GRAVEL -	0%
PAY OVERDEPTH -	0 cyds
O.D. NOT DREDGED -	0 cyds
OVERDIG FOOTAGE -	1.00 ft
NONPAY YARDAGE -	282,700 cyds
GROSS YARDAGE -	1,382,700 cyds

PG 3 OF 14: LOCAL AREA FACTORS

FUEL COST -	$1.00 /gal
CFC RATE -	7.000%
USE MONTHS / YEAR -	9 mo/yr
MARINE INSUR -	1.5%
TAXES -	1.0%
PROVISIONS & SUPP -	$15 /man

PG 4 OF 14: DREDGE SELECTION (ALT-D)

DREDGE: SUGAR ISLAND

LOADS PER DAY -	2.2
CYCLE TIME -	588 min/load

PG'S 5-7 OF 14: PRODUCTION WORKSHEET

HOPPER CAPACITY -	3,600 cyds	DUMP/CONNECT TIME -	5 min
EFF. HOPPER CAP. -	1,500 cyds	JET PUMP AVAIL? -	YES
AVAIL DREDGING RATE -	2,100 cy/hr	TYPE OF DISPOSAL -	GRAVITY DUMP
AVAIL. DRAGHEADS -	2 ea	PUMPING RATE -	cy/hr
ACT. DRAGHDS USED -	2 ea	TRVL SPD TO DREDG -	11.7 mph
DRDGE RATE USED -	2,100 cy/hr	MAX TRVL SPD LIGHT -	13.8 mph
TURNS/CYCLE -	2 ea	EFFECTIVE TIME -	90.0%
MIN. PER TURN -	3 min	OPER WORK DAYS/MO -	30.42 days
DISPOSAL DIST -	50 mi	ADD. CLEANUP TIME -	10%
TRVL SPD TO DISP -	10.8 mph	SPECIAL COST -	$0 /mo
MAX TRVL SPD LOADED -	12.7 mph	SPECIAL COST -	$0 /job

PG'S 8-9 OF 14: PLANT OWN. & OPER.

DREDGE	$424,432
PROPULSION TUG	self prop
SURVEY VESSEL	$30,000
BOOSTER	$0
CRANE BARGE	$0
TENDER TUG	$0
SHORE EQUIP	$0

PG 14 OF 14: DREDGE OPER. ADJ. FAC.

PUMP LOAD FACTOR	50%
RPR & MAINT. ADJ	1.00
JET PUMP % USAGE	100%

PG'S 10-12 OF 14: LABOR, 24 Jun 88

OVERTIME % -	28.00%
VACATION/HOLIDAY % -	8.64%
TAX & INSUR % -	30.61%
FRINGE BENEFITS -	$4.35 /hr
DREDGE CREW:	
SUGG. CREW SIZE -	14 ea
USED CREW SIZE -	14 ea
SHORE CREW:	
USED CREW SIZE -	0 ea
GOVERNMENT PERSON -	3 ea
FRE. PD TRAVEL -	28 days
RT TRAVEL COST -	$400

TABLE 9
TAMPA HARBOR DISPOSAL AREA STUDY
HOPPER DREDGE AND OCEAN DISPOSAL COSTS

CUT NAME	SHOAL QUANTITY (CY)	MOB & DEMOB PER CUT	EXCAVATION COST PER CUT	SUBTOTAL COSTS PER CUT	CONTINGENCY COSTS 25%	E&D AND CM 15%	HOPPER TOTAL $	DREDGING COSTS $/(CY)
EGMONT 1	3,200,000	500,000	9,276,000	9,776,000	2,444,000	1,466,400	13,686,400	4.28
	3,200,000	500,000						
EGMONT 2	5,000	1,300	17,550	18,850	4,700	2,800	26,350	5.27
MULLET	25,000	6,500	113,250	119,750	29,900	18,000	167,650	6.71
A	75,000	19,400	374,250	393,650	98,400	59,000	551,050	7.35
B	110,000	28,500	782,100	810,600	202,700	121,600	1,134,900	10.32
D	20,000	5,200	182,200	187,400	46,900	28,100	262,400	13.12
F	60,000	15,500	563,400	578,900	144,700	86,800	810,400	13.51
G	650,000	168,400	7,650,500	7,818,900	1,954,700	1,172,800	10,946,400	16.84
K	20,000	5,200	293,000	298,200	74,600	44,700	417,500	20.88
	965,000	250,000						
GADSEN	200,000	74,500	2,142,000	2,216,500	554,100	332,500	3,103,100	15.52
A(HB)	156,000	58,100	1,734,720	1,792,820	448,200	268,900	2,509,920	16.09
BIG BEND	315,000	117,400	3,502,800	3,620,200	905,100	543,000	5,068,300	16.09
	671,000	250,000						
C(HB)	1,100,000	250,000	13,079,000	13,329,000	3,332,300	1,999,400	18,660,700	16.96
	1,100,000	250,000						
ALAFIA	550,000	134,100	6,737,500	6,871,600	1,717,900	1,030,700	9,620,200	17.49
SUTTON	375,000	91,500	4,826,250	4,917,750	1,229,400	737,700	6,884,850	18.36
EAST BAY	100,000	24,400	1,345,000	1,369,400	342,400	205,400	1,917,200	19.17
	1,025,000	250,000						
D(HB)	175,000	102,900	2,248,750	2,351,650	587,900	352,700	3,292,250	18.81
SPARKMAN	150,000	88,200	2,103,000	2,191,200	547,800	328,700	3,067,700	20.45
YBOR	100,000	58,800	1,439,000	1,497,800	374,500	224,700	2,097,000	20.97
	425,000	250,000						

TABLE 10
TAMPA HARBOR DISPOSAL AREA STUDY
CLAMSHELL DREDGE ESTIMATE
CUT C(HB)

CHECKLIST FOR INPUT DATA.
Planning Est. 25 Jan 1993

UNIT COST... $8.10 PER C.Y.
JOB DURATION 6.95 MONTHS
TOTAL....... $8,910,000

DREDGE TIME 5.18 MONTHS
HAUL TIME.. 6.95 MONTHS

PG 1 OF 7: PROJECT TITLE

PROJECT -	CUT C (HB)
LOCATION -	Tampa Harbor Disposal Area Study
INVIT # -	Preliminary
EST -	Al Fletcher/Tim Murphy

PG 2 OF 7: EXCAVATION QTY'S

DREDGING AREA -	7,633,000 sf
REQ'D EXCAVATION -	1,100,000 cyds
PAY OVERDEPTH -	0
O.D. NOT DREDGED -	0
OVERDIG FOOTAGE -	1.0 ft
NONPAY YARDAGE -	282,700 cyds
GROSS YARDAGE -	1,382,700 cyds

PG 3 OF 7: EQUIPMENT COSTS

DREDGE -	12 C.Y. Clamshell
DREDGE COST -	$130,000 /mo (Ea)
WORK TUG(S) COST -	$42,000 /mo
SURVEY VESSEL COST -	$11,000 /mo
OTHER EQUIP COST -	$0 /mo
TOWING VESSEL -	2400 Hp Diesel--Twin Screw
TOWING VESSEL COST -	$160,000 /mo (Ea)
SCOW -	3000 C.Y. Bottom Dump
SCOW COST -	$44,000 per Month (Each)

PG 4 OF 7: LABOR AND OTHER COSTS

DREDGE LABOR -	$95,000 /mo (Ea)
TOW VESSEL LABOR -	$0 /mo (Ea)
OTHER LABOR -	$70,000 /mo
SPEC EXCAV COSTS -	$0 /mo
ADD EXCAV COSTS -	$0 /job
OH -	15 %
PROFIT -	10 %
BOND -	1 %

PG 5 OF 7: DREDGE PRODUCTION WORKSHEET

BUCKET SIZE -	12 cy
BUCKET CYCLE TIME -	45 sec
CLEANUP DREDGING -	10 % Additional Time
BUCKET FILL -	0.7
CYCLE EFF FACTOR -	0.75
OPER TIME FACTOR -	0.8

MOBILIZATION COST

$350,000

LOCATION: CUT C (HB)

50 MI TO ODMDS

1,100,000 CY

7,633,000 SF (SURFACE AREA)

2,160 CY PER LOAD

40 % MUD
60 % SAND

1.0 FT OVERDIG
(NON-PAY)

PG 6 OF 7: HAULING PRODUCTION WORKSHEET

TOWING CYCLE:

PREPARE SCOW TOW -	15 min
HAUL DIST -	50 mi
SPEED TO D/A -	5 mph
SPEED FROM D/A -	6 mph
DUMP OR PUMPOUT -	20 min
DISENGAGE TOW -	10 min
TOW EFFICIENCY -	80 %

SCOW EFFICIENCY:

USEABLE VOLUME -	90 %
% SOLIDS -	80 %

PG 7 OF 7: EQUIPMENT MATCHING

# OF PIECES:	Used
DREDGES -	1
TOWING VESSELS -	3
SCOWS PER TOW -	1
ADDITIONAL SCOWS -	1
TOT SCOWS ON JOB -	4

TABLE 11
TAMPA HARBOR DISPOSAL AREA STUDY
CLAMSHELL DREDGE AND OCEAN DISPOSAL COSTS

CUT NAME	SHOAL QUANTITY (CY)	MOB & DEMOB PER CUT	EXCAVATION COST PER CUT	SUBTOTAL COSTS PER CUT	CONTINGENCY COSTS 25%	E&D AND CM 15%	CLAMSHELL TOTAL $	DREDGING COSTS $/(CY)
EGMONT 1	3,200,000	450,000	10,336,000	10,786,000	2,696,500	1,617,900	15,100,400	4.72
	3,200,000	450,000						
EGMONT 2	5,000	1,600	20,400	22,000	5,500	3,300	30,800	6.16
MULLET	25,000	7,800	112,250	120,050	30,000	18,000	168,050	6.72
A	75,000	23,300	378,000	401,300	100,300	60,200	561,800	7.49
B	110,000	34,200	796,400	830,600	207,700	124,600	1,162,900	10.57
D	20,000	6,200	183,800	190,000	47,500	28,500	266,000	13.30
F	60,000	18,700	582,000	600,700	150,200	90,100	841,000	14.02
G	650,000	202,100	5,473,000	5,675,100	1,418,800	851,300	7,945,200	12.22
K	20,000	6,200	204,200	210,400	52,600	31,600	294,600	14.73
	965,000	300,000						
GADSEN	200,000	89,400	1,726,000	1,815,400	453,900	272,300	2,541,600	12.71
A(HB)	156,000	69,700	1,408,680	1,478,380	369,600	221,800	2,069,780	13.27
BIG BEND	315,000	140,800	2,847,600	2,988,400	747,100	448,300	4,183,800	13.28
	671,000	300,000						
C(HB)	1,100,000	350,000	8,910,000	9,260,000	2,315,000	1,389,000	12,964,000	11.79
	1,100,000	350,000						
ALAFIA	550,000	187,800	4,048,000	4,235,800	1,059,000	635,400	5,930,200	10.78
SUTTON	375,000	128,000	2,910,000	3,038,000	759,500	455,700	4,253,200	11.34
EAST BAY	100,000	34,100	807,000	841,100	210,300	126,200	1,177,600	11.78
	1,025,000	350,000						
D(HB)	175,000	123,500	1,634,500	1,758,000	439,500	263,700	2,461,200	14.06
SPARKMAN	150,000	105,900	1,512,000	1,617,900	404,500	242,700	2,265,100	15.10
YBOR	100,000	70,600	1,042,000	1,112,600	278,200	166,900	1,557,700	15.58
	425,000	300,000						

UPLAND DISPOSAL

Three dredging methods were used to compare upland disposal costs. One was to use a hopper dredge to transport the material to hydraulic pumpout locations for pipeline transfer to the disposal sites. The second was to use a clamshell dredge with barges to move material to hydraulic pumpout locations for pipeline transfer to the disposal sites. The third method involved the traditional hydraulic dredging and transport to the upland site. As mentioned earlier, hydraulic dredging and material movement via pipeline has a 10 mile limit due to equipment limitations and dredging efficiencies. All three methods place material into the designated upland disposal site with the use of a pipeline. All three methods use the same pipeline access route to each potential upland site. Of the three methods, hydraulic dredging and transport is generally the most economical method when the disposal site is within 5 miles of the dredging location. The total cost for upland disposal includes dredging and transportation costs, site preparation cost, and site procurement cost. Further discussion of dredging and transportation costs for each method is in the subsequent text.

Hopper Dredge and Pumpout - The hopper dredging operation is identical to the ocean disposal alternative with the difference being in the transfer of material to a pipeline for transport to the disposal site. The hopper dredge fills the storage hopper with dredge material then proceeds to a designated pumpout location where the material is hydraulically pumped via a pipeline to the disposal site. The advantages are a reduction in travel time if the pumpout location is closer than the ODMDS and utilization of upland disposal areas farther than 10 miles from the dredging location. However, the disadvantages are that more equipment is necessary for the operation and cost efficiency decreases with the need to transfer material to a pipeline rather than ocean disposal. Another disadvantage is the inefficient utilization of pumpout equipment due to the down time between dredge visits. The cost estimates reflect the advantages and disadvantages while providing a basis for comparison with other methods. A sample estimate summary for hopper dredging is provided in table 12.

The pumpout locations required a water depth of at least 25 feet to allow the fully loaded dredge direct access to the site. Several pumpout locations shown on figure 4, were strategically placed in the harbor to allow deep water access while staying within the 10 mile pumping limit. Costs for to the pumpout equipment included the pipeline required to carry the material from the pumpout location to the potential upland site. Table 13 provides a sample of the total cost to hopper dredge and transport dredge material from each cut in the harbor to a pumpout location with the material hydraulically pumped to an upland site. The sample demonstrates the

TABLE 12
TAMPA HARBOR DISPOSAL AREA STUDY
HOPPER DREDGE WITH PUMPOUT ESTIMATE
BIG BEND <PUMPOUT LOCATION>

CHECKLIST FOR INPUT DATA.	UNIT $.	$3.32 /CY
Planning Est. 22 Jan 1993	TOTAL..	$3,652,000 JOB COST
	TIME...	4.19 MONTHS

PG 1 OF 14: PROJECT TITLES

PROJECT -	CUT C (HB)
LOCATION -	Tampa Harbor Disposal Area Study
INVIT # -	Preliminary
BID ITEM # -	
FILENAME -	THF301P
EST -	Al Fletcher/Tim Mur
MIDPT DATE -	Mar-93
DESCRIPTION ENTERED-	ERR

PG 13 OF 14: MARKUPS USED

O.H.	15%
PROFIT	10%
BOND	1.000%

MOBILIZ. COST PER DREDGE:

$250,000

LOCATION: CUT C (HB)

5 MI TO PUMPOUT

1,100,000 CY

7,633,000 SF (SURFACE AREA)

1,500 CY PER LOAD

40 % MUD

60 % SAND

1.0 FT OVERDIG
(NON-PAY)

PG 2 OF 14: EXCAVATION QTY'S

DREDGING AREA -	7,633,000 sf
REQ'D EXCAVATION -	1,100,000 cyds
% MUD -	40%
% SAND -	60%
% GRAVEL -	0%
PAY OVERDEPTH -	0 cyds
O.D. NOT DREDGED -	0 cyds
OVERDIG FOOTAGE -	1.00 ft
NONPAY YARDAGE -	282,700 cyds
GROSS YARDAGE -	1,382,700 cyds

PG 3 OF 14: LOCAL AREA FACTORS

FUEL COST -	$1.00 /gal
CFC RATE -	7.000%
USE MONTHS / YEAR -	9 mo/yr
MARINE INSUR -	1.5%
TAXES -	1.0%
PROVISIONS & SUPP -	$15 /man

PG 4 OF 14: DREDGE SELECTION (ALT-D)

DREDGE:	SUGAR ISLAND
LOADS PER DAY -	7.95
CYCLE TIME -	163 min/load

PG'S 5-7 OF 14: PRODUCTION WORKSHEET

HOPPER CAPACITY -	3,600 cyds	DUMP/CONNECT TIME -	60 min
EFF. HOPPER CAP. -	1,500 cyds	JET PUMP AVAIL? -	YES
AVAIL DREDGING RATE -	2,100 cy/hr	TYPE OF DISPOSAL -	GRAVITY DUMP
AVAIL. DRAGHEADS -	2 ea	PUMPING RATE -	cy/hr
ACT. DRAGHDS USED -	2 ea	TRVL SPD TO DREDG -	11.7 mph
DRDGE RATE USED -	2,100 cy/hr	MAX TRVL SPD LIGHT -	13.8 mph
TURNS/CYCLE -	2 ea	EFFECTIVE TIME -	90.0%
MIN. PER TURN -	3 min	OPER WORK DAYS/MO -	30.42 days
DISPOSAL DIST -	5 mi	ADD. CLEANUP TIME -	10%
TRVL SPD TO DISP -	10.8 mph	SPECIAL COST -	$0 /mo
MAX TRVL SPD LOADED -	12.7 mph	SPECIAL COST -	$0 /job

PG'S 8-9 OF 14: PLANT OWN. & OPER.

DREDGE	$430,972
PROPULSION TUG	self prop
SURVEY VESSEL	$30,000
BOOSTER	$0
CRANE BARGE	$0
TENDER TUG	$0
SHORE EQUIP	$0

PG 14 OF 14: DREDGE OPER. ADJ. FAC.

PUMP LOAD FACTOR	50%
RPR & MAINT. ADJ	1.00
JET PUMP % USAGE	100%

PG'S 10-12 OF 14: LABOR, 24 Jun 88

OVERTIME % -	28.00%
VACATION/HOLIDAY % -	8.64%
TAX & INSUR % -	30.61%
FRINGE BENEFITS -	$4.35 /hr
DREDGE CREW:	
SUGG. CREW SIZE -	14 ea
USED CREW SIZE -	14 ea
SHORE CREW:	
USED CREW SIZE -	0 ea
GOVERNMENT PERSON -	3 ea
FRE. PD TRAVEL -	28 days
RT TRAVEL COST -	$400

TABLE 13
TAMPA HARBOR DISPOSAL AREA STUDY
HOPPER DREDGE WITH PUMPOUT COST

CUT NAME	SHOAL QUANTITY (CY)	DREDGE MOB & DEMOB PER CUT	PUMPOUT MOB & DEMOB PER CUT	PUMPOUT COSTS PER CUT	EXCAVATION COST PER CUT	SUBTOTAL COSTS PER CUT	CONTINGENCY COSTS 25%	E&D AND CM 15%	TOTAL COSTS $	DREDGING COSTS $/(CY)
PUMPOUT: BIG BEND										
DA SITE 1										
DISTANCE 1.76 MILES FROM PUMPOUT TO DA										
EGMONT 1	3,200,000	250,000	400,000	3,904,000	21,536,000	26,090,000	6,522,500	3,913,500	36,526,000	11.41
	3,200,000	250,000	400,000							
EGMONT 2	5,000	1,300	2,100	6,100	26,150	35,650	8,900	5,300	49,850	9.97
MULLET	25,000	6,500	10,400	30,500	130,500	177,900	44,500	26,700	249,100	9.96
A	75,000	19,400	31,100	91,500	348,000	490,000	122,500	73,500	686,000	9.15
B	110,000	28,500	45,600	134,200	601,700	810,000	202,500	121,500	1,134,000	10.31
D	20,000	5,200	8,300	24,400	96,200	134,100	33,500	20,100	187,700	9.39
F	60,000	15,500	24,900	73,200	228,000	341,600	85,400	51,200	478,200	7.97
G	650,000	168,400	269,400	793,000	2,892,500	4,123,300	1,030,800	618,500	5,772,600	8.88
K	20,000	5,200	8,300	24,400	121,000	158,900	39,700	23,800	222,400	11.12
	965,000	250,000	400,000							
GADSEN	200,000	74,500	119,200	244,000	670,000	1,107,700	276,900	166,200	1,550,800	7.75
A(HB)	156,000	58,100	93,000	190,320	453,960	795,380	198,800	119,300	1,113,480	7.14
BIG BEND	315,000	117,400	187,800	384,300	752,850	1,442,350	360,600	216,400	2,019,350	6.41
	671,000	250,000	400,000							
C(HB)	1,100,000	250,000	400,000	1,342,000	3,652,000	5,644,000	1,411,000	846,600	7,901,600	7.18
	1,100,000	250,000	400,000							
ALAFIA	550,000	134,100	214,600	671,000	1,914,000	2,933,700	733,400	440,100	4,107,200	7.47
SUTTON	375,000	91,500	146,300	457,500	1,575,000	2,270,300	567,600	340,500	3,178,400	8.48
EAST BAY	100,000	24,400	39,000	122,000	459,000	644,400	161,100	96,700	902,200	9.02
	1,025,000	250,000	400,000							
D(HB)	175,000	102,900	164,700	213,500	728,000	1,209,100	302,300	181,400	1,692,800	9.67
SPARKMAN	150,000	88,200	141,200	183,000	736,500	1,148,900	287,200	172,300	1,608,400	10.72
YBOR	100,000	58,800	94,100	122,000	510,000	784,900	196,200	117,700	1,098,800	10.99
	425,000	250,000	400,000							

PAGE NOT

AVAILABLE

DIGITALLY

procedure for proration of mobilization costs and includes contingencies, engineering and design costs, as well as construction management costs. The sample also enables a view of the additional costs involved with the pumpout operation.

Clamshell/Barge and Pumpout - The actual dredging operation is identical to the ODMDS alternative. As with the hopper dredge operation, the material is transported to pumpout locations and hydraulically pump via pipeline to an upland site. The same pumpout locations in figure 4 were also used in the clamshell operation. A sample cost estimate summary for clamshell dredging and barge transport to the pumpout location is in table 14. As identified in other dredging estimates in this study, no mobilization costs are included in the these estimates. Table 15 presents a sample of the total cost to clamshell dredge shoal material for transport by barge to a pumpout location where the material is hydraulically pumped to an upland site.

Hydraulic Dredging - As stated throughout this report, hydraulic dredging is the traditional method for upland disposal and generally, the most economical for pumping distances less than 5 miles. This fact is possible because the dredge can work continuously without stopping to empty the hopper as with a hopper dredge or having to wait for a barge to return as with a clamshell dredge. Disadvantages relate primarily to the expanse of Tampa Bay. The bay is wide with an extremely long channel which greatly reduces the inland area within reach for possible disposal. This restricts the number of cuts within the pumping limits of any one upland site.

A sample estimate for hydraulic dredging is given in table 16. The total cost is in table 17. As described earlier, hydraulic dredging to a disposal site is restricted to about a distance of 10 miles which greatly reduces the number of cuts available to pump to any one site. This required another proration of the mobilization costs. Where possible the same groups of cuts in the hopper and clamshell alternative considerations were utilized. In most cases, the mobilization cost proration was over the cuts within the 10 mile pumping distance of the potential site. The exceptions would be similar to the situation on cut C. The extensive shoaling in that cut warrants exclusion from grouping with other cuts. Sites that were only within pumping distance of one cut had the entire mobilization cost added to the dredging cost for that cut. This caused the hydraulic dredging cost to be high for many potential sites in comparison to other dredging methods.

TABLE 14
TAMPA HARBOR DISPOSAL AREA STUDY
CLAMSHELL DREDGE WITH PUMPOUT ESTIMATE
BIG BEND <PUMPOUT LOCATION>

CHECKLIST FOR INPUT DATA.
Planning Est. 25 Jan 1993

UNIT COST... $3.85 PER C.Y.
JOB DURATION 5.18 MONTHS
TOTAL....... $4,235,000

DREDGE TIME 5.18 MONTHS
HAUL TIME.. 2.84 MONTHS

PG 1 OF 7: PROJECT TITLE

PROJECT -	CUT C(HB)
LOCATION -	Tampa Harbor Disposal Area Study
INVIT # -	Preliminary
EST -	Al Fletcher/Tim Murphy

PG 2 OF 7: EXCAVATION QTY'S

DREDGING AREA -	7,633,000 sf
REQ'D EXCAVATION -	1,100,000 cyds
PAY OVERDEPTH -	0
O.D. NOT DREDGED -	0
OVERDIG FOOTAGE -	1.0 ft
NONPAY YARDAGE -	282,700 cyds
GROSS YARDAGE -	1,382,700 cyds

PG 3 OF 7: EQUIPMENT COSTS

DREDGE -	12 C.Y. Clamshell
DREDGE COST -	$130,000 /mo (Ea)
WORK TUG(S) COST -	$42,000 /mo
SURVEY VESSEL COST -	$11,000 /mo
OTHER EQUIP COST -	$0 /mo
TOWING VESSEL -	2400 Hp Diesel--Twin Screw
TOWING VESSEL COST -	$160,000 /mo (Ea)
SCOW -	3000 C.Y. Bottom Dump
SCOW COST -	$44,000 per Month (Each)

PG 4 OF 7: LABOR AND OTHER COSTS

DREDGE LABOR -	$95,000 /mo (Ea)
TOW VESSEL LABOR -	$0 /mo (Ea)
OTHER LABOR -	$70,000 /mo
SPEC EXCAV COSTS -	$0 /mo
ADD EXCAV COSTS -	$0 /job
OH -	15 %
PROFIT -	10 %
BOND -	1 %

PG 5 OF 7: DREDGE PRODUCTION WORKSHEET

BUCKET SIZE -	12 cy
BUCKET CYCLE TIME -	45 sec
CLEANUP DREDGING -	10 % Additional Time
BUCKET FILL -	0.7
CYCLE EFF FACTOR -	0.75
OPER TIME FACTOR -	0.8

MOBILIZATION COST

$250,000

LOCATION: CUT C(HB)

5 MI TO CDMDS

1,100,000 CY

7,633,000 SF (SURFACE AREA)

2,160 CY PER LOAD

40 % MUD
60 % SAND

1.0 FT OVERDIG
(NON-PAY)

PG 6 OF 7: HAULING PRODUCTION WORKSHEET

TOWING CYCLE:

PREPARE SCOW TOW -	15 min
HAUL DIST -	5 mi
SPEED TO D/A -	5 mph
SPEED FROM D/A -	6 mph
DUMP OR PUMPOUT -	20 min
DISENGAGE TOW -	10 min
TOW EFFICIENCY -	80 %

SCOW EFFICIENCY:

USEABLE VOLUME -	90 %
% SOLIDS -	80 %

PG 7 OF 7: EQUIPMENT MATCHING

# OF PIECES:	Used
DREDGES -	1
TOWING VESSELS -	1
SCOWS PER TOW -	1
ADDITIONAL SCOWS -	2
TOT SCOWS ON JOB -	3

TABLE 15
TAMPA HARBOR DISPOSAL AREA STUDY
CLAMSHELL – BARGE DREDGE WITH PUMPOUT COST

CUT NAME	SHOAL QUANTITY (CY)	DREDGE MOB & DEMOB PER CUT	PUMPOUT MOB & DEMOB PER CUT	PUMPOUT COSTS PER CUT	EXCAVATION COST PER CUT	SUBTOTAL COSTS PER CUT	CONTINGENCY COSTS 25%	E&D AND CM 15%	TOTAL COSTS $	DREDGING COSTS $/(CY)
PUMPOUT	BIG BEND									
DA SITE 1										
DISTANCE	1.76 MILES FROM PUMPOUT TO DA									
EGMONT 1	3,200,000	350,000	900,000	5,504,000	17,632,000	24,386,000	6,096,500	3,657,900	34,140,400	10.67
	3,200,000	350,000	900,000							
EGMONT 2	5,000	1,800	4,700	8,600	26,750	41,850	10,500	6,300	58,650	11.73
MULLET	25,000	9,100	23,300	43,000	118,500	193,900	48,500	29,100	271,500	10.86
A	75,000	27,200	69,900	129,000	333,750	559,850	140,000	84,000	783,850	10.45
B	110,000	39,900	102,600	189,200	635,800	967,500	241,900	145,100	1,354,500	12.31
D	20,000	7,300	18,700	34,400	114,400	174,800	43,700	26,200	244,700	12.24
F	60,000	21,800	56,000	103,200	277,800	458,800	114,700	68,800	642,300	10.71
G	650,000	235,800	606,200	1,118,000	2,047,500	4,007,500	1,001,900	601,100	5,610,500	8.63
K	20,000	7,300	18,700	34,400	86,200	146,600	36,700	22,000	205,300	10.27
	965,000	350,000	900,000							
GADSEN	200,000	74,500	268,300	344,000	776,000	1,462,800	365,700	219,400	2,047,900	10.24
A(HB)	156,000	58,100	209,200	268,320	613,080	1,148,700	287,200	172,300	1,608,200	10.31
BIG BEND	315,000	117,400	422,500	541,800	1,174,950	2,256,650	564,200	338,500	3,159,350	10.03
	671,000	250,000	900,000							
C(HB)	1,100,000	250,000	900,000	1,892,000	4,235,000	7,277,000	1,819,300	1,091,600	10,187,900	9.26
	1,100,000	250,000	900,000							
ALAFIA	550,000	134,100	482,900	946,000	1,512,500	3,075,500	768,900	461,300	4,305,700	7.83
SUTTON	375,000	91,500	329,300	645,000	1,110,000	2,175,800	544,000	326,400	3,046,200	8.12
EAST BAY	100,000	24,400	87,800	172,000	335,000	619,200	154,800	92,900	866,900	8.67
	1,025,000	250,000	900,000							
D(HB)	175,000	123,500	370,600	301,000	514,500	1,309,600	327,400	196,400	1,833,400	10 48
SPARKMAN	150,000	105,900	317,600	258,000	555,000	1,236,500	309,100	185,500	1,731,100	11 54
YBOR	100,000	70,600	211,800	172,000	388,000	842,400	210,600	126,400	1,179,400	11.79
	425,000	300,000	900,000							

TABLE 16
TAMPA HARBOR DISPOSAL AREA STUDY
HYDRAULIC DREDGE ESTIMATE
SITE 1

CHECKLIST FOR INPUT DATA.

CUT C(HB)

BID QUANTITY	1,100,000 C.Y.
UNIT COST...	$4.50 PER C.Y.
EXCAV. COST.	$4,950,000
TIME........	3.13 MONTHS

PG 1 OF 9: PROJECT TITLES

FILENAME -	THF303
PROJECT -	CUT C(HB)
LOCATION -	Tampa Harbor Disposal Area Study
INVIT # -	Preliminary
DATE OF EST. -	02 FEB 93
EST. BY -	Al Fletcher/Barbara Harrison
TYPE OF EST. -	Planning Estimate

PG 2 OF 9: EXCAVATION QTY'S

DREDGING AREA -	7,633,000 sf
REQ'D EXCAVATION -	1,100,000 cyds
PAY OVERDEPTH -	0 cyds
CONTRACT AMOUNT -	1,100,000 cyds
NOT DREDGED -	0 cyds
NONPAY YARDAGE -	282,700 cyds
GROSS YARDAGE -	1,382,700 cyds
NONPAY HEIGHT -	1.0 ft overdig.
TOTAL BANK HEIGHT -	4.9 ft

PG 3 OF 9: MAXIMUM PIPELINE REQUIRED

FLOATING -	1,500 ft
SUBMERGED -	44,100 ft
SHORE -	7,000 ft
TOTAL -	52,600 ft
COST CATEGORY -	2 SAND
EQUIVALENT -	1,500 ft

****

Mobilization:

$600,000	LS	$600,000
$50,000	Per Booster	$100,000
$10	Per Lf Pipe	$526,000
	Mobil:	$1,226,000

PG 4 OF 9: MATERIAL FACTOR

DESCRIPTION	FACTOR	PERCENTAGE %
MUD & SILT	2.5	40
LOOSE SAND	1	60
RESULTANT MATERIAL FACTOR -	1.32	

PG 5 OF 9: DREDGE SELECTION

DREDGE SELECTED -	30 " HYDRAULIC DREDGE
COMPUTED BANK FACTOR -	0.72
BANK FACTOR USED -	0.72 >
OTHER FACTOR -	0 >
CLEANUP -	10% More Time

PG 6 OF 9: PRODUCTION ANALYSIS

AVE. PIPELINE -	36,300 ft
MAX. PIPE AVAILABLE -	52,600 ft
MAX. POSSIBLE -	65,140 ft
BASED ON -	2 boosters
TOTAL HORSEPOWER -	20,400 hp
EFFECTIVE TIME -	49.3%
BASED ON -	20% Booster Losses
-	18 hours per day
-	25 days per month
NET PRODUCTION -	1,226 net cy per hour
PAY PRODUCTION -	351,438 pay cy per month

PG 7 OF 9: HORSEPOWER CONSIDERATIONS

CHART H.P. -	5,200 hp
AVAILABLE H.P. -	5,200 hp
BOOSTER H.P. -	7,600 hp(ea)
LOSS PER BOOSTER -	10%

PG 8 OF 9: GROSS PRODUCTION & LOCAL AREA FACTORS

PRODUCTION OVERRIDE -	0
FUEL PRICE -	$0.82 /gal
ANNUAL PLANT USE -	10 mos/yr
INTEREST RATE -	7.000% /yr
TIME PERIOD -	July to December, 1992

PG 9 OF 9: OTHER ADJUSTMENTS

SPECIAL COST/MO -	$0 >
SPECIAL COST LS -	$0 >
CONTRACTOR'S O.H. -	15%
CONTRACTOR'S PROFIT -	10%
CONTRACTOR'S BOND -	1%

TABLE 17
TAMPA HARBOR DISPOSAL AREA STUDY
HYDRAULIC DREDGE AND UPLAND DISPOSAL COST

CUT NAME	SHOAL QUANTITY (CY)	EXCAVATION COST PER CUT ($/CY)	MOB & DEMOB PER CUT ($/CY)	SUBTOTAL PER CUT ($/CY)	CONTINGENCY 25% ($/CY)	E&D CM 15% ($/CY)	DREDGING COST ($/CY)
SITE 1							
BIG BEND	315,000	2.31	0.98	3.29	0.82	0.49	4.61
SITE 1 (HILLSBOROUGH BAY)							
C(HB)	1,100,000	4.50	1.11	5.61	1.40	0.84	7.86
ALAFIA	550,000	3.49	0.98	4.47	1.12	0.67	6.26
SUTTON	375,000						*
EAST BAY	100,000						*
D(HB)	175,000						*
SPARKMAN	150,000						*
YBOR	100,000						*
SITE 1 (PORT TAMPA)							
A(HB)	156,000	3.40	0.98	4.38	1.10	0.66	6.14
GADSEN	200,000	5.23	0.98	6.21	1.55	0.93	8.70
G	650,000						*
K	20,000						*
SITE 1(MAIN SHIPPING CHANNEL)							
F	60,000	16.35	0.98	17.33	4.33	2.60	24.27
D	20,000						*
B	11,000						*
A	75,000						*
MULLET	25,000						*
EGMONT 2	5,000						*
EGMONT 1	3,200,000						*

NOTES:

* – Maximum Pipeline Length (50,000 feet) Exceeded

INITIAL COST COMPARISON

The Tampa Harbor Federal Project also includes two existing dredged material disposal islands located in Hillsborough Bay. Disposal island 2D is just north of the Alafia River Federal Channel and 3D is south of that channel. The islands are currently for disposal of material dredged from the upper harbor (north of Tampa Bay Cut F). An analysis during this study concluded that certain cuts in the Tampa Harbor Federal Project were feasible to place in the islands. Those cuts were from Tampa Bay Cut C northward. The remaining cuts from Cut B to the Gulf of Mexico were more costly for upland disposal.

Dredging costs for each of the ocean disposal methods provided a base condition for comparison with potential upland sites to determine at this level of detail what upland areas appear feasible for future consideration. The ocean disposal costs in tables 7 and 9 provided the base costs for comparison with total dredging and site preparation cost on a site by site basis. Table 18 uses site 1 as a sample comparison generated for each potential upland site. The most economical alternative for a particular cut in that table is identified with an "*". If the most economical alternative for every cut was either of the two ocean disposal methods, the site was not feasible for further consideration. A site that had only one or two cuts feasible for upland disposal was reanalyzed to realign the proration of mobilization costs over the feasible cuts. In some cases, this reapportionment resulted in the site being dropped from further consideration. Table 19 provides a list of potential sites considered infeasible after the initial cost comparison.

REAL ESTATE VALUES

Real estate values for the each site were not included in the initial cost comparison. The remaining evaluations involve an assessment of real estate values on the upland sites. The real estate analysis is last because of the field work involved in obtaining estimates for each site. Engineering and environmental investigations reduced the number of sites prior to initiating the real estate analysis. During the real estate analysis, site H28 was discovered to be scheduled for residential development in the near future. This fact removed the site from further consideration. The real estate evaluations are in attachment A and the results are in table 20. The real estate market in the area during the field work appeared to be in a depressed state. Numerous land parcels were for sale in the area with some parcel sales below assessed value. The estimated real estate values are for a fee simple purchase of the site with any severance damage caused by the purchase and utilization of the site. The values do not include any easements required for pipeline access to the site. Attachment A provides details concerning the methods used to obtain the real estate values as well as assumptions and limitations of the analysis.

TABLE 18
TAMPA HARBOR UPLAND DISPOSAL AREA STUDY
COST COMPARISON

CUT NAME	QUANTITY PER CUT (CY)	COSTS PER DREDGE AND DISPOSAL TYPE ($/CY) CLAMSHELL TO OCEAN	HOPPER TO OCEAN	HYDRAULIC TO SITE	CLAMSHELL W/PUMPOUT TO SITE	HOPPER W/PUMPOUT TO SITE
SITE 1						
EGMONT 1	3,200,000	$4.72	$4.28 *		$11.63	$12.38
	3,200,000					
EGMONT 2	5,000	$6.16	$5.27 *		$12.68	$10.94
MULLET	25,000	$6.72	$6.71 *		$11.82	$10.93
A	75,000	$7.49	$7.35 *		$11.42	$10.11
B	110,000	$10.57	$10.32 *		$13.28	$11.28
D	20,000	$13.30	$13.12		$13.20	$10.35 *
F	60,000	$14.02	$13.51	$25.24	$11.67	$8.94 *
G	650,000	$12.22	$16.84		$9.60 *	$9.85
K	20,000	$14.73	$20.88		$11.22 *	$12.09
	965,000					
GADSEN	200,000	$12.71	$15.52	$9.67	$11.21	$8.72 *
A(HB)	156,000	$13.27	$16.09	$7.11 *	$11.28	$8.10
BIG BEND	315,000	$13.28	$16.09	$5.58 *	$11.00	$7.38
	671,000					
C(HB)	1,100,000	$11.79	$16.96	$8.83	$10.23	$8.15 *
	1,100,000					
ALAFIA	550,000	$10.78	$17.49	$7.23 *	$8.79	$8.43
SUTTON	375,000	$11.34	$18.36		$9.09 *	$9.44
EAST BAY	100,000	$11.78	$19.17		$9.63 *	$9.99
	1,025,000					
D(HB)	175,000	$14.06	$18.81		$11.44	$10.64 *
SPARKMAN	150,000	$15.10	$20.45		$12.51	$11.69 *
YBOR	100,000	$15.58	$20.97		$12.76	$11.96 *
	425,000					

* – Most Economical Dredging Method Per Cut

TABLE 19
TAMPA HARBOR DISPOSAL AREA STUDY
SITES REMOVED AFTER INITIAL COST COMPARISON

SITE NUMBER	
H4	M1
H7	M2
H8	M3
H9	M4
H13	M5
H14	M6
H15	M7
H16	M9
H17	M10
H18	M11
H19	M12
H20	M13
H21	M14

TABLE 20
TAMPA HARBOR DISPOSAL AREA STUDY
REAL ESTATE VALUES (1)

Site No.	Acres Required	Estimated Value ($)	Severance Cost ($)	Total Compensatory Value ($)
H1	12.7	396,900	0	396,900
H2	61.8	1,931,300	819,000	2,750,300
H3	22.4	700,600	646,000	1,346,600
H6	247.8	1,464,700	558,000	2,022,700
H10	189.4	1,119,500	318,100	1,437,600
H11	377.3	2,230,300	0	2,230,300
H12	125.3	467,200	135,400	602,600
H22	119.1	779,300	40,600	819,900
H23	56.0	832,000	45,000	877,000
H26	117.2	472,500	0	472,500
H27	379.7	2,244,400	53,200	2,297,600
1	306.4	2,005,100	0	2,005,100
2	41.3	166,400	0	166,400
3	181.8	1,074,600	299,300	1,373,900
4	238.4	1,559,900	491,500	2,051,400
6	54.0	201,400	511,500	712,900
8	86.3	347,900	0	347,900
9A	484.3	3,169,000	41,400	3,210,400
9B	590.3	3,862,200	8,000	3,870,200
10	294.3	4,372,800	572,400	4,945,200
11	118.9	443,600	66,200	509,800
12	70.3	459,700	41,600	501,300
16	227.0	846,800	22,400	869,200
19	261.0	1,542,700	222,700	1,765,400
20A	238.8	1,411,300	2,174,100	3,585,400
20B	112.5	665,000	2,054,100	2,719,100
20C	311.0	1,838,200	1,087,100	2,925,300
23	155.0	912,900	605,800	1,518,700
24	313.0	2,048,000	0	2,048,000
25	215.9	1,412,800	172,700	1,585,500
27	176.9	1,157,300	0	1,157,300
28	139.0	818,700	263,000	1,081,700

(1) Real Estate Values are only for Planning Purposes.

FINAL COST COMPARISON

The estimated real estate cost were converted to a per cubic yard value for each evaluated site. The value was added to the previously calculated total costs for dredging and upland disposal. The resulting totals were again compared to the ocean disposal costs for each cut. Based on the size of the sites and relatively low real estate cost, only two sites (H1 and H2) exceeded the ocean disposal costs leaving 30 sites that are feasible for use.

SENSITIVITY ANALYSIS

As indicated earlier, market conditions in the Tampa area indicated depressed land prices at the time field information was obtained concerning land values. Considering the market uncertainties involved, a sensitivity analysis on real estate costs seemed appropriate. To assess the impact, the final real estate cost on each site was doubled and a comparison was made with ocean disposal. The results indicated only four upland sites would be impractical to use. Site size and capacity on the remaining sites made the real estate a minor factor in the overall cost for upland disposal.

SUMMARY

The initial analysis involved 77 potential upland disposal sites located in three counties. Environmental evaluations determined that ten sites were unsuitable for disposal. A field trip revealed development on four sites making them unsuitable for further consideration. Three sites were inaccessible by pipeline due to Interstate 275. Pipeline access problems to one site resulted in unacceptable environmental impacts making it unsuitable for further study. The initial cost comparison between ocean and upland disposal alternatives indicated 26 sites were more costly than the ocean disposal considerations. The final cost evaluation was a real estate analysis on the property values of the remaining sites. During the real estate analysis, information on scheduled development in the near future indicated one site would not be available for use. The estimate of real estate values on the remaining sites with the dredging and the upland site preparation costs caused two additional sites to be more expensive that ocean disposal. Table 21 contains the final 30 sites (see figure 5 for general locations) considered suitable along with the cuts and dredge types used in making that feasibility determination. Disposal islands 2D and 3D are also included in the table for comparison purposes. The results in table 21 show no available upland disposal sites would be environmentally, engineeringly, or economically feasible for the Tampa Harbor Federal channel from Egmont Bar Channel through Tampa Bay Cut B (26.5 miles).

During the course of this study, the preparation of over 700 cost estimates enabled a detailed cost comparison between 5 possible dredging techniques. This report shows only a sampling of those estimates. Detailed documentation on the estimates is available in the Jacksonville District Office.

RESULTS

This study indicates that 30 possible upland sites could serve as disposal areas for portions of the Tampa Harbor Federal Project from Tampa Bay Cut C to the northernmost Ybor Channel. Each site in table 21 would need further, more detailed engineering evaluations on a case by case basis to confirm that specific assumptions in this analysis are correct before implementation.

Study findings discussed in the initial cost comparison section of this report indicate that the existing disposal islands 2D and 3D should be improved to increase capacity. The islands' location affords easy access and shorter haul or pumping distances. The absence of any real estate requirements contributes to the islands competitiveness with any potential upland site. As stated earlier, the cost comparison demonstrates that the existing disposal islands could serve the disposal needs of the Tampa Harbor Federal Project from Tampa Bay Cut C to the northernmost Ybor Channel.

The results presented in table 21 demonstrate the need for an Ocean Dredged Material Disposal Site for the Tampa Harbor Federal Project. No upland disposal sites were found to be environmentally, engineeringly, or economically feasible for the Federal channel stretching from the Egmont Bar Channel through Tampa Bay Cut B, a 26.5 mile reach of the existing Federal channel (see figure 5).

TABLE 21
TAMPA HARBOR DISPOSAL AREA STUDY
POTENTIAL UPLAND DISPOSAL SITES

	HARBOR CUT WITH OPTIMUM DREDGE TYPE FOR UPLAND DISPOSAL																		
	MAIN SHIPPING CHANNEL							PORT TAMPA		HILLSBOROUGH BAY									
SITE	E1	E2	MK	A	B	D	F	CUT G	CUT K	GAD	A	BB	C	ALA	SUT	EB	D	SPK	YB
H2											HP	HP	HP		HY	HY	HY	HY	HY
H3													HP		HY	HY	HY	HY	HY
H10						HP	HP	HP	CL	CL	HP	HP	HP						
H11						HP	HP	HP	CL	HP	HP	HP							
H12						HP	HP	HP	CL	HP	HP	HP					CL	CL	CL
H22						HP	HP	CL	CL	HP	HP	HP	HP	HY	CL	CL	HP	HP	HP
H23											HP	HP	HP		HY	HY	HY	HY	HY
H26						HP	HP	CL	CL	HP	HP	HP	HP	HY	HP	CL	HP	HP	HP
H27						HP	HP	CL	CL	HP	HP	HP	HP	HY	HP	CL	HP	HP	HP
1						HP	HP	CL	CL	HP	HY	HY	HP	HY	CL	CL	HP	HP	HP
2						HP	HP	CL	CL	HP	HY	HY	HP	HY	CL	CL	HP	HP	HP
3						HP	HP	CL	CL	HP	HY	HY	HP	HY	CL	CL	HP	HP	HP
4						HP	HP	CL	CL	HP	HY	HY	HP	HY			HP	HP	HP
6						HP	HP	CL	CL	HP	HY	HY	HP	HY	CL	CL	HP	HP	HP
8						HP	HP	CL	CL	HP	HY	HY	HP	HY	CL	CL	HP	HP	HP
9A							HP		CL	HP	HY	HY	HP	HY			HP	HP	HP
9B							HP		CL	HP	HY	HY	HP	HY			HP	HP	HP
10							HP		CL	HP	HY	HY	HP	HY					
11						HP	HP	CL	CL	HP	HP	HY	HP	HY	CL	CL	HP	HP	HP
12						HP	HP	CL	CL	HP	HY	HY	HP	HY	CL	CL	HP	HP	HP
16						HP	HP	CL	CL	HP	HY	HY	HP	HY	CL	CL	HP	HP	HP
19							HP				HY	HY		HY					
20A											HY	HY		HY					
20B											HY	HY		HY					
20C											HY	HY		HY					
23						HP	HP		CL	HP	HY	HY	HP	HY			HP	HP	HP
24							HP				HY	HY		HY					
25											HY	HY		HY					
27											HY	HY		HY					
28											HY	HY	HY	HY					
2D						HP	HP	HY	CL	HP	HY	HY	HY	HY	HY	HY	HY	HY	HY
3D						HP	HP	HY	CL	HP	HY	HY	HY	HY	HY	HY	HY	HY	HY

LEGEND

MAIN SHIPPING CHANNEL	PORT TAMPA	HILLSBOROUGH BAY	DREDGE TYPES
E1–Egmont Cut 1	Cut G	GAD–Gadsen Point Cut	HP–Hopper Dredge w/Pumpout Plant
E2–Egmont Cut 2	Cut K	A–Cut A (HB)	
MK–Mullet Key Cut		BB–Big Bend Channel	
A–Cut A (TB)		C–Cut C (HB)	CL–Clamshell Dredge w/Pumpout Plant
B–Cut B (TB)		ALA–Alafia River	
D–Cut D (TB)		SUT–Port Sutton	
F–Cut F (TB)		EB–East Bay	HY–Hydraulic Dredge
		D–Cut D (HB)	
		SPK–Sparkman Channel	
		YB–Ybor Channel	

NOTES:

1. Main Shipping Channel cuts from Egmont Cut 1 to Cut B (TB) do not have a feasible upland site.

PAGE NOT

AVAILABLE

DIGITALLY

TAMPA HARBOR DISPOSAL AREA STUDY

REAL ESTATE SECTION

ATTACHMENT A

REAL ESTATE SECTION FOR POTENTIAL UPLAND DISPOSAL SITES FOR TAMPA HARBOR DISPOSAL AREA STUDY

PURPOSE

The purpose of this study is to investigate potential upland disposal sites to be utilized in conjunction with the Tampa Harbor Federal Project. (Refer to Figure 2 for the locations of potential sites considered for this study.)

DESCRIPTION OF STUDY AND STUDY AREA

Tampa Harbor is located in Hillsborough County, on the Gulf Coast of Florida. Initially there were 55 potential disposal sites identified through the use of past studies, aerial photography and geographical limitations. An upland disposal site must be environmentally and economically feasible to purchase, permit construction of the necessary features, and allow for transportation of the material to the site. Each potential site had to be open land with no dwellings, meet a minimum size requirement of 10 acres, and be within the limitations imposed by the geographical area. Initial geographical boundaries were usually related to pipeline access to any potential site. Interstate 75 and Interstate 275 were assumed to be the eastern and northern boundaries with the Gulf of Mexico being the western boundary. The southern boundary was defined by equipment limitations relating to pumping the dredged material to the site. The maximum pumping distance for this study was identified as approximately 10 miles from the hydraulic dredge plant or pump-out plant location. These restrictions and boundaries greatly reduced the domain for potential site locations and limited the scope of the study.

The study area consists of open agricultural and commercial parcels which were valued in fee simple. Although 55 sites were initially targeted for study, this number was reduced to 32 potential upland disposal sites based on site selection criteria and other limitations as previously described.

ESTIMATES OF VALUE

Each potential site was valued in fee simple using the standard Corps estate. The following table (Table A-1) provides the acres required, site size, estimated value and severance damages (if any) for each of the 32 potential sites. These indicated values are only estimates of a value range which a potential site may have at the date of this study and are for preliminary purposes only. A more detailed analysis of each site will be necessary if consideration is given beyond the potential analysis stage.

TABLE A-1
TAMPA HARBOR DISPOSAL AREA STUDY
REAL ESTATE VALUES (1)

Site No.	Acres Required	Site Size	Cost Per Acre	Estimated Value	Severance Acres	Severance Cost	Total Compensatory Value
H1	12.70	39.00	$31,300	$396,900	26.30	$0	$396,900
H2	61.80	93.00	$31,300	$1,931,300	31.20	$819,000	$2,750,300
H3	22.42	47.03	$31,300	$700,600	24.61	$646,000	$1,346,600
H6	247.80	374.30	$5,900	$1,464,700	126.50	$558,000	$2,022,700
H10	189.40	261.52	$5,900	$1,119,500	72.12	$318,100	$1,437,600
H11	377.33	427.72	$5,900	$2,230,300	50.39	$0	$2,230,300
H12	125.25	235.31	$3,700	$467,200	110.06	$135,400	$602,600
H22	119.10	129.08	$6,500	$779,300	9.98	$40,600	$819,900
H23	56.00	60.45	$14,900	$832,000	4.45	$45,000	$877,000
H26	117.17	117.17	$4,000	$472,500	0.00	$0	$472,500
H27	379.71	395.30	$5,900	$2,244,400	15.59	$53,200	$2,297,600
1	306.44	306.44	$6,500	$2,005,100	0.00	$0	$2,005,100
2	41.27	41.27	$4,000	$166,400	0.00	$0	$166,400
3	181.81	269.57	$5,900	$1,074,600	87.76	$299,300	$1,373,900
4	238.40	359.94	$6,500	$1,559,900	121.54	$491,500	$2,051,400
6	54.00	469.84	$3,700	$201,400	415.84	$511,500	$712,900
8	86.27	86.27	$4,000	$347,900	0.00	$0	$347,900
9A	484.33	491.24	$6,500	$3,169,000	6.91	$41,400	$3,210,400
9B	590.27	591.86	$6,500	$3,862,200	1.59	$8,000	$3,870,200
10	294.32	344.72	$14,900	$4,372,800	50.40	$572,400	$4,945,200
11	118.92	172.76	$3,700	$443,600	53.84	$66,200	$509,800
12	70.25	78.50	$6,500	$459,700	8.25	$41,600	$501,300
16	227.00	324.59	$3,700	$846,800	97.59	$22,400	$869,200
19	261.00	326.29	$5,900	$1,542,700	65.29	$222,700	$1,765,400
20A	238.76	876.15	$5,900	$1,411,300	637.39	$2,174,100	$3,585,400
20B	112.50	714.69	$5,900	$665,000	602.19	$2,054,100	$2,719,100
20C	311.00	629.69	$5,900	$1,838,200	318.69	$1,087,100	$2,925,300
23	155.00	408.48	$5,900	$912,900	253.48	$605,800	$1,518,700
24	313.00	313.00	$6,500	$2,048,000	0.00	$0	$2,048,000
25	215.93	253.93	$6,500	$1,412,800	38.00	$172,700	$1,585,500
27	176.88	176.88	$6,500	$1,157,300	0.00	$0	$1,157,300
28	139.00	230.00	$5,900	$818,700	91.00	$263,000	$1,081,700

(1) Real Estate Values are only for Planning Purposes.

The valuations as presented in this Real Estate Section are based upon information and conditions existing during the study period and are preliminary. A more detailed real estate study will be required to implement any upland site recommended in this report.

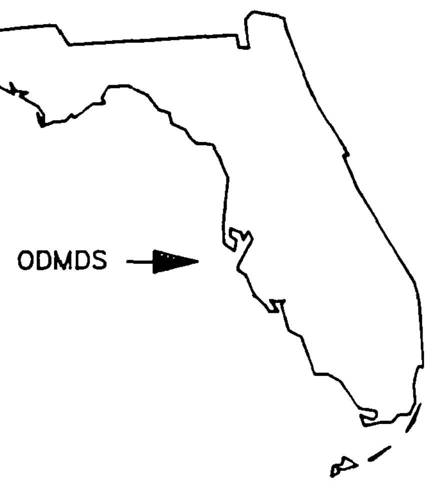
APPENDIX F

EPA VIDEO SURVEY

REPORT

OCTOBER, 1991

SURVEY REPORT
TAMPA, SITE IV, ODMDS
DISPOSAL CORRIDOR (PILE) VIDEO
OCTOBER 8–9, 1991



Prepared by:

U.S. EPA
REGION IV

U.S.E.P.A.
ENVIRONMENTAL SERVICES DIVISION
ECOLOGICAL SUPPORT BRANCH
COLLEGE STATION ROAD
ATHENS, GEORGIA 30613–7799

SURVEY REPORT
TAMPA SITE IV
DISPOSAL CORRIDOR VIDEO
OCTOBER 8-9, 1991

INTRODUCTION

The Tampa Site IV, Ocean Dredged Material Disposal Site (ODMDS) was designated on a temporary basis for the Tampa Harbor deepening project in the mid 1980's. Disposal of material associated with the deepening of Tampa Harbor ceased in 1985 and the temporary designation later expired. The Corps of Engineers has stated a continuing need for an offshore disposal site for dredged material at Tampa and has requested that EPA redesignate Site IV on a permanent basis. EPA, Region IV, and the Jacksonville District, COE, are presently preparing the draft environmental impact statement (EIS) for the redesignation. Prior to completion of the draft EIS, EPA revisited the disposal corridor (pile) during the period October 8-9, 1991 and conducted continuous towed camera video and diver inspections in order to assess the visual status of sessile biota which have colonized areas of the pile.

During monitoring activities conducted by Continental Shelf Associates, under contract to EPA, during and after the disposal operations which ended in 1985, it was evident that assemblages of various sessile animals, such as sponges and ascidians, were beginning to colonize some areas of the pile where larger consolidated clay "boulders" were present. While working in the area on another project in 1988, EPA divers made a cursory visit to one area of the pile and conducted video recordings which revealed that armoring of the clay boulders was still evident in some areas but that boring by marcoinvertebrates was causing fragmentation of the consolidated clay.

OBJECTIVE

The purpose of the October 1991 visit to the Tampa Site IV dredged material disposal pile was to visually assess the extent of fragmentation of the consolidated clay boulders and observe the status of sessile invertebrate colonization. The record of this visual assessment will serve as part of the draft EIS presently in preparation for redesignation of Site IV.

TASK AND METHODS

Corner coordinates and the approximate location of the disposal corridor for Tampa Site IV are presented in Figure 1. Initial activities for the cruise focused on delimiting the disposal corridor, logistically, by conducting bathymetric recordings along short transects beginning at the east end and perpendicular to the plotted disposal corridor (Figure 1). Once the east terminus was located, additional transects perpendicular to the pile were used to locate the crest, north and south toe, and western end of the disposed material.

With the disposal pile generally located through the above work, the camera sled was deployed and bathymetry/video recordings were conducted along transects perpendicular to the pile, and spaced at approximately 500 feet (150 meters).

As constructed, the disposal pile at Site IV was approximately 600 feet wide and 5000 feet long. The bathymetry/video cross section transects confirmed this to be generally correct. Subsequently, longitudinal bathymetry/video transects along the disposal corridor were conducted at a line spacing of approximately 500 feet (150 meters). Orientation of these transects allowed for observation of the crest and north and south toe of the pile throughout its length.

During the course of the video recordings, coordinates and visual observations of areas of the pile were verbally entered onto the video records. Coordinates of areas exhibiting features representative of the substrate characte: ere recorded for ground truthing by divers.

On-board review of the video record resulted in four sites being chosen for diver observation and photography. Two areas were located along the south toe with the other two dive locations position on the crest of the pile near the east and west ends, respectively. Dive teams obtained 35mm photographs and video records of each site.

RESULTS

A total of seventeen (17) transects were navigated on October 9, 1991. Video coverage revealed the disposal area to be largely dominated by irregular substrate consisting of a size ranging from rubble to boulders. Interspersed throughout the corridor were large zones (approximately 50-100 meter spans) dominated by a mixture of fine to coarse grain sands with silt. At and beyond the north and south toe of the pile, the seafloor consisted of moderate to coarse grained sands with small shell hash (visual observation). Fathometer records of each transect are appended (Appendix 1) to this report along with logistical and descriptive information (Appendix 2) and should be referenced to Figure 1 for location. "Fix" numbers written on the fathometer records (App. 1) correspond to the "fix" number on the logistical data (App. 2) for direct reference.

Diving operations to ground-truth selected representative areas of the pile were conducted on October 10, 1991. Examination of the various substrate by divers revealed both the rubble and boulder material to consist primarily of rock with porosity varying from limestone to solid rock. Larger boulders (three to five feet diameter and larger) were encrusted by calcareous algae, sponges, ascidians, and tube coral (Cladocora sp.). In many cases, the entire surface area of the rocks was near 100% colonized by these varying assemblages of biota. Dive location are depicted on Figure 1. Appendix 3 is a compilation of representative photographs of the substrate and associated biota observed at each respective location.

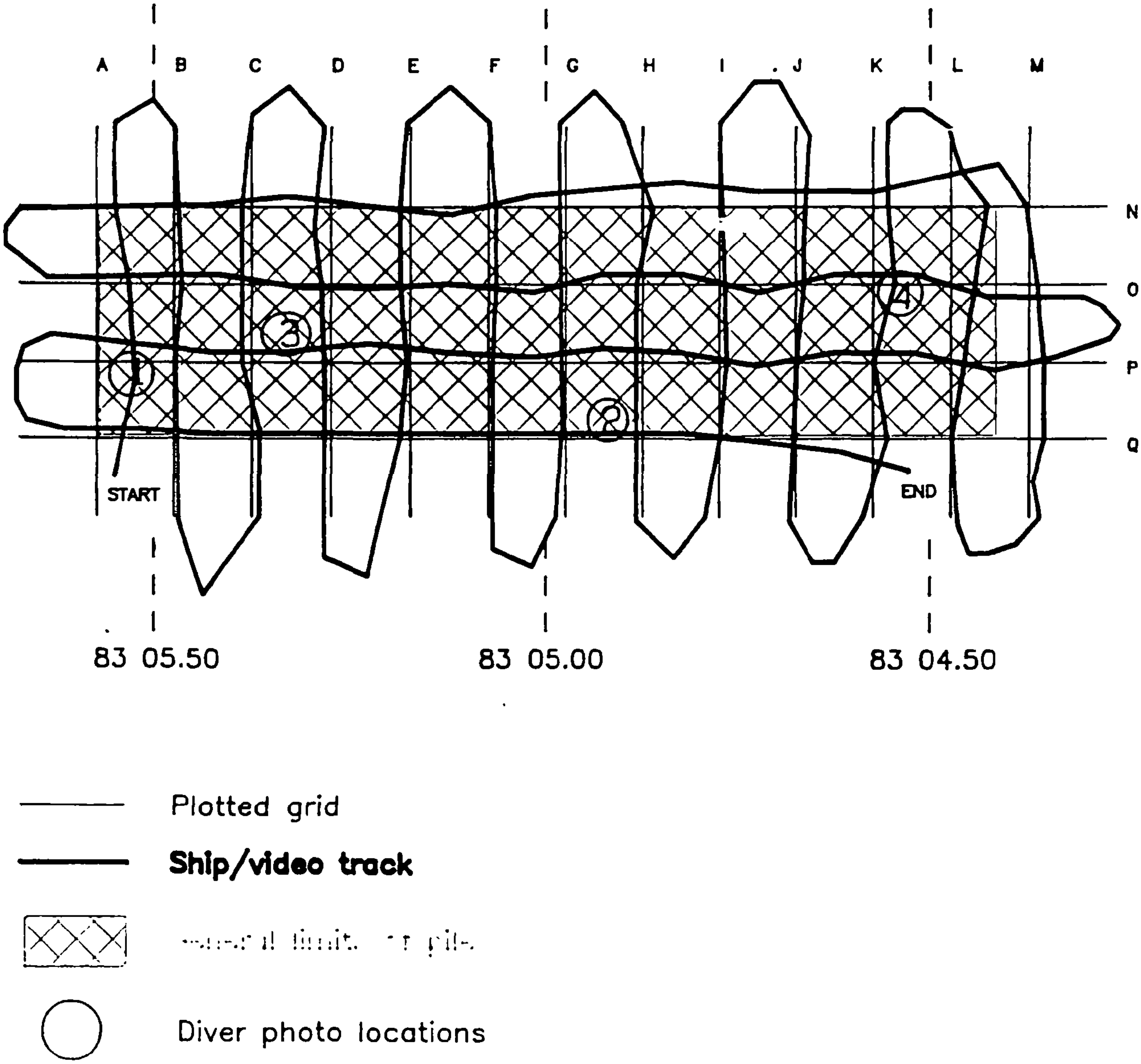
Visually, fish were abundant at all dive locations and included butterfly fish, wrasse, damselfish, angelfish, highhats, grunts, snapper, jacks, grouper, needlefish, and barracuda. Grouper were the most abundant sport/commercial fish observed. Good habitat is afforded by the rocky irregular relief of the disposed material, providing both cover and attached food sources for the wide variety of fishes attracted to the pile.

PROJECT PERSONNEL

EPA, Athens	EPA, Atlanta	EPA, HDQT
Philip Murphy	Gary Collins	Ed McLean
Don Lawhorn		
Mel Parsons		

As always, this effort could not have been accomplished without the most competent assistance of Captain Dwight Paine, and the technicians and crew of the EPA OSV Peter W. Anderson.

FIGURE 1
VIDEO TRANSECTS
TAMPA SITE IV
OCTOBER 1991



APPENDIX

1

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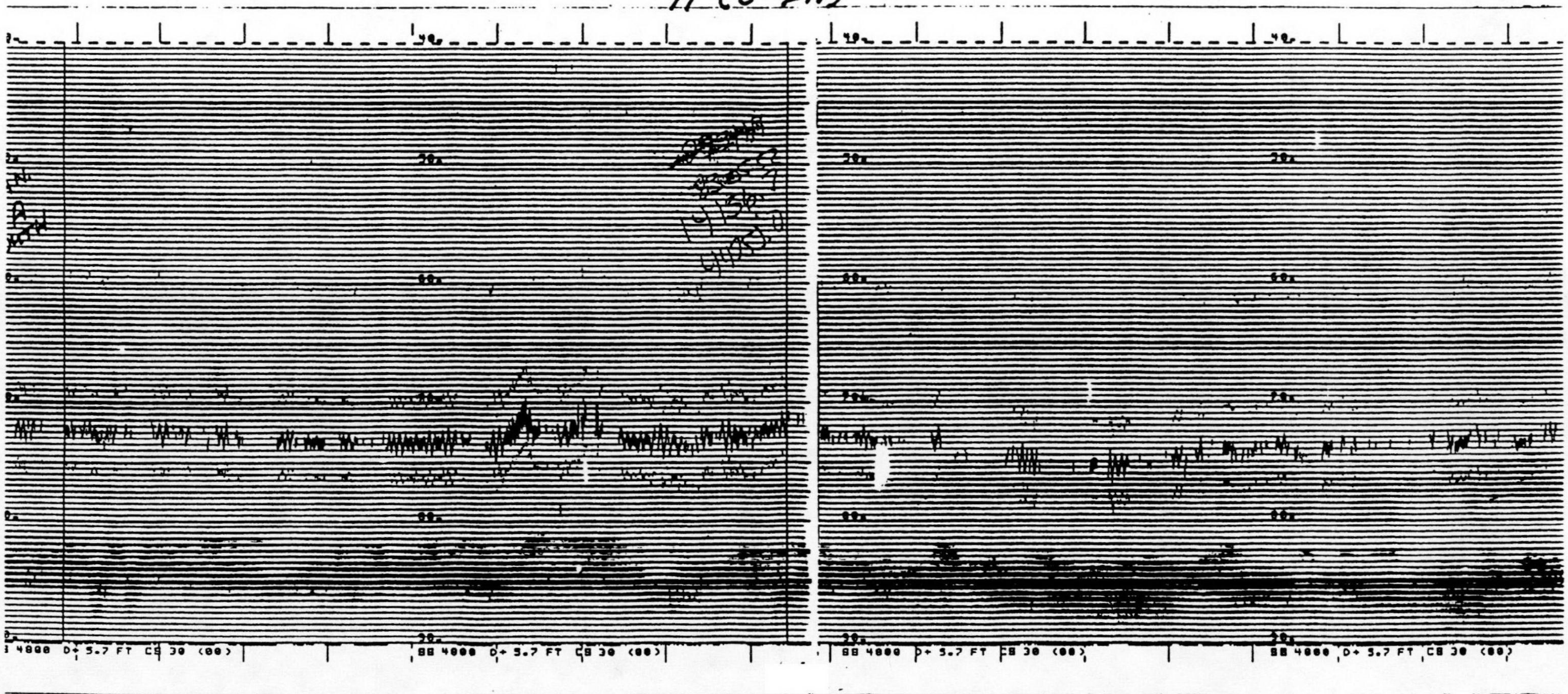
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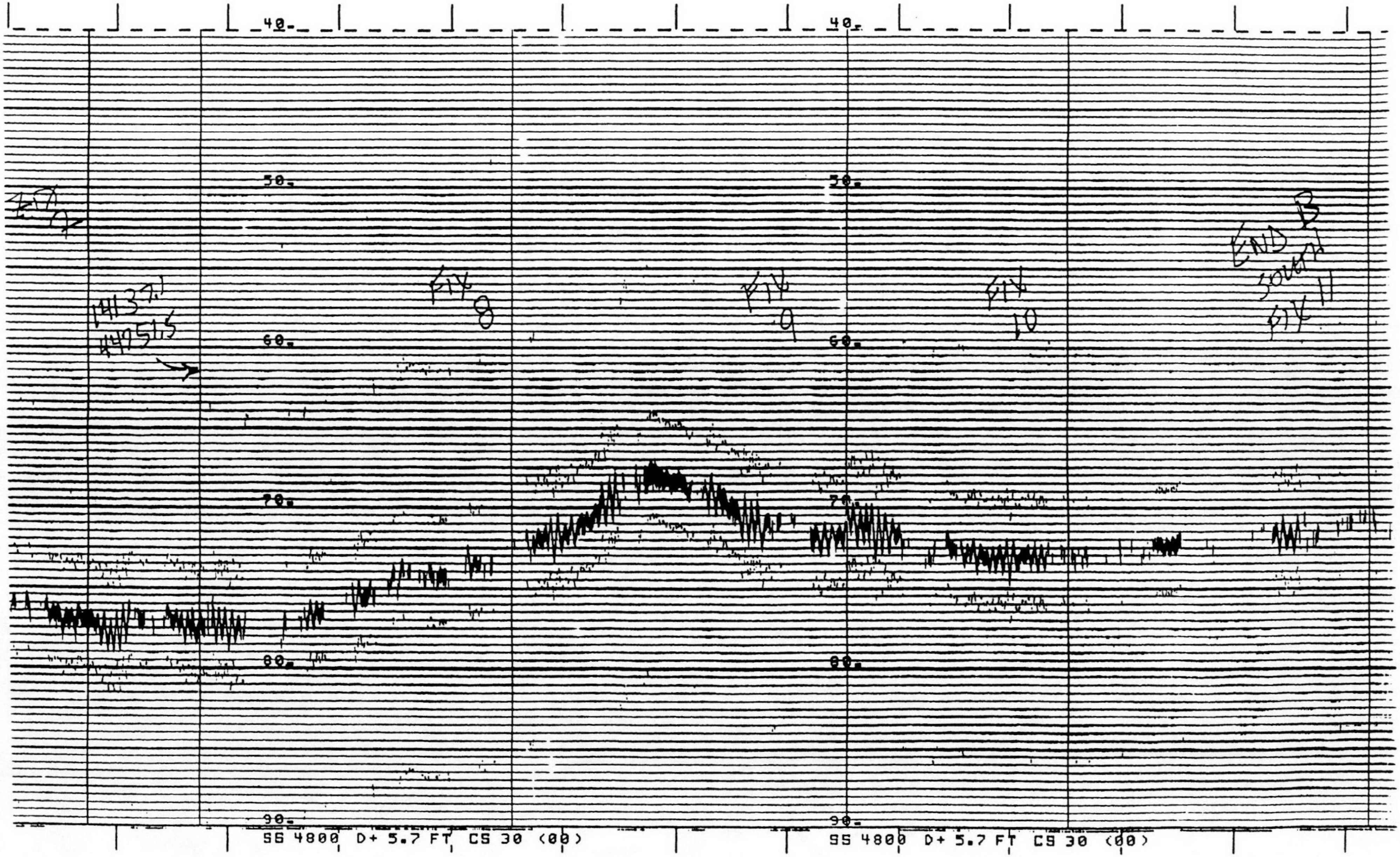
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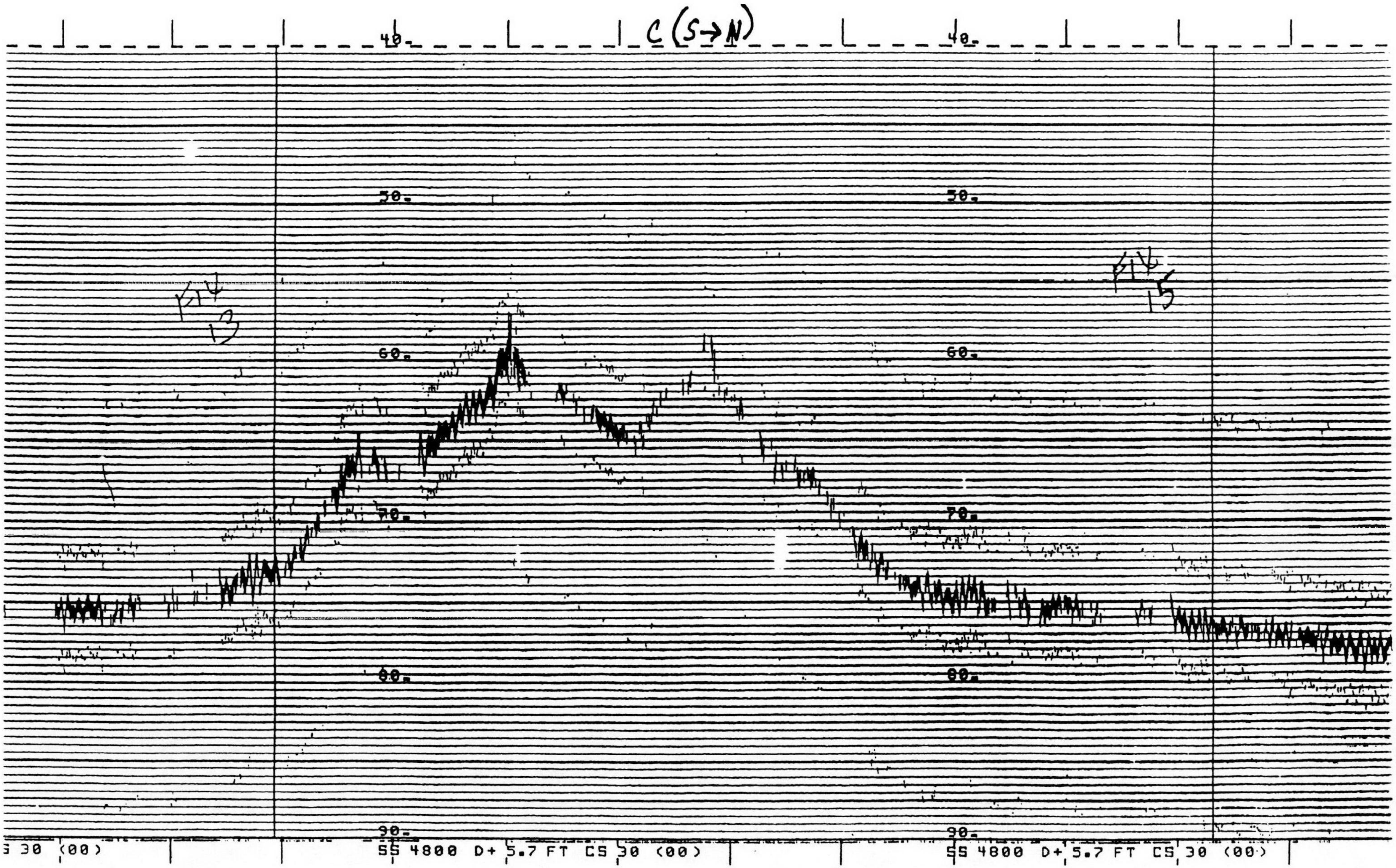
SOUTH
FIX 11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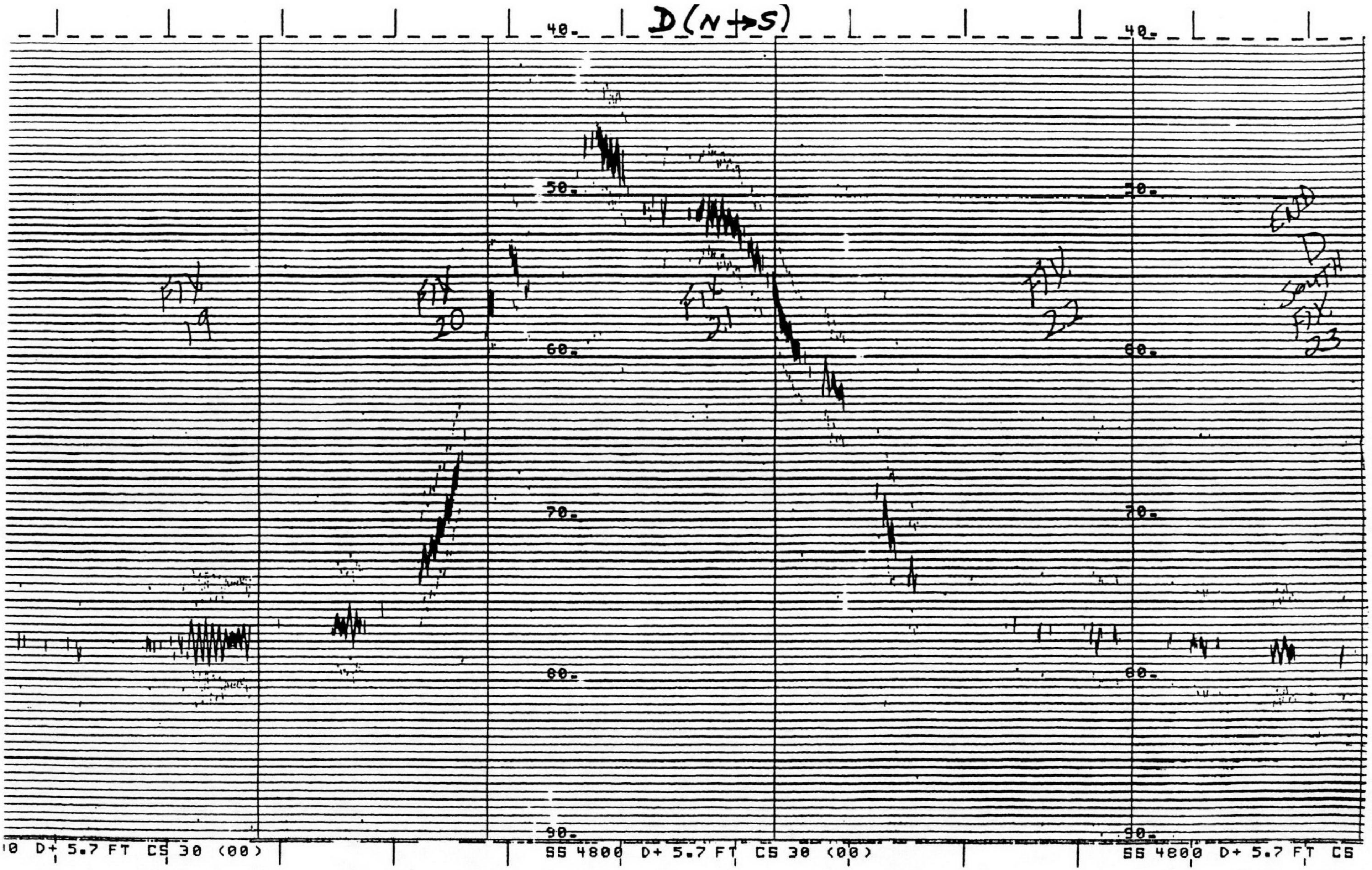
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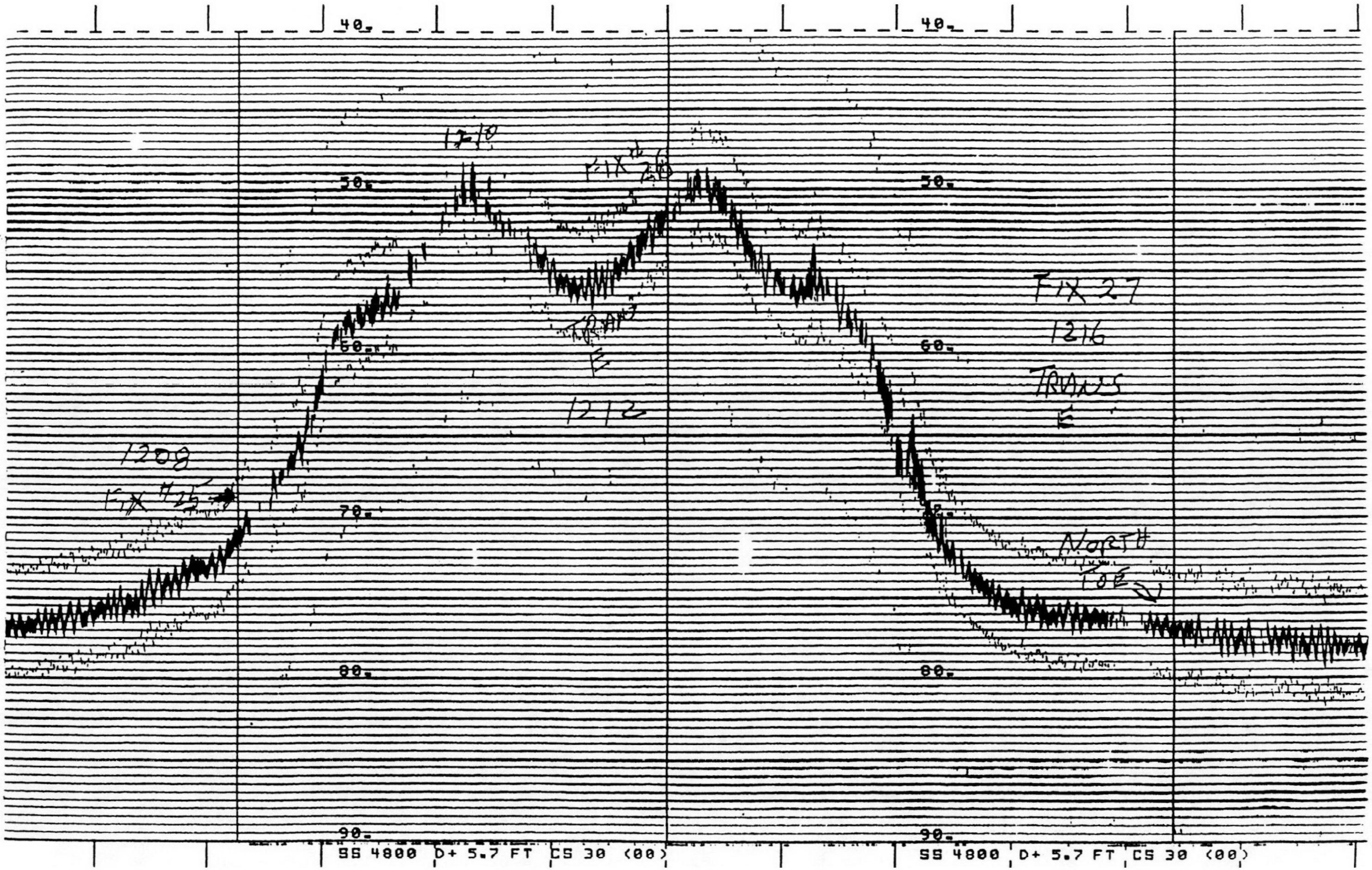
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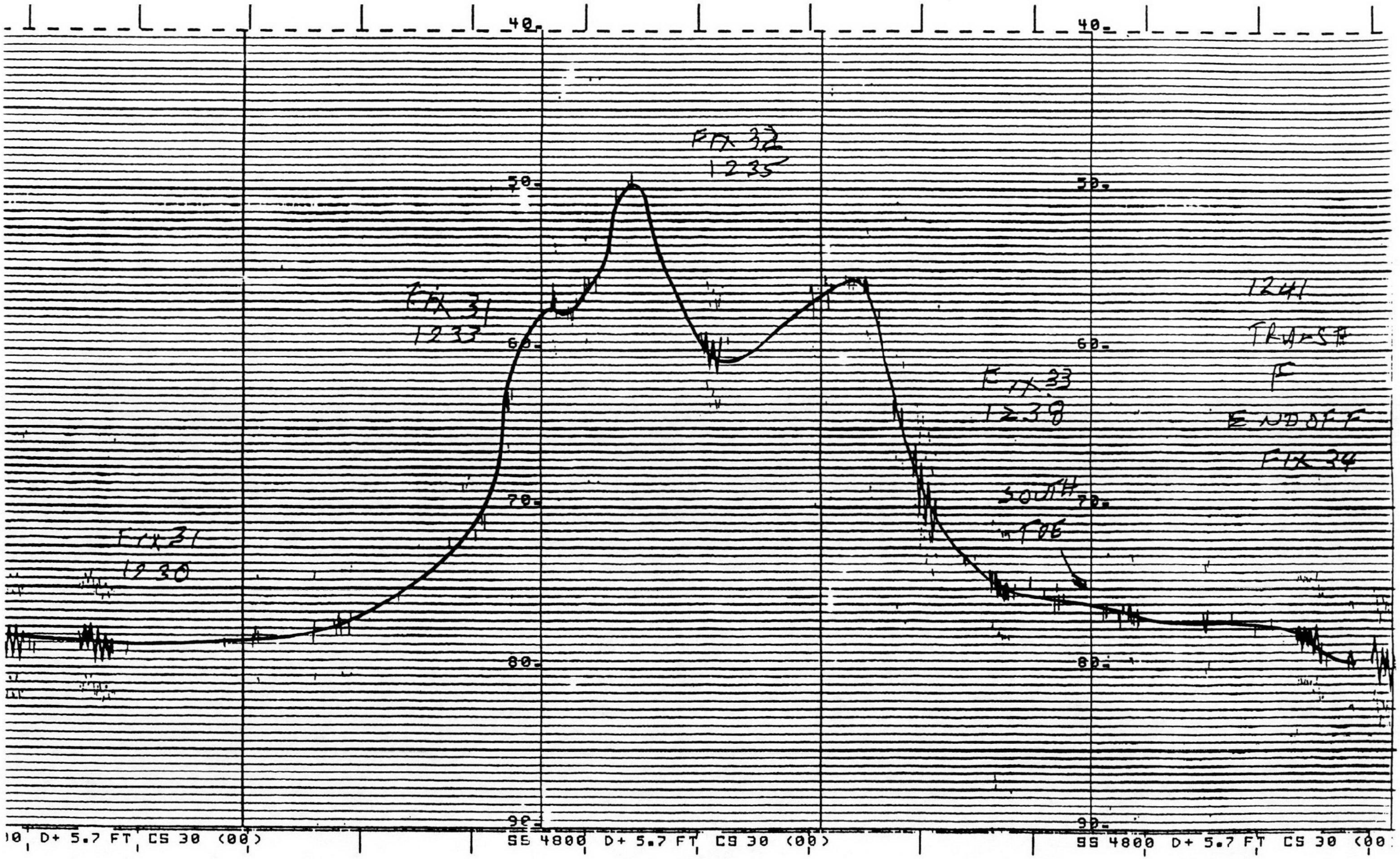
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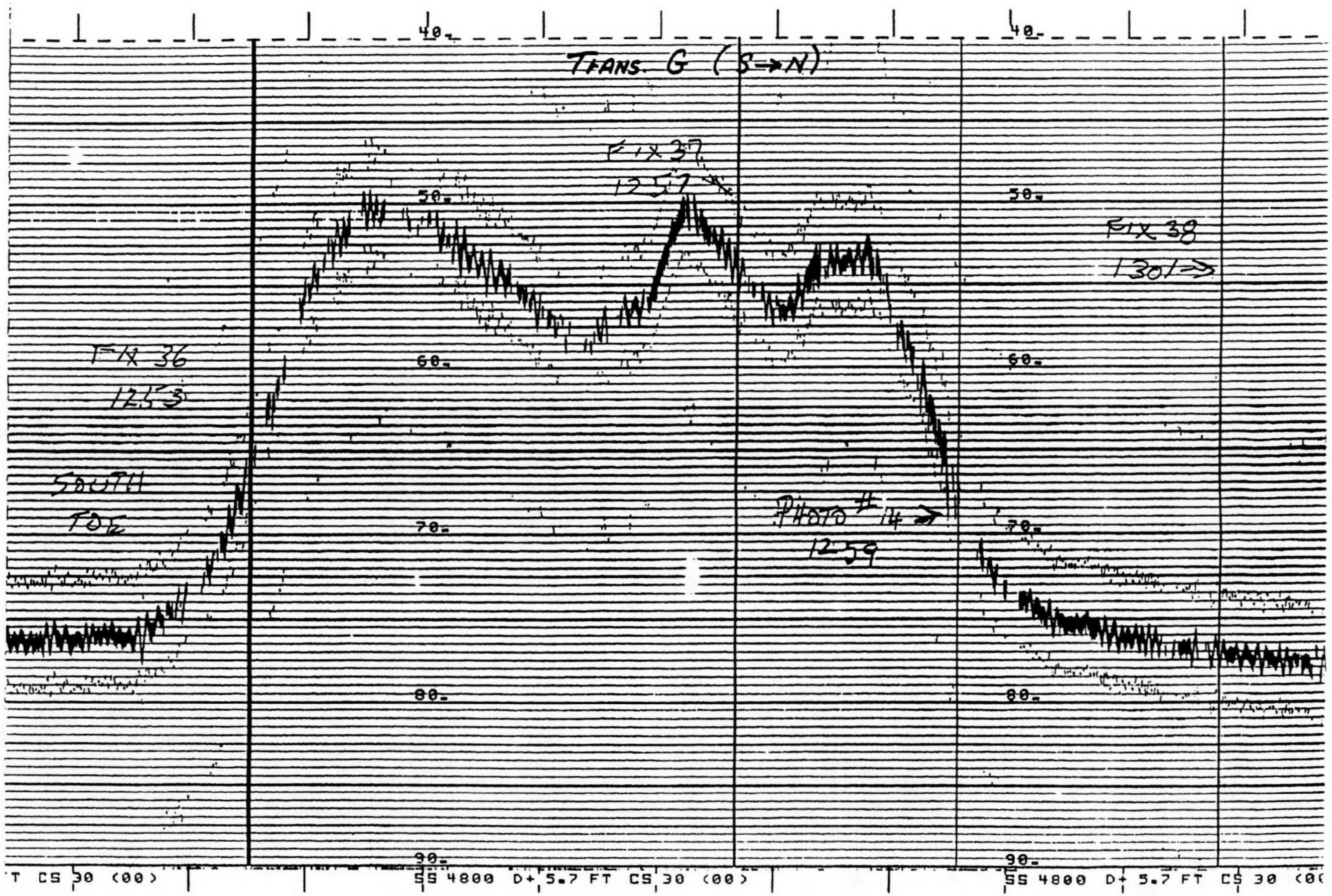
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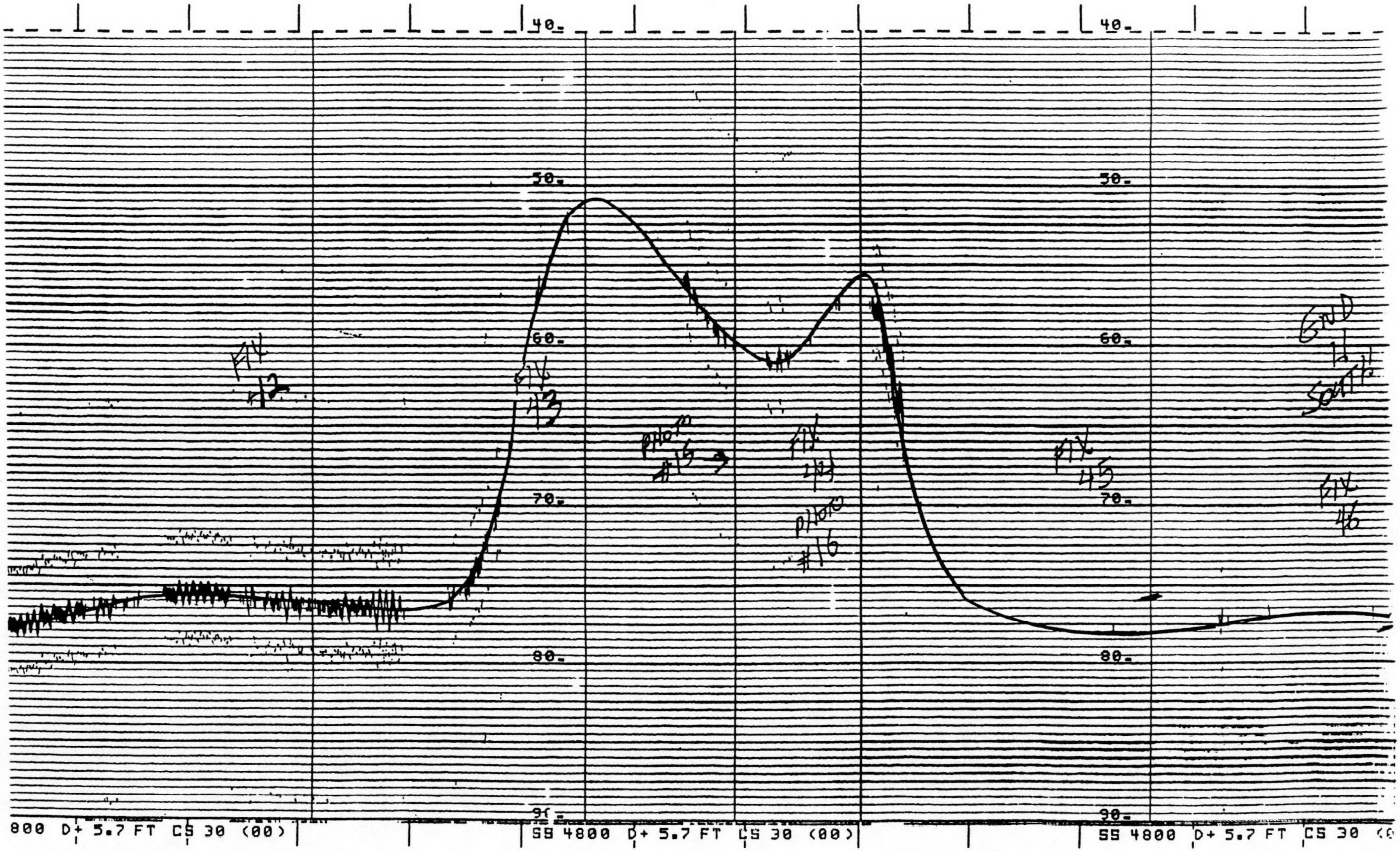
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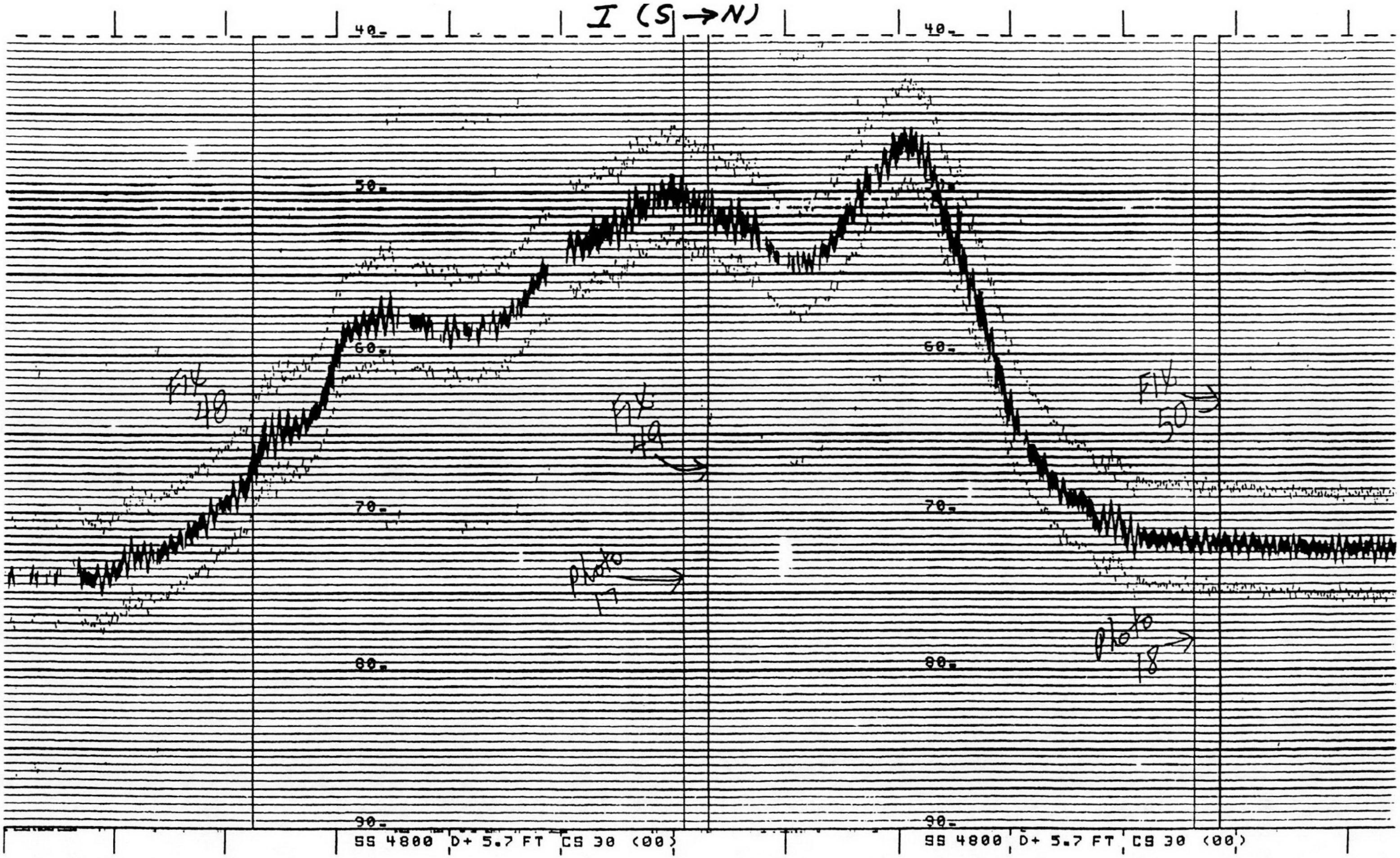
PHOTO #15
FIV 44
PHOTO #16
FIV 45
FIV 46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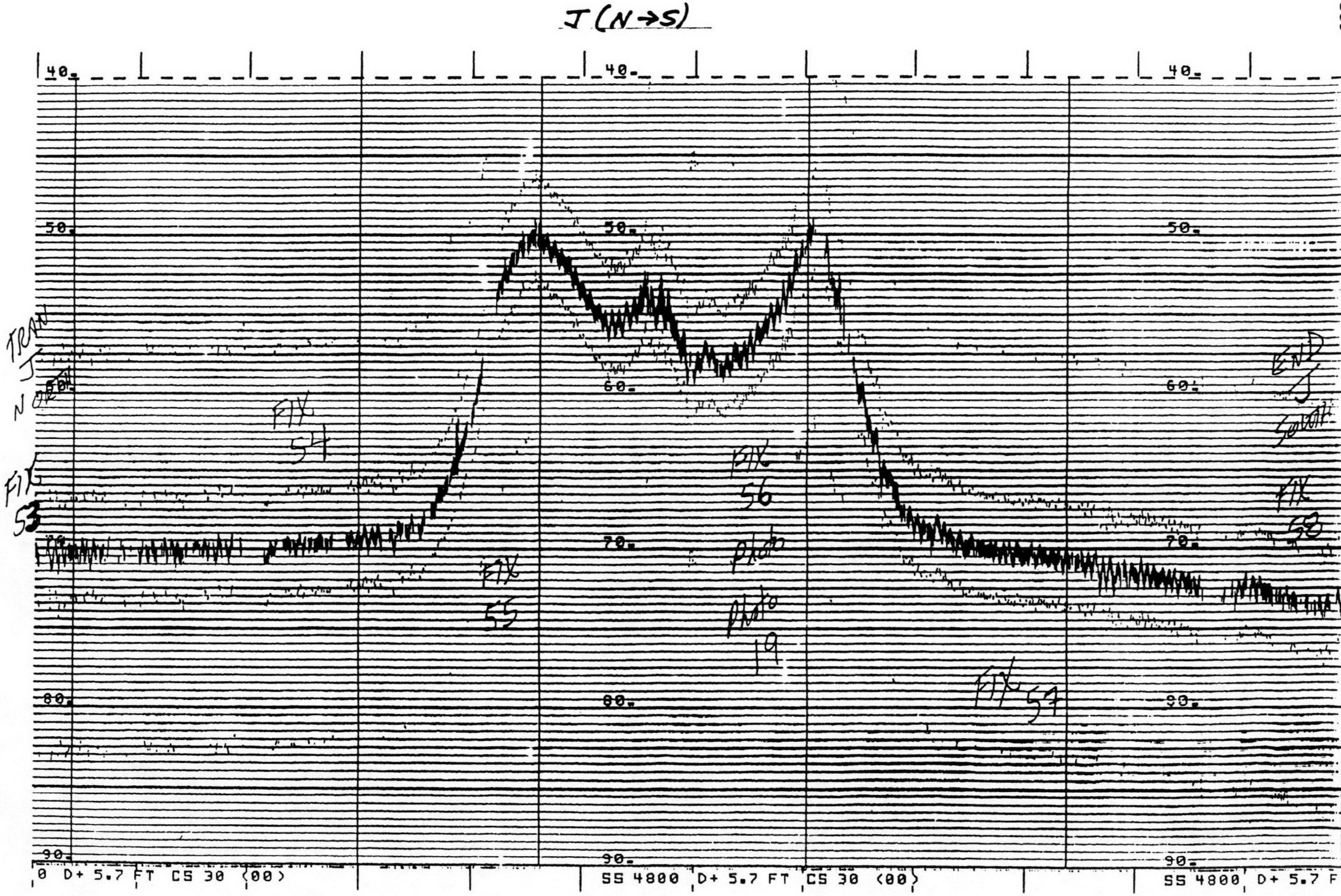
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TRAN J NORTH
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FIX 54
FIX 55
FIX 56
Photo
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FIX 57
END J South
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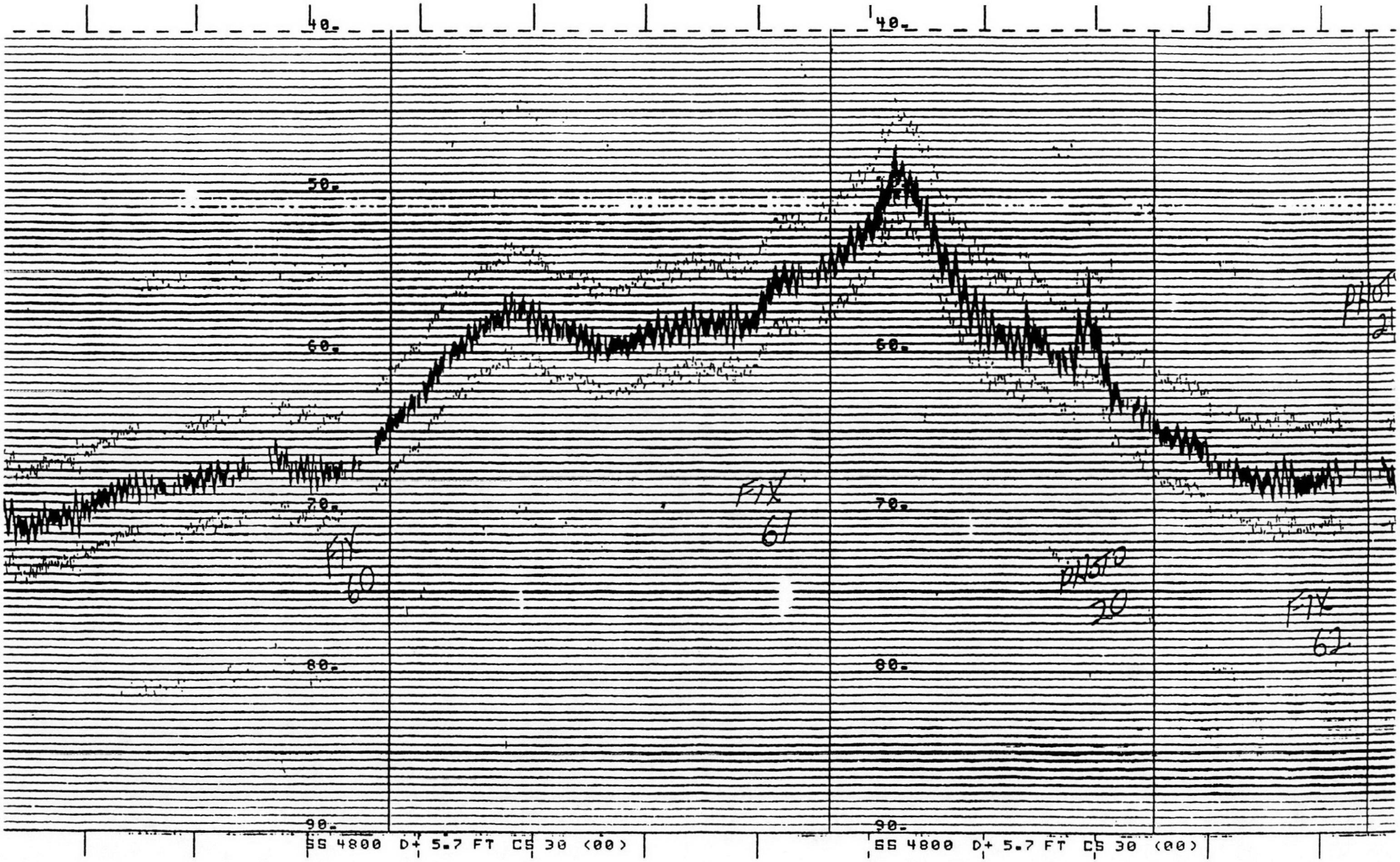
K(S→N)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FIX 60
FIX 61
PHOTO 20
FIX 62
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SS 4800 D+ 5.7 FT CS 30 (00)

APPENDIX

2

Page No. 1
09/16/91

SURVEY	DATE	TRANS	FIX	TAPE	DEPTH	LATDEG	LATMIN	LONDEG	LONMIN	TIMEHOUR	TIMEMIN	BOTTYPE	PATTERN	WAVEHT	WAVEWIDTH	PHOTO	NOTES
		0			0	0	0.00	0	0.00	0	0			0.000	0.000		
TAM	10-09-91	0	8		72	27	31.28	83	5.46	10	52	sand-clump		0.000	0.000		change in type of materia from sand to darker matee
TAM	10-09-91	0	9		70	27	31.17	83	5.46	10	55	sand-clump		0.000	0.000		crest of pile with clumpe maetrial
TAM	10-09-91	0	10		73	27	31.12	83	5.47	10	56	sand-clump		0.000	0.000		crest of pile with clumpe maetrial south toe of pil
TAM	10-09-91	0	11		70	27	31.01	83	5.45	10	59	sand-clump		0.000	0.000		end of transect b at sout end all sand with not clu material
TAM	10-09-91	0	12		70	27	30.93	83	5.45	11	2	sand mud		0.000	0.000		apparent material out of thedump corridor small a 14136.1 44748.1
TAM	10-09-91	0	12		76	27	31.01	83	5.37	11	8	sand mud?		0.000	0.000		beginning of trans c at s end some clumped materia apparent coral
TAM	10-09-91	0	13		9999	27	31.12	83	5.37	11	12	sand		0.000	0.000		toe of pile with large cl clump apparent growth of coral
TAM	10-09-91	0	14		62	27	31.19	83	5.37	11	15	clay clums		0.000	0.000		north slope of pile with balls encrusted
TAM	10-09-91	0	15		77	27	31.31	83	5.39	11	19	clay sand		0.000	0.000		apparent toe (north) with clumps and sand
		0			0	0	0.00	0	0.00	0	0			0.000	0.000		
TAM	10-09-91	0	18		77	27	31.49	83	5.28	11	33	sand relif		0.000	0.000		sand with clumps and some coral sparse
TAM	10-09-91	0	19		0	27	31.36	83	5.30	11	36	sand relif		0.000	0.000		predom sand
TAM	10-09-91	0	20		55	27	31.36	83	5.30	11	36	fine mattr		0.000	0.000		peak of pile with very fi material and no growth ca to 46 feet
TAM	10-09-91	0	21		52	27	31.20	83	5.28	11	40	fine mattr		0.000	0.000		going down south slope largeclay balls not much growth
TAM	10-09-91	0	22		9999	27	31.02	83	5.29	11	44	fine-clump		0.000	0.000		going down south slope largeclay balls with encrusting growth
TAM	10-09-91	0	23		9999	27	31.02	83	5.29	11	44	mud		0.000	0.000		end of trans d very fine powder like material
TAM	10-09-91	0	24		77	27	31.00	83	5.21	12	5	sand	irregular	0.000	0.000		begin trans e runnine n-s

															some spoil material. coar grain sand
TAM	10-09-91	0	25	72	27	31.10	83	5.19	12	9	sand	smooth	0.000	0.000	smooth fine sand, coming pile.
TAM	10-09-91	0	26	52	27	31.21	83	5.18	12	13	hard	irregular	0.000	0.000	large clay balls, coarse material, at peak of pile
TAM	10-09-91	0	27	77	27	31.30	83	5.18	12	17	hard	irregular	0.000	0.000	large clay balls, coarse material, north of main p
TAM	10-09-91	0	28	78	27	31.40	83	5.18	12	21	sand	dimpled	0.000	0.000	fine dimpled sand, occasionally soft coral.
TAM	10-09-91	0	29	78	27	31.50	83	5.17	12	25	sand	irregular	0.000	0.000	fine dimpled sand, occasionally soft coral, rubble
TAM	10-09-91	0	30	78	27	31.50	. 3	5.05	12	25	sand	DIMP	0.000	0.000	fine dimpled sand, occasionally soft coral, rubble
TAM	10-09-91	0	31	78	27	31.40	83	5.05	12	31	sand	DIMP	0.000	0.000	COARSE SAND SOME BRYZOANS SOME RUBBLE.
TAM	10-09-91	0	32	57	27	31.30	83	5.07	12	34	SAND	DIMP	0.000	0.000	COARSE SAND, SOME RUBBLE THE UPSLOPE OF PILE.

09/16/91

SURVEY	DATE	TRANS	FIX	TAPE	DEPTH	LATDEG	LATMIN	LONDEG	LONMIN	TIMEHOUR	TIMEMIN	BOTTYPE	PATTERN	WAVEHT	WAVEWIDTH	PHOTO	NOTES
TAM	10-09-91	0	33		57	27	31.20	83	5.07	12	34	HARD/CLAY	IRREGULAR	0.000	0.000		ON TOP OF PILE, LARGE CLA BALLS, LOTS OF RUBBLE.
TAM	10-09-91	0	34		76	27	31.10	83	5.08	12	34	SAND	DIMPLED	0.000	0.000		ON SOUTH TOE OF PILE, FIN MEDIUM SAND
TAM	10-09-91	0	35		79	27	31.00	83	5.07	12	42	SAND	DIMPLED	0.000	0.000		END OF TRANSECT F MEDIUM SOME RUBBLE.
		0			0	0	0.00	0	0.00	0	0			0.000	0.000		
TAM	10-09-91	0	35		76	27	31.00	83	4.99	12	50	SAND/SHELL	DIMP/IRREG	0.000	0.000	12	BEGIN TRANSECT G, SOUTH T NORTH,
TAM	10-09-91	0	36		65	27	31.10	83	4.97	12	50	SAND/FINES	DIMPLED	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
TAM	10-09-91	0	37		65	27	31.20	83	4.98	12	50	RUBBLE	IRREGULAR	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
TAM	10-09-91	0	37		65	27	31.20	83	4.98	12	50	RUBBLE	IRREGULAR	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
TAM	10-09-91	0	37		65	27	31.20	83	4.98	12	50	RUBBLE	IRREGULAR	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
TAM	10-09-91	0	37		65	27	31.20	83	4.98	12	50	RUBBLE	IRREGULAR	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
TAM	10-09-91	0	37		65	27	31.20	83	4.98	12	50	RUBBLE	IRREGULAR	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
TAM	10-09-91	0	37		65	27	31.20	83	4.98	12	50	RUBBLE	IRREGULAR	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
TAM	10-09-91	0	37		65	27	31.20	83	4.98	12	50	BBLE	IRREGULAR	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
TAM	10-09-91	0	37		65	27	31.20	83	4.98	12	50	RUBBLE	IRREGULAR	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
TAM	10-09-91	0	37		65	27	31.20	83	4.98	12	50	RUBBLE	IRREGULAR	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
TAM	10-09-91	0	37		65	27	31.20	83	4.98	12	50	RUBBLE	IRREGULAR	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
TAM	10-09-91	0	37		65	27	31.20	83	4.98	12	50	RUBBLE	IRREGULAR	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
TAM	10-09-91	0	37		65	27	31.20	83	4.98	12	50	RUBBLE	IRREGULAR	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
TAM	10-09-91	0	37		65	27	31.20	83	4.98	12	50	RUBBLE	IRREGULAR	0.000	0.000		TRANSECT G, SOUTH TOE OF RUBBLE AND SOME GROWTH.
AM	10-09-91	0	37		54	27	31.20	83	4.98	12	57	RUBBLE	IRREGULAR	0.000	0.000	13	TRANSECT G, CENTER TROUGH OFPILE, LARGE CLAY BALLS.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	83	4.98	13	2	RUBBLE	IRREGULAR	0.000	0.000	TRANSECT G, NORTH TOE OF CLAY BALLS, SOFT CORALS A SPONGES.
TAM	10-09-91	0	39	78	27	31.40	13	4.97	13	5	SAND	DIMPLED	0.000	0.000	TRANSECT G, NORTH OF PILE RUBBLE OR GROWTH.
TAM	10-09-91	0	40	78	27	31.50	83	4.98	13	9	SAND	DIMPLED	0.000	0.000	END OF TRANSECT G. NO RUB GROWTH.
		0		0	0	0.00	0	0.00	·0	0			0.000	0.000	
		0		0	0	0.00	0	0.00	0	0			0.000	0.000	
TAM	10-09-91	0	41	9999	27	31.50	83	4.91	13	15	SAND SHELL	SM - DIMP	0.000	0.000	BEGIN TRANS H AT NORTH EN SAND SHELL BOTTOM NO GRO
TAM	10-09-91	0	42	76	27	31.40	83	4.88	13	18	SAND SHELL	SM - DIMP	0.000	0.000	SAND SHELL BOTTOM NO GROW
TAM	10-09-91	0	43	56	27	31.30	83	4.88	13	20	SAND FINES	SM - DIMP	0.000	0.000	SAND AND FINES NO GROWTH NEAR NORTH TOW GOING UP SLOPE
TAM	10-09-91	0	44	66	27	31.20	83	4.88	13	23	RUBBLE		0.000	0.000	RUBBLE AND MUCH SHELL FRA APPARENT BRYO OR HYDROIDS STILL ON PILE
TAM	10-09-91	0	45	76	27	31.09	83	4.88	13	26	RUBBLE		0.000	0.000	TOE ON SOUTH SLOPE SAND A FINES NO GROWTH AND NO

SURVEY	DATE	TRANS	FIX	TAPE	DEPTH	LATDEG	LATMIN	LONDEG	LONMIN	TIMEHOUR	TIMEMIN	BOTTYPE	PATTERN	WAVEHT	WAVEWIDTH	PHOTO	NOTES
																	OTHERREMARKABLE FEATURES
TAM	10-09-91	0	46		78	27	30.99	83	4.88	13	28	SAND FINES	SM TO DIMP	0.000	0.000		SMOOTH BOTTOM WITH NO REMARKABLE FEATURES
		0			0	0	0.00	0	0.00	0	0			0.000	0.000		
TAM	10-09-91	0	47		75	27	30.98	83	4.79	13	35	SAND	SM	0.000	0.000		SMOOTH SAND WITH LARGE DE PRESSIONS
TAM	10-09-91	0	48		68	27	31.10	83	4.79	13	39	SAND	SM	0.000	0.000		SMOOTH SAND WITH LARGE DE PRESSIONS NOTHING REMARK SOUTH TOE OF PILE
TAM	10-09-91	0	49		50	27	31.19	83	4.77	13	43	CLAY CLUMP		0.000	0.000	17	NEAR PEAK OF PILE LARGE C WITH MOD GROWTH
TAM	10-09-91	0	50		71	27	31.30	83	4.77	13	48	CLAY CLUMP		0.000	0.000	18	NEAR NORTH TOE OF PILE CL CLUMPS W/ VARYING AMTS OF GROWTH
TAM	10-09-91	0	51		73	27	31.41	83	4.77	13	53	SAND	SMOOTH	0.000	0.000		SMOOTH SAND WITH NO REMAR ABLE FEATURES
TAM	10-09-91	0	52		73	27	31.50	83	4.77	13	56	SAND	SMOOTH	0.000	0.000		SMOOTH SAND WITH NO REMAR ABLE FEATURES END OF TRA SECT I
		0			0	0	0.00	0	0.00	0	0			0.000	0.000		
TAM	10-09-91	0	53		70	27	31.45	83	4.64	14	1	SAND	SM	0.000	0.000		BEGIN TRANS J NORTH TO S REMARK FEATURES
TAM	10-09-91	0	54		69	27	31.35	83	4.65	14	3	SAND	SM	0.000	0.000		NORTH TO SOU NO REMARK FEATURES
TAM	10-09-91	0	55		50	27	31.30	83	4.65	14	4	S .D SHELL	IRR DIMP	0.000	0.000		NEAR CREST OF PILE RUBBLE SAND AND SHELL LITTLE EN-CRUSTING
TAM	10-09-91	0	55		50	27	31.19	83	4.68	14	7	RUBBLE	IRR	0.000	0.000	19	NEAR SECOND CREST OF PILE CLAY RUBBLE WITH MOD GROW ROUGH BOTTOM
TAM	10-09-91	0	57		71	27	31.10	83	4.66	14	9	SAND FINES	SM TO DIMP	0.000	0.000	19	SOUTH TOE ON BERM SMOOTH WITH FINES NO GROWTH OR O REMARKABLE FEATURES
TAM	10-09-91	0	58		74	27	30.93	83	4.69	14	13	SAND FINES	SM TO DIMP	0.000	0.000	19	END OF TRANS J AT SOUTH E SAND WITH NO GROWTH OR O REMARKABLE FEATURES
		0			0	0	0.00	0	0.00	0	0			0.000	0.000		
		0	60		64	0	0.00	0	0.00	0	0	sand	irregular	0.000	0.000		
TAM	10-09-91	0	61		55	27	31.20	83	4.58	14	30	sand	irregular	0.000	0.000		some clumps

TAM	10-09-91	0	62	68	27	31.31	83	4.53	14	35	sand	irregular	0.000	0.000	21	many clumps, growth
TAM	10-09-91	0	63	68	27	31.40	83	4.55	14	39	sand	irregular	0.000	0.000	21	mostly sand some spots of growth
TAM	10-09-91	0	64	69	27	31.50	83	4.59	14	44	sand	irregular	0.000	0.000		mostly sand, a some scatt soft corals
		0		0	0	0.00	0	0.00	0	0			0.000	0.000		
TAM	10-09-91	0	65	66	27	31.48	83	4.48	14	48	SAND	IRREGULAR	0.000	0.000		START TRANS L NORTH TO SOUTHBRAIDED SAND PATTERN
TAM	10-09-91	0	66	66	27	31.39	83	4.41	14	51	SAND	IRREGULAR	0.000	0.000		APPROX 200 FT EAST OF TRA
TAM	10-09-91	0	67	67	27	31.31	83	4.44	14	53	SAND	IRREGULAR	0.000	0.000		NO REMARKABLE FEATURES
TAM	10-09-91	0	68	65	27	31.20	83	4.46	14	55	SAND	IRREGULAR	0.000	0.000		SPARSE CLUMPS OF SOFT COR WITH FEW CLAY BALLS
TAM	10-09-91	0	69	70	27	31.09	[illegible]3	4.44	14	58	SAND	IRREGULAR	0.000	0.000		TOOK PHOTO 22 JUST BEFORE SOME LARGE CLAY CLUMPS
TAM	10-09-91	0	70	75	27	31.01	83	4.45	15	0	SAND	IRREGULAR	0.000	0.000		SOME SPARSE SOFT CORAL
		0		0	0	0.00	0	0.00	0	0			0.000	0.000		
TAM	10-09-91	0	71	75	27	30.97	83	4.36	15	14	SAND-MUD	IRREGULAR	0.000	0.000		START TRANS M SOUTH TO NO
TAM	10-09-91	0	72	71	27	31.08	83	4.34	15	18	SAND-MUD	IRREGULAR	0.000	0.000		
TAM	10-09-91	0	73	67	27	31.19	83	4.35	15	23	SAND-MUD	IRREGULAR	0.000	0.000		
TAM	10-09-91	0	74	66	27	31.29	83	4.34	15	28	SAND-MUD	IRREGULAR	0.000	0.000		SOME SOFT CORAL WITH FEW

SURVEY	DATE	TRANS	FIX	TAPE	DEPTH	LATDEG	LATMIN	LONDEG	LONMIN	TIMEHOUR	TIMEMIN	BOTTYPE	PATTERN	WAVEHT	WAVEWIDTH	PHOTO	NOTES
																	CLUMPS
TAM	10-09-91	0	75		66	27	31.38	83	4.36	15	32	SAND-MUD	IRREGULAR	0.000	0.000		END OF TRANS
TAM	10-09-91	0	76		67	27	31.44	83	4.42	15	36	SAND-MUD	IRREGULAR	0.000	0.000		START OF TRANS N
TAM	10-09-91	0	77		67	27	31.37	83	4.52	15	39	SAND-MUD	IRREGULAR	0.000	0.000		NOTHING REMARKABLE
TAM	10-09-91		79		72	27	31.40	83	4.72	15	45	SAND-MUD	SMOO DIMP	0.000	0.000		NOTHING REMARKABLE
TAM	10-09-91	0	80		75	27	31.40	83	4.82	15	48	SAND-MUD	SMOO DIMP	0.000	0.000		NOTHING REMARKABLE
TAM	10-09-91	0	81		77	27	31.40	83	4.92	15	50	SAND-MUD	SMOO DIMP	0.000	0.000	23	NOTHING REMARKABLE
TAM	10-09-91	0	82		78	27	31.40	83	5.02	15	54	SAND-MUD	SMOO DIMP	0.000	0.000	23	NOTHING REMARKABLE EXCEPT
																	FEW SMALL CLUMPS OF CLAY
																	IMMEDIATELY AT FIX
TAM	10-09-91	0	83		77	27	31.39	83	5.12	15	56	SANDRUBBLE	DIMPLED	0.000	0.000		NOTHING REMARKABLE SAND
																	OVERWHAT APPEARS TO BE SM
																	RUBBLE
TAM	10-09-91	0	84		77	27	31.39	83	5.22	15	59	SANDRUBBLE	DIMPLED	0.000	0.000		NOTHING REMARKABLE SAND
																	OVERWHAT APPEARS TO BE SM
																	RUBBLE
TAM	10-09-91	0	85		78	27	31.40	83	5.32	16	2	SANDRUBBLE	DIMPLED	0.000	0.000		NOTHING REMARKABLE SAND
																	OVERWHAT APPEARS TO BE SM
																	RUBBLE OCCURRING IN SM PA
TAM	10-09-91	0	86		77	27	31.40	83	5.43	16	5	SANDRUBBLE	DIMPLED	0.000	0.000		NOTHING REMARKABLE SAND
																	OVERWHAT APPEARS TO BE SM
																	RUBBLE OCCURRING IN SM PA
TAM	10-09-91	0	86		77	27	31.40	83	5.43	16	5	ANDRUBBLE	DIMPLED	0.000	0.000		NOTHING REMARKABLE SAND
																	OVERWHAT APPEARS TO BE SM
																	RUBBLE OCCURRING IN SM PA
TAM	10-09-91	0	87		74	27	31.38	83	5.52	16	8	SAND	DIMPLED	0.000	0.000		NOTHING REMARKABLE SAND
		0			0	0	0.00	0	0.00	0	0			0.000	0.000		
TAM	10-09-91	0	88		69	27	31.20	83	5.42	16	14	HARD	IRREG	0.000	0.000		BEGIN TRANS P, WEST TO EA
TAM	10-09-91	0	89		74	27	31.20	83	5.32	16	19	HARD	IRREG	0.000	0.000		CLAY BALLS WEST TO EAST
TAM	10-09-91	0	91		48	27	31.20	83	5.32	16	19	HARD	IRREG	0.000	0.000		CLAY BALLS WEST TO EAST
TAM	10-09-91	0	92		48	27	31.20	83	5.22	16	28	HARD	IRREG	0.000	0.000		LARGE CLAY BALLS, MUCH DE
TAM	10-09-91	0	93		58	27	31.20	83	5.12	16	38	HARD	IRREG	0.000	0.000	27	LARGE CLAY BALLS, MUCH DE
TAM	10-09-91	0	94		56	47	31.20	83	5.02	16	35	CLAY BALLS	IRREG	0.000	0.000		LARGE CLAY BALLS, MUCH DE
TAM	10-09-91	0	95		56	47	31.20	83	5.02	16	38	CLAY BALLS	IRREG	0.000	0.000		LARGE CLAY BALLS, MUCH DE
																	COARSE MATERIAL BETWEEN.
TAM	10-09-91	0	96		51	47	31.20	83	4.82	16	40	CLAY BALLS	IRREG	0.000	0.000		LARGE CLAY BALLS, MUCH DE
																	COARSE MATERIAL BETWEEN.
TAM	10-09-91	0	97		57	47	31.20	83	4.72	16	43	CLAY BALLS	IRREG	0.000	0.000		LARGE CLAY BALLS, MUCH DE
																	COARSE MATERIAL BETWEEN.

TAM	10-09-91	0	98	59	47	31.20	83	4.62	16	48	CLAY BALLS	IRREG	0.000	0.000	LARGE CLAY BALLS, MUCH DE COARSE MATERIAL BETWEEN.
TAM	10-09-91	0	99	60	47	31.20	83	4.52	16	49	CLAY BALLS	IRREG	0.000	0.000	LARGE CLAY BALLS, MUCH DE COARSE MATERIAL BETWEEN.
TAM	10-09-91	0	100	66	47	31.20	83	4.42	16	53	CLAY BALLS	IRREG	0.000	0.000	LARGE CLAY BALLS, MUCH DE COARSE MATERIAL BETWEEN. SAND ROWS.
TAM	10-09-91	0	101	70	47	31.20	83	4.32	16	55	CLAY BALLS	IRREG	0.000	0.000	END TRANSECT P, ALMOST NO CLAY BALLS, SAND ROWS, SO HARD BOTTOM.
		0		0	0	0.00	0	0.00	0	0			0.000	0.000	
TAM	10-09-91	0	102	66	27	30.46	33	4.42	17	3	SAND	SMOOTH	0.000	0.000	BEGIN TRANSECT O, EAST TO WEST.
TAM	10-09-91	0	103	67	27	30.46	83	4.52	17	5	SAND	SMOOTH	0.000	0.000	TRANS O, SANDY, SMOOTH, N CLAY BALLS, SOME HARD BOT
TAM	10-09-91	0	104	69	27	30.46	83	4.62	17	8	SAND	DIMPLED	0.000	0.000	TRANS O, SANDY, COARSE, N CLAY BALLS, SOME HARD BOT
TAM	10-09-91	0	105	69	27	30.46	83	4.72	17	11	SAND	IRREGULAR	0.000	0.000	TRANS O, SANDY, COARSE, N CLAY BALLS, APPARENT LIVE BOTTOM

SURVEY	DATE	TRANS	FIX	TAPE	DEPTH	LATDEG	LATMIN	LONDEG	LONMIN	TIMEHOUR	TIMEMIN	BOTTYPE	PATTERN	WAVEHT	WAVEWIDTH	PHOTO	NOTES
TAM	10-09-91	0	106		75	27	30.46	83	4.82	17	14	SAND	IRREGULAR	0.000	0.000		TRANS O, SANDY, COARSE, N CLAY BALLS, APPARENT LIVE BOTTOM
TAM	10-09-91	0	107		75	27	30.46	83	4.92	17	17	SAND	IRREGULAR	0.000	0.000		TRANS O, SANDY, COARSE, N. CLAY BALLS, APPEARS TO BE RUNNING ON NORTHERN TOE
TAM	10-09-91	0	108		75	27	30.46	83	5.02	17	20	SAND	IRREGULAR	0.000	0.000		TRANS O, SANDY, COARSE, N CLAY BALLS, APPEARS TO BE RUNNING ON NORTHERN TOE
TAM	10-09-91	0	109		74	27	31.27	83	5.12	17	23	SAND	IRREGULAR	0.000	0.000		TRANS O, SANDY, COARSE, N CLAY BALLS, APPEARS TO BE RUNNING ON NORTHERN TOE
TAM	10-09-91	0	110		75	27	31.29	83	5.22	17	26	SAND	IRREGULAR	0.000	0.000		SCATTERED CLUMPS, LARGE
TAM	10-09-91	0	111		74	27	31.29	83	5.31	17	29	SAND	IRREGULAR	0.000	0.000		MOSTLY SAND
TAM	10-09-91	0	112		75	27	31.29	83	5.42	17	29	SAND	IRREGULAR	0.000	0.000	28,29	SAND WITH INTERMITTENT HARDER PATCHES SOME GROWT
TAM	10-09-91	0	113		75	27	31.29	83	5.52	17	35	SAND	IRREGULAR	0.000	0.000	28,29	SAND WITH INTERMITTENT HARDER PATCHES SOME GROWT
TAM	10-09-91	0	114		78	27	31.31	83	5.62	17	38	SAND	IRREGULAR	0.000	0.000	28,29	SAND WITH INTERMITTENT HARDER PATCHES SOME GROWT
		0			0	0	0.00	0	0.00	0	0			0.000	0.000		
TAM	10-09-91	0	115		73	27	31.10	83	5.60	17	51	SAND	IRREGULAR	0.000	0.000		IRRREGULAR SAND SOME HARD AND SOFT CORALS
TAM	10-09-91	0	116		72	27	31.10	83	5.49	17	54	SAND	IRREGULAR	0.000	0.000		IRRREGULAR SAND SCATTERRE HARD PARCHES SOME SOFT & CORALS
TAM	10-09-91	0	117		73	27	31.09	83	5.42	17	56	SAND	IRREGULAR	0.000	0.000		IRRREGULAR SAND SCATTERRE HARD PARCHES SOME SOFT & CORALS
TAM	10-09-91	0	118		73	27	31.09	83	5.30	17	59	SAND	IRREGULAR	0.000	0.000		IRRREGULAR SAND SCATTERRE HARD PARCHES SOME SOFT & CORALS
TAM	10-09-91	0	120		9999	27	31.10	83	5.11	18	4	SAND	IRREGULAR	0.000	0.000		NO REMARKABLE FEATURES
TAM	10-09-91	0	121		76	27	31.10	83	5.02	18	7	SAND	IRREGULAR	0.000	0.000		SCATTERED CLUMPS WITH LIG GROWTH
TAM	10-09-91	0	122		76	27	31.09	83	4.91	18	10	SAND	IRREGULAR	0.000	0.000	130	
TAM	10-09-91	0	123		76	27	31.09	83	4.91	18	10	SAND	IRREGULAR	0.000	0.000	130	
TAM	10-09-91	0	123		73	27	31.09	83	4.83	18	12	SAND	IRREGULAR	0.000	0.000		
TAM	10-09-91	0	124		69	27	31.08	83	4.73	18	15	SAND	IRREGULAR	0.000	0.000		

				[illegible]	[illegible]	[illegible]	83	[illegible]	18	17	SAND	IRREGULAR	0.000	0.000	
TAM	10-09-91	0	126	71	27	31.04	83	4.52	18	20	SAND	IRREGULAR	0.000	0.000	END OF Q
		0		58518	3643	4023.14	10.[illegible]7	639.30	1817	4052			0.000	0.000	

APPENDIX G

TAMPA OCEAN DREDGED MATERIAL DISPOSAL SITE DESIGNATION

FLORIDA COASTAL ZONE MANAGEMENT PROGRAM

CONSISTENCY EVALUATION

Submitted by:

U.S. Environmental Protection Agency

Region IV

June 1993

I. INTRODUCTION

The U.S. Environmental Protection Agency (EPA), in cooperation with the U.S. Army Corps of Engineers (CE), has prepared an Environmental Impact Statement (EIS) titled "Environmental Impact Statement For Designation of a Tampa, Florida Ocean Dredged Material Disposal Site." This EIS evaluates the environmental conditions relevant to the designation of an ocean disposal site offshore Tampa, Florida. Additionally, the EIS evaluates the proposed Tampa site according to the eleven environmental criteria required for site designations under 40 CFR 228.6 (Ocean Dumping Regulations).

The site proposed for final designation is the Tampa site that received an EPA designation (40 CFR 228.12) and was used for dredged material disposal for the Tampa Harbor Deepening Project from 1983 until 1985. The total area of the proposed site is 4 square nautical miles (nmi). The eastern boundary of this site is located 18 nmi west of Egmont Key, Florida in the Gulf of Mexico. Since 1985, no disposal has occurred at this site.

The site designation is needed in this area to provide an ocean disposal option for dredging projects in the area. It should be emphasized that final designation of the interim Tampa site does not by itself authorize any dredging or on-site disposal of dredged material. EPA and the CE must conduct an environmental review of each proposed ocean disposal project. That review ensures that there is a demostrated need for ocean disposal and that the material proposed for disposal meets the requirements for dredged material given in the Ocean Dumping Regulations.

II. THE FLORIDA COASTAL ZONE MANAGEMENT PROGRAM (CZMP)

There are eight Florida statutes relating to ocean disposal site designations. This assessment discusses how the referenced EIS for the Tampa site designation will meet the CZMP objectives to protect coastal resources while allowing multiple use of coastal areas. Consult the EIS for further data and information.

Although the EIS serves a dual role of NEPA documentation for site designation and CE permitting under Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972, as amended (see Section 2.01 of EIS), this CZMP consistency evaluation is only relevant for site designation. Therefore, COE permitting actions will need a separate CZMP consistency evaluation.

A. Chapter 161: Beach and Shore Preservation

The intent of Chapter 161 is the protection of thousands of miles of Florida's coastline by regulating construction activities near and within these areas. The Tampa site designation will, by itself, require no new construction and therefore no related support activities will be subject to the construction regulations in this chapter.

The eastern boundary of the Tampa ODMDS is located 18 nmi from Egmont Key, the nearest beach and shore-related amenity. Sediment transport in the vicinity of the site is driven mainly by weather events. Because of this, dispersion of the material can be in any direction. Extensive monitoring of previous disposal at this site showed that no adverse impacts occurred due to movement of dredged material. In the event that significant accumulation of the dredged material towards any amenity is evident, use of the site can be modified or terminated by EPA.

B. Chapter 253: State Lands

This chapter addresses the responsibilities of the State Board of Trustees in managing the State sovereign lands by issuing leases, easements, rights of way, or other forms of consent for those wishing to use State lands, including State submerged lands.

Since the Tampa site is not within State waters, Chapter 253 is not relevant.

C. Chapter 258: State Parks and Preserves

There are no State Parks or Preserves in close proximity to the proposed Tampa site. As similarily discussed in Section A above, the distance from these areas to the proposed site should prevent any impacts to these areas from use of the site.

D. Chapter 267: Historic Preservation

There are no known features of historical importance in the vicinity of the proposed site, and therefore it is unlikely that the proposed site designation will result in any impact to these areas.

E. Chapter 288: Commercial Development and Capital Improvements; Industrial Siting Act

The final designation of the Tampa site provides an environmentally acceptable ocean location for the disposal of dredged material that meets the Ocean Dumping Criteria. If ocean disposal is selected as the most feasible option for a dredged material disposal project, this site designation ensures that an ocean disposal option is available in the area. Therefore, the designation removes one barrier to free and advantageous flow of commerce in the area in that dredging projects and their associated navigational benefits cannot be halted due to the lack of an acceptable ocean disposal site.

The Industrial Siting Act is not applicable to this proposed site designation.

F. Chapter 370: Saltwater Fisheries

Chapter 370 ensures the preservation, management and protection of saltwater fisheries and other marine life. Most commercial and recreational fishing activity in the Tampa vicinity is concentrated in inshore and nearshore waters. No natural hardbottom areas are known to occur in close proximity to the proposed site. The Tampa site does not represent a unique habitat for any of the important commercial or recreational fisheries. Use of the site will smother the non-motile or slow moving benthic organisms at the site. However, the ability of these organisms to recolonize in similar sediments renders this impact short-term and insignificant. Should the disposed material differ in grain-size, other benthic organisms would likely colonize the area. The EIS will serve as the Biological Assessment from which the National Marine Fisheries Service (NMFS) and, as appropriate, the U.S. Fish and Wildlife Service (FWS) can determine any adverse impacts of the proposed EIS action on threatened and endangered species under their purview.

G. Chapter 376: Pollutant Discharge Prevention and Removal

Possible effects associated with the use of this site are local mounding, temporary increases in turbidity and the smothering of benthic organisms. The effect on the benthos should be minor as discussed in Section F above. Turbidities resulting from use of the site will be temporary. Any suspended sediments remaining in the water column will be diluted and dispersed so that the long term effect would not be greater than ambient suspended solids concentrations.

Any material proposed for ocean disposal must meet the criteria given in 40 CFR Part 227 (Ocean Dumping Criteria). EPA and the CE will continue to monitor the site as long as it is used to detect movement of the material and any associated impacts. The Site Management and Monitoring Plan (SMMP) for the Tampa ODMDS is included in the EIS (see Appendix C).

H. Chapter 403: Environmental Control

The principle concerns raised in this chapter are similar to those addressed in many of the chapters discussed above: pollution control, waste disposal and dredging.

The CE and EPA will evaluate all federal dredged material disposal projects in accordance with the EPA criteria given in the Ocean Dumping Regulations (40 CFR Sections 220-229), the CE regulations (33 CFR 209.120 and 209.145), and any state requirements. The CE will also issue permits to private dredged material disposal projects after review under the same regulations.

EPA has the right to disapprove any ocean disposal project if, in its judgement, all provisions of the MPRSA and associated implementing regulations have not been met.

III. CONCLUSIONS

Based on the information presented in the EIS and the above summary, EPA concludes that the proposed designation of the Tampa ODMDS is consistent with the Florida CZMP to the extent feasible.

APPENDIX H

SHORT-TERM TRANSPORT AND DEPOSITION EVALUATION

PREFACE

The following evaluation was conducted prior to the development of the current Site Management and Monitoring Plan. The Site Management and Monitoring Plan and disposal requirements referenced in the evaluation are those presented in the Draft Environmental Impact Statement for the Designation of an Ocean Dredged Material Disposal Site Located Offshore Tampa, Florida.

TAMPA ODMDS DREDGED MATERIAL SHORT-TERM TRANSPORT AND DEPOSITION EVALUATION

1.0 INTRODUCTION

The U.S. Environmental Protection Agency is currently in the process of designating an Ocean Dredged Material Disposal Site (ODMDS) offshore Tampa Bay, Florida. The proposed site is square-shaped, covers 4 square nmi, and its boundary coordinates are as follows:

NW	27°32'27"N,	83°06'02"W
NE	27°32'27"N,	83°03'46"W
SW	27°30'27"N,	83°06'02"W
SE	27°30'27"N,	83°03'46"W

The site is 18 nmi west-southwest of the mouth of Tampa Bay in water depths of about 22 meters.

Previous disposal of consolidated materials within the site has created communities that have colonized the disposal mound. Therefore, the draft Site Management and Monitoring Plan requires: 1) no disposal directly on any portion of the mound; 2) restriction within the area of the mound to disposal of material that consists of at least 90% gravel or larger grain size; 3) restriction of disposal of sand-sized material to those areas within the site north and south of the mound; and 4) allows the disposal of any material meeting EPA ocean disposal criteria within the northernmost sector of the site. The site and the restriction areas are shown in figure 1-1.

During a meeting held in Tallahassee, Florida in September 1993 between the State of Florida, Jacksonville District Army Corps of Engineers and EPA Region IV, concerns were raised regarding possibilities of initial deposition of fine material on the mound and on previously unmapped areas to the north of the site boundaries. It was decided to use the Army Corps of Engineers STFATE (Short-Term Fate of dredged material disposal in open water) model to determine the deposition distribution due to disposal of fine grained dredged material under a worst case scenario.

This study examines the hydrography of the Tampa ODMDS area, disposal operational data, and dredged material characteristics for input into the STFATE model and describes the predicted results of both deposition of material and suspended sediment concentrations. It does not address long-term dispersal of material. Modelling of long-term dispersal of material at the Tampa ODMDS can be found in *Tampa Bay Dredged Material Disposal Site Analysis*, October 1983, by David T. Williams.

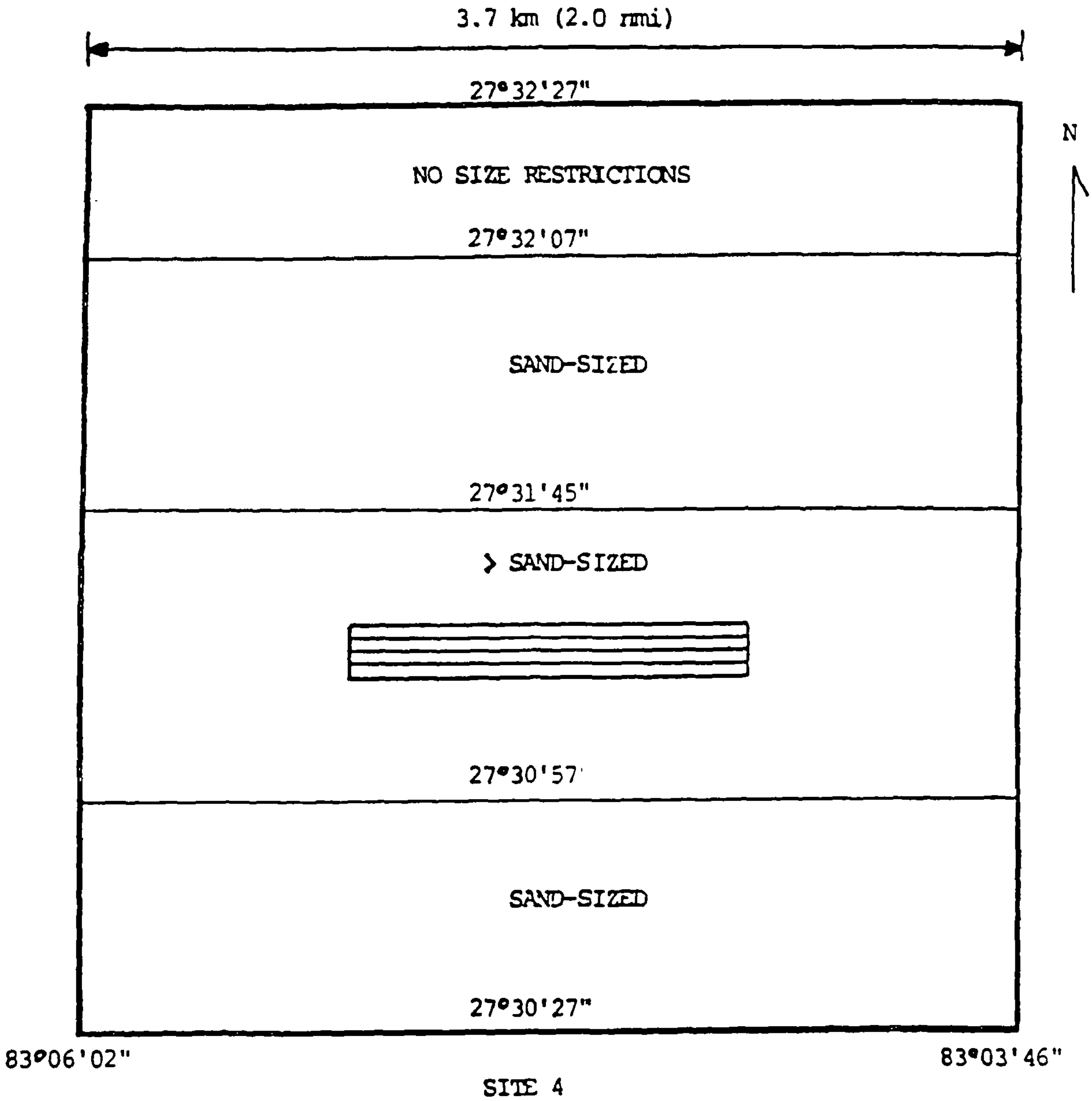

3.7 km (2.0 nmi)
27°32'27"
N
NO SIZE RESTRICTIONS
27°32'07"
SAND-SIZED
27°31'45"
> SAND-SIZED
27°30'57'
SAND-SIZED
27°30'27"
83°06'02"
83°03'46"
SITE 4

Figure 1-1

2.0 HYDROGRAPHY

2.1 Currents

Currents in this area are primarily influenced by detached cyclonic eddies from the Gulf loop current, tides and by wind inducement. Average circulatory current direction has two seasons, summer and winter. Circulatory currents are generally southward in the winter and northward in the summer. Tidal currents are generally in the east-west direction. Bottom currents are generally parallel in direction to the surface currents, however they can occasionally differ by 180° (Williams, 1983). The Loop Current front will reach the Tampa ODMDS with a frequency of less than 5% as seen in Figure 2-1. The frontal eddies associated with the Loop Current are rotating (period=10 to 15 days), westward translating (approximately 3 to 7 km/day) masses of relatively warm water (SAIC, 1989). The loop current eddy intrusions onto the shelf generally stay outside of the 20 meter isobath (Danek, 1986).

2.1.1 ODMDS Field Measurements and Analysis

The physical oceanography of the Gulf of Mexico has been extensively studied. However, most of the studies have focused on the oil and gas bearing areas in the central and western Gulf. The Eastern Gulf and especially as far shoreward as the Tampa ODMDS has had limited study. Therefore limited measured current data is available for the vicinity of the Tampa ODMDS. Two field studies have been undertaken that included measurements of currents. From March 9, 1983 to May 12, 1983 the U.S. Army Corps of Engineers Waterways Experiment Station (WES) and the Jacksonville District of the Army Corps of Engineers (SAJ) deployed four current meters at the site. Two were deployed at the center of the site 3ft and 9ft from the bottom and two were deployed 1nmi from the site at 3ft and mid-depth. Unfortunately, the one at mid-depth was lost. During this study 99% of the recorded velocities were below 20cm/sec and 76% were below 10cm/sec. The average was 6.9cm/sec. A majority of the current measurements from all meters were in the southerly direction, with the predominant direction being towards the southeast (Williams, 1983).

From April 1984 to May of 1985 a more extensive study was conducted by Battelle Ocean Sciences for EPA. Currents were measured based on hourly averages. Results of the 13 month data set indicate that currents flowed predominately toward the east during spring and early summer 1984, then shifted toward the southeast and south during fall, winter and spring of the following year. The strongest currents occurred during late fall and winter and were directed due south. Most current velocities were less than 10cm/sec, and only rarely did they exceed 20 cm/sec. The mean velocity during all quarters was between 5 and 8 cm/sec (Battelle, 1987). Frequency distribution plots at station 5 for magnitude and direction are shown in Figures 2-2 and 2-4 respectively. These show that for all seasons, the most probable current magnitude lies between 5 and 10cm/sec and the current direction varies. However, direction is predominately towards the south and east.

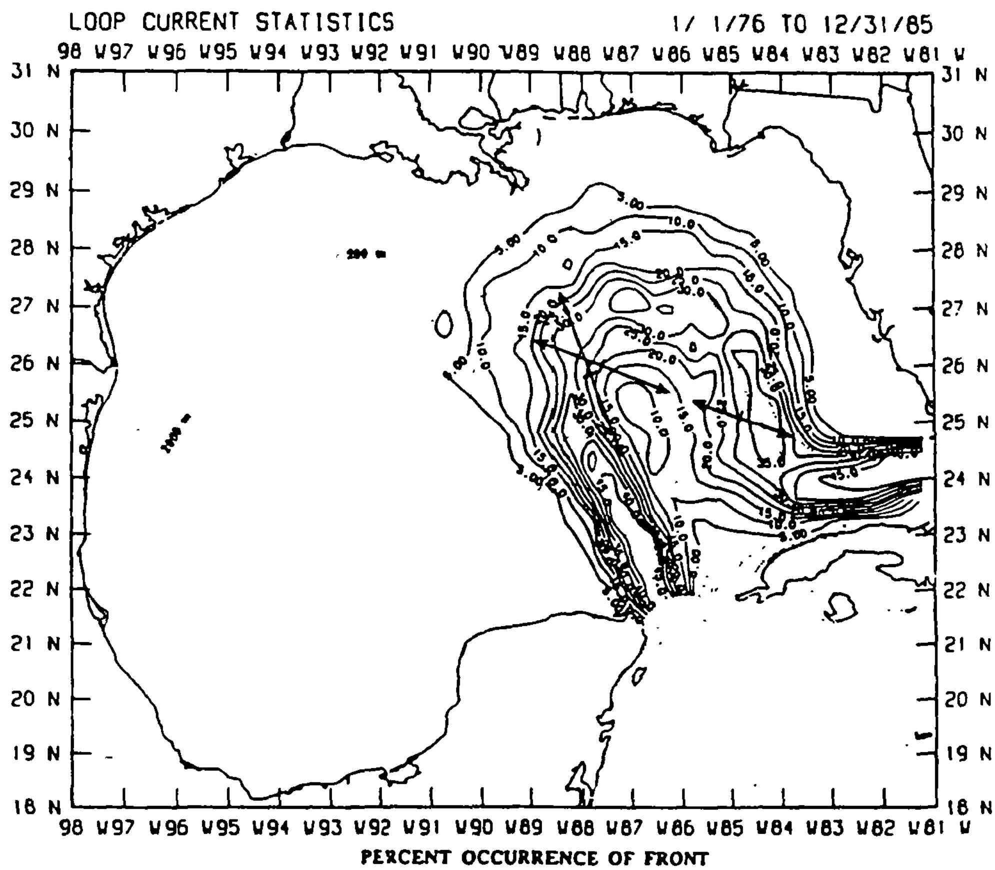
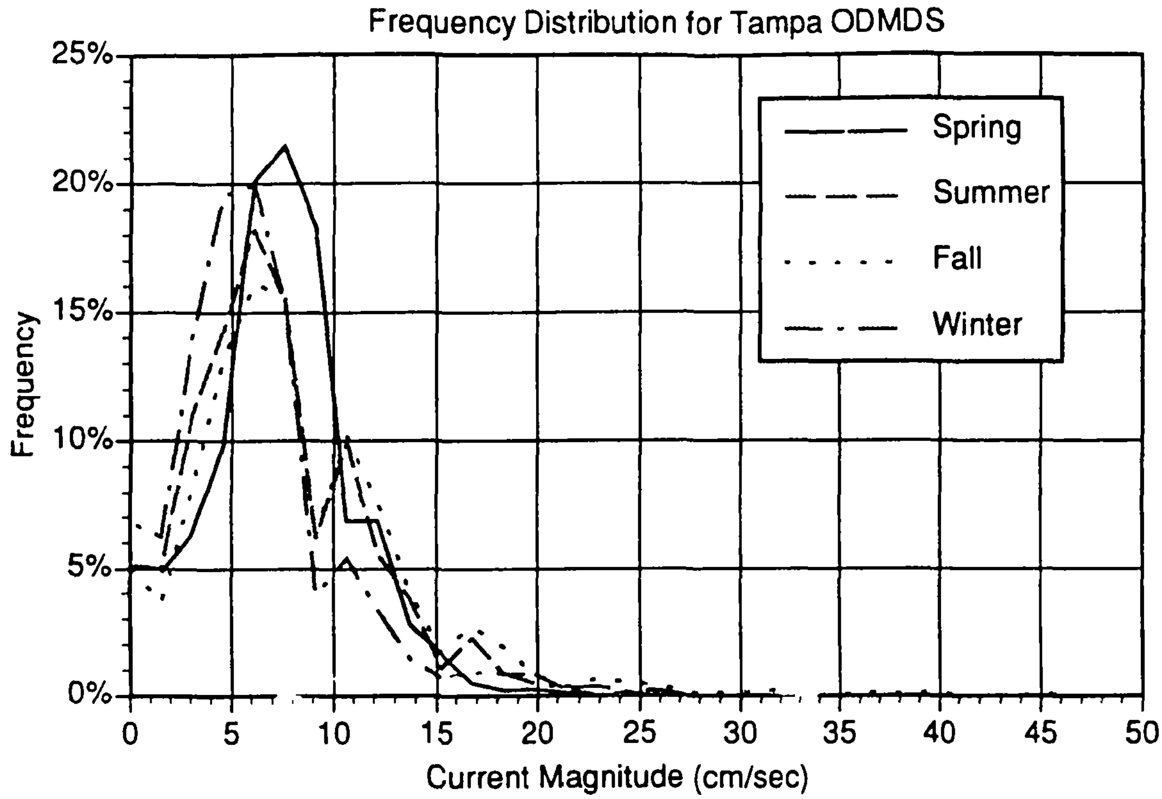


Figure 2-1 Isopleths of the relative frequency that the Loop Current Front was observed in the indicated 1/2° squares. The arrows show the mean east-west and northern LC boundary location as determined from SOOP transects. (SAIC, 1989)



Spring: MAR-MAY 1985; Summer: APR-AUG 1984; Fall: AUG-DEC 1984; Winter: DEC 1984-MAR 1985

Fig. 2-2

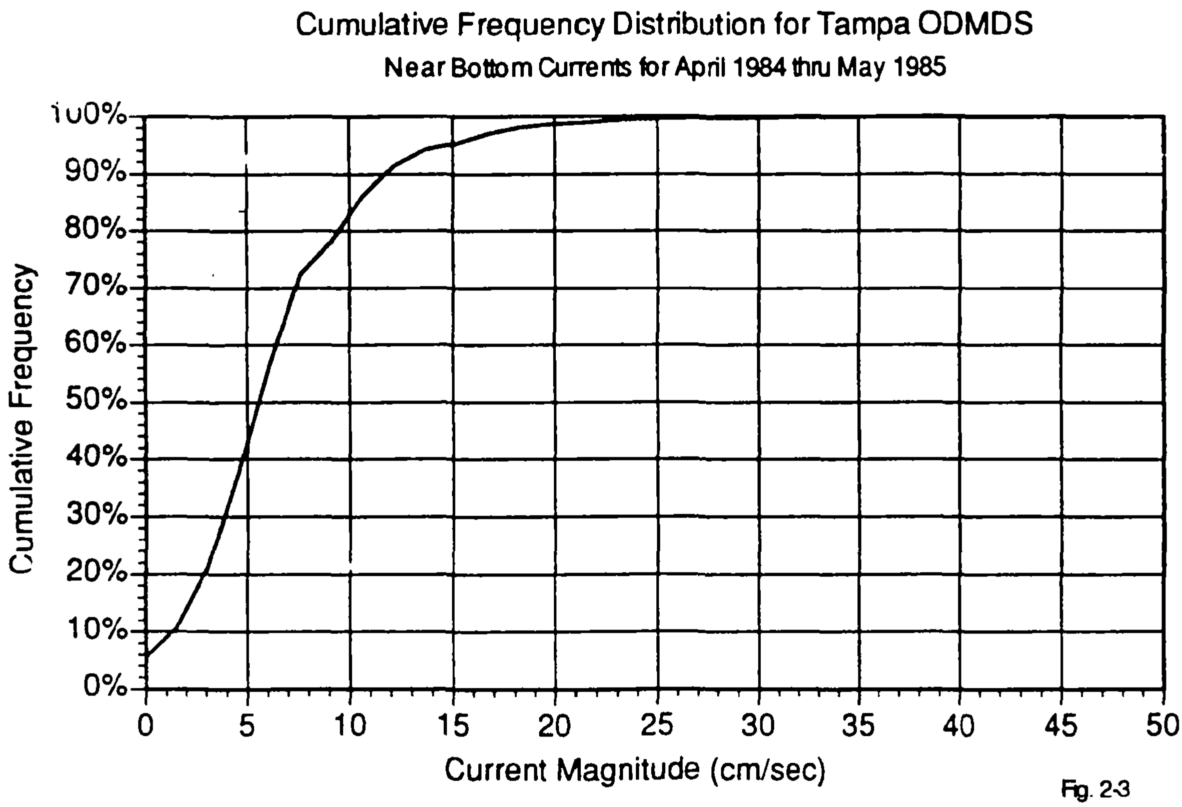


Fig. 2-3

A cumulative probability plot for current magnitude at station 5 is shown in Figure 2-3. Figure 2-3 shows that 95% of the current measurements had magnitudes less than 15cm/sec.

A progressive vector diagram for the data set is shown in Figure 2-5. The diagram is intended to show the theoretical trajectory of a particle in suspension. The total distance travelled and the location of the endpoint should not be considered realistic since the diagram does not take into account the spatial variations in the current. Instead, the direction of transport is the important feature to notice. Figure 2-5 indicates that material transport would be primarily toward the southeast. Similar calculations were made for the seasonal intervals. Results for spring indicate transport toward the southeast, for summer toward the west, for fall toward the east and for winter toward the south.

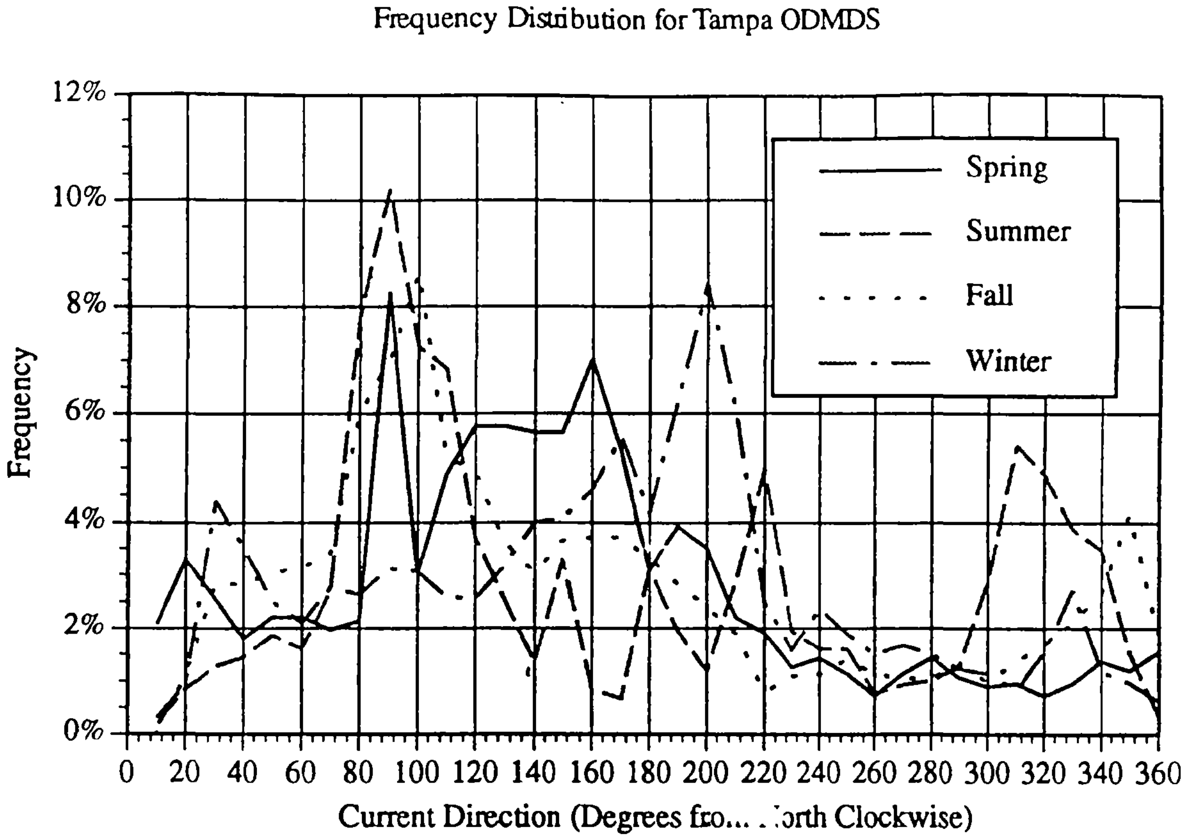
A more meaningful estimation of material advection than the progressive vector diagram that can be derived from this data set is the streakline. As described in Fischer et al., this concept assumes that the ocean current is spatially homogeneous but temporally variable. Using measured current velocity data, the location of the center of the suspended material plume during advective transport can be shown to be:

$$x(\tau, T) = \int_{\tau}^{T+\tau} \mathbf{u}(t)\, dt$$

where: $\mathbf{u}(t)$ is the measured current velocity
T is the time of travel
τ is the release time

For each travel time (T) and release time (τ), the values of $x(\tau,T)$ can be determined by integrating the current data and then tested for whether or not it is beyond some imaginary line (such as the berm or ODMDS boundary). By varying T and τ throughout the range of available current data, this would provide some measure of the probability of transport to the area of concern for various travel times. The estimates of the probabilities become progressively worse for longer travel times. It should be noted that this type of analysis is subject to the assumption that the ocean current is spatially homogenous. (Fischer et al., 1979)

Estimated probabilities of transport using the Battelle data to two distances north and south for the four seasons separately and the complete data set as a whole are shown in figures 2-6 through 2-9. Due to the predominately southerly current, the probabilities are much greater for the southern boundaries.



Spring: MAR-MAY 1985; Summer: APR-AUG 1984; Fall: AUG-DEC 1984; Winter: DEC 1984-MAR 1985

Fig. 2-4

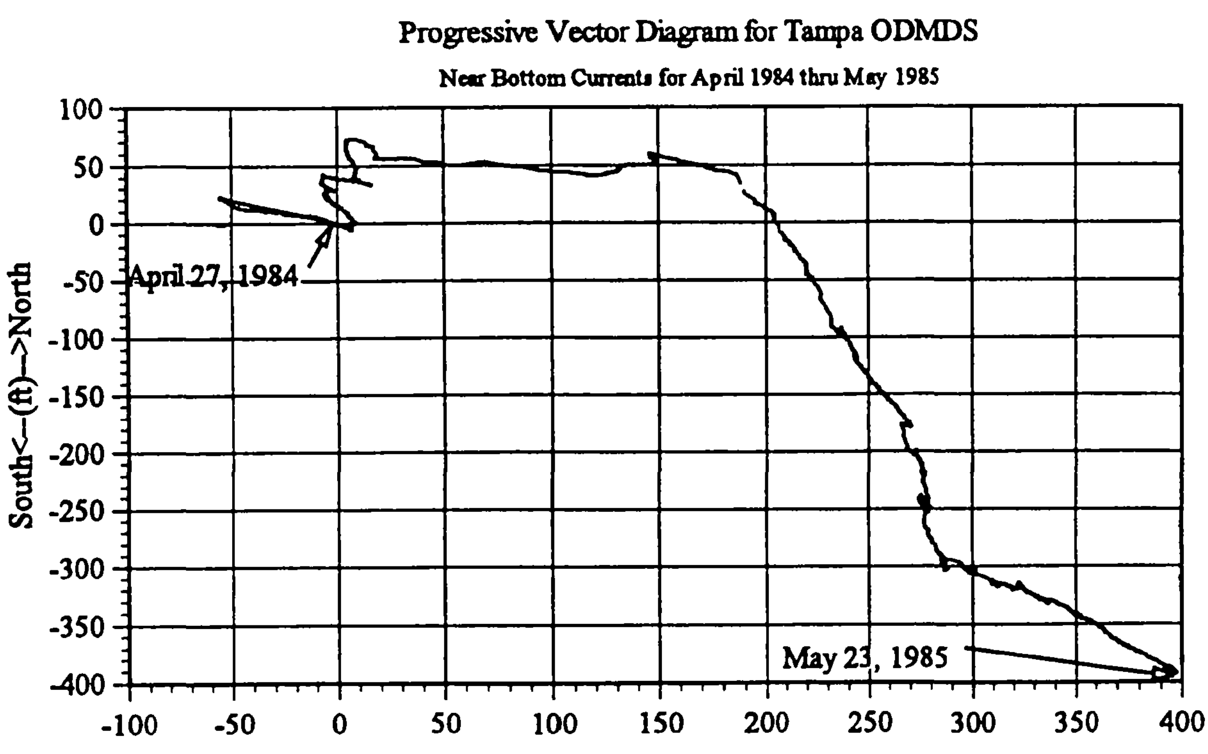


Fig 2-5

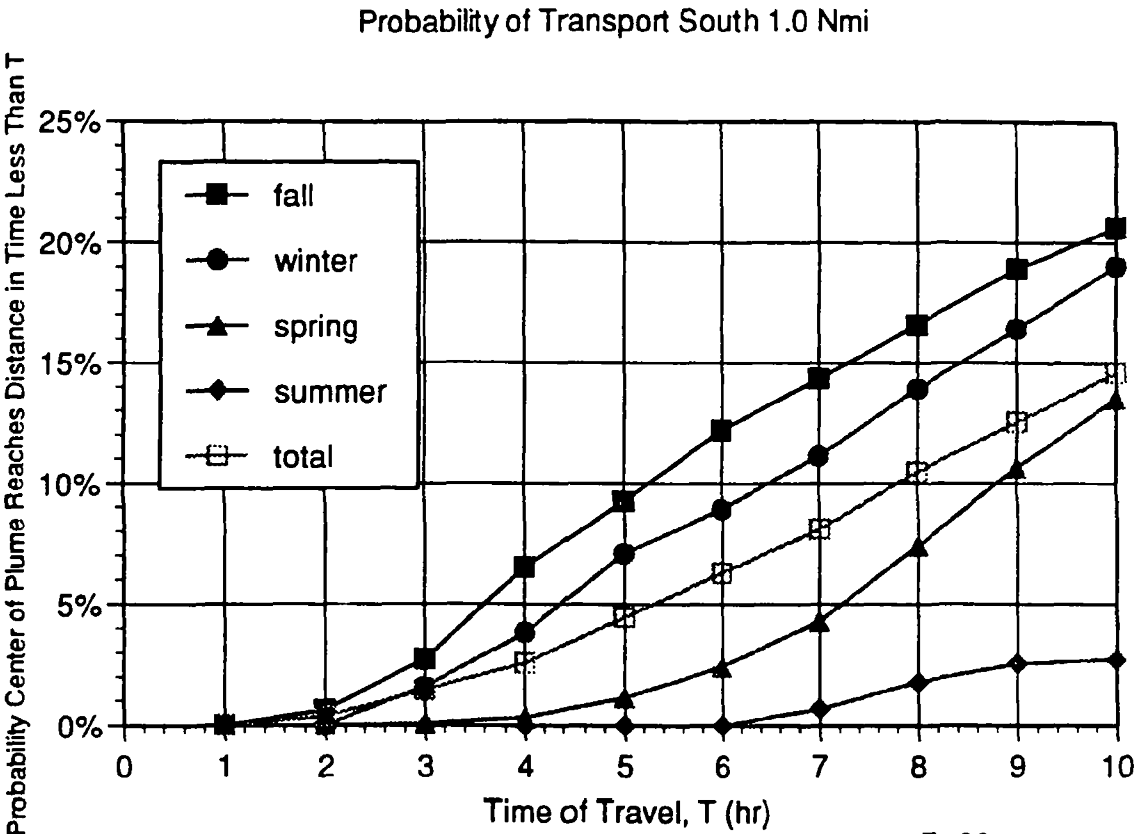

Probability of Transport South 1.0 Nmi
Probability Center of Plume Reaches Distance in Time Less Than T
25%
20%
15%
10%
5%
0%
fall
winter
spring
summer
total
0
1
2
3
4
5
6
7
8
9
10
Time of Travel, T (hr)

Fig. 2-6

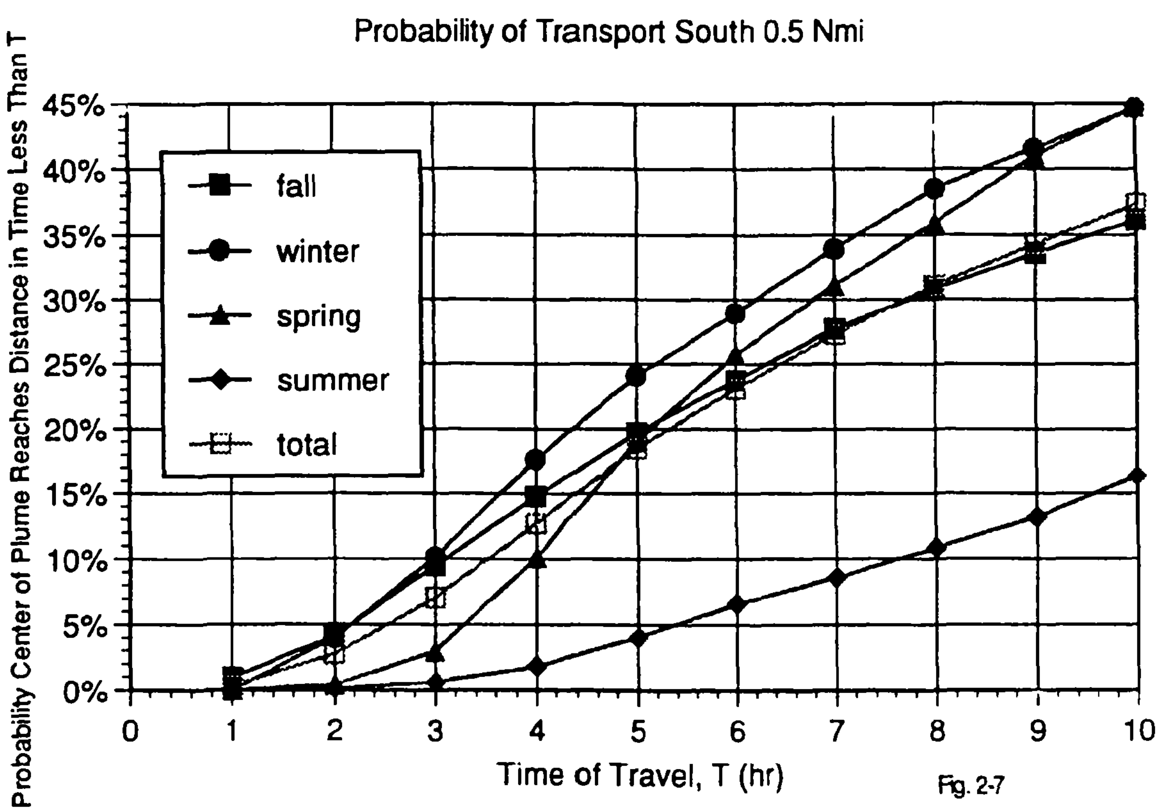

Probability of Transport South 0.5 Nmi
Probability Center of Plume Reaches Distance in Time Less Than T
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
fall
winter
spring
summer
total
0
1
2
3
4
5
6
7
8
9
10
Time of Travel, T (hr)

Fig. 2-7

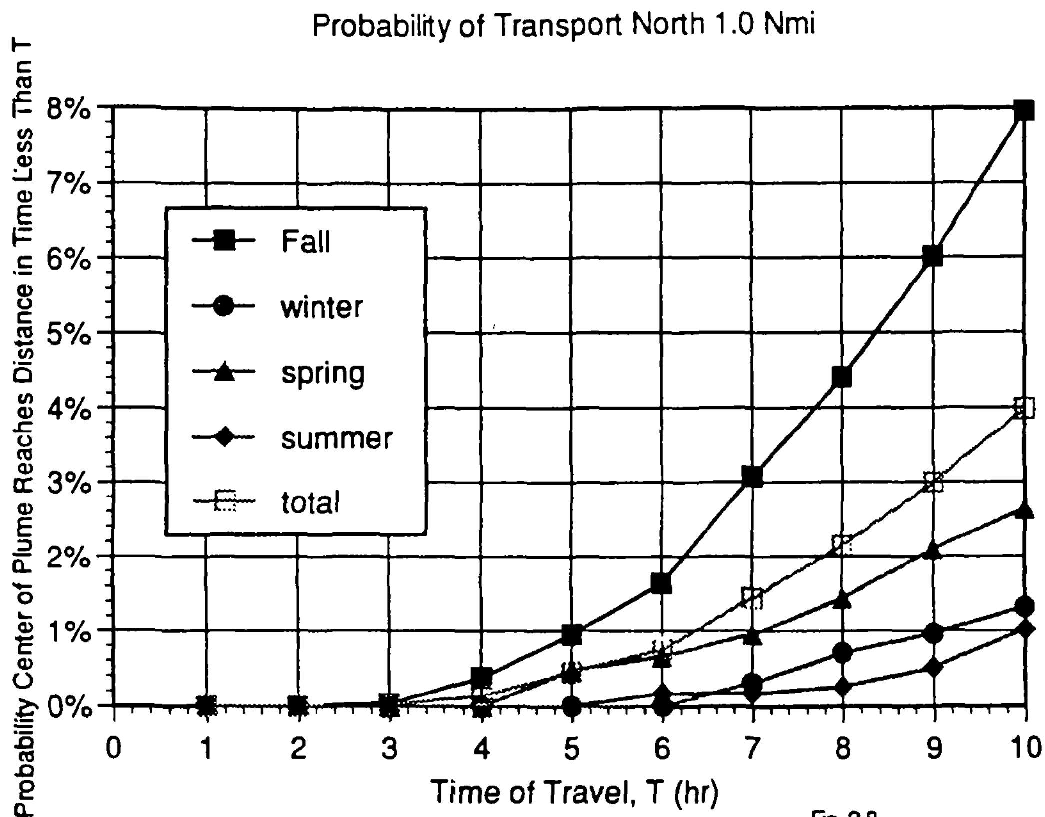

Probability of Transport North 1.0 Nmi
Probability Center of Plume Reaches Distance in Time Less Than T
8%
7%
6%
5%
4%
3%
2%
1%
0%
Fall
winter
spring
summer
total
0
1
2
3
4
5
6
7
8
9
10
Time of Travel, T (hr)

Fig. 2-8

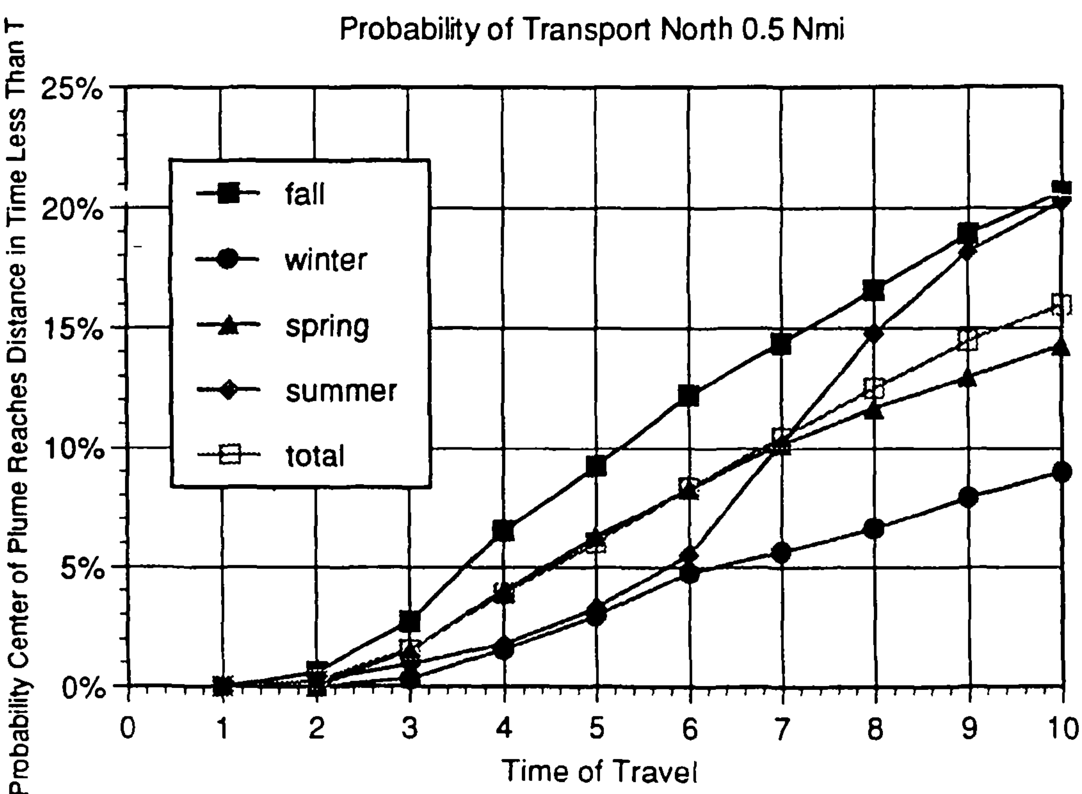

Probability of Transport North 0.5 Nmi
Probability Center of Plume Reaches Distance in Time Less Than T
25%
20%
15%
10%
5%
0%
fall
winter
spring
summer
total
0
1
2
3
4
5
6
7
8
9
10
Time of Travel

Fig. 2-9

2.1.2 Other Studies

Other studies have been conducted in the vicinity of the Tampa ODMDS. The Minerals Management Service conducted a five year survey, *Southwest Florida Shelf Benthic Communities Study*, south of Charlotte Harbor, Florida. Based on two years of current data, surface currents at the shallower stations (near the 20 meter isobath) exceeded 20 cm/sec 4.6% of the time with an average speed of 8.4 cm/sec. Net currents at the shallower stations (using a progressive vector diagram) exhibited considerable constancy at velocities less than 2 cm/sec and setting toward the south or southeast (Danek, 1986). Ichiye et al. estimated yearly average surface ekman currents (wind currents) for the Tampa ODMDS vicinity at 3 cm/sec with a maximum monthly average of 8.6 cm/sec for October in the westerly direction (Ichiye et al, 1973).

2.1.3 Tides

Tides along the east coast of Florida consist of semi-diurnal and diurnal tides. From measurements taken for about a week in June 1972 about 120 nautical miles west of Naples, Florida (26° 03.1'N, 83°49.4'W and 25°57.6'N, 83°49.9'W) the tidal current amplitudes reach 15cm/sec at mid-depth (Ichiye et.al., 1973). Also, Dr. Norman Scheffner of WES predicted peak surface tidal velocities at 15cm/sec for the Tampa ODMDS location using a tidal prediction computer program. These values indicate that tides can be a significant periodic component of the total current.

2.1.4 Storms

The most severe current effects detected during any study in the vicinity of the Tampa ODMDS occurred during the *Southwest Florida Shelf Benthic Communities Study*, during Tropical Storm Bob in July 1985. The current speeds increased nearest the center of the storm at the stations in approximately 20 meters of water from an average of less than 10 cm/sec to peak speeds of approximately 60 cm/sec (Danek, 1986).

2.2 Current Analysis for STFATE Input

The STFATE module requires current data at two depths. The current throughout the water column is then interpolated based on this input. For the bottom depth, the 95 percentile current magnitude (ie. 95% of the currents measured were less than this value) from the Battelle 84/85 study will be used (15cm/sec). This current input will be designated as 3 meters off the bottom. At the surface a current magnitude of 20cm/sec will be used. Surface currents are typically greater than those near the bottom (although they usually vary in magnitude and direction) and the Minerals Management Service study discussed above indicated that 95.4% of the surface current measurements were less than 20cm/sec. Currents due to tides and wind will not exceed either of these values and are considered a component of these values. Disposal will not occur during storm conditions.

2.3 Water Temperature and Salinity

The water column over the shallow shelf generally exhibits very weak temperature and/or salinity stratification. Peak temperature stratification may result in a temperature differential of 5°C between surface and bottom waters. The mean vertical temperature differentials measure by JRB Associates was 0.3°C. Surface and bottom water temperatures may reach 30°C in summer and decrease to 17°C in winter. Salinity stratification is greater during the summer. The mean salinity gradient measured by JRB Associates was 0.2 ppt. (EPA, 1993). Winter and summer temperature and salinity measurements taken by Molinari et al. are shown in Figures 3-6 and 3-7 in the Tampa ODMDS EIS.

Other studies in the Southwest Florida Shelf indicate similar values. The *Southwest Florida Shelf Benthic Communities Study* reported near bottom salinities in the range of 34.8 to 36.0 parts per thousand and temperature in the range of 20.3° to 29.6°C at the station in 20 meters of water offshore Charlotte Harbor (Danek, 1986). The *Southwest Florida Shelf Ecosystem Study - Year 2* reported temperatures at the surface from 30.6°C during summer to 24.5°C during the winter and 20 meter temperatures from 26°C during summer to 20°C during winter offshore Charlotte Harbor. Salinities were reported for the surface ranging from 35.6 to 36.4 parts per thousand in the summer and winter respectively and for 20 meter depth from 36.0 to 36.5 per thousand in summer and winter respectively (MMS, 1985). Molinari et al. reported temperatures in the ODMDS vicinity at 19°C and 30°C for winter and summer respectively. Salinities were in the range of 35.6 parts per thousand for winter and 36.2 parts per thousand for summer (Molinari et al., 1975).

2.4 Water Density Analysis

For short term plume transport analysis, a conservative density gradient will be used. The greater the gradient, the more likely the turbidity plume will remain suspended longer. For maximum stratification, summer temperature conditions are assumed with a 5°C differential selected, ie. temperature at surface equals 30°C and at bottom equals 25°C. Also the greatest salinity stratification is assumed with the surface at 35.6 and the bottom at 36.0 parts per thousand. Density is a function of both temperature and salinity and can be expressed as a sigma-t value. For a small range of salinities such as found in sea water, linear interpolation suffices to a high degree of accuracy using the equation:

$$\sigma t(T,S) = \sigma t(T,S_0) + \partial \sigma t/\partial S(T,S)\,[S-S_0]$$

and tables as developed in Fischer et al. (1979) where S_0 is some reference salinity (in this case S_0=34 parts per thousand). Using this method, the conservative densities are: density at bottom=1024.117kg/m^3 and density at surface=1022.196kg/m^3.

2.5 Turbidity

Suspended sediment concentrations were measured in an EPA study in September/October 1979 and January 1980. Concentrations were taken at three depths approximately 3 nautical miles inshore from the current Tampa ODMDS. Surface total suspended solids (TSS) concentrations ranged from 0.61 to 2.87 mg/l in September/October, and from 1.08 to 2.97 mg/l in January; bottom TSS concentrations (10 to 15 meters in depth) ranged from 0.55 to 2.53 mg/l in September/October and from 0.76 to 2.97 mg/l in January (EPA, 1993). No other TSS data was found for the vicinity of the site, however, TSS concentrations are generally higher in coastal than offshore waters and can be expected to be slightly lower at the current ODMDS than those measured.

3.0 DISPOSAL CHARACTERISTICS

The dredging season is generally from February/March to August although there are no seasonal restrictions on dredging in the Tampa vicinity. However, disposal activities would be halted during significant meteorological events such as frontal systems, tropical storms, and hurricanes. The dredged material to be disposed of at the ODMDS will be collected either by clamshell and loaded for transport into scows or by hopper dredge. The dump scow would have a capacity of approximately 3,000 cubic yards and on a busy day (two clamshell dredges operating) be able to dispose of 24,000 cubic yards with dumps occurring approximately every 2 hours. The hopper dredge on the other hand would have a capacity of approximately 3,600 cubic yards and could dispose of a total of 18,000 cubic yards per day with dumps occurring approximately every 4 hours.(Miller, JAX, 1993/94)

The split-hull barge with a capacity of 3600 cubic yards with dimensions of 280 ft by 50 feet wide will be assumed for the simulation. The freeboard is 3ft and it will draw 17 to 19 feet. If speed is not restricted, the barges speed at disposal is about 6 knots. Disposal will occur every two hours. These assumptions are conservative, using the greater volume of material per dump and the greater dump rate. The total time for disposal is 5 minutes where most of the material is disposed of within 20 seconds. (Miller, JAX, 1993/94) Disposal of fine material will occur in the ODMDS north of the areas identified as having live bottom habitat. This is the area designated for fine material as shown in the Draft Monitoring and Management Plan and figure 1-1. This disposal will occur approximately 1/6 nmi south of the north border of the ODMDS (Collins, 1993).

4.0 SEDIMENT CHARACTERISTICS

Core boring data was supplied by the Jacksonville District of the Corps of Engineers for a core in the Egmont Bar Channel (Sample #24, 1992). This core was chosen for its poor quality of material, ie large percentage of fines. The finer material is more likely to be transported a greater distance. The characteristics of the material is given below:

Characteristic	Weight Fraction of Total Solids	Volumetric Fraction
Silt or Clay	60%	27.0%
Fine Sand	37%	16.7%
Medium Sand	3%	1.35%
Coarse Sand	0%	0.0%
Water		54.9%

Specific Gravity of Solids = 2.66
Bulking Factor = 2.21
Pore Water Density = 1017.5 kg/m^3

Percent Solid = 45.1%
Percent Moisture Content = 45.6%

Adamec et al. reported typical silt/clay characteristics for dredged material as consisting of 30% clumps, 65% flocculated as cohesive material and 5% as individual non-cohesive particles (Adamec, 1987). For this simulation, since long-term diffusion of fines is of major concern, 50% of the silt/clay is assumed to be non-cohesive. The cohesive fraction settling velocity is computed as a function of the suspended sediment concentration of that type. The non-cohesive fraction will fall at a slower rate than the individual settling velocity of the particles. Therefore, by assuming a greater fraction of non-cohesive material, more material will remain suspended for a longer period of time and consequently be transported a greater distance.

The density of the pore water of the dredged material was estimated from temperature and salinity measurements taken in Tampa Bay as given in "Surface Water Quality, Hillsborough County, Florida 1990, 1991." (Boler, 1991) An average temperature of 24.5°C and a salinity of 27 parts per thousand where used to obtain a density of 1017.5 kg/m^3.

Characteristics of material more likely to be disposed at the ODMDS (too fine for beneficial beach renourishment) is given below:

Characteristic	Weight Fraction of Total Solids	Volumetric Fraction
Silt or Clay	25%	16.9%
Fine Sand	67%	45.4%
Medium Sand	7%	4.7%
Coarse Sand	1%	0.7%
Water		32.3%

Specific Gravity of Solids = 2.66 Percent Solid = 67.7%
Bulking Factor = 1.48 Percent Moisture Content = 18%

5.0 STFATE MODEL

5.1 Description

The behavior of dredged material during disposal is assumed to be separated into three phases: convective descent, during which the disposal cloud falls under the influence of gravity and its initial momentum imparted by gravity; dynamic collapse, occurring when the descending cloud either impacts the bottom or arrives at a level of neutral buoyancy where descent is retarded and horizontal spreading dominates; and passive transport-dispersion, commencing when the material transport and spreading are determined more by ambient currents and turbulence than by the dynamics of the disposal operation. See figures 5-1 and 5-2. (Inland Testing Manual-Draft, 1993)

The numerical model used in this short term transport analysis is the STFATE (Short-Term Fate of dredged material disposal in open water) model. It is a module of the Automated Dredging and Disposal Alternatives Management System (ADDAMS) (Schroeder and Palermo, 1990). The STFATE module was developed from the DIFID (DIsposal From an Instantaneous Discharge) module.

The model run discussed here is not intended to simulate typical disposal at the Tampa ODMDS. Instead, it is intended to simulate a worst case condition for short-term transport of fine material away from the site. Worst case material assumptions have been made based on sediment core data provided by the Corps of Engineers Jacksonville District and previous work done in this field with some added factors of safety as discussed in previous sections. Worst case spatially homogeneous and temporally constant oceanographic conditions have also been assumed based on field collected data in the vicinity of the Tampa ODMDS as discussed previously.

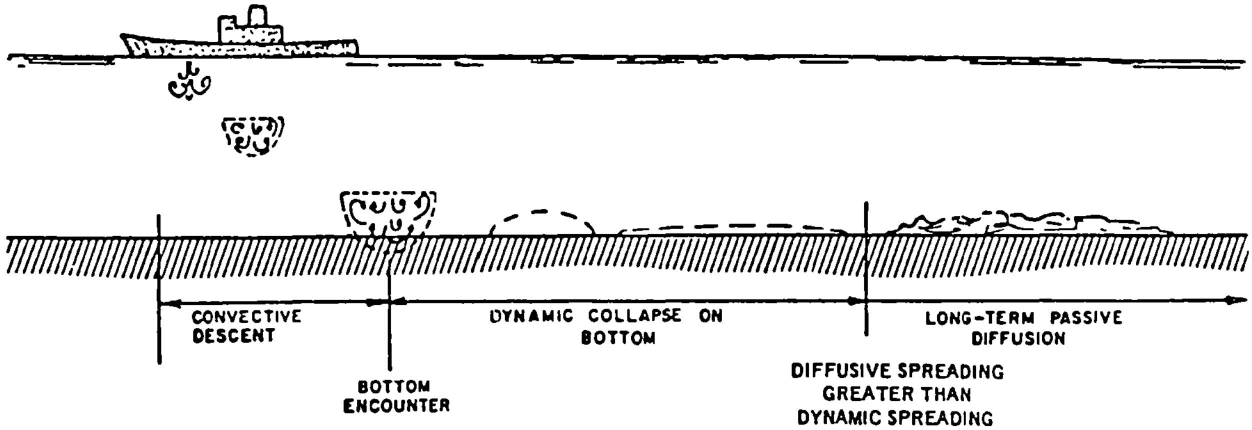


Figure 5-1 Idealized illustration of phases of dredgeo material after instantaneous disposal (From Brandsma and Divoky 1976)

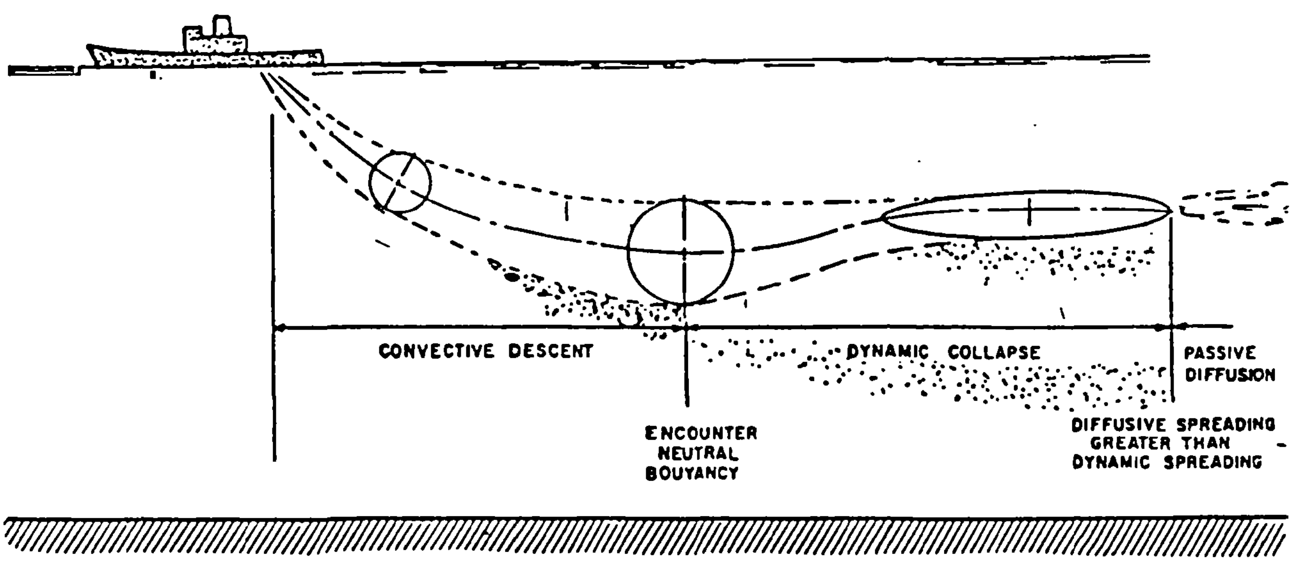


Figure 5-2 Idealized illustration of phases of dredged material with dynamic collapse above sea floor (From Brandsma and Divoky 1976)

5.2 Input

Model input data is given in Appendix A. Default model coefficients were used due to the absence of calibration data. Current values and density structure were used as discussed in sections 2.2 and 2.4 respectively. Operational data values were used as determined in section 3.0 and sediment characteristics as determined in section 4.0.

5.3 Results

5.3.1 Disposal Mound

A mound is formed consisting of all material not in the turbidity plume that has settled after the passive dispersion phase. The extent of the mound depends on various factors such as water depth, volume of release, ambient currents, and composition of material being released. As the dredging project proceeds, successive disposals will increase the size of the mound. For the situation modelled, the extent of deposition is of concern for extreme conditions.

Figure 5-3 shows the qualitative spatial extent of the disposal mound for a single dump. Quantitatively the mound is shown in figure 5-4 and in cross-section in Figure 5-5. The deposition thickness is less than 0.05 inches 2430 feet from the disposal point and has a maximum thickness of 7.4 inches. The side slopes range from 0.1% at the center to .003% near the outer edges. At the Tampa alternative site A used previously, 13nmiles offshore and in 10 to 17 meters depth, the slope of the deposits ranged from 0.3 to 1 percent (Williams, 1983). The slopes predicted by the model are gentler likely due to the assumed finer than average material and stronger currents causing the mound to be more spread out.

Figure 5-6 shows the distribution of material on the bottom as a percentage of the total material disposed. As can be seen, 90 percent of the material is deposited within 945 feet down current of the disposal point.

5.3.2 Turbidity Plumes

The turbidity plume consists of the transport-diffusion of the collapsed dredged material cloud and fine material lost to the water column at the top of the collapsing cloud. Centerline concentration in mg/l are plotted in figures 5-7, 5-8, 5-9, and 5-10 for depths of 15, 30, 45 and 65 feet for times from 300 to 1200 seconds. Shaded contour plots are shown in figures 5-10 through 5-15 to give a better conceptual representation of the plume movement. As expected, concentrations are greatest near the bottom and decrease towards the surface. In addition, the plume is transported more quickly near the surface than along the bottom due to the current gradient. The time from disposal and distance from disposal at which peak suspended sediment concentrations fall below ambient levels (0.5 to 3.0 mg/l) are given below:

Tampa ODMDS Disposal Mound from Single Dump
Surface Current of 20cm/sec

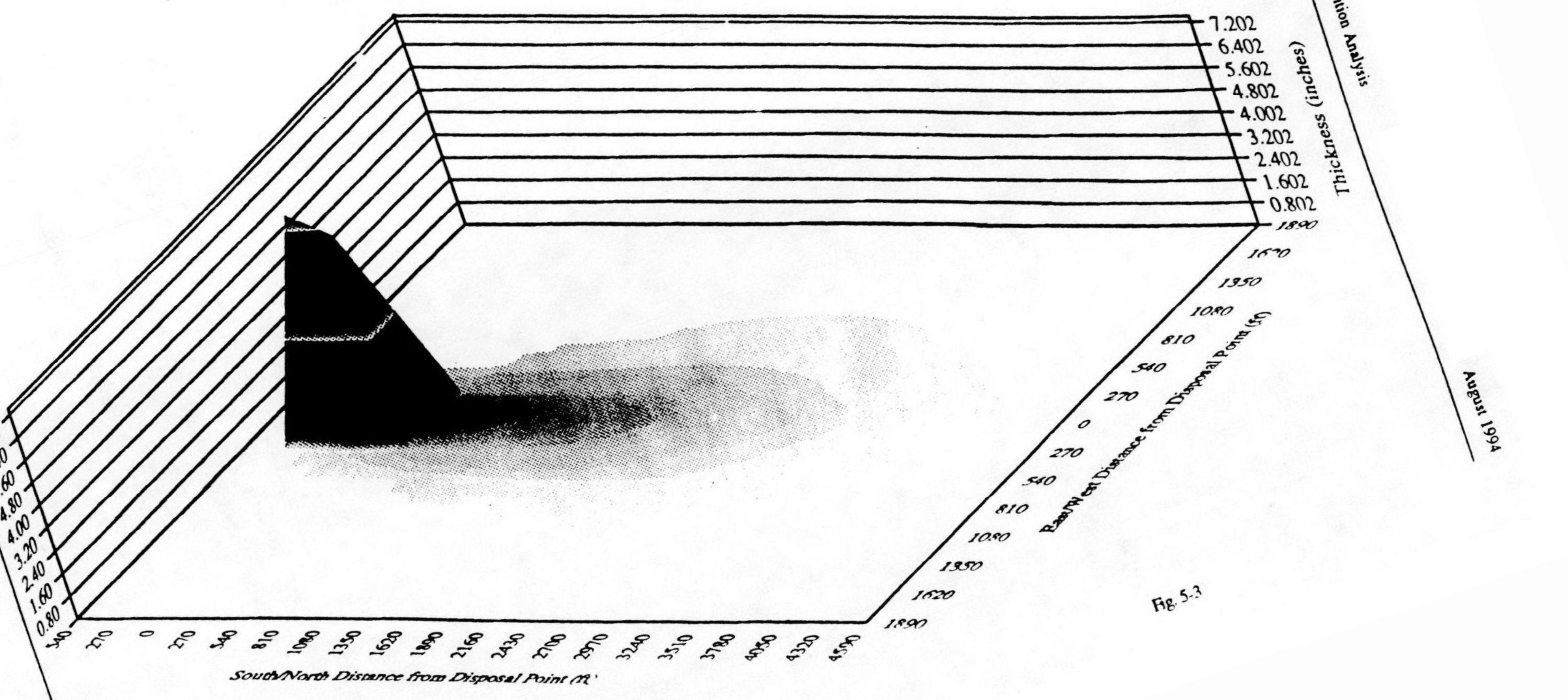
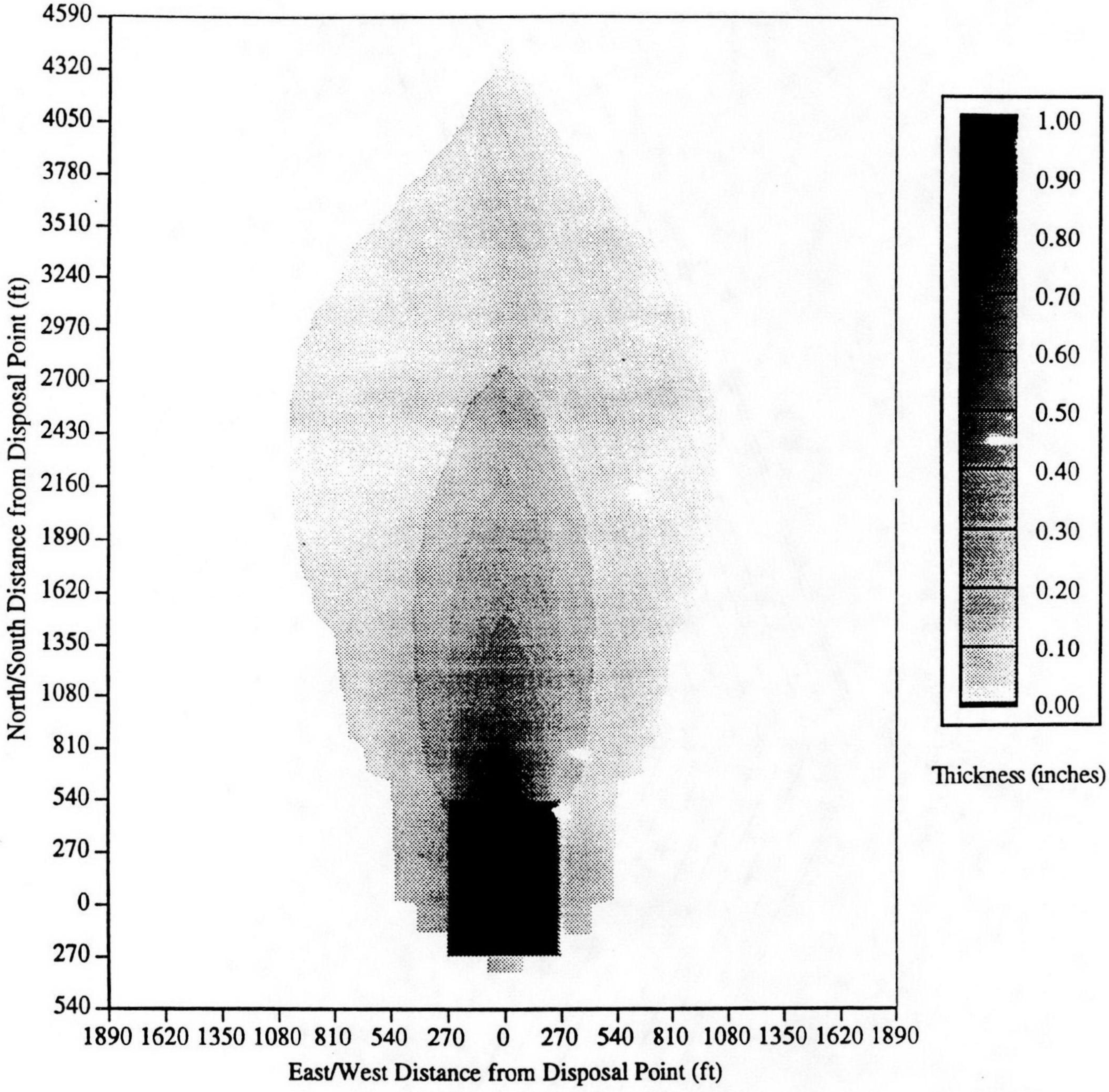


Fig. 5-3

Tampa ODMDS Disposal Mound from Single Dump



Note: Solid represents a thickness greater than 1.00 inches.

5-4

Tampa ODMDS Single Disposal Mound

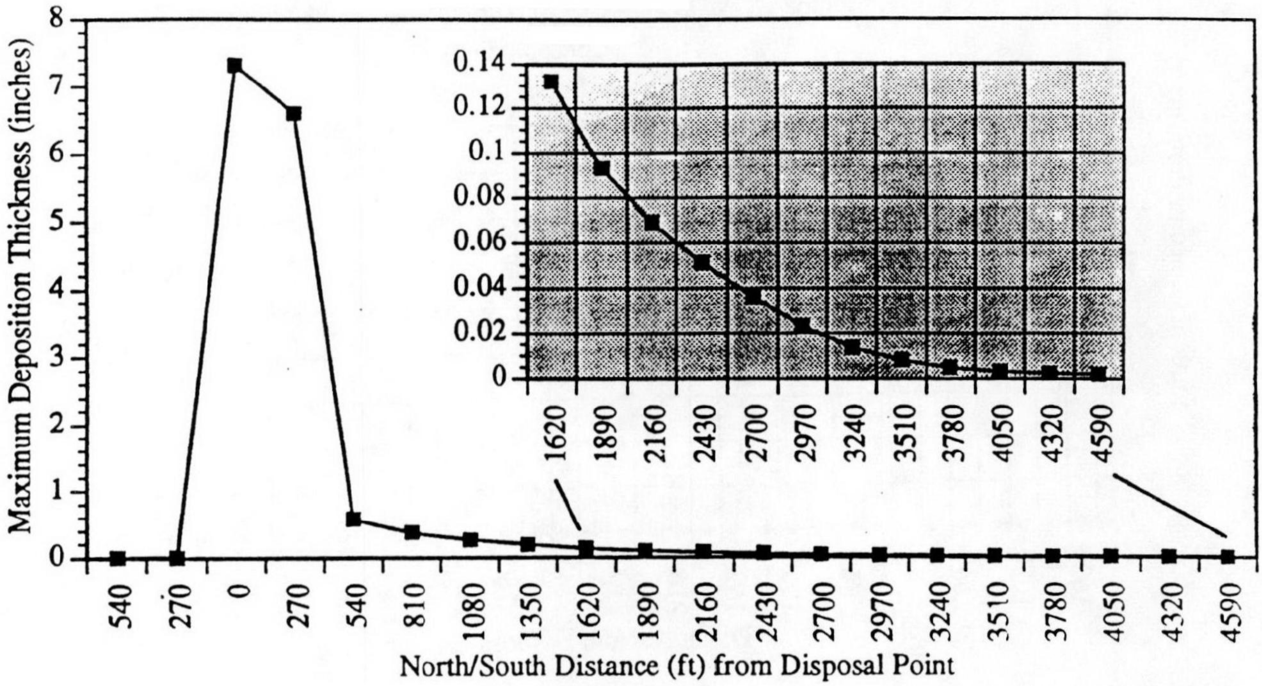


Fig. 5-5

Tampa ODMDS
Percent of Total Material Deposited on Bottom

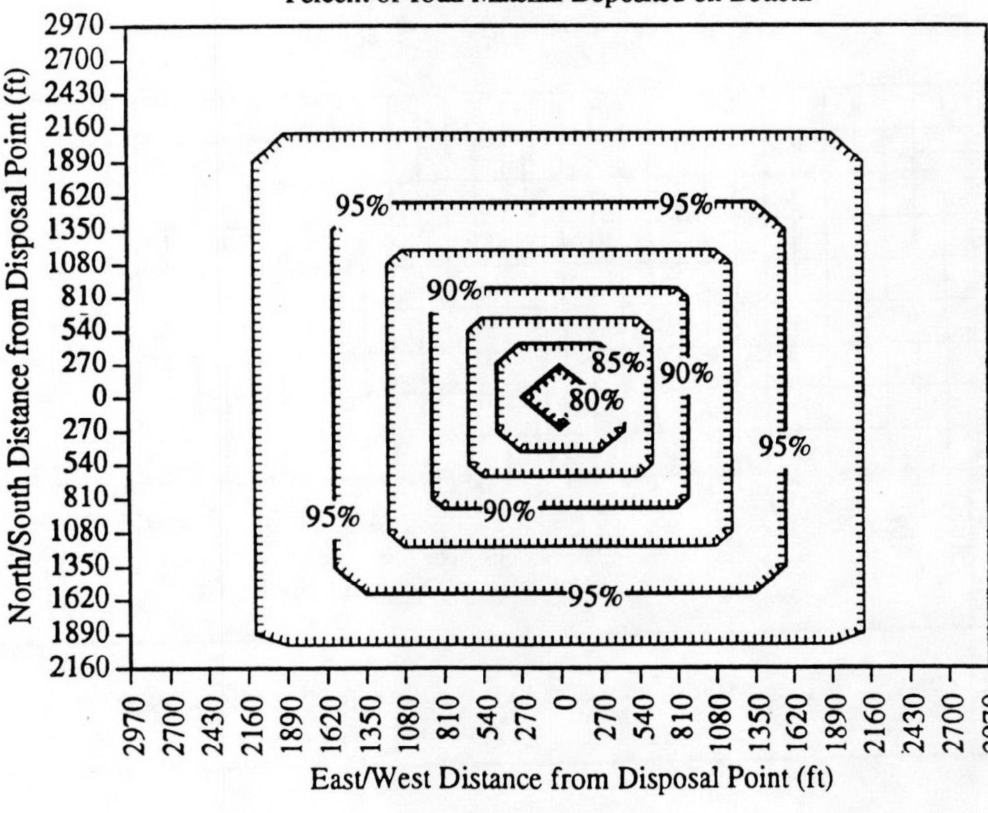


Fig. 5-6

Tampa ODMDS Predicted Maximum Suspended Sediment Concentrations

At Depth of 15 ft

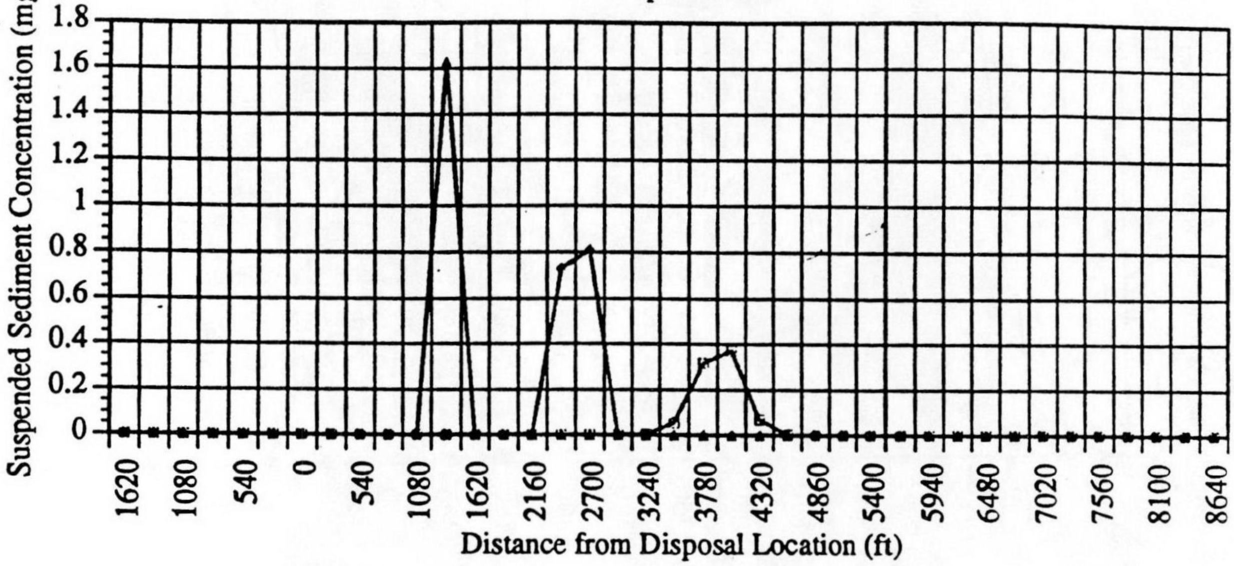


Fig. 5-7

At Depth of 30ft

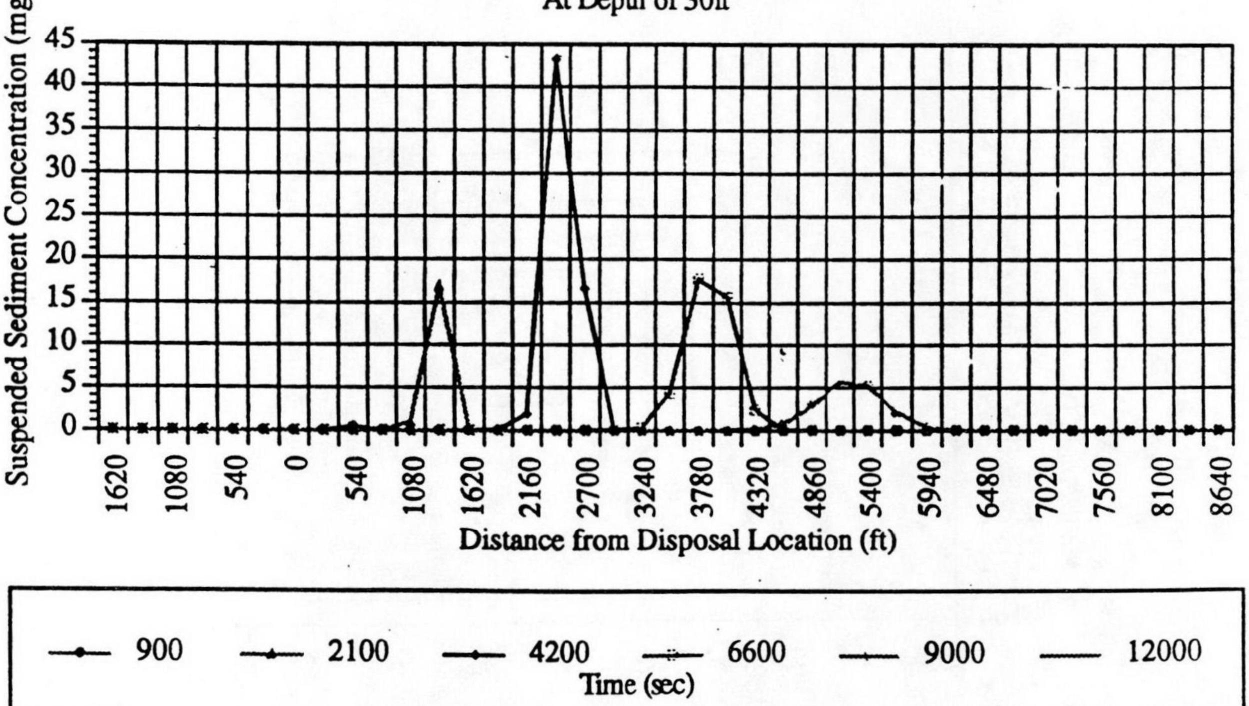


Fig. 5-8

Tampa ODMDS Predicted Maximum Suspended Sediment Concentrations

At Depth of 45ft

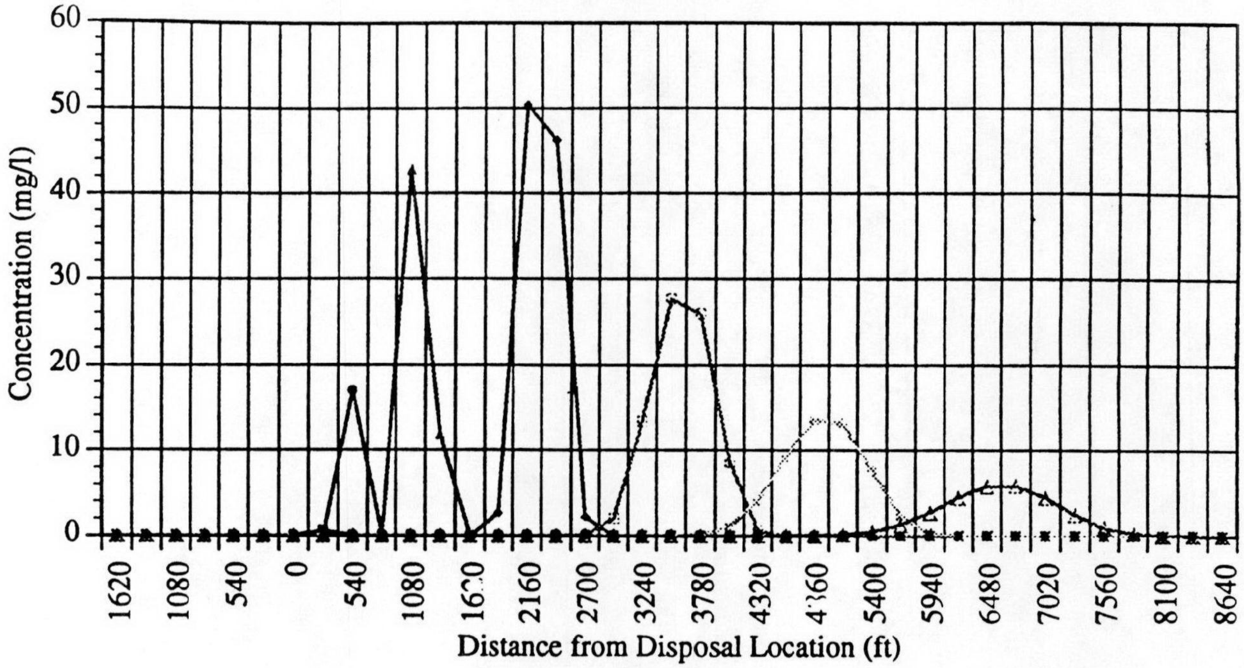


Fig. 5-9

At Depth of 65ft

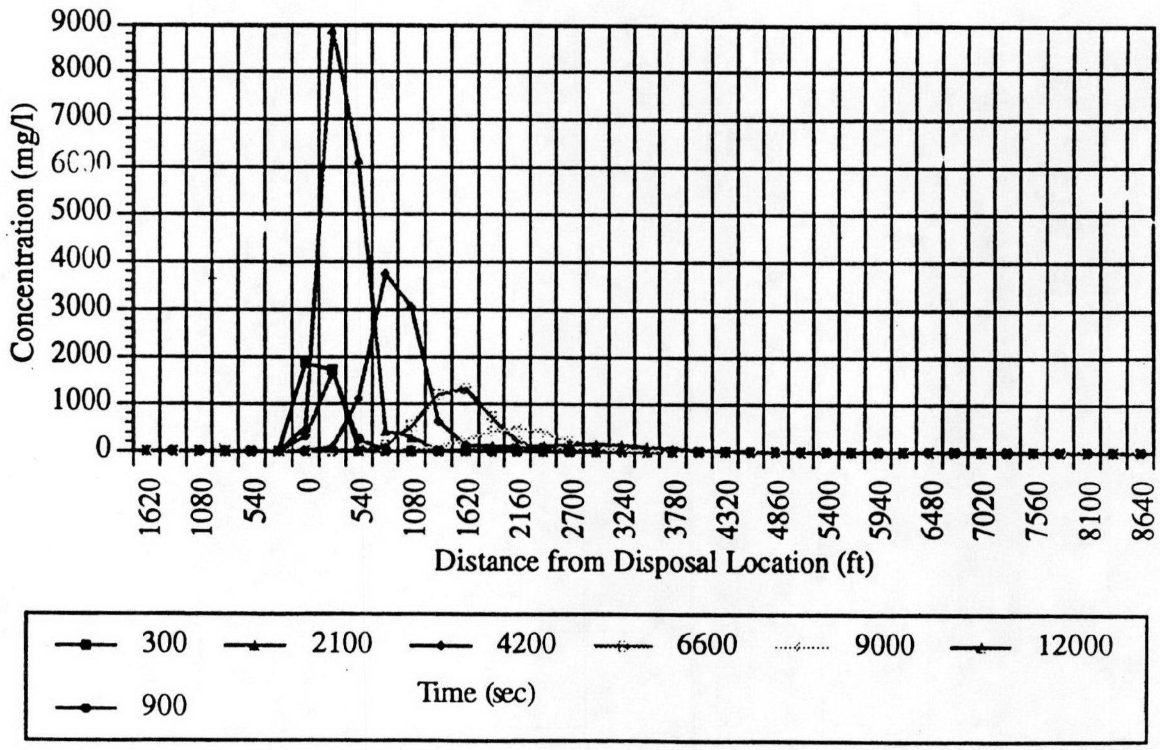
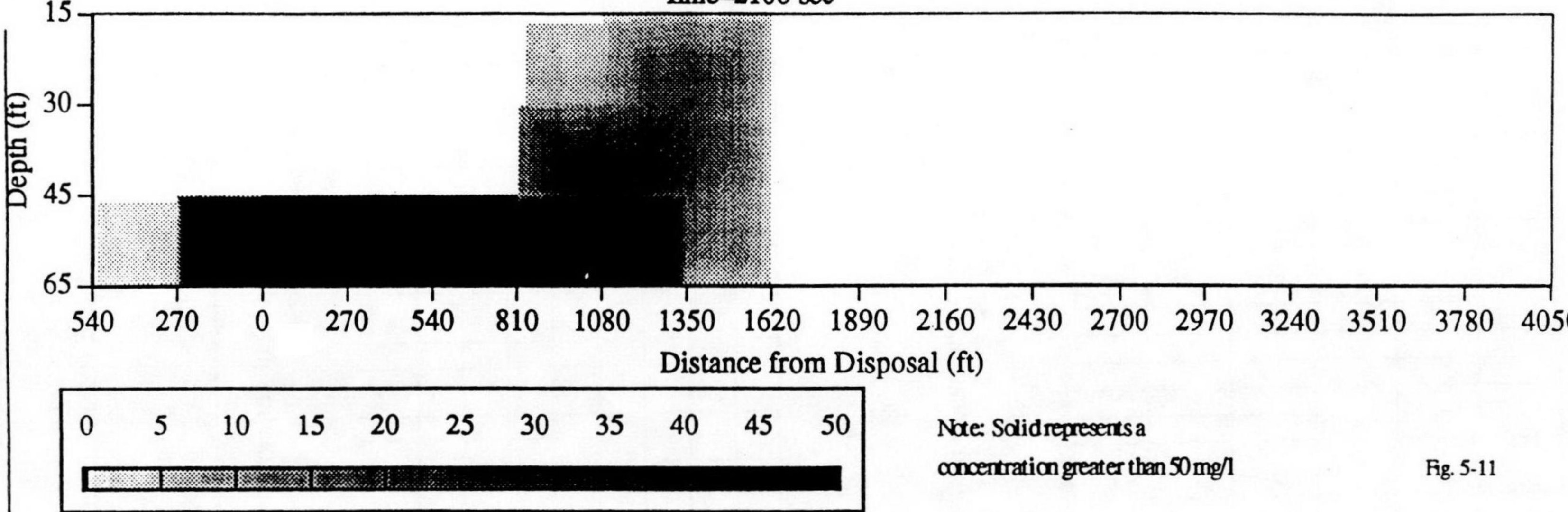


Fig. 5-10

Tampa ODMDS Suspended Sediment Concentration Profile

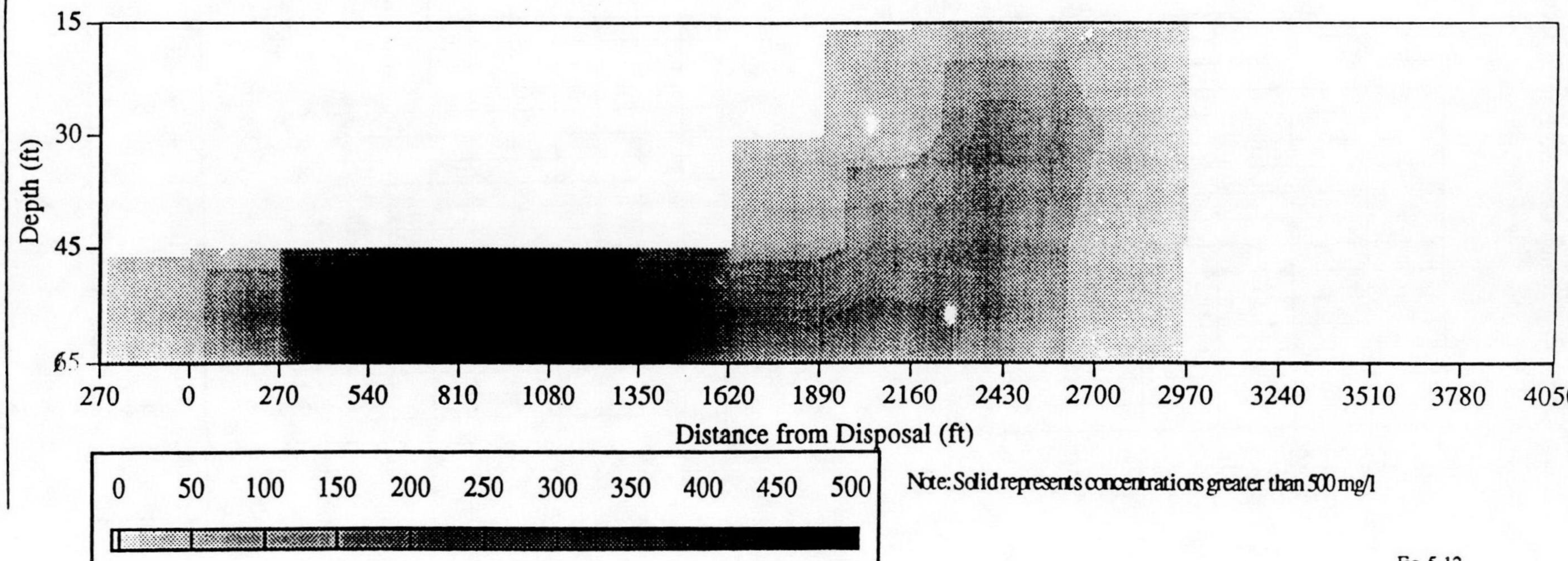
Time=2100 sec



Note: Solid represents a concentration greater than 50 mg/l

Fig. 5-11

Concentration at Time = 4200 sec

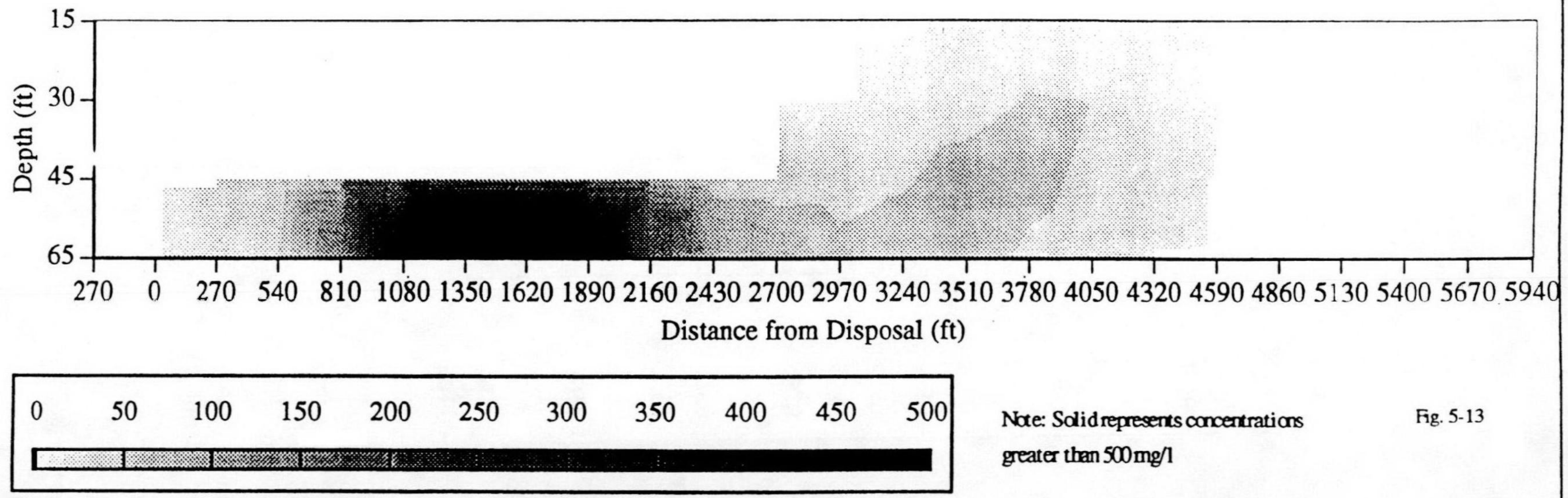


Note: Solid represents concentrations greater than 500 mg/l

Fig. 5-12

Tampa ODMDS Suspended Sediment Concentration Profile

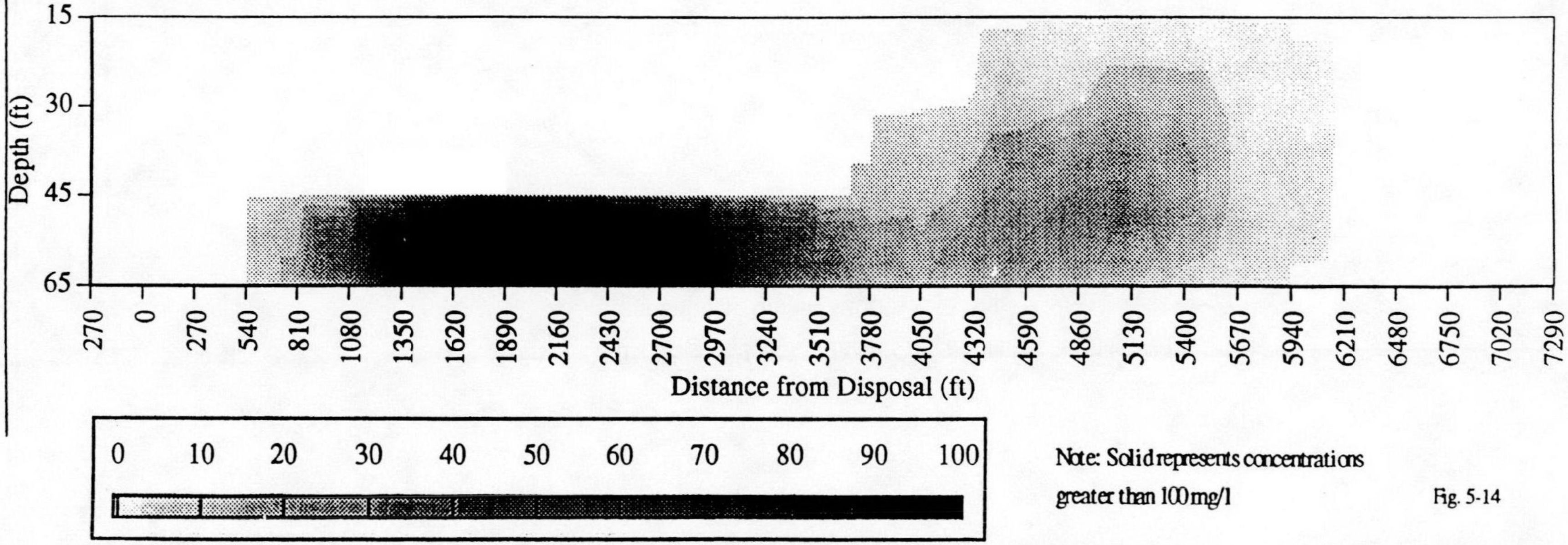
Concentration at Time = 6600sec



Note: Solid represents concentrations greater than 500 mg/l

Fig. 5-13

Concentration at time = 9000sec

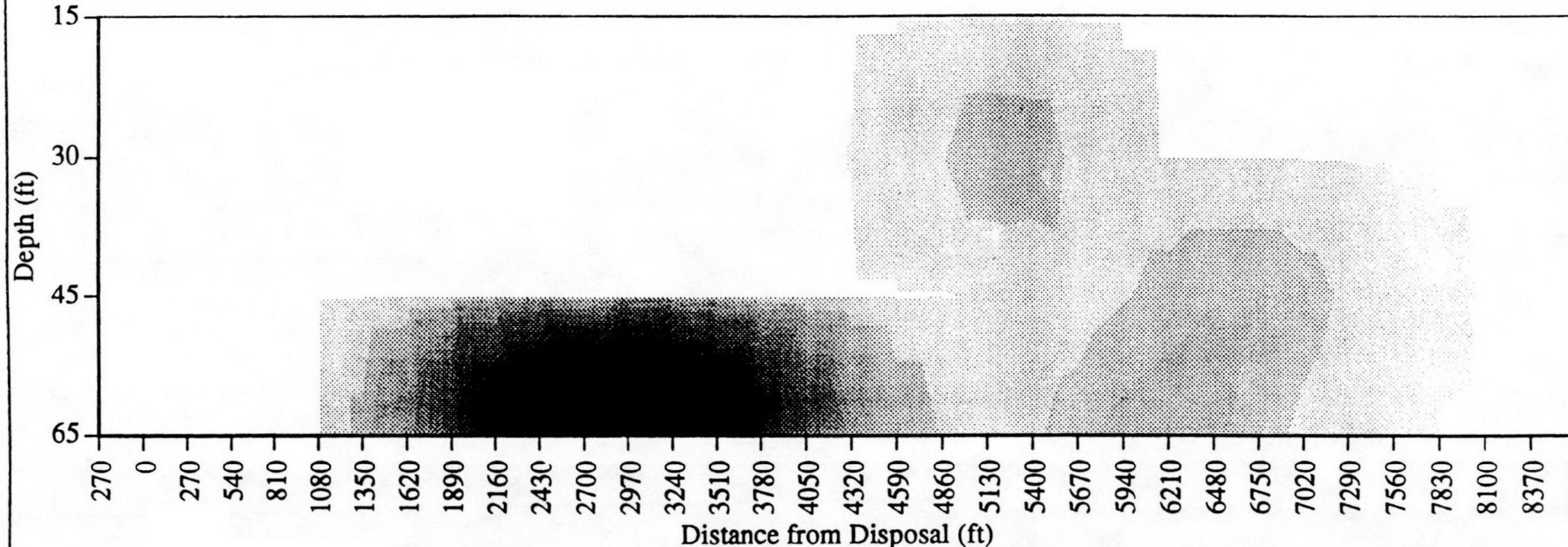


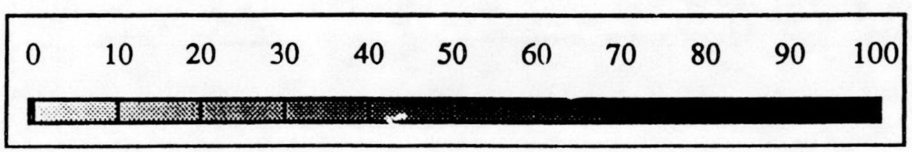
Note: Solid represents concentrations greater than 100 mg/l

Fig. 5-14

Tampa ODMDS Suspended Sediment Concentration Profile

Concentration at Time = 12000sec=3.3hrs





Note: Solid represents concentrations greater than 100 mg/l

Fig. 5-15

Depth (ft)	Time (minutes)	Distance (nmiles)
15	<35	<0.22
30	180	1.01
45	243	1.36
65	375	0.97

During heavy use of the site, disposal actions may occur so that turbidity plumes from successive dumps will overlap. The most frequent interval between disposal actions was determined to be two hours as discussed in section 3.0. For this assumption, suspended sediment concentrations versus time has been plotted for two distances from the disposal point at a depth of 65 feet in figures 5-16 and 5-17. The concentrations at the other depths were computed, but are not shown. At both locations, the ambient conditions are not exceeded at depths of 15 and 30 feet. At 0.5 nmile from the disposal point, concentrations reach 15mg/l periodically at a depth of 45 feet and fluctuate between 60 and 120 mg/l near the bottom (65 feet). At 1.0 nmile from the disposal point, concentrations reach 2.8 mg/l periodically at a depth of 45 feet and fluctuate between 5 and 13 mg/l near the bottom (65 feet). These results are for the assumptions of successive dumps of worst case material, a busy disposal day and temporally and spatially constant currents that are exceeded only 5 percent of the time.

6.0 SUMMARY

The currents used in the STFATE deposition analysis can be assumed to be in either the northerly or southerly direction. A northerly oriented current can be assumed for examining impacts to the north and the southerly for impacts to the berm. If disposal is assumed to occur at the center of the "no size restriction area" of the ODMDS, the berm of concern is 1.0 nmi (6076 feet) to the south and the northern ODMDS boundary is 1/6 nmi (1013 feet) to the north.

Assuming the current is to the south, 97.5% of the dredged material will reach the bottom within 2160 feet of the disposal, one third of the distance to the berm, and there would be no measurable deposition of material at the berm. Peak suspended sediment concentrations along the bottom at the berm would be 7.4 mg/l. On the other hand, assuming the current is to the north, 90% of the dredged material will reach the bottom within the northern boundary of the ODMDS.

The STFATE analysis assumes the currents are constant with time and spatially homogenous. The streakline analysis discussed in section 2.1, assumes only that the currents are spatially homogeneous. Considering the streakline analysis, the probabilities that the plume will reach the areas of concern can be estimated. Figures 6-1 and 6-2

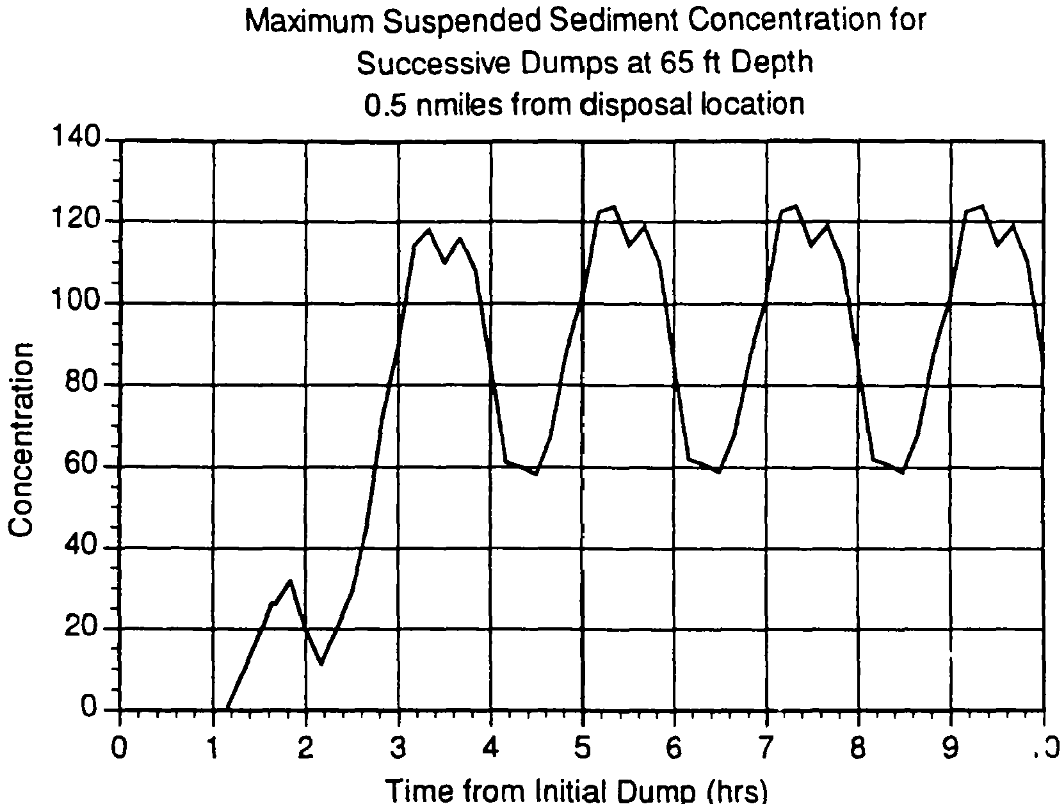


Fig. 5-16

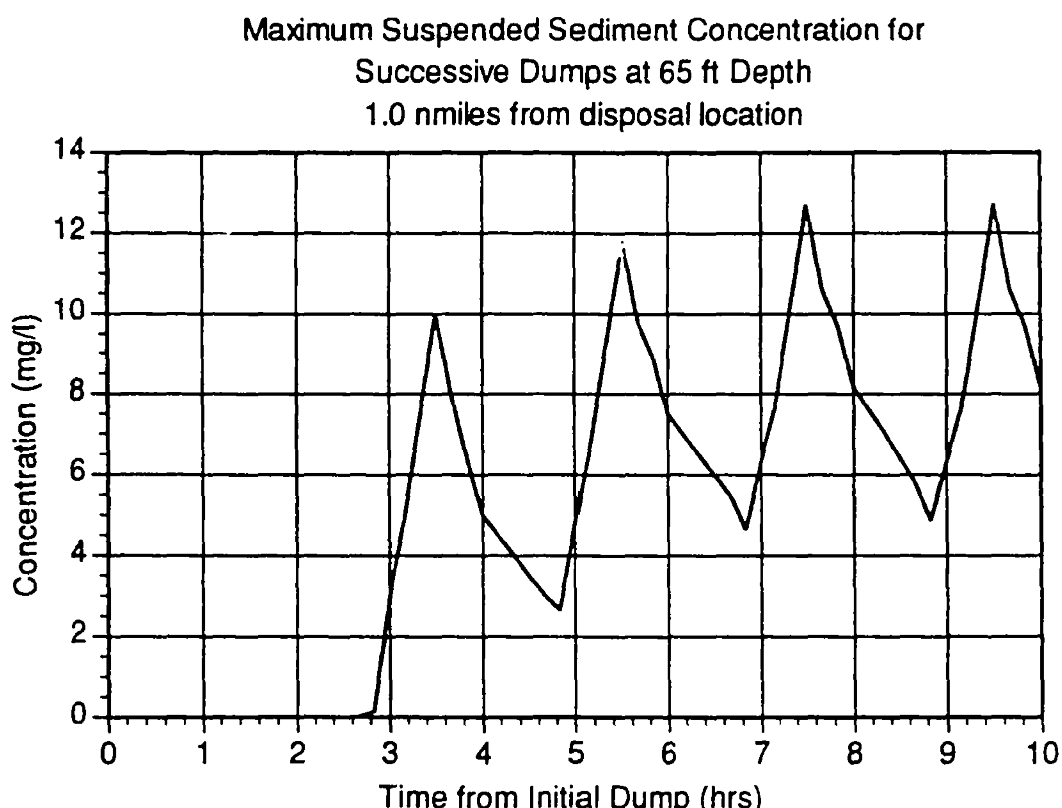


Fig. 5-17

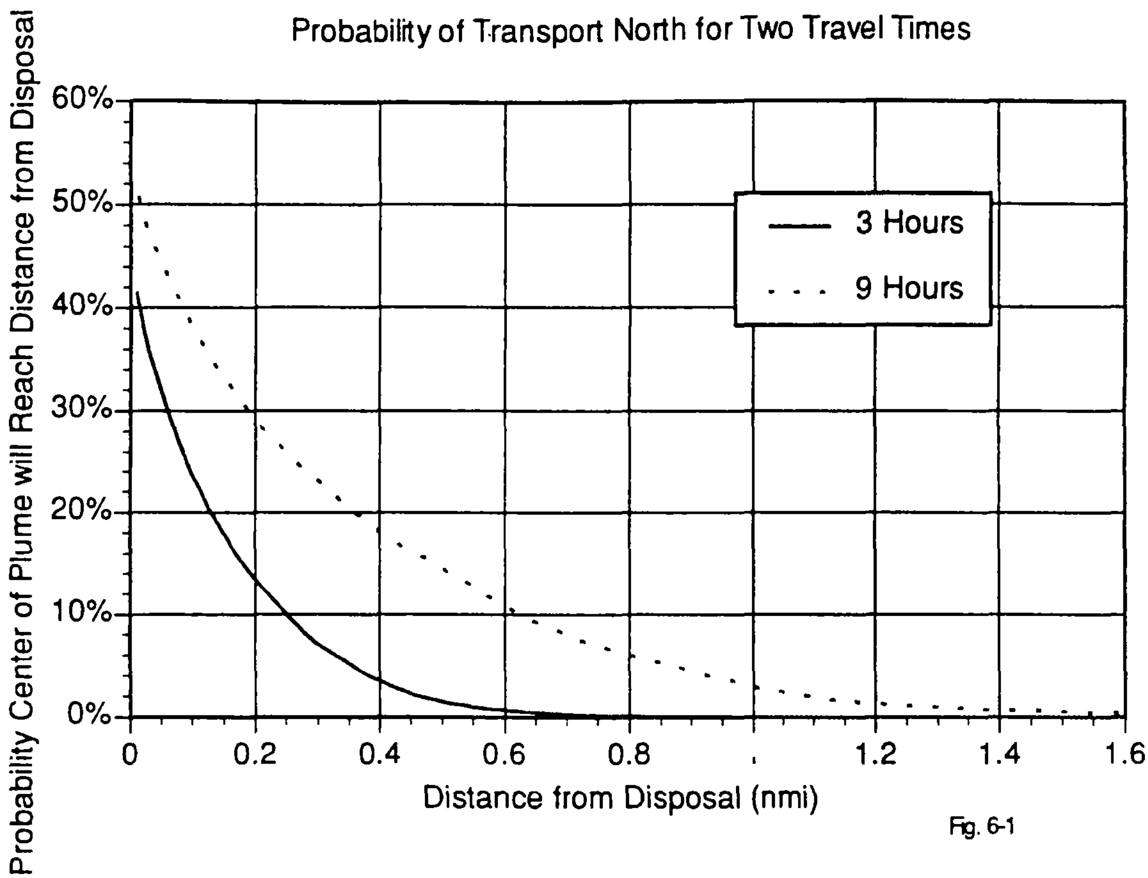

Probability of Transport North for Two Travel Times
Probability Center of Plume will Reach Distance from Disposal
60%
50%
40%
30%
20%
10%
0%
0
0.2
0.4
0.6
0.8
1.2
1.4
1.6
Distance from Disposal (nmi)
3 Hours
9 Hours

Fig. 6-1

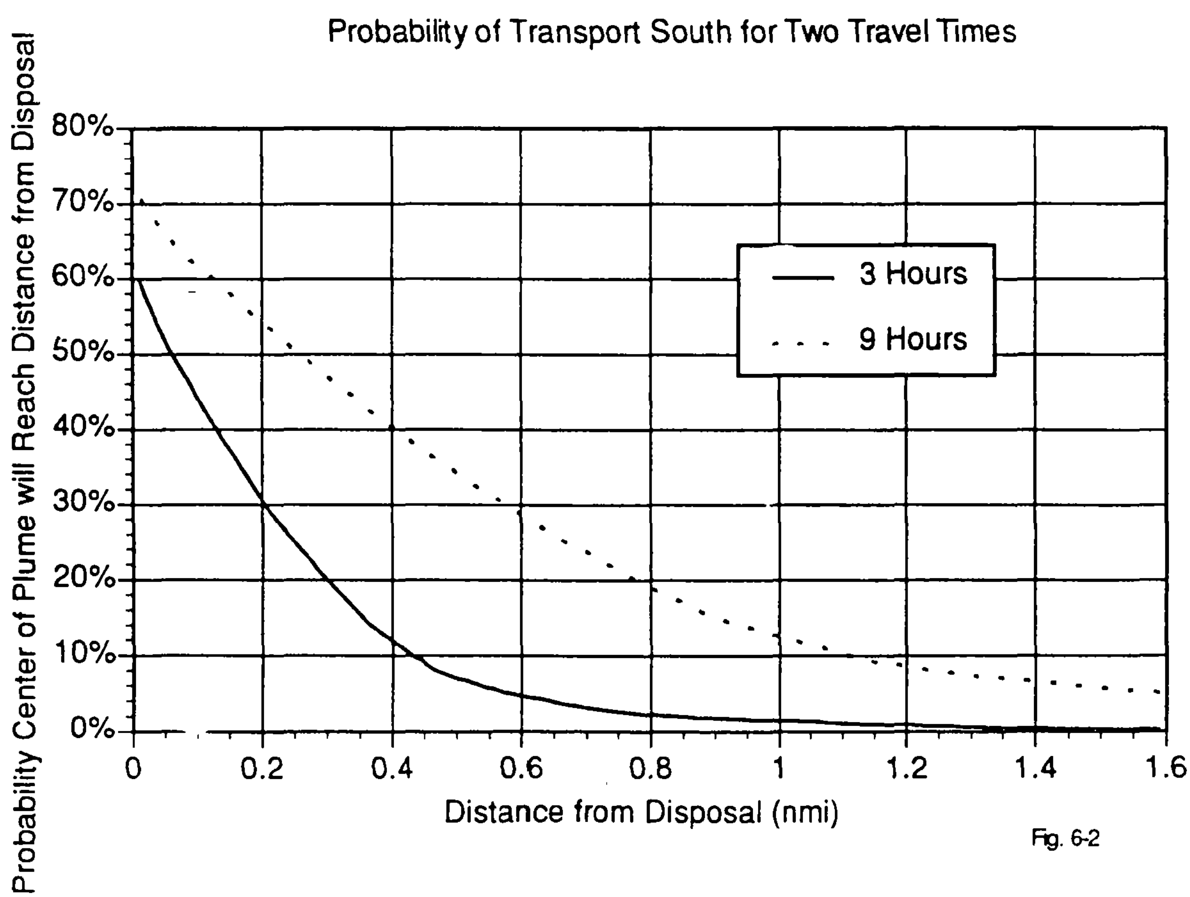

Probability of Transport South for Two Travel Times
Probability Center of Plume will Reach Distance from Disposal
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Distance from Disposal (nmi)
3 Hours
9 Hours

Fig. 6-2

show, based on streakline analysis, the probabilities that the center of a disposal plume will reach distances for travel times of three hours and nine hours. After three hours the STFATE deposition analysis predicts that 97% of the dredged material has settled to the bottom. After nine hours, based on settling velocities, 100% of the material has settled to the bottom. For a three hour travel time, figures 2-6, 2-9, 6-1 and 6-2 show that the probability that the plume would move as far south as the berm or as far north as 0.5 nmi for any disposal would be less than 2%. For a nine hour travel time the probability would be less than 15%.

REFERENCES

Adamec, Stephen A., Jr., et al. 1987. "Technical Supplement to Dredged Material Disposal Study US Navy Home Port, Everett, Washington." Technical Report HL-87-12. US Army Corps of Engineer Waterways Experiment Station, Vicksburg, MS.

Battelle Ocean Sciences, 1987. "Synthesis Report: Tampa Harbor Dredged Material Disposal Site Monitoring Study." Submitted to the U.S. Environmental Protection Agency, Criteria and Standards Division, Washington, D.C.

Boler, Richard, ed. 1991. "Surface Water Quality Hillsborough County Florida, 1990-1991." Hillsborough County Environmental Protection Commission, Tampa, Florida.

Collins, Gary. Tampa Bay ODMDS Manager, US EPA Region IV. Personal Interview on Dredge Material Placement. 1993.

Danek, L. J., and G. S. Lebwel, editors. 1986. "Southwest Florida Shelf Benthic Communities Study Year 5 Annual Report." A final report by Environmental Science and Engineering, Inc. and LGL Ecological Research Associates, Inc. (Contract No. 14-12-0001-30211) submitted to the Minerals Management Service, New Orleans, Louisiana. 3 vol.

Ichiye, T., Han-Hsiung Kuo, and M. R. Carnes. 1973. "Assessment of Currents and Hydrography of the Eastern Gulf of Mexico." Contribution No. 601. Department of Oceanography, College of Geosciences, Texas A&M University.

Miller, Matt. Jacksonville District Army Corps of Engineers. Personal Telephone Interview on Dredge Disposal Operation and Dredge Material Characteristics. September 14, 1993 and January 31, 1994.

Molinari, R.L., D. Cochrane, and G.A. Maul. 1975. "Deep Basin Oceanographic Conditions and General Circulation." *In*: Compilation and Summation of Historical Existing Physical Oceanographic Data from the Eastern Gulf of Mexico in Support of the Creation of a MAFLA Sampling Program. BLM 08550-CT-16. State University System Florida Institute of Oceanography (SISIO).

Schroeder, P.R. and M.R. Palermo. 1990. Automated dredging and disposal alternatives management system, User's Guide. Technical Note EEDP-06-12, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Science Applications International Corporation, 1989. "Gulf of Mexico Physical Oceanography Program, Final Report: Year 5. Volume I: Executive Summary." OCS Report/MMS - 89-0067, U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, LA. 14pp.

U.S. Environmental Protection Agency, 1993. "Draft Environmental Impact Statement for Designation of an Ocean Dredged Material Disposal Site Located Offshore Tampa, Florida, June 1993." U.S. EPA Region IV, Atlanta, GA.

U.S. Environmental Protection Agency and U.S. Army Corps Engineers, 1993. "Draft Inland Testing Manual." Appendix C: Numerical Model for Initial Mixing Evaluations.

U.S. Minerals Management Service, 1985. "Southwest Florida Shelf Ecosystem Study" Contract 14-12-0001-29144, U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, Metairei, Louisiana.

Williams, David T. 1983. "Tampa Bay Dredged Material Disposal Site Analysis," Misc. Paper, HL-83-8, US Army Corps of Engineer Waterways Experiment Station, Vicksburg, MS.

APPENDIX A

STFATE MODEL INPUT DATA

MODEL: SHORT-TERM FATE OF DREDGED MATERIAL FROM SPLIT HULL BARGE OR HOPPER DREDGE
(PC Version 5.01 MAY, 1993)

TITLE: Tampa Bay ODMDS 20/15cm/sec current to the north-unidirect

FILE: TAMPA2 .DUE

AREA: THE PROJECT AREA IS DESCRIBED BY A 45 X 45 GRID.

THERE ARE 45 GRID POINTS (NMAX) IN THE Z-DIRECTION (FROM LEFT TO RIGHT) AND 45 GRID POINTS (MMAX) IN THE X-DIRECTION (FROM TOP TO BOTTOM).

EXECUTION PARAMETERS:

MODEL COEFFICIENTS SPECIFIED IN INPUT DATA (KEY1 = 1).

VERTICAL DIFFUSION COEFFICIENT (AKY0) COMPUTED FROM PRITCHARD EQUATION (IPRIT = 1).

PERFORM COMPLETE ANALYSIS INCLUDING DESCENT, COLLAPSE, AND TRANSPORT-DIFFUSION (KEY2 = 0).

PERFORM LONG-TERM DIFFUSION COMPUTATIONS FOR A CONSERVATIVE TRACER (KEY3 = 1).

PRINTING OF CONVECTIVE DESCENT RESULTS REQUESTED (IPCN = 1).

PRINTING OF CONVECTIVE DESCENT RESULTS REQUESTED (IPCN = 1).

PRINTING OF DYNAMIC COLLAPSE RESULTS REQUESTED (IPCL = 1).

PRINTING OF LONG-TERM TRANSPORT DIFFUSION RESULTS REQUESTED AT 12 TIME PERIOD(S) (IPLT = 12).

LONG-TERM TRANSPORT DIFFUSION RESULTS REQUESTED AT THE FOLLOWING 5 DEPTH(S):

5.00 FT
15.00 FT
30.00 FT
45.00 FT
65.00 FT

GRID: NUMBER OF LONG TERM GRID POINTS IN Z-DIRECTION (NMAX) = 45

NUMBER OF LONG TERM GRID POINTS IN X-DIRECTION (MMAX) = 45

GRID SPACING IN Z-DIRECTION (DZ) = 270.00000 FT

GRID SPACING IN X-DIRECTION (DX) = 270.00000 FT

CONSTANT DEPTH GRID SPECIFIED HAVING A DEPTH (DEPC) OF 70.00000 FT.

DISPOSAL LOCATION:

THE DUMP LOCATION IS 9114. FT (XBARGE) OR ABOUT GRID POINT #35 FROM THE TOP OF THE GRID
AND 6076. FT (ZBARGE) OR ABOUT GRID POINT #24 FROM THE LEFT EDGE OF THE GRID.

THE BOTTOM SLOPE IN THE X-DIRECTION AT THE DUMP SITE (SLOPEX, POSITIVE IF DEPTH INCREASES
FROM TOP OF GRID TO BOTTOM OF GRID) IS 0.00 DEGREES.

THE BOTTOM SLOPE IN THE Z-DIRECTION AT THE DUMP SITE (SLOPEZ, POSITIVE IF DEPTH INCREASES
FROM LEFT SIDE OF GRID TO RIGHT SIDE OF GRID) IS 0.00 DEGREES.

THE DISPOSAL LOCATION IS NOT AT A HOLE OR DEPRESSION. (DHOLE = 0.0)

AMBIENT DENSITY PROFILE:

DEPTH (FT)	DENSITY (G/CC)
0.0000E+00	1.0222
70.00	1.0241

COMPUTED DEPTH:

THE DEPTH AT THE DUMP LOCATION WAS INTERPOLATED TO BE 70.00 FT.

VELOCITY DISTRIBUTION:

TWO-VELOCITY PROFILES ARE SPECIFIED IN BOTH X AND Z DIRECTIONS FOR USE AT ALL GRID POINTS PROVIDING "QUICK LOOKS".

DEPTH IN FT IS ASSUMED CONSTANT AND VELOCITIES IN FPS ARE CONSIDERED STEADY IN TIME.

VELOCITY PROFILE PARAMETERS FOLLOW...

FROM TOP TO BOTTOM ON GRID FROM LEFT TO RIGHT ON GRID
UPPER: DEPTH, DU1 = 0.000E+00 X-VELOCITY, UU1 = -0.652 DEPTH, DW1 = 0.000E+00 Z-VELOCITY, WW1 = 0.000E+00
LOWER: DEPTH, DU2 = 60.0 X-VELOCITY, UU2 = -0.492 DEPTH, DW2 = 60.0 Z-VELOCITY, WW2 = 0.000E+00

TIME PARAMETERS:

DURATION OF THE DISPOSAL, TREL = 20.00 SECONDS

DURATION OF THE SIMULATION, TSTOP = 12000.00 SECONDS

LONG-TERM TIME STEP USED IN THE SIMULATION, DTL = 300.00 SECONDS

BARGE DESCRIPTION:

LENGTH OF BARGE, BARGL = 0.28E+03 FT

WIDTH OF BARGE, BARGW = 50. FT

DRAFT OF LOADED BARGE, DREL1 = 18.0 FT

DRAFT OF UNLOADED BARGE, DREL2 = 5.00 FT

MODEL COEFFICIENTS READ FROM INPUT:

TURBULENT THERMAL ENTRAINMENT ALPHA0 = 0.2350

SETTLING COEFFICIENT BETA = 0.0000

APPARENT MASS COEFFICIENT CM = 1.0000

DRAG COEFFICIENT FOR A SPHERE CD = 0.5000

RATIO--CLOUD/AMBIENT DENSITY GRADIENTS GAMA = 0.2500

FORM DRAG FOR COLLAPSING CLOUD CDRAG = 1.0000

SKIN FRICTION FOR COLLAPSING CLOUD CFRIC = 0.0100

DRAG FOR AN ELLIPSOIDAL WEDGE CD3 = 0.1000

DRAG FOR A PLATE CD4 = 1.0000

ENTRAINMENT IN COLLAPSE ALPHAC = 0.1000

FRICTION BETWEEN CLOUD AND BOTTOM FRICTN = 0.0100

4/3 LAW HORIZ. DIFF. DISSIPATION FACTOR ALAMDA = 0.0010

UNSTRATIFIED WATER VERT. DIFF. COEF. AKY0 = 0.0190

STRIPPING COEF. OF FINES DURING CONVERTIVE DESCENT= 0.0030

MATERIAL DESCRIPTION: 2 LAYERS OF DREDGED MATERIAL WITH 4 SOLIDS FRACTIONS

VOLUMETRIC CONCENTRATIONS OF SOLIDS FRACTIONS DO NOT VARY FROM LAYER TO LAYER.

LAYER 1

DESCRIPTION	SPEC. GRAV. OR DENSITY (GM/CC)	VOLUMETRIC CONCENTRATION (VOL/VOL)	FALL VELOCITY (FPS)	VOID RATIO	DEPOSITIONAL CHARACTER
SILT	2.650	0.1350	0.01000	4.500	NONCOHESIVE

CRITICAL SHEAR STRESS FOR DEPOSITION = 0.9000E-02 LBS/SQ. FT.
SEDIMENT FRACTION WILL BE STRIPPED DURING CONVECTIVE DESCENT.

MEDIUM S	2.700	0.1350E-01	0.10000	0.6000	NONCOHESIVE

CRITICAL SHEAR STRESS FOR DEPOSITION = 0.2000E-01 LBS/SQ. FT.
SEDIMENT FRACTION WILL BE STRIPPED DURING CONVECTIVE DESCENT.

FINE S	2.700	0.1670	0.02000	0.7000	NONCOHESIVE

CRITICAL SHEAR STRESS FOR DEPOSITION = 0.1500E-01 LBS/SQ. FT.
SEDIMENT FRACTION WILL BE STRIPPED DURING CONVECTIVE DESCENT.

CLAY	2.650	0.1350	0.00200	7.000	NONCOHESIVE

CRITICAL SHEAR STRESS FOR DEPOSITION = 0.2000E-02 LBS/SQ. FT.
SEDIMENT FRACTION WILL BE STRIPPED DURING CONVECTIVE DESCENT.

DESCRIPTION	SPEC. GRAV. OR DENSITY (GM/CC)	VOLUMETRIC CONCENTRATION (VOL/VOL)
FLUID	1.000	0.5495

DISCHARGE PARAMETERS:

VOLUME OF LAYER 1 = 2400. CU YD

INITIAL RADIUS OF CLOUD, RB = 31.39344 FT

INITIAL DEPTH OF CLOUD CENTROID, DREL = 27.73 FT

INITIAL CLOUD VELOCITIES...

X-DIRECTION (FROM TOP TO BOTTOM OF GRID), CU(1) = -1.680 FPS

Y-DIRECTION (FROM SURFACE TO BOTTOM), CV(1) = 0.4090 FPS

Z-DIRECTION (FROM LEFT TO RIGHT OF GRID), CW(1) = 0.0000E+00 FPS

BULK PARAMETERS:

BULK DENSITY, ROO = 1.752350 G/CC

AGGREGATE OR BULK VOIDS RATIO, BVOID = 3.724

APPENDIX I

COMMENT LETTERS TO THE DRAFT EIS
AND RESPONSES, WHERE APPROPRIATE

AUGUST 1994

Section I

Comment letters, with responses from EPA and CE

STATE OF FLORIDA
DEPARTMENT OF COMMUNITY AFFAIRS

2740 CENTERVIEW DRIVE • TALLAHASSEE, FLORIDA 32399-2100

LAWTON CHILES
Governor

LINDA LOOMIS SHELLEY
[redacted]
Secretary

October 15, 1993

Mr. Wesley B. Crum
Chief, Coastal Programs Section
Region IV, Environmental Protection Agency
345 Courtland Street, Northeast
Atlanta, Georgia 30365

RE: U.S. Environmental Protection Agency Draft Environmental Impact Statement for Designation of an Ocean Dredged Material Disposal Site Located Offshore Tampa, Florida
SAI: FL9306170872C

Dear Mr. Crum:

The State of Florida has completed its review of the Draft Environmental Impact Statement (DEIS) for the designation of an approximately 4 square nautical mile area, located 18 nautical miles west of Egmont Key in the Gulf of Mexico, as an Ocean Dredged Material Disposal Site (ODMDS). The DEIS has been reviewed in accordance with the requirements of the National Environmental Policy Act and the Coastal Zone Management Act of 1972, as amended.

The U.S. Environmental Protection Agency (EPA) is the lead federal agency for designation of the ODMDS and the Corps of Engineers (COE) will be the primary user of the proposed site. The COE, a cooperating federal agency in the preparation of the DEIS, has proposed that the site be used for the disposal of spoil from maintenance dredging of federal navigation channels and berthing sites in greater Tampa Bay. The COE has stated that the ODMDS is required because most of the dredged material will not be suitable for use in beach nourishment.

Mr. Wesley B. Crum
October 15, 1993
Page Two

The Department of Community Affairs (Department), as the lead coastal agency for the State of Florida, pursuant to section 306(c) of the Federal Coastal Zone Management Act, 16 U.S.C. section 1456(c), and section 380.22, Florida Statutes (F.S.), hereby notifies the U.S. Environmental Protection Agency that the State of Florida cannot support the recommended permanent Site 4 ODMDS designation as described in the DEIS. The state's objections are based on (1) the lack of project justification, (2) the lack of complete information, and (3) the inadequacy of the site management and monitoring plan.

As explained in the attached correspondence, the proposed ODMDS designation is inconsistent with the following specific provisions of the Florida Coastal Management Program: sections 161.042 and 161.142; 253.03(1); 370.025; 373.414; and 403.021, 403.061, 403.062, and 403.161, F.S. and Rule 17-312, Florida Administrative Code (sections 403.918 and 403.919, F.S, have been repealed and are now codified in sections 373.414, F.S. and Rule 17-312, F.A.C., pursuant to Florida House Bill 1751).

In order for the state to reconsider its findings, the EPA will need to modify the DEIS to address the concerns contained in the enclosed October 7, 1993 letter from the Department of Environmental Protection (DEP). The required information must be submitted to the State Clearinghouse for review.

The state acknowledges that significant progress has already been made toward the resolution of these issues. The Environmental Protection Agency, Region IV and the Corps of Engineers, Jacksonville District, has participated in meetings with the state which helped to clarify project related issues and establish the scope of the Final Environmental Impact Statement.

In accordance with 15 CFR 930.42(c), a copy of this letter has been sent to the U.S. Department of Commerce, NOAA, Office of Ocean and Coastal Resource Management. Mediation by the Secretary, U.S. Department of Commerce, may be sought pursuant to 15 CFR 930, subpart G, for serious disagreements between the state and a federal agency taking direct action governed by 15 CFR 930, subpart C.

Mr. Wesley B. Crum
October 15, 1993
Page Three

We will continue to work closely with your staff to resolve the identified issues prior to the submittal of the Final Environmental Impact Statement for the permanent designation of the referenced ODMDS.

Very truly yours,

Linda Loomis Shelley
Secretary

LLS/dh

Enclosures

cc: Virginia Wetherell, DEP
Ben Watts, DOT
Dr. Russell Nelson, MFC
Colonel Brantly, GFWFC
Greg Farmer, FDC
Estus Whitfield, OPB
Frank Maloney, OCRM, NOAA
Colonel Rock Salt, COE

Florida Department of
Environmental Protection

Lawton Chiles
Governor

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

Virginia B. Wetherell
Secretary

October 7, 1993

Estus Whitfield
Executive Office of the Governor
Office of Planning and Budgeting
The Capitol
Tallahassee, Florida 32399-0001

Dear Mr. Whitfield:

Re: Draft Environmental Impact Statement
Ocean Dredged Material Disposal Site Designation
Tampa, Florida
SAI FL9306170872C

On August 23, 1993, we provided comments on the referenced designation and notified you that the designation, as proposed, is inconsistent with the department's statutory authorities in the Florida Coastal Management Program. Subsequently, the department participated in a meeting with the EPA and the Corps to discuss the issues addressed in our letter. At this meeting, we made considerable progress toward resolution of the department's objections. We would like to summarize our understanding of the conclusions of those discussions and clarify the department's position on the proposed designation.

Our determination of inconsistency is based on three main issues: a lack of project justification; incomplete information; and the adequacy of the site management and monitoring plan. Regarding the first issue, we agreed that the need for using an ocean disposal site will be determined through the cooperative development of dredged material disposal plans for Tampa Harbor federal dredging projects. These plans will be developed by the state and the Corps and will establish criteria for placement of material which
(1) prioritize beneficial use and upland disposal over ocean disposal where those options are viable. The final designation rule will include a condition requiring the disposal of material in the site to be in accordance with approved dredged material disposal plans. To provide a basis for the development of project-specific plans, the Corps will expand its discussion in the final EIS to better address the need for the ocean disposal site and will provide additional

Mr. Estus Whitfield
October 7, 1993
Page Two

information on material quantities, qualities, and available and proposed disposal locations throughout the reaches of the federal project. We are confident that these actions will resolve the department's objection to this designation based on a lack of demonstrated need for the site.

(2) Regarding the other issues of incomplete information and adequacy of site management and monitoring, the Corps and EPA agreed to provide supplemental information to address the points made in our comments. Notably, dredged material dispersion will be modeled and EPA will try to complete supplemental video scans of the northern section of the proposed site.

(3) Between now and publication of the final EIS, the state will work with the Corps and EPA as needed to complete these tasks. In particular, the department and the Corps need to develop the language of the condition to be included in the designation rule. Draft language has been provided by the Corps and is being reviewed at this time.

We appreciate the cooperation of the EPA and the Corps in resolving the department's concerns for this site designation. If you have any questions or need further information, please contact Lynn Griffin at 488-0784.

Sincerely,

Virginia B. Wetherell
Secretary

LG/l

cc: George Henderson
Kirby Green
John Abendroth
Richard Garrity
Fritz Wettstein
Frank Votra

1. The language agreed to by the State of Florida and the Corps of Engineers concerning the dredged material disposal plan for Tampa can be found in Section 2.2.3. This language will also be included in the rulemaking for site designation. The expanded discussion on need is included in the introductory paragraphs of Section 2.2. Information concerning material qualities and quantities proposed for ocean disposal can be found within the Site Management and Monitoring Plan in Appendix C. Available disposal locations throughout the federal project can be found in Appendix E. (Mr. Dichiara, CESAJ-CO-ON)

2. The problem with pages missing from Appendix E has been corrected. An updated draft Site Management and Monitoring Plan has been provided, and further modifications may be made by the team prior to final rulemaking to designate the site. The dispersion model requested by the State is provided in Appendix B. Supplemental video of the area outside the northern boundary of the site has been done and copies of the tapes have been provided to the State. (Mr. Collins, USEPA-4)

3. The language included in Section 2.2.3 is that provided by the State to the CE District office. (Mr. Schuster, CESAJ-PD-ES)

tampa bay regional planning council

agency on bay management

9455 Koger Boulevard
St Petersburg, FL 33702-2491
(813) 577-5151/Tampa 224-9380
Suncom 586-3217

July 21, 1993

Mr. W. Bowman Crum
Water Management Division
Environmental Protection Agency
Region IV
345 Courtland Street, NE
Atlanta, GA 30365

SUBJECT: Draft Environmental Impact Statement for Tampa Ocean Dredged Material Disposal Site

Dear Mr. Crum:

The Tampa Bay Regional Planning Council's Agency on Bay Management reviewed the Draft Environmental Impact Statement for the Designation of the Tampa Ocean Dredged Material Disposal Site (ODMDS) during the July, 8, 1993 Executive Steering Committee meeting. The Agency recommended that based upon available information provided within the Environmental Impact Statement and with the understanding that site specific information will be developed on the type of material to be disposed of on Site 4, conceptual approval should be given to the long-term use of Site 4 as the approved EPA ODMDS.

The Agency had several question during its review of the Draft EIS, which include:

(1) • What is the composition of materials which will be disposed of at the designated site?

(2) • What are the locations of the natural and artificial reefs in proximity to the recommended site. Will there be any perturbations to these important communities?

(3) • What is the expected life of the project?

(4) • What was the impact of recent storms on the existing materials on Site 4, including Hurricane Elena and the March 13, 1993 storm?

5 It is strongly recommended that if the spoil material is appropriate for beach nourishment or for habitat restoration projects the material should be used for such purposes. Clean sand material is an important resource in the Tampa Bay region. A list and map of habitat restoration projects that will benefit by receiving clean spoil material should be developed with the Florida Department of Environmental Protection.

The Agency would like to request a representative of the project attend the next committee meeting of the Agency on Bay Management on September 9, 1993 to address the questions and recommendations for the proposed ODMDS. To arrange a presentation or if you have any additional questions feel free to contact me or Mr. Peter Clark at (813) 577-5151.

Sincerely,

Jan K. Platt, Chairman
Agency on Bay Management

1. The composition of the materials proposed for disposal in the ODMDS can be found in the SMMP (Appendix C).

2. The locations of the natural and artificial reefs in proximity to the site are discussed throughout Chapter 3. Chapter 4 discusses the monitoring efforts throughout the 1980's that concluded that impacts to these communities could not be discerned.

3. The expected life of the project is unbounded. The CE does not anticipate a closing of Tampa Harbor or the navigation channel. (Mr. DiChiara, CESAJ-CO-ON)

4. We believe that the impact of severe storms, such as hurricanes, on the natural habitats that occur offshore Tampa is such that the presence of disposed dredged material is inconsequential.

5. EPA supports the beneficial use of material whenever appropriate. The language found in Section 2.2.3 addresses how the State and the CE will address this issue on a project by project basis. According to Mr. DiChiara of the District office, the CE is not aware of any habitat restoration projects planned or underway that would desire or could benefit from the use of this material.

Florida Department of

Environmental Protection

Lawton Chiles
Governor

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Virginia B. Wetherell
Secretary

July 19, 1993

Mr. W. Bowman Crum, Chief
Coastal Programs Section
U.S. Environmental Protection Agency
Region IV
345 Courtland Street, Northeast
Atlanta, Georgia 30308

Dear Mr. Crum:

We have reviewed the draft EIS for an Ocean Dredged Material Disposal Site offshore Tampa, Florida. The location of the disposal site for sediments dredged from Tampa Bay appears to be appropriate based on past studies.

(1) A concern of the Florida DEP pertains to possible ocean disposal of contaminated sediments from Tampa Bay that were not evaluated in past studies. Data collected by DEP and NOAA indicate high sediment concentrations of metals (e.g. cadmium, copper, lead and zinc) and organic compounds (e.g. PAHs and PCBs), particularly in areas of the lower Hillsborough River and Hillsborough Bay. Plans to dredge the shipping channels of Hillsborough Bay and dispose of the material should be evaluated in light of the sediment contamination.

(2) Page 20 of the EIS states, "The ocean disposal option for material of all types has been determined by the CE to be essential...". The concentrations of potentially toxic compounds vary greatly within Tampa Bay sediments and consequently could lead to varying concentrations in the dredged material. Dredged material evaluations should be of sufficient detail to determine the potential for biological impacts in areas where sediment contamination exists. If sediments are found to be toxic, ocean disposal at the designated site may not be the best alternative since sediment analysis suggested transport of dredged material outside the site boundary (page 36).

If further information is needed concerning these comments you may contact Kevin Petrus at 904/488-0780.

Sincerely,

Al Bishop, P.E.,
Environmental Administrator
Point Source Evaluation Section

AB/kp

1. and 2. The evaluation of dredged material proposed for ocean disposal addresses the physical, chemical and biological nature of the material. Material that fails any of the criteria for ocean disposal cannot be disposed without a waiver. Further discussion on this issue is provided throughout Chapter 1.

COMMISSION
PHYLLIS BUSANSKY
JOE CHILLURA
SYLVIA KIMBELL
LYDIA MILLER
JIM NORMAN
JAN KAMINIS PLATT
ED TURANCHIK

FAX (813) 272-5157

ENVIRONMENTAL PROTECTION COMMISSION
HILLSBOROUGH COUNTY

ROGER P STEWART
EXECUTIVE DIRECTOR
ADMINISTRATIVE OFFICES AND WATER MANAGEMENT DIVISION
1900 - 9TH AVENUE
TAMPA FLORIDA 33605
TELEPHONE (813) 272 5960

AIR MANAGEMENT DIVISION
TELEPHONE (813) 272-5530

WASTE MANAGEMENT DIVISION
TELEPHONE (813) 272 5788

ECOSYSTEMS MANAGEMENT DIVISION
TELEPHONE (813) 272-7104

July 22, 1993

W. Bowman Crum
U.S. Environmental Protection Agency
Coastal Programs Section
345 Courtland Street N.E.
Atlanta, Georgia 30365

SUBJECT: EPC REVIEW OF THE DEIS, DESIGNATION OF AN OCEAN DREDGED MATERIAL DISPOSAL SITE (ODMDS), OFFSHORE TAMPA BAY DATED JUNE, 1993, RECEIVED JUNE 18, 1993

Dear Mr. Crum:

The Environmental Protection Commission of Hillsborough County recognizes the need to designate a permanent ODMDS offshore of Tampa Bay. Of the alternatives presented within the Draft EIS (DEIS), Site 4 (the proposed site) appears to present the best case scenario for disposal of the sediments accumulating within the shipping lanes of Tampa Bay. There are several concerns which EPC staff feel need to be addressed before a full agency approval can be given.

1. The 1987 sediment mapping technique (CAIS, 1988) results suggested that transport of dredged materials to areas outside of the site boundary may be occurring. The DEIS also reports that long term water movement measured in the area of the proposed disposal site is consistent with the potential for distribution of dredged material outside the site. What methods are to be taken to control this spoil from being transported offsite, and to minimize potential environmental impacts from occurring outside of the target area? (1)

2. It is unclear to EPC staff after reviewing the DEIS as to whether the spoil generated from individual dredging events is to be tested as to potential contaminants before deposition at the ODMDS. The EPC will recommend that before disposal is to occur, that the sediments be subjected to testing as to possible contaminants (including bioassay testing) before disposal is to occur. Sediments which are proven to be contaminated should be disposed of in contained upland areas. (2)

Mr. Bowman Crum
July 22, 1993
page two

3. As two spoil disposal islands currently exist within Tampa Bay to receive materials from Tampa Port Authority and Army Corps of Engineers dredging projects within the Bay, the need for ocean dumping should be clearly demonstrated with each permit application for ocean disposal. The potential for upland disposal (concerning individual dredging events) should be explored at the time of permit application also.

(3)

4. The EPC concurs with Mr. Robin Lewis' recommendation in his correspondence to you of June 23, 1993, that any surveillance and monitoring program of the ODMDS be placed in the hands of the natural resource management and protection agencies.

(4)

EPC staff will strongly recommend that all mitigation measures as outlined in Section 4.3.7 of the DEIS be implemented as permit conditions in the final designation of the ODMDS. These measures include:

a. site specific management

b. sediment mapping

c. the determination of the significance of any biological impacts of dredged material outside ODMDS boundaries (if needed)

d. the avoidance of hard bottom

e. the protection of existing communities on site (even those communities resulting from previous disposal)

f. the use of monitoring to define the maximum discharge rate of dredged materials that would not result in excessive mortality due to burial and/or smothering

g. the deposition of spoil material during appropriate weather conditions and times of the year

h. periodic bioassay and bioaccumulation testing of dredged materials.

Mr. Bowman Crum
July 22, 1993
page two

With the satisfactory address of these issues and/or inclusion of these recommendations, the EPC will endorse the use of Site 4 as an ODMDS. If you have any questions concerning these comments, please feel free to contact me at this agency.

Sincerely,

P. Daniel Alberdi, Jr.
Environmental Scientist II
Environmental Protection Commission
of Hillsborough County

pf
cc: Roger Stewart, EPC
Chuck Cou- -ney, EPC
Chris Dunn, EPC
Tom Cardinale, EPC
Peter Clark, TBRPC/ABM
Dave Parsche', TPA
Robin Lewis, Lewis Environmental

1. Based upon the monitoring done subsequent to the referenced sediment mapping, impacts to the benthic communities could not be discerned. At this time, management of the material to inhibit offsite migration is not deemed necessary. However, the SMMP (Appendix C) is a 'living' document and such measures can be implemented should monitoring show that they are necessary.

2. Each project, regardless of the its frequency, is evaluated for suitability for ocean disposal. If the material fails the criteria, it cannot be placed in the ocean (see Chapter 1). If material from a project has been determined to be suitable and is disposed of in the site, it will be re-evaluated on a 3-year cycle or when proposed for disposal, which ever is longer (see Appendix C).

3. The State of Florida and the CE has agreed that each project and its proposed disposal location will be reviewed according to the language provided in Section 2.2.3.

4. The SMMP team will review the data and recommend appropriate management and/or monitoring measures to the CE and EPA. It is our intention that the natural resource management and protection agencies be part of this team.

Tampa Bay
Regional
Planning
Council

9455 Koger Boulevard
St Petersburg, FL 33702-2491
(813) 577-5151/Tampa 224-9380
Suncom 586-3217

July 26, 1993

Mr. W. Bowman Crum, Chief
Coastal Programs Section
U. S. Environmental Protection Agency
Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365

Subject: Recommended for APPROVAL, IC&R #140-93, Tampa Ocean Material Disposal Site Draft Environmental Impact Statement, Hillsborough, Pinellas and Manatee Counties

Dear Mr. Crum:

The enclosed agenda item regarding the above-referenced matter was considered and staff comments approved by the Clearinghouse Review Committee of the Tampa Bay Regional Planning Council at its July 26, 1993 meeting.

Please contact me, or Sheila Benz of our Council staff, if further information regarding this item is desired.

Sincerely,

Janet K. Vorhees/bj

Janet K. Vorhees, Project Manager
Intergovernmental Coordination & Review

JKV/bj

Enclosure

cc: Ms. Rea Boothby, U.S. Army Corps of Engineers tampa bay regional planning council

Agenda Item #5.
CRC - 7/26/93

Clearinghouse Review

TAMPA OCEAN MATERIAL DISPOSAL SITE DRAFT ENVIRONMENTAL IMPACT STATEMENT, HILLSBOROUGH, PINELLAS AND MANATEE COUNTIES, IC&R #140-93

The U.S. Environmental Protection Agency (EPA), in cooperation with the U.S. Army Corps of Engineers (COE), has requested review and comment on a Draft Environmental Impact Statement for the designation of an Ocean Dredged Material Disposal Site (ODMDS) located in the Gulf of Mexico offshore Pinellas, Hillsborough and Manatee counties. The proposed action is the permanent designation of an offshore ODMDS which will be managed by EPA. The proposed site (Site 4) is square-shaped, covers four nautical miles (nmi) squared and is located 18 nmi from Egmont Key. The proposed disposal site will be designated to receive suitable dredged materials resulting from the Tampa Harbor Federal Project and potentially receive disposal materials from other government or private dredging projects in the greater Tampa Bay area.

The purpose of this action is to recommend an environmentally acceptable ocean location for the disposal of dredged materials that comply with the environmental impact criteria of the Ocean Dumping Regulations and Criteria (40 CFR 220-229). Ultimately this process is intended to result in the final designation of an acceptable ODMDS. The Council's Agency on Bay Management also reviewed the EIS during its July 8, 1993 committee meetings.

Council Comments/Concerns

Based on the need to continue dredging projects in the Tampa Bay area, the EPA originally designated two ODMDSs offshore Tampa Bay. These sites included Site A (13 nmi off Egmont Key) and Site B (9 nmi off Egmont Key). In May 1982, action was brought in Federal District Court by Manatee County which ultimately halted disposal of dredged material at Site A as of December 1982. In 1983, EPA recommended a site (Site 4) located 18 nmi from Egmont Key for dredge material disposal on an interim basis. During the period of interim designation, additional information was compiled at other potential sites 25 to 35 nmi from shore. Site 5 is 30 nmi offshore Egmont Key.

The suitability of permanent designation of Site 4 and a site within Site 5 is evaluated in this EIS. Site 5 was excluded from additional review since the COE has indicated the distance from shore was unacceptable to transport spoil material. Site 5 also appears to contain more hard bottom habitats than Site 4 making it more environmentally sensitive to disposal activities. Therefore, Site 4 is being forwarded as the selected site for permanent disposal

9455 Koger Boulevard St Petersburg FL 33702 • (813) 577-5151/Tampa 224-9380

of dredged material by the EPA. Unless this action is taken by EPA, an EPA-designated ODMDS will not be available for the disposal of suitable dredged material for the Tampa Bay area.

EPA describes the adverse environmental effects of the proposed action as follows:

- mounding,
- smothering of bottom habitats,
- possible habitat alteration of the site, and
- temporary water quality perturbations.

Adverse impacts within the site are unavoidable, but the disposal operations will be regulated to prevent unacceptable adverse impacts outside site boundaries.

Several questions need to be addressed by the EPA and other reviewing agencies. These questions include:

- What is the composition of materials which will be disposed of at the designated site?

- What are the locations of the natural and artificial reefs in proximity to the recommended site. Will there be any perturbations to these important communities?

- What is the expected life of the project?

- What was the impact of recent storms on the existing materials on Site 4, including Hurricane Elena and the March 13, 1993 storm?

The following concerns have been identified:

- potential impacts to water quality and adjacent habitats due to disposal of contaminated or inappropriate material,

- long-term stability of the spoil material, and

- alternative uses of appropriate dredge materials for other activities have not been identified.

The following recommendations should be included in the project design:

- All material placed in the designated site should be thoroughly evaluated to ensure that the material will not degrade water quality. Contaminated material should be disposed of in upland contained areas that prevent reintroduction of contaminants into the environment.

- Spoil material that is appropriate for beach nourishment or for habitat restoration projects should be used for such purposes. Clean sand material is an important resource in the Tampa Bay region. A list and map of habitat restoration projects that will benefit by receiving appropriate spoil material should be developed with the Florida Department of Environmental Protection.

- Disposal of dredged material should be timed to coincide with periods of calmer weather and Gulf currents to prevent additional losses of disposed spoil material outside of the designated ODMDS.

- Proper construction procedures and techniques (Best Management Practices) should be implemented during all construction activities to reduce turbidity and other pollution discharged to surface waters.

- Dredging activities must be timed to prevent impacts to West Indian manatees, sea turtles and any bird nesting or foraging activities. The applicant, or contractor, must conform with Florida Department of Environmental Protection (formerly Department of Natural Resources) and U.S. Fish and Wildlife Service requirements for construction activities within areas providing habitat for listed species.

Based upon available information provided within the Environmental Impact Statement and with the understanding that site specific information will be developed on the type of material to be disposed of on Site 4, conceptual approval should be given to the long-term use of Site 4 as the approved EPA ODMDS.

IC&R #140-93
Page 4

Recommendation

The Tampa Bay Regional Planning Council recognizes the need to designate a permanent Ocean Dredge Material Disposal Site offshore Tampa, and concurs with the recommendations in the Draft Environmental Impact Statement with the proviso that the aforementioned questions be fully addressed and recommendations be included in the Final Environmental Impact Statement for Site 4 ODMDS.

Further, it is recommended that any additional comments addressing local concerns be considered prior to final action.

Committee adopted July 26, 1993.

Charles A. McIntosh, Jr., Chairman
Clearinghouse Review Committee

This project has been reviewed for consistency with the Council's adopted growth policy, Future of the Region, A Comprehensive Regional Policy Plan for the Tampa Bay Region. Upon inclusion of the aforementioned recommendations, this proposal will be consistent with Council policy 9.5.11 and 9.5.13.

Local Comments Requested From:

Agency	Request Date
Manatee Co.Environmental Action Commission	7/13/93
Hillsborough Co. City-County Planning Commission	7/13/93
Hillsborough Co. Environmental Protection Commission	7/13/93
Hillsborough Co. Planning & Development Management	7/13/93
Pinellas Co. Environmental Management	7/13/93
Pinellas Co. Permit Coordinator	7/13/93
Pinellas Co. Planning Department	7/13/93

PLEASE NOTE: Unless notified of additional consideration by the full Council, action by the Clearinghouse Review Committee is final. Please append a copy to your application to indicate compliance with clearinghouse requirements. The Committee's comments constitute compliance with Florida's Intergovernmental Coordination and Review process only.

All comments and concerns expressed by the Tampa Bay Regional Planning Council are duplicated throughout the previous letters. For the sake of brevity, responses will not be repeated.

Section II

Comment letters which do not need any response

Lewis Environmental Services, Inc

June 23, 1993

W. Bowman Crum
U.S. Environmental Protection Agency
Coastal Programs Section
345 Courtland St. NE
Atlanta, GA 30365

Re: **DEIS, Designation of an Ocean Dredged Material Disposal Site (ODMDS), Offshore Tampa Bay**

Dear Bo:

I would like to endorse the designation of a new ODMDS (Site 4) in the Gulf of Mexico offshore of Tampa Bay.

Having spent 26 years researching the biology of Tampa Bay and having dived offshore of Tampa Bay on many of the general habitat types discussed in the DEIS and specifically in the area in the vicinity of Site 5, I am convinced that offshore disposal of dredged material from Tampa Harbor is the only viable option to achieve both continued necessary maintenance dredging of the Tampa Harbor channels and the protection of the essential marine resources of Tampa Bay and the Gulf of Mexico.

As a professional environmental consultant and researcher, it is my professional opinion that neither in-bay disposal nor on-shore disposal of dredged material from Tampa Harbor offers any real alternative to resolve the future long-term problems of maintenance-dredged material.

The record of activities related to the planning, implementation and monitoring of the two diked disposal areas in Hillsborough Bay (2D and 3D) by the Corps of Engineers and the Tampa Port Authority represents the epitome of "too little, too late" and "if done, done wrong".

For this reason, any surveillance and monitoring program of the ODMDS <u>must</u> be placed in the hands of <u>dedicated</u> natural resource management and protection agencies. Neither

(continued)

P.O. BOX 20005 • TAMPA, FL 33622-0005 • (813) 889-9684

the Corps of Engineers nor the Port Authority has the will or the natural resource protection commitment to genuinely protect even the offshore ODMDS site that is the subject of this document (Site 4). Therefore, the U.S. Environmental Protection Agency and the National Marine Fisheries Service (with appropriate funding provided by the Corps and Port Authority) should be the primary agencies responsible for any permit monitoring and enforcement.

Sincerely,

Roy R. Lewis III, CEP
President/Principal Ecologist
LEWIS ENVIRONMENTAL SERVICES, INC

cc: Sally Thompson, Hillsborough Environmental Coalition
Richard Paul, National Audubon Society
Frank Dunstan, National Audubon Society
Richard Eckenrod, Tampa Bay National Estuary Program
National Marine Fisheries Service (Panama City and St. Petersburg)
Rea Boothby, U.S. Army Corps of Engineers (Jacksonville)
David Farrell, U.S. Fish and Wildlife Service (Vero Beach)
Roger Johansson, City of Tampa Bay Study Group
Nanette Holland, The Tampa Tribune
David Parsché, Tampa Port Authority
Virginia Wetherall, Florida Dept. of Environmental Protection

RRL/sft

JUL 21 J 43 :14 33

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES
R A Gray Building
500 South Bronough
Tallahassee, Florida 32399-0250
Director s Office (904) 488-1480
Telecopier Number (FAX) (904) 488-3353

July 15, 1993

Mr. Patrick M. Tobin
United States Environmental Protection Agency, Region IV
Coastal Programs Section
345 Courtland Street, NE
Atlanta, Georgia 30365

In Reply Refer To:
Denise M. Breit
Historic Sites Specialist
(904) 487-2333
Project File No. 931817

RE: Cultural Resource Assessment Request
Draft Environmental Impact Statement for the Designation of an Ocean Dredged Material Disposal Site Located Offshore Tampa
Hillsborough County, Florida

Dear Mr. Tobin:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Protection of Historic Properties"), we have reviewed the referenced project(s) for possible impact to historic properties listed, or eligible for listing, in the National Register of Historic Places. The authority for this procedure is the National Historic Preservation Act of 1966 (Public Law 89-665), as amended.

It is the opinion of this agency that the continued use of Site 4 as an offshore dredge disposal site will have no effect on any historic properties. In addition, if any of the alternatives, whether they be offshore or in the uplands, are selected as dredge disposal sites, because of their nature, they will also have no effect on cultural resources. Therefore, it has been determined by this office that the proposed project will have no effect on any sites listed, or eligible for listing, in the National Register. The project may proceed.

Mr. Tobin
July 15, 1993
Page 2

If you have any questions concerning our comments, please do not hesitate to contact us. Your interest in protecting Florida's historic properties is appreciated.

Sincerely,

Laura A. Kammerer

for George W. Percy, Director
Division of Historical Resources
and
State Historic Preservation Officer

GWP/Bdb

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

ATLANTA REGIONAL OFFICE, REGION IV
Richard B. Russell Federal Building
75 Spring Street, S.W.
Atlanta, Georgia 30303-3388

June 18, 1993

Mr. W. Bowman Crum, Chief
Coastal Programs Section
U. S. Environmental Protection Agency
Region IV
345 Courtland Street, NE
Atlanta, Georgia 30365

Dear Mr. Crum:

This refers to your memorandum dated June 11, 1993, transmitting the Draft Environmental Impact Statement (DEIS) for an Ocean Dredged Material Disposal Site (ODMDS) offshore Tampa, Florida.

Our review indicates there will be no significant adverse impact on any HUD programs as a result of this project.

Thank you for the opportunity to review and comment on your proposed project.

Sincerely,

Warren J. Howze
Director,
Program Support Division

U.S. Department
of Transportation
Federal Aviation
Administration

Southern Region

P.O. Box 20636
Atlanta, Georgia 30320

July 9, 1993

W. Bowman Crum
U.S. EPA
Coastal Programs Section
345 Courtland Street, NE
Atlanta, Georgia 30365

Re: Draft Environmental Impact Statement for the Designation of an Ocean Dredged Material Disposal Site Located Offshore, Tampa, Florida

Dear Mr. Bowman:

We have reviewed the above referenced proposed project and determined that it will not impact any civil aviation operations or facilities.

Thank you for the opportunity to comment on this project.

Sincerely,

Jacqueline M. Sweatt

Jacqueline M. Sweatt
Environmental Protection Program Manager

FLORIDA DEPARTMENT OF TRANSPORTATIO[N]
LAWTON CHILES
GOVERNOR
BEN G. WATTS
SECRETARY

PD&E Department, MS 7-500
11201 N. McKinley Drive
Tampa, FL 33612-6403
July 14, 1993

Mr. W. Bowman Crum
US EPA
Coastal Programs Section
345 Courtland Street, NE
Atlanta, Georgia 30365

RE: Draft Environmental Impact Statement for the Designation of an Ocean Dredged Material Disposal Site Located Offshore Tampa, Florida

Dear Mr. Crum:

The Project Development and Environment staff has reviewed the EPA Draft EIS for the designation of an ocean dredged material disposal site located offshore Tampa, Florida.

The Department raises no concerns that would prevent the selection of Site 4 for use in the ODMDS program. As long as the existing permitting process continues to address concerns about toxins/contaminants in dredged material there is no need to raise these concerns in connection with selection of a site.

There are occasions which involve the Department of Transportation with dredging and the ocean disposal of materials. Structural materials from bridge replacements can be used to create or enhance artificial reefs. Channel realignments due to bridge construction and/or replacement sometimes require dredge work. These types of projects are evaluated during permitting and thus have no effect on the selection of a disposal site.

Thank you for ncluding the Department of Transportation in the review process. If we may be of further assistance please feel free to contact us.

Sincerely,

Richard Darden

Richard Darden
Environmental Specialist

RD/ck

cc: M. Coleman
R. Adair

eis.off

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
Atlanta GA 30333

July 16, 1993

W. Bowman Crum
U.S. EPA
Coastal Programs Section
345 Courtland Street, NE
Atlanta, Georgia 30365

Dear Mr. Crum:

We have completed our review of the Draft Environmental Impact Statement (DEIS) for the Designation of an Ocean Dredged Material Disposal Site Located Offshore Tampa, Florida. We are responding on behalf of the U.S. Public Health Service.

We note that the ocean dumping alternative has been determined by the U.S. Army Corps of Engineers as essential to meeting their obligations to maintain navigation. Based on the information reviewed, we concur with the preferred alternative. We understand that designation of an ODMDS by the Environmental Protection Agency does not by itself authorize the disposal of dredged material at that site. The need for ocean dumping must be demonstrated with each permit application for ocean disposal. These procedures, along with routine monitoring of potential impacts, should help ensure that impacts will be minimized during the implementation of the proposed plans. Continued monitoring is important because long-term effects of ocean dumping are the most difficult to assess, therefore, adjustments to mitigation efforts may need to be made in the future.

Although we were able to complete our review, we would like to mention that the DEIS sent to us was missing the following information: (1) in the table of contents, sections 3.1.4.2 through 4.3.6; and (2) pages ii, iv, and vi.

Thank you for the opportunity to review and comment on this document. Please ensure that we are included on your mailing list to receive a copy of the Final EIS, and future EIS's which may indicate potential public health impact and are developed under the National Environmental Policy Act (NEPA).

Sincerely yours,

Kenneth W. Holt

Kenneth W. Holt, M.S.E.H.
Special Programs Group (F29)
National Center for Environmental Health

STATE OF FLORIDA

Office of the Governor

THE CAPITOL
TALLAHASSEE, FLORIDA 32399-0001

LAWTON CHILES
GOVERNOR

July 19, 1993

Mr. W. Bowman Crum
Water Management Division
Coastal Programs Section
Environmental Protection Agency
Region IV
345 Courtland Street, Northeast
Atlanta, Georgia 30365

RE: Draft Environmental Impact Statement for the Designation of an Ocean Dredge Material Disposal Site Located Offshore Tampa, Hillsborough County, Florida

SAI: FL9306170872C

Dear Mr. Crum:

The Florida State Clearinghouse is awaiting additional comments from our reviewing environmental agencies, therefore, we are requesting an additional fifteen (15) days for completion of the consistency review in accordance with 15 CFR 930.41 (b). Our reviewing agencies have indicated that August 30, 1993 would be a more suitable completion date if possible.

We will make every effort to conclude the review and forward comments to you on or before August 30, 1993 if this date meets with your approval.

Sincerely,

Janice L. Alcott

Janice L. Alcott
State Clearinghouse

JLA/bl

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

In Reply Refer To:
ER 93/507

AUG 3 1993

Mr. W. Bowman Crum
U.S. Environmental Protection Agency
Coastal Program Section
345 Courtland Street, NE
Atlanta, Georgia 30365

Dear Mr. Crum:

We have reviewed the draft environmental impact statement for the designation of an ocean-dredged material disposal site offshore Tampa, Florida. We have no comments to offer.

.hank you for th.. opportunity to comment.

Sincerely,

Jonathan P. Deason
Director
Office of Environmental Affairs

Great Lakes
Dredge & Dock
Company

9218 CYPRESS GREEN DRIVE
JACKSONVILLE, FL 32256
904-737-2739 • 800-223-4697
FAX 904-737-1815

Launching Our Second Century

August 2, 1993

Mr. Wesley B. Crumb
Chief of Coastal Program Section
U.S. Environmental Protection Embassy
345 Courtland Street NE
Atlanta, GA 30365

Subj: Offshore Dredge Material Disposal Site - Tampa

Dear Mr. Crumb:

We have read with interest your progress on designation of an offshore disposal area for dredged material in the Gulf of Mexico. As the nations largest dredging contractor, we can appreciate the need for comprehensive studies of all issues involved with selecting such a site. We would be pleased to provide any technical or historical data relative to our operations for either typical or unusual dredging applications. It is our belief that an accurate portrayal of dredging processes alleviates much of the negative concerns.

We also request that you place our name on your mailing list for public information regarding plans for offshore disposal of dredge materials from Tampa Bay.

If you have any questions, please contact me at (904) 737-2739.

Sincerely,

William H. Hanson

WHH/mt