UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND STREET
ATLANTA, GEORGIA 30365

FINAL
ENVIRONMENTAL IMPACT STATEMENT
FOR
DESIGNATION OF A NEW
OCEAN DREDGED MATERIAL DISPOSAL SITE

PENSACOLA, FLORIDA

SEPTEMBER, 1988

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APPROVED BY:

Lee A. DeHihns III, for — September 9, 1988

Greer C. Tidwell
Regional Administrator

Date

COVER SHEET

FINAL

ENVIRONMENTAL IMPACT STATEMENT

FOR

DESIGNATION OF A NEW

OCEAN DREDGED MATERIAL DISPOSAL SITE

PENSACOLA, FLORIDA

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

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

Abstract: Pursuant to 40 CFR 1501.5, the EPA is the lead Federal agency for the purpose of preparing the Environmental Impact Statement (EIS) for designation of a new Ocean Dredged Material Disposal Site (ODMDS) in the Gulf of Mexico south of Pensacola, Florida, i.e., the Pensacola (offshore) ODMDS. The U.S. Navy Pensacola Strategic Homeport Project, the initial project proposed for site use, requires additional National Environmental Policy Act (NEPA) documentation. The CE also requires NEPA documentation pertaining to the permitting, under Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 as amended (MPRSA), of the transportation of dredged material from the project for disposal at the ODMDS. The U.S. Navy and the U.S. Army Corps of Engineers are designated as cooperating agencies as defined in 40 CFR 1501.6. This role enabled the Navy and the CE to ensure that the EIS contained all the information considered necessary for their decision-making processes and further that the EIS contained all information required by NEPA. The Navy and the CE found the ODMDS EIS to meet the standards for an adequate EIS and to be in compliance with NEPA; therefore, pursuant to the relevant regulations, the Navy and CE will adopt this EIS for their purposes. Communication regarding permitting and dredged material disposal should therefore be addressed to the CE and 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 effects: (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 very temporary and localized and would not significantly affect water quality of the region. Changes in site bathymetry will be minimized by controlling the discharge point of the dredged material. Some changes in sediment composition and smothering benthic organisms are unavoidable impacts of the proposed action.

The Pensacola (offshore) ODMDS is restricted to the disposal of predominately fine-grained dredged material that meets the Ocean Dumping Criteria, but is not suitable for beach nourishment or disposal in the existing Pensacola (nearshore) ODMDS.

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Comments: Comments on the Final EIS must be received by EPA at the above address by October 24, 1988.

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1.0 SUMMARY

1.01 Major Findings and Conclusions. The U.S. 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 Coast. At Pensacola, the Navy will homeport the USS *Kitty Hawk* and a naval reserve patrol craft. To provide adequate navigation facilities for the USS *Kitty Hawk*, deepening of the existing channel to the Naval Air Station is required. Approximately 4.1 million cubic yards of predominately fine-grained material will be dredged during construction of the turning basin and Pensacola Bay channel. In January 1987, the U.S. Navy filed a Final Environmental Impact Statement (FEIS) for the Gulf Coast Strategic Homeport Project with the EPA. As part of that FEIS, the Navy evaluated a number of alternatives for the placement of this predominately fine-grained material. As a result of these evaluations, the need for designation of an Ocean Dredged Material Disposal Site (ODMDS) suitable to receive predominately fine-grained material was justified. The location of the Naval Air Station and other geographic areas are shown on Figure 1-1.

The Corps of Engineers maintains a civil works navigation channel from the Gulf of Mexico to the Port of Pensacola as well as a number of smaller navigation channels in the area. In addition to these 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 Pensacola area would serve as one possible alternative for the disposal of predominately fine-grained dredged material from various local governmental and/or private projects as well as accommodating construction material from the improvement of the channel to the Naval Air Station. Use of the new ODMDS will be restricted to disposal of predominately fine-grained dredged material that meets the ocean dumping criteria but that is not suitable for beach nourishment or disposal in the existing Pensacola (nearshore) ODMDS.

Several alternative ocean disposal areas have been considered in addition to the preferred location. The existing EPA-designated Pensacola (nearshore) ODMDS was eliminated from consideration due to the restriction that materials placed in this site be predominately sand sized. 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 lack of environmental advantage for use of the site over the preferred location. Sites between the continental shelf location and the preferred location were eliminated because coral and other invertebrate fauna occur on sediment free rock outcrops at depths of 80 to 100 feet off Pensacola. These resources become more numerous with increasing depth towards the Mississippi-Alabama reef-interreef facies which occur along the shelf edge.

Extensive field investigations of alternative Sites B and C were performed in November 1986 and February/April 1987. Although the sites are very similar in nature, the results of these investigations indicate that Site C would be more suitable for designation as an ODMDS due to its distance from existing artificial reefs, live hard bottom communities, and other coastal amenities. The increased distance associated with transportation of the dredged material to Site C would be outweighed by the reduction of possible impacts to the marine environment associated with it's use.

The proposed action is the final designation of a new ODMDS for the Pensacola area. The preferred new ODMDS is located within Alternative Site C which covers approximately 19 square miles and is defined by the following coordinates:

30° 09' 35" N	87° 21' 05" W
30° 09' 35" N	87° 15' 43" W
30° 06' 36" N	87° 15' 43" W
30° 06' 36" N	87° 21' 05" W

Site C is located outside state territorial waters (3 leagues or 10.4 statute miles) except for a small portion of the northwest corner. The actual size of the ODMDS and it's location within Alternative Site C were determined utilizing the results of a numerical model (DIFID) which was run by the U.S. Army Corps of Engineers Coastal Engineering Research Center. This model simulates transport of disposed material as it descends through the water column and spreads over the ocean bottom under varying hydrodynamic conditions. The preferred new ODMDS covers 6 square miles defined by the following coordinates:

30° 08' 50" N	87° 19' 30" W
30° 08' 50" N	87° 16' 30" W
30° 07' 05" N	87° 16' 30" W
30° 07' 05" N	87° 19' 30" W

The impacts associated with the placement of dredged material would be temporary and localized in nature and would not significantly affect the long-term productivity of the site. A monitoring program would be implemented at the designated ODMDS to measure impacts and to help prevent any adverse long-range impacts.

1.02 <u>Areas of Controversy</u>. No areas of controversy have been identified.

1.03 <u>Issues to be Resolved</u>. There are no major unresolved issues.

1.04 <u>Relationship of Alternative Actions to Environmental Protection Statutes</u>. The relationship of the alternative actions to environmental protection statutes and other environmental requirements is presented in Table 1-1.

Table 1-1
Relationship of Alternative Actions to Environmental Protection Statutes and Other Environmental Requirements

Federal Statutes	No Action	Site B	Site C
Archeological and Historic Preservation Act, as amended, 16 USC 469, et seq.	NA	FC	FC
Clean Air Act, as amended, 42 USC 1857h-7, et seq.	NA	FC	FC
Clean Water Act, as amended, (Federal Water Pollution Control Act) 33 USC 1251, et seq.	NA	FC	FC
Coastal Zone Management Act, as amended, 17 USC 1451, et seq.	NA	FC	FC
Endangered Species Act, as amended, 16 USC 1531, et seq.	NA	FC	FC
Estuary Protection Act, 16 USC 1221, et seq.	NA	FC	FC
Federal Water Project Recreation Act, as amended, 16 USC 460-1(12), et seq.	NA	NA	NA
Fish and Wildlife Coordination Act, as amended, 16 USC 661, et seq.	NA	FC	FC
Land and Water Conservation Fund Act, as amended, 16 USC 4601-4601-11, et seq.	NA	FC	FC
Marine Protection, Research and Sanctuaries Act, 33 USC 1401, et seq.	NA	FC	FC
National Historic Preservation Act, as amended, 16 USC 470a, et seq.	NA	FC	FC
National Environment Policy Act, as amended, 42 USC 4321, et seq.	NA	FC	FC
Rivers and Harbors Act, 33 USC 401, et seq.	NA	FC	FC
Watershed Protection and Flood Prevention Act, 16 USC 1001, et seq.	NA	NA	NA
Wild and Scenic Rivers Act, as amended, 16 USC 1271, et seq.	NA	NA	NA
Uniform Relocation Assistance and Real Property Acquisition Policies Act (PL 97-646)	NA	NA	NA
The Gulf Islands National Seashore (GIN) System (PL 91-660)	NA	FC	FC
Coastal Barrier Resources Act (PL 97-348)	NA	FC	FC

NOTES: The compliance categories used in this table were assigned based on the following definitions:

FC. Full compliance--All requirements of the statute, E.O., or other policy and related regulations have been met for this stage of coordination.
PC. Partial compliance--Some requirements of the statute, E.O., or other policy and related regulations remain to be met for this stage of coordination.
NC. Noncompliance--None of the requirements of the statute, E.O., or other policy and related regulations have been met for this stage of coordination.
NA. Not applicable-- Statute, E.O., or other policy not applicable.

Table 1-1 (Continued)
Relationship of Alternative Actions to Environmental Protection Statutes and Other Environmental Requirements

Executive Orders, Memoranda, etc.	No Action	Site B	Site C
Floodplain Management (E.O. 11988)	NA	FC	FC
Protection of Wetlands (E.O. 11990)	NA	FC	FC
Environmental Effects Abroad of Major Federal Actions (E.O. 12114)	NA	NA	NA
Analysis of Impacts on Prime and Unique Farmlands (CEQ Memorandum, 11 Aug 80)	NA	NA	NA
State and Local Policies	NA	FC	FC
State Water Quality Criteria	NA	FC	NA

NOTES: The compliance categories used in this table were assigned based on the following definitions:

FC. Full compliance--All requirements of the statute, E.O., or other policy and related regulations have been met for this stage of coordination.

PC. Partial compliance--Some requirements of the statute, E.O., or other policy and related regulations remain to be met for this stage of coordination.

NC. Noncompliance--None of the requirements of the statute, E.O., or other policy and related regulations have been met for this stage of coordination.

NA. Not applicable-- Statute, E.O., or other policy not applicable.

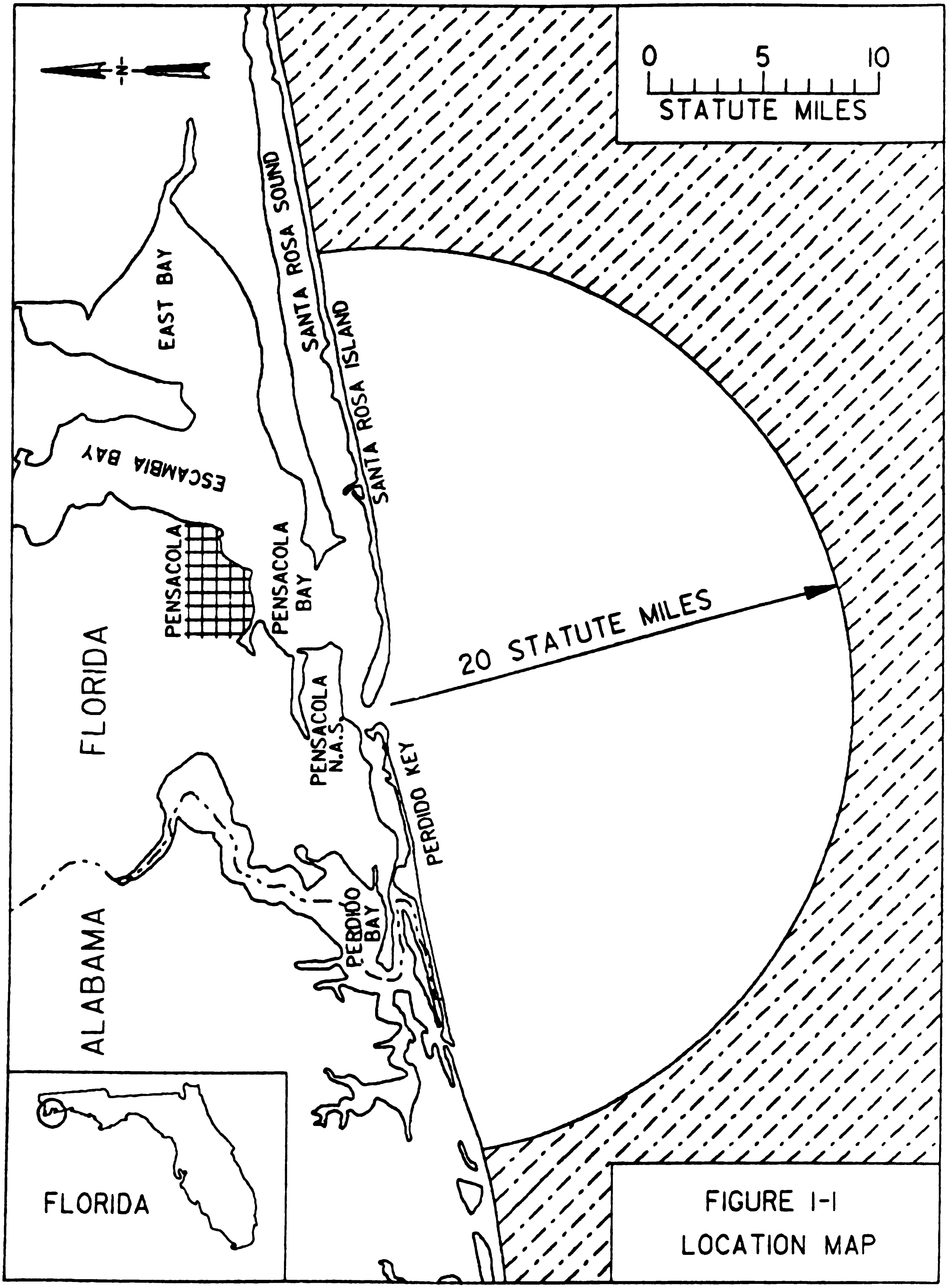

FIGURE 1-1
LOCATION MAP

2.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

2.01 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. This EIS has been prepared to fulfill the NEPA requirements of several Federal agencies. First, this EIS carries out the U.S. Environmental Protection Agency's (EPA) policy to prepare 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 Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972, as amended. Second, it will satisfy the U.S. Army Corps of Engineers need for NEPA documentation relating to permitting under Section 103 of the MPRSA. The EIS will also satisfy the U.S. Navy's responsibility under the NEPA for ocean dredged material disposal activities associated with their Pensacola Strategic Homeport Project.

2.02 Marine Protection, Research, and Sanctuaries Act. The dumping of all types of materials 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 and Criteria (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 Corps of Engineers to issue permits for the transportation of dredged material for the purpose of dumping it into ocean waters. 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 required in the Corps of Engineers permitting process.

2.03 Pensacola Homeport Project. The U.S. 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 Coast. The Navy's Gulf Coast Strategic Homeport Project will locate twenty-seven ships at eight sites along the Gulf Coast. The Final Environmental Impact Statement for the Gulf Coast Strategic Homeport Project was filed with the EPA in January 1987, and is incorporated into this EIS by reference. At Pensacola, the Navy will homeport the USS Kitty Hawk and a naval reserve patrol craft. The USS Lexington, currently based at Pensacola, will be moved to Corpus Christi, Texas, as part of the overall Gulf Coast Strategic Homeport Project. The Pensacola Homeport Project will require deepening of the existing channel to the Naval Air Station (NAS) in Pensacola. Approximately 4.1 million cubic yards of predominately fine-grained new work dredged material that is not suitable for beach nourishment is initially proposed for disposal in the new ODMDS. The U.S. Navy 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, the EPA-designated Pensacola (nearshore) ODMDS is restricted to receive predominately sandy material, and there are no practicable alternatives to ocean disposal of this material.

2.04 Other Needs. The new ODMDS is being designated for predominately fine-grained dredged material that meets the ocean dumping criteria but is not suitable for beach nourishment or disposal in the existing EPA-designated Pensacola (nearshore) ODMDS (median grain size greater than 0.125 mm and a composition of less than 10 percent fines). The new ODMDS is initially required for disposal of predominately fine-grained dredged materials from the Navy Homeport Project at Pensacola. However, the site could also be used in the future for maintenance material dredged from the Navy's channel, the Pensacola Harbor Ship Channel or private dredging projects provided the material meets the criteria specified in the MPRSA. Additional Section 103 permit review would be required prior to use of the new ODMDS for any dredged material other than the initial 4.1 million cubic yards proposed for disposal. Additional dredged material testing and NEPA documentation may also be required. Only material that meets the Ocean Dumping Criteria (40 CFR 220-229) would be placed in the site.

3.0 ALTERNATIVES

3.01 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 Pensacola, Florida. The U.S. Navy proposes to establish a new homeport at Pensacola for the aircraft carrier USS Kitty Hawk and one naval reserve patrol craft. The USS Lexington, currently based at Pensacola, will be moved to Corpus Christi, Texas as part of the overall Gulf Coast Strategic Homeport Project. The proposed project will require deepening the existing channel to NAS Pensacola. Approximately 4.1 million cubic yards of new work dredged material from the turning basin and channel is initially proposed for disposal. The EPA is proposing the designation of a new ODMDS off Pensacola, Florida, to accommodate the Navy's anticipated disposal needs for predominately fine-grained dredged material that meets the criteria for ocean disposal. However, the site will also be available for subsequent Federal or private disposal needs for predominately fine-grained material that meets the ocean dumping criteria but is not suitable for beach nourishment or disposal in the existing Pensacola (nearshore) ODMDS.

3.02 Land Disposal. Land disposal alternatives are considered when evaluating the need for ocean disposal as required in Section 103 of the MPRSA. As required by the NEPA, the U.S. Navy has completed a Final Environmental Impact Statement (FEIS) for the overall Gulf Coast Strategic Homeport Project, including the Pensacola Homeport. The Notice of Availability of the FEIS was published in the Federal Register on January 23, 1987, and the Navy's Record of Decision was published in the Federal Register on June 4, 1987. Dredged material disposal alternatives, including land disposal, for the Pensacola Homeport Project were evaluated in the Navy's FEIS and will not be repeated in detail in this EIS. The reader should refer to the Navy's FEIS for a more complete discussion of the dredged material disposal alternatives that were considered. The purpose of this 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.

3.03 No Action. The no action alternative is defined as not designating a new ODMDS off Pensacola, Florida. The no action alternative would not provide an acceptable EPA-designated ODMDS for use by the Navy or other entities for the disposal of dredged material that is not suitable for beach nourishment or is not predominately sandy in nature, i.e., acceptable for disposal in the EPA-designated Pensacola (nearshore) ODMDS.

3.04 EPA Designated Nearshore Disposal Site. The EPA-designated Pensacola (nearshore) ODMDS, located approximately 1.5 miles south of Pensacola Pass, was considered for disposal of the 4.1 million cubic yards of material from the Navy turning basin and bay channel. This disposal site was eliminated from consideration because the dredged material proposed for disposal does not meet the grain size criteria for use of the site. The nearshore site has been designated to receive materials which are predominately sandy in nature.

3.05 Selection of a New Ocean Dredged Material Disposal Site. 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 Pensacola and a deepwater area south of Mobile, Alabama. 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. EPA noted that, although the shelf off Pensacola is characterized by rock formations with associated corals and other invertebrates beginning at depths of 80 to 100 feet, and becoming more numerous approaching the reef-interreef facies along the shelf edge, there was at least one area which might be devoid of these significant resources and therefore suitable as an ODMDS (See Figure 3-1). 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 3-1). 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. As noted in paragraph 3.04 above, the Pensacola ODMDS was restricted to receive only sand sized dredged materials. 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. The EPA-designated Pensacola (nearshore) ODMDS is addressed in that FEIS.

Considering this information, a decision was made to evaluate the possibility of designating a mid-shelf site for dredged material which did not meet the sand size restriction applied to the EPA-designated Pensacola (nearshore) ODMDS. Three sites were selected for detailed evaluation based on 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 Pensacola in which an ODMDS could be economically located. That distance was determined to be 20 miles from Pensacola Pass. Then, a selective screening process was used to eliminate sensitive and incompatible areas within a 20-mile radius of Pensacola Pass from consideration as an ODMDS. The results of the selective screening process are presented in Appendix A. Figure 3-2 presents a composite of the areas excluded from consideration as an ODMDS. Three alternative sites were then selected for detailed studies from the area that remained in consideration for an ODMDS. The sites chosen for detailed studies covered approximately 19 square miles each, and it was felt that an area of sufficient size for an ODMDS could be located within each of these sites. Alternative Sites A and B are located within Florida state waters (3 leagues or 10.4 statute miles); Site C is located seaward of state waters with the exception of a small portion of the northwest corner.

3.06 Alternative Site A. Alternative Site A was a four square mile area located approximately 13 statute miles southwest of Pensacola Pass in depths of 60 to 70 feet. During the initial field evaluation, this site was eliminated because it had no apparent environmental advantages, would be more expensive to use than either of the two other alternative sites because it was farther from Pensacola Pass, and was adjacent to Alabama state waters which would complicate the coordination process.

3.07 Alternative Site B. Site B covers approximately 19 square miles as defined by the following coordinates:

30° 13' 30" N	87° 18' 17" W
30° 13' 30" N	87° 13' 00" W
30° 10' 26" N	87° 13' 00" W
30° 10' 26" N	87° 18' 17" W

The northern side of Site B is approximately seven statute miles southeast of Pensacola Pass. Depths in the area range from 60 to 87 feet and the bottom is generally classified as compacted sand bottom.

3.08 Alternative Site C. Site C covers approximately 19 square miles as defined by the following coordinates:

30° 09' 35" N	87° 21' 05" W
30° 09' 35" N	87° 15' 43" W
30° 06' 36" N	87° 15' 43" W
30° 06' 36" N	87° 21' 05" W

The northern side of Site C is approximately eleven statute miles south of Pensacola Pass. Depths in the area range from 60 to 95 feet and the bottom is generally classified as compacted sand shell.

3.09 Preferred Alternative. The proposed or preferred alternative is the final designation of a new ocean dredged material disposal site for the Pensacola area. The preferred new site is located within the site referred to above as alternative Site C. Since the DEIS was filed, additional studies have been conducted utilizing a numerical model (DIFID) available at the U.S. Army Engineer Waterways Experiment Station. This model simulates transport of disposed material as it descends through the water column and spreads over the ocean bottom under varying hydrodynamic conditions. The results of all the model simulations indicated that 100 % of the sand and silt/clay clumps fell to the bottom within less than 100 seconds of the beginning of the disposal operation. In addition, the simulations indicated that this material fell directly beneath the barge, regardless of the input data. The actual deposits of each of these solids fractions were different in that the sand tended to cover a larger area of bottom at a lesser thickness than did the silt/clay clumps. The non-cohesive silt and clays did not behave in a similar fashion with a large percentage of these particles remaining suspended in the water column after disposal. Depending upon the ambient conditions, these particles can be transported from the dump location as a turbidity plume. The area affected by the plume varies greatly, depending primarily upon the type of material disposed. The area with suspended solids concentrations of more than 10 parts per million would cover approximately 300 acres, 90 minutes after discharge, under worst case conditions, i.e., 95 percent silt/clay. Since approximately 93 % of the 4.1 million cubic yards to be disposed can be classified as sand or silt/clay clumps, a management plan was devised to utilize this material to form a submerged containment area into which the non-cohesive material would then be disposed. The model results, the management plan, and the comments received on the Draft EIS, were used to define the actual coordinates of the area to be designated as the ODMDS. For additional details on the model and the management plan, see Appendices H and I, respectively.

The preferred site for the new offshore ODMDS at Pensacola, Florida is defined by the following coordinates:

30^{o} 08' 50" N	87^{o} 19' 30" W
30^{o} 08' 50" N	87^{o} 16' 30" W
30^{o} 07' 05" N	87^{o} 16' 30" W
30^{o} 07' 05" N	87^{o} 19' 30" W

This site, 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 5-1). The site is large enough and deep enough so that potential impacts outside the site will be minimized. 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.

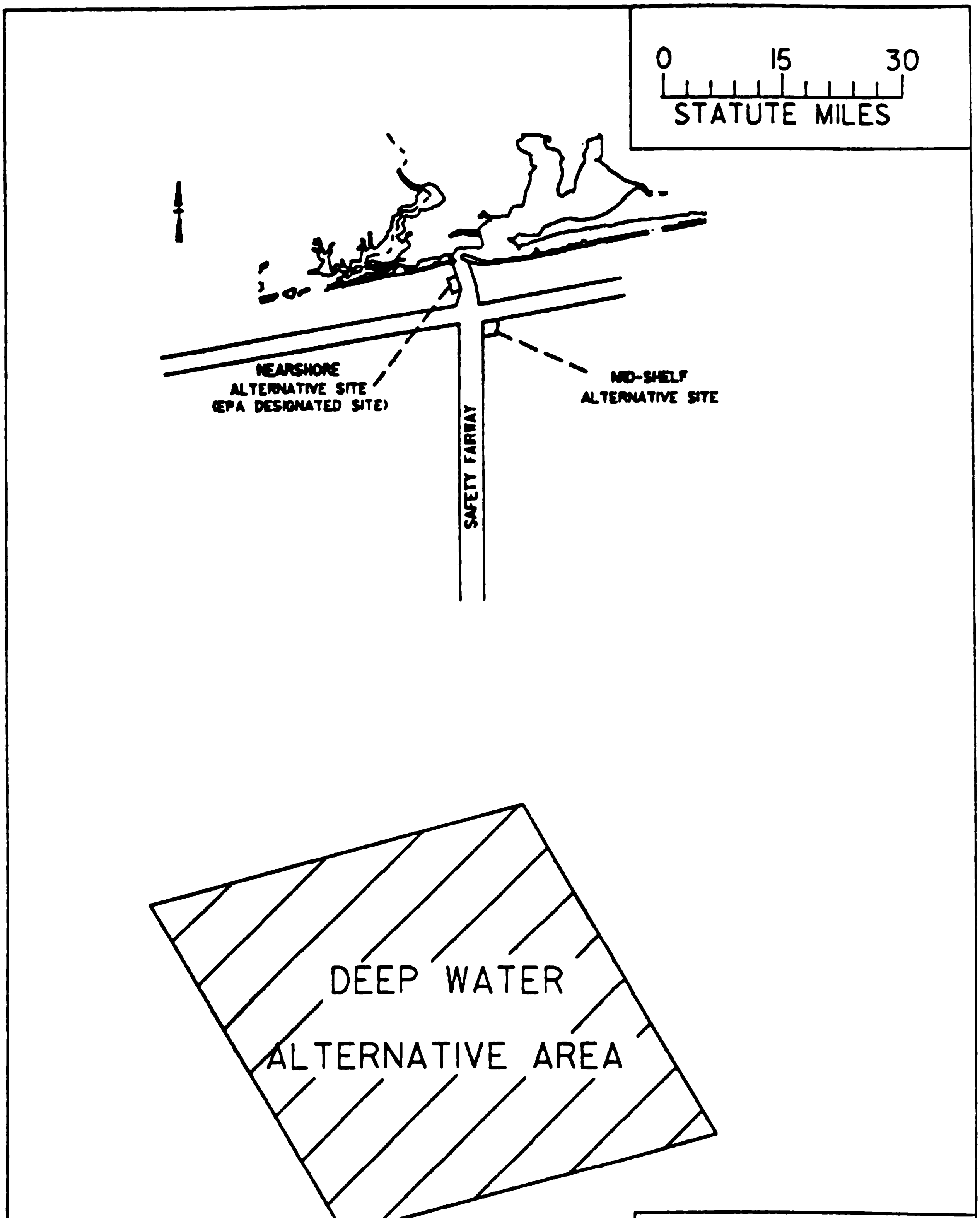

FIGURE 3-1
ALTERNATIVE ODMDS'S
EPA 1986

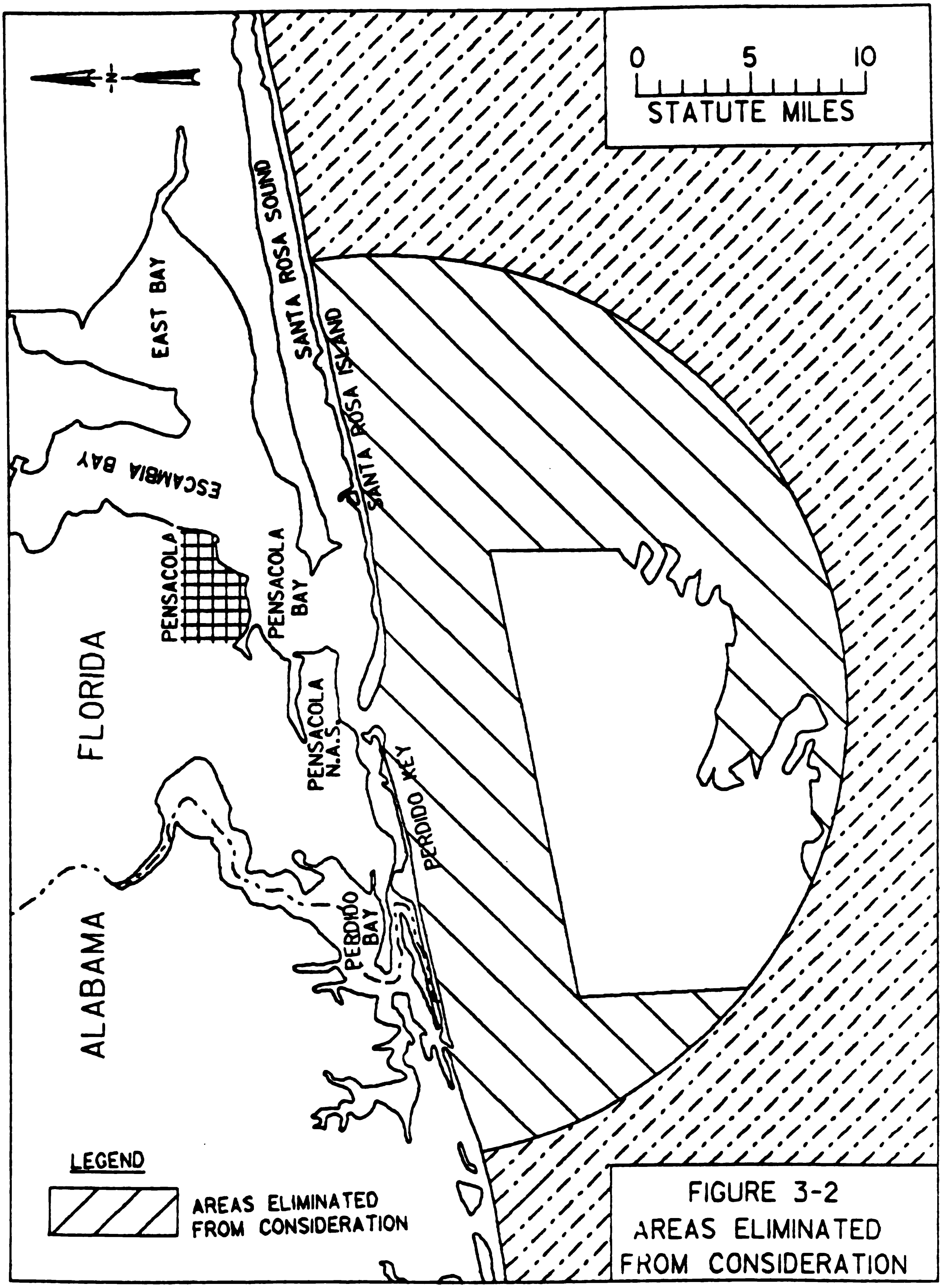

FIGURE 3-2
AREAS ELIMINATED FROM CONSIDERATION

4.0 AFFECTED ENVIRONMENT

4.01 Introduction. This section contains a description of the existing environment in the vicinity of the alternative ODMDS's. The information will form the baseline for projecting environmental impacts that would result from disposal of dredged material into either of the alternative sites studied in detail. The information presented in this section was developed from the literature and from field evaluations conducted by the EPA (EPA 1987) and by the Naval Oceanographic Research and Development Activity (NORDA 1988).

4.02 Climatology and Meteorology. The Pensacola area has warm summers and mild winters. According to data from the National Oceanographic and Atmospheric Administration (NOAA), the average annual temperature is 68^{O}F with 54 days having a maximum temperature of 90^{O}F or higher and 18 days having a minimum temperature of 32^{O}F or lower. The average annual precipitation at Pensacola is 61 inches and ranges from 29 to 90 inches. The average annual wind speed for Pensacola is 8.3 miles per hour with prevailing winds from the south 18 percent of the time and from the north 22 percent of the time. The north and south winds generally have higher velocities than east and west winds. On the average, hurricanes strike the Pensacola region about once every 17 years with fringe effects being felt about every 5 years (NOAA 1986).

4.03 Geology. The Gulf of Mexico in the vicinity of Pensacola is characterized by the Mississippi-Alabama Shelf depositional system and the western Florida barrier spit and island depositional system. The Mississippi-Alabama Shelf extends from De Soto Canyon on the east to the Mississippi River Delta on the west and from the barrier islands to the 200 meter (656-foot) contour. The shelf is from 20 to 30 miles wide off Pensacola with it's width increasing to the west. The shelf surface is relatively smooth in the western portion of the gulf; however, south of Pensacola it becomes highly irregular. As the sand sheet thins towards the east, the limestone karst topography of the West Florida Shelf predominates. Coral and other invertebrate fauna occur on sediment free rock outcrops at depths of 80 to 100 feet off Pensacola becoming more numerous with increasing depth. The Mississippi-Alabama reef-interreef facies occur along the shelf edge and consists 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 De Soto Canyon is a region of sediment instability marked by active mudflows, slumping, and erosional furrows and gullies. Evidence of recent slumping also exists in the bottom of the De Soto Canyon approximately 40 nautical miles southeast of Pensacola (EPA 1986).

The Florida barrier spit and island system were formed during the submergence of dune beach ridges in the Holocene period. This system is composed of long narrow islands with sandy beaches and forms the northern boundary of Mississippi-Alabama Shelf in Florida (EPA 1986).

4.04 Bathymetry. Bathymetry data for the alternative ODMDS's is presented on Figure 4-1. Water depths at Site B range from approximately 65 to 88 feet and average 71 feet. At Site C, the depths range from 60 to 95 feet and average 76 feet.

4.05 Circulation and Mixing. A field study conducted between February 1987 and January 1988 by the Naval Ocean Research and Development Activity (NORDA) showed the nearshore currents off Pensacola are wind driven, parallel to the coast and attain speeds of up to 62 centimeters per second (2.0 feet per second). Currents are typically uniform, both in speed and direction, with depth and between the two alternative disposal sites. A significant reversal in direction with depth, however, was noted during the October through January survey in Site C. A similar reversal was not noted at Site B. The total extent of this phenomena or its contribution to total circulation within this area is not discernable from the data (NORDA 1988) (Appendix B).

The measured currents and wind data recorded at Pensacola were used to calibrate a multi-layered numerical current model. The calibrated model was then used to hindcast currents at the alternative disposal sites using winds recorded at Pensacola since 1948. The model showed that over long time periods, currents at the disposal sites will be stronger and toward the west more frequently than observed during the field study. The model hindcast 100 centimeters per second (3.3 feet per second) currents during Hurricane Fredric in 1979 as the strongest current during the forty year period of record (Resio in NORDA 1988) (Appendix B).

4.06 Water Quality. Water quality data was collected by the EPA at the alternative ODMDS's during November 1986, April 1987, and July 1987. Samples were collected at the top, middle, and bottom of the water column from eight stations at each site. No significant difference in water quality was observed between the alternative ODMDS's (EPA 1987) (Appendix C).

Dissolved oxygen values measured during the EPA surveys ranged from 4.7 to 8.1 parts per million (ppm). The maximum dissolved oxygen values always occurred at the surface and the minimum values always occurred at the bottom. The maximum differential value between the top and bottom at any one station was 3.2 ppm.

The temperature structure at the alternative ODMDS's was relatively isothermal during the EPA surveys. The maximum temperature differential at any one station was 3.2^{o}C. The range of temperature values was from 19.0^{o}C in April 1987, to 30.4^{o}C in July 1987.

Salinity values measured during the EPA surveys ranged from 31.4 to 38.0 part per thousand (ppt). No significant salinity stratification was observed during the surveys. The maximum salinity differential at any one station was 4.5 ppt.

The percent light transmission was also measured during the EPA surveys. Light transmission averaged 60 percent at a depth of 1-foot and was reduced to approximately 2 percent at 60 feet.

4.07 Sediment Quality and Characteristics. Sediment samples were collected from 20 stations at each alternative ODMDS and analyzed for metals, nutrients, oil and grease, pesticides and chlorinated hydrocarbons. As shown in Appendix C, all parameters were either below the minimum detection limits or in very low concentrations (EPA 1987).

The sediments at each alternative ODMDS are predominately medium and coarse sands as shown in Appendix C. The samples ranged from 88 to 99 percent medium and coarse sand and averaged 96 percent.

4.08 Sediment Transport. At times, currents at the alternative ODMDS's are sufficiently strong to transport the medium and coarse grained sand on the sites. This is especially true under hurricane and other extreme weather conditions. The maximum current projected for Hurricane Fredric was 100 centimeters per second and the maximum current observed during a recent survey was 62 centimeters per second. Appendix B presents a summary of the measured and projected currents at the alternative ODMDS's (NORDA 1988). A 62 centimeter per second current would transport some of the medium size sand but should not move the coarse sand. A 100 centimeter per second current would transport the coarse sand. Bottom currents are expected to be 30 centimeters per second or less approximately 70 percent of the time. Medium grain sand would not be moved by these currents.

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). No site specific studies of phytoplankton, however, have been conducted at the alternative ODMDS's.

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).

4.10 Benthos. During the site designation 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. Side scan sonar of both alternative sites B and C revealed no features interpretive of live/hard bottoms. Real time observation of the video and subsequent review of all video recordings revealed the homogeneity of alternative sites B and C. The sites are dominated by coarse and medium sand with varying amounts of shell fragments. Sand waves at each site are oriented in a generally northeast to southwest direction, however, many observations in alternative site B revealed a tendency for a shift to a somewhat more east to west orientation. Sand wave height and pattern was quite variable throughout each alternative site and ranged from approximately 2 inches with a dimpled pattern up to heights of 6 inches with a well defined regular pattern where wave crest and trough were parallel. Intermediate heights of approximately 2 to 4 inches with an irregular, or braided, configuration were also prevalent throughout each site. The only biological feature present in the video/still photographs was the sea pen, Virgularia presbytes. These octocorals are associated with soft bottoms and have been recorded from North Carolina southeastward through the Gulf of Mexico to Galveston, Texas.

Field surveys of the alternative ODMDS's indicate infaunal communities characteristic of medium and coarse grain sediments of the northern Gulf of Mexico. Polychaetes are numerically dominant, typically making up over 50 percent of the individuals collected. Various species of molluscs and arthropods also contribute to the overall community composition. Polychaetes found to be dominant in alternative Site B include the Paraonidae Cirrophorus spp., the Spionidae Aonides paucibranchiata, Spiophanes bombyx, and Prionospio cristata, Sabellidae, particularly Fabriciola trilobata, and an unidentified Serpulidae (designated as Genus C). Abundant molluscs include the pelecypod Crassinella lunulata and the gastropods Caecum imbricatum, C. pulchellum, and Caecum sp. A. Arthropods include numerous species of ostracods, the amphipods Ampelisca agassizi and Metharpina floridana, the cumacean Cyclaslpsis unicornis, and the tanaids Apseudes sp. H and Leptochelia sp. D. Other benthic species found in abundance include cephalochordates in the genus Branchiostoma, asteriods and echinoids. Appendix E presents a full listing of all species collected at Site B during November 1986 and April 1987. Mean density of individuals from Site B ranged from a low of 3571 per m^2 to a high of 15076 per m^2 in November to a low of 9670 per m^2 and high of 23780 per m^2 in April. Diversity is relatively high with individuals being somewhat evenly distributed among the various taxa. The number of taxa per station ranged from 122 to 205. Biomass is highly variable between stations depending primarily upon the percent contribution of molluscs to the total. Appendix E presents a summary of the biological community parameters for Site B.

Q-mode cluster analyses indicate a high degree of similarity between the sampling stations in alternative site B. This analysis, based on species abundance, revealed greater than 65% similarity between the stations for the November 1986 sampling period and greater than 60% similarity for the April 1987 sampling period. During November 17 out of 20 stations were 75% similar or greater. The remaining 3, stations 8, 16, and 13, formed a group which was similar to the rest at the 67% level (See Appendix E). Investigation of sediment texture of these three stations indicates a significantly lower proportion of sediment in the coarse sand category and a significantly higher proportion in the medium sand category than the remaining 17 stations. This difference in sediment texture is reflected in the abundance and distribution of benthic species. Similar groupings are also noted for the April sampling. R-mode cluster analyses were also performed in which biological units were clustered based on their distribution among the stations sampled. In these analyses a high degree of similarity is recognized between species which were relatively equally abundant at all of the stations and a lower degree of similarity between those with spotty abundance.

Alternative Site C is also dominated by polychaetes. Abundant forms include the Paraonidae, especially Cirrophorus spp., the Sabellidae, particularly Fabriciola trilobata, the Spionidae, Prionospio cristata and Spiophanes bombyx, and the Serpulidae Genus C. Dominant molluscs include the gastropods Caecum pulchellum, C. imbricatum, and Caecum sp. A. Abundant arthropods include numerous species of ostracods, the amphipod Microdeutopus myersi and the tanaid Leptochelia sp. D. Other forms found with wide distribution include Branchiostoma spp., asteriods and echinoids. Appendix E presents a full listing of all species collected at Site C during the two sampling periods. Abundance at Site C ranged between 10582 per m^2 to 24168 per m^2 in November and 6531 per m^2 to 19907 per m^2 in April. Diversity at Site C was somewhat higher than Site B due to the fact that distribution of individuals among the various taxa was higher. Number of taxa per station ranged from 154 to 196. Biomass was also highly variable due to the contribution of molluscs to the total. Appendix E presents a summary of biological community parameters for Site C.

Q-mode cluster analysis of data from alternative site C revealed similar conclusions as with site B. In the November sampling 18 of the twenty stations showed 75% or greater similarity. Stations 7 and 16, which formed an outlier group with about 61% similarity, again showed lower percentage of coarse sand and higher percentage medium sand. Similar rationale applies to the outlier groups formed of stations 7, 18+16, and 13+6 for the April sampling period. R-mode cluster analyses revealed similar findings to those discussed for alternative site B above. Appendix E presents the Q- and R-mode dendrograms and the data matrix two-way contingency tables to characterize the relationships resulting from these analyses.

4.11 Commercial and Recreational Fisheries. Pybas (1986) suggests that there are numerous active reefs and proposed artificial reef sites offshore of Pensacola, Florida and provides locational information on ten active reefs. Information provided by the Escambia County Marine Recreation Committee indicated that an additional 17 sites in the area offshore Pensacola are being considered as possible reef locations (Wine, Personal Communication) (See Figure 4-2). Of the ten active reefs, one site (Escambia Site #15) is located in the southeast quadrant of Site B and one site known as the "Russian Freighter" is located just east of the east boundary of Site B. Of the locations considered for future reef development, two are located in the southeast quadrant of Site C (Escambia Sites #3 and #4). Artificial reefs in the project area are fished primarily for snapper, grouper, triggerfish and amberjack.

The U.S. Army Engineer District, Mobile, Alabama, and the EPA, Athens, Georgia, sampled, on May 19-20, 1987, demersal fishes from alternative Sites B and C. Appendix F contains a figure showing the location of the sample sites and a list of the fishes and invertebrates collected.

A total of 49 species contained in 42 genera and 27 families were collected at Site B. The results of the diel sampling of Site B indicate that the cusk-eels (Ophidiidae) were by far the most abundant both from a total species and total number of specimens per species standpoint. Dominant cusk-eel species were Lepophidium graellsi (blackedge cusk-eel), Ophidion holbrooki (bank cusk-eel), and Otophidium omostigmum (polka-dot cusk-eel). Other abundant species included Diplectrum formosum (sand perch), Stenotomus caprinus (longspine porgy), Prionotus martis (barred searobin), and Syacium papillosum (dusky flounder). The results of the sampling at Site C indicate a total of 31 species contained in 27 genera and 18 families. The dominant species collected at Site C were Hemipteronotus novacula (pearly razorfish), Trachurus lathami (rough scad), and Syacium papillosum.

Epifauna collected from Site B included crustaceans, echinoderms, molluscs, cnidarians and ascidians. The most abundant crustaceans were Sicyonia brevirostris (rock shrimp) and Portunus spinicarpus (crab). The most abundant mollusc was Loligo pealeii (squid), and the only cnidarian was Virgularia presbytes. Epifauna collected from Site C include crustaceans, echinoderms, molluscs, and ascidians. The most abundant crustacean was Sicyonia brevirostris. The most abundant mollusc was Loligo pealeii. A list of epifaunal species collected from both sites is presented in Appendix E.

The alternative ocean disposal sites may also be utilized for shrimping although shrimping appears to be limited to pink shrimp (Peneaus duorarum) and rock shrimp. Information presented in Darnell and Kleypas (1987) indicates that pink shrimp inhabit the area predominantly in the fall, whereas, rock shrimp inhabit the area year round. Information presented in the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico (Gulf of Mexico Fishery Management Council 1987) indicates that little or no recreational fishery exists for pink shrimp or rock shrimp.

4.12 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:

listed species	scientific name	status
finback whale	Balaenoptera physalus	endangered
humpback whale	Megaptera novaeangliae	endangered
right whale	Euballaena 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. This information has been coordinated with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service (See Section 7.0).

4.13 Mineral Resources. According to the Minerals Management Service (MMS), most oil and gas leasing has occurred in the Destin Dome area to the east of the alternative ODMDS's. Leases have also been granted to the west and south of the ODMDS's. There are no active or inactive oil and gas leases within six miles of the alternative ODMDS's (Elvers, Personal Communication).

4.14 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). Both alternative ODMDS's overlap the navigation safety fairway established for the Pensacola Channel as shown on Figure 4-3.

4.15 Coastal Amenities. Coastal amenities located in the area include parks, aquatic preserves, historic forts and national seashores which are shown on Figure 4-4. The gulf beaches on Santa Rosa Island and Perdido Key are used extensively for recreational activities such as swimming, fishing and sun bathing. Alternative Sites B and C are located approximately 4 and 8 miles, respectively, from the nearest aquatic preserve.

4.16 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. A number of recorded wrecks are listed for the Pensacola area; however, no wrecks were identified in the vicinity of the alternative ODMDS's (Berman 1972; Coastal Environments, Inc. 1977; Fischer, Personal Communication, 1987; Lytle 1975, NOAA n.d.). These results have been coordinated with the Florida State Historic Preservation Officer (See Section 7.0).

4.17 Military Restrictions. The alternative ODMDS's are not located within any military restricted areas. The U. S. Navy special use airspace area W-155 is located south of the alternative ODMDS's.

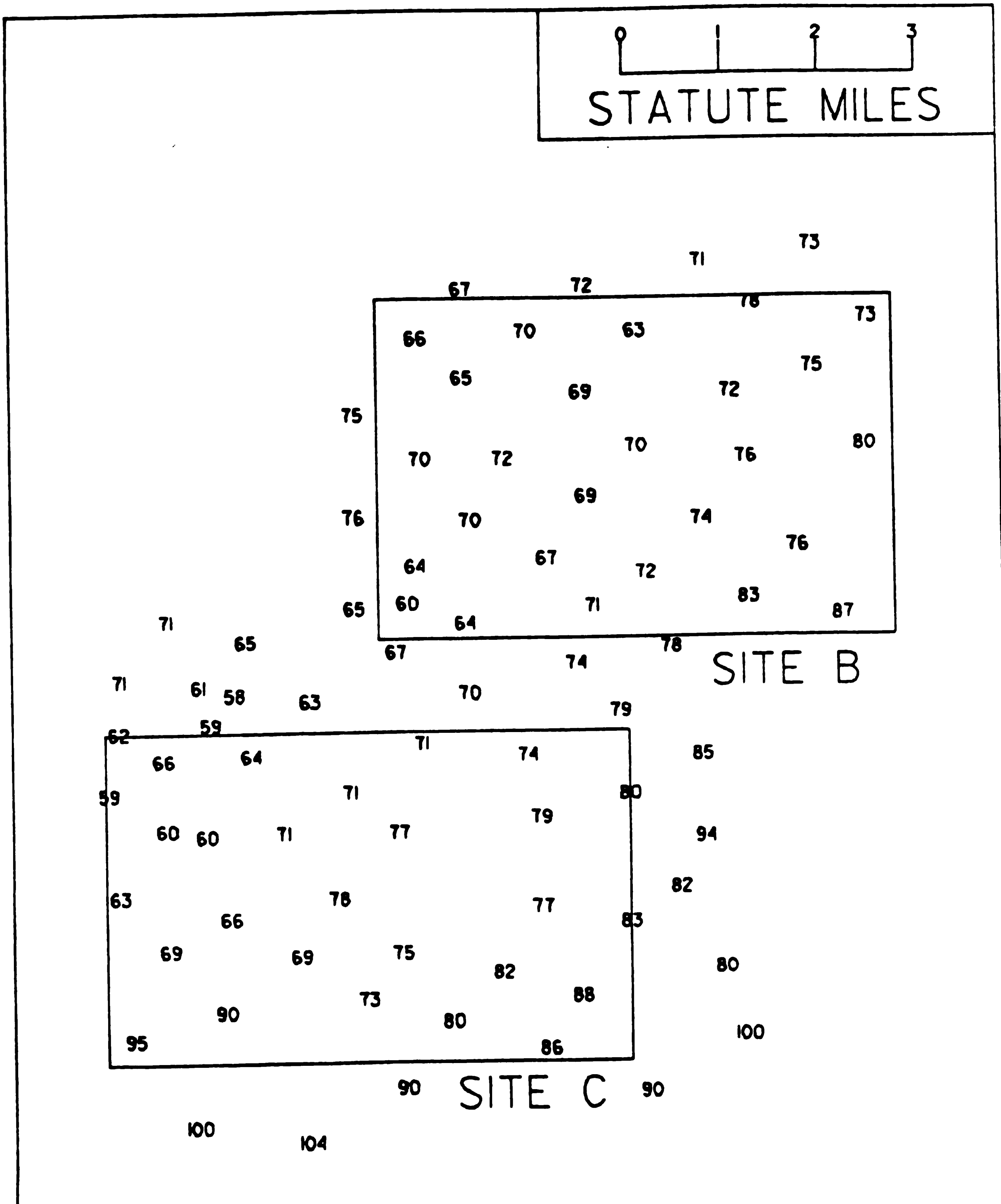

FIGURE 4-1
BATHYMETRY OF
ODMDS'S IN FEET

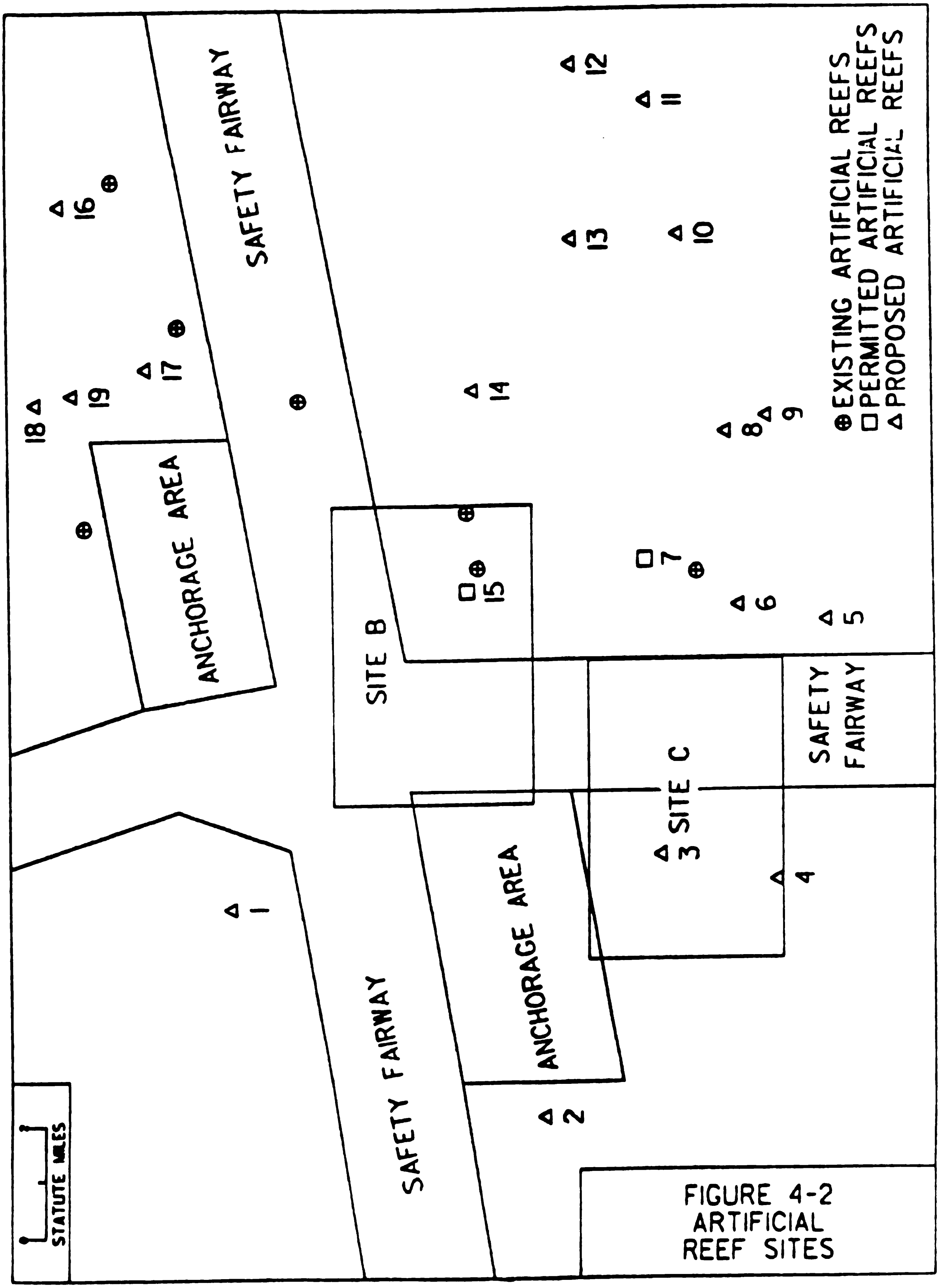

FIGURE 4-2
ARTIFICIAL
REEF SITES

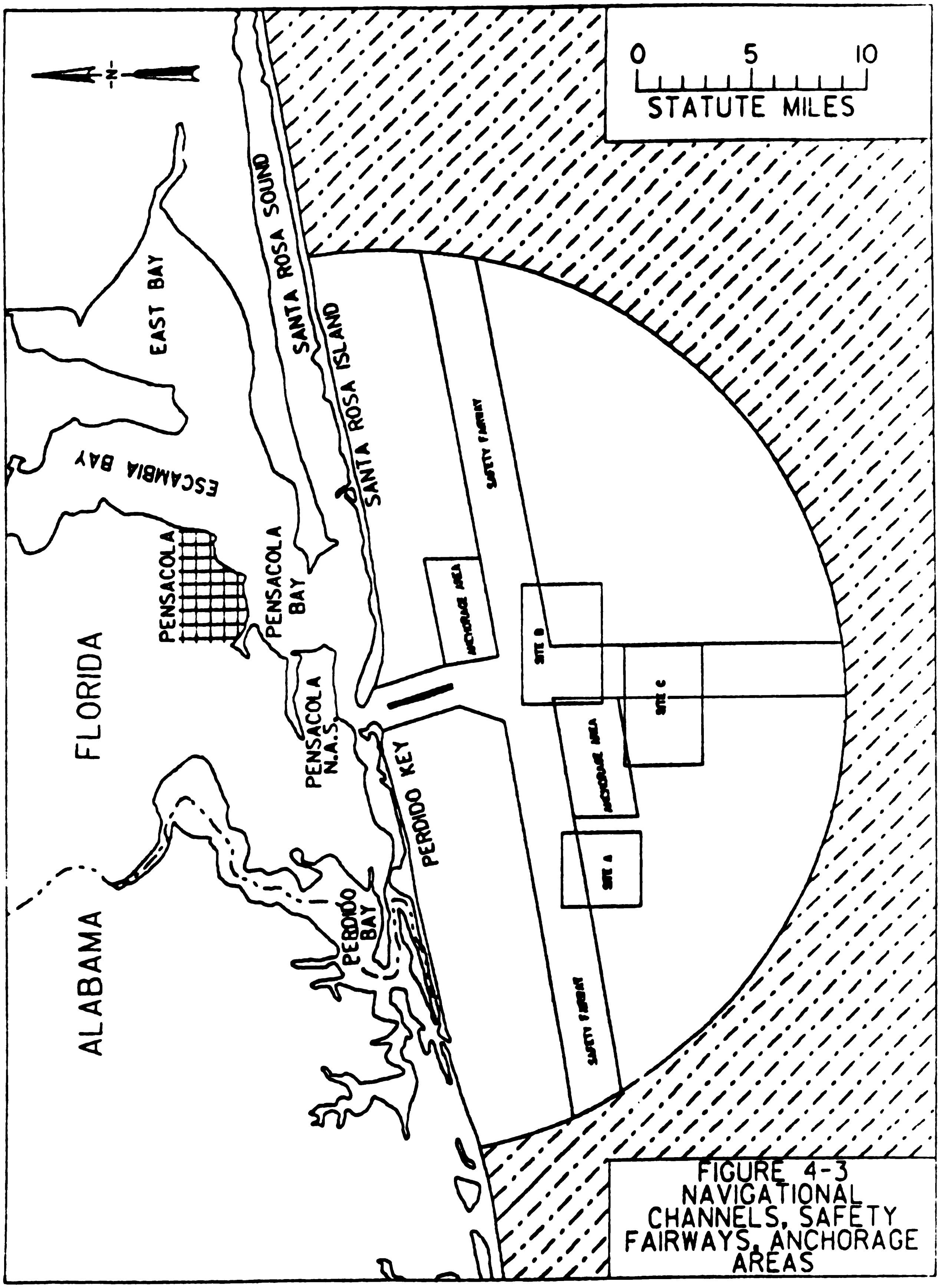

FIGURE 4-3
NAVIGATIONAL CHANNELS, SAFETY FAIRWAYS, ANCHORAGE AREAS

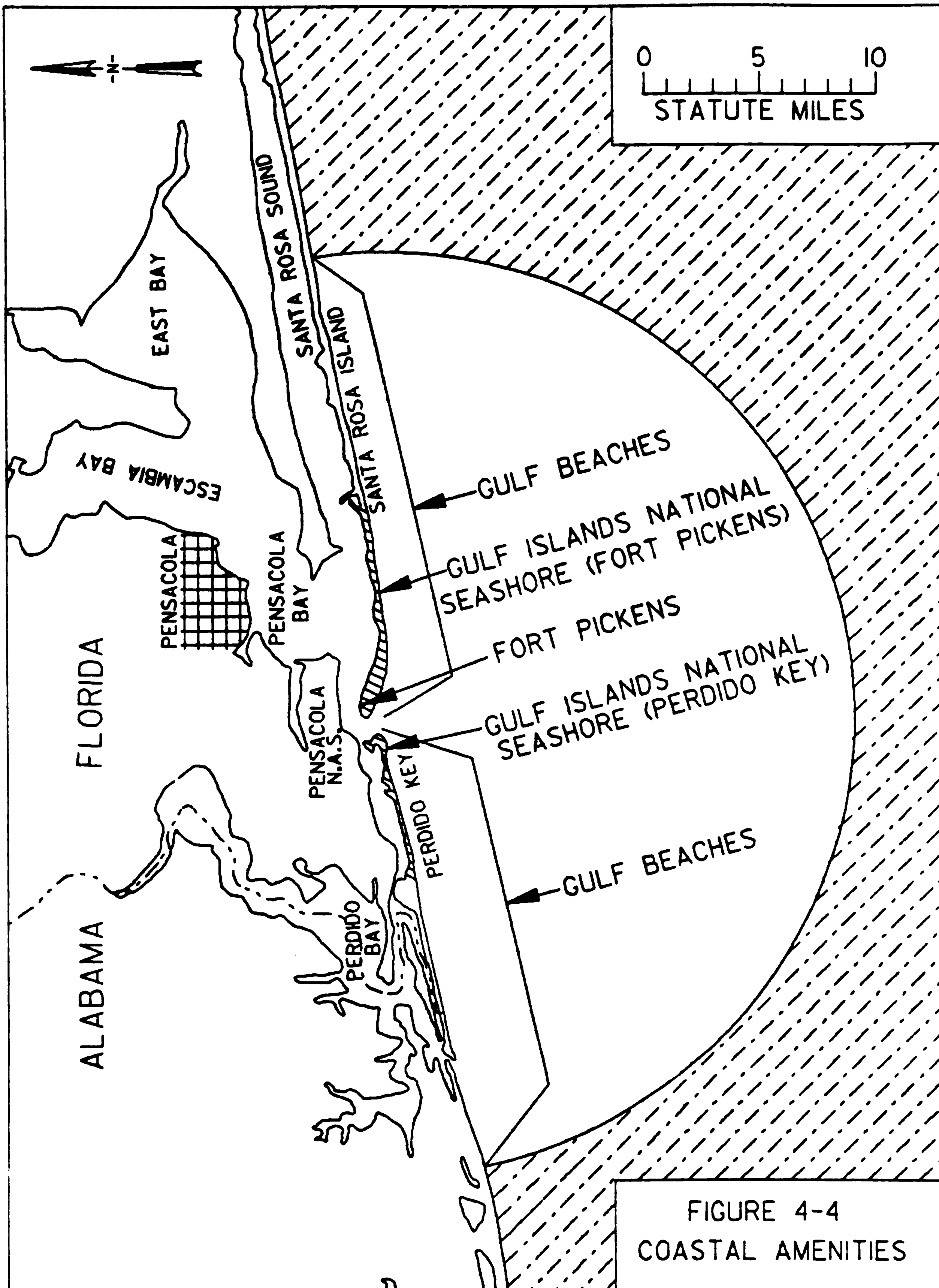

FIGURE 4-4
COASTAL AMENITIES

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 Pensacola, Florida. 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 alternative sites surveyed are located on the shallow continental shelf off Pensacola, Florida (See Figure 5-1). Site B is located approximately seven statute miles from the coast and is defined by the following coordinates:

30° 13' 30" N	87° 18' 17" W
30° 13' 30" N	87° 13' 00" W
30° 10' 26" N	87° 13' 00" W
30° 10' 26" N	87° 18' 17" W

and Site C is located approximately eleven statute miles from the coast and is defined by the following coordinates:

30° 09' 35" N	87° 21' 05" W
30° 09' 35" N	87° 15' 43" W
30° 06' 36" N	87° 15' 43" W
30° 06' 36" N	87° 21' 05" W

Water depths range from 65 to 88 feet at Site B and from 60 to 95 feet at Site C. Bottom topography of the alternative ODMDS's is relatively flat as shown on Figure 4-1. In general, the shelf surface off Pensacola is highly irregular with the sand sheet thinning toward the east, where limestone karst topography predominates. Coral and other invertebrate fauna occur on rock outcrops at depths of 80 to 100 feet and becomes more numerous with increasing depth. The alternative ODMDS's have been located in areas of sand bottoms to avoid impacting areas which contain live bottom communities.

The material to be dredged from the Navy channel and turning basin is approximately 30 percent clays and silts, 69 percent sand and 1 percent shell. The numerical model (DIFID), available at the U.S. Army Engineer Waterways Experiment Stations, was utilized to simulate transport of the disposed dredged material as it descends through the water column and spreads over the bottom under varying hydrodynamic conditions. Input data for the model consisted of characteristics of the dredged material, the proposed disposal site, and the disposal operation. Various sensitivity tests relative to the actual environment were conducted to investigate disposal operations. The output of the model includes disposal mound characteristics (horizontal dimensions, thickness of deposit, materials deposited), whether the material remains within the limits of an artificially applied boundary or moves out of this boundary, and what percentaged of the disposed material is lost from the site. This information has been utilized to determine the actual size and location of the ODMDS within the alternative site studied as well as the disposal site management plan described in Appendix I.

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 Pensacola Bay. 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. Specific migration routes and actual location of spawning areas within the northern Gulf are not well known; however, the passes between the barrier islands and shallow vegetated estuarine systems are important in the life cycles of these species.

Alternative Sites B and C are located approximately seven and eleven statute miles, respectively, from Pensacola Pass. Therefore, use of either site should not affect migratory passage through the pass. The distance from important nursery and feeding areas is even greater since these areas are located inside the estuary itself. In addition, the alternative sites are not known to be located near any major breeding or spawning area.

5.04 Location in Relation to Beaches and Other Amenity Areas [40 CFR 228.6 (a) 3]. Sites B and C are located seven and eleven statute miles, respectively, south of the nearest beach. Beach and shore-related amenities include Santa Rosa Island, Perdido Key, Gulf Islands National Seashore, Fort Pickens and Fort Pickens Aquatic Preserve. The aquatic preserve boundary extends three miles into the gulf. The alternative ODMDS's are located a sufficient distance offshore to prevent impacting these amenities. Further protection is afforded since the predominant currents 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 Pensacola Bay area which meets the criteria specified in Section 103 of the MPRSA but that is not suitable for beach nourishment or disposal in the existing Pensacola (nearshore) ODMDS. Initially, it will be used for approximately 4.1 million cubic yards of sand, silt, and clay dredged for the Navy Homeport Project. The ODMDS may also be used for the disposal of additional fine-grained dredged material in the future but no immediate requirement is known. The dredged material will be transported to the ODMDS and discharged by hopper dredge, hopper barge or dump scow.

Analyses of the sediments initially proposed for discharge indicate that no contaminants are present in unacceptable levels and that the material meets the criteria specified in Section 103 of the MPRSA (See Appendix D). The sediments proposed to be disposed were subjected to biological and chemical testing to determine toxicity and bioaccumulation potential utilizing three representative marine organisms. The toxicity of the sediments tested 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). The suspended solid phase of the sediments had little effect on mysids (Mysidopsis bahia)(EPA 1988a). No chemicals of interest were bioaccumulated sufficiently from the sediments tested to warrant concern. No pesticides or PCBs were detected in sediments or animal tissues before or after the 10-day exposure. Several metals and petroleum hydrocarbons were detected; however, the increase in concentrations in tissues of lugworms, oysters, and shrimp was always less than 3 times greater than concentrations in animals exposed to reference sediments and appeared ecologically insignificant (EPA 1988b).

In addition to the required bioassay/bioaccumulation studies, sediment samples were collected from eight stations during March and May 1986. The results generally show that heavy metal and nutrient concentrations in the sediments are similar to those from studies of Pensacola Bay sediments conducted in 1984. In addition, recent studies conducted by the EPA in other Gulf of Mexico estuaries and estuaries along the Atlantic coast have revealed similar heavy metal concentrations in sediments (Parrish, personal communication). However, the results show a slight enrichment in chromium at four locations, mercury at one location and zinc enrichment at three locations. All the locations are in the vicinity of the existing Navy Turning Basin where the initial dredged material would originate. Although some heavy metal enrichment exists, the levels are not sufficient to warrant capping of the dredged material with clean sediments.

Sediment samples were collected from 20 stations at each alternative ODMDS and analyzed for metals, nutrients, oil and grease, pesticides, and chlorinated hydrocarbons. All parameters were either below the minimum detection limits or in very low concentrations (See Appendix C). The sediments on each alternative ODMDS are predominately medium and coarse sands as shown in Appendix B. The 4.1 million cubic yards of dredged material consists of approximately 30 percent clays and silts, 69 percent sands and 1 percent shell. Thus, the surface sediments on the ODMDS will become somewhat finer immediately after the discharge. The ODMDS is expected to become armored with sand and shell as the clay and silt are winnowed out by the currents. Some "clay balls" may also be present on the surface due to the cohesive nature of some of the material. These changes would not pose a significant threat to the marine environment and would not require capping of the dredged material.

5.06 Feasibility of Surveillance and Monitoring [40 CFR 228.6 (a) 5]. The location of the alternative ODMDS's presents no special problems for surveillance and monitoring. Sites B and C are located seven and eleven miles offshore, respectively. Water depths range from 65 to 88 feet at Site B and from 60 to 95 feet at Site C. The size of the ODMDS will be limited to facilitate monitoring and surveillance of the site designated. The results of the modeling simulation discussed in Section 5.02 above was utilized to define the actual size and location of the site. The approximately 6 square miles included in the ODMDS will not present an unrealistic demand on surveillance or monitoring activities. These water depths are amenable to either surface sampling or diver collection and do not require the use of a large oceanographic surface vessel. High turbidity may occasionally restrict diver operations and photography but is not expected to be a significant hindrance to surveillance and monitoring. Data collected at the ODMDS's by the EPA in 1987 will serve as the baseline for future monitoring. Site surveillance can be accomplished by air from Pensacola Municipal Airport or by water from numerous facilities in Pensacola Bay. A proposed site monitoring plan has been developed to determine the short and long term impacts to the marine ecosystem associated with disposal of dredged material into the ODMDS (See Appendix G).

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]. A field study conducted between February, 1987 and January, 1988, by the Naval Ocean Research and Development Activity (NORDA) showed the nearshore currents off Pensacola to be wind driven, parallel to the coast and to obtain speeds up to 62 centimeters per second. The currents are typically uniform, both in speed and direction, throughout the water column and between the alternative ODMDS's. A significant reversal in direction with depth; however, was noted during the October through January survey in Site C. A similar reversal was not noted at Site B. The total extent of this phenomena or its contribution to total circulation within the area is not discernable from the data.

The measured currents and wind data recorded at Pensacola were used by NORDA to calibrate a numerical current model. The calibrated model was then used to hindcast currents at the alternative ODMDS's using winds recorded at Pensacola since 1948. The model showed that over long time periods, currents at the ODMDS's are stronger and toward the west more frequently than observed during the field study. The model hindcast 100 centimeters per second currents during Hurricane Fredric in 1979 as the strongest current during the forty-year period of record (Resio 1987 in NORDA 1988).

This information was utilized in simulating the transport of the disposed dredged material as it descends through the water column and spreads over the bottom under varying hydrodynamic conditions as described in Section 5.02 above.

The ODMDS's occupy a small area relative to the area of the continental shelf near Pensacola. As noted in Section 5.02 above, changes in bathymetry are small in relation to the water depths on the sites. Therefore, the discharge of dredged material into either alternative ODMDS would have negligible impact on the circulation and mixing of the 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. Clay size particles can be eroded by currents as low as 20 centimeters per second. These currents can be expected to occur up to 65 percent of the time. Thus, as stated above, 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. Impacts outside the designated ODMDS will be minimal because: (1) the site is being sized to contain the majority of the fine-grained material under normal hydrographic conditions and (2) the location of the site is being chosen to be a sufficient distance from any unique resources or resources of special concern. 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.

5.08 Existence and Effects of Current and Previous Discharges and Dumping in the Area (Including Cumulative Effects) [40 CFR 228.6 (a) 7]. There have been no previous discharges within either alternative site. The only other ODMDS in the area is the EPA-designated Pensacola (nearshore) ODMDS approximately one and one-half miles south of Pensacola Pass. It's use, however, is limited to sandy dredged material containing less than 10 percent clays and silts.

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 ODMDS's 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.

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.

One permitted and two existing artificial fishing reefs are located in the eastern quadrant of alternative Site B. Two sites are located within the area chosen for detailed investigation while the other is on the eastern boundary (See Figure 4-2). Use of the eastern side of alternative Site B as an ODMDS would impact the existing and permitted artificial reefs.

The eastern boundary of alternative Site C is located approximately 2 miles due west of the nearest known fishing reef (Escambia County #7) and approximately 3 miles from a permitted reef site. Two sites being considered for proposal as artificial reef sites are located within alternative Site C and two sites are located east and southeast of the eastern boundary of the site (See Figure 4-2). Since the predominant currents are towards the west, the use of alternative Site C would not impact the known or permitted reef sites or those proposed for establishment that are outside the detailed area of study. The proposed reef locations within alternative Site C would be impacted by designation and use of an ODMDS in this area. This impact is not considered significant since these are only two of over twenty proposed reef locations in the vicinity of the alternative sites studied. In addition, there are other areas within this general region which would be suitable for establishment of artificial reefs.

There are no known 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.

Mineral resources would not be significantly affected since there are no active or inactive oil or gas leases within six miles of either ODMDS. Most oil and gas leasing has occurred in the Destin Dome area to the east of the alternative ODMDS's. Designation and use of an ODMDS and mineral exploration and extraction are considered compatible uses; therefore, future use of an ODMDS for these activities should not be in conflict.

The alternative ODMDS's overlap the shipping safety fairways (See Figure 4-2). The western half of alternative Site B and the eastern half of alternative Site C overlap the north-south safety fairway. The use of either alternative as an ODMDS would not affect navigation. Both sites are much deeper than the existing or proposed channels at Pensacola and bathymetric changes on the site would be restricted to prevent impacting navigation. Some increase in traffic in the shipping lanes would be expected during the disposal operation; however, no significant impacts would accrue due to this action.

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

5.10 <u>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]</u>. Baseline surveys were conducted on the alternative ODMDS's during 1986 and 1987. The surveys 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 sand/shellhash sediments predominate. The results of the surveys are discussed in the Affected Environment Section and presented in Appendix C (EPA 1987). In summary, neither of the alternative sites possesses unique characteristics which would preclude it's designation and use as an ODMDS.

The alternative locations have been coordinated with the National Marine Fisheries Service (NMFS) in accordance with Section 7 of the Endangered

Species Act. The NMFS has determined that neither ODMDS would affect any endangered or threatened species or any critical habitat (See Section 7.0). The designation and use of a new ODMDS was coordinated with the U.S. Fish and Wildlife Service during review of the U.S. Navy Gulf Coast Strategic Homeporting Project. In a letter to the U.S. Navy dated February 18, 1987 the U. S. Fish and Wildlife Service concurred that the proposed activity would not affect any endangered or threatened species for which they have jurisdictional responsibility (See Section 7.0).

5.11 Potentiality for the Development or Recruitment of Nuisance Species in the Disposal Site [40 CFR 228.6 (a) 10]. Some change in benthic species composition on the designated ODMDS can be expected due to a difference in grain size from the existing bottom. However, there is no evidence to suggest that 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]. There are no recorded shipwrecks in the vicinity of the alternative ODMDS's (Berman 1972; Coastal Environments, Inc., 1977; Fischer, Personal Communication, 1987; Lytle 1975; NOAA n.d.). Thus, no impact to cultural resources would be expected to occur from the use of either ODMDS. There are no natural features of historical importance in the vicinity of the alternative ODMDS's. These results have been coordinated with the Florida State Historic Preservation Officer (SHPO) (See Section 7.0). In a letter dated March 16, 1988, the SHPO stated: "...it is the opinion of this agency that the proposed offshore dredge disposal area will have ro affect on any properties listed, or eligible for listing, in The National Register of Historic Places."

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. The sites were selected to minimize potential impacts to existing fisheries or shellfisheries. As discussed in Section 5.09 above, two artificial reefs are located within the southeast quadrant of alternative Site B and the artificial reef known as the 'Russian Freighter' is located on the eastern boundary of the site. There are no permitted or natural reef areas in the vicinity of Site C. In addition to possible impacts to the artificial reefs, the western portion of Site B and the eastern portion of Site C are in a designated navigation safety fairway. However, use of the navigation safety fairway for an ODMDS is not prohibited by U. S. Coast Guard Regulations. Both alternative ODMDS's are much deeper than the existing or proposed navigation channels at

Pensacola and bathymetric changes on the sites would be restricted to prevent impacting navigation.

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. A discharge is expected to occur approximately every three hours during the initial use of the ODMDS. Therefore, potential cumulative impacts to the water column were considered. This was done by evaluating output from the numerical model (DIFID) at incremental time steps up to three hours for numerous velocity and material composition scenarios. As expected, the model predicts the highest suspended solids concentration shortly after discharge with the concentration decreasing with time. The model predicted a concentration of less than 1 part per million in the water column after three hours for the most probable scenario. Even under worst case conditions, the model predicts a suspended solids concentration of only a few parts per million in the water column after three hours. Thus, the cumulative impact of repeated discharges on the water column is not considered to be significant.

The turbidity plume created during the discharge will move in the down current direction and will become more dispersed over time. As stated above, the suspended solids concentration will be reduced to essentially ambient conditions within three hours, even under worst case conditions. The area affected by the plume varies greatly depending primarily upon the type of material disposed. The area with suspended solids concentrations of more than 10 parts per million would cover approximately 300 acres, 90 minutes after the discharge, under worst case conditions, i.e., 95 percent silt/clay.

The location and boundaries of the alternative ODMDS's were specifically chosen such that impacts to any beach, shoreline or marine sanctuary would not occur. There are no known geographically limited fisheries or shellfisheries near the alternative ODMDS's; however, the National Marine Fisheries Service periodically restricts the taking of certain species in gulf waters; i.e., King and Spanish mackerel, grouper, redfish and red snapper. These species are highly motile and the extremely small area of the alternative ODMDS's in relation to the gulf waters affected by the ban would make any potential impact to these species negligible.

5.15 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)]. This criteria is not applicable to the initial selection and designation of an ODMDS. However, 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 of the ODMDS has been limited to localize any adverse impacts and to facilitate monitoring and surveillance of the site designated. The results of the modeling simulation discussed in Section 5.02 above was utilized to define the actual size and location of the site. Approximately 6 square miles will be included in the ODMDS. A smaller disposal area would have potential problems with respect to impacts occurring outside the disposal area. The nature of the material, predominately fine-grained sediments, and the physical oceanographic conditions require that a larger site be designated. A management plan for use of the ODMDS has been established utilizing the results of the modeling effort and information on location of significant resources. The management plan specifies location(s) and method of disposal (See Appendix I). In addition, a monitoring program will be implemented at the designated ODMDS to determine whether or not disposal at the site is significantly affecting adjacent areas and to detect the presence of long-term adverse effects.

The proposed monitoring program is discussed in Appendix G. Results of this monitoring program will be used to modify, if necessary, aspects of the management plan.

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 Pensacola infeasible. It is not considered to be economically feasible to haul the large volume of dredged material beyond twenty miles from Pensacola Pass. Also, the habitats within the Gulf of Mexico south of Pensacola become more environmentally sensitive with increasing depth. Coral and other invertebrate fauna occur on rock outcrops at depths of 80 to 100 feet and become more numerous with increasing depth (EPA 1986).

The Pensacola (nearshore) ODMDS has been restricted to receive dredged material that is of a predominantly sandy nature; therefore, the use of this site for fine-grained material is not feasible.

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. The construction of artificial fishing reefs on the designated ODMDS would be prohibited; however, the ODMDS is very small compared to the continental shelf near Pensacola and adequate space is available for constructing artificial reefs such that no long-term impact to productivity of organisms associated with these structures would result. 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.

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 and the loss of benthic organisms smothered during disposal operations. 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 for predominately fine-grained material could potentially lead to its use for other Federal projects. The most likely project to require use of the site would be maintenance of the Pensacola Bay portion of the commercial ship channel. 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 12 to 18 month period after the discharge is completed. Changes in the site's bathymetry and altering of the site's sediment composition are also unavoidable impacts. Some of the adverse environmental effects associated with disposal activities can be reduced through proper management of the ODMDS. The mounding of material can be controlled by strict enforcement of the dump location and by periodically surveying the site's bathymetry. The proposed management plan is presented in Appendix I. The loss of benthic organisms and effects outside the ODMDS can be minimized by confining discharges to the central portion of the ODMDS. A monitoring program will be implemented at the designated ODMDS to measure impacts and to help prevent any adverse long-range impacts. The proposed monitoring program is presented in Appendix G.

TABLE 5-1

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

Criteria as Listed in 40 CFR 228.6	Site B	Site C
1. Geographical position, depth of water, bottom topography and distance from coast.	See Figures 5-1 and 4-1; 65-88 feet; relatively flat; 7 miles from coast	See Figures 5-1 and 4-1; 60-95 feet; relatively flat; 11 miles from coast
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 areas are 7 miles or more from site	May occur within area but no unique uses are known; nearest known nursery or passage areas are 11 miles or more from site
3. Location in relation to beaches and other fishing amenity areas.	Located 7 miles from beaches and 4 miles from aquatic preserve; one permitted and two existing artificial reefs within site; one existing and one proposed reef east of site	Located 11 miles from beaches and 8 miles from aquatic preserve two proposed artificial reefs within site; one existing, one permitted and two proposed reefs east of site
4. Types and quantities of wastes proposed to be disposed of and proposed methods of release, including methods of packing the wastes, it any.	Initially, approximately 4.1 mcy of sand, silt, and clay released by hopper dredge, barge, or dump scow	Same as Site B
5. Feasibility of surveillance and monitoring.	Surveillance and monitoring possible by boat or plane	Same as Site B
6. Dispersal, horizontal transport, and vertical mixing characteristics of the area, including prevailing current velocity, if any.	Currents are parallel to coast at speeds of up to 62 cm/sec under normal weather conditions; may reach 100 cm/sec during hurricanes	Same as Site B

TABLE 5-1
(continued)

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

Criteria as Listed in 40 CFR 228.6	Site B	Site C
7. Existence and effects of current and previous discharge and dumping in the area including cumulative effects.	No previous discharges	No previous discharges
8. Interference with shipping, fishing, recreation, mineral extraction, desalination, fish and shellfish culture, areas of special scientific importance, and other legitimate uses of the ocean.	Half of site overlaps safety fairway, no significant impact to navigation; three artificial reefs in site; other parameters would not be affected	Half of site overlaps safety fairway, no significant impact to navigation; other parameters would not be affected
9. The existing water quality and ecology of the sites as determined by available data, and by baseline surveys.	Water quality typical of gulf waters and bottom habitat typical of sandy bottom habitat in gulf	Same as Site B
10. Potentiality for the development or recruitment of nuisance species in the disposal sites.	No nuisance species are anticipated	Same as Site B
11. Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.	No known impacts to cultural resources or any significant natural resource	Same as Site B

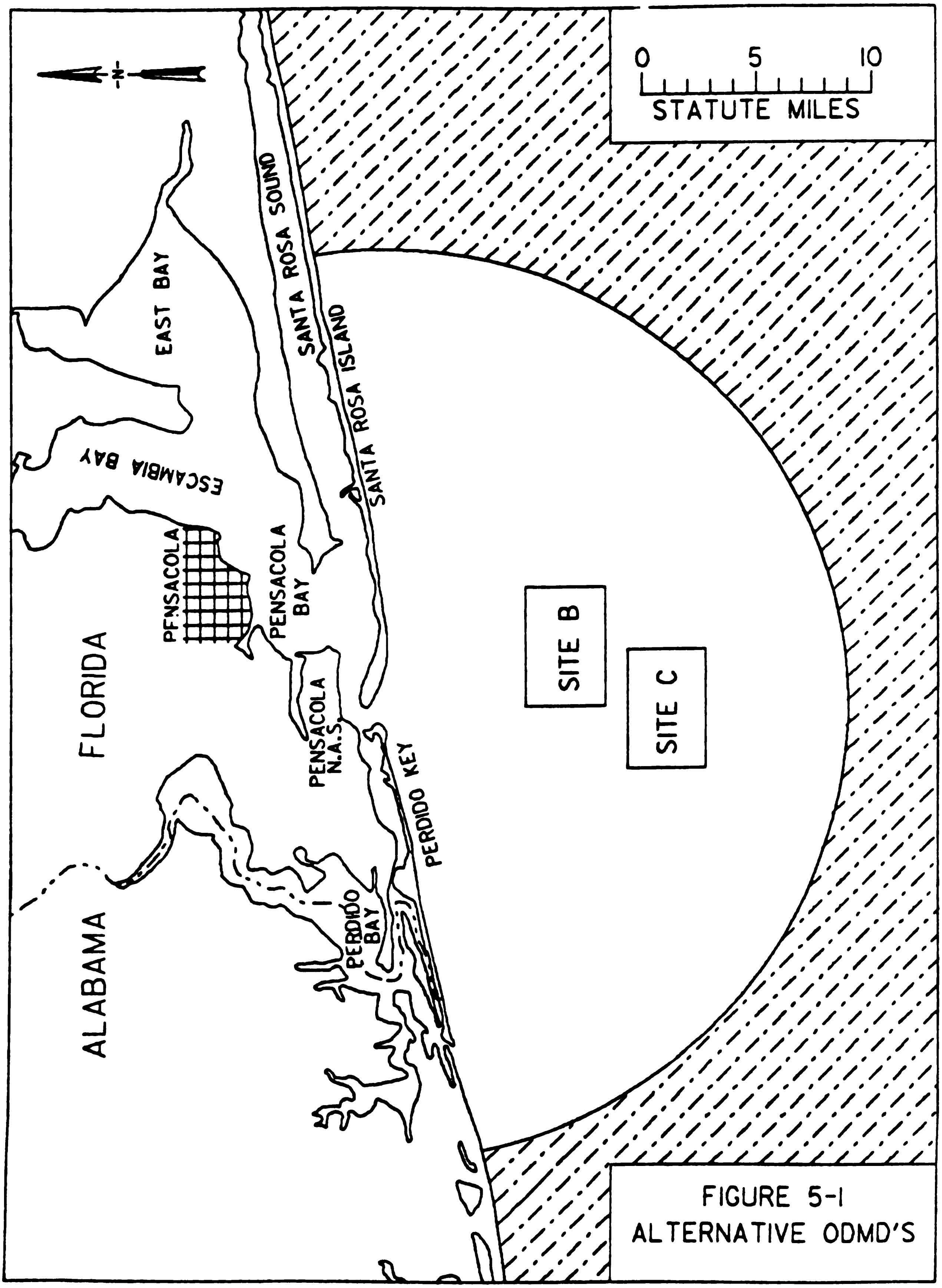

FIGURE 5-1
ALTERNATIVE ODMD'S

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

Name/Education/ Organization	Expertise/Experience	Contribution
Henry A. Malec, M.E. Corps of Engineers Mobile District	Environmental Engineer: 15 years experience environmental studies.	EIS Coordination
Susan Ivester Rees, Ph.D. Corps of Engineers Mobile District	Oceanographer: 13 years experience in coastal navigation, beach nourishment and education.	EIS Preparation, Site Designation Studies
Dorothy H. Gibbens, M.S. Corps of Engineers Mobile District	Archaeologist: 13 years experience as cultural resources specialist.	Cultural Resources
R. Douglas Nester, M.S. Corps of Engineers Mobile District	Biologist: 10 years experience in biological studies.	Fisheries
Reginald G. Rogers, M.S. Environmental Protection Agency, Region IV	Ecologist: 29 years experience in coastal studies.	EPA Coordination
Christian M. Hoberg, M.S. Environmental Protection Agency, Region IV	Environmental Scientist: 10 years experience in marine studies, EIS review.	EIS Review EPA Coordination
Laurens M. Pitts, M.E. Navy Facilities Engineering Command	Environmental Engineer: 16 years experience in environmental studies	EIS Review Navy Coordination

7.0 PUBLIC INVOLVEMENT. The Final Environmental Impact Statement is being coordinated with the following agencies, groups, and individuals:

Federal

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 Health and Human Services
Department of Housing and Urban Development
Department of the Interior
  Bureau of Mines
  Fish and Wildlife Service
  Minerals Management Service
  National Park Service
  U.S. Geological Survey
Department of Transportation
  Federal Aviation Administration
  Federal Highway Administration
  U.S. Coast Guard
Department of Defense
  Pentagon
  U.S. Air Force, Eglin Air Force Base
  U.S. Army Corps of Engineers
    South Atlantic Division
    Jacksonville District
    Mobile District
  U.S. Navy
    Naval Ocean Research and Development Activity
    Pensacola Naval Air Station
    Southern Division Naval Engineering Facilities Command
Economic Development Administration
Environmental Government Affairs
Environmental Protection Agency
Federal Maritime Commission
Federal Power Commission
Food and Drug Administration
National Aeronautics and Space Administration
National Science Foundation
U.S. Senators
  Honorable Lawton Chiles
  Honorable Bob Graham
U.S. House of Representatives
  Honorable Earl Hutto

State

Governor of Florida
  Honorable Bob Martinez
Florida Senate
  Honorable W.D. Childers (1st. District)
Florida House of Representatives
  Honorable Tom Tobiassen (1st. District)
  Honorable Virginia Bass (2nd. District)
  Honorable Tom Benjamin (3rd. District)
  Honorable Bolley L. Johnson (4th. District)
Board of Trustees of the Internal Improvement Trust Fund
Florida Department of Agriculture and Consumer Services
  Agriculture Advisory Council
  Division of Forestry
  Soil and Water Conservation Office
Florida Department of Community Affairs
Florida Department of Environmental Regulation
  Bureau of Laboratories and Special Projects
  Bureau of Permitting
  Bureau of Sanitary Engineering
  Bureau of Special Programs
  Groundwater Administration
  NPDES Permits
Florida Department of General Services
Florida Department of Legal Affairs
Florida Department of Natural Resources
  Bureau of Beaches and Shores
  Coastal Coordinating Council
  Division of Marine Resources
  Division of Recreation and Parks
Florida Department of State
  Bureau of Publication
  Department of Archives, History and Records Management
Florida Department of Transportation
  Bureau of Environment
  Director of Road Operations
  State Topographic Bureau
Florida Environmental Regulation Commission
Florida Game and Freshwater Fish Commission
Florida State Health Officer
Florida State Historic Preservation Officer
Florida State Treasure's Office
Northwest Florida Regional Planning Commission
Northwest Florida Water Management District
Office of the Governor
  Office of Planning and Budgeting
  State Planning and Development Clearinghouse
Florida Marine Fisheries Commission

Local

Apalachee Regional Planning Council
Escambia County Commission
Manager, City of Pensacola
Mayor of Pensacola
  Honorable Vince Whibbs
West Florida Regional Library
West Florida Regional Planning Council
Pensacola Port Authority
University of West Florida
Pensacola Chamber of Commerce
Pensacola News Journal

Organizations and Public

Action
AGC
Bay County Audubon Society
Citizens Committee 100
Coalition to Cease Ocean Dumping
Council on Clean Air
Ecology Action of Hollywood
Ecology Unlimited - Manatee Junior College
Environmental Action Group
  University of Florida
  Florida State University
  Florida Presbyterian College
Environmental Affairs Ad Hoc Committee - Florida State University
Environmental Demonstration Center - Miami-Dade Community College
Envisions, Inc.
Florida Bass Chapter
Florida Coalition for Clean Water
Florida Conservation Foundation, Inc.
Florida Division IWLA
Florida Forestry Association
Florida League of Anglers, Inc.
Florida Local Environmental Regulation Association
Florida Lung Association
Florida Sea Grant Extension Program
Florida Soil and Water Conservation Council
Florida State UAW-CAP Council - Environmental Committee
Florida State University
Gulf States Marine Fisheries Commission
Harbor Branch Oceanographic Institute
Hillsborough Environmental Coalition
Information
International Women's Fishing Association
Izaak Walton League of America, Inc.
Lemon Bay Conservancy
Mana-Sota 88
Marine Environmental Sciences Consortium, Dauphin Island Sea Lab

State

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  Honorable Bob Martinez
Florida Senate
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Florida House of Representatives
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Florida Department of Environmental Regulation
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  Bureau of Permitting
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  Bureau of Special Programs
  Groundwater Administration
  NPDES Permits
Florida Department of General Services
Florida Department of Legal Affairs
Florida Department of Natural Resources
  Bureau of Beaches and Shores
  Coastal Coordinating Council
  Division of Marine Resources
  Division of Recreation and Parks
Florida Department of State
  Bureau of Publication
  Department of Archives, History and Records Management
Florida Department of Transportation
  Bureau of Environment
  Director of Road Operations
  State Topographic Bureau
Florida Environmental Regulation Commission
Florida Game and Freshwater Fish Commission
Florida State Health Officer
Florida State Historic Preservation Officer
Florida State Treasure's Office
Northwest Florida Regional Planning Commission
Northwest Florida Water Management District
Office of the Governor
  Office of Planning and Budgeting
  State Planning and Development Clearinghouse
Florida Marine Fisheries Commission

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Pensacola News Journal

Organizations and Public

Action
AGC
Bay County Audubon Society
Citizens Committee 100
Coalition to Cease Ocean Dumping
Council on Clean Air
Ecology Action of Hollywood
Ecology Unlimited - Manatee Junior College
Environmental Action Group
  University of Florida
  Florida State University
  Florida Presbyterian College
Environmental Affairs Ad Hoc Committee - Florida State University
Environmental Demonstration Center - Miami-Dade Community College
Envisions, Inc.
Florida Bass Chapter
Florida Coalition for Clean Water
Florida Conservation Foundation, Inc.
Florida Division IWLA
Florida Forestry Association
Florida League of Anglers, Inc.
Florida Local Environmental Regulation Association
Florida Lung Association
Florida Sea Grant Extension Program
Florida Soil and Water Conservation Council
Florida State UAW-CAP Council - Environmental Committee
Florida State University
Gulf States Marine Fisheries Commission
Harbor Branch Oceanographic Institute
Hillsborough Environmental Coalition
Information
International Women's Fishing Association
Izaak Walton League of America, Inc.
Lemon Bay Conservancy
Mana-Sota 88
Marine Environmental Sciences Consortium, Dauphin Island Sea Lab

Mote Marine Laboratory
National Audubon Society
National Wildlife Federation
Natural Resources Defense Council
Nature Conservancy
NE Florida Air Conservation Council
North Broward Environmental Action Committee
Oceanic Society
Clean Ocean Action
Organized Fisherman of Florida
Polk County Coalition for the Environment
Racal Survey, Inc.
Save Our Bays Association, Inc.
Sierra Club
Southeastern Fisheries Association, Inc.
Sport Fish Institute, Artificial Reef Development Center
Survive
Suwannee River Coalition
University of Florida
University of Miami - RSMAS
University of South Alabama
University of South Florida
West Florida Lung Association
Wildlife Society - University of Florida
Ybor City Civitan Club

Coordination with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service as required by Section 7 of the Endangered Species Act of 1973 was concluded prior to filing the DEIS. The National Marine Fisheries Service in a letter dated December 14, 1987 concurred with the determination that populations of endangered/threatened species under their purview would not be adversely affected by the proposed action. The U.S. Fish and Wildlife Service in a letter dated February 18, 1987 concurred with the determination that populations of endangered/threatened species under their jurisdiction 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 Florida State Historic Preservation Officer (SHPO) was also completed prior to filing the DEIS. In a letter dated March 16, 1988, the SHPO stated: ".....it is the opinion of this agency that the proposed offshore dredge disposal will have no affect on any properties listed, or eligible for listing, in The National Register of Historic Places."

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

December 14, 1987 F/SER23:TAH:td

Mr. N. D. McClure IV
Chief, Environment and Resources Branch
Department of the Army
Mobile District, Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628-0001

Dear Mr. McClure:

This responds to your November 17, 1987, letter regarding the proposed designation of new ocean dredged material disposal sites (ODMDS) in the Gulf of Mexico south of Pensacola, Florida. You stated that additional studies have been conducted to better define the location of the ODMDS and enclosed a map with coordinates of the proposed sites. The Navy's Environmental Impact Statement (EIS) served as the Biological Assessment (BA) for the proposed project pursuant to Section 7 of the Endangered Species Act of 1973.

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,

Charles A. Oravetz

Charles A. Oravetz, Chief
Protected Species Management Branch

cc: F/PR2
F/SER1

United States Department of the Interior
FISH AND WILDLIFE SERVICE
ENDANGERED SPECIES FIELD STATION
2747 ART MUSEUM DRIVE
JACKSONVILLE, FLORIDA 32207

February 18, 1987

Commanding Officer
Naval Facilities Engineering Command
Southern Division
Department of the Navy
2155 Eagle Drive, P.O. Box 10068
Charleston, S.C. 29411-0068

FWS Log No. 4-1-87-084
11000, Code 202LP

Dear Sir:

This is in response to your letter of February 4, 1987 regarding the Section 7 consultation process for the United States Navy Gulf Coast Strategic Homeporting sites in Pensacola and Key West, Florida.

We have reviewed the information provided in the August 1986 Draft Environmental Impact Statement (EIS) and the January 1987 Final EIS. With regard to the proposed homeporting facility, we concur with the Navy's determination of "no adverse effect" to the following species: West Indian manatee, bald eagle, red-cockaded woodpecker, and eastern indigo snake. We also concur with the Navy's determination of "no adverse effect" to the Perdido Key beach mouse from the construction of the homeporting facility at Pensacola, Florida, as long as the conditions stated in your February 4, 1987 letter are met. If these conditions are adhered to, and the safety of beach mice present on the site is ensured, we do not feel the construction of the project will adversely affect the existence of the Perdido Key beach mouse.

This does not constitute a Biological Opinion as described in Section 7 of the Endangered Species Act. However, it does satisfy the requirements of the Act and no further action on your part is required. If modifications are made in the project or if additional facts involving potential impacts on listed species arise, you should contact this office.

Sincerely yours,

David J. Wesley
Field Supervisor

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES
R.A. Gray Building
Tallahassee, Florida 32399-0250
(904) 488-1480

March 16, 1988

Mr. Earl G. Baham
Head, Planning Services Branch
Department of Navy
Commanding Officer, Southern Division
Naval Facilities Engineering Command
P.O. Box 10068
Charleston, S.C. 29411-0068

In Reply Refer To:
Louis D. Tesar
Historic Preservation Supervisor
(904) 487-2333
Project File No. 880446

RE: October 27, 1987 letter, code 202LP
Cultural resource assessment request for proposed dredge disposal from Pensacola Harbor Homeporting Project at coordinates:

87° 23'00"	30° 05'00"
87° 23'00"	30° 15'00"
87° 11'00"	30° 15'00"
87° 11'00"	30° 15'00"

Gulf of Mexico, Florida

Dear Mr. Baham:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Procedures for the Protection of Historic and Cultural Properties"), we have reviewed the above referenced project for possible impact to archaeological and historical sites or properties listed, or eligible for listing, in the National Register of Historic Places. The authorities for these procedures are the National Historic Preservation Act of 1966 (Public Law 89-665) as amended by P.L. 91-243, P.L. 93-54, P.L. 94-422, P.L. 94-458 and P.L. 96-515, and Presidential Executive Order 11593 ("Protection and Enhancement of the Cultural Environment").

As we discussed with your staff and the staff archaeologists in the office of the Mobile District, Corps of Engineers, we are concerned with the continuing exposure and erosion of shipwreck remains and the remains of Ft. McRae on the west side of the Pensacola Bay entrance channel and along Perdido Key. This problem is the result of sand starving as the westward littoral drift along Santa Rosa Island gets trapped in the Pensacola Bay. For that reason in order to minimize or avoid the adverse impact to significant archaeological resources, which would occur within the subject are do to increased erosion scour as a result of the channel deepening, we recommend that all soil suitable for beach nourishment be used as such along the west bank of the channel (the east end of Perdido Key) and along the Gulf beach of Perdido Key.

With respect to the disposal of other dredge materials within the above cited open water coordinates, then even though we have identified potentially significant historic shipwrecks within that area (as well as several non-historic shipwrecks and artificial fish reefs important to the local fishing economy), we would have to conclude that its use as a dredge disposal site would not affect the qualities which make such shipwrecks eligible for listing in the National Register. Thus, if the clean sand is used for beach nourishment, it is the opinion of this agency that the proposed offshore dredge disposal will have no affect on any properties listed, or eligible for listing, in The National Register of Historic Places.

If you have any questions regarding this matter, please do not hesitate to contact our office. Your interest and cooperation in helping to protect Florida's archaeological and historical resources are appreciated.

Sincerely,

fr George W. Percy, Director
Division of Historical Resources and
State Historic Preservation Officer

GWP/Tgv
cc: Dottie Gibbons

Several review copies of the DEIS were returned due to change of address. Of those groups listed in the DEIS (pages 7-1 to 7-4), the Alachua Conservation Council, Conservation, Environmental Confederation of Southwest Florida, FMCCA, Gulf Coast TB, and Trout Unlimited were returned and have been removed from the FEIS mailing list. Correct addresses were determined for other returns and DEIS copies were subsequently provided. For other returns, copies were not supplied to specific addresses since these groups were generically still represented on the DEIS list. Also, new addressees were provided copies during the DEIS review period and have been included on the FEIS mailing list.

The Notice of Availability of the Draft EIS was published in the Federal Register on June 10, 1988, and the public comment period closed on July 25, 1988. The Draft EIS was coordinated with approximately 150 Federal, State, and local agencies, interested groups, and individuals. A total of 19 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 FLORIDA
Office of the Governor
THE CAPITOL
TALLAHASSEE, FLORIDA 32399-0001

BOB MARTINEZ
GOVERNOR

August 11, 1988

Mr. Reginald Rogers
Coastal Programs Unit
Water Management Division
U.S. Environmental Protection Agency,
Region IV
345 Courtland Street, Northeast
Atlanta, Georgia 30365

Dear Mr. Rogers:

RE: Draft Environmental Impact Statement for Pensacola Deepwater Ocean Disposal Site Designation

This office has reviewed and coordinated a state review of the above Draft Environmental Impact Statement (DEIS). This review was conducted pursuant to the National Environmental Policy Act and other federal laws and directives. The State of Florida's statues, relevant state policies, goals and objectives, were considered as part of our review.

The Florida Departments of Environmental Regulation (DER) and Natural Resources (DNR) and the Florida Game and Fresh Water Fish Commission (GFWFC) have provided comments on the DEIS. These comments are attached for your consideration and summarized here as part of the State's response to the proposed action.

Before summarizing our comments, I would like to take the opportunity to express our sincere appreciation for the early coordination and consultation provided between the state, EPA, the Corps of Engineers and the Navy in consideration of locating a deep water disposal site off Pensacola. From the earliest stages of survey planning and site selection, you have met with representatives of the DER, DNR and this office to [1] discuss informational needs for proper site location, monitoring and management planning. This has resulted in a logical, comprehensive and scientifically defendable approach to solving environmental concerns. The opportunity afforded in the review of preliminary documents also greatly aided in further resolving or refining our differences early in the process. We believe that this continued cooperation will facilitate resolution of remaining concerns expressed in this review of the DEIS. Further, we recommend that this coordination process continue to serve as a model for future state-federal consultation on other ODMDS designations.

Several issues which have been the subject of ongoing discussion with EPA and the state remain unresolved by the DEIS. Concerns expressed by the reviewing agencies center [2]
primarily on locating the 2x3 mile disposal site within the 3 1/2 x 5 1/2 square mile area surveyed and the nature and fate of materials to be disposed there.

The Department of Natural Resources points out that the preferred alternative site is partially within state waters (see Figure A-8). If upon final site selection and the resolution of any environmental concerns the site remains in [3]
state waters the DNR staff will recommend approval of the project to the Governor and Cabinet for authorization pursuant to Sections 253.03 and 253.77, Florida Statutes.

The DNR also reiterates its position that all compatible sand should be placed on adjacent eroding beaches or in the littoral system and not offshore. Since the DEIS states that this new ocean disposal site is being designated for "predominately [4]
fine-grained dredged material" this should not pose a problem. We request that you clearly express in the final EIS the state's policy on beach quality sand disposal with respect to this site.

The Department of Environmental Regulation points out that approximately 50% of the preferred alternative site occupies the safety fairway established for the Pensacola navigational channel. They request clarification and discussion on any use conflicts this situation may present and means of mitigating them in designating this site. The DER also points out that [5]
only about 13 mi^2 of the calculated 19.25 mi^2 site (the DEIS reports 17 mi^2) has been covered in the live-bottom video survey. This situation reduces the level of confidence in moving the final site boundaries to avoid live-bottom habitat. As previously recommended by the State, we request that the final site be fully surveyed.

The DEIS states that the results of modeling studies currently underway to simulate transport of disposed material will be used to better define the actual size and location of the area to be designated as the ODMDS. Dispersion modeling is also essential for EPA to properly design and implement its site monitoring and management plan to ensure that siting criteria requirements are met. [6]

Upon completion of the dispersion analysis we request a meeting between the State, EPA and Corps representative to review and discuss the results. Application of the modeling results for selection of site boundaries can then be addressed in relation to other siting concerns brought out in this review. This information will be necessary to complete our review and concur with the consistency of the site designation under the Coastal Management Program. Consultation should occur as soon as possible so we may work to resolve any outstanding concerns prior to preparation of the final EIS. Please contact Mr. Paul Johnson at (904) 488-5551 to coordinate this request. [7]

Again, we thank you for EPA's cooperation in working with the State on this important matter.

Sincerely,

Estus D. Whitfield
Policy Coordinator
Environmental Policy Unit

EDW/rs

cc: Susan Invester, Mobile COE

enclosure

RESPONSE

1. We agree that the coordination process has worked very well on this project and can serve as a model for future projects of this type.

2. As stated in the DEIS, the numerical model (DIFID) was being utilized to simulate transport of the disposed dredged material as it descends through the water column and spreads over the bottom. That modeling effort has been completed and the results have been used to locate and determine the final size of the disposal site to be designated. The FEIS includes the results of the modeling effort and an analysis of the nature and fate of the materials to be disposed (See page 3-4 and Appendix H).

3. The Department of Natural Resources is correct, Alternative Site C is partially within state waters. The FEIS states that Alternative Site C is partially within state waters; however, the site proposed for final designation is completely outside state waters (See pages 1-2 and 3-3).

4. The FEIS states that the site is being designated for predominately fine-grained dredged material that meets the ocean dumping criteria but is not suitable for beach nourishment or disposal in the existing Pensacola (nearshore) ODMDS (See pages 1-1 and 2-2). We believe this language more clearly states the purpose for designating the new ODMDS.

5. The FEIS contains additional information on the regulations governing navigation safety fairways. Site C covers approximately 19 square miles including approximately half within the navigation safety fairway. There is no prohibition against designating an ODMDS within a navigation safety fairway. The final site proposed for designation is partially within the safety fairway and is in an area that was fully covered by the live-bottom video survey (See pages 4-7, 5-6, and 5-8).

6. Concur with comment.

7. A meeting was held in Tallahassee on August 16, 1988, to review and discuss the results of the numerical modeling. We believe the siting concerns brought out in the State's review of the DEIS have been resolved through the modeling effort and the final site selection. The FEIS includes the results of the modeling effort are presented in the FEIS (See page 3-4 and Appendix H).

State of Florida
DEPARTMENT OF NATURAL RESOURCES

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399

TOM GARDNER
Executive Director

BOB MARTINEZ
Governor
JIM SMITH
Secretary of State
BOB BUTTERWORTH
Attorney General
GERALD LEWIS
State Comptroller
BILL GUNTER
State Treasurer
DOYLE CONNER
Commissioner of Agriculture
BETTY CASTOR
Commissioner of Education

PLEASE ADDRESS REPLY TO:

GOVERNOR'S OFFICE
Planning and Budgeting
Intergovernmental Coord.
JUL 20 1988
RECEIVED

July 18, 1988

MEMORANDUM

TO: Wylie J. Dassie
State Clearinghouse
Office of the Governor

FROM: Pam McVety PM McVety/cwc
Environmental Administrator
Executive Director's Office

SUBJECT: Draft EIS for the Pensacola Ocean Dredged Material Disposal Site

Jack Woodard asked that I coordinate the department's comments on this project. The preferred alternative disposal site is partially within Florida waters. If the site remains there, permanent designation would require an easement pursuant to sections 253.03 and 253.77, Florida Statutes. Further, all beach compatible sand should be placed on adjacent eroding beaches or in the littoral system. The department has expressed this position in commenting on the pending Corps permit for the Pensacola Harbor Civil Works Project, on the Homeporting Project and in an earlier review of this document. [1]

We plan to work closely with the Corps and other affected agencies to get the beach compatible dredge material on our beaches.

PM/cwc
cc: Kirby Green
Ed Conklin

RESPONSE

1. See response to Comment Number 4 of State's cover letter.

FLORIDA GAME AND FRESH WATER FISH COMMISSION

FARRIS BRYANT BUILDING
620 South Meridian Street
Tallahassee, Florida 32399-1600
(904) 488-1960

June 28, 1988

RECEIVED
JUN 30 1988
COMMUNITY AND ECONOMIC
DEVELOPMENT POLICY UNIT
OFFICE OF THE GOVERNOR

Mr. Walt Kolb
Office of the Governor
The Capitol
Tallahassee, FL 32399-0001

RE: SAI FL8806061652E, Draft Environmental Impact Statement on an Ocean Dredged Material Disposal Site (ODMDS) in Deep Water offshore of Pensacola, FL

Dear Mr. Kolb:

The Office of Environmental Services of the Florida Game and Fresh Water Fish Commission has reviewed the referenced project and has no comments. [1]

If we may offer further assistance, please contact us.

Sincerely,

Douglas B. Bailey

Douglas B. Bailey
Assistant Director,
Office of Environmental
Services

DBB/BB/kh
ENV 1-3-2

RESPONSE

1. Thank you for your comment. No response required.

Florida Department of Environmental Regulation

Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400

Bob Martinez, Governor | Dale Twachtmann, Secretary | John Shearer, Assistant Secretary

July 19, 1988

Mr. Paul Johnson, Senior Governmental Analyst
Intergovernmental Coordination
Office of the Governor
404 Carlton Bldg
Tallahassee, FL 32399-0001

Dear Mr. Johnson:

RE: Draft Environmental Impact Statement
Pensacola Deepwater Ocean Disposal Site Designation

We have completed a review of the referenced document and offer the enclosed comments from staff of our Tallahassee and Pensacola offices. Our preliminary remarks of April 21, 1988 are also incorporated by reference.

Several issues which have been the subject of ongoing discussion remain unresolved by the DEIS. This is primarily due to the need to review the results of the dispersion analysis which is not yet [1] complete. When this study is finalized, we would like to review it and then meet with EPA and Corps representatives to discuss the points outlined in our comments. This consultation should occur as soon as possible following our receipt of the dispersion study so that we may resolve any outstanding concerns prior to preparation of the final EIS.

If you have any questions regarding our comments, please contact Lynn Griffin at 904/487-2477.

Sincerely,

Gary L. Shaffer, Deputy Director
Division of Water Management

GLS/jmw

Enclosure

cc Randy Armstrong
Dave Worley
Dave Arnold
Robert Kriegel

RESPONSE

1. See response to Comment Number 7 of State's cover letter.

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

Interoffice Memorandum

For Routing To Other Than The Addressee	
To:	Location:
To:	Location:
To:	Location:
From:	Date:

TO: Gary Shaffer

THROUGH: Mickey Bryant

FROM: Lynn Griffin

DATE: July 14, 1988

RE: Draft Environmental Impact Statement, Pensacola Deepwater Ocean Disposal Site Designation

This site designation has been the subject of much prior coordination including a review of a preliminary version of the referenced DEIS. (See attached comments.) This coordination has been productive and resulted in a much-improved site designation process. However, several of the points and recommendations raised in our April 21 comments went unaddressed or require further clarification.

1. EPA surveyed two 3½ x 5½-mile sites with benthic and water quality sampling and photography. The chosen site was to have a 2 x 3-mile disposal site designated within this larger area. On review of the preliminary DEIS, we requested figures showing the 2 x 3-mile site boundaries and the area of video survey coverage. The figure of the survey transects was provided showing that video covered only about 13 mi^2 of the 19.25 mi^2 area of Site C (figure A-10). Now EPA states that it is not certain that the actual dump site boundaries will be coincident with the area photographed. It would not be appropriate to designate a site which has not been surveyed. We agree with using the dispersion analysis results to guide in positioning the site, but the entire 3½ x 5½-mile site should have been cleared if this approach is to be used. [1]

We also would like further clarification as to how the fairway will affect siting since it overlaps over 50% of Site C. Previously we were assured that the fairway presented no use conflicts. However, the DEIS now states that no discharge is allowed in a safety fairway (Table 5-1). How is this apparent conflict to be resolved? [2]

2. Paragraph 5.09 expresses EPA's opinion that the two artificial reef sites proposed in Site C present no impediment to designation since their elimination would not be a significant impact to the area. While this may be true, our preliminary comments requested confirmation that EPA had resolved this issue with the applicants for the reef sites. [3]

Gary Shaffer
July 14, 1988
Page 2

3. We made several points regarding the monitoring program protocol and requested consultation on these issues prior to completing the DEIS. We recommended that the program specify the following: [4]

station locations in and around the 2 x 3-mile site;
operational monitoring;
contingencies if unacceptable impacts occur;
triggers for contingencies;
reporting requirements.

The program presented in the DEIS, Appendix G is unchanged from that provided with the preliminary document.

4. We requested that EPA provide the still photographs for our review if they were not reproduced in the DEIS. We have not received this information. [5]

5. We appreciate that the dispersion analysis is still in preparation. Since many final decisions rest on the conclusions of this study, it is very important that we review it before it is presented in the final EIS. [6]

6. In several places in the text, Sites B and C are referred to as 17 mi^2 in area. Using 3½ x 5½-mile dimensions, this figure should be 19.25 mi^2. [7]

7. Table 5-1, item 8, lists the amount of fairway overlap for Site C as 33%. If figure 4-2 is scaled correctly, the overlap exceeds 50%. [8]

In order to ensure a final EIS which fully addresses these unresolved issues, we request a meeting between EPA, the Corps and appropriate state representatives as soon as the dispersion study is available for review. At that time we wish to discuss its results, dump site boundaries, the monitoring program, and any other points raised in the state's comments on the DEIS. This information will be necessary to complete our review and concur with the consistency of the site designation under the Coastal Management Program. [9]

Florida Department of Environmental Regulation

Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400

Bob Martinez, Governor | Dale Twachtmann, Secretary | John Shearer, Assistant Secretary

April 21, 1988

Mr. Paul Johnson
Senior Governmental Analyst
Environmental Policy Unit
Governor's Office of Planning
and Budgeting
404 Carlton Building
Tallahassee, Florida 32399-0001

Dear Mr. Johnson:

Re: Preliminary Draft Environmental Impact Statement, Pensacola Deepwater Ocean Disposal Site Designation

Enclosed are our comments on the referenced draft EIS. Overall, we are pleased that our preliminary consultation over the last year has resulted in a quality environmental evaluation.

We very much appreciate the opportunity for early coordination on EPA's site designation studies. We believe the cooperation between the EPA, the Corps, the Navy and the State on this site review will facilitate its designation. We also believe this coordination can serve as a model for state-federal consultation on other site designations.

Please contact Lynn Griffin at 904/487-2477 if you have any questions concerning our comments.

Sincerely,

Gary L. Shaffer

Gary L. Shaffer, Deputy Director
Division of Environmental
Permitting

GLS/ka

Enclosure

cc: Randy Armstrong
Dave Worley
Dave Arnold

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

Interoffice Memorandum

For Routing To Other Than The Addressee

To:		Location:	
To:		Location:	
To:		Location:	
From:		Date:	

TO: Gary Shaffer

THROUGH: Mickey Bryant

FROM: Lynn Griffin

DATE: April 21, 1988

SUBJECT: Preliminary Draft Environmental Impact Statement, Pensacola Deepwater Ocean Disposal Site Designation

Background

EPA and the Corps have provided us an advance copy of the referenced DEIS to allow for preliminary consultation on its conclusions and recommendations. This is the first ocean disposal site designation with which we have been involved from the earliest stages of survey planning and site selection. We hope the close cooperation we have experienced from EPA, Corps and Navy staff will continue as we proceed with this designation and others in the future.

In the past, our criticisms of the site designation process centered on its lack of scientific investigation into the geological and biological characteristics of the site and an analysis of the probable fate of dispersed material. We also have objected to proceeding with final designation without specifying site management and monitoring programs for the use of the site. The studies for the Pensacola deepwater site designation are much closer to meeting these concerns than any of the site studies we have seen so far.

Site Characterization

The search for a site was approached in a logical, comprehensive manner, examining broad concerns first. A target area was mapped based on economic and environmental exclusion criteria. Within this area, alternative sites were selected for more in-depth studies. The site survey protocol closely matches our recommendations made during earlier coordination.

The EIS should include a figure showing the video transects and still photo locations. It should distinguish which 6 mi^2 was photographed within the 3 1/2 x 5 1/2 mile study area (p. A-3, para. 10). The EIS should also include copies of still photos or make them available for our review.

The two sites under consideration are soft bottom habitats. As such, changes in benthic infaunal community structure is the best indicator of biological impact from dredged material deposition. The characterization of benthic macroinvertebrates should be more thorough than that presented in section 4.10. Rather than gross densities and a list of abundant forms, species data should be interpreted through cluster analyses of similarity dendograms in order to describe spatial variability within the proposed sites.

Dispersion Analysis
NORDA conducted a field study of area currents and used the data to calibrate a numerical model. The study is very well done and we are confident of the utility and reliability of the model. However, in section 5.07 it is concluded that, based on the model's results, "the discharge of dredged material into either alternative ODMDS would have negligible impact on the circulation and mixing of the shelf waters."

Our interest in this study was not prompted by the concern addressed in the above conclusion. Instead, it's the circulation's impact on the dredged material which should be addressed. NORDA's study was expected to incorporate a predictive analysis of the probable footprint of a given quantity and type of dredged material disposed at a specific location in the proposed site. This should be accompanied by an assessment of the probability of mounding, redistribution on the bottom, and resuspension of desposited materials. Without such information, there is no support for conclusions such as "impacts would be localized to the immediate area of the disposal operation and would be temporary in nature" (5.09) or that ambient water quality levels will be maintained "within a short distance from the release point" (5.14).

Site Management/Monitoring Program
We are pleased to see a monitoring program outlined in the DEIS. Its protocol mirrors that used in the site characterization studies and will, therefore, allow before and after comparisons.

The goals of the monitoring program should be to document the short and long term environmental consequences of dredged material disposal, to verify that impacts are contained within the boundaries of the site, and to trigger site management contingencies if unacceptable impacts are detected outside the site. To do this, monitoring should be conducted during operations as well as over a longer term. Benthic infauna should be used as indicators of biological change. Contingency measures and the conditions which trigger them should be specified. Prompt reporting of monitoring results is essential to a responsive monitoring and site management program. We would like to consult with EPA further on these points to help establish the final monitoring program for the DEIS.

Miscellaneous

Most of the figures in the DEIS need legends. All of the figure labeled as sites B and C show the 3 1/2 x 5 1/2 mile study area. The actual 2 x 3 mile site boundaries should be shown. For monitoring, the stations should fall in and around the perimeter of the 2 x 3 mile site.

There are proposed and existing artificial reefs located in areas B and C. Has there been some resolution with the applicants for the proposed reef sites? If a disposal site in area B is selected, obviously it should not include the existing artifical reef sites. Monitoring stations would need to be established on these reefs if site B is chosen.

LG/ke

RESPONSE

1. See Response to Comment Number 5 of State's Cover Letter.

2. See Response to Comment Number 5 of State's Cover Letter.

3. The two proposed artificial fishing reefs within Site C are only two of a large number of reefs that have been proposed for construction by the Escambia County Commission. Permit applications have not been filed for these two sites. Escambia County personnel were contacted by telephone and the DEIS was provided to the Escambia County Commission for review. We believe that we have adequately coordinated with the Escambia County Commission on this issue. Section 5.09 of the EIS has been revised to more accurately present the status of the sites being considered for proposal as artificial reefs.

4. Appendix G of the EIS has been modified to address these concerns.

5. The still photos are being provided to the Florida Department of Environmental Regulation.

6. See Response to Comment Number 7 of State's Cover Letter.

7. These errors have been corrected in the FEIS.

8. Table 5-1 and Figure 4-2 have been corrected in the FEIS.

9. See Response to Comment Number 7 of State's Cover Letter.

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

Interoffice Memorandum

For Routing To Other Than The Addressee	
To: David Arnold	Location:
To:	Location:
To:	Location:
From:	Date:

TO : David Arnold

THROUGH: Robert V. Kriegel

FROM : W. Richard Fancher

DATE : July 18, 1988

SUBJECT: Draft EIS for Designation of a New Ocean Dredged Material Disposal Site, Pensacola, FL

RECEIVED
BUR. OF PERM.
JUL 26 1988

You asked that we send our response to EPA's June 1988 request for comments concerning the Draft EIS for the Pensacola ODMDS.

My biggest concern is with the quality of the dredged material and its fate in the Gulf of Mexico. Thirty-six percent (36%) of the 4.1 million cubic yards of material to be dredged is clays and silts according to the EIS. Sections 4.07 Sediment Quality and Characteristics and 4.10 Benthos indicate the existing bottom conditions as medium to coarse heavily rippled sand. Water currents are up to 1.6 fps normally. [1]

Though the Draft EIS indicates that the ODMDS is large enough for the dredged material to settle out within it, the water current data and existing bottom conditions seem to indicate that the clays and silts will not settle out within the proposed 17 square mile site.

Previous sampling of the area to be dredged by Northwest District and Coastal Zone Management staff has demonstrated elevated levels of heavy metals, pesticides (including PCBs) and petroleum hydrocarbons within the bottom sediments, in contrast with the much lower levels reported in the Draft EIS. [2] A summary memo of July 6 from Donald Ray with attachments is enclosed. I recommend the Final EIS include the DER acquired sediment information, and reconcile the seemingly disparate sets of data.

The Draft EIS stated that the Final EIS will contain modelling to better define the expected settling zone for the dredged material. I recommend that the modelling effort look at the clays, and their constituents separately from the sand; [3] that the modelling take into account any water column stratification that exists; attempt to predict where the clays and silts will settle out, and at what concentrations any problem constituents will be.

Can the dredged material be expected to induce or aggravate red tide conditions (Section 3.11 Potentially for the Development or Recruitment of Nuisance Species in the Disposal Site)? If the clays and silts do not settle out within the 17 sq. mi. ODMDS, could they induce or aggravate red tide elsewhere? [4]

I recommend the final EIS include consideration of the 1,200' deep ODMDS site for the initial 4.1 million cubic yard dredging and spoil disposal project, and the use of the 17 sq. mi. Site C for future disposal of smaller quantities of maintenance dredged material. [5]

WRF/wfw

RECEIVED
BUR. OF PERM.
JUL 26 1988

Florida Department of Environmental Regulation

Northwest District ● 160 Governmental Center ● Pensacola, Florida 32501-5794 ● 904-436-8300

Bob Martinez, Governor | Dale Twachtmann, Secretary | John Shearer, Assistant Secretary
Robert Kriegel, Deputy Assistant Secretary

August 19, 1988

Henry Malec
U.S. Army Corp of Engineers
P.O. Box 2288
Mobile, Alabama 36628

Dear Mr. Malec:

This is in response to your August 19 telephone request for the water quality data attachments to my July 18 memo regarding the draft EIS for Designation of a New Ocean Dredged Material Disposal Site for Pensacola, Florida.

The data is attached. If you have any questions about the sampling sites or results, feel free to call me at (904)436-8300.

Sincerely,

W. Richard Fancher
Special Assistant

WRF/wfw
Attachment

For Routing To Other Than The Addressee	
To	Location
To	Location
To	Location
From	Date

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

Interoffice Memorandum

TO: Dick Fancher

THROUGH: Bob Brazzell

FROM: Donald Ray

DATE: July 6, 1988

SUBJECT: Comments on Draft Copy of Homeport EIS Sediment Analyses from Pensacola Bay

In reviewing sediment data collected in Pensacola Bay by Corps of Engineer (1978) EG & G (1980), DER Coastal Zone Management (1984 & 1985) and the Northwest District (1985), I found many samples indicating anthropogenic enrichment of metals, pesticides (including PCB's), and petroleum hydrocarbons.

DER monitoring found a considerable number of samples high in organic material compared to mostly sand substrate sampled by the Navy. Most contaminates settle in depositional areas in contrast to erosional areas characterized by insert sand.

Water quality violations of silver, copper, and nickel were found by DER industrial compliance monitoring in Pensacola Bay near the Lexington dock behind Building 631 January 3, 1986. A cursory examination of sediment quality in lower Pensacola Bay January 28, 1985 revealed high concentrations of cadmium, chromium, copper, lead, and zinc off the NAS bulkhead near Building 604. Since this is an uncontrolled and uninvestigated source(s), I have concerns about the fate of these pollutants in Pensacola Bay.

In summary I have concerns about the adequacy of the Navy's monitoring, since monitoring by DER and other agencies have found higher concentrations of pollutants in lower Pensacola Bay. I suggest that DERCZM experts on sediment quality review and coordinate their findings on Pensacola Bay with Reginald Rogers of EPA.

RB:drh
Attachments

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

Interoffice Memorandum

FOR ROUTING TO OTHER THAN THE ADDRESSEE

To: ______ Loctn: ______
To: ______ Loctn: ______
To: ______ Loctn: ______
From: ______ Date: ______

TO: DONALD RAY

FROM: JOE RYAN

DATE: JULY 23, 1987

SUBJECT: CHEMICAL DATA FOR THE PENSACOLA BAY SYSTEM

I have enclosed copies of the most recent chemical data compiled by the Office of Coastal Management (1985-1987) for your files. As I mentioned, we are currently preparing a technical report for the Pensacola area, and I anticipate a draft report to be released sometime this fall. All of the results are for bottom sediments.

Currently, we have 3 quarters of seasonal nutrient data for clean (unpolluted) sediments in the Perdido River, East Bay, and Santa Rosa Sound, and the final sampling will take place in October. You might also be interested to know that we have also collected data from similar sites in Choctawhatchee, St. Andrew, St. Joe, Apalachicola, Ochlocknee, and Apalachee Bays. From these data we hope to develop a nutrient interpretive tool based on nutrient chemistry (TKN, TOC, and TP) from clean areas like these throughout State.

Additionally, we have plans to collect more chemical data on the Perdido Bay system. However, this is contingent on federal funding later this summer. I would like to meet with you and anyone in your office that might be inerested, should we receive the money. I will keep you informed of the status of the project over the next few mont

Please call me if you have any questions. You will note that none of the data have been interpreted, and only raw data are presented on th sheets.

cc: Robert Brazzell

Donald,
I'm wrapping
up the Perdido data
(a separate "Area")
& not yet available
call [illegible] Steve Schropp.
— [illegible]

CZM CHEMICAL DATA
for
PENSACOLA BAY SYSTEM

..T OF ENVIRONMENTAL REGULATION

..ER QUALITY REPORT FORM

AGENCY	STATION	DATE	TIME A - GRAB SAMPLE	DEPTH
		1/3/86	10:30AM	0.25m

TIME B COMPOSITE SAMPLE

COMP | BEGIN | END

004344

REMARKS

WATER:METALS

LOCATION Pensacola Bay-NAS Behind Bldg 631

PARAMETER	UNIT	CODE	VALUE	PARAMETER	UNIT	CODE	VALUE
AG	UG/L	1077	40				
CA	MG/L	916					
CD	UG/L	1027	10K				
CR	UG/L	1034	40K				
CU	UG/L	1042	100				
FE	UG/L	1045	130				
K	MG/L	937					
MG	MG/L	927	645				
MN	UG/L	1055	30				
NA	MG/L	929					
NI	UG/L	1067	290				
PB	UG/L	1051	40K				
SR	UG/L	1097					
ZN	UG/L	1092	280				

SAMPLE TAKEN BY: STEPHEN Baisden

REPORT PREPARED BY:

REPORT VERIFIED BY: David Staples 1-14-86

( ) CHANGE DATE SUBMITTED

DER Form PERM 21-10 (Jun 76)

For Routing To District Offices And/Or Other Than The Addressee	
To:	Locn.:
To:	Locn.:
To:	Locn.:
From:	Date:
Reply Optional [ ] Reply Required [ ]	Info. Only [ ]
Date Due:	Date Due:

..NT OF ENVIRONMENTAL REGULATION

..EROFFICE MEMORANDUM

May 1, 1985

TO : Dick Fancher

THRU : Robert J. Brazzell
William T. Young

FROM : Donald H. Ray

SUBJECT: Results of Sediment Metals Analyses for the Proposed Pensacola Naval Air Station Dredging lower Pensacola Bay

Limited sediment sampling for metal parameters was done on January 28-29, 1985 by Glenn Butts and myself. These samples were taken to obtain a cursory examination of the sediment quality in lower Pensacola Bay. Six sediment samples were taken in relation to the harbor deepening projects. Two samples each were taken near the NAS Industrial Wastewater Treatment Plant out-fall and the Main Street Wastewater Treatment Plant out-fall. Both dischargers are just up bay from the proposed project and sediment migration down channel would be expected.

Data interpretation using the DER Deepwater Ports Maintenance Dredging Manual found some elevated levels of metals in the sediments which suggest anthroprogenic inputs:

Station 1 - Mainstreet WWTP - lead, mercury, zinc, arsenic.
Station 2 - Mainstreet WWTP - lead, mercury, zinc, arsenic.
Station 3 - NAS WWTP - lead, chromium, cadmium.
Station 4 - NAS WWTP - lead, zinc, arsenic.
Station 5 - Lexington Berth - lead, zinc.
Station 6 - NAS Old NARF outfall - lead, copper, chromium, cadmium, mercury, zinc, arsenic.
Station 7 - Middle-Turning Basin - lead, zinc, arsenic.
Station 8 - Between Lex Dock and Marker 16 - lead
Station 9 - Near Marker 34 - lead.
Station 10- Near Marker 19 - lead, zinc.

Metal parameters analyzed for this project included all the metals found at Station 6 plus nickel. Chlorinated hydrocarbon and synthetic organic compound analyses were not performed on these samples.

All samples consisted of 3 petite ponar replicates composited for each station. No core sampling was done for this survey.

The highest levels of metals were found along the NAS bulkhead. Only Station 3 and 5 did not consist of organic ooze. Station 3 was washed by the NAS outfall and Station 5 was scoured by prop wash from the USS Lexington (or its tugs).

DHR/drg

RESPONSE

1. See Response to Comment Number 2 of State's Cover Letter.

2. We believe the sediment quality data presented in the DEIS is representative of the material to be dredged. The Navy and the Corps of Engineers worked very closely with the Department of Environmental Regulation, particularly the Coastal Zone Management Office, to ensure that the sediment sampling program would be adequate for the homeport project. A very extensive sediment sampling program was developed including collection of 51 vibracore samples and conducting physical, chemical and biological testing of the sediments. The sediment quality data was included in the Navy's FEIS which was filed with EPA in January 1987. The results are similar to those from other Pensacola Bay sediments conducted in 1984. In addition, recent studies conducted by the EPA in other Gulf of Mexico Estuaries and estuaries along the Atlantic coast have revealed similar heavy metal concentrations in sediments (See Section 5.05 of the FEIS).

3. See Response to Comment Number 2 of State's Cover Letter. No significant water column impacts were found (See Section 4.06 of the FEIS and Appendix C). Water and sediment chemical analyses, elutriate tests, and bioassays all indicate that no particular constituent will be a problem (See Section 5.05 and Appendices C and D). No significant stratification was found (See Section 4.06 of the FEIS and Appendix C).

4. There is no known evidence to indicate that the dredged material would induce or aggravate red tide conditions.

5. The 1,200-foot deep alternative ODMDS was considered but was not selected for detailed analysis because it is outside the economic haul distance of 20 miles from Pensacola Pass (See Section 3.05 of the FEIS). Site C will also be considered as a disposal area for future maintenance material.

(oan)
(504) 589-6234

16500

Coastal Programs Unit
Attn: Reginald Rogers
Water Management Division
U. S. Enviromental Protection Agency
Region IV
345 Courtland Street, NE
Atlanta, GA 30365

Dear Gentlemen:

After reviewing the Draft Enviromental Impact Statement for an Ocean Dredged Material Disposal site in deepwater offshore Pensacola, Florida, I find no reason to object to its establishment. My position is predicated on the fact that direct discharge into the safety fairway will be prohibited as stated in paragraph d, page 5-6 of the study.

Sincerely,

GARY A. BIRD
Commander, U. S. Coast Guard
Chief, Aids to Navigation Branch, Acting
By direction of District Commander

(oan)
(504) 589-6234

16500
6 SEP 1988

Coastal Programs Unit
Attn: Reginald Rogers
Water Management Division
U. S. Enviromental Protection Agency
Region IV
345 Courtland Street, NE
Atlanta, GA 30365

Gentlemen:

The Army CORPS of Engineers in Mobile has voiced concern over my comments on the Draft Environmental Impact Statement (EIS) for the designation of a new Ocean Dredged Material Disposal Site offshore near Pensacola. Although the draft EIS indicates a prohibition of direct dumping in the safety fairway, the Army COE feels it is necessary and intends dumping a substantial portion of the material into a brimmed area in the fairway. After a careful review of water depths in the area, I find no reason to object to the establishment of "Site C" and encroaching on the fairway as long as a minimum navigable water depth of 65 feet is maintained. [1]

Sincerely,

GARY A. BIRD
Commander, U. S. Coast Guard
Chief, Aids to Navigation Branch, Acting
By direction of District Commander

BOHNER/eh/9-2-88

RESPONSE

1. The FEIS has been revised to indicate that direct discharge into the navigation safety fairway will be allowed but bathymetric changes in the navigation safety fairway will be restricted to prevent impacting navigation (See Section 5.16). A minimum navigation depth of 65 feet will be maintained.

United States Department of the Interior

OFFICE OF ENVIRONMENTAL PROJECT REVIEW
RICHARD B. RUSSELL FEDERAL BUILDING, SUITE 1320
75 SPRING STREET, S.W.
ATLANTA, GEORGIA 30303

TAKE PRIDE IN AMERICA

July 19, 1988

ER-88/504

Mr. Reginald Rogers
Coastal Programs Unit
Water Management Division
Environmental Protection Agency
Region IV
345 Courtland Street NE
Atlanta, GA 30365

Dear Mr. Rogers:

The Department of the Interior has reviewed the draft Environmental Impact Statement for the Designation of a New Ocean Dredged Material Disposal Site, Pensacola, Florida, and has the following comments to offer.

The draft statement adequately addresses the biological and technical aspects of ocean dumping offshore Pensacola, Florida. The proposed monitoring plan should provide sufficient post-dumping data to assess site conditions. We have no further comments to offer at this time. [1]

Thank you for the opportunity to comment on the statement.

Sincerely yours,

James H. Lee

James H. Lee
Regional Environmental Officer

RESPONSE

1. Thank you for your comment. No response required.

United States Department of the Interior

TAKE PRIDE IN AMERICA

OFFICE OF ENVIRONMENTAL PROJECT REVIEW
RICHARD B. RUSSELL FEDERAL BUILDING, SUITE 1320
75 SPRING STREET, S.W.
ATLANTA, GEORGIA 30303

July 20, 1988

ER-88/504

Mr. Reginald Rogers
Coastal Programs Unit
Water Management Division
Environmental Protection Agency
Region IV
345 Courtland Street NE
Atlanta, GA 30365

Dear Mr. Rogers:

This supplements Department of the Interior comments sent to you on July 19, 1988, and addresses National Park Service interests.

Figure 4-4 on page 4-11 incorrectly identifies areas on Santa Rosa Island. Delete "Fort Pickens State Park" and change "Gulf Islands National Seashore (Santa Rosa)" to "Gulf Islands National Seashore (Fort Pickens)". The former Fort Pickens State Park is now a part of Gulf Islands National Seashore. [1]

Section 5.04 on page 5-2 incorrectly identifies beaches and amenity areas. Delete "Fort Pickens State Park" and correctly identify the aquatic preserve as the "Fort Pickens Aquatic Preserve." [2]

Appendix A, part 6, page A-2, under the heading of Aquatic Preserves incorrectly identifies park lands on Santa Rosa Island. Change "State Park" to "former State Park, now part of Gulf Islands National Seashore." [3]

Figure A-6 on page A-11 in Appendix A incorrectly identifies the aquatic preserve. Change "Fort Pickens State Park Aquatic Preserve" to "Fort Pickens Aquatic Preserve." [4]

Appendix D, tables 7 and 8, pages D-50 and D-51. The horizontal axis labels on these two tables appear to have been transposed. The horizontal axis label on table 7 should read "Concentrations in ug/g wet weight" and the label on table 8 should be "Concentrations in ug/g wet tissue weight." [5]

Section 5.05, third paragraph, on page 5-3. The statement "The results generally show that heavy metals... in the sediments (from the eight sample stations in the turning basin area) are at levels lower than would normally be expected in "natural" sediments" is misleading and inaccurate. The phrase "natural" sediments apparently refers to the "average crustal material" as defined by the Handbook of Chemistry and Physics, 1984, and listed as a comparison on page D-7 of Appendix D. This type of material bears little resemblance to the types of sediments normally occurring in an area like Pensacola Bay and constitutes an unrealistic comparison standard. A more meaningful comparison could be obtained by using sediments from an unperturbed area within the Bay but outside the study area. This type of comparison was utilized in the bioaccumulation study and clearly showed a significant elevation in certain heavy metal concentrations over what could reasonably be considered "natural" levels. [6]

Appendix B. Statements within the abstract and conclusion of chapter one (pages B-4
and B12-14 contradict the abstract and conclusion of chapter three (pages B-38 and B- [7]
92). Chapter one states that the current analysis model predicts currents will be
stronger and more often toward the west while chapter three makes the opposite
conculsion.

Appendix D. The test species utilized in the toxicity and bioaccumulation analyses do
not seem to accurately represent the marine communities in question. The use of
esturarine, shallow water species such as Arenicola cristata and Crassostrea virginica to
evaluate effects upon marine, deep water species seems inappropriate and of
questionable value. Of additional concern was the use of Arenicola cristata collected [8]
from St. Petersburg, FL rather than this area and the lack of distinction as to life cycle
stage of the Penaeus duorarum utilized (juvenile forms of Penaeus d. are estuarine,
adults are marine). Geographic variations and developmental state can be significant
factors in an organism's ability to deal with environmental stress.

Appendix D, Abstract, pages D 32-33. The statement regarding mean values for
organisms exposed to the reference sediment is misleading and undermines test results.
Significant bioaccumulation was determined to occur; the generalization that this may
not indicate a potential problem because the degree was less than an order of magnitude [9]
greater is an oversimplification. Depending upon the species involved, stage of life
cycle, position in the food chain, presence of other stressing factors, etc.,
bioaccumulation of toxic compounds at less than an order of magnitude could have
adverse effects.

Appendix G, Proposed Monitoring Plan. The apparent establishment of sampling station
locations prior to the determination of the exact location of dredged material deposition
seems premature. While establishing fixed locations for the sample sites is prudent, it
would appear necessary to await final site determination in order to ensure the presence [10]
of a sampling site within the actual zone of deposition. The present scheme provides for
good coverage in monitoring spread and effects within the entire disposal site but could
potentially miss the actual zone of deposition.

Sincerely yours,

James H. Lee

James H. Lee
Regional Environmental Officer

RESPONSE

1. Figure 4-4 has been corrected in the FEIS.

2. Section 5.04 has been corrected in the FEIS.

3. Appendix A, part 6, page A-2 has been corrected in the FEIS.

4. Figure A-6, page A-11, Appendix A has been corrected in the FEIS.

5. The EIS has been corrected as suggested. Parts 2 and 3 of Appendix D have been replaced in total with the final bioassay and sediment and chemical analyses reports.

6. We do not agree that the levels of heavy metals presented in the DEIS are misleading or inaccurate. The data presented in the DEIS are the same as presented in the Navy's FEIS for their Gulf Coast Strategic Homeporting Project. Florida Department of Environmental Regulation (FDER) guidelines for deepwater ports maintenance dredged material management plans were used for interpreting heavy metals concentrations in the sediments and not the average crustal material values in Appendix D. Included in the FDER guidelines is a methodology for the interpretation of heavy metal concentrations in estuarine sediments. The need for this methodology results from the natural chemical processes occurring in the estuary and its associated drainage basin. For fine-grained sediments a metal-to-aluminum ratio has been developed for Florida estuaries against which a recorded value can be compared. This allows a determination of whether a particular metal concentration is the result of natural processes or man-induced activities. In addition, recent studies conducted by the EPA in other Gulf of Mexico estuaries and estuaries along the Atlantic Coast have revealed similar heavy metal concentrations in sediments (See page 5-3).

7. The EIS has been corrected as suggested.

8. We believe the selected test species are appropriate sensitive marine organisms which are representative of benthic and epibenthic animals from the "communities in question." The use of surrogate species in aquatic, avian, and mammalian toxicological studies is well founded. The same three types of organisms were used in similar tests that were conducted in 1984 for the Department of the Interior, Fish and Wildlife Service, to evaluate sediment from Mobile Bay, Alabama.

9. We do not believe the statements in Appendix D about concentrations of chemicals in the reference sediment or in tissues of organisms exposed to the reference "misleading" nor do they "undermine test results." The reference sediment was the control for the tests and essential for comparative purposes. The reference sediment served as the baseline to which mortality, water quality, and bioaccumulation in the two site sediments could be compared.

The commenter is correct in stating (as we did) that "significant bioaccumulation" of some metals occurred. However, apparently the commenter did not consider the magnitude of bioaccumulation. The data from which "significant" bioaccumulation calculations were made are listed below to aid data interpretation.

Organism	Metal	Concentration (ug/g) Reference sediment	Site[1]	Difference
Arenicola cristata	Ni	1.27	3.60(2)	2.8X
Crassostrea virginica	Cd	0.27	0.59(2)	2.2X
	Ni	2.60	2.88(2)	1.1X
	As	2.2	2.9(1)	1.3X
		2.2	3.7(2)	1.7X
	Cu	4.6	7.5(1)	1.6X
		4.6	11.4(2)	2.5X
	Zn	136	234(1)	1.7X
		136	326(2)	2.6X

[1]Site number in parentheses.

We reaffirm the conclusion that the bioaccumulation magnitude (<3X) exhibited by the test organisms under the test conditions does not warrant concern. The conclusion 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 ≤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 but, is an essential factor in conducting a risk assessment or preparing an environmental impact statement.

10. The sampling station locations shown on Figure D-1 in Appendix D have been modified to reflect the proposed discharge location.

DEPARTMENT OF THE AIR FORCE
REGIONAL CIVIL ENGINEER, EASTERN REGION (HQ AFESC)
526 TITLE BUILDING, 30 PRYOR STREET, SW
ATLANTA, GEORGIA 30335-6801

REPLY TO ATTN OF: ROV2

12 July 1988

SUBJECT: Draft Environmental Impact Statement (DEIS) for Designation of a New Ocean Dredged Material Disposal Site (ODMDS), Pensacola, Florida

TO: US Environmental Protection Agency
Region IV
Water Management Division
Coastal Programs Unit
Attn: Mr Reginald Rogers
345 Courtland Street, NE
Atlanta, GA 30365

1. We have reviewed the subject DEIS and find that the location of the ODMDS, as proposed, will not impact Air Force operations in the vicinity of Pensacola, Florida. However, the proposed ODMDS may be located within special use airspace area W-155 as shown on the attached map (Attachment 1). The Navy periodically uses W-155 for surface and air training, so that ships discharging dredged material could encounter naval vessels and low-flying aircraft conducting training exercises. Should you desire to contact the Navy, their point of contact (POC) is: [1]

Training Air Wing 6
Pensacola NAS
Pensacola, Florida 32508-5000
Attn: LCDR Vollundorf
Phone: 904-452-4671

2. Thank you for the opportunity to review this DEIS. Our POC is Mr Winfred G. Dodson at 404-331-5313/6776.

GEORGE A. VALENTE, JR., Lt Col, USAF
Deputy Regional Civil Engineer

1 Atch
Airspace Map

cc: HQ USAF/LEEVX
HQ AFSC/DEEV
HQ MAC/DEEV
AD/DEEV
834 CSG/DEEV


Tuscaloosa
Louisville-Winston Co.
Macon Muni
Philadelphia Muni
OLF Alpha
OLF Joe Williams
NAS Meridian
Meridian
O'Keefe Field
Key Field
Meridian FSS
Clarke Co
Demopolis Field
Vaiden Field
Craig Field
Selma
Wetumpka Muni
Maxwell AFB
Montgomery
MONTGOMERY
Donnelly Field
Auburn-Opelika Robert G. Pitts
Moton Field
Tallassee Muni
Lawson AAF
Weedon Field
Troy Muni
Elba Muni
Andalusia-Opp
Enterprise Muni
Dothan FSS
Dothan
Cairns AAF
Headland
Nuclear Power Plant
Geneva Muni
Crestview FSS
DeFuniak Springs
Marianna Muni
Thigpen Field
Waynesboro Muni
Wesley Noble Field
Richton Perry Co
Evergreen
Brewton Muni
ACTIVITY CONCENTRATED STUDENT FLYING
Bay Minette Muni
NAS Whiting Field-North
NAS Whiting Field-South
NAS Ellyson
Milton Field
Pensacola Regional
MOBILE
Bates Field
St Elmo
Fairhope Muni
OLF Barin
Foley Muni
OLF Wolf
NAS Pensacola
Hurlburt Field
Destin-Ft Walton Beach
Panama City
Tyndall AFB
Apalachicola Muni
Gulfport-Biloxi Regional
Stennis Intl
Keesler AFB
Dauphin Island
I.H. Bass Jr. Mem
Dean Griffin Memorial
BRETON SOUND
A-211
A-292
R-2905A
R-2905B
W-453
W-155
W-151A
W-151B
W-151C
W-151D

RESPONSE

1. Comment Noted. Thank you for your comment. The proposed ODMDS is not within special use air space area W-155 as designated on the map you provided (See pages 4-8 and 5-7).

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

August 9, 1988

Mr. Chris Hoberg
U.S. Environmental Protection Agency
Region IV
345 Courtland Street
Atlanta, Georgia 30365

Dear Mr. Hoberg:

This is in reference to our July 29, 1988, letter to your office. We erroneously referred to the report on the Designation of a New Ocean Dredged Material Disposal Site, Pensacola, Florida, as a Final Environmental Impact Statement. It should have read Draft Environmental Impact Statement.

As stated in the July 29 letter, the National Oceanic and Atmospheric Administration has no comments on this DEIS. [1]

Thank you for giving us an opportunity to review the document.

Sincerely,

David Cottingham

David Cottingham
Ecology and Environmental
Conservation Office

RESPONSE

1. Thank you for your comment. No response required.

DEPARTMENT OF HEALTH & HUMAN SERVICES — Public Health Service

Centers for Disease Control
Atlanta GA 30333

July 20, 1988

Reginald Rogers
Coastal Programs Unit
Water Management Division
U.S. Environmental Protection Agency
Region IV
345 Courtland Street, NE
Atlanta, Georgia 30365

Dear Mr. Rogers:

Thank your for sending the Draft Supplemental Environmental Impact Statement (DEIS) for "Ocean Dredged Material Disposal Site (ODMDS)." We are responding on behalf of the U.S. Public Health Service. We have reviewed the document and based upon the information provided in the EIS, we see no potential for adverse effects on human health. [1]

Thank you for sending this document for our review. Please insure that we are included on your mailing list for further documents which are developed under the National Environmental Policy Act (NEPA).

Sincerely yours,

David E. Clapp, Ph.D., P.E., CIH
Environmental Health Scientist
Special Programs Group
Center for Environmental Health
and Injury Control

RESPONSE

1. Thank you for your comment. No response required.

U.S. Department of Housing and Urban Development
Atlanta Regional Office, Region IV
Richard B Russell Federal Building
75 Spring Street, S.W.
Atlanta, Georgia 30303-3388

June 15, 1988

Mr. Reginald Rogers
Coastal Programs Unit
Water Management Division
US Environmental Protection Agency
Region IV
345 Courtland Street, N.E..
Atlanta, Georgia 30365

Dear Mr. Rogers:

This refers to your letter dated June 1988, transmitting the Draft Environmental Impact Statement (DEIS) for an Ocean Dredged Material Disposal Site (ODMDS) in deep water offshore Pensacola, Florida.

Our review indicates there will be no significant adverse impact on any HUD programs as a result of this project. [1]

Thank you for the opportunity to review and comment on your proposed project.

Sincerely,

for Ivar O. Iverson
Regional Environmental Officer

RESPONSE

1. Thank you for your comment. No response required.

US Department
of Transportation

Federal Aviation
Administration

Southern Region

P. O. Box 20636
Atlanta, Georgia 30320

JUN 10 1988

Mr. Reginald Rogers
Coastal Programs Unit
Water Management Division
U. S. Environmental Protection Agency
Region IV
345 Courtland Street, N. E.
Atlanta, Georgia 30365

Dear Mr. Rogers:

This is to advise that we have no comments on the Draft Environmental Impact Statement for an Ocean Dredged Material Disposal Site offshore Pensacola, Florida. [1]

Sincerely,

Arthur K. Weathers
Manager, Planning and Development Branch
Airports Division

RESPONSE

1. Thank you for your comment. No response required.

GULF OF MEXICO FISHERY MANAGEMENT COUNCIL
Lincoln Center, Suite 881 • 5401 W. Kennedy Blvd
Tampa, Florida 33609-2486 • 813 228 2815

August 2, 1988

Mr. Chris Hoberg
United States Environmental Protection Agency
Wetlands and Coastal Programs Section
345 Courtland Street
Atlanta, Georgia 30365

Dear Mr. Hoberg:

The Gulf of Mexico Fishery Management Council has reviewed the Draft Environmental Impact Statement (DEIS) for an Ocean Dredged Material Disposal Site in deep water offshore Pensacola, Florida. The Council finds that the DEIS adequately describes project features and potential impacts to fishery resources. [1]

We appreciate the opportunity to comment on the DEIS.

Sincerely,

John Green

John M. Green
Chairman

JMG:RJH:mjw

cc: Gulf Council
Staff

RESPONSE

1. Thank you for your comment. No response required.

Northwest Florida
Water Management District

Route 1, Box 3100, Havana, Florida 32333

J. William McCartney
Executive Director

(904) 487-1770

June 15, 1988

Mr. Reginald Rogers
Coastal Programs Unit
Water Management Division
U.S. Environmental Protection Agency
Region IV
345 Courtland Street, NE
Atlanta, Georgia 30365

Dear Mr. Rogers:

The District has reviewed the information submitted by your office of the Draft Environmental Impact Statement for an Ocean Dredge Material Disposal [1] Site in deep water offshore Pensacola, Florida and have no comments to submit.

Sincerely,

Pat Blackshear
Pat Blackshear
Intergovernmental Coordinator

PB/cac

RESPONSE

1. Thank you for your comment. No response required.

WEST FLORIDA REGIONAL PLANNING COUNCIL

POST OFFICE BOX 486
PENSACOLA, FLORIDA 32593-0486 • PHONE (904) 444-8910

Daniel F. Krumel
Executive Director

Bill W. Peebles, Jr.
Chairman

M E M O R A N D U M

DATE: July 22, 1988

TO: Mr. Reginald Rogers

FROM: Joseph J. Campus, Jr. - Clearinghouse Coordinator

RE: E-695-06-1088 Draft Environmental Impact Statement
Dredged Material Disposal Site
Pensacola, Florida

The staff of the West Florida Regional Planning Council has reviewed the above referenced proposal.

Based upon review of the information submitted the Planning Council finds the proposal in accord with state and local plans, goals and objectives of the Council and local governing bodies. [1]

Please append a copy of this letter to the formal application.

Approval of the above referenced project by the West Florida Regional Planning Council does not obligate funding by local governments.

This project is consistent with the intent of the Comprehensive Regional Policy Plan (CRPP).

JJCjr/lgw

WEST FLORIDA REGIONAL PLANNING COUNCIL

M E M O R A N D U M

TO: Joseph J. Campus, Jr., IC&RP Coordinator

FROM: Lel Czeck, Director, Comprehensive Planning

DATE: July 22, 1988

SUBJECT: Draft Environmental Impact Statement
Dredged Material Disposal Site, Pensacola, Fl
E695-06-1088

The subject document has been reviewed by staff and appears to be consistent with goals and policies contained in the West Florida Comprehensive Regional Policy Plan, 29A-2.001 F.A.C.

RESPONSE

1. Thank you for your comment. No response required.

FLORIDA DEPARTMENT OF STATE
Jim Smith
Secretary of State
DIVISION OF HISTORICAL RESOURCES
R.A. Gray Building
Tallahassee, Florida 32399-0250
(904) 488-1480

July 19, 1988

In Reply Refer To:
Robert C. Taylor
Historic Sites Specialist
(904) 487-2333
Project File Nos. 880446 & 881416

Mr. Reginald Rogers
Coastal Programs Unit
Water Management Division
U.S. Environmental Protection Agency
Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365

RE: June, 1988, Letter and Attachments
Draft Environmental Impact Statement for and Ocean Dredged Material Disposal Site in deep water offshore Pensacola, Escambia County, Florida

Dear Mr. Rogers:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Protection of Historic Properties"), we have reviewed the above referenced projects for possible impact to archaeological and historical sites or properties listed, or eligible for listing, in the National Register of Historic Places. The authority for this procedure is the National Historic Preservation Act of 1966 (Public Law 89-665), as amended.

We have reviewed the above referenced draft environmental impact statement, and note that this agency's comments have been included on pages 7-7 and 7-8. A copy of these comments is enclosed. [1]

If you have any questions concerning our comments, please do not hesitate to contact us. Your interest and cooperation in helping to protect Florida's archaeological and historical resources are appreciated.

Sincerely,

George W. Percy, Director
Division of Historical Resources
and
State Historic Preservation Officer

GWP/rct
Enclosure (1)

Archaeological Research [illegible] | Florida Folklife Programs [illegible] | Historic Preservation (904) 487-2333 | Museum of Florida History (904) 488-1484

RESPONSE

1. Thank you for your comment. No response required.

The Florida State University
Tallahassee, Florida 32306-2043

Department of Biological Science

June 6, 1988

Reginald Rogers
Coastal Programs Unit
Water Management Division
U.S. Environmental Protection Agency
Region IV
345 Courtland Street, NE
Atlanta, Georgia 30365

Dear Dr. Rogers:

Dr. Abele has asked me to respond to your request of June 6, 1988, for a review of the enclosed document. I regret to inform you that his schedule at this time prohibits any additional review activity. He is sorry that he is not able to accomodate your request. [1]

Sincerely,

Travis Boline

Travis S. Boline
Administrative Secretary

/tsb

RESPONSE

1. Thank you for your comment. No response required.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

June 1988

Dear Reviewer(s):

Enclosed please find your copy of the Draft Environmental Impact Statement (DEIS) for an Ocean Dredged Material Disposal Site (ODMDS) in deep water offshore Pensacola, Florida. Technical questions on the DEIS may be addressed to the U.S. Environmental Protection Agency (EPA)/Region IV in Atlanta, Georgia (404/347-2126 or FTS 257-2126); procedural questions may be addressed either to EPA/Region IV or to the EPA Headquarters Office in Washington, D.C. (202/382-5075 or FTS 382-5075).

Please provide any review comments by the end of the 45-day review period on July 25, 1988. Comments should be sent to EPA/Region IV at the following address:

Reginald Rogers
Coastal Programs Unit
Water Management Division
U.S. Environmental Protection Agency
Region IV
345 Courtland Street, NE
Atlanta, Georgia 30365

We look forward to your timely comments.

EPA/Region IV
Atlanta, Georgia

June 13, 1988

Our Department has no comments. [1]

James V. Chisholm

RESPONSE

1. Thank you for your comment. No response required.

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APPENDIX A

SELECTION OF ALTERNATIVE

OCEAN DREDGED MATERIAL DISPOSAL SITES

APPENDIX A

SELECTION OF ALTERNATIVE OCEAN DREDGED

MATERIAL DISPOSAL SITES

1. Introduction. Alternative Ocean Dredged Material Disposal Sites (ODMDS's) were selected for detailed evaluation based on environmental and economic considerations as outlined in Pequegnat et al., 1981. 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). Factors used in determining the ZSF included: (1) cost of transporting dredged material to the disposal site; (2) type of dredging/disposal equipment; (3) navigation restrictions; and (4) political boundaries. Once the ZSF was established, an interagency team reviewed existing information to determine areas within the ZSF which should be eliminated for environmental reasons. The results of the selective screening process are presented in the following paragraphs.

2. Establishment of the ZSF. It was determined that a 20-mile radius from Pensacola Pass provided an economic haul distance for the material to be dredged from the turning basin at the Pensacola Naval Air Station (Figure A-1). In addition, the most likely dredging and disposal plant, hopper barges, could easily work within this area of the Gulf of Mexico. The western edge of the 20-mile radius extends into waters of the State of Alabama, therefore this area was eliminated from consideration as part of the ZSF. With the exception of the restrictions associated with the Federal navigation channel at Pensacola no other navigation restrictions apply to this area.

3. Navigation Channels, Anchorage Areas, and Safety Fairways. The entrance channel to Pensacola Bay extends approximately three miles into the Gulf of Mexico and is the only navigation channel that could potentially be affected by the ODMDS. As shown on Figure A-2, a 1-mile buffer zone was established adjacent to the channel to prevent any significant amount of material from being carried back into the channel. Also shown on Figure A-2 are the anchorage areas and navigation safety fairways. These areas were not specifically excluded from consideration as an ODMDS since they are located in deep water and the ODMDS could be managed in a way that would not conflict with their designated use.

4. Beaches and Recreation Areas. Due to the nature of the material to be initially disposed in this site, predominately fine-grained materials, a very conservative buffer zone was established to avoid any possibility of impacting the beaches and recreation areas on Santa Rosa Island and Perdido Key. These areas are known for their white sand beaches and clear blue waters and it was felt that a 5-mile buffer zone was required to eliminate the possibility of impact to these valuable resources (Figure A-3).

5. Biologically Sensitive Areas. Within this area of the northern Gulf coast, one major biologically sensitive resource are areas of live bottoms. In addition to these areas, considerable resources have been expended for the creation of artificial reefs which serve as significant fish havens. Other biologically sensitive areas include fish nursery, spawning, and migratory areas. The continental shelf is highly irregular off Pensacola and its sand sheet thins toward the east, where limestone karst topography predominates. Coral and other invertebrate growth occurs on rock outcrops at depths of 80 to 100 feet and becomes more numerous with increasing depth. Therefore, water depths greater than 100 feet were eliminated from consideration. The eastern quadrant of the area within a 20-mile radius of Pensacola Pass was also eliminated from consideration because of the potential for hard bottoms. This includes all the area to the east of a north-south line located seven miles from Pensacola Pass as shown on Figure A-4. Artificial reefs are shown on Figure A-5 and generally a 1-mile buffer zone was established around existing and permitted reefs. The exception to this was the existing reef in the southeast quadrant of Site B and the reef known as the "Russian Freighter" located on the east boundary of Site B. Little specific information was available relative to fishery resource areas; however, the tidal pass and nearshore areas are known to be heavily utilized during spawning and migration. These areas had already been excluded from consideration in the 5-mile buffer zone established to protect the beaches and recreational areas and it was felt that this buffer was also adequate to protect spawning and migration.

6. Aquatic Preserves. The Fort Pickens Aquatic Preserve is shown on Figure A-6. This Preserve was established by the State of Florida to provide an aesthetic buffer around the former State Park on Santa Rosa Island. The former State Park is now part of the Gulf Islands National Seashore. The 5-mile buffer zone established to protect the beaches and recreational areas is considered to be adequate to protect the aquatic preserve.

7. Other Factors. Other factors were considered during the selective screening process including: mineral resource exploration, cultural resources, and the feasibility for monitoring and surveillance of the ODMDS. All of these factors were considered but no additional areas were eliminated from consideration because of them.

8. Selection of Alternative ODMDS's. Figure A-7 presents a composite of all the areas eliminated from consideration as an ODMDS. The area remaining in consideration was reviewed by personnel from the State of Florida and Corps of Engineers in coordination with the EPA and the Navy to identify alternative ODMDS's for detailed evaluation. Bottom contours were used to select areas to be evaluated in detail. Areas of greatest relief were avoided since they represent areas with the highest probability of containing live/hard bottoms. Based on this review, three areas were selected for detailed consideration. These three alternative ODMDS's are shown on Figure A-8. Two of the sites (A and B) are within the State of Florida's coastal waters (10.4 statute miles) and one site (Site C) is beyond the limit of state waters.

8. Study Approach. Once the three alternative ODMDS's were selected, more detailed studies were planned and initiated. The first phase of study was to survey the alternative ODMDS's using side scan sonar to characterize the bottom and to locate any potential live/hard bottoms that should be avoided. Alternative sites could be eliminated and additional ODMDS's selected if live/hard bottom communities were encountered at any of the selected sites. However, these initial surveys at Sites B and C indicated little possibility for live/hard bottoms; they were considered to be the two most viable alternatives and a survey of Site A was not initiated. The tasks and methods used during the detailed studies of Sites B and C are discussed in the following paragraphs.

9. Side Scan Sonar. The initial task was a bathymetric survey using side scan sonar for characterizing the bottom and search for potential live/hard bottom communities. Using a 100 KH transponder, transects traversing each site were navigated at approximately 800-foot intervals. The goal was to achieve a 40-percent overlap between transects. Actually, transect overlaps ranged between 15 to 65 percent during the survey due to varying sea states affecting the ship's course. Along each transect, navigation fixes of latitude and longitude were entered on the ship's plotter and recorded along with a tape recorded verbal interpretation of the side scan chart. Accordingly, a real time analysis of the side scan information was accomplished. If side scan sonar images of suspect bottom characteristics were encountered at any point along the transect of suspect bottom characteristics, coordinates for such areas were recorded for subsequent investigation by divers or Remotely Operated Vehicle (ROV). In all, a total of 31 transects were conducted at Site B and 30 transects at Site C.

10. Photographic Records. The second task associated with site clearing involved the use of a towed camera sled to obtain continuous video records of transects spaced at 800-foot intervals covering each 6-square mile site. Along each individual transect, navigation fixes of latitude and longitude were recorded along with depth and entered on the ship's plotter. Spacing between each fix was also at intervals of approximately 800 feet.

A total of 19 transects, each approximately 2 miles long, were completed at Site C. The video survey of Site B was expanded eastward of the originally delimited area which resulted in a total of 31 transects. Two circumferential courses spaced at 800- and 1600-foot distances outside the perimeter of each site and outside the termination of the 2-mile transects were initiated, but were not completed in February 1987 due to foul weather and technical problems which extended the length of the survey. These surveys could not be completed in February because of the ship's schedule. Another attempt to complete these transects in April 1987 was unsuccessful because turbidity precluded acceptable video clarity. Figures A-9 and A-10 show the video transects for Sites B and C, respectively.

Still photographs of bottom characteristics were taken by divers during the benthic sampling at each site. Photographs were taken at random at each of 20 stations at Sites B and C (See Figures A-9 and A-10) during November 1986 and April 1987.

11. Bottom Sampling. Bottom sampling included sampling for benthic marcoinvertebrates, sediment chemistry and sediment particle size. These areas are discussed below and sample stations are shown on Figures A-11 and A-12. See Appendices C and E for results.

11.1 Benthic Macroinvertebrates. A total of 20 stations were sampled at each site for benthic macroinvertebrates using round stainless steel hand cores 10 cm in diameter and 15 cm long. The top end of each corer was screened with 0.5 mm mesh. At each station, cores were taken by divers. Each corer was pushed into the sediment to its full length (15 cm), capped on the bottom end by the diver's hand, momentarily inverted and placed in a cloth bag which was tightly secured to prevent escape of sediment and organisms. All samples were sieved through 0.5 mm screens aboard ship, placed in containers, and immersed in 10% seawater formalin solution with rose bengal stain for transport to the laboratory. Identifications were made to the lowest practicable limit, which in most cases was the species level.

During the November 1986 survey, 15 replicate benthic macroinvertebrate cores were taken at each station. At two of the 20 stations for each site, 15 additional cores, for a total of 30 reps, were taken to verify whether or not the species saturation curve could be satisfied with 15 reps. This information would be used to adjust the replication effort for the April 1987 effect.

The species saturation analysis established that 15 replicates were sufficient to satisfy the curve at approximately the 80 to 85% level. Accordingly, 15 replicates were also collected at each station during the April 1987 survey.

11.2 Sediment Chemistry. During the course of macroinvertebrate sampling, cores for sediment chemical analysis were collected with Teflon coring tubes. Consistent with the macroinvertebrate sampling, core penetration was to the 15 cm depth. All cores were refrigerated and iced for return to the lab for analysis. Analyses include metals scan, pesticides, chlorinated hydrocarbons, oil and grease, and nutrients (NH_3, NO_2+NO_3-N, TKN).

Sampling and analysis for only the metals scan and nutrients were repeated during the April survey since pesticide, chlorinated hydrocarbon, and oil and grease concentrations in the November samples were generally below analytical detection limits.

11.3 Sediment Particle Size. Simultaneous with and in the same manner as sediment chemistry sampling, cores were also collected during November and April for sediment particle size analysis. Upon return aboard ship, all cores were carefully decanted, frozen, and returned to the lab. Processing was according to the wet sieve Modified Wentworth method.

12. Water Quality Sampling. During the November 1986 and April 1987 surveys, water quality sampling was conducted at eight stations at both Site B and Site C. Although quarterly water quality sampling was planned, extremely rough weather and sea conditions aborted sampling in February. The final quarterly sampling effort was conducted in August 1987.

Water quality sampling consisted of dissolved oxygen, salinity and temperature (DST) profiles at 5-foot increments from surface to bottom. Light extinction profiles were determined using 10-foot increments from surface to bottom. After determination of the 90, 50, and 10% light levels, water samples were collected, composited, and a sample extracted and filtered for chlorophyll-a analysis during November and April surveys.

In conjunction with DST profiles, water samples were collected at surface, mid-depth, and bottom for nutrient analysis.

13. Demersal Fishes. On May 19 and 20, 1987, demersal fishes were collected at ten stations within each of the two disposal sites. Sampling was conducted from the Dauphin Island Sea Lab Research vessel, the R/V Verrill. The sampling method utilized was a 40-foot otter trawl, equipped with a 0.25 inch mesh liner. Sampling began at 1445 hours on May 19, 1987, and was completed at 0450 hours on May 20, 1987. Travel times were standardized at 20 minutes. Trawl catches from each station placed in separate 5-gallon buckets and fixed with 10 percent formalin. Fish specimens larger than 4 inches standard length were slit to allow for proper fixation. Appendix F presents a figure showing station locations and a list of fishes and invertebrate collected.

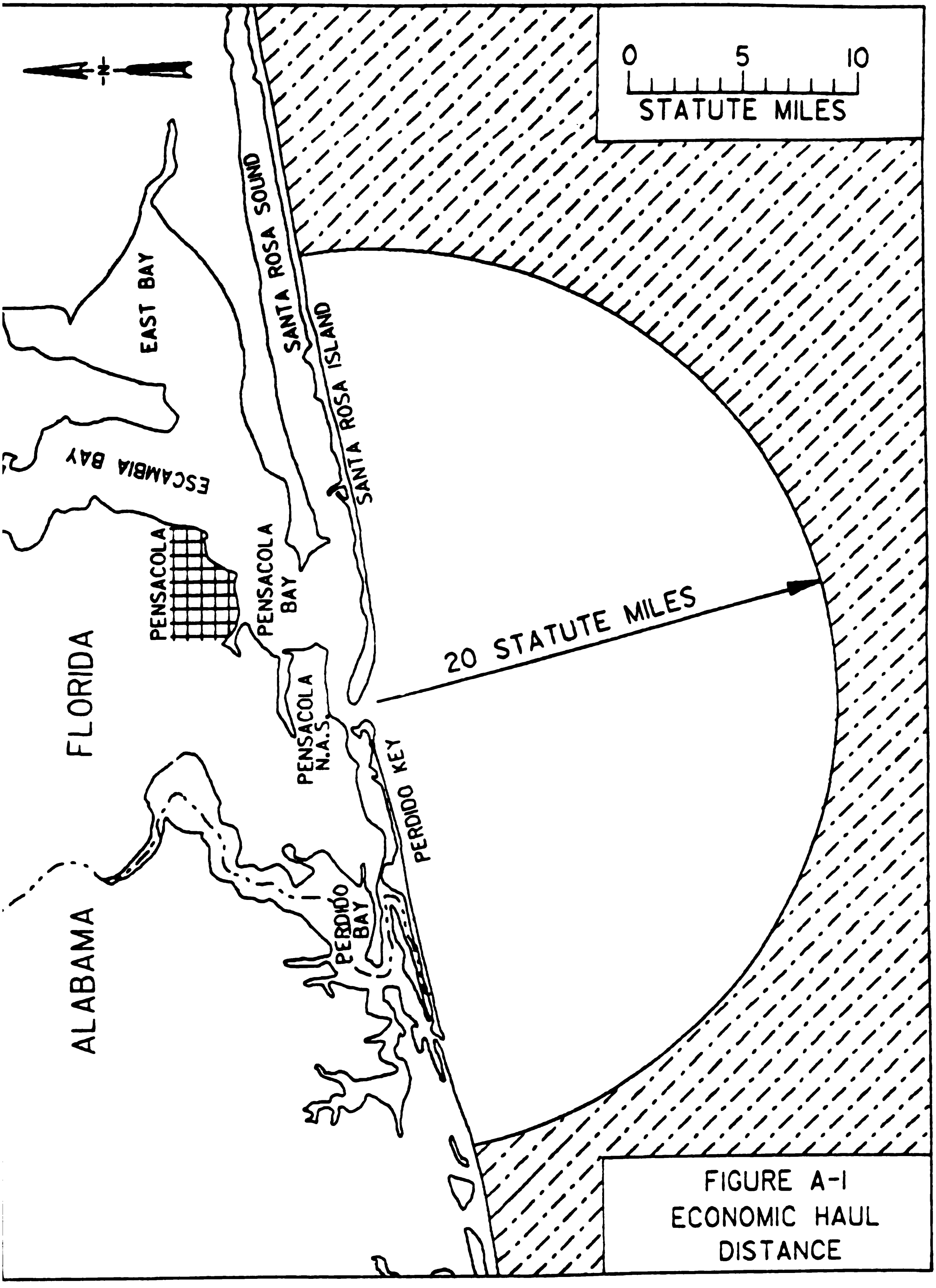

FIGURE A-1
ECONOMIC HAUL
DISTANCE

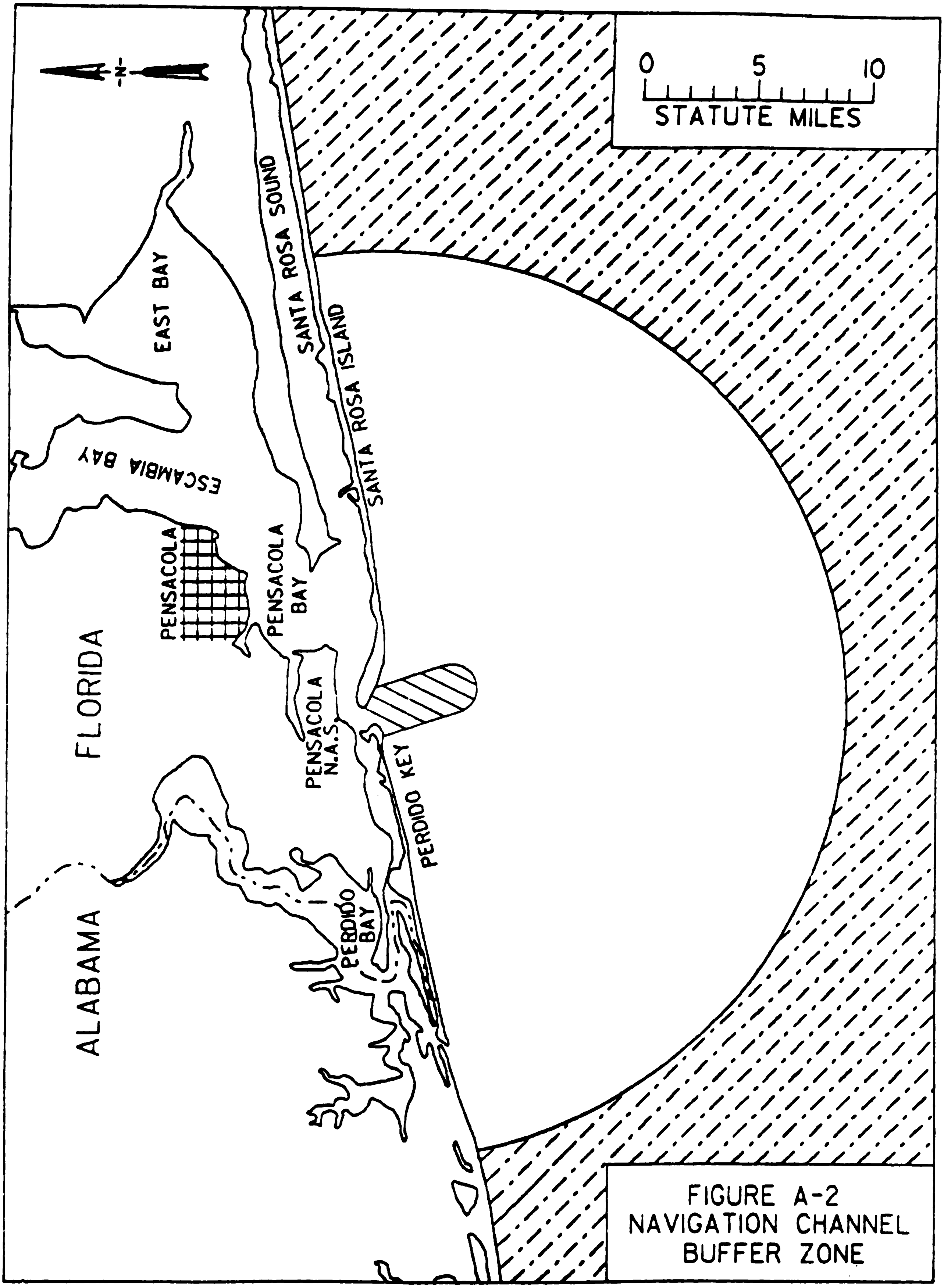

FIGURE A-2
NAVIGATION CHANNEL
BUFFER ZONE

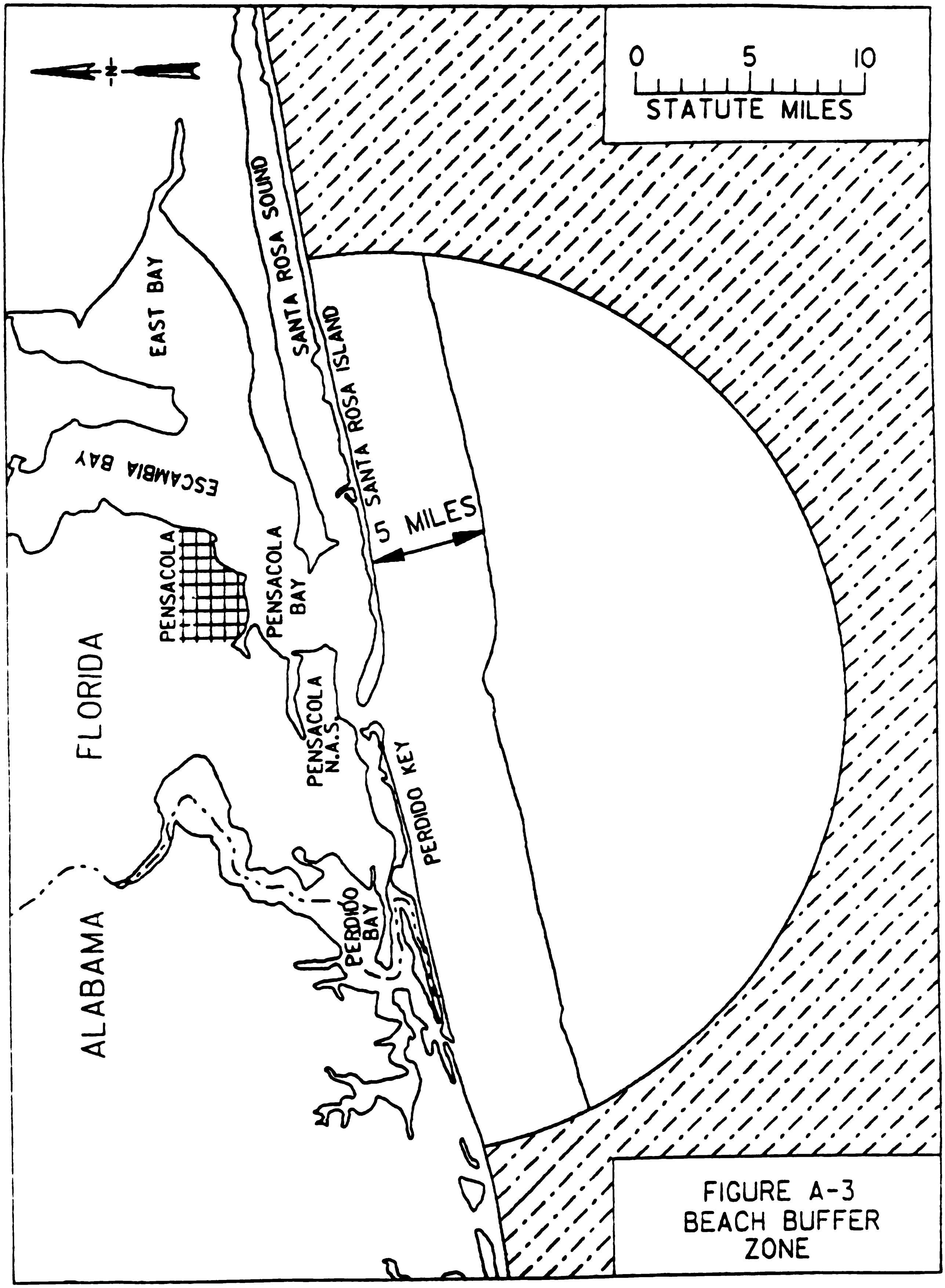

FIGURE A-3
BEACH BUFFER ZONE

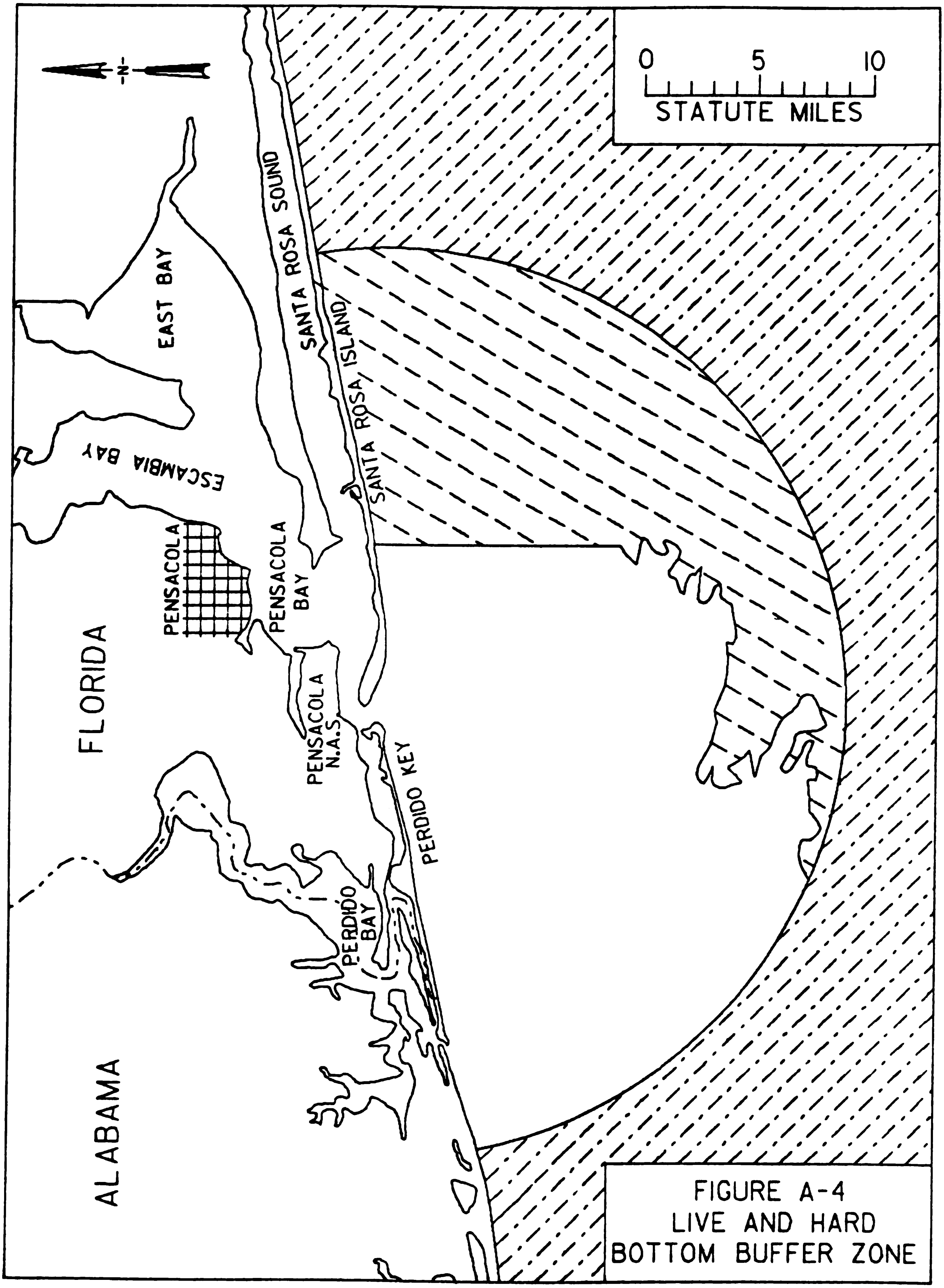

FIGURE A-4
LIVE AND HARD
BOTTOM BUFFER ZONE

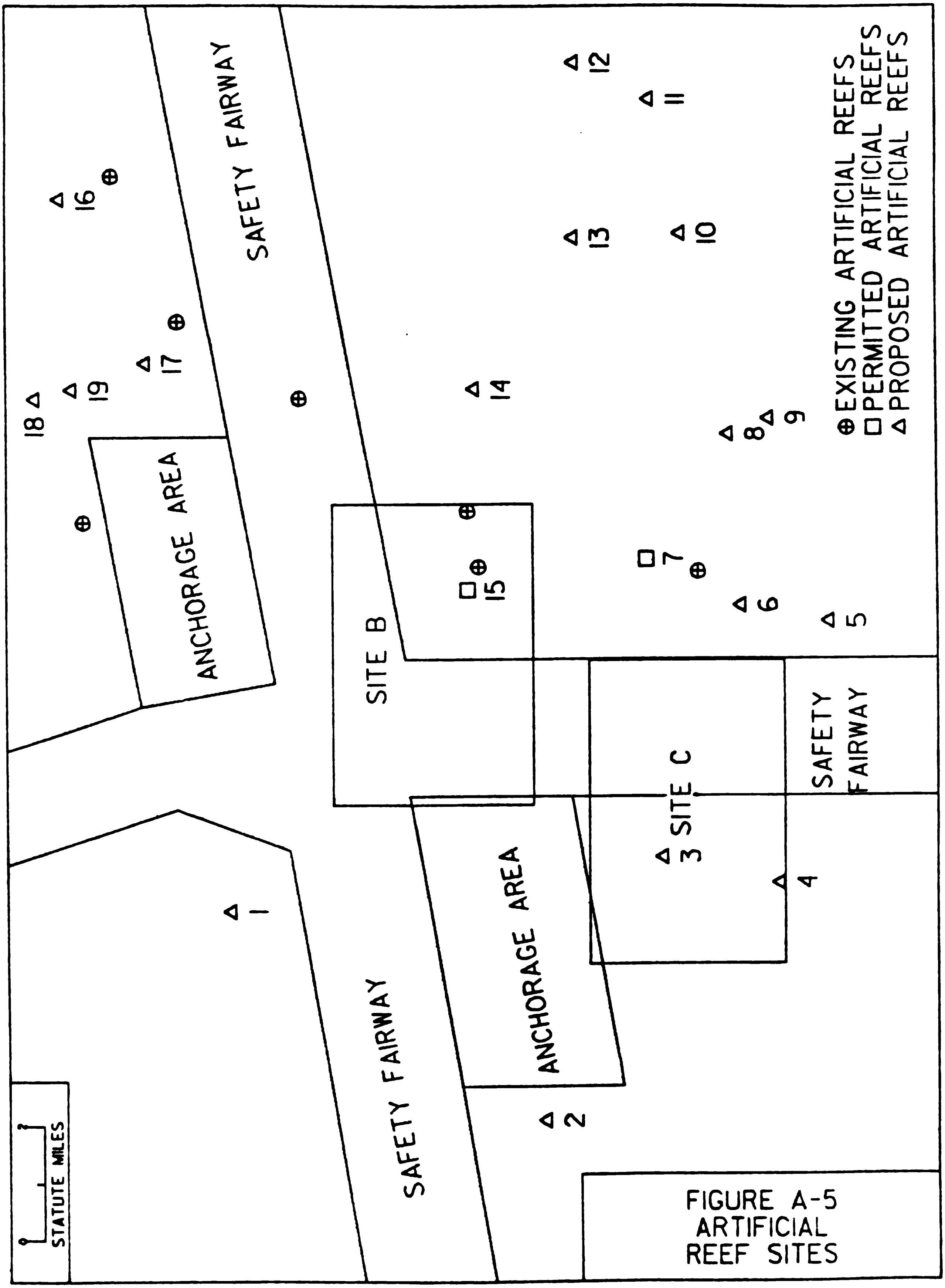

FIGURE A-5
ARTIFICIAL
REEF SITES

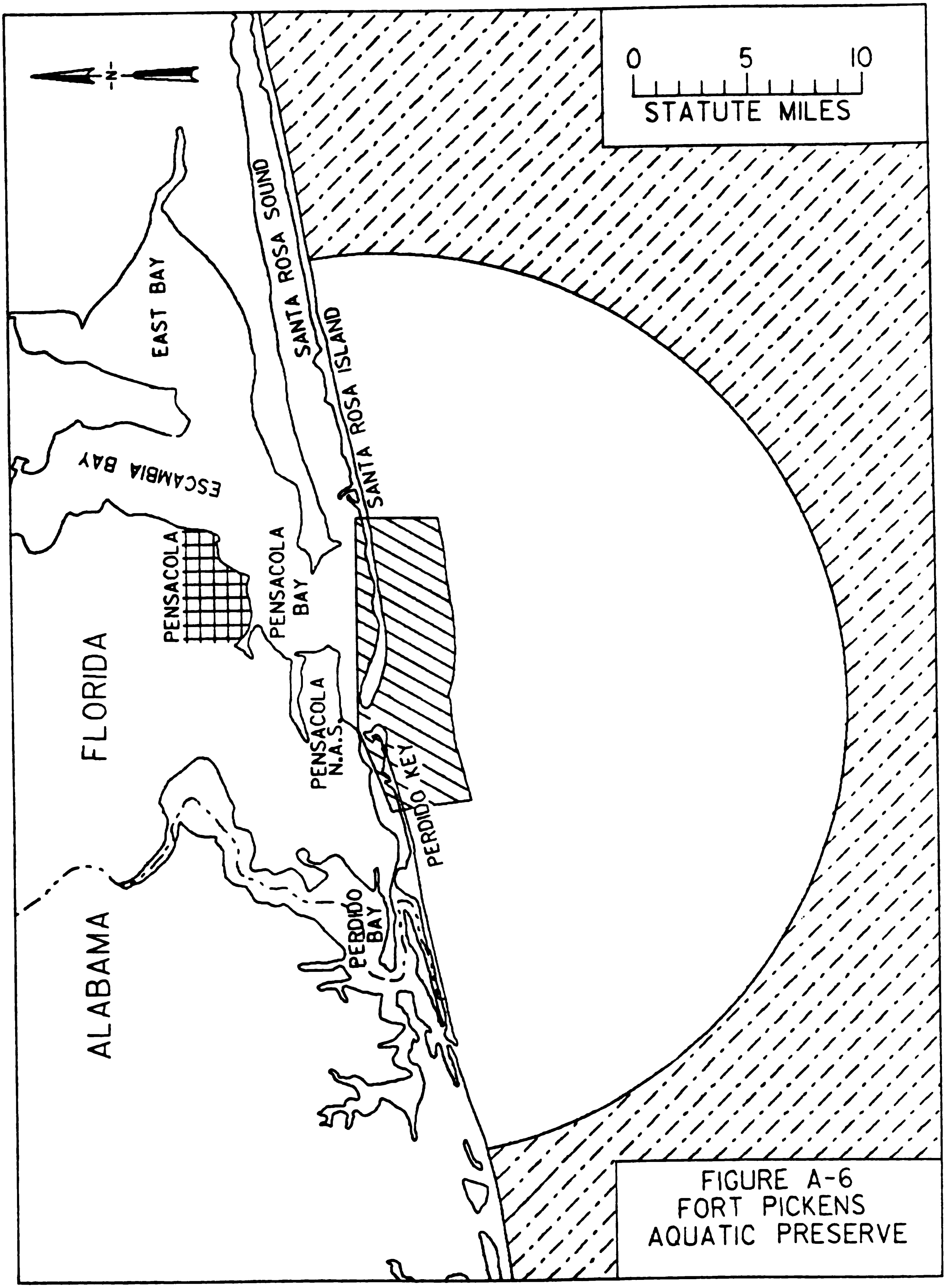

FIGURE A-6
FORT PICKENS
AQUATIC PRESERVE

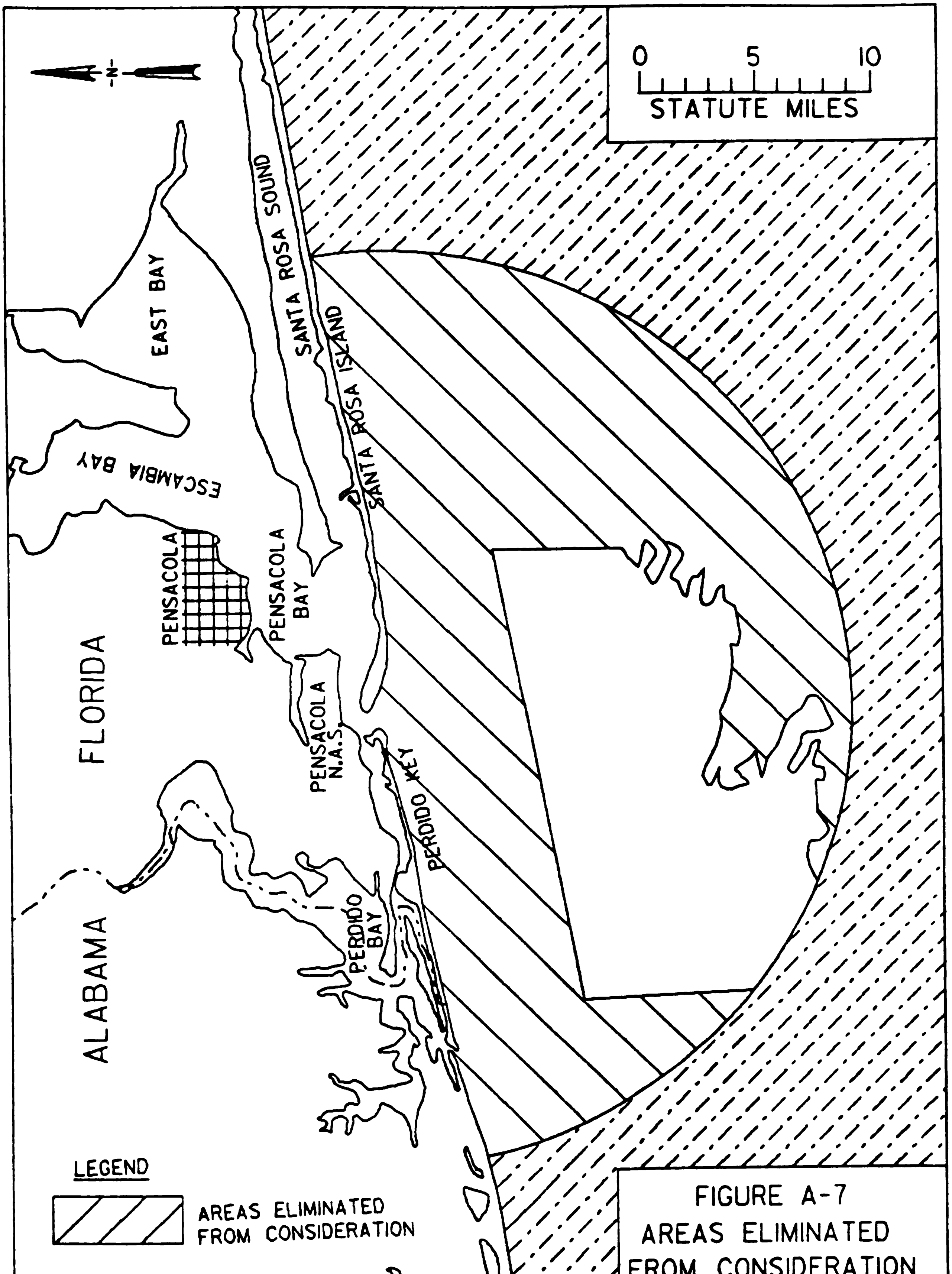

FIGURE A-7
AREAS ELIMINATED
FROM CONSIDERATION

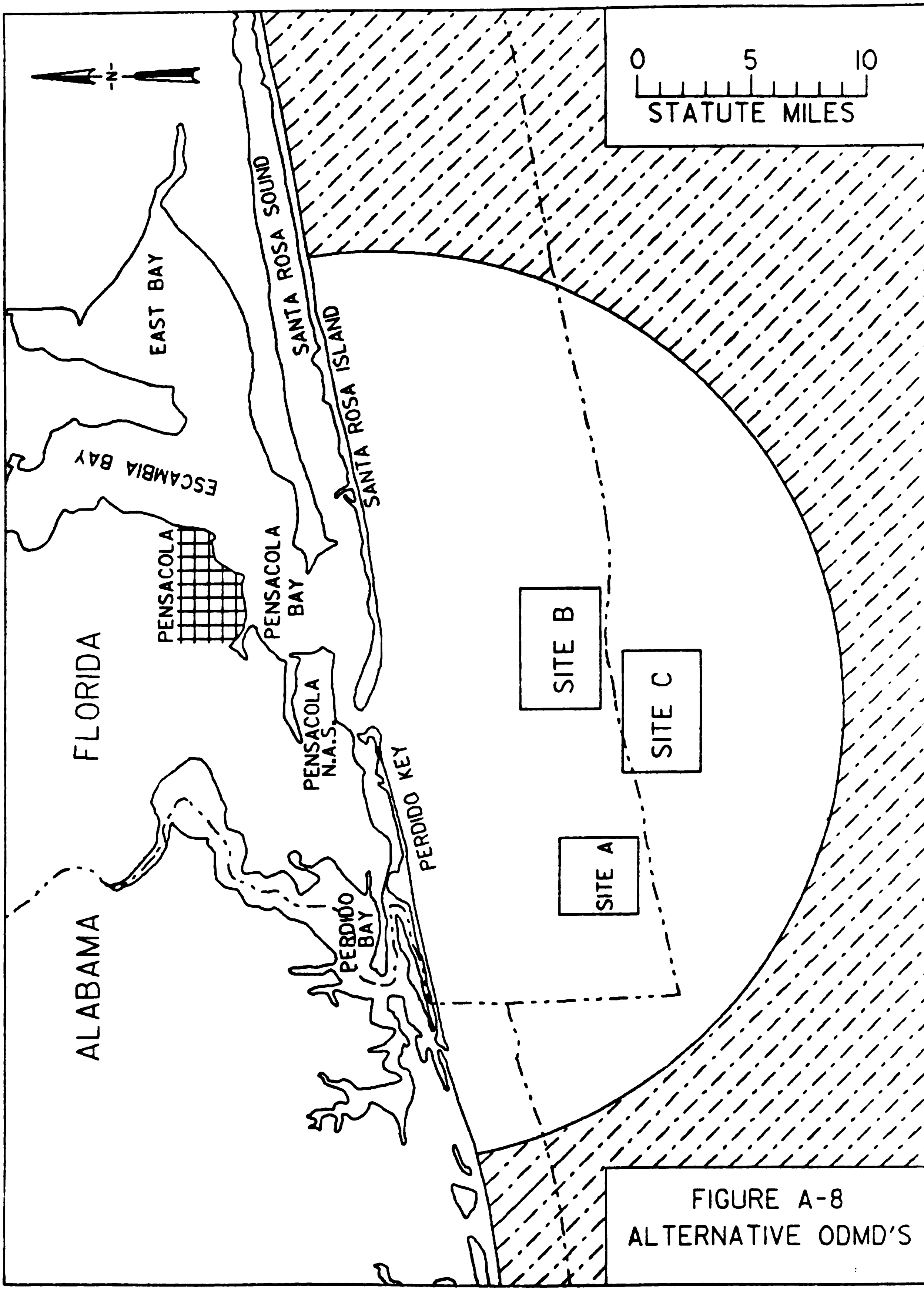

FIGURE A-8
ALTERNATIVE ODMD'S

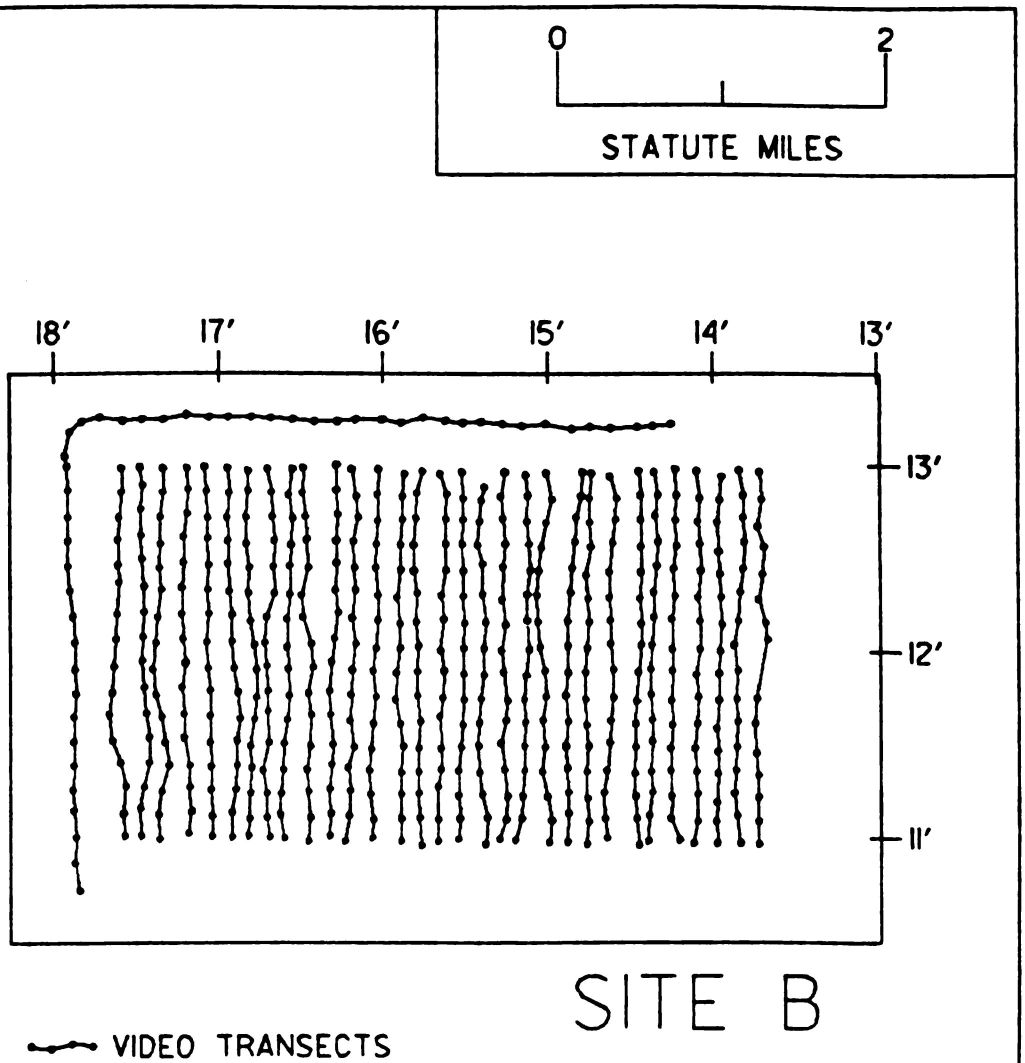

FIGURE A-9
SITE B
VIDEO TRANSECTS

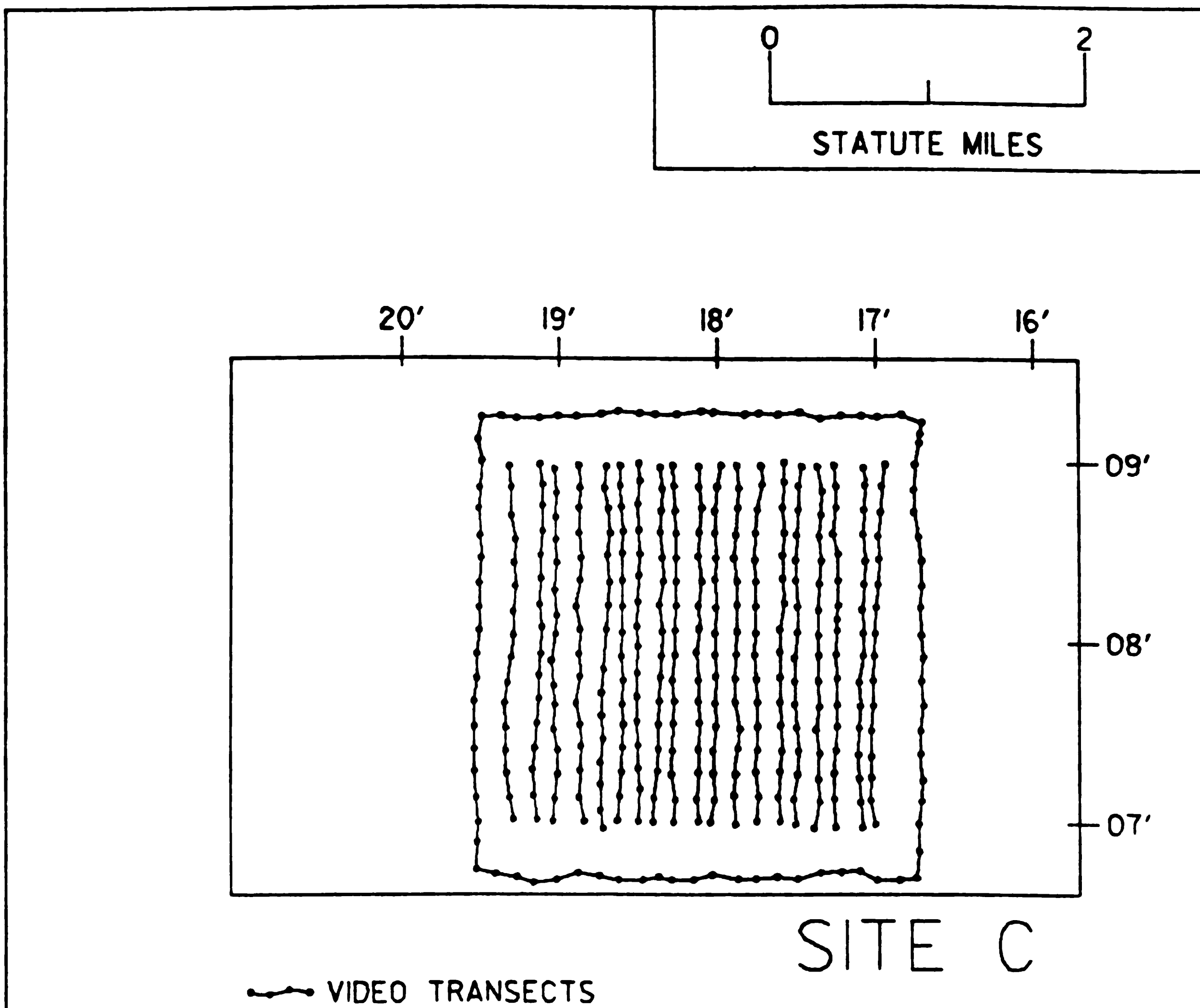

FIGURE A-10
SITE C
VIDEO TRANSECTS

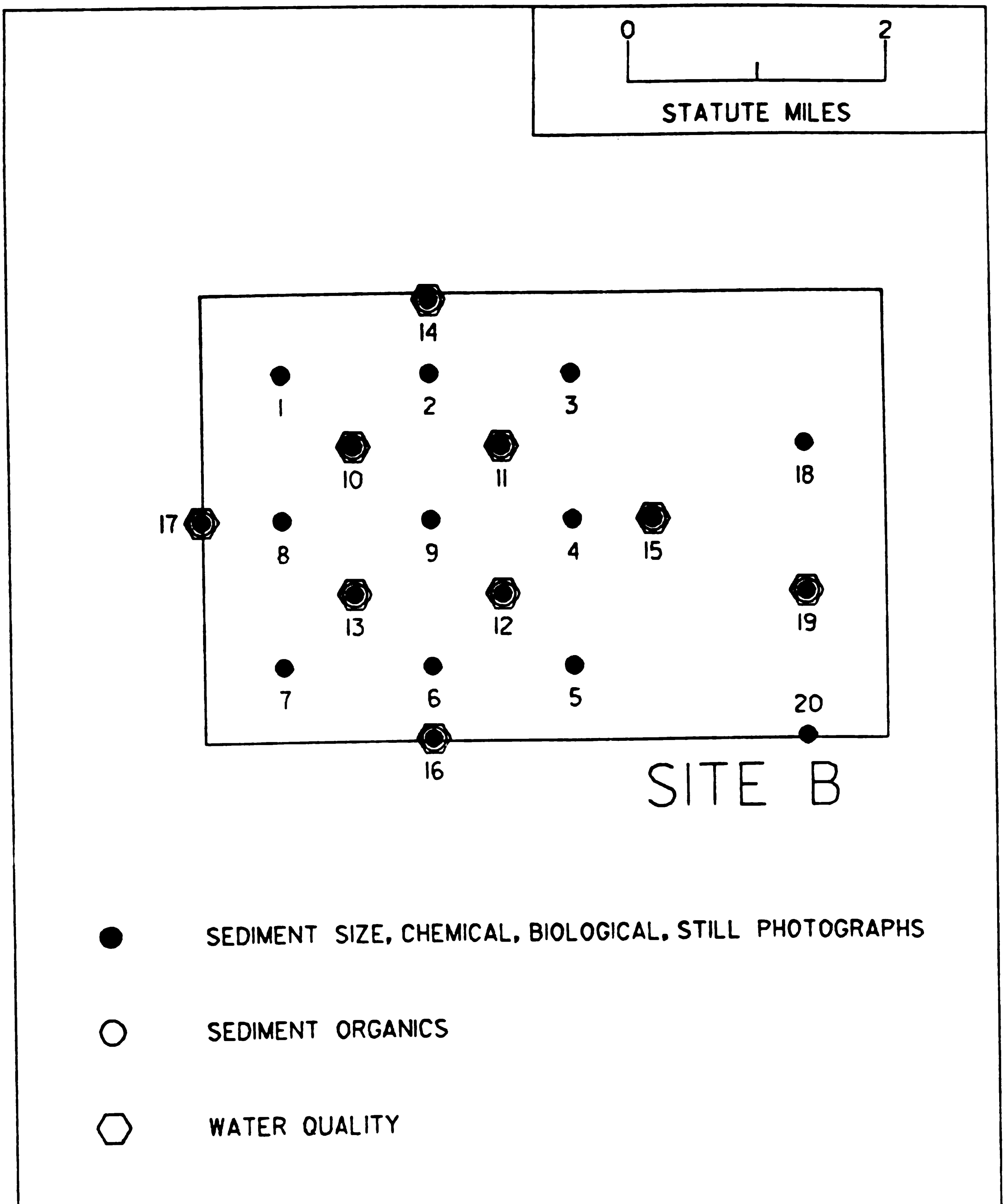

FIGURE A-11
SITE B
SAMPLING STATIONS

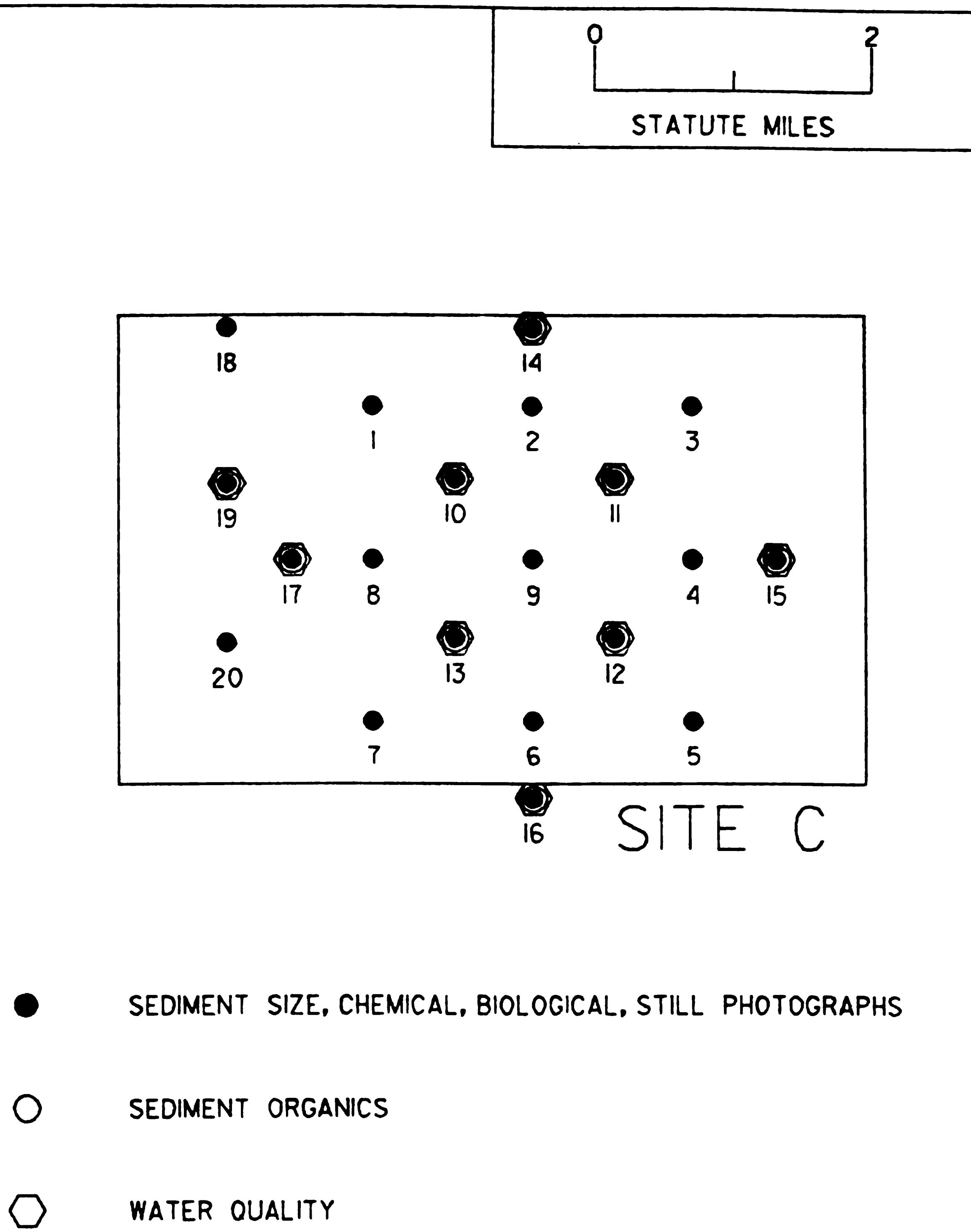

FIGURE A-12
SITE C
SAMPLING STATIONS

APPENDIX B

CURRENTS OFF PENSACOLA, FLORIDA

(R. L. Pickett and D. A. Burns,

Naval Ocean Research and Development Activity

August, 1987)

Appendix B

A Summary Of The Currents Off Pensacola, Florida:Final Report

R.L. Pickett and D.A. Burns

Physical Oceanography Division

Naval Ocean Research and Development Activity

Stennis Space Center Station, MS 39529-5004 USA

July 1988

CHAPTER 1

SUMMARY:

CURRENTS OFF PENSACOLA, FLORIDA

NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY
NSTL STATION, MS 39529

A Summary Of The Currents Off Pensacola, Florida:Final Report

R.L. Pickett and D.A. Burns

Physical Oceanography Division

Naval Ocean Research and Development Activity

NSTL Station, MS 39529-5004 USA

July 1988

ACKNOWLEDGMENTS

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ABSTRACT

Eight months of current meter observations in shallow (20-24 meters) water off Pensacola, Florida, showed nearshore currents were wind driven, parallel to the coast, and attained peak speeds up to 62 cm/s. The mean resultant flow varied between 1 and 6 cm/s, and approximately 90% of the record variance was nontidal.

A numerical current model showed that over long time periods the climatological currents should be directed westward and parallel to the coast with speeds greater than those measured . The model also hindcasted 100 cm/s current speeds during hurricane Fredrick in 1979.

I. INTRODUCTION

This paper presents the results of an observation and model study of currents off Pensacola, Florida. The purpose of this work was to document currents in potential dredge spoil sites, as part of the U.S. Navy's homeport project.

For the observational program, six moorings with mid-depth and near-bottom current meters were placed approximately 20 km south of Pensacola in about 20 m of water (Figure 1). Current data were collected from Feburary to June 1987, and from October 1987 to January 1988. Surface wind data were recorded at the Pensacola Naval Air Station during these time periods.

For the model study, the February through June data were used to calibrate a numerical current model. This calibrated model was then used to hindcast currents in the same region using winds observed during the past 40 years.

In essence, the study showed that currents off Pensacola are wind driven and parallel to the coast.

II. METHOD

A. Data

Twelve calibrated, acoustic current meters were placed in six subsurface, taut-mooring arrays (each containing current meters at 9 m below the surface, and 4 m above the bottom) off Pensacola. During the October phase a solid state S4 current meter was deployed 1 m above the bottom at site E. Twelve of the thirteen meters recorded useful data and were used to estimate spatial and seasonal variability of the offshore currents. The near–bottom meter at site D failed.

The six array sites A,B,C,D,E, and F are shown in Figure 1. Arrays A and F, and B and E are at the same location, but were deployed at different times. Data were recorded from 6 February to 7 April 1987 at arrays A and B, from 13 March to 18 June 1987 at arrays C and D, and from 24 October 1987 to 24 January 1988 at locations E and F (see Table 1).

The acoustic meters were sampled 15 times per hour, and the S4 meter was sampled 6 times per hour. The S4 current meter recorded data through 26 November. Data were edited then averaged over one hour intervals to eliminate meter noise and turbulence.

Hourly observations of wind speed and direction are routinely recorded at the Pensacola Naval Air Station. The wind records covering the same time period as the current data recordings were extracted, edited, and averaged in a similiar manner.

B. Model

A 10-layer, 2 n.m. grid, numerical current model was driven with observed winds. The bottom roughness coefficient was adjusted until the model output matched the current meter readings.

Next, the model was run for a variety of winds that have been recorded at Pensacola since 1948. The object was to calibrate the model with observed currents, and then use it to estimate currents in other seasons and years. Model currents were analyzed in the same manner as the recorded currents.

III. RESULTS

A. Current Data

• 1.- The current flow at all locations and depths was strongly nontidal. More than 90% of all the data variance was due to nontidal forces.

• 2.– Mean resultant flows were generally southeasterly or southwesterly, and the persistence of the mean resultant flow varied from 4 to 52 percent of the time at low speeds ranging from about 1 to 6 cm/s. Maximum current speed varied from 22 to 62 cm/s (see Table 1). The mean resultant near–bottom flow at sites A,B,C, and E tended to be rotated cyclonically (counterclockwise) from the mean resultant flow at mid–depth. Figures 2 through 7 show the frequency distribution of the hourly averaged currents.

• 3.– The frequency of occurence of any current speed during the observation period can be estimated from the histograms in Figures 2 through 7. Figure 2 shows that observed mid–depth currents at site A exceeded 22 cm/s about 20% of the time, and that observed near–bottom currents exceeded 16 cm/s about 20% of the time.

• 4.– Currents were generally parallel to the coast, which runs slightly northeast of due east, and appear to be wind driven.

• 5.– The currents contained two major periodic components. The high-speed component had roughly a 5-day period, and corresponded to weather changes. As fronts moved through the area, the wind-driven currents moved with the east-west component of the wind. However, there was a lag between winds and currents; the currents peaked about 17 hours after the wind.

• 6.– The low-speed periodic component was at 24 hours, and was due to the tide. Tidal currents were generally an order of magnitude smaller than wind-driven currents, and tended to rotate clockwise.

• 7.– The wind directions were more scattered than the current directions. Figure 8 shows the wind rose data during the time of the array deployments. Winds were often from the north as Figure 8 shows.

B. Model Runs

• 1.– The frequency of various current speeds over long time periods (40 years), was estimated by running the model with historical winds. The histograms in Figures 2 through 7 show these model results. Figure 2 (Array A) shows that, over long time periods (and hence many severe storms), mid-depth currents would be expected to exceed 40 *cm/s* about 35% of the time, and that near-bottom currents would be expected to exceed 20 *cm/s* about 80% of the time.

- 2.- Historical winds were most frequently out of the northeast as were the Naval Air Station recorded winds. As a result, the model predicted a net westerly current drift at all depths.

- 3.- Currents for two hurricanes (Eloise, 1975 and Fredrick, 1979) which had complete wind records and which passed near Pensacola were also hindcast with the model. Both produced strong model currents toward the west as the hurricanes approached, followed by strong currents toward the east as they moved on north. The maximum current speed was 100 *cm/s* during Fredrick.

IV. CONCLUSIONS

- 1.- The main conclusion from the observations is that nearshore currents off Pensacola, Florida are controlled by the east-west component of the wind. A wind with a strong component from the west will generate, after a 17 hour delay, a strong current toward the east. This current will move parallel to the coast, and will be fairly uniform both horizontally and vertically.

- 2.- In similar fashion, a wind from the east will generate an equivalent current toward the west. During the observation period, both of these current directions occured about equally as often.

- 3.- The main conclusion from the modeling work. is that the net transport will be westerly, as measured, but the current speeds will be stronger than measured.

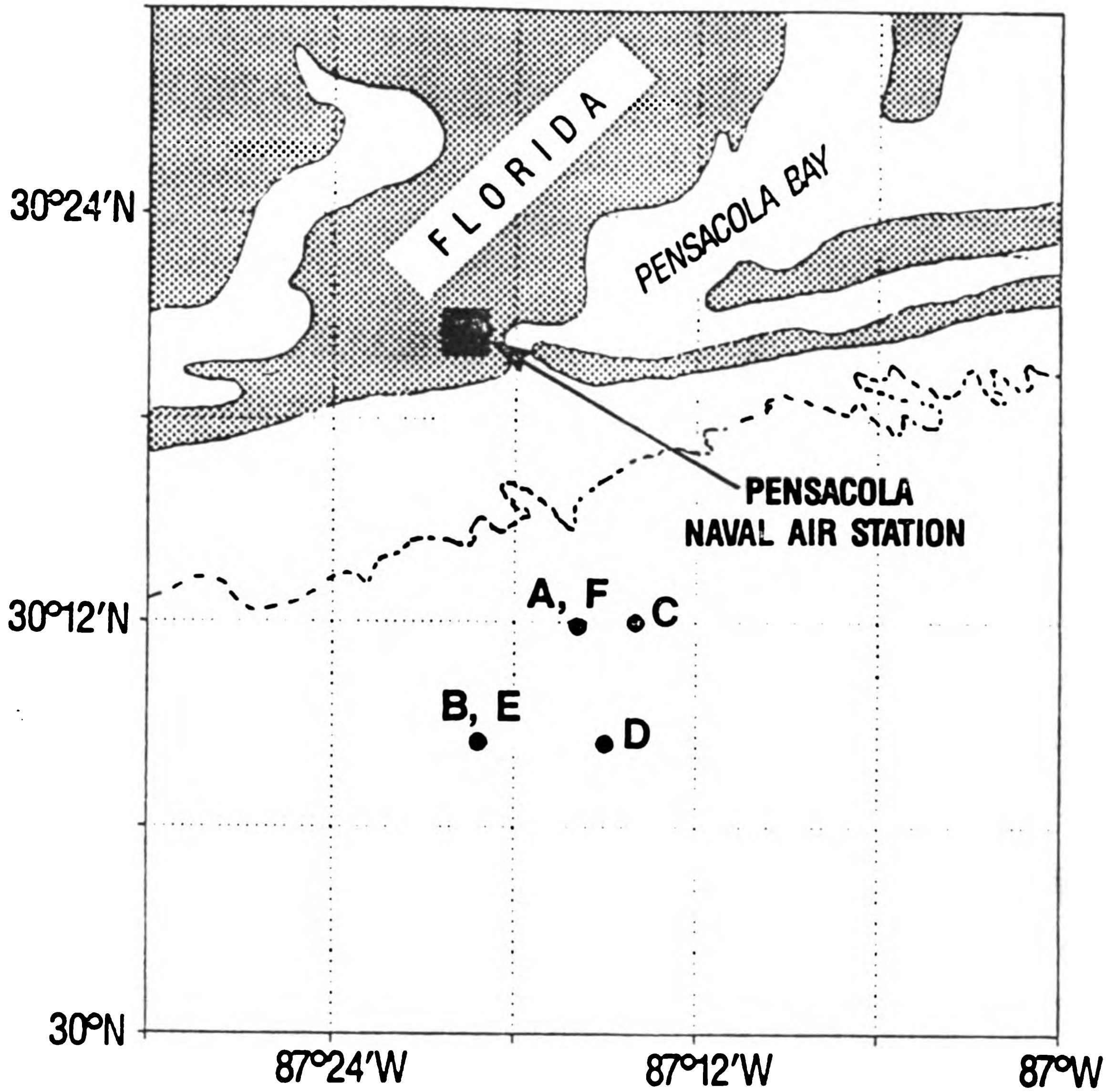


Figure 1. The six current meter sites south of Pensacola, Florida. Arrays A,F, and B,E, are at the same location, but were deployed at different times. Site water depths ranged from 20 to 24 meters. Two current meters (9 m below the surface, and 4 m above the bottom) were deployed as shown in Table 1. At Array E, one additional current meter was deployed 1 m above the bottom. The dashed line is the 20 m isobath.

Table 1. Current Meter Summary Statistics. Column 1 gives the array name; columns 2 and 3 are the latitude and longitude of the array; column 4 is the water depth in meters at the array site; column 5 shows the instrument depth in meters below the surface; columns 6 and 7 are the mean resultant direction and speed in degrees and cm/s; column 8 indicates the persistence of the mean resultant flow in percentage of time the mean resultant flow had the indicated speed and direction; columns 9 and 10 tabulate the scalar mean speed and its standard deviation (σ); columns 11 and 12 show the minimum and maximum current speed. The calendar at the bottom of the table shows the deployment schedule for the arrays.

Current Meter Summary

Array	Lat (N)	Long (W)	Water (M)	Meter (M)	Mean-Vector-Resultant Dir-	Speed-	Persistence	Scalar-Speed Mean-	σ-	Min.-	Max.
A	30.20°	87.26°	21	9	123°	1	4	16	8	.09	43.
				17	113°	1	7	10	5	.18	28.
B	30.14°	87.32°	20	9	220°	3	18	14	8	.23	48.
				16	214°	1	6	10	5	.26	32.
C	30.20°	87.23°	21	9	132°	3	20	15	9	.03	62.
				16	073°	3	25	12	6	.44	35.
D	30.14°	87.25°	24	11	103°	2	14	14	9	.15	58.
E	30.14°	87.32°	20	9	251°	5	44	12	7	.06	41.
				16	150°	6	52	12	5	.00	29.
				19	217°	2	25	8	4	.00	22.
F	30.20°	87.26°	21	9	243°	4	38	12	7	.10	41.
				17	243°	4	35	12	6	.00	38.

1987 |1988

|JAN |FEB |MAR |APR |MAY |JUN |JULY |AUG |SEPT |OCT |NOV |DEC |JAN |

|⇐ arrays *A,B* ⇒|

|⇐ arrays *C,D* ⇒|

|⇐ arrays *E,F* ⇒|

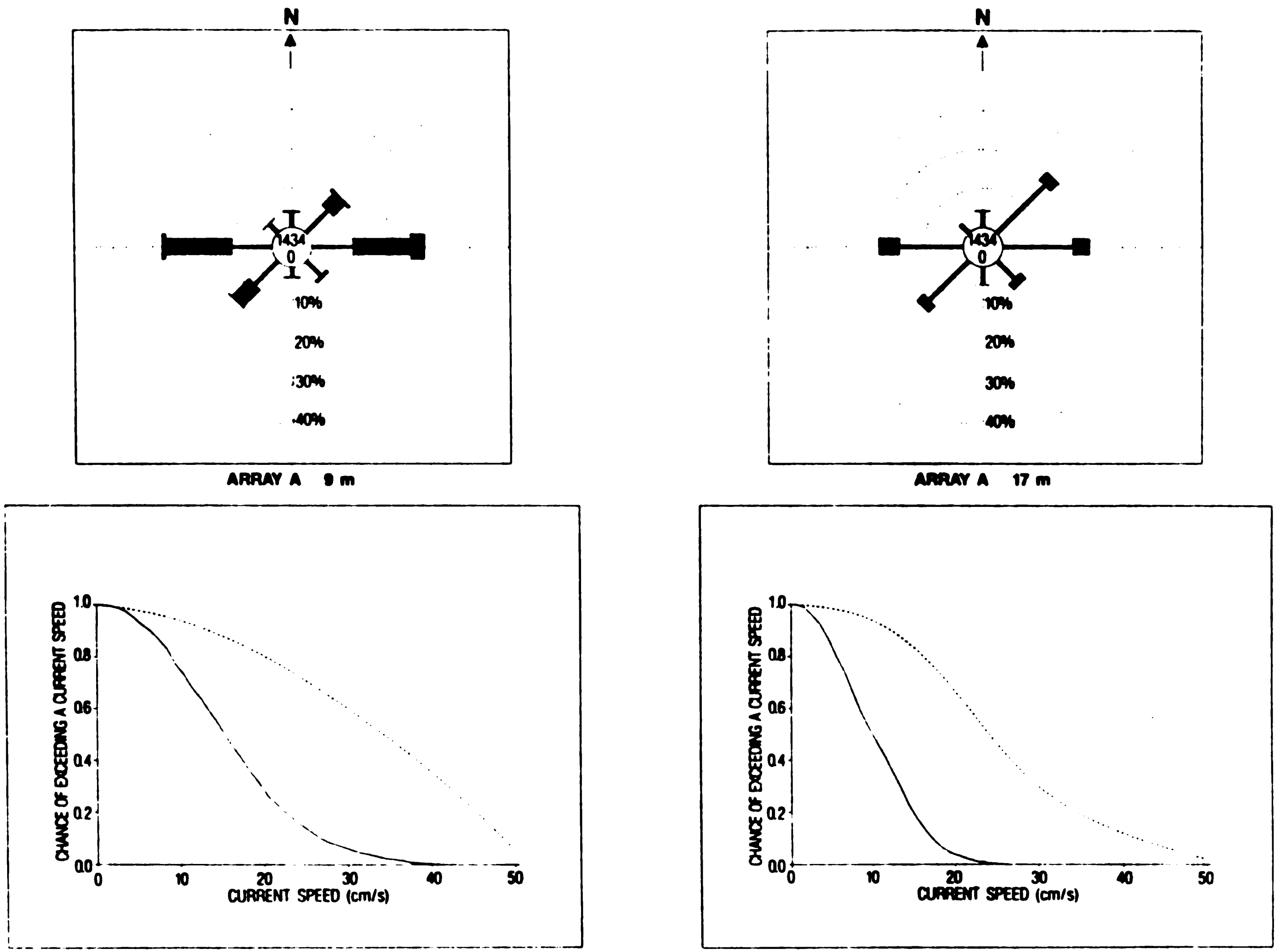


Figure 2. Current rose (upper panel) and speed probability distribution (lower panel) for specified array at the depth shown. Dotted circles on rose show percent frequency of current by direction (towards). Thickness of bar indicates speed of current: 0-15 (thinnest bar), 15-30, 30-45, and greater than 45 cm s^{-1}. Numerals inside of the rose show the number of hourly averages used and the percentage of zero speeds. The solid line in the lower panel is for observed currents and the dashed line is for modeled currents from 1948 to present.

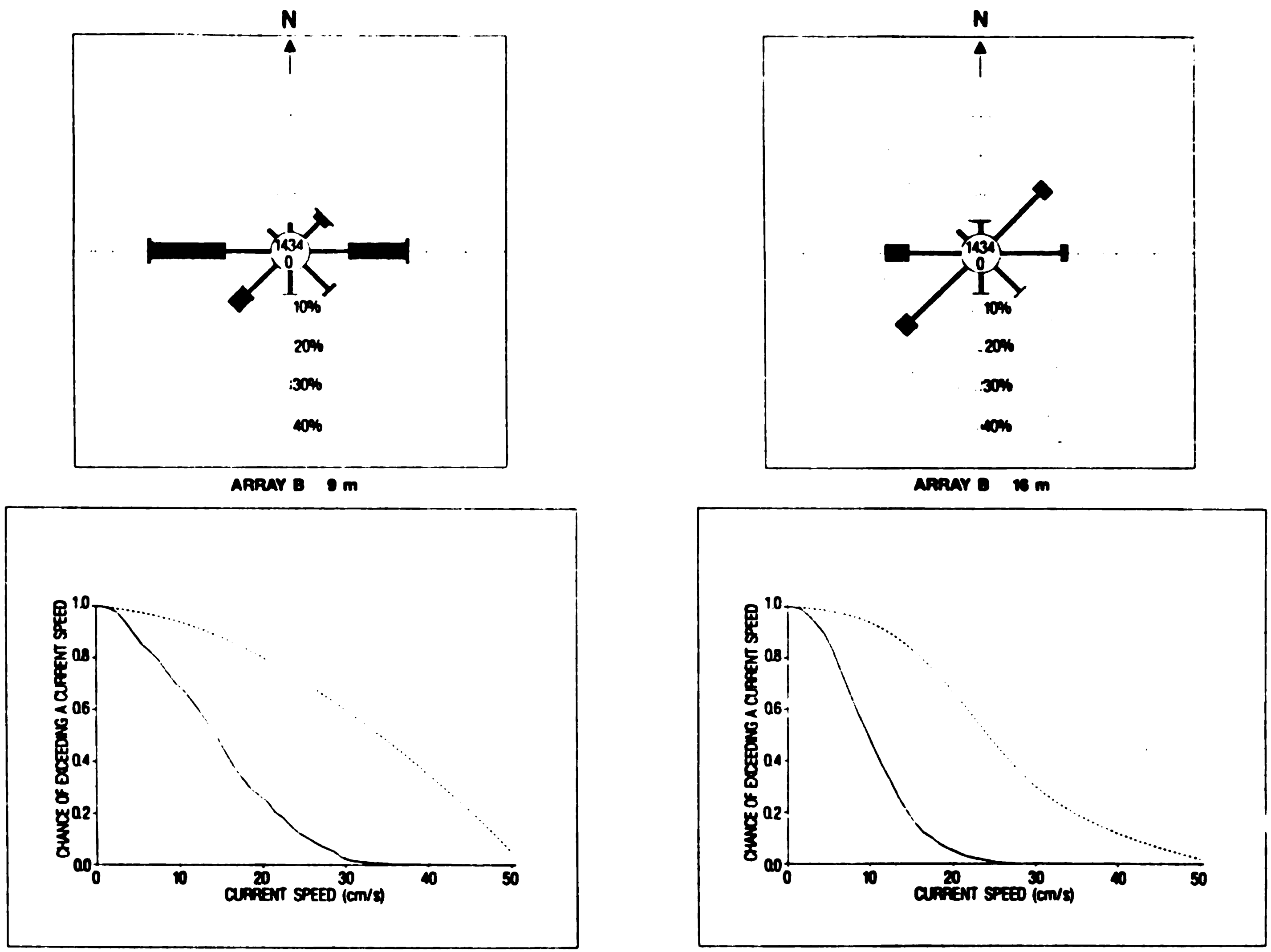


Figure 3. Current rose (upper panel) and speed probability distribution (lower panel) for specified array at the depth shown. Dotted circles on rose show percent frequency of current by direction (towards). Thickness of bar indicates speed of current: 0-15 (thinnest bar), 15-30, 30-45, and greater than 45 cm s^{-1}. Numerals inside of the rose show the number of hourly averages used and the percentage of zero speeds. The solid line in the lower panel is for observed currents and the dashed line is for modeled currents from 1948 to present.

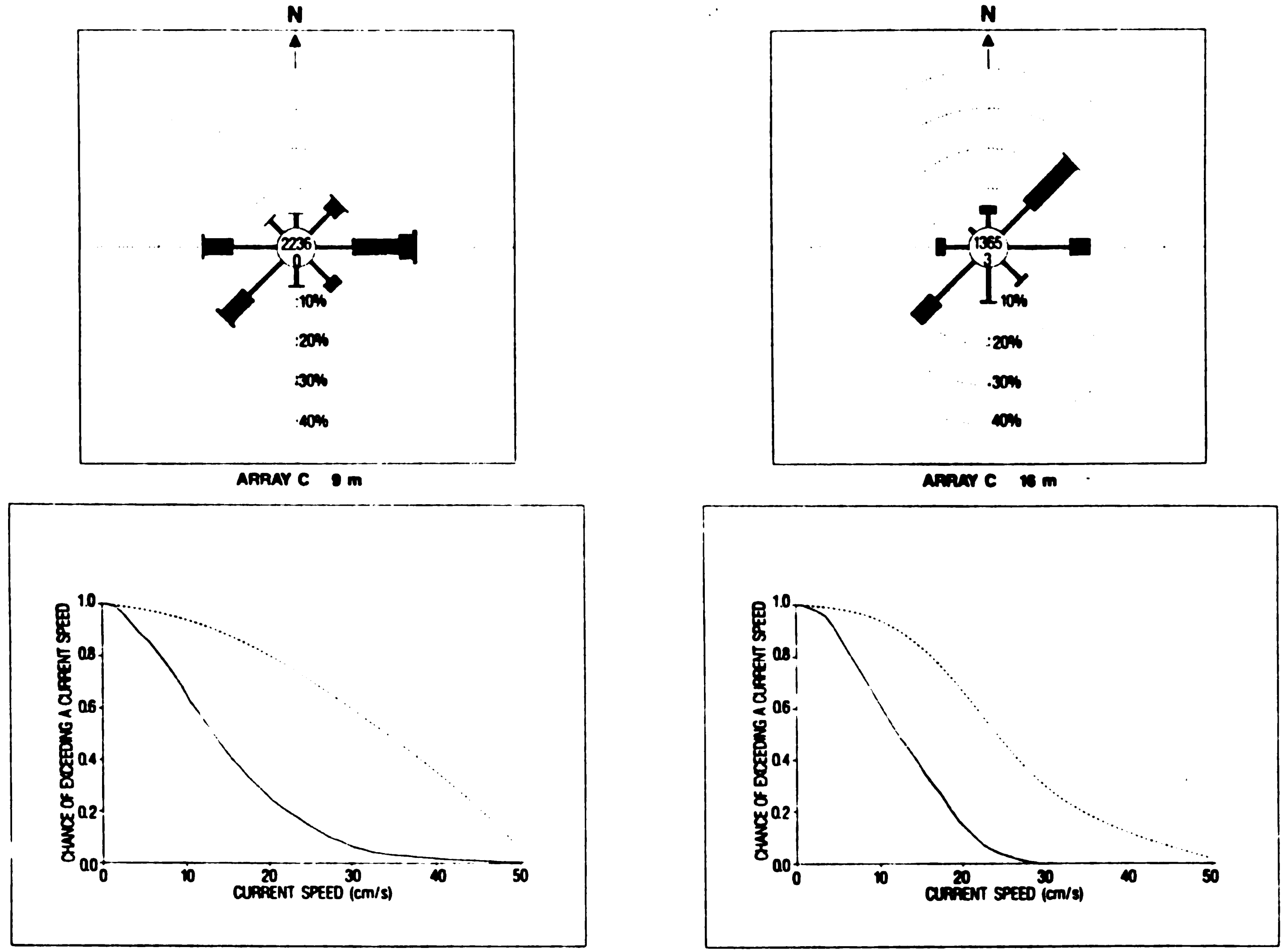


Figure 4. Current rose (upper panel) and speed probability distribution (lower panel) for specified array at the depth shown. Dotted circles on rose show percent frequency of current by direction (towards). Thickness of bar indicates speed of current: 0-15 (thinnest bar), 15-30, 30-45, and greater than 45 cm s^{-1}. Numerals inside of the rose show the number of hourly averages used and the percentage of zero speeds. The solid line in the lower panel is for observed currents and the dashed line is for modeled currents from 1948 to present.

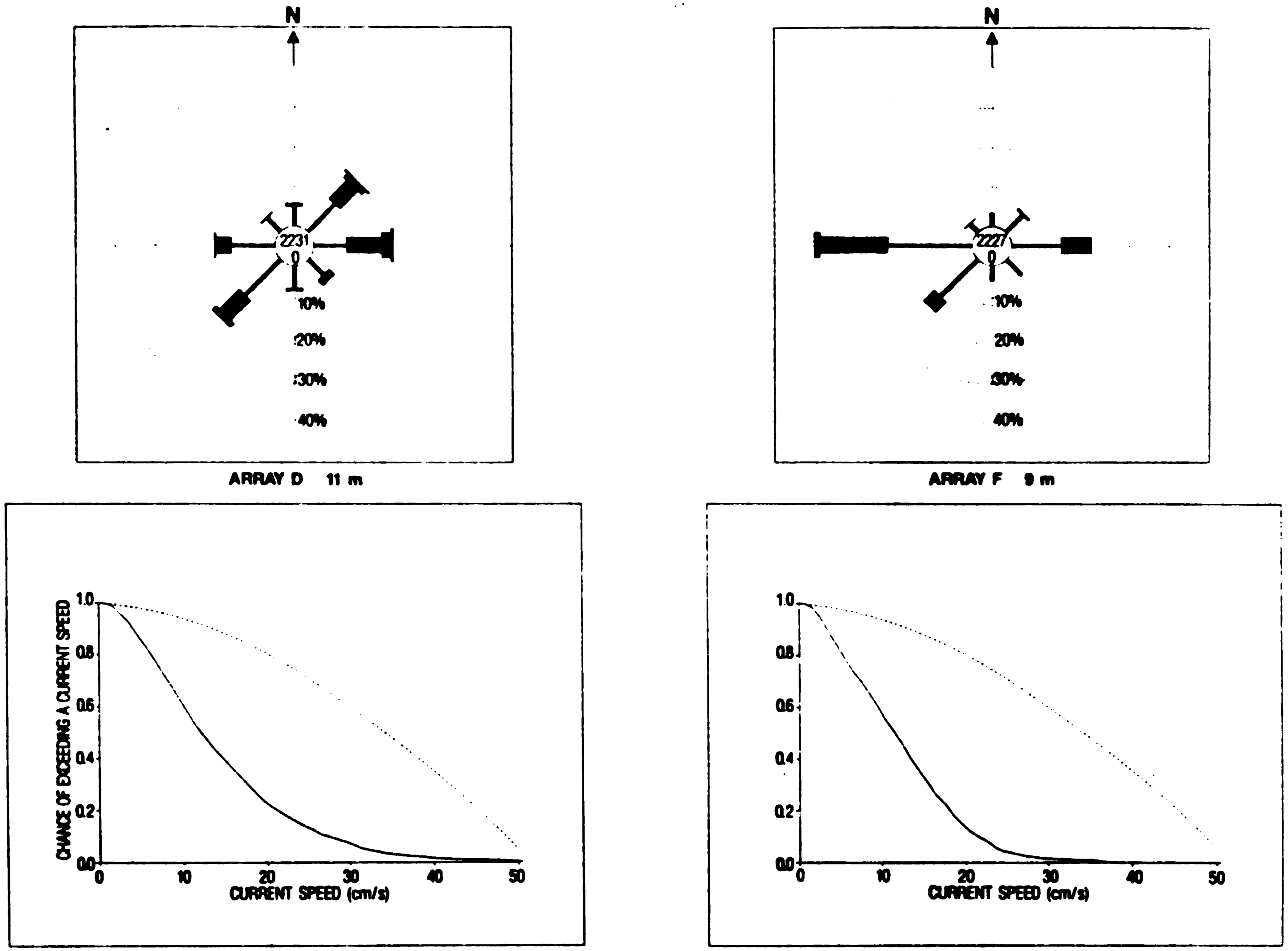


Figure 5. Current rose (upper panel) and speed probability distribution (lower panel) for specified array at the depth shown. Dotted circles on rose show percent frequency of current by direction (towards). Thickness of bar indicates speed of current: 0-15 (thinnest bar), 15-30, 30-45, and greater than 45 cm s^{-1}. Numerals inside of the rose show the number of hourly averages used and the percentage of zero speeds. The solid line in the lower panel is for observed currents and the dashed line is for modeled currents from 1948 to present.

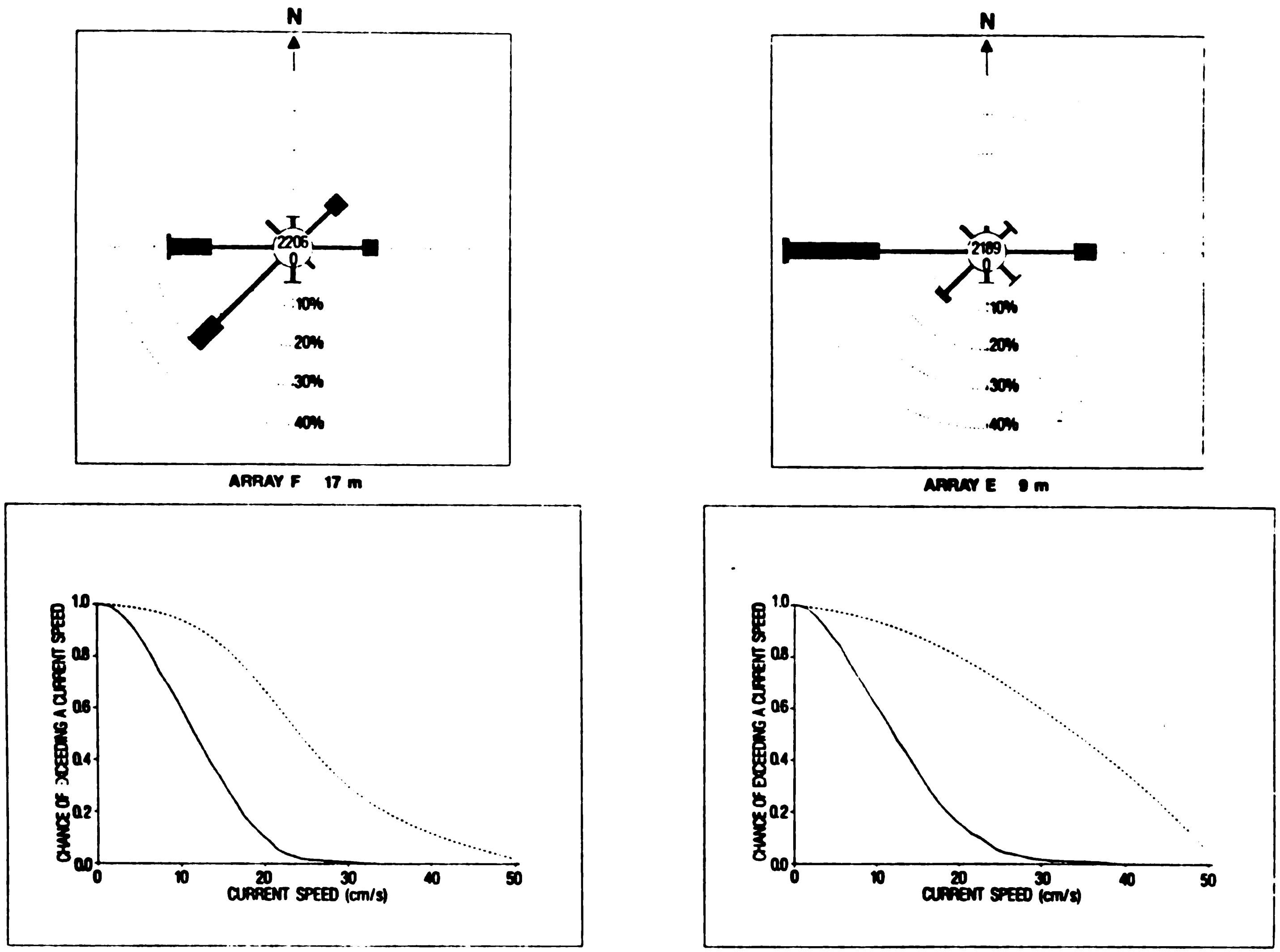


Figure 6. Current rose (upper panel) and speed probability distribution (lower panel) for specified array at the depth shown. Dotted circles on rose show percent frequency of current by direction (towards). Thickness of bar indicates speed of current: 0-15 (thinnest bar), 15-30, 30-45, and greater than 45 cm s^{-1}. Numerals inside of the rose show the number of hourly averages used and the percentage of zero speeds. The solid line in the lower panel is for observed currents and the dashed line is for modeled currents from 1948 to present.

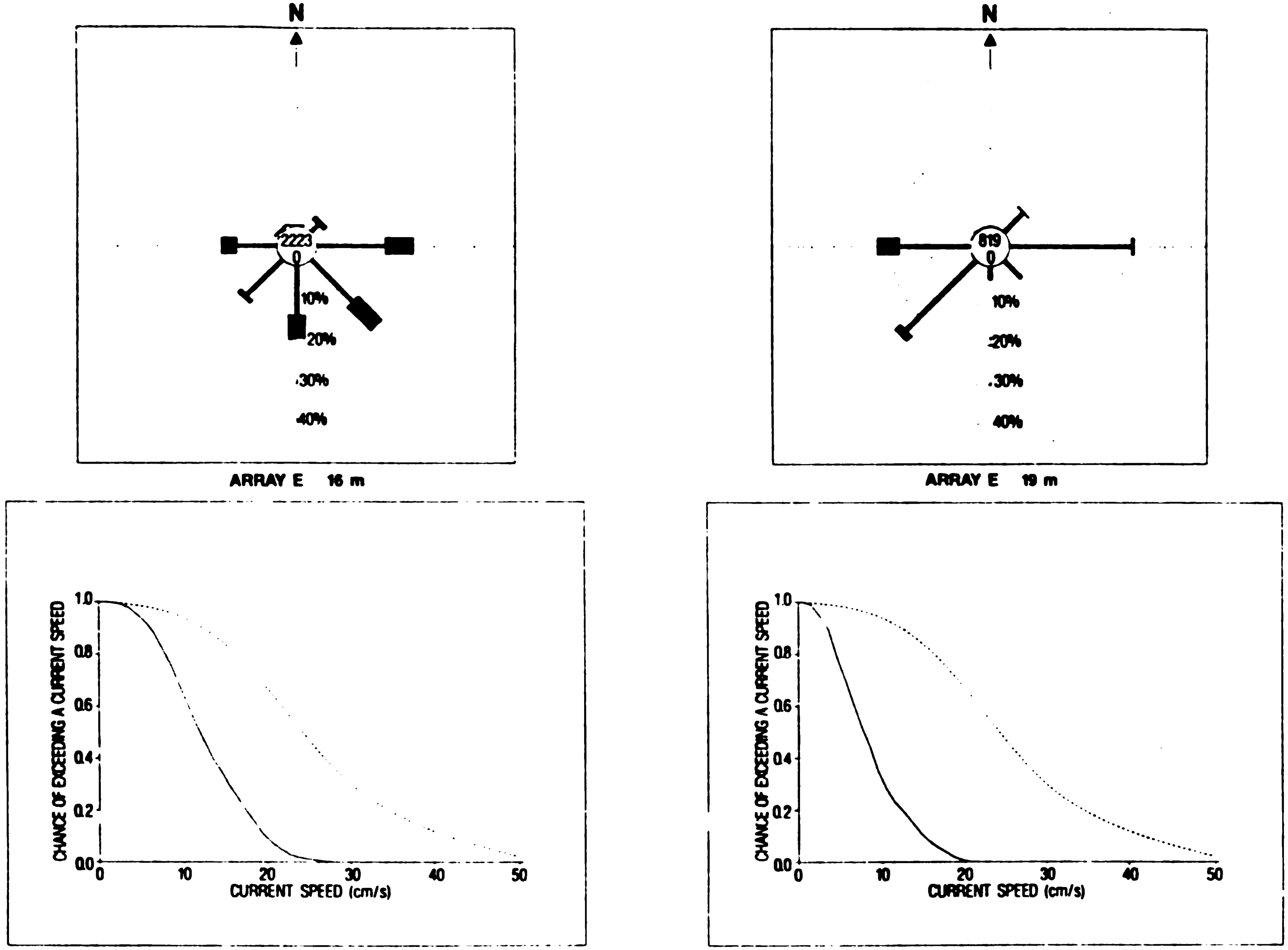


Figure 7. Current rose (upper panel) and speed probability distribution (lower panel) for specified array at the depth shown. Dotted circles on rose show percent frequency of current by direction (towards). Thickness of bar indicates speed of current: 0-15 (thinnest bar), 15-30, 30-45, and greater than 45 cm s^{-1}. Numerals inside of the rose show the number of hourly averages used and the percentage of zero speeds. The solid line in the lower panel is for observed currents and the dashed line is for modeled currents from 1948 to present.

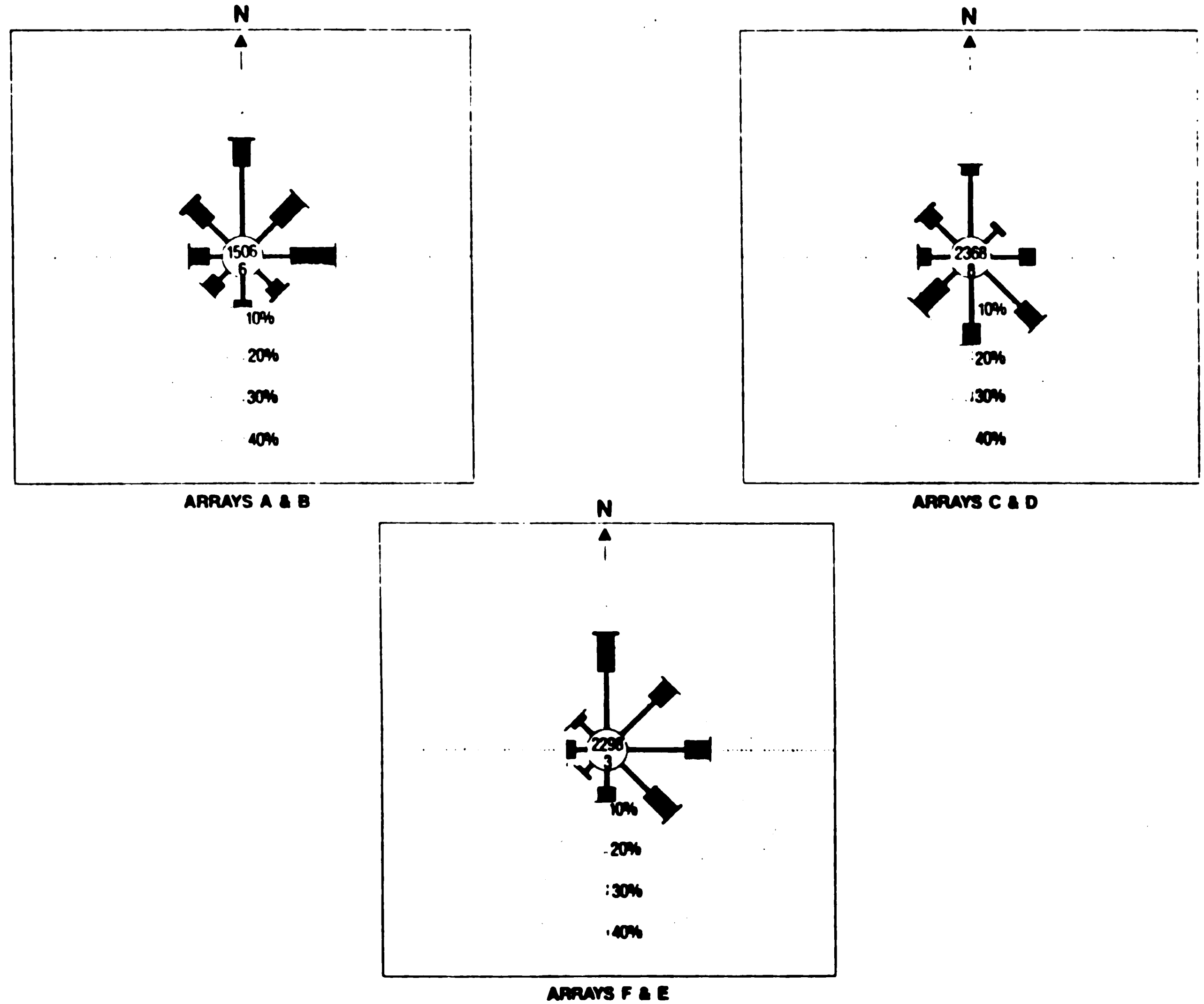


Figure 8. Wind rose data from the Pensacola Naval Air Station (elevation + 30 feet) during the time of deployment of the indicated current meter arrays. Dotted circles on the roses show the percent frequency of wind direction (from). Bar thickness indicates wind speed: 0-5 (thinnest bar), 5-10, and 10-15 m s^{-1}. Numerals inside the rose show the number of hourly observations used and the percentage of calms.

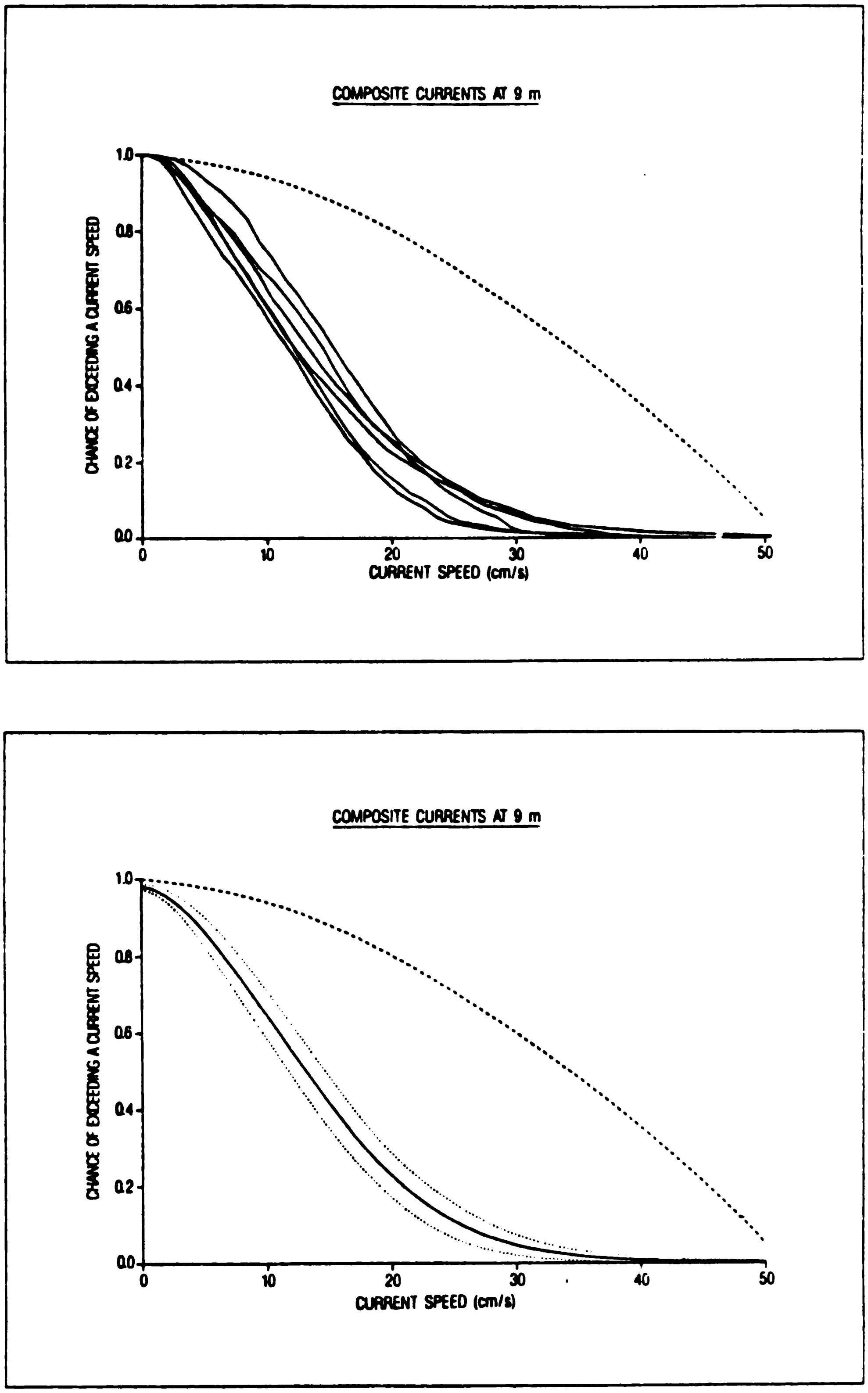
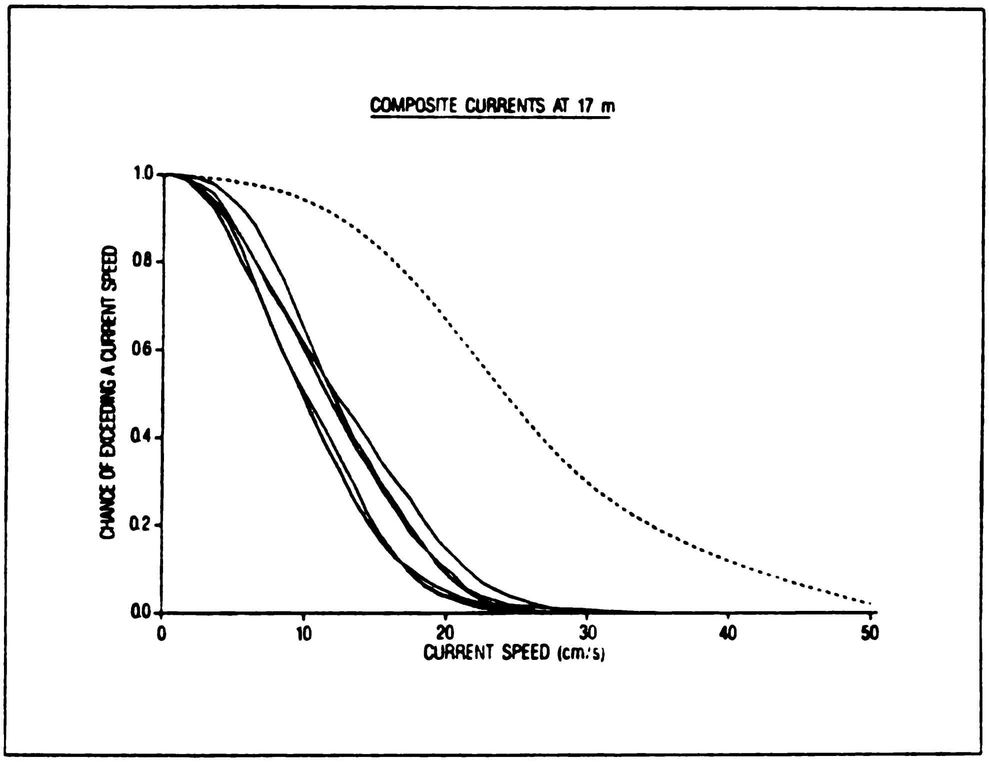


Figure 9. Composite current profiles at 9 m below the surface (upper panel). The solid line is for observed currents and the dashed line is for modeled currents from 1948 to present. The solid line in the lower panel is a smoothed average value of the observed currents, the dotted curves are ± 1 standard deviation, and the dashed line is for the modeled currents.



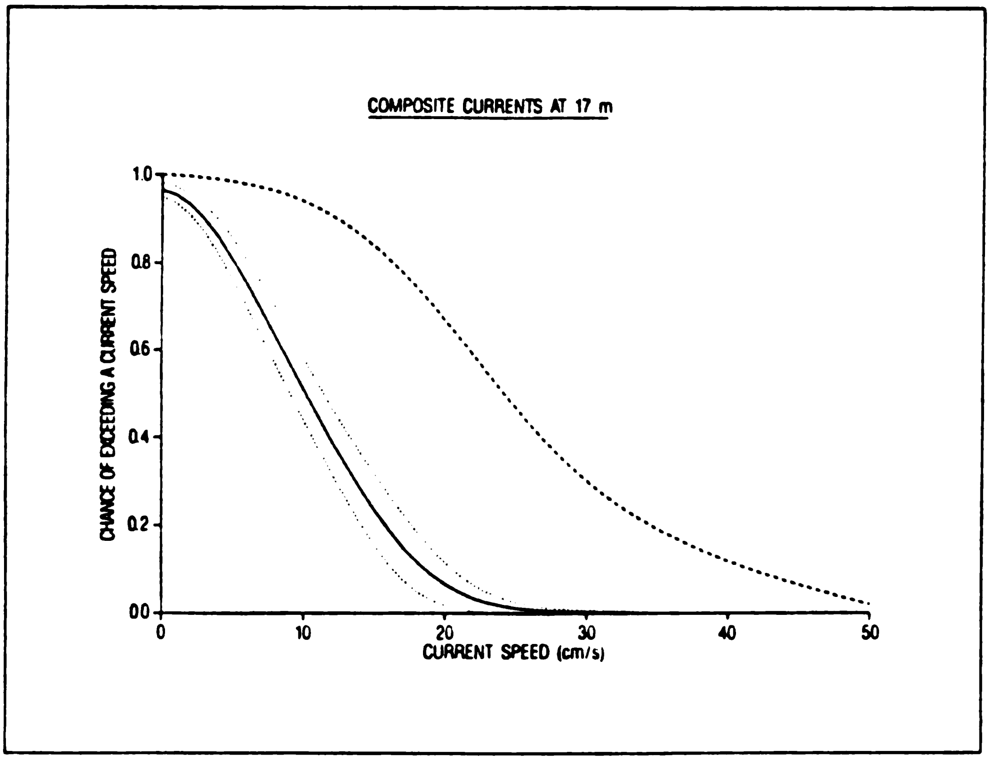


Figure 10. Composite current profiles at 17 m below the surface (upper panel). The solid line is for observed currents and the dashed line is for modeled currents from 1948 to present. The solid line in the lower panel is a smoothed average value of the observed currents, the dotted curves are ± 1 standard deviation, and the dashed line is for the modeled currents.

CHAPTER 2

CURRENT ANALYSIS

CURRENTS OFF PENSACOLA, FLORIDA

NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY
NSTL STATION, MS 39529

HOME PORT CURRENT METER ANALYSIS

6 FEBRUARY 1987 - 7 APRIL 1987 DEPLOYMENT

OFF PENSACOLA BAY, FLORIDA

Prepared for:
Naval Ocean Research and Development Activity (NORDA)
NSTL, Mississippi 39529

Prepared by:
MEC Systems Corporation
10629 Crestwood Drive
Manassas, Virginia 22110

Under Subcontract from:
Planning Systems Incorporated
115 Christian Lane
Slidell, Louisiana, 70458

9 June 1987

SUMMARY OF ANALYSIS TECHNIQUES

General

The acoustic current meter (ACM) data were processed with frequently used analysis techniques. The purpose of the analysis was to rapidly and cost-effectively provide standard products for applications and for documentation of the measurements. It is anticipated that these products will be used for follow-on work by NORDA or absorbed into an overall NORDA report. The following sections summarize the analysis methods.

Data Editing and Pre-Processing

Computer terminal displays of four minute velocity components (north-south and east-west relative to magnetic north) and temperature values as recorded by the meters were inspected manually. The data were of high quality with the following exceptions. The temperature record for Array A at 17 m depth was not suitable for analysis with bad values throughout the entire record. This current meter also had seven consecutive bad current values which simply were replaced by the previous good values since this small length of bad data would only affect two subsequently determined 20 minute vector averaged values. Table 1 summarizes the data that were analyzed.

The current measurements were next vector-averaged over 20 minute time intervals centered on one-third hour times (i.e. on the hour, on the hour plus 20 minutes, etc.). Vector averaging removes wave contamination which could be important for the relatively shallow sensor depths. Temperature measurements were averaged over the same time periods. Vector-averaged current components were rotated from the magnetic north reference used for the measurements to a true north reference used for the analysis products. The following information was output to magnetic tape at each 20 minute time: data point 20 minute index (from 1 to the number of 20 minute values), original time series data point index corresponding to the center of the 20 minute time period, time in decimal days from the beginning of the year, average value of east-west component, standard deviation of this component from the 20 minute average, maximum absolute difference of this component from the 20 minute average, average value of north-south component, a similar standard deviation and maximum difference for this component, vector mean speed computed from the averages of the two components, vector mean direction computed from the averages of the two components, average value of temperature, and a similar standard deviation and maximum absolute difference for temperature. The 20 minute values of speed, direction, and temperature were used for subsequent analysis. The

Table B-1 **Data Information**

Array	Position	Water Depth (m)	Meter Depth (m)	Starting Time (CST)	Ending Time (CST)
A	30.198 N 87.265 W	21	9	1220 6 Feb 87	0540 7 Apr 87
			17	1220 6 Feb 87	0540 7 Apr 87
B	30.142 N 87.320 W	20	9	1220 6 Feb 87	0540 7 Apr 87
			16	1220 6 Feb 87	0540 7 Apr 87

Starting and ending times are for vector averaged values used in analysis.

information on the magnetic tape was preceded by a header record for each current meter record and was provided to NORDA for archival. Table 2 provides the tape format and an example of the information on the magnetic tape.

Probability Distributions

Current speed and direction probability distributions and joint probability distributions were calculated by counting occurrences within 10 cm/s ranges, dividing by the total number of measured values, and converting to percentages. The distributions in the tables are provided in units of percent multiplied by 100 (i.e. 100 = one percent). Occurrences on a boundary between two ranges were counted in the higher of the two ranges. The joint distributions are summed over all speeds to provide direction distributions and over all directions to provide speed distributions. The speed distributions are summed from low to high speed ranges to provide cumulative speed distributions (i.e. probabilities for speeds to be less than the upper values of each speed range). The probability distributions are accompanied by the following summary statistics: vector mean speed and direction calculated from the north-south and east-west current components, the scalar mean speed calculated by averaging all speeds regardless of direction, the standard deviation of speeds about the scalar mean speed, the maximum speed, and the minimum speed. The relative size of a vector mean speed compared to a corresponding scalar mean speed is a measure of directional variability. If a vector mean speed is much smaller than a corresponding scalar mean speed, directions of the individual measurements are highly variable. If a vector mean speed is almost as large as a scalar mean speed, individual measurements tend to be unidirectional over the measurement time period.

Table B-2

Magnetic Tape Format and Information

Density: 1600 bpi
Code: ASCII
Record Size: 96

Type: Unlabelled, 9 track
Records/Block: 32
Block Size: 3072

No. Files: 4
Start of First File is below. Note folding on this printer.

```
01987,Home Port ACM Data Array A @ 9m(31 ft),DT=4 min
E-W,N-S(cm/s),Temp C,Time(Julian Days,Cent.Std.Time, add +0.25 d
30 deg,11.9 ' N.,087 deg,15.9'W. Z=69 ft(21 m)
    1     6  37.5139 -15.12    1.34    1.02     .24     .00    1.22  15.12 270.91   18.
32       .02      .02
    2    11  37.5278 -15.61    1.56    2.03   -1.02    1.04    1.56  15.64 266.27   18.
36       .02      .03
    3    16  37.5417 -13.92    1.00    1.13    -.31     .69    1.22  13.92 268.74   18.
36       .01      .01
    4    21  37.5556 -14.72     .77    1.30   -1.75    1.07    1.39  14.02 263.23   18.
37       .01      .01
    5    26  37.5695 -15.38     .51     .55   -3.15    1.42    1.00  15.70 250.41   18.
37       .01      .01
    6    31  37.5833 -17.36     .86    1.22   -3.84    1.18    1.50  17.70 257.52   18.
35       .01      .01
    7    36  37.5972 -19.06     .67     .70   -4.99     .92    1.30  19.71 255.34   18.
33       .02      .83
    8    41  37.6111 -15.46    1.22    1.88   -6.77     .74    1.01  16.88 246.33   18.
30       .01      .81
    9    46  37.6250 -13.89     .54     .69   -4.53     .75    1.13  14.61 251.93   18.
32       .01      .02
   10    51  37.6389 -15.09     .31     .41   -5.40     .30     .30  16.03 250.29   18.
30       .00      .00
   11    56  37.6520 -14.79     .52     .75   -5.63    1.13    1.48  15.03 249.17   18.
30       .01      .01
   12    61  37.6667 -14.54     .56     .93   -5.24     .82     .96  15.46 250.17   18.
27       .01      .02
   13    66  37.6806 -14.33     .66    1.16   -5.50     .85    1.39  15.35 249.81   18.
28       .01      .01
   14    71  37.6945 -13.72     .53     .78   -7.08     .54     .81  15.83 240.48   18.
25       .01      .01
   15    76  37.7083 -14.29     .46     .72   -7.09    1.84    1.24  15.95 243.61   18.
23       .01      .01
   16    81  37.7222 -14.34     .55     .98   -6.28     .95    1.42  15.66 246.34   18.
24       .02      .83
   17    86  37.7361 -13.33     .39     .52   -7.21     .81    1.87  15.16 241.59   18.
24       .00      .00
   18    91  37.7500 -14.22     .59     .78   -6.48     .78     .90  15.63 245.50   16.
23       .02      .03
   19    96  37.7639 -12.89     .98    1.45   -5.23     .69    1.13  13.91 247.92   18.
16       .02      .03
   20   101  37.7778 -10.88     .65    1.10   -6.94     .79    1.01  12.90 237.45   19.
13       .01      .02
   21   106  37.7917 -12.50    1.29    1.53  -11.24    1.60    2.81  16.81 226.04   17.
99       .06      .10
   22   111  37.8056 -11.20    2.15    3.42  -12.34     .55     .61  16.66 222.23   17.
91       .02      .03
```

Tidal Analysis

Each current record was analyzed by least-squares techniques to provide amplitudes and phases of primary tidal constituents and to approximately remove astronomical tidal currents from the current time series. The east-west and north-south current velocity components were each represented by a time series of the form

$$u(idt) = u_o + \sum_{n=1}^{N} c_n \cos(\sigma_n idt - \phi_n)$$

where u is a current component, dt is the time interval between samples (20 minutes), (i-1)dt is the time of the ith sample relative to the starting time of the record, u_o is the mean value of the current component, N is the number of tidal constituents considered in the analysis, c_n is the amplitude of the nth constituent, σ_n is the radian frequency of the nth constituent, and ϕ_n is the phase of the nth constituent. The last equation can be written as

$$u(idt) = u_o + \sum_{n=1}^{N} a_n \cos(\sigma_n idt) + b_n \sin(\sigma_n idt)$$

where

$$c_n = (a_n^2 + b_n^2)^{1/2}$$

$$\tan \phi_n = b_n/a_n$$

The cosine and sine coefficients, a_n and b_n, were calculated so that the given representation of current components by sums of sinusoidal tidal constituents provides the best least-squares fit to each measured current component. That is, tidal constituents were determined to minimize the square of the differences between the previous summation equations and each measured current component. This analysis was separately performed for each current meter record using all available data at 20 minute intervals.

Residual currents were calculated by vector subtraction of tidal currents (calculated from the summation equations during the measurement time period) from the measured currents (referred to as total currents to avoid confusion). Residual or nontidal currents include current contributions associated with large scale circulation or prevailing currents, local wind-driven currents, internal waves, thermohaline (i.e. density driven) currents, and currents related to nontidal sea surface slopes. Nontidal currents may also include contributions at tidal frequencies due to the presence of internal waves at tidal frequencies. Such tidal frequency internal waves can be generated by interaction of astronomical tides with bottom topographic variations and the continental shelf.

There are mathematical requirements for minimum record lengths in order to separate tidal constituents with nearly identical frequencies or periods. The primary constituents that were used are listed in the results by their common abbreviations. Information about the constituents is provided by Schureman (1958) and Hicks (1975). Effects of not being able to resolve constituents with nearly identical frequencies is often not a serious problem in using least-squares analysis as a filtering method to separate tidal and nontidal currents because the least-squares criterion forces good self-prediction agreement when only one of two similar frequencies is used. Resolution effects are more serious for tidal predictions at other times. Techniques to correct for effects of similar frequency constituents are given by Shureman (1958).

For the tidal analysis results in this data report, the phases are referenced to the start of the analysis (i.e. the time of the first 20 minute data point) for each current meter record. The amplitudes are as provided by the analysis and do not consider node factors which are described in the next paragraph.

In the field of tides, amplitudes and phases are often given for use in the following equation

$$u(idt) = u_o + \sum_{n=1}^{N} f_n d_n \cos(\sigma_n idt + V_n - K'_n)$$

where d_n and K'_n are tidal amplitudes and phases. The parameter f_n is the node factor for the nth constituent and V_n is the equilibrium argument for the nth constituent. The last equation generally is used for tidal predictions. Node factors are specified for the middle of the year of the desired predictions and equilibrium arguments are specified for the year, month, day, and hour of the start of the predictions. Node factors are functions of the year and the constituent of concern, and are typically near unity plus or minus up to roughly 10% for constituents of most importance. Equilibrium arguments range from 0° to 360° and depend on the time and the constituent of concern. Node factors and equilibrium arguments are provided by Schureman (1958). Each tidal constituent has a known frequency, which can be written in degrees or radians per hour, and the equilibrium arguments adjust the phase of the constituent of interest to the start time of the predictions. By specifiying node factors and equilibrium arguments for the start of an analyzed time series and equating the previous summation equations to the last summation equation, calculated amplitudes and phases can be placed in the form as used by the last equation. The phases, K'_n, are sometimes called modified epochs. Another equivalent approach to consider equilibrium arguments is to use the phases as referenced to the start of the analysis and to have a tidal current prediction program automatically adjust the phases to account for the time interval between the start of the analysis and the start of the predictions.

Relative importance of total, tidal, and residual currents can be estimated from the percent of the total variance that is nontidal. This is 100 multiplied by the variance of the residual record divided by the variance of the total record. For each current component, these results are shown with the constituents. These percentages also represent the ratio of the nontidal current kinetic energy to the total current kinetic energy. If a record is totally tidal, the percentage is 0% and, if a record is totally nontidal, the percentage is 100%. The Home Port data typically are greater than 95% nontidal.

Spectral Analysis

Spectra were calculated by standard fast Fourier transform techniques (e.g. Otnes and Enochson, 1978). Fourier coefficients of the two velocity components (north-south and east-west) were determined for sections of each record containing 4096 data points at the 20 minute sampling interval. Short partial sections (205 data points) at the ends of each record were not used. No window was applied to the time series. From the Fourier coefficients, kinetic spectra and rotary spectra parameters were computed using techniques described by Gonella (1972) and Mooers (1973). There are minor mathematical errors in the latter paper and these were corrected. Some of these errors were noted by Middleton (1982). During calculations, band averaging over Fourier frequencies was performed.

The utilized equations for rotary spectral analysis of the data are summarized here. In the literature, there have been some differences in the manner in which band averages of various parameters have been performed. The amplitudes of the anti-clockwise, A, and clockwise, C, rotating velocity components are given by

$$A = \frac{1}{2}\left((a_1+b_2)^2 + (a_2-b_1)^2\right)^{\frac{1}{2}}$$

$$C = \frac{1}{2}\left((b_2-a_1)^2 + (b_1+a_2)^2\right)^{\frac{1}{2}}$$

where a_1 and b_1 are the cosine and sine Fourier coefficients of the east-west velocity component and a_2 and b_2 are similar parameters for the north-south velocity component. Corresponding phases are given by

$$\tan \phi = (a_2-b_1)/(a_1+b_2)$$

$$\tan \theta' = (-b_1-a_2)/(a_1-b_2)$$

From these, the following parameters were obtained:

Clockwise Energy Spectrum: $E_C = \overline{C^2}$

Anti-Clockwise Energy Spectrum: $E_A = \overline{A^2}$

Difference Spectrum: $E_D = E_C - E_A$

Total Kinetic Energy Spectrum: $E_T = E_A + E_C$

Rotary Coefficient: $$R_C = \frac{E_C - E_A}{E_C + E_A}$$

Rotary Ellipse Orientation: $$\alpha = \frac{1}{2}\tan^{-1}\left(\frac{\overline{AC\sin(\Phi'-\theta')}}{\overline{AC\cos(\Phi'-\theta')}}\right)$$

Rotary Ellipse Stability: $$S = \frac{\overline{AC\sin(\Phi'-\theta')}^{\,2} + \overline{AC\cos(\Phi'-\theta')}^{\,2}}{\overline{A^2}\;\overline{C^2}}$$

where the overbars indicate averaging individual Fourier components over each band.

Interpretations of the spectral definitions are relatively clear. Values of all spectra are those for energy density, that is $(cm/s)^2/cph$. The rotary coefficient varies between zero and one with the latter value occuring for perfectly circular motion. The ellipse orientation is the direction along which the current velocities are a maximum. The ellipse stability varies between zero and one and is a measure of the similarity of ellipses at the individual Fourier frequecnies within each band. It approaches unity if there is little variation over a given band. The tables of rotary spectra parameters also provide the degrees of freedom for each frequency band. The degrees of freedom are twice the number of Fourier frequencies in each band multiplied by the number of separate sections used to analyze each record. The 90% percent confidence intervals for kinetic energy spectra (total spectrum in the tables) are given by

$$\frac{vE_T}{\chi^2_{v;0.05}} \leq E'_T < \frac{vE_T}{\chi^2_{v;0.95}}$$

where v is degrees of freedom, E_T is the total kinetic energy density for the band, E'_T is true total kinetic energy density, and χ^2 values are obtained from chi-square distributions.

HOME PORT CURRENT METER ANALYSIS

13 MARCH 1987 - 18 JUNE 1987 DEPLOYMENT

OFF PENSACOLA BAY, FLORIDA

Prepared for:
Naval Ocean Research and Development Activity (NORDA)
NSTL, Mississippi 39529

Prepared by:
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Under Subcontract from:
Planning Systems Incorporated
115 Christian Lane
Slidell, Louisiana, 70458

17 July 1987

SUMMARY

This data report provides data analysis products which document currents off Pensacola, Florida, between 13 March and 18 June 1987. The data were collected during the second deployment of acoustic current meters in the area. A previous data report (Reference 1) describes currents during the first deployment.

Of the three current meter records that were provided, there were two data quality problems. The temperature record for Array C at 16 m depth was not suitable for analysis with bad values throughout the entire record. This is of little importance because the temperatures measured by the other meters adequately describe temperatures in the area. The current record for Array C at 16 m depth contained several incorrect zero values near the end of the record starting at 0240 on 8 May. These data were excluded from further processing. Table 1 summarizes the data that were processed.

Table B-3 **Home Port Deployment 2 Data Information**

Array	Position	Water Depth (m)	Meter Depth (m)	Starting Time (CST)	Ending Time (CST)
C	30.200 N 87.233 W	21	9	0840 13 Mar 87	1140 14 Jun 87
			16	0840 13 Mar 87 (currents only)	0220 8 May 87
D	30.142 N 87.250 W	24	11	0920 13 Mar 87	1140 18 Jun 87

Starting and ending times are for vector-averaged values used in analysis.

The data were processed with frequently used analysis techniques which are described in Reference 1. The only minor difference was that spectra were calculated using blocks of 2048 data values (after vector-averaging to 20 minute values). The following numbers of data values were used for each record: 6144 values (3 blocks) for Array C at 9 m depth; 4096 values (2 blocks) for Array C at 16 m depth; and 6144 values (3 blocks) for Array D at 11 m depth. Since 4014 vector-averaged 20 minute values were available for Array C at 16 m depth, zero values were added to obtain the 4096 values required by the fast Fourier transform part of the spectral analysis.

The 20 minute values of speed, direction, and temperature were used for all analysis. These values also are provided on magnetic tape in the same format as the magnetic tape for the first deployment.

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Mooers, C.N.K., A technique for the cross-spectrum analysis of pairs of complex-valued time series, with emphasis on properties of polarized components and rotational invariants, Deep-Sea Res., 20, 1129-1141, 1973.

Otnes, R.K., and L. Enochson, Applied Time Series Analysis, John Wiley and Sons, New York, 1978.

Schureman, P., Manual of Harmonic Analysis and Prediction of Tides, U.S. Coast and Geodetic Survey, U.S. Government Printing Office, 1958, reprinted 1971.

CHAPTER 3

MODEL ANALYSIS

CURRENTS OFF PENSACOLA, FLORIDA

NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY
NSTL STATION, MS 39529

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ABSTRACT

Using a multi-layered current model, currents at two proposed dredged material disposal sites in the vicinity of Pensacola, Florida, were investigated. The first step of this procedure involved calibration of the model with measurements taken at two levels at two separate sites. Comparisons between modeled and measured data indicate that the model predictions correspond quite well to the measurements at both levels and both sites. These currents, due to the proximity of the coastline, are directed primarily in the alongshore direction.

In the second part of this study, winds from two historical hurricanes (Eloise and Frederic) were used to drive the current model. Results indicate that, during such events, currents of about 1 m/sec can be expected in the vicinity of the proposed dredged disposal sites. These currents will be directed primarily in the along-coast direction.

In the final phase of this study, steady-state currents were calculated for various wind speeds and directions. Climatological wind statistics were obtained for nearby Pensacola airport. These were converted to overwater winds via the method of Resio and Vincent (1977). These probabilities of wind speeds and directions were converted to probabilities of current speeds and directions using the results of the steady-state model runs. Results show that dominant current directions are along the coast with the net current toward the west. The onshore-offshore transport is low-velocity and about balanced in terms of their percentage occurrences. Thus, any transports associated with these currents should be directed primarily along the coast rather than toward or away from the shore.

PREDICTED CLIMATOLOGY OF CURRENTS AT TWO SITES
OFF PENSACOLA BAY, FLORIDA

1. INTRODUCTION

During the last ten years the ability to predict accurate currents has improved markedly as a better understanding of turbulence closure and related mixing effects has been coupled into multi-layer numerical models. Unfortunately, many of these models require large amounts of computer time and related expenses, particularly for the case of fine-scale applications in near-coastal locations. To overcome this problem, OCTI has developed and employed in several studies a class of models which incorporates a high-order turbulence closure scheme (in the vertical dimension) into a multi-layered model. Since the grid spacing in the horizontal is typically much larger than the spacing in the vertical, a split timing can be used to optimize computer run time.

Careful studies of currents in water depths less than 30 meters, or so, have demonstrated that the advective terms in such shallow coastal areas tend to be much smaller than the local balance terms. Thus, the three-component equations of motion can be approximated as

$$\text{(1a)} \qquad \frac{dU}{dt} = -\frac{1}{\rho}\frac{\partial p}{\partial x} + fV + \frac{\partial}{\partial z}\left(-\overline{uw} + \nu\frac{\partial U}{\partial z}\right)$$

$$\text{(1b)} \qquad \frac{dV}{dt} = -\frac{1}{\rho}\frac{\partial p}{\partial y} - fU + \frac{\partial}{\partial z}\left(-\overline{vw} + \nu\frac{\partial V}{\partial z}\right)$$

$$\text{(1c)} \qquad \frac{dW}{dt} = -\frac{1}{\rho}\frac{\partial p}{\partial z} + g$$

where z is the vertical space coordinate (positive upward), t is the time coordinate, f is the coriolis parameter, U and V are the mean velocities in the x and y directions, respectively, g is gravity, ρ is the density of water, $\overline{uw}$ and $\overline{vw}$ are the Reynolds stresses, and ν is the molecular kinematic viscosity. If we assume that the vertical pressure distribution is hydrostatic and that mean vertical motions are much smaller than the horizontal motions, we can reduce the solution in our vertical dimension to equations for U and V only,

$$\text{(2a)} \qquad \frac{dU}{dt} = -g\frac{\partial \eta}{\partial x} + fV + (-\overline{uw} + \nu\frac{\partial U}{\partial z})$$

$$\text{(2b)} \qquad \frac{dV}{dt} = -g\frac{\partial \eta}{\partial y} - fU + (-\overline{vw} + \nu\frac{\partial V}{\partial z}) .$$

The existence of the Reynolds stresses, which result from temporal averaging of the exact equations of motion, results in what is classically called the closure problem of turbulence. In order to reduce our system so that there are the same number of equations as unknowns, it is necessary to parameterize the Reynolds stress terms in equations 2a and 2b. The usual practice for parameterizing turbulent stresses is to invoke the Boussinesq eddy viscosity/diffusivity closure hypothesis, in which the turbulent fluxes of mean flow momentum are approximated by the product of the eddy viscosity/diffusivity coefficient and the vertical mean flow strain rate. These closure expressions are written as follows:

$$\text{(3a)} \qquad -\overline{uw} = \nu_t\frac{\partial U}{\partial z}$$

and

$$\text{(3b)} \qquad -\overline{vw} = \nu_t\frac{\partial V}{\partial z}$$

in which ν_t is the turbulent eddy viscosity/diffusivity coefficient.

The problem with this type of closure methodology is that one trades one unknown quantity, the turbulent Reynolds stress, for another unknown quantity, the turbulent eddy viscosity/diffusivity coefficient.

If the eddy viscosity/diffusivity coefficient is not correctly specified, then the turbulent stresses are, in fact, misrepresented. To avoid this problem, a state-of-the-art modeling methodology for calculating the vertical distribution of the eddy viscosity/diffusivity coefficient is employed, namely, the two-equation (k-ε) turbulence closure approach.

The two-equation (k-ε) turbulence closure model as presented by Launder and Spalding (1974) is based on the following fundamental principles. Unlike the kinematic molecular viscosity, ν, the kinematic turbulent eddy viscosity, ν_t, is flow dependent and can vary in both space and time. An approximation for the distribution of the turbulent eddy viscosity is obtained by assuming that it is proportional to the product of the characteristic velocity and length scales of turbulence, namely:

$$(4) \qquad \nu_t \propto k^{1/2} \ell$$

in which k is the turbulence energy per unit mass defined as $\frac{1}{2}(\overline{uu} + \overline{vv} + \overline{ww})$ or one half the sum of the normal Reynolds stress components, and ℓ is the macroscale of turbulence (a measure of the size of the energy containing eddies). An inviscid estimate of the energy dissipation rate per unit mass, ε, is obtained when one assumes that the amount of energy dissipated at the small scales of turbulence equals the rate of supply at the large scales.

Again utilizing the characteristic velocity and length scales of turbulence, dimensional considerations require that (Tennekes and Lumley, 1972)

$$\epsilon \sim \frac{k^{3/2}}{\ell} . \tag{5}$$

Substitution of equation 4 into equation 5 yields a functional relationship for the turbulent eddy viscosity in terms of the kinetic energy of turbulence, k, and its rate of dissipation, ϵ, specifically:

$$\nu_t = C_\nu \frac{k^2}{\epsilon} \tag{6}$$

where C_ν is an empirical coefficient.

Transport equations required for the computation of the turbulence energy per unit mass, k, and its rate of dissipation, ϵ, may be derived in an exact form from the Navier-Stokes equation. Unfortunately, construction of the transport equations results in an additional closure problem. The details of the derivation of the transport equation for k and ϵ are given by Chapman (1982, 1983), in which the following set of model equations are presented

$$\frac{\partial k}{\partial t} = \frac{\partial}{\partial z}\left(\frac{\nu_{eff}}{\sigma_k}\frac{\partial k}{\partial z}\right) + \nu_t\left(\left(\frac{\partial U}{\partial z}\right)^2 + \left(\frac{\partial V}{\partial z}\right)^2\right) - \epsilon \tag{7a}$$

and

$$\frac{\partial \epsilon}{\partial t} = \frac{\partial}{\partial z}\left(\frac{\nu_{eff}}{\sigma_\epsilon}\frac{\partial \epsilon}{\partial z}\right) + C_1\nu_t \frac{\epsilon}{k}\left(\left(\frac{\partial U}{\partial z}\right)^2 + \left(\frac{\partial V}{\partial z}\right)^2\right) - C_2 \frac{\epsilon^2}{k} \tag{7b}$$

where ν_{eff} is the effective viscosity $(\nu_t + \nu)$; σ_k and σ_ϵ, Prandtl/Schmidt numbers; and C_1 and C_2, empirical constants. Estimates for the empirical constants found in equations 7a and 7b were originally obtained by applying the model equations to simple turbulent flows for which data from careful experiments were available. OCTI has tested its k-ε model against measured data in several studies ranging from ice floes in the Beaufort Sea to hurricane currents in the Gulf of Mexico and found that the originally derived coefficients appear to work well. Consequently, no adjustments have been made in the present model to the value of the empirical coefficients listed below:

$$C_\nu = 0.09,$$

$$C_1 = 1.44,$$

$$C_2 = 1.99,$$

$$\sigma_k = 1.00, \text{ and}$$

$$\sigma_\varepsilon = 1.30.$$

Solution of the transport equations for the turbulence kinetic energy, k, and its rate of dissipation, ε, along with the transport equations for mean momentum allows one to dynamically specify the temporal and spatial distribution of the turbulent eddy viscosity, ν_t. In conjunction with the definition of the turbulent Reynolds stresses (equations 3a and 3b), the equations and constants outlined above constitute the complete (k-ε) closure methodology.

The boundary condition at the air-water interface is obtained in the finite difference scheme by simply setting

$$(8a) \qquad \left(-\overline{uw} + \nu \frac{\partial U}{\partial z}\right)_{z=0} = \frac{\tau_x(t)}{\rho_w}$$

and

$$(8b) \qquad \left(-\overline{vw} + \nu \frac{\partial V}{\partial z}\right)_{z=0} = \frac{\tau_y(t)}{\rho_w} .$$

where τ_x and τ_y are the components of wind stress in the x and y directions, respectively.

The ocean bottom boundary condition is obtained using the "wall function method" (Launder and Spalding, 1974) which is based on an extrapolation of the log velocity profile.

Following along the lines of Blumberg and Mellor (1979), in the mode splitting version of OCTI's multi-layered model, the solution to the external driving mode is obtained by integrating the internal mode equations over depth. In this context, the continuity equation becomes

$$(9) \qquad \frac{\partial \eta}{\partial t} + \frac{\partial \bar{u}D}{\partial x} + \frac{\partial \bar{v}D}{\partial y} = 0$$

where η is the water surface elevation, $\bar{u}$ and $\bar{v}$ are the depth-integrated velocities for the x and y directions, respectively, and D is the total water depth. Under the assumption of neglegible vertical accelerations and neutrally-stable, incompressible water, we can represent the momentum equations as

$$(10a) \qquad \frac{\partial \bar{u}}{\partial t} - f\bar{v} + g\frac{\partial \eta}{\partial x} + \bar{u}\frac{\partial \bar{u}}{\partial x} + N_H \nabla^2 \bar{u} + F_x = 0$$

and

$$(10b) \qquad \frac{\partial \bar{v}}{\partial t} + f\bar{u} + g\frac{\partial \eta}{\partial y} + \bar{v}\frac{\partial \bar{v}}{\partial y} + N_H \nabla^2 \bar{v} + F_y = 0$$

where N_H is a horizontal eddy viscosity coefficient and F_x and F_y are the external forcing mechanisms (wind stresses).

2. AVAILABLE DATA

NORDA recently completed a two-month current measurement program, with current arrays located as shown in Figure 1. The same points A and B are the points of interest in the present study. Additional information on currents in this general area has been taken by Schroeder (1976) and by Murray (1975). Figure 2 shows a time series of currents from the summer of 1976 at a site located in about 25 meters of water on the Alabama shelf. As can be seen there, the general tidal currents in this region are expected to be on the order of 10 cm/sec or so.

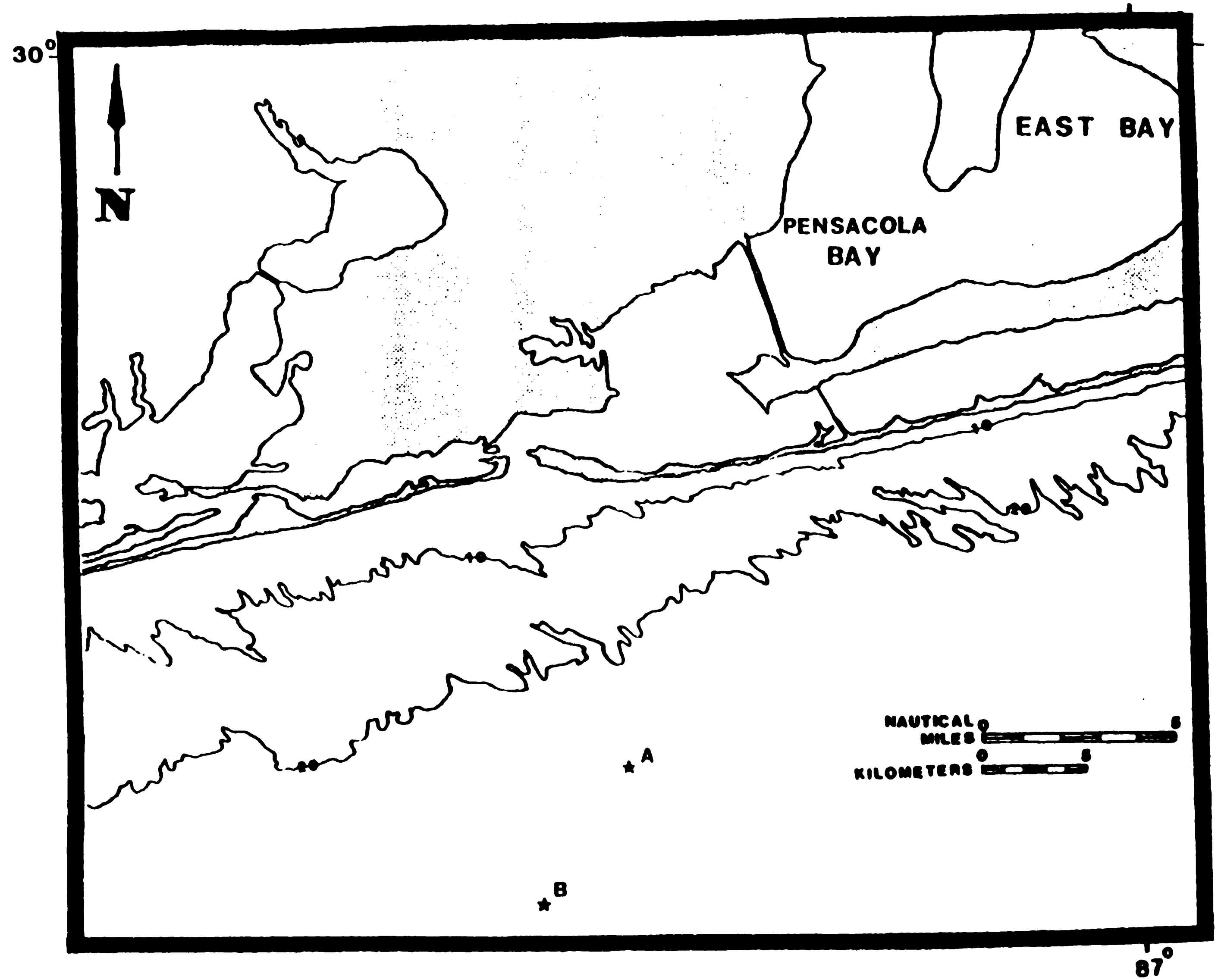
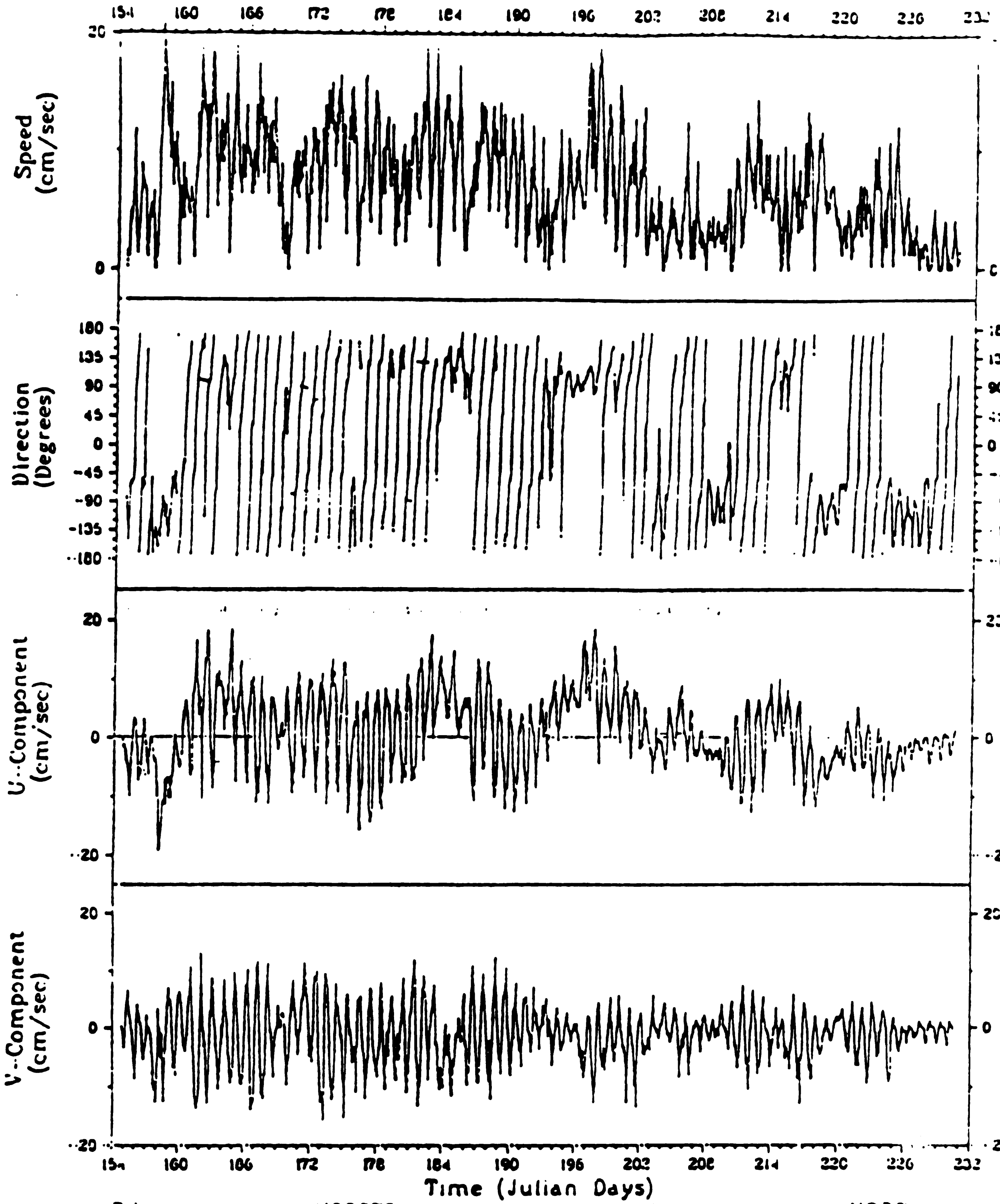


Figure 1. Site map showing location of study points A and B.



File :	N00676	Array :	NODC
Meter :	0	Depth :	20
Latitude :	30 1 0 N	Start :	2 JUN 1976
Longitude :	88 5 0 S	End :	

Figure 2. Currents measured on Alabama shelf in the summer of 1976 by Schroeder (1976).

3. CALIBRATION

In order to calibrate OCTI's current model to the specific sites of interest, we selected 2 three-day time increments from the overall set of measurements from MEC. It is possible that stratification may play a significant role in determining the precise nature of the onshore-offshore transport process. As discussed by Murray (1975), the onshore-offshore transport under neutral stratification forms a two-layer system (Figure 3). Under stable stratification, the transport pattern shifts into a characteristic three-layer regime (Figure 4). Without an intensive multi-level measurement program and a coincident set of measurements of water temperatures, it would be difficult to calibrate a model which includes stratification effects. Consequently, for this study we used the assumption of neutral stratification for all calibration runs and final production runs.

It should also be noted that stability effects will tend to diminish as the wind-driven circulation gets stronger, due to increased mixing throughout the water column. Hence, although the effects of stability may be very important under low wind conditions, the assumption of neutral stability should be quite acceptable for modeling moderate to high wind conditions (say winds greater than 20 knots or so). Since moderate to high wind events are likely to control the overall sediment transport at the bottom, this assumption should also be adequate for climatological modeling.

In OCTI's current model, the surface drag at the air-sea interface is typically not used as a tuning parameter. Instead, the Large and Pond (1980) form for a velocity-dependent drag coefficient is imposed.

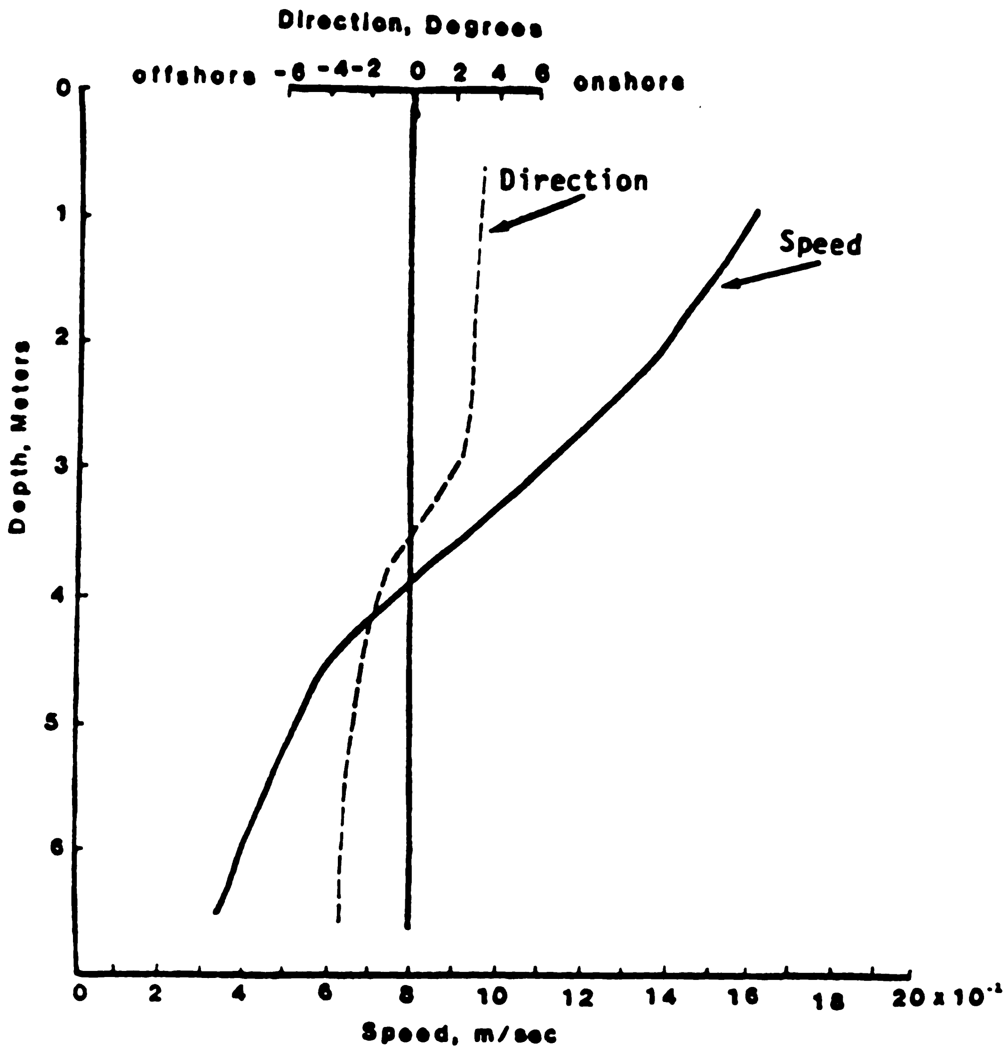


Figure 3. Example of near-coastal currents in unstratified water. (Note: There are basically two flow layers.)

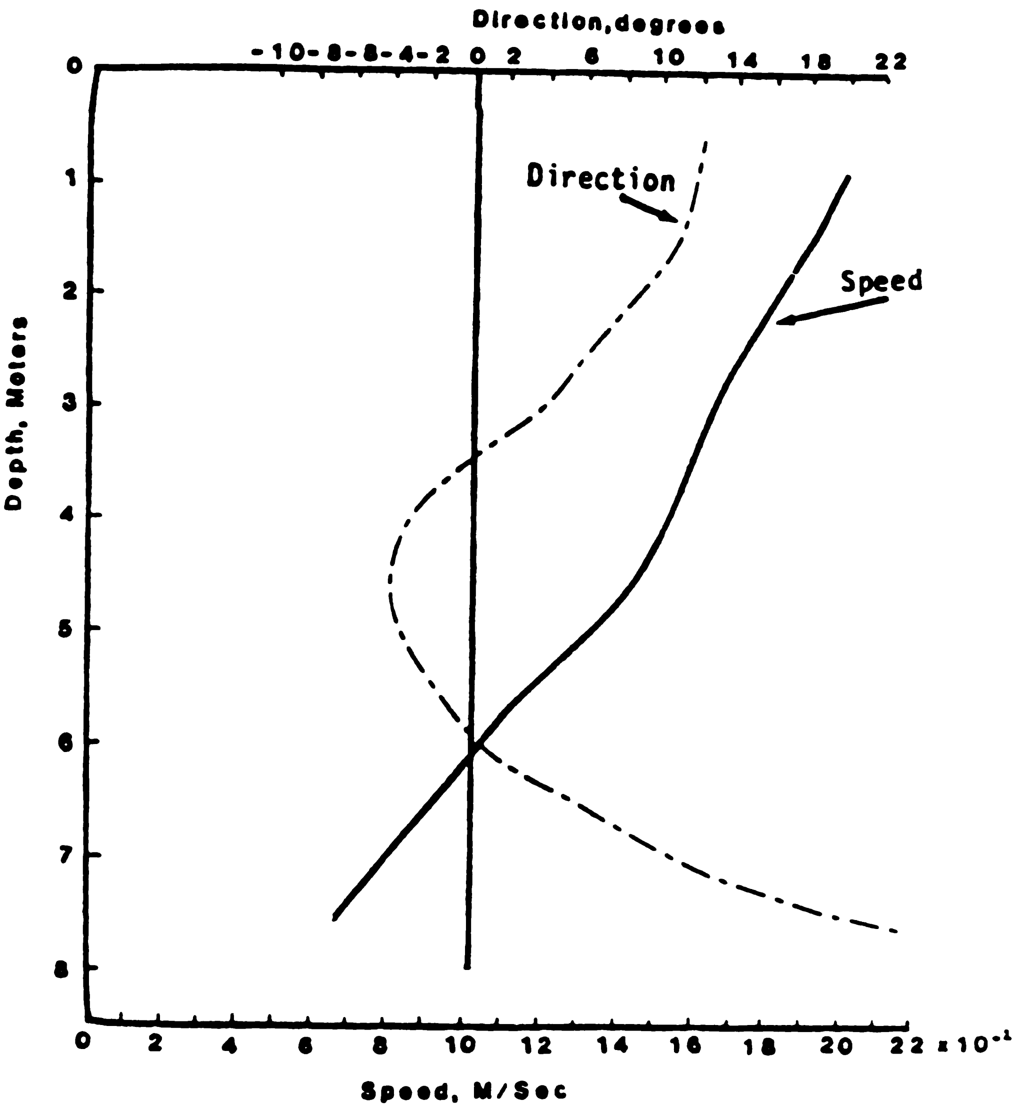


Figure 4. Example of near-coastal currents in stratified water. (Note: There are basically three flow layers.)

Their form for the drag coefficient was obtained from an analysis of an extensive field data set and is approximated by

$$C_D = 1.2 \times 10^{-3} \qquad W < 11 \text{ m/sec}$$

$$C_D = (.49 + .065\,W) \times 10^{-3} \qquad W \geq 11 \text{ m/sec}$$

where C_D is the (air-sea) coefficient of drag and W is the wind speed in meters per second at a 10-meter reference height. This leaves two pertinent problems for calibration, the specification of a reasonable wind field over the study area and the selection of an appropriate bottom roughness parameter. For calibration purposes it would have been best to have had good wind measurements at the sites of the current measurements. However, since these were not available, winds for the study area were obtained by kinematic analysis with nearshore wind conditions estimated via the methodology described by Resio and Vincent (1977).

The local wind data were obtained from the National Climatic Data Center (NCDC) in Ashville, North Carolina. The most comprehensive data set was available for the years 1948 through the present at the Pensacola airport. The weather maps for the kinematic analyses for the period of current measurements had to be special-ordered from the National Weather Service office in Washington, D.C., because they were not yet available at NCDC. After three sensitivity tests of the bottom roughness parameter, a value of 1 mm was found to yield reasonable results and was used in all final calibration and production runs.

As pointed out in section 1, a quadratic stress law is assumed to govern the boundary at the bottom of the water column. If it is desirable to convert the roughness length given here into a coefficient of drag, the following relationship can be used

$$(11) \qquad C_B = \left[\frac{K}{\ln(\frac{z}{z_0})} \right]^2$$

where C_B is the coefficient of drag at the bottom, K is Von Karmen's constant, z is the level at which the current is specified, and z_0 is the roughness height (1 mm in this case).

Figures 5-20 show a comparison between OCTI's model predictions (with superimposed tidal currents added) and the measured currents for 9 and 17 meters at Site A and 9 and 16 meters at Site B. For all calibration runs and production runs, the depth at Site A was set at 22 meters, and the depth at Site B was set at 21 meters. This is slightly larger than the depth at these sites reported by MEC; however, they fit better with the overall bathymetric data available to us. Velocities were calculated at 10 levels throughout the water column; and the horizontal grid mesh size was 2 n.mi. in the primary area of interest. The time periods covered are March 22-25 and 28-31, 1987. As can be seen in these figures the overall current magnitudes and directions seem to agree reasonably well, particular in light of the lack of accurate wind measurements at the site. All directions are referenced as vectors in a standard mathematical coordinate system. Thus, 0^o represents a current heading east, 90^o represents a current heading north, 180^o represents a current heading west, and 270^o represents a current heading south. In order to ensure that no spin-up effects were included in these comparisons, only the last 3 days of each model run are shown.

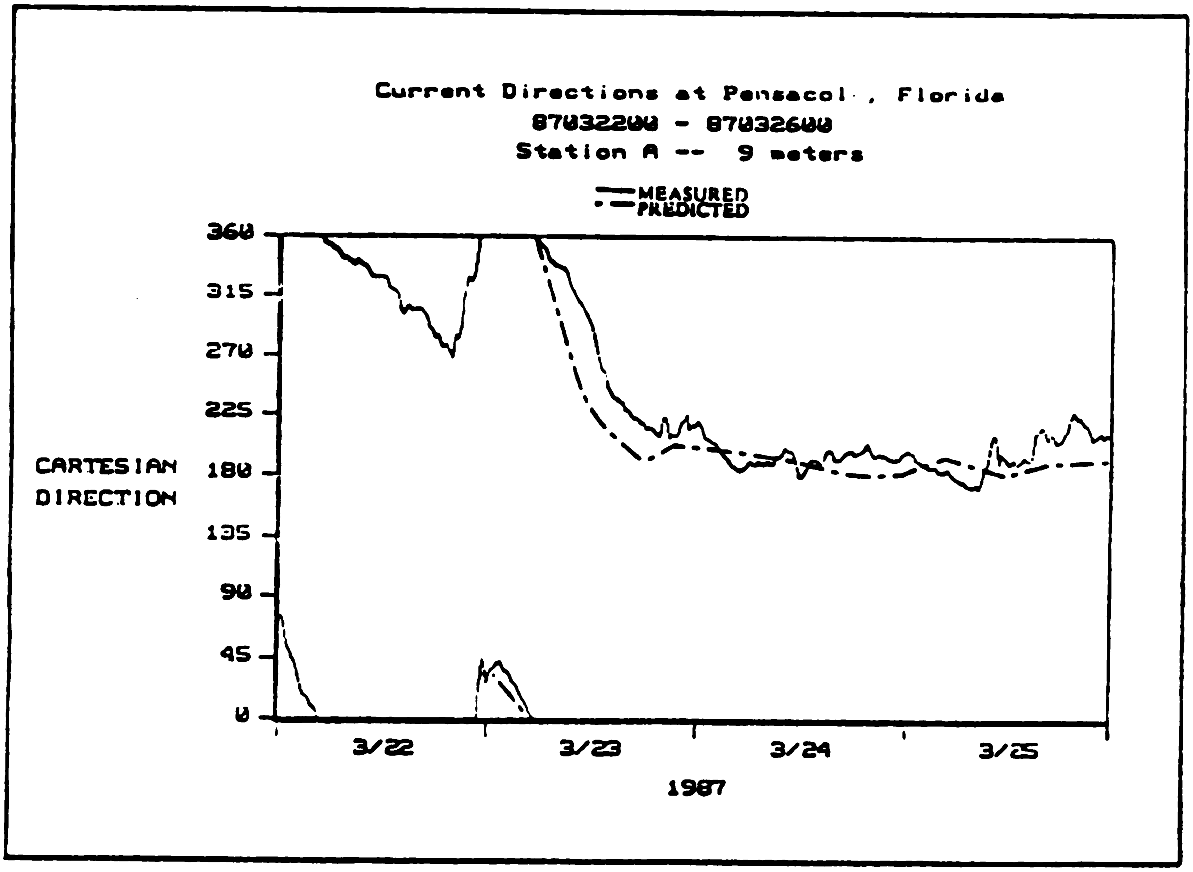


Figure 5. Comparison of measured and predicted current directions for March 22-25, 1987, in depth of 9 meters at Site A.

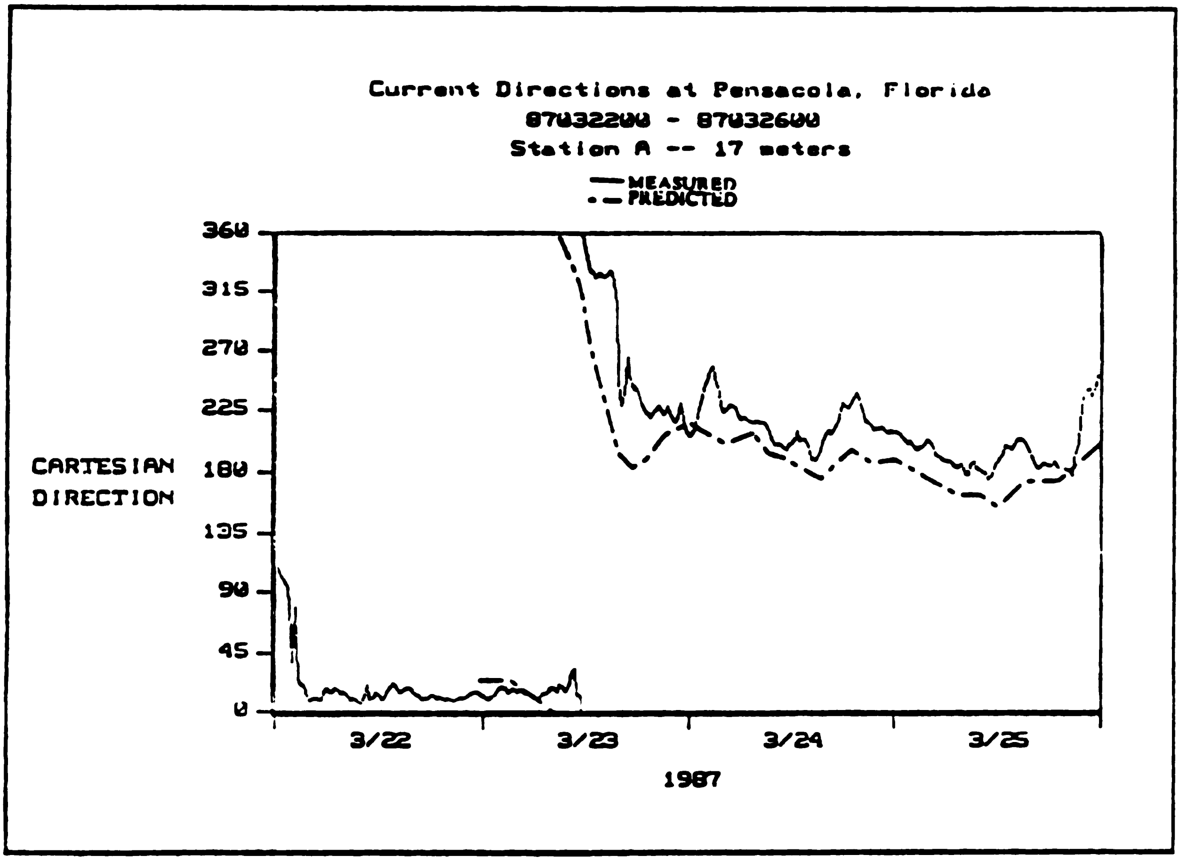


Figure 6. Comparison of measured and predicted current directions for March 22-25, 1987, in depth of 17 meters at Site A.

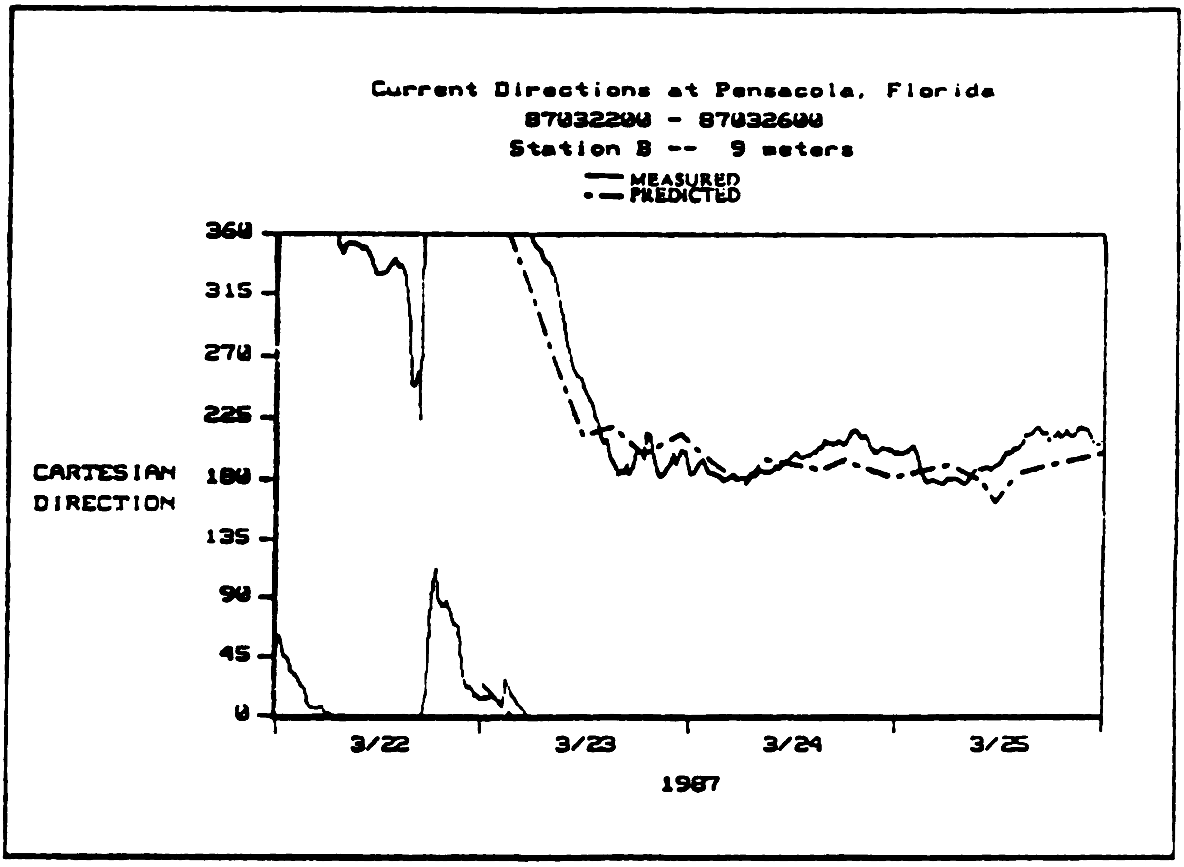


Figure 7. Comparison of measured and predicted current directions for March 22-25, 1987, in depth of 9 meters at Site B.

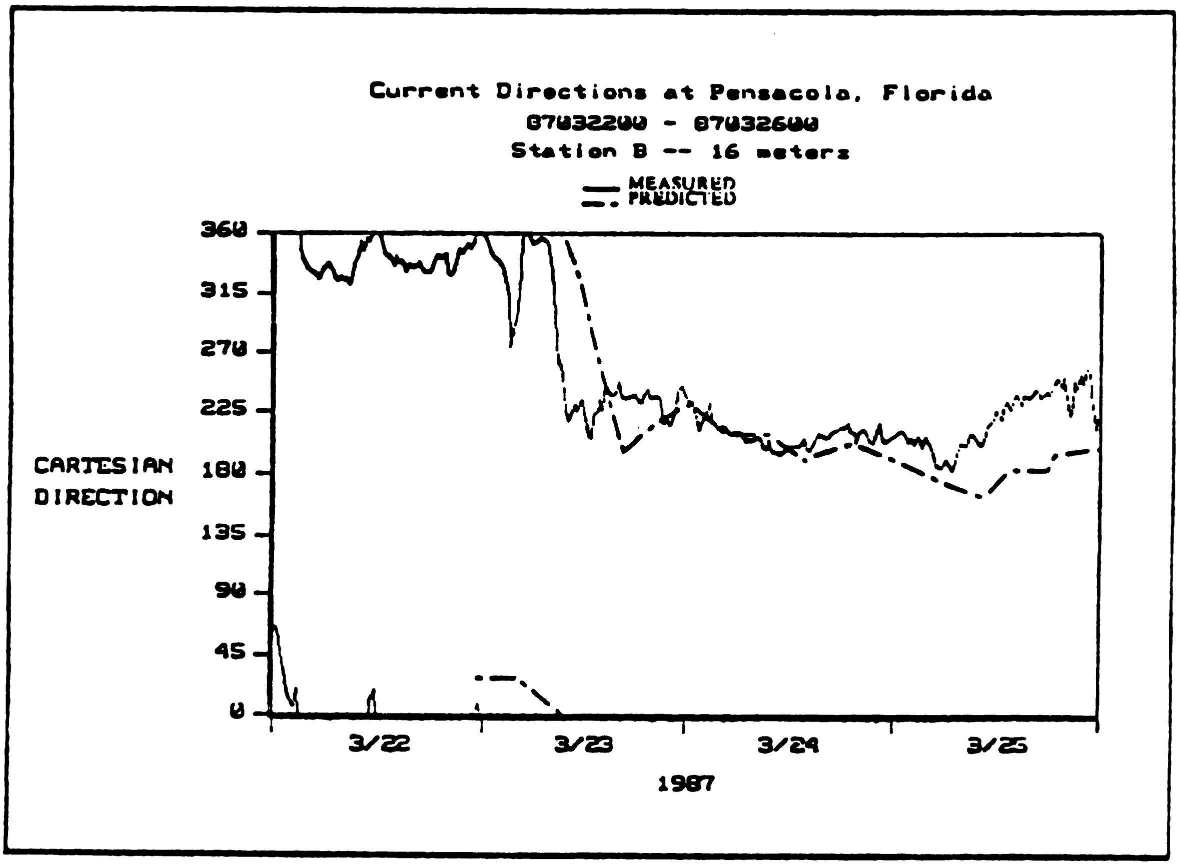


Figure 8. Comparison of measured and predicted current directions for March 22-25, 1987, in depth of 16 meters at Site B.

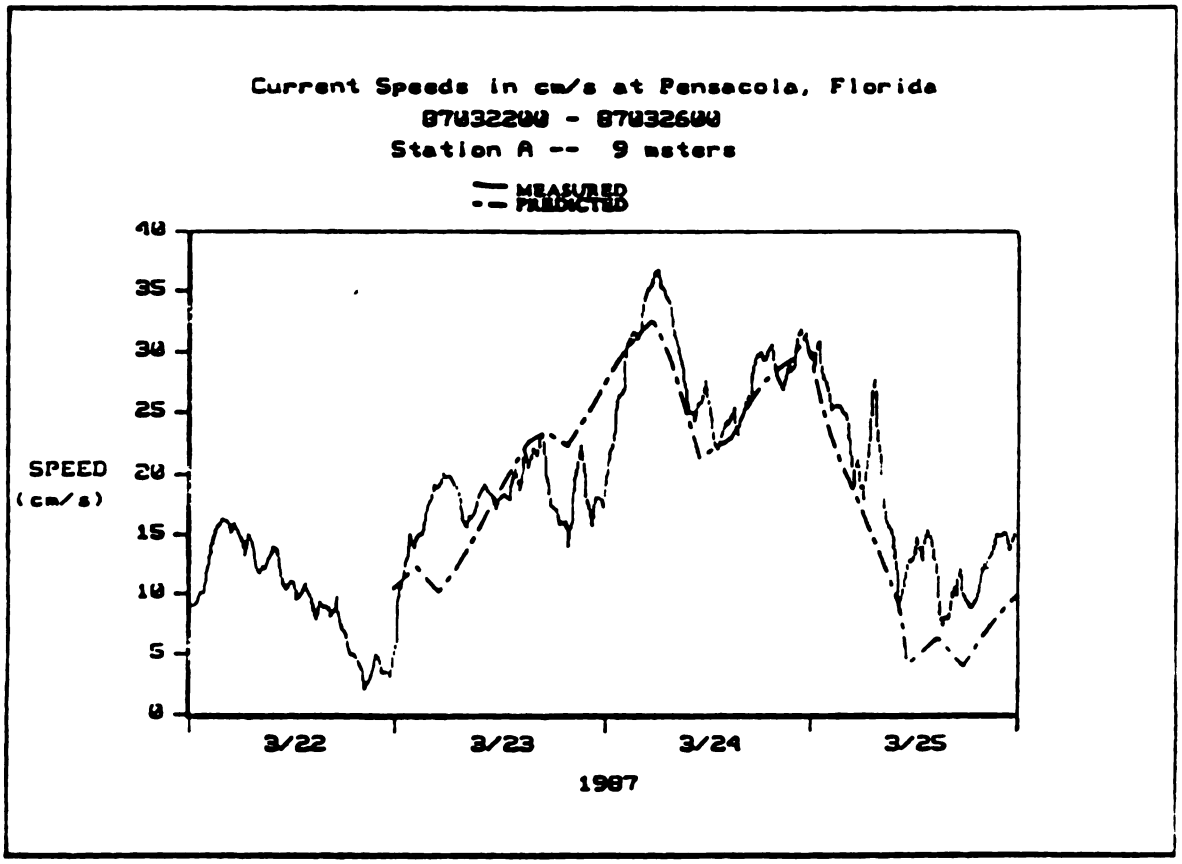


Figure 9. Comparison of measured and predicted current speeds for March 22-25, 1987, in depth of 9 meters at Site A.

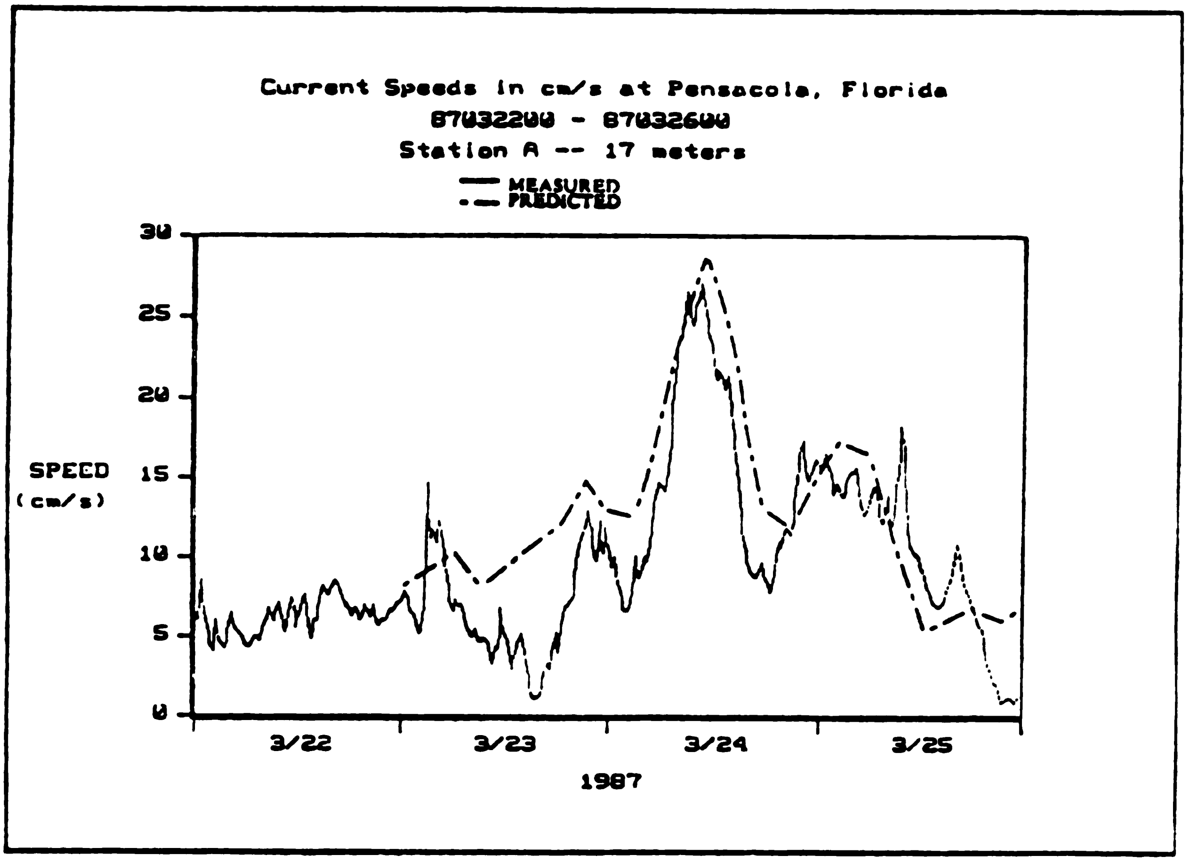


Figure 10. Comparison of measured and predicted current speeds for March 22-25, 1987, in depth of 17 meters at Site A.

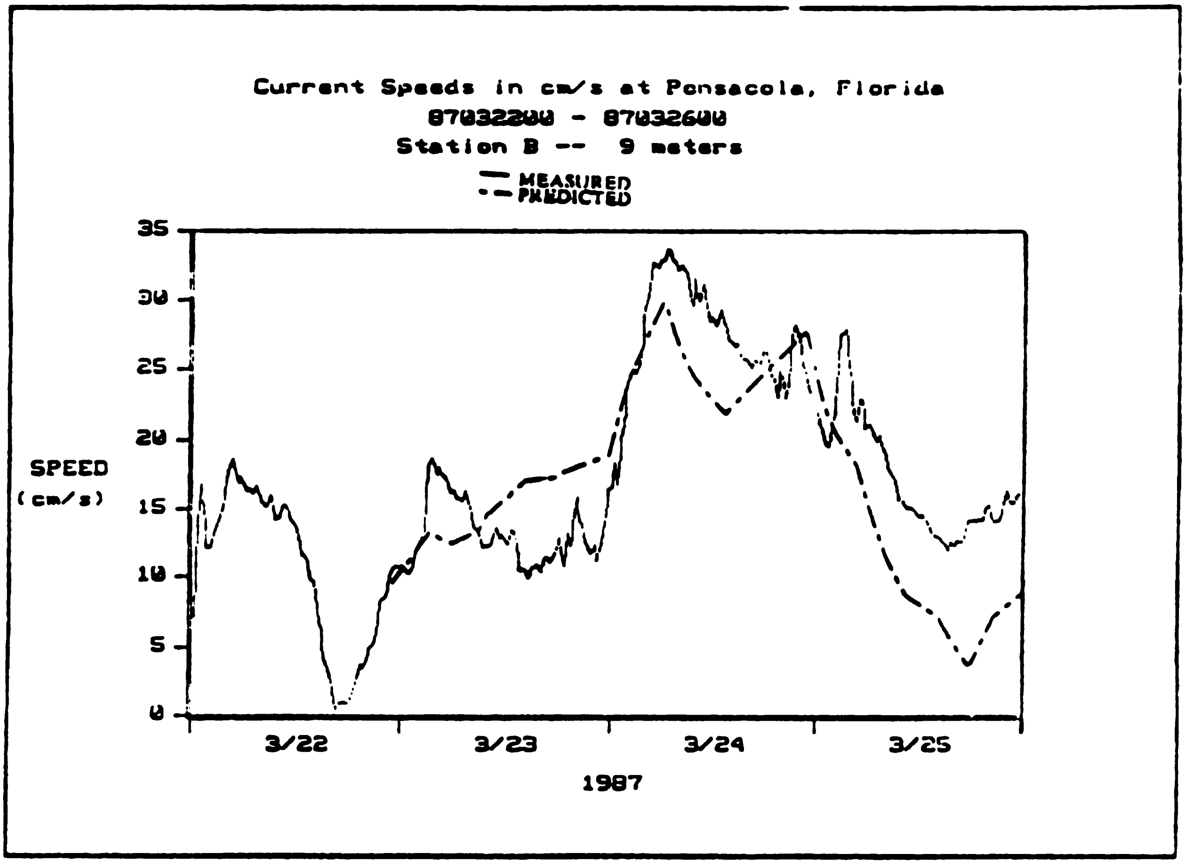


Figure 11. Comparison of measured and predicted current speeds for March 22-25, 1987, in depth of 9 meters at Site B.

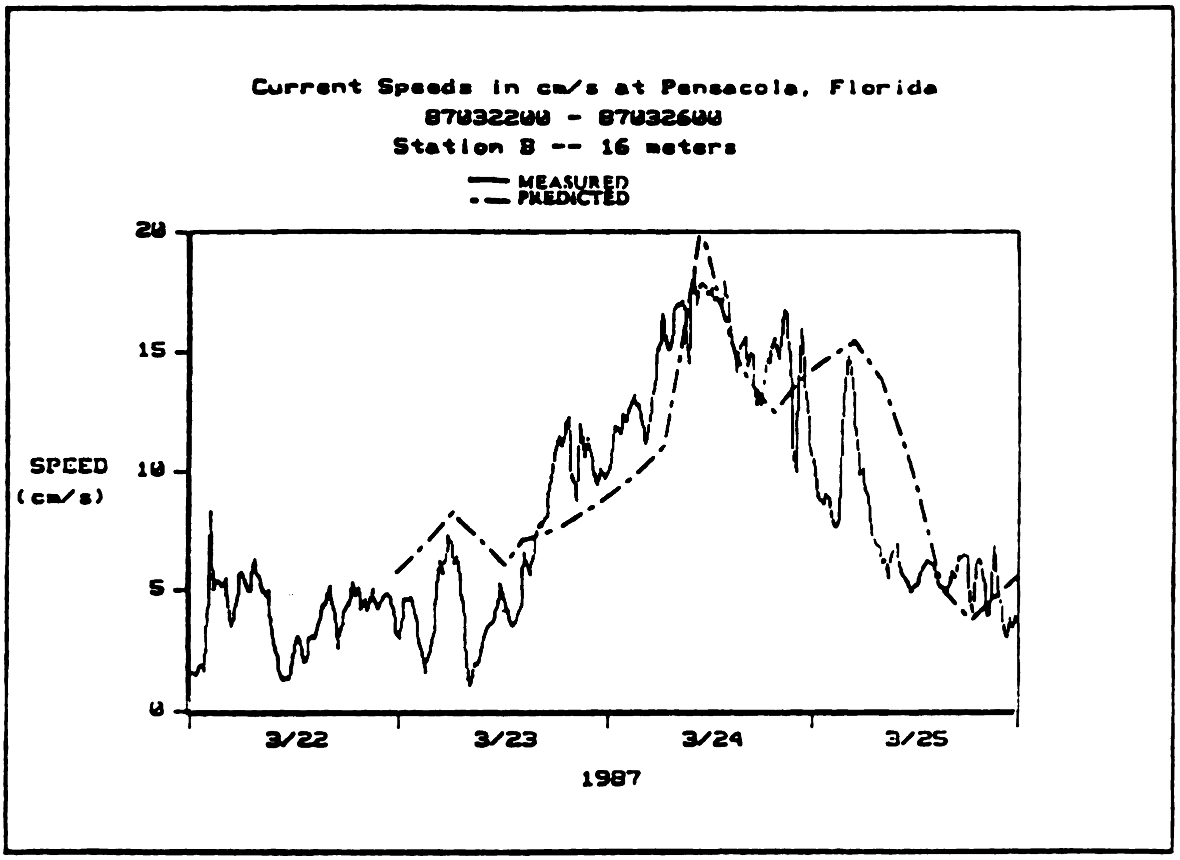


Figure 12. Comparison of measured and predicted current speeds for March 22-25, 1987, in depth of 16 meters at Site B.

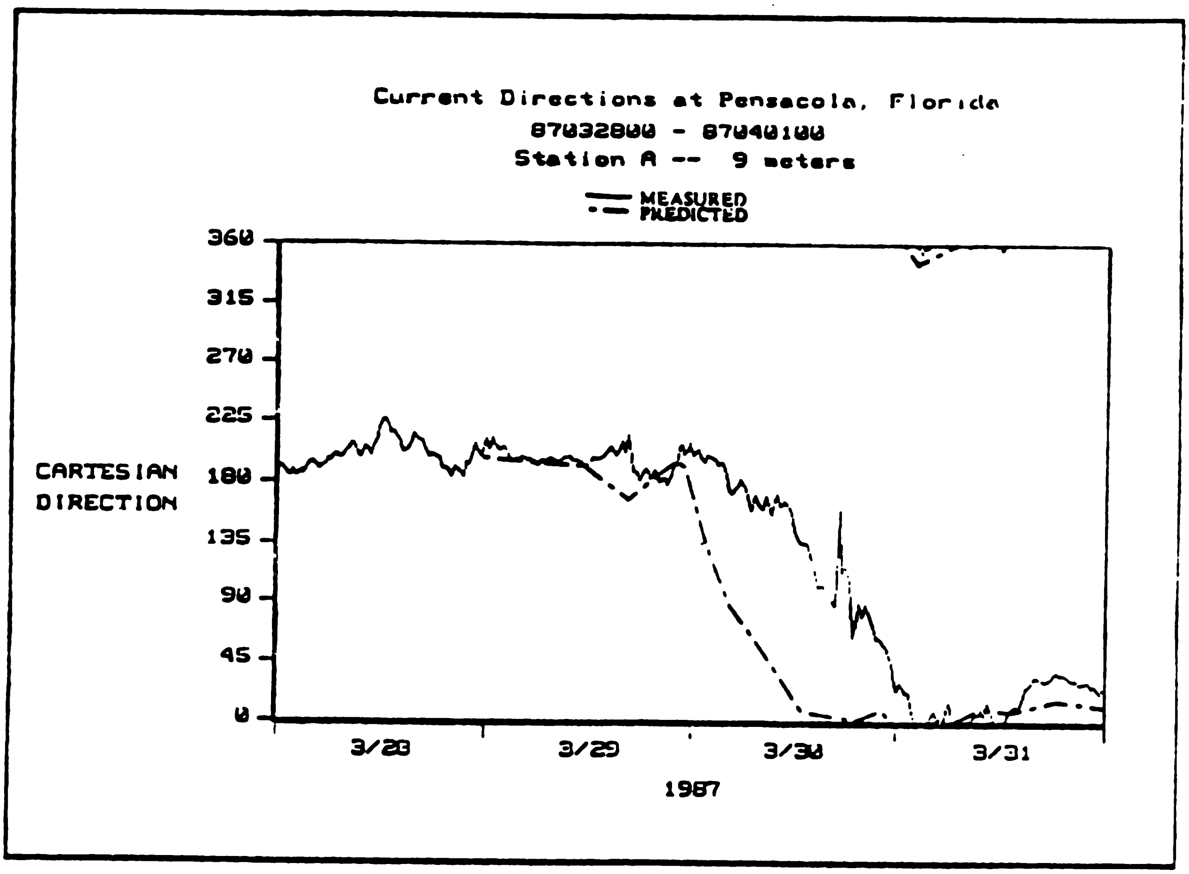


Figure 13. Comparison of measured and predicted current directions for March 28-31, 1987, in depth of 9 meters at Site A.

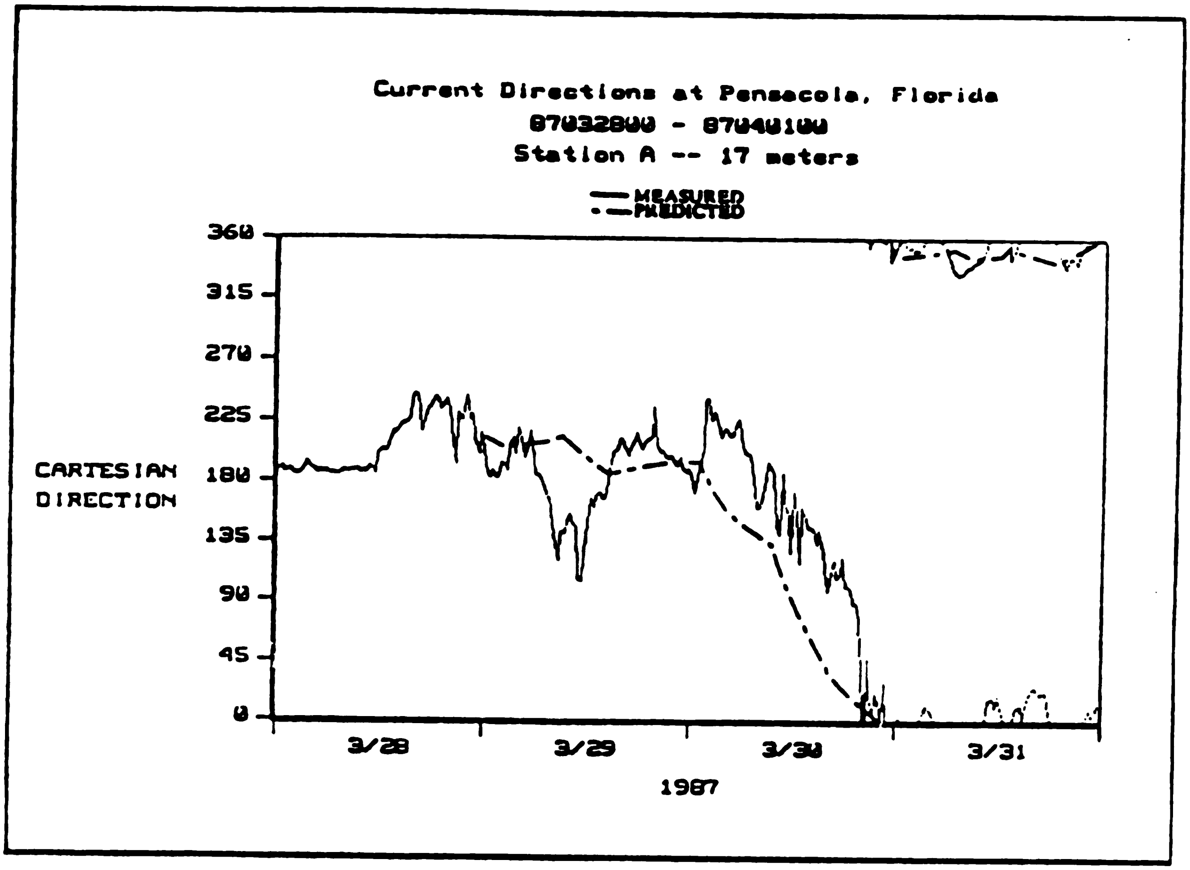


Figure 14. Comparison of measured and predicted current directions for March 28-31, 1987, in depth of 17 meters at Site A.

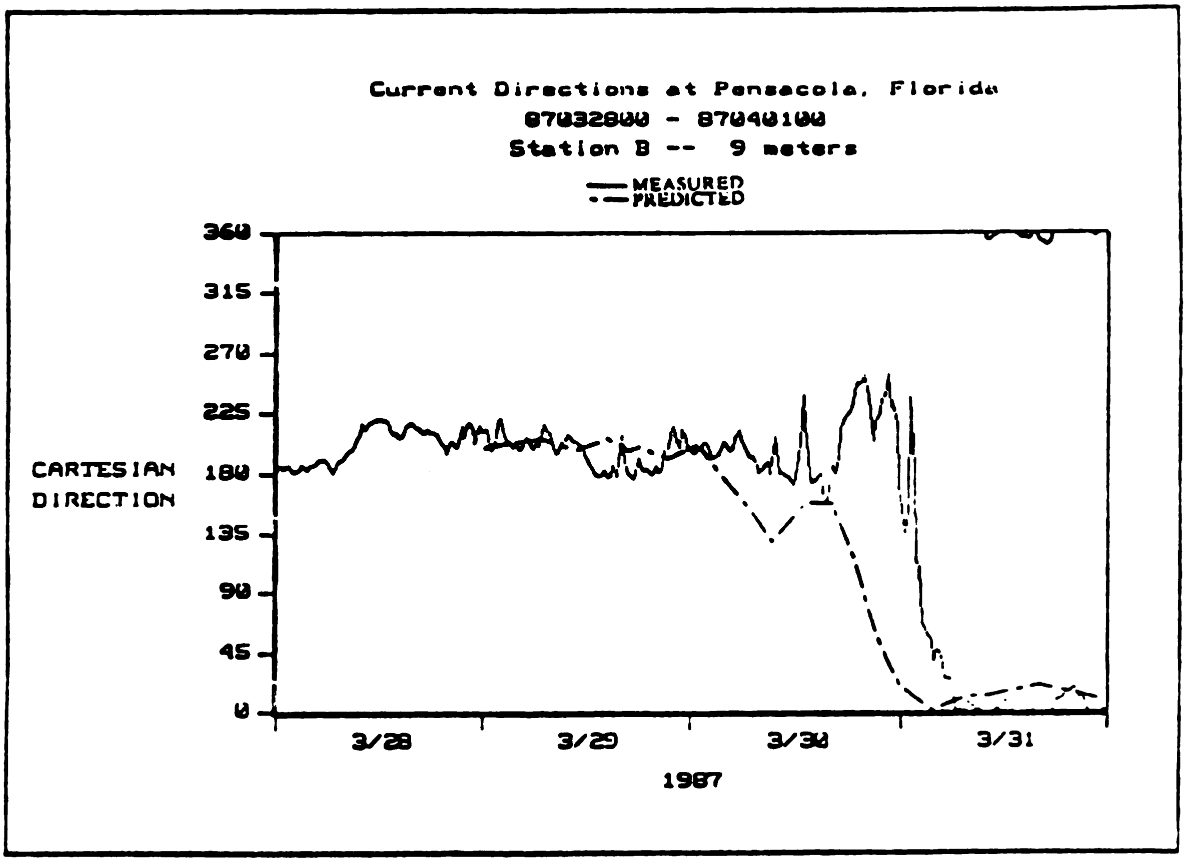


Figure 15. Comparison of measured and predicted current directions for March 28-31, 1987, in depth of 9 meters at Site B.

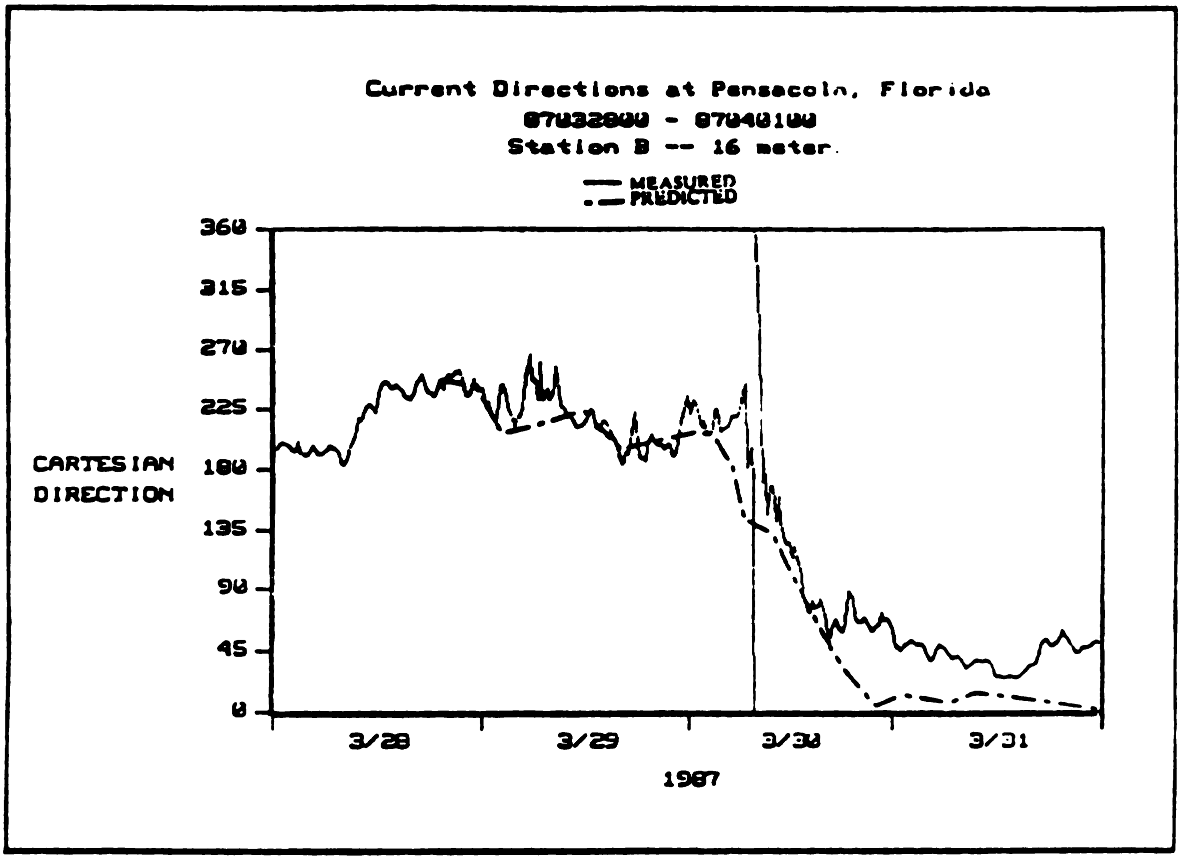


Figure 16. Comparison of measured and predicted current directions for March 28-31, 1987, in depth of 16 meters at Site B.

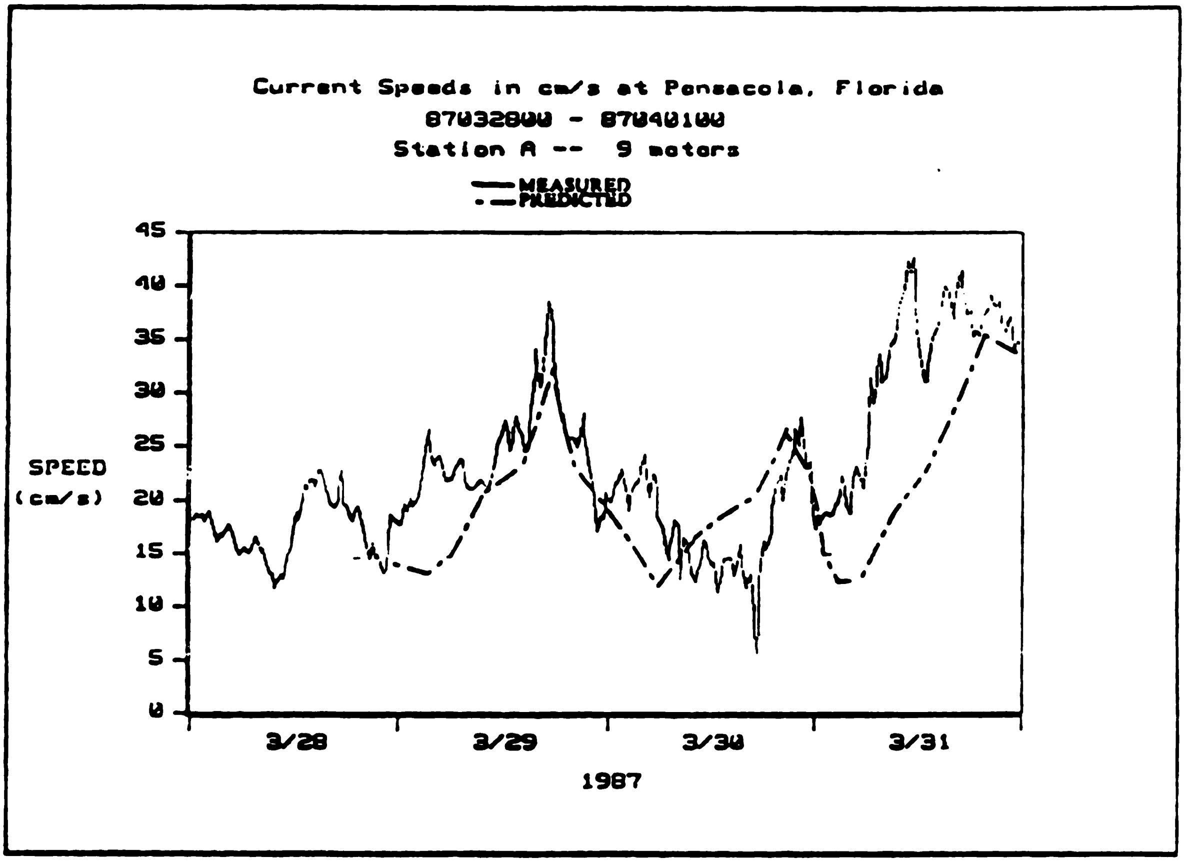


Figure 17. Comparison of measured and predicted current speeds for March 28-31, 1987, in depth of 9 meters at Site A.

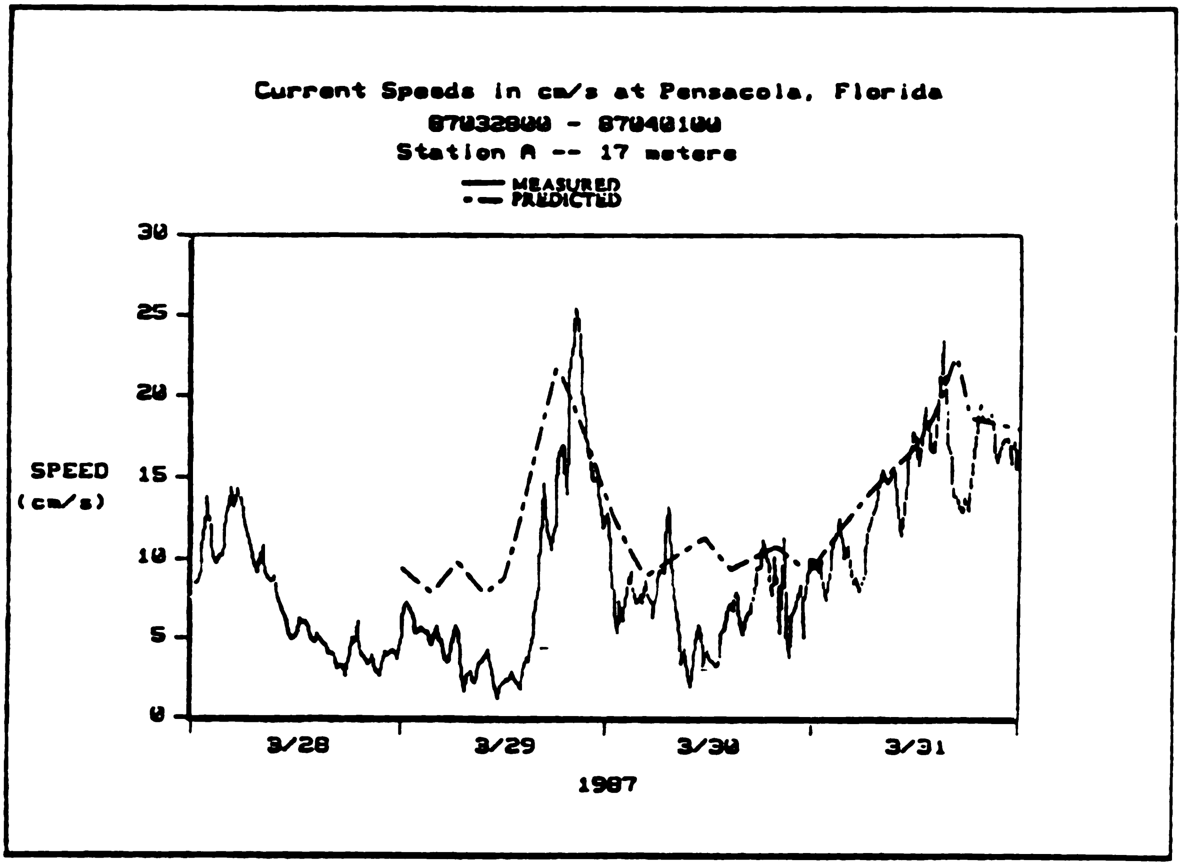


Figure 18. Comparison of measured and predicted current speeds for March 28-31, 1987, in depth of 17 meters at Site A.

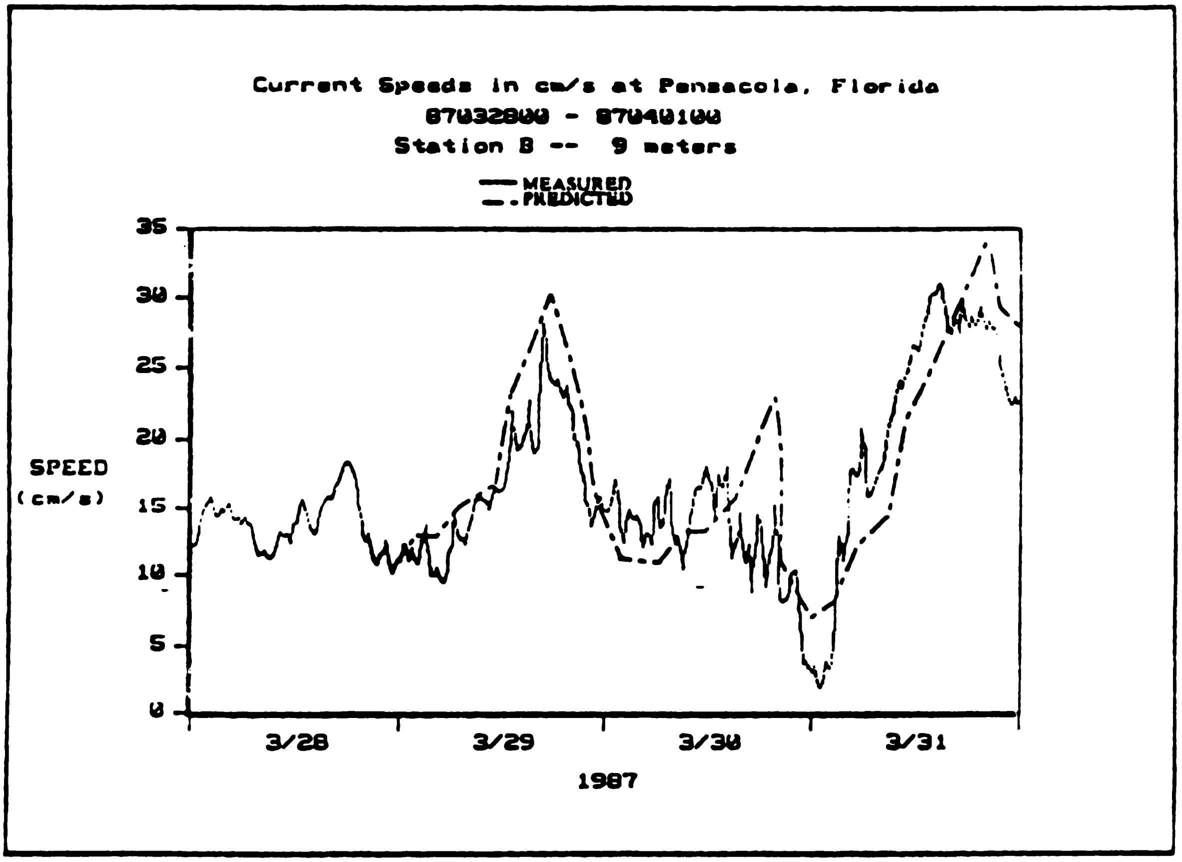


Figure 19. Comparison of measured and predicted current speeds for March 28-31, 1987, in depth of 9 meters at Site B.

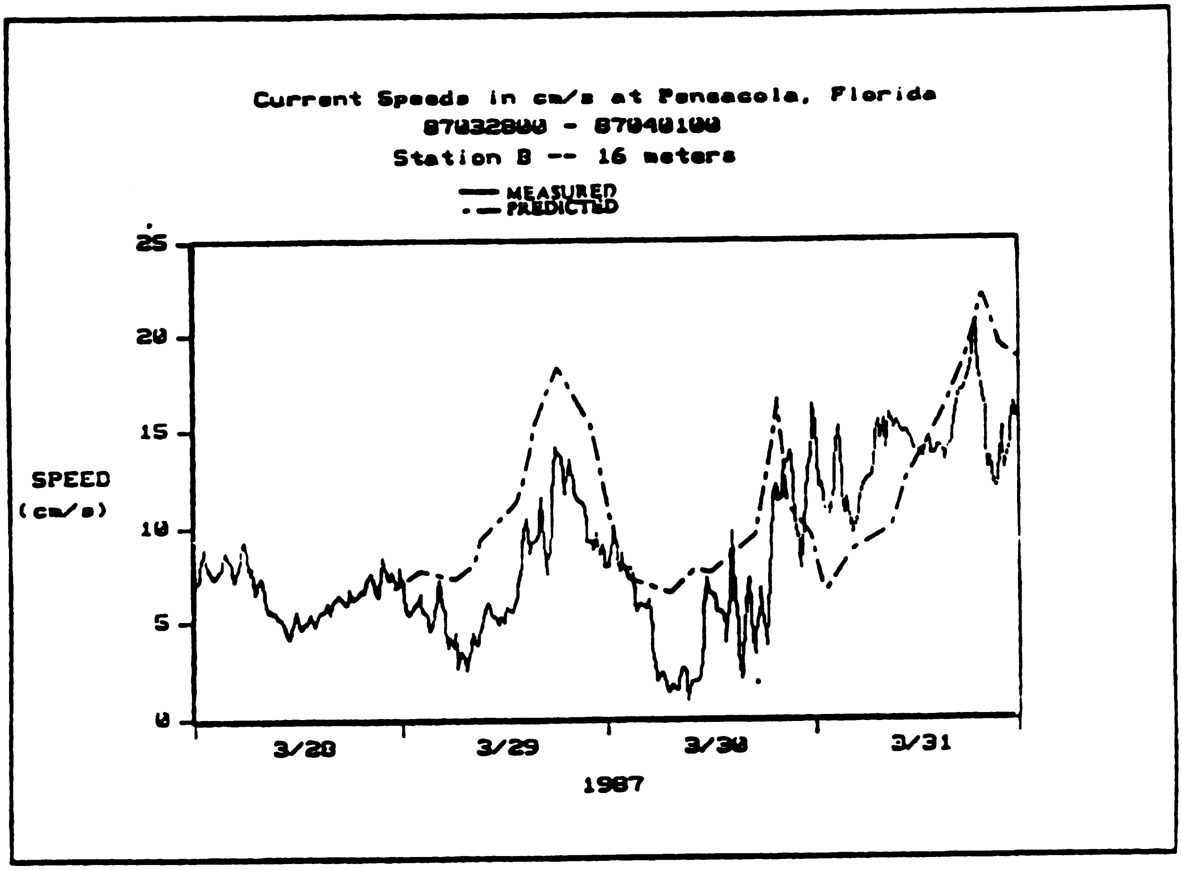


Figure 20. Comparison of measured and predic.ed current speeds for March 28-31, 1987, in depth of 16 meters at Site B.

As expected in the comparisons, the current model can be tuned (via the bottom roughness parameter) to match the magnitude of the peaks quite well. Some problems with phasing of the predicted currents are evident but these should not be important in climatological applications. One point of interest in the comparisons is the relatively good agreement in current directions. This is due to the proximity of the shoreline to Sites A and B and suggests that the steady-state approximation used in the climatological hindcasts should provide a good overall representation of the actual currents.

4. HURRICANE CURRENTS

In order to ascertain the possible effects of hurricanes on dredged materials placed at the study sites, wind fields from two historical hurricanes, Eloise and Frederic, were used to drive OCTI's current model. The tracks of these storms are shown in Figure 21. Hindcast currents at a nine-meter (from the top) level are shown in Figure 22 for Hurricane Eloise and Figure 23 for Hurricane Frederic. Currents at 10 levels and bottom stress components are provided on magnetic tape in the following format:

Header:	date-time,	direction,	velocity
Currents: (cm/sec)	depth of 1st level,	x-component,	y-component
	depth of 2nd level,	x-component,	y-component
	depth of 3rd level,	x-component,	y-component
	depth of 4th level,	x-component,	y-component
	depth of 5th level,	x-component,	y-component
	depth of 6th level,	x-component,	y-component
	depth of 7th level,	x-component,	y-component
	depth of 8th level,	x-component,	y-component
	depth of 9th level,	x-component,	y-component
	depth of 10th level,	x-component,	y-component
Friction Velocity:		x-component,	y-component

Directions are given in the mathematical, cartesian system. The x-direction is positive eastward and the y-direction is positive northward. Table 1 shows an annotated example of currents at Site B from Hurricane Eloise. Figure 24 shows a plot of the current direction and speed at this time.

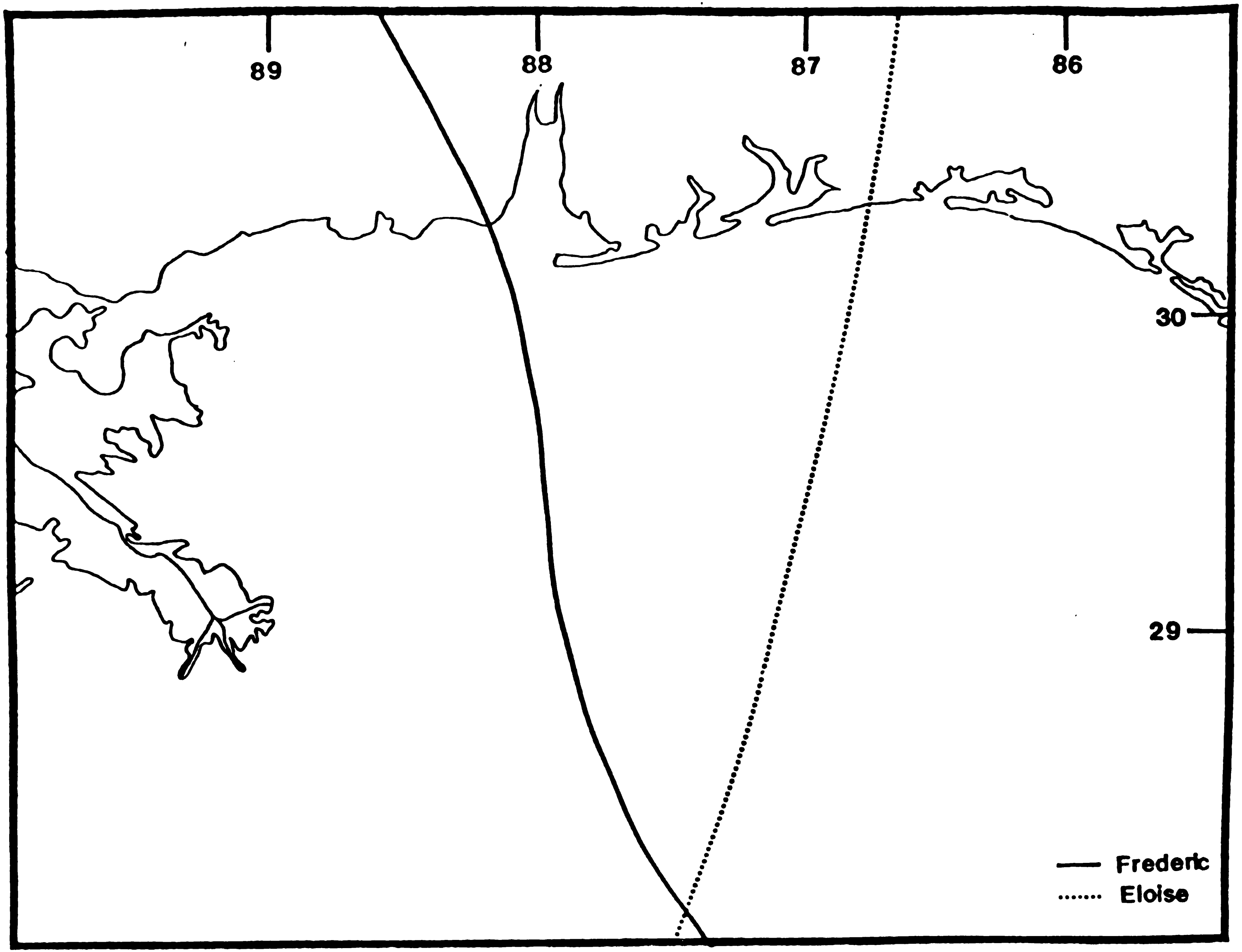


Figure 21. Storm tracks for Hurricanes Eloise (1975) and Frederic

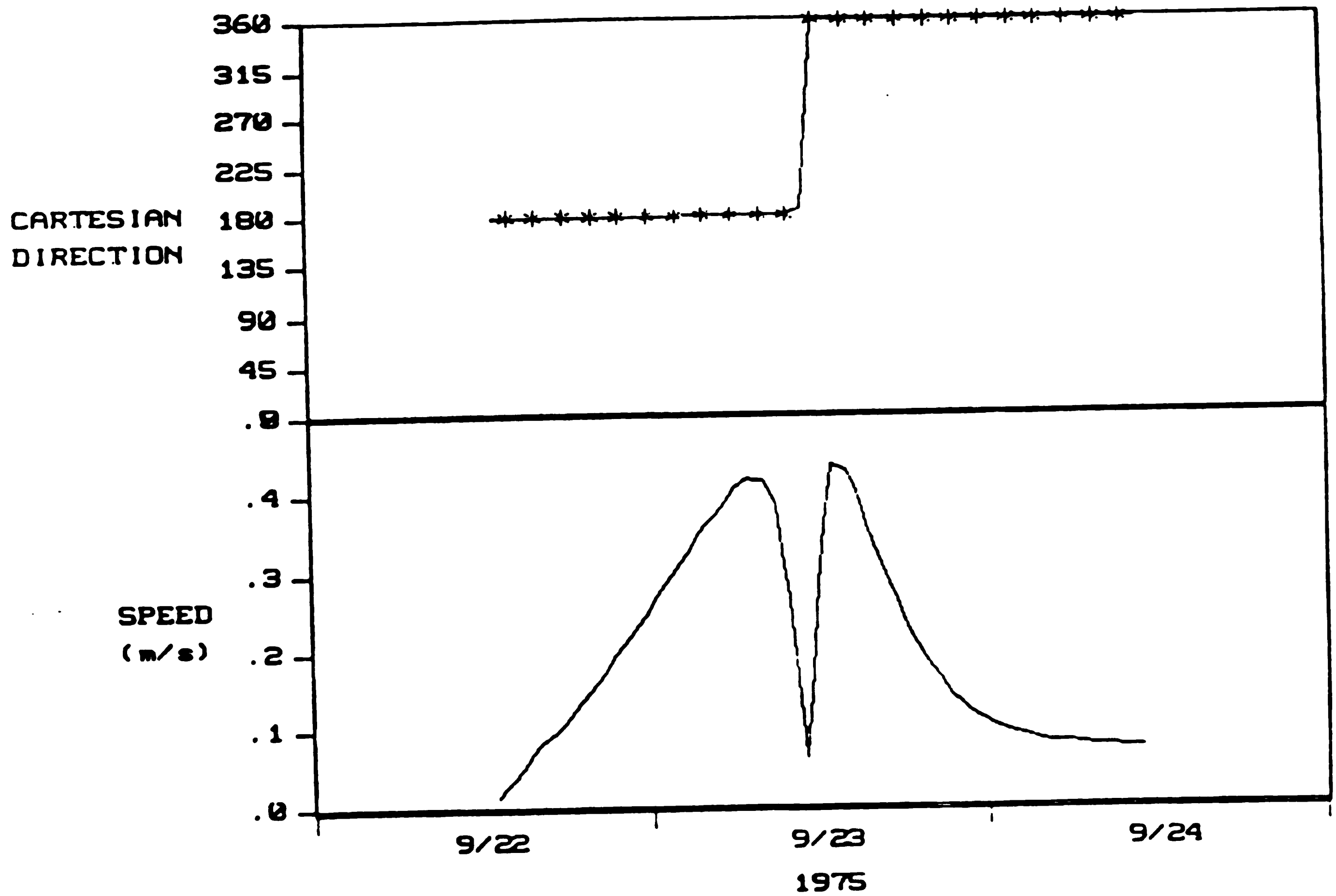


Figure 22. Hindcast currents at 9-meter level for Site B in Hurricane Eloise.

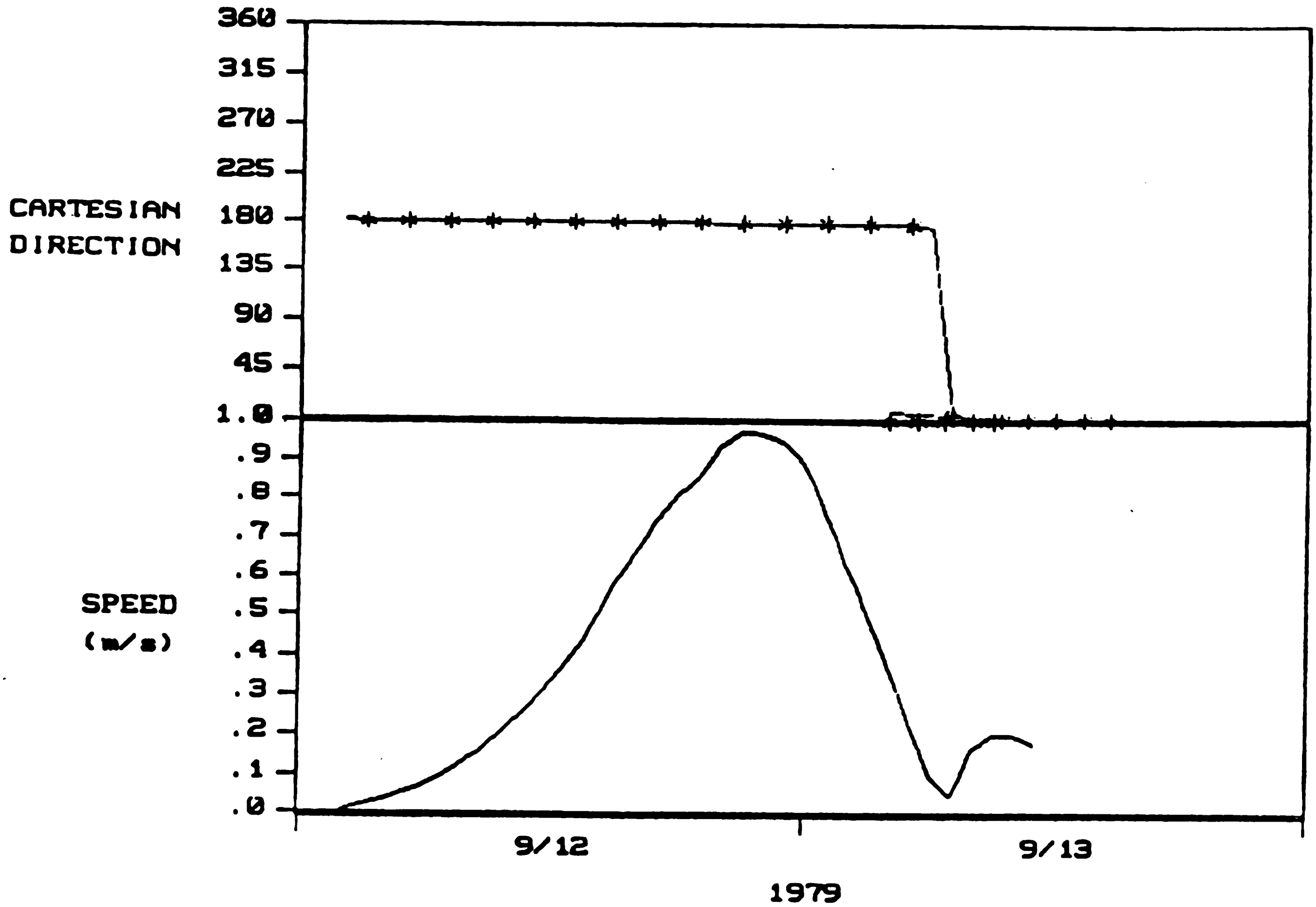


Figure 23. Hindcast currents at 9-meter level for Site B in Hurricane Frederic.

Table B-4

ANNOTATED EXAMPLE OF CURRENTS AT SITE B
FROM HURRICANE ELOISE

header line

DATE-TIME = 79091303 W-SPEED (KTS) = 48.4 W-DIR (DEG) = 111.9

1.9080	170.4995	.5537	-.5461	.0914
3.8160	173.3940	.5398	-.5363	.0621
5.7240	175.9746	.5279	-.5266	.0371
7.6320	178.2775	.5171	-.5169	.0155
9.5400	180.3303	.5071	-.5070	-.0029
11.4480	182.1561	.4971	-.4967	-.0187
13.3560	183.7734	.4867	-.4856	-.0320
15.2640	185.1976	.4751	-.4731	-.0430
17.1720	186.4424	.4609	-.4580	-.0517
19.0800	187.5352	.4399	-.4361	-.0577
	187.5352	.0758	-.0758	-.0100
depths (meters)	cartesian directions (degrees)	current speed (m/sec)	x-component of current (m/sec)	y-component of current (m/sec)

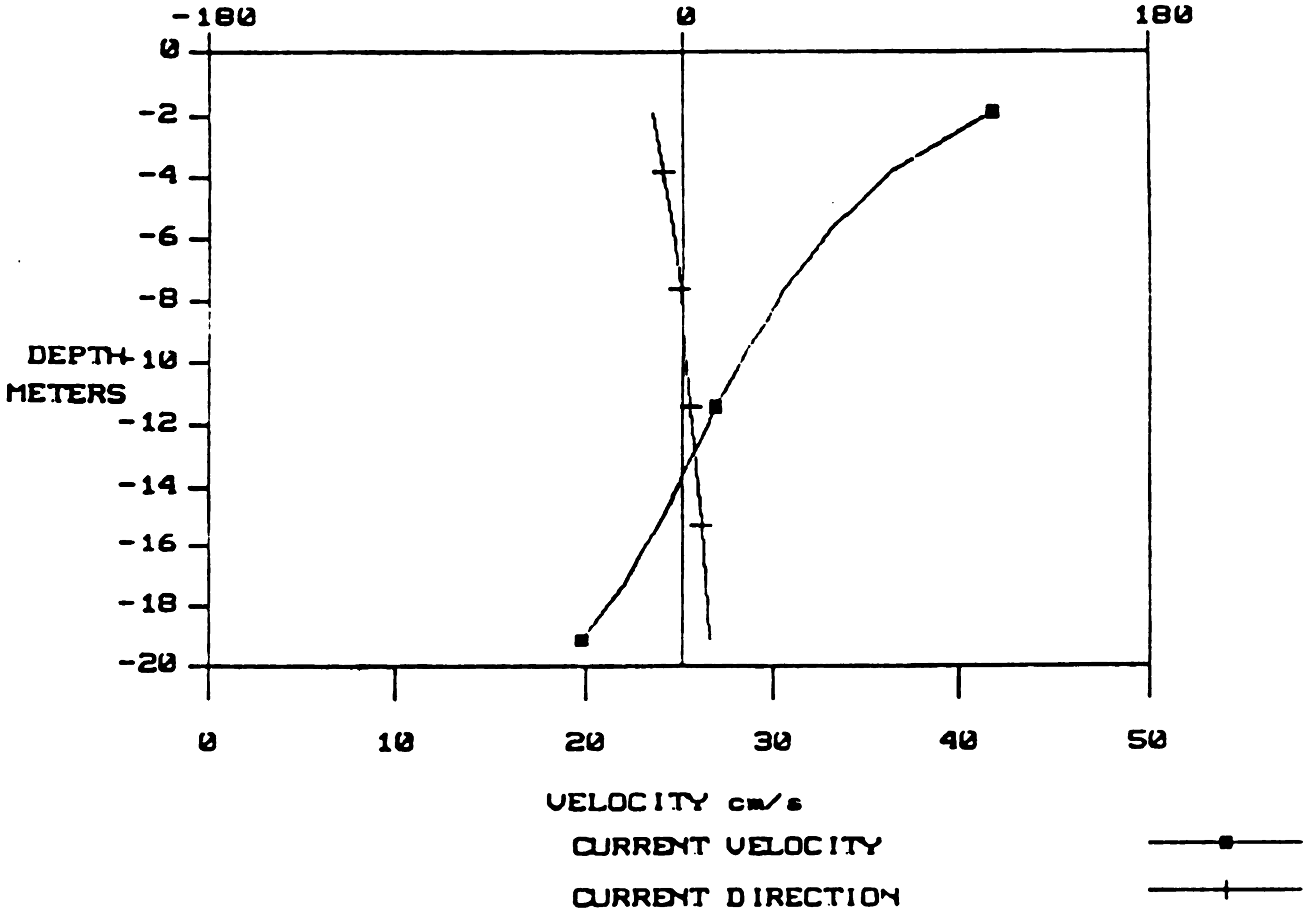


Figure 24. Example of calculated currents for Hurricane Eloise.

5. CLIMATOLOGICAL CURRENTS

As the final phase of this study, OCTI's multi-layer current model was exercised over a range of wind conditions typical of the study area. For each case, the model was run from initial zero-current conditions to a steady-state condition (typically 3 hours to 11 hours of simulated time). No tidal effects were added; however, a reasonable approximation to the combined tide/wind-driven current regime should be obtainable by linear superposition. Thus, a convolution method can be used to generate the final combined current probabilities. If additional detail on currents is needed relative to some threshold value, it appears that a linear interpolation method should suffice to estimate currents between any two velocities simulated.

The wind conditions simulated were from 0^{o} through 315^{o} azimuth in 45^{o} increments (referenced here in standard meteorological terms of winds out of a direction relative to north). Velocities simulated ranged from 8 knots through 32 knots in 8-knot increments. Information on all results for each case is provided in Appendix A and on magnetic tape in the same format as described in Section 4.

Figure 25 shows a wind rose for the winds at Pensacola airport. As seen there, winds at this site come from the southwest over 25% of the time. However, winds out of the north and northeast also constitute a significant portion of the winds in excess of 16 knots. As shown by Resio and Vincent (1977), the wind speeds offshore should be considerably higher than those at this airport station (from as much as 200% at the lowest wind category to about 25% at the highest category shown). On the other hand, the distribution of wind directions offshore should not be much altered from those measured at this site.

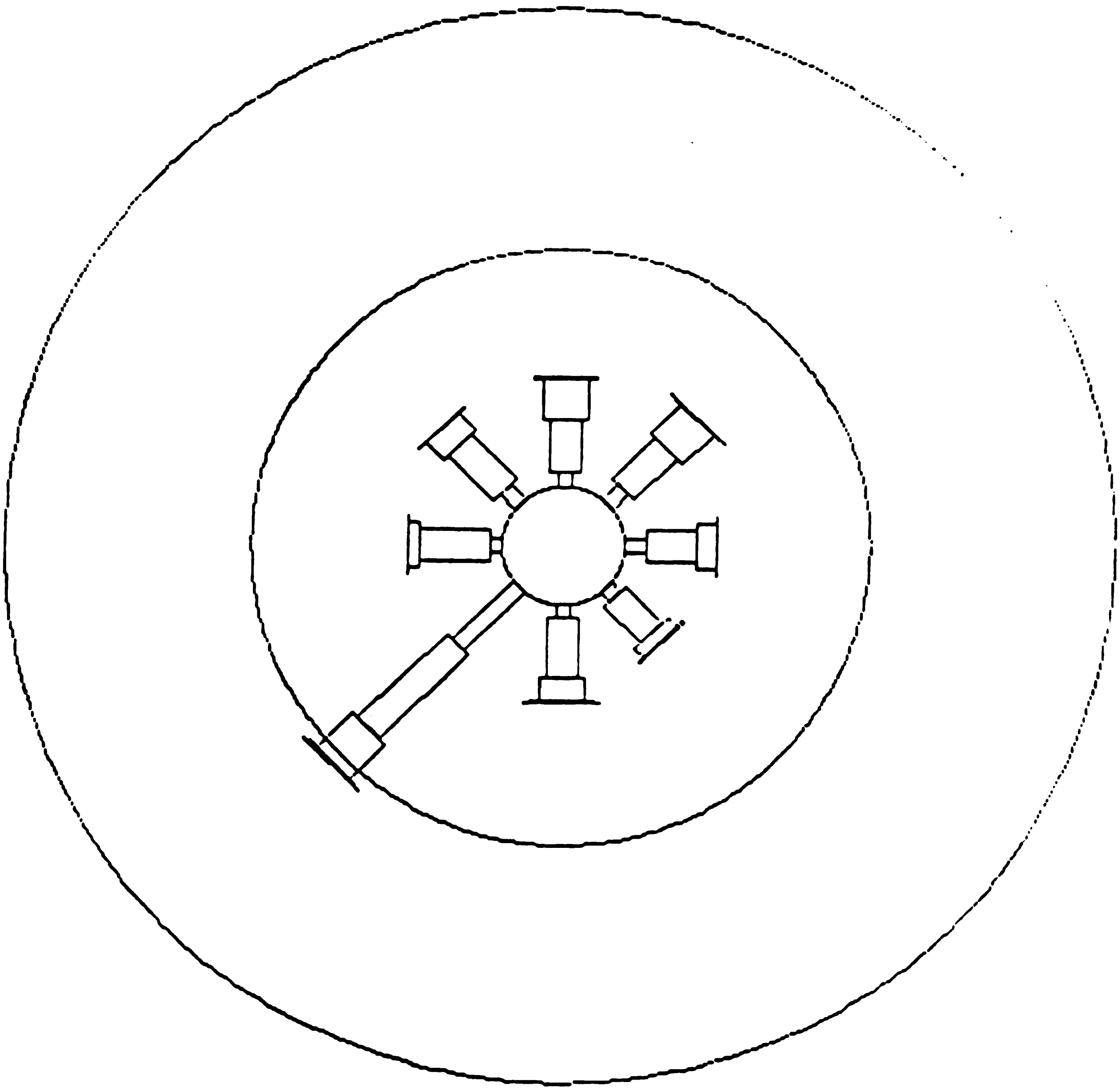


Figure 25. Wind rose for the winds at Pensacola (Fla.) airport. Speed categories are 8 knots and reference circles are 25%. Direction categories are referenced in terms of directions from which winds are coming.

Figures 26-29 show calculated current roses for the top and bottom levels in the current model at Sites A and B. Tables 2-5 show the probability matrices for these currents, and Figures 30-33 show the cumulative distribution of current velocities. As can be seen in these figures and tables, currents are primarily directed along the shore with secondary maxima in the onshore offshore direction. The physical reason for this is that, for winds within about 60 to 70% of parallel to the coast, the current system develops into one with dominant alongshore directions, while, for wind directions forming angles greater than 70% of parallel to the coast, the current system sets up a slow onshore-offshore circulation. Murray (1975) provides an excellent description of the balance of forces (wind stress, coriolis acceleration, bottom stress and surface slope) primarily responsible for this behavior. Since the surface slope term always tends to oppose the wind stress term for onshore-offshore winds, the currents in this direction always tend to be somewhat small under steady-state conditions. This still can be responsible for significant upwelling of cold water for offshore winds but does not produce any high velocities directed onshore near the bottom, such as would be required to transport substantial quantities of bottom material to the shore.

As expected from the distribution of wind directions and speeds, there is a predominance of currents out of the west (toward the east) for both sites A and B. Since sites A and B are located in about the same depth anc similar distances from the shorelines, the currents at the top and bottom levels at these sites do not differ much from each other. Most of the currents at the bottom levels are less than 0.4 m/sec with only a small percentage in the 0.4 to 0.6 m/sec category.

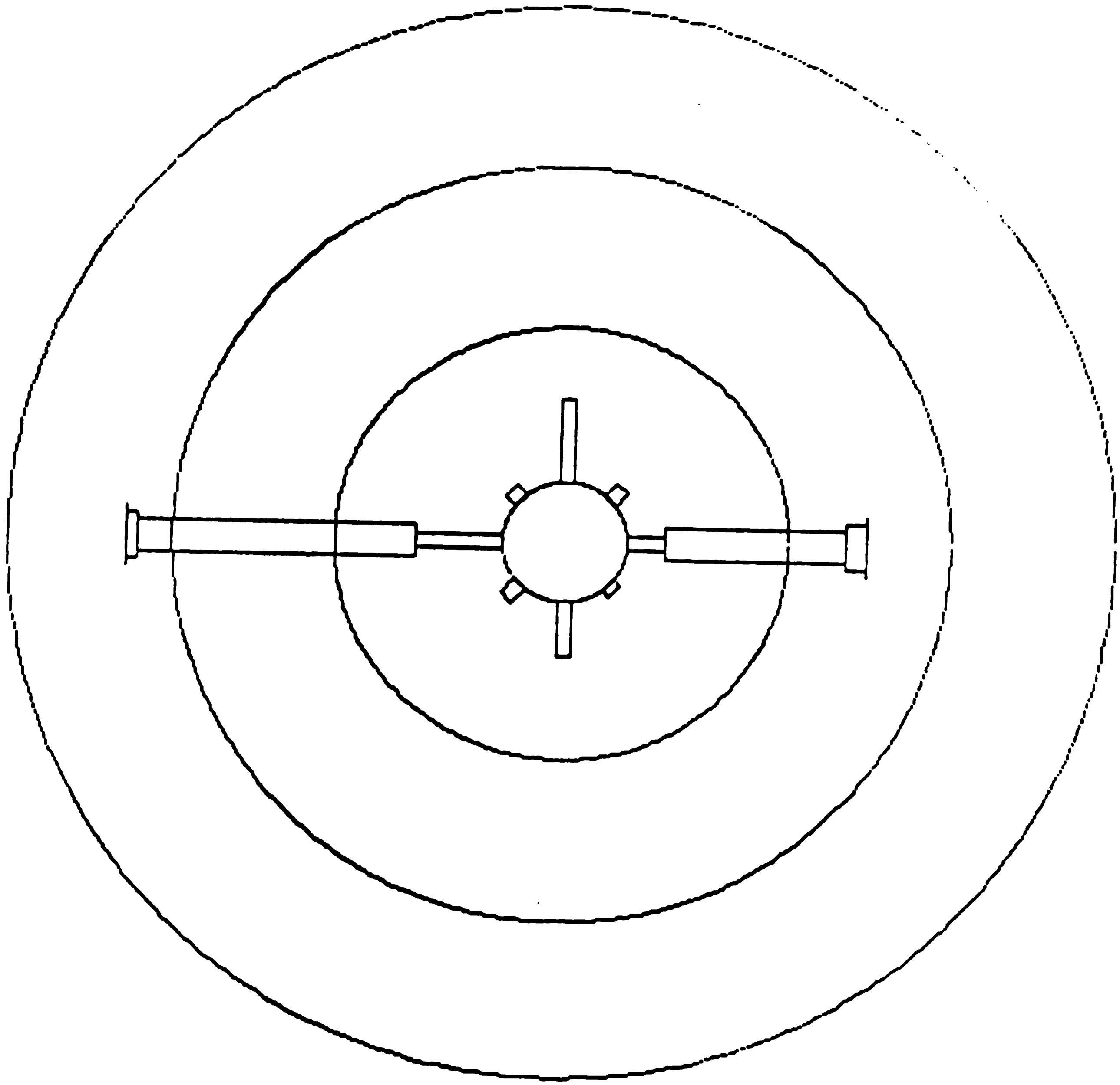


Figure 26. Current rose for velocities at top grid point for Site A (approximately 2.0 meters below the water surface). Speed classes are 0.2 m/sec and reference circles are 20%. For consistency in comparison to the wind roses, direction categories are referenced in terms of directions from which currents are coming.

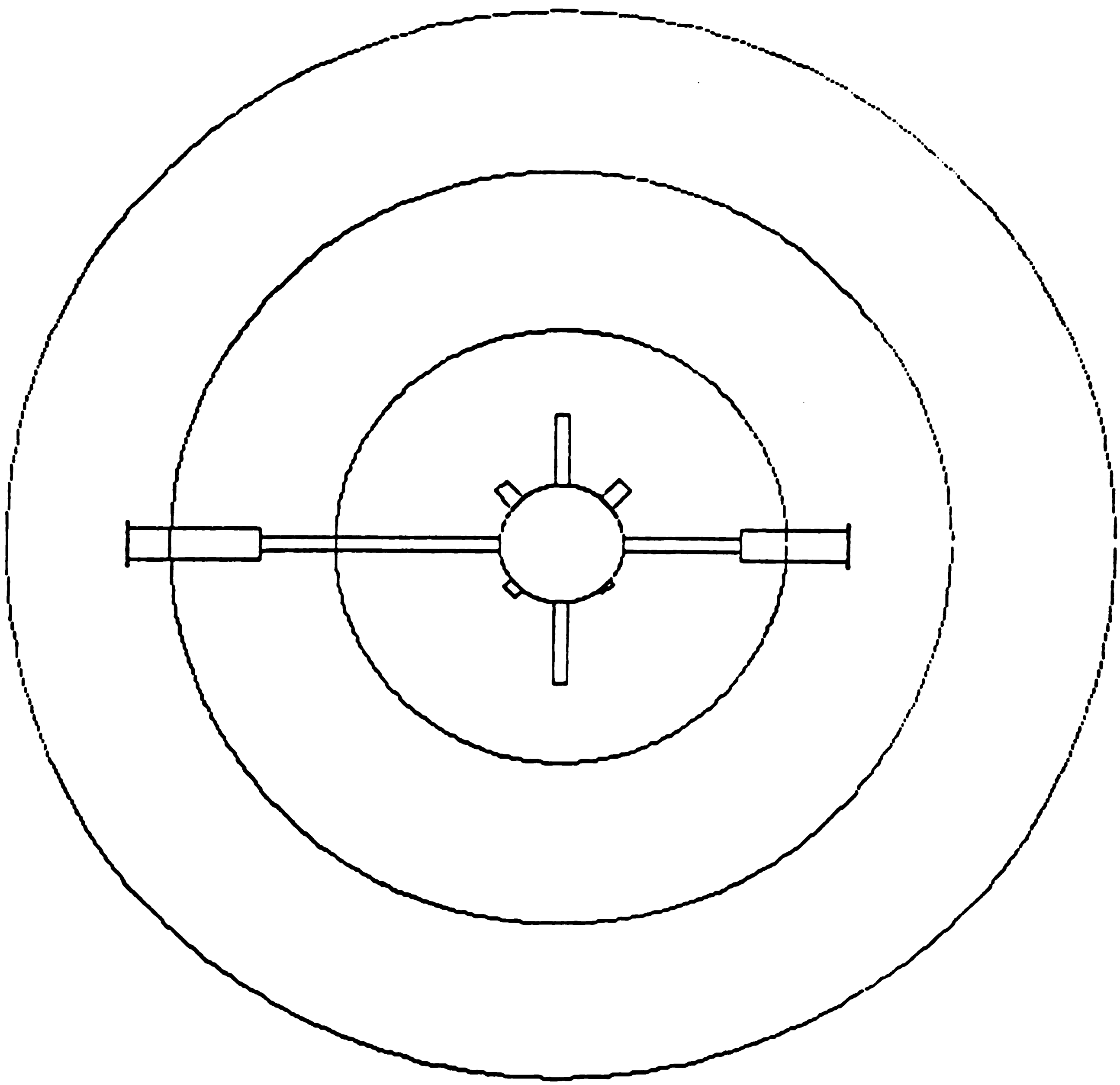


Figure 27. Current rose for velocities at bottom grid point for Site A (approximately 2.0 meters above the bottom). Speed classes are 0.2 m/sec and reference circles are 20%. For consistency in comparison to the wind roses, direction categories are referenced in terms of directions from which currents are coming.

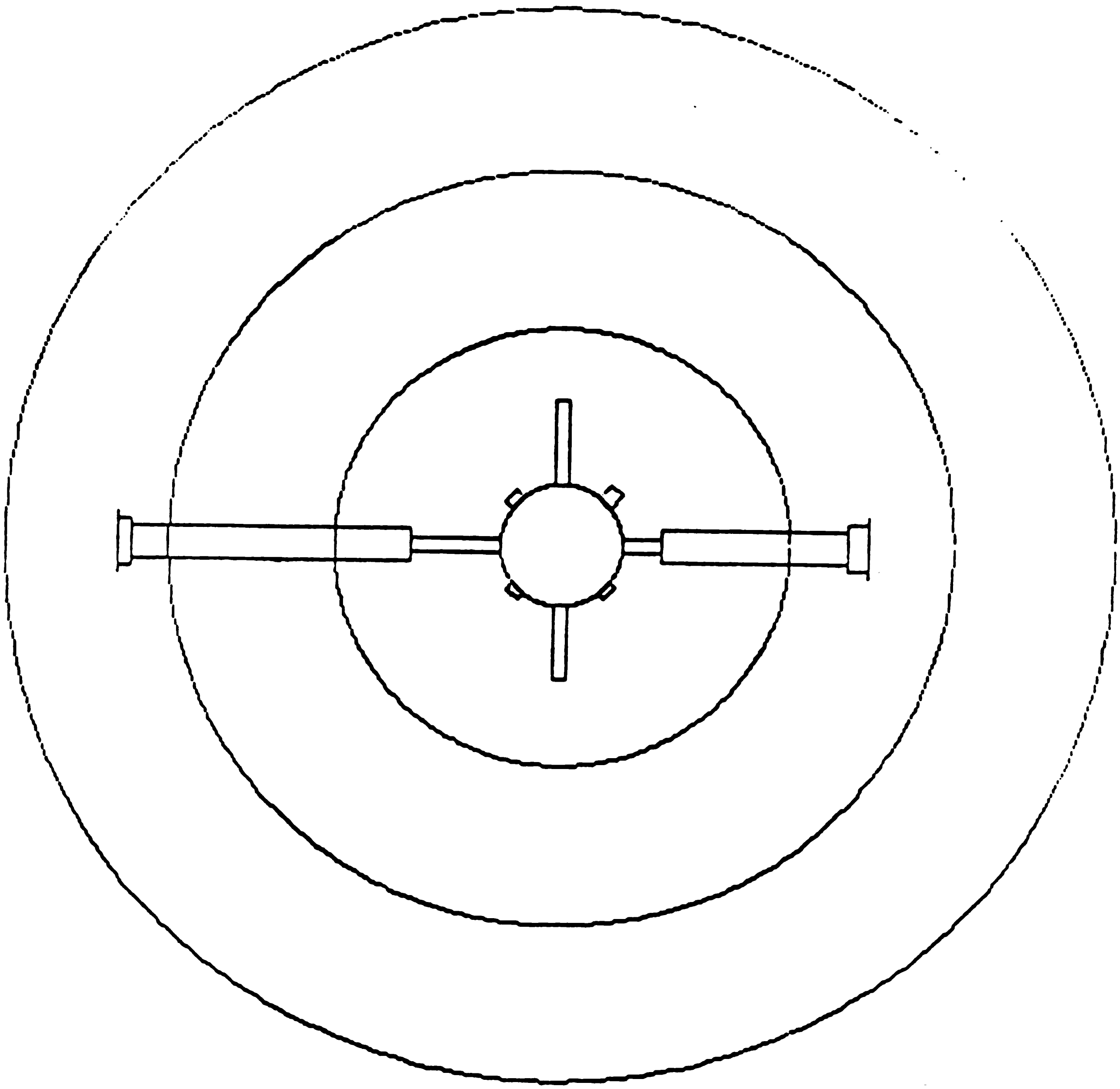


Figure 28. Current rose for velocities at top grid point for Site B (approximately 1.9 meters below the water surface). Speed classes are 0.2 m/sec and reference circles are 20%. For consistency in comparison to the wind roses, direction categories are referenced in terms of directions from which currents are coming.

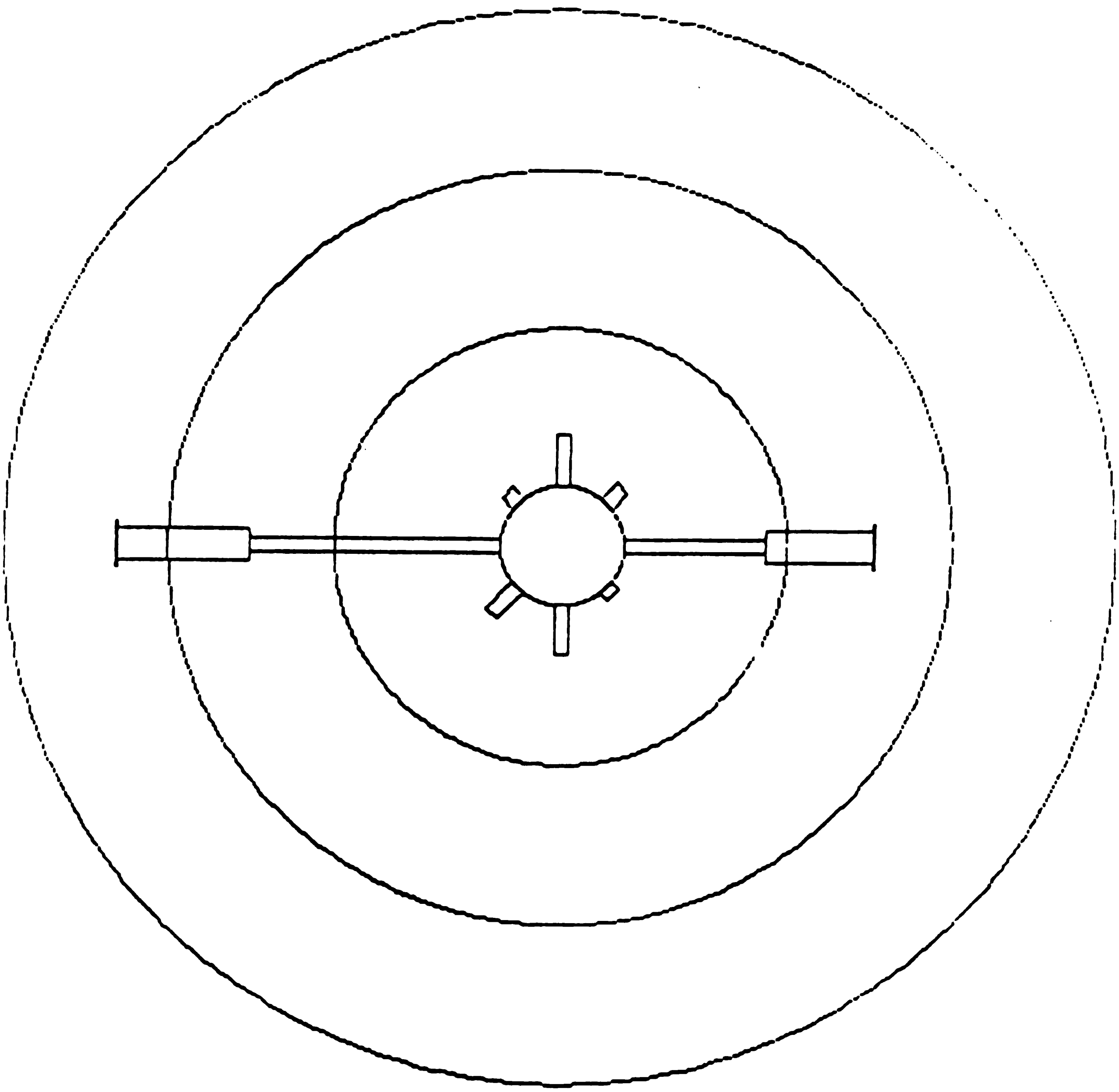


Figure 29. Current rose for velocities at bottom grid point for Site B (approximately 1.9 meters above the bottom). Speed classes are 0.2 m/sec and reference circles are 20%. For consistency in comparison to the wind roses, direction categories are referenced in terms of directions from which currents are coming.

Table B-5
PROBABILITY MATRIX FOR CURRENTS AT TOP
GRID POINT FOR SITE A

0°	45°	90°	135°	180°	225°	270°	315°
4.75	2.13	10.74	1.56	10.39	2.33	7.11	1.06
21.51	0.00	0.00	0.00	33.14	0.00	0.00	0.00
3.17	0.00	0.00	0.00	2.00	0.00	0.00	0.00
0.11	0.00	0.00	0.00	0.02	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table B-6

PROBABILITY MATRIX FOR CURRENTS AT BOTTOM
GRID POINT FOR SITE A

0°	45°	90°	135°	180°	225°	270°	315°
14.43	3.20	9.11	3.01	29.08	1.18	10.11	0.50
10.69	0.00	0.00	0.00	16.93	0.00	0.00	0.00
1.33	0.00	0.00	0.00	0.42	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table B-7

PROBABILITY MATRIX FOR CURRENTS AT TOP GRID POINT FOR SITE B

0°	45°	90°	135°	180°	225°	270°	315°
4.68	2.10	10.58	1.22	10.56	0.94	9.13	0.84
22.30	0.00	0.00	0.00	33.63	0.00	0.00	0.00
2.32	0.00	0.00	0.00	1.57	0.00	0.00	0.00
0.11	0.00	0.00	0.00	0.02	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table B-8
PROBABILITY MATRIX FOR CURRENTS AT BOTTOM
GRID POINT FOR SITE B

0°	45°	90°	135°	180°	225°	270°	315°
17.40	2.67	6.50	1.90	30.20	4.50	6.06	1.21
12.90	0.00	0.00	0.00	16.01	0.00	0.00	0.00
0.33	0.00	0.00	0.00	0.32	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

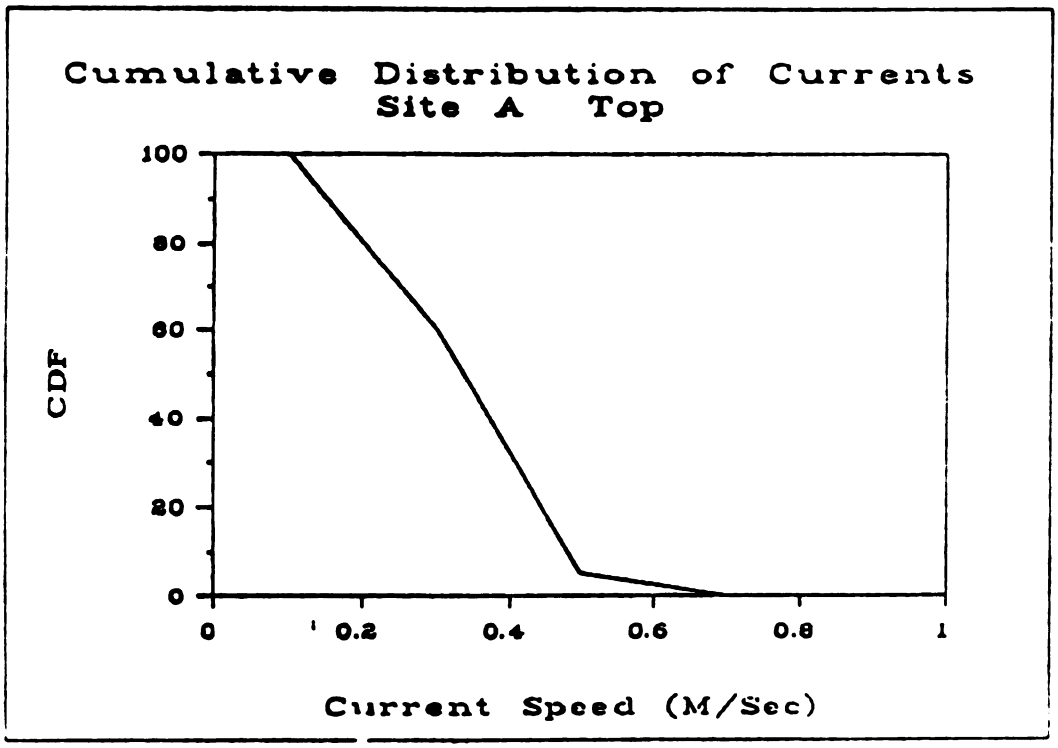


Figure 30. Cumulative distribution of current velocities at top grid point for Site A.

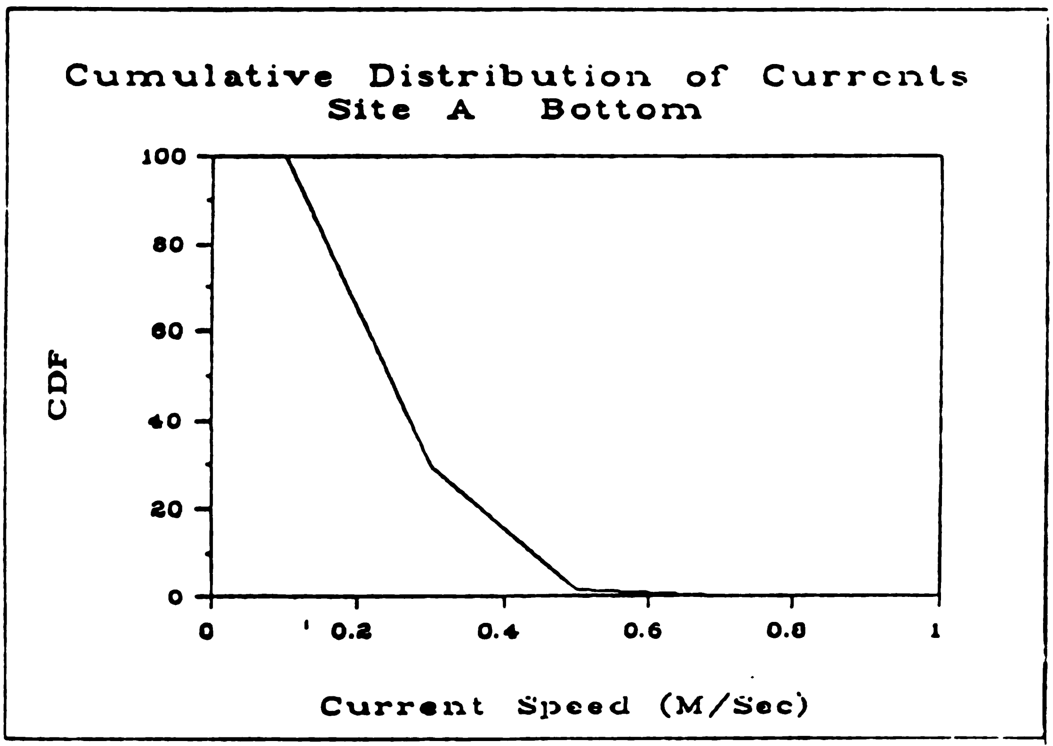


Figure 31. Cumulative distribution of current velocities at bottom grid point for Site A.

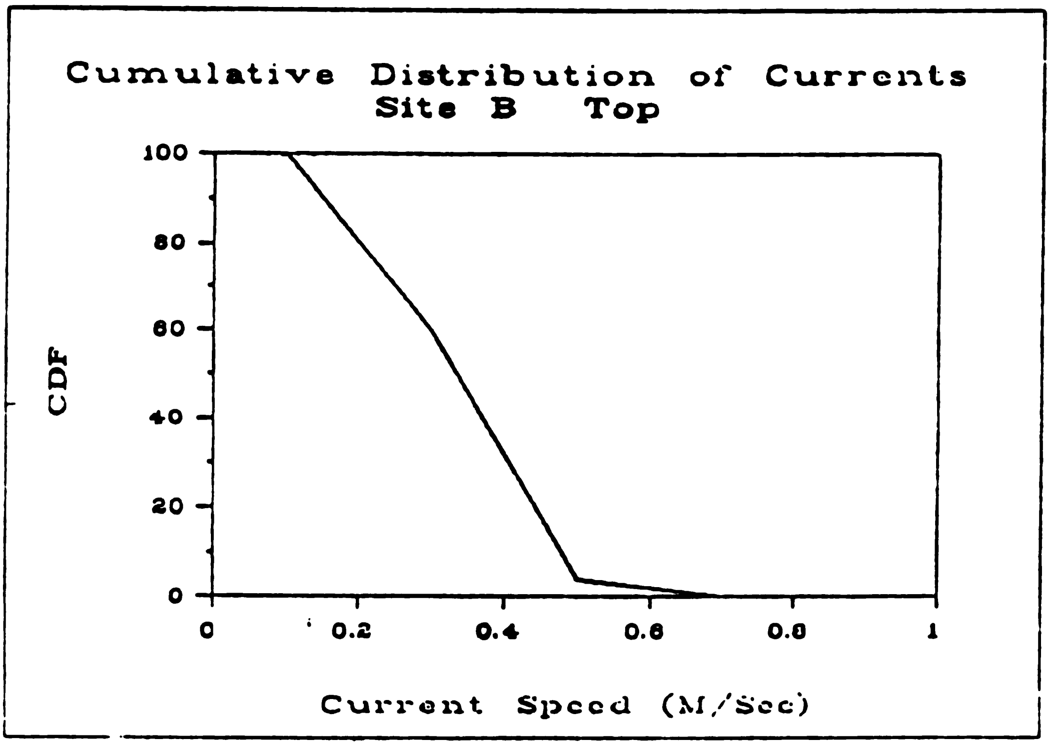


Figure 32. Cumulative distribution of current velocities at top grid point for Site B.

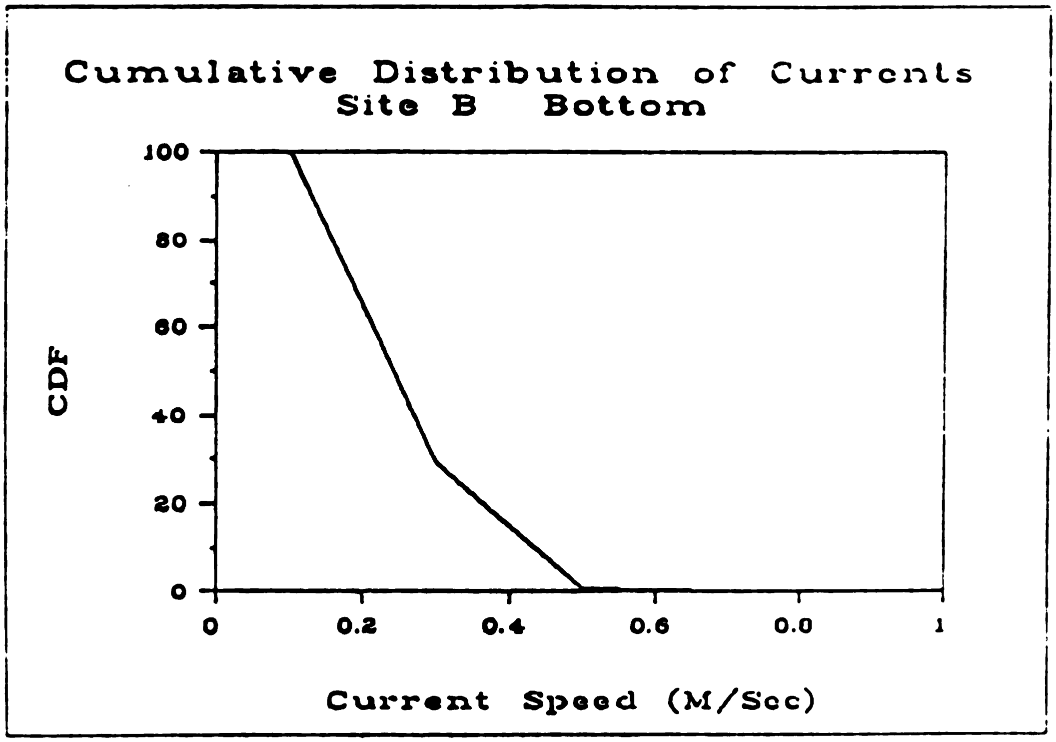


Figure 33. Cumulative distribution of current velocities at bottom grid point for Site B.

At the surface levels at sites A and B some currents exceed 0.6 m/sec. It should also be noted that there appears to be an approximate balance in the percentages of onshore-offshore currents.

Since the model runs for climatological purposes were each allowed to attain steady-state conditions, transient effects, such as those associated with changes in wind speeds and directions and tidal fluctuations, are not present in the results shown here. However, about two-thirds of all of the measured currents at sites A and B are directed at angles within 30 degrees of parallel to the coast; over 80 percent of all measured currents greater than 20 cm/sec are aligned within these same directed bands; and over 95 percent of all measured currents greater than 40 cm/sec fall within these directions. Thus, although transient effects are certainly present, they are not dominant features of the current regime; and the representation of currents shown here should provide a good overall picture of the expected currents.

6. CONCLUSIONS

In this study we have employed a numerical model which incorporates a k-ε closure method in the vertical dimensions. Calibration of this model has demonstrated that it can reasonably represent both the magnitude and structure of the currents in the vicinity of proposed dredged material disposal sites A and B. Exercising the model with winds from historical hurricanes (Hurricanes Eloise and Frederic), it was found that alongshore currents of approximately 1 m/sec could be expected during these events, with the dominant current direction along the coast. Using climatological statistics of winds from nearby Pensacola airport combined with steady-state runs of the current model, expected current roses for the top and bottom levels in the model were constructed for sites A and B. These results indicated that the climatological currents should be oriented primarily along the coast, with only a small proportion of low current speeds directed normal to the coast. Thus, any dispersion of dredged material should occur primarily in the along the coast direction. Since the percentages of offshore and onshore currents are approximately equal, the primary climatological effect of the currents should be to disperse and dredge material in extremely eccentric ellipses with the major axes parallel to the coast. Since currents out of the east occur more frequently than those out of the west, any associated net transport should be directed toward the west.

7. REFERENCES

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APPENDIX C

U.S. Environmental Protection Agency

Water and Sediment

Quality Data

Site B

Site C

Site B

WATER QUALITY PARAMETERS

November 1986
April 1987
July 1987

SEDIMENT DATA

Sediment Nutrients
November 1986
April 1987

Heavy Metals
November 1986
April 1987

Pesticide/PCB/Extrable Organics

Grain Size Analysis
November 1986
April 1987

PENSACOLA SITE B
SITE WATER NUTRIENT ANALYSIS
NOVEMBER 1986

CONVENTIONAL PARAMETERS	STA. B10	STA. B11	STA. B12	STA. B13	STA. B14	STA. B15	STA. B16	STA. B17
AMMONIA								
TOP	.09	ND	.16	ND	ND	ND	ND	.17
MID	.05	.45	ND	.15	ND	ND	.38	.11
BOT	ND	.07	ND	.14	ND	ND	ND	.06
NITRATE-NITRITE NITROGEN								
TOP	ND	ND	ND	ND	ND	ND	ND	ND
MID	ND	ND	ND	ND	ND	ND	ND	ND
BOT	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL KJELDAHL NITROGEN								
TOP	.13	.21	.2	.28	.23	.23	.14	.21
MID	.13	.8	.25	.24	.17	.24	.51	.22
BOT	.36	.29	.16	.3	.19	.14	.18	.16
TOTAL-PHOSPHORUS								
TOP	ND	ND	ND	ND	ND	ND	ND	ND
MID	ND	ND	ND	ND	ND	ND	ND	ND
BOT	ND	ND	ND	ND	ND	ND	ND	ND

Concentration in mg/l
ND = Not Detected at Minimum Detection Limit
NA = Not Analyzed
Top = 1 foot below surface; Mid = 50% total depth; Bot = 1 foot above bottom

PENSACOLA SITE B
SITE WATER NURTIENT ANALYSIS
APRIL 1987

CONVENTIONAL PARAMETERS	STA. B10	STA. B11	STA. B12	STA. B13	STA. B14	STA. B15	STA. B16	STA. B17
AMMONIA								
TOP	ND	.09	ND	ND	ND	.09	ND	ND
MID	ND	.08	ND	ND	ND	ND	ND	ND
BOT	ND	ND	.09	ND	ND	ND	ND	.07
NITRATE-NITRITE NITROGEN								
TOP	ND	.1	ND	ND	ND	ND	.27	ND
MID	ND	ND	ND	ND	ND	.06	.25	ND
BOT	ND	.05	.05	ND	ND	ND	.25	.09
TOTAL KJELDAHL NITROGEN								
TOP	ND	ND	.35	ND	ND	ND	ND	ND
MID	ND	ND	ND	ND	ND	.29	ND	ND
BOT	ND	.31	ND	ND	ND	ND	ND	ND
TOTAL-PHOSPHORUS								
TOP	.02	ND	ND	ND	ND	ND	ND	ND
MID	ND	ND	ND	ND	.04	ND	ND	ND
BOT	.05	.02	.05	ND	ND	ND	ND	.02

Concentration in mg/l
ND = Not Detected at Minimum Detection Limit
Top = 1 foot below surface; Mid = 50% total depth; Bot = 1 foot above bottom

PENSACOLA SITE B
SITE WATER NURTIENT ANALYSIS
JULY 1987

CONVENTIONAL PARAMETERS	STA. B10	STA. B11	STA. B12	STA. B13	STA. B14	STA. B15	STA. B16	STA. B17
AMMONIA								
TOP	ND	ND	ND	ND	ND	ND	ND	ND
MID	ND	ND	ND	ND	ND	ND	ND	ND
BOT	ND	ND	ND	ND	ND	ND	ND	ND
NITRATE-NITRITE NITROGEN								
TOP	ND	ND	ND	ND	ND	ND	ND	ND
MID	ND	ND	ND	ND	ND	ND	ND	ND
BOT	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL KJELDAHL NITROGEN								
TOP	.41	.31	.26	.56	.41	.4	.36	.3
MID	1	.33	.35	.30	.38	.35	.31	.36
BOT	.33	.36	.43	.32	.55	.38	.37	.35
TOTAL-PHOSPHORUS								
TOP	ND	ND	ND	ND	ND	ND	ND	ND
MID	ND	ND	ND	ND	ND	ND	ND	ND
BOT	ND	ND	ND	ND	ND	.03	ND	ND
TOTAL ORGANIC CARBON								
TOP	1.2	ND	1.3	1.3	1	1	1	ND
MID	ND	ND	1	1.2	1	ND	1.6	ND
BOT	ND	ND	1	1.1	ND	1	1	ND

Concentration in mg/l
ND = Not Detected at Minimum Detection Limits
Top = 1 foot below surface; Mid = 50% water depth; Bot = 1 foot above bottom

SEDIMENT NUTRIENTS

SITE B, NOVEMBER 1986

CONVENTIONAL PARAMETERS	STA. B1	STA. B2	STA. B3	STA. B4	STA. B5	STA. B6	STA. B7	STA. B8	STA. B9	STA. B10
AMMONIA	2.6	2.9	7.9	6.4	7.9	6	6	7.6	6.2	5.3
TKN	90	88	89	130	120	140	100	82	65	66
TOTAL-PHOSPHORUS	28	30	43	32	31	34	29	45	29	21
OIL AND GREASE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

CONVENTIONAL PARAMETERS	STA. B11	STA. B12	STA. B13	STA. B14	STA. B15	STA. B16	STA. B17	STA. B18	STA. B19	STA. B20
AMMONIA	5.7	4	3.4	2.8	ND	ND	3.6	5.8	4.2	ND
TKN	51	110	67	54	35	72	64	48	74	40
TOTAL-PHOSPHORUS	30	40	37	32	26	25	26	33	34	40
OIL AND GREASE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Concentration in mg/kg

ND = Not Detected at Minimum Detection Limits

SEDIMENT NUTRIENTS
SITE B, APRIL 1987

CONVENTIONAL PARAMETERS	STA. B1	STA. B2	STA. B3	STA. B4	STA. B5	STA. B6	STA. B7	STA. B8	STA. B9	STA. B10
AMMONIA	5.8	12	8.9	9.6	6.9	8.2	10	10	16	5.8
TKN	53	71	49	58	61	55	58	50	65	67
TOTAL-PHOSPHORUS	12	18	6	7	ND	15	5	ND	5	9
OIL AND GREASE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

CONVENTIONAL PARAMETERS	STA. B11	STA. B12	STA. B13	STA. B14	STA. B15	STA. B16	STA. B17	STA. B18	STA. B19	STA. B20
AMMONIA	10	6.6	11	7.4	8.2	12	9.8	9.1	8.4	15
TKN	74	55	85	71	85	83	66	66	64	73
TOTAL-PHOSPHORUS	7	13	8	6	8	10	22	24	6	22
OIL AND GREASE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Concentration in mg/kg
ND = Not Detected at Minimum Detection Limits

SEDIMENT HEAVY METAL CONCENTRATIONS

SITE B, NOVEMBER 1986

ELEMENT	STA. B1	STA. B2	STA. B3	STA. B4	STA. B5	STA. B6	STA. B7	STA. B8	STA. B9	STA. B10
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ba	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Be	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	1.4	1.5	1.8	1.9	1.8	1.9	1.6	1.9	1.6	1.1
Cu	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sr	50	96	160	76	48	54	45	76	32	100
Te	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ti	3.9	2.6	2.4	3.4	2.6	4.5	2	14	4.2	1.5
V	1.1	1.1	1.6	1.4	1.1	1.5	ND	1.4	1	ND
Y	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Al	110	130	160	160	140	150	110	190	110	79
Mn	ND	2.7	3.2	2.9	ND	ND	ND	4.8	ND	ND
Ca	9300	13000	25000	11000	7600	7500	7600	11000	4900	16000
Mg	500	720	1500	720	610	720	700	710	610	350
Fe	280	320	410	420	420	450	270	340	260	200
Na	1800	2100	1900	1900	2000	1800	1800	2100	1500	1900

Concentration in mg/kg

ND = Not Detected At Minimum Detection Limit

SEDIMENT HEAVY METAL CONCENTRATIONS
SITE B, NOVEMBER 1986

ELEMENT	STA. B11	STA. B12	STA. B13	STA. B14	STA. B15	STA. B16	STA. B17	STA. B18	STA. B19	STA. B20
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ba	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Be	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	1.2	1.4	1.8	1	1.5	1.2	1.4	1.9	2	1.5
Cu	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sr	83	100	45	45	85	130	70	210	290	290
Te	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ti	2	2.2	3.8	3.1	2.5	2.2	3.7	2.8	1.6	3.4
V	ND	1.5	1.2	1.1	1.3	1.2	1	2.3	1.8	1.4
Y	ND	ND	ND	ND	ND	ND	ND	1.1	1.5	1.2
Zn	ND	ND	ND	1	ND	ND	ND	1.1	1.1	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Al	96	140	140	110	120	120	130	220	210	190
Mn	ND	3.5	2.8	ND	ND	3.9	ND	4.8	8.6	7.9
Ca	13000	14000	6800	7200	12000	17000	11000	37000	46000	48000
Mg	730	950	660	580	660	910	640	1400	2500	1500
Fe	200	480	350	320	420	310	260	660	790	540
Na	1800	1900	2500	1800	1600	3000	2000	2300	2700	2600

Concentrations in mg/kg
ND = Not Detected at Minimum Detection Limit

SEDIMENT HEAVY METAL CONCENTRATIONS
SITE B, APRIL 1987

ELEMENT	STA. B1	STA. B2	STA. B3	STA. B4	STA. B5	STA. B6	STA. B7	STA. B8	STA. B9	STA. B10
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ba	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Be	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	1.4	1.2	1.8	1.4	1.8	2.6	1.7	1.7	1.6	1.3
Cu	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sr	64	50	70	160	82	98	94	47	71	47
Te	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ti	1.8	1.7	2.8	1.6	3.6	2.6	4.8	2.1	3.1	2
V	1	ND	1.3	1.5	1.4	2	ND	1.3	1.1	1
Y	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND
Zn	ND	ND	ND	ND	1	1	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Al	110	11	1200	140	160	230	140	120	110	110
Mn	ND	3.5	ND	4.3	3.1	5.3	3.4	ND	ND	ND
Ca	8000	8000	10000	12000	12000	15000	14000	7400	11000	7000
Mg	670	700	940	1100	840	960	660	710	910	700
Fe	290	270	340	410	510	630	270	290	230	280
Na	2100	2900	2200	2200	2400	2300	2600	2600	2800	2100

Concentration in mg/kg
ND = Not Detectable at Minimum Detection Limits

SEDIMENT HEAVY METAL CONCENTRATIONS
SITE B, APRIL 1987

ELEMENT	STA. B11	STA. B12	STA. B13	STA. B14	STA. B15	STA. B16	STA. B17	STA. B18	STA. B19	STA. B20
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ba	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Be	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	1.7	1.6	1.4	1.4	1.1	1.8	1.8	1.7	1.6	1.3
Cu	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sr	30	38	55	120	46	36	120	86	130	150
Te	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ti	3.7	3	3	2.5	3.3	3.6	4.5	3.4	2.2	6.4
V	1.1	1	1.3	1.3	ND	1.1	1.7	1.3	1.7	1.3
Y	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	ND	ND	ND	ND	ND	ND	ND	ND	1.7	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Al	130	110	120	170	14	140	200	150	250	220
Mn	ND	2.7	ND	5	ND	2.7	5	3.8	7	5.6
Ca	4600	5500	9100	17000	6300	5000	16000	13000	20000	21000
Mg	630	710	740	1300	560	600	1300	810	970	1100
Fe	370	260	340	530	260	260	640	500	81	420
Na	1900	2400	2700	2500	2400	2600	2400	2100	2500	2600

Concentration in mg/kg
ND = Not Detected at Minimum Detection Limits

The following is a listing of pesticide, PCB, and extractable organic compounds that were analyzed for in sediments from each of seven stations in alternative Site B and alternative Site C during November 1986 and April 1987. None of the compounds on the list were detected at any station in concentrations in excess of the minimum detection limit. See Appendix A for a discussion of the sampling program.

PESTICIDE/PCB/EXTRACTABLE
ORGANIC COMPOUNDS

ALDRIN	HEXACHLOROETHANE	BENZYL ALCOHOL
HEPTACHLOR	BIS (2-CHLOROISOPROPYL) ETHER	4-CHLOROANILINE
HEPTACHLOR EXPOXIDE	N-NITROSODI-N-PROPYLAMINE	DIBENZOFURAN
ALPHA-BHC	NITROSENZENE	2-METHYLNAPHITHALENE
BETA-BHC	HEXACHLOROBUTADIENE	2-NITROANILINE
GAMMA-BHC (LINDANE)	1,2,4-TRICHLOROBENZENE	3-NITROANILINE
DELTA-BHC	NAPHTHALENE	4-NITROANILINE
ENDOSULFAN I (ALPHA)	BIS (2-CHLOROETHOXY) METHANE	HEXADECANOIC ACID
DIELDRIN	ISOPHORONE	1,3-DICHLOROBENZENE
4,4'-DDT (P,P'-DDT)	HEXACHLOROCYCLOPENTADIENE (HCCP)	1,4-DICHLOROBENZENE
4,4'-DDE (P,P'-DDE)	2-CHLORONAPHTHALENE	1,2-DICHLOROBENZENE
4,4'-DDD (P,P'-DDD)	ACENAPHTHYLENE	BIS (2-CHLOROETHYL) ETHER
ENDRIN	ACENAPHTHENE	2,4-DIMETHYLPHENOL
ENDOSULFAN II (BETA)	DIMETHYL PHTHALATE	2,4-DICHLOROPHENOL
ENDO SULFAN SULFATE	2,4-DINITROTOLUENE	2,4,6-TRICHLOROPHENOL
CHLORDANE (TECH. MIXTURE) /1	2,6-DINITROTOLUENE	4-CHLORO-3-METHYLPHENOL
PCB-1242 (AROCLOR 1242)	4-BROMOPHENYL PHENYD ETHER	BENZO (A) ANTHRACENE
PCB-1254 (AROCLOR 1254)	FLUORENE	CHRYSENE
PCB-1221 (AROCLOR 1221)	DIETHYL PHTHALATE	3,3'-DICHLOROBENZIDINE
PCB-1232 (AROCLOR 1232)	N-NITROSODIPHENYLAMINE/DIPHENYLAMINE	DI-N-OCTYLPHTHALATE
PCB-1248 (AROCLOR 1248)	HEXACHLOROBENZENE (HCB)	BENZO (B AND/OR K) FLUORANTHENE
PCB-1260 (AROCLOR 1260)	4-BROMOPHENYL PHENYL ETHER	BENZO (B AND/OR K) FLUORANTHENE
PCB-1016 (AROCLOR 1016)	PHENANTHRENE	BENZO-A-PYRENE
TOXAPHENE	ANTHRACENE	INDENO (1,2,3-CD) PYRENE
METHOXYCHLOR	DI-N-BUTYLPHTHALATE	DIBENZO (A,H) ANTHRACENE
ENDRIN KETONE	FLUORANTHENE	BENZO (GHI) PERYLENE
BENZOIC ACID	PYRENE	2-CHLOROPHENOL
2-METHYLPHENOL	BENZYL BUTYL PHTHALATE	2-NITROPHENOL
4-METHYLPHENOL	BIS (2-ETHYLHEXYL) PHTHALATE	PHENOL
2,4,5-TRICHLOROPHENOL	2-METHYL-4,6-DINITROPHENOL	2,4-DINITROPHENOL
4-NITROPHENOL	PENTACHLOROPHENOL	

PARTICLE SIZE* OF SEDIMENTS AT SELECTED STUDY STATIONS
PROPOSED OFFSHORE DISPOSAL SITE B
PENSACOLA, FLORIDA, OCT. - NOV., 1986

Inorganic fraction subtended by organic fraction
(all as % dry weight)

Station	Medium Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	TOTALS
B1	0.00	3.91	40.34	54.69	0.09	0.04	0.41	99.47
	0.00	0.03	0.11	0.06	0.00	0.01	0.31	0.53
B2	0.00	1.71	38.07	58.72	0.11	0.00	0.80	99.42
	0.00	0.07	0.09	0.09	0.05	0.05	0.24	0.59
B3	0.00	0.56	28.46	69.31	0.16	0.07	0.94	99.49
	0.00	0.03	0.07	0.09	0.01	0.03	0.28	0.51
B4	0.56	2.11	40.85	55.49	0.11	0.11	0.51	99.74
	0.02	0.04	0.00	0.06	0.00	0.02	0.12	0.26
B5	0.00	1.35	43.64	53.76	0.11	0.13	0.60	99.60
	0.00	0.02	0.13	0.06	0.00	0.05	0.14	0.40
B6	0.00	1.08	42.98	54.13	0.07	0.07	0.91	99.24
	0.00	0.04	0.04	0.04	0.04	0.06	0.45	0.68
B7	0.00	1.85	46.03	50.78	0.07	0.06	0.91	99.70
	0.00	0.02	0.08	0.07	0.00	0.03	0.09	0.30
B8	0.00	0.07	4.79	93.32	0.31	0.13	0.75	99.37
	0.00	0.02	0.05	0.16	0.03	0.05	0.32	0.63
B9	0.00	1.17	62.13	35.67	0.06	0.04	0.80	99.86
	0.00	0.01	0.07	0.02	0.00	0.00	0.04	0.14
B10	0.00	0.53	47.34	50.93	0.11	0.04	0.44	99.39
	0.00	0.01	0.10	0.04	0.03	0.03	0.40	0.61
B11	3.57	3.47	42.61	49.42	0.07	0.06	0.31	99.51
	0.08	0.07	0.06	0.07	0.00	0.00	0.21	0.49
B12	0.00	0.69	51.12	47.38	0.06	0.10	0.17	99.52
	0.00	0.03	0.04	0.06	0.01	0.01	0.32	0.48

* Particle size headings are not indicative of the composition of the material retained in sieving. For example, material reported under the heading "Medium Gravel" may be wood, shells, minerals or other matter.

PARTICLE SIZE* OF SEDIMENTS AT SELECTED STUDY STATIONS
PROPOSED OFFSHORE DISPOSAL SITE B
PENSACOLA, FLORIDA, OCT. - NOV., 1986
(Continued)

Inorganic fraction subtended by organic fraction
(all as % dry weight)

Station	Medium Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	TOTALS
B13	0.00	0.16	9.03	89.41	0.14	0.15	0.52	99.41
	0.00	0.03	0.03	0.14	0.00	0.04	0.34	0.59
B14	0.00	0.88	57.88	39.96	0.04	0.05	0.56	99.38
	0.00	0.06	0.11	0.07	0.01	0.04	0.33	0.62
B15	0.00	7.46	56.61	34.45	0.09	0.03	0.75	99.39
	0.00	0.10	0.13	0.10	0.02	0.04	0.22	0.61
B16	0.00	0.49	12.66	86.26	0.09	0.03	0.30	99.83
	0.00	0.00	0.00	0.04	0.01	0.00	0.12	0.17
B17	0.00	0.31	21.16	77.15	0.19	0.03	0.96	99.80
	0.00	0.00	0.13	0.03	0.00	0.01	0.03	0.20
B18	0.00	3.02	40.53	54.04	0.25	0.19	1.34	99.38
	0.00	0.06	0.17	0.07	0.00	0.06	0.25	0.62
B19	0.00	3.20	39.81	54.90	0.16	0.31	0.91	99.29
	0.00	0.00	0.21	0.10	0.00	0.10	0.30	0.71
B20	0.00	7.60	46.75	43.58	0.20	0.30	0.95	99.37
	0.00	0.08	0.15	0.04	0.02	0.11	0.22	0.63

* Particle size headings are not indicative of the composition of the material retained in sieving. For example, material reported under the heading "Medium Gravel" may be wood, shells, minerals or other matter.

PARTICLE SIZE* OF SEDIMENTS AT SELECTED STUDY STATIONS
PROPOSED OFFSHORE DISPOSAL SITE B
PENSACOLA, FLORIDA, APRIL 1987

Inorganic Fraction subtented by organic fraction
(all as % total dry weight)

Station	Medium Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	TOTALS
B1	0.00	2.48	41.47	54.71	0.09	0.07	0.82	99.64
	0.00	0.04	0.06	0.09	0.02	0.00	0.15	0.36
B2	0.00	1.59	35.07	62.14	0.21	0.08	0.62	99.72
	0.00	0.04	0.01	0.08	0.00	0.02	0.14	0.28
B3	0.00	1.54	41.72	55.89	0.16	0.01	0.02	99.34
	0.00	0.05	0.16	0.05	0.01	0.06	0.33	0.66
B4	0.00	5.33	51.26	41.78	0.20	0.08	0.67	99.32
	0.00	0.10	0.04	0.08	0.00	0.07	0.39	0.68
B5	0.00	2.10	41.95	54.38	0.03	0.06	0.77	99.30
	0.00	0.08	0.13	0.10	0.03	0.04	0.32	0.70
B6	0.00	2.02	40.12	56.22	0.11	0.17	0.96	99.59
	0.00	0.08	0.10	0.02	0.00	0.06	0.15	0.41
B7	0.00	2.44	48.20	47.71	0.08	0.06	0.95	99.43
	0.00	0.05	0.08	0.00	0.03	0.06	0.34	0.57
B8	0.00	0.30	14.90	83.21	0.27	0.09	0.88	99.65
	0.00	0.05	0.03	0.08	0.00	0.04	0.14	0.35
B9	0.00	0.40	39.34	58.82	0.08	0.06	0.87	99.57
	0.00	0.00	0.06	0.06	0.01	0.02	0.27	0.43
B10	0.00	0.38	32.62	65.17	0.05	0.11	0.70	99.03
	0.00	0.00	0.04	0.09	0.03	0.00	0.80	0.97
B11	2.48	2.80	43.07	49.82	0.16	0.09	0.94	99.36
	0.05	0.06	0.06	0.04	0.01	0.04	0.36	0.64
B12	0.00	1.26	46.08	50.94	0.12	0.07	1.13	99.60
	0.00	0.03	0.07	0.06	0.02	0.01	0.21	0.40

* Particle size headings are not indicative of the composition of the material retained in sieving. For example, material reported under the heading "Medium Gravel" may be wood, shells, minerals or other matter.

PARTICLE SIZE* OF SEDIMENTS AT SELECTED STUDY STATIONS
PROPOSED OFFSHORE DISPOSAL SITE B
PENSACOLA, FLORIDA, APRIL 1987
(Continued)

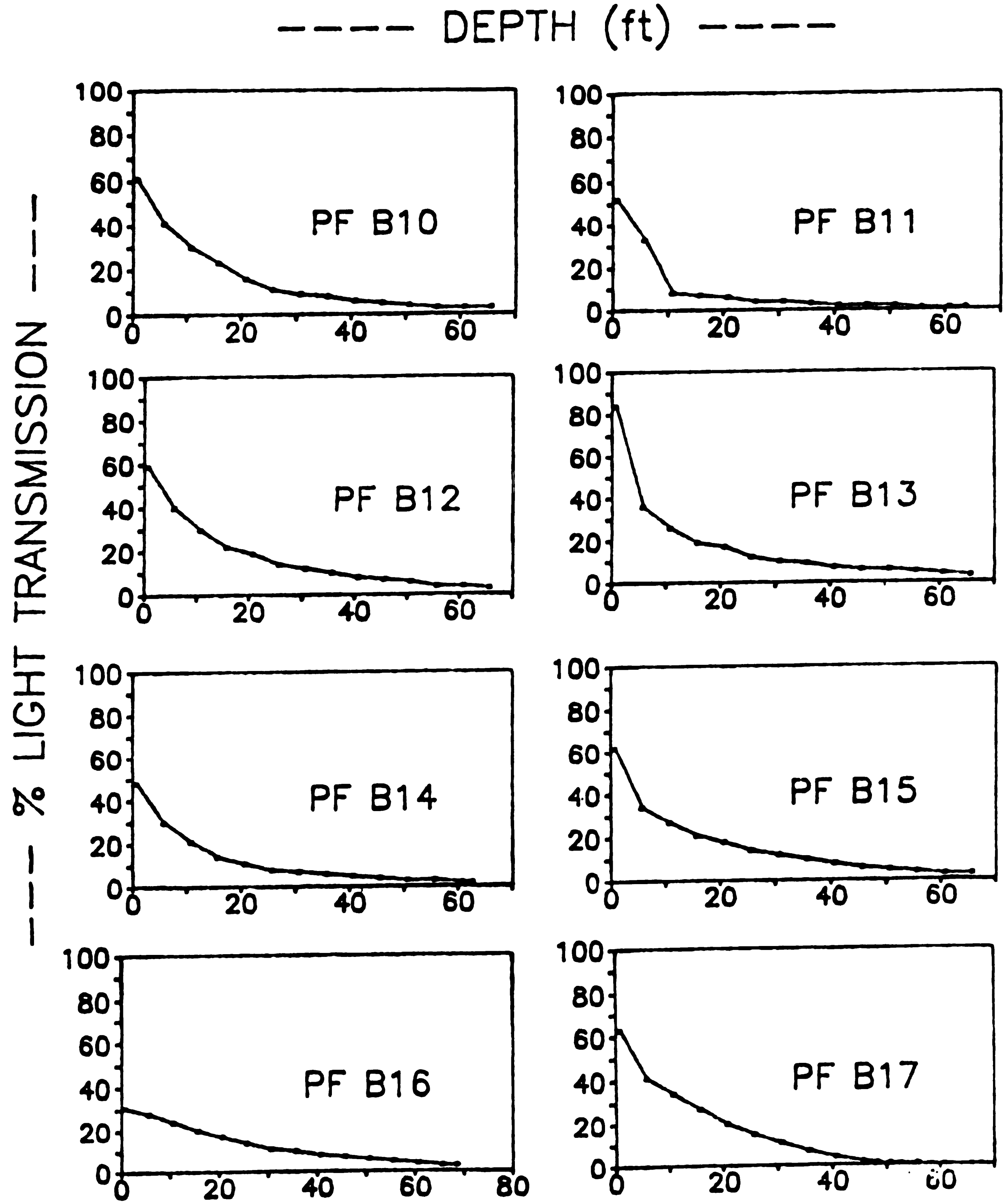
Inorganic Fraction subtented by organic fraction
(all as % total dry weight)

Station	Medium Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	TOTALS
B13	0.00	0.58	31.51	66.65	0.11	0.11	0.42	99.39
	0.00	0.01	0.06	0.07	0.01	0.07	0.40	0.61
B14	0.00	0.98	42.53	55.31	0.16	0.07	0.18	99.23
	0.00	0.01	0.06	0.05	0.04	0.01	0.61	0.77
B16	0.00	0.59	9.61	87.90	0.18	0.08	1.02	99.38
	0.00	0.03	0.07	0.14	0.04	0.07	0.28	0.62
B17	0.00	2.35	25.90	70.19	0.18	0.07	0.56	99.25
	0.00	0.10	0.13	0.07	0.01	0.04	0.40	0.75
B18	0.00	2.63	40.51	55.37	0.20	0.21	0.51	99.43
	0.00	0.06	0.14	0.06	0.01	0.06	0.25	0.57
B19	0.00	3.64	38.96	56.12	0.13	0.13	0.71	99.68
	0.00	0.05	0.13	0.05	0.00	0.02	0.07	0.32
B20	0.00	10.58	35.46	52.06	0.30	0.18	0.95	99.53
	0.00	0.15	0.15	0.02	0.02	0.02	0.09	0.47

* Particle size headings are not indicative of the composition of the material retained in sieving. For example, material reported under the heading "Medium Gravel" may be wood, shells, minerals or other matter.

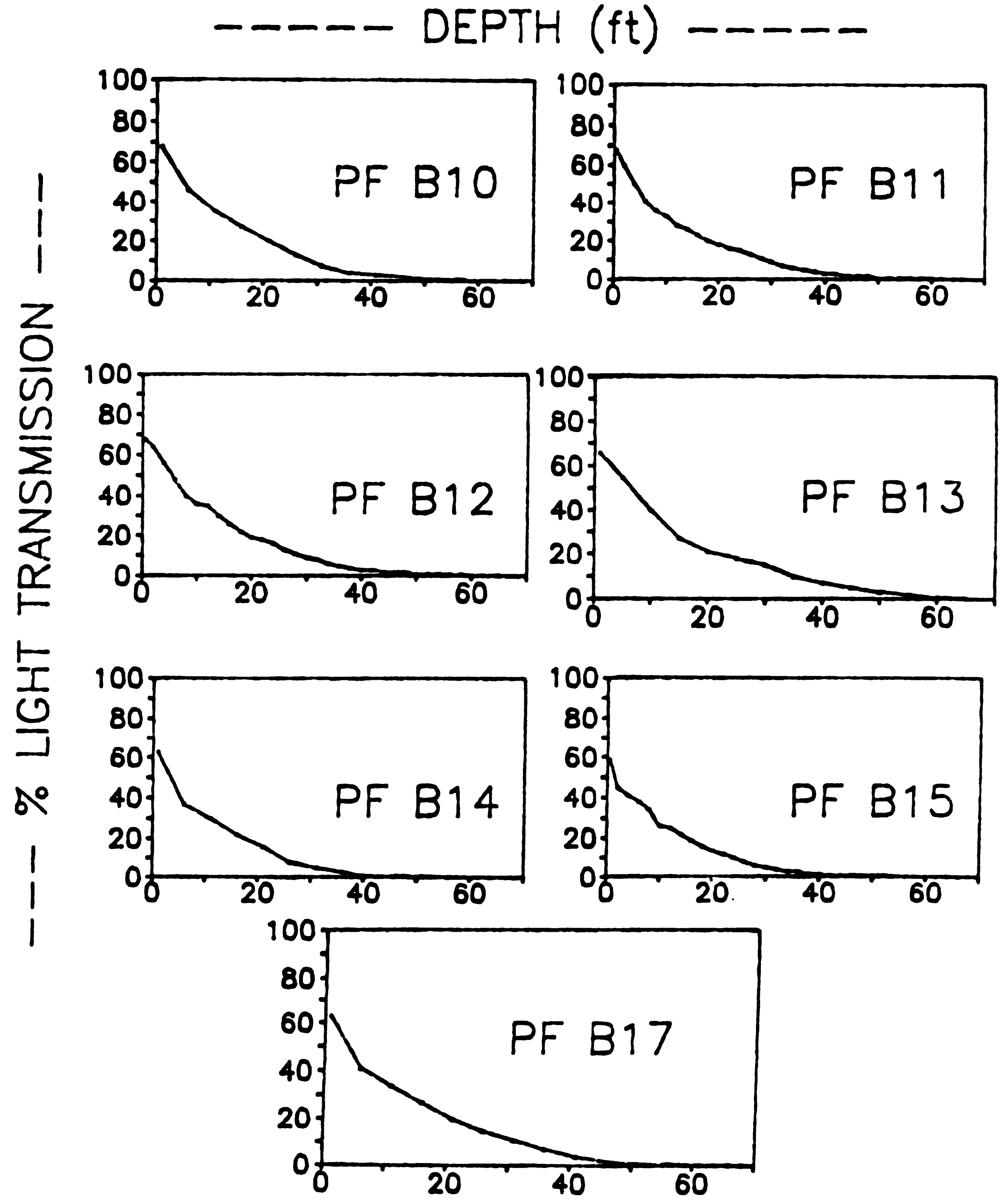
Percent Light Transmission Through Water

Column, Pensacola, Florida, November 1986



Percent Light Transmission Through Water

Column, Pensacola, Florida, April 1987



Pensacola Site B Dissolved Oxygen, Salinity and Temperature Records from Water Column Surface, Middle and Bottom Depths, November 1986, April 1987, July 1987

Station	Sampling Period	Depth(ft)	Dissolved Oxygen(mg/L)	Salinity (o/oo)	Temperature(°C
PF-B10	November 1986	1	6.7	34.2	d23.3
		33	6.6	35.8	23.9
		65	6.5	36.4	23.9
PF-B10	April 1987	1	7.6	36.8	20.1
		32	5.6	37.7	19.3
		64	5.3	38.0	19.4
PF-B10	July 1987	1	6.0	34.0	29.6
		30	5.8	34.9	29.7
		60	5.6	35.6	29.0
PF-B11	November 1986	1	6.9	34.3	23.1
		32	6.5	36.1	24.0
		63	6.5	36.3	24.0
PF-B11	April 1987	1	7.9	35.3	22.0
		30	5.8	37.0	19.7
		60	4.7	37.0	19.2
PF-B11	July 1987	1	5.9	34.5	29.9
		30	5.8	34.9	29.8
		60	5.5	35.7	28.8
PF-B12	November 1986	1	6.7	35.4	23.3
		32	6.6	36.2	23.6
		64	6.4	36.9	24.1
PF-B12	April 1987	1	7.7	36.2	21.1
		30	5.4	37.2	19.3
		60	4.7	37.3	19.4
PF-B12	July 1987	1	5.9	35.0	30.0
		30	5.8	35.5	29.5
		60	5.3	35.8	28.5

Dissolved Oxygen, Salinity and Temperature Records from Water Column Surface, Middle and Bottom Depths, Pensacola, Florida, November 1986, April 1987, July 1987

Station	Sampling Period	Depth(ft)	Dissolved Oxygen(mg/L)	Salinity (o/oo)	Temperature(°C
PF-B13	November 1986	1	6.7	35.6	23.3
		34	6.65	36.4	23.7
		68	6.4	36.9	24.0
PF-B13	April 1987	1	7.6	36.5	20.3
		30	7.6	36.5	20.3
		60	5.4	37.3	19.5
PF-B13	July 1987	1	6.1	33.8	30.3
		30	5.9	35.1	29.7
		60	5.5	35.7	29.0
PF-B14	November 1986	1	6.6	34.1	23.6
		31	6.7	36.0	23.6
		61	6.3	36.6	24.2
PF-B14	April 1987	1	7.5	36.6	20.0
		32	5.1	37.6	19.0
		64	5.0	37.4	19.5
PF-B14	July 1987	1	6.0	33.4	29.8
		30	5.8	35.0	29.7
		60	5.6	35.7	29.1
PF-B15	November 1986	1	6.7	35.3	23.4
		32	6.6	36.1	23.7
		64	6.4	36.7	24.0
PF-B15	April 1987	1	8.1	36.5	21.3
		35	5.1	37.8	19.4
		70	5.0	37.9	19.3
PF-B15	July 1987	1	5.9	35.4	29.8
		35	5.8	35.4	29.5
		70	5.4	35.9	28.5

Dissolved Oxygen, Salinity and Temperature Records from Water Column Surface, Middle and Bottom Depths, Pensacola, Florida, November 1986, April 1987, July 1987

Station	Sampling Period	Depth(ft)	Dissolved Oxygen(mg/L)	Salinity (o/oo)	Temperature(°C
PF-B16	November 1986	1	6.55	35.9	23.6
		34	6.45	36.2	23.6
		68	6.5	36.5	23.9
PF-B16	April 1987	1	7.5	35.0	21.8
		34	7.6	35.8	20.8
		68	7.3	37.2	19.8
PF-B16	July 1987	1	6.0	34.4	30.1
		30	5.9	35.2	29.5
		60	5.4	35.8	28.5
PF-B17	November 1986	1	7.0	33.7	23.3
		33	6.5	36.2	23.9
		66	6.5	36.7	24.0
PF-B17	April 1987	1	7.7	36.1	20.8
		34	5.7	37.4	19.4
		68	5.3	37.4	19.1
PF-B17	July 1987	1	6.0	34.3	29.5
		35	5.9	34.4	29.4
		75	5.2	35.2	29.0

Site C

WATER QUALITY PARAMETERS

November 1986
April 1987
July 1987

SEDIMENT DATA

Sediment Nutrients
November 1986
April 1987

Heavy Metals
November 1986
April 1987

Pesticide/PCB/Extrable Organics

Grain Size Analysis
November 1986
April 1987

PENSACOLA SITE C
SITE WATER NURTIENT ANALYSIS
NOVEMBER 1986

CONVENTIONAL PARAMETERS	STA. C10	STA. C11	STA. C12	STA. C13	STA. C14	STA. C15	STA. C16	STA. C17
AMMONIA								
TOP	.15	ND	.07	.1	ND	ND	ND	.08
MID	ND	.08	.19	.2	ND	ND	ND	.09
BOT	ND	ND	.08	.08	ND	ND	ND	ND
NITRATE-NITRITE NITROGEN								
TOP	ND	ND	ND	ND	ND	ND	ND	ND
MID	ND	ND	ND	ND	ND	ND	ND	ND
BOT	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL KJELDAHL NITROGEN								
TOP	.21	.15	.1	.1	ND	ND	.36	ND
MID	.2	.23	.33	.38	ND	ND	ND	ND
BOT	.11	.12	ND	ND	ND	ND	ND	ND
TOTAL-PHOSPHORUS								
TOP	ND	ND	ND	ND	ND	ND	.02	ND
MID	ND	ND	ND	ND	ND	ND	ND	ND
BOT	ND	ND	ND	ND	ND	ND	ND	ND

Concentration in mg/l
ND = Not Detected at Minimum Detection Limits
Top = 1 foot below surface; Mid = 50% water depth; Bot = 1 foot above bottom

PENSACOLA SITE C
SITE WATER NUTRIENT ANALYSIS
APRIL 1987

CONVENTIONAL PARAMETERS	STA. C10	STA. C11	STA. C12	STA. C13	STA. C14	STA. C15	STA. C16	STA. C17
AMMONIA								
TOP	ND	ND	.09	ND	ND	.07	ND	.08
MID	.09	ND	ND	.08	.08	.07	ND	ND
BOT	.08	ND	ND	ND	.09	ND	ND	ND
NITRATE-NITRITE NITROGEN								
TOP	ND	.29	ND	ND	.24	ND	.3	ND
MID	.05	.27	ND	ND	.25	ND	.28	ND
BOT	ND	.29	ND	ND	.26	ND	ND	.29
TOTAL KJELDAHL NITROGEN								
TOP	ND	ND	.1	ND	1.2	ND	ND	ND
MID	ND	ND	ND	ND	ND	ND	ND	ND
BOT	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL-PHOSPHORUS								
TOP	ND	ND	ND	ND	ND	ND	ND	ND
MID	ND	ND	ND	ND	ND	ND	ND	ND
BOT	ND	ND	.04	ND	ND	ND	ND	ND

Concentration in mg/l
ND = Not Detectable at Minimum Detection Limit.
Top = 1 foot below surface; Mid = 50% water depth; Bot = 1 foot above bottom

PENSACOLA SITE C
SITE WATER NURTIENT ANALYSIS
JULY 1987

CONVENTIONAL PARAMETERS	STA. C10	STA. C11	STA. C12	STA. C13	STA. C14	STA. C15	STA. C16	STA. C17
AMMONIA								
TOP	ND	ND	ND	ND	ND	ND	ND	ND
MID	ND	ND	ND	ND	ND	ND	ND	ND
BOT	ND	ND	ND	ND	ND	ND	ND	ND
NITRATE-NITRITE NITROGEN								
TOP	ND	ND	ND	ND	ND	ND	ND	ND
MID	ND	ND	ND	ND	ND	ND	ND	ND
BOT	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL KJELDAHL NITROGEN								
TOP	.58	.42	.37	.37	.31	.44	.37	.71
MID	.31	.46	.3	.35	.24	.3	.67	.49
BOT	.33	.32	.32	.34	.74	.33	.93	.41
TOTAL-PHOSPHORUS								
TOP	ND	ND	ND	ND	ND	ND	ND	ND
MID	ND	ND	ND	ND	ND	ND	ND	ND
BOT	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL ORGANIC CARBON								
TOP	1.2	1.2	1.3	1.2	ND	ND	1.2	1.7
MID	ND	ND	ND	1	ND	ND	ND	ND
BOT	ND	ND	1	ND	ND	ND	ND	ND

Concentration in mg/l
ND = Not Detectable at Minimum Detection Limits
Top = 1 foot below surface; Mid = 50% water depth; Bot = 1 foot above bottom

SEDIMENT NUTRIENTS

SITE C, NOVEMBER 1986

CONVENTIONAL PARAMETERS	STA. C1	STA. C2	STA. C3	STA. C4	STA. C5	STA. C6	STA. C7	STA. C8	STA. C9	STA. C10
AMMONIA	2.5	3	ND	ND	ND	ND	4.7	3	7.1	7.2
TKN	55	51	66	77	56	58	42	56	47	69
TOTAL-PHOSPHORUS	24	30	24	34	24	16	23	23	27	35
OIL AND GREASE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

CONVENTIONAL PARAMETERS	STA. C11	STA. C12	STA. C13	STA. C14	STA. C15	STA. C16	STA. C17	STA. C18	STA. C19	STA. C20
AMMONIA	ND	4.9	ND	4.7	3.6	2.9	3	3.2	3.4	3.5
TKN	53	62	45	74	71	61	60	87	74	67
TOTAL-PHOSPHORUS	30	23	20	27	34	49	14	25	20	27
OIL AND GREASE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Concentration in mg/kg

ND = Not Detected at Minimum Detection Limits

SEDIMENT NUTRIENTS

SITE C, APRIL 1987

CONVENTIONAL PARAMETERS	STA. C1	STA. C2	STA. C3	STA. C4	STA. C5	STA. C6	STA. C7	STA. C8	STA. C9	STA. C10
AMMONIA	7.7		20		13	9.6	6		6.4	9
TKN	67		78		95	110	42		46	72
TOTAL-PHOSPHORUS	ND		9		8	14	10		5	9
OIL AND GREASE	ND		ND		ND	ND	ND		ND	ND

CONVENTIONAL PARAMETERS	STA. C11	STA. C12	STA. C13	STA. C14	STA. C15	STA. C16	STA. C17	STA. C18	STA. C19	STA. C20
AMMONIA	10	7.7	13	8	8	9.3	9.1	10	11	8.8
TKN	54	26	76	61	45	120	61	72	54	72
TOTAL-PHOSPHORUS	3	17	17	6	14	28	ND	8	4	12
OIL AND GREASE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Concentration in mg/kg

ND = Not Detected at Minimum Detection Limits

SEDIMENT HEAVY METAL CONCENTRATIONS
SITE C, NOVEMBER 1986

ELEMENT	STA. C1	STA. C2	STA. C3	STA. C4	STA. C5	STA. C6	STA. C7	STA. C8	STA. C9	STA. C10
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ba	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Be	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	1.2	1.2	1.5	1.5	ND	ND	ND	1.0	1.3	1.6
Cu	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sr	30	44	110	170	25	67	390	39	83	53
Te	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ti	5.9	10	2.3	3.5	2.7	3.0	3.4	4.4	7.4	14
V	ND	ND	1.1	1.4	ND	ND	ND	ND	ND	1.0
Y	ND	ND	ND	1.0	ND	ND	ND	ND	ND	ND
Zn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Al	110	140	130	160	73	78	130	82	99	170
Mn	ND	2.7	4.4	7.7	ND	ND	5.5	ND	3.1	3.9
Ca	4200	6200	17000	24000	3800	6600	63000	5600	12000	7500
Mg	540	630	890	1200	420	540	1000	520	860	770
Fe	180	230	350	530	130	99	160	130	240	280
Na	2600	2900	2100	3200	2200	2600	4100	2400	2900	2900

Concentrations in mg/kg
ND = Not Detected at Minimum Detection Limits

SEDIMENT HEAVY METAL CONCENTRATIONS
SITE C, NOVEMBER 1986

ELEMENT	STA. C11	STA. C12	STA. C13	STA. C14	STA. C15	STA. C16	STA. C17	STA. C18	STA. C19	STA. C20
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ba	ND	ND	ND	ND	ND	3.4	ND	ND	ND	ND
Be	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	1.0	ND	1.0	1.0	1.0	1.1	1.1	1.3	1.2	1.0
Cu	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sr	130	99	39	92	120	330	100	39	24	69
Te	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ti	3.4	1.9	9.2	3.2	2.6	5.4	5.7	11	4.4	3.0
V	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND
Y	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND
Zn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Al	110	76	90	120	110	210	110	100	99	120
Mn	4.1	ND	ND	3.9	4.3	9.2	3.9	ND	ND	2.6
Ca	18000	14000	5200	13000	18000	54000	17000	6600	3500	8500
Mg	1100	660	510	720	980	1700	1100	580	490	650
Fe	210	150	150	310	270	370	190	160	150	170
Na	2600	2500	2100	2200	4800	4800	2400	3100	2100	3000

Concentrations in mg/kg
ND = Not Detected at Minimum Detection Limits

SEDIMENT HEAVY METAL CONCENTRATIONS

SITE C, APRIL 1987

ELEMENT	STA. C1	STA. C2	STA. C3	STA. C4	STA. C5	STA. C6	STA. C7	STA. C8	STA. C9	STA. C10
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ba	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Be	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	1	1.5	1.7	1.2	1	ND	ND	1.0	1.4	1.2
Cu	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sr	55	66	99	100	44	37	65	39	74	53
Te	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ti	1.2	2.6	1.3	2.2	3.3	2.4	4.2	4.4	1.8	1.7
V	ND	ND	1.2	ND	ND	ND	ND	ND	ND	1.0
Y	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Al	76	94	130	100	92	120	99	82	810	85
Mn	2.6	3.3	5	3.6	3	2.5	2.5	ND	2.9	3.9
Ca	9000	11000	16000	14000	6700	6700	7700	5600	11000	4600
Mg	680	840	1200	830	510	510	570	520	1100	560
Fe	180	250	390	270	160	160	150	130	240	200
Na	2700	3800	3700	2500	2200	2500	3000	2400	2900	2400

Concentrations in mg/kg

ND = Not Detected at Minimum Detection Limits

SEDIMENT HEAVY METAL CONCENTRATIONS
SITE C, APRIL 1987

ELEMENT	STA. C11	STA. C12	STA. C13	STA. C14	STA. C15	STA. C16	STA. C17	STA. C18	STA. C19	STA. C20
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ba	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Be	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	ND	1	1.2	1.5	1.3	1.9	1.2	1.2	1.2	ND
Cu	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sr	52	44	81	42	76	94	31	24	170	95
Te	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ti	1.1	2.2	2.5	1.5	1.2	7.9	1.3	2	ND	1.3
V	ND	ND	ND	1.1	ND	1.6	ND	ND	ND	ND
Y	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	ND	ND	1.1	ND	ND	1.1	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Al	76	83	120	120	87	350	63	83	790	65
Mn	19	ND	3.9	39	3.6	8.1	ND	2.7	3.7	2.8
Ca	6900	6300	13000	6500	10000	13000	4500	3400	19000	15000
Mg	520	520	1000	620	790	1000	460	510	840	840
Fe	190	200	200	340	250	480	130	150	180	140
Na	2000	2000	2600	2200	2200	3700	2100	3000	3600	2800

Concentrations in mg/kg
ND = Not Detected at Minimum Detection Limits

The following is a listing of pesticide, PCB, and extractable organic compounds that were analyzed for in sediments from each of seven stations in alternative Site B and alternative Site C during November 1986 and April 1987. None of the compounds on the list were detected at any station in concentrations in excess of the minimum detection limit. See Appendix A for a discussion of the sampling program.

PESTICIDE/PCB/EXTRACTABLE
ORGANIC COMPOUNDS

ALDRIN
HEPTACHLOR
HEPTACHLOR EXPOXIDE
ALPHA-BHC
BETA-BHC
GAMMA-BHC (LINDANE)
DELTA-BHC
ENDOSULFAN I (ALPHA)
DIELDRIN
4,4'-DDT (P,P'-DDT)
4,4'-DDE (P,P'-DDE)
4,4'-DDD (P,P'-DDD)
ENDRIN
ENDOSULFAN II (BETA)
ENDO SULFAN SULFATE
CHLORDANE (TECH. MIXTURE) /1
PCB-1242 (AROCLOR 1242)
PCB-1254 (AROCLOR 1254)
PCB-1221 (AROCLOR 1221)
PCB-1232 (AROCLOR 1232)
PCB-1248 (AROCLOR 1248)
PCB-1260 (AROCLOR 1260)
PCB-1016 (AROCLOR 1016)
TOXAPHENE
METHOXYCHLOR
ENDRIN KETONE
BENZOIC ACID
2-METHYLPHENOL
4-METHYLPHENOL
2,4,5-TRICHLOROPHENOL
4-NITROPHENOL

HEXACHLOROETHANE
BIS (2-CHLOROISOPROPYL) ETHER
N-NITROSODI-N-PROPYLAMINE
NITROSENZENE
HEXACHLOROBUTADIENE
1,2,4-TRICHLOROBENZENE
NAPHTHALENE
BIS (2-CHLOROETHOXY) METHANE
ISOPHORONE
HEXACHLOROCYCLOPENTADIENE (HCCP)
2-CHLORONAPHTHALENE
ACENAPHTHYLENE
ACENAPHTHENE
DIMETHYL PHTHALATE
2,4-DINITROTOLUENE
2,6-DINITROTOLUENE
4-BROMOPHENYL PHENYD ETHER
FLUORENE
DIETHYL PHTHALATE
N-NITROSODIPHENYLAMINE/DIPHENYLAMINE
HEXACHLOROBENZENE (HCB)
4-BROMOPHENYL PHENYL ETHER
PHENANTHRENE
ANTHRACENE
DI-N-BUTYLPHTHALATE
FLUORANTHENE
PYRENE
BENZYL BUTYL PHTHALATE
BIS (2-ETHYLHEXYL) PHTHALATE
2-METHYL-4,6-DINITROPHENOL
PENTACHLOROPHENOL

BENZYL ALCOHOL
4-CHLOROANILINE
DIBENZOFURAN
2-METHYLNAPHITHALENE
2-NITROANILINE
3-NITROANILINE
4-NITROANILINE
HEXADECANOIC ACID
1,3-DICHLOROBENZENE
1,4-DICHLOROBENZENE
1,2-DICHLOROBENZENE
BIS (2-CHLOROETHYL) ETHER
2,4-DIMETHYLPHENOL
2,4-DICHLOROPHENOL
2,4,6-TRICHLOROPHENOL
4-CHLORO-3-METHYLPHENOL
BENZO (A) ANTHRACENE
CHRYSENE
3,3'-DICHLOROBENZIDINE
DI-N-OCTYLPHTHALATE
BENZO (B AND/OR K) FLUORANTHENE
BENZO (B AND/OR K) FLUORANTHENE
BENZO-A-PYRENE
INDENO (1,2,3-CD) PYRENE
DIBENZO (A,H) ANTHRACENE
BENZO (GHI) PERYLENE
2-CHLOROPHENOL
2-NITROPHENOL
PHENOL
2,4-DINITROPHENOL

PARTICLE SIZE* OF SEDIMENTS AT SELECTED STUDY STATIONS
PROPOSED OFFSHORE DISPOSAL SITE C
PENSACOLA, FLORIDA, OCT. - NOV., 1986

Inorganic fraction subtended by organic fraction
(all as % dry weight)

Station	Medium Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	TOTALS
C1	0.00	1.86	36.73	60.47	0.07	0.13	0.45	99.71
	0.00	0.00	0.01	0.00	0.01	0.00	0.27	0.29
C2	0.00	1.78	37.52	58.64	0.25	0.18	1.54	99.92
	0.00	0.01	0.01	0.01	0.03	0.00	0.01	0.08
C3	0.00	1.78	47.39	49.62	0.08	0.02	0.47	99.37
	0.00	0.05	0.13	0.00	0.02	0.01	0.42	0.63
C4	1.39	2.61	30.18	63.19	0.44	0.39	0.97	99.17
	0.03	0.04	0.17	0.08	0.01	0.11	0.37	0.83
C5	0.00	1.38	21.65	75.32	0.30	0.26	0.94	99.84
	0.00	0.00	0.04	0.07	0.00	0.05	0.00	0.16
C6	0.00	0.16	56.15	42.21	0.07	0.14	1.02	99.74
	0.00	0.00	0.00	0.00	0.02	0.00	0.24	0.26
C7	0.00	0.57	5.10	92.57	0.30	0.13	0.86	99.53
	0.00	0.01	0.05	0.10	0.01	0.02	0.27	0.47
C9	0.00	1.02	53.14	44.76	0.05	0.05	0.53	99.55
	0.00	0.02	0.12	0.06	0.02	0.02	0.23	0.45
C10	0.00	2.53	48.36	47.66	0.10	0.00	0.25	98.91
	0.00	0.07	0.14	0.09	0.05	0.05	0.68	1.09
C11	0.00	3.24	6.61	88.84	0.03	0.06	0.90	99.90
	0.00	0.01	0.02	0.07	0.00	0.00	0.00	0.10
C12	0.00	1.28	36.13	62.18	0.09	0.08	0.13	99.90
	0.00	0.02	0.00	0.00	0.00	0.00	0.08	0.10

* Particle size headings are not indicative of the composition of the material retained in sieving. For example, material reported under the heading "Medium Gravel" may be wood, shells, minerals or other matter.

PARTICLE SIZE* OF SEDIMENTS AT SELECTED STUDY STATIONS
PROPOSED OFFSHORE DISPOSAL SITE C
PENSACOLA, FLORIDA, OCT. - NOV., 1986
(Continued)

Inorganic fraction subtended by organic fraction
(all as % dry weight)

Station	Medium Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	TOTALS
C13	0.00	0.33	12.25	85.96	0.16	0.13	0.76	99.59
	0.00	0.00	0.02	0.07	0.01	0.08	0.24	0.41
C14	0.00	2.32	42.76	53.17	0.23	0.08	0.65	99.21
	0.00	0.08	0.11	0.08	0.04	0.06	0.42	0.79
C15	0.00	1.22	33.95	63.60	0.26	0.11	0.60	99.73
	0.00	0.01	0.08	0.07	0.01	0.02	0.08	0.27
C16	0.00	2.08	16.07	78.54	1.19	0.51	0.58	98.98
	0.00	0.07	0.09	0.14	0.03	0.11	0.58	1.02
C17	0.00	3.67	44.09	51.04	0.10	0.03	0.64	99.56
	0.00	0.04	0.12	0.09	0.00	0.04	0.15	0.44
C18	0.00	0.11	35.01	63.63	0.15	0.09	0.69	99.68
	0.00	0.00	0.03	0.07	0.00	0.03	0.19	0.32
C19	0.00	0.51	20.03	77.35	0.32	0.12	0.83	99.16
	0.00	0.05	0.10	0.14	0.04	0.09	0.43	0.84
C20	0.00	0.19	17.33	80.79	0.19	0.15	0.52	99.17
	0.00	0.01	0.02	0.10	0.00	0.04	0.66	0.83

* Particle size headings are not indicative of the composition of the material retained in sieving. For example, material reported under the heading "Medium Gravel" may be wood, shells, minerals or other matter.

PARTICLE SIZE* OF SEDIMENTS AT SELECTED STUDY STATIONS
PROPOSED OFFSHORE DISPOSAL SITE C
PENSACOLA, FLORIDA, APRIL 1987

Inorganic fraction subtended by organic fraction
(all as % total dry weight)

Station	Medium Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	TOTALS
C1	0.00	0.73	27.64	69.97	0.12	0.10	0.60	99.15
	0.00	0.02	0.07	0.08	0.00	0.01	0.66	0.85
C2	0.00	5.68	43.12	49.71	0.04	0.07	0.82	99.45
	0.00	0.09	0.08	0.07	0.01	0.03	0.27	0.55
C3	0.00	4.26	42.11	51.66	0.18	0.23	0.79	99.22
	0.00	0.13	0.10	0.08	0.03	0.06	0.38	0.78
C4	0.00	0.35	32.89	65.24	0.10	0.11	1.03	99.72
	0.00	0.02	0.08	0.07	0.00	0.01	0.09	0.28
C5	0.00	1.12	22.95	74.26	0.10	0.16	0.83	99.43
	0.00	0.05	0.06	0.12	0.02	0.02	0.28	0.57
C6	0.00	0.63	19.93	78.08	0.16	0.18	0.85	99.83
	0.00	0.01	0.06	0.09	0.00	0.01	0.00	0.17
C7	0.00	0.74	13.33	83.97	0.28	0.10	1.23	99.66
	0.00	0.02	0.01	0.06	0.00	0.04	0.20	0.34
C9	0.00	0.82	49.30	48.99	0.03	0.05	0.24	99.42
	0.00	0.04	0.10	0.00	0.00	0.05	0.38	0.58
C10	0.00	1.81	40.42	56.01	0.07	0.16	0.87	99.34
	0.00	0.04	0.11	0.07	0.00	0.07	0.37	0.66
C11	0.00	2.14	34.32	61.54	0.15	0.09	1.23	99.48
	0.00	0.05	0.07	0.08	0.01	0.02	0.30	0.52
C12	0.00	6.49	32.89	58.67	0.30	0.22	0.66	99.32
	0.00	0.09	0.12	0.11	0.02	0.05	0.38	0.77

* Particle size headings are not indicative of the composition of the material retained in sieving. For example, material reported under the heading "Medium Gravel" may be wood, shells, minerals, or other matter.

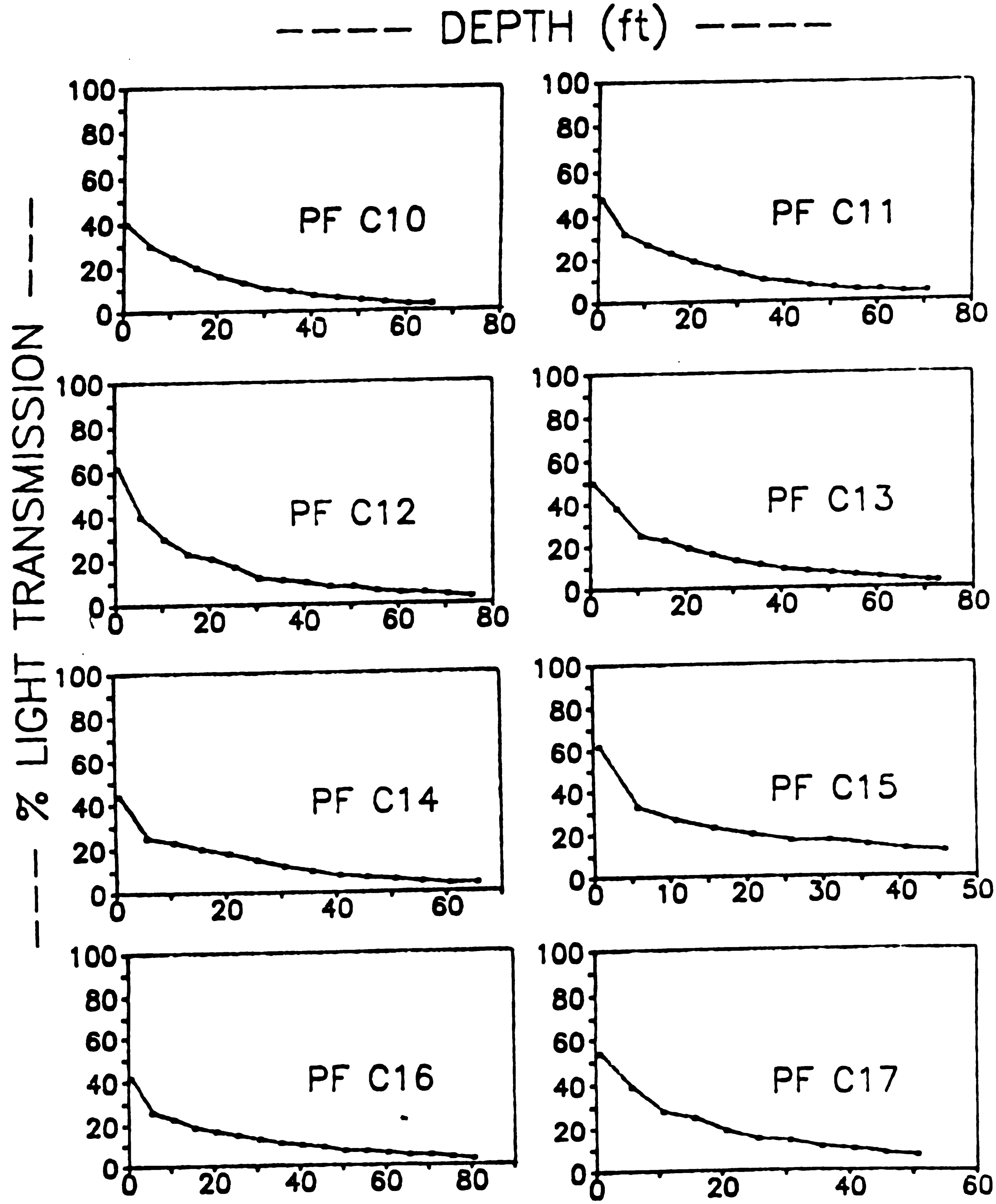
PARTICLE SIZE* OF SEDIMENTS AT SELECTED STUDY STATIONS
PROPOSED OFFSHORE DISPOSAL SITE C
PENSACOLA, FLORIDA, APRIL 1987
(Continued)
Inorganic fraction subtended by organic fraction
(all as % total dry weight)

Station	Medium Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	TOTALS
C13	0.00	1.23	13.09	83.25	0.32	0.07	0.95	98.91
	0.00	0.08	0.08	0.13	0.01	0.0[illegible]	0.73	1.09
C14	0.00	1.24	44.89	52.76	0.08	0.05	0.73	99.74
	0.00	0.01	0.01	0.01	0.00	0.02	0.21	0.26
C15	0.00	2.07	33.42	62.69	0,12	0.06	0.96	99.31
	0.00	0.02	0.08	0.07	0.01	0.01	0.50	0.69
C16	0.00	0.15	9.11	88.71	0.13	0.15	0.84	99.09
	0.00	0.02	0.02	0.12	0.00	0.05	0.69	0.91
C17	0.00	2.30	43.31	53.13	0.04	0.03	0.73	99.53
	0.00	0.02	0.08	0.09	0.03	0.02	0.23	0.47
C18	0.00	0.22	3.81	94.18	0.22	0.02	0.85	99.29
	0.00	0.00	0.00	0.14	0.05	0.04	0.49	0.71
C19	0.00	0.71	29.73	68.16	0.09	0.17	0.86	99.72
	0.00	0.01	0.01	0.03	0.01	0.01	0.20	0.28
C20	0.00	1.26	25.00	72.36	0.07	0.17	0.84	99.69
	0.00	0.02	0.04	0.09	0.01	0.02	0.12	0.31

* Particle size headings are not indicative of the composition of the material retained in sieving. For example, material reported under the heading "Medium Gravel" may be wood, shells, minerals or other matter.

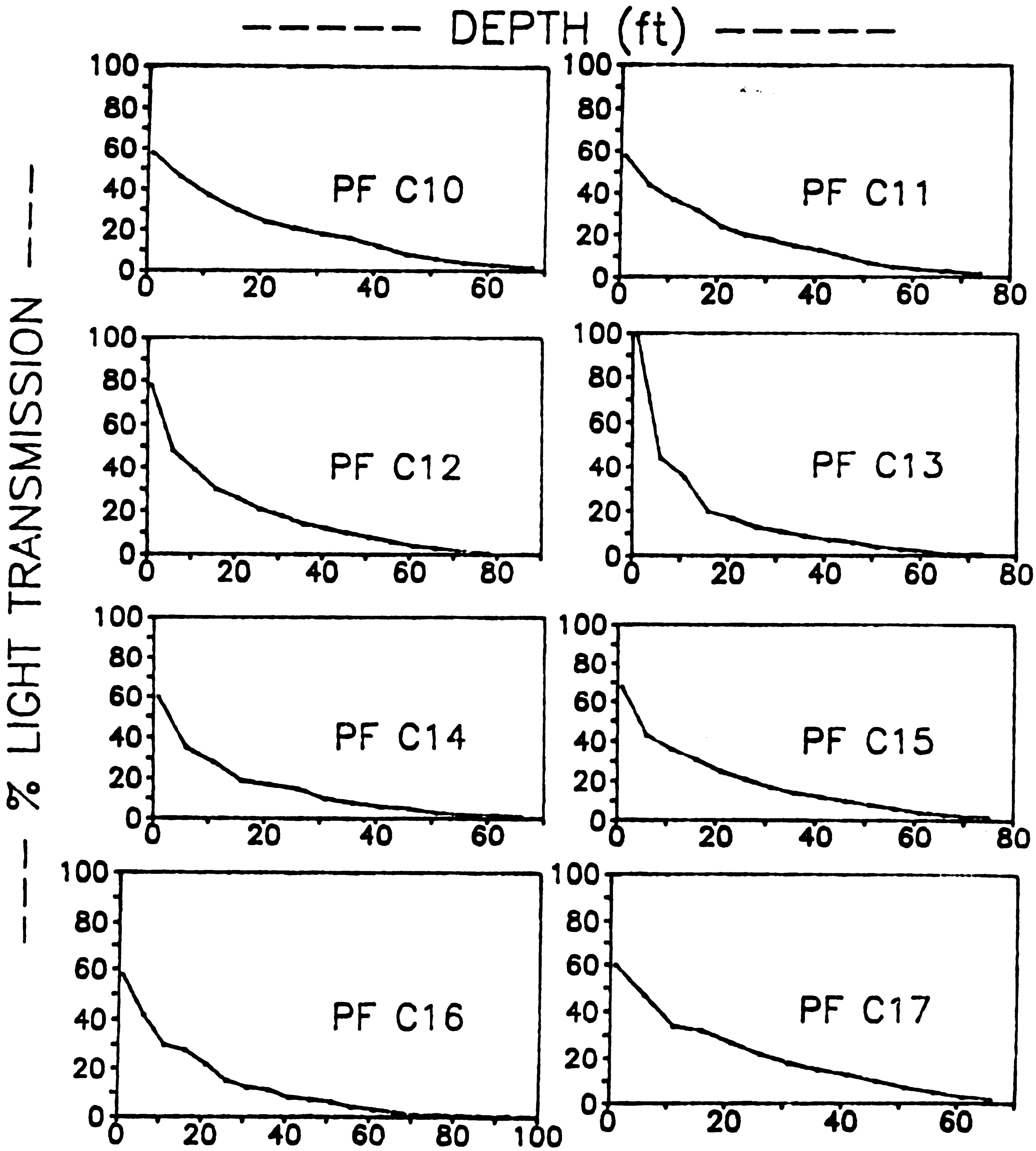
Percent Light Transmission Through Water

Column, Pensacola, Florida, November 1986



Percent Light Transmission Through Water

Column, Pensacola, Florida, April 1987



Pensacola, Site C Dissolved Oxygen, Salinity and Temperature Records from Water Column Surface, Middle and Bottom Depths, November 1986, April 1987, July 1987

Station	Sampling Period	Depth(ft)	Dissolved Oxygen(mg/L)	Salinity (o/oo)	Temperature(°C
PF-C10	November 1986	1	6.45	36.4	24.1
		34	6.45	36.4	23.8
		68	6.45	36.7	24.2
PF-C10	April 1987	1	7.7	35.1	22.7
		34	7.6	36.2	20.6
		68	5.8	37.7	20.1
PF-C10	July 1987	1	6.3	31.8	29.7
		30	6.0	34.8	29.7
		65	5.2	35.7	28.2
PF-C11	November 1986	1	6.4	36.2	23.6
		36	6.45	36.4	23.6
		72	6.4	36.8	24.2
PF-C11	April 1987	1	7.8	34.7	21.9
		37	7.4	36.8	19.9
		74	5.9	37.5	20.1
PF-C11	July 1987	1	6.3	31.4	29.7
		35	6.0	35.3	29.6
		70	5.3	35.9	28.1
PF-C12	November 1986	1	6.4	36.8	24.1
		38	6.3	36.7	24.2
		75	6.3	36.6	24.1
PF-C12	April 1987	1	7.7	34.5	21.9
		39	7.6	36.0	19.9
		78	5.7	37.0	20.0
PF-C12	July 1987	1	6.3	31.9	30.0
		35	6.0	35.3	29.5
		70	5.2	36.1	27.8

Dissolved Oxygen, Salinity and Temperature Records from Water Column Surface, Middle and Bottom Depths, Pensacola, Florida, November 1986, April 1987, July 1987

Station	Sampling Period	Depth(ft)	Dissolved Oxygen(mg/L)	Salinity (o/oo)	Temperature(°C
PF-C13	November 1986	1	6.4	36.4	24.0
		36	6.4	36.4	24.0
		72	6.4	36.6	24.1
PF-C13	April 1987	1	7.8	35.1	21.0
		36	7.6	37.0	19.7
		73	5.7	37.4	19.6
PF-C13	July 1987	1	6.4	32.0	30.1
		35	6.0	35.0	29.7
		70	5.4	36.0	28.0
PF-C14	November 1986	1	6.4	35.8	23.5
		34	6.4	36.0	23.5
		68	6.3	36.6	24.0
PF-C14	April 1987	1	7.15	35.6	21.9
		38	7.0	37.2	19.7
		76	6.7	37.3	19.6
PF-C14	July 1987	1	6.0	34.4	30.4
		30	5.9	35.0	29.7
		60	5.3	35.9	28.7
PF-C15	November 1986	1	6.0	-	24.2
		39	6.0	-	24.2
		77	6.0	-	24.2
PF-C15	April 1987	1	7.7	34.7	21.6
		37	7.6	36.4	20.1
		75	5.8	37.7	19.8
PF-C15	July 1987	1	6.1	34.9	29.8
		35	6.0	35.7	29.3
		70	5.2	36.1	27.8

Dissolved Oxygen, Salinity and Temperature Records from Water Column Surface, Middle and Bottom Depths, Pensacola, Florida, November 1986, April 1987, July 1987

Station	Sampling Period	Depth(ft)	Dissolved Oxygen(mg/L)	Salinity (o/oo)	Temperature(°C
PF-C16	November 1986	1	5.8	37.0	24.5
		45	5.8	37.0	24.9
		95	5.8	37.0	24.8
PF-C16	April 1987	1	7.5	34.4	22.5
		46	6.1	37.5	19.9
		93	5.9	37.6	20.3
PF-C16	July 1987	1	6.3	32.2	30.4
		40	5.8	35.3	29.4
		80	5.6	36.3	27.3
PF-C17	November 1986	1	6.4	36.5	23.8
		33	6.4	36.4	23.8
		66	6.35	36.8	24.6
PF-C17	April 1987	1	7.7	34.7	22.9
		33	7.8	35.4	20.6
		66	6.0	37.1	19.7
PF-C17	July 1987	1	6.2	32.0	29.5
		30	5.9	35.0	29.4
		60	5.0	35.9	28.3

APPENDIX D

Characteristics of Dredged Material

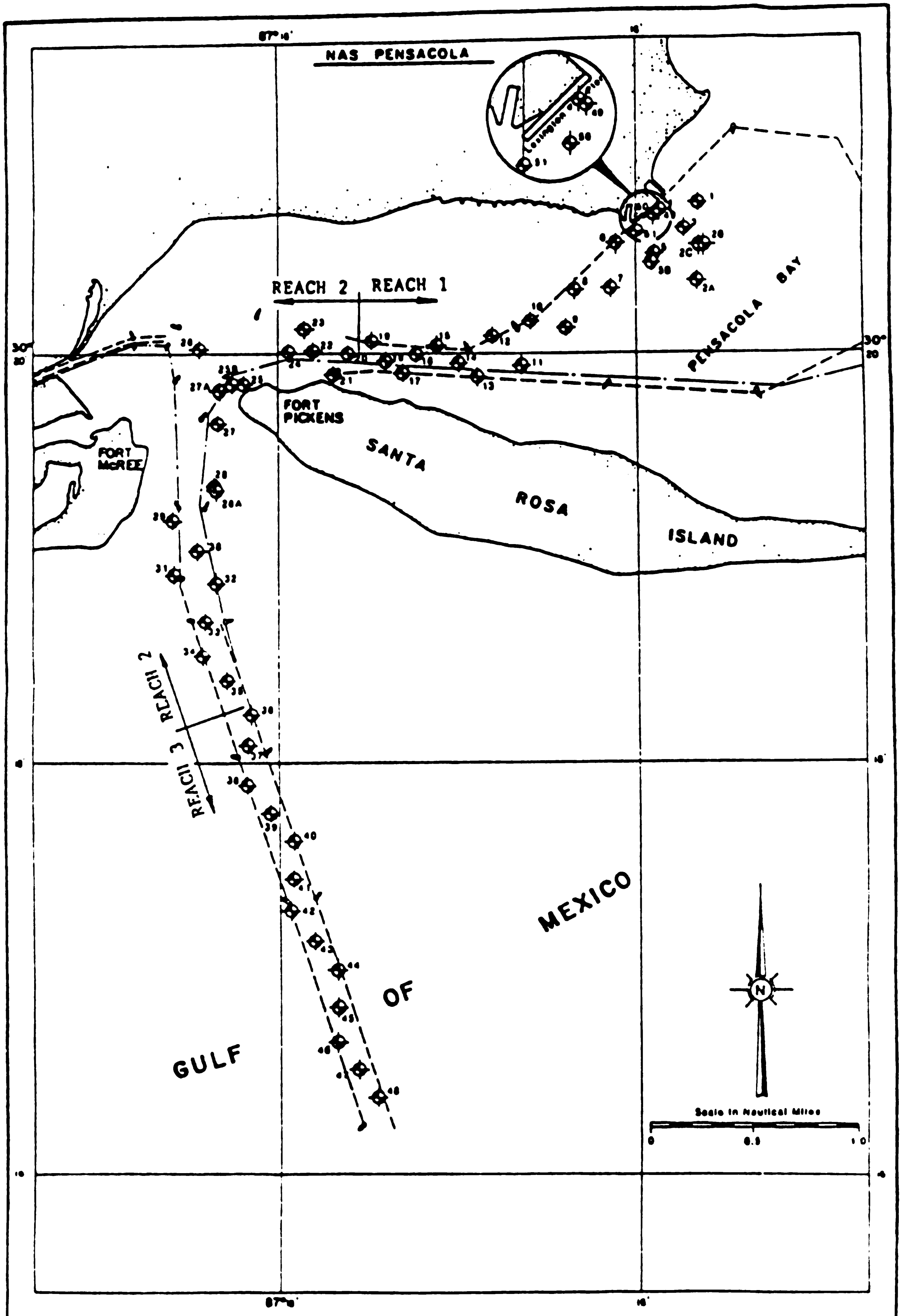
1. Physical/Chemical Data
2. Effects of Sediment From Two Locations Near the Pensacola, Florida, Naval Air Station on Representative Marine Organisms
3. Chemical Analysis of Sediment From Two Sites Near the Pensacola, Florida, Naval Air Station and Tissues of Marine Organisms Exposed to the Sediment

APPENDIX D

Characteristics of Dredged Material

Physical/Chemical Data

Source: Navy 1987



VIBRACORE/PONAR STATION

PENSACOLA-NAVY HOMEPORT
STATION LOCATION PLAN

SUMMARY
OF
GEOTECHNICAL DATA
REACH 1

Station No.	Sample No.	Wentworth Scale[1/] Gravel (Shell)	Sand	Silt	Clay	Statistical Parameters (Folk's) Median	Sorting Coefficient	Skewness	Kurtosis
1	S-1	0.0 [2/]	32.5	36.0	31.5	5.300	3.640	0.42	0.80
	S-2	0.0	3.5	36.5	60.0	8.800	2.850	0.17	0.76
2B	S-1	1.0	86.5	3.0	9.5	2.350	1.850	0.48	5.65
	S-2	2.0	81.5	9.5	7.0	1.950	1.980	0.34	3.10
	S-3	0.0	13.5	59.5	27.0	5.850	3.170	0.50	1.06
3	S-1	0.5	59.0	20.0	20.0	3.000	3.750	0.69	0.97
	S-3	0.0	30.5	47.0	22.5	4.850	3.050	0.52	1.10
4	S-1	11.5	83.5	(5.0)		1.200	1.690	-0.12	1.76
	S-2	1.0	37.5	38.0	23.5	4.650	3.470	0.53	1.31
5	S-2	0.5	28.5	37.5	33.5	5.950	3.580	0.26	0.82
	S-3	0.0	8.0	45.5	46.5	7.850	3.420	0.14	0.65
6	S-1	0.5	97.0	0.5	1.5	2.150	0.760	-0.04	1.15
	S-2	0.0	97.5	(2.5)		1.650	0.460	-0.08	1.38
	S-3	0.5	50.0	32.5	17.0	3.950	3.770	0.32	0.94
7	S-1	0.5	91.5	5.0	3.0	2.600	1.030	0.31	1.74
	S-2	0.5	98.0	(1.5)		1.750	0.790	-0.11	1.02
8	S-1	0.0	97.0	(3.0)		2.550	0.610	0.25	1.29
	S-2	0.0	97.0	(3.0)		1.250	0.690	0.10	0.92
9	S-1	0.0	97.5	(2.5)		2.500	0.500	0.23	1.17
	S-2	1.0	96.5	(2.5)		1.700	0.720	-0.05	1.28
10	S-2	0.0	97.5	(2.5)		2.250	0.640	-0.29	1.10
	S-4	0.5	22.5	55.0	22.0	4.750	3.100	0.46	1.42
11	S-1	4.5	93.0	(2.5)		1.700	1.060	-0.21	1.51
	S-2	2.5	57.0	19.5	21.0	2.350	4.460	0.56	0.92
12	S-1	0.0	97.0	(3.0)		1.950	0.670	0.42	1.37
	S-2	0.0	42.5	30.5	27.0	4.550	3.930	0.41	0.79
	S-3	0.0	78.0	14.5	7.5	2.250	2.460	0.48	1.56
13	S-1	0.0	97.5	(2.5)		2.300	0.610	-0.07	1.17
	S-3	0.5	34.0	44.0	21.5	4.550	3.390	0.32	1.21
14	S-1	0.5	98.0	(1.5)		1.500	0.772	-0.07	0.91
	S-2	10.0	40.5	23.5	26.0	3.950	4.910	0.22	0.80
15	S-1	2.0	96.0	(2.0)		1.350	1.280	-0.17	1.84
	S-2	0.0	22.5	38.0	39.5	6.350	4.090	0.19	0.74

1/ Wentworth Scale Size Classifications:
Gravel(Shell)/Sand Separation - 2.00 mm
Sand/Silt Separation - 0.0625 mm
Silt/Clay Separation - 0.0039 mm

2/ Percent

SUMMARY OF GEOTECHNICAL DATA REACH 2

Station No.	Sample No.	Wentworth Scale[1/] Gravel (Shell)	Sand	Silt	Clay	Statistical Parameters (Folk's) Median	Sorting Coefficient	Skewness	Kurtosis
16	S-1	0.0 [2/]	98.5	(1.5)		1.80Ø	0.64Ø	0.05	1.06
	S-2	14.0	55.5	25.5	5.0	1.90Ø	2.76Ø	0.08	0.92
17	S-1	0.5	94.0	3.0	2.5	2.20Ø	1.08Ø	0.002	1.38
	S-2	10.5	59.0	19.5	11.0	2.35Ø	3.29Ø	0.17	1.50
18	S-2	0.0	95.0	0.5	4.5	1.70Ø	1.04Ø	0.19	1.92
	S-3	1.0	33.5	43.5	22.0	4.45Ø	3.80Ø	0.33	1.30
19	S-1	0.0	98.0	(2.0)		1.85Ø	0.79Ø	0.02	1.09
	S-3	1.0	25.5	41.5	33.0	5.90Ø	4.04Ø	0.20	0.89

1/ Wentworth Scale Size Classifications:
Gravel(Shell)/Sand Separation - 2.00 mm
Sand/Silt Separation - 0.0625 mm
Silt/Clay Separation - 0.0039 mm

2/ Percent

SUMMARY
OF
GEOTECHNICAL DATA
(COMPOSITE SAMPLES)
REACH 1

Station No.	Gravel (Shell)	Sand	Silt	Clay
	WENTWORTH SCALE			
1	0.0	12.5	36.3	51.2
2R	0.4	38.8	40.1	20.7
3	0.1	33.4	44.3	22.2
4	3.4	48.1	(48.5)	
5	0.1	10.7	44.4	44.8
6	0.1	89.4	(10.5)	
7	0.5	97.3	(2.2)	
8	0.0	97.0	(3.0)	
9	0.7	96.8	(2.5)	
10	0.3	52.5	(47.2)	
11	2.9	65.3	(31.8)	
12	0.0	86.3	(13.7)	
13	0.1	91.1	(8.8)	
14	4.5	73.8	(21.7)	
15	1.0	59.2	(39.8)	
16	4.5	84.7	(10.8)	
17	3.0	85.3	7.1	4.6
18	0.2	83.9	8.2	7.7
19	0.0	97.3	(2.7)	
Reach 1	1.1	68.6	(30.3)	

Site Water/Elutriate Results NAS Turning Basin and Pensacola Bay Entrance Channel, 1984

Parameter	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	"Control" Sea Water	Water Quality Standard
Mercury - Site Water	<.1	<.1	<.1	<.1	<.1	<.1		
Mercury - Elutriate (Avg.)	<.1	<.1	<.1	<.1	<.1	<.1	<0.1	0.1
Copper - Site Water	0.6	0.5	0.3	<.1	0.2	0.1		
Copper - Elutriate (Avg.)	0.6	0.5	0.4	0.8	0.1	2.2	0.9	15
Zinc - Site Water	0.2	4.0	0.2	<.2	<.2	0.2		
Zinc - Elutriate (Avg.)	1.0	1.0	<.2 (.07)	1.9	<.2 (.07)	<.2 (.07)	0.4	1,000
Cadmium - Site Water	0.05	0.01	0.03	0.02	<.01	0.01		
Cadmium - Elutriate (Avg.)	0.25	0.09	0.09	0.11	<.01	<.01	0.04	5.0
Lead - Site Water	<.2	<.2	<.2	<.2	<.2	<.2		
Lead - Elutriate (Avg.)	<.2	<.2	<.2	<.2	<.2	<.2 (.07)	0.2	50
Nickel - Site Water	0.2	0.2	0.8	0.2	0.3	0.3		
Nickel - Elutriate (Avg.)	2.7	5.7	2.0	1.9	0.5	0.7	0.6	100
Chromium - Site Water	0.3	0.5	0.4	0.3	0.8	<.2		
Chromium - Elutriate (Avg.)	0.9	0.2	0.5	1.4	0.6	0.3	0.3	50

Notes:

1. All values reported in ug/l (parts per billion - ppb).
2. Elutriate results shown are mean values of triplicate elutriates. "Less than (<)" values are averaged as zero. A value in parentheses next to a "less than" value indicates that one or more replicates were detectable, and is the mean value derived.
3. "Control" sea water collected 1/4 mile east of Entrance Channel Marker "2" (about 2 miles offshore).
4. Water quality standards refer to predominantly marine, Class III.

Averaged Results of Sediment Analyses for Pensacola, Florida Samples Collected March 1986

Constituent*	Site 1	3	6	8	10	49	50	51	Average Crustal Material**
Al	34,400	10,835	1,385	565	284	14,850	3,595	13,795	83,200
Cd	0.245	0.055	<0.05	<0.05	<0.05	0.09	0.08	0.0625	0.2
Cr	91.7	28	3.145	3.355	2.405	40.9	4.27	33	100
Pb	2.05	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	<1.0	12.5
Hg	0.175	<0.1	0.125	<0.1	<0.1	0.12	<0.1	<0.1	0.08
Zn	56.4	15.75	4.05	2.8	2.05	68.3	14	26.5	70
Ca	13,860	11,900	6,225	6,775	2,000	34,750	27,900	20,900	41,500
Fe	26,350	3,895	602.5	434.5	255	7,125	3,640	6,500	56,300
TOC	98,500	23,500	5,500	4,000	4,000	38,000	9,000	15,500	—
CO_3 as C	75,500	39,500	14,000	6,000	5,500	70,500	107,500	44,500	—
TKN	2,320	623	118.5	83.75	54.55	1,088	284	580.5	—
TP	2,045	726	122	108.5	91.75	470	608	724.5	1,050
Specific Organics	ND	ND	ND	ND	ND	ND	ND	ND	—

Note: ND = None detected.

*All values in mg/kg - dry weight.
†Less than values averaged using one-half the detection limit.
**Handbook of Chemistry and Physics 1984.

Specified Detection Limits for Organic Compounds Tested for in Pensacola Bay, Florida Water Sediment and Elutriate Samples Collected May 1986 (Page 1 of 2)

	Water (ug/l)	Sediment (ug/kg)
PAHs		
Acenaphthene	<10	100
Acenaphtylene	<10	100
Anthracene	<10	100
Benzo(a)anthracene	<10	100
Benzo(a)pyrene	<10	100
Benzo(b)fluoranthene	<10	100
Benzo(ghi)perylene	<10	100
Benzo(k)fluoranthene	<10	100
Chrysene	<10	100
Dibenzo(a,h)anthracene	<10	100
Fluoranthene	<10	100
Fluorene	<10	100
Indeno(1,2,3-cd)pyrene	<10	100
Naphthalene	<10	100
Pheranthrene	<10	100
Pyrene	<10	100
Phenols		
4-Chloro-3-methylphenol	<1.0	300
2-Chlorophenol	<0.5	800
2,4-Dichlorophenol	<0.5	300
2,4-Dimethylphenol	<0.5	300
2,4-Dinitrophenol	<1.0	300
2-Methyl-4,6-dinitrophenol	<1.0	300
2-Nitrophenol	<0.5	300
4-Nitrophenol	<1.0	300
Pentachlorophenol	<1.0	300
Phenol	<0.5	300
2,46-Trichlorophenol	<1.0	300

Specified Detection Limits for Organic Compounds Tested for in Pensacola Bay, Florida Water Sediment and Elutriate Samples Collected May 1986 (Page 2 of 2)

	Water (ug/l)	Sediment (ug/kg)
PCB-1016	0.5	200
PCB-1221	0.5	200
PCB-1232	0.5	200
PCB-1242	0.5	200
PCB-1248	0.5	200
PCB-1254	0.5	200
PCB-1260	0.5	200
Aldrin	0.01	20
Alpha-BHC	0.01	20
Beta-BHC	0.01	20
Delta-BHC	0.01	20
Gamma-BHC	0.01	20
Chlordane	0.25	20
4,4'-DDD	0.25	20
4,4'-DDE	0.25	20
4,4'-DDT	0.25	20
Dieldrin	0.25	20
Endosulfan I	0.05	20
Endosulfan II	0.05	20
Endosulfan Sulfate	0.25	20
Endrin	0.25	20
Endrin Aldehyde	0.25	20
Heptachlor	0.01	20
Heptachlor Epoxide	0.01	20
Toxaphene	0.25	200

Summary Results of Filtered Site Water and Elutriate Samples Collected from Pensacola Bay, Florida in May 1986

Parameter	Station 1		Station 49		Average Seawater†	Applicable Florida Criteria†
	Water	Elutriate*	Water	Elutriate*		
Alkalinity (mg/L $CaCo_3$)	106	144	104	128	--	--
Carbonate (mg/L $CaCo_3$)	ND	ND	ND	ND	--	--
TKN (mg/L)	<0.1	0.87	<0.1	0.5	--	--
TP (mg/L)	<0.03	0.087	<0.03	<0.03	0.07	0.1
TOC (mg/L)	3	41	3	32	--	--
Ca (mg/L)	352	347	355	363	400	--
Al (ug/L)	1,230	1,010	1,790	1,450	10	1,500
Cd (ug/L)	0.09	0.08	0.31	0.38	0.11	5.0
Cr (ug/L)	<0.2	<0.2	<0.2	<0.2	0.05	50
Fe (ug/L)	<10	<10	<10	<10	10	300
Pb (ug/L)	<0.2	0.47	<0.2	0.6	0.03	50
Hg (ug/L)	<0.1	<0.1	<0.1	<0.1	0.03	0.1
Zn (ug/L)	21	37	16	18	10	1,000
Anthracene (ug/l)	<10	<10	<10	11	--	--
Pheranthrene (ug/l)	<10	<10	<10	<10	--	--
2-Methyl-4,6-dinitrophenol (ug/l)	<1.0	3.6	<1.0	<1.0	--	--
4-Nitrophenol (ug/l)	2.7	1.1	<1.0	<1.0	--	--
Phenol (ug/l)	<0.5	1.5	<0.5	<0.5	--	1.0

*Average of three values.
†Handbook of Chemistry and Physics 1984.

Note: Values less than detectable are averaged using one-half the detection limit. All other PAHs, phenols, PCBs, and chlorinated hydrocarbons tested were below the limit of detection. specific compounds and their detection limits.

TKN and TOC Results from Pensacola Bay Sediment Cores Collected March 1986

Site	Depth Below Sediment Surface (feet)	TKN (mg/kg)	TOC (mg/kg)	TKN/TOC Ratio
10	8-12	1,800	17,000	0.11
5B	0-2	655	5,000	0.13
14	0-4	89.4	300	0.30
5B	5-8	1,510	24,000	0.06
15	6-9.5	957	12,000	0.08
2	0-2	690	10,000	0.069
19	0-8	8.36	1,000	0.01
49	3-6	1,700	26,000	0.06
17	4.5-6	961	18,000	0.05
49	0-3	1,630	36,000	0.04
8	0-2.5	79.6	1,000	0.08
1	5-8	2,070	27,000	0.08
8	3-4	54.8	600	0.09
3	6-9	2,350	29,000	0.08
15	0-5	8.48	400	0.02
3	0-3	2,410	32,000	0.08
17	0.5-3.5	162	2,000	0.08
1	0-5	884	25,000	0.04
14	4.5-6	1,600	30,000	0.05
2	2-5	2,200	23,000	0.10
10	0-4	35.2	200	0.18
6	1-3.5	15.9	800	0.02
6	0-1	2,040	28,000	0.07
6	5.5-7	575	17,000	0.03

APPENDIX D

Characteristics of Dredged Material

Effects of Sediment From Two Locations near the Pensacola, Florida, Naval Air Station on Representative Marine Organisms

EXECUTIVE SUMMARY

EFFECTS OF SEDIMENT FROM TWO LOCATIONS NEAR THE PENSACOLA, FLORIDA, NAVAL AIR STATION ON REPRESENTATIVE MARINE ORGANISMS

Prepared by:

Dredged Materials Research Team
P.R. Parrish, Coordinator

U.S. Environmental Protection Agency
Environmental Research Laboratory
Sabine Island
Gulf Breeze, Florida 32561-3999

Submitted to:

Susan Ivester Rees, PD-EC
U.S. Army Corps of Engineers
Mobile District
109 St. Joseph Street
Mobile, Alabama 36628-0001

In partial fulfillment of:
IAG RW96932347-01-1

Draft Report: May 1988
Final Report: August 1988

EXECUTIVE SUMMARY -- PENSACOLA

Sediment to be dredged from near the Pensacola, Florida, Naval Air Station 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 sediment samples and reference sediment 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 lugworms was 90% in the reference sediment and 92% in Site 1 and Site 2 sediment; oyster survival was 100% in the reference sediment and in Site 1 and 2 sediment; shrimp survival was 98% in the reference sediment, 94% in Site 1 sediment, and 96% in Site 2 sediment. The SPP of the sediments had little effect on mysids (*Mysidopsis bahia*). Survival in 100% SPP of all samples was 100%.

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 several metals and petroleum hydrocarbons were detected. However, the concentrations in tissues of lugworms, oysters, and shrimp were always < 3 times greater than concentrations in animals exposed to the reference sediment.

Based on the tests that we conducted, sediments to be dredged from near the Pensacola, Florida, Naval Air Station were not acutely toxic nor were chemicals in them bioavailable for accumulation to concentrations of concern.

EFFECTS OF SEDIMENT FROM TWO LOCATIONS NEAR THE PENSACOLA, FLORIDA, NAVAL AIR STATION ON REPRESENTATIVE MARINE ORGANISMS

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ABSTRACT

A toxicity and bioaccumulation test was conducted with sediment from two locations near the Pensacola, Florida, Naval Air Station. Three types of marine organisms from benthic and epibenthic habitats were exposed to sediment samples from each of the two sites for 10 days in flowing, natural seawater; a reference sediment collected near Gulf Breeze, Florida, was used as a control. The purpose of the test 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 each sediment sample; the purpose was to compare toxicity of the whole sediment to that of the SPP.

The toxicity of each of the three sediment samples 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 lugworms was 90% in the reference sediment and 92% in Site 1 and Site 2 sediment; oyster survival was 100% in the reference sediment and Site 1 and Site 2 sediment; and shrimp survival was 98% in the reference sediment, 94% in Site 1 sediment and 96% in Site 2 sediment.

The SPP of the sediments had no adverse effect on mysids (Mysidopsis bahia). Survival in 100% SPP of the reference sediment and Site 1 and Site 2 sediment was 100%.

The results of the bioaccumulation test are reported in a separate document.

INTRODUCTION

In accord with an agreement with the U.S. Army Corps of Engineers (CE), Mobile District, tests were conducted with sediment from two locations near the Pensacola, Florida, Naval Air Station to determine toxicity to representative marine organisms and the potential for bioaccumulation of chemicals from the sediment samples. Ten-day tests with the solid phase (whole sediment) and 96-hour (h) tests with the suspended particulate phase (SPP) of each sediment sample and a reference sediment were conducted at the U.S. EPA Environmental Research Laboratory, Gulf Breeze (ERLGB), Florida, in February 1988.

The chemical analyses of sediments and animal tissues also were conducted at ERLGB, and the results are reported in a separate document.

MATERIALS AND METHODS

Test Materials

The sediments to be tested were collected by ERLGB personnel on 8 February 1988, at two sites designated by CE, Mobile District (Figure D-1). The reference sediment was collected the same day from near Gulf Breeze, Florida. All samples were transported to ERLGB on the day of collection and placed in a large cooler where temperature was maintained at approximately 4°C. Before testing, all sediment subsamples of each sediment were combined in a large container and mixed well. A characterization of the two sediment samples and the reference sediment is contained in Table 1.

Sodium lauryl sulfate was used as a reference toxicant to gauge the condition of the test animals for the SPP tests. The chemical used was manufactured by Sigma Chemical Company, No. L-5750, Lot 42F-0039, and was approximately 95% pure.

Test Animals

For the solid-phase (whole-sediment) tests, three types of marine organisms from benthic and epibenthic habitats were tested. They were lugworms (*Arenicola cristata*), oysters (*Crassostrea virginica*), and pink shrimp (*Penaeus duorarum*). The polychaetes were purchased from a bait dealer in St. Petersburg, Florida; the oysters were collected from East Bay, near ERLGB; and the shrimp were purchased from a local bait dealer. All animals were maintained for at least 48 h at ERLGB where they were acclimated to test conditions.

Mysids (*Mysidopsis bahia*) for the SPP and reference toxicant tests were cultured at ERLGB. Mysids (5 ± 1 days old) were fed *Artemia salina* nauplii (32 to 48 h post-hydration) during holding and testing.

Test Water

Natural seawater pumped from Santa Rosa Sound into the ERLGB seawater system was used for all tests. For the solid-phase test, 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 20 ± 2 parts per thousand by the addition of aged tap water, and temperature was controlled at 25 ± 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 lugworms, oysters, and shrimp, approximately 7 liters (l) of reference sediment was placed in each of fifteen 20-gallon (76-l) glass aquaria. This resulted in a layer of reference sediment approximately 30 millimeters (mm) deep. After about 1 h, seawater flowed into each aquarium at approximately 25 l/h, and the system was allowed to equilibrate for 24 h. Then, the seawater flow was stopped, approximately 3.5 l of the appropriate sediment was added to each aquarium (resulting in a layer about 15 mm deep), the sediment was allowed to settle for approximately 1 h, and the seawater flow was resumed. Then 10 lugworms were placed in the back section and 10 shrimp and 10 oysters were placed in the front section of each aquarium. (A nylon screen, 2-mm mesh, had been inserted in each aquarium and secured with silicone sealant in order to separate the lugworms from the predacious shrimp.) Ten test organisms per replicate of each species were used 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 five control (reference sediment) aquaria were prepared at the same time and in the same manner as the sediment exposure aquaria except that only the reference sediment was added to each aquarium.

The 10-day solid-phase test was conducted from 16 to 26 February 1988. 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 h, they were placed in acid-cleaned glass jars, then frozen, and later provided to the ERLGB Chemistry Laboratory for chemical analyses to determine bioaccumulation. Animals from the test populations were treated similarly before the test began to provide information on background concentrations.

To prepare the suspended particulate phase (SPP) of the two sediments and the reference sediment, 1,000 milliliters (ml) of chilled seawater was added to a 2-l Erlenmeyer flask. Then, 200 ml of well-stirred sediment was added to the flask. More seawater (800 ml) was added to the flask to bring the contents to the 2-l mark. This 1-part sediment:9-part seawater mixture was placed on a magnetic stirrer, mixed for at least 5 minutes (min), and then allowed the settle for 1 h. The SPP was decanted into a separate container, and pH and dissolved oxygen (DO) concentrations were measured. The SPP of the reference sediment had to be aerated to increase the DO to acceptable concentrations ($\geq$ 60% of saturation). The appropriate volume of 100% SPP in seawater of 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 stirred for approximately 5 min; the DO, pH, temperature and salinity were measured; and test animals were added to the dishes.

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 controller at 14 h light:10 h dark. The seawater in all treatments was aerated at a volume estimated to be 100 cubic centimeters/min during the tests.

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

Tests with the SPP prepared from the sediments were conducted 22 to 26 February 1988; a reference toxicant test with mysids from the same population was conducted at the same time.

Statistical Analyses

There was no statistical analyses of the data from the solid-phase tests or the SPP tests because no median effect (50% mortality) occurred. Mortality data from the mysid reference toxicant test were subjected to statistical analyses, however. The 96-h LC50 (the concentration lethal to 50% of the test animals after 96 h of exposure) was calculated by using the moving average method (Stephan, 1977). The 95% confidence limits were also calculated.

RESULTS AND DISCUSSION

Sediment from two sites near the Pensacola, Florida, Naval Air Station had little observable adverse effects on lugworms, oysters, or pink shrimp after a 10-day exposure. Survival of lugworms was 90% in the reference sediment and 92% in Site 1 and Site 2 sediment; oyster survival was 100% in the reference sediment and in Site 1 and Site 2 sediment; and shrimp survival was 98% in the reference sediment, 94% in

Site 1 sediment, and 96% in Site 2 sediment (Table 2).

The suspended particulate phase (SPP) of the sediments did not cause any adverse effects on mysids. When up to 100% SPP was tested, survival was 100% (Table 3).

Results of the reference toxicant test showed that the mysids were in suitable condition for testing; the 96-h LC50 was 6.3 ppm with 95% confidence limits of 4.8 to 8.4 ppm. Our experience and the literature (Roberts et al., 1982) show that the 96-h LC50 of sodium lauryl sulfate for mysids is usually 5 to 8 ppm.

Salinity, temperature, and pH were within acceptable ranges during the 10-day test (Tables 4 and 5).

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U.S. Environmental Protection Agency. 1985. Oil and Gas Point Source Category, Offshore Subcategory; Effluent Limitations Guidelines and New Source Performance Standards; Proposed Rule. FEDERAL REGISTER 50(165):34592-34636.

Table 1. Characterization of two sediment samples from near the Pensacola, Florida, Naval Air Station and a reference sediment from near Gulf Breeze, Florida, for water content, silt-clay (< 62 micrometers), and organic carbon (Folk, 1957). Values reported are the means of three measurements.

Sediment	Water (%)	Silt-Clay (%)	Organic Carbon (%)
Reference	64.5	45.0	6.2
Site 1	48.3	19.3	4.5
Site 2	22.8	0	0.5

Table 2. Results of a 10-day laboratory exposure of lugworms (Arenicola cristata), oysters (Crassostrea virginica), and pink shrimp (Penaeus duorarum) to sediment from near the Pensacola, Florida, Naval Air Station, along with a reference sediment from near Gulf Breeze, Florida. Numbers of animals that were alive at the end of the exposure are given; numbers of animals per replicate at the beginning of the test were 10 lugworms, oysters, and pink shrimp.

	Replicate	Lugworms	Oysters	Shrimp
	1	9	10	10
	2	9	10	10
Reference Sediment	3	9	10	10
	4	9	10	10
	5	9	10	9
	Total	45	50	49
	1	8	10	10
	2	10	10	10
Site 1	3	10	10	8
	4	9	10	10
	5	9	10	9
	Total	46	50	47
	1	10	10	10
	2	10	10	10
Site 2	3	9	10	9
	4	9	10	9
	5	8	10	10
	Total	46	50	48

Table 3. Results of acute toxicity tests conducted with mysids (*Mysidopsis bahia*) and the suspended particulate phase (SPP) of sediment from two sites near the Pensacola, Florida, Naval Air Station and a reference sediment from near Gulf Breeze, Florida. The percentage of animals alive after 96 hours of exposure is given.

	Exposure Concentration (% SPP[a])					
Test material	Control	1%	10%	25%	50%	100%
Reference Sediment	100	90	100	80	100	100
Site 1	90	100	90	90	100	100
Site 2	100	100	100	100	100	100

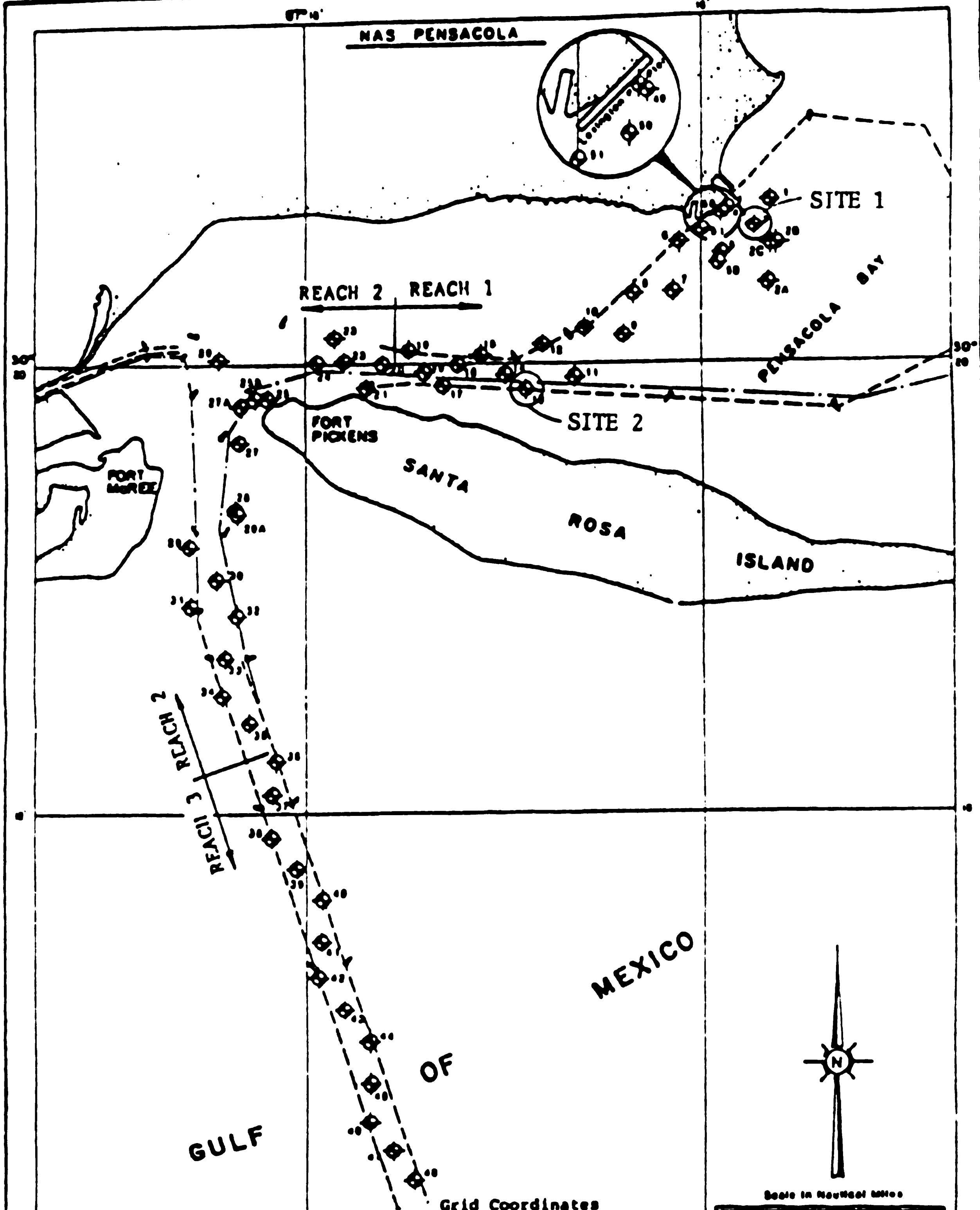
[a] The SPP (suspended particulate phase) was prepared by mixing 1 part sediment with 9 parts seawater (v:v), allowing the mixture to settle for 1 h, and decanting the unsettled portion.

Table 4. Temperature, salinity, and dissolved oxygen measurements during a 10-day laboratory exposure of marine organisms to sediments from near the Pensacola, Florida, Naval Air Station and a reference sediment from near Gulf Breeze, Florida.

	Test day									
	1	2	3	4	5	6	7	8	9	10
Temp. (°C)	20.0	20.0	20.0	20.0	20.5	20.0	20.0	20.0	19.0	20.0
Salinity (°/oo)	25.0	26.0	25.0	21.0	16.0	20.0	21.0	20.0	20.0	20.0
DO (ppm)										
Reference Sediment										
Rep. 1	6.8	7.2	6.6	6.5	8.0	7.9	8.0	7.4	7.8	7.8
2	3.8	6.7	5.2	6.3	7.7	5.2	6.7	5.8	5.6	4.0
3	4.1	7.0	6.6	6.9	8.0	7.8	7.9	7.6	7.1	7.5
4	2.5	6.9	6.6	6.5	8.0	5.5	6.7	6.7	6.8	7.6
5	4.8	6.9	7.0	6.8	8.1	7.8	7.8	7.8	7.9	7.7
Site 1										
Rep. 1	4.3	7.2	5.5	7.2	8.1	8.1	7.8	7.9	7.9	7.7
2	6.9	7.1	6.5	7.3	8.2	7.9	7.8	7.7	8.0	7.8
3	6.7	7.1	6.6	7.1	7.8	8.1	7.6	7.6	5.9	7.8
4	7.3	7.0	6.2	7.0	7.7	7.7	7.8	7.8	7.8	7.7
5	3.8	6.9	5.0	6.0	7.8	7.7	7.1	7.5	7.5	7.6
Site 2										
Rep. 1	6.9	7.1	7.0	7.4	8.1	7.9	7.7	7.8	8.0	7.8
2	4.9	6.7	5.3	6.4	7.6	7.7	7.5	6.5	7.8	7.7
3	5.8	6.5	5.5	5.5	7.4	7.6	7.1	6.7	7.7	7.6
4	5.2	6.7	6.5	6.8	7.9	7.8	7.4	6.1	7.7	7.6
5	6.7	7.1	5.5	7.2	8.1	7.9	7.4	7.9	7.9	7.9

Table 5. pH measurements during a 10-day laboratory exposure of marine organisms to sediments from near the Pensacola, Florida, Naval Air Station and a reference sediment from near Gulf Breeze, Florida.

	Test day									
pH	1	2	3	4	5	6	7	8	9	10
Reference Sediment										
Rep. 1	8.00	8.06	8.07	8.05	8.06	7.96	7.99	8.06	8.05	8.04
2	8.14	7.98	8.06	8.06	8.06	8.03	8.02	8.04	8.04	8.03
3	8.15	8.04	8.06	8.06	8.07	7.96	8.01	8.04	8.06	8.04
4	9.16	8.02	8.05	8.07	8.06	8.06	8.04	8.09	8.07	8.03
5	8.13	8.07	8.10	8.09	8.09	7.98	8.04	8.06	8.10	8.09
Site 1										
Rep. 1	8.18	8.06	8.09	7.98	8.07	7.99	8.05	8.08	8.08	8.06
2	8.07	8.07	8.10	8.03	8.08	7.99	8.05	8.06	8.09	8.07
3	8.05	8.09	8.12	7.99	8.08	8.04	8.04	8.06	8.07	8.07
4	8.16	8.10	8.13	8.03	8.07	8.03	8.05	8.06	8.07	8.08
5	8.11	8.09	8.11	8.03	8.09	8.03	8.03	8.08	8.09	8.05
Site 2										
Rep. 1	8.05	8.08	8.11	8.01	8.07	7.97	8.03	8.08	8.09	8.06
2	7.98	8.03	8.11	8.09	8.07	7.93	8.06	8.09	8.09	8.07
3	7.98	8.02	8.14	8.08	8.06	7.97	8.03	8.08	8.09	8.03
4	8.02	8.06	8.08	8.02	8.06	7.89	8.04	8.06	8.08	8.03
5	8.06	8.10	8.17	8.03	8.08	8.00	8.06	8.08	8.10	8.09



Grid Coordinates

	Latitude/ Longitude	FL N Lambert	Local	UTM
SITE 1	30-20-36.032 N 87-15-43.310 W	N 499,073 E 1,128,798	N 36,311 E 39,104	N 3,35[illegible] 679 E 474,814
SITE 2	30-19-53.442 N 87-16-52.923 W	N 494,920 E 1,122,595	N 32,007 E 33,004	N3,355,373 E 472,952

VIBRACORE/PONAR STATION

Figure D-1

PENSACOLA-NAVY HOMEPORT STATION LOCATION PLAN

APPENDIX D

Characteristic of Dredged Material

Chemical Analyses of Sediment from Two Sites near the Pensacola, Florida, Naval Air Station and Tissues of Marine Organisms Exposed to the Sediment

CHEMICAL ANALYSES OF SEDIMENT FROM TWO SITES NEAR THE PENSACOLA, FLORIDA, NAVAL AIR STATION AND TISSUES OF MARINE ORGANISMS EXPOSED TO THE SEDIMENT

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In partial fulfillment of:

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ABSTRACT

Chemical analyses were performed on sediment collected from two sites near the Pensacola, Florida, Naval Air Station and on three types of marine organisms exposed to these sediment samples during a 10-day bioaccumulation test conducted by the Dredged Materials Research Team of the Gulf Breeze Laboratory. Five 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. The purpose of these chemical analyses was to determine if residues were detectable in the sediments and if chemicals accumulated in tissues of organisms exposed to the sediments. Two samples of each type of organism and sediment were analyzed before use in the bioaccumulation test.

Residues of selected pesticides or PCBs were not detected in sediments or animal tissues before or after exposure but several metals were detected in sediments and in tissues of organisms before and after exposure. Concentrations of cadmium in oysters (*Crassostrea virginica*) exposed to sediment from Site 2 were statistically greater than concentrations of cadmium in animals exposed to the reference sediment. Concentrations of arsenic, copper, and zinc were statistically greater in oysters exposed to sediment from Site 1 and in oysters exposed to sediment from Site 2 than those exposed to the reference sediment. Concentrations of lead in shrimp (*Penaeus duorarum*) exposed to sediment from Site 1 and in shrimp exposed to sediment from Site 2 were greater than

concentrations of lead in shrimp exposed to the reference sediment. Certain metals were detected in lugworms (Arenicola cristata) exposed to sediment from Site 1 and from Site 2 but concentrations were not significantly greater than in lugworms exposed to the reference sediment. Aliphatic and aromatic petroleum hydrocarbon residues were found in oysters, shrimp and lugworms after the 10-day exposure study; however, no statistically significant differences were determined.

INTRODUCTION

In accord with an agreement between the U.S. Army Corps of Engineers (CE), Mobile District, and EPA's Gulf Breeze Environmental Research Laboratory (ERL/GB), chemical analyses were performed on sediment collected from two locations near the Pensacola, Florida, Naval Air Station and on three species (shrimp, oyster, and lugworm) of marine organisms exposed to these sediments during a 10-day bioaccumulation test. Five replicates of each sediment and 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 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. After the 10-day exposure period, five replicates of each test organism from each test sediment, and the reference sediment, were collected and maintained at - 4°C 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 (1600x 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. 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.

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. PCB reference standard, obtained from U.S. EPA Chemical Repository, Washington, DC, was described by Sawyer (1978). Analyses were performed on a Hewlett-Packard Model 5710 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 (Supleco, INc., Bellefonte, PA) on 80-100 mesh Supelcoport. 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.

Recoveries of PCBs and pesticides from spiked samples and detection limits for pesticides and petroleum hydrocarbons are shown in Table 1.

B. Heavy Metals

One to two grams of tissue or sediment were weighed into a 40 ml reaction vessel. Five ml 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 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. Method detection limits for each element are based on wet-weight analyses. No detectable residues could be found in method blanks. A solution of ten percent nitric acid/distilled water was analyzed between samples to prevent carryover of residues from one sample to the next. Standards 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 Hewlett Packard gas chromatograph (GC) equipped with flame ionization detection (FID). Separations were performed by using a 182-cm by 2-mm i.d. glass column packed with 3% OV101 on 100/120 mesh Supelcoport. Helium carrier gas was used at a flow of 30 ml/min.

<u>Quality Assurance of Chemical Analyses</u>

All standards used for quantitations of pesticides were obtained from the U.S. EPA 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 (Table 1), and metals (Table 7). 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). After calculations were performed to determine whether variance of data sets were homogeneous, analysis of variance (ANOVA) was used to compare mean tissue concentration in animals exposed to each dredged material sediment sample with mean tissue concentrations in animals exposed to reference sediment. Nondetectable (ND) concentrations were treated as missing values when analysis of variance procedures were performed. Because so many values for petroleum hydrocarbons and lead in lugworms and for lead and nickel in shrimp were reported as not detected (ND), a zero was substituted for each ND so that statistical analyses could be performed. When the calculated F-value exceeded the tabulated value, Student-Newman-Keuls multiple-range test was used to determine which dredged material mean tissue concentration was significantly different from the reference mean tissue concentration. These analyses were performed by using Statistical Analysis System (SAS) procedures (SAS, 1982).

RESULTS AND DISCUSSION

Analyses of Pesticides and PCBs

During these analyses, only oysters were available in sufficient numbers to allow them to be used for spiking. However, we believe that 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 concentrations above the detection limits. Residues of pesticides or PCBs were not detected in replicate samples of the reference sediment or sediment from Sites 1 and 2. Detection limits were the same as those in Table 1.

After organisms were exposed to the reference sediment or Site 1 or 2 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 3) or to sediment from Sites 1 or 2 (Tables 4 and 5, respectively).

Analyses of Metals

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. Metals detected in sediments are shown in Table 7. 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 or Site 1 and 2 sediment are shown in Table 8. Test for homogeneity of variances on concentrations of arsenic (As), cadmium (Cd), copper (Cu), selenium (Se), and zinc (Zn) (Tables 9 through 14) showed that only chromium concentrations needed to be transformed. Analysis of variance of arsenic, cadmium, chromium, copper, nickel and zinc concentrations (Tables 15 through 20) showed that significant differences were detected for these metals at the 0.050 alpha level except for nickel and chromium.

A Student-Newman-Keuls multiple-range test was then performed to compare treatment mean concentrations and determine if metals in animals exposed to Site 1 and 2 sediment were different from those exposed to the reference sediment. Results of these analyses (Tables 21 through 24) showed that both Sites 1 and 2 were different from the reference sediment for arsenic, copper, and zinc, and only Site 2 was different from the reference sediment for cadmium.

Concentrations of metals in replicate samples of lugworms exposed for 10 days to the reference sediment or Site 1 or 2 are shown in Table 25. Results of tests for homogeneity of variance (Tables 26 through 31) indicated that variances for all metals except chromium and nickel were homogeneous. Analyses of variance tests for arsenic, chromium, nickel, and lead (Tables 32 through 35) did not find significant differences at the 0.05 alpha level.

Concentrations of metals in replicate samples of shrimp exposed for 10 days to the reference sediment or Site 1 or 2 sediment are shown in Table 36. Because so many values were reported as not detected (ND) for lead and nickel in tissues of shrimp, a zero was substituted for each ND so that statistical analyses could be performed. Test for homogeneity of variances (Tables 37 through 43) indicated that transformation of data was not necessary. Because of similarity of means or because means from the sites were less than means for the reference sediment, no further analyses were necessary for cadmium and copper. Statistically significant differences were found for lead using ANOVA (Tables 44 through 48). Student-Newman-Keuls multiple-range-test showed that concentrations of lead residues were statistically higher in shrimp tissues exposed to Site 1 sediment and Site 2 sediment than in shrimp exposed to the reference sediment.

Analyses of Petroleum Hydrocarbons

Results from samples of 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 50. Pre-test shrimp contained detectable concentrations of aliphatic petroleum hydrocarbon residues; however, lugworms and oysters contained both aliphatic and aromatic hydrocarbons fractions. The reference sediment contained higher concentrations of both aliphatic and aromatic hydrocarbons than did Site 1 sediment. Sediment from Site 2 did not contain detectable residues of either fraction.

Concentrations of aliphatic and aromatic petroleum hydrocarbon residues in oysters after a 10-day bioaccumulation study are shown in Table 51. Test for homogeneity of variances showed that transformation of aliphatic residue concentrations was necessary but not for aromatic hydrocarbon residue concentrations. No significant differences (alpha = 0.05) were found between residue concentrations in oysters exposed to Site 1 or Site 2 sediment and those exposed to the reference sediment using analysis of variance (Table 52 and 53).

Concentrations of aliphatic and aromatic petroleum hydrocarbon residues in lugworms after a 10-day bioconcentration study are shown in Table 54. Test for homogeneity of variance (Table 54) showed transformation of aliphatic hydrocarbon concentrations was necessary but not necessary for aromatic hydrocarbon concentrations. No significant differences (alpha = 0.05) were found between aliphatic or aromatic petroleum hydrocarbon residue concentrations in lugworms exposed to reference sediment and these hydrocarbon residue concentrations in lugworms exposed to Site 1 or Site 2 sediment (Tables 55 and 56).

Concentrations of aliphatic and aromatic petroleum hydrocarbon residues in shrimp after a 10-day bioconcentration study are shown in Table 57. Transformation was necessary for aromatic hydrocarbon residue concentrations but not for aliphatic hydrocarbon concentrations. No significant differences (alpha = 0.05) were found between aliphatic or aromatic hydrocarbon residue concentrations in shrimp exposed to the reference sediment and those hydrocarbon residue concentrations in shrimp exposed to Site 1 or Site 2 sediment (Table 58 and 59) when ANOVA was performed.

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Compound	Spike Concentration (µg/g)	Lugworm	Shrimp	N	Oyster	N	Sediment	Detection Limit (µg/g)
Aldrin	0.010	a	a	17	83 (6.7)	3	71 (24)	0.0020
BHC Isomers								
Alpha	0.0050	a	a		a		a	0.00080
Beta	0.010	a	a		a		a	0.0040
Gamma (lindane)	0.010	a	a	17	90 (7.7)	3	74 (13)	0.0020
Delta	0.020	a	a		a		a	0.0020
Chlordane	0.10	a	a		a		a	0.040
Chlorpyrifos (Dursban)	0.10	a	a	17	96 (12)	4	90 (1.3)	0.010
DDE	0.020	a	a	17	79 (14)	4	103 (15)	0.0040
DDD	0.040	a	a	17	88 (6.0)	4	90 (14)	0.0080
DDT	0.060	a	a	17	82 (7.3)	4	90 (8.3)	0.010
Dieldrin	0.020	a	a	17	95 (8.9)	4	79 (2.5)	0.0040
Endrin	0.020	a	a	17	96 (11)	4	70 (4.0)	0.010
Endosulfan I	0.020	a	a		a		a	0.010
Endosulfan II	0.020	a	a		a		a	0.010
Endosulfan Sulfate	0.10	a	a		a		a	0.050
Heptachlor	0.010	a	a	17	69 (13)		a	0.0020
Heptachlor epoxide	0.010	a	a	17	88 (13)	3	41 (27)	0.010
Hexachlorobenzene	0.050	a	a		a		a	0.0020
Methoxychlor	0.10	a	a	17	88 (7)		a	0.030
Mirex	0.10	a	a	17	84 (8.6)		a	0.020
PCBs	0.50	a	a		a		a	0.10
Toxaphene	1.0	a	a		a		a	0.20
Petroleum Hydrocarbons								
Aliphataic	1.0-5.0					2	58 (36)	0.50
Aromatic	1.0-1.5					1	74	0.50

[a] Analytes were not spiked for recovery.

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

	Lugworm		Shrimp		Oyster	
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

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

Table 3. Concentrations of selected chlorinated pesticides and PCBs in replicate samples of three marine organisms analyzed after a 10- day exposure to a reference sediment from Pensacola, FL.

	Lugworm					Shrimp					Oyster				
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 4. Concentrations of selected chlorinated pesticides and PCBs in replicate samples of three marine organisms analyzed after a 10-day exposure to Site 1 sediment from Pensacola, FL.

	Lugworm					Shrimp					Oyster				
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 a 10-day exposure to Site 2 sediment from Pensacola, FL.

	Lugworm					Shrimp					Oyster				
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 sediment from Pensacola, FL. Method detection limits for each element is given in µg/g wet tissue weight.

Pre-Test Organism	Replicate	Concentrations in µg/g wet tissue weight								
		As[a]	Cd	Cr	Cu	Hg	Ni	Pb[a]	Se	Zn
Shrimp	1	6.0	0.27	0.39	5.0	b	0.34	ND	ND	19
	2	9.8	0.24	0.57	5.3	ND	ND	2.5	ND	18
Lugworm	1	6.3	ND	ND	3.8	ND	ND	ND	ND	8.8
	2	5.0	ND	ND	4.2	1.4	ND	ND	ND	12
Oyster	1	7.1	0.25	0.25	6.1	0.77	0.29	ND	ND	160
	2	5.3	0.23	0.27	6.4	ND	0.29	ND	ND	170
Method Detection Limits[c]										
		0.375	0.125	0.25	0.15	0.625	0.25	0.50	0.375	0.125

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

[b] Sample was contaminated by residues from standard that was analyzed immediately before this sample.

[c] 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 and sediment from Sites 1 and 2, Pensacola, FL.

Sediment Location	Replicate	Concentrations in µg/g wet tissue weight								
		As[a]	Cd	Cr	Cu	Hg	Ni	Pb[a]	Se	Zn
Reference	1	2.2	ND	9.5	ND	ND	4.0	3.1	ND	1.0
	2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Site 1	1	14	ND	15	2.9	ND	6.1	11	ND	66
	2	3.6	ND	16	4.4	ND	5.8	7.6	ND	106
Site 2	1	28	ND	26	6.6	ND	9.4	13	ND	50
	2	1.2	ND	9.2	1.2	ND	3.4	ND	ND	51

ND = not detected; see Table 7 for detection limits.

NA = sample not available for analysis.

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

Table 8. Concentrations of selected metals in samples of oysters from a 10-day bioaccumulation study with the reference sediment from test sites 1 and 2, Pensacola, FL.

Sediment Location	Replicate	Concentrations in µg/g wet weight								
		As[a]	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Reference	1	2.2	0.37	0.26	6.2	1.0	0.56	ND	ND	175
	2	2.3	0.38	0.19	5.8	ND	0.51	ND	ND	165
	3	1.8	0.21	0.15	3.4	0.76	ND	ND	ND	97
	4	2.4	0.20	ND	3.9	ND	0.33	ND	ND	117
	5	2.4	0.20	ND	3.7	ND	1.2	ND	ND	108
	Mean $\bar{x}$ =	2.22	0.272	0.052	4.60	0.88	0.650	--	--	136
Site 1	1	2.5	0.26	0.14	5.3	ND	0.40	ND	ND	170
	2	3.0	0.35	0.14	8.0	ND	0.35	ND	ND	260
	3	2.8	0.35	ND	8.4	ND	0.51	ND	ND	270
	4	3.1	0.45	0.21	6.9	ND	0.45	ND	ND	220
	5	3.3	0.47	0.29	8.7	ND	0.62	ND	ND	250
	Mean $\bar{x}$ =	2.94	0.376	0.058	7.46	--	0.466	--	--	234
Site 2	1	4.0	0.59	0.63	14	ND	0.59	ND	ND	390
	2	3.4	0.53	0.63	11	ND	0.49	ND	ND	310
	3	3.7	0.51	0.24	11	ND	ND	ND	ND	330
	4	3.0	0.52	0.24	7.9	ND	0.60	ND	ND	250
	5	4.3	0.80	0.45	13	ND	1.2	ND	ND	350
	Mean $\bar{x}$ =	3.68	0.590	0.438	11.38	--	0.720	--	--	326

ND = not detected

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

Table 9. Statistical analysis of arsenic (μg/g wet tissue) in oysters from the 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	2.2	2.5	4.0
2	2.3	3.0	3.4
3	1.8	2.8	3.7
4	2.4	3.1	3.0
5	2.4	3.3	4.3
Sum of data, Σx =	11.1	14.7	18.4
Mean $\bar{X}$ =	2.22	2.94	3.68
Sum of squared data, Σx^2 =	24.89	43.59	68.74
CSS = $\Sigma x - \frac{(\Sigma X)^2}{n}$ =	0.248	0.372	1.028
Variance =	0.062	0.093	0.257

$C = \frac{0.257}{0.412} = 0.623$ where $C = \frac{S^2max}{\Sigma S^2}$; ($S^2max$ = largest variance) (ΣS^2 = sum of all variances)

Chi square (3,4) = 0.7457

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

Table 10. Statistical analysis of cadmium (µg/g wet tissue) in oysters from the 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	0.37	0.26	0.59
2	0.38	0.35	0.53
3	0.21	0.35	0.51
4	0.20	0.45	0.52
5	0.20	0.47	0.80
Sum of data, Σx =	1.36	1.88	2.95
Mean X =	0.272	0.376	0.590
Sum of squared data, Σx^2 =	0.405	0.736	1.799
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	0.0355	0.0291	0.0590
Variance =	0.0089	0.0073	0.0148

$C = \frac{0.0148}{1.779} = 0.477$; see Table 9 for equation.

Chi square (3,4) = 0.7457

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

Table 11. Statistical analysis of chromium (μg/g wet tissue) in oysters from the 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	0.26	0.0	0.63
2	0.0	0.0	0.63
3	0.0	0.0	0.0
4	0.0	0.0	0.0
5	0.0	0.29	0.45
Sum of data, Σx =	0.26	0.29	1.71
Mean $\bar{X}$ =	0.052	0.058	0.34
Sum of squared data, Σx^2 =	0.0676	0.0841	0.99
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	0.0541	0.0673	0.4115
Variance =	0.0135	0.0168	0.1029

A zero was substituted for each value reported as not detected so that statistical analyses could be performed.

$C = \frac{0.1029}{0.1332} = 0.7725$; see Table 9 for equation.

Chi square (3,4) = 0.7457

Since calculated C value is greater than tabulated chi-square value, variances are not homogeneous and transformation is necessary.

Table 12. Statistical analysis of copper ($\mu g/g$ wet tissue) in oysters from the 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	6.2	5.3	14
2	5.8	8.0	11
3	3.4	8.4	11
4	3.9	6.9	7.9
5	3.7	8.7	13
Sum of data, Σx =	23.0	37.3	56.9
Mean $\bar{X}$ =	4.60	7.46	11.38
Sum of squared data, Σx^2 =	112.54	285.95	669.41
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	6.74	7.69	21.88
Variance =	1.685	1.923	5.472

$C = \frac{5.472}{9.08} = 0.6026$; see Table 9 for equation.

Chi square (3,4) = 0.7457

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

Table 13. Statistical analysis of nickel (µg/g wet tissue) in oysters from the 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	0.56	0.40	0.59
2	0.51	0.35	0.49
3	ND	0.51	ND
4	0.33	0.45	0.60
5	1.2	0.62	1.2
Sum of data, Σx =	2.60	2.33	2.88
Mean $\bar{X}$ =	0.650	0.466	0.720
Sum of squared data, Σx^2 =	2.122	1.129	2.388
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	0.432	0.0437	0.314
Variance =	0.1442	0.0109	0.1049

$C = \frac{0.1442}{0.260} = 0.554$; see Table 9 for equation.

Chi square (3,4) = 0.7457

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

Table 14. Statistical analysis of zinc (µg/g wet tissue) in oysters from the 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	180	170	390
2	170	260	310
3	100	270	330
4	120	220	250
5	110	250	350
Sum of data, Σx =	680	1170	1630
Mean $\bar{X}$ =	136	234	326
Sum of squared data,			
Σx^2 =	97800	280300	592100
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	5320	6520	10720
Variance =	1330	1630	2680

$C = \frac{2680}{5640} = 0.475$; see Table 9 for equation.

Chi square (3,4) = 0.7457

Since calculated C value is less than tabulated chi-square value, variances are homogeneous and transformation is unnecessary.

Table 15. Analysis of variance of arsenic accumulation in oysters from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	0.06529	0.03264	20.98	0.0001
Error	12	0.01867	0.001556		
Corrected Total	14	0.08397			

C.V.	Root MSE	PPM Mean
6.689	0.03945	0.5897

Table 16. Analysis of variance of cadmium accumulation in oysters from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	0.26289	0.13144	12.76	0.001
Error	12	0.12360	0.010300		
Corrected Total	14	0.38649			
		C.V.	Root MSE		PPM Mean
		24.593	0.10148		0.41266

Table 17. Analysis of variance of chromium accumulation in oysters from the 10-day bioaccumulation study, Pensacola, FL, using transformed data.

Analysis of Variance Procedure

Dependent Variable: Log PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	0.03076	0.01538	2.83	0.0987
Error	12	0.06531	0.005442		
Corrected Total	14	0.09607			
		C.V.	Root MSE		Log PPM Mean
		138.8	0.07377		0.05311

Table 18. Analysis of variance of copper accumulation in oysters from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	115.8573	57.9286	19.14	0.0002
Error	12	36.320	3.02666		
Corrected Total	14	152.177			

C.V.	Root MSE	PPM Mean
22.266	1.7397	7.8133

Table 19. Analysis of variance of nickel accumulation in oysters from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	0.15737	0.07868	0.99	0.4036
Error	10	0.79092	0.07909		
Corrected Total	12	0.94829			
		C.V.	Root MSE		PPM Mean
		46.812	0.28123		0.60076

Table 20. Analysis of variance of zinc accumulation in oysters from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	90280	45140.0	24.01	0.0001
Error	12	22560	1880.0		
Corrected Total	14	112840			
		C.V.	Root MSE		PPM Mean
		18.689	43.3589		232.0

Table 21. Comparison of arsenic residues in oysters used in the Pensacola, FL, study.

$$S_{\bar{x}} = \sqrt{\frac{MSE}{n}} = \sqrt{\frac{0.001556}{5}} = 0.0176$$

At the alpha = 0.05 level,

	K: 2	K: 3
Q	3.08	3.77
$S_{\bar{x}}$	0.0176	0.0176
$LSR = QS_{\bar{x}}$	0.0542	0.0663

Treatment means from computer printout

Ref	Site 1	Site 2
2.22	2.94	3.68

Mean Comparison

K	LSR	Difference between means
2	0.0542	Site 1 - Ref = 0.72*
3	0.0663	Site 2 - Ref = 1.46*

* Indicates significant difference at alpha = 0.05

Table 22. Comparison of cadmium residues in oysters used in the Pensacola, FL, study.

$$S_{\bar{x}} = \sqrt{\frac{MSE}{n}} = \sqrt{\frac{0.010300}{5}} = 0.0454$$

At the alpha = 0.05 level,

	K = 2	K = 3
Q	3.08	3.77
$S_{\bar{x}}$	0.0454	0.0454
LSR = $QS_{\bar{x}}$	0.139	0.171

Treatment means from computer printout

Ref	Site 1	Site 2
0.272	0.376	0.590

Mean Comparison

K	LSR	Difference between means
2	0.139	Site 1 - Ref = 0.104 n.s.
3	0.171	Site 2 - Ref = 0.318*

* Indicates significant difference at alpha = 0.05

n.s = not significantly different.

Table 23. Comparison of copper residues in oysters used in the Pensacola, FL, study.

$$S_{\bar{x}} = \sqrt{\frac{MSE}{n}} = \sqrt{\frac{3.02666}{5}} = 0.7780$$

At the alpha = 0.05 level,

	K = 2	K = 3
Q	3.08	3.77
$S_{\bar{x}}$	0.7780	0.7780
$LSR = QS_{\bar{x}}$	2.39	2.93

Treatment means from computer printout

Ref	Site 1	Site 2
4.60	7.46	11.38

Mean Comparison

K	LSR	Difference between means
2	2.39	Site 1 - Ref = 2.86*
3	2.93	Site 2 - Ref = 6.78*

* Indicates significant difference at alpha = 0.05

Table 24. Comparison of zinc residues in oysters used in the Pensacola, FL, study.

$$S_{\bar{x}} = \sqrt{\frac{MSE}{n}} = \sqrt{\frac{1880}{5}} = 19.39$$

At the alpha = 0.05 level,

	K = 2	K = 3
Q	3.08	3.77
$S_{\bar{x}}$	19.39	19.39
$LSR = QS_{\bar{x}}$	59.72	73.10

Treatment means from computer printout

Ref	Site 1	Site 2
136	234	326

Mean Comparison

K	LSR	Difference between means
2	59.72	Site 1 - Ref = 98.0*
3	73.10	Site 2 - Ref = 190.0*

* Indicates significant difference at alpha = 0.05

Table 25. Concentrations of selected metals in samples of lugworms from a 10-day bioaccumulation study with sediments from two sites near Pensacola, FL, and a reference sediment.

Sediment Location	Replicate	Concentration in µg/g wet tissue weight								
		As[b]	Cd	Cr	Cu	Hg	Ni	Pb[b]	Se	Zn
Reference	1	3.9	ND	0.83	6.1	ND	0.75	1.8	ND	22
	2	3.8	ND	3.6	5.4	ND	2.8	ND	ND	18
	3	5.3	ND	1.2	4.6	ND	1.0	ND	ND	105
	4	6.2	ND	1.4	7.2	ND	1.2	ND	ND	16
	5	4.1	ND	0.77	4.5	ND	0.63	ND	ND	13
	Mean $\bar{x}$ =	4.66	--	1.56	5.56	--	1.27	1.8	--	34.8
Site 1	1	5.4	ND	0.59	2.8	ND	ND	ND	ND	24
	2	4.6	ND	0.41	4.6	ND	0.41	ND	ND	19
	3	5.3	ND	0.29	3.8	ND	0.38	ND	ND	21
	4	4.6	ND	0.68	3.5	ND	0.58	1.9	ND	58
	5	5.3	ND	0.38	3.3	ND	ND	2.6	ND	13
	Mean $\bar{x}$ =	5.04	--	0.47	3.60	--	0.46	2.25	--	27.0
Site 2	1	5.7	ND	7.5	2.8	ND	5.7	4.2	ND	36
	2	5.0	ND	1.3	3.2	ND	0.79	ND	ND	60
	3	5.3	ND	2.2	3.4	ND	1.0	ND	ND	15
	4	6.5	ND	1.9	4.4	ND	0.90	2.6	ND	16
	5	4.7	ND	0.32	3.4	ND	0.35	4.0	ND	19
	Mean $\bar{x}$ =	5.44	--	2.64	3.44	--	1.75	3.60	--	29.2

ND = Not detected.

[b] Concentrations are given as the maximum amount due to interference from unknown elements.

Table 26. Statistical analysis of arsenic (μg/g wet tissue) in lugworms from a 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	3.9	5.4	5.7
2	3.8	4.6	5.0
3	5.3	5.3	5.3
4	6.2	4.6	6.5
5	4.1	5.3	4.7
Sum of data, Σx =	23.3	25.2	27.2
Mean $\bar{X}$ =	4.66	5.04	5.44
Sum of squared data, Σx^2 =	112.99	127.66	149.92
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	4.412	0.6520	0.4880
Variance =	1.103	0.1630	0.4880

$C = \frac{1.103}{1.754} = .6288$; see Table 9 for equation.

Chi square (3,4) = 0.7457

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

Table 27. Statistical analysis of chromium (µg/g wet tissue) in lugworms from the bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	0.83	0.59	7.5
2	3.6	0.41	1.3
3	1.2	0.29	2.2
4	1.4	0.68	1.9
5	0.77	0.38	0.32
Sum of data, Σx =	7.80	2.35	13.22
Mean $\bar{X}$ =	1.56	0.47	2.64
Sum of squared data, Σx^2 =	17.64	1.207	66.49
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	5.47	0.102	31.53
Variance =	1.36	0.025	7.88

$C = \frac{7.88}{9.26} = 0.851$; see Table 9 for equation.

Chi square (3,4) = 0.7457

Since calculated C value is greater than tabulated chi-square value, transformation is necessary.

Table 28. Statistical analysis of copper (μg/g wet tissue) in lugworms from the 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	6.1	2.8	2.8
2	5.4	4.6	3.2
3	4.6	3.8	3.4
4	7.2	3.5	4.4
5	4.5	3.3	3.4
Sum of data, Σx =	27.8	18.0	17.2
Mean $\bar{X}$ =	5.56	3.60	3.44
Sum of squared data, Σx^2 =	159.62	66.58	60.56
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	5.052	1.780	1.392
Variance =	1.263	0.445	0.3480

$C = \frac{1.263}{2.056} = 0.6143$; see Table 9 for equation.

Chi square (3,4) = 0.7457

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

Table 29. Statistical analysis of nickel ($\mu g/g$ wet tissue) in lugworms from the 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	0.75	0.0	5.7
2	2.8	0.41	0.79
3	1.0	0.38	1.0
4	1.2	0.58	0.90
5	0.63	0.0	0.35
Sum of data, Σx =	6.38	1.37	8.74
Mean X =	1.27	0.274	1.748
Sum of squared data, Σx^2 =	11.23	0.6489	35.046
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	3.098	0.2735	19.76
Variance =	0.7746	0.0684	4.942

$C = \frac{4.94}{5.79} = 0.85$; see Table 9 for equation.

Chi square (3,4) = 0.7457

Since calculated C value is greater than tabulated chi-square value, transformation is necessary.

Table 30. Statistical analysis of lead (μg/g wet tissue) in lugworms from the 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	1.8	0.0	4.2
2	0.0	0.0	0.0
3	0.0	0.0	0.0
4	0.0	1.9	2.6
5	0.0	2.6	4.0
Sum of data, Σx =	1.8	4.5	10.8
Mean X =	0.36	0.90	2.16
Sum of squared data,			
Σx^2 =	3.24	10.37	40.40
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	2.59	6.32	17.07
Variance =	0.648	1.58	4.26

$C = \frac{4.26}{6.49} = 0.66$; see Table 9 for equation.

Chi square (3,4) = 0.7457

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

Table 31. Statistical analysis of zinc (μg/g wet tissue) in lugworms from the 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	22	24	36
2	18	19	60
3	105	21	15
4	16	58	16
5	13	13	19
Sum of data, Σx =	174	135	146
Mean X =	34.8	27.0	29.2
Sum of squared data,			
Σx^2 =	12258.0	4911.0	5738.0
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	6202.8	1266.0	1474.8
Variance =	1550.7	316.5	368.7

Since the mean concentration for reference sediment samples was greater than the mean concentration for Site 1 or 2, no further analyses were performed.

Table 32. Analysis of variance of arsenic accumulation in lugworms from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	1.5213	0.76066	1.30	0.308
Error	12	7.0160	0.58466		
Corrected Total	14	8.5373			

C.V.	Root MSE	PPM Mean
15.151	0.76463	5.0466

Table 33. Analysis of variance of chromium accumulation in lugworms from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: Log PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	0.25287	0.12629	3.24	0.0749
Error	12	0.46742	0.03895		
Corrected Total	14	0.72000			

C.V.	Root MSE	Log PPM Mean
58.030	0.19736	0.34009

Table 34. Analysis of variance of nickel accumulation in lugworms from the 10-day bioaccumulation study, Pensacola, FL, using transformed data.

Analysis of Variance Procedure

Dependent Variable: Log PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	0.20822	0.1041	3.05	0.0850
Error	12	0.40988	0.03415		
Corrected Total	14	0.61811			

C.V.	Root MSE	Log PPM Mean
70.09	0.1848	0.2636

Table 35. Analysis of variance of lead accumulation in lugworms from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	8.5320	4.2660	1.97	0.182
Error	12	25.9840	2.1653		
Corrected Total	14	34.5160			

C.V.	Root MSE	PPM Mean
129.07	1.4715	1.140

Table 36. Concentrations of selected metals in samples of shrimp from a 10-day bioaccumulation study with sediments from two sites near Pensacola, FL, and a reference sediment.

Sediment Location	Replicate	Concentration in µg/g wet tissue weight								
		As[a]	Cd	Cr	Cu	Hg	Ni	Pb[a]	Se	Zn
Reference	1	8.0	0.31	0.67	13	SL	ND	ND	ND	16
	2	7.9	0.15	0.30	10	SL	ND	ND	ND	11
	3	7.8	0.15	0.33	14	SL	ND	ND	ND	14
	4	9.3	ND	0.27	12	SL	ND	ND	ND	16
	5	8.8	0.13	0.15	12	SL	ND	ND	ND	25
Site 1	1	8.8	0.23	0.85	16	ND	ND	ND	ND	18
	2	11	0.18	0.38	12	ND	ND	ND	ND	15
	3	8.1	0.16	0.49	11	ND	0.71	1.1	ND	16
	4	8.7	0.21	0.27	9.1	ND	ND	1.5	ND	25
	5	9.9	0.15	0.40	10	ND	0.61	1.4	ND	18
Site 2	1	9.6	0.12	0.49	9.9	ND	0.40	1.2	ND	14
	2	9.8	0.15	0.24	12	ND	ND	1.5	ND	15
	3	10	0.13	0.23	10	ND	ND	1.2	ND	13
	4	8.8	0.18	0.34	11	ND	0.57	1.8	ND	18
	5	9.9	0.15	0.33	12	ND	ND	2.0	ND	20

ND = Not detected.

SL - samples lost

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

Table 37. Statistical analysis of arsenic (μg/g wet tissue) in shrimp from a 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	8.0	8.8	9.6
2	7.9	11	9.8
3	7.8	8.1	10
4	9.3	8.7	8.8
5	8.8	9.9	9.9
Sum of data, Σx =	41.8	46.5	48.1
Mean $\bar{X}$ =	8.36	9.30	9.62
Sum of squared data, Σx^2 =	351.18	437.75	463.65
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	1.732	5.300	0.9280
Variance =	0.4330	1.3250	0.2320

$C = \frac{1.325}{1.990} =$ 0.665; see Table 9 for equation.

Chi square (3,4) = 0.7457

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

Table 38. Statistical analysis of cadmium (μg/g wet tissue) in shrimp from the 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	0.31	0.23	0.12
2	0.15	0.18	0.15
3	0.15	0.16	0.13
4	ND	0.21	0.18
5	0.13	0.15	0.15
Sum of data, Σx =	0.74	0.93	0.73
Mean $\bar{X}$ =	0.185	0.186	0.146
Sum of squared data,			
Σx^2 =	0.158	0.177	0.108
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	0.0211	0.0045	0.0021
Variance =	0.0070	0.0011	0.0005

Because of similarity of means or because mean for Site 1 was less than the mean for the reference sediment, no further analyses were necessary.

Table 39. Statistical analysis of chromium (μg/g wet tissue) in shrimp from a 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	0.67	0.85	0.49
2	0.30	0.38	0.34
3	0.33	0.49	0.23
4	0.27	0.27	0.34
5	0.15	0.40	0.33
Sum of data, Σx =	1.72	2.39	1.73
Mean $\bar{X}$ =	0.34	0.47	0.35
Sum of squared data, Σx^2 =	0.743	1.33	0.633
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	0.151	0.197	0.034
Variance =	0.037	0.049	0.0086

$C = \frac{0.049}{0.0946} = 0.518$; see Table 9 for equation.

Chi square (3,4) = 0.7457

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

Table 40. Statistical analysis of copper ($\mu g/g$ wet tissue) in shrimp from a 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	13	16	9.9
2	10	12	12
3	14	11	10
4	12	9.1	11
5	12	10	12
Sum of data, Σx =	61	58.1	54.9
Mean $\bar{X}$ =	12.2	11.6	10.9
Sum of squared data,			
Σx^2 =	753.0	703.8	607.0
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	8.80	28.68	4.20
Variance =	2.20	7.17	1.05

Since mean concentration in reference samples was greater than mean concentrations in samples from Site 1 and Site 2, no further analyses were performed.

Table 41. Statistical analysis of lead (μg/g wet tissue) in shrimp from a 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	0.0	0.0	1.2
2	0.0	0.0	1.5
3	0.0	1.1	1.2
4	0.0	1.5	1.8
5	0.0	1.4	2.0
Sum of data, Σx =	0.0	4.0	7.7
Mean X =	0.0	0.80	1.54
Sum of squared data, Σx^2 =	0.0	5.42	12.37
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	0.0	2.220	0.512
Variance =	0.0	0.5550	0.128

$C = \frac{0.5550}{0.6830} = 0.812$; see Table 9 for equation.

Chi square (3,4) = 0.7457

Since calculated C value is greater than tabulated Chi square, variances are not homogeneous and transformation is necessary.

Table 42. Statistical analysis of nickel (μg/g wet tissue) in shrimp from a 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	0.0	0.0	0.40
2	0.0	0.0	0.0
3	0.0	0.71	0.0
4	0.0	0.0	0.57
5	0.0	0.61	0.0
Sum of data, Σx =	0.0	1.32	0.97
Mean $\bar{X}$ =	0.0	0.264	0.194
Sum of squared data, Σx^2 =	0.0	0.8762	0.4849
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	0.0	0.5277	0.2967
Variance =	0.0	0.1319	0.0742

$C = \frac{0.1319}{0.2061} = 0.639$; see Table 9 for equation.

Chi square (3,4) = 0.7457

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

Table 43. Statistical analysis of zinc (μg/g wet tissue) in shrimp from a 10-day bioaccumulation study, Pensacola, FL.

Replicate (n = 5)	Reference	Sites 1	Sites 2
1	16	18	14
2	11	15	15
3	14	16	10
4	16	25	18
5	25	18	20
Sum of data, Σx =	82	92	77
Mean $\bar{X}$ =	16.4	18.4	15.4
Sum of squared data, Σx^2 =	1454	1754	1245
CSS = $\Sigma x^2 - \frac{(\Sigma X)^2}{n}$ =	109.2	61.2	59.2
Variance =	27.3	15.3	14.8

$C = \frac{27.3}{54.4} = 0.475$; see Table 9 for equation.

Chi square (3,4) = 0.7457

Since calculated C is less than tabulated chi-square value, transformation is unnecessary.

Table 44. Analysis of variance of arsenic accumulation in shrimp from a 10-day bioaccumulation study, Pensacola, FL, using transformed data.

Analysis of Variance Procedure

Dependent Variable: Log PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	0.0081826	0.0004091	3.44	0.0659
Error	12	0.014265	0.001188		
Corrected Total	14	0.022447			

C.V.	Root MSE	Log PPM Mean
3.439	0.03447	1.0023

Table 45. Analysis of variance of chromium accumulation in shrimp from a 10-day bioaccumulation study, Pensacola, FL, using transformed data.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	0.058973	0.02948	0.92	0.4239
Error	12	0.383525	0.03196		
Corrected Total	14	0.44249			

C.V.	Root MSE	PPM Mean
45.917	0.17877	0.3893

Table 46. Analysis of variance of nickel accumulation in shrimp from a 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	0.18705	0.09352	1.36	0.2932
Error	12	0.82444	0.06870		
Corrected Total	14	1.01149			

C.V.	Root MSE	PPM Mean
171.68	0.2621	0.15266

Table 47. Analysis of variance of lead accumulation in shrimp from a 10-day bioaccumulation study, Pensacola, FL, using transformed data.

Analysis of Variance Procedure

Dependent Variable: Log PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	0.40408	0.20204	13.52	0.0008
Error	12	0.17937	0.01494		
Corrected Total	14	0.5834			

C.V.	Root MSE	Log PPM Mean
59.0174	0.1222	0.2071

Table 48. Analysis of variance of zinc accumulation in shrimp from a 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	23.3333	11.66666	0.61	0.559
Error	12	229.6000	19.13333		
Corrected Total	14	252.9333			

C.V.	Root MSE	PPM Mean
26.1404	4.37417	16.733

Table 49. Comparison of lead residues in shrimp for the 10-day bioaccumulation study, Pensacola, FL.

$$S_{\bar{x}} = \sqrt{\frac{MSE}{n}} = \sqrt{\frac{0.01494}{5}} = 0.05466$$

At the alpha = 0.05 level,

	K: 2	K: 3
Q	3.08	3.77
$S_{\bar{x}}$	0.05466	0.05466
LSR = $QS_{\bar{x}}$	0.1693	0.2060

Treatment means from computer printout

Ref	Site 1	Site 2
0.0	0.800	1.54

Mean Comparison

K	LSR	Difference between means
2	0.168	Site 1 - Ref = 0.800*
3	0.206	Site 2 - Ref =0.740*

* Indicates significant difference at alpha = 0.05

Table 50. 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 Pensacola, FL, in a 10-day bioaccumulation study. Concentrations are given in μg/g wet tissue.

Sample Origin	Shrimp					Lugworm					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	0.80	ND	NA	NA	NA	NA	17	17	NA	NA	6.8	3.6	NA	NA	NA	-	-
Aromatic	ND	ND	NA	NA	NA	3.9	2.9	NA	NA	NA	2.5	ND	NA	NA	NA	-	-
Site 1																	
Aliphatic	3.1	5.3	1.4	1.21	0.96	10	12	12	12	8.7	1.8	1.8	1.3	1.3	1.6	9.0	SNA
Aromatic	ND	ND	0.63	ND	ND	1.9	4.7	8.3	0.78	2.6	ND	0.96	ND	ND	ND	ND	SNA
Site 2																	
Aliphatic	ND	ND	1.1	3.9	ND	12	9.3	7.4	8.4	20	1.4	1.7	1.2	0.85	5.0	ND	SNA
Aromatic	ND	ND	ND	ND	ND	3.5	4.9	5.1	2.9	4.4	ND	0.77	1.8	2.5	5.8	ND	SNA
Reference																	
Aliphatic	0.81	ND	SC	ND	ND	11	7.4	7.1	9.8	6.4	ND	0.88	1.4	1.6	1.8	16	SNA
Aromatic	ND	ND	2.5	ND	ND	11	ND	ND	ND	ND	2.5	3.2	ND	ND	ND	1.3	SNA

ND = Not detected.

NA = Sample not applicable.

SC = Sample contaminated, unable to quantitate accurately.

SNA = Sample not analyzed.

Table 51. Statistical analysis of petroleum hydrocarbons (μg/g wet tissue) in oysters from a 10-day bioaccumulation study, Pensacola, FL.

Replicate	Reference		Sites 1		Sites 2	
	ALH	ARH	ALH	ARH	ALH	ARH
1	0.0	2.5	1.8	0.0	1.4	0.0
2	0.88	3.2	1.8	0.96	1.7	0.77
3	1.4	0.0	1.3	0.0	1.2	1.8
4	1.6	0.0	1.3	0.0	0.85	2.5
5	1.8	0.0	1.6	0.0	5.0	5.8
Sum Σx =	5.68	5.7	7.8	0.96	10.15	10.87
Mean $\bar{X}$ =	1.13	1.14	1.56	0.192	2.03	2.17
Sum of squared data,						
Σx^2 =	8.53	16.49	12.42	0.9216	30.01	43.72
CSS =	2.081	9.99	0.252	0.7373	11.40	20.09
Variance =	0.5205	2.498	0.063	0.1843	2.85	5.022

A zero number was substituted for each ND value so that statistical analyses could be performed.

$C\ (ALH) = \frac{2.85}{3.43} = 0.830$; $C(ARH) = \frac{5.022}{7.70} = 0.652$; see Table 9 for equation.

Chi square (3,4) = 0.7457

Since calculated C(ALH) value is greater than tabulated chi-square value, variances are not homogeneous and transformation is necessary. However, since calculated C(ARH) value is less than the tabulated chi-square value, variances are assumed to be homogeneous and transformation is unnecessary.

Table 52. Analysis of variance of aliphatic petroleum hydrocarbon accumulation in oysters from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: Log PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	0.0083266	0.004163	0.25	0.781
Error	11	0.181706	0.016518		
Corrected Total	13				

C.V.	Root MSE	Log PPM Mean
31.300	0.1285	0.4106

Table 53. Analysis of variance of aromatic petroleum hydrocarbon accumulation in oysters from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	9.8269	4.9134	1.91	0.19
Error	12	30.8208	2.5684		
Corrected Total	14	40.6477			

C.V.	Root MSE	PPM Mean
137.132	1.6026	1.168

Table 54. Statistical analysis of petroleum hydrocarbons (μg/g wet tissue) in lugworms from the 10-day bioaccumulation study, Pensacola, FL.

Replicate	Reference		Sites 1		Sites 2	
	ALH	ARH	ALH	ARH	ALH	ARH
1	11	11	10	1.9	12	3.5
2	7.4	0.0	128	4.7	9.3	4.9
3	7.1	0.0	123	8.3	7.4	5.1
4	9.8	0.0	123	0.78	8.4	2.9
5	6.4	0.0	8.7	2.6	20	4.4
Sum Σx =	41.7	11.0	54.7	18.28	57.1	20.8
Mean X =	8.34	2.2	10.94	3.65	11.4	4.16
Sum of squared data,						
Σx^2 =	363.17	121.0	607.69	101.95	755.81	90.04
CSS =	15.39	96.8	9.27	35.12	103.72	3.51
Variance =	3.84	24.2	2.31	8.78	25.9	0.878

A zero was substituted for each not detected value so that statistical analyses could be performed.

C (ALH) = $\frac{25.9}{32.05}$ = 0.808 Chi square (3,4) - 0.7457; see Table 9 for equation.

Since calculated C value is greater than tabulated chi-square value for ALH, variances are not homogeneous and transformation is necessary.

C(ARH) = $\frac{24.2}{33.86}$ = 0.7147

Since calculated C value is less than tabulated chi-square value for ARH, variances are assumed to be homogeneous, and transformation is unnecessary.

Table 55. Analysis of variance of aliphatic petroleum hydrocarbon accumulation in lugworms from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: Log PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	0.03945	0.01972	1.64	0.214
Error	12	0.14460	0.01205		
Corrected Total	14	0.18406			

C.V.	Root MSE	Log PPM Mean
10.602	0.10977	1.0354

Table 56. Analysis of variance of aromatic petroleum hydrocarbon accumulation in lugworms from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	10.359	5.179	0.46	0.642
Error	12	135.43	11.286		
Corrected Total	14	145.79			

C.V.	Root MSE	PPM Mean
100.62	3.359	3.33

Table 57. Statistical analysis of petroleum hydrocarbons (μg/g wet tissue) in shrimp from the 10-day bioaccumulation study, Pensacola, FL.

Replicate	Reference		Sites 1		Sites 2	
	ALH	ARH	ALH	ARH	ALH	ARH
1	0.81	0.0	3.1	0.0	0.0	0.0
2	0.0	0.0	5.3	0.0	0.0	0.0
3	SC	2.5	1.4	0.63	1.1	0.0
4	0.0	0.0	1.2	0.0	3.9	0.0
5	0.0	0.0	0.96	0.0	0.0	0.0
Sum Σx =	0.81	2.5	11.96	0.63	5.0	0.0
Mean $\bar{X}$ =	0.2025	0.50	2.39	0.126	1.0	0.0
Sum of squared data,						
Σx^2 =	0.656	6.25	42.02	0.396	16.42	0.0
CSS =	0.4921	5.00	13.41	0.3175	11.42	0.0
Variance =	0.164	1.25	3.35	0.0794	2.855	0.0

SC = Sample contaminated, unable to quantitate accurately.

Since only one detectable concentration was determined for the aromatic and the aliphatic fractions in the reference samples, a zero was substituted for each ND value so that statistical analyses could be performed.

C (ALH) = $\frac{3.35}{6.37}$ = 0.530; C(ARH) = $\frac{1.25}{1.33}$ = 0.94; Chi square (3,4) = 0.7457; see Table 9 for equation.

Since calculated C value is less than tabulated chi-square value for ALH, variances are assumed to be homogeneous and transformation is unnecessary. However, since calculated C value for ARH is greater than tabulated Chi square, transformation is necessary.

e value for AOV is greater than tabulated chi square, transformation is necessary.

Table 58. Analysis of variance of aliphatic petroleum hydrocarbon residue accumulation in shrimp from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	11.2171	5.608	2.44	0.133
Error	11	25.3253	2.3023		
Corrected Total	13	36.542			

C.V.	Root MSE	PPM Mean
119.5	1.517	1.269

Table 59. Analysis of variance of aromatic petroleum hydrocarbon accumulation in shrimp from the 10-day bioaccumulation study, Pensacola, FL.

Analysis of Variance Procedure

Dependent Variable: Log PPM

Source	DF	Sum of Squares	Mean Square	F Value	Pr < F
Model	2	0.030078	0.01503	0.66	0.533
Error	12	0.2728	0.02273		
Corrected Total	14	0.3029			

C.V.	Root MSE	Log PPM Mean
299.07	0.1507	0.0504

APPENDIX E

BENTHIC STUDIES

SITE B NOVEMBER 1986

SITE B APRIL 1987

SITE C NOVEMBER 1986

SITE C APRIL 1987

DATA ANALYSIS RESULTS

SITE B NOVEMBER 1986

Biological Community Parameters

Biomass Data

Taxonomic List

SITE B
BIOLOGICAL COMMUNITY PARAMETERS

EPA--PENSACOLA, FLORIDA
Sample Type: MACROFAUNA

Sample Date (YY/MM/DD): 86/11/07
Sample Area (sq. m.): 0.0079

STATION NUMBER	TOTAL TAXA	MEAN TAXA PER REPL.	TOTAL NO. INDIVIDUALS	MEAN DENSITY	STANDARD DEVIATION	H'	J'	D
001	177	38.4	1207	10185	6013	4.36	0.84	24.80
002	179	45.6	1562	13181	3487	4.21	0.81	24.21
003	151	35.6	1612	13603	7173	3.62	0.72	20.31
004	160	41.6	1410	11898	3605	4.19	0.83	21.93
005	182	48.8	3632	30649	13162	2.93	0.56	22.08
006	179	41.6	1586	13383	6972	3.92	0.76	24.16
007	167	39.0	1307	11029	3611	4.12	0.81	23.13
008	162	40.4	2242	18919	9420	3.18	0.63	20.87
009	194	48.8	2893	24413	12385	3.47	0.66	24.22
010	174	45.1	1633	13780	5556	4.12	0.80	23.38
011	196	42.2	1325	11181	5246	4.30	0.81	27.12
012	160	38.9	1503	12683	6138	3.94	0.78	21.74
013	190	49.0	3038	25637	9158	3.01	0.57	23.57
014	164	39.1	2387	20143	15076	2.90	0.57	20.96
015	177	43.0	1447	12210	7073	4.19	0.81	24.18
016	133	37.3	1389	11721	3579	3.67	0.75	18.24
017	181	50.4	3169	26742	10146	3.11	0.60	22.33
018	185	42.1	1208	10194	3716	4.33	0.83	25.93
019	182	45.2	1671	14101	7164	4.00	0.77	24.39
020	184	43.6	1532	12928	3571	4.06	0.78	24.95

Wet weight biomass for Pensacola, Florida, B Site, November 1986. All weights in grams.

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB1	ANNELIDA	0.031	0.021	0.054	0.012	0.006	0.010	0.071	0.025	0.031	0.021	0.004	0.012	0.032	0.021	0.024	[illegible]
PFB1	ARTHROPODA	0.039	0.017	0.002	0.005	0.002	0.006	0.005	0.004	0.007	0.025	0.004	0.007	0.004	0.001	0.002	[illegible]
PFB1	MOLLUSCA	0.006	0.190	0.064	0.015	0.521	0.001	0.070	0.015	0.054	0.003	0.009	0.002	0.148	0.022	0.001	[illegible]
PFB1	ECHINODERMATA	0.001	0.000	0.001	0.001	0.002	0.001	0.001	0.005	0.015	0.001	0.000	0.000	0.000	0.001	0.001	0.033
PFB1	MISCELLANEOUS	0.000	0.001	0.007	0.001	0.001	0.033	0.002	0.004	0.009	0.003	0.002	0.001	0.001	0.001	0.001	0.089
	TOTAL	0.077	0.229	0.128	0.034	0.532	0.001	0.149	0.053	0.116	0.033	0.019	0.022	0.185	0.046	0.029	1.753

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB2	ANNELIDA	0.024	0.008	0.020	0.015	0.015	0.032	0.034	0.004	0.074	0.271	0.003	0.013	0.005	0.019	0.005	0.542
PFB2	ARTHROPODA	0.003	0.007	0.008	0.008	0.003	0.002	0.001	0.007	0.014	0.003	0.006	0.006	0.004	0.041	0.007	0.160
PFB2	MOLLUSCA	0.010	0.025	0.021	0.039	0.007	1.429	0.016	0.023	0.042	0.017	0.011	0.015	0.039	0.033	0.014	1.741
PFB2	ECHINODERMATA	0.001	0.000	0.000	0.001	0.001	0.001	0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	[illegible]
PFB2	MISCELLANEOUS	0.005	0.015	0.003	0.003	0.001	0.001	0.001	0.001	0.004	0.011	0.003	0.001	0.002	0.007	0.002	0.061
	TOTAL	0.043	0.055	0.052	0.126	0.027	1.465	0.052	0.036	0.134	0.303	0.024	0.036	0.051	0.100	0.030	2.534

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB3	ANNELIDA	0.012	0.006	0.027	0.014	0.011	0.003	0.026	0.004	0.057	0.010	0.005	0.015	0.005	0.003	0.014	0.206
PFB3	ARTHROPODA	0.063	0.007	0.007	0.006	0.004	0.005	0.002	0.001	0.003	[illegible]	0.013	0.003	0.006	0.003	0.002	0.068
PFB3	MOLLUSCA	0.031	0.033	0.049	0.028	0.031	0.028	0.020	0.007	0.001	0.139	0.010	0.046	0.014	0.008	0.004	0.449
PFB3	ECHINODERMATA	0.000	0.001	0.001	0.001	0.001	0.002	0.005	0.000	0.001	[illegible]	0.001	0.004	0.004	[illegible]	0.000	0.023
PFB3	MISCELLANEOUS	0.003	0.004	0.002	0.005	0.001	0.002	0.003	0.001	0.000	0.003	0.001	0.002	0.001	0.001	0.005	0.035
	TOTAL	0.049	0.051	0.086	0.054	0.048	0.040	0.050	0.013	0.062	0.156	0.036	0.071	0.030	0.016	0.025	0.761

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB4	ANNELIDA	0.026	0.020	0.006	0.962	0.007	0.004	0.005	0.010	0.016	0.012	0.017	0.011	0.045	0.009	0.010	1.160
PFB4	ARTHROPODA	0.010	0.003	0.006	0.010	0.004	0.003	0.009	0.005	0.008	0.008	0.371	0.002	0.005	[illegible]	0.005	0.472
PFB4	MOLLUSCA	0.007	0.001	0.019	0.019	0.027	0.002	0.035	0.015	0.008	0.004	0.014	0.069	0.003	0.036	0.004	[illegible]
PFB4	ECHINODERMATA	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.006	0.001	0.001	0.001	0.001	0.013
PFB4	MISCELLANEOUS	0.001	0.003	0.002	0.003	0.004	0.001	0.005	0.001	0.001	0.001	0.002	0.001	0.001	0.005	0.003	0.034
	TOTAL	0.045	0.028	0.033	0.986	0.043	0.011	0.055	0.032	0.034	0.026	0.404	0.034	0.055	0.056	0.023	1.867

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB5	ANNELIDA	0.005	0.017	0.013	0.029	0.032	0.120	0.007	0.022	0.006	0.009	0.011	0.102	0.012	0.019	0.011	0.423
PFB5	ARTHROPODA	0.003	0.006	0.011	0.010	0.014	0.002	0.007	0.010	0.066	0.001	0.011	0.023	0.015	0.002	0.005	0.126
PFB5	MOLLUSCA	0.060	0.026	0.068	0.040	0.056	0.102	0.052	0.069	0.053	0.073	0.002	0.094	0.052	0.031	0.046	0.898
PFB5	ECHINODERMATA	0.001	0.001	0.005	0.001	0.001	0.001	0.005	0.001	0.001	0.001	0.000	0.000	0.005	0.001	0.001	0.025
PFB5	MISCELLANEOUS	0.001	0.003	0.003	[illegible]	0.005	0.066	0.004	0.003	0.002	0.002	0.009	0.005	0.053	0.003	0.007	0.109
	TOTAL	0.070	0.047	[illegible]	0.083	0.106	0.239	0.075	0.105	0.068	0.086	0.113	0.224	0.137	0.056	0.070	1.561

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB6	ANNELIDA	0.008	0.049	0.026	0.005	0.015	0.008	0.016	0.009	0.019	0.009	0.003	0.009	0.046	0.010	0.038	0.238
PFB6	ARTHROPODA	0.004	0.062	0.005	0.003	0.004	0.011	0.008	0.008	0.002	0.009	0.002	0.005	0.001	[illegible]	0.002	0.073
PFB6	MOLLUSCA	0.023	0.006	0.021	0.065	0.032	0.027	0.023	0.038	0.009	12.040	0.016	0.029	0.005	0.038	[illegible]	[illegible]
PFB6	ECHINODERMATA	0.001	0.001	0.000	0.001	0.001	0.005	0.001	0.002	0.000	[illegible]	0.006	0.001	0.001	0.011	0.001	0.093
PFB6	MISCELLANEOUS	0.003	0.004	0.004	0.006	0.007	0.007	0.004	0.006	0.003	[illegible]	0.002	0.001	0.001	0.004	0.001	0.054
	TOTAL	0.039	0.062	0.056	0.080	0.059	0.058	0.052	0.063	0.033	12.060	0.009	0.045	0.014	0.070	0.053	12.841

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB7	ANNELIDA	0.047	0.013	0.034	0.023	0.007	0.008	0.006	0.037	0.002	0.006	0.011	0.009	0.027	0.002	0.067	0.239
PFB7	ARTHROPODA	0.005	0.002	0.403	0.004	0.004	0.001	0.007	0.015	0.010	0.002	0.002	0.026	0.034	0.003	0.005	0.523
PFB7	MOLLUSCA	0.021	0.003	0.004	0.016	0.036	0.021	0.003	0.011	0.004	0.171	0.011	0.002	0.061	0.002	0.004	0.310
PFB7	ECHINODERMATA	0.002	0.001	0.001	0.004	0.001	0.003	0.001	2.310	0.004	0.006	0.001	0.001	0.001	0.000	0.000	2.336
PFB7	MISCELLANEOUS	0.015	0.002	0.004	0.022	0.007	0.011	0.007	0.006	0.019	0.044	0.007	0.002	0.006	0.005	0.004	0.161
	TOTAL	0.090	0.021	0.446	0.069	0.055	0.044	0.024	2.379	0.039	0.229	0.032	0.040	0.069	0.012	0.020	3.569

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB8	ANNELIDA	0.021	0.039	0.016	0.022	0.022	0.062	0.031	0.019	0.016	0.046	0.026	0.014	0.018	0.012	0.008	0.372
PFB8	ARTHROPODA	0.003	0.062	0.006	0.001	0.004	0.004	0.011	0.003	0.002	0.008	0.004	0.003	0.003	0.006	0.015	0.075
PFB8	MOLLUSCA	0.028	0.022	0.030	0.029	0.033	0.025	0.001	0.051	0.042	0.067	0.004	0.010	0.026	0.024	0.074	0.634
PFB8	ECHINODERMATA	0.001	0.001	0.006	0.004	0.006	0.000	0.000	0.001	0.006	0.006	0.006	0.000	0.006	0.006	0.001	[illegible]
PFB8	MISCELLANEOUS	0.046	0.002	0.002	0.002	0.007	0.066	0.009	0.003	0.003	0.002	0.010	0.002	0.003	0.002	0.007	0.106
	TOTAL	0.099	0.066	0.054	0.058	0.066	0.099	0.132	0.077	0.063	0.123	0.124	0.037	0.056	0.044	0.105	1.197

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB9	ANNELIDA	0.006	0.020	0.063	0.022	0.023	0.029	0.015	0.023	0.051	0.037	0.016	0.039	0.009	0.028	0.010	0.391
PFB9	ARTHROPODA	0.009	0.012	0.026	0.026	0.007	0.004	0.001	0.004	0.067	0.018	0.014	0.014	0.025	0.014	0.003	0.244
PFB9	MOLLUSCA	0.010	0.114	0.009	0.007	0.024	0.017	0.012	0.029	0.019	0.022	0.019	0.003	0.017	0.011	0.007	0.320
PFB9	ECHINODERMATA	0.001	0.003	0.001	0.003	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.004	0.001	0.001	0.000	0.020
PFB9	MISCELLANEOUS	0.016	0.007	0.001	0.005	0.004	0.002	0.067	0.007	0.001	0.012	0.004	0.002	0.003	0.001	0.003	0.075
	TOTAL	0.042	0.156	0.100	0.063	0.059	0.053	0.036	0.064	0.139	0.089	0.054	0.062	0.055	0.055	0.023	1.050

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB10	ANNELIDA	0.055	0.010	0.017	0.027	0.009	0.005	0.043	0.062	0.039	0.023	0.037	0.006	0.011	0.012	0.008	0.364
PFB10	ARTHROPODA	0.005	0.003	0.008	0.008	0.017	0.005	0.062	0.025	0.003	0.043	0.009	0.003	0.012	0.008	0.009	0.120
PFB10	MOLLUSCA	0.054	0.018	0.051	0.138	0.016	0.005	0.007	0.016	0.044	0.030	0.025	0.069	0.005	0.012	0.026	0.456
PFB10	ECHINODERMATA	0.008	0.012	0.001	0.002	0.003	0.008	0.013	0.001	0.002	0.003	0.004	0.001	0.003	0.004	0.001	0.050
PFB10	MISCELLANEOUS	0.005	0.026	0.007	0.009	0.003	0.001	0.003	0.005	0.001	0.001	0.001	0.001	0.003	0.001	0.002	0.069
	TOTAL	0.119	0.069	0.084	0.184	0.048	0.016	0.068	0.109	0.089	0.060	0.076	0.020	0.034	0.037	0.046	1.059

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB11	ANNELIDA	0.004	0.016	0.002	0.013	0.005	0.006	0.003	0.017	0.073	0.002	0.028	0.042	0.018	0.036	0.018	0.283
PFB11	ARTHROPODA	0.002	0.065	0.023	0.004	0.002	0.006	0.061	0.018	0.005	0.004	0.016	0.001	0.012	0.009	0.005	0.113
PFB11	MOLLUSCA	0.005	0.066	0.010	0.001	0.051	0.002	0.066	0.066	0.033	0.056	0.101	0.603	0.004	0.035	0.012	0.333
PFB11	ECHINODERMATA	0.000	0.027	0.000	0.008	0.001	0.001	0.001	0.007	0.001	0.000	0.002	0.000	0.001	0.000	0.001	0.050
PFB11	MISCELLANEOUS	0.012	0.001	0.001	0.003	0.002	0.003	0.001	0.003	0.031	0.001	0.001	0.000	0.003	0.001	0.012	0.075
	TOTAL	0.023	0.057	0.036	0.029	0.061	0.018	0.012	0.051	0.143	0.063	0.148	0.046	0.038	0.081	0.048	0.854

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB12	ANNELIDA	0.017	0.007	0.012	0.015	0.063	0.012	0.063	0.004	0.017	0.016	0.010	0.004	0.015	0.011	0.029	0.169
PFB12	ARTHROPODA	0.033	0.004	0.004	0.013	0.003	0.004	0.003	0.003	0.006	0.004	0.011	0.006	0.003	0.002	0.019	0.118
PFB12	MOLLUSCA	0.034	0.005	0.004	0.015	0.015	0.005	0.003	0.004	0.007	0.010	0.010	0.001	0.151	0.010	0.002	0.278
PFB12	ECHINODERMATA	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.012
PFB12	MISCELLANEOUS	0.012	0.06.	0.001	0.005	0.001	0.004	0.004	0.006	0.002	005	0.003	0.063	0.016	0.003	0.001	0.061
	TOTAL	0.097	0.018	0.022	0.049	0.022	0.026	0.014	0.018	0.033	0.030	0.035	0.015	0.166	0.026	0.051	0.636

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB13	ANNELIDA	0.012	0.041	0.012	0.008	0.014	0.030	0.048	0.022	0.041	0.011	0.013	0.064	0.034	0.006	0.012	0.388
PFB13	ARTHROPODA	0.066	0.011	0.012	0.004	0.004	0.003	0.015	0.015	0.007	0.006	0.022	0.004	0.009	0.005	0.008	0.133
PFB13	MOLLUSCA	0.117	0.062	0.024	0.054	0.138	0.064	0.107	0.055	0.035	0.058	0.057	0.054	0.034	0.053	0.072	0.904
PFB13	ECHINODERMATA	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.003
PFB13	MISCELLANEOUS	0.012	0.005	0.001	0.010	0.302	0.005	0.003	0.002	0.002	0.004	0.001	0.002	0.003	0.002	0.002	0.356
	TOTAL	0.147	0.119	0.049	0.077	0.458	0.102	0.173	0.094	0.085	0.082	0.093	0.064	0.081	0.066	0.094	1.784

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB14	ANNELIDA	0.016	0.005	0.036	0.003	0.028	0.004	0.002	0.036	0.008	0.009	0.011	0.009	0.006	0.017	0.006	0.190
PFB14	ARTHROPODA	0.063	0.014	0.018	0.005	0.000	0.007	0.002	0.003	0.001	0.001	0.001	0.003	0.004	0.008	0.004	0.082
PFB14	MOLLUSCA	0.070	0.113	0.007	0.008	0.026	0.118	0.150	0.040	0.067	0.014	0.613	0.119	0.010	0.017	0.008	0.780
PFB14	ECHINODERMATA	0.001	0.000	0.000	0.001	0.002	0.001	0.001	0.006	0.001	0.001	0.006	0.002	0.001	0.000	0.002	0.013
PFB14	MISCELLANEOUS	0.003	0.004	0.001	0.001	0.001	0.002	0.001	0.005	0.003	0.001	0.001	0.001	0.001	0.001	0.002	0.028
	TOTAL	0.007	0.136	0.062	0.018	0.065	0.132	0.156	0.084	0.080	0.026	0.626	0.134	0.022	0.043	0.022	1.093

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB15	ANNELIDA	0.029	0.030	0.005	0.024	0.023	0.019	0.007	0.047	0.028	0.027	0.635	0.020	0.026	0.020	0.062	0.342
PFB15	ARTHROPODA	0.010	0.013	0.004	0.019	0.007	0.029	0.006	0.005	0.006	0.065	0.004	0.006	0.013	0.005	0.003	0.135
PFB15	MOLLUSCA	0.002	0.026	0.009	0.030	0.003	0.020	0.004	0.005	0.015	0.359	0.001	0.010	0.010	0.026	0.002	0.522
PFB15	ECHINODERMATA	0.001	0.005	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.000	0.017
PFB15	MISCELLANEOUS	0.004	0.014	0.001	0.001	0.001	0.001	0.001	0.003	0.002	0.062	0.001	0.001	0.002	0.001	0.003	0.038
	TOTAL	0.046	0.088	0.020	0.075	0.035	0.070	0.019	0.061	0.051	0.394	0.042	0.038	0.052	0.053	0.010	1.054

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB16	ANNELIDA	0.060	0.029	0.003	0.010	0.040	0.050	0.002	0.001	0.038	0.029	0.023	0.008	0.036	0.017	0.011	0.313
PFB16	ARTHROPODA	0.008	0.026	0.002	0.007	0.004	0.007	0.066	0.005	0.010	0.007	0.008	0.009	0.001	0.015	0.064	0.113
PFB16	MOLLUSCA	0.049	0.037	24.017	0.011	0.612	0.061	0.031	0.021	0.010	0.042	0.020	0.028	0.059	0.010	0.261	24.669
PFB16	ECHINODERMATA	0.006	0.001	0.006	0.000	0.000	0.001	0.000	0.001	0.006	0.001	0.006	0.006	0.006	0.000	0.001	0.085
PFB16	MISCELLANEOUS	0.001	0.001	0.001	0.000	0.001	0.001	0.002	0.002	0.001	0.004	0.001	0.001	0.001	0.023	0.001	0.049
	TOTAL	0.066	0.088	24.623	0.036	0.057	0.126	0.041	0.030	0.059	0.083	0.052	0.046	0.097	0.065	0.278	25.149

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PF017	ANNELIDA	0.032	0.016	0.058	0.014	0.034	0.008	0.021	0.018	0.011	0.025	0.043	0.022	0.006	0.013	0.003	0.344
PF017	ARTHROPODA	0.005	0.002	0.025	0.003	0.013	0.004	0.003	0.005	0.007	0.005	0.006	0.008	0.006	0.010	0.005	0.107
PF017	MOLLUSCA	0.042	0.122	0.265	0.007	0.075	0.040	0.045	0.049	0.078	0.081	0.040	0.098	0.023	0.007	0.085	1.057
PF017	ECHINODERMATA	0.001	0.002	0.000	0.005	0.001	0.003	0.001	0.001	0.000	0.004	0.006	0.063	0.003	0.001	0.004	0.035
PF017	MISCELLANEOUS	0.001	0.004	0.003	0.002	0.012	0.002	0.002	0.011	0.011	0.006	0.003	0.004	0.003	0.035	0.005	0.104
	TOTAL	0.101	0.146	0.351	0.031	0.135	0.057	0.072	0.084	0.107	0.121	0.098	0.135	0.041	0.066	0.102	1.647

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PF018	ANNELIDA	0.004	0.028	0.018	0.007	0.035	0.098	0.033	0.012	0.016	0.030	0.010	0.013	0.025	0.024	0.007	1.152
PF018	ARTHROPODA	0.019	0.032	0.004	0.003	0.021	0.011	0.004	0.004	0.013	0.005	0.011	0.010	0.015	0.010	0.007	0.169
PF018	MOLLUSCA	0.025	0.005	0.002	0.001	0.003	0.002	0.003	0.002	0.004	0.007	0.001	0.001	0.006	0.011	0.003	0.076
PF018	ECHINODERMATA	0.000	0.006	0.001	0.001	0.001	0.003	0.001	0.001	0.001	0.000	0.002	0.000	0.000	0.001	0.000	0.610
PF018	MISCELLANEOUS	0.005	0.005	0.007	0.001	0.001	0.001	0.001	0.003	0.308	0.001	0.009	0.003	0.002	0.002	0.001	0.050
	TOTAL	0.053	0.068	0.032	0.013	0.061	0.115	0.042	0.022	0.342	0.043	0.033	0.027	0.048	0.048	0.018	1.465

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PF019	ANNELIDA	0.019	0.021	0.014	0.007	0.013	0.008	0.029	0.021	0.022	0.017	0.003	0.007	0.065	0.003	0.006	0.257
PF019	ARTHROPODA	0.040	0.007	0.002	0.007	0.007	0.002	0.012	0.023	0.008	0.012	0.021	0.009	0.003	0.006	0.004	0.163
PF019	MOLLUSCA	0.008	0.005	0.023	0.005	0.019	0.004	0.011	0.006	0.018	0.003	0.007	0.004	0.006	0.006	0.003	0.920
PF019	ECHINODERMATA	0.001	0.006	0.000	0.001	0.001	0.001	0.000	0.002	0.000	0.001	0.001	0.001	0.567	0.001	0.001	0.578
PF019	MISCELLANEOUS	0.006	0.001	0.001	0.023	0.001	0.003	0.005	0.001	0.004	0.002	0.001	0.001	0.002	0.002	[illegible]	0.054
	TOTAL	0.074	0.034	0.040	0.043	0.043	0.018	0.057	0.053	0.052	0.335	0.033	0.022	0.643	0.018	0.015	1.980

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PF020	ANNELIDA	0.023	0.034	0.014	0.019	0.020	0.009	0.019	0.005	0.019	0.013	0.037	0.008	0.006	0.018	0.007	0.253
PF020	ARTHROPODA	0.003	[illegible]	0.068	0.050	0.005	0.005	0.005	0.020	0.003	[illegible]	0.016	[illegible]	0.005	0.004	0.002	0.151
PF020	MOLLUSCA	0.007	0.004	[illegible]	0.006	0.009	0.001	0.002	0.006	0.008	[illegible]	[illegible]	0.001	0.008	0.002	0.003	0.071
PF020	ECHINODERMATA	0.001	0.001	0.001	0.000	0.006	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.011
PF020	MISCELLANEOUS	0.056	0.004	0.002	0.002	0.003	0.002	0.003	0.001	0.001	0.004	0.006	0.002	0.004	0.015	0.004	0.109
	TOTAL	0.090	0.054	0.031	0.077	0.037	0.018	0.030	0.033	0.032	0.028	0.043	0.020	0.026	0.040	0.016	0.395

TAXONOMIC LISTING

TAXONOMIC SPECIES LIST 09/01/87
EPA-PENSACOLA---SITE B---COLLECTED NOVEMBER 1986
==

ANNELIDA
- OLIGOCHAETA
  - OLIGOCHAETA (LPIL)*
- POLYCHAETA
  - AMPHARETIDAE
    - AMPHARETE SP.A
    - AMPHARETIDAE (LPIL)
    - AMPHICTEIS SCAPHOBRANCHIATA
    - ISOLDA PULCHELLA
    - MELINNA MACULATA
    - SABELLIDES SP.A
  - AMPHINOMIDAE
    - CHLOEIA VIRIDIS
    - PARAMPHINOME SP.B
  - ARABELLIDAE
    - ARABELLIDAE (LPIL)
    - DRILONEREIS LONGA
  - CAPITELLIDAE
    - CAPITELLA CAPITATA
    - CAPITELLIDAE (LPIL)
    - MEDIOMASTUS (LPIL)
    - MEDIOMASTUS CALIFORNIENSIS
    - NOTOMASTUS (LPIL)
  - CHAETOPTERIDAE
    - MESOCHAETOPTERUS (LPIL)
    - SPIOCHAETOPTERUS OCULATUS
  - CHRYSOPETALIDAE
    - BHAWANIA HETEROSETA
    - PALEANOTUS SP.A
  - CIRRATULIDAE
    - CAULLERIELLA (LPIL)
    - CAULLERIELLA CF. ALATA
    - CHAETOZONE (LPIL)
    - CIRRATULIDAE (LPIL)
    - CIRRIFORMIA (LPIL)
    - THARYX (LPIL)
    - THARYX CF. ANNULOSUS
  - DORVILLEIDAE
    - DUGIA TENUIDENTIS
    - PETTIBONEIA DUOFURCA
    - PROTODORVILLEA KEFERSTEINI
    - SCHISTOMERINGOS CF. RUDOLPHI
    - SCHISTOMERINGOS PECTINATA
  - EUNICIDAE
    - EUNICE VITTATA
    - EUNICIDAE (LPIL)
    - LYSIDICE SP.B
  - FLABELLIGERIDAE
    - FLABELLIGERIDAE (LPIL)

*LPIL - Lowest Practicable Identification Level

TAXONOMIC SPECIES LIST 09/01/87

EPA-PENSACOLA---SITE B---COLLECTED NOVEMBER 1986

==

THEROCHAETA SP.A

GLYCERIDAE

GLYCERA (LPIL)

GLYCERA DIBRANCHIATA

GLYCERA SP.A

GLYCERA SP.E

GLYCERA SP.I

GLYCERA SP.O

GLYCERIDAE (LPIL)

GONIADIDAE

GONIADA LITTOREA

GONIADIDAE (LPIL)

GONIADIDES CAROLINAE

HESIONIDAE

HESIONIDAE (LPIL)

HESIONIDAE GENUS D

HETEROPODARKE FORMALIS

HETEROPODARKE LYONSI

PODARKE (LPIL)

PODARKE SP.E

PODARKEOPSIS LEVIFUSCINA

LUMBRINERIDAE

LUMBRINERIDAE (LPIL)

LUMBRINERIDES DAYI

LUMBRINERIS (LPIL)

LUMBRINERIS LATREILLI

LUMBRINERIS SP.D

LUMBRINERIS SP.V

LUMBRINERIS VERRILLI

MAGELONIDAE

MAGELONA (LPIL)

MAGELONA SP.B

MAGELONA SP.C

MAGELONA SP.I

MALDANIDAE

ASYCHIS ELONGATUS

AXIOTHELLA SP.A

BOGUEA ENIGMATICA

MALDANIDAE (LPIL)

NEPHTYIDAE

NEPHTYS PICTA

NEPHTYS SIMONI

NEREIDAE

CERATOCEPHALE OCULATA

CERATONEREIS (LPIL)

NEREIDAE (LPIL)

NEREIS (LPIL)

NEREIS MICROMMA

ONUPHIDAE

DIOPATRA CUPREA

MOOREONUPHIS PALLIDULA
ONUPHIDAE (LPIL)
OPHELIIDAE
ARMANDIA MACULATA
OPHELIA DENTICULATA
OPHELIIDAE (LPIL)
TRAVISIA HOBSONAE
ORBINIIDAE
LEITOSCOLOPLOS (LPIL)
SCOLOPLOS (LPIL)
OWENIIDAE
OWENIA SP.A
OWENIIDAE (LPIL)
PARAONIDAE
ARICIDEA (LPIL)
ARICIDEA CERRUTII
ARICIDEA PHILBINAE
ARICIDEA SP.A
ARICIDEA SP.E
ARICIDEA SP.H
ARICIDEA TAYLORI
ARICIDEA WASSI
CIRROPHORUS (LPIL)
CIRROPHORUS BRANCHIATUS
LEVINSENIA GRACILIS
PARAONIDAE (LPIL)
PARAONIS PYGOENIGMATICA
PECTINARIIDAE
PECTINARIA GOULDII
PHYLLODOCIDAE
ANAITIDES LONGIPES
ETEONE LACTEA
EUMIDA SANGUINEA
GENETYLLIS SP.A
HESIONURA SP.A
MYSTIDES BOREALIS
PARANAITIS SPECIOSA
PHYLLODOCE ARENAE
PHYLLODOCIDAE (LPIL)
PILARGIDAE
ANCISTROSYLLIS HARTMANAE
LITOCORSA ANTENNATA
PILARGIDAE (LPIL)
SIGAMBRA BASSI
SIGAMBRA TENTACULATA
SYNELMIS EWINGI
SYNELMIS KLATTI
PISIONIDAE
PISIONE SP.A

POECILOCHAETIDAE
    POECILOCHAETUS (LPIL)
POLYGORDIIDAE
    POLYGORDIUS (LPIL)
POLYNOIDAE
    HARMOTHOE (LPIL)
    HARMOTHOE SP.B
    MALMGRENIELLA SP.C
    POLYNOIDAE (LPIL)
SABELLARIIDAE
    SABELLARIA SP.A
SABELLIDAE
    CHONE (LPIL)
    EUCHONE (LPIL)
    EUCHONE CF. INCOLOR
    FABRICIOLA TRILOBATA
    MEGALOMMA BIOCULATUM
    POTAMILLA (LPIL)
    SABELLIDAE (LPIL)
SACCOCIRRIDAE
    SACCOCIRRUS SP.A
SERPULIDAE
    HYDROIDES (LPIL)
    HYDROIDES MICROTIS
    HYDROIDES PROTULICOLA
    POMATOCEROS AMERICANUS
    PSEUDOVERMILIA OCCIDENTALIS
    SERPULA SP.A
    SERPULIDAE (LPIL)
    SERPULIDAE GENUS C
SIGALIONIDAE
    SIGALION SP.A
    SIGALIONIDAE (LPIL)
    THALENESSA CF. SPINOSA
SPIONIDAE
    AONIDES PAUCIBRANCHIATA
    DISPIO UNCINATA
    LAONICE CIRRATA
    MALACOCEROS (LPIL)
    MALACOCEROS INDICUS
    PARAPRIONOSPIO PINNATA
    POLYDORA CORNUTA
    POLYDORA SOCIALIS
    PRIONOSPIO (LPIL)
    PRIONOSPIO CIRRIFERA
    PRIONOSPIO CRISTATA
    SCOLELEPIS SQUAMATA
    SCOLELEPIS TEXANA

    SPIO PETTIBONEAE

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SPIONIDAE (LPIL)
SPIOPHANES BOMBYX
SPIOPHANES CF. MISSIONENSIS
SYLLIDAE
BRANIA WELLFLEETENSIS
EURYSYLLIS TUBERCULATA
EXOGONE (LPIL)
EXOGONE ATLANTICA
EXOGONE DISPAR
EXOGONE LOUREI
ODONTOSYLLIS ENOPLA
OPISTHODONTA SP.A
PARAPIONOSYLLIS LONGICIRRATA
PIONOSYLLIS GESAE
PLAKOSYLLIS QUADRIOCULATA
SPHAEROSYLLIS (LPIL)
SPHAEROSYLLIS ACICULATA
SPHAEROSYLLIS PIRIFEROPSIS
STREPTOSYLLIS PETTIBONEAE
SYLLIDAE (LPIL)
SYLLIDES FULVUS
TYPOSYLLIS AMICA
TEREBELLIDAE
LOIMIA SP.A
POLYCIRRUS (LPIL)
POLYCIRRUS SP.F
POLYCIRRUS SP.I
TEREBELLIDAE (LPIL)
TRICHOBRANCHIDAE
TEREBELLIDES SP.A
TRICHOBRANCHIDAE (LPIL)
TRICHOBRANCHUS GLACIALIS
ARTHROPODA (CRUSTACEA)
CRUSTACEA (LPIL)
AMPHIPODA
AMPHIPODA (LPIL)
AMPELISCIDAE
AMPELISCA (LPIL)
AMPELISCA AGASSIZI
AMPELISCA SP.A
AMPELISCA SP.C
AMPELISCA SP.L
AMPHILOCHIDAE
AMPHILOCHUS SP.C
GITANA CALITEMPLADO
AORIDAE
ACUMINODEUTOPUS (LPIL)
ACUMINODEUTOPUS SP.A

AORIDAE (LPIL)

TAXONOMIC LISTING

TAXONOMIC SPECIES LIST 09/01/87

EPA-PENSACOLA---SITE B---COLLECTED NOVEMBER 1986

===

AORIDAE GENUS B
LEMBOS (LPIL)
LEMBOS SMITHI
MICRODEUTOPUS MYERSI

ARGISSIDAE
ARGISSA HAMATIPES

BATEIDAE
CARINOBATEA CARINATA

COROPHIIDAE
COROPHIUM (LPIL)
COROPHIUM ACHERUSICUM
COROPHIUM ACUTUM
COROPHIUM SP.F
COROPHIUM SP.L
COROPHIUM SP.M

HAUSTORIIDAE
ACANTHOHAUSTORIUS INTERMEDIUS
ACANTHOHAUSTORIUS SP.B
PROTOHAUSTORIUS SP.B
PROTOHAUSTORIUS SP.C

ISAEIDAE
ISAEIDAE (LPIL)
MEGAMPHOPUS SP.A
PHOTIS (LPIL)
PHOTIS MELANICUS
PHOTIS SP.D

ISCHYROCERIDAE
CERAPUS SP.B

LILJEBORGIIDAE
LILJEBORGIA (LPIL)
LILJEBORGIA SP.A
LISTRIELLA (LPIL)
LISTRIELLA SP.F
LISTRIELLA SP.G

LYSIANASSIDAE
HIPPOMEDON (LPIL)
HIPPOMEDON SP.A
HIPPOMEDON SP.B
LYSIANASSA CUBENSIS
LYSIANASSIDAE (LPIL)

MELITIDAE
CERADOCUS SP.A
CERADOCUS SP.C
DULICHIELLA SP.B
ELASMOPUS (LPIL)
ELASMOPUS SP.C
ERIOPISA SP.B
MAERA (LPIL)

MAERA SP.D

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MELITIDAE (LPIL)
NEOMEGAMPHOPIDAE
NEOMEGAMPHOPUS HIATUS
NEOMEGAMPHOPUS KALANII
OEDICEROTIDAE
MONOCULODES NYEI
OEDICEROTIDAE (LPIL)
SYNCHELIDIUM AMERICANUM
PHOXOCEPHALIDAE
METHARPINA (LPIL)
METHARPINA FLORIDANA
PLATYISCHNOPIDAE
EUDEVENOPUS HONDURANUS
PODOCERIDAE
PODOCERUS (LPIL)
PODOCERUS SP.B
SYNOPIIDAE
GAROSYRRHOE SP.B
TIRON (LPIL)
TIRON TRIOCELLATUS
TIRON TROPAKIS
CUMACEA
CUMACEA (LPIL)
BODOTRIIDAE
CYCLASPIS (LPIL)
CYCLASPIS SP.D
CYCLASPIS SP.O
CYCLASPIS UNICORNIS
DIASTYLIDAE
OXYUROSTYLIS (LPIL)
OXYUROSTYLIS SP.B
OXYUROSTYLIS SP.C
NANNASTACIDAE
CAMPYLASPIS (LPIL)
CAMPYLASPIS SP.I
CAMPYLASPIS SP.L
CAMPYLASPIS SP.M
CAMPYLASPIS SP.O
CUMELLA (LPIL)
CUMELLA SP.G
CUMELLA SP.H
CUMELLA SP.I
DECAPODA (NATANTIA)
DECAPODA NATANTIA (LPIL)
ALPHEIDAE
ALPHEIDAE (LPIL)
ALPHEUS (LPIL)
ALPHEUS NORMANNI

HIPPOLYTIDAE
LATREUTES PARVULUS

LUCIFERIDAE
    LUCIFERIDAE GENUS A
PALAEMONIDAE
    PALAEMONIDAE (LPIL)
PASIPHAEIDAE
    LEPTOCHELA (LPIL)
    LEPTOCHELA PAPULATA
PROCESSIDAE
    PROCESSA (LPIL)
    PROCESSA HEMPHILLI
SICYONIIDAE
    SICYONIA (LPIL)
    SICYONIA BREVIROSTRIS
SOLENOCERIDAE
    SOLENOCERA (LPIL)
DECAPODA (REPTANTIA)
    DECAPODA REPTANTIA (LPIL)
ALBUNEIDAE
    ALBUNEA (LPIL)
    ALBUNEA GIBBESII
CALAPPIDAE
    CYCLOES BAIRDII
    HEPATUS EPHELITICUS
DORIPPIDAE
    ETHUSA MASCARONE AMERICANA
DROMIIDAE
    DROMIDIA ANTILLENSIS
    HYPOCONCHA ARCUATA
GONEPLACIDAE
    GLYPTOPLAX SMITHII
LEUCOSIIDAE
    EBALIA (LPIL)
    SPELOEOPHORUS PONTIFER
MAJIDAE
    BATRACHONOTUS FRAGOSUS
    HEMUS CRISTULIPES
    INACHOIDES FORCEPS
    MAJIDAE (LPIL)
PAGURIDAE
    PAGURIDAE (LPIL)
PARTHENOPIDAE
    MESORHOEA SEXSPINOSA
    PARTHENOPE GRANULATA
    PARTHENOPIDAE (LPIL)
PORCELLANIDAE
    PORCELLANA SAYANA
PORTUNIDAE
    OVALIPES (LPIL)

    PORTUNIDAE (LPIL)

RANINIDAE
RANILIA SP.A
ISOPODA
ANTHURIDAE
ANTHURIDAE (LPIL)
APANTHURA MAGNIFICA
PTILANTHURA SP.B
PTILANTHURA TRICARINA
IDOTEIDAE
EDOTEA (LPIL)
EDOTEA LYONSI
SEROLIDAE
SEROLIS MGRAYI
LEPTOSTRACA
NEBALIIDAE
NEBALIA BIPES
MYSIDACEA
MYSIDAE
AMATHIMYSIS BRATTEGARDI
ANCHIALINA TYPICA
BOWMANIELLA (LPIL)
BOWMANIELLA PORTORICENSIS
MYSIDAE (LPIL)
MYSIDOPSIS FURCA
OSTRACODA
OSTRACODA (LPIL)
CYLINDROLEBERIDIDAE
AMBOLEBERIS AMERICANA
ASTEROPELLA MACLAUGHLINAE
ASTEROPTERYGION OCULITRISTIS
SYNASTEROPE (LPIL)
OSTRACODA FAMILY H
OSTRACODA FAMILY H
OSTRACODA FAMILY I
OSTRACODA FAMILY I
OSTRACODA FAMILY J
OSTRACODA FAMILY J
PHILOMEDIDAE
HARBANSUS PAUCICHELATUS
PSEUDOPHILOMEDES AMBON
RUTIDERMATIDAE
RUTIDERMA DARBYI
SARSIELLIDAE
EUSARSIELLA (LPIL)
EUSARSIELLA DISPARALIS
EUSARSIELLA ELOFSONI
EUSARSIELLA GIGACANTHA
EUSARSIELLA PILLIPOLLICIS

TRACHYLEBERIDIDAE
ACTINOCYTHEREIS SP.A

ACTINOCYTHEREIS SP.C
RETICULOCYTHEREIS SP.A
RETICULOCYTHEREIS SP.B
TANAIDACEA
TANAIDACEA (LPIL)
APSEUDIDAE
APSEUDES (LPIL)
APSEUDES PROPINQUUS
APSEUDES SP.H
KALLIAPSEUDIDAE
KALLIAPSEUDES (LPIL)
KALLIAPSEUDES SP.A
KALLIAPSEUDES SP.C
KALLIAPSEUDES SP.D
LEPTOCHELIDAE
LEPTOCHELIA SP.D
NOTOTANAIDAE
TANAISSUS SP.A
BRACHIOPODA
BRACHIOPODA (LPIL)
CEPHALOCHORDATA
LEPTOCARDII
BRANCHIOSTOMIDAE
BRANCHIOSTOMA (LPIL)
BRANCHIOSTOMA BERMUDAE
BRANCHIOSTOMA FLORIDAE
BRANCHIOSTOMA LONGIROSTRUM
BRANCHIOSTOMA VIRGINIAE
CNIDARIA
ACTINIARIA
ACTINIARIA (LPIL)
ANTHOZOA (PENNATULACEA)
PENNATULACEA (LPIL)
ECHINODERMATA
ASTEROIDEA
ASTEROIDEA (LPIL)
ECHINOIDEA
ECHINOIDEA (LPIL)
MELLITIDAE
ENCOPE ABERRANS
HOLOTHUROIDEA
PHYLLOPHORIDAE
STOLUS COGNATUS
SYNAPTIDAE
LEPTOSYNAPTA CRASSIPATINA
OPHIUROIDEA
OPHIUROIDEA (LPIL)
AMPHIURIDAE
AMPHIODIA (LPIL)

AMPHIODIA TRYCHNA
AMPHIURA (LPIL)
AMPHIURA FIBULATA
AMPHIURIDAE (LPIL)
HEMICHORDATA
ENTEROPNEUSTA
BALANOGLOSSUS AURANTIACUS
MOLLUSCA
GASTROPODA
GASTROPODA (LPIL)
ACTEOCINIDAE
ACTEOCINA BIDENTATA
ACTEOCINA CANDEI
ACTEOCINIDAE (LPIL)
ACTEONIDAE
ACTEON PUNCTOSTRIATUS
ATYIDAE
ATYS (LPIL)
ATYS SANDERSONI
CAECIDAE
CAECUM (LPIL)
CAECUM CUBITATUM
CAECUM IMBRICATUM
CAECUM JOHNSONI
CAECUM PULCHELLUM
CAECUM SP.A
CAECUM SP.C
CANCELLARIIDAE
CANCELLARIIDAE (LPIL)
CERITHIIDAE
SEILA ADAMSI
COLUMBELLIDAE
ANACHIS LAFRESNAYI
ANACHIS OBESA
MITRELLA LUNATA
NASSARINA GLYPTA
CONIDAE
CONUS FLORIDANUS FLORIDENSIS
CREPIDULIDAE
CALYPTRAEA CENTRALIS
CREPIDULA (LPIL)
CREPIDULA CONVEXA
CYCLOSTEMATIDAE
ARENE TRICARINATA
EPITONIIDAE
EPITONIUM (LPIL)
MARGINELLIDAE
MARGINELLA (LPIL)

MARGINELLA SP.C

TAXONOMIC LISTING

TAXONOMIC SPECIES LIST 09/01/87

EPA-PENSACOLA---SITE B---COLLECTED NOVEMBER 1986

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- MELANELLIDAE
  - MELANELLIDAE (LPIL)
  - NISO AEGLEES
  - STROMBIFORMIS (LPIL)
  - STROMBIFORMIS AURICINCTUS
- NATICIDAE
  - NATICA PUSILLA
  - NATICIDAE (LPIL)
  - POLINICES LACTEUS
  - SIGATICA SEMISULCATA
- OLIVIDAE
  - OLIVELLA (LPIL)
  - OLIVELLA ADELAE
  - OLIVELLA FLORALIA
- PYRAMIDELLIDAE
  - TURBONILLA (LPIL)
  - TURBONILLA CONRADI
- TROCHIDAE
  - TROCHIDAE GENUS C
- TURRIDAE
  - CRASSISPIRA TAMPAENSIS
  - CRYOTURRIS CITRONELLA
  - INODRILLIA SP.A
  - KURTZIELLA RUBELLA
  - TURRIDAE (LPIL)
  - TURRIDAE GENUS K
- TURRITELLIDAE
  - TURRITELLA ACROPORA
  - TURRITELLIDAE (LPIL)
- VITRINELLIDAE
  - VITRINELLA HELICOIDEA
  - VITRINELLIDAE (LPIL)

NUDIBRANCHIA
  - NUDIBRANCHIA (LPIL)

PELECYPODA
  - PELECYPODA (LPIL)
- ARCIDAE
  - ANADARA (LPIL)
  - ANADARA TRANSVERSA
- CARDIIDAE
  - CARDIIDAE (LPIL)
  - LAEVICARDIUM (LPIL)
- CARDITIDAE
  - PLEUROMERIS TRIDENTATA
- CORBULIDAE
  - CORBULA (LPIL)
  - VARICORBULA OPERCULATA
- CRASSATELLIDAE
  - CRASSINELLA LUNULATA

CUSPIDARIIDAE
- CARDIOMYA ORNATISSIMA

GLYCYMERIDIDAE
- GLYCYMERIS UNDATA

HIATELLIDAE
- HIATELLA SP.B

LEPTONIDAE
- MYSELLA (LPIL)

LIMIDAE
- LIMATULA (LPIL)
- LIMATULA SP.A

LUCINIDAE
- LINGA AMIANTUS
- LINGA PENSYLVANICA
- LUCINA SOMBRERENSIS
- LUCINA SP.B
- LUCINA SP.D
- LUCINIDAE (LPIL)

LYONSIIDAE
- LYONSIA (LPIL)
- LYONSIA SP.A

MESODESMATIDAE
- ERVILIA CONCENTRICA

MYTILIDAE
- CRENELLA DIVARICATA

NUCULIDAE
- NUCULA AEGEENIS

PANDORIDAE
- PANDORA (LPIL)
- PANDORA BUSHIANA
- PANDORA TRILINEATA
- PANDORIDAE (LPIL)

PELECYPODA FAMILY D
- PELECYPODA FAMILY D

SEMELIDAE
- SEMELE BELLASTRIATA
- SEMELE NUCULOIDES
- SEMELIDAE (LPIL)

TELLINIDAE
- STRIGILLA (LPIL)
- TELLINA (LPIL)
- TELLINA AEQUISTRIATA
- TELLINA LISTERI
- TELLINA TEXANA
- TELLINA VERSICOLOR

THRACIIDAE
- BUSHIA SP.A

THYASIRIDAE
- THYASIRA TRISINUATA

UNGULINIDAE
- DIPLODONTA PUNCTATA

VENERIDAE
- CHIONE (LPIL)
- CHIONE INTAPURPUREA
- CHIONE LATILIRATA
- GOULDIA CERINA
- PITAR (LPIL)
- PITAR FULMINATUS
- PITAR SP.C
- VENERIDAE (LPIL)

VERTICORDIIDAE
- VERTICORDIA ORNATA

POLYPLACOPHORA
- POLYPLACOPHORA (LPIL)

SCAPHOPODA
- SCAPHOPODA (LPIL)

DENTALIIDAE
- DENTALIUM (LPIL)
- DENTALIUM SP.M

SIPHONODENTALIIDAE
- CADULUS (LPIL)
- CADULUS AGASSIZII
- CADULUS TETRODON

PHORONIDA
- PHORONIS (LPIL)

PLATYHELMINTHES

TURBELLARIA
- TURBELLARIA (LPIL)

RHYNCHOCOELA
- RHYNCHOCOELA (LPIL)

SIPUNCULA
- SIPUNCULA (LPIL)

ASPIDOSIPHONIDAE
- ASPIDOSIPHON (LPIL)
- ASPIDOSIPHON ALBUS
- ASPIDOSIPHON MUELLERI

GOLFINGIIDAE
- PHASCOLION STROMBI

SIPUNCULA FAMILY C
- SIPUNCULA FAMILY C

SIPUNCULIDAE
- SIPUNCULUS NUDUS

SITE B APRIL 1987

Biological Community Parameters

Biomass Data

Taxonomic List

SITE B

BIOLOGICAL COMMUNITY PARAMETERS

EPA---PENSACOLA, FLORIDA — Sample Date (YY/MM/DD): 87/04/24

Sample Type: MACROFAUNA — Sample Area (sq. m.): 0.0079

STATION NUMBER	TOTAL TAXA	MEAN TAXA PER REPL.	TOTAL NO. INDIVIDUALS	MEAN DENSITY	STANDARD DEVIATION	H'	J'	D
001	135	33.8	1146	9670	3360	3.91	0.80	19.02
002	168	46.6	2022	17063	8068	3.88	0.76	21.94
003	158	37.0	1571	13257	6226	3.77	0.74	21.33
004	171	46.2	1996	16843	10427	3.85	0.75	22.37
005	158	43.4	2161	18236	11166	3.62	0.72	20.45
006	160	40.0	1442	12168	5848	3.93	0.77	21.86
007	171	41.2	2102	17738	15996	3.51	0.68	22.22
008	193	54.6	2818	23780	8772	3.89	0.74	24.17
009	144	36.4	1745	14725	7239	3.25	0.65	19.16
010	164	40.3	1616	13637	3624	3.76	0.74	22.06
011	149	39.2	1282	10818	4327	4.00	0.80	20.68
012	142	40.0	1071	11297	5062	3.97	0.80	20.21
013	165	44.8	1392	11746	3643	4.24	0.83	22.66
014	164	45.7	2119	17881	3996	3.77	0.74	21.28
015	168	40.2	1617	13645	4657	3.82	0.75	22.60
016	153	37.1	1329	11215	3233	3.83	0.76	21.13
017	205	56.0	2641	22286	7577	3.94	0.74	25.89
018	184	47.0	2294	19358	8322	3.82	0.73	23.65
019	171	44.4	2005	16919	8736	3.66	0.71	22.36
020	162	36.7	1328	11206	6117	3.98	0.78	22.39

Wet weight biomass for Pensacola, Florida, B Site, April 1987. All weights in grams.

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB1	ANNELIDA	0.003	0.006	0.019	0.010	0.036	0.019	0.015	0.022	0.009	0.010	0.011	0.014	0.009	0.009	0.012	0.212
PFB1	ARTHROPODA	0.001	0.001	0.005	0.005	0.040	0.003	0.002	0.002	0.003	0.003	0.005	0.002	0.006	0.004	0.011	0.093
PFB1	MOLLUSCA	0.000	0.001	0.002	0.009	0.019	0.003	0.001	0.002	0.014	0.005	0.003	0.002	0.038	0.047	0.006	0.154
PFB1	ECHINODERMATA	0.040	0.000	0.001	0.000	0.020	0.001	0.056	0.000	0.001	0.012	0.000	0.023	0.001	0.003	0.001	0.167
PFB1	MISCELLANEOUS	0.001	0.006	0.001	0.001	0.002	0.005	0.002	0.001	0.002	0.001	0.002	0.001	0.001	0.000	0.001	0.035
	TOTAL	0.045	0.014	0.028	0.025	0.123	0.031	0.076	0.027	0.029	0.030	0.021	0.042	0.055	0.071	0.031	0.661

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB2	ANNELIDA	0.019	0.025	0.014	0.049	0.062	0.035	0.014	0.020	0.034	0.033	0.023	0.026	0.006	0.020	0.015	0.395
PFB2	ARTHROPODA	0.000	0.000	0.004	0.013	0.009	0.003	0.004	0.003	0.024	0.000	0.002	0.010	0.002	0.002	0.003	0.111
PFB2	MOLLUSCA	0.025	0.026	0.005	0.045	0.006	0.010	0.010	0.013	0.009	0.007	0.001	0.015	0.005	0.024	0.004	0.205
PFB2	ECHINODERMATA	0.001	0.001	0.011	0.001	0.001	0.000	0.009	0.000	0.000	0.001	0.000	0.001	0.001	0.001	0.000	0.028
PFB2	MISCELLANEOUS	0.001	0.000	0.001	0.006	0.010	0.006	0.002	0.004	0.002	0.005	0.002	0.003	0.005	0.003	0.002	0.068
	TOTAL	0.054	0.060	0.035	0.114	0.096	0.054	0.039	0.040	0.069	0.134	0.028	0.063	0.019	0.050	0.024	0.807

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB3	ANNELIDA	0.028	0.017	0.012	0.017	0.037	0.007	0.012	0.045	0.016	0.027	0.013	0.015	0.013	0.013	0.018	0.290
PFB3	MOLLUSCA	0.004	0.004	0.001	0.108	0.006	0.005	0.000	0.035	0.269	0.008	0.911	0.451	0.064	0.012	0.002	0.928
PFB3	ECHINODERMATA	0.015	0.047	0.000	0.001	0.000	0.003	0.001	0.001	0.001	0.024	0.016	0.000	0.061	0.001	0.000	0.111
PFB3	MISCELLANEOUS	0.005	0.006	0.004	0.001	0.001	0.001	0.055	0.002	0.006	0.007	0.010	0.007	0.015	0.004	0.009	0.133
	TOTAL	0.052	0.074	0.017	0.127	0.044	0.016	0.076	0.083	0.292	0.066	0.950	0.473	0.033	0.030	0.029	1.462

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB4	ANNELIDA	0.008	0.013	0.041	0.013	0.034	0.050	0.050	0.030	0.018	0.022	0.014	0.025	0.011	0.019	0.021	0.385
PFB4	ARTHROPODA	0.001	0.003	0.004	0.005	0.006	0.004	0.014	0.016	0.003	0.002	0.000	0.004	0.003	0.003	0.001	0.071
PFB4	MOLLUSCA	0.006	0.003	0.010	0.024	0.060	0.017	0.032	0.013	0.003	0.004	0.009	0.005	0.007	0.002	0.003	0.190
PFB4	ECHINODERMATA	0.001	0.001	0.017	0.000	0.000	0.000	0.001	0.001	0.004	0.001	0.003	0.001	0.000	0.002	0.001	0.033
PFB4	MISCELLANEOUS	0.009	0.001	0.003	0.011	0.001	0.001	0.010	0.009	0.006	0.004	0.004	0.001	0.007	0.006	0.001	0.074
	TOTAL	0.025	0.021	0.075	0.053	0.101	0.072	0.115	0.071	0.034	0.033	0.030	0.036	0.028	0.032	0.027	0.761

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB5	ANNELIDA	0.008	0.009	0.016	0.004	0.019	0.083	0.000	0.002	0.031	0.013	0.034	0.021	0.022	0.021	0.016	0.307
PFB5	ARTHROPODA	0.005	0.004	0.005	0.004	0.039	0.019	0.002	0.001	0.003	0.000	0.005	0.015	0.003	0.004	0.013	0.136
PFB5	MOLLUSCA	0.147	0.007	0.011	0.019	0.028	0.037	0.053	0.026	0.021	0.022	1.658	0.041	0.096	0.025	0.025	2.210
PFB5	ECHINODERMATA	0.001	0.001	0.001	0.000	0.001	0.001	0.005	0.000	0.001	0.018	0.006	0.000	0.001	0.026	0.000	0.062
PFB5	MISCELLANEOUS	0.560	0.001	0.004	0.000	0.003	0.011	0.004	0.001	0.001	0.002	0.002	0.002	0.001	0.002	0.037	0.631
	TOTAL	0.721	0.022	0.037	0.027	0.090	0.151	0.072	0.024	0.057	0.063	1.705	0.079	0.123	0.078	0.091	3.343

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB6	ANNELIDA	0.007	0.012	0.013	0.012	0.015	0.017	0.010	0.017	0.031	0.010	0.019	0.012	0.013	0.005	0.011	0.212
PFB6	ARTHROPODA	0.003	0.003	0.002	0.000	0.004	0.007	0.000	0.002	0.011	0.002	0.007	0.003	0.003	0.002	0.015	0.072
PFB6	MOLLUSCA	0.027	0.001	0.002	0.012	0.050	0.077	0.001	0.003	0.004	0.002	0.031	0.029	0.019	0.001	0.008	0.267
PFB6	ECHINODERMATA	0.006	0.006	0.011	0.000	0.011	0.001	0.000	0.001	0.000	0.000	0.010	0.000	0.001	0.001	0.001	0.043
PFB6	MISCELLANEOUS	0.001	0.026	0.001	0.001	0.006	0.002	0.005	0.001	0.001	0.006	0.004	0.013	0.002	0.004	0.002	0.075
	TOTAL	0.044	0.042	0.029	0.033	0.086	0.104	0.016	0.024	0.047	0.028	0.071	0.057	0.038	0.013	0.037	0.669

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB7	ANNELIDA	0.033	0.008	0.010	0.013	0.014	0.012	0.029	0.021	0.030	0.131	0.012	0.044	0.014	0.006	0.014	0.399
PFB7	ARTHROPODA	0.000	0.002	0.005	0.001	0.014	0.007	0.003	0.020	0.015	0.00-	0.003	0.010	0.006	0.002	0.002	0.107
PFB7	MOLLUSCA	0.007	0.004	0.006	0.005	0.119	0.003	0.011	0.019	0.534	0.066	0.006	0.003	0.005	0.030	0.027	0.845
PFB7	ECHINODERMATA	0.001	0.000	0.001	0.007	0.015	0.001	0.000	0.008	0.001	0.060	0.000	0.000	0.006	0.008	0.000	0.042
PFB7	MISCELLANEOUS	0.022	0.013	0.012	0.003	0.012	0.002	0.011	0.016	0.004	0.010	0.012	0.013	0.006	0.003	0.006	0.145
	TOTAL	0.071	0.027	0.034	0.029	0.174	0.025	0.054	0.084	0.592	0.216	0.033	0.070	0.031	0.049	0.049	1.538

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB8	ANNELIDA	0.021	0.059	0.081	0.028	0.014	0.034	0.030	0.040	0.022	0.014	0.730	0.044	0.077	0.056	0.022	1.280
PFB8	ARTHROPODA	0.004	0.004	0.008	0.004	0.003	0.009	0.005	0.005	0.004	0.004	0.004	0.004	0.018	0.015	0.009	0.097
PFB8	MOLLUSCA	0.044	0.042	0.076	0.190	0.037	0.064	0.047	0.034	0.056	0.039	0.072	0.056	0.126	0.115	0.014	1.012
PFB8	ECHINODERMATA	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.017	0.001	0.001	0.001	0.001	0.031
PFB8	MISCELLANEOUS	0.001	0.002	0.016	0.003	0.001	0.002	0.060	0.001	0.001	0.007	0.001	0.002	0.002	0.015	0.007	0.056
	TOTAL	0.071	0.108	0.176	0.226	0.056	0.111	0.091	0.081	0.084	0.065	0.824	0.107	0.216	0.202	0.053	2.471

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB09	ANNELIDA	0.044	0.005	0.004	0.006	0.004	0.011	0.010	0.009	0.008	0.009	0.003	0.011	0.060	0.014	0.005	0.159
PFB09	ARTHROPODA	0.006	0.003	0.000	0.006	0.018	0.001	0.003	0.005	0.004	0.004	0.004	0.004	0.006	0.005	0.001	0.078
PFB09	MOLLUSCA	0.042	0.002	0.092	0.003	0.007	0.014	0.020	0.008	0.004	0.011	0.001	0.020	0.004	0.179	0.002	0.409
PFB09	ECHINODERMATA	0.002	0.003	0.018	0.008	0.061	0.000	0.001	0.001	0.001	0.001	0.003	0.029	0.011	0.001	0.005	0.077
PFB09	MISCELLANEOUS	0.010	0.002	0.007	0.003	0.004	0.004	0.005	0.648	0.002	0.004	0.000	0.007	0.002	0.016	0.002	0.717
	TOTAL	0.104	0.015	0.121	0.026	0.034	0.030	0.047	0.671	0.019	0.029	0.011	0.071	0.031	0.215	0.016	1.440

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB10	ANNELIDA	0.013	0.016	0.021	0.028	0.019	0.045	0.021	0.016	0.006	0.012	0.012	0.008	0.010	0.008	0.049	0.284
PFB10	ARTHROPODA	0.010	0.004	0.002	0.009	0.004	0.003	0.006	0.002	0.000	0.009	0.003	0.001	0.005	0.004	0.004	0.070
PFB10	MOLLUSCA	0.075	0.008	0.023	0.022	0.278	0.016	0.305	0.033	0.022	0.030	0.021	0.005	0.007	0.019	0.050	0.914
PFB10	ECHINODERMATA	5.000	0.000	0.000	0.001	0.005	0.000	0.001	0.001	0.001	0.000	0.052	0.001	0.001	0.001	0.001	5.073
PFB10	MISCELLANEOUS	0.004	0.008	0.004	0.002	0.003	0.001	0.006	0.002	0.001	0.002	0.005	0.002	0.000	0.001	0.001	0.042
	TOTAL	5.102	0.036	0.050	0.062	0.309	0.065	0.339	0.054	0.030	0.061	0.093	0.017	0.023	0.033	0.105	6.383

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB11	ANNELIDA	0.010	0.059	0.014	0.015	0.012	0.010	0.005	0.007	0.006	0.009	0.008	0.004	0.010	0.017	0.046	0.240
PFB11	ARTHROPODA	0.005	0.002	0.005	0.001	0.018	0.001	2.005	0.002	0.004	0.004	0.006	0.004	0.004	0.002	0.009	2.072
PFB11	MOLLUSCA	0.005	0.063	0.031	0.013	0.060	0.002	0.006	0.005	0.004	0.014	0.024	0.005	0.002	0.010	0.071	0.255
PFB11	ECHINODERMATA	0.000	0.001	0.000	0.001	0.000	0.000	0.044	0.001	0.000	0.001	0.001	0.004	0.000	0.001	0.006	0.054
PFB11	MISCELLANEOUS	0.001	0.009	0.005	0.003	0.004	0.003	0.065	0.002	0.001	0.003	0.002	0.002	0.005	0.001	0.006	0.052
	TOTAL	0.021	0.134	0.055	0.033	0.034	0.024	2.065	0.017	0.015	0.031	0.041	0.019	0.029	0.031	0.132	2.681

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB12	ANNELIDA	0.005	0.022	0.017	0.010	0.021	0.014	0.022	0.021	0.008	0.005	0.089	0.014	0.000	0.000	0.000	0.248
PFB12	ARTHROPODA	0.006	0.001	0.002	0.001	0.001	0.001	0.001	0.003	0.003	0.001	0.015	0.004	0.000	0.000	0.000	0.039
PFB12	MOLLUSCA	0.007	0.020	0.013	0.034	0.004	0.018	0.004	0.009	0.008	0.001	0.005	0.031	0.000	0.000	0.000	0.154
PFB12	ECHINODERMATA	0.001	0.000	0.001	0.002	0.002	0.001	0.001	0.010	0.003	0.000	0.004	0.001	0.000	0.000	0.000	0.026
PFB12	MISCELLANEOUS	0.001	0.006	0.001	0.002	0.017	0.002	0.010	0.004	0.938	0.020	0.007	0.000	0.000	0.000	0.000	1.008
	TOTAL	0.026	0.049	0.034	0.049	0.045	0.036	0.038	0.047	0.960	0.027	0.120	0.050	0.000	0.000	0.000	1.475

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB13	ANNELIDA	0.000	0.011	0.020	0.013	0.012	0.022	0.002	0.015	0.008	0.039	0.023	0.028	0.010	0.016	0.007	0.234
PFB13	ARTHROPODA	0.004	0.001	0.002	0.002	0.001	0.006	0.006	0.005	0.016	0.007	0.013	0.003	0.020	0.002	0.003	0.093
PFB13	MOLLUSCA	0.040	0.047	0.575	0.012	0.013	0.047	0.005	0.015	0.053	0.004	0.006	0.016	0.024	0.005	0.033	0.895
PFB13	ECHINODERMATA	0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.009	0.001	0.001	0.000	0.001	0.000	0.001	0.019
PFB13	MISCELLANEOUS	0.004	0.004	0.022	0.002	0.004	0.005	0.002	0.001	0.002	0.004	0.005	0.004	0.032	0.021	0.001	0.113
	TOTAL	0.056	0.064	0.619	0.030	0.031	0.083	0.016	0.037	0.088	0.055	0.048	0.051	0.087	0.044	0.045	1.354

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB14	ANNELIDA	0.036	0.017	0.019	0.034	0.008	0.050	0.037	0.023	0.017	0.030	0.018	0.026	0.029	0.015	0.044	0.397
PFB14	ARTHROPODA	0.011	0.003	0.005	0.066	0.007	0.011	0.002	0.003	0.005	0.002	0.001	0.007	0.063	0.002	0.064	0.272
PFB14	MOLLUSCA	0.079	0.060	0.010	0.034	0.032	0.048	0.018	0.010	0.024	0.015	0.021	0.015	0.011	0.020	0.047	0.444
PFB14	ECHINODERMATA	0.001	0.001	0.001	0.026	0.000	0.001	0.006	0.001	0.001	0.018	0.015	0.000	0.006	0.014	0.001	0.080
PFB14	MISCELLANEOUS	0.004	0.006	0.001	0.132	0.001	0.002	0.008	0.019	0.006	0.002	0.007	0.004	0.005	0.005	0.010	0.292
	TOTAL	0.131	0.087	0.036	0.232	0.048	0.112	0.145	0.056	0.053	0.067	0.062	0.046	0.648	0.056	0.166	1.285

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB15	ANNELIDA	0.019	0.000	0.023	0.015	0.016	0.033	0.019	0.019	0.008	0.045	0.012	0.008	0.022	0.023	0.082	0.352
PFB15	ARTHROPODA	0.002	0.002	0.001	0.003	0.028	0.603	0.004	0.006	0.004	0.001	0.002	0.004	0.004	0.003	0.026	0.687
PFB15	MOLLUSCA	0.032	0.027	0.003	0.021	0.067	0.025	14.211	0.025	0.016	0.004	0.003	0.017	0.008	0.015	0.021	14.495
PFB15	ECHINODERMATA	0.001	0.014	0.005	0.000	0.001	0.001	0.001	0.001	0.009	0.001	0.001	0.001	0.001	0.001	0.001	0.039
PFB15	MISCELLANEOUS	0.001	0.000	0.001	0.002	0.005	0.022	0.001	0.001	0.006	0.003	0.002	0.001	0.006	0.001	0.001	0.047
	TOTAL	0.055	0.051	0.033	0.041	0.117	0.684	14.236	0.052	0.043	0.054	0.020	0.031	0.035	0.043	0.125	15.020

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFB16	ANNELIDA	0.021	0.012	0.022	0.021	0.006	0.030	0.023	0.014	0.014	0.024	0.018	0.006	0.012	0.028	0.007	0.258
PFB16	ARTHROPODA	0.003	0.001	0.005	0.003	0.063	0.612	0.005	0.003	0.002	0.003	0.018	0.008	0.002	0.002	0.003	0.074
PFB16	MOLLUSCA	0.023	0.021	0.012	0.010	0.058	0.034	0.021	0.073	0.054	0.030	0.006	0.009	0.005	0.107	0.019	0.482
PFB16	ECHINODERMATA	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.010	0.001	0.001	0.001	0.024
PFB16	MISCELLANEOUS	0.000	0.000	0.001	0.001	0.002	0.003	0.003	0.001	0.002	0.001	0.001	0.246	0.005	0.005	0.002	0.274
	TOTAL	0.048	0.035	0.041	0.036	0.070	0.680	0.053	0.092	0.073	0.059	0.044	0.279	0.025	0.144	0.033	1.112

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PF017	ANNELIDA	0.014	0.000	0.033	0.012	0.037	0.028	0.029	0.028	0.042	0.022	0.011	0.024	0.024	0.010	0.013	0.415
PF017	ARTHROPODA	0.005	0.000	0.009	0.009	0.001	0.002	0.004	0.007	0.012	0.033	0.003	0.012	0.029	0.003	0.014	0.151
PF017	MOLLUSCA	0.066	0.143	0.049	0.010	0.410	0.010	0.162	0.070	0.090	0.039	0.039	0.100	0.147	0.015	0.069	1.435
PF017	ECHINODERMATA	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.125	0.001	0.001	0.001	0.139
PF017	MISCELLANEOUS	0.005	0.001	0.007	0.001	0.009	0.000	0.002	0.009	0.002	0.002	0.001	0.014	0.001	0.020	0.005	0.107
	TOTAL	0.091	0.233	0.099	0.033	0.458	0.057	0.198	0.195	0.147	0.097	0.055	0.283	0.202	0.057	0.102	2.307

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PF018	ANNELIDA	0.019	0.010	0.024	0.023	0.000	0.056	0.017	0.013	0.034	0.071	0.049	0.017	0.031	0.016	0.064	0.460
PF018	ARTHROPODA	0.003	0.013	0.009	0.002	0.001	0.005	0.001	0.001	0.001	0.021	0.011	0.003	0.004	0.017	0.003	0.095
PF018	MOLLUSCA	0.003	0.029	0.002	0.009	0.001	0.006	0.009	0.023	0.050	0.041	0.023	0.004	0.048	0.020	0.005	0.269
PF018	ECHINODERMATA	0.006	0.001	0.000	0.000	0.001	0.001	0.000	0.000	0.001	0.235	0.001	0.001	0.001	0.075	0.001	1.132
PF018	MISCELLANEOUS	0.001	0.003	0.014	0.002	0.001	0.006	0.001	0.002	0.004	0.001	0.005	0.001	0.002	0.001	0.002	0.046
	TOTAL	0.032	0.064	0.049	0.036	0.012	0.074	0.028	0.047	0.090	0.369	0.089	0.026	0.082	0.929	0.075	2.002

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PF019	ANNELIDA	0.047	0.057	0.024	0.025	0.055	0.030	0.043	0.026	0.063	0.633	0.027	0.052	0.038	0.020	0.042	0.516
PF019	ARTHROPODA	0.006	0.004	0.003	0.005	0.023	0.009	0.002	0.003	0.003	0.000	0.003	0.019	0.032	0.063	0.018	0.191
PF019	MOLLUSCA	0.002	0.010	0.001	0.016	0.022	0.003	0.029	0.020	0.064	0.031	0.006	0.023	0.010	0.001	0.002	0.181
PF019	ECHINODERMATA	17.002	0.001	0.001	0.001	0.001	0.001	0.001	0.016	0.066	0.063	0.001	0.000	0.002	0.011	0.011	17.052
PF019	MISCELLANEOUS	0.002	0.002	0.003	0.002	0.028	0.008	0.004	0.063	0.000	0.045	0.004	0.003	0.032	0.001	0.006	0.143
	TOTAL	17.059	0.074	0.032	0.049	0.129	0.051	0.079	0.062	0.018	0.120	0.041	0.097	0.114	0.036	0.000	18.033

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PF020	ANNELIDA	0.002	0.019	0.023	0.052	0.038	0.009	0.061	0.010	0.036	0.022	0.032	0.004	0.016	0.075	0.018	0.420
PF020	ARTHROPODA	0.005	0.063	0.004	0.302	0.040	0.000	0.014	0.008	0.030	0.025	0.007	0.009	0.003	0.022	0.064	[illegible]
PF020	MOLLUSCA	0.025	17.307	0.006	0.051	0.002	0.001	0.032	0.018	0.028	0.030	0.013	0.102	0.010	0.012	0.004	17.721
PF020	ECHINODERMATA	0.000	0.001	0.009	0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.000	0.003	0.017
PF020	MISCELLANEOUS	0.002	0.003	0.031	0.007	0.043	0.000	0.013	0.024	0.024	0.004	0.026	0.003	0.005	0.018	0.002	[illegible]
	TOTAL	0.034	17.333	0.073	0.112	0.124	0.010	0.121	0.061	0.119	0.062	0.076	0.198	0.035	0.127	0.020	18.321

TAXONOMIC LISTING

TAXONOMIC SPECIES LIST 09/01/87

EPA-PENSACOLA---SITE B---COLLECTED APRIL 1987

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ANNELIDA
- HIRUDINEA
  - HIRUDINEA (LPIL) *
- OLIGOCHAETA
  - OLIGOCHAETA (LPIL)
- POLYCHAETA
  - AMPHARETIDAE
    - AMPHARETE SP.A
    - AMPHARETIDAE (LPIL)
    - ISOLDA PULCHELLA
    - SABELLIDES SP.A
  - AMPHINOMIDAE
    - PARAMPHINOME SP.B
  - APHRODITIDAE
    - APHROGENIA SP.A
  - CAPITELLIDAE
    - CAPITELLIDAE (LPIL)
    - MASTOBRANCHUS VARIABILIS
    - MEDIOMASTUS (LPIL)
    - MEDIOMASTUS CALIFORNIENSIS
    - NOTOMASTUS (LPIL)
  - CHAETOPTERIDAE
    - CHAETOPTERIDAE (LPIL)
    - MESOCHAETOPTERUS (LPIL)
    - SPIOCHAETOPTERUS OCULATUS
  - CHRYSOPETALIDAE
    - BHAWANIA HETEROSETA
    - PALEANOTUS SP.A
  - CIRRATULIDAE
    - CAULLERIELLA CF. ALATA
    - CAULLERIELLA SP.A
    - CHAETOZONE (LPIL)
    - CIRRATULIDAE (LPIL)
    - THARYX CF. ANNULOSUS
  - DORVILLEIDAE
    - DORVILLEIDAE (LPIL)
    - PETTIBONEIA DUOFURCA
    - PROTODORVILLEA KEFERSTEINI
    - SCHISTOMERINGOS PECTINATA
  - EULEPETHIDAE
    - GRUBEULEPIS (LPIL)
  - EUNICIDAE
    - EUNICE VITTATA
    - EUNICIDAE (LPIL)
    - LYSIDICE SP.B
    - MARPHYSA SANGUINEA
  - FLABELLIGERIDAE
    - FLABELLIGERIDAE (LPIL)
  - GLYCERIDAE
    - GLYCERA (LPIL)

*LPIL - Lowest Practicable Identification Level

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GLYCERA AMERICANA
GLYCERA SP.A
GONIADIDAE
GONIADIDES CAROLINAE
HESIONIDAE
HESIONIDAE (LPIL)
HESIONIDAE GENUS D
HETEROPODARKE FORMALIS
HETEROPODARKE LYONSI
PODARKEOPSIS LEVIFUSCINA
LUMBRINERIDAE
LUMBRINERIDES DAYI
LUMBRINERIS (LPIL)
LUMBRINERIS LATREILLI
LUMBRINERIS SP.D
LUMBRINERIS SP.V
LUMBRINERIS VERRILLI
MAGELONIDAE
MAGELONA (LPIL)
MAGELONA SP.B
MAGELONA SP.C
MALDANIDAE
AXIOTHELLA SP.A
BOGUEA ENIGMATICA
BOGUEA SP.A
MALDANIDAE (LPIL)
NEPHTYIDAE
NEPHTYIDAE (LPIL)
NEPHTYS PICTA
NEPHTYS SIMONI
NEREIDAE
CERATOCEPHALE OCULATA
NEREIDAE (LPIL)
NEREIS MICROMMA
RULLIERINEREIS SP.A
ONUPHIDAE
DIOPATRA (LPIL)
DIOPATRA CUPREA
MOOREONUPHIS PALLIDULA
ONUPHIDAE (LPIL)
RHAMPHOBRACHIUM SP.C
OPHELIIDAE
ARMANDIA MACULATA
OPHELIIDAE (LPIL)
TRAVISIA HOBSONAE
OPHELLIDAE
OPHELINA DENTICULATA
ORBINIIDAE

LEITOSCOLOPLOS (LPIL)

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SCOLOPLOS SP.F
OWENIIDAE
GALATHOWENIA OCULATA
OWENIA SP.A
OWENIIDAE (LPIL)
PARAONIDAE
ARICIDEA (LPIL)
ARICIDEA CATHERINAE
ARICIDEA CERRUTII
ARICIDEA PHILBINAE
ARICIDEA SP.A
ARICIDEA SP.E
ARICIDEA SP.H
ARICIDEA TAYLORI
ARICIDEA WASSI
CIRROPHORUS (LPIL)
CIRROPHORUS BRANCHIATUS
LEVINSENIA GRACILIS
PARAONIDAE (LPIL)
PECTINARIIDAE
PECTINARIIDAE (LPIL)
PHYLLODOCIDAE
ANAITIDES LONGIPES
ANAITIDES MUCOSA
ETEONE LACTEA
GENETYLLIS SP.A
HESIONURA SP.A
MYSTIDES BOREALIS
PARANAITIS SPECIOSA
PHYLLODOCIDAE (LPIL)
PILARGIDAE
ANCISTROSYLLIS (LPIL)
ANCISTROSYLLIS CAROLINENSIS
ANCISTROSYLLIS HARTMANAE
ANCISTROSYLLIS JONESI
LITOCORSA ANTENNATA
SIGAMBRA (LPIL)
SIGAMBRA BASSI
SIGAMBRA WASSI
PISIONIDAE
PISIONE SP.A
POECILOCHAETIDAE
POECILOCHAETUS (LPIL)
POLYGORDIIDAE
POLYGORDIUS (LPIL)
POLYNOIDAE
HARMOTHOE (LPIL)
HARMOTHOE SP.B

LEPIDASTHENIA VARIUS

POLYNOIDAE (LPIL)
POLYNOIDAE GENUS H
SABELLARIIDAE
SABELLARIA SP.A
SABELLIDAE
CHONE (LPIL)
EUCHONE (LPIL)
FABRICIOLA TRILOBATA
MEGALOMMA BIOCULATUM
SABELLIDAE (LPIL)
SACCOCIRRIDAE
SACCOCIRRUS SP.A
SERPULIDAE
PSEUDOVERMILIA OCCIDENTALIS
SERPULIDAE (LPIL)
SERPULIDAE GENUS C
SIGALIONIDAE
SIGALION SP.A
SIGALIONIDAE (LPIL)
SPIONIDAE
AONIDES PAUCIBRANCHIATA
DISPIO UNCINATA
LAONICE CIRRATA
MALACOCEROS INDICUS
PARAPRIONOSPIO PINNATA
POLYDORA CORNUTA
POLYDORA SOCIALIS
PRIONOSPIO (LPIL)
PRIONOSPIO CRISTATA
SPIO PETTIBONEAE
SPIONIDAE (LPIL)
SPIOPHANES BOMBYX
SPIOPHANES CF. MISSIONENSIS
SYLLIDAE
BRANIA WELLFLEETENSIS
EHLERSIA CORNUTA
EHLERSIA FERRUGINA
EURYSYLLIS TUBERCULATA
EXOGONE ATLANTICA
EXOGONE DISPAR
EXOGONE LOUREI
OPISTHODONTA SP.A
PARAPIONOSYLLIS LONGICIRRATA
PIONOSYLLIS GESAE
PLAKOSYLLIS QUADRIOCULATA
SPHAEROSYLLIS ACICULATA
SPHAEROSYLLIS PIRIFEROPSIS
STREPTOSYLLIS PETTIBONEAE

SYLLIDAE (LPIL)

SYLLIDES FULVUS
TYPOSYLLIS AMICA
TYPOSYLLIS CF. LUTEA
TEREBELLIDAE
POLYCIRRUS (LPIL)
TEREBELLIDAE (LPIL)
TRICHOBRANCHIDAE
TRICHOBRANCHUS GLACIALIS
ARTHROPODA (CRUSTACEA)
CRUSTACEA (LPIL)
AMPHIPODA
AMPHIPODA (LPIL)
AMPELISCIDAE
AMPELISCA (LPIL)
AMPELISCA AGASSIZI
AMPELISCA PARAPACIFICA
AMPELISCA SP.C
AMPELISCA SP.L
AMPHILOCHIDAE
AMPHILOCHUS SP.C
AORIDAE
ACUMINODEUTOPUS (LPIL)
ACUMINODEUTOPUS NAGLEI
ACUMINODEUTOPUS SP.A
AORIDAE (LPIL)
LEMBOS (LPIL)
LEMBOS SMITHI
MICRODEUTOPUS MYERSI
UNCIOLA SP.B
ARIGISSIDAE
ARGISSA HAMATIPES
COROPHIIDAE
COROPHIUM (LPIL)
COROPHIUM SP.L
COROPHIUM SP.M
HAUSTORIIDAE
PROTOHAUSTORIUS BOUSFIELDI
PROTOHAUSTORIUS SP.E
ISAEIDAE
ISAEIDAE (LPIL)
MEGAMPHOPUS SP.A
PHOTIS (LPIL)
PHOTIS MELANICUS
PHOTIS SP.D
ISCHYROCERIDAE
CERAPUS SP.B
ERICHTHONIUS (LPIL)
LEUCOTHOIDAE

LEUCOTHOIDAE (LPIL)

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LILJEBORGIIDAE
- LILJEBORGIA SP.A
- LISTRIELLA SP.F

LYSIANASSIDAE
- HIPPOMEDON SP.A
- HIPPOMEDON SP.B
- LYSIANASSA ALBA
- LYSIANASSIDAE (LPIL)

MELITIDAE
- DULICHIELLA (LPIL)
- ELASMOPUS SP.C
- MAERA SP.D

NEOMEGAMPHOPIDAE
- NEOMEGAMPHOPUS HIATUS
- NEOMEGAMPHOPUS KALANII

OEDICEROTIDAE
- MONOCULODES NYEI
- OEDICEROTIDAE (LPIL)
- SYNCHELIDIUM AMERICANUM

PHOXOCEPHALIDAE
- METHARPINA FLORIDANA

PLATYISCHNOPIDAE
- EUDEVENOPUS HONDURANUS

PODOCERIDAE
- PODOCERIDAE (LPIL)
- PODOCERUS SP.B

STENOTHOIDAE
- PARAMETOPELLA SP.A

SYNOPIIDAE
- GAROSYRRHOE SP.B
- TIRON (LPIL)
- TIRON TRIOCELLATUS
- TIRON TROPAKIS

CUMACEA
- CUMACEA (LPIL)

BODOTRIIDAE
- CYCLASPIS (LPIL)
- CYCLASPIS BACESCUI
- CYCLASPIS SP.D
- CYCLASPIS SP.N
- CYCLASPIS SP.O
- CYCLASPIS SP.S
- CYCLASPIS UNICORNIS

DIASTYLIDAE
- OXYUROSTYLIS (LPIL)
- OXYUROSTYLIS SP.B
- OXYUROSTYLIS SP.C

NANNASTACIDAE
- CAMPYLASPIS SP.I

TAXONOMIC LISTING

TAXONOMIC SPECIES LIST 09/01/87

EPA-PENSACOLA---SITE B---COLLECTED APRIL 1987

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CAMPYLASPIS SP.M
CAMPYLASPIS SP.O
CUMELLA (LPIL)
CUMELLA SP.G
NANNASTACIDAE (LPIL)

DECAPODA (NATANTIA)
DECAPODA NATANTIA (LPIL)
ALPHEIDAE
ALPHEUS (LPIL)
PASIPHAEIDAE
LEPTOCHELA PAPULATA
PROCESSIDAE
PROCESSA HEMPHILLI
SOLENOCERIDAE
SOLENOCERA ATLANTIDIS

DECAPODA (REPTANTIA)
DECAPODA REPTANTIA (LPIL)
ALBUNEIDAE
ALBUNEA GIBBESII
CALAPPIDAE
CALAPPA SULCATA
OSACHILA SEMILEVIS
DROMIIDAE
HYPOCONCHA ARCUATA
GONEPLACIDAE
GLYPTOPLAX SMITHII
MAJIDAE
BATRACHONOTUS FRAGOSUS
INACHOIDES FORCEPS
PAGURIDAE
PAGURIDAE (LPIL)
PINNOTHERIDAE
DISSODACTYLUS SP.B
PINNIXA SAYANA
PINNOTHERES OSTREUM
PORCELLANIDAE
EUCERAMUS PRAELONGUS
PORTUNIDAE
OVALIPES STEPHENSONI

ISOPODA
ISOPODA (LPIL)
ANTHURIDAE
APANTHURA MAGNIFICA
ANTIASIDAE
ANTIAS (LPIL)
IDOTEIDAE
EDOTEA (LPIL)
EDOTEA LYONSI

SEROLIDAE
SEROLIS MGRAYI

LEPTOSTRACA
NEBALIIDAE
NEBALIA BIPES
MYSIDACEA
MYSIDACEA (LPIL)
MYSIDAE
ANCHIALINA TYPICA
BOWMANIELLA PORTORICENSIS
MYSIDOPSIS FURCA
PROMYSIS ATLANTICA
OSTRACODA
OSTRACODA (LPIL)
CYLINDROLEBERIDIDAE
AMBOLEBERIS AMERICANA
ASTEROPELLA MACLAUGHLINAE
SYNASTEROPE (LPIL)
OSTRACODA FAMILY A
OSTRACODA FAMILY A
OSTRACODA FAMILY H
OSTRACODA FAMILY H
OSTRACODA FAMILY I
OSTRACODA FAMILY I
OSTRACODA FAMILY J
OSTRACODA FAMILY J
PHILOMEDIDAE
HARBANSUS PAUCICHELATUS
PSEUDOPHILOMEDES AMBON
PSEUDOPHILOMEDES ZETA
RUTIDERMATIDAE
RUTIDERMA DARBYI
SARSIELLIDAE
EURYPYLUS SP.A
EURYPYLUS SP.B
EUSARSIELLA (LPIL)
EUSARSIELLA DISPARALIS
EUSARSIELLA ELOFSONI
EUSARSIELLA GETTLESONI
EUSARSIELLA GIGACANTHA
EUSARSIELLA PILLIPOLLICIS
EUSARSIELLA RADIICOSTA
EUSARSIELLA SP.E
EUSARSIELLA SP.F
EUSARSIELLA TEXANA
SARSIELLIDAE (LPIL)
TRACHYLEBERIDIDAE
RETICULOCYTHEREIS SP.A
RETICULOCYTHEREIS SP.B
TANAIDACEA
TANAIDACEA (LPIL)

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                              APSEUDIDAE
                                   APSEUDES PROPINQUUS
                                   APSEUDES SP.H
                                   APSEUDIDAE (LPIL)
                              KALLIAPSEUDIDAE
                                   KALLIAPSEUDES (LPIL)
                                   KALLIAPSEUDES SP.A
                                   KALLIAPSEUDES SP.B
                                   KALLIAPSEUDES SP.C
                                   KALLIAPSEUDES SP.D
                                   KALLIAPSEUDES SP.E
                              LEPTOCHELIDAE
                                   LEPTOCHELIA SP.D
                              NOTOTANAIDAE
                                   TANAISSUS SP.A
          BRACHIOPODA
                                   BRACHIOPODA (LPIL)
          CEPHALOCHORDATA
                    LEPTOCARDII
                              BRANCHIOSTOMIDAE
                                   BRANCHIOSTOMA (LPIL)
                                   BRANCHIOSTOMA FLORIDAE
                                   BRANCHIOSTOMA VIRGINIAE
          CNIDARIA
                    ACTINIARIA
                                   ACTINIARIA (LPIL)
                    ANTHOZOA (PENNATULACEA)
                                   PENNATULACEA (LPIL)
          ECHINODERMATA
                    ASTEROIDEA
                                   ASTEROIDEA (LPIL)
                              ASTROPECTINIDAE
                                   ASTROPECTEN ARTICULATUS
                    ECHINOIDEA
                                   ECHINOIDEA (LPIL)
                              MELLITIDAE
                                   ENCOPE ABERRANS
                    HOLOTHUROIDEA
                                   HOLOTHUROIDEA (LPIL)
                    OPHIUROIDEA
                                   OPHIUROIDEA (LPIL)
                              AMPHIURIDAE
                                   AMPHIODIA (LPIL)
                                   AMPHIODIA TRYCHNA
          MOLLUSCA
                    APLACOPHORA
                                   APLACOPHORA (LPIL)
                    GASTROPODA

                                   GASTROPODA (LPIL)
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ACTEOCINIDAE
- ACTEOCINA BIDENTATA
- ACTEOCINA CANDEI

ACTEONIDAE
- ACTEON PUNCTOSTRIATUS

CAECIDAE
- CAECUM (LPIL)
- CAECUM CUBITATUM
- CAECUM IMBRICATUM
- CAECUM PULCHELLUM
- CAECUM SP.A
- CAECUM SP.C

CANCELLARIIDAE
- CANCELLARIA RETICULATA

COLUMBELLIDAE
- ANACHIS LAFRESNAYI
- MITRELLA LUNATA
- NASSARINA GLYPTA

CONIDAE
- CONUS FLORIDANUS FLORIDENSIS

CREPIDULIDAE
- CALYPTRAEA CENTRALIS
- CREPIDULA (LPIL)
- CREPIDULA MACULOSA

EPITONIIDAE
- EPITONIUM (LPIL)

FISSURELLIDAE
- LUCAPINELLA LIMATULA

MARGINELLIDAE
- MARGINELLA SP.C
- MARGINELLIDAE (LPIL)

MELANELLIDAE
- MELANELLIDAE (LPIL)
- NISO AEGLEES
- STROMBIFORMIS (LPIL)
- STROMBIFORMIS SP.H

NATICIDAE
- NATICA PUSILLA
- NATICIDAE (LPIL)
- SIGATICA SEMISULCATA

OLIVIDAE
- OLIVELLA (LPIL)
- OLIVELLA ADELAE
- OLIVELLA FLORALIA

PYRAMIDELLIDAE
- TURBONILLA (LPIL)
- TURBONILLA CONRADI

RETUSIDAE
- VOLVULELLA PERSIMI.IS

TAXONOMIC SPECIES LIST 09/01/87

EPA-PENSACOLA---SITE B---COLLECTED APRIL 1987

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- TROCHIDAE
  - TROCHIDAE GENUS C
- TURRIDAE
  - CERODRILLIA THEA
  - CRASSISPIRA TAMPAENSIS
  - CRYOTURRIS CITRONELLA
  - INODRILLIA SP.A
  - TURRIDAE GENUS K
- TURRITELLIDAE
  - TURRITELLA ACROPORA

NUDIBRANCHIA
- NUDIBRANCHIA (LPIL)

PELECYPODA
- PELECYPODA (LPIL)
- ARCIDAE
  - ANADARA TRANSVERSA
  - ARCIDAE (LPIL)
- CARDITIDAE
  - PLEUROMERIS TRIDENTATA
- CRASSATELLIDAE
  - CRASSINELLA LUNULATA
- GLYCYMERIDIDAE
  - GLYCYMERIS (LPIL)
- HIATELLIDAE
  - HIATELLA SP.B
- LIMIDAE
  - LIMATULA SP.A
- LUCINIDAE
  - LUCINA SOMBRERENSIS
  - LUCINA SP.B
  - LUCINA SP.D
  - LUCINIDAE (LPIL)
- LYONSIIDAE
  - LYONSIA SP.A
- MYTILIDAE
  - CRENELLA DIVARICATA
  - MYTILIDAE (LPIL)
- NUCULIDAE
  - NUCULA AEGEENIS
  - NUCULA PROXIMA
- PANDORIDAE
  - PANDORA (LPIL)
  - PANDORA ARENOSA
  - PANDORA BUSHIANA
- PECTINIDAE
  - ARGOPECTEN NUCLEUS
  - PECTINIDAE (LPIL)
- PELECYPODA FAMILY D
  - PELECYPODA FAMILY D

SEMELIDAE
- SEMELE BELLASTRIATA
- SEMELE NUCULOIDES
- SEMELIDAE (LPIL)

SOLEMYACIDAE
- SOLEMYA VELUM

SOLENIDAE
- ENSIS MINOR

TELLINIDAE
- STRIGILLA MIRABILIS
- TELLINA (LPIL)
- TELLINA AEQUISTRIATA
- TELLINA TEXANA
- TELLINA VERSICOLOR
- TELLINIDAE (LPIL)

THRACIIDAE
- BUSHIA SP.A

THYASIRIDAE
- THYASIRA TRISINUATA

UNGULINIDAE
- DIPLODONTA SP.C

VENERIDAE
- CHIONE (LPIL)
- CHIONE INTAPURPUREA
- CHIONE LATILIRATA
- GOULDIA CERINA
- MACROCALLISTA MACULATA
- PITAR SP.C
- VENERIDAE (LPIL)

VERTICORDIIDAE
- VERTICORDIA ORNATA

POLYPLACOPHORA
- POLYPLACOPHORA (LPIL)

SCAPHOPODA
- SCAPHOPODA (LPIL)

DENTALIIDAE
- DENTALIUM (LPIL)

SIPHONODENTALIIDAE
- CADULUS TETRODON

PHORONIDA
- PHORONIS (LPIL)

PLATYHELMINTHES

TURBELLARIA
- TURBELLARIA (LPIL)

RHYNCHOCOELA
- RHYNCHOCOELA (LPIL)

SIPUNCULA
- SIPUNCULA (LPIL)

ASPIDOSIPHONIDAE
- ASPIDOSIPHON (LPIL)

TAXONOMIC SPECIES LIST 09/01/87

EPA-PENSACOLA---SITE B---COLLECTED APRIL 1987

==

ASPIDOSIPHON ALBUS
ASPIDOSIPHON MUELLERI
GOLFINGIIDAE
PHASCOLION STROMBI
SIPUNCULA FAMILY C
SIPUNCULA FAMILY C

SITE C NOVEMBER 1986

Biological Community Parameters

Biomass Data

Taxonomic List

SITE C

BIOLOGICAL COMMUNITY PARAMETERS

EPA--PENSACOLA, FLORIDA — Sample Date (YY/MM/DD): [illegible]

Sample Type: MACROFAUNA — Sample Area (sq. m.): [illegible]

STATION NUMBER	TOTAL TAXA	MEAN TAXA PER REPL.	TOTAL NO. INDIVIDUALS	MEAN DENSITY	STANDARD DEVIATION	H'	J'	D
101	188	52.8	2098	17704	5526	4.05	0.77	24.45
102	174	45.2	1583	13358	4869	4.12	0.80	23.48
103	176	44.2	1533	12936	6520	4.12	0.80	23.86
104	162	45.4	2119	17881	7984	3.75	0.74	21.02
105	161	40.4	1516	12793	291[illegible]	3.86	0.76	21.85
106	160	42.3	1416	11949	294[illegible]	4.02	0.79	21.91
107	167	37.8	1254	10582	3192	3.93	0.77	23.27
108	156	43.1	1577	13308	4315	4.05	0.80	21.05
109	165	43.7	1901	16042	6507	3.68	0.72	21.72
110	173	45.0	1873	15805	6521	3.97	0.77	22.83
111	190	48.6	1623	13696	7334	4.37	0.83	25.57
112	164	45.2	1937	16345	5293	3.82	0.75	21.54
113	175	45.6	1723	14540	7308	4.17	0.81	23.35
114	174	49.7	2524	21299	13163	3.64	0.71	22.08
115	173	50.8	1950	16455	5565	3.96	0.77	22.7[illegible]
116	180	37.0	1541	13004	6410	3.81	0.73	24.39
117	186	48.6	2003	16902	5[illegible]37	4.11	0.79	24.33
118	160	47.8	1743	14708	6[illegible]58	4.15	0.80	23.96
119	190	60.0	2864	24168	9910	4.13	0.79	23.74
120	196	51.0	2190	18481	5858	3.99	0.76	25.35

Wet weight biomass for Pensacola, Florida, C Site, November 1986 All weights in grams.

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC1	ANNELIDA	0.037	0.015	0.027	0.017	0.012	0.015	0.013	0.027	0.059	0.007	0.010	0.062	0.021	0.009	0.017	0.346
PFC1	ARTHROPODA	0.016	0.004	0.011	0.021	0.003	0.004	0.019	0.018	0.016	0.004	0.042	0.038	0.018	0.064	0.007	0.277
PFC1	MOLLUSCA	0.214	0.008	0.018	0.021	0.005	0.536	0.021	0.004	0.005	0.356	0.022	0.152	0.015	0.003	0.017	1.397
PFC1	ECHINODERMATA	0.066	0.001	0.001	0.000	0.004	0.000	0.045	0.002	0.000	0.001	0.001	0.001	0.001	0.000	0.006	0.127
PFC1	MISCELLANEOUS	0.001	0.002	0.035	0.005	0.007	0.004	0.006	0.002	0.005	0.002	0.005	0.008	0.005	0.002	0.003	0.092
	TOTAL	0.268	0.030	0.092	0.064	0.031	0.557	0.064	0.053	0.085	0.370	0.080	0.261	0.052	0.078	0.044	2.129

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC2	ANNELIDA	0.036	0.019	0.003	0.018	0.003	0.012	0.004	0.013	0.026	0.003	0.011	0.013	0.030	0.037	0.009	0.235
PFC2	ARTHROPODA	0.005	0.012	0.003	0.008	1.657	0.005	0.009	0.025	0.016	0.011	0.013	0.015	0.610	0.003	0.008	1.860
PFC2	MOLLUSCA	0.002	0.016	5.047	0.005	0.003	0.001	0.029	0.014	0.008	0.024	0.004	0.072	0.078	0.539	0.025	5.867
PFC2	ECHINODERMATA	0.001	0.003	0.012	0.001	0.001	0.003	0.001	0.000	0.002	0.001	0.004	0.004	0.001	0.008	0.000	0.034
PFC2	MISCELLANEOUS	0.049	0.001	0.005	0.010	0.001	0.005	0.011	0.001	0.006	0.033	0.004	0.004	0.002	0.009	0.003	0.152
	TOTAL	0.093	0.051	5.070	0.040	1.665	0.026	0.054	0.053	0.058	0.072	0.036	0.108	0.121	0.588	0.045	8.[illegible]

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC3	ANNELIDA	0.018	0.030	0.063	0.016	0.016	0.015	0.036	0.030	0.000	0.007	0.156	0.002	0.019	0.053	0.026	0.503
PFC3	ARTHROPODA	0.003	0.014	0.004	0.015	0.008	0.018	0.032	0.008	0.064	0.006	0.006	0.006	0.066	0.066	0.054	0.390
PFC3	MOLLUSCA	0.011	0.004	0.051	0.014	0.003	0.038	0.177	0.005	0.001	0.067	0.003	0.031	0.011	0.028	0.062	0.386
PFC3	ECHINODERMATA	0.001	0.001	0.001	0.001	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.000	0.002	0.001	0.013	0.023
PFC3	MISCELLANEOUS	0.001	0.001	0.003	0.002	0.015	0.004	0.010	0.006	0.001	0.006	0.011	0.001	0.001	0.004	0.016	0.062
	TOTAL	0.034	0.050	0.122	0.048	0.042	0.076	0.255	0.058	0.015	0.026	0.176	0.040	0.039	0.092	0.111	1.104

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC4	ANNELIDA	0.069	0.056	0.027	0.002	0.001	0.020	0.007	0.013	0.006	0.006	0.009	0.015	0.036	0.360	0.604	[illegible]
PFC4	ARTHROPODA	0.009	0.020	0.004	0.010	0.013	0.025	0.014	0.025	0.043	0.015	0.006	0.025	0.013	0.009	0.013	0.254
PFC4	MOLLUSCA	0.066	0.001	0.011	0.015	0.009	0.027	0.026	0.003	0.046	0.008	0.046	0.013	0.016	0.010	0.008	0.332
PFC4	ECHINODERMATA	0.001	0.000	0.000	0.234	0.001	0.003	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.001	0.006	0.245
PFC4	MISCELLANEOUS	0.001	0.006	0.009	0.001	0.003	0.001	0.002	0.004	0.066	0.002	0.004	0.003	0.015	0.001	0.002	[illegible]
	TOTAL	0.086	0.085	0.051	0.262	0.037	0.076	0.050	0.126	0.104	0.033	0.068	0.056	0.060	0.329	0.627	1.470

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC5	ANNELIDA	0.011	0.010	0.030	0.016	0.006	0.024	0.003	0.068	0.005	0.008	0.011	0.004	0.007	0.007	0.030	[illegible]
PFC5	ARTHROPODA	0.054	0.000	0.028	0.008	0.006	0.021	0.000	0.004	0.014	0.010	0.003	0.011	0.010	0.068	0.012	0.205
PFC5	MOLLUSCA	0.061	0.024	0.051	0.018	0.026	0.084	0.005	0.036	0.032	0.008	0.017	0.058	0.019	0.051	0.026	0.498
PFC5	ECHINODERMATA	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.003	0.005	0.000	0.002	0.000	0.001	0.003	0.000	0.012
PFC5	MISCELLANEOUS	0.007	0.008	0.003	0.005	0.002	0.001	0.001	0.005	0.010	0.002	0.003	0.006	0.063	0.003	0.006	[illegible]
	TOTAL	0.133	0.050	0.112	0.048	0.040	0.110	0.018	0.058	0.066	0.026	0.036	0.079	0.040	0.067	0.074	0.959

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC6	ANNELIDA	0.003	0.002	0.018	0.024	0.007	0.003	0.013	0.041	0.017	0.009	0.012	0.034	0.020	0.049	0.011	0.223
PFC6	ARTHROPODA	0.009	0.006	0.008	0.018	0.010	0.318	0.012	0.009	0.009	0.008	0.015	0.021	0.015	0.010	0.010	0.478
PFC6	MOLLUSCA	0.025	0.026	0.010	0.026	0.015	0.042	0.028	0.127	0.007	0.021	0.079	0.072	0.140	0.053	0.009	[illegible]
PFC6	ECHINODERMATA	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.002	0.001	0.000	0.002	0.000	0.000	0.000	[illegible]
PFC6	MISCELLANEOUS	0.002	0.001	0.001	0.001	0.036	0.001	0.004	0.004	0.001	0.001	0.001	0.001	0.001	0.001	0.001	[illegible]
	TOTAL	0.039	0.035	0.037	0.069	0.068	0.365	0.057	0.182	0.036	0.040	0.107	0.130	0.176	0.073	0.031	1.445

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC7	ANNELIDA	0.018	0.014	0.013	0.016	0.080	0.063	0.102	0.009	0.040	0.049	0.016	0.006	0.008	0.010	0.045	0.489
PFC7	ARTHROPODA	0.006	0.003	6.254	0.004	0.011	0.004	0.002	0.004	0.023	0.062	0.062	0.003	0.001	0.001	0.009	6.329
PFC7	MOLLUSCA	0.671	2.370	0.010	0.021	0.017	0.001	0.074	0.021	0.002	0.005	0.080	0.008	0.013	0.016	0.614	2.723
PFC7	MISCELLANEOUS	0.001	0.001	0.000	0.007	0.002	0.034	0.001	0.247	0.001	0.003	0.001	0.001	0.017	0.005	0.002	0.323
	TOTAL	0.096	2.388	6.277	0.048	0.110	0.102	0.179	0.281	0.066	0.059	0.099	0.018	0.039	0.032	0.670	9.864

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC8	ANNELIDA	0.036	0.023	0.035	0.007	0.062	0.046	0.003	0.013	0.071	0.054	0.018	0.011	0.003	0.016	0.067	0.462
PFC8	ARTHROPODA	0.006	0.010	0.008	0.004	0.015	0.009	0.009	0.016	0.015	0.013	0.019	0.014	0.014	0.069	0.017	0.178
PFC8	MOLLUSCA	0.052	0.112	0.018	0.001	0.005	0.004	0.007	0.442	0.002	0.099	0.005	0.009	0.002	0.005	0.001	0.764
PFC8	ECHINODERMATA	0.000	0.000	0.001	0.000	0.000	0.001	0.007	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.00[illegible]	[illegible]
PFC8	MISCELLANEOUS	0.001	0.004	0.001	0.001	0.001	0.008	0.008	0.009	0.001	0.005	0.062	0.010	0.002	0.004	0.002	0.059
	TOTAL	0.095	0.149	0.063	0.013	0.083	0.068	0.034	0.481	0.089	0.171	0.044	0.044	0.021	0.634	0.066	[illegible]

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC9	ANNELIDA	0.019	0.020	0.003	0.045	0.012	0.016	0.003	0.006	0.020	0.015	0.004	0.004	0.003	0.047	0.003	6.220
PFC9	ARTHROPODA	0.010	0.003	0.008	0.004	0.005	0.066	0.013	0.015	0.007	0.004	0.006	0.005	0.006	0.024	0.100	0.216
PFC9	MOLLUSCA	0.067	0.029	0.121	0.116	0.122	0.018	0.015	0.017	0.022	0.017	0.029	0.015	0.025	0.010	0.026	0.509
PFC9	ECHINODERMATA	0.001	0.002	0.001	0.000	0.002	0.001	0.001	0.004	0.000	0.001	0.001	0.000	0.004	0.006	0.000	0.020
PFC9	MISCELLANEOUS	0.005	0.004	0.002	0.066	0.004	0.002	0.011	0.003	0.002	0.001	0.001	0.001	0.016	0.004	0.004	0.066
	TOTAL	0.042	0.058	0.135	0.171	0.145	0.043	0.043	0.045	0.051	0.038	0.041	0.025	0.056	0.085	0.133	1.111

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC10	ANNELIDA	0.042	0.027	0.007	0.050	0.026	0.019	0.013	0.033	0.025	0.064	0.008	0.015	0.005	0.041	0.066	0.381
PFC10	ARTHROPODA	0.000	0.007	0.015	0.004	0.012	0.000	0.017	0.011	0.000	0.000	0.750	0.010	0.011	0.014	0.000	0.899
PFC10	MOLLUSCA	0.012	0.042	0.013	0.004	0.002	0.020	0.001	0.170	0.020	0.010	0.004	0.005	0.000	0.005	0.011	0.343
PFC10	ECHINODERMATA	0.000	0.001	0.001	0.001	0.003	0.002	0.000	0.001	0.000	0.006	0.001	0.001	0.003	0.007	0.000	0.027
PFC10	MISCELLANEOUS	0.003	0.004	0.003	0.063	0.001	0.007	0.002	0.005	0.009	0.001	0.015	0.006	0.001	0.002	0.604	0.066
	TOTAL	0.065	0.001	0.039	0.062	0.044	0.056	0.033	0.220	0.070	0.037	0.786	0.037	0.020	0.069	0.009	1.716

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC11	ANNELIDA	0.017	0.014	0.002	0.010	0.033	0.005	0.008	0.034	0.020	0.027	0.009	0.014	0.006	0.018	0.055	0.272
PFC11	ARTHROPODA	0.003	0.010	0.003	0.026	0.007	0.007	0.002	0.030	0.017	0.017	0.006	0.015	0.005	0.006	0.035	0.189
PFC11	MOLLUSCA	0.002	0.017	43.559	0.115	0.018	0.026	0.015	0.035	0.010	0.013	0.095	0.023	0.006	0.008	0.032	43.966
PFC11	ECHINODERMATA	0.000	0.001	0.020	0.006	0.001	0.003	0.006	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.031
PFC11	MISCELLANEOUS	0.002	0.020	0.001	0.010	0.004	0.001	0.001	0.002	0.006	0.002	0.002	0.013	0.002	0.008	0.006	0.082
	TOTAL	0.024	0.062	43.585	0.161	0.055	0.042	0.026	0.102	0.053	0.060	0.113	0.066	0.019	0.041	0.131	44.540

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC12	ANNELIDA	0.011	0.018	0.016	0.016	0.023	0.008	0.008	0.018	0.011	0.006	0.009	0.011	0.004	0.009	0.005	0.253
PFC12	ARTHROPODA	0.067	0.012	0.010	0.006	0.022	0.006	0.007	0.000	0.008	0.010	0.009	0.012	0.026	0.019	0.0[illegible]	0.187
PFC12	MOLLUSCA	0.013	0.015	0.010	0.023	0.126	0.024	0.003	0.003	0.096	0.022	0.001	0.006	0.011	0.036	0.005	0.388
PFC12	ECHINODERMATA	0.000	0.001	0.000	0.000	0.006	0.005	0.000	0.000	0.001	0.008	0.001	0.001	0.000	0.000	0.001	0.024
PFC12	MISCELLANEOUS	0.003	0.002	0.001	0.008	0.006	0.024	0.005	0.002	0.001	0.007	0.806	0.007	0.003	0.005	0.004	0.884
	TOTAL	0.034	0.048	0.037	0.055	0.183	0.069	0.023	0.033	0.117	0.061	0.906	0.037	0.044	0.063	0.026	1.736

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC13	ANNELIDA	0.066	0.005	0.005	0.060	0.007	0.043	0.017	0.021	0.018	0.012	0.014	0.008	0.017	0.004	0.009	0.274
PFC13	ARTHROPODA	0.010	0.019	0.046	0.008	0.010	0.016	0.010	0.016	0.008	0.013	0.003	0.016	0.022	0.005	0.007	0.209
PFC13	MOLLUSCA	0.057	0.125	0.065	0.033	0.023	0.040	0.013	2.282	0.043	0.046	0.017	0.075	0.039	0.027	0.015	2.899
PFC13	ECHINODERMATA	0.060	0.000	0.001	6.0%	0.001	0.001	0.000	0.060	0.000	0.001	0.000	0.001	0.004	0.000	0.001	0.011
PFC13	MISCELLANEOUS	0.003	0.004	0.004	0.002	0.003	0.002	0.001	0.005	0.002	0.004	0.003	0.006	0.004	0.003	0.001	0.047
	TOTAL	0.076	0.153	0.121	0.132	0.044	0.102	0.041	2.324	0.070	0.076	0.037	0.106	0.086	0.039	0.033	3.440

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC14	ANNELIDA	0.032	0.011	0.033	0.009	0.012	0.007	0.039	0.011	0.127	0.063	0.016	0.022	0.010	0.045	0.012	0.443
PFC14	ARTHROPODA	0.008	0.010	0.013	0.012	0.005	0.002	0.026	0.004	0.000	0.015	0.003	0.004	0.005	0.004	0.004	0.123
PFC14	MOLLUSCA	0.026	0.006	0.001	0.027	0.007	0.003	0.041	0.020	0.011	0.007	0.006	0.007	0.109	0.400	0.005	0.676
PFC14	ECHINODERMATA	0.001	0.003	0.000	0.001	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.001	0.000	0.001	0.001	0.014
PFC14	MISCELLANEOUS	0.008	0.044	0.002	0.052	0.005	0.007	0.022	0.005	0.016	0.006	0.013	0.066	0.007	0.004	0.005	0.262
	TOTAL	0.075	0.074	0.049	0.101	0.031	0.026	0.129	0.041	0.163	0.091	0.032	0.100	0.131	0.454	0.027	1.518

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC15	ANNELIDA	0.012	0.012	0.012	0.007	0.014	0.005	0.015	0.003	0.008	0.021	0.017	0.020	0.005	0.028	0.015	0.194
PFC15	ARTHROPODA	0.063	0.006	0.008	0.005	0.014	0.005	0.012	0.012	0.065	0.016	0.013	0.012	0.012	0.016	0.013	0.212
PFC15	MOLLUSCA	0.006	0.019	0.065	0.012	0.015	0.005	0.009	0.017	0.018	0.017	0.007	0.028	0.037	0.037	0.013	0.385
PFC15	ECHINODERMATA	0.001	0.000	0.001	0.001	0.006	0.004	0.001	0.000	0.006	0.001	0.000	0.001	0.006	0.001	0.001	0.012
PFC15	MISCELLANEOUS	0.001	0.003	0.023	0.008	0.004	0.002	0.003	0.001	0.003	0.010	0.008	0.005	0.002	0.006	0.006	0.083
	TOTAL	0.023	0.040	0.109	0.033	0.047	0.101	0.038	0.033	0.094	0.065	0.045	0.066	0.056	0.088	0.048	6.886

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC16	ANNELIDA	0.023	0.023	0.033	0.019	0.013	0.032	0.169	0.020	0.023	0.039	0.027	0.018	0.017	0.007	0.038	0.381
PFC16	ARTHROPODA	0.001	0.035	0.007	0.001	0.002	0.022	0.020	0.005	0.001	0.025	0.003	0.012	0.005	0.003	0.006	0.148
PFC16	MOLLUSCA	0.001	0.008	0.074	0.009	0.001	1.384	0.036	0.063	0.004	0.000	0.000	0.003	0.005	0.010	0.001	1.537
PFC16	ECHINODERMATA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.023	0.000	0.000	0.000	0.000	0.027	0.054
PFC16	MISCELLANEOUS	0.002	0.001	0.002	0.001	0.012	0.005	0.002	0.003	0.00[illegible]	0.005	0.002	0.008	0.003	0.008	0.005	0.0[illegible]
	TOTAL	0.027	0.067	0.116	0.036	0.028	1.443	0.228	0.035	0.024	0.092	0.032	0.039	0.030	0.028	0.077	2.301

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC17	ANNELIDA	0.017	0.034	0.007	0.063	0.020	0.003	0.005	0.010	0.015	0.022	0.009	0.035	0.022	0.034	0.034	0.330
PFC17	ARTHROPODA	0.032	0.030	0.003	0.066	0.020	0.007	0.008	0.018	0.016	0.010	0.011	0.015	0.004	0.006	0.016	0.196
PFC17	MOLLUSCA	0.013	0.002	0.004	0.009	0.060	0.013	0.017	0.007	0.006	0.015	0.015	0.018	0.007	0.006	0.014	0.266
PFC17	ECHINODERMATA	0.000	0.000	0.000	0.000	0.000	0.008	0.002	0.000	0.000	0.000	0.000	0.500	0.000	0.000	0.001	0.511
PFC17	MISCELLANEOUS	0.007	0.001	0.004	0.004	0.005	0.001	0.259	0.005	0.002	0.017	0.010	0.004	0.010	0.002	0.016	0.341
	TOTAL	0.077	0.067	0.018	0.082	0.105	0.024	0.291	0.032	0.039	0.064	0.045	0.572	0.043	0.048	0.077	1.584

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC18	ANNELIDA	0.021	0.047	0.017	0.045	0.018	0.051	0.032	0.010	0.035	0.020	0.033	0.010	0.038	0.028	0.035	0.448
PFC18	ARTHROPODA	0.003	0.019	0.008	0.003	0.000	0.008	0.010	0.003	0.019	0.007	0.006	0.006	0.012	0.007	0.008	0.129
PFC18	MOLLUSCA	0.015	0.030	0.011	0.017	0.019	0.056	0.022	0.077	0.142	0.013	0.054	0.035	0.020	0.109	0.027	0.655
PFC18	ECHINODERMATA	0.000	0.000	0.001	0.005	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.007
PFC18	MISCELLANEOUS	0.053	0.002	0.286	0.004	0.025	0.001	0.001	0.001	0.004	0.007	[illegible]	0.001	0.005	0.000	0.001	0.400
	TOTAL	0.092	0.098	0.323	0.074	0.070	0.116	0.065	0.093	0.201	0.047	[illegible]	0.060	0.083	0.144	0.071	1.639

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC19	ANNELIDA	0.027	0.041	0.020	0.027	0.023	0.011	0.023	0.042	0.056	0.123	0.022	0.054	0.025	0.060	0.023	0.585
PFC19	ARTHROPODA	0.009	0.024	0.022	0.017	0.021	0.008	0.023	0.016	0.018	0.012	0.027	0.007	0.016	0.004	0.006	0.230
PFC19	MOLLUSCA	0.011	0.039	0.215	0.240	0.093	0.062	0.020	0.014	0.100	0.040	0.036	0.008	0.075	0.074	0.039	1.074
PFC19	ECHINODERMATA	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.005
PFC19	MISCELLANEOUS	0.001	0.008	0.023	0.004	0.025	0.014	0.004	0.005	0.006	0.001	0.012	0.008	0.014	0.006	0.004	0.135
	TOTAL	0.049	0.112	0.288	0.296	0.163	0.095	0.075	0.079	0.180	0.176	0.097	0.077	0.131	0.144	0.072	2.029

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC20	ANNELIDA	0.033	0.010	0.057	0.037	0.022	0.069	0.049	0.050	0.021	0.012	0.065	0.633	0.035	0.065	0.060	[illegible]
PFC20	ARTHROPODA	0.005	0.022	0.009	0.026	0.016	0.020	0.009	0.020	0.015	0.003	0.003	0.011	0.014	0.015	0.005	0.201
PFC20	MOLLUSCA	0.032	0.000	0.035	0.035	0.069	0.096	0.013	0.075	0.153	0.146	0.061	0.032	0.046	0.047	0.020	0.934
PFC20	ECHINODERMATA	0.007	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	[illegible]
PFC20	MISCELLANEOUS	0.001	0.002	0.008	0.009	0.001	0.009	0.010	0.010	0.366	0.019	0.002	0.001	0.001	0.004	0.009	0.460
	TOTAL	0.078	0.114	0.109	0.107	0.108	0.143	0.082	0.163	0.555	0.184	0.071	0.077	0.091	0.131	0.094	2.903

TAXONOMIC LISTING

TAXONOMIC SPECIES LIST 08/25/87

EPA-PENSACOLA---SITE C---COLLECTED NOVEMBER 1987

==

- ANNELIDA
  - HIRUDINEA
    - HIRUDINEA (LPIL)*
  - OLIGOCHAETA
    - OLIGOCHAETA (LPIL)
  - POLYCHAETA
    - AMPHARETIDAE
      - AMPHARETIDAE (LPIL)
      - ISOLDA PULCHELLA
      - MELINNA MACULATA
      - SABELLIDES SP.A
    - AMPHINOMIDAE
      - CHLOEIA VIRIDIS
      - PARAMPHINOME SP.B
    - APHRODITIDAE
      - APHROGENIA SP.A
    - ARABELLIDAE
      - DRILONEREIS LONGA
    - CAPITELLIDAE
      - CAPITELLIDAE (LPIL)
      - MASTOBRANCHUS VARIABILIS
      - MEDIOMASTUS (LPIL)
      - MEDIOMASTUS CALIFORNIENSIS
      - NOTOMASTUS (LPIL)
    - CHAETOPTERIDAE
      - CHAETOPTERIDAE (LPIL)
    - CHRYSOPETALIDAE
      - BHAWANIA HETEROSETA
      - PALEANOTUS SP.A
    - CIRRATULIDAE
      - CAULLERIELLA (LPIL)
      - CAULLERIELLA CF. ALATA
      - CHAETOZONE (LPIL)
      - CHAETOZONE SP.I
      - CIRRATULIDAE (LPIL)
      - CIRRIFORMIA (LPIL)
      - THARYX CF. ANNULOSUS
    - DORVILLEIDAE
      - DORVILLEIDAE (LPIL)
      - PETTIBONEIA DUOFURCA
      - PROTODORVILLEA KEFERSTEINI
      - SCHISTOMERINGOS (LPIL)
      - SCHISTOMERINGOS CF. RUDOLPHI
      - SCHISTOMERINGOS PECTINATA
    - EULEPETHIDAE
      - EULEPETHIDAE (LPIL)
      - GRUBEULEPIS SP.A
    - EUNICIDAE
      - EUNICE VITTATA

*LPIL - Lowest Practicable Identification Level

TAXONOMIC SPECIES LIST 08/25/87

EPA-PENSACOLA---SITE C---COLLECTED NOVEMBER 1987

==

- EUNICIDAE (LPIL)
- LYSIDICE SP.B
- MARPHYSA SANGUINEA

FLABELLIGERIDAE
- FLABELLIGERIDAE (LPIL)
- THEROCHAETA SP.A

GLYCERIDAE
- GLYCERA (LPIL)
- GLYCERA AMERICANA
- GLYCERA DIBRANCHIATA
- GLYCERA SP.A
- GLYCERA SP.I
- GLYCERA SP.P

GONIADIDAE
- GONIADA LITTOREA
- GONIADA MACULATA
- GONIADIDES CAROLINAE

HESIONIDAE
- HESIONIDAE (LPIL)
- HESIONIDAE GENUS D
- HETEROPODARKE FORMALIS
- HETEROPODARKE LYONSI
- PODARKEOPSIS LEVIFUSCINA

LUMBRINERIDAE
- LUMBRINERIDAE (LPIL)
- LUMBRINERIDES DAYI
- LUMBRINERIS (LPIL)
- LUMBRINERIS LATREILLI
- LUMBRINERIS SP.D
- LUMBRINERIS VERRILLI

MAGELONIDAE
- MAGELONA (LPIL)
- MAGELONA PETTIBONEAE
- MAGELONA SP.B
- MAGELONA SP.C
- MAGELONA SP.I

MALDANIDAE
- AXIOTHELLA SP.A
- BOGUEA ENIGMATICA
- BOGUEA SP.A
- MALDANIDAE (LPIL)

NEPHTYIDAE
- AGLAOPHAMUS VERRILLI
- NEPHTYIDAE (LPIL)
- NEPHTYS PICTA
- NEPHTYS SIMONI

NEREIDAE
- CERATOCEPHALE OCULATA
- NEREIDAE (LPIL)

- NEREIS (LPIL)
- NEREIS MICROMMA
- RULLIERINEREIS SP.A

ONUPHIDAE
- DIOPATRA CUPREA
- DIOPATRA TRIDENTATA
- MOOREONUPHIS PALLIDULA

OPHELIIDAE
- ARMANDIA MACULATA
- OPHELIA DENTICULATA
- OPHELIIDAE (LPIL)
- TRAVISIA HOBSONAE

ORBINIIDAE
- LEITOSCOLOPLOS (LPIL)
- LEITOSCOLOPLOS FRAGILIS
- ORBINIIDAE (LPIL)
- SCOLOPLOS (LPIL)
- SCOLOPLOS RUBRA

OWENIIDAE
- GALATHOWENIA OCULATA
- OWENIA SP.A
- OWENIIDAE (LPIL)

PARAONIDAE
- ARICIDEA (LPIL)
- ARICIDEA CATHERINAE
- ARICIDEA CERRUTII
- ARICIDEA PHILBINAE
- ARICIDEA SP.A
- ARICIDEA SP.E
- ARICIDEA SP.H
- ARICIDEA SP.L
- ARICIDEA SP.T
- ARICIDEA SP.X
- ARICIDEA TAYLORI
- ARICIDEA WASSI
- CIRROPHORUS (LPIL)
- CIRROPHORUS BRANCHIATUS
- LEVINSENIA GRACILIS
- PARAONIDAE (LPIL)
- PARAONIS PYGOENIGMATICA

PECTINARIIDAE
- PECTINARIIDAE (LPIL)

PHYLLODOCIDAE
- ANAITIDES GROENLANDICA
- ANAITIDES LONGIPES
- ANAITIDES MUCOSA
- ETEONE LACTEA
- GENETYLLIS SP.A

- HESIONURA SP.A

MYSTIDES BOREALIS
PARANAITIS SPECIOSA
PHYLLODOCE ARENAE
PHYLLODOCIDAE (LPIL)
PILARGIDAE
ANCISTROSYLLIS (LPIL)
ANCISTROSYLLIS HARTMANAE
LITOCORSA ANTENNATA
SIGAMBRA BASSI
SIGAMBRA TENTACULATA
PISIONIDAE
PISIONIDAE (LPIL)
POECILOCHAETIDAE
POECILOCHAETUS (LPIL)
POLYGORDIIDAE
POLYGORDIUS (LPIL)
POLYNOIDAE
POLYNOIDAE (LPIL)
SABELLARIIDAE
SABELLARIA SP.A
SABELLIDAE
CHONE (LPIL)
EUCHONE (LPIL)
FABRICIOLA TRILOBATA
POTAMILLA SP.E
SABELLIDAE (LPIL)
SACCOCIRRIDAE
SACCOCIRRUS SP.A
SERPULIDAE
SERPULA SP.A
SERPULIDAE (LPIL)
SERPULIDAE GENUS C
VERMILIOPSIS ANNULATA
SIGALIONIDAE
SIGALION SP.A
SIGALIONIDAE (LPIL)
THALENESSA SP.C
SPIONIDAE
AONIDES PAUCIBRANCHIATA
LAONICE CIRRATA
MALACOCEROS (LPIL)
MICROSPIO PIGMENTATA
PARAPRIONOSPIO PINNATA
POLYDORA (LPIL)
POLYDORA CORNUTA
POLYDORA SOCIALIS
PRIONOSPIO (LPIL)
PRIONOSPIO CIRRIFERA

PRIONOSPIO CRISTATA

SCOLELEPIS SQUAMATA
SPIO PETTIBONEAE
SPIONIDAE (LPIL)
SPIOPHANES BOMBYX
SPIOPHANES CF. MISSIONENSIS
SYLLIDAE
BRANIA WELLFLEETENSIS
EHLERSIA FERRUGINA
EURYSYLLIS TUBERCULATA
EXOGONE ATLANTICA
EXOGONE DISPAR
EXOGONE LOUREI
HAPLOSYLLIS SPONGICOLA
ODONTOSYLLIS ENOPLA
OPISTHODONTA SP.A
PARAPIONOSYLLIS LONGICIRRATA
PIONOSYLLIS GESAE
PLAKOSYLLIS QUADRIOCULATA
SPHAEROSYLLIS ACICULATA
SPHAEROSYLLIS PIRIFEROPSIS
STREPTOSYLLIS PETTIBONEAE
SYLLIDAE (LPIL)
SYLLIDES FULVUS
TYPOSYLLIS AMICA
TYPOSYLLIS CF. LUTEA
TYPOSYLLIS SP.C
TEREBELLIDAE
POLYCIRRUS (LPIL)
POLYCIRRUS SP.F
POLYCIRRUS SP.G
TEREBELLIDAE (LPIL)
TRICHOBRANCHIDAE
TRICHOBRANCHUS GLACIALIS
ARTHROPODA (CRUSTACEA)
CRUSTACEA (LPIL)
AMPHIPODA
AMPHIPODA (LPIL)
AMPELISCIDAE
AMPELISCA (LPIL)
AMPELISCA AGASSIZI
AMPELISCA SP.A
AMPELISCA SP.C
AMPELISCA SP.L
AORIDAE
ACUMINODEUTOPUS (LPIL)
ACUMINODEUTOPUS NAGLEI
ACUMINODEUTOPUS SP.A
AORIDAE (LPIL)

LEMBOS (LPIL)

- LEMBOS SMITHI
- MICRODEUTOPUS MYERSI

ARGISSIDAE
- ARGISSA HAMATIPES

BATEIDAE
- BATEIDAE (LPIL)
- CARINOBATEA CARINATA

COROPHIIDAE
- COROPHIIDAE (LPIL)
- COROPHIUM (LPIL)
- COROPHIUM ACUTUM
- COROPHIUM SP.F
- COROPHIUM SP.L
- COROPHIUM SP.M

HAUSTORIIDAE
- ACANTHOHAUSTORIUS SHOEMAKERI
- ACANTHOHAUSTORIUS SP.B
- HAUSTORIIDAE (LPIL)
- PROTOHAUSTORIUS BOUSFIELDI
- PROTOHAUSTORIUS SP.B
- PROTOHAUSTORIUS SP.C

ISAEIDAE
- ISAEIDAE (LPIL)
- MEGAMPHOPUS (LPIL)
- MEGAMPHOPUS SP.A
- PHOTIS (LPIL)
- PHOTIS MELANICUS
- PHOTIS SP.D

LILJEBORGIIDAE
- LILJEBORGIA (LPIL)
- LILJEBORGIA SP.A
- LILJEBORGIIDAE (LPIL)
- LISTRIELLA (LPIL)
- LISTRIELLA SP.F
- LISTRIELLA SP.G

LYSIANASSIDAE
- HIPPOMEDON SP.A
- HIPPOMEDON SP.B
- LYSIANASSA (LPIL)
- LYSIANASSA CUBENSIS

MELITIDAE
- DULICHIELLA (LPIL)
- DULICHIELLA SP.B
- ELASMOPUS (LPIL)
- ELASMOPUS SP.C
- MELITIDAE (LPIL)

NEOMEGAMPHOPIDAE
- NEOMEGAMPHOPUS HIATUS

OEDICERCTIDAE
- MONOCULODES NYEI

SYNCHELIDIUM AMERICANUM
PHOXOCEPHALIDAE
METHARPINA FLORIDANA
PLATYISCHNOPIDAE
EUDEVENOPUS HONDURANUS
PODOCERIDAE
PODOCERUS (LPIL)
PODOCERUS SP.B
SYNOPIIDAE
GAROSYRRHOE SP.B
SYNOPIIDAE (LPIL)
TIRON (LPIL)
TIRON TRIOCELLATUS
TIRON TROPAKIS
CUMACEA
CUMACEA (LPIL)
BODOTRIIDAE
BODOTRIIDAE (LPIL)
CYCLASPIS (LPIL)
CYCLASPIS SP.D
CYCLASPIS SP.N
CYCLASPIS SP.O
CYCLASPIS UNICORNIS
DIASTYLIDAE
OXYUROSTYLIS (LPIL)
OXYUROSTYLIS SP.B
OXYUROSTYLIS SP.C
NANNASTACIDAE
CAMPYLASPIS (LPIL)
CAMPYLASPIS SP.I
CAMPYLASPIS SP.M
CAMPYLASPIS SP.O
CUMELLA (LPIL)
CUMELLA SP.G
CUMELLA SP.H
DECAPODA (NATANTIA)
DECAPODA NATANTIA (LPIL)
ALPHEIDAE
ALPHEIDAE (LPIL)
ALPHEUS (LPIL)
ALPHEUS NORMANNI
PASIPHAEIDAE
LEPTOCHELA PAPULATA
PENAEIDAE
PENAEUS (LPIL)
PROCESSIDAE
PROCESSA HEMPHILLI
SICYONIIDAE
SICYONIA BREVIROSTRIS

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SICYONIA PARRI
SICYONIIDAE (LPIL)
SOLENOCERIDAE
SOLENOCERA ATLANTIDIS
DECAPODA (REPTANTIA)
DECAPODA REPTANTIA (LPIL)
ALBUNEIDAE
ALBUNEA GIBBESII
DROMIIDAE
DROMIDIA ANTILLENSIS
HYPOCONCHA ARCUATA
GONEPLACIDAE
FREVILLEA HIRSUTA
GLYPTOPLAX SMITHII
LEUCOSIIDAE
EBALIA SP.B
EBALIA STIMPSONII
SPELOEOPHORUS PONTIFER
MAJIDAE
BATRACHONOTUS FRAGOSUS
INACHOIDES FORCEPS
MAJIDAE (LPIL)
PAGURIDAE
PAGURIDAE (LPIL)
PARTHENOPIDAE
CRYPTOPODIA CONCAVA
HETEROCRYPTA GRANULATA
MESORHOEA SEXSPINOSA
PARTHENOPIDAE (LPIL)
PINNOTHERIDAE
PINNIXA (LPIL)
PINNIXA SAYANA
PORCELLANIDAE
EUCERAMUS PRAELONGUS
PORTUNIDAE
PORTUNUS SPINICARPUS
XANTHIDAE
NANOPLAX XANTHIFORMIS
ISOPODA
ISOPODA (LPIL)
ANTHURIDAE
APANTHURA MAGNIFICA
PTILANTHURA SP.B
IDOTEIDAE
EDOTEA (LPIL)
EDOTEA LYONSI
SEROLIDAE
SEROLIS MGRAYI

LEPTOSTRACA
NEBALIIDAE
NEBALIA BIPES

TAXONOMIC LISTING

TAXONOMIC SPECIES LIST 08/25/87

EPA-PENSACOLA---SITE C---COLLECTED NOVEMBER 1987

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MYSIDACEA
- MYSIDACEA (LPIL)
- MYSIDAE
  - ANATHIMYSIS (LPIL)
  - ANCHIALINA TYPICA
  - BOWMANIELLA PORTORICENSIS
  - MYSIDOPSIS FURCA

OSTRACODA
- OSTRACODA (LPIL)
- CYLINDROLEBERIDIDAE
  - AMBOLEBERIS AMERICANA
  - ASTEROPELLA MACLAUGHLINAE
  - ASTEROPTERYGION OCULITRISTIS
  - SYNASTEROPE (LPIL)
- OSTRACODA FAMILY A
  - OSTRACODA FAMILY A
- OSTRACODA FAMILY H
  - OSTRACODA FAMILY H
- OSTRACODA FAMILY I
  - OSTRACODA FAMILY I
- OSTRACODA FAMILY J
  - OSTRACODA FAMILY J
- PHILOMEDIDAE
  - HARBANSUS PAUCICHELATUS
- RUTIDERMATIDAE
  - RUTIDERMA DARBYI
- SARSIELLIDAE
  - EUSARSIELLA DISPARALIS
  - EUSARSIELLA ELOFSONI
  - EUSARSIELLA GIGACANTHA
  - EUSARSIELLA PILLIPOLLICIS
- TRACHYLEBERIDIDAE
  - ACTINOCYTHEREIS SP.A
  - RETICULOCYTHEREIS SP.A
  - RETICULOCYTHEREIS SP.B

TANAIDACEA
- TANAIDACEA (LPIL)
- APSEUDIDAE
  - APSEUDES PROPINQUUS
  - APSEUDES SP.H
  - APSEUDIDAE (LPIL)
- KALLIAPSEUDIDAE
  - KALLIAPSEUDES (LPIL)
  - KALLIAPSEUDES SP.A
  - KALLIAPSEUDES SP.B
  - KALLIAPSEUDES SP.C
  - KALLIAPSEUDES SP.D
- LEPTOCHELIDAE
  - LEPTOCHELIA SP.D

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                    NOTOTANAIDAE
                         TANAISSUS SP.A
  BRACHIOPODA
                         BRACHIOPODA (LPIL)
  CEPHALOCHORDATA
            LEPTOCARDII
                    BRANCHIOSTOMIDAE
                         BRANCHIOSTOMA (LPIL)
                         BRANCHIOSTOMA FLORIDAE
                         BRANCHIOSTOMA LONGIROSTRUM
                         BRANCHIOSTOMA VIRGINIAE
  CNIDARIA
            ACTINIARIA
                         ACTINIARIA (LPIL)
                    ACTINIARIA (LPIL)
  ECHINODERMATA
            ASTEROIDEA
                         ASTEROIDEA (LPIL)
                    ASTROPECTINIDAE
                         ASTROPECTEN ARTICULATUS
                         ASTROPECTINIDAE (LPIL)
            ECHINOIDEA
                         ECHINOIDEA (LPIL)
                    ECHINOIDEA (LPIL)
            OPHIUROIDEA
                         OPHIUROIDEA (LPIL)
                    AMPHIURIDAE
                         AMPHIODIA (LPIL)
                         AMPHIODIA TRYCHNA
                         AMPHIURIDAE (LPIL)
                         AMPHIURIDAE GENUS B
  ECHIURA
                         ECHIURA (LPIL)
  HEMICHORDATA
                         HEMICHORDATA (LPIL)
  MOLLUSCA
            GASTROPODA
                         GASTROPODA (LPIL)
                    ACTEOCINIDAE
                         ACTEOCINA CANDEI
                    ACTEONIDAE
                         ACTEON PUNCTOSTRIATUS
                    ARCHITECTONICIDAE
                         ARCHITECTONICA NOBILIS
                    ATYIDAE
                         ATYS (LPIL)
                         ATYS SANDERSONI
                    CAECIDAE

                         CAECUM (LPIL)
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CAECUM CUBITATUM
CAECUM IMBRICATUM
CAECUM PULCHELLUM
CAECUM SP.A
CAECUM SP.C
CANCELLARIIDAE
CANCELLARIA RETICULATA
COLUMBELLIDAE
ANACHIS LAFRESNAYI
NASSARINA GLYPTA
CONIDAE
CONUS FLORIDANUS FLORIDENSIS
CREPIDULIDAE
CALYPTRAEA CENTRALIS
CREPIDULA (LPIL)
CREPIDULA CONVEXA
CREPIDULA MACULOSA
CREPIDULIDAE (LPIL)
EPITONIIDAE
EPITONIUM (LPIL)
FISSURELLIDAE
FISSURELLIDAE (LPIL)
MARGINELLIDAE
GRANULINA OVULIFORMIS
MARGINELLA (LPIL)
MARGINELLA SP.C
MELANELLIDAE
NISO AEGLEES
STROMBIFORMIS (LPIL)
STROMBIFORMIS AURICINCTUS
NATICIDAE
NATICA PUSILLA
NATICIDAE (LPIL)
POLINICES LACTEUS
SIGATICA SEMISULCATA
SINUM (LPIL)
SINUM PERSPECTIVUM
OLIVIDAE
JASPIDELLA SP.A
OLIVA SAYANA
OLIVELLA (LPIL)
OLIVELLA ADELAE
OLIVELLA FLORALIA
PYRAMIDELLIDAE
TURBONILLA (LPIL)
TURBONILLA CONRADI
RETUSIDAE
VOLVULELLA PERSIMILIS

TEREBRIDAE
TEREBRA DISLOCATA

TEREBRIDAE (LPIL)
TROCHIDAE
TROCHIDAE GENUS C
TURRIDAE
CRYOTURRIS CITRONELLA
INODRILLIA SP.A
KURTZIELLA RUBELLA
TURRIDAE (LPIL)
TURRIDAE GENUS K
TURRIDAE GENUS L
TURRITELLIDAE
TURRITELLA ACROPORA
PELECYPODA
PELECYPODA (LPIL)
ARCIDAE
ANADARA TRANSVERSA
ARCIDAE (LPIL)
CARDIIDAE
CARDIIDAE (LPIL)
LAEVICARDIUM (LPIL)
LAEVICARDIUM LAEVIGATUM
CARDITIDAE
PLEUROMERIS TRIDENTATA
CHAMIDAE
ARCINELLA CORNUTA
CRASSATELLIDAE
CRASSINELLA LUNULATA
HIATELLIDAE
HIATELLA SP.B
LIMIDAE
LIMA PELLUCIDA
LIMATULA SP.A
LUCINIDAE
DIVARICELLA QUADRISULCATA
LINGA SP.A
LUCINA (LPIL)
LUCINA SOMBRERENSIS
LUCINA SP.B
LUCINA SP.D
LUCINIDAE (LPIL)
PARVILUCINA MULTILINEATA
LYONSIIDAE
LYONSIA SP.A
MESODESMATIDAE
ERVILIA CONCENTRICA
MYTILIDAE
CRENELLA DIVARICATA
NUCULIDAE
NUCULA AEGEENIS

PANDORIDAE
- PANDORA (LPIL)
- PANDORA BUSHIANA

PECTINIDAE
- ARGOPECTEN (LPIL)
- PECTEN RAVENELI

PELECYPODA FAMILY D
- PELECYPODA FAMILY D

SEMELIDAE
- SEMELE BELLASTRIATA
- SEMELE NUCULOIDES
- SEMELIDAE (LPIL)

SOLEMYACIDAE
- SOLEMYA VELUM

TELLINIDAE
- STRIGILLA (LPIL)
- STRIGILLA MIRABILIS
- TELLINA (LPIL)
- TELLINA AEQUISTRIATA
- TELLINA LISTERI
- TELLINA TEXANA
- TELLINA VERSICOLOR

THRACIIDAE
- BUSHIA SP.A

THYASIRIDAE
- THYASIRA TRISINUATA

VENERIDAE
- CHIONE (LPIL)
- CHIONE INTAPURPUREA
- CHIONE LATILIRATA
- GOULDIA CERINA
- MACROCALLISTA MACULATA
- PITAR FULMINATUS
- PITAR SP.C
- VENERIDAE (LPIL)

VERTICORDIIDAE
- VERTICORDIA ORNATA

POLYPLACOPHORA
- POLYPLACOPHORA (LPIL)

SCAPHOPODA
- SCAPHOPODA (LPIL)

SIPHONODENTALIIDAE
- CADULUS (LPIL)
- CADULUS AGASSIZII
- CADULUS SP.C
- CADULUS TETRODON

PHORONIDA
- PHORONIS (LPIL)

PLATYHELMINTHES

TURBELLARIA
- TURBELLARIA (LPIL)

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RHYNCHOCOELA
- RHYNCHOCOELA (LPIL)

SIPUNCULA
- SIPUNCULA (LPIL)

ASPIDOSIPHONIDAE
- ASPIDOSIPHON (LPIL)
- ASPIDOSIPHON ALBUS
- ASPIDOSIPHON MUELLERI

GOLFINGIIDAE
- GOLFINGIA (LPIL)
- PHASCOLION STROMBI

SIPUNCULA FAMILY C
- SIPUNCULA FAMILY C

SIPUNCULIDAE
- SIPUNCULUS NUDUS

SITE C APRIL 1987

Biological Community Parameters

Biomass Data

Taxonomic List

SITE C
BIOLOGICAL COMMUNITY PARAMETERS

EPA-PENSACOLA, FLORIDA
Sample Type: MACROFAUNA

Sample Date (YY/MM/DD): [illegible]
Sample Area (sq. m.): [illegible]

STATION NUMBER	TOTAL TAXA	MEAN TAXA PER REPL.	TOTAL NO. INDIVIDUALS	MEAN DENSITY	STANDARD DEVIATION	H'	J'	D
101	168	45.5	1731	14607	6824	3.91	0.76	22.40
102	171	46.0	1408	11881	4347	4.19	0.81	23.45
103	170	43.4	1457	12295	4366	4.11	0.80	23.20
104	171	41.6	1589	13409	6103	3.78	0.74	23.06
105	173	42.4	1266	10683	3149	4.23	0.82	24.08
106	168	41.4	1157	9763	3662	4.31	0.84	23.68
107	141	27.4	774	6531	2000	3.97	0.80	21.05
108	170	41.0	1073	9054	2330	4.37	0.85	24.22
109	156	40.2	1511	12751	6321	3.85	0.76	21.17
110	177	45.6	1536	12962	4345	4.14	0.80	23.99
111	169	42.6	1726	14565	7565	3.72	0.73	22.54
112	175	43.8	1625	13713	4177	3.86	0.75	23.53
113	154	36.4	950	8016	2555	4.32	0.86	22.31
114	181	48.0	2033	17156	7785	3.82	0.73	23.63
115	170	46.4	1974	16658	9394	3.58	0.70	22.27
116	167	38.8	1330	11223	4435	3.99	0.78	23.08
117	174	47.6	1588	13400	4528	4.19	0.81	23.47
118	161	43.7	1583	13358	1928	3.89	0.77	21.72
119	178	49.2	2359	19907	7435	3.72	0.72	22.79
120	171	42.8	1247	10523	4192	4.31	0.84	23.85

Wet weight biomass for Pensacola, Florida, C Site, April 1987. All weights in grams.

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC1	ANNELIDA	0.054	0.011	0.007	0.010	0.025	0.014	0.011	0.009	0.005	0.003	0.017	0.012	0.016	0.036	0.012	0.242
PFC1	ARTHROPODA	0.001	0.005	0.002	0.007	0.005	0.004	0.002	0.004	0.005	0.004	0.002	0.002	0.008	0.005	0.003	0.059
PFC1	MOLLUSCA	0.020	0.007	0.028	0.032	0.253	0.004	0.024	0.022	0.003	0.018	0.003	0.008	0.094	0.156	0.002	0.674
PFC1	ECHINODERMATA	0.001	0.074	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.084
PFC1	MISCELLANEOUS	0.010	0.011	0.000	0.015	0.022	0.014	0.001	0.005	0.007	0.005	0.016	0.014	0.008	0.001	0.007	0.130
	TOTAL	0.086	0.108	0.038	0.065	0.305	0.037	0.039	0.040	0.021	0.030	0.033	0.037	0.127	0.199	0.024	1.189

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC2	ANNELIDA	0.016	0.010	0.012	0.019	0.004	0.014	0.049	0.008	0.033	0.017	0.011	0.038	0.012	0.011	0.045	0.299
PFC2	ARTHROPODA	0.004	0.008	0.003	0.009	0.003	0.001	0.011	0.004	0.003	0.005	0.005	0.003	0.010	0.012	0.003	0.084
PFC2	MOLLUSCA	0.024	0.031	0.007	0.045	0.011	0.006	0.004	0.004	0.023	0.019	0.015	0.035	0.043	0.004	0.006	0.277
PFC2	ECHINODERMATA	0.001	0.017	0.001	0.025	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.053
PFC2	MISCELLANEOUS	0.003	0.005	0.001	0.009	0.002	0.006	0.003	0.020	0.006	0.001	0.004	0.003	0.002	0.004	0.002	0.071
	TOTAL	0.048	0.071	0.024	0.107	0.020	0.028	0.068	0.037	0.065	0.043	0.036	0.080	0.068	0.032	0.057	0.784

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC3	ANNELIDA	0.051	0.023	0.008	0.012	0.005	0.017	0.004	0.012	0.023	0.070	0.035	0.010	0.026	0.014	0.016	0.334
PFC3	ARTHROPODA	0.015	0.004	0.020	0.002	0.002	0.062	0.000	0.004	0.007	0.004	0.019	0.002	0.004	0.013	0.002	0.100
PFC3	MOLLUSCA	0.012	0.024	0.016	0.010	0.007	0.004	0.006	0.007	0.002	0.097	0.020	0.003	0.062	0.023	0.022	0.249
PFC3	ECHINODERMATA	0.003	0.001	0.001	0.024	0.000	0.001	0.001	0.000	0.001	0.001	[illegible]	0.008	0.001	0.001	0.001	0.045
PFC3	MISCELLANEOUS	0.006	0.002	0.048	0.006	0.001	0.003	0.001	0.001	0.001	0.001	[illegible]	0.002	0.001	0.001	0.005	0.081
	TOTAL	0.087	0.054	0.087	0.054	0.015	0.027	0.012	0.024	0.034	0.181	0.077	0.025	0.034	0.052	0.046	0.809

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC4	ANNELIDA	0.016	0.021	0.042	0.025	0.028	0.026	0.009	0.006	0.005	0.035	0.017	0.015	0.045	0.010	0.007	0.307
PFC4	ARTHROPODA	0.010	0.004	0.003	0.005	0.001	0.005	0.007	0.003	0.004	0.004	0.003	0.002	0.009	0.005	0.003	0.069
PFC4	MOLLUSCA	0.021	0.051	0.067	0.044	0.017	0.011	0.012	0.033	0.013	0.018	0.013	0.005	0.035	0.033	0.002	0.375
PFC4	ECHINODERMATA	0.001	0.001	0.001	0.001	0.025	0.001	0.001	0.016	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.054
PFC4	MISCELLANEOUS	0.001	0.002	0.004	0.066	0.004	0.006	0.005	0.006	0.599	0.004	0.001	0.036	0.001	0.002	0.001	0.680
	TOTAL	0.049	0.079	0.117	0.081	0.075	0.051	0.034	0.064	0.622	0.062	0.035	0.060	0.091	0.051	0.014	1.485

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC5	ANNELIDA	0.014	0.028	0.024	0.028	0.017	0.033	0.019	0.014	0.003	0.039	0.035	0.036	0.015	0.057	0.013	0.375
PFC5	ARTHROPODA	0.066	0.002	0.003	0.003	0.006	0.012	0.005	0.014	0.004	0.020	0.011	0.007	0.006	0.003	0.066	0.168
PFC5	MOLLUSCA	0.004	0.020	0.011	0.005	0.069	0.038	0.023	0.004	0.010	0.017	0.001	0.097	0.043	0.046	0.016	0.404
PFC5	ECHINODERMATA	0.007	0.001	0.001	0.001	0.001	0.068	0.001	0.001	0.242	0.001	0.000	0.001	0.000	0.001	0.001	0.267
PFC5	MISCELLANEOUS	0.004	0.001	0.002	0.021	0.004	[illegible]	0.001	0.025	0.010	0.005	0.020	0.023	0.014	0.002	0.001	0.134
	TOTAL	0.035	0.052	0.041	0.056	0.097	0.092	0.049	0.058	0.269	0.062	0.067	0.164	0.078	0.109	0.037	1.288

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC6	ANNELIDA	0.029	0.006	0.029	0.097	0.015	0.016	0.027	0.007	0.023	0.020	0.014	0.020	0.011	0.024	0.009	0.351
PFC6	ARTHROPODA	0.004	0.007	0.014	0.015	0.008	0.001	0.008	0.022	0.003	0.002	0.003	0.006	0.004	0.034	0.003	0.134
PFC6	MOLLUSCA	0.018	0.005	0.016	0.217	0.016	1.012	0.020	0.007	0.017	0.878	0.110	0.002	0.009	0.090	0.045	2.462
PFC6	ECHINODERMATA	0.001	0.001	0.001	0.000	[illegible]	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.000	0.001	0.001	0.022
PFC6	MISCELLANEOUS	0.524	0.007	0.006	0.005	0.002	[illegible]	0.005	0.004	0.001	0.001	0.005	0.002	0.001	0.002	0.028	0.593
	TOTAL	0.576	0.026	0.066	0.334	0.052	1.030	0.061	0.041	0.045	0.906	0.132	0.031	0.025	0.151	0.086	3.562

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC7	ANNELIDA	0.028	0.020	0.013	0.034	0.014	0.020	0.015	0.024	0.015	0.052	0.036	0.034	0.045	0.018	0.040	0.416
PFC7	ARTHROPODA	1.507	0.003	0.002	0.001	0.009	0.010	0.006	0.002	0.001	0.003	0.008	0.001	0.002	0.003	0.006	1.564
PPC7	MOLLUSCA	0.029	0.010	0.017	0.008	0.067	0.012	0.004	0.006	0.011	0.005	0.017	0.002	0.003	0.004	0.002	0.137
PFC7	ECHINODERMATA	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.006	0.000	0.001	0.013
PFC7	MISCELLANEOUS	0.001	0.120	0.001	0.000	0.002	0.001	0.001	0.001	0.013	0.001	0.001	0.001	0.062	0.001	0.001	0.147
	TOTAL	1.566	0.153	0.034	0.044	0.033	0.044	0.027	0.034	0.041	0.063	0.063	0.039	0.052	0.026	0.050	2.277

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC8	ANNELIDA	0.017	0.034	0.011	0.097	0.016	0.024	0.019	0.029	0.013	0.009	0.018	0.022	0.010	0.013	0.012	0.344
PFC8	ARTHROPODA	0.008	0.002	0.008	0.005	0.003	0.001	0.003	0.005	0.006	0.002	0.002	0.003	0.006	0.001	0.007	0.062
PFC8	MOLLUSCA	0.719	0.027	0.032	0.005	0.003	0.026	0.004	0.555	[illegible]	0.003	0.008	0.005	0.013	0.011	0.051	1.472
PFC8	ECHINODERMATA	0.001	0.001	0.001	0.001	0.002	[illegible]	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.012
PFC8	MISCELLANEOUS	0.001	0.003	0.001	0.002	0.002	0.006	0.001	0.001	0.071	0.000	0.002	0.002	0.001	0.020	0.001	0.114
	TOTAL	0.746	0.067	0.053	0.110	0.026	0.057	0.028	0.596	[illegible]	0.015	0.031	0.033	[illegible]	0.046	[illegible]	[illegible]

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC9	ANNELIDA	0.015	0.010	0.029	0.006	0.013	0.042	0.006	0.024	0.020	0.017	0.003	0.013	0.023	0.026	0.009	[illegible]
PFC9	ARTHROPODA	0.002	0.002	0.004	0.001	0.001	0.006	0.004	0.002	0.012	0.004	0.030	0.003	0.014	0.001	0.005	0.091
PFC9	MOLLUSCA	0.011	0.004	0.019	0.015	0.004	0.010	0.012	0.003	0.023	0.005	0.002	0.014	0.018	0.024	0.005	0.169
PFC9	ECHINODERMATA	0.000	0.024	0.001	0.002	0.001	0.000	0.001	0.001	0.001	0.000	0.000	0.005	0.002	0.001	0.006	0.052
PFC9	MISCELLANEOUS	0.004	0.007	0.005	0.009	0.002	0.062	0.005	0.008	0.002	0.063	0.000	0.06?	0.062	0.062	0.003	[illegible]
	TOTAL	0.032	0.047	0.058	0.033	0.021	0.028	0.020	0.038	0.058	0.029	0.035	0.036	0.062	0.054	0.020	0.58?

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC10	ANNELIDA	0.015	0.010	0.014	0.031	0.007	0.008	0.027	0.031	0.015	0.008	0.007	0.047	0.010	0.015	0.005	0.258
PFC10	ARTHROPODA	0.002	0.004	0.004	0.003	0.003	0.003	0.020	0.014	0.013	0.007	0.008	0.005	0.003	0.006	0.005	0.100
PFC10	MOLLUSCA	0.011	0.040	0.003	0.025	0.103	0.014	0.012	0.094	0.020	0.012	0.006	0.006	0.004	0.003	0.012	0.365
PFC10	ECHINODERMATA	0.001	0.001	0.000	0.061	0.000	0.001	0.001	0.001	0.060	0.001	0.001	0.000	0.000	0.007	0.001	0.016
PFC10	MISCELLANEOUS	0.003	0.010	0.010	0.019	0.003	0.014	0.004	0.009	0.009	0.005	0.009	0.003	0.011	0.005	0.004	0.118
	TOTAL	0.032	0.073	0.031	0.079	0.116	0.040	0.064	0.109	0.057	0.033	0.031	0.061	0.020	0.036	0.027	0.857

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC11	ANNELIDA	0.047	0.019	0.019	0.023	0.020	0.023	0.025	0.015	0.022	0.029	0.018	0.003	0.066	0.005	0.013	0.287
PFC11	ARTHROPODA	0.006	0.006	0.009	0.002	0.006	0.003	0.015	0.001	0.001	0.005	0.002	0.005	0.001	0.016	0.017	0.095
PFC11	MOLLUSCA	0.053	0.003	0.033	0.002	0.004	0.003	0.001	0.011	0.003	0.017	0.015	0.004	0.011	0.005	0.003	[illegible]
PFC11	ECHINODERMATA	0.001	0.012	0.000	0.061	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.006	0.007	0.028
PFC11	MISCELLANEOUS	0.002	0.00?	0.002	0.001	0.002	0.001	0.002	0.003	0.002	0.006	0.001	0.001	0.062	0.066	0.067	[illegible]
	TOTAL	0.109	0.041	0.063	0.029	0.033	0.031	0.043	0.031	0.029	0.058	0.036	0.014	0.021	0.032	0.107	0.677

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC12	ANNELIDA	0.032	0.003	0.009	0.003	0.058	0.010	0.009	0.009	0.024	0.010	0.139	0.000	0.004	0.012	0.010	0.336
PFC12	ARTHROPODA	0.601	0.000	0.063	0.069	0.006	0.062	0.005	0.004	0.007	0.005	0.003	0.002	0.026	0.067	0.002	[illegible]
PFC12	MOLLUSCA	0.006	0.009	0.052	0.032	0.017	0.048	0.005	0.003	0.044	0.023	0.015	0.012	0.068	0.016	0.038	0.388
PFC12	ECHINODERMATA	0.000	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.002	0.001	0.002	0.001	0.001	0.015
PFC12	MISCELLANEOUS	0.003	0.002	0.006	0.002	0.001	0.061	0.003	0.077	0.003	0.002	0.059	0.002	0.062	0.061	0.036	0.264
	TOTAL	0.044	0.022	0.071	0.047	0.003	0.062	0.022	0.094	0.079	0.049	0.216	0.025	0.182	0.039	0.095	1.133

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC13	ANNELIDA	0.015	0.019	0.009	0.018	0.011	0.012	0.009	0.005	0.010	0.011	0.011	0.016	0.004	0.007	0.026	[illegible]
PFC13	ARTHROPODA	0.029	0.002	0.076	0.029	0.063	0.065	0.017	0.002	0.066	0.005	0.004	0.006	0.007	0.065	0.066	0.262
PFC13	MOLLUSCA	0.003	0.003	0.011	0.014	0.015	0.276	0.015	0.010	0.006	0.044	0.216	0.561	0.017	0.018	0.014	1.223
PFC13	ECHINODERMATA	0.002	0.001	0.001	0.00?	0.001	0.001	0.001	0.001	0.061	1.771	0.000	0.001	0.061	0.001	0.001	1.785
PFC13	MISCELLANEOUS	0.064	0.011	0.001	0.007	0.001	0.010	0.003	0.001	0.002	0.003	0.000	0.002	0.063	0.067	0.005	0.668
	TOTAL	0.053	0.036	0.178	0.069	0.031	0.312	0.045	0.019	0.033	1.834	0.231	0.586	0.032	0.038	0.052	3.549

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC14	ANNELIDA	0.615	0.021	0.021	0.020	0.067	0.013	0.046	0.013	0.002	0.011	0.03?	0.061	0.022	[illegible]	[illegible]	[illegible]
PFC14	ARTHROPODA	0.063	0.010	0.004	0.004	0.004	0.061	0.064	0.062	0.013	0.001	0.06?	0.006	0.069	0.066	0.063	0.364
PFC14	MOLLUSCA	0.006	0.003	0.005	0.004	0.021	0.063	0.036	0.095	0.004	0.003	[illegible]	0.003	0.009	0.635	0.065	0.229
PFC14	ECHINODERMATA	0.00?	0.001	0.001	0.00?	0.00?	0.635	0.001	0.001	0.001	0.001	0.001	0.000	0.006	0.006	0.006	0.644
PFC14	MISCELLANEOUS	0.063	0.001	0.069	0.048	0.000	0.001	0.053	0.000	0.063	0.066	0.005	0.001	0.001	0.045	0.065	0.189
	TOTAL	0.027	0.044	0.040	0.005	0.041	0.053	0.142	0.111	0.023	0.022	0.049	0.011	0.051	0.219	0.629	[illegible]

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC15	ANNELIDA	0.022	0.024	0.066	0.016	0.032	0.015	0.004	0.062	0.017	0.039	0.027	0.017	0.022	0.038	0.049	0.336
PFC15	ARTHROPODA	0.063	0.007	0.002	0.005	0.005	0.002	0.003	0.001	0.017	0.002	0.003	0.004	0.010	0.001	0.003	[illegible]
PFC15	MOLLUSCA	2.536	0.035	0.035	0.007	0.004	0.026	0.005	0.034	0.064	0.028	0.004	0.003	0.063	0.024	0.008	[illegible]
PFC15	ECHINODERMATA	0.001	0.001	0.001	0.000	0.001	0.061	0.001	0.006	0.001	0.001	0.008	0.001	0.002	0.002	0.061	0.022
PFC15	MISCELLANEOUS	0.003	0.003	0.002	0.156	0.003	0.062	0.001	0.062	0.066	0.033	0.006	0.003	0.006	0.002	0.064	0.252
	TOTAL	2.565	0.070	0.047	0.104	0.045	0.046	0.014	0.039	0.045	0.073	0.048	0.028	0.051	0.067	0.065	[illegible]

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC16	ANNELIDA	0.068	0.061	0.044	0.020	0.039	0.056	0.020	0.012	0.015	0.021	0.063	0.030	0.640	0.027	0.065	[illegible]
PFC16	ARTHROPODA	0.149	0.064	0.004	0.062	0.002	0.062	0.002	0.063	0.001	0.002	0.006	0.004	0.006	0.004	0.062	0.109
PFC16	MOLLUSCA	0.037	0.018	0.078	0.000	0.064	0.035	0.002	0.035	0.026	0.032	0.017	0.001	0.027	0.012	0.001	[illegible]
PFC16	ECHINODERMATA	0.001	0.06?	0.661	0.006	0.002	0.001	0.001	0.00?	0.000	0.001	0.000	0.602	0.000	[illegible]	0.063	0.015
PFC16	MISCELLANEOUS	0.601	0.067	0.065	0.001	0.00?	0.062	0.002	0.062	0.061	0.601	0.061	0.002	[illegible]	0.001	0.062	[illegible]
	TOTAL	0.256	0.09?	0.132	0.023	0.040	0.091	0.027	0.053	0.637	0.658	0.087	0.029	[illegible]	[illegible]	[illegible]	[illegible]

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC17	ANNELIDA	0.015	0.025	0.009	0.048	0.007	0.018	0.015	0.007	0.034	0.008	0.023	0.033	0.028	0.032	0.028	[illegible]
PFC17	ARTHROPODA	0.003	0.005	0.001	0.004	0.005	0.002	0.002	0.066	0.005	0.004	0.004	0.010	0.005	0.006	0.007	[illegible]
PFC17	MOLLUSCA	0.033	0.004	0.003	0.208	0.003	0.043	0.020	0.026	0.004	0.015	0.022	0.052	0.003	0.018	0.002	0.456
PFC17	ECHINODERMATA	0.001	0.001	0.038	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	[illegible]
PFC17	MISCELLANEOUS	0.014	0.019	0.001	0.015	0.003	0.005	0.001	0.002	0.006	0.007	0.025	0.002	0.030	0.005	0.006	0.141
	TOTAL	0.066	0.054	0.052	0.275	0.019	0.069	0.039	0.042	0.650	0.035	0.075	0.096	0.067	0.062	0.044	1.047

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC18	ANNELIDA	0.034	0.026	0.015	0.010	0.032	0.033	0.024	0.017	0.016	0.029	0.010	0.022	0.028	0.011	0.031	0.346
PFC18	ARTHROPODA	0.062	0.002	0.009	0.003	0.003	0.006	0.013	0.003	0.003	0.019	0.001	0.002	0.048	0.009	0.003	[illegible]
PFC18	MOLLUSCA	0.030	0.003	0.011	0.139	0.051	0.044	0.006	0.019	0.028	0.359	0.014	0.018	0.314	0.006	0.016	1.026
PFC18	ECHINODERMATA	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.583	0.001	0.000	0.000	0.001	0.595
PFC18	MISCELLANEOUS	0.004	0.002	0.003	0.004	0.001	0.383	0.006	0.062	0.003	0.015	0.001	0.001	0.470	0.002	0.005	[illegible]
	TOTAL	0.071	0.034	0.039	0.157	0.088	0.467	0.050	0.042	0.051	0.423	0.617	0.044	0.820	0.028	0.056	2.987

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC19	ANNELIDA	0.036	0.018	0.031	0.012	0.031	0.028	0.028	0.069	0.014	0.004	0.620	0.027	0.013	0.011	0.013	0.247
PFC19	ARTHROPODA	0.005	0.006	0.004	0.006	0.006	0.004	0.003	0.004	[illegible]	0.003	0.004	0.006	0.062	0.004	0.035	[illegible]
PFC19	MOLLUSCA	0.012	0.015	0.035	0.042	0.026	0.400	0.337	0.005	0.062	3.656	0.616	0.028	0.492	0.597	0.760	7.111
PFC19	ECHINODERMATA	0.001	0.001	0.001	0.000	0.004	0.001	0.001	0.000	0.038	0.001	0.001	0.001	0.003	0.001	0.001	[illegible]
PFC19	MISCELLANEOUS	0.003	0.011	0.003	0.006	0.018	0.010	0.025	0.014	0.006	0.043	0.010	0.011	0.002	0.009	0.017	0.148
	TOTAL	0.057	0.051	0.074	0.066	0.085	0.531	0.386	0.092	0.062	3.667	0.651	0.073	0.510	0.622	0.796	7.733

STATION	TAXON	REP A	REP B	REP C	REP D	REP E	REP F	REP G	REP H	REP I	REP J	REP K	REP L	REP M	REP N	REP O	TOTALS
PFC20	ANNELIDA	0.025	0.018	0.027	0.018	0.011	0.045	0.014	0.022	0.004	0.018	0.013	0.012	0.012	0.007	0.031	[illegible]
PFC20	ARTHROPODA	0.010	0.064	0.002	0.009	0.004	0.002	0.003	0.001	0.063	0.004	0.002	0.001	0.006	0.006	0.002	[illegible]
PFC20	MOLLUSCA	0.002	0.027	0.045	0.004	0.063	0.006	0.020	0.045	0.004	0.000	0.014	0.018	0.003	0.021	0.047	[illegible]
PFC20	ECHINODERMATA	0.001	0.001	0.000	0.001	0.003	0.001	0.001	0.001	[illegible]	0.000	[illegible]	0.001	0.001	0.001	0.010	[illegible]
PFC20	MISCELLANEOUS	0.001	0.005	0.002	0.002	0.005	0.003	0.022	0.009	0.001	0.000	0.008	0.011	0.004	0.002	0.003	0.079
	TOTAL	0.039	0.055	0.076	0.034	0.023	0.057	0.060	0.078	0.013	0.014	[illegible]	0.043	0.026	0.037	0.093	[illegible]

TAXONOMIC LISTING

TAXONOMIC SPECIES LIST 09/11/87

EPA-PENSACOLA---SITE C---COLLECTED APRIL 1987

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ANNELIDA
- OLIGOCHAETA
  - OLIGOCHAETA (LPIL)*
- POLYCHAETA
  - AMPHARETIDAE
    - AMPHARETE SP.A
    - AMPHARETIDAE (LPIL)
    - ISOLDA PULCHELLA
    - MELINNA MACULATA
    - SABELLIDES SP.A
  - AMPHINOMIDAE
    - CHLOEIA VIRIDIS
    - PARAMPHINOME SP.B
  - APHRODITIDAE
    - APHROGENIA SP.A
  - ARABELLIDAE
    - DRILONEREIS LONGA
  - CAPITELLIDAE
    - CAPITELLIDAE (LPIL)
    - MEDIOMASTUS (LPIL)
    - NOTOMASTUS (LPIL)
  - CHAETOPTERIDAE
    - SPIOCHAETOPTERUS OCULATUS
  - CHRYSOPETALIDAE
    - BHAWANIA HETEROSETA
    - PALEANOTUS SP.A
  - CIRRATULIDAE
    - CAULLERIELLA CF. ALATA
    - CHAETOZONE (LPIL)
    - CHAETOZONE SP.A
    - CIRRATULIDAE (LPIL)
    - THARYX (LPIL)
    - THARYX CF. ANNULOSUS
  - DORVILLEIDAE
    - DORVILLEIDAE (LPIL)
    - PETTIBONEIA DUOFURCA
    - PROTODORVILLEA KEFERSTEINI
    - SCHISTOMERINGOS CF. RUDOLPHI
    - SCHISTOMERINGOS PECTINATA
    - SCHISTOMERINGOS SP.D
  - EULEPETHIDAE
    - EULEPETHIDAE (LPIL)
    - GRUBEULEPIS SP.A
  - EUNICIDAE
    - EUNICE VITTATA
    - EUNICIDAE (LPIL)
    - LYSIDICE SP.B
    - MARPHYSA SANGUINEA
  - FLABELLIGERIDAE
    - THEROCHAETA SP.A

*LPIL - Lowest Practicable Identification Level

GLYCERIDAE
- GLYCERA (LPIL)
- GLYCERA SP.A

GONIADIDAE
- GONIADA LITTOREA
- GONIADIDAE (LPIL)
- GONIADIDES CAROLINAE

HESIONIDAE
- HESIONIDAE (LPIL)
- HETEROPODARKE FORMALIS
- HETEROPODARKE LYONSI
- PODARKEOPSIS LEVIFUSCINA

LUMBRINERIDAE
- LUMBRINERIDAE (LPIL)
- LUMBRINERIDES DAYI
- LUMBRINERIS (LPIL)
- LUMBRINERIS JANUARII
- LUMBRINERIS LATREILLI
- LUMBRINERIS SP.D
- LUMBRINERIS VERRILLI

MAGELONIDAE
- MAGELONA (LPIL)
- MAGELONA PETTIBONEAE
- MAGELONA SP.B
- MAGELONA SP.C

MALDANIDAE
- AXIOTHELLA MUCOSA
- AXIOTHELLA SP.A
- BOGUEA ENIGMATICA
- BOGUEA SP.A
- MALDANIDAE (LPIL)

NEPHTYIDAE
- AGLAOPHAMUS VERRILLI
- NEPHTYIDAE (LPIL)
- NEPHTYS PICTA
- NEPHTYS SIMONI

NEREIDAE
- CERATOCEPHALE OCULATA
- NEREIDAE (LPIL)
- NEREIS MICROMMA
- RULLIERINEREIS SP.A

ONUPHIDAE
- DIOPATRA CUPREA
- KINBERGONUPHIS SP.E
- MOOREONUPHIS PALLIDULA
- ONUPHIDAE (LPIL)
- ONUPHIS EREMITA OCULATA
- RHAMPHOBRACHIUM SP.C

OPHELIIDAE
- ARMANDIA MACULATA

- OPHELIA DENTICULATA
- TRAVISIA HOBSONAE

ORBINIIDAE
- LEITOSCOLOPLOS (LPIL)
- ORBINIA RISERI
- SCOLOPLOS SP.H

OWENIIDAE
- GALATHOWENIA OCULATA
- OWENIA SP.A
- OWENIIDAE (LPIL)

PARAONIDAE
- ARICIDEA (LPIL)
- ARICIDEA CATHERINAE
- ARICIDEA CERRUTII
- ARICIDEA PHILBINAE
- ARICIDEA SP.A
- ARICIDEA SP.E
- ARICIDEA SP.H
- ARICIDEA SP.L
- ARICIDEA SP.X
- ARICIDEA TAYLORI
- ARICIDEA WASSI
- CIRROPHORUS (LPIL)
- CIRROPHORUS BRANCHIATUS
- LEVINSENIA GRACILIS
- PARAONIS PYGOENIGMATICA

PECTINARIIDAE
- PECTINARIA (LPIL)
- PECTINARIA GOULDII
- PECTINARIIDAE (LPIL)

PHYLLODOCIDAE
- ETEONE LACTEA
- GENETYLLIS SP.A
- HESIONURA SP.A
- MYSTIDES BOREALIS
- PHYLLODOCIDAE (LPIL)

PILARGIDAE
- SIGAMBRA BASSI
- SYNELMIS EWINGI

POECILOCHAETIDAE
- POECILOCHAETUS (LPIL)

POLYGORDIIDAE
- POLYGORDIUS (LPIL)

POLYNOIDAE
- HARMOTHOE (LPIL)
- HARMOTHOE SP.B
- POLYNOIDAE (LPIL)

SABELLARIIDAE
- SABELLARIA SP.A

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SABELLIDAE
- CHONE (LPIL)
- EUCHONE (LPIL)
- FABRICIOLA TRILOBATA
- POTAMILLA (LPIL)
- POTAMILLA SP.E
- SABELLIDAE (LPIL)

SACCOCIRRIDAE
- SACCOCIRRUS SP.A

SERPULIDAE
- SERPULIDAE (LPIL)
- SERPULIDAE GENUS C

SIGALIONIDAE
- SIGALION SP.A
- SIGALIONIDAE (LPIL)

SPIONIDAE
- AONIDES PAUCIBRANCHIATA
- DISPIO UNCINATA
- LAONICE CIRRATA
- MALACOCEROS (LPIL)
- MALACOCEROS INDICUS
- PARAPRIONOSPIO PINNATA
- POLYDORA CORNUTA
- POLYDORA SOCIALIS
- PRIONOSPIO CRISTATA
- SCOLELEPIS SQUAMATA
- SPIO PETTIBONEAE
- SPIONIDAE (LPIL)
- SPIOPHANES BOMBYX
- SPIOPHANES CF. MISSIONENSIS

SYLLIDAE
- BRANIA WELLFLEETENSIS
- EURYSYLLIS TUBERCULATA
- EXOGONE ATLANTICA
- EXOGONE DISPAR
- EXOGONE LOUREI
- OPISTHODONTA SP.A
- PARAPIONOSYLLIS LONGICIRRATA
- PIONOSYLLIS GESAE
- PLAKOSYLLIS QUADRIOCULATA
- SPHAEROSYLLIS ACICULATA
- SPHAEROSYLLIS PIRIFEROPSIS
- STREPTOSYLLIS PETTIBONEAE
- SYLLIDAE (LPIL)
- SYLLIDES FULVUS
- TYPOSYLLIS (LPIL)
- TYPOSYLLIS AMICA
- TYPOSYLLIS CF. LUTEA

TEREBELLIDAE
- LOIMIA SP.A

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POLYCIRRUS (LPIL)
TEREBELLIDAE (LPIL)
TRICHOBRANCHIDAE
TRICHOBRANCHUS GLACIALIS
ARTHROPODA (CRUSTACEA)
CRUSTACEA (LPIL)
AMPHIPODA
AMPHIPODA (LPIL)
AMPELISCIDAE
AMPELISCA (LPIL)
AMPELISCA AGASSIZI
AMPELISCA BICARINATA
AMPELISCA SP.C
AMPELISCA SP.L
AMPELISCA SP.M
AMPHILOCHIDAE
AMPHILOCHUS SP.C
GITANA (LPIL)
GITANOPSIS (LPIL)
AORIDAE
ACUMINODEUTOPUS (LPIL)
ACUMINODEUTOPUS NAGLEI
ACUMINODEUTOPUS SP.A
LEMBOS (LPIL)
LEMBOS SMITHI
MICRODEUTOPUS MYERSI
UNCIOLA (LPIL)
UNCIOLA SP.B
ARIGISSIDAE
ARGISSA HAMATIPES
COROPHIIDAE
COROPHIUM (LPIL)
COROPHIUM ACHERUSICUM
COROPHIUM SP.L
HAUSTORIIDAE
ACANTHOHAUSTORIUS (LPIL)
ACANTHOHAUSTORIUS SP.B
ACANTHOHAUSTORIUS SP.H
ACANTHOHAUSTORIUS SP.L
PROTOHAUSTORIUS (LPIL)
PROTOHAUSTORIUS BOUSFIELDI
PROTOHAUSTORIUS SP.E
PROTOHAUSTORIUS SP.G
ISAEIDAE
MEGAMPHOPUS SP.A
PHOTIS (LPIL)
PHOTIS MELANICUS
PHOTIS SP.D

ISCHYROCERIDAE
ERICHTHONIUS BRASILIENSIS

==

LILJEBORGIIDAE
- LILJEBORGIA SP.A
- LISTRIELLA SP.F

LYSIANASSIDAE
- HIPPOMEDON SP.A
- HIPPOMEDON SP.B
- LYSIANASSA (LPIL)
- LYSIANASSA ALBA
- LYSIANASSIDAE (LPIL)

MELITIDAE
- ELASMOPUS SP.C

OEDICEROTIDAE
- MONOCULODES NYEI
- SYNCHELIDIUM AMERICANUM

PHOXOCEPHALIDAE
- METHARPINA FLORIDANA

PLATYISCHNOPIDAE
- EUDEVENOPUS HONDURANUS

PODOCERIDAE
- PODOCERUS SP.B

STENOTHOIDAE
- PARAMETOPELLA CYPRIS
- PARAMETOPELLA SP.A
- PARAMETOPELLA SP.B
- STENOTHOE (LPIL)

SYNOPIIDAE
- GAROSYRRHOE SP.B
- SYNOPIIDAE (LPIL)
- TIRON TRIOCELLATUS
- TIRON TROPAKIS

CUMACEA
- CUMACEA (LPIL)

BODOTRIIDAE
- CYCLASPIS (LPIL)
- CYCLASPIS SP.D
- CYCLASPIS SP.N
- CYCLASPIS SP.O
- CYCLASPIS UNICORNIS

DIASTYLIDAE
- OXYUROSTYLIS (LPIL)
- OXYUROSTYLIS SP.B
- OXYUROSTYLIS SP.C

NANNASTACIDAE
- CAMPYLASPIS SP.I
- CAMPYLASPIS SP.M
- CAMPYLASPIS SP.O
- CUMELLA SP.G
- CUMELLA SP.H

DECAPODA (NATANTIA)
- DECAPODA NATANTIA (LPIL)

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- PASIPHAEIDAE
  - LEPTOCHELA PAPULATA
- PROCESSIDAE
  - PROCESSA HEMPHILLI
- SICYONIIDAE
  - SICYONIA TYPICA
- SOLENOCERIDAE
  - SOLENOCERA ATLANTIDIS

DECAPODA (REPTANTIA)

- DECAPODA REPTANTIA (LPIL)
- ALBUNEIDAE
  - ALBUNEA GIBBESII
- CALAPPIDAE
  - CYCLOES BAIRDII
- DROMIIDAE
  - HYPOCONCHA ARCUATA
- GONEPLACIDAE
  - GLYPTOPLAX SMITHII
- LEUCOSIIDAE
  - SPELOEOPHORUS PONTIFER
- MAJIDAE
  - BATRACHONOTUS FRAGOSUS
- PAGURIDAE
  - PAGURIDAE (LPIL)
- PARTHENOPIDAE
  - CRYPTOPODIA CONCAVA
- PINNOTHERIDAE
  - DISSODACTYLUS (LPIL)
  - DISSODACTYLUS SP.B
  - PARAPINNIXA BOUVIERI
  - PINNOTHERES OSTREUM
  - PINNOTHERIDAE (LPIL)

ISOPODA

- ANTHURIDAE
  - APANTHURA MAGNIFICA
- ANTIASIDAE
  - ANTIAS SP.B
- IDOTEIDAE
  - EDOTEA LYONSI
- SEROLIDAE
  - SEROLIS MGRAYI

LEPTOSTRACA

- NEBALIIDAE
  - NEBALIA BIPES

MYSIDACEA

- MYSIDACEA (LPIL)
- MYSIDAE
  - AMATHIMYSIS BRATTEGARDI
  - ANCHIALINA TYPICA

BOWMANIELLA PORTORICENSIS
MYSIDOPSIS FURCA
PROMYSIS ATLANTICA
OSTRACODA
OSTRACODA (LPIL)
CYLINDROLEBERIDIDAE
AMBOLEBERIS AMERICANA
ASTEROPELLA MACLAUGHLINAE
ASTEROPTERYGION OCULITRISTIS
PARASTEROPE SP.A
SYNASTEROPE (LPIL)
OSTRACODA FAMILY H
OSTRACODA FAMILY H
OSTRACODA FAMILY I
OSTRACODA FAMILY I
PHILOMEDIDAE
HARBANSUS PAUCICHELATUS
PSEUDOPHILOMEDES (LPIL)
PSEUDOPHILOMEDES AMBON
PSEUDOPHILOMEDES FERULANUS
PSEUDOPHILOMEDES POLYANCISTRUS
PSEUDOPHILOMEDES ZETA
RUTIDERMATIDAE
RUTIDERMA DARBYI
SARSIELLIDAE
EURYPYLUS (LPIL)
EURYPYLUS SP.A
EURYPYLUS SP.B
EUSARSIELLA (LPIL)
EUSARSIELLA CARINATA
EUSARSIELLA DISPARALIS
EUSARSIELLA ELOFSONI
EUSARSIELLA GETTLESONI
EUSARSIELLA GIGACANTHA
EUSARSIELLA PILLIPOLLICIS
EUSARSIELLA RADIICOSTA
EUSARSIELLA SP.E
TRACHYLEBERIDIDAE
ACTINOCYTHEREIS SP.A
RETICULOCYTHEREIS SP.A
RETICULOCYTHEREIS SP.B
TANAIDACEA
TANAIDACEA (LPIL)
APSEUDIDAE
APSEUDES PROPINQUUS
APSEUDES SP.H
KALLIAPSEUDIDAE
KALLIAPSEUDES (LPIL)
KALLIAPSEUDES SP.A

KALLIAPSEUDES SP.B
KALLIAPSEUDES SP.C
KALLIAPSEUDES SP.D
LEPTOCHELIDAE
LEPTOCHELIA SP.D
NOTOTANAIDAE
TANAISSUS SP.A
BRACHIOPODA
BRACHIOPODA (LPIL)
CEPHALOCHORDATA
LEPTOCARDII
BRANCHIOSTOMIDAE
BRANCHIOSTOMA (LPIL)
BRANCHIOSTOMA FLORIDAE
BRANCHIOSTOMA LONGIROSTRUM
CNIDARIA
ACTINIARIA
ACTINIARIA (LPIL)
ANTHOZOA (PENNATULACEA)
PENNATULACEA (LPIL)
ECHINODERMATA
ASTEROIDEA
ASTEROIDEA (LPIL)
ASTROPECTINIDAE
ASTROPECTEN (LPIL)
ECHINOIDEA
ECHINOIDEA (LPIL)
MELLITIDAE
ENCOPE ABERRANS
HOLOTHUROIDEA
HOLOTHUROIDEA (LPIL)
OPHIUROIDEA
OPHIUROIDEA (LPIL)
AMPHIURIDAE
AMPHIODIA TRYCHNA
HEMICHORDATA
ENTEROPNEUSTA
BALANOGLOSSUS AURANTIACUS
MOLLUSCA
APLACOPHORA
APLACOPHORA (LPIL)
GASTROPODA
GASTROPODA (LPIL)
ACLIDIDAE
ACLIDIDAE GENUS A
ACTEOCINIDAE
ACTEOCINA CANDEI
ACTEONIDAE
ACTEON PUNCTOSTRIATUS

CAECIDAE
- CAECUM (LPIL)
- CAECUM CUBITATUM
- CAECUM IMBRICATUM
- CAECUM PULCHELLUM
- CAECUM SP.A
- CAECUM SP.C

COLUMBELLIDAE
- ANACHIS LAFRESNAYI
- NASSARINA GLYPTA

CONIDAE
- CONUS FLORIDANUS FLORIDENSIS

CREPIDULIDAE
- CALYPTRAEA CENTRALIS
- CREPIDULA (LPIL)
- CREPIDULA MACULOSA
- CREPIDULIDAE (LPIL)

CYCLOSTREMATIDAE
- ARENE TRICARINATA

EPITONIIDAE
- EPITONIUM (LPIL)

MARGINELLIDAE
- GRANULINA OVULIFORMIS
- MARGINELLA (LPIL)
- MARGINELLA SP.C

MELANELLIDAE
- MELANELLIDAE (LPIL)
- NISO AEGLEES
- STROMBIFORMIS (LPIL)

NATICIDAE
- NATICA PUSILLA
- NATICIDAE (LPIL)
- POLINICES LACTEUS
- SIGATICA SEMISULCATA

OLIVIDAE
- JASPIDELLA SP.A
- OLIVELLA (LPIL)
- OLIVELLA ADELAE

PYRAMIDELLIDAE
- TURBONILLA (LPIL)
- TURBONILLA CONRADI

RETUSIDAE
- VOLVULELLA PERSIMILIS

TROCHIDAE
- TROCHIDAE GENUS C

TURRIDAE
- CERODRILLIA THEA
- CRYOTURRIS CITRONELLA
- INODRILLIA SP.A

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KURTZIELLA RUBELLA
TURRIDAE (LPIL)
TURRIDAE GENUS K
TURRITELLIDAE
TURRITELLA ACROPORA
NUDIBRANCHIA
NUDIBRANCHIA (LPIL)
PELECYPODA
PELECYPODA (LPIL)
CARDITIDAE
PLEUROMERIS TRIDENTATA
CORBULIDAE
CORBULIDAE (LPIL)
CRASSATELLIDAE
CRASSINELLA LUNULATA
CUSPIDARIIDAE
CARDIOMYA (LPIL)
GLYCYMERIDIDAE
GLYCYMERIS (LPIL)
LIMIDAE
LIMATULA SP.A
LIMIDAE (LPIL)
LUCINIDAE
LINGA PENSYLVANICA
LUCINA NASSULA
LUCINA SOMBRERENSIS
LUCINA SP.A
LUCINA SP.B
LUCINA SP.D
LUCINIDAE (LPIL)
LYONSIIDAE
LYONSIA SP.A
MYTILIDAE
CRENELLA DIVARICATA
MUSCULUS LATERALIS
NUCULIDAE
NUCULA AEGEENIS
NUCULA PROXIMA
PANDORIDAE
PANDORA (LPIL)
PANDORA ARENOSA
PANDORA BUSHIANA
PANDORA TRILINEATA
PECTINIDAE
PECTINIDAE (LPIL)
SEMELIDAE
SEMELE BELLASTRIATA
SEMELE NUCULOIDES

SEMELIDAE (LPIL)

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SOLEMYACIDAE
- SOLEMYA VELUM

SOLENIDAE
- ENSIS MINOR
- SOLENIDAE (LPIL)

TELLINIDAE
- STRIGILLA MIRABILIS
- TELLINA AEQUISTRIATA
- TELLINA LISTERI
- TELLINA TEXANA
- TELLINA VERSICOLOR
- TELLINIDAE (LPIL)

THRACIIDAE
- BUSHIA SP.A

THYASIRIDAE
- THYASIRA TRISINUATA

UNGULINIDAE
- DIPLODONTA SP.C

VENERIDAE
- CHIONE (LPIL)
- CHIONE INTAPURPUREA
- MACROCALLISTA MACULATA
- PITAR (LPIL)
- VENERIDAE (LPIL)

VERTICORDIIDAE
- VERTICORDIA ORNATA

POLYPLACOPHORA
- POLYPLACOPHORA (LPIL)

SCAPHOPODA
- SCAPHOPODA (LPIL)

DENTALIIDAE
- DENTALIUM (LPIL)

SIPHONODENTALIIDAE
- CADULUS SP.C
- CADULUS TETRODON

PHORONIDA
- PHORONIS (LPIL)

PLATYHELMINTHES

TURBELLARIA
- TURBELLARIA (LPIL)

RHYNCHOCOELA
- RHYNCHOCOELA (LPIL)

SIPUNCULA
- SIPUNCULA (LPIL)

ASPIDOSIPHONIDAE
- ASPIDOSIPHON (LPIL)
- ASPIDOSIPHON ALBUS
- ASPIDOSIPHON MUELLERI

GOLFINGIIDAE
- GOLFINGIA (LPIL)

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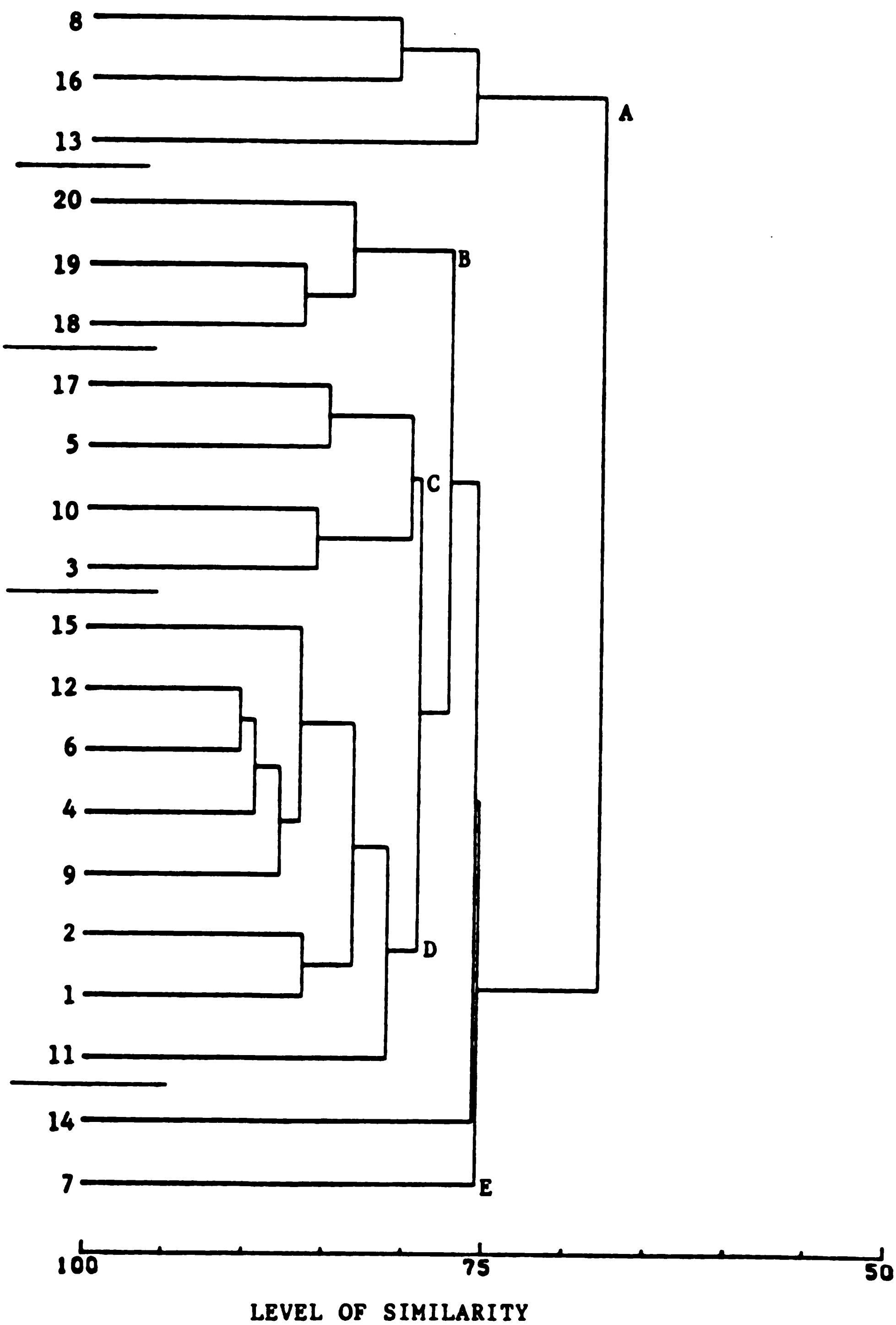
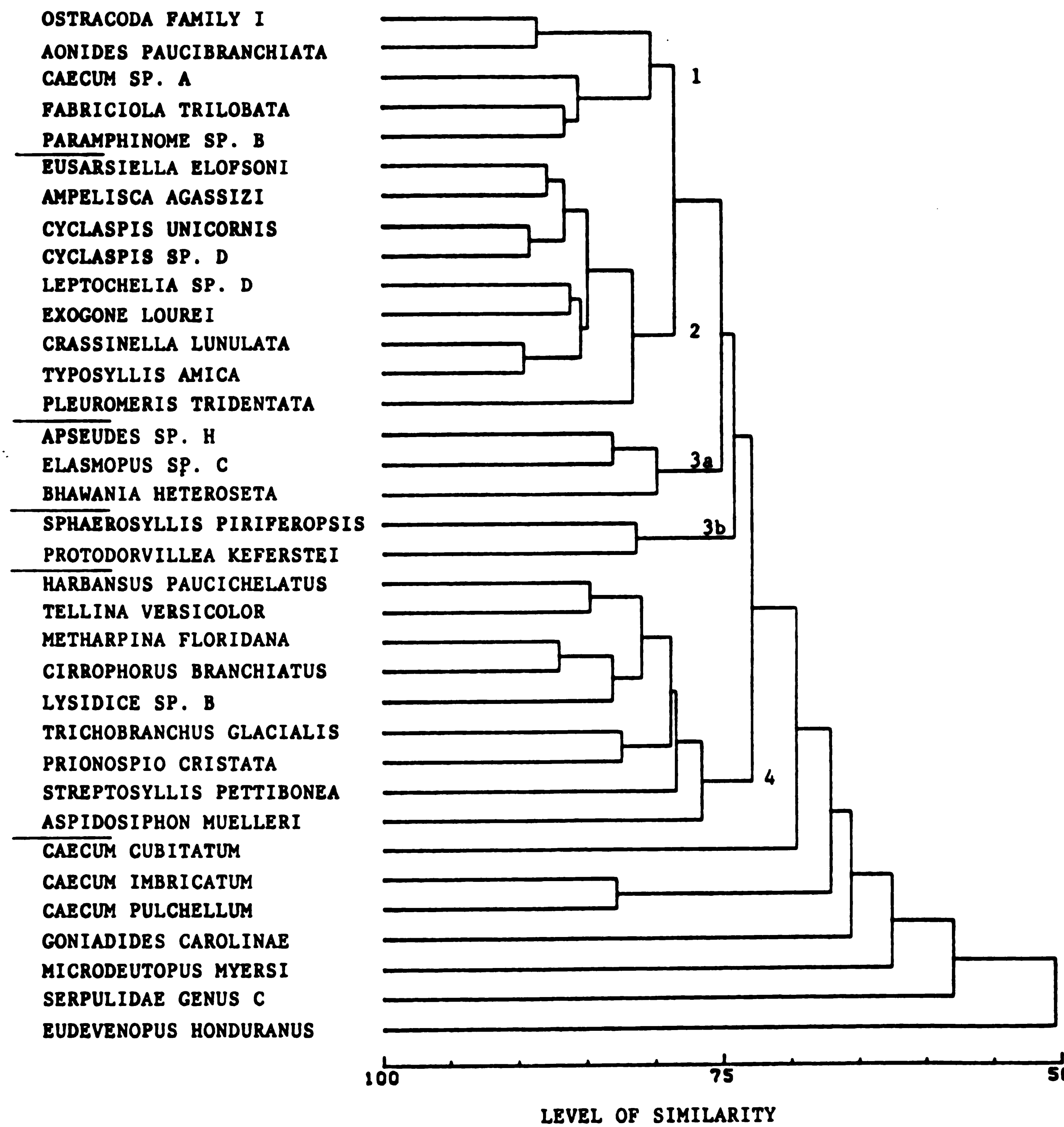
PHASCOLION STROMBI
SIPUNCULA FAMILY C
SIPUNCULA FAMILY C

DATA ANALYSIS RESULTS



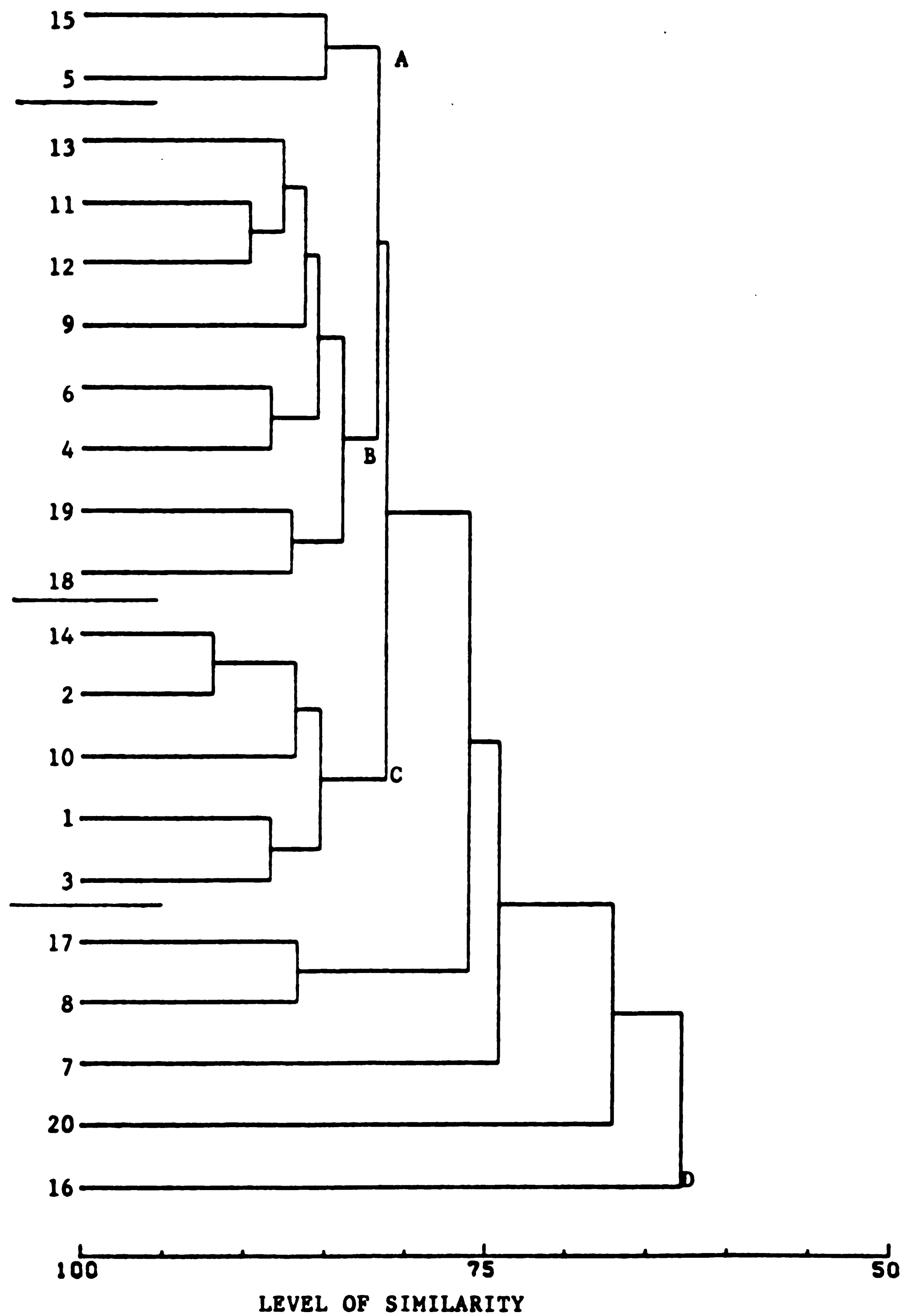
Q-MODE ANALYSIS, SITE B; NOVEMBER, 1986



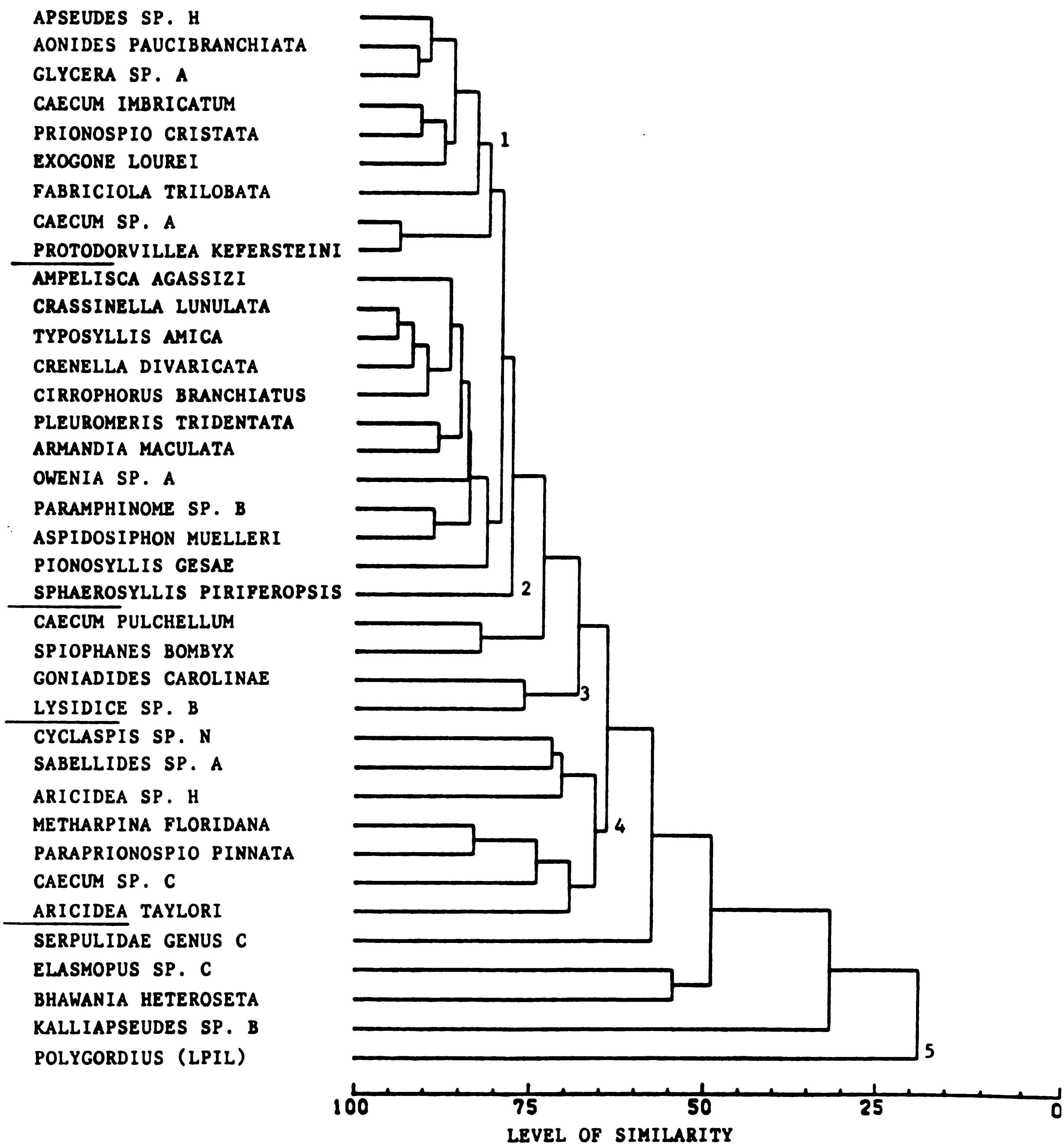
R-MODE ANALYSIS, SITE B; NOVEMBER, 1986

Data matrix of station and species groups compiled from classification analysis dendrograms for Pensacola, FL survey, "B" site, November 1986.

		A			B			C				D								E	
	STATION:	8	16	13	20	19	18	17	5	10	3	15	12	6	4	9	2	1	11	14	7
	OSTRACODA FAMILY I	31	84	144	39	147	45	50	92	62	88	107	158	147	176	245	71	17	130	20	78
	AONIDES PAUCIBRANCHIATA	10	51	0	44	51	41	71	67	70	80	50	53	62	63	61	72	56	72	50	9
1	CAECUM SP.A	1	0	0	4	14	2	32	16	33	110	44	60	78	34	155	41	48	11	54	82
	FABRICIOLA TRILOBATA	19	13	0	3	8	7	21	8	35	11	30	19	30	18	86	28	41	18	12	86
	PARAMPHINOME SP.B	2	2	1	22	14	24	5	17	11	11	38	55	11	23	86	37	21	23	15	42
	EUSARSIELLA ELOFSONI	14	25	41	4	1	4	7	15	23	7	5	16	10	16	25	19	8	12	13	7
	AMPELISCA AGASSIZI	4	38	9	2	8	8	15	18	21	21	9	21	23	24	17	30	13	9	6	16
	CYCLASPIS UNICORNIS	10	9	13	11	8	10	23	5	21	11	24	12	12	9	15	18	4	5	33	13
	CYCLASPIS SP.D	13	6	24	1	7	4	30	5	13	10	10	5	14	13	3	17	9	13	15	12
2	LEPTOCHELIA SP.D	22	23	29	181	59	30	25	19	34	7	27	11	27	27	20	16	30	24	11	21
	EXOGONE LOUREI	7	19	22	5	12	21	25	19	24	10	13	17	7	42	6	18	16	56	8	0
	CRASSINELLA LUNULATA	6	1	6	10	21	11	8	22	7	15	35	15	8	14	20	20	10	11	18	3
	TYPOSYLLIS AMICA	10	3	28	6	36	17	33	41	5	8	25	14	20	15	28	8	11	19	10	5
	PLEUROMERIS TRIDENTATA	12	5	21	2	2	2	60	33	36	72	12	21	22	16	34	40	20	0	34	30
	APSEUDES SP.H	0	2	5	7	18	12	2	14	0	4	8	11	14	27	22	16	30	10	14	10
3a	ELASMOPUS SP.C	11	0	18	42	31	49	5	11	0	7	8	39	44	26	42	16	16	15	3	3
	BHAWANIA HETEROSETA	1	0	2	58	30	27	2	6	2	2	16	7	9	5	21	9	10	1	3	2
3b	SPHAEROSYLLIS PIRIFEROPSIS	0	0	0	3	2	1	0	3	22	29	13	22	32	15	35	15	29	52	28	9
	PROTODORVILLEA KEFERSTEINI	0	0	0	8	17	9	0	8	26	35	22	14	15	2	103	6	13	5	11	48
	HARBANSUS PAUCICHELATUS	34	12	33	4	2	5	11	7	5	2	3	4	1	6	2	8	5	2	5	2
	TELLINA VERSICOLOR	39	55	34	7	13	2	28	17	6	3	4	4	9	14	8	13	2	5	5	1
	METHARPINA FLORIDANA	7	20	11	10	16	7	8	15	5	3	11	7	2	7	3	2	5	7	4	2
	CIRROPHORUS BRANCHIATUS	20	5	6	5	17	12	10	14	1	2	12	6	5	11	9	6	6	9	2	7
4	LYSIDICE SP.B	1	1	9	29	8	5	4	25	3	4	5	5	8	6	5	14	7	8	2	4
	TRICHOBRANCHUS GLACIALIS	11	6	11	7	5	2	15	16	6	3	10	9	13	22	22	10	2	0	0	2
	PRIONOSPIO CRISTATA	5	1	3	4	5	3	5	5	9	2	6	7	19	15	21	11	7	12	0	23
	STREPTOSYLLIS PETTIBONEA	11	19	18	2	0	3	10	9	4	3	2	7	10	8	10	4	0	3	2	19
	ASPIDOSIPHON MUELLERI	2	0	1	11	19	4	14	19	5	4	2	15	7	8	11	1	4	3	12	12
	CAECUM CUBITATUM	22	14	15	2	21	5	33	44	25	19	7	2	0	0	7	7	5	1	18	0
	CAECUM IMBRICATUM	154	88	523	7	52	50	503	259	135	210	26	20	28	17	36	79	58	15	0	12
	CAECUM PULCHELLUM	788	315	0	1	10	10	1120	1461	120	219	13	9	7	5	6	138	21	6	0	8
5	GONIADIDES CAROLINAE	0	0	1	27	2	16	8	33	2	1	19	2	3	9	1	9	48	3	9	0
	MICRODEUTOPUS MYERSI	16	0	18	62	14	19	5	5	8	0	7	6	1	2	1	0	0	3	3	2
	SERPULIDAE GENUS C	3	4	0	44	288	58	1	375	0	1	185	199	291	56	853	1	1	0	1	9
	EUDEVENOPUS HONDURANUS	10	48	27	1	0	1	31	2	0	5	0	1	7	0	0	6	0	0	1	6



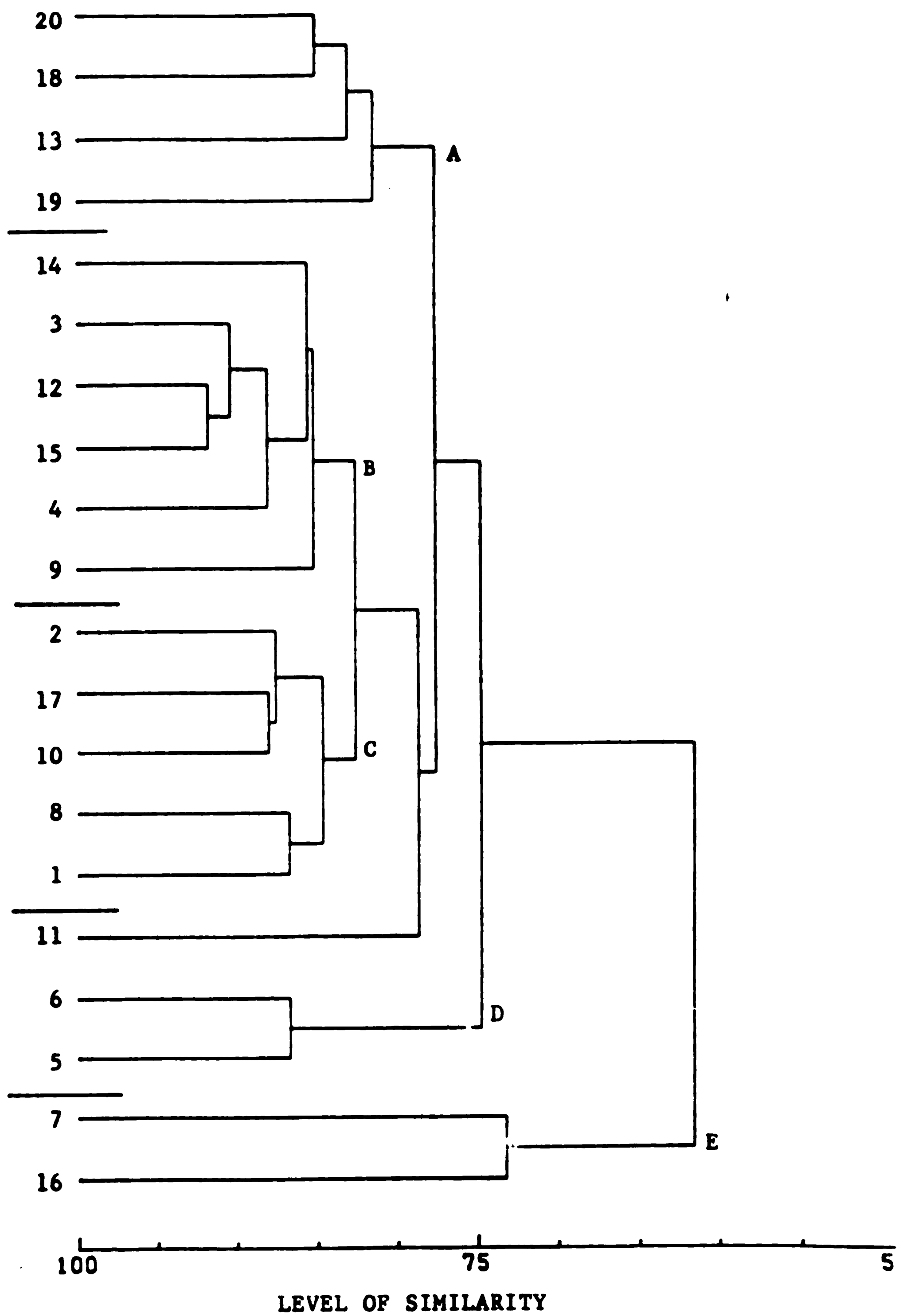
Q-MODE ANALYSIS, SITE B; APRIL, 1987



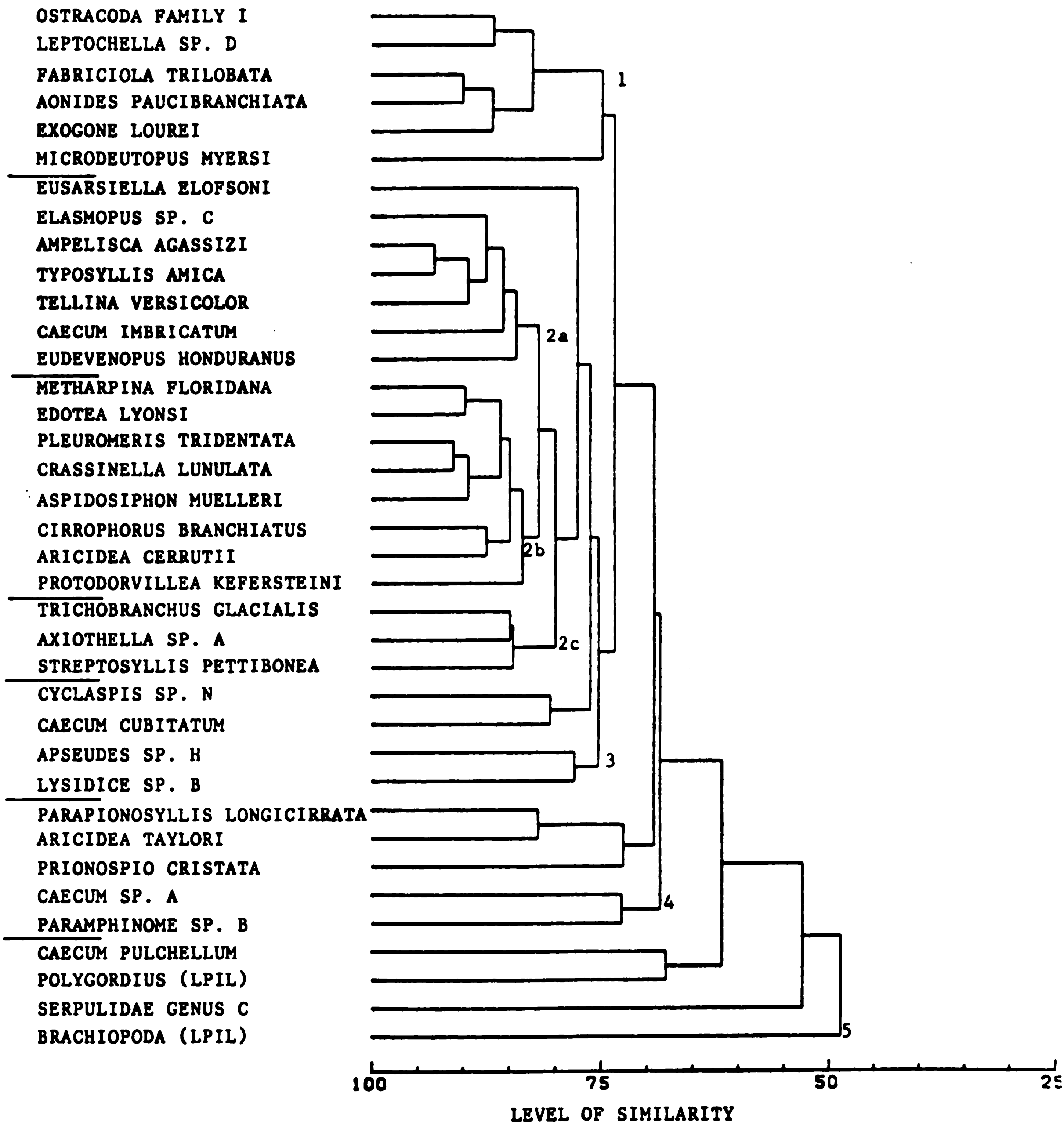
R-MODE ANALYSIS, SITE B; APRIL, 1987

Data matrix of station and species groups compiled from classification analysis dendrograms for Pensacola, FL survey, "B" site, April 1987.

		A		B								C					D				
	STATION:	15	5	13	11	12	9	6	4	19	18	14	2	10	1	3	17	8	7	20	16
	APSEUDES SP.H	22	69	17	10	31	56	45	49	39	26	72	101	45	70	59	25	17	20	15	0
	AONIDES PAUCIBRANCHIATA	32	36	47	32	29	26	18	37	25	34	40	69	18	44	31	50	26	3	14	4
	GLYCERA SP.A	19	13	11	20	25	20	21	24	27	29	30	29	28	31	23	22	19	18	13	16
	CAECUM IMBRICATUM	77	112	47	31	21	12	11	29	28	67	158	48	123	27	30	201	224	11	6	70
1	PRIONOSPIO CRISTATA	68	58	30	12	22	7	12	54	35	105	34	54	79	28	15	109	78	0	19	34
	EXOGONE LOUREI	30	25	28	31	14	3	18	63	8	17	33	55	18	15	29	56	86	1	2	22
	FABRICIOLA TRILOBATA	8	10	33	14	18	24	29	50	10	9	30	17	12	24	38	41	178	494	0	6
	CAECUM SP.A	3	6	63	44	50	96	44	64	26	33	49	34	31	56	93	23	0	125	8	2
	PROTODORVILLEA KEFERSTEINI	3	15	22	45	40	93	73	49	30	33	57	27	23	87	79	14	0	249	31	0
	AMPELISCA AGASSIZI	15	7	7	11	4	9	14	19	3	8	6	8	32	13	7	6	38	11	3	4
	CRASSINELLA LUNULATA	8	13	25	12	14	13	18	20	14	24	28	24	11	7	14	39	43	15	20	2
	TYPOSYLLIS AMICA	14	16	11	14	7	6	19	17	24	24	12	12	10	7	15	31	43	19	11	2
	CRENELLA DIVARICATA	7	13	21	9	10	12	18	13	12	15	14	8	12	8	16	27	68	21	2	12
	CIRROPHORUS BRANCHIATUS	29	24	10	11	12	14	13	25	11	35	6	11	14	4	3	28	24	14	6	8
2	PLEUROMERIS TRIDENTATA	7	2	14	19	6	15	6	10	3	3	21	21	19	16	16	41	56	30	1	1
	ARMANDIA MACULATA	3	5	4	14	6	10	5	13	5	5	20	16	14	13	13	13	18	4	2	4
	OWENIA SP.A	12	26	4	11	14	12	10	31	7	4	12	13	2	7	22	4	16	7	9	0
	PARAMPHINOME SP.B	4	13	11	8	6	41	26	21	14	34	12	27	10	22	34	9	2	58	46	0
	ASPIDOSIPHON MUELLERI	4	14	10	15	9	20	15	16	21	7	22	9	5	13	7	9	4	42	18	2
	PIONOSYLLIS GESAE	6	12	5	10	10	10	6	18	12	18	5	8	3	0	9	15	2	25	0	1
	SPHAEROSYLLIS PIRIFEROPSIS	1	9	5	19	20	12	32	22	4	4	28	28	12	15	46	1	1	7	0	1
	CAECUM PULCHELLUM	123	405	58	9	13	14	2	5	5	12	229	106	236	14	21	397	408	26	1	155
3	SPIOPHANES BOMBYX	246	76	101	136	57	100	89	102	100	123	227	211	173	115	143	210	232	81	19	206
	GONIADIDES CAROLINAE	0	28	10	7	2	1	3	46	8	54	19	28	1	12	4	7	0	1	10	0
	LYSIDICE SP.B	2	9	2	3	3	2	8	13	19	10	4	5	2	2	3	7	0	6	49	0
	CYCLASPIS SP.N	6	0	6	6	5	7	1	7	2	1	22	6	4	2	5	3	4	3	0	1
	SABELLIDES SP.A	2	5	4	2	2	1	10	9	0	0	4	5	6	1	5	5	20	0	0	1
	ARICIDEA SP.H	2	6	13	2	6	8	10	3	1	6	1	3	1	2	1	6	5	22	1	2
4	METHARPINA FLORIDANA	25	14	21	8	2	7	6	1	13	10	2	6	6	9	3	30	30	2	23	31
	PARAPRIONOSPIO PINNATA	13	8	11	7	12	2	15	6	6	13	2	3	9	1	1	34	47	2	0	49
	CAECUM SP.C	8	8	5	4	1	2	0	2	1	2	5	2	9	0	0	48	53	1	0	6
	ARICIDEA TAYLORI	3	2	4	1	3	3	1	2	4	8	1	1	0	0	0	12	10	1	6	20
	SERPULIDAE GENUS C	51	269	64	46	114	580	247	254	430	331	0	0	1	0	1	1	3	34	117	6
	ELASMOPUS SP.C	1	1	0	0	0	3	2	2	3	0	1	1	0	1	19	2	5	21	4	0
5	BHAWANIA HETEROSETA	1	1	4	1	0	0	10	10	7	21	0	1	0	2	2	1	1	2	79	0
	KALLIAPSEUDES SP.B	0	0	2	2	0	2	0	1	0	1	0	1	0	0	0	1	2	20	0	0
	POLYGORDIUS (LPIL)	0	0	0	0	0	0	0	1	0	91	0	0	0	0	0	0	1	0	0	27



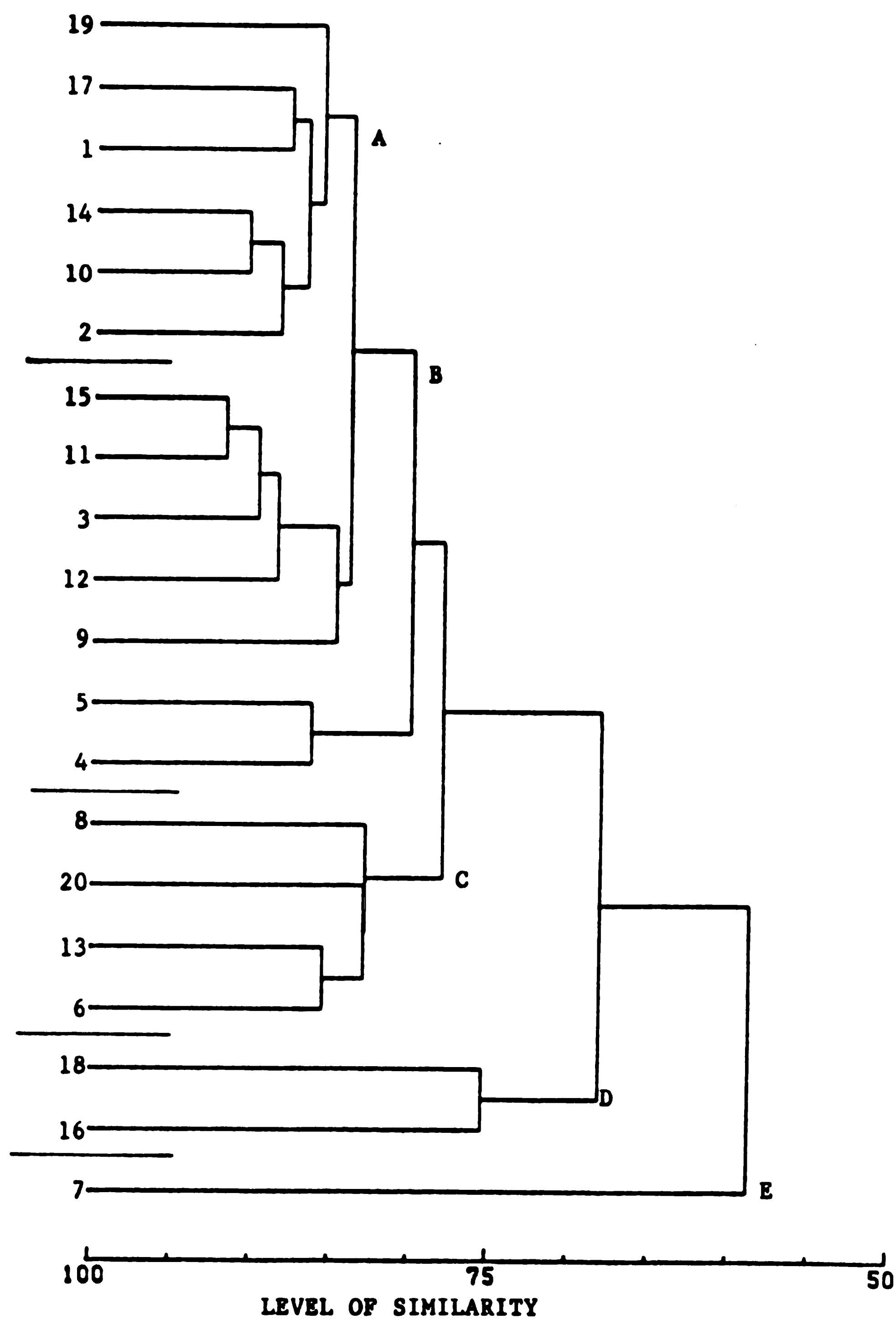
Q-MODE ANALYSIS, SITE C; NOVEMBER, 1986



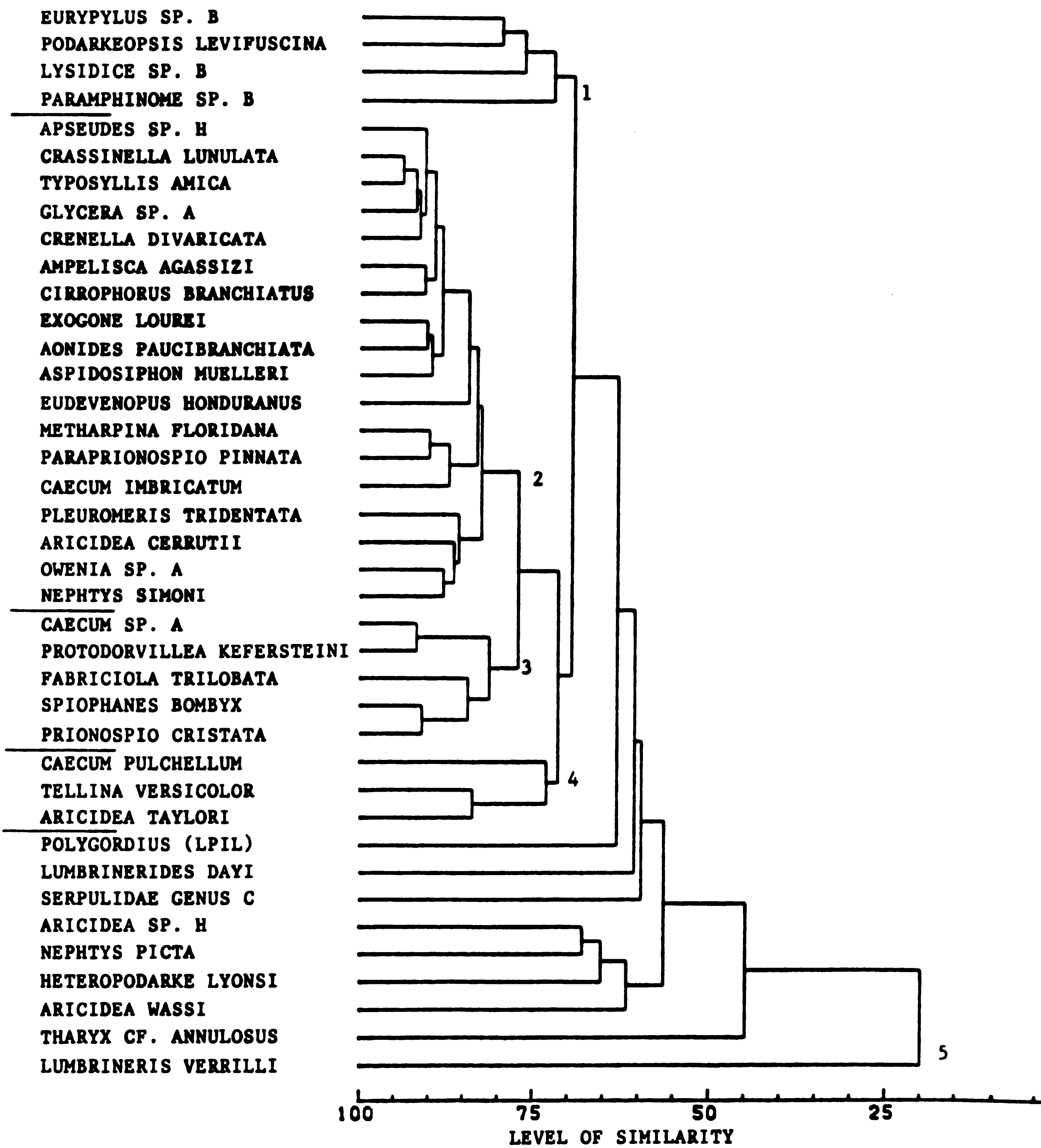
R-MODE ANALYSIS, SITE C; NOVEMBER, 1986

Data matrix of station and species groups compiled from classification analysis dendrograms for Pensacola, FL survey, "C" site, November 1986.

		A				B						C					D			E	
		20	18	13	19	14	3	12	15	4	9	2	17	10	8	1	11	6	5	7	16
1	OSTRACODA FAMILY I	200	132	147	330	173	140	323	283	315	144	241	172	280	112	233	59	232	167	7	0
	LEPTOCHELIA SP.D	169	42	85	63	33	68	96	88	120	62	58	142	41	110	66	73	120	119	219	281
	FABRICIOLA TRILOBATA	22	169	71	147	231	35	60	50	6	24	84	184	170	166	286	69	10	3	4	10
	AONIDES PAUCIBRANCHIATA	63	27	30	48	60	52	73	82	20	57	71	94	88	98	70	75	20	11	7	16
	EXOGONE LOURFI	3	61	16	23	40	22	27	19	9	16	52	42	45	19	79	40	6	5	5	9
	MICRODEUTOPUS MYERSI	295	12	51	57	2	8	21	25	220	21	4	10	0	10	32	27	47	51	42	41
2a	EUSARSIELLA ELOFSONI	16	17	43	50	5	4	2	10	3	3	12	7	0	2	46	20	23	4	3	0
	ELASMOPUS SP.C	10	6	33	26	17	16	45	24	38	14	82	4	24	9	30	42	16	19	3	1
	AMPELISCA AGASSIZI	36	18	45	78	16	26	20	31	34	40	32	38	44	57	104	37	40	46	13	3
	TYPOSYLLIS AMICA	71	18	36	59	18	29	14	21	30	17	32	18	23	21	28	42	19	19	15	7
	TELLINA VERSICOLOR	56	41	55	61	8	7	22	19	24	23	16	12	6	7	15	20	47	51	8	2
	CAECUM IMBRICATUM	77	137	107	172	39	6	11	16	28	26	12	14	15	17	21	0	17	18	7	2
	EUDEVENOPUS HONDURANUS	18	52	41	88	9	4	1	3	8	10	6	18	15	57	37	15	45	16	6	2
2b	METHARPINA FLORIDANA	16	8	29	10	5	10	9	20	18	6	10	9	10	22	5	11	12	15	2	2
	EDOTEA LYONSI	15	9	19	17	13	7	4	6	9	10	8	8	15	10	12	5	11	18	6	1
	PLEUROMERIS TRIDENTATA	12	19	14	48	16	17	13	9	8	18	28	13	18	15	23	10	7	10	0	0
	CRASSINELLA LUNULATA	7	4	11	19	20	20	14	15	11	24	16	11	17	6	11	19	6	6	1	0
	ASPIDOSIPHON MUELLERI	7	7	5	13	23	11	25	23	25	36	14	23	37	11	22	9	6	20	2	0
	CIRROPHORUS BRANCHIATUS	4	6	5	17	12	13	19	18	10	4	12	6	7	13	8	16	15	7	12	11
	ARICIDEA CERRUTII	4	27	9	14	15	15	4	8	4	6	10	22	6	36	24	18	8	4	3	7
	PROTODORVILLEA KEFERSTEINI	5	4	2	15	32	13	13	14	8	32	10	42	57	11	7	3	5	1	2	5
2c	TRICHOBRANCHUS GLACIALIS	39	12	19	52	15	10	8	14	5	1	7	8	4	19	32	46	1	1	5	5
	AXIOTHELLA SP.A	39	28	2	23	11	7	7	7	6	0	6	4	13	15	2	8	2	0	3	0
	STREPTOSYLLIS PETTIBONEA	20	10	3	22	22	3	13	14	12	6	11	28	17	44	37	20	2	2	3	0
3	CYCLASPIS SP.N	8	15	0	26	9	13	2	7	14	10	24	30	5	1	10	0	11	5	0	0
	CAECUM CUBITATUM	3	12	16	21	15	7	2	20	24	15	4	6	10	2	2	1	9	16	0	1
	APSEUDES SP.H	4	0	1	0	15	20	13	24	17	33	50	12	49	9	33	11	8	16	0	8
	LYSIDICE SP.B	12	1	7	5	0	16	35	18	17	9	18	7	13	4	16	8	1	1	1	7
4	PARAPIONOSYLLIS LONGICIRRATA	5	6	2	7	14	3	17	7	6	0	4	30	15	5	16	11	0	2	5	5
	ARICIDEA TAYLORI	7	10	1	16	4	4	4	10	4	1	3	5	3	7	9	8	0	2	16	55
	PRIONOSPIO CRISTATA	11	10	0	30	51	6	4	3	0	0	13	15	11	20	50	1	0	0	0	10
	CAECUM SP.A	1	2	0	62	50	27	43	27	17	96	35	85	67	7	10	0	2	8	0	0
	PARAMPHINOME SP.B	0	0	1	16	24	14	8	9	17	23	5	23	18	2	2	3	0	0	0	4
5	CAECUM PULCHELLUM	23	87	51	133	15	4	5	1	8	2	0	1	5	9	5	0	11	0	14	3
	POLYGORDIUS (LPIL)	31	58	35	0	1	1	2	1	2	0	3	3	3	35	4	12	0	0	37	30
	SERPULIDAE GENUS C	0	0	0	2	652	214	236	264	378	479	3	0	1	0	10	0	31	42	7	15
	BRACHIOPODA (LPIL)	2	2	22	0	4	2	3	1	4	2	0	3	0	0	0	0	9	250	4	41



Q-MODE ANALYSIS, SITE C; APRIL, 1987



R-MODE ANALYSIS, SITE C; APRIL, 1987

Data matrix of station and species groups compiled from classification analysis dendrograms for Pensacola, FL survey, "C" site, April 1987.

		A						B							C				D		E
	STATION:	19	17	1	14	10	2	15	11	3	12	9	5	4	8	20	13	6	18	16	7
	EURYTHUS SP.B	9	4	17	5	6	11	2	3	2	4	10	2	1	2	3	2	3	0	0	0
	PODARKEOPSIS LEVIFUSCINA	6	5	2	4	5	4	15	12	4	3	5	2	5	5	12	5	5	0	0	0
1	LYSIDICE SP.B	5	5	10	6	9	3	16	5	7	12	11	17	17	3	0	2	1	1	0	1
	PARAMPHINOME SP.B	16	0	3	33	47	9	19	14	7	7	27	0	10	3	3	0	1	1	0	0
	APSEUDES SP.H	18	20	19	22	29	15	15	25	23	21	27	28	44	9	11	7	2	0	5	11
	CRASSINELLA LUNULATA	19	27	21	22	17	18	19	7	17	22	13	25	20	5	9	8	6	9	2	12
	TYPOSYLLIS AMICA	18	26	30	9	19	17	18	18	15	24	27	21	22	12	11	15	10	9	8	13
	GLYCERA SP.A	10	14	16	21	15	11	14	21	29	12	20	13	9	10	11	6	7	6	8	12
	CRENELLA DIVARICATA	20	26	20	37	30	14	24	18	31	42	9	20	12	4	17	11	12	18	10	29
	AMPELISCA AGASSIZI	11	23	11	6	4	7	17	16	16	12	9	15	13	11	18	16	7	9	6	7
	CIRROPHORUS BRANCHIATUS	17	4	11	16	10	10	19	18	10	20	4	10	9	9	19	13	17	11	8	25
	EXOGONE LOUREI	7	15	47	34	35	27	14	16	20	18	22	11	17	8	13	8	11	50	3	1
	AONIDES PAUCIBRANCHIATA	20	22	15	22	28	23	40	33	23	18	38	10	20	20	15	9	7	4	4	0
2	ASPIDOSIPHON MUELLERI	24	27	43	18	28	16	16	13	18	36	22	41	24	5	22	20	11	1	2	1
	EUDEVENOPUS HONDURANUS	47	22	18	6	23	15	10	5	6	7	23	13	7	22	22	30	33	4	2	0
	MEDIHARPINA FLORIDANA	14	9	2	7	11	6	5	10	10	10	4	13	3	17	22	30	26	29	9	4
	PARAPRIONOSPIO PINNATA	4	14	1	13	8	7	6	10	16	9	3	9	8	23	19	13	17	32	103	9
	CAECUM IMBRICATUM	40	15	27	13	5	27	6	3	10	8	7	12	16	21	15	9	18	47	10	5
	PLEUROMERIS TRIDENTATA	37	15	22	11	17	9	4	7	10	6	11	2	3	9	11	7	6	17	0	1
	ARICIDEA CERRUTII	10	14	9	9	7	8	9	10	8	7	1	1	5	12	8	0	6	15	3	1
	OWENIA SP.A	11	7	6	14	5	10	6	12	15	9	8	2	8	5	9	6	3	7	2	3
	NEPHTYS SIMONI	4	17	4	8	9	12	16	14	16	8	6	4	5	10	7	13	10	8	10	1
	CAECUM SP.A	157	71	88	61	95	53	49	35	23	29	39	4	12	1	41	3	5	2	0	1
	PROTODORVILLEA KEFERSTEINI	131	36	50	86	85	31	21	28	17	13	39	2	15	2	14	2	8	1	1	0
3	FABRICIOLA TRILOBATA	529	120	323	176	158	31	23	19	21	72	38	26	10	42	20	29	9	227	6	1
	SPIOPHANES BOMBYX	73	57	65	82	60	86	61	64	64	20	33	29	33	117	67	40	73	204	132	6
	PRIONOSPIO CRISTATA	20	43	44	57	56	63	51	54	75	9	45	12	25	48	91	6	41	34	53	0
	CAECUM PULCHELLUM	17	3	23	6	11	6	5	5	1	3	0	0	6	30	3	1	2	90	6	4
4	TELLINA VERSICOLOR	4	5	6	2	2	2	2	1	5	3	3	12	9	14	6	14	6	24	10	3
	ARICIDEA TAYLORI	4	6	6	3	4	3	8	9	6	1	3	10	11	10	0	4	2	9	25	7
	POLYGORDIUS (LPIL)	38	1	1	6	7	0	7	1	0	1	9	1	0	25	9	5	15	80	15	0
	LUMBRINERIDES DAYI	0	7	5	10	7	9	9	16	7	9	1	0	0	0	2	1	0	1	1	0
	SERPULIDAE GENUS C	8	1	42	390	1	5	499	386	179	336	354	84	339	1	0	57	65	2	1	23
	ARICIDEA SP.H	53	23	20	5	3	6	0	1	2	0	0	5	4	6	3	6	5	7	0	2
5	NEPHTYS PICTA	1	1	1	2	0	2	0	0	2	1	0	7	3	5	4	2	4	19	2	3
	HETEROPODARKE LYONSI	2	2	0	1	1	3	8	2	2	7	0	7	6	6	7	0	16	6	0	0
	ARICIDEA WASSI	1	0	0	0	1	1	0	3	0	0	0	20	4	17	3	11	23	4	4	0
	THARYX CF. ANNULOSUS	0	0	0	0	0	2	2	4	2	1	0	0	0	0	4	4	9	16	8	1
	LUMBRINERIS VERRILLI	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	4	2	21

APPENDIX F

Demersal Fishes

and

Invertebrates

Site B

Site C

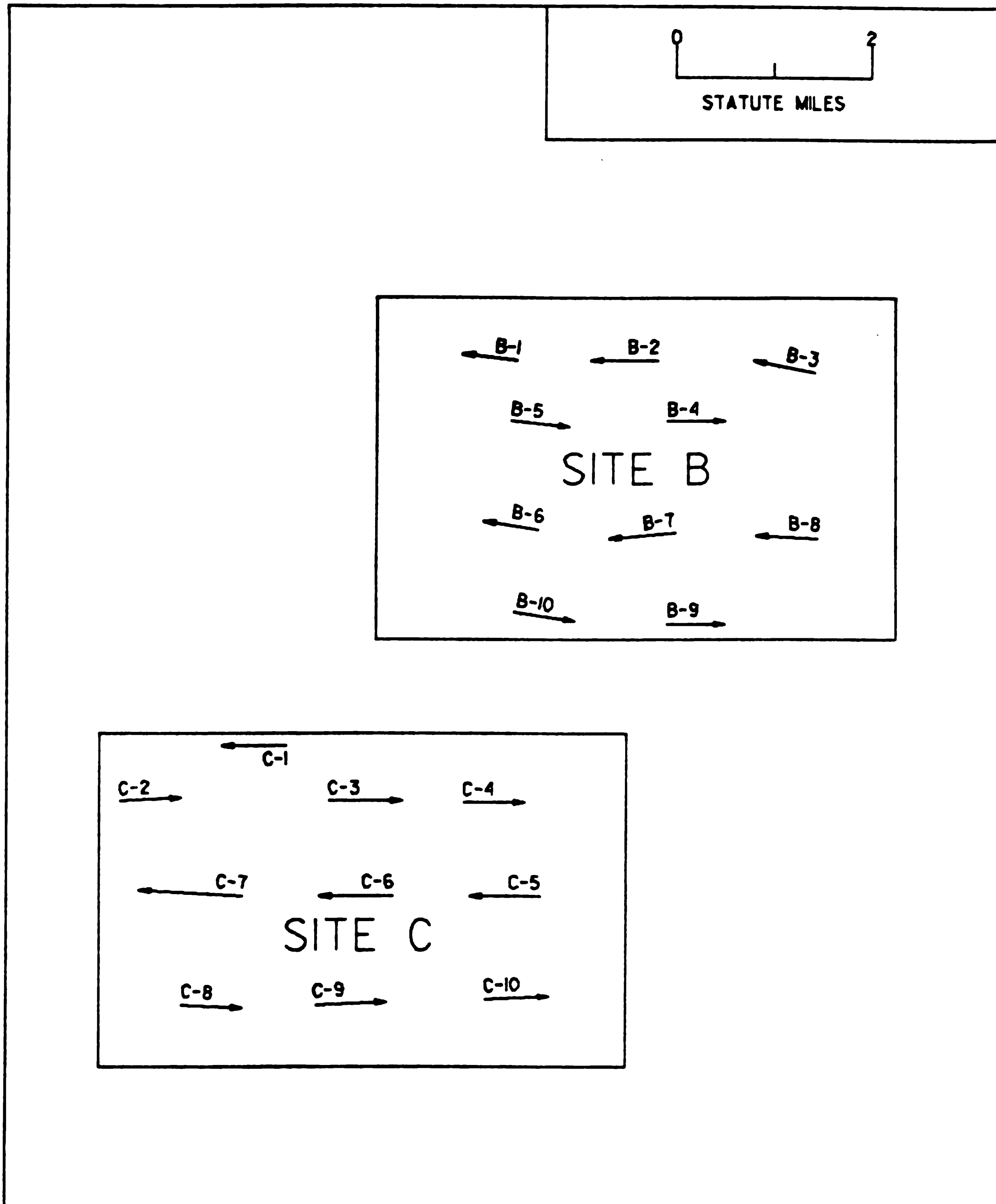


FIGURE F-1
DEMERSAL FISH
SAMPLING SITES

SAMPLING CHRONOLOGY
PENSACOLA, FLORIDA OCEAN DISPOSAL SITE
DEMERSAL FISH CHARACTERIZATION
MAY 19 - 20 , 1987

MAY 19, 1987

ARRIVE AT DISL*.................................0800 HOURS
DEPART DISL.....................................0900 "

EN ROUTE TO SITE C, TRANSECT 4, STATION C-8

ARRIVE AT STATION C-8...7980 - W - 13183.1
7980 - Y - 47055.0....1445 "

NET OVER................7980 - W - 13183.2
7980 - Y - 47055.0....1446 "

NET FISHING.............13186.1
47055.0................1451 "

*NOTE THAT CABLE LENGTH IS 5:1 OR ABOUT 500 FEET

TRAWL COMPLETE..........13192.5
47055.0.............. 1511 "

NET UP..................13193.6
47055.0................1517 "

NET ON DECK.............13193.6
47055.0................1518 "

EN ROUTE TO STATION C-9

ARRIVE AT STATION C-9...13200.0
47055.0................1525 "

NET OVER................13200.0
47055.0................1526 "

NET FISHING.............13200.2
47055.0................1530 "

TRAWL COMPLETE..........13207.1
47054.9................1550 "

NET UP..................13207.9
47054.8................1555 "

NET ON DECK.............13207.6
47055.0................1556 HOURS

*DISL - Dauphin Island Sealab

EN ROUTE TO STATION C-10

<u>ARRIVE AT STATION C-10</u>..13216.0
47055.0................1603 "

NET OVER................13216.0
47055.0................1604 "

NET FISHING.............13217.7 (DEPTH 75 FEET)
47055.0................1607 "

TRAWL COMPLETE..........13224.0 (DEPTH 80 FEET)
47055.0................1627 "

NET UP..................13224.7
47054.9................1630 "

NET ON DECK.............13224.7
47054.9................1632 "

EN ROUTE TO TRANSECT 3, STATION C-5

<u>ARRIVE AT STATION C-5</u>...13226.0
47060.0................1650 "

NET OVER................13226.0
47060.0................1651 "

NET FISHING.............13225.0 (DEPTH 70 FEET)
47060.0................1653 "

TRAWL COMPLETE..........13217.5 (DEPTH 75 FEET)
47060.0................1713 "

NET UP..................13216.6
47060.0................1715 "

NET ON DECK.............13216.6
47060.0................1718 "

EN ROUTE TO STATION C-6

<u>ARRIVE AT STATION C-6</u>...13211.1
47060.0................1725 HOURS

NET OVER................13210.0
47060.0................1726 "

NET FISHING.............13209.0 (DEPTH 68 FEET)
47060.0................1730 "

TRAWL COMPLETE..........13202.4 (DEPTH 68 FEET)
47060.0................1750 "

NET UP..................13201.7
47060.0...............1753 "

NET ON DECK.............13201.7
47060.0...............1755 "

EN ROUTE TO STATION C-7

ARRIVE AT STATION C-7...13194.0
47060.0...............1803 "

NET OVER................13194.3
47060.5...............1804 "

NET FISHING.............13194.1 (DEPTH 65 FEET)
47060.0...............1808 "

TRAWL COMPLETE..........13186.9 (DEPTH 58 FEET)
47060.3...............1828 "

NET UP..................13186.1
47060.3...............1830 "

NET ON DECK.............13186.1
47060.3...............1832 "

EN ROUTE TO TRANSECT 2, STATION C-2

ARRIVE AT STATION C-2...13181.1
47065.0...............1852 "

NET OVER................13181.4
47065.3...............1853 "

NET FISHING.............13182.8 (DEPTH 54 FEET)
47065.0...............1856 "

TRAWL COMPLETE..........13188.7 (DEPTH 57 FEET)
47065.1...............1916 HOURS

NET UP..................13189.4
47065.1...............1918 "

NET ON DECK.............13189.4
47065.1...............1920 "

EN ROUTE TO STATION C-3

ARRIVE AT STATION C-3...13202.0
47065.0................1931 "

NET OVER.................13202.0
47064.9................1932 "

NET FISHING.............13203.8 (DEPTH 60 FEET)
47065.0................1935 "

TRAWL COMPLETE..........13211.6 (DEPTH 65 FEET)
47065.0................1955 "

NET UP..................13212.4
47065.0................1957 "

NET ON DECK.............13212.4
47065.0................1959 "

EN ROUTE TO STATION C-4

ARRIVE AT STATION C-4...13216.0
47065.0................2005 "

NET OVER.................13216.0
47065.0................2006 "

NET FISHING.............13217.7 (DEPTH 67 FEET)
47065.0................2009 "

TRAWL COMPLETE..........13224.1 (DEPTH 67 FEET)
47065.0................2029 "

NET UP..................13225.0
47065.0................2031 "

NET ON DECK.............13225.0
47065.0................2034 HOURS

EN ROUTE TO TRANSECT 1, STATION C-1

ARRIVE AT STATION C-1...13202.1
47067.6................2051 "

NET OVER.................13202.1
47067.6................2052 "

NET FISHING.............13200.3 (DEPTH 53 FEET)
47067.5................2055 "

TRAWL COMPLETE..........13193.3 (DEPTH 55 FEET)
47067.5................2115 "

NET UP..................13192.6
47067.5...............2118 "

NET ON DECK.............13192.6
47067.5...............2121 "

SITE C SAMPLING COMPLETED AT 2135 WHILE
EN ROUTE TO SITE B, TRANSECT 4, STATION B-10

ARRIVE AT STATION B-10..13222.4
47074.0...............2149 "

NET OVER................13224.4
47074.0...............2150 "

NET FISHING.............13224.5 (DEPTH 55 FEET)
47074.5...............2153 "

TRAWL COMPLETE..........13230.8 (DEPTH 62 FEET)
47074.0...............2213 "

NET UP..................13231.5
47074.2.............. 2215 "

NET ON DECK.............13231.5
47074.2...............2217 "

EN ROUTE TO STATION B-9

ARRIVE AT STATION B-9...13240.0
47074.0...............2230 "

NET OVER................13240.0
47074.0...............2231 HOURS

NET FISHING.............13240.2 (DEPTH 67 FEET)
47074.0...............2233 "

TRAWL COMPLETE..........13246.1 (DEPTH 73 FEET)
47074.0...............2253 "

NET UP..................13246.0
47074.0...............2255 "

NET ON DECK.............13246.0
47074.0...............2257 "

EN ROUTE TO TRANSECT 3, STATION B-8

ARRIVE AT STATION B-8...13258.7
47078.0...............2313 "

NET OVER................13258.7
47078.0...............2314 "

NET FISHING.............13257.0 (DEPTH 70 FEET)
47078.0...............2318 "

TRAWL COMPLETE..........13250.6 (DEPTH 70 FEET)
47078.0...............2338 "

NET UP..................13249.9
47078.0...............2340 "

NET ON DECK.............13249.9
47078.0...............2343 "

EN ROUTE TO STATION B-7

ARRIVE AT STATION B-7...13245.1
47078.0...............2353 "

NET OVER................13245.1
47078.0...............2355 "

NET FISHING.............13242.1 (DEPTH 70 FEET)
47078.0...............2358 "

MAY 20, 1987

TRAWL COMPLETE..........13235.4 (DEPTH 60 FEET)
47077.9...............0018 HOURS

NET UP..................13234.5
47077.7...............0020 "

NET ON DECK.............13234.5
47077.7...............0023 "

EN ROUTE TO STATION B-6

ARRIVE AT STATION B-6...13230.5
47078.1...............0030 "

NET OVER................13230.1
47078.1...............0031 "

NET FISHING.............13228.0 (DEPTH 58 FEET)
47078.0...............0035 "

TRAWL COMPLETE..........13221.6 (DEPTH 58 FEET)
47078.5................0055 "

NET UP..................13220.6
47078.3................0057 "

NET ON DECK.............13220.6
47078.3................0100 "

EN ROUTE TO TRANSECT 2, STATION B-5

ARRIVE AT STATION B-5...13226.0
47082.0................0108 "

NET OVER................13226.0
47082.2................0110 "

NET FISHING.............13226.2 (DEPTH 60 FEET)
47082.2................0115 "

TRAWL COMPLETE..........13232.4 (DEPTH 58 FEET)
47081.9................0135 "

NET UP..................13232.7
47082.0................0139 "

NET ON DECK.............13232.7
47082.0................0142 HOURS

EN ROUTE TO STATION B-4

ARRIVE AT STATION B-4...13241.0
47082.3............... 0154 "

NET OVER................13241.0
47082.3................0155 "

NET FISHING.............13242.4 (DEPTH 58 FEET)
47082.2................0158 "

TRAWL COMPLETE..........13248.7 (DEPTH 65 FEET)
47082.2................0215 "

NET UP..................13249.2
47082.2................0220 "

NET ON DECK.............13249.2
47082.2................0223 "

EN ROUTE TO TRANSECT 1, STATION B-3

<u>ARRIVE AT STATION B-3</u>...13261.1
47085.3...............0237 "

NET OVER................13260.9
47085.0...............0239 "

NET FISHING.............13258.6 (DEPTH 65 FEET)
47084.3...............0243 "

TRAWL COMPLETE..........13252.0 (DEPTH 63 FEET)
47085.0...............0303 "

NET UP..................13251.9
47085.0...............0307 "

NET ON DECK.............13251.9
47085.0...............0310 "

EN ROUTE TO STATION B-2

<u>ARRIVE AT STATION B-2</u>...13244.0
47085.0...............0325 "

NET OVER................13244.4
47085.0...............0326 HOURS

NET FISHING.............13242.0 (DEPTH 50 FEET)
47085.0...............0330 "

TRAWL COMPLETE..........13235.4 (DEPTH 50 FEET)
47085.0...............0350 "

NET UP..................13033.9
47085.0...............0358 "

NET ON DECK.............13033.9
47085.0...............0400 "

EN ROUTE TO STATION B-1

<u>ARRIVE AT STATION B-1</u>...13230.0
47085.0...............0403 "

NET OVER................13230.0
47085.0...............0404 "

NET FISHING.............13228.0 (DEPTH 60 FEET)
47085.0...............0407 "

TRAWL COMPLETE..........13022.0 (DEPTH 60 FEET)
47085.2...............0427 "

NET UP..................13219.3
47085.0...............0429 "

NET ON DECK.............13219.3
47085.0...............0432 "

SITE B SAMPLING COMPLETED AT 0450 HOURS WHILE
EN ROUTE TO DAUPHIN ISLAND SEALAB.

ARRIVE DISL AT 1010 HOURS, TRIP COMPLETE.

PENSACOLA OFFSHORE DISPOSAL SITES - FISH SPECIES LIST

SPECIES	STA. B-1	STA. B-2	STA. B-3	STA. B-4	STA. B-5	STA. B-6	STA. B-7	STA. B-8	STA. B-9	STA. B-10
Raja eglanteria		2						1		
Gymnothorax nigromarginatus				1		1		3	1	
Ariosoma balaericum	8	1	2	4	3	2	9	6	5	3
Hildebrandia flava	1									
Paraconger caudilimbatus	1	1	2		2	1			1	
Ophichthus ocellatus		1						1		1
Etrumeus teres			1			1		1		
Synodus foetens		1			1	2	1	1	1	
Synodus sp. (larvae)										1
Trachinocephalus myops	1	4			2	2		1	3	6
Arius felis	3	3	7							
Halieutichthys aculeatus			1	1		1				1
Ogcocephalus cubifrons					1			1		
Urophycis regia		2	2	3	2	3	1	3		1
Lepophidium graellsi		10	38	32	171	141	93	64	35	117
Ophidion grayi	1	1	2			3	3	1	2	3
Ophidion holbrooki	9	10	28	22	14	10	17	20	5	7
Otophidium omostigmum	1		30	23	8	3	14	25	5	5
Centropristis ocyurus	6	1	37	1	4	4	1	4	6	4
Centropristis philadelphica			5							
Diplectrum formosum	11	5	3	6	15	20	7	7	8	20
Serraniculus pumilio			2							
Trachurus lathami	1	4	3	1		3			1	5
Haemulon aurolineatum	5	17	2		4	2		62	1	

PENSACOLA OFFSHORE DISPOSAL SITES - FISH SPECIES LIST (Continued)

SPECIES	STA. B-1	STA. B-2	STA. B-3	STA. B-4	STA. B-5	STA. B-6	STA. B-7	STA. B-8	STA. B-9	STA. B-10
Orthopristis chrysoptera	2	16	4	3	1	4			3	9
Pagrus pagrus	3	3	5	2	2	2	2		1	
Stenotomus caprinus	3,111	4,103	460	61	135	588	33	32	15	
Sciaenid sp.						1				
Hemipteronotus novacula										1
Sphyraena borealis					1					
Microgobius carri			1							
Peprilus burti			1		1	9	2		12	8
Prionotus martis	8	10	16	6	31	9	4	36	14	4
Prionotus salmonicolor				1		1		2	1	
Prionotus scitulus	2	5	1		7	2		1		
Prionotus tribulus		1			1	1	1		1	
Scorpaena brasiliensis								1		
Ancylopsetta quadrocellata				1						
Bothus robinsi			3					3		
Citharichthys macrops	3	1	1	3	5	2	3	6	4	
Etropus rimosus	2	1	20	2	2	4		1	1	
Syacium papillosum	13	4	6	4	9	6	5	22	18	3
Gymnachirus melas				1				1		
Symphurus minor	1		2	6	5	6	4	6	13	2
Symphurus urospilus		1								
Aluterus schoepfi	1	1		7		1	2	2	1	
Aluterus scriptus		1		1						
Monacanthus hispidus			1							
Lactophrys quadricornis						1			1	

PENSACOLA OFFSHORE DISPOSAL SITES - FISH SPECIES LIST

SPECIES	STA. C-1	STA. C-2	STA. C-3	STA. C-4	STA. C-5	STA. C-6	STA. C-7	STA. C-8	STA. C-9	STA. C-10
Raja eglanteria				2				1	1	
Gymnothorax nigromarginatus				1					3	
Ariosoma balaericum				6						
Ophichthus ocellatus	1			5						
Ophichthus ophis									1	
Saurida brasiliensis								6	66	
Synodus foetens	1	1	2	3	4	3		1	3	2
Synodus poeyi				3				1	1	
Trachinocephalus myops	1	1	2	4		1	1			
Ogcocephalus cubifrons	1									
Urophycis regia	2									
Lepophidium graellsi	150			3						
Ophidion holbrooki	5			13						
Otophidium omostigmum				3						
Centropristis ocyurus	3		2	2			1		7	
Diplectrum formosum	12	1	8	8	8	3	8	3	3	2
Trachurus lathami	30	12	70	20	544	8	62	23		36
Haemulon aurolineatum	2									
Orthopristis chrysoptera				1						
Pagrus pagrus		1						1		
Stenotomus caprinus			4	2		7	3	45	2	8
Hemipteronotus novacula		14	5	1	11	15	50	60	3	29
Kathetostoma albigutta				1						
Peprilus burti		2		5	8			2	4	2
Prionotus martis	11	2	1	9	3			1	7	1

PENSACOLA OFFSHORE DISPOSAL SITES - FISH SPECIES LIST (Continued)

SPECIES	STA. C-1	STA. C-2	STA. C-3	STA. C-4	STA. C-5	STA. C-6	STA. C-7	STA. C-8	STA. C-9	STA. C-10
Prionotus scitulus									2	
Prionotus tribulus	2					1			1	
Ancylopsetta quadrocellata	2				1			1		
Citharichthys macrops	5	1	4	6	2	5			1	
Etropus rimosus				1				1		1
Syacium papillosum	7	1	2	1	1	7		6	21	1
Monacanthus hispidus	1		1	1						
Sphoeroides dorsalis					1				1	

PENSACOLA OFFSHORE DISPOSAL SITES
INVERTEBRATE SPECIES LIST - SITE B

INVERTEBRATE TAXA	STA. B-1	STA. B-2	STA. B-3	STA. B-4	STA. B-5	STA. B-6	STA. B-7	STA. B-8	STA. B-9	STA. B-10
CRUSTACEA										
Sicyonia brevirostris	5	8	59	67	31	20	67	135	96	8
Solenocera atlantidis		8	58	181	117	90	53	79	146	59
Mesopenaeus tropicalis								1		1
Penaeus duorarum				1						
Penaeus aztecus							1	1		
Pontonia domestica						1				
Scyllarus chacei									1	
Porcellana sayana			1							
Albunea gibbesii						1				
Dromidia antillensis	1	1	5			2	2	1		
Calappa flammea								1		
Pondochela sp.										1
Parthenope sp.								1		
Lobopilumnus agassizii									1	
Portunus spinimanus		1			2		4	5	3	
Portunus spinicarpus	3		14		3	3	8	8	12	4
ECHINODERMS										
Luidia clathrata	1	2	1		1		2	3		
Astropecten duplicatus	1	1		1				1		
Echinaster sp.				1				1		
Encope michelini		1	1				5	1		

PENSACOLA OFFSHORE DISPOSAL SITES
INVERTEBRATE SPECIES LIST - SITE B
(Continued)

INVERTEBRATE TAXA	STA. B-1	STA. B-2	STA. B-3	STA. B-4	STA. B-5	STA. B-6	STA. B-7	STA. B-8	STA. B-9	STA. B-10
MOLLUSCS										
Loligo pealeii	42	105	495	322	104	211	95	36	155	228
Octopus vulgaris					1		1			
Pleurobranchaea hedgpethi			5	2		1	1	3	10	
Argopecten gibbus		2		9	11	3	2	5	8	6
Busycon spiratum			1	1	1				1	
Pecten raveneli			3		1		3		5	
CNIDARIAN										
Virgularia presbytes					1			2		
ASCIDIAN (LPIL)*	1		3	3					1	

*LPIL - Lowest Practicable Identification Level

PENSACOLA OFFSHORE DISPOSAL SITES
INVERTEBRATE SPECIES LIST - SITE C

INVERTEBRATE TAXA	STA. C-1	STA. C-2	STA. C-3	STA. C-4	STA. C-5	STA. C-6	STA. C-7	STA. C-8	STA. C-9	STA. C-10
CRUSTACEA										
Sicyonia brevirostris	25		1	10		2		2		1
Solenocera atlantidis	20			12						
Trachypenaeus constrictus	1									
Leptochela papulata						52				
Ovalipes floridanus		1								
ECHINODERMS										
Luidia clathrata		1		3	1				2	1
Astropecten duplicatus		1	2		2	1	5			2
Echinaster sp.			1							
Encope michelini							1			1
Clypeaster prostratus										2
MOLLUSCS										
Loligo pealeii	553	1	243	934	40	13	5	92	17	5
Octopus vulgaris	1									
Pleurobranchaea hedgpethi	5	1							1	
Busycon spiratum	1	1								
Argopecten gibbus				5						
Pecten raveneli				1						
Laevicardium laevigatum			1							
Stenoplax sp.							1			
ASCIDIAN (LPIL)*						1	1			

*LPIL - Lowest Practicable Identification Level

APPENDIX G

SITE MONITORING PLAN

PENSACOLA (OFFSHORE) ODMDS

APPENDIX G

SITE MONITORING PLAN

PENSACOLA (OFFSHORE) ODMDS

Introduction. 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. Section 228.10(b) states that in addition to other necessary or appropriate considerations, the following types of effects will be considered in determining to what extent the marine environment has been impacted by materials disposed at an ocean site:

(1) Movement of materials into estuaries or marine sanctuaries, or onto oceanfront beaches, or shorelines;
(2) Movement of materials toward productive fishery or shellfishery areas;
(3) Absence from the disposal site of pollution-sensitive biota characteristic of the general area;
(4) Progressive, non-seasonal, changes in water quality or sediment composition at the disposal site, when these changes are attributable to materials disposed of at the site;
(5) Progressive, non-seasonal, changes in composition or numbers of pelagic, demersal, or benthic biota at or near the disposal site, when these changes can be attributed to the effects of materials disposed of at the site; and
(6) Accumulation of material constituents (including without limitation, human pathogens) in marine biota at or near the site.

Part 228.10(c) states: "The determination of the overall severity of disposal at the site on the marine environment, including without limitation, the disposal site and adjacent areas, will be based on the evaluation of the entire body of pertinent data using appropriate methods of data analysis for the quantity and type of data available. Impacts will be categorized according to the overall condition of the environment of the disposal site and adjacent areas based on the determination by the EPA management authority assessing the nature and extent of the effects identified in paragraph (b) of this section in addition to other necessary or appropriate considerations."

The results surveys conducted during the site designation phase in November 1986 and February/April 1987 will serve as the main body of baseline data for the monitoring of the impacts associated with the initial disposal into the Pensacola (Offshore) ODMDS (See Appendices A, C, D, E, and F). The monitoring program proposed for the area addresses possible changes in bathymetric, sedimentological, chemical, and biological aspects of the ODMDS and surrounding areas as a result of the disposal of dredged material into the site. In addition, information will be collected during the disposal operation which will be utilized to verify the results of the DIFID model. The ODMDS will be monitored once during the first year following its initial use. Sedimentological investigations will be initiated shortly after disposal. However, biological sampling will be delayed until later in the year to avoid bias from the short term impacts of dredged material disposal. Future monitoring requirements will be determined based on the results of the first year's monitoring. The proposed monitoring plan is discussed in the following paragraphs.

<u>During Disposal Monitoring</u>. The initial disposal operation is estimated to require approximately 4 months to complete. During this time the dredging contractor will be required to prepare and operate under an approved electronic verification plan for all disposal operations. As part of this plan the contractor will provide an automated system that will continuously track the horizontal location and draft condition (vertical) of the disposal vessel from the point of dredging to the disposal area, and return to the point of dredging. Digital data required is as follows:

(a) Date:

(b) Time:

(c) Vessel Name:

(d) Captain of Vessel:

(e) Number of Scows in tow and distance from vessel or other vessel used:

(f) Vessel position, every five (5) minutes (time recorded) when within the channel limits, every two (2) minutes between the dredging area and the disposal area, and every thirty (30) seconds when within the disposal area limits, and similar intervals on the return of vessel and scow(s) to the dredging area:

(g) Dredge scow draft, coincidental measurement with "f" above.

The Contractor 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 to the daily and monthly report of operations, the Contractor will be required to perform bathymetric surveys of the disposal area. Surveys will be required "before" disposal begins, subsequent to the disposal of one (1), two (2), and three (3) million cubic yards, and "after" the disposal operation is completed for a total of five (5) surveys. "Before" and "after" condition surveys will be taken within a fifteen (15) day time period prior to commencement of disposal operations and immediately following completion of all disposal operations. These surveys will be taken along lines spaced on 200-foot intervals and be of sufficient length of adequately cover the disposal area. Accuracy of the surveys will be ±1.0 feet. These surveys will be referenced to MLLW and corrected for tide conditions at the time of survey.

Other data collected during the disposal operation will be utilized to verify the DIFID model which was used to simulate the disposal of dredged material from a dump scow. Data to be collected would include: total suspended solids concentration within the dredged material plume and within the ambient water column, composition of material being dumped, salinity/density of ambient water, and current speed and direction.

After Disposal Monitoring. A number of data collection techniques will be employed to determine the level of impact associated with the disposal of approximately 4.1 million cubic yards of predominately fine-grained material at the ODMDS. Each of these techniques is described in detail below. It should be noted that some of these monitoring techniques will occur shortly after disposal is completed, while others are planned at longer time intervals to avoid bias from the short-term impacts associated with disposal of dredged material. The monitoring program is designed to be somewhat flexible to take advantage of information gained through earlier monitoring efforts.

Sediment Characterization. A detailed characterization of the sediments of the ODMDS and adjacent area will be performed utilizing gamma spectrometry and x-ray fluorescence (XRF) analysis. The initial characterization will be performed just prior to disposal to establish a baseline of elemental composition of the native sediment. Data obtained during this survey will 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 will be performed to obtain a new characterization of sediments with the dredged material in place. Comparison of pre-disposal and post-disposal elemental characterizations will be utilized to determine the distribution of disposed dredged material. Prior to the bottom sampling, a third characterization will be performed to aid in station selection.

Bottom Sampling. Bottom sampling will include sampling for benthic macroinvertebrates, sediment chemistry and sediment particle size. These areas are discussed in the following paragraphs and the baseline sample stations are shown on Figure G-1. The first post disposal bottom sampling will be scheduled for approximately 6 months after the disposal operation has been completed, additional monitoring periods will be established on an as needed basis. Sampling should be scheduled to occur during the same months as the baseline survey, i.e. November and/or April, so that comparisons can be made on a temporal (seasonal) as well as a spatial basis.

Benthic Macroinvertebrates. At a minimum, 11 stations will be sampled for benthic macroinvertebrates. The final number and location of stations and the designation of certain stations as reference stations (i.e., areas known to be outside of dredged material influence) will be determined based on sediment characterization studies. 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. 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.

Sediment Chemistry. Sediment will 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 will include a metals scan, pesticides, chlorinated hydrocarbons, oil and grease, and nutrients (NH_3, NO_2+NO_3-N, TKN). Sampling for sediment chemistry will be adjusted as necessary depending on the results of the initial survey.

Sediment Particle Size. Samples will 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.

Water Quality Sampling. Water quality will be sampled at each of the above stations. Water quality sampling will 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 will be collected at surface, mid-depth, and bottom at each sampling station for nutrient analysis.

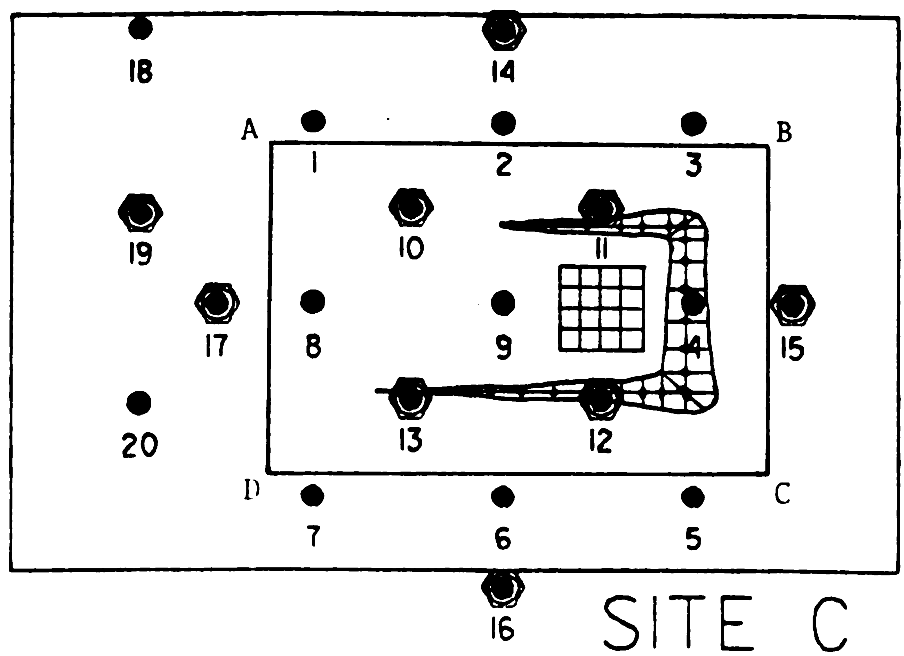
Demersal Fishes. Demersal fishes will be collected along transects established within the ODMDS and the area adjacent to the ODMDS using a 40-foot otter trawl equipped with a 0.25 inch mesh liner. A minimum of four (4) transects will be established in each area. Trawl times will be standardized at 20 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.

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 Pensacola (offshore) ODMDS. Close coordination between the EPA, COE, Navy, and the State of Florida 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 and the verification of the disposal model.

PROPOSED ODMDS

A = 30° 08' 50"N 87° 19' 30"W
B = 30° 08' 50"N 87° 16' 30"W
C = 30° 07' 05"N 87° 16' 30"W
D = 30° 07' 05"N 87° 19' 30"W

0 2
STATUTE MILES



SEDIMENT SIZE, CHEMICAL, BIOLOGICAL, STILL PHOTOGRAPHS

SEDIMENT ORGANICS

WATER QUALITY

FIGURE G-1
SITE C
SAMPLING STATIONS

APPENDIX H

DIFID

(DISPOSAL FROM AN INSTANTANEOUS DUMP)

MODEL RESULTS

U.S. ARMY ENGINEER DISTRICT MOBILE

AND

U.S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION

AUGUST 1988

APPENDIX H

DIFID

(DISPOSAL FROM AN INSTANTANEOUS DUMP)

MODEL RESULTS

1. Introduction. Disposal of dredged material from a dump scow at the Pensacola offshore ODMDS was modeled using the Disposal From An Instantaneous Dump (DIFID) model. This program is the result of modifications made in the 1980's to the Dredged Material Fate (DMF) model (Johnson 1987). DMF model was originally developed by Brandsma and Divoky in 1976 for the U. S. Army Corps of Engineers Waterways Experiment Station (WES). Much of the basis for this model came from earlier model development for barged disposal of wastes in the ocean that was funded by the U. S. Environmental Protection Agency (EPA) (Koh and Chang 1973). DIFID can be used to estimate concentrations of solids in the water column as well as the initial deposition of dredged material on the bottom. Major factors affecting the concentration and short-term location of the dredged material are the disposal site environment, composition of the dredged material and the method of disposal.

The model treats the behavior of the disposed material as three separate phases: convective descent, dynamic collapse, and passive transport-diffusion. During convective descent, a single cloud of hemispherical shape is assumed to be instantaneously released. This cloud falls through the water column under the influence of gravity. Because the solids concentration in the dredged material is low, the cloud is expected to behave as a dense liquid and therefore a buoyant thermal analysis is utilized. The equations governing the motion of the cloud during this phase are those for conservation of mass, momentum, buoyancy, solid particles, and vorticity. During convective descent, the dumped material cloud grows as a result of entrainment, advection, and turbulent diffusion. The entrainment coefficient associated with the entrainment of ambient fluid into the descending hemispherical cloud is assumed to vary smoothly between its value for a vortex ring and the value for turbulent thermals. Model results, therefore, are quite sensitive to the entrainment coefficient, which in turn is dependent upon the material being dumped.

The dynamic collapse phase commences when the leading edge of the descending cloud comes into contact with the bottom or arrives at a level of neutral buoyancy where vertical motion is retarded and horizontal spreading dominates. During this phase the basic shape assumed for the collapsing cloud is a general ellipsoid. With the exception of the vorticity, which is assumed to have been dissipated by the water column, the same conservation equations used in convective descent, but written for an ellipsoid, are applicable. In addition, a frictional force between the bottom and the collapsing cloud is included which accounts for energy dissipation as a result of the radial spreading as well as movement of the cloud centroid. During collapse, solid particles can settle as a result of their fall velocities. As these particles leave the main body of the cloud, they are stored in small clouds that are characterized by a uniform concentration, thickness and position in the water column, i.e. the particles are not allowed to settle to the bottom.

The passive transport-dispersion phase commences when the rate of spreading in the dynamic collapse phase becomes less than the estimated rate of spreading due to turbulent diffusion in both the horizontal and vertical directions. Only during the passive transport-dispersion phase is the material, which was previously 'stored' in small clouds, actually allowed to settle on the bottom. In addition to the deposition of material on the bottom and the advection or transport of the cloud during this phase, the cloud grows both horizontally and vertically as a result of turbulent diffusion.

At the end of the convective descent phase, the location of the cloud centroid, the velocity of the cloud centroid, the radius of the hemispherical cloud, the density difference between the cloud and the ambient water, and the total volume and concentration of each solid fraction are provided as functions of time since release of the material. At the conclusion of the collapse phase, time-dependent information concerning the size of the collapsing cloud, its density, and its centroid location and velocity , and solids concentrations are provided. Output from the transport-diffusion phase can be requested at specified times. Output includes suspended sediment concentrations, at specified depths, solids deposited on the bottom, and the volume of each sediment fraction that has been deposited in each grid cell. At the conclusion of the simulation, a void ratio specified through input data is used to compute the thickness of the deposited material in each grid cell. The reader should refer to the User's Guide For Models of Dredged Material Disposal in Open Water (Johnson 1987) for a more complete explanation of DIFID and other related models.

2. Limitations. 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 since the model assumes an instantaneous dump that falls as a hemispherical cloud. In addition, the material is expected to behave as a dense liquid, i.e., primarily fine-grained material. The model should not be applied to the disposal of purely sandy material.

The model requires that the dredged material be divided into various solids fractions with a settling velocity specified for each fraction. A significant portion of the dredged material may fall as 'clumps', especially if a mechanical dredge is used or consolidated clays are hydraulically dredged. Significant consolidation can also take place in the vessel during transit to the disposal site. Thus, specification of the 'clump' fraction is rather subjective and prevents a quantitative interpretation of model results.

The major limitation of DIFID is the assumption that once solid particles are deposited on the bottom, they remain there. Thus, the model should only be applied over time frames where erosion of the material is expected to be insignificant. The reader should refer to Johnson (1987) for a more complete discussion of the model's limitations.

3. Input Data. Input data as required by the model can be grouped into four categories: (a) description of the disposal site environment, (b) characteristics of the dredged material, (c) data related to the disposal operation, and (d) model coefficients.

(a) The model requires input relative to the physical and chemical nature of the disposal site. Data utilized in the modeling effort at Pensacola included:

1. Depth - one scenario was run:
   (a) 75-foot constant depth

2. Ambient water density - a constant density of 1.023 gm/cc with depth

3. Currents - four scenarios were run:
   (a) a 0.3 fps current towards west, constant with depth
   (b) a 1.0 fps current towards west, constant with depth
   (c) a 2.54 fps current towards northeast, constant with depth
   (d) still water.

(b) Input data describing the nature of the dredged material include:

1. Percent of volume occupied by solids - 70%

2. Composition of solid fraction - three scenarios were run:
   (a) 58% sand and 42% silt/clay
   (b) 5% sand and 95% silt/clay
   (c) 70% sand, 22.5% silt/clay in the form of 'clumps', and 7.5% silt/clay

3. Fall velocity of each solid fraction:
   (a) sand - 0.0466 fps
   (b) silt/clay clumps - 1.2 fps
   (c) silt/clay - 0.00256 fps

4. Voids ratio for each solid fraction (used in determining bulking factor):
   (a) sand - 0
   (b) silt/clay clumps - 0.5
   (c) silt/clay - 1.0

(c) Data related to the disposal operation included:

1. Position of the barge or scow on the horizontal grid

2. Vessel dimensions - 236 feet x 53 feet x 21 feet

3. Velocity of the vessel - 2 knots

4. Unloaded draft of the disposal vessel - 3 feet 11 inches

5. Loaded draft of the disposal vessel - 19 feet 8 inches

6. Volume of material to be dumped - 4,000 cubic yards (2800 cubic yards of solid material per dump based on 70% solids)

7. Scow opening width - 12 feet

8. Time required to empty scow - 3 to 5 seconds

(d) The DIFID model program contains default values for the 13 coefficients necessary to model an instantaneous dump. Johnson and Holliday (1978) have shown that model results appear to be fairly insensitive to many of these coefficients. Six of the 13 have been shown to be important in the instantaneous dump program:

1. ALPHA0 is the entrainment coefficient for a turbulent thermal. This coefficient is dependent upon the material being dumped; i.e. the higher the moisture content, the larger the value of the entrainment coefficient. Default value = 0.235.

2. CD is the drag coefficient for a sphere in the range of Reynolds numbers expected. Default value = 0.50.

3. CDRAG is the drag coefficient for an elliptic cylinder edge on to the flow. Default value = 1.0

4. FRICTN is a bottom friction coefficient. Default value = 0.10.

5. AKYO is the vertical diffusion coefficient in a well mixed water body. Default value = 0.05.

6. ALPHAC is the coefficient for entrainment due to cloud collapse. Default value = 0.001.

4. Model Output. During the convective descent and dynamic collapse phases, output from the program includes the time history of position in the water column, velocity, and size of the cloud. In addition, the volume of the solids and the corresponding concentrations, as well as the density difference between the discharged material and the ambient water is provided.

During collapse, solid particles can settle as a result of their fall velocity. As these particles leave the main body of material, they are stored in small clouds that are characterized by a uniform concentration, thickness, and position in the water column. These small clouds are then allowed to settle and disperse until they become large enough to be inserted into the long-term, two-dimensional passive dispersion grid positioned in the horizontal plane. Once small clouds are inserted at particular net points, those net points then have a concentration, thickness, and top position associated with them. This is the manner in which the three-dimensional nature of the problem is handled on a two-dimensional grid. The output, therefore, during the passive dispersion-transport phase, consists of the concentration, position of the top and thickness of each suspended solids profile at each net point of the horizontal grid at the specified time step. In addition, at each net point the amount and thickness of deposited solids on the bottom are also provided as functions of time (Johnson and Holliday 1978).

5. Sensitivity Analysis. Because the model has been shown to be sensitive to the values utilized for the coefficients listed above, a series of sensitivity runs, as suggested in Johnson and Holliday (1978) were made in which the value of one coefficient was changed, with all others held constant at the default values suggested in Brandsma and Divoky (1976). Results of these runs (see Table H-1) indicated that using the default values provided the most conservative estimate for both period of time to collapse and concentration of solids remaining in the water column. In light of these results, the default values were used for all subsequent model runs.

6. Model Applications. The results of all of the model simulations indicated that 100 % of the sand and silt/clay clumps fell to the bottom within less than 100 seconds of the beginning of the disposal operation (i.e., opening of the scow). In addition, this material fell directly beneath the barge, regardless of the input velocity data. The sand material tended to spread over a larger area than the silt/clay clumps which tended to 'stack' higher. Under typical conditions, currents of 0.3 fps towards west, sands tend to fall within a 1000- x 1000-foot area; silt/clay in the form of clumps, tends to fall within a 600- x 600-foot area. Figure H-1 is a representation of output at 45 minutes for a material composition of 5 % sand and 95 % silt/clay and a velocity of 2.54 fps towards the northeast.

The non-cohesive silt and clays, which represent approximately 300,000 cubic yards of the total 4.1 million to be disposed, do not behave in the same manner as the sand or clumped silt/clay. As shown on Table H-2, a large percentage of these particles tend to remain suspended in the water column after disposal and are therefore transported away from the dump location by the currents. The actual percentage of silt/clay which is deposited on the bottom and 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. Under extreme conditions, i.e. a dump load that is almost 100 percent non-cohesive silt/clay or ambient velocities of 1 fps or greater, the results in Table H-2 indicate that a significant percentage of the silt/clay will not be deposited on the bottom. Also under these extreme conditions some of this material will be transported outside the defined boundaries of the ODMDS. In this case, however, the concentration of material within the water column has been diluted significantly.

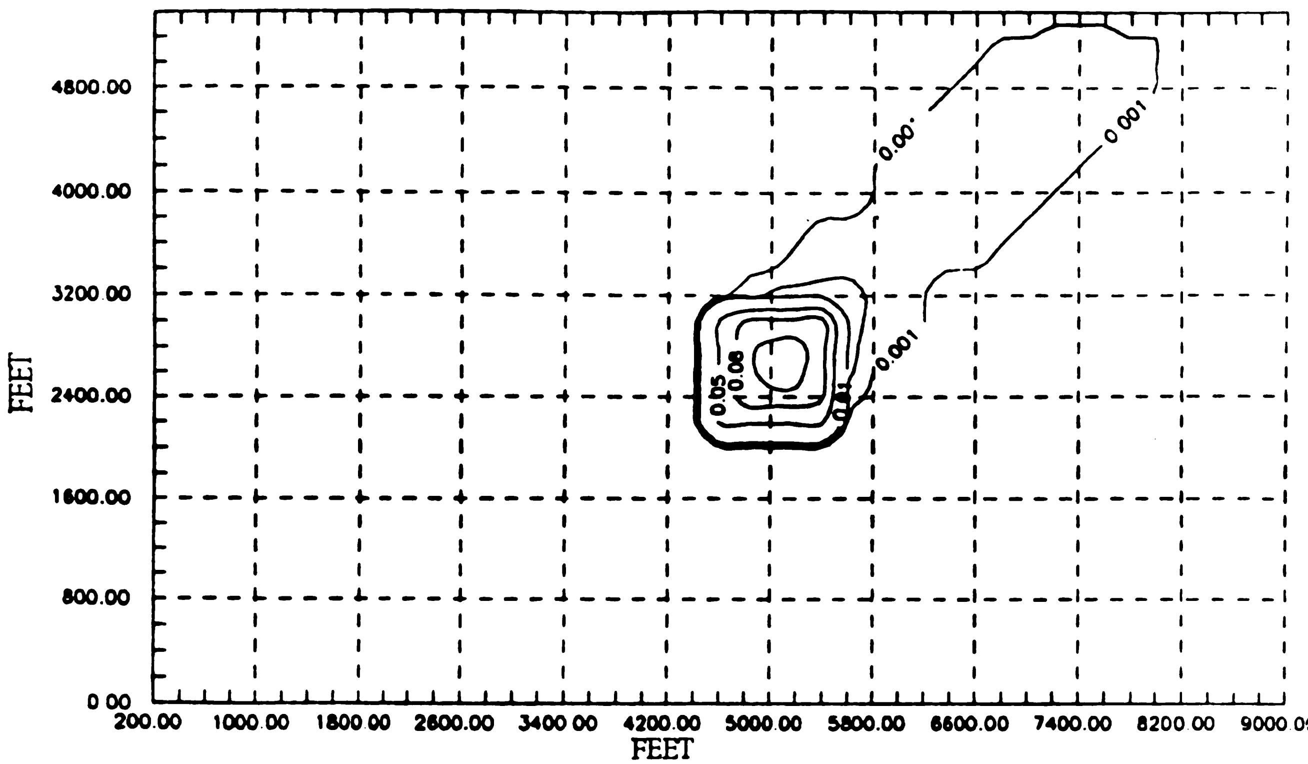
Coefficient	T Conv	V Conv	R Conv	T Coll	A	X	B	% of Solids on Bottom After 2700 Sec	Area of Cloud After 2700 Sec (X 10000)	Max Conc of Cloud @ 10' After 2700 (X 0.00001)
Default Values	202	178	533	6290	054		984	7400	130	29
ALPHA 0 - 120	198	218	476	4850	0.48	X	858	7780	103	27
ALPHA 0 - 235	202	178	533	6290	054	X	984	7400	130	29
ALPHA 0 - 300	207	163	56	6980	0.57	X	1043	7510	143	26
CD - 075	202	184	535	6280	054	X	984	7400	130	29
CD - 050	202	178	533	6290	054	X	984	7400	130	29
CD - 200	202	151	514	6350	054	X	986	7410	130	29
CDRAG - 05	202	178	533	3220	054	X	1006	7720	135	24
CDRAG - 10	202	178	533	6290	054	X	984	7400	130	29
CDRAG - 20	202	178	533	15370	054	X	1020	7410	130	29
ALPHAC - 0005	202	178	533	6290	054	X	983	7410	129	29
ALPHAC - 0010	202	178	533	6290	054	X	984	7400	130	29
ALPHAC - 0050	202	178	533	6470	054	X	1006	7560	135	26
FRICTN - 005	202	178	533	6200	054	X	987	7580	130	27
FRICTN - 010	202	178	533	6290	054	X	984	7400	130	29
FRICTN - 100	202	178	533	7330	079	X	811	7320	93	35
AKYO - 01	202	178	533	6290	054	X	984	7600	130	26
AKYO - 05	202	178	533	6290	054	X	984	7400	130	29
AKYO - 10	202	178	533	6290	054	X	984	7360	130	29
AKYO - 005	202	178	533	6290	054	X	985	7760	130	25

Coefficient	% of Solids on Bottom After 5400 Sec	Area of Cloud After 5400 Sec (X 10000)	Max Conc of Cloud @ 10' After 5400 Sec (X 0.00001)	% of Solids on Bottom After 8100 Sec	Area of Cloud After 8100 Sec (X 10000)	Max Conc of Cloud @ 10' After 8100 Sec (X 0.00001)	% of Solids on Bottom After 10800 Sec	Area of Cloud After 10800 Sec (X 10000)	Max Conc of Cloud @ 10 After 10800 Sec (X 0.00001)
Default Values	7630	205	06	7840	306	02	8030	431	01
ALPHA 0 - 120	7980	169	06	8160	257	02	8320	373	01
ALPHA 0 - 235	7630	205	06	7840	306	02	8030	434	01
ALPHA 0 - 300	7730	223	06	7930	329	02	8110	463	01
CD - 075	7630	205	06	7830	306	02	8030	434	01
CD - 050	7630	205	06	7840	306	02	8030	434	01
CD - 200	7640	206	06	7850	306	02	8040	435	01
CDRAG - 05	7930	212	05	8110	315	02	8280	446	01
CDRAG - 10	7630	205	06	7840	306	02	8030	434	01
CDRAG - 20	7640	206	06	7850	306	02	8040	435	01
ALPHAC - 0005	7630	205	06	7840	305	02	8030	433	01
ALPHAC - 0010	7630	205	06	7840	306	02	8030	434	01
ALPHAC - 0050	7770	212	06	7970	314	02	8150	445	01
FRICTN - 005	7790	205	06	7990	306	02	8160	434	01
FRICTN - 010	7630	205	06	7840	306	02	8030	434	01
FRICTN - 100	7560	155	07	7770	239	02	7970	350	01
AKYO - 01	7810	205	06	8000	306	02	8180	434	01
AKYO - 05	7630	205	06	7840	306	02	8030	434	01
AKYO - 10	7590	205	06	7810	306	02	8000	434	01
AKYO - 005	7950	206	06	8130	306	02	8300	435	01

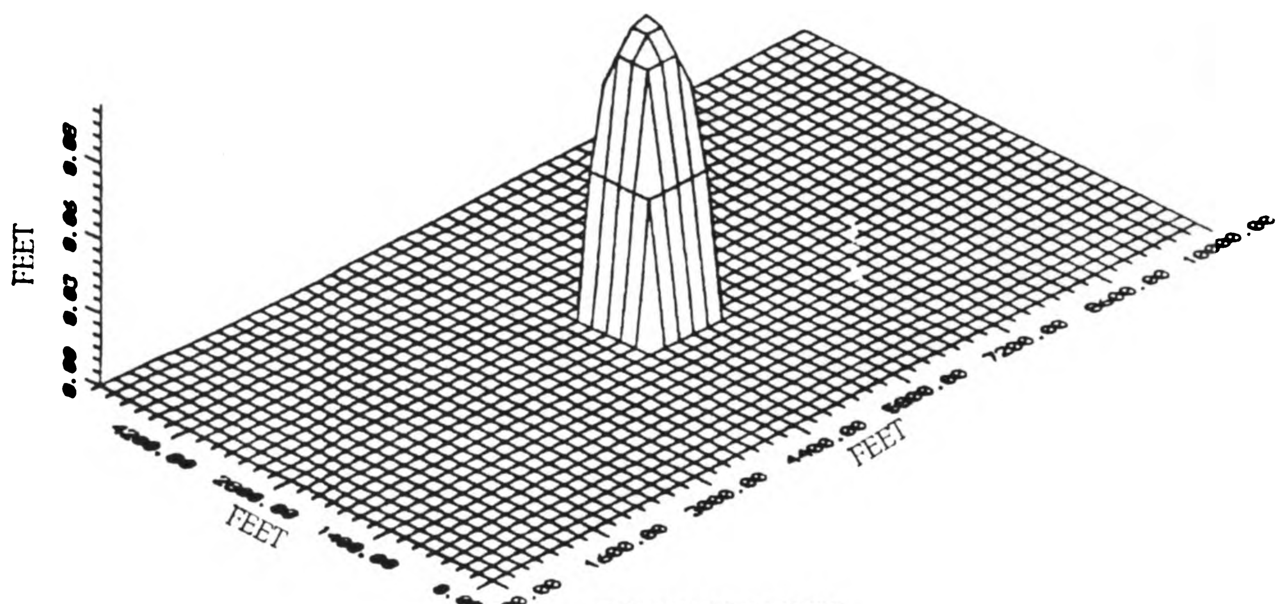
Table H-1. Results of sensitivity analysis of DIFID model coefficients.

Table H-2. Results from Selected DIFID Model Simulations for Pensacola (Offshore) ODMDS.

Velocity (fps)	Material Composition	Time (Min)	Max. Conc. 60' Depth (PPM)	Area with Conc. ≥10 PPM @ 60' (ac)	Percent Silt/ Clay on Bottom	Max. Conc. @ Dump Point @ 60' (PPM)
0.0	58/42	45	39.0	170	37	39.0
		90	8.6	0	43	8.6
		135	3.0	0	48	3.0
		180	1.3	0	53	1.3
0.0	95/5	45	77.0	269	43	77.0
		90	17.0	298	48	17.0
		135	6.1	0	52	6.1
		180	2.7	0	56	2.7
0.3	95/5	45	77.0	269	43	54.0
		90	17.0	298	48	6.6
		135	6.1	0	52	4.5
		180	2.7	0	56	2.1
0.3	58/42	45	38.0	170	37	27.0
		90	8.5	0	43	6.0
		135	3.0	0	48	2.2
		180	1.3	0	53	1.0
0.3	70/22.5/7.5	45	5.8	0	49	4.0
		90	1.2	0	54	0.9
		135	0.4	0	58	0.3
		180	0.1	0	62	0.2
1.0	95/5	45	76.0	279	42	17.0
		90	17.0	301	47	3.0
		135	6.2	0	52	0.2
		180	2.7	0	56	0.1
1.0	58/42	45	36.0	162	41	0.6
		90	8.1	0	47	0.2
		135	2.8	0	51	0.1
		180	1.2	0	56	0.1
1.0	70/22.5/7.5	45	8.0	0	36	0.1
		90	1.7	0	42	0.0
		135	0.6	0	47	0.0
		180	0.2	0	51	0.0
2.54	95/5	45	76.0	269	42	0.0



BOTTOM DEPOSITS
SCALE AS SHOWN



BOTTOM DEPOSITS
SCALE AS SHOWN

FIGURE H-1
BOTTOM DEPOSITS

APPENDIX I

PENSACOLA (OFFSHORE) ODMDS

MANAGEMENT PLAN

APPENDIX I

PENSACOLA (OFFSHORE) ODMDS

MANAGEMENT PLAN

1. Introduction. The purpose of the ODMDS Management Plan is to describe how the ODMDS will be managed for both the initial use of the site and for any future use. It will also describe how the Monitoring Plan presented in Appendix G will be used to modify management practices, if necessary.

2. Initial Use of ODMDS. Approximately 3 million of the 4.1 million cubic yards of dredged material initially proposed for disposal is sand or cohesive material that will form clumps. Numerical model results discussed in Appendix H, indicate that all of this material will reach the bottom within 100 seconds and within a few feet of the discharge point. The proposed plan is to use this material to create an underwater berm that will be used to partially contain the remaining 1.1 million cubic yards of dredged material. This should reduce the area of bottom impacted by the less desirable material from the new Navy turning basin. The 1.1 million cubic yards is approximately 40 percent sand and 60 percent silt/clay. Approximately 50 percent of the silt/clay is expected to form clumps. The berm will also provide some protection to reduce movement of this material by the currents. The berm will be constructed from the shallower water in the western section of the ODMDS along two alignments. The northern alignment will be constructed from approximately the -70-foot NGVD contour on the west along the 30° 08' 28"N latitude to 87° 17' 00"W longitude. The southern alignment will be constructed from approximately the -70-foot NGVD contour on the west along the 30° 07' 28"N latitude to 87° 17' 00"W longitude. These two alignments will be connected along the 87° 17' 00"W longitude. The berm will be constructed to an elevation of approximately -70 feet NGVD. Once the underwater berm has been completed, the remaining 1.1 million cubic yards of material to be dredged from the new Navy turning basin will be dumped within a one-half mile square area defined by the following coordinates:

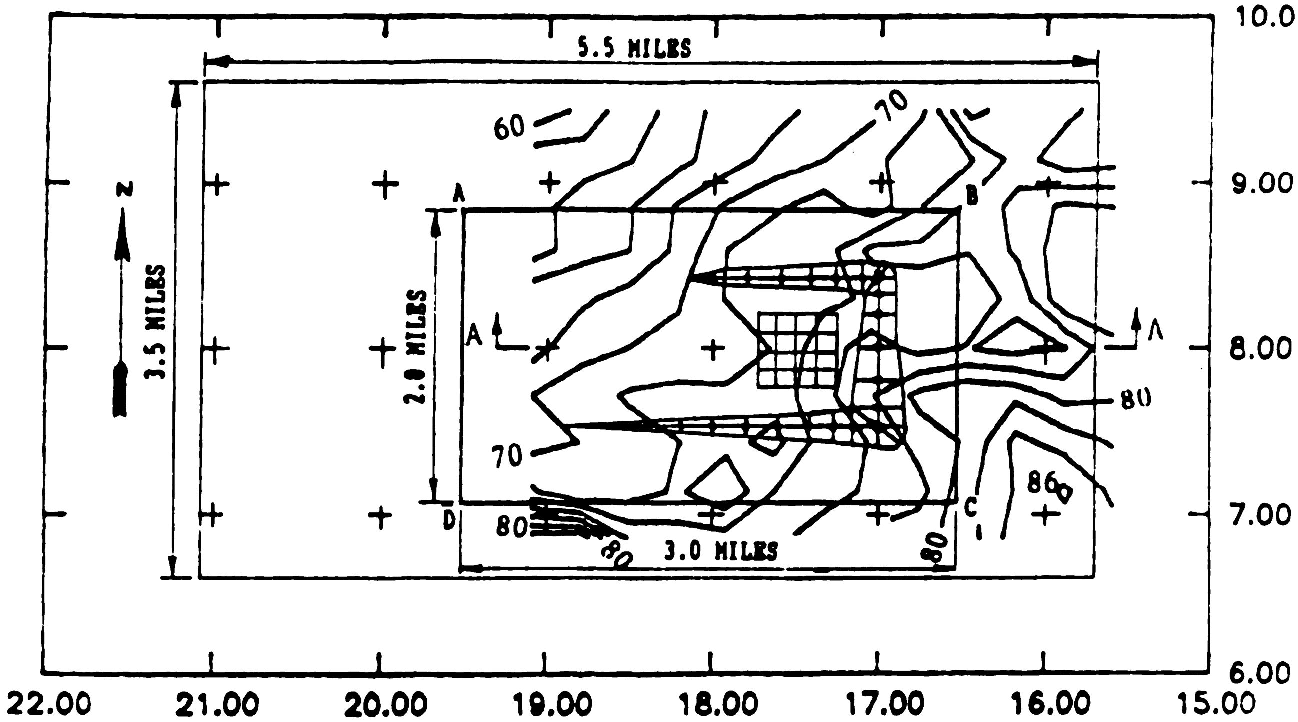
30° 08' 13"N	87° 17' 45"W
30° 08' 13"N	87° 17' 15"W
30° 07' 43"N	87° 17' 15"W
30° 07' 43"N	87° 17' 45"W

The one-half mile square area will be divided into sixteen equal cells (660 x 660 feet) and a specified quantity of material will be discharged into each cell. The amount of material to be placed in a given cell will be based on depth, with the deeper cells receiving proportionately higher quantities. The proposed disposal plan is shown on Figure I-1.

3. Future Use of ODMDS. The Pensacola (offshore) ODMDS is restricted to the disposal of predominately fine-grained dredged material that meets the Ocean Dumping Criteria, but is not suitable for beach nourishment or disposal in the existing Pensacola (nearshore) ODMDS. Additional Section 103 permit review will be required prior to use of the ODMDS for any dredged material other than the initial 4.1 million cubic yards proposed for disposal. Additional dredged material testing and NEPA documentation may also be required. Any future disposal plans would depend upon these considerations and the need for site use, as well as the quantity and composition of the material and frequency of the proposed discharges.

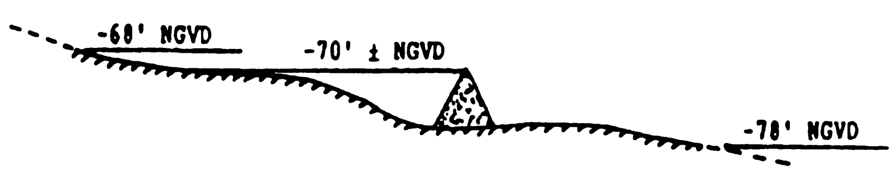
Any future discharges of predominately fine-grained dredged material will be placed in the same one-half mile square area defined above and shown on Figure I-1, unless site monitoring identifies a need to modify this plan. The quantity and composition of the material proposed for discharge should also be considered and the plan modified, if necessary.

4. Modification of ODMDS Management Plan. A need for modification of the ODMDS Management Plan is not anticipated. The proposed ODMDS monitoring plan presented in Appendix G is designed to identify any unanticipated impacts that would require modification of the Management Plan. Monitoring data collected by the EPA will be provided to the State of Florida, U.S. Navy and the U.S. Army Corps of Engineers.



NEW OCEAN DREDGED MATERIAL DISPOSAL SITE
SCALE: As Shown

A = 30° 08' 50"N 87° 19' 30"W
B = 30° 08' 50"N 87° 16' 30"W
C = 30° 07' 05"N 87° 16' 30"W
D = 30° 07' 05"N 87° 19' 30"W



SECTION A - A
VERTICAL SCALE: 1" = 20'
HORIZONTAL SCALE: 1" = 5,280'

FIGURE I - 1

PROPOSED ODMDS

APPENDIX J

CONSISTENCY STATEMENT

FOR THE

FLORIDA COASTAL ZONE MANAGEMENT PROGRAM

THE U.S. ENVIRONMENTAL PROTECTION AGENCY

CONSISTENCY STATEMENT

FOR THE

FLORIDA COASTAL ZONE MANAGEMENT PROGRAM

DESIGNATION OF A NEW

PENSACOLA OCEAN DREDGED MATERIAL DISPOSAL SITE

OFFSHORE PENSACOLA, FLORIDA

Submitted by:

U.S. Environmental Protection Agency/Region IV

September 1988

I. INTRODUCTION

The U.S. Navy is proposing to establish a new homeport for the USS Kitty Hawk at Naval Air Station (NAS), Pensacola, Florida. The USS Lexington, currently based at Pensacola, will be moved to Corpus Christi, Texas, as part of the overall Gulf Homeport action. The proposed project will require deepening the existing channel to NAS, Pensacola.

In response to this anticipated need for ocean disposal of dredged material, the U.S. Environmental Protection Agency (EPA), in cooperation with the Army Corps of Engineers (Corps) and the U.S. Navy, has prepared a Draft Environmental Impact Statement (DEIS) and a Final Environmental Impact Statement (FEIS) entitled "Designation of a New Ocean Dredged Material Disposal Site, Pensacola, Florida." This EIS evaluates environmental factors, assesses alternative dumping sites, and reports the field surveys for the designation of a new offshore Ocean Dredged Material Disposal Site (ODMDS) in the Pensacola area, i.e., the Pensacola (offshore) ODMDS. Additionally, as part of the EIS, 11 environmental site selection criteria are evaluated for all potential sites in accordance with 40 CFR 228.6 (Ocean Dumping Regulations).

The DEIS-preferred site (Site "C"), which encompasses the actual Pensacola (offshore) ODMDS, is located outside of State waters offshore of Pensacola, Florida, approximately 11 miles from the nearest beach, with the exception of a small portion of the site located inside of State waters. The actual ODMDS within Site "C" selected in the FEIS is located entirely outside of State waters. The Pensacola (offshore) ODMDS is considerably more offshore than the existing EPA-designated Pensacola (nearshore) ODMDS, which is located approximately three miles from the nearest beach. The boundary coordinates for the Pensacola (offshore) ODMDS are:

30° 08' 50"N	87° 19' 30"W
30° 08' 50"N	87° 16' 30"W
30° 07' 05"N	87° 16' 30"W
30° 07' 05"N	87° 19' 30"W

This site covers an area of approximately 6 square miles (2 mile x 3 mile site). The final size of the ODMDS within Site "C" was determined by utilizing the results of a numerical dispersion model run by the Corps Coastal Engineering Research Center.

The material initially to be dumped at the site is to be dredged from the Pensacola Navy Channel and the Pensacola Harbor Ship Channel. Materials will be dredged and dumped by hopper dredges, hopper barges or dump scows. Dredging, based on Navy interpretation, is in the best interest of the United States to provide a better mix of ships in traditional ports as well as new homeporting actions. Homeporting of the USS Kitty Hawk at Pensacola requires dredging the Pensacola Navy Channel deeper to allow access of the larger aircraft carrier. Materials being dredged from the channel include fine-grained material, material not suitable for beach nourishment, and/or material not suitable for disposal at the existing, designated Pensacola (nearshore) ODMDS.

Thirty-six percent of the 4.1 million cubic yards of dredged material expected to be dredged initially will be fine-grained clays and silts (page 5-3 of DEIS). Suitable dredged materials from the Pensacola Harbor Ship Channel and from other dredging projects within the Pensacola Bay area may also be disposed at the Pensacola (offshore) ODMDS in the future. For the anticipated Navy project and projects in the future, the Pensacola (offshore) ODMDS is restricted to disposal of predominantly fine-grained dredged material that meets the Ocean Dumping Criteria but is not suitable for beach nourishment or disposal in the existing, designated Pensacola (nearshore) ODMDS. The Pensacola (nearshore) ODMDS is restricted to suitable dredged material with a median grain size >0.125 mm and a composition of <10% fines.

This consistency statement is only relevant for the area within the above coordinates. EPA final designation of an ODMDS is made based on the assessment of the 11 site selection criteria considered in the referenced DEIS (see pages 5-1 through 5-9 of the DEIS). EPA final designation, by itself, does not authorize any dredging or on-site disposal of dredged material. The need for disposal use of the ODMDS must be considered at the project level, where options to ocean disposal, such as upland disposal and beach nourishment alternatives, should be considered when relevant. Before any disposal can occur at the designated ODMDS, the disposal project must comply with the Ocean Dumping Criteria and Corps permitting regulations and any applicable requirements governing consistency with the State's Coastal Zone Management Program. Use of the site is not limited to Federal projects; it can also be utilized for disposal by private applicants if the dredged material is determined suitable and permitting requirements are satisfied. Analysis of the dredged material and monitoring of the dump site will be conducted through the permitting and review process.

II. The Florida Coastal Zone Management Program (FCZMP)

There are nine statutes within the FCZMP relating to ocean dumping activities. This consistency statement discusses how the final designation of the Pensacola (offshore) ODMDS will meet the FCZMP objectives to protect coastal resources while allowing multiple use of coastal areas.

A. Chapter 161: Beach and Shore Preservation

The primary intent of Chapter 161 is the protection of the thousands of miles of Florida's coastline by regulating construction activities near and within these valuable resource areas. Ocean dumping activities at the proposed ODMDS should have no adverse effects on coastal resources since Site "C" is located some 8-11 miles south of the beaches and shore-related amenities of Santa Rosa Island, Perdido Key, Gulf Islands National Seashore, Fort Pickens, and the Fort Pickens State Park and Aquatic Preserve. If designated, it is anticipated that the Pensacola (offshore) ODMDS will be used for disposal of both new and maintenance material dredged from the Pensacola Bay area which meet the criteria specified in Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972, as amended. Data in the DEIS indicate that the currents in the site area are primarily wind-driven and parallel to the shoreline. These currents are, therefore, not expected to transport any of the dredged material to the beaches or shoreline. Site monitoring will detect movement of this nature (see pages 5-7 through 5-9 of the DEIS). Also, since any dredging and subsequent dumping require permits, the permit applicant must abide by any restrictions placed in the permits. Thus, analyses of the dredged material and monitoring of the site will be detailed in any issued permits.

B. Chapter 253: State Lands

This chapter addresses the responsibilities of the State Board of Trustees in managing the State sovereign lands by issuing leases, easements, rights of way, or other forms of consent for those wishing to use State lands, including State submerged lands.

With the exception of a small portion, Site "C" is located outside of State of Florida waters (using the State definition of State waters as extending 10.36 miles from shore). The Pensacola (offshore) ODMDS within Site "C" is located entirely outside of State waters. As such, EPA believes that the designation of the Pensacola (offshore) ODMDS does not encroach on State sovereignty over submerged lands.

C. Chapter 258: State Parks and Preserves

Within the vicinity of the proposed ODMDS is the Fort Pickens State Park and Aquatic Preserve (page 5-2 of the DEIS). There also are beaches on Perdido Key and Santa Rosa Island. Site "C" is located some 8-11 miles from these areas. Prevailing longshore currents would not transport dumped material toward Pensacola Bay and local beaches (pages 5-4 and 5-5).

The onshore and nearshore amenities should not be affected and "impacts outside the designated ODMDS will be minimal because: (1) the site is being sized to contain the majority of the fine-grained material under normal hydrographic conditions and (2) the location of the site is being chosen to be a sufficient distance from any unique resources or resources of special concern" (DEIS text 5.07, page 5-5).

D. Chapter 267: Historic Preservation

No resources of historical importance are located within or near Site "C" (pages 5-7, 5-12, and 7-7 of the DEIS). However, there are shipwrecks and unidentified obstructions closer to shore near the designated Pensacola (nearshore) ODMDS. The nearest shipwrecks are the Bride of Lorne, located 0.7 nautical miles (nmi) north of the existing nearshore site, and the Massachusetts, located 1 nmi north of the nearshore site. Corps coordination with the Florida State Historic

Preservation Officer (SHPO) has been completed. In a letter to the Corps dated March 16, 1988, the SHPO stated that "... it is the opinion of this agency that the proposed offshore dredge disposal will have no effect on any properties listed, or eligible for listing, in The National Register of Historic Places."

E. Chapter 288: Commercial Development and Capital Improvements: Industrial Siting Act

The proposed final designation of the Pensacola (offshore) ODMDS will have a definite effect on the Pensacola Bay area. By designating this site for disposal of suitable dredged material, an acceptable place for ocean disposal of predominantly fine-grained dredged material that meets the Ocean Dumping Criteria, but is not suitable for beach nourishment or disposal in the existing, designated Pensacola (nearshore) ODMDS will have been identified. Thus, if ocean disposal is the chosen disposal method for harbor construction or maintenance projects, the projects can proceed in a timely fashion, allowing for substantial port commerce within the Pensacola area.

F. Chapter 370: Saltwater Fisheries

Chapter 370 was enacted to ensure the preservation, management, and protection of saltwater fisheries and other marine life. The effects of ocean dumping at the Pensacola (offshore) ODMDS will have some impacts on the marine life at the site, but these impacts should be minimal. The non-motile or slow-moving benthic infauna will be smothered, but recolonization should occur rather rapidly after the discharge is completed. As stated in the DEIS (text 5.12, page 5-10), "[a] monitoring program will be implemented at the designated ODMDS to measure impacts and to help prevent any adverse long-range impacts" (see Appendix G of the DEIS).

It should be noted that the location choice of the ODMDS reflects consideration for avoidance of areas supporting significant marine resources. For instance, reefs, fish havens, and offshore banks with unique habitats were not considered as potential sites in the site evaluation process. Therefore, the impacts expected from use of the site are consistent with Chapter 370. A video survey of the ODMDS portion of Site "C" has been conducted by EPA. No significant hard (live) bottom areas were determined.

Several existing, permitted but not yet constructed, and proposed artificial reefs are found within the vicinity of Site "C." The nearest known fishing reef (Escambia County #7) is approximately three miles east of Site "C," with the nearest permitted reef being approximately three miles from Site "C." Two proposed reefs are within the boundaries of Site "C" (one or both are also within the ODMDS) and two are just east of the site. The proposed reefs east of Site "C" should not be impacted by disposal operations since the predominant currents are towards the west. As stated in the DEIS (page 5-6), "[t]he proposed reef locations within alternative Site C would be impacted by designation and use of an ODMDS in this area," but that "[t]his impact is not considered significant since these are only two of over twenty proposed reef locations in the vicinity of the alternative sites studied." Both of these proposed artificial reef sites are located within the ODMDS portion of Site "C". It should also be emphasized that the proposals for these two reef locations were in the very early stages.

G. Chapter 373: Water Resources

This chapter provides authority to regulate the withdrawal, diversion, storage, and consumptive uses of water. The actual designation of the ODMDS or disposal of dredged material does not require these types of uses of either freshwater or saltwater.

The proposed designation and ultimate use of the ODMDS will not have a negative significant impact upon State water resources, since the site proposed for designation is located offshore of Pensacola, Florida, in the Gulf of Mexico. There will be no discharges of any sort into any of Florida's freshwaters caused by either the designation or the actual disposal operation of dredged material. Therefore, local or State communities are not exposed to any significant health or welfare risks.

EPA believes that the proposed designation of the Pensacola (offshore) ODMDS does not violate Florida's water resource law and is therefore in compliance with Chapter 373.

H. Chapter 376: Pollutant Discharge Prevention and Removal

Dredged material must pass toxicity testing before it is considered suitable for ocean disposal. Effects caused by the increase in turbidity due to dredged material disposal will be short-lived and the majority of the dredged material will simply be dispersed on the ocean bottom (pages 5-4 and 5-5 of the DEIS). EPA will also review any proposed Corps dumping activity and require any appropriate restrictions. EPA and the Corps will monitor the site for movement of the material and any associated environmental impacts for as long as the site is used (pages 5-3, 8 and Appendix G).

I. Chapter 403: Environmental Control

The principal concerns raised in this chapter of the FCZMP are similar to those addressed in several of the chapters discussed above: pollution control, waste disposal and dredging.

The actual dredging and dredged material disposal for each project will be performed by the Corps or private entity in accordance with Federal and State laws and regulations. Permits for each project must be acquired from the State and all provisions in the permit met by private applicants. Although the Corps is not issued an actual permit by the State, it must comply with State permitting procedures and restrictions for dredging and/or disposal within State waters.

The Corps and EPA evaluate all Federal dredged material disposal projects in accordance with the EPA criteria given in the Ocean Dumping Regulations (40 CFR 220-229), the Corps regulations (33 CFR 209.120 and 209.145), and any State requirements. The Corps also issues permits to private applicants for transport of dredged material for the purpose of disposal after compliance with the same regulations is determined. EPA has the right to disapprove any ocean disposal project if it believes that all provisions of MPRSA and attendant implementing regulations have not been met.

Because the Pensacola (offshore) ODMDS is located outside of State waters, the State's involvement concerns consistency with the Florida Coastal Zone Management Program.

EPA's planned sediment mapping of the Pensacola (offshore) ODMDS is another form of environmental control. This technique will help determine the fate of dumped dredged material.

III. Conclusion

Based on the information presented in the EIS and the above analysis, EPA concludes that the proposed EPA designation of the Pensacola (offshore) ODMDS is consistent with the FCZMP to the maximum extent practicable as required by Section 307 of the Coastal Zone Management Act.