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 Pascagoula, Mississippi

July 1991

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

FINAL
ENVIRONMENTAL IMPACT STATEMENT

for

the Designation of an
Ocean Dredged Material Disposal Site

Located Offshore
Pascagoula, Mississippi

Cooperating Agencies

U.S. Army Corps of Engineers
and
U.S. Navy

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June 28, 1991
Date

COVER SHEET

FINAL

ENVIRONMENTAL IMPACT STATEMENT

FOR

DESIGNATION AND USE OF A NEW

OCEAN DREDGED MATERIAL DISPOSAL SITE

PASCAGOULA, MISSISSIPPI

Lead Agency: U.S. Environmental Protection Agency (EPA)

Cooperating Agency: U.S. Army Corps of Engineers (CE)
U.S. Navy (Navy)

Abstract: Pursuant to 40 CFR 1501.5, the EPA is the lead Federal agency for preparing the Environmental Impact Statement (EIS) for designation of a new Ocean Dredged Material Disposal Site (ODMDS) in the Gulf of Mexico south of Pascagoula, Mississippi, i.e., the Pascagoula ODMDS. The proposed ODMDS will encompass part or all of the former interim disposal site and an adjacent charted former disposal site. For the purposes of this EIS, the proposed site is considered a new ODMDS and an enlargement of the former interim site. The U.S. Army Corps of Engineers and the U.S. Navy are designated as cooperating agencies as defined in 40 CFR 1501.6. This EIS provides the CE the National Environmental Policy Act (NEPA) documentation pertaining to the transportation to the ocean for the purpose of disposal of dredged material from the existing Pascagoula Harbor Federal Navigation Project and the authorized improvements to that project under Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972, as amended. In addition, the CE requires NEPA documentation pertaining to the permitting, under Section 103 of MPRSA, of the transport of dredged materials from non-CE navigation projects for disposal at the ODMDS. The U. S. Navy Pascagoula Strategic Homeport Project requires additional NEPA documentation relative to disposal of dredged material in the Gulf of Mexico. As cooperating agencies, the CE and Navy ensure that the EIS contains all the information required by NEPA for their decision-making processes. Both the CE and the Navy have coordinated appropriate NEPA documents on the projects described above. These documents and their contents are incorporated into this EIS by reference. Communication regarding the Federal navigation project and dredged material disposal should be addressed to the CE and communication regarding the Strategic Homeport should be addressed to the Navy, while communication regarding site designation, which by itself does not authorize dredging or on-site disposal, should be directed to EPA.

The proposed action will be conducted in accordance with the MPRSA, Ocean Dumping Regulations (40 CFR 220-229) and all other applicable laws and regulations. The proposed action would cause the following adverse environmental impacts: (1) water quality impacts, (2) alteration of site bathymetry and sediment composition, and (3) smothering benthic organisms. Water quality impacts include increased turbidity, the possible release of some chemical constituents, and lowering of dissolved oxygen levels. These impacts would be temporary and localized to the vicinity of the ODMDS and would not significantly affect water quality of the region. Changes in site bathymetry can be minimized by controlling the discharge point of the dredged material; however, it may be more desirable to mound the dredged material within the site. Options for management of the site are contained within the EIS and its appendices. Some changes in sediment composition and the smothering of benthic organisms are unavoidable impacts of the proposed action.

The CE has determined a need for a new ODMDS offshore Pascagoula, Mississippi. This need for ocean disposal is primarily based on the lack of economically, engineeringly, and environmentally feasible alternatives for the disposal of the projected quantities of dredged material. The proposed new site will be considerably larger than the interim Pascagoula site, the designation of which expired December 31, 1989. EPA is proposing to designate a new and larger ODMDS at this time due to the expiration of the designation of the interim site, the CE's anticipation of local dredged material disposal needs, and the anticipated volume of the material to be dredged. Section 3.0 of the EIS presents a detailed analysis of the alternatives to ocean disposal.

The Pascagoula ODMDS is restricted to the disposal of dredged material from the Mississippi Sound area that meets the Ocean Dumping Criteria. No grain size restrictions have been applied to the proposed ODMDS. Both coarse and fine grained dredged materials are anticipated for disposal at the site.

The Draft EIS for the subject action was coordinated with Federal, state, and local agencies and the public in July 1990. Comments received on the draft have been included in the FEIS as indicated in Section 7. Only those portions of the DEIS which have been revised and additional information which should be added to the documentation package have been provided. The DEIS filed with EPA on 27 July 1990 must be used together with this document to provide the complete Final Environmental Impact Statement.

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Comments: Comments on the Final EIS (FEIS) must be received by EPA at the above address by 9 September 1991 or 30 days after publication of the Notice of Availability in the Federal Register.

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1.0 SUMMARY

1.01 Major Findings and Conclusions. The U. S. Army Corps of Engineers, Mobile District, is responsible for the operation and maintenance of the Pascagoula Harbor (Federal) navigation project. The existing project provides for deep draft navigation traffic via a 40-foot channel from the Gulf of Mexico through Horn Island Pass and 38-foot channels through Mississippi Sound into the Pascagoula River and Bayou Casotte. This project, which was completed in August 1965, is maintained on a 12 - 18 month basis. The entrance channel through the Gulf and Horn Island Pass is maintained annually, with approximately 300,000 cubic yards of primarily sand-sized materials being disposed in the Gulf of Mexico. Historically this material was placed in the EPA interim disposal site at Pascagoula.

This site was designated on an interim basis on January 11, 1977. The interim designation was extended until December 31, 1988, so that an EIS could be prepared initiating final designation. A draft supplement to the Final EIS (FEIS) for the Designation of the Pensacola, FL; Mobile, AL; and Gulfport, MS ODMDSs was prepared in 1986 and coordinated with appropriate Federal, state and local agencies and interested public. The action discussed in that supplement describes the impacts which could result from continued ocean disposal of dredged material at the existing EPA interim designated site south of Horn Island Pass, Mississippi. Included in this document was the final report on U. S. Army Corps of Engineers, Mobile District Contract No. DACW01-83-C-009 entitled "Report on Disposal Site Designation for the Interim Approved Pascagoula Offshore Dredged Material Disposal Area" dated 1984. Although the Final Supplement for Final Designation of the Pascagoula interim site was prepared, it was never officially circulated for comment. Due to the limited size of this site and because of the need for disposal of approximately 11 million cubic yards of new work material from future improvement to the Federal navigation channel, it was determined that the most expeditious action would be to allow the designation of the interim site to expire and to prepare appropriate NEPA documentation relative to the designation of a new enlarged site at Pascagoula. Subsequent to this decision, the northern portion of this interim site was used for disposal of new work material under a CE Section 103 permit. Bathymetric surveys of the area following the disposal showed significant reductions in water depth in the northern half of the site, which might further reduce the area available for disposal. The former interim site will be encompassed by the proposed new Pascagoula ODMDS.

In 1985, the U.S. Navy announced the establishment of a naval station at Pascagoula as part of the Gulf Coast Strategic Homeporting project. The location of the station was proposed for Singing River Island, which had historically served as one of three upland disposal areas for the Federal navigation project at Pascagoula, Mississippi. The site proposed for the naval facility occupied the northern portion of the island, leaving approximately 90 acres of the former disposal area available for use for the disposal of dredged material. To facilitate the development of Naval Station Pascagoula, the CE agreed to relinquish the use of the Singing River Island disposal area after the 1987 dredging cycle. Material which had historically been placed in the Singing River Island disposal area would be transported to the Gulf of Mexico for disposal in accordance with all applicable Federal laws and regulations unless a less costly, environmentally acceptable alternative could be developed. Although a number of investigations have been performed, no other feasible disposal alternatives have been identified to date.

In January 1987, the Navy filed a final EIS for the Gulf Coast Strategic Homeport Project with the EPA. As part of that FEIS, the Navy evaluated the impacts associated with the construction and operation and maintenance of a naval facility associated with two cruisers and two destroyers. Dredging of the turning basin and berthing area requires the disposal of approximately 1,000,000 cubic yards of new work material and approximately 225,000 cubic yards of maintenance material every 18 months. A number of generic dredged material disposal alternatives were considered including:

Open Water in Mississippi Sound
Beach Nourishment
Gulf Disposal
Diked Mississippi Sound Disposal Area
On Land Diked Disposal (Singing River Island)

Of these alternatives only the existing disposal area on Singing River Island was evaluated in detail. Open water disposal, diked or undiked, and beach nourishment were eliminated due to perceived environmental impacts, quantity, and quality of the material. Gulf disposal was eliminated from consideration because the cost associated with transporting the relatively small amount of dredged material to the Gulf and the availability of the disposal area on Singing River Island. The FEIS indicated, however, that Gulf disposal of Navy's maintenance material could become economically feasible if combined with dredged material from the Federal navigation project being transported to the Gulf. Since the above mentioned EIS was finalized, the use of the disposal area on Singing River Island by the Navy and others, including the Pascagoula Port Authority, has been the subject of numerous discussions. As a result of these discussions and evaluation of possible alternatives, the need for the detailed consideration of the Gulf disposal option for both new work and maintenance material from Naval Station Pascagoula has been established. This action is being considered in detail in this document.

In 1985, the Mobile District of the CE completed feasibility level studies relative to the improvement of the Federal Deep-Draft Navigation Channel at Pascagoula. On July 12, 1985, the CE filed a FEIS for the proposed improvements with the EPA. As part of that FEIS, a number of alternatives for the placement of the new work and future maintenance material were evaluated. As a result of these evaluations, which are discussed in detail in Section 3.0 of this DEIS, the need for the designation of a new ODMDS at Pascagoula was justified. In a letter dated 5 March 1985, the EPA concurred with the CE assessment that a suitable ODMDS could be identified within a 14 mile zone south of Horn and Petit Bois Islands (See Appendix I).

In 1985, the Port of Pascagoula Special Management Area (SMA) Plan was prepared under the auspices of the Mississippi Department of Wildlife

Conservation, Bureau of Marine Resources. The SMA plan, which is incorporated in the Mississippi Coastal Management Plan, includes three elements: a development plan, a mitigation plan, and a long-term plan for the disposal of dredged material from the Port area. In 1986, the long-term dredged material disposal plan was modified to include ocean disposal of suitable maintenance material from the Federal navigation channel which had historically been placed in the Singing River Disposal Area. The long-term dredged material disposal plan is currently undergoing revision in light of changes in upland disposal site availability and quantity of material to be dredged during the maintenance of the Federal navigation channel, the Port of Pascagoula berthing areas, the Navy facility, and Ingalls Shipbuilding berthing areas.

In 1989, the CE prepared a Section 103 designation for the former EPA-interim site at Pascagoula. This designation was necessary because of the dredging requirements in the Gulf and Horn Island Pass channels as well as requirements from the Pascagoula River and Upper Mississippi Sound channels. The Section 103 designation was for the one time use of the site in late 1989.

In addition to the Federally maintained channels, numerous channels in the area are maintained by local entities and private citizens. The need for disposal of maintenance dredged materials is expected to continue. A new approved ODMDS for the Pascagoula area would serve as one possible alternative for the disposal of dredged material from various local governmental and/or private projects. Use of the new ODMDS would be restricted to disposal of dredged material from the Mississippi Sound area that meets the Ocean Dumping Criteria (40 CFR 228). No grain size restrictions have been applied to the ODMDS.

Several alternative ocean disposal areas have been considered in addition to the preferred location. The interim EPA-designated Pascagoula ODMDS was eliminated from consideration due to the small size of the site and the volumes of dredged material projected for disposal. A site off the continental shelf was also considered and eliminated based on the cost associated with transportation of dredged materials to the site, the costs associated with surveillance and monitoring of the site, and the absence of significant environmental benefits resulting from use of this site over the preferred location. Sites between the continental shelf location and the preferred location were also considered and have been carried through the detailed analysis included in this DEIS.

Extensive field investigations of the preferred area were performed in 1981 and 1982 in association with the U.S. Army Corps of Engineers Mississippi Sound and Adjacent Areas Study, in 1984 associated with the EPA interim designated site, and in November 1986 and April 1987 on an expanded area west and south of the interim site. The results of these studies are presented in the following chapters and serve as the foundation for the proposal to designate an ODMDS.

The proposed action is the final designation of a new ODMDS for the Pascagoula area. The preferred new ODMDS is defined by the following coordinates [based on North Atlantic Datum, 1927 (NAD 27)]:

Boundary Coordinates:	30°12'06" N	88°44'30" W
	30°11'42" N	88°33'24" W
	30°08'30" N	88°37'00" W
	30°08'18" N	88°41'54" W
Center Coordinates:	30°10'09" N	88°39'12" W

Proposed specific uses detailed in this document include the placement at the proposed ODMDS of maintenance and new work dredged material from the Federal navigation channel at Pascagoula and the U.S. Navy Strategic Homeport at Pascagoula.

The impacts associated with the placement of dredged material would be localized to the vicinity of the disposal site and the period of disposal and would not significantly affect the long-term productivity of the site. Monitoring and management programs would be implemented at the designated ODMDS to measure impacts and to help prevent any adverse long-range impacts. These programs are discussed in the FEIS and in Appendix G.

1.02 Areas of Controversy. No areas of controversy have been identified.

1.03 Issues to be Resolved. There are no major unresolved issues.

1.04 Relationship of Alternative Actions to Environmental Protection Statutes. The alternative actions are in compliance with the environmental protection statutes and other environmental requirements as presented in Table 1-1.

TABLE 1-1

Environmental Statutes and Executive Orders

Federal Statutes

Archeological and Historic Preservation Act of 1974, as amended, 16 USC 469, et. seq.
Clean Air Act of 1963, as amended, 42 USC 1857h-7, et seq.
Clean Water Act of 1977, as amended, (Federal Water Pollution Control Act) 33 USC 1251, et seq.
Coastal Zone Management Act of 1972, as amended, 17 USC 1451, et seq.
Endangered Species Act of 1973, as amended, 16 USC 1531 et seq.
Estuary Protection Act of 1968, 16 USC 1221, et seq.
Federal Water Project Recreation Act of 1965, as amended, 16 USC 460-1(12), et seq.
Fish and Wildlife Coordination Act of 1958, as amended, 16 USC 661, et seq.
Land and Water Conservation Fund Act of 1965, as amended, 16 USC 4601-11, et seq.
Marine Protection, Research and Sanctuaries Act of 1972, as amended, 33 USC 1401, et seq.
National Historic Preservation Act of 1966, as amended, 16 USC 470a, et seq.
National Environmental Policy Act of 1969, as amended, 42 USC 4321, et seq.
River and Harbor Acts, 33 USC 401 et seq.
Watershed Protection and Flood Prevention Act of 1954, 16 USC 1001, et seq.
Wild and Scenic Rivers Act of 1968, as amended, 16 USC 1271, et seq.
Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (PL 91-646)
Coastal Barrier Resources Act of 1982 (PL 97-348)
The Gulf Islands National Seashore (GIN) System (PL 91-660) (8 January 1971)

Executive Orders, Memoranda, etc.

Flood Plain Management (E.O. 11988) (24 May 1977)
Protection of Wetlands (E.O. 11990) (24 May 1977)
Environmental Effects Abroad of Major Federal Actions (E.O. 12114) (4 January 1979)
Analysis of Impacts on Prime and Unique Farmland (CEQ Memorandum, 11 Aug 80)

2.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

2.01 Introduction. The proposed action addressed in this EIS is the designation of an environmentally acceptable and economically feasible ODMDS in the Gulf of Mexico south of Pascagoula, Mississippi. The CE has determined the need for an ocean disposal site to accommodate approximately 1 million cubic yards of maintenance material to be dredged from the Upper Pascagoula segment of the existing Federal navigation project at Pascagoula. In addition, in 1985 the CE identified the need for an ODMDS to accommodate approximately 12 million cubic yards of new work to be dredged during the construction of authorized improvements to the project. A need has also been identified for an ocean disposal site to accommodate new work and maintenance material from Naval Station Pascagoula. The EPA is proposing the designation of a new ODMDS off Pascagoula, Mississippi at this time to accommodate these anticipated needs. However, the site will also be an available option for subsequent Federal or private disposal needs for dredged material which meet the criteria established under Section 102 of the MPRSA. The CE and Navy are proposing to utilize this new ODMDS for the disposal of materials described above.

The CE has determined a need for a new ODMDS offshore Pascagoula, Mississippi. This need for ocean disposal is primarily based on the lack of economically, engineeringly, and environmentally feasible alternatives for the disposal of the projected quantities of dredged material. The proposed new site will be considerably larger than the interim Pascagoula site, the designation of which expired December 31, 1989. EPA is proposing to designate a new and larger ODMDS at this time due to the expiration of the designation of the interim site, the CE's anticipation of local dredged material disposal needs, and the anticipated volume of the material to be dredged. Section 3.0 of the EIS presents a detailed analysis of the alternatives to ocean disposal.

2.02 National Environmental Policy Act. The National Environmental Policy Act (NEPA) of 1969, as amended, requires that an Environmental Impact Statement (EIS) be prepared for major Federal actions that may significantly affect the quality of the human environment. Primarily, this EIS carries out the EPA policy to prepare voluntary EIS's (30 FR 16186 [May 7, 1984]) as part of the designation process of an Ocean Dredged Material Disposal Site (ODMDS) under Section 102 of the MPRSA of 1972. Second, it will satisfy the CE need for NEPA documentation relating to transportation of maintenance dredged material from the existing Pascagoula Harbor, Mississippi, navigation project and new work and maintenance dredged material from authorized channel improvements to the ocean for the purpose of disposal under Section 103 of the MPRSA. In addition, it will satisfy the CE need for NEPA documentation relating to permitting under Section 103 of the MPRSA. The EIS will also satisfy the Navy responsibility under the NEPA for ocean dredged material disposal activities associated with their Pascagoula Strategic Homeport.

2.03 Marine Protection, Research, and Sanctuaries Act. The transportation of all types of materials for the purpose of disposal into ocean waters is regulated by the MPRSA. Section 102 of the Act authorizes the EPA to designate sites for ocean disposal pursuant to criteria established in this section. EPA's site designation does not, by itself, authorize any dredging or on-site dumping of dredged material. EPA Ocean Dumping Regulations (40 CFR 220-229) establish procedures and criteria for selection and management of ocean disposal sites and evaluation of permits. Section 103 of the Act authorizes the CE to regulate the transportation of dredged material for the purpose of disposing it into ocean waters. Section 103 also authorizes the Corps of Engineers to designate sites in the ocean for the purpose of disposal of dredged material, when no feasible EPA designated site is available. The purpose of the action is to comply with the provisions of the MPRSA and 40 CFR 220-229 by providing the information required to evaluate the suitability of the proposed site for designation as an ocean disposal site as well as providing information governing the proposed discharge of dredged material from the existing Pascagoula Harbor Federal Navigation Project and authorized improvements to that project and from dredging associated with construction and operation of Naval Station Pascagoula.

2.04 Port of Pascagoula Special Management Area Plan (SMA). In 1985, the Port of Pascagoula Special Management Area (SMA) Plan was prepared under the auspices of the Mississippi Department of Wildlife Conservation, Bureau of Marine Resources. This plan, which is incorporated in the Mississippi Coastal Management Plan, includes three elements: a development plan; a mitigation plan; and a long-term plan for the disposal of dredged material from the Port area. The expansion of one upland disposal area and the continued use of two others provided the foundation of the long-term management plan. Extensive dewatering and mining of these three sites would provide 30 - 40 years capacity for material dredged from the Federal navigation channel and Port related facilities. In 1986, the SMA Plan was modified to include the need for ocean disposal of approximately 650,000 cubic yards of suitable maintenance material which had historically been placed in the Singing River disposal area. The modification was necessary due to the loss of a large portion of the Singing River disposal area resulting from the construction of Naval Station Pascagoula as part of the U. S. Navy Gulf Coast Strategic Homeporting. The material anticipated for ocean disposal would be dredged during the maintenance of the existing Federal navigation project and authorized improvements to that project.

2.05 Pascagoula Harbor, Mississippi Feasibility Report Entitled "Improvement of the Federal Deep-Draft Navigation Channel". In 1985, the Mobile District of the CE completed feasibility level studies relative to the improvement of the Federal Deep-Draft Navigation Channel at Pascagoula. On July 12, 1985, the CE filed a FEIS for the proposed improvements with the EPA (50 FR 28469). The information presented in this EIS is incorporated into this EIS by reference. As a result of these studies, improvements to the channel were recommended including: deepening the existing entrance channel to 44 feet at a width of 550 feet from the Gulf to the southern end of Horn Island Pass, then continuing the 44-foot depth through Horn Island Pass at a width of 600 feet. Within Mississippi Sound and into the Pascagoula River, the channel would be deepened to 42 feet at the present width of 350 feet. The existing Bayou Casotte Channel would be deepened to 42 feet and widened to 350 feet and would include a new 1,150-foot diameter turning basin just inside the mouth of Bayou Casotte. New work material from the mouth of the Pascagoula River inner harbor, an estimated 623,000 cubic yards, would be deposited in an existing upland disposal site on Singing River Island or the Lowery Island site. New work material from the mouth of the Pascagoula River to the north end of Horn Island Pass and all of the Bayou Casotte channel material, an estimated total of 11,126,000 cubic yards, is anticipated for disposal in the Gulf of Mexico about 14 miles southwest of Horn Island. New work material to be dredged from the entrance channel (including Horn Island Pass), about 3,348,000 cubic yards, would be disposed in a nearshore area between the 15- and 30-foot depth contours south of Horn Island in an effort to maintain the littoral drift system of the island system. Maintenance material was recommended for disposal following current practice including upland disposal areas, open water disposal in the Mississippi Sound, and disposal in the Gulf of Mexico. At the time these documents were prepared, the EPA concurred with the CE that a suitable ODMDS could most likely be located within 14 miles of Horn and Petit Bois Islands. They also concurred that the site specific designation studies would be appropriate during the post authorization phase of the project (Appendix I). The Water Resources Development Act of 1986 (P.L. 99-662) authorized the improvements in accordance with the recommendations included in the report.

The authorized improvements to the Federal navigation channel included placement of approximately 623,000 cubic yards of new work material to be dredged from the Pascagoula River inner harbor into the Lowery Island and Singing River Island disposal areas. With the modification to the long-term disposal plan as discussed in Section 2.04 above, however, this material is also anticipated for disposal in the Pascagoula ODMDS due to the lack of available upland disposal capacity. Section 3.0 provides a detailed discussion of upland disposal alternatives.

2.06 Pascagoula Homeport Project. The Navy has determined that it is in the best interest of the United States to provide a better mix of ships in its traditional ports as well as to establish new homeports for a battleship surface action group, an aircraft carrier battle group, naval reserve vessels and mine sweepers on the Gulf of Mexico coast. The Navy's Gulf Coast Strategic Homeport Project will locate twenty-seven ships at six sites along the Gulf Coast. The FEIS for the Gulf Coast Strategic Homeport Project was filed with the EPA in January 1987, and is incorporated into this EIS by reference. At Pascagoula, the Navy will homeport two guided missile destroyers and two cruisers. The Pascagoula Homeport Project will require the construction of an entrance channel from the existing Federal navigation channel to the ship berthing area and construction of the berthing area. Approximately 1 million cubic yards of new work material will be removed during the construction. Maintenance of these areas will require the removal of approximately 225,000 cubic yards every 18 months. During the preparation of the FEIS described above, the Navy intended to place the new work and future maintenance material in the remaining portion of the disposal area on Singing River Island. That site, which is approximately 90 acres, was last utilized for maintenance of the Federal navigation project and for unsuitable material overlying fill which was dredged during site preparation of Naval Station Pascagoula during 1987. In addition, the Port of Pascagoula will place material dredged from public berthing areas into the site in late 1989. Placement of this material will 'fill' the site within the existing dikes. To extend the future life of the site, extensive dewatering and management practices must be undertaken prior to the placement of additional material. These management actions will take approximately 4 - 6 years to accomplish, during which time no additional material will be allowed. In order to have the station operational by 1992 when the ships will arrive, the Navy must accomplish the new work dredging during 1990/91. Although the Navy FEIS addressed ocean disposal in general, it was eliminated because of cost. The Navy therefore has a need for a new ODMDS in which to place the material since the MPRSA prohibits the disposal of dredged material in the ocean except in designated sites. Toxicity and bioaccumulation tests required for determining the suitability of the material for ocean disposal have been completed and are included in Appendix C. Results of these tests indicate that the material is suitable for ocean disposal.

2.07 Other Needs. It is anticipated that the new ODMDS will initially be used for disposal of suitable dredged materials from the existing Pascagoula Harbor Federal Navigation Project, authorized improvements to that project and from the turning basin and berthing area at Naval Station Pascagoula, as described above. However, the site is also an available option for other Federal or private dredging projects in the Mississippi Sound area provided the dredged material meets the criteria specified in the MPRSA. Projects in this category which have been recently identified include the Port of Pascagoula and Ingalls Shipbuilding, Inc. Additional Section 103 permit review would be required prior to use of the new ODMDS for any dredged material other than that initially proposed for disposal. Additional dredged material testing and NEPA documentation would also be required for transportation of dredged material for these additional users of the ODMDS. Only material that meets the Ocean Dumping Criteria (40 CFR 220-229) would be placed in the site. A need for use of the ODMDS must be demonstrated for all dredging activities.

3.0 ALTERNATIVES

3.01 Introduction. In addition to the No Action alternative, a number of alternatives to the proposed designation and use of a new ODMDS offshore Pascagoula, Mississippi are addressed. These alternatives include land disposal, beach nourishment or placement in nearshore littoral areas, open water disposal in the Mississippi Sound, either diked or undiked, the former interim Pascagoula disposal site, or alternative locations within the Gulf of Mexico.

3.02 No Action. The no action alternative is defined as not designating a new ODMDS off Pascagoula, Mississippi. The No Action alternative would not provide an acceptable EPA-designated ODMDS for use by the CE, Navy, or other entities for the disposal of dredged material that is acceptable for ocean disposal. Without the new ODMDS, the maintenance of the existing Federal navigation project at Pascagoula would be severely impacted with subsequent impacts to local and regional economies and national security. Construction of the berthing requirements for Naval Station Pascagoula would be impeded with subsequent impacts to the local economy and national security. For these reasons the No Action alternative is not feasible and will not be considered further.

3.03 Land Disposal. Land disposal alternatives are considered when evaluating the need for ocean disposal as required in Section 103 of the MPRSA. Extensive analyses to locate land disposal sites to supplement those currently in use at Pascagoula have been undertaken on a number of different occasions. As part of the Port of Pascagoula Special Management Plan (SMA), a management plan for the long-term disposal of dredged material from the harbor area was developed. As described in the SMA, this plan involved the extensive management of two existing disposal areas, Lowery and Greenwood Islands, and the expansion of a third area, Singing River Island. The proposed expansion involved the filling of approximately 103 acres of wetlands and was mitigated through preservation of over 3500 acres of wetlands. It was estimated that this management plan would provide for up to 40 years disposal capacity for material dredged from the Federal navigation channel and Port of Pascagoula related facilities. Following the Navy's announcement of development of Naval Station Pascagoula on a portion of Singing River Island, an extensive search was undertaken to locate additional confined disposal areas. The results of this search identified three sites, the 'Tenneco' site, a small parcel at the northern end of the Bayou Casotte Channel, and lands in the vicinity of the Jackson County Airport, northeast of the terminus of the Bayou Casotte Channel. Analyses of these sites indicated that the best use of the 'Tenneco' site was industrial development following fill. This fill/development could result in extensive mitigation and is being considered in connection with development of the Greenwood Island East facility and the improvements to the Federal navigation project. The small parcel at the northern end of the Bayou Casotte Channel is scheduled to house a much needed barge mooring facility and the lands in the vicinity of the airport have been dedicated to industrial development. At present therefore, there are no feasible land disposal alternatives to ocean disposal. Investigations of possible alternatives north of the Escawatpa River and/or Interstate Highway 10, are currently ongoing as part of the re-evaluation of the long-term dredged material disposal plan as described in Section 2.04 above. Although areas may be available, the size required to contain the estimated quantities of dredged material would more than likely prove to be cost prohibitive if all requirements relative to ocean disposal are met.

As required by the NEPA, the CE completed in 1976 a FEIS for the operation and maintenance of the existing Federal navigation Project. The CE has also completed a FEIS for the improvement of the Federal deep-draft navigation channel. The Notice of Availability of the FEIS was published in the Federal Register on July 12, 1985, and the improvements were authorized in the Water Resources Development Act of 1986 (P.L. 99-662). Dredged material disposal alternatives, including land disposal, for these improvements were included in the 1976 and 1985 FEIS and will not be repeated in detail in this EIS. The information presented in the CE FEISs is incorporated into this EIS by reference. The purpose of this ODMDS EIS and the site designation process, in general, is to determine an environmentally acceptable and economically feasible ocean disposal site so that such a disposal option will be available to meet the anticipated dredged material disposal needs.

3.04 Beach Nourishment or Disposal in Nearshore Littoral Areas. These alternatives are appropriate for suitable sandy materials, dredged primarily from the Horn Island Pass and Entrance Channel. As indicated in the CE 1985 FEIS concerning improvements to the Federal navigation channel, it is CE policy to utilize dredged material beneficially and therefore these alternatives will be utilized to the maximum extent practicable. During certain instances, i. e., emergency actions following hurricanes, it may not be possible to utilize these sites. At these times the use of the ODMDS may be required.

3.05 Open Water Disposal in Mississippi Sound. Disposal of significant quantities of new work material within the shallow waters of Mississippi Sound has been determined to be environmentally unacceptable due to possible changes in circulation and water quality. Disposal of maintenance material within the Sound, as is currently practiced during maintenance of the Federal navigation project, will be continued. However the expansion of areas required to handle the quantities of material proposed is infeasible and would not be consistent with the State of Mississippi Coastal Zone Management Plan. Creation of diked areas within the Sound has been proposed as a means of containing dredged material. Analyses performed during the 1985 CE Feasibility Studies indicated that the quality and quantity of new work material which would be required to construct the ring dikes would not be available from the proposed improvements. For these reasons, these alternatives are not considered further.

3.06 EPA Interim Designated Ocean Dredged Material Disposal Site. A 1.19 square nautical mile area south of Horn Island, Mississippi has historically been used for the disposal of dredged material (Figure 3-1). This site was designated on an interim basis on January 11, 1977. This interim designation was extended until December 31, 1988, so that an EIS could be prepared initiating final designation. A draft supplement to the FEIS for the Designation of the Pensacola, FL, Mobile, AL, and Gulfport, MS ODMDSs was prepared in 1986 and coordinated with appropriate Federal, state and local agencies and interested public. The action discussed in this supplement was the impact which could result from continued ocean disposal of dredged material at the existing EPA interim designated site south of Horn Island Pass, Mississippi. Included in this document was the final report on U. S. Army Corps of Engineers, Mobile District Contract No. DACW01-83-C-009 entitled "Report on Disposal Site Designation for the Interim Approved Pascagoula Offshore Dredged Material Disposal Area" dated 1984. Although the Final Supplement for Final Designation of the Pascagoula interim site was prepared, it was never officially circulated for comment because of the need for disposal of approximately 11 million cubic yards of new work material from future improvement to the Federal channel. Due to the limited size, shallow depths, previous use of this site and the estimated quantity of dredged material anticipated for disposal, it was determined that the most expeditious action would be to allow the designation of the interim site to expire and to prepare appropriate NEPA documentation relative to the designation of a new site at Pascagoula. The former interim site will be encompassed by the proposed new Pascagoula ODMDS.

3.07 Selection of a New ODMDS. As part of the final designation of the interim disposal sites for Pensacola, Florida, Mobile, Alabama, and Gulfport, Mississippi, the EPA conducted an extensive evaluation of a number of areas in addition to the existing interim sites (EPA 1986). As part of this process, the EPA considered a mid-shelf area south of the Pascagoula interim site location and a deepwater area south of Mobile, Alabama (See Figure 3-2). EPA defined the mid-shelf area as extending seaward of the nearshore area to depths of 200 meters (656 feet). In this area, physical and biological characteristics are influenced by seasonal oceanographic and climatic patterns. The area in which the mid-shelf site lies was investigated during the Mississippi-Alabama-Florida (MAFLA) Outer Continental Shelf Studies sponsored by the Department of Interior [Minerals Management Service (MMS), formerly the Bureau of Land Management (BLM)] in 1974 - 1978, and was reported to support a benthic community with low diversity and low abundance. In addition, the area contains no known fish havens, shipwrecks, or obstructions but does occur in an area fished for shrimp and bottomfish. In addition to this mid-shelf area, the EPA also defined a deepwater alternative area some 64 nautical miles south of Mobile, in waters deeper than 1200 feet (See Figure 3-2). This area was considered favorable by Pequegnat et al. (1978) because it was outside the principal economic and sport fisheries regions, and the receiving capacity of the deep gulf would ameliorate effects from disposal of dredged material. Based on the evaluation of each of the sites relative to the criteria outlined in the MPRSA, in particular the proximity of the interim sites to the navigation channels and the ease of surveillance and monitoring of the interim sites, it was determined that the interim sites provided the best location for the ODMDS's. The information presented in the 1986 EPA FEIS entitled "Final Environmental Impact Statement for the Pensacola, FL, Mobile, AL, and Gulfport, MS Dredged Material Disposal Site Designation" is incorporated into this EIS by reference. Although the mid-shelf area was not recommended for designation during the 1986 action and is not recommended here, it has currently ongoing as part of the re-evaluation of the long-term dredged material disposal plan as described in Section 2.04 above. Although areas may be available, the size required to contain the estimated quantities of dredged material would more than likely prove to be cost prohibitive if all requirements relative to ocean disposal are met.

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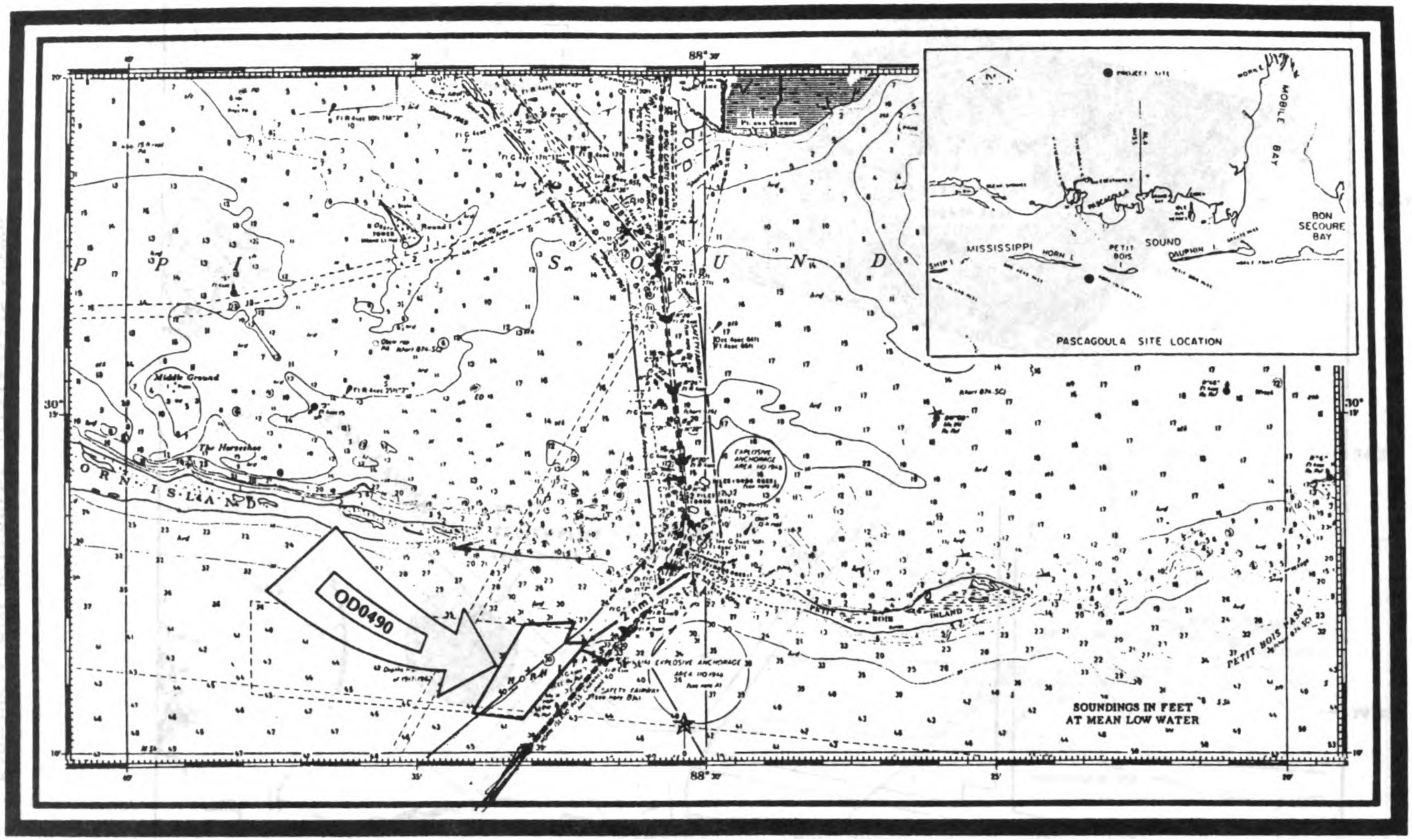
A large area south of Horn Island was selected for detailed evaluation in 1986/87. This area was chosen based on historical disposal operations, existing environmental information and economic considerations. A site designated for ocean disposal of dredged materials must be located within an economically and operationally feasible radius from the point of dredging called a Zone of Siting Feasibility (ZSF). Initially, an economic haul distance was developed to define the area south of Pascagoula in which an ODMDS could be economically located. That distance was determined to be approximately 14 miles from Horn Island Pass. Then, a selective screening process was used to eliminate any sensitive and incompatible areas. Areas of known importance, i.e. navigation safety fairways, anchorage areas, fish havens, artificial reefs etc., were utilized during this selective screening process to eliminate areas within this 14 miles.

3.08 Proposed ODMDS. The proposed action is the designation and use of a new ODMDS for the Pascagoula area. The preferred new site is located within the area bounded by Horn Island to the north, the Pascagoula Ship Channel to the east, the navigation safety fairway to the south, and a north-south line running through Dog Keys Pass to the west (Figure 3-3).

The preferred site for the new offshore ODMDS at Pascagoula, Mississippi comprises an area of 18.5 square nautical miles and is defined by the following coordinates (NAD 27):

Boundary Coordinates:	30°12'06" N	88°44'30" W
	30°11'42" N	88°33'24" W
	30°08'30" N	88°37'00" W
	30°08'18" N	88°41'54" W
Center Coordinates:	30°10'09" N	88°39'12" W

This site and its use for the Federal navigation project and Naval Station Pascagoula, was evaluated and selected with full cognizance of the site selection criteria set forth in 40 CFR 228.5 and 228.6. The preferred site meets the eleven specific selection criteria (See Paragraphs 5.02 - 5.12 and Table 5-2). The site is large enough and deep enough so that potential impacts outside the site will be minimized. The site is also large enough such that appropriate management techniques can be applied to the disposal of dredged material of differing types and from differing entities. A conceptual management plan for this multi-use site is described in Appendix G. The site is within an economically transportable distance, yet is sufficiently removed from amenities such as beaches, fish havens, artificial reefs, and hard bottom areas so that these will not be impacted. The location of the site is amenable to surveillance and monitoring utilizing standard equipment and should not pose an undue monetary constraint on users of the site.



Boundary Coordinates	30°11'54"N., 88°33'06"W.
	30°11'54"N., 88°32'18"W.
	30°11'36"N., 88°32'24"W.
	30°11'36"N., 88°32'06"W.
	30°10'30"N., 88°33'12"W.
	30°10'36"N., 88°34'00"W.
Center Coordinates	30°11'12"N., 88°33'06"W.

Navigation Chart No.	NOS 11373
Area	1.19 Square Nautical Miles
Local Navigational Aids	Loran A & C, Omega, RDF, Radar
Material Type	Dredged Material

Figure 3-1. EPA Interim ODMDS, Pascagoula, Mississippi (expired 31 December 1988).

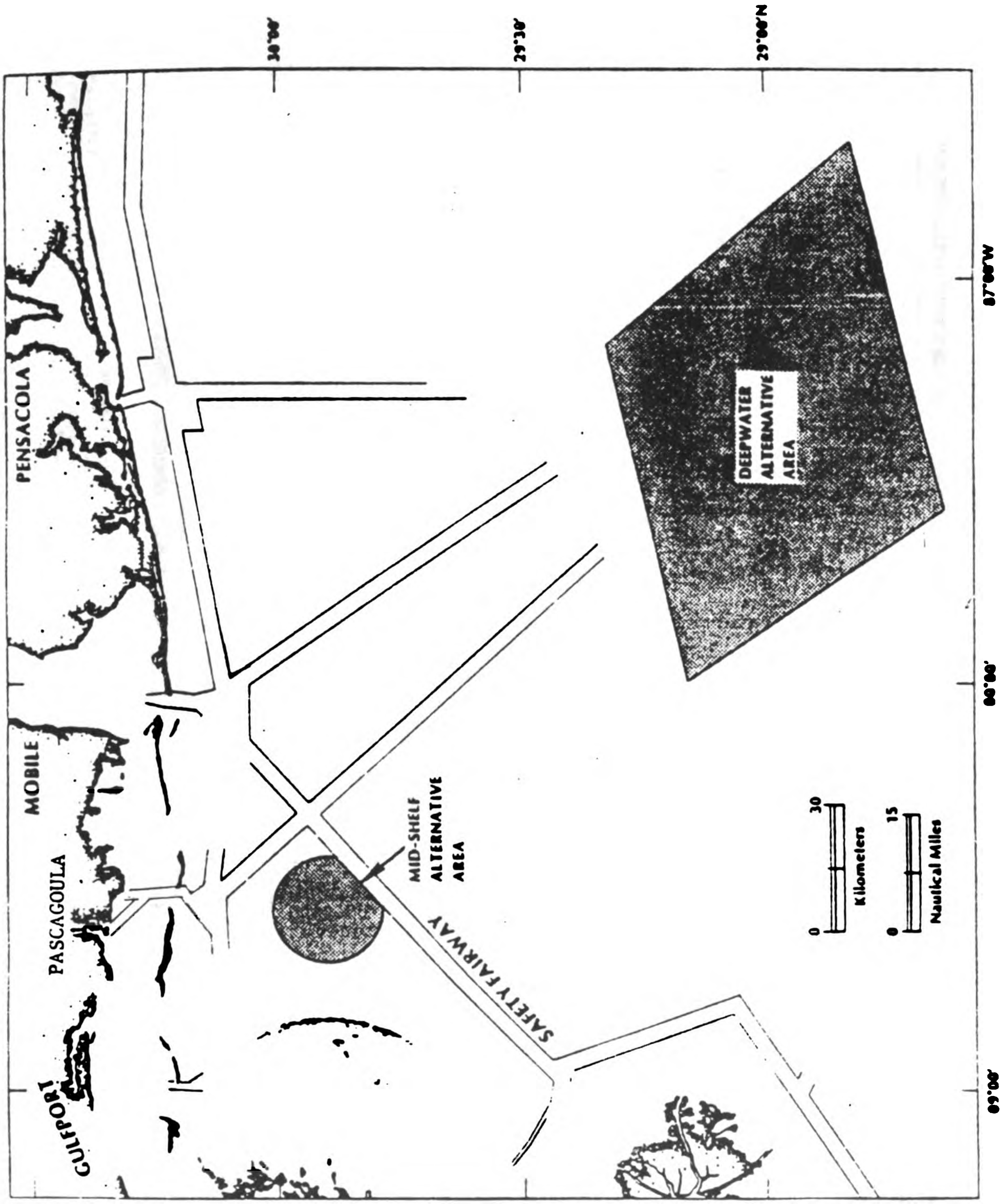


Figure 3-2. Mid-Shelf and Deepwater Alternative ODMDS
Source: EPA 1986

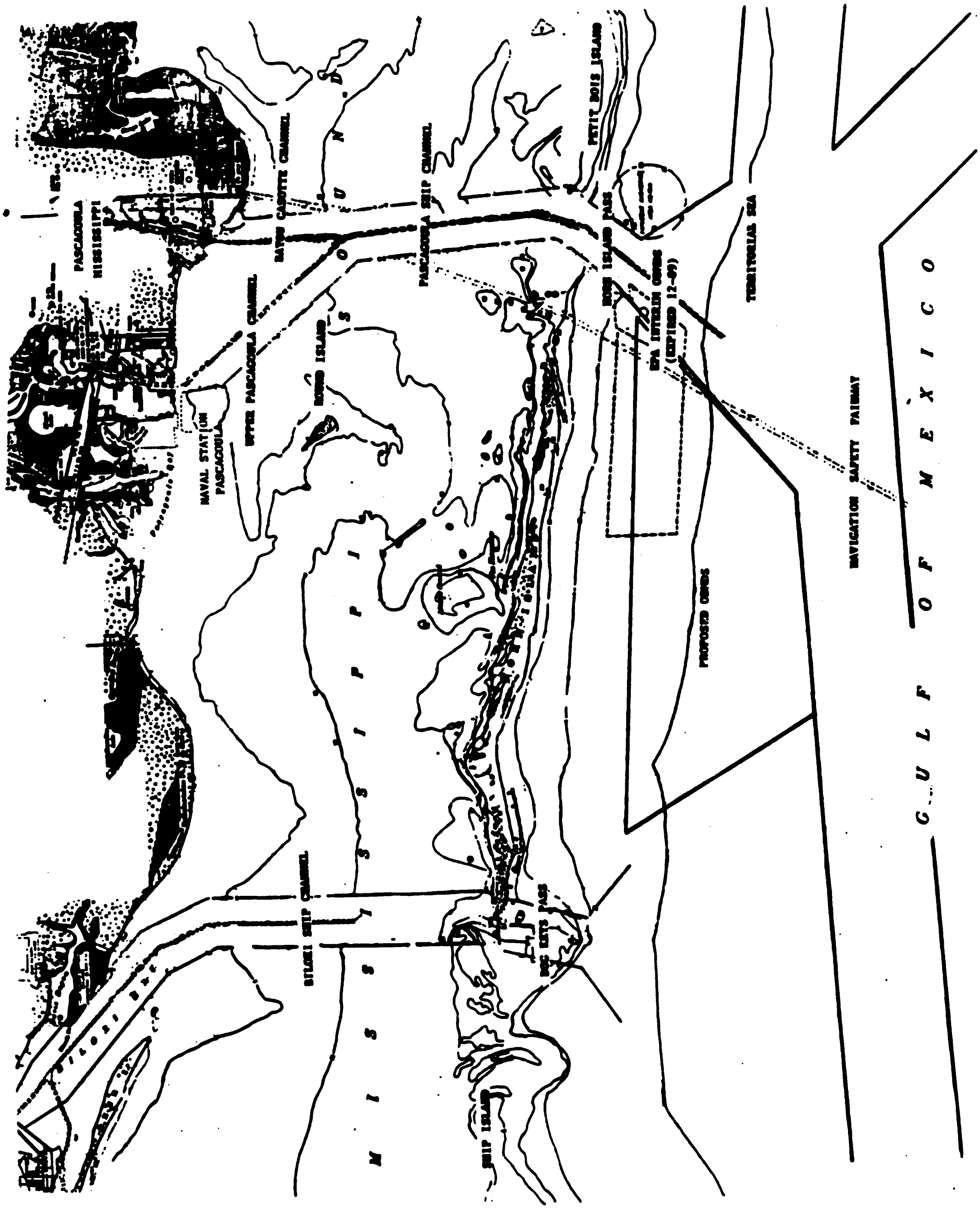
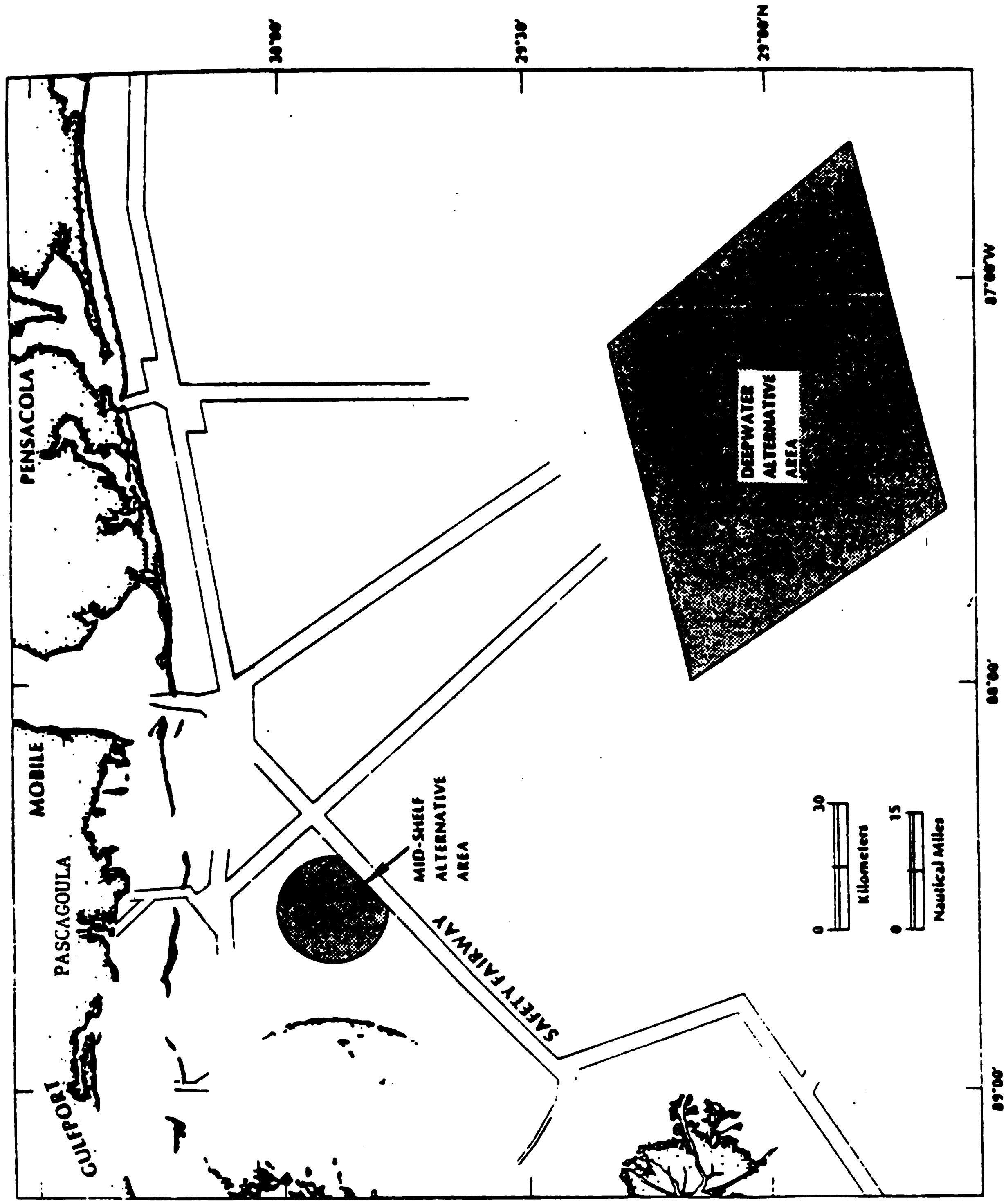


Figure 3-3. Location of Proposed ODMDS at Pascagoula, Mississippi



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Source: EPA 1986

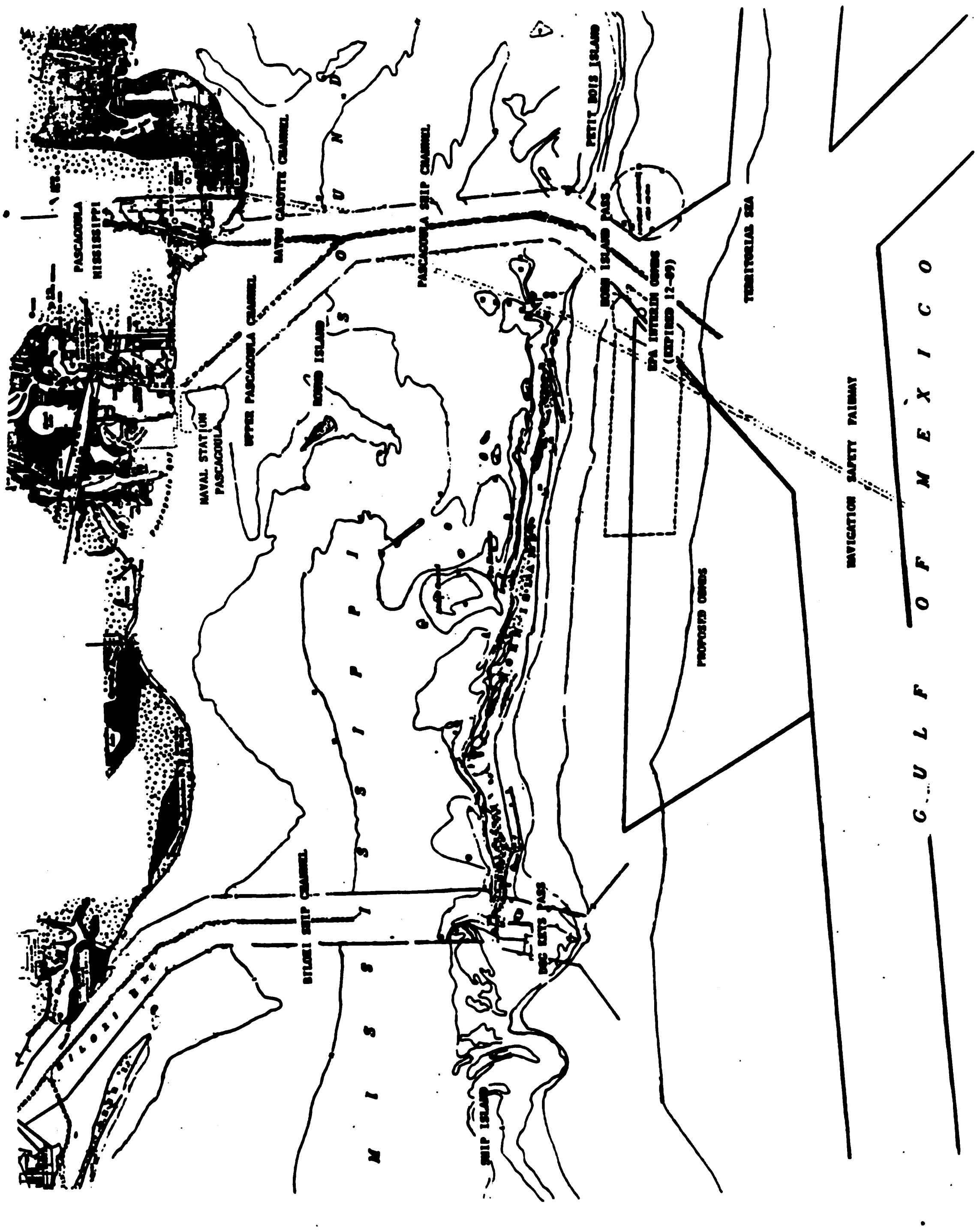


Figure 3-3. Location of Proposed ODMDS at Pascagoula, Mississippi

4.0 AFFECTED ENVIRONMENT

4.01 Introduction. This section contains a description of the existing environment in the vicinity of the proposed ODMDS and the mid-shelf alternative. The information will form the baseline for projecting environmental impacts that would result from disposal of dredged material in this region of the Gulf of Mexico. The information presented in this section was developed from the literature and from field evaluations conducted in:

a. 1980 - 1983 under the U.S. Army Corps of Engineers' Mississippi Sound and Adjacent Areas Study (Kjerfve and Sneed 1984; Raytheon Ocean Systems Co. 1981; U. S. Army Engineer District Mobile (CE) 1984; and B. A. Vittor and Associates 1982);

b. 1983 in Designation for the Interim Approved Pascagoula Offshore Dredged Material Disposal Area (Harmon Engineering & Testing 1984a); and

c. 1986 - 1987 in Designation Studies for the New Pascagoula ODMDS (Environmental Protection Agency (EPA) 1987).

In addition, data relative to chemical analyses of sediment and water samples from the Pascagoula Harbor and Mississippi Sound (GeoScience Inc. 1984) and the impact of these sediments on sensitive marine organisms (EPA 1988a, b, c, d, e) are utilized in discussing the suitability of these materials for ocean disposal. Additional information relative to the effects of material to be dredged from the Naval Station Pascagoula facilities is currently being obtained.

4.02 Climatology and Meteorology. The Pascagoula area has a humid, warm-temperate to sub-tropical climate, although occasional subfreezing temperatures do occur. Air temperatures are influenced by the Gulf of Mexico, with average annual temperatures ranging between 60° F to 70° F. Summer temperatures are influenced by the Bermuda High, a semipermanent high-pressure cell that extends over portions of the Gulf of Mexico near 30° N latitude and range between 70° F to 90° F. In the winter, winds are northerly and move in cold, continental air masses. Temperatures remain relatively mild, ranging from lows in the 40's to highs in the 60's (° F). Rainfall ranges between 55 to 64 inches annually and is fairly evenly distributed over the year. Although wind direction tends to be variable throughout the year, the overall pattern is for northerly winds from September through February and southerly winds the remainder of the year. Throughout the year, wind speeds average 7 - 10 knots (Eleuterius 1978). The probability of a tropical storm or hurricane affecting the 50-mile area between Biloxi, Mississippi, and Mobile Bay, Alabama, has been calculated as 13% for a tropical storm, 6% for a hurricane, and 1% for a severe hurricane each year (O'Neil and Mettee 1982). Hurricane Camille, a severe hurricane, came inland in the St. Louis Bay/Waveland area west of Pascagoula on 17 August 1969. Winds were estimated near 200 mph at the center of the hurricane with tides rising in excess of 22 feet. This storm almost completely destroyed the entire Mississippi coast. On 13 September 1979, Hurricane Frederic came inland in the Dauphin Island/Mobile area east of

Pascagoula. Wind gusts of 145 mph were recorded at the Dauphin Island Bridge. Considerable damage to the Pascagoula area resulted from this storm.

4.03 Geology. The Gulf of Mexico in the vicinity of Pascagoula is characterized by the Mississippi-Alabama Shelf, a triangular area seaward of the barrier islands, extending from the Mississippi River Delta on the west to the DeSoto Canyon south of Panama City, Florida on the east to the 200 meter (656-foot) contour (Figure 4-1). The shelf is about 80 miles wide in the west and narrows to about 35 miles in the east. It is an extensive, almost flat plain bounded on the landward side by the relatively steep but narrow shoreface of the Mississippi Sound. The break in slope between shoreface and shelf occurs at a depth of about 20 feet along the barrier island system. The shoreface has a gradient of from 50 to 60 feet per mile while the shelf has a gradient of approximately 3.2 feet per mile in the vicinity of Dauphin Island. At a depth of approximately 180 feet, the slope increases to about 31 feet per mile (Upshaw et al. 1966).

The Mississippi-Alabama reef-interreef facies occur along the shelf edge and consist of a series of well-cemented carbonate and terrigenous sand pinnacles about 1 mile wide with an average relief of 27 feet, interspaced by an unconsolidated sand-silt-clay mixture. The Continental Slope from the Mississippi River Delta to the DeSoto Canyon is a region of sediment instability marked by active mudflows, slumping, and erosional furrows and gullies (EPA 1986).

The Mississippi Sound barrier island system is comprised of Cat, West and East Ship, Horn, Petit Bois, and Dauphin Islands. Winds and currents from the east transport sand from the eastern to the western islands. The islands are more continuous than in the past indicating continuing reworking of relict sand sources from the continental shelf to the east. Erosion of the eastern ends of the islands and accretion on the western ends indicate considerable occurrence of longshore drift (Waller and Malbrough 1976). The rate of accretion is greater than the rate of erosion so that the islands lengthen and migrate westward with time. Surficial mapping of sediments indicates that the shelf source of sand is east of Mobile Bay, where the sand is continuous from the mainland to the shoal bottom (Shabica 1978). Immediately south of the Mississippi Sound barrier island system is a near-shore fine-grained facies similar in lithology to that of Mobile Bay and Mississippi Sound. Movement of sediment from these estuaries forms a fine-grained facies which overlaps with the Mississippi-Alabama Shelf sand facies in a zone about 7 miles wide, south of the barrier islands.

4.04 Bathymetry. Bathymetric data in the vicinity of the proposed ODMDS is presented on Figure 4-2. Water depths range from approximately 39 to 53 feet and averages approximately 46 feet. Depths in the vicinity of the mid-shelf alternative area range from 69 to 87 feet.

4.05 Circulation and Mixing. Circulation patterns within the area are controlled by astronomical tides, winds, and freshwater discharges. In Mississippi Sound and adjacent Gulf waters, the average tidal range is 1.5 feet with a predominant diurnal period of 24.8 hours. The tidal wave progresses from south to north and enters Mississippi Sound first through Horn Island Pass and splits, traveling both eastward and westward, causing as much as a 6-hour phase shift within Mississippi Sound. Water velocities range between 0 to 3 feet per second (fps) in the barrier island passes.

Wind driven currents are the primary non-tidal water motions in the study area. Although tidal currents are the most energetic currents seen in the area, non-tidal wind-induced circulation is the principal driving force of the low frequency circulation. The enhanced importance of meteorological circulation results from the tendency of tidal currents to integrate to near-zero values when averaged over periods of one or more tidal cycles (Kjerfve and Sneed 1984, excerpted in Appendix F).

The Mississippi Sound offshore area exhibits strong seasonal variations. The most profound seasonal variations are displayed by meteorological conditions which annually vary between two different states. In addition, river runoff also displays a pronounced annual signal, peaking in the spring and remaining quite low during the remainder of the year. These annual changes in the forcing functions result in seasonal differences in both current patterns and vertical structure within the area.

Within the Gulf, south of the barrier islands to the 120-foot bottom contour, meteorological forcing results from: (1) the daily, land-sea breeze cycle and associated small pressure changes; and (2) the passage of fronts. DiMego et al. (1976) in Kjerfve and Sneed (1984) report that roughly 8 frontal passages per month can be expected within the Gulf between November and January (winter), 6 frontal passages per month between March and May (spring), and 2 weak, slow-moving frontal passages per month between July and September (summer). During the winter, the fronts are highly energetic with respect to wind and atmospheric pressure due to the sharp contrast between the adjoining air masses and the passage of pressure system centers through the region. The spring fronts are still highly energetic but the typical ground track of their low pressure centers is slightly north of the region. The summer frontal passages are less frequent, traveling along paths well north of the region and exerting very little influence within the Gulf.

These changes result in pronounced differences in the oceanographic conditions encountered in the area, both in vertical structure and in the overall current pattern. Winter, with frequent energetic storms and low freshwater inputs, is characterized by a well mixed water column. The regional winter current pattern is dominated by longshore currents flowing to the west in response to the strong offshore directed mean winds. In spring, increased freshwater runoff, coupled with a reduction in mixing energy as a result of fewer and less intense storms, results in the development of a partially stratified water column. Once initiated, stratification can be maintained through the summer by solar heating of the surface waters and a further reduction of storm derived mixing. With the reversal of the prevailing winds to onshore conditions the regional circulation reverses to exhibit along shore movement towards the east. The intensity and persistence of this pattern is reduced over that seen in the winter regional conditions due to the reduction in strength of the mean winds (Kjerfve and Sneed 1984). Figures 4-3, 4-4, and 4-5 show the mean currents, as mean vectors, for each of three current meter deployments between 1980 and 1981. The three deployment periods showed differing overall current characteristics. During the November, 1980 - January, 1981 deployment (A), mean surface flow was towards the west with bottom currents flowing north and west (Fig. 4-3). During the March - May, 1981 deployment (B), surface currents were largely to the east with bottom currents to the north at 6 of the 8 stations (Fig. 4-4). And finally, during the July - September, 1981 deployment (C), both surface and bottom currents were largely directed towards the west (Fig. 4-5). It appears that a two-layer circulation pattern exists between surface and bottom waters when stratification occurs. The stratification decouples the currents throughout the water column causing variation in velocities and direction to occur.

From data collected within the Gulf between November 1980 and September 1981 (Kjerfve and Sneed 1984), it appears that the progression of the tide through Horn Island Pass segments the Gulf into an eastern and western area. The eastern area is between Horn Island Pass and the main pass entering Mobile Bay and the western area is between Horn Island Pass and the Chandeleur Islands. As the tide propagates from the Gulf through Horn Island Pass, a general clockwise movement of water in the eastern area is set in motion, whereas, in the western area, a general counter clockwise movement occurs. In the shallow area of the Gulf, near the barrier islands, the wind and pressure forces tend to dilute the influence of the tide on the general circulation pattern, creating a highly variable pattern. TerEco (1978) reported that nearshore wind patterns produce a net westerly surface water transport from September to April and net easterly flow during June and July, while May and August are typically transitional periods.

4.06 Water Quality. Water quality data have been collected in the preferred area on numerous occasions (1980/81 - Kjerfve and Sneed 1984; Vittor and Associates 1982; 1983 - Harmon Engineering & Testing 1984a; and 1986/87 - EPA 1987). The water quality of this area is highly variable, depending upon a number of factors including: location relative to Horn Island Pass, freshwater inflow, and climatic conditions. Water quality data from the mid-shelf alternative is relatively scarce, however the water quality parameters would be expected to be more constant due to the depth of the water and the remoteness from shore. Appendix B contains data from the most recent surveys conducted in 1986/87.

Dissolved oxygen (D.O.) values have been shown to exhibit some seasonal variation in the general vicinity of the preferred site. Low D.O. values are prevalent during late summer months and are attributed to stratification and isolation of bottom waters from surface waters, turbidity and organic loading (Turner and Allen 1982). Mean annual D.O. concentrations ranged from 6 to 9 parts per million (ppm) throughout the region in 1980/81 (Barry A. Vittor & Associates, Inc. 1982). Hydrographic studies performed in April and August 1983 indicated minor stratification (Harmon Engineering & Testing 1984a). Surface D.O. values ranged from 7.0 to 9.2 mg/l while bottom water levels ranged from 4.8 to 7.5 mg/l. Surveys performed in 1986/87 showed D.O. values ranging from 2.3 to 8.4 ppm. The maximum D.O. values always occurred at the surface (range 6.4 - 8.4 ppm) and the minimum values always occurred at the bottom (range 2.3 - 7.0). The maximum differential values between surface and bottom at any one station was 4.1 in July 1987. Lowest surface and bottom values occur during summer (July) while highest surface and values occur in fall/winter (October and February).

No dissolved oxygen data are available from the mid-shelf area. However, dissolved oxygen would be expected to be relatively high and stable throughout the year. Seasonal variations in D.O. concentrations in offshore waters consist mainly of a slight lowering of oxygen content in the upper 100 meters during the summer (Jones et al. 1973).

During the 1986/87 surveys, ammonia, nitrate-nitrite nitrogen, total Kjeldahl nitrogen, total phosphorus, and total organic carbon were analyzed at 1-foot below the surface, mid-depth, and 1-foot above the bottom. Water column nutrient concentrations are shown to vary with depth and with season. Typically surface values are less than those at depth. Values determined for the preferred ODMDS are typical of nearshore oceanic waters. No nutrient data are available from the mid-shelf area, however, values are expected to be lower due to distance from land drainage systems.

Chlorophyll A concentrations range from 0.88 to 3.51 mg/l in fall to 3.64 to 5.01 mg/l in spring. In general, concentrations are highest in shallow areas and in areas which receive outflows through Horn Island Pass and lowest in areas farther offshore (EPA 1987).

The temperature of the nearshore surface waters of the northern Gulf closely approximates the air temperature. This is also true for waters seaward of the barrier islands but to a lesser extent. Surface water temperatures in the vicinity of the preferred site range from about 53° F in January and February to 81° F in July while bottom water temperatures range from about 55° F to 72° F during these same respective time periods (Allen and Turner 1977). Surveys performed during 1986/87 showed the water column to be isothermal during summer (July) and stratified during April with surface waters 4 to 5° warmer than bottom waters. During winter (October and February) there is a slight gradient between surface and bottom temperatures, with bottom being slightly warmer (EPA 1987). Water temperature of the mid-shelf site would be similar to those for the preferred site. Stratification at this site would be more pronounced due to depths of the area.

General salinity distribution patterns are greatly influenced by river and tidal inlet plumes and periodic Loop Current intrusions and are thus extremely variable. Hydrographic studies in the project area show that salinities may range from 11 parts per thousand (ppt) to 36 ppt. The average annual salinity reported for the site is about 27 ppt (CE 1975).

Kjerfve and Sneed (1984) report that surface salinities varied between 20 and 30 ppt and that bottom salinities were, in general, somewhat greater with most variation contained between 30 and 35 ppt. Time series measurements of the instantaneous vertical salinity gradients during this study indicate that stratification of the water column was generally slight, presumably as a result of below-normal freshwater input to the region during this time frame.

Surface salinity values measured during the EPA surveys ranged from 23.4 ppt (February) to 34.4 ppt (October). Bottom salinities ranged from 31.0 ppt (April, July) to 37.8 (April) ppt. The maximum salinity differential at any one station was 11.4 ppt. No clear cut pattern in salinity structure could be discerned during these surveys. Salinities were highly variable from station to station within the survey area as well as within a station.

Salinities at the mid-shelf alternative location should be more constant due to the lack of influence of freshwater outflow and depth of the water column.

Water clarity in the northern Gulf is directly related to the turbulent energy (e.g., currents, internal wave seiches) on the benthic boundary layer and to the turbidity of riverine waters, and biological productivity (e.g., phytoplankton blooms) (Barry A. Vittor & Associates, Inc. 1985). Harmon Engineering & Testing (1984a) hydrographic studies showed that water clarity, as indicated by transmissivity readings, was relatively constant throughout the water column ranging between 83 to 98%.

Light transmission, as a measure of water clarity, was measured during the 1986/87 surveys. Light transmission ranged between 30 to 65 percent at a depth of 1-foot below the surface to approximately 5 percent at 30 feet during October. In February surface light transmission ranged between 40 to 65 percent in surface waters to approximately 5 percent at 30 feet. In April surface water light transmission ranged between 40 to 85 percent and to approximately 2 percent at 30 feet. Analysis of the data indicates a transition from the eastern portion of the survey area where light transmission values are lower to the west of the area where the values are higher. This is likely in response to the influence of the Mississippi Sound outflow through the Horn Island Pass (EPA 1987).

Although light transmission has not been investigated at the mid-shelf area, suspended solid concentrations of 0.1 to 0.2 mg/l were reported in this general vicinity (MAFLA studies, Dames and Moore 1979). Levels of total suspended matter ranging from 0.12 to 0.25 mg/l were reported for shelf-break waters by Manheim et al. (1972). These levels are consistent with the frequently observed trend of deeper waters generally being less turbid than coastal waters.

With respect to metal abundance in the water column, mercury concentrations ranged from 0.0002 to 0.0003 mg/l, cadmium concentrations ranged from 0.003 to 0.0018 mg/l, lead concentrations ranged from 0.0045 to 0.016 mg/l, and copper concentrations ranged from 0.003 to 0.028 mg/l during the 1983 surveys. No aromatic hydrocarbons were detected in the April survey and only three were identified in August. These data indicate the general absence of detectable quantities of HMWHC in the open waters of the ODMDS. Neither pesticide constituents nor PCB isomers were indicated above an average detection limit of 0.1 mg/l. The contaminant concentrations are generally lower than those described for other offshore waters in the area (e.g., Mobile ODMDS; Harmon Engineering & Testing, 1984b).

Information relative to water column metal abundance at the mid-shelf site is lacking. However surveys of areas south of this location failed to denote concentrations in excess of average sea water levels (Dames and Moore 1979).

4.07 Sediment Quality and Characteristics. Immediately south of the barrier island system is a nearshore fine-grained facies similar in lithology to that of Mississippi Sound. Movement of sediment from the estuary forms a fine-grained facies which overlaps the Mississippi-Alabama sand facies in a zone about 7 miles wide, south of the islands. Sediments taken from the vicinity of the preferred area are highly variable in sediment texture, ranging from 98% sand to 77% silt-clay. Data presented on Table 4-1 and in Appendix B indicate that areas with the highest sand content are located in the eastern and northern portion of the area studied (Stations A1 - A7, A14 & A15, and 363 & 367 on Figure 4-5). Stations A1, A2, A3, and A6 are located within the former EPA interim approved ODMDS which historically received sand materials dredged from the Pascagoula entrance channel. Stations A4 and A14 are in shallow water, 23 - 24 feet, south of Horn Island.

TABLE 4-1. Sediment Characteristics, Fall 1980 and Spring 1981. (B.A. Vittor & Associates 1982).

Station	% Sand	% Silt	% Clay	% TOC	% Moisture
Fall 1980					
362	22.88	26.88	50.25	0.85	105.00
363	67.60	12.55	19.75	0.68	53.25
364	51.65	19.10	29.25	0.82	71.57
365	40.98	29.28	29.75	0.68	101.00
366	55.13	27.13	17.75	0.60	68.50
367	79.50	10.75	9.75	0.50	49.75
Spring 1981					
362	38.49	33.98	27.53	1.14	113.50
363	70.36	18.65	10.99	0.29	45.00
364	59.20	28.45	12.35	0.86	66.00
365	51.96	33.83	14.20	0.76	98.50
366	55.74	32.22	12.05	0.61	67.75
367	75.42	16.28	8.31	0.69	38.75

The mid-shelf site is located in a transition zone between the silty St. Bernard pro-delta (the easternmost facies of the Mississippi Delta), and the predominantly sandy Shelf region. This results in a sediment distribution very similar to that of the preferred area, i.e. ranging from about 70 to 90% sand along the eastern edge, to about 85 to 95% silt-clay in the west. Sediment samples were collected from 21 locations in the vicinity of the proposed area and analyzed for metals, nutrients, oil and grease, pesticides and chlorinated hydrocarbons. As shown in Appendix B, all parameters were either below the minimum detection limits or in concentrations representative of other areas of the Gulf of Mexico (EPA 1987). Appendix B also includes the results of a sediment mapping survey conducted during April and May, 1987.

Previous studies in the vicinity of the mid-shelf site have indicated typical concentrations for certain sediment metals which are similar to those reported for the preferred area in Appendix B and Table 4-2. Data on the presence of petroleum hydrocarbons in offshore areas indicate that major sources are in the Mississippi Delta Area and to a lesser extent Mobile Bay.

TABLE 4-2. Range of Heavy Metal Concentrations in Sediments in the Vicinity of the Mid-Shelf Site (Trefry *et al*. 1978).

Metal	Concentration (mg/kg)
Cadmium	0.01 to 1.7
Copper	0.33 to 7.4
Chromium	2.4 to 38.5
Iron	420 to 22,700
Nickel	0.5 to 13.3
Lead	1.1 to 16.2

4.08 Sediment Transport. As discussed in paragraph 4.05, circulation patterns within Mississippi Sound and the nearshore Gulf waters are controlled by astronomical tides, winds, and freshwater discharges. It is expected that, due to the water depth of the ODMDS (39 - 53 feet), currents, wind and wave action may be of sufficient strength, at times, to transport both the coarse- and fine-grained sediments. Sediment transport would appear to be more likely under hurricane or other extreme weather conditions. Net transport would be expected to be towards the west or northwest.

4.09 Plankton. Over 900 species of 110 diatom genera and 400 species of 61 dinoflagellate genera have been reported from the Gulf of Mexico. The dominant component of phytoplankton in the Gulf of Mexico are diatoms including *Nitzschia seriata*, *Thalassiothrix frauenfeldii*, *Thalassionema nitzschioides*, *Skeletonema costatum*, *Asterionella japonica*, and *Chaetoceros* spp. (Simmons and Thomas 1962). Exceptions to this are in silicate-depleted waters or during red tides when dinoflagellates may become more abundant. Dinoflagellates reported to have widespread distribution in the Gulf include: *Ceratium*, *Glenodinium*, *Goniodoma*, *Pyrocystis*, *Gymnodinium*, and *Peridinium*. The highest diversity of phytoplankton has been reported from areas affected by river discharges where both riverine and marine species occur. Phytoplankton concentrations as high as 31,400 cells per liter have been recorded by the State University System Florida Institute of Oceanography (SUSIO) in waters from the mid-shelf area south of the Mississippi Coast (SUSIO 1975). Peaks in abundance occur during the spring and summer in estuarine and coastal areas and during the winter in offshore areas (EPA 1986).

Copepods are normally the dominant component of the zooplankton in the vicinity of the alternative ODMDS's (EPA 1986). U.S. Department of the Interior (DOI) data indicate that, in nearshore and estuarine waters, Acartia tonsa is the dominant species whereas Euchaeta, Eucalanus, and Candacea are more abundant offshore (DOI 1974). In the mid-shelf region south of Mississippi, Paracalanus has been reported in concentrations of 3036 individuals per cubic meter (SUSIO 1975). Relatively high zooplankton abundance and diversity have been reported within the passes of the nearshore barrier islands off Mississippi (Perry and Christmas, 1973).

4.10 Benthos. The Pascagoula ODMDS is located in an area which undergoes relatively frequent benthic disturbances (i.e., sediment disposal, storm action, and maritime activity). Benthic infaunal species established in this area are those tolerant of disruption and tend to recolonize rapidly following burial or displacement. Benthic infaunal communities associated with the ODMDS were investigated as part of the Corps of Engineers Mississippi Sound and Adjacent Areas Study (Barry A. Vittor & Associates, Inc. 1982). The results of this study identified two different community types within the vicinity of the preferred ODMDS: offshore mud bottom and offshore muddy sand.

The mud bottom community was found to be dominated by five polychaete taxa (Magelona cf. phyllisae, Mediomastus spp., Diopatra cuprea, Myriochele oculata, and Parapironospio pinnata), one crustacean (Oxyurostylis smithi), one sipunculid (Golfingia trichocephala), and one nemertean (Cerebratulus cf. lacteus). Four of these mud bottom dwellers, Magelona cf. phyllisae, Mediomastus spp., Paraprionospio pinnata, and Golfingia trichocephala, were also among the dominant taxa in the muddy sand community. The other dominant muddy sand taxa were represented by three polychaete taxa (Lumbrineris spp., Aricidea sp. C, and Prionospio cristata).

The mud bottom community dominated the northern portion of the area, which is characterized by shallow depths and hydrographically variable conditions (Figure 4-6 stations 362, 364, 365 spring and fall and stations 363 and 366 spring). Sand content of these areas averaged less than 39%. The dominant taxa of this area had extremely high frequencies of occurrence. The predominant feeding types of these taxa were surface and subsurface deposit-feeders. The most characteristic species for this habitat indicate a positive association for finer (silt and/or clay) sediments with a high organic and moisture content and a negative association for sands. Community structure parameters, based on averages of all stations showing this habitat type, indicate moderate faunal densities, and lower number of taxa, diversity, richness, evenness, and biomass as compared to the muddy sand habitat.

The muddy sand community dominated deeper water areas seaward of the mud habitat and between a third offshore community type identified in this study, the offshore sand areas (Figure 4-6 station 367 spring and fall and stations 363 and 366 spring). Sediments in this general area are classified as fine to very fine sand and hydrographically the area exhibits higher and more stable salinities. Frequency of occurrence of dominant taxa was extremely high, however biomass values were generally low and evenly distributed among the taxa. The predominant feeding types in this community were also surface and subsurface deposit-feeders.

The 'flip-flop' of stations 363 and 366 between the two community types is indicative of the highly variable hydrographic conditions within this area of the northern Gulf of Mexico and also the relationship between community structure and sediment grain size.

Additional benthic studies were performed during the 1986/87 joint survey efforts between the CE and EPA. Analysis of data from 21 locations in the eastern half of the proposed area provided similar results to those described above. The area is typically dominated by polychaetes including *Galathowenia occulata* (= *Myriochele oculata*), *Mediomastus* spp., *Paraprionospio pinnata*, and *Magelona* spp.. In addition, a sipunculid (= *Golfingia* ?), a rhynchocoel (= *Cerebratulus* ?), *Phascolion strombi* (sipunculid) and two molluscs, *Tellina* spp. and *Turbonilla* spp. contributed significantly to the communities during this period. Both molluscs were present during the earlier studies, however they did not contribute significantly to the community structure.

During the 1986/87 studies a combination of side scan sonar, continuous video recording, and still photography were utilized to characterize the bottom and determine the presence of potential live/hard bottom communities. For the purpose of the survey, live-bottom was defined in accordance with the Minerals Management Service definition:

> "Attached communities of invertebrates and plants and mobile invertebrates and fishes, occurring on emergent or thinly covered hard substrates or on layers of biogenic rubble."

Minimal results were obtained at the Pascagoula site due to the turbid nature of the water column. Data that were obtained indicated that sediments in the area appeared to be composed of very fine silty muds in the southwest grading into a slightly coarser substrate of mud and fine grained sand to the north and east. Greater concentrations of fine sand were seen on the eastern side of the area surveyed which increased toward shore. Faint evidence of a mottled, sand ribbon-type distribution of muds and sands was seen, indicating a limited amount of wave sorting. No evidence of out cropping or thinly covered hard bottom was seen.

4.11 *Nekton/Epifauna*. Nekton investigations of the northeastern Gulf have focused primarily on commercially important species; consequently, a characterization of nearshore nekton assemblages has been biased toward these species. It has been estimated that 96% of the fish caught shoreward of the 22 m contour utilize coastal estuaries and bays during part of their life cycle (Chittenden and McEachran 1977). Coastal estuaries provide productive nursery areas for these species, and the tidal passes and adjacent nearshore areas are pathways for migrating nekton. Seasonal variation in nekton abundance at a nearshore ODMDS should coincide with the migration patterns of the dominant coastal species (EPA 1982).

In relation to the Pascagoula disposal site, the work of Christmas and Waller (1973) is the most recent published comprehensive faunal summary. Data collected by Christmas and Waller between 1968 and 1969 indicate that 98% of the fishes collected in the Mississippi Sound were also present in offshore trawl samples. Dominant fish families as determined by percentage of catch were the Sciaenidae (drums) and the Clupeidae (herrings). Epifaunal trawls were made along three transects within the Pascagoula disposal site area in April & August, 1983 (Harmon Engineering & Testing 1984a). The results of the April 1983 trawl samples show the bay anchovy (Anchoa mitchilli), hardhead catfish (Arius felis), sheepshead (Archosargus probatocephalus), and Gulf butterfish (Peprilus burti) to be the dominant fishes collected, although the total number of individuals collected was low. The August 1983 trawl samples resulted in a higher species diversity and a somewhat different group of dominant species. Dominant species from the August 1983 samples are given as follows: Atlantic threadfin (Polydactylus octonemus), sand seatrout (Cynoscion arenarius), longspine porgy (Stenotomus caprinus), Atlantic stingray (Dasyatis sabina), spot (Leiostomus xanthurus), and striped anchovy (Anchoa hepsetus). Due to the fact that the tidal passes and adjacent nearshore areas serve as pathways for migrating nekton, the dominant species at the Pascagoula ODMDS will vary seasonally. However, six fish species were found to be dominant almost year round. These included the bay anchovy, menhaden (Brevoortia patronus), Atlantic croaker (Micropogonias undulatus), spot, butterfish (Peprilus paru), and sand seatrout. The U.S. Department of Commerce, National Marine Fisheries Service (NMFS), Pascagoula, Mississippi, provided data concerning the results of groundfish surveys conducted in and around the proposed ODMDS between 1950 and 1985 (T. Henwood, personal communication). Appendix E presents a total list of fish and invertebrate species collected by NMFS during the 35-year period as well as a list of those species collected by Harmon Engineering & Testing in 1983 (1984a) and the information presented in Benson (1982).

In general, movement of nekton into the estuaries occurs mainly from January to June, while migration back into the Gulf typically occurs from August to December. Table 4-3 provides information on the migratory behavior of some coastal nekton common to the Gulf. Also, many artificial reefs (sunken liberty ships) occur within approximately 9 miles of the preferred ODMDS (Figure 4-7). These artificial reefs have been shown, through research conducted by the Gulf Coast Research Laboratory, Ocean Springs, Mississippi, and Dauphin Island Sea Lab, Dauphin Island, Alabama, to provide suitable habitat for many fish species that are not normally encountered over a sandy bottom. Fishes such as gag grouper, warsaw grouper, red snapper, lane snapper, gray snapper, vermillion snapper, triggerfish, and amberjack readily associate with these structures (R. Shipp, personal communication).

Table 4-3. Migratory Behavior of Some Coastal Nekton Common to the Gulf.

Month of Occurrence	Species Moving into Estuaries (or nearshore zone)	Species Moving from Estuaries
January	Southern hake, red drum (peak)	Menhaden, spadefish
February	Stingray, brown shrimp (post larvae)	
March	Gulf killifish, spot, cutlassfish, hogchoker, butterfish, rough silverside, flounder, tonguefish	Blue catfish, sheepshead minnow, longnose killifish
April	Gafftopsail and sea catfish, bluefish, bumper, sand seatrout, southern kingfish, skipjack, herring (in and out same month), adult croaker, black drum (peak), pinfish, Atlantic threadfin, toadfish, midshipman	Bighead searobin
May	Striped anchovy, lizardfish, sardine, Spanish mackerel, white shrimp (post larvae)	Menhaden, southern hake
June	Needlefish, pompano, crevalle jack, leatherjacket, Atlantic moonfish	Butterfish
July	Ladyfish, lookdown	
August		Ladyfish, Atlantic threadfin
September		Adult croaker, rough silverside
October	Menhaden, sheepshead minnow, bighead searobin	Sardine, bluefish, leatherjacket, Atlantic moonfish, sand seatrout, cutlassfish, Spanish mackerel

Table 4-3 Cont'd. Migratory Behavior of Some Coastal Nekton Common to the Gulf.

Month of Occurrence	Species Moving into Estuaries (or nearshore zone)	Species Moving from Estuaries
November	Blue catfish, juvenile croaker	Striped anchovy, gafftopsail catfish, needlefish, pompano, crevalle jack, bumper, lookdown, pinfish, tonguefish, toadfish, midshipman, white shrimp (juveniles)
December	Longnose killifish	Stingray, lizardfish, Gulf killifish, spot, southern kingfish, flounder, hogchoker

Source: After Christmas, 1973.

4.12 Commercial Fisheries. Gunter (1963) called the region between Pascagoula, Mississippi, and Port Arthur, Texas, the 'Fertile Fisheries Crescent' and in 1988, the Gulf States ranked second to the Pacific Coast and Alaska in fisheries landings and value of processed fishery products in the United States. In 1987, the Gulf States ranked above the northwest region in fisheries landings (NMFS 1989). The major fisheries landed along the Mississippi and Alabama gulf coast are menhaden, mullet, and croakers. These species are described in detail in Section 4.11 above. In addition, shrimp (*Penaeus aztecus*, *P. setiferus* and *P. duorarum*), blue crabs (*Callinectes sapidus*), and oysters (*Crassostrea virginica*) make up a substantial portion of the commercial fishery of the northern Gulf of Mexico.

Brown shrimp (*P. aztecus*) is the principal component of the commercial shrimp industry and are harvested in Mississippi Sound and Mobile Bay from May to August and offshore from June to November. The adults spawn offshore from about November to April and postlarvae move toward marshy and soft bottom shallow areas of the estuaries in February to April. The juveniles and adults migrate offshore from May through August. In the offshore area brown shrimp are found on mud and sandy bottoms (Van Lopik *et al*. 1979). White shrimp (*P. setiferus*) are abundant in the estuaries from July through November. Spawning occurs in the Gulf of Mexico from March to October with postlarval recruitment to the estuaries extending from May through October (Loesch 1976). Offshore migration of late juveniles and adults occurs between June and November, primarily at night and during ebbing tides (Russell 1965). Pink shrimp (*P. duorarum*) is a relatively uncommon species west of Mobile Bay (NMFS 1981).

4.13 Threatened and Endangered Species. Endangered and threatened species that do occur or that could potentially occur in the vicinity of the ODMDS's are listed below (T. Henwood, telephone conversation with S. I. Rees, 23 February 1989):

Listed Species	Scientific name	Status
finback whale	*Balaenoptera physalus*	endangered
humpback whale	*Megaptera novaeangliae*	endangered
right whale	*Eubalaena glacialis*	endangered
sei whale	*Balaenoptera borealis*	endangered
sperm whale	*Physeter catodon*	endangered
green sea turtle	*Chelonia mydas*	endangered
hawksbill sea turtle	*Eretmochelys imbricata*	endangered
Kemp's ridley sea turtle	*Lepidochelys kempi*	endangered
leatherback sea turtle	*Dermochelys coriacea*	endangered
loggerhead sea turtle	*Caretta caretta*	threatened

There are no other species proposed for listing. Also, no critical habitat or proposed critical habitat occurs in the vicinity of the ODMDS's.

Usually the large cetaceans inhabit the continental slope and deep oceanic waters, however, they are occasionally sighted nearshore (Schmidly 1981; Loeheffner 1988). With the exception of the sperm whale, which is a toothed whale, the others are baleen whales. Most baleen whales do not exhibit well-defined social structure, and in most of their range are solitary or found in small groups. The sperm whale, on the other hand, does appear to have a well defined social hierarchy (Matthews 1978).

The finback whale is cosmopolitan and occurs in all oceans. It feeds primarily on krill and small schooling fish. In the Gulf of Mexico this species is present through the year and sightings at sea have been recorded in the northern Gulf between 28° and 30° N latitude and 86° and 88° W longitude. There are reports of five strandings and four sightings in the northern Gulf primarily along the Florida, Texas, and Louisiana coasts (Schmidly 1981). Aerial surveys conducted for the Fish and Wildlife Service in 1980/81 failed to detect the presence of this species (Fitts *et al*. 1983). Darnell *et al*. (1983) illustrate finback whale habitat as waters at the continental slope and deeper.

Humpback whales are a coastal species and feed primarily on krill and fish. Humpbacks have been sighted in the central Gulf (1952, 1957), in the eastern Gulf near the mouth of Tampa Bay (1962, 1983), and near Seahorse Key, Florida in 1983 (Layne 1965; Schmidly 1981; *Gainesville Sun* 1983). Other sightings have been in deep water (>200 meters) off the Alabama/Florida coasts. No humpback whales were observed during the 1980/81 surveys described above.

Right whales are the most endangered cetacean in the Gulf of Mexico. The population in the Gulf is currently unknown. Right whales are specialized as 'skimmers' that feed by swimming slowly with their mouths wide open through concentrations of copepods. They typically feed at or just below the surface. Right whales have been reported in the northern Gulf, near Brazoria County, Texas in 1972 and Manatee County, Florida in 1963 (Lowery 1974). No right whales were observed in the 1980/81 surveys.

Sei whales usually travel in groups of two to five individuals and feed primarily on copepods, krill, and small schooling fish. Strandings have been recorded from the coasts of Mississippi and Louisiana in the vicinity of the Mississippi River Delta (Schmidly 1981).

The sperm whales are probably the most abundant whales in the northern Gulf.. They feed mainly on mesopelagic squid and also large demersal and mesopelagic sharks, skates, and fish (Rupp-Fulwiler 1978). Numerous strandings and sightings of sperm whales have been reported in the Gulf for every month. These whales usually inhabit offshore waters and are usually not found in waters less than 1,000 meters in depth (Watkins 1977). During the 1980/81 aerial surveys, sperm whales were observed on 13 different occasions in the northern Gulf.

Although marine turtles occasionally enter estuaries, they generally prefer higher salinity waters such as those of the Gulf of Mexico. Nesting may occur throughout the range but most nesting occurs on restricted areas of beach that the turtles return to each nesting season. Foraging areas are often very far from nesting beaches and in order to nest, turtles may migrate long distances. Mating generally takes place in offshore waters near the nesting beach and males rarely come ashore (Fuller 1978).

Green turtles are most abundant between 35° north and 35° south latitudes, particularly in the Caribbean. The green turtle usually frequents shallow reefs, shoals, lagoons, and bays where marine grasses and algae are plentiful. Its preferred nestings sites are steep, sloped beaches, well above high tide, in the Yucatan Peninsula, Caribbean, and Florida (MMS 1989). Immature turtles are found along the Florida west coast (Carr and Caldwell, 1956) and have been known to nest on the barrier islands of the northern Gulf coast in the past.

The loggerhead turtle occurs throughout the Gulf and has been observed as far as 500 miles offshore. It frequents natural and manmade structures, including oil and gas platforms, where they forage on benthic invertebrates, fish, and aquatic vegetation. Only a small portion of loggerhead nesting occurs in the Gulf. About 90 percent of the total nesting in the United States occurs on the south Atlantic coast of Florida (Carr and Carr 1977). Christmas and Waller (1973) reported loggerhead nestings on the beaches of the Mississippi Sound barrier islands. Ogren (1977) stated that historically the loggerhead nested on the remote beaches of Cat, Ship, Horn, Petit Bois, and Dauphin Islands. Human disturbance, natural predation, and island development have reduced the use of the barrier islands for nestings. Normally 1 to 2 loggerhead crawls are noted on the Mississippi barrier islands each year. One nesting attempt was noted on June 7, 1987, on east Ship Island which represents the only confirmed nesting attempt on the Mississippi Islands in the last four years (T. Simons, personal communication).

The leatherback is probably the most oceanic of all sea turtles, preferring deep waters (Rebel 1974). It occasionally enters shallow waters and estuaries usually in the more northern waters of its range (Ernst and Barbour 1972). Leatherbacks are frequently seen in the Gulf of Mexico and are seasonally abundant off the Florida coast near Panama City (Pritchard 1976). No recent nesting has been reported along the Gulf Coast (MMS 1989).

The hawksbill turtle inhabits reefs, shallow coastal areas, and passes in water less than 15 meters deep, where they feed on benthic invertebrates and vegetation (Fuller et al. 1987). The hawksbill is a solitary nester between 25° N and 25° S latitude and along the Gulf Coast of Florida.

Kemp's ridley sea turtles are probably the most endangered of the sea turtles in the Gulf of Mexico. Their nesting is restricted to a small stretch of beach near Rancho Nuevo, Ramaulipas, Mexico. Ridley turtles commonly inhabit shallow coastal and estuarine waters. Ridley turtles commonly occur in shallow water areas from Marsh Island to the Mississippi Delta in Louisiana (Hildebrand 1982) and from Bolivar Roads to Sabine Pass in Texas. Immature ridley's are regularly encountered (strandings) in the Mississippi Sound and adjacent to the barrier islands (R. Smith, personal communication). Ogren (personal communication) indicated that this species tends to congregate in vegetated shallow-water areas within the estuaries. It feeds on crabs, fish, jellyfish, barnacles, and molluscs. Coastal Louisiana has been indicated to be an important sub-adult and feeding habitat (Hildebrand 1982). A head-start release program for this species has been initiated by the Fish and Wildlife Service, National Marine Fisheries Service, and National Park Service in Padre Island, Texas.

4.14 Mineral Resources. Although oil and gas exploration/production activities have historically occurred west of the preferred ODMDS in the region offshore Louisiana and Texas, recent activities related to natural gas resources in the vicinity of Mobile Bay and Dauphin Island to the east indicate a continuing trend for exploration of mineral resources in the Gulf of Mexico. At present there are no active oil and gas activities in the vicinity of the preferred ODMDS, however much of the area south of the site is included in Gulf of Mexico Lease Sale 123 which is planned by the Minerals Management Service in 1990. The area of the mid-shelf alternative is also included in this sale (Doug Elvers, Minerals Management Service, New Orleans, LA. Two buried pipelines transit the far northeastern corner of the ODMDS. These high pressure lines transport natural gas from the Main Pass (Louisiana) area ('41 Field') to the Chevron Refinery at Bayou Casotte (Chevron Pipeline Co.).

4.15 Shipping. Navigation safety fairways have been established by the U. S. Coast Guard to control the erection of structures therein to provide safe approaches through oil fields in the Gulf of Mexico to entrances to the major ports along the Gulf Coast (33 CFR 166.20). The preferred ODMDS and the mid-shelf area both lie outside safety fairways.

4.16 Coastal Amenities. The primary coastal amenity is the Gulf Islands National Seashore which includes Petit Bois, Horn, and Ship Islands to the north of the preferred ODMDS. The gulf beaches of these islands are used for recreational activities such as swimming, fishing and sun bathing. The northern boundary of the preferred ODMDS is approximately one and one-half miles south of Horn Island.

4.17 Cultural Resources. A literature search was conducted to determine if significant submerged cultural resources such as historic shipwrecks were located in the vicinity of the alternative ODMDS's. This search failed to reveal any known submerged cultural resources. In addition, due to the water depths of the area, the potential for shipwrecks is considered to be extremely low. These results have been coordinated with the Mississippi State Historic Preservation Officer (See Section 7.0 and Appendix I).

4.18 Military Restrictions. The alternative ODMDS's are not located within any military restricted areas.

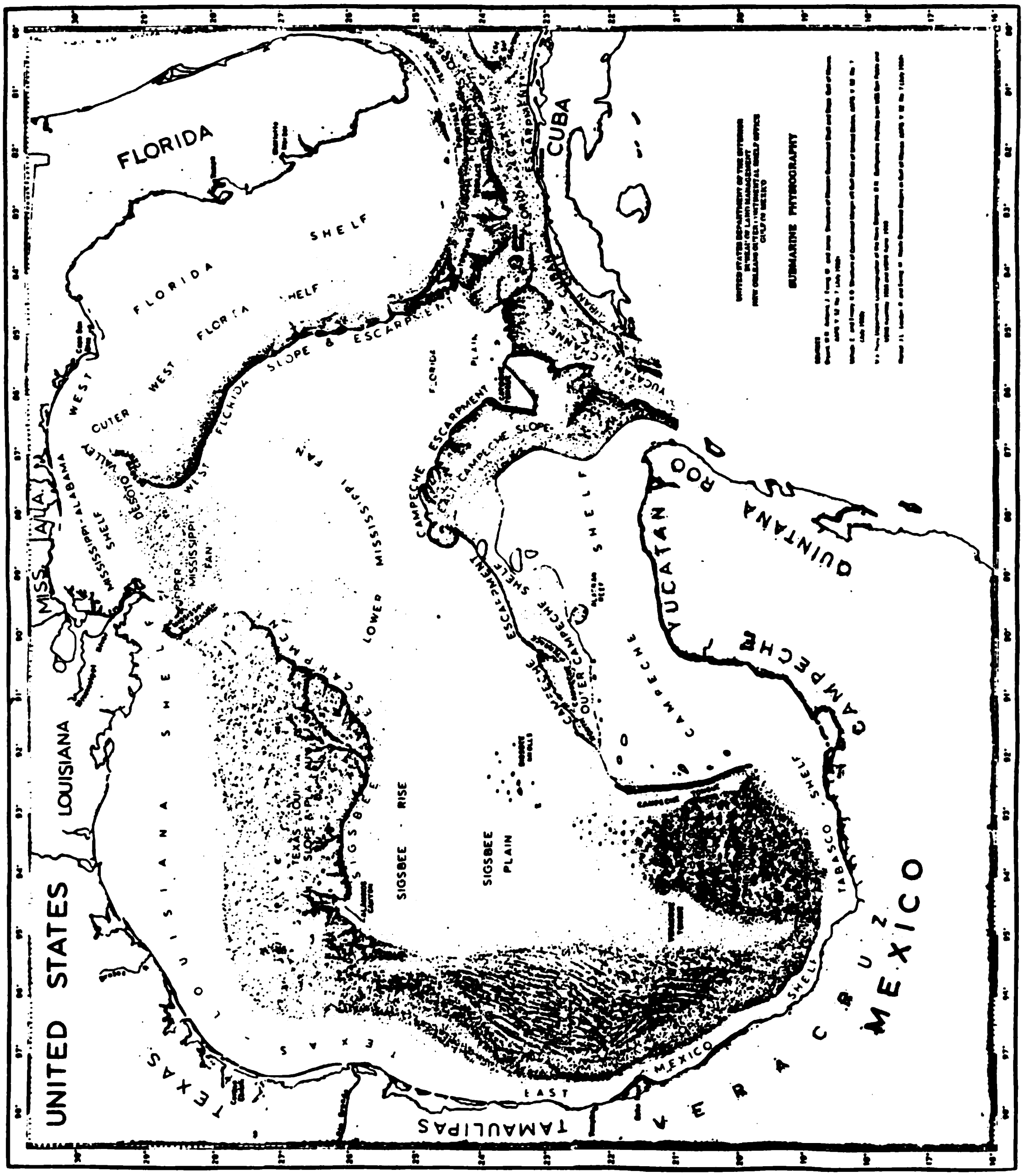


Figure 4-1. Submarine Physiography of the Gulf of Mexico
Source: USDI, Minerals Management Service 1989

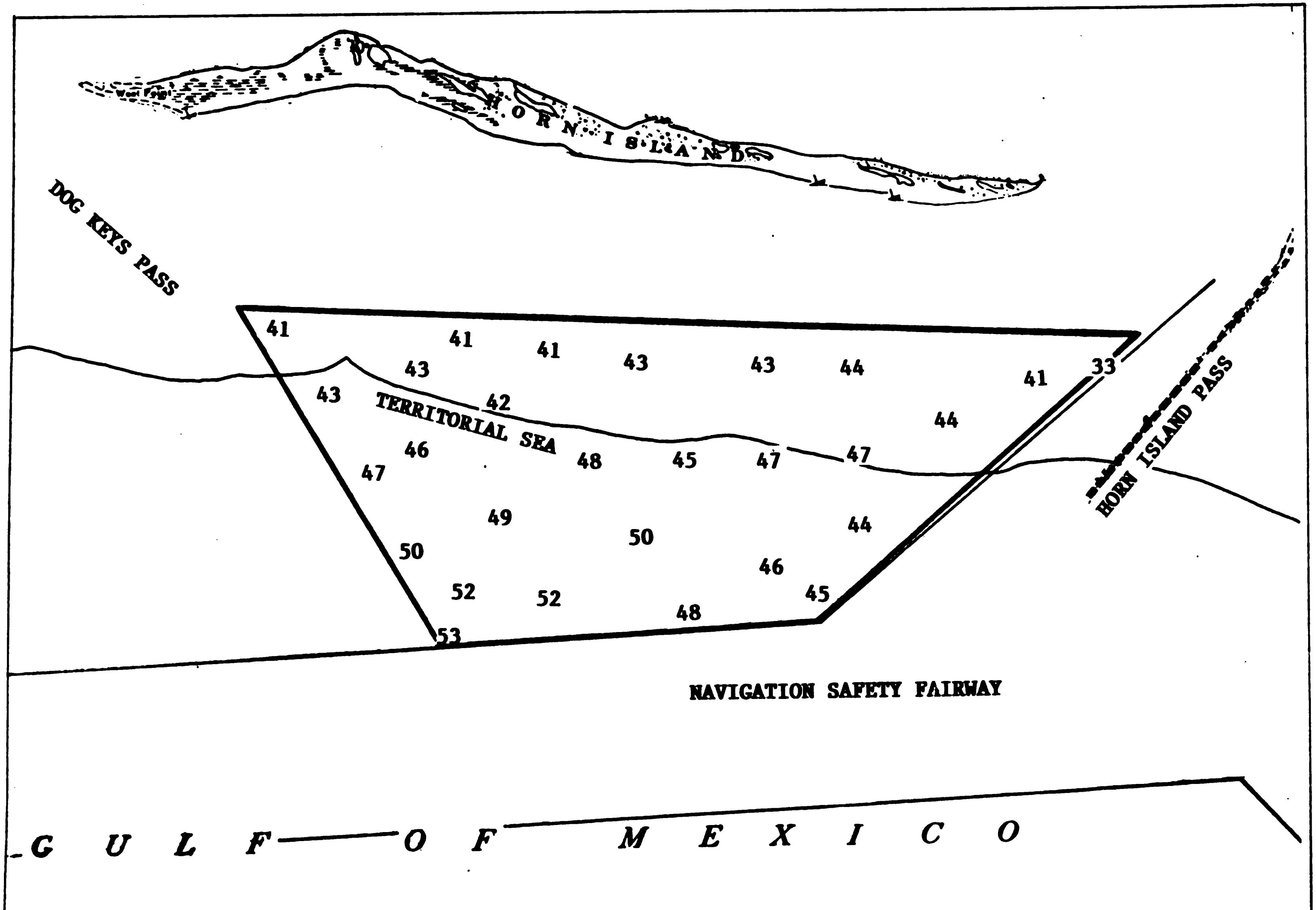


Figure 4-2. Bathymetry (feet) of Proposed ODMDS

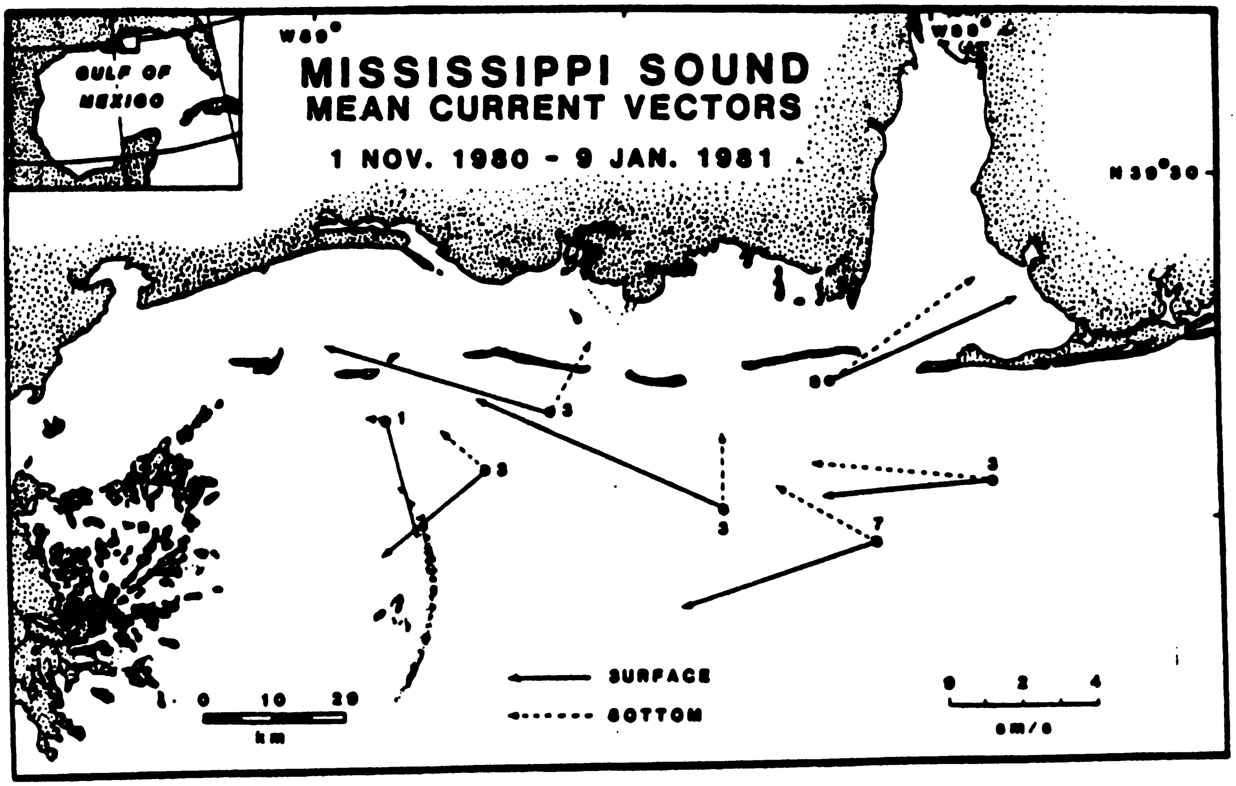


Figure 4-3. Resultant surface (solid) and bottom (dashed) current vectors for the 7 recovered current moorings in the Mississippi Sound Offshore Study Area during deployment period A. The origin of the vector is the station location. (from: Kjerfve and Sneed 1984).

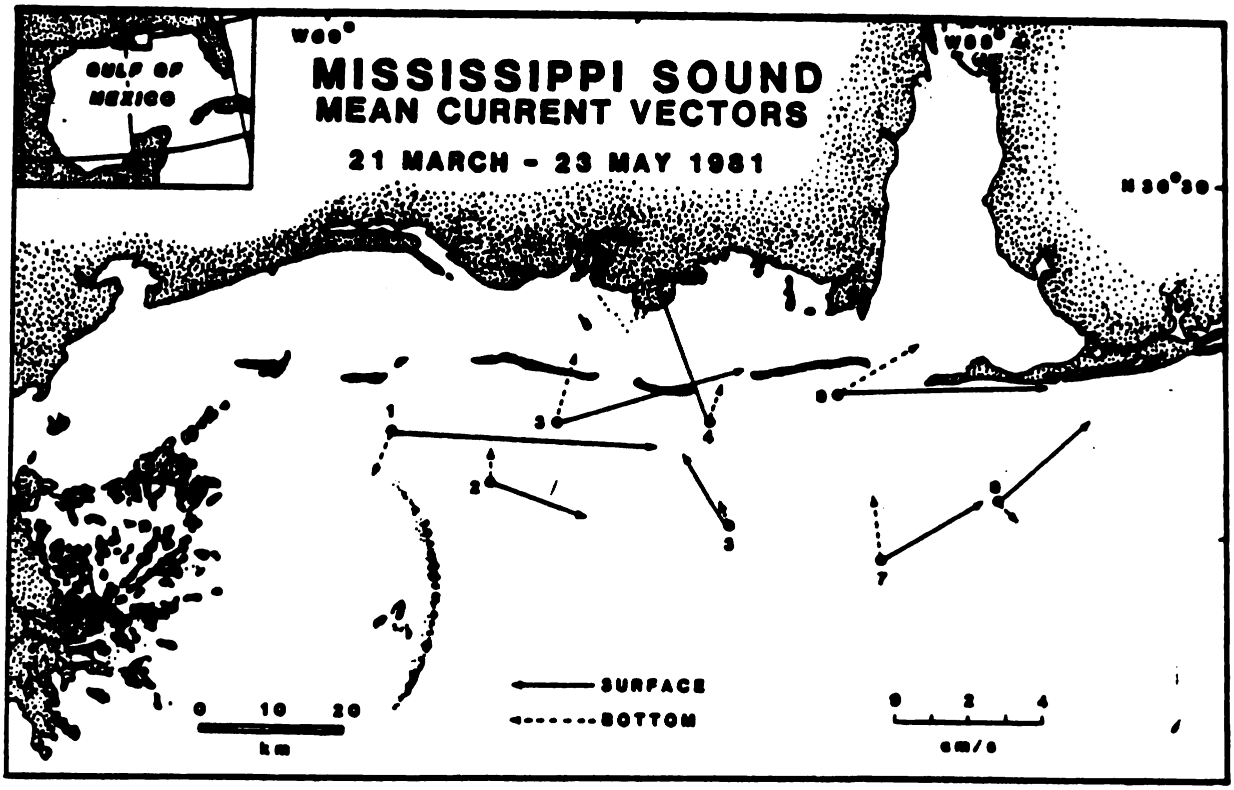


Figure 4-4. Resultant surface (solid) and bottom (dashed) current vectors for the 8 current moorings in the Mississippi Sound Offshore Study Area during deployment period B. The origin of the vector is the station location. (from: Kjerfve and Sneed 1984).

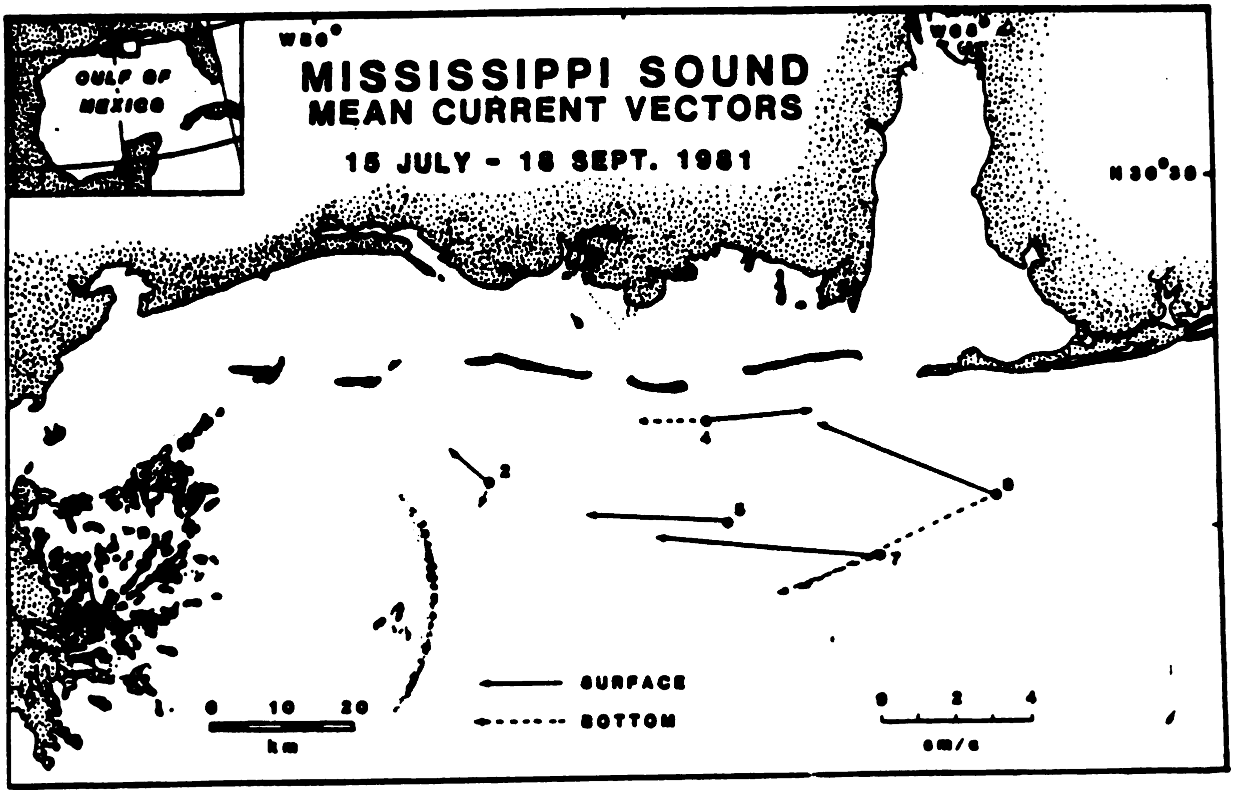


Figure 4-5. Resultant surface (solid) and bottom (dashed) current vectors for the 5 recovered current moorings in the Mississippi Sound Offshore Study Area during deployment period C. The origin of the vector is the station location (from: Kjerfve and Sneed 1984).

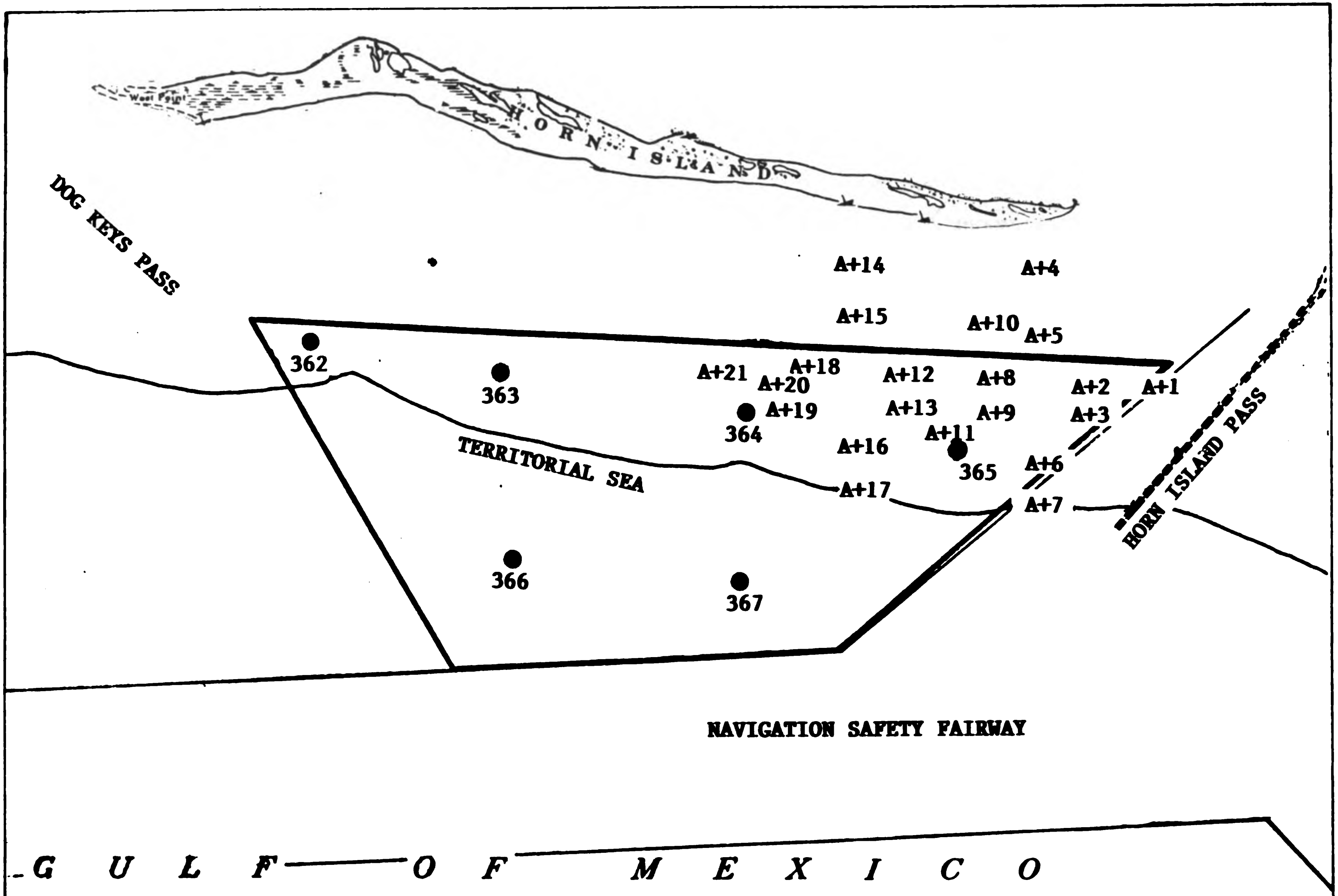


Figure 4-6. Locations of Sampling Stations in Proposed ODMDS and Vicinity
A+ Stations from EPA 1987; ● Stations from B.A. Vittor & Assoc. 1982

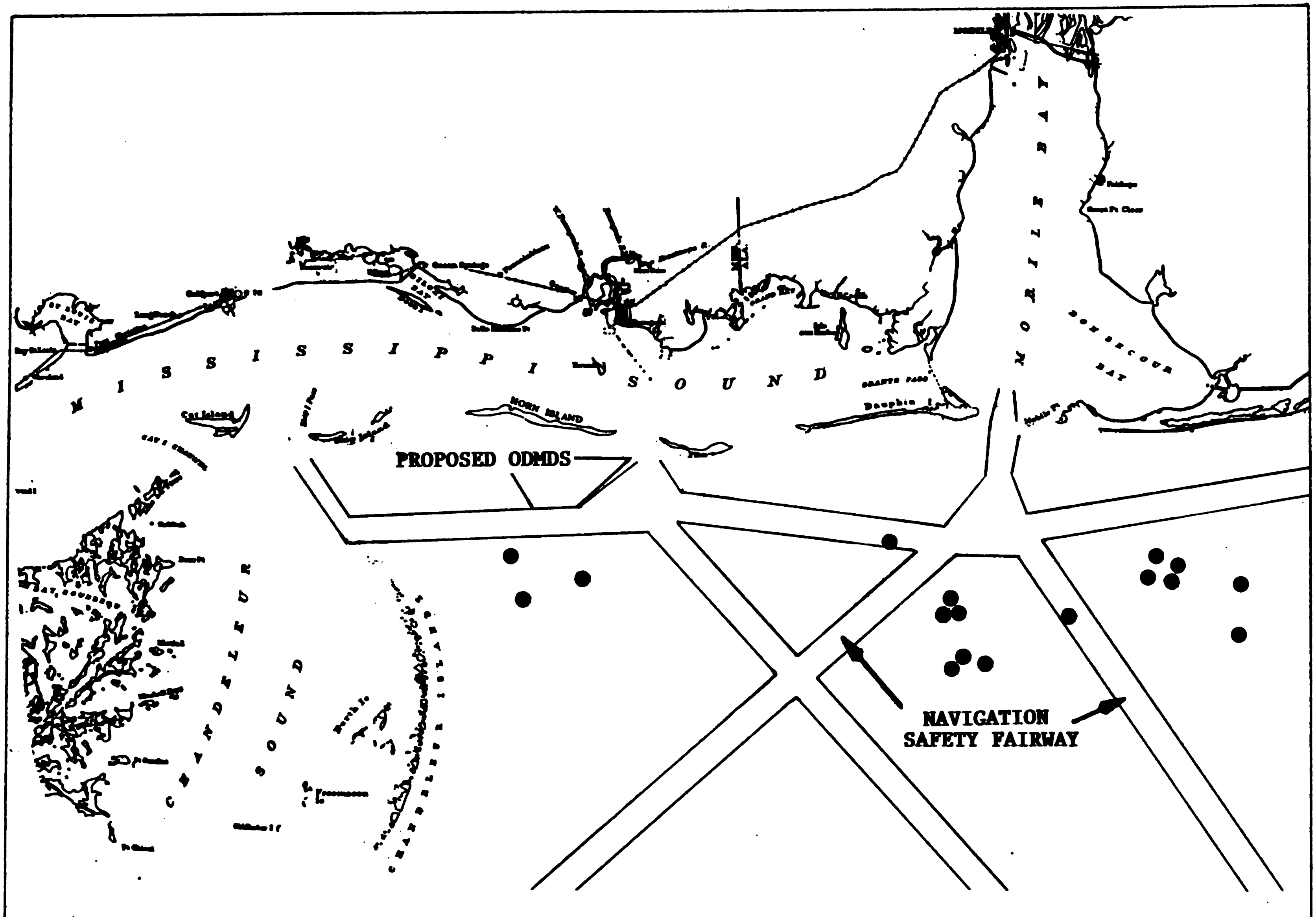


Figure 4-7. Location of Artificial Fishing Reefs (●) in Proximity to the Proposed ODMDS

5.0 ENVIRONMENTAL CONSEQUENCES

5.01 Introduction. This section contains an evaluation of the environmental consequences of designating and using a new ODMDS in the Gulf of Mexico south of Pascagoula, Mississippi. Alternative ODMDS's are evaluated in the following paragraphs relative to the five general criteria [40 CFR 228.5] and the eleven specific criteria [40 CFR 228.6(a)] as required by the MPRSA. These criteria identify factors that must be considered when evaluating alternative ODMDS's to prevent unreasonable degradation of the marine environment.

5.02 Geographical Position, Depth of Water, Bottom Topography, and Distance from Coast [40 CFR 228.6 (a) 1]. The northern boundary of the proposed ODMDS is approximately two nautical miles south of Horn Island. The area is bounded on the east by the north-south safety fairway, on the south by the east-west safety fairway, and on the west by an imaginary line on the eastern boundary of Dog Keys Pass and is defined by the following coordinates (NAD 27):

Boundary Coordinates:	30°12'06" N	88°44'30" W
	30°11'42" N	88°33'24" W
	30°08'30" N	88°37'00" W
	30°08'18" N	88°41'54" W
Center Coordinates:	30°10'09" N	88°39'12" W

This area represents approximately 18.5 nmi². Water depths range from 39 to 53 feet and average approximately 46 feet. Bottom topography within this site is relatively flat, sloping gently seaward.

The mid-shelf alternative area is located approximately 24 nautical miles south of Ship Island and south west of Horn Island. This area is represented by a circle encompassing approximately 130 nmi² defined by the following center coordinates (NAD 27):

29°54'00" N 88°32'00" W

Water depths in this area range from 69 to 87 feet. The bottom topography is relatively flat, sloping gently to the southeast.

5.03 Location in Relation to Breeding, Spawning, Nursery, Feeding, or Passage Areas of Living Resources in Adult or Juvenile Phases [40 CFR 228.6 (a) 2]. A great deal is known about the general life-cycle of fish and shellfish in the northern Gulf of Mexico. Many of these species are estuarine dependent, spending a portion of their life cycle in an estuary such as Mississippi Sound. In general, the species spawn in the waters of the Gulf of Mexico and eggs or larvae are carried by the currents into the estuaries through the barrier island passes. Once in the estuary, the larvae and juveniles congregate in the shallow bays and wetland areas. After a season or more, the species then migrate through the pass into the gulf where spawning occurs. Literature surveys performed during the CE Mississippi Sound and Adjacent Areas Study (CE 1984) indicate that the

Horn Island Pass area is an important migration route as are all the other barrier island passes along the northern gulf coast. The use of the migratory routes is heavier during the spring and early summer months than during late summer and fall/winter. The preferred site is about two and one-half miles from the shallow vegetated areas on the northern sides of the barrier islands and approximately fourteen miles from the extensive mainland marshes of the Pascagoula Delta and Point aux Chenes Bay area. This site is approximately 24 miles east of the Chandeleur Island complex, which is a very important fishery resource area. Artificial reefs have been established approximately 9 miles to the southwest and southeast of this site. The preferred site is not located near any known major breeding or spawning area.

In addition, a number of commercial, sport and recreational species such as grouper, ling, red snapper are known to utilize natural and artificial reef areas for feeding and refuge areas. In the vicinity of the proposed ODMDS, a number of identified fish havens are located to the east, south of the entrance to Mobile Bay, to the west and to the south.

The mid-shelf alternative is approximately 24 miles from the marshes of Horn Island and 35 miles southwest of the mainland marshes described above. The site is approximately 21 miles from the Chandeleur complex. The alternative site is not located near any known major breeding or spawning areas.

5.04 Location in Relation to Beaches and Other Amenity Areas [40 CFR 228.6 (a) 3]. As indicated in Section 4.14, the primary coastal amenity is the Gulf Islands National Seashore (GINS) which includes Petit Bois, Horn, and Ship Islands to the north of the preferred ODMDS. The preferred ODMDS is approximately 2 nautical miles south of Horn Island (1 mile south of the aquatic boundary of the GINS) or about 14 nautical miles south of the mainland, and about 24 nautical miles east of the Chandeleur Islands. The mid-shelf site is approximately 24 nautical miles south of Horn Island, 35 miles south of the mainland, and 21 miles east of the Chandeleur Islands. The gulf beaches of these islands are used for recreational activities such as swimming, fishing, and sun bathing. Further protection is afforded the Gulf Islands National Seashore since the predominant currents shoreward of the preferred site are parallel to the shoreline and any migration of material from the ODMDS would be alongshore rather than in an onshore direction.

5.05 Types and Quantities of Dredged Material Proposed to be Disposed of, and Proposed Methods of Release, Including Packing the Dredged Material, if Any [40 CFR 228.6 (a)4]. The designated ODMDS will be used for disposal of new work and maintenance material dredged from the eastern Mississippi Sound area which meets the criteria specified in Section 102 of the MPRSA. Material to be placed in the ODMDS could include both fine-grained or sand-sized dredged materials. Known quantities of material to be placed in the ODMDS are given as follows:

New Work

U.S. Navy............................750,000 - 1,000,000 cubic yards
Federal Navigation Project...........11,000,000 cubic yards

Operation and Maintenance

U.S. Navy..............................250,000 cubic yards/18 months
Federal Navigation Project...........3,000,000 cubic yards/18 months

The material may be dredged by mechanical or hydraulic means and placed into dump scows for transport to the site, or a hopper dredge may be utilized. The entrance channel will normally be maintained utilizing a hopper dredge.

The material dredged from the Gulf and Entrance channels meets the exclusion criteria specified in 40 CFR 227.13 b(1), i.e. "... dredged material composed predominantly of sand, gravel, rock, or any other naturally occurring bottom material with particle sizes larger than silt, and the material is found in areas of high current or wave energy such as streams with large bed loads or coastal areas with shifting bars and channels...", therefore no testing of the material was performed.

The materials to be dredged from the lower Pascagoula River, Upper Mississippi Sound, and Bayou Casotte channels and Naval Station Pascagoula dredging areas were subjected to biological and chemical testing to determine toxicity and bioaccumulation potential utilizing three representative marine organisms. These materials are primarily fine-grained in nature, predominately silts and clays. In addition the lower Pascagoula River and Bayou Casotte channels are in areas of extensive industrial development and maritime activities (See Appendix C).

The toxicity of the nine sediment samples tested from the Federal navigation channel was minimal. Exposure to the sediments for 10 days had little observable adverse effect on lugworms (*Arenicola cristata*), oysters (*Crassostrea virginica*), or pink shrimp (*Penaeus duorarum*); survival of all three types of animals was $\geq$ 86% (Table 5-1). Exposure of the two sediment samples from the Navy channels had little effect on survival of clamworms (*Nereis virens*), oysters or pink shrimp. Exposure to test sediments was $\geq$ 94% in all cases.

The suspended particulate phase (SPP) of the sediments had little effect on mysids (*Mysidopsis bahia*). Survival in 100% SPP was $\geq$ 80% for all samples. Survival in 100% SSP of the reference sediment and sediment from the Naval sites was $\geq$ 85%.

Chemical analyses of sediments and animal tissues were performed as part of 10-day bioaccumulation studies. Residues of selected chlorinated hydrocarbon pesticides, PCB's, and chlorpyrifos were not detected in sediments or animal tissues before or after exposure to any sediments tested. However, several metals and petroleum hydrocarbons were detected in sediments and in tissues of organisms before and after exposure. Although oysters, lugworms, and shrimp exposed to Bayou Casotte sediments accumulated petroleum hydrocarbons and some heavy metals, the concentrations were not significantly greater than concentrations in animals exposed to reference sediments. Lugworms exposed to sediments from the lower Pascagoula River channel showed statistically significant differences relative to the tissue concentrations of copper, lead, and zinc. Zinc was bioaccumulated by clamworms exposed to Navy Site 2 sediment, however the mean concentration of zinc in the tissues was only 11 parts per million (ppm) greater than clamworms exposed to reference sediment (35 ppm vs. 24 ppm). Petroleum hydrocarbon residues were found in the tissues of all organisms exposed to Navy sediments after the 10-day exposure, but the accumulation was not statistically significant.

Table 5-1. Survival Rate of Representative Marine Organisms Exposed to Channel Sediments (percent).

Channel Segment	Representative Marine Organism		
	A. cristata	*C. virginica*	*P. duorarum*
Lower Pascagoula River (3 samples)	95, 95, 93	99, 100, 99	94, 98, 100
Reference	93	100	99
Upper Mississippi Sound (3 samples)	98, 93, 92	49, 100, 100	89, 86, 96
Reference	97	100	89
Bayou Casotte (3 samples)	86, 92, 98	100, 100, 100	98, 94, 92
Reference	96	100	96
	N. virens		
Navy Channels (2 samples)	96, 94	100, 98	98, 94
Reference	88	100	100

Although statistically significant differences were determined, this may not indicate bioaccumulation because of the order of magnitude of bioaccumulation that was evidenced. The greatest difference (bioaccumulation magnitude) between uptake in reference and channel sediments was less than 3X. The conclusion that this bioaccumulation magnitude does not warrant concern is based on a comparison of the uptake of single chemicals in laboratory tests under conditions of constant exposure. In such tests, commonly conducted with similar organisms and pesticides/toxic substances, bioaccumulation of chemicals in tissue $\leq$ 100X the chemical concentration in water is usually of little concern, particularly when the expected environmental concentration of the chemical is less or much less than the concentration tested in the laboratory.

Potential exposure, a factor that the tests were not intended to address, is an essential factor in conducting a risk assessment. Lugworms exposed to sediments from the Upper Mississippi Sound channel showed statistically significant differences for residue concentrations of arsenic and zinc, however, this may not indicate bioaccumulation as described above (Rod Parrish, personal communication).

5.06 Feasibility of Surveillance and Monitoring [40 CFR 228.6 (a) 5]. The location of both the preferred and mid-shelf ODMDS's presents no special problems for surveillance and monitoring. The two sites are 14 and 35 miles south of the mainland. Water depths range from 39 to 53 feet at the preferred site and from 69 to 87 feet at the mid-shelf site. These water depths are amenable to either surface sampling or diver collection and, under normal circumstances, do not require the use of a large oceanographic vessel. The distance of the mid-shelf from the protected waters of the Mississippi Sound, however, may require the use of a much larger vessel. In this case, the costs associated with surveillance and monitoring would be substantially higher compared to the preferred site. High turbidity may occasionally restrict diver operations and photography but is not expected to be a significant hindrance to surveillance and monitoring.

Site surveillance can be accomplished by air from Jackson County Airport in Pascagoula, Mississippi or the Mobile Airport in Mobile, Alabama, or by water from numerous facilities located along Mississippi Sound. A site management and monitoring plan has been developed to determine short- and long-term impacts to the marine ecosystem associated with disposal of dredged material into the ODMDS (See Appendix G). The data referenced in Section 4.01 will be used as a baseline for management and monitoring activities.

5.07 Dispersal, Horizontal Transport, and Vertical Mixing Characteristics of the Area, Including Prevailing Current Direction and Velocity, if Any [40 CFR 228.6 (a) 6]. Data collected within the Gulf of Mexico between November 1980 and September 1981 (Kjerfve and Sneed 1984) indicate that the progression of the tide through Horn Island Pass segments the gulf into an eastern and western areas dominating circulation within this portion of the gulf. The eastern area is between Horn Island Pass, Mississippi, and the main pass entering Mobile Bay, Alabama. The western area is between Horn Island Pass and the Chandeleur Islands. As the tide propagates from the gulf through Horn Island Pass, a general clockwise movement of water in the eastern area is set in motion, whereas, in the western area, a general counterclockwise movement occurs. In the shallow areas of the gulf, near the barrier islands, the wind and pressure forces tend to dilute the influence of the tide on the general circulation pattern, creating a highly variable pattern. It appears that a two-layer circulation pattern exists between surface and bottom waters when stratification occurs. The stratification decouples the currents throughout the water column causing variable velocities and directions to occur. Predominant currents in the vicinity of the proposed ODMDS are to the west-southwest and west-northwest.

Root mean square analysis of the data indicate that oscillations in the east-west direction are stronger than that in the north-south direction, especially for locations closer to shore. Analysis of frequency distribution plots of current speed and direction indicate that over 95% of the recorded velocities are less than 20 cm/sec (0.66 ft/sec). Currents oriented in the north to north-northeast quadrants are predominately between 2.56 - 10 cm/sec, while those in the north-west to west quadrants range up to 20 - 30 cm/sec. Based on this information, it is likely that any movement of material from the site would be in a westerly to northwesterly direction.

The ODMDS's occupy a small area relative to the area of the continental shelf near Pascagoula. As noted in Section 4.05 above, circulation patterns in the northern Gulf of Mexico are controlled by astronomical tides, winds, and freshwater discharges. Although the discharge of dredged material into the preferred ODMDS might cause localized changes on water movement patterns, e.g. if a submerged mound were constructed, this would result negligible impact on the circulation and mixing of the shelf waters. The depths available within the mid-shelf site and its distance offshore further reduce any possibility of resultant changes in circulation or mixing of shelf waters.

The fine-grained dredged material proposed for discharge onto the ODMDS will be more easily transported than the existing bottom materials; i.e. the finer material can be moved by a lower current. Thus, the clay and silt size particles on the surface of the ODMDS can be expected to be winnowed out by the currents and the site will become armored with sand, shell, and "clay balls". The fine-grained particles should become more difficult to erode over time as the material consolidates.

The environmental consequences of the transport of this fine-grained material on the marine ecosystem will vary depending on the proximity of the area in question to the actual disposal location. Impacts within the designated ODMDS would range from direct burial of benthic resources and increased suspended solids concentrations in areas adjacent to the disposal location to minimal impacts near the boundaries of the site. The preferred site could be described as a 'dispersive' site, especially regarding fine-grained maintenance material. This is not expected to result in impacts outside the boundaries of the ODMDS since much of this region of the northern Gulf of Mexico is characterized as having a fine-grained facies which overlaps with the Mississippi-Alabama Shelf sand facies. In addition, the location of the site is being chosen to be a sufficient distance from any significant resources. Under abnormal hydrographic conditions, i.e. hurricane conditions, impacts due to the movement of ambient sediment particles would mask any impacts due to movement of fine-grained materials as described above.

5.08 <u>Existence and Effects of Current and Previous Discharges and Dumping in the Area (Including Cumulative Effects) [40 CFR 228.6 (a) 7]</u>. A portion of the preferred ODMDS has been utilized historically for the placement of dredged material from the eastern Mississippi Sound area. Since 1965, an average of 464,000 cubic yards of material dredged from the Entrance and Gulf channels has been placed in the site annually. In 1986, approximately 65,000 cubic yards of new work material was placed in the site under a Department of the Army permit. In 1989, approximately 500,000 cubic yards of fine-grained dredged material and 300,000 cubic yards of sandy dredged material were placed in the site during maintenance of the Federal navigation project. There have been no demonstrable adverse impacts to the marine ecosystem of this area due to this disposal. Although much of the material historically placed at the site was sand-sized, recent disposal actions have included both new work and maintenance fine-grained material. The mid-shelf area has never been utilized for the placement of dredged material.

5.09 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 alternative ODMDSs chosen for detailed evaluation were selected to minimize interference with the activities listed. See Appendix A for a more detailed discussion of the site selection process.

The preferred site is located outside the designated shipping lanes, therefore no impact to commercial vessel traffic is expected. Commercial fishing vessels routinely use this area, however their drafts are such that no conflict would arise from use of the site as an ODMDS. The mid-shelf site, although outside designated shipping lanes, is characterized by water depth which are sufficient for commercial vessel traffic. Any use of the site which resulted in significant changes to bathymetry could conflict with ship traffic.

Fish, due to their motile nature, would not be directly affected by the discharge since they can avoid the area. However, some species would be indirectly affected due to the loss of benthic organisms which serve as a food source for these species. These impacts would be localized to the immediate area of the disposal operation and would be temporary in nature. Chemical analyses and bioassays of the dredged material indicate that no significant toxic effects are expected. The are no artificial fishing reefs in the vicinity of either alternative ODMDS and there are no known sensitive fishery resource areas in proximity to either site. The nearest artificial reefs are 9 miles southwest and southeast of the preferred site.

There are no areas of shellfish culture in the vicinity of the alternative sites nor are there any known areas of special scientific importance in the vicinity of either alternative site; therefore, no impacts to these resources would result from the proposed action.

Although the possibility of oil and gas leasing operations within the ODMDS's is a likelihood, experience in dealing with the Mobile, Alabama, ODMDS suggests that offshore oil and gas operations and dredged material disposal are not mutually exclusive. Placement of material into the ODMDS would not impact the high pressure natural gas transmission lines because they are located in the far northeastern corner of the site, This area would not be utilized as a discharge location due to its proximity to the site boundaries. The site management and monitoring plan for the use of the ODMDS will be revised to include any ongoing or proposed oil and gas leasing activities.

There are no military restricted areas that would be affected by designation and use of the ODMDS.

5.10 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]. Past surveys and the baseline surveys conducted during the ODMDS siting activities show the water quality and other environmental characteristics of the alternative ODMDS's to be typical of the northern Gulf of Mexico where sand or sandy mud sediments predominate. The results of these surveys are discussed in the Affected Environment Section and presented in Appendices B and C. In summary, neither of the alternative sites possess unique characteristics which would preclude its designation and use as an ODMDS.

The designation and use of the alternative sites has been coordinated with the National Marine Fisheries Service (NMFS) in accordance with Section 7 of the Endangered Species Act (ESA). Review of the information presented on Endangered and Threatened Species which may occur within the alternative sites (Section 4.12) indicates that the use of the preferred site for disposal of dredged material would not result in adverse impacts to any endangered or threatened species or its critical habitat. The use of the mid-shelf alternative site would increase the possibility of conflict with those species which are typically found in open waters of the Gulf of Mexico. Even though this possibility exists, it is not believed that it would result in adverse impacts to those species. The National Marine Fisheries Service concurred with this determination in a letter dated January 24, 1991 (Appendix I).

5.11 Potentiality for the Development or Recruitment of Nuisance Species in the Disposal Site [40 CFR 228.6 (a) 10]. Based on information available on the community structure of the preferred site (Section 4.10), no change in benthic species composition is expected. The communities currently defining the site are characteristic of mud and sandy mud habitats. The material proposed for disposal includes both fine-grained and sandy material; therefore, no change of the substrate is expected following use. Use of the mid-shelf alternative, however, may result in some change in benthic species composition. The sediment of this site is primarily sand; therefore, the disposal of substantial quantities of fine-grained material onto the site may result in the replacement of species requiring coarse-grained substrates which those which prefer fine grained substrates. There is no evidence, however, to suggest that the benthic species which would develop would be considered nuisance species. Some fecal coliform bacteria may be contained in the dredged material; however, it is improbable that these species would become established in either of the alternative sites due to the existing salinity regime of the area.

5.12 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]. Review of literature pertaining to the cultural resources of the general area of the proposed ODMDS's suggests that there are no natural or cultural features of historical importance within or in the vicinity of the proposed ODMDS's. Coordination, by letter dated January 25, 1989, with the Mississippi State Historic Preservation Officer indicates that the potential for shipwrecks in open water of these depths is considered extremely low. In addition, since the use of the ODMDS is for disposal of dredged material, the possible conflict with unknown natural or cultural resources is reduced.

5.13 The Dumping of Materials into the Ocean will be Permitted Only at Sites or in Areas Selected to Minimize the Interference of Disposal Activities with Other Activities in the Marine Environment, Particularly Avoiding Areas of Existing Fisheries or Shellfisheries, and Regions of Heavy Commercial or Recreational Navigation [40 CFR 228.5(a)]. The alternative ODMDS's chosen for detailed evaluation were selected to minimize interference with other activities of the marine environment. The avoidance of live or hard bottoms was of paramount concern. As indicated in Section 5.09 above, the sites were selected to minimize potential impacts to existing fisheries by eliminating areas near Horn Island Pass, nearshore to the barrier islands, and in the vicinity of artificial reefs. Historic usage of the former interim site at Pascagoula and the Mobile ODMDS indicate an absence of conflict between use of the ODMDS and the fishing industry. The preferred site is located outside the designated shipping fairways and water depths in this area would preclude use by large commercial navigation. Use of the area by commercial fishing vessels or recreational vessels would not conflict with the proposed management of the ODMDS. The mid-shelf alternative is within an area of heavy commercial navigation traffic, however proper management of the ODMDS should not conflict with this traffic.

5.14 Locations and Boundaries of Disposal Sites will be so Chosen that Temporary Perturbations in Water Quality or other Environmental Conditions during Initial Mixing Caused by Disposal Operations Anywhere within the Site can be Expected to be Reduced to Normal Ambient Seawater Levels or to Undetectable Contaminant Concentrations or Effects Before Reaching Any Beach, Shoreline, Marine Sanctuary, or Known Geographically Limited Fishery or Shellfishery [40 CFR 228.5(b)]. The temporary perturbations in water quality resulting from the disposal of dredged material are expected to be localized to the general vicinity of the ODMDS. Modelling efforts in association with the designation of the Pensacola (Offshore) ODMDS (EPA 1988f) were utilized to portray the behavior of the dredged material as it leaves the disposal vessel and falls to the bottom. The Disposal From An Instantaneous Dump (DIFID) model, as modified by the U. S. Army CE Waterways Experiment Station, treats the behavior of the disposed material in three phases: convective descent, dynamic collapse, and passive transport-diffusion. One of the main limitations of the model is that the total time required for the material to leave the disposal vessel should not be greater than the time required for the material to reach the bottom. This is due to the fact that the model assumes an instantaneous dump that falls as a hemispherical cloud and is sensitive to the disposal vessel characteristics and the depth of the water in the disposal site. The most likely disposal vessel is a 4,000 cubic yard scow which has a loaded draft of 19 feet, 8 inches and an emptying time of 3 - 5 seconds. Comparing these data with the depth of the preferred site, it is evident that the material would be on the bottom (phase I of the model) before the material had left the disposal vessel and therefore the model would be an inappropriate tool at the preferred site. Some of the results from the Pensacola effort, however, provide insight toward the behavior of the material proposed for disposal and have been utilized in determining the location of the preferred site. Results of the model indicate that coarse-grained material (sands) and fine-grained new work materials which may 'clump' during the dredging process tend to fall directly below the disposal vessel almost immediately after disposal is initiated. The non-cohesive silt and clays do not behave in the same manner as the sand or clumped silt/clay. A large percentage of these particles may remain suspended in the water column after disposal and are therefore available for transport away from the disposal location by the currents. The actual percentage of silt/clay which is deposited on the bottom vs. the concentration which remains in the water column is highly dependent upon the composition of the material within the dump scow and the ambient velocities and depth of the disposal site. One of the analyses performed for the Pensacola site involved the disposal of 95% silt/clay - 5% sand, velocities over 1 ft/sec (30.5 cm/sec), and ODMDS depths of 75 feet. Under this scenario, the model predicted that the suspended solids concentration within the water column would be reduced to near ambient conditions within three hours. Under the current conditions of 20 cm/sec described in Section 5.07 above, a particle could travel approximately 7,000 feet assuming a steady current in one direction and no downward transport in the water column. Attainment of these conditions in the field would be highly unlikely based on the data collected at the site.

In addition to this information, the preferred ODMDS is located in an area which is described as a fine-grained facies overlying the Mississippi Alabama Shelf sand sheet. The primary reason given for this phenomenon is that waters laden with suspended material exit Mississippi Sound through Horn Island Pass and are moved westward by Corolius movements, wind conditions, and tidal activities. The suspended particles settle from the water mass forming the fine-grained facies. The natural conditions of this area, therefore, suggest that the deposition of fine-grained material would not cause adverse impacts to the resources of the barrier islands.

Due to the depth of the water and the distance from the above mentioned resources, the use of the mid-shelf alternative would not be expected to result in any adverse impacts to these resources.

5.15 <u>If at Anytime 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 CFR 228.5 and 228.6, the Use of Such Sites will be Terminated as soon as Alternate Disposal Sites can be Designated [40 CFR 228.5(c)]</u>. EPA has the responsibility to suspend, modify, or discontinue use of ODMDS's if unacceptable adverse impacts occur.

5.16 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 Part of the Disposal Site Evaluation or Designation Study [40 CFR 228.5(d)]. The size, configuration, and location of the Pascagoula ODMDS is based on a number of factors including:

- proximity of significant resources
- physical/biological environment of the northern Gulf of Mexico
- multiple-use management
- quantity of materials projected for disposal
- type of materials projected for disposal.

The preferred ODMDS represents approximately 18.5 nmi^2, the mid-shelf alternative approximately 130 nmi^2 in area. Although these areas appear very large in comparison to other ODMDSs or to the former interim site at Pascagoula, it believed an area of this size is necessary to provide adequate capacity for the estimated quantity of dredged material which may be placed in the site and to allow for the proper management of the site for these uses. It is not intended that the entire area would be utilized for disposal of dredged material but rather that this area is suitable for designation as an ODMDS. Within this larger area appropriate management techniques will be applied to each disposal action. Since the preferred site is relatively homogenous from an environmental standpoint, the size of the site does not present undue problems relative to monitoring activities. The main difficulty with monitoring of the mid-shelf alternative is the distance from shore as described in Section 5.06 above.

5.17 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)]. There are economic and environmental factors that make designation of an ODMDS beyond the edge of the continental shelf in the area of Pascagoula infeasible. Comparison of the preferred site and the mid-shelf alternative based on the eleven specific and five general criteria indicate that there are no environmental advantages associated with the designation and use of the mid-shelf alternative site. In addition, it is not considered to be economically feasible to haul the large volume of dredged material beyond twenty miles from Horn Island. A portion of the preferred ODMDS has historically received material dredged from the Pascagoula navigation complex.

5.18 The Relationship Between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity. The designation and use of the ODMDS should not significantly affect the long-term productivity of the site. Commercial and sport fishing near the ODMDS would not be significantly affected because the site is not known to be located in a limited fishery area. It is not anticipated that short-term perturbations at the site will significantly affect the long-term productivity of the region. Information available from other ODMDSs in the northern Gulf of

Mexico, i.e. Mobile North, Pensacola (Offshore), and Gulfport East and West, indicate that the designation and use of these areas for the placement of dredged material is compatible with many uses of the marine environment including: navigation, oil and gas exploration and production activities, and commercial and recreational fishing. With proper management use of ODMDSs, e.g. the Mobile North ODMDS and underwater berm construction, may prove beneficial to adjacent areas.

5.19 Irreversible or Irretrievable Commitment of Resources. Resources irreversibly or irretrievably committed by use of the designated ODMDS include the loss of fuel and monetary resources used to transport the dredged material. The manpower, energy and monetary resources required to monitor the ODMDS would also be irreversibly and irretrievably committed.

5.20 Relationship of the Proposed Action to Other Federal Projects. Designation of an ODMDS offshore Pascagoula, Mississippi, is intended to provide a viable disposal option for projects, Federal and non-Federal, in the eastern Mississippi Sound area. Initial use of the site is projected for the Pascagoula Harbor Deep-Draft Navigation Project and Naval Station Pascagoula. Other likely Federal projects to require use of the site include the Pascagoula and Escatawpa Rivers above the Highway 98 bridge, in Pascagoula, Mississippi, which is currently in the feasibility phase of investigation. Federally permitted private dredging projects could also use the ODMDS in the future. However, none of the other projects could use the site without proper permitting, environmental documentation and testing of the dredged material. Only material that meets the Ocean Dumping Criteria would be allowed to be discharged on the site.

5.21 Unavoidable Adverse Environmental Effects and Mitigation Measures. The disposal of dredged material on the designated ODMDS would result in unavoidable environmental impacts such as temporary increases in turbidity, nutrients and some heavy metals. Most of the benthic infauna in the discharge area would be destroyed. However, the benthic infauna would be expected to recover over a 6 to 12 month period after the discharge is completed. Changes in the site's bathymetry and altering of the site's sediment composition may also be unavoidable impacts. Some of the adverse environmental effects associated with disposal activities will be reduced through proper management of the ODMDS.

TABLE 5-2

SUMMARY OF THE SPECIFIC CRITERIA AS APPLIED TO ALTERNATIVE ODMDS's

Criteria as Listed in 40 CFR 228.6	Preferred Site	Mid-Shelf Site
1. Geographical position, depth of water, bottom topography and distance from coast.	See Figure 3-2; 39 - 53 feet; relatively flat, sloping seaward; 2 miles from Horn Island	See Figure 3-1; 69 - 87 feet; relatively flat, sloping southeast; 24 miles from Ship and Horn Islands
2. Location in relation to breeding, spawning, nursery, feeding, or passage of living resources in adult or juvenile phases.	May occur within area but no unique uses are known; nearest known nursery or passage area 2 miles from site	Nearest known nursery or passage areas are 21 or more miles from site
3. Location in relation to beaches and other fishing amenity areas.	Beach is 2 miles from site; artificial reefs are located about 9 miles southwest and southeast of site	Beach is 21 or more miles from site; no fishing amenities in vicinity of site
4. Types and quantities of wastes proposed to be disposed of and proposed method of release, including methods of packing the wastes, if any.	New work: Navy: 750,000 cy CE: 11,000,000 cy O & M: Navy: 250,000/18mo CE: 3,000,000/18mo; Sand, silt, & clay; Hopper dredge, barge or dump scow	Same as Preferred Site
5. Feasibility of surveillance and monitoring.	Surveillance and monitoring possible by boat or plane	Same as Preferred Site except larger oceanographic vessels required
6. Dispersal, horizontal transport, and vertical mixing characteristics of the area, including prevailing current velocity, if any.	Currents variable in response to winds, tides, and freshwater inflow; typically in range 0 - 20 cm/s up to 40 cm/s; may be much higher in hurricanes	No actual data available. Assumed to be similar but less variable than at Preferred Site

TABLE 5-2
(continued)

SUMMARY OF THE SPECIFIC CRITERIA AS
APPLIED TO ALTERNATIVE ODMDS's

Criteria as Listed in 40 CFR 228.6	Preferred Site	Mid-Shelf Site
7. Existence and effects of current and previous discharge and dumping in the area including cumulative effects.	Portion of site used historically, no documented impacts	No previous discharges
8. Interference with shipping, fishing, recreation, mineral extraction, shellfish culture, scientific importance, and other legitimate uses of the ocean.	No conflicts expected with any of the listed uses of the ocean	Shipping could be restricted depending of management techniques employed
9. The existing water quality and ecology of the sites as determined by available data, and by baseline surveys.	Water quality typical of northern Gulf of Mexico; bottom habitat typical of mud and muddy sand bottoms	Water quality typical Gulf of Mexico; bottom habitat typical of sandy bottoms
10. Potentiality for the development or recruitment of nuisance species in the disposal sites.	No nuisance species are anticipated to develop or be recruited to the the site	Same as Preferred Site
11. Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.	No known natural or cultural resources in vicinity of the site; disposal would not cause adverse impacts to unknown resources	Same as Preferred Site

6.0 LIST OF PREPARERS. The following people were primarily responsible for preparing this EIS:

Name/Education/ Organization	Expertise/Experience	Contribution
Susan Ivester Rees, Ph.D. Corps of Engineers Mobile District	Oceanographer: 16 years experience in coastal navigation, beach nourishment and education.	EIS Preparation, Site Designation Studies, CE Coordination
Dorothy H. Gibbens, M.S. Corps of Engineers Mobile District	Archaeologist: 14 years experience as cultural resources specialist.	Cultural Resources
R. Douglas Nester, M.S. Corps of Engineers Mobile District	Biologist: 12 years experience in biological studies.	Fisheries
Christian M. Hoberg, M.S. Environmental Protection Agency, Region IV	Environmental Scientist: 10 years experience in marine studies, EIS review.	EIS Review
Jeffrey Kellam, M.S. Environmental Protection Agency, Region IV	Environmental Scientist: 9 years experience in marine geology.	EIS Review, EPA Coordination
Philip Murphy Environmental Protection Agency, Region IV	Ecologist: 20 years experience aquatic/marine ecology, biology, and water quality studies.	Site Designation Studies
Laurens M. Pitts, M.E. Naval Facilities Engineering Command	Environmental Engineer: 18 years experience in environmental studies	EIS Review, Navy Coordination

7.0 PUBLIC INVOLVEMENT. The Draft Environmental Impact Statement was coordinated with the following agencies, groups, and individuals:

<u>FEDERAL</u>

Advisory Council on Historic Preservation
Council on Environmental Quality
Department of Agriculture
  Forest Service
  Soil Conservation Service
Department of Commerce
  National Oceanic and Atmospheric Administration
    National Marine Fisheries Service
    National Ocean Survey
    Office of Coastal Zone Management
  Gulf of Mexico Fishery Management Council
Department of Defense
  Pentagon
  Department of Air Force
Department of Energy
Department of Health and Human Services
Department of Housing and Urban Development
Department of Interior
  Bureau of Mines
  Fish and Wildlife Service
  Geological Survey
  Minerals Management Service
  National Park Service
Department of Transportation
  Coast Guard
    Eighth District, New Orleans, LA
  Federal Aviation Administration
  Federal Highway Administration
  Maritime Administration
Economic Development Administration
Environmental Government Affairs
Federal Emergency Management Administration
Federal Maritime Commission
Federal Power Commission
Food and Drug Administration
General Services Administration
National Aeronautics and Space Administration
National Science Foundation
U.S. Senate
  Honorable Thad Cochran
  Honorable Trent Lott
U.S. House of Representatives
  Honorable Gene Taylor

STATE

Mississippi Senate
  Honorable Stephen Hale (51st District)
  Honorable Claude Bilbo (52nd District)
  Honorable Cecil Mills (43rd District)
Mississippi House Representatives
  Honorable Frank I. Ely (109th District)
  Honorable Mitchell Ellerby (110th District)
  Honorable Curt Hebert, Jr. (111th District)
  Honorable Raymond Vecchio (112th District)
  Honorable Alvin C. Endt (113th District)
Mississippi Archaeological Association
Mississippi Department of Energy and Transportation
Mississippi Department of Environmental Quality
  Bureau of Geology
  Bureau of Pollution Control
Mississippi Department of Planning and Policy
Mississippi Department of Wildlife, Fisheries, and Parks
  Wildlife and Fisheries Division
  Bureau of Marine Resources
  Parks Division
Mississippi Museum of Natural Sciences
Mississippi State Board of Health
Mississippi State Highway Department
Mississippi State Historic Preservation Officer
Mississippi State Oil and Gas Board
Office of the Governor
  Governor of Mississippi
    Honorable Ray Mabus
  State Planning and Development Clearinghouse
Mississippi-Alabama Sea Grant Consortium

LOCAL

Biloxi Public Library
Gulf Coast Research Lab
Jackson County Board of Supervisors
Jackson County Planning Commission
Jackson County Port Authority
Mayor of Moss Point
Mayor of Ocean Springs
Mayor of Pascagoula
Mississippi Press Register
Mississippi Research and Development Council
Pascagoula Bar Pilots Association
Pascagoula City Branch Library
Pascagoula Port Commission
Southern Mississippi Sun
Sun Herald

ORGANIZATIONS AND PUBLIC

Action
Auburn University
Battelle Ocean Sciences
Center for Action
Clean Ocean Action
Conservation Foundation
Corpus Christi State University
Ecology Center of Louisiana
Environmental Protection Commission
Gulf Regional Planning Commission
Gulf States Marine Fisheries Commission
Harbor Branch Oceanographic Institute
International Women's Fishing Association
Izaak Walton League of America, Inc.
Louisiana State University
Mississippi Bass Chapter Federation
Mississippi Coast Audubon Society
Mississippi League of Women Voters
Mississippi State University
Mississippi University for Women
Mississippi Wildlife Federation
Mote Marine Laboratory
National Audubon Society
National Wildlife Federation
Natural Resources Defense Council
Nature Conservancy
Oceanic Society
Organized Fishermen of Florida
Racal Survey, Inc.
Sierra Club
Southeastern Fisheries Association, Inc.
University of Alabama
University of Florida
University of Georgia
University of Miami-RSMAS
University of South Alabama
University of Southern Mississippi
University of West Florida
Wildlife Society - Mississippi Chapter

Coordination with the National Marine Fisheries Service as required by Section 7 of the Endangered Species Act of 1973 has been concluded. The National Marine Fisheries Service in a letter dated January 24, 1991 concurred with the determination that populations of endangered or threatened species under their purview would not be adversely affected by the proposed action. Should additional information become available concerning possible impacts or should the activity be modified, additional consultation would be requested.

Coordination with the Mississippi State Historic Preservation Office (SHPO) was completed prior to filing the DIES. In a response dated 29 January 1989, the SHPO concurred with a determination that the potential for shipwrecks in the proposed ODMDS was extremely low and that no additional underwater cultural resource surveys were warranted.

The Notice of Availability of the Draft EIS was published in the Federal Register on July 27, 1990, and the public comment period closed on September 10, 1990. The Draft EIS was coordinated with approximately 150 Federal, State, and local agencies, interested groups, and individuals. A total of 7 comment letters were received during the public review period. All the comment letters are included on the following pages along with responses to the comments. The comment number(s) in the right margin of the comment letter correspond to the response number(s) on the pages immediately following the comment letter.

STATE OF MISSISSIPPI
Department of Wildlife, Fisheries and Parks
RAY MABUS
Governor

September 5, 1990

Mr. Robert B. Howard
Coastal Programs Unit
EPA - Region IV
345 Courtland Street, NE
Atlanta, Georgia 30365

RE: MS900726-001R, BMR-C 9108030-G - Draft Environmental Impact Statement for Designation and Use of a New Ocean Dredged Material Disposal Site (ODMDS) off Pascagoula, Mississippi

Dear Mr. Howard:

The Department of Wildlife, Fisheries and Parks/Bureau of Marine Resources has completed a review of the above document. Based on this review we offer the following comments and suggestions for the final document and eventual authorization of the project:

- Section 5.09 should be expanded to detail more specific information relative to commercial and recreational fishing impacts. 1

- In order to secure federal consistency certification the Coastal Wetlands Use Plan of Mississippi's Coastal Management Program will have to be adjusted to designate the new ODMDS. 2

The Bureau is committed to ocean disposal of dredged material and we stand ready to assist the Corps and EPA in the designation of the new ODMDS. 3

Please feel free to contact our office if you have any questions regarding this correspondence.

Sincerely,

Joseph I. Gill, Jr.
Deputy Director

JIG:GJC:dw

2620 Beach Boulevard, Biloxi, MS 39531, (601) 385-5860

RESPONSE

1. Impacts to commercial and recreational fishery resources are discussed in Sections 5.03, 5.09, and 5.13. As indicated in each of these sections, the designation and use of the proposed ODMDS would have minimal or no impacts to the species themselves nor to operations associated with harvesting these species. Since all aspects of the fishery resource were discussed in the DEIS and impacts to the resources are not significant, we do not believe that additional information is required.

2. Thank you for your comment. Appropriate steps have been undertaken requesting the adjustment to the Coastal Wetlands Use Plan.

3. Thank you for your comment. We appreciate the assistance that has been provided by the Bureau of Marine Resources and look forward to our continuing relationship.

General Services Administration
401 West Peachtree Street
Atlanta, GA 30365

AUG 3 1 1990

Mr. Robert B. Howard, Chief
Coastal Programs Unit
U.S. Environmental Protection Agency
345 Courtland Street, NE - Region IV
Atlanta, GA 30365

Re: Draft Environmental Impact Statement (EIS) for the Designation of an Ocean Dredged Material Disposal Site Located Offshore Pascagoula, MS

Dear Mr. Howard:

The Safety and Environmental Management Branch (4PMS) has reviewed the submitted draft EIS. The proposed actions will not affect General Services Administration (GSA) operations in the area. GSA has no comment on the submitted draft.

If you have questions, please contact Gerald Hust, Chief, Safety and Environmental Management Branch on 331-3125.

Sincerely,

Thomas E. Davis
Assistant Regional Administrator
Public Buildings Service

RESPONSE

Thank you for your comment. No response required.

DEPARTMENT OF THE AIR FORCE
REGIONAL CIVIL ENGINEER, EASTERN REGION (HQ AFESC)
77 FORSYTH STREET, SW, SUITE 291
ATLANTA, GEORGIA 30335-6801

REPLY TO ATTN OF: ROV

5 September 1990

SUBJECT: Air Force Review of the Draft Environmental Impact Statement for Designation of an Ocean Dredged Material Disposal Site (ODMDS) Offshore Pascagoula MS

TO: U.S. EPA Region IV
Attn: Mr Robert B. Howard, Chief
Coastal Programs Unit
345 Courtland Street NE
Atlanta GA 30365

As the Air Force single point of contact for environmental matters in the eastern United States, we have reviewed the Draft Environmental Impact Statement (DEIS) for the ODMDS and find that implementation of the proposal will not affect Air Force operations in the site area. Thank you for the opportunity to review this DEIS. Our point of contact is Mr George Dodson at telephone number 331-5313/6776.

ANTHONY E. FONTANA III, Capt, USAF
Deputy Chief
Environmental Planning Division

1 Atch
DEIS

cc: HQ USAF/LEEV wo Atch

RESPONSE

Thank you for your comment. No response required.

United States Department of Agriculture | Forest Service | Regional Office | 1720 Peachtree Rd., NW Atlanta, Ga. 30367

Reply to: 1950

Date: SEP 07 1990

Mr. Robert B. Howard
Chief, Coastal Programs Unit
U.S. Environmental Protection Agency
345 Courtland Street, NE
Atlanta, GA 30365

Dear Mr. Howard:

Reference the Draft Environmental Impact Statement for the Ocean Dredged Material Disposal Site, at Pascagoula, Mississippi.

We have no comments on the proposed project.

Thank you for the opportunity to review this environmental document.

Sincerely,

for JOHN E. ALCOCK
Regional Forester

FS-6200-28a (5/84)

RESPONSE

Thank you for your comment. No response required.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
Atlanta GA 30333

August 24, 1990

Robert B. Howard, Chief
Coastal Programs Unit
U.S. Environmental Protection Agency
Region IV
345 Courtland Street, NE
Atlanta, Georgia 30365

Dear Mr. Howard:

We have completed our review of the Draft Environmental Impact Statement (DEIS) for Pascagoula Harbor Ocean Dredged Material Disposal Site Designation. We are responding on behalf of the U.S. Public Health Service.

Our general concern with this type of project involves the potential for toxic substances which may exist in the dredged material to be transported to a new site and potentially cause adverse impacts. We note, however, that chemical analyses and bioassays of the dredged material done thus far indicate that no significant toxic effects are expected. Some testing is currently ongoing around the Singing River Island, and results will be summarized in the Final EIS. 1

The preferred disposal site meets the eleven specific selection criteria, and due to the depth and size of the site, potential impacts outside the site will be minimized. Also, it is noted that the preferred site is amenable to surveillance and monitoring, and we encourage these actions to facilitate adequate management of this operation and to ensure that adverse impacts are minimized and specified criteria are met. 2

Thank you for the opportunity to review and comment on this document. Please insure 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.
Environmental Health Scientist
Center for Environmental Health
and Injury Control

RESPONSE

1. We share your concern relative to the potential for adverse impacts from toxic substances in the materials proposed for disposal. As noted in your comment, recent analyses of the sediments to be dredged including those around Singing River Island (US Naval Station Pascagoula) meet the criteria for disposal in the ocean. In addition, provision for re-evaluating the suitability of these sediments for disposal is contained in the Site Management and Monitoring Plan (Appendix G). These periodic re-evaluations and the required site monitoring activities will ensure that adverse impacts from toxic substances do not occur as a result of the proposed actions.

2. Thank you for your comments.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of the Chief Scientist
Washington, D.C. 20230

September 8, 1990

Mr. Robert B. Howard, Chief
Coastal Program Unit
U.S. EPA, Region IV
345 Courtland Street, NE
Atlanta, Georgia 30365

Dear Mr. Howard:

Enclosed are comments to the Draft Environmental Impact Statement for the Designation of an Ocean Dredged Material Disposal Site located offshore of Pascagoula, Mississippi. We hope our comments will assist you. Thank you for giving us an opportunity to review the document.

Sincerely,

David Cottingham

David Cottingham
Director
Ecology and Environmental
Conservation Office

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF CHARTING AND GEODETIC SERVICES
ROCKVILLE, MARYLAND 20852

SEP 5 1990

MEMORANDUM FOR: David Cottingham
Ecology and Environmental Conservation Office
Office of the Chief Scientist

FROM: Rear Admiral Wesley V. Hull, NOAA
Director, Charting and Geodetic Services

SUBJECT: Comments About Draft Environmental Impact Statement - Designation of an Ocean Dredged Material Disposal Site Located Offshore of Pascagoula, Mississippi

The subject statement has been reviewed within the areas of Charting and Geodetic Services' (C&GS) responsibility and expertise and in terms of the impact of the proposed actions on C&GS activities and projects. Since safety of navigation is one of C&GS' primary missions, this proposal was examined with that in mind and any other impact this activity may have on C&GS activities and projects.

C&GS considers the maintenance and improvement of navigation channels to be an extremely important and worthwhile effort. Consequently, C&GS endorses this project primarily because of improved navigation conditions not only for private and commercial vessels but also for naval vessels ported at the Singing River Island facility. 1

C&GS has no objections to the proposed site. However, it should be noted that the center coordinates of 30°10'09"N and 88°34'12"W listed in the statement do not mark the center of this proposed area. In fact, they are almost at the eastern limit. It appears that perhaps the longtitude of this point should be 5 minutes further west at 88°39'12"W. 2

This site is covered on NOS nautical charts 11373 and 11375; all changes resulting from this project will be incorporated into future editions of these charts. If appropriate, marine safety information would be disseminated through Notices to Mariners and/or issuance of chartlets.

Questions about the navigation aspects of this response should be directed to the Mapping and Charting Branch, N/CG22x2, WSC1, Room 804, Nautical Charting Division, NOAA, Rockville, Maryland 20852, telephone 301-443-8742.

Attachment

SEP 7 1990
RECEIVED
EC

RESPONSE

1. Thank you for your support.

2. We concur with your comment. Based on file documents the center coordinates of the site are 30° 10' 09" N and 88° 39' 12" W. A typographical error resulted in the incorrect coordinates presented in the DEIS. The coordinates in the FEIS have been corrected per your comment.

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Affairs
Richard B. Russell Federal Building
75 Spring Street, S.W.
Atlanta, Georgia 30303

September 4, 1990

SEP. 7 1990
REGION IV

ER-90/676

Mr. Greer C. Tidwell
Regional Administrator
Environmental Protection Agency
345 Courtland Street
Atlanta, Georgia 30365

Dear Mr. Tidwell:

The Department of the Interior has reviewed the draft environmental impact statement for the Designation of an Ocean Dredged Material Disposal Site Located Offshore Pascagoula, Mississippi. We have no comments to offer.

Thank you for the opportunity to comment on this draft statement.

Sincerely,

James H. Lee

James H. Lee
Regional Environmental Officer

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Affairs
Richard B. Russell Federal Building
75 Spring Street, S.W.
Atlanta, Georgia 30303

September 14, 1990

Mr. Greer C. Tidwell
Regional Administrator
Environmental Protection Agency
345 Courtland Street
Atlanta, Georgia 30365

Dear Mr. Tidwell:

My letter of September 4, 1990, stated that the Department of the Interior has no comments to offer on the draft EIS for the Designation of an Ocean Dredged Material Site located offshore Pascagoula, MS (ODMDS). Subsequent to that letter I have received additional information and comments from the National Park Service (NPS) and the Minerals Management Service (MMS). Please accept the following comments to amend the Department of the Interior letter of September 4, 1990.

General Comments

The Horn Island and Petit Bois Island units of Gulf Islands National Seashore (GUIS) are also components of the National Wilderness System. As designated wilderness, these islands are to be afforded the highest level of Federal protection, and managed to prevent adverse man-caused change. The potential effects associated with the proposed action could provoke such changes and, consequently, are of utmost concern to the NPS.

The preferred location for the proposed ODMDS has been sited in very close proximity to the offshore boundaries (1 mile) of Horn Island. Dependent upon the type, quantity, disposal method and timing of dredged materials placement, use of the northern portions of the proposed site can, from the GUIS perspective, be either beneficial or detrimental. Maintenance of the Horn Island Pass ship channel has resulted in the disruption of natural sand transport system across the pass from Petit Bois to Horn Island. The placement of sandy materials resulting from maintenance dredging of the channel within selected portions of the proposed site may serve to mitigate the existing adverse effects. Use of northern portions of the proposed site for disposal of fine grained materials, however, could directly or indirectly represent a threat to the preservation of existing bottom communities and other resources within the offshore portions of the national seashore.

The Management and Monitoring Plan addresses many of the environmental concerns as well as describing potentially beneficial methods of using dredged materials within the proposed site. It is, however, insufficient in defining restrictions to, and acceptable uses of, those portions of the site in close proximity 2
to GUIS. Management options within those areas should be strictly limited to those clearly compatible with long-term protection of park resources and not subject to compromise from short-term exigencies which may arise in the future.

Additionally, dredging and the disposal of dredged material is an ongoing Federal action in numerous sites along the Gulf Coast, as well as other regions. Therefore, the Corps of Engineers (COE) should analyze the cumulative effects of these numerous site specific actions on estuarine and marine ecosystems within the Gulf of Mexico. The same reasoning applies to the analysis of the 3
cumulative effects of dredging and dredged material disposal on migratory species which migrate through the Gulf of Mexico Region. The analysis of cumulative impacts is mandated by the National Environmental Policy Act (Sections 1502.16, 1508.7, and 1508.8).

There is no indication in the DEIS of any preliminary coordination with the Gulf of Mexico Regional Office of the MMS, pertaining to possible oil and gas pipelines within the proposed ocean dredged material disposal site. There are two gas pipelines (one 16" and one 12" pipeline) and possibly two 20" oil pipelines, which may 4
cross the proposed dredged material site. These pipelines are owned by the Chevron USA Inc. It is suggested that COE contact Mr. Dennis Fahy, Chevron Pipeline Company, (504) 569-2264, for additional information.

There are no figures in the DEIS indicating the source of the dredged material. The FEIS should indicate the source of the dredged material, describe the type of dredge that will be used, indicate the mode and route of transport for the dredged material, 5
and indicate a time frame for the proposal. This is important basic information and should be provided in the environmental analysis for the FEIS.

<u>Specific Comments</u>

The description of the affected environment defines the proposed
ODMDS as dispersive, with net transport "expected to be towards the
west or northwest." This appears to contradict the findings of
Kjerfe and Sneed, 1984, presented in Appendix F of the DEIS. This
data indicates the presence of well defined bottom currents within
the proposed site with a dominant direction of north-northeast.
The Mississippi-Alabama sand facie which defines the bottom
sediments surrounding the GUIS barrier islands is a primary 6
determinant of the benthic marine communities within the boundaries
of GUIS. Protecting the integrity of this geologic feature and the
associated biological communities is a primary responsibility of
the national seashore. Given the characteristics of the proposed
ODMDS as dispersive and the northerly bottom currents, adverse
impacts could be expected if northern portions of the proposed site
are used for fine grained materials disposal.

Past use of the EPA Interim ODMDS for placement of fine grained
material is presented as an example of the ability to place this
type material in close proximity to sensitive resources without
adverse affects. The basis for this conclusion appears to have
been reached by default (no demonstrable adverse affects) rather 7
than concise evaluation of the material's actual performance over
time. The timeframe involved (1989 placement) suggests that
potential effects from this type of disposal are, at this point,
still unknown.

<u>Recommendations</u>

The use of northern portions of the proposed site for the disposal
of fine grained materials should be permanently excluded as a 8
management option.

Sandy materials, especially those removed from the bar channel at
Horn Island pass, should be clearly designated for placement within
those portions of the site most effective in mitigating the effects 9
of channel dredging on sand transport from Petit Bois Island to
Horn Island.

Monitoring goals should include a complete performance evaluation
of any sandy materials placed within the site for mitigation of 10
channel dredging effects. Efforts should emphasize the development
of optimum placement methods, timing and locations.

The interagency team responsible for ODMDS monitoring should include a representative of the Department of the Interior to evaluate upland wildlife and habitat concerns potentially affected by disposal options.

If you have any questions concerning these comments, please call me at 404/331-4524.

Sincerely,

James H. Lee
Regional Environmental Officer

RESPONSE

1. We appreciate your concerns relative to possible impacts to the Horn Island unit of the Gulf Island National Seashore. The entire designation process is geared toward determining the best possible location for an ODMDS and sizing the ODMDS such that unacceptable impacts outside the boundaries of the designated site do not occur. Based on the guidelines established by the EPA in coordination with the CE, the size and location of the Pascagoula ODMDS and the site management and monitoring plan provide ample protection to the resources of Horn Island and adjacent waters. The following responses to your other comments will address your concerns in more detail.

2. As indicated in response to comment one, the Pascagoula ODMDS is of a large enough size such that use of the site for any type of material would not result in unacceptable impacts outside the boundary of the site. As discussed in Section 5.14 of the DEIS, temporary perturbations in water quality or other environmental conditions caused by disposal will be reduced to normal ambient levels before reaching any significant resource. To insure this, use of portions of the site near the boundaries is not considered at any time. These aspects were discussed in Sections 5.07 and 5.14 and Appendix A, "Alternative Ocean Dredged Material Disposal Site Selection Process", of the DEIS. Although we are unsure of what 'short-term exigencies' you are referring to, we do not believe that additional restrictions are necessary in the site management and monitoring plan to protect the resources of the National Seashore.

3. Sections 1502.16, 1508.7, and 1508.8 to which you refer are part of the Council on Environmental Quality Regulations on Implementing National Environmental Policy Act Procedures. The DEIS adequately covers the requirements of Section 1502.16 via the discussion of alternatives to the proposed action and the discussion of the eleven specific and five general criteria specified in EPA regulations implementing the Marine Protection, Research and Sanctuaries Act. Sections 1508.7 and 1508.8 are vague relative to the extent of coverage required to address cumulative impacts. Section 1508.25, however, provides guidance on the scope of actions, alternatives, and impacts to be considered in an EIS. Based on this guidance and input gained during the Scoping Process the study area for this action was defined and the impacts associated with the proposed action within this study area discussed. In the late 1970's, Congress authorized the Mississippi Sound and Adjacent Areas Study to investigate the regional aspects of dredging and disposal along the northern (Mississippi and Alabama) Gulf Coast. The results of these studies, published as a series of documents in the early to mid 1980's, indicated no cumulative impacts to the resources of the northern Gulf and resulted in a recommendation of no further action. For these reasons, we believe that the DEIS adequately addresses the aspects of cumulative impacts and that no further actions are required for compliance with the provisions of the National Environmental Policy Act.

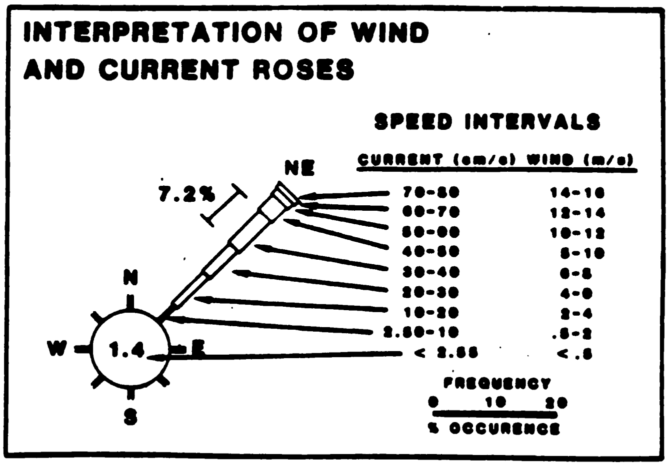
4. The information presented in the DEIS concerning oil and gas activities at the proposed ODMDS was obtained from Mr. Doug Elvers, Leasing Section, Minerals Management Service, New Orleans, LA (504-736-2775). This specific

reference has been added to Section 4.14 of the FEIS. Two of the pipelines to which you refer were installed in 1964 and 1969 and transport natural gas from the Main Pass (Louisiana) area ('41 Field') to the Chevron Refinery at Bayou Casotte. These pipelines transit a small area of the far northeastern corner of the site and would not be impacted by the proposed designation or use of the site. This information has been added to Sections 4.14 and 5.09 of the FEIS. We are unaware of any other permitted pipelines crossing the proposed ODMDS. We foresee no conflict with the proposed action should additional hydrocarbon transmission lines be required in the future.

5. We do not concur that the addition of figures to the document would add information relative to this issue above that which is already presented, nor that these details are necessary for the analysis of the impacts associated with the designation and use of the ODMDS. As stated in Section 5.05 and the Site Management and Monitoring Plan, the material proposed for placement in the DEIS would include any material from the Mississippi Sound area which meets the ocean disposal criteria. Section 5.05 and the SMMP also predict the quantity and location of material proposed for disposal in the foreseeable future. The exact location of material, however, cannot be defined until the need for dredging and disposal arises. These portions of the DEIS also present information on the type of equipment likely to be used and the time frame for disposal. Additional details associated with the discharge of dredged material into ocean waters is presented in Section 103 Evaluations. These evaluations, although still somewhat general in nature, will be prepared every five years for each use as described in the SMMP and coordinated with concerned Federal, state and local agencies and the general public.

6. Although Figures 4-3 and 4-4 of the DEIS would seem to indicate 'the presence of well defined bottom currents within the proposed site with a dominant direction of north-northeast', the analysis of the body of data and that presented in Appendix F do not support your conclusion as quoted. These figures are produced from a summation of all the current vectors over the period of record and show the residual or net direction over the period of measurement. Figures 10.2 and 10.7 show the rms current ellipses which result when the root mean square of all of the east-west vectors and the north-south vectors is calculated. In this analysis, vector direction is lost, and the result is an indication of the net direction of movement. For example, in Figure 10.2, the oscillation in the east-west direction is stronger than that in the north-south direction for Station 3. A comparison of Stations 1 and 2 gives a good example of dominance of east-west oscillation (Station 1) vs. dominance of north-south oscillation (Station 2). Station 3 bottom currents as shown on Figure 10.7 do not reveal a dominance in either of the primary directions (i.e., ellipse is circular). One should also note the general trend as shown on these figures and Figure 10.12 of the dominance of oscillations in the east-west direction at the stations closest inshore. Analysis of frequency distribution plots of current speed and direction (Figures III.95 through III.100, Appendix F DEIS) reveal another important facet of the data relative to the strength of the bottom currents. As indicated over 95 % of the recorded velocities are less than 20 cm/sec (.66 ft/sec). This is more graphically represented in

the current roses shown in Figures IV.30-32. According to the scaling diagram presented below, it is evident that the area is dominated by currents in the low velocity ranges, i.e. 38.1 % of the currents have velocities of less than 2.56 cm/sec (0.08 ft/sec). Currents oriented in the north to north-northeast quadrants are predominately between 2.56 - 10 cm/sec, while those in the north-west to west quadrants range up to 20 - 30 cm/sec. The current description may be more accurately portrayed as being highly variable in nature, however based on the body of information presented by Kjerfve and other data in the DEIS is likely that any movement of material from the site would be in a westerly to northwesterly direction.



Legend to interpretation of wind and current roses. Direction is synthesized into 8 sectors, indicating flow or wind towards that direction. The example details wind or current towards the northeast (NE). The length of the arm is proportional to the frequency of occurrence of all NE vectors. The speed intervals are differentiated by arm thickness. The length of each interval represents the frequency of occurrence of NE vectors in that speed interval. The interval is n x 10 cm/s for currents and n x 2 m/s for winds n=1,2,3... The value within the circle gives the percentage of winds or currents below the instrument threshold.

As indicated in Section 5.14 of the DEIS, modelling performed during the designation of an ODMDS offshore Pensacola indicated that suspended solids concentrations are reduced to near ambient conditions within three hours of the discharge. This modelling effort utilized average velocities of 1 foot per second. Under the current conditions of 20 cm/sec discussed above a particle could travel approximately 7,000 feet assuming a steady current in one direction and no downward transport in the water column. Attainment of these conditions in the field would be highly unlikely based on the data presented. Preliminary analysis of data obtained during field studies recently conducted at the Mobile ODMDS as part of the CE Dredging Research Program indicated that the plume of suspended sediments was localized to the vicinity of the actual dump location and that the plume dissipated rapidly.

This information has been added to appropriate sections of the FEIS.

As indicated by the sediment grain size information presented in the DEIS, the sedimentary environment of the ODMDS is variable. The area north of the proposed northern boundary is shown to be predominately sand as the area in the eastern portion of the ODMDS (this is the area which has historically been utilized for disposal of material dredged from the entrance channel).

Areas to the south and west are variable, containing increasing quantities of silt and clay. The data presented also indicate that the sediments within these areas may change seasonally, probably in response to sediment laden freshwater flows from the Mississippi Sound area. The studies conducted by Vittor and Associates (1982) classify the benthic communities of the ODMDS as offshore mud bottom and offshore mixed sediment (muddy sand) communities. Comparison of the community structure parameters of these two communities and the third offshore community delineated, the offshore clean sand community, indicate that the offshore mixed sediment community has the highest density of organisms per unit area. Results of this study also indicated that although sediment grain size is an important determinant in delineation of the benthic community, a number of organisms are common in all three community types. As discussed in Section 5.14, the ODMDS is located in an area which has been described as a fine-grained facies overlying the Mississippi-Alabama sand sheet. The primary reason given for this phenomenon is that waters laden with suspended material exit Mississippi Sound through Horn Island Pass and are moved offshore and westward by Corolius movements, wind conditions, and tidal activities. The natural conditions of this area suggest therefore that the deposition of fine grained material would not cause adverse impacts to the resources of the Gulf Islands National Seashore.

7. The statements presented in Section 5.08 of the DEIS are factual. Studies performed in the historically utilized site and adjacent areas do not show adverse impacts. In fact analysis of the data indicate that the communities of these areas are very similar to comparable areas of the northern Gulf which have not been utilized for the disposal of dredged material. The conclusion that the proposed ODMDS can be utilized for disposal of suitable dredged material is based on all of the information presented in the DEIS, analysis of information presented on past studies of this site in particular and a large body of information gathered on other similar sites which have been utilized for disposal of very large quantities of dredged material.

8. We fail to see any reason to specifically exclude the areas of the northern portion of the site for the disposal of fine grained material. As discussed in response to your comments number one and six, the site has been sized large enough such that disposal of dredged material into the ODMDS will be managed such that unacceptable impacts do not occur outside the boundaries of the site. The northern boundary of the ODMDS is approximately 1 mile from the aquatic boundary of the seashore therefore ample protection of the resources of the seashore is already provided through the site selection and sizing process.

9. It is unlikely that placement of sand in the northern portion of the proposed ODMDS would have any beneficial effects relative to erosion of Horn Island due to the depths of the site and the low velocities of the currents which characterize the area. The CE, has for a number of years, dredged the impoundment basin at Horn Island Pass and discharged the material immediately west of the channel in Disposal Area 10. These activities have resulted in the development of a small island, locally known as Sand Island.

It is likely that a substantial quantity of this material also enters the littoral drift system which would feed the shores of Horn Island. The Mobile District CE also proposes to place sand from the inlet portion of the channel in the littoral zone of Horn Island whenever possible. This option is described in detail in the Feasibility Report on improvements to the Pascagoula Harbor and was incorporated by reference into the DEIS (Section 2.05).

10. We do not concur that monitoring of placement of sandy material with reference to mitigation is appropriate. The designation and use of the ODMDS is shown within the DEIS to not result in significant adverse impacts which require mitigation and therefore no mitigation is proposed. The monitoring plan is designed to determine whether unacceptable impacts occur due to the placement of dredged material in the ODMDS so that appropriate changes to the management plan can be undertaken. The Department of Interior should correspond directly with the CE relative to their concerns associated with erosion of Horn Island.

11. The Interagency team will be composed of agencies who have the need to have representation based on statutory or regulatory responsibilities relative to potential impacts of placement of dredged material at the ODMDS. The designation and use of the ODMDS would not impact any upland wildlife or habitat and therefore there is no need for Department of Interior participation on the team at this time. The U.S. Fish and Wildlife Service and their State counterpart have been integral players in the activities that have led to the need for the designation of the new ODMDS at Pascagoula.

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APPENDIX C

CHARACTERISTICS OF DREDGED MATERIAL

PASCAGOULA HARBOR NAVIGATION PROJECT

MISSISSIPPI

APPENDIX C

TABLE OF CONTENTS

STUDIES WITH SEDIMENT FROM THE NAVAL STATION, PASCAGOULA, MISSISSIPPI, AND REPRESENTATIVE MARINE ORGANISMS

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In fulfillment of:
IAG RW96932374-01-1

Final Report Submitted: December 1990

EXECUTIVE SUMMARY

Sediment to be dredged from the Naval Station, Pascagoula, Mississippi, was subjected to biological and chemical testing in accord with Section 103 of Public Law 92-532. A 10-day test to determine toxicity and bioaccumulation potential was conducted with sediment from two locations and three representative marine organisms. Chemical analyses were performed on each sediment sample, the reference sediment, and tissues from each type of test organism before and after the 10-day test. A 96-hour toxicity test was conducted with sensitive marine crustaceans and the suspended particulate phase (SPP) of each sample and the reference sediment.

The toxicity of the two Naval Station sediment samples and the reference sediment was minimal in the 10-day test. Exposure to the sediments had little effect on survival of clamworms (*Nereis virens*), oysters (*Crassostrea virginica*,) or pink shrimp (*Penaeus duorarum*).

SURVIVAL OF TEST ANIMALS

	Clamworms	Oysters	Shrimp
Reference Sediment	88%	100%	100%
Site 1	96%	100%	98%
Site 2	94%	98%	94%

The SPP of the sediments was not toxic to mysids (*Mysidopsis bahia*). Survival in 100% SPP of the reference sediment and sediment from the two sites was $\geq$85%.

No chemicals of interest were bioaccumulated sufficiently from the two sediment samples to warrant concern. No pesticides or PCBs were detected in sediments or animal tissues before or after the 10-day exposure, but zinc was bioaccumulated significantly by clamworms exposed to Site 2 sediment. The mean concentration of zinc in tissues of clamworms exposed to Site 2 sediment was only 11 parts per million greater than clamworms exposed to the reference sediment, however (35 ppm vs. 24 ppm). Petroleum hydrocarbon residues were found in oysters, shrimp, and clamworms after the 10-day exposure, but accumulation was not statitically significant.

In summary, sediments to be dredged from the Naval Station, Pascagoula, Mississippi, were not toxic to representative marine organisms and chemicals in the sediments were not bioavailable for accumulation to concentrations of concern.

EFFECTS OF SEDIMENT FROM THE NAVAL STATION, PASCAGOULA, MISSISSIPPI, ON REPRESENTATIVE MARINE ORGANISMS

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ABSTRACT

Toxicity and bioaccumulation tests were conducted with sediment from two locations adjacent to the docks at the Naval Station, Pascagoula, Mississippi. Three types of marine organisms from benthic and epibenthic habitats were exposed to the sediment samples for 10 days in flowing, natural seawater. Reference sediment, collected south of Rabbit Island in Mississippi Sound, was used as a control. The purpose of the tests was to evaluate, in the laboratory, the toxicity of the sediment samples and the potential for bioaccumulation of chemicals from the sediments. A 96-hour toxicity test was conducted with the suspended particulate phase (SPP) of the two Naval Station sediments and reference sediment and sensitive marine crustaceans; the purpose was to compare toxicity of the whole sediment to that of the SPP.

The toxicity of the sediment samples and the reference sediment was minimal. Exposure to the sediment from both sites at the Pascagoula Naval Station and the reference sediment had little observable adverse effect on clamworms (*Nereis virens*), oysters (*Crassostrea virginica*), or pink shrimp (*Penaeus duorarum*). After 10 days of exposure, survival was ≥ 90% in all cases except for clamworms exposed to the reference sediment, where survival was 88%. Decreased salinity of test water in the laboratory resulted from 100-year record rainfall and could have contributed to clamworm mortality. The SPP of the sediments had minimal toxic effect on mysids (*Mysidopsis bahia*); survival in 100% SPP was ≥ 85%.

INTRODUCTION

In accord with an agreement with the U.S. Army Corps of Engineers, Mobile District, tests were conducted with sediments from the Naval Station, Pascagoula, Mississippi, to determine toxicity to representative marine organisms and the potential for bioaccumulation of chemicals from the sediments. Ten-day tests with the solid phase (whole sediment) and 96-hour tests with the suspended particulate phase (SPP) of sediment from two sites adjacent to the docks at the Pascagoula Naval Station and a reference sediment from south of Rabbit Island in Mississippi Sound, west of the Naval Station, were conducted at the U.S. EPA Environmental Research Laboratory, Gulf Breeze (ERL/GB), Florida, in March 1990.

The chemical analyses of sediments and animal tissues to determine bioaccumulation also were conducted at ERL/GB, and the results are reported in a separate section.

MATERIALS AND METHODS

Test Materials

The sediments to be tested were collected by Corps of Engineers and EPA personnel at sites designated by Mobile District (Appendix 1). Sediment from two sites adjacent to the Naval Station docks (east end, Site 1, and west end, Site 2) and the reference sediment were collected on 7 March 1990. The two site samples were a composite of grab-samples taken along a transect at the docks. The samples were transported to ERL/GB and placed in a large cooler where temperature was maintained at approximately 4°C. Before testing, all subsamples of each sediment were combined in a large container and mixed well.

Characteristics of the three sediments are given in Table 1.

Sodium lauryl sulfate (Fisher Scientific, Lot Number 742584) was used as a reference toxicant to gauge the condition of the test animals for the SPP tests.

Test Animals

For the solid-phase (whole-sediment) tests, three types of marine organisms from benthic and epibenthic habitats were tested: clamworms (*Nereis virens*), oysters (*Crassostrea virginica*), and pink shrimp (*Penaeus duorarum*). The clamworms were purchased from a bait dealer in New Castle, Maine; the oysters were purchased from a seafood wholesaler in Bon Secour, Alabama; and the shrimp were purchased from a Gulf Breeze, Florida, bait dealer. All animals were maintained for at least 48 hours at ERL/GB where they were acclimated to test conditions.

Mysids (*Mysidopsis bahia*) for the SPP and reference toxicant tests were cultured at ERL/GB. Mysids (4 ± 1 days old) were fed *Artemia salina* nauplii (32 to 48 hours post-hydration) during holding and testing.

Test Water

Natural seawater pumped from Santa Rosa Sound into the ERL/GB seawater system was used for all tests. For the solid-phase tests, the water was not filtered as it was pumped into elevated reservoirs. There it was aerated and allowed to flow by gravity into the wet laboratory where it was siphoned from an open trough into the test aquaria. For the SPP tests, the seawater was filtered through sand and 20-μm fiber filters; salinity was controlled at 10 ± 2 parts per thousand by the addition of aged tap water, and temperature was controlled at 20 ± 1°C by a commercial chiller and/or heater.

Test Methods

Test methods for the solid-phase tests were based on those of U.S. EPA/Corps of Engineers (1977) and methods for the SPP test were after U.S. EPA (1985). To prepare for the exposure of clamworms, oysters, and shrimp, approximately 7 liters (L) of reference sediment was placed in each of fifteen 20-gallon (76-L) glass aquaria set in temperature-controlled water baths. This resulted in a layer of reference sediment approximately 30 millimeters (mm) deep. After about 1 hour, seawater flowed into each aquarium at approximately 25 L/h, and the system was allowed to equilibrate for 24 hours. Then, the seawater flow was stopped, approximately 3.5 L of sediment from each site was added to each of five aquaria (resulting in a layer about 15 mm deep), the sediment was allowed to settle for approximately 1 hour, and the seawater flow was resumed. Then 10 clamworms were placed in the back section and 10 shrimp and 10 oysters were placed in the front section of each of the 5 aquaria. (Two separate sections were created in each aquarium by inserting a nylon screen, 2-mm mesh, and securing it with silicone sealant in order to separate the clamworms from the predacious shrimp.) Ten test organisms of each species were used per replicate for this test because this number was sufficient to perform a statistical analysis of mortality and the individuals were of such a size that sufficient biomass was available for chemical analyses to determine bioaccumulation.

The 5 reference sediment aquaria were prepared at the same time and in the same manner as the Naval Station sediment aquaria, except that only the reference sediment was added to each of the 5 aquaria (total depth about 45 mm).

The 10-day solid-phase test was conducted from 13 March to 23 March 1990. Water temperature, salinity, pH, and dissolved oxygen were recorded daily. Dead animals were noted and removed from the aquaria daily. At the end of the exposure, the remaining live animals in each aquarium were removed, rinsed with seawater to remove sediment, and were placed separately in flowing seawater to purge their gut. After 24 hours, they were placed in acid-cleaned glass jars, then frozen, and later provided to the ERL/GB Chemistry Laboratory for chemical analyses to determine bioaccumulation of chemicals from the sediments. Animals taken from the test populations before the test began were chemically analyzed to provide information on background concentrations of chemicals.

To prepare the suspended particulate phase (SPP) of each sediment and the reference sediment, 1,200 milliliters (ml) of aerated seawater were added to a 4-L Erlenmeyer flask. Then, 800 ml of well-stirred sediment were added to the flask. More seawater (2,000 ml) was added to the flask to bring the contents to the 4-L mark. This 1-part sediment:4-parts seawater mixture was mixed with a high-speed mixer for 3 minutes (min), and then allowed to settle for 1 hour. The SPP was then decanted into a separate container, and pH and dissolved oxygen (DO) concentrations were measured. The SPP of the sediment from Site 1 and 2, along with the reference sediment, had to be aerated to increase the DO to an acceptable concentration (≥60% of saturation). The appropriate volume of 100% SPP in seawater or seawater only was added to 2-L Carolina culture dishes (the total volume in each dish was 1 L) to prepare the test mixtures and control. The mixtures were then stirred for approximately 3 min; the DO, pH, temperature, and salinity were measured; and test animals were added to the dishes. For all tests, twenty animals were placed in each dish in holding cups fabricated by attaching a collar of 363-μm mesh nylon screen to a 15-centimeter (cm) wide glass Petri dish with silicone sealant; the nylon screen collar was approximately 5 cm high.

After water quality measurements and addition of animals, the dishes were stacked, with a cover on the top dish, and placed in an incubator. The temperature controller was set at 20°C and the light controlled at 14 hours light:10 hours dark. The seawater in all treatments was gently aerated during the tests; air volume to each dish was estimated to be 100 cubic centimeters/min.

Water quality was measured at 24-hour intervals, and estimates of live animals were made daily. After 96 hours, the number of live animals was determined and the tests were terminated.

Test conditions for the reference toxicant test were similar to those for the sediment tests. The test material was prepared by weighing 1 gram of sodium lauryl sulfate on an analytical balance, adding the chemical to a 100-ml volumetric flask, and bringing the flask to volume with deonized water. The test mixtures were prepared by adding 0.1 ml of the stock solution for each part per million desired to 1 L of seawater in glass culture dishes. The mixtures were stirred briefly, water quality was measured, 20 mysids were added to each dish (holding cups were not used), and the test was begun. Incubation and monitoring procedures were the same as those for the sediment tests, except that test mixtures were not aerated and animals were counted at 24-hour intervals.

Tests with the SPP prepared from the Naval Station sediment and the reference sediment were conducted 26 to 30 March 1990. A reference toxicant test was conducted concurrently with mysids from the same population.

Statistical Analyses

There was no statistical analyses of the data from the solid-phase or SPP tests because survival during the sediment solid-phase and suspended particulate-phase tests was equal to or greater than survival in the comparable reference sediment tests. No median effect (50% mortality) occurred in the Naval Station or reference sediment tests, but mortality data from the mysid reference toxicant test were subjected to statistical analyses. The 96-hour LC50 (the concentration lethal to 50% of the test animals after 96 hours of exposure) was calculated by using the moving average method (Stephan, 1977), along with the 95% confidence limits.

RESULTS AND DISCUSSION

Exposure to sediment collected from the two sites at the Pascagoula Naval Station had minimal toxic effect on clamworms, oysters, or shrimp; survival was $\geq$90% (Table 2) except for clamworms exposed to reference sediment where survival was 88%. Test water salinity decreased during the test because of 100-year record rainfall in Northwest Florida. This stress probably contributed to lugworm mortality. In view of 96% lugworm survival in the Site 1 sediment and 94% survival in Site 2 sediment, 12% mortality in the reference sediment was considered acceptable.

The toxicity of the suspended particulate phase (SPP) of the sediments and reference sediment to mysids was also minimal; survival was $\geq$ 85% in 100% SPP (Table 3).

Results of the reference toxicant test showed that the mysids were in suitable condition for the SPP test (Table 4); the 96-hour LC50 was 9.1 ppm with 95% confidence limits of 7.4 to 11.4 ppm. Our experience and the literature (Roberts et al., 1982) show that the 96-hour LC50 of sodium lauryl sulfate for mysids ranges from 3 to 10 ppm.

Salinity, temperature, dissolved oxygen (DO) concentration, and pH were within acceptable ranges during the 10-day test (Tables 5 and 6) and the 96-hour tests (Table 7 and 8), except for a few low DO measurements. Based on test results, however, low DO had no effect on animal survival.

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Table 1. Characterization of sediment samples from the Naval Station, Pascagoula, Mississippi, and a reference sediment from south of Rabbit Island in Mississippi Sound, west of the Naval Station, for water content, sand ($\geq$ 63 μm) silt-clay (< 63 micrometers), and organic material (Folk, 1957). Values reported are means of three measurements, and are reported as percentages.

Sediment	Water	Sand	Silt-Clay	Organic Carbon
Reference	42.9	62.8	3.0	34.2
Site 1	62.6	18.3	7.5	74.2
Site 2	74.2	2.1	9.7	88.1

Table 2. Results of a 10-day laboratory exposure of clamworms (Nereis virens), oysters (Crassostrea virginica), and pink shrimp (Penaeus duorarum) to sediment from the Naval Station, Pascagoula, and a reference sediment from South of Rabbit Island in Mississippi Sound, west of the Naval Station. Numbers of animals that were alive at the end of the exposure are given, along with percentage survival in parentheses. Numbers of animals per replicate at the beginning of the test were 10 clamworms, oysters, and pink shrimp, except as noted.

	Replicate	Clamworms	Oysters	Shrimp
	1	7	10	10
	2	8	10	10
Reference	3	10	10	10
Sediment	4	10	11[1]	10
	5	9	10	10
	Total	44 (88%)	51 (100%)	50 (100%)
	1	9	10	10
	2	10	10	10
Pascagoula Naval	3	10	10	10
Station	4	9	10	10
(Site 1)	5	10	10	9
	Total	48 (96%)	50 (100%)	49 (98%)
	1	10	10	10
	2	10	9	11[1]
Pascagoula Naval	3	9	10	8
Station	4	10	10	9
(Site 2)	5	8	10	10
	Total	47 (94%)	49 (98%)	48 (94%)

[1]Apparently one extra animal was placed in the aquarium when the test organisms were distributed.

Table 3. Results of acute toxicity tests conducted with mysids (*Mysidopsis bahia*) and the suspended particulate phase (SPP) of sediment from the Naval Station Pascagoula, Mississippi, and a reference sediment from south of Rabbit Island is the Mississippi Sound, west of the Naval Station. The percentage of animals alive after 96 hours of exposure is given.

	Exposure Concentration (% SPP[1])					
Sediment	Control	1%	10%	25%	50%	100%
Reference	95	95	100	95	95	90
Site 1	100	95	100	100	100	85
Site 2	100	95	95	90	90	90

[1] The SPP (suspended particulate phase) was prepared by mixing 1 part sediment with 4 parts seawater (v:v), allowing the mixture to settle for 1 h, and decanting the unsettled portion.

Table 4. Results of acute toxicity test with mysids (*Mysids bahia*) and sodium lauryl sulfate, a reference toxicant. The percentage of animals alive at each time interval is given; 20 mysids were tested in each treatment.

Concentration (mg/L)	24 h	48 h	72 h	96 h
Control	100	100	100	100
2	100	100	100	100
4	100	100	100	95
8	80	80	80	75
16	25	5	5	5
32	0	0	0	0

Table 5. Temperature, salinity, and dissolved oxygen measurements during a 10-day laboratory exposure of marine organisms to sediments from the Naval Station, Pascagoula, Mississippi, and a reference sediment from south of Rabbit Island in Mississippi Sound, west of the Naval Station.

	Test day									
	1	2	3	4	5	6	7	8	9	10
Temp. (°C)	19	19	19	19	20	19	19	19	19	19
Salinity (°/oo)	22	24	24	20	18	12[1]	11	12	14	12
DO (ppm)										
Reference Sediment										
Rep. 1	5.9	5.7	5.0	6.1	6.4	7.0	6.9	7.9	7.5	7.4
2	5.7	4.6	4.3	5.5	5.4	6.3	6.5	7.2	7.5	7.5
3	4.5	5.9	3.7	1.8	5.0	4.3	7.1	7.1	2.9	7.7
4	5.0	5.8	3.2	2.0	4.1	2.8	5.3	5.3	6.0	7.2
5	6.4	7.3	6.0	6.8	6.9	7.6	8.0	8.5	7.1	8.0
Site 1										
Rep. 1	5.7	5.5	5.4	6.3	6.5	7.0	7.2	7.9	7.5	7.8
2	6.5	5.1	5.1	5.0	4.5	7.6	6.9	7.2	7.6	7.9
3	6.7	7.1	6.3	6.5	6.8	7.6	8.0	8.3	7.9	8.1
4	5.8	5.5	5.4	6.1	5.2	4.4	6.0	5.3	3.5	7.6
5	6.0	5.5	4.8	6.1	6.0	7.5	7.2	7.0	7.2	7.6
Site 2										
Rep. 1	4.3	6.6	3.5	5.4	5.1	3.8	6.0	4.2	6.3	7.1
2	6.7	2.8	4.0	1.8	4.5	1.8	6.5	5.0	6.6	7.7
3	6.5	6.7	5.3	3.0	5.1	5.3	6.7	5.8	6.7	7.8
4	5.9	4.4	4.3	6.3	6.1	6.9	7.3	8.0	6.4	7.2
5	5.9	5.4	*[2]	5.9	6.5	7.2	7.0	7.6	7.1	7.5

[1] 12 inches of rain in the past 24 hours.

[2] A crack in the test aquarium caused the water level to drain too low to sample. It was immediately repaired and the aquarium refilled.

Table 6. The pH measured during a 10-day laboratory exposure of marine organisms to sediments from the Naval Station, Pascagoula Mississippi, and a reference sediment south of Rabbit Island in Mississippi Sound, west of the Naval Station.

	Test day									
pH	1	2	3	4	5	6	7	8	9	10
Reference Sediment										
Rep. 1	8.0	8.1	8.0	8.0	8.0	8.0	7.7	7.8	7.7	7.7
2	7.9	8.2	8.2	8.0	8.0	7.9	8.0	7.8	7.7	7.7
3	7.9	8.2	8.1	8.1	8.1	8.0	8.1	7.9	7.9	7.9
4	8.0	8.2	8.1	8.1	8.0	7.9	7.9	7.9	7.7	7.6
5	8.1	8.2	8.1	8.2	8.1	8.0	8.0	8.0	8.0	7.9
Site 1										
Rep. 1	8.0	8.2	8.0	8.1	8.1	8.0	8.0	7.9	7.5	7.8
2	8.2	8.3	8.2	8.2	8.1	8.0	8.1	8.0	8.0	8.0
3	8.2	8.2	8.2	8.2	8.1	8.0	8.0	8.0	8.0	8.0
4	8.1	8.2	8.2	8.1	8.1	8.1	8.0	8.0	7.9	8.0
5	8.0	8.1	8.0	8.1	8.0	8.1	7.9	8.0	8.0	7.8
Site 2										
Rep. 1	7.9	8.2	8.0	8.1	8.1	8.1	7.7	7.9	7.7	7.7
2	8.2	8.3	8.2	8.2	8.2	8.0	8.1	8.0	8.0	7.9
3	8.2	8.3	8.3	8.2	8.2	8.1	8.1	8.0	8.0	8.0
4	8.1	8.2	8.1	8.1	8.1	8.0	7.9	8.0	7.9	8.0
5	8.1	8.2	8.1	8.2	8.1	8.0	7.9	7.9	8.0	7.8

Table 7. Water quality measurements during a 96-hour toxicity test with mysids (*Mysidopsis bahia*) and a reference sediment from south of Rabbit Island in Mississippi Sound, west of the Naval Station. Salinity and temperature were measured in the control only at the respective time intervals.

Concentration	0 h		24 h		48 h		72 h		96 h	
(% SPP[1])	DO	pH	DO	pH	DO	pH	DO	pH	DO	pH
Control	7.5	7.9	8.1	7.8	8.4	7.7	8.3	7.7	7.5	7.8
1	7.4	7.9	8.2	7.8	8.3	7.7	8.3	7.7	7.4	7.8
10	6.6	8.2	8.0	7.8	8.2	7.7	8.1	7.7	8.0	7.9
25	5.3	8.4	7.7	7.8	7.8	7.7	7.8	7.7	7.1	7.7
50	3.9	8.5	7.9	7.8	7.8	7.8	7.7	7.7	7.3	7.8
100	2.0	8.6	7.8	7.8	6.6	7.7	6.5	7.7	7.3	7.9

	0 h		24 h		48 h		72 h		96 h	
	°C	‰	°C	‰	°C	‰	°C	‰	°C	‰
Control	24.2	10	18.9	10	20.7	11	20.6	11	20.8	12

1 The SPP (suspended particulate phase) was prepared by mixing 1 part sediment with 4 parts seawater (v:v), allowing the mixture to settle for 1 h, and decanting the unsettled portion.

Table 8. Water quality measurements during a 96-hour toxicity test with mysids (*Mysidopsis bahia*) and sediment from the Naval Station, Pascagoula, Mississippi, Site 1. Salinity and temperature were measured in the control only at the respective time intervals.

Concentration	0 h		24 h		48 h		72 h		96 h	
(% SPP[1])	DO	pH	DO	pH	DO	pH	DO	pH	DO	pH
Control	6.7	7.9	7.8	7.8	8.4	7.8	8.4	7.8	7.5	7.8
1	7.0	7.9	8.0	7.8	8.2	7.8	8.3	7.8	7.2	7.8
10	6.7	8.0	7.8	7.7	8.1	7.7	8.2	7.8	7.8	7.9
25	5.7	8.1	7.7	7.7	7.9	7.7	7.8	7.8	6.7	7.7
50	4.5	8.2	7.4	7.9	7.8	7.8	7.7	7.8	7.4	7.8
100	1.3	8.2	7.4	7.9	7.4	7.8	7.5	7.7	7.2	7.9

	0 h		24 h		48 h		72 h		96 h	
	°C	‰	°C	‰	°C	‰	°C	‰	°C	‰
Control	24.8	11	19.3	11	19.8	12	20.8	12	20.1	12

1 The SPP (suspended particulate phase) was prepared by mixing 1 part sediment with 4 parts seawater (v:v), allowing the mixture to settle for 1 h, and decanting the unsettled portion.

Table 9. Water quality measurements during a 96-hour toxicity test with mysids (*Mysidopsis bahia*) and sediment from the Naval Station, Pascagoula, Mississippi, Site 2. Salinity and temperature were measured in the control only at the respective time intervals.

Concentration	0 h		24 h		48 h		72 h		96 h	
(% SPP[1])	DO	pH	DO	pH	DO	pH	DO	pH	DO	pH
Control	6.7	7.8	8.0	7.8	7.9	7.7	8.3	7.7	7.9	7.9
1	6.9	7.9	8.1	7.8	7.6	7.6	7.9	7.7	7.2	7.7
10	6.0	8.2	7.4	7.7	7.9	7.6	7.9	7.7	6.7	7.6
25	5.0	8.3	6.8	7.8	7.7	7.6	7.6	7.8	6.6	7.7
50	2.8	8.4	7.1	8.1	7.5	8.0	7.4	8.0	6.5	8.0
100	1.1	8.4	5.7	8.2	5.7	8.1	5.8	8.1	6.7	8.3

	0 h		24 h		48 h		72 h		96 h	
	°C	‰	°C	‰	°C	‰	°C	‰	°C	‰
Control	24.9	10	20.1	10	20.4	11	20.6	11	19.9	12

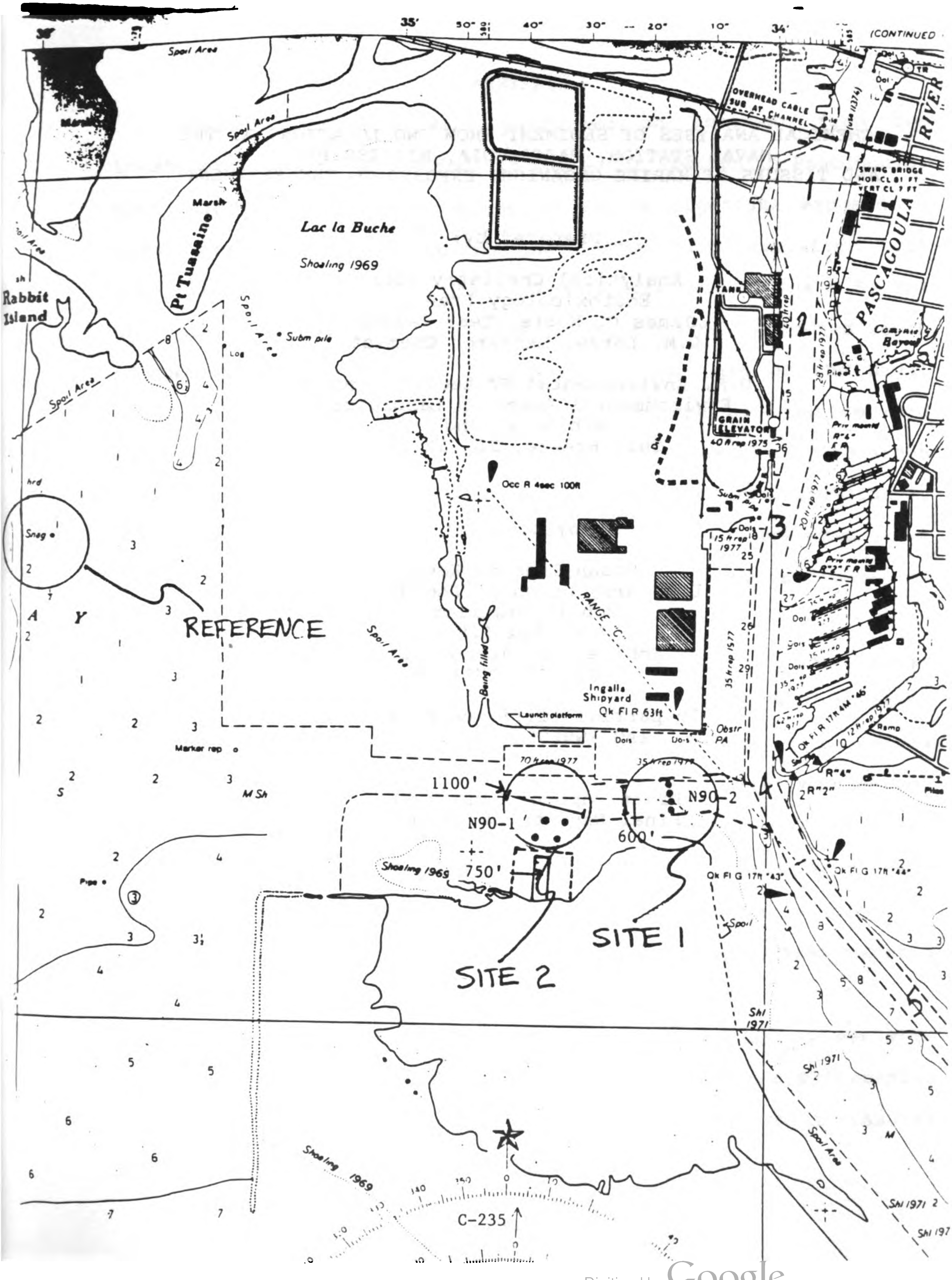
1 The SPP (suspended particulate phase) was prepared by mixing 1 part sediment with 4 parts seawater (v:v), allowing the mixture to settle for 1 h, and decanting the unsettled portion.

Table 10. Water quality measurements during a 96-hour toxicity test with mysids (*Mysidopsis bahia*) and sodium lauryl sulfate, a reference toxicant. Salinity and temperature were measured in the control only.

Concentration	0 h		24 h		48 h		72 h		96 h	
(mg/L)	DO	pH	DO	pH	DO	pH	DO	pH	DO	pH
Control	7.1	7.9	7.2	7.7	8.0	7.7	8.2	7.7	7.5	7.8
2	7.3	7.9	6.7	7.6	7.6	7.6	7.7	7.6	7.4	7.8
4	7.4	7.8	7.1	7.7	6.7	7.5	7.3	7.6	7.1	7.7
8	7.0	7.8	6.8	7.6	7.5	7.6	7.4	7.6	7.2	7.8
16	7.4	7.8	7.1	7.6	7.1	7.5	7.0	7.5	7.1	7.7
32	7.0	7.8	6.7	7.6	---	---	---	---	---	- -

	0 h		24 h		48 h		72 h		96 h	
	°C	‰	°C	‰	°C	‰	°C	‰	°C	‰
Control	24.2	10	21.8	10	21.0	11	21.1	11	19.8	12

APPENDIX 1. Location of the sediment sampling sites near the Naval Station, Pascagoula, Mississippi, and the reference sediment sampling site south of Rabbit Island in Mississippi Sound, west of the Naval Station.



Spoil Area
Lac la Buche
Shoaling 1969
Pt Tussaine
Rabbit Island
Marsh
Subm pile
Occ R 4sec 100ft
RANGE "C"
Ingalls Shipyard
Qk Fl R 63ft
Launch platform
Being filled
OVERHEAD CABLE
SUB AT CHANNEL
SWING BRIDGE
GRAIN ELEVATOR
PASCAGOULA RIVER
REFERENCE
1100'
N90-1
N90-2
600'
750'
SITE 1
SITE 2
Marker rep
Qk Fl G 17ft "43"
Qk Fl G 17ft "44"
C-235
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CHEMICAL ANALYSES OF SEDIMENT FROM TWO LOCATIONS AT THE NAVAL STATION, PASCAGOULA, MISSISSIPPI, AND TISSUES OF MARINE ORGANISMS EXPOSED TO THE SEDIMENT

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ABSTRACT

Chemical analyses were performed on sediment from two locations adjacent to the dock at the Naval Station in Pascagoula, Mississippi, and on three types of marine organisms exposed to these sediment samples during the 10-day bioaccumulation test conducted by the Dredged Materials Research Team of the U.S. EPA Gulf Breeze Laboratory. A reference sediment was collected south of Rabbit Island (RI), in Mississippi Sound west of the Naval Station. Replicates of each sediment and type of organism were analyzed for residues of selected chlorinated hydrocarbon pesticides, PCBs, chlorpyrifos (Dursban), petroleum hydrocarbons, and nine heavy metals to determine if these residues were detectable in the sediments and if they accumulated in tissues of organisms exposed to the sediments.

Residues of selected pesticides or PCBs were not detected in sediments or animal tissues before or after exposure. Although some metals were detected in sediments and in tissues of organisms before and after exposure, the only statistically significant (ANOVA, as 95-percent confidence level) difference in mean concentrations were determined for zinc in clamworms. Mean residues concentrations were higher in organisms exposed to sediment from Site 2 for 10 days than in those organisms exposed to the reference sediment for 10 days.

Petroleum hydrocarbon residues were also found in oysters, shrimp, and clamworms after the 10-day exposure, but differences in mean residue concentrations were not statistically (ANOVA) significant at the 95-percent confidence level.

INTRODUCTION

In accord with an agreement between the U.S. Army Corps of Engineers (US ACE), Mobile District, and EPA's Gulf Breeze Environmental Research Laboratory (ERL/GB), chemical analyses were performed on sediment collected from the Pascagoula Naval Station (PNS), Mississippi (MS), and a reference sediment from South of Rabbit Island in Mississippi Sound, West of the Naval Station, and on three species of marine organisms (clamworms, *Nereis virens*; oysters, *Crassostrea virginica*; and pink shrimp, *Penaeus duorarum*) exposed to these sediments during the 10-day bioaccumulation test. Two replicates of each sediment and five replicates of each organism were analyzed for the following chemical residues: PCBs, selected chlorinated hydrocarbon pesticides, chlorpyrifos (Dursban), selected heavy metals, and two petroleum hydrocarbon fractions (aliphatic and aromatic). These analyses were performed on sediments and organisms before the bioaccumulation test and on organisms after the bioaccumulation test. Chemical analyses were performed by gas-liquid chromatography for pesticides, PCBs, and petroleum hydrocarbons, and inductively coupled argon plasma emission spectroscopy (ICAP) for heavy metals. Methods of chemical analyses were modified and validated at ERL/GB, except for the petroleum hydrocarbon method. This method was used as recommended by the U.S. Army Corps of Engineers Implementation Manual (EPA/CE, 1977).

MATERIALS AND METHODS

Test Sediments and Animals

Samples of sediments and test organisms were obtained from the ERL/GB Dredged Materials Research Team prior to initiation of the bioaccumulation test. Sampling locations and methods for the PNS and reference sediments are indicated in Appendix 1. After the 10-day exposure period, five replicates of each test organism from the PNS sediment, and the RI reference sediment, were collected and frozen until chemical analyses were performed.

Methods of Chemical analyses

A. Chlorinated Hydrocarbon Pesticides and PCBs

Tissue samples were weighed into a 150-mm by 25-mm screw top test tube and homogenized three times with 10 ml of acetonitrile with a Willems Polytron Model PT 20-ST (Brinkman Instruments, Westbury, NY). Following each homogenization, the test tube was centrifuged (1600 x g) and the liquid layer decanted into a 120-ml oil sample bottle. Seventy-five ml of a 2% (w/v) aqueous sodium sulfate and 10 ml of petroleum ether were added to the bottle and the contents shaken for 1 minute (min). After the layers separated, the solvent was pipetted into a 25-ml concentrator tube and the extraction with petroleum ether was repeated two more times. The combined solvent extract was concentrated to 1 ml on a nitrogen evaporator in preparation for cleanup.

Sediments were air dried and blended as necessary, then weighed into 150-mm by 25-mm screw top test tube. Add 20 mℓ of 20%(v/v) acetone in petroleum ether and spin on a rotorack at 60-

90 rpm for 30 minutes. Centrifuge (1600 x g) for 10 minutes and then pipet the solvent extract into an oil sample bottle containing 50 mℓ of 20% (v/v) aqueous sodium sulfate. Shake for one minute and allow separation of the two phases. Pipet the solvent extract into a 25 mℓ-concentrator tube and repeat the extraction two more times. Concentrate the combined solvent extracts to 1 mℓ on a nitrogen evaporator in preparation for Florisil cleanup. Samples to be analyzed with electron-capture detectors should be shaken with 500 μℓ of mercury to remove sulfur before gas chromatographic analysis.

Cleanup columns were prepared by adding 3 g of PR-grade Florisil (stored at 130°C) and 2 g of anhydrous sodium sulfate, (powder) to a 200-mm by 9-mm i.d. Chromaflex column (Kontes Glass Co., Vineland, NJ) and rinsing with 20 ml of hexane. Tissue and sediment extracts were transferred to the column with two additional 2-ml volumes of hexane. Pesticides and PCBs were eluted with 20 ml of 5% (v/v) diethyl ether in hexane.

Quantitations of pesticides were made with external standard methods. All standards were obtained from the EPA pesticide repository. Analyses were performed on a Hewlett-Packard Model 5890 gas chromatograph equipped with a ^{63}Ni electron-capture detector. Separations were performed by using a 182-cm by 2-mm i.d. glass column packed with 2% SP2100 (Supelco, Inc., Bellefonte, PA) or 80-100 mesh Supelcoport, by using a 182-cm by 2-mm i.d. glass column packed with 1.5% OV-17/1.95% OV-210 on 80/100 Gas-Chrom Q (Applied Science Lab., Inc.). Other gas chromatographic parameters were: flow rate of the 10% methane-in-argon carrier gas, 25 ml/min; column temperature, 190°C; inlet temperature, 200°C; and detector temperature, 300°C.

B. Heavy Metals

One to two grams of tissue or sediment were weighed into a 40-ml reaction vessel. Five milliliters of concentrated nitric acid (Baker Chemical Instra-Analyzed) were added and the samples digested for 2 to 4 h at 70°C in a tube heater. Digestion was continued, with vessels capped, for 48 h at 70°C. After digestion, samples were transferred to 15-ml tubes and a 2-ml aliquot was diluted to 10 ml for aspiration into a Jarrell-Ash AtomComp 800 Series inductively-coupled argon-plasma emission spectrometer (ICP). This instrument acquires data for 15 elements simultaneously. No detectable residues could be found in method blanks. A solution of 10% nitric acid/distilled water was aspirated between samples to prevent carryover of residues from one sample to the next. Standards in 10% nitric acid were used to calibrate the instrument initially and adjustments were made when necessary. Concentrations are reported in two significant figures as our method allows, and were not corrected for percentage recovery.

C. Petroleum Hydrocarbons

Ten grams of tissue or sediment were weighed into culture tubes and extracted as described by J.S. Warner (1976). Sample extracts were concentrated to approximately 0.50 ml for gas chromatographic analyses. Analyses were performed on a Perkin Elmer Sigma 2100 gas chromatograph (GC) equipped with flame ionization detectors (FID). Separations were performed by using a 30-m, 0.32-mm i.d. DB-5 fused silica capillary column. Helium carrier gas was used at a flow of 1.5 ml/min. Other gas chromatographic parameters were: oven temperature programmed from 50°C (hold for 2 min) at a rate of 10°/min to 310°C (hold for 10 min).

Quality Assurance of Chemical Analyses

All standards used for quantitations of pesticides were obtained from EPA's repository in Las Vegas, Nevada. Standard solutions of metals were obtained from J.T. Baker Chemical Co., Phillipsburg, NJ, and were Instra-Analyzed quality. Dotriacontane was obtained from Alltech Associates, Deerfield, Illinois, and was used as an internal standard to quantitate petroleum hydrocarbons.

A part of our quality assurance procedures includes fortification (spiking) of samples of organisms and sediments with selected chemicals to evaluate the entire analytical system during the period of time quantitative analyses of test organisms and sediments are performed. Separate samples were fortified with selected pesticides and petroleum hydrocarbons and metals. Reagent and glassware blanks were analyzed to verify that the analytical system was not contaminated with chemical residues that could interfere with quantitations.

Statistical Analyses

Residue data were analyzed according to guidance in the Implementation Manual (EPA/CE, 1977). These analyses were performed by using Statistical Analysis System procedures (SAS, 1985). Concentrations of analytes reported as ND were replaced by the method detection limit so that statistical analyses could be performed.

RESULTS AND DISCUSSION

Analyses of Pesticides and PCBs

The results of spiked samples (Table 1) indicate that the extraction and quantitation techniques were adequate for determining concentrations of chemical residues in organisms and sediments used in the bioaccumulation study. Results of reagent and glassware blank analyses verified that residues of pesticides, PCBs, petroleum hydrocarbons, metals, or other contaminants were not present prior to the analyses of test organisms and sediments.

Before the bioaccumulation test, chemical analyses were performed on samples of each group of organisms and sediments. Results indicated that residues of pesticides and PCBs were not present in tissues of organisms at concentrations above their detection limits (Table 2). Low concentrations of aliphatic hydrocarbons were detected in all three organisms (Table 2). Residues of pesticides or PCBs were not detected in replicate samples of the reference or PNS sediments (Table 3); however, sediments from PNS Site 2 contained aliphatic and aromatic petroleum hydrocarbons.

After organisms were exposed to the reference sediment or PNS sediments for 10 days, they were analyzed for pesticides and PCBs. Pesticides or PCBs did not accumulate in any of the organisms exposed to the reference sediment (Table 4) or to PNS sediments (Table 5).

<u>Analyses of Metals</u>

Replicate samples of each group of organisms and sediment were analyzed for selected metals before the bioaccumulation test and replicate samples of each organism were analyzed after the 10-day bioaccumulation test. Metals detected in pretest animals are shown in Table 6, along with method detection limit for each element. Concentrations of metals detected in sediments shown in Table 7 were lower than those reported in the first draft because these samples were reanalyzed after instrument maintenance and restandardization had been performed. Reagent blanks for metals were analyzed at regular intervals with no residues detected.

Concentrations of metals in replicate samples of oysters exposed for 10 days to the reference sediment and sediment from the PNS are shown in Table 8. Arsenic and mercury, residues were not detected. Variance in zinc concentrations were determined to be homogeneous (Table 9). Differences in mean concentrations of zinc in oysters exposed to PNS sediment, and mean concentrations in those exposed to the reference sediment, were not statistically (ANOVA) significant at the 95-percent confidence level (Table 10).

Concentrations of metals in replicate samples of clamworms exposed for 10 days to the reference sediment and PNS sediments shown in Table 11. Samples from Site 1 (Rep 4) and Site 2 (Reps 1-5) were reanalyzed after maintenance and restandardization of the instrument. Arsenic, cadmium, mercury, and lead were not detected. Variances were homogeneous for copper concentrations (Table 12). Mean copper concentrations in clamworms were not statistically significant at the 95 percent confidence level (Table 13). Variance were homogeneous for zinc concentrations (Table 14). Because mean metal concentrations of zinc were higher in organisms exposed to PNS sediments than mean concentrations in organisms exposed to the reference sediment, statistical analyses (ANOVA) were performed (Table 15). These differences were significant for Site 2 using Student-Newman-Keuls (SNK) test at the 95-percent confidence level (Table 16).

Concentrations of metals in replicate samples of shrimp exposed for 10 days to the reference sediment or the PNS sediment are shown in Table 17. Mercury and lead residues were not detected. Concentrations of cadmium, copper, nickel, and zinc were analyzed for homogeneity of variances (Tables 18-21). Differences in mean concentrations were not statistically significant (ANOVA) at the 95-percent confidence level (Tables 22-25).

Analyses of Petroleum Hydrocarbons

Results from organisms and sediments that were analyzed for residues of both aliphatic and aromatic petroleum hydrocarbons before and after the 10-day bioaccumulation test are shown in Table 26. Variances were homogeneous for aliphatic and aromatic petroleum hydrocarbon concentrations in shrimp (Table 27). Mean residue concentrations of aliphatic and aromatic petroleum hydrocarbons in shrimp exposed to sediment from PNS were not statistically different from mean residue concentrations in shrimp exposed to the reference sediment (Tables 28 and 29) when analyses of variances were performed.

Variances were homogeneous for aliphatic and aromatic petroleum hydrocarbon concentrations in oysters (Table 30). Mean concentration of aliphatic petroleum hydrocarbons in oysters exposed to PNS sediment were not statistically different (ANOVA, at 95-percent confidence level) as shown in Table 31. However a significant difference was found for aromatic hydrocarbons (Table 32) using ANOVA. SNK test showed that this difference was not due, to the concentrations of hydrocarbons in oysters exposed to Site 1 (Table 33) but to concentrations in oysters exposed to Site 2 sediment which were actually lower than concentrations in oysters exposed to reference sediment.

Because mean concentrations of aliphatic and aromatic petroleum hydrocarbons were higher in clamworms exposed to reference sediments than those exposed to the PNS sediment no further statistical analyses were performed.

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Table 1. Percentage recovery of chlorinated hydrocarbon pesticides, and petroleum hydrocarbons spiked in tissues of organisms and reference sediment used in a bioaccumulation study with sediment from PNS, Mississippi. Method detection limit for each compound is given in µg/g wet tissue weight. Standard deviation is shown in parentheses.

Compound	Spike Concentration (µg/g)	N	Clamworms	N	Shrimp	N	Oysters	N	Sediment	Method Detection Limit (µg/g)
Aldrin	0.010	2	89(1.4)	2	98(7.8)	2	78(3.5)	4	76(14)	0.0020
BHC Isomer										
Alpha	0.010		a		a		a	3	103(14)	0.00080
Beta	0.040		a		a	2	88(0.71)	4	103(20)	0.0040
Gamma (lindane)	0.010	2	103(6.4)	2	98(6.4)		a	4	98(23)	0.0020
Delta	0.040		a		a		a	4	110(28)	0.0020
Chlordane	0.20	2	95(0.71)	2	91(2.1)	2	100(2.1)	4	82(14)	0.040
Chlorpyrifos (Dursban)	0.10		a		a		a		a	0.010
DDE	0.020	2	100(5.7)	2	99(8.5)	2	85(3.5)	4	84(6.8)	0.0040
DDD	0.040	2	120(5.0)	2	120(12)	2	100(0.35)	4	86(10)	0.0080
DDT	0.060	2	120(7.1)	2	110(5.7)	2	100(0.71)	4	83(9.0)	0.010
Dieldrin	0.020	4	98(3.6)	2	100(0.0)	2	92(3.5)	8	88(11)	0.0040
Endrin	0.020	4	100(5.6)	2	92(11)	2	55(7.8))	8	90(10)	0.010
Endosulfan I	0.020	4	99(6.3)	3	88(10)	4	97(7.9)	7	88(19)	0.010
Endosulfan II	0.020	4	93(9.6)	3	92(9.1)	4	81(11)	7	93(9.7)	0.010
Endosulfan Sulfate	0.10		a	3	82(11)	4	85(31)	8	79(20)	0.050
Heptachlor	0.010	2	75(5.7)	2	87(0)	2	66(0)		a	0.0020
Heptachlor epoxide	0 010		a	2	76(6.4)		a		a	0.010
Hexachlorobenzene	0.010		a	1	94	2	60(3.5)		a	0.0020
Methoxychlor	0.020		a		a		a	8	110(12)	0.030
Mirex	0.020		a		a		a	8	105(9.2)	0.020
PCBs	0.50	2	99(8.5)	3	110(5.5)	2	110(13)	4	95(9.9)	0.10
Toxaphene	0.50	2	(0.71)		a		a	4	110(22)	0.20
Petroleum Hydrocarbons										
Aliphatic	0.5-1.5	7	89(7.5)	5	73(16)	7	86(11)	14	67(12)	0.50
Aromatic	0.5-1.0	7	82(5.1)	6	62(22)	7	73(8.9)	14	49(14)	0.50

[a]Analytes were not spiked for recovery.

Table 2. Concentrations of selected chlorinated pesticides, PCBs, and petroleum hydrocarbons in replicate samples of three marine organisms analyzed prior to a bioaccumulation study with sediments from PNS, Mississippi.

	Clamworms		Shrimp		Oysters	
Replicate	1	2	1	2	1	2
Aldrin	ND	ND	ND	ND	ND	ND
BHC Isomers	ND	ND	ND	ND	ND	ND
Alpha	ND	ND	ND	ND	ND	ND
Beta	ND	ND	ND	ND	ND	ND
Gamma (lindane)	ND	ND	ND	ND	ND	ND
Delta	ND	ND	ND	ND	ND	ND
Chlordane	ND	ND	ND	ND	ND	ND
Chlorpyrifos (Dursban)	ND	ND	ND	ND	ND	ND
DDE	ND	ND	ND	ND	ND	ND
DDD	ND	ND	ND	ND	ND	ND
DDT	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND	ND
Endosulfan Sulfate	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND	ND
PCBs	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND
Petroleum Hydrocarbons						
Aliphatic	3.7	ND	2.3	7.8	0.54	ND
Aromatic	ND	ND	0.54	ND	ND	ND

ND = Not detected; see Table 1 for detection limits.

Table 3. Concentrations of pesticides, PCBs, and petroleum hydrocarbons in replicate samples of sediment from PNS, Mississippi, and a reference sediment from south of Rabbit Island, in Mississippi Sound. Analyses were performed prior to a bioaccumulation study with these sediments.

			PNS			
	Reference		Site 1		Site 2	
Replicate	1	2	1	2	1	2
Aldrin	ND	ND	ND	ND	ND	ND
BHC Isomers	ND	ND	ND	ND	ND	ND
Alpha	ND	ND	ND	ND	ND	ND
Beta	ND	ND	ND	ND	ND	ND
Gamma (lindane)	ND	ND	ND	ND	ND	ND
Delta	ND	ND	ND	ND	ND	ND
Chlordane	ND	ND	ND	ND	ND	ND
Chlorpyrifos (Dursban)	ND	ND	ND	ND	ND	ND
DDE	ND	ND	ND	ND	ND	ND
DDD	ND	ND	ND	ND	ND	ND
DDT	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND	ND
Endosulfan Sulfate	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND	ND
PCBs	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND
Petroleum Hydrocarbons						
Aliphatic	ND	ND	0.51	8.1	9.9	13
Aromatic	ND	ND	ND	0.99	1.3	1.3

ND = Not detected; see Table 1 for detection limits.

Table 4. Concentrations of selected chlorinated pesticides and PCBs in replicate samples of three marine organisms analyzed after the 10-day exposure to a reference sediment from south of Rabbit Island in Mississippi Sound.

	Clamworms					Shrimp					Oysters				
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Aldrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BHC Isomers	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Alpha	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Beta	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gamma (lindane)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlordane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorpyrifos (Dursban)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDD	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan Sulfate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Not detected, see Table 1 for detection limits.

Table 5. Concentrations of selected chlorinated pesticides and PCBs in replicate samples of three marine organisms analyzed after the 10-day exposure to sediment from PNS, Mississippi.

	Clamworms					Shrimp					Oysters				
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Aldrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BHC Isomers	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Alpha	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Beta	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gamma (lindane)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlordane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorpyrifos (Dursban)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDD	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan Sulfate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Not detected, see Table 1 for detection limits.

Table 6. Concentrations of selected metals in tissues of organisms that were determined as background residues before the organisms were used in a bioaccumulation study with PNS, Mississippi, sediment. Method detection limit for each element in tissue and sediment is given in μg/g wet weight.

Pre-Test Organism	Replicate	Concentrations in μg/g wet tissue weight								
		As[a]	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Shrimp	1	6.1	0.075	ND	8.8	ND	ND	ND	ND	20
	2	7.0	0.068	ND	9.8	ND	ND	ND	1.3	28
Clamworms	1	4.0	ND	ND	2.1	ND	ND	ND	1.1	27
	2	4.4	ND	ND	3.0	ND	ND	ND	1.1	31
Oysters	1	ND	0.70	ND	20	ND	0.99	ND	ND	250
	2	ND	0.78	ND	23	ND	1.7	ND	ND	280
Method Detection Limits[b]										
		0.625	0.050	0.225	0.100	0.625	0.625	0.125	0.875	0.50

[a] Background subtraction techniques normally used could not be applied due to interference from unknown elements that cause intense background signal. Therefore, arsenic values are reported as maximum possible concentrations.

[b] Based on final volume of 50 ml and a sample weight of 2 g (maximum sample size).

ND = Not detected.

Table 7. Concentrations of selected metals in the reference sediment south of Rabbit Island in Mississippi Sound, and sediment from two locations adjacent to PNS, Mississippi.

Sediment Location	Replicate	Concentrations in µg/g wet weight								
		As[a]	Cd	Cr	Cu	Hg	Ni	Pb[a]	Se	Zn
Reference	1	ND	ND	5.1	1.1	ND	ND	ND	ND	18
	2	ND	ND	ND	1.5	ND	ND	ND	ND	24
Site 1	1	ND	ND	35	20	ND	ND	25	ND	48
	2	ND	ND	ND	2.8	ND	ND	ND	ND	17
Site 2	1	ND	ND	5.6	3.7	ND	ND	ND	ND	39
	2	ND	ND	ND	ND	ND	ND	ND	ND	25
Method Detection Limits										
		0.750	0.050	0.125	0.025	0.500	0.250	0.375	0.500	0.025

[a] Usual background correction techniques could not be applied because of the intense interference; therefore, without subtracting background, arsenic and lead may be present but not in quantities greater than these shown.

Table 8. Concentrations of selected metals in oysters from the 10-day bioaccumulation study with sediment from two locations adjacent to PNS, Mississippi, and a reference sediment from south of Rabbit Island in Mississippi Sound.

		Concentrations in µg/g wet weight								
Sediment Location	Replicate	As[a]	Cd	Cr	Cu	Hg	Ni[b]	Pb[a]	Se[b]	Zn
Reference	1	ND	0.43	ND	13	ND	ND	ND	ND	220
	2	ND	0.42	ND	15	ND	ND	ND	1.3	260
	3	ND	0.40	0.42	20	ND	1.1	ND	ND	250
	4	ND	0.58	ND	17	ND	ND	ND	1.7	250
	5	ND	0.60	ND	15	ND	1.9	ND	ND	200
	Mean $\bar{x}$ =	--	0.49	--	16.0	--	0.975	--	1.12	240
Site 1	1	ND	0.59	ND	18	ND	0.86	ND	ND	270
	2	ND	0.36	ND	13	ND	1.1	ND	ND	180
	3	ND	0.45	ND	16	ND	ND	ND	ND	240
	4	ND	0.43	ND	15	ND	ND	ND	ND	210
	5	ND	0.48	ND	15	ND	ND	ND	1.9	220
	Mean $\bar{x}$ =	--	0.46	--	15.4	--	0.767	--	1.08	220
Site 2	1	ND	0.63	ND	19	ND	ND	0.52	1.5	270
	2	ND	0.67	ND	17	ND	ND	ND	ND	270
	3	ND	0.42	ND	13	ND	1.1	ND	ND	180
	4	ND	0.42	ND	16	ND	ND	ND	ND	240
	5	ND	0.58	ND	22	ND	1.1	ND	ND	300
	Mean $\bar{x}$ =	--	0.54	--	17.4	--	0.815	--	1.00	250

ND = not detected (Method detection limits in Table 6)

[a] Background subtraction techniques normally used could not be applied due to interference from unknown elements that cause intense background signal. Therefore, arsenic values are reported as maximum possible concentrations.
[b] Method detection limit was substituted for ND when statistical analyses were performed.

Table 9. Statistical analysis of zinc (μg/g wet tissue) in samples of oysters from the 10-day bioaccumulation study with sediment from two locations adjacent to PNS, Mississippi and a reference sediment from south of Rabbit Island in Mississippi Sound.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	220	270	270
2	260	180	270
3	250	240	180
4	250	210	240
5	200	220	300
Sum of data, Σx =	1180	1120	1260
Mean X =	236	224	252
Sum of squared data, Σx^2 =	281000	255400	325800
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	2520	4520	8280
Variance =	630	1130	2070

$C = \frac{2070}{3830} = 0.5405$ where $C = \frac{\text{maximum variance}}{\text{sum of variances}}$

Tabulated C (3, 4) = 0.7457

Since calculated C is less than tabulated C value, variances are assumed to be homogeneous and transformation is unnecessary.

Table 10. Analysis of variance of zinc accumulation in oysters from the 10-day bioaccumulation study with sediments from PNS, Mississippi.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1973.3	986.6	0.77	0.4834
Error	12	15320	1276.6		
Corrected Total	14	17293			

C.V.	Root MSE	PPM Mean
15.05	35.73	237.3

Table 11. Concentrations of selected metals in clamworms from the 10-day bioaccumulation study with sediments from two locations adjacent to PNS, Mississippi and a reference sediment from south of Rabbit Island in Mississippi Sound.

Sediment Location	Replicate	As[a]	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
		Concentrations in μg/g wet weight								
Reference	1	ND	ND	ND	5.1	ND	ND	ND	1.4	22
	2	ND	ND	ND	0.70	ND	ND	ND	ND	20
	3	ND	ND	ND	ND	ND	ND	ND	ND	29
	4	ND	ND	ND	ND	ND	ND	ND	ND	26
	5	ND	ND	ND	ND	ND	ND	ND	ND	22
	Mean $\bar{x}$ =	--	--	--	1.22	--	--	--	--	23.8
Site 1	1	ND	ND	ND	0.81	ND	ND	ND	ND	24
	2	ND	ND	ND	2.3	ND	ND	ND	1.3	20
	3	ND	ND	ND	ND	ND	ND	ND	ND	26
	4	ND	ND	ND	2.9	ND	ND	ND	ND	25
	5	ND	ND	ND	2.9	ND	ND	ND	ND	38
	Mean $\bar{x}$ =	--	--	--	1.80	--	--	--	--	26.6
Site 2	1	ND	ND	ND	2.8	ND	ND	ND	ND	35
	2	ND	ND	ND	2.3	ND	ND	ND	ND	29
	3	7.1	ND	ND	3.0	ND	ND	ND	ND	35
	4	ND	ND	ND	1.5	ND	ND	ND	ND	41
	5	ND	ND	ND	3.0	ND	1.7	ND	ND	34
	Mean $\bar{x}$ =	--	--	--	2.52	--	--	--	--	34.8
		Method Detection Limits								
Reference (Reps 1-5) Site 1 (Reps 1-4)		0.625	0.050	0.225	0.100	0.625	0.625	0.125	0.875	0.50
Site 1 (Rep 5) and Site 2 (Reps 1-5)		0.750	0.050	0.125	0.025	0.500	0.250	0.375	0.500	0.025

ND = not detected (Method detection limits changed after annual service). Method detection limits were substituted for ND when statistical analyses were performed.

[a] Background subtraction techniques normally used could not be applied due to interference from unknown elements that cause intense background signal.

Table 12. Statistical analysis of copper ($\mu g/g$ wet tissue) in samples of clamworms from the 10-day bioaccumulation study with sediment from two locations adjacent to PNS, Mississippi and a reference sediment from south of Rabbit Island in Mississippi Sound.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	5.1	0.81	2.8
2	0.70	2.3	2.3
3	0.10	0.10	3.0
4	0.10	2.9	1.5
5	0.10	2.9	3.0
Sum of data, Σx =	6.1	9.01	12.6
Mean X =	1.22	1.80	2.52
Sum of squared data,			
Σx^2 =	26.530	22.776	33.380
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	19.088	6.540	1.628
Variance =	4.772	1.635	0.407

$C = \frac{4.772}{6.8140} = 0.7003$ where $C = \frac{\text{maximum variance}}{\text{sum of variances}}$

Tabulated C (3, 4) = 0.7457

Since calculated C is greater than tabulated C value, variances are assumed to be unequal and transformation is necessary.

Table 13. Analysis of variance of copper accumulation in clamworms from the 10-day bioaccumulation study with sediments from two locations adjacent to PNS, Mississippi and a reference sediment from South of Rabbit Island in Mississippi Sound.

Analysis of Variance Procedure

Dependent Variable Log: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	4.24049	2.1202	0.93	0.42
Error	12	27.256	2.2713		
Corrected Total	14	31.496			

C.V.	Root MSE	Log PPM Mean
81.582	1.507	1.847

Table 14. Statistical analysis of zinc ($\mu g/g$ wet tissue) in samples of clamworms from the 10-day bioaccumulation study with sediment from two locations adjacent to PNS, Mississippi and a reference sediment from south of Rabbit Island in Mississippi Sound.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	22	24	35
2	20	20	29
3	29	26	35
4	26	25	41
5	22	38	34
Sum of data, Σx =	119	133	174
Mean X =	23.8	26.6	34.8
Sum of squared data, Σx^2 =	2885.0	3721	6128
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	52.80	183.2	72.8
Variance =	13.20	45.8	18.2

$C = \frac{45.8}{77.2} = 0.5932$ where $C = \frac{\text{maximum variance}}{\text{sum of variances}}$

Tabulated C (3, 4) = 0.7457

Since calculated C is less than tabulated C value, variances are assumed to be equal and transformation is not necessary.

Table 15. Analysis of variance of zinc accumulation in clamworms from the 10-day bioaccumulation study with sediments from PNS, Mississippi.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	326.8	163.4	6.35	0.0132
Error	12	308.8	25.73		
Corrected Total	14	635.6			

C.V.	Root MSE	Log PPM Mean
17.86	5.072	28.4

Table 16. Comparison of mean zinc residues in clamworms from the 10-day bioaccumulation study with sediment from PNS, Mississippi.

$$S\bar{x} = \sqrt{\frac{MSE}{n}} = \sqrt{\frac{25.73}{5}} = 2.2685$$

At the alpha = 0.05 level,

	K = 2	K = 3
Q	3.00	3.65
$S\bar{x}$	2.2685	2.2685
$LSR = QS\bar{x}$	6.805	8.280

Treatment means from computer printout

Ref	Site 1	Site 2
23.80	26.60	34.80

Mean Comparison

K	LSR	Difference between means
2	6.805	Site 1 - Ref = 26.60 - 23.80 = 2.80 n.s.
3	8.280	Site 2 - Ref = 34.80 - 23.80 = 11.00*

* Indicates significant difference at alpha = 0.05.

n.s = not significantly different.

Table 17. Concentrations of selected metals in shrimp from the 10-day bioaccumulation study with sediments from two locations adjacent to PNS, Mississippi and a reference sediment from south of Rabbit Island in Mississippi Sound.

Sediment Location	Replicate	Concentrations in µg/g wet weight								
		As[a]	Cd[b]	Cr	Cu	Hg	Ni[b]	Pb	Se[b]	Zn
Reference	1	6.9	ND	0.62	6.9	ND	3.5	ND	1.6	24.0
	2	6.1	0.12	ND	8.4	ND	ND	ND	1.1	15.0
	3	4.8	0.11	ND	12	ND	1.0	ND	ND	25.0
	4	5.2	ND	ND	7.9	ND	ND	ND	ND	17.0
	5	6.7	0.10	1.2	9.2		0.85	ND	ND	23.0
	Mean x̄ =	5.94	0.0860	0.499	8.88	--	1.32	--	1.06	20.80
Site 1	1	5.6	0.10	ND	8.5	ND	4.2	ND	1.4	40.0
	2	5.9	0.11	ND	8.4	ND	2.2	ND	ND	28.0
	3	4.1	ND	0.44	8.7	ND	ND	ND	1.1	18.0
	4	4.9	ND	ND	10	ND	ND	ND	1.1	16.0
	5	7.1	0.75	0.49	8.9	ND	ND	ND	1.6	33.0
	Mean x̄ =	5.52	0.212	0.321	8.90	--	1.65	--	1.21	27.00
Site 2	1	5.9	0.85	ND	12	ND	2.3	ND	ND	31.0
	2	4.8	0.14	ND	14	ND	1.7	ND	ND	27.0
	3	4.4	0.69	ND	10	ND	ND	ND	ND	26.0
	4	4.4	0.62	ND	12	ND	ND	ND	ND	26.0
	5	2.6	ND	ND	3.9	ND	ND	ND	ND	12.0
	Mean x̄ =	4.42	0.470	--	10.4	--	1.17	--	--	24.40

ND = not detected (Method detection limits in Table 6).
[a] Background subtraction techniques normally used could not be applied due to interference from unknown elements that cause intense background signal .
[b] Method detection limit was substituted for ND when statistical analyses were performed.

Table 18. Statistical analysis of cadmium ($\mu g/g$ wet tissue) in samples of shrimp from the 10-day bioaccumulation study with sediment from two locations adjacent to PNS, Mississippi and a reference sediment from south of Rabbit Island in Mississippi Sound.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	0.050	0.10	0.85
2	0.12	0.11	0.14
3	0.11	0.050	0.69
4	0.050	0.050	0.62
5	0.10	0.75	0.050
Sum of data, Σx =	0.43	1.06	2.35
Mean X =	0.086	0.2120	0.470
Sum of squared data, Σx^2 =	0.0415	0.5896	1.605
CSS = $\Sigma x2 - \frac{(\Sigma X)^2}{n}$ =	0.00452	0.3648	0.5006
Variance =	0.00113	0.0912	0.1251

$C = \frac{0.1251}{0.2174} = 0.5754$ where $C = \frac{\text{maximum variance}}{\text{sum of variances}}$

Tabulated C (3, 4) = 0.7457

Since calculated C is less than tabulated C value, variances are assumed to be homogeneous and transformation is unnecessary.

Table 19. Statistical analysis of copper ($\mu g/g$ wet tissue) in samples of shrimp from the 10-day bioaccumulation study with sediment from two locations adjacent to PNS, Mississippi and a reference sediment from south of Rabbit Island in Mississippi Sound.

Replicate (n = 5)	Reference	Sites	
		1	2
1	6.9	8.5	12
2	8.4	8.4	14
3	12	8.7	10
4	7.9	10	12
5	9.2	8.9	3.9
Sum of data, Σx =	44.4	44.5	51.9
Mean X =	8.88	8.90	10.38
Sum of squared data, Σx^2 =	409.2	397.7	599.2
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	14.94	1.66	60.48
Variance =	3.737	0.4150	15.122

$C = \frac{15.122}{19.274} = 0.7846$ where $C = \frac{\text{maximum variance}}{\text{sum of variances}}$

Tabulated C (3, 4) = 0.7457

Since calculated C is greater than tabulated C value, variances are assumed not to be homogeneous and transformation is necessary.

Table 20. Statistical analysis of nickel (μg/g wet tissue) in samples of shrimp from the 10-day bioaccumulation study with sediment from two locations adjacent to PNS, Mississippi and a reference sediment from south of Rabbit Island in Mississippi Sound.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	3.5	4.2	2.3
2	0.625	2.2	1.7
3	1.0	0.625	0.625
4	0.625	0.625	0.625
5	0.85	0.625	0.625
Sum of data, Σx =	6.60	8.275	5.875
Mean $\bar{x}$ =	1.320	1.655	1.175
Sum of squared data,			
Σx^2 =	14.753	23.651	9.351
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	6.0417	9.956	2.448
Variance =	1.5104	2.489	0.6121

$C = \frac{2.489}{4.611} = 0.5398$ where $C = \frac{\text{maximum variance}}{\text{sum of variances}}$

Tabulated C (3, 4) = 0.7457

Since calculated C is less than tabulated C value, variances are assumed to be homogeneous and transformation is unnecessary.

Table 21. Statistical analysis of zinc ($\mu g/g$ wet tissue) in samples of shrimp from the 10-day bioaccumulation study with sediment from two locations adjacent to PNS, Mississippi and a reference sediment from south of Rabbit Island in Mississippi Sound.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	24.0	40.0	31.0
2	15.0	28.0	27.0
3	25.0	18.0	26.0
4	17.0	16.0	26.0
5	23.0	33.0	12.0
Sum of data, Σx =	104.0	135.0	122.0
Mean $\bar{X}$ =	20.80	27.00	24.40
Sum of squared data, Σx^2 =	2244.00	4053.00	3186.00
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	80.80	408.00	209.20
Variance =	20.20	102.00	52.30

$C = \frac{102.00}{174.50} = 0.5845$ where $C = \frac{\text{maximum variance}}{\text{sum of variances}}$

Tabulated C (3, 4) = 0.7457

Since calculated C is less than tabulated C value, variances are assumed not to be homogeneous and transformation is unnecessary.

Table 22. Analysis of variance of cadmium accumulation in shrimp from the 10-day bioaccumulation study with sediments from PNS, Mississippi.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.38316	0.1915	2.64	0.112
Error	12	0.8700	0.0725		
Corrected Total	14	1.2531			

C.V.	Root MSE	PPM Mean
105.17	0.2692	0.2560

Table 23. Analysis of variance of copper accumulation in shrimp from the 10-day bioaccumulation study with sediments from PNS, Mississippi.

Analysis of Variance Procedure

Dependent Variable: Log PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.004274	0.002137	0.14	0.868
Error	12	0.18015	0.01501		
Corrected Total	14	1.2531			

C.V.	Root MSE	Log PPM Mean
12.209	0.1225	1.0035

Table 24. Analysis of variance of nickel accumulation in shrimp from the 10-day bioaccumulation study with sediments from PNS, Mississippi.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.6060	0.3030	0.20	0.8237
Error	12	18.4472	1.5372		
Corrected Total	14	19.0533			

C.V.	Root MSE	PPM Mean
89.62	1.239	1.383

Table 25. Analysis of variance of zinc accumulation in shrimp from the 10-day bioaccumulation study with sediments from PNS, Mississippi.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	96.933	48.466	0.83	0.4583
Error	12	698.000	58.166		
Corrected Total	14	794.933			

C.V.	Root MSE	PPM Mean
31.68	7.6267	24.06

Table 26. Concentrations of aliphatic and aromatic fractions of petroleum hydrocarbons in replicate samples of three marine organisms. Each group of organisms was analyzed before and after exposure to sediment from two locations adjacent to PNS, Mississippi in a 10-day bioaccumulation study. Concentrations are given in $\mu g/g$ wet tissue.

Sample Origin	Shrimp					Clamworm					Oyster					Pre-test Sediment	
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2
Pre-test Animals																	
Aliphatic	1.3	1.9	NA	NA	NA	ND	1.9	NA	NA	NA	ND	ND	NA	NA	NA	-	-
Aromatic	0.59	0.89	NA	NA	NA	2.0	4.7	NA	NA	NA	1.5	2.4	NA	NA	NA	-	-
Site 1																	
Aliphatic	ND	ND	2.0	1.8	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	0.5	8.1
Aromatic	ND	0.52	1.3	1.7	0.69	ND	ND	ND	ND	ND	5.7	4.5	4.4	2.8	0.92	ND	0.99
Site 2																	
Aliphatic	1.6	1.0	1.3	2.1	4.0	ND	ND	ND	ND	ND	3.6	ND	ND	ND	ND	9.9	1.3
Aromatic	1.1	ND	0.74	1.1	1.1	ND	ND	ND	ND	ND	1.1	1.8	ND	ND	ND	13	1.3
Reference																	
Aliphatic	1.1	0.97	1.2	1.2	ND	1.5	ND	0.82	7.0	1.3	ND	ND	ND	2.4	ND	ND	ND
Aromatic	0.99	0.63	0.66	ND	ND	3.6	0.51	ND	2.5	ND	1.1	3.7	4.1	5.3	2.6	ND	ND

NA = Sample not applicable. ND = Not detected. SL = Sample lost.

Table 27. Statistical analysis of petroleum hydrocarbons (μg/g wet tissue) in shrimp from the 10-day bioaccumulation study with sediment from PNS, Mississippi.

Replicate	Reference		SITES			
			1		2	
	ALH	ARH	ALH	ARH	ALH	ARH
1	1.1	0.99	0.50	0.50	1.6	1.1
2	0.97	0.63	0.50	0.52	1.0	0.50
3	1.2	0.66	2.0	1.3	1.3	0.74
4	1.2	0.50	1.8	1.7	2.1	1.1
5	0.50	0.50	1.3	0.69	4.0	1.1
Sum =	4.97	3.28	6.10	4.71	10.0	4.54
Mean $\bar{X}$ =	0.994	0.656	1.220	0.942	2.00	0.908
Sum of squared data,						
Σx^2 =	5.280	2.312	9.43	5.576	25.66	4.427
CSS =	0.3407	0.1609	1.988	1.139	5.66	0.3052
Variance =	0.08518	0.04023	0.497	0.2849	1.415	0.0763

ND = Not detected.

C (ALH) = $\frac{1.415}{6997}$ = 0.7086; Tabulated C (3, 4) = 0.7457; see Table 9 for equation.

Because calculated C is less than Tabulated C value, variances are assumed to be homogeneous and transformation is unnecessary.

C (ARH) = $\frac{0.2849}{0.4014}$ = 0.7098; Tabulated C (3, 4) = 0.7457; see Table 9 for equation.

Because calculated C value is less than Tabulated C value, variances are assumed to be homogeneous, and transformation is unnecessary.

Table 28. Analysis of variance of aliphatic petroleum hydrocarbon accumulation in shrimp from the 10-day bioaccumulation study with sediments from PNS, Mississippi.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	2.785	1.392	2.09	0.166
Error	12	7.9887	0.6657		
Corrected Total	14	10.774			

C.V.	Root MSE	PPM Mean
58.086	0.8159	1.404

Table 29. Analysis of variance of aromatic petroleum hydrocarbon accumulation in shrimp from the 10-day bioaccumulation study with sediments from PNS, Mississippi.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.2440	0.1220	0.91	0.427
Error	12	1.605	0.1338		
Corrected Total	14	1.849			

C.V.	Root MSE	PPM Mean
43.79	0.3658	0.835

Table 30. Statistical analysis of petroleum hydrocarbons ($\mu g/g$ wet tissue) in oysters from the 10-day bioaccumulation study with sediment from PNS, Mississippi.

Replicate	Reference		SITES			
			1		2	
	ALH	ARH	ALH	ARH	ALH	ARH
1	0.50	1.1	0.50	5.7	3.6	1.1
2	0.50	3.7	0.50	4.5	0.50	1.8
3	0.50	4.1	0.50	4.4	0.50	0.50
4	2.4	5.3	0.50	2.8	0.50	0.50
5	0.50	2.6	1.5	0.92	0.50	0.50
Sum Σx =	4.40	16.8	3.50	18.32	5.60	4.40
Mean $\bar{X}$ =	0.88	3.36	0.700	3.66	1.12	0.880
Sum of squared data,						
Σx^2 =	6.76	66.56	3.25	80.78	13.96	5.200
CSS =	2.88	10.11	0. 800	13.669	7.68	1.328
Variance =	0.722	2.52	0.200	3.415	1.922	0.332

ND = Not detected.

C (ALH) = $\frac{1.922}{2.844}$ = 0.6758; Tabulated C (3, 4) = 0.7457; see Table 9 for equation.

Because calculated C is less than Tabulated C value, variances are assumed to be homogeneous and transformation is unnecessary.

C (ARH) = $\frac{3.415}{6.267}$ = 0.5449; Tabulated C (3, 4) = 0.7457; see Table 9 for equation.

Because calculated C value is less than Tabulated C value, variances are assumed to be homogeneous, and transformation is unnecessary.

Table 31. Analysis of variance of aliphatic petroleum hydrocarbon accumulation in oysters from the 10-day bioaccumulation study with sediments from PNS, Mississippi.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.4440	0.2220	0.23	0.7948
Error	12	11.376	0.9480		
Corrected Total	14	11.820			

C.V.	Root MSE	PPM Mean
108.18	0.9736	0.900

Table 32. Analysis of variance of aromatic petroleum hydrocarbon accumulation in oysters from the 10-day bioaccumulation study with sediments from PNS, Mississippi.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	23.322	11.661	5.57	0.0194
Error	12	25.1019	2.0918		
Corrected Total	14				

C.V.	Root MSE	PPM Mean
54.89	1.446	2.634

Table 33. Comparison of mean aromatic petroleum hydrocarbons residues in oysters from the 10-day bioaccumulation study with sediment from PNS, Mississippi.

$$S\dot{x} = \sqrt{\frac{MSE}{n}} = \sqrt{\frac{2.0918}{5}} = 0.6468$$

At the alpha = 0.05 level,

	K
	2
Q	3.08
$S\dot{x}$	0.6468
LSR = $QS\dot{x}$	1.992

Treatment means from computer printout

Ref	Site 1
3.36	3.66

Mean Comparison

K	LSR	Difference between means
2	1.992	Site 1 - Ref = 3.66 - 3.36 = 0.30 n.s.

n.s. = not significantly different.

APPENDIX G

PASCAGOULA ODMDS

SITE

MANAGEMENT AND MONITORING PLAN

PASCAGOULA ODMDS

SITE MANAGEMENT AND MONITORING PLAN

1.0 Introduction. It is the responsibility of EPA under MPRSA to manage and monitor each of the designated ODMDSs. As part of this responsibility, a management and monitoring plan has been developed to specifically address the deposition of dredged material into the Pascagoula ODMDS. A generalized flow chart showing the relationship between management and monitoring is presented on Figure G-1.

2.0 Site Management. Section 228.3 of the Ocean Dumping Regulations (40 CFR 220-229) states that "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 through the monitoring process.

It is intended that the Pascagoula ODMDS will be utilized for new work and maintenance material from the Pascagoula Harbor Federal navigation project, for new work and maintenance material from the channels and turning basin associated with Naval Station Pascagoula, and by private entities such as the Port of Pascagoula, Ingalls Shipbuilding, and Chevron Refinery. Much of this use is projected to occur in the future and therefore the exact nature and quantity of the material, the time of disposal, and the type of equipment to be used are unknown.

2.1 Management Objectives. There are three primary objectives in the management of the Pascagoula ODMDS:

- o protection of the marine environment;
- o beneficial use of dredge material; and
- o documentation of the disposal activities at the ODMDS.

The following sections provide the framework for meeting these objectives.

2.2 Dredged Material Volumes. In 1985, the Port of Pascagoula Special Management (SMA) Plan was prepared to implement a strategy for the management of the port. Included in this plan was a long-term plan for the disposal of dredged material from the maintenance of the Federal project and Port facilities. In 1986, the plan was modified to include the need for ocean disposal of approximately 650,000 cubic yards of maintenance material. The modification was made necessary due to construction of Naval Station Pascagoula at an area previously used for disposal of dredged material.

Also in 1985, the Mobile District Corps of Engineers completed studies on the improvement of the Federal Deep-Draft Navigation Channel at Pascagoula. These studies recommended improvements which would result in approximately

14 million cubic yards of construction dredged material being transported to the Gulf for disposal. These improvements were authorized by the Water Resources Development Act of 1986.

In addition, the construction of the access channel and turning basin at Naval Station Pascagoula will require the dredging of approximately 1 million cubic yards of material with subsequent maintenance of approximately 250,000 cubic yards. Initially, this material was to be placed in the remaining disposal area on Singing River Island, the location of the station. Due to the size and condition of this area, the materials from the Navy channels are currently being proposed for placement in the ODMDS. The CE anticipates that the new ODMDS will be a possible alternative for other dredging projects in the vicinity, provided that the material meets the criteria as specified in MPRSA.

A small portion of the ODMDS has historically been utilized for placement of dredged material as shown in Table G-1. Estimated volumes of dredged material for the period 1990-95 are also shown (maintenance material = O&M; new work = NW).

Table G-1. Dredge material placement at the Pascagoula ODMDS.

Year	Volume	Material Type	Project
1985	300,000	O&M: Sand	Civil Works Channel
1986	65,000	NW: Sandy Mud	Point Cadet Marina
	300,000	O&M: Sand	Civil Works Channel
1987	300,000	O&M: Sand	Civil Works Channel
	100,000	O&M: Silt/Clay	Civil Works Channel
1988	300,000	O&M: Sand	Civil Works Channel
1989	500,000	O&M: Silt/Clay	Civil Works Channel
	300,000	O&M: Sand	Civil Works Channel
1990	70,000	O&M: Mixture	Civil Works Channel
	300,000	O&M: Sand	Civil Works Channel
	*		
1991	1,000,000	NW: Mixture	Navy Channels
	700,000	O&M: Mixture	Civil Works Channel
	300,000	O&M: Sand	Civil Works Channel
	100,000	O&M: Silt/Clay	Port of Pascagoula
1992	300,000	O&M: Sand	Civil Works Channel
1993	250,000	O&M: Silt/Clay	Navy Channels
	11,000,000**	NW: Mixture	Civil Works Channel
1994	***		
1995	250,000	O&M: Silt/Clay	Navy Channels

Notes:

* Disposal of O&M dredged material from Ingalls Shipbuilding may be required during 1990/91.

** Construction estimated to take 2 years therefore no O&M from the Civil Works Channel estimated for 1994/95 although some O&M may occur.

*** Disposal of new work material from the Port of Pascagoula facilities may be required during this time frame.

No restriction on material volumes are necessary for this site.

2.3 Material Suitability. Two basic sources of material are expected to be placed at the site, i.e. construction or new work dredged material and maintenance dredged material. These sediments will consist of mixtures of silts, clays, sands, in varying percentages.

There is no general restriction regarding the type of material that may be placed at the site. However, the suitability of the dredged material for disposal in the ocean will be evaluated by the CE and concurred with by EPA prior to disposal. Evaluation will involve: 1) a case-specific evaluation against the exclusion criteria (40 CFR 227.13(b); 2) a determination of the necessity for bioassay and bioaccumulation testing for non-excluded material based on the potential for contamination of the sediment since last tested; and when needed 3) completion of testing and determination of suitability of material for ocean disposal. Only those materials determined to be suitable for ocean disposal through this process will be considered for unrestricted placement at the ODMDS. Additional evaluation of management options will be required for any materials which do not meet the suitability criteria.

Baseline sediment and/or bioassay/bioaccumulation testing will be performed on all sediments proposed for ocean disposal for the first time or on new work dredged sediments unless it can be shown that those sediments meet the exclusion criteria as described above. CESAM will coordinate with EPA, Region IV prior to implementing the baseline evaluation program. Testing and evaluation will follow guidelines developed jointly by EPA/CE.

Re-evaluation of sediments which are routinely transported to the ocean for disposal will follow the procedure outlined above. Should the re-evaluation conclude that there is a potential for contamination of the sediments since the last bioassays, CESAM will coordinate with EPA, Region IV prior to any retesting.

A Section 103 Evaluation and any required NEPA documentation will be completed prior to the initial placement of material in the Pascagoula ODMDS. For recurring activities, similar documentation be required on a 5 year basis or prior to each dredging event, whichever interval is longest. For repetitive maintenance events (i.e. Federal navigation project) re-evaluation will be accomplished every three years with the exchange of letters between CESAM Ocean Dumping Coordinator and EPA.

2.4 Timing of Disposal. At present no restrictions have been determined to be necessary for disposal related to seasonal variations in ocean current or biota activity. As monitoring results are compiled, should any such restriction 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.

2.5 Disposal Techniques. No specific disposal technique is required for this site. However, there may be some environmental advantages to disposing suitable dredged material using one of the following procedures.

Disposal in a thin layer over a large portion of the site may be a preferred management technique especially for unconsolidated fine-grained maintenance material. Studies performed utilizing this technique in Mobile Bay and Mississippi Sound indicate a more rapid recovery of the benthos as compared to continuous deposition in a confined area which results in a thicker buildup of dredged material. In view of the large area encompassed by the Pascagoula ODMDS, this type disposal could result in reduced environmental impact.

Due to the predominant current regime in the area, the site is considered to be dispersive, so that erosion and off-site dispersion is expected to occur. Based on the results of the sediment mapping study and current studies, it is desirable to predetermine the disposal methodologies and locations within the ODMDS for disposal of dredged material, at least until sufficient monitoring information has been collected to provide assurance that dispersal does not result in adverse impacts. Since currents tend to be predominantly west-southwest or west-northwest in the proposed area, initial disposal of fine material will be made in the easternmost portions of the selected site, to the extent practical, in order to assure that the material does not migrate offsite.

It also appears, based on geology of the area and analysis of the sediment mapping data, that finer-grained material is more predominant in the central and southernmost portions of the proposed ODMDS. When possible, consideration should also be given to disposal of finer grained-material in this area, with coarser material being disposed in the northern portion of the ODMDS.

The benefits associated with the construction of a submerged berm, wave energy reduction and habitat creation, are currently being investigated as part of the National Underwater Berm Demonstration Project at Mobile, Alabama. Should this type disposal in the ODMDS prove to be beneficial, it is envisioned that a similar technique would be utilized with suitable materials, i.e. material to be dredged during the construction of the authorized improvements to the Federal navigation channel, the construction of Naval Station Pascagoula navigation facilities, or sandy material.

Another submerged structure is included in the Pensacola, FL Offshore ODMDS management plan. In this instance the submerged structure is used to control the placement of fine-grained material within the site. A horse-shoe shaped, 6-foot high, berm is being constructed of sand and a sandy-mud mixture. The berm is open on the western end and fine-grained material will be placed in the eastern midsection of the horse-shoe. The management goal expected to be gained with this plan will be the restriction of movement of the fine-grained materials in the northerly or easterly direction. This goal was developed due to the nature of the resources north and east of the ODMDS. Although no significant resources have been defined in the vicinity of the Pascagoula ODMDS, this technique may prove beneficial if segregation of different types of material within the ODMDS is appropriate.

2.6 Multiple Use Management. The Pascagoula ODMDS is intended for multiple use by a number of entities including the Corps of Engineers, US Navy, Port of Pascagoula, Ingalls Shipbuilding, Chevron Refinery etc. Each of these users will have different needs relative to quantity, type of material, timing etc., therefore partitioning of the site for specific users may be an appropriate management technique. This could facilitate monitoring and surveillance of individual disposal activities, however, it may not be the most appropriate management technique if beneficial results as described in Section 2.5 above are desired.

3.0 Site Monitoring. Part 228 of the Ocean Dumping Regulations (40 CFR 228) 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.

3.1 Monitoring Objectives. The purposed of the site monitoring plan for the Pascagoula ODMDS are:

- o Delineation of the geographic location of the discharged dredged material;
- o Determination of the direction, if any, in which the discharged dredged material is migrating, and the extent of movement;
- o Delineation of the effect, if any, on the ecology within and outside the ODMDS.

3.2 Pre-Disposal 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 Pascagoula ODMDS. This baseline data includes the following surveys: benthic macroinvertebrates, fisheries, water and sediment chemistry, sediment mapping, physical oceanographic conditions, bathymetry, side scan sonar, and video photography. These studies include:

a. U.S. Army Corps of Engineers' Mississippi Sound and Adjacent Areas Study (Kjerfve and Sneed 1984; Raytheon Ocean Systems Co. 1981; CE 1984; and B.A. Vittor and Associates 1982);

b. Harmon Engineering & Testing 1984a; and

c. Surveys conducted during the site designation phase in November 1986 and February/April/July 1987 (EPA 1987), and a survey planned for August 1990.

Bathymetric surveys of a planned placement area within the ODMDS will be conducted prior to use. No additional pre-disposal monitoring at this site is proposed.

3.3 During Disposal Monitoring. The purpose of this monitoring effort is to determine the location, amount, and timing of dredged material placement within the site. Each user of the Pascagoula ODMDS will be required to prepare and operate under an approved electronic verification plan for all disposal operations. As part of this plan the user 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. At a minimum the following data will be required:

a. Date;
b. Time;
c. Vessel Name;
d. Number of Scows in tow and distance from vessel or other vessel used;
e. Vessel position, at pre-specified times when within the channel limits, between the dredging area and the disposal area, and when within the disposal area limits, and similar intervals on the return vessel and scow(s) to the dredging area;
f. Dredge scow or vessel draft, coincidental measurement with "e" above; and
g. Volume of material disposed.

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

In addition, water quality sampling relative to turbidity during disposal may be required as specified in State Water Quality Certification documents.

3.4 Post Disposal Monitoring. Based on the type and volume of material disposed, monitoring surveys will be used to determine movement of material and impacts to the site and adjacent area. A tiered approach will be utilized to determine the level of monitoring effort required following each disposal event. At a minimum bathymetry and sediment mapping will follow all disposal events, until deemed unnecessary. Bathymetric surveys will be the responsibility of the dredged material generator while EPA will be responsible for sediment mapping activities.

The rationale for a phased or tiered monitoring approach is based upon that delineated in the EPA/CE Draft Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters (1990). The basic philosophy behind the tiered approach is to provide for proper oversight of ocean placement activities at the Pascagoula ODMDS while properly managing personnel and fiscal resources. Because a portion of the Pascagoula ODMDS has been used historically without significant environmental impacts, we believe that the phased approach would provide the necessary information to determine the need for additional monitoring and be the most expeditious approach. This phased approach is especially appropriate for repeated disposal operations such as occur during maintenance of projects. For construction (new work) dredged material placement operations, which typically involve large quantities of material, variations of the phased approach may be appropriate.

With the phased approach, an interagency team, consisting of representatives of the State of Mississippi, U. S. Army Corps of Engineers, Environmental Protection Agency, National Marine Fisheries Service, and the user, would be established at the time when use of the ODMDS is proposed. This team would suggest appropriate monitoring techniques and level of monitoring required for a specific action. These suggestions should be based on type of disposal activity (i.e. O&M vs. construction), type of material (i.e. sand vs. mud), location of placement activity within ODMDS, or quantity of material. EPA and CE will ultimately determine the actual monitoring activities to be required.

Within six (6) months of completion of a disposal event, detailed bathymetric surveys of the placement area would be completed. Within twelve (12) months of the event, sediment mapping of the placement and adjacent areas would be complete. The interagency team would meet to review the results of these efforts and determine the need for additional information. This need would be based on variations from the expected scenario associated with the specific disposal event. Should the results of the bathymetric and sediment mapping surveys conform with the expected scenario no additional monitoring would be required for the disposal event. At the next event, this phased monitoring approach would be applied in a similar fashion. At some point in time, to be agreed upon by the interagency team, a reassessment of the site would be undertaken. At a minimum, this reassessment would include benthic macroinfaunal and sediment chemistry surveys. Additional surveys for water quality or the use of remote sensing equipment might also be required.

4.0 Monitoring Techniques. A number of techniques have proven to be useful in monitoring ODMDSs in the northern Gulf of Mexico and are presented below. This is not to be taken as an exhaustive list of possible techniques or recommendation for specific methods, but rather a general discussion.

4.1 Material Tracking.

4.1.1 Discharged Material Geographic Extent, Thickness, and Movement. Several methodologies can be utilized to characterize the extent of the discharged sediments. Precision bathymetry or vertical sediment profiling can be utilized. Additionally, high resolution (shallow) acoustic subbottom profiling may be utilized to determine the vertical extent of the material. Sidescan sonar and sediment mapping can be utilized to determine the geographic extent of the discharged material. A planned sequence of surveys may be necessary to determine whether movement is occurring, as well as the nature and extent of the movement.

4.1.2 Sediment Characterization. One means of sediment mapping utilizes gamma spectrometry (sand sized material) and x-ray fluorescence (XRF) (fine-grained material) analysis. An initial characterization is performed just prior to disposal to establish a baseline of elemental composition of the native sediment. Data obtained during this survey would be used to construct computer generated maps showing isopleths of selected elements throughout the surveyed area. Upon completion of the disposal activity, a second survey is performed to obtain a new characterization of sediments with the dredged material in place. Comparison of pre-disposal and post-disposal elemental characterizations is utilized to determine the distribution of disposed dredged material.

4.2 Disposal Effects. Bottom sampling may include sampling for benthic macroinvertebrates, sediment chemistry and sediment particle size as discussed below.

4.2.1 Benthic Macroinvertebrates. The number of replicates taken at each station will be determined based on sampling technique to be employed, i.e., box core, grab, or diver collected core samples, and an evaluation of the species area curves from the site designation surveys. Past experience in the area of the Pascagoula ODMDS indicates that 5 box cores or 13 dover collected cores is sufficient to describe species evaluation curves. All samples will be sieved through 0.5 mm screen in the field, placed in appropriate containers, and immersed in 10% formalin/seawater solution with rose bengal stain for transport to the laboratory. Species identification will be to the lowest practicable level. Data analyses will include, at a minimum, species diversity, evenness, and richness and Q- and R- mode cluster analyses.

4.2.2 Sediment Chemistry. Sediment should be collected from these same stations for sediment chemical analysis. All cores will be refrigerated and iced for return to the laboratory for analysis. Analyses may include a metals scan, pesticides, chlorinated hydrocarbons, oil and grease, and nutrients (NH_3, NO_2+NO_3-N, TKN).

4.2.3 Sediment Particle Size. Samples should be collected for sediment particle size analyses simultaneously with and in the same manner as sediment chemistry sampling. All cores will be carefully decanted and frozen aboard ship prior to shipment to the laboratory. The samples will be processed according to the wet sieve Modified Wentworth method.

4.2.4 Water Quality Sampling. Water quality may be sampled at each of the above stations. Water quality sampling may consist of dissolved oxygen, salinity and temperature profiles at 5-foot increments from surface to bottom. Light extinction profiles will be conducted at 10-foot increments from surface to bottom. After determination of the 90, 50, and 10% light levels, water samples will be collected, composited, and a sample extracted and filtered for chlorophyll-a analysis. Water samples should be collected at surface, mid-depth, and bottom at each sampling station for nutrient analysis.

4.2.5 Demersal Fishes. Demersal fishes may be collected along transects established within the ODMDS and the area adjacent to the ODMDS using a 40-foot otter trawl equipped with a 0.25 inch mesh liner. A minimum of four (4) transects should be established in each area. Trawl times will be standardized at 20 minutes. Trawl catches from each station will be placed in appropriate containers and fixed with 10% formalin. Fish specimens larger than 4 inches standard length will be slit to allow proper fixation.

4.3 Other Techniques. Additional sampling techniques such as side scan sonar, video records, diver accomplished still photography, vertical sediment profiling may be utilized as necessary to determine the overall effects of disposal in the Pascagoula ODMDS. Close coordination between the EPA, COE, the State of Mississippi, and the user will be maintained during development of the detailed monitoring plan and evaluation of results. Should the initial disposal into the 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 proposed management plan may require revision based on the outcome of the monitoring program.

5.0 Reporting and Data Formatting. Any data collected will be provided to the Interagency Team. Data will also be provided to other interested parties to the extent feasible. Data will be provided in an appropriate format to be specified by the Interagency Team (e.g. National Ocean Data Center (NODC) format). Any reports generated during the monitoring will indicate how the survey relates to the Site Management and Monitoring Plan (SMMP) and list previous surveys from the Pascagoula ODMDS and other ODMDS within the northern Gulf of Mexico, as appropriate. The report will provide data interpretations, conclusions, and recommendations. Appropriate reporting deadlines will be established for each monitoring activity.

5.1 Modification of the ODMDS SMMP. A need for modification of the use of the Pascagoula 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.

APPENDIX I

PASCAGOULA ODMDS

DOCUMENTATION

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

JAN 27 1989

January 25, 1989

REPLY TO
ATTENTION OF:

Environmental Resources
Planning Section

Mr. Elbert R. Hilliard
Mississippi State Historic
Preservation Officer
Department of Archives and History
Post Office Box 571
Jackson, Mississippi 39205

Dear Mr. Hilliard:

The Mobile District, U.S. Army Corps of Engineers has entered into a cooperative agreement with the Environmental Protection Agency to prepare a Draft Environmental Impact Statement for an Ocean Dredged Material Disposal Site (ODMDS) to be located in the Gulf of Mexico south of Pascagoula, Mississippi. The general area under consideration is indicated on the attached section of National Oceanographic and Atmospheric Administration (NOAA) chart 11373. The Ocean Dredged Material Disposal Site (ODMDS) will be confined to a smaller area within this general location.

As can be seen on this chart, water depths in the area range from 34 to 51 feet. The potential for shipwrecks in open water of these depths is considered to be extremely low. In addition, since the proposed activity consists of disposal of dredged material, no bottom disturbance will occur.

Given the above considerations, it is our opinion that underwater cultural resources surveys of this Ocean Dredged Material Disposal Site are not warranted. If you agree with this determination, please sign this letter in the space provided below and return it to me within thirty (30) days. An expeditious response will be sincerely appreciated.

Should you require additional information, please contact Ms. Dottie Gibbens at 205/694-4114.

Sincerely,

Hugh A. McClellan
Chief, Environment and Resources
Branch

Enclosure

CONCURRENCE:

1-29-89
Elbert R. Hilliard (Date)
Mississippi State Historic
Preservation Officer

February 8, 1985

Environmental Studies and
Evaluation Section

Mr. Charles Jeter
Regional Administrator
U.S. Environmental Protection Agency
Attention: Mr. Reginald Rogers
345 Courtland Street
Atlanta, Georgia 30365

Dear Mr. Jeter:

Our Feasibility Report on the Improvement of the Federal Deep-Draft Navigation Channel at Pascagoula Harbor, Mississippi, indicated that suitable sites for disposal of dredged materials were available in the Gulf of Mexico within a reasonable distance of the project. Based on existing environmental information, these sites would be available within a 14 mile zone south of Horn and Petit Bois Islands. This information is contained within a number of contract reports prepared for the Mobile District including TerEco Corporation (1979), B. A. Vittor (1982), and Kjerfve (1984) and summarized in the Mississippi Sound and Adjacent Areas Study which was made available to your staff in 1983. During the Continued Planning and Engineering (CP&E) phase of studies we will conduct site specific investigations as required in Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972.

We are requesting a statement of concurrence on the availability of a Gulf of Mexico dredge disposal site within this reasonable distance and our approach to performing the site specific designation studies during the post authorization phase.

We would appreciate a response by March 1, 1985. Should you have any questions, please contact Dr. Susan Ivester Rees at FTS 537-2724. We look forward to working with you on this effort.

Sincerely,

Lawrence R. Green
Chief, Planning Division

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

MAR 5 1985

4PM-EA/RGR

Mr. Lawrence R. Green, Chief
Planning Division
U.S. Army Corps of Engineers, Mobile
P.O. Box 2288
Mobile, Alabama 36628

Dear Mr. Green:

This response is in regard to your letter of February 8, 1985, concerning a Gulf of Mexico dredge disposal site off the coast of Mississippi. We are in agreement with the concept of finding a suitable disposal site within a 14 mile zone south of Horn and Petit Bois Islands in order to save additional costs of transporting dredged materials. However, we must caution you that suitable site-specific investigations are necessary to assure that an environmentally acceptable site(s) is available within this 14 mile zone. Based on your experience of finding sites within 16 miles offshore of Mobile Bay, you should be successful off the coast of Mississippi. Should suitable sites be unavailable within this zone we would have to look further offshore.

We look forward to working with you during the site specific designation studies during the port authorization phase of this project. Should you have any questions, please contact Reginald Rogers of this office.

Sincerely yours,

E.T. Heinen, Chief
Environmental Assessment Branch
Office of Policy and Management

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9450 Koger Boulevard
St. Petersburg, FL 33702

January 24, 1991 F/SER13:TAH:td

Mr. Jeff Kellam
Ocean Disposal Program
U.S. Environmental Protection Agency
Region IV
345 Courtland Street, N.E.
Atlanta, GA 30365

Dear Mr. Kellam:

This responds to your September 19, 1990, letter regarding the proposed designation of an Ocean Dredged Material Disposal Site offshore Pascagoula, Mississippi. An Environmental Impact Statement (EIS) was transmitted pursuant to Section 7 of the Endangered Species Act of 1973 (ESA).

We have reviewed the EIS and concur with your determination that populations of endangered/threatened species under our purview would not be adversely affected by the proposed action.

This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be reinitiated if new information reveals impacts of the identified activity that may affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified or critical habitat determined that may be affected by the proposed activity.

If you have any questions, please contact Dr. Terry Henwood, Fishery Biologist at FTS 826-3366.

Sincerely yours,

Terry Henwood

for Charles A. Oravetz, Chief
Protected Species Management Branch

cc: F/PR2
F/SER2